

## Chapter 9. 1630\* *Boreal baltic coastal meadows* (S. Rūsiņa, A. Auniņš, V. Spunģis)

### 9.1 Characteristics of the Habitat Type

#### 9.1.1 Brief Description

Habitat type 1630\* *Boreal Baltic coastal meadows* (referred to as coastal meadows in the text) corresponds to grasslands in sub-saline soils on shallow sea shores where flooding with brackish water takes place. Most of these grasslands have been traditionally grazed or mown, thus increasing the areas with low vegetation abundant in plant species and suitable for breeding waders. The vegetation is typically arranged in several bands, from which the halophytic vegetation is located nearest to the sea (Rūsiņa 2013a).

In Latvia this habitat type is very rare (its total area is only 180 ha, which is only 0.4% of the total semi-natural grassland area). It only occurs in the Coastal Lowland along the coasts of the Baltic Sea, the Gulf of Riga, in lower courses of rivers running into the sea and lake floodplains, where they become

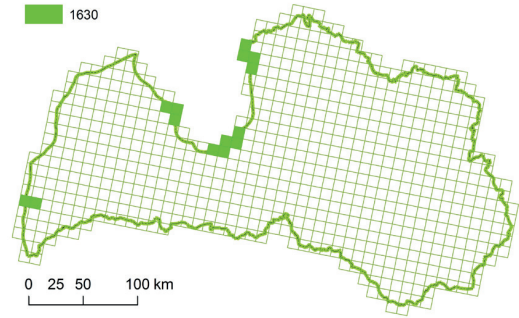


Fig. 9.1.1. Distribution of EU protected habitat type 1630\* *Boreal Baltic coastal meadows* in Latvia (Anon. 2013a).

flooded with brackish seawater. The known localities are Randu meadows between Ainaži and Salacgrīva, Bērciems, Lielupe mouth, Daugavgrīva, Vecdaugava, Mērsrags and the shores of Lake Liepāja (Fig. 9.1.1). Latvia has 0.7% of the total area of habitat type 1630\* *Boreal Baltic coastal meadows* of the EU boreal region (which includes Sweden, Finland, Estonia and Lithuania).



Fig. 9.1.2. Halophyte plant species. Photos: V. Baroniņa, A. Priede, S. Rūsiņa.



Fig. 9.1.3. Coastal meadows in "Randu Pļavas" Nature Reserve in 2009. Photo: S. Rūsiņa.



Fig. 9.1.4. Coastal meadows in Mērsrags "Engures Ezers" Nature Park in 2016. Photo: S. Rūsiņa.



Fig. 9.1.5. Coastal meadows in Estonia, "Matsalu" Nature Reserve. Photo: S. Rūsiņa.

Of all sites of habitat type 1630\* *Boreal Baltic coastal meadows*, the most important and largest ones are Randu meadows (Fig. 9.1.3), however, they are heavily overgrown by shrubs, in wet places by *Phragmites australis*, in dry places by *Calamagrostis epigeios* and *Deschampsia flexuosa*. Coastal meadows near Mērsrags are mown each year (Fig. 9.1.4), but not grazed, resulting in a too even sward height and excessive litter accumulation. Estonia, where the area of coastal meadows is much larger than in Latvia, is a perfect destination to see the habitat in favourable condition. The largest coastal meadow areas of Estonia are concentrated in "Matsalu" Nature Reserve on the west coast of Estonia (Fig. 9.1.5).

The most important literature sources for the preparation of management and restoration guidelines of this habitat were the Estonian Guidelines for Coastal Meadow Management (Lotman 2011) and the coastal meadow management guidelines issued by the European Commission (Doody 2008).

### 9.1.2 Vegetation, Plant and Animal Species

**Vegetation** is very diverse – dry and mesic plant communities alternate with moist and wet ones. Almost all semi-natural grassland plant communities found in Latvia occur in the largest coastal meadow areas (such as Randu meadows). The vegetation structure is very diverse as well – from very low (10–20 cm) to tall (over 150 cm), in drier areas the vegetation is sparse, a moss and lichen layer develops, while in moister places the vegetation is closed. Several layers can be distinguished. The presence of halophytes such as *Triglochin maritimum*, *Juncus gerardii*, *Glaux maritima* is a significant distinguishing feature of the habitat. These species mainly occur in moist depressions (Fig. 9.1.6), where the influence of seawater is the highest, and are almost absent on dry elevations. Most halophytes are low species that only find suitable conditions in regularly grazed or mown



Fig. 9.1.6. A depression that is a suitable habitat for halophytes. The depression is surrounded by mesic grassland that contains no halophytes. *Scirpus tabernaemontani* grows in the depression. Photo: S. Rūsiņa.

areas (Rūsiņa 2013a).

