

Chapter 24. Landscape Ecological Aspects of Grassland Biodiversity Conservation (S. Rūsiņa, A. Auniņš, V. Spunģis)

24.1 The Significance of Landscape for the Protection of Grassland Habitats and Species

The landscape, in which the grassland is located, is very important for the conservation of semi-natural grassland diversity.

Dispersal of species is the most important landscape ecological process that ensures biodiversity. It is necessary to ensure stable and genetically diverse populations of species. Plant and invertebrate species of semi-natural grasslands are not successful in overcoming large distances, therefore grasslands must be connected in the landscape. For instance, the seeds of *Asteraceae* species (*Hypochoeris radicata*, *Centaurea scabiosa*, *Senecio jacobaea*) have pappi that enable the dispersal of seeds by the wind. However, most of the seeds fall within the distance of 1 m from the parent plant at a wind speed of 6 km h⁻¹ and the distance of dispersal at a wind speed of 16 km h⁻¹ is 10 m (Sheldon, Burrows 1973).

Seeds of plant species that lack dispersal adaptations travel even shorter distances. The process of habitat fragmentation in Europe and Latvia is increasing. Most grasslands are isolated from each other by forests, construction sites or intensively managed farmland.

If surrounded by forests or, on the contrary, arable land, then species living in a particular grassland

find it very difficult to move to another grassland and species from other grasslands have almost no chance of entering this grassland. However, such mobility is necessary to ensure stable, genetically variable populations of species. Forests or intensively exploited arable land is an unsurpassable barrier for the species of semi-natural grasslands. During the time of extensive farming the grasslands were connected in the landscape not only directly, but also indirectly, by the movement of grazing animals from barns to pastures, grazing in the forest, transportation of open hay (Fig. 24.1.1). All of these actions helped plant species to move from one grassland to another, either by getting caught in animal fur, or passing through the digestive tract of the animals while retaining germination capacity, as well as by falling off hay truckloads.

Awareness of the fact that most plant species of semi-natural grassland habitats only have a short-term seed bank is important for the restoration of semi-natural grasslands. Overgrown grasslands, where the grassland species have disappeared or, where conditions are unfavourable for the blooming of these species, lack viable seeds of these species in the soil, even if appropriate environmental conditions were restored. Therefore connectivity to other grasslands is crucial for successful restoration (Bossuyt, Honnay 2008).

24.2 Landscape Management that Promotes Grassland Biodiversity

Purposeful formation and maintenance of landscape that is favourable to biodiversity promotes the dispersal of grassland species, even if the creation of new semi-natural grasslands or restoration

Grassland species disperse very slowly. Fragmentation is unfavourable for grassland habitats, because the grassland species are not good at overcoming long distances and their seed bank is very unstable (seeds retain their germination capacity for only one or a few years). For instance, it took 5 – 10 years for orchids such as *Listera ovata*, *Orchis militaris*, and *Gymnadenia conopsea*, the seeds of which are wind-dispersed, to arrive in a meadow that was restored from another semi-natural meadow at a distance of 300 m in the Netherlands. *Gentianella campestris*, which uses animals for seed dispersal, only arrived at the meadow after 25 years, although the soil and vegetation conditions would have allowed it to establish in the grassland in the first year (Willems 2001). Seeds of many semi-natural grassland species common in Latvia only spread over short distances (Gustiņa 2012). *Briza media* retains its germination capacity for only one year – all seeds sprout in the first autumn after spreading, and in spring not a single seed capable of germination is left, furthermore, only 3% of seeds spread farther than to the distance of 1 metre (Dixon 2002). Studies have proven that even the species that disperse by wind are only capable of travelling within a distance of 2–3 m from the mother plant, with the maximum distance being 50 metres. For instance, the seeds of *Tragopogon pratensis* (these have pappi like dandelions, but larger) only travel distances of up to 7 m (Verkaar 1990; Donath et al. 2003).

