EUROPEAN UNION PROTECTED HABITATS IN LATVIA

INTERPRETATION MANUAL
2ND REVISED EDITION

The manual has been prepared within
the project "Elaboration of methodology and manual for field identification of EU habitats"
that was funded by the Norwegian Financial Mechanism

The preparation of the 2nd revised edition of the Interpretation manual of European Union
protected habitats in Latvia has been funded by the Latvian Environmental
Protection Fund Administration

EUROPEAN UNION PROTECTED HABITATS IN LATVIA

INTERPRETATION MANUAL
2ND REVISED EDITION

Editor in chief: Ainārs Auniņš

Authors: Ainārs Auniņš, Liene Auniņa, Baiba Bambe, Lelde Eņģele, Sandra Ikauniece, Ivars Kabucis, Brigita Laime, Viesturs Lārmanis, Ilze Rēriha, Ieva Rove, Solvita Rūsiņa, Rūta Sniedze-Kretalova, Solvita Strāķe

Latvijas Dabas fonds

VIDES AIZSARDZĪBAS UN REĢIONĀLĀS ATTĪSTĪBAS MINISTRIJA

Riga 2013

UDK 502(474.3)(035)
EU 600

Editor in chief: Ainārs Auniņš

Editorial Advisors: Ainārs Auniņš
Rūta Sniedze-Kretalova
Valda Baroniņa
Ivars Kabucis

Layout: Marta Grīnberga and "E Forma" Ltd.

Consultants: Austra Āboliņa, Juris Aigars, Madara Alberte, Valda Baroniņa, Vilnis Bernards, Edgars Dreijers, Laura Grīnberga, Vadims Jermakovs, Mārtiņš Kalniņš, Jānis Kotāns, Vija Kreile, Māris Laiviņš, Vita Līcīte, Aivars Markots, Ilona Mendziņa, Anita Namatēva, Ansis Opmanis, Māra Pakalne, Aivars Petriņš, Alfons Piterāns, Agnese Priede, Ingrīda Puriņa, Agnija Skuja, Jānis Sprūds, Voldemārs Spuņģis, Ivars Strautnieks, Antra Stīpniece, Dmitrijs Teļnovs, Uvis Suško, Andris Urtāns, Vija Znotiņa, Egita Zviedre.

Book quotation example: European Union Protected Habitats in Latvia. Interpretation Manual (2013) Auniņš, A. (ed.), Riga, Latvian Fund for Nature, Ministry of Environmental Protection and Regional Development, 320 pp.

Chapter quotation example: Auniņa, L. (2013) 7150 *Rhynchosporion albae* pioneer communities on wet peat or sand. In: Auniņš, A. (ed.), European Union Protected Habitats in Latvia. Interpretation Manual. Riga, Latvian Fund for Nature, Ministry of Environmental Protection and Regional Development, 200-201 p.

Cover photo: Uvis Suško

This English translation has been prepared by a contracted party for general reference purposes only. Authors of the original text and the Publisher are not responsible for any consequence resulting from the use of the English translation in place of the original Latvian text.

ISBN 978-9934-14-019-8

TABLE OF CONTENTS

INTRODUCTION

This manual includes methodology for determination of European Union protected habitats that are encountered in the territory of Latvia. It was necessary to publish this manual in order to implement requirements of the EU Habitats Directive more successfully. Nature conservation and development projects with various scale and impact are carried out on a regular basis both in areas of special protection and outside of them. In order to ensure that these projects are not in conflict with the requirements of environmental protection, legislation provides procedures to assess the impact of development projects on the environment, incl. protected habitats. In order to perform this assessment, these areas are examined in nature and habitats that are found in these areas are evaluated. Habitat mapping is performed when developing nature conservation plans and before habitat monitoring is commenced. However, since there has not been a single practically verified method for the identification of habitats, experts are not always unanimous in the decision-making process. Along with the publication of this manual, there will be less possibilities for arbitrary interpretation of habitats and it will serve as a point of reference in identification of habitats. Thus, the society will also be able to get acquainted with the criteria and methods that are used to identify habitats that will, in its turn, promote access to information, better compliance with the principles of environmental management, openness of habitat identification process and better understanding of the environmental conservation criteria.

HABITATS DIRECTIVE

In the territory of Europe natural habitats continue to deteriorate and an increasing number of wild species and their natural territories are seriously endangered. This is largely related to the intensification of agriculture and forestry, as well as imbalance in industrial development and urbanization. That is why in 1992, the European Community (the predecessor of today's European Union) adopted the Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Plants (hereinafter – the Habitats Directive). Along with the Council Directive 2009/147/EC on the Conservation of Wild Birds (hereinafter – the Birds Directive) it forms the basis of the EU nature conservation legislation and is a legal tool that allows European Community countries to build a common system of wild fauna and plants species, as well as natural habitat conservation whose protection is in the interest of all EU Member States. The main aim of the Habitats Directive is defined in Article 2 – to contribute towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and plants, as well as measures designed to maintain or restore them at favourable conservation status. In the context of the Habitats Directive in the field of interest of the European Union, those are natural habitats that are encountered within its territory and:

1) are in danger of disappearance in their natural range; or
2) have a small natural range following their regression or by reason of their intrinsically restricted area; or
3) present outstanding examples of typical characteristics of one or more biogeographic regions.

Such habitat types are listed in the Annex I of the Habitats Directive and thus are the international obligation objects of the EU Member States, including Latvia. Since the accession of Bulgaria and Romania to the European Union, there are 231 types of natural habitats included in the Annex I of the Directive. Distribution of habitats is evaluated in subcontinental scale or in a scale of its distribution range because although certain habitats types can be quite common locally, they all are endangered in a wider context. The Habitats Directive highlights those habitats that are in danger of extinction and whose distribution is mainly or only related to the territory of the European Union. These are called the priority habitats and they are marked with an asterisk in the Annex I of the Directive. Currently 71 habitats are recognized as priority habitats. Member States shall take measures to ensure that the Directive obligation objects are preserved or restored at favourable conservation status. The conservative status of a natural habitat will be considered as "favourable" when:

1) its natural range and areas it covers in the territory of a member state are stable or increasing;
2) its specific structure and functions, which are necessary for its long-term existence, exist and are likely to continue to exist for the foreseeable future;
3) conservation status of its typical species in the territory of a member state is favourable.

One of the measures to be taken by the EU Member States in order to protect habitats that are listed in Annex I and species that are listed in Annex II of the Directive is separation of special areas of conservation (Article 3 of the Habitats Directive). Along with the areas that have been established under the Birds Directive, they form the European ecological network known as *Natura 2000*. Establishment of specially protected areas is done on the basis of scientific information and criteria that are provided in Annex III of the Directive (Article 4). Administrative and economic considerations cannot be used in determining boundaries of areas. For each of the areas to be established, Member States have to submit a detailed characteristic information of the area to the European Commission, incl. information on species that are included in the annexes of both "nature directives" and other specially protected or rare species that are abundant in in the particular area. For each area Standard Data Form (SDF) is completed and information is prepared digitally by entering it into the database of the *Natura 2000*. Sufficiency and adequacy of the offer of each member state is evaluated from the perspective of each species or habitat in the context of the entire biogeographic region in the biogeographic seminars that are organized by the European Commission. All available scientific information is used in evaluation and each member state can defend its positions only with scientific arguments. Latvia along with Estonia, Lithuania, Finland and Sweden belong to the Boreal Region. Latvia prepared its offer for the *Natura 2000* network in its territory and submitted it to the European Commission in 2004. In 2006, at the biogeographic seminar of the Boreal Region the European Commission recognized it as sufficient for almost 90% of the obligation objects of the Habitats Directive. Therefore, the process of establishing *Natura 2000* network in Latvia is not over and the state must work in order to improve it. Member States must also ensure a strict protection system of species that are included in the Annex IV (Article 12 and 13) of the Directive. In accordance with Article 6 of the directive, Member States shall establish the necessary conservation measures for special areas of conservation, for example, management plans or laws and regulations. These measures must be aimed at preventing deterioration of the status of natural species and habitats or negative disturbances in these areas. All plans or projects that may have an impact on the specially protected areas should be carefully considered, taking into account objectives of the conservation of the area. A plan or a project can be approved only after it has been ascertained that it will not have a negative impact on the area. Exceptions can only be acceptable if the plan must be implemented for a particular public interest and no alternative solutions are possible. In such cases, compensatory measures must be carried out. If an area hosts priority natural habitat types or species, it is allowed to take into account only those considerations that are related to public health, public safety or a general improvement of environmental conditions. Member States must carry out surveillance or monitoring (Article 11) of the conservation status of the Directive obligation objects (habitats of the Annex I and species of the Annex II, IV and V) and once every six years it must prepare a report on the measures taken in implementation of this Directive and impact of these measures on the obligation objects (Article 17). In practice, this report on species and habitats is in a form of an updated SDF for each *Natura 2000* area, updated *Natura 2000* database and a filled special detailed report form that is developed by the European Commission for each obligation object of the Directive that would allow assessing their conservation status in the country. In the spring of 2007, Latvia submitted its first report; the next report must be submitted in 2013. In order to improve ecological coherence of the *Natura 2000* network, the Directive recommends that the Member States promote the conservation of the characteristic features of sceneries that are important for wildlife species in their land use plans and development strategies (Article 10). The Directive also promotes research and scientific work for its purposes, as well as surveillance of protected areas and obligation objects (Article 18). None of the Member States host all of the habitats or species included in the annexes of the Directive. Therefore, each state has a list, approved by EC, of species and habitats of European Union importance that are encountered within its territory and the state is responsible for their protection within its territory (reference list). Each item on the list of obligation objects must be provided sufficient protection and a favourable conservation status and the state must report on each of them. The list of habitats and species in the annexes of the Habitats Directive is not unchangeable. It has changed with the expansion of the EU. Annexes of the Directive have been supplemented with species and habitats after Finland, Sweden and Austria joined the EU in 1995, Eastern European in 2004, as well as after Romania and Bulgaria joined the EU in 2007. Suggestions for changes in lists of species and habitats are proposed by the Member States. Requirements of the Habitats Directive in Latvian legislation are mainly defined by the Law on the Conservation of Species and Biotopes and related regulations of the Cabinet of Ministers, of which the most important ones are:

- Cabinet Regulation No. 421 of 5 December 2000 "Regulations of the List of the Specially Protected Biotopes";
- Cabinet Regulation No. 396 of 14 November 2000 "Regulations of the Lists of the Specially Protected Species and the Specially Protected Species whose use is Limited";
- Cabinet Regulation No. 940 of 18 December 2012 "Regulation of Procedures for the Establishment of Micro-reserves and their Management, Conservation, as well as Interpretation of Micro-reserves and Buffer Zone";
- Cabinet Regulation No. 153 of 21 February 2006 "Regulations of the List of Priority Species and Biotopes of the European Union Encountered in Latvia";
- Cabinet Regulation No. 1055 of 15 September 2009 "Regulation of the List of those Specimens of Animal Species and Plant Species of the European Community Significance, for the Acquisition of which in the Wild the Conditions for Restricted use may be Applied".

NATURA 2000 IN LATVIA

Natura 2000 is an EU-wide ecological network that has been set up in accordance with uniform criteria to provide protection for values of EU importance – wild plants and fauna species, as well as natural habitats. Legal basis of this network are both EU "nature directives": Birds Directive and Habitats Directive. Creation of *Natura 2000* network is determined by the Habitats Directive, indicating that the ecological network within the European Union in special areas of conservation is established under the provisions of Article 3 and 4 of this Directive, as well as areas that has been established under the Article 4 of the Birds Directive. In other words, *Natura 2000* areas are created for protection of species specified in the Annex II of the Habitats Directive and Annex I of the Birds Directive. In total, there are 58 habitats and 132 species for whose conservation specially protected nature territories that are incorporated in *Natura 2000* network are established. Although creation of the *Natura 2000* network is one of the most important implementation instruments of "nature directives", it is not the only one – a favourable conservation status of the directive obligation object must be ensured throughout the whole territory of the country.

The *Natura 2000* network in Latvia is based on the existing basis of the specially protected nature territories (SPNT). In order to assess the extent to which the existing SPNT system provides protection of species and habitats included in the annexes of both "nature directives", within the framework of the project Emerald (full title – "Analysis of Latvian Special Areas of Conservation and Creation of the *Natura 2000* Network" (Latvijas īpaši aizsargājamo dabas teritoriju analīze un *Natura 2000* tīkla izveide), an inventory of the existing SPNT system was performed from 2001 until 2004. For the protection of habitats and species for which the existing system did not provide it to a sufficient amount, new areas were looked for in order to fill these "gaps" in protection. The necessary information on all existing and areas yet to be established was collected in order to complete the standard data forms and the *Natura 2000* database. The most important species and habitats of each area were specially separated, namely those for which the site qualifies for the status of the *Natura 2000* area. According to interests of these species and habitats the regime of area protection and the applicable management measures must be arranged. At the end of April 2004 when Latvia joined the European Union, Latvia submitted its offer for the *Natura 2000* network to the European Commission. It included information on 336 areas. It means that the Latvian government has undertaken the responsibility to protect these areas and is ready to ensure a favourable conservation status for the species and habitats for which the areas are separated (i.e. to ensure that neither the populations of these species or habitat areas nor their biological quality decreases). The network covered 11.9% of the total terrestrial area of the country. After the Biogeographic seminar of the Boreal Region in which the European Commission recognized Latvia's offer to be sufficient for almost 90% of the Annex 1 habitats and Annex II species of the Habitats Directive, several *Natura 2000* areas in Latvia were merged into larger areas (e.g. "Lubāns wetlands") and two new *Natura 2000* areas were established. Currently the *Natura 2000* network includes 332 areas that cover approximately 12% of the total area of the country.

To ensure a favourable conservation status to the species and habitats for whose protection territories were established, targeted measures should be implemented – providing an adequate protection regime and management. To ensure that, exact locations of the protection objects must be known through a survey of species deposits and habitats. Nature conservation (management) plans must be developed, that provide an appropriate zoning and adequate management measures for the protection of surveyed natural values ranging from a complete non-disturbance to regular mowing or restoration of destructed habitats. In order to follow up, whether the established network of *Natura 2000* areas and its management ensures the protection of species and habitats that are abundant, each of the 332 areas must be monitored. Member States must notify the European Commission regularly on the status of species and habitats, as well as the existing impacts and threats. Reporting takes place every 6 years when the Standard Data Form together with a completed *Natura 2000* database on every area must be submitted. In 2007, Latvia submitted its first report on the period from 2000 until 2006 (Report on implementation.., 2007), report on the period from 2007 until 2012 was submitted in 2013 (Conservation status of.., 2013).

SCIENTIFIC AND LEGAL BASIS FOR CLASSIFICATION AND INTERPRETATION OF HABITATS

Initially habitats were defined as plots of land or water with homogeneous environmental conditions with communities of organisms that have adapted to these specific conditions. A broader definition describes habitats as areas hosting fauna and plants species that are primarily characterized by their physical features (topography, structures that are formed by plants and fauna, soil characteristics, climate, water quality, etc.) and, secondly, by the fauna and plants species that are abundant it this area. Thus, a habitat is determined by both abiotic (non-living environment) and biotic (living environment) components, for example, species communities. Natural habitats are the ones that are characterized by natural or semi-natural geographic, biotic and abiotic conditions. In other words, these are habitats whose formation is determined by environment that is unaltered or minimally altered by human activities and that are dominated by natural processes. Earlier habitat classification systems, such as CORINE Biotopes Classification (Devillers et al., 1991) were largely based on traditional phytosociology. Plant communities, which are determined by their characteristic species, are its key component. Such segregated habitats can be recognized visually by the spatial structure of the plant communities and presence of characteristic species. However, not all habitats are covered by vegetation and it does not always play the key role in ecological processes, consequently the possibilities of phytosociological habitat classification were limited. In the following subcontinental-scale habitat classification systems, such as the Palearctic Habitat Classification (Devillers, Devillers-Terschuren, 1996) and EUNIS Habitat Classification (Davies et al., 2004), an increasing importance has been given to various abiotic criteria for habitat separation. Scientific habitat classifications have been developed as comprehensive hierarchical systems. They classify all habitats, including man-made artificial habitats. Habitats, classified according to these classifications, do not overlap and the cut-off degree of detailed elaboration for habitats in one hierarchical level is similar. They do not leave the "unclassified gaps" at the current level of knowledge. Palearctic habitat classification and subsequent EUNIS habitat classification are examples of such comprehensive habitat classifications. It is different with the classification used in the "political" or nature protection objectives in lists intended for habitats, such as the list of the Annex I of the EU Habitats Directive. This list contains only natural habitats with a protection value. They have developed historically by coordinating different national views on which habitats should be protected at the political level. As in many European countries, national habitat classifications exists that differ from each other by the principles of habitat classification, the opinions of scientists representing different schools and scholars, as well as understanding which habitats of the national classification systems are with the European protection value were also harmonized. Thus, the list of protected habitats and the names of habitats included are a compromise, in order for the result to be acceptable to all Member States.

Due to changes in the composition of the EU Member States the list of habitats in the Annex I of the Habitat Directive has changed over time. The original version of the list was created at a time when there were only 12 European Union Member States. In 1995, when Finland, Sweden and Austria joined the EU, habitat and species lists were supplemented to cover European natural values that are common to these countries, but were not previously represented in the annexes of Directives at that time. The Directive was supplemented by another biogeographic region – Boreal – which currently includes Latvia. Nordic countries had their own habitat classifications and, in order to relieve the implementation of the Directive at a national level, many of the habitats of the Annex I were adopted from the national qualifiers, although some of them overlapped with habitats already listed in the annex significantly. Significant changes in the annexes of the Directive also took place in 2004 when 10 new Member States joined the EU, including the Baltic States, as well as in 2007 when Romania and Bulgaria joined the EU. As a result, the EU Habitats Directive annex habitats are not classified in a single hierarchical system. It includes habitats separated by the phytosociological classification of plant communities as well as habitat groups that include several habitats divided by communities of species that are under one name. It also includes habitats that have been separated by characteristics of relief or geological origin and essentially are habitat complexes, as well as those that are separated after other biotic or abiotic criteria. The scale of habitat separation varies – the list includes habitats that are described in detail and that take up only a few square meters and also those that are diverse and at the same time take up areas of several square kilometres. To minimize misunderstandings and different approaches in habitat interpretation in different countries, the Environment Directorate-General of the European Commission has published an Interpretation manual of European Union habitats (Interpretation manual.., 2013) that describes all habitats of the Annex I of the Directive. The manual includes:

1) definitions of these habitats;
2) characteristics of fauna and plants species;
3) appropriate habitats in accordance with their national habitat classification systems in countries where such exist;
4) habitat types with whom described habitat usually is found/is together with others in nature;
5) list of references to the literature, which makes a significant contribution to raising awareness of the habitat separation.

Habitat Interpretation Manual is a document approved by the EC Habitats Committee consisting of delegated representatives from all EU Member States. Although, unlike the Habitats Directive, the Interpretation Manual itself is not a normative act, its contents, however, are binding to the Member States because decisions of the Habitats Committee are approved by the European Commission. Moreover, in the absence of other, more precise information on habitat interpretation, this manual is used in decision-making process of the EU judicial system.

In Latvia the creation of habitat list started in 1998 when in the framework of the project "Auditing of Species and Habitats, Development of Nature Protection Plans and Nature Protection Structure Development in Latvia in Relation with the Transposition of the EU Birds and Habitats Directives" (Sugu un biotopu inventarizācija, dabas aizsardzības plānu izstrāde un dabas aizsardzības struktūru attīstība Latvijā saistībā ar ES putnu un biotopu direktīvu transpozīciju) the Latvian Fund for Nature prepared the first "Habitat Manual" with the description of the habitats of EU importance (Biotopu rokasgrāmata.., 2000) and established the Latvian habitat classification system (Latvijas biotopi.., 2001). During the preparation of the scientific basis for the *Natura 2000* protected areas network, the amount of information on the abundance of specially protected habitat types of EU importance in Latvia increased significantly, during this period there also were many discussions with other experts from the Member States that supplemented the understanding of the interpretation of habitats significantly – the list of the specially protected species of EU importance that are encountered in Latvia was supplemented with a number of habitats, while the number of others were eliminated and as a result – supplemented edition of "Habitat Manual" was published (Biotopu rokasgrāmata.., 2004). The existing descriptions of the habitats of EU importance that are encountered in Latvia (Biotopu rokasgrāmata.., 2000; Biotopu rokasgrāmata.., 2004) gave an idea on the identification of these habitats in the most typical cases; however, they left relatively large possibilities of interpretation to an expert, because they did not describe the minimum criteria to recognize a given area to be a specially protected habitat of EU importance (EU SPH), as well as did not describe the possible variants of this habitat and the actual habitat separation from other similar habitats. Over time, it was also found that in practice certain habitats are interpreted too narrowly or too broadly, thereby creating a gap between Latvian habitat descriptions and descriptions from the Interpretation manual of European Union habitats (Interpretation manual.., 2007).

As EU Member States must report regularly to the European Commission on the situation of the EU SPH, the need for a standardized criteria for assessing the quality of habitats that could be used in the monitoring of *Natura 2000* areas, as well as for habitat conservation status assessment emerged. Interpretation manual of European Union habitats (Interpretation manual.., 2013) helps to address issues related to habitat interpretation on a national level, but in practice it cannot be used as a guide to the experts, as it aims to create a single view of the very broad interpretation of habitat biogeographic context, which can often be difficult to use in a local, Latvian, context. Habitat definitions that are included in it cover the entire broad range in which a habitat may occur, and many of these conditions have nothing to do with the conditions in Latvia. Among the plants communities that characterize habitats and species, there also are some that are not abundant in Latvia or do not characterize habitats in Latvian conditions. There are significant differences in the degree of detailed elaboration in which habitats are described. There are no strict minimum quality thresholds for a habitat nor quality evaluation criteria of a habitat provided, leaving it for an interpretation on a national level. In order to ensure a degree of detailed elaboration that is required for it to be applied on a local scale, it was necessary to develop a new manual reducing any possibilities in habitat interpretation to a minimum. The aim of this manual is to provide methodology for identification of each specially protected habitat of EU importance that are encountered in Latvia, describing its variants that are specific to Latvian conditions. For each habitat the minimum quality requirements are described for it to be considered a specially protected habitat of European Union importance, as well as indicators used to assess habitat quality are listed and explained. All texts of methodologies have been repeatedly discussed in specially organized open work groups to which all active habitat experts in Latvia have been invited, and any interested individuals could take part. Thus, the habitat descriptions included in the methodology reflect the agreement among Latvian habitat experts for the interpretation of each habitat. This methodology can be used both by mapping of protected habitats of EU importance and monitoring of *Natura 2000* areas, as well as in a variety of other works that require identification of protected habitats in nature.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2000) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Davies, C.E., Moss, D., Hill., M.O. (2004) EUNIS Habitat Classification. Revised 2004. Report to European Environmental Agency, European Topic Centre on Nature Protection and Biodiversity. October 2004

Devillers, P., Devillers-Terschuren, J. (1996) A classification of Palaearctic habitats. Council of Europe, Strasbourg: Nature and environment, No 78

Devillers, P., Devillers-Terschuren, J., Ledant, J.P. (1991) CORINE biotopes manual. Commission of the European Communities, Luxembourg, http://biodiversity-chm.eea.europa.eu/

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

For a more detailed description see the section "Habitat descriptions". Information that is included in the description of a specific habitat and a habitat group is relevant for each habitat.

Distribution
Habitat distribution and specific distribution characteristics (if there are any).

Specific characteristics of habitat interpretation in Latvia
Habitat characteristics that are specific to Latvia or the Baltics have been described

Conservation value
The specific conservation value of a habitat that highlights it among other habitats has been emphasized. Values that are common and generally known for all habitats are not shown. The habitat importance in conservation of specially protected species that occur only in these habitats has been emphasized. Information on the current occurrence of the habitat in Latvia and on reasons for its reduction, if there is any, is provided.

Habitat group label
The color describes the adherence of a habitat to one of habitat groups, therefore the respective introductory chapter corresponds to the habitat. In cases when several introductory chapters refer to one habitat, these colors show in the label of the habitat group.

***Natura 2000* code**
Corresponds to the Annex I of the Habitats directive. The asterisk (*) next to the code indicates habitats, whose conservation is a priority

Habitat name
Corresponds to the Interpretation Manual of European Union habitats

Habitat definitions
Correspond to definitions of habitats of EU importance that have been confirmed by the European Commission. However, references to geographic areas, species or species complexes that are not characteristic in Latvia or are not specifically related to the habitat in Latvia have been excluded.

8310

8310 *Caves not open to the public*

Latvian habitat classification: H.2.1., H.2.2., H.2.3., H.3.5.

Syntaxonomy: plant communities are not present.

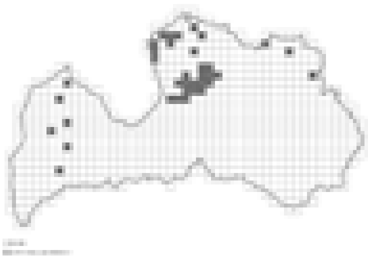


Figure 8.12. Distribution of the habitat 8310 *Caves not open to the public* in Latvia (Conservation status of.., 2013).

Definition: caves not open to the public, including their water bodies and streams, hosting specialised or high endemic species, or that are of paramount importance for the conservation of Annex II species (e.g., bats, amphibians).

Figure 8.13. Ellīte Cave is siliceous rocky slopes near Līgatne (Photo: A.Opmanis).

Specific characteristics of habitat interpretation in Latvia: Caves of a natural origin, which are at least 3 m long, are considered as this habitat type if there are at least two light zones (*Fig. 8.13*).

Distribution: very rare – on the banks of the River Gauja and its tributaries, the River Salaca basin, individual caves at by the River Venta, in the River Abava basin etc.

Conservation value: a very rare habitat, occupying a very small area of the territory of Latvia of 0.17 km^2 (Conservation status of.., 2013). Caves shelter animals and plants that have adapted to specialised conditions. The habitat is the only or one of the very few living environments that are suitable to several species: moss – *Schistostega pennata*; fungi – *Genea hispidula*, *Melanogaster ambiguus*, *Suillus cothurnatus var.hiemalis*, *Tomentella radiosa*; lichens – *Collema spp.*; spiders – *Nesticus cellulanus*, *Metellina merianae*. Caves are the only natural habitat for several specially protected bat species in Latvia. Drier caves are often populated by *Eptesicus nilssoni*, while caves with water-bodies and streams – by *Myotis mystacinus*, *Myotis brandtii*, *Myotis dasycneme*, *Myotis myotis*, *Myotis nattereri*, *Myotis daubentoni*, *Barbastella barbastellus*, *Pipistrellus pipistrellus*, *Vespertilio murinus*, *Pipistrellus nathusii*, *Eptesicus serotinus*, *Nyctalus leisleri* and *Nyctalus noctula*.

Environmental factors: caves in Latvia have formed as a result of suffusion (in siliceous rocks) and in rarer cases as a result of karst process (in calcareous rocks). Three different zones of light are formed in caves (euphotic or sunlight zone, disphotic or twilight zone and aphotic or midnight zone) that determine the possibility for organisms to exist in caves (Pakalne, Āboliņa, Pilāts, 2007). The number of species is higher near the entrance and, starting with higher taxonomic units, it decreases deeper in a cave. Plants and fungi occur mostly in siliceous rock caves since the formation of vegetation in dolomite caves is restricted by the high abundance of soluble inorganic salts and regular rock falls.

254

Environmental factors
Environmental factors that are important for the existence of a habitat - totality of environmental conditions that provides formation and existence of structures and plant communities that are characteristic to the habitat

Vegetation (overgrowth) characteristics
Characterizes specific features of the habitat vegetation – layers and dominant species of possible plant communities in each of them

Characteristic species
Species with a qualifying value are listed – species that occur only in the specific habitat of whose occurrence indicated a habitat. Species that are almost always present in a habitat are listed, but a habitat can not be identified only by these species.

EXPLANATIONS FOR DESCRIPTION OF A HABITAT (SCHEME)

Processes with a functional role
Environmental processes with a functional role in the habitat existence have been described, explaining their impact on the habitat. To avoid duplication, this chapter can be combined with the previous one.

Umbrella species
(typical species within the meaning of the Habitats Directive)
Species that are easy to study and whose presence and condition helps to early detect changes in the habitat quality and indirectly indicates the status of other species in the habitat.

8310

Processes with a functional role: washing out of caves is a positive occurrence, since it increases the habitat area. Rock falls, on the other hand, are considered negative occurrence, since it decreases the habitat area, delimits a cave section and interrupts the connection between species living in the cave and the outside.

Vegetation characteristics: vegetation is unstable. Vascular plants do not occur in caves. The most important role is played by algae and fungi (Piterāns, 2001; Santesson et al., 2004).

Characteristic species: moss – *Schistostega pennata*; fungi – *Laccaria fraterna*, *Roesleria pallida*; lichens – *Cystocoleus ebenus*, *Collema* and *Lepraria* genus species, algae – *Gloeocapsa alpina*, *Gloeocystis rupestris*, *Schizotrix calcicola*; animals – above mentioned species of spiders and bats.

Umbrella species (typical species within the meaning of the Habitats Directive): *Schistostega pennata*, bat species.

Variants: none.

Habitat quality

Minimum habitat requirements: caves of a natural origin, which are at least 3 m long if there are at least two light zones. Shorter caves or niches in the outcrop wall are not considered as this habitat (*Fig. 8.14*).

Structural indicators: all indicators common to rock outcrop habitats.

Function and process indicators: all indicators common to rock outcrop habitats; the presence of water-bodies and springs within the cave have the greatest importance.

Restoration potential and quality improvement indicators: all indicators common to rock outcrop habitats.

Threats: all threats common to rock outcrop habitats.

Management: habitat requires non-intervention.

Similar habitats: none.

Overlap with other habitats of EU importance: 8220 *Siliceous rocky slopes with chasmophytic vegetation* – the cave entrance can be located in the wall of siliceous rocky slope, and in such cases both habitats are marked.

Corresponding specially protected habitats in Latvia: 8.16. Undisturbed caves.

Figure 8.14. Niche at Stiglava siliceous rocky slope that does not belong to the habitat *Caves not open to the public*, since the depth of the niche is less than 3 m (Photo: A.Namatēva).

Literature

Krauze, I. (2010) Latvijas alas, http://www.alas.lv

Pakalne, M., Āboliņa, A., Pilāts, V. (2007) Iežu atsegumi un alas. Grām.: Pilāts, V. (red.) Bioloģiskā daudzveidība Gaujas nacionālajā parkā. Sigulda, Gaujas nacionālā parka administrācija, 47.–51. lpp.

Piterāns, A. (2001) Latvijas ķērpju konspekts. Latvijas veģetācija 3, 5.–46. lpp.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T., Vitikainen, O. (2004) Lichen-forming and lichenicolous fungi of Fennoscandia, 359 p.

Smaļinskis, J., Kušners, E. (1994) Latvijas smilšakmens un dolomīta alu faunas un floras izpēte. Līdzsvarota attīstība – Latvijas nākotnei. III. Zaļās loģikas konferences referātu krājums. Rīga, Gandrs, 67.–70. lpp.

255

Similar habitats habitats of EU
importance that can be mistaken in field conditions are listed, also criteria for a mutual separation of these habitats have been provided.

Overlap with other habitats of EU
importance
Habitats that can be located in the same area as the described habitat and overlap with it spatially.

Corresponding specially protected habitats in Latvia
Habitats that are included in the list of specially protected habitats in Latvia and fully or partially match the described habitat are listed.

Literature
All literature sources that have been cited in the description, as well as research that has been performed in Latvia regarding the respective habitat are listed

Threats
Factors that pose direct and, more rarely, indirect threats to a sustainable existence of a habitat and its quality.

Management
Habitat specific management measures that can be used to restore its quality or as a regular maintenance measure.

Variants
If there are distinct variants or problematic situations for a habitat and they have an impact on the logic of habitat identification, these variants are described in this section. Each variant can have different minimum quality requirements for it to be identified as a habitat of EU importance.

Habitat quality
Minimum habitat requirements
qualitative and quantitative criteria are listed that a given habitat must correspond to for it to be considered a habitat of EU importance.

Structural indicators
Indicators that are used to assess the quality of habitat structure are listed
Function and process indicators
Indicators that are used to assess the extent of preservation of habitat functions are listed.

Restoration potential and quality improvement indicators
Indicators that are used to assess habitat restoration potential or its quality improvement opportunities.

This section of methodology provides detailed information that is required for identification of specially protected habitats of EU importance in nature and separation from other similar habitats. Habitat descriptions within the limits of the Interpretation manual of European Union habitats (Interpretation manual.., 2007) were designed for it to be possible to mutually separate European specially protected habitats encountered in Latvia to the extent possible. However, there are habitats included in the Annex I of the Habitats Directive which, by their definitions, can overlap each other. Most of the protected habitats are separated by biotic criteria, while for a number of habitats the main determinant is their geological origin. For example, habitat 9060 *Coniferous forests on, or connected to, glaciofluvial eskers*, that is separated by the dominant geological features, can spatially overlap with habitat 9010* *Western taiga*. Habitats from the list of protected habitats of EU importance are also defined at different scales – on the same level of the hierarchy in the list along with other habitats there also are habitat complexes that combine a number of habitats, such as the 6450 *Northern Boreal alluvial meadows* and micro habitats that are naturally present in very small areas and can be found in other protected habitats, for example, springs. In such cases of overlapping in habitat interpretation it was not possible to develop a system to separate them. Therefore, if the habitat area is clearly identifiable to a description of two protected habitats of EU importance and such overlapping is accepted in the methodology, it shall be recognized as belonging to both. If mutual overlapping of habitats is not accepted in the methodology, then by following the identification marks of similar habitats that are provided in the habitat or habitat group description, it shall be recognized as belonging to only one of them.

HABITAT GROUP DESCRIPTIONS

All protected habitats of EU importance that are found in Latvia belong to one of nine top-level hierarchy habitat groups. Habitats described in the methodology are joined in relevant chapters of these groups. Belonging of a habitat to certain group is defined by the first number of its four-digit code. For each group, with the exception of the fifth a group of "Scrubs" that has only one habitat encountered in Latvia, before the habitat description an introductory chapter of the group is provided, which describes all or most of the common features of habitats from this group. Thus, the introductory chapter of a habitat group provides information that is related to all habitats of the group, unless stated otherwise, and is not duplicated in the habitat description. For the latter, only the habitat-specific information has been provided, which supplements or clarifies information provided in the description of the group. Thus, the habitat description and the description of the habitat group relate to each of the habitats. Some habitats possess characteristics of two groups. For example, the habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* is considered as a habitat of both dunes and forest, but 2140 *Decalcified fixed dunes with Empetrum nigrum* – as a habitat of dunes and heaths. Descriptions of both groups relate to such habitats. In the beginning of each description it is specified whether it relates also to other habitats of the group. Habitat group descriptions largely follow the same chapter structure as habitat descriptions. The standard sections that do not include information that generally applies to the group are not included in the descriptions. If necessary, special sections that are not included in habitat descriptions are created to define the common features of a group more accurately.

STRUCTURE OF HABITAT DESCRIPTIONS AND COMMON PRINCIPLES OF ALL HABITATS

Explanations for each standard section that is provided in habitat descriptions and habitat group descriptions are further included. In the sections that are not mentioned below there are no common unifying explanations for all habitats.

Habitat name

Habitat names are formed to better reflect the nature of the habitat in accordance with the Interpretation manual of European Union habitats (Interpretation manual.., 2007) as well as the situation in Latvia. Consequently, habitat names are not always direct translations of the Annex I of the Habitats Directive, because parts that do not apply to Latvia are removed and adopted traditional terms to describe habitats in Latvia are used. English names of many habitats were formed at a time when the Directive applied only to 12 Member States. Later on, when the composition of the Member States changed, habitat definitions in the Interpretation manual of European Union habitats were also supplemented according to habitat characteristics in these countries, and, as a result, the original names of some habitats were no longer relevant to habitat descriptions, but due to the complex nature of the legal procedures they were not changed in the Annex I of the Directive. As far as possible, previously Latvianised habitat names have been used (Biotopu rokasgrāmata.., 2004), but in some cases they were changed due to the following reasons or combination of reasons:

1) the former name did not reflect the meaning of a habitat sufficiently and caused misunderstandings in practice;
2) compared to the previously used term, name of the habitat has been changed because its interpretation has been extended to meet the given habitat description of the Interpretation manual of European Union habitats (Interpretation manual.., 2007);
3) compared to the previously used term, name of the habitat has been changed because the interpretation of the habitat has been narrowed to meet the given habitat description of the Interpretation manual of European Union habitats (Interpretation manual.., 2007);
4) inaccurate or outdated terminology has been used in the previous name.

The unifying element that indicates compliance with habitats listed in the Annex I of the Habitats Directive and Latvian names is the four-digit code of a habitat.

Latvian habitat classification

Lists habitat codes of the Latvian Habitat Classification (Latvijas biotopi.., 2001) that fully or partly comply with the described habitat. In all cases, the codes of the highest level are used below which all lower-level codes correspond to the habitat described. As the Latvian Habitat Classification for habitat groups is not equally developed in all the detail and is obsolete, it is not possible to find an appropriate habitat in for all protected habitats of EU importance. Sometimes habitats listed in the Latvian habitat classification do not represent all the diversity of the habitats of EU importance in Latvia.

Other habitat classifications

Habitat descriptions do not individually describe the compatibility of habitats of the Annex I of the Directive with habitats that have been divided by other classifications used in Europe. Information on compatibility of habitats to the habitat of interest has been separated by EUNIS, Palearctic or CORINE Biotopes habitats classifications, as well as the national classifications of different countries that can be found on the Environment Agency website EUNIS in the following section http://eunis.eea.europa.eu/habitats-code.jsp.

Syntaxonomy

Lists the appropriate vegetation classification units of the habitat that are known in Latvia. These are mostly communities in accordance with the Central-European Vegetation Classification System (Ellenberg, 1996). However, sometimes it does not reflect the diversity of habitats because Latvian vegetation studies have been carried out only partially. The highest possible classification units have been used under which all the lower-level units comply with the habitat described. For habitats in whose interpretation plant communities are irrelevant, the relevant syntaxonomic units are not available.

Definition

Definitions of habitats have been created on the basis of definitions approved by the EU Habitats Committee (Interpretation manual.., 2007), adopting them unchanged to the extent possible. However, they often contain references to geographic areas that are not binding for Latvia and include species or communities of species that do not exist in Latvia or in Latvian conditions are not specifically associated with the habitat. Such references from habitat definition are excluded.

Specific characteristics of habitat interpretation in Latvia

Latvia is located on the eastern border of the European Union and its geographic location determines that here species that fulfil a specific ecological function in a habitat are often different from those that perform the same function in Central or Western Europe. This section describes the specific regional habitat characteristics of the Baltic States or Latvia.

Distribution

Most of the protected habitats of EU importance in Latvia are distributed unevenly. Some of them are only related to the coast of the sea or of the Gulf of Riga, and by definition they cannot be found inland, while others are associated with specific geobotanic areas or their distribution is determined by climatic conditions or significant geological formations, such as distribution of river valleys. Correlations in distribution are specified in this section in habitat descriptions, if they exist. This chapter also includes a distribution map created pursuant to report guidelines of the Article 17 of the Habitats Directive in 10 x 10 km ETRS network LAEA ETRS89 projection (Evans, Arvela, 2011). The information on habitat distribution provided in the maps has been compiled in 2013 and is in accordance with the Latvian official report on the implementation of Article 17 of the Habitats Directive (Conservation status of.., 2013). When viewing the distribution maps, it should be noted that until now a nationwide mapping of habitats of EU importance has not taken place in Latvia. The most accurate data is provided on *Natura 2000* areas. For the rest of the country different and often approximate and indirect sources of data have been used. For example, the Biologically valuable grassland database that has been created on the basis of historical grassland (but not the mappings of habitats of EU importance) mappings in relation to the rural development programme can be approximately transmitted in the context of habitats of EU importance. The most important source of data for forest habitats is the State Forest Register, where, according to an approximate match between certain vegetation types and forestry typology and in combination with information on the age of a tree stand and composition, the potential habitat distribution map has been generated – it has not, however, been undoubtedly tested. In general, it can be said that the distribution maps are created using the best currently available information, but in a case of a comprehensive and accurate mapping of habitats, they most likely will be different.

Conservation value

All of the protected habitats of EU importance in their distribution range are endangered. Some of them have always been rare or with a very limited distribution; therefore they have a high risk of extinction if they are exposed to even relatively small adverse changes. Other habitats have been widespread in the past, but in the last century due to human activities, their distribution and ranges have significantly declined and continue this trend. These habitats can be preserved locally in relatively large areas, and it is by looking at the distribution of only local, rather than biogeographic region or subcontinental scale, that a false perception about the low priority of their protection might be created. In fact quite the opposite – places where the habitat is well represented should be given the highest priority. Habitats in these areas are less fragmented and form significant core zones that ensure the ecological integrity of the habitat and thus affects its position in the entire distribution range.

To describe the frequency of habitat abundance in Latvia (i.e. local incidence), 3 mainly used categories exist: very rare, rare and relatively rare. In some exceptional cases, habitat abundance in Latvia is estimated to be relatively frequent. For example, these habitats are 91D0* *Bog woodland*, occupying nearly 3% of the territory, 3150 *Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation* that occupy most of the Latvian natural reservoirs and 7110* *Active raised bogs* that occupy about 4% of the territory of Latvia. The above mentioned habitat areas and their proportion in the country has been taken from the Latvian report to the European Commission on the implementation of the Habitats Directive (Conservation status of.., 2013), unless other source of information is specified.

Species distribution is closely related to habitats. There are species whose ecological niche is very narrow and it almost entirely depends on the niche-forming habitat in at least one of their life-cycle stages. This section identifies those plants and fauna species, which are characterized by a strong dependence on the habitat described. In this section of habitat description the habitat importance in global processes, biodiversity protection, economics and other fields, which is well known, is not provided. Instead, this section emphasizes the unique value of each habitat that highlights it among other habitats. In addition to the value of protection from the point of view of biodiversity conservation, the scenic, recreational and cultural heritage value, as well as economic importance of a habitat is provided.

Environmental factors

Habitat distribution is not random. A very long time is necessary to establish one of the protected habitats of EU importance – it can be measured from decades to millenaries. Prerequisite for the formation of any habitat is a set of environmental conditions that permit formation of structures or plant communities that are specific to the habitat. These factors, such as habitat position in the relief and its impact on habitat vegetation, soil characteristics, hydrological conditions, position in relation to bodies of reservoirs or watercourses, are summarized in this section.

Processes with functional role

Only a few of the protected habitats reach final stages of natural succession or climax stage. A part of habitats cannot exist for long without regular natural or human-made disturbances. In the absence of such disturbances, due to natural succession they transform into other habitats, often in such that do not have significance of protection. Therefore, the existence of these disturbances is very important and it is also important to identify them in order to ensure a sustainable existence of these habitats in situations where for some reason these events do not occur or do not occur often enough. Also habitats that can reach the climax stage are affected by various disturbances and natural processes, ensuring their natural restoration and habitats for species that are related to the ecological niches of such disturbances. In habitat descriptions such processes with a functional significance are specified, explaining their impact on the habitat described. Environmental factors and processes with functional significance are often interrelated. In order to avoid duplication, a number of habitats in this chapter have been merged into one.

Vegetation characteristics (Periphyton)

Most of the habitats can be determined by their vegetation. Habitat descriptions in this chapter provide characteristics of vegetation – created layers and dominant species or potential plant communities in each of them. Information on the main succession stages that are significant in habitat determination also is provided. The section describes factors that determine vegetation in the habitat. For marine habitats a broader concept "periphyton" is used instead of the concept "vegetation" because part of this periphyton consists of representatives of fauna.

Characteristic species

In almost every habitat there are species that have a qualifying value – those which occur only in the habitat or the presence of which indicates the habitat. There are also species in a habitat that are almost always encountered, but it is not possible to identify a habitat only after them. The concept of "characteristic species" was introduced specifically for the needs of this manual because the species used for the identification of protected habitats of EU importance precisely does not correspond to any of the following designations in the phytosociological view – dominant, typical, characteristic, specific or indicator species, but may include any of the above. This is due to the large variety of criteria for separating these habitats – by plant communities, management type, geological origin, degree of naturalness etc. The list of characteristic species for the most of the habitats is based on the Interpretation manual of European Union habitats (Interpretation manual.., 2013), however, it does not include species that are not encountered in Latvia or occur as alien species. It does not include native species, which in Latvian conditions do not help to identify describable habitat or which occur too infrequently to be used in habitat identification. Additionally, species that are not included in the habitat description in the version of the Interpretation manual of European Union habitats, but in Latvian conditions they have a role in identifying habitats, can be listed. Habitats in whose descriptions in the Interpretation manual of European Union habitats there are no characterising species mentioned, this section lists species that have a qualifying value in Latvian conditions. Names of vascular plants, mosses, charophytes, lichens and mushrooms in Latvian and Latin are used by the latest Latvian published taxonomic lists (Kavacs, 1998 – Latvian names of vascular plants, Gavrilova, Šulcs, 1999 – Latin names of vascular plants; Āboliņa, 2001 – Latvian and Latin names of moss; Piterāns, 2001 – Latin names of lichens, Meiere, 2002 – Latvian and Latin name of polypores; Zviedre, Deķere, 2005 – Latvian and Latin names of charophytes; Hill et al., 2006 – latest moss nomenclature). Names of several groups of species in Latvian have not been published or can be found only partially.

Umbrella species

Habitat Directive demands to ensure a favourable conservation status to the habitats and species that depend on them, because its overarching aim is to stop overall biodiversity loss. By following a habitat condition, clarity is needed on the species associated to these habitats that depend on habitat quality. Existence of species is often determined not only by processes in individual habitat fragments, but also by individual species interactions in broader landscape, that is why it would be necessary to assess the state of the landscape in ecological aspect of the metapopulation point of view etc. As the number of species is very large, it is not possible to monitor changes in the status of all species. That is why simplified and less expensive ways to keep track of processes in habitats are searched. One of the simplest currently used methods in the practical environmental protection, based on the best available knowledge, is to choose species that are easy to study and whose presence and condition helps to early detect changes in the habitat quality and indirectly indicates the status of other species in the habitat. By assessing implementation of the Habitat Directive, the need to identify these species (Evans, Arvela, 2011), calling this group of species as "typical species", has been indicated. Unfortunately, the term "typical species" often leads to misunderstandings because it is a term used in phytosociology with a different meaning than it is meant in the Directive. Therefore, this manual uses the term "umbrella species", which is also not entirely accurate to the classical definition of umbrella species, but its meaning is much closer to the one of the Directive.

When choosing umbrella species, it is advised to consider the following aspects (Evans, Arvela, 2011):

– they should indicate habitat quality for both themselves and also for other species with similar ecological requirements;
– they should be mainly related to the specific habitat;
– they should be sensitive to the changes in habitat quality;
– they should be such whose state can be easily followed without having a negative effect on the observed species;
– the state assessment costs should be relatively low;
– they should provide a perception on the status of habitat when assessing it in the medium and longer term.

The selected spectrum of umbrella species should provide a thorough perception on the state of the habitat in different aspects. Species may be from any organism group; these can also be species that characterize habitats, species of annexes of the Habitats Directive or any species that are good for this purpose. However, the list should be sufficiently short so it would be easily applicable. Most of the EU countries for the majority of habitats thus far have noted herbaceous plant species, but it is recommended to take notice of the species of lichens, fungus and fauna (Evans, Arvela, 2011).

A good example of umbrella species is a capercaillie. Capercaillie range is mainly related to the Boreal class forests, especially to the 91D0* *Bog woodland* and 9010* *Western taiga*. Within the meaning of the benchmark of the Directive (stop the loss of biodiversity) it is necessary not only to ensure stable or increasing areas to these two habitats of EU importance, but also to ensure stable or increasing capercaillie population that depends on it. While this is not achieved, it is hardly possible to assess habitat condition as favourable. When evaluating only the dynamics of the habitat area, currently it would be close to stable. But it is known that the capercaillie population is fragmented and it tends to decrease (Strazds et al., 2004). To achieve their objective of favourable conservation status of the capercaillie, it is necessary to increase the required habitats and promote passage of spatial relation in the restoration of the currently degraded habitat areas or take any additional steps.

Inclusion of species of other groups of organisms, not only the ones that form vegetation, into the habitat functional assessment helps to identify aspects that might not be noticed if the habitat is restricted to the phytosociological view. For example, presence or absence of the resident or large alluvial meadows (usually 6450 *Northern Boreal alluvial meadows*) – Great Snipe - does not affect the assessment of the habitat quality, if it is assessed only from the botanical point of view. However, in the context of the purpose of the Directive, the conditions in these grassland habitats must provide a territory for a stable population of the Great Snipe. Therefore the only way for assessing this dimension of this habitat quality is to draw attention to the Great Snipe, whose presence usually indicates suitability of conditions for a number of other bird species. There are species that are useful for assessment of a number of different habitats. For example, sand lizard indicates conditions in several dry grassland, forest and dune habitats, and allows evaluating ecological functionality of the habitats from the metapopulation point of view.

Lists of umbrella species provided in this manual are under development. The Directive requires extensive and at the same time practically applicable view that is still fairly new and unusual in Latvian nature conservation practice, therefore it requires further research.

Variants

In many cases one and the same EU protected habitat may be visually, in terms of species composition or various environmental factors so diverse that it is impossible to provide a single and precise description. In cases when such radical differences or problem situations exist within a habitat and they influence the logics for the classification of a habitat, variants have been distinguished for habitats. Differences in the origin, as well as differences in environmental conditions and the species content have been used in partition thereof and names. Habitat variants are closely linked with the habitat classification schemes (Annex No. 1) – each variant therein is a separate unit. Each habitat variant may also have its minimum quality requirements, and in habitat mapping each of them is also a separate mapping unit.

Habitat quality

Habitat is in an ideal condition if it fully complies with the description and it contains all characteristic structures of the relevant habitat variant. However, in reality many habitat deposits are partly influenced by unfavourable factors, degraded or the habitat might be only in the process of formation; therefore, several components that characterize habitats may not be in a good condition or may be missing. The lack of some components or a low quality thereof does not automatically mean that the respective area does not qualify for the status of a habitat of EU importance. If such habitat performs its ecological function and ensures habitats with species related to it or it is possible to restore its quality within reasonable terms, it is still considered as a habitat of the Directive. Therefore, the description of each habitat includes qualitative and/or quantitative criteria to which the specific habitat must comply with so that the habitat area under consideration would be identified as a protected habitat of EU importance. These criteria are regarded as the minimum quality requirements or the minimum quality threshold of habitats. If the habitat does not conform to the minimum requirements, the latter shall not be regarded as a protected habitat of EU importance.

During the past decades, large-scale habitat restoration measures are being implemented in developed countries; within the scope of these measures the habitat is restored in the place where it has been destroyed for a long period of time. In such cases the following question becomes quite reasonable – can such habitat of artificial origin be considered as a natural habitat within the context of the Directive? If the restored habitat performs the same ecological functions that would be fulfilled by a habitat of a natural origin, and it conforms to the minimum quality requirements of this habitat, the latter shall be regarded as the relevant protected habitat of EU importance. A broad range of quality between a habitat that conforms only to the minimum quality requirements and a habitat of excellent quality is possible in nature. Over a period of time, the quality of many habitat deposits tends to deteriorate under the impact of various negative factors. Meanwhile, their quality improves by performing successful habitat restoration and maintenance measures. The Habitat Directive obligates Member States to perform regular monitoring od protected habitats of EU importance and to regularly report to the European Commission about the quality thereof or their "conservation status". This criterion comprises three sub-criteria:

i) degree of conservation of the structure;
ii) degree of conservation of the functions; and
iii) restoration possibilities.

There may be three possible evaluations for the sub-criterion i) degree of conservation of the structure.

I: excellent structure;
II: structure well conserved;
III: average or partially degraded structure.

In cases where the sub-class "excellent structure" is given, the habitat conservation degree should be classified as "A: excellent conservation", independently of the grading of the other two sub-criteria.

There may be three possible evaluations for the sub-criterion ii) degree of conservation of the functions.

I: excellent prospects;
II: good prospects;
III: average or unfavourable prospects.

In cases where the sub-class "I: excellent prospects" or '"II: good prospects" are combined with the grading "II: structure well conserved" of the first sub-criterion, the habitat conservation degree should in its totality by classified "A: excellent conservation" or "B: good conservation" respectively, independently of the grading of the third sub-criterion. In cases where the sub-class "III: average or unfavourable prospects" is combined with the grading "III: average or partially degraded structure" of the first sub-criterion, the habitat conservation degree should be classified as "C: average or reduced conservation" independently of the grading of the third sub-criterion.

There may be three possible evaluations for the sub-criterion iii) restoration possibilities.

I: restoration easy;
II: restoration possible with an average effort;
III: restoration difficult or impossible.

The overall evaluation is obtained by combining all three sub-criteria according to the following scheme:

A: excellent conservation – the habitat has excellent structure or the structure is well conserved and excellent prospects independent of the grading of the third criterion;

B: good conservation – the habitat has a well conserved structure and good prospects independent of the grading of the third sub-criterion or it has a well conserved structure and average or unfavourable prospects, but restoration is easy or possible with average effort, or the habitat has an average structure or partially degraded, but excellent prospects and restoration is easy or possible with average effort, or the habitat has an average structure or partially degraded, but good prospects and easy restoration;

C: average or reduced conservation – all other combinations of the remaining sub-criteria.

So that it was possible to perform evaluation of habitat quality or conservation degree according to the aforementioned standardised evaluation system, indicators have been identified for each habitat by which evaluation of its structure, functions and restoration possibilities can be performed. Quality evaluation is performed only to those habitats that reach the minimum quality threshold. Within the scope of one habitat group, many of the quality indicators are similar; therefore the largest part of them is given and is explained in detail in the introductory chapter of the relevant habitat group. The habitat description itself includes those common indicators of the habitat group that are not used in the evaluation of the quality of the described habitat, and those that are significant in the evaluation of the quality of the respective habitat, but are not included in the list of common indicators of the habitat group. A complete list of indicators has been given in the quality section of the habitat description only for those habitats to which the largest part of the common quality criteria of the relevant group cannot be used. Only such indicators have been included in the list of quality indicators that can be measured or evaluated in field circumstances while visiting the habitat. Thereby, possibly, several significant factors of landscape or broader scale have not been included in this list. In particular the latter applies to indicators that characterize the conservation degree of habitat functions – the current level of knowledge does not allow precise identification and measurement thereof.

If a habitat conforms to the determined minimum requirements, it is possible to improve its structure or to perform restoration of the habitat. The latter may be reached by using various means depending on the habitat group – by mowing or grazing, cutting of trees and shrubs, restoring the hydrological regime, destroying inferior species, etc. Nevertheless, restoration possibilities differ in various cases. The habitat restoration possibility evaluation system that is described in this manual does not include indicators for factors that must be evaluated in a broader – either landscape or social and economical – context, and that cannot be identified in field conditions, for instance, habitat isolation, costs, possible managers, attitude of owners. Habitat quality evaluation forms have been elaborated on the basis of quality indicators given in habitat descriptions; it is still necessary to test these forms in practice, therefore they have not been included as an annex to this manual. The latest versions of the forms are available on the website of the Latvian Nature Foundation www.ldf.lv, section "Augu un biotopu monitorings" ("Plant and Habitat Monitoring" with an indication "Biotopu kvalitātes novērtēšanas anketas 2010" ("Habitat Quality Evaluation Forms 2010")).

Threats

Sustainable existence of habitats is endangered both by human activity and presence or lack of various natural processes. Factors that have direct impact on habitats and their quality have been examined better, therefore all factors, bearing a significant direct impact on the described habitat or habitat group in Latvia's circumstances, have been listed in this section. As factors causing indirect impact have been examined less precisely, this section lists only those factors whose significant impact has been proved. Factors, whose impact on a habitat is very insignificant or incidental, have not been listed in this section. Also various global factors (for instance, climate change) that influence all habitats have not been listed.

Management

Many of protected habitats that are present Latvia cannot exist without special management. Most frequently it is necessary in cases when a habitat represents a specific stage of the natural succession, which is not the final stage thereof. Due to the reason that Latvia is located in the boreonemoral biogeographic region, a forest is the final stage of a normal natural succession.

Therefore all open and partly open habitats, whose survival and long-term existence is not ensured by active natural processes, require regular maintenance measures similar to those that have taken place there historically, but no longer take place in the contemporary social and economical context. A part of habitats require special measures that promote or imitate various natural disturbances that nowadays do not take place or take place rarer. Special measures that would improve the ecological quality of habitats might be necessary also to those habitats that are at the final stage of succession and to whom avoidance to interfere in natural processes is the most optimal maintenance regime, especially if previously they have been partly degraded or the adverse impacts are continuous. Most frequently the largest part of the habitats of a single group require similar management measures, therefore these joint measures are given in the list of the habitat group, whereas habitat descriptions include only management measures specific for the habitat under consideration. Only those measures have been described that must be performed in the habitat itself or in a close proximity to it. Measures on a landscape level that ensure habitat integrity in a broader context have not been included. Planning of management measures is important in habitat management, by selecting the most appropriate measures for each specific situation that provide greater ecological effects at lower costs.

Similar habitats of EU importance

In many cases it is difficult to draw a clear boundary between two or several protected habitats of EU importance. Very frequently in nature there are situations when characteristic features of several habitats exist in one and the same field unit. In such cases experts must decide, which is the habitat whose characteristics dominate. This chapter of habitat descriptions define those habitats that tend to have such similarity, and provides criteria that aid to differentiate such habitats one from another.

Overlap with other habitats of EU importance

Habitats that, along with the described habitat, may be located in the same field unit under consideration and spatially overlap with it have been specified. In such cases experts must not select only one of the two habitats, but both of them must be marked as separate mapping units, separating the area where both habitats overlap.

Corresponding specially protected habitats of Latvia

Habitats that have been included in the list of specially protected habitats of Latvia (Cabinet Regulation No. 421 of 5 December 2000 with amendments made by Cabinet Regulation No. 61 of 25 January 2005 and Cabinet Regulation No. 74 of 27 January 2009) and fully or partially match with the described habitat are listed here. A scheme depicting the overlap of all protected habitats of EU importance with especially protected habitats of Latvia has been provided in Annex No. 4.

Literature

List of literature includes all literature sources that have been used and cited in the description text, as well as research works that have been conducted in Latvia regarding the relevant habitat, even if they have not been directly quoted.

Classification schemes

In order to ease the classification of habitats in field conditions, the quintessence of the descriptions of habitats and their variants has been structured in the form of schemes. Each habitat group has its own classification scheme where other similar protected habitats of EU importance, if there are such, have been included in addition to the habitats of the relevant group. These schemes are been provided in Annex No. 1 at the end of this manual.

HABITAT MAPPING

Habitat mapping is performed by inspecting an area and marking all encountered habitats of EU importance in a map. The degree of detailed elaboration and methodology of habitat mapping may differ depending on the goal; the method specified below has been described as one of the possible methods and thus far it has been used for mapping of Natura 2000 territories. The optimal mapping scale is 1:10 000 or finer, but in separate cases the scale may be broader, for instance, when mapping large high mire territories. If an older habitat mapping is available for a territory, it should definitely be used as the basis for the new mapping, making changes that are required according to the situation in nature. The latter will allow avoiding such gaps between mappings that do not depict changes in nature, but have incurred due to imprecision in marking boundaries of different habitats. When mapping a territory of Natura 2000, the latest version of Natura 2000 database (http://natura2000.eea.europa.eu/#) must be taken into account and one must make sure that all habitats therein have been encountered during mapping. If discrepancies with the information of Natura 2000 database are encountered, the changes must be substantiated by providing reasons for them. Information on the habitat mappings at the disposal of state institutions may be obtained at the data management system OZOLS that has been created by the Nature Conservation Agency of Latvia. The map available on the website of the Rural Support Service may be also used as an information source about occurrence of habitats (http://www.karte.lad.gov.lv/), to make sure whether biologically valuable grasslands that mostly correspond to EU grassland habitats are a part of the mapping territory.

Performing habitat mapping, an expert must mark the boundaries of all encountered EU protected habitats in the map. Plans of forest stands are used as the basis for marking forest habitats. If a forest habitat does not correspond with the boundaries of the forest plot, the habitat is marked the way it is in nature, specifying coordinates of the breakage points of the line. Those habitats whose classification is based on relief features (for in-

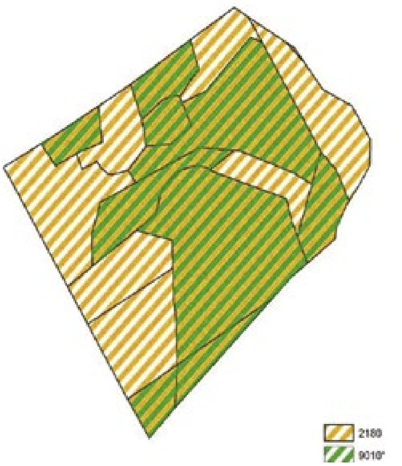


Figure 1. *Habitat 9010* is fully included in some parts of the site of habitat 2180 (Author: R.Sniedze-Kretalova)*

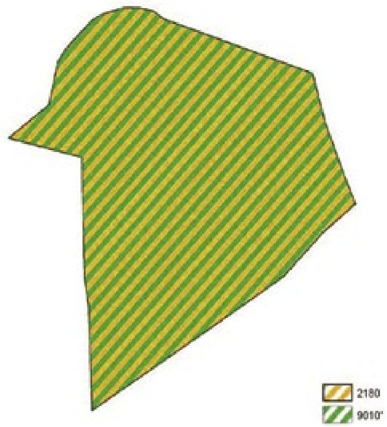


Figure 2. *Habitats 2180 and 9010* fully overlap and their site boundaries are identical (Author: R.Sniedze-Kretalova)*

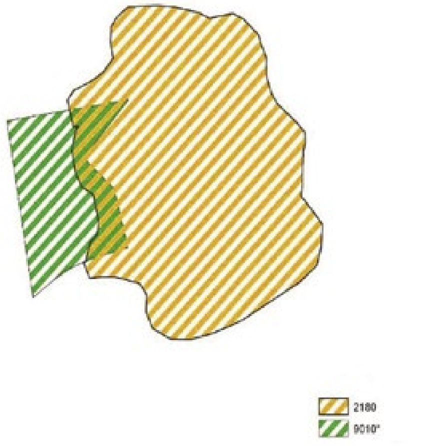


Figure 3. *Habitat 9010*, which continues outside the boundaries of 2180, is partly included in the site of habitat 2180 (Author: R.Sniedze-Kretalova)*

Scheme 1. Instructions for the creation of habitat layer (Author: R.Sniedze-Kretalova).

Field name	Field type	Description/notes	Example for the completed field
Habitat code	Text[5]	A 4-sign code of EU specially protected habitat is specified in this field; also a star must be specified in addition to the 4-sign code to priority habitats	7220*
Name	Text[100]	Full name of the habitat according to the EU protected habitat classification methodology is provided in this field	Springs that create alkaline springs
Variant	Text[1]	Variant of the EU specially protected habitat according to the EU protected habitat classification methodology is provided in this field. Must be completed obligatory, if habitat has variants. The field remains empty for habitats which do not have variants	
Problem (P)	Text[1]	Designation "P" is being used in this field, if the habitat is unusual, influenced, but later on it conforms to the minimum quality criteria in accordance with the EU protected habitat classification methodology	P
Problem description	Text[255]	Field for problem explanation where the problematic issue is being described must be completed obligatory if "P" has been indicated	Spring outflow regulation
Overlap	Text[1]	Place of habitat overlap is marked	0 - no overlap
			1 - another EU protected habitat is fully included
			2 - fully included in another EU protected habitat
			3 - partial overlap with another EU protected habitat
Area, ha	Long integer	Automatically calculated area occupied by habitat	0.12
Observation date	Date	Date of habitat mapping entered	31.12.2012
Expert	Text[50]	Expert, who inspected or classified the relevant habitat, is specified in this field	J.Kalniņš
Notes	Text[255]	Any important information is specified	Non-interference must be specified

stance, 9180 *Tilio-Acerion forests of slopes, screes and ravines*) are marked on a topographic map of a corresponding scale. Open areas (grasslands, mire habitats) are marked on orthophotos or satellite images. Upon habitat mapping, the degree of detailed elaboration may vary depending on the specifics of the work; however, the criteria specified below are applicable when mapping vast territories, for instance, *Natura 2000* sites. The minimum area of an object (site) is 0.1 ha. Such objects are used for mapping the majority of coastal, lake, grassland, mire and forest habitats. Habitats that are encountered in nature in small areas – caves, springs – are an exception as their area may be less than 0.1 ha; nevertheless, it is still necessary to mark them as polygons (in order to be able to determine the size of the area of a specific object). If a concentration area of spring habitats is encountered in a forest, the site or a part of the site, where they are located, shall be mapped as a polygon. Even if the habitat quality is not good or it is in the transition stage and therefore is not typical, but corresponds to the minimum quality requirements specified in the description of the relevant habitat, it is marked, choosing a variant that corresponds to it. If the habitat quality is low (close to the minimum quality threshold according to any of the criteria), the indication "P" (problem) must be added to the habitat code, providing a short description about the reason of such indication in the Problem field, for instance, overgrown grasslands, impact of beaver activity, etc. For habitats that have several variants in accordance with the habitat description, the variant of each polygon must be specified obligatory during mapping, indicating which variant the respective site conforms with. If several variants of a habitat are located next to each other, they shall be marked as separate polygons in the map.

Habitats must be marked clearly and unmistakeably. If significant differences in respect to the boundaries of a habitat are encountered, they must be depicted in the mapping with an indication (for instance, 9010* – 1, 9010* – 2 or 9010*–1P). In digitalisation of the habitat mapping, the habitat layer must be created, taking into account the instructions specified in Scheme 1, as well as by adding additional fields in the case of necessity. In case of spatial overlap between two habitats of EU importance, each habitat is mapped as a separate polygon object and these objects may overlap. The nature of the overlap must be specified in the corresponding field of the attribute table: 0 – habitat does not overlap; 1 – in the polygon that characterizes a habitat fully includes another habitat of EU importance, for instance, a part of the forests that are included in habitat 2180 (habitat under consideration) corresponds to 9010* criteria (*Fig.1.*); 2 – the polygon that characterizes a habitat is fully included in another protected habitat of EU importance, for instance, habitat 9010* (habitat under consideration) is included in the area of 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* (*Fig. 2.*); 3 – the polygon that characterizes the habitat under consideration partly overlaps with another habitat of EU importance and it is neither of the aforementioned overlap variants (*Fig. 3.*).

Literature

Anon. (2013) Dabas datu pārvaldības sistēma „OZOLS", http://ozols.daba.gov.lv/pub/

Āboliņa, A. (2001) Latvijas sūnu saraksts. Latvijas veģetācija 3, 74.–87. lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Ellenberg, H. (1996) Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht., Ulmer

European Environment Agency (EEA) (2013) *Natura 2000* Viewer, http://natura2000.eea.europa.eu/#

Gavrilova, Ģ., Šulcs, V. (1999) Latvijas vaskulāro augu flora. Taksonu saraksts. Rīga, Latvijas Akadēmiskā bibliotēka, 135 lpp.

Hill, M.O., Bell, N., Bruggeman-Nannenga, M.A., Brugués, M., Cano, M.J., Enroth, J., Flatberg, K.I., Frahm, J.-P., Gallego, M.T., Garilleti, R., Guerra, J., Hedenäs, L., Holyoak, D.T., Hyvönen, J., Ignatov, M.S., Lara, F., Mazimpaka, V., Muńoz, J., Söderström, L. (2006) An annotated checklist of the mosses of Europe and Macaronesia. Journal of Bryology 28, 198-267 p.

Interpretation Manual of European Union Habitats. EUR 27 (2007) European Commission, DG Environment, 144 p.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Latvijas daba. Enciklopēdija. 6. sējums (1998) G.Kavaca red. Rīga, Preses nams, 187.–323. lpp.

Lauku atbalsta dienests (2006–2013) Lauku reģistra ģeogrāfiskā informācija, http://www.karte.lad.gov.v/

Meiere, D. (2012) Latvijas piepju konspekts. Grām.: Latvijas veģetācija 5, Rīga, 7.–42. lpp.

Piterāns, A. (2001) Latvijas ķērpju konspekts. Latvijas veģetācija 3: 5.-46. lpp.

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

Zviedre, E., Deķere, Z. (2005) Mieturaļģu sugu nosaukumi un termini latviešu valodā. Acta Universitatis Latviensis, 2005, Vol. 691, Biology, 145.–155. lpp.

Previous habitat name: *Coastal and halophytic habitats* (previous name did not accurately reflect the nature of the habitat group while the Baltic Sea has a very low, close to brackish, level of salinity).

Marine and coastal halophytic habitat group unites both marine habitats and habitats that are related to and depend on impacts from the sea: beaches and other habitats in the Coastal Lowlands that seasonally or irregularly are flooded with brackish sea water. The diverse habitat group unites temporary, seasonal microhabitats and relatively permanent habitats as well as habitat complexes of different sizes. These habitats are an integral functioning complex that forms belts of various widths parallel to the shore of the sea. Along the shore of the Baltic Sea lines of these habitats are wider than on the shores of the Gulf of Riga.

Marine and coastal halophytic habitats are permanent and very dynamic at the same time. If a beach is intensely flushed with sea water and vegetation cannot strengthen, some of the habitats may not establish even for several seasons. It is often more important to identify the dominant processes and to provide no disturbances to natural coastal processes instead of identifying the habitat. The floristic structure and characteristic vegetation of coastal brackish habitats that are co-influenced by maritime activities completely establishes only at the end of the vegetation season.

Distribution

Habitats of this group are found in the sea, on the beach and in a close proximity to the sea, less often – coastal meadows and coastal lagoons are formed further inland, but never outside the Coastal Lowlands. The general spatial positioning scheme of marine and coastal brackish habitat groups is provided in the *Figure 1.1.*

Conservation value

The distribution and quality of habitats of this group has decreased worldwide mainly because of anthropogenic factors. Latvia is one of the few countries in Europe where marine and coastal habitats are relatively undisturbed in larger areas and can potentially develop within a stretch of more than 450 km, which is ~ 9/10 of the total length of the seashore of Latvia. Only ~ 1/10 of the seashore is directly impacted by the infrastructure of ports, shore revetments and the proximity of settlements. Nevertheless, until now, the European brackish habitats that are related to the terrestrial part of the coast are identified in a total area of 426 ha, which is only 0.007% of the total land area of Latvia (Conservation status of.., 2013). Because of the expansion of urban areas in the previous centuries (such as Rīga, Liepāja, Salacgrīva, etc.) and because of an inadequate management of habitats 1150* *Coastal lagoons* and 1630* *Boreal Baltic coastal meadows* are relatively more affected which has resulted in the decrease of total area of the habitats. In the second half of the 20th century, most of the Latvian shore of the Baltic Sea was a restricted area – the border of the former USSR – therefore, partially undisturbed and undisturbed beaches, shallow water marine and seaside areas are preserved in Latvia.

Marine and brackish habitats provide conservation of the complex of species and communities of species that are characteristic to the eastern part of the Baltic Sea. These communities are formed by species that have adapted to the continued impact of sea, wind and sand, brackish environmental conditions and fluctuating moisture regime – it is the only habitat for of littoral plant species in Latvia. Due to the small number of species and the dynamic conditions, these communities are very susceptible to human activities.

Habitats of this group are an important migration corridor for plants and invertebrates, as well as important feeding grounds for many bird species during the spring and autumn migrations.

Beach is a natural buffer limiting coastal erosion, which protects mainland from erosion during storms, reducing the amount of soil that is flushed out into the sea.

Coastal brackish habitats also possess landscape and cultural heritage value. They are recognized resources of high value for recreation, sports, tourism and medical purposes.

Environmental factors and processes with a functional role

Existence of marine and brackish habitats is mainly conditioned by their connection to the sea, ranging from permanently submerged marine habitats to locations flooded by brackish water every couple of years, therefore sea water quality is an important factor. These processes involve both physical and chemical impact of flooding; flooding with seawater provides adequate moisture and enriches the substrate with salt. The Baltic Sea is almost completely enclosed and has a large freshwater inflow from rivers and precipitation, thus the average salinity of the sea water varies from 1‰ in the northern part to 6–8‰ in the central part of the Baltic Sea. It is also characteristic that fluctuation in average water temperature coincides with the salinity gradient. Due to these two fac-

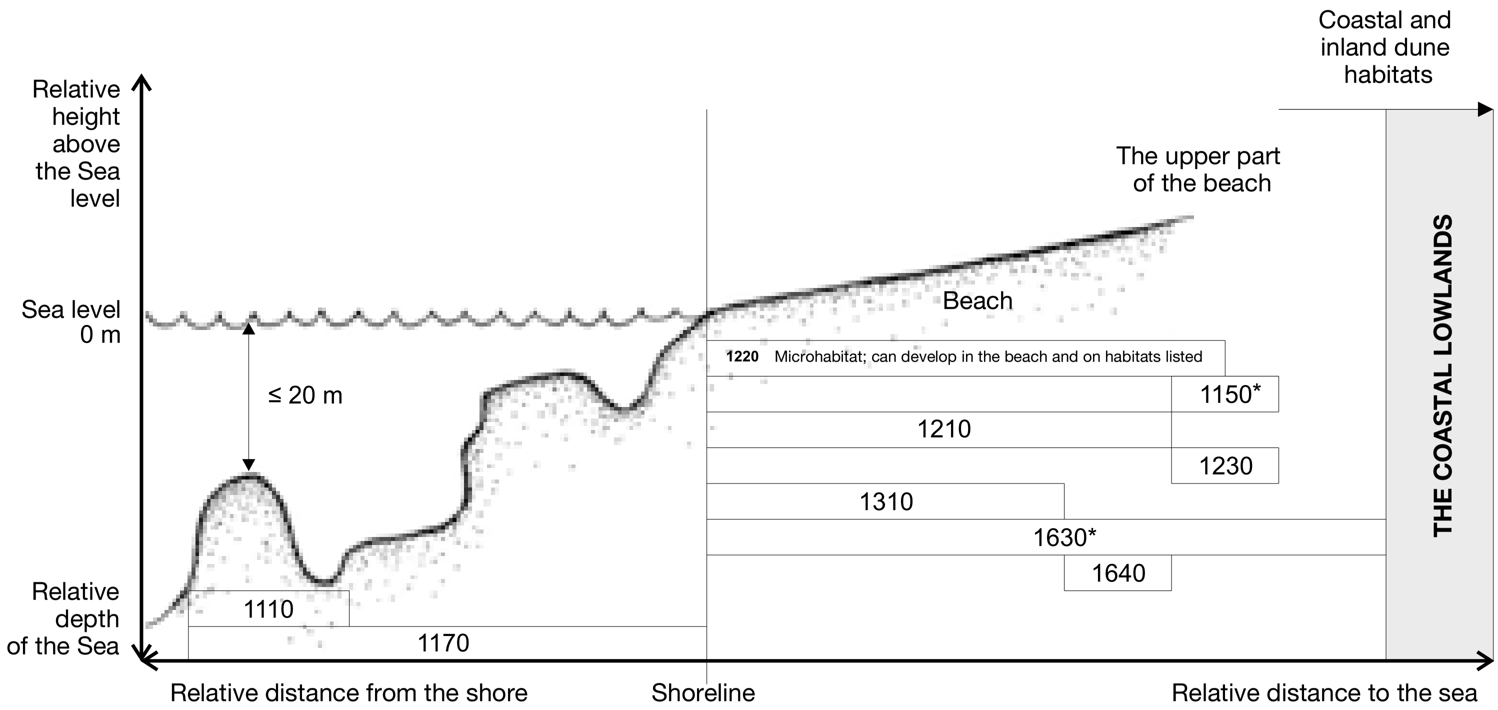


Figure 1.1. Marine and brackish habitat spatial occurrence scheme or profile; in relation to shoreline; (Scheme: I.Rove).

tors – salinity and temperature – different species occur in various parts of the Baltic Sea.

It is important for natural marine and seashore processes, whose assessment must be performed beyond the borders of habitats themselves, to take place without disturbances. Habitat development and conservation, as well as their dynamics are determined by the flow and volume of the longshore drift which is parallel to the shore. This flow impacts an intense sediment exchange, causing it to be washed off or accumulated on the beach. The impact of the regular drift flow is changed by season related climatic processes. In autumn and winter period due to the impact of storms erosion and narrowing of the beach predominate, while in summer beach expansion and accumulation of sediments prevails. Sandy shores are characterized by a markedly short cycle of beach regeneration, which only takes up to 5 years. In the phase of storm decay wind-blown water flows and their ebb-tides transform substantially the shore and the beach, promoting restoration and preservation of salinity in the substrate, as well as cause fluctuations in water level and changes in salinity in coastal water-bodies. Habitats also are influenced by the direction and strength of the prevailing wind, beach erosion or expansion, 'buried with sand' during storms and after them. Ice has a significant influence in both protecting the main land from erosion during winter storms and impacting the vegetation at the sea shore if ice blocks are pushed up on the beach.

Drifts of organic material, carried by wind and waves, can be found everywhere on the beach. The drift material can be transported on top of other coastal and marine habitats.

In some sections of the shore there is a significant influence of springs, which in places of outflow onto surface locally affect humidity and chemical composition of the soil, and have a consequent impact on vegetation. The geological composition and geomorphology of the seashore, as well as width of habitat line have a great impact on the functions of coastal brackish substrate habitat functions.

Figure 1.1. Marine and brackish habitat spatial occurrence scheme or profile; close to the shoreline (Scheme: I.Rove).

Environmental conditions may cause a situation when a certain habitat can disappear seasonally or even for several years, depending on the intensity of beach flooding and accumulation processes. A cyclical nature that partly overlaps with the cycles of beach is characteristic to these habitats. Vegetation starts to establish when active flooding processes cease temporarily; if flooding processes are absent for several years, a relatively stable vegetation can establish. Due to the impact of natural and anthropogenic factors, naturally functioning seashores may subside, and processes of accumulation and/or erosion of varied intensity may begin.

Vegetation characteristics

The habitat group is characterized by a various and distinct vegetation that is determined by environmental conditions and dominating processes. The group combines habitats that are rarely covered with vegetation or are covered with sparse vegetation of few species as well as species-rich and dense habitats, such as coastal grasslands. Vegetation can be comprised of organisms from a variety of systematic groups: only of shellfish or perennial marine macrophytic algae, herbaceous plants and in rare cases moss and lichens. Characteristic species of salty and brackish habitats – *halophytes* – have an important role in plant communities of terrestrial habitats. In the highest areas of the beach plants that are able to grow in the moving (by wind) sand – *psammophytes*, are characteristic. In nutrient rich areas, nitrogen and phosphorus in particular, such as low and wet beaches, shores of lagoons and drift lines, weeds and ruderal species can often be found. Lack of competition promotes distribution of ecologically plastic, mostly annual species, as well as spreading of some of the invasive adventive species (e.g. *Lactuca tatarica*). Habitat forms belts of plant communities that are parallel to the sea shore or in a concentric manner around lagoons. Relief and microtopography conditions and the associated lighting, humidity, temperature and salinity variants determine the formation of diverse communities.

A significant vegetation layering is formed only in 1630* *Boreal Baltic coastal meadows*, permanent 1150* *Coastal lagoons*, as well as in habitats 1220 *Perennial vegetation of stony banks*, 1640 *Boreal Baltic sandy beaches with perennial vegetation*. Vegetation in all the other habitats is not permanent and often sparse, generally it is not possible to define layers. The layer of low herbaceous plants is up to 10 cm high, the layer of medium herbaceous plants ranges from 10–100 cm height (average 50 cm) and the layer of tall herbaceous plants exceeds 100 cm in height. In permanent habitats the layer of moss and lichen is separated very seldom. In some habitats of 1170 *Reefs* with rich coverage of living organisms it is also possible to observe layers that consist of perennial algae and mussels.

Habitats are characterized by notable alternation of areas covered in vegetation and areas with open substrate. It includes the total cover of the layer and the layout of the open substrate areas that are free from vegetation, and also the layout among plants – mosaic of vegetated and open substrata. Vegetation of all habitats, except for 1630* *Boreal Baltic coastal meadows*, is very irregular, areas of open substrate of various sizes and layouts are formed. Vegetation is not characteristic for most of the habitat 1110 *Sandbanks which are slightly covered by sea water all the time.*

The habitats of this group are simultaneously permanent and very dynamic ecosystems that change very rapidly with the changes in environmental conditions and management.

Habitat Quality

Minimum habitat requirements

Individually provided for each habitat of this group. All or most of the marine and coastal brackish habitats have several common quality indicators.

Structural indicators

Proportion of the area in which at least one of the characteristic plant species occurs – shows the adequacy of environmental conditions for the existence of a specific habitat. Exceptions are 1150* *Coastal lagoons* and 1110 *Sandbanks which are slightly covered by sea water all the time* where in some cases none of the characteristic species can be found.

Total number of characteristic species – an important indicator for the quality of the habitat. When the quality of a habitat decreases, the amount of characteristic species also decreases.

Invasive species – non-native species that can rapidly spread in the habitat in favourable conditions for these species, thereby changing its floristicstructure. Ideally, a habitat contains no such species or they are found in a small number and area.

Proportion of area in which vegetation has the characteristic mosaic structure – good indicator of habitat diversity, frequently also indicates age structure and restoration possibilities.

The number of various organism groups related to a certain habitat, rare and specially protected species that depend on the habitat – determines the value of habitat protection and suitability of the environment to the ecological requirements of a specific habitat.

Function indicators

Intensity of anthropogenic impact on vegetation, substrate and relief (for example, driving, coastal fisheries, recreation, net casting and pulling, moving and storing of boats as well as fishing gear) – significant indicator, ideally there is no anthropogenic impact or it is negligible.

Number of visible man-made objects in the sea and at the seashore that influence natural processes and conditions for habitat (for example, breakwaters, shore revetments, impeding natural processes, underwater constructions) – indicate potential changes in natural processes, for example, changes in long-shore drift movement.

Influence of neighbouring habitats on the specific habitat – can be positive, neutral or negative. This indicator points out ecological functions of the habitat and the direction of its development.

Quality of habitat structure as a precondition for its function – evaluation depends on total evaluation of structure indicators.

Habitat Restoration Possibilities

Restoration possibilities of habitat structure and functions – evaluated by the condition of structure and functions, as well as the amount of drift flow; ideally, habitat does not have to be restored; in order for natural processes to take place, non-intervention and control can be appropriate; often, however, it is necessary to perform biotechnical or technical interventions; in significantly degraded habitats it is necessary to perform extensive actions including long-shore drift movement restoration and/or supplementing substrate, to restore habitat structure and functions.

Necessity to plan, remove or build engineering objects in order to maintain/ restore habitats – such measures are necessary to, for instance, restore natural long-shore drift movement etc., ideally, such extensive measures are not required.

Restoration costs – an important factor for potential habitat restoration possibilities.
All habitats of this group that meet the minimum quality requirements are potentially restorable, except of the habitat 1110 *Sandbanks which are slightly covered by sea water all the time*, but the progress of recovery depends on the above-mentioned factors and the set of factors that is specific for each habitat. It should be emphasized that habitats of this group are complex indicators of marine environmental quality and there may be occasions when locally implemented measures do not improve the situation significantly.

Threats

People traditionally have lived at the shore of the sea, creating a wide range of significant anthropogenic pressures on relatively narrow, dynamic and fragile beach and shoreline areas. Coastal habitats are simultaneously ecologically resilient and able to regenerate, determined by their explicit dynamics and extreme sensitivity to various impacts. All habitats of this group are affected by climate change and sea-water quality, that are determined by many processes with cumulative effects, including terrestrial activities as well as the quality of water that flows into the sea. The most negative impact is caused by both increased amount of nitrogen and phosphorus that leads to eutrophication, and insufficient inflow of oxygen-rich water. Water quality is also affected by chemical and toxic pollution, including heavy metals (mercury, cadmium, lead), as well as oil products. The considerable amount of PET bottles in the sea also poses a significant problem. Environmental eutrophication is increased by nitrogen deposition, as well as local effects, including inadequate sanitation infrastructure in popular tourist sites and recreation. In the last fifteen years, tourism and recreation has been recognized as one of the most important factors that have a negative impact on seashores (EEA, 2006).

Different types of human economic activity (trawling, soil deposition areas, dredging) and recreation (trampling, driving) can destroy habitats mechanically. Underwater constructions and artificial protection of the sea shore by construction of breakwaters, placement of *gabions*, strengthening of the shore with concrete plates, inconsiderate construction and renovation of wave breakers or breakwaters can significantly change processes in the place of direct influence and often at a considerable distance from the site of direct impact, it is expressed particularly negatively with changing the amount and direction of long-shore drift flows. Extraction of natural resources (shells, algae, amber, stone, etc.) and minerals (sand, pebbles, seabed material, etc.) reduces the amount of habitat-forming material directly and often destroys the habitat itself; even extraction of sand outside the borders of protected habitats of EU importance can change the movement and volume of natural sediments significantly. Unbalanced coastal fishing, including use of improper gear, also causes a negative impact. This impact is viewed in conjunction with the infrastructure for coastal fishing located on the beach and inland (access roads, boat houses, fish processing, etc.), which increases its impact on this habitat group.

Due to the low number of native species, invasive species have a significant influence on the structure of plant communities and native species populations. In recent years in Latvia, *Populus tremula* and invasive species such as *Cercopagis pengoi*, *Rosa rugosa*, *Eleagnus commutata, Lactuca tatarica*, various garden escapees and weeds, in many cases, *Gypsophila spp*. and *Asparagus officinalis* are particularly expansive as well as alien species that have been brought by sea currents; marine habitats are affected by invasive sessile and floating species whose distribution is promoted by both climate change and intensive traffic of ships in the Baltic Sea.

It should be emphasized that the adverse effects may result from both insufficient and excessive volume of natural or anthropogenic disturbances, for example, erosion may increase or natural processes may subside, both of which have a negative effect on the habitats. During the last decade plans on construction of wind farms, whose influence is much broader than a mechanical alteration of the environment, including effects on species and habitats in general as well as on the landscape, in the shallow water part of the sea have been topical.

Management

Management and protection of marine and coastal brackish habitats is extensive and intricate, as it must be carried out in a complex manner, even at an international level, as local measures can be mostly ineffective. One of important factors in ensuring the protection of habitats is qualitative planning, which is addressed by the methods of integrated coastal zone management and spatial planning (ICZM) in the sea and at the shore, that not only include nature protection itself, but also social, economic and tourism planning.

In order to ensure protection of these habitats, it is essential to not interfere with the natural processes. Only habitat 1630* *Boreal Baltic coastal meadows* must be regularly managed by grazing or mowing. Thinning of trees and shrubs might also be necessary. In most habitats it is necessary to reduce the amount of human disturbance by organizing the flow of visitors and introducing various restrictions and planning tools. In order to restore habitats that are degraded significantly, separate sections of sea, beach or coast must be closed temporarily.

However in cases when the amount of natural disturbances is not sufficient, conservation of dynamic habitats is provided by simulating the necessary disturbances.

Improvement of sea water quality or at least ensuring that it remains at the current level has a significant impact on the conservation of these habitats.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Eberhards, G., Lapinskis, J. (2008) Baltijas jūras Latvijas krasta procesi. Atlants. Rīga, LU Akadēmiskais apgāds, 64 lpp.

Eberhards, G. (2004) Jūra uzbrūk! Ko darīt? Rīga, Latvijas Universitāte, 23 lpp.

Eberhards, G. (2003) Latvijas jūras krasti (Baltijas jūras Latvijas krasta josla). Morfoloģija, uzbūve, mūsdienu procesi, riska zonas, prognozes, aizsardzība un monitorings. Monogrāfija. Āboltiņš, O. (red.) Rīga, Latvijas Universitāte, 296 lpp.

European Environment Agency (EEA) (2006) The changing faces of Europe's coastal areas. European Environmental Agency Report No. 6. Copenhagen, 107 p.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Laime, B. (2005) Augi jūras krastā. Rīga, Latvijas Universitāte, 63 lpp.

1110 *Sandbanks which are slightly covered by sea water all the time*

Latvian habitat classification: A.4.1.; partly A.1.1., A.2.1., A.1.7.

Syntaxonomy: *Zosteretalia marinae*.

Definition: sandbanks are elevated, elongated, rounded or irregular topographic features, permanently submerged and predominantly surrounded by deeper water. They consist mainly of sandy sedimants, but larger grain sized, including boulders and cobbles, or smaller grain sizes including mud may also be present on a sandbank. Banks where sandy sediments occur on a layer over hard substrata are classed as sandbanks if the associated biota are dependent on the sand rather than on the underlying hard substrata.
"Slightly covered by sea water all the time" means that above a sandbank the water depth is seldom more than 20 m below chart datum. Sandbanks can, however, extend beneath 20 m below chart datum. It can, therefore, be appropriate to include in designations such areas where they are part of the feature and host its biological assemblages.

Specific characteristics of habitat interpretation in Latvia: unknown.

Distribution: can be located in the Baltic Sea in the area between Akmensrags and the estuary of the Užava; in the sandbank complex that forms Ovīši-Serve threshold in the western part of the Irbe Strait. The total indicative area of the habitat in the territorial waters of Latvia – 100 km^2 (Report on Implementation.., 2007). According to the information available to the researchers of the Latvian Institute of Aquatic Ecology, this habitat could potentially be found only in one place in the territorial waters of Latvia – on a sandbank deep in the sea in front of Pāvilosta where there is an elevation above the seabed.

Conservation value: typical habitat complex of the Baltic Sea and Irbe Strait. It is a site for the macrophytic algae and *Zostera marina* (it should be noted that as is determined by the Latvian seashore configuration, until now this particular species has not been registered in the territorial waters of Latvia) stands that are characteristic to the Baltic Sea, a site for bacteria, polychaete, mollusc and crustacean communities, important spawning grounds for fish and feeding site for wintering water birds. This habitat is a significant socio-economic factor in coastal fishing and shipping. In the broad sense sandbanks are described in written sources of different historical periods, including legends, fairy tales and coastal region folklore.

Environmental factors and processes with a functional role: shape and structure of the habitat are determined by the contents and the amount of sand that forms the sandbanks, as well as the amount of pebble and stone inclusions in the layers of sand. Stability and height of the habitat is influenced by the direction and strength of sea currents, frequency and strength of storms, impact of wind flows and wind surges that create different thickness of the layer of water over sandbanks. Essential prerequisites for development of the habitat are an undisturbed natural movement of sand sediments and brackish environment.

Vegetation characteristics: sandbanks can completely lack vegetation. Growth of macrophytic *Chlorophyta* or *Zostera marina* that are characteristic to sand substrate can develop, it can also be covered by a sparse growth of *Mytilus edulis* (up to 10%). Different communities develop on the slopes of sandbanks at various depths – vertical segmentation of vegetation can be observed.
A sandbank is inhabited by various organism communities of sandy sublittoral environment. Sessile and floating algae, as well as animal species are abundant. Algae in their turn create an environment for a number of other benthic organisms.

Characteristic species: *Zostera marina*, *Ruppia maritima*, *Potamogeton pectinatus*, *Zannichellia palustris*, *Myriophyllum spicatum*, as well as *Tolypella nidifica* and *Chara spp*.

Umbrella species (typical species within the meaning of the Habitats Directive): potentially *Zostera marina;* proportion and *Amphibalanus improvisus (Balanus improvisus)*.

Variants: none

Habitat Quality

Minimum habitat requirements: a relatively stable foundation of elongated, round or irregular shape that rises at least 1 m above the seabed, completely covered and surrounded by ~20 m of water, and which species communities are related to sand.
Sandbanks vary, a single excellent composition reference model cannot be applied to them, but it is possible to distinguish common quality criteria.

Structural indicators: all indicators that are important for marine and brackish habitat group, except for the *proportion of the polygon area where the vegetation is characterized by a mosaic structure* as mostly there is no vegetation or its total cover is small; the *proportion of the site area, which is covered with overgrowth*, is additionally evaluated. A higher quality of the structure is also determined by a higher relative height (m) of the geological formation (sandbank) above the seabed and larger average width, providing space for biological communities to develop.

Function and process indicators: all important indicators of marine and brackish habitat group, as well as *an undisturbed development of habitat* and *mass water bird feeding*. The quality of function process is also characterized by a high consolidation of the habitat and no signs of eutrophication (algal blooms, expansive species, etc.) have been observed.

Restoration potential and quality improvement indicators: determined by the criteria that are important to the whole marine and brackish habitat group, as well as *the amount of drift flow*. Sandbanks are complex indicators of the quality of marine environment and often local measures do not improve their condition significantly. Theoretically, sandbanks can be restored by pouring a set amount of sand in a chosen place, but they may not become stabilised.

Threats: the composition of plant and animal species communities is influenced by water pollution. Local impacts can be created by discharge of ship ballast water, as well as accidents at the sea. The surface of sandbanks and the communities that cover them are negatively affected by mechanical damage, especially – trawling. Natural seabed relief is modified during extraction of the mineral resource – sand, as well through dredging and disposal of dredged soil – soil placement areas. Over-exploitation, in particular, fishing, has a long-term negative impact.

Management: an undisturbed development of sandbanks must be ensured, minimizing mechanical disturbances, while not disturbing natural sand sediment movement. Specific management measures are not necessary. Compliance with the regulations of fishing and environmental protection can provide preservation of habitat quality.

Similar habitats: visually similar, covered with soft sediments are 1170 *Reefs*. In these cases, the sediment layer is thin, with is a solid substrate – rocks and pebbles – underneath it. The communities present (perennial macrophytic algae or mussels) are associated with hard substrate. There are no plant communities on sandbanks or they are related to sands (e.g. *Zostera marina*).

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: partly 7.4. Stands of *Zostera marina*.

Literature

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

Baltijas Vides Forums, (2009) LIFE–Daba projekta „Jūras aizsargājamās teritorijas Baltijas jūras austrumu daļā" darba materiāli, http://www.balticseaportal.net

Dinesen, E.G. (ed.) (2008) Mapping and modelling of marine habitats in the Baltic Sea region. BALANCE Interim report No.27, 183 p.

Guidelines for the establishment of the *NATURA 2000* network in the marine environment. Application of the Habitats and Birds Directives (2007), European Commission, 112 p.

HELCOM (2009) Biodiversity in the Baltic Sea – An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea. Balt. SeaEnviron.Proc. No.116B, 188 p.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

1150* *Coastal lagoons*

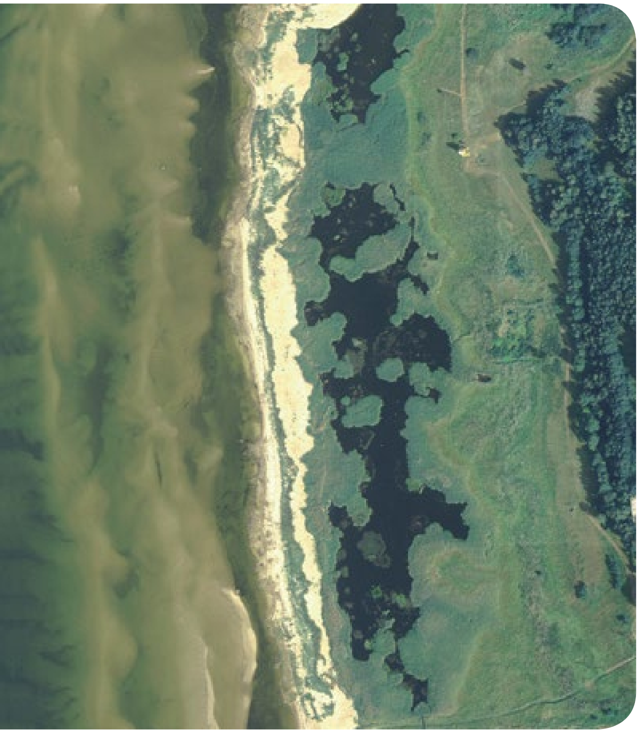


Figure 1.2. Coastal lagoons in the Gulf of Riga nature reserve "Randu Meadows" and between Salacgrīva and Ainaži (Photo: Latvian coastal orthophoto 2007, © Latvian Environmental Protection Fund, prepared by SIA "Metrum").

Latvian habitat classification: A.5.

Syntaxonomy: *Ruppietea maritimae*, *Potametea*, *Charetea*, *Zosteretea*.

Definition: expanses of shallow coastal salt water, of varying salinity and water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks (*Fig. 1.2.*). Salinity may vary from brackish water to hypersalinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding of the sea in winter or tidal exchange. With or without vegetation from *Ruppietea maritimae*, *Potametea*, *Zosteretea* or *Charetea*.

Specific characteristics of habitat interpretation in Latvia: the habitat includes the enclosed water area, the bank that separates it from the sea, as well as the separated water area that impacts the shore zone of coastal lagoon directly. Lagoons can be of different ages and at different stages of development – separated from the sea for a relatively long time and stable, as well as sea-related and dynamic lagoons in a formation stage. Coastal lagoons are usually constantly filled with water, it may contain only a small amount of salt – varying from brackish to even fresh water.

Transient, periodically disappearing pools (puddles) on the beach, as well as geologically relatively old formations – oxbows (e.g. Vecdaugava), lakes of lagoon origin, where brackish water flows through rivers or canals due to prevailing winds (e.g., Ķīšezers, Liepāja, Pape Lake, etc.) are not considered a habitat of this type.

Distribution: very rare (*Fig. 1.3.*). It can form on the shores of the Gulf of Riga. Several most durable lagoons have developed on the eastern shore of the Gulf of Riga between Salacgrīva and Ainaži, as well as between the estuary of the River Svētupe and Salacgrīva. On the western shore of the Gulf of Riga a couple of small coastal lagoons have formed in Mērsrags, but in the southern part of the bay – in the Daugavgrīva Island.

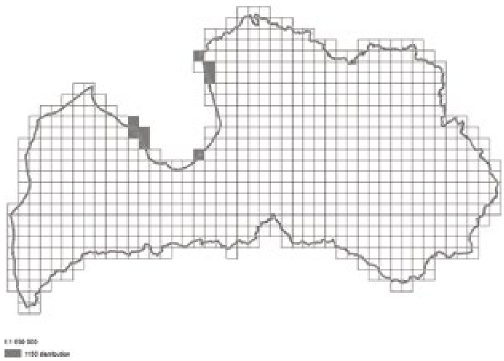


Figure 1.3. Distribution of the habitat 1150* *Coastal lagoons* in Latvia (Conservation status of.., 2013).

Conservation value: the dynamic geomorphological formation coastal lagoons is one of the rarest habitats in Latvia, so far the habitat has been identified in the total area of 22 hectares (~ 0.0003% of the total territory of land area) (Conservation status of.., 2013). It is a habitat of significant value for rare and specially protected species and the communities they form; these depend on brackish environment (*halopyhtes*) in water and on land. A significant habitat for invertebrates as well as feeding grounds for birds.

Coastal lagoons are one of the few habitats in Latvia where aquatic plant communities that are characteristic to brackish water with very rare and protected plant species can be found: *Ruppia maritima* and *Batrachium baudotii*. The belt of amphibious plants of coastal lagoon is an important habitat to the very rare *Spergularia salina* that grows in brackish environment. The most permanent and sustainable sources of rare and protected *Montia fontana* deposits in the country are found in this belt. The rarest species of oraches – *Atriplex calotheca*, *A.glabriuscula*, *A.longipes* can be found here.

Coastal lagoons are dynamic systems that function in conjunction with adjacent habitats, such as contemporary dunes or Boreal Baltic coastal meadows, creating a complex of diverse habitats, thus increasing ecological capacity of the environment and also biodiversity.

Coastal lagoons are an essential component of the coastal complex that creates the microclimate of the closest area, provide rich moisture conditions for the surrounding habitats, enrich poor sandy soils with extra nutrients by overflowing, and provide regular regeneration of salt concentration in soil.

Lagoons and their shores are landscapes of high visual quality that is found in a limited area, and is different from the typical sandy beaches and dune landscapes of Latvian seashore. They are suitable for angling, fishing, watching and hunting of water birds, traditionally used for grazing as well as hay and cane production.

Environmental factors: territory that is exposed to wind and sunlight, as well as ultraviolet radiation. Highly variable water level – depends on the wind direction, as well as melting of snow and rain water volume and regularity of its inflow. These factors are connected to variable concentration of salt in water and in lagoon shore substrate. Composition of species is largely determined by brackish water and its impact on soil, sandy shores and sandy bottom. Content of minerals and organic matter in water depends on the age of the coastal lagoon – in the water of lasting coastal lagoon it is higher than in newer coastal lagoons. Regular wave and ice impact often changes the shoreline of coastal lagoons, affects the relation of coastal lagoons to the sea, as well as the spatial structure of plant communities in water and at shores of coastal lagoons.

Processes with functional significance: formation of coastal lagoons and their continued existence is related to the dominant direction of the long-shore drift flow and the sand deposition at the shore that is generated by the prevailing winds, creating sand banks and ridges which separate the lagoon from the sea when their height increases. Wind and, hence, wave power, storm frequency and their strength are the factors that determine width and height of sand banks that separate coastal lagoons and also affect relations of coastal lagoons to the sea. During strong wind the bank can be broken, renewing or extending its relation to the sea, or on the contrary – a large sand flow can expand and raise the ridges, isolating the coastal lagoon from the sea completely.

The water that is carried by wind surges and storms provides a higher content of salt and also its regular renewal in water of coastal lagoon and its shore substrate. Rain and melted snow water, as well as inflow of other surface waters and groundwater decrease salinity in lagoons.

Wind, waves and ice completely or partially destroy its vegetation or separate structural elements both in water and on shores of the coastal lagoon, therefore restoring the natural succession. Consequently, species communities are highly variable annually and differ even seasonally. These factors ensure expansion of species by transferring seeds, fruits, as well as their vegetative parts.

As a result of wind, wave and ice activities, drift lines may form on the shores of coastal lagoons. Their length, width and height are very diverse annually. In specific seasons or on the shores of certain coastal lagoons drift lines might not be formed.

Water salinity in long-isolated lagoons is low or they are filled with freshwater. The longer lagoon is isolated from the sea, the more stable vegetation establishes both in water and on its shores. Within a long development of vegetation, the amount and proportion of species, that are characteristic to brackish water and soils, decreases, thickness of mud layer on the bottom of coastal lagoon increases, the amount of oxygen in the water decreases, while the amount of mineral and organic materials are increased. A complete isolation from the sea and a minimal impact from wind, waves and ice on vegetation may cause overgrowing of the coastal lagoon – with an increasing projective cover of surface vegetation of reeds and rushes, areas of open water decrease until they disappear, creating passages and vegetation that is characteristic to fens, occasionally maintaining some of the species that are characteristic to brackish environment.

Vegetation characteristics: the projective cover of aquatic plant communities of coastal lagoons varies depending on the activity of the dynamic processes described. Open water with no permanent macrophyte species vegetation is present in newer coastal lagoons and in the deepest areas of older coastal lagoons, as well as in places where a sea water inflow takes part. Coastal lagoons that are partly or wholly covered with reeds and other emergent plants, as well as other aquatic plant communities, however, are mostly separated from the sea, stable and relatively older. Lagoons can be almost completely overgrown with the surface vegetation, where no open water is visible.
The most characteristic are species communities of brackish submerged aquatic plants with *Ruppia maritima*, *Zannichelia palustri*s, *Batrachium baudotii*. In surface water not only *Phragmites australis,* but also *Scirpus tabernaemontani* is a common species. *Bolboschoenus maritimus* is often found in surface and amphibious plant layer. The most characteristic species of amphibious plant layer is *Spergularia salina*. Apart from common inland species it is possible to find species that are characteristic to Boreal Baltic coastal meadows: *Alopecurus arundinaceus, Triglochin maritimum.* In places with greater disturbances in the amphibious plant layer orache species that are characteristic to beaches can be found: *Atriplex littoralis*, *Atriplex calotheca*. Characteristic species might not be found in coastal lagoons that have been isolated from the influence of the sea for a longer period of time. Communities of floating-leaf and submerged aquatic plants that are characteristic to eutrophic waters can be formed. Surface layer overgrows with *Phragmites australis*. Perennial plant communities that are characteristic to the habitat 1210 *Annual vegetation of drift lines* form on drift lines in the amphibious plant layer.

Relatively stable and permanent shores of coastal lagoons overgrow with vegetation, grass and other plant communities. Brackish site species have a significant role in the habitat. At grazed or mowed shores of coastal lagoons seaside grassland communities have an important role and they are dominated by the *Agrostis stolonifera*, *Festuca rubra* and it is possible to find species that are characteristic to brackish soils, such as *Triglochin maritimum*, *Glaux maritima*, *Trifolium fragiferum.*

Characteristic species: *Batrachium baudotii*, *Ruppia maritima*, *Zannichelia palustri*s, *Potamogeton pectinatus*, *Scirpus tabernaemontani*, *Bolboschoenus maritimus*, *Spergularia salina*, *Alopecurus arundinaceus*, *Triglochin maritimum*, *Tolypella nidifica*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Batrachium baudotii*, *Ruppia maritima, Zannichelia palustris*, *Potamogeton pectinatus*, *Bolboschoenus maritimus*, *Spergularia salina*, *Alopecurus arundinaceus*, *Triglochin maritimum*, *Tolypella nidifica.*

Variants: none.

Habitat Quality

Minimum habitat requirements: by origin or functionality related to the sea, permanent body of water with changing water level.
Sandbanks vary, a single etalon composition reference model cannot be applied to them, but it is possible to distinguish common quality criteria.

Structural indicators: all indicators that are significant to marine and brackish habitat group. *Higher proportion of the site area in which it is possible to find at least one characteristic plants species*, excluding *Scirpus spp*. and *Phragmites australis*, indicates on a better quality of structures where there is higher open water proportion against total area of the habitat.

Function and process indicators: all indicators that are significant to marine and brackish natural habitat group. The best function maintenance and preservation is ensured by *regular flooding or brackish water inflow* that is characterized by sediments. A long-term management of coastal habitat complex is necessary – mowing and grazing indicate better functioning of the habitat, while overgrowing with shrubs and trees, interference with the hydrological regime and signs of eutrophication signal an insufficient functioning of the habitat. Indicator of the quality of the habitat is the proportion of *Phragmites australis*, when monodominant reed stands form, spatial structures of the floristic composition and vegetation of the habitat simplifies.

Restoration potential and quality improvement indicators: determined by criteria significant to all marine and brackish habitats, as well as *amount of sediment flow*. Coastal lagoons are a complex habitat and often local measures lack the necessary impact on their quality.

Threats: course of natural processes is threatened with artificially caused separation or connection of the coastal lagoon with the sea, changes to the inflow of brackish water; mechanical damage or alteration of the separating sandbank, which may lead to both confluence and a complete separation of the coastal lagoon and the sea; overexploitation, including fishing and poor management of coastal lagoon shores. Insufficient maintenance of relatively stable and permanent coastal lagoon shores – mowing and grazing, which results in overgrowth of the shoreline. Artificial changing of the appropriate hydrological regime (e.g., targeted drainage) in a coastal lagoon and its surroundings impacts the lagoon system and changes processes in a complex manner. Transformation, including construction, change of land use type, etc., of lagoon shores also causes a negative impact.

Management: sustainable natural development of coastal lagoons, minimizing mechanical disturbances to the maximum and – at the same time – maintaining appropriate hydrological regime without preventing the natural drift flow movement and connection to the sea. Preservation of the existing land use type in areas adjacent to the coastal lagoons. Grazing and mowing is necessary in a stable, relatively permanent coastal lagoon shores covered with vegetation where grasslands have been developed, as well as it is necessary to mow reeds in the oldest areas (the most isolated from the sea). In some cases it might be necessary to thin out trees and shrubs.

Similar habitats: in some cases there might be difficulties to distinguish it from lakes of coastal lagoon origin.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 7.9. Coastal lagoons; partly 7.6. Stands of *Zannichelia palustris*, *Ruppia maritima* and *Batrachium baudotii* in coastal lagoons and bays.

Literature

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Life-Nature project „Protection and Management of Coastal Habitats in Latvia" (2006) Coastal habitat database of Faculty of Biology (University of Latvia), http://piekraste.daba.lv/

Eberhards, G., Lapinskis, J. (2008) Baltijas jūras Latvijas krasta procesi. Atlants. Rīga, LU Akadēmiskais apgāds, 64 lpp.

Eberhards, G., Lapinskis, J., Saltupe, B. (2006) Hurricane Erwin 2005 coastal erosion in Latvia. Vilnius. Baltica 19, 10–19 p.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

1170 *Reefs*

Figure 1.3. Reefs with stands of *Rhodophyta* (Photo: M.Bucas).

Latvian habitat classification: A.4.3., party A.1.3. - A.1.7., A.4.2., A.2.

Definition: hard compact substrata (usually > 64 mm in diameter) on solid and soft bottoms, which arise from the sea floor in the sublittoral and littoral zone. Reefs may support a zonation of benthic communities of algae and animal species as well as concretions and corallogenic concretions. Such hard substrata that are covered by a thin and mobile veneer of sediment are classed as reefs if the associated biota are dependent on the hard substratum rather than the overlying sediment. Where an uninterrupted zonation of sublittoral and littoral communities exist, the integrity of the ecological unit should be respected in the selection of sites.

Specific characteristics of habitat interpretation in Latvia: includes only hard substrates of natural and indefinite origin, including sandstone and dolomite rock outcrops in the sea with biological communities (*Fig. 1.4.*). Reefs with perennial macrophytic algae and mussel overgrowth on various hardness substrates are common in Latvia. Highest areas of shallow water reefs periodically or almost permanently can be located above water, creating little rock 'islands'. The habitat does not include reefs of technogenic origin, for example, wrecks, piers, shore revetments, bases of wind turbines, etc.

Distribution: In Latvian territorial waters the habitat is rare, relatively rare in shallow sea water areas and occupies at least 64 900 ha of Latvian territorial waters (Conservation status of.., 2013). Found in the Baltic Sea below the depth of 5 m, but in the Gulf of Riga – below 1 m. Largest and biologically the most significant reefs are found on the coast of the open Baltic Sea in areas from Nida to Pērkone, from Akmensrags to Pāvilosta and Irbe Strait. Found in the Gulf of Riga along the eastern shore from Vitrupe to Tūja and from Salacgrīva to Ainaži, and along the western shore from Jaunķemeri to Kaltene (*Fig. 1.5*).

Conservation value: Reefs have a significant role in ensuring biodiversity and quality of marine environment; they are inhabited by many sedentary and floating plant species, creating characteristic communities. Communities created by

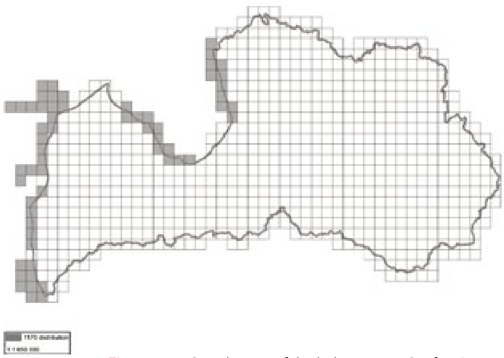


Figure 1.5. Distribution of the habitat 1170 *Reefs* in Latvia (Conservation status of.., 2013).

perennial macrophytic algae have a significant meaning as they create habitat for various bacteria, invertebrate and fish species. Reefs are important for fish spawning, fish development and fish feeding sites, as well as important feeding sites for water birds.

Significant habitat for fish: *Platichthys flesus trachurus*, *Zoarces viviparus, Scophthalmus maximus, Coregonus lavaretus lavaretus, Clupea harengus, Gadus morhua callarias, Myoxocephalus scorpius scorpius.* Significant feeding site for seabirds and water birds: *Mergus merganser*, *Mergus serrator*, *Gavia stellata, G.arctica, Melanitta fusca, M.nigra, Clangula hyemalis, Cepphus grylle.*

Often reefs are found with the habitat 1110 *Sandbanks which are slightly covered by sea water all the time* creating unified, geomorphological and biologically diverse habitat complex.

Shallow water reefs are a typical and visually high-value element of seashore landscape. They have a meaning in coastal fishing and shipping. Reefs have been widely described in literature sources of various historical periods: legends, fairy tales and stories, especially about battles and accidents on the sea, including running on shoals.

Environmental factors and processes with a functional role: prerequisite of formation of geological reefs is a solid seabed – granite, rocks, pebbles, sandstone, dolomite (*Fig. 1.6.*). Hard seabed can be covered with a thin layer of sediment. Biological communities that are related to reefs are limited by water quality, light availability in the layer near to the seabed, impact of waves and current, at the scale of the Baltic Sea – also by water temperature, salinity and other factors that determine the composition of species that form overgrowth and vertical zoning. An important factor is a regular water exchange, which provides oxygen to the environment.

Vegetation characteristics: depending on the dominant substrate and other environmental conditions, various different benthic organism communities can be formed. Often in one conventional reef it is possible to distinguish several microhabitats or even different habitat complexes, for example:

- stands of perennial macrophytic algae;
- stands of macrophytic algae and overgrowth of mussels;
- overgrowth of mussels and *Amphibalanus improvisus (Balanus improvisus)*;

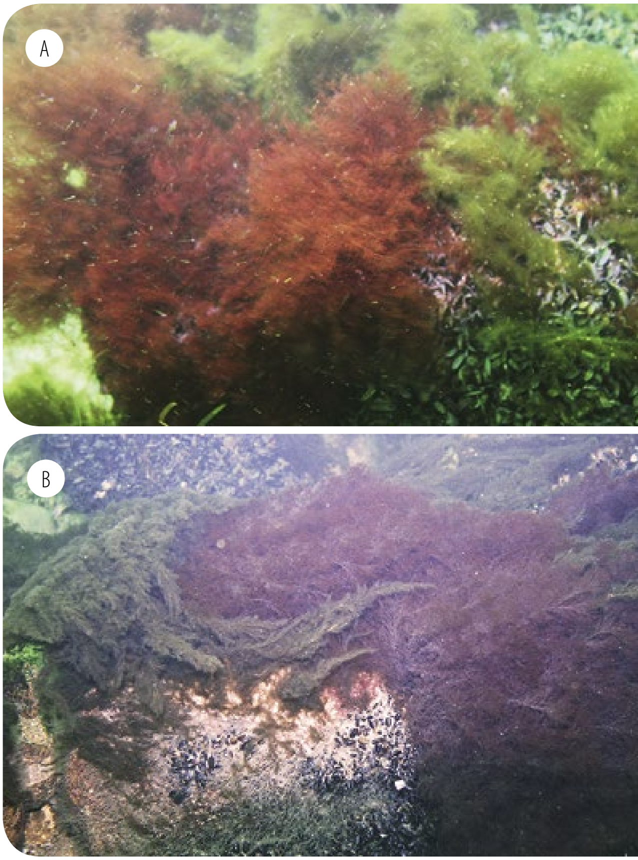


Figure 1.4. Reefs with stands of *Pylaiella littoralis* and *Rhodophyta spp*. in the Irbe Strait (Photo: J.Aigars).

- overgrowth of mussels – *Mytilus trossulus* or *Dreissena polymorpha*[1] (*Fig. 1.7.*).

Furcellaria lumbricalis dominates in the open part of the Baltic Sea (*Fig. 1.4.*), but in the Gulf of Riga – *Pylaiella littorali* (*Fig. 1.8.*). Relatively large overgrowth both in the open area and the Gulf can consist of red algae *Ceramium spp.* and *Polysiphonia spp.*, brown algae *Ectocarpus confervoides* and *Pylaiella littoralis*, green algae *Cladophora glomerata* and *Ulva spp.* Many organisms that are not significant in habitat formation depend

1 According to studies by the Latvian Institute of Aquatic Ecology (analyzed samples), reef overgrowth of the Gulf of Riga on average consists of 50% of *Dreissena polymorpha* and 50% of *Mytilus trossulus*. Thus despite the fact that the *Dreissena polymorpha* has been brounght in the Baltic Sea with the sea transport, it is considered to be an important componend of the reef overgrowth.

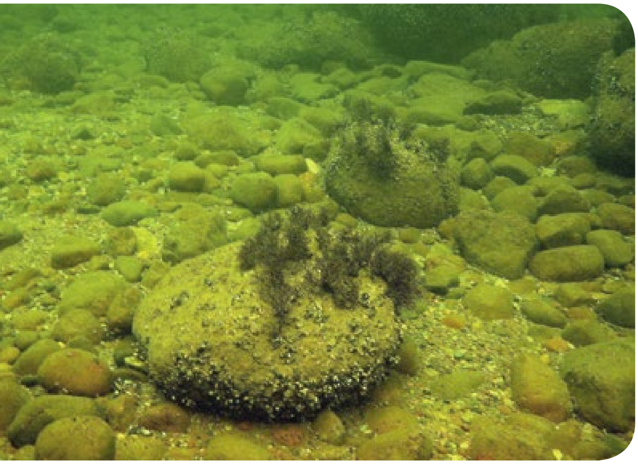


Figure 1.6. Solid ground is a prerequisite for the formation of a reef (Photo: M.Bucas).

Figure 1.7. Overgrowth formed by mussels (Photo: M.Bucas).

on it ecologically, for example, epibiontic and free-floating invertebrates, epibiontic macrophytic algae. Typical groups of species are hydroids *Hydroida*, moss animals *Bryozoa*, molluscs or slugs *Mollusca*, as well as a variety of moving, free-floating crustaceans and fish species.

Characteristic species: *Fucus vesiculosus*, *Furcellaria lumbricalis, Ceramium spp., Polysiphonia spp., Coccotylus truncatus*, *Battersia arctica, Pylaiella littoralis, Ectocarpus confervoides*, as well as *Ulva spp., Cladophora rupestris, C.glomerata*. Mussels – *Mytilus trossulus*, *Dreissena polymorpha*. As well as *Amphibalanus improvisus (Balanus improvisus)*, *Idotea spp., Jaera albifrons*, *Theodoxus fluviatilis*, *Hydrobiidae*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Fucus vesiculosus*, *Furcellaria lumbricalis*, *Polysiphonia spp.*, *Battersia arctica, Pylaiella littoralis*, *Mytilus trossulus*, *Dreissena polymorpha*, as well as *Amphibalanus improvisus (Balanus improvisus)*, *Idotea spp.*, *Jaera albifrons*, *Theodoxus fluviatilis*, *Hydrobiidae*.

Variants: none.

Habitat Quality

Minimal habitat requirements: hard substrate with biological community that is rising above seabed. Reefs are characterized by an explicit overgrowth and structural diversity; they cannot apply to a single ideal composition model, but can be distinguished by the common quality criteria.

Structural indicators: all criteria that is significant to marine and brackish natural habitat group. Additional indicators that show the quality of the structure are *greater height of geological formation (m) above seabed* and *structure of various substrates, the total number of species, and projective cover of communities directly linked to the substrate* where macrophytic algae or mussels dominate, as well as *mass feeding of water birds*. *Cover of expansive species* also is a structural indicator and when it increases, it signals the degradation of the habitat.

Function and process indicators: all significant criteria of marine and brackish habitat group, as well as *undisturbed habitat development* and *high consolidation of the habitat*. Eu-

trophication signs also are observable, the main *factors degrading the habitat* – trawling, massive anchor throwing, substrate extraction and soil placement areas, as well as *withering of mussels and/or macrophytic algae* indicate the deterioration of the habitat function.

Restoration potential and quality improvement indicators: determined by criteria significant to all marine and coastal brackish habitats. Reefs are potentially renewable habitat. Restoration success depends not only on the available hard substrate, but also the quality of water environment and abiotic indicators. Reefs are complex marine environmental quality indicators and there may be occasions when local activities do not significantly improve the quality of the habitat.

Threats: eutrophication, mechanical damage of sandbanks, especially when trawling, extensively dropping anchors, and construction works under water, etc. Port activities, including soil placement areas in the sea and port infrastructure, which changes the amount and flow of sediments. Extraction of mineral deposits as it reduces the amount of the habitat-forming substrate. Over-exploitation, including fishing. Potential threat to reefs is the organized neutralization of unexploded ammunition in Latvian territorial waters, as well as spontaneous detonation of unexploded ammunition, although damage caused by one exploded unit is contained in a relatively small area – about 10 m^2.

Management: Long-term uninterrupted development and lack of mechanical disturbances are necessary in order to ensure favourable conservation conditions, as well as improvement of quality of marine environment or maintaining it at the existing level. In order to ensure bird and fish protection, it is necessary to establish seasonal protected areas in appropriate periods of time.

Similar habitats: reefs covered with a soft layer of sediment are similar to the habitat 1110 *Sandbanks which are slightly covered by sea water all the time.* Differs with hard substrate (rocks, pebbles, etc.) and associated benthic communities.

Overlap with other habitats of EU importance: none.

Figure 1.8. Reefs with mussel colonies found in the Irbe Strait (Photo: J.Aigars).

Figure 1.9. Reefs with *Fucus vesiculosus* in the sea (Photo: D.Daunys).

Figure 1.10. Reefs with stands of red alga in front of Pape Lake (Photo: J.Aigars).

Corresponding specially protected habitats in Latvia: 7.2. Stands of *Fucus vesiculosus* in the sea, 7.7. stands of *Rhodophyta* in the sea and 7.8. Seashore reefs; partly also 7.1. Rocky seabed, 7.3. Dolomite seabed and 7.5. Shingly seabed where there is macrophyte overgrow, as well as stands of 7.6. *Zannichelia palustris*, *Ruppia maritima* and *Batrachium baudoti*i in coastal lagoons and bays if they grow on a hard substrate in bays.

Literature

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Baltijas Vides Forums (2009) LIFE–Daba projekta „Jūras aizsargājamās teritorijas Baltijas jūras austrumu daļā" darba materiāli, http://www.balticseaportal.net

Mapping and modeling of marine habitats in the Baltic Sea region (2008) Dinesen, G.E. Andersen, J.H. Reker, J.B. (ed.) BALANCE Interim report No.27, 183 p.

Guidelines for the establishment of the *NATURA 2000* network in the marine environment. Application of the Habitats and Birds Directives (2007), European Commission, 112 p.

HELCOM (2009) Biodiversity in the Baltic Sea – An integrated thematic assessment on biodiversity and nature conservation in the Baltic Sea. Balt. SeaEnviron.Proc. No.116B, 188 p.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Müller-Karulis, B., Jermakovs, V., Aigars, J. (2007) The modelling of Furcellaria lumbricalis habitats along the Latvian coast. Balance Report No.23, pp. 25, http://balance-eu.org/xpdf/balance-interim-report-no-23.pdf

Strāķe, S., Ikauniece, A., Alberte, M., Bārda, I., Jurgensone, I., Lavrinovičs, A., Livdane, L., Puriņa, I., Purviņa, S., Rimša, E., Strode, E., Fedoroviča, D., Kurakins, A., Holodkēvičs, S., Balode, M. (2013) The ecosystem of the west coast of the Gulf of Riga: environmental quality and biological diversity. Grām.: Kļaviņš, M., Melecis, V. (red.) Cilvēks un daba: Engures ekoreģions. Rīga, LU Akadēmiskais apgāds, 249.–287. lpp.

1210 *Annual vegetation of drift lines*

Latvian habitats classification: none.

Syntaxonomy: *Cakiletea maritimae (Atriplicion littoralis, Salsolo kali-Honkenyion peploidis)*.

Definition: formations of annuals or representatives of annuals and perennials, occupying accumulations of drift material and gravel rich in nitrogenous organic matter.

Specific characteristics of habitat interpretation in Latvia: none.

Distribution: very rare, mostly in the coast of the Gulf of Riga. Regularly forms in the following areas Mērsrags–Bērzciems, Svētupe–Salacgrīva, also periodically in the following areas: Ainaži–Kuiviži, Šķīsterciems–Vitrupe, Jūrmala, estuary of River Lielupe–Rītabuļļi, Bigauņciems–Ragaciems, Engure, Kaltene–Roja, Žocene–Ģipka, and Kolka–Uši. In Latvia the habitat takes up about 26 ha or 0.0004% of the total territory of the country.

Conservation value: one of the rarest and most vulnerable habitats in Latvia, occurs in a small area that is seasonally variable. Drift lines are the most important habitat for species endemic to the Baltic and North Sea shores, for rare and specially protected species in Latvia – *Atriplex calotheca*. The habitat is one of the main natural sites for other very rare Latvian plant species – *Atriplex glabriuscula* and *Atriplex longipes*. In the drift complex of the wet part of the beach there is a rich fauna of saprophagic dipterous and springtails, which is an important part of the food chain. Drift zones are an important hideout for insects during strong wind or other adverse weather conditions (Spungis, 2002, Spungis, 2008). Habitat is a feeding site for many wading bird species, especially during spring and autumn migrations. In addition, the habitat ensures

Figure 1.11. Annual plant communities on drift lines in Lapmežciems vicinity – such vegetation is often formed in bays (Photo: B. Laime).

