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MANAGEMENT of Natura 2000 habitats

Alpine and Boreal heaths

4060

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

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environment

The European Commission (DG ENV B2) commissioned the Management of Natura 2000 habitats. 4060 Alpine and Boreal heaths

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Alpine shrubby heaths in high Valle Buscagna, Alpe Veglia and Alpe Devero Natural Park, Italy. Photo: Paolo Pirocchi

40 – Temperate heaths and scrubs

EUNIS Classification:

F2.2 - Evergreen alpine and subalpine heath and scrub

Summary

Within the European Union, the Alpine and Boreal heaths habitat is distributed along mountain chains, located between the natural altitudinal tree line and the grassland formations. The heaths are usually associated with shallow mineral soils, which are, in some cases, eroding and unstable. They can also be found on areas of loose rock and coarse sediment on mountaintops and ridges. The presence and abundance of characteristic vascular plants, mosses, lichens and alpine fungi assemblages are important indicators of habitat quality.

The heaths also are a key habitat for the threatened *Tetrao tetrix* (black grouse), which is listed in the Birds Directive and in need of coordinated conservation action across the EU. In northern Finland and Sweden, the Alpine heath is a key habitat for both species of ptarmigan: the willow grouse *Lagopus lagopus* breeds and winters here while the rock ptarmigan *Lagopus mutus* uses it primarily as a winter habitat.

The management of Alpine and Boreal heaths is normally linked to low level grazing after snowmelt once the ground has had time to dry out. This is to avoid soil degradation and the compression of the herbaceous layer. Regular grazing limits scrub invasion. Within the distribution area of the Alpine and Boreal heaths, different types of grazing are carried out: summer grazing in south and central Europe (e.g. France, Italy), and year-round grazing in places like the United Kingdom. In northern Sweden and Finland, reindeer grazing has a very long tradition. The Alpine heaths above the tree line constitute the main summer grazing habitat for semi-domestic reindeer, and it is clear that reindeer grazing has been a key factor affecting the structure of the habitat.

The first step in rationalising grazing activities is to formulate a “pasturage plan”, based on accurate field surveys to determine the habitat's characteristics and needs, the sustainable pasturage load, as well as the typology of grazing and its timing, taking into consideration the local conditions. For example, in the United Kingdom heather can tolerate higher levels of grazing in the phase of growth and during the summer. Burning is also used in some EU countries, but inappropriate use of this technique can be dangerous. Burning should be therefore adequately planned and carefully carried out only if really necessary.

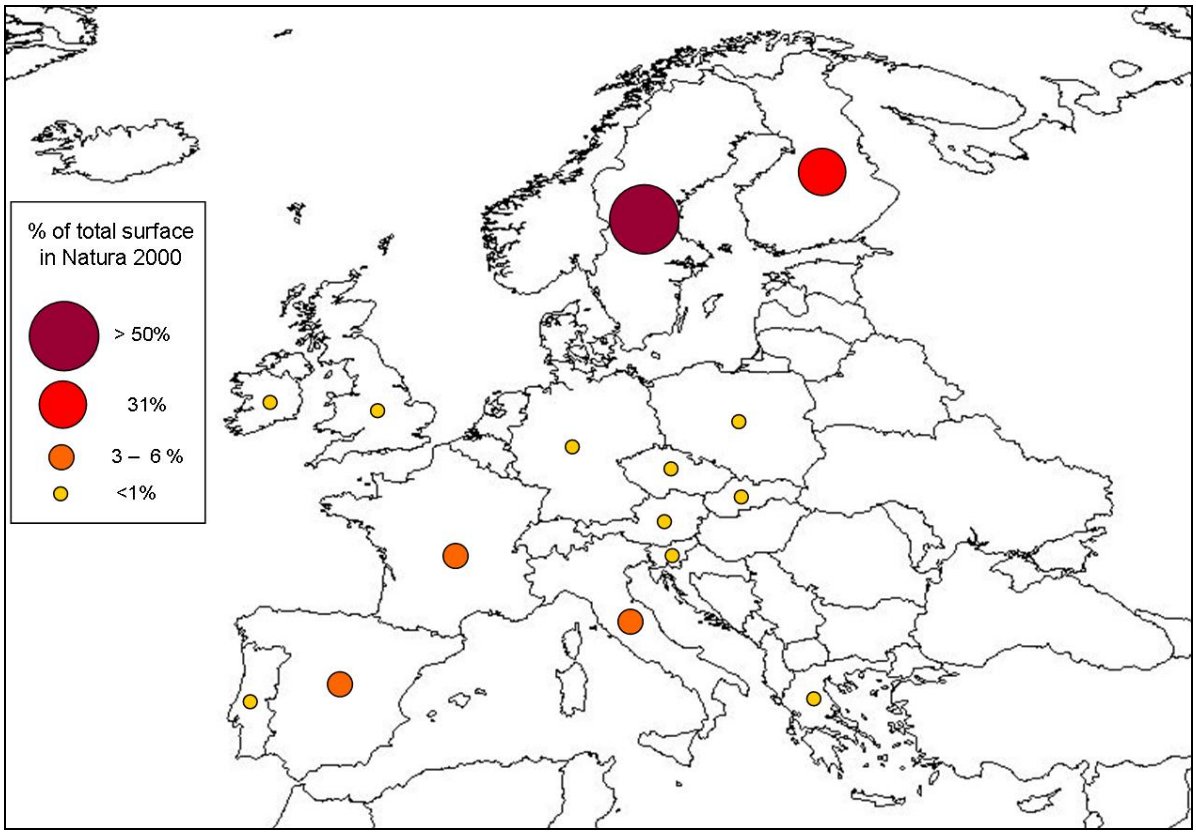
The long-term maintenance of the habitat does not always require active management. For instance, in Sweden and Finland, with a land use history primarily linked to reindeer grazing, this habitat is mostly under passive management, while in the Czech Republic no interventions are recommended.

1. Description of habitat and related species

The habitat is characterised by small, dwarf or prostrate shrub formations in the alpine and sub-alpine zones of the mountains of Eurasia, dominated by ericaceous species, dwarf junipers, brooms or greenweeds (EC 2007).

Distribution

Within the European Union, the Alpine and Boreal heaths are distributed along all major mountain chains: the Alps, the Apennines, the Pyrenees, the Carpathians and in the Fennoscandia area. The habitat is located between the natural altitudinal tree-line and the grassland formations. In northern countries it occurs at a lower altitude. The heaths can also develop below the tree-line, in gaps within scrubby high-altitude woods or as replacements for the subalpine woods lost due to grazing and burning (JNCC 2007a).



