



# MANAGEMENT of Natura 2000 habitats Fennoscandian wooded pastures

9070

*Directive 92/43/EEC on the conservation of natural habitats and  
of wild fauna and flora*

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## 9070 | Fennoscandian wooded pastures



Fennoscandian wooded pasture with large old oak trees at Kinnekulle (SE0540063) in Västra Götaland County, South Sweden. Photo: Vikki Bengtsson.



90 Forests of boreal Europe

EUNIS Classification:

X.09 Pasture woods (with a tree layer overlaying pasture)

### Summary

The habitat type can briefly be characterised as pastures in which a tree layer of varying density is a striking element. The type covers various complexes ranging from sparse forest to coppice of trees and scrub, in a mosaic with open patches of grassland character. The tree layer consists mostly of deciduous trees, including oak, ash, lime, birch and grey alder, although conifers may also occur. The impact of grazing is a key element and the ground vegetation is characterised by species typical for grassland and meadow habitats. The habitat is almost entirely exclusive to the Boreal region.

Wooded pasture are some of the most species-rich habitats of the Boreal biogeographic region. Several rare and threatened species of insects (including the hermit beetle, *\*Osmoderma eremita*), lichens and fungi are linked to the large old trees of various species that are typical for this habitat.

Using outlying forest land for grazing was the traditional way of keeping livestock in most parts of the Nordic countries, often combined with slash-and-burn practice, from the establishment of permanent settlements in Northern Europe around 5000-6000 years ago until recently. It was not until the shift towards more intensive livestock husbandry on cultivated land and the use of artificial fertilisers during the 20th century that this practice was finally broken. The changes over the last 100-150 years have resulted in a drastic decline of various kinds of wooded pastures, i.e. what remains today are just fragments of the former range.

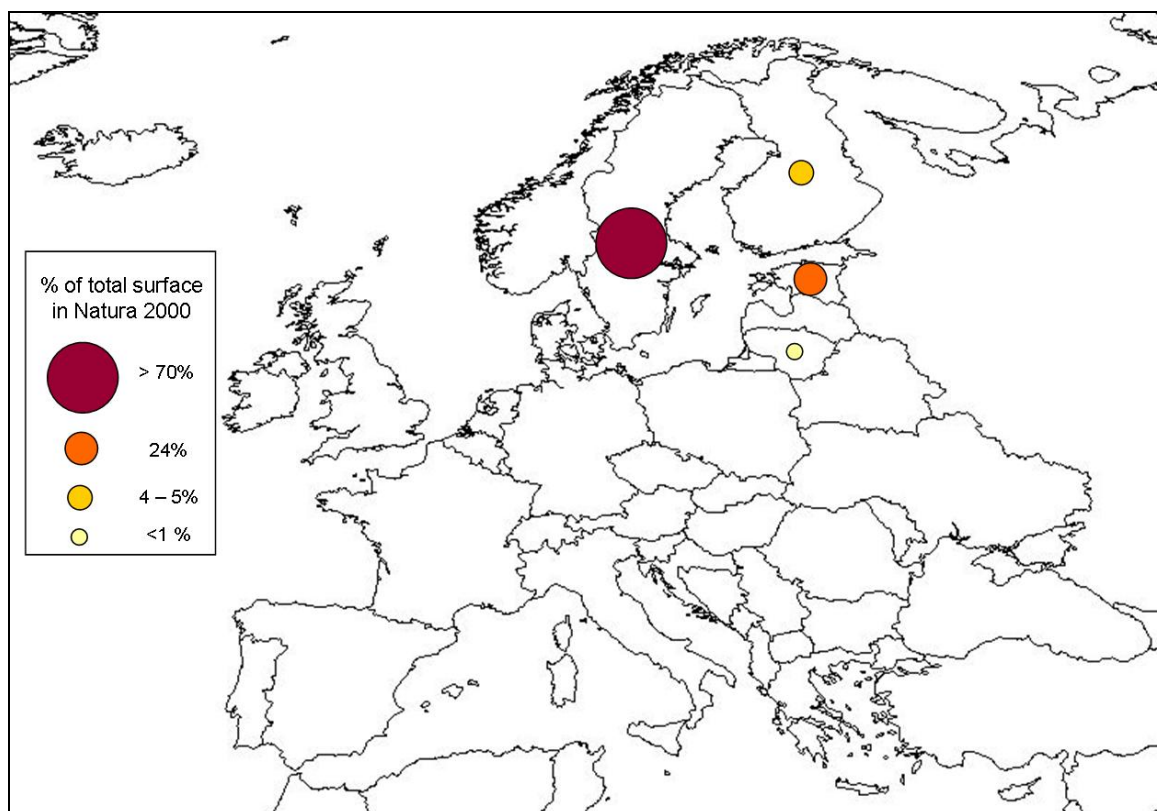
The main objectives for the management of the remaining wooded pastures are to maintain the mosaic of small open glades (max. 1 ha, often smaller) dominated by grassland vegetation, to reduce shading that allows for inflow of light to the ground and on tree trunks, while providing an adequate density of trees. Grazing must be the key tool for their ongoing management, although regular clearing may be a necessary complementary measure. When reopening a site for grazing, restoration in order to reduce overgrowth and to overcome problems of internal fertilising is usually a necessary first step. For sites where protecting viable populations of any threatened and rare species is a key objective, regular active management as well as any restoration has to consider various species-specific requirements. In order to avoid gaps in the age structure of large host trees, management planning has to be for a time frame of several centuries (or many human generations).

## 1. Description of habitat and related species

The Fennoscandian wooded pasture includes a range of vegetation types from sparse forests to coppice, mostly comprised of deciduous trees, in combination with grasslands, often with a long-term grazing continuity. Animal and plant communities are often species-rich; with several species of plants, insects, lichens and fungi that are confined to this habitat. The habitat is known to host one of the most species-rich communities in the Boreal biogeographical region.

### Distribution

The habitat is almost entirely exclusive to the Boreal region, which includes 665 (90.0%) of the total of 739 Natura 2000 sites that host it. 68 sites (9.2%) are located in the part of south-west Sweden belonging to the Continental region. Six sites (0.8%) in the Alpine region are located in the Swedish part of the Scandinavian mountain ridge. Habitats with a very similar appearance also occur in the UK.



