PART III DESCRIPTION OF GRASSLAND HABITAT TYPES, THEIR MAINTENANCE AND RESTORATION OPTIONS

Chapter 8. (Semi)Improved Grasslands and Ex-arable Land that do not Meet EU Protected Habitat Status (S. Rūsiņa, A. Auniņš)

8.1 Characteristics of the Habitat Type

8.1.1 Brief Description

Perennial grasslands occupy 657,000 ha in Latvia (Anon. 2015a) and include old ex-arable land that is used for mowing and grazing. A large area of agricultural land in Latvia is currently abandoned – 370,000 ha (Anon. 2015b). Grassland vegetation also occurs there, which is potentially important for biodiversity, if mowing or grazing were to be recommenced.

The perennial grassland management recommendations for the preservation and promotion of biodiversity provided in this chapter apply to ex-arable land, improved grasslands and to grasslands sown in arable land (*see Chapter 1.1* and Table 1.1). Soil conditions there have been severely altered by humans. Species composition has developed under direct human influence by sowing desirable plant species, while in ex-arable land their development depends on the previous management regime.

8.1.2 Vegetation, Plant and Animal Species

Plants and vegetation. In perennial improved grasslands vegetation is relatively uniform, it consists of sown grasses and legumes (Fig. 8.1). Sown species mixtures are selected depending on grassland type (meadow or pasture) and the grassland moisture regime. In mesic improved meadows these are *Festuca pratensis, Poa pratensis, Phleum pratense, Dactylis glomerata, Festuca pratensis*, in moist areas – *Alopecurus pratensis, Festuca arundinacea, Phalaroides arundinacea, Bromopsis inermis, Trifolium pratense*. In pastures, *Lolium perenne* and *Trifolium repens* are most usually sown.

Soil reaction and fertility in improved grasslands is regulated by liming and fertilisation, therefore the botanical diversity of such grasslands has no chance of reaching that of semi-natural grasslands. If grassland is regularly ploughed and sown (at least every five years), wild plant species cannot be established and such grassland is equal to arable land. Without ploughing, but with intensive maintenance of sown grassland (mineral fertilisation, harrowing and admixture sowing of grasses or legumes, frequent mowing), a very low species diversity can be maintained for years. The more often the grassland is ploughed, sown or fertilised using mineral fertilisers, the lower the likelihood is that wild plant species will get established.

If grassland is maintained extensively, wild species establish with time. In such grasslands the sward develops depending on changes in soil conditions (for example, how quickly the soil fertility decreases or soil acidity increases) and the occurrence of wild species in the nearest vicinity. By increasing the duration and extent of extensive management, the number of wild species also increases.

In ex-arable land the vegetation consists of wild perennial grasses and forbs. Yet, the species composition and vegetation structure still does not correspond to semi-natural grassland – turf is weakly developed, plant species occur in patches rather than evenly, typical semi-natural grassland species have not entered (for information on distinguishing between semi-natural grassland and improved grassland or ex-arable land, *see Chapter 1.2*).

In ex-arable land the vegetation composition develops depending on time of abandonment (age of the ex-arable land), soil conditions and wild species pool in surroundings, as well as the previous management of ex-arable land. New ex-arable land (up to 5–10 years old) is initially dominated by annual and biennial weeds (*Stellaria media, Chenopodium* spp., *Cirsium arvense*), later they are replaced by perennial plant species, such as *Elytrigia repens, Phleum pratense, Artemisia vulgaris*, forbs may get established temporarily in great quantities (Fig. 8.2). If ex-arable land is left abandoned, semi-natural grassland vegetation does not develop, and it overgrows with forest. If mowing or grazing is commenced, the development of semi-natural grassland vegetation can begin.

Birds. Intensively managed cultivated grasslands are uniform in structure therefore their bird

Fig. 8.1. Improved grassland dominated by *Dactylis glomerata*. Photo: S. Rūsiņa.

Fig. 8.2. New ex-arable land dominated by *Leucanthemum vulgare*. Photo: S. Rūsiņa.

species communities are depleted. Only ecologically tolerant species that can adapt to uniform conditions occur. Bird species composition depends on the frequency and time of mowing – the more often and early the grassland is mown, the fewer bird species and specimens of each species occur there.