**Birds.** Species that are typical of grassland passerine communities, such as *Motacilla flava*, *Anthus pratensis*, *Saxicola rubetra*, *Acrocephalus schoenobaenus*, *Locustella naevia*, *Emberiza schoeniclus*, often occur in coastal meadows. *Alauda arvensis* does not occur or occurs only rarely in drier places of a larger area. The grassland may feature a mosaic of low-density shrubs and shrub clusters that attract certain passerine species (*Emberiza schoeniclus*, *Carpodacus erythrinus*), however they may be absent as well. If there are permanently wet depressions in the grassland, *Rallus aquaticus* and on rarer occasions *Porzana porzana* may occur there. Meadow waders, such as *Tringa totanus*, *Gallinago gallinago*, *Vanellus vanellus*, on rarer occasions also *Calidris alpina schinzii*, *Limosa limosa* and *Philomachus pugnax* may occur, if the grassland area is sufficiently large. If a coastal meadow borders a water body or water course with emergent vegetation mosaic, the meadow ducks – *Anas querquedula*, *A. clypeata*, *A. strepera* nest there. If coastal meadows feature larger areas with tall herbs, *Crex crex* can also occur there. The occurrence of other species depends on the configuration of surrounding habitats – the foraging resources of coastal meadows attract species that usually breed near farmsteads, such as *Sturnus vulgaris*, *Ciconia ciconia*, as well as species feeding on flying insects – *Hirundo rustica*, *Delichon urbicum* and *Apus apus*, reeds may accommodate *Circus aeruginosus* and various forest edge species (for example, *Emberiza citrinella*, *Columba palumbus*), predator birds (for example, *Accipiter nisus* and *Buteo buteo*) can

occur near forests. During passage migration (especially in spring, when coastal meadows are usually partially flooded), they are used as resting and foraging grounds by a large number of various waterbird species, especially waders.

Coastal meadows are the only suitable habitat for the Baltic subspecies of the critically endangered dunlin species – *Calidris alpina schinzii*, the breeding of which has not been observed in Latvia in recent years, but still occurs in neighbouring countries (Leito et al. 2014; Thorup et al. 2011). Species included in Annex I of the EU Birds Directive, such as *Crex crex*, *Porzana porzana*, *Philomachus pugnax*, *Asio flammeus* and almost globally endangered *Limosa limosa* ("near threatened" according to IUCN criteria), breed in coastal meadows of Latvia and neighbouring countries.

**Invertebrates.** Coastal meadows because of their diverse micro-terrain are inhabited by invertebrate species typical for various grassland habitat types, however they are dominated by species inhabiting moist and wet habitats. There is a high diversity of saprophagous dipterous insects Diptera. Non-biting midges *Chironomidae* and flies *Muscidae*, phorid flies *Phoridae* the saprophagous larvae of which develop in the soil, fruit flies *Chloropidae*, as well as dagger flies *Empididae* dominate them. Rare species also occur, such as *Aspistes berolinensis* described by B. A. Gimmerthal (Gimmerthal 1842) more than 150 years ago. Locust *Stenobothrus lineatus* is typical of grasslands, there is a large diversity of long-legged flies *Dolichopodidae*. In drier areas species diversity is higher and in moister areas lower, with pronounced dominating species. There are many fragmented sources of literature on coastal meadows, where individual species have been mentioned, but there is little aggregated data (Meleci et al. 1998). The diversity and density of beetles in coastal grasslands is lower than in inland habitats (unpublished data). Approximately 200 spider species have been found in coastal meadows (Cera 2013). Also the protected whorl snail *Vertigo angustior* sometimes occurs in coastal meadows (Randu meadows).

Coastal meadows are subject to unpredictable effects of seawater, particularly in the case of severe storms. However, coastal species, such as flies, have adapted to such catastrophic changes (Kajzer-Bonk et al. 2013).

**Amphibians.** Small lagoons with shallow banks and depressions with sparse aquatic plant vegetation, which can dry out in summer, are a suitable frog and toad habitat. *Bufo calamita* uses



Fig. 9.1.7. Low-grazed vegetation structure suitable for waders on a lagoon coast in a coastal grassland in Finland. Photo: A. Priede.



Fig. 9.1.8. Low-grazed vegetation suitable for waders in coastal meadow in "Matsalu" Nature Reserve in Estonia. Photo: A. Priede.

the shallow water bodies for spawning, but winters on dry land by burrowing into the sand or in burrows. To enable the movement of *Bufo calamita* from one water body to another or to reach wintering areas it is important that grassland vegetation is low (Bērziņš 2008).

### 9.1.3 Important Processes and Structures

The most important environmental factor is the influence of brackish seawater, which forms subsaline soils. Tides are negligible on the Latvian coast and therefore wind activity is more important – during severe marine winds, seawater mass floods the grassland areas. Vegetation is also affected by ice and sea drift carried with the water during storms, which diversify the micro-terrain, create free niches in the vegetation and promote the maintenance of a mosaic of various grassland development stages and diversity of communities. Seawaters promote pronounced zones of vegetation. Halophytes are mainly found on the very coast of the sea in low beaches, as well as in floodplains at river mouths, where the brackish seawater enters during wind breezes. Typically, the land surface in such places is uneven, so dry and mesic elevations alternate with moist and wet depressions. Shallow ponds form in coastal meadows under the influence of seawater. They are very important for amphibian diversity and as bird foraging areas. If such places are not mown or grazed, sedge or reed beds gradually develop and open water areas disappear (Rüsiņa 2013a).

