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MANAGEMENT of Natura 2000 habitats
Northern Boreal alluvial meadows
6450

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Contents

6450 | Northern Boreal alluvial meadows

Nordic Boreal alluvial meadow site under restoration in Svansele Dammängar (SE081 0073), Northern Sweden. Photo: Mats O.G. Eriksson

64 Semi-natural tall-herb humid meadows

EUNIS Classification:

E3.47 Semi-natural tall-herb humid meadows

Summary

Northern Boreal alluvial meadows are a semi-natural habitat located along watercourses that are normally ice-covered in winter. The meadows are characterised by two main features; regular flooding in spring and the impact of mowing, whether discontinued or still ongoing. Flood sediments form the substrate for the vegetation, and silt transported by river water is the main nutrient source.

The mowing helps to maintain the alluvial meadows in an early succession stage, with a flora including low-growing species with weak competitive ability. Enhanced foraging conditions for various species of water birds due to the rich abundance and good availability of plants and invertebrates is an important by-product.

The habitat is restricted to regions in Northern Europe with pronounced seasonal differences, with a vegetative period ranging between 100 and 200 days, depending on the location. At northern sites, longer summer daylight compensates for the short vegetative period.

The use of naturally inundated meadows for hay-making was often the corner-stone of the farming economy in northern Europe in earlier days. The alluvial meadows might provide rich harvests of winter fodder year after year, without any external input of fertilisers other than the annual input of nutrients in flood water. In northern Sweden, techniques to regulate or dam the river flow in order to increase the inundated area or the length of the period of flooding were developed and became widespread from the end of the 18th century. The use of the alluvial meadows for hay-making peaked during the second half of the 19th century. With the development of methods for cultivating sown hay crops on arable land, this kind of labour-intensive land use was gradually phased out, and very few sites were still managed in the traditional way by the 1950s.

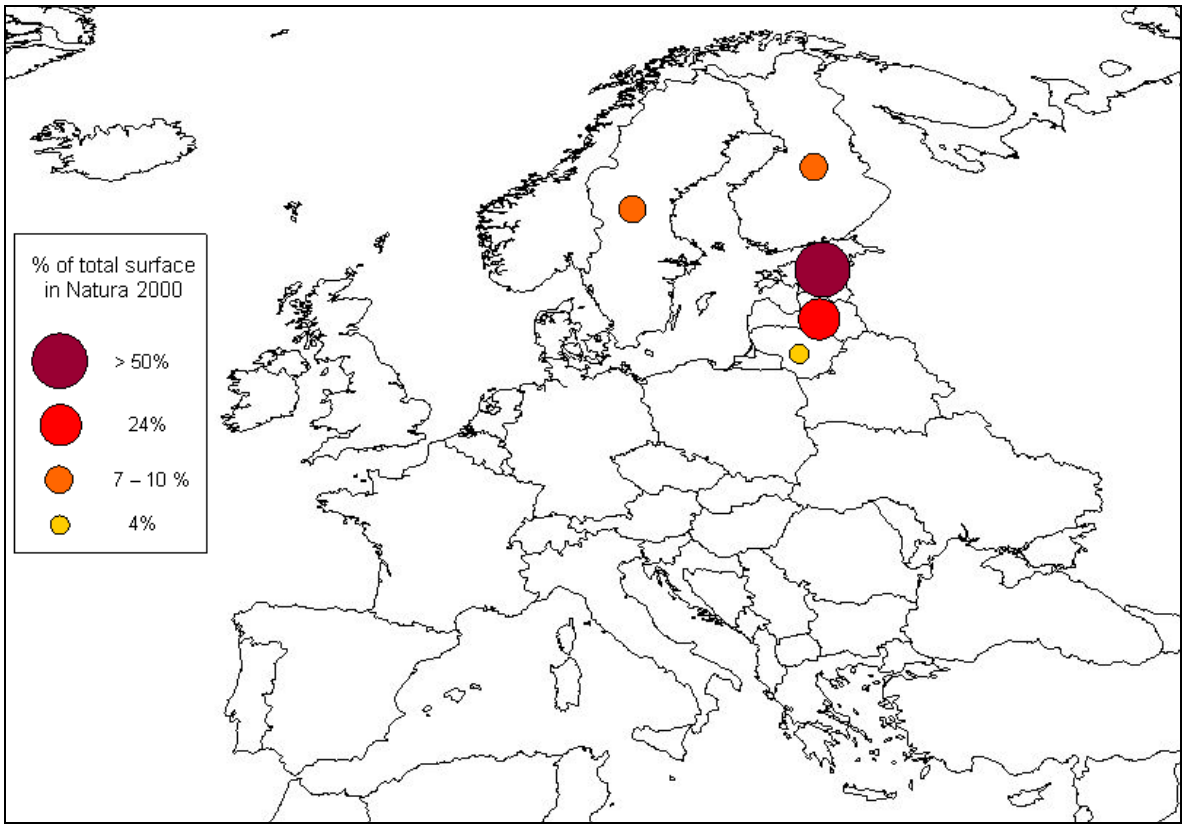
Regular removal of the overgrowth is a prerequisite for the long-term maintenance of the grasslands' conservation status and, together with providing a flood regime which follows the natural seasonal pattern; these are the two main factors to consider in order ensuring their proper management. Traditionally, the meadows were scythed, and this is still the preferred recommendation, although it is mostly too labour-intensive and thus too expensive unless voluntary workers are available or it can at least be combined with mechanical methods. If the site has not been mowed for some years, initial clearing may be necessary.