Percentage distribution of the total surface of Alpine and Boreal heaths in Natura 2000

Alpine and boreal heaths 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 200
Alpine	331	822,884	49.1
Boreal	56	708,981	42.3
Mediterranean	80	93,254	5.6
Atlantic	88	41,854	2.5
Continental	54	7,132	0.4
Macaronesia	3	963	0.1
Countries	Nº of sites	Estimated surface in Natura 2000 (ha)	% of total surface in Natura 200
Sweden	71	891,493	53.2
Finland	29	516,797	30.9
Spain	72	86,792	5.2
France	93	56,957	3.4
Italy	212	56,470	3.4
United Kingdom	33	15,020	0.9
Greece	7	14,874	0.9
Ireland	32	13,074	0.8
Austria	20	11,762	0.7
Slovenia	6	4,951	0.3
Portugal	4	3,612	0.2
Slovakia	6	1,495	0.1
Germany	19	954	0.1
Czech republic	4	462	0.03
Poland	4	358	0.02
TOTAL	**612**	**1,675,071**	**100**

Note: the Alpine and Boreal heaths are also present in Bulgaria and Romania according to the national lists of habitats included in the Habitats Directive (92/43/EEC).

Main habitat features, ecology and variability

The Alpine heaths occur at high altitude above the natural altitudinal tree-line, while Boreal heaths develop below the tree-line in gaps within scrubby high-altitude woods or as replacements for those subalpine woods lost due to grazing and burning (JNCC 2007a). The heaths are usually associated with shallow mineral soils which, in some cases, are eroding and unstable. It can also be found on areas of loose rock and coarse sediment on mountain tops and ridges.

Alpine and Boreal heaths are exposed to extreme weather conditions typical of its area of distribution. Among the main ecological factors affecting the habitat, low temperature and wind action play an important role: winter storms remove the snow layer which then exposes the vegetation to long and intense cold periods (-20 -40ºC). These drastic seasonal conditions are only tolerated by species that are highly resistant to cold, mainly perennial plants and lichens that are able to photosynthesise rapidly when temperatures rise above 0ºC (Bensettiti *et al.* 2001).

The presence and abundance of characteristic vascular plants, mosses and lichens and alpine fungi assemblages are important indicators of habitat quality. Montane heath in good condition is typically dominated by a range of dwarf shrubs such as heather *Calluna vulgaris* (heather), *Vaccinium myrtillus* (bilberry) and *Empetrum hermaphroditum* (crowberry). Average dwarf-shrub height is generally short (EHS 2003).

Main subtypes identified

This habitat comprises a wide range of heathland types that vary according to climate, soil, local exposure and snow-lie. The main typologies follow.

Alpine dwarf ericoid with heaths (*Loiseleurio-Vaccinion* Br.-Bl. 1926)

Very low, single-stratum, carpets of *Loiseleuria procumbens* (trailing azalea), prostate *Vaccinium* spp. (bilberry) or other prostate ericoid shrublets, accompanied by abundant lichens, on high windswept, mostly snow-free, localities in the alpine belt of the high mountains within the Alpine system (EC 2007) and in Sweden (Grahn 2007). The habitat occurs on acid soil, mainly on siliceous substrate. The trailing azalea constitutes a dense population (70-100% of coverage), which protect the other species against wind (Bensettiti *et al.* 2001).

Characteristic species: *Arctostaphylos alpina, Loiseleuria procumbens, Cladonia langiferina, Cetraria nivalis, C. islandica, Vaccinium uliginosum, V. myrtillus, V. gaultherioides (*Šibík *et al. 2006).*

Acidocline alpenrose heaths (*Rhododendro-Vaccinion* Schnyder 1930)

Rhododendron spp. (rhododendron) dominated heaths on acid podsols in the Alps, the Pyrenees, the Dinarids, the Carpathians, the Balkan Range, the Pontic Range, the Caucasus and the Himalayan system, often with *Vaccinium* spp., and sometimes with dwarf pines (EC 2007). The habitat occurs on siliceous or calcareous substrates, on acid soil poor in nutrients and on shady slopes protected by snow (the rhododendron is sensitive to the winter cold). In some cases, due to human factors such as deforestation and pastureland abandonment, the habitat has colonised sites below the tree line (Pirocchi and Ianner 2003b).

Characteristic species: *Rhododendron ferrugineum, Vaccinium myrtillus, V. vitis-idaea, V. uliginosum, Gentiana burseri, Luzula sieberi, Calluna vulgaris.*

Mountain dwarf juniper scrubs (*Juniperion nanae* Br.-Bl. *et al.* 1939)

Usually dense formations of prostrate junipers on the higher levels of southern Palaearctic mountains (EC 2007). The habitat is resistant both to summer drought and to very low winter temperatures (i.e. –30 – 40°C). It occurs on acid soil poor in nutrients, belonging to the type lithosol with dry humus. The substrate is siliceous or calcareous, and/or acidified due to organic deposition (Bensettiti *et al.* 2001).

Characteristic species: *Juniperus sibirica, J. Sabina, Arctostaphylos uva-ursi, Vaccinium uliginosum, V. vitis-idaea, Calluna vulgaris, Cladonia arbuscula.*

High mountain *Empetrum-Vaccinium* heaths

Two-layered dwarf heaths dominated by *Empetrum hermaphroditum* and *Vaccinium uliginosum* (bilberry), in the sub-alpine belt of the Alps, the Carpathians, the Pyrenees, the French Central Massif, the Jura, the Northern Apennines. The habitat is characteristic of relatively windswept, frost-exposed, snow-free stations, situations. The conditions are, however, less extreme than those where communities of Alpine dwarf ericoid with heaths dominate (EC 2007). The high mountain *Empetrum-Vaccunium* heaths occur on acid, often shallow, soil.

Characteristic species: *Empetrum hermaphroditum, Arctostaphylos alpina, Vaccinium uliginosum, V. myrtillus, V. vitis-idaea* and lycopodes (*Huperzia selago*, *Diphasiastrum alpinum*), mosses (*Barbilophozia lycopodioides*, *Hylocomium splendens*, *Pleurozium schreberi*, *Rhythidiadelphus triquetrus*) and lichens (*Cetraria islandica*, *Cladonia arbuscula*, *C. rangiferina*, *C. stellaris*, *C. gracilis*, *Peltigera aphthosa*)

Boreo-Alpine heaths

Alpine heaths in Scotland and in boreal mountains, particularly in the mountains of Scandinavia, at, or just south of, the limit of the boreal zone (EC 2007). It is also present in Ireland where vegetation cover is rarely complete but normally exceeds 50% (Heritage Council 2007). It occurs at moderately high altitude on acid mountain rocks, and is found on exposed lower summits and ridges as well as on sheltered slopes. Exposure or snow-lie which suppress the growth of dwarf-shrubs also favours the growth of characteristic lichens and bryophytes (JNCC 2007a).

Characteristic species: *Calluna vulgaris, Juniperus communis, Empetrum hermaphroditum, Arctostaphylos uva-ursi, A. alpina, Salix herbacea, Loiseleuria procumbens, Cladonia alpestris, Vaccinium myrtillus, Betula nana*. Some forms of the habitat support Atlantic mosses and liverworts that are have a restricted world distribution, such as *Anastrophyllum donianum*, *Plagiochila carringtonii* and *Scapania ornithopodioides* (JNCC 2007a).

Alpide bearberry heaths. *Mugo-Rhodoretum hirsuti* p., *Juniperion nanae* p., i.a.