*Percentage distribution of the total surface of Fennoscandian wooded pastures in Natura 2000*

### Fennoscandian wooded pastures 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	N° of sites	Estimated surface in Natura 2000 (ha)	% of total surface in Natura 2000
Boreal	665	14,471	89.85
Continental	68	1,316	8.17
Alpine	6	320	1.98
Countries	N° of sites	Estimated surface in Natura 2000 (ha)	% of total surface in Natura 2000
Sweden	577	11,462	71.15
Estonia	67	3,865	24.00
Finland	89	723	4.49
Lithuania	6	57	0.36
<b>TOTAL</b>	<b>739</b>	<b>16,107</b>	<b>100</b>

### Main habitat features, ecology and variability

Wood pastures have a long evolutionary history dating back at least to the Pleistocene or even the Tertiary (Guthrie 1984, Lindgren 2000, Appelqvist *et. al.* 2001). Large grazing animals have also, over the millennia, shaped parts of the landscape to form savannah-like habitats in the temperate parts of the world. After the Ice Age, during the Holocene period, there are strong indications that large ungulates influenced the landscape and shaped the vegetation in a similar way (Vera 2000). As large herbivores declined, man and his domestic animals took over as “caretakers” of wooded grasslands but the physical habitat as such and the various interactions between different species had already been in existence for a long time. Understanding the evolutionary past of the habitat is crucial in optimising the future management.

The habitat type can briefly be characterised as pastures with a tree layer of varying density as a striking element. The type covers various complexes from sparse forest to coppice of trees and scrub, in a mixture with open patches of grassland character. The tree layer mainly consists of deciduous trees, including *Quercus robur* (pedunculate oak), *Fraxinus excelsior* (ash), *Tilia cordata* (small-leaved lime), *Betula* spp. (birch), *Sorbus* spp. (rowan) and *Alnus incana* (grey alder), although conifers such as *Picea abies* (Norway spruce) *Pinus sylvestris* (Scots pine) and *Juniperus communis* (juniper) may also occur (EC 2007). In addition to small-grown junipers, the scrub vegetation may include *Crataegus* spp. (hawthorn), *Rosa* spp. (rose) and *Corylus avellana* (hazel).

The impact of grazing is a key element and the ground vegetation is characterised by species typical for grassland and meadow habitats (e.g. 6230, 6270, 6410, 6430 and 6510, ref. Annex 1 of the Habitats Directive; Naturvårdsverket 1997a).

The flora of vascular plants varies considerably depending on subtype (see below) and geographical location. Under favourable conditions the grass sward shows no signs of fertilizing or other improvements, but it is worth stressing that even in wooded pastures affected by fertilizers considerable conservation values can nevertheless be associated with old trees. Characteristic plant species include *Agrostis capillaris*, *Antennaria dioica*, *Ajuga pyramidalis*, *Botrychium* spp., *Calluna vulgaris*, *Campanula persicifolia*, *Campanula rotundifolia*, *Carex panicea*, *Coeloglossum viride* (primarily in southern Finland), *Danthonia decumbens*, *Fragaria vesca*, *Gentianella campestris*, *Lathyrus linifolius*, *Melampyrum cristatum*, *Prunella vulgaris*, *Ranunculus polyanthemus*, *Scorzonera humilis*, *Succisa pratensis*, *Veronica chamaedrys* and *Veronica officinalis* (selected from EC 2007, Lindgren 2000, Naturvårdsverket 1997a, Airaksinen & Karttunen 1999, etc.).

Lichens that are characteristic for the habitat include the following species: *Calicium adpersum*, *Calicium quercinum*, *Chaenotheca phaeocephala*, *Cyphelium inquinans*, *Gyalecta ulmi*, *Schismatomma* spp. and *Sclerophora* spp., and among fungi e.g. *Fistulina hepatica* and *Laetiporus sulphureus* are often characteristic.

## Ecological requirements

The habitat is found on dry or mesic soils where the two main criteria, i.e. tree or scrub coverage in combination with the tangible impact of grazing, are met, but occurs in a wide range of soil humidity and nutrient levels.

## Main subtypes identified

Three subtypes can be identified:

Wooded pastures with native, large, old trees (mostly oak trees, Swedish = 'ekhagar'): A rich assembly of rare or threatened lichens, fungi and invertebrates associated with the bark and dead or decaying wood is an important feature of this subtype. There is a general tendency for the tree layer to become denser and for light penetration to the ground to have decreased during recent decades. This subtype contributes to a specific character of the landscape in various parts of south Sweden, and it is also found in Estonia and at minor areas in south-west Finland. In Estonia, the tree layer is often more varied, and includes large and open-grown spruce and birch as well as oak (Paal 2004).

Wooded pastures dominated by birch, pine, rowan, willow, grey alder and/or spruce: This type is scattered over large parts of Sweden and Finland, although rarer towards the north and with a considerable regional variation. In various parts of Finland and Sweden, these pastures are still characterized by the impact of pollarding deciduous trees for providing winter-fodder for livestock (e.g. Lindgren 2000, Højer & Hultengren 2004).

In central and northern Sweden and in large parts of Finland the use of shielings, where livestock were taken for summer-grazing, contributed to creation of wooded pastures of the subtype by pine, grey alder or spruce also on high altitudes, located closely to the tree-line. In eastern Finland, this practice mostly resulted in wooded pastures dominated by *Alnus incana* (grey alder) along hillsides.

Wooded pastures dominated by deciduous trees established on land opened up for grazing after slash-and-burn cultivation: This subtype is primarily found in central and eastern Finland. It is an open forest type dominated by deciduous trees and maintained by repeated burning with an interval of 15-30 years (MMM 2006). In early successional stages, this subtype is dominated by grey alder and aspen while birch and/or pine take over later. Forests of this subtype maintained in an early successional stage or still being grazed are nowadays very rare (see also under "main trends").

## Species that depend on the habitat

For some invertebrate (arthropod) species listed in Annex II of the Habitats Directive, key elements in the habitat requirements are often met in the subtype of wooded pastures of open character and with large-grown deciduous trees.