Grazing is an indispensable process that develops habitat structure that is necessary for birds and halophytic plants. Grazing ensures very low grass and open lagoon coasts with low vegetation, where

low-growing halophytes can grow and waders can feed on the lagoon coasts (Fig. 9.1.7, 9.1.8). For more information on coastal lagoons, see Laime (ed.) 2017, Chapter. 10.

### 9.1.4 Succession

The habitat forms naturally when the sea recedes and land develops in the previous sea area. Under natural conditions and in the absence of wild herbivores the grassland stage is usually temporary. It is maintained by the influence of ice and sea surges that prevent the establishment of trees and shrubs. However, *Pragmites australis* gets introduced with time in the moist conditions, and – shrubs – in drier conditions. Therefore, coastal grasslands can only be maintained in the long term by permanent management. If management is ceased, *Pragmites australis* gets introduced rapidly, creating shade and displacing almost all other species from the sward (Fig. 9.1.9, 9.1.10). In some cases, communities of *Alopecurus arundinaceus* or *Festuca arundinacea* develop as an intermediate stage between grassland and reed beds. Drier sites may initially overgrow with expansive grass and sedge species, for example, *Deschampsia flexuosa*, *Calamagrostis epigeios* and *Carex arenaria*, or with shrubs and trees. Most typically, grasslands overgrow with *Betula pendula* and *Populus tremula*, in moist places – with *Salix* spp. and *Alnus incana*, in dry areas – with *Pinus sylvestris*.

Similar succession can occur in the case of management which is unsuitable for the habitat – mulching, mowing without hay removal. This leads to an increase in grassland fertility and moisture and the abundance of tall grasses and forbs (*An-*



Fig. 9.1.9. Coastal grassland fully overgrown with reed near Helsinki in Finland. Photo: A. Priede



Fig. 9.1.10. There are hardly any other species in grassland overgrown with reed. Photo: A. Priede

*thriscus sylvestris*, *Aegopodium podagraria*, *Urtica dioica*, *Filipendula ulmaria* in moist areas) (Fig. 9.1.11).

With extensive use, the grassland can remain almost unchanged for decades or centuries. In moister areas, paludification and establishment of fen plants may occur for example, *Tomenthypnum nitens*, *Scorpidium* spp., *Sphagnum* spp. in the moss layer, *Menyanthes trifoliata*, *Comarum palustre*, *Thelypteris palustris*, *Phragmites australis*, *Eriophorum* spp. in the herb layer.

In mesic and dry areas, the long-term use of pastures without maintenance (mowing, moss harrowing, etc.) and completely without fertilisation slowly causes vegetation changes (over 50–100 years or faster in highly acid and poor soils). As the soil becomes poorer in nutrients, *Nardus* grasslands (EU protected habitat type 6230\* *Species-rich Nardus grasslands*, or heathlands (EU protected habitat type 2320 *Dry sand heaths with Calluna and Empetrum nigrum*) may develop.

### 9.1.5 Pressures and Threats

Among all influencing factors that are relevant for the majority of EU protected grassland habitats (see Chapter 3), habitat type 1630\* *Boreal Baltic coastal meadows* is most adversely affected by the cessation of management resulting in overgrowth of large areas with expansive species, especially with common reed. Drainage is not necessarily adverse, because the earlier drainage systems are mostly clogged. Depending on each specific situation it can have a positive or negative impact. Habitat type-specific threats are:

- intervention in coastal geomorphological processes – construction of hydrotechnical structures (piers, ports), which significantly reduces or increases (by causing coastal erosion) the impact of

seawater on the habitat and thus deteriorates the environmental conditions for halophytic species and communities;

- Baltic Sea eutrophication – seawater carries biogenic elements into grasslands and increases the introduction of nutrients during seawater surges, thus reducing the biodiversity;
- growing numbers of predators – coastal meadow birds are increasingly threatened by various nest predators. Significant nest predators are mammals (*Vulpes vulpes*, *Nyctereutes procyonoides*, *Mustela vison*), and birds (corvids, gulls and *Circus aeruginosus*) (Ottvall et al. 2005; Pakanen et al. 2011; Pehlak, Lõhmus 2008). The extent of damage caused by predators is increased both by disturbance, when the birds are forced to temporarily leave the nest making it easily accessible to predators, and the low nesting density of wader species. When birds nest in semi-colonies, some species (*Vanellus vanellus*, *Limosa limosa*) ensure the collective protection of nests both for their own and for other bird species. In coastal meadows near populated areas (for example, Daugavgrīva or the shore of Lake Liepāja), when they were still regularly used by waders for nesting, additional disturbance and threat to nests was caused by dogs walked without a leash.