Mats of *Arctostaphylos uva-ursi* (common bearberry) or *Arctostaphylos alpina* (Alpine bearberry) in the alpine, sub-alpine and local montane belts of the Alps, the Pyrenees, the northern and central Apennines, the Dinarids, the Carpathians, the Balkan Range, and the Rhodopes, as well as in the Moeso-Macedonian mountains (including mount Athos and mount Olympus), the Pelagonides and the Thessalian mountains. The habitat occurs mostly on calcareous substrates (EC 2007).

Characteristic species: *Arctostaphylos uva-ursi*, *A. alpina.*

Hairy alpenrose-erica heaths. *Mugo-Rhodoretum hirsuti* p.

Forest substitution heaths, treeline fringe formations or mats of Alpine heaths on calcareous soils in the Alps and the Dinarides (EC 2007).

Characteristic species: *Rhododendron hirsutum, R. intermedium, Rhodothamnus chamaecistus, Erica herbacea, Clematis alpina, Daphne striata, D. mezereum, Globularia cordifolia, Arctostaphylos uva-ursi.*

Mountain avens mats

Dwarf heaths formed by mats of the *Dryas octopetala (*woody mountain avens) in high Palaearctic mountains, within boreal regions and in isolated Atlantic coastal outposts (EC 2007).

Characteristic species: *Kobresia myosuroides, Dryas octopetala, Cassiope tetragona* (Airaksinen and Karttunen 2001).

High Mountain dwarf bilberry heaths

Vaccinium-dominated dwarf heaths in the sub-alpine belt of southern mountains, in particular, of the northern and central Apennines, the Balkan Range, the Helenides, the Pontic Range and the Caucasus, They are richer in grassland species than the communities of high mountain *Empetrum-Vaccinium* heaths and often take on the appearance of Alpine grasslands with dwarf shrubs (EC 2007).

Characteristic species: *Vaccinium myrtillus, V. uliginosum, V. gaultherioides, Empetrum hermaphroditum.*

High mountain greenweedheaths

Low *Genista* spp. or *Chamaecytisus* spp. heaths in the sub-alpine, low alpine or montane belts of the high southern Nemoral Mountains, in particular in the southern Alps, the Apennines, the Dinarides, the southern Carpathians, the Balkan Range, the Moeso-Macedonian mountains, the Pelagonides, the northern Pindus, the Rhodopes and the Thessalian mountains (EC 2007). It occurs on calcareous soil.

Characteristic species: *Genista radiata, G. holopetala, Chamaecytisus eriocarpus.*

Species that depend on the habitat management

Tetrao tetrix

The black grouse *Tetrao tetrix* is listed in Annex I of the Birds Directive and ranges between the upper limit of the treeline and the high altitude grasslands. It is the same distribution area as the Alpine and Boreal heaths, upon which it depends. It requires a mosaic of habitats including widely-spaced conifer woods, clear-felled areas with well-developed field and shrub layers that include rushes, heather and bilberry.

The main threats to the species linked to management of the Alpine and Boreal heaths are as follows:

- Overgrazing has removed key food plants such as bilberry, heather and birch scrubs in many areas. These plants also provide nest sites and support invertebrate prey important for chicks (JNCC 2007b).
- Abandonment of grazing or under-stocking of livestock result in the overgrowth of the shrubs and the consequent closure of the open areas used by black grouse as lek sites (Rotelli 2007).

Lagopus lagopus and *Lagopus mutus*

In northern Finland and Sweden, the Alpine heath is a key habitat for both species of ptarmigan. For *Lagopus lagopus* (willow grouse) the heaths, sub-arctic *Salix* scrub (habitat 4080) and Nordic subalpine birch forest (habitat 9040), are important both for breeding and wintering. *Lagopus mutus* (rock ptarmigan) primarily breeds in rocky and stony area at high altitude above the treeline but uses the Alpine heath as an important wintering habitat. In Piedmont (Italy) *Lagopus mutus helveticus* uses the heaths as breeding and wintering areas (Bionda 2007).

Pluvialis apricaria

Within Europe, a substantial part of the breeding population of *Pluvialis apricaria* (Eurasian golden-plover), listed in Annex I of the Birds Directive, is found in this habitat, primarily in Sweden, Finland and UK, but also in Norway, Iceland, Faroe Islands and Russia. Currently, the conservation status of the species is provisionally evaluated as "secure" in Europe (BirdLife International 2004).

Related habitats

4030 European dry heaths.

Mesophile or xerophile heaths on siliceous, podsolic soils located in moist Atlantic and sub-Atlantic climates along the plains and low mountains of Western, Central and Northern Europe (EC 2007). On lower slopes, Boreal heaths may grade into the floristically-similar habitat of European dry heaths (JNCC 2007a).

4070 Bushes with *Pinus mugo* and *Rhododendron hirsutum* (*Mugo-Rhododendretum hirsuti*)

Pinus mugo (mountain pine) formations usually with *Rhododendron* spp found on the dry inner eastern Alps, the outer northern and south-eastern Alps, the south-western Alps and the Swiss Jura, the eastern greater Hercynian ranges, the eastern and southern Carpathians, the Apennines, the Dinarides and the neighbouring Pelagonides, the Pirin, the Rila and the Balkan Range (EC 2007). The habitat usually occurs on dolomitic substrates (in the Carpathians also on calcareous substrates), whereas the Alpine and Boreal heaths grow on siliceous substrates (Lasen and Wilhalm 2004).

6150 Siliceous alpine and boreal grasslands

These grasslands grow on siliceous ground above the treeline, often having a thin soil layer dominated by material that results from the disintegration and decomposition of rock by physical and chemical processes. In the Scandes, this habitat is often affected by grazing from domestic reindeer. As a general rule of thumb, one can differentiate this habitat type from the Alpine and Boreal heaths in Scandinavia by the fact that it has less than 50% coverage of scrub (Grahn 2007).

6170 Alpine and subalpine calcareous grasslands

Grasslands on base-rich soils, dominated by the prostrate dwarf-shrub *Dryas octopetala* in mountain ranges such as the Alps, Pyrenees, Carpathians and Scandinavia. Also included are grasslands at subalpine (oro-Mediterranean) and alpine levels in the highest mountains of Corsica, and the closed, mesophile, short turfs at sub-alpine and alpine levels in the southern and central Apennines which have developed locally above the tree line on calcareous substrates (EC 2007). It is present at the upper limit of distribution of the Alpine and Boreal heaths in areas with intense grazing (Lasen and Wilhalm 2004).

Ecological services and benefits of the habitat

Functional implications of mountain biodiversity are strongly related to slope stability. For instance, the type of vegetation and its stability influences mountain hydrology. Moreover, the sustainable land use of high altitude habitats is associated with high biodiversity, productivity and catchments value. Both intensification and abandonment of traditional land use in the alpine zone decreases plant biodiversity. Sustainable grazing regimes in particular can facilitate high diversity, reduce evapo-transpiration and increase runoff without causing erosion, these benefits of grazing the highlands are often unrecognised.

In northern Sweden and Finland, reindeer grazing has a very long tradition, to a large extent linked to the Sámi culture. The alpine heath above the treeline is the main summer grazing habitat for semi-domestic reindeer and it is obvious that reindeer grazing has been a key factor affecting the composition of the vegetation and the abundance of species (Suominen and Olofsson 2000, Olofsson and Oksanen 2003).