\**Osmoderma eremita* (hermit beetle): This is a 3 cm long, dark-brown beetle, dependent on old, hollow broadleaved deciduous trees (primarily oak and beech) where the larvae live for a period of four years in a mixture of wood mould in the cavities. The fully developed beetle (imago) is hatched during late summer (end of July in south Sweden) and is very short-lived, 2-5 weeks, when it only rarely leaves its tree. The flying distance recorded seldom exceeds 200 meters. Oak trees have to reach an age of at least 150-200 years for hollows with wood mould to develop. The same tree can be inhabited for many decades, and trees can be alive or dead (Antonsson 2002).

*Osmoderma eremita* has a wide distribution range in central Europe but has generally decreased in abundance everywhere. Within the area of Fennoscandian wooded pastures, it occurs in south and central Sweden (where it was found at around 130 sites during surveys in 1993-2003; Antonsson *et al.* 2003) plus one site both in Estonia and south-western Finland. *Elater ferrugineus* is a very rare beetle, being a predator on *Osmoderma* larvae and attracted by the same kind of pheromones as *Osmoderma eremita* (the species is not listed in Annex 2 of the EU Habitats Directive but classified as "endangered" in the national red-list for Sweden).

*Lucanus cervus* (stag beetle): This is the largest beetle in Europe. The male can reach the impressive length of 8 cm and is easily identified by its massive mouthparts. The female is considerably smaller but still about 4 cm long. The larval development takes place in decaying, subterranean parts of deciduous trees, primarily oak, and the larval stage lasts between 3 and 5 years whereas the adults only live for the summer. The lifespan of the adult male is particularly short, often only a couple of weeks. The beetle prefers warm and sunny habitats and is readily found in wood pastures with old deciduous trees and other similar habitats. It can also be found in woodlands. The species is distributed throughout south and central Europe but occurs also in the northern parts of Europe. Within the present distribution range of Fennoscandian wood pastures it occurs in the south and central parts of Sweden. It is reported as extinct from Latvia.

*Cerambyx cerdo* (great capricorn beetle): This magnificent longhorn beetle can sometimes reach a length exceeding 5 cm. Its larval stage lasts 3-5 years and takes place under the bark of large deciduous trees, primarily oak, that have been damaged or weakened. Sunny and exposed locations are preferred. Inhabited trees can be identified by the large holes and galleries created by the larvae. The adults only live for a summer. The distribution range includes Europe, Caucasus, Asia Minor and northern Africa. In Europe the majority of sites are located in the southern and central parts, but in most regions the species has declined over the last century. Within the present distribution range of Fennoscandian wood pastures it is known from a few sites in Sweden and Lithuania.

*Anthrenochernes stellae*: This is a 2.5 mm long pseudoscorpionid that inhabits tree hollows with nests of insects (wasps, bees, ants) or birds in deciduous trees (found in oak, lime, aspen and beech trees). It occurs in the subtype of quite open wooded pastures with large oak trees etc in south Sweden, but also in more dense forest types. The species was described only in 1939, although a record from Denmark in 1886 has been confirmed retroactively. Outside Sweden, this species is known only from two sites in Denmark and one in Poland, although it might be overlooked elsewhere (Cederberg & Löfroth 2000).

Wooded pastures are also important for some endangered species of fungi:

*Hapalopilus croceus* is an annual bracket fungus with saffron yellow fruit bodies. It is a wood decaying or weakly parasitic fungus that grows in cavities or at the stem bases of old oaks. Wood pastures, wooded meadows and similar habitats with old and exposed trees are the main habitats. The species is scattered throughout Europe within the distribution range of the oak but is reported as rare or very rare more or less everywhere. A large number of its known sites are located in Sweden and Latvia.

*Inonotus dryadeus* (dryad's saddle, oak bracket) is another rare, annual bracket fungus associated with old oaks. The fruit body is grey to brownish yellow and on its surface a number of characteristic, brown droplets can often be found. The oak bracket causes a white rot in its host trees. It grows on old trees and is favoured by warm and sunny conditions. Wood pastures are very important habitats but it also occurs in woodlands. It is distributed throughout northern and central Europe, Russia and North America. The oak bracket is reported on the national red-lists for several European countries.

*Piptoporus quercinus* (oak polypore) is yet another annual bracket fungus found on old oaks. Its fruit bodies have a tongue-like shape and can sometimes be found forming small clusters. Oak polypore is a wood decaying species that causes brown rot in its host trees. It occurs mainly on very old oak trees, primarily in relatively open habitats such as wood pastures, parks etc. It has also been found in shadier woodlands but it is not known whether it merely can persist under these conditions or if it can maintain a population (Roberts 2001). The distribution of oak polypore is said to be "rare but widespread" in Europe (Ryvarden & Gilbertson 1994) and it is known from many countries but few sites in the southern and central Europe. It also occurs throughout Asia up to Japan.

In addition, several other rare and threatened species of insects, lichens and fungi are linked to old and large-sized trees of various species, and the patches of grassland vegetation that are typical for the wooded pastures.

## Related habitats

The main criteria for the identification of Fennoscandian wooded pastures are the density of trees or shrubs in combination with the distinct impact of grazing. For Sweden, a recommendation applies that sites with canopy coverage <30% should be classified as grassland or meadow habitats among which e.g. species rich grasslands on siliceous substrates (\*6230), Fennoscandian lowland species-rich dry to mesic grasslands (\*6270), *Molinia* meadows (6410), hydrophilous tall herb fringe communities (6430) and lowland hay meadows (6510) are the ones that mostly might be considered as options. If a site is primarily managed by mowing instead of grazing, it should be classified as a Fennoscandian wooded meadow (\*6530).

If grazing is very extensive, e.g. the ground vegetation is dominated by species characteristic to forest habitats rather than grasslands or pastures, or if overgrowth due to lack of grazing has reached the state that nature conservation values linked to forests are predominant, the site should be classified according to relevant forest habitats, e.g. western taiga (\*9010), Fennoscandian hemiboreal natural old broad-leaved deciduous forest rich in epiphytes (\*9020), Fennoscandian herb-rich forests with *Picea abies* (9050), relevant beech forest habitats (e.g. 9110, 9130, 9150) or oak forest habitats (e.g. 9160, 9170, 9190). For sites on wet soils Fennoscandian deciduous swamp woods (\*9080) and on peat soils bog woodland (\*91D0) should be considered as alternatives.