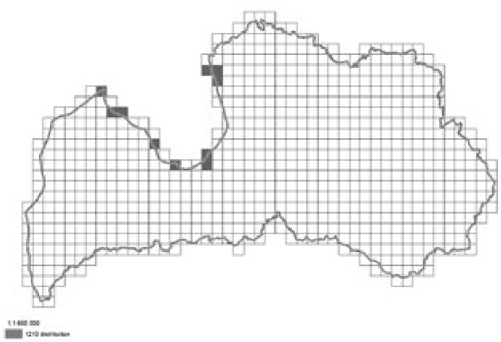


Figure 1.12. Distribution of the habitat 1210 *Annual vegetation of drift lines* in Latvia. (Conservation status of.., 2013).

Figure 1.13. Stand of *Cakile baltica* on drifts on the beach that has been overblown with sand (Photo: B.Laime).

Figure 1.14. Community of *Atriplex littoralis* that has been created in border zone between wet and dry beach in Mērsrags vicinity (Photo: B.Laime).

natural barrier function, which protects other coastal habitats and contributes to the development of vegetation.

Environmental factors: the most important factor is the amount of drifts (algae, reeds, rushes and other plants washed in the coast of the sea together with shells, amber, as well as tree branches, trunks and bark fragments). Habitat generation and regeneration is dependent on the overgrowth of sand-banks with algae, processes in the sea coast underwater line, wind and wave direction, as well as their intensity and duration, which significantly affects the flow of drift-material, as well as coastal vegetation, especially distribution of reeds and rush meadows. Habitat development depends on the height and angle of a beach and dunes, as well as adjacent habitats in both marine and terrestrial directions. Frequently drift lines are formed and remain in low beaches, mostly in bays which during the growing season often are in lee-side promoting annual plant community development on drifts beached during storms (*Fig. 1.11.*).

Vegetation characteristics: littoral halophytic species dominate in the vegetation. Vegetation mainly depends on the height and width of the drift line. On small, often sand covered drift lines there is relatively sparse vegetation with species of succulent pioneer plants of *Cakiletum maritimae* (*Fig. 1.13.)*. If there are more drifts, then a dense, up to 1.5 m high vegetation forms, which is dominated by oraches of *Atriplicetum littoralis* (*Fig. 1.14.*). As the substrate is very fertile (a lot of nitrogen, phosphorus and potassium) and there are washed out vegetative parts and seeds of many species, then nitrophilous species often are found in the vegetation, including weeds and ruderal species. Sometimes for a short period of time some garden escapes grow and even flower in drift lines, for example, sunflower, calendula or tomato. In the previous ten years, increasing numbers of sightings of alien species to Latvian flora *Lactuca tatarica* have been made on the drift lines on southern shore of the Gulf of Riga and Vidzeme coast. In the vegetation there often are species of adjacent habitats, for example, primary dune and/or coastal wetlands (reeds and rush meadows), seldom species characteristic to grey dunes (*Fig. 1.15.*). In the coastal areas with drift lines there is a diverse mosaic of vegetation, as well as high diversity of species.

Characteristic species: plants – *Cakile baltica*, *Atriplex spp.* (especially *Atriplex littoralis*, *Atriplex calotheca*), *Polygonum spp.* (especially *Polygonum hydropiper* and *Polygonum lapathifolium*), *Chenopodium rubrum*, *Salsolo kali*, seldom *Corispermum intermedium* and *Agrostis stolonifera*; animals – *Scatella stagnalis, Setacera aurata, Omophron limbatum, Heterocerus fusculus, Hydrophilidae* species (*Helochares obscurus, Cercyon spp.*).

Umbrella species (typical species within the meaning of the Habitats Directive): *Atriplex spp.*, *Chenopodium spp.*, *Cakile baltica*, *Salsolo kali.*

Variants: none.

Habitat Quality

Minimal habitat requirements: presence of drifts. There might be a very few drifts, even barely visible (also covered with sand), fragmentary, at least with one of the previously mentioned and/or ecologically similar species. Also areas with a 'stable' drift line are considered a habitat (from the previous season and/or far from the sea) without plants (either trampled down or have not grown), but annual plants are observed in adjacent habitats. Annual plant communities on an artificial drift piles are not considered as this habitat. Annual plant communities (from *Cakiletea marimae*) that develop in areas with gravel or mixed sand-gravel substrate also belongs to the habitat, but vegetation of this class that forms on beaches and embryonic dunes only in sand substrate does not belong to this habitat.

Structural indicators: common indicators of marine and brackish habitat group, as well as – height and width of drift line.

Function and process indicators: significant indicators are available resources of organic material (algae, reeds, etc.) (habitat crosses and/or influences stands of reeds in shallow water area and on the shore) and proportion of the area where natural materials (drifts etc.) on the beach are not collected and/or moved, as well as impact of nearby habitats, for example, beach is not rammed (it has natural structure), other common indicators of marine and brackish habitat group. Drifts of previous years also indicate relative stability of the habitat and annual restoration.

Restoration potential and quality improvement indicators: common indicators of marine and brackish habitats. In order to ensure self-restoration of the habitat, it is necessary to promote natural processes at the shore that sometimes might require demolition of buildings in the sea and on the shore or changes in placement and width of recreation territories.

Threats: historically drift lines around fishing villages were regularly removed, obtaining fertilizer for gardens. Nowadays the main threat is establishment of recreation areas in towns and nearby territories. Drifts are removed in order to increase areas covered with sand and to improve visual quality of environment, as well as to prevent odour of decomposing plants. Amount and regularity of drift line formation is influenced by the amount of drift flow, as well as frequency of storms and strong winds.

Management: on the shoreline of the sea it is necessary to determine areas in which drifts are not removed, especially it applies to populated areas. If necessary, recreation, sports and other activities must be restricted in these areas. In order to promote understanding of drift lines, inhabitants and vacationists must be informed about ecological meaning of this habitat. It is very important to determine and ensure appropriate pro-

Figure 1.15. One of the highest drift lines with *Atriplex spp.* are observed in vegetation of reeds and rush meadows or in nearby areas (Photo: B.Laime).

tection in *Natura 2000* areas and adjacent seashore areas.

Similar habitats: if drift lines are covered with sand, they might be similar to the habitat 2110 *Embryonic shifting dunes*, especially if *Cakile baltica*, *Salsolo kali* and *Corispermum intermedium* can be found in the habitat. The most significant difference is presence of organic drift-material under the layer of sand, as well as presence of annual nitrophilous oraches and goosefoot species. In wetter areas there may be similarities with the habitat 1310 *Salicornia and other annuals colonising mud and sand* where there often are a lot of oraches in the vegetation. In these cases the main difference is the characteristic micro relief – drift line in a form of a low bank.

Overlap with other habitats of EU importance: annual plant communities on drift lines are considered a microhabitat that often develops in dry and wet beaches (habitat 1220 *Perennial vegetation of stony banks*, 1310 *Salicornia and other annuals colonising mud and sand*, 1640 *Boreal Baltic sandy beaches with perennial vegetation*), dunes (2110 *Embryonic shifting dunes* and/or 2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)*), habitat 1630* *Boreal Baltic coastal meadows,* borders of forests – in border zone with the habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region*, seldom 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes).* Significant feature is washed drifts that sometimes can be covered with sands, as well as vegetation *Cakiletea maritimae* established in gravel or gravel-sand substrate.

Corresponding specially protected habitats in Latvia: 6.13. Annual plant communities on drift lines.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Kalvišķis, K. (2006) Piekrastes biotopu kartēšanas rezultāti. Latvijas Universitāte, http://piekraste.daba.lv/LV/biotopi/piekrastes_ biotopu_kartesanas_rezultati.shtml

Laime, B. (1999) Pludmales un primāro kāpu aizsardzības plāns. Rīga, Latvijas Dabas fonds, 45 lpp.

Laime, B. (2000) Seashore plant communities of the Lake Engures (Engure) Nature Park, Latvia. Proceedings of the Latvian Academy of Sciences 54, 5/6, 190–197 p.

Laime, B. (2010) Latvijas kāpu un pludmaļu fitosocioloģiskais raksturojums Baltijas jūras reģiona kontekstā. Promocijas darbs. Rīga, LU, 97 lpp.

Laime, B., Tjarve, D. (2012) Jūras piekrastes augu sabiedrības uz sanesumu joslām Engures ezera dabas parkā. Coastal plant communities of drift lines in the Lake Engure Nature park, Latvia. Latvijas Veģetācija 23, 137.–153. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Spungis, V. (2002) Invertebrates of the sandy coastal habitats in Latvia. Latvijas Entomologs 39, 8–15 p.

Spuņģis, V. (2008) Slīteres nacionālā parka biotopu bezmugurkaulnieku (Invertebrata) fauna un ekoloģija, (mācību materiāli), Rīga, Latvijas Universitātes Bioloģijas fakultāte, 59 lpp.

1220 *Perennial vegetation of stony banks*

Latvian habitat classification: B.1.3.2., partly B.1.2.2.

Syntaxonomy: *Elymo-Crambetum*.

Definition: perennial vegetation of the upper beaches of great shingle banks, formed by *Crambe maritima*, *Honckenya peploides* other perennial species (*Fig. 1.17.*). A wide range of vegetation types may be found on large shingle structures inland of the upper beach. On more mature, stable, shingle coastal forms of grassland, heath and scrub vegetation may develop. Some areas of unusual vegetation dominated by lichens and bryophites are found on more mature shingle.

Specific characteristics of habitat interpretation in Latvia: habitat also develops on low stony and pebbly beaches.

Distribution: very rare, it can be found only in separate areas on the coast of the Gulf of Riga between Tūja and Vitrupe – Ķurmrags vicinity, there are relatively wider areas of this habitat, between Kaltene and Upesgrīva, Lepste (*Fig. 1.16.*) as well as in small areas (spots) along the open coast of the Baltic Sea - Užava vicinity and northwards from Pāvilosta.

Conservation value: one of the rarest habitats (~0,0006% of the territory of Latvia), its total length does not exceed 20 km and total area – 41 ha. It is one of the few natural sites for *Crambe maritima* in Latvia, as well as significant habitat for other littoral species, incl. insects. Stones and shingle are major specific microhabitat for some invertebrate groups.
In the eastern part of the Gulf of Riga the habitat often occurs near exposed shallow water *Reefs* (1170) and *Vegetated sea cliffs of the Atlantic and Baltic coasts* (1230), creating a unique habitat and landscape complex.
Stony beaches covered with vegetation in Latvia are rare landscapes with a high visual value. Habitat has a socioeconomic significance as a place of interest. On the 20th and 21st century, stony beaches on the eastern coast of the Baltic Sea have been significant objects in the Latvian visual art – they have been reproduced in paintings, watercolors, graphics and photos.

Environmental factors and processes with a functional role: prerequisite for the formation of the habitat is a stony or pebbly beach that is flooded only during severe storms. Stones and pebbles stabilize the sand, so the beach can overgrow with vegetation of perennial plants. Often the beach forming materials have been mixed, but in all cases there should be high proportion of stones or pebbles.
Stable wind and intensity of the wave activity is important for the habitat in order for the vegetation to be washed with water, but not destroyed or washed off completely. Stones create a shade and form microhabitat for various invertebrates that hide beneath them. Stones and pebbles also help to form and ensure specific microclimate in the habitat.

Vegetation characteristics: in direction from the seashore to inland different plant community lines form. Vegetation develops in open areas among stones or plants squeeze through pebbles. Most often vegetation is sparse, plants grow scattered or in groups, seldom connected overgrowth forms. Perennial plant species dominate, but there might be a small proportion of annual plant species. In some areas beach vege-

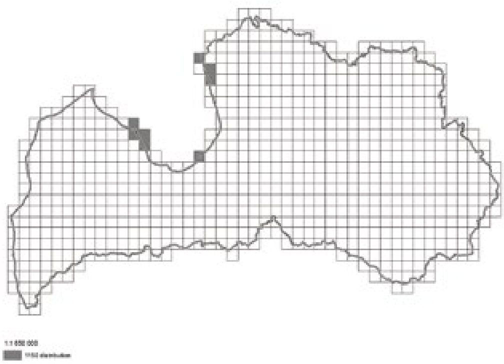


Figure 1.16. Distribution of the habitat 1220 *Perennial vegetation of stony banks* in Latvia (Conservation status of.., 2013).

Figure 1.17. Perennial vegetation on stony beaches. A – beach on the eastern coast of the Gulf of Riga near Dzeņi, B – stony beach at Mērsrags (Photo: I.Rove).

tation without sharp boundaries change into the shallow water coastal high grass communities formed by the *Phragmites australis*, *Scirpus tabernaemontani*, *Bolboschoenus maritimus*, *Typha angustifolia,* etc.

In areas where vegetation has developed for a longer period, it is possible to find vegetation of perennial grasses and in some places separate shrubs. In long-term stable beaches stones and pebbles can also overgrow with moss and lichens.

Characteristic species: *Honkenya peploides*, *Leymus arenarius*, *Agrostis stolonifera*, *Lathyrus maritimus*, *Elytrigia repens*, *Achillea millefolium*, *Rumex crispus*, *Angelica archangelica*, *Potentilla anserina*, *Petasites spurius*, *Carex arenaria*, *Cakile baltica*, *Salsolo kali*, *Atriplex spp*., *Phragmites australis*, *Scirpus tabernaemontani*, *Bolboschoenus maritimus*, *Typha angustifolia*, seldom: *Alopecurus pratensis*, *Arrhenatherum elatius*, *Calamagrostis arundinacea* etc. Also invertebrates: *Paradromius longiceps* (in the Northern Europe very related to *Leymus arenarius*), *Melanimon tibiale*, *Oedemera croceicollis*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Honkenya peploides*, *Leymus arenarius*, *Agrostis stolonifera*, *Rumex crispus*, *Potentilla anserina*, *Petasites spurius*.

Variants: none.

Habitat Quality

Minimum habitat requirements: the beach substrate consists of at least 20% of stones or at least 80% of pebbles and the total cover of vegetation at least 10%.

Due to diversity of the site and vegetation it cannot apply for one etalon composition reference model, but it is possible to distinguish common quality criteria.

Structural indicators: important criteria of all marine and coastal brackish group habitats, except for the *proportion of the site area where the vegetation is characterized by a mosaic structure* because vegetation mostly establishes among stones. Additional indicators are *proportion of the site area that has area that is free from overgrowth, total length of the habitat line*, including gaps. Presence of invasive and expansive species, as well as tree and shrub cover indicates a lower quality of the habitat.

Function indicators: all significant criteria of marine and coastal brackish habitats, as well as *proportion of the site area in which undisturbed habitat development takes place, existence of spring and groundwater outflow areas*, as well as *intensity of sand over blowing and accumulation*.

Restoration potential and quality improvement indicators: significant factors of all marine and coastal brackish habitat group, as well as *the need to plan, build recreation places and viewing infrastructure for habitat restoration and maintenance, and the need to plan, remove or build engineering objects for habitat maintenance and/or restoration*; in the best case scenario, no such measures must be undertaken. Habitat is potentially renewable. Restoration success depends not only on the available stones and pebbles on the beach, but regularity and intensity of beach flooding.

Threats: the habitat is threatened by mechanical disturbances; stone removal or relocation can completely destroy the habitat, therein altering the structure of the beach and, therefore, resistance to wind and wave action, destructing natural relief, microclimate, etc. Beach flooding especially during severe storms can partially or completely destroy the characteristic vegetation. Long-lasting marine water shortage also has a negative impact – regular and moderate flooding is not happening and, as a result, the habitat starts to overgrow.

Management: must provide undisturbed development of beaches and natural coastal and seaside processes, preventing stone collection and handling, as well as minimizing mechanical disturbances. Moderate grazing is allowed in areas that have been overgrown for a long time.

Similar habitats: long-term beaches with relatively small amount of stones are hard to separate from the habitats 1630* *Boreal Baltic coastal meadows* and 1640 *Boreal Baltic sandy beaches with perennial vegetation.* In these cases it is necessary to evaluate structure and amount of stones on the beach according to the minimum habitat determination criteria. Specific habitat differs from the Boreal *Baltic sandy beaches with perennial vegetation* (1640) with significant cover of rocks and pebbles. In the *Boreal Baltic coastal meadows* (1630) a small proportion of stones and sod is formed. In low beaches where fewer rocks are located by the sea, sand is exposed and habitat 1310 *Salicornia and other annuals colonising mud and sand* can be formed - in such cases it is necessary to evaluate size of the habitat, proportion of stones and characteristic plant species.

Overlap with other habitats of EU importance: 1210 *Annual vegetation of drift lines* can form as a separate microhabitat.

Corresponding specially protected habitats in Latvia: 6.7. Perennial vegetation on stony beaches.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Eberhards, G. (2003) Latvijas jūras krasti (Baltijas jūras Latvijas krasta josla). Morfoloģija, uzbūve, mūsdienu procesi, riska zonas, prognozes, aizsardzība un monitorings. Monogrāfija. Āboltiņš, O. (red.) Rīga, Latvijas Universitāte, 296 lpp.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Laime, B. (1999) Pludmales un primāro kāpu aizsardzības plāns. Rīga, Latvijas Dabas fonds, 45 lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

1230 *Vegetated sea cliffs of the Atlantic and Baltic coasts*

Latvian habitat classification: B.4.

Syntaxonomy: *Agropyro-Honkenion peploides*; *Ammophilion arenariae*; *Galio-Koelerion*.

Definition: vegetated cliffs exhibit a complex pattern of variation reflecting the degree of maritime exposure, geology and geomorphology, biogeographical provenance and pattern of human management. Typically, on the most exposed cliffs there is a zonation from crevice and ledge communities of the steepest slopes besides the sea through to closed maritime grasslands on upper cliff slopes, cliff tops and cliff ledges where there is deeper accumulation of soils. Further inland and on more sheltered cliffs, these grade into a complex assemblage of maritime and paramaritime types of heath, calcareous grassland, acid grassland, therophyte, tall herb, scrub and wind-pruned woodland vegetation, each enriched by floristic elements characteristic of coastal habitats. On soft coasts with much active movement, complex assemblages of maritime and non-maritime vegetation occur.

Specific characteristics of habitat interpretation in Latvia: sea cliffs are outcrops of bedrock of any height and outcrops of quaternary sediments higher than 4 metres that have been eroded in wind and wave influence and that are steeper than 45°. The habitat also includes sea-cliff forming material landslides on the beach. Height of the sea cliff is measured from the upper edge of the beach to the top of the rock outcrop, determining average height of the shore and not eliminating separate lower stages in a unified sea cliff line (*Fig. 1.18.*). Projective cover of vegetation covering sea cliffs might be various. Accumulative seashore (must have a simple structure – made of sand), regardless their height, are not considered the habitat 1230.

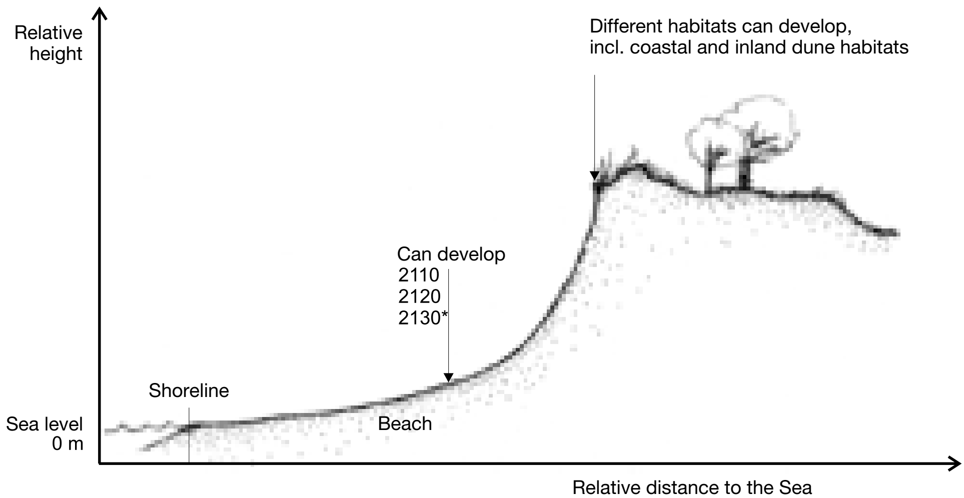


Figure 1.18. An overall scheme of a sea cliff profile. On the base of the sea cliff a habitat 2110 *Embryonic shifting dunes* might form, but when wave action decreases 2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)* might also form there, and, at the foot of sea cliffs, even - 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)*. Above the upper ledge of a sea cliff, most often it is possible to find 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)* and 2180 *Wooded dunes of the Atlantic, Continental and Boreal region*, seldom – various grasslands and anthropogenic or semi–natural habitats (Scheme: I.Rove).

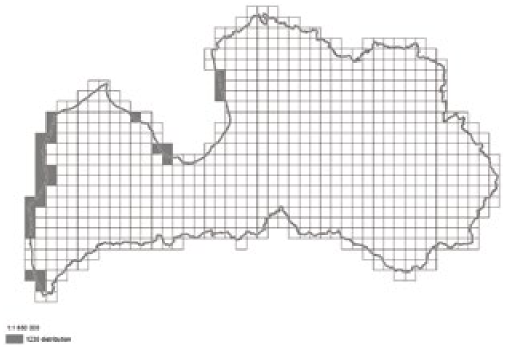


Figure 1.19. Distribution of the habitat 1230 *Vegetated sea cliffs of the Atlantic and Baltic coasts* in Latvia (Conservation status of.., 2013).

Distribution: rare – on the shores of the Baltic Sea, Irbe Strait and Gulf of Riga. Sea cliffs that are formed of sandstone rock outcrops are found in a small area of the eastern shore area of the Gulf of Riga between Tūja and Vitrupe. Sea cliffs formed of quaternary sediments are found in the vicinity of Bernāti, Ziemupe, Pāvilosta, Jūrkalne, Lībciems, Staldzene, Mērsrags, Ragaciems, Tūja and point-like sites in Vaide, Uši and Kaltene (Eberhards, Lapinskis, 2008; Conservation status of.., 2013).

Conservation value: a significant habitat for rare lichen species – *Pycnothelia papillaria*, *Cladonia stellaris*, *C.foliacea*, *Peltigera aphthosa*. Habitat where species that are endemic to eastern shore of the Baltic Sea grow – *Linaria loeselii*, *Tragopogon heterospermus*, as well as the rare *Alyssum gmelinii.* Rare and valuable scenery that differs from the dune landscape that is characteristic to Latvian sea-coast.

Environmental factors: geological origin of sea cliffs determines their resistance against wind and wave impacts, soil production, as well as development and preservation of vegetation. Sandstone rock outcrop sea cliffs are more stable. Sea cliffs at Ķurmrags are formed of both sandstones and quaternary sediments (*Fig. 1.20.*). High and averagely height sea cliffs of quaternary sediments can be with a simple geological structure - consisting only from sand or clay or with complex, layered structure that consists of clay, aleirites, gravel, pebbles, sand and peat (*Fig. 1.21.*) (Eberhards, 2003). Groundwater often flows out in sea cliffs of complex geological structure. Depending on the content of rocks, there are different growth conditions – different pH environment and humidity.

Processes with functional significance: the most significant factor is wind and wave influence. Sea water and splashes ensure brackish environment. Landslides, landslips and spillages that disturb establishment of seamless vegetation cover are characteristic to active and partly passive sea cliffs. This process is influenced by action of sea, surface water and groundwater. Sandstone rock outcrop surface relief is primarily created by wave action. During strong storms, caves and niches of various sizes are formed in them. Very strong storms can wash off part of the rock outcrop, changing its appearance and completely destroying vegetation on it.

Vegetation characteristics: on passive sea cliffs that are located outside the area of active wave and floating ice action linked vegetation cover is formed. On less active sea cliffs vegetation that is characteristic to meadows is developed. Mostly vegetation consists of landslides of the upper edge together with fragments of the vegetation grown there that on partially passive seashores may remain as undisturbed vegetation cover. If on passive and party passive sea cliffs a spring outflow is located, it forms vegetation that is characteristic to dispersed groundwater outflow sites. Around spring outflow sites in active sea cliffs or at its base grows moisture-loving species that do not form linked spring mire vegetation. Vegetation of passive sea cliffs corresponds to vegetation of various type grasslands, dispersed groundwater outflow sites rich with mineral substances or dry pine forests. Above the beach terrace at the foot of the sea cliff a narrow line of black alder might grow as well. In these plant communities littoral plant species are often found. On active sea persistent vegetation cover does not establish (*Fig. 1.22.*) as it is washed off during storms. Separate more dense vegetation areas are preserved in the highest and less eroded places of sea cliff and sandstone rock niches where species characteristic to surrounding forest, beach and grey dunes grows.
Species that are characteristic to sea cliffs are with long rhizomes and underground sprouts that ensure existence of species in case of washes and landslides, and perennial plant species, often with low competitiveness and short growing period, which allow them to develop in a short time period between storms and restore seed fund.

Figure 1.20. Sandstone rock outcrop in Ķurmrags (Photo: D.Kretalovs).

Figure 1.21. Layered structure sea cliff in Ziemupe with substrate landslides covered with vegetation (Photo: V.Baroniņa).

Figure 1.22. Active sea cliff in Strante is formed of sand sediments (Photo: I.Rēriha).

Characteristic species: *Calamagrostis epigeios*, *Leymus arenarius*, *Festuca arenaria*, *Tussilago farfara*, *Petasites spurius*, *Thymus serpyllum*, *Hieracium umbellatum*, *Galium album*, *Silene nutans*, *Festuca ovina*, *Koeleria glauca*, *Cardaminopsis arenosa*, *Arabidopsis thaliana*, *Linaria loeselii*, *Cakile baltica*, *Corispermum intermedium*, *Anthyllis*, *Chenopodium* and *Atriplex* family species.

Umbrella species (typical species within the meaning of the Habitats Directive): as this habitat is predominantly subject to continuous substantial changes of environmental factors, it does not provide stable conditions for the survival of specific species for a longer period of time. At the same time, all rare or specially protected species, for whose development these conditions are suitable, can develop and conserve their seed fund, for example, plant species with lowered competitive ability. This is the reason why any species that are rare or specially protected in Latvia should be considered umbrella species – e.g. *Linaria loeselii*, *Tragopogon heterospermus*, *Alyssum gmelinii* etc.

Variants: none.

Habitat Quality

Minimum habitat requirements: Any sea cliff in solid bedrock (sandstone) or in combination of bedrock and quaternary sedimentary rocks (in both cases – without height restriction) and sea cliffs of quaternary sedimentary rocks that are higher than 4m and steeper than 45° are considered to correspond to this habitat. There might be no characteristic species.

Structural indicators: all common indicators of rock outcrop habitats.

Function and process indicators: all common indicators of rock outcrop habitats.

Restoration potential and quality improvement indicators: all common indicators of rock outcrop habitats. Habitat restoration success after preventing human activities depends on natural processes.

Threats: all common threats of rock outcrop habitats, additionally – construction of hydro-technic structures in the sea or at the shore.

Management: the same as for other rock outcrop habitats.

Similar habitats: 8220 *Siliceous rocky slopes with chasmophytic vegetation.* Differs with geographic location – sandstone rock outcrops are not located at the shore, but on inland.

Overlap with other habitats of EU importance: 2180 *Wooded dunes of the Atlantic* (only on passive sea cliffs), *Continental and Boreal region* (only on passive sea cliffs), 6120* *Xeric sand calcareous grasslands* (only on passive sea cliffs), 7160 *Fennoscandian mineral-rich springs and springfens.*

Corresponding specially protected habitats in Latvia: partly 8.17. Sandstone rock outcrops.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Eberhards, G. (2003) Latvijas jūras krasti (Baltijas jūras Latvijas krasta josla). Morfoloģija, uzbūve, mūsdienu procesi, riska zonas, prognozes, aizsardzība un monitorings. Monogrāfija. Āboltiņš, O. (red.) Rīga, Latvijas Universitāte, 296 lpp.

Eberhards, G., Lapinskis, J. (2008) Baltijas jūras Latvijas krasta procesi. Atlants. Rīga, LU Akadēmiskais apgāds, 64 lpp.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Piterāns, A. (2001) Latvijas ķērpju konspekts. Latvijas veģetācija 3, 5.–46. lpp.

1310 *Salicornia and other annuals colonising mud and sand*

Latvian habitat classification: partly B 1.1.2.

Syntaxonomy: *Saginetea maritimae, Nano-Cyperion flavescentis.*

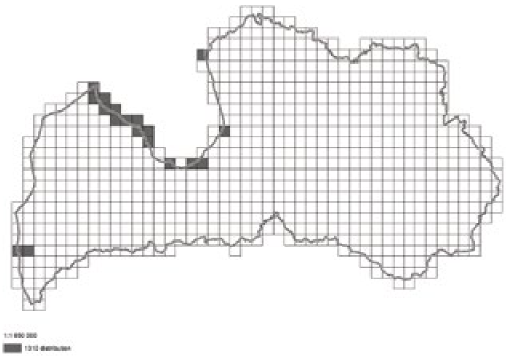


Figure 1.23. Distribution of the habitat 1310 *Salicornia and other annuals colonising mud and sand* in Latvia (Conservation status of.., 2013).

Definition: formations composed mostly or predominantly of annuals, in particular Chenopodiaceae of the genus *Salicornia* or grasses, colonising periodically inundated muds and sands of marine or interior salt marshes.

Specific characteristics of habitat interpretation in Latvia: establishes only on beaches of sea and coastal lakes, therefore because of low environmental salinity, halophyte plant species (from genus *Salicornia* and others) are found in the habitat very rarely with a small population. *Juncus* species are more characteristic (*Fig. 1.16.*).

Distribution: very rare, mostly at the seashore of the Gulf of Riga, coast of Irbe Strait between Saunags and Kolka, in some places at the seashore of the Gulf of Riga and Vidzeme, as well as on the shore of Liepāja Lake. In Latvia the habitat occupies about 40 ha or 0.0006% of the total territory of the country.

Conservation value: one of the rarest habitats in Latvia, Found in a very small area. Significant feeding and recreation area for water birds, species of *Atriplex spp*., species of dipterous and *Bufo calamita*. At the seashore several isolated populations of *Bufo calamita* have been found (Bērziņš, 1984; Bērziņš, 1987). Habitat has an important role in ensuring diversity of coastal landscapes.

Environmental factors: geological origin and geomorphology of the seashore has a significant role. Low beaches with depressions and puddles are the most suitable place for habitat development, and it is closely connected to processes in the sea, periodical beach flooding, rain and wind; wind surges are important – frequency of flooding and width of the flooded area. Habitat is significantly impacted by beach erosion and/or increase, 'cover of sands' during storms and after them. On Latvian shores this habitat is also influenced by springs whose waters flow out on the beach or near it.

Vegetation characteristics: annual moisture loving species dominate in the habitat. Vegetation can be very sparse, fragmented to seamless with plant cover of 80% and more (*Fig. 1.24.*). Vegetation develops in lines parallel to the shore of the sea, depending on moisture gradient. Vegetation that is dominated by annual plants mostly belongs to *Juncetum bufonii* species community, which often forms a mosaic vegetation with coastal rush meadows, reeds and grasslands, as well as plants of dune depressions and dunes (*Fig. 1.25.*). Characteristic species of the *Juncetum bufonii* communities indicate on its close relation with *Bidentetalia* plant communities. Pretty often *Chenopodium spp.* and *Atriplex spp.* have a high ratio. In dryer places dominates vegetation of *Agrostis stolonifera* and *Sagina nodosa.* Similar to other beach plant communities also in these it is often possible to find weeds and ruderal plant species.

Characteristic species: plants – *Juncus bufonius*, *Ranunculus sceleratus*, *Polygonum hydropiper*, *Agrostis stolonifera*, *Spergularia salina*, *Atriplex spp.*, *Sagina nodosa*, *Juncus articulatus*, *Chenopodium rubrum* etc.; animals – *Ephedridae* species

Scatella stagnalis, *Setacera aurata*, *Omophron limbatum*, *Heteroceridae* species *Heterocerus fusculus*, *Hydrophilidae* species (*Helochares obscurus, Cercyon spp.*).

Umbrella species (typical species within the meaning of the Habitats Directive): plants – *Juncus bufonius*, *Ranunculus sceleratus*, *Polygonum hydropiper*, *Agrostis stolonifera*, *Sagina nodosa*, *Juncus articulatus*.

Variants:

1310_1 (typical): dominated by *Juncus*, *Ranunculus sceleratus* and other moisture loving plants; develops mostly in the lowest part of the beach, puddles are characteristic;

1310_2: dominated by *Sagina nodosa* and *Agrostis stolonifera*, creates line between coastal wetlands and dunes.

Habitat Quality

Minimum habitat requirements: often flooded beach in which at least in some places it is possible to find at least one of the characteristic species and where moisture loving annual plant community might develop. Flooding is evaluated by wave marks on the beach and dunes, as well as drifts, height and micro relief of the beach.

Structural indicators: common indicators of marine and brackish habitats, as well as puddles and depressions on the beach. The most favourable habitat is shallow beach pool that gradually dries out and periodically floods a little bit. Excellent habitat (with big annual plant population) establishes if at the beginning of summer there are optimal conditions for germination of the previously mentioned annual plants. Evaluation of habitat should be performed in the middle or at the end of summer.

Function indicators: regular flooding with sea water, springs and other water outlets on the beach; beach is not rammed due to anthropogenic influences (natural structure), other common function indicators of marine and brackish habitats.

Restoration potential and quality improvement indicators: common indicators of marine and brackish habitats; necessary to ensure non-disturbance in order to allow the course of natural processes. Restoration possibilities are related

Figure 1.24. Beach in the area of Kolka-Melnsils – vegetation of annual plants is dominated by *Juncus bufonius* (Photo: B.Laime).

Figure 1.25. Beach in the area of Kolka – development of vegetation is influenced by coastal depressions, pools and springs (Photo: B.Laime).

Figure 1.26. Beach in Vaide vicinity – moisture loving plant community indicates on periodically wet beach in which celery-leaved buttercup *Ranunculus sceleratus* with rushes and reeds are widely represented (Photo: B.Laime).

to demolition of buildings on the shore and/or in the sea.

Threats: habitat is threatened by coastal micro relief transformation (alignment) by driving or by the beach improvement and maintenance; substrate relocation and/or placement, tree and shrub planting, excessive anthropogenic pressure (recreational, fairways and other influences), as well as alteration of coastal hydrological regime.

Management: it is recommended to determine coastal sea areas in which continuously or periodically to ensure minimal human intervention or even non-disturbance in natural processes within the nature conservation plans, spatial plans and other documents. It is necessary to evaluate the impact of the existing and planned infrastructure on this habitat.

Similar habitats: can be similar with 1210 *Annual vegetation of drift lines.* The main difference is formation of vegetation on drifts. If perennial plants on the beach dominate over annual plants, then this habitat is considered 1640 *Boreal Baltic sandy beaches with perennial vegetation* or 1220 *Perennial vegetation of stony banks* where large amount of boulders influences structure and function of the habitat. On higher beaches that are dominated by *Agrostis stolonifera* and *Sagina nodosa*, it might be difficult to distinguish habitat from the 2110 *Embryonic shifting dunes*. In this case the main indication is hummocks of embryonic dunes. But in borderline case of beach and shifting dunes, it is necessary to look for distribution of dune banks and psammophytic plants.

Overlap with other habitats of EU importance: partly can overlap with the habitat 1210 *Annual vegetation of drift lines.* Especially in small bays, where beaches are narrow and where a lot of micro-habitats establishing drifts are present.

Corresponding specially protected habitats in Latvia: 6.12. Communities of annual plants in mud and low sandy beaches.

Literature

Bērziņš, A. (1984) Smilšu krupja – *Bufo calamita Laur.* – izplatība Latvijā. Retie augi un dzīvnieki. Apskats. Rīga, LatZTIZPI, 33.–36. lpp.

Bērziņš, A. (1987) Jaunas ziņas par smilšu krupi – *Bufo calamita Laur.* – Latvijā. Retie augi un dzīvnieki. Apskats. Rīga, LatZTIZPI, 26.–31. lpp.

Kalvišķis, K. (2006) Piekrastes biotopu kartēšanas rezultāti. Latvijas Universitāte, http://piekraste.daba.lv/LV/biotopi/piekrastes_ biotopu_kartesanas_rezultati.shtml

Laime, B. (1999) Pludmales un primāro kāpu aizsardzības plāns. Rīga, Latvijas Dabas fonds, 45 lpp.

Laime, B. (2000) Seashore plant communities of the Lake Engures (Engure) Nature Park, Latvia. Proceedings of the Latvian Academy of Sciences 54, 5/6, 190–197 p.

Laime, B. (2010) Latvijas kāpu un pludmaļu fitosocioloģiskais raksturojums Baltijas jūras reģiona kontekstā. Promocijas darbs. Rīga, LU, 97 lpp.

Spungis, V. (2002) Invertebrates of the sandy coastal habitats in Latvia. Latvijas entomologs 39, 8–15 p.

Spuņģis, V. (2008) Slīteres nacionālā parka biotopu bezmugurkaulnieku (Invertebrata) fauna un ekoloģija, (mācību materiāli). Rīga, Latvijas Universitātes Bioloģijas fakultāte, 59 lpp.

1630* *Boreal Baltic coastal meadows*

Latvian habitat classification: E.3.4.

Syntaxonomy: *Armerion maritimae*.

Definition: coastal meadows, mostly with low growing plant communities in the geolittoral zone, sometimes interspersed with salt patches, salinity is low (brackish water), tide hardly exists but there can be influence from land upheaval. Most of the areas were traditionally used for mowing or grazing, thus enlarging the areas and keeping the vegetation low, rich in vascular plants and suitable for nesting waders. Characteristically the vegetation occurs in distinct zones, with saline vegetation closest to the sea.

Specific characteristics of habitat interpretation in Latvia: this habitat includes natural grasslands that are located at the shore of the Baltic Sea, lower reaches of rivers and lakes flowing into the sea where they are flooded with brackish sea water.

Distribution: very rare – only in the Coastal Lowlands, there are sites in Rand Meadows between Ainaži and Salacgrīva, Bērzciems, estuary of River Lielupe, Daugavgrīva, Vecdaugava, Mērsrags, on shores of Liepāja Lake.

Conservation value: One of the rarest natural grassland habitats in Latvia (about 180 ha or 0.003% of the total territory of the country), which has been rapidly shrinking during the previous decades. Habitat has an excellent cultural heritage (nearly the only grasslands, which in Latvia formed without the forest stage), landscape (unusual seaside landscape that differs significantly from other seashore landscapes) and biological diversity (irreplaceable resting and breeding sites for birds; includes a quarter of the Latvian higher plant species; the only habitat for many rare insects) value of protection. This habitat is the only suitable site for many rare herbaceous plant (for example, *Carex mackenziei*, *Angelica palustris*, *Juncus gerardii*, *Odontites litoralis*, *Plantago maritima*, *Blysmus rufus*, *Triglochin maritimum*, etc.) and bird species (for example, *Calidris alpina subsp. schinzii*) in Latvia.

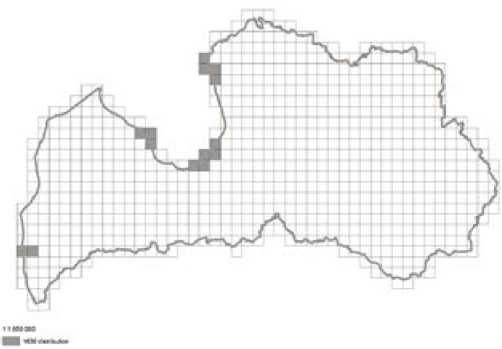


Figure 1.27. Distribution of the habitat 1630* *Boreal Baltic coastal meadows* in Latvia (Conservation status of.., 2013).

Environmental factors: significant environmental factor is influence of brackish sea water, which results in formation of brackish soils. On the Latvian seashore tides (tide and ebb) are negligible, therefore activity of wind is more important – during strong episodic sea wind water masses flood grassland areas. Vegetation is also affected by ice blocks and drifts that are moved on the beach during storms and creates diversity in conditions of micro relief, creates free spaces in vegetation, thus contributing to a variety of grassland development stage mosaics and existence of diversity of communities. Mainly the habitat can be found in the low beaches of seashores, as well as flood plains of river estuaries where the salty sea water is carried during wind surges. It is characteristic that in these places ground surface is not smooth, so dry and moderately wet rises interchange with moist and wet depressions.

Vegetation characteristics: very diverse – dry and moderately moist site plant communities interchange with moist and wet site plant communities. In wider coastal grassland areas (such as Randu Meadows) are represented by almost all of the natural grassland communities (*Fig. 1.28.*). The sward structure is various – from very low (10–20 cm) to high (above 150 cm), in the driest parts vegetation is fragmented an open, moss and lichen layer is formed, but in the wettest areas vegetation of herbaceous plants is linked, several layers can be distinguished. An important feature in contrast to all other grassland habitats is distribution of species of saline soils (halophyte), for example, *Triglochin maritimum*, *Juncus gerardii*, sea *Glaux maritima* (*Fig. 1.29.*) They mainly grow in wet depressions where the impact of the brackish sea water is the biggest, but they do not grow in dry elevations. Most halophytes are low height species for which suitable conditions are formed only in regularly grazed or mown areas. When the maintenance ceases, *Phragmites australis* spreads very rapidly and creates shade and pushes almost all the other species from the sward. Sometimes as an intermediate between grasslands and reeds communities, *Alopecurus arundinaceus* may form. Dryer places (further from water) overgrow with shrubs and trees.

Characteristic species: (Halophytes are marked with^{H}) plants – *Agrostis stolonifera*, *Angelica palustris*^{H}, *Blysmus rufus*^{H}, *Bolboschoenus maritimus*^{H}, *Carex nigra*, *Centaurium littorale*^{H}, *C.Pulchellum*^{H}, *Eleocharis uniglumis*^{H}, *Festuca rubra*, *Glaux maritima*^{H}, *Juncus gerardii*^{H}, *Ophioglossum vulgatum*, *Plantago maritima*^{H}, *Puccinellia capillaris*^{H}, *P.maritima*^{H}, *Scirpus tabernaemontani*^{H}, *Trifolium fragiferum*^{H}, *Triglochin maritimum*^{H}. Birds – *Calidris alpina schinzii*. High diversity of *Diptera dipterous*, especially *Chironomidae*, *Muscidae*, *Chloropidae*, *Phoridae*, *Empididae*.

Umbrella species (typical species within the meaning of the Habitats Directive): all halophytes are characteristic species – *Angelica palustris*, *Blysmus rufus*, *olboschoenus maritimus*, *Centaurium littorale*, *C.pulchellum*, *Eleocharis uniglumis*, *Glaux maritima*, *Juncus gerardii*, *Plantago maritima*, *Puccinellia capillaris*, *P.maritima*, *Scirpus tabernaemontani*, *Trifolium fragiferum*, *Triglochin maritimum*. Birds – *Calidris alpina schinzii*.

Variants: none.

Figure 1.28. Whole grassland band from the seashore to forest in nature reserve 'Randu Meadows' complies with the habitat 1630* *Boreal Baltic coastal meadows*. In this band it is possible to find plant communities that belong to dry and moderately moist, wet and wet grasslands (Photo: S.Rūsiņa).

Habitat Quality

Minimum habitat requirements: a habitat that floods with brackish sea water and in which at least 1% of the area is covered with saline soil vegetation with at least one brackish (halophyte) species.

Structural indicators: all common indicators of grasslands.

Function indicators: all indicators that are significant for grasslands, additionally also flooding with water brackish sea water (most significant factor that determines quality of plant species and communities in the coastal grassland) and width of grassland band in direction from the sea to inland (it is limiting for bird species).

Restoration potential and quality improvement indicators: all indicators that are significant for grasslands.

Threats: all factors that are threatening grasslands; specific risk is construction of hydro-technical buildings, which significantly decreases or increases (causing coastal erosion) sea-water impacts on the habitat and thus worsen environmental conditions for brackish site species and communities.

Management: mowing and/or grazing.

Similar habitats: in marine habitats plant communities that are characteristic to all natural grassland habitats might establish. Boreal Baltic coastal meadows are separated from the others, based on the geological origin and contemporary impact of the sea, as evidenced by the presence of brackish species. Generally, they are concentrated closer to the seashore, but towards the inland their occurrence decreases. Whole territory that is covered with natural grassland vegetation and which is subjected to impact of sea water is considered to be coastal grasslands, even if there are no brackish natural sites further from the shore.

Overlap with other habitats of EU importance: 1210 *Annual vegetation of drift lines.*

Corresponding specially protected habitats in Latvia: 3.16. Coastal meadows.

Figure 1.29. 1630* *Boreal Baltic coastal meadows* with halophytes (with *Triglochin maritimumin* in the foreground) (Photo: A.Kuzemko).

Literature

Birkmane, K. (1960) Ainažu–Salacgrīvas jūrmalas pļavu veģetācija. Latvijas veģetācija 3, 15.–24. lpp.

Laime, B. (2000) Seashore plant communities of the Lake Engures (Engure) Nature Park, Latvia. Proceedings of the Latvian Academy of Sciences 54, 5/6, 190–197 p.

Life-Nature project „Protection and Management of Coastal Habitats in Latvia" (2006) Coastal habitat database of Faculty of Biology (University of Latvia), http://piekraste.daba.lv/

Martinsone, A. (1937) Salacgrīvas–Ainažu jūrmalas pļavu ziedaugu flora un veģetācija. Rokraksts. Kandidāta darbs. Rīga. 134 lpp.

Melecis, V., Karpa, A., Spuņģis, V. (1998) The grass-dwelling arthropod communities of the coastal reserve „Randu pļavas" in Latvia. Latvijas Entomologs, 36, 55-65 p.

Матвеева, Е.П. (1967) Луга Советской Прибалтики. Ленинград, Наука, 335 с.

Сабардина, Г.С. (1957) Луговая растительность Латвийской ССР. Изд. АН ЛССР, Рига. 303 с.

1640 *Boreal Baltic sandy beaches with perennial vegetation*

Latvian habitat classification: partly B.1.1.1.2., B.1.1.2.2., B.1.2.2.

Syntaxonomy: *Atriplicion littoralis, Salsolo kaliHonkenyion peploidis*, *Ammophilion arenariae*, *Cakiletum maritimae*, etc.

Definition: sheltered to exposed, gently sloping sand beaches influenced by wave action, but less influenced by tides than on the Atlantic coast, giving a higher representation of perennial plant species. Occasional stones or boulders may be scattered along the beach. The vegetation is often sparse and large areas of bare sand are common especially in the part closest to the shore. Sand-binding plants are common. The insect fauna on sand beaches is conspicuous. Drift belts of organic matter are often present.

Specific characteristics of habitat interpretation in Latvia: the habitat mostly develops on the upper part of the beach (*Fig. 1.31.*).

Distribution: very rare – on the shores of the Baltic Sea, Irbe Strait and Gulf of Riga. Mainly found on the western shore of the Gulf of Riga in the area between Kolka and Mērsrags, as well as near Lapmežciems. In a small area (patches) can be found on the coast of Irbe Strait in Saunags vicinity where during the previous 10 years the habitat has been increasing due to influence of dominating coastal processes.

Conservation value: a rare habitat in Latvia ~0.0011% or 71 ha of the total land area of Latvia. One of the few habitats for *Crambe maritima*. Significant habitat for specially protected species of oraches: *Atriplex calotheca*, *A.longipes,* babington's orache *A.glabriuscula.* Habitat is a significant site for littoral species. Feeding site for wading birds. Habitat is uncharacteristic, visually high value landscape element to the shore of Latvia.

Environmental factors and processes with a functional role: prerequisite for habitat formation is a sandy beach that is regularly, but moderately exposed to the wave action. In some places an admixture of gravel and pebbles may be present. Habitat may establish and disappear depending on intensity of beach flooding and sand accumulation processes. It is one of development phases of dynamic growth or accumulative seashore. Habitat often is formed in areas where the dunes are washed off.

Vegetation characteristics: dynamic environmental conditions determine diversity of vegetation. Plant community content varies in direction from the shore towards inland (*Fig. 1.32.*). Depending on the width and location of the habitat it is possible to separate several belts of the habitat that are parallel to the coast. In the driest places of the highest part of the beach vegetation is mostly sparse, at the end of summer and autumn closed vegetation, which is dominated by halophytes and psammophytes, might form. In wet growing conditions – the lower part of the beach – dense vegetation might form, mainly consisting of moisture loving plants and halophytic species. Often drift zones of organic materials are formed. On drift lines and among perennial plants, annual plant species also have a significant role in communities which in some places can co-dominate. Around spring outflows develops vegetation characteristic to wet beaches. In

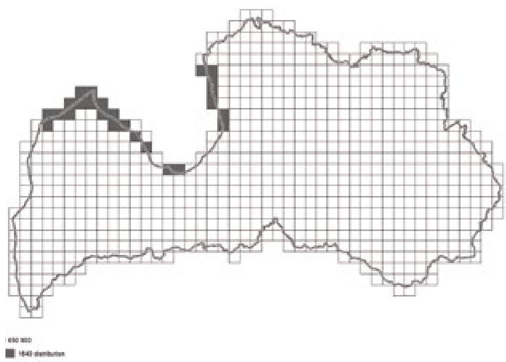


Figure 1.30. Distribution of the habitat 1640 *Boreal Baltic sandy beaches with perennial vegetation* in Latvia (Conservation status of.., 2013).

Figure 1.31. Sandy beach with perennial vegetation in Mērsrags vicinity. Vegetation of habitat mostly develops in the upper part of the beach (Photo: I.Rove).

sections of sea coast, where dunes are washed off, perennial plant communities form border between open beach (without any vegetation) and forest or scrub.

Characteristic species: in the driest parts of the beach – *Ammophila arenaria*, *Honkenya peploides*, *Leymus arenarius*, *Elytrigia spp*., *Cakile baltica*, *Salsolo kali*, *Lathyrus maritimus*, *Atriplex spp*., *Chenopodium spp*., *Calamagrostis epigeios*, *Festuca arenaria*, *X Calammophila baltica*, *Carex arenaria*, *Phragmites australis*, *Calamagrostis arundinacea*, seldom: *Salix spp*., *Corispermum intermedium*, *Crambe maritima*, etc.; in the lowest and wettest parts of the beach – *Ranunculus sceleratus*, *Bidens spp*., *Polygonum hydropiper*, *Rorippa palustris*, *Juncus bufonius*, *Juncus balticus*, *Aster tripolium*, *Atriplex calotheca* *Scirpus tabernaemontani*, *Bolboschoenus maritimus*, etc. Also the following invertebrates: *Paradromius longiceps* (in the Northern Europe it is especially related to *Leymus arenarius*), *Anthicus anxillaris*, *Psylliodes marcida* (oligophagous on *Cakile spp.*).

Umbrella species (typical species within the meaning of the Habitats Directive): *Ammophila arenaria*, *Honkenya peploides*, *Leymus arenarius*, *Calamagrostis epigeios*, *Festuca arenaria*, *Juncus bufonius*.

Variants: none.

Habitat Quality

Minimum habitat requirements: sandy beaches with at least 10% of vegetation composed of perennial plant species. Due to diversity of plant communities of the habitat it cannot apply for one etalon composition reference model, but it is pos-

Figure 1.32. Both sparse (A) and dense vegetation (Photo: I.Rove).

sible to distinguish common quality criteria.

Structural indicators: all significant criteria of marine and coastal brackish habitat group, as well as *proportion of the polygon that is free from overgrowth. Amount of puddles and dips on the beach* is evaluated. *Presence of expansive species,* as well as *tree and shrub cover* indicates lower quality of the habitat.

Function indicators: all significant criteria of marine and coastal brackish habitats, as well as *proportion of the site area in which undisturbed habitat development takes place, in which natural materials (drifts, stones, etc.) are not collected and/or transformed at the seashore. Spring and groundwater outflow areas* indicate higher quality of functions.

Restoration potential and quality improvement indicators: criteria that are significant to the entire marine and coastal brackish habitat group, as well as *the need to plan, build the infrastructure of recreation and sightseeing for restoration and maintenance of the habitat* to reduce anthropogenic pressure. Restoration progress is determined by regularity and intensity of flooding, as well as dynamics of sand accumulation.

Threats: mechanical disturbances, including driving and trampling that change natural relief of the beach and impact vegetation. Beach flooding, especially during severe storms, can partly or completely destroy the vegetation. Long-lasting marine water absence also has a negative impact – regular and moderate over-wash does not happen and, as a result, beach starts to overgrow.

Management: an essential prerequisite for provision of favourable conservation status of the habitat is non-disturbed development and control of natural processes. Mechanical disturbances, trampling and driving should be minimized. It is necessary to ensure non-disturbed development of natural coastal processes.

Similar habitats: it might be difficult to distinguish from the habitat 2110 *Embryonic shifting dunes;* in this case it is necessary to evaluate profile of the given coastal area. Embryonic dunes consist of blown sand hummocks (pillows) of different size, whereas the habitat 1640 *Boreal Baltic sandy beaches with perennial vegetation* is formed on a flat, slightly sloping upper part of a sandy beach or in whole width of the beach. Habitat 1310 *Salicornia and other annuals colonising mud and sand* can form on the lower part of the beach. In order to separate it, it is necessary to evaluate the size of the habitat and compliance with minimum determination criteria.

Overlap with other habitats of EU importance: as a separate habitat 1210 *Annual vegetation of drift lines* can form, it must be described and mapped separately.

Corresponding specially protected habitats in Latvia: 6.11. Sandy beaches with perennial vegetation.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Eberhards, G., Lapinskis, J. (2008) Baltijas jūras Latvijas krasta procesi. Atlants. Latvijas Universitāte. Rīga, Akadēmiskais apgāds, 64 lpp.

Eberhards, G., Lapinskis, J., Saltupe, B. (2006) Hurricane Erwin 2005 coastal erosion in Latvia. Vilnius. Baltica 19, 10–19 p.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Laime, B. (2010) Latvijas kāpu un pludmaļu fitosocioloģiskais raksturojums Baltijas jūras reģiona kontekstā. Promocijas darbs. Rīga, LU, 97 lpp.

Laime, B. (1999) Pludmales un primāro kāpu aizsardzības plāns. Rīga, Latvijas Dabas fonds, 45 lpp.


Photo: I.Rove

Previous name: *Seaside and inland dunes* (name was changed as inaccurate terminology was used previously). This diverse habitat group unites nine independent and at the same time very dynamic and successionally connected habitats that develop on Aeolian relief forms – dunes, including preliminary stage of primary dunes on the upper part of a beach and partially stabilised secondary dune habitats and relatively stable tertiary dune habitats towards inland as far as the ancient shore of the Baltic Ice Lake, as well as inland dune habitats. This habitat group also includes wet components of dune systems – inter dunal depressions – with high groundwater level or dune slacks. These habitats are a united functioning part of the current and geologically older seashore and inland dune complex. Most of the dune habitats in the Coastal Lowlands are interrelated stages of succession, so often it is difficult to distinguish one habitat from another (with the exception for 2190 *Humid dune slacks* and 2330 *Inland dunes with open Corynephorus and Agrostis grasslands).* Habitats form zones of different width parallel to the coast. At the open shore of the Baltic Sea habitat zones mostly are wider, comparing to the same habitat zone widths along the Gulf of Riga. If erosion processes dominate, then coastal dunes do not form and vegetation cannot stabilise, some of the habitats may not establish even over several seasons. Therefore sometimes it is more important to register the dominant processes and ensure that natural coastal processes take place rather than identifying a habitat itself.

Distribution

Wooded dunes of the Atlantic, Continental and Boreal region (2180) are located in a relatively wide area in the Coastal Lowlands: from the seashore to the ancient shore of the Baltic Ice Lake – in the main distribution area of aeolian relief forms (*Fig. 2.1.*). Relatively small areas of aeolian sediments related to the Baltic Sea development also can be found inland – outside the Coastal Lowlands. Dune habitat spatial distribution in relation to the shoreline and inter-related development stages are shown in *figure 2.2.* Depending on the prevailing processes, one or more habitat lines may not be formed. In separate sections of seashore several parallel zones of one habitat can be found, for example, several ridges of shifting dunes along the shoreline etc. Some of the habitat zones are eroded during storms, which is why beaches sometimes border with the habitat 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)* or even with 2180 *Wooded dunes of the Atlantic, Continental and Boreal region.*

Conservation value

Worldwide, distribution of habitats of this group has decreased significantly because of the influence of both natural and mostly anthropogenic factors. Latvia is one of the rare European countries in which coastal dune habitats can still be found and are evaluated as relatively non-disturbed. Part of primary and secondary dune habitats in Latvia have preserved as during the second half of the 20th century most of the Baltic Sea coast in Latvia was a restricted area – the former USSR border. High sensitivity of habitats that is elevated by the dynamic environmental conditions must be stressed. According to the latest information (Conservation status of.., 2013), the total registered coastal and inland dune habitat area is 65 478 ha or 1.01% of the total area of the land territory of Latvia.

Primary and secondary dune habitats are two of the few regumes for littoral species in Latvia. Many species that have adapted to living in sand plains, coastal dunes and brackish substratum can be found only in these habitats. Several insect and animal species of other groups can only be found in open dune and sand habitats. Coastal dune habitats are significant migration route for species of natural open habitats – particularly important to littoral plant and invertebrate species, as well as birds.

Primary and secondary dunes are natural and the most effective buffer for decreasing coastal erosion and protection of inland habitats.

Coastal dune habitats are a high-quality recreation, sports, tourism and medical resources and form visually highly valued landscapes and their elements that are characteristic to the seashore of Latvia.

Coastal and inland dune habitats have developed as a result of long lasting interaction of nature and humans, thus they have a high cultural heritage value (including little fields between du-

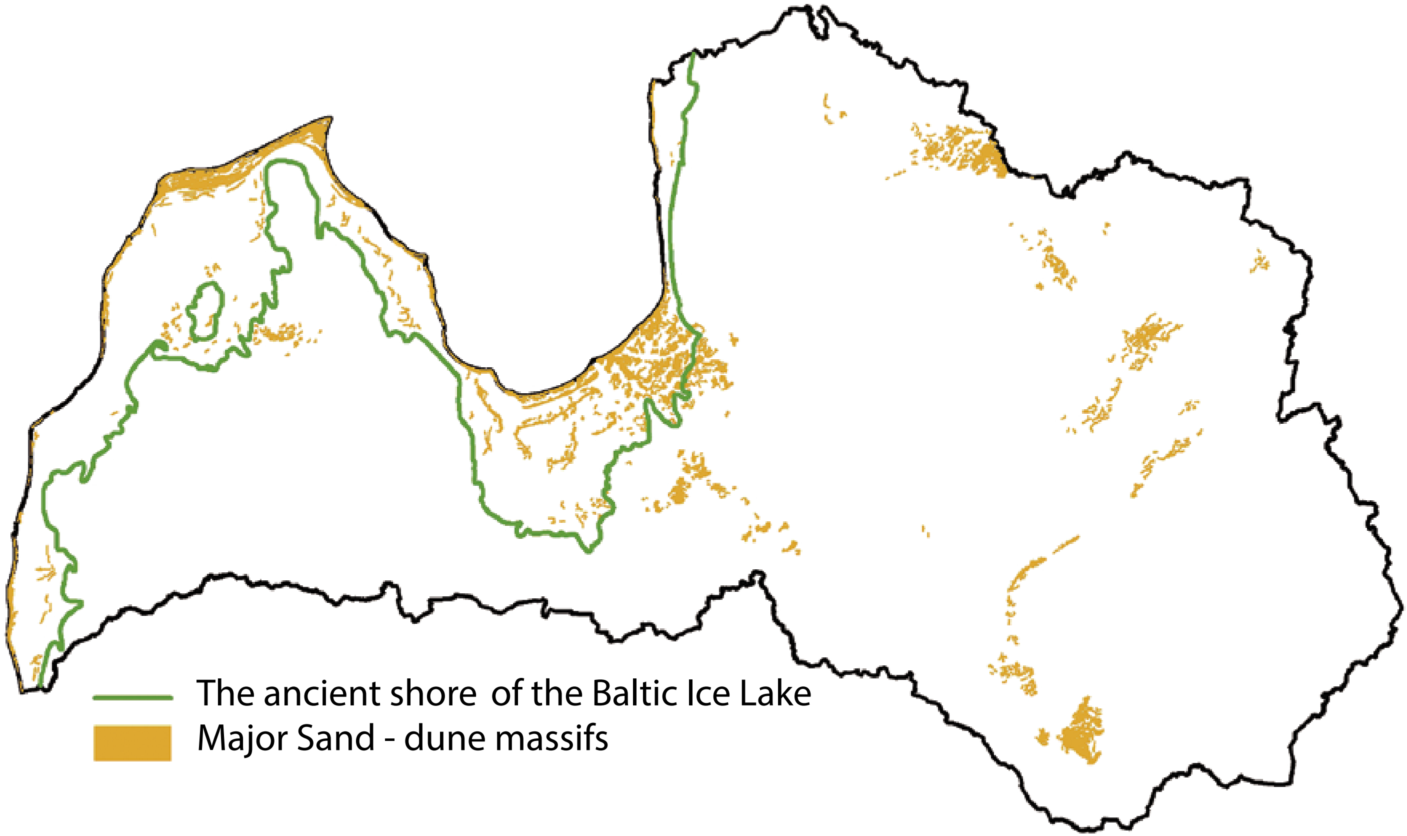


Figure 2.1. *Distribution of the major aeolian relief forms in Latvia.*

nes), which also includes information on the Latvian material and spiritual culture. Open dune landscape with the characteristic mosaic of vegetation and relief, especially in fishermen villages and their surroundings, indicate on sustained and uniform use of coastal habitat for drying of fishing nets, grazing, and other pursuits that are related to traditional lifestyle and managing the household. Wooded dune areas in many places are pine plantations of different ages, suggesting about restricting activities upon moving sand dunes and afforestation of open dunes in various historical periods. Dunes and sands at the coast have been used for protection of national border, which in some places is indicated by military infrastructure (buildings, permanent positions, etc.) and their preserved fragments.

Environmental factors and processes with a functional role

Dune habitats, opposite to inland habitats, have formed in very difficult and extreme conditions. Coastal and inland dune habitats are simultaneously ecologically durable and environmentally resilient, determined by their high dynamic and extreme sensitivity to various impacts. One of the most significant factors – habitats develop on windblown, moving or settled sand. Sufficient sand accumulation is ensured by non-disturbed flow of sediments moved by natural sea currents and prevailing winds, as well as natural amount of sand and other hard particles that are taken to the sea with water of unregulated and free flowing rivers. Inland dunes form when wind blows available sand along river valleys, as well as over the plains. Sand is loose, so it easily succumbs to the influence of wind and waves, it is oxygen-rich, but there is little organic matter and it is dry. Water is quickly absorbed into the sand thus promoting leaching of organic and mineral substances, including calcium (Ca). During storms brackish water or its splashes get on the sand and plants in primary and secondary dunes.

Open dune habitats are exposed to intense solar radiation that is determined by the light color of sand. They are characterized by extreme diurnal temperature fluctuations – during the first half of the day in the leeward side of the dune sand surface layer and vegetation heats up, during the second half of the day – they cool down very rapidly. Radical temperature fluctuations greatly hinder survival possibilities of the typical inland species.

Only specific plant species can live in the moving sands, which with their long roots can gradually settle sand and also 'catch' sand blown by the wind with their aerial parts – shoots, promoting the development of dunes – specially the 'growth'. If the dune is not destroyed (washed off, leveled, blown, affected by ice blocks, etc.), then the process continues until the roots of the plants are no longer able to reach ground water, begin to accumulate humus, vegetation changes until there is a relatively fixed dune, even covered with forest. At any point in time during the existence of the dune, it is possible that it will start to move due to various natural and anthropogenic factors. When the dunes become older, a layer of humus gradually develops, environment becomes richer with nutrients; it determines the need for regular disturbances – dune erosion and subsequent accumulation of sand, impact of fire, grazing, mowing, trampling, etc., for conservation of the specific habitat and cyclical natural restoration. Under natural conditions, most of the primary and secondary dune habitats due to impact of storms regenerate naturally in a cyclic manner – they are partially or completely washed off during storms, followed by accumulation of calcium-rich sand and habitat formation starts again; therefore, processes in the sea are very important for the existence of primary and secondary dunes.

Environmental conditions may cause situation when habitats of primary and secondary dunes seasonally disappear or disappear even for several years, depending on the intensity of erosion and sand accumulation processes. Cycles that partially overlap with the cyclical nature of the beach are characteristic to these habitats. When active flooding processes cease for a time, vegetation starts to establish, if the absence period of flooding is longer than several years, it is possible that relatively stable vegetation might establish. Due to the impact of natural and anthropogenic factors, naturally functioning sea coasts might also settle-down, and accumulation and/or erosion processes of different intensity levels might begin. A typical example is *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)* (2120) that in Latvia are both active and passive. In primary and sometimes secondary dunes natural drifts of organic matter can be found on which vegetation of the habitat 1210 *Annual vegetation of drift lines* might develop.

Vegetation characteristics

Plant communities are dynamic and relatively temporary.

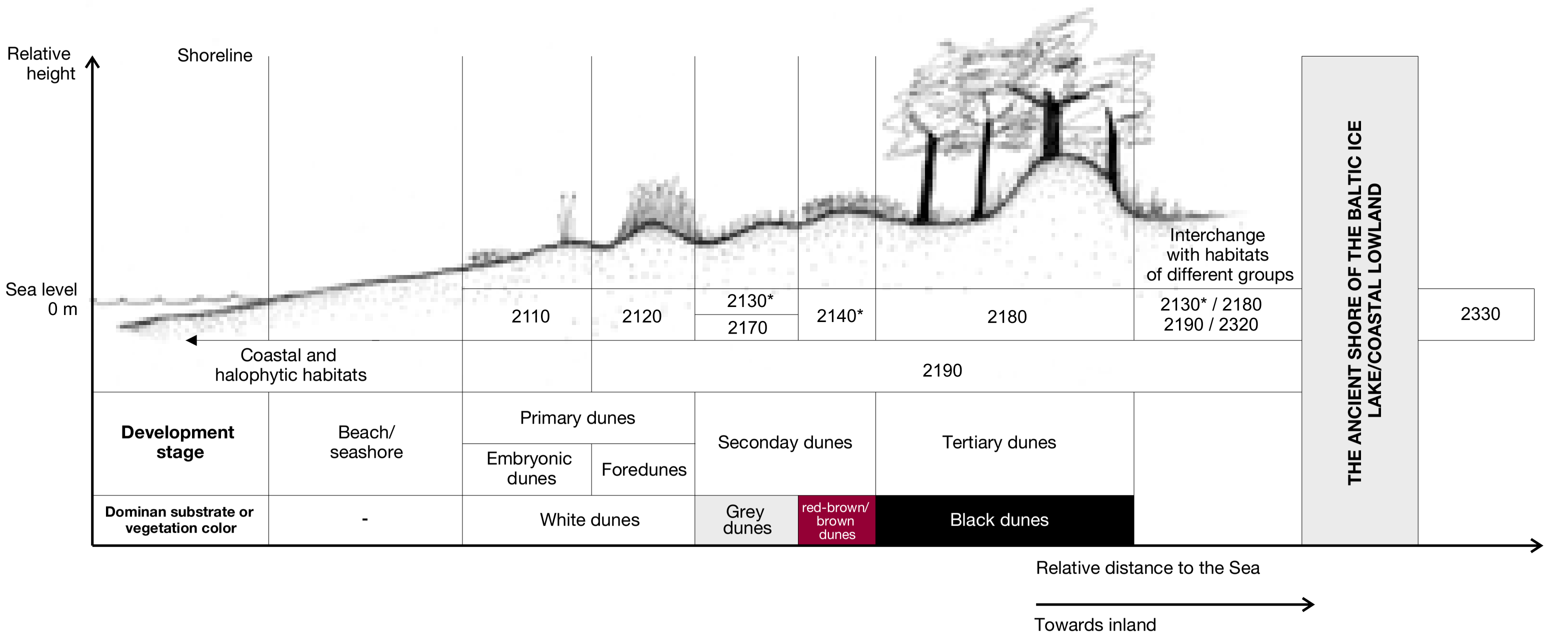


Figure 2.2. Location of coastal and dune habitats and full development profile. In general, with increasing distance from the sea, age of dunes increase, movement of sand decreases, amount of lime in sand decreases and humus layer increases (Scheme: I.Rove)

Their development depends on the strength of the wind and periodicity of storms. Floristic structure of plant communities is poor – it is possible to find some highly specialized species that have adapted to the specific circumstances. In the floristic content it is possible to find drought tolerant (*xerophytes*) and light-demanding species. Plant species with deep root systems that are resistant against flooding and burying with sand that is transported by wind (*psammophytes*) have a role of forming and stabilizing the dunes. Caulescent plants dominate plant communities. The dominant group of caulescent plant in primary, secondary and inland dunes are monocotyledons – several species of grasses and *Carex arenaria*.

In the dune communities due to the low competition, it is possible to find annual species, including weeds. Several species are found only in brackish soils (*halophytes*). Primary and tertiary dunes have an aerodynamic shape, which has a direct impact on vegetation. Depending on the slope and exposure of the dune (facing the sea, leeside, sunlit, shaded, etc.), different plant communities develop there.

Habitats are characterized by mosaic vegetation – interaction of overgrown areas and open substrate areas.

Primary, secondary and tertiary dune plant communities are consecutive stages of dune succession in the direction from the sea towards inland (*Fig 2.2.*), so objective problems may arise to accurately separate them from each another.

Habitat Quality

Minimum habitat requirements

Individually provided for each habitat, but it is possible to distinguish several common indicators that characterize the quality of all or most of the coastal sand dunes and inland dune habitats.

Structural indicators

Proportion of the area in which it is possible to find at least one of the characteristic plant species – presents evidence on the suitability of environmental conditions for the existence of the specific habitat.

Total amount of characteristic species – an important indicator for the habitat quality evaluation. When the quality of habitat decreases, amount of species present that are characteristic to it also decreases.

Proportion of area in which vegetation has the characteristic mosaic structure – a good indicator of vegetation diversity, age structure and restoration of the plant community.

Amount of various organism groups related to habitat, rare and protected species that depend on it – characterizes the habitat conservation value and suitability of the environment to the specific habitat.

Amount of invasive species – ideally, the habitat does not contain such species or they are found in small number and area.

Amount of expansive species – the higher the proportion of these species in the vegetation, the lower the quality of the habitat.

Proportion of area which is free from vegetation – significant for a part of dune habitats because pioneer vegetation might develop in open sand areas, such areas are significant for several species of insects.

Moss (except for expansive) and lichens can be found with at least 20% cover – mosses and lichens are weaker competitors than caulescent plants because they need more light to grow, as well as substrate that is not rich in nutrients, therefore their population is a good indicator of changes in dune habitats.

Proportion of the site area in which expansive moss species do not dominate (*Rhytidiadelphus squarrosus*, *Hylocomium splendens*, *Pleurozium schreberi)* – excessively high proportion of moss which are not characteristic to the habitat might indicate on its degradation.

Functional and process indicators

Intensity of anthropogenic impacts on vegetation, substrate and relief – ideally, there is no anthropogenic impact or it is negligible.

Influence of adjacent habitats on the specific habitat – it can be positive, neutral or negative. This indicator points to ecological functions of habitats and the direction of their development.

Proportion of the site area in which amount of necessary disturbances complies with ecological requirements of the habitat – very significant indicator of dune habitat condition and function as it provides information on a wide set of factors that affect the dunes, as well as indicates habitat stability, quality and necessity of restoration.

Quality of the structure of habitat as a precondition for its function – evaluation depends on the total evaluation of structure and indicators.

Habitat Restoration Possibilities

Restoration possibilities of structure and functions – (evaluated by structure and function conditions, as well as the amount of long-shore drift and hydrological regime) ideally, habitat does not have to be restored; there might be necessity for non-disturbance and control so natural processes can take place; often, however, it is necessary to carry out some biotechnical or technical measures; in significantly degraded habitats it is necessary to make large-scale structure and function restoration measures, including drift movement restoration and/or addition of substrate, as well as optimization of hydrological regime.

Necessity to plan and build recreation and sightseeing infrastructure to maintain and restore the habitat – for example, to divert or divide the flow of visitors, reduce sand erosion, etc., ideally, such measures are not required.

Restoration costs – an important factor for potential habitat restoration possibilities.

All habitats of this group that comply with the minimum quality requirements are restorable, it is more difficult to restore primary dune habitats 2110 *Embryonic shifting dunes* and 2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)* as it is difficult and sometimes impossible to imitate natural accumulation of sands. Restoration results depend on the aforementioned and habitat-specific factors. It should be emphasized that habitats of this group are complex indicators of the quality of marine environment and there may be occasions when local measures do not significantly improve the quality of the targeted habitat.

Threats

Humans have lived at the seashore for a very long time, creating a wide range of anthropogenic pressures. Dune habitats are endangered by mechanical damages – driving, trampling, etc. In the previous decades, significant coastal dune areas in Latvia have been covered with buildings by expanding the existing populated areas (Riga, Saulkrasti, Ventspils, Liepāja, Pāvilosta, coastal villages, etc.) and by erecting country estates in previously vacant territories. Also extraction of sand as a mineral resource directly decreases the amount of material forming the habitats, as well as it rather often destroys the habitat itself. Weakly considered infrastructure of coastal fisheries (access roads, boat houses, fish processing, etc.) in coastal dunes also causes a negative impact that significantly increase the pressure on this habitat group.

Dune formation and restoration, by changing flows of sediments in the sea and rivers, is significantly influenced by construction of underwater structures and breakwaters, artificial strengthening of seashores, construction of dams on the rivers that flow into the sea.

Natural plant community structure alters when areas of invasive and expansive species increase and their population density increases, which reduces the living space to native species and alter conditions that are appropriate to them.

Open dune habitats are threatened by "soft" protection measures of artificial dunes by planting local or alien tree and shrub species. Traditionally, to stabilise and restore primary dunes several willow species have been planted. In the middle of the 20th century *Pinus sylvestris* was planted in the secondary dunes, also alien species – *Pinus mugo*, in some places *Rosa rugosa* and *Eleagnus commutata*, etc.

All habitats of this group in a complex manner are affected by overall environmental eutrophication due to nitrogen deposition (with air pollution) and surface run-off. Local eutrophication is caused by inadequate sanitation infrastructure at popular tourism objects and recreation.

It should be noted that the adverse effects may result from both insufficient and excessive volume of natural or anthropogenic disturbances, for example, erosion might increase or natural processes could begin to cease, both of which negatively affect the habitats.

Management

Management and protection of coastal sand dune and inland dune habitats are extensive and complex, as it must be carried out in a complex manner, in many cases at the international level as local measures may be ineffective. One of the most important factors in ensuring the protection of habitat is quality of planning, which in the sea and at the shore is dealt with the ICZM methods, which include not only environmental protection, but also social, economic and tourism planning.

In majority of cases in order to protect coastal and inland dune habitats, non-intervention in the natural proceses must be ensured, given that the natural processes provide the necessary amount of disturbances – flushing, fires, etc. In cases when the amount of disturbance is not sufficient, dynamic habitats must be conserved by simulating the disturbances. In cases when much degraded habitats are restored, it is necessary to temporarily isolate individual areas of primary or secondary coastal dunes so the habitat can restore. The following habitats must be managed moderately 2140* *Decalcified fixed dunes with Empetrum nigrum*, 2330 *Inland dunes with open Corynephorus and Agrostis grasslands* and part of 2190 *Humid dune slacks* – moderately grazed, mowed, etc., to maintain open certain plant communities and prevent overgrowth of habitats. When restoring part of the dune habitats, it might be necessary to thin out trees and shrubs, including cutting out parts of or all of the planted trees and shrubs.

Primary and secondary dunes can be restored by planting *Ammophila arenaria, Salix daphnoides* and other willow species, creating wickerwork from wickers or branches, using special nets etc. In some cases, several engineering techniques can be applied.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Eberhards, G. (2003) Latvijas jūras krasti (Baltijas jūras Latvijas krasta josla). Morfoloģija, uzbūve, mūsdienu procesi, riska zonas, prognozes, aizsardzība un monitorings. Monogrāfija. Āboltiņš, O. (red.) Rīga, Latvijas Universitāte, 296 lpp.

Eberhards, G. (2004) Jūra uzbrūk! Ko darīt? Rīga, Latvijas Universitāte, 23 lpp.

Eberhards, G., Lapinskis, J. (2008) Baltijas jūras Latvijas krasta procesi. Atlants. Rīga, LU Akadēmiskais apgāds, 64 lpp.

European Environment Agency (EEA) (2006) The changing faces of Europe's coastal areas. European Environmental Agency Report No. 6. Copenhagen, 107 p.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Laime, B., Rove, I. (2000) Pelēko kāpu dabas aizsardzības plāns. Rīga, 42 lpp.

Rove, I. (2001) Pelēko kāpu augu sabiedrības Rīgas līča piekrastē. Maģistra darbs. Rīga, Latvijas Universitāte, 73 lpp.

Rove, I. (2006) Plant Communities of the Grey Dunes along the Gulf of Riga. Publication. Living Marine Resources and Coastal Habitats, edited by Tubielewicz, A., Gdansk, Gdansk University of Technology, Faculty of Management and Economics, EUROCOAST-LITTORAL, 136–141 p.

2110 *Embryonic shifting dunes*

Latvian habitat classification: B 2.1.1.

Syntaxonomy: *Salsolo kali-Honkenyion peploidis, Ammophilion arenariae*.

Definition: formations of the coast representing the first stages of dune construction, constituted by ripples or raised sand surfaces of the upper beach or by a seaward fringe at the foot of the tall dunes.

Specific characteristics of habitat interpretation in Latvia: none.

Distribution: rare, mainly associated with distribution of sandy beaches and more extensively used locations on the seashore. In Latvia, the habitat takes up about 207 ha or 0.003% of the total territory of the country.

Conservation value: natural site for several littoral flora species, including the *Linaria loeselii* specially protected in the European Union and Latvia and insect species, such as *Cicindela maritima.* Embryonic dunes play an important role as a natural barrier protecting the shore and development of coastal habitat complex.

Environmental factors: most important factors are the amount of sand on the beach, dunes and underwater area of the shore, as well as drif flow, wind, height and slope of the beach. Formation of embryonic dunes depends on natural sea coast processes. Formation of embryonic dunes can be observed not only on accumulation shores, but also at the dynamic equilibrium shores where erosion of the coasts interacts with accumulation of sand (*Fig. 2.4.*).

Vegetation characteristics: vegetation of embryonic shifting dunes is very dynamic due to environmental and anthropogenic factors. Often after severe storms dunes are completely eroded; in the next growing season do not develop or on the contrary – due to accumulated sand, develop in relatively large areas. Therefore embryonic dunes in one seashore area are evaluated over the course of several years. The vegetation is poor in plant species. In young and most disturbed embryonic shifting dunes plants often grow dispersed in small groups, creating multi-patch type vegetation (*Fig 2.5.*). Mostly those plant communities belong to the union of *Salsolo kali-Honkenyion peploides.* Denser vegetation is observed in the older dunes where dune grass strengthens their position (*Fig 2.6.*). Vegetation cover may range from a few up to 50–70% or more of the total area of the dune.

Characteristic species: flora – *Honckenya peploides*, *Cakile baltica*, *Salsolo kali*, *Leymus arenarius*, *Festuca arenaria*, *x Calammophila baltica*, *Calamagrostis epigeios*, *Elytrigia x littorea*, *Petasites spurius*, in some places *Ammophila arenaria* and *Carex arenaria*; fauna – *Broscus cephalotes*, *Cicindela maritima*.

Umbrella species (typical species within the meaning of the Habitats Directive): flora – *Honckenya peploides*, *Cakile baltica*, *Salsolo kali*, *Leymus arenarius*, *Festuca arenaria*; fauna – *Broscus cephalotes*, *Cicindela maritima*.

Variants:

2110_1: dominated by *Honckenya peploides*, forming quite

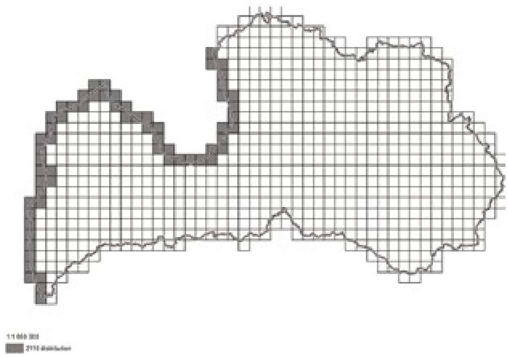


Figure 2.3. Distribution of the habitat 2110 *Embryonic shifting dune*s in Latvia (Conservation status of.., 2013).

Figure 2.4. Formation of embryonic shifting dunes in the upper part of Akmensrags beach. One of the relatively most stable embryonic dune formation sites are dynamic equilibrium coasts (Photo: B. Laime).

dense cover for dune hummocks. It is especially characteristic at shores that have been eroded after storms, as well as sea coast areas where shifting dunes or all the shore is periodically flooded;

2110_2: vegetation mostly consists of *Leymus arenarius* and *Festuca arenaria*, often also *Calamagrostis epigeios*. Usually dunes are low, characteristic to shores that are affected by sand deficit;

2110_3: great diversity of psammophytic grasses, richly developed dune hummocks, characteristic to continuous or periodic accumulation coasts.

Habitat Quality

Minimum habitat requirements: sand hummocks created as a result of wind activity on the seacoast have established and also might be without plant cover or characteristic species (they have not grown, have disappeared or have been destroyed). Embryonic shifting dunes do not include sand banks created by water that often can be observed on higher beaches.

Structural indicators: common structure indicators of coastal and inland dunes, proportion of the area in which there are observable areas with characteristic species of succulents (sea sandwort, sea-rocket and prickly saltwort with high cover) and dune hummocks are present.

Functional and process indicators: overblow of sand (formation of dunes) or amount of disturbance is optimal; wide, high, not free from anthropogenically-influenced sandy beach; proportion of the site area with formation of embryonic dunes in eroded slope of shifting dunes (dynamic equilibrium coastal development); other function indicators of coastal and inland dunes.

Restoration potential and quality improvement indicators: common indicators of coastal and inland dune habitats.

Threats: trampling, mechanical destruction, flooding, soiling, storms, increase of sand deficits, sand flow disturbances due to buildings on the shore and in the sea.

Management: coastal sections where presence of people at

Figure 2.5. Embryonic shifting dunes in Daugavgrīva. Habitat is characterized by mostly sparse vegetation with denser layers of *Honckenya peploides* (Photo: B.Laime).

Figure 2.6. Development of embryonic shifting dunes at the seaside of Ainaži on sand deficit shores (A) and active accumulation coasts in Kolka vicinity (B) (Photo: B.Laime).

the beach and dunes should be limited (at least periodically). In some places it is necessary to take measures for embryonic dune restoration (especially on longer anthropogenically-influenced areas) by spreading branches, planting local species of seaside plants.

Similar habitats: there might be similarities with the habitat 2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)*, varying by the dune bank and smaller amount of succulent halophytic flora than in embryonic shifting dunes. Sometimes in the bordering with the beach, where small hummocks with prickly Saltwort or Sea-Rocket are formed there might be similarity with 1210 *Annual vegetation of drift lines* covered with sand – embryonic dune is not characterized by sediments, but by blown sands.

Overlap with other habitats of EU importance: 1210 *Annual vegetation of drift lines* that establishes as a microhabitat in the embryonic shifting dunes.

Corresponding specially protected habitats in Latvia: none.

Literature

Eberhards, G., Lapinskis, J. (2008) Baltijas jūras Latvijas krasta procesi. Atlants. Rīga, LU Akadēmiskais apgāds, 64 lpp.

Kabanova, I. (2010) Augāja kā indikatora izmantošana kāpu traucējumu ietekmes novērtēšanā. Maģistra darbs. Latvijas Universitāte zin. vad. Brigita Laime, Rīga

Laime, B. (1999) Pludmales un primāro kāpu aizsardzības plāns. Rīga, Latvijas Dabas fonds, 45 lpp.

Laime, B. (2010) Latvijas kāpu un pludmaļu fitosocioloģiskais raksturojums Baltijas jūras reģiona kontekstā. Promocijas darbs. Rīga, LU, 97 lpp.

Spungis, V. (2002) Invertebrates of the sandy coastal habitats in Latvia. Latvijas Entomologs 39, 8–15 p.

Spuņģis, V. (2008) Slīteres nacionālā parka biotopu bezmugurkaulnieku (Invertebrata) fauna un ekoloģija, (mācību materiāli). Rīga, Latvijas Universitātes Bioloģijas fakultāte, 59 lpp.

2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)*

Latvian habitat classification: B 2.1.2.

Syntaxonomy: *Ammophilion arenariae*.

Definition: mobile dunes forming the seaward cordon or cordons of dune systems of the coasts *Ammophila arenaria* (white dunes).

Specific characteristics of habitat interpretation in Latvia: none.

Distribution: rare, more actively forming in approximately half of the total length of the Latvian shoreline, mainly common along the shoreline of Liepāja, Ovīši-Saunags and Rīga-Lilaste. In Latvia the habitat occupies about 558 ha or 0.009% of the total territory of the country. The area of the habitat significantly decreases after major storms.

Conservation value: shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) are the main habitat of littoral psammophytic species of plants, natural sites of such rare species of plants as *Eryngium maritimum*, *Linaria loeselii*, *Lathyrus maritimus*, *Tragopogon heterospermus*, *Anthyllis maritima*, as well as the site for *Cicindela maritima*. Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) have major importance in the formation of a natural barrier and ensuring functioning of the habitat complex in its entirety. At the same time these dunes are high-value landscape resources.

Environmental factors: *shifting dunes along the shoreline with Ammophila arenaria (white dunes)* mainly are characteristic to accumulative coasts (*Fig. 2.8.*). The development to a large extent is determined by the amount of sands on the beach, strength of wind, width and height of the beach, number of embryonic shifting dunes, their vegetation, area and height. The formation of *shifting dunes along the shoreline with Ammophila arenaria (white dunes)* depends on natural coastal processes and drift flows.

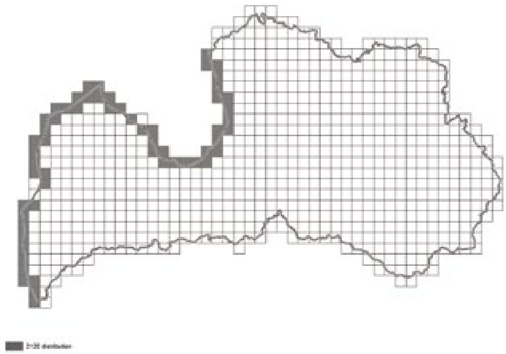


Figure 2.7. Distribution of the habitat 2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)* in Latvia (Conservation status of.., 2013).

Vegetation characteristics: *Gramineae* grass family species, covering the territory very sparsely or very densely, dominate in shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) and their height ranges from 0.5–1.5 m and more. Along the shoreline, where very active sand overblow takes place, *Ammophila arenaria* is most frequent (*Fig. 2.9.*), whereas *Leymus arenarius* dominates along shorelines with sand deficit; communities of *Festuca arenaria* - *Calamagrostis epigeios* develop along the shoreline of dynamic balance. Most frequently *x Calammophila baltica* may be found in new shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (in border zone with embryonic shifting dunes). Vegetation differs in various dune slopes: marram grass and other psammophytic grasses mainly dominate near the sea; on the leeside here is a larger variety of the plant species – *Hieracium umbellatum*, *Anthyllis maritima* and *Artemisia campestris*. Frequently *Salix daphnoides* or *S.viminalis*, as well as *Rosa rugosa*, which have been planted in some places, but mostly have spread by themselves, dominate in shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) (*Fig. 2.10.*).

Characteristic species: flora – *Ammophila arenaria*,

Figure 2.8. Seaside near Pērkone – several banks of shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) form at places with broad zone of embryonic shifting dunes (Photo: B.Laime).

Figure 2.9. Bank of shifting dunes along the shoreline with marram grass *Ammophila arenaria* (white dunes) in Užava (Photo: B.Laime).

Leymus arenarius, *Festuca arenaria*, *x Calammophila baltica*, *Hieracium umbellatum*, *Calamagrostis epigeios*, *Tragopogon heterospermus*, *Anthyllis maritima*, *Lathyrus maritimus*, *Artemisia campestris*, *Honckenya peploides*; fauna – *Myrmeleon formicarius* and *Euroleon nostra*, *Cicindela maritima*.

Umbrella species (typical species within the meaning of the Habitats Directive): flora – *Ammophila arenaria*, *Leymus arenarius*, *Festuca arenaria*, *x Calammophila baltica*; fauna - *Myrmeleon formicarius* and *Euroleon nostras*, *Cicindela maritima*.

Variants: none.

Habitat Quality

Minimum habitat requirements: formed dune bank with at least one characteristic plant species. Habitats where very old marram grass dominates or/and that partly overgrow with shrubs, or in some places the habitat lack of vegetation is applicable as well.

Structural indicators: all common indicators of coastal and inland dune habitats, as well as area that partly is not overgrown, promoting restoration of shifting dune along the shoreline with *Ammophila arenaria* (white dunes) vegetation structure; cover of litter, which shows ageing of the dune and decrease in the number of typical plant species.

Functional and process indicators: sand overblow (formation of dunes) takes place or the extent of disturbance is optimal (young marram grass plants dominate), other common function indicators of coastal and inland dune habitats. Coastal habitats mostly must be evaluated as a complex of habitats. Quality of the shifting dune along the shoreline with *Ammophila arenaria* (white dunes) is higher if it borders embryonic shifting dunes and primary dunes occupy a large, relatively continuous territory.

Restoration potential and quality improvement indicators: all common indicators of coastal and inland dune habitats.

Threats: mechanical influence on dune vegetation, dune destruction under the impact of anthropogenic factors, disruption of the bank of the dune, footpaths, as well as erosion during storms. Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) are also negatively influenced by degradation of adjacent habitats, pollution, including driving along the beach. Constructions along the shoreline and near the sea are one of the most crucial factors. Intensified accumulation of sand or, vice versa, wash-off of dunes take place under their impact.

Management: appointment of coastal sections where presence of people on the beach and dunes should be limited (at least periodically). In some places it is necessary to perform measures aimed at the restoration of dunes, especially in longer sections under anthropogenic impact, using only local plantspecies, for instance, marram grass and/or forming artificial barriers (fences, branch layers, etc.). Periodically it is recomended to clear out the household waste from dunes deposited by wind and water.

Similar habitats: shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) differ from 2110 *Embryonic shifting dunes* with a bank of dunes. Older shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) tend to be similar with habitat 2130 *Fixed coastal dunes with herbaceous vegetation (grey dunes)*, which are characterized by moss and lichen and where low herbaceous vegetation, which is not typical of shifting dunes along the shoreline with *Ammophila arenaria* (white dunes), dominate.

Overlap with other habitats of EU importance: rarely with habitat 1210 *Annual vegetation of drift lines* – differentiated by plant communities and formation of drift lines.

Corresponding specially protected habitats in Latvia: none.

Figure 2.10. European violet-willow *Salix daphnoides* is mainly characteristic to old shifting dunes along the shoreline with Ammophila arenaria (white dunes) and in some places it dominates over dune grass. Seaside of Pape (Photo: B.Laime).

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Eberhards, G., Lapinskis, J., Saltupe, B. (2006) Hurricane Erwin 2005 coastal erosion in Latvia. Vilnius. Baltica 19, 10–19 p.

Laime, B. (1999) Pludmales un primāro kāpu aizsardzības plāns. Rīga, Latvijas Dabas fonds, 45 lpp.

Laime, B. (2010) Latvijas kāpu un pludmaļu fitosocioloģiskais raksturojums Baltijas jūras reģiona kontekstā. Promocijas darbs. Rīga, LU, 97 lpp.

Spungis, V. (2002) Invertebrates of the sandy coastal habitats in Latvia. Latvijas Entomologs 39, 8–15 p.

Spuņģis, V. (2008) Slīteres nacionālā parka biotopu bezmugurkaulnieku (Invertebrata) fauna un ekoloģija, (mācību materiāli). Rīga, Latvijas Universitātes Bioloģijas fakultāte, 59 lpp.

2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)*

Latvian habitat classification: 2.2.1.1.

Syntaxonomy: *Corynephorion canescentis, Koelerion glaucae*.

Definition: fixed dunes, stabilised and colonised by more or less closed perennial grasslands and abundant carpets of lichens and mosses. The vegetation may be a closed cover of grassland, sparse annual grassland on sand or dominated by mosses and lichen; the content of limestone (Ca2+) may vary greatly and is generally diminishing with age and succession toward brown dune systems (dune heathland).

Specific characteristics of habitat interpretation in Latvia: succession where grey dunes gradually overgrow with trees and form into a dune forest is more characteristic; succession of grey dunes in the direction of *Empetrum nigrum* is rare. Along with decrease in management of grey dunes, *Pinus sylvestris* and *Salix* obtain a higher proportion in vegetation.

Distribution: rare, in comparatively longer and broader shore sections, along the shoreline of the Baltic Sea, whereas in shorter and narrower sections – along the shoreline of the Gulf of Riga. In Latvia the habitat occupies approximately 1 171 ha or 0.018% of the total territory of the country.

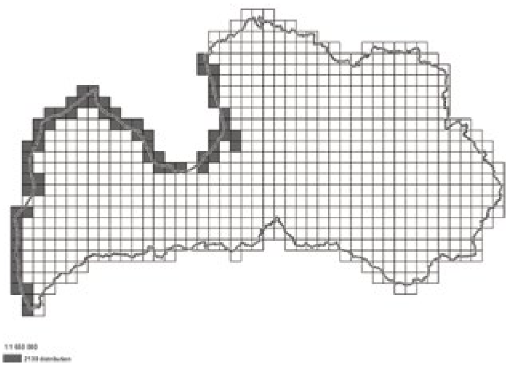


Figure 2.11. Distribution of the habitat 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)* in Latvia (Conservation status of.., 2013).

Conservation value: a rare habitat, which stands out with high diversity of species and plant communities (*Fig. 2.12.*), main habitat for *Dianthus arenarius s.l.*, *Alyssum gmelinii*, *Pulsatilla pratensis*, *Eryngium maritimum*, *Psophus stridulus*, *Oedipoda coerulescens*, *Bufo calamita*, *Lullula arborea* and other rare species; a habitat, which represents a biologically varied dune succession stage and is a significant element of the shoreline`s natural, as well as heritage landscape.

Environmental factors: the habitat is significantly influenced by the dune topography, substratum and exposition (leeside slopes, slopes directed towards the South have drier vegetation conditions). The habitat is favourably influenced by periodical disturbances (sand movement, sandy beaches and shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)) that restore and maintain the vegetation in a specific stage of succession. Formation of soil is characteristic to the habitat that in its turn depends on the management and eutrophication level of environment.

Vegetation characteristics: vegetation is lower than on *shifting dunes along the shoreline with Ammophila arenaria (white dunes)*. Grass, sedge and lichens mainly dominate in the habitat. Grey dunes may differ, depending on coastal processes and geographic disposition of the shore, as well as adjacent habitats, succession pace and stage. Large areas may be covered only with mosses or lichens, especially in primary succession stages or places with strong sand movement or that are facing the South, and there is a very xerophyte environment (*Fig. 2.13.*). In the case of optimal disturbances, vegetation has a mosaic structure, low caulescent plant cultivation units interchange with mosses and lichens, there is a broad diversity of plant species. *Carex arenaria*, *Festuca sabulosa*, *Calamagrostis epigeios* and other species often dominate on leeside slopes of eutrophied areas that have been subject to slight disturbances. Vegetation with high and dense sward

Figure 2.12. Grey dunes in Pāvilosta – characterized by rich diversity of lichens, mosses and herbaceous vegetation (Photo: B.Laime).

develops there; the number of species is low. Along with ageing of the grey dunes and lack of dune management, the proportion of trees and shrubs increases. A zone of gradual transition from shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) and grey dunes may be frequently observed. In such cases the proportion of mosses and low herbaceous vegetation may be one of the indicators for determining the relative boundaries of the grey dunes. Areas overgrown with trees and shrubs have been rapidly increasing over a period of the past twenty years. Frequently along the shoreline one may observe a landscape with flat dune areas interchanging with clusters of trees and shrubs, sparse or even rather dense pine-stands.

Characteristic species: herbaceous vegetation – *Festuca sabulosa*, *Carex arenaria*, *Hieracium umbellatum*, *Corynephorus canescens*, *Koeleria glauca*, *Dianthus arenarius s.l.*, *Astragalus arenarius*, *Thymus serpyllum*, *Pulsatilla pratensis*, *Alyssum gmelinii*, *Epipactis atrorubens*, *Artemisia campestris*, *Jasione montana*; mosses – *Polytrichum juniperinum*, *P. piliferum*, *Brachythecium albicans*, *Syntrichia ruralis*, *Racomitrium canescens*, *Ceratodon purpureus*; lichen – *Cetraria spp.*, *Cladonia spp.*, *Peltigera spp.*; fauna – *Lullula arborea*, *Oedipoda coerulescens*, *Myrmeleotettix maculatum*, *Psophus stridulus*, *Sciocoris cursitans*, *Opatrum sabulosum*, and *Melanimon tibiale*, *Gronops inequalis*, and *Barynotus obscurus*.

Umbrella species (typical species within the meaning of the Habitats Directive): herbaceous vegetation - *Festuca sabulosa*, *Carex arenaria*, *Corynephorus canescens*, *Koeleria glauca*, *Dianthus arenarius s.l.*, *Thymus serpyllum*, *Pulsatilla pratensis*, *Alyssum gmelinii;* mosses – *Syntrichia ruralis*, *Racomitrium canescens*, *Ceratodon purpureus*; lichen – *Cetraria spp.*, *Cladonia spp.*, *Peltigera spp.*; fauna – *Lullula arborea*, *Oedipoda coerulescens*, *Myrmeleotettix maculatum*, *Sciocoris cursitans*, *Opatrum sabulosum* and *Melanimon tibiale*, *Psophus stridulus*, *Gronops inequalis*, and *Barynotus obscurus*.

Variants:

2130*_1: Grey dune with sparse vegetation where such pioneer species as *Corynephorus canescens*, *Jasione montana*

Figure 2.13. Grey dunes in the surroundings of Pāvilosta – vegetation is formed by plant communities that are capable of existing in extremely dry vegetation conditions (Photo: B.Laime).

Figure 2.14. Grey dune with a relatively stable vegetation slope with out-blown sand along the seaside of Užava (Photo: B.Laime).

or *Carex arenaria* dominate. It is characteristic to places where rather active sand movement or trampling periodically takes place.

2130*_2: Grassland-type grey dune where *Thymus serpyllum*, dune grasses and mosses are frequently encountered.

2130*_3: Typically xerophytic grey dune characterized by large amounts of *Epipactis atrorubens, Astragalus arenarius*, *Koeleria glauca*, *Syntrichia ruralis* and lichen.

Habitat Quality

Minimum habitat requirements: dominated by herbaceous-lichen vegetation, situated in the complex of other coastal habitats; at least three characteristic species are present. Also secondary dune habitats, which are dominated by *Carex arenaria*, *Calamagrostis epigeios*, *Leymus arenarius*, *Ammophila arenaria* or another expansive plant species, or invasive plant species or the majority of the dune vegetation has been destroyed; however, there is a possibility for the grey dune with herbaceous vegetation to develop.

Structural indicators: common indicators of all coastal and inland dune habitats, as well as cover of mosses and lichens that is a significant characteristic of the grey dune vegetation.

Function indicators: continuous required management – preservation (for instance, pasturage/mowing, etc.), sufficient of the disturbances (optimal disturbance, for instance, sand movement, proportion of pioneer plant communities), areas that have not been overgrown are mainly formed by windblown depressions (*Fig. 2.14.*), other common function indicators of coastal and inland dune habitats.

Restoration potential and quality improvement indicators: common indicators of coastal and inland dune habitats.

Threats: lack of required regular moderate (favourable) disturbances (grazing, mowing, trampling or other factors limiting the area of vegetation and/or the height and vitality). There is also the threat of overgrowing with trees and shrubs or/and too excessive anthropogenic pressure.

Management: mowing, grazing, cutting down of trees and shrubs, limitation of alien/aggressive species; removal of the viable ground cover and/or the topsoil; improving recreational infrastructure of dunes. Management measures must be evaluated and selected, depending on the territory and the situation, taking into account culture and history, as well as development of the specific site.

Similar habitats: the habitat may be differentiated from the habitat 2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)*, based on the domination of moss, lichen or low herbaceous vegetation in ground cover. The habitat may be differentiated from the habitats 2140* *Decalcified fixed dunes with Empetrum nigrum* and 2170 *Dunes* *with Salix repens ssp. argentea (Salicion arenariae)*, based on *Empetrum nigrum* or *Salix repens ssp. argentea (Salicion arenariae)* that occupies at least 25% of the habitat. The habitat may be similar to habitat 6120* *Xeric sand calcareous grasslands*, but the origin of grey dunes is related to coastal processes.

Overlap with other habitats of EU importance: rarely with habitat 1210 *Annual vegetation of drift lines*, which differs based on plant communities and formation of drifts.

Corresponding specially protected habitats in Latvia: 6.6. Fixed coastal dunes with herbaceous vegetation (grey dunes).

Literature

Biseniece, E. (2012) Veģetācijas telpiskā struktūra Papes, Akmensraga un Daugavgrīvas pelēkajās kāpās. Maģistra darbs. Latvijas Universitāte, zin. vad. G.Brūmelis. Rīga

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Laime, B., Tjarve, D. (2009) Grey dune plant communities (KoelerioCorynephoretea) on the baltic coast in Latvia. Tuexenia. Göttingen. 29, 409–435 p.

Laime, B. (2010) Latvijas kāpu un pludmaļu fitosocioloģiskais raksturojums Baltijas jūras reģiona kontekstā. Promocijas darbs. Rīga, LU, 97 lpp.

Laime, B., Rove, I. (2000) Pelēko kāpu dabas aizsardzības plāns. Rīga, 42 lpp.

Mizga, L. (2009) Pelēko kāpu veģetācijas struktūra dabas liegumā „Pāvilostas pelēkā kāpa", Bakalaura darbs. Latvijas Universitāte, zin. vad. B.Laime. Rīga

Rove, I. (2001) Pelēko kāpu augu sabiedrības Rīgas līča piekrastē. Maģistra darbs. Rīga, Latvijas Universitāte, 73 lpp.

Spungis, V. (2007) Fauna and ecology of Grasshoppers (Orthoptera) in the coastal dune habitats in Ziemupe Nature Reserve, Latvia. Latvijas Entomologs 44, 66–76 p.

2140* *Decalcified fixed dunes with Empetrum nigrum*

Figure 2.15. Stands of low scrubs with groups of trees (Photo: I.Rove).

Latvian habitat classification: partly B.2.2.1.2., F.7.1.

Syntaxonomy: *Empetrion nigri*.

Definition: decalcified dunes (*Fig. 2.15.*) colonized by *Empetrum nigrum* heaths of the coasts.

Specific characteristics of habitat interpretation in Latvia: none.

Distribution: very rare – distributed in lines parallel to the seacoast or forming inclusions within the communities of habitat 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)*. Width of the habitat line in the Gulf of Riga about 1–5 m, along the open shore of the Baltic Sea on average 5–10 m, very rarely – lines and polygons are wider than 10 m. The longest sections so far have been located on the coast of the Baltic Sea and along the Strait of Irbe: the surrounding area of Ventspils, Pāvilosta, Jūrkalne, Šķēde and Kolka, along the shore of the Gulf of Riga between Upesgrīva and Roja, Ragaciems, southern part

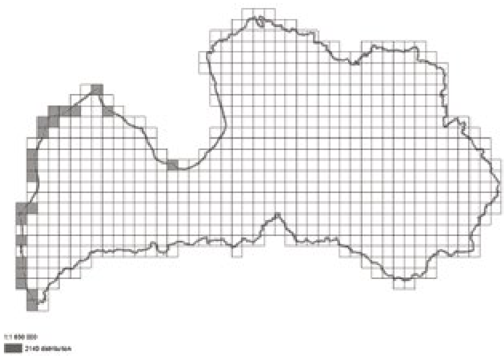


Figure 2.16. Distribution of the habitat 2140* *Decalcified fixed dunes with Empetrum nigrum* in Latvia (Conservation status of.., 2013).

of the Gulf of Riga, etc.

Conservation value: matches all of the most significant factors of the heath habitat group; it is a very rare habitat (~0.001% of the total land territory of Latvia) and it forms primarily in natural conditions, so far in Latvia has been identified in total area of 66 ha (Conservation status of.., 2013). At the beginning of the 20th century, the habitat could be encountered in larger areas, as the extent of open sand areas was significantly higher than nowadays. *Dianthus arenarius s.l.*, *Pulsatilla pratensis*, very rarely *P.patens* and other rare and especially protected natural sites of plant species may be encountered in dry heaths. The habitat is a significant living and feeding site for various invertebrate species exclusively specific to dune habitats. Heath form a part of visually high-value landscapes characteristic to Latvia. Nowadays the habitat does not have a special social and economic importance, but in certain historical periods it was used as pastureland for livestock and bees.

Environmental factors and processes with a functional role: existence of the habitat requires relatively stable decalcified sand, low in nutrients. Active processes of soil podsolization and accumulation of humus take place. Climate, height above the sea level, pH of substratum and water permeability are significant factors. Over time heaths form and preserve a specific local microclimate.

The habitat forms in extremely dry growing conditions, low scrubs naturally overgrows open secondary dune cenosis – primary succession takes place. In natural conditions, in absence of disturbances, the habitat overgrows and in most cases transforms into a pine-tree forest, including *Wooded dunes of the Atlantic, Continental and Boreal region* (2180). In separate cases, especially close to populated areas, the habitat forms on a secondary basis as areas overgrow due to disturbances of various extents. Lack of nutrients and presence of moderate disturbances are a significant factor for sustained existence of the habitat. Recreation delays overgrowing of the habitats situated close to populated areas. During 20th century on some parts of the open Baltic Sea coast the overgrowth of the habitat have been delayed by defence routines – regular patrols along the former USSR border created the necessary disturbances, thus delaying the transformation from dune to forest habitats. In historically more distant periods, overgrowing of the habitat was delayed by moderate grazing.

The habitat may be washed off in strong storms. Under the impact of a very strong wind, the habitat may be covered with sand, as well as deflation depressions may be formed.

Vegetation characteristics: the vegetation that is characteristic to the habitat is formed by low scrubs – *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Calluna vulgaris* and *Vaccinium vitis-idaea* – in various combinations and stands of a single species. Frequently with groups of *Pinus sylvestris*, *Juniperus communis*, *Lonicera caerulea var. pallasii*, *Salix spp.* (*Salix repens*, *S. rosmarinifolia*). Characterized by pine-trees with low, creeping lower branches that frequently form if the tree is partly covered with sand. There may be sparsely (park-type) growing trees in the habitat, as well as tree groups, mainly formed by *Pinus sylvestris*. Cover of trees and shrubs does not exceed 70% and they are not the main producers of organic material.

Depending on the age of the habitat and extent of disturbances, the vegetation varies from unlinked, with explicit mosaic-type structure (*Fig. 2.17.*) where the patches may be formed by open sand and xerophyte pioneer vegetation, as well as mosses and lichens up to mono-dominant low scrubs of one specie and similar age. Annual plants and dune grasses characteristic to sands may be found. Height of ground cover varies, but in most cases the height of herbaceous vegetation does not exceed 20 cm. Habitats with high ratio of biologically old heaths open areas are formed in vegetation following the withering of the heaths. The plant communities of the habitat is a transition form from

Figure 2.17. Vegetation with a mosaic structure (Photo: I.Rove).

Figure 2.18. Concentric inclusion of Arctostaphylos uva-ursi and *Salix spp.* in fixed coastal dunes with herbaceous vegetation (grey dunes) (Photo: I.Rove).

Fixed coastal dunes with herbaceous vegetation (grey dunes) (2130*) to ecosystems rich in nutrients, therefore the plant communities typical to the habitat are very diverse and frequently with characteristics of ecologically related adjacent habitats. It is possible to distinguish several sub-groups of the habitat – both sparse low scrubs with characteristics of the grey dunes and pure stands of *Arctostaphylos uva-ursi* or stands of *Salix spp*. that form concentric inclusions in other communities of open secondary dunes (*Fig. 2.17.*), also a line of low scrubs parallel to the shoreline or monodominant stands of *Calluna vulgaris.*
Mosses, for instance, *Racomitrium spp*., *Ceratodon purpureus*, as well as lichens: *Cladonia spp*., *Cladina spp.*, *Stereocaulon spp*., *Peltigera canina* and *Cetraria spp*. have a significant role in plant communities.

Characteristic species: low scrubs – *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Calluna vulgaris*, *Vaccinium vitis-idaea*; vascular plants – *Carex arenaria*, *Thymus serpyllum*, *Dianthus arenarius s.l.*, *Festuca sabulosa*, *Koeleria glauca*, *Jasione montana*, etc.

Umbrella species (typical species within the meaning of the Habitats Directive): *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Calluna vulgaris* (including various phases of age), *Vaccinium vitis-idaea*; vascular plants – *Carex arenaria*, *Festuca sabulosa*, *Koeleria glauca*; moss: *Racomitrium spp*.

Variants: none.

Habitat Quality

Minimum habitat requirements: open secondary dunes with at least 25% low scrub cover where the proportion of trees and shrubs do not exceed 70% and they are not the main producers of organic material.

Structural indicators: all criteria significant for seaside or inland dune habitat group, as well as *areas free from low scrubs and greater width of the habitat site (m), measuring perpendicularly to the shoreline (adding 0.5 m to each side of the concentration sites of low scrubs),* as it ensures place for the development of vegetation. In addition *proportion of the area of the site where the cover of grasses does not exceed 25%* is evaluated. In ideal case *heather in the site have a various age structure and saturation of plant species (number of plant species per nine square metres selected at the best place)* is high within the site. Lower quality of the habitat is evident by *cover of trees above 20%* and *cover of shrubs above 10% of total area of the habitat.* Proportion of the area of site where *mosaic-type structure that is characteristic to the vegetation*, as well as *area free from overgrowth* is not evaluated, because these indicators mostly are characteristic in all cases.

Function and process indicators: all criteria significant to shoreline and inland dune habitat group, as well as *greater distance of the site to intensive agriculture lands* and *greater total area of the habitat within the site under consideration*, as both factors ensure undisturbed occurrence of natural processes.

Restoration potential and quality improvement indicators: determined by all criteria significant to shoreline and inland dune habitat group. Based on overall evaluation, low scrubs characteristic to dry growing conditions have quite good restoration possibilities, compared to mire and other wetland habitats. Impact caused by dynamic shoreline processes must be taken into consideration upon the restoration of a habitat.

Threats: nowadays overgrowing is the main threat to habitats as the extent of required disturbances (sand movement, deflation depressions, partial washing off during storms, etc.), moderate and sporadic grazing decreases, as well as all threats characteristic to the habitat group of moors (see Chapter 4). In separate cases environmental conditions are so dry that the habitat may remain bare for a long period of time. No historical and cultural traditions for the management of low scrubs have remained in Latvia.

Management: all management measures of the habitat group of moors, if the impact caused by storms, wind and sand movement does not create sufficient disturbances. As the habitat forms in extremely dry growing conditions, management may be carried out once per several years, because accumulation of nutrients and the overgrowing process take place very slowly. The best management type must be determined separately in each case, observing local characteristics. Considering the limited knowledge about the habitat, evaluation monitoring of management efficiency should be implemented in all cases.
Grazing may cause nutrient build-up within the environment, therefore moderate grazing or mechanically created disturbances without adding additional nutrients is preferable.

Similar habitats: it may be difficult to distinguish from 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)*, 2170 *Dunes with Salix repens ssp. argentea (Salicion arenariae)* and 2180 *Wooded dunes of the Atlantic, Continental and Boreal region*; if the area subject to evaluation is a secondary dune in Coastal Lowlands, at least 25% of the site is covered with low scrubs, the proportion of trees and shrubs does not exceed 70% and they are not the main producers of organic material, there are no *Salix spp.* or the cover formed by them does not exceed 25%, the area is classified as habitat 2140* *Decalcified fixed dunes with Empetrum nigrum*. The habitat may be mixed up with 2320 *Dry sand heaths with Calluna and Empetrum nigrum* and 4030 *European dry heaths* – in this case habitats must be identified according to their location: *European dry heaths* (4030) are located only outside the Coastal Lowlands, whereas *Dry sand heaths with Calluna vulgaris and Empetrum nigrum* (2320) is located within the Coastal Lowlands, but never on secondary dunes in direct proximity of the sea.

Overlap with other habitats of EU importance: the habitat may overlap with habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands*, but it must be distinguished as a separate habitat only in such cases when it occupies by 0.1 ha larger continuous area and ground cover is mainly formed only by heather; in all other cases juniper groups are a natural component of habitat 2140* *Decalcified fixed dunes with Empetrum nigrum*.

Corresponding specially protected habitats in Latvia: 6.10. Decalcified fixed dunes with *Empetrum nigrum*.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Laime, B., Rove, I. (2000) Pelēko kāpu dabas aizsardzības plāns. Rīga, 42 lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Rove, I. (2001) Pelēko kāpu augu sabiedrības Rīgas līča piekrastē. Maģistra darbs. Rīga, Latvijas Universitāte, 73 lpp.

Rove, I. (2006) Plant Communities of the Grey Dunes along the Gulf of Riga. Publication. Living Marine Resources and Coastal Habitats, edited by Tubielewicz, A., Gdansk, Gdansk University of Technology, Faculty of Management and Economics, EUROCOAST-LITTORAL, 136–141 p.

2170 *Dunes with Salix repens ssp. argentea (Salicion arenariae)*

Latvian habitat classification: B 2.2.1.2.

Syntaxonomy: Mosaic-type *Salicion arenariae* with *Koelerion glaucae*.

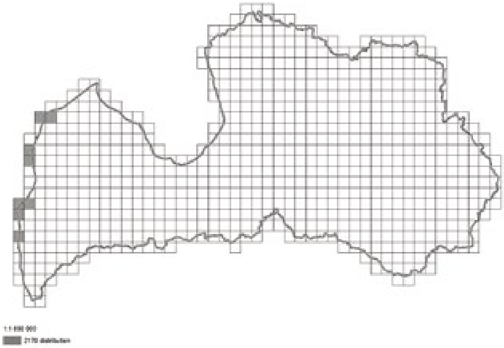


Figure 2.19. Distribution of the habitat 2170 *Dunes with Salix repens ssp. argentea (Salicion arenariae)* in Latvia (Conservation status of.., 2013).

Definition: *Salix repens* communities, colonizing wet dune slacks. Following the lowering of the ground water table or accumulation of drift sand, these communities may develop into mesophilous communities as the *Pyrolo-Salicetum* (with *Pyrola rotundifolia*, *Monotropa hypopitys*) or, into xerophilous *Salix* communities.

Specific characteristics of habitat interpretation in Latvia: secondary dune communities with *Salix repens* and *S.rosmarinifolia.* Depressions in-between dunes with *Salix spp.* have not been researched extensively; therefore xerophytic willow communities have been described for the time being.

Distribution: very rare – along the shoreline of the Baltic Sea, mainly in the surroundings of Užava. In Latvia the habitat occupies about 66 ha or 0.001% of the total territory of the country.

Conservation value: a very rare habitat with diverse and peculiar vegetation structure that is a development stage in one of succession variants of the shoreline dunes. Main habitat of several protected plant species, including *Dianthus arenarius s.l.*, *Alyssum gmelinii* and *Pulsatilla pretensis*. A significant shoreline landscape element and bio indicator for shoreline processes.

Environmental factors: humidity is one of the determinant factors that is significantly influenced by the depth of groundwater, substratum (well-drained) and microtopography. Relative sand deficit and dryness that delay development of herbaceous vegetation are favourable for the development of vegetation of *Salix spp.* (*Fig. 2.20.*). Along with the ageing of the habitat, light conditions and adjacent habitats (especially proximity of wooded dunes) have major importance.

Vegetation characteristics: a mosaic structure is mainly characteristic of the habitat, where small areas of *Salix repens* and dune hummocks of *S.rosmarinifolia* interchange with sparse herbaceous-lichen vegetation, and in some places with *Arctostaphylos uva-ursi* layers (*Fig. 2.21.*). Continuous vegetation formed by *Salix spp.* together with *Empetrum nigrum*, and other plants, frequently with lone-standing *Pinus silvestris* or even their stands (*Fig. 2.17.*). Vegetation of creeping willow is one of the succession stages of dunes. Along with increase of the proportion of Scots pine or cessation of sand movement, willow shrubs begin to perish.

Characteristic species: shrubs, low scrubs – *Salix repens*, *S.rosmarinifolia*, *Arctostaphylos uva-ursi*; herbaceous vegetation – *Koeleria glauca*, *Astragalus arenarius*, *Alyssum gmelinii*, *Dianthus arenarius s.l.*, *Epipactis atrorubens*, *Festuca sabulosa Pulsatilla pratensis*, *Thymus serpyllum*; mosses – *Ceratodon purpureus*, *Ditrichum flexicaule*, *Syntrichia ruralis*; lichens – *Diploschistes muscorum*, *Cetraria aculeata*, *Cladonia spp.*; fauna – *Oedipoda coerulescens*, *Myrmeleotettix maculatum*, *Sciocoris cursitans*, *Cicindela maritima*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Salix repens*, *S.rosmarinifolia*; fauna – *Oedipoda coerulescens*, *Myrmeleotettix maculatum*, *Sciocoris cursitans*, *Cicindela maritima*.

Variants: none.

Habitat Quality

Minimum habitat requirements: secondary dune where willow (creeping willow, rosemary willow) occupy at least 25% of the vegetation cover, whereas tree cover is less than 50% and low scrubs cover is less than 25%.

Structural indicators: all common indicators of shoreline and inland dune habitats, as well as *Salix spp.* cover, *Salix spp.* of various age, vegetation with mosaic-type structure, area without overgrown sites, cover of trees and shrubs, dry willow shrubs.

Function indicators: sufficient disturbances (optimal disturbance, for instance, sand movement, proportion of dry willow), other common function indicators of shoreline and inland dune habitats.

Restoration potential and quality improvement indicators: all common indicators of shoreline and inland dune habitats.

Threats: overgrowing with pine-trees, European violet-willow, invasive plant species; constructions along the shore, sand deficit at the beach.

Management: cutting down of trees and other shrubs, ensuring favourable disturbance (by creating open areas without vegetation), prevention of planning any type of constructions within the habitat or near the habitat, especially between the habitat and the sea.

Figure 2.20. Habitat with *Salix spp.* in very xerophytic growing conditions in grey dunes in the surrounding area of Užava (Photo: B.Laime).

Figure 2.21. Grey dunes in the surrounding area of Užava – mosaic of the habitat vegetation is formed by *Salix spp*., herbaceous-lichen vegetation and pine-tree communities (Photo: K.Goba).

Figure 2.22. With the decrease of disturbances, grey dunes overgrow with continuous willow, low scrubs and pine-trees (Photo: B.Laime).

Similar habitats: Habitat 2140* *Decalcified fixed dunes with Empetrum nigrum* where low scrubs forms at least 25% of the total vegetation, whereas *Salix spp.* occupies not less than 25% of the vegetation cover. Habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* where *Pinus sylvestris* cover exceeds 50%, there are differences within the structure of vegetation and characterising species.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 6.9. Grey dunes with creeping willow *Salix repens*.

Literature

Isoda, A. (2009) Veģetācija pelēkajās kāpās ar ložņu kārklu *Salix repens* Latvijā. Bakalaura darbs. Rīga, Latvijas Universitāte, 37 lpp.

Isoda-Krasovska, A. (2011) Veģetācijas telpiskās struktūras un floristiskās daudzveidības savstarpējā ietekme Užavas piekrastē. Maģistra darbs. Latvijas Universitāte, zin. vad. B. Laime, G.Tabors. Rīga

Laime, B. (2010) Latvijas kāpu un pludmaļu fitosocioloģiskais raksturojums Baltijas jūras reģiona kontekstā. Promocijas darbs. Rīga, LU, 97 lpp.

Laime, B., Rove, I. (2000) Pelēko kāpu dabas aizsardzības plāns. Rīga, 42 lpp.

Laime, B., Tjarve, D. (2009) Grey dune plant communities (Koelerio-Corynephoretea) on the baltic coast in Latvia. Tuexenia. Göttingen. 29, 409–435 p.

2180 *Wooded dunes of the Atlantic, Continental and Boreal region*

Latvian habitat classification: partly F.1.1., also in lowland relief: F.1.2., F.1.3., F.1.5., F.2.1.–F.2.4., F.4.5.

Syntaxonomy: *Dicrano Pinion*, in small areas also *Piceion abietis*, *Alnion glutinosae, Alnion incanae*.

Definition: natural or semi-natural forests (long established) of the Atlantic, Continental and Boreal region coastal dunes with a well developed woodland structure and an assemblage of characteristic woodland species (*Fig. 2.24.*). Pioneer stages are open forests with *Betula spp*. and *Crataegus monogyna*, mixed forests with *Fraxinus excelsior*, *Quercus robur*, *Ulmus minor* and *Acer pseudoplatanus* or, in wet dune slacks, pioneer forests with *Salix alba* which develop into humid mixed forests or marsh forests. Plant species are highly varied and depend on local site conditions. This habitat type includes semi-natural forests with a typical undergrowth, spontaneously developed from old plantations.

Specific characteristics of habitat interpretation in Latvia: the habitat is situated only in the Coastal Lowlands, enclosed from inland by the ancient seaside slope of the Baltic Ice Lake (*Fig. 2.1.*). The habitat includes separate dunes covered with a forest, compact dune groups and broad massifs of dunes where dunes are connected with flat and wavy wind overblow areas of various width and dune depressions of various forms. Also included in the habitat:

– inclusions of other habitats less than 0.1 ha, including wet habitats that have developed in dune depressions;
– up to 30 m wide, waterlogged depressions with shrubs or waterlogged forests if they form a unified wooded seaside dune complex;
– up to 3 ha large cultivation units of birch, grey alder, black alder, mixed tree and mirey forests, shrubs, *Myrica gale* if they form a part of a unified wooded seaside dune complex;
– openings, wind-throws, burning sites clearings, young forest stands and degraded sites if their total area does not exceed 10% of the entire habitat, and at the same time they are characterized by conditions and species corresponding to the habitat, as well as they form a part of a unified wooded seaside dune complex.

Watercourses, bodies of water and their shore zones are not included within this habitat.

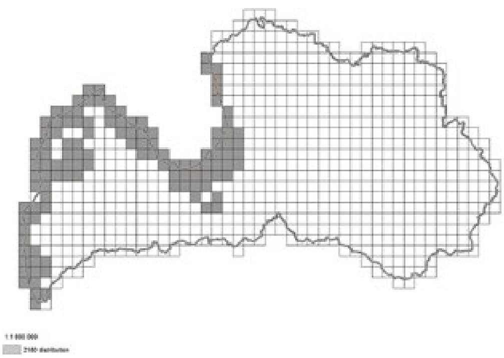


Figure 2.23. Distribution of the habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* in Latvia (Conservation status of.., 2013).

Distribution: Rare, only in Coastal Lowlands (*Fig. 2.1.*). Concentration sites of the habitat correspond with the location of the largest Baltic Sea dune field locations of the previous development stages: Bernāti, the surrounding area of Kolka, section between Engure and Ragaciems, Southern part of the Gulf of Riga, Saulkrasti, etc. Wooded seaside dunes may be encountered in the entire distribution area of aeolian sediments related with the development of the Baltic Sea – up to the ancient seashore of the Baltic Ice Lake.

Conservation value: a rare habitat – occupies 0.9% of the entire land territory of Latvia or 60,000 ha of the total area. On the seashore the respective habitat may be found comparatively regularly, but it radically varies in terms of its quality. Dunes are a natural defence zone of the inland area, protecting the inland area from dynamic processes along the shoreline.
Wooded dunes possess a high ecological value, determined by relief, hydrological conditions and also diversity of micro-

Figure 2.24. Wooded coastal dunes in Plieņciems (Photo: I.Rove).

climate that create broad diversity of communities within a comparatively small area. Old, non-disturbed, naturally thinned pine-tree forests with a natural structure and diverse floristic composition are of special importance. In some places the habitat has formed primarily from naturally overgrowing secondary dunes which correspond to and point to processes taking place in primeval conditions.

Wooded dunes are a significant natural site for rare and protected plant species – *Dianthus arenarius s.l.*, *Pulsatilla patens*, *Lycopodium spp.*, *Diphasiastrum spp*. It is a significant habitat and feeding site for specially protected invertebrates – *Nothorhina muricata*, *Ergates faber*, *Tragosoma depsarium* and birds – *Columba oenas*, *Lullula arborea*. The habitat is very important for several species of (*Buprestidae*) and *Bembix rostrata*.

Latvia is one of the few European Union countries where natural dunes covered with forests can be found; also the wooded dune habitats have not been transformed. In Latvia wooded dunes hold 6.5% of the total area of the habitat in Boreal Biogeographic region that is regarded as a very high indicator for such a small country as Latvia. Comparatively high distribution of habitats is determined by geomorphological conditions in Latvia, especially the historical development of the Baltic Sea.

The habitat forms a visually high-value shoreline landscape characteristic to Latvia. It has high and diverse social and economic importance: in recreation, sports, tourism, logging, all season and seasonal construction, etc. Wooded dunes are a significant object in Latvian art in the 20th and 21st centuries. The habitat has been described in written sources of various historical periods, including legends and chronicles. During war dunes were important in surveillance and arrangement of war positions. Nowadays separate dunes are being used in military training. Fishing villages, cemeteries, as well as villages covered with sand and other objects possess a high aesthetic, as well as cultural and historical value.