## 9.2 Conservation and Management Objectives of Coastal Meadows

- Ensuring the ecological processes characteristic for coastal meadows (flooding with seawater, vegetation structure diversity and nutrient cycling ensured by appropriate mowing or grazing), creating preconditions to ensure that the diversity and quality of the ecosystem services offered by coastal meadows do not decrease.
- Promoting the increase of improvement in the

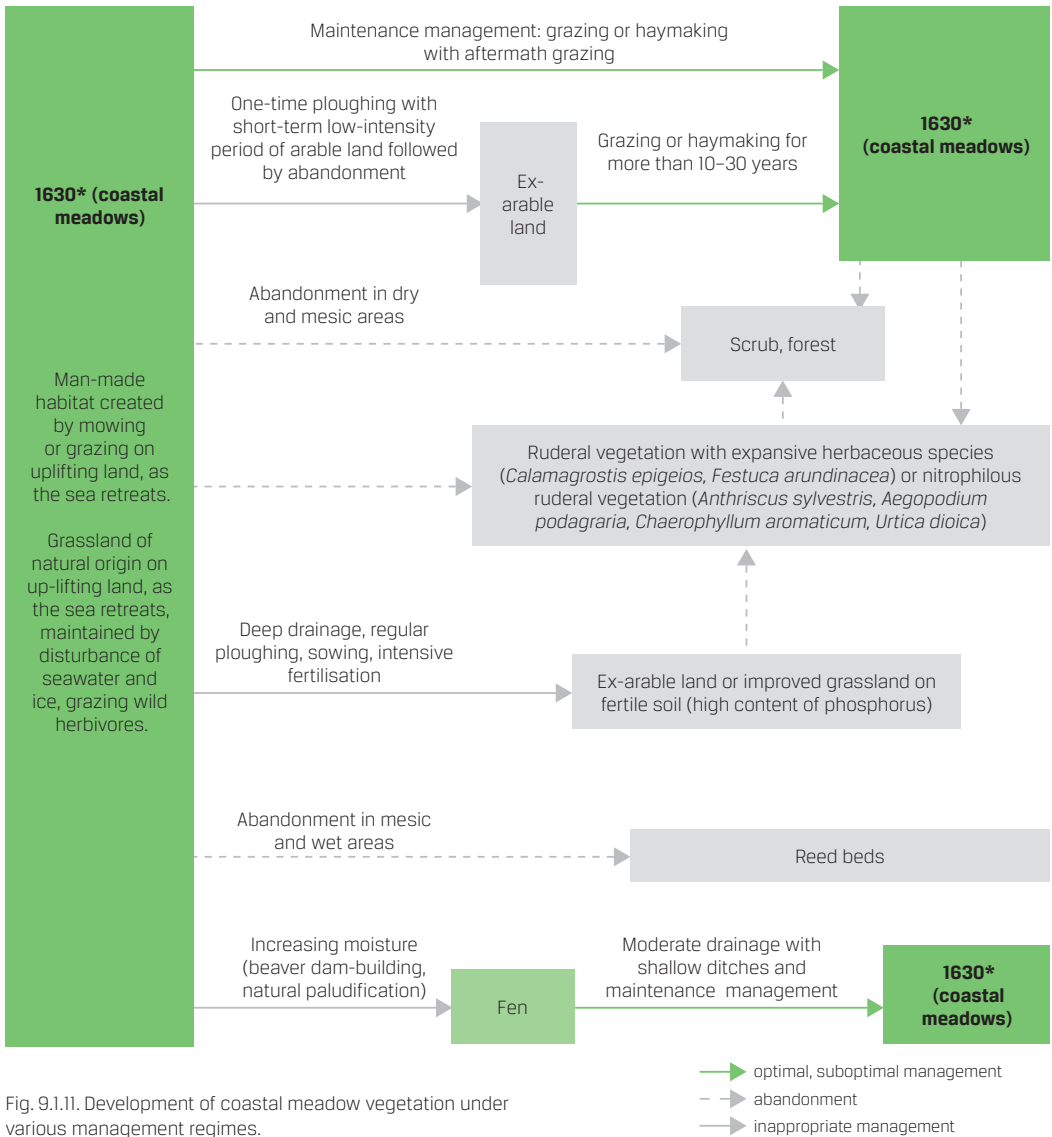


Fig. 9.1.11. Development of coastal meadow vegetation under various management regimes.

number and condition of typical and rare localities of coastal meadow species, restoring suitable habitats for them.

- Restoring the declining bird populations: the population of *Calidris alpina schinzii* in the 20th century has decreased in Latvia as well as in the entire global breeding range of this subspecies, therefore this species has not only been included in Annex I of the Birds Directive, but also assigned the status of "threatened". Currently, this species has become extinct in Latvia due to the decrease in coastal meadow area and quality, however irregular observations of the species in the remaining coastal meadow fragments during the nesting season allow one to hope that the breeding population of this subspecies can be restored. Management and conservation should be aimed at the restoration of coastal meadows that are in a bad condition. However, given that the population of *Calidris alpina schinzii* has decreased dramatically in the entire Baltic Sea region and continues to decrease, its restoration may take a very long time.
- Restoring and maintaining the diversity of plant species and communities and suitable habitats for halophytic species: a quarter of all vascular plants of Latvia occur in coastal meadows. For some specially protected halophytic plant spe-

cies, such as *Carex mackenziei*, *Angelica palustris*, *Juncus gerardii*, *Odontites litoralis*, *Plantago maritima*, *Blysmus rufus*, *Triglochin maritimum*, this is the only suitable habitat in Latvia.