Finally, the Alpine and Boreal heaths are attractive for various kinds of recreational activities, such as skiing and hunting (e.g. *Lagopus* spp.and *Tetrao tetrix* in the Scandes Mountains).

Trends

Recent analyses by the European Environment Agency show a decrease in heathland land cover of about 2% from 1990 to 2000 (EEA 2006). The major causes affecting the distribution of Alpine and Boreal heaths over the last decades are both natural and anthropogenic.

Some of the subtypes of the Alpine and Boreal heaths, such as Acidocline alpenrose heaths, are not a climax vegetation community and are therefore subject to natural evolution towards forest. This occurs when the soil acidifies, which if the temperature conditions are suitable, favours colonisation by acidophilus tree species (Minelli 2007).

Recent changes in traditional uses of land, such as overgrazing and afforestation, also influence Alpine and Boreal heath distribution. Both activities reduce the coverage of the habitat but in different ways: heavy grazing increases the surface of grasslands at the expense of heathland at higher level, while afforestation reduces its distribution at lower levels.

In the United Kingdom, the Alpine and Boreal heaths are a relatively widespread habitat across the uplands. Since 1994 its distribution range has not changed which indicates that it is close to its favourable reference range (JNCC 2007d).

Threats

Overgrazing

The main and most diffused threat to the habitat is overgrazing. The excessive utilization of Alpine and Boreal heaths has both direct and indirect impacts.

Direct impacts: overgrazing can destroy the shrubby vegetation or can prevent regeneration by native scrubs. The latter is substituted by species belonging to different plant communities that are more resistant to grazing. This in turn encourages an evolution towards other less valuable habitats types. Changes to species composition also results from a high density of dung that enriches the naturally poor soils. Over grazing can also facilitate the further expansion of grassland habitats that are already present at higher altitude. The problem is particularly important in Northern Ireland where heavy grazing pressure on mountain summits in recent years has resulted in the degradation and loss of montane heaths, including Alpine and Boreal heaths, to grassland. This is due to the fact that montane heaths were included in the Less Favoured Areas (LFA) schemes and farmers were favoured for receiving livestock subsidies. As a result, the number of sheep grazing on the mountains tripled between 1981 and 1993. Even though livestock quotas were introduced in 1993, the number of sheep is still too high and over-stocking remains a problem in many areas (EHS 2003).

Indirect impacts: too high numbers of livestock can lead to blighted soil caused by trampling damage. A heavy grazing pressure may initiate or exacerbate natural erosion of the friable rocks and shallow soil (EHS 2003).

Reindeer grazing in the Scandes Mountains

In Scandinavia, the potential negative impact of grazing (or overgrazing) by semi-domestic reindeer on natural values has been under debate for a long time, especially with reference to lichens (Bernes 1996). However, results from field surveys and research are not clear-cut and suggest a more nuanced picture. There seems nowadays to be a consensus that grazing impact is very complex: it appears to have little influence on the diversity of species present but a high impact on their relative abundance. On low-productive sub-types, such as the Alpine dwarf ericoid wind heaths types, there are indications that increased grazing pressure leads to a reduced number of species , while on more high-productive sub-types increased grazing pressure may result in an overall increase in biomass, except for lichens. There are also indications of a positive effect on rare or threatened plant species (Suominen and Olofsson 2000, Olofsson and Oksanen 2003). High grazing pressure might, however, reduce the scrub component to such a low level that the habitat changes into an alpine grassland type (habitats 6150 or 6170).

Grazing abandonment or under stocking

During the last decades, there has been a general decrease in traditional pastoral activity in mountain areas which is more strongly felt in the western parts of Europe than in the eastern parts. Abandonment usually negatively affects the biological diversity associated with the habitats linked to grazing (Norderhaug *et al.* 2000). In the past, shepherds brought animals to appropriate pastures, including those above the tree line, at the fight time and also burned scrublands to improve grazing. Often animals are now left to wander at random over wide areas, which results in over-grazing in some patches and overgrowth of shrubs and forest species in others. As a result some species of the Alpine and Boreal heaths, such as rhododendron, tend to increase their cover excluding other less competitive species.

Uncontrolled burning

Certain types of Alpine and Boreal heaths are particularly susceptible to disturbance by fire. This applies to all heaths rich in bryophytes and juniper. Similarly, lichen-rich heaths are susceptible to damage by fire or trampling (JNCC 2007c).

In some countries, such as in the United Kingdom and in France, burning of the upland heathland, including Alpine and Boreal heaths, is a commonly used to enlarge grasslands and to prevent the succession to woodland thereby increasing the area available for grazing. Poorly managed burning (i.e. large-scale and too frequent in operation) reduces the habitat quality by causing the loss of dwarf shrubs and a simplification of structure, as well as the loss of lower plant assemblages and the erosion of soil (JNCC 2007c).

Erosion

Erosion is mainly due to rainwater, but it could also be the consequence of the presence of paths which increase the vulnerability of the habitat, and of overgrazing which leads to the disappearance of shrubs that anchor down the soil (MATT 2004).

Recreational activities

Tourism is increasing in most mountain areas; the Alps, for instance, now receive some 100 million tourists every year. There is thus increased pressure to develop mountain areas for tourism, winter activities and ski resorts are of particular concern as the development of new ski runs often has a substantial impact on the natural vegetation cover (EEA 2006). The construction of new ski runs in the Pirin National Park (Bulgaria), for instance, had a significant and irreversible impact on several Natura 2000 habitats, including the Alpine and Boreal heaths (NGO coalition 2006).

Tourism activities can have wide ranging effects. For instance, skiing can have an abrasive effect on dwarf heaths, while trekking, terrain vehicles, and motor-bikes may damage the vegetation and cause path erosion, especially in summer when there is no snow on the ground (EHS 2003, Pirocchi and Ianner 2003b, Naturvårdsverket 2005).

Climate change effects

In the last decades the alpine environment has been intensely studied in order to detect the effects of climate change on vegetation (see also the project GLORIA, Global Observation Research Initiative in Alpine environments, at the website http://www.gloria.ac.at/). Alpine vegetation is considered particularly sensitive to climate warming due to its dependency on low-temperature conditions.

According to several authors, the results of a prolonged climate warming could enhance local species richness in the short term, but over the longer term, it is expected to reduce alpine biodiversity by driving cold-adapted species out of their distribution range (Pauli *et al.* 2007). The disappearance of high-altitude species at lower altitude and their increase at higher altitude has already been documented in the southern Norwegian Scandes (Klanderud and Birks 2003), suggesting that the entire range of alpine species has shifted.

The most evident effect of this phenomenon is the increase in altitude of the tree line and, as a consequence, of the heaths, which area located between the forest and the high altitude grasslands. This directly affects the Alpine and Boreal heaths. A simulation of possible tree line changes in Sweden, based on the predictions of regional climate models, shows that the Alpine heaths may be reduced by 75–85 % by 2100 as a result of upward migration of the tree line (Moen *et al.* 2004).

A four-year study conducted on *Dryas* heaths in Scandinavia shows that experimental environmental change alters dominance hierarchies, community structure and the diversity of the habitat. Species diversity declines due to a decrease in abundance of bryophytes and lichens, and dwarf shrubs (Totland and Klanderud 2005).