1. Description of habitat and related species

Northern Boreal alluvial meadows are a semi-natural habitat located along watercourses that are normally ice-covered in winter. They are characterised by past mowing activities and are subject to flooding in spring-early summer during snowmelt.

Distribution

The habitat is almost entirely restricted to the Boreal region. 175 (96.7%) of the 181 Natura 2000 sites containing this habitat are located within this region. The remaining six sites are in the Alpine region and are all located in the Swedish part of the Scandinavian mountain ridge.



Percentage distribution of the total surface of Boreal alluvial meadows in Natura 2000

Northern Boreal alluvial meadows in Natura 2000 sites

The following data have been extracted from the Natura 2000 Network database, elaborated by the European Commission with data updated on December 2006. The surface was estimated on the basis of the habitat cover indicated for each protected site and should be considered only as indicative of the habitat surface included in Natura 2000.

Biogeographical region	Nº of sites	Estimated surface in Natura 2000 (ha)	% of total surface in Natura 2000
Boreal	174	27,922	99.5
Alpine	6	144	0.5
Countries	**Nº of sites**	**Estimated surface in Natura 2000 (ha)**	**% of total surface in Natura 2000**
Estonia	67	15,348	54.7
Latvia	26	6,659	23.7
Finland	29	2,839	10.1
Sweden	45	2,169	7.7
Liathuania	13	1,051	3.7
TOTAL	**180**	**28,066**	**100**

Main habitat features, ecology and variability

The meadows occur along large rivers with placid reaches which are frozen every winter and affected by flooding in spring. In most cases the traditional management for hay has ceased, but the sites are not yet severely overgrown with bushes and trees. In Estonia, most of the alluvial meadows are the result of felling floodplain forests in past times (Estonian Fund for Nature & Royal Dutch Society for Nature Conservation 2001).

The formal definition according to the interpretation manual (EC 2007) leaves room for some flexibility, for instance, with reference to the meaning of 'large rivers' and how strictly the criterion of 'frozen every winter' should be applied. This is reflected in the national interpretations of the habitat. For Sweden, they are defined as grasslands along watercourses, periodically flooded during the summer period (Naturvårdsverket 1997), while in Finland, the definition used follows more closely that of the EC interpretation manual (Airaksinen & Karttunen 1999). Estonia also applies a broad interpretation and includes a range of types, from lake shores to tall grassy vegetation along watercourses (Paal 2004).

The main characteristic plant species are *Calamagrostis canescens, Calamagrostis purpurea, Carex acuta, Carex aquatilis, Convallaria majalis, Deschampsia cespitosa, Elymus fibrosus, E. mutabilis, Equisetum fluviatile, Festuca ovina, Filipendula ulmaria, Galium boreale, Molinia caerulea, Nardus stricta, Phalaris arundinacea, Salix triandra, Solidago virgaurea, Thalictrum simplex* subsp. *boreale, Trollius europaeus* and *Veronica longifolia.*

Ecological requirements

The habitat is found along rivers in both mountain regions and lowland, as well as on deltas and at river outlets into lakes. It is characterised by two main features: regular flooding in spring and the impact of mowing for hay (even if this has recently stopped). The substrate is made up of flood sediments and the main source of nutrients is the silt transported by the river.

Mowing helps to maintain the alluvial meadows in an early succession stage which enables flora that are unable to compete with more vigorous plants, such as low-growing species, to survive. Scything has created an even ground surface with few or no tussocks. An important by-product of this traditional land-use is the rich abundance, and good availability, of plants and invertebrates which provide enhanced foraging conditions for various species of water birds (Sjöberg & Ericson 1992, for a detailed description of the underlying mechanisms).