### 9.3 Maintenance and Restoration of Coastal Meadows

Coastal meadows form a complicated and diverse complex with other coastal habitats – 1150\* *Coastal lagoons*, 1210 *Annual vegetation of drift lines*, 1220 *Perennial vegetation of stony banks*, 1640 *Boreal Baltic sandy beaches with perennial vegetation*, as well as various grassland habitats. Therefore their restoration and management must be planned after a comprehensive evaluation of priorities and possible

interaction of various habitats and species, taking into account both the guidelines of grassland management and coastal habitat management guidelines (Laime (ed.) 2017).

If a coastal meadow is in a favourable condition, restoration is not necessary and maintenance management is sufficient. If any grassland features indicate the opposite (see Chapter 9.3.3), restoration is necessary. Before habitat restoration or management, the area must be examined to ascertain the present nature values and a management plan has to be developed (see Chapter 7), also considering the legal framework of habitat management (see Chapter 7.2).

Table 9.3.1 Indications of a well-managed habitat type 1630\* *Boreal Baltic coastal meadows*.

Parameter	Meadow	Pasture
<b>Litter</b>	Litter covers no less than 10% and no more than 30% of the ground, no mulching residues	
<b>Vegetation</b>	A very colourful meadow in full bloom, proportion of forbs and grasses at least 1:1.	At least 30–75% of the area has low grass (3–5 cm) until October, in the rest of the area the height of grass is 10–15 cm, the highest grass is no taller than 50–60 cm.
<b>Plant species</b>	Great diversity of flowering plant species.	Richly flowering plants in at least 20% of the area.
<b>Plant communities</b>	Plant community mosaic: dry, mesic, moist and wet grasslands are found, each with their own specific species composition. Halophytic species occur in moister depressions and nearer to the coast (Fig. 9.1.2).	
<b>Bird species</b>	<i>Calidris alpina chinzii</i> , <i>Tringa totanus</i> , <i>Vanellus vanellus</i> , <i>Limosa limosa</i> , <i>Philomachus pugnax</i> and other meadow wader species breed and grassland passerine community is present (if a grassland is smaller than 10 ha, there can be no waders and the passerine community may be incomplete). A large number of waders of different species, as well as migrating geese and other waterfowl are present during passing migration.	
<b>Invertebrate species</b>	Large diversity of hygrophilous invertebrate species and those related to pastures with animal excrement; coastal grasslands are an important feeding area for anthophile (related to flowers) species.	
<b>Tussocks</b>	In moister areas, large sedge tussocks are preserved, which are important for birds.	
<b>Lagoons and ponds</b>	The lagoon shores are open, with low vegetation. Lagoons feature both sparse vegetation and <i>Scirpus</i> spp. and reed groups, as well as open water (not densely overgrown with reed).	
<b>Expansive plant species</b>	<i>Phragmites australis</i> , <i>Festuca arundinacea</i> , <i>Anthriscus sylvestris</i> , <i>Filipendula ulmaria</i> , <i>Calamagrostis epigeios</i> and other expansive plant species are absent or dominate up to 10% of the grassland area.	Overgrazing indicators do not cover more than 30% of the area, for example <i>Trifolium repens</i> , <i>Plantago major</i> , <i>Polygonum arenastrum</i> , <i>Poa annua</i> , <i>Prunella vulgaris</i> . <i>Lolium</i> spp. are absent.
<b>Drainage ditches</b>	Shallow drainage ditches are maintained, deep ditches are absent.	
<b>Shrubs and trees</b>	If the grassland is important for waders, trees and shrubs are not present there. In grasslands that only have botanical value, trees and shrubs occur in up to 10% of the grassland area.	
<b>Sand patches</b>	Larger and smaller open sand patches occur over the entire area (usually closer to the sea shore).	

### 9.3.1 Coastal Meadows Requiring Maintenance

Management is necessary for all coastal meadows in favourable condition. Coastal meadows in favourable condition are characterised by the following features: grassland has not been drained, no ditches have been dug or they are shallow and do not significantly change hydrological conditions, the grassland has been managed – annually grazed or mown with grazing in the aftermath every year and therefore not overgrown with shrubs, it lacks a dense layer of litter and species diversity is high, there are various plant communities (both with low and tall grass) (Table 9.3.1). The grass is mostly low, but not uniformly low as it is in a lawn. There are tufts, depressions and tussocks where waders can hide their nests and offspring. The grassland is characterised by shallow ponds with water; not overgrown with dense, tall vegetation; birds can forage here. It is close to sea shore with wide beach with sea drift and algae, where there is a great diversity of insects that the adult birds can feed on. Grass along the sea coast is grazed low; overall, there are many rich-flowering herbs on which butterflies and other invertebrates can feed.