Environmental factors and processes with a functional role: Existence of the habitat is determined by aeolian sediments and their thickness. Forests form both on separate dunes of various forms, compact dune groups of various forms and homogeneous dune fields where aeolian sediments form a thick layer – dune depressions are dry, there may be flat or wavy sand overflow, plains of various sizes, between dunes. The habitat may be uneven field of dunes covered with forests – a complex where aeolian sediments have various thicknesses and where both dry and waterlogged dune depressions may be found (a natural wet component of dunes) or there may be various size flat or wavy sand overflow plains between dunes.

Wooded dunes are almost completely fixed where sand movement may be caused only by especially powerful storms. Their impact may be intensified by various anthropogenic factors. Such as logging of various intensity; recreation or construction may cause local erosion either by completely or partly destroying the vegetation.

These forests form on sand or podzolic soil, sod may accumulate in wetter depressions and gleying of soil. Nevertheless, in all cases sand determines formation of the environment. Therefore dry growing conditions, lacking nutrients, dominate. Rather broad diversity and the differences in humidity conditions are determined by dunes of various height as well as humidity conditions of dune depressions.

Pine-tree forests are well-lit – with sparse tree and shrub layer.

Dune relief creates surfaces, exposed directly to the sun that in a comparatively small area create different lighting and temperature conditions, as well as different wind impact. Microclimate diversity is ensured by dune interchange with waterlogged depressions.

In order to reduce accumulation of soil and to prevent the formation of irregular herbaceous vegetation and overgrowing with *Picea abies* and other trees, natural disturbances are necessary for long-term existence of the habitat – storms, fires, moderate walking and other disturbances, characteristic to all dry coniferous tree forests. In the case of lack of natural disturbances, the habitat becomes richer in nutrients and transforms into forests rich in nutritional substances.

Vegetation characteristics: pine-tree dry site forests with explicit forest stand structure and ground cover typical of the habitat dominate. Oligotrophic and mezzo-oligotrophic *Pinus sylvestris* plant communities where the tree layer is dominated by pine-trees, more rarely by *Picea abies*. Corresponds to *Vaccinio - Piceetea* class. The layer of shrubs is usually sparse, but in some case it may be explicit. *Juniperus communis* may frequently be found within the shrub layer. Plant species characteristic to pine-tree dry site forests are mainly encountered within the layer of herbaceous vegetation. Moss and lichen ground cover layer is similar to that of dry coniferous tree forests, but areas of bare soil may develop on steep slopes, which become the growing site for pioneer species. Patches of *Cladonia spp*. and *Cladina spp*. form in especially dry conditions.

Natural thinning takes place in biologically old pine-tree stands and it is followed by renewal – a mosaic of plant communities is formed. In natural conditions structure of the vegetation is determined by various disturbances that are similar to all dry coniferous tree forest habitats (see Chapter 9).

Characteristic species: *Pinus sylvestris*, *Juniperus communis*, *Vaccinium vitis-idaea*, *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Calluna vulgaris*, *Vaccinium myrtillus*, *Chimaphila umbellata*, *Festuca ovina*, *F. sabulosa*, *Koeleria glauca*, *Silene nutans*, *Thymus serpyllum*, *Dianthus arenarius s.l.*, *Pulsatilla patens*, *P.pratensis*, *Diphasiastrum complanatum*, *Trommsdorfia maculata*, *Lerchenfeldia flexuosa*, *Pleurozium schreberi*, *Hylocomium splendens*, *Polytrichum juniperinum*, *P.piliferum*, *Cladonia spp*., *Cetraria islandica*, *Cladina spp*., as well as *Nothorina Nothorhina muricata*, *Ergates faber*, *Tragosoma depsarium*, *Chalcophora mariana*, *Laphria gibbosa*, *Dryocopus martius*, *Lacerta agilis*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Arctostaphylos uva-ursi*, *Festuca ovina*, *F.sabulosa*, *Thymus serpyllum*, *Dianthus arenarius s.l.*, *Pulsatilla patens*, *P.pratensis*, *Diphasiastrum complanatum*, *Cladonia spp*., *Cladina spp*., as well as *Nothorina Nothorhina muricata*, *Ergates faber*, *Tragosoma depsarium*, *Chalcophora mariana*, *Laphria gibbosa*, *Dryocopus martius*, *Lacerta agilis*.

Variants: none.

Habitat Quality

Minimum habitat requirements: aeolian sediments along the Coastal Lowlands linked with previous development stages of the Baltic Sea up to the ancient shoreline of the Baltic Ice Lake – a dune or a dune complex, covered mainly with dry pinetree forests with explicit forest wooded plant structure and characteristic ground cover.

In cases when the dune complex contains wavy or flat aeolian sediment plains, they are included in the habitat if the territory conforms with the following criteria.

The area is a natural (with untransformed relief, without dense cover of buildings, not used in agriculture, non-fragmented by motor roads) component of a unified dune complex that may be clearly subdivided in the topographic map, forest stand plan, aeolian sediment map, etc.

In cases when the area is former agricultural land etc. that has recovered at the time of evaluation of the habitat and species, structures and processes characteristic to shoreline wooded dunes dominate therein, it is allowed to include them within the habitat: *Wooded dunes of the Atlantic, Continental and Boreal region* (2180).

Meanwhile, in cases if wind overblow regions are fragmented by motor roads, the complex of wooded dunes is subdivided in parts if it also continues after the fragmenting object.

The habitat is determined in a complex manner, evaluating both the information in field conditions and cartographic materials: quaternary geological, topographic and geomorphological maps, forest stand plans and other materials.

Habitat quality is evaluated according to the relief and the conditions of the forest stand.

Structural indicators: main criterion for relief evaluation – *greater relative height of the dune (m).* All common indicators of forest habitats are used for the evaluation of the structure of a forest stand.

Function and process indicators: main criterion for relief evaluation – *intensity of anthropogenic impact on vegetation, substratum and relief, not evaluating older disturbances covered with vegetation* – a higher value if the intensity of this impact is low or it is insignificant. All common indicators of forest site functions are used for the evaluation of functions and processes of a forest stand.

Restoration potential and quality improvement indicators: determined by common criteria of all forest habitats, as well as criteria important for all shoreline and inland dune habitats. Necessity of the *restoration of geomorphological conditions (observance of erosion, etc.)* is additionally evaluated if significant damages of anthropogenic origin are observed. Restoration possibilities of wooded dunes are comparatively good. Upon the restoration of a habitat the possible sand movement, as well as amount of nutritional substances must be taken into consideration.

Threats: both historically and nowadays wooded dunes are endangered by several factors, mainly caused by human activity. Intense logging causes a significant negative impact, including formation of clear-cuts and afforestation with spruce-trees, as well as improper soil preparation, especially ploughing. Recreation in particular leaves a negative impact on habitats along shoreline that frequently also enhances environmental eutrophication, thus encouraging significant changes in the structure and content of plant communities. The habitats are negatively influenced by construction works, including reconstruction of roads and newly placed roads.

During the past 200 years the habitat in terms of its area and quality has decreased mainly as a result of the development of residential areas, for instance, Riga, Saulkrasti, Ventspils, Liepāja, Kolka and many seaside towns have been developed on dune fields. Green areas and formation of small architectural forms of green areas and arrangement during or after construction leaves a significant negative impact on the floristic composition of the habitat and spatial structure of vegetation, as well as local landscape. Moreover, during the past 10 years a trend of using alien plant species and varieties in green areas, as well as plants whose ecological requirements differ significantly from that of the specific habitat, may be observed.

It should be noted that as a result of the lack of the required extent of disturbances (fire, storms, moderate walking, etc.), natural transformation of the habitat into nutrient-rich ecosystems takes place. Excessive amount of disturbances, for instance, frequent fire accidents are a negative factor as well. In some cases the habitat is negatively influenced by the acquisition of sand resources that reduces the volume and area of aeolian sediments. In some places the area of wooded dunes is reduced by dynamic process of the sea – dunes are washed into the sea, for instance, at the Gauja estuary, Kolkasrags, the surrounding area of Pāvilosta, etc. This habitat is also influenced by all common threats of forest habitats.

Management: non-disturbed habitat development, maintenance of natural hydrological regime and control of anthropogenic pressure are the most appropriate management methods to ensure a favourable conservation status of wooded dunes. In the case of the lack of the extent of required favourable disturbances, they must be replaced with corresponding biotechnical measures, for instance, thinning of trees and shrubs, controlled burning, loosening of ground cover. In management of commercial forests of wooded dunes, clear cutting and soil preparation by ploughing should be limited, whereas soil preparation by controlled burning should be encouraged. Management measures common to all forest habitats also apply to this habitat.

Similar habitats: wooded dunes may be similar to the following habitats: park-type or overgrown 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)*, 2140* *Decalcified fixed dunes with Empetrum nigrum*, 2170 *Dunes with Salix repens ssp. argentea (Salicion arenariae)*, 2320 *Dry sand heaths with Calluna and Empetrum nigrum*, as well as 4030 *European dry heaths*. Habitat 4030 *European dry heaths* are situated only outside Coastal Lowlands. In other cases the minimum criteria for habitat determination must be evaluated, drawing attention to the location of the habitat, relief, characteristic species and the fact that trees are the main producers of organic matter in wooded dunes. The habitat may be visually similar to 9060 *Coniferous forests on, or connected to, glacioflucial eskers*, whereas eskers and esker-type relief forms are not situated in Coastal Lowlands. It may be difficult to subdivide wooded dune complex in narrow lowlands with small brooks from habitat 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)*, but in all cases natural and artificial watercourses and bodies of water, and their coastal sections are not included within the complex of *Wooded dunes of the Atlantic, Continental and Boreal region* (2180).

Overlap with other habitats of EU importance: it may overlap with habitat 9010* *Western taiga* – in this case geological origin of the habitat is a priority and in all cases habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* is subdivided. Waterlogged dune depressions with total area up to 3 ha, as well as elongated up to 30 m wide dune depressions may overlap with habitats 9080* *Fennoscandian decidous swamp forests* or 91D0* *Bog woodlands*; in these cases a habitat complex is subdivided – *Wooded dunes of the Atlantic, Continental and Boreal region* (2180) in accordance with specific habitat characteristics in Latvia.

Corresponding specially protected habitats in Latvia: 1.8. Wooded dunes of the Atlantic, Continental and Boreal region.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Jermacāne, S., Laiviņš, M. (2001) Latvijā aprakstīto augu sabiedrību sintaksonu saraksts. Latvijas veģetācija 4, 115.–132. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

2190 *Humid dune slacks*

Latvian habitat classification: B.3., partly F.6., F.6.3., G.1., G.2., G.3.

Syntaxonomy: *Hippuridetum vulgaris, Hottonietum palustris, Juncenion bufonii, Charetum tomentosae, Elodeetum canadensis, Potametum pectinati, Caricion davallianae, Scheuchzerio–Caricetea nigrae, Oxycocco–Sphagnetea* and others, as well as communities of grasses.

Definition: humid depressions of dunal systems. Humid dune-slacks are extremely rich and specilised habitats very threatened by the lowering of water tables. The following subtypes are distinguished:

– dune-slack pools: fresh-water aquatic communities of permanent dune-slack water bodies;
– dune-slack pioneer swards: pioneer formations of humid sands and dune pool fringes, on soils with low salinity;
– dune-slack fens: calcareous and, occasionally, acidic fen formations, often invaded by creeping willow, occupying the wettest parts of dune-slacks;
– dune-slack grasslands; humid grasslands and rush-beds of dune-slacks, also often with *Salix spp.* (*Salix rosmarinifolia*);
– dune-slack reedbeds, sedgebeds and canebeds; reedbeds, tall-sedge communities and canebeds of dune-slacks.

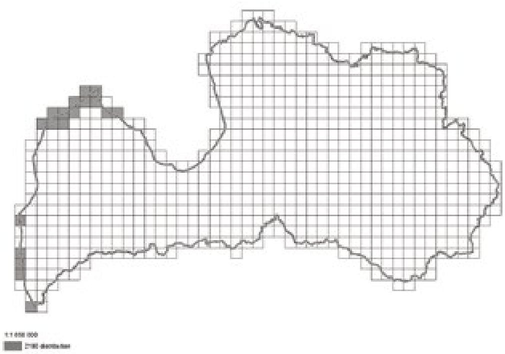


Figure 2.25. Distribution of the habitat 2190 *Humid dune slacks* in Latvia (Conservation status of.., 2013).

Specific characteristics of habitat interpretation in Latvia: the habitat is situated only in Coastal Lowlands. The habitat also includes dune slacks with:

– transition bogs and quagmires (*Fig. 2.26.*);
– raised bogs whose hydrological regime is significantly influenced by discharge of surface water from dune banks;
– stands of *Myrica gale* (*Fig. 2.27.*);
– up to 30 m wide dune slacks subdividing dune banks if they are a part of a unified dune slack complex where humid dune slacks dominate both in terms of the area and environmental conditions.

Lakes within dune slacks are not included in this habitat.

Distribution: the habitat is very rare in Latvia – highest concentration sites match with locations of those dune fields of the previous development stages of the Baltic Sea in Coastal Lowlands that have formed as a result of a relatively fast accumulation of sand. Most significant habitat complexes may be found between Nīca and Rucava, between Bernāti and Liepāja, between Ovīši and Lūžņa, as well as the surrounding area of Kolka (also called the Vigas), between Žocene and Roja, in the surrounding area of Engure and Ragaciems. In recent history, a broad and heterogenic distribution region of the habitat was in the section between Ovīši and Lūžņa, nowadays humid dune slacks in this area are mainly overgrown in various degrees.

Conservation value: A rare habitat in Latvia, which occupies about 0.022% of the land territory of Latvia with total area of 1 400 ha (Conservation status of.., 2013). The habitat is an integral part of the dune system with a high ecological value. Intermittence of waterlogged slacks with dune banks forms an environment especially saturated with habitats and eco-tone diversity, ensuring a broad diversity of species. In some places the habitat has formed primarily by natural overgrowth of dune slacks that correspond to and indicates processes taking place in primeval conditions.

Dune slacks are a significant natural site of *Liparis loeselii*, *Cladium mariscus*, *Salix repens*, *Myrica gale*, *Glaux maritima*, *Juncus balticus*, as well as significant natural site of certain rare mosses - *Bryum spp*. and *Calliergon spp*. Slacks are habitat for *Bufo calamita* and *Pelobates fuscus*, as well as a significant feeding and living site for *Grus grus* and *Tringa ochropus*.

The habitat not only possesses a biological value, but also landscape and cultural heritage value. It forms a visually high-value landscape element, which is very rare in Latvia. Nowadays the habitat does not have a special social and economical meaning, whereas in separate historical periods it has been used for grazing and as arable land in seaside villages.

Environmental factors and processes with a functional role: dune slacks are represented wetland components of dune systems. Formation of the habitat is determined by two factors: dune slack and high groundwater level. Seasonal fluctuations are characteristic to groundwater level – the maximum level is reached in winter and spring, whereas the minimum – in summer. Waterlogged dune slacks, depending on their origin and development stage, are divided into primary and secondary slacks.

Primary dune slacks are long and narrow formed parallel to the shoreline of the sea (*Fig. 2.28.*); slack endings may also be open, retaining link with the sea. Initially these slacks are mostly richly calcareous, which is ensured by shells; substratum - sand – has alkaline reaction, primary slacks decalcify under the impact of atmospheric water. Natural formation of these slacks is directly influenced by shoreline processes. Nowadays primary slacks may be encountered mainly in the surrounding area of Liepāja and Roja.

Secondary dune slacks emerges as a result of wind erosion down to the groundwater level. The habitat may also form if the groundwater level increases in the dune fields, without sand erosion caused by wind. These slacks are characterized by diversity of forms (for instance, parabola, etc.) and they have various orientation against the shoreline of the sea.

Historically the largest part of dune slacks have formed as a result of natural sand movement processes, whereas nowadays formation of dune slacks is a very rare occurrence on a European scale. Dune slacks that have formed nowadays are mostly enclosed in relatively stable dune systems.

Dune slacks are formed by sand. Sand to a large extent is moist, especially on the sides of pools. Microorganisms have a major role in the initial stages of slack formation as they attract nit-

Figure 2.26. Dune slack with transition bogs and quagmires in the surrounding area of Ģipka (Photo: I.Rove).

Figure 2.27. Dune slack with *Myrica gale* around Ģibka (Photo: I.Rove).

Figure 2.28. Primary dune slack in the surrounding area of Liepāja (Photo: I.Rove).

rogen, creating a possibility for higher plants to colonise the slack. Humus and soil form in older slacks along with accumulation of nutrients. In waterlogged slacks peat forms and accumulates as well. Formation of vegetation and floristic diversity are influenced by width, length and depth of the slack, as well as groundwater level and its fluctuations, age of the slack, amount of nutrients, as well as hydro-chemical makeup of water. Mostly dune slacks are not rich in nutrients. Plant toxins discharged in anaerobic conditions is also an important factor in slack subject to regular flooding.

A specific process – discharge of water and substances that have dissolved therein along dune slopes forming the slack – is characteristic to all dune slacks. This process changes classical feeding circumstances that are characteristic to habitats situated on flat surfaces. For instance, both fens and raised bogs in dune slacks alongside with absorption of water from atmosphere characteristic to them also feed from lateral discharge specific to slacks.

Vegetation characteristics: described environmental conditions and age of the slack determine vegetation diversity in dune slacks. It varies from open sand areas with poor pioneer vegetation and open water up to stable grass, tall-sedge, mire and shrub communities. Vegetation may vary even within the scope of one slack, forming a mosaic of plant communities. There are explicit differences in the dune slack vegetation in the direction from the seashore to inland area. Not only plant species specific to slacks may be encountered– species that are widespread in wetlands are growing there as well.

In very rare cases park-type communities form in dune slacks. In various dune development stages, trees may form a significant cover, but they are never the main producers of organic matter, except for *Salix spp.* and *Myrica gale*.

Depending on the age of slacks, several dune slack communities may be distinguished. For the most part of the year, dune slack pools are permanently filled with water, freshwater communities with *Chara spp*., *Elodea canadensis*, *Hippuris vulgaris*, *Hottonia palustris* may be encountered there. Unlinked pioneer communities of dune slacks have a small number of plant species, permanent or periodically drying out pools of brackish water or freshwater may be encountered in slacks. Microorganisms have a major role in the initial stages of slack formation as they attract nitrogen, creating a possibility for higher plants to colonise the slack. If the slack has retained link with the sea, halophytes may be encountered. *Sagina nodosa*, *Juncus bufonius*, *J. balticus*, *J. articulatus*, *Equisetum variegatum*, *Bryum spp.* may be found in plant communities. In older slacks may encounter also *Centaurium littorale*, *C.pulchellum*, *Agrostis stolonifera*, *Trifolium fragiferum*, *Parnassia palustris*, *Carex flacca*, etc. may be found in older slacks. Short-term stage in which orchids, for instance, *Liparis loeselii*, *Dactylorhiza spp*., *Epipactis palustris*, etc. have a significant role in plant communities is characteristic to dune slacks. Orchids mainly emerge in such development stage of slack when it is about 30–40 years old and when open sand may be still encountered there.

As nitrogen and phosphorus keep accumulating and no disturbances take place, grasses of various types emerges in slacks. Depending on the hydrological regime, along with further development of the slack, both mono-dominant and mosaic-type tall-sedge communities with *Phragmites australis*, *Scirpus spp*., *Carex spp*. may emerge.

Fen (grass or minerotrophic) communities, including calcareous grass fen communities may form under the circumstances of rich humidity – mostly they are rich in plant species. Various transition bog and floating bog communities, as well as plant communities characteristic to raised (moss or ombrotrophic) bogs may be encountered in dune slacks. Communities with *Myrica gale* form in especially changing humidity dune slacks.

Characteristic species: there is no specific plant content, because it varies depending on diverse environmental conditions.

Communities characteristic to primary slacks are formed by *Equisetum variegatum*, *Sagina nodosa*, *Juncus bufonius*, *J. balticus*, *J. Articulatus*, and *Centaurium littorale*.

Communities characteristic to secondary depressions are formed both by *Sphagnum spp*. and *Myrica gale*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Equisetum variegatum*, *Sagina nodosa*, *Juncus bufonius*, *J.balticus*, *J.Articulatus*, and *Centaurium littorale*, *Myrica gale*.

Variants: none.

Habitat Quality

Minimum habitat requirements: permanently or periodically waterlogged dune slack with herbaceous vegetation in Coastal Lowlands. The vegetation differs significantly from the vegetation on dune banks. Trees are not the main organic material producers, except for *Salix spp*. and *Myrica gale*. Dune bank slope, which encloses slack, is over 1 m long.

Structural indicators: all most significant criteria of seaside and inland dune habitats, except for the *proportion of field area where encounter at least one characteristic plant species may be encountered* and *total number of characteristic plant species*, because plant communities are very variable. *Tree and non-characteristic shrub cover* is evaluated in addition. Special attention must be paid to the *number of rare and especially protected species.*

Function indicators: all significant criteria of seaside and inland dune habitats, as well as *proportion of field area where regular required management/maintenance takes place*, where there is an *appropriate hydrological regime*. *Isolation degree of the habitat* is evaluated as well, because significant functions take place within complexes of the particular habitat.

Restoration potential and quality improvement indicators: determined by all significant criteria of seaside and inland dune habitats, as well as *necessity to plan, demolish or build engineering and technical objects for the maintenance/preservation of the habitat*; in ideal case such measures are not necessary. Waterlogged dune slacks are regarded as habitats that may be restored, whereas success depends on hydrological regime of each local place and its hydro-chemical indicators, as well as seed bank. Upon restoring the habitat, the hydrological regime of the entire dune system must be taken into consideration.

Threats: nowadays the main threats of the habitat are purposeful land melioration, insufficient volume of required disturbances (mowing, moderate pasturage, etc.), as well as recreation. Dune slacks are highly endangered by flooding, intensively managed agricultural land located nearby, afforestation, construction and natural change of slack relief, including digging of ponds. Slacks with grass and tall-sedge communities are endangered both by over-exploitation and cultivation, including ploughing, fertilisation, sowing, etc., as well as non-management, as a result of what slacks overgrow. Creation of roads and paths may change water regime, as well as fragment the slacks, reducing their ecological resistance and stopping species migration corridors or reducing migration possibilities. Potentially negative impact may be imposed on primary slacks by seaside fortification, which will reduce the impact of natural dynamic seaside process on open, new dune slacks.

Management: depends on the development stage of the slack and what exactly – definite plant communities, specific species – are selected for preservation and maintenance. Along with the preservation of appropriate hydrological regime, non-disturbed development of slacks must be ensured.
Meanwhile, selecting to preserve specific plant communities, appropriate biotechnical measures must be performed. Regular disturbances are necessary for long-term maintenance of a specific slack development stage – pasturage, mowing, walking, etc. In ideal case grazing is ensured by using sheep, in especially wet places – also horses. In most cases grazing must be combined with mowing, because it may prolong phase of open communities, whereas it does not stop the accumulation process of nutrients; therefore frequent removal of the upper layer of soil up to 10 cm is required to reduce the amount of nutritional substances.
Upon the habitat restoration, optimisation of the hydrological regime, activation of sand movement, as well as thinning of trees and shrubs, limiting sprouts following it, may be necessary as well.

Similar habitats: it may be difficult to separate dune slacks overgrown with tress from forest habitats – if trees are the main producers of organic material, such areas are part of habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* complex; dune slacks with *Salix spp.* and *Myrica gale*, which may form a significant cover in slacks. It may be difficult to separate new dune slacks from relief lowering among several banks of habitat 2120 *Shifting dunes along the shoreline with Ammophila arenaria (white dunes)*. If sand is especially wet in the lowering and at least one halophyte plant species is encountered, it is included in habitat *Humid dune slacks* (2190) as a pioneer stage of the habitat.

Overlap with other habitats of EU importance: the following habitats of EU importance may be situated in dune slacks: 4010 *Northern Atlantic wet heaths with Erica tetralix* (variant 4010_ 2), 6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)*, 6510 *Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)*, 7110* *Active raised bogs*, 7120 *Degraded raised bogs still capable of natural regeneration*, 7140 *Transition mires and quaking bogs*, 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae*, 7230 *Alkaline fens.*

Corresponding specially protected habitats in Latvia: 6.8. Humid dune slacks.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Houston, J. A. (2008) Management of *Natura 2000* habitats. 2190 Humid dune slacks. European Commission

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Lammerts, E.J., Grootjans, A.P. (1997) Nutrient deficiency in dune slack pioneer vegetation: a review. Journal of Coastal Conservation 3, 87–94 p.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

2320 *Dry sand heaths with Calluna and Empetrum nigrum*

Latvian habitat classification: F.7.1.

Syntaxonomy: *Nardo-Callunetea, Empetrion nigri*.

Definition: coastal non-dunal *Calluna vulgaris* and *Empetrum nigrum* heaths, formed on quartzic sands originating in redeposited and reworked glacial drift and outwash (*Fig. 2.29.*).

Specific characteristics of habitat interpretation in Latvia: the habitat contains heaths, which are located only in the Coastal Lowlands. It also includes dunes and barriers of dunes located in sandy plains. The habitat includes wet heath inclusions and those of variable moisture regime with an area up to 0.1 ha, if they are part of an integrated complex of dry heaths. Short-term successional stages are not recognized as the habitat, i.e. clearings, roadsides and open heather stands with an area of 0.1 ha in other habitats. In some cases, it is allowed to identify larger areas of burned dry forest as the habitat – from which trees are removed, if a decision is made not to renew the forest and to sustain open heaths, providing the required amount of disturbances necessary for open heath, as well as excellent quality, stable and durable dry heaths, which have developed into the sandy substrate below and adjacent to linear objects of anthropogenic origin, such as a variety of transportation and communication tracks, etc.

Distribution: a very rare habitat in Latvia – largest areas are in Ādaži, Sēja and Garkalne districts, where heaths have been established and maintained as a result of military activities in the 20th century. The major areas of the habitat in combination with 4010 *Northern Atlantic wet heaths with Erica tetralix* (variant 4010_ 2) are located in *Ādaži protected landscape area* and its surroundings; it is also the largest area of continuous open heaths in the Baltic region. The habitat in small areas is also found in other parts of the Coastal Lowlands.

Conservation value: area of dry heaths in Latvia in the previous century has significantly decreased, it is considered to be one of the rarest habitats in Latvia (~ 0.024% of the total territory of land area of the country). Currently the total area of the habitat in the country is 1 579 ha (Conservation status of.., 2013). Habitat meets all the important values of protection of the heather habitat group.

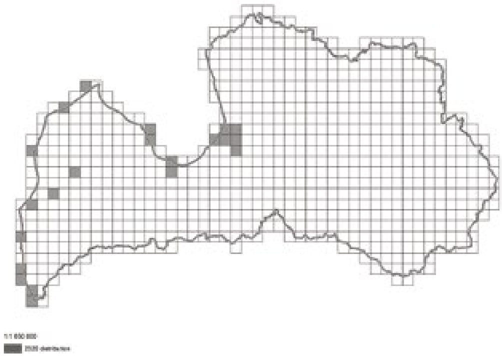


Figure 2.30. Distribution of the habitat 2320 *Dry sand heaths with Calluna and Empetrum nigrum* in Latvia (Conservation status of.., 2013).

The habitat is a significant natural site for *Dianthus arenarius s.l.*, *Pulsatilla patens* and *Teesdalia nudicaulis*. It is an important habitat for several rare and specially protected animal species found only in dry open areas, such as birds – *Anthus campestris*, *Lullula arborea*, insects – *Myrmeleotettix maculatus*, *Psophus stridulus, Eupelix cuspidata*, *Lycaena alciphron, Coscinia striata*, etc.

The habitat has not only biological, but also landscape, cultural heritage and economic value. Heaths create visually high-value open landscapes; they are a historical evidence of the traditional management, as well as bee pasture for production of heather honey. Heather stands in Ādaži and Sējas regions have an essential socio-economic significance in the provision of military training in the Baltic region.

Environmental factors and processes with a functional role: a key factor in the development of heaths is nutrient-poor substrate – sand – and all significant environmental factors and processes that are important for the heather

Figure 2.29 Dry heaths of sand plains of the Coastal Lowlands in the specially protected landscape area "Ādaži" (Photo: I.Rove, I.Rēriha).

habitat group. Podsolization of soil is present. Over time, small shrub stands establish and maintain specific local microclimate.

The habitat establishes in the long-term influence of grazing, fire or other disturbances, such as military activity. Local differences are determined by the substrate, development stage of succession, environmental humidity and heath usage intensity. An important factor for a long-term existence of the habitat is lack of nutrients and pesticides and presence of regular disturbances, including fire. Regular burning or other regular disturbances that directly affect the substrate and reduce nutrient accumulation form extreme dry conditions, which slow down overgrowth of the heather. Under natural conditions, in the absence of disturbances, the habitat overgrows and mostly converts to dry pine forest. Formerly, overgrowth of the habitat was also prevented with moderate grazing.

Vegetation characteristics: depending on the heather lifecycle phase and stage of habitat development, vegetation of dry sand heaths with *Calluna vulgaris* and *Empetrum nigrum* is very diverse. Projective cover of vegetation and open space structure varies in the heather. All characteristic aspects of heather habitat group are characteristic to the vegetation.

Vegetation consists of small shrubs dominated by *Calluna vulgaris*, as well as *Calluna vulgaris* in combination with *Arctostaphylos uva-ursi*, *Empetrum nigrum* and *Vaccinium vitis-idaea*, very rarely with *Vaccinium myrtillus.*

Heathland vegetation varies from linked, where area can be formed of sand, undisturbed pioneer vegetation or structured fragments of Nardus grassland fragments with sod to monodominant heather of the same age. In old heather stands with no disturbances, when biologically old heather withers away, open areas form in vegetation. Heaths may contain tree and shrub groups. After burning, remarkable areas can also be covered with *Rumex acetosella* and grasses which in few years change with heathers that have germinated from seeds. Often in the relief depressions it is possible to find *Molinia caerulea* which is resistant to burning and can become expansive.

Characteristic species: *Calluna vulgaris*, *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Vaccinium vitis-idaea*, *Carex arenaria*, *Dianthus arenarius s.l.*

Umbrella species (typical species within the meaning of the Habitats Directive): *Calluna vulgaris*, *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Thymus serpyllum*, *Corynephorus canescens*, *Koeleria glauca*, *Nardus stricta*, *Sieglingia decumbens*, *Festuca ovina*; moss – *Racomitrium spp.*, *Ceratodon purpureus*; lichens – *Cladina spp., Cetraria spp*.

Variants:

2320_1: Dry sand heaths with *Calluna vulgaris* and *Empetrum nigrum*, which formed by overgrowing of sand areas; apart from the characteristic species it is possible to find communities of caulescent plants – *Carex pilulifera*, *Festuca sabulosa*, *Thymus serpyllum*, *Sedum acre*, *Dianthus arenarius s.l.*, *Festuca ovina*, *Agrostis tenuis*, *Pilosella officinarum*, *Lerchenfeldia flexuosa*, *Carex ericetorum*, *Trifolium arvense*, *Jasione montana*, *Pulsatilla pratensis*, *Corynephorus canescens*, *Koeleria glauca* etc.; mosses – *Racomitrium spp.*, *Ceratodon* *purpureus*, *Dicranum spp*.; lichens – *Cladonia spp*., *Cladina spp., Stereocaulon spp*., *Peltigera canina*, *Cetraria spp*. etc.;

2320_2: Dry sand heaths with *Calluna vulgaris* and *Empetrum nigrum*, which developed when nutrient-poor grasslands overgrew, mostly on long-term pastures in nutrient-poor sandy soils 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)*; in areas covered with small shrubs structured grass fields with Nardus grasslands characteristic plant species remain and it is possible to find sod; area of grassland consists of *Nardus stricta*, *Sieglingia decumbens, Festuca ovina*, *Antennaria dioica*, *Veronica officinalis*, etc.

Habitat Quality

Minimum habitat requirements:

2320_1: nutrient-poor coastal sand plain and at least 25% of the dominant dwarf shrubs is *Calluna vulgaris*, woody shrubs and shrubs do not exceed more than 70% and are not the main producers of the organic matter;

2320_2: nutrient-poor area of Coastal Lowlands and at least 50% of dispersed small shrubs growing with predominant *Calluna vulgaris*, woody shrubs and shrubs do not exceed more than 70% and are not the main producers of the organic matter.

Structural indicators: all criteria that are important for coastal and inland dune habitats, as well as the *proportion of the site area where grass layer cover is less than 25% and where there are grass glades.*

Ideally, *heather site area has different age structure* and plant species saturation (amount of species in the area of 9 m^2 selected by the best site) in the site area is high. *Cover of tree layer that is above 20% and shrub layer cover above 10%* indicate lower quality of the habitat. *The proportion of the site area where the mosaic structure vegetation is characteristic*, as well as *total number of its characteristic plant species* is not evaluated because evaluation of these indicators is covered with other criteria.

Function and process indicators: all criteria that are significant to coastal and inland dune habitat group, as well as *bigger distance of the site area to intensively cultivated farmlands and increased total area of the habitat in the viewed site area* as both of these indicators ensure *undisturbed functioning of natural processes*. In this case, *impact of adjacent habitats* is not measured because often it is not possible to adequately evaluate this indicator in large heather areas.

Restoration potential and quality improvement indicators: determined by all criteria which are significant to the whole coastal and inland dune habitat group, except for *the need to plan and build infrastructure for recreation and sightseeing in order to restore and maintain the habitat*. Overall, Dry sand heaths with *Calluna vulgaris* and *Empetrum nigrum* are considered to be relatively well-renewable compared to mire and other wetland habitats. In cases when 10–20% of open heathland areas have been maintained and they have been overgrown for more than 30 years and nutrients have been accumulated, habitat restoration will be lengthy and time-consuming, but possible.

Threats: nowadays the main threat of the habitat is the possibility that it might overgrow, due to decreasing amount of the required disturbances (fire effects, driving over, etc.) and the absence of moderate grazing, as well as all the heathland habitat group-specific threats. In some cases, environmental conditions are so dry that the habitat may remain open for a long time. In Latvia, there are no historical and cultural traditions of heathland management.

Management: all management measures of heather habitat group if the amount of fires and other disturbances is insufficient. Very dry heaths with open sand glades can be managed once in several years since the accumulation of nutrients in them and overgrowing is very slow. The best management method must be determined individually for each case, subject to local specifics.

Grazing may overly enrich the environment with nutrients, therefore it is recommended to carry out moderate grazing or mechanical disturbances without additional nutrient inputs.

Similar habitats: based upon the dominating vegetation, the habitat can be confused with the habitat 2140* *Decalcified fixed dunes with Empetrum nigrum* or 4030 *European dry heaths*. In this case, habitats are distinguished by their location because *European dry heaths* (4030) are only located outside the Coastal Lowlands, while 2140* *Decalcified fixed dunes with Empetrum nigrum* establish in open secondary dunes directly at the seacoast. It might be difficult to distinguish habitat that overgrows with small shrubs – 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)*, in such cases it is necessary to evaluate cover of small shrubs – if it is at least 50%, and small shrubs grow dispersed, the habitat must be added to 2320 *Dry sand heaths with Calluna and Empetrum nigrum* (as a variant No. 2). Habitat with sparse vegetation can be difficult to distinguish from 2330 *Inland dunes with open Corynephorus and Agrostis grasslands* and 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)*, inland dunes with open Corynephorus and Agrostis grasslands (2330) are located just outside the Coastal Lowlands, in turn, to separate grey dunes (2130*) covered with caulescent plants, cover of small shrubs is less than 25%. Park-like heather can be difficult to distinguish from the 2180 *Wooded dunes of the Atlantic, Continental and Boreal region*. If tree plants are the main producers of organic matter, then the habitat is added to *Wooded dunes of the Atlantic, Continental and Boreal region* (2180).

Overlap with other habitats of EU importance: may overlap with the habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands*. As a separate habitat is distinguished only in cases where its area is larger than 0.1 ha and vegetation consists mainly of *Calluna vulgaris*, in all other cases juniper group is a natural part of the habitat 2320 *Dry sand heaths with Calluna and Empetrum nigrum.*

Corresponding specially protected habitats in Latvia: 1.12. Dry sand heaths with *Calluna vulgaris* and *Empetrum nigrum*.

Literature

Aizsargājamo ainavu apvidus „Ādaži" dabas aizsardzības plāns (2008) I.Roves red. Jaunmārupe, Latvijas Dabas fonds, 122 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Dabas vērtību stāvokļa novērtēšana un kontrole Ādažu militārajā poligonā. Rokasgrāmata, paredzēta Nacionālo bruņoto spēku personālam (2008) I.Roves red., Rīga, Latvijas Dabas fonds, 42 lpp.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Rove, I. (2011) Evaluation and control of nature values in the Adazi village military training area. Manual. For the usage of armed forces personnel, can be used for the assessment of certain described nature values also in other military polygons. Riga, Erfurt, 38 p.

2330 *Inland dunes with open Corynephorus and Agrostis grasslands*

Latvian habitat classification: E.1.1.4., partly E.1.1.

Syntaxonomy: *Corynephorion*.

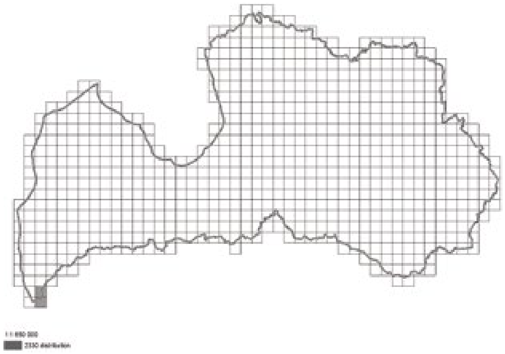


Figure 2.31. Distribution of the habitat 2330 *Inland dunes with open Corynephorus and Agrostis grasslands* in Latvia (Conservation status of.., 2013).

Definition: open formations found on inland dunes with dry siliceous soils (*Fig. 2.32.*), often species-poor and with a strong representation of annuals. It includes formations of unstable Germano-Baltic fluvio-glacial inland sands with *Corynephorus canescens*, *Carex arenaria*, *Teesdalia nudicaule* and carpets of fruticose lichens (*Cladonia, Cetraria*) and other grasslands of more stabilized Germano-Baltic fluvio-glacial inland dune systems *Agrostis spp.* and *Corynephorus canescens* or other acidophilic grasses.

Specific characteristics of habitat interpretation in Latvia: habitat is located only on inland – outside the Coastal Lowlands.

Distribution: very rare – mostly in valleys of the River Sventāja, Daugava and Gauja.

Conservation value: very rare habitat which total area in the territory of Latvia is small (approximately 0.007% of the total land area of the country), it is registered in the total area of 427 ha (Conservation status of.., 2013). Important habitat for several rare and specially protected species, found only in open, dry areas, for example, plants – *Agrostis vinealis*, *Teesdalia nudicaule*, *Dianthus arenarius sl*; birds – *Anthus campestris*, *Lullula arborea*, insects – *Myrmeleotettix maculatus*, *Psophus stridulus* etc.
Habitat has not only biological value, but also landscape and cultural heritage value. Inland dunes in Latvia create rare, visually high-value open landscapes, that are historical evidence of traditional management.

Environmental factors and processes with a functional role: a key factor in development of the habitat is nutrient and limes-poor, neutral and acidic, very dry sand with a small amount of humus. Significant factors include climate, microclimate, height above the sea level and water permeability of soil in each local site of the habitat; they determine characteristics of the natural site and affect plant community composition. Formation and podzoling of soil have been observed. Over time, grass stands form and maintains specific local microclimate.
Habitat forms when sand areas overgrow, as well as in areas where vegetation has been destroyed. Overgrowing is prevented by regular disturbances that cause partial destruction of vegetation, as well as extremely dry growing conditions. The habitat is naturally dependent on grazing and trampling related disturbances. Near populated areas open dune overgrowth is largely prevented by grazing. In the absence of disturbances, habitat mainly overgrows with *Pinus sylvestris.*

Vegetation characteristics: depending on the age of the habitat and amount of disturbances, vegetation varies from highly sparse, fragmented, with a mosaic structure, where area can consist of sand, undisturbed pioneer vegetation, mosses and lichens, up to partly linked vegetation. Completely linked vegetation is not characteristic to the habitat. Annual plants and dune grasses are common. The height of the ground cover varies – mostly height of caulescent plants is 30 cm. Groups of

Figure 2.32. Open inland dunes in the valley of Sventāja (Photo: L.Salmiņa).

trees and shrubs might be present in the habitat – mainly *Pinus sylvestris* and *Juniperus communis*.
Characteristic vegetation of the habitat mostly consists of acidophilic grasses: *Corynephorus canescens* (*Fig. 2.33.*), *Agrostis tenuis* in various combinations, as well as forming pure stands of single species. Number of plant species in communities is small. Drought tolerant plants dominate. Perennial plant species have a relatively large significance in communities. In some places considerable projective cover is made of lichens – *Cladonia spp. Cladina spp., Cetraria spp., Stereocaulon condensate, S. incrustatum*, etc.; moss – *Racomitrium canescens sl., Polytrichum piliferum, Ceratodon purpureus*, etc.

Characteristic species: *Corynephorus canescens*, *Agrostis tenuis*, *Carex arenaria*, *Festuca sabulosa*, *F. ovina*, *Lerchenfeldia flexuosa*, *Koeleria glauca*, *Thymus serpyllum* or *T. ovatus*, etc., as well as *Lacerta gailis*, *Melanimon tibiale*, *Lasius spp.*

Umbrella species (typical species within the meaning of the Habitats Directive): *Corynephorus canescens*, *Agrostis tenuis*, *Carex arenaria*, *Festuca sabulosa*, *Lerchenfeldia flexuosa*, *Lacerta gailis*, *Melanimon tibiale*.

Variants: none.

Habitat Quality

Minimum habitat requirements: inland dunes outside the Coastal Lowlands where the vegetation is dominated by *Corynephorus canescens* and/or *Agrostis tenuis*, woody shrubs and shrubs do not exceed 70% and are not the main producers of organic matter.

Structural indicators: all significant criteria of coastal and inland dune habitats, as well as higher percentage of the proportion of site area in which *cover of caulescent plants is 15–75%*. Vegetation structure is characterized by *the proportion of Corynephorus caulescent stands in the site area, as well proportion of Agrostis tenuis or dune Fescue in pure stands or in admixture with Festuca sabulosa in the site area*. Ideally, *cover of litter is smaller than the plant cover, average height of vegetation does not exceed 40 cm*. Cover *of trees and shrubs, including planted, that is over 10%* indicates lower quality of the habitat.

Function and process indicators: all criteria which are significant for coastal and inland dune habitat group, as well as higher proportion of the site area in which there is no inappropriate *management*, *larger continuous area of the habitat can be viewed in the site area* that provides undisturbed conduct of natural processes. Functioning of the habitat is also determined by *the isolation (separation) degree*, the smaller it is – the more successfully functions and processes take place.

Restoration potential and quality improvement indicators: determined by all criteria which are significant for coastal and inland dune habitat group. In general, open inland dunes are relatively well-renewable, compared to mires and other wetland habitats. In any case it is necessary to evaluate habitat restoration options, depending on the state of the natural relief. In cases when the natural relief is significantly altered, restoration value of the habitat must be evaluated. Restoration is complex and should be treated critically, if the vegetation is fully linked, more than 70% of it consists of shrubs and trees and their average height is over 1.5 m.

Threats: nowadays the main threat of the habitat is overgrowth that occurs when the amount of required disturbances decreases and moderate grazing is absent. In some cases, the environmental conditions are so dry that the habitat may remain open for a long time. Habitat is often overexploited, including overgrazing and fertilization. In a significant amount of overexploitation large open sandy areas are formed and due to wind action sand might begin to move.

In some places open dunes are afforested and covered with buildings.

Management: open inland dunes is a habitat that requires management. In order to maintain the habitat open for long-term, it is necessary to create the required amount of disturbances, such as grazing, mowing, controlled driving over, moderate grazing, etc. Mowing with mulching cannot be supported. Taking that into the account, the habitat forms in extremely dry growing conditions, it can be managed once in several years since nutrient accumulation and overgrowth is very slow. The best management method must be determined individually for each case, subject to local specifics. If the amount of disturbances is significantly high, the habitat may be degraded. If the habitat has overgrown, before ground-cover restoration it is necessary to thin out shrubs and trees. In such cases, it is necessary to limit the woody shoots. The long overgrown habitats can be restored by removing the topsoil to 10 cm depth. All cut down and mowed materials that occur during the management must be collected and removed from the habitat to reduce nutrient inflow. Grazing may overly enrich the environment with nutrients, so it is recommended to moderately graze it or carry out mechanical disturbances without additional nutrient inputs.

Similar habitats: similar to habitats 2130* *Fixed coastal dunes with herbaceous vegetation (grey dunes)*, 2140* *Decalcified fixed dunes with Empetrum nigrum*, 2170 *Dunes with Salix repens ssp. argentea (Salicion arenariae)*, 2320 *Dry sand heaths with Calluna and Empetrum nigrum,* but all habitats listed are located only in the Coastal Lowlands, where dry sand heaths with *Calluna vulgaris* and *Empetrum nigrum* (2330) cannot be located. In some cases, the habitat can be difficult to distinguish from the 4030 *European dry heaths*, 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)* and 6120* *Xeric sand calcareous grasslands*. In the *European dry heaths* (4030) cover of dwarf shrubs is at least 25%, cover of dwarf shrubs in inland dune surface is less than 25%. In order to distinguish open inland dunes from other dry grasslands, it is necessary to assess the characteristic plant species and vegetation structure.

Overlap with other habitats of EU importance: may overlap with the habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands*. 5130 as a separate habitat must be distinguished only if it consists of more than 0.1 ha of continuous areas, in all other cases juniper groups are natural components of *Inland dunes with open Corynephorus and Agrostis grasslands* (2330).

Corresponding specially protected habitats in Latvia: 3.18. Open inland dunes with meadows of *Corynephorus canescens*.

Figure 2.33. Vegetation of open inland dunes with *Corynephorus canescens* (Photo: I.Rove).

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Photo: U.Suško

3. FRESHWATER HABITATS

This group unites seven protected habitats of EU importance that can be found in Latvia and in whose existence freshwater has the determinant role. Five of these are lake habitats, while the other two are river related habitats. While assessing conformity of lakes to any of EU protected habitats, a lake must be assessed in its entirety – usually all its parts can be considered to represent the same habitat. In exceptional cases a naturally confined part of a lake that functions as an independent water-body and is characterized by environmental factors and species communities that are different from the rest of the lake, can be separated and considered a different habitat. A running freshwater habitat is considered to be a river or its section in its natural bed, which is characterized by the flow velocity, river bottom and species communities.

Latvian habitat classification

Several habitats that characterize environmental conditions of a particular site, its level of eutrophication or anthropogenic influence that are referred to in the classifier can be found in every lake or river. However, the habitat description lists only the most typical ones, according to which a certain habitat of EU importance can be identified.

Distribution

Distribution mostly depends on the geomorphology of a territory, for example, there are more lakes in uplands; from the perspective of geology and historical development – lakes with oligothropic to mesotrophic plant communities have preserved better in territories with sandy soils, whereas hard oligo-mesotrophic waters with benthic vegetation of *Chara spp*. are related to calcareous silt. Karst lakes can develop only in active gypsum karst areas where karst processes occur in limestone and dolomite bedrock. The proportion of bogs is larger in plains, hence also dystrophic lakes and ponds. The impact of human activities, that has resulted in destruction of a large part of the natural river stretches through digging over and damming, is more pronounced in plains.

Conservation value

Almost all lakes of natural origin and natural river stretches as well as river stretches with gravel riverbeds and flow velocity exceeding 2 m/sec meet the criteria of a certain habitat of EU importance. The total area that is occupied by freshwater habitats of EU importance is approximately 101 639 ha, which equals to 1.5% of the area of Latvia (Conservation status of.., 2013). Freshwater habitats are an integral part of the natural water circulation and therefore influence the regime of the surrounding waters and microclimate. These habitats are ecologically and visually significant elements of the landscape, and also an essential socio-economic resource in fishing industry, tourism and recreation. Freshwater habitats are a specific environment for typical, rare and protected species. These are ecosystems with a particular set of environmental factors and species communities. The conservation value of several habitats is significantly increased by their rarity and vulnerability to the impact of human activities.

Environmental factors and processes with a functional role

Environmental factors that are significant for the existence of freshwater habitats are water depth, physical and chemical qualities of water (conduction, transparency, chromaticity, pH) that are determined by the content of dissolved substances in water, the content of nutrients that are available to plants (compounds of phosphorus and nitrogen) in water and bottom, and the bottom composition. The flow velocity and the shading that is created by the vegetation on river banks are also significant environmental factors for river habitats. The composition of dissolved elements in the water of rivers and lakes is determined by the water from the catchment area, therefore the size of the catchment area, intensity of water exchange, parent material and soils, habitats of the catchment area as well as the impact of human activities (proportion of transformed habitats, additional inflow of nutrients and pollution) are significant. Natural or semi-natural dynamics of the hydrological regime in a river or a lake as well as within the entire drainage basin is of a particular importance. A drainage basin that has preserved unaffected by human activities and natural or semi-natural dynamics of the hydrological regime determine the circulation of substances and natural processes of eutrophication (enrichment with nutrients) and dystrophication (enrichment with humic substances) that are characteristic of each habitat. During eutrophication when environmental conditions and species composition change, oligotrophic and mesotrophic lakes become eutrophic and dyseutrophic. If the inflow of humic substances in semidystrophic lakes continues, these lakes become dystrophic.

Vegetation characteristics

It is characteristic of freshwater habitats to form species communities that represent diverse ecological groups – communities of moisture loving coastal (amphibious) plants, emergent-leaved plants (helophytes), floating-leaved plants (nymphaeids), freely floating plants (lemnids), submerged aquatic plants (elodeids), or submerged rosetted plants (isoetids). Communities of algae and aquatic moss species that grow on and are attached to stones are also characteristic of river habitats. Plant species composition in vegetation zones, their location and the area occupied by them is determined by environmental factors. Number of species in plant communities is often low, communities that consist only of one or few species can often be found. When the amount of nutrients increases, it usually results in a lusher vegetation and an increase of area occupied by it, whereas the number of species decreases.

Habitat quality

Minimum habitat requirements: natural origin of the water-body; other minimum requirements for a lake or a river to be recognized as a habitat of EU importance are given in habitat descriptions. Freshwaters unite habitats that are mutually very different, but there is only one indicator of function quality that is common for all habitats of this group – the natural or semi-natural state of their hydrological regime (water level and run-off from the catchment area). There are several common structural and function quality indicators for lake habitats.

Structural indicators: the number of characteristic species – species that are indicators of a specific environment in the particular freshwater habitat. The area occupied by the communities of the characteristic species – indicates the typical nature and ecological condition of a habitat. Area that is free of dense vegetation of expansive species, species indistinctive of the habitat or indicate a high level of trophy. There are several aquatic plant species that occur widely, are extremely competitive and in favourable conditions can form dense monodominant stands. A typical expansive, widely occurring and a very competitive aquatic plant species is *Phragmites australis*. Likewise, also *Ceratophyllum demersum* and other species of freely-floating aquatic plants indicate an increased amount of nutrients in water. The number of protected species and species included in the Red Data Book – the quality assessment of freshwater habitats is increased by the presence of rare species of various organism groups that have adapted to specific environmental conditions and the habitat is significant for the conservation of populations of these species. Water transparency – important for several lake habitats as the plant species composition and the area of the littoral zone depend on the amount of the available light. Water transparency decreases in the result of eutrophication, phytoplankton blooms or through inflow of swamp waters that increase the chromaticity of water. Chromaticity of water – characterizes the concentration of humic substances and it has a significant impact on the water transparency. Water chromaticity in clear water lakes does not exceed 80° Pt/Co, in brown water lakes it exceeds 80° Pt/Co. The total amount of phosphorus *(TP)* – it is present in water in the form of orthophosphates, polyphosphates and organic compounds. If the concentration of phosphorus compounds exceeds 0.05 mg/l, it promotes eutrophication and creates increased reproduction of phytoplankton and aquatic plants. Nowadays the majority of phosphorus compounds find their way into water-bodies in the result of human economic activities. Chlorophyll *a* - the primary photosynthetic pigment of algae that is involved in the process of photosynthesis and is a part of all photosynthetic organisms. High values of this parameter indicate rapid growth of phytoplankton (the so-called "phytoplankton blooms") that significantly decreases the water transparency. Regular phytoplankton blooms can depress development of aquatic plants, especially those that grow on the bottom of a water-body. The presence of oxygen in water is necessary for the majority of living organisms, it determines circulation of many elements in water and also influences the composition of inorganic materials in water; therefore, the presence of oxygen throughout the whole water column of deep lakes also during water stratification in summer and winter periods indicates high ecological quality. Bottom composition depends on geological conditions and level of eutrophication. A higher proportion of mineral bottom indicates lower level of eutrophication and a higher ecological quality.

Function and process indicators: Natural or semi-natural state of the hydrological regime – significant to all freshwater habitats. Negative changes in the natural hydrological regime are caused by lowering or rising of water level, alterations of the shore structure or dyking as well as by drainage of catchment area. The structure of habitat and shore vegetation – ensures functions characteristic of the habitat. The volume of nutrient input and the extent of anthropogenic influence – characterizes the intensity of eutrophication. It is increased and consequently the quality of the habitat is deteriorated by discharge of wastewater, heavy pressure from recreation and intensive economic activities (building, forestry, agriculture, land reclamation) in the catchment area.

Indicators of restoration possibility and quality improvement: prospects for habitat restoration are higher when it is necessary to restore only the structure of a habitat. Functions of a habitat are more difficult to restore. It is practically impossible to restore freshwater habitats with very specific structures, such as 3130 *Oligothropic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea*, or functions, for example, 3190* *Lakes of gypsum karst*. Measures for restoration of characteristic vegetation in the littoral zone and shore – these measures are usually related to the removal of undesirable species, sometimes it includes mechanical purification of mineral bottom by removing organic debris that have been accumulated. Restoration of hydrological regime – restoration of the natural water level, removal of land reclamation systems, destruction of beaver dams and reduction of the number of beavers. Decreasing of nutrient pressure – wastewater treatment or a complete discontinuation of wastewater inflow, decreasing the impact of recreation, decrease of the intensity of human economic activities in the catchment area.

Threats

Majority of threats are similar to all freshwater habitats. Natural changes in the hydrological regime of a territory – decrease of precipitation and run-off that is related to it and subsequent lowering of water level. Processes of eutrophication and dystrophication – in natural conditions these processes develop very slowly, but nowadays it is difficult to distinguish natural processes from the impact that is caused by human activities. Due to eutrophication the environmental conditions that are necessary for rare aquatic plant species change and they are depressed by phytoplankton or more competitive aquatic plant species. The process of dystrophication also changes environmental conditions – water chromaticity increases, while water transparency decreases, water becomes more acid, which is followed by changes in species composition. Human economic activities have a negative impact or destroy structures or functions of habitats. For example, excavation of riverbeds, creation of dykes, construction of dams, transformation of flood plains and coastal area of lakes (including digging off or banking of lake shores), alteration of water level (with the exception of normalizing water level in order to improve the quality of a habitat), land reclamation in the catchment area, inflow of mire waters, intensive forestry and agricultural activities in the drainage basin and the whole catchment area, artificial increase of benthos-feeding fish (tenches, breams, carps) stocks, input of wastewater, heavy pressure from recreation, damaging or destroying of ground cover and soil erosion at lake shores and riverbanks.

Management

Natural freshwater habitats usually do not require management. Some of these habitats require management in order to delay natural eutrophication, avert or decrease the consequences of increased eutrophication and other impacts that have been caused by human activities in order to preserve and improve the habitat quality. Potential management measures: averting negative anthropogenic influences such as pollution and recreational pressure; restoration of the natural hydrological regime or maintenance of the water level that has stabilized over a longer period of time (if there are water regulating constructions on the outlet of the water-body); reducing overgrowth and limiting the spread of inferior species, such as common reed; improving the structure of shore vegetation, e.g., cutting of shrubs and thinning of trees, removal of branches, windfallen trees, organic debris and destruction of beaver dams. Prior to implementation of management measures their potential impact on the ecosystem of a lake or a river, as well as the expected effectivity should be assessed.

Related habitats

Freshwater habitats that are included in the Habitats Directive in their typical variants can be easily distinguished from each other by environmental factors or vegetation structure and characteristic species. Eutrophication increases the proportion of features characteristic to eutrophic lakes, thus the minimum necessary features that should be used in habitat identification are given in habitat descriptions.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses Nams, 160 lp.;

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw;

Ellenberg, H. (1996) Vegetation Mitteleuropas mit den Alpen in ökologischer, dynamischer und historischer Sicht., Ulmer;

Interpretation manual of European Union habitats. EUR 27 (2007) European Commission, DG Environment, pp.144.;

Kļaviņš, M., Cimdiņš, P. (2004) Ūdeņu kvalitāte un tās aizsardzība. Rīga. 208 lp.;

Mäemets, A. (1974) On Estonian lake types and main trends of their evolution. Estonian wetlands and their life. Estonian Contributions to the International Biological programme, No.7, Tallinn, Valgus, pp.29–62;

Poikāne, S. (2000) Latvijas ezeru tipoloģija: teorija un prakse. Maģistra darbs. Latvijas Universitāte, Rīga;

Urtāns, A. (2008) Upju biotopu apsaimniekošana: Salacas un Jaunupes rekultivācijas pieredze. Grām.: Aktuālā savvaļas sugu un biotopu apsaimniekošanas problemātika Latvijā (2008) A.Auniņa red. Rīga, Latvijas Universitāte, 162 lp.;

3130 *Oligotrophic to mesotrophic standing waters with vegetation of the Littorellatea uniflorae and/Isoeto-Nanojuncetea*

Latvian habitat classification: C.2.4.6., C.2.5., C.3.1.1., C.3.2.2.; partially C.2.3.7.

Syntaxonomy: *Littorelletea, Isoeto-Nanojuncetea*.

Definition: clear water or brown water lakes poor in nutrients, in the ecosystem of which the species of *Lobelia-Isoëtes* complex have a significant role.

Specific characteristics of habitat interpretation in Latvia: lakes and their floodland zone with a characteristic vegetation of species of *Lobelia-Isoëtes* complex, as well as mesotrophic and semidystrophic lakes represent this habitat. Periodically dried up water-bodies, at shores of which plant communities of *Isoeto-Nanojuncetea* class can be found, are not considered to represent this habitat.

Distribution: this lake type is very rarely found in Latvia. It occupies the total area of 5 570 ha, which equals to 0.08% of the total territory of Latvia (Conservation status of.., 2013). It is found mainly in Vidzeme region (e.g., Lake Ummis, Lake Mazuika, Lake Kadagas and Lake Ungurs etc.), but much fewer lakes in Kurzeme region (e.g., Lake Pinku, Lake Klāņezers etc.) and Latgale region (Lake Sīvers, Lake Laukezers, Lake Svātavas etc.).

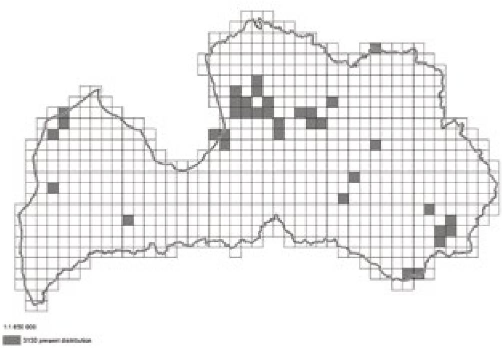


Figure 3.1. Distribution of the habitat 3130 *Oligotrophic to mesotrophic standing waters with vegetation of the Littorellatea uniflorae and/or Isoeto-Nanojuncetea* in Latvia (Conservation status of.., 2013).

Value of protection: a very rarely found lake type in Latvia that is especially vulnerable to and threatened by eutrophication and pollution. The number of lakes representing this habitat has decreased dramatically during the last century; moreover, the quality of this habitat has also decreased in majority of lakes. Lakes of this type are the only sustainable habitat for species of the *Lobelia-Isoëtes* complex. During the last century 63% of the localities of this habitat have gone extinct in the result of human activity.

Environmental factors and processes with a functional role: the most significant factor for the existence of lake ecosystems of this type is the low concentration of nutrients in water. It determines slow development of eutrophication and provides the necessary light and nutrient conditions for the characteristic species. It also provides preservation of sandy, gravelly, shingly or stiny bottom in the littoral zone of the lake. Nutrient poor soils in lake drainage basin, small size of the drainage basin and slow water exchange in the lake contribute to low concentration of nutrients in the water. Littoral zone with the bottom of the mineral soil, water that is poor in nutrients and natural annual fluctuations of water level provide existence of the typical floodland zone that is characteristic to this habitat. Because of nutrient poor soils, shores of these lakes in Coastal Lowlands are usually covered by pine forests that decrease accumulation of organic sediments and eutrophication within the coastal zone and also favour the enrichment of lake water with oxygen under the influence of wind.

Vegetation characteristics: vegetation of these lakes is visually poor; stretches of the littoral zone with the bottom dominated by mineral soil that are free of vegetation are present. Short perennial and annual plants of wet and periodically dried up sites form sparse vegetation in the floodland zone that gradually transforms into forest vegetation (*Fig. 3.2.*). Plant communities formed by species of the *Lobelia-Isoëtes* complex and the accompanying plant species are characteristic of the zone of submerged rosette plants and floating-leaved plants as well as in the floodland zone (*Fig. 3.3., 3.4.*). The emergent-leaved vegetation is absent or it is

Figure 3.2. Shallow coastal and floodland zone is characteristic of plant communities of *Lobelia dortmanna* (Photo: V.Baroniņa).

usually formed by sparse stands of *Phragmites australis*, *Eleocharis spp.*, *Carex spp.* and other species. The zone of floating-leaved plants is either formed by *Sparganium angustifolium*, *S.gramineum* or it has not been established, or it is fragmentarily formed by other species of floating-leaved plants (*Fig. 3.5.*). The zone of submerged aquatic plants is either formed by *Myriophyllum alterniflorum* or it has not been established, or it is fragmentarily formed by other species of aquatic plants.

Characteristic species: vascular plants – *Eleocharis acicularis*, *Eleocharis multicaulis*, *Isoëtes lacustris*, *I.echinospora*, *Juncus bulbosus*, *Littorella uniflora*, *Lobelia dortmanna*, *Lycopodiella inundata*, *Myriophyllum alterniflorum*, *Ranunculus reptans*, *Sparganium angustifolium*, *S.gramineum*, *Subularia aquatica*; bryophites – *Fontinalis dalecarlica*, *Fossombronia foveolata*, *Riccardia chamaedryfolia*, *Scapania irrigua*, *Warnstorfia exannulata*, *Sphagnum inundatum*; invertebrates – *Orectochilus villosus*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Isoëtes lacustris, I.echinospora*, *Juncus bulbosus*, *Littorella uniflora*, *Lobelia dortmanna*, *Lycopodiella inundata*, *Myriophyllum alterniflorum*, *Ranunculus reptans*, *Sparganium angustifolium*, *S.gramineum*, *Subularia aquatic, Leucorrhinia albifrons.*

Variants: Depending on whether the compliance to the habitat is determined by occurrence of characteristic plant communities or physical, chemical and other biological parameters of water, the following variants are distinguished:

3130_1: lakes in the ecosystem of which typical plant communities of class *Littorelletea* formed by species of the *Lobelia-Isoëtes* complex have a significant role;

3130_2: mesotrophic lakes (*Fig. 3.6.*);

3130_3: semidystrophic lakes (*Fig. 3.7.*).

Habitat quality

Minimum habitat requirements: occurrence of characteristic plant specie communities in at least 1% of the littoral zone of a

Figure 3.3. Floodland zone (*High water zone*) with sparse vegetation at the shore of Lake Klāņezers (Photo: V.Baroniņa).

Figure 3.4. Plant community with *Lobelia dortmanna* and *Myriophyllum alterniflorum* (Photo: E.Zviedre).

Figure 3.5. Stands of *Sparganium gramineum* in the zone of floating-leaved plants (Photo: V.Līcīte).

lake, mesotrophicity of a lake (in stratified lakes oxygen is present throughout the whole water column till the bottom), or semidistrophy of a lake (the littoral zone is predominantly covered by mineral soil, water chromaticity does not exceed 80 Pt-Co, electrical conductivity is less than 165 µS/cm, pH exceeds 5).

Structural indicators: all indicators described in the introductory chapter of freshwater habitats. A higher quality of the habitat is indicated by a greater diversity of characteristic species, a larger area covered by communities of these species and of the bottom covered by mineral soil that is free of mud, occurrence of rare and protected species, indicator species for oligotrophic, mesotrophic or semidystrophic environment, a higher level of water transparency, good oxygen conditions throughout the whole water column, lower water chromaticity, lower concentration of total phosphorus and chlorophyll, structure of coastal vegetation characteristic of this habitat.

Functional and processes indicators: all indicators described in the introductory chapter of freshwater habitats.

Restoration potential and quality improvement indicators: all indicators described in the introductory chapter of freshwater habitats.

Threats: the habitat is extremely vulnerable to all threats described in the introductory chapter.

Management: it is necessary to preserve the natural hydrological regime, to manage the drainage basin extensively, to limit recreational activities and prohibit inflow of any wastewater and any other activities that could result in nutrient inflow. It may be necessary to limit distribution of inferior species (e.g., reeds) and to improve the structure of coastal vegetation (e.g. cutting of inferior trees and shrubs). However, prior to the implementation of these measures their potential impact on the ecosystem of a lake should be assessed.

Similar habitats: vegetation of *Chara spp*. can be present in deep mesotrophic lakes making them visually similar to the habitat 3140 *Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.* In such cases the trophic condition of a lake is determinant – if a lake is mesotrophic, it is considered to be the habitat 3130. Dark brown water with chromaticity higher than 80 Pt-Co can also be found in *Natural dystrophic lakes and ponds* (3160) as well as dyseutrophic lakes which is one of the varieties of the habitat 3150 *Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation*. *Natural dystrophic lakes and ponds* (3160) are identified by the fact that they are located on peat, whereas habitat 3130 – on mineral soil. Dyseutrophic lakes, however, contain rich vegetation that is characteristic to the habitat 3150 and is not found in the habitat 3130.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats of Latvia:
4.2. Lakes with oligothropic to mesotrophic plant communities; 4.9. Mesotrophic lakes; 4.15. Semidystrophic (oligodystrophic) lakes; partially complies with 4.7. Lakes with stands of *Sparganium angustifolium* and *Sparganium gramineum*; 4.11. Extensive lake beaches that are not overgrown; 4.12. Lakes with stands of *Myriophyllum alterniflorum*; 4.14. Coastal dune lakes and their shores with plant communities of *Eleocharis multicaulis*, *Rhynchospora fusca* and *Myrica gale*; 4.16. Lakes with stands of *Nuphar pumila*; 4.19. Lakes with the littoral dominated by mineral soil.

Figure 3.6. Lake Pinku. Clear water, high water transparency and poor vegetation are characteristic of mesothrophic lakes (Photo: V.Līcīte).

Figure 3.7. Lake Ungurs. Brown water, predominantly mineral soil in the littoral and poor vegetation are characteristic of semidystrophic lakes (Photo: V.Līcīte).

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw;

Sniedze, R. (2004) Oligotrofās augu sabiedrības ezeros Latvijā. Bakalaura darbs. Latvijas Universitāte, Rīga, 39 lpp.;

Suško, U. (1990) Rietumu Garezera flora. Daugavpils Pedagoģiskais institūts, Daugavpils. 116 lpp.;

Suško, U. (1996) Lobēliju-ezereņu komplekss. Nepublicēts;

Suško, U. (1999) Vides aizsardzības speciālistu priekšlikumi un ieteikumi līdzsvarotai attīstībai unikālajos Rīgas rajona lobēliju-ezereņu ezeros. Nepublicēts;

Suško, U. (2008) Dabas lieguma "Stiklu purvi" ezeri un to ūdensaugu flora. Grām.: Pakalne, M. (red.) Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā, Latvijas Dabas fonds, Rīga, p. 62–67;

Suško, U. (2008) Klāņezera raksturojums, makrofītu flora un izmaiņas 10 gados. Grām.: Pakalne, M. (red.) Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Latvijas Dabas fonds, Rīga. p. 90–93;

Suško U., Āboliņa A. (2010) Bryophyte species composition in natural lakes of Latvia and their role in processes of overgrowing// Bryology: traditions and state-of-the-art. *Proceedings of the international bryological conference devoted to the 110-th birthdays of Zoya Nikolaevna Smirnova and Claudia Ivanovna Ladyzhenskaja*, pp. 136. – 140. Saint Petersburg, 11 – 15 October, 2010.

3140 *Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.*

Latvian habitat classification: C.2.4.14.

Syntaxonomy: *Charetea.*

Definition: mainly hard water lakes with communities of *Charophyta* dominating the ecosystem.

Specific characteristics of habitat interpretation in Latvia: waterbodies of artificial origin and bog pools that may have benthic vegetation of *Chara spp*. are not considered as the habitat of EU importance 3140.

Distribution: this lake type is found in Latvia rather rarely. It occupies an area of 8 810 ha, which equals 0.1% of the total territory of Latvia (Conservation status of.., 2013). This type of lakes is represented by, e.g., Lake Zvirgzdu, Lake Engures, Lake Kaņieris, Lake Kurjanovas and Lake Silabebru.

Conservation value: specific, relatively rare type of lakes with a characteristic species complex. Stoneworts accumulate nutrients, therefore water quality in lakes is high during the vegetation period. Lakes of this type are a significant habitat for waterbird species, and significant habitat for protected plant species such as *Cladium mariscus* and *Najas marina*.

Figure 3.9. Benthic vegetation of charophytes in Lake Zvirgzdu (Photo: J.Sprūds).

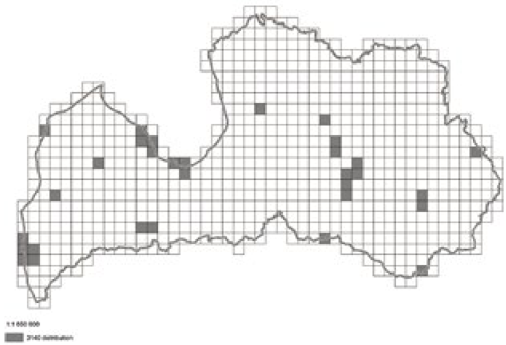


Figure 3.8. Distribution of the habitat 3140 *Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.* in Latvia (Conservation status of.., 2013).

Environmental factors and processes with a functional role: formation and existence of this habitat is promoted by the presence of lime rich soil, wide and shallow littoral zone, hard water (rich in compounds of calcium and magnesium), and low concentration of nutrients in the water. Water transparency usually exceeds 2 m or reaches the bottom of shallow lakes. The water pH usually exceeds 7.

Vegetation characteristics: characteristic vegetation of submerged and emergent-leaved aquatic plants (*Fig. 3.9.*). Quagmires are frequently present at lake shores. In zone of submerged aquatic plants communities of *Chara spp.* dominate occupying the largest part of the lake area (*Fig. 3.10.*). Sometimes communities of *Najas marina* can be found. The zone of emergent-leaved plants or shoreline quagmires consist of *Phragmites australis*, *Typha angustifolia*, *Cladium mariscus* and stands of other species. Zone of floating-leaved vegetation is usually fragmentary.

Characteristic species: charophytes – *Chara spp.*, *Nittellopsis obtusa*; invertebrates – *Chaoborus*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Chara aspera*, *Ch.contraria*, *Ch.hispida*, *Ch.intermedia*, *Ch.rudis*, *Ch.tomentosa*, *Nitellopsis obtusa*, *Cladium mariscus*, *Najas marina*, *Dytiscus latissimus*, *Leucorrhinia albifrons*.

Varieties: none.

Habitat quality

Minimum habitat requirements: a macrophyte lake (one where nutrients are fixed mostly in aquatic plants rather than plankton) and *Chara spp.* communities dominate the lake ecosystem.

Structural indicators: all indicators described in the introductory chapter of freshwater habitats, except for the presence of oxygen in the water. Higher quality of the habitat is indicated by a larger diversity of characteristic species and larger area that is covered by these species, larger area of the bottom covered by mineral soil that is free of mud, greater water transparency, lower water chromaticity and concentration of chlorophyll. The conservation value of this habitat is increased by the presence of rare and protected species, e.g., *Najas marina*, *Najas* and *Cladium mariscus*.

Function and process indicators: all indicators described in the introductory chapter of freshwater habitats.

Restoration potential and quality improvement indicators: all indicators described in the introductory chapter of freshwater habitats.

Threats: all factors described in the introductory chapter of freshwater habitats.

Management: maintenance of the water level that has stabilized over a longer period of time (if there is water regulating constructions on the outlet of the water-body), reduction of the concentration of nutrients in the inflowing waters. Recreation and tourism should be limited in lakes of high quality and windfalls of trees should be removed from the coastal part of mineral soil. Inflow of wastewater should be averted.

Similar habitats: in cases when communities of *Chara spp.* are found in a lake, but its ecosystem is largely determined by communities of other aquatic plants, a lake is considered to represent the habitat 3150 *Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation*. Benthic vegetation of *Chara spp.* can also be found in deep mesotrophic lakes that represent the habitat 3130 *Oligotrophic to mesotrophic standing waters with vegetation of the Littorellatea uniflorae and/or Isoeto-Nanojuncetea*. In such cases the trophic condition of a lake becomes determinant – if a lake is mesotrophic, it is considered to represent the habitat 3130 *Oligothropic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea*. Communities of *Cladium mariscus* that are larger than 4 m^2 in hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.* are classified as a separate habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae* (smaller communities are not identified separately).

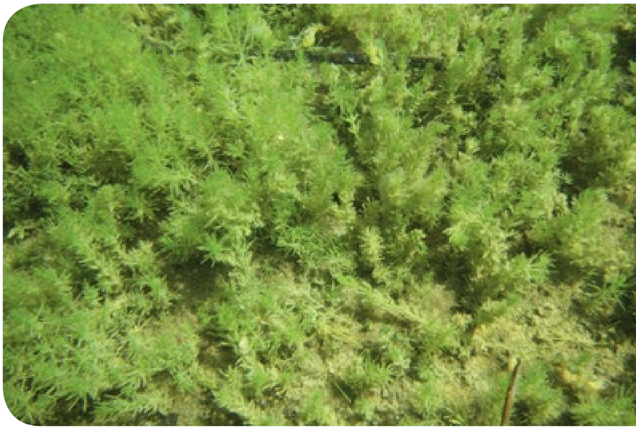


Figure 3.10. Benthic vegetation of charophytes (Photo: U.Suško).

Overlap with other habitats of EU importance: if stands of *Cladium mariscus* are located within the habitat 3140*, its cover exceeds 50% of the herb layer and the habitat occupies at least 4 m^2, they are threated separately as the habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae*.

Corresponding specially protected habitats of Latvia: 4.18. Lakes with vegetation of *Charophyta*; partially complies with: 4.4. Lakes and their coastal areas with stands of *Cladium mariscus*. 4.10. Lakes with stands of *Najas spp*.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

Zviedre, E. (2008) Latvijas saldūdens mieturaļģu (*Charophyta*) flora un ekoloģija. Promocijas darbs. Latvijas Universitāte, Bioloģijas fakultāte

3150 *Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation*

Latvian habitat classification: C.2.1., C.2.2.4., C.2.3., C.2.4., C.3.1.2., C.3.2.3., C.4., C.5.

Syntaxonomy: *Potamogetonion*, *Nymphaeion*, *Hydrocharition*, *Phragmition*, *Magnocaricion*.

Definition: lakes with diverse and rich vegetation of submerged and floating aquatic plant species, with the water pH mostly exceeding 7.

Specific characteristics of habitat interpretation in Latvia: the habitat comprises clear water and brown water lakes as well as oxbows (oxbow and distributary lakes originated from rivers) with appropriate vegetation. Water-bodies of artificial origin (created by raising the water level of a river or excavated) are not considered as the habitat of EU importance 3150.

Distribution: found quite often throughout Latvia. The area occupied by this habitat is 66 330 ha, which equals to 1% of the total territory of Latvia (Conservation status of.., 2013). The majority of lakes in Latvia belong to this habitat type, for example, Lake Svētes, Lake Zebrus, Lake Kālezers, Lake Nedzis, Lake Svente, Lake Bižas and Lake Cārmaņa.

Conservation value: a habitat of natural origin, which is the most significant habitat for typical freshwater plant and animal species in Latvia. Rarely found slightly eutrophic lakes that are vulnerable to eutrophication are especially valuable (Fig. 3.16.). Shallow, overgrowing lakes are significant habitats for waterbirds. This habitat is significant also for such rare and specially protected species as *Callitriche hermaphroditica*, *Najas flexilis*, *N.marina*, *N.minor*, *N.tenuissima*, *Nuphar pumila*, *Potamogeton acutifolius*, *P.rutilus*, *P.trichoides*, *Trapa natans*, *Hirudo medicinalis*, *Botaurus stellaris*, *Circus aeruginosus* and other species.

Environmental factors and processes with a functional role: diverse bottom conditions and physical and chemical indicators of water are characteristic. Both sandy and muddy bottoms occur. Water is usually medium rich to rich in nutrients and its color varies from yellow-green to yellow-brown and brown, pH usually exceeds 7. Water transparency differs depending on the content of humic acids and phytoplankton development, however, during the vegetation season it is most often 0.5–2.5 m. Occasionally the water transparency in clean lakes with small catchment areas as well as in some slightly eutrophic lakes reaches even 2.5–6, in some lakes occasionally even 8.4 m (Lake Sventes). Natural hydrological regime, size of the drainage basin, types of soils and human economic activities in the drainage basin are significant. In natural conditions lakes with small catchment areas and slow water exchange become eutrophicated slowlier, whereas running-water lakes with a fast water exchange are dependent on the concentration of nutrients and humic substances etc. of the inflowing water.

Vegetation characteristics: medium diverse to diverse, usually rich in species, vegetation is characteristic. All zones of macrophyte vegetation represented by emergent-leaved, floating-leaved and submerged vegetation which contain various communities of characteristic and other plant spe-

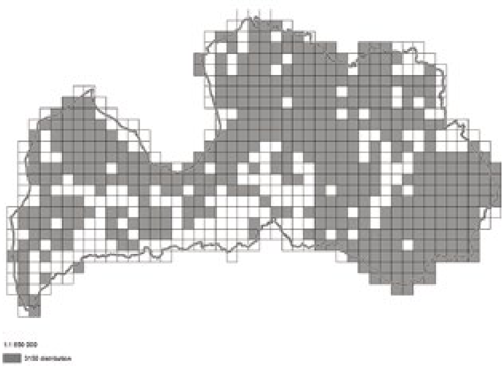


Figure 3.11. Distribution of the habitat *3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation* in Latvia (Conservation status of.., 2013).

Figure 3.12. Lake Skujine. Plant communities are formed by species of emergent-leaved, floating-leaved and submerged aquatic plant species (elodeids) (Photo: U.Suško).

cies, are usually well developed (*Fig. 3.12.*). Zone of shoreline quagmires can also occur.

Characteristic species: vascular plants – *Alisma plantago-aquatica*, *Batrachium circinatum*, *Butomus umbellatus*, *Eleocharis palustris*, *Hydrocharis morsus-ranae*, *Myriophyllum spicatum*, *M.verticillatum*, *Nuphar lutea*, *N.pumila*, *Nymphaea alba*, *N.candida*, *Polygonum amphibium*, *Potamogeton acutifolius*, *P.berchtoldii*, *P.compressus*, *P.filiformis*, *P.friesii*, *P.gramineus*, *P.lucens*, *P.natans*, *P.pectinatus*, *P.perfoliatus*, *P.praelongus*, *P.pusillus*, *P.rutilus*, *P.sturrockii*, *P.trichoides*, *Sagittaria sagittifolia*, *Scirpus lacustris*, *Stratiotes aloides*, *Typha angustifolia*, *Utricularia australis*, *U.vulgaris*; bryophytes - *Calliergon megalophyllum*, *C.richardsonii*, *Drepanocladus aduncus*, *D.sendtneri*, *Fontinalis antipyretica*, *F.hypnoides*, *Rhynchostegium riparioides*, *Scorpidium scorpioides*; invertebrates - *Anodonta spp.*, *Orthetrum spp.*, *Baetis spp.*, *Caenis spp.*, *Dytiscus spp.*, *Agabus spp.*, *Ilybius spp.*, *Sigara spp.*, *Hydrometra spp*. and other species, *Ranatra linearis*.

Umbrella species (typical species within the meaning of the Habitats Directive): vascular plants – *Alisma gramineum*, *Calliergon megalophyllum*, *Callitriche hermaphroditica*, *Elatine hydropiper, Hamatocaulis lappnicus*, *Hydrilla verticillata*, *Nuphar pumila*, *Najas flexilis*, *N.major*, *N.marina*, *N.minor*, *N.tenuissima*, *Potamogeton acutifolius*, *Potamogeton rutilus*, *Potamogeton trichoides*, *Scirpus radicans*, *Scolochloa festucacea*, *Sparganium erectum*, *Trapa natans*; invertebrates – *Hirudo medicinalis*, *Dytiscus latissimus*, *Graphoderus bilineatus*, *Aeshna viridis*, *Leucorrhinia pectoralis*, *Leucorrhinia caudalis*; birds – *Botaurus stellaris*, *Circus aeruginosus*.

Variants: depending on water chromaticity and origin of lakes, the following habitat variants are distinguished:

3150_1: clear water lakes with submerged vegetation,
3150_2: brown water lakes with diverse vegetation,
3150_3: oxbows (lakes of oxbow and distributary origin) with diverse vegetation typical of eutrophic lakes (*Fig. 3.13.*).

Figure 3.13. Pededze oxbow with vegetation of *Stratiotes aloides* and other aquatic plant species (Photo: V.Kreile).

Figure 3.14. Lake Bardinska. Shallow overgrowing clear water and brown water lakes with quaking shores are also considered to represent habitat 3150 *Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation* (Photo: U.Suško).

Habitat quality

Minimum habitat requirements: vegetation is formed by communities of characteristic plant species (*Fig. 3.14., 3.15.*), plant communities that characterize habitat 3130 do not cover more than 1% of the littoral zone length, and vegetation of *Chara spp*. (habitat 3140) is not dominant in the lake.

Structural indicators: all indicators that are described in the introductory chapter of freshwater habitats. A higher habitat quality is indicated by a greater diversity of characteristic species and communities formed by these species, especially in zone of submerged macrophytes, larger area of mineral soil not covered by mud, greater water transparency, good oxygen conditions, especially in deepest layers of water, lower water chromaticity and total concentration of phosphorus and chlorophyll, coastal vegetation structure typical of the habitat, as well as the presence of indicator species of mesotrophic and slightly eutrophic environments. Value of the habitat is increased by the presence of rare and protected species, and also by its importance in preservation of waterbird populations.

Function and process indicators: all indicators described in the introductory chapter of freshwater habitats.

Restoration potential and quality improvement indicators: all indicators described in the introductory chapter of freshwater habitats.

Threats: all factors described in the introductory chapter of freshwater habitats. Slightly eutrophic lakes with slow water exchange are especially endangered.

Management: it is necessary to preserve natural hydrological regime, to reduce nutrient concentration in the inflowing waters and to avert inflow of insufficiently cleaned wastewater. In slightly eutrophic lakes of high quality with slow water exchange, inflow of any wastewater should be prevented. Limitations of recreation and tourism in slightly eutrophic lakes.

Similar habitats: water chromaticity of habitat variant 3150_2 (brown water lakes with diverse vegetation) is higher than 80 Pt-Co, therefore it can resemble semidystrophic lakes belonging to the habitat 3130 and dystrophic lakes (habitat 3160). Communities of characteristic species and trophic level of a lake are the determinant factors. Characteristic species communities of habitat 3150 can also be found in habitat 3140, however, in this habitat, communities of *Chara spp*. have the determinant role in lake ecology.

Overlap with other habitats of EU importance: habitat 3150 can develop in lake beds of gypsum karst origin – such lakes belong to habitat 3190*. If communities of *Cladium mariscus* are located within the habitat 3150 and the cover of *Cladium mariscus* exceeds 50% of the total cover of the herb layer and the habitat occupies at least 4 m^2, these stands are separated as the habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae*.

Corresponding specially protected habitats in Latvia: 4.20. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation. 4.13. Lakes with stands of *Trapa natans*. Partially corresponds to: 4.11. Extensive lake beaches that are not overgrown. 4.12. Lakes with stands of *Myriophyllum alterniflorum*. 4.16. Lakes with stands of *Nuphar pumila*. 4.19. Lakes with the littoral dominated by mineral soil.

Figure 3.15. Lake Dviete. Rapid growth of *Lemna spp.* and *Spirodela polyrhiza* indicates increased concentration of nutrients in water and lower habitat quality (Photo: U.Suško).

Literature:

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Mäemets, A. (1974) On Estonian lake types and main trends of their evolution. Estonian wetlands and their life. Estonian Contributions to the International Biological programme, No.7, Tallinn, Valgus, 29–62 p.

Poikāne, S. (2000) Latvijas ezeru tipoloģija: teorija un prakse. Maģistra darbs. Rīga, Latvijas Universitāte

Figure 3.16. Lake Svente. Mineral soil and very clear water are characteristic of slightly eutrophic lakes (Photo: U.Suško).

3160 *Natural dystrophic lakes and ponds*

Latvian habitat classification: C.3.2.1.

Syntaxonomy: *Utricularietalia*.

Definition: natural lakes and ponds with brown tinted water due to peat and humic acids, generally on peaty soils in bogs or in heaths with natural evolution toward bogs. The pH is often low, 3 to 6.

Specific characteristics of habitat interpretation in Latvia: water-bodies of artificial origin are not considered to represent this habitat.

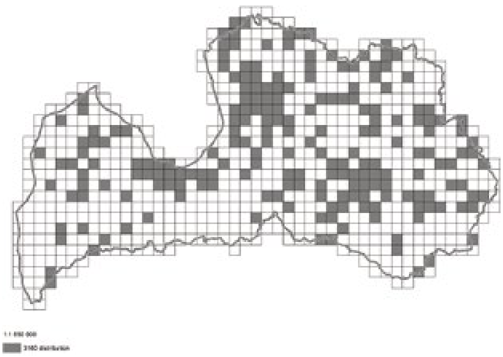


Figure 3.17. Distribution of the habitat 3160 *Natural dystrophic lakes and ponds* in Latvia (Conservation status of.., 2013).

Distribution: type of lakes that are rarely represented in Latvia. These lakes are to be found throughout the whole territory of Latvia in accordance with the distribution of raised bogs (e.g., Lake Murmastiene, Lake Ramata, Lake Skaista, Lake Akacis). The total area occupied by this habitat is 3 140 ha, which equals to 0.05% of the territory of Latvia (Conservation status of.., 2013).

Figure 3.18. A typical dystrophic lake in Cena Moorland (Photo: V.Baroniņa).

Conservation value: a rare type of lakes that is usually a part of the ecological complex of bogs that supplement their landscape. Specific zooplankton cenosis are present in dystrophic lakes – the complex of *Holopedium*, which is formed by zooplankton species typical of dystrophic lakes: *Holopedium gibberum, Diaphanosoma brachyurum, Ceriodaphnia quadrangula, Bosmina obtusirostris, Polyphemus pediculus* (Mäemets, 1974). Lakes of large peat bogs are the only nesting places for the protected *Gavia arctica* in Latvia.

Environmental factors and processes with a functional role: dystrophic lakes have formed in raised bogs or the drainage basins of these lakes are dominated by peat soil, which provides the inflow of humic substances. Water rich in humic substances and peaty bottom is characteristic of these lakes. Water color ranges from brown to red-brown, water pH is 3–6. Natural hydrological regime of the drainage basin is of great importance – it ensures natural development of the bog habitat complex, also including these lakes.

Vegetation characteristics: a very poor vegetation is characteristic; lakes often lack any vegetation (*Fig. 3.18.*). Separate stands or specimen of characteristic species, sometimes species of other aquatic plants (e.g., *Nuphar lutea*, *N.pumila*, *Nymphaea spp.*) are to be found. Sedges and *Sphagnum* mosses occur mainly around the shoreline and at shores (*Fig.* 3.19.). Plant communities of transition or raised bogs with sedges and *Sphagnum* mosses or bogswamp forests occur at shores.

Characteristic species: vascular plants – *Carex lasiocarpa*, *C.limosa*, *Utricularia minor*; bryophites – *Sphagnum cuspidatum*; complex of zooplankton species – *Bosmina obtusirostris, Ceriodaphnia quadrangula, Diaphanosoma brachyurum, Holopedium* *gibberum*, *Polyphemus pediculus*; invertebrates – *Chaoborus*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Bosmina obtusirostris, Ceriodaphnia quadrangular*, *Diaphanosoma brachyurum*, *Holopedium gibberum*, *Polyphemus pediculus*, *Dytiscus lapponicus*, *Leucorrhinia albifrons*, *Somatochlora arctica*.

Variants: none.

Habitat quality

Minimum habitat requirements: location in bog habitat complex or pH 3–6 and water chromaticity exceeds 80 Pt-Co.

Structural indicators: occurrence of characteristic species, number of protected species and species included in the Red Data Book of Latvia, zooplankton cenosis (*Holopedium gibberum + Diaphanosoma brachyurum + Ceriodaphnia quadrangula + Bosmina obtusirostris + Polyphemus pediculus*), concentration of chlorophyll *a* and water pH.

Function and process indicators: all indicators described in the introductory chapter of freshwater habitats.

Restoration potential and quality improvement indicators: restoration of the hydrological regime and decrease of nutrient inflow.

Threats: drainage of bogs located within the drainage basin or lowering of water level that causes mineralization of peat and increases the concentration of nutrients in the inflowing waters. Additional input of nutrients into the lake caused by any other activity.

Management: non-intervention – no alterations of to the natural hydrological regime or its restoration, preservation of untouched bogs in the drainage basin and prevention of inflow of any pollution and additional nutrients.

Similar habitats: dark brown water with chromaticity exceeding 80 Pt-Co can also occur in dyseutrophic lakes which is one of variants of the habitat 3150 *Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation* (brown water lakes with diverse vegetation) and in semidystrophic lakes, which is one of variants of the habitat *Oligothrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or Isoeto-Nanojuncetea*. These can be distinguished by pH, which is always below 6 in dystrophic lakes that also have a peaty bottom. Likewise brown water can be also present in lakes with vegetation of *Chara spp*., which can also have peaty shores, but these lakes belong to the habitat 3140 *Hard oligo-mesotrophic waters with benthic vegetation of Chara spp*. In such cases the pH of the lake water is higher than 6 and communities of *Chara spp*. dominate in the ecology of the lake.

Overlap with other habitats of EU importance: if bog-pools in raised bogs are larger than 0.1 ha, they are identified as habitat 3160 *Natural dystrophic lakes and ponds*.

Figure 3.19. Narrow zones of sedges Carex *spp*. and floating *Sphagnum* mosses (e.g., *Sphagnum cuspidatum*), as well as separate stands of floating-leaved plants are characteristic of natural dystrophic lakes and ponds (Photo: V.Lārmanis).

Corresponding specially protected habitats in Latvia:
4.3. Dystrophic lakes.

Literature:

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw;

Mäemets, A. (1974) On Estonian lake types and main trends of their evolution. Estonian wetlands and their life. Estonian Contributions to the International Biological programme, No.7, Tallinn, Valgus, pp.29–62;

Suško U., Āboliņa A. (2010) Bryophyte species composition in natural lakes of Latvia and their role in processes of overgrowing// Bryology: traditions and state-of-the-art. *Proceedings of the international bryological conference devoted to the 110-th birthdays of Zoya Nikolaevna Smirnova and Claudia Ivanovna Ladyzhenskaja*, pp. 136. – 140. Saint Petersburg, 11 – 15 October, 2010.

3190* *Lakes of gypsum karst*

Latvian habitat classification: H.3.1., H.3.4.

Syntaxonomy: not significant in determination of the habitat.

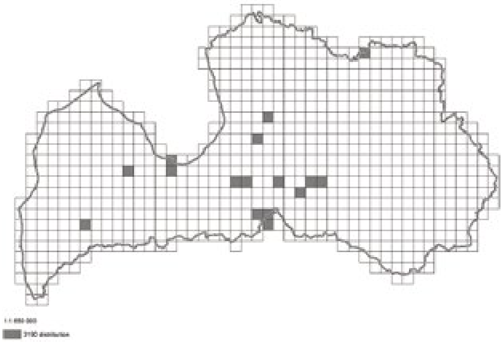


Figure 3.20. Distribution of the habitat 3190* *Lakes of gypsum karst* in Latvia (Conservation status of.., 2013).

Definition: small permanent lakes that have developed in springs or spring complexes of active gypsum karst areas. These water bodies are characterised by large fluctuations of water level which is related with the level of the underlying water table and amount or precipitation.

Specific characteristics of habitat interpretation in Latvia: includes permanent as well as periodically dried up water-bodies that have developed in the result of gypsum karst processes in dolomite and limestone rocks.

Distribution: a very rare habitat that is mostly found in surroundings of Allaži, Skaistkalne and Saldus, where surface disclosure of karst processes is observed (*Fig. 3.16.*). The total area occupied by this habitat is 47 ha, which equals 0.0007% of the territory of Latvia (Conservation status of.., 2013).

Conservation value: a type of water-bodies that is very rarely found in Latvia. It is a unique geological process that provides formation of lakes also nowadays. Many legends are related to karst processes; therefore, these processes have a cul-

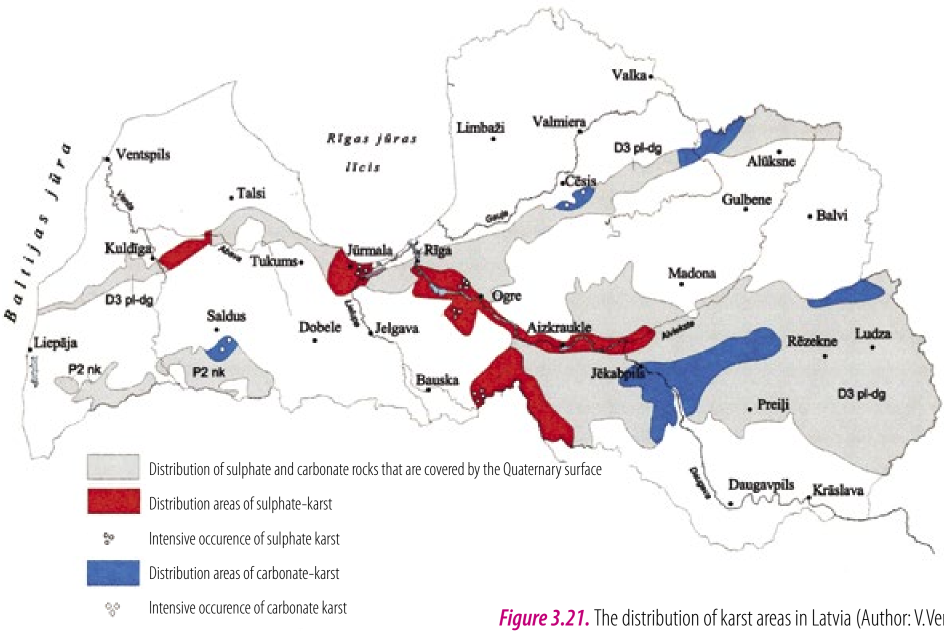


Figure 3.21. The distribution of karst areas in Latvia (Author: V.Venska).

tural heritage value.

Environmental factors and processes with a functional role: significant precondition for the formation of this habitat are the underground water flows in soluble gypsum, dolomite and limestone bedrocks with suitable structure (cracks, etc.). Processes of gypsum karst occur in Latvia up to the depth of 52 m and, as a result of these processes, karst sinkholes of different shapes – chains of funnel-shaped sinkholes and small hollows – appear on the surface. Surface cave-ins usually accumulate water, the oldest and shallowest sinkholes paludify in course of time. Occasionally, karst sinkholes with an open bottom that is connected to lower permeable sediments are formed, thereby the accumulation of water in them is impossible. The depth of dry karst sinkholes reaches up to 11.5 m in Latvia, while lakes of gypsum karst can reach the depth of 9.5 m. Pronounced fluctuations of water level (*Fig. 3.22.*) as well as high concentration of calcium and sulphate ion are characteristic of the majority of water-bodies that have developed in karst funnels. The course of karst processes is unpredictable – sinkholes can develop suddenly within few hours or a day, or the process can develop very slowly as a gradual "sinking" of a larger territory.

Vegetation characteristics: as lakes of gypsum karst significantly differ in shape, size, age and type of origin, their vegetation can be very diverse. Older sinkholes can develop into bogs or lakes of different types, whereas recently formed sinkholes can lack any vegetation at all. Lakes of gypsum karst are mostly small-sized and have a very poor vegetation that is mainly formed by plant species that have adapted to variable moisture conditions. Communities of freely floating and submerged aquatic plants can be found, whereas older sinkholes can have communities of terrestrial plants.

Characteristic species: there are no species of plants or animals characteristic specifically of this habitat.

Umbrella species (typical species within the meaning of the Habitats Directive): no species closely related to karst processes are known in Latvia until now.

Variants: none.

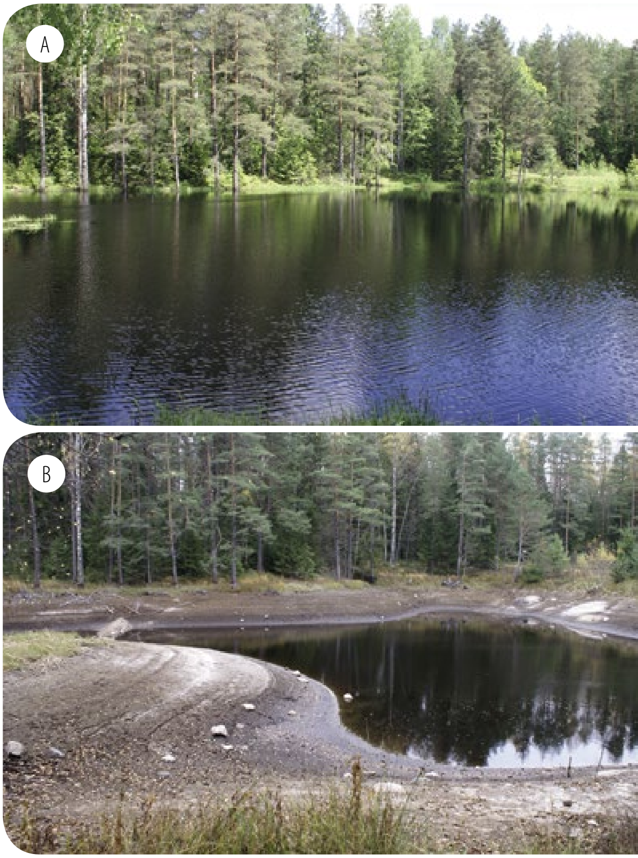


Figure 3.22. Lake Linezers of karst origin in surroundings of Allaži in spring 2010 (A), and the same lake in autumn 2013 (B) (Photo: V.Baroniņa).

Habitat quality

Minimum habitat requirements: suitable geological origin.

Structural indicators: geological origin is a significant factor for this habitat, however, environmental conditions in sinkholes can vary greatly and plant communities of aquatic and terrestrial species can be found there. Therefore, in order to characterize the quality of habitat structure, indicators that characterize the size of the areas that have not been adversely affected are used: the area of the sinkhole with no communities of invasive species and the area of sinkhole with no negative anthropogenic influence.

Function and process indicators: naturalness of the hydrological regime and the scope of anthropogenic impact.

Restoration potential and quality improvement indicators: all indicators described in the introductory chapter of freshwater habitats.

Threats: all factors that are described in the introductory chapter of freshwater habitats as well as the establishment of pits in primary rock within areas of karst processes. Formerly several sinkholes have been used as dumps.

Management: conservation of natural hydrological regime, extensive management of gypsum karst areas, pollution removal and prevention.

Similar habitats: none.

Overlap with other habitats of EU importance: in lake beds of karst origin the habitat 3150 *Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation* can form. However, if a lake is known to have a karst origin, it is identified as the habitat 3190*.

Corresponding specially protected habitats in Latvia: 8.10. Karst lakes, 8.11. Karst sinkholes.

Literature:

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw;

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses Nams, 160 lp.

3260 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation*

Latvian habitat classification: partially D. Rivers.

Syntaxonomy: *Ranunculionon fluitantis*, *Callitricho-Batrachion*, *Sparganio-Glycerion fluitantis*.

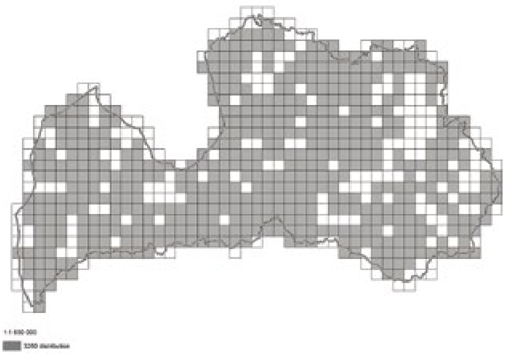


Figure 3.23. Distribution of the habitat 3260 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation* in Latvia (Conservation status of.., 2013).

Definition: water courses of plain to montane levels, with vegetation of *Ranunculion fluitantis* and *Callitricho-Batrachion* or aquatic mosses (*Fig. 3.24.*). In summer the water level in rivers can be very low.

Specific characteristics of habitat interpretation in Latvia: all river stretches with stony, shingly or gravelly riverbed, with the average flow velocity higher than 0.2 m/s as well as all natural unaltered river stretches regardless of flow velocity are identified as this habitat. Dyked, excavated or dredged river stretches with the average flow velocity below 0.2 m/s are not considered to represent this habitat.

Distribution: a relatively rare habitat in the territory of Latvia. Total area occupied by this habitat is 17 620 ha, which equals to 0.3% of the territory of the country (Conservation status of.., 2013).

Conservation value: rivers are a very significant habitat for many plant and animal species; they serve as natural migration roads of species. River rapids with stony or shingly riverbed are of particular importance – it is the only habitat for species that have adjusted to fastly flowing and oxygen-rich waters. The water in river rapids is rich in oxygen and thus considerably accelerates the decomposition of organic materials and increases the self-purification of water. Rivers are the only habitat for several rare and protected species, for example, *Hildebrandia rivularis*, *Margaritifera margaritifera*, *Ancylus fluviatilis*, *Theodoxus fluviatilis*, *Unio crassus*, *Lampetra planeri*, *Alburnoides bipunctatus*, *Salmo trutta fario*. Rivers are the only spawning areas for *Salmo salar*, *Salmo trutta* and *Lampetra fluviatilis*. Rivers also ensure the existence of populations of rare bird species such as *Alcedo atthis*, *Cinclus cinclus* and *Motacilla cinerea*. Rivers and their natural processes, e.g., floods ensure the existence of several other protected habitats such as *Northern Boreal alluvial meadows*, *Alluvial forests with Alnus glutinosa and Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*).

Environmental factors: the water level in rivers is strongly variable and dependent on climatic and meteorological conditions as well as on the groundwater supply, the size and naturalness of the catchment area. The most significant factors that determine formation of the habitat, abundance and diversity of species are flow velocity and riverbed conditions that are closely interrelated as well as light conditions. Riverbeds can be covered by different sediments and also flow velocity can be variable within a habitat. The most appropriate illumination for a river ecosystem to function is a partial (mosaic) illumination, which is also related to the width of a river and the width of the zone which is appropriate for plant development. Nutrient concentration (phosphorus and nitrogen compounds) in water is another significant factor that largely depends on types of land-use and also the proportion of intensively managed agricultural land in the drainage basin. A great part of rivers in

Figure 3.24. A stretch of the Mazā Jugla River with vegetation that is characteristic of the habitat (Photo: R.Sniedze-Kretalova).

their upper reaches mainly corresponds to the category of river rapids (ritral stretches with the average flow velocity higher than 0.2 m/s), whereas in lower reaches, due to the decrease of flow velocity, changes in riverbed conditions and the increase in nutrient concentration in water, rivers are characterized by communities of pothamal or slowly flowing river plant communities. In the middle reaches river rapids usually interchange with slowlier flowing river stretches and are characteristic of riverbeds with differing sediments and variable flow velocity.

Processes with a functional role: the most significant process that determines the existence of rivers and their related ecosystems is the natural hydrological regime and natural fluctuations of water level, including high water and floods (*Fig. 3.26.*). It promotes cyclic development of vegetation and formation of various microhabitats in rivers, self-purification of rivers as well as the existence of specific habitats in river flood plains that are dependent on high water.

Vegetation characteristics: vegetation can be formed by various plant species, occurrence of which depends on flow velocity, water depth, structure of the riverbed, shading and concentration of nutrients in water. Separate, mainly stony or fully shaded river stretches can lack any vegetation. Due to fluctuations of the water level riverbanks and sandbanks uncover themselves and display the vegetation formed by various moisture-loving plant species, e.g., *Carex spp.*, *Phalaroides arundinacea*, *Lythrum salicaria* etc. Fastly flowing, stony rivers are characteristic of communities of red and green algae as well as aquatic mosses attached to stones as well as communities of submerged elodeids rooted in riverbed. Stands of submerged or floating-leaved forms of various *Potamogeton* species and *Nuphar lutea* are characteristic of sandy, deepr and slowlier flowing river stretches, while stands of *Butomus umbellatus*, *Scirpus lacustris*, *Sagittaria sagittifolia*, *Sparganium emersum* and others species are formed in shallower places. *Butomus umbellatus*, *Scirpus lacustris*, *Sagittaria sagittifolia*, species of *Sparganium* are forming also the emergent-leaved (helophyte) zone that is especially characteristic of well-illuminated river stretches that are rich in nutrients (Kłosowski, Kłosowski, 2006). The preferable proportion of the area of river ecosystems covered by vegetation should not exceed 30% of the total area of a river stretch.

Characteristic species: (R - rheophilic species) plants: algae – *Batrachospermum spp.*R, *Hildenbrandia rivularis*R, *Cladophora spp.*R; bryophites – *Fontinalis antipyretica*R, *Rhynchostegium riparioides*R; vascular plants – *Batrachium aquatile*, *B.circinatum*, *B.peltatum*, *B.trichophyllum*, *Berula erecta*, *Butomus umbellatus*, *Callitriche spp.*, *Elodea canadensis*, *Mentha aquatica*, *Myriophyllum spicatum*, *Nuphar lutea*, *Phalaroides arundinacea*, *Potamogeton alpinus*, *P.berchtoldii*, *P.perfoliatus*, *Rorippa amphibia*, *Sagittaria sagittifolia*, *Scirpus lacustris*, *Sium latifolium*, *Sparganium emersum*, *S.erectum*, *Veronica anagallisaquatica*, *V.beccabunga*; invertebrates: molluscs – *Ancylus fluviatilis*R, *Margaritifera margaritifera*R, *Theodoxus fluviatilis*R, *Unio*, *Unio crassus*R; species of stonefly larvae (*Plecoptera*R, *Perlodidae*R of different families); *Elmidae*; *Gammarus spp.*R, *Heptagenia spp.*, *Ecdyonurus spp.*, *Ahelocheirus aestivalis*, *Simuliidae*, *Calopteryx*, *Platycnemis pennipes*, *Orectochilus villosus*; cyclostomes and fishes – *Alburnoides bipunctatus*R, *Lampetra fluviatilis*, *L.planeri*, *Salmo salar*R, *S.trutta*R, *S.trutta fario*R, *Thymallus thymallus*R.

Umbrella species (typical species within the meaning of the Habitats Directive): *Hildenbrandia rivularis*, *Batrachium aquatile*, *Berula erecta*, *Ancylus fluviatilis*, *Margaritifera margaritifera*, *Theodoxus fluviatilis*, *Unio crassus*, *Plecoptera spp.*, *Deronectes latus*, *Brychius elevatus*, *Cordulegaster boltonii*, *Ophiogomphus cecilia, Gomphus flavipes*, *Alburnoides bipunctatus*, *Lampetra fluviatilis*, *L.planieri*, *Salmo salar*, *S.trutta*, *S.trutta fario*, *Thymallus thymallus*.

Variants:

3260_1: river rapids – rivers or river stretches with stony or shingly riverbed and the average flow velocity higher than 0.2 m/sec (*Fig. 3.25.*);

3260_2: all natural rivers and river stretches with the average flow velocity below 0.2 m/sec. Naturalness of a river is indicated by unaltered riverbed and hydrological regime (*Fig. 3.26.*).

Habitat quality

Minimum habitat requirements:

1) if the flow velocity exceeds 0.2 m/s and the riverbed is stony, shingly or gravelly, the habitat represents variant 3260_1;
2) if the flow velocity is lower than 0.2 m/s but a river has a natural riverbed and a natural hydrological regime, the habitat represents variant 3260_2.

Structural indicators: occurrence of characteristic, reophylic, protected species and species that are included in the Red Data Book, structure of riverbed. The total overgrowth of a river does not exceed 30% in optimal conditions. A higher proportion of overgrowth can decrease the flow velocity and favour the accumulation of nutrients. Presence of eutrophication indicator species (e.g., *Ceratophyllum demersum*, *Potamogeton pectinatus*, *Lemna spp.* and other species of freely-floating plants) as well as dense stands of helophytes indicate a lower ecological quality.

Function and process indicators: all indicators that are important for freshwater water-bodies, as well as the proportion of habitats that depend on high water and proportion of natural habitats on river banks and the degree of shading. Mosaic shading is preferable for rivers with the proportion of shaded and illuminated stretches approximately 3:1.

Restoration potential and quality improvement indicators: measures of river habitat restoration that are described in the introductory chapter of freshwater habitats. Removal of undesirable species should be performed in cases when these species have a significant impact on the flow regime. Restoration of the hydrological regime is possible by averting the

Figure 3.25. River rapid on the Īvande River near Renda (Photo: A.Auniņš).

Figure 3.26. Unaltered stretches of the Pededze River are characteristic of natural hydrological regime, meanders, oxbows and large areas of high water dependent habitats at river banks (Photo: A.Auniņš).

impact of changes that have been caused by land amelioration systems, dams and other anthropogenic effects, as well as beaver dams.

Threats: all factors that endanger freshwater habitats. Alterations of the hydrological regime caused by construction of hydroelectric power plants; straightening or excavation of riverbeds; construction of land amelioration systems; alterations to river banks through dyking, banking of river banks or erection of buildings along river-banks; changing of the natural relief of flood plains.

Management: all management activities listed in the introductory chapter of freshwater habitats. In rivers of bad quality the possibility to remove undesirable vegetation and invasive species should be considered. Removing of beaver dams or, in particular cases, limiting the number of beavers, is occasionally necessary in river habitats.

Similar habitats: none.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 5.18. River rapids and natural river stretches, 5.1. Concentrations of stones in riverbeds, 5.4. Stands of *Batrachospermum* in rivers, 5.5. Stands of *Hildenbrandia rivularis* in rivers, 5.6. Waterfalls, 5.7. Stands of *Fontinalis* and *Rhynchostegium riparioides* in rivers 5.8. Stands of *Tolypella prolifera* in rivers, 5.11. Stands of *Zannichellia palustris* in rivers, 5.13. Stands of *Berula erecta* in rivers and at riverbanks, 5.15. Stands of *Batrachium* in rivers, 5.16. River estuaries, 5.17. Stands of *Potamogeton praelongus* and *Potamogeton alpinus* in rivers.

Literature:

Anon. (2009) Priekšlikumi grozījumiem MK noteikumos Nr. 858 (19.10.2004). Projekta„Virszemes ūdeņu kvalitātes kritēriju vērtības atbilstoši Ūdens struktūrdirektīvā 2000/60/EK un Ūdens apsaimniekošanas likumā noteiktajām 5 kvalitātes klasēm – upes". Atskaite

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Kłosowski, S., Kłosowski, G. (2006) Flora Polski. Rośliny wodne i bagienne. Warszawa. 333 p.

Kļaviņš, M., Cimdiņš, P. (2004) Ūdeņu kvalitāte un tās aizsardzība. Rīga. 208 lpp.

Plikšs, M., Aleksejevs, Ē. (1998) Zivis. Rīga. 304 lpp.

Poppels, A., Druvietis, I. (2006) Reto un aizsargājamo fito- un zoobentosa sugu izpēte Vitrupē. Grām.: Ģeogrāfija. Vides zinātne. Ģeoloģija: Referātu tēzes. Rīga, 282.–283. lpp.

Urtāns, A. (2008) Upju biotopu apsaimniekošana: Salacas un Jaunupes rekultivācijas pieredze. Grām.: Auniņš, A.(red.) Aktuālā savvaļas sugu un biotopu apsaimniekošanas problemātika Latvijā. Rīga, Latvijas Universitāte, 131.–141. lpp.

3270 *Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation*

Latvian habitat classification: D.11.2.

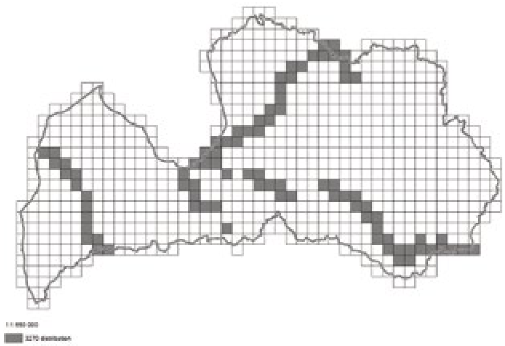


Figure 3.27. Distribution of the habitat 3270 *Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation* in Latvia (Conservation status of.., 2013).

Syntaxonomy: *Chenopodion rubri, Bidention*.

Definition: muddy banks of plain to submontane levels of large rivers. During the spring and at the beginning of the summer, sites look like muddy banks without any vegetation (developes later in the year). Lack vegetation in spring and at the beginning of summer, depending on fluctuations of water level, but afterwards overgrow with the vegetation of annual nitrophilous pioneer species.

Specific characteristics of habitat interpretation in Latvia: it also includes communities of characteristic plant species that develop on slightly muddy sand, gravel or shingly bottom (*Fig. 3.28., 3.29., 3.30.*).

Figure 3.28. Muddy river banks of the Daugava River in Augšdaugava (Photo: A.Opmanis).

Figure 3.29. Sandy and muddy sands in the Gauja River with the characteristic vegetation (Photo: A.Opmanis).

Distribution: a very rare habitat, its distribution is linked only to large rivers – it is found on the banks of River Daugava, River Gauja, River Venta, possibly also River Lielupe. The total area occupied by this habitat is approximately 122 ha, which equals to 0.002% of the territory of Latvia (Conservation status of.., 2013).

Conservation value: this habitat is part of an ecosystem complex of large, natural rivers with a characteristic species composition and indicate natural hydrological regime. The habitat is a significant feeding area for wading birds (*Fig. 3.28.*).

Environmental factors and processes with a functional significance: natural hydrological regime with pronounced fluctuations of the water level that determine a cyclic development of vegetation is necessary for the existence of this habitat. Formation of this habitat is promoted by soils rich in nitrogen.

Vegetation characteristics: due to natural fluctuations of water level permanent vegetation cannot establish, however, in late summer of favourable years communities of annual plants are formed on sand or gravel accumulations of gently sloped river banks (*Fig. 3.28., 3.29.*). In years with a high water level the habitat can fail to develop. Medium tall to tall annual plants that have adapted to nitrogen-rich soils dominate plant communities. Plant species that have adapted to varying moisture conditions as well as aquatic plant species can be found.

Characteristic species: <u>bryophytes and vascular plants</u> – *Riccia glauca, Chenopodium rubrum*, *Chenopodium acerifolium*, *Bidens cernua*, *B.tripartita*, *Limosella aquatica*, *Xanthium albinum*, *X.strumarium*, *Polygonum nodosum*, *Gnaphalium uliginosum*, *Juncus bufonius*; <u>birds</u> – *Actitis hypoleucos*, *Charadrius dubius*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Riccia glauca*, *Chenopodium acerifolium*, *Bidens cernua*, *B.tripartita*, *Cyperus fuscus*, *Gnaphalium uliginosum*, *Limosella aquatica*, *Xanthium* *albinum*, *X.strumarium*, *Polygonum nodosum*, ground beetles of genus *Elaphrus spp.*, *Nebria livida*, *Agonum marginatum*, *Gomphus (Stylurus) flavipes*, *Actitis hypoleucos*, *Haematopus ostralegus*, *Xenus cinereus*.

Variants: none.

Habitat quality

Minimum habitat requirements: appropriate environmental conditions (at least 2 m wide areas of open muddy or sandy-muddy soil, that uncover on banks of large rivers when the water level has fallen), communities of characteristic species can also be absent (*Fig. 3.30.*).

Structural indicators: width and length of relief that is appropriate for the habitat, number of characteristic species, area occupied by communities of characteristic species, area free of stands of expansive species and species untypical of the habitat. Higher quality of the habitat is indicated by a wider coastal zone with open soil that is suitable for the development of this habitat and a larger number of characteristic species.

Function and process indicators: naturalness of the hydrological regime.

Restoration potential and quality improvement indicators: restoration of the hydrological regime.

Threats: this habitat is endangered by regulation of the hydrological regime and alterations of river banks that alter environmental conditions necessary for the existence of this habitat.

Management: non-intervention – preservation of the natural hydrological regime, natural coastal relief and vegetation as well as the drift line.

Similar habitats: none.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: none.

Literature:

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Figure 3.30. Muddy and gravelly sands with no vegetation in River Venta (Photo: A.Priede).

Photo: M.Pakalne

4. HEATH HABITATS

Heaths are habitats that are biologically significant and have a high cultural heritage value, which have developed in regions with a low annual variant between average highest and lowest temperatures, and moderate, but regular precipitation. In the poor, acid sandy soils with varying levels of humidity mainly mosaic of heather family plant communities can be found. Soil podzolation is also characteristic. Heath habitats not only include habitats 4010 *Northern Atlantic wet heaths with Erica tetralix* and 4030 *European dry heaths*, but also two coastal habitats – 2320 *Dry sand heaths with Calluna and Empetrum nigrum* and 2140* *Decalcified fixed dunes with Empetrum nigrum*. Majority of heaths with the exception of *coastal dune heaths* 2140* have formed secondarily, mainly as a result of human activities, through cutting or burning of woodlands and consequently using these areas for grazing or maintaining them by other methods, such as military activities (*Fig. 4.1.*).

Distribution

In the beginning of the 20th century heaths were an important component of the landscape of Latvian countryside. Along with scrubs and coastal and inland sand dunes, heaths occupied approximately 14% of the territory of Latvia (Skujenieks, 1927). However, already since the 1950s areas covered by heaths decreased rapidly. The main cause of this process was the rapid land transformation to attend the need for a more intensive agriculture. Wet heaths were dried-out, while the dry heaths were ameliorated and reshaped into lands that are appropriate for an intensive agriculture, or abandoned. Heath abandonment resulted in overgrowing by trees and shrubs, turning former heaths into woodlands. A part of heaths was destroyed by construction or afforested. Nowadays heaths are found mainly on Coastal Lowlands and its surroundings. The total area occupied by heath habitats (2140*, 2320, 4010, 4030) is currently only 1 924 ha (Conservation status of.., 2013).

Conservation value

On average, during the 20th century the area covered by heaths has decreased by 80% in all European countries (Rebane, Wynde, 1992). Nowadays heaths have almost gone extinct also from the landscape of Latvian countryside, occupying only 0.03% of the total territory of Latvia (Conservation status of.., 2013). A specific management, which is no longer performed nowadays because of socio-economic factors, is necessary for heaths, therefore heath habitat formation no longer takes place (with the exception of comparatively small areas in close proximity to the seashore (2140*)) as it did 100 years ago, while the existing heath habitats go extinct. Therefore, if no special management and protection planning is implemented, heaths are bound to total extinction. All heath types that are found in Latvia correspond to habitats described in the Appendix I of the EU Habitats Directive. Traditionally heaths together with grasslands were used for grazing and setting up bee apiaries. Nowadays heaths are also a resource of rural and nature tourism. Heathland landscapes and their management history are cultural heritage values of regions of Latvia.

Environmental factors

Abiotic, biotic and anthropogenic (influence caused by human activities) factors are equally significant in formation and existence of heaths. Heaths form in diverse soil humidity conditions, in acid to slightly alkaline, nutrient poor siliceous soils in Latvia. The anthropogenic factor has the greatest importance in the existence of heaths in Latvia, as in the climatic conditions of Latvia heaths cannot last without grazing and/or regular controlled burning – otherwise they overgrow with shrubs and trees as a result of natural succession. Although the territory of Latvia is located in the centre of the distribution range of *Calluna vulgaris*, the most favourable climatic conditions for the development of heaths are in the western part of Latvia, as the variant between the average highest and lowest temperatures is smaller there, and the amount of preci-

Figure 4.1. Dry heaths in a military polygon in the protected landscape area, *Natura 2000* site "Ādaži" (Photo: I.Mārdega).

pitation is more regular in comparison to the eastern part of Latvia. Climatic factors are significant for the development of heaths, as *Calluna vulgaris* and *Erica tetralix* often die off in low temperatures unless covered by snow and lasting drought has a negative impact on growth and germination of these species (Symes, Day, 2003).

Processes with functional significance

In the climatic conditions of Latvia fires of natural origin in heaths occur increasingly rare. In earlier times fires occurred more frequently, therefore plant species and the vegetation altogether, along with animal species, have adapted to regular fires. Fires have a significant role in the formation and preservation of high quality heaths, since fires promote formation of populations of heather family plants of different ages. Burning of heaths favours their reproduction with seeds, a mosaic development of vegetation of different ages and provide conditions for development of a range of annual plant species that are characteristic to heaths and whose existence depends on such interference, for example, *Filago minima*, *Lycopodiella inundata*, *Teesdalia nudicaulis* etc. Many animal species are dependent on the presence of sandy patches in heaths, as they serve as feeding and nursery grounds for them.

Vegetation

Significant characteristics of heath vegetation are their vertical and horizontal structure, and the composition of characteristic and dominant species. Mosaic horizontal structure that can be formed by stands of heather and other dwarf shrubs, grassland vegetation, tiny copses of trees and patches of open substratum or moss and lichen in different proportions is characteristic to heaths. The layer of dwarf shrubs is well pronounced in the vertical structure of heaths. Depending on the stage of heath development, as well as the type and intensity of management, tree and moss layers are poorly to medium developed.

Characteristic species

In comparison to heath habitats in Central and Western Europe, the geographic location of Latvia determines differences in the distribution and ecology of many heath plant species and communities. Therefore characteristic species that are mentioned in descriptions of Latvian heath habitats include species that are mentioned in the habitat definition and also species that are characteristic only to heaths in Latvia. Most frequently several species that are not included in the Interpretation Manual of the European Union Habitats (Interpretation manual.., 2013) are listed for each habitat – these species are found in the respective habitat also in other parts of Europe, while in the conditions of Latvia they are important in identification of the habitat.

Variants

Different hydrogeological and climatic conditions have promoted formation of diverse heath and plant community types in Latvia. In some cases a habitat is so diverse visually and by the composition of dominant species that variants of a habitat need to be distinguished. These variants are distinguished and named by differences in their environmental conditions and are characterized by species composition and plant communities.

Habitat quality

The quality of a habitat is characterized by its structures and functions. It is not always possible to assess these aspects directly, therefore indicators that indicate specific parameters of structure and functions indirectly are used (JNCC, 2004). Identical minimum quality requirements for heaths cannot be defined, thus they are mentioned separately for each heath habitat.

Structural indicators: indicators that are common to all types of heaths are listed here. The specific structural and function indicators of each habitat are mentioned additionally in the habitat description.

Number of characteristic species: the number of characteristic species of a habitat is a good indicator of the quality of a habitat. The total number of characteristic species varies for each habitat, as it depends on the set of environmental conditions that are characteristic to the habitat, the overall geographic distribution of the habitat and its position in Latvia, as well as the history of vegetation development and management. By deterioration of the habitat quality the number of characteristic species decreases.
Area of bare soil (substratum). Open areas of soil are very important in conservation of heath habitats. These areas provide space for moss and lichen, enable plant seeds (including rare vascular plants) to germinate and are significant to various animal species (solitary bees, ants, lizards etc.). The optimal area of bare soil is different for each habitat. Patches of bare soil can form naturally or be man-made.
The number of specially protected species and species listed in the Red Data Book of Latvia. The conservation value of a heath is higher when it contains many rare and specially protected species

that are related to the heath habitat.

Woodland and shrub cover. The larger is part of the habitat that has overgrown with trees and shrubs in heath habitats, the more rapid is the deterioration of the habitat quality – the area becomes too shaded, evaporation and species competition increases etc. In separate cases small copses of trees and sparsely located trees that create a landscape of woodland meadows can be present in heaths. Tree and shrub cover below 10% indicates heaths of outstanding quality.