Usually the most efficient dispersal of species in meadows and pastures occurs by grassland animals. It has been observed that within a year in dry calcareous pastures one sheep (seed transfer in fur and hooves, or by means of passing through the digestive tract) can spread 50% of all pasture plant species, while the dispersal of calcareous grassland seeds by wind occurred to a distance of only 100 metres over a year (Poschlod et al. 1998).

of overgrown grasslands in the particular landscape is impossible. Examples have been described in the recommendations developed within the project Demo Farm (Anon. 2011).

24.2.1 Grass Strips along Road Verges, Ditches, River Banks, Arable Land

These strips function as dispersal corridors of plant and animal species. Under the conditions of intensive agriculture these are the only places, where the species of semi-natural grasslands can find refuge and travel from one grassland to another. The most significant measure for the management of these strips is mowing with the gathering and removal of hay, furthermore, this must only be done once per season. The width of the strip must be at least 3 m, optimally 10 m, to ensure sufficient species diversi-

ty (Fig. 24.2.1–24.2.5). Covering of the roadsides with soil should be avoided and plants should be allowed to spread themselves by seeds. Covering with soil not only limits the introduction of species typical for semi-natural grasslands (because it is too fertile), but can also facilitate the introduction of invasive species. Combating of invasive species may require huge investment of labour and resources. The best solution is bringing freshly mown grass of semi-natural meadow together with seeds and spreading it on the road verge. It is recommended to have trees in the grassland strips, especially in places with very intensive agriculture. In intensive agriculture landscapes road verges receive both fertilisers and herbicides and therefore they lack conditions that are suitable for semi-natural grassland species. If a tree grows on such a roadside, it protects the soil from



Fig. 24.2.1. A road verge unsuitable for grassland diversity conservation. It is too narrow, it is mown frequently and affected by herbicides used on the adjacent field. Photo: S. Rūsiņa.



Fig. 24.2.2. A roadside suitable for grassland species diversity. It is sufficiently wide, not affected by the maintenance of arable land. It is not mown too frequently – plants manage to bloom and shed their seeds. Photo: S. Rūsiņa.



Fig. 24.2.3. Environmental conditions suitable for grassland plant species in the landscape of intensive agriculture can be found near solitary trees, shrubs and their groups. Photo: S. Rūsiņa.



Fig. 24.2.4. A road verge unsuitable for the distribution of grassland species. Infrequent mowing resulted in roadside completely overtaken by shrubs. No space for the germination of herbs is available. Photo: S. Rūsiņa.