Large improved grasslands (continuous area larger than 10 ha) in flooding floodplains are most important among cultivated grasslands because meadow wader communities can establish there. If there are moist depressions or oxbow lakes in the grassland, the number of bird species here is high. Given that bird communities in grasslands are mainly determined by grassland area and moisture regime as well as the type and intensity of management, any grassland bird species except for *Calidris alpina* schinzii may theoretically occur in such grasslands. Therefore, a small percentage of cultivated grasslands are important habitats for birds. However, most of the cultivated grasslands are only suitable for passerine communities the composition of which is determined by the amount of shrubs.

Invertebrates. Species composition depends on the type and intensity of grassland use.

8.1.3 Pressures and Threats

The primary pressure on biodiversity in improved grasslands and ex-arable land is associated with management intensity. Regular ploughing completely destroys vegetation and prevents the establishment of wild species. Intensive fertilisation, especially with mineral fertilisers, makes the soil conditions unsuitable for most of the semi-natural grassland plant species. Botanical diversity decreases by at least half, when the grassland is treated with 20-50 kg ha^{-1} of nitrogen fertiliser per year. Forbs almost do not occur in grasslands fertilised with more than 75 kg ha^{-1} of nitrogen fertiliser per year. In grasslands with soil phosphorus content above 50 mg kg^{-1} (by the Olsen method) botanical diversity is very low. The quantity of potassium does not affect the species diversity as much as nitrogen and phosphorus. High biodiversity is retained even if the amount of potassium is 10-20 mg per 100 g of soil (Janssens et al. 1998; Plantureux et al. 2005).

Frequent mowing (two times and more per season) decreases the establishment of wild plant species because they are not adapted to frequent removal of their aboveground parts. Frequent mowing is very unfavourable for entomological diversity because plants are not allowed to flower and ripen seeds and invertebrates mainly feeding on nectar, pollen or seeds cannot survive. Frequent mowing depletes the grassland bird species composition and transforms grassland into an ecological trap (Battin 2004). Breeding success of birds in such grasslands is unlikely or completely impossible. The grassland cannot provide birds with a sufficient nutrient base, especially birds feeding on plant seeds and invertebrates. Early mowing also affects the grassland species diversity adversely. It is especially harmful for bird species nesting in grasslands. Weed control using herbicides destroys forbs.

8.2 Objectives of Improved Grassland and Ex-arable Land Management in the Context of Nature Conservation

The objective of improved grassland and ex-arable land management for nature conservation purposes in Latvia is to promote biodiversity in agricultural land, thus ensuring the availability of grassland ecosystem services to the public. Environmentally-friendly management of improved grasslands and ex-arable land provides habitats and feeding areas for grassland wildlife, and future habitats for EU protected grassland habitats.

Improved perennial grasslands and ex-arable lands are very important in the conservation of rural landscape biodiversity because semi-natural grasslands occupy only 10% of the total perennial grassland area in Latvia, which is insufficient to fully ensure a living space for all semi-natural grassland plant and animal species.

Perennial grasslands are significant for biodiversity, especially in intensive agriculture landscapes. The biodiversity of forests and arable land is greater if the landscape also contains grasslands. Even intensively managed grasslands play an important role in the conservation of biodiversity in comparison with landscapes without grasslands (Fedoroff et al. 2005).

Research in Latvia shows that perennial improved grasslands and ex-arable land include a significant part of *Crex crex* population (Keišs 2005) and are an invaluable foraging resource for *Aquila pomarina* (Anon. 2012b). Many species of the Latvian rural landscape prefer the presence of grasslands in the agricultural landscape mosaic (Aunins et al. 2010). Botanical diversity is relatively high in at least a quarter of the area of perennial improved grasslands and ex-arable land and their potential for the restoration of semi-natural grasslands is high (Anon. 2014b).

Compared to arable fields, perennial grasslands provide more and better ecosystem services, especially the support and regulatory services (carbon dioxide sink, water infiltration and storage, reduction of watercourse pollution).

8.3 Management of Improved Grasslands and Ex-arable Land to Promote Biodiversity

To maintain and promote biodiversity in improved grassland and ex-arable land, the same principles should be followed as for EU protected habitat maintenance (Annex 2). The management methods and their influence on grassland biodiversity are described in detail in Chapter 22. To reduce the adverse impact on grassland species, the intensity of management should be reduced as much as possible – mowing frequency should be reduced to one or two times a year, fertilisation stopped, grazing pressure reduced (Walker et al. 2004).

Mowing should be carried out with the use of bird scaring devices and from the centre to the edges or from one edge to the other, towards the forest or other semi-natural habitat, where birds may find shelter. An alternative is to leave unmown patches or strips that are only mown at the end of summer or next year. Animal and plant friendly equipment with an as narrow as possible work zone and slow operation speed should be used.