Expansive species. Local species of herbaceous plants and moss that are usually found in heaths, but due to traditional management the proportion of these species is negligible. When management is ceased or the environmental conditions change, expansive species reproduce rapidly, outrival species that are characteristic for heaths and usually become dominant up to the point when stable monodominant plant communities of one or few species are formed (Alonso et al., 2001). Consequently, the larger is the proportion of such species in the habitat, the lower is its quality.

Invasive species. Alien herbaceous and moss species with a tendency for a rapid reproduction that outrival local species. The quality of a heath is higher if there are no invasive species.

Species saturation. Species saturation (species density) represents the number of species in a set areal unit. The higher is the habitat quality, the higher is the species saturation. This indicator is individual for each habitat and each area.

Vitality of heather or cross-leaved heath population. It is important to create and maintain a structure with heather of different ages, which is also related to the existence of other species in heaths. There are four development phases for heather – pioneer, building, maturity and degenerate (Watt, 1955). In heaths of outstanding quality all four development phases must be represented. Development stages of cross-leaved heath and other dwarf shrubs are not as pronounced, but generative dwarf shrubs and juvenile plants should be represented in dry heaths of outstanding quality.

Function and process indicators: heath functions are primarily indicated by their structural quality. However, there are several function indicators that can be identified by other features.

Habitat area. The larger is the habitat area, the more pronounced are its functions. Therefore it can host larger number of habitat-related species and it has a more significant role in regulation of the surrounding hydrological regime etc.

Zone of contact with natural habitats (ecotone). If a heath habitat is surrounded by natural or partially natural habitats, its hydrological regime is more natural and the possibilities for invasive species to establish are smaller.

Proportion of habitat area, where the necessary regular management is performed (grazing, fires, unmanaged). The larger is the area of heaths which is properly managed, the higher is its quality.

Indicators of restoration possibility and quality improvement: improvement of habitat quality is possible to all heath habitats (4010 *Northern Atlantic wet heaths with Erica tetralix*, 4030 *European dry heaths*, 2320 *Dry sand heaths with Calluna and Empetrum nigrum*, 2140* *Decalcified fixed dunes with Empetrum nigrum*) that correspond to the minimum quality criteria of habitat identification. However, the level of effort that is necessary can differ depending on the structural and function quality and the amount of necessary resources – a factor that is influenced by the remoteness of a habitat and its accessibility. In each case the necessity and possible implementation of heath management should be individually assessed. The amount of necessary resources for the implementation of restoration measures should also be bared in mind while assessing restoration possibilities. Majority of heaths in Latvia require measures for structure improvement that include tree felling, clearing of shrubs and resuming regular management. Measures for habitat function improvement, such as decreasing the impact of drainage and the density of trees are often necessary in humid heaths. In comparison to bogs and other wetland habitats, restoration of dry heaths can be implemented successfully within 5 years. In cases when habitats have been abandoned for overgrowing for more than 30 years and 10–20% of open heath patches have preserved, restoration is expected to be long and labour-consuming, however, possible.

Minimum quality requirements for heath habitats

Minimum criteria for separating heaths from woodlands or scrubs: if the characteristic species and vegetation structure of heath habitats are no longer present in more than 75% of habitat area, heaths that have overgrown with scrubs and trees do not correspond to the habitat of EU importance. Moreover, tree cover exceeds 75% and the average height of trees is more than 5 m.

Minimum criteria for separating heaths from grasslands: in order for a habitat to be separated as heath habitat, the cover of dwarf shrubs in the habitat area must be at least 25%.

Significant indicators of heath structure and functions are:

– **development phases of *Calluna vulgaris*** and their proportion in a polygon; ideally, all development phases of heather are represented in a heath habitat or heath polygons of different development phases of mosaic vegetation structure;
– **heath propagation:**
  - can be **vegetative** (dominant *ramets*) – a plant propagates from its side shoots, thereby plant communities of the same clonal colony exist for a long time; grazing or cutting of heaths provide long-term existence to one clonal community and the existing genetic material remains unchanged for a long period of time – the genetic diversity of heath is not promoted;
  - can be **generative** (dominant *gametes*) when heather propagates from seeds; such propagation occurs after burning of heaths, which is followed by plant generative propagation from seeds, while promoting an increase to the genetic diversity within the polygon;

vegetative propagation of heather is promoted in cut heaths, on average 5–7–10 side shoots have grown from the side buds in one shrub; thicker stems of older heather can be well observed (phase III); in cut areas the soil surface is uncovered, creating space for a mosaic development of vegetation, which is considered a positive factor; other plant species can introduce in these areas therefore creating a floristically diverse plant communities;

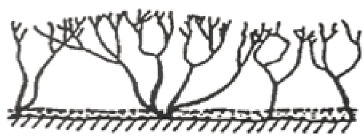
  - can be **generative** (dominant *gametes*) when heather propagates from seeds; such propagation occurs after burning of heaths, which is followed by plant generative propagation from seeds, while promoting an increase to the genetic diversity within the polygon;

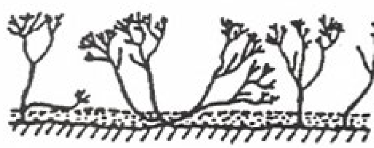
in burned areas heather propagates from seeds in different intensity, its generative propagation is promoted, the heather develops pronounced, separate pyramid-shaped shrubs.

Heather life cycle or development stages (schemes after Watt, 1955):

I – juvenile heather, correspond to the pioneer stage of heath development (0–6 years), open vegetation; heather plants that propagate from seeds are characteristic with small pyramid shape; short mowed or grazed heather forms the "pseudo pioneer phase";

II – growing heather; corresponds to the stage of heath building (6–14 years), open vegetation; heaths with closed canopy and the average height – 40 cm;



III – maturity stage, vegetation is formed mainly by 14–25 years old branched heathers; plants become ligneous like small trees; openings occur in the canopy; these openings are gradually occupied by other species (mainly moss); interspersedly heathers can reach up to 60–100 cm;	
IV – degenerate stage, formed heathers gradually die off (starting from 25 years) or "burn out" – brown leafless branches occur, central branches collapse and cling to the substratum; it is typical that only branches form the central part, whereas leaves and blossoms preserve in sides of the shrub. Usually the number and size of leaves and blossoms decreases;	
V – died off heaths, extremely rare, they are formed as a result of a lasting lack of management; in a polygon all heathers have died off and it is formed by dried dwarf shrubs. Such areas are significant as colonization sites for other species; the area has lost its nature conservation value as a heath.	

– formation phase (6–14 years) – heath covers up to 90%; therefore, the occurrence of other species is negligible; the biomass created by heathers does not reach the maximum yet, however, the productivity in juvenile heather branches is rather high; density and the projective cover of heather canopy influences the microclimate of the layer of dwarf shrubs, for example, the illumination on the ground level decreases by 2%; daytime temperature is generally lower in comparison to heather plants of the pioneer stage, but during the night (including winter months) the temperature is higher; relative humidity is high, air circulation in heaths – minimal (after Matthews, 1993);

– maturity phase (14–25 years) – heath plants cover up to ~78%; the projective cover of other species (especially moss) increases; heath biomass has reached its maximum, but the productivity in young branches has decreased; illumination on the ground soil increases by 20%; relative humidity is high, air circulation in heather communities is limited (after Matthews, 1993);
Cutting of heather promotes its vegetative propagation (from the side shoots), whereas burning of heather provides for their generative propagation from seeds.

Management

Heath management is an integral element for the maintenance of these ecosystems. Its aim is to preserve open heaths with heather and cross-leaved heath of different development stages and a mosaic horizontal vegetation structure. Only extensive management is suitable for heaths, i.e., grazing without fertilization and regular controlled burning (at least once every 10–20 years) in small areas (up to 30 ha). Duration of the grazing period and type and density of livestock are important factors. Periodicity and season of prescribed burning depend on the grazing intensity, soil type, heather development stage and climate (Miller, Myles, 1970). Grazing and regular prescribed burning are the main heath management methods, but there are several additional measures that have to be implemented periodically, such as cutting out trees and removing of shrubs in areas with a lower grazing intensity. An alternative measure to prescribed burning is sod cutting in certain areas of the upper soil layer or removal of ground cover in the depth of few centimetres (up to 10 cm), which also promotes distribution of several plant species that are characteristic to heaths and creates living and feeding grounds to various animal species. Heaths can also be cut; however, removal of the cut material is mandatory. Temperate driving over or tramping of small areas of heath habitats is allowed and even desirable in all heath types, as patches of bare soil are created.

When performing management and restoration of heaths, the most significant changes in the landscape of evaluated heaths are determined by the height of tree, shrub and dwarf shrub layers and their projective cover (Krauklis, 1999):

– in areas where heaths have been cut the insolation increases radically, the relative humidity in the dwarf shrub layer decreases, the temperature within the plant communities and the upper layer of air-soil evens out; small patches of soil with minimal vegetation or bare soil uncover around the cut heather shrubs. In accordance with literature data (Matthews, 1993; JNCC, 2004; Degn, 2001; Rydin, Jeglum, 2006; Hampton, 2008; Webb, 1986), which is also substantiated by vegetation descriptions, plant species that are weak competitors introduce in these soil patches for a short-term existence, for example, *Rumex acetosella*, in dry areas – *Corynephorus canescens*, common haircap moss: communities of haircap moss *Polytrichum ssp.*;

– in **burned areas** vegetation of *Rumex acetosella* is replaced by *Agrostis tenius*, *Festuca ovina* and *Lerchenfeldia flexuosa* after a single vegetation season; according to literature data, these are short-term communities that will be outrivaled by the resurged heathers in a few years' time; the proportion of *Calamagrostis epigeios* also tends to increase significantly in burned areas.

Threats

All heath habitats are directly influenced by land transformation. Within the last 60 years a major part of dry heaths in Latvia have been permanently destroyed through transformation of dry heaths into lands that are appropriate for intensive agriculture, construction or afforested. Heaths are indirectly influenced by the fact that their traditional management has ceased, which allows natural succession to take place. In Latvian climate conditions it almost always results in development of scrubs and woods. A potential threat to the long term existence of this habitat is an inappropriate management of heaths. Overgrazing or too frequent burning of heaths can lead to degraded plant communities that no longer correspond to the heath habitats that have been described in this manual by their structure and functions. Moreover, nitrogen-rich air depositions can have a negative impact on heath vegetation through promotion of introduction of nitrophilous plant species and causing disappearance of characteristic heath habitat species. Eutrophication causes a similar impact. Fertilization of nearby agricultural lands has a negative impact of heath vegetation, as additional nutrients (especially nitrogen and phosphorus) can be transported into heaths by groundwater or surface water.

Literature

Aizsargājamo ainavu apvidus „Ādaži" dabas aizsardzības plāns (2008) I.Roves red. Jaunmārupe, Latvijas Dabas fonds, 122 lpp.

Alonso, I., Hartley, S.E., Thurlow, M. (2001) Competition between heather and grasses on Scottish moorlands: Intercating effects of nutrient enrichment and grazing regime. Journal of Vegetation Science 12, 249– 260 p.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Dabas lieguma „Sakas grīņi" dabas aizsardzības plāns (2004) L.Salmiņas red. Rīga, Latvijas Dabas fonds, 60 lpp.

Dabas lieguma „Sakas grīņi" dabas aizsardzības plāna ieviešana (2007) L.Salmiņas red. Rīga, Latvijas Dabas fonds, 59 lpp.

Dabas vērtību stāvokļa novērtēšana un kontrole Ādažu militārajā poligonā. Rokasgrāmata, paredzēta Nacionālo bruņoto spēku personālam (2008) I.Roves red., Latvijas Dabas fonds, 42 lpp.

Degn, H.J. (2001) Succession from farmland to heathland: a case for conservation of nature and historic farming methods. Biological Conservation 97, Elevier, 319–330 p.

Degn, H.J. (2009) Heathland management in Denmark. Overview, 4 p.

Grīņu dabas rezervāta dabas aizsardzības plāns (2008) L.Salmiņas red. Jaunmārupe, Latvijas Dabas fonds, 72 lpp.

Hampton, M. (2008) Management of *Natura 2000* habitats. 4010 Northern atlantic wet heath with Erica tetralix. European Commission

Indriksons, A. (2007) Hidroloģiskā stāvokļa raksturojums dabas liegumā „Sakas grīņi". Projekta atskaite, Latvijas Dabas fonds

Indriksons, A. (2008) Gruntsūdens līmeņa monitorings LIFE projekta „Purvi" vietās. Grām.: Pakalne, M. (red.) Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Rīga, Latvijas Dabas fonds, 142.–151. lpp.

Joint Nature Conservation Committee (JNCC) (2004) Common Standards Monitoring Guidance for Woodland, Version February 2004. JNCC, United Kingdom, Peterborough, 31 p.

Krauklis, A. (1999) Viršu bioģeocenozes Britānijas un Latvijas ainavās. Heath biogeo-coenoses in the Brittish and Latvian landscapes. Ģeogrāfiski Raksti, VII, 31.–58. lpp.

LIFE-Daba projekta „Bioloģiskās daudzveidības atjaunošana militārajā poligonā un *Natura 2000* teritorijā „Ādaži"" pasākumu ietekmes uz sugām un biotopiem novērtēšana (2007) L.Auniņas red. LU Bioloģijas institūts, Salaspils

Matthews, R.F. (1993) Calluna vulgaris The Fire Effects Information System [database] U.S. Department of Agriculture, Forest Service, Intermountain Research Station, Intermountain Fire Sciences Laboratory Missoula, MT Fischer, WC compiler

Miller, G.J., Myles, J. (1970) Regeneration of heather (Calluna vulgaris (L). Hull) at different seasons of burning in North-East Scotland. Journal of Applied Ecology 7(1), 51–60 p.

Rebane, M., Wynde, R. (1997) Lowland Atlantic Heathland. In: Tucker, G.M., Evans, M.I. (eds.), Habitats for birds in Europe a conservation strategy for the wider environment. BirdLife International, Cambridge, 187–202 p.

Rydin, H., Jeglum, J. (2006) The biology of peatlands, Oxford University press. 343 p.

Symes, N., Day, J. (2003) A practical guide to the restoration and management of lowland heathland. The RSPB, Sandy

Watt, A.S. (1955) Bracken versus heather, a study in plant sociology. Journal of Ecology 43, 490–506 p.

Webb, N. (1986) Heathlands. Collins New Naturalist, 223 p.

4010 *Northern Atlantic wet heaths with Erica tetralix*

Latvian habitat classification: F.7.2.

Syntaxonomy: *Ericion tetralix*, *Dicrano-Pinion*.

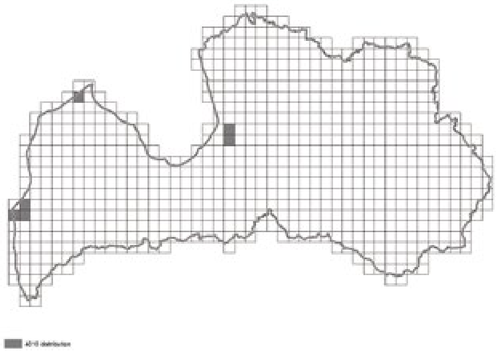


Figure 4.2. Distrubution of the habitat 4010 *Northern Atlantic wet heaths with Erica tetralix* in Latvia (Conservation status of.., 2013).

Definition: wet heaths with fully or partially developed peat layer in the Atlantic and sub-Atlantic region.

Specific characteristics of habitat interpretation in Latvia: in Latvia this habitat is not only represented by sparse wet heaths (*Fig. 4.3.*), but also by wet heath woodlands in Coastal Lowlands with a prerequisite that *Erica tetralix* and other species that are typical of wet heaths are abundant, and the area corresponds to minimum criteria of heath habitats. Wet heaths have often formed in areas of former wet heaths or sparse woods after traditional management (extensive grazing, cutting and regular prescribed burning) has ceased (*Fig. 4.4.*). The habitat also includes wet heaths that lack the cross-leaved heath but have other species that are characteristic to Atlantic heaths.

Distribution: a rare habitat, found only in the Coastal Lowlands. The majority of this habitat in its typical variant is concentrated in a small area in Piemare Plains. In other places only separate fragments of this habitat are found. Temperate Atlantic heath variant has been found only in Rīgava Sandy Plain.

Conservation value: the habitat is rarely found in Latvia and has only few sites that occupy approximately 350 ha, which equals to 0.005% of the territory of Latvia (Conservation status of.., 2013). A precise area occupied by this habitat is not known. The current data is based on the data from the *Natura 2000* habitat survey. During the last century the total area of this habitat has decreased dramatically, as heaths were gradually drained and their use in agriculture was terminated. It is a significant habitat for specially protected species *Erica tetralix*, *Radiola linoides*, *Juncus squarrosus*, *Lycopodiella inundata* and *Pedicularis sceptrum-carolinum*. Management measures of wet heath habitats – burning, felling of trees, grazing and cutting – also possess a cultural heritage value, indicating management traditions.

Environmental factors: wet heaths have formed in plains of the Coastal Lowlands in areas with poor surface drainage and siliceous soils that are poor in nutrients. These soils are periodically waterlogged, range from slightly acid to acid, with a pH of 3.8–4 (Salmiņa, 2007; Indriksons, 2007). Soils of wet heaths frequently contain ortstein (hardpan) horizon and also a well pronounced gley horizon, which prevents absorption of water into the deepest soil layers and supports peat formation. A soft and humid climate with sufficient precipitation and a relatively even distribution of precipitation throughout the year that promotes formation of heaths and the existence of species with the Atlantic distribution are significant for the existence of the habitat. Well pronounced, periodic fluctuations in groundwater level are characteristic to wet heaths – in areas where *Molinia caeruela* predominates, these fluctuations can reach up to 1 m (Indriksons, 2008). The considerable annual groundwater fluctuations prevent formation of peat and, consequently, also formation of bogs in wet heaths. As a result, in most cases the layer of peat is only 10–20 cm thick or is absent. Occasionally, however, depressions that can contain *Sphagnum* moss or bare peat form in wet heaths. Although wet heaths have developed as a result of a long-term grazing and regular burning, nowadays open heaths are rarely found in Latvia. However, provided that this habitat has not been dried-out or the impact of drainage is insignificant, the characteristic species composition can

Figure 4.3. Sparse wet heath with *Molinia caeruela*, *Myrica gale* and *Erica tetralix* that can be identified as habitat 4010 *Northern Atlantic wet heaths with Erica tetralix* (Photo: L.Auniņa).

Figure 4.4. Medium dense wet heath with *Calluna vulgaris* and *Erica tetralix* that can be identified as habitat 4010 *Northern Atlantic wet heaths with Erica tetralix* (Photo: L.Auniņa).

remain long after the management has ceased in wet heaths.

Processes with a functional role: human activity – cutting or grazing, in some places regular prescribed burning or loosening of the upper layer of soil – is necessary to provide existence of wet heath habitats in Latvia. A part of wet heath species, for example, heather and cross-leaved heath, have adapted to burning and they not only recover successfully, but also reproduce after fires, whereas some species, such as *Sphagnum* moss, can be lost during a strong fire, and their regeneration can be slow (Symes, Day, 2003). If a heath is dominated by dwarf shrubs, after fire the vegetation succession includes a short-term phase of grasses. Most often after fires wet heaths are temporarily dominated by *Molinia caeruela*. Within few years after fire dwarf shrubs should be dominant again (Aerts, 1993). Periodical flooding that interchanges with periods of drought is another factor that is important in wet heaths – as a result, formation of peat is prevented. Unmanaged heaths gradually transform into woodlands.

Vegetation characteristics: the habitat has the horizontal and vertical structure that is typical of all heaths, only the horizontal structure is characteristic with patches of open peat or depressions with hygrophytic *Sphagnum* moss. The moss layer is mostly dominated by *Sphagnum* moss, which requires less humidity and has adapted to periodical groundwater level fluctuations. In separate cases the dwarf shrub layer can be small, whereas the tree and shrub layer ranges from sparse to dense, and is dependent on the heath development stage, impact of drainage and the type and intensity of habitat management. Vegetation is mostly formed by dwarf shrubs with dominant *Calluna vulgaris* or *Erica tetralix* (*Fig. 4.5.*), occasionally – *Molinia caeruela*. The tree layer is formed by *Pinus sylvestris*, *Betula pubescens*, shrub layer - *Juniperus communis, Frangula alnus*.

Characteristic species: dwarf shrubs – *Calluna vulgaris*, *Erica tetralix*, *Salix rosmarinifolia*, *Vaccinium vitis-idaea*, *Vaccinium uliginosum*; herbaceous plants – *Molinia caerulea*, *Juncus squarrosus*, *Trichophorum cespitosum*, *Juncus bulbosus*, *Carex panicea*, *Carex nigra*, *Potentilla erecta*; bryidae – *Sphagnum compactum*, *Sph.capillifolium*, *Sph.contortum*, *Sph.subsecundum*, *Sph.papillosum*, *Hypnum jutlandicum*, *Leucobryum glaucum*, *Lophozia ventricosa*, *Ptilidium ciliare*, *Cephaloziella spp.*, *Fossombronia spp.*, *Calypogeia spp.*; lichen – *Cladonia spp.*, *Cladina spp*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Erica tetralix*, *Sphagnum compactum*, *Sph.capillifolium*, *Sph. contortum*, *Sph.subsecundum*, *Sph.papillosum*.

Variants:

4010_1: typical variant – wet heaths with cross-leaved heath. Vegetation of cross-leaved heath *Erica tetralix* is a characteristic feature of this variant (*Fig. 4.6.*). Plant communities adjusted to periodically waterlogged, (ideally) sparse, acid nutrient poor soils with a pronounced layer of dwarf shrubs that is dominated by *Calluna vulgaris* and occasionally pronounced layer of herbaceous plants dominated by *Molinia caeruela*. The moss layer is well pronounced and dominated by *Sphagnum* moss. *Sphagnum* moss (*Sphagnidae*) of *Subsecunda* group is often found, but a lot of moss from subclasses *Bryidae* and *Hepaticophytina* can also be present. The occurrence of low annual herbaceous plant species, which can grow in conditions of changing moisture regime, is relatively frequent;

4010_2: temperate Atlantic variant – wet heaths without the cross-leaved heath. Plant communities adjusted to periodically waterlogged, (ideally) sparse, acid nutrient poor soils with pronounced layer of dwarf shrubs that is dominated by *Calluna vulgaris* (*Fig. 4.7.*). Cross-leaved heath is not represented, but a range of other slightly Atlantic species is present – *Juncus squarrosus*, *Sphagnum compactum*, *Hypnum jutlandicum*, *Gymnocolea inflata*, *Trichophorum cespitosum*, *Lycopodiella inundata*. Moss layer is dominated by *Sphagnum* moss (*Sphagnidae*), species of *Bryidae* subclass moss can also occur.

Figure 4.5. Partially overgrown wet heath with *Calluna vulgaris* and *Erica tetralix* in the Nature Reserve Grīņi. In the centre a peat depression with *Juncus bulbosus* can be observed (Photo: L.Auniņa).

Figure 4.6. *Erica tetralix* is found only in the typical variant of the habitat (Photo: L.Auniņa).

Habitat quality

Minimum habitat requirements: only wet heaths that correspond to general heath habitat quality requirements can be included. The cross-leaved heath must be dispersely present and plant species and communities characteristic to the habitat have to dominate the vegetation in the typical variant of wet heaths. In temperate Atlantic variant of wet heaths at least two characteristic species of this habitat, apart from heather and purple moor-grass, must be dispersely present.

Structural indicators: all structural indicators common to heaths. In addition, the cover of *Sphagnum* moss must be evaluated, because humidity is significant for this habitat type, and the amount of *Sphagnum* moss indicates hydrological conditions. Application of the indicator *vitality of heather or cross-leaved heath population* is different for each habitat variant – in typical variant only the vitality of cross-leaved heath is evaluated, whereas in the temperate Atlantic variant attention is only drawn to the vitality of heather. When using the indicator *area of uncovered soil (substratum)*, only the presence or lack of patches of peat or depressions with hygrophytic *Sphagnum* moss (*Sphagnum cuspidatum, Sph.subsecundum*) is evaluated.

Function and process indicators: all function indicators common to heaths.

Restoration potential and quality improvement indicators: all restoration indicators common to heaths.

Threats: in addition to all factors that threaten heath habitats, this habitat is also endangered by drying-up. Under its influence, the hydrological regime changes, causing introduction of species which are not typical of wet heaths, while the occurrence and

Figure 4.7. Temperate Atlantic variant of a wet heath in the Protected Landscape Area "Ādaži" (Photo: L.Auniņa).

cover of characteristic species decreases. The cover of herbaceous plants, especially *Molinia caerulea* and *Bryidae* subclass moss, increases in drained heaths, whereas the cover of *Sphagnum* moss decreases, shrubs and trees start to establish. If grazing is ceased in such heaths, it transforms into woodlands in a short time. Majority of wet heaths in Latvia have been drained.

Management: management measures can differ for each area – they are determined by the vegetation structure and opportunities to implement particular measures. Such measures can include extensive grazing, regular prescribed burning in small areas at least once every 20 years (Hampton, 2008) or loosening of the upper layer of soil in small areas as an alternative to prescribed burning, also cutting of heaths or various combinations of these measures. Tree felling and shrub cutting is often necessary for habitat restoration, which can replace grazing and promote distribution of cross-leaved heath in cases if the substratum is waterlogged for the most of the year. In dried-up wet heaths it is necessary to decrease the influence of drainage. In separate cases when wet heaths are in a good conservation status, no management measures are necessary. It is mandatory to monitor the efficiency of all management measures when starting implementation of wet heath management and to change the management type or its separate parameters in situations when a measure fails to promote the improvement of heath quality. Experience in wet heath management in Latvia is not yet sufficient, therefore the scope and intensity, as well as season for its implementation, of any measure has to be assessed accurately in every case.

Similar habitats: presence of juniper is a natural component of wet heaths; therefore, it is not necessary to distinguish habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands* separately.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 1.1. Wet heaths, 1.16. Wet heaths with *Erica tetralix*.

Literature

Aerts, R. (1993) Competition between dominant plants species in heathlands, 125–151 p. In: Aerts, R., Heil, G.W. (eds.), Heathlands. Patterns and processes in a changing environment. Kluwer Academic Publishers, Dordrecht, The Netherlands

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Dabas lieguma „Sakas grīņi" dabas aizsardzības plāns (2004) L.Salmiņas red. Rīga, Latvijas Dabas fonds, 60 lpp.

Dabas lieguma „Sakas grīņi" dabas aizsardzības plāna ieviešana (2007) L.Salmiņas red. Rīga, Latvijas Dabas fonds, 59 lpp.

Gailis, J. (1958) Grīņos – pavasara ūdeņu, vēju un viršu valstībā. Grām.: Valeskalns, P. (red.) Saudzējiet un mīliet dabu, 51.–60. lpp.

Hampton, M. (2008) Management of *Natura 2000* habitats. 4010 Northern atlantic wet heath with Erica tetralix. European Commission

Indriksons, A. (2007) Hidroloģiskā stāvokļa raksturojums dabas liegumā „Sakas grīņi". Projekta atskaite, Latvijas Dabas fonds

Indriksons, A. (2008) Gruntsūdens līmeņa monitorings LIFE projekta „Purvi" vietās. Grām.: Pakalne, M. (red.) Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Rīga, Latvijas Dabas fonds, 142.–151. lpp.

Laiviņš, M., Laiviņa, S. (1981) Grīņu rezervāta augu sabiedrību struktūra un vides faktori. Mežsaimniecība un mežrūpniecība 3, 16.–21. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Salmiņa, L. (2008) Grīņa fitosocioloģiskais raksturojums un sintaksonomiskā piederība. Mežzinātne 18(51), 84.–97. lpp.

Salmiņa, L. (2008) Mežu un slapju virsāju ar grīņa sārteni *Erica tetralix L.* eksperimentālā apsaimniekošana dabas liegumā „Sakas grīņi". Grām.: Auniņš, A. (red.) Aktuālā savvaļas sugu un biotopu apsaimniekošanas problemātika Latvijā. Rīga, Latvijas Universitāte, 111.–122. lpp.

Symes, N., Day, J. (2003) A practical guide to the restoration and management of lowland heathland. The RSPB, Sandy.

4030 *European dry heaths*

Latvian habitat classification: F.7.1.

Syntaxonomy: *Nardo-Callunetea*.

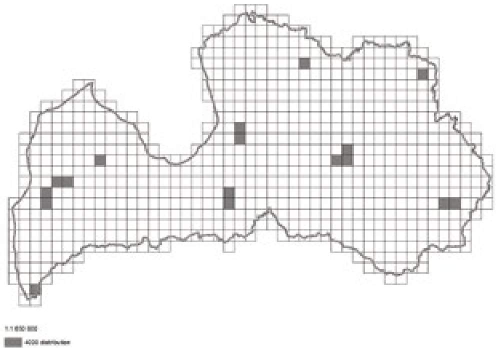


Figure 4.8. Distrubution of the habitat 4030 *European dry heaths* in Latvia (Conservation status of.., 2013).

Definition: mesophile or xerophile on siliceous, podsolic soils in moist Atlantic and sub-Atlantic climates on plains, and low mountains in Western, Central and Northern Europe.

Specific characteristics of habitat interpretation in Latvia: heaths that are not located in Coastal Lowlands (*Fig. 4.9.*) are included in this habitat type. Short-term succession stages, such as clearings and roadsides, are not identified as this habitat. Habitat 4030 can include: vast burned xerophile forest areas, from which trees have been removed, if it has been decided not to restore the forest and provide a sufficient amount of disturbance that is necessary for dry heaths; also stable and permanent dry heaths of outstanding quality, which have formed on eolic sediments below or alongside linear objects of anthropogenic origin, such as transport and communication lines etc. This habitat also contains inclusions of variable moisture regime and waterlogged heaths with area up to 0.1 ha, if such territories are a part of an integral dry heath complex.

Figure 4.9. Dry open heath (Photo: I.Rove).

Distribution: Nowadays dry heaths are rare in Latvia. They are found mostly in the southeast part of Latvia and have formed on eolic sediments (inland dunes) and in the valley of the River Daugava on dry and sandy banks. In small areas habitats that were created and maintained during the 20th century as a result of military activities in former and present military polygons, have preserved outside the Coastal Lowlands.

Conservation value: the total area of dry heaths has decreased dramatically during the last century and it is now one of the rarest habitats in Latvia. Nowadays the habitat is found in the total area of approximately 18 ha (or 0.0003% of the territory of Latvia), which is a negligible part of the dry heath area that was registered in the early 20th century (Skujenieks, 1927). Dry heaths are a significant habitat for several rare and specially protected species found only in dry and open areas: <u>birds</u> – *Anthus campestris*; <u>insects</u> – *Psophus stridulus*, *Eupelix cuspidata*, *Lycaena arion*, *Bembix rostrata*, *Oedipoda caerulescens*.

This habitat is highly valuable not only from the biological perspective – it has a high scenic, cultural heritage and economic value. Heaths create open visually high-quality landscapes, showing evidence of the history of traditional management and are used as bee apiaries to obtaining heather honey.

Environmental factors: the most significant factor in heath development is the nutrient-poor substratum – sand. Substratum, climate and microclimate, elevation, pH and permeability of the soil are important factors. Soil podsolization can be observed in heaths.

The habitat forms under the influence of permanent grazing, fires or other types of disturbance, as well as a result of overgrowing of nutrient-poor siliceous grasslands, when their management is ceased.

Local differences are determined by substratum, development stage of the succession, humidity of the surrounding environment and the intensity of heath use. Regular fires or other disturbances, which have a direct impact on soil and decrease accumulation of nutrients, create extremely dry conditions that delay overgrowing of heaths.

Processes with functional significance: dry heaths have adapted to fires and other disturbance types. As a result of burning or other disturbances that are caused by different management measures, a mosaic vegetation structure, which is inhabited by many plant and animal species that have adapted to heath dynamics, that is characteristic to heath habitats is formed. If a heath is not managed, monodominant communities of the same development stage of *Calluna vulgaris* are formed, grassland fragments and patches of bare soil disappear and a heath gradually transforms into woodland.

Vegetation characteristics: the habitat has the horizontal and vertical vegetation structure that is typical of all heaths, only the horizontal structure is characteristic with patches of open sand or patches of moss and lichen. The layer of dwarf shrubs is dominated by *Calluna vulgaris* and heather communities mixed with *Arctostaphylos uva-ursi*, *Empetrum nigrum* and *Vaccinium vitis-idaea*, less frequently – *Vaccinium myrtillus*. *Molinia caerulea*, which is a fire resistant plant and can become expansive, can be often found in relief depressions. A well pronounced first layer of trees – park-like-heath – forms relatively rare. After fires considerable areas can be covered by *Rumex acetosella* and various types of grass, which are replaced by heathers that have germinated from seeds in few years' time.

Characteristic species: *Calluna vulgaris*, *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Vaccinium vitis-idaea*, *Vaccinium myrtillus*.

4030_1: <u>herbaceous plants</u> – *Carex pilulifera*, *Euphrasia micrantha*, *Diphasiastrum complanatum*, *Festuca sabulosa*, *Thymus serpyllum*, *Galium verum*, *Sedum acre*, *Dianthus arenarius s.l.*, *Veronica spicata*, *Campanula rotundifolia*, *Pilosella officinarum*, *Lerchenfeldia flexuosa*, *Agrostis tenuis*, *Carex ericetorum*, *Trifolium arvense*, *Erigeron acris*, *Jasione montana*, *Pulsatilla pratensis*, *Corynephorus canescens*, *Koeleria glauca* etc.; <u>bryidae</u> – *Racomitrium canescens*, *R.ericoides*, *Ceratodon purpureus*, *Dicranum spp.*, in wet depressions also *Sphagnum capillifolium* etc.; <u>lichen</u> – *Cladonia spp.*, *Cladina spp.*, *Stereocaulon spp.*, *Peltigera canina*, *Cetraria spp.* etc.

Grassland areas representing habitat variant 4030_2 are mostly formed by *Nardus stricta*, *Sieglingia decumbens*, *Festuca ovina*, *Antennaria dioica*, *Veronica officinalis* etc.

Umbrella species (typical species within the meaning of the Habitats Directive): *Calluna vulgaris* (including its development stages and propagation), *Arctostaphylos* *uva-ursi*, *Anthus campestris*, *Psophus stridulus*, *Eupelix cuspidata*, *Lycaena arion*, *Bembix rostrata*, *Oedipoda caerulescens*.

Variants: two variants of this habitat are distinguished, based on the origin of a heath:

- **4030_1:** dry heath, which has developed as a result of overgrowing of a sandy area;
- **4030_2:** dry heath, which has developed as a result of of overgrowing of nutrient-poor grasslands (*Fig. 4.10.*), mostly - lasting pastures on nutrient-poor siliceous soils - 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)*; in areas that are not covered with dwarf shrubs, patches of a structured grassland with plant species that are characteristic to the habitat 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)* remain. In such heath areas plant litter can also be found.

Habitat quality

Minimum habitat requirements:

4030_1 – previously described environmental conditions and a cover of dwarf shrubs at least 25% with dominating *Calluna vulgaris*;

4030_2 – previously described environmental conditions and a cover of dispersed dwarf shrubs at least 50% with dominating *Calluna vulgaris*.

As dry heaths are different from one another, it is not possible to apply a single model for the ideal composition of the habitat; however, common quality criteria can be specified.

Structural indicators: all structural indicators that are common for heaths, except for the indicator *number of characteristic species*. This indicator is replaced by *proportion of area with at least one characteristic species*. Indicators that are also used to assess the structural quality of heath habitats is the *proportion of area with mosaic-type vegetation*, *proportion of area with cover of moss* (except for expansive species *Rhytidiadelphus squarrosus*, *Hylocomium splendens* and *Pleurozium schreberi*) *and lichen at least 20% of grassland area cover* (only for variant 4030_2) and *proportion of area with grass cover less than 25%* (only for 4030_1). Ideally, heathers in the polygon represent different heath development stages.

Figure 4.10. Dry heath in the River Sventāja valley, which has developed as a result of grassland overgrowing (Photo: S.Rūsiņa).

Function and process indicators: all function indicators that are common for heaths. The necessary regular management includes disturbances, the amount of which complies with the ecological requirements of the habitat – controlled prescribed burning and driving over, grazing, cutting etc. Such management measures are necessary for more than 60% of the habitat area under consideration.

Restoration potential and quality improvement indicators: all restoration indicators that are common for heaths.

Threats: in addition to all threats that are common to heath habitats, this habitat is endangered by overexploitation, including overgrazing, too frequent burning and fertilization. Nowadays the main threat to dry heath habitats is overgrowing when the management is reduced and most threatening factor is overgrowing, when the amount of management activities and disturbances decreases. Afforestation of some heaths can be observed. Historical and cultural traditions of heath management have not been preserved in Latvia.

Management: to preserve open dry heaths for a long term, they must be grazed or the necessary amount of disturbance must be created in other ways – for example, prescribed burning, driving over etc. Grazing and burning can be temporarily replaced by cutting (mowing) and removal or burning of the cut material. Combined cutting (mowing) and grinding of the cut material is unacceptable – if the cut material is not removed, it functions as a fertilizer. As a result, in the area of a dry heath formation of other nutrient-richer habitats can take place, overgrowing of the habitat and increase in the moss cover can begin.

Extremely dry heaths with bare patches of sand can be managed once every few years, as nutrient accumulation and overgrowing of the habitat are very slow. The most appropriate management measure must be selected separately in each case, among others, considering the special features of the historical management, if such are known. If a heath has overgrown with trees and scrubs, thinning of undergrowth should be performed prior to implementing regular management measures. In such cases tree shoots also have to be limited. Removal of the upper soil layer (sod cutting, up to 10 cm deep) may also be necessary for the restoration of permanently overgrown heaths. All cut material must be removed or burned on the site.

Similar habitats: by the dominant vegetation this habitat may be mistaken for 2140* *Decalcified fixed dunes with Empetrum nigrum* and 2320 *Dry sand heaths with Calluna and Empetrum nigrum*. In this case habitats are distinguished by their location, as only 4030 *European dry heaths* is located outside the Coastal Lowlands, whereas 2140* and 2320 are situated in the Coastal Lowlands. Difficulties may arise when trying to distinguish dry heaths from 6230 *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)* that have overgrown with dwarf shrubs. In such cases the cover of dwarf shrubs, where *Calluna vulgaris* is dominant, has to be assessed. Provided that it covers at least 50% and the dwarf shrubs are dispersed, this habitat is included in 4030 *European dry heaths* as variant 4030_2. Heaths have formed naturally in separate extremely dry inland dunes, among others, after overgrowing of habitat 2330 *Inland dunes with open Corynephorus and Agrostis grasslands* - if the cover of dispersed dwarf shrubs exceeds 25%, this area should be included in 4030 *European dry heaths*. If juniper communities are found in dry heaths, areas that correspond to the minimum quality requirements of habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands* are considered to represent this habitat.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 1.13. Dry heaths.

Literature

Aizsargājamo ainavu apvidus „Ādaži" dabas aizsardzības plāns (2008) I.Roves red. Jaunmārupe, Latvijas Dabas fonds, 122 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Dabas vērtību stāvokļa novērtēšana un kontrole Ādažu militārajā poligonā. Rokasgrāmata, paredzēta Nacionālo bruņoto spēku personālam (2008) I.Roves red. Latvijas Dabas fonds, 42 lpp.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

LIFE-Daba projekta „Bioloģiskās daudzveidības atjaunošana militārajā poligonā un *Natura 2000* teritorijā „Ādaži"" pasākumu ietekmes uz sugām un biotopiem novērtēšana (2009) L.Salmiņas red. Salaspils, LU Bioloģijas institūts

Rove, I. (2011) Evaluation and control of nature values in the Adazi village military training area. Manual. For the usage of armed forces personnel, can be used for the assessment of certain described nature values also in other military polygons. Riga, Erfurt, 38 p.

Skujenieks, M. (1927) Latvija. Zeme un iedzīvotāji. A.Gulbja apgādniecība. Rīga. 752 lpp.

5130 *Juniperus communis formations on heaths or calcareous grasslands*

Figure 5.1. Juniper community in grassland on a slope of the River Abava valley near Drubažas (Photo: V.Lārmanis).

Latvian habitat classification: none.

Syntaxonomy: none.

Definition: formations with *Juniperus communis* of plain to montane levels. They mainly correspond to phytodynamic succession of the following types of vegetation:

a) generally, mesophilous or xerophilous calcareous and nutrient poor grasslands, grazed or let lie fallow, of the *Festuco-Brometea* and *Elyno-Sesleretea*;
b) more rarely, heathlands of the *Calluno vulgaris-Ulicetea minoris*.

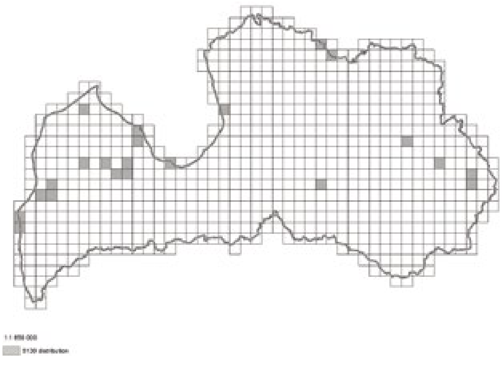


Figure 5.2. Distrubution of the habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands* in Latvia (Conservation status of.., 2013).

Specific characteristics of habitat interpretation in Latvia: the determinant criterion for the identification of this habitat is the presence of juniper communities in grasslands with xerophilous to hygrophilous soil (*Fig. 5.1.*), including cultivated grasslands, fallow lands or heaths. This habitat does not include groups of juniper in forest undergrowth, wet heaths and bogs, or juniper communities in artificial greeneries in urban areas, parks etc. A growth of at least five viable junipers can be recognized as a habitat when imaginary circular projections (with their radius triple the height of the measured juniper) that are located around each individual juniper form a continuous area of at least 0.1 ha (*Fig. 5.2.*). Areas that are smaller than 0.1 ha or groups of less than five junipers are included in the respective grassland or heath habitat in which these junipers are found (*Fig. 6.17.*). If a part of the area that aligns with the above mentioned circular projections is located outside grassland or heath habitat, for example, overlaps with arable land, this part is not considered as belonging to the habitat. The natural borders that are set by the relief also have to be taken under consideration when habitat borders are determined. For example, if a juniper community is located on a slope, on the foot of which open grassland of heath continues, this habitat should be marked only up to the foot of the slope. The method for setting borders for the area that belongs to a juniper community in relation to the juniper height that has been mentioned above, is based on observations on the distance in which trees and shrubs have an impact on the development of the vegetation that is located next to it in a plain. On the leeward this impact can reach up to 24 times the distance than the height of the obstacle that the wind is facing. However, both windward and leeward, the impact is normally greater than three times the height of the obstacle (Melluma, Leinerte, 1992; Kruše et al., 1995).

Distribution: a very rare habitat, mostly found in Coastal Lowlands, in valleys of the Daugava, the Abava and others rivers (Biotopu rokasgrāmata.., 2004).

Conservation value: one of the five rarest habitats of EU importance which are typical to the agricultural landscape of Latvia. It covers only 0.001% of the territory of Latvia (Conservation status of.., 2013). In the past it has been found relatively more often, while during the last 50 years it has disappeared almost fully. It has been assessed that in Latvia this habitat occupies only 66 ha (Conservation status of.., 2013). Juniper communities possess high aesthetic landscape and cultural heritage value. It is possible that a part of juniper communities were not only a distinctive grazing landscape but were historically also managed for junipers themselves, as in the past juniper was used for food (juniper berries) and other needs more often than nowadays. The habitat con-

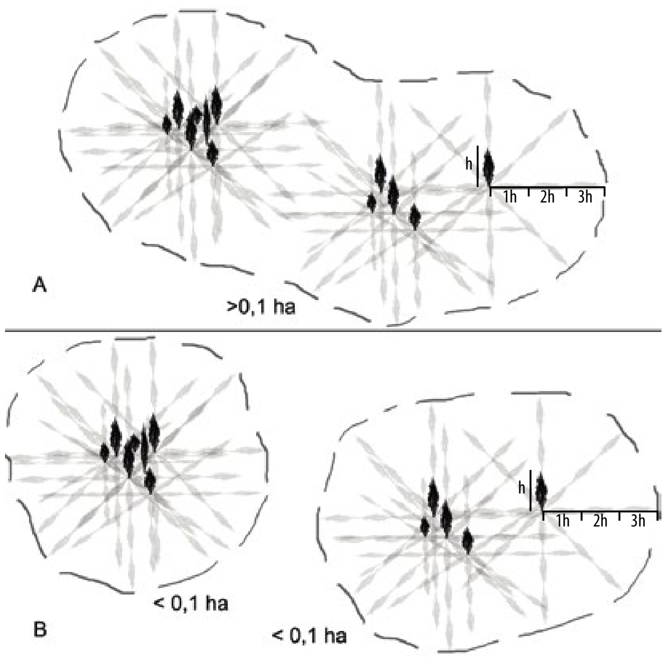


Figure 5.3. Habitat polygon separation chart: A – area that is large enough for a habitat to be separated, as imaginary circular projections (with their radius tripple the height of the measured juniper) that are located around each individual juniper form a continuous area of at least 0.1 ha; the dashed line indicates the outside border of the habitat; B – two separate juniper groups that are too small for the separation of the habitat; the imaginary circular projections of each group cover an area less than 0.1 ha and they do not overlap, therefore they cannot be merged and considered as one polygon (Chart: V.Lārmanis).

Figure 5.4. Juniper community with dense juniper groups (Photo: V.Lārmanis).

servation value in the perspective of plant communities overlaps with the value of several other habitats of EU importance: 6120* *Xeric sand calcareous grasslands*, 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)*, 6230 Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe), 6270* *Fennoscandian lowland species-rich dry to mesic grasslands* and 4030 *European dry heaths*. The presence of juniper in these habitats diversifies environmental conditions, therefore promoting relatively higher species diversity than it is typical of grasslands or heaths in open conditions.

Environmental factors: the habitat is present on calcareous, xerophilous to hygrophilous nutrient-poor soils. In grassland habitats it mostly occurs in river valleys (*Fig. 5.1.*) and hill slopes or the highest (driest) parts of alluvial deposits, which can be temporarily flooded by seasonal high water (*Fig. 5.4.*). In coastal or inland dune landscapes this habitat is usually related to heaths. Apparently, in many locations the distinctive factor for the existence of juniper communities has been their unsuitability for an intensive agricultural use. Juniper communities usually occur in less fertile areas (abandoned meadows or fields) and locations that are difficult to manage – on slopes, which can only be used for grazing due to their gradient.

Processes with a functional role: this habitat is the following development phase of grasslands or heaths towards afforestation. It is either temporary or managed in a long-term through grazing, less frequently – mowing in-between junipers. Regular grazing is the main process, which ensures the existence of the habitat. Regular mowing excludes formation of juvenile junipers and replacement of juniper generations, as their seedlings are also removed. Nowadays formation of this habitat in new areas is mostly related to termination of management in meadows and grazing sites. In these cases juniper communities are usually temporary – without an appropriate management these communities afforest very soon. It is possible that the existence of this habitat in a relatively low density historically has been determined not only by grazing, but also by periodical cutting of separate junipers for various household needs, thereby creating thinned juniper communities. Although part of the current juniper communities have formed only during the last decades in overgrown fields, juniper communities that are 50–70 years old can also be found (Salna, Kalniņš, 2007).

Vegetation characteristics:

<u>Layer of trees taller than junipers</u>. Presence of individual taller, field-grown trees of various species, for example, pines, is occasionally characteristic to the habitat. It should be noted that trees of the same

species, that are taller than junipers can belong to the habitat and can be expansive, in cases when they have introduced during afforestation, at the same time. Old trees and shrubs that have developed at the same time as junipers or earlier, belong to the habitat fully and are not considered inferior. Such trees can be recognized by a relatively thicker and more wrinkled trunk and denser foliage.

Juniper layer. Dominated by junipers, but a significant role can also be given to various species of *Rosa spp.*, *Crataegus spp.*, *Malus spp.*, *Rhamnus cathartica* and others in admixture. Admixture of other trees or shrubs is not a mandatory feature – pure stands of juniper are frequently found. The projective cover of junipers in a habitat of good status usually does not exceed 25%. However, the arrangement of junipers can be irregular and separate denser juniper groups with occasionally closed foliage can be present (*Fig. 5.4.*). Several dead or damaged junipers can also be found and exist in long term in juniper growths.

Ground cover vegetation. The structure and composition of the ground cover vegetation can be diverse and they are not of a qualification value in the identification of the habitat. The ground cover is indicatedly described in descriptions of other habitats of EU importance, where juniper growths can be found: 6120* *Xeric sand calcareous grasslands*, 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)*, 6230* Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe), 6270* *Fennoscandian lowland species-rich dry to mesic grasslands*, 4030 *European dry heaths*. The shading and leeward created by trees promote occurrence of species that are typical of plant communities on woodland borders. Part of the juniper communities have formed relatively recently (last 10–15 years) when juniper entered overgrowing grasslands or heaths as a pioneer species. In such cases the presence of species of woodland borders is poorly pronounced, as the impact of juniper on the ground cover has been too recent. Moreover, in afforested juniper communities, the ground cover vegetation and a more pronounced layer of moss, which is typical of forests, can also occur.

Characteristic species: shrub layer – *Juniperus communis*, *Rosa spp.*, *Crataegus spp.*, *Rhamnus cathartica*, *Malus spp.* Layer of grassland herbaceous plants – species are not specified, as the existence of this habitat is possible in diverse herbaceous plant communities; indicatively these species are typical of grasslands of *Festuco-Brometea* class and species characteristic to the habitat of EU importance 6120* *Xeric sand calcareous grasslands*, 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)*, 6230* Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe), 6270* *Fennoscandian lowland species-rich dry to mesic grasslands*. Heaths – *Calluna vulgaris*, *Empetrum nigrum*, *Lerchenfeldia flexuosa*, *Nardus stricta*.

Umbrella species (typical species within the meaning of the Habitats Directive): juniper *Juniperus communis* in the context of appropriate landscape.

Variants:

5130_1: juniper communities in grasslands, including cultivated grasslands and fallow lands;

5130_2: juniper communities in heaths, including heaths in dune landscape.

Habitat quality

Minimum habitat requirements: the main criterion for separation of this habitat is juniper communities on humid to xerophile soils in grasslands, including fallow lands of cultivated grasslands and fields, or heaths that are sufficiently large. If there are patches of species composition that is characteristic to a grassland or heath in the ground cover vegetation of overgrowing agricultural land or heaths, juniper communities that are currently located under the foliage of taller trees, projection of which does not exceed 75% against the total habitat area and the average height is not more than 7 m, can be identified as belonging to this habitat. In these cases the juniper community is not considered to be located in the undergrowth that is typical of a forest, which cannot be separated as the respective habitat, because the ground cover vegetation indicates a restorable open area in an agricultural land or heath that has overgrown relatively recently. In such cases special attention must be paid, whether junipers in this particular area have occurred before or after the development of these taller trees. Only cases that clearly show that the juniper community has existed before the afforestation can be mapped as this habitat. In forest stands that are narrower than 20 m a larger cover and height of tall trees is acceptable, providing that they are surrounded by open grasslands or juniper communities in a better condition.

Structural indicators:

1) In order to evaluate the habitat quality in grasslands, same

indicators that are used for all grasslands, except *ground cover vegetation of moss and lichen*, are used. For the habitat quality assessment in heaths the same indicators with the same exception as above, are used, additionally excluding the indicator *number of non-ameliorated grasslands indicative species*. As regards to the number of characteristic species in heaths, it is taken into consideration that this number in heaths is naturally lower than in grasslands.

2) Quality assessment criteria specific to juniper communities:

Density of the juniper stand. The minimum acceptable stand density is indicated by conditions for habitat border marking. The principle used in marking that belongs to a habitat automatically means that junipers whose projections do not overlap (circular imaginary projections marked around a juniper with radius that triple the respective juniper height) are separately existing junipers – distributed too sparse to be established as a continuous juniper stand (*Fig. 5.3.*). The highest level of "normal density" is one, where the area occupied by the exact projections of juniper foliage's respective to the total habitat area does not exceed 25%. This percentage is based on a presumption that after a juniper community becomes even denser, species diversity on the ground cover decreases due to shading, consequently, the importance of the juniper stand in conservation of biological diversity decreases. The arrangement of junipers can be irregular, separate juniper groups with higher density and completely closed foliages can also be found there and the projections of juniper foliages for these groups exceed 25% (*Fig. 5.4.*). High density of separate juniper groups is admissible; however, if it exceeds the limit against the total habitat area, it indicates habitat degradation.

Viable junipers. Both types of junipers – viable and dead – can be found in juniper communities. Oftentimes part of junipers of grazed habitats has been damaged by livestock even up to losing their vigour. However, junipers can have died off under the influence of other factors. In a community of "normal density" (see: Density of juniper community) up to 20% of dead junipers is considered to be an ordinary situation. A higher proportion of dead junipers may indicate unfavourable habitat condition.

Trees that are taller than junipers. Junipers and the ground cover of a habitat can be suppressed by excessive shading, which is created by higher trees. In habitats that are in a good condition, tall trees should not occupy more than 10% of their projective cover against the total area of the habitat. The impact of a higher proportion can be negative.

Figure 5.5. Juniper community on the River Gauja alluvial plain in the Protected Landscape Area "Ziemeļgauja" flooded by spring high water (Photo: V.Lārmanis).

Other trees and shrubs that do not exceed juniper height. Trees and shrubs of other species that are approximately of the same height or smaller than junipers can be present in juniper communities. Sometimes these plants reproduce to such extent that it depresses junipers and the ground cover vegetation. Proportion of such trees and shrubs should not exceed 10% of their projective cover against the habitat area. The impact of a higher proportion can be negative.

Function and process indicators

Management. This habitat can exist in long-term only if it is grazed. If grazing is not possible, it can be temporarily replaced by mowing. Regular felling of expansive trees and cutting of shrubs as well as thinning of overly dense juniper growths have a positive impact, but it is not enough unless the previously mentioned management methods are implemented simultaneously.

Area. Similarly to any other habitat, the significance of juniper stands in the preservation of its biological diversity increases along with an increase of the continuous habitat area.

Restoration potential and quality improvement indicators:

considerations for restoration of juniper communities in guidelines are similar to those defined for grassland habitats. Restoration opportunities of overgrown/unmanaged juniper communities according to their labor intensity can be divided into three levels of difficulty depending on the extent of overgrowing:

– felling/cutting/thinning and removing trees that are higher

than junipers + trees and shrubs that are up to the height of junipers and/or junipers themselves + regular management has to be resumed;
- felling/cutting/thinning and removing trees and shrubs that are up to the height of junipers and/or junipers themselves + regular management has to be resumed;
- regular management only has to be resumed.

The economic probability to restore and maintain permanent habitat maintenance has an additional significance in the assessment of restoration possibilities. Such possibility is indirectly indicated by the remoteness of the habitat or its location nearby currently managed agricultural land, as well as the type of management in this area (for example, when a grazing site is nearby, the possibility that an appropriate management will be restored in this habitat is higher).

Threats: the habitat is endangered by all threats that are common for grasslands and, in addition, a complete cutting or excessive thinning of the juniper stand and other characteristic trees and shrubs. Unlike open grasslands, which are endangered if annual burning takes place for five years in a row or more, when juniper foliages start to burn, juniper stands can be burn down fully during one burning activity. High groundwater level, which can be caused, for example, by a nearby flooding provoked by beavers etc., can be mentioned as a threat (Kilevica, 2005). It has been observed that juniper communities survive temporary flooding caused by spring high water with no negative consequences (*Fig. 5.5.*).

Management: measures include grazing or mowing, if grazing is not possible, and periodical partial cutting and removal of junipers to maintain the density of the community at a moderate density. From the perspective of habitat conservation, no special cutting of dead junipers is necessary, if there is no evidence that these junipers have a negative impact on the viable ones. Although the positive ecological influence of dead junipers in promoting the diversity of habitat species has not been proven yet, the possibility still exists (Greķe, Teļnovs, 2005). However, partial cutting of both viable and dead junipers can be acceptable to avert an excessive density of the juniper community (see: Structural indicators); cutting of isolated junipers or their branches for household needs is also an ordinary element of the traditional management of this habitat. In any case, the oldest and largest junipers should always be preserved. It is always advised to perform clearing of the juniper community of inferior trees and shrubs gradually, cutting only part of the inferior plants every year. It is also advised to implement these measures in the darkest period of the year, as fast removal of thick shading can result in burns on junipers (Kilevica, 2005).

Similar habitats: applying the main criteria – presence of the juniper community – all habitats where juniper communities are present, can be considered related. However, this habitat definitely does not include: juniper communities in undergrowth of forests, wet heaths and bogs, artificial greeneries in urban areas, parks etc. From the perspective of plant vegetation this habitat is similar to several grassland habitats and heaths. However, such considerations do not cause difficulties to separate these habitats, because, as soon as juniper community corresponds to the habitat size described in subchapter *Specific features of the habitat in Latvia*, it should be included in habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands* with no regard to whether it overlaps with any other grassland habitat. Smaller juniper stands are included in the respective grassland or heath habitat in which they are located.

Overlap with other habitats of EU importance: the habitat can overlap with various grassland or heath habitats of EU importance, or it can be overlapped by habitat 6530* *Fennoscandian wooded meadows* or *9070 Fennoscandian wooded pastures.*

Corresponding specially protected habitats in Latvia:
1.7. Juniper stands on calcareous meadows.

Literature:

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Greķe, K., Teļnovs, D. (2005) Nokaltušo kadiķu iespējamās vērtības, kā īpaši aizsargājamo bezmugurkaulnieku biotopa noteikšana dabas liegumā „Gudenieki". Atskaite Dabas aizsardzības pārvaldei

Kilēvica, M. (2005) Gudenieku kadiķu audzes veselības stāvokļa novērtējums. Atskaite Dabas aizsardzības pārvaldei

Kruše, P., Althauss, D., Gabriēls, I., Kruše, M. (1995) Aizsardzība pret vēju. Grām.: Ekoloģiskā būvniecība. Rīga, VAK „Ekofonds", a/s „Preses nams", 50.– 52. lpp. [tulkojums no vācu val. – Krusche, P., Althaus, D., Gabriel, I., Weig – Krusche, M., (1982) Ökologisches bauen. Umweltbundesamt. Bauverlag GmbH, Wiesbaden und Berlin]

Melluma, A., Leinerte, M. (1992) Ainava un cilvēks. Rīga, Avots, 175 lpp.

Salna, I., Kalniņš, M. (2007) Gudenieku kadiķu karaliste. Vides Vēstis Nr.4 (99) 2007, Rīga

6. GRASSLAND HABITATS

Semi-natural grasslands (meadows and pastures) are habitats in which vegetation consists of perennial grasses and herbs; mowing and/or grazing is a prerequisite for their existence. Semi-natural grasslands (unlike cultivated grasslands) are biologically very diverse and repetitive extensive use (mowing or grazing without fertilizing and other improvement) has a key role in their existence. Grassland habitat group includes natural (management is not needed), as well as semi-natural (management is required) grasslands and other perennial herbaceous plant communities. Almost all grassland habitats found in Latvia are semi-natural (the term *natural* is used only by following the tradition of the scientific language in Latvia), except for two habitats (6110* *Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi* and 6430 *Hydrophilous tall herb fringe communities of plains and the montane to alpine levels*), which do not conform with grassland habitats by definition, but are the closest to grasslands by their structure if compared to other habitat groups.

Habitat names

In comparison to the previous publication on protected habitats of EU importance in Latvia (Biotopu rokasgrāmata.., 2000; Biotopu rokasgrāmata.., 2004), several habitat names have been redefined and, based on their terminological meaning, the term *meadows* has been replaced by the term *grasslands*. *Grasslands* is a superordinate term that includes all perennial herbaceous plant communities that have formed under the influence of mowing and/or grazing, while terms *meadow* and *pasture* can be used to name a type of grassland use (management) (Rūsiņa, 2008). The term *meadows* is maintained in the habitat name only if the appropriate management for the habitat is mowing and this habitat does not form in pasture land. The term *grasslands* is also not used in cases, when the existence of a habitat does not require management that is characteristic to grasslands (mowing or grazing).

Distribution

Semi-natural grasslands occupied the largest area in the 19th century, when they covered 30% of the total area of Latvia. Even in the middle of the 20th century the area covered by grasslands was about 13% of the total area of the country. Since 1950s the distribution of grassland habitats decreased quite rapidly due to two simultaneous processes – agricultural intensification and farmland abandonment, and nowadays they occupy only about 0.3 to 0.8% of the total area of Latvia (Kabucis et al., 2003).

The EU Grassland Habitats Data Base of the Nature Conservation Agency was used to create maps of the grassland habitats of EU importance, and it was prepared based on the two most important data sources (Strazdiņa, 2013):

1) Valuable Grassland Data Base of the Latvian Fund for Nature (LFN VGD Data Base). It has been formed since 2000, and it includes data on semi-natural grasslands that were mapped within the framework of the project implemented by the LFN in 2000, 2001 and 2002 and within the project "Inventory of Meadows in Latvia" by the order of the Ministry of Agriculture (MoA) in 2005, 2006, 2007 and 2009;
2) mappings of habitats of EU importance in *Natura 2000* sites.

It should be noted that the used data has several flaws that must be considered when interpreting the habitat distribution maps and evaluating the real habitat distribution in Latvia. The habitat distribution that is included in distribution maps and the total habitat distribution has been overestimated in majority of cases and is larger than the area that can be found in nature because:

1. data base includes areas that are larger than those actually observed: botanically valuable grasslands in the project "Inventory of Meadows in Latvia" by the LFN, which was implemented from 2000–2003, were mapped using a cartographic base of a lower precision (Landsat 7 satellite images with the minimum mapping unit of 0.5 ha). When transferring them to maps of higher precision, it was not always possible to identify the exact location of botanically valuable grasslands on the map. In such cases larger areas of grasslands were included in the LFN VGD Data Base than were identified during the meadow inventory, i.e. neighbouring grasslands were also included (to the closest border that in seen nature and orthophotographs) (in reality 17 323 ha were mapped, but the data base includes data on 23 430 ha);
2. obsolete data: 10–15 years have passed since the implementation of the project "Inventory of Meadows in Latvia" by the LFN in 2000–2003 (during the project data on grasslands that were mapped in the 1990s within a variety of other projects and studies was also entered). Taking into account that only about 50% of all semi-natural grasslands are managed (Strazdiņa,

2013), it must be assumed that the unmanaged grasslands gradually die out. Without a repeated inventory it cannot be assured that the remaining 50% still comply with the minimum quality requirements of habitats of EU importance (they are, however, included in the distribution maps);

3. an unsatisfactory conservation status of managed grassland habitats. For the past 5–7 years almost half of the managed grassland habitats of EU importance are managed by inappropriate methods - mulching (chopping) or mowing of grass and leaving it on the field. It has changed the habitat quality. It is possible that some grasslands that have been included in preparation of distribution maps have lost their quality to an extent that no longer allows them to be considered habitats of EU importance.
    a) When the data base of grasslands of EU importance was developed, the compliance of the majority of grassland polygons that were included in the data base to a habitat of EU importance was determined by remote sensing, based on the information on the compliance of a polygon to the habitat according to the Latvian habitat classification (Latvijas biotopi.., 2001) and information on species composition. Since in many cases the species composition was incomplete or was not available at all, it is likely that there is a comparatively large number of grasslands whose compliance with habitats of EU importance has been identified incorrectly.

Conservation value of semi-natural grasslands

All semi-natural grasslands that are found in Latvia comply with the status of habitats of EU importance. The conservation value of grasslands is determined by several aspects. Firstly, they possess a value of nature diversity: one of the richest (most saturated) habitats in plant species in the world (Wilson et al., 2012); an important habitat to many animal (especially insect and bird) species and at least one third of the specially protected plant species of Latvia; a great diversity of plant communities that ensures the overall ecosystem diversity in a region and are not found outside semi-natural grasslands. Secondly, they possess an aesthetic and cultural heritage value: an important element of the traditional rural landscape of Latvia; cultural heritage value, because they are a result of cooperation between nature and human, they store information on the tangible and intangible culture of Latvia; they are a source of inspiration for human creative expressions. Thirdly, they have a value of ecological functions: feeding ground and living site for crop pollinating insects; purification of surface run-off pollution and flood control (especially flood plain grasslands); an important element of the natural and semi-natural ecosystem complex as a feeding ground and place of residence of wild animals that are involved in food chains of other ecosystems; ecosystem maintenance functions – soil formation, limiting erosion, carbon fixation, nutrient circulation, etc., as well as the economic value: resource of nature and rural tourism; forage resource; genetic resource (for medicinal herbs, future selection activities, needs of species population and habitat restoration). Semi-natural grasslands must be protected because the area that is covered by grasslands has decreased significantly for an average of 50–90% in the 20th century. In the last 120 years, the grassland area in Latvia has decreased from 30% to 0.3–0.8% of the total area of the country. In addition, grasslands require specific management, which is no longer performed nowadays due to socio-economic factors. That is the reason why new semi-natural grasslands do not establish, as they did 100 years ago, but the existing ones disappear. Without a special management and protection planning semi-natural grasslands are subject to complete extinction.

Environmental factors and processes with a functional role

Formation and existence of semi-natural grasslands is equally influenced by abiotic, biotic and anthropogenic (human impact) factors. Types and distribution of grasslands is mainly determined by soil conditions. Grasslands can develop in various conditions of soil humidity, pH and fertility. Depending on the combination of these factors, various plant and animal communities are formed. Climatic factors are more important for dry grasslands whose vegetation has a large proportion of species whose main distribution is in south of Latvia, hence they only occur in regions of Latvia that have a milder and warmer climate, as well as locally in areas where due to topographic factors a larger amount of heat is available for plants (slope that is facing south and southwest and relatively steep slopes). However, the anthropogenic factor is the most significant for the existence of semi-natural grasslands in Latvia, as in the climatic conditions of Latvia these habitats cannot exist without mowing and grazing – they overgrow with shrubs and trees as a result of natural succession. Nowadays there are no large wild herbivores that could graze grassland areas naturally. Several natural abiotic processes also ensure appropriate environmental conditions for grasslands. Flooding is vital for flood plain grasslands. It provides adequate hydrological regime throughout the year, creates gradation of environmental conditions both within the vegetation season (e.g., change of humidity from wet to very dry conditions, the amount of nutrient circulation – gradual decrease toward the end of the summer and renewal again at the beginning of the next season) and spatially, creating an uneven microtopography that provides ecological niches to a very large number of plant and animal species (this is the essence of flood plain grasslands). Natural fires are almost absent in grasslands in the climatic conditions of Latvia, thus plant species and vegetation in general, as well as animal species, have not adapted to frequent fires. Fire is an important factor that provides existence of grassland ecosystems only in the steppe zone. In the conditions of Latvia burning is usually undesirable because it promotes distribution of aggressive grasses (e.g., *Calamagrostis epigeios*), which leads to a drastic reduction in species diversity and changes the soil conditions significantly, making them unsuitable for grassland vegetation in a long-term perspective. However, a single controlled burning that has been intended for grassland restoration is acceptable in all grassland habitats. In dry habitats that are related to steppes of Eastern Europe (6120*, 6210), burning is acceptable more than once, but then not every year and not as the only management method, because fire burns out open spaces in sod that facilitates introduction of woody plants and rapid overgrowing of the grassland with a forest, as well as proliferation of aggressive nitrophytic herbaceous plants that are atypical to the habitat.

Vegetation characteristics

Vegetation is the most important component in grassland habitats, as it is the primary producer of organic matter, and thus maintains all the other organisms in this habitat as a living place and a feeding resource. Vegetation is also the key element according to which grassland habitats are classified and identified in nature, as it perfectly demonstrates the prevailing environmental conditions and management. Vegetation is formed by a set of specimen of higher and lower plant species of the territory. An important characteristic of the grassland vegetation is its vertical structure (layers), horizontal structure (spatial arrangement of plant species), composition of characteristic and dominant species, sod distribution, microtopography; therefore these parameters are characterized in habitat descriptions. It should be noted that the numerical values given in descriptions are only indicative. Depending on the vegetation period, in which habitat is surveyed, and its annual fluctuations in vegetation development, deviation to one or the other side can be present; therefore the vegetation characteristics of a habitat in an ideal condition might be slightly different than it is indicated in the description.

<ins>Vertical structure of the vegetation</ins>. Grassland vegetation consists of several layers. Vegetation of the herbaceous plants is the main one and it is always present. Three different layers can be distinguished, depending on the height of the plant - layer of low herbaceous vegetation (formed by plants that are on average 5 cm high, usually with a creeping, lying shoots and rosette leaves, for example, *Trifolium repens*, *Plantago media*, etc.), layer of medium herbaceous plants (about 50 cm high, for example, lower grasses: *Agrostis tenuis*, *Festuca rubra*, etc.) and layer of tall herbaceous plants (usually above 100 cm, for example, *Crepis biennis*, *Festuca pratensis*, *Arrhenatherum elatius*, etc.). Moss layer consists of moss and lichen species. In many grassland habitats the moss layer does not establish; because of the closed herbaceous plants the insulation is insufficient.

<ins>Horizontal vegetation structure</ins>. Each grassland habitat has a characteristic horizontal layout of calcareous plant and moss layer. It includes the total layer cover and the layout of patches that are free of vegetation, as well as the layout among plant species. An even layer of herbaceous plants is characteristic to all grasslands; very large patches of open soil do not form, but their layout in uniformly small (few cm^2) areas. Patches of open soil are characteristic and essential for the provision of specific functions mainly for dry grassland habitats, where they are used by single bee species, sand lizard, etc. Semi-natural grassland plant species are evenly arranged throughout the area – if the environmental conditions do not change drastically, they form a visually homogeneous plant community. In degraded grasslands this layout is discontinuous, mono-dominant patches of one species alter with patches of one or several other species.

<ins>Dominant species.</ins> One or several species always have a higher proportion (within terms of the number of specimen or green biomass) than other species in grassland vegetation. They affect the diversity of the rest of the species and their ability to grow (because they create shade and physical competition), as well as create an overall visual impression of the vegetation, therefore the composition of dominant species often helps to assess to which habitat the particular grassland belongs, as well as to assess its quality and to predict direction of grassland development.

<ins>Characteristic species</ins>. In each grassland habitat, in addition to the dominant species there is a number of species that usually do not dominate due to their biological characteristics, but are always or almost always present, as they include the most suitable living conditions for them. It should be noted that the dominant species can also be characteristic species, but it is not always the case. For example, if degradation takes place in a grassland due to overgrowing or influence of chemical pollution, ruderal species that are not characteristic to

particular grassland habitat begin to dominate the herbaceous plant layer. Plant species are easier to identify in grassland habitats, but animal, especially insect and bird species, are also very important.

Sod. Grasslands are dominated by grasses and forked fibrous roots are characteristic to them. They (live, dead, as well as root modifications) form sod - a dense network in the upper layer of soil. Formation of sod is characteristic exactly in grasslands (this process is less pronounced in forests and mires). In permanent grasslands sod is usually thick (even several decimetres) and closed. Sod that is less pronounced is usually in dry or disturbed (over-grazed or trampled) areas.

Succession. Semi-natural grasslands are dynamic ecosystems which transform relatively fast with a change of environmental conditions and management and it is reflected in the vegetation structure. The succession that is observed most frequently in Latvia is overgrowing of semi-natural grasslands after abandonment of management. Three stages can be distinguished. The first stage is relatively short (usually only 2–4 years), and is characterized by blooming of vegetation and a large species diversity, as plant species can grow and bloom with no disturbance, they are not restricted by grazing or mowing. The second stage is formation of litter layer that causes excessive humidity, eutrophication and other adverse changes in the environmental factors, therefore, herb layer simplifies, the majority of herbaceous plant species that are characteristic to semi-natural grasslands go extinct and they are replaced by a variety of expansive species. They are nitrophilous (nitrophilous) tall herbaceous plant species and some of the most competitive tall grasses. A large cover of these species indicates grassland degradation. The second stage can last from few years to even few decades. The third stage is introduction of trees and formation of shrubs of woodland. Succession that is characteristic to each habitat and the most common expansive species are listed in the vegetation section of the description.

Habitat quality

Habitat quality is characterized by its structure, function and restoration possibilities. It is not always possible to evaluate them directly; therefore indirect pointers are used to indicate some of the structural and functional parameters.

Minimum quality requirements for grassland habitats

By their overall vegetation structure and environmental conditions semi-natural grassland habitats of lower quality can be very similar to habitats that do not have a special nature conservation value. Usually the environmental conditions change gradually and form wide transition lines (ecotones) among habitats. Fluctuation of natural conditions is supplemented by human-caused habitat variants. It is particularly typical in grasslands since they are natural systems only partially. On one hand, human activity creates suitable conditions for them, but on the other hand, in a relatively short time a habitat can be not only destroyed, but also re-created. Through changing of management, one habitat can be transformed into another (e.g., humans cannot create natural old forests instead of a field, but through the use of appropriate management, a species-rich grassland can be created within 20–30 years). Consequently, there are situations when characteristics of several habitats that have been described in this manual are expressed in a similar extent in one and the same grassland area or characteristics of only one habitat, which are so poorly expressed that it is difficult to assess, whether an area corresponds to any of grassland habitats. A habitat of any quality should be considered a habitat of EU importance, as long as essential structures (ecosystem components) that allow it to be restored or created in a good quality have preserved or developed (are at the habitat formation stage). The most common problematic cases in semi-natural grassland separation are: 1) from a cultivated grassland or young fallow land that has not been fertilized or restored for a longer period of time, but has instead been mowed or grazed, and currently is not being used or has been used for mowing and grazing for few years; 2) from ruderal perennial herbaceous plant vegetation. Such habitats establish in semi-natural grasslands that have not been managed for a longer period of time and are characterized by pronounced dominance of one or several herbaceous plant species that are atypical of grasslands; 3) from scrubland or a young forest that has formed as a result of natural overgrowing with absence of management in semi-natural grasslands for a longer period of time; 4) from fens and drained peat fields with the dominant grass *Molinia caerulea.*

Minimum habitat quality criteria to distinguish semi-natural grasslands from cultivated grasslands and fallow land: when viewing similarities of cultivated grasslands and fallow lands to semi-natural grasslands, it is important to understand that these habitats are frequently in the initial formation stage of semi-natural grasslands. Already since the introduction of agriculture in the territory of Latvia, fallow lands have been dynamically related with vegetation of semi-natural grasslands both regarding species composition and management cycle. Cultivated grasslands as the potential areas of semi-natural grasslands have gained greater importance over the past two decades. It is often difficult to distinguish semi-natural grasslands from cultivated grasslands or fallow lands in mesic and wet growing conditions where cultivation and ploughing is performed more frequently; such situations can sometimes be present in xerophilous and wet grasslands. The most important and easily assessable differences are in the vegetation structure, plant species composition, age and management (*Table 6.1.*). In order to distinguish grassland that has established in the place of a cultivated grassland or fallow land as a habitat of EU importance, one of the following conditions must be fulfilled:

1) at least 5 semi-natural grassland indicator species (Annex 2) (frequent distribution: indicator species are found in at least four out of ten spots that have been distributed every 20 meters or form at least 10% of the herbaceous plant cover) are common throughout the grassland;
2) well-established sod and natural vegetation structure is characteristic across all grassland (vegetation is dominated by species that are typical to semi-natural grassland habitats, not sown grasslands), at least three semi-natural grassland indicator species, of which at least one species is with high occurrence (found in four out of the ten spots that have been distributed every 20 meters) or cover (it forms at least 10% of herbaceous plant cover) (such cases are often found in the habitat 6270* *Fennoscandian lowland species-rich dry to mesic grasslands*) can be found; at the same time grasses that have been sown previously and aggressive nitrophilous tall herb species (*Agropyron repens*, *Anthyscus sylvestris*, *Aegopodium podagraria*, *Calamagrostis epigeios*, *Chaerophyllum aromaticum*, *Dactylis glomerata*, *Phleum pratense*, *Taraxacum officinale*, *Trifolium hybridum*, *T.pratense*, *Urtica dioica*) and alien species do not form more than 60% of the total herbaceous plant layer cover;
3) in order to acknowledge flood plain grassland as a semi-natural grassland and habitat alluvial grasslands (6450) of EU importance, semi-natural grassland indicator species can be absent, but it must be subject to flooding with a typical flood-plain

Table 6.1.* Features of semi-natural and cultivated grasslands (supplemented according to Rūsiņa, 2008).

Feature	Semi-natural grassland	Cultivated grassland or fallow land
Number of plant species per 1 m^2	In mesic areas 30 and more species characteristic to semi-natural grasslands (high diversity of species), in dry and wet areas the number of species can be much smaller due to natural conditions.	1–15 species (species diversity is low), many of which are not characteristic to grasslands, for example, weeds: *Cirsium arvense, Aegopodium podagraria, Elytrigia repens, Myosotis arvensis, Tussilago farfara, Artemisia vulgaris*, etc. (there are usually less than 15 species that are typical to semi-natural grasslands in 1 m^2). In a larger area the number of species can be rather big (more than 30), however it is characteristic that these species are of broad ecological amplitude and many of them are not typical to semi-natural grasslands.
Vegetation structure	Vegetation consists of several layers (3–4), including moss layer (although it can be absent in grasslands of more fertile soil, the soil is fully shaded by herbaceous plants). Usually, there are no dominant species. Well established sod – relatively dense, created by root networks of grass. Polidominance is less common in dry and wet areas – in the herbaceous plant layer one or two species may be dominant (these species are also typical of grasslands).	Vegetation structure is simple with 1–2 layers; 1–3 species dominate explicitly (sown grasses, in fallow lands also species that are characteristic to semi-natural grasslands with a wide ecological amplitude, such as *Agrostis tenuis*), the cover of other species is very small, sod is sparse, open. Characteristic species: *Dactylis glomerata, Phleum pratense, Poa pratensis, Poa palustris, Alopecurus pratensis, Trifolium hybridum, T.pratense* (these species are also found in semi-natural grasslands, however usually they are not typical dominants; in cultivated grasslands these are species that are sown most frequently and establish a sward that is almost monodominant (if only one species is sown) or consists of few species – *Taraxacum officinale, Aegopodium podagraria, Anthriscus sylvestris*.
Management	Traditional management, which was common in Latvia in the first half of the 20th century – meadows and pastures were not fertilized, grasses were not sown, territory was consistently managed for several decades.	Intensive management that began in Latvia in the second half of the 20th century – regular fertilization, mainly with mineral fertilizers, grasslands were sown by grass seed mixtures or were completely renewed by ploughing and sowing different grass seed mixtures (the restoration took place on average once in every 4–6 years).
Age	Used as a meadow or pasture for 20 years or longer (during this time ploughing or other meadow or pasture amelioration works have not been performed).	Age of grassland or fallow land is usually less than 10–15 years.

** this table has only a descriptive meaning, it CANNOT be used to determine semi-natural grasslands in field conditions, because it describes only typical situations of semi-natural grasslands of good quality and intensively cultivated grasslands*

Figure 6.1. Gradual ruderalization of 6510 *Lowland hay meadows* (*Alopecurus pratensis, Sanguisorba officinalis)* with *Anthriscus sylvestris* (areas in white), after termination of management. Such grassland is still considered a habitat of EU importance because there still are patches that are free from cow parsley (areas in green) where the vegetation structure and species composition corresponds to the habitat description. If management will be resumed, ruderal areas will restore relatively quickly because resources of plant species are adjacent to it and environmental factors have not been changed substantially (Photo: S.Rūsiņa).

Figure 6.2. 6450 *Northern Boreal alluvial meadows* that have overgrown with *Phragmites australis*. Such grassland still corresponds to the habitat as the plant species and habitat structure are characteristic to the habitat (in the foreground *Dactylorhiza spp*. can be seen) (Photo: S.Rūsiņa).

grassland vegetation with plant species that usually dominate in flood-plains – *Alopecurus pratensis*, *Phalaroides arundinacea*, *Poa palustris*, *Poa trivialis*, *Deschampsia cespitosa*. At the same time, at least three species that are characteristic to flood-plain grasslands with high occurrence must be present (found in at least four out of ten selected spots selected every 20 meters), species: *Caltha palustris*, *Cardamine spp., Carex acuta*, *C.cespitosa, C.disticha, C.nigra, Calamagrostis canescens, Cnidium dubium, Filipendula ulmaria, Galium palustre, G.uliginosum, Geum rivale, Lathyrus palustris, Lythrum salicaria, Peucedanum palustre, Thalictrum flavum, T.lucidum, Valeriana officinalis, Veronica longifolia, Viola persicifolia*. If there are no characteristic species, grassland should be a mosaic of several flood-plain grass and sedge species (one or the other species dominates in different patches). At the same time, the cover of cultivated grassland species *Dactylis glomerata*, *Phleum pratense*, *Trifolium hybridum*, *T.pratense*, alien species *Ehinocystis lobata*, *Impatiens glandulifera* etc., and nitrophilous species *Aegopodium podagraria, Agropyron repens*, *Anthriscus sylvestris*, *Chaerophyllum aromaticum*, *Taraxacum officinale*, *Urtica dioica* is less than 60% of the total cover.

4) In *Fennoscandian wooded meadows* (6530*) semi-natural grassland indicator species can be absent – presence of any grassland is sufficient. It is acceptable because the value of this habitat is also related to insect, fungi and epiphytic moss and lichen species found in the tree layer.

Minimum quality criteria to distinguish semi-natural grass–land from ruderal perennial vegetation: ruderal perennial vegetation that has developed without the phase of semi-natural grassland is not considered a semi-natural grassland, for example, on a causeway or at the construction site where the natural ground cover is removed, or in a young fallow land where no appropriate semi-natural grassland management has been applied etc. If the origin of a territory is related to a semi-natural grassland (habitat has formed through the ruderization of a semi-natural grassland), it is still categorised as a semi-natural grassland as long as it has recovery possibilities (characteristic species are found or they are present in similar grassland habitats that are close to the territory) (*Fig. 6.1., 6.2., 6.3.*). Under the influence of various factors, semi-natural grasslands transform into ruderal habitats dominated by perennial herbaceous plants. The most common reasons in Latvia are abandonment of management, continued burning (annually for more than 5 years), eutrophication or direct or indirect fertilization (influenced by air deposition, surface run-off from the nearby fertilized areas), change of hydrological regime (mainly drainage). Until now, degradation due to excessive trampling or chemical pollution in Latvia has been rarely detected. The typical vegetation within the process of ruderization is replaced by species that are not characteristic to semi-natural grasslands or species that are commonly found in grassland plant communities, but never dominate if management activities are performed properly. Ruderalization is usually gradual (*Fig. 6.1.*, *6.2.*), and a grassland is no longer considered to be the original habitat only in the final stage, when it has transformed into a ruderal habitat with a perennial herbaceous vegetation. In this situation there are no possibilities to improve the habitat quality or to restore it without a significant artificial intervention (e.g. removing of sod, sowing of seeds). For example, if characteristic species are no longer present in dry calcareous grassland and a monodominant community of *Calamagrostis epigeios* has developed, and in its immediate surroundings there are no good quality habitats from which the characteristic species might root, such sites are no longer included in dry calcareous grasslands (*Fig. 6.3.*).

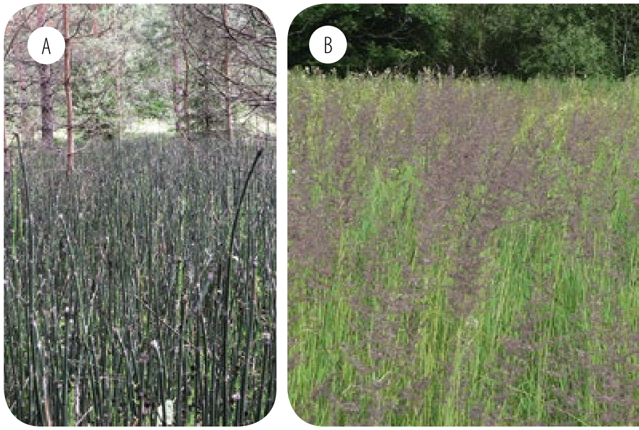


Figure 6.3. A - 6120* *Xeric sand calcareous grassland* that is overgrowing by *Equisetum hyemale* and *Pinus sylvestris*, B - 6120* *Xeric sand calcareous grassland* that is overgrowing by *Calamagrostis epigeios*. Such grassland no longer conforms to the definition of 6120* because herbaceous plant layer no longer includes species that are characteristic to this habitat (Photo: S.Rūsiņa).

Minimum quality criteria to distinguish semi-natural grassland from woodland or shrubs: grassland that has overgrown with shrubs and trees is not considered a habitat of EU importance if the species composition and vegetation structure that is characteristic to grassland in not found in more than 75% of the territory (*Fig. 6.4.*). Several variants can form in which grassland still conforms with the grassland habitat:

- continuous vegetation or copses of mainly shrub species (shrubby alder, osier, buckthorn, etc., except for juniper). An area is considered as grassland if the shrub cover is below 75% and patches of the typical grassland species composition have been conserved throughout the whole territory (*Fig. 6.5.*);
- continuous vegetation or copses of tree pioneer species (goat willow, alder, aspen, pine, birch, etc.). An area is considered as grassland if the tree cover is below 75%, their average height does not exceed 7 m and/or the average trunk diameter at the height of 1.3 m is not larger than 12 cm and in the whole area there are patches with the typical grassland species composition (*Fig. 6.6.*);
- In 6530* *Fennoscandian woodland meadows* and 5130 *Juniperus communis formations on heaths or calcareous grasslands* the criteria differ from the ones mentioned above (see detailed explanation in the habitat descriptions).

Figure 6.4. Overgrown grassland in spring. Steady overgrowing without patches of structure and species that are characteristic to grasslands. Not considered a grassland habitat (Photo: S.Rūsiņa).

The provision of functions applies to all cases of habitat transformation. A habitat is not considered as a habitat of EU importance if any of the natural environmental factors or processes that are important for the provision of habitat functions have been irreversibly changed. For example, if amelioration has stopped flooding of a flood plain grassland and the hydrological regime has become much drier, leading to peat decomposition, thus creating the possibility for development of ruderal nitrophylous of tall grasses, such flood-plain cannot be restored only by restoration of traditional management.

Minimum quality criteria to distinguish semi-natural grassland from a fen: a part of semi-natural grasslands are related to fens by their origin. During the period of traditional agriculture fens were mowed and grazed in many areas, bringing their vegetation closer to grassland characteristics. The reverse process also takes place, by an increase in humidity, semi-natural grasslands gradually transform into mires. An area in which only natural processes occur and peat formation dominates formation of sod, most likely belongs to mires, but an area which is or recently has been mowed or grazed, and where the presence of grassland characteristic species can be identified, is more likely to be considered a grassland. Most frequently they belong to the following habitats of EU importance: *Fennoscandian lowland species-rich dry to mesic grasslands* (6270*), *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)* (6410) and *Northern Boreal alluvial meadows* (6450). The primary criterion to distinguish semi-natural grassland from a mire is the species composition and structure, but the criterion that is often used in agriculture - thickness of peat layer – cannot be applied in this case.

Structural indicators

Number of characteristic species. The number of species that are characteristic to the habitat is a good quality indicator. The total number of characteristic species is individual to each habitat as it depends on a habitat-specific set of environmental conditions and the overall geographic distribution of the habitat and the place where it is in Latvia, as well as history of vegetation. When the habitat quality decreases, the number of characteristic species also decreases.

Number of semi-natural grassland indicator species. This indicator shows the sustainability of a habitat in terms of management as well as its resistance to degradation. Semi-natural grassland indicator species can be found only in semi-natural grasslands that have been used traditionally for a long time. The larger the number of indicator species, the higher is the habitat quality.

Species richness. Species richness (species density) indicates the number of species per area unit. Among all habitats in Latvia (and in Europe altogether) semi-natural grasslands are characterized by the highest species richness. The higher is the habitat quality, the higher is the species richness. This indicator is individual for each habitat. In semi-natural grasslands (with the exception of very wet and very dry grasslands where due to extreme environmental conditions the number of species can be lower) there are usually more than 15 plant species per 1m^2. In qualitative semi-natural grasslands the number of species frequently exceeds 30.

Figure 6.5. Overgrowing grassland in spring. Areas where the structure and species that are characteristic to grassland habitats, can be seen. It is, therefore, considered a grassland habitat (Photo: S.Rūsiņa).

Number of protected and Red Data Book of Latvia species. The quality of semi-natural grassland habitats is increased by the presence of rare and protected plant, animal and other organism group species. These species usually have narrow ecological amplitude and they can exist in long term only in stable, fully-functioning semi-natural grasslands – for these reasons these species are good indicators of the grassland quality.

Amount of open soil (substrate). Patches of open soil are very important to conserve grassland as a habitat. They ensure place of residence for mosses and lichens, provide an opportunity to germinate seeds and are important for a variety of species in many habitats (single bees, ants, lizards, etc.). In each habitat group the amount of open soil is different. In dry grasslands in order to preserve the habitat quality, a larger proportion of vegetation free areas is required than in mesic fertile grasslands. In grassland of good quality at least 5% of the total area must be vegetation free and arranged in a dispersed manner across the grassland.

Cover of mosses and lichens. Mosses and lichens are weaker competitors than herbaceous plants, for their growth good lighting conditions and nutrient-poor soil are necessary, therefore their proportion is a good indicator of changes in the habitat. Too small cover of mosses and lichens in dryer grasslands indicate eutrophication processes. Too large proportions of mosses that are not typical to the habitat indicate its degradation.

Cover of herbaceous plants. This indicator is less applicable in characterising the habitat quality as it varies greatly from year to year, depending on weather conditions during the vegetation season. However, it is applicable for some grassland habitats because it shows the intensity of various disturbances.

Cover of trees and shrubs. The layer of ligneous plants is a significant structure of two grassland habitats – *6530* Fennoscandian wooded meadows* and *5130 Juniperus communis formations on heaths or calcareous grasslands.* The layer of trees and shrubs is not characteristic to other semi-natural grassland habitats. The larger is the spontaneous cover of trees and shrubs (occurs when management is terminated), the lower is the grassland quality (it is too shaded, humidity and competition increase, etc.). It should be noted that a small proportion of ligneous plants in a grassland (proportion of the projective cover is below 10%) improves its quality, as it diversifies the environmental conditions that allow a higher number of species to grow and live in the grassland.

Expansive species. Expansive species are native herbaceous plant species (seldom moss) that are usually found in semi-natural grasslands, but due to traditional management their proportion in vegetation is small. When management is ceased or when the environmental conditions change, they proliferate rapidly, outrival the characteristic grassland species and usually start to dominate until persistent mono-dominant communities of one or several species establish. The higher is the proportion of these species in vegetation, the lower is the habitat quality.

Invasive species. In semi-natural grasslands invasive species are alien herbaceous plant species with a tendency to proliferate rapidly and outrival native species from the vegetation. Semi-natural grasslands are typically resistant to alien species; therefore appearance of these species indicates deterioration of the grassland habitat quality.

Litter layer. Life cycle of annual plants ends with dying-off every year, but parts of perennial plants change gradually throughout their life cycle (a part dies off and another part forms anew). Litter consists of dead undecomposed and partially decomposed plant surface parts. Thickness and structure of the litter layer indicate the nutrient cycle in grassland ecosystems. A thick litter layer is not characteristic to semi-natural grassland ecosystems (as mowing and grazing prevent its formation) and usually it has a negative effect on the habitat quality. A thick litter layer indicates that grassland has not been mowed and grazed for a long time. Litter prevents seeds from germinating, creates a more humid micro-climate which has a negative impact on the regeneration of grassland plant and animal communities. Litter also forms if grassland is mowed only once in early spring, as until autumn the grass manages to grow back in a length that already creates litter, but such formation of litter usually does not have a negative impact on vegetation. Mulching (chopping of mowed grass and leaving it on the grassland) that has been practised in the recent years also increases formation of litter, as the chopped grass often decomposes only in several years (especially in the driest areas and areas with a very high and thick layer of herbaceous plants). Litter indicates the way animals use the territory in pastures. If the grazing

Figure 6.6. Semi-natural grassland that has overgrown with tree pioneer species (aspen and birch). It is still considered a semi-natural grassland as the herbaceous plant species that are typical to semi-natural grasslands can be found throughout the ground cover (Photo: V.Lārmanis).

load is optimal for the area, almost no litter is formed.

Function indicators

Firstly, the quality of structures (viewed previously) provides evidence on the functions of semi-natural grasslands. However, there are several function indicators that can be recognized by other features. Some of them may be absent from the grassland structure for a very long time, as many features of the grassland structure have a long "latent period", i.e., although significant functions do not occur for a long time, its structure remains in a good quality for a long time. For example, when the grassland management is ceased, the number of species can decrease very slowly, but the information on the lack of management can be obtained by the ones who manage the grassland.

Influence of flooding. The influence of flooding is positive to all grassland habitats. They diversify the microtopography, creating additional ecological niches, reduce undergrowth of trees and shrubs, transport nutrients, promote species dispersal (transport seeds and viable parts of plants) etc. Therefore, provided that other conditions are similar, a habitat has a relatively higher quality in an area that is subject to spring flooding other than in an area that is not flooded (due to artificial or natural conditions).

Appropriate moisture regime. Humidity conditions are one of the most important factors in ensuring the habitat quality. Even small fluctuations from the average level (making it overly wet or too dry) can stimulate disappearance of the habitat. The most important indicators of negative changes in hydrological regime are recent drainage activities, activity of beavers, etc.

Management. Semi-natural grasslands are habitats that cannot exist without management; therefore management is a precondition for ensuring habitat functions.

Inappropriate management. Over-grazing and too frequent mowing decreases habitat quality (decreases species diversity, weakens plant generative propagation, etc.). Over-grazing is indicated by a large cover of hummocks and disturbances in sod that are caused by too frequent trampling, as well as a pronounced dominance of few creeping plants (*Trifolium repens*, *Prunella vulgaris*) and an increased proportion of ruderal species (*Cirsium vulgare*, *Plantago major*, *Polygonum arenastrum*, *Poa annua*, etc.). Too frequent mowing is indicated by formation of the vertical vegetation structure and species composition that is characteristic to lawns.

Influence of grinding (mulching). Grinding of grass and leaving it on the grassland (mulching) is not a traditional management method for semi-natural grasslands. It causes rapid decomposition of the green mass of plants and its returning to the nutrient cycle that causes fertilization effect and increased biomass production. The cover of grinded grass in some places is thick, causing disturbances in sod, destroys plant species, and contributes to introduction of species that are not characteristic to grassland (for example, weeds). As a result, in a shorter or longer period of time semi-natural grassland habitats degrade and are destroyed.

Impact of recreation. Recreation can have a negative effect on the grassland structure and functions due to very intense trampling, as well as setting up of fireplaces (the vegetation in fireplaces changes and species that are not characteristic to grasslands are introduced), and due to household and nitrogen pollution.

Restoration potential and quality improvement indicators

Habitat restoration/quality improvement is possible in all grassland habitats that correspond to minimum quality requirements, but the degree of difficulty may vary depending on the function and structure quality as well as the amount of necessary resources for the restoration – the latter is affected by the degree of habitat fragmentation. In most cases these possibilities are similar to all grassland habitats. Specific details are mentioned to each individual habitat, but the possibilities described in this section relate to all habitats.

Condition of structure and functions. The less is the number of structures and functions that require restoration, the easier it is to restore the habitat. It must be evaluated, whether the restoration can be reached with resumption of the appropriate management or other additional measures for habitat structure restoration are required (alignment of hummocks or their mechanical removal, mowing more frequently than 2 times per season (in order to reduce the amount of inferior species), removal of ligneous vegetation etc.). The most difficult is restoration of a habitat if its functions have to be restored (regulation of hydrological regime, removal of sod to create soil fertility that is appropriate to the habitat and opportunities to enter the nutrient cycle), reintroduction of characteristic species (artificial introduction with planting or seed sowing) in to habitat, removal of ligneous vegetation in more than 50% of the area, etc.

Visual evaluation of restoration costs. This criterion includes conditions that can be observed in nature and can have an impact on restoration costs. It does not include socio-economic factors that cannot be evaluated in the field (for example, interest of potential managers, available financial resources, availability of labour etc.). Habitats with lower estimated restoration costs have higher restoration possibilities.

Degree of isolation. Isolation of a habitat from other similar habitats is a spatial matter and it has a significant impact on the quality and stability of the habitat. Pronounced isolation means that the exchange of individuals of characteristic species of the habitat is limited and therefore the exchange of genes does not take place and species are subject to local extinction. Habitats that are located near other similar habitats or species dispersal routes have better restoration possibilities.

Area. Area of the habitat is a very important factor that determines possibilities for habitat conservation and restoration. The total number of species that can be present in a territory is determined by the area of territory. The smaller is the area, the smaller is the number of species. Habitat with a small area can secure only small populations of plant and animal species, but it poses threats of local extinction of species.

Threats

Semi-natural grasslands are mainly threatened by anthropogenic factors. Most of them are similar in all grassland habitats. Specific threats are mentioned in the description of each habitat.

Direct factors (factors that change the use of grassland in an unsuitable way). One of the major threats currently is the change of the use of land and grassland management type in Latvia. It destructs the habitat either instantly (e.g., in case of construction, ploughing) or in a relatively short time (e.g., afforesting, changing hydrological regime, ameliorating by fertilization and sowing of grass, annual burning for more than five years in a row). Termination of management that is suitable for grassland allows development of natural succession, which almost always results with formation of woodlands or scrubs in the climatic conditions of Latvia. The cases when bogging up of grassland or its degradation take place, converting it to a relatively stable (even for decades) mono-dominant vegetation of one or few tall herbaceous plant species, are more rare. Over-grazing and too frequent mowing (more than 2 times per season) leads to degraded communities that no longer correspond to the grassland habitat that is described in this manual according to their structure and functions. Too rare mowing (less than once every two years) or insufficient grazing intensity have similar results.

Indirect factors (do not affect grasslands directly, but indirectly through other activities that are not directly related to grasslands). Eutrophication that is caused by nitrogen deposition from air (with air pollution) or surface run-off from adjacent intensive agricultural areas (in particular, it is characteristic to river flood-plains) increase soil fertility. In a long term perspective it causes irreversible changes in vegetation and leads to habitat degradation or extinction. Habitat fragmentation creates unfavourable conditions for a healthy existence of species populations. Grassland plant species overcome long distances weakly and they have a very unstable seed bank (seeds retain the possibility of germination only for few years), therefore in territories of fragmented meadows and pastures local extinction of species takes place, besides, the first to go extinct are the specially protected species, as they mostly have smaller proliferation possibilities. Wide ecological species that are able to proliferate mostly remain. Fragmentation can also lead to local extinction of species in a case when management measures are appropriate, when gene exchange does not take place within the species (Rūsiņa, 2008).

Management

Grassland management is an integral element of the existence of these ecosystems. Semi-natural grasslands have established in a system of extensive agriculture and their management has been characterized by a diversity of approaches (mowing, grazing, various combinations of the previous activities, setting the time for mowing by plant phonological phases, etc.). Only by preserving this management diversity, an effective protection of biological and landscape diversity is possible. This manual does not include a detailed description of the traditional grassland management methods and evaluation of modern tendencies, as it is available in other literature sources (Rūsiņa, 2008 and provided references).

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2000) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Kabucis, I., Rūsiņa, S., Veen P. (2003) Grasslands of Latvia. Status and conservation of semi-natural grasslands. European Grasslands. Report Nr.6. Royal Dutch Society for Nature Conservation, Latvian Fund for Nature, 46 p.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Rūsiņa, S. (2007) Latvijas mezofīto un kserofīto zālāju daudzveidība un kontaktsabiedrības. Latvijas veģetācija 12, 1.–366. lpp.

Rūsiņa, S. (2008) Dabisko zālāju apsaimniekošana augāja daudzveidībai. Grām.: Auniņš, A.(red.) Aktuālā savvaļas sugu un biotopu apsaimniekošanas problemātika Latvijā. Rīga, Latvijas Universitāte, 29.–43. lpp.

Strazdiņa, B. (2013) Atskaite par ES nozīmes zālāju, krūmāju un virsāju biotopu Latvijā oriģinālas datu bāzes izveidošanu un stratificētu statistisko datu apstrādi. Izstrādāta pēc Dabas aizsardzības pārvaldes LIFE+ projekta „*Natura 2000* Nacionālā aizsardzības un apsaimniekošanas programma", LIFE11NAT/LV/371 pasūtījuma. Rīga, Dabas aizsardzības pārvalde, 23 lpp.

Wilson, J.B., Peet, R.K., Dengler, J., Pärtel, M. (2012) Plant species richness: the world records. Journal of Vegetation Science, 23, 796–802 p.

6110* *Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi*

Latvian habitat classification: E.1.3.

Syntaxonomy: *Alysso-Sedion albi*.

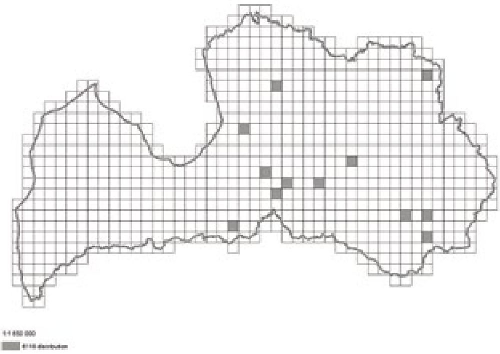


Figure 6.7. Distribution of the habitat 6110* *Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi* in Latvia (Conservation status of.., 2013).

Definition: open xerothermophile pioneer communities on superficial calcareous or base-rich soils, dominated by annuals and succulents. Similar communities may develop on artificial substrates; these should not be taken into account.

Specific characteristics of habitat interpretation in Latvia: in most cases this habitat forms on horizontal or inclined (but not vertical) dolomite and limestone outcrops (*Fig. 6.8.*), but natural and artificial gravelly sites where almost no soil is present, but the substrate consists of calcareous gravel or pebbles (for example, steep slopes in places, where the ground cover has been removed, in old quarries) have a large impact on the conservation of plants of this habitat. Artificially created habitats should be included in this habitat type as long as the dominance of ruderal species is not pronounced and there is a typical, habitat-specific species composition. Succulent communities in cemeteries and adjacent areas (mostly on sandy substrate or rock piles and fences), where succulents have apparently introduced from greeneries, are not included. Presence and domination of alien succulent species *Sedum album*, *Sedum sexangulare*, etc. is also acceptable in these habitats as they do not compete with local species.

Distribution: very rare in the territory of Latvia, most of them are located in the River Daugava valley from Pļaviņas to Koknese.

Conservation value: in Latvia this habitat type is very close to its northern distribution border, less than 10 localities are known (1 ha or 0.00006% of the total territory of Latvia). It is the only habitat of moss species *Mannia fragrans* (Āboliņa et al., 2002), which has only one locality in Latvia (it is the only known locality in the Eastern Baltics). A significant habitat for such rare species as *Jovibarba globifera*, *Saxifraga tridactylites*, etc. Outstanding landscape value, important geological objects.

Environmental factors and processes with a functional role: on horizontal and inclined dolomite outcrops or on steep, gravelly hill slopes. In the conditions of Latvia they mainly establish in sites exposed to south or southwest that provide more heat than on average in climatic conditions of Latvia. The substrate is calcareous and very dry.

Vegetation characteristics: drought and heat loving plant communities that are formed as pioneer communities on calcareous rock outcrops. The layer of herbaceous plants is usually very low (up to 20 cm) and open (below 80%), there is no sod as the soil layer is very shallow (few cm); therefore, herbaceous plants root mainly in fissures in dolomite (*Fig. 6.9.*). Dominated by succulents (thick-leaved plants): *Sedum acre* and *Jovibarba globifera* and annual plants: *Erophila verna*, *Veronica verna*, *Cerastium semidecandrum*, *Arabis spp.* etc., in some areas the layer of mosses (usually *Abietinella abietina*, *Pottiaceae* family species) and lichens (*Cladonia spp.* and *Peltigera spp.*) may be dense. From the perennial herbaceous plant species the most characteristic are species with prostrate or creeping shoots and long, strong roots that are able to root in dolomite fissures (for example, *Potentilla arenaria*, *Potentilla reptans*, *Medicago falcata*). The natural succession is ensured by gradual weathering of dolomite and formation of ground cover – in natural conditions it takes place very slowly. With an increasing soil depth, annual plant and succulent communities are replaced by calcareous grassland vegetation and trees and shrubs begin to introduce.

Characteristic species: herbaceous plants – *Acinos arvensis*, *Anthemis tinctoria*, *Cerastium semidecandrum*, *Erophila verna*, *Jovibarba globifera*, *Poa compressa*, *Potentilla arenaria*, rue *Saxifraga tridactylites*, *Sedum acre*; moss – *Abietinella abietina*, *Pottiacea* family species; lichen – *Cladonia spp.*, *Peltigera spp.*; invertebrates – *Diplopoda*, *Armadillidium pulchellum*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Jovibarba sobolifera, Saxifraga tridactylites*.

Variants:

6110*_1 (typical): on limestone outcrops;

6110*_2 (on gravelly soils): mainly formed artificially on slopes of hills by digging for road construction or removal of ground cover, as well as in areas (steep south or south-west oriented hill slopes) where the ground cover has been a subject to natural erosion.

Habitat Quality

Minimum habitat requirements: only areas where the slope of the outcrop is equal or smaller than 45 degrees correspond to the habitat, in shallow gravelly soils *Jovibarba globifera* must be present.

Structural indicators: all indicators that are important for grasslands, except for the number of indicator species of semi-natural grasslands because these habitats develop nature without the influence of mowing and grazing; in addition – the succulent cover (in a habitat of good quality it must be at least 25% of the total cover of herb layer) and herbaceous plant cover (if it is below 15%, it indicates too intensive disturbances, but the cover that exceeds 75% indicates eutrophication and shade that reduce the habitat quality for typical plant and lichen species).

Figure 6.8. Pioneer herbaceous plant communities in shallow calcareous soils at the bank of the River Daugava near Dzelmes (Photo: S.Rūsiņa).

Figure 6.9. Plant community consists of succulents, annual and perennial plants (Photo: S.Rūsiņa).

Function, process, quality improvement indicators and restoration potential: all indicators that are important to grasslands.

Threats: all factors that threaten grasslands; a specific threat is dolomite mining or mechanical damage that occurs during rock climbing. At the river banks it is caused by frequent and severe water level fluctuations that usually occur as a result of hydroelectric plants. In such sites due to action of water and frost the erosion of banks occurs faster than under natural conditions, thus these habitats are being gradually destroyed. Outcrop walls become vertical and growing conditions become unsuitable for the majority of characteristic species (it should be noted that as a result of this impact the habitat 8210 *Calcareous rocky slopes with chasmophytic vegetation* does not form as well, because the rapid erosion prevents colonization of this habitat by characteristic species).

Management: unlike other grassland habitats, regular management is not required, since the environmental conditions are so extreme that the succession is slow. Usually these habitats are kept open by irregular grazing and under the influence of natural erosion. In case of overgrowing, it is necessary to cut out trees and shrubs regularly.

Similar habitats: frequently found adjacent to habitat 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)*, which is basically the next phase of vegetation succession, when dolomite erodes and gradually thicker soil layer is formed. Majority of plant species are found in both habitat types, but 6110* is easy to distinguish by the large cover of succulents (*Sedum acre*, *Jovibarba globifera*) and the pronounced involvement of perennial plant species in formation of the community. Similarity with habitat 8210 (usually these habitats are located next to each other). Mainly differ by the outcrop type: habitat 8210 is characterized by vertical outcrops, but in habitat 6110* they are either horizontal or inclined. Many herbaceous plant and moss species are common, but usually ferns are not found in the habitat 6110* and diversity of moss species is not as high.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 3.19. Herbaceous plant pioneer communities in calcareous soils.

Literature

Āboliņa, A., Blom, H.H., Fagerstén, R., Flatberg, K.I., Frisvoll, A.A., Haapasaari, M., Hallingbäck, T., Hedenäs, L., Heegaard, E., Huttunen, S., Ingerpuu, N., Isoviita, P., Jóhannsson, B., Jukonienė, I., Koponen, T., Lewinsky-Haapasaari, J., Ohenoja, M., Økland, R.H., Piipo, S., Prestø, T., Syrjänen, K.,Thingsgaard, K., Ulvinen, T., Vellak, K., Virtanen, R. Söderström, L., Hassel, K., Weibull, H. (eds.) (2002) Distribution maps of bryophytes in Northwestern Europe. Vol. 1. Hepaticae and Anthocerotae (2-nd ed.). Nordic Bryological Society & Mossornas Vänner, Trondheim, 1–55 p.

Jermacāne, S., Laiviņš, M. (2001) Aronas pilskalna veģetācija. Mežzinātne 10(43), 55.–72. lpp.

Jermacāne, S., Laiviņš, M. (2001) Dry calcareous dolomite outcrop and grassland communities on the Daugava River bank near „Dzelmes". Latvijas veģetācija 4, 51–70 p.

Laiviņš, M., Jermacāne, S. (2000) Emergence of certain neophytic plant communities in the vicinity of cemeteries in Latvia. Botanica Lithuanica vol. 6(2). 143–155 p.

Rūsiņa, S. (2007) Latvijas mezofīto un kserofīto zālāju daudzveidība un kontaktsabiedrības. Latvijas veģetācija 12, 1.–366. lpp.

Spuņģis, V. (2008) Fauna, distribution, habitat preference and abundance of woodlice (*Oniscidea*) in Latvia. Latvijas Entomologs, 45, 25–37 p.

Фатаре, И. (1989) Флора долины реки Даугавы. Рига, Зинатне, 167 с.

6120* *Xeric sand calcareous grasslands*

Latvian habitat classification: E.1.1., E.1.2.

Syntaxonomy: *Koelerion glaucae, Plantagini-Festucion*.

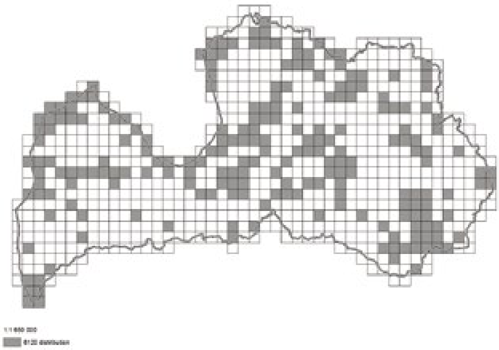


Figure 6.10. Distribution of the habitat 6120* *Xeric sand calcareous grasslands* in Latvia (*Conservation status of.., 2013*).

Definition: dry, frequently open grasslands on more or less calciferous sand with a subcontinental centre of distribution.

Specific characteristics of habitat interpretation in Latvia: plant communities that are found not only in calciferous soils, but also in moderately and slightly acidic soils that belong to *Plantagini-Festucion* are included in the habitat, since the respective plant communities form there and they are significant in conservation of typical species and vegetation of this habitat type.

Distribution: very rare in the whole territory of Latvia; can be found in valleys of River Gauja, River Daugava and River Abava, as well as in sandy plains of the Coastal Lowlands. It is possible that they occur in valleys of many small rivers in Latvia, but until now they have not been inventoried. These habitats usually occupy very small grassland patches (less than 0.5 ha).

Conservation value: a disappearing habitat in Europe and Latvia (in Latvia it occupies about 900 ha or 0.01% of the total territory, but the majority is in a very critical condition as they are not being managed). Habitat has an outstanding biodiversity conservation and cultural heritage value. Important habitat for such rare plant species as *Armeria vulgaris*, *A.maritima*, *Botrychium matricariifolium*, *Jovibarba globifera*, etc. It is one of the few habitats for several insect species (*Sphingonotus caerulans*, *Psophus stridulus*, *Bembix rostrata*, *Bombus schrencki*) in Latvia. Overall, a very high diversity of xerophile and thermophilic species.

Environmental factors and processes with a functional role: mainly on inland dunes (occasionally in coastal dune complexes) and siliceous substrate, on sandy sediments

Figure 6.11. A typical variant with *Koeleria glauca*, *Thymus serpyllum*, *Jovibarba globifera*, *Veronica spicata*. Very explicit layer of mosses and lichens with *Cladonia spp.* (in the background) (Photo: S.Rūsiņa).

Figure 6.12. A typical variant with *Veronica spicata*, *Sedum acre*, *Poa angustifolia* in the River Gauja valley (GNP) (Photo: S.Rūsiņa).

Figure 6.13. In the semi-dry variant *Poa angustifolia* (in the background) usually dominates. In the foreground with yellow flowers *Trifolium campestre* and *T.arvense* (with grey flowers) (Photo: S.Rūsiņa).

of river valleys; it can also be found in the highest parts of flood plains that are subject to flooding very rarely or are not flooded at all (this is a common feature of the River Gauja valley), but flooding is not a mandatory prerequisite for the existence of the habitat. Soil is poor in nutrients; the reaction is usually moderately acidic to alkaline. A very important factor is the micro-climate – due to sparse vegetation and sandy soil surface that is poor in humus, the ground layer of air and surface soil gets very hot on sunny summer days and cools rapidly during the nights, creating explicit diurnal temperature fluctuations. These conditions are suitable for sub-continental and continental species.

Vegetation characteristics: plant communities of dry and semi-dry soils with relatively sparse and low herbaceous plant layer, its cover usually is below 70% and the height does not exceed the 15–25 cm. Sod is usually poorly expressed, there are many patches of open soil. The moss (usually *Brachythecium albicans*, *Polytrichum juniperinum*, *P.formosum*, *Abietinella abietinum*, *Syntrichia ruralis*, *Pottiace* species) and lichen (*Cladonia spp.*, *Cladina spp.*) layer is very characteristic, but it can occasionally be absent (e.g. if the grassland has been burned or has not been managed for a long time). Dominated by grasses *Koeleria glauca*, *Poa angustifolia*, *Festuca ovina*, *Phleum phleoides*, more seldom also sedges: *Carex praecox* and *C.caryophyllea*. Dominating grasses are frequently absent from the herb layer, but blooming herbs *Veronica spicata*, *Sedum acre*, *Viscaria vulgaris*, *Galium verum* etc. have the largest cover. Abandonment of grasslands leads to a decrease in the species diversity and the moss layer is dominated by one species diversity (mainly *Rhytidiadelphus squarrosus*) or it disappears altogether as light is blocked by the thick cover of herbaceous plants. The herbaceous plant layer is pronouncedly dominated by expansive grass *Calamagrostis epigeios*, *Rubus caesium*, and these are the only grasslands that are characterized by overgrowing of *Equisetum hyemale*. Usually, the next succession phase is a pine forest, occasionally young forest stands of aspens and birches are formed. Due to the extremely dry conditions, the characteristic vegetation structure and species composition can persist for a long time even after management has ceased (even for more than 20 years).

Characteristic species: herbaceous plants – *Armeria vulgaris*, *Astragalus arenarius, Cardaminopsis arenosa*, *Carex praecox*, *Cerastium arvense*, *Dianthus arenarius*, *Festuca ovina*, *Festuca trachyphylla*, *Helichrysum arenarium*, *Hylotelephium maximum*, *Hylotelephium purpureum*, *Herniaria glabra*, *Koeleria glauca*, *Phleum phleoides*, *Poa angustifolia*, *Potentilla arenaria*, *Saxifraga tridactylites*, *Sedum acre*, *Thymus serpyllum*, *Thymus ovatus*, *Trifolium campestre*, *Trifolium dubium*, *Veronica spicata*, *Viola rupestris*; moss – *Syntrichia ruralis*, *Polytrichum piliferum*, *P.juniperinum*, etc.; lichen – *Cladonia spp.*, *Cladina spp.*, *Peltigera spp.*; insects – *Myrmeleotettix maculatus*, *Decticus verrucivorus*, *Pompyliidae*, *Sphecidae* (incl. *Bembix rostrata*), *Andrenidae*, *Agelena labyrinthica*, *Meloe spp.*, *Maculinea arion*, *Psophus stridulus, Oedipoda caerulescens*, *Aelia acuminata, Cicindela spp.*, *Opatrum sabulosum, Lygaeidae.*

Umbrella species (typical species within the meaning of the Habitats Directive): *Astragalus arenarius, Dianthus arenarius, Festuca trachyphylla, Helichrysum arenarium, Koeleria glauca, Phleum phleoides, Potentilla arenaria, Saxifraga tridactylites, Thymus serpyllum, Veronica spicata, Viola rupestris, Syntrichia ruralis, Polytrichum spp., Cladonia spp., Cladina spp., Peltigera spp.*, insects – *Psophus stridulus*, *Bembix rostrata,* birds – *Anthus campestris*, *Lullula arborea*, reptiles – *Lacerta agilis*.

Variants:

6120* _1 (typical): sandy grasslands with a great importance of sub-continental plant species in the vegetation (dominated by *Koeleria glauca*, *Festuca trachyphylla*, *Veronica spicata*, *Poa angustifolia, Phleum phleoides* or *Carex praecox*) (*Fig. 6.11., 6.12.*);

6120*_2 (semi-dry): sandy grasslands with a larger proportion of plant species of mesic areas in the vegetation (dominated by *Poa angustifolia*, the sub-continental species complex is less pronounced) (*Fig. 6.13.*);

6120*_3 (of skeletal soils): plant communities on gravelly substrate. The species composition does not differ greatly from the typical variant; of grasses, *Poa compressa* is more important (*Fig. 6.14.*).

Habitat Quality

Minimum habitat requirements: includes grasslands that entail the general quality requirements of habitats of EU importance, in vegetation of which the characteristic plant species and communities of this habitat are determinant.

Structure, function, process, quality improvement indicators and restoration potential: all indicators that are important to grasslands.

Threats: all threats common to grasslands.

Management: grazing and/or mowing. A restorative burning is acceptable.

Figure 6.14. Variant on skeletal soils with *Thymus ovatus* on Istra hills. This community is dominated by *Poa compressa* (photo: S.Rūsiņa).

Similar habitats: vegetation is similar to grey dune habitats, but grey dunes are included in the habitat 2130* *Fixed coastal dunes with herbaceous vegetation* due to other parameters (geological origin, the processes affected by the closeness of the sea). Often found adjacent to habitats 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)* and 2330 *Inland dunes with open Corynephorus and Agrostis grasslands.* Unlike the vegetation of inland dunes, the vegetation of this habitat is more closed and a smaller proportion of species of acidic soils; it can be easily separated from dry calcareous grasslands by the large proportion of sandy community species (predominantly annual species of the class *Koelerio-Corynephoretea*) in the vegetation. The variant with *Poa angustifolia* borders with pasture (*Cynosurion*) communities (6270* *Fennoscandian lowland species-rich dry to mesic grasslands*), but there is still a large proportion of sandy species, as well as calcareous (sub) continental species in the vegetation.

Overlap with other habitats of EU importance: may overlap with habitats 6530* *Fennoscandian woodland meadows* and 6450 *Northern Boreal alluvial meadows.*

Corresponding specially protected habitats in Latvia: 3.17. Calcareous sandy grasslands.

Literature

Briede, L., Rūsiņa, S., Gustiņa, L., Čakare, I. (2012) Dabisko zālāju daudzveidība un dinamika Gaujas nacionālajā parkā. Latvijas veģetācija, 22, 81.–104. lpp.

Jermacāne, S. (2000) Gaujas Nacionālā parka smiltāju pļavu augu sabiedrības. Jauns gadsimts – jauna ģeogrāfija. 2. Latvijas Ģeogrāfijas kongress. Rīga, 50.–53. lpp.

Jermacāne, S. (2003) Sociology of Armeria vulgaris Willd. in Latvia. Acta Universitatis Latviensis. Earth and Environment Sciences, vol. 654, 38–63 p.

Jermacāne, S., Laiviņš, M. (2002) Dry grassland vegetation in the Daugava River valley near „Slutišķi". LLU Raksti 6(301), 98–109 p.

Rūsiņa, S. (2007) Latvijas mezofīto un kserofīto zālāju daudzveidība un kontaktsabiedrības. Latvijas veģetācija 12, 1.–366. lpp.

Фатаре, И. (1989) Флора долины реки Даугавы. Рига, Зинатне, 167 с.

6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)*

Latvian habitat classification: E.1.4., E.1.5.

Syntaxonomy: *Festuco-Brometea*.

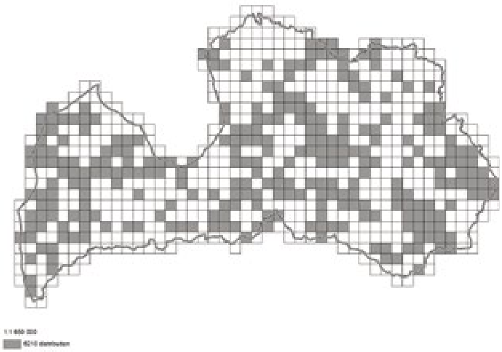


Figure 6.15. Distribution of the habitat 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)* in Latvia (*Conservation status of.., 2013*).

Definition: dry to semi-dry grasslands of the *Festuco-Brometea.* Abandonment results in thermophile scrub with an intermediate stage of thermophile fringe vegetation (*Trifolium-Geranietea*). Important orchid sites in dry calcareous grasslands are a priority habitat. These are deposits that host several species of orchids; a substantial population of at least one orchid species; rare or very rare species on the national territory.

Specific characteristics of habitat interpretation in Latvia: the species composition changes significantly in the direction from west to east, and it is created by the climatic continental gradient. Typical calcareous species of Central Europe are practically not found in the eastern part of Latvia (species characteristic to *Festuco-Brometea* class). Grasslands in which only one of the following species occurs: *Orchis militaris*, *O.ustulata*, *O.mori, O.mascula* are also considered important orchid sites in Latvia.

Distribution: rare in all territory of Latvia, mainly concentrated in the valleys of major rivers (Venta, Abava, Gauja, Rinda, Irbe, Daugava, etc.) and on dry hills with calcareous substrates (e.g., Istra Upland).

Conservation value: a disappearing habitat in Europe and Latvia (in Latvia it occupies 3 000 ha or 0.05% of the total area of the country). This habitat has an outstanding cultural heritage and biodiversity conservation value. The only suitable habitat for many herbaceous plant species (for example, *Cirsium acaule*, *Filipendula vulgaris*, *Helictotrichon pratense* etc.) in Latvia (habitat 6120* *Xeric sand calcareous grasslands* is also partially suitable). The most significant habitat for species like *Astragalus danicus, Carex ornithopoda*, *Gymnadenia conopsea*, *Orchis militaris, O.ustulata*, *O.morio, O.mascula, Viola collina,* etc.; invertebrates: *Vertigo angustior*, *Bombus schrencki.*

Environmental factors: mostly in river valleys and on hill slopes and summits, where calcareous bedrock is common. The largest areas are found on terraces and slopes in river valleys, can be found also on the highest parts of flood-plains that are flooded very rarely or are not flooded at all (it is very characteristic to River Gauja valley). Occur mostly on hill slopes in the eastern part of Latvia. Soils are dry or semi-dry, neutral to alkaline – it is the most important soil factor determining the composition of plant and animal species of this habitat. Very high diversity of various invertebrates.

Processes with a functional role: flooding, which is a prerequisite for the existence of this habitat in areas with sandy bedrock, may be present in the flood plains, as flood waters increase the soil reaction, therefore no pronounced soil acidification takes place during podsolization, which is a dominant process of soil formation in sandy soils in Latvia's conditions. In conservation of structure and species that are characteristic to the habitat, shorter or longer drought peri-

Figure 6.16. Western variant. The aspect is formed by *Filipendula vulgaris* and *Viscaria vulgaris* (Photo: A.Priede).

ods have a high significance, when soils dry-out completely, reducing the proportion of perennial grasses in the herb plant layer.

Vegetation characteristics: plant communities of dry to semi-dry soils with a relatively sparse or closed (usually the cover is 45–80%) and low (on average 25–35 cm) herb layer, which consists mainly of calciphilous species, there is a relatively large amount of annual plant species. Sod is relatively well-established, but in dryer areas, where the vegetation is often disturbed during the extended periods of drought or on very steep slopes, where erosion is pronounced, the sod can be more sparse or disturbed. The herbaceous plant layer is polidominant – it does not have one or few dominating species, but all species are evenly distributed in the sward. Moss layer is usually well pronounced, but sometimes it may not establish at all (due to the lack of management and also in places, where substrates are not completely dry and provide formation of herb layer that shades the soil). Lichens are usually absent. In the western part of Latvia the herbaceous plant layer is dominated by *Helictotrichon pratense*, *Trifolium montanum*, *Filipendula vulgaris*, *Fragaria viridis*. These species are almost never encountered in the eastern part of Latvia, where the habitat is dominated by *Poa angustifolia*, *Fragaria vesca*, *Pimpinella saxifraga*, *Agrimonia eupatoria*, *Centaurea scabiosa*. In Europe this habitat includes both natural (steppe) and semi-natural grasslands. In Latvia only semi-natural grasslands are found, abandonment of which results in formation of forest fringe communities and the following species start to dominate: *Geranium sanguineum*, *Brachypodium pinnatum* or *Calamagrostis epigeios*, but later forest vegetation is formed (mostly pine trees). Frequently several years after the abandonment of grassland, *Helictotrichon pratense* starts to dominate, creating large tussocks, but later shrubs that are characteristic to dry places introduce: *Rhamnus cathartica*, *Crataegus spp.*, *Rosa spp*. Expansion of nitrophytic herbs characterizes the degradation phase of grasslands in semi-dry soils (*Aegopodium podagraria*, *Chaerophyllum aromaticum*, *Anthriscus sylvestris*).