The habitat is restricted to regions in Northern Europe with pronounced seasonal differences, where the vegetative period ranges between 100 and 200 days, depending on location. For sites in northern locations, longer summer day length compensates for the short vegetative period.

Subtypes identified

The habitat includes several vegetation types related to moisture or flooding gradient: *Equisetum fluviatile* type, *Carex acuta-C. aquatilis* type, *Calamagrostis* type, *Phalaris* type, *Deschampsia cespitosa* type, tall-herb type and dry alluvial type. The different subtypes may occur in zones or in a mosaic pattern within the same site, depending on the topography and thus on the moisture and impact of floods. For Estonia, 24 sub-types based on vegetation are identified (Paal 2004).

Species that depend on the habitat

Nordic alluvial meadows are a key habitat for certain water bird species listed in Annex I of the Birds Directive (79/409/CEE), as well as for many other wetland bird species. In the Baltic countries (Estonia, Latvia, Lithuania), alluvial meadows are an important but not exclusive habitat for *Crex crex* (corncrake) and for *Gallinago media* (great snipe). Collectively these three countries host 66,000-93,000 pairs of *Crex crex* or around 40% of the EU27 population, and 900-1,300 pairs *Gallinago media,* or around one third of the EU27 population (BirdLife International 2004). Both species are classified as 'near threatened' in the global IUCN Red List, and *Crex crex* is a priority species under the Birds Directive.

The meadows are also important sites for *Philomachus pugnax* (ruff), although the decline in this species in most parts of Europe is thought to be primarily related to factors affecting their migration and wintering sites (Widemo 2007). In addition, Nordic alluvial meadows often hold good populations of some still widespread bird species, which are not listed in Annex I of the Birds Directive, but which have an unfavourable conservation status in Europe due to recent declines in their populations in agricultural landscape. These include *Vanellus vanellus* (northern lapwing), *Gallinago gallingo* (common snipe) and *Numenius arquata* (Eurasian curlew).

Related habitats

Molinia meadows on calcareous, peaty or clayey-silt-laden soils (6410): On particular sites there might be some ambiguity over whether to classify meadows on moist soils as Nordic alluvial meadows or *Molinia* meadows (in fact some sites in Sweden have recently been reclassified). In the Boreal region, these latter meadows are usually dominated by *Molinia caerulea* and/or *Carex* spp. and are mostly found on nutrient-poor soils, although a specific and more species-rich sub-type has also been identified on calcareous soils. These meadows may result from extensive management practices and are sometimes still grazed or mowed. They also may be subject to flooding, although in their case this is not a prerequisite.

Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430): This habitat is widespread in the Boreal region. Alluvial meadows, like other meadow and pasture habitats on moist soils which are dependent on regular mowing or grazing, may turn into this habitat if the traditional land-use ceases. It is not necessarily flooded at regular intervals.

Alluvial meadows of river valleys of the *Cnidion dubii* (6440): *Cnidion* meadows are also characterised by natural flooding, but occur under continental to subcontinental climatic conditions. There is no overlap in distribution with the Northern Boreal alluvial meadows, whether by biogeographical region or country.

Ecological services and benefits of the habitat

As the vegetation is to a large extent dependent on the inflow of nutrients transported by river water, the role of alluvial meadows as nutrient sinks must not be underestimated, provided that vegetation is harvested on an annual basis.

Alluvial meadows are an important habitat for several bird species that have decreased significantly over large areas of Europe due to the decrease in the area of wetlands and changes in agricultural practices. At a regional level, these meadows may be among the few sites which still harbour good populations of these species. The few meadows that are still managed in a traditional way also represent a significant cultural heritage value.

Alluvial meadows may work as buffers and temporary water reservoirs during periods of high flow and thus prevent or reduce flood damage further downstream along the river.

Trends

Like other semi-natural habitats, Nordic alluvial meadows have declined due to changes in agricultural practices over the last 100 years. In Norrbotten County, northern Sweden, the total surface area of mown wet meadows reduced from 200,000 hectares in 1927 to only 300 ha (0.15%) in the 1990s (Lindström-Battle 1998). The habitat has also been negatively affected by river regulation and the resulting changes in flood regimes. In Finland, alluvial meadows in a good conservation state are nowadays almost exclusively restricted to areas along unregulated rivers in northern parts of the country, e.g. along River Ounasjoki (Airaksinen & Karttunen 1999, Priha 2003). In Estonia, alluvial meadows still covered around 83,000 ha in the 1950s, but this declined to only 27,500 ha by the end of 1970s. Thereafter, there was an even faster decline as many meadows evolved into scrub and forest (Paal 2004). Today, the most extensive areas are found in the catchment of River Kasari and important sites are also located along the Emajõgi, Pedja and Koiva-Mustajõgi rivers (Estonian Fund for Nature & Royal Dutch Society for Nature Conservation 2001).