## Ecological services and benefits of the habitat

Wooded pastures are among the most species-rich terrestrial habitats in northern Europe, especially concerning vascular plants, lichens, fungi and insects. Many species among these groups are host-specific to single tree species. As many as 1500 species are believed to be more or less confined to old oak trees (Hultengren & Pleijel 1997). For Sweden, it has been found that wooded pastures with hollow trees of e.g. oak, beech, aspen and lime may host more than 200 species on the national red-list of threatened and rare species (Antonsson 2002). *The role of the wooded pastures as "reservoirs" of a large number of species must not be overlooked.*

The landscape associated with the wooded pastures makes them attractive for outdoor recreation.

The various subtypes of wooded pastures also represent a cultural heritage value with a long and unbroken tradition of management.

## Trends

The evolutionary history of wooded grasslands dates back to well before the last Ice Age. The more recent development of the wooded pastures can be understood in the perspective of interactions between livestock husbandry and cultivation over a period of around 5000-6000 years, since the establishment of permanent settlements in northern Europe (e.g. Ekstam & Forshed 2000). During the whole of that period, using outlying forest land for grazing was the traditional way of keeping livestock in most parts of the Nordic countries, and it was often combined with slash-and-burn practice. It was not until the shift towards more intensive livestock husbandry on cultivated land and the use of artificial fertilisers during the 20th century that this practice was finally ended.

Thus, forests have played an enormous role as grazing land from the time of establishment of permanent settlements until very recently. The grazed forests form a spectrum from very extensive use over large areas at one end to more intensive grazing resulting in open pasture lands where trees and scrub make up an important element at the other. Climatic, geological and edaphic conditions, as well as differences of cultural and socio-economic character lead to large local and regional variations, and to changes over time in these practices. Although statistics on land-use are difficult to use for historical analysis (due to changes in definitions etc.), it is obvious that the changes of the last 100-150 years have resulted in a drastic decline of various kinds of wooded pastures and fragmentation of large and continuous areas into small patches. In the 1990s, those remaining areas which had high nature conservation values were estimated to cover around 38,000 hectares in Sweden (of which around 4,900 hectares is of the subtype

dominated by large old trees) and 2,000 hectares in Finland (Naturvårdsverket 1997b, MMM 2006), which represents only fragments of the historical distribution.

In eastern Finland, the slash-and-burn technique was widely used until the beginning of the 20th century, but thereafter it rapidly declined and it was no longer in practice by 1960s. At one well-studied location, fragments of this old cultural impact had almost totally vanished as a result of natural forest succession (Aarnio 1999). Today, representative wooded pastures created by burning and still affected by grazing are very rare - only around 300 hectares in total according to recent surveys (MMM 2006).

In Estonia, there are large areas of forests which were traditionally grazed by cattle. Such stand types can still be seen today, although most of them are overgrown and in succession (Andersson *et al.* 2003). The same is true for Lithuania, where only a tiny proportion is still managed by grazing (Andersson *et al.* 2005).

## Threats

Grazing is a prerequisite for maintaining the nature conservation values linked to wooded pastures. If this condition is not met, a process of encroachment is initiated and this will eventually lead to a shift to forest habitats. For sites kept open by livestock, use of supplementary feeding (e.g. in winter) will negatively affect the conservation status. Altered landuse, such as transfer to commercial forestry will of course change the character of the site entirely, and these kinds of measures may also have a negative impact if done on surrounding land. Fertilisers or acidifying air-borne pollutants may also have a negative impact (Naturvårdsverket 2005).

### Abandonment of grazing or low grazing pressure

When the land is no longer grazed, or the grazing pressure is too low, encroachment will be the inevitable consequence. The succession starts with the spread of deciduous scrub of fast-growing species, such as birch, ash, rowan and willows into open glades. On dry and nutrient-poor soils, the rate of encroachment may be rather slow, while on more fertile soils the deterioration of nature conservation values may occur more rapidly. Invasion by spruce may lead to additional negative impact on subtypes characterised by a dominance of deciduous trees.

The shading impact of encroachment can have very detrimental effects on large, old and hollow trees, such as oaks. These can be both on the health of the trees themselves and on the species-rich communities of insects, lichens and fungi linked to them. This problem is highly relevant for the management of sites with e.g. \**Osmoderma eremita* and *Anthrenochernes stellae*. Shading causes changes in bark qualities – thinner bark will be produced (more prone to drying out if opened up very quickly), which may also be less suitable for the associated species. Moreover, the competition for water, light and nutrients can be very significant and can result in a severe decline in the existing old trees (Read 2000).

### Gaps in the age-structure among deciduous large and hollow trees

Many of the threatened or rare species confined to broad-leaved deciduous trees, are further restricted to trees of a specific age, mostly old or very old ones. For various species, including *Osmoderma eremita*, insufficient continuity of age classes and low recruitment of potential host trees (primarily oak) has been identified as a problem that might hamper the long-term survival at several sites (Antonsson *et al.* 2003). Gaps in age continuity has also been identified as a potential threat for other species linked to large-sized and old trees in wooded pastures.

### Lack of dead and decaying wood

The species-richness of the wooded pastures is not only related to the age of trees but also to abundance of dead and decaying wood, be it dead standing tree trunks, dead branches of living trees or wood left on the ground as fallen branches and twigs or logs. Removal of dead and decaying wood, as an element of forestry practice or of misdirected ambitions to keep a site neat and tidy, may result in loss of several threatened and rare species; among insects as well as lichens and fungi.

## Climate change effects

Milder and more humid climate conditions in northern Europe are expected to lead to an increased forest growth (e.g. IPCC 2007). What concerns some deciduous wooded pasture tree species (including oak) this might include their spreading northwards and consequently a change in the physiognomy of the habitat and a more rapid overgrowth rate in cases of low grazing pressure (or no grazing at all).

Concern has recently been expressed about more intensive beef cattle farming as the cattle emit methane gas, a more problematic greenhouse gas compared to carbon dioxide. This could potentially lead to a decrease in the number of stock in the Fennoscandian region as a whole and thus to an increased difficulty in obtaining grazing animals for wood pastures and other habitats of great nature conservation value where grazing is a main management tool. If on the other hand the cattle farming system becomes extensive, with smaller breeds and using larger areas of mainly unimproved pastures rather than smaller areas of heavily fertilized pastures, this perceived threat can be counteracted and this concern could even be considered an opportunity.