Mowing should only be performed once or twice per season, not earlier than 20 June. To ensure the protection of birds, mowing only once per season after 20 July is appropriate. To protect *Crex crex*, grass should not be mown lower than 10-20 cm. To facilitate plant species introduction, grassland should be mown at least twice to decrease the abundance of highly competitive sown grasses and facilitate the establishment of wild species. Those parts with a higher number of species should only be mown every few years after the shedding of seeds. The mown grass must be collected, and it is recommended not to collect it while still green because drying on the field helps seed maturation and shedding. Use of herbicides is not permissible.

Grazing. Pastures should be grazed no more than 2–3 times per season with an approximate grazing pressure of 1.0–1.2 LU ha^{-1} or lower, ensuring that at least during the most intensive growing period (approximately in the first half of July) approximately 25% of the grassland is ungrazed and has blooming plants. During grazing, the sward should be up to 10 cm tall in cattle and horse pastures and above 10 cm in sheep pastures. Maintaining heterogeneous vegetation is desirable – in approximately 20% of the area the grass should be lower than 5 cm and in at least 20% of the area it should be higher than 15 cm.

Leaving up to 10% of the grassland area ungrazed every year is recommended. This is necessary to maintain the diversity of grass-dwelling invertebrates. The best option is leaving the ungrazed part as a band along the edge of grassland, however, the ungrazed areas must be changed every year.

In grasslands suitable for waders, grazing should not be commenced earlier than in mid-July; seasonal grazing is recommended. Grazing during the breeding season of waders (especially from mid-April to

mid-June) should only be performed during the day, because night grazing significantly increases the risk of nest trampling.

If the grazing pressure is optimal, mowing is necessary only periodically (not every year), if the increased formation of tussocks or ungrazed patches is observed followed by the establishment of shrubs. Mowing is not permitted during the breeding season. Mowing is required, if unpalatable species have spread (*Cirsium vulgare, Rumex* spp.). However, small quantities of these species must be preserved until next spring, because they are usually higher than the snow cover, and serve as a food source for birds in snowy winter conditions.

Insufficient grazing (during the entire vegetation season less than 50 % of the area is grazed) or overgrazing (grass at the end of the grazing season is lower than 5 cm, indications of trampling and overgrazing, areas free from vegetation exceed 30% of the pasture) is undesirable.

Use of animal medical supplies more than those permitted for conditions of organic agriculture is not permissible because it threatens pasture biodiversity by manure.

Fertilisation is undesirable in both meadows and pastures, (however, excrement and urine that the animals leave in the pasture are very important for the diversity of invertebrates). If fertilisation is nevertheless necessary to produce a sufficient amount of animal feed, use of solid manure is recommended. Use of mineral fertilisers and liquid manure must be avoided because they are mineralised very quickly, while their role in the creation of soil humus is insignificant and they only promote the spread of some tall grasses which suppress and outcompete other species.

8.4 Restoration of Semi-natural Grassland on Improved Grasslands and Ex-arable Land

8.4.1 Restoration Potential

To determine whether semi-natural grassland can be created or restored in improved (sown) grassland or ex-arable land, evaluation of vegetation and soil conditions is necessary. Chapter 1.2 provides recommendations on evaluating whether the grassland has indications of a semi-naturalness; Chapter 7 provides tips on semi-natural grassland creation and restoration planning (including the legal framework of habitat restoration).

If semi-natural grassland development is unlikely, it is possible to plan the creation of a semi-natural grassland habitat anew. In both cases it must be determined which semi-natural grassland habitat type potentially can be established. Restoration and maintenance works should be planned depending on measures recommended for that particular habitat type (*see Chapters 8–19*).

In xeric and dry soils with weakly acid to alkaline reaction, EU grassland habitat types 6120* *Xeric sand calcareous grasslands and* 6210 *Semi-natural dry grasslands and scrubland facies on calcareous substrates* can develop, while in acid soils 6230* *Species-rich Nardus grasslands, on siliceous substrates in mountain areas* can develop. In mesic soils, it is most likely that habitat types 6510 *Lowland hay meadows* or 6270* *Fennoscandian lowland species-rich dry to mesic grasslands* can develop. In moist and wet soils of floodplains 6450 *Northern boreal alluvial meadows* can develop. This habitat type can also be established in cultivated grasslands if the hydrological regime is restored. In moist and wet soils outside floodplains, depending on the hydrological regime, the moist variant of habitat type 6270* *Fennoscandian lowland species-rich dry to mesic grasslands* (6270*_3) or habitat type 6410 Molinia *meadows on calcareous, peaty or clayey-silt-laden soils* may develop.