In earlier days, the use of naturally inundated meadows for hay-making was central to the economy of farming communities in northern Europe. They provided rich harvests of winter fodder year after year, thanks to the annual input of nutrients from floods. No other inputs of fertilisers were required. Annual harvests could be as high as 5-6 tonnes per hectare of dry matter on alluvial meadows of the *Equisetum fluviatile* type and 2-4 tonnes per hectare on the *Carex acuta-C. aquatilis* type (Elveland 1983), although productivity differed considerably between sites. In some places, hay was taken only every second or third year (Sjöberg & Ericson 1992). For Estonia, the annual productivity varied from 0.4 to 5 tonnes per hectare for various subtypes (Aug & Kokk 1983).

In northern Sweden and Finland, techniques to regulate or dam the river flow in order to increase the area inundated or the length of the flooding period were developed already during the 17th century. These became more widespread by the end of the 18th century. However, it is important for alluvial meadows that flooding occurs at the right time of the year, e.g. in spring or early summer in connection with snowmelt. Floods at the wrong time of the year might result in reduced productivity and the dying-off of important fodder plants (Alexandersson & Eriksson 1988); e.g. root-channels might become filled with water when the cut plants are inundated (Elveland 1984).

The maximum use of alluvial meadows for hay-making occurred during the second half of the 19th century. With the development of methods for cultivating sown grasslands for hay on arable land, this kind of labour-intensive land-use was gradually phased out, especially during the 1920s-1930s in Sweden and 1950s in Finland, although individual meadows were still managed in the traditional way in the 1960s (Elveland 1983).

Transportation of hay in summer was difficult due to the wet, soft ground, so it was often more practical to store the dried hay in barns on site and to remove it in winter, when frozen ground and snow made transportation much easier. The timber barns and hay-stands are thus a distinctive feature linked to the cultural heritage associated with alluvial meadows in northern Sweden and parts of Finland.

The large-scale regulation of most of the rivers in the Nordic countries for hydro-power production has disturbed the natural flooding regime of the meadows during the spring melt. Although socio-economic factors, rather than disrupted inundation regimes, were the main reason for meadows being abandoned, the lack of a naturalistic water regime may pose a problem for the proper management of the remaining or restored alluvial meadow sites.

Threats

The main threats identified for the Nordic alluvial meadows are overgrowth by tall grasses and scrub as a result of insufficient appropriate management, and failed floods in spring. Altered land use, including afforestation and drainage, changes the character of the site entirely, even if carried out on adjacent land.

The impact of off-site fertilising or acidifying air-borne pollutants may also have a negative impact (Naturvårdsverket 2005).

Abandonment of mowing

The abandonment of traditional mowing normally results in overgrowth, and an accumulation of litter. Once a meadow is abandoned the specific features linked to an early succession stage will disappear. The abundance of various plant species will change substantially, and weak competitors favoured by mowing might suffer while tall graminoids and herbs will increase in frequency. The ground will be more uneven due to an increase the abundance of tussock-forming species. With the increased accumulation of litter, the establishment of scrub and trees - primarily willows, alder and birch - may follow at a later stage (Elveland 1983). By this stage the factors contributing to a rich abundance of food for waterbirds are no longer in place (Sjöberg & Ericson 1992).

If the alluvial meadows are drained and converted into arable land or afforested, their character is of course entirely lost.

Regulation of river water-flow

The regulation of water flow may result in complete prevention of floods, floods of shorter duration or at the 'wrong time' of the year. This may affect important key factors for the long-term maintenance of the habitat, such as the influx of nutrients via silt deposition and may result in a change towards a meadow type of a different and mostly drier character (Nilsson 1992).

Climate change effects

If the climate in northern latitudes were to become more humid, with a substantially increased annual river runoff and an increase in inland flash floods (IPCC 2007), the water-holding capacity of alluvial meadows and other habitats characterised by regular flooding might play an increasingly important role as temporary water reservoirs during periods of high water-flow. This might help to prevent or reduce damage downstream of the river.