## 2. Conservation management

### General recommendations

The main objectives for the management of wooded pastures are to maintain a mosaic of open glades dominated by grassland vegetation, and to provide an adequate density of trees while reducing shade to an extent that allows for inflow of light to the ground and onto tree trunks. Nectar and pollen sources, for example flowering bushes, are also important features because many of the species found in the ancient trees require pollen and nectar to complete their life cycle (Appelqvist *et al.* 2001).

Grazing is the key element in the ongoing management of wooded pastures, although regular clearing or mowing may be a necessary complementary measure for assuring the basic requirements of openness at sites where it is difficult to maintain a satisfactory grazing pressure. To reopen a site for grazing, restoration is usually required initially in order to reduce the infill vegetation and to overcome problems with internal fertilising (see text below, under "restoration").

For sites and spots where viable populations of any threatened and rare species is a key objective, regular active management and any restoration activities should consider species-specific requirements related to nourishment as well as concealment, for recruitment as well as for hibernation, giving special attention to species with very limited dispersal ranges. In order to avoid gaps in the age structure of large-sized host trees, the management has to be planned in a time frame of several hundred years (or several human generations). It is a key priority to take account of the health of all age classes of the tree component, but in particular the middle-aged to ancient classes and to secure a management which will favour the longevity of these trees.

For detailed management planning of a particular site it would be advisable to do some research and to document knowledge about traditional land-use as much as possible. Often, it is neither appropriate nor possible to mimic the traditional techniques, but such knowledge might nevertheless help to understand the specific requirements that have to be met at a particular site, and to adjust management details accordingly. Surveys and inventories of the insect fauna, lichens and fungi, especially with reference to species confined to old and large-sized trees is recommended if this kind of information is lacking, scanty or not recently updated.

In addition to detailing prescriptions about grazing and clearing in the management plans (or similar documents) for wooded pastures, it is also recommended that the use of fertilizers, supplementary feeding of livestock and the introduction of non-native species all be prohibited. Spontaneously dead and decaying wood should not be removed from the site (Naturvårdsverket 2005). Material from clearing and thinning operations can also be used to increase the volume of dead wood habitats; either as log piles, piles of wood chips (or a combination of the two) or standing trunks if some of the clearing is done as ring-barking. However, these dead wood habitats should however not have a negative impact on the ability of grazing animals to graze the cleared areas.

### Active management

#### Grazing

Continuous grazing is a basic prerequisite for the long-term maintenance of the conservation status of a wooded pasture site. The grazing pressure has to be balanced in accord with the main objective, which is to preserve a mosaic with open glades by minimising encroachment and maintaining enough light penetration to prevent an increase in shading and to encourage recruitment. The number of animals has to be determined with reference to the specific objectives set up for a particular site rather than to common standards in terms of animals per hectare (e.g. the recommendation of 0.5-1.0 cattle per hectare which has been proposed for some wooded pastures in Finland should only be regarded as very indicative, Priha 2003a). Upper as well as lower limits might be considered in more sensitive cases, especially for sites where rare species or fragile environments are under pressure. Matters such as the duration of the grazing period or whether to restrict grazing to part of the vegetative period have to be

decided on site-by-site basis, with reference to site-specific conservation targets, local traditions, species of grazing animals etc..

Grazing by cattle, if possible of one of the older, hardy breeds, normally gives the best nature conservation result. These cattle tend to create and maintain a herb-rich grass sward, to eat scrub and other woody plants and have little or no negative impact on the mature tree layer. Horses are known occasionally to damage older trees by eating bark and almost ring-barking trees. This seems to be a particular problem in smaller wooded pastures. For all grazing systems, the use of wormers and other animal medicines should be minimized. Concerns have for example been raised about wormers, in particular the Avermectin group, and their negative impact on the insect fauna (Cooke 1997, Suarez 2002). Suspicions regarding the wider knock-on effects on the soil ecosystems and the mycorrhizal fungi communities have also been discussed.

Grazing is also a prerequisite for the flora of vascular plants and mushrooms that is typical for the habitat. The traditional livestock used at the wooded pastures in large parts of Sweden, Finland and the Baltic countries are cattle, more rarely sheep and horses, and also goats in the central and northern parts of Sweden and locally in Finland. Livestock have been kept outdoors more or less all the year round during periods with warmer winter weather in the more sub-oceanic south-western part of Sweden. In other parts of the southern Fennoscandian region livestock have traditionally been housed for 4-5 months during winter, longer in the north. Where permitted by climate and animal welfare guidelines grazing all year round reflects more closely the natural system from which the wood pastures have evolved. All year round grazing with very hardy cattle at relatively low numbers (e.g. 0.2 per hectare) has been very successful in England. In the winter they feed more on the scrub vegetation, which may help to maintain an open structure.

In recently restored areas (see below, under "restoration by clearing") it might be advisable to adjust the grazing pressure as well as the choice of livestock (cattle, sheep, goats, horses) to the need to minimise the effects of internal fertilising and of sprouting from roots and stumps (Johansson & Hedin 1991). Temporary electrical fencing of smaller areas and relatively intense grazing by sheep for shorter periods (1-2 weeks) have successfully been used during the phase immediately after clearing, followed up with cattle grazing (V. Bengtsson, pers. comm.)

At sites with little or no re-establishment of oak trees, measures to prevent grazing by cattle as well as wild cervids (roe deer, moose etc.) has to be considered, e.g. by cages over the young plants or temporarily fencing out of the animals from minor areas. The same effect can sometimes be reached by first planting thorny bushes and then planting seedlings in the middle of this bush. This mimics the naturally occurring cyclic succession in a wooded grassland ecosystem (e.g. Olff *et al.* 1999).

### **Complementary clearing**

In situations when it is difficult to secure a satisfactory grazing pressure, regular clearing may be a necessary complementary measure to keep root and trunk shoots from cleared deciduous trees and scrub under control (see below, under "restoration by clearing"). Aspects to consider in the planning of complementary clearing are the maintenance of open areas with a characteristic vegetation of vascular grassland plants, and the penetration of light to large old individual trees in order to assure the environmental requirements for rare or threatened species living on and in the trees, as well as to enable them to deal with competitive vegetation and to maintain their health. Open patches and glades must not be too large, however; a maximum area of 1 hectare is recommended for southern Sweden and even less for Finland. In wooded pastures consisting primarily of deciduous trees, the removal of invasive spruce trees, e.g. from surrounding commercial forests, is often a necessary measure and one that may have to be done repeatedly.