Ideally, coastal meadows are grazed in a permanent enclosure by horses, cattle and sheep or a mixed herd, or by periodically alternating animal species. Cattle pasturing is very important because they also consume water plants and keep the sea and lagoon coasts open. For bird diversity, it is best if grazing is supervised by a shepherd, who deters foxes and other predators searching for bird nests and offspring.

A favourable condition is indicated by the presence of coastal meadow umbrella species – halophytes and *Calidris alpina schinzii*.

### 9.3.2 Optimal, Suboptimal and Inappropriate Management

See Tables 1 and 2 of Annex 1 for optimal, suboptimal and inappropriate management.

Optimal management is mixed herd grazing or periodic change of animals. Grazing pressure should be prescribed depending on the local grassland yield and nature values that should be conserved. For *Calidris alpina schinzii*, low vegetation should be maintained (less than 10 cm in early June, and the height of grass should not exceed 25 cm). It is recommended to use 1–2 LU ha<sup>-1</sup> per year (Doddy 2008).

Mowing with haymaking is an equally recommended method as grazing, especially if the main nature values are plant species and communities. Mown coastal meadows have higher plant species

diversity as well as more favourable conditions for rare plant species. Mowing should be chosen in places where the key values are plants or meadow birds which do not need very low grass. Grazing is best preferred in areas close to lagoons and the sea coast, if there are grasslands (for example, grassland in Randu meadows starts mainly behind the beach and dunes), and mowing is better suited for the areas further from the coast. In mown meadows the aftermath should be grazed.

Extensive grazing is the best way to preserve the invertebrate species diversity. Intensive grazing in paddocks is only permissible for a single season because animals successfully suppress the reed, but significantly affect the soil and therefore soil inhabitants, for example, *Vertigo angustior*.

Seaweed should be at least partially left unremoved because it forms an EU protected habitat type 1210 *Annual vegetation of drift lines* (Laieme (ed.) 2017). It is important for birds and invertebrates, as well as annual plants, for example the endangered *Atriplex calotheca*.

Pasture weeds, for example, *Cirsium* spp., get introduced in pastures with time and litter accumulates, therefore it is recommended to mow the pasture or burn it in spring once every 5–10 years.

### 9.3.3 Coastal Meadows Requiring Ecological Restoration

Grassland requires restoration, if it has one or more of the following features:

- it is not managed for several years;
- it has been mown by mulching or leaving the grass for more than five years;
- there are many tussocks, therefore management is difficult;
- it is overgrowing or already overgrown with trees and shrubs;
- vegetation is dominated by one or several expansive species, for example, *Calamagrostis epigeios*, *Phragmites australis*, *Festuca arundinacea*, *Aegopodium podagraria*, *Anthriscus sylvestris*, *Elytrigia repens*, *Filipendula ulmaria*;
- There are signs of overgrazing in at least half of the area – disturbed turf or abundant overgrazing indicators (*Plantago major*, *Trifolium repens*, *Polygonum arenastrum*, *Poa annua*).

### 9.3.4 Restoration Potential

The most important problem of coastal meadows in Latvia is overgrowth. If a grassland is permanently overgrowing, moisture increases, gradually





Fig. 9.3.1. Coastal meadow overgrown with common reed that is difficult to restore. There are almost no other species, except for reed. Photo: S. Rūsiņa.



Fig. 9.3.2. Coastal meadow overgrown with common reed that is moderately difficult to restore. Grassland characteristic species are still preserved under the reed cover. Photo: S. Rūsiņa.



Fig. 9.3.3. Coastal meadow overgrown with *Festuca arundinacea* that is relatively easy to restore. Photo: S. Rūsiņa.



Fig. 9.3.4. Coastal meadow that is relatively easy to restore, with a dense litter layer and reeds which start to introduce. Photo: S. Rūsiņa.

transforming the grassland into a reed bed. Also clogging of a shallow drainage ditch system encourages grassland rewetting and overgrowth with reed (Anon. 2005a). If the process has lasted for several decades, other plant species are no longer preserved in the sward and there is no seed bank in the soil from which the species can recover. In such cases, restoration of a coastal meadow from a reed bed is a long process (Fig. 9.3.1– 9.3.4).

Coastal meadows often border reed beds, which are habitats having their own biodiversity importance. It is therefore necessary to understand the difference between the two habitats, before reed control methods are applied. Reed beds are continuous stands of reeds that grow permanently in at least 5 cm deep water. However, if a small pond is surrounded by grasslands, it should be

cleared from reeds because a pond with low grass serves a more important ecological function.

### 9.3.5 Restoration Methods

The required restoration methods are summarised in Table 20.1 of Chapter 20 and in Chapter 21.

Habitat restoration should be planned so as to reach the specific objectives of habitat restoration. One of the most important of these grassland restoration target species is *Calidris alpina schinzii*, therefore restoration activities should primarily focus on habitat suitability for this species. Other bird species characteristic of coastal meadows (for example, other waders, *Anas strepera*, *Motacilla flava*) will also benefit from these measures, moreover, they will most likely restore their populations earlier



Fig. 9.3.5. Baling hay in Randu meadows. A stake marks a stone that is not visible during mowing. Photo: G. Rubenis.