Characteristic species: ([R] - mostly only in the western variant, [A] - mostly only in the eastern variant): herbaceous plants – *Acinos arvensis*, *Agrimonia eupatoria*, *Allium oleraceum*, *Anthyllis vulneraria*, *Brachypodium pinnatum*, *Briza media*, *Campanula glomerata*, *Carex caryophyllea*, *C.flacca*, *C.ornithopoda*[R], *Carlina vulgaris*, *Centaurea scabiosa*, *Cirsium acaule*[R], *Filipendula vulgaris*[R], *Fragaria viridis*, *Fragaria vesca*[A], *Galium verum*[R], *Helictotrichon pratense*[R], *Leontodon hispidus*, *Linum catharticum*, *Medicago falcata*, *Medicago lupulina*, *Origanum vulgare*, *Phleum phleoides*[R], *Pimpinella saxifraga*, *Plantago media*, *Poa angustifolia*, *Polygala comosa*, *Scorzonera humilis*, *Sesleria caerulea*[R], *Trifolium montanum*[R]; animals – *Pupilla muscorum*, *Andrenidae*, *Agelena labyrinthica*, *Meloe spp*., *Vertigo angustior*, *Decticus verrucivorus*, *Acrididae*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Acinos arvensis, Anthyllis vulneraria, Carex caryophyllea, Carex flacca, Carex ornithopoda, Carlina vulgaris, Cirsium acaule, Filipendula vulgaris, Helictotrichon pratense, Leontodon hispidus, Linum catharticum, Medicago lupulina, Origanum vulgare, Phleum phleoides, Polygala comosa, Sesleria caerulea, Trifolium montanum*; insects – *Psophus stridulus*, *Bembix rostrata*; birds – *Anthus campestris*, *Lullula arborea*, reptiles – *Lacerta agilis*.

Variants:

6210_1 (western): calcareous grasslands mainly in the western part of Latvia with typical calciphilous species of the western part of Latvia (see the list of characteristic species and vegetation characteristics) (*Fig. 6.16., 6.17.*);

6210_2 (eastern): calcareous grasslands mainly in the eastern part of Latvia in which there are no typical calciphilous species of the western part of Latvia (see the list of characteristic species and vegetation characteristics) (*Fig. 6.18.*);

6210_3 (sandy): grasslands in weakly acidic and neutral soils, mainly in the western part of Latvia, there are less calciphilous species in the herbaceous plant layer than in the western variant, and their role in formation of sward is relatively small (*Fig. 6.19.*). Usually instead of *Helictotrichon pratense* species *Helictotrichon pubescens* and *Festuca rubra* predominate; *Fragaria viridis*, *Trifolium montanum* and *Filipendula vulgaris* are very characteristic, but there is almost no *Cirsium acaule*;

6210_4 (forest fringe): grasslands with a large proportion of forest fringe species, usually found in patches in other variants in areas that are shaded by trees or after management is abandoned. Domination of the *Geranium sanguineum*, *Brachypodium pinnatum*, *Melampyrum spp*. is characteristic.

Habitat Quality

Minimum habitat requirements: includes grasslands that comply with the general criteria of grassland habitats of EU importance and whose vegetation is determined by the characteristic plant species and communities of this habitat.

Structural, function, process, quality improvement indicators and restoration potential: all indicators that are important to grasslands.

Figure 6.17. Western variant in a pasture on the slopes of the Abava River terrace (Photo: A.Priede).

Threats: all threats common to grasslands.

Management: grazing and/or mowing. A restorative burning is acceptable.

Similar habitats: can be similar to habitat 6120* *Xeric sand calcareous grasslands*, however it can be easily separated by a smaller proportion of sandy species (species characteristic to *Koelerio-Corynephoretea* alliance), and the large number of species of calcareous soils. Can be similar with 6110* *Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi* because with a gradual deepening of the soil, pioneer communities are replaced by calcareous grassland vegetation; distinguished on the basis of characteristic species composition.

Overlap with other habitats of EU importance: can overlap with habitats 6530* *Fennoscandian wooded meadows* and 6450 *Northern Boreal alluvial meadows.*

Corresponding specially protected habitats in Latvia: 3.21. Dry meadows on calcareous soils.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Jermacāne, S., Laiviņš, M. (2001) Aronas pilskalna veģetācija. Mežzinātne 1 (43), 55.–72. lpp.

Jermacāne, S., Laiviņš, M. (2001) Dry calcareous dolomite outcrop and grassland communities on the Daugava River bank near „Dzelmes". Latvijas veģetācija 4, 51–70 p.

Jermacāne, S., Laiviņš, M. (2002) Dry grassland vegetation in the Daugava River valley near „Slutišķi". LLU Raksti 6(301), 98–109 p.

Kabucis, I., Jermacāne, S. (1998) Abavas ielejas pļavas. Botāniska in-

Figure 6.18. Eastern variant in the River Daugava valley. The aspect consists of *Centaurea scabiosa*, *Medicago falcata* and *Plantago media* (Photo: V.Baroniņa).

ventarizācija, kartēšana un novērtējums. Projekta atskaite. Rīga, Latvijas Dabas fonds, 26 lpp.

Rusina, S. (2003) Dry calcareous grassland communities (Filipendula vulgaris-Helictrotrichon pratense) in western and central Latvia. Annali di Botanica nuova serie (Rome) vol. III, 91–104 p.

Rūsiņa, S. (2007) Latvijas mezofīto un kserofīto zālāju daudzveidība un kontaktsabiedrības. Latvijas veģetācija 12, 1.–366. lpp.

Rusina, S., Kiehl, K. (2010) Long-term changes in species diversity in abandoned calcareous grasslands in Latvia. Tuexenia 30, 467–486 p.

Матвеева, Е.П. (1967) Луга Советской Прибалтики. Ленинград, Наука, 335 с.

Табака, Л.В., Клявиня, Г.Б. (1981) Долина реки Абава. Флора охраняемых территорий Латвии. Рига, Зинатне, 130 с.

Фатаре, И. (1989) Флора долины реки Даугавы. Рига, Зинатне, 167 с.

Figure 6.19. Sandy variant at the seashore bluffs of the Baltic Sea near Ulmale. From grasses, *Helictotrichon pubescens* and *H.pratense* predominate, *Medicago falcata* and *Campanula rotundifolia* flower (Photo: S.Rūsiņa).

6230* Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

Figure 6.20. Nardus grassland, which is dominated by *Nardus stricta*, *Calluna vulgaris* has already introduced, indicating the relation of this habitat to heath habitats (Photo: L.Salmiņa, A.Priede).

Latvian habitat classification: E.2.1.

Syntaxonomy: *Nardetalia*.

Definition: closed dry or mesophile, perennial *Nardus* grasslands occupying siliceous soils. Vegetation is highly varied, but the variation os characterised by continuity. Habitats that have become irreversibly degraded through overgrazing, are not considered the habitat.

Specific characteristics of habitat interpretation in Latvia: compared to other natural grasslands, species diversity in these habitats is relatively small – it is determined by the extreme edaphic conditions, nonetheless, they are unique by the species composition and geographic distribution (belong to the Bore-Atlantic region), this is why both species-rich (*Fig. 6.22.*) and species-poor Nardus grasslands (*Fig. 6.23.*) have an equal conservation value.

Distribution: rare in the territory of Latvia. Mostly concentrated in the Coastal Lowlands, the Ropaži Plain in the central part of Latvia and Viduslatvija depression, as well as in the eastern part of Latvia – the Adzele Upland and Freimaņi hillocks. The present distribution of Nardus grasslands is determined by appropriate substrate (they are more widely distributed in regions with wide-spread types of podzol soil) and permanent uniform management that has been maintained in the eastern part of Latvia.

Conservation value: a rapidly decreasing habitat in Europe and Latvia (occupies 550 ha or 0.008% of the total territory of Latvia). The habitat has an outstanding biodiversity conservation and cultural heritage value. The most important habitat for plant species *Gentiana pneumonanthe* and *Bembix rostrata*.

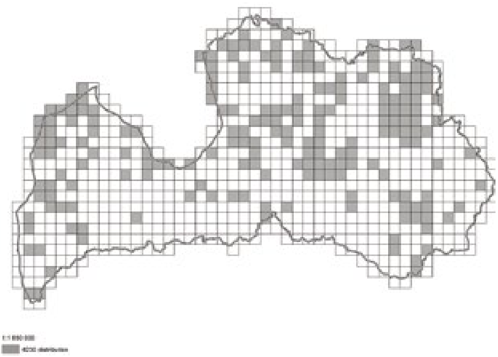


Figure 6.21. Distribution of the habitat 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)* in Latvia (Conservation status of.., 2013).

Environmental factors: mostly outside river valleys in sandy plains, occasionally in river valleys on sandy bedrocks, usually in flat relief conditions. The most significant factors that determine the existence of this habitat is the acidic reaction of soil and pronounced nutrient scarcity.

Processes with a functional role: Nardus grasslands establish only as a result of a long-term (even several decades) grazing (more rarely – mowing). It is often the next phase of succession of sandy poor soil grasslands 6270* *Fennoscandian lowland species-rich dry to mesic grasslands* after a long-term grazing and mowing without amelioration. In such areas a relatively large number of characteristic species of habitat 6270* can be present in the sward, but the typical acidic soil species are not explicit dominants yet.

Vegetation characteristics: layer of herbs is very low (about 15–20 cm), but it is thick and closed (cover can be up to 100%). Usually, sod is very dense and thick (*Fig. 6.18.*). The herb layer is dominated by one or several grass species of acidic soils (acidophilus) – *Nardus stricta*, *Sieglingia decumbens*, *Festuca ovina* (*Fig. 6.18., 6.19.*). Moss layer is usually dominated by *Rhytidiadelphys squarrosus*, but it may also be absent. The limiting edaphic factor is soil fertility, but humidity conditions may vary greatly, hence the composition of the accompanying plant species is variable – plant species that are characteristic to dry soils may establish (with *Antennaria dioica*, *Carex pilulifera*, *Veronica officinalis*, etc.), as well as plant communities that are characteristic to mesic (with *Carex pallescens*, *Viola canina*, *Agrostis tenuis*) and even waterlogged soils (with *Carex panicea*, *Succisa pratensis*, *Potentilla erecta*, *Carex nigra*, etc.). Some areas may paludify – it is indicated by the formation of peat and introduction of *Sphagnum spp.* in the moss layer. By abandonment of management, occasionally *Calamagrostis epigeios* (in dryer areas) can expand, but overgrowing mostly takes place without the stage of expansive grasses. Typical shrubs and trees in the overgrowing phase are *Salix spp.*, *Frangula alnus*, *Betula spp.*, *Populus tremula*, *Alnus spp.*

Characteristic species: herbaceous plants – *Antennaria dioica*, *Calluna vulgaris*, *Carex pilulifera*, *Euphrasia spp.*, *Festuca ovina*, *Trommsdorfia maculata*, *Nardus stricta*, *Platanthera bifolia*, *Polygala vulgaris*, *Potentilla erecta*, *Sieglingia decumbens*, *Vaccinium vitis-idaea*, *Veronica officinalis*, *Viola canina*; animals – *Decticus verrucivorus*, *Pompyliidae*, *Sphecidae* (incl. *Bembix rostrata*), *Andrenidae*, *Pupilla muscorum*, *Agelena labyrinthica*.

Figure 6.22. Nardus grassland that is very rich in species and has been formed as a result of long-term grazing in soil of medium fertility. The herb layer is polidominant, there is no one dominating specie; protected species – *Gentiana pneumonanthe* - flowers with blue flowers (Photo: S.Rūsiņa).

Umbrella species (typical species within the meaning of the Habitats Directive): *Gentiana pneumonanthe, Nardus stricta, Polygala vulgaris, Sieglingia decumbens, Bembix rostrata.*

Variants:

6230*_1 (dry): plant species with *Antennaria dioica*, *Carex pilulifera*, *Veronica officinalis*, etc. that are characteristic to dry soils;

6230*_2 (wet): plant communities on mesophylous and moist soils (with *Carex pallescens*, *Viola canina*, *Agrostis tenuis, Carex panicea*, *Succisa pratensis*, *Potentilla erecta*, *Carex nigra* etc.).

Habitat Quality

Minimum habitat requirements: includes grasslands that comply with the general criteria of grassland habitats of EU importance and whose vegetation is determined by the characteristic plant species and communities of this habitat.

Structural indicators: all indicators that are important for grasslands, additionally also the proportion of characteristic

Figure 6.23. Species-poor Nardus grassland that has established in sandy, acidic and nutrient-poor soil. Dominating species are *Sieglingia decumbens*, but the cover of *Nardus stricta* is small (Photo: S.Rūsiņa).

species in the vegetation (in habitats of good and excellent quality the herb layer is usually dominated by *Nardus stricta*, *Sieglingia decumbens* or *Festuca ovina*, but dominance of other grasses indicates unfavourable conditions for the habitat) and the composition of dominating moss layer (dominance of *Rhytidiadelphus squarrosus*, *Hylocomium splendens* and *Pleurozium schreberi* that is characteristic to acidic soils indicates deterioration of the habitat quality since a thick moss carpet competes with herbaceous plant species, which leads to decrease in the number of herbaceous plant species because, when the soil is covered by mosses, germination of seeds is limited).

Structural, function, process, quality improvement indicators and restoration potential: all indicators that are important to grasslands.

Threats: all threats common to grasslands.

Management: grazing or mowing.

Similar habitats: by the species composition and structure, it can be similar to heaths 2320 *Dry sand heaths with Calluna vulgaris and Empetrum nigrum*, 4010 *Northern Atlantic wet heaths with Erica tetralix* and 4030 *European dry heaths*, since heaths can form as a next succession phase after Nardus grassland. Both habitats can be distinguished by the dominating life form (herbaceous plants or chamaephytes (dwarf shrubs)) in herb layer. In Nardus grasslands *Calluna vulgaris* can be found only as a separate specimen or in small sparse groups, but they dominate pronouncedly in habitats 4010 and 4030 – the threshold is 50% of the total projective cover of herb layer. Plant communities can be similar also to 6270* *Fennoscandian lowland species-rich dry to mesic grasslands*, as Nardus communities represent the next stage after fallow land vegetation in the succession, if grassland is intensively grazed or mowed without addition of nutrients. In wet soils a similar situation can be with 6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)*. In order to separate these habitats, it is necessary to evaluate which set of characteristic species of the habitat dominates the vegetation.

Overlap with other habitats of EU importance: may overlap with habitat 6530* *Fennoscandian wooded meadows* and 6450 *Northern Boreal alluvial meadows.*

Corresponding specially protected habitats in Latvia: 3.22. Species-rich mat-grass Nardus stricta meadows on sandy soils.

Literature

Rūsiņa, S. (2007) Latvijas mezofīto un kserofīto zālāju daudzveidība un kontaktsabiedrības. Latvijas veģetācija 12, 1.–366. lpp.

Матвеева, Е.П. (1967) Луга Советской Прибалтики. Ленинград, Наука, 335 с.

Сабардина, Г.С. (1957) Луговая растительность Латвийской ССР. Рига, Изд. АН ЛССР, 303 с.

6270* *Fennoscandian lowland species-rich dry to mesic grasslands*

Latvian habitat classification: E.2.2.

Syntaxonomy: *Cynosurion*, *Calthion*.

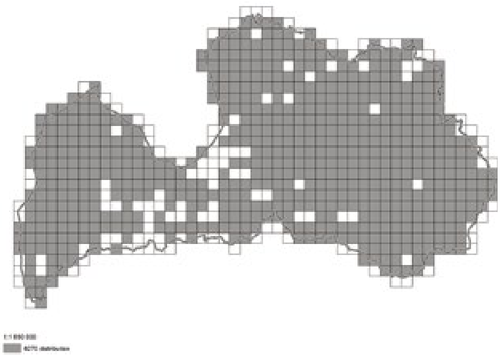


Figure 6.24. Distribution of the habitat 6270* *Fennoscandian lowland species-rich dry to mesic grasslands* in Latvia (*Conservation status of.., 2013*).

Definition: this habitat type occurs in the Fennoscandian lowlands varying from dry to mesic grasslands mainly on siliceous substrates. The vegetation is formed by long-term continuous grazing and/or mowing. No fertilization may occur. Species composition varies in different geographic areas, on different soils, moisture and management regimes. Includes habitats which are still traditionally managed, as well as recently abandoned habitats with a species-rich vegetation. The habitat often supports species-rich vascular plant communities. Several endangered fungi-species also occur.

Specific characteristics of habitat interpretation in Latvia: these habitats can be found not only in dry and mesic, but also humid soils and they are characterized by a great diversity of soils (established on sand and gravel, moraine loam and other bedrocks; in more humid areas (including drained areas) can be found in peaty soils). Traditionally these habitats have been continuously used for grazing or mowing and grazing in after-grass, or by changing mowing and grazing over the years. There can be cases, when grassland has been only used for mowing. Nowadays, in many cases grazing is not performed, and the origin of a grassland is indicated only by vegetation features. Grasslands on wet soils (*Calthion*) can be included in this habitat only outside flood plains, but in flood plains they comply with the habitat 6450 *Northern Boreal alluvial meadows.*

Distribution: relatively rare in the territory of Latvia. Typical variant is found on uplands (mostly in Vidzeme and Alūksne Upland) more often, but the variant of poor-soils is more often found in the Coastal Lowlands.

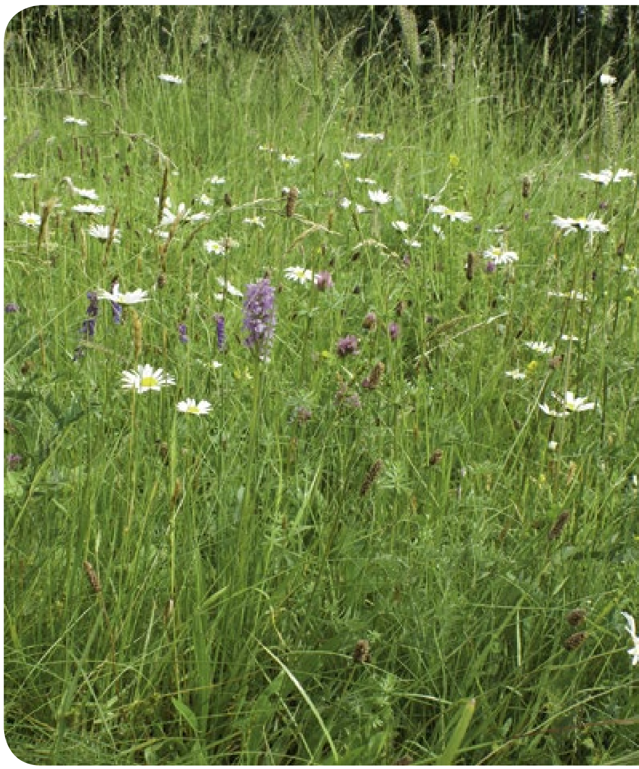


Figure 6.25. Herbaceous plants form two distinct layers. The low herb layer, where rosette plants occur (*Plantago lanceolata*, *Prunella vulgaris*, *Luzula campestris* and others) and medium tall grassland and herbaceous plant layer with *Anthoxanthum odoratum*, *Cynosurus cristatus*, *Leucanthemum vulgare*, etc. (Photo: V.Baroniņa).

Figure 6.26. Typical variant. Distinct grazing structure – micro relief that has been established due to trampling and tussocks herb layer, which is caused by uneven grazing (Photo: S.Rūsiņa).

Figure 6.27. Polidominance and great diversity of species is characteristic to the typical variant, including species of calcareous soils, e.g., *Polygala amarella* and *Primula veris* that can be seen in the image (Photo: A.Priede).

Conservation value: a rapidly decreasing habitat in Europe and Latvia. It is the most widespread of all grassland habitats of EU importance (occupies 18 500 ha or 0.3% of the total area of Latvia), however the biodiversity quality is high only in a small part of all area and most of them only comply with the minimum habitat quality requirements, as they slowly form in areas of previous cultivated grasslands and fallow lands. In Latvia it occurs relatively more often than other grassland habitats, therefore it has a great value in conservation of the traditional rural landscape on a national level, as well as nature diversity conservation and cultural heritage value. It is a significant habitat for many rare plant species: *Polygonum viviparum*, *Botrychium spp.*, *Dactylorhiza spp.* and *Platanthera spp.*

Environmental factors: on plains, hills and their slopes, moist variant also in valleys. Mostly occurs outside river valleys, but frequently also in river valleys, especially where soils are relatively poor and are not calcareous. The typical variant occurs on hills in eroded soils with neutral or slightly acidic reaction to various bedrocks more frequently, but the variant of poor soils is more common in plains, where sandy bedrock is common. Soils are usually mesic or wet, poor to moderate in nutrients with moderately acidic to neutral reaction. Under the influence of continuous grazing they can also form on fertile soils, but in Latvia fertile soils are mainly used as arable land, thus semi-natural grasslands are rarely found on them.

Processes with a functional role: grazing is the most significant process that determines formation and existence of this habitat. It establishes a microtopography and structure of sward that is typical of pasture, as well as creates prerequisites for species diversity because it ensures the existence of various ecological niches (*Fig. 6.26.*).

Vegetation characteristics: sward is thick (cover can reach up to 100%, usually it is about 90%) and approximately 40 cm high, but can also be lower (even 3–5 cm), especially in long-grazed areas. Well-developed sod and an explicit microtopography due to grazing that is formed by trampled area and unevenly grazed grass. Herbaceous plant vegetation is polidominant (there is no one dominating specie) (*Fig. 6.27.*), two layers can be distinguished – layer of characteristic lower plants, which consists of species with creeping or prostrate shoots and rosette leaves (for example, *Trifolium repens*, *Prunella vulgaris*, *Leontodon hispidus*, *Primula veris*, *Plantago lanceolata, P.media*) and layer of medium herbaceous plants, that normally consists of grasses (*Anthoxanthum odoratum*, *Briza media*, *Festuca rubra* and *Agrostis tenuis*, but in weter areas also *Holcus lanatus*, *Cynosurus cristatus* and *Deschampsia cespitosa*). Layer of tall herbs and grasses has almost not been established or is very sparse (formed by few tall grasses, for example, *Helictotrichon pubescens*, *Festuca pratensis*, that occupy a small proportion in the vegetation) (*Fig. 6.25.*). When management is abandoned, grasslands gradually overgrow with woodlands (usually young forest stands of birch and aspen form, more rarely spruce introduces). The intermediate stage often is formed by mono-dominant vegetation of *Calamagrostis epigeios.* In case of eutrophication *Dactylis glomerata*, *Holcus lanatus* or nitrophytic herbaceous plants *Aegopodium podagraria*, *Anthriscus sylvestris* etc. may dominate.

Characteristic species: herbaceous plants - *Agrostis tenuis*, *Alchemilla spp.*, *Anthoxanthum odoratum*, *Briza media*, *Cynosurus cristatus*, *Deschampsia cespitosa*, *Dianthus deltoides*, *Euphrasia spp.*, *Festuca ovina*, *F.rubra*, *Leontodon hispidus*, *Luzula campestris*, *Plantago lanceolata*, *P.media*, *Primula veris*, *Prunella vulgaris*, *Rhinanthus minor*, *Trifolium repens*. In the wet variant also: *Caltha palustris*, *Carex panicea*, *Crepis paludosa*, *Geranium palustre*, *Cirsium oleraceum*, *Galium uliginosum*, *Geum rivale*, *Holcus lanatus*, *Ophioglossum vulgatum*, *Polygonum bistorta*, *Potentilla erecta*, *Succisa pratensis*, *Trollius europaeus*, *Scirpus sylvestris.* Animals – great diversity of day-flying butterflies *Rhopalocera*, bees and bumble bees *Apoidea*, orthoptera *Orthopyera*, bugs *Heteroptera*, leaf-cutting beetles *Chrysomelidae*, as well as species that are related to grazing animals – blow flies *Calliphoridae*, flesh fly *Sarcophagidae*, *Scatophaga stercoraria*.

Umbrella species (typical species within the meaning of the Habitats Directive): in the habitat 6270* there are no species that would be characteristic only to this grassland habitat, hence it is most likely to use species that are used as semi-natural grassland indicator species in Latvia as the typical species – *Briza media, Dianthus deltoides, Carex panicea, Leontodon hispidus, Primula veris, Polygala vulgaris, Cynosurus cristatus, Galium Boreale, Galium verum, Plantago media, Linum catharticum, Trollius europaeus, Viscaria vulgaris*. In addition, *Cynosurus cristatus* is included also, as it is a typical pasture species that does not have suitable conditions in other habitats. Most significant species could be insect species, but no such research has been performed.

Variants:

6270*_1 (typical): species-rich, usually on neutral mesic soils. Characteristic species – *Briza media*, *Primula veris*, *Plantago media*, *Leontodon hispidus*, *Fragaria viridis* (*Fig. 6.26., 6.27.*);

6270*_2 (on poor soils): relatively less species because it forms on poor, moderately acidic, mesic and wet soils (*Fig. 6.28., 6.29.*). *Agrostis tenuis* and *Anthoxanthum odoratum* are more important in the vegetation than they are in the typical variant; the number and proportion of acidic soil species is larger, e.g., *Nardus stricta*, *Sieglingia decumbens*, *Rumex acetosella, Hieracium umbellatum*;

6270*_3 (moist): in wet soils, can also be on peaty soils, therefore grasses of wet areas dominate: *Deschampsia cespitosa*, *Holcus lanatus* and dicotyledonous plants *Geum rivale*, *Potentilla erecta*, *Succisa pratensis* (*Fig. 6.30., 6.31., 6.32.*).

Figure 6.28. Variant of poor soils, dominated by *Agrostis tenuis* and *Anthoxanthum odoratum* (Photo: S.Rūsiņa).

Figure 6.29. The species richness in the variant of poor soils is lower, but a typical structure of a grassland is present (an even distribution of species, distinct layers and dense sod). In the foreground *Agrostis tenuis* and *Campanula patula* can be seen, in the background a typical dominating grass of this variant – *Festuca rubra* (Photo: A.Priede).

Figure 6.30. Moist variant, which is dominated by *Deschampsia cespitosa*, the second most significant grass in the layer of herbaceous plants is *Cynosurus cristatus* (Photo: S.Rūsiņa).

Figure 6.31. In the moist variant an important role is given to species of moist areas, for example, *Geum rivale*, *Trollius europaeus*, *Filipendula ulmaria* (Photo: S.Rūsiņa).

Habitat Quality

Minimum habitat requirements: includes grasslands that comply with the general criteria of grassland habitats of EU importance and whose vegetation is determined by the characteristic plant species and communities of this habitat.

Structural indicators: all grassland indicators, except for the number of characteristic species, since the vegetation is variable, but additionally – the proportion of semi-natural grassland indicator species in the vegetation (the herb layer of a good quality habitat is dominated by one or several semi-natural grassland indicator species or their abundance is very high) and composition of dominating moss species (pronounced domination of *Rhytidiadelphus squarrosus*, *Hylocomium splendens* and *Pleurozium schreberi* in acidic soils indicates degradation of the habitat quality, as a thick carpet of moss competes with herbaceous plant species, leading to a decrease in the number of herbaceous plant species because by covering soil, mosses do not allow plant seeds to germinate), as well as herb layers structure (in a grassland of good quality the herb layer of medium grasses and rosette plants or creeping plants is well developed, but the layer of tall grasses is absent).

Function, process, quality improvement indicators and restoration potential: all indicators that are important to grasslands.

Threats: all threats common to grasslands.

Management: grazing or combination of grazing and mowing. Since nowadays it is not always possible to restore traditional management, as an alternative for the habitat conservation could be mowing without grazing.

Similar habitats: in moist conditions a transition toward moist grasslands 6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)* is formed, which is indicated by the presence of species of moist areas. On sandy soils communities can be similar to 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)* are established because it is the next phase after a species-rich vegetation of pasture and grazed grasslands in the succession if a grassland is intensively grazed or mowed without adding of nutrients. In dryer areas there can also be a transition to dry grasslands 6120* *Xeric sand calcareous grasslands* and 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)*. In order to separate species-rich pasture and grazed meadows from other grassland habitats, it is necessary to evaluate which set of characteristic species of the habitat dominates the vegetation. In fertile soils and mostly mowed areas a transition to 6510 *Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)* can be present. Both habitats are separated based on the characteristic species composition and dominating management (if the main use is mowing and characteristic grasses of habitat 6510 dominate, the habitat is recognized as 6510).

Figure 6.32. Often in the wet variant species of *Juncus spp.* are very important, especially if the habitat has been continuously grazed, because rushes are very tolerant to soil compression (Photo: L.Briede).

Overlap with other habitats of EU importance: may overlap with habitats 6530* *Fennoscancial wooded meadows* and 6450 *Northern Boreal alluvial meadows.*

Corresponding specially protected habitats in Latvia: none.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Rūsiņa, S. (2007) Latvijas mezofīto un kserofīto zālāju daudzveidība un kontaktsabiedrības. Latvijas Veģetācija 12, 1.–366. lpp.

Биркмане, К.Я. (1964) Очерк современной растительности восточных геоботанических районов ЛаССР. В кн. Растительность Латвийской ССР, Рига, изд. АН ЛССР, 4, 117–196 с.

Матвеева, Е.П. (1967) Луга Советской Прибалтики. Ленинград, Наука, 335 с.

Сабардина, Г.С. (1957) Луговая растительность Латвийской ССР, Рига, изд. АН ЛССР, 303 с.

6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)*

Figure 6.33. Moist grasslands on periodically drying soils in Vītiņu meadow at Lake Liepāja, where fluctuations of water level and the associated groundwater level fluctuations ensure periodical drying of these soils (Photo: S.Rūsiņa).

Figure 6.34. Moist grassland on periodically drying calcareous mineral soil, which is dominated by *Carex flacca* (Photo: S.Rūsiņa).

Latvian habitat classification: E.3.3.

Syntaxonomy: *Molinion*, partly *Caricion davallianae*.

Definition: *Molinia* meadows of plain to montane levels, on more or less wet nutrient poor soils (nitrogen, phosphorus). They stem in areas with extensive management, sometimes they are mowed, and are a deteriorated stage of drainage peat bogs. Two subtypes can be distinguished: on neutron-alkaline to calcareous soils with a fluctuating water table, relatively rich in species (*Eu-molinion*), soil is occasionally peaty and becomes dry in summer; on more acid soils of the *Junco-Molinion* (*Juncion acutiflori*), except species-poor meadows or meadows on degraded peaty soils.

Specific characteristics of habitat interpretation in Latvia: unlike in Central Europe, where *Molinia* meadows were mainly used as litter meadows (mown in late summer or autumn), in Latvia their use has been diverse – both as meadows and pastures; therefore, grazed areas also comply with the habitat. Late mowing that is characteristic to the Central Europe determines pronounced dominance of *Molinia caerulea.* Diverse management has allowed several plant communities to develop in Latvia, and also those meadows and pastures that are not dominated by *Molinia* (it can also be absent) comply with this habitat, but a large cover of other characteristic species of *Molonion* (for example, *Sesleria caerulea*, *Carex flacca*, *C.panicea*, etc.) can occur (*Fig. 6.34., 6.36., 6.37.*).

Distribution: rare in the territory of Latvia. In larger areas it is found in the Western part of Latvia (Ķemeri National Park,

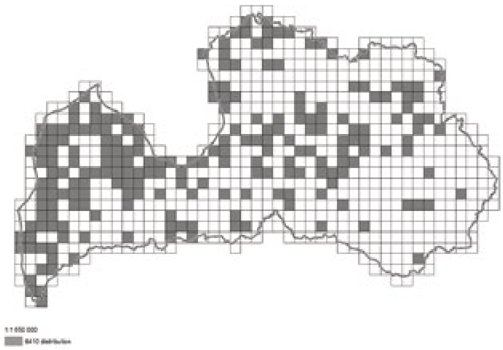


Figure 6.35. Distribution of the habitat 6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)* in Latvia (Conservation status of.., 2013).

around Liepāja Lake, the Ugāle Plain, etc.), in some areas in the central part of Latvia (the Ropaži Plain), but only few localities are known in the southeast part of Latvia.

Conservation value: rare, endangered plant communities. Occupies only 1 400 ha or 0.02% of the total territory of Latvia. Compared to previously known areas, they have diminished significantly in the last decades. One of the most significant habitats for several specially protected plant species: *Sanguisorba officinalis*, *Iris sibirica*, *Serratula tinctoria*, *Dianthus superbus*, *Viola persicifolia*, *Gymnadenia conopsea*, as well as several species of early mire orchids *Dactylorhiza spp.* and *Orchis spp.* Biodiversity and cultural heritage value such as for grasslands that have been continuously used only for mowing or grazing and in majority of cases have never been ploughed due to excessively wet conditions. It is possible that they have been mowed not only for fodder, but also litter. Important habitats of *Euphydryas aurinia*, *Lycaena dispar*, *Coenonympha hero*, great diversity of other insects.

Environmental factors: nutrient-poor, medium acid to calcareous soils with fluctuating moisture regime – wet in springs and rainy periods, periodically dry (*Fig. 6.29.*). Due to excessively wet conditions, gleying occurs and usually peaty soils develop. Most frequently located in the lowest parts of relief – relief depressions, plains, river and lake flood plains, as well as at the foot and on the slopes of hills and slopes in groundwater discharge areas.

Processes with a functional role: more or less regular alternation of soil humidity conditions: excessively wet periods and even flooding is followed by drying of soil. In especially dry summers, a part of the plant species may die off, creating free spaces in the sod, where new species can regenerate, promoting recovery of the vegetation structure and species richness. In different years, altering moisture conditions determine formation of a different vegetation structure, changing the role of different species and groups of species in plant communities and thereby changing the appearance of the grassland. By reducing regularity or intensity of management, the cover of *Molinia caerulea* or *Sesleria caerulea* in plant communities increases, and almost mono-dominant stands of these species are formed. The cover of *Molina* increases also after drainage.

Figure 6.36. Wet grassland on periodically drying peaty soil, which is dominated by *Molinia caerulea* (Photo: A.Priede).

When management of these meadows is abandoned, in the western part of Latvia, in some places almost mono-dominant stands of *Carex hostiana* or *Carex buxbaumii* may form; overgrowing takes place mostly with willow, and continues with birch and alders. Periodically due to overly humid conditions, particularly in flood-plains and groundwater run-off areas, overgrowing takes place relatively slowly and for a long time a sparse layer of scrubs may persist. In areas with longer lasting or more regular overly humid conditions, the role of mosses increases and communities of fens may form.

Vegetation characteristics: depending on the dominant grass species, vegetation can be of different heights: low (15–20 cm) and high (~1 m).

Low vegetation can consist of a single dominating species – *Sesleria caerulea* or *Carex panicea*. With them a relatively large number of grasses, sedges and other species of a low height occur, that are found in large numbers in regularly managed grasslands. Low vegetation is also in grasslands without the dominating species – *Carex flacca* or *Scorzonera humilis* in meadows. In these grasslands *Carex panicea*, *Briza media*, *Inula salicina*, *Succisa pratensis*, *Trollius europaeus*, *Carex hostiana*, *Carex buxbaumii* also grows. One of these species, particularly sedges, may dominate, creating medium height vegetation in which other intermediate and tall herbaceous species have a greater role. Tall sward grasslands are dominated by *Molinia caerulea* (*Fig. 6.36.*). Regularly managed grasslands are characterized by large species diversity. Periodically the proportion of dry grassland species, especially if the soil is neutral or calcareous, can be relatively high due to the dry conditions of these grasslands. These are species like *Briza media*, *Filipendula vulgaris*, *Plantago media*, *Poa angustifolia*, etc. Unmanaged grasslands are characterized by a sparse scrub layer, which mainly consists of various species of *Salix spp.* and *Frangula alnus*, but often also *Myrica gale* and *Lonicera pallasii*.

Figure 6.37. Moist grassland on periodically drying mineral soil, which is pronouncedly dominated by *Sesleria caerulea* (Photo: S.Rūsiņa).

Figure 6.38. Moist grassland on periodically drying mineral soil with a polidominant layer of herbaceous plants in which dicotyledonous plants, not grasses and sedges, have the most important role (*Succisa pratensis* flowers) (Photo: S.Rūsiņa).

Characteristic species: herbaceous plants – *Molinia caerulea*, *Sesleria caerulea*, *Carex flacca*, *Carex hostiana*, *Carex panicea*, *Carex buxbaumii*, *Galium Boreale*, *Inula salicina*, *Selinum carvifolia*, *Succisa pratensis*, *Potentilla erecta*, *Epipactis palustris*, *Scorzonera humilis*, *Trollius europaeus*, *Ophioglossum vulgatum*; invertebrates – *Vertigo angustior*, *Chrysochraon dispar*, *Euphydryas aurinia*, *Lycaena dispar*, *Cicadella viridis*, *Coenonympha arcania* and *C.hero*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Carex panicea, Carex flacca, Carex hartmanii, Crepis praemorsa, Gladiolus imbricatus, Gymnadenia conopsea, Molinia caerulea, Ophioglossum vulgatum, Polygala amarella, Primula farinosa, Sesleria caerulea, Scorzonera humilis, Succisa pratensis, Trollius europaeus.*

Variants:

6410_1 (*Molina* grasslands): grasslands, which are dominated by *Molina caerulea*;

6410_2 (*Sesleria* grasslands): grasslands, which are dominated by *Sesleria caerulea*;

6410_3 (sedge grasslands): grasslands, which are dominated by species of sedge: *Carex flacca*, *Carex hartmanii*, *Carex hostiana*, *Carex panicea*, *Carex buxbaumii*;

6410_4 (grasslands without pronouncedly dominant species): mostly great species diversity, with many dicotyledonous plant species.

Habitat Quality

Minimum habitat requirements: includes grasslands that comply with the general criteria of grassland habitats of EU importance and whose vegetation is determined by the characteristic plant species and communities of this habitat. This habitat does not include mono-dominant Molina communities in drained fens.

Structural, function, process, quality improvement indicators and restoration potential: all indicators that are important to grasslands.

Threats: all threats common to grasslands.

Management: grazing or combining of grazing and mowing.

Similar habitats: in dryer growth conditions a transition to mesic grasslands 6270* *Fennoscandian lowland species-rich dry to mesic grasslands*, which is indicated by the presence of mesophytes and xerophytes, are formed. In dryer areas with calcareous soils a transition towards dry grasslands 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)* can be formed. In order to separate this habitat from other habitats, it is necessary to evaluate to which habitat does the dominant set of specific species and communities in the vegetation belong, as well as the variable soil hydrological regime. In more humid places a transition to fens 7230 *Alkaline fens* can be present. Habitat is considered a grassland habitat, if characteristic species of grassland habitats dominate (it is possible to find *Carex davalliana* and *Schoenus ferrugineus*, but they are not dominating species of herb layer), the layer of mosses is not distinct, bogging-up of the area is not observed (layer of peat is small), but the process of sod formation predominates (pronounced vital sod formed by grass root network). Also drained calcareous fens are often dominated by *Molinia caerulea*, but they should not be included in the habitat 6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae*), and they can be distinguished by the vegetation structure – in drained calcareous fens *Molinia caerulea* forms high tussocks, among which there often are areas of open soil and on tussocks moss and herbaceous plant species that are characteristic to calcareous fens still remain. Drained mires are most frequently overgrown by trees and scrubs and the species composition that is characteristic to Molinia grasslands is not present.

Overlap with other habitats of EU importance: may overlap with habitats 6530* *Fennoscandian woodland meadows* and 6450 *Northern Boreal alluvial meadows.*

Corresponding specially protected habitats in Latvia: 3.23. Humid grasslands on periodically drying soils.

Literature

Priede, A. (2011) Phytosociology and Dynamics of calcareous grasslands in Ķemeri National Park, Latvia. Estonian Journal of Ecology, 60, 4, 284-304 p.

Матвеева, Е.П. (1967) Луга Советской Прибалтики. Ленинград: Наука, 335 с.

Сабардина, Г. (1952) Естественные луга в районе нижнего течения реки Венты. Zootehnikas un Zoohigienas Institūta Raksti 1, 68–103 с.

Сабардина, Г. (1952) Луга бассейна реки Абулс в среднем ее течении. Zootehnikas un Zoohigienas Institūta Raksti 1, 104–150 с.

Сабардина, Г.С. (1957) Луговая растительность Латвийской ССР. Рига, изд. АН ЛССР, 303 с.

Сабардина, Г. (1962) Эколого-фитоценологическая классификация сеслериевых лугов. В кн.: Геоботаническое изучение лугов. Сборник ботанических работ. Изд. АН Белорусской ССР, Минск, 4, 21–28 с.

6430 *Hydrophilous tall herb fringe communities of plains and the montane to alpine levels*

Figure 6.39. River bank variant on the bank of the River Daugava at Dignāja, where the diversity of tall grass vegetation is maintained by irregular grazing up to the water level (Photo: V.Kreile).

Figure 6.40. River bank variant (Photo: V.Baroniņa).

Latvian habitat classification: none.

Syntaxonomy: *Glechometalia hederaceae, Convolvuletalia sepium*.

Definition: wet and nitrophilous tall herb edge communities, along water courses and woodland borders on mesic to wet soils. Mono-dominant communities of tall herbaceous plants that have formed after overgrowing of grasslands and communities of alien species (for example, *Impatiens glandulifera*, *Helianthus tuberosus*, etc.) are not included in the habitat.

Specific characteristics of habitat interpretation in Latvia: none.

Distribution: relatively rare throughout Latvia; however, the quality of these habitats in many areas is low, as in the second half of the 20th century, as a result of intensive land reclamation, hydrological regime of many rivers was changed and the activities of natural processes on the river banks that were caused by flooding, decreased. In larger areas conserved on the banks of the River Venta, the River Aiviekste and the River Lielupe. Until now the habitat has been identified and mapped only in *Natura 2000* sites, but beyond them its distribution is unknown.

Conservation value: en endangered habitat in Europe and Latvia (the total are of this habitat in Latvia is unknown, area known in *Natura 2000* sites is 700 ha or 0.01% of the total area of Latvia). It has nature diversity conservation and scenic value, as well as a great significance in restricting the invasion

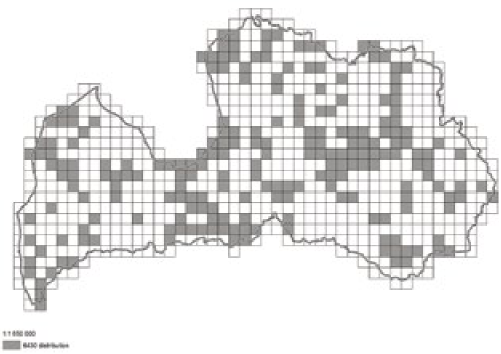


Figure 6.41. Distribution of the habitat 6430 *Hydrophilous tall herb fringe communities of plains and the montane to alpine levels* in Latvia (Conservation status of.., 2013).

and further expansion of alien species (intensive migration of alien invasive species takes place along anthropogenically disturbed riverbanks, but natural habitats prevent this process).

Environmental factors: on the ecotones along water courses on river banks and lake shores (on riverside point bars, the edge of riverbed and low flood-plain), where a large amount of nutrients (usually in the form of silt) and relatively pronounced water-level fluctuations, thus soils are usually overly wet, but they can periodically dry out. As a result of river activity, plants are often mechanically disturbed, hence these habitats are in a constant dynamic equilibrium – plant communities are renewed and do not overgrow with scrubs and trees. River activity in Latvia is not particularly intensive (because of lowland conditions), therefore formation and conservation of this habitat is promoted by fragmentary grazing (*Fig. 6.39.*). The main factor for forest edge is partial shading and impact of forest litter on the nutrient circulation. Habitats are usually linear, their width is normally less than a metre, in wider lines they can be found on the banks of larger rivers, where water level fluctuations are more pronounced and flood activity is stronger, as well as in areas where the banks are flat.

Processes with a functional role: fluctuations in water level, nutrients and silt that are brought by water, microtopography that has established as a result of the impact of water and ice and mechanical disturbances are important for river bank and lake shore habitats.

Vegetation characteristics: the herb layer usually is high (even 200 cm and more), but the cover is very variable, it can be relatively sparse in areas where the mechanical activity of water and water level fluctuations are more pronounced, but is closed in areas where the river activity is not as dynamic. therefore, sod can be relatively sparse or disturbed and also well-established. Dominated by hygrophyte and nitrophilous species *Carex acuta*, *Phalaroides arundinacea*, *Calamagrostis canescens* etc., in areas with smaller water level fluctuations, also *Filipendula ulmaria* and *Epilobium hirsutum*. Annual and biennial species of higher herbaceous plants that use open spaces in sward that are created by disturbances and the large amount of available nutrients (*Bidens tripartita*, *Angelica*

Figure 6.42. River bank variant in the upper course of the River Gauja. The habitat has established on a shallow island in the river, dominated by *Phalaroides arundinacea* (Photo: S.Rūsiņa).

Figure 6.43. Typical plant community of a river bank variant with *Senecio paludosus* (in the centre), *Phalaroides arundinacea*, *Lythrum salicaria* and *Calystegia sepium* (in the foreground) (Photo: S.Rūsiņa)

Figure 6.44. Forest edge variant. Dominated by a protected species of EU importance - *Agrimonia pilosa* (Photo: S.Rūsiņa).

archangelica) are rather common. Liana species are very characteristic, for example, *Calystegia sepium* (*Fig. 6.43.*), *Cuscuta europaea* (parasite), *Humulus lupulus*. Forest edge habitats are dominated by various species of parsley family *Apiaceae*, important rare species are *Alliaria petiolata*, *Anthriscus nitida*, *Agrimonia pilosa* (rare in the western part of Latvia), *Astrantia major*, *Delphinium elatum*, *Digitalis grandiplants* (*Fig. 6.45.*).

Characteristic species: <u>herbaceous plants</u> – *Aegopodium podagraria*, *Astrantia major*, *Alliaria petiolata*, *Alopecurus pratensis*, *Angelica archangelica*, *Anthriscus sylvestris*, *A.nitida*, *Agrimonia pilosa*, *Calystegia sepium*, *Cirsium oleraceum*, *Crepis paludosa*, *Cuscuta spp.*, *Delphinium elatum*, *Digitalis grandiplants*, *Epilobium hirsutum*, *Eupatorium cannabinum*, *Filipendula ulmaria*, *Galium rivale*, *Geranium robertianum*, *Glechoma hederacea*, *Inula britannica*, *Lamium album*, *Lythrum salicaria*, *Mentha aquatica*, *Phalaroides arundinacea*, *Senecio paludosus*, *Melandrium dioicum*, *Thalictrum flavum*, *Valeriana officinalis*, *Veronica longifolia*; <u>invertebrates</u> – *Pholidoptera griseoaptera*, *Dolomedes plantarius*, *Chrysochraon dispar*, *Lycaena dispar*, *Lixus spp*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Angelica archangelica, Convolvulus sepium, Senecio paludosus, Angelica sylvestris, Lythrum salicaria, Thalictrum flavum, Epilobium hirsutum, Cirsium oleraceum, Alliaria petiolata, Valeriana officinalis, Veronica longifolia.* Insect species could be very significant, however, no studies has been done.

Variants:

6430_1 (river bank variant): on river banks and lake shores (see characteristic species by the vegetation characteristics) (*Fig. 6.35., 6.36., 6.37.*);

6430_1 (forest edge variant): at forest edge fringes (forest and non-forest eco-tone) (see characteristic species by the vegetation characteristics) (*Fig. 6.44., 6.45.*).

Habitat Quality

Minimum habitat requirements: site complies with the habitat, if there is a set of appropriate environmental conditions and there are at least 3 characteristic plant species of the habitat.

Structural indicators: all indicators that are important for grasslands, except for the number of semi-natural grassland indicator species, since the habitat establishes naturally, not as a result of regular mowing or grazing.

Function and process indicators: all indicators that are important for grasslands, except for the impact of mulching (as these habitats are usually not mowed), but additionally – activity of waves and stream (it creates constant changes in the hydrological regime, provides silt, creates open substrate areas etc., that are necessary for the existence of the habitat) and implementation of management (although in general management is not necessary for this habitat, when irregular, extensive management takes place, habitats of a higher quality are formed).

Figure 6.45. Forest edge variant. Dominated by *Pteridium aquilinum*, *Origanum vulgare* and protected species *Digitalis grandiplants* (Photo: S.Rūsiņa).

Restoration potential and quality improvement indicators: all indicators that are important to grasslands.

Threats: regulation of water courses and alterations to the water level, construction of artificial ponds and reservoirs, intensive management of banks and invasion of alien species, household waste, overall environmental pollution.

Management: if it is not threatened, management is not necessary. In river sections that have been regulated or have an anthropogenic origin and have been significantly influenced by eutrophication, extensive grazing or rare mowing may be necessary (once in 2–3 years).

Similar habitats: in areas with flood plain grasslands, contact communities with moist and wet grasslands (including 6410 and 6450) can form. From the perspective of plant communities, abandoned semi-natural and cultivated grasslands in fertile soils, where nitrophilous species *Aegopodium podagraria*, *Chaerophyllum aromaticum* etc. can be found, can be similar, but are not included in the habitat.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: none.

Literature

Laiviņš, M. (1992) Nitrofilas piekrastes dižtīteņu-dižzirdzenes sabiedrības (Convolvulo-Angelicetum archangelicae littoralis Pass. (1957) 1959) Ventas ielejā. Proceedings of the Latvian Academy of Sciences, B5 (538), 68–70 p.

Сабардина, Г. (1952) Естественные луга в районе нижнего течения реки Венты. Zootehnikas un Zoohigienas Institūta Raksti 1, 68–103 c.

6450 *Northern Boreal alluvial meadows*

Latvian habitat classification: all grassland/meadow habitats E.

Syntaxonomy: *Magnocaricion, Alopecurion, Caricion nigrae, Calthion.*

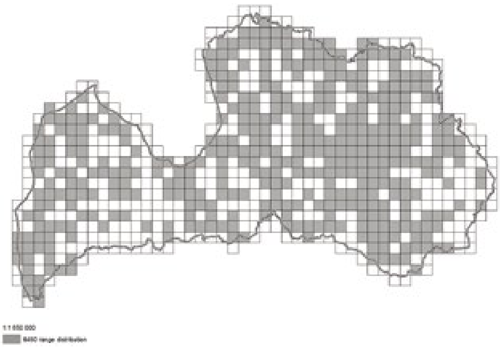


Figure 6.46. Distribution of the habitat 6450 *Northern Boreal alluvial meadows* in Latvia (Conservation status of.., 2013).

Definition: grasslands along large rivers with placid river sections which are frozen every winter, the type is affected by flooding in spring. The traditional management as hay meadows has usually ceased. Type includes areas that are not yet severely overgrown with trees and shrubs. Includes several vegetation types which vary according to the moisture (flooding) gradient.

Specific characteristics of habitat interpretation in Latvia: such grasslands occur also in flood plains of small rivers and lakes in Latvia; traditionally they are not only mowed, but also grazed. The habitat includes only moist and wet grasslands that are located on flood plains, except for grasslands that comply with the habitat 6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)*. All dry and mesic grasslands that are found in flood plains in Latvia correspond to other semi-natural grassland habitat types of EU importance and are not included into 6450 *Northern Boreal alluvial meadows* (*Fig. 6.47.*).

Distribution: relatively rare in all territory of Latvia, majority has been significantly influenced by amelioration and soil improvement. In larger areas habitat is foundin the valleys of rivers such as the Aiviekste, the Pededze, the Gauja, the Dviete, the Rūja, the Užava, alluvial lands of Lake Lubāna, Burtnieks, Lake Liepāja and Lake Durbe.

Conservation value: endangered habitat in Europe and Latvia (in Latvia it occupies 15 600 ha or 0.24 % of the total territory). Habitat has a great scenic, biodiversity conservation and cultural heritage value. Alluvial grasslands are significant nesting and feeding grounds for several bird species. It is the only appropriate habitat for *Gallinago media* (Auniņš, 2001), but *Crex crex* reach the highest population density only in alluvial grasslands, thus they are important as *Crex crex* donor territories for other habitats (Keišs, 1997). Alluvial grasslands are the only habitat for grassland wader species. From insects, *Lycaena dispar* should be mentioned. Alluvial grasslands provide important ecological functions – flood control, provide nutrient circulation, purify surface waters. This is one of the most affected grassland habitats in Latvia, as due to land reclamation and cultivation in the 20th century at least 90% of all alluvial grasslands have been lost (Сабардина, 1957; Conservation status of.., 2013).

Environmental factors and processes with a functional role: on alluvial soils of rivers and lakes in various moisture conditions. A significant factor in maintaining it is flood. Flooding can be both annual and have longer intervals. Flooding activity and formation of oxbows create very diverse and rapidly changing soil humidity and fertility conditions in small areas. Traditionally, they have been used mainly for mowing and were not fertilized, as nutrients brought by the flood provide natural restoration of soil fertility (*Fig. 6.48.*). This habitat can occupy very wide areas (for example, Aiviekste alluvial grasslands) and very narrow lines, for example, *Allium schoenophrasum* grasslands on banks of River Daugava (*Fig. 6.49.*) and narrow flood plains of small rivers.

Vegetation: communities of *Calthion*, *Alopecurion* and *Magnocaricion* (seldom also *Caricion nigrae*) on moist and wet soils. Due to diverse environmental conditions, species composition and vegetation structure can be very diverse, and even in small areas several plant communities can be found (*Fig. 6.50.*). In more dry areas communities of tall sedges (*Carex acuta*, *C.cespitosa* etc.) and grasses (*Phalaroides arundinacea*, *Calamagrostis neglecta*, *C.canescens*) (height of the sward is above 150 cm) form, but in moist and mesic areas the sward usually is lower (20–100 cm), in addition to dominating grasses and sedges (*Alopecurus pratensis*, *Deschampsia cespitosa*, *Carex disticha*) hydrophilous dicotyledons are also important (*Geum rivale*, *Filipendula ulmaria*, *Galium palustre* etc.). Depending on the cover of herbaceous plant layer (typically above 80%), layer of moss can be rather pronounced or absent. Occasionally it is difficult to separate cultivated (improved) alluvial grasslands from semi-natural grasslands, not knowing the history of the site management, since local herbaceous plant species that are characteristic to alluvial grasslands have been sown in cultivated grasslands. Also, nowadays many meadows are not managed; therefore, mono-dominant communities of grasses, which are similar to those of intensively cultivated grasslands, develop. Sometimes nitrophilous ruderal communities with explicit domination of *Urtica dioica*, *Elytrigia repens*, *Dactylis glomerata*, *Cirsium arvense*, *Epilobium spp.*, *Filipendula ulmaria* are formed. In these cases it is important to follow the minimum habitat quality criteria.

Characteristic species: *Alopecurus pratensis*, *Caltha palustris*, *Cardamine spp.*, *Carex acuta*, *C.cespitosa*, *C.disticha*, *C.nigra*, *Calamagrostis canescens*, *Cnidium dubium*, *Deschampsia cespitosa*, *Filipendula ulmaria*, *Galium palustre*, *Galium uliginosum*, *Geum rivale*, *Lathyrus palustris*, *Lythrum salicaria*, *Phalaroides arundinacea*, *Peucedanum palustre*, *Poa palustris*, *P.trivialis*, *Thalicturm flavum*, *T.lucidum*, *Valeriana officinalis*, *Veronica longifolia*, *Viola persicifolia*. Invertebrates – *Lycaena dispar*, *Pholidoptera griseoaptera*, *Dolomedes plantarius*, *Vertigo angustior*, *Chrysochraon dispar*. Meadow wading birds – *Haematopus ostralegus*, *Vanellus vanellus*, *Philomachus pugnax*, *Tringa totanus*, *Tringa stagnatilis*, *Limosa limosa*, *Numenius arquata*, *Gallinago gallinago*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Carex aquatilis, Cnidium dubium, Gladiolus imbricatus, Trollius europaeus, Stellaria palustris, Lathyrus palustris, Viola persicifolia, Thalictrum simplex, Gallinago media,* grassland wading bird species.

Figure 6.47. Alluvial grassland in the River Gauja flood plain. Although the grassland is fully located in a flood plain, the driest parts comply with the habitat 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites)* and only more humid parts (depressions) can be included in the habitat 6450 *Northern Boreal alluvial meadows* (Photo: S.Rūsiņa).

Figure 6.48. Alluvial grassland in the River Gauja valley that has been flooded during spring floods (Photo: V.Lārmanis).

Variants:

6450_1: high sedge and reed canarygrass grasslands (vegetation of *Magnocaricion* community);

6450_2: meadow foxtail grasslands in very fertile soils (vegetation of *Alopecurion* community);

6450_3: wet alluvial grasslands in moderately rich soils (veg-

Figure 6.49. Alluvial grassland in a narrow flood plain of the Daugava River, where dolomite is very close to the surface and consequently, distinctive and very rare plant communities in Latvia with *Allium schoenoprasum* develop (Photo: V.Baroniņa).

etation of *Calthion* community with water avens, meadowsweet and other wet grassland species).

Habitat Quality

Minimum habitat requirements:

Unlike other grassland habitats, in order to identify flood plain grassland as a habitat 6450 of EU importance, indicator species of semi-natural grasslands can be absent, but in such cases all of the following criteria must be met:

– grassland must be subject to flooding and the typical alluvial grassland vegetation must be present with plant species that typically dominate in flood plains – *Alopecurus pratensis*, *Phalaroides arundinacea*, *Poa palustris*, *Poa trivialis*, *Deschampsia cespitosa*;
– at the same time at least three characteristic species of alluvial grasslands with high occurence must be present (encountered in at least four out of ten selected points every 20 meters), species: *Caltha palustris*, *Cardamine spp.*, *Carex acuta*, *C.cespitosa*, *C.disticha*, *C.nigra*, *Calamagrostis canescens*, *Cnidium dubium*, *Filipendula ulmaria*, *Galium palustre*, *G.uliginosum*, *Geum rivale*, *Lathyrus palustris*, *Lythrum salicaria*, *Peucedanum palustre*, *Thalictrum flavum*, *T.lucidum*, *Valeriana officinalis*, *Veronica longifolia*, *Viola persicifolia*. If there are no characteristic species, the grassland should be a mosaic of several alluvial grass and sedge species (one or other species dominates in patches);
– and cultivated grassland species *Dactylis glomerata*, *Phleum pratense*, *Trifolium hybridum*, *T.pratense*, alien species *Ehinocystis lobata*, *Impatiens glandulifera* etc., nitrogen-demanding species *Aegopodium podagraria, Chaerophyllum aromaticum, Anthriscus sylvestris*, *Agropyron repens*, *Taraxacum officinale*, *Urtica dioica* cover is less than 60% of the total herb layer cover.

Structural indicators: all indicators that are important for grasslands, except for the number of characteristic species, as the vegetation is very variable, but additionally – diversity of plant communities (in a qualitative flood plain grassland it is possible to find a mosaic of at least three or more different plant communities) (*Fig. 6.43.*).

Function and process indicators: all indicators that are important for grasslands, in addition, also the mosaic of ecotopes (in a qualitative grassland there are oxbows and depressions that have been created by flooding, as well as elevations that are occupied by other grassland habitats, relief has not been mechanically levelled, for example, filled oxbows and depressions) (*Fig. 6.43.*) and the width of the grassland zone (grassland habitat is suitable for significant bird species of alluvial grasslands only if the most narrow axis (width) of a grassland is at least 500 m).

Restoration potential and quality improvement indicators: all indicators thatare important to all grasslands.

Threats: all threats common to grasslands.

Management: grazing or mowing.

Similar habitats: none.

Overlap with other habitats of EU importance: may overlap with 5130 *Juniperus communis formations on heaths or calcareous grasslands*, 6120* *Xeric sand calcareous grasslands*, 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)*, 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and sumbountain areas, in Continental Europe)*, 6270* *Fennoscandian lowland species-rich dry to mesic grasslands*, 6410 *Molinia meadows in calcareous, peaty or* *clayey-silt-laden soils (Molinion caeruleae)*, 6510 *Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)* and 6530* *Fennoscandian woodland meadows.*

Corresponding specially protected habitats in Latvia: none.

Literature

Aktuālā savvaļas sugu un biotopu apsaimniekošanas problemātika Latvijā (2008) A.Auniņa red. Rīga, Latvijas Universitāte, 162 lpp.

Auniņš, A. (2001) Ķikuta populācijas teritoriālais izvietojums, skaits un biotopa izvēle Latvijā: patreizējā situācija (1999 –2001) un vēsturiskā informācija. Putni dabā 1. pielikums, 4.–12. lpp.

Jermacāne, S. (1998) Gaujas augšteces rajona purvaino pļavu augu sabiedrības. Latvijas purvu veģetācijas klasifikācija un dinamika. Latvijas Universitātes Zinātniskie Raksti, 613, Rīga, 67.–75. lpp.

Keišs, O. (1997) Griežu uzskaišu rezultāti Latvijā 1989.–1995. gadā. Putni dabā 7.1. pielikums, 11.–21. lpp.

Marga, D. (2002) Aiviekstes augšteces palieņu pļavu veģetācija un apsaimniekošana. Maģistra darbs. Ģeogrāfijas un Zemes zinātņu fakultāte, Latvijas Universitāte, Rīga, 75 lpp.

Marga, D. (2002) Augu sabiedrības ar mānīgo knīdiju Cnidium dubium Aiviekstes augšteces palienē LU 60. Zinātniskā konference. Ģeogrāfija, ģeoloģija, vides zinātne. Referātu tēzes, 89.–92. lpp.

Sabardina, G. (1949) Rīgas-Jelgavas līdzenuma dabīgās pļavas. Latvijas PSR ZA Vēstis 3, 69.–84. lpp.

Матвеева, Е.П. (1967) Луга Советской Прибалтики. Ленинград, Наука, 335 с.

Сабардина, Г. (1952) Луга бассейна реки Абулс в среднем ее течении. Zootehnikas un Zoohigienas Institūta Raksti 1, 104–150 c.

Сабардина, Г. (1952) Естественные луга в районе нижнего течения реки Венты. Zootehnikas un Zoohigienas Institūta Raksti 1, 68–103 c.

Сабардина, Г. (1968) Растительность островов – мест массового гнездования уток на озере Энгурес. В кн. Экология водоплавающих птиц Латвии. Рига, 45–69 с.

Сабардина, Г. (1952) Естественные луга северо-западного берега Лубанского озера. Zootehnikas un Zoohigienas Institūta Raksti 2, 43–56 c.

Сабардина, Г.С. (1957) Луговая растительность Латвийской ССР. Рига, изд. АН ЛССР, 303 с.

Figure 6.50. Alluvial grassland in the River Aviekste flood plain in which its high quality is indicated by the distinct ecotope mosaic (depressions and elevations) and the diversity of plant communities (in depressions there are different communities of tall sedges, but on elevations – communities of grass (*Phalaroides arundinacea* and *Alpoecurus pratensis*) and dicotyledons (*Veronica longifolia*, *Filipendula ulmaria* etc.) (Photo: S.Rūsiņa).

6510 *Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)*

Figure 6.51. In a qualitative mesic grassland several layers of vegetation can be seen. In the plant community that is shown in the image pronounced medium high grass and dicotyledon layer (*Galium verum* and *G. album* flower, *Lathyrus pratensis*, of grasses – *Briza media* and *Anthoxanthum odoratum* have a large cover) and layer of tall grasses (dominated by *Arrhenatherum elatius*) can be seen (Photo: S.Rūsiņa).

Latvian habitat classification: E.2.3., partly E.3.1.

Syntaxonomy: *Arrhenatherion, Alopecurion*.

Definition: species-rich hay meadows on lightly to moderately fertilised soils with plant communities belonging to the *Arrhenatherion* and the *Brachypodio-Centaureion nemoralis* alliances. These extensive grasslands are rich in dicotyledonous (grassland broad-leaved) plants and are not cut before the grasses flower and then only one or two times per year.

Specific characteristics of habitat interpretation in Latvia: meadows are traditionally grazed in aftergrass; therefore, this type also includes meadows, where grazing is performed and where the vegetation that is typical to this habitat has been conserved. With the disappearance of traditional agricultural practices, these meadows are not mowed regularly as they do not provide sufficient production. This habitat also includes wet meadows outside river flood plains that are dominated by tall grasses of fertile soil: *Alopecurus pratensis*, *Poa palustris*, *Poa trivialis*, *Bromopsis inermis* (plant communities belong to alliance *Alopecurion*) (*Fig. 6.49.*). If the above mentioned grasslands are found in flood plains, they are included in the habitat 6450 *Northern Boreal alluvial meadows.*

Distribution: relatively rare in the territory of Latvia. Usually have preserved in small areas. Larger continuous areas are formed only in flood plains.

Conservation value: a rare and disappearing habitat, occupies only 5 300 ha or 0.08% of the total territory of Latvia. Only a small part of these areas have a high quality of biodiversity, but majority of them comply only with the minimum habitat quality requirements, since they gradually form in former areas of cultivated grasslands and fallow lands. Continuously and regularly mowed meadows where species-rich plant communities have established due to the continuous management or

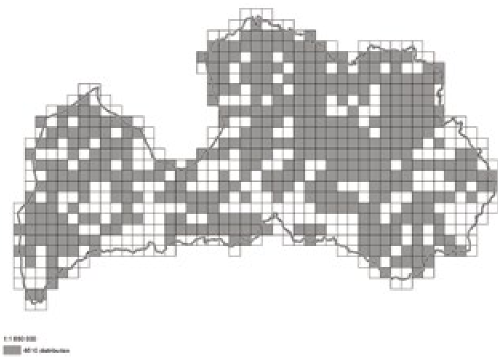


Figure 6.52. Distribution of the habitat 6510 *Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)* in Latvia (Conservation status of.., 2013).

have a biological and cultural heritage value. Important habitat for species of *Dactylorhiza spp.* and *Platanthera spp.* One of the habitats for *Cnidium dubium* and other rare species.

Environmental factors and factors with a functional role: relief conditions are very diverse – plain areas, hills and flat slopes, shallow valleys, terraces of river valleys and gentle slopes of terraces (usually with northern or western exposure), river and lake flood plains that are flooded rarely or temporarily. Mesic and moist soils in which favourable moisture conditions persist throughout the vegetation season. The moisture regime in the lowest areas of the relief can be overly wet. They are well aerated with slightly acidic to neutral reaction. May be peaty, gleyed in the wetest areas. Soils are rich in nutrients – moderately fertile and fertile to very fertile.

Vegetation: vegetation is thick, medium high (~50 cm) to high (~1 m and more). Sod is dense, well-established. Several layers are characteristic to plant communities (*Fig. 6.51.*). Moss layer is normally poor. Moderately tall and tall grasses have the determinant role in the formation of species composition of communities. Usually there are several species of grass in these meadows, however none of them dominates. Large number of various species of dicotyledons occur (*Fig. 6.53.*). The greatest projective cover in the vegetation of fertile mesic soils is formed by *Festuca pratensis*, *Phleum pratense* and *Poa pratensis*. Frequently *Dactylis glomerata* has an important role. Plant communities in which *Arrhenatherum elatius*, which grows together with several other species of grass, but can dominate in irregularly mowed areas, have a significant role in fertile, xerothermic mesic soils that can be found mainly in river valleys in the southern and southwestern part of Latvia (*Fig. 6.54.*). In less fertile mesic areas *Helictotrichon pubescens* has a significant role, which dominates occasionally (*Fig. 6.55.*). In these communities the proportion of low grasses is higher – *Anthoxanthum odoratum*, *Briza media*. In humid, periodically overly wet fertile and moderately fertile soils in depressions and on wet slopes species rich plant communities have established in which *Deschampsia cespitosa*, *Filipendula ulmaria*, *Carex panicea*, *Geum rivale*, *Geranium palustre* co-dominate. Depending on the dominating species, the vegetation height varies from average to high. When management is abandoned, habitat overgrows with silver birch, aspen, Norway spruce, goat willow, but in the wetest areas mostly with a variety of willow species. Before shrub encroachment, nitrophilous tall grass vegetation with *Chaerophyllum aromaticum*, *Aegopodium podagraria*, *Anthriscus sylvestris* can form.

Figure 6.53. Typical variant. polidominance of grasses, from grasses *Festuca pratensis* is more important (Photo: V.Baroniņa).

Figure 6.54. Typical variant on a slope of a hill at Āraiši Lake. Dominated by *Arrhenatherum elatius* and *Trisetum flavescens* with admixture of *Alopecurus pratensis* (Photo: S.Rūsiņa).

Characteristic species: in mesic meadows – *Arrhenatherum elatius*, *Briza media*, *Campanula patula*, *Carum carvi*, *Crepis biennis*, *Centaurea jacea*, *Helictotrichon pubescens*, *Festuca pratensis*, *Galium album*, *Heracleum sibiricum*, *Knautia arvensis*, *Lathyrus pratensis*, *Leontodon hispidus*, *Pastinaca sativa*, *Plantago media*, *Tragopogon pratensis*, *Trisetum flavescens*. In very fertile soils of moist meadows – *Alopecurus pratensis*, *Ga-*

Figure 6.55. Wet variant. Dominated by *Helictotrichon pubescens*, high occurence of dicotyledons in wet areas – *Geum rivale* and *Filipendula ulmaria* (Photo: S.Rūsiņa).

Figure 6.56. Wet variant. Dominated by *Alopecurus pratensis* (Photo: V.Baroniņa).

lium uliginosum, *Galium Boreale*, *Geum rivale*, *Lychnis flos-cuculi*, *Poa palustris*, *Ranunculus auricomus*, *Veronica longifolia*. Insects – large diversity of day-flying butterflies *Rhopalocera*, bees and bumble bees *Apoidea*, bugs *Heteroptera*, leaf-cutting beetles *Chrysomelidae*, grasshoppers *Acrididae*, house flies *Muscidae* and flies *Anthomyiidae* and fruit fly *Tephritidae* species.

Umbrella species (typical species within the meaning of the Habitats Directive): *Crepis biennis, Tragopogon pratensis, Leontodon hispidus, Plantago media, Helictotrichon pubescens, Trisetum flavescens.*

Variants:

6510_1 (typical): species-rich, usually in moderately fertile or fertile neutral soils. Characteristic dominating species are *Festuca pratensis*, *Helictotrichon pubescens*, *Arrhenatherum elatius*, *Bromopsis inermis* (*Fig. 6.53., 6.54.*);

6510_2 (wet): relatively more poor in species, forms on wet very fertile soils in valleys and wet plain areas. In vegetation *Alopecurus pratensis*, *Poa palustris* and *Poa trivialis* (*Fig. 6.55., 6.56.*) have the more significant role.

Habitat Quality

Minimum habitat requirements: includes grasslands that comply with the general criteria of grassland habitats of EU importance and whose vegetation is determined by the characteristic plant species and communities of this habitat.

Structural indicators: all indicators that are significant for grasslands, additionally the proportion of semi-natural grassland indicator species in vegetation (in a habitat of good quality the herbaceous plant layer is dominated by one or several semi-natural grassland indicator species or these species have a high ocurrence), as well as the number of herbaceous plant sub-layers (in a grassland of good quality, three sub-layers are well developed – layer of tall grasses, medium grasses and low rosette or creeping plant layer.

Function, quality improvement indicators restoration potential: all indicators that are significant to grasslands.

Threats: all threats that are significant to grasslands. Tractor equipment in more humid areas and seasons compresses the soil, making the growing conditions worse for many characteristic species. Similar consequences are created after late and too intensive grazing in autumn. Habitat is threatened by cultivation and ploughing more than other grassland habitats due to suitable conditions of humidity and soil fertility.

Management: the main use of grasslands should be mowing, moderate fertilization with manure is accaptable, as well as grazing in aftergrass. It is important to preserve the traditional methods of hay cutting and raking (turning of hay during drying), which promote species dispersion, as well as harrowing as it promotes destruction of moss layer and ensures a favourable oxygen regime in the soil, and preservation of a neutral reaction.

Similar habitats: in weakly acidic soils of comparatively low fertility, as well as in areas with intensive grazing a transition to 6270* *Fennoscandian lowland species-rich dry to mesic grasslands* can be formed. Both habitats are separated based on the composition of characteristic species and dominating management (if the main use is mowing and typical grasses of 6510 *Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis)* predominate, the habitat is identified as 6510). In order to separate this habitat from other grassland habitats, it is necessary to evaluate to which habitat the dominant set of characteristic species and communities in the vegetation belongs.

Overlap with other habitats of EU importance: may overlap with habitats 6530* *Fennoscandian woodland meadows* and 6450 *Northern Boreal alluvial meadows.*

Corresponding specially protected habitats in Latvia: none.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Rūsiņa, S. (2007) Latvijas mezofīto un kserofīto zālāju daudzveidība un kontaktsabiedrības. Latvijas veģetācija 12, 1.–366. lpp.

Матвеева, Е.П. (1967) Луга Советской Прибалтики. Ленинград, Наука, 335 с.

6530* *Fennoscandian wooded meadows*

Figure 6.57. Fennoscandian wooded meadows in a good quality (in autumn) in the Ziemeļgauja (Northern Gauja) Protected Landscape Area (Photo: V.Lārmanis).

Latvian habitats classification: none

Syntaxonomy: none.

Definition: a vegetation complex that consists of scattered trees or small copses of trees and shrubs that interchanges with patches of open meadows. The most characteristic tree species are *Quercus robur*, *Tilia cordata*, *Ulmus glabra*, *Ulmus laevis* and *Fraxinus excelsior*. Nowadays very few areas are managed, but traditionally these areas were managed by combination of raking, hay-cutting, grazing of grassland and using of the branches. This is a species-rich vegetation complex with rare or threatened meadow species and well developed epiphytic flora of mosses and lichens are characteristic. Many threatened species occur on old trees of semi-open habitats. The habitat includes managed areas (*Fig. 6.57.*) and overgrown areas with old trees that have established as a result of traditional management. The habitat does not include abandoned meadows invaded by trees (*Fig. 6.6.*).

Specific characteristics of habitat interpretation in Latvia: by the interpretation of Latvia this habitat also includes areas that comply with the habitat 9070 *Fennoscandian wooded pastures*, which is not currently included in the official list of specially protected habitats in Latvia (Conservation status of..., 2013). Therefore the official habitat name in Latvian is 6530* *Wooded meadows and pastures*. Nowadays in most of the cases it is not possible to determine, whether a habitat has been or has not been mowed in the past, as both – wooded meadows and forest pastures – usually are not managed and are afforested. In Latvia's conditions, unification of these habitats is logical, because the economic context of modern agriculture determines that the most possible type of permanent management of these habitats is the same – grazing. The habitat also includes small isolated patches of park-like trees – if a group of at least five trees with circular projections of each tree of a radius that is triple the height of the trees create the total projection which is 0.1 ha or more – however, the afforested wooded-pasture must be wider. Stands in cultivated arable lands that have the typical shape of wooded-pastures, artificially formed greeneries in populated areas, homes, parks, alleys, etc., are usually not identified as this habitat. However, in some cases it is acceptable to include in the habitat old abandoned home places or parks of the appropriate structure, if they have the typical shape of wooded-pastures, they are dominated by local tree species, buildings no longer remain and the existing or potential management is generally typical to the habitat. Currently there are not known examples of the habitat

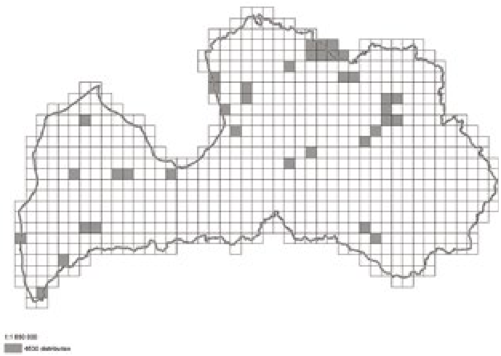


Figure 6.58. Distribution of the habitat 6530* *Fennoscandian wooded meadows* in Latvia (Conservation status of.., 2013).

with pollarded trees, as it has been mentioned in the original habitat description (Interpretation manual.., 2013). Historically groups of trees that have been managed for this purpose could have existed. Trees of appropriate shape can be seen in several images of the Latvian landscape from K.Broce collection in a suitable context that has been drawn at the turn of the 18th and 19th centuries (Anon., 1997).

Distribution: relatively rare in the territory of Latvia. By summing areas that have been mapped within the framework of the current *Natura 2000*, which partly includes afforested habitats, it has been estimated that the habitat occupies 0.02% (1 160 ha) of the total area of Latvia (*Conservation status of.., 2013*). The habitat has been previously present ir larger areas and it is possible that it also currently occupies considerably larger areas in afforested condition than it has been assessed. It is known that grazing in forests was widely distributed until 1940 in Latvia (Dumpe, 1999; Vasiļevskis, 2007) and grazed sparse park-like forests or woodland type situations with ground cover that is characteristic to grasslands were often found even in the 1950s (Ramans, 1958), in seperate cases appropriately managed habitats were found in 1980s and after few years of management abandonment they also exist nowadays (Lārmanis, 2012). The current view on the habitat distribution has been significantly influenced by the fact that a total inventory of the habitat has never been carried out in the country and in the beginning of 2000s, when mapping of this habitat was started for the first time, situations with afforested woodland trees were not taken into account. Currently examples from areas where the initial mapping has been adjusted according to the presence of old park-like trees in a forest show that the habitat areas with a potential for its restoration are present in significantly larger areas than it was initially thought. The habitat occurs mainly in river valleys. Largest areas are found in the banks of middle reach of River Gauja, River Pededze and River Abava, as well as near River Ogre, River Venta, and River Kuja (Kabucis, 2004; Rove, 2007; Vilka, 2007; Lārmanis, 2012).

Conservation value: as wooded meadows and pastures are a complex of several different habitats, it is distinguished by larger species richness among other habitats of EU importance. The set of species that are characteristic to grasslands overlaps with species that live in the tree layer – also each separate layer

Figure 6.59. A forest stand that has a structure of old woodland meadow that has been abandoned for decades and complies with the habitat (Photo: V.Lārmanis).

can be very rich in species. For example, in an area of 25 m^2 up to 60 species of herbaceous plants have been found (Rūsiņa, 2008), while the number of epiphytic lichen species reaches 192 (Leppik, Saag, 2006). Habitat is rich in specially protected species of various organism groups – for several of them it is an irreplacable habitat. In Latvia it is the most significant habitat for fungus *Hapalopilus croceus*, which is found only on oaks that are older than 200 years. Population of *Osmoderma eremita* which is a priority species of EU importance largely depends on the habitat conservation and its maintenance in a good quality (Teļnovs, 2005); this habitat has a characteristic community of saproxylic insect species, the living environment of which can not be replaced by a forest with closed canopy (Sverdrup-Thygeson et al., 2010). Quite often this habitat overlaps with the typical vegetation of several other habitats of EU importance – 6210* *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-brometalia) (*important orchid sites)*, 6270* *Fennoscandian lowland species-rich dry to mesic grasslands* etc. Habitat has a high aesthetic and cultural heritage value as a feature of the traditional rural landscape of Latvia that was typical at the time when Latvia emerged as a country. It is considered to be one of the oldest landscape elements in our climatic zone, formed by the interaction between human and nature and has existed until today at least since the Bronze Age 3500 years ago (UNESCO WHC, 1992-2013; Ek, Johannesson, 2005). It is not excluded that the appearance of wooded meadows and their importance in biodiversity conservation is close to pristine – human undisturbed – conditions that were

Figure 6.60. Partly afforested wooded meadow during spring floods in the protected landscape area "Ziemeļgauja" (Northern Gauja) (Photo: V.Lārmanis).

maintained by large wild herbivores in the ancient times (Vera, 2000; Vera, 2006).

Environmental factors: habitat can be found on various soils, with the exception of deep peaty soils. In Latvia it is mostly found on slopes of ancient river banks and in valleys, including alluvial plains (*Fig. 6.60.*). Can also be found in any other relief conditions, but it is less distributed there, apparently due to the fact that the maintenance of other landscapes has been more beneficial economically.

Processes with a functional role: habitat fragments that have been preserved until today have formed as a result of traditional agriculture mainly in the period from the 19th century until the first half of the 20th century. Grazing and gathering of hay (to a smaller extent) has been mostly performed in the habitat. In many areas the habitat has formed as a result of long-term grazing of a forest that has gradually transformed into sparse park-like woodland (Ramans, 1958). Formation and structure of the habitat has been influenced by its multifunctional use – in addition to grazing and hay production, it has served as a source of many other products (wood, acorns, apples, berries, nuts etc.) (UNESCO WHC, 1992-2013). It is possible that apple-trees, rowan trees with a dense foliage, large old hazels etc. that are typical to the habitat, were particularly nurtured and their growth was promoted. Existence of the tree stand and underwood at an appropriate density may have been determined by periodic felling of individual trees. Large old trees become dry and fall in the habitat. Dry trees are a habitat for species that are related to dead-wood that can exist for many decades. Sometimes the heavily branched crown of fallen trees serves as a protective environment in which young trees can establish without being threatened by livestock. Similar functions are provided by thick shrub copses. The habitat is structurally and functionally similar to the landscape that has been described by the theory on ecology of pristine broad-leaved forests in relation to the impact of large herbivores (Vera, 2000).

Vegetation characteristics: the habitat is a vegetation complex of scattered trees or copses of trees and scrubs mixed with patches of open meadows. Nowadays the majority of woodland meadows and pastures are partially or fully afforested, therefore, forest glades are rarely found. Trees of the same species can belong to the habitat and also be undesirable, if they have been introduced during habitat afforestation. It is important to distinguish and separate park-like trees that have established during formation of the wooded meadow or pasture from those that have established during overgrowing of the habitat. The shape of the crown of trees and their stem that have formed in a park-like woodland situation is the main feature by which an afforested habitat can be recognized.
Layer of woodland forest stand. Thickness of the forest stand can vary from individual trees in fields to groups of densely grown trees that can form sparse stands that occupy several hectares. Crowns of trees that have grown in open or sparser areas can have very dense foliage (*Fig. 6.60.*) – these are more characteristic to wooded meadows in areas where gathering of hay has been performed formerly. In thicker forest stands that have only been grazed, trees can be less branched, but their branching is always more pronounced than it is for trees that have grown in dense, even-aged forest stands (*Fig. 6.59.*). The most characteristic dominating tree species are *Quercus robur*, *Tilia cordata*, *Ulmus glabra*, *Ulmus laevis* and *Fraxinus excelsior*. Sometimes *Pinus sylvestris* or *Picea abies* can dominate (*Fig. 9.3.*), since due to permanent grazing well-established and stable grasslands have historically existed on different soils (Ramans, 1958). However, in practice, permanently unmanaged situations with dominance of coniferous trees are usually included in variant 9010*_2 of *Western taiga*, if they are not located on the edge of a field or do not connect to a larger wooded meadow or pasture. A mixture of different tree species

is possible. Epiphytic mosses and lichens are an important aspect of the vegetation in the layer of forest stand.

Undergrowth layer. Usually, different species of underwood shrubs and trees occur in the habitat – *Sorbus aucuparia*, *Juniperus communis*, *Corylus avellana*, *Malus sylvestris*, *Crataegus spp.*, *Rhamnus catharticus*, *Padus avium*, *Rosa spp*. Unlike closed forest stands, where these trees are usually small and suppressed, in a habitat of good quality they are branchy shrubs with several stems or low leafy trees with relatively thicker stems. Rather frequently separate trees and shrubs have grown tight to old trees of the first layer for a long time. In such cases they are not considered a threat to the existence of old trees. In habitats of a good quality, the projective cover of undergrowth usually is about 10–20%.

Ground vegetation. The ground vegetation in habitats of a good quality is dominated by grassland, but in habitats of poor quality that have overgrown the vegetation that is typical to a forest might dominate. The ground vegetation of this habitat does not have a qualifying significance in habitat determination (EFFN, RDSFNC, 2001), and the grassland structure and species composition can be very diverse. A common feature in all woodland grasslands is the presence of species that are characteristic to forest edges and forest herb communities and are promoted by shading that is created by trees.

Characteristic species: the tree is usually dominated by *Quercus robur*, *Tilia cordata*, *Ulmus glabra*, *Ulmus laevis*, *Fraxinus excelsior*, *Salix alba*, but there also might dominate other species of trees; most often mixed with *Betula pendula*, *Picea abies*, *Pinus sylvestris*, *Populus tremula*. In the underwood layer – *Sorbus aucuparia*, *Juniperus communis*, *Corylus avellana*, *Malus sylvestris*, *Crataegus spp.*, *Rhamnus catharticus*, *Padus avium*, *Rosa spp*. Herb layer can be very diverse, in many cases it is possible to find the following species – *Ficaria verna*, *Briza media*, *Primula veris*, *Orchis mascula*, *Melampyrum nemorosum*.

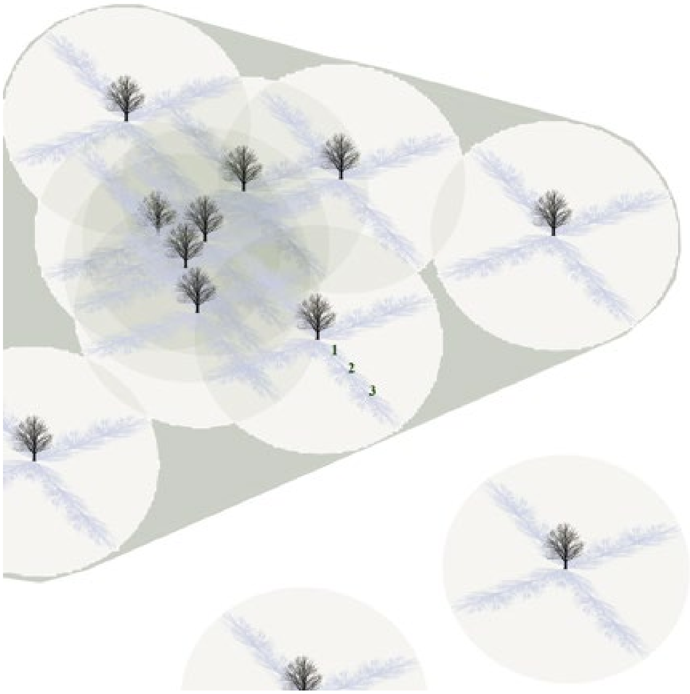


Figure 6.61. Scheme for marking a habitat polygon. Following the principle that circles with a radius triple the height of the tree is drawn around every park-like tree and one polygon includes woodland trees whose circle projections overlap or osculate, the darkest contour in the upper part of the image is used to draw the habitat in a continuous polygon. In the bottom part of the image two isolated trees that are located too far from each other to be included in the habitat polygon, are shown (Photo: V.Lārmanis).

Figure 6.62. Old park-like trees that are suppressed by young birches. Although birches already exceed the height of old trees, this is, and for several decades probably will be, an appropriate and restorable area for the habitat Wooded meadows and pastures 6530*/9070 (Photo: V.Lārmanis).

Umbrella species (typical species within the meaning of the Habitats Directive): *Osmoderma eremita*, *Lyocola marmorata*, *Hapalopilus croceus*, *Xylobolus frustulatus*, *Chaenotheca phaeocephala*, *Orchis mascula*.

Variants: none.

Habitat Quality

Minimum habitat requirements: the main criterion – trees of the characteristic shape of park-like forest stand to sparsely grown trees must occur (*Fig. 6.57., 6.60., 6.62.*). If a grassland can still be found in the habitat, i.e., the situation meets the minimum quality criteria of separating open semi-natural grasslands from forest or shrubs (see the corresponding subchapter of Grassland Habitats), the habitat is marked, if at least five viable park-like trees of the first layer are found. Frequently a habitat can be afforested and located deeper in the forest, but in such cases viable park-like trees must be part of a wider habitat area. In typical cases groups of park-like trees to isolated trees that can be included in a continuous mosaic area acording to the principle indicated in the figure 6.61. and occupy an area of several hectares, can be found. To determine an afforested park-like situation as corresponding to 6530*/9070, its conservation value must be related mainly to elements of old park-like tree and shrub layer, other than the layer of trees and shrubs that has established during overgrowing. The principle for determining habitat borders is displayed in figure 6.61. and is defined in the description of the habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands.*

Minimum quality threshold for overgrown 6530* (9070) or separation from forest habitats: separation of afforested *6530*/9070 Wooded meadows and pastures* from forest habitats is inevitably related to the issue of which nature conservation values will be the future priority – should a stable forest habitat be allowed to form instead of the old wooded meadow or pasture or it would be more appropriate to reconstruct the ancient cultural landscape. However, in practice, the decision on whether 6530*/9070 or none of the habitats of EU importance should be mapped is encountered more frequently than the matter of choosing between mapping a forest habitat of EU importance or habitat 6530*/9070, since the majority of ancient woodland situations have been overgrown by stands of young to medium grey alder, birch, aspen or pine trees, and the density of old park-like trees is relatively low, thus formation of a forest habitat of EU importance in the foreseeable future cannot take place (Lārmanis, 2012). Frequently during the initial mapping it is not possible to address the issue of the most appropriate future scenario of a site, since more detailed and extensive evaluation of the situation is required that would include information that is not known in the initial field works. Bearing in mind that a reassessment can follow, where detailed comments on the specific situation are useful, already during the initial habitat mapping a decision should be made whether the area should be mapped as habitat 6530*/9070 or a forest habitat of EU importance. The decision on whether a forest habitat of EU importance or 6530*/9070 *Wooded meadows and pastures* should be mapped, should be based on the conclusion on the man nature conservation value of the habitat in the particular situation. Could the value that is related to a stable forest environment or to an ancient park-like habitat and trees that have formerly grown in a more open situation be higher at the time of inventory? It is often possible to follow the age structure of tree vegetation, indicating that the park-like tree generation with a significant age difference is separated from the younger generation of trees. For example, if trees of park-like stands are 150 years old or older, but the age of the majority of the younger trees is below 50, it indicates that before the introduction of the younger trees park-like trees have grown in more sparce conditions for a long time.

The diversity of epiphytic lichens may indicate the time boundary, when the characteristic values of a stable forest environment begin to dominate over the ones that are specific to 6530*/9070. The greatest number of lichen species is found in open wooded meadows, the proportion of species decreases by 25% in areas that have been overgrown for 30 years, but the greatest reduction (52%) is seen in situations that have been overgrown for more than 70 years. While in areas that can be considered oak forests (that have been afforested for more than 70 years even in cases if it has previously been an ancient forest pasture), the number of lichen species increases slightly (Plociņa, 2007). This could indicate that forest stands that have been overgrown for about 70 years are on the border when the values that are typical to the forest environment begin to stabilize and dominate. However this cannot be generalized, as it depends on the individual situation and the compatibility between the old and young tree species in conservation of the values of the same type. For example, 70 year old pines and birches that have developed around park-like broad-leaved trees (*Fig. 6.62.*) that have little in common with the broad-leaved trees in conservation of species diversity are more likely to be less important than the old broad-leaved trees. At the same time a situation with younger broad-leaved trees can be assessed as a forest habitat that is permanently stable and important in biodiversity conservation. Stable situations that are characteristic to forest environment can be recognized by a relatively even tree age structure and a greater diversity of shade and humidity-loving epiphytes on stems of trees of different generations. Guidelines for a sustainable wooded pasture management (Eriksson, 2008) show that woodland habitat restoration is usually not performed in areas that have been unmanaged for more than 50 years, but it is also noted that situations must be assessed in relation to specially protected species that occur in each case. Addressing the issue of what is the border until which overgrown wooded meadows or pastures can be restored, it has been concluded in studies in Estonia that even 60 years after management abandonment and afforestation of habitat specific light demanding species that are characteristic to grassland can be identified in the forest, therefore a set of different indicators must be taken into account when deciding on reconstruction of an area (Palo et al. 2013).

Structural indicators:

Proportion of ground vegetation that is characteristic to grassland versus the habitat area – in a habitat of excellent quality the majority of ground vegetation is occupied by a vegetation that is characteristic to grasslands.

Expansive trees that are higher or are of the same height as the park-like tree layer – when wooded meadows or pastures afforest, the youngest trees eventually reach the height of old park-like trees and often exceed it. They suppress park-like trees by growing into their crowns or outgrowing them, creating a situation when park-like trees are found in the shade of the canopy (*Fig. 6.63.*). This overgrowth shades tree stems, threatening light demanding epiphytic species and suppresses the characteristic herb layer. The larger is the area of the habitat that is occupied by this overgrowth, the porrer is its quality.

Figure 6.63. Expansive undergrowth has been removed around a woodland oak tree, but the old tree is still suppressed by the young pine trees. The next step in conservation of the old tree is cutting of the young trees in a sufficiently wide line to provide suitable amount of light that could reach the crown of the old tree and it could exist in a long-term (Photo: V.Lārmanis).

Expansive undergrowth – when a habitat afforests, the thickness of undergrowth also increases. This overgrowth shades stems of park-like trees, suppressing light demanding epiphytic species and the characteristic ground vegetation. The larger is the area of the habitat that is occupied by this overgrowth, the porrer is its quality. It should be taken into account that also relevant undergrowth occurs in wooded grasslands. It must be separated from the expansive undergrowth that has established as a result of overgrowing of a habitat.

Viable park-like trees – both living and dead, as well as separate dry trees, are found in woodland grasslands. Massive drying of trees indicates poor habitat status.

Grassland quality indicators – same indicators that are important to all grasslands: number of semi-natural grassland indicator species, species saturation in the grassland, expansive species, and invasive species.

Number of specially protected species – together in the forest and ground cover layers indicates a particularly high significance of the habitat in biodiversity conservation.

Natural forest habitat indicator species and habitat-specialist species that are related to park-like trees – characterizes the quality of a park-like stand and its importance in biodiversity conservation.

Function and process indicators:

Management – the habitat can exist in long-term only when grazing or mowing is performed. Regular cutting of inferior trees and shrubs can have a positive role, but it is not enough if grazing or mowing is not performed simultaneously.

Area – the importance of the habitat in biodiversity conservation increases by the size of its continuous area.

Restoration potential and quality improvement indicators: evaluation of restoration possibilities are similar to grassland habitats. According to the labour-intensity, three levels of difficulty can be distinguished in restoration possibilities of overgrown/unmanaged habitats depending on overgrowing of the habitat:

– expansive trees and scrubs that are as tall as as the 1st layer of crowns of park-like trees + expansive trees and scrubs that reach the height of the 1st layer of crowns of park-like trees must be cut and removed + permanent management must be restored;
– expansive trees and shrubs that reach the height of the 1st tree crown layer of a park-like trees must be cut and removed + permanent management must be restored;
– permanent management must be restored.

Economic opportunities for restoration and regular habitat management have an additional importance. It is indirectly shown by remoteness of a habitat, its position adjacent to currently cultivated agricultural land as well as management type.

Threats: habitat is threatened by abandonment or too low intensity of management (grazing, mowing) (Eriksson, 2008); significant problems are interruptions in the age structure of tree stands, i.e., often the trees of medium age or young trees that could substitute old hollow trees in a long-term are missing, as well as absence of dead wood (Eriksson, 2008). Occasionally a complete or partial cutting of park-like tree stands and its pertaining undergrowth takes place, especially in afforested situations. A particular problem in a close proximity to waters is beaver activity – they chew woodland trees up to a point where they lose their viability; often trees die because burrows are established underneath their roots. It is possible that cutting of expansive trees and shrubs in the habitat activates beaver activity and concentrates it on park-like trees (Vilka, 2007). Currently, the only known effective method for the protection of park-like trees from beavers is a timely protection of potentially endangered trees by placing metal mesh on the lowest part of tree stems.

Management: grazing, hay-cutting or a combination of grazing and mowing are appropriate management methods. A part of the traditional management has been cutting of individual park-like trees and shrubs or their branches for their further use of household purposes. Managed landscape must be mosaic, where small copses of trees of appropriate density (bright enough, sparse conditions) are interspersed with open forest glades; presence of various flowering trees is necessary as availability of nectar and pollen must be provided for insect species that inhabit the old trees (Eriksson, 2008). In areas where the habitat is afforested, initially landscape reconstruction is necessary – it can be performed by cutting expansive trees and scrubs (Eriksson, 2008). If grazing of the habitat is not possible or it is not intensive enough to completely restrict repeated overgrowing of the habitat, periodical cutting of expansive trees and scrubs can be implemented as a temporary solution to maintain the necessary conditions.

Similar habitats: it may be difficult to distinguish afforested 6530*/9070 from several forest habitats. Domination of the conservation value that either belongs to park-like forest stand or a forest is the determininant factor. References on viewing such cases have been provided in the previous subchapter – Minimum habitat requirements. Grazing in forests has been distributed in very diverse forest types (Ramans, 1958), thus indistinct situations can be related to almost all types of forest habitats of EU importance – most frequently 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli* along large rivers, 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes.*

Overlap with other habitats of EU importance: as a vegetation complex, which includes open grasslands; habitat may also overlap with different grassland habitats of EU importance.

Corresponding specially protected habitats in Latvia: 3.20. Wooded meadows.

Literature

Aizsargājamo ainavu apvidus „Ziemeļgauja" dabas aizsardzības plāns (2007) I.Vilkas red. Rīga, Latvijas Dabas fonds, 173. lpp.

Anon. (1997) Johana Kristofa Broces kolekcija „Sammlung verschiedner Liefländischer Monumente ...". Digitālais arhīvs. Latvijas Akadēmiskā bibliotēka, http://www3.acadlib.lv/broce/

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 144.–145. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Dabas lieguma „Pededzes lejtece" dabas aizsardzības plāns (2007) I.Roves red. Rīga, Latvijas Dabas fonds, 67. lpp., http://www.daba.gov.lv

Dumpe, L. (1999) Meža ganību izmantošana jaunos laikos. Grām.: Latvijas mežu vēsture līdz 1940.gadam. WWF – Pasaules Dabas fonds, 305.–358. lpp.

Ek, T., Johannesson, J. (2005) Multi-purpose management of oak habitats. County administration of Östergötland. 97 p.

Eriksson, M.O.G. (2008) Management of *Natura 2000* habitats. 9070 Fennoscandian wooded pastures. European Commission

Estonian Fund for Nature, Royal Dutch Society for Nature Conservation (EFFN, RDSFNC) (2001) The inventory of semi-natural grasslands in Estonia 1999-2001. The final report.European Grassland Report Nr.6. Tartu, Estonia 52 p.

Interpretation Manual of European Union Habitats. EUR 27 (2007) European Commission, DG Environment, 144 p.

Lārmanis, V. (2012) Parkveida pļavas un ganības aizsargājamo ainavu apvidū „Ziemeļgauja": aktualizēts kartējums un ieteikumi tālākajām darbībām biotopa labvēlīga aizsardzības stāvokļa nodrošināšanai. Atskaite Dabas aizsardzības pārvaldes projektam „Zaļais koridors", 17 lpp.

Leppik, E., Saag, L. (2006) Poster: Epiphytic lichen flora in wooded meadows of Estonia. Institute of Botany & Ecology, University of Tartu, Lai St. 38, 51005 Tartu, Estonia. http://www.nordiclichensociety.org/Excursions/2006_ Nordplus/talks/Leppik_poster.pdf

Palo, A., Ivask, M., Liira, J. (2013) Biodiversity composition reflects the history of ancient semi-naturalwoodland and forest habitats – Compilation of an indicator complex for restoration practice. Ecological Indicators 34, 336–344 p.

Plociņa, J. (2007) Epifītisko ķērpju monitorings uz ozoliem parkveida pļavās un ozolu mežos Ziemeļgaujas aizsargājamo ainavu apvidū. Nepublicēta atskaite. 20 lpp.

Ramans, K. (1958) Vidzemes vidienas ģeogrāfisko ainavu tipoloģija. Pielikums kandidāta disertācijai. Pētera Stučkas Latvijas Valsts universitāte Ģeogrāfijas fakultāte, 359 lpp.

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

Rūsiņa, S. (2008) Dabisko zālāju atjaunošanas pasākumu ietekme uz veģetāciju aizsargājamo ainavu apvidū „Ziemeļgauja". Grām.: Aktuālā savvaļas sugu un biotopu apsaimniekošanas problemātika Latvijā. Red. A.Auniņš, Rīga, Latvijas Universitāte, 57.–72. lpp.

Sverdrup-Thygeson, A., Skarpaas, O., Ødegaard, F. (2010) Hollow oaks and beetle conservation: The significance of the surroundings. - Biodiversity and Conservation 19, 837–852 p.

Teļnovs, D. (2005) Lapkoku praulgrauža Osmoderma eremita (SCOPOLI, 1763) sugas aizsardzības plāns. Rīga, Latvijas Entomoloģijas biedrība, 100 lpp.

UNESCO World Heritage Centre (UNESCO WHC) (1992-2013) Wooded meadows (Laelatu, Kalli-Nedrema, Mäepea, Allika, Tagamoisa, Loode, Koiva, Halliste), submitted by Estonian Seminatural Community Conservation Association, Date of Submission 06/01/2004. United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage tentative list. http://whc.unesco.org/en/ tentativelists/1854/

Vasiļevskis, A. (2007) Lopu ganīšana valsts mežos. Grām.: Latvijas valsts mežu apsaimniekošana 1918–1940. Red. A.Vasiļevskis, Rīga, SIA Nacionālais apgāds, 303.–304. lpp.

Vera, F. (2000) Grazing ecology and Forest history. Wallingford: CABI Publishing, 506 p.

Vera, F. (2006) Oak behaviour in relation to large herbivores. The Oak – History, Ecology, Management and Planning. Proceedings from a conference in Linkoping, Sweden, 9–11 May 2006.


Photo: M.Pakalne

7. MIRE HABITATS

A mire is an area of land surface, which is characterized by persistent or prolonged humidity, specific plants, as well as the formation and accumulation of peat, however there are cases when layer of peat in mire can still be undeveloped. It is possible to distinguish minerotrophic and ombrotrophic mirs. Minerotrophic (fens and transition mires) mirees receive nutrients mainly from groundwater, while ombrotrophic (raised bogs) mires receive water and nutrients mainly from precipitation. Fens containing a high concentration of calcium can be distinguished as calcareous fens in a broad sense.

Distribution

As Latvia's environmental conditions are suitable for mire development, it is possible to find mires in the whole territory of Latvia. Moderate climate in which amount of precipitation exceeds evaporation, slightly undulated relief and the clayey sediments with low permeability in depressions, as well as the nature of hydrological regime are the factors that have contributed to the formation and development of mires in Latvia (Kalniņa, 2008). However, distribution of mires is uneven and generally associated with lowlands and plains. Most mires, as well as the largest mires are located in the Eastern Latvia Lowland, northern part of the Middle Latvia Plain and in the Tīreļi Plain (*Fig. 7.1.*). In Latvia, largest areas are occupied by raised bogs and transition mires, but fens occupy smaller areas. Fens are mostly located in the Coastal Lowlands and the Latgale Uplands. Springs and springfens are very rare in the whole territory of Latvia; their distribution is mainly determined by geological conditions of the site. The largest concentration areas of springs are associated with ancient river valleys and segmentation of relief in them – ravines and slopes of the hills. There is no exact data about the area that is occupied by mires because former studies have been related to the inventory of peat deposits, but not all deposits of the peat are mires in the scientific meaning of the term. According to rough estimates, mires occupy 4.9% of the total territory of Latvia or 316 900 ha (Conservation status of.., 2013).

Conservation value of mires

Comparing to the past and present distribution of mires in the continents, areas of mires have mostly decreased in Europe

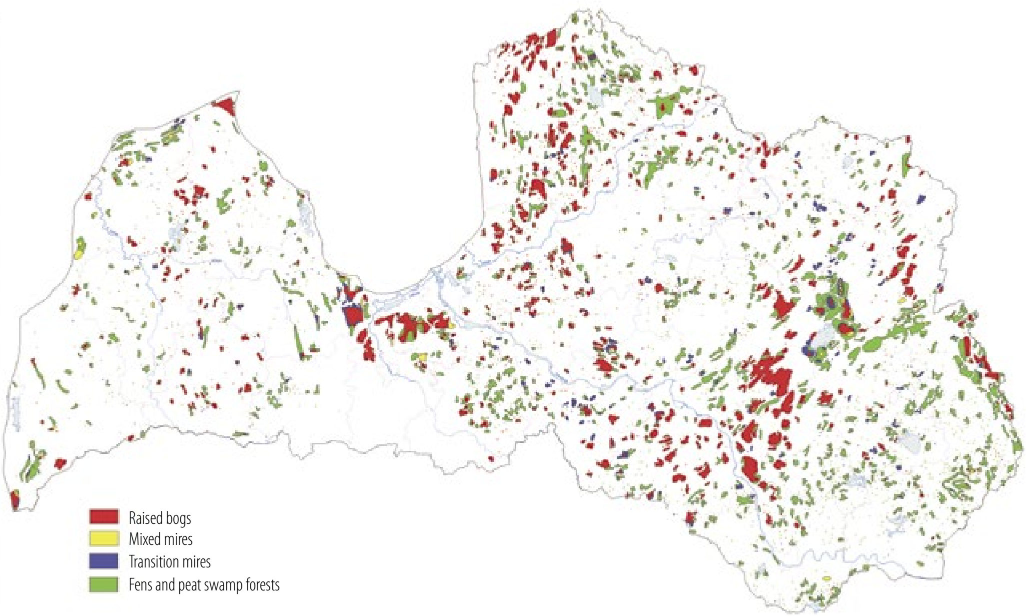


Figure 7.1. Mires and deposits of peat in Latvia (Author: A.Lācis).

(Raeymaekers, 1998). This is the basis of protection of all types of mires in the European Union. In majority of the older member states of the European Union, mire areas have been reduced by an average of 90%, except for Sweden, where areas of mires have decreased by 35% from the former area of mires (Raeymaekers, 1998). In Latvia, the area of mires has decrease significantly since the beginning of the 20th century, when ambitious exploration of mires and peat deposits began. It was followed by conversion of mires into lands of intensive agriculture and peat extraction. The greatest decrease in mire area was between 1960 and 1980 (Šņore, 2004), when extraction of peat in Latvia exceeded 4 million tons per year.

All types of mires found in Latvia comply with one of the habitats of the Annex I of the EC Habitats Directive, except of transition mires poor in species that are located outside quaking bogs. Importance of mires in nature is mainly related with the functions of mires. One of the main functions of a mire is to capture and store carbon, as well as formation of hydrological conditions and local climate of an area. Mires in the river basin reduce maximum flow rates of flood and rain. In addition, mires are an important resting place for migratory birds. Fens previously were significant agricultural lands as they were also used for grazing and hay production. Spring water is used in medicine and food; there are stories and legends related to them.

Environmental factors

Mire formation and existence is mostly affected by relief and climate as well as clayey deposits at the bottom of depressions and hydrological regime. Natural intact mire habitats are constantly wet, they often contain surface waters. Temperate climate and predominance of precipitation over evaporation contributes to the formation and accumulation of peat. Plants growing in mires have adapted to low availability of nutrients, particularly the amounts of phosphorus and nitrogen, therefore an increased inflow of nutrients from the surrounding areas can have a negative impact on the distribution of species that are typical to mires.

Figure 7.2. A mire that has overgrown with trees and shrubs, that can be distinguished as habitat 7140 *Transition mires and quaking bogs*. Vegetation that is characteristic to transition mires can be found in mosaic type distribution (Photo: B.Bambe).

Processes with a functional role

Natural process that is important to all mire habitats is formation and accumulation of peat, which is determined by appropriate hydrological and climate conditions. In Latvia, average peat growth rate per year is approximately 1 mm. It is the smallest in spring habitats, but the highest – in raised bogs. An important factor is succession of mires, when fens gradually transform into transition mires and then raised bogs, as well as the formation of mires duringterrestrialization process. Intact or relatively intact mire habitats are permanently waterlogged and natural disturbances are not typical. Natural fires in Latvian climatic conditions in intact mires occur very rarely, thus plant species and vegetation in general, as well as animal species, have not adapted to frequent burning. Anthropogenic factors play a significant role in conservation of fens (including 7230 *Alkaline fens*), as well as springs (7160 *Fennoscandian mineral-rich springs and springfens* and 7220* *Petrifying springs with tufa formation* (*Cratoneurion*)), if they are in the grasslands or fens; they are positively affected by appropriate management of each type of mire vegetation – mowing and extensive grazing. Permanent discharge of groundwater is important for spring habitats (7160, 7220*).

Vegetation and mire microtopography

In order to identify mire habitat in nature, this manual provides description of vegetation and microtopography of each habitat. Microtopography. The most explicit structures are present in intact or relatively intact raised bogs (7110 * *Active raised bogs*) – of bog pools and hollows, linear ridges and up to 50 cm high hummocks. Often it is possible to find hummocks, pools and hollows also in transition mires and fens, but only in raised bogs the surface pattern is so well expressed. However, these mire structures are not present in all raised bogs. Pools and hollows can start to form only if the peat layer is thick enough, the bog dome has established and when the pressure on slopes of dome increases. Only then the upper layers of peat, under the influence of gravity, slides on the slope of dome, and deep cracks are formed in the peat layer. Formation of such mire structures shows that raised bog has reached the maturation stage of raised bogs (Zelčs et al., 1989; Zelčs, 1994). In raised bogs or parts of bogs that have been affected by drainage mainly hummocks overgrown with dwarf shrubs are present.

Vegetation. There are two main layers in mires – moss and herb layer. Layers of trees and shrubs in intact or relatively intact mires are sparse or absent, with an exception of springs and springfens (7160, 7220*), that can be found in the forest.

Characteristic species

Compared to mires of Central and Western Europe, geographical location of Latvia determines differences between distribution and ecology of mire plant species and plant communities. Thus descriptions of mire habitats in Latvia include species that are mentioned in the definition of habitat and also those that are typical to Latvian mires. Most often each description provides several characteristic species that are not included in the Interpretation manual of European Union habitats (Interpretation manual.., 2013), but that are found in the corresponding habitat elsewhere in the Europe and in Latvia's conditions they are necessary for identification of the habitat.

Habitat Quality

It is not always possible to directly evaluate the quality of mire habitats, therefore indicators are used that indirectly point to some parameters of structure and function. For assessment of habitat quality of mires, it is advisable to use aerial photographs and topographic maps in which it is possible to clearly see overgrown areas and the network of ditches. Introductory chapter lists only common indicators of all mire habitats, but the specific structure and function indicators are mentioned in the description of each habitat. The most important indicators to distinguish the forest habitats from mire habitats (except for 7160 and 7220*) is the average height of tree layer which is less than 5 m, as well as specific plant species and plant communities (*Fig. 7.2.*).

Structural indicators:

Cover of moss layer. In mires (except springs and springfens, where this parameter is not so important) – the larger the layer of moss cover, the better the quality of the mire.

Amount of specially protected species. The value of mire is greater when there is a lot of rare and specially protected species, as their presence often indicates a high quality of the habitat.

Cover of trees and shrubs. The layer of trees is an essential habitat structure of the two mire habitats, if they are in the forest – 7160 *Fennoscandian mineral-rich springs and springfens* and 7220* *Petrifying springs with tufa formation* (Cratoneurion). To other mire habitats – the larger is the overgrowth of trees and shrubs, the lower the quality of mire (it creates shade, evaporation increases, competition, etc.).

Expansive species. Expansive species are native herbaceous plant (seldom moss) species that are found in mires, but their proportion in vegetation is small. When management ceases or when the environmental conditions change, they rapidly proliferate, wins the competition with characteristic mire species and start to dominate until they establish a persistent mono-dominant stands of one or several species. Therefore; the higher the proportion of these species in the vegetation, the lower is the quality of habitat.

Invasive species. Invasive species are alien herbaceous plant or moss species that have a tendency to proliferate rapidly and displace native species. Natural mires are highly resistant to alien species, so the appearance of these species indicates that the quality of the mire is lower.

Characteristic species. The greater the number of characteristic species in the habitat, the habitat quality is more likely to be higher.

Umbrella species. Distribution of these species or groups of species or high incidence of habitat shows excellent habitat quality. However, disappearance of species provides evidence on significant structural and functional changes of the habitat.

Function indicators: Mire functions are, primarily, indicated by the quality of structures. However, there are several function indicators that can be defined by other features.

Indicators of influence on mire hydrology. Wet conditions are among the most important factors in ensuring the quality of the habitat. Even minor deviations from the average indicators (in the direction of getting dryer/drying out) may contribute to

Figure 7.3. Habitat 7220* Petrifying springs with tufa formation (*Cratoneurion*) (in the middle of the picture) in Puzuri Ravine, Kandava (Photo: A.Opmans).

habitat degradation. The most important indicators for negative changes of hydrological regime are activities of drainage (ditches), occasionally - activity of beavers.

Area of the habitat. The larger the area, the more explicit are the features of the habitat – it can support more species, habitat has a greater role in the regulation of hydrological regime, etc.

Contact zones with natural habitats. If mire habitat is surrounded from all sides by natural habitats, its hydrological regime is more natural, as well as it is less likely that expansive and invasive species will establish in it.

Indicators of restoration possibility and quality improvement: For all mire habitats that meet the minimum quality requirements, quality improvement is possible, but the degree of difficulty can vary depending on three key indicators.

Structure and function restoration options that are measured by status of mire structures and functions. Structure restoration in mires mainly includes thinning out of trees and shrubs in the overgrown parts of mire and/or restoration of mowing or grazing in fens. Meanwhile, in mires that have been influenced by drainage it is necessary to restore the functions of marsh, i.e. restoration of hydrological regime as close to the natural state as possible.

Visual evaluation of restoration and quality improvement costs. It is necessary to evaluate whether and what mire restoration or quality improvement measures are required in the field conditions. More complex restoration measures (e.g., installation of dams in ditches) present higher expected costs.

Degree of habitat fragmentation. The further away from each other is location of any of the mire habitats, the higher is the degree of fragmentation and there is a larger risk that there is no gene exchange. Therefore, the species may be at risk of local extinction and habitat quality is lower. Specific details are listed on any given habitat. Anyhow, it is necessary to evaluate whether the quality improvement is needed and whether it is possible. It is not possible to restore mires that were used for extraction of peat as the active upper layer of peat formation – acrotelm – is destroyed, however by raising water level in them, it is possible to achieve establishment of characteristic mire plant species if there is mire-specific vegetation near it (Money, Wheeler, 1999; Sliva, Pfadenhauer, 1999). It is not possible to restore drained mires in such condition as they were before drainage. However, when carrying out drainage mitigation measures, it is possible to achieve that proportion of mire vegetation gets closer to the natural ratio. The measures include hydrological surveys in mires, building of dams, monitoring of groundwater level and vegetation (Bergmanis et al., 2002; Pakalne, 2008). These measures require large financial and human resource investments, and after their implementation regular investments for dam maintenance are required. In some cases it is possible to observe that influence of drainage is also decreasing as beavers create dams in mire drainage ditches. In addition to the drainage mitigation measures, it is recommended to cut out trees and shrubs.

Threats

Direct threats

Traditionally, mires in Latvia and other parts of the world are mainly used for peat extraction. In Latvia, there are 330 million tons of peat resources for industrial use (Šņore, 2004). Largest amount of peat in Latvia was extracted during the period from 1950s–1980s; however, there there was an explicit drop in the 1990s, but in the recent years the peat extraction is about 1 million tonnes of peat per year. By extracting peat, mire is destroyed.

Draining results in decreased groundwater level, which results in gradual changes of natural structures of raised bog – pools and hollows disappear. Consequently, vegetation also changes – cover of dwarf shrubs inclreases, while the cover of bog-mosses decreases. As a result of intensive drainage, peat mineralization begins and formation of peat stops. Drier growing conditions are favourable for the development of trees and layer of trees form in mires. In Latvia overgrowing of raised bogs by trees and reduction of areas of bog pools and hollows over the past 50–60 years has likely substantially reduced the population size of birds nesting in mires. There are very few mires in Latvia that are not affected by drainage. Most of the mires can be considered to be relatively intact, but still in the periphery of these mires it is possible to clearly see the effects of drainage. It is possible to observe that in many 7110* *Active raised bogs* influence of drainage has gradually decreased, as drainage ditch systems have not been maintained for a long time, and often the groundwater level is close to the natural level of mire due to beaver activity. Fens and transition mires (including 7230 *Alkaline fens*, 7140 *Transition mires and quaking bogs*) are more sensitive to drainage, since they occupy smaller area and peat layer in them on average is more shallow than in raised bogs. Therefore, fens and transition mires overgrow with trees and shrubs more quickly than raised bogs. As a result of drainage, purple moor-grass often starts dominating in the habitat – it can grow in areas with high periodic groundwater fluctuations that are characteristic to drained mires.

Mires are affected by <u>fires.</u> Most often fires affect the mires that have been influenced by drainage, but sometimes they also occur in unaffected and relatively intact mires. In the drained mires influence of fire is greater than in the undisturbed – deeper layer of peat burns out and burning of mire takes place in larger areas. After the fire, several species of annual plants that are not typical to mire can temporarily establish in them, as well as birch trees can establish there.

<u>As a result of beaver activity,</u> mires, including springs, can be flooded. It is unknown how the mire development in such areas takes place after water level is lowered.

<u>Influence of recreation.</u> Nowadays, construction of nature trails is becoming increasingly popular; nevertheless it can also cause a number of adverse effects. Negative impacts of recreation are trampling of vegetation, influx of nitrogen in natural habitats, introduction of atypical species, as well as the waste that is left.

Indirect threats

Nitrogen-rich air pollution can negatively affect mire vegetation, contributing to the introduction of nitrophilous plant species and extinction of species that are typical to mires. There is no evidence in Latvia on changes of mire vegetation as a result of air pollution; however it can be concluded from research that has been performed elsewhere in Europe that it negatively affects quality of mires (Šefferova Stanova et al., 2008). Fertilization of neighbouring areas negatively affect mire vegetation since with groundwater or surface water additional nutrients can be brought into mires, especially nitrogen and phosphorus, which contribute to introduction of nitrophilous plant species and reduction of species frequency that are characteristic to mires. Mires are surrounded by wet forests or are located at lakes, occasionally they are surrounded by dry forests. By changing the surrounding vegetation, vegetation of mire may also change. Deforestation in surrounding wet forests most likely changes the hydrological regime of mire. In springs and

Figure 7.4. Old burning in the habitat 7110* *Active raised bog*, which is now dominated by bog-moss and *Eriophorum vaginatum*. The layer of shrubs consists of sparse *Betula pubescens* (Photo: A.Namatēva).

Figure 7.5. Old burning in a raised bog that has been influenced by drainage (7120), which is now dominated by *Polytrichum juniperinum* and *Andromeda polifolia* (Photo: L.Auniņa).

springfens, which are located in forests, species have adapted to partial shade, and cutting out of trees near springs reduce vitality and distribution of these species. As a result of habitat fragmentation, some native plant species can disappear as there is no gene exchange within species.

Management

Mire habitats 7110* *Active raised bogs* and 7140 *Transition mires and quaking bogs*, as well as most of habitats 7160 *Fennoscandian mineral-rich springs and springfens*, 7220* *Petrifying springs with tufa formation (Cratoneurion)* (*Fig. 7.3.*) do not require management, however, fens and springfens (7230 *Alkaline fens*, 7220*, 7160), that are located in grasslands or fens (*Fig. 7.3.*) require it. In the past, fens, as well as spring fens, if they were located together with fens or grasslands, were often used for hay production and pastures, but nowadays fens in Latvia are managed rarely. Extensive irregular grazing, leaving ungrazed parts of mire or mowing at least once in three years is one of the management requirements for fens. Appropriate management type should be chosen for each fen, taking into account former management of mire and the quality of the habitat. In many fens and transition mires it is necessary to cut out trees and shrubs.

Literature

Bergmanis, U., Brehm, K., Mathes, J. (2002) Dabiskā hidroloģiskā režīma atjaunošana augstajos un pārejas purvos. Grām.: Aktuāli savvaļas sugu un biotopu apsaimniekošanas piemēri Latvijā. Red. O.Opermanis, Rīga, Vides aizsardzības un reģionālās attīstības ministrija, 49.–61. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Danilāns, A. (1994) Avoksnāji. Grām.: Latvijas daba. Enciklopēdija. I sējums. Red. G.Kavacs, 98 lpp.

Danilāns, A. (1994) Avoti. Grām.: Latvijas daba. Enciklopēdija. I sējums. Red. G.Kavacs, 99.–100. lpp.

Indriksons, A. (2008) Gruntsūdens līmeņa monitorings LIFE projekta „Purvi" vietās. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 142.–151. lpp.

Kalniņa, L. (2008) Purvu veidošanās un attīstība Latvijā. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 30.–33. lpp.

Ķuze, J., Priede, A. (2008) Ūdens līmeņa paaugstināšana meliorācijas ietekmētajās Ķemeru tīreļa daļās: paņēmieni un pirmie rezultāti. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 132.–141. lpp.

Latvijas PSR Meliorācijas un ūdenssaimniecības ministrija, Latvijas Valsts Meliorācijas projektēšanas institūts (1980) Latvijas PSR Kūdras fonds, 716 lpp.

Money, R.P, Wheeler, B.D. (1999) Some critical questions concerning the restorability of damaged raised bogs. Applied Vegetetion Science, 2, 107–116 p.

Namatēva, A. (2012) Mikroainavu telpiskā struktūra un to ietekmējošie faktori Austrumlatvijas zemienes augstajos purvos. Promocijas darbs. LU Ģeogrāfijas un Zemes zinātņu fakultāte

Nusbaums, J. (2008) Nosusināšanas ietekmes novēršana augstajos purvos. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 118.–131. lpp.

Pakalne, M. (2008) Purvu biotopi un to aizsardzība. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 8.–19. lpp.

Pakalne, M., Kalniņa, L. (2000) Mires in Latvia. Suo, 51(4), 213–226 p.

Pakalne, M., Kalnina, L. (2005) Mire ecosystems in Latvia. In: Steiner, M. (ed.) Moore – von Sibirien bis Feurland, 147–174 p.

Pakalne, M., Salmiņa, L., Segliņš, V. (2004) Vegetation diversity of valuable peatlands in Latvia. International Peat Journal, 12, 99–112 p.

Piterāns, A. (2002) Latvijas ķērpju saraksts, http://latvijas.daba.lv/scripts/db/saraksti/saraksti.cgi?d=keerpji

Raeymaekers, G. (1998) Conserving mires in the Europena Union. Ecosystems LTD

Salmiņa, L. (2009) Limnogēno purvu veģetācija. Latvijas veģetācija 19, 1.–188. lpp.

Salmiņa, L., Bambe, B. (2008) Apsaimniekošanas ietekme uz purvu veģetāciju. Grām.: Pakalne, M. (red.) Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Latvijas Dabas fonds, Rīga, 152.–157. lpp.

Sliva, J., Pfadenhauer, J. (1999) Restoration of cut-over raised bogs in southern Germany: a comparison of methods. Applied Vegetation Science 2(1),137–148 p.

Šefferova Stanova, V., Šeffer, J., Janak, M. (2008) Management of *Natura 2000* habitats. 7230 Alkaline fens

Šnore, A. (2004) Kūdra Latvijā. Latvijas Kūdras ražotāju asociācija. Rīga. 64 lpp.

Zelčs, V. (1994) Augstā purva mikroreljefs. Grām.: Latvijas daba. Enciklopēdija. 1. sējums. Red. G.Kavacs, 84. lpp.

Zelčs, V., Zelča, L., Markots, A. (1989) Augsto purvu fenomens. Zinātne un Tehnika, 11, 26.–28. lpp.

7110* *Active raised bogs*

Latvian habitat classification: G.3.

Syntaxonomy: *Oxycocco-Empetrion hermaphroditi*, *Sphagnion magellanici*, *Rhynchosporion albae*, *Leuko-Scheuchzerion palustris*.

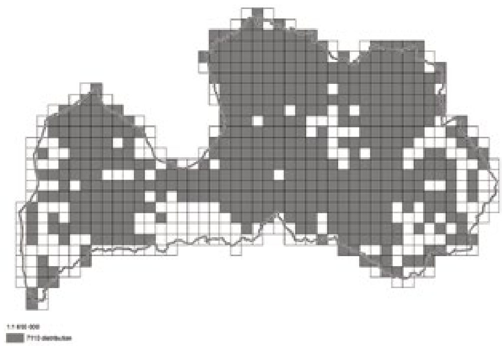


Figure 7.6. Distribution of the habitat 7110* *Active raised bogs* in Latvia (Conservation status of.., 2013).

Definition: acid bogs, ombrotrophic, poor in mineral nutrients, sustained mainly by rainwater, with a water level generally higher than the surrounding water table, with perennial vegetation dominated by colorful Sphagnum hummocks allowing for the growth of the bog. The term "active" must be taken to mean still supporting a significant area of vegetation that is normally peat forming, but bogs where active peat formation is temporarily at a standstill, such as after a fire or during a natural climatic cycle, i.e. period of drought.

Specific characteristics of habitat interpretation in Latvia: none

Distribution: relatively common in the whole territory of Latvia. However, distribution of raised bogs is uneven and generally associated with lowlands and plains. Most of raised bogs, as well as the largest bogs are located in the Eastern Latvia Lowland, northern part of the Middle Latvia Lowland and in the Tīreļi Plain. Approximate estimates suggest that in Latvia habitat 7110* *Active raised bogs* occupies about 266 200 ha or 4.1% of the total territory (Conservation status of.., 2013). There are no accurate data on the area of the habitat in Latvia.