At sites where it is not only difficult to maintain satisfactory grazing pressure but also to keep encroachment under full control with complementary clearing, it is mostly advisable to concentrate the management so that zones around large-sized old trees are kept clear. The radius of the cleared zone should be large enough to enable the tree trunk to be directly exposed to sunlight, e.g. the radius from the trunk should be 15X the diameter of the tree canopy. This distance from the trunk is also a suitable limit for ploughing and other potentially damaging activities (Read 2000).

## Pollarding

Pollarding of deciduous trees for collection of winter fodder has a long tradition, and it is not uncommon to find trees affected by pollarding (and sometimes still pollarded) at wooded pasture sites. The cultural heritage values linked to pollarded trees have long since been recognised, while the importance of pollarding for maintaining "micro-habitats" for a variety of insects, lichens, fungi and bryophytes has been recognised more recently (e.g. Höjer & Hultengren 2004). Pollarding may be a useful management tool to consider when there is a large generation gap, as it may help to increase the longevity of a tree. It has also been shown to speed up the process of hollowing and might therefore help to provide thus "micro-habitat" more quickly than under natural circumstances (Read 2000).

There are variations in local practice, both with reference to the species of trees involved and how frequently the pollarding was done. Most species of deciduous trees have been subject to pollarding, particularly ash, elm and lime in southern Sweden, and birch, rowan and aspen further north. The frequency might vary from once every few years to much longer intervals.

Thus, pollarding is a relevant measure to consider in the management of wooded pastures, although the potential benefits should be balanced against the risk of negative impact and sometimes taking detailed considerations into account with reference to tree-living species etc. At sites with a sufficient number of large trees, the trees to be subject to pollarding can be selected. Knowledge of local practice and traditions should be considered in decisions about the kind of trees to be pollarded and how often it should be done.

Experimental pollarding of lime and ash trees by professionals is currently being carried out by a LIFE-Nature project on "Natural meadows and pastures of Östergötland – restoration and maintenance" (LIFE Nature project LIFE05NAT/S/000108).

## Restoration by clearing

It is usually necessary to restore highly over-grown pastures before grazing can be reinstated (e.g. Johansson & Hedin 1991, Priha 2003b). One of the main problems that have to be tackled after a break in grazing is the accumulation of nitrogen in the plant biomass as well as an increased accumulation of litter. In the initial phase of the clearing, the release of accumulated nutrients is an unavoidable consequence. In traditional land-use practice the farmer took advantage of this fertilising effect, but when the aim is to restore conditions for characteristic wooded pasture flora and fauna, it is mostly regarded as a complication.

Clearing of deciduous trees and scrub inevitably results in much sprouting of shoots from roots and stumps, partly triggered by the release of nutrients. Thus, the initial work has to be followed up with complementary measures. It is often advisable to plan the clearing in several stages or working phases. A possible approach is to do the first work during autumn-winter and to open up the site for grazing in the following season. Thereafter, repeated and complementary cutting, including removal of root and stump shoots generally has to be done at least once or twice. Aspen and grey alder should be removed in the early phase, as they are more "aggressive" in creating root shoots than other deciduous trees. By following this method, problems with shoots from roots and stumps should diminish over time, provided that a satisfactory grazing pressure can be maintained (Johansson & Hedin 1991). Ring-barking may be considered as a work-effective measure for controlling aspen and alder. The roots around stumps could also be cut with a spade to prevent the growth of root shoots (Suurkask 1991).

This fertilising effect may also result in an abundance of plants that rarely dominate in pastures with a continuous grazing history, such as *Anthriscus sylvestris* (cow parsley) and on more wet soil *Filipendula ulmaria* (meadow-sweet). Mowing can be considered as a measure in order to reduce the dominance of these plants, but it has to be adjusted to a quite precise period in the growth and flowering cycle to keep it effective. Elaborations with a variety of intensive grazing patterns (using sheep or goats in the case of *Filipendula ulmaria*) are possible alternatives (Johansson & Hedin 1991).

Among other plants that may expand drastically on recently cleared patches *Pteridium aquilinum* (bracken) may be difficult to tackle. Bracken propagates vegetatively, and produces toxic and carcinogenic substances that make it unattractive for grazing. Still, the expansion can be partly prevented

by livestock trampling, although usually repeated mechanical clearing will be necessary. Bracken may also present a fire hazard which can result in hollow trees being killed due to the fire spreading to the decaying wood and mould inside the trees. In UK, bracken has successfully been tackled by using a specially designed roller pulled by a tractor or quad bike. The roller damages the stem of the bracken without cutting it. If this operation is done at the peak of the bracken growth period the plants are considerably weakened. Successive treatment over a limited number of years normally reduces the bracken cover to acceptable levels (Forbes & Warnock 1996, Read 2000).

A basic rule is that some of the cleared material has to be removed from the site. Burning at a limited number of predetermined patches may be considered as an alternative (and may be consistent with local landuse traditions, e.g. in south-west Finland; Lindgren 2000), but it is important to keep all burning locations away from the roots of the ancient trees in order to avoid risk of damage (Forbes 2003). Some of the cleared material should be left, for examples as log piles or wood chip piles. Ideally, some of those piles should be placed in sunny and exposed locations whilst others are placed in dappled shade. This may enhance the recovery of some rare species which depend on various types of dead wood habitats.