2. Conservation management

General recommendations

As alluvial meadows are, by definition, a habitat characterised by haymaking, the regular removal of overgrowth is a prerequisite for the long-term maintenance of its conservation status. This, together with providing a flooding regime that follows the natural seasonal variations, is crucial for the proper management of the meadows. However, when planning the detailed management of each particular site, it is highly advisable to find out how the site was traditionally used and then to try to imitate these traditional methods as much as possible. This might include decisions about the timing of damming and mowing, the equipment to be used etc. Special considerations and adjustments might need to be made as regards the habitat requirements of water birds.

In addition to the detailed prescriptions for mowing, grazing, damming and clearing given below, it is recommended that the use of fertilisers or lime, draining, supplementary feeding of livestock or the introduction of non-native species be forbidden (Naturvårdsverket 2005).

Active management

Mowing

Mowing is crucial for the long-term maintenance of the conservation status of a Nordic alluvial meadow. Traditionally, the meadows were scythed, and this is still the preferred management recommendation. However, this is mostly too labour-intensive and thus too expensive, unless done by voluntary workers. The average manpower needed has been estimated to be six man-days per hectare, including raking and other kinds of necessary complementary activities (Elveland 1983). Thus, the use of machinery is nowadays often the only realistic solution. At some sites a combination of scything on minor sub-areas, e.g. with high nature or cultural heritage values, and machinery on the rest is applied. Recommendations for the mowing of Nordic alluvial meadows can be summarised as follows, based on experience from Northern Sweden, Finland and Estonia (e.g. Elveland 1983, Vainio *et al.* 2001, Lotman 2004).

- Scythes should be specially adapted for use on wet and soft ground (making use of any local traditional knowledge). For example, long blades (85-100 cm) are usually recommended for meadows dominated by *Carex* spp. and/or *Equisetum fluviatile* (Elveland 1983).
- In the case of machinery, traditional equipment can be used if the ground is not too soft. For the management of a famous alluvial meadow site in Norrbotten County, Northern Sweden (Vasikkavuoma, SE082 0400) a special mowing-machine that can be used on dry as well as very wet and water-covered ground has been developed using a modified reed-cutting machine (Bölenius 2004).
- In Northern Sweden, the recommended time for mowing is mid summer (e.g. not before mid-July), or in late summer and preferably not until early August for meadows where the inundation period has been extended artificially (see below, under 'damming'). The mown hay is usually left to dry on the ground for a few days after which it is piled on drying-racks or transported directly to the barn. For Estonia, mowing after 30th June is recommended (Estonian Fund for Nature & Royal Dutch Society for Nature Conservation 2001).
- It is essential that all cut plant material should be removed from the mown ground in order to prevent choking of the vegetation and an initiation of a decaying process (Elveland 1983).
- If the site has not been mowed for some years, initial clearing may be necessary (see below, under 'restoration by clearing'), and if possible the site should also have been kept inundated during the previous winter (see below, under 'damming').
- Recommended to change the direction for mowing by 90° from one year to the next; this helps to maintain an even ground and makes the sites easier to manage.

- Recommended stubble height after mowing is 10-12 centimetres (10-15 centimetres proposed in some management plans).
- Mowing on an annual basis is the primary recommendation, but the frequency has to be decided on site-by-site basis and with reference both to local tradition and land-use and to any specific habitat requirements for plant or animal species. However, if mowing is done only on an irregular basis, complementary clearing of deciduous scrub may be necessary (see below, under 'restoration by clearing').

The recommendations for the management of alluvial meadows in Finland (Priha 2003) and Estonia (Estonian Fund for Nature & Royal Dutch Society for Nature Conservation 2001) are basically the same.

Grazing

Mowing was the main land use on Nordic alluvial meadows, while less productive out-lying land and forests were used for grazing by the livestock (e.g. Rosén & Borgegård 1999). Cattle were usually actively kept out of the alluvial meadows by fences or herders, although they sometimes were allowed to graze the aftermath in late summer (Elveland 1983). With the phasing out of traditional land uses, mowing was replaced by grazing in some meadows.

More recently, grazing has sometimes been considered as a complement or alternative to mowing in order to prevent the overgrowth of alluvial meadows. This has, however, raised the question of the effects of grazing on the vegetation and whether this might change the character of the habitat. A study conducted on a series of meadow sites along River Vindelälven (Västerbotten County, Northern Sweden) indicated a lower number of vascular plant species and higher level of erosion along the riverbanks at grazed sites as compared to sites that had been mowed in the past but since abandoned (Nilsson 2001). It is not possible to give any categorical recommendations on whether to accept grazing as an alternative to mowing. Instead, decisions should be made on site-by-site basis taking other aspects into account such as whether ornithological values might suffer significantly if a site is left to overgrow.