Conservation value: several specially protected plant species can be found only in raised bogs, for example, *Sphagnum lindbergii*, *Sphagnum molle*, *Odontoschisma sphagnii* ([R] - mostly in the western part of Latvia). Important habitat for such specially protected species and plant species as *Betula nana* ([A] - mainly in the eastern and northern part of Latvia), *Trichophorum cespitosum*[R], *Gymnocolea inflata*[R]; bird species – *Tringa glareola*, *Pluvialis apricaria*, *Numenius phaeopus*, *Numenius arquata*, *Gavia stellata*, *Gavia arctica*, *Lanius excubitor*, invertebrate species – *Leucorrhinia albifrons*, *Anax imperator*, *Clossiana frigga*.

Environmental factors and processes with a functional role: formed over a long period of time during land paludification or terrestrialization of relict glacial lakes (Kalniņa, 2008). Water level in raised bogs is high, therefore periodical surface waters are characteristic. Raised bogs are poor in nutrients, since water and nutrients are received mainly from precipitation. Thick layer of peat whose depth can reach more than 10 m, hinders access to nutrients from the mineral soil. An acidic environment (pH 3–4) in raised bogs establishes as a result of *Sphagnum* metabolism and its preservation is promoted by precipitation, which usually has low buffering capacity (Rydin, Jeglum, 2006). In natural conditions with non-disturbed mire and surrounding hydrological regime, raised bogs are open, and a sparse layer of trees or shrubs with *Pinus silvestris* is found only in the periphery of mire or on ridges.

Mire microtopography: in large raised bogs there are bog hollows, pools and low ridges and hummocks up to 50 cm in height l. In small bogs more often it is possible to find only few of structural mire microforms. There are differences in raised bog microtopography between raised bogs in western Latvia and bogs elsewhere in Latvia. In raised bogs in western Latvia, mainly complex of mud-bottom hollows and low ridges

Figure 7.7. Complex of bog hollows, pools and ridges in Teiči Mire in spring. Surface water is observed in part of the bog (Photo: A.Namatēva).

Figure 7.8. Typical raised bog in the western part of Latvia with a complex of low ridges and mud-bottom pools in Dunika Mire (Photo: L.Auniņa).

is found (*Fig. 7.8.*). Pools and bog lakes are few there or they are absent. Complex of ridges and hollows has an irregular surface pattern. While in the eastern and northern parts of Latvia in raised bogs complex of ridges and hollows form concentric or eccentric surface pattern and bog pools and lakes are common there. High hummocks are often found. Patterned raised bogs are often found in these parts of Latvia, especially in 200–300 ha large raised bogs of Northern Vidzeme (Zelčs, 1994; Zelčs et al., 1989). Many raised bogs there host complex of ridges with trees and bog pools and lakes (*Fig. 7.10.*). Surface pattern of raised bogs are best seen in aerial photographs. The above-mentioned structural differences can be seen in large raised bogs, which have an area of at least several hundred hectares. In the largest relatively intact or intact raised bogs it is also possible to find areas of bare peat, which concentrate on the slope of domes – areas where an active formation of mire microforms is taking place.

Vegetation characteristics in intact raised bogs two vegetation layers are well developed – layers of herbs and mosses, and moss layer is dominated by *Sphagnidae*. Lichens are mainly found on *Sphagnum* hummocks. In bogs or their parts that are not affected by drainage there is no layer of trees and shrubs or it is poorly developed. Bog margins and areas around islands of mineral soil are an exception, where even in intact bogs there will be a sparse layer of trees and shrubs as in these areas the peat layer is shallower. Trees and shrubs can also be located on ridges. Habitat also includes parts of raised bog, where it is possible to find *Eriophorum vaginatum – Sphagnum spp.* communities. This habitat also includes raised bogs that are little affected by the drainage, where drainage impact is limited and current natural processes in bogs or parts of them are favourable for the development of mire. Mire structure – layer of trees is absent or it is very sparse and there are trees with small annual increments, rounded tops, moss layer is dominated by living bog-mosses and dwarf shrubs are not the dominant life form there.

Characteristic species: <u>species of hummocks and ridges</u> – *Calluna vulgaris*, *Eriophorum vaginatum*, *Chamaedaphne calyculata* (in the eastern and northern part of Latvia), *Andromeda polifolia*, *Oxycoccus palustris*, *Empetrum nigrum*, *Rubus chamaemorus*, *Drosera rotundifolia*, *Sphagnum magellanicum*, *Sph.fuscum*, *Sph.rubellum*, *Sph.angustifolium*, *Mylia anomala*, *Kurzia pauciplants*, *Cladonia squamosa*, *Cladina ciliata var. tenuis*, *C.stellaris*, *C.stygia* (Piterāns, 2002; Pakalne, 2008). <u>Species of pools and hollows</u> – *Rhynchospora alba*, *Carex limosa*, *Andromeda polifolia*, *Oxycoccus palustris*, *Drosera anglica*, *Sphagnum magellanicum*, *Sph.cuspidatum*, *Sph.rubellum*, *Sph. tenellum*, *Sph.majus*, *Sph.papillosum*, *Cladopodiella fluitans*. <u>Birds</u> – *Tringa glareola*, *Pluvialis apricaria*, whimbrel *Numenius phaeopus*, *Numenius arquata*. <u>Invertebrates</u> – *Colias palaeno*, *Fritillary Clossiana euphrosyne*, *Plebejus argus*, *Coenonympha tul-*

lia, *Vaccinia optilete*, *Agonum ericeti* and *Pterostichus rhaeticus*, *Metrioptera brachyptera*, *Actenicerus sjaelandicus*, *Actenicerus sjaelandicus*, *Formica gagatoides,* dragonflies – *Leucorrhinia pectoralis, L.albifrons*, *Anax imperator*, *Agelena labyrinthica.*

Umbrella species (typical species within the meaning of the Habitats Directive): *Rhynchospora alba, Scheuchzeria palustris*, *Carex limosa*, *Sph.cuspidatum, Sph. tenellum, Sph.majus, Sph.balticum, Sphagnum angustifolium.* Birds – *Tringa glareola*, *Pluvialis apricaria*, *Numenius phaeopus*.

Variants: none.

Habitat Quality

Minimum habitat requirements: characteristic plant species and communities of these habitats are dominating in vegetation. Average height of the tree layer is less than 5 m, except for raised bogs with pool-ridge complexes in which average height of pine trees growing on ridges can be 5 m. In the layer of moss *Sphagnum* moss usually occupies more than 80% and dwarf shrubs do not dominate. Massive die back of *Sphagnum* moss is not characteristic; other processes that would indicate degradation of mires do not dominate.

Structural indicators: all indicators that are common to mires. In addition – the proportion of mire area occupied by the bog hollow-hummock complex within the bog. The larger is the area of the complex, the more suitable the mire is for many species that depend on it. The cover of dwarf shrubs is also evaluated – a large cover of small shrubs indicates deterioration of bog quality.

Function and process indicators: all indicators that are common to mires. In addition – the proportion of bog area in which habitat 7150 is gound, since it indicates the diversity of mire microtopography structures.

Restoration potential and quality improvement indicators: indicators that are common to all mire habitats.

Threats: all indicators that are common to mires.

Management: in intact or relatively intact bogs it is necessary to maintain the existing hydrological regime in the bog and its hydrologically-related area. In drained bogs it is necessary to carry out measures for the reduction of impacts of drainage and sometimes to thin out trees and shrubs.

Figure 7.9. Pool in Teiči Mire which can be identified as the habitat 3160 because it is larger than 0.1 ha (Photo: A.Namatēva).

Figure 7.10. Raised bog with bog pool-ridge complex with trees in Purgaiļu Mire – a bog surface pattern often found in northern and eastern part of Latvia (Photo: L.Salmiņa).

Similar habitats: raised bogs that have been slightly affected by drainage, can be similar to habitat 7120 Degraded raised bogs still capable of natural regeneration in which natural restoration is possible or it takes place, but in 7120 influence of drainage and bog degradation processes still continues. In degraded bogs there are few *Sphagnum* mosses and it is possible to often find mesophitic brown mosses, mainly *Pleurozium schreberii, Hylocomium splendens, Dicranum polysetum,* or if there are a lot of bog-mosses, then dwarf shrubs dominate. From the habitat 91D0* *Bog woodlands*, they differ with an average height of trees in bogs, that are smaller than 5 meters, except for complexes of bog hollows and hummocks in which the average height of pine trees growing on hummocks sometimes can be 5 m and more. *Eriophorum vaginatum-Sphagnum spp*. community, if it is located in filling-in lakes can be distinguished as 7140 *Transition mires and quaking bogs*, but in a complex of raised bogs it is included in the habitat 7110* *Active raised bogs*.

Overlap with other habitats of EU importance: none. If pools in raised bogs are larger than 0.1 ha, they are identified as habitat 3160 *Natural dystrophic lakes and ponds.*

Corresponding specially protected habitats in Latvia: none.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

Indriksons, A. (2008) Gruntsūdens līmeņa monitorings LIFE projekta „Purvi" vietās. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 142.–151. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Kalniņa, L. (2008) Purvu veidošanās un attīstība Latvijā. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 30.–33. lpp.

Namatēva, A. (2012) Mikroainavu telpiskā struktūra un to ietekmējošie faktori Austrumlatvijas zemienes augstajos purvos. Promocijas darbs. LU Ģeogrāfijas un Zemes zinātņu fakultāte

Pakalne, M. (2008) Purvu biotopi un to aizsardzība. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 8.–19. lpp.

Pakalne M., Kalnina L. 2005. Mire ecosystems in Latvia. In: M. Steiner (ed.). Moore – von Sibirien bis Feurland, 147–174 p.

Pakalne, M., Kalnina, L. (2005) Mire ecosystems in Latvia. In: Steiner, M. (ed.) Moore – von Sibirien bis Feurland, 147–174 p.

Pakalne, M., Salmiņa, L., Segliņš, V. (2004) Vegetation diversity of valuable peatlands in Latvia. International Peat Journal, 12, 99–112 p.

Piterāns, A. (2002) Latvijas ķērpju saraksts, http://latvijas.daba.lv/scripts/db/saraksti/saraksti.cgi?d=keerpji

Zelčs, V. (1994) Augstā purva mikroreljefs. Grām.: Latvijas daba. Enciklopēdija. 1. sējums. Red. G.Kavacs, 84. lpp.

Zelčs, V., Zelča, L., Markots, A. (1989) Augsto purvu fenomens. Zinātne un Tehnika, 11, 26.–28. lpp.

7120 Degraded raised bogs still capable of natural regeneration

Latvian habitat classification: G.3.

Syntaxonomy: none.

Definition: raised bogs where there has been a disruption (usually anthropogenic) to the natural hydrology of the peat body, leading to surface desiccation and/or species change or loss or they are partially used for extraction of peat. Sites judged to be still capable of natural regeneration will include those areas where the hydrology can be repaired and where, with appropriate rehabilitation management, there is a reasonable expectation of re-establishing vegetation with peat-forming capability within 30 years. Does not include peat extraction areas, as well as areas where perennial nitrophilous vegetation is established. A significant part of vegetation is still formed of species that are typical of mires.

Specific characteristics of habitat interpretation in Latvia: this habitat includes raised bogs or parts of them in which as a result of drainage natural processes that are unfavourable for the existence and development of mires takes place, which is indicated by vegetation parameters described below.

Figure 7.11. A - Raised bog that has overgrown with pine trees and is influenced by drainage, and is dominated by *Calluna vulgaris*, – classified as the habitat 7120 *Degraded raised bogs* still capable of natural regeneration, in which restoration is possible or it already takes place. B - As a result of drainage, the groundwater lavel has decreased significantly in a bbog hollow (Photo: V.Lārmanis).

Distribution: relatively common in the whole territory of Latvia. Distribution is the same as the habitat 7110* *Active raised bogs.* Approximate estimates suggest that in Latvia habitat 7120 *Degraded raised bogs still capable of natural regeneration* occupies about 31 700 ha (Conservation status of.., 2013). There are no accurate data on the area of the habitat in Latvia.

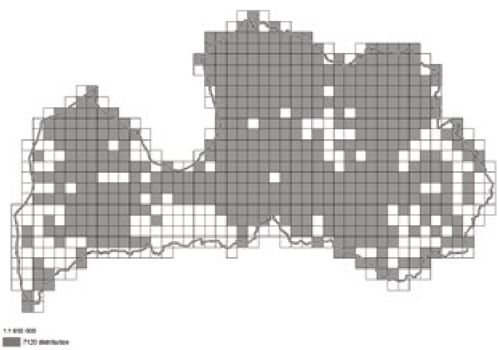


Figure 7.12. Distribution of the habitat 7120 *Degraded raised bogs still capable of natural regeneration* in Latvia (Conservation status of.., 2013).

Conservation value: In Latvia, intact raised bogs, degrad-

Figure 7.13. A part of drainage-influenced raised bog in Ašenieku Mire (Photo: A.Namatēva).

ed raised bogs and neighbouring wet forests form a wetland complex. By eradicating the effect of drainage in raised bogs, negative impact on neighbouring intact or relatively intact raised bogs and hydrological regime of other wetlands is lowered. Habitat conservation value in long-term is the same as for habitat 7110* *Active raised bogs,* as in case of hydrological regime restoration, within time it will transform into 7110*.

Environmental factors with a functional role and succession: origin, factors and succession in restored condition the same as for habitat 7110* *Active raised bogs.* The current condition has occurred as a result of mire drainage, as well as, occasionally, due to lowering of water level in bog lakes. In degraded bogs the average groundwater level is lower than in intact raised bogs, it is characterized by large and sharp fluctuations depending on the amount of precipitation (Indriksons, 2008). In places where drainage systems continue to operate efficiently (usually installed in 1960s–1980s), drainage process continues. In places where drainage systems continuously operate only partially (usually installed until the first half of the 20th century), natural development process of mire quite often begins to dominate over drainage, but it is possible to see previous drainage effects in vegetation – continuous layer of dwarf shrubs, stands of pine trees and birches that have been stimulated by drainage. If restoration of mire groundwater level is performed, the cover of *Calluna vulgaris* can gradually decrease and distribution and cover of plant species typical to raised bogs can increase (Ķuze, Priede 2008; Salmiņa, Bambe, 2008). Fires more often occur in drained mires than in intact mires. Several years after burning, different annual grasses can dominate, as well as cover of *Eriophorum vaginatum* can increase and birches *Betula spp.* can establish. Later on, burning of mire is indicated by *Polytrichum spp.*, birches, large cover of *Calluna vulgaris*, bare dry peat, as well as burned trees, if they were present during the burning.

Mire microtopography and vegetation: degraded raised bogs can have a gradient of vegetation cover from explicit layer of trees to open bog area. Layer of shrubs is sparse to dense or it is absent. Hummocks overgown with dwarf shrubs often dominate in degraded raised bogs. It is possible to find *Sphagnidae*, and *Bryidae*, but there are no hygrophytic bog mosses or they are found very rarely. In drained raised bogs bare dry peat can be found. Lichens are found both on hummocks and on bare peat. Depending on the degree of drainage effect, it is possible to distinguish two types of drainage influenced raised bogs.

1) <u>Raised bogs that are very heavily affected by drainage.</u> In the layer of moss, *Sphagnum* have mostly disappeared, their cover in the concerned area is small, 3–10% on average, but plant species that are typical to raised bogs, for example, *Eriophorum vaginatum*, *Drosera rotundifolia*, *Rhynchospora alba* still are present. Often it is possible to find dead upper parts of *Sphagnum*. The cover of *Sphagnum* is often lower than that of brown mosses. It is often possible to find mesophytic brown moss, mainly *Pleurozium schreberii*, *Hylocomium splendens*, *Dicranum polysetum*. Most of the trees are characterised by relatively large annual increment in contrast to pre-drainage period and sharp top of the tree (*Fig. 7.15.* A). Height of trees can vary, but most frequently their average height is smaller than 5 m. Dominated by one of dwarf shrub species or its complex – *Calluna vulgaris*, *Ledum palustre*, *Vaccinium uliginosum*, *Chamaedaphne calyculata*. Patches of dry bare peat can also be found. Pools are rare and small. Most common *Sphagnum* species – *Sphagnum fuscum*, *Sph.rubellum* and *Sph.angustifolium*.
2) Raised bogs that have been moderately affected by draining or heavily influenced raised bogs where restoration activities have been carried out and there is a tendency

for bog vegetation to recover. Dense continuous stands of dwarf shrubs indicate drainage influence (*Fig. 7.11.* A). It is formed by one of the species of dwarf shrubs or their complex: *Calluna vulgaris*, *Ledum palustre*, *Chamaedaphne calyculata*, *Vaccinium uliginosum*, as well as high frequency of mesophytic moss species such as *Hylocomium splendens* and *Pleurozium schreberi*. *Sphagnum magellanicum*, *Sph.fuscum*, *Sph.rubellum*, and *Sph.angustifolium* are the most common and widespread *Sphagnum* species, and their total cover in some places can be even 80–90%. There are no bog hollows, but if there are any, the water level is remarkably lower than in intact raised bogs there (*Fig. 7.11.* B). Influence of draining in the herb layer can also be indicated by *Molinia caerulea* (*Fig. 7.14.*). The density of the tree stand can vary, but on average it is less than 50%. Most of the trees are characterised by a relatively large annual increment and sharp tops in contrast to pre-draining period (*Fig. 7.15.* A). Height of trees can vary, but their average height is smaller than 5 m. Layer of trees can also be absent (*Fig. 7.15.* B). Layer of shrubs is absent or it consists of *Pinus sylvestris*, *Betula spp.*, *Frangula alnus* of different density.

Characteristic species: trees and shrubs: *Pinus sylvestris*, *Betula pubescens*, *Betula pendula*, seldom – *Picea abies*; dominating dwarf shrubs and herbs: *Calluna vulgaris*, *Ledum palustre*, *Chamaedaphne calyculata* (in the eastern and northern part of Latvia), *Eriophorum vaginatum*; it is possible to often find – *Andromeda polifolia*, *Oxycoccus palustris*, *Empetrum nigrum*, *Rubus chamaemorus*, *Drosera rotundifolia*; seldom – *Molinia caeruela*; moss – *Sphagnum rubellum*, *Sph.magellanicum*, *Sph.angustifolium*, *Sph.fuscum*, *Pleurozium schreberii*, *Hylocomium splendens*, *Dicranum polysetum*, *Polytrichum spp.* (especially in burned raised bogs); lichens – *Cladonia squamosa*, *C.glauca*, *C.chlorophylla* and *Cladina ciliata var.tenuis, C.stellaris*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Calluna vulgaris, Eriophorum vaginatum, Rhynchospora alba, Sphagnum spp.*

Figure 7.14. Raised bog that has overgrown with *Pinus sylvestris* and *Betula pubescens*, that is dominated by *Calluna vulgaris* and *Molinia caerulea* is propagating – classified as the habitat 7120 *Degraded raised bogs* still capable of natural regeneration, since in the layer of moss it is still possible to find *Sphagnum* species and other species that are characteristic to intact raised bogs (Photo: I.Silamiķele).

Figure 7.15. A - in a raised bog that has been affected by drainage it is often possible to find pine trees with large annual increment and sharp tops. B - Open raised bog that has been affected by drainage, which is dominated by dwarf shrubs, cover of *Sphagnum* moss is small – classified as habitat 7120 *Degraded raised bogs* still capable of natural regeneration, in which restoration is possible or it already takes place (Photo: V.Lārmanis (A), L.Auniņa (B)).

When restoring natural hydrological regime in raised bog, cover of *Eriophorum vaginatum*, *Rhynchospora alba* increases, but cover of *Calluna vulgaris* – decreases (Salmiņa, Bambe, 2008).

Variants: none.

Habitat Quality

Minimum habitat requirements: characteristic plant species and communities of these habitats dominate. In the moss layer patches of *Sphagnum* moss must be present and the average height of trees cannot exceed 5 m. *Calluna vulgaris* and *Chamaedaphne calyculata* (in the eastern and northern part of Latvia) or *Ledum palustre* markedly dominate. To ensure hydrological integrity of a raised bog, this habitat also includes parts of drained raised bogs that have overgrown with trees (average tree h>5m), if the territory does not meet the minimum criteria of the habitat 91D0* *Bog woodlands*. This habitat can also include parts of raised bogs in which previously chunk peat was extracted in quarries, if following preconditions are fulfilled 1) in the territory of peat extraction the living upper peat layer – acrotelm – is still present on unused peat strips; 2) peat extraction area borders with raised bog which meet the criteria of habitat 7110* or 7120. For example, Zaļais Mire in Ķemeri National Park.

Structural indicators: of all indicators that are common for mires, only cover of trees, cover of shrub layer and cover of moss layer. In addition, it is necessary to assess distribution of *Rhynchospora alba* or *Eriophorum vaginatum* as these species provide evidence on favourable humidity conditions of mire, as well as cover of dwarf shrub layer that indicates effect of drainage.

Function and process indicators: predominance of the habitat 7110* area over 7120 – the higher it is, the less affected is the hydrological regime of mire; quality of habitat structure as a precondition of functions.

Restoration potential and quality improvement indicators: all indicators that are common to mires.

Threats: all indicators that are common to mires.

Management: it is necessary to reduce the effect of draining, e.g. by dam construction or by filling-in of ditches. In some cases it is essential to thin out trees and shrubs. It is necessary to regularly monitor the condition of dams and, if needed, to repair them.

Similar habitats: can be similar with 91D0* *Bog woodlands*, but unlike the forest habitat, average height of trees in mires that are affected by draining is less than 5 m. The differences between 7110* *Active raised bogs* and 7120 are determined according to the actual vegetation and status of trees.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: none.

Literature

Bergmanis, U., Brehm, K., Mathes, J. (2002) Dabiskā hidroloģiskā režīma atjaunošana augstajos un pārejas purvos. Grām.: Aktuāli savvaļas sugu un biotopu apsaimniekošanas piemēri Latvijā. Red. O.Opermanis, Rīga, Vides aizsardzības un reģionālās attīstības ministrija, 49.–61. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Indriksons, A. (2008) Gruntsūdens līmeņa monitorings LIFE projekta „Purvi" vietās. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds,142.–151. lpp.

Ķuze, J., Priede, A. (2008) Ūdens līmeņa paaugstināšana meliorācijas ietekmētajās Ķemeru tīreļa daļās: paņēmieni un pirmie rezultāti. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 132.–141. lpp.

Nusbaums, J. (2008) Nosusināšanas ietekmes novēršana augstajos purvos. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 118.–131. lpp.

Pakalne, M. (2008) Purvu biotopi un to aizsardzība. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 8.–19. lpp.

Salmiņa, L., Bambe, B. (2008) Apsaimniekošanas ietekme uz purvu veģetāciju. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 152.–157. lpp.

Figure 7.16. Drainage influenced bog margin with *Ledum palustre*, which can be distinguished as the habitat 7120 (Photo: A.Namatēva).

7140 *Transition mires and quaking bogs*

Figure 7.17. Transition mire with *Carex lasiocarpa* at the raised bog margin (Photo: V.Lārmanis).

Latvian habitat classification: G.2., C.1.7.2., C.1.7.3., C.1.7.4., C.1.7.5., C.1.7.6.

Syntaxonomy: *Caricion lasiocarpae*, *Sphagno recurvi-Caricion canescentis*, *Leuko-Scheuchzerion palustris*, *Eriophorion gracilis*, *Magnocaricion elatae*.

Definition: peat-forming communities developed at the surface of oligotrophic to mesotrophic waters, with characteristics intermediate between soligenous and obrogenous types. They present a large and diverse range of plant communities. In large peaty systems the most prominent communities are swaying swards, floating carpets or quaking mires formed by medium-sized or small sedzes, associated with Sphagnum or brown mosses. They are generally accompanied by aquatic and amphibious communities. In the Boreal region this habitat also includes minerotrophic fens that are not part of a larger mire complex, open swamps and small fens in the transition zone between water (lakes, ponds) and mineral soil. This habitat also includes mono-dominant inclusions of *Carex rostrata* stands in coastal quagmires.

Specific characteristics of habitat interpretation in Latvia: includes transition mires in the periphery of raised bogs around mineral soil islands in raised bogs if their area is larger than 0.1 ha, however if they are found in a smaller area then they are considered as component of the habitat 7110* *Active raised bogs.* Also includes transition mires in valleys.

Distribution: relatively rare in the whole territory of Latvia and usually occupy small areas. Approximated estimates suggest that in Latvia habitat 7140* occupies about 8 500 ha or 0.13% of the total territory of Latvia(Conservation status of.., 2013). There are no accurate data on the area of habitat in Latvia.

Conservation value: the only habitat for several specially protected plant species, for example, *Hammarbya paludosa*, *Malaxis monophyllos*, *Saxifraga hirculus*, *Carex heleonastes*, *Hamatocaulis vernicosus*, *Hamatocaulis lapponicus*, *Calliergon richardsonii*. Important habitat for such specially protected species as *Liparis loeselii*, *Dactylorhiza incarnata*, *D.maculata*, *D.russowii*, *Salix myrtilloides*, *Meesia triquetra*, *Scapania irrigua*, *Sphagnum obtusum.*

Environmental factors and processes with a functional role: the habitat is found in small and medium-sized filling-in lakes, bays of large lakes, in the periphery of raised

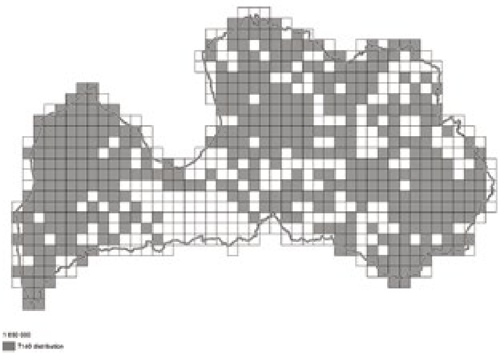


Figure 7.18. Distribution of the habitat 7140 *Transition mires and quaking bogs* in Latvia (Conservation status of.., 2013).

Figure 7.19. Transition mire formed in process of filling-in of alake distinguished as 7140 *Transition mires and quaking bogs* (Photo: L.Auniņa).

Figure 7.20. Floating rafts of *Menyanthes trifoliata* and *Carex spp.* is a part of limnogenous mires and also can be distinguished as the habitat 7140 *Transition mires and qua*king bogs (Photo: L.Auniņa).

Figure 7.21. Partly overgrown transition mire with *Trichophorum alpinum* - meets the criteria of 7140 *Transition mires and qua*king bogs (Photo: D.Marga).

Figure 7.22. In dystrophic or dyseutrophic lakes habitat 7140 can be formed only of a thin line of bog moss and *Eriophorum vaginatum.* Most often narrow, species-poor quaking mires establish as a result of lowering of lake water level (Photo: L.Auniņa).

bogs or near mineral soil islands in raised bogs, occasionally - in interhill depressions. The main precondition for the existence of habitat is high water level with small annual fluctuations. Transition mire peat is usually acidic to moderately alkaline and contain little amount of nitrogen and phosphorus. Average pH of the soil usually is 4.5–5.5 (Pakalne, 2008). In limnogenous mires poor and/or rich fen vegetation can be found. In natural conditions, transition mires are open habitats are plain with a sparse layer of trees and shrubs on the mire margins. The thickness of peat can be reach meters or there might be no layer of peat in the early stages of lake terrestrialization. Formation of mire, when lakes overgrow and fill-in, is a natural process, but if water that is rich in nutrients flows into the lake or water level of lake is significantly lowered, overgrowing of the lake is faster. It often causes development of species-poor vegetation.

Vegetation characteristics: The above-mentioned environmental factors determine that the habitat is dominated by plants of open, moist to excessively wet, poor in nitrogen, acidic to moderately alkaline soils. Layer of trees usually is absent or it consists of sparse *Pinus sylvestris*, *Betula spp.*, *B.pendula*. Layer of shrubs consists of sparse pine trees, *Frangula alnus*, *Betula humilis* and *Salix spp.* Explicit layer of herbaceous plants and mosses. Lake Limnogenous mires are dominated by *Bryidae* or *Sphagnidae*, while in the transition mires that are located in the periphery of raised bogs or near islands and in interhill depressions – *Sphagnidae.* Therefore in the filling-in lakes this habitat can consist of fen and transition mire communities. Mire surface is flat or with hummocks.

Characteristic species: dominating herbaceous plants – *Carex rostrata*, *C.lasiocarpa*, *C.limosa*, *Rhynchospora alba*, *Eriophorum vaginatum*, *Trichophorum alpinum*, *Thelypteris palustris*; species with high frequency – *Oxycoccus palustris*, *Comarum palustre*, *Menyanthes trifoliata*, *Eriophorum polystachion*, *Carex chordorhiza*, *Calla palustris*, *Peucedanum palustre*, *Equisetum fluviatile*, *Andromeda polifolia*, *Drosera rotundifolia*, *Drosera anglica*, *Dactylorhiza incarnata*, *Dactylorhiza maculata*. Dominating moss species – *Sphagnum flexuosum*, *Sph. fallax*, *Scorpidium revolvens*, *Hamatocaulis vernicosus*, *Cinclydium stygium*, *Calliergonella cuspidata*; common moss species – *Straminergon stramineum*. Invertebrates – *Clossiana euphrosyne*, *Coenonympha tullia*, *Vaccinia optilete*, *Mecostetus grossus*, *Culicoides spp.*, *Ephedridae spp.*, *Syrphidae spp.*, *Leucorrhinia* family dragonflies, *Dolomedes fimbriatus*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Sphagnidae* and *Bryidae*.

Variants: depending on the location of habitat, it is possible to distinguish two variants.

7140_1: Transition mires in the periphery of raised bogs, near the mineral soil islands or in interhill depressions. Poor in species to moderately rich in species transition mires with explicit layer of moss (*Fig. 7.17.*), which is dominated by bog moss.

7140_2: Limnogenous mires (*Fig. 7.19.*), including floating vegetation rafts (*Fig. 7.20.*) – in contrast to the first variant can be formed of fen and transition mire vegetation, which has established as a result of overgrowing and filling-in of lakes. Moss layer varies from moderately developed near open water to well developed – further from water. In addition to previously listed characteristic species the following plant species can also be listed: *Carex elata*, *Thelypteris palustris*, *Pedicularis palustris*, *Carex chordorrhiza*, *Eriophorum gracile*, *Galium trifidum*. Fringe vegetation near water – *Cicuta virosa*, *Carex pseudacorus*. In hollows – *Utricularia intermedia*. Mosses – *Cinclidium stygium*, *Scorpidium revolvens*, *Hamatocaulis vernicosus*, *Calliergonella cuspidata*, *Calliergon cordifolium*, *Calliergon giganteum*, *Sphagnum subsecundum*, *Sphagnum contortum*, *Helodium blandowii*.

Habitat Quality

Minimum habitat requirements: transition mires and limnogenous mires in whose vegetation characteristic plant species and communities of these habitats are dominating. Transition mires in the periphery of raised bogs or around mire islands of mineral soil must occupy at least 0.1 ha. Transition mires and raised bogs that are partly overgrown with trees and shrubs (*Fig. 7.21.*) or reeds (*Fig. 7.23.*), if typical structure and plant species of this habitat has been preserved in the whole area of the habitat. Cover of tree and shrub layer must be below 75%. Does not include plain helophyte stands on shores of lakes (Latvian habitats classification C.2.1), but in habitat 7140 there might be inclusions of small and scattered helophyte stands. If in a topogenous mire the bog-moss covers more than 25% of the territory, it is classified as habitat type 7140.

Structural indicators: all indicators that are common to all mire habitats. In addition – the proportion of the area in which the transition mire is wider than 10 m. Mire that occupies large continuous areas has a higher value than a mire that occupies a thin line.

Function and process indicators: all indicators that are common to mire habitats. In addition – part of the perimeter of mire that is more than 200 m from the intensive agricultural land. The larger part of the mire is located further than 200 m, the smaller is the risk that additional nutrients will flow into mire and will favour establishment of species that are not typical to the habitat.

Figure 7.23. Transition mire that has overgrown with trees and shrubs, which still can be distinguished as habitat 7140 *Transition mires and quaking bogs* (Photo: V.Lārmanis).

Restoration potential and quality improvement indicators: all indicators that are common to mire habitats.

Threats: threats that are mentioned to all mires. In addition to the variant 7140_2, lowering of lake water level, since it has the same impact as mire drainage.

Management: in intact or relatively intact transition mires it is necessary to maintain the existing hydrological regime in the lake and its catchment area or raised bog and its surrounding. In mires that are overgrown with trees and shrubs it is necessary to cut down trees and shrubs. Maintenance of open areas by mowing the shoots will be necessary. There might be a need to trim reeds. In drained mires it is necessary to carry out mitigation measures of drainage effects.

Similar habitats: if stands of *Cladium mariscus* in a filling-in lake are found, and their cover is at least 50% of the total cover of herbaceous plants, and habitat occupies at least four square meters, it is classified as the habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae.* Plant communities in filling-in lakes with calcareous species can be classified as 7230 *Alkaline fens*, if they meet the minimum quality criteria of this habitat. Previous studies have proved that the habitat 7230, unlike habitat 7140, is dominated by one of the following species or they are codominants: *Schoenus ferrugineus*, *Carex davalliana*, *Carex buxbaumii*, *Carex hostiana, Carex lepidocarpa*, seldom – *Carex lasiocarpa, Sesleria carulea* (in the Coastal Lowlandss). Species whose high frequency provides evidence on the habitat 7140 in cases when one must chose between 7140 and 7230: *Carex chordorhiza*, *Carex limosa*, *Dactylorhiza maculata*, *Trichophorum alpinum*, *Cinclydium stygium*, *Paludella squarrosa, Hamatocaulis vernicosus*. It should be noted that a moss species that is characteristic and dominates alkaline fens – *Scorpidium cossonii* – and *Scorpidium revolvens*, which is not strongly calciolous species, can be precisely determined only by use of microscope. Therefore it is recommended to collect moss samples and identify the species using a laboratory equipment.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 2.7. *Transition mires and quaking bogs.*

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Pakalne, M. (2008) Purvu biotopi un to aizsardzība. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 8.–19. lpp.

Pakalne, M., Kalniņa, L. (2000) Mires in Latvia. Suo, 51(4), 213–226 p.

Pakalne, M., Kalnina, L. (2005) Mire ecosystems in Latvia. In: Steiner, M. (ed.) Moore – von Sibirien bis Feurland, 147–174 p.

Pakalne, M., Salmiņa, L., Segliņš, V. (2004) Vegetation diversity of valuable peatlands in Latvia. International Peat Journal, 12, 99–112 p.

Salmiņa, L. (1998) The quaking mire vegetation of Latvia. Proceedings of the 41st IAVS symposium, 303–307 p.

Salmiņa, L. (2002) Lake-shore vegetation in western Latvia. Proceedings of the Latvian Academy of Sciences, B, 69–77 p.

Salmiņa, L. (2009) Limnogēno purvu veģetācija. Latvijas veģetācija 19, 1.–188. lpp.

7150 Depressions on peat substrates of the Rhynchosporion

Latvian habitat classification: there is no suitable habitat.

Syntaxonomy: *Rhynchosporion albae*.

Definition: highly constant pioneer communities of humid exposed peat or, sometimes, sand, with *Rhynchospora alba*, *Drosera intermedia*, *Lycopodiella inundata*, forming on stripped areas of blanket bogs or raised bogs, but also on naturally seep- or frost-eroded areas of wet heaths and bogs, in flushes and in the fluctuation zone of oligotrophic pools with sandy, slightly peaty substratum. These communities are similar, and closely related, to those of shallow bog hollows and of transition mires.

Figure 7.24. Pioneer communities with *Drosera intermedia* in the transition mire in Pētera lake (Photo: I.Rēriha).

Specific characteristics of habitat interpretation in Latvia: the habitat includes open peat area complexes in intact or relatively intact raised bogs (*Fig. 7.26.*). They are found on the slope of bog domes, where active formation of mire structures takes place. Habitat is dynamic and in a longer period of time the area it has been occupying and the configuration of patches can change. There is no information on distribution of this habitat in Latvia on wet heaths or water fluctuation zone of nutrient-poor shallow waters with sandy or slightly peaty substrate. However, fragments in a size of couple square decimetres with *Lycopodiella inundata* and *Drosera spp*. are included in the habitat 3130 *Oligotrophic to mesotrophic standing waters with vegetation of the Littorellatea and/or Isoeto-Nanojuncete* or heath habitats. The very rare species compositions on wet peat with *Lycopodiella inundata, Drosera spp.* could be identified as this habitat. Data on distribution of this habitat and species composition in heaths, transition mires and shallow waters is fragmented and insufficient. Research of this habitat is needed in Latvia.

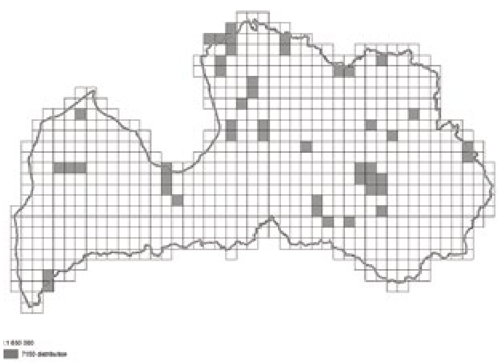


Figure 7.25. Distribution of the habitat 7150 *Depressions on peat substrates of the Rhynchosporion* in Latvia (Conservation status of.., 2013).

Distribution: very rare, until now the habitat is known only in the largest intact mires in which there is an active formation of peat. Most of raised bogs, as well as the largest mires are found in the Eastern Latvia Lowland, northern part of the Middle Latvia Lowland and the Tīreļi Plain. In raised bogs this habitat can potentially form in 1870 ha or 0.03% of the total territory of Latvia (Conservation status of.., 2013), but the habitat itself occupies only a few hectares of this area.

Conservation value: a very rare. It is a component of natural raised bog or heath. Individually they have a value as a specific structure in the mire.

Figure 7.26. Mud-bottom hollows with sparse vegetation, that corresponds to habitat 7150, in Dunika Mire (Photo: L.Auniņa).

Environmental factors and processes with a functional role: consistently high level of groundwater is necessary in the mire, active formation of peat. Depressions in heaths need periodical inundation.

Vegetation characteristics: vegetation is weakly developed, fragmented, most of it consists of moist or wet peat in which *Rhynchospora alba*, *Drosera spp.*, *Cladopodiella fluitans*, *Gymnocolea inflata* or other plant species.

Figure 7.27. Habitat 7150 *Depressions on peat substrates of the Rhynchosporion* in Tīreļi Mire (Photo: A.Namatēva).

Characteristic species: herbaceous plants - *Rhynchospora alba*, *Drosera anglica*, *Drosera intermedia*, *Lycopodiella inundata* (*Fig. 7.28.*); moss – *Cladopodiella fluitans, Gymnocolea inflata.*

Umbrella species (typical species within the meaning of the Habitats Directive): *Rhynchospora alba, Drosera spp*.

Variants: none.

Habitat Quality

Minimum habitat requirements: in a raised bog – it is possible to find patches of bare peat.

Structural indicators: average size of bare peat patches, amount of specially protected plant species in the habitat.

Function and process indicators: not evaluated individually in raised bogs, identical to the evaluation of the same mire habitat 7110*_Active raised bogs._

Restoration potential and quality improvement indicators: in intact or relatively intact mires restoration possibilities are unknown, but in periodically wet conditions similar habitat may establish in abandoned peat extraction areas.

Threats: all threats that are characteristic to mires.

Management: in intact or relatively intact raised bogs it is necessary to maintain the existing hydrological regime in the bog and its surroundings.

Similar habitats: none.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: none.

Figure 7.28. Bare peat with *Lycopodiella inundata* and *Drosera spp.* In an abandoned peat extraction site (Photo: A.Priede).

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Namatēva, A. (2012) Mikroainavu telpiskā struktūra un to ietekmējošie faktori Austrumlatvijas zemienes augstajos purvos. Promocijas darbs. LU Ģeogrāfijas un Zemes zinātņu fakultāte

7160 *Fennoscandian mineral-rich springs and sprinfens*

Latvian habitat classification: G.1.4., partly - F.2.6.5., F.2.6.6., F.2.4.2., F.2.3.3., F.2.2.4.

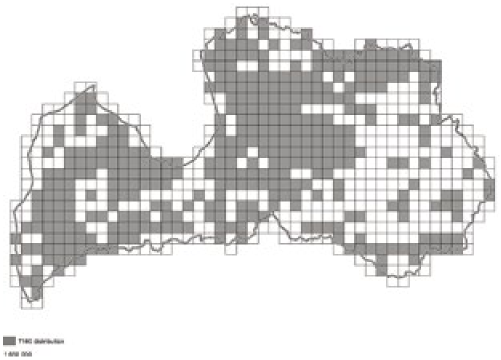


Figure. 7.29. Distribution of the habitat 7160 *Fennoscandian mineral-rich springs and sprinfens* in Latvia (Conservation status of.., 2013).

Syntaxonomy: *Caricion remotae*.

Definition: springs and springfens are characterised by continuous flow of ground-water. The water is cold, of even temperature, and rich in oxygen and minerals due to the rapid percolation. Springs may have a basin where the water wells up and an adjacent outflow with typical vegetation. In springfens the water seeps up through the ground and the accumulated peat, enhancing the growth of specialized vegetation. Since the water originates from deeper layers, these springs often have running water during the winter even if the surrounding areas are frozen and snow-covered. The invertebrate fauna is often very specific to this habitat and the flora rich in northern species.

Specific characteristics of habitat interpretation in Latvia: springs can have small water seepage flows or run-

Figure 7.30. Springfen in a forest (Photo: S.Ikauniece).

ning water, and there may be only wet soil areas. Depending on the water regime, microtopography and other environmental conditions, peat formed from plant debris can accumulate, creating a continuous layer, or might not accumulate. There may be distinct tree and shrub layers if the habitat is located in a forest. The habitat includes springs and springfens with various content of mineral compounds in water, including springs rich in sulphur and also spring mires. Includes springs in which the water flow is slow and water is not much enriched with oxygen.

Distribution: rare in Latvia – in large river valleys (for example, the Daugava, the Gauja, the Ogre, and the Salaca), ravine complexes, in the lower parts of hills and hill slopes in places where pressure water flows out. Found in fens in lowlands, for example, Zemgale lowland. In Latvia occupies about 240 ha (Conservation status of.., 2013).

Conservation value: specific environmental factors have reduced management options, and therefore the habitat usually has not been altered, natural ecological processes are evident and characteristic species are evident. The habitat is important for orchid species. Several specially protected species are specialists of this habitat, for example, *Montia fontana*, *Trichocolea tomentella*, and *Hylocomium umbratum*. Sulphur springs and seepage sources that are rich in iron are inhabited by specific bacterial and algal plants. Often springs have a heritage value, and are associated with folk stories and legends; they have been used for both water procurement and cult rituals. Spring water that is rich in minerals is important in folk medicine.

Environmental factors and processes with a functional role: the habitat develops when weakly acidic or neutral underground pressurised water with low calcium concentration flows onto the ground surface. Water is rich in minerals, contains iron, sometimes sulphur, which precipitate as iron oxides or sulphur compounds, resulting in a red-brown of other hue of color of the spring area and stream bed. Water temperature is even, often low. Source outflow areas and the seepage soil areas often do not freeze in winter and water flow continues, which ensures constant moisture and promotes growth of epiphytic and epixylic species. Soil is pauldified, wet, in some places peat is formed; and fens can form in a wider area.

Figure 7.31. David's springs – iron-rich outflow with few characteristic species (Photo: S. Ikauniece).

Vegetation characteristics: environmental and relief conditions create a diverse vegetation structure. Habitat can be either as a specific point site (one spring) or as a complex of water outflow sites that cover a wider area. Characterized by a mosaic structure, flat or hummocky microtopography, and may form a small elevated surface or depression at the place of spring outflow. Wet open soil areas can be interchanged with patched of tall herbaceous plants and sedge hummocks. As the habitat is common in forest, then heterogenous tree age structure and tree and shrub species composition can occur. Usually trees are slow growing.

Characteristic species: herbaceous plants – *Cirsium oleraceum*, *Epilobium palustre*, *Carex remota*, *Myosotis palustris*, *Chrysosplenium alternofolium*, *Veronica beccabunga*, *Crepis paludosa*, *Caltha palustris*, *Stellaria crassifolia*, *Cardamine amara*, *Equisetum palustre*; bryophytes – *Trichocolea tomentella*, *Plagiomnium undulatum*, *P.elatum, P.ellipticum*, *Cratoneuron*

Figure 7.32. A - Spring mire on the edge of a transition mire (Photo: I. Rēriha); B - Spring mire with components of fen vegetation (Photo: I. Čakare).

filicinum, *Brachythecium rivulare*, *Philonotis spp.*, *Pellia spp.*; shrubs – willows *Salix spp.*, alder buckthorn *Frangula alnus*; trees – white alder *Alnus glutinosa*, Norway spruce *Picea abies*, downy birch *Betula pubescens*.

Common invertebrate species found in soil: *Carychium minimum, C.tridentatum, Cochlicopa lubrica, Vallonia costata, V.pulchella, Euconulus fulvus vai E.alderi, Punctum pygmaeum, Vertigo substriata, V.angustior, V.antivertigo, V.pusilla, V.pygmaea, Nesovitrea hammonis, Pupilla muscorum.*

Umbrella species (typical species as considered within the Habitats Directive): bryophytes – *Trichocolea tomentella*, *Plagiomnium undulatum*, *P. elatum*, *P.ellipticum*, *Cratoneuron filicinum*, *Brachythecium rivulare*.

Variants:

It is possible to distinguish 3 variants that differ visually:

7160_1: springfens – mostly found in forest stands, distinct layers of trees and shrubs (*Fig. 7.30.*). The habitat may occur as point outflow source or occupy a wider area, often with several groundwater discharge sites. Might not be fast-flowing water, but only wet open soil areas;

7160_2: springs – various chemical composition and characteristic mineral salt composition, few characteristic plant species of the habitat, peat accumulation practically does not occur, as the flow of water washes away plant debris (*Fig. 7.31.*). May be located in forest and on agricultural land;

7160_3: spring mires – usually located on flat topography or in a depression, soil paludified, accumulation of peat, water saturated areas of open soil interspersed with vegetation patches on wet soil (*Fig. 7.32.*). The rarest variant of the habitat 7160 in Latvia. In addition to the listed characteristic species, also *Carex paniculata*, *Equisetum fluviatile*, *Deschampsia cespitosa*, and *Filipendula ulmaria* and other moisture loving plants.

Habitat Quality

Minimum habitat requirements: constant spring outflow or springfen with water-saturated soil. No precipitation of limestone. Presence of characteristic species is not the decisive factor in habitat identification.

Structural indicators: diversity of characteristic herbaceous plants and mosses; richness of specially protected plant species in the habitat; proportion of area with expansive and invasive species in the habitat.

Function and process indicators: all indicators common to mire habitats, except the contact zones with natural habitats.

In addition – proportion of the habitat area with no other human-made changes (forest cutting, trampling, etc.); proportion of habitat area in which required long-term management (grazing/hay collection) occurs in cases when springfens are located in a complex of grasslands or fens; non-intervention; proportion of habitat area in which there are appropriate light conditions; habitat structural quality as a prerequisite for functions.

Restoration potential and quality improvement indicators: indicators common for all mire habitats, in addition – degree of aggressivity of invasive species (if the species are aggressive, their control will be more difficult). If as a result of human activities flow of water in the habitat is altered, including by soil compression in the spring feeding area, its restoration is difficult or impossible. Restoration is easier in cases where humans have caused only local alterations, such as trampling, regulated or facilitations implemented at outflow of spring and stream bed. By amending these alterations, regeneration of natural vegetation will occur in the habitat.

Threats: the main threat is economic activities, such as land surface alteration, soil compression, and clear-cuts, which can lead to a change of hydrological regime. Careful observance of a sensitive management regime is essential also in the surrounding area of springs where the spring water is collected (spring feeding basin), as carrying out thoughtless land transformation, excavation and drainage can disrupt the spring seepage system and water flow, thereby destroying the habitat. In some cases, flooding is a threat, if dams are built on water courses, including by beaver activity. Threats are also implementation of facilities at water collection points, expanding the outflow of springs, building of concrete runways or wells at outflows. As a result of natural factors (succession), increased overgrowing of spring fens with shrubs and trees might occur.

Management: maintenance of the surrounding hydrological regime, area around springs, observation of low anthropogenic load, management of the surrounding grassland or fen habitats. Fast-growing pioneer trees or invasive species must be removed.

Similar habitats: can be similar to 7220* *Petrifying springs with tufa formation (Cratoneurion)*, but there is different composition of plant species, only *Palustriella commutata* can be found in both spring habitats. The most significant difference is limestone precipitation in habitat 7220* *Petrifying springs with tufa formation (Cratoneurion)*.

Overlap with other habitats of EU importance: frequently habitat 7160 *Fennoscandian mineral-rich springs and springfens* is found in several forest habitats: 9010* *Western taiga*, 9080* *Fennoscandian decidous swamp forests*, 91D0* *Bog woodlands*, 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae*, *Salicion albae)*, 9180* *Tilio-Acerion forests of slopes, screes and ravines*. In cases when springs and springfens are found scattered throughout a forest stand or a substantial part of it, the entire stand or part should be identified as 7160. In grasslands and fens, springs should be identified as a separate habitat 7160.

Corresponding specially protected habitats in Latvia: 2.6. Mineral-rich springs and springfens.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Danilāns, A. (1994) Avoksnāji. Grām.: Latvijas daba. Enciklopēdija. I sējums. Red. G.Kavacs, 98 lpp.

Danilāns, A. (1994) Avoti. Grām.: Latvijas daba. Enciklopēdija. I sējums. Red. G.Kavacs, 99.–100. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Latvijas PSR ģeogrāfija (1975) V.Pūriņa red. Rīga, Zinātne, 672 lpp.

Pakalne, M., Opmanis, A. (2004) Inventory and evolution of spring mire habitats in Latvia. Final Report. 50 p.

Pakalne, M., Čakare, I. (2004) Spring vegetation in the Gauja National Park. Latvijas Veģetācija 4, 17–34 p.

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae*

Latvian habitat classification: C.2.1.12.

Syntaxonomy: *Magnocaricion elatae*.

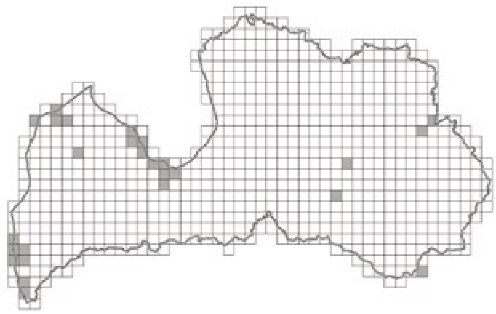


Figure 7.33. Distribution of the habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae* in Latvia (Conservation status of.., 2013).

Definition: *Cladium mariscus* beds of the emergent-plant zones of lakes, fallow lands or succession stage of extensively farmet wet meadows in contact with the vegetation of the *Caricion davalliane* or *Phragmition communis* species.

Figure 7.34. Habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae* in Engure Lake, where *Cladium mariscus* grows together with common reed (Photo: L.Auniņa).

Specific characteristics of habitat interpretation in Latvia: not found in wet meadows, but occurs in calcareous fens.

Distribution: very rare – in following geobotanical regions: in the Coastal Lowlandss, in Kurzeme, in the Eastern Latvia, as well as in the South East Latvia. The largest areas are located in the Coastal Lowlands.

Conservation value: one on the rarest habitats in Latvia which currently occupies only approximately 220 ha or 0.003% of the total territory (Conservation status of.., 2013). The habitat for *Acrocephalus paludicola* in Latvia.

Environmental factors and processes with a functional role: found in nutrient (mainly phosphorus) poor, but calcium-rich lakes with shallow and wide littoral zone, depressions in calcareous fens. High concentration of calcium is ensured by the location of bedrock that is rich in lime close to the soil surface or at lake bottom, high concentration of shells in soil or calcium-rich groundwater discharge (Salmiņa, 2003; Salmiņa, 2009).

Vegetation characteristics: vegetation structure depends on the habitat and its quality. Under favourable conditions – in open areas of lakes in the depth of 15–25cm – *Cladium mariscus* forms dense mono-dominant stands in which presence of other species is low (*Fig. 7.35.*). The most commonly found species are helophytes and elodeas. In small filling-in lakes *Cladium mariscus* with other helophytes can form only narrow vegetation fringe (*Fig. 7.36.*). Sometimes there is a layer of moss, which consists of *Bryidae* and *Sphagnidae*. In calcareous fens layer of herbaceous plants is sparse to dense (*Fig. 7.37.*), that consists of *Cladium mariscus* and calcareous fen species. Layer of moss can be well-developed and consist of *Bryidae*.

Characteristic species: herbaceous plants – *Cladium mariscus* dominates; often it is possible to find: *Utricularia spp.*,

Figure 7.35. Stands of *Cladium mariscus* in Kaņieris Lake (Photo: L.Auniņa).

Carex elata, *C.lasiocarpa*, *Phragmites australis*, *Schoenus ferrugineus*; moss – *Scorpidium scorpioides*, *Campylium stellatum*, *Scorpidium cossonii*; Charophyta – *Chara aspera*, *C.globularis*, *C.tomentosa* (Rudzroga, 1995; Zviedre, 2008).

Umbrella species (typical species within the meaning of the Habitats Directive): *Cladium mariscus*.

Variants: none.

Habitat Quality

Minimum habitat requirements: cover of great fen-sedge *Cladium mariscus* is at least 50% of the total cover of herbaceous plants and habitat occupies at least four square meters.

Structural indicators: an area of *Cladium mariscus* generative shoots, total cover of *Cladium mariscus*, cover of other herbaceous plants – as it is important to evaluate vitality of *Cladium mariscus* population in this habitat, which is habitat-forming species. The more generative shoots there are and the larger area they occupy, the better the quality of the habitat. In contrary, the

Figure 7.36. Stand of *Cladium mariscus* in a filling-in lake that can be classified as 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae* (Photo: L.Auniņa).

Figure 7.37. Stands of *Cladium mariscus* in fen near Pape Lake (Photo: L.Auniņa).

cover of other herbaceous plant species should be small.

Function and process indicators: of all indicators that are common for mires, only total area of the habitat and quality of the habitat structure is a prerequisite for conduction of functions. In addition – proportion of the area in which *Cladium mariscus* constantly is located in shallow water, since that is the optimal habitat for these species.

Restoration potential and quality improvement indicators: of all indicators that are common to mires only the degree of habitat fragmentation. Habitat restoration possibilities have not yet been identified and used in Latvia. It has been observed that when water level in Kaņieris Lake is raised, areas of *Cladium mariscus* stands in calcareous fens increase.

Threats: in lakes the habitat is mostly directly and indirectly influenced by eutrophication, as a result of which lake overgrows and the filling-in process proceeds faster, while in calcareous fens – drainage is the most important threat. As a result of strong drainage influence the competitive ability of the *Cladium mariscus* gradually weakens, stands become sparser and even more herbaceous plants and moss species can establish, later vitality of *Cladium mariscus* decreases and plants no longer form generative shoots. In such case, habitat can be classified as 7230 *Alkaline fens.* Intense fertilization of surrounding agricultural areas can negatively influence both stands of *Cladium mariscus* in mires and habitat 7230 *Alkaline fens.*

Management: if the vitality of *Cladium mariscus* is high, it is necessary to maintain the existing hydrological regime in the lake or mire and its surroundings. In case calcareous fens gradually overgrow with *Cladium mariscus*, but a priority is conservation of the habitat 7230 *Alkaline fens*, the *Cladium mariscus* can be mowed to reduce their cover.

Similar habitats: if stands of *Cladium mariscus* are located in the habitat 7230 *Alkaline fens* or in habitat 7140 *Transition mires and quaking bogs* or in any of the lake habitats, then they are identified as the habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae*, if cover of great fen-sedge is at least 50% of the total cover of herbaceous plants and habitat occupies at least four square meters.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia:: 2.5. Calcareous fens with great fen-sedge *Cladium mariscus*, 4.4. Lakes and their shores with stands of *Cladium mariscus*.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Pakalne, M., Salmiņa, L., Segliņš, V. (2004) Vegetation diversity of valuable peatlands in Latvia. International Peat Journal, 12, 99–112 p.

Rudzroga, A. (1995) Haras. Grām.: Latvijas daba. Enciklopēdija. Red. G.Kavacs, Rīga, Preses nams, 2, 123 p.

Salmiņa, L. (2004) Factors influencing distribution of Cladium mariscus in Latvia. Annales Botanici Fennici, 41(5), 367–372 p.

Salmiņa, L. (2009) Limnogēno purvu veģetācija. Latvijas veģetācija 19, 1.–188. lpp.

Salmiņa, L. (2003) The *Cladium mariscus (L.) Pohl* community in Latvia. Acta Universitatis Latviensis, Earth and Environmental Sciences, 654, 23–37 p.

Zviedre, E. (2008) Latvijas saldūdens mieturaļģu (*Charophyta*) flora un ekoloģija. Promocijas darbs. Latvijas Universitāte, Bioloģijas fakultāte.

7220* Petrifying springs with tufa formation (Crataneuron)

Latvian habitat classification: G.1.4.1., H.1.5.

Syntaxonomy: *Cratoneurion commutati*.

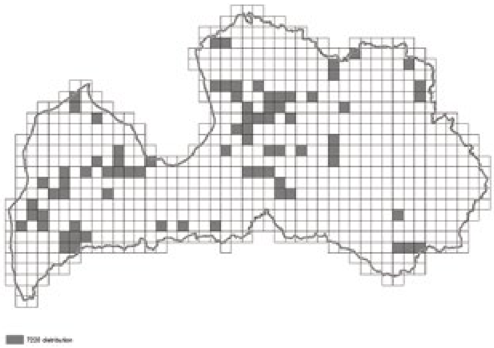


Figure 7.38. Distribution of the habitat 7220* *Petrifying springs with tufa deposition* in Latvia (Conservation status of.., 2013).

Definition: hard water springs with active formation of travertine or tufa. These formations are found in such diverse environments as forests or open countryside. They are generally small (point or linear formations) and dominated by bryophytes (*Cratoneurion commutati*).

Specific characteristics of habitat interpretation in Latvia: habitat also includes the deposits of freshwater lime, if no formation of new deposits takes place in the outcrop area, and deposits of freshwater lime, if they have been uncovered due to human activity.

Distribution: very rarely found in the whole territory of Latvia, more frequently in the basin of the River Gauja; in the river (also small rivers) valleys and their gullies, occasionally in the relief cliff. This habitat occupies approximately 52 ha of the whole territory of Latvia (Conservation status of.., 2013).

Conservation value: petrifying springs/springs that deposit with tufa deposition are the only or nearly the only habitat for multiple species: moss – *Palustriella decipiens*, *Eucladium verticillatum*, *Gymnostomum aeruginosum*, *Seligeria pusilla*; snails – *Vertigo genesii*, *V.geyeri*, *V.angustior*. Forming a habitat complex with other habitats, springs that deposit tufa increase air humidity in the vicinity, and this is especially significant factor for epixylic and epiphytic species in forest habitats, as well as increase carbonate content in the vicinity, thus promoting development of lime loving species in the contacting habitats.

Environmental factors: water of the petrifying springs/springs that deposit tufa contains higher or lower level of lime particles precipitating in the brook bed throughout its length or in limited section. Usually freshwater lime precipitates as tiny glumes or cements itself forming smaller or bigger porous pieces of lime rock (tufa, travertine) (*Fig. 7.40.*). Springs in the relief depressions precipitate spring lime even under the groundwater level – in such case it reminds floury and grainy mass. Occasionally dripstones of freshwater lime may form harder and larger structures reminding outcrops of carbonic bedrocks (8210 *Calcareous rocky slopes with chasmophytic vegetation*) (*Fig. 7.39.*). The spring run-off may have been subsided or it may have changed its course, however the outcrop

Figure 7.39. Lībānu-Jaunzemju rocks in the Gauja National Park were created by spring currently having ceased washing the deposits of freshwater lime (Photo: I.Rēriha).

of freshwater lime rock has been preserved (possibly uncovered due to human activity), – such cases should also be defined as habitat 7220*. Mostly outflow points of calcareous springs are located in the river terraces, ravines, relief cliffs and in their feet, outflow points of springs may also be located at significant distance from the relief uplift.

Processes with a functional role: intensity and character of freshwater lime precipitation is the key process determining volume and quality of habitat. In some cases freshwater lime dripstones are formed solely under the top layer of soil before the visible outflow point of the spring revealed only in case of freshwater lime extraction in these sites. Vegetation of calciphyte pioneering species forms in the uncovered sites possibly transferring into *Cratoneurion commutati* vegetation and *Caricion davallianae* vegetation in the long term.

Vegetation characteristics: formation of habitat plant vegetation is affected both by location of the spring (forest, open phytocenosis) and volume of precipitation and structure of the spring lime (porosity, density). *Palustriella commutata* can always be found in the habitat, although in several cases (on drier outcrops of freshwater lime) its amount may be insignificant. Communities of mono-dominant *Palustriella commutata* usually develop above the springs forming explicit tufa of freshwater lime and being located in overshadowed situation (*Fig. 7.41.*). However, depending on the location of a spring in the forest or field the plant cover dominating in its outflow territory may be very different and related to the vegetation of the surrounding habitats forming a habitat complex with vegetation of transition mire, fen, calcareous meadows and forest communities. Habitat is characterized by an explicit moss layer, but the layer of herbaceous plants is mostly thin. Plant species typical to both rich deciduous forests (for example, *Allium ursinum*, *Crepis paludosa* and other) and fens and meadows (for example, *Carex acutiformis*, *C.hostiana*, *C.paniculata*, *Primula farinosa* and other) can be found there. On large area of humid or medium humid freshwater lime-rock outcrops, similarly as on calcareous sandstone outcrops, the phytocenosis is not linked, and mostly calciphytic species of terricolous bryophytes and lichens (there may also be no vascular plant species) can be found. Small-size dripstones of freshwater lime and travertine shivers may be a significant living environment for rare species.

Figure 7.40. Spring in Kazu ravine in the Gauja National Park depositing spring lime as large pieces of tufa (Photo: I.Rēriha).

Characteristic species: herbaceous plants – *Pinquicula vulgaris*, *Primula farinosa*, *Carex ornithopoda* (there may be no herbaceous plants); moss – *Cratoneuron filicinum*, *Palustriella commutata*, *Philonotis calcarea*, *Scorpidium cossonii*, *Bryum pseudotriquetrum*, *Preissia quadrata*, *Pellia endiviifolia*; lichens – species of *Verrucaria* and *Thelidium* genus; animals – *Aporrectodea rosea*, *Vertigo spp.*, *Pedicia rivosa*, in the water – *Gammarus spp*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Pinquicula vulgaris*, *Primula farinosa*, *Carex ornithopoda*, species of *Dactylorhiza spp.* genus, moss of *Philonotis spp.* genus, *Palustriella commutata*, *Pellia endiviifolia*.

Variants: none.

Habitat Quality

Minimum habitat requirements: spring precipitating spring lime in any of its flow section as glumes (*Fig. 7.41.*) or larger structures or if there is lime dripstones that have originated as a result of previous spring flow.

Structural indicators: all indicators common to mire habitats, except the cover of moss layer that is irrelevant for this habitat.

Function and process indicators: all indicators common to mire habitats, except for the contact zones with natural habitats, since habitat can also be in good condition in anthropogenic environment. Following criteria should also be assessed additionally: area with the necessary regular management provided (grazing/cutting) in cases, when springfen is located in complex of meadows or fens, or non-interference; ratio of the habitat area unaffected by other negative modifications caused by humans (tree cutting and trampling etc.); habitat area with active lime precipitation, as this process indicates higher quality of habitats; volume of the precipitation of freshwater lime – in higher quality habitat the freshwater lime precipitates creating continuous pieces or layer of tufa; ratio of habitat area with appropriate light conditions to the habitat that indicates better growing conditions for the species.

Restoration potential and quality improvement indicators: all the indicators common to mire habitats, additionally -

Figure 7.41. Tufa created by the spring is completely covered by community of *Palustriella commutata* (Photo: I.Rēriha).

Figure 7.42. Spring precipitating spring lime as tiny glumes (Photo: I.Rēriha).

aggression rate of invasive species. Habitats with very aggressive invasive species are of lower quality, since large amounts of resources must be provided for their elimination. If water flow and thus formation of freshwater lime has been interrupted in the habitat due to human activity, restoration of habitat is complicated or even impossible. If there is large volume of depositions of freshwater lime in the habitat, in several cases the habitat may keep functioning as an outcrop of freshwater lime preserving the characterizing species. The habitat is relatively easy restorable, if there are local damages caused by human activity (trampling, regulated spring outflow). Natural restoration of vegetation occurs in the habitat after prevention of aforementioned factors. Restoration of the habitat without interference of humans may take place, if the spring has changed the bed due to natural reasons (for example, landslide), and precipitation of spring lime and introduction of species characteristic to the habitat takes place in the new spring outflow site.

Threats: all the factors endangering the mires and additionally the damages caused to springfen by humans (trampling, lime extraction, regulation or modification of spring outflow).

Management: preservation of the hydrological regime and habitats of the vicinity, prevention of anthropogenic load, maintenance of the habitats of the surrounding grasslands/ meadows or fens.

Similar habitats: 7160 *springs and springfens rich in mineral substances*, however, no active precipitation of freshwater lime is observed there, although the typical moss *Palustriella commutate* may appear in the plant community.

Overlap with other habitats of EU importance: tufa-forming springs may be located fully under the tree corollas, for example, in habitat 9180* *Tilio-Acerion forests of slopes, screes and ravines* – in such case it should be marked as point type feature or linear object 7220*. In case the springs or springfens can be found dispersed in the entire section or large area of the forest, the entire section or part of it should be marked as 7220*. If the tufa-forming springs flow out in calcareous fen, the habitat complex should be separated as habitat 7230_1. If spring flows over habitats 8210 *Pits of carbonatic bedrocks* and 8220 *Sandstone pits*, both habitats should be marked, but the species growing in this territory will be better characterized by 7220*.

Corresponding specially protected habitats in Latvia: 2.1. Springs precipitating spring lime.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Latvijas PSR ģeogrāfija (1975) V.Pūriņa red. Rīga, Zinātne, 672 lpp.

Pakalne, M., Āboliņa, A., Pilāts, V. (2007) Iežu atsegumi un alas. Grām.: Bioloģiskā daudzveidība Gaujas nacionālajā parkā. Red. V.Pilāts, Sigulda, Gaujas nacionālā parka administrācija, 47.–51. lpp.

Pakalne, M., Kalniņa, L. (2000) Mires in Latvia. Suo, 51(4), 213–226 p.

Pakalne, M., Kalnina, L. (2005) Mire ecosystems in Latvia. In: Steiner, M. (ed.) Moore – von Sibirien bis Feurland, 147–174 p.

Pakalne, M., Opmanis, A. (2004) Inventory and evolution of spring mire habitats in Latvia. Final Report, 50 p.

Pakalne, M., Salmiņa, L., Segliņš, V. (2004) Vegetation diversity of valuable peatlands in Latvia. International Peat Journal, 12, 99–112 p.

Аболинь, А. (1968) Листостебельные мхи Латв. ССР. Рига, Зинатне, 329 с.

7230 *Alkaline fens*

Latvian habitat classification: G.1.1.

Syntaxonomy: *Caricion davallianae.*

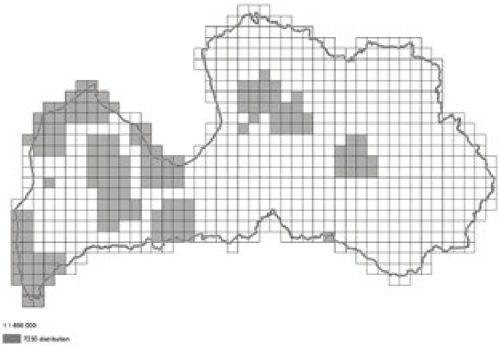


Figure 7.43. Distribution of the habitat 7230 *Alkaline fens* in Latvia (Conservation status of.., 2013).

Definition: wetlands mostly or largely occupied by peat – or tufa-producing small sedge and brown moss communities developed on soils permanently waterlogged, with a soligenous or topogenous base-rich, often calcareous water supply, and with the water table at, or slightly above or below, the substratum. They often form complexes of wetlands, therefore inclusions of Molina grasslands/meadows (*Molinion*), tall-sedges (*Magnocaricion elatae*), reeds (*Phragmition australis*) and plants of various humid depressions in calcareous fens should also be added. Vegetation of fens includes plant communities from the union *Caricion davallianae sensu stricto* and their transition to Molina grasslands/meadows in calcareous, peaty or clayey-silt-laden soils (*Molinion*). In any case, plant species from the community *Caricion davallianae* is explicitly represented there.

Specific characteristics of habitat interpretation in Latvia: none.

Distribution: rarely found in the entire territory of Latvia. The largest calcareous fens are located in the western part of Latvia, especially in the Coastal Lowlands. Approximate estimates show that the habitat 7230 occupies just approximately 900 ha or 0.01% of the territory of Latvia (Conservation status of.., 2013). There are no accurate data regarding the exact area of this habitat in Latvia.

Conservation value: one of the rarest habitats in Latvia. During the last 100 years its area has significantly decreased due to human activity. Several plant species, for example, *Scorpidium cossonii*, *Schoenus ferrugineus*, *Carex davalliana*, *Ophrys insectifera*, *Saussurea esthonica*, *Juncus subnodulosus* are only found in calcareous fens. Important habitat for such specially protected plant species as *Liparis loeselii*, *Primula farinosa*, *Pinguicula vulgaris*, *Gymnadenia conopsea*, *Dactylorhiza incarnata*, *D.ruenta*, *D.ochroleuca*, *Preissia quadrata*, *Moerkia hibernica,* and for specially protected snail species – *Vertigo genesii*, *V.geyeri*.

Environmental factors and processes with a functional role: found in the relief depressions with limited groundwater runoff, next to the tufa-forming springs (7220*), rarely – in limnogenous mires. The main prerequisite for the development and existence of fen is high groundwater level with small annual fluctuations. Depth of peat layer may reach 5 m, or it may not be formed at all if the fen is at the initial stage of development. High concentration of calcium in soil is caused by location of bedrocks that are rich in lime near soil surface, high concentration of shells in soil or supply of groundwater that is rich in calcium. Soils of calcareous fens are rich in calcium, often – also with magnesium and potassium, however, they are poor in nitrogen and phosphorous. The pH of the soil is alkaline, most often pH>6 (Tabaka, 1960; Pakalne, 2008). Under natural conditions with undisturbed hydrological regime the calcareous fens are open, with sparse tree or shrub layer on mire margin. Due to the influence of drainage, as well as by ceasing of traditional management the mire area gradually overgrows with reed, trees and shrubs.

Vegetation characteristics: aforementioned environmental factors determine that calcareous fens are dominated by plants of open, humid to wet nitrogen-poor soils, and calciolous plant species can be found there (*Fig. 7.44.*). Usually there is no tree layer or it consists of sparse *Pinus sylvestris*, *Betula pubescens*, *B.pendula*. Layer of shrubs consists of sparse *Pinus silvestris*, *Myrica gale*, *Frangula alnus*, *Betula humilis* and *Salix spp*. There is explicit layer of herbaceous plants and mosses, but, if the mire forms as a result of overgrowing of shallow water-body initially there may be no moss layer. Layer of herbaceous plants may be dominated by *Schoenus ferrugineus*, *Carex davalliana*, *Carex buxbaumii*, *Eleocharis quinqueflora* (in depressions), *Carex hostiana*, *C.lasiocarpa*, *C.panicea*. Layer of mosses is dominated by *Bryidae*. Most often – *Scorpidium cossonii*, *S.revolvens*, *S.scorpioides*, *Campylium stellatum*; often found species are *Fissidens adianthoides*, *Ctenidium molluscum*; rarely found species – *Bryum neodamense*, *Pseudocalliergon trifarium*, *Drepanocladus lycopodioides*, *Tomenthypnum nitens*, *Catoscopium nigritum*, *Moerckia hibernica*, *Preissia quadrata*. Scattered bog-moss hummocks can be found in the mire, mostly formed by *Sphagnum warnstorfii*, *Sph.teres*, *Sph.angustifolium*. Rarely depressions with *Chara spp.* can be found in calcareous fens, often – with *Utricularia intermedia*.

Characteristic species: herbaceous plants – *Schoenus ferrugineus*, *Carex davalliana*, *C.buxbaumi*, *Carex lepidocarpa, Carex hostiana*, *Carex flacca, C.panicea*, *Primula farinosa*, *Pinguicula vulgaris*, *Equisetum variegatum*, *Sesleria caerulea*, *Eriophorum latifolium*, *Parnassia palustris*, *Blysmus compressus*, *Triglochin palustris*, *Dactylorhzia ochroleuca*. Moss – *Scorpidium cossonii*, *Ctenidium molluscum*; *Tomentypnum* moss *Tomenthypnum nitens*, *Catoscopium nigritum*, *Moerckia hibernica*, *Preissia quadrata*. Charophytes – *Chara aspera, Ch.contraria* (Rudzroga, 1995; Zviedre, 2008). Invertebrates – *Vertigo geyeri*, *V.angustior, V.antivertigo*, *V.substriata, V.pusilla, V.pygmaea, Carychium minimum, C.tridentatum, Cochlicopa lubrica, Vallonia costata, V.pulchella, Euconulus fulvus, E.alderi, Punctum pygmaeum, Nesovitrea hammonis, Pupilla muscorum*; in small pools – *Galba truncatula, Bathyomphalus contortus, Valvata cristata, Cicadella viridis*, *Syrphidae spp.*, *Diplopoda spp.*, *Dolomedes fimbriatus*, *Chrysochraon dispar*, *Conocephalus dorsalis*, *Euthystira brachyptera*, *Cymus glandicolor*, *Eurygaster testudinarius*, *Oodes gracilis*, *Aphthona spp.*, *Chaetocnema spp.*, *Longitarsus spp.*, *Psylliodes spp.*, *Larinus spp*.

Figure 7.44. *Alkaline fens* (7230_2) occasionally dominated by *Carex lasiocarpa*, occasionally – by *Schoenus ferrugineus* or *Carex hostiana* in Ječu Mire (Photo: L.Auniņa).

Umbrella species (typical species within the meaning of the Habitats Directive): *Scorpidium revolvens, Scorpidium cossonii, Campylium stellatum, Scorpidium scorpioides, Primula farinosa, Pinguicula vulgaris*.

Variants:

7230_1: calcareous fens with springs. Most frequently located on slopes of valleys or at their foot and occupy a small area (up to few hectares). In the areas of active tufa formation and on a narrow zone along the spring streams the following moss species are found – *Cratoneuron filcinum, Palustriella commutate, Philonotis valcarea*. Alkaline fens have been formed under the influence of springs. Species composition is richer than in the variant 7230_2;

7230_2: calcareous fens in plains. Formed in waterlogged conditions in relief depressions of various origin. It can occupy areas of several tens of hundreds of hectares. Species-poor to species-rich alkaline fens.

Habitat Quality

Minimum habitat requirements: alkaline fens with dominating characteristic plant species and communities. The habitat also includes the alkaline fens partly overgrown with trees and shrubs or reeds (*Fig. 7.44.*), if the structure and plant species typical of this habitat has been preserved in mosaic-pattern throughout the habitat area. Density of the layer of trees or shrubs must be under 75%. If the drained alkaline fens are dominated by *Molinia caerulea* and the vegetation structure typical of this habitat cannot be found in mosaic-pattern in the entire mire it cannot be identified as habitat 7230. Most often these mires are also overgrown with shrubs and trees, and their cover exceeds 75%. Total cover of *Sphagnum* in the habitat 7230 is smaller than 25%. If the cover is higher, the habitat should be identified as 7140 *Transition mires and quaking bogs*.

Structural indicators: all indicators relevant to mire habitats.

Function and process indicators: all indicators relevant to mire habitats. Additionally – area with the necessary regular management (grazing, mowing or without management); perimeter section of the mire located further than 200 m from lands of intensive agriculture. The larger the section of the mire which is located further than 200 m from lands of intensive agriculture, the lower is the risk of run-off of additional nutrients into the mire.

Restoration potential and quality improvement indicators: all indicators relevant to mire habitats.

Threats: all indicators relevant to mire habitats. A large part of the alkaline fens in Latvia have been transformed into agricultural lands or water-bodies, and their natural values have been lost irreversibly. Discontinuation of management appropriate for alkaline fens and the impacts of drainage allow more rapid development of natural succession which under the climatic conditions of Latvia occurs as formation of shrubs or forest. Potential existence of habitats is also endangered by wrong application of the management typical of calcareous fens. Over-grazing or too frequent mowing may lead to degraded plant communities not conforming by the structure and functions with the habitat of alkaline fen described in this manual. In the future, upon continuation of decrease of the number and area of alkaline fens the preservation of habitat can be negatively affected by habitat fragmentation.

Management: nowadays alkaline fens are rarely mowed or grazed, but back in the 1930s management of fens was widespread. Mowing of alkaline fens should be supported and encouraged, especially after cutting out the trees and shrubs, as this promotes preservation of the restored open areas. Extensive grazing is also allowable for a short period of time during the season of vegetation. Type and intensity of the management depends on structure and quality of the habitat and previous management. For intact or slightly disturbed mires it is necessary to preserve the existing hydrological regime in the lake and its catchment area or mire of at least 200 m around the fen. Clear-cuts should not be planned within a 20 m distance of the fen. In order to decrease the cover of reeds or *Molinia caerulea* in the fens, mowing is recommended at the beginning of the flowering period of these plants (Šefferova Stanova et al., 2008). There is still insufficient experience accumulated in Latvia regarding management of alkaline fens, therefore the extent and intensity of every management measure, as well as season of performance in each site must be carefully assessed.

Similar habitats: drained alkaline fens are often dominated by *Molinia caerulea*, but they can be distinguished from habitat 6410 *Molinia meadows in calcareous, peaty or clayey-silt-laden soils* by the vegetation structure – *Molinia caerulea* forms high tussocks in drained alkaline fens, and usually there is bare soil among them, as well as species of herbaceous plants and moss typical of alkaline fens preserved on the tussocks. Most frequently the drained fens are overgrown with trees and shrubs, and no composition of species typical of moor-grass meadows can be found among them. Grasslands dominated by *Carex panicea, Sesleria caerulea, Carex hostiana* or *Carex buxbaumii* (habitat 6410) are richer in species than fens, and no well developed layer of moss can be found there. Possibly alkaline fens can develop, if the grassland habitat 6410 becomes paludified after discontinuation of management. In wet depressions of alkaline fen communities of different sedges without layer of moss or with poorly developed layer of moss are sometimes found. They should be included in habitat 7230 due to the territorial integrity of the mire. Junipers in calcareous fens form natural part of this habitat, and the habitat 5130 *Juniperus communis formations on heaths or calcareous grasslands* do not have to be distinguished there.

Plant communities with calciphyte plant species located in

Figure 7.45. *Alkaline fens* (7230_1) with springs in the Abavas Senleja (Photo: L.Auniņa).

limnogenous mires should be distinguished as 7230 *Alkaline fens*, if they meet the minimum quality requirements of this habitat. Previous research shows that habitat 7230 in contradiction to 7140 is dominated by one of the following species or they are co-dominants: *Schoenus ferrugineus, Carex davalliana, Carex buxbaumii, Carex hostiana, Carex lepidocarpa*, more rarely – *Carex lasiocarpa, Sesleria caerulea* (in the Coastal Lowlands). Distinguishable from the habitat 7140 by the typical calcicolous species, indicated in the chapter Characteristic species. Species, high occurrence of which often identifies habitat 7140: *Carex chordorhiza*, *Carex limosa*, *Dactylorhiza maculata, Trichophorum alpinum*, *Cinclydium stygium*, *Paludella squarrosa*. It must be taken into consideration that *Scorpidium cossonii* typical of alkaline fens can be accurately distinguished from *Scorpidium revolvens,* which are not explicit calcicolous plant species only by using a microscope, therefore moss sampling is recommended.

Overlap with other habitats of EU importance: plant communities with the *Schoenus ferrugineus* located in the dune slacks should be distinguished as habitat 2190 *Humid dune slacks*. If communities of *Cladium mariscus* are found in the mire and their cover is at least 50% of overall cover of the herbaceous plant layer and the habitat occupies at least four square meters, it should be separated as habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae*.

Specially protected habitats in Latvia: 2.3. Calcareous fens with *Carex davalliana*, 2.4. Calcareous fens with *Schoenus ferrugineus*, 2.8. Fens with *Juncus subnodulosus*.

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Pakalne, M. (1994) Rare rich fen and lake side communities of the Baltic Coast (Latvia, Coastal Lowland). PhD thesis, University of Latvia

Pakalne, M. (2008) Purvu biotopi un to aizsardzība. Grām.: Purvu aizsardzība un apsaimniekošana īpaši aizsargājamās dabas teritorijās Latvijā. Red. M.Pakalne, Rīga, Latvijas Dabas fonds, 8.–19. lpp.

Pakalne, M., Kalniņa, L. (2000) Mires in Latvia. Suo, 51(4), 213–226 p.

Pakalne, M., Kalnina, L. (2005) Mire ecosystems in Latvia. In: Steiner, M. (ed.) Moore – von Sibirien bis Feurland. 147–174 p.

Pakalne, M., Salmiņa, L., Segliņš, V. (2004) Vegetation diversity of valuable peatlands in Latvia. International Peat Journal, 12, 99–112 p.

Rudzroga, A. (1995) Haras. Grām.: Latvijas daba. Enciklopēdija. Red. G.Kavacs, Rīga, Preses nams, 2, 123 p.

Salmiņa, L. (2005) New fen communities in Latvia. Acta Universitatis Latviensis, 685, 96–111 p.

Salmiņa, L. (2009) Limnogēno purvu veģetācija. Latvijas veģetācija 19, 1.–188. lpp.

Sundberg, S. (2006) Åtgärdsprogram för bevarande av rikkärr inklusive arterna gulyxne Liparis loeselii (NT), kalkkärrsgrynsnäcka Vertigo geyeri (NT) och större agatsnäcka Cochlicopa nitens (EN). Naturvårdsverket Report 6501

Šefferova Stanova, V., Šeffer, J., Janak, M. (2008) Management of *Natura 2000* habitats. 7230 Alkaline fens

Tabaka, L. (1960) Kurzemes zāļu purvu veģetācija. Grām.: Latvijas PSR veģetācija, III daļa. Red. L.Tabaka, Latvijas PSR ZA izdevniecība, 13.–19. lpp.

Zviedre, E. (2008) Latvijas saldūdens mieturaļģu (*Charophyta*) flora un ekoloģija. Promocijas darbs. Latvijas Universitāte, Bioloģijas fakultāte

8. ROCKY HABITATS AND CAVES

This group includes habitats with outcropped rock as the main common characteristic feature. In addition to 8210 *Calcareous rocky slopes with chasmophytic vegetation*, 8220 *Siliceous rocky slopes with chasmophytic vegetation* and 8310 *Caves not open to the public* that are included in this chapter, also habitat 1230 *Vegetated sea cliffs of the Atlantic and Baltic coasts* that belongs to marine and halophytic habitats is considered to be related. Compared to the rock outcrops found in majority of European countries, rock outcrops that are found in Latvia are relatively small in size, therefore the minimum size of the habitat is not determined, with the exception of vegetated sea cliffs on quaternary sediments (the minimum height of a vegetated sea cliff – 4 m). Broken rock pits and artificial rock outcrops are also considered protected habitats, given that the plant community that is characteristic to the habitat is formed.

Distribution

All rock outcrops are very rarely found in Latvia, and are mostly related to river valleys and relief cliffs, with the exception of 1230 *Vegetated sea cliffs of the Atlantic and Baltic coasts* that can be located only in close proximity to the sea.

Conservation value

Rock outcrops are a specific habitat for many species of moss, lichens and algae, more rarely – vascular plants. All rock outcrops possess landscape value and many outcrops have a high geological value.

Environmental factors

Part of geologically valuable rocks is located below the ground surface. Such rock deposits, above which the habitat-specific plant communities do not form, are not considered a habitat of EU importance. Rock outcrop habitats form when the ground cover is over-washed or removed during a landslide. Depending on their hardness, rocks are subjugated to surface erosion. In majority of cases the size of outcrops is small and the habitat is closely related to other adjacent habitats that can promote rich biological diversity on the outcrop. Favourable hydrological regime, which is provided by watercourses on or adjacent to the outcrop as well as tree foliage above the outcrop that retain the vaporised water, is one of the determinant environmental factors on rock outcrops. Micro-climate is also influenced by the outcrop exposition according to cardinal points. Significant difference between temperature, humidity and light conditions occur on the outcrop surface that is constantly exposed to the sun or fully shaded, creating a mosaic of plant communities. Resistance of plant communities also depends on the height, steepness, positive and negative forms of the microtopography of the outcrop surface.

Processes with a functional role

The most significant processes, which determine the character of vegetation on outcrops, are landslides of the rock surface and formation of fissures and other microtopography forms.

Vegetation characteristics

Plant communities in outcrop habitats are unstable and usually have open, but very specific vegetation. Habitats often include species with low competitiveness, as there are vegetation free patches on outcrops. Pioneer species have the determinant role; therefore bryophytes, lichens and algae usually dominate on the outcrops. The number of species on an outcrop can vary greatly depending on various environmental factors – from a few micro-algae up to 100 and more species. Inter-species proportions and dominating species also differ; therefore it is difficult to identify syntaxonomic units of the vegetation. Vegetation classification that would be suitable for conditions of Latvia has not yet been developed for outcrop habitats.

Characteristic species

Since the differences in vegetation between rock habitats of the same type are considerable, it is difficult to identify characteristic species. Habitat-specific species are found rarely; therefore the list of characteristic species also includes species that occur in other habitats.

Umbrella species

Occurrence of these species in a habitat indicates a very good or excellent habitat quality – the larger is the number of such species, the higher the habitat quality. Disappearance of typical species indicates negative processes within the habitat or in its closest proximity.

Habitat quality

There are several habitat quality indicators that are important to all outcrop habitats.

Structural indicators:

Number of characteristic species – since rock outcrops are a specific habitat for many species, the number of characteristic species is a good indicator of the habitat quality. The number of species on an outcrop is determined by the characteristics of the rock (hardness and calcareousness), the impact of the surrounding habitats on the micro-climate of the rock surface (humidity, light conditions) and also by processes that transform the rock surface (over-washing, landslides).

Number of protected species and species listed in the Red Data Book of Latvia – occurrence of rare or protected plant, animal and other organism group species improves the outcrop habitat quality. Species that occur on outcrops often have very narrow ecological amplitude and low competitiveness, therefore existence of these species indicates that the processes that take place in the habitat are balanced and beneficial to the habitat.

Projective vegetation cover – indicates the stability of the outcrop surface and the intensity of weathering. The most favourable situation for biodiversity occurs when the outcrop has both, rock areas covered by vegetation and open patches for development of species with low competitiveness. A cover of the rock outcrop with one or few expansive species is considered undesirable.

The presence of expansive and invasive species – characterizes the negative trends as an increase in the proportion of such species decreases the proportion of habitat specific species.

The size of an outcrop (cave) – it is an important indicator since a larger area of an outcrop (cave) usually creates opportunities for a larger number of species to inhabit the habitat.

Characteristics of rock surface (hardness, microtopography of the outcrop) – fissures, overhangs and niches provide better conditions for plants to root.

Presence of habitats that provide beneficial conditions for the development of species that are specific to the outcrop – appropriate substrate and air humidity is essential for algae, lichen and moss species, which is increased by closed tree canopy above the rock, shading, nearby springs and watercourses, therefore location of deciduous forests, spring fens and rivers adjacent to the rock provide a better habitat quality.

Function indicators: Active processes on the surface of a rock (over-washing, landslides) – in an optimal situation they are in balance with areas of a stable rock where the development of plant species is possible. Air humidity and light conditions – these factors promote and limit biodiversity in the habitat.

Restoration potential and quality improvement indicators: If a rock has been completely destroyed, its restoration is not possible. In a case of changing environmental conditions, it is possible to improve the quality of habitat (combating invasive species, restoring the forest stand artificially or naturally, and restoring the hydrological regime).

Threats

Outcrops and caves are threatened by damage inflicted by humans (scratches, rock landslides next to trails etc.) and also by disturbances to nearby habitats (cutting of forests, changing watercourse beds, pollution with household waste). Plant communities are also threatened by eutrophication and the spread of invasive species.

Management

Non-intervention and conservation of nearby habitats is important for all outcrop habitats. Anthropogenic pressure must be prevented when necessary.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Krauze, I. (2010) Latvijas alas, http://www.alas.lv

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Pakalne, M., Āboliņa, A., Pilāts, V. (2007) Iežu atsegumi un alas. Grām.: Bioloģiskā daudzveidība Gaujas nacionālajā parkā. Red. V.Pilāts, Sigulda, Gaujas nacionālā parka administrācija, 47.–51. lpp.

Piterāns, A. (2001) Latvijas ķērpju konspekts. Latvijas veģetācija 3, 5.–46. lpp.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T., Vitikainen, O. (2004) Lichen-forming and lichenicolous fungi of Fennoscandia, 359 p.

Skuja, H. (1936) Latvijas sporaugi. Latvijas zeme, daba un tauta. II sējums. Latvijas daba. Rīga, Valtera un Rapas akc. sab. apgāds, 52.–152. lpp.

Аболинь, А. (1968) Листостебельные мхи Латв. ССР. Рига, Зинатне, 329 с.

Питеранс, А.В. (1982) Лишайники Латвии. Рига, Зинатне, 352 с.

8210 *Calcareous rocky slopes with chasmophytic vegetation*

Latvian habitat classification: H.1.2.; D.10.6.

Syntaxonomy: communities that are characteristic to this habitat in the conditions of Latvia have not been described.

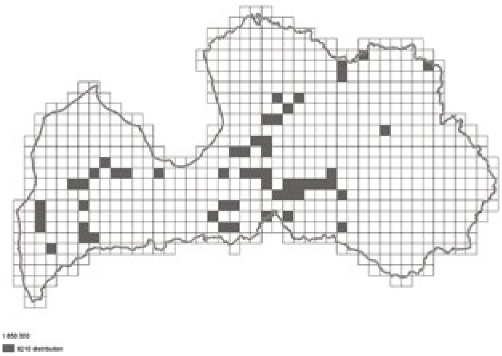


Figure 8.1. Distribution of the habitat 8210 *Calcareous rocky slopes with chasmophytic vegetation* in Latvia (Conservation status of.., 2013).

Definition: vegetation of fissures of limestone cliffs, in the Mediterranean region and in the Euro-Siberian plain to alpine levels. The habitat type presents a great regional diversity, with many endemic plant species.

Specific characteristics of habitat interpretation in Latvia: on calcareous rocky slopes in Latvia no plant communities characteristic to the Central European mountain regions or Boreal regions are found. In the conditions of Latvia this habitat also includes non-flooded or temporarily flooded dolomite rock outcrops and their pits found on river banks and also limestone deposits that have been exposed as a result of human activities, if active limestone mining has been stopped and the vegetation that is characteristic to this habitat type forms on the calcareous rock.

Distribution: very rare, mostly found in southern and western parts of Latvia – in the River Venta, the River Abava, the River Lielupe and the River Daugava catchment area and at the middle course of the Gauja River Gauja and the banks of the tributaries of this course.

Conservation value: a very rare habitat that occupies an area of only 0.2 km^2 of the total territory of Latvia (Conservation status of.., 2013). Calcareous rocky slopes have an exceptional role in the conservation of bryophytes in Latvia, as this group of plants is determinant in the habitat vegetation formation. Calcareous rock outcrops are the only or one of the very few habitats for such rare species as *Asplenium trichomanes*, *Asplenium rutamuraria*, *Gymnocarpium robertianum*, *Fissidens crassipes*, *Gymnostomum calcareum*, *Myurella julacea*, *Collema spp.*, *Trentepohlia aurea*, *Truncatellina cylindrica* etc.

Environmental factors: calcareous rocky slopes can be formed by dolomites (*Fig. 8.2*), dolomite marl screes and limestone (*Fig. 8.3.*). Rock often contains inclusions of clay layer. Such outcrops are found in river banks and gullies where they form walls that are 90-45 degree steep. Gypsum rocks do not belong to the class of calcareous rocks by their chemical composition; in addition there are no natural outcrops or gypsum rock in Latvia.

Figure 8.2. A small dolomite rock outcrop located on the river bank of the River Abava cascade creates a specific environment for the growth of bryophytes (Photo: I.Rēriha).

Figure 8.3. Calcareous rocky slope on the Lielupe bank downstream from Bauska (Photo: I.Rēriha).

Figure 8.4. Dolomite rock outcrop that has overgrown with moss – the Randatu Cliffs on the shore of the River Gauja (Photo: V.Lārmanis).

Processes with a functional role: unstable plant communities that are influenced by hydrological conditions on the rock (stream outflows is beneficial), exposition and features of the substrate surface, form on calcareous rocky slopes; majority of plants need fissures where the roots and rhizoids are strengthened and humus is accumulated. When pits of rock migrate to a different environment (on a river bank where it is washed by water more frequently), positive conditions, which cannot be found on the monolith rock, may form for the existence of other calciphyte species.

Vegetation characteristics: both specific calciphyte species that are characteristic to this habitat and also vascular and bryophyte species that are characteristic to the adjacent grassland or forest habitats can be found on calcareous rock outcrops. The phytocoenosis is usually open – individual samples or small groups of plants occur. The most significant role is taken by bryophytes (*Fig. 8.4*).

Characteristics species: in addition to the rare species that have been mentioned above this habitat also includes vascular plants – *Cystopteris fragilis*, *Poa nemoralis, Hylotelephium maximum;* moss – *Encalypta streptocarpa*, *Homalothecium lutescens, Pohlia*, *Bryum, Tortula* and *Didymodon* genus species; lichens – *Polyblastia albida*, *Thelidium papulare*, *T.decipiens*, *Verrucaria marmorea*, *V.calciseda*, *Opegrapha rupestris*, *Aspicilia contorta*, *Hymenelia prevostii;* algae at the sites of spring overflow – *Hildenbrandia rivularis*, *Petalonema crustaceum*, *Scytonema julianum*; invertebrates – many animals whose body cover requires an increased content of calcium in the environment: *Diplopoda, Armadillidium spp., Truncatellina cylindracea, Trogulus tricarinatus.*

Umbrella species (typical species within the meaning of the Habitats Directive): *Asplenium* genus species, *Gymnocarpium robertianum*, *Didymodon spp.* genus moss, *Fissidens spp.* genus moss, *Gymnostomum calcareum*, *Myurella julacea*, *Collema spp.* genus species.

Variants: none.

Habitat quality

Minimum habitat requirements: all natural calcareous rocky slopes including their parts and limestone deposits that have been exposed as a result of human activities, if active limestone mining has been stopped and the vegetation that is characteristic to this habitat type forms on the calcareous rock.

Structural indicators: all indicators common to rock outcrop habitats.

Function indicators: all indicators common to rock outcrop habitats.

Restoration potential and quality improvement indicators: all indicators common to rock outcrop habitats.

Threats: all threats that are important for rock outcrop habitats, in addition – flooding of rocks.

Management: common to all outcrop habitats.

Similar habitats: 6110 *Rupicolous calcareous or basophilic grasslands of the Alysso-Sedion albi* – habitat is located on the upper part of the outcrop and its incline is below 45 degrees. Dolomitized sandstone belongs to 8220 *Siliceous rocky slopes with chasmophytic vegetation.*

Overlap with other habitats of EU importance: 9180* *Tilio-Acerion forests of slopes, screes and ravines* – calcareous rocky slopes can be located fully below the canopy - in such case 8220 is marked as a punctate or linear object. 7220 *Petrifying springs with tufa formation (Cratoneurion)* or 7160 *Fennoscandian mineral-rich springs and springfens* – if a rock is overflowed by a spring, both habitats are marked (spring is marked as a punctate object), however, species that occur in this area mostly represent the spring habitat. Calcareous rocky slopes located at the bottom of a river are classified as habitat 3260 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-batrachion vegetation*, while outcrops located on the river banks belong to habitat 8210 *Calcareous rocky slopes with chasmophytic vegetation.*

Corresponding specially protected habitats in Latvia: 8.15. Calcareous rock outcrops.

Figure 8.5. Although soil that is uncovered as a result of soil erosion, is calcareous, its structure is too loose with no structures of solid rock and cannot be identified as the habitat 8210 *Calcareous rocky slopes with chasmophytic vegetation* (Photo: I.Rēriha).

Figure 8.6. Calcareous rock outcrop that is located on the river bottom, is classified as the habitat 3260 *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-batrachion vegetation*, but on the shores of rivers these outcrops form habitat 8210 *Calcareous rocky slopes with chasmophytic vegetation* (Photo: I.Rēriha).

Literature

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Latvijas PSR ģeogrāfija (1975) V.Pūriņa red. Rīga, Zinātne, 672 lpp.

Pakalne, M., Āboliņa, A., Pilāts, V. (2007) Iežu atsegumi un alas. Grām.: Bioloģiskā daudzveidība Gaujas nacionālajā parkā. Red. V.Pilāts, Sigulda, Gaujas nacionālā parka administrācija, 47.–51. lpp.

Piterāns, A. (2001) Latvijas ķērpju konspekts. Latvijas veģetācija 3, 5.–46. lpp.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T., Vitikainen, O. (2004) Lichen-forming and lichenicolous fungi of Fennoscandia, 359 p.

Skuja, H. (1936) Latvijas sporaugi. Latvijas zeme, daba un tauta. II sējums. Latvijas daba. Rīga, Valtera un Rapas akc. sab. apgāds, 52.–152. lpp.

8220 *Siliceous rocky slopes with chasmophytic vegetation*

Latvian habitat classification: H.1.1., H.1.3.

Syntaxonomy: communities that are characteristic to this habitat in the conditions of Latvia have not been described; vegetation is very unstable.

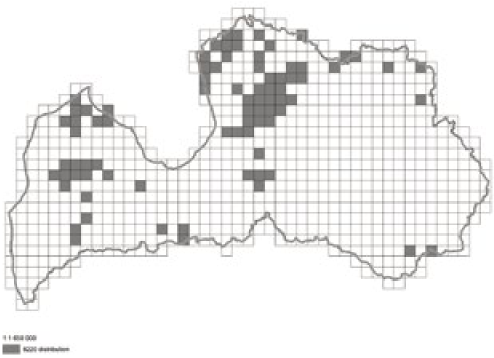


Figure 8.7. Distribution of the habitat 8220 *Siliceous rocky slopes with chasmophytic vegetation* in Latvia (Conservation status of.., 2013).

Definition: vegetation of fissures of siliceous inland cliffs, which presents many regional sub-types.

Figure 8.8. Outcrop with clay layers, rich admixture of clay particles and overflowing spring; located on the River Amata bank (Photo: I.Rēriha).

Specific characteristics of habitat interpretation in Latvia: as species can exist on almost all siliceous rocky slopes, conservation measures are applied to slopes that are currently not covered by vegetation. Dolomitized sandstone outcrops and their parts are also included in this habitat.

Distribution: very rare – mostly in river valleys (e.g., the Abava, the Gauja, the Salaca etc.) and also in valleys and gullies of small rivers, more rarely in relief cliffs that are overflown by small streams and rivers (e.g. Blue mountains in Slītere).

Conservation value: very rare habitat occupying only 0.52 km^2 of the territory of Latvia (Conservation status of.., 2013). Siliceous rocky slopes are ones of the few habitats for many species: vascular plants – *Equisetum scirpoides*; moss – *Tortula lingulata*, *Jungermannia hyalina*, *J.sphaerocarpa*, *Anastrophyllum minutum*, *Bartramia pomiformis*, *Seligeria campylopoda*, *Saelania glaucescens*, *Fissidens pusillus*, *Gymnostomum calcareum*, *Gyroweisia tenuis*, *Isopterigyopsis pulchella*, *Lophozia collaris*, *Diplophyllum albicans*; lichens – *Solorina saccata*, *Bryoria bicolor*, *Opegrapha caesareensis*, *Leproloma membranaceum*, *Cystocoleus ebeneus*, *Porpidia macrocarpa*, *Micarea lignaria*, *Lecanora umbrina*, *Hypogymnia vittata*, *Bryoria chalybeiformis*, *Caloplaca chrysodeta*; algae – *Schizotrix arenaria*, *Petalonema densum*, *Scytonema varium*. The geological value of siliceous rocky slopes is determined by their age, size, fossil inclusions, resistance towards external environmental factors (geological structure, cracks, exposition etc.).

Environmental factors and processes with a functional role: siliceous rocky slopes are formed by more or less cemented sand, quartz and feldspar rocks. The binding agent between the rock grains can be iron hydroxides or carbonates (calcite, dolomite), which determine the chemical reaction of the substrate and also its looseness/hardness. A humus layer can form above the outcrop, however, not inside the rock. Siliceous rocky slopes can be found on more or less vertical relief forms (*Fig. 8.9*). Formation of new outcrops is related to wash-out of gullies and processes of soil erosion. In rare cases dolomitized siliceous rocky slopes can be located at the bottom of a river (e.g., Swedish ditch waterfall in Slītere National Park). If larger or smaller cemented pits with moss vegetation of the outcrop have broken off, the habitat conforms to the criteria of 8220 *Siliceous rocky slopes with chasmophytic vegetation*. In some cases siliceous rocky slopes can have a layered structure of clay interlayers or admixture of clay particles (*Fig. 8.8*). Siliceous rocky slopes can be similar to open patches of soil that have formed as a result of erosion of relief slopes (*Fig. 8.10*). In such cases there are no dense, cemented rock structures neither in their upper layer, nor in the deeper layers; in majority of cases the presence of humus can be seen between sand or clay particles – such cases are not classified as 8220 *Siliceous rocky slopes with chasmophytic vegetation*. Occasionally species that are typical to siliceous rocky slopes (e.g., *Pohlia cruda*, *Encalypta streptocarpa* etc.) can be found on pronouncedly sandy soil outcrops – in such cases special attention should be drawn to the deepest layer.

Processes with a functional role: rather unstable plant communities, which are influenced by substrate landslides, accumulation of humus and the competition between species, form on siliceous rocky slopes. Pioneer species (algae, lichens, and characteristic species to the habitat) do not require a large amount of nutrients. Cyanobacteria have a high importance in cementation of the surface layer of siliceous rocky slopes, since they prevent the layer from crumbling (Skuja, 1936). When humus is accumulated, vascular plants as well as moss species and plants that are characteristic to forest habitats with wider ecological amplitude start to develop. Therefore landslides of the surface of siliceous rocky slopes is a positive occurrence in limited areas, since it reduces the amount of humus on the outcrop and forms conditions suitable to species with low competitiveness.

Vegetation characteristics: bryophytes have the determinant role in plant communities of siliceous rocky slopes (*Fig. 8.11*) as well as lichens and algae. Vascular plant species grow on siliceous rocky slopes in areas where humus has been accumulated. Usually these are plant species from the adjacent

Figure 8.9. Siliceous rocky slope – the Gūda Rock nearby the River Gauja. The intensive illumination prevents its overgrowing by moss and lichen (Photo: B.Bambe).

Figure 8.10. Siliceous rocky slope on the bank of the River Gauja - a result of erosion that cannot be classified as habitat *Siliceous rocky slope with chasmophytic vegetation* (Photo: V.Lārmanis).

habitats, including seedlings of forest plants. Very different plant communities that can consist of only one species or several dozens of species form on siliceous rocky slopes. Therefore a united vegetation classification of siliceous rocky slope habitats of Latvia has not been created.

Characteristic species: vascular plants (there can also be no vascular plants) – *Polypodium vulgare*, *Cystopteris fragilis*, *Oxalis acetosella*, *Galeobdolon luteum*, *Carex digitata*; moss – *Plagiochila porelloides*, *Conocephalum conicum*, *Pohlia cruda*, *Leptobryum pyriforme*, *Mnium marginatum*; *Bryoerythrophyllum recurvirostrum*; lichens – *Pertusaria amara*, *Peltigera leucophlebia*, *Bryoria bicolor*, *Bryoria chalybeiformis*, *Dibaeis baeomyces*, *Baeomyces carneus*, *Lepraria membranaceum*, *Lobaria scrobiculata*, *Baeomyces rufus*, *Hypogymnia vittata*; algae – *Cyanophyta* – species of gleocapsa genus *Gloecapsa rupestris*, *G.magma*, *G.montana*, *Gleothece rupestris*, *G.palea*, *Chroococcus varius*, *Schizotrix calcicola*, diatoms *Bacillariophyta* and *Chlorophyta*; invertebrates – bees that form separate caves and those which live in colonies; usually *Colletidae* and *Anthophoridae*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Tortula spp.*, *Didymodon spp.*, *Jungermannia spp.*, *Gymnostomum spp.*, *Scapania spp.*, *Mnium spp.* genus species.

Figure 8.11. Siliceous rocky slope by a river in the Nature Reserve Kaļķupe Valley in the vicinity of Vīdāle. The mixed forest above the outcrop, appropriate shading and beneficial hydrological regime provides great richness of plants on the outcrop (Photo: I.Rēriha).

Variants: none.

Habitat quality

Minimum habitat requirements: all siliceous rocky slopes with a dense structure on the rock surface or deeper layers or pits of a cemented siliceous outcrop. No humus between sand and clay particles is present or the humus has been accumulated only in the surface of the rock.

Structural indicators: all indicators common to rock outcrop habitats.

Function and process indicators: all indicators common to rock outcrop habitats.

Restoration potential and quality improvement indicators: all indicators common to rock outcrop habitats.

Threats: all threats important to rock outcrop habitats.

Management: the same as for all outcrop habitats.

Similar habitats: outcrops are similar to siliceous rocky slopes located on the coast of the sea (1230 *Vegetated sea cliffs of the Atlantic and Baltic coasts*); however, understanding of this habitat is limited by its geographical location.

Overlap with other habitats of EU importance: 7220 *Petrifying springs with tufa formation (Cratoneurion)* or 7160 *Fennoscandian mineral-rich springs and springfens* – if the rock is overflowed by a spring, both habitats are marked (spring as a punctuate object). 8310 *Caves not open to the public* – the entrance of a cave can be located in a wall of siliceous rock slope – in this case both habitats are marked. 9180* *Tilio-Acerion forests of slopes, screes and ravines* – siliceous rocky slope can be fully located under a tree canopy and in this case 8220 is marked as a punctuate or linear object.

Corresponding specially protected habitats in Latvia: 8.17. Limestone outcrops – limestone outcrops that are located by the sea coast are also included in this habitat within the Latvian protected habitats list.

Literature

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 160 lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Malta, N. (1925) Latvijas smilšakmeņa flora. Daba, 7, 219.–226. lpp.

Malta, N. (1926) Die Kryptogamenflora der Sandsteinfelsen in Lettland. Latvijas Universitātes Botāniskā dārza raksti. 1.1.

Pakalne, M., Āboliņa, A., Pilāts, V. (2007) Iežu atsegumi un alas. Grām.: Bioloģiskā daudzveidība Gaujas nacionālajā parkā. Red. V.Pilāts, Sigulda, Gaujas nacionālā parka administrācija, 47.–51. lpp.

Piterāns, A. (2001) Latvijas ķērpju konspekts. Latvijas veģetācija 3, 5.–46. lpp.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T., Vitikainen, O. (2004) Lichen-forming and lichenicolous fungi of Fennoscandia, 359 p.

Skuja, H. (1936) Latvijas sporaugi. Latvijas zeme, daba un tauta. II sējums. Latvijas daba. Rīga, Valtera un Rapas akc. sab. apgāds, 52.–152. lpp.

Аболинь, А. (1968) Листостебельные мхи Латв. ССР. Рига, Зинатне, 329 с.

Питеранс, А.В. (1982) Лишайники Латвии. Рига, Зинатне, 352 с.

8310 *Caves not open to the public*

Latvian habitat classification: H.2.1., H.2.2., H.2.3., H.3.5.

Syntaxonomy: plant communities are not present.

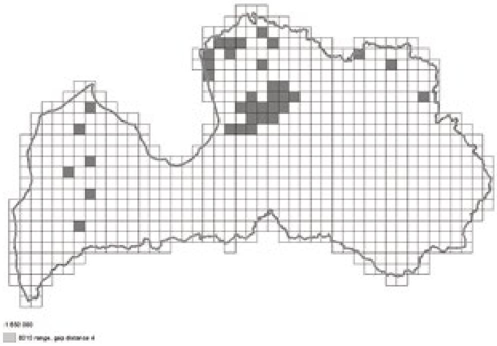


Figure 8.12. Distribution of the habitat 8310 *Caves not open to the public* in Latvia (Conservation status of.., 2013).

Definition: caves not open to the public, including their water bodies and streams, hosting specialised or high endemic species, or that are of paramount importance for the conservation of Annex II species (e.g., bats, amphibians).

Figure 8.13. Ellīte Cave is siliceous rocky slopes near Līgatne (Photo: A.Opmanis).

Specific characteristics of habitat interpretation in Latvia: Caves of a natural origin, which are at least 3 m long, are considered as this habitat type if there are at least two light zones (*Fig. 8.13*).

Distribution: very rare – on the banks of the River Gauja and its tributaries, the River Salaca basin, individual caves at by the River Venta, in the River Abava basin etc.

Conservation value: a very rare habitat, occupying a very small area of the territory of Latvia of 0.17 km^2 (Conservation status of.., 2013). Caves shelter animals and plants that have adapted to specialised conditions. The habitat is the only or one of the very few living environments that are suitable to several species: moss – *Schistostega pennata*; fungi – *Genea hispidula*, *Melanogaster ambiguus*, *Suillus cothurnatus var.hiemalis*, *Tomentella radiosa*; lichens – *Collema spp.*; spiders – *Nesticus cellulanus*, *Metellina merianae*. Caves are the only natural habitat for several specially protected bat species in Latvia. Drier caves are often populated by *Eptesicus nilssoni*, while caves with water-bodies and streams – by *Myotis mystacinus*, *Myotis brandtii*, *Myotis dasycneme*, *Myotis myotis*, *Myotis nattereri*, *Myotis daubentoni*, *Barbastella barbastellus*, *Pipistrellus pipistrellus*, *Vespertilio murinus*, *Pipistrellus nathusii*, *Eptesicus serotinus*, *Nyctalus leisleri* and *Nyctalus noctula*.

Environmental factors: caves in Latvia have formed as a result of suffusion (in siliceous rocks) and in rarer cases as a result of karst process (in calcareous rocks). Three different zones of light are formed in caves (euphotic or sunlight zone, disphotic or twilight zone and aphotic or midnight zone) that determine the possibility for organisms to exist in caves (Pakalne, Āboliņa, Pilāts, 2007). The number of species is higher near the entrance and, starting with higher taxonomic units, it decreases deeper in a cave. Plants and fungi occur mostly in siliceous rock caves since the formation of vegetation in dolomite caves is restricted by the high abundance of soluble inorganic salts and regular rock falls.

Processes with a functional role: washing out of caves is a positive occurrence, since it increases the habitat area. Rock falls, on the other hand, are considered negative occurrence, since it decreases the habitat area, delimits a cave section and interrupts the connection between species living in the cave and the outside.

Vegetation characteristics: vegetation is unstable. Vascular plants do not occur in caves. The most important role is played by algae and fungi (Piterāns, 2001; Santesson et al., 2004).

Characteristic species: moss – *Schistostega pennata*; fungi – *Laccaria fraterna*, *Roesleria pallida*; lichens – *Cystocoleus ebenus*, *Collema* and *Lepraria* genus species, algae – *Gloeocapsa alpina*, *Gloeocystis rupestris*, *Schizotrix calcicola*; animals – above mentioned species of spiders and bats.

Umbrella species (typical species within the meaning of the Habitats Directive): *Schistostega pennata*, bat species.

Variants: none.

Habitat quality

Minimum habitat requirements: caves of a natural origin, which are at least 3 m long if there are at least two light zones. Shorter caves or niches in the outcrop wall are not considered as this habitat (*Fig. 8.14*).

Structural indicators: all indicators common to rock outcrop habitats.

Function and process indicators: all indicators common to rock outcrop habitats; the presence of water-bodies and springs within the cave have the greatest importance.

Restoration potential and quality improvement indicators: all indicators common to rock outcrop habitats.

Threats: all threats common to rock outcrop habitats.

Management: habitat requires non-intervention.

Similar habitats: none.

Overlap with other habitats of EU importance: 8220 *Siliceous rocky slopes with chasmophytic vegetation* – the cave entrance can be located in the wall of siliceous rocky slope, and in such cases both habitats are marked.

Corresponding specially protected habitats in Latvia: 8.16. Undisturbed caves.

Figure 8.14. Niche at Stiglava siliceous rocky slope that does not belong to the habitat *Caves not open to the public*, since the depth of the niche is less than 3 m (Photo: A.Namatēva).

Literature

Krauze, I. (2010) Latvijas alas, http://www.alas.lv

Pakalne, M., Āboliņa, A., Pilāts, V. (2007) Iežu atsegumi un alas. Grām.: Pilāts, V. (red.) Bioloģiskā daudzveidība Gaujas nacionālajā parkā. Sigulda, Gaujas nacionālā parka administrācija, 47.–51. lpp.

Piterāns, A. (2001) Latvijas ķērpju konspekts. Latvijas veģetācija 3, 5.–46. lpp.

Santesson, R., Moberg, R., Nordin, A., Tønsberg, T., Vitikainen, O. (2004) Lichen-forming and lichenicolous fungi of Fennoscandia, 359 p.

Smaļinskis, J., Kušners, E. (1994) Latvijas smilšakmens un dolomīta alu faunas un floras izpēte. Līdzsvarota attīstība – Latvijas nākotnei. III. Zaļās loģikas konferences referātu krājums. Rīga, Gandrs, 67.–70. lpp.


Photo: V.Baroniņa

9. FOREST HABITATS

This habitat group unites nine forest habitats that include natural or semi-natural forests. Habitats 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* and 6530* *Fennoscandian wooded meadows* are closely related to forest habitats, although they represent two other habitat groups, therefore some of the issues that are discussed in the introductory of the forest habitats part also refer to these habitats.

Differences in opinions regarding the identification of EU forest habitats

Forest habitat descriptions included in the Interpretation manual of European Union habitats (Interpretation manual.., 2013) have been developed from different perspectives (Evans, 2006). Compared to other habitat groups, an exact compliance of vegetation to syntaxonomic units has been more rarely put on the foreground regarding forest habitats that are related to Latvia. For example, it has been defined unclearly for such habitats as 9010* *Western taiga* and 91D0* *Bog woodland* (Priedītis, 2002). In several descriptions significant attention has been drawn to the relation of a habitat to specific humidity conditions (9080* *Fennoscandian decidous swamp forests*, 91D0* *Bog woodland)* or their location adjacent to rivers (91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae),* 91F0 *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)*. For habitats 9060 *Coniferous forests on, or connected to, glaciofluvial eskers* and 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* the most important factor is their position on a specific geological base. Occasionally in nature it can overlap with the factors characteristic to habitat 9010*. In two cases – 9010* *Western taiga* and 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* – the naturalness of a forest has been particularly emphasized, mostly the indications of a natural forest structure, role of natural disturbances, presence of elements of a natural forests in a habitat are described and not only related plant, but also fungi, lichen and animal species are specified. For the habitat 9010* *Western taiga* its compliance with any syntaxonomic groups has not been specified and only its name indicates its compliance to the very diverse class of Boreal forests.

Specific characteristics of interpretation of forest habitats in Latvia

The official list of forest habitats of EU importance in Latvia that determines which habitats have and have not been described in this manual, only partly complies with the actual situation in nature. The reason is the fact that historically Latvia has had a very limited number of comprehensive studies and experts in this field. It is currently known that, in addition to habitats that are included in the official list, several other habitats of EU importance, such as 9050 *Fennoscandian herb-rich forests with Picea abies*, 9070 *Fennoscandian wooded pastures,* can be found. It is discussed that from the point of view of vegetation a wide area of inland dunes actually host forests that conform with the description of habitat 91T0 *Central European lichen pine forests* and the only non-conformity with the Interpretation manual of European Union habitats (Interpretation manual.., 2013) is the "Central Europe" that has been included in the original habitat name. Such deficiencies in the habitat list have had a significant impact on the descriptions of forest habitats that are included in this manual and the practical habitat mapping in Latvia. For example, according to the dominance of tree species that are typical to Boreal forests, habitats 9050 *Fennoscandian herb-rich forests with Picea abies* and 91T0 *Central European lichen pine forests* are currently mapped as the habitat 9010* *Western taiga* but only in cases when they comply with (P)WKH. All the other cases are not mapped. Meanwhile the habitat 9070 *Fennoscandian wooded pastures* is included in habitat 6530* *Fennoscandian wooded meadows*. It certainly influences the estimates of the overall amount of habitats in the country – if habitat 9050 was separated from 9010*, it could possibly be one of the most widespread habitats, therefore it would also influence the assessment of the total area of habitat 9010*.

Additional criteria and their application in forest habitat identification

In relation to all habitats of EU importance the Interpretation manual of European Union habitats specifies (Interpretation manual.., 2013) that these are natural or semi-natural forests and several additional criteria should be taken into account when identifying a habitat. It is further described how these criteria were applied in interpretation of forest habitats of EU importance within this methodology.

Forests with local tree species. Local Latvian tree species are dominant in all forest habitats of EU importance. There are cases when trees of introduced species are in admixture, however, they do not dominate and they are not the reason for the identification of a habitat of EU importance in nature. The proportion of introduced species in the undergrowth of partially degraded habitats of EU importance can occasionally be relatively large. For example, a markable undergrowth of *Amelanchier spicata* that indicates a lower quality of the habitat can be found rather frequently in the habitat 9010* *Western taiga* in the vicinity of urban areas.

Forests with a high degree of naturalness. In majority of cases the Interpretation manual of European Union habitats (Interpretation manual.., 2013) indicates such characteristics of forest habitats (plant species, their communities, growth conditions etc.) that can be found in substantially transformed forest stands, often such that can be comparable to plantations and certainly do not correspond to a high degree of naturalness from the ecological perspective, in the conditions of Latvia. This context has been determined by the development history of Latvian forests – almost always only local tree species are grown or establish in conditions that are mostly naturally appropriate for them. Wild plant species are sufficiently represented in most forests that allow them to be included in one or the other type of natural vegetation from the phytosociology point of view. However, such characteristics as diverse age structure of a forest stand, sufficient amount of natural forest elements (large sized dead wood, biological old trees etc.) that are essential for a natural forest as well as a long continuity of the forest cover can be found only in rare cases. Therefore a formal compliance with the description of a particular habitat is not a sufficient reason to consider a forest to have a high degree of naturalness. Further on, a more precise perception of the establishment of the habitat naturalness degree of EU importance in Latvia are provided.

9010* *Western taiga* and 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* are closely related to the presence of natural forest elements, natural structure of the forest stand and other characteristics, which are very similar to Woodland key habitats (WKH) or Potential Woodland key habitats P(WKH) (Ek et al., 2002; Lārmanis et al., 2000), which can generally be considered forests with a high degree of naturalness, in the Interpretation manual of European Union habitats (Interpretation manual.., 2013). Therefore, considering previous work, practical considerations and similar experience in the neighbouring countries, it has been assumed in the Latvian interpretation that these two habitats of EU importance comply with (P)WKH, allowing certain exceptions that are included in descriptions of particular habitats. All other descriptions of forest habitats of EU importance lack precise guidelines that could explain, directly or indirectly, the relation of these habitats to the criterion of the degree of naturalness (Interpretation manual.., 2013). In the Latvian interpretation it has been determined that sites whose content or functions are equal or similar to sites that have not been human-affected or sites that are irreplaceable for the protection of wild species of a habitat, can be identified as habitats of EU importance. This approach is based on the tasks of the Habitats Directive in relation to providing habitat status, which also includes provision of the status of wild

Table 9.1. Indicative relation of forest habitats of EU importance and 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* to the degree of forest naturalness.

No.	***Degrees of naturalness/habitats***	***9010****	***9020****	***9060***	***9080****	***9160***	***9180****	***91D0****	***91E0****	***91F0***
		Possible degrees of naturalness								
1.	(PWKH) regardless of their origin and the level of influence									
2.	Naturally restores, unmanaged forest stands on natural soils	Burnings								
3.	Forest stands of various origin on natural soils with elements or structures of a natural forest									
4.	All other forest stands with less pronounced naturalness indications than the previous									

species that are characteristic to the habitat (Council Directive 92/43/EEC..., 1992). An indicative relation between the degree of naturalness and habitats of EU importance is provided in *Table 9.1*. It is assumed that (P)WKH always conform with the first (the highest) degree of naturalness even if they are of artificial origin or have been affected. The second degree comprises forest stands that restored naturally in natural sites and have not been subject to cutting since restoration. These stands are mostly similar to situations that are possible in completely natural conditions. For example, a naturally restored and untended young forest stand in a bog (usually a habitat of EU importance 91D0* *Bog woodland*) can be identical to a situation in the first few decades after the occurrence of a great-scale natural disturbance in forests that have not been affected by humans from the ecological perspective. The third degree includes forest stands of natural and artificial origin in natural soils, where some elements or structures of a natural forest (dead standing trees, stools, fallen trees, snags, openings in tree canopy, flooded areas, stands with trees of varying ages etc.) are present. The fourth degree includes all situations where the characteristics of a natural forest are less expressed compared to the previous stages. Forests of this stage are possible in only one habitat of EU importance – 9060 *Coniferous forests on, or connected to, glaciofluvial eskers*, since the protection of this habitat is related to a specific ground vegetation, which has a small relation to a high degree of naturalness of forest stands and in the habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region*. The third degree of naturalness described in *Table 9.1*, is the "space", where forest stands that comply with the minimal criteria of forest habitats of EU importance border with situations that do not comply with them. When assessing the situation in nature, presence of individual elements or structures of natural forests should not be perceived as an automatic characteristic that allows each case to be identified as a forest habitat of EU importance. The amount of these elements and structures must be sufficient to generally characterize the habitat. When determining the degree of naturalness, it is assessed, whether the forest stand could host the same amount of wild species and ecological functions that would exist in a forest stand of similar soil, area and development stage that has not been human affected. If a stand conforms to such criteria, this forest stand can be considered to have a high degree of naturalness as it provides the same content and functions that would be present in a natural forest stand in similar conditions. Occasionally forest stands that have been subject to cutting or have been affected differently still possess a sufficient amount of characteristics that maintain the content and functions of this forest stand similar to the ones that are possible in natural conditions. It is not the identification of the fact that some trees in the forest stand have been cut, but the amount of characteristics of a natural forest that can still be identified, that is determinant. The decision may be influenced by the context of the surrounding environment – the conservation value of a set area is definitely higher if it borders with a habitat in a good quality – and by the criterion *Forests with significant areas* that is described below.

<u>Presence of old and dead trees.</u> This criterion is included in the previous criterion, since presence of old and dead trees is one of the characteristic features indicating a high degree of naturalness of a forest.

<u>Forests with significant areas.</u> The importance of a habitat area is viewed mostly in relation to landscape ecology and is not discussed in more detail in this methodology. It is determined that every forest stand that complies with the minimum quality requirements stipulated by descriptions of habitats of EU importance and has an area of at least 0.1 ha is to be considered suitable for registration as a habitat or EU importance. Area is used as a criterion for evaluation of the habitat quality. Historically this approach was applied when *Natura 2000* sites were designated, aiming to include larger continuous forest habitat areas or sites with a high concentration of fragments of forest habitat. When planning the practical nature conservation, the criterion of area could be a basis to identify areas that currently do not comply with the habitat requirements as habitats in order to consolidate fragmented situations and to refuse the protection of small habitat fragments with low functionality after extensive and overall assessments, based on reasons of landscape ecology.

<u>Forests, whose significance has been promoted by a long-term sustainable management.</u> A part of the former forest pastures could be considered forests that have been important in biodiversity conservation due to a long-term management in Latvia. Past pastures are significant as an environment where ecologically similar conditions to one of the natural disturbances – the impact of large herbivores – prevail. It is a prerequisite for the existence of wild species, including many specially protected species that are characteristic to scree forests. Formerly grazed forests have been identified as possible in several forest habitats and they are also included in 6530* *Fennoscandian wooded meadows*.

<u>Rare forests or forests that remain in a considerably small area compared to the initial area.</u> This criterion should be mostly viewed from the point of view of landscape ecology, the de-

scription of which has not been expanded in this methodology in relation to each individual habitat. 20% of the total potentially possible habitat area in a natural landscape are the marginal point to conclude that the number of species dependant on the particular habitat will disappear if the habitat area will continue to shrink (Angelstam et al., 2005) (unacceptable situation according to the requirements of the Habitats Directive (Council Directive 92/43/EEC.., 1992)). Each habitat of EU importance with its area below this mark is considered a habitat that has been preserved in a small area. For an approximate notion on this marginal point the totality of all habitats of EU importance that occupy approximately 4% of the territory of Latvia can be assessed in a simplified manner (Conservation status of.., 2013). Knowing that in natural conditions a forest would occupy 80% or more of the territory of Latvia (Priedītis, 1999) and that habitats of EU importance represent almost all forest types possible, it is obvious that the total area of forest habitats that has been preserved until today is significantly lower than the marginal point.