For sites where the maintenance or restoration of large old deciduous trees, such as oaks, is a main purpose for clearing, some of the following additional recommendations, based on experiences from restoration projects in south and central Sweden (e.g. LIFE97NAT/S/004202, Preservation of the beetle, *Osmoderma eremita* in Sweden; Antonsson 2002 etc.) are applicable:

- Opening up of pastures that have been overgrown for a long period (e.g. 20 years or more) has to be done in at least two stages over a period of 3-5 years; in order to avoid the negative impact of changing light conditions too abruptly. Clearing should start from the remaining open patches. In addition, clearing in the areas surrounding large trees should be prioritised. Grazing livestock can be allowed into the area after the first clearing. If the vegetation to be removed is conifers, then the clearing should be phased over a longer period and include perhaps three or more operations. The number of operations can be reduced by using management operations which complement clearing, such as ring-barking. This causes the trees to die slowly, preventing shooting from the roots, and light conditions therefore change more slowly.
- Pastures with moderate encroachment can mostly be fully cleared in one operation, although the need of any additional clearing of shoots from roots and stumps has to be checked. It is recommended that livestock be let into the site the season after clearing; heavy grazing pressure reduces the need of complementary clearing. An alternative approach is to open the site for grazing the season before clearing. Saving some "flowering" scrub species such as *Crataegus* spp. (hawthorn), *Rosa* spp. (rose) and *Prunus spinosa* (blackthorn) increases the internal habitat diversity and the potential for a species rich insect fauna. (It also makes the site more attractive for outdoor recreation.) It is also possible to use sheep in the first years in order to manage any regrowth, after which grazing by cattle only is often adequate.
- If there is a need to make decisions between keeping or removing individual trees, trees with documented occurrence of rare or threatened species should be prioritised.

Heavily overgrown wooded pastures may have developed so far in the direction of alternative forest habitats that any restoration may lead to conflicts with other nature conservation objectives. For such sites, inventoring in order to find out if the flora and fauna still includes species characteristic of pasture habitats is advisable before any decision are taken. For south Sweden, it is mostly recommended that pastures that been ungrazed for several decades (>50 years, Antonsson 2002) be left without any intervention. But clearing around old-grown and large-sized trees might still be worth considering (following the guidelines given above under "complementary clearing") at this kind of sites. Similar recommendations have not been proposed for Finland and Estonia, where much fewer traditionally managed wooded pastures are left reasonably intact.

If the trees (in particular more sensitive species such as oak) have been in shade for a longer period or if shade has been caused by coniferous trees, the clearing should be spread over a period of 10 years as a minimum and should be done in stages. Ring-barking may be used in combination with removal, in order to reduce the time period and to make it possible for some trees to die more slowly. This will make the change in light conditions more gradual.

It is important to study the condition of the trees prior to making a decision about clearance. Many ancient trees do not survive well under very competitive conditions, but encroachment may have reached the stage where clearing will not help their recovery. Moreover, the growth pattern will often have changed, and opening up may make them more vulnerable to wind throw. Thus, potential harmful exposure to wind and sun have to be considered and shelters of vegetation may be left in order to protect the tree from these.

The Ancient Tree Forum has prepared a web-site with useful information about the management of large old trees, [www.woodland-trust.org.uk/ancient-tree-forum](http://www.woodland-trust.org.uk/ancient-tree-forum). Although the website is primarily aimed for application in UK, the information is in essence also applicable to similar situations in the Nordic and Baltic countries.

An additional aspect to consider before making any decisions about restoration is the representation of wooded pastures and alternative forest habitats in a regional or landscape perspective, and if any restoration might lead to an increased diversity of habitats on that scale.

### **Additional aspects for other subtypes than wooded pastures with large old trees**

Much of the knowledge and experience relevant to the management of Fennoscandian wooded pastures is based on work in the large old trees subtype (mostly oak), mainly because of a combination of the unique species-richness connected to this subtype and the need to tackle acute threats and loss of this habitat. However, the management guidelines outlined above are in all essence also relevant for the other subtypes, with grazing and complementary clearing being the basic elements, combined with specific and sometimes specimen-based considerations for single large old trees.

In the northern parts of Sweden and Finland, e.g. north of the distribution ranges of broad-leaved trees such as oak, elm and lime; aspen and various species of willow (*Salix* spp.) are of similar importance as host trees for several rare and threatened species of insects, lichens, fungi and bryophytes. The same issues need to be considered as with large old and hollow trees. However, the management may need to be adjusted somewhat and compromises made between the removal of shoots and saplings of birch, willow, aspen and alder and the need to save and manage old and large-sized trees of the same species on the one hand, and the necessity to secure the recruitment of large trees of these species on the other. Basically, the problem of controlling the invasion of spruce trees is the same.

The recurring management of the subtype of wooded pastures left for grazing after slash-and-burn cultivation has primarily to be based on continued grazing (MMM 2006).

Some complementary information on the clearing of overgrown wooded pastures are given in the website prepared by the ManTra project; [www.landscape.fi](http://www.landscape.fi). Further, useful hints about the management of individual trees of various species is given by Reed (2000). Although primarily prepared for application in UK, the information is also applicable in similar situations in the Nordic and Baltic countries.

### **Other relevant measures**

#### **Monitoring**

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

- The surface area (in hectares) meeting the definition of 'Fennoscandian wooded pastures'.
- The percentage of well-managed pastures with favourable conservation status.
- Maximum frequency of vascular plants indicating high nutrient load (e.g. *Anthriscus sylvestris*, *Pteridium aquilinum*).
- Canopy cover of trees and scrubs.
- Degree of encroachment by shrubs and trees.
- Number or proportion of large and/or hollow trees.
- Number or proportion of pollarded trees.

- Minimum percentage of monitoring study plots with vascular plants characteristic for the habitat (examples on species to be selected for single sites are *Antennaria dioica*, *Bistorta major*, *Lathyrus linifolius*, *Nardus stricta* and *Succisa pratensis*).
- Minimum percentage of monitored trees with lichens characteristic for the habitat (examples on species to be selected for single sites are *Calicium quercinum* and *Cyphelium inquinans*).

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

- Canopy cover, at 18 year intervals.
- Scrub (>1.3 m) encroachment, at 6 year intervals.
- "Negative" indicative species, e.g. species indicating high nutrient load, at 6 year intervals using a minimum of 4 sample plots of 100 m<sup>2</sup>.
- Characteristic plant species on a minimum of 30 study plots of 0.25 m<sup>2</sup> along permanent transects, at 12 year intervals.
- Characteristic lichen species on a minimum of 20 trees with rich lichen vegetation plus an additional number of 10 trees in order to follow up the recruitment.
- Some parameters describing the condition of trees, including proportions of dead and decaying wood of various species.

It is recommended that the monitoring be done at shorter intervals, if that is needed because of changes caused by exploitation or other activities, or to monitor recovery after restoration.