In the United Kingdom, many heathland communities may benefit from the predicted increase in rainfall, especially in winter, which will result in extended periods of growth. However, although suitable climatic conditions are likely to persist for some heathlands in Northern Ireland, the effect on montane heaths is more uncertain. Any climatic change will be exacerbated on the mountain summits and particularly on habitats currently at the edge of their natural range. The composition and structure of montane communities may well change with the more sensitive species, especially mosses and lichens, being lost completely (Arkell *et al.* 2007).

2. Conservation management

General recommendations

Alpine and Boreal heaths are present in dynamic and often fragile environments. Biodiversity and conservation values are closely linked to geomorphological processes and soils as well as a history of human use and impacts from deforestation, pasturing, grazing, recreational activities. Landscape change therefore involves a complex interplay between natural and anthropogenic factors. It is crucial that management systems are based on the understanding of these links.

The long-term maintenance of the nature values of the habitat does not always require active management. For instance, in Sweden and Finland, with a land use history primarily linked to reindeer grazing, this habitat is mostly under passive management. In the Czech Republic and Slovakia no interventions are recommended (Háková 2003, Polák & Saxa 2005).

Active management

Management of grazing

The management of Alpine and Boreal heaths is normally linked to extensive grazing after the snow period and once that the terrain dries out in order to avoid soil degradation and compression of the herbaceous *stratum*. Regular grazing limits colonization by ligneous plants (Bensettiti *et al.* 2005). Inside the area of heathland distribution two main typology of grazing are carried out: summer grazing in south and central Europe (e.g. France, Italy), and all year round grazing in more northerly areas such as in the United Kingdom.

Summer grazing is present in high altitude areas (at approx 2,000 m) and is linked to the traditional practise of transhumance (the seasonal long-distance movement of herds). It is usually carried out between mid-June and mid-October, depending on the local meteorological conditions. In areas where the Alpine and Boreal heaths occur at lower altitude (e.g. in the United Kingdom where it is present at 600 m), grazing can be carried out all year round depending on snow cover.

Apart from the timing and duration of grazing, stocking levels also need to be appropriate for the type and age structure of the vegetation present taking into consideration the local characteristics of the habitat. For example, in the United Kingdom heather can tolerate higher levels of grazing in the building phase of growth and during the summer. Levels of grazing damage to dwarf shrubs tend to be lower in summer because livestock generally prefer to graze other herbage which is usually plentiful at this time. Bilberry is more tolerant of heavy grazing than heather being rhizomatous, and so tends to be grazed most in September and October, with a secondary, lower peak in March and April (FRCA 1997).

The first step in rationalising grazing activities is to formulate a "pasturage plan". This should be based on accurate field surveys to determine habitat characteristics and needs as well as the actual pasturage load (Gusmeroli 2003). Then appropriate stocking levels for heaths should be determined, taking into consideration its conservation status, other management practices, such as burning, and the number of wild herbivores present (Backshall *et al.* 2001). Also grazing by different animal species should be taken into consideration because different species favour or refuse different sorts of food. For instance, temporal rotation of goat, sheep, cow and horse grazing was practised in the Mölltal (Möll Valley) of Carinthia and proved to have a very positive effect on the ecological stability of the Alpine pasture vegetation (Bätzing 1991).

The plan should also sub-divide the grazing areas into different lots and establish for each one their dimensions, location, the period over which grazing animals are present and any sucessional land use changes. (Gusmeroli 2003). In some cases, temporary fencing may be an option to enable different management regimes to be implemented (Backshall *et al*. 2001).

In Scandinavia, control of reindeer herding has been discussed but is seldom applied. The key is to find a balance between high and low grazing pressure over a larger area in order to allow for a variation in

vegetation and plant species which are dependant upon, or affected by, various degrees of impact from reindeer. This is also likely to have an indirect impact on the abundance of different species of butterflies and other insects that are dependant on various plant species grazed by reindeer (CBM 2006).

Recommendations for management of grazing in Alpine and Boreal heaths

Extract from the Cahiers d'habitats, France (Bensettiti *et al.* 2005**)**

Alpine dwarf ericoid with heaths:
- Utilization period: after mid August
- Maximum utilisation: 60 – 70% of the area

Extract from the Alpine pasturage manual of the Veneto Region, Italy (Ziliotto *et al.* 2004)

Alpine dwarf ericoid with heaths:
- Altitude: (1900) 2100-2600 m
- Utilization period: July-August
- Advised pasturage load: 0-0.1 UBA*/ha
- Animals to be used: sheep, goats

High mountain *Empetrum-Vaccinium* heaths
- Altitude: (1800) 2000-2500 m
- Advised pasturage load: 0 UBA*/ha

Level of grazing recommended in England by Backshall *et al.* (2001)

To maintain heaths in favourable condition:
- year round stocking rates should not exceed 0.5-1.5 sheep/ha or 0.075-0.225 Lus*/ha;
- winter stocking rates should be reduced by 25%, with all hogs, cattle and horses removed, and stocking should not exceed 1 sheep/ha or 0.15 Lus*/ha;
- increasing altitude and wetness will reduce environmentally sustainable, year round grazing levels to below 1.0 sheep/ha or less than 0.15 Lus*/ha.

To bring heaths into favourable condition:
- year round stocking rates should not exceed 0.5-0.75 sheep/ha or 0.075-0.1 Lus*/ha;
- winter stocking rates should be reduced by at least 25%, with all hogs, cattle and horses removed, and preferably all stock should be removed in winter.

* Adult bovine unit (1 sheep/goat = 0.15 UBA; 1 bovine younger than 2 year = 0.6 UBA)
* Livestock Unit (1 sheep/goat = 0.15 LU)

Burning

Burning has been used for centuries to manage vegetation in some EU countries, such as the United Kingdom, and for stimulating new growth of grasses or heather for agriculture, game rearing, wildlife conservation and intrinsic landscape appeal (Backshall *et al.* 2001). However, inappropriate use of this technique can be dangerous for the survival of the Alpine and Boreal heaths as it encourages the predominance of heather to the exclusion of other species, impoverishing the bryophyte and lichen flora, increasing erosion, etc. Burning should be therefore adequately planned and carefully carried out only if really necessary. For instance, in the United Kingdom, the law defines the date and conditions under which heaths can be burnt. The relevant Agricultural departments publish codes of good practice. The regulations restrict the burning of heaths to specific times of the year (JNCC 2007c).

After a fire, the vegetation of the Alpine and Boreal heaths shows a regular pattern of succession which can nevertheless be influenced by grazing. A typical pattern would start with a predominance of grass

species and sometimes bilberry because of their ability to grow and spread faster than heather after a fire, followed by the growth of the other dwarf scrubs. However, this pattern is affected by the frequency of burning. The old heather bushes may not regenerate by shooting when burning is carried out with a too low frequency, but the presence of a seed source may allow successful regeneration even though in a longer period of time (Backshall *et al.* 2001).