Fig. 9.3.6. In the first year after reed grinding, the vegetation develops very slowly (the dark area in the image is a ground meadow in Finland). If the entire meadow has been ground and there are no other coastal meadows in proximity, it is recommended to spread plant seeds containing hay harvested in a coastal meadow over the ground area. Photo: S. Rūsiņa.

than *Calidris alpina schinzii*.

To ensure the suitability of grassland for *Calidris alpina schinzii*, the following should be restored:

- free transitional zone with water (lagoon or sea) not overgrown with reeds;
- areas with very low vegetation (<10 cm) in early June, alternating with slightly taller, but not tall (up to 25 cm) grassland vegetation; such mosaic structure is best ensured by grazing before the vegetation season ends;
- sufficiently large (at least 1 ha, preferably larger) continuous open area;
- open grassland in the direct vicinity of the sea, regularly flooded during storms (often these areas are overgrown with reed due to a lack of management).

Such restoration will also be suitable for halophytic plant species, which are the second target species group in this habitat.

When restoring the habitat type 1630\* *Boreal Baltic coastal meadows*, several other restoration aspects should be taken into account.

**Rewetting:** to ensure the diversity of coastal meadow species, the diversity of moisture conditions is very important, so drainage is generally not beneficial. However, if the only restoration solution for the area is mowing, but it is difficult due to moist conditions, then restoration of a shallow ditch system should be evaluated.

**Grinding of shrub roots and reed rhizomes:** grinding should only be used if tree and shrub roots substantially interfere with the commencement

of mowing. Reed rhizomes should be ground if the reed has taken over the entire area and it may take too long to reach the desired changes in vegetation by mowing or grazing alone. If there are only reeds in the sward, livestock grazing is impossible, because their mobility is impaired due to the stand density and thick layer of old dead reed stems. Animals cease eating reeds that have overgrown in summer.

**Grassland surface smoothing and removal of litter:** if the grassland surface is flat, then only litter and the layer of old reeds should be removed. For this purpose, burning can be used. The necessity for burning should be carefully evaluated by consulting habitat experts and only prescribed burning (in coordination with authorities) should be performed. Grassland terrain is often changed by large ice blocks taken from the sea, which also brings reed, tree and sand mass. These marks remain visible for several years as ridges.

Before mowing, household waste that has accumulated over the years and has been brought by sea surges should be collected because it can damage the equipment and is dangerous to grazing animals (for example, animals can become tangled in the remains of fishing nets). Ice and water can form deep pits that are only a few square metres large and are difficult to notice when mowing.

Management is also complicated by boulders. They are very important for the landscape and for biodiversity and therefore should be preserved as much as possible (Fig. 9.3.5). However, if grassland is left unmanaged due to boulders, it is better to gather them and place them in piles, rather than to

abandon the grassland. The piles can be left in the grassland as a landscape element, but should not be so high that predator birds use them as "hunting towers".

**Soil nutrient removal:** such restoration may only be necessary in places that are heavily eutrophicated and overgrown with nitrogen-demanding expansive species. In Latvia, coastal meadows are not substantially improved, therefore less invasive methods are sufficient for nutrient removal. If turf is removed, in coastal meadows it should only be done to a depth of 15–20 cm. Removing up to 50–60 cm in depth will reduce soil nutrients, but the groundwater table will increase and anaerobic conditions will develop in soil that would delay the establishment of plant species.

**Targeted creation of species composition:** only required if reed roots are ground or turf is removed and no grasslands are situated close to the ground area (Fig. 9.3.6). In other cases, regular grazing or mowing is sufficient because plant species

will enter the area from adjacent grasslands. Since autumn winds can remove the seed containing hay spread on grasslands in summer, it is better to harvest it in the previous vegetation season and store it until spring (mid-April, early May) and then spread it on the ground areas.

**Ensuring free access to the water edge:** for most waders, including the most important species of this habitat, *Calidris alpina schinzii*, free and shallow access to open water is important, therefore the water's edge should be cleared from all types of cover.

**Restorative grazing:** coastal meadows are exposed to severe wind and storms coming from the sea, therefore the arrangement of any kind of enclosure is very complicated (enclosures and shelters often get damaged during storms). Construction of mobile enclosures and seasonal grazing would be a better solution. Animals should be gradually accustomed to the area because the conditions here are extreme.