Forests that are habitats for specially protected species of EU importance. Habitat conservation includes protection of all wild species that are characteristic to the habitat. Therefore lack of specially protected species within a particular habitat cannot be the basis to consider any situation inappropriate for the habitat. Occurrence of specially protected species or European and national importance has been shown as an indicator that demonstrates a higher habitat quality – a higher importance of the site in the conservation of biodiversity is understood by it. Occurrence of a specially protected species can be an appropriate basis to recognize marginal circumstances, when a habitat barely meets the minimum quality requirements, as a forest habitat of EU importance.

Relation to Woodland Key Habitats

Forest Woodland Key Habitats (WKH) are defined as areas which contain habitat specialists that cannot sustainably survive in stands managed for timber production; a well-funded expectation that a habitat specialist exists within an area is a sufficient criterion for designating the area a Woodland Key Habitat (Priedītis, 2000; Ek et al., 2002). The so-called Potential Woodland Key Habitats (P) WKH are also identified – these are woodlands that may become WKH after a certain period of time, depending on the dominant tree species in a situation when the main management focus is put on biodiversity conservation (Ek et al., 2002). The identification of

Figure 9.1. Habitat 9010* *Western taiga* located in the Slītere National Park in the vicinity of Bažu swamp; the photo has been taken few years after a disturbance of a great intensity – fire (Photo: I.Rēriha).

(P)WKH has been described in a specific methodological material and in a manual (Ek et al., 2002; Lārmanis et al., 2000). The concept of WKH differs from the phytosociological approach; however, when identifying forests with the highest protection priority, both approaches complement each other (Prieditis, 2002).

The concept of (P)WKH and its previous incorporations have a triple practical significance in the interpretation of habitats of EU importance. Firstly, habitats 9010* *Western taiga* and 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* (with certain exceptions) are only considered habitats of EU importance if they conform both – to its description from a phytosociological perspective, and also to (P)WKH. Secondly, in determination of the quality of every forest habitat of EU importance, the criteria applied are almost the same as the ones that have been used until now to determine the conformity of a forest stand to (P)WKH. Thirdly, (P)WKH is an irreplaceable habitat for species specific to natural forests; therefore in cases when a habitat of EU importance conforms to the description only partially, including cases when the habitat has artificial origin or it is partially degraded, its compliance with the (P)WKH can be strong basis to consider a site to be compliant with the requirements of a habitat of EU importance. Occasionally (P)WKH are possible in situations when they are partially degraded or have an artificial origin if the prerequisites for the existence of WKH specific species are met – especially important separate elements of a natural forest have preserved in a woodland or a long continuity of the woodland or its separate elements can be identified. Species that are specific to WKH are wild species that belong to habitats of EU importance, however, compared to other species their populations are usually decreased to such extent, vulnerable and have such a low ability to spread, that the maintenance of their conservation status is possible only by protecting all habitats (including partially degraded habitats and habitats of artificial origin) – in a foreseeable future they are mostly irreplaceable and cannot be compensated by protection of other sites.

All (P)WKH that have been identified in nature during previous inventories correspond to a forest habitat or EU importance or a habitats of another ecosystem. The only partial exceptions can be applied to sub-types of (P)WKH – giant solitary trees and areas of beaver activity (Ek et al., 2002). Giant solitary trees are usually separate trees that do not form woodland and therefore cannot correspond to a habitat of EU importance. In some cases if this habitat has been associated with a group of trees rather than individual trees it can overlap with an afforested habitat 6530* *Fennoscandian wooded meadows*. Areas of beaver activity are not considered as ordinary forest stands, as they are subject to significant flooding that is initiated by beavers, typical features of these forests are their richness in woody debris and the occurrence of standing water. However, there are cases when they overlap with forest habitats of EU importance – if these stands are small and can be considered as an integral part of a larger habitat and if the flood has not resulted in destruction of all trees and the woodland, although more sparse, still continues to exist. From the perspective of biodiversity conservation priorities it should be emphasized that (P)WKH are included in areas of habitats of EU importance, representing relatively the most significant part of forest habitats of EU importance. The total area of habitats of EU importance is approximately 4% of the territory of Latvia (Report on implementation.., 2007), while (P)WKH that are a part of forest habitats of EU importance, have been identified in nature in an area of 57 110 ha (Valsts meža.., 2005) that is approximately 0.9% of the territory of Latvia or 22% of all forest habitats of EU importance.

Figure 9.2. The different age structure of this forest stand has formed by survival of a large number of pines in repeated fires, while the site has overgrown by a new generation of trees (Photo: A.Petriņš).

Processes with a functional role

Disturbances that influence forests in natural conditions and the succession that such processes entail are one of the most important processes that must be understood when identifying habitats and planning their conservation. In addition to the main natural disturbances that will be described further, several other processes take place in habitats that are not discussed in detail, e.g. – bogging-up, influence of floods, differing succession if a habitat forms as a result of afforestation of agricultural lands and swamps etc. The most important processes of such disturbances have been specified and their role has been explained in habitat descriptions. Artificial disturbances that have a negative impact on habitats have been described in the section "Threats".

Natural disturbances. Latvian forests are characterized by four main types of natural disturbances that have determined the structure and development of the forest and influenced the content of species historically.

- Rare disturbances of great intensity. Fires (*Fig. 9.1*), windfalls (*Fig. 9.4*) and massive insect damage belong to this type of disturbances. A disturbance is followed by a succession in all area that has been influenced – it usually starts with the stage of deciduous trees (in rarer cases also coniferous trees), which are then gradually replaced by coniferous trees and in the latest stage an old growth forest is formed with dominance of coniferous trees. Such disturbances (and the following succession) are mainly characteristic to the forests of the Boreal forest class that are located on more fertile or humid soils (Priedītis, 1999; Angelstam et al., 2005).
- Frequent disturbances of small intensity (cohort dynamic). Disturbances can be similar to the above mentioned (*Fig. 9.2*), however, with a lower intensity and after them the majority of the forest stand remains vital. For example, compared to swamp forests, fire encounter dry pine forests on mineral-soil more often, but in such environment the fire moves faster and its influence on tree roots is more shallow, as the layer of burning topsoil is shallow. Therefore the number of trees that survive this type of disturbance is higher. The succession is similar to the forests that encounter more intense disturbances; however, due to the larger number of living trees from the previous generation, its structure has more pronounced mosaic stands of different ages – cohort structure (Angelstam et al., 2005; Kuuluvainen, Akala, 2011). Fire limits formation of thick undergrowth and creates conditions for development of light loving ground cover vegetation and for species that live on tree stems. If disturbances occur frequently, the number of situations when the habitat reaches the same late development stage as in cases of rare disturbances is rarer; however, it is still possible. Frequent disturbances of small intensity are mostly characteristic to the forests of the Boreal class that are located on dry mineral soils but in rarer cases they can also occur in other conditions.
- Gap dynamics. In this case gap dynamics of a forest stand dominates (*Fig. 9.5*). It is a process where individual trees or small groups of trees die due to such disturbances as windfalls, snow breakages, due to insect damage, reaching the biological age of trees etc., revealing gaps in the canopy of the tree stand that afterwards overgrow with young trees, while new gaps emerge in other spots etc. A mosaic of forest stands of different ages and gaps, as well as the presence of standing and fallen trees in different stages of decomposition, are characteristic to these forests. Structure and elements form and transform very slowly; the change of tree species also is very slow (Priedītis, 1999; Angelstam et al., 2005). Therefore specific species that have adapted to a sustained stable environment occur in these forests – they have low distribution ability and poorly endure rapid changes in the environment. Gap dynamics is the determinant process in forests of the class of black alder swamps, in a part of the forests of the broad-leaved class and also in classes of Boreal coniferous forests (especially swamp spruce forests) in cases when a delayed great disturbance results in a long-term existence of the late phase of succession.
- Influence of herbivores. Large-size wild herbivores (aurochs, European bisons and horses) have had a significant ecological role in creating forest structures in natural conditions, especially in broad-leaved forests. Under their influence in a part of forests a mosaic of open grazed patches and park-type sites (6530* *Fennoscandian wooded meadows*) to thick woodlands existed with a gradual transformation of glades into woodlands and vice versa (Vera, 2000). Such landscape could simultaneously host woodlands that were not influenced by herbivores, whose inner structure was determined by the gap dynamics, as well as sparse grazed forest stands where well-illuminated tree stems served as habitats for light demanding epiphytic lichens and insects; sparse conditions also encouraged the growth of relatively thicker trees, which are important for species living in stems and tree hollows. The dominant role of wild herbivores in the development and formation of the structure of the ancient forests is also being questioned and there are valid arguments that support the dominant role of herbivores in formation of the ancient landscapes and a much wider distribution of partially-opened forests in Europe, and strong opposite arguments that argue

that the dominant role was played by thick closed forests, if formation of which *herbivores were not the most important factor* (Birks, 2005; Ozols, 2008; Emanuelsson, 2009). However, even if the herbivores did not have a major impact during the ancient times, it is now known that for several thousands of years up to nowadays a park-type landscape and sparse forests have been formed through interaction between nature and humans (Birks, 2005; UNESCO WHC, 2004; Vera, 2006; Emanuelsson, 2009), and these are one of the richest habitats in our climatic zone by the number of species (UNESCO WHC, 2004). It is likely that within the context of species and habitat conservation in Latvia the real distribution and significance of formerly grazed forests has not received a proportionally sufficient attention. Grazed forests in Latvia have been widely spread and existed for a long time (Dumpe, 1999; Vasiļevskis, 2007). Even in the middle of the 20th century it was possible to find grazed forests in many places in various forest types, including even oligotrophic pine forests (Ramans, 1958). Descriptions of Vidzeme inland vegetation by K. Ramans (1958) in the middle of the 20th century can be transferred to the present times with a high credibility – these indicate that long-term grazing has had a definite impact on sites that could currently be classified as forest habitats of EU importance: 9010*, 9020*, 9060, 9160, 9180, if these sites have not been cut down yet, but have been reforested with a thicker growth. This example does not characterize the situation in these habitats fully, however it shows that grazing has had an influence on these habitats at least in some cases (*Fig. 9.3*, *9.61*), and nowadays the old trees, that can still be found there, that have previously grown in sparser or open conditions are significant habitats for specially protected species related to sparse forests even at the moment and these old habitats are threatened by the suppressive negative influence of the younger surrounding trees.

Figure 9.3. Formerly grazed forest with vegetation characteristic to grasslands and a forest stand characteristic to Boreal forests (Photo: B.Bambe).

Figure 9.4. Habitat 9010* *Western taiga*, which has been affected by a natural disturbance – windfall – that still meets the minimum requirements for habitat (Photo: A.Namatēva).

Habitat quality

Minimum habitat requirements: specific for each habitat. One of the common features for all forest habitats is that when assessing the situation in every habitat, it is important to consider a wider habitat ecology, not only at the scale of one forest stand. For example, a forest stand that has suffered from a windfall or a massive insect damage can still be considered a habitat of EU importance from the ecological perspective, since the same damage is also possible in natural conditions (*Fig. 9.4*). It should also be considered, whether a forest stand is isolated or it borders a larger forest habitat. If a forest stand is connected to larger areas of forest habitats, exceptions can be made regarding the minimum quality requirements (they can be recognized as habitats in a relatively inadequate or poorer condition), since the stand is related to the surroundings by ecological functions, which are not present in a case of an isolated forest stand.

Forest habitat quality indicators: the principle of quality assessment is based on a comparison between the highest theoretically possible quality and the real habitat quality that can be identified in nature. In case of forest habitats it has been accepted that habitats that conform to a pristine WKH, have a higher quality. The more characteristics of a WKH (Appendix 3) are possessed by a habitat of EU importance, the higher is its quality. Therefore the majority of indicators used in the quality assessment are identical to characteristics that are used to determine the conformity of a forest to WKH (Ek et al., 2003). A list of quality indicators that are common for all forest habitats is further provided with short comments. Indicators that are specific only to individual habitats are presented and explained only in the descriptions of particular habitats.

Structural Indicators

Number of characteristic species. Characteristic species differ for each habitat and indicate the level of its conformity to the habitat description mostly from the perspective of phytosociology. The number of characteristic species depends on the set of environmental conditions that are characteristic to the habitat, its geographical distribution in the world and the location of Latvia in it, the overall vegetation history and the local history of the area. In the conditions of Latvia the characteristic species that are listed in the descriptions of forest habitats of EU importance can be mostly found in habitats of very different quality and even outside of them; however, at the highest degrees of habitat degradation the number of species tends to decrease.

Large-sized coarse woody debris. Coarse woody debris is a part of vegetation of a natural forest, and a large part of the diversity of forest species depends on it. Dead wood of a large diameter is of the outmost significance, since its micro-environment is more stable and sustainable when compared to thinner trees, therefore it can be a suitable habitat for a larger number of various organisms (Suško, 1998; Priedītis, 1999; Gmizo, 1999). When comparing the dimensions of lying logs, a significant difference that has an impact on the species diversity, e.g. ground snails, can be seen when the size of the deadfall was at least 20-25 cm (Gmizo, 1999).

Biologically old trees, large-sized trees or slowly grown trees of a small size. Similarly to the previous indicator, biologically old and large-sized trees have a significant role in improvement of the biodiversity of a forest. As in the case with large-sized dead wood, these trees are also a suitable environment for species that are characteristic to large-sized and old trees (Suško, 1998; Priednieks et al., 1998). Slowly grown small trees, which have existed in stable micro-climate conditions for a long time, also have a great value. Very often the stems and branches of such trees host an increased richness of epiphytic lichens. Slowly growing pines usually have a denser, highly resinous wood, therefore when they die off, a substrate that takes long to decompose, is formed.

Density of undergrowth and the second tree layer characteristic to the main habitat value. Each habitat has its natural characteristic density conditions of undergrowth and the second layer of trees that determine the characteristic illumination/shade of a forest stand. These conditions can be influenced adversely by cutting significant trees and shrubs as well as due to other negative factors or lack of natural disturbances that lead to overgrowing by excessively dense layer of undergrowth and the second layer of trees. When evaluating a habitat, it is necessary to firstly identify its relation to the main conservation value of a forest stand. The positive or negative impact of density or light conditions should be assessed according to the requirements of the main conservation value of a forest stand.

The age structure of a forest stand. A more diverse age structure of a forest stand is usually characteristic to stands that have not been affected by human activity in a long term; it is a positive indication that improves biodiversity.

Open gaps in the canopy and glades. Open gaps in the canopy (*Fig. 9.5*) and glades are characteristic to natural forests. Through these more sunlight reaches the lowest layers of the forest stand and it enhances the ecological niches that are available in the habitat. Namely, these are gaps in the canopy that have been created as a result of falling of separate large trees (with an extensive canopy) or a group of closely growing trees and also glades or different origin that exist within the forest stands. Falling of a separate average-sized or smaller tree usually does not create gaps of significant sizes; therefore it is not marked within this indicator.

Self-thinning. A process, which often takes place in thick and relatively young forest stands of the same age structure. It results in a greater amount of dead-wood.

Trees with woodpecker signs and hollow trees. This feature indicates the richness of insects in a forest stand, while the hammered and hollowed trees indicate the additional ecological niches in comparison to a forest stand where there are none.

Specially protected species and spiecies listed in the Red Data Book of Latvia. This feature shows higher significance of a forest stand in biodiversity conservation.

Indicator species and habitat specialists of WKH. The feature indicates the degree of naturalness of the forest stand and its significance in biodiversity conservation. The list of WKH species has been included in Appendix 3.

Function indicators

Impact of forest cutting. The more notable is the identified impact

of forest cutting in a habitat, the lower is the quality of a forest.
Appropriate soil humidity conditions. The more pronounced are changes in the hydrological regime that are not found in a habitat in natural conditions, the lower is its quality.
Area. The role of an individual forest stand in biodiversity conservation is more significant in stands with a larger continuous area.
Isolated habitats or a habitats within forest massives. Location of a habitat in a larger forest massive increases its stability and functional importance in the conservation of biodiversity that is dependent upon larger areas.

Restoration potential and quality improvement indicators

Habitat restoration possibilities are the greatest, when the restoration can occur naturally without human intervention. The restoration is more difficult if there is a need for one type of management measures, for example, cutting of expansive trees and shrubs, or imitating a natural disturbance – e.g. fire. Situations when a set of restoration measures is required are the most difficult ones. For example, cases when both restoration of the hydrological regime and cutting of expansive trees and shrubs is needed. The possible management activities are described in the section "Management".

Threats

Cutting of trees. Cutting of a forest habitat in a clear-cut is the most destructive type of forest cuts. The negative impact of selective cuts depends on their intensity. Securing a favourable conservation status to the majority of forest habitats of EU importance cannot be implemented when types of cuts of intensive forestry are used.
Limitations of natural disturbances. At present such natural forest disturbances as seasonal flooding, natural forest fires and influence of herbivores have been limited significantly or even completely prevented. Seasonal flooding, which is extremely important for river bank habitats, has been stopped by straightening and deepening of rivers. Forest fires are prevented by different barriers (roads, ditches and other non-forest lands), fragmented landscape and successful fire-fighting system. Large herbivores have been eliminated from the wild, and grazing of cattle in the forest, which has influenced forests for many centuries in a similar manner, has also almost disappeared. The prevention of such disturbances has resulted in overgrowing of former sparse forests by a thick undergrowth and second layer of trees. With forests becoming more shaded the vegetation changes and the sun loving species that are typical to sparse woodlands become more threatened. The distribution of

Figure 9.5. As a result of falling of a group of spruce, a gap has formed in the canopy of the habitat 9010* *Western taiga* (Photo: V.Lārmanis).

forest succession stages in time that are not suitable to natural conditions also have a significant impact. Due to a decreased impact of fires, pyrogenic species become endangered.
Changes in hydrological conditions. The most important cause of dangerous hydrological conditions is the drainage of bog and swamp woods. Drainage changes the characteristic species of the habitat and also reduces species diversity in a long run (Priedītis, 1993; Priedītis, 1999). Drained forests often overgrow by overly extensive undergrowth. Drainage is not always caused by intentional actions aimed to increase forest productivity. Habitats can suffer from an adverse impact from the ditches created to maintaining forest roads. In many sites the nearby forests have been drained after deepening of rivers and decreasing the water level of lakes. Habitats can also be threatened by an excessively high groundwater level or over-flooding. Such influence is usually caused by flooding that forms as a result of beaver dams; however, the runoff is also sometimes blocked by artificial barriers, for example, road embankments. Beaver activity as a threat to a habitat that has been greatly promoted by forest drainage. Nowadays due to the large amount of drainage ditches it is possible for beavers to create flooding in areas where it was not possible in natural conditions, since there were no watercourses – ditches – to be blocked.
Synantropization. This process is particularly characteristic to forests located near large cities and motorways. Changes in vegetation that endanger the habitat, are supported by accumulation of pollution in the soil, presence of alien species that have migrated from populated areas, and disproportionate increase in shrub density (Laiviņš, 1998; Priedītis, 1999).
Fragmentation. Continuous areas of a habitat are usually fragmen-

Figure 9.6. Spruces burned during a fire, while the older pines have survived. This process in natural conditions sustains the characteristic light conditions and the sparse conditions of Boreal forests that form an irreplaceable environment for many wild species that are currently endangered (Photo: V.Lārmanis).

ted due to clear cutting, however, a similar effect can result from all activities (drainage, overgrowing by shrubs etc.) that have a negative impact on the habitat and as a result of which the former continuous habitat area in its initial quality has been degraded to a separate habitat fragment. Ecological functions, number of populations of wild species and their resilience that are characteristic to the habitat decrease in limited and comparably smaller habitat areas.

Management

Within this chapter, management is defined as actions that are undertaken within the habitat area and are directed towards promotion of habitat conservation value. The issues of acceptable forestry activities, which can be important for coordination of nature conservation and economic interests, are not discussed in this section. For the provision of the common habitat functionality on a wider landscape ecology perspective on regional and national scale, measures outside habitat areas must be applied; however, this topic is not discussed here. It is possible to combine a set of management measures within the area of one habitat.

<u>Non-intervention.</u> Non-intervention in the natural processes of the habitat is the most appropriate management to the majority of habitats of EU importance, if they are in a good quality.

<u>Restoration of hydrological regime.</u> In praxis it usually means damming of drainage ditches. There are cases when restoration of hydrological conditions requires restoration of river curves in straightened rivers, promoting the impact of seasonal flooding. Destruction of beaver dams is an appropriate solution in areas that have been flooded due to beaver activity.

<u>Continuous cutting of expansive trees and shrubs</u>. Such measures are usually required in formerly sparse forests, where the overgrowth by shrubs or the youngest tree generation has started to endanger the valuable elements of the habitat – in such cases these can be considered expansive trees. From the ecological perspective these measures partly imitate natural disturbances – forest fires or the impact of herbivores – which make the forest sparser and ensure a better illumination to the ground cover vegetation and stems of the old trees. If this is the only measure carried out for habitat management, it can be considered as insufficient, since it covers a very narrow aspect of the natural disturbance and does not create all niches that would form during an actual natural disturbance. Former praxis shows that these measures can occasionally have a very temporary effect, as the areas that have been freed from overgrowth rapidly overgrow again. From the perspective of a long-term habitat management, this measure is considered only as the initial or interim measure, if a better imitation of the natural disturbance or a permanent management is not possible.

<u>Cutting of expansive trees and shrubs around individual trees of particular importance.</u> This measure has the same ecological value as the previous one; however, in this case the attention is drawn not on the habitat or some of its parts but on individual trees of the habitat. This measure is usually necessary in relation to trees that have grown formerly in open pastures, but have now grown into a forest.

<u>Controlled burning.</u> It is applied to the class of Boreal forests in areas where the main conservation value is endangered by overgrowing by shrubs or introduction of spruce (*Fig. 9.6.*) or for habitat formation/restoration in areas that currently host artificial forest stand structure formed as a result of artificial restoration and/or stand cultivation in commercial forests. It would be ecologically sound to implement only this measure in the relevant situations; however, for the reasons of fire-safety it can be sometimes necessary to cut the expansive trees to prevent the occurrence of an uncontrollable crown fire. Occasionally prior cutting of expansive trees can be based upon financial reasons, since the obtained wood can cover the management expenses.

<u>Grazing.</u> This measure is applicable in forests that have gained their conservation value as a result of long-term pasture of cattle when grazing is the most possible management approach in maintaining the conservation value. Normally this measure would be applicable to forest habitat 9070 *Fennoscandian wooded pas-*

tures. However, as it has not been included in the official habitat list of Latvia yet, current mappings of other forest habitats partly include sites of habitat 9070 where such management is needed. Grazing should be applied in the habitat on a regular basis. It is important to choose appropriate grazing intensity not to endanger the conservation value of the habitat. Simultaneously with starting the use of this measure it might be necessary to cut expansive trees and shrubs, if they endanger the main conservation value or are too large for herbivores to deal with them.

Consolidation of habitat fragments. The aim of this measure is to increase the speed of merging of separate habitat fragments to improve the restoration and stability of natural ecological functions, which are characteristic to a continuous habitat area (Ek, Bērmanis, 2004; Vilka, 2007). Forest stands that are located between fragments and have a structure and composition that is not characteristic to the habitat, can be left untouched for natural development if it is anticipated that after some time they will form similar to the habitat in a natural way. It is possible to speed up the process by the so called naturalisation. For example, an unmixed stand of coniferous trees of an artificial origin that is located between fragments of broadleaved forest can be thinned or open spaces can be created to speed up the development of broad-leaved tree species. This management activity can be topical for every forest habitats of EU importance.

Literature

Aizsargājamo ainavu apvidus „Ziemeļgauja" dabas aizsardzības plāns (2007) I.Vilkas red. Rīga, Latvijas Dabas fonds, 173. lpp.

Angelstam, P., Bērmanis, R., Ek, T., Šica, L. (2005) Bioloģiskās daudzveidības saglabāšana Latvijas mežos. Noslēguma ziņojums. Rīga, 96 lpp.

Birks, H.J.B. (2005) Mind the gap: how open were European primeval forests? Trends in Ecology and Evolution 20, 154–156 p.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Council Directive 92/43/EEC of 21 May 1992, on the conservation of natural habitats and of wild fauna and flora. In: European Community environment legislation. Vol. 4, 81–158 p.

Dumpe, L. (1999) Meža ganību izmantošana jaunos laikos. Grām.: Latvijas mežu vēsture līdz 1940.gadam. Rīga, WWF – Pasaules Dabas fonds, 305.–358. lpp.

Ek, T., Bērmanis, R. (2004) Dabisko meža biotopu koncentrācijas. Noteikšanas metodika. Valsts meža dienests, Latvija, akciju sabiedrība Latvijas Valsts meži, Latvija, Östra Götaland Meža pārvalde, Zviedrija. Rīga, 35 lpp.

Ek, T., Suško, U., Auziņš, R. (2002) Mežaudžu atslēgas biotopu inventarizācijas metodika, Rīga, Valsts meža dienests

Emanuelsson, U. (2009) The Rural Landscapes of Europe. How the man has shaped European nature. The Swedish Research Coubcil Formas, 383 p.

Evans, D. (2006) The habitats of the European union Habitats directive. Biology and environment: Proceedings of the Royal Irish Academy, vol. 106B, No. 3, 167–173 p.

Gmizo, I. (1999) Kritušu koku ietekme uz gliemežu skaitu un sugu bagātību. Bakalaura darbs. LU Bioloģijas fakultāte, Zooloģijas un ģenētikas katedra. Rīga

Interpretation Manual of European Union Habitats, EUR 28, April (2013), European Commission, DG Environment

Kuuluvainen, T., Aakala, T. (2011) Natural forest Dynamics in boreal Fennoscandia: a review and clasification. Silva Fennica 45, 823–841 p.

Laiviņš, M. (1998) Latvijas boreālo priežu mežu sinantropizācija un eitrofikācija. Latvijas veģetācija, 1, 137. lpp.

Lārmanis, V., Priedītis, N., Rudzīte, M. (2000) Mežaudžu atslēgas biotopu rokasgrāmata. Rīga, 127 lpp.

Priedītis, N. (1993) Latvijas purvainie meži un to aizsardzība. Rīga, WWF – Pasaules Dabas fonds, 74 lpp.

Priedītis, N. (1999) Latvijas mežs: daba un daudzveidība. Rīga, WWF – Pasaules dabas fonds, 209 lpp.

Priedītis, N. (2000) Meža ilglaicība un indikatorsugas. Biotopi. Grām.: Lārmanis, V., Priedītis, N., Rudzīte, M. (2000) Mežaudžu atslēgas biotopu rokasgrāmata. Rīga, Valsts meža dienests, 127 lpp.

Prieditis, N. (2002) Evaluation frameworks and conservation system of Latvian forests. Biodiversity and Conservation 11, 1361–1375 p.

Priednieks, J., Petriņš, A., Lārmanis, V., Vilka, I. (1998) Priežu mežu ornitofauna un mežsaimnieciskās darbības ietekme uz to. Mežzinātne 8(41), 84.–128. lpp.

Ramans, K. (1958) Vidzemes vidienas ģeogrāfisko ainavu tipoloģija. Pielikums kandidāta disertācijai. Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

UNESCO World Heritage Centre (UNESCO WHC) (1992-2013) Wooded meadows (Laelatu, Kalli-Nedrema, Mäepea, Allika, Tagamoisa, Loode, Koiva, Halliste), submitted by Estonian Seminatural Community Conservation Association, Date of Submission 06/01/2004. United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage tentative list. http://whc.unesco.org/en/ tentativelists/1854/

Valsts meža dienests, akciju sabiedrība Latvijas Valsts meži, Östra Götaland Meža pārvalde (Zviedrija) (2005) Dabisko meža biotopu apsaimniekošana Latvijā. Noslēguma pārskats. Rīga, 49 lpp.

Ozols, D. (2008) Pirmie dabīgās noganīšanas rezultāti divās teritorijās Ziemeļvidzemes Biosfēras rezervātā. Grām.: Aktuālā savvaļas sugu un biotopu apsaimniekošanas problemātika Latvijā. Red. A.Auniņš, Rīga, Latvijas Universitāte, 101.–110. lpp.

Pētera Stučkas Latvijas Valsts universitātes Ģeogrāfijas fakultāte, 359 lpp.

Suško, U. (1998) Latvijas dabiskie meži. Pētījums par bioloģiskās daudzveidības struktūrām, atkarīgajām sugām un meža vēsturi. Rīga, Pasaules Dabas fonds, 185 lpp.

Vasiļevskis, A. (2007) Lopu ganīšana valsts mežos. Grām.: Latvijas valsts mežu apsaimniekošana 1918–1940. Red. A.Vasiļevskis, Rīga, Nacionālais apgāds, 303.–304. lpp.

Vera, F. (2000) Grazing ecology and Forest history. Wallingford: CABI Publishing, 506 p.

Vera, F. (2006) Oak behaviour in relation to large herbivores. The Oak – History, Ecology, Management and Planning. Proceedings from a conference in Linkoping, Sweden, 9–11 May 2006.

9010* *Western taiga*

Figure 9.7. The habitat 9010 *Western taiga* of a high-quality located on a dry-land soil. All dead wood has very often been removed from the dry-land forests, however, even in this case a forest stand of this age and structure conforms with the habitat, but is of lower quality (Photo: V.Lārmanis).

Latvian habitat classification: Partially (only if they apply to (P)WKH, burned forests or forests that have naturally developed after fires) F.1.1., F.1.2., F.1.3., F.1.4.1., F.1.8.1., F.2.1.1., F.2.1.2., F.2.1.3., F.2.2.1., F.2.2.2., F.2.3.1., F.2.6.1., F.3.1., F.3.2.1., F.3.3.1., F.3.6.1.

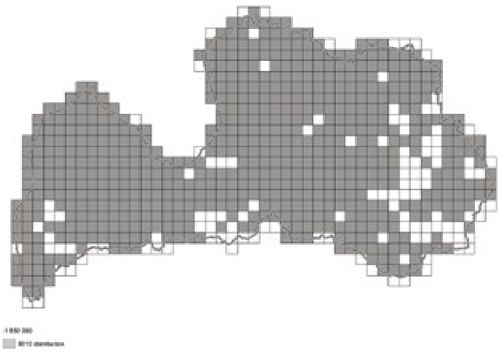


Figure 9.8. Distribution of the habitat 9010* *Western taiga* in Latvia (Conservation status of.., 2013).

Syntaxonomy: *Vaccinio-Piceetea*.

Definition: natural old forests and young forest stages naturally developing after fire. Natural old forests represent climax or late succession stages with slight human impact or without any human impact. Present natural old forests are only minor remnants of those originally occurring in their original distribution regions. With intensive forestry, the main features of natural old forests disappear, i.e. the considerable amount of dead and rotten wood, the great variant in tree age and length and species composition, the more stable microclimate. Old natural forests are habitats of many threatened species, especially bryophytes, lichens, fungi and invertebrates (mainly beetles). Some of the present old natural forests have human impact, but in spite of that they maintain many characteristics of the natural forests. Because of the important role of fire, burned forest areas and their young succession stages have been naturally common in the Boreal region. Nowadays they are extremely rare because of efficient fire protection. Natural, recently burned forest areas are very important habitats for many endangered species. Typical of natural burned areas is a great amount of dead burned wood and a varying density of living trees which greatly conditions the regeneration of the forest. The character of the forests varies with different Boreal zones (southern, northern etc.). Sub-types:

- natural old spruce forests;
- natural old pine forests;
- natural old mixed forests;
- natural old deciduous forests;
- recently burnt areas;
- younger forests naturally developed after fire.

Specific characteristics of habitat interpretation in Latvia: considering the ecological aspects specified in the description that indicate the characteristics of natural forests, it is assumed that this habitat complies to (P)WKH in nature. Burned forest areas are considered as this habitat even if they do not comply with (P)WKH. Forests that have been burnt by different fires (starting from a ground fire to crown fires) are accepted, as in unaffected nature it is also possible to distinguish different types of fires. To understand the borderline when a forest restored after a fire still belongs to the sub-type '*younger forests naturally developed after fire*' that has been specified in the Interpretation manual of European Union habitats (Interpretation manual.., 2013), it is accepted that this sub-type includes forest stands that have not yet reached the quality of (P)WKH, have developed after a fire and have not been disturbed by forestry. Therefore all forests that have reached the quality of (P)WKH automatically belong to the category of old forests, while the "younger forests" can theoretically be even 100 years old if they have developed naturally, but do not yet conform to (P)WKH.

Distribution: a rather rare fragmented distribution across the whole country – it has been assessed that it occupies 0.5% of the territory of Latvia (Conservation status of.., 2013).

Conservation value: this habitat is a small, yet the most significant part of the most abundant forests in Latvia Boreal forests on soils with changing humidity to dry soils. The conditions characteristic to natural habitats are mostly present and they are an irreplaceable habitat to several species specific to primary forests that cannot exist in managed forests.

Figure 9.9. Variant of the habitat on drained soils. The former ground cover of a bog woodland has transformed and is now similar to dry soil forests (Photo: V.Lārmanis).

Figure 9.10. Forest, which has recently encountered fire (Photo: S.Ikauniece).

Environmental factors: Usually found, well-drained to periodically humid mineral-soils that are poor to rich in nutrients. Occasionally also found in forests on drained soils that have encountered a significant mineralization of peat layer and the vegetation conforms with the habitat description (*Fig. 9.9*). Relief and vicinity of water do not have a qualifying influence on the identification of the habitat.

Processes with a functional role: in natural conditions almost any type of natural disturbances are possible in this habitat, except for the influence of significant seasonal flooding and impact of herbivores. The drier is the site, the more frequent are fires and their significance is higher (*Fig. 9.2.*). More humid sites, on the other hand, encounter fires more rarely and during the phases in between fires gap dynamics can dominate in a long-term (*Fig. 9.5. and 9.13.*). However, both processes can be found in the opposite conditions of humidity. Forest fires are the main process that forms a broader landscape in a long-term. Different stages of habitat succession can be found in sites where rare disturbances of great intensity dominate (*Fig. 9.1.*). Historically sparse forests were sometimes preserved in long-term by grazing, especially on the edge between a forest and agricultural land (Ramans, 1958). In such cases a great number of grassland species that are not characteristic to Boreal forest herb layer can have a significant role (*Fig. 9.3.*). Nowadays significant processes within the habitat, for example, overgrowing by shrubs (Laiviņš, 1998), are related to various threats.

Vegetation characteristics: generally the structure of the forest stand conforms to the character of natural disturbance and stage of succession. The ground cover vegetation in pine forests is usually homogenous, and dry soils are dominated by lichens, cowberries and heather, while richer soils or soils of higher humidity are dominated by bilberries. In general, a continuous lichen or moss cover is characteristic to pine forests. Forests of aspen or birch and mixed forests usually have a denser shrub layer, which is not pronounced in thicker spruce forests due to the poorer light conditions. Due to poorer light conditions the ground cover vegetation is sparser compared to pine forests, and moss rarely forms continuous growths (Priedītis, 1999). Elements such as dead wood, stands of different ages and others, that are characteristic to (P)WKH are significant in the habitat structure (Ek et al., 2002). Dry pine forests often lack dead wood in the form of fallen logs and snags, since they are often removed during selective cutting. Therefore the main characteristics of (P)WKH for these forests are the old age of trees that is indicated by relatively thick stems and rounded crowns. When evaluating the presence of deadwood, large dry branches on growing trees should be considered, occasionally old scars of resigned pines can have a similar significance. This habitat also includes development phases after forest fires. Separate patches in a site that has burnt recently can lack vege-

Figure 9.11. Younger forests naturally developed after fire (Photo: V.Lārmanis).

tation, however, in the first years after the fire the ground cover vegetation can be dominated by pioneer species characteristic to disturbed areas, for example, *Chamaenerion angustifolium*, in more fertile spots – *Rubus idaeus* etc. (Priedītis, 1999).

Characteristic species: plants of pine forests – *Pinus sylvestris*, *Vaccinium vitis idaea*, *Calluna vulgaris*, *Empetrum nigrum*, *Pleurozium schreberi*, *Cladina spp.*, *Cladonia spp.*; plants of spruce and mixed forests – *Picea abies*, *Pinus sylvestris*, *Betula spp.*, *Vaccinium myrtillus*, *Lerchenfeldia flexuosa*, *Maianthenum bifolium*, *Oxalis acetosella*, *Trientalis europaea*, *Dicranum spp.*, *Pleurozium schreberi*, *Hylocomium splendens*; plants of narrow-leaved forests – *Betula spp.*, *Populus tremula*, *Lerchenfeldia flexuosa*, *Vaccinium myrtillus*, *Agrostis tenuis*, *Equisetum sylvaticum*. Epiphitic lichens – *Evernia divaricata*, *Lobaria pulmonaria*. Moss on fallen logs – *Anastrophillum hellerianum*. Polypores – *Fomitopsis pinicola*, *Fomitopsis rosea*, *Phellinus populicola*, *Pycnoporellus fulgens*. Beetles – *Tragosoma depsarium*, *Cucujus cinnaberinus*, *Peltis grossa*, *Saperda perforata*, *Ergates faber*, *Nothorhina punctata*. Birds – *Picoides tridactylus*, *Dendrocopos leucotos*. Since the habitat is closely related to WKH, a significant role is also played by WKH indicator and specialist species and the specific species (Ek et al., 2002; Lārmanis et al., 2000). A list of WKH species is provided in Appendix 3.

Umbrella species (typical species within the meaning of the Habitats Directive)

General: *Bonasa bonasia*, *Dendrocopus leucotos, Dryocopus martius*, *Tetrao urogallus*, *Picoides tridactylus*, *Pteromys volans*.
Related to a late stage of succession and forests with gap dynamics: *Anastrophyllum hellerianum, Odontoschisma denudatum*, *Asterodon ferruginosus*, *Phellinus ferrugineofuscus*, *Phellinus nigrolimitatus*, *Fomitopsis rosea, Leptogium saturninum, Lobaria pulmonaria, Cetrelia spp*., *Nephroma spp*., *Ceruchus chrysomelinus, Clausilidae*.
Related to sparse oligotrophic forests and burned forests with light demanding species: *Pulsatilla patens*, *Dianthus arenarius*, *Arctostaphylos uva-ursi, Diphasium complanatum*, *Diphasium tristachyum, Chimaphila umbellata*, *Cladonia L.subgenus Cladina*, *Chalcophora mariana*, *Ergates faber*, *Nothorhina punctata, Melanophila acuminata, Tragosoma depsarium, Lacerta agilis*, *Coracias garrulus*, *Caprimulgus europaeus*.

Figure 9.12. Pine with a fire sign – a habitat-specific structure indicator. The fact that several pines have scars on one side of the stem is a strong indicator that the scars have been formed by fires unlike cases when an individual tree has such sign. Fire scars are usually formed on the leeward side. If there is only one tree with such sign, it can be a result of mechanical damage as long as remains of coal are absent from the scar (Photo: V.Lārmanis).

Figure 9.13. Habitat dominated by spruce. Stand also consists of pines, however, the main conservation value is related to shaded conditions, and therefore management measures are not needed (Photo: V.Lārmanis).

Variants:

9010*_1: typical variant. WKH that fully correspond to the description and are located on soils of dry or changing humidity in Boreal class forests.

9010*_2: partially corresponding vegetation. The first layer of trees only contains species characteristic to Boreal forests or species dominate, however admixture of some broadleaved trees is possible. The second layer, undergrowth and ground cover contains an admixture of Boreal forest species with broad-leaved, invasive or grassland species. A part of these cases may have formerly been forest pastures and now have overgrown with shrubs, and some of them are former Boreal forests in vicinity of large cities and motorways that have overgrown by shrubs as a result of eutrophication. When mapping habitats in such situations one should follow these guidelines: a) if the main conservation value of a forest stand is related to Boreal forests, for example, the most important role is played by very old pines and the stand is located in a larger forest area, the habitat should most likely be marked as 9010*; b) if the main conservation value is related to species of rich spruce forests, it should be marked as 9010*, since the official list of specially protected habitats in Latvia does not contain habitat 9050 *Fennoscandian herb-rich forests with Picea abies*, however, it should be added to the comments that the habitat actually belongs to 9050; c) if the main conservation value of a forest stand is related to broad-leaved forests, for example, when the first layer of the stand is dominated by pines, which have, possibly, populated an ancient meadow, while the second layer is dominated by broad-leaved trees and it is anticipated that the stand will develop in the direction of broad-leaved forest, then it should be marked as 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* or 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli*; d) if the structure of the stand (trees that have previously grown in open conditions, are branched and sparse) and its position (the vicinity of a field) indicate that previously the stand might have been a site of forest pasture, and if it is seen that a park-type landscape continues on the field, the habitat should be marked as 6530* *Fennoscandian wooded meadows* (9070 *Fennoscandian wooded pastures*); however, if a continuation of the park-type landscape cannot be seen or such observations cannot be made within the particular mapping task, the habitat 9010* should be marked, adding a comment that this area may have previously been a forest pasture, so that such information could be taken into account during further wider inventories.

9010*_3: drained soil. A habitat in forest stands located on drained soils, where a significant mineralization of the peat layer has taken place and the vegetation has developed towards dry-land Boreal forests and restoration of swamp forests without threatening the present specially protected species is not possible (*Fig. 9.9.*);

9010*_4: recently burned forests – sites where "black" burning marks or burned dwarf shrubs etc., can still be observed. They can include sites that correspond to (P)WKH (*Fig. 9.6. and 9.10.*);

9010*_5: younger forests naturally developed after a fire – older than the fourth sub-type, naturally developed after burning (burned trees have not been cut, young trees have not been planted etc.), but does not correspond to (P)WKH yet (*Fig. 9.11.*).

Habitat quality

Minimum habitat requirements: a habitat must correspond to (P)WKH that includes vegetation characteristic to Boreal forests. There can be exceptions regarding the correspondence of ground cover vegetation and shrub layer to forests of Boreal class, as it has been already described in variants 9010*_2 and 9010*_3. It is possible for a habitat to not correspond to (P)WKH, if it is a recently burned forest or a younger forest that has naturally developed after fire – in such case the interpretation regarding burned forests that is provided in section *Specific features on the habitat in Latvia* should be noted.

Structural indicators: all indicators common to forest habitats and an additional indicator – pines with fire signs (*Fig. 9.12.*).

Function and process indicators: all indicators common to forest habitats and an additional indicator – impact of fire (*Fig. 9.10, 9.11., 9.12.*).

Restoration potential and quality improvement indicators: considering the identified threats, it should be assessed the same way as for other forest habitats.

Threats: all threats common to forest habitats.

Management: depending on the main conservation value and the type of threat any forest habitat management approach can be applied (see the section Management in the introductory chapter). If the forest does not include fragments of the ancient cultural landscape, the appropriate management is non-intervention (*Fig. 9.13.*) or controlled burning, imitating the natural disturbances that are characteristic to the habitat. Controlled burning can also be used as a restoration measure in an area that does not meet the minimum quality criteria at the moment, for example, a forest stand with an artificial structure can correspond to a natural habitat after controlled burning. Sometimes there are opinions within the practical nature conservation in Latvia that cutting of expansive trees and shrubs and burning of forest stand are questionable activities, since the succession is a natural process that should not be altered. However, although the character of the succession conforms to the one that is present in natural conditions, nowadays, most probably, it takes place in unnaturally large extent, as the role of natural forest fires has decreased significantly. In addition, a practical issue of nature conservation exists – the shade created by new spruces and shrubs decreases the quality of habitats that host specially protected plant and animal species of well-lit forest habitats. Without cutting of expansive trees and scrubs and controlled burning it is impossible to ensure a favourable conservation status for these species and the habitat itself, since the condition of habitat and its characteristic wild species is closely related. More detailed technical references for the management of Boreal forests can be found in WKH management guidelines (Johansson, 2005).

Similar habitats: habitat 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* (*Fig. 9.17.*) the ground cover vegetation of which contains characteristics of both broad-leaved and Boreal class forests. It might be difficult to differentiate forests located on soils of changing humidity from habitat 91D0* *Bog woodland* especially due to the fact that both habitats belong to the same class of forests and under the influence of micro relief, small dry areas interchange with small overly humid sites. In both cases the determinant factor in habitat identification is – the dominance of which qualities prevail in the habitat. It can occasionally be difficult to differentiate the habitat from older situations of habitat 6530* *Fennoscandian wooded meadows* (9070 *Fennoscandian wooded pastures*) that have been afforested for a longer period of time. Practical suggestions on determining the difference between such afforested habitat with a restoration potential as 6530*/9070 from a habitat that is yet to be classified as forest habitat, are provided in the description of a particular habitat in section *Minimum habitat requirements.* Currently habitat 9050 *Fennoscandian herb-rich forests with Picea abies* is also mapped as 9010* and the existence of habitat 91T0 is also discussed, since both of these habitat types have not been included in the official list of specially protected habitats in Latvia. If a separate mapping and registration of 9050 and 91T0 will be established, it will be important to discuss the factors distinguishing them from 9010*.

Overlap with other habitats of EU importance: can overlap with habitats 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* and 9060 *Coniferous forests on, or connected to, glaciofluvial eskers*.

Corresponding specially protected habitats in Latvia: none.

Literature:

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Ek, T., Suško, U., Auziņš, R. (2002) Mežaudžu atslēgas biotopu inventarizācijas metodika. Rīga, Valsts meža dienests

Interpretation Manual of European Union Habitats. EUR 27 (2007) European Commission, DG Environment, 144 p.

Johansson, T. (2005) Dabisko meža biotopu apsaimniekošanas vadlīnijas. Valsts meža dienests, Latvija valsts akciju sabiedrība Latvijas Valsts meži, Östra Götaland Meža pārvalde, Zviedrija, Rīga, 37 lpp.

Laiviņš, M. (1998) Latvijas boreālo priežu mežu sinantropizācija un eitrofikācija. Latvijas veģetācija 1, 137 lpp.

Lārmanis, V., Priedītis, N., Rudzīte, M. (2000) Mežaudžu atslēgas biotopu rokasgrāmata. Rīga, 127 lpp.

Priedītis, N. (1999) Latvijas mežs: daba un daudzveidība. Rīga, WWF – Pasaules dabas fonds, 209 lpp.

Ramans, K. (1958) Vidzemes vidienas ģeogrāfisko ainavu tipoloģija. Pielikums kandidāta disertācijai. Pētera Stučkas Latvijas Valsts universitātes Ģeogrāfijas fakultāte, 359 lpp.

9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes*

Latvian habitat classification: F.1.8.3., F.1.6.1., F.1.8.2., partially F.1.4.2., F.3.5.1., F.3.5.2., F.3.6.2. and F.3.6.4., in cases where the tree species and understory vegetation are characteristic.

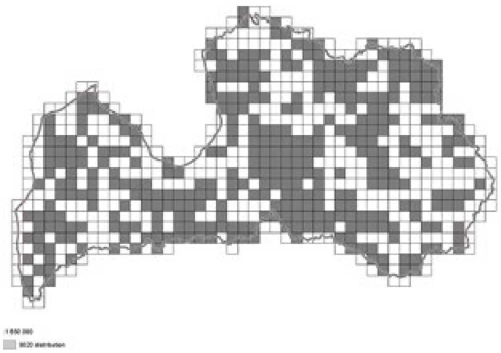


Figure 9.14. Distribution of the habitat 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* in Latvia (Conservation status of.., 2013).

Figure 9.15. The transition boreal-nemoral habitat is characterised by mixed broad-leaved tree species stands with individual boreal tree species (spruce) in the canopy and understory. Habitat 9020 *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* in the Nature Reserve "Paltupe forests" (Photo: S.Ikauniece).

Syntaxonomy: *Querco-Fagetea*.

Definition: hemiboreal natural old broad-leaved deciduous forests that form a transition between the Western Taiga and nemoral forest zones. The tree canopy layer is dominated by *Quercus robur*, *Ulmus spp.*, *Acer platanoides*, *Tilia cordata*, and *Fraxinus excelsior*. Any combination with of these species is possible. *Betula spp.*, *Populus tremula*, *Picea abies* or *Pinus sylvestris* can occur in mixed stands (*Fig. 9.15*). There is typically a considerable amount of dead wood in different stages of decomposition in the forest stands. The species diversity of lichens, fungi, insects and soil-organisms is high. In many cases the forests have previously been used as wooded pasture or for hay collection.

Specific characteristics of habitat interpretation in Latvia: in Latvia, the dominant species in stands of this habitat may be aspen, birch or spruce, but where a distinct broad-leaved tree species subcanopy and/or understorey layer occurs, which will likely form the overstory layer in the future. The habitat can include forest stands that have been previously used as wooded pasture, but have been unmanaged for a longer period of time. Considering the level of forest naturalness, this habitat corresponds to woodland key habitat (WKH) or potential woodland key habitat (PWKH) criteria as defined in inventory methods (Ek, Auziņš, 2002) (*Fig. 9.16.*).

Distribution: rare in Latvia; mostly found in regions of the historical distribution range of broad-leaved forest – Zemgale, Lubāna lowland, central part of Kurzeme, Sēlija (south-western Latvia). Also occurs as small fragments in other areas.

Conservation value: a rare type of natural forest vegetation in Latvia, with an area of 8500 ha or 0.13% of Latvia (Conservation status of.., 2013). The habitat has many characteristics of an old-growth or natural forest – considerable amount of dead wood in different stages of decomposition, snags, biologically old trees, canopy gaps, etc. (Peterken, 1996). Such forests are rare in other parts of Europe where forestry has been intensive. During the last 100 years, the main goal of forest management on soils suitable for broad-leaved forests has been development of productive coniferous stands by promoting natural regeneration and planting of spruce after clear cutting. As a result, spruce stands with intermediate age are now found in large areas of fertile soils where mixed and deciduous (including broad-leaved) tree stands previously occured (Nilsson, 1997). With an increase in intensity of forestry in Latvia, a significant reduction in the total habitat area is possible. These broad-leaved forests are an important habitat and dispersal source for epiphytic lichens and moss, including specially protected species. The majority of protected species are specialists of old broad-leaved forests, for example, lichens – *Lobaria pulmonaria*, *Cetrelia spp.*, *Leptogium spp.*, *Parmeliella triptophylla*, *Arthonia byssacea*, *Collema spp.*, bryophytes – *Lejeunea cavifolia*, *Antitrichia curtipendula*, fungi – *Hericium coralloides*; vascular plants – *Cinna latifolia*, *Glyceria lithuanica*, *Poa remota*, *Dentaria bulbifera*, *Allium ursinum*. The habitat is also important for rare species of invertebrates, particularly beetles.

Figure 9.16. The habitat has a high degree of naturalness – the natural structure of the stand is formed by trees of various size, age and species; and many specialist epiphytes of natural forests – *Lobaria pulmonaria, Homalia trichomanoides* and *Neckera pennata.* Nature Reserve "Paltupe Forests" (Photo: S.Ikauniece).

Figure 9.17. Habitat in a small fragmented oak stand in the Nature Reserve "Audīle forests". In this case the proportion of oak in the stand is below 50%; if the proportion was higher the habitat would correspond to 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli (Photo: S.Ikauniece).*

Environmental factors: the climatic and soil conditions in Latvia are suitable for broad-leaved forests and therefore the area of this habitat type could be larger than at present. This is confirmed by historical data on species composition and distribution. The habitat is located on various topographical reliefs outside of river valleys on fertile mineral soils with dry moist conditions. It can also be located on drained wet fertile mineral soils and on fertile drained peat soils, where stand succession indicates development of a broad-leaved forest.

Processes with a functional role: the disturbances characteristic to the habitat are gap dynamics and the influence of large herbivores in previous wooded pastures. Disturbances of large scale and intensity are not common. Found in stands where no clear cutting has occurred during the past 70–100 years. The most significant process is gap dynamics, when one or several large trees suffer mortality by wind or due to other causes, creating an opening in the tree canopy (Angelstam, 2004). Due to natural processes the stand remains in a stage of complex development; as a result of natural mortality. Irregular gaps are formed, which are typically colonized by pioneer species, a broad-leaved tree species understory establishes, or in which growth of an already present broad-leaved understory is promoted (Johanson, 2002).

Vegetation characteristics: the habitat belongs to the class of European broad-leaved forests, therefore the herb layer is characterised by a spring aspect. The habitat has distinct ver-

Figure 9.18. The first layer of the habitat is dominated by *Populus tremula;* over-brush and ground cover hosts a mixture of habitat-specific broad-leaved forest species with species characteristic to boreal forest habitat of EU importance – 9010* *Western taiga*. It should be decided, characteristics of which habitat dominate (Photo: S.Ikauniece).

tical stand layers – in addition to canopy and subcanopy layers there is also a well-developed understorey of tree and tall shrub layers. Due to natural disturbances, the vegetation and tree camopy form a mosaic, the spatial pattern of trees is heterogenous with irregular groups of younger trees in the canopy; young trees may dominate, stand density may be low, and groups of understorey trees can occur. Considering that the habitat is located in the transition zone between boreal and nemoral forest zones, communities with species of boreal forests can be present, for example, *Picea abies*, *Trientalis europaea*, and *Maianthemum bifolium*.

Characteristic species: <u>trees</u> – *Quercus robur*, *Tilia cordata*, *Ulmus laevis*, *Ulmus glabra*, *Fraxinus excelsior*, *Populus tremula*, *Acer platanoides*; <u>shrubs</u> – *Corylus avellana*, *Lonicera xylosteum*, *Sorbus aucuparia*; <u>herbaceous plants</u> – *Allium ursinum*, *Anemone nemorosa*, *Lathyrus vernus*, *Milium effusum*, *Hepatica nobilis*, *Pulmonaria obscura*, *Mercurialis perennis*, *Galium odoratum*; <u>lichens and moss</u> – *Homalia trichomanoides*, *Neckera spp.*, *Anomodon spp.*, *Orthotrichum spp.*, *Arthonia vinosa*, *Lobaria pulmonaria*, *Arthonia byssacea*, *Acrocordia gemmata*.

Umbrella species (typical species as considered within the Habitats Directive): *Lejeunea cavifolia, Pulmonaria obscura, Anomodon attenuatus, Anomodon viticulosus, Anomodon longifolius, Neckera complanata, Neckera pennata, Lobaria pulmonaria, Galium odoratum, Lathyrus vernus, Clausilia cruciata, Bulgarica cana, Sanicula europaea, Poa remota, Dendrocopos leucotus*.

Variants:

9020*_1: typical variant – mixed broad-leaved forest on dry mineral soils. Forest stand consists of *Quercus robur*, *Ulmus spp.*, *Acer platanoides*, *Tilia cordata*, *Fraxinus excelsior* or any combination of these species. Forest stands with only *Fraxinus excelsior* occur in the Zemgale region. The mixed stands can include other species (*Fig. 9.15.*), for example, *Pinus sylvestris* or *Picea abies*;

9020*_2: forest stand is dominated by old *Populus tremula*, in some cases with other species. It can also be a mixed stand of *Populus tremula*, *Picea abies*, and *Betula spp*. Characteristic broad-leaved tree understory and spring aspect of the herb layer vegetation;

9020*_3: mixed forests on drained soils. Forests contain a combination of *Quercus robur*, *Ulmus spp.*, *Acer platanoides*, *Tilia cordata*, and *Fraxinus excelsior*. In some cases the stands can consist only of *Fraxinus excelsior*, and with *Picea abies*. The herb layer vegetation consists of characteristic species, and the development of the habitat is towards a mixed broad-leaved forest and is not affected by increased soil moisture;

9020*_4: mixed stands of pine and broad-leaved trees that have developed on former agricultural lands on soils suitable for broad-leaved species (meadows, pasture), where pine as the colonizing pioneer species forms the canopy layer and may dominate, but in all cases a characteristic subcanopy or understorey layer of broad-leaved species occurs and herb layer vegatation that is characteristic of the habitat has developed.

Habitat quality

Minimum habitat requirements: forest stand contains at least two species of broad-leaved trees and five herb and shrub species that are characteristic of the habitat; in some cases the forest stand can be formed only by *Fraxinus excelsior*. The habitat corresponds at least to a potential woodland key habitat (PWKH). Structure characteristic of a natural forest has formed – dead wood is abundant, and there are old trees and uneven tree age structure.

Structural indicators: all indicators common to all forest habitats and an additional indicator – richness of broad-leaved tree species.

Function and process indicators: all indicators common to all forest habitats and an additional indicator – impact of grazing.

Restoration potential and quality improvement indicators: related to absence of forestry activities (different types of cutting), which will lead to continuity of the characteristic forest stand composition and structure. If a habitat has been affected, given that non-intervention is continued, the characteristic structures will develop in a period of time that depends on the intensity of previous management. By applying non-intervention measures it is always possible to restore habitats that have poor quality. If a habitat has values that require management, restoration possibilities should be assessed in the same way as for other habitats.

Threats: all threats of common forest habitats are possible. The main threat is forestry management (cutting of any type and removal of dead wood), as the main value of a forest stand is the structures that are characteristic to biologically old forests, which can be removed during forest management. Habitat fragmentation and lack of appropriate structures endanger the existence of species characteristic of the habitat.

Management: all management measures suitable for forest habitats are possible, with the exception of *Continuous cutting of trees and shrubs that are unfavourable for the habitat*, and *Controlled burning*. The most common management measure is non-intervention; other approaches are rarely used.

Similar habitats: it can be difficult to distinguish from cases of 6530* *Fennoscandian wooded meadows* that have overgrown over a long period of time. The main characteristics for distinguishing habitat the overgrown meadow habitat is wide and branched tree crowns and trunks (see description of 6530*). If a habitat has a large number of oak and lime trees, it may be similar to the 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli* habitat¸ but in that case the proportion of oak or lime trees in the tree stand exceeds 50% (*Fig. 9.17.*). Habitat 9010* *Western taiga* also may be similar (*Fig. 9.18.*). In such cases the relative amounts of habitat characteristics of one or the other habitat in tree and vegetation layer is used for distinguishing the two.

Overlap with other habitats of EU importance: it is often possible for an old mixed broad-leaved forest 9020* to be located on slopes by rivers or lakes, or in ravine complexes with small periodically dry creeks, which are characteristics of habitat 9180* *Tilio-Acerion forests of slopes, screes and ravines*.

Corresponding specially protected habitats in Latvia: 1.6. Mixed broad-leaved forests.

Literature:

Angelstam, P., Kuluvainen, T. (2004) Boreal forest disturbance regimes, successional dynamics and landscape structure – a European perspective. Ecological Bulletins 51, 117–136 p.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 130.–131. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Ek, T., Suško, U., Auziņš, R. (2002) Mežaudžu atslēgas biotopu inventarizācijas metodika. Rīga, Valsts meža dienests

Ikauniece, S., Brūmelis, G., Zariņš, J. (2012) Linking woodland key habitat inventory and forest inventory data to prioritize districts needing conservation efforts. Ecological Indicators 14, 18–26 p.

Johanson, P.S., Shifley, S.R., Rogers, R. (2002) The Ecology and Silvicutlture of Oak. CABI., 523 p.

Laiviņš, M. (1986) Latvijas ezeru salu ozolu un liepu (Querco-Tilietum Laiv. 1983) mežu sabiedrības. Jaunākais mežsaimniecībā 28, 16.–23. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Nilsson, S.G. (1997) Forests in the temperate-boreal transition: natura and management features. Ecological Bulletins 46, 61–71 p.

Peterken, G.F. (1996) Natural Woodland: Ecology and Conservation in Northern Temperate Regions. Cambridge, UK: Cambridge University Press

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

Sakss, K. (1969) Dažas vērtīgākās platlapju sugas Latvijas PSR mežos. LLA. Raksti. XXVI sējums, 37.–44. lpp.

9060 *Coniferous forests on, or connected to, glaciofluvial eskers*

Latvian habitat classification: F.4.4., partially also F.1.1., F.1.2., F.1.8.

Syntaxonomy: *Dicrano-Pinion (Vaccinio vitis-idaeo-Pinetum var. Pulsatilla patens, Vaccinio myrtilli-Pinetum var. Pteridium aquilinum), Cytiso-Pinion (Melico nutantis-Pinetum), Piceion abietis (Melico-Piceetum)* (Bambe, 1999a; Kreile, 2003).

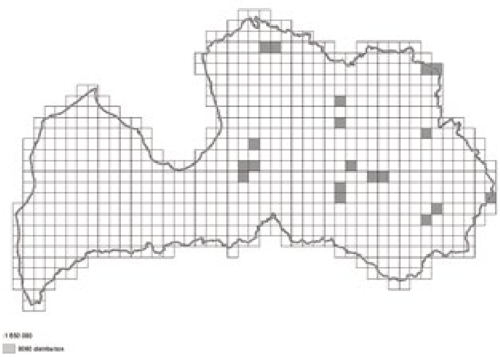


Figure 9.19. Distribution of the habitat 9060 *Coniferous forests on, or connected to, glaciofluvial eskers* in Latvia (Conservation status of.., 2013).

Definition: forest vegetation complexes found on or close to eskers. In particular the microclimate differs notably between shaded and sunny slopes and their foot, where the soil is occasionally influenced by spring outflows. Aspect and slope inclination, which reflect the effects of solar radiation and soil and air temperatures are important ecological factors. Flora and fauna are rich in specific species and contain species of dry grasslands and leguminous plants as well as some eastern steppe plant species.

Specific characteristics of habitat interpretation in Latvia: habitat is formed by a complex of plant communities that are dependent on the relief, therefore there are cases when one side of the esker has an expressed slope hosting characteristic species (usually on the south slope), while on the other side of the esker the relief declines gradually and plant communities may vary. In such cases the habitat borders are determined by the depth of glaciofluvial gravel sediments that are characteristic to glaciofluvial eskers.

Distribution: very rare, only in the central and eastern parts of Latvia. The most characteristic places – Nature Parks Ogres Zilie kalni, Driksnas sils, Numernes valnis; Nature Reserves Lielie Kangari, Grebļakalns, Andrupene (Birkmane, 1957; Birkmane, 1981; Jukna, 1979; Āboltiņš, Laiviņš, 1995; Шулц, 1975).

Conservation value: one of the rarest forest habitats in Latvia, occupying not more than 0.02% (approximately 14 km^2) of the territory of Latvia. The habitat is important to populations of rare species, especially for plants of ground vegetation and insects. The soil usually consists of sand and gravel of high economic value; therefore many eskers have been levelled. In boggy areas there are often roads built on the top of an esker. Eskers are also endangered elements of the landscape. Eskers host rare and specially protected plant species of Latvia: *Arenaria procera*, *Dianthus arenarius*, *Dracocephalum ruyschiana*, *Lathyrus niger*, *Onobrychis arenaria*, *Pulmonaria angustifolia*, *Pulsatilla patens*. The populations of rare plants are related to rare insect species that feed on these plants, especially butterfly species: *Agrodiaetus damon*, *Grapholitha caecana* and others.

Environmental factors: relief is the determinant factor – a range of hills or a bank of glaciofluvial origin (*Fig. 9.20.*) that have formed parallel to the direction of glacier movement. Since the soil can contain gravel or shingle, its pH reaction is weakly acid or neutral. In slopes that are well-lit by the sun the parameters of ground vegetation illumination and temperature of air and soil are higher than in forest plains. A set of the aforementioned factors creates environment for the growth of specific species.

Processes with a functional role: similar to Boreal coniferous forests, an ecologically significant role is played by forest fires that result in elimination of spruce and undergrowth while the pine-trees survive. As a result steep slopes encounter soil erosion due to the influence of water, which results in uncovered soil and gullies. Until the middle of the 20th century grazing in forests had a certain impact. In other European countries (Estonia, Finland) it is considered that grazing is essential to preserve light and warmth demanding species in forests on eskers (unpublished sources).

Vegetation characteristics: plant communities of oligotrophic and meso-oligotrophic coniferous forests and mixed forests where the tree layer is dominated by Scots pine or Norway spruce (*Fig. 9.21.*). Corresponds to classes *Vaccinio-Piceetea* and *Pulsatillo-Pinetea*. Undergrowth is usually sparse; however, in some cases it can be explicit. Herbaceous plants contain both species characteristic to coniferous forests and species that exist in grasslands and on woodland borders. The layer of ground vegetation of moss and lichen is similar to the ones present in coniferous forests; however, on steep slopes uncovered patches of soil that can develop that are then populated by colonist species.

Characteristic species: <u>on slopes illuminated by the sun</u> – *Pinus sylvestris*, *Juniperus communis*, *Antennaria dioica*, *Astragalus arenarius*, *A.danicus*, *Carex ericetorum*, *Chimaphila umbellata*, *Convallaria majalis*, *Festuca ovina*, *Fragaria vesca*, *Geranium sanguineum*, *Peucedanum oreoselinum*, *Polygonatum odoratum*, *Pyrola chlorantha*, *Silene nutans*, *Thymus serpyllum*, *Trommsdorfia maculata*, *Viola rupestris*; <u>moss layer</u> – *Pleurozium schreberi*, *Dicranum polysetum*, *D.scoparium*. <u>On shady slopes</u> – *Picea abies*, *Brachypodium pinnatum*, *Calamagrostis arundinacea*, *Lathyrus vernus*, *Melica nutans*, *Pteridium aquilinum*, *Rubus saxatilis* and *Hylocomium splendens* in the moss layer.

Umbrella species (typical species within the meaning of the Habitats Directive): <u>vascular plants</u> – *Arenaria procera*, *Dianthus arenarius*, *Dracocephalum ruyschiana*, *Lathyrus niger*, *Onobrychis arenaria*, *Pulmonaria angusti-*

Figure 9.20. A forest on a glaciofluvial esker nearby Andrupene (Photo: B.Bambe).

Figure. 9.21. Ground vegetation that is characteristic to forests on eskers in the Nature Park Driksnas Sils. It is dominated by *Geranium sanguineum* and *Convallaria majalis* (Photo: B.Bambe).

Figure 9.22. Forest on a glaciofluvial esker nearby Andrupene, in the territory of Rāzna National Park. On the northern slope of the ridge the Scots pine, Norway spruce and undergrowth hazel can be found, while the ground vegetation in dominated by bracken and there is a large variety of flowering plants (Photo: B.Bambe).

folia and butterflies *Agrodiadetus damon*, *Grapholita caecana*.

Variants: none.

Habitat quality

Minimum habitat requirements: Corresponding relief forms together with a forest, whose vegetation hosts at least 5 species that are characteristic to the ground vegetation of this habitat.

Structural indicators: all indicators common to forest habitats. An additional indicator – pines with burn scars (*Fig. 9.11*).

Function and process indicators: all indicators common to forest habitats. An additional indicator – impact of fires.

Restoration potential and quality improvement indicators: if a habitat hosts values that are in need of restoration, restoration possibilities are assessed in the same way as for all forest habitats. Restoration of vegetation is possible as long as the esker-type relief form is preserved. Natural regeneration of pines should be facilitated. Artificial regeneration of spruce on sunny slopes of esker-type relief forms is not acceptable.

Threats: from all of the threats common to all factors of forest habitats, this habitat is endangered by restriction of natural disturbances and synanthropization. In addition, the habitat is also threatened by establishment of gravel pits, since eskers are significant localities of gravel extraction. Another threat is the extension of lane width when reconstructing roads, as it is frequently characteristic for populations of valuable plant species to occur alongside roads. The habitat is also endangered by clear cuts and artificial restoration of clearings that are appropriate for pines with Norway spruce. Similarly to other oligotrophic habitats, esker forests have also been highly influenced by eutrophication during the last decades. As a result of eutrophication, increasing populations of Norway spruce (in some cases species of undergrowth shrubs) have been invading pine forests, oppressing light demanding species. These species become extinct or the population size and vitality decrease.

Management: cutting of inferior trees and shrubs in pine forests. Controlled burning and grazing of average intensity are acceptable.

Similar habitats: the vegetation on shaded slopes of esker forests can be similar to 9180* *Tilio-Acerion forests of slopes, screes and ravines* in cases when spruce is accompanied by broad-leaved trees. In this case the geological origin is determinant – esker type of relief. Relief shape and the forest stand can be visually very similar to habitat 2180 *Wooded* *dunes of the Atlantic, Continental and Boreal region*, however, as the geological origin, soil and ground vegetation are different, these habitats are never located nearby and cannot be mistaken.

Overlap with other habitats of EU importance: 9010* *Western taiga* if it is a woodland key or potential woodland key habitat or a forest influenced by fire; 7160 *Fennoscandian mineral-rich springs and springfens* – if at the foot of an esker type of relief a spring or spring mire that is rich in nutrients is located; 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae* – if there is a spring forming calcareous tufa.

Corresponding specially protected habitats in Latvia: 1.14. Coniferous forests on esker type of relief.

Figure 9.23. Forest ground vegetation on the southern slope of a glaciofluvial esker nearby Andrupene. *Dracocephalum ruischiana* flowers (Photo: B.Bambe).

Figure 9.24. A forest on a glaciofluvial esker nearby Andrupene, in the area of Rāzna National Park. Biodiversity of coniferous forests is increased by an admixture of deciduous trees, decaying branches and trees (Photo: B.Bambe).

Literature

Āboltiņš, O., Laiviņš, M. (1995) Grebļa kalns. Grām.: Latvijas daba. Enciklopēdija. Red. G.Kavacs, Rīga, Preses nams, 2, 123 lpp.

Bambe, B. (1998) Floristiski vērtīgi priežu meži Latvijā. Meža Dzīve 1, 22.–26. lpp.

Bambe, B. (1999a) Sausieņu priežu mežu augu sabiedrības paugurainēs un uz pauguru grēdām. Salaspils, Mežzinātne 8(41), 98, 3.–42. lpp.

Bambe, B. (1999b) Priežu mežu veģetācijas īpatnības uz osu grēdām. Zeme. Daba. Cilvēks. LU 57. konference. Rīga, 12 lpp.

Bambe, B. (2003) Osu meži. Grām.: Meža enciklopēdija. Rīga, Zelta grauds 1, 236 lpp.

Birkmane, K. (1957) Īss pārskats par Šķaunes osa veģetāciju. LPSR ZA Vēstis, 1957, 1

Birkmane, K. (1981) Šķaunes osa floras un veģetācijas pārmaiņas pēdējo divdesmit gadu laikā. Latvijas PSR floras aizsardzības aktuālās problēmas. Rīga, Avots, 20.–24. lpp.

Jermacāne, S., Laiviņš, M. (2001) Latvijā aprakstīto augu sabiedrību sintaksonu saraksts. Latvijas veģetācija 4, 115.–132. lpp.

Jukna, J. (1979) Ko vēstī Lielie Kangari. Rīga, Zinātne, 56 lpp.

Kabucis I. (red.) 2001. Latvijas biotopi. Klasifikators. Latvijas Dabas fonds, 96 lpp.

Laiviņš, M. (1998) Latvijas ziedaugu un paparžaugu augstākie sintaksoni. [Higher syntaxonomic units of plant communities of Latvia]. Latvijas purvu veģetācijas klasifikācija un dinamika. Latvijas Universitātes Zinātniskie Raksti. Rīga, 613, 7.–22. lpp.

Kreile, V. (1996) Madonas-Trepes vaļņa sauso priežu mežu veģetācija. Latvijas ģeogrāfu kongress. Tēzes un programmas. Rīga, 33.–35. lpp.

Kreile, V. (2003) Vegetation of dry oligotrophic pine forests in central and eastern Latvia. Acta Universitatis Latviensis. Earth and Environmental Sciences 654, 99–136 p.

Kreile, V. (2005) Dabas lieguma Posolnīca priežu mežu veģetācija. Ziemeļaustrumlatvijas daba un cilvēki reģionālā skatījumā. Rīga, Latvijas Ģeogrāfijas biedrība, 139.–141. lpp.

Zelčs, V. (1997) Oss. Grām.: Latvijas daba. Enciklopēdija. Red. G.Kavacs, Rīga, Preses nams, 4, 60.–61. lpp.

Шулц, А.А. (1975) Характерные черты охраняемого природного обьекта Греблякалнс. In: Охрана примечательных природных обьектов в Латвийской ССР. Рига, Зинатне, 83–99 с.

Figure 9.25. A forest on a glaciofluvial esker in the Nature Park "Driksnas sils". On the southern slope of the esker, *Convallaria majalis* can often be found in the ground vegetation of a coniferous forest (Photo: B.Bambe).

Figure 9.26. On the sides of roads that have been constructed on glaciofluvial eskers, similarly to forests in areas with a good illumination, rich growths of *Geranium sanguineum* are encountered (Photo: B.Bambe).

9080* *Fennoscandian decidous swamp forests*

Latvian habitat classification: F.2.4.1., F.2.4.2., F.2.4.3., 2.3.3., F.2.3.4., F.2.5.1., F.2.5.2., partially also F.3.4.1., F.3.4.2., F.3.5.1., F.3.5.2., if the stand is developing towards a deciduous swamp forest.

Syntaxonomy: belong to the European-Siberian alder swamp communities of the Class *Alnetea glutinosae*.

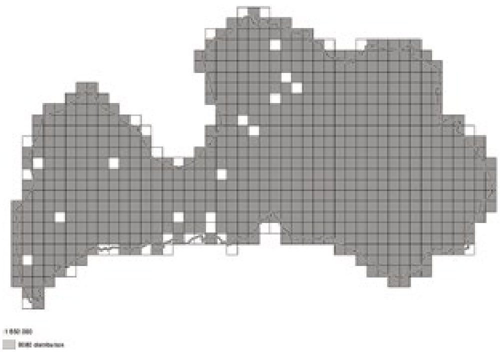


Figure 9.27. Distribution of the habitat 9080* *Fennoscandian decidous swamp forests* in Latvia (Conservation status of.., 2013).

Definition: deciduous swamps are under permanent influence of surface water and usually flooded annually. They are moist or wet, wooded wetlands with some peat formation, but the peat layer is usually very thin. *Fraxinus excelsior* and *Alnus glutinosa* are the most typical tree species. *Alnus incana*, *Betula pubescens* and *Salix spp*. are also common. A mosaic of patches with different water level and vegetation is typical for the type (*Fig. 9.29.*). Around the tree stems are small hummocks, but wet flooded surfaces are dominant.

Specific characteristics of habitat interpretation in Latvia: the habitat includes not only alder swamps but also swamps with other deciduous trees located on peaty soils of various depth: wet mineral soils and wet peat soils. The type also includes habitats that have been degraded as a result of drainage, if characteristic of natural forest structures that are important for biodiversity are present and if habitat restoration is possible after implementation of management. One of the variants of the habitat is its early successional stage: overgrowing of wet meadows, lakebeds or riverbeds.

Distribution: rather rare in Latvia. The southern part of Latvia along with areas in Lithuania, Belarus, Eastern Poland and North-West Ukraine are the most favourable regions for growth of alderin its distribution range.

Conservation value: relatively rare type of natural forest vegetation in Latvia; occupies approximately 225 km^2 or 0.3% of the area of Latvia (Conservation status of.., 2013). It is very rare in other parts of Europe. As a result of forestry during the last 50–60 years in Latvia, rather extensive habitat areas have been completely or partially degraded due to drainage. The habitat is important for specialist species adapted to stable microclimatic conditions. Species have adapted to stable conditions of moderate shading, consistently high air humidity and soil moisture, abundance of dead wood in various stages of decomposition, and regular inflow of nutrients by ground waters and seasonal floods (Priedītis, 1999). There are many specially protected species of epiphytic lichens and bryophytes that are closely associated with this habitat, for example, *Cetrelia spp.*, *Leptogium spp.*, *Arthonia spadicea*, *Jungermannia leiantha*, *Geocalyx graveolens*, and at spring outflows – *Trichocolea tometella*.

Environmental factors: the most important factor is the hydrological regime. These forests are located on fertile, rich, constantly or periodically wet mineral soils or constantly wet tree and sedge peat soils. They have developed as a result of groundwater flow, in areas of intensive outflows of groundwater, and often in floodplains of rivers and lakes. In degraded habitats the natural hydrological regime has typically been altered and partial mineralization of the peat layer has occurred.

Processes with a functional role: the habitat generally includes forest stands where natural disturbances do not have

Figure 9.28. A habitat with typical structures and flooding depressions, located at in the Nature Reserve "Dūre Forest" (Photo: V.Baroniņa).

Figure 9.29. Typical habitat landscape with two quality characteristics - flooded areas that are presently dry, while regular flooding is indicated by a less closed layer of ground cover and hummocks with alder (Photo: S.Ikauniece).

large scale and intensity. These are consistently wet forests that do not burn, are resilient against windfalls, and are adapted to regular water level fluctuations of various durations (Priedītis, 1999). Forest stands can include woodlands in different phases of succession. Gap dynamics is characteristic of the habitat. One of the most important prerequisites for habitat stability is a suitable hydrological regime and continuity of the tree layer. Gap formation occurs when a large tree or several trees suffer mortality due to wind damage or from other sources (Angelstam, Kuluvainen, 2004). Structures are formed during a long period of time, and the rate of development of structures is slow; replacement of tree species occurs very slowly as individual trees die. Trees with large diameter and uprooted trees are uncommon. Habitats in an early successional stage are in the initiation stage of rapid changes that are characterised by intensive inter-species competition.

Vegetation characteristics: the most significant characteristics are a mosaic vegetation pattern and varied microtopography (*Fig. 9.28., 9.29.*). There are no mono-dominant species in the moss and herbaceous plant layers. In the phase of habitat formation, the future species composition is mostly determined by that of the initial stage, but species composition may change when the stand becomes older. Variable moisture and shading creates suitable microhabitats for species with different ecological requirements. Light demanding species and species of dryer soils occur on hummocks, while species requiring wetter conditions occur in flooded depressions or on hummock bases. understorey vegetation layers can be lacking in depressions and flooded slacks. In degraded habitats, the microtopography is more variable, the species composition of the understorey vegetation has changed, and tree species are replaced in the canopy (increase in the proportion of *Picea abies*). During the habitat initiation stage, the mosaic structure of vegetation is not pronounced, and domination of individual species is possible (usually *Carex spp.*).

Characteristic species: herbaceous plants – *Solanum dulcamara*, *Dryopteris cristata*, *Lysimachia vulgaris*, *Carex elongata*, *Thelypteris palustris*, *Iris pseudacorus*, *Carex acutiformis*, *Galium palustre*, *Carex elata*, *Filipendula ulmaria*, *Lycopus europaeus*, *Cirsium oleraceum*, *Circaea alpina*, *Scirpus sylvaticus*. Moulds contain *Oxalis acetosella* and *Vaccinium myrtillus*. Bryophytes – *Calliergonella cuspidata*, *Plagiomnium elatum*, *Dicranum polisetum*, *Plagiochila asplenioides*, *Climacium dendroides*. On moulds *Rhytidiadelphus triquetrus*, *Eurhynchium angustirete*. Shrubs – *Frangula alnus*, *Ribes nigrum*, *Viburnum opulus*, *Salix cinerea*, *Salix aurita*, *Padus avium*. Trees – *Alnus glutinosa*, *Betula pubescens*, *Fraxinus excelsior*, *Picea abies*.

Umbrella species (typical species as considered within the Habitats Directive): *Arthonia spadicea*, *Jungermannia leiantha*, *Thelypteris palustris*, *Iris pseudacorus*, *Carex elongate*, *Carex acutiformis*, *Menegazzia terebrata*.

Variants:

9080*_1: typical variant (*Fig. 9.28., 9.29., 9.31.*) – forests on wet peat and mineral soils that are periodically flooded or situated in areas of groundwater outflows. Stable and late successional habitats in the complex development stage. Dominated by alder, downy birch, ash and an admixture of spruce. Typical vegetation structure of the habitat, hummock and depression microtopography, understory vegetation lacks a dominant species;

9080*_2: habitat initiation stage (*Fig. 9.30.*) – young forest stands with typical soil conditions and hydrological regime; often develop by overgrowing of wet meadows and lakebeds. The development of vegetation composition is on-going, and is in the initiation stage of succession. Understorey vegetation can be dominated by one or several species. Natural forest structure is developing – gaps, dead wood, including coarse wood debris, but dead wood size is relatively small;

9080*_3: habitat degradation stage – biologically old forest stands on drained wet mineral or peat soils, often dominated by alder or ash with birch and spruce. Corresponds to quality criteria of woodland key habitats (WKH). The characteristic structures, species and ecological processes are still present. The understory vegetation still contains the characteristic species of the habitat. Hummocks can be very pronounced, and high hummocks with trees have developed as a result of soil mineralization and collapse.

Figure 9.30. Habitat in which the initial succession stage is still continuing (variant - habitat initiation stage). The forest stand has relatively homogenous with pronounced dominance of one species in the understory vegetation (Photo: L.Salmiņa).

Figure 9.31. Typical habitat variant dominated by *Betula pubescens* (Photo: A.Auniņš).

Habitat Quality

Minimum habitat requirements: suitable soil moisture regime, vegetation structure (hummocks) and at least 5 characteristic species of the habitat in the forest herbaceous and shrub layers. The characteristic structure of a natural forest is forming – gaps, dead wood, trees of various age. In cases of the habitat degradation stage, woodland key habitat (WKH) criteria are met.

Structural indicators: indicators common to all forest habitats and two additional indicators – extent of hummocks, patches (depressions) regularly or continuously flooded.

Function and process indicators: indicators common to all forest habitats.

Restoration potential and quality improvement indicators: in all cases related to absence of forest management (various types of cutting) and maintenance of a suitable hydrological regime (no drainage management; beaver dams need to be destroyed and beaver population size regulated in cases where they have caused flooding), which will ensures the conservation of the structure that is characteristic of the habitat. If non-intervention measures are applied continuously, restoration of the habitat will eventually occur; the length of the restoration period depends on the extent of the previous alteration. It is always possible to restore the habitat by non-intervention in partially degraded areas, even when

quality is poor. Habitat restoration is possible in partially degraded areas, if the impact of drainage and the functioning of drainage systems has declined or stopped as a result of various reasons, as there is a possibility over time to restore the previous hydrological regime and ecological processes. It is possible to terminate habitat degradation and ensure the continuation of a natural development of the habitat if the former hydrological regime has been partially or completely restored (when function of drainage systems has stopped).
In cases of the degraded stage of the habitat, it is important to assess the occurrence and density of *Picea abies*, as this can be used to indicate the extent of the degradation, restoration difficulties and the functional quality of the drainage system. To assess the degree of difficulty of habitat restoration, indicators common to all forest habitats are used.

Threats: swamp forests are endangered by all threats common to forest habitats. Drainage is a particularly important threat. The goals of construction of land drainage systems in forests are to change the hydrological regime and drain surface waters, which frequently has an effect on groundwater flows. These goals contradict the ecological needs of this habitat, and it is usually impossible to find a compromise. Habitat quality is not only influenced by drainage systems located in the area of the habitat, but also by systems located in nearby areas, especially regarding the main ditches and other construction elements that affect the hydrological regime in a wider area. A similar effect can be created by construction of roads and other infrastructure objects that have an impact on the hydrological regime in the habitat or its adjacent area. A threat that occurs relatively more frequently than in other habitats is flooding. Unexpected flooding (for example, caused by beavers) or extensive clear cutting (results in the disturbance of the natural transpiration regime) can lead to a regressional development (regression) resulting in excessive wetness and dominance of *Salix*, *Phragmites australis* and sedges. This can affect regeneration of regeneration of alder and will result in replacement of the forest stand by shrubs or *Phragmites australis* (Priedītis, 1999). The habitat is negatively influenced not only by clear cutting but also by other types of cutting (selective cutting, thinning, sanitation cutting), which results in removal of dead wood, affects understory vegetation and creates larger gaps that are colonized by non-characteristic species of the habitat.

Management: some types of habitat management are possible, but not cutting of unfavourable trees and shrubs, controlled burning and grazing. Any type of tree cutting will affect the environmental conditions of the habitat and lead to changes in species composition of the understory vegetation. Non-intervention is the management approach that should be applied most frequently; restoration of the hydrological regime is often necessary, and other measures should be applied rarely. In almost all cases conservation of the habitat requires creation of a buffer zone around the habitat to reduce the edge effect and ensure stable micro-climate conditions (moderate shading, stable air humidity and soil moisture conditions). It is necessary to limit economic activities in the buffer zone and cutting of trees is unacceptable. The conditions of the site should be considered when determining the width of a buffer zone – usually the width can be up to 30 m.

Similar habitats: swamp forests corresponding to habitat 91D0* *Bog woodland* are located at the edges of bogs. The understory vegetation in this habitat consists of plants characteristic of bog, especially *Sphagnum*, and there is no groundwater inflow. Occasionally it can be mistaken for the habitat 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae)* if the stand is located in a floodplain and the tree stand is dominated by alder. In such cases the main difference is in the vegetation structure and species composition, which in the case of 91E0* corresponds to broad-leaved forest classes.

Overlap with other habitats of EU importance: 7160 *Fennoscandian mineral-rich springs and springfens* occurs frequently around spring outflows within habitat 9080* *Fennoscandian decidous swamp forests*, creating a complex type. There are specific cases when habitat 9080* is located in moist relief depressions within habitat 2180 *Wooded dunes of the Atlantic, Continental and Boreal region* (indicators to differentiate these cases are provided in the description of habitat 2180).

Corresponding specially protected habitats in Latvia: 1.11. Wet broad-leaved forests, 1.15. Swamp forests.

Literature:

Angelstam, P., Kuluvainen, T. (2004) Boreal forest disturbance regimes, successional dynamics and landscape structure – a European perspective. Ecological Bulletins 51, 117–136 p.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 144.–145. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Odiņš, J. (1971) Meža zemju hidrotehniskā meliorācija. Rīga, Zvaigzne, 385 lpp.

Prieditis, N. (1997) Vegetation of wetland forests in Latvia: A synopsis. Annales Botanici Fennici 34, 91–108 p.

Priedītis, N. (1999) Latvijas mežs: daba un daudzveidība. Rīga, WWF – Pasaules dabas fonds. 209 lpp.

Report on Implementation Measures under Article 17 of the Habitats Directive. Latvia 2001-2006 (2007), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17

9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli*

Latvian habitat classification: F.1.7.1, partially F.1.8.2., F.1.8.3., F.3.6.2., F.3.6.4., in cases of characteristic trees stand cpm-position.

Syntaxonomy: *Querco-Fagetea, Carpinion betuli, Querco-Tilietum*.

Definition: forests of *Quercus robur* on hydromorphic soils or soils with high water table (bottoms of valleys, depressions or in the vicinity of riparian forests). The substrate corresponds to silts, clayey and silt-laden colluvions, as well as to silt-laden alterations or to siliceous rocks with a high degree of saturation. Forests of *Quercus robur* or natural mixed forests composed of *Carpinus betulus* and *Tilia cordata*.

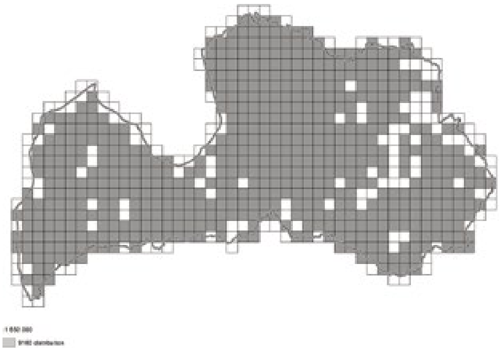


Figure 9.32. Distribution of the habitat 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli* in Latvia (Conservation status of.., 2013)

Specific characteristics of habitat interpretation in Latvia: forest stands that are dominated by oak, hornbeam, lime or a combination of these species correspond to the habitat. Interpretation of the habitat considers specific features in Latvia, which is geographically located in the transition zone between boreal and

Figure 9.33. Typical variant of the habitat 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli*, located in the Nature Reserve "Tebras ozoli". The herbaceous vegetation has a spring aspect that is typical of the habitat – *Anemone nemorosa* flowers (Photo: S.Ikauniece).

nemoral forest zones. Oak forests are often mixed with tree species common in boreal forests, and therefore an additional sub-type is defined as oak forests with a boreal vegetation in the understorey. The habitat type also includes periodically flooded oak forests located in lower floodplains. Non-typical soil moisture conditions may occur, if the habitat or surrounding area has been drained, rivers have been straightened or if the groundwater level has changed for other reasons. Structural elements of natural forests are characteristic of the habitat (dead wood, gaps, and trees of various ages). Forest stands that have been planted or otherwise resulted from forest management are included if the habitat corresponds to the minimum quality requirements.

Figure 9.34. Habitat 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli* located on Moricsala Island; dominated by *Quercus robur*, but the plant community also consists also of species that are characteristic of boreal forests. In cases where the forest stand is not dominated by oak, the habitat could be classified as 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* (Photo: S.Ikauniece).

Distribution: very rare. Forest stands with both *Carpinus betulus* and with *Tilia cordata* are found in the south-eastern part of Latvia. Small fragmented areas with *Tilia cordata* are located in the eastern part. The habitat also occurs on lake islands. Even though the distribution map based on the data base of the State Forest Register shows that the habitat can be found in large areas, these are often small oak stands that do not comply with the minimum quality criteria.

Conservation value: one of the rarest types of natural forest vegetation in Latvia, with an area of 6 434 ha or 0.1% of the area of Latvia (Conservation status of.., 2013). In Europe very few stands of the habitat are natural with minimal past human disturbance. Usually they are managed forests, and cutting of shrubs facilitates the development of the characteristic herbaceous vegetation. In Latvia, the stands have been less affected as management has been less. The habitat is important for species of epiphytic lichens and bryophytes, including protected species. Most of the specially protected species, for example, *Arthonia byssacea*, *Arthonia vinosa*, *Pertusaria pertusa,* are specialist species of old broad-leaved forests. The habitat is also important for rare invertebrates, especially beetles. The habitat can serve as a dispersal source for many species.

Environmental factors: in lowlands on alluvial clay deposits with moderately moist to moist loamy sand and clay loam soils. Also found on lake islands. Stands on drained wet fertile mineral soils are included, if the canopy layer is dominated by oak or lime or if the successional development is tending toward a broad-leaved or oak forest.

Processes with a functional role: An important process in the habitat is gap dynamics. In some cases past impact of herbivores is important, if the area has been used as wooded pasture. The most significant process is gap dynamics, which occurs when a large tree or several trees suffer mortality due to wind or other reasons, which results in the development of openings in the tree canopy (Angelstam, Kuvulainen, 2004). Natural disturbances of large scale and intensity are not characteristic of the habitat, but may be an important prerequisite for the regeneration of oak in the forest stand. As a result of natural processes, the stand is in a phase of complex development – irregular gaps in the stand are formed by mortality of trees; the gaps are then colonized by trees, often other broad-leaved tree species, creating a new age class. A stage of mixed development is possible, where the structure of a stand is mosaic formed by groups of younger trees located irregularly in gaps among older trees (Johanson, 2002). Human impact may have occurred due to recreation or felling of individual or groups of trees, leading to changes in tree species composition. Significant impact from recreation has occurred on lake islands by trampling, destruction of vegetation and loss of dead wood (campfires). With management by cutting of boreal tree species (e.g., spruce), typical vegetation of broad-leaved forest habitat can develop.

Vegetation characteristics: the habitat belongs to a class of European broad-leaved forests with rich herbaceous vegetation; a

Figure 9.35. Young oak stand characteristic of the habitat (Photo: B.Bambe).

Figure 9.36. Habitat variant with lime dominating in the forest stand, located on an island of Zvirgzdene Lake (Photo: S.Ikauniece).

spring aspect is characteristic of the vegetation. *Galium odoratum* is common. The tree canopy is often layered, with a well-developed understory of broad-leaved tree species and shrubs. The moss layer can be sparse. Regeneration with oaks does not occur, and broad-leaved tree species such as *Ulmus glabra*, *Fraxinus excelsior* and *Tilia cordata* often occur in the subcanopy and understory (Ikauniece, 2008). In the future, natural succession of the habitat to 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes* is possible. However, also included are intermediate aged oak and lime stands formed by trees with the same age, which have developed after large scale disturbance (windfalls, clear cutting); these stands have not reached the complex development stage (*Fig. 9.35.*).

Characteristic species:

herbaceous plants – *Anemone nemorosa, Stellaria holostea*, *Mercurialis perennis*, *Phyteuma spicatum*, *Pulmonaria obscura*, *Galeobdolon luteum*, *Corydalis solida*, *Polygonatum multiflorum*, *Lathyrus vernus*, *Galium odoratum*; lichens and bryophytes – *Homalia trichomanoides*, *Anomodon spp.*, *Eurhynchium angustirete, Antrichum undulatum*, *Plagiomnium undulatum*, *Arthonia vinosa, Arthonia byssacea, Acrocordia gemmata*; shrubs – *Corylus avellana*, *Lonicera xylosteum*; trees – *Quercus robur*, *Tilia cordata*, *Carpinus betulus*.

Umbrella species (typical species as considered within the Habitats Directive):

Arthonia vinosa, *Arhonia byssacea*, *Quercus robur*, *Galium odoratum*, *Stellaria holostea*, *Xylobolus frustulatus*.

Variants:

9160_1: typical variant – found in the southern part of Kurzeme; the tree stand consists of *Quercus robur* and *Carpinus betulus*, mixed with other species. The herbaceous vegetation is dominated by *Galium odoratum* and is characterised by seasonal development with a spring aspect;

9160_2: various successional and mixed variants; stands dominated by oak, hornbeam or lime, or a combination of these species (*Fig. 9.36.*). Oak stands of various age with characteristic natural structures of the habitat. Vegetation is characterised by species with a spring aspect and boreal species can occur (*Fig. 9.24.*);

9160_3: forest stand dominated by oak; spruce occurs in the subcanopy and understory; vegetation is characterised by species with a spring aspect, but with high occurrence of boreal species.

Habitat Quality

Minimum habitat requirements: forest stand is dominated by oak, hornbeam, linden or a combination of these species, and contains at least five characteristic species in the herbaceous and shrub layers. Natural forest structures have developed – dead wood, trees of various age, gaps in the canopy.

Structural indicators: indicators common to all forest habitats.

Functional and process indicators: indicators common to all forest habitats and an additional indicator – impact of past grazing.

Restoration potential and quality improvement indicators: associated with lack of forest management (different types of cutting). Non-intervention will ensure the conservation of the natural structures and passive restoration of the habitat. The time required for restoration depends on the extent of past effects. It is always possible to restore a habitat by non-intervention even in cases of poor quality. If a habitat has specific values that require management measures, possibilities of restoration are assessed in the same way as for other forest habitats.

Threats: oak forests are endangered by all threats common to forest habitats. The main threats are forest management (cutting of trees) and recreation (especially on lake islands). Natural succession is tended to development of mixed broad-leaved forests and decline of oak dominance. Natural succession can lead to development of habitats 9020* or 9010* (variant with respect to vegetation to habitat 9050 *Fennoscandian herb-rich forests with Picea abies*, which has not been included in the official list of habitats of Latvia).

Management: all types of forest habitat management can be applied, with the exception of controlled burning. The preferred management option is non-intervention, allowing natural development; other measures should be applied in rare cases. Additional studies on the effects of management, including thinning and cutting of spruce understory, on vegetation composition are required. Limiting and controlling recreational activities can be required if the vegetation has been excessively trampled and if dead wood or other structures characteristic to a natural forest are being destroyed. There may be a need for management in separate areas around biologically old trees by cutting of trees and scrubs for conservation of biological values and species habitats (particularly for rare species of beetles).

Similar habitats: it may be difficult to distinguish oak forests from overgrown habitat 6530* *Fennoscandian wooded meadows*, but stand density (oaks) of canopy trees is much lower in wooded meadows. In that case trees have low and wide branches and tree crowns are wide and very branched, and the herbaceous layer contains species that are characteristic of meadows (see description of 6540*). If oak stands are mixed with other species of broad-leaved trees, it might be difficult to distinguish older forest stands from habitat 9020 *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes*, but in that habitat the proportion of oak, lime and hornbeam is less than 50% in the stand (*Fig. 9.15*, *9.24*). If habitat 9160 is located on a river floodplain, it may be similar to 91F0 *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)*; for these differences see description of habitat 91F0 in section *Similar habitats*.

Overlap with other habitats of EU importance: there can be cases when typical vegetation of habitat 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli* occurs on slopes beside lakes and rivers or in ravine complexes; in such cases the habitat should be classified as 9180* *Tilio-Acerion forests of slopes, screes and ravines.*

Corresponding specially protected habitats in Latvia:
1.10. Oak forests.

Literature:

Angelstam, P., Kuluvainen, T. (2004) Boreal forest disturbance regimes, successional dynamics and landscape structure – a European perspective. Ecological Bulletins 51, 117–136 p.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 144.–145. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Ikauniece, S. (2008) Ozolu mežu struktūra un attīstības tendences Lubānas zemienē. Maģistra darbs. Latvijas Universitāte, Bioloģijas fakultāte

Ikauniece, S., Brūmelis, G., Kondratovičs, T. (2012) Naturalness of Quercus robur stands in Latvia, estimated by structure, species, and processes. Estonian Journal of Ecology, 61, 1, 63–80 p.

Johanson, P.S., Shifley, S.R., Rogers, R. (2002) The Ecology and Silvicutlture of Oak. CABI., 523 p.

Jones, EW. (1959) Biological Flora of the British Isles. No. 67. Quercus L. genus, Quercus robur L. and Q. petraea (Matt.) Liebl. (169–216 p.), Quercus borealis Mich. var. maxima Sarg. (p. 216), Quercus cerris L. (216–217 p.), Quercus ilex L. (218–222 p.). Journal of Ecology. 47, 169–222 p.

Laiviņš, M. (1986) Latvijas ezeru salu ozolu un liepu (Querco-Tilietum Laiv.1983) mežu sabiedrības. Jaunākais mežsaimniecībā 28, 16.–23. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Nilsson, S.G. (1997) Forests in the temperate-boreal transition: natura and management features. Ecological Bulletins 46, 61–71 p.

Peterken, G.F. (1996) Natural Woodland: Ecology and Conservation in Northern Temperate Regions. Cambridge, UK: Cambridge University Press

9180* *Tilio-Acerion forests of slopes, screes and ravines*

Latvian habitat classification: partly conforms with F.1.4., F.1.6., F.1.8., F.4.2.

Syntaxonomy: *Alno-Ulmion, Tilio-Acerion* (Laiviņš, 2000).

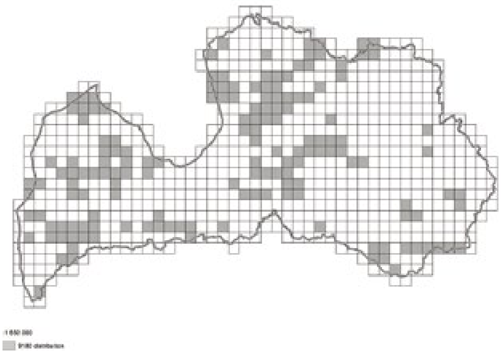


Figure 9.37. Distribution of the habitat 9180* *Tilio-Acerion forests of slopes, screes and ravines* in Latvia (Conservation status of.., 2013).

Definition: mixed forests with *Tilia cordata*, *Acer platanoides*, *Ulmus glabra*, *Ulmus laevis* and *Fraxinus excelsior* of coarse scree, abrupt rocky slopes or coarse colluvions of slopes.

Specific characteristics of habitat interpretation in Latvia: admixture of *Picea abies* can be often found in broad-leaved forests. The proportion of *Alnus incana* or *Populus tremula* can be relatively large.

Figure 9.38. *Ravine forest* in Nature Reserve "Pilskalnes Siguldiņa" (Photo: U.Suško).

Distribution: rarely found in the territory of Latvia, most frequently on the banks of River Gauja, River Daugava, River Ogre, River Venta and their tributaries, as well as in small areas in river valleys, coasts and islands of lakes, as well as elsewhere on a hilly relief.

Conservation value: the habitat occupies not more than 0.1% (approximately 65 km^2) of the territory of Latvia. It is a significant habitat for the populations of rare species, especially for moisture and rich soil-loving plant species, as well as epiphytic species of mosses, lichens and molluscs (Lārmanis et al., 2000; Mežaka et al., 2005; Mežaka, Znotiņa, 2006). Species that are rare and specially protected in Latvia occur – *Aconitum lasiostomum*, *Anthriscus nitida*, *Allium ursinum*, *Bromopsis benekenii*, *Circaea lutetiana*, *Carex pilosa*, *C.brizoides*, *Dentaria bulbifera*, *Euonymus verrucosa*, *Festuca altissima*, *Galium schultesii*, *Hordelymus europaeus*, *Lunaria rediviva*, *Dicranum viride*, *Anomodon spp.*, *Lobaria pulmonaria*, *Ena montana*, *Clausiliidae*, *Ceruchus chrysomelinus*, *Denticollis rubens* and others.

Environmental factors: relief – slope or ravine – is the determinant factor. A habitat can be found both on calcareous and siliceous soils. Erosion leads to disruptions in the vegetation cover, as the soil is uncovered. The light and temperature conditions differ from the conditions in plain relief forests and depend on the exposition and incline of the slope. The humidity and shading are more pronounced in deep ravines, there is no impact from wind (*Fig. 9.38.*). Such conditions allow preservation of species that have adapted to constantly cool and humid environment. Occasionally the impact of springs can be observed. Rocks and stones and their collections can be frequently found in ravines – both granites and dolomites.

Processes with a functional role: water erosion is a natural process. If the ravine was formed recently, it overgrows with forest as a result of natural succession. Gap dynamics has a significant role in forest development, similarly as in the rest of the broad-leaved forests and spruce forests.

Vegetation characteristics: mesotrophic or eutrophic communities of mixed, mostly broad-leaved tree forests. Conforms to the vegetation class *Querco Fagetea*. Trees of different age and dimensions usually occur (*Fig. 9.39.*). The layer of shrubs is sparse or relatively dense. Natural restoration with species of broad-leaved trees is typical. Layers of herbaceous plants and mosses are often highly dispersed due to erosion or shading. Larger cover of ground vegetation is found on slope terraces and in the lower part of slopes, a spring aspect is typical. Microtopography is formed by ravines with gullies, with specific vegetation formed by springs and brooks. In separate cases, when the plant community has formed on the slope in an area that has been previously used for agricultural purposes (meadows, grasslands) on soils suitable for broad-leaved trees, the 1st layer may be populated by pine or birch as a pioneer species, more rarely aspen, that can dominate (for example, in the valley of Gauja River), but a characteristic second layer of broad-leaved species or advance growth, as well as the ground vegetation that is typical to the habitat has formed in all cases.

Characteristic species: on the trees layer – *Acer platanoides*, *Fraxinus excelsior*, *Quercus robur*, *Tilia cordata*, *Ulmus glabra*, *Ulmus laevis*; on shrub layer – *Corylus avellana*, *Lonicera xylosteum*, *Padus avium*. On herbaceous plant layer in shadowed locations – *Actaea spicata*, *Aegopodium podagraria*, *Anemone nemorosa*, *A.ranunculoides*, *Athyrium filixfemina*, *Carex sylvatica*, *Crepis paludosa*, *Elymus caninus*, *Ficaria verna*, *Galeobdolon luteum*, *Hepatica nobilis*, *Mercurialis perennis*, *Oxalis acetosella*, *Pulmonaria obscura*; in dryer and lighter locations – *Convallaria majalis*, *Carex digitata*, *Poa nemoralis*. On the moss layer – *Brachythecium rutabulum*, *Eurhynchium angustirete*, *Eurhynchiastrum hians*, *Plagiomnium affine*, *Plagiomnium undulatum*, *Rhytidiadelphus triquetrus*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Aconitum lasiostomum*, *Anthriscus nitida*, *Allium ursinum*, *Bromopsis benekenii*, *Circaea lutetiana*, *Carex pilosa*, *Dentaria bulbifera*, *Hordelymus europaeus*, *Lunaria rediviva*, *Dicranum viride*, *Lobaria pulmonaria*, *Ena montana*, *Clausiliidae*, as well as beetles – *Ceruchus chrysomelinus*, *Denticollis rubens*.

Variants: none.

Figure 9.39. Slope forest in the Nature Reserve "Starinas mežs" nearby Ostrovna Lake (Photo: B.Bambe).

Figure 9.40. Slope forest in the Nature Reserve "Jaša"; broad-leaved trees of different age are present (Photo: B.Bambe).

Figure 9.41. Slope forest in the Nature Reserve "Jaša". The spring aspect of the ground vegetation dominated by *Stellaria holostea* as well as the natural forest regeneration with broad-leaved trees, mainly *Acer platanoides*, can be seen (Photo: B.Bambe).

Figure 9.42. *Tilio-Acerion forests of slopes, screes and ravines* are frequently found adjacent to large rivers. Depicted – forests in valley of the Gauja River (Photo: B.Bambe).

Habitat Quality

Minimum habitat requirements: appropriate relief form and a forest with vegetation that includes at least five typical species (together in all layers of vegetation).

Structural indicators: all the indicators common to forest habitats. An additional indicator: at least four different species of broad-leaved trees.

Function and process indicators: all the indicators common to forest habitats.

Restoration potential and quality improvement indicators: usually restoration measures are not necessary. If a habitat hosts values that depend on separate old trees that have previously grown in more open conditions that must be cleared the younger trees and shrubs that have grown around these trees, restoration possibilities must be assessed the same way as for all forest habitats.

Threats: from all the common indicators of the habitat group – cutting of trees (especially clear cutting) and synantropization. The impact of overly high recreation intensity – trampling that promotes erosion – can be seen in the most popular areas. Disposal of household waste is hazardous in the vicinity of populated areas.

Management: usually management is not necessary. If a habitat hosts values that are dependent on separate old trees of open fields, *cutting of inferior trees and shrubs around separate especially significant trees* should be applied.

Similar habitats: this habitat is similar to nearly all habitats whose vegetation is dominated by broad-leaved trees: 9020* *Fennoscandian hemiboreal natural old broad-leaved deciduous forests (Quercus, Tilia, Acer, Fraxinus or Ulmus) rich in epiphytes*, 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli*; in springy areas and nearby watercourses – 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae)* and 91F0 *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)*. Separation is usually not an issue, as all of the previously mentioned habitats should be included to habitat 9180* *Tilio-Acerion forests of slopes, screes and ravines* if they are situated on slopes.

Overlap with other habitats of EU importance: 7160 *Fennoscandian mineral-rich springs and springfens* – if a spring or spring-mire can be found on the slope or in the ravine; 7220* *Petrifying springs with tufa formation (Cratoneurion)* – if a spring forming calcareous tufa can be found; 8210 *Calcareous rocky slopes with chasmophytic vegetation*, 8220 *Siliceous rocky slopes with chasmophytic vegetation*, 8310 *Caves not open to the public* – if a limestone outcrop or sandstone outcrop or a cave not open to the public can be found on the slope or in ravine.

Corresponding specially protected habitats in Latvia: 1.9. Slope and ravine forests.

Literature

Ek, T., Suško, U., Auziņš, R. (2002) Mežaudžu atslēgas biotopu inventarizācijas metodika. Rīga, Valsts meža dienests

Jermacāne, S., Laiviņš, M. (2001) Latvijā aprakstīto augu sabiedrību sintaksonu saraksts. Latvijas veģetācija 4, 115.–132. lpp.

Laiviņš, M. (1998) Latvijas ziedaugu un paparžaugu augstākie sintaksoni. [Higher syntaxonomic units of plant communities of Latvia]. Latvijas purvu veģetācijas klasifikācija un dinamika. Latvijas Universitātes Zinātniskie Raksti. Rīga, 613, 7.–22. lpp.

Laiviņš, M. (2000) Kalamecu un Markūzu gravu mežu augu sabiedrības. Referātu tēzes. LU 58. Zinātniskā konference. Zemes un Vides zinātņu sekcija. Rīga, 96.–99. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Lārmanis, V., Priedītis, N., Rudzīte, M. (2000) Mežaudžu atslēgas biotopu rokasgrāmata. Rīga, 127 lpp.

Mežaka, A., Znotiņa, V. (2006) Epiphytic bryophytes in old growth forests of slopes, screes and ravines in north-west Latvia. Acta Universitatis Latviensis 710, 103–116 p.

Mežaka, A., Znotiņa, V., Piterāns, A. (2005) Distribution of epiphytic bryophytes in five Latvian natural forest stands of slopes, screes and ravines. Acta Biologica Universitatis Daugavpiliensis 5(2), 101–108 p.

Priedītis, N. (1999) Latvijas mežs: daba un daudzveidība. Rīga, WWF – Pasaules dabas fonds, 209 lpp.

Figure 9.43. Ravine forest in Ērgļi municipality by "Braki". Biodiversity of the forest is increased by decaying trees in different stages of decomposition (Photo: B.Bambe).

Figure 9.44. Ravine forest in Ērgļi municipality by "Braki". Both – periodically drying and constantly flowing brooks where the springs flow in – can be frequently found in ravines (Photo: B.Bambe).

Figure 9.45. Ravine forest in Ērgļi municipality by "Braki". High air humidity in ravines provides favourable conditions for the development of epiphytic and epixylic species (Photo: B.Bambe).

91D0* *Bog woodland*

Latvian habitat classification: F.2.1.4., F.2.1.5., F.2.6.4.; partly also F.2.1.1., F.2.1.2., F.2.1.3., F.2.2., F.2.3., F.2.4., F.2.6.1., F.2.6.2., F.2.6.5., F.3., F.4.5.

Syntaxonomy: *Dicrano-Pinion*, *Ledo-Pinion*, *Piceion abietis*, *Alnion glutinosae* (Priedītis 1993a,b,c,d; Priedītis, 1997).

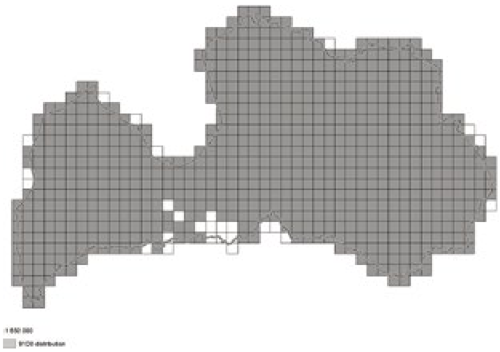


Figure 9.46. Distribution of the habitat 91D0* *Bog woodland* in Latvia (Conservation status of.., 2013).

Definition: coniferous and broad-leaved forests on humid to wet peaty poor in nutrients substrate, with the water level permanently high. Layer of trees usually consists of *Pinus sylvestris*, *Picea abies*, *Betula pubescens* and *Alnus glutinosa*. A wide distribution of dwarf scrubs is typical to the ground vegetation, as well as different species of *Carex spp.* and *Sphagnum spp*.

Figure 9.47. Boggy pine forest in Kalsnava forest district. Ground vegetation contains *Eriophorum vaginatum* and *Sphagnum spp.* – similar as in moss bog (Photo: B.Bambe).

Specific characteristics of habitat interpretation in Latvia: drained forests are also included, if the drainage system operates poorly and hygrophyte species occur in the ground vegetation, as well as the forest conforms with requirements of a woodland key habitat or potential woodland key habitat.

Distribution: relatively often in the territory of Latvia, frequently in the vicinity of moss bogs. Boggy spruce forests are more frequently found in the north-eastern part of Latvia.

Conservation value: the habitat occupies approximately 3% (2 000 km^2) of the territory of Latvia. It is significant for the populations of rare species, especially for the hygrophyte vascular plants, as well as epixylic bryophytes and several species of lichens. Rare and specially protected plant species of Latvia occur, from which the following species can be found <u>in wet pine forests</u> – *Betula nana*, *Corallorhiza trifida*, *Listera cordata*, *Dactylorhiza fuchsii*, *Salix myrtilloides*, *Myrica gale*; <u>in spruce and mixed forests</u> – *Carex disperma*, *C.paupercula*, *Cinna latifolia*, *Galium triflorum*, *Glyceria lithuanica*, *Poa remota*, *Hylocomiastrum umbratum*, *Bazzania trilobata*. In various boggy forests on decaying wood – *Anastrophyllum hellerianum*, *Lophozia ascendens*, *Odontoschisma denudatum* and <u>lichen</u> – *Cladonia parasitica,* on branches of coniferous trees *Evernia divaricata* and other can be found. Bog pine woodlands are a significant habitat for the protected bird species *Tetrao urogallus*, the distribution of which has decreased substantially during the last century.

Environmental factors: hydrological regime is the determinant factor. Bog woodlands form in relief depressions, on

Figure 9.48. Alnus glutinosa forest, where the moss layer is dominated by *Sphagnum spp.* (Photo: L.Auniņa).

the edges of peat bogs or transition mires, where the surface water accumulates or groundwater outflows are located. The groundwater level is high for the most part of the year. Periodically flooded humid depressions can occur, especially in cases with wet forests on mineral soils. Due to high humidity and the anaerobic conditions plant remains decompose slowly and form peat. Often the roots of trees do not reach the mineral soil. There are areas of boggy forests that grow on peat of depth of 5–6 m in Latvia. Soil is usually acidic (pH 3–5).

Processes with a functional role: along with a natural development of bogging-up, wet forests on mineral soils (swamp forests) may turn into wet forests on peaty soils (peat-land forests), whereas the peat-land forests may turn into bogs. Contrary processes take place due to drainage. Occasionally it is difficult to determine, whether a habitat has developed as a boggy forest over a long period of time or it has formed due to overgrowing of peatbog or transition mire. If the tree layer conforms to a forest (average height of the forest stand exceeds 5 m) and the ground vegetation develops under conditions that are typical to a forest (under conditions of partial shading), overgrown swamps with hygrophyte ground vegetation should be included in bog woodlands. Similarly to all forests of the Boreal class, but in significantly rarer cases than other habitats, bog woodlands may be affected by natural forest fires.

Vegetation characteristics: oligotrophic and mesotrophic coniferous and mixed or birch and black alder plant communities. Conforms with classes *Vaccinio Piceetea* or *Vaccinetea uliginosi*, rarer – *Alnetea glutinosae* (poorest variant of community of deciduous swamp forest with bog-moss and other species of Boreal forests in the ground vegetation) (*Fig. 9.48.*). The shrub layer is sparse to relatively dense. Hummocked microtopography and a vast cover of dwarf scrubs are typical to the ground vegetation, but richer and shadier forests may lack such cover. Typical plants of the ground vegetation are moisture-loving species of sedges, grass and other herbaceous plants. On the moss layer genus *Sphagnum* dominates, but on mineral soils of wet forests *Bryidae* with admixture of *Sphagnum* may dominate.

Characteristic species: on the layer of trees – *Pinus sylvestris*, *Picea abies*, *Betula pubescens*, *Alnus glutinosa*; on the shrub layer – the above mentioned species, as well as *Frangula alnus*, *Betula humilis*, *Salix aurita*, *S.cinerea*; on the layer

Figure 9.49. A typical bog forest in the Nature Reserve "Kinkausku meži". In the ground vegetation of the pine forest a significant role is played by different dwarf scrubs – *Ledum palustre*, *Vaccinium uliginosum* (Photo: B.Bambe).

Figure 9.50. Mixed bog forest (*Caricoso-phragmitosa*) in the Nature Reserve "Kinkausku meži". In the ground vegetation a significant role is played by different species of *Carex spp.* (Photo: B.Bambe).

of herbaceous plants and dwarf shrubs of the oligotrophic pine forests there is more of *Carex cinerea*, *C.pauciflora*, *C.nigra*, *Eriophorum vaginatum*, *Ledum palustre*, *Molinia caerulea*, *Oxycoccus palustris*, *Vaccinium myrtillus*, *V.uliginosum*; in mesotrophic pine and mixed forests – more of *Agrostis stolonifera*, *Calamagrostis canescens*, *Carex echinata*, *C.globularis*, *C.lasiocarpa*, *C.rostrata*, *Crepis paludosa*, *Viola palustris*; on the moss layer in oligotrophic forests – *Sphagnum angustifolium*, *S.capillifolium*, *S.magellanicum*; in mesotrophic forests – *S. girgensohnii*, *S.palustre*, *S.russowii*, *S.squarrosum*; in wet forests on mineral soils also *Polytrichum commune*, *Hylocomium splendens* and other.

Umbrella species (typical species within the meaning of the Habitats Directive): vascular plants – *Corallorhiza trifida*, *Listera cordata*, *Carex disperma*, *C.paupercula*, bryophytes – *Anastrophyllum hellerianum*, *Lophozia ascendens*, *Odontoschisma denudatum*; lichens – *Cladonia parasitica*, *Evernia divaricata*; birds – *Tetrao urogallus*.

Variants:

91D0*_1: peat-land forests with the peat layer thicker than 30 cm – *Sphagnosa, Caricoso-phragmitosa, Dryopterioso-caricosa* (*Fig. 9.47., 9.49., 9.50.*). Bogs and transition mires overgrown by forests, where the average height of the forest stand may reach at least 5 m and current or potential canopy projection exceeds 20%;

91D0*_2: swamp forest with a peat layer at the initial stage of formation, more shallow than 30 cm – poor pine forest on wet sandy soils, wet pine forest with spruce in the second layer, wet pine-spruce forest, wet spruce forest (*Callunoso-sphagnosa, Vaccinioso-sphagnosa, Myrtilloso-sphagnosa, Murtilloso-polytrichosa*);

91D0*_3: drained forests, if they conform with the requirements of woodland key habitats or potential woodland key habitats – drained forests on peat soils, rarely on wet mineral soils.

Habitat Quality

Minimum habitat requirements: a forest whose vegetation hosts at least five typical species (together in all vegetation layers), as well as an appropriate hydrological regime. Compliance of the hydrological regime is not mandatory condition for the 3rd variant, but it must additionally conform with (P)WKH.

Structural indicators: all indicators common to forest habitats, as well as an additional indicator – pine trees with burnt scars.

Function and process indicators: all indicators common to forest habitats.

Restoration potential and quality improvement indicators: restoration possibilities of the habitat are assessed for young and drained stands or, if they have unnaturally thick undergrowth or spruce regrowth, the assessment is performed in the same way as for all forest habitats.

Threats: alterations to the hydrological regime. Cutting of trees, especially clear cuttings. Climate change, when the conditions become less favourable for the Boreal species and they are outrivaled by species that have adapted to a warmer climate.

Management: most frequently management is not necessary. Restoration of hydrological regime may be necessary in drained forests. Cutting out of unnaturally thick shrub layer is necessary in separate cases, especially in drained forests, when the habitat is also an area for capercaillie leck, where management is necessary to improve the quality of the environment for this species. It is recommended to perform it jointly with restoration of the hydrological regime.

Similar habitats: 7110* *Active raised bogs* – usually in the Eastern part of Latvia, where natural peat bogs that have overgrown by pines of various height and thickness occur. In this case the boundary between habitats is determined by a criterion applied in forestry – average height of the trees. The average height of trees exceeds 5 m in bog woodlands, but only separate trees can exceed this limit in a bog. 7120 *Degraded raised bogs still capable of natural regeneration*, where natural restoration is possible or in progress – a layer of trees has developed in a bog woodland with the average height of trees exceeding 5 m, but the ground vegetation plant species of humid localities have preserved partly. 9080* *Fennoscandian decidous swamp forests* – boggy alder forests included in 91D0* can be similar to alder swamp wood, but differ by the hydrological regime – in bog woodlands the movement of groundwater is slow and there is no surface run-off in natural conditions; in the tree layer birch and coniferous trees are frequently found together with alders; the ground vegetation that is typical of bog woodland can be found, and genus *Sphagnum* plays a significant role.

Overlap with other habitats of EU importance: 7160 *Fennoscandian mineral-rich springs and springfens* – if a spring or a springfen can be found in bog woodland.

Figure 9.51. Bog woodland in the Teiči Nature Reserve. As a result of natural disturbances – windfalls and wind broken trees – glades are formed and the biodiversity is increased by cultas, decaying trees and protruded roots as habitats of different organism groups (Photo: B.Bambe).

Figure 9.52. Bog woodland in the Nature Reserve "Vesetas palienes purvs". In the foreground – hygrophytic sedges and a growth of *Dactylorhiza fuchsia* (Photo: B.Bambe).

Corresponding specially protected habitats in Latvia: partly conforms with 1.1. Wet heaths.

Literature

Āboliņa, A., Jermacāne, S., Laiviņš, M. (2001) Post-Drainage Dynamics of the Ground Vegetation in a Transitional Mire. Baltic Forestry Vol. 7, Nr.1, 19–28 p.

Bambe, B. (2008) Sūnu izplatību ietekmējošie faktori uz trupošas skujkoku koksnes. LLU Raksti 20(315), 93.–102. lpp.

Bušs, K. (1981) Meža ekoloģija un tipoloģija. Rīga, Zinātne, 68 lpp.

Ek, T., Suško, U., Auziņš, R. (2002) Mežaudžu atslēgas biotopu inventarizācijas metodika. Rīga, Valsts meža dienests

Jermacāne, S., Laiviņš, M. (2001) Latvijā aprakstīto augu sabiedrību sintaksonu saraksts. Latvijas veģetācija 4, 115.–132. lpp.

Laiviņš, M. (1998) Latvijas ziedaugu un paparžaugu augstākie sintaksoni. [Higher syntaxonomic units of plant communities of Latvia]. Latvijas purvu veģetācijas klasifikācija un dinamika. Latvijas Universitātes Zinātniskie Raksti. Rīga, 613, 7.–22. lpp.

Latvijas biotopi. Klasifikators (2001) I.Kabuča red. Rīga, Latvijas Dabas fonds, 96 lpp.

Liepa, I. (2003) Purvaiņi. Grām.: Meža enciklopēdija. Red. J.Broks, Rīga, Zelta grauds, 266. lpp.

Liepa, I. (2003) Slapjaiņi. Grām.: Meža enciklopēdija. Red. J.Broks, Rīga, Zelta grauds, 266. lpp.

Priedītis, N. (1993a) Latvijas purvainie meži un to aizsardzība. Rīga, WWF – Pasaules Dabas fonds, 74 lpp.

Priedītis, N. (1993b) Pine-birch forest communities on nondrained peatlands in Latvia. Feddes repertorium 104, Vol. 3–4, 271–281 p.

Priedītis, N. (1993c) Geobotanical features of Latvian peatland forest communities. Flora 188, 413–424 p.

Priedītis, N. (1993d) Spruce forests (ass. Sphagno girgensohnii-Piceetum (Br.-Bl. 1939) Polak. 1962) on excessively moistened peatlands in Latvia Acta Societatis Botanicorum Poloniae 62, Vol. 3–4, 199–202 p.

Prieditis, N. (1997) Vegetation of wetland forests in Latvia: A synopsis. Annales Botanici Fennici 34, 91–108 p.

Priedītis, N. (1999) Latvijas mežs: daba un daudzveidība. Rīga, WWF – Pasaules dabas fonds, 209 lpp.

Аболинь, А. (1968) Листостебельные мхи Латв. ССР. Рига, Зинатне, 331 с.

Буш, К.К., Аболинь, А.А. (1968) Строение и изменение растительного покрова важнейших типов леса подвлиянием осушения. Вопросы гидролесомелиорации. Рига, Зинатне, 71–126 с.

91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae)

Latvian habitat classification: F.1.5., F.1.6., F.2.3.4., F.2.4., F.2.5., F.2.6.6., F.4.3.

Syntaxonomy: *Alno-Padion, Alnion incanae, Salicion albae*.

Definition: riparian forests of *Fraxinus excelsior* and *Alnus glutinosa* in river valleys (*Alno-Padion*); riparian woods of *Alnus incanae* (*Alnion incanae*); arborescent galleries of *Salix alba* and *Salix fragilis* along rivers (*Salicion albae*). All types occur on hard soils (generally rich in alluvial deposits) periodically inundated by the annual rise of the river level, but otherwise well-drained and aerated during low water. *Filipendula ulmaria*, *Angelica sylvestris*, *Cardamine spp.*, *Carex spp.* and *Cirsium oleraceum* can often be found in the layer of herbaceous plants and vernal geophytes such as *Ficaria verna*, *Anemone nemorosa*, *Anemone ranunculoides*, *Corydalis solida*. This habitat includes several sub-types:

– ash-alder woods of springs and their rivers (*Carici remotae-Fraxinetum*),
– ash-alder woods of slow-flowing rivers (*Pruno-Fraxinetum, Ulmo-Fraxinetum*),
– grey-alder riparian woods (*Alnion incanae*),
– white willow gallery forests (*Salicion albae*).

Mostly these forests are in contact with moist meadows and ravine forests (*Tilio-Acerion*). Habitat succession in the direction of *Carpinion* is possible.

Figure 9.53. The light crown of *Salix alba* marks the willow galleries that conform with the habitat 91E0* on the banks of the River Gauja between Strenči and Valmiera (Photo: V.Lārmanis).

Figure 9.54. The forest variant of *Fraxinus excelsior* of the habitat on wet soils in the Ķemeri National Park nearby Vēršupīte. The high roots of ash trees indicate regular flooding of the habitat (Photo: V.Lārmanis).

Figure 9.55. Forest stand of *Alnus glutinosa* appropriate to habitat 91E0* with a pronounced layer of high herbaceous plants in the vicinity of Ziemupe (Photo: V.Lārmanis).

Specific characteristics of habitat interpretation in Latvia: unlike the definition given in the Interpretation manual of European Union habitats (Interpretation manual.., 2013) the relation of few habitat sub-types to montane and sub-montane rivers has not been indicated as it does not have a practical importance in the conditions of Latvia. Riparian woods of grey alder are sometimes dominated by *Padus avium*. In a proximity to ravines and slopes it is possible that small, narrow sections of habitat at the foot of slopes can be considered as a part of ravine or slope complex. In such situations it is acceptable that a habitat is not separated, but is classified as 9180* *Tilio-Acerion forests of slopes, screes and ravines*. A habitat does not always have to be directly related to permanent water courses, since appropriate vegetation forms already by interaction with springfens that are hardly noticeable on the surface, high groundwater level, seasonally drying brooks etc. In general these are various wet or watercourse-related forests of the broad-leaved class.