Burning may be beneficial to mountain dwarf juniper scrubs only when juniper plants are young because it encourages the regeneration by seeds. Burning has to be avoided in mature formation of this habitat because adult plants are likely to be killed by fire. If burning is used as a management tool then the rotation should be very long, e.g. 40 - 50 years at least, and mature bushes themselves should not be burnt, because the control of the spread of the fire would be very difficult. If restructuring of stands of mature juniper were felt desirable to diversify the ages present then cutting would be preferable to burning (Backshall *et al*. 2001).

If vegetation is to be managed by burning then different regimes should be applied to increase habitat biodiversity, affecting its structure as well as the composition of plant and animal species and the ages of plants.

Timing

Heaths are best burnt when heather has reached the end of its building stage or the early mature phase. The time taken to reach this stage depends on the local climatic and edaphic conditions, but usual rotations are around 10-15 years (Coulson *et al.* 1992). A practical way to adjust the burning regime to take account of local productivity is to burn when the heather is 20-30 cm tall. For conservation purposes, some longer burning regimes will be desirable to favour certain plant and animal species, e.g. the merlin *Falco columbarius*, to provide taller nesting cover, and lichens, which are intolerant of frequent burns. Spring burning can be preferable if it is conducted on cold, frosty days when the fire travels swiftly across the vegetation because it is less likely to damage some intolerant species (Backshall *et al.* 2001).

Temperature

The temperature of burning is very important for a successful regeneration of the heaths. The actual temperature produced is determined by a number of factors, such as wind speed, rate of passage, amount of moisture in the vegetation and amount and nature of the combustible material.

The plants can regenerate through two different ways: by shooting or by seeds. The temperature of burning to favour one of the two types of regeneration is different. Vegetative regeneration is favoured by fires that remove all the above-ground parts of the plants but leave the stem bases from which new shoots are produced. The regeneration from seeds usually requires hotter, more intense fires to clear the litter and produce a good, consolidated seed bed (Backshall *et al.* 2001).

Frequency

Frequent burning can lead to the permanent alteration of the heaths by suppressing the re-growth of the heather and of the other dwarf shrubs, for instance, burning *Calluna*-dominated stands at about 3-6 year intervals shifts the dominance to grasses. This is because dwarf shrubs need sufficient time to grow tall enough to begin to shade out the graminoids, which re-grow much more rapidly after disturbance. Less frequent burning may favour the growth of dwarf shrubs typical of the heaths (Backshall *et al.* 2001). According to Bensettiti *et al*. (2005) the frequency of burning of the subtype high mountain greenweed heaths cannot be lower than ten year.

Size of burns

It is preferable to burn a patchwork of widely scattered, small areas across the heath. Small burns provide structural diversity inside the plant community also for birds and other animals. The prescription to obtain the financial support from the Rural Development Service in England indicates the maximum surface to be burn as 2 ha (DEFRA 2007).

Burning and grazing of dry heath

To maintain dwarf shrub cover on heaths where grazing and burning occur together, the right balance needs to be attained. Limited grazing with appropriate burning can be compatible with maintaining the heath. Heavy grazing causes the loss of heather whatever the burning practice.

General recommendations concerning burning of heaths (Backshall et al. 2001)

- Plan a long-term programme of burning for the area concerned.
- Identify areas where burning is desirable to promote biodiversity and mark them in a map for inclusion in the burning programme.
- Where burning is appropriate, it should be continued on a regular rotation basis because this keeps stock moving around the moor and prevents recently burnt areas suffering excessive grazing.
- Use a variety of burning cycles and patch sizes across an area, to improve habitat complexity. Aim for patches as small as possible but occasional larger fires may suit some species.
- Burn some heathland areas and margins less intensively to encourage habitat diversity, particularly abutting onto other habitats.
- Consider cutting some areas instead of burning them (see section on cutting below).
- Ensure that a sufficient total area is burnt at any one time to prevent concentration of livestock on recently burnt patches, to the extent that they severely poach the ground or retard or obliterate dwarf shrub regeneration.

To benefit wildlife, do not burn in the following situations:

- Dwarf shrub stands which have not been burnt for long periods (more than 40 years), where known, and which have well developed layering.
- Grass-heath mosaics because the grassland may spread at the expense of the heaths, although this depends on the frequency of fire and the grazing pressure.
- Steep, rocky or scree slopes, rocky outcrops, gills and cloughs, because of the risk of erosion and the wildlife value of these habitats.
- Exposed summits, ridges, areas above the natural tree line, and where heather is already prostrate through natural causes, because vegetation cover here is often patchy and growth very slow.
- Juniper scrub because of its wildlife value and slow regeneration.

Cutting

Cutting, like burning, is a drastic event for the vegetation and its associated fauna. When it is used for management, it should be adequately planned and monitored.

It is possible to use two different techniques: cutting by hand and using mechanical means. However, the machinery used in cutting can damage fragile ground and therefore its use should be restricted to areas with suitable topography (light slopes and not too shallow soil).

Cutting is more expensive than burning, but in some particular cases, the sale of cut heather for commercial purposes can reduce the cost (North York Moors National Park 1991).

Recommendations concerning heather cutting (Backshall et al. 2001)

- Plan a programme of cutting.
- Avoid cutting during the main bird-nesting season.
- Regeneration is generally better after spring rather than autumn cutting.
- Do not leave material on the cut area as this prevents regeneration.

Other relevant measures

Habitat restoration

Generally, it is most cost-effective and a higher nature conservation priority to concentrate effort on restoration by improving the condition of heavily impacted heaths, rather than trying to re-create it where it has completely disappeared (Thompson *et al.* 1995).

The first step to be carried out is the reduction/removal of the cause of habitat degradation, e.g. prohibition of grazing in some cases for up to five years. Afterward, the status condition of the habitat can be increased by targeted planting of native species in areas of low existing wildlife interest, provided only species typical to the location and of local provenance are used (Rodwell and Patterson 1994).

Where no seed bank remains, the import of dwarf shrub seed will be necessary to re-create heaths. Seeds can be obtained from adjacent seed-bearing plants. A forage harvester or flail mower and baler can be used where conditions are suitable (e.g. flat, no boulders) and this material is normally applied at about 600 g per m^2. Collecting some litter and soil from areas of vigorous heather, either by hand or an industrial vacuum cleaner run from a portable generator, can provide an alternative source of seed. This material is usually spread at the lower rate of about 200 g per m^2. If storage of either type of material is required, it should be dried first. To prevent loss of the seed-bearing material from the application site, the application of an open covering of forestry brushings is employed (Backshall *et al.* 2001).

The slow attainment of mature bush size and the difficulties of transplanting make bilberry unsuitable for use as a main species in schemes to recreate heaths. Heather is easier to establish, either from transplants or seeding (Welch *et al.* 1994).

Indicators of success (DEFRA 2007)

By year 10:
- cover of dwarf shrubs (of at least 2 species) should be at least 33%.
- flowering heather plants should be abundant between July and September.
- no more than 33% of heather shoots should be grazed by February-April.
- no more than 10% of the cover of dwarf shrub heath should be burnt. No single burn should be greater than 2 ha and 35 metres wide.
- the area of disturbed bare ground should be less than 10%.