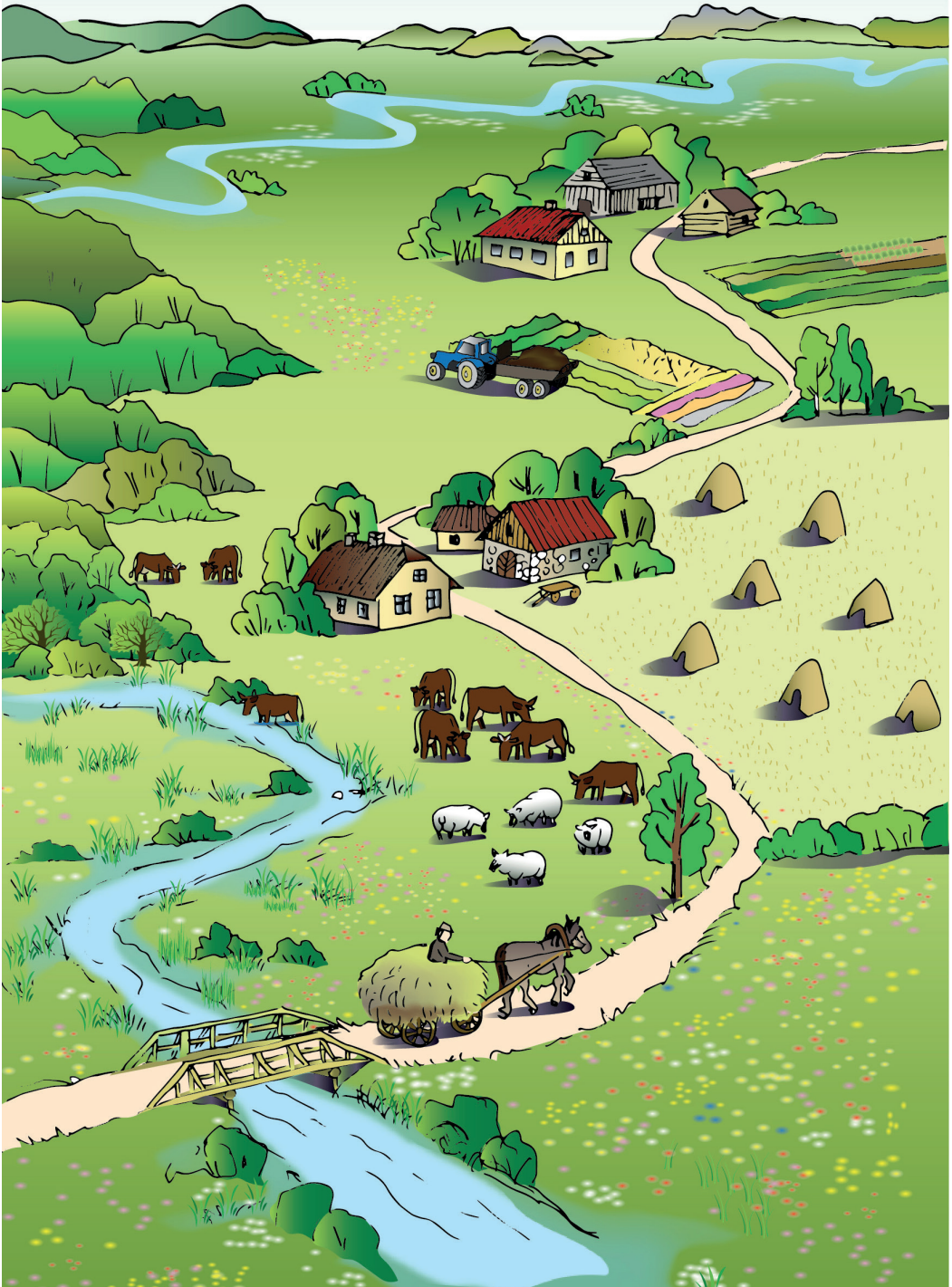


Figure 24.1.1. The simplification of extensively farmed landscapes creates serious barriers on the distribution routes of semi-natural grassland species:

- the living area of semi-natural grassland species has considerably decreased, because meadows and pastures were ploughed;
- straightened forest edges do not ensure appropriate lighting conditions;
- no spring floods occur in the floodplains of straightened rivers and water no longer carries seeds from one meadow to another;



- the area up to the river bank, which is a ploughed field or a sown grassland, fails to provide a hiding place;
 - grazing animals are no longer moving through the landscape and therefore cannot carry seeds;
 - hay is transported in tightly packed bales, and seeds cannot be dispersed on roadsides, furthermore, roadsides are no longer as wide as earlier;
 - fields and roads lack buffer belts, or they are not managed in an environmentally friendly manner.
- Drawing by D. Segliņa

herbicides (tractors drive around trees at a larger distance), the trees “eat up” the nutrients (competing for them with herbs). Therefore the soil around a tree is poorer and more suitable for semi-natural grassland species (Fig. 24.2.3).

Ditches and rivers function in a similar manner to road verges. River banks are an important species dispersal corridor. In floodplain grasslands shrubs and trees that can serve as “hunting towers” for raptors and corvids must be removed to provide a safe environment for grassland waders. In large unfragmented homogeneous open grasslands with river embankments on both sides of the watercourse, riverbank trees and shrubs have less impact on waders. In floodplains, which are not suitable for waders due to their small area, the banks can be partly mown, especially in gently-sloping places, or lines of trees or shrubs may be left untouched.