Success of semi-natural grassland restoration (creation) depends on the initial condition of the habitat and the selected restoration type. Semi-natural grassland indications may already be present before the restoration measures, but it is also possible that the first signs of success appear in 5–10 years and the habitat will fully establish after 20–50 years. If soil fertility is high but the chosen restoration methods are mowing or grazing, restoration success will be low – indications of semi-natural grassland may only appear in 20–40 years (Table 8.4.1).

If the grassland has been fertilised with mineral fertilisers for a long time, the formation of semi-natural grassland can be hindered by the depleted soil fauna. Use of mineral fertilisers adversely affects soil fauna by reducing the number of species, increasing the role of bacteria and reducing the role of fungi in organic matter decomposition, thus increasing the number of soil animal species that feed on bacteria. However, the composition of bacteria species changes as well, because the number of bacteria with lower catabolic activity is increasing, they can process less diverse food than the bacteria of semi-natural grassland soils. In unfertilised semi-natural grasslands balanced soil fauna develops which includes not only bacteria but also fungi, which diversify the composition of animal species and positively affects the plant species composition, while the plant species themselves affect the microbial fauna (Bardgett et al. 1999; Plantureux et al. 2005). Soil invertebrate

Table 8.4.1. Possibilities of semi-natural grassland restoration on improved grassland or ex-arable land.

Potential of creation and restoration	Description of improved grassland and ex-arable land, where creation or restoration of a semi-natural grassland is planned
Low potential, high costs	Cultivation period longer than 5–10 years. Intense use of mineral fertilisers. The time between the end of cultivation and the planned creation of semi-natural grassland is short (a few years) or it is never managed extensively. Soil is fertile (phosphorus content in soil exceeds 50 mg kg^{-1} by the Olsen method or 80 mg kg^{-1} by the Egner-Riehm method) (*see Chapter 21.7*). Vegetation is dominated by productive grasses, such as *Phleum pratense, Dactylis glomerata*, or expansive species, for example, *Taraxacum officinale, Urtica dioica, Anthriscus sylvestris, Aegopodium podagraria, Calamagrostis epigeios*. In the surrounding area there are no semi-natural grasslands from where wild plant and animal species may enter.
High potential, low costs	Short cultivation period (up to five years) and low cultivation intensity (minimum fertilisation or mainly using animal manure), or a long time between the end of cultivation and the planned creation of semi-natural grassland (20 years or more), and for a long period of time grassland was managed extensively. Soil is nutrient-poor. Many semi-natural grassland species are present in vegetation. Dominated by annual or perennial plant species of nutrient-poor soils, for example, in new ex-arable land: *Viola arvensis, Myosotis* spp., *Plantago lanceolata, Rumex acetosella, Trifolium arvense, Artemisia campestris, Senecio jacobaea, Solidago virgaurea, Pilosella officinarum*. In old ex-arable land and previously cultivated grasslands: *Agrostis tenuis, Anthoxanthum odoratum, Festuca rubra, Centaurea jacea*. In the surrounding area there are semi-natural grasslands from where wild grassland species can naturally enter the managed area.

Fig. 8.3. Dry ex-arable land in nutrient-poor sandy soil. Semi-natural grassland can develop there with time if the ex-arable land is mown or grazed extensively and there are species-rich semi-natural grasslands in surroundings.

Fig. 8.4. Sown grassland in fertile soil with dense and high sward which is formed by tall grass species. Semi-natural grassland can be created there only if the soil nutrients are removed, seed bank of weeds is depleted and semi-natural grassland species are introduced by sowing.

fauna can directly affect the formation of plant species diversity by reducing the biomass of dominating species (eating the roots of these species) and thus giving an opportunity to other, less competitive plant species to establish (De Deyn et al. 2003).

8.4.2 Restoration Methods

Restoration methods are summarised in Table 20.1 of Chapter 20 and in Chapter 21. Depending on soil and vegetation conditions, one or more restoration methods described in Table 20.1 should be used.

If the objective is to restore a moist semi-natural grassland, rewetting is often necessary (*see Chapter 21.6*).

Comparing restoration in arable land (weed species eliminated, reduced amount of nutrients) and improved grassland with preservation of the existing vegetation, the restoration is more efficient in arable land. Species establish more successfully in arable land because of less competition with weed and expansive generalist species.