Damming

Damming to increase the flooded area or to adjust the timing of flooding was a technique that became widespread in Northern Sweden during the early 19th century. The most common method was to keep the meadows inundated from late spring until around one month before the mowing took place, normally in mid or late July or early August. Water depth was mostly kept at around 0.5 m.

At some sites, more advanced dam constructions made it possible to keep the meadows under water for the whole of the winter, to a depth of up to 1 m to maintain an unfrozen water column above the meadow. At the time of snow-melt (normally around mid-April in Västerbotten County, North Sweden), most of the water was drawn down. With help of the heavy ice cover, unwanted willow scrub and sphagnum mosses were killed off and the unevenness on the ground was flattened out ('ice-pressing'). Sometimes, temporary bottom freezing was allowed, and when the water-level was raised again encroaching scrub was pulled loose from the ground ('ice-pulling').

A slow drawing off of the water was initiated in early summer (mid or late June) in order to make the meadow drier before the mowing took place some weeks or up to a month later (often mid or late July). To establish of the flooding regime appropriate for a specific site, traditional and local knowledge about the manipulation of water flow and levels should be consulted.

This kind of management made sedimentation of silt and nutrients during spring and early summer possible. Encroachment by scrub and mosses was kept under control and the ground was kept flat, which facilitated scythe-mowing, and (not least) the ground was also kept free from frost which encourage an early growth of fodder (Elveland 1983).

At sites where damming is still technically possible, the following recommendations can be made, based on knowledge acquired from traditional techniques and experiences from more recent research (Elveland 1983):

- Keeping the site inundated in winter is desirable, whenever possible. Sluices should usually be closed at the end of September. Water depth should be kept at a level that prevents bottom-freezing.
- Towards the end of winter, and timed to coincide with snow-melt, drawing down should be considered in order to demolish the scrub and moss overgrowth through 'ice-pressing'. The alternative method of allowing a temporary bottom-freezing and then raising the water-level in order to pull loose the overgrowth might be considered as a complement ('ice-pulling') - this should be done in late autumn.
- Drawing down in early summer has to be done slowly, in order to reduce the risk of sediments being washed away. The meadow should be kept dry at least during 2-3 weeks before mowing. If to maintain good breeding conditions for dabbling ducks, the water level might be lowered to 20-30 cm by early June.
- If the meadow is again flooded in late summer and after mowing (sometimes recommended to create good foraging conditions for ducks), the stubble must not be drowned in order to reduce the risk of dying off.

Restoration by clearing

Initial clearing of heavy scrub and tree encroachment may sometimes be necessary before any regular management is undertaken on an abandoned meadow. Clearing of deciduous scrub is preferably done manually using axes and chain-saws in early summer before the leaves are fully developed, and in order to minimize problems with new shoots. The use of tractor-mounted machines (e.g. a mulcher) is a possible alternative if the ground is not too soft, but this should then preferably be done in late summer. Uprooting is usually necessary as a complementary measure in order to avoid regrowth and to achieve an even ground surface for scything. This is most effectively done in autumn. Removal of overgrowth by 'ice-pressing' or 'ice-pulling' (see above, under 'damming') might be considered where technically feasible. If it is necessary to fell larger trees, it is recommended that this be done in winter (Elveland 1983).

Some caution is recommended at river margins, where clearing in stages and leaving single trees or scrubs might be considered in order to avoid undesired erosion (Priha 2003). On the other hand, moderate erosion of water margins is sometimes a natural element of the dynamics of this habitat and the beds of meandering rivers should be manipulated only in exceptional cases.

A basic principle is that all cleared material should be removed from the meadow, although leaving small quantities could be acceptable if the site is kept under water in winter, as in this case the material will be washed away. If cleared material is to be burnt, this should preferably be done away from the meadow. If burning sites on the meadow are used, they should be placed on wet ground in order to avoid the fire burning into the peat.

It is usually possible to start mowing again in the summer after clearing, but at sites that are dammed it might be worth considering delayed for a few years, in order to allow the re-establishment of characteristic vegetation communities (usually dominated by *Carex* spp. and *Equisetum fluviatile*).

Management when not possible to assure a proper flooding regime

At meadow sites where damming was not a part of the regular management in the past, or where it is no longer possible to carry out regular damming in the traditional way because of technical or legal constraints, the manager has to rely on a flooding regime that is not too different from the natural regime of an unregulated river. At rivers whose natural hydrology is still intact this is not usually a problem, but many rivers are significantly affected by large-scale damming and flow regulation, e.g. for hydro-electric power generation.