Anti-erosion measures

Erosion phenomena caused by rainwater can be natural, linked to the steep slopes and the shallow soil in the areas of distribution of the Alpine and Boreal heaths, and anthropogenic, linked to the passage of tourists and/or cattle along the paths inside the habitat.

As a general rule, naturalistic engineering techniques with low environmental impact should be used whenever possible to increase soil stability and to consolidate the slope. To reduce path erosion it is possible to choose among different techniques, such as:

- stone pitching on slopes of between 15 and 30 degrees, which consists of positioning large blocks of undressed local stone on the path line to create a series of irregular steps up the eroded slope (Moors for the future partnership 2007).

- On a gradient of less than 15 degrees (Moors for the future partnership 2007) it is possible to reduce the erosion scar and provide a reasonably sustainable path by carrying out landscaping and drainage work with a mini-digger. The work consist in (LIFE2002NAT/IT/8574):
  - re-profiling and levelling the eroded path surface;
  - providing adequate drainage of the path by ditching and small draining channels;

- cambering to ensure any surface water is taken off the path and not allowed to run along the surface;
- blocking off multiple walk-lines with boulders;
- re-vegetating and stabilisation of the sides of the path.

This technique has the advantage of being cheap, since labour costs are minimal. The minimum use of materials ensures that, with care, the finished path will have a natural look (Moors for the future partnership 2007).

Tourist management

Adequate information aimed at the tourist on the conservation value of the habitat, and in particular on behaviours considered compatible and not compatible, can help reduce the negative impact of tourism. The informative campaign could include the distribution of leaflets, the placement of signs for paths and of signboards, etc. In areas highly frequented for winter tourism, e.g. in the Alps, skiing outside of the ski runs and particularly in areas where the habitat and the *Tetrao tetrix* is present, should be prohibited (LIFE Nature project Alpe Veglia). Where it cannot be prohibited, it would be advisable to realise precise paths for skiers, with an obligation to use them and a communication campaign to motivate and illustrate the reasons for the measures taken.

The construction of new tourist infrastructures should be restricted to areas of low natural value (NGO coalition 2006).

Monitoring

The establishment of monitoring programmes is particularly important in order to assess the condition, the conservation state and the effects of activities or interventions carried out on the Alpine and Boreal heaths.

This habitat is vulnerable to rapid and unchecked changes. It is therefore recommended that sites should be checked frequently, at least every two years if possible, to detect any changes. The best visiting period could be from June to August (JNCC 2006, Pirocchi and Ianner 2003a). The attributes to be monitored are:

- Habitat extent.
- Vegetation structure: cover of characteristic dwarf shrubs, of ericaceous species and of bryophytes and lichens.
- Vegetation composition: frequency of characteristic species (dwarf shrubs, graminoids).
- Indicators of negative trends (percentage of alien or invasive species which may reduce the diversity of the habitat and affect its integrity; soil erosion, trampling; uncontrolled burning).

Variations in the structure of the vegetation, in terms of vegetation height, amount of canopy closure, and patch structure are needed to maintain high niche diversity and hence high species richness of plants and animals. However, it is important to note that in some sites, the structure of the vegetation can be altered by natural and human actions. For instance, wind-pruned dwarf-shrubs can be short and at the same time fairly mature and heather structure can be altered if grazing is present (English Nature 2003). Establishing indicators to monitor the damage of terrain vehicles would help to identify the need for restrictions and/or criteria for permits to use them.

The French Agence Méditerranéenne de l'Environnement (1999) recommends monitoring is carried out through a permanent transect with at least 10 stops within each assessment unit (block, management unit, etc.) to avoid excessively variable results. At each stop, the appropriate attributes (e.g. percentage cover and/or presence of relevant species) should be assessed within approximate 4 m^2 permanent sampling units.

The Swedish Environmental Protection Agency recommends monitoring at 6-year intervals, with aerial surveys over large areas in order to map the habitat and its sub-groups, and to monitor the distribution of trees, scrub and ground without vegetation. This is to be combined with study plots on the ground, using a large plot with a radius of 10 m in combination with three smaller plots with a 0.28 m radius. If there are

indications of negative trends, more intensive monitoring with complementary methods is proposed (Naturvårdsverket 2005).

Table 1. Common Standards Monitoring Guidance for Upland habitats (extracted from JNCC 2006)

Mandatory attributes	Targets	Method of assessment / Comments
Vegetation composition - frequency of dwarf-shrubs, bryophytes and lichens	(1) At least 1 species from each of the following should be present (a) dwarf-shrub, and (b) moss, liverwort or non-crustose lichen.	Target (1) assessed against visual estimate at 4 m^2 scale.
Vegetation composition – cover	(1) The collective cover of indicator species should make up at least 66% of the vegetation cover. (2) Less than 1% of the vegetation cover should be made up of non-native species.	Target (1) assessed against visual estimate at 4 m^2 scale. Target (2) assessed against visual estimate for as much of the feature as is visible while standing at a sample location.
Vegetation composition - indicators of current grazing	(1) Less than 10% of the vegetation cover should consist of, collectively, *Agrostis capillaris, A. vinealis, Anthoxanthum odoratum, Deschampsia flexuosa, Festuca ovina / vivipara*, *Galium saxatile, Poa* spp. (other than arctic-alpine spp.) and *Potentilla erecta*. (2) Signs of grazing on less than 10% of live leaves of any of *Carex bigelowii, Deschampsia flexuosa, Festuca ovina, Festuca vivipara, Juncus trifidus.* (3) Less than 33% of the last complete growing season's shoots of dwarf-shrub species (collectively) should show signs of browsing.	Targets (1-3) assessed against visual estimate at 4 m^2 scale. Assessment is best done in late winter through spring.
Vegetation structure - presence of burnt vegetation	(1) There should be no signs of burning inside the feature boundaries.	Target (1) assessed against visual estimate for as much of the feature as is visible while standing at a sample location.
Physical structure - indicators of ground disturbance due to herbivore and human activity	(1) Less than 10% of the ground cover should be disturbed bare ground.	Target (1) should be assessed in the following two ways: (a) for diffuse/scattered disturbance of the ground, not on clearly defined paths or tracks, by visual estimate at 4 m^2 scale; and (b) for distinct and clearly defined paths and tracks (exclude constructed tracks) by visual estimate for as much of the feature as is visible while standing at a sample location.

Special requirements driven by relevant species

Tetrao tetrix

Over-frequent moorland burning can affect the habitat, leading to the formation of impoverished acidic grasslands and thus resulting in the loss of key food plants (Thom & Court 2000, JNCC 2007b), but the main threats to the species linked to management of the Alpine and Boreal heaths are connected with the regulation of the grazing inside the habitat:

- Overgrazing: the management indications for a rational grazing for the benefit of the black grouse are the same as for the heathland habitat itself. In addition, the reproduction areas of the black grouse should be excluded from grazing until mid-August to avoid damages to the eggs and to chicks (Masson *et al.* 2000) in the Alpine areas and from April 1 to July 1 in the United Kingdom (DEFRA 2007).