Table 9.4.1 Conflicting management priorities of habitat 1630\* *Boreal Baltic coastal meadows*

Problem	Solution
<p><b>Habitats</b></p> <p>Habitat type 1210 <i>Annual vegetation of drift lines</i> can overlap with coastal meadows, when organogenic debris (seaweed) is washed up from the sea. Vegetation in drift lines is replaced by characteristic vegetation.</p>	<p>Drift lines should be at least partially left, thus preserving suitable conditions for the habitat 1210 <i>Annual vegetation of drift lines</i>. If, however, sea debris covers a large area of grassland and hinders its management, then the debris can be removed. Habitat 1210 <i>Annual vegetation of drift lines</i> does not form on reed turf often washed out during storms, so they can be removed (Fig. 9.4.1, 9.4.2).</p>
<p><b>Late flowering plants</b></p> <p><i>Angelica palustris</i> is a relatively late-flowering plant species (July–September). Coastal meadows are its only suitable habitat, therefore it is mandatory to protect this species.</p>	<p>Long-term intensive grazing is not permitted in areas with <i>Angelica palustris</i> and mowing should be used instead. Mowing should be done when species is deflorated. If the area is important for <i>Calidris alpina schinzii</i> at the same time, then areas temporarily excluded from pastures should be established for the protection of <i>Angelica palustris</i>. Their location should be changed over the years so that the species can flower and shed seeds there every few years.</p>
<p><b>Halophytic plant species</b></p> <p><i>Triglochin maritimum</i>, <i>Juncus gerardii</i>, <i>Plantago maritima</i>, <i>Glaux maritima</i>, <i>Trifolium fragiferum</i>. Very low species that are intolerant to shading by other species, therefore late mowing is not suitable for them.</p>	<p>The best solution is rather intense grazing (average grass height during the grazing season – 5 cm).</p>
<p><b>Birds</b></p> <p><i>Calidris alpina schinzii</i> needs very low-grazed vegetation that is not favourable for many plant species and also the whorl snails.</p>	<p>Even in grasslands where it is not currently found, management should be organised so that it is favourable for this species. The total number of individuals of the species in the region is small, so it may take a long time before the species starts inhabiting a grassland, however the restoration of meadow wader complex in the grassland is an important precondition to ensure nesting of <i>Calidris alpina schinzii</i>. Late-flowering plant species and whorl snails can be protected if a part of the area is excluded from pasture.</p>

The most important target species of coastal meadows is *Calidris alpina schinzii*, which requires low-grazed vegetation, therefore the grazing pressure in coastal meadows should be higher than in other grasslands, especially in areas near lagoons and the sea shore. Due to the rough terrain, mowing is not an alternative to grazing because such low mowing is impossible here.

**Control of expansive species:** to limit reeds, their first mowing should be in late May; the livestock eats this hay because the young reed shoots are soft; they are also valuable fodder.

**Predator control:** predators are a threat specific to coastal meadows. *Vulpes vulpes*, *Nyctereutes procyonoides*, *Mustela vison*, corvids, gulls and *Circus aeruginosus* inflict most damage to the population of waders.



Fig. 9.4.1. Lines of washed-up organogenic debris in a coastal meadow. Habitat type 1210 *Annual vegetation of drift lines* can form in such areas. Photo: S. Rūsiņa.

The effect of predators can be reduced as follows: (1) start grazing later so that it is difficult for predators to spot the nests; (2) avoid tall shrubs or trees, which enable the observation of nests; (3) actively reduce the predator populations by hunting; (4) construct fences, to prevent the access of foxes and racoon dogs to the territory.

## 9.4 Conflicting Management Priorities of Coastal Meadows

Managers of coastal meadows can experience both conflicting management situations applicable to all grasslands (see Chapter 7.1.4), as well as specific conflicts, related to the management of nature values of coastal grasslands (Table 9.4.1).



Fig. 9.4.2. Habitat type 1210 *Annual vegetation of drift lines* does not develop on washed up pieces of reed turfs. Photo: S. Rūsiņa.



Fig. 9.5.1 Grassland in "Randu Pļavas" Nature Reserve. (a) Immediately after reed root grinding (2014); (b) one year after grinding (2015). Photo: G. Rubenis.

## 9.5 Examples of Coastal Meadow Restoration in Latvia

As part of the LIFE project "Protection and management of coastal habitats in Latvia" LIFE02 NAT/LV/008498 (2002–2006), reed stands were cut around lagoons and the lagoon-coastal grassland habitat complex: 26 ha of pastures were restored, 96 ha mown. The effect of restoration of "Randu Pļavas" Nature Reserve on vegetation and insects have been evaluated and published in several publications (Grisone 2009; Krautmane 2010; Petrova 2010). It was described that grazing has a favourable effect on insect and vegetation diversity, but with increasing grazing intensity it decreases again.

Approximately 1 ha of topsoil was ground in "Randu Pļavas" Nature Reserve in autumn of 2014, where at least 50% was covered by reeds. Intensive mowing (four times a year) was carried out in 2015 to reduce the growth of reeds (Fig. 9.5.1). The results show that intensive mowing must also be continued in 2016 in areas where the reeds keep regrowing (unpublished data by Gintārs Rubenis). Coastal meadow restoration also took place near Mērsrags (LIFE project "Implementation of management plan for Lake Engure Nature Park" LIFE00 NAT/LV/007134 (2000–2004)), Lake Liepāja and Lie-lupe estuary, but no data on restoration experience at these sites has been published.