24.2.2 Forest Edges

Forest edge is a transitional zone between a forest – a shady environment that is not favoured by light loving herbs and – a non-forest – a light environment suitable for grassland herbaceous species. Plant and animal species that cannot survive in sown grasslands or arable land can find refuge on forest edges. Forest edges have enough light for the grassland species to survive. If grazed, forest edges are usually uneven. There are larger and smaller trees, lower and higher vegetation (Fig. 24.2.6, 24.2.7). Nowadays such forest edges are most frequently already overgrown with a dense layer of trees and shrubs and must be re-created by selective felling, leaving large, biologically old trees and richly blooming shrubs (*Crataegus* spp., *Rhamnus cathartica*, *Sorbus* spp., *Euonymus* spp.), which serve as a food source for butterflies and other insects. Some of these species are rare and included in the Red Data Book of Latvia, for instance, *Prunus spinosa*, *Cotoneaster niger*, *Lonicera caerulea* subsp. *palasii*, *Rosa rubiginosa*. In the consolidation of fields (merging multiple small fields into larger fields) and drainage works performed in the 60–80s of the 20th century in Latvia, contemporary grasslands are frequently separated from the forests by ditches. In these cases the creation of an uneven forest edge is only possible if the ditch is filled. If it is not possible, the effect of an uneven forest edge can be achieved by planting solitary trees or shrubs on the bank of the ditch (at the side of the grassland), and managing the grassland extensively around the trees at a distance of least at 5–10 m around the trees.



Fig. 24.2.5. If the roadsides are well lit, grassland species can also disperse through a forest landscape. Photo: S. Rūsiņa.



Fig. 24.2.6. A forest edge suitable for high biodiversity with a transitional zone into the forest, which consists of separate trees and grassland vegetation under them. Photo: S. Rūsiņa.



Fig. 24.2.7. Different forest edges. (a) A forest edge not suitable for high biodiversity – straight, sharp, without a gradual change of environmental conditions. (b) Ecotonal belt rich in species develops at the uneven forest edge. Photo: S. Rūsiņa.

The main principles of creating a forest edge (Anon. 2011):

- the forest edge should extend into the forest up to 20 m;
- young trees and shrubs should be felled (except for the abovementioned richly blooming shrubs), especially those that have grown around old and large trees with a low crown;
- trees with nests and groups of trees around them should be preserved (in the direction of the forest away from the grassland) (daily observation of wildlife processes in the neighbourhood allows one to spot the nests of large birds);
- old, hollow trees should be preserved (including large trees, the hollows of which are usually internal and not externally seen), biologically old trees, smaller deciduous trees that could become large with time, snags and stumps, richly blooming shrubs, junipers;
- application of chemical plant protection products and mineral fertilisers should be avoided;
- once per year, the forest edge should be mown with the gathering of hay or grazed;
- leaving of felled shrubs, mown grass or hay on the forest edge must be avoided (Fig. 24.2.12, 24.2.13).

24.2.3 Conservation of Landscape Elements

Various landscape elements – large solitary trees and clusters of shrubs, wet slacks, fences, piles of stones – are highly important in intensive agriculture landscape for wild plant and animal species as a living environment and hiding place (Fig. 24.2.8–24.2.11). It is recommended to preserve or to create at least a 3 m wide strip of semi-natural grassland around landscape elements, which is mown followed by grass removal once per year. Grass or hay should not be stored in such places (Fig. 24.2.12, 24.2.13). It is recommended to leave the piles of stones without tree and shrub cover, because sunlight and warmth is significant for animals who live there.



Fig. 24.2.8. A wet slack in spring provides a resting and feeding place for birds. Photo: S. Rūsiņa.



Fig. 24.2.9. A pile of stones. Not only can plant species find refuge here, but *Lacerta agilis* and grasshoppers are basking in the sun. Photo: S. Rūsiņa.



Fig. 24.2.10. A pasture enclosure and stones create diverse micro environments for plant and animal species. Photo: S. Rūsiņa.



Fig. 24.2.11. A cluster of shrubs with stones. Photo: S. Rūsiņa.



Fig. 24.2.12. A line of trees in the meadow, the significance of which has changed from favourable (increasing the diversity of species in the meadow) to unfavourable (reduces the diversity of species, promotes eutrophication and is a centre from where expansive species expand), because the grass mown during previous years is stored at the trees. This enriches the soil and promotes the introduction of expansive species. Photo: A. Namatēva.



Fig. 24.2.13. Hay bales placed on the forest edge have facilitated eutrophication, and the forest edge no longer performs its functions. Photo: S. Rūsiņa.