- Abandonment of grazing or understocking of livestock. To solve the problem of the overgrowth of the shrubs and the consequent closure of the open space used by the black grouse as lek sites, it is sometimes necessary, in additional to grazing, to selectively cut the Alpine and Boreal heaths in order to create clearings inside them. According to the Dolomiti National Park (LIFE Nature project Dolomiti bellunesi) cutting shrubs on 30% of the surface of the heaths with coverage of 100% is sufficient to increase the black grouse summer population. The interventions can be realised using mechanical means during August-October in order to avoid the disturbance of chicks (Brugnoli and Gianesini 2007, Università di Udine 2002).

Cost estimates and potential sources of EU financing

Management of grazing

The reduction in the number of animals implies a loss for the farmers, for instance in terms of less milk/cheese produced and therefore sold. Also the eventual cost of transporting the animals to other areas because grazing is excluded from certain areas and the construction of small infrastructures, such as drinking troughs and temporary fences, should be considered.

Cutting

The cost of cutting depends on the different typology of intervention: whether by hand or by mechanical means. Experience in Trento (Italy) indicates that the latter is more expensive because of the costs related to the use of machinery and equipments (purchase, insurance, combustible, lubricants, maintenances, reparations, etc.).

Table 2. Costs of cutting extracted form Rural Development Programme 2007-2013 of the Trento Province (Italy)

	Manually		**By mechanical means**	
Type of action	**Cost per hectare**		**Cost per hectare**	
Elimination of alien species	Manual cutting with sickle or pruning knife, to be carried out every year (infestation not above 5%)	€ 60	Elimination by mechanical means, gathering and build up of clumps in suitable areas (extraordinary action) (rate of infestation between 20 and 40%)	€ 1,380
	Manual removal of clumps with pickaxe, gathering and build up in suitable areas (extraordinary action) (rate of infestation not above 20%)	€ 760	Cutting of clumps, gathering and build up of necromass (extraordinary action) (rate of infestation not above 40%)	€ 1,200
Manual cutting	Manual hedge cutting of shrubs of medium large size, build up and burning of remaining debris, rate of infestation above 50% in not mechanised areas)	€ 2,600	Mechanical trimming of shrub of small dimensions (rate of infestation not above 50%)	€ 1,150
			Mechanical trimming of shrubs of medium and large size with cutting of branches, uprooting of stumps, building up and burning of debris (rate of infestation above 50%)	€ 2,700

Burning

Estimates on the area of heather to burn varies on a case by case, but a guide for England estimates about 2 ha per person per day, which is calculated using a speed of fire advance of about 2 m per minute, a fire

width restricted to 30 m and 6 hours of actual burning time in a day (Backshall *et al.* 2001). Therefore the cost of burning is relatively cheap and corresponds to the cost of the manpower.

Habitat restoration, anti-erosion measures

The cost of these types of actions varies according to the means to be used and products to be obtained. It always includes the cost of elaborating a technical blueprint as well as the manpower, the eventual rental and/or use of mechanical means and the cost of plants to be used for re-vegetation, etc.

Tourist management

The costs essentially consist of external assistance for the realization of signs, of the informative materials and of the information campaign and restoration measures.

Monitoring

Often monitoring is carried out by competent institutions, such as research bodies or universities. The costs should be calculated on a biennial basis and should include the cost of the monitoring program, of the researchers and, eventually of the equipment for triangulation of the habitat on the territory and for cartography.

Table 3. Extracted from "Tranche 2 Action Plans Cost estimates - terrestrial and freshwater habitats" (UK Biodiversity Group 2000)

Type of action required by Habitat Action Plan	£ 1,000	Indicative cost
Undertake sample survey of vegetation condition	0.18/day	Contractor cost covering 4 km^2 per day
Commission and undertake applied research on conserving and restoring upland heath	90	3 year post-doctoral research
Compile inventory of priority sites for restoration	10	Research contract based on ,180/day
Commission and undertake research on impacts of reducing or removing grazing and burning	17/yr	PhD studentship
Promote sociological research to explore ways of integrating agriculture, sport and recreation with nature conservation	10/study	Based on past contracts
Develop and implement surveillance and monitoring program	5	Lead agency staff time@,250/day

Potential sources of EU financing

EU funds for Natura 2000 in the period 2007-2013 should come from different existing Community financial instruments aiming to enhance rural, regional, and marine development in the EU. The integrated use of these resources will allow the financing of various management actions for areas with habitats listed in the Habitats Directive and included in the Natura 2000 network.

Each Member State has identified the issues that are of most concern locally and has prioritized EU funds in order to address these issues. National and regional programs, which have been prepared by Member States on the basis of the EU Regulations, determine the concrete funding possibilities for Natura 2000.

The funds to be taken into consideration are:

- The Structural Funds: (European Social Fund (ESF) and European Regional Development Fund (ERDF));
- The Cohesion Fund (CF);
- The European Agricultural Fund for Rural Development (EAFRD);

- The Financial Instrument for the Environment (LIFE+);
- The 7th Research Framework Program (FP7).

The following table is extracted from the EU Guidance Handbook for the period 2007-2013 (Torkler 2007):

Table 4. Types of activities and related EU funds

Types of activities	**EU fund concerned**
Management planning	
Preparation and reviews of management plans, strategies and schemes (Elaboration and/or update of management and action plans, land use plans etc.)	**EAFRD** **LIFE+ Nature and Biodiversity** component **ERDF** could finance development of management plan, but only where management of the Natura 2000 site is crucial for risk management and in transnational cooperation initiatives to favor ecotourism in areas needing socio-economic diversification. **FP7** Transnational Cooperation, theme Environment, could finance plans review as part of a research projects aimed at determining plans efficacy.
Establishment of management bodies (Start-up funding, feasibility studies, management plans etc.)	**ERDF**
Consultation – public meetings, liaison with landowners (Including costs incurred for the organisation of meetings and workshops, the publication of consultation outcomes, financial support of stakeholders, etc.)	**EAFRD** could support regional networking, sharing of positive experiences to communicate economic benefits of Natura 2000 sites in the context of initiatives to conserve and upgrade the rural heritage, and within, private-public partnership for sustainable rural development. **FP7** Transnational Cooperation, theme Environment. **ERDF** could finance networking and consultations on various socio-economic aspects of Natura 2000 sites on local/regional/transnational level. **ESF** Could finance networking between public and private bodies, departments, public administrations and public services etc., in objective Convergence regions.
Maintenance of facilities for public access to and use of the sites, interpretation works, observatories and kiosks etc. (Including costs related to guides, maps, related personnel)	**EAFRD** **ERDF**
Habitat management and monitoring	
Conservation management measures – maintenance and improvement of habitats' favourable conservation status (Including restoration work, provision of wildlife passages, management of specific habitats, agreements with owners and managers of land)	**EAFRD** **LIFE+ Nature and biodiversity** component **FP7** Transnational Cooperation, theme Environment **ERDF**
Conservation management measures in relation to invasive alien species (IAS) (Including restoration work, infrastructure, management of specific species, preparation of management plans).	**EAFRD** could finance removal of invasive plant species that degrade native plants and forest structure in the context of forest-environment payments. **LIFE+ Nature and biodiversity** component, could finance removal of IAS or elaboration of demonstrative methodologies as part of larger nature conservation projects. **ERDF** could be used to fund a one-off eradication or control programme for an IAS with significant negative economic/social