Technical constraints may occasionally be overcome by restoring the river bed and dam constructions. Constraints related to water rights and regulation of the water flow might be tackled legally. Whilst the feasibility of these kinds of measures should be investigated when planning the management of an alluvial meadow site, they are in most cases too complex and too costly to be considered seriously. At some sites the river bed or water flow may have changed so much that restoration is no longer realistic.

The management of alluvial meadows where it is no longer possible to assure a proper flooding regime is currently being tested in a LIFE/Nature project in Latvia, "Restoration of Latvian floodplains for EU priority species and habitats" (LIFE04NAT/LV/000198). Controlling scrub invasion is one of the benefits of damming in winter and early spring, so the project will attempt to combat encroachment by clearing round 960 ha of former meadow instead.

Other relevant measures

Monitoring

In Sweden, the following criteria are proposed for evaluating the conservation status of a specific site (e.g. Naturvårdsverket 2005):

- The surface area (in hectares) that meets the definition of 'Nordic boreal alluvial meadows'.
- The percentage of well-managed meadow.
- Canopy coverage of trees and scrub (typical target is ca 5%, with a range between zero to 30% canopy cover for specific sites).
- Minimum area to be flooded on an annual basis (typical target is ca 50%)
- Minimum percentage of monitoring study plots which contain vascular plants characteristic of the habitat (examples of the species proposed to be selected for specific sites are Bartsia alpina, Equisetum fluviatile, Parnassia palustris, Menyanthes trifoliata, Pedicularis palustris and Pinguicula vulgaris).

The Swedish Environmental Protection Agency (SEPA) recommends a monitoring program that includes the following elements (Naturvårdsverket 2005):

- Vegetation height, at 6-year intervals.
- Canopy cover, at 18-year intervals.
- Scrub encroachment, at 6-year intervals.
- Characteristic plant species on a minimum of 30 study plots along permanent transects, at 12-year intervals

It is recommended that the monitoring be done at shorter intervals if necessary in the light of exploitation or other activities.

Special requirements driven by relevant species

The proposed management measures should in general meet the habitat requirements of those bird species listed in Annex I of the Birds Directive which have an unfavourable conservation status in Europe and for which Nordic alluvial meadows are a key habitat, with no or only with small adjustments.

Crex crex (corncrake): This species prefers mown to grazed areas. Vegetation must not be too short (at least 20 cm at the start of breeding) nor too dense, so as to allow the birds to walk on the ground (e.g. Berg & Pettersson 2007). Removal of dead or decaying vegetation material through mowing, grazing, or inundation a key element in the management of a *Crex crex* habitat (e.g. Ottvall & Pettersson 1998 and references therein). The species favours late mowing, and if it postponed until as late as early September, the birds may be able to raise two broods. If machines are used for mowing, working from one edge of the field to the other, or from the centre outwards in order to avoid trapping or killing the birds is recommended. The last cuts have to be done at a very low speed in order to avoid killing birds that have used these strips as refuges (Anon. 2000).

Measures to accommodate the needs of *Crex crex* are primarily of relevance to Baltic alluvial meadows, as most of the sites in Sweden and Finland are located outside the normal breeding range of the species. For the restoration of breeding sites in other kinds of meadow habitats in Sweden, a territory size of 5-10 ha has been proposed (Widemo 2006).

Gallinago media (great snipe): The normal management of the alluvial meadows is usually enough for this species. Some adjustments might however be needed with reference to the presence of lek (display) or breeding grounds for this species. Selective uprooting of deciduous scrub, carried out in autumn, might occasionally be considered in order to avoid the invasion of lekking grounds by unwanted vegetation (Elveland & Tjernberg 1984, Kuresoo & Luigujõe 2003). For the restoration of breeding sites in Sweden, a minimum surface area of 30-40 ha has been estimated (Widemo 2006).

Philomachus pugnax (ruff): The preferred breeding habitat is open and partly wet areas with graminoid and *Carex* vegetation of average height. Breeding starts later than for other waderbirds, and the Ruff is thus favoured by mowing or grazing in late summer (Widemo 2007).

Cost estimates and potential sources of EU financing

Some idea of management costs can be gleaned from previous work:

- The traditional management of Nordic alluvial meadows by scything, including raking and other kinds of necessary complementary activities has a labour demand of 6 man-days/ha (Elveland 1983).