For Estonia, the monitoring programme applied to wooded pastures basically takes a similar approach to that for Sweden, but is less detailed (EELIS 2006). A similar monitoring programme is also used for the Archipelago Sea National Park in south-west Finland (which hosts a substantial part of this habitat in this country).

For surveys of the occurrence of large and hollow deciduous trees in various age classes, and their suitability for tree-living beetles and old-tree-living beetles (incl. *Osmoderma eremita*), a special inventory method has been proposed (Jansson & Antonsson 1995).

### Special requirements driven by relevant species

Adjusting details in the management of a particular wooded pasture according to specific habitat requirements among rare or threatened species at the site should be the rule rather than the exception. Sometimes this might involve compromises or priorities to benefit particular species. For detailed management planning it is useful to have access to recent information about the occurrence of those species that should be considered. Below, some species-specific aspects are given for relevant species listed in Annex II of the EU Habitats Directive, although similar kinds of adjustments might be necessary also for other rare and threatened species, e.g. found on national or regional red-lists.

*\*Osmoderma eremita* (hermit beetle): Large hollow deciduous trees in a sun-exposed environment is a key requirement that is often met in wooded pastures, but also in parks and avenues. Oak is the most frequently used host tree, but larvae can also survive in the hollows of many other broad-leaved deciduous tree species. Among the measures described above under "active management" and "other relevant measures", the following aspects are to be prioritised at sites with this species (e.g. Antonsson 2002):

- Maintenance of a minimum of at least 10-20 potential host trees, with a mutual distance of less than 200 meters (due to the limited dispersal distance of imagos), but at the same time **not** neglecting potential host trees located further away or even solitary trees.
- For sites with too few potential host trees or gaps in the age structure, to manage for the recruitment of new host trees.
- For sites where controlling encroachment is difficult, keeping zones around large hollow trees clear, preferably within a radius slightly larger than the ground area shadowed by the canopy.

*Anthrenochernes stellae*: Prescriptions about leaving old, large and hollow trees and standing dead wood, as well as fallen trees and larger branches are recommended for inclusion in the management plans for sites with this species. As for *Osmoderma eremita*, it is also necessary to arrange for a continuity of age classes of large and hollow trees (Cederberg & Löfroth 2000).

## Cost estimates and potential sources of EU financing

Some idea of management costs can be obtained from previous projects:

- In the LIFE-Nature project LIFE05NAT/S/000108, "Natural meadows and pastures of Östergötland", some cost assessments for the clearing of wooded pastures and other broad-leaved deciduous forest habitats in south and central Sweden were made, e.g.:
  - Restoration by clearing of overgrown wooded pastures: Around €1320 /hectare, plus administrative costs.
  - Complementary clearing in order to avoid the scrubbing over of recently restored wooded pastures: Around €220 /hectare, plus administrative costs.
  - Pollarding of broad-leaved deciduous trees by professional tree surgeons: Around €1100 per tree, plus administrative costs.
- In the LIFE-Nature project LIFE03NAT/S/00070, "Natural pastures and hay meadows in Jämtland/Härjedalen", thinning and clearing of overgrown wooded pastures and other deciduous forest habitats in northern Sweden were estimated to cost €860-1500/hectare.
- For relevant active management measures, the current approximate levels (September 2007) of annual compensation payments within the agri-environmental scheme in Sweden are:
  - Grazing: €120-270/hectare, with the highest amount for sites with high conservation values.
  - Pollarding: €11/tree and a maximum of around €215/hectare (20 trees).
  - Summer pasture: Around €1950 plus €75/hectare. Additional €490 for each shieling where there are several within one management unit.
- For Finland, clearing costs for wooded pastures, using multi-purpose forestry machine complemented by heaping and cleaning has been estimated to cost around €1200/hectare in 2003 (Priha 2003b). But costs may be substantially higher, e.g. if boat transportation is needed (which applies for many archipelago sites in south-west Finland).
- The compensation levels within the previous agri-environmental scheme in Finland is €450/hectare for an existing wooded pasture. From 2008 a maximum compensation of €676/hectare can be claimed for restoration clearing (MAVI 2008), i.e. around 50% of the estimated real cost.
- For Matsalu National Park in Estonia, the following annual compensation levels apply for 2008 (K. Lotman pers. comm.):
  - €187/hectare for grazing,
  - clearing of shrubs etc, €178-435/hectare depending on the thickness and height of the overgrowth,
  - opening up of forest patches, €160-249/hectare, depending on conservation value,
  - fencing, €1/metre.

At single sites, the maintenance of the nature conservation values connected to wooded pastures might require restrictions on timber felling, i.e. that landowners might qualify for compensation payments for income foregone when their management has to be adjusted to achieve conservation objectives.

A possibility for the initial restoration of an overgrown wooded pasture at low cost is the engagement of volunteers. This has been successfully practiced in Finland during the last 10-20 years, and mostly initiated by public authorities in cooperation with NGOs. The volunteers were organised in a series of

work-camps, each with a group of around 20 people working under expert supervision and guidance. Through these initiatives, knowledge about professionally executed restoration is transferred to devoted volunteers and NGOs. Overall the experience has been positive.

Among the diversity of sources for EU funding, the following funds might primarily be of interest for the management of Fennoscandian wooded pastures:

- The European Fund for Rural Development (EARDF): This program has a potential to cover several management activities that might be relevant for the wooded pastures, although the measures have to be covered in the National Strategy Plans and related Rural Development plans (RDPs) in order to be eligible at the national level. Costs for grazing of the Fennoscandian wooded pastures are mostly eligible for agri-environmental subsidies within this programme. To some extent, also necessary infrastructure, such as fences and shelters may be eligible. – 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 in a broader development context, and for ERDF also related to productive investments (e.g. infrastructure). However, the Interreg approach is more flexible, but requires 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 on concrete non-recurring management actions (at least 25 % of the budget) and when needed compensation payments for restrictions in commercial land-use are eligible under 'Nature'. Recurring management is not eligible under LIFE+.

For the identification to what extent management measures required for a specific site are eligible for financial support from various EU funds, further consultation of the "Financing Natura 2000 Guidance Handbook" (Torkler 2007) is recommended.

[http://ec.europa.eu/environment/nature/natura2000/financing/index\\_en.htm](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](http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm)).

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