Fig. 24.2.14. Asote hillfort in 2005. Photo: S. Rūsiņa.



Fig. 24.2.15. The southern slope of Kņāvi hillfort in 2005. Photo: S. Rūsiņa.



Fig. 24.2.16. The eastern slope of Pentjuši hillfort with junipers in 2005. Photo: S. Rūsiņa.



Fig. 24.2.17. *Anemone sylvestris* on the southern slope of Sudrabkalns hillfort in 2006. Photo: S. Rūsiņa.

24.2.4 Regular Moving of Grazing Animals over Longer Distances

The movement of the herd over longer distances along the roads, through forests and grasslands facilitates the dispersal of plant species.

24.2.5 Hillforts

Hillforts of the Bronze Age and Iron Age are a significant place of refuge for wild grassland species, because the southern slopes, due to their steepness and increased sun exposure take much longer to get overgrown with trees. Many hillforts even up to the middle of the 20th century have been grazed, therefore, many of them have retained the vegetation of semi-natural grasslands (for instance, Arona



Fig. 24.2.18. The coastal grassland managed by grazing in "Matsalu" Nature Reserve in Estonia. The grassland is suitable for *Calidris alpina schinzii* and other waders. Vegetation is diverse with various height of sward. There are no elements fragmenting the landscape, for instance, towers, high trees or shrub belts. The stone increases the structural diversity of landscape, which is used by invertebrates. Photo: A. Auniņš.

hillfort, Sudrabkalns, Kņāvi, Buse, Indzēni, Kandava Kurši and Aizkraukle hillforts) (Fig. 24.2.14, -24.2.17). It is recommended to keep the hillforts clear (Rūsiņa 2006). Due to steep slopes, grazing is more appropriate (for instance, with sheep), while mowing and grass removal, most likely, will only be possible manually.

24.2.6 Landscape Elements that are most Important for Birds

The importance of wet depressions in grasslands or arable lands, which do not dry out until at least late May, is determined by their attractiveness for waders. If there are slacks with a constant presence of water, they are used by waterbirds. The effect of other natural or artificially created water edges is



Fig. 24.2.19. Grassland with a considerable amount of trees and shrubs, which is suitable for passerines but completely unsuitable for waders. This particular grassland would not be suitable for waders even without trees and shrubs. The slope is too dry for waders, and the flat part is too narrow. For this reason, the trees and shrubs should be left as landscape elements (some of them can be removed to make the grassland more open). They increase the diversity of plants, invertebrates, and passerines. Photo: A. Auniņš.



Fig. 24.2.20. (a) Shrub clusters are fragmenting the landscape and decrease the suitability of the grassland for waders in "Sitas un Pēdzes paliene" Nature Reserve. (b) The grassland became more suitable for waders after the removal of shrubs.

similar, if they are low-sloped and at least partially open (grassy).

Individual shrubs and clusters of shrubs are also important, since they increase the structural diversity of available ecological niches. Trees and attract different species of passerines, providing them with suitable nesting or feeding places (Fig. 24.2.19). Solitary trees are also preferred by different raptors and owls as observation posts or rest sites, as well as by storks. However, such trees and high (2 m and higher) shrubs can be undesirable in the grasslands populated by meadow waders because they serve as observation posts for avian nest predators such as corvids (Fig. 24.2.20). Wooded pasture landscapes with old deciduous trees, especially oaks, are preferred by the middle spotted woodpecker, as well as various forest passerines.

Landscape features of traditional management,

for instance, the previous year's hay stacks and poles of pasture enclosures serve as the posts from which the song can be started by tawny pipit, as well as surveillance posts for other species.

24.2.7 Landscape Elements that are most Important for Invertebrates

Forest edges are important, as they ensure wind protection and are a place where the invertebrates can warm up; the same is true about linear structures – forest edges, lines of shrubs, ditch verges, roadsides and river valleys, which also serve as corridors for species distribution. Large trees with hollows that grow in wood pastures are inhabited by saproxylic species that require good lighting conditions. Small ponds contribute to hygrophilous species diversity.