- For Sweden, the current level of compensation (September 2007) within the agri-environmental scheme is around €760 /ha for scything, although it is generally felt that this payment does not cover the full cost. If a tractor-mounted mower is used (on ground that is not too soft or wet etc.), the compensation is around €120-380 /ha (with the highest levels for sites of high conservation values). If the land is grazed after mowing, an additional €75 /ha can be claimed. For grazing–only management, the approximate level of compensation is €120-270 /ha, again with high conservation value sites receiving most.

- In Finland, the agri-environmental compensation scheme is applied as follows:

    - Manual labour (e.g. scything), €14.80 /hour.
    - Tractor with driver (70kW at most), €29 /hour.
    - Mowing by tractor in traditional rural habitats, €84 /ha.
    - Mowing with hand-held mechanical device (only if not possible to use cheaper methods), €275 /ha.
    - Mowing with clearing-saw (only if not possible to use cheaper methods), €19.60 /hour.
    - Harvesting of cut vegetation, €198 /ha.

- In Latvia, the current level for compensation (November 2007) within the Rural Development Programme for management such as mowing and the extensive grazing of biologically valuable grasslands is €123 /hectare. In nutrient sensitive regions, compensation for adjusting the management of buffer zones around water bodies and fields may be substantially higher, up to 273 and €526 /ha, respectively.

- In Lithuania, the compensation level for agreements of at least 5 years within the national grasslands management scheme is a minimum of €230-240 /ha (figures for 2006). Eligible activities include grazing, mowing (timed to suit nature values) and scrub removal.

- Clearing overgrown wet meadow habitats (including Nordic Boreal alluvial meadows) in Jämtland County in Northern Sweden within a LIFE-Nature project ('Natural pastures and hay meadows in Jämtland/Härjedalen', LIFE03NAT/S/000070) cost €500-600 /ha (M. Brunsell, pers. comm.). But the cost can be substantially higher if the area is seriously overgrown.

- For Finland, some average cost-levels for restoration and management have been assessed (autumn 2007, ref. Finnish Agency for Rural Affairs), e.g.:

    - Basic clearing, first year, €421 /ha
    - Management clearing in consecutive years, €98 /ha
    - Harvesting of cut material, €211 /ha

- Burning of cut material, €226 /ha
- Transport of cut material, €130 /ha
- Clearing with brush-cutter, €19.60 /hour.
- Heaping and burning of cut material by hand, €14.80 /hour.
- Heaping by machine, €33.90 /hour.
- Transport of cut material, using tractor and trailer, €32.60 /hour.

As most of Nordic alluvial meadows have been abandoned and there is no alternative land use, it is probably unlikely that compensation payments have to be considered for income foregone when the management is adjusted to achieve conservation objectives.

Among the diversity of sources for EU funding, the following funds might primarily be of interest for the management of Nordic alluvial meadows:

- The European Fund for Rural Development (EARDF): This program has a potential to cover several management activities that might be relevant for the Nordic alluvial meadows, although the measures have to be covered in the National Strategy and related Rural Development Plans (RDPs) in order to be eligible on a national basis. However, costs for mowing or grazing of the Nordic alluvial meadows are mostly eligible for agri-environmental subsidies within this program. To some extent, also necessary infra-structure, such as fences and shelters may be eligible under this program. – LEADER projects may be designed to include management of sites in the Natura 2000 network.

- The European Regional Development Fund (ERDF), The Cohesion Fund and Interreg: These funds might be relevant in single cases although activities related to Natura 2000 sites mostly need to be integrated into a broader development context, and for ERDF also related to productive investments (e.g. infrastructure). However, the Interreg approach is more flexible, but this needs a European objective and partnership. Different geographical levels are defined and all of them have their specific rules, eligibility criteria and objectives.

- The Financial Instrument for the Environment (LIFE+): The 'Nature' component of LIFE+ supports best practise and demonstration projects contributing to the implementation of the Birds and Habitats Directives but only exceptionally outside Natura 2000 sites. The 'Biodiversity' component is for demonstration and innovation projects contributing to the objectives of the Commission Communication 'Halting the loss of biodiversity by 2010 – and beyond'. Both the 'Nature' and 'Biodiversity' components emphasise practical non-recurring management actions (at least 25 % of the budget). When clearly justified, compensation payments for restrictions in commercial land-use are eligible under 'Nature'. Recurring management is not eligible under LIFE+.

For more information on what management measures are eligible for financial support under various EU funds, it is recommended to consult the "Financing Natura 2000 Guidance Handbook" (Torkler 2007) http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.
Furthermore an IT-tool is available on the EC web site:
(http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm).

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