Distribution: there is a more complete understanding only regarding associations *Carici remotae-Fraxinetum* and *Pruno-Fraxinetum*. They occupy small total area, but are fragmentary distributed throughout the whole country (Priedītis, 1993; Priedītis, 1999; Priedītis, 2002; Mangale, 2005; Bambe, 2003; Biotopu rokasgrāmata.., 2004). Considering the available information on the aforementioned plant communities it has been assessed that this habitat occupies approximately 0.1% of the territory of Latvia (Conservation status of.., 2013). The notion regarding the total area of riparian grey alder woods and white willow gallery forests is rather unclear. Until now the most significant areas of riparian willow galleries have been registered in the middle course of the banks of River Gauja (Aizsargājamo ainavu.., 2007).

Conservation value: in terms of the total area this is one of the rarest forest habitats of EU importance in Latvia. It is a significant habitat for specially protected species with a considerable share of their population found in riparian forests, for example, epiphytic lichens *Collema spp.* and *Leptogium spp.*

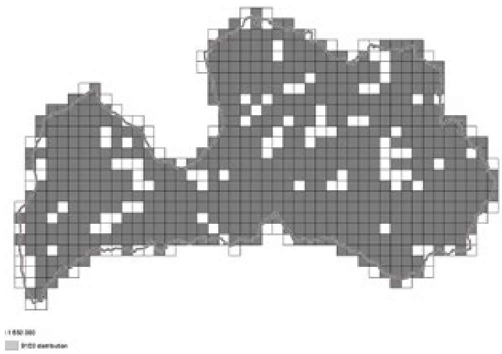


Figure 9.56. Distribution of the habitat 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae)* in Latvia (Conservation status of.., 2013).

Environmental factors: most frequently the habitat is located in valleys of rivers and brooks and it forms on alluvial soils. Wet forests with ash tree and black alder form on periodically wet and gleyed soils. The layer of peat is usually absent; flooding forms the alluvium of sand (Priedītis, 1999). Dry or moderately humid soils that are sandy in a thicker top layer are mostly characteristic to the habitat variants that include communities of grey alders (Priedītis, 1999) and willows. They are flooded less frequently – usually during the seasonal flooding. The proximity of water or the wet soil provides constantly increased air humidity in the forest stand.

Processes with a functional role: gap dynamics is determinant. Vegetation is often affected by a seasonal or more frequent flooding. It determines the mosaic structure of micro habitats within the forest stand and promotes or prevents formation of certain vegetation in patches – mainly by formation of patches of alluvial sand, layers of alluvial plant remains, eroded deepenings that are flooded more frequently than the highest points and occasionally remain flooded throughout the year. The flow of water has a significant role in the nutrient cycle of the habitat and distribution of plants. Activities of beavers have a significant impact – communities of willow are affected the most. Situations that comply with the habitat with communities of grey alders or bird-cherries frequently form by overgrowing of former agricultural lands in frequently flooded flood plains, where the habitat could form the final stage of the succession under natural conditions. The environment of such places is mostly appropriate and the characteristic species of a habitat occur, but the conditions have not stabilized, as is indicated by the even-aged structure of the forest stand. By continuation of habitat succession, grey alders and bird-cherries can be gradually replaced by elms in a long term resulting in formation of species composition of the forest stand that is characteristic to another habitat of EU importance next to larger rivers – habitat 91F0 *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)*. It has been observed that in such cases the situation is occasionally "reversed" by the activity of beavers that damage elms and oaks more frequently than grey alders and bird-cherries.

Vegetation characteristics: the habitat belongs to the European broad-leaved forest class, therefore its vegetation is characterized by species of this forest class and a pronounced spring aspect. The structure is significantly affected by the mosaic that is created by flood alluvium and wash-outs. Plant species that are able to endure periodic flooding are characteristic. In variants of the habitat on wet soils the forest stand is dominated by ashes and black alders with a possible mixing with other tree species (*Fig. 9.54.*). Whereas on dryer soils in riparian forests where grey alder dominates, the admixture of bird-cherries, different willow species and elms is significant. In some cases bird-cherries or any of willow species may

Figure 9.57. A habitat with a mixed layer of willow-grey alder elms (*Salix spp.-Alnus incana-Ulmus glabra*) on the banks of the River Vizla. Bent trees that are covered by epiphytes are a structural feature that is characteristic to this habitat (Photo: V.Lārmanis).

Figure 9.58. A habitat without a wide flood plain where the typical structure, for example, high tree roots, forms directly by the water course (Photo: V.Lārmanis).

dominate. A significant function is provided by trees that have continuously grown in a bent condition in riparian forests – these are especially suitable for epiphytes (*Fig. 9.57.*). Within the area of one habitat patches of different dominating species interchange – for example, grey alders and bird-cherries may dominate in relief uplifts, while in slightly lower areas a mixture of grey alders and flattering elms can dominate, constantly flooded depressions lack trees with galleries of willow formed along their edges. The undergrowth in relief uplifts is usually relatively thicker. In the layer of herbaceous plants a significant role is played by plants that are able to adapt to emerging niches in a short time in the varying conditions. In relation to the constantly increased air humidity the abundance of epiphytes on tree stems is high. This is one of the features for separation of stable vegetation from the pioneering stage of succession, when the number of epiphytes is much lower. Due to flooding the lower part of tree stems is often adhered with soil particles and a different epiphytic cover of moss forms on it, or – in cases of a particularly frequent flooding – the cover does not form. It is a convenient feature that can be noticed easily and indicates the height of the flood level (during the season without flood) and prove the impact of flood. Depending on the river and the size of its flood plain the habitat often forms in a narrow band; communities of white willow occur almost exclusively as narrow galleries (*Fig. 9.53.*). Occasionally there is no vast flood plain around small brooks, and niches that are typical to the habitat form only in relation with the tree row, whose roots are in a direct constant contact with the water course (*Fig. 9.58.*). Around meandering brooks in such situations a wide area of habitat-specific vegetation is frequently formed. A structure of different ages of the trees of the forest stand is typical of the climax stage of succession in all habitat variants. Habitat includes both shaded and more sparse spots or open patches that provide opportunity for the existence of the epiphytes of rare species that require a combination of well-lit conditions and a high level of air humidity.

Characteristic species: trees and shrubs – *Alnus glutinosa*, *Alnus incana*, *Fraxinus excelsior*, *Salix alba, S.fragilis*, *Betula pubescens*, *Ulmus glabra*, *U.laevis*, *Padus avium*, *Euonymus europaea*, *Lonicera xylosteum*; herbaceous plants – *Angelica sylvestris*, *Cardamine amara*, *C.pratensis*, *Carex acutiformis*, *C.remota*, *C.sylvatica*, *Cirsium oleraceum*, *Equisetum spp.*, *Filipendula ulmaria*, *Lycopus europaeus*, *Stellaria nemorum*, *Urtica dioica*, *Crepis paludosa*, *Humulus lupulus, Ficaria verna*, *Anemone nemorosa*, *Anemone ranunculoides*, *Corydalis solida*.

Umbrella species (typical species within the meaning of the Habitats Directive): *Fraxinus excelsior*, *Anomodon spp.*, *Lobaria pulmonaria*, *Thelotrema lepadinum*, *Cetrelia spp.*, *Collema spp.*, *Leptogium spp.*, *Polyporus badius, Clausilidae*.

Variants:

91E0*_1: wet broad-leaved forests dominated by *Fraxinus excelsior* (*Fig. 9.54.*) and *Alnus glutinosa*, including narrow tree bands in a direct contact with water courses (*Fig. 9.55., 9.58.*);

91E0*_2: riparian or flood plain forests of *Salix spp.*, *Alnus incana*, *Padus avium* or their mixture of any kind (*Fig. 9.53., 9.57.*);

91E0*_3: both previously indicated variants, if the forest stand is partly degraded (for example, with a reduced impact of flood on the banks of an artificially deepened river), but conforms with (P)WKH.

Habitat Quality

Minimum habitat requirements: the habitat must be a forest of broad-leaved class on alluvial soils or periodically flooded, or the tree band that forms the habitat must be in a direct contact with the water course. The habitat must include at least three characteristic species and a total of at least three features, elements or indicator species of the WKH structure (i.e., a sign of structure + element + species ≥ 3 or 1 element + 2 species = 3 etc.). Variant 91E0*_3 of the habitat 91E0* may be flooded rarely or unflooded. The habitat does not include forests of the pioneer phase in early stages of succession that have spread in agricultural lands.

Structural indicators: all indicators common to forest habitats; additional indicators – richness of the broad-leaved tree species, flooded areas.

Function and process indicators: all indicators common to forest habitats, except for the area of habitat; additional indicator – impact of flood.

Restoration potential and quality improvement indicators: considering the threats that are identified, restoration possibilities are assessed the same way as for all forest habitats.

Threats: all factors that endanger forest habitats are possible.

Management: usually no special restoration activities are required; the most appropriate solution is non-intervention. Restoration of the hydrological regime is occasionally needed. The habitat may seldom contain values that depend on separate old trees that have previously grown in open fields and require management – the measure *Cutting of expansive trees and shrubs* around separate especially significant trees can be applied in such cases.

Similar habitats: the variant on wet soils may be mistaken for 9080* *Fennoscandian decidous swamp forests*. In order to separate these two habitats it must be taken into consideration that 91E0* belongs to the class of European broad-leaved forests and it usually does not have a layer of peat or it is very thin, or the habitat is directly affected by water courses. In riparian forests on dry or moderately humid soils this habitat may be the initial succession stage for the habitat 91F0 *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)*. In such case the most significant practical importance in separation of these habitats belongs to the domination of the total proportion of elms, oaks and ash trees in the layer of trees that are typical of 91F0. Many situations are solved by the factor that 91F0 can only be identified near great rivers. Taking into consideration the close ecological relation of both habitats, in cases when a transition of one habitat to the other is identified, the separation of the given situation as compliant to one or the other habitat is of minor importance from the perspective of nature conservation.

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 1.11. Wet broad-leaved forests; partly: 1.4. Primary forests of river meanders.

Literature:

Aizsargājamo ainavu apvidus „Ziemeļgauja" dabas aizsardzības plāns (2007) I.Vilkas red. Rīga, Latvijas Dabas fonds, 173. lpp.

Bambe, B. (2003) Upju ieleju meži. Grām.: Meža enciklopēdija. I sējums. Red. J.Broks., Rīga, Zelta graudš, 332.–333. lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 144.–145. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Interpretation Manual of European Union Habitats. EUR 27 (2007) European Commission, DG Environment, 144 p.

Mangale, D. (2005) Oša mežu augu sabiedrības. Atskaite: Laiviņš, M. (red.) Latvijas oša mežu vitalitāte un daudzveidība: stāvoklis un prognoze. Salaspils, LV Mežzinātnes institūts *Silava*, 110 lpp.

Priedītis, N. (1993) Latvijas purvainie meži un to aizsardzība. Rīga, WWF – Pasaules Dabas fonds, 74 lpp.

Priedītis, N. (1999) Latvijas mežs: daba un daudzveidība. Rīga, WWF – Pasaules dabas fonds, 209 lpp.

Prieditis, N. (2002) Evaluation frameworks and conservation system of Latvian forests. Biodiversity and Conservation 11, 1361–1375 p.

91F0 *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)*

Latvian habitat classification: F.1.8.3.

Syntaxonomy: *Querco-Fagetea*.

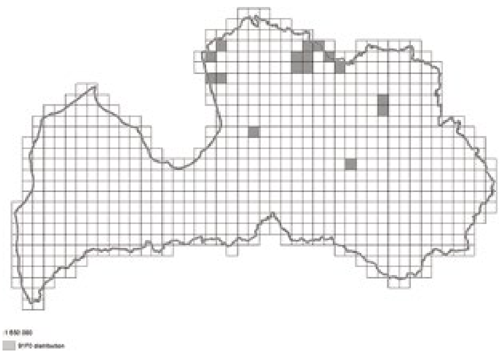


Figure 9.59. Distribution of the habitat 91F0 *Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris)* in Latvia (Conservation status of.., 2013).

Definition: forests of hardwood trees of the major part of the river bed, liable to flooding during regular rising of water level or of low areas liable to flooding following the rising of the water table. These forests develop on recent alluvial deposits. The soil may be well drained between inundations or remain wet. Following the hydric regime, the woody dominated species belong to *Fraxinus, Ulmus* or *Quercus* genus. The undergrowth is well developed. These forests form mosaics with pioneer or stable forests of soft wood trees, in low areas of the river bed. The habitat type often occurs in conjunction with alder-ash woodlands.

Specific characteristics of habitat interpretation in Latvia: the habitat is marked on river banks that are at least the size of River Pededze or River Ogre starting from their middle course. This habitat is ecologically similar to habitat 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae)*, which is sometimes an earlier development stage of 91F0. Rather frequently the habitat by its origin is an overgrown former habitat 6530* *Fennoscandian wooded meadows* (*Fig. 9.60.*) or 9070 *Fennoscandian wooded pastures*. In the vicinity of slopes and ravines it is possible that small, narrow sections of habitat at the foot of slopes can be justifiably considered a component of ravine or slope complex. In such situations it is acceptable that a habitat is not separated, but is classified as 9180* *Tilio-Acerion forests of slopes, screes and ravines*.

Distribution: in Latvia this habitat has been studied very little (Prieditis, 2002), therefore the perception of its distribution is rather unclear. According to previous inventories of habitats in *Natura 2000* areas it has been assessed as occupying approximately 0.006% of the territory of Latvia (Conservation status of.., 2013). Only small fragments of habitats (mostly at the area of 1 ha) have been found so far – mainly in the middle course of River Gauja (Aizsargājamo ainavu apvidus.., 2007) and on shores of River Pededze (Dabas lieguma.., 2005; Dabas lieguma.., 2007) and River Ogre (Bambe, 2003; Biotopu rokasgrāmata.., 2004).

Conservation value: this habitat occupies the smallest area of all the forest habitats of EU importance in Latvia. It is a significant habitat for specially protected species, an essential share of the population of which can be found in the riparian forests, for example, epiphytic lichen, *Collema spp.* and *Leptogium spp.*

Environmental factors: the habitat is located in river valleys and forms on alluvial soils. Vegetation is influenced by flooding or flood-caused fluctuations to the groundwater level. Fresh flood-drifted sand areas can be often observed, as well as tree bases that have adhered with dirt etc. Eroded deepening can be frequently observed in the microtopography of the habitat. The proximity of water determines the constantly increased level of air humidity.

Processes with a functional role: gap dynamics is the determinant factor. It determines the mosaic structure of micro habitats within the forest stand and promotes or prevents formation of certain vegetation in patches – mainly by formation of patches of alluvial sand, layers of alluvial plant remains, eroded deepenings that are flooded more frequently than the highest points and occasionally remain flooded throughout the year. The flow of flood water has a significant role in the nutrient cycle of the habitat and distribution of plants. Frequently the habitat forms as the final stage of succession to separate variants of the habitat 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae)* on the banks of great rivers. Occasionally when the majority of trees of the first layer die, mostly as a result of the activity of beavers, and an increase in the proportion of bird-cherries and similar trees takes place, a situation that is characteristic to variants of the habitat 91E0* forms. In part of situations the historical origin of a habitat and its development stage is related to afforestation of flood plains that have formerly been used in agriculture, including wooded meadow and pasture landscapes. In the latter case separate elements can be found in the habitat – old trees of open areas whose conservation value depends on the maintenance of more sparse conditions around them.

Vegetation characteristics: the habitat belongs to the class of European broad-leaved forests, therefore its vegetation is characterized by species of this forest class and a pronounced spring aspect. Vegetation structure is significantly affected by the mosaic of conditions created by flood alluvium and wash-outs. Species of plants that are able to endure periodical flooding are typical. Relatively thicker undergrowth is present on the uplifts of the microtopography. In the layer of herbaceous plants more significant role is played by plants that are able to spread quickly in the emerged niches under variable conditions. Vegetation structure depends on the frequency of flooding. The rarer it is the more closed is the layer of shrubs and ground cover vegetation (*Fig. 9.61.*). In relation to the constantly increased air humidity tree trunks often have a plentiful cover of epiphytes. Habitat includes both shaded and more sparse spots or open patches that provide opportunity for the existence of the epiphytes of rare species that require a combination of well-lit conditions and a high level of air humidity. A different cover of epiphytic moss can form on the lower part of the tree stems that are frequently adhered with soil particles due to flood or, if the impact flooding is especially frequent, there is no vegetation on these trunk parts.

Characteristic species: trees and shrubs – *Quercus robur*, *Ulmus glabra*, *U.laevis*, *Fraxinus excelsior*, *Populus tremula*, *Alnus glutinosa*, *Padus avium*, *Ribes rubrum*, *Lonicera xylosteum*. Taking into consideration the variable conditions, the composition of ground cover vegetation can be very different, in many cases following species can be found – *Humulus lupulus*, *Corydalis solida*, *Gagea lutea* etc.

Umbrella species (typical species within the meaning of the Habitats Directive): *Ulmus glabra*, *Ulmus laevis*, *Anomodon spp.*, *Schlerphora spp.*, *Collema spp.*, *Lobaria pulmonaria*, *Arthonia byssacea*, *Parmeliella triptophylla*, *Pertusaria flavida*, *Clausilidae*.

Variants: none.

Habitat Quality

Minimum habitat requirements: habitat must be located in a regularly flooded flood plain of a great river (as indicated in chapter *Specific features of the habitat in Latvia*) or area that is regularly affected by the groundwater fluctuations caused by flood. Forest stands where only the relief lowlands within the habitat or the bordering forest stands are regularly flooded can be considered as forest stands that are regularly affected by flood – all the other area can be flooded rarely, without or with poor features that prove a direct impact of floods on the surface. Adding the first and the second tree layer, one of the following tree species or a mixture of these species must dominate the forest stand: *Ulmus glabra*, *Ulmus laevis*, *Fraxinus excelsior* and *Quercus robur*.

Structural indicators: all indicators common to forest habitats; additional indicators – richness of broad-leaved tree species.

Figure 9.60. Habitat that is regularly affected by spring flooding in the Protected Landscape Area "Ziemeļgauja" (Photo: V.Lārmanis).

Function and process indicators: all indicators common to forest habitats; additional indicators – impact of grazing and flood.

Restoration potential and quality improvement indicators: no restoration activities are usually necessary. If a habitat includes values that depend on separate old trees of open field that require management, restoration possibilities should be assessed the same way as for all forest habitats.

Threats: all the factors endangering forest habitats are possible.

Management: in the majority of cases no special management activities are required; the most suitable solution is non-intervention. If the habitat contains values that depend on separate old trees that have grown in open fields, *Cutting of expansive trees and shrubs* around separate especially significant trees should be applied. Occasionally situations can occur, when the habitat 91F0 has historically developed from the habitat 6530* *Fennoscandian wooded meadows* (9070 *Fennoscandian wooded pastures*) and a choice must be made of the more important environmental protection aspect in the particular situation - whether a continuation of forest should be allowed or a park-like landscape should be restored. An assessment of a broader context must be performed in such cases, taking into consideration the endangered species it serves for, it must be assessed, whether this site is more significant/irreplaceable for the values of that are linked to a closed forest or a park-like landscape.

Similar habitats: since the habitat may form as a late stage of succession for separate variants of the habitat 91E0* *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-padion, Alnion incanae, Salicion albae)*, identification of these habitats may be difficult in transition stages. In this case the highest practical meaning is given to the domination of the total proportion of elms, oaks and ash trees in the tree layers. Taking into consideration the close ecological affinity of these habitats in transition cases inclusion of this situation in one or the other habitat is secondary from the perspective of environmental protection. In situations in flood plains the habitat 9160 *Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli* may be similar. It should be considered that in case of 9160 the share of oaks in a forest stand must reach or exceed 50%. The importance of flooding must also be evaluated. If a microtopography that has been affected by flood and vegetation structure is characteristic (as described in sections *Processes with a functional role* and *Vegetation characteristics*) and under their influence a composition of undergrowth and ground cover has formed, the habitat 91F0 may also include a forest stand with the proportion of oaks of first layer exceeding 50%. Especially in cases, if the second layer is dominated by other broad-leaved tree species. Occasionally it can be difficult to distinguish habitat 91F0 from old situations of the habitat 6530* *Fennoscandian wooded meadows* or 9070 *Fennoscandian wooded pastures* that have grown in a forest for a longer period of time (*Fig. 9.61.*). Recommendations on how to separate a habitat 6530*/9070 that has grown in a forest from one that should be classified as a forest are provided in the description of 6530* in the sub-section *Minimum quality requirements*.

Figure 9.61. A habitat whose vegetation has been rarely affected by flooding directly. Depicted location nearby the Gauja River was used as a wooded meadow several decades ago. It has been found after a more detailed assessment that conservation value of this habitat is more related to the continuously stable forest situation, therefore the habitat should be included in 91F0, not 6530* *Fennoscandian wooded meadows* (Photo: V.Lārmanis)

Overlap with other habitats of EU importance: none.

Corresponding specially protected habitats in Latvia: 1.5 Mixed forests of oak, elm and ash on river banks.

Literature

Aizsargājamo ainavu apvidus „Ziemeļgauja" dabas aizsardzības plāns (2007) I.Vilkas red. Rīga, Latvijas Dabas fonds, 173. lpp.

Bambe, B. (2003) Upju ieleju meži. Grām.: Meža enciklopēdija. I sējums. Red. J.Broks, Rīga, Zelta graudi, 332.–333. lpp.

Biotopu rokasgrāmata. Eiropas Savienības aizsargājamie biotopi Latvijā (2004) I.Kabuča red. Rīga, Preses nams, 144.–145. lpp.

Conservation Status of Species and Habitats. Reporting under Article 17 of the Habitats Directive. Latvia, assessment 2007-2012 (2013), European Commission, http://cdr.eionet.europa.eu/lv/eu/art17/envuc1kdw

Dabas lieguma „Pededzes lejtece" dabas aizsardzības plāns (2007) I.Roves red. Rīga, Latvijas Dabas fonds, 67 lpp.

Dabas lieguma „Sitas un Pededzes paliene" dabas aizsardzības plāns (2005) L.Salmiņas red. Rīga, Latvijas Dabas fonds, 104 lpp.

Prieditis, N. (2002) Evaluation frameworks and conservation system of Latvian forests. Biodiversity and Conservation 11, 1361–1375 p.

NOTES

Figure 1. Pool in a bog in Oļļas raised bog (Photo: U.Suško).

Figure 2. Pool in a bog in Aizkraukles raised bog (Photo: U.Suško).

Figure 3. Complex of tussocks and mixed forests on wet peaty soils in Tīreļu bog (Photo: A.Namatēva).

Figure 4. Complex of piles - mixed forests on wet peaty soils in Teiču bog (Photo: A.Namatēva).

Figure 5. Tussock microtopography in Gaiņu bog (Photo: A.Namatēva).

Figure 6. Tussock microtopography in Oļļas bog (Photo: L.Auniņa).

Figure 7. Dip in Ašenieku bog (Photo: A.Namatēva).

Figure 8. Complex of piles and pools in Teiču bog (Photo: A.Namatēva).

Figure 9. Quagmire in Teiču bog (Photo: A.Namatēva).

COASTAL AND HALOPHYTIC HABITAT IDENTIFICATION TABLE

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Dominating and characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
1110 Sandbanks which are slightly covered by sea water all the time										
Typical – deep water sandbanks	A formation that rises at least 1 m above the seabed and is fully covered and surrounded by ~20 m of water	Elongated, round or of irregular shape	Mainly sand with an addition of gravel, pebbles, rocks and mud	Relatively stable	Can be absent, usually formed by few sand-related species	Mostly absent	Various, mainly: *Zostera marina*, *Potamogeton pectinatus*, *Ruppia maritima*, *Tolypella nidifica* and others	1170	Characteristic plant species usually occur only on relatively stable sandbanks, but all complex of underwater relief is included in the habitat	-
1150* Coastal lagoons										
Typical	Permanent waterbodies that are connected to the sea (by their origin or prevailing processes) with a varying water volume, perennial hygrophytes – stands of reed and bulrush, in separate cases – *Scirpus spp.* and *Phragmites australis* are the only characteristic plant species	A shallow lagoon that is separated from the sea by sand banks of varying height and width	Sand	Regular connection to the sea of different volume – flooding with brackish water, accumulation-erosion dynamics of the streak that separates the lagoon from the sea	Various, mainly: *Ruppietea maritimae*, *Potametea*, *Charetea*, *Zosteretea*	Vegetation is varied	Various, mainly: *Potamogeton pectinatus*, *Batrachium baudotii*, *Ruppia maritima*, *Lemna trisulca*, *Callitriche spp.*, *Chara spp.*, *Tolypella nidifica*, *Najas marina*, *Phragmites australis*, *Stratiotes aloides*, *Typha spp.*, *Scirpus tabernaemontani*, *Eleocharis spp.*, *Bolboschoenus maritimus* and others	Lakes of lagoon origin	This habitat forms a unified complex that includes the lagoon, the streak that separates the lagoon from the sea and the separated water area that affects the shore of the coastal lagoon directly	-
1170 Reefs										
Typical	Hard compact substrata, which arises from the sea floor with a biological community that is formed by: perennial macrophytic algae with the cover >20% in the site to be assessed or overgrowth by mussels >50% in the site to be assessed	Varied, a part of the sandbank can permanently of periodically be located below water	Hard material of geogenic origin - pebbles, rocks and others as well as mussel stands	Relatively stable, water exchange	Communities formed by various groups of organisms	Overgrowth is formed mostly by macrophytic algae and mussels	Algae - ***Fucus vesiculosus*** (dominates in the Gulf of Riga), ***Furcellaria lumbricalis*** (dominates in the open part of the Baltic Sea), *Ceramium spp.*, *Polysiphonia spp.*, *Rhodomeda subfusca*, *Pilayella littoralis*, *Ectocarpus confervoides*, *Enteromorpha spp.*, *Chorda filum*, *Coccotylus truncatus*, *Cladophora rupestris*, *C.glomerata* and others, mussels – ***Mytilus edulis, Dreissena polymorpha, Modiolus modiolus*** and others	1110	The habitat does not include reefs of technogenic origin; plant species that are characteristic to the habitat usually occur only on relatively stable sandbanks, but all complex of underwater relief is included in the habitat; if the cover of overgrowth is smaller than the minimum criteria, the site to be assessed should be registered as a potential habitat	-

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Dominating and characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
1210 Annual vegetation of drift lines										
Typical	Naturally formed accumulations of drift material that can be overblown with sand, fragmentary with at least one annual plant species on the accumulations or adjacent to them	Mostly low, flat beach, more frequently in bays	Nitrogen rich accumulations of drift material	Moderate overwashing with sea water during the vegetation season	Mostly *Atriplicion littoralis, Salsolo kali-Honkenyion peploidis*	Littoral halophytic plant species dominate the vegetation	***Atriplex prostrata, A.littoralis, A.calotheca, Chenopodium rubrum***, *Cakile baltica, Salsola kali, Polygonum hydropiper, P.lapathifolium, Corispermum intermedium, Agrostis stolonifera*; animals – *Scatella stagnalis, Setacera aurata, Omophron limbatum, Heterocerus fusculus, Hydrophilidae* sugas (*Helochares obscurus*, *Cercyon spp.*).	2110, 1310, 1220, 1630*, 1640, 2120, 2130, 2180	Considered as a microhabitat, forms on the beach, dunes and other habitats	-
1220 Perennial vegetation of stony banks										
Typical	The beach is covered by at least 20% of rocks or at least 80% of pebbles with the total vegetation cover at least 10%	Low beach	Stony or pebbly beach	Regular, but moderate overwashing with sea water	Various, most frequently *Elymo-Crambetum*	Vegetation is formed mostly by perennial plant species	*Honkenya peploides, Leymus arenarius, Agrostis stolonifera, Lathyrus maritimus, Elytrigia repens, Achillea millefolium, Rumex crispus, Rumex spp., Angelica archangelica, Potentilla anserina, Carex arenaria, Cakile baltica, Lepidium latifolium, Salsola kali, Atriplex spp., Phragmites australis, Scirpus tabernaemontani, Bolboschoenus maritimus, Typha angustifolia;* less frequently: *Alopecurus pratensis, Arrhenatherium elatius, Calamagrostis arundinacea;* very rarely: *Crambe maritima*	1630*, 1640, 1310, 1210	Habitat also forms on low stony-beaches and pebbly beaches. Vegetation can transform into tall grass wetland vegetation without a distinct boundary	-
1230 Vegetated sea cliffs of the Atlantic and Baltic coasts										
Typical	All sea cliffs on a hard bedrock (sandstones) or in a combination of sandstone with quaternary sediments (with no height restrictions) and sea cliffs in quarternary sediments that are at least 4 m high are considered as this habitat. Characteristic species may be absent, as vegetation cover that is characteristic to other habitat types forms in inactive bluffs	Bluffs	Sandstone, sand, clay, aleirites, gravel, pebbles, peat	The outcrop is inactive (overgrown) or subject to an active wave and wind activity	*Agropyro-Honkenion peploides; Ammophilion arenariae; Galio-Koelerion*	Various, but it has no significance in identification of this habitat. Vegetation can be absent	*Calamagrostis epigeios, Leymus arenarius, Festuca arenaria, Tussilago farfara, Petasites spurius, Cardaminopsis arenosa, Arabidopsis thaliana, Linaria loeselii, Cakile baltica, Chenopodium spp., Atriplex spp., Corispermum, Anthyllis spp., Thymus serpyllum, Hieracium umbellatum, Galium album, Silene nutans, Festuca ovina, Koeleria glauca,Dicranella varia, Pohlia spp., Bryum spp.*	8220, 2180, 6120*, 7160		-

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Dominating and characteristic species	Similar habitats, <u>possible overlapping of habitats</u>	Comments	Variant code
1310 *Salicornia* and other annuals colonising mud and sand										
Typical	Annual moisture loving plant community in the beach	Low humid beaches with depressions and puddles	Muddy-humid sand	Beach that is subject to acive flooding, occasion-allysprings occur	Mostly *Nano-Cyperion flavescentis*, also *Bidentetalia*	From very sparse and fragmented to closed	<u>Plants</u>: ***Juncus bufonius, Ranunculus sceleratus, Polygonum hydropiper,*** *Spergularia salina, Chenopodium spp., Atriplex spp., Juncus articulatus;* *abiem variantiem;* <u>animals</u>*: Scatella stagnalis, Setacera aurata, Omophron limbatum, Heterocerus fusculus, Helochares obscurus, Cercyon spp.*	1220, 1640, <u>1210</u>	Often forms a mosaic vegetation with coastal rush meadows, reeds and grasslands, as well as plants of dune depressions and dunes	**1310_1**
Dominated by *Sagina nodosa* and *Agrostis stolonifera*				A periodically flooded beach	*Saginetea maritimae, Nano-Cyperion flavescentis*	Low vegetation in a continuous cover, patches and belts	***Agrostis stolonifera, Sagina nodosa***	2110, <u>1210</u>		**1310_2**
1630* Boreal Baltic coastal meadows										
Typical	The habitat is considered a coastal meadow if it is flooded by brackish sea water and at least 1% of the area is covered with brackish soil vegetation with at least one brackish (*halophytic*) species	Low humid beaches, flood plains of river estuaries, floodplains of lakes that are related to the sea	Particles of a small diameter and sand, the amount or rocks < 20%	Accumulation of particles whose diameter is smaller than that of a grain of sand	Various	Mostly closed vegetation of perennial plant species	*Agrostis stolonifera, Bolboschoenus maritimus, Centaurium littorale, C.pulchellum, Eleocharis uniglumis, Glaux maritima, Juncus gerardii, Plantago maritima, Puccinellia capillaris, P.maritima, Scirpus tabernaemontani, Triglochin maritimum*	1210	Plant species that are characteristic to the habitat most frequently occur only in relief depressions, but all complex is included in the habitat	-
1640 Boreal Baltic sandy beaches with perennial vegetation										
Typical	Sand beaches with at least 10% of vegetation composed of perennial plant species	Low beach	Sand	Regular, but moderate flooding with sea water; small accumulation of cand can be present	Various	Mostly sparse, of different heights, closed areas can be formed at the end of summer and in autumn	*Ammophila arenaria, Honkenya peploides, Leymus arenarius, Elytrigia spp., Cakile baltica, Salsola kali, Lathyrus maritimus, Atriplex littoralis, Atriplex spp., Chenopodium spp., Calamagrostis epigeios, Festuca arenaria, Carex arenaria, Phragmites australis, Calamagrostis arundinacea*	2110, 1310, <u>1210</u>		-

COASTAL SAND DUNE AND INLAND DUNE HABITAT IDENTIFICATION TABLE

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
2110 Embryonic shifting dunes										
Dominated by *Honckenya peploides*	Dune hummocks that have formed as a result of wind activity	Mostly low dune hummocks	Sand	Overblowing of sand	*Salsolo kali-Honkenyion peploidis*	Low succulent plants in patches or continuous stands	***Honckenya peploides***	2120, 1210	Often developed after erosion or shores	**2110_1**
Leymus arenarius and *Festuca arenaria*					*Ammophilion arenariae*	Individual plants or plants in groups, frequently stands of a pillow-like shape	***Leymus arenarius, Festuca arenaria***		Characteristic to shores with sand deficit	**2110_2**
Typical		Low undulated or pillow-like dunes mostly on medium high and high beaches		Active overblowing of sand, accumulation		Individual plants, plants in groups or continuous stands; low and medium tall succulents; rare grasses	***Cakile baltica, Salsola kali,*** *x Calammophila baltica, Elytrigia x littorea, Calamagrostis epigeios, Petasites spurius,* occasionally *Carex arenaria* or *Ammophila arenaria;* animals for all variants - *Broscus cephalotes, Cicindela maritima*		Can form in accumulation and erosion shores	**2110_3**
2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)										
Typical	A dune cordon with at least one characteristic species	Dune cordon	Sand	Active overblowing of sand and accumulation	*Ammophilion arenariae*	Very sparse to dense, dominated by tall grasses	***Ammophila arenaria, Leymus arenarius, Festuca arenaria,*** *x Calammophila baltica, Lathyrus maritimus, Hieracium umbellatum, Calamagrostis epigeios, Tragopogon heterospermus, Anthyllis maritima, Artemisia campestris, Petasites spurius, Honckenya peploides;* animals – *Myrmeleon formicarius* and *Euroleon nostras, Cicindela maritima*	2110, 2130*, 1210	Stands of *Salix daphnoides* or *Salix viminalis,* as well as stands of *Rosa rugosa* frequently dominate the foredunes	-

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
2130* Fixed coastal dunes with herbaceous vegetation (grey dunes)										
Corynephorus canescens	Vegetation of grass, sedge and lichens mainly dominates, which is located in another complex of coastal habitats with at least three characteristic species	Mainly plain (plateau), can be undulated as well as on slopes of dune cordons	Sand, pebbles, gravel, well drained	Overblowing of sand, which is occasionally active	*Corynephorion canescentis*	Plants of the primary succession stages dominate, patches of bare soil are characteristic	***Corynephorus canescens,*** *Jasione montana*, *Carex arenaria*	2120, 2140* 2170, 6120, 1210	Frequently dominated by *Corynephorus canescens*	**2130*_1**
Grassland-type				Passive overblowing of sand, soil formation	*Koelerion glaucae*	Mostly continuous vegetation	***Festuca sabulosa, Carex arenaria, Hieracium umbellatum, Koeleria glauca,*** *Sedum acre, Dianthus arenarius s.l., Astragalus arenarius,* ***Thymus serpyllum,*** *Artemisia campestris, Pulsatilla pratensis, Alyssum gmelinii, Viola tricolor, Epipactis atrorubens,* mosses and lichens: ***Cetraria aculeata, C.islandica,*** *Polytrichum juniperinum, P.piliferum, Brachythecium albicans,* ***Syntrichium ruralis, Racomitrium canescens,*** *Ceratodon purpureus,* ***Cladonia spp.;*** animals for all variants: *Lullula arborea, Oedipoda coerulescens, Myrmeleotettix maculatum, Psophus stridulus, Sciocoris cursitans, Opatrum sabulosum, Melanimon tibiale, Gronops inequalis* and *Barynotus obscurus*		*Thymus serpyllum* is often present, as well as dune grasses and mosses. Due to reduction of management and insufficiency of optimal disturbances *Carex arenaria*, *Calamagrostis epigeios*, *Leymus arenarius*, *Ammophila arenaria* or other expansive or invasive plant species may dominate in separate areas	**2130*_2**
Typical (*xerophytic*)				Overblowing of sand is very small, soil formation, frequent sharp fluctuations of the daily temperature in the soil sover – a typically xerophytic environment		Sparse cover or low herbaceous plants, fragmented or continuous cover of mosses and lychens			*Epipactis atrorubens*, *Astragalus arenarius*, *Koeleria glauca*, *Syntrichia ruralis* and *Cetraria spp.* are often found	**2130*_3**

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
2140* Decalcified fixed dunes with *Empetrum nigrum*										
Typical	Open secondary dunes with the cover of low scrubs a least 25%, the cover of trees and shrubs does not exceed 70% and are not the main producers of the organic material	Mostly low secondary dunes	Sand	Accumulation of humus, soil formation, dynamic processes of the seashore, including disturbances created by storms and wind, frequent sharp fluctuations of the daily temperature in the soil sover – a typically xerophytic environment	Mostly *Empetrion nigri*	Varies from sparse to closed, dominated by low scrubs	*Arctostaphylos uva-ursi*, ***Empetrum nigrum, Calluna vulgaris, Vaccinium vitis-idaea,*** *Carex arenaria, Pyrola rotundifolia, Thymus serpyllum, Dianthus arenarius s.l., Festuca sabulosa, Koeleria glauca, Jasione montana, Racomitrium canescens, R.ericoides, Ceratodon purpureus, Cladonia spp., Cladina spp., Stereocaulon spp., Peltigera canina, Cetraria spp.* and others	2130*, 2170, 2180, 2140 2320, 4030, 5130	Includes dry heaths that have formed by overgrowing of open secondary dunes in a direct proximity of the Coastal Lowlands	-
2170 Dunes with *Salix repens spp. argentea (Salicion arenariae)*										
Xerophytic variant	Grey dunes where stands of low willows take up at least 25% of the vegetation cover, the cover of other tree species is smaller than 50%	With low hummocks or plane	Sand, pebbles, gravel, well drained	Very little over-blowing of sand, soil formation, frequent sharp fluctuations of the daily temperature in the soil sover – a typically xerophytic environment	*Salicion arenariae* in mosaic with *Koelerion glaucae*	Mosaic structure, where small dune hummocks of *Salix repens* interchange with sparse herbaceous plant – lichen vegetation, in separate areas with covers of *Uvae ursi* and *Empetrum nigrum* or continuous stands of willows	***Salix repens, S.rosmarinifolia, Koeleria glauca, Festuca sabulosa, Thymus serpyllum, Ceratodon purpureus,*** *Arctostaphylos uva-ursi, Astragalus arenarius, Alyssum gmelinii, Anthyllis maritima, Carex arenaria, Dianthus arenarius s.l., Epipactis atrorubens, Hieracium umbellatum, Pulsatilla pratensis, Ditrichum flexicaule, Syntrichium ruralis, Diploschistes muscorum, Cetraria aculeata, Cladonia spp.;* animals – *Oedipoda coerulescens, Myrmeleotettix maculatum, Sciocoris cursitans Cicindela maritima*	2140*, 2180	Habitat with stands of low willows also forms in depressions among grey dunes, where mesophylous or hygrophitic plant species dominate; until now this habitat has been less studied, therefore only its xerophytic variant has been characterized	-

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
2180 Wooded dunes of the Atlantic, Continental and Boreal region										
Typical	Eolic sediments in the Coastal Lowlands that are related to the previous development stages of the Baltic Sea up to the ancient seaside slope of the Baltic Ice Lake – a dune or dune complex that are covered mostly with dry pine forests	Dunes, flat or undulated sand plain, dune slacks of various shapes	Sand, in humid slacks also peat and topsoil	Accumulation of humus, soil podsolation	Various, mostly *Dicrano-Pinion*	Vegetation that is characteristic to dry pine forests, dominant life form – trees	*Juniperus communis, Vaccinium vitis-idaea*, ***Pinus sylvestris***, *Arctostaphylos uva-ursi, Empetrum nigrum, Calluna vulgaris, Vaccinium myrtilloides, Antennaria dioica, Carex ericetorum, Chimaphila umbellata, Festuca ovina, F.sabulosa, Silene nutans, Thymus serpyllum, Monotropa hypopitys, Solidago virgaurea, Trommsdorfia maculata, Diphasiastrum complanatum, Lerchenfeldia flexuosa, Racomitrium canescens s.l., Cladonia spp., Cetraria islandica, Cladina spp., Stereocaulon spp.* and others	2130*, 2140*, 2170, 2320, 4030, 9060, 91E0, 9010*, 9080*, 91D0*	The habitat is located in the section from the upper part of the seashore to the ancient seaside slope of the Baltic Ice Lake. Habitat overlaps with 9010* *Western Taiga*	-
2190 Humid dune slacks										
One - variable	Constantly or periodically humid dune slack with herbaceous plant vegetation in the Coastal Lowlands. Vegetation is substantially different from the vegetation on dune cordons. Main producers of the organic substances are not trees with the exception of low willows and *Myrica gale*. The slope of the dunes that surround dune slack is longer than 1 m	Dune slack of various shapes	Sand; humus and occasionally also peat accumulate in the slack	Overgrowing, accumulation of humus or peat, water erosion on the slopes of the dune slack	Various	Various, varies from sparse pioneer vegetation to grasslands, tall grass communities, mires, stands of *Myrica gale* and others	Various	2120, 2180, 4010, 6410, 6510, 7110*, 7120, 7140, 7210, 7230	Habitat is located only in the Coastal Lowlands	-

Variant	Minimum criteria	Relief	Substrate	Process	Plant community	Vegetation	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
2320 Dry sand heaths with *Calluna* and *Empetrum nigrum*										
The heath has formed by overgrowing of sand plains	Nutrient poor sand heath of the Coastal Lowlands, at least 25% of low scrubs with dominating *Calluna vulgaris*, trees and shrubs do not exceed 70% and are not the main producers of the organic material	Plain, undulated	Sand	Humus formation, podsolation, natural overgrowing of the heath if the amount of disturbances is insufficient, sod is absent, frequent sharp fluctuations of the daily temperature in the soil sover – a typically xerophytic environment	Mostly *Nardo-Callunetea, Empetrion nigri*	Monodominant stands of *Calluna vulgaris* or in a combination with other low scrubs; often with inclusions of xerophytic pioneer vegetation and open sand	***Calluna vulgaris, Vaccinium vitis-idaea, Arctostaphylos uva-ursi, Empetrum nigrum, Carex areanria,*** *Cladonia spp., Cladina spp., Cetraria spp., Racomitrium canescens s.l., Syntrichium ruralis* and others	2130*, 2140*, 2180, 2330, 4030, 9010*, <u>5130</u>	The habitat often occurs as a mosaic complex with inclusions of variable humidity regime, wet heaths and other habitats; rarely park-type; overgrows with *Pinus sylvestris*, ***located in the Coastal Lowlands***	**2320_1**
The heath has formed by overgrowing of nutrient-poor grasslands on sand soils	Nutrient-poor area in the Coastal Lowlands and at least 50% of sparsely growing low scrubs with dominant *Calluna vulgaris*, trees and scrubs do not exceed 70% and are not the main producers of the organic material			Podsolation, natural overgrowing if the amount of disturbances is insufficient, sod is present, peat formation can take place in more humid slacks		Monodominant stands of *Calluna vulgaris* or in a combination with other low scrubs; often with inclusions of Nardus grasslands	***Calluna vulgaris, Vaccinium vitis-idaea, Arctostaphylos uva-ursi, Empetrum nigrum,*** *Nardus stricta, Sieglingia decumbens, Festuca ovina, Antennaria dioica, Carex pilulifera, Agrostis tenuis, Veronica officinalis* and others	2140*, 4030 6230*, <u>5130</u>		**2320_2**
2330 Inland dunes with open *Corynephorus* and *Agrostis* grasslands										
Typical	Inland dunes outside the Coastal Lowlands, where the vegetation is dominated by *Corynephorus canescens* and/ or *Agrostis tenuis*; trees and scrubs do not exceed 70% and are not the main producers of the organic material	Inland sand plains and dunes	Sand	Soil formation, podsolation, frequent sharp fluctuations of the daily temperature in the soil sover – a typically xerophytic environment	*Corynephorion*	Mostly sparse – open	***Corynephorus canescens, Agrostis tenuis, Carex arenaria,*** *Teesdalia nudicaulis, Festuca sabulosa, F.ovina, Lerchenfeldia flexuosa, Koeleria glauca, Thymus serpyllum, Dianthus arenarius s.l.,Campanula rotundifolia;* <u>mosses</u>: *Racomitrium canescens s.l., Polytrichum piliferum, Ceratodon purpureus,* <u>lychens</u>: *Cladonia spp., Cetraria spp., Stereocaulon spp.*	2130*, 2140*, 2170, 2320, 4030, 6210, 6120*, <u>5130</u>	Located inland – only outside the Coastal Lowlands	-

FRESHWATER HABITAT IDENTIFICATION TABLE

Variant	Environmental factors	Vegetation	Characteristic species	Minimum habitat requirements	Similar habitats, possible overlapping of habitats	Variant code
3130 Oligotrophic to mesotrophic standing waters with vegetation of the *Littorellatea* and/or *Isoeto-Nanojuncete*						
Lakes with the *Lobelia-Isoëtes* complex	Low concentration of nutrients (nitrogen and phosphorus compounds) in water, mineral soil, clear water or brown water	Visually poor, stretches of the littoral zone with the bottom dominated by mineral soil that are free of vegetation are present, floodland zone with low and sparse vegetation, characteristic species from communities formed by species of the *Lobelia-Isoëtes* complex, stands of species of other ecological groups of aquatic plants are fragmented, sparse or absent	*Eleocharis acicularis, E.multicaulis, Isoetes lacustris, I.echinospora, Juncus bulbosus, Littorella uniflora, Lobelia dortmanna, Lycopodiella inundata, Myriophyllum alterniflorum, Ranunculus reptans, Sparganium angustifolium, S.gramineum, Subularia aquatica;* mosses: *Drepanocladus tenuinervis, Fontinalis dalecarlica, Fossombronia foveolata, Riccardia chamaedryfolia, Scapania irrigua, Sphagnum lescurii*	Occurrence of communities of characteristic plant species in 1% of the lake	3140, 3150, 3160	**3130_1**
Mesotrophic lakes	Low concentration of nutrients in water, mineral soil, clear water	Visually comparatively poor, stretches of the littoral zone with the bottom dominated by mineral soil that are free of vegetation are present, stands of aquatic plant species are fragmented or sparse		In stratified lakes oxygen is present throughout the whole water column till the bottom		**3130_2**
Semi-distrophic lakes	Low concentration of nutrients in water, mineral soil, brown water	Visually poor, stretches of the littoral zone with the bottom dominated by mineral soil that are free of vegetation are present, stands of aquatic plants are fragmented or sparse, stands of sedge are characteristic		Littoral dominated by mineral soil, water chromacity >80 Pt-Co, electroc conductivity <165 mkS/cm, pH>5		**3130_3**
3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.*						
Typical	Lime rich soil, wide and shallow littoral zone, hard water (rich in compounds of calcium and magnesium), low concentration of nutrients in water, water transparency usually >2 or reaches the bottom of shallow lakes, water pH usually exceeds 7	*Chara spp.* dominate occupying the largest part of the lake area, stands of emergent-leaved plants and shoreline quagmires frequently occur, stands of aquatic plants from other ecological groups are fragmented	*Chara spp., Nitella spp., Nittellopsis obtusa*	*Chara spp*. communities are found in at least 30% of the lake , they have the dominant role in the lake	3130, 3150, 7210	**-**

Variant	Environmental factors	Vegetation	Characteristic species	Minimum habitat requirements	Similar habitats, possible overlapping of habitats	Variant code
3150 Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation						
Clear water lakes with a diverse vegetation	Diverse bottom conditions and physical and chemical indicators of water, but usually the bottom is sandy, water is medium rich to lich in nutrients (compounds of nitrogen and phosphorus), the color of water ranges from yellow-green to yellow, water pH >7	Visually medium rich to rich, diverse and species rich vegetation; all zones of macrophyte vegetation represented by emergent-leaved, floating-leaved and submerged vegetation which contain various communities of characteristic and other plant species, are usually well developed; zone of shoreline quagmires can occur	*Batrachium circinatum, Hydrocharis morsus-ranae, Myriophyllum spicatum, M.verticillatum, Nuphar lutea, N.pumila, Nymphaea alba, N.candida, Polygonum amphibium, Potamogeton berctholdii, P.compressus, P.gramineus, P.lucens, P.natans, P.perfoliatus, P.praelongus, Scirpus lacustris, Stratiotes aloides, Typha angustifolia, Utricularia vulgaris;* mosses: *Drepanocladus aduncus, D.sendtnerii, Fontinalis antipyretica, F.hypnoides, Platyhypnidium riparioides, Scorpidium scorpioides*	Vegetation is formed by communities of characteristic plant species in emergent-leaved, floating-leaved and submerged zones, but the plant communities that are characteristic to the habitat 3130 do not occur in more than 1% of the lake littoral and the cover of vegetation of *Chara spp.* (habitat 3140) does not reach 30% of the lake littoral	3130, 3140, 3160	**3150_1**
Brown water lakes with a diverse vegetaton	Diverse bottom conditions and the physical and chemical indicators of water, but the bottom is usually muddy, water ir medium rich to rich in nutrients, the water color – from yellow-brown to brown, water pH >7					**3150_2**
Oxbows with a diverse vegetation	Diverse bottom conditions and the physical and chemical indicators of water					**3150_3**
3160 Natural dystrophic lakes and ponds						
Typical	Peaty soil and water rich in humic acids, the water is brown to red-brown, water pH 3-6	Very poor vegetation, lakes often lack any vegetation, separate stands or specimen of characteristic species, sometimes species of other aquatic plants are to be found; Sedges and *Sphagnum* mosses occur mainly around the shoreline and at shores; plant communities of transition or raised bogs with sedges and *Sphagnum* mosses or bogswamp forests occur at shores	*Carex lasiocarpa, C.limosa, Utricularia minor;* mosses: *Sphagnum cuspidatum*	Location in a bog habitat complex or water pH 3-6 and chromacity > 80 Pt-Co	3130, 3140, 3150	-

Variant	Environmental factors	Vegetation	Characteristic species	Minimum habitat requirements	Similar habitats, possible overlapping of habitats	Variant code
3190* Lakes of gypsum karst						
Typical	Areas of karst processes that are characterized by chains of funnel-shaped sinkholes and small hollows; large fluctuations of water level, high concentration of calcium and sulphate ion in water	A very poor vegetation that is mainly formed by plant species that have adapted to variable moisture conditions; communities of freely floating and submerged aquatic plants can be found, whereas older sinkholes can have communities of terrestrial plants	This habitat has no characteristic vascular plant species. Green algae, blue-green algae, diatoms and specific bacteria species	Suitable geological origin	3150	-
3260 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-batrachion* vegetation						
River rapids	Flow velocity > 2 m/s; stony, shingly, pebbly bottom	Communities of red and green algae as well as moss that are attached to rocks and communities of submerged elodeids rooted in riverbed are characteristic	*Batrachospermum spp., Hildenbrandia rivularis, Cladophora spp., Fontinalis antipyretica, Platyhypnidium riparioides, B.trichophyllum, Berula erecta, Potamogeton alpinus, Veronica anagallis-aquatica, V.beccabunga;* invertebrates: *Oulimnius spp., Limnius spp., Riolus cupreus, Hydraenidae spp., Gammarus spp., Ancylus fluviatilis, Hydraenidae spp., Margaritifera margaritifera, Theodoxus fluviatilis, Unio crassus;* fishes: *Alburnoides bipunctatus, Lampetra fluviatilis, L.planeri, Salmo salar, S.trutta, Salmo trutta fario, Thymallus thymallus*	Flow velocity exceeds 0.2 m/s and it has a stony, shingly or pebbly bottom	none	**3260_1**
Natural rivers and river stretches	Natural bottom, natural hydrological regime, flow velocity < 2 m/s, the bottom usually consists of sand or muddy sand	Aquatic plant communities of different ecological groups	*Batrachium aquatile, B.circinatum, B.trichophyllum, Berula erecta, Butomus umbellatus, Callitriche spp., Elodea canadensis, Mentha aquatica, Myriophylum spicatum, Nuphar lutea, Phalaroides arundinacea, Potamogeton alpinus, P.berchtoldii, P.perfoliatus, Rorippa amphibia, Sagittaria sagittifolia, Scirpus lacustris, Sium latifolium, Sparganium emersum, S.erectum, Veronica anagallis-aquatica, V.beccabunga*	Flow velocity is smaller than 0.2 m/s, but the river has a natural bottom and natural hydrological regime	none	**3260_2**
3270 Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation						
Typical	Natural hydrological regime with pronounced water level fluctuations, substrate that is nitrogen rich, muddy or partly muddy and is formed by sand, gravel or pebbles	Vegetation can be absent or consist of medium tall to tall annual plants; plant species that have adapted to varying humidity conditions as well as aquatic plant species can be found	*Chenopodium rubrum, C.cerifolium, Bidens cernua, Xanthium albinum, Polygonum nodosum*	Appropriate environmental conditions (at least 2 m wide areas of open muddy or sandy-muddy soil, that uncover on banks of large rivers when the water level has fallen), communities of characteristic species can also be absent	none	-

HEATH HABITAT IDENTIFICATION TABLE

Variant	Minimum criteria	Susbtrate	Process	Plant communities	Characteristic species	Similar habitats	Comments	Variant code
4010 Northern Atlantic wet heaths with *Erica tetralix*								
Typical	*Erica tetralix* is dispersely present and the plant species and communities characteristic to the habitat dominate the vegetation. The tree and scrub cover ir smaller than 75% and the average height of trees is smaller than 5 m	Shallow peat or sand	Podsolation	*Ericion tetralix, Dicrano-Pinion*	*Calluna vulgaris, Erica tetralix, Salix rosmarinifolia, Vaccinium vitis-idaea, Vaccinium uliginosum, Myrica gale, Molinia caerulea, Juncus squarrosus, Trichophorum cespitosum, Juncus bulbosus, Carex panicea, Carex nigra, Potentilla erecta, Sphagnum compactum, Sphagnum capillifolium, Sphagnum contortum, Sphagnum subsecundum, Sphagnum papillosum, Hypnum jutlandicum, Leucobryum glaucum, Lophozia ventricosa, Ptilidium ciliare, Cephaloziella spp., Fossombronia spp., Calypogeia spp., Cladonia spp., Cladina spp.*	5130, 91D0*	Can be distinguished from the habitat 91D0* in the Coastal Lowlands by the height of trees and the characteristic species	**4010_1**
Temperate Atlantic	At least two characteristic species of this habitat apart from *Calluna vulgaris* and *Molinia cearulea* are dispersely present and the tree density must be below 75% and the layer of low scrubs must be at least 50%, *Erica tetralix* is not present	Shallow peat or sand	Podsolation	*Ericion tetralix*				**4010_2**
4030 European dry heaths								
Heath that has developed as a result of overgrowing of a sandy area	At least 25% of low scrubs with *Calluna vulgaris* as the dominant species, trees and scrubs do not exceed 70% and are not the main producers of the organic material	Nutrient poor sand, sod is not present	Formation of humus, podsolation, natural overgrowing of the heath if the amount of disturbances is insufficient	Monodominant stands of *Calluna vulgaris* or in combination with other low scrubs; frequently – xerophytic pioneer vegetation on patches of bare sand	*Calluna vulgaris, Vaccinium vitis-idaea, Arctostaphylos uva-ursi, Empetrum nigrum, Cladonia spp., Cladina spp., Cetraria spp., Racomitrium canescens s.l., Syntrichia ruralis* and others	2140*, 2320, 2330, 5130	The habitat is often found as a mosaic complex with a variable humidity regime, inclusions of wet heaths and other habitats; rarely – park-type; overgrows with *Pinus sylvestris*	**4030_1**
Heath that has developed as a result of overgrowing of nutrient-poor grasslands	At least 50% of low scrubs with *Calluna vulgaris* as the dominant species, trees and scrubs do not exceed 70% and are not the main producers of the organic material	Nutrient poor sand soil, sod is present	Podsolation, natural overgrowing of the heath, if the amount of disturbances ir insufficient, peat formation can occur in depressions	Monodominant stands of *Calluna vulgaris* or in a combination with other low scrubs; frequently with inclusions of *Nardus stricta* grasslands	*Calluna vulgaris, Vaccinium vitis-idaea, Arctostaphylos uva-ursi, Empetrum nigrum, Nardus stricta, Sieglingia decumbens, Festuca ovina, Antennaria dioica, Carex pilulifera, Agrostis tenuis, Veronica officinalis* and others	2320, 2330, 5130 6230*		**4030_2**

GRASSLAND HABITAT IDENTIFICATION TABLE

Variant	Relief	Soil	Plant community	Latvian habitat code	Characteristic species, *dominant species*	Comments	Similar habitats, possible overlapping of habitats	Variant code
5130 *Juniperus communis* formations on heaths or calcareous grasslands								
Juniper communities in grasslands	Diverse	Dry to humid	Mostly grasslands from the *Festuco-Brometea* class	(not included in the classification)	Herbaceous plants that are characteristic to grasslands from the *Juniperus communis, Rosa spp., Crataegus spp., Rhamnus cathartica, Malus spp., Festuco-Brometea* classes	The determinant criterion in separation of this habitat is the occurrence of juniper stands – variations that have not been mentioned here are acceptable for the soil cover vegetation. A growth of at least five viable junipers can be recognized as a habitat when imaginary circular projections (with their radius triple the height of the measured juniper) that are located around each individual juniper form a continuous area of at least 0.1 ha. This habitat does not include juniper stands in wet heaths, bogs and in forests	6530*; various grassland habitats	**5130_1**
Juniper communities in heaths	Diverse		Mostly heaths from the *Calluno vulgaris-Ulicetea minoris* classes	(not included in the classification)	*Juniperus communis, Rosa spp., Calluna vulgaris, Empetrum nigrum, Lerchenfeldia flexuosa, Nardus stricta*			**5130_2**
6110* Rupicolous calcareous or basophilic grasslands of the *Alysso-Sedion albi*								
Typical	Limestone (usually dolomite) outcrops	Poorly developed soil	*Saxifrago-Poetum compressae*	1.3.1. *Poa conpressa - Saxifraga tridactylites* meadows	*Anthemis tinctoria, Cerastium semidecandrum,* ***Jovibarba globifera****, Poa compressa, Potentilla arenaria, Saxifraga tridactylites, Sedum acre;* mosses: *Abietinella abietina*, species of the *Pottiacea* genus; lychens: *Cladonia spp., Peltigera spp.*	Adventive species *Sedum album, S.reflexum* and others can also be found among succulents	6210, 8210	**6110*_1**
On gravelly soils	Slopes or upper parts of moraine hills, where calcareous gravel substrate uncovers as a result of natural erosion or artificially removed soil cover	On gravelly soils, poorly developed soil	*Jovibarba globifera* complexes	1.3.2. *Jovibarba sobolifera* meadows		Succulent communities in cemeteries and adjacent areas (mostly on sandy substrate or rock piles and fences), where succulents have apparently introduced from greeneries, are not included		**6110*_2**

Variant	Relief	Soil	Plant community	Latvian habitat code	Characteristic species, *dominant species*	Comments	Similar habitats, possible overlapping of habitats	Variant code
6120* Xeric sand calcareous grasslands								
Typical	Inland dunes, parts of flood plains that are subject to flooding very rarely or are not flooded at all, terrace slopes, sand plains	Nutrient poor sand, poorly developed soil	*Koeleria glauca* complexes	1.1.5. *Koeleria glauca* grasslands	***Koeleria glauca,*** *Astragalus arenarius, Silene otites, Pulsatilla patens, Helichrysum arenarium, Carex praecox*	None	2130 , 2330, 6210, 6450, 6530*	**6120*_1**
			Diantho-Armerietum	1.2.3. *Dianthus deltoides - Armeria vulgaris* meadows, 1.2.4. *Festuca ovina* and *Festuca trachyphylla* meadows	*Veronica spicata, Hylotelephium maximum, Festuca trachyphylla, Equisetum hyemale,* ***Poa angustifolia,*** *Potentilla arenaria*	Comparatively large number of mesophytic species, *Agrostis tenuis* and *Anthoxanthum odoratum*, (*Armeria vulgaris* can be present, but its occurrence is not determinant) can dominate		
			Pulsatillo-Phleetum	1.2.2. *Phleum phleoides* meadows	Species complex in calcareous sand grasslands and dry grasslands on calcareous soils, ***Phleum phleoides***	Often found adjacent to habitat 6210, it can be separated by a smaller proportion of sandy community species		
			Carex praecox complex	(not included in the classification)	***Carex praecox****, Hylotelephium spp., Poa angustifolia, Galium verum* and others	The communities are often monodominant (dominated by *Carex praecox*), but it is usually caused by termination of management		
Semi-dry	Sand plains	Sandy soil, more mesophilous and fertile compared to the other subtypes	*Poa angustifolia* complex	1.2.1. *Poa pratensis* meadows	Species complex of habitats 6210, 6120 and 6270. Indicators are the continental and calciphilous species, ***Poa angustifolia***	The most mesophilous from all 6120, borders with *Cynosurion*	6270, 6450, 6530*	**6120*_2**
Of skeletal soils	Slopes of moraine hills	Gravelly-sandy materials, poorly developed soil	*Poetum compressae*	(not included in the classification)	*Acinos arvensis, Anthemis tinctoria, Consolida regalis, Helichrysum arenarium, Carex caryophyllea,* ***Poa compressa,*** *Thymus ovatus*	none	6210, 6450, 6530*	**6120*_3**

Variant	Relief	Soil	Plant community	Latvian habitat code	Characteristic species, *dominant species*	Comments	Similar habitats, possible overlapping of habitats	Variant code
6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-brometalia*) (*important orchid sites)								
Western	River valleys (river banks, floodplains, terraces and their slopes), more rarely on hill slopes	Calcareous-poorly acid sandy-clayey soil, also alluvial	*Filipendulo-Helictotrichetum*	1.4.1. *Helictotrichon pratense-Filipendula vulgaris*	*Carex caryophyllea, Carex flacca, Carex ornithopoda, Cirsium acaule,* ***Filipendula vulgaris,*** *Galium verum,* ***Helictotrichon pratense,*** *Trifolium montanum*		6110, 6120, 6450, 6530*	**6210_1**
Eastern	Mostly on hill slopes and summits	Gravelly moraine is the bedrock	*Centaureo-Fragarietum vescae*	1.4.5. *Centaurea scabiosa- Fragaria vesca*	*Agrimonia eupatoria, Carex caryophyllea, Centaurea scabiosa,* ***Fragaria vesca, Poa angustifolia****, Pimpinella saxifraga, Polygala comosa*			**6210_2**
Sandy	River valleys (river banks, floodplains, terraces and ther slopes), sea cliffs, possible also on hill slopes	Calcareous-poorly acid sandy-clayey soil, also alluvial	*Medicagini-Avenetum*	1.4.2. *Medicago falcata-Helictotrichon pubescens*	*Allium oleraceum, Campanula rotundifolia, Cerastium arvense, Helictotrichon pubescens,* ***Medicago falcata****, Poa angustifolia, Potentilla reptans*			**6210_3**
	Mostly river valleys (river banks, floodplains, terrace slopes)		*Filipendulo-Helictotrichetum*	1.4.4. *Helictotrichon pubescens – Fragaria viridis* meadows	*Filipendula vulgaris,* ***Fragaria viridis, Helictotrichon pubescens,*** *Plantago media, Poa angustifolia, Polygala comosa, Trifolium montanum*			
Forest fringe	River valleys (river banks, floodplains, terraces and their slopes), hill slopes	Calcareous-poorly acid sandy-clayey soil, also alluvial	*Brachypodium pinnatum* complex	1.4.3. *Brachypodium pinnatum* meadows	***Brachypodium pinnatum***	As habitat 6210 it is separated only if it is in a complex with other variants, dry belts of ecotone do not comply with 6210	6450, 6530*	**6210_4**
			Geranium sanguineum complex	1.5.1. *Geranium sanguineum* meadows	***Geranium sanguineum***		6450, 6530*	

Variant	Relief	Soil	Plant community	Latvian habitat code	Characteristic species, *dominant species*	Comments	Similar habitats, possible overlapping of habitats	Variant code
6230* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)								
Dry	Sandy plains, more rarely – river valleys	Very poor dry podsol soils and podsols	*Polygalo-Nardetum*	2.1.1. Dryest *Nardus* grasslands	*Agrostis tenuis, Anthoxanthum odoratum, Carex pilulifera, Festuca ovina,* ***Nardus stricta****, Potentilla erecta, Polygala vulgaris,* ***Sieglingia decumbens,*** *Viola canina*	Communities of dry and humid areas can be occur	Heath habitats (the threshold is below 50% of *Calluna vulgaris*, then it is considered 6230) 6270 (the proportion of characteristic species must be considered)	**6230*_1**
			Festuca ovina complex	1.1.2. Dry *Festuca ovina* meadows	*Agrostis tenuis, Campanula rotundifolia, Nardus stricta, Potentilla argentea,* ***Festuca ovina***			
Wet		Very poor mesophilous and humid podsol soils and podsols	*Polygalo-Nardetum*	2.1.2. More humid *Nardus* grasslands	*Agrostis tenuis, Anthoxanthum odoratum, Carex pilulifera, Festuca ovina, Potentilla erecta, Polygala vulgaris, Viola canina,* ***Nardus stricta, Sieglingia decumbens***			**6230*_2**
6270* Fennoscandian lowland species-rich dry to mesic grasslands								
Typical	On hills and river valleys	Mostly on sod-podsol calcareous soils and eroded podsol soils	*Anthoxantho-Agrostietum subasoc. typicum*	2.2.2. *Anthoxanthum odoratum – Briza media* meadows	***Briza media, Festuca rubra, Anthoxanthum odoratum****, Campanula glomerata, Carum carvi, Fragaria viridis, Galium album, Leontodon hispidus, Medicago lupulina, Plantago media, Primula veris*	Young fallow lands with a pronounced domination of *Agrostis tenuis* or *Holcus lanatus*, where no typical structure (layers and sod) has formed are not included in the habitat	6120, 6210, 6230, 6410, 6510, 6450, 6530*	**6270*_1**
On poor soils	Mostly in plains	Sod-podsol soils	*Anthoxantho-Agrostietum subasoc. typicum* and *Nardetosum, Cynosurion* with a transition toward *Violion caninae*	2.2.1. *Anthoxanthum odoratum – Agrostis tenuis* meadows	***Anthoxanthum odoratum, Agrostis tenuis, Festuca rubra, Festuca ovina****, Carex leporina, Hieracium umbellatum, Hypochoeris radicata, Leontodon hispidus, L.autumnale, Rumex acetosella*			**6270*_2**
Moist	Mostly in plains	Diverse, mostly on wet soils, can also be on peaty soils, gleying can take place in the soil	*Anthoxantho-Agrostietum subasoc. holcetosum lanati, Cynosurion* with a transition toward *Calthion*	2.2.3. *Anthoxanthum odoratum – Deschampsia cespitosa* meadows; 2.2.4. *Anthoxanthum odoratum – Holcus lanatus* meadows	***Holcus lanatus, Anthoxanthum odoratum, Deschampsia cespitosa,*** *Filipendula ulmaria, Galium uliginosum, Geum rivale, Lychnis flos-cuculi, Polygonum bistorta, Potentilla anserina*			**6270*_3**

Variant	Relief	Soil	Plant community	Latvian habitat code	Characteristic species, *dominant species*	Comments	Similar habitats, possible overlapping of habitats	Variant code
6410 *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)								
Molina grass-lands	Plains, slopes, floodplains	Mostly semi hydromorphic soils, the process of gleying of soil as well as peat formation (on peaty soils) can occur	*Molinion*, partly *Caricion davallianae*	3.3.1. *Molinia caerulea* meadows	***Molinia caerulea,*** *Briza media, Carex flacca, C.hostiana, C.panicea, C.hartmanii, Epipactis paustris, Galium boreale, Inula salicina, Ophioglossum vulgatum, Molinia caerulea, Scorzonera humilis, Selinum carvifolia, Sesleria caerulea, Succisa pratensis*	Monodominant stands of *Molinia caerulea* in drained bogs are not included in the habitat	6270*, 6210, 7230	**6410_1**
Sesleria grass-lands				3.3.2. *Sesleria caerulea* meadows	***Sesleria caerulea,*** *Briza media, Carex flacca, C.hostiana, C.panicea, C.hartmanii, Epipactis paustris, Galium boreale, Inula salicina, Ophioglossum vulgatum, Molinia caerulea, Scorzonera humilis, Selinum carvifolia, Sesleria caerulea, Succisa pratensis*			**6410_2**
Sedge grass-lands				3.3.3. *Carex flacca* meadows	***Carex flacca,*** *Briza media, Carex flacca, C.hostiana, C.panicea, C.hartmanii, Epipactis paustris, Galium boreale, Inula salicina, Ophioglossum vulgatum, Molinia caerulea, Scorzonera humilis, Selinum carvifolia, Sesleria caerulea, Succisa pratensis*			**6410_3**
Grasslands without pronouncedly dominant species				3.3.4. *Scorzonera humilis* meadows	*Briza media, Carex flacca, C.hostiana, C.panicea, C.hartmanii, Epipactis paustris, Galium boreale, Inula salicina, Ophioglossum vulgatum, Molinia caerulea, Scorzonera humilis, Selinum carvifolia, Sesleria caerulea, Succisa pratensis*			**6410_4**
6430 Hydrophilous tall herb fringe communities of plains and the montane to alpine levels								
River bank variant	River banks and lake shores	Not formed or aluvial	*Convolvuletalia sepium*	(not included in the classification)	*Angelica archangelica, Crepis paludosa, Epilobium hirsutum, Lythrum salicaria, Phalaris arundinacea, Senecio fluviatilis, Thalictrum flavum, Valeriana officinalis*	Monodominant communities of tall herbaceous plants that have formed by overgrowing of humid grasslands (*Molinietalia*), and communities that are dominated by invasive neophytic species (e.g., *Impatiens glandulifera, Helianthus tuberosus* and others) are not included in this habitat	6410, 6450	**6430_1**
Forest edge variant	Forest and non-forest ecotone	Variable	*Glechometalia hederaceae*	(not included in the classification)	***Aegopodium podagraria,*** *Alliaria petiolata, Anthriscus sylvestris, A.nitida, Agrimonia pilosa,* ***Chaerophyllum aromaticum,*** *Geranium robertianum,* ***Lamium album,*** *Melandrium dioicum, Delphinium elatum, Astrantia major, Digitalis grandiflora, Cirsium heterophyllum*	Only habitats with high species diversity and those that are important for protected species are included (e.g. *Anthriscus nitida, Agrimonia pilosa*) in a belt of a pronounced ecotone with ecotone functions. Monodominant communities with *Aegopodium podagraria*, *Chaerophyllum aromaticum*, *Anthriscus sylvestris* are not included in this habitat		**6430_2**

Variant	Relief	Soil	Plant community	Latvian habitat code	Characteristic species, *dominant species*	Comments	Similar habitats, possible overlapping of habitats	Variant code
6450 Northern Boreal alluvial meadows								
Tall *Carex spp*. and *Phalaroides arundinacea* grasslands	Lake and river floodplains	Alluvial	*Magnocaricion*	4.3. Meadows of tall *Carex spp*.	*Carex acuta, C.acutiformis, C.paniculata, C.appropinguata, C.vesicaria, C.rostrata, C.vulpina, C.diandra, C.disticha, Calamagrostis canescens,* ***C.neglecta, Phalaris arundinacea, Glyceria maxima, Stellaria palustris, Lathyrus palustris***	Such communities can form also outside river floodplains but they are not included in this habitat. Small fragments with plant communities of different natural grasslands which are smaller than 0.1 ha can be included in the habitat		**6450_1**
Alopecurus pratensis and *Poa spp*. grasslands on very fertile soils			*Arrhenatherion (?)*	2.3.4. *Bromopsis inermis* meadows	***Bromopsis inermis,*** *Arrhenatherion* or characteristic species of *Magnocaricion*			**6450_2**
			Alopecurion	3.1.1. *Alopecurus pratensis* meadows	***Alopecurus pratensis, Poa palustris, P.trivialis,*** *Veronica longifolia, Lychnis flos-cuculi, Geum rivale, Ranunculus auricomus, Galium uliginosum, Galium boreale*	*Alopecurus pratensis* meadows that are located outside floodplains are included in the habitat 6510	Outside flooodplains 6510_2	
Humid floodplain grasslands on medium fertile soils			*Calthion*	3.2. Humid meadows and pastures on fertile and moderately fertile soils	*Deschampsia caespitosa, Geranium palustre, Polygonum bistorta, Carex caespitosa, Scirpus sylvaticus, Cirsium oleraceum, Juncus effusus, J.conglomeratus, Geum rivale*			**6450_3**
			Caricion nigrae	4.1. Acidophilous meadows of low *Carex spp*. 4.2. Calciphilous meadows of low *Carex spp*.	***Carex nigra, C.panicea****, Agrostis canina, Carex cinerea, C.flava, Juncus filiformis, Ranunculus flammula, Viola palustris*			
			Potentillion anserinae	2.4.1. *Agrostis stolonifera – Potentilla reptans* meadows; 2.4.2. *Alopecurus aequalis* meadows	*Potentilla anserina, Alopecurus aequalis, A.geniculatus, Agrostis stolonifera, Ranunculus repens, R.flammula, R.reptans, Inula britannica, Allium schoenophrasum, Potentilla reptans*			

Variant	Relief	Soil	Plant community	Latvian habitat code	Characteristic species, *dominant species*	Comments	Similar habitats, possible overlapping of habitats	Variant code
6510 Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)								
Typical	Various	Alluvial and automorphic soils, mostly calcareous sod-podsol soils, brown soils as well as podsol soils	*Arrhenatherion*	2.3.1. *Festuca pratensis* meadows	*Arrhenatherum elatius,* ***Festuca pratensis,*** *Helictotrichon pubescens, Campanula patula, Crepis biennis, Centaurea jacea, Carum carvi, Leontodon hispidus, Heracleum sibiricum, Knautia arvensis, Galium album,* ***Poa pratensis, Phleum pratense****, Pastinaca sativa, Lathyrus pratensis, Tragopogon pratensis, Briza media, Plantago media*		6270*_3	**6510_1**
				2.3.2. *Helictotrichon pubescens* meadows	*Arrhenatherum elatius,* ***Festuca pratensis, Helictotrichon pubescens****, Campanula patula, Crepis biennis, Centaurea jacea, Carum carvi, Leontodon hispidus, Heracleum sibiricum, Knautia arvensis, Galium album, Pastinaca sativa, Lathyrus pratensis, Tragopogon pratensis, Briza media, Plantago media*			
				2.3.3. *Arrhenatherum elatius* meadows	***Arrhenatherum elatius,*** *Festuca pratensis, Helictotrichon pubescens, Campanula patula, Crepis biennis, Centaurea jacea, Carum carvi, Leontodon hispidus, Heracleum sibiricum, Knautia arvensis, Galium album, Pastinaca sativa, Lathyrus pratensis, Tragopogon pratensis, Briza media, Plantago media*			
				2.3.4. *Bromopsis inermis* meadows	*Arrhenatherum elatius,* ***Bromopsis inermis,*** *Festuca pratensis, Helictotrichon pubescens, Campanula patula, Crepis biennis, Centaurea jacea, Carum carvi, Leontodon hispidus, Heracleum sibiricum, Knautia arvensis, Galium album, Pastinaca sativa, Lathyrus pratensis, Tragopogon pratensis, Briza media, Plantago media*			
Wet	Slopes and relief depressions	Mesic and moist soils	*Alopecurion*	3.1.1. *Alopecurus pratensis* meadows	***Alopecurus pratensis, Poa palustris, P.trivialis,*** *Veronica longifolia, Lychnis flos-cuculi, Geum rivale, Ranunculus auricomus, Galium uliginosum, Galium boreale*	*Alopecurus pratensis* meadows that are located in floodplains are included in the habitat 6450	In floodplains 6450_2	**6510_2**
6530* Fennoscandian wooded meadows								
Typical	Diverse	Diverse	Vegetation complex that is not linked to specific plant communities – reflection of a peculiar management type in the landscape	None	*Quercus robur, Tilia cordata, Ulmus glabra, Ulmus laevis, Fraxinus excelsior, Salix alba, Betula pendula, Picea abies, Pinus sylvestris, Populus tremula, Sorbus aucuparia, Juniperus communis, Corylus avellana, Malus spp., Crataegus spp., Rhamnus catharticus, Prunus padus, Rosa spp., Ficaria verna, Briza media, Primula veris, Orchis mascula, Melampyrum nemorosum*	The determinant criterion in separation of this habitat is the presence of trees that are characteristic to park-type meadows– ground cover vegetation can be represented by variations that have not been mentioned here. Situations where at least five trees that are characteristic to the park-type situation of the 1st tree layer, with circular projections of each tree of a radius that is triple the height of trees create the total projection, which is 0.1 ha or more	9020, 9160, 9180, 91F0	-

RAISED BOG AND MIRE AND FEN HABITAT IDENTIFICATION TABLE

Variant	Minimum criteria	Substrate	Humidity regime and process	Plant communities	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
7110* Active raised bogs								
Typical	Characteristic plant species and communities of these habitats dominate the vegetation. Average height of the tree layer is less than 5 m, except for raised bogs with pool-ridge complexes in which the average height of pine trees growing on ridges can be 5 m. In the layer of moss *Sphagnum* moss usually occupies more than 80% and dwarf shrubs do not dominate. Massive die back of *Sphagnum* moss is not characteristic; other processes that would indicate degradation of mires do not dominate	Peat	Permanently waterlogged, peat formation and accumulation	*Oxycocco-Empetrion hermaphroditi, Sphagnion magellanici, Leuko-Scheuchzerion palustris*	*Calluna vulgaris, Eriophorum vaginatum, Rhynchospora alba, Carex limosa, Chamaedaphne calyculata, Andromeda polifolia, Oxycoccus palustris, Empetrum nigrum, Rubus chamaemorus, Drosera rotundifolia, Drosera anglica, Trichophorum cespitosum, Betula nana, Sphagnum magellanicum, Sph.fuscum, Sph.rubellum, Sph.cuspidatum, Sph.angustifolium, Sph.tenellum, Mylia anomala, Kurzia pauciflora, Cladopodiella fluitans, Sphagnum lindbergii, Sph.majus, Sph.pappilosum, Gymnocolea inflata, Odontoschisma sphagnii, Cladonia squamosa, Cladina ciliata var.tenuis, Cladina stellaris, Cladina stygia.* Animals: *Pluvialis apricaria, Tringa glareola, Numenius arquata, Numenius phaeopus.*	7120, 91D0*		-
7120 Degraded raised bogs still capable of natural regeneration								
Typical	Characteristic plant species and communities of these habitats dominate. In the moss layer patches of *Sphagnum* moss must be present and the average height of trees cannot exceed 5 m	Peat	Permanently waterlogged, peat formation is slow or does not occur	Are not divided	*Pinus sylvestris, Betula pubescens, Betula pendula, Picea abies, Calluna vulgaris, Ledum palustre, Chamaedapahne calyculata, Eriophorum vaginatum, Andromeda polifolia, Oxycoccus palustris, Empetrum nigrum, Rubus chamaemorus, Molinia caeruela, Drosera rotundifolia, Sphagnum rubellum, Sph.magellanicum, Sph.fuscum, Pleurozium schreberii, Hylocomium splendens, Sphagnum angustifolium, Dicranum polysetum, Polytrichum spp., Cladonia squamosa, Cladina ciliata var.tenuis, Cladina stellaris, Cladonia glauca, Cladonia chlorophylla*	7110*, 91D0*		-

Variant	Minimum criteria	Substrate	Humidity regime and process	Plant communities	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
7140 Transition mires and quaking bogs								
Transition mires in the periphery of raised bogs, near mineral soil islands or in interhill depressions	Transition mires and limnogenous mires in whose vegetation characteristic plant species and communities of these habitats dominate. Transition mires in the periphery of raised bogs or around mire islands of mineral soil must occupy at least 0.1 ha. Transition mires and raised bogs that are partly overgrown with trees and shrubs or reeds, if typical structure and plant species of this habitat has been preserved in the whole area of the habitat. Cover of tree and shrub layer must be below 75%	Peat	Permanently waterlogged, peat formation and accumulation	*Caricion lasiocarpae, Rhynchosporion albae, Sphagno recurvi - Caricion canescentis, Leuko-Scheuchzerion palustris, Eriophorion gracilis*	*Carex rostrata, Carex lasiocarpa, Rhynchospora alba, Carex limosa, Eriophorum vaginatum, Oxycoccus palustris, Comarum palustre, Menyanthes trifoliata, Eriophorum polystachion, Calla palustris, Peucedanum palustre, Equisetum fluviatile, Andromeda polifolia, Drosera rotundifolia, Drosera anglica, Sphagnum flexuosum, Sph.fallax, Calliergon stramineum*	none		**7140_1**
Limnogenous mires, including floating vegetation rafts		Waterbody	Permanently waterlogged, overgrowing and filling-in of the lake, peat formation and accumulation	*Caricion lasiocarpae, Rhynchosporion albae, Sphagno recurvi – Caricion canescentis, Leuko-Scheuchzerion palustris, Eriophorion gracilis, Magnocaricion elatae*	In addition to the above mentioned species also: *Thelypteris palustris, Pedicularis palustris, Carex chordorrhiza, Eriophorum gracile, Galium trifidum, Cicuta virosa, Carex pseudacorus, Utricularia intermedia, Cinclidium stygium, Scorpidium revolvens, Hamatocaulis vernicosus, Calliergonella cuspidata, Calliergon cordifolium, Sphagnum subsecundum, Sph.contortum*	7210*, 7230	If stands of *Cladium mariscus* occur in a filling-in lake, and their cover is at least 50% of the total cover of herbaceous plants, and the habitat occupies at least four square meters, it is classified as the habitat 7210* *Calcareous fens* with *Cladium mariscus* and species of the *Caricion davallianae*. Plant communities in filling-in lakes with calcareous species can be classified as 7230 *Alkaline fens*, if they meet the minimum quality criteria of this habitat	**7140_2**
7150 Depressions on peat substrates of the rhynchosporion								
Typical	In a raised bog mocaic patches of bare peat can be found	Open peat and sand	Permanently waterlogged in rased bogs, formation of depressions in raised bogs or a periodic inundation in wet heaths	*Rhynchosporion albae*	*Rhynchospora alba, Drosera anglica, Drosera intermedia, Lycopodiella inundata, Cladopodiella fluitans, Gymnocolea inflata*	none	Fragments in the size of few square centimeters with *Lycopodiella inundata* and *Drosera spp.* are included in the habitat 3130 or heath habitats	-

Variant	Minimum criteria	Substrate	Humidity regime and process	Plant communities	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
7160 Fennoscandian mineral-rich springs and springfens								
Springfens	Constant spring outflow or springfen with water-saturated soil. Do not precipitate limestone. Presence of characteristic species is not the decisive factor in habitat identification	Soils of different types	Permanently waterlogged, continuous flow of ground-water, peat formation can occur	*Caricion remotae*	In addition to species that characterize springs, also: *Salix spp., Frangula alnus, Alnus glutinosa, Picea abies, Betula pubescens*	7220*, 9010*, 9080*, 91D0*, 91E0*, 9180*	The habitat 7160 occurs and is registered as a point site in forest habitats. In cases when springs and springfens are found scattered throughout a forest stand or a substantial part of it, the entire stand or part should be identified as 7160. In grasslands and fens, springs should be identified as a separate habitat 7160. In grasslands or fens springs should be registered as point type or linear sites, however, if springfens form complexes that are at least 0.1 ha large, the habitat should be registered as an separate polygon	**7160_1**
Springs		Soils of different types	Permanently waterlogged, continuous flow of ground-water	Are not divided, various communities of humid soils	*Cirsium oleraceum, Epilobium palustris, Carex remota, Myosotis palustris, Chrysosplenium alternofolium, Veronica beccabunga, Crepis paludosa, Stellaria crassifolia, Cardamine amara, Equisetum palustre, E.sylvatica;* Mosses: *Trichocolea tomentella, Plagiomnium undulatum, P.elatum, P.ellipticum, Cratoneuron filicinum, Brachytecium rivulare, Sphagnum warnstorfii, Philonotis spp., Pellia spp.*			**7160_2**
Spring mires		Shallow peat	Permanently waterlogged, continuous flow of ground-water, poor formation and accumulation of peat	Are not divided, various communities of humid soils	In addition to species that are characteristic to springs also other species of humid grasslands or fens: e.g. *Equisetum fluviatile, Carex paniculata, Deschampsia cespitosa*			**7160_3**

Variant	Minimum criteria	Substrate	Humidity regime and process	Plant communities	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*								
Typical	The cover of *Cladium mariscus* is at least 50% of the total cover of herbaceous plants and habitat occupies at least four square meters	A lake or various calcareousoils	Permanently or periodically waterlogged	*Magnocaricion elatae*	*Cladium mariscus, Utricularia spp., Carex elata, Carex lasiocarpa, Phragmites australis, Schoenus ferrugineus, Scorpidium scorpioides, Campylium stellatum, Scorpidium cossonii, Chara aspera, Chara contraria*	7140, 7210*, 7230	If stands of *Cladium mariscus* occur in a bog and their cover is at least 50% of the total cover of herbaceous plant layer and the habitat occupies at least four square metres, it is separated as the habitat 7210*. If in a quaking bog (7140) stands of *Cladium mariscus* are present and their cover is at least 50% of the total cover of the herbaceous plant layer, and the habitat occupies at least four square metres, it is separated as the habitat 7210*	-
7220* Petrifying springs with tufa formation (*Cratoneurion*)								
Typical	A spring precipitating spring lime as flakes or larger structures in any of its flow sections or if there are lime dripstones that have originated as a result of previous spring flow	Diverse soils	Permanently or periodically waterlogged, formation of freshwater lime, tufa formation	*Cratoneurion commutati*	Herbaceous plants – *Pinquicula vulgaris, Primula farinosa, Carex ornithopoda* (herbaceous plants can also be absent); mosses – *Cratoneuron filicinum, Palustriella commutata, Philonotis calcarea, Scorpidium cossonii, Bryum pseudotriquetrum, Preissia quadrata, Pellia endiviifolia;* lychens – *Verrucaria* spp. and *Thelidium* spp.; animals – *Aporrectodea rosea*, *Vertigo spp., Pedicia rivosa*, in water – *Gammarus spp*.	7160, 7230, 8210, 8220, 9180*	Can be fully located under the tree canopy, for example, in habitat 9180* *Tilio-Acerion forests of slopes, screes and ravines* - in such case it should be marked as a point type feature or linear object 7220*. In case the springs or springfens pccur dispersed in the entire section or a large area of the forest, the entire section or part of it should be marked as 7220*	-

Variant	Minimum criteria	Substrate	Humidity regime and process	Plant communities	Characteristic species	Similar habitats, possible overlapping of habitats	Comments	Variant code
7230 Alkaline fens								
Calcareous fens with springs	Fens with dominant characteristic plant species and communities. The habitat also includes alkaline fens that have partly overgrown with trees and shrubs or reeds, if the structure and plant species typical of this habitat have been preserved in a mosaic pattern throughout the habitat area. Density of the tree or shrub layer must be below 75%. If drained alkaline fens are dominated by *Molinia caerulea* and the vegetation structure typical of this habitat cannot be found in a mosaic in the entire mire it cannot be identified as habitat 7230	Peat, occasionally mineral soils which are rich in lime	Permanemtly waterlogged, peat formation and accumulation	*Caricion davallianae*	*Cratoneuron filicinum, Palustriella commutata, Philonotis calcarea, Schoenus ferrugineus, Eleocharis quinqueflora, Carex davalliana, Carex buxbaumii, Carex flacca, Carex hostiana, Carex lepidocarpa, Triglochin palustre, Blysmus compressus, Carex panicea, Primula farinosa, Pinguicula vulgaris, Equisetum variegatum, Sesleria caerulea, Dactylorhiza ochroleuca, Eriophorum latifolium, Scorpidium cossonii, Ctenidium molluscum, Tomenthypnum nitens, Catoscopium nigritum, Moerckia hibernica, Preissia quadrata.* Chara spp*: Chara aspera, Ch.contraria*. Animals: *Vertigo genesii, V.geyeri*			**7230_1**
Calcareous fens in plains	The same as for variant 7230_1	Peat, occasionally mineral soils which are rich in lime	Permanemtly waterlogged, peat formation and accumulation	*Caricion davallianae*	The same as for variant 7230_1, with the exception of *Cratoneuron filicinum, Palustriella commutata, Philonotis calcarea*	5130, 6410, 7140, 2190, 7210*	In dune slacks it should be distinguished as habitat 2190 *Humid dune slacks*. If communities of *Cladium mariscus* are found in the mire and their cover is at least 50% of the overall cover of the herbaceous plant layer and the habitat occupies at least four square meters, it should be separated as habitat 7210* *Calcareous fens with Cladium mariscus and species of the Caricion davallianae*. Plant communities in quaking bogs (7140) that contain calciphilous species should be separated as the habitat 7230, if they correspond to the minimum quality requirements of this habitat	**7230_2**

ROCKY HABITAT AND CAVE IDENTIFICATION TABLE

Variant	Minimum criteria	Substrate	Process	Characteristuc species	Similar habitats, possible overlapping of habitats
8210 Calcareous rocky slopes with chasmophytic vegetation					
Typical	All natural calcareous rocky slopes including rock shivers and limestone deposits that have been exposed as a result of human activities, if active limestone mining has been terminated and the vegetation that is characteristic to this habitat type forms on the calcareous rock	Limestone, dolomites	Fissures, crumblings of rock	*Cystopteris fragilis, Poa nemoralis, Hylotelephium maximum, Encalypta streptocarpa, Homalothecium lutescens, Pohlia spp., Bryum spp., Tortula spp. Didymodon spp. Polyblastia albida, Thelidium papulare, T.decipiens, Verrucaria marmorea, V.calciseda, Opegrapha rupestris, Aspicilia contorta, Hymenelia prevostii, Hildenbrandia rivularis, Petalonema crustaceum, Scytonema julianum, Diplopoda spp., Armadillidium spp., Truncatellina cylindrica, Trogulus tricarinatus*	6110, 7220, 9180*
8220 Siliceous rocky slopes with chasmophytic vegetation					
Typical	All siliceous rocky slopes with a dense structure on the rock surface or deeper layers or pits of a cemented siliceous outcrop	Limestone rock, cemented limestone	Humus formation, landslides of soil cover and rock	*Polypodium vulgare, Cystopteris fragilis, Oxalis acetosella, Galeobdolon luteum, Carex digitata, Plagiochila porel-loides, Conocephalum conicum, Pohlia cruda, Leptobryum pyriforme, Mnium marginatum, Bryoerythrophyllum recurvirostrum, Pertusaria amara, Peltigera leucophlebia, Bryoria bicolor, Bryoria chalybeiformis, Dibaeis baeomyces, Baeomyces carneus, Lepraria membranaceum, Lobaria scrobiculata, Baeomyces rufus, Hypogymnia vittata; Gloecapsa rupestris, G.magma, G.montana, Gleothece rupestris, G.palea, Chroococcus varius, Schizotrix calcicola, Bacillariophyta, Chlorophyta, Colletidae spp., Anthophoridae spp.*	1230, 7220, 8310, 9180*
8310 Caves not open to the public					
Typical	Caves of a natural origin, which are at least 3 m long	Sandstone or carbonate rock	Landslides, erosion	*Schistostega pennata, Laccaria fraterna, Roesleria pallida, Cystocoleus ebenus, Collema spp., Lepraria spp., Gloeocapsa alpina, Gloeocystis rupestris, Schizotrix calcicola, Nesticus cellulanus, Metellina merianae, Myotis spp., Barbastella barbastellus, Pipistrellus spp., Vespertilio murinus, Eptesicus serotinus, Nyctalus spp.*	8220

Variant	Geology, location	Soil humidity, composition	Disturbance, development stage	Soil cover	Tree layer composition	Conformity with woodland key habitats (incl. potential) requirements	Similar habitats, possible overlapping of habitats	Variant code
9010* Western taiga								
Typical	Does not have a determinant value	Located on soils of dry or changing humidity (also swamp forests, peat-land forests)	Does not have a determinant value	Soil cover conforms with the 9010* habitat description	Dominated by one of these species: pine, spruce, aspen, birch or their combination	(PWKH)	9020, 91D0*, 2180	**9010_1**
Sinantropic or with broad-leaved or grass-land features				Sinantropic or with characteristics of grasslands or broad-leaved forests	Dominated by one of these species: pine, spruce, aspen or their combination	(PWKH)		**9010_2[1]**
Of drained soils		Drained soil of previous bijušo swamp forests, peat-land forests (drained forests on wet mineral soils, drained forests on peaty soils)		Soil cover that is characteristic to the habitat 9010* introduces, which already dominates or will dominate in a short time	Dominated by one of these species: pine, spruce, aspen, birch or their combination	(PWKH)		**9010_3**
Recently burned forests		Dry or variable	Recent fire	Before the fire the soil cover conformed with 9010*		Does not have a determinant value		**9010_4[2]**
Younger forests naturally developed after a fire			Naturally devel-oped after fire	Before the fire the soil cover conformed or it has already restored as corresponding to the habitat 9010*	Young stands with a tree layer that is char-acteristic to the habitat 9010* (dominated by one of these species: pine, spruce, aspen, birch or their combination), that have intro-duced naturally and have developed after a forest fire, but have not reached the quality tthat is characteristic to (PWKH)			**9010_5[2]**

9010-2[1] in this case the majority of the tree layer is formed by pine and spruce that are characteristic to 9010, while other layers can be uncharacteristic – the most frequent cases are:1) sinantropic and eutrophied forests of the tree compostion of 9010 (most frequently in urban and sub-urban areas, sides of roads), where the Boreal soil cover disappears, sharbush, *Acer spp*., oaks and others enter the underlayer.; 2) formerly grazed polygons of pine, spruce with a various admixture (usually oak, birch, aspen), where the soil cover can be dominated by vegetation that is characteristic to grasslands; 3) a forest, where underneath stands of pine or spruce that dominate the vegetation (occasionally with the admixture of oak, birch and others) on the second layer, undergrowth and soil cover can also include characteristics of broad-leaved forests

9010-4[2], 9010-5[2] – recently burned forests are forests that have experienced various types of fires – starting from a ground fire to crown fires, as in unaffected nature it is also possible to distinguish different types of fires

Variant	Geology, location	Soil humidity, composition	Disturbance, development stage	Soil cover	Tree layer composition	Conformity with woodland key habitats (incl. potential) requirements	Similar habitats, possible overlapping of habitats	Variant code
9020* Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus, Tilia, Acer, Fraxinus or Ulmus*) rich in epiphytes								
Typical	Outside river floodplains[3]	Dry or variable	Does not have a determinant value	Sybcanopy layer of broad-leaved trees and the herb layer is characterised by a spring aspect	The tree layer is dominated by an admixture of ash, elm, V, L, oak, aspen in different combinations, there is no one pronouncedly dominant species, a minor admixture of spruce, birch, pine is possible	(PWKH)	9010*, 9180*	**9020*_1**
Transition stage				Various compositions of the soil cover that are possible in the transition between Boreal and Nemoral forest, or are characteristic to a nemoral forest	The first layer of the tree stand is dominated by aspen, other species can be found in admixture. It can also be a mixed stand of aspen, spruce, birch, with the second layer dominated by broad-leaved trees			**9020*_2**
On drained soils		Dried		The soil cover consists of the habitat characteristic species, habitat does not development dtoward a mixed broad-leaved forest, it is not affected by an increased soil humidity	Thee layer is dominated by an admixture of ash, elm, V, L, oak, aspen in various combinations, there is no one pronouncedly dominant species, spruce, birch, pine can also be found in admixture			**9020*_3**
Mixed stands of pine and broad-leaved trees	Can be located in river valley slopes and floodplains	Dry or variable	Does not have a determinant value	The soil cover consists of the habitat characteristic species with a possible admixture of Boreal species	Pine (can dominate) and broad-leaved trees (ash, elm, V, L, oak) in the tree layer, the second layer and underbrush is dominated by vroad-leaved trees	(PWKH)	9010*, 9180*	**9020*_4**

[3] rarely flooded areas in a close proximity to rivers where flooding has no significant impact on the vegetation structure and composition

Variant	Geology, location	Soil humidity, composition	Disturbance, development stage	Soil cover	Tree layer composition	Conformity with woodland key habitats (incl. potential) requirements	Similar habitats, possible overlapping of habitats	Variant code
9060 Coniferous forests on, or connected to, glaciofluvial eskers								
Typical	An esker or esker-type relief form	Does not have a determinant value	Does not have a determinant value	Any vegetation on the esker, soil cover that corresponds to the description of habitat 9060 on eskers, which is relatively more rich in comparison to a similar tree composition in a plain location due to relief	Dominant tree species pine and spruce are the dominant species, but also deciduous trees can be present	Does not have a determinant value	9180*, 7160, 7210*, 9010*	**9060**
9080* Fennoscandian decidous swamp forests								
Typical	Does not have a determinant value	Peat-land forests and swamp forests	Does not have a determinant value	Soi cover that corresponds to the description of habitat 9080*	Dominated by one of these species: alder, ash, birch; various tree species can be found in admixture	Does not have a determinant value	91E0*, 91D0*, 7160	**9080*_1**
Habitat initiation stage		Formed by overgrowing of swampy glades (grasslands, bottoms of lowered lakes and others)	Early stage	Soil cover partly corresponds to the description of habitat 9080*, as succession still takes place, but in the final stage of development it will correspond to 9080*	Dominated by alder or ash; admixture of various tree species			**9080*_2**
On drained wet soils		Drained soil of former peat-land forests or swamp forests	Does not have a determinant value	Degraded soil sover that corresponds to the description of habitat 9080*, altogether can be uncompliant with 9080*	Dominated by alder or ash, or an admixture of alder/ash and birch; admixture of various tree species	(PWKH)		**9080*_3**
9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*								
Typical	Does not have a determinant value	Dry or variable	Does not have a determinant value	9160 ground cover that corresponds to the de-scription, definitely with a spring aspect	Forest stand dominated by oak, hornbeam, linden or a mixture of these, various trees in admicxture	Does not have a determinant value	6530*, 9020, 9180*	**9160_1**
Various successional and mixed variants				Species of the spring aspect are characteristic in the vegetation, possible significant presence of Boreal species	Forest stand dominated by oak, hornbeam, linden or a combination of these			**9160_2**
Mixed oak and spruce forests	Does not have a determinant value	Dry or variable	Does not have a determinant value	Species of Nemoreal forests and spring aspect are characteristic in vegetation, possible significant presence of Boreal species	Forest stand dominated by oak, spruce in admixture and sub-canopy	Does not have a determinant value	9020*, 9010*	**9160_3**

Variant	Geology, location	Soil humidity, composition	Disturbance, development stage	Soil cover	Tree layer composition	Conformity with woodland key habitats (incl. potential) requirements	Similar habitats, possible overlapping of habitats	Variant code
9180* *Tilio-Acerion* forests of slopes, screes and ravines								
Typical	Slope, ravine	Does not have a determinant value	Does not have a determinant value	Soil cover that corresponds to the description of habitat 9180*, usually with the spring aspect	The tree layer is separately or in amixture dominated by linden, ash, oak, elm, willow, maple	Does not have a determinant value	9020*, 9160, 91E0, 91F0, 7160, 7210*, 8210, 8220, 8310	**9180**
91D0* Bog woodland								
Peat-land forests with the peat layer thicker than 30 cm [4]	Does not have a determinant value	Peat-land forests, usually with a thick layer of peat – *Caricoso-phragmitosa*, *Sphagnosa*, *Dryopterioso-caricosa*	Does not have a determinant value	Soil cover that corresponds to the description of 91D0* (*Sphagnum* moss is usually present, but not mandatory, these *Dryopterioso-caricosa* are different from the 9080* *Dryopterioso-caricosa* due to the Boreal soil cover)	Dominated by one species or admixture of: pine, spruce, birch; occasionally aspen or alder are found in admixture, these dominate rarely	Does not have a determinant value	7110*, 7120, 7140, 9080*, 7160	**91D0*_1**
Swamp forest with a peat layer at the initial stage of formation		Swamp forests, with a shallow peat layer, which has occasionally just started formation		Soil cover that corresponds to the description of 91D0*, which generally corresponds to the soil cover of Boreal forests in wet conditions in an oligotrophic environment, dominance of *Sphagnum* moss usually has the determinant value, but, if it is absent, presence of slowly growing trees or a hummock micro-relief is significant	Dominated by one species or admixture of: pine, spruce, birch; occasionally aspen or alder are also found in admixture			**91D0*_2**
Drained forests		Drained (drained forests on wet mineral soils)		Soil cover that partly corresponds to the description of 91D0*, that will regenerate adequately by a restoration of the natural hydrological regime, but not the type where due to peat decomposition the transition toward broad-leaved forests takes place	Dominated by one species or an admixture of: pine, spruce, birch; occasionally aspen or alder are found in admixture	(PWKH)		**91D0*_3**

91D0_1[4] the variant also includes bogs that have afforested by a specific vegetation

Variant	Geology, location	Soil humidity, composition	Disturbance, development stage	Soil cover	Tree layer composition	Conformity with woodland key habitats (incl. potential) requirements	Similar habitats, possible overlapping of habitats	Variant code
91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion, Alnion incanae, Salicion albae*)								
Permanently wet	Floodplains, incl. around small springs; areas of high groundwater level	Peat-land forests, swamp forests, also narrow belts around small springs	Does not have a determinant value	Soil cover that corresponds to the description of 91E0*, spring aspect, vegetation is affected by flooding	Dominated by one of these species: ash, alder, elm, willow, gray alder, incl. bird cherry from the second layer of underbrush and others; various trees in admixture; first layer occasionally dominated by aspen or birch	Does not have a determinant value	9080*, 91F0	**91E0*_1**
Riparian or flood plain forests	River floodplains, often an undulated micro-relief	Dry or variable (also swamp forests)			Dominated by species of willow or tall osiers, or gray alder or bird cherry or an admixture of these species in variable proportions; admixture of elm, willow, more rarely by oak, bird cherry in the underbrush and others			**91E0*_2**
Degraded	Dredged river floodplains that do not function				Both above mentioned, but it also includes spruce and/or birch	(PWKH)		**91E0*_3**
91F0 Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)								
Typical	Floodplains of large rivers, occasionally undulated terrain	Dry or variable	Does not have a determinant value	Soil cover that is characteristic to 91F0, spring aspect, vegetation is influenced by floods or the proximity of water – this is the characteristics that allows this habitat to be separated from 9160 and 9020, which can also be located in a close proximity to water	Dominated by one of these species: oak, elm, willow, ash or different combinations of these	Does not have a determinant value	91E0*, 9160, 6530*	**91F0**

Comments

1) when a tree stand is evaluated, the 1st and 2nd tree layer as well as the underbrush is considered

2) a sufficient habitat age for the habitat registration has been reached after the restoration of a clearing when in the majority of the area of the former clearing the soil cover that is characteristic to the habitat and the tree composition that corresponds to the habitat has formed

SEMI-NATURAL GRASSLAND INDICATOR SPECIES

Latin name	Occurrence in grassland habitats[1]					
	6120*	6210	6230*	6270*	6410	6510
Acinos arvensis	+	+	+			
Agrimonia eupatoria	+	+	+	+	+	+
Antennaria dioica	+	+	+	+		
Betonica officinalis		+		+	+	
Botrychium lunaria	+	+	+	+		
Briza media	+	+	+	+	+	+
Campanula rotundifolia	+	+	+	+		
Cardamine pratensis			+	+	+	+
Carex caryophyllea	+	+		+	+	
Carex flacca		+		+	+	+
Carex hartmanii		+		+	+	+
Carex ornithopoda	+	+				
Carex panicea		+	+	+	+	+
Cirsium acaule	+	+		+		
Dactylorhiza baltica		+	+	+	+	+
Dactylorhiza cruenta		+	+	+	+	+
Dactylorhiza incarnata		+	+	+	+	+
Dactylorhiza maculata		+	+	+	+	+
Dianthus deltoides	+	+	+	+	+	+
Epipactis palustris				+	+	+
Filipendula vulgaris	+	+		+	+	
Fragaria viridis	+	+		+	+	+
Galium boreale	+	+	+	+	+	+
Galium verum	+	+	+	+	+	+
Geranium palustre			+	+	+	+
Geranium sanguineum	+	+				
Helictotrichon pratense	+	+		+		
Koeleria glauca	+					
Lathyrus palustris					+	
Leontodon hispidus		+	+	+	+	+
Linum catharticum	+	+	+	+	+	+

Latin name	Occurrence in grassland habitats[1]					
	6120*	6210	6230*	6270*	6410	6510
Nardus stricta	+	+	+	+		
Ophioglossum vulgatum		+		+	+	
Parnassia palustris			+	+	+	
Phleum phleoides	+	+				
Pimpinella saxifraga	+	+	+	+	+	+
Plantago media	+	+		+	+	+
Platanthera bifolia		+	+	+	+	+
Platanthera chlorantha		+	+	+	+	+
Polygala amarella	+	+	+	+	+	+
Polygala comosa	+	+		+	+	+
Polygala vulgaris	+	+	+	+	+	+
Primula farinosa					+	
Primula veris		+		+	+	+
Ranunculus auricomus			+	+	+	+
Scorzonera humilis		+	+	+	+	+
Sedum acre	+	+	+	+		
Sesleria caerulea		+		+	+	
Sieglingia decumbens	+	+	+	+	+	
Stellaria palustris					+	
Succisa pratensis			+	+	+	+
Thymus ovatus	+	+	+	+		+
Thymus serpyllum	+	+	+			
Trifolium montanum	+	+		+	+	+
Trollius europaeus				+	+	+
Veronica spicata	+	+				
Viola rupestris	+	+				
Viscaria vulgaris	+	+	+	+		+

[1] only species occurrence in habitats where transition toward atmata of cultivated grassland habitats can be observed is shown. In habitats 1630, 6450 and 6530 all grassland plant communities can occur, therefore all indicator species can be found

ATTACHMENT 3

WKH STRUCTURAL INDICATORS AND ELEMENTS, CHARACTERISTIC SPECIES, INDICATOR SPECIES

Structural indicators and elements
Stands with trees of varying ages
Canopy gaps/glades
Self-thinning of the forest stand is ongoing
Occurrence of permanently flooded areas
Occurrence of temporarily flooded areas
Occurrence of dead wood in few stages of decomposition
Occurrence of dead wood in several stages of decomposition
Large number of wood-decay fungus
Large number of old hazels
At least 4 different broad-leaved tree species
Impact of springs
Impact of beaver activity
Occurrence of natural watercourses
Hummocks surrounding tree stems
Trees with burning marks
Hollow trees
Trees with woodpecker signs and hollow trees
Biologically old trees
Slowly growing biologically old trees of small dimensions
Biologically olg broad-leaved trees that are exposed to the sun
Dead or dying trees
Snags

WKH specific species	WKH indicator species

FUNGUS

Latin name	Latin name
Asterodon ferruginosus	*Clavicorona pyxidata*
Ceriporiopsis pannocincta	*Gloeoporus taxicola*
Climacocystis borealis	*Grifola frondosa*
Dentipellis fragilis	*Inonotus rheades*

Latin name	Latin name
Dichomitus campestris	*Junghuhnia nitida*
Fistulina hepatica	*Oxyporus corticola*
Fomitopsis rosea	*Phaeolus schweinitzii*
Hapalopilus croceus	*Phellinus chrysoloma*
Hericium coralloides	*Phellinus pini*
Inonotus dryophilus	*Phellinus populicola*
Junghuhnia collabens	*Pycnoporellus fulgens*
Leptoporus mollis	*Skeletocutis nivea*
Oligoporus guttulatus	
Oligoporus leucomalellus	
Oligoporus placentus	
Perenniporia subacida	
Phellinus ferrugineofuscus	
Phellinus ferruginosus	
Phellinus nigrolimitatus	
Phellinus viticola	
Phlebia centrifuga	
Polyporus badius	
Rigidoporus crocatus	
Skeletocutis lenis	
Skeletocutis odora	
Skeletocutis stellae	
Xylobolus frustulatus	

LICHENS

Latin name	Latin name
Bactrospora spp.	*Acrocordia gemmata*
Alectoria sarmentosa	*Arthonia leucopellea*
Calicium adspersum	*Arthonia spadicea*
Chaenotheca phaeocephala	*Arthonia vinosa*
Collema spp.	*Bacidia rubella*
Lobaria pulmonaria	*Buellia alboatra*
Menegazzia terebrata	*Chaenotheca brachypoda*
Nephroma spp.	*Graphis scripta*
Parmeliella triptophylla	*Hypogymnia farinacea*
Sclerophora spp.	*Icmadophila ericetorum*

Latin name	Latin name
Thelotrema lepadinum	*Lecanactis abietina*
Arthonia byssacea	*Lecidea botryosa*
Arthonia cinereopruinosa	*Mycoblastus sanguinarius*
Arthonia cinnabarina	*Parmelia acetabulum*
Bacidia rosella	*Peltigera collina*
Buellia violaceofusca	*Pertusaria flavida*
Caloplaca lucifuga	*Pertusaria hemisphaerica*
Cetrelia spp.	*Pertusaria pertusa*
Cybebe gracilenta	*Phlyctis agelaea*
Evernia divaricata	
Evernia mesomorpha	
Gyalecta ulmi	
Hypogymnia vittata	
Leptogium cyanescens	
Lobaria scrobiculata	
Opegrapha vermicellifera	
Ramalina thrausta	
Usnea florida	
Biatora sphaeroides	
Chaenotheca chlorella	
Cladonia parasitica	
Cliostomum corrugatum	
Cyphelium sessile	
Leptogium lichenoides	
Letogium saturninum	
Parmelia tiliacea	

MOSSES

Latin name	Latin name
Anastrophyllum hellerianum	*Anomodon spp.*
Antitrichia curtipendula	*Homalia trichomanoides*
Barbilophozia attenuata	*Jamesoniella autumnalis*
Bazzania trilobata	*Jungermannia leiantha*
Buxbaumia viridis	*Lejeunea cavifolia*
Calypogeia suecica	*Leucobryum glaucum*
Frullania tamarisci	*Metzgeria furcata*

Latin name	Latin name
Geocalyx graveolens	*Neckera complanata*
Hylocomium umbratum	*Nowellia curvifolia*
Lophozia spp.	*Neckera pennata*
Neckera crispa	*Odontoschisma denudatum*
Plagiothecium latebricola	*Isothecium alopecuroides*
Scapania spp.	*Rhytidiadelphus subpinnatus*
Trichocolea tomentella	*Ulota crispa*
	Sphagnum wulfianum

HERBACEOUS PLANTS

Latin name	Latin name
Bromopsis benekenii	*Allium ursinum*
Carex disperma	*Carex remota*
Cinna latifolia	*Corallorhiza trifida*
Circaea lutetiana	*Diphasiastrum complanatum*
Cypripedium calceolus	*Diphasiastrum tristachyum*
Dentaria bulbifera	*Listera cordata*
Epipogium aphyllum	*Lunaria rediviva*
Festuca altissima	*Matteuccia struthiopteris*
Galium schultesii	*Polygonatum verticillatum*
Galium triflorum	*Sanicula europaea*
Geranium bohemicum	
Glyceria lithuanica	
Poa remota	
Ranunculus lanuginosus	

INVERTEBRATES (!- can be identified by traces of their activity)

Latin name	Latin name
Agonum quadripunctatum	*Dendrophagus crenatus*
Agrilus biguttatus!	*Mycetophagus quadripustulatus*
Ampedus erythrogonus	*Necydalis major!*
Ampedus tristis	*Peltis grossa!*
Anoplodera sexguttata	*Platycerus spp.*
Anoplodera variicornis	*Strangalia attenuata*
Anthaxia similis!	*Thymalus limbatus*
Boros schneideri	

Latin name	Latin name
Buprestis novemmaculata	
Buprestis octoguttata	
Calitys scabra	
Ceruchus chrysomelinus	
Chalcophora mariana!	
Corticeus unicolor	
Denticollis borealis	
Dicerca alni!	
Dicerca furcata	
Dicerca moesta	
Dircaea quadriguttata	
Dorcus parallelepipedus	
Ergates faber	
Grynocharis oblonga	
Harminius undulatus	
Lasius brunneus	
Leptura nigripes	
Leptura thoracica	
Liocola marmorata!	
Lymexylon navale	
Melandrya dubia	
Melanophila acuminata	
Monochamus urussovi	
Nothorhina punctata!	
Opilo mollis	
Oplocephala haemorrhoidalis	
Osmoderma eremita!	
Platydema violaceum	
Platyrrhinus resinosus	
Poecilonota variolosa!	
Prionus coriarius	
Prionychus ater	
Pseucocistela ceramboides	
Rhamnusium bicolor	
Saperda perforata!	
Strangalia attenuata	

Latin name	Latin name
Tragosoma depsarium!	
Tropideres albirostris	
Velleius dilatatus	

SNAILS

Latin name	Latin name
Ena montana	*Bulgarica cana*
Ena obscura	*Clausilia bidentata*
Isognomostoma isognomostoma	*Clausilia cruciata*
	Clausilia dubia
	Clausilia pumila
	Cochlodina orthostoma
	Lacinaria plicata
	Limax cinereoniger
	Macrogastra latestriata
	Macrogastra plicatula
	Macrogastra ventricosa
	Ruthenica filograna
	All snails from the family *Clausilidae* with the exception of *Cochlodina laminata*

ATTACHMENT 4

OVERVIEW TABLE OF THE HABITATS OF EU IMPORTANCE THAT OCCUR IN LATVIA

Code	Title in english	Latvian title	Corresponding specially protected habitat in Latvia	Lpp.
1110	Sandbanks which are slightly covered by sea water all the time	Smilts sēkļi jūrā	7.4. Stands of *Zostera marina* [1]	**30**
			7.6. Stands of *Zannichelia palustris*, *Ruppia maritima* and *Batrachium baudoti* in coastal lagoons and bays [1]	
1150*	Coastal lagoons	Lagūnas	7.4. Stands of *Zostera marina* [1]	**32**
			7.6. Stands of *Zannichelia palustris*, *Ruppia maritima* and *Batrachium baudoti* in coastal lagoons and bays [1]	
1170	Reefs	Akmeņu sēkļi jūrā	7.2. Stands of *Fucus* in the sea	**36**
			7.7. Stands of *Rhodophyta* in the sea	
			7.8. Seashore reefs	
			7.1. Rocky seabed [1]	
			7.3. Dolomite seabed [1]	
			7.5. Shingly seabed [1]	
			7.6. Stands of *Zannichelia palustris*, *Ruppia maritima* and *Batrachium baudoti* in coastal lagoons and bays [1]	
1210	Annual vegetation of drift lines	Viengadīgu augu sabiedrības uz sane-sumu joslām	6.13. Annual plant communities on drift lines	**41**
1220	Perennial vegetation of stony banks	Daudzgadīgs augājs akmeņainās pludmalēs	6.7. Perennial vegetation on stony beaches	**45**
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts	Jūras stāvkrasti	8.17. Sandstone rock outcrops	**48**
1310	*Salicornia* and other annuals colonising mud and sand	Viengadīgu augu sabiedrības dūņainās un zemās smilšainās pludmalēs	6.12. Communities of annual plants in mud and low sandy beaches	**52**
1630*	Boreal Baltic coastal meadows	Piejūras zālāji	3.16. Coastal meadows	**55**
1640	Boreal Baltic sandy beaches with perennial vegetation	Smilšainas pludmales ar daudzgadīgu augāju	6.11. Sandy beaches with perennial vegetation	**58**
2110	Embryonic shifting dunes	Embrionālās kāpas		**70**
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Priekškāpas		**73**
2130*	Fixed coastal dunes with herbaceous vegetation (grey dunes)	Ar lakstaugiem klātas pelēkās kāpas	6.6. Grey dunes with herbaceous vegetation	**76**
2140*	Decalcified fixed dunes with *Empetrum nigrum*	Pelēkās kāpas ar sīkkrūmu audzēm	6.10. Grey dunes with stands of low scrubs	**80**
2170	Dunes with *Salix repens ssp.* argentea (*Salicion arenariea*)	Pelēkās kāpas ar ložņu kārklu	6.9. Grey dunes with creeping willow *Salix repens*	**84**
2180	Wooded dunes of the Atlantic, Continental and Boreal region	Mežainas piejūras kāpas	1.8. Wooded coastal dunes	**87**

Code	Title in english	Latvian title	Corresponding specially protected habitat in Latvia	Lpp.
2190	Humid dune slacks	Mitras starpkāpu ieplakas	6.8. Humid dune slacks	**92**
2320	Dry sand heaths with *Calluna* and *Empetrum nigrum*	Piejūras zemienes smiltāju līdzenumu sausi virsāji	1.12. Dry coastal heaths of sand plains	**97**
2330	Inland dunes with open *Corynephorus* and *Agrostis* grasslands	Klajas iekšzemes kāpas	3.18. Open inland dunes with meadows of *Corynephorus canescens*	**101**
3130	Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*	Ezeri ar oligotrofām līdz mezotrofām augu sabiedrībām	4.2. Oligotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or *Isoeto-Nanojuncetea*	**108**
			4.7. Lakes with stands of *Sparganium angustifolium* and *Sparganium gramineum*	
			4.9. Mesotrophic lakes	
			4.12. Lakes with stands of *Myriophyllum alterniflorum*	
			4.14. Coastal dune lakes and their shores with plant communities of *Eleocharis multicaulis*, *Rhynchospora fusca* and *Myrica gale*;	
			4.15. Semidystrophic (oligodystrophic) lakes	
			4.11. Extensive lake beaches that are not overgrown [1]	
			4.19. Lakes with the littoral dominated by mineral soil [1]	
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp.*	Ezeri ar mieturaļģu augāju	4.18. Lakes with vegetation of *Charophyta*	**112**
			4.4. Lakes and their coastal areas with stands of *Cladium mariscus* [1]	
			4.10. Lakes with stands of *Najas spp.* [1]	
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* –type vegetation	Eitrofi ezeri ar iegrimušo ūdensaugu un peldaugu augāju	4.13. Lakes with stands of *Trapa natans*	**114**
			4.16. Lakes with stands of *Nuphar pumila*	
			4.20. Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition*-type vegetation	
			4.19. Lakes with the littoral dominated by mineral soil [1]	
3160	Natural dystrophic lakes and ponds	Distrofi ezeri	4.3. Dystrophic lakes	**118**
3190*	Lakes of gypsum karst	Karsta kritenes	8.10. Karst lakes	**120**
			8.11. Karst sinkholes	
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho – Batrachion* vegetation	Upju straujteces un dabiski upju posmi	5.1. Concentrations of stones in riverbeds [1]	**123**
			5.4. Stands of *Batrachospermum* in rivers [1]	
			5.5. Stands of *Hildenbrandia rivularis* in rivers [1]	
			5.6. Waterfalls [1]	
			5.7. Avotsūnu *Fontinalis* un krasta garknābītes *Rhynchostegium riparioides* audzes upēs [1]	
			5.13. Stands of *Fontinalis* and *Rhynchostegium riparioides* in rivers [1]	
			5.15. Stands of *Batrachium* in rivers [1]	
			5.16. River estuaries [1]	
			5.17. Stands of *Potamogeton praelongus* and *Potamogeton alpinus* in rivers [1]	
			5.18. River rapids and natural river stretches [1]	

Code	Title in english	Latvian title	Corresponding specially protected habitat in Latvia	Lpp.
3270	Rivers with muddy banks with *Chenopodion rubri p.p.* and *Bidention p.p.* vegetation	Dūņaini upju krasti ar slāpekli mīlošu viengadīgu pioniersugu augāju		**127**
4010	Northern Atlantic wet heaths with *Erica tetralix*	Slapji virsāji	1.1. Wet heaths 1.16. Wet heaths with *Erica tetralix*	**137**
4030	European dry heaths	Sausi virsāji	1.13. Dry heaths	**141**
5130	*Juniperus communis* formations on heaths or calcareous grasslands	Kadiķu audzes zālājos un virsājos	1.7. Juniper stands on calcareous meadows [1]	**145**
6110*	Rupicolous calcareous or basophilic grasslands of the *Alysso-Sedion albi*	Lakstaugu pioniersabiedrības seklās kaļķainās augsnēs	3.19. Herbaceous plant pioneer communities in calcareous soils	**162**
6120*	Xeric sand calcareous grasslands	Smiltāju zālāji	3.17. Calcareous sandy grasslands	**165**
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites)	Sausi zālāji kaļķainās augsnēs	3.21. Dry meadows on calcareous soils	**169**
6230*	Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submontain areas, in Continental Europe)	Vilkakūlas zālāji	3.22. Species-rich mat-grass *Nardus stricta* meadows on sandy soils	**174**
6270*	Fennoscandian lowland species-rich dry to mesic grasslands	Sugām bagātas ganības un ganītas pļavas		**177**
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)	Mitri zālāji periodiski izžūstošās augsnēs	3.14. *Sesleria caerulea* meadows 3.23. *Molinia caerulea* meadows on calcareous, peaty or clayey soils	**182**
6430	Hydrophilous tall herb fringe communities of plain and of the montane to alpine levels	Eitrofas augsto lakstaugu audzes		**186**
6450	Northern boreal alluvial meadows	Palieņu zālāji		**190**
6510	Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)	Mēreni mitras pļavas		**194**
6530*	Fennoscandian wooded meadows	Parkveida pļavas un ganības	3.20. Wooded meadows	**198**
7110*	Active raised bogs	Neskarti augstie purvi		**213**
7120	Degraded raised bogs still capable of natural regeneration	Degradēti augstie purvi, kuros iespējama vai noris dabiskā atjaunošanās		**217**
7140	Transition mires and quaking bogs	Pārejas purvi un slīkšņas		**222**
7150	Depressions on peat substrates of the *Rhynchosporion*	Ieplakas purvos		**227**

Code	Title in english	Latvian title	Corresponding specially protected habitat in Latvia	Lpp.
7160	Fennoscandian mineral-rich springs and springfens	Minerālvielām bagāti avoti un avoksnāji	2.6. Mineral-rich springs and springfens	**230**
7210*	Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*	Kaļķaini zāļu purvi ar dižo aslapi	2.5. Calcareous fens with great fen-sedge *Cladium mariscus* [1]	**234**
			4.4. Lakes and their coastal areas with stands of *Cladium mariscus* [1]	
7220*	Petrifying springs with tufa formation (*Cratoneurion*)	Avoti, kuri izgulsnē avotkaļķus	2.1. Springs precipitating spring lime	**237**
7230	Alkaline fens	Kaļķaini zāļu purvi	2.3. Calcareous fens with *Carex davalliana*	**241**
			2.4. Calcareous fens with *Schoenus ferrugineus*	
			2.8. Fens with *Juncus subnodulosus*	
8210	Calcareous rocky slopes with chasmophytic vegetation	Karbonātisku pamatiežu atsegumi	8.15. Calcareous rock outcrops	**247**
8220	Siliceous rocky slopes with chasmophytic vegetation	Smilšakmens atsegumi	8.17. Limestone outcrops	**250**
8310	Caves not open to the public	Netraucētas alas	8.16. Undisturbed caves	**254**
9010*	Western taiga	Veci vai dabiski boreāli meži		**268**
9020*	Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus, Tilia, Acer, Fraxinus* or *Ulmus*) rich in epiphytes	Veci jaukti platlapju meži	1.6. Mixed broad-leaved forests	**274**
9060	Coniferous forests on, or connected to, glaciofluvial eskers	Skujkoku meži uz osveida reljefa formām	1.21. Coniferous forests on eskers	**278**
9080*	Fennoscandian deciduous swamp forests	Staignāju meži	1.15. Swamp forests	**283**
9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the *Carpinion betuli*	Ozolu meži	1.10. Oak forests	**288**
9180*	*Tilio-Acerion* forests of slopes, screes and ravines	Nogāžu un gravu meži	1.9. Slope and ravine forests	**292**
91D0*	Bog woodland	Purvaini meži	1.1. Wet heaths [1]	**296**
91E0*	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)	Aluviāli krastmalu un palieņu meži	1.11. Wet broad-leaved forests	**301**
			1.4. Primary forests of river meanders [1]	
91F0	Riparian mixed forests of *Quercus robur, Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)	Jaukti ozolu, gobu, ošu meži gar lielām upēm	1.5. Mixed oak, elm and ash forests on river banks	**306**

[1] partly overlaps with the respective habitat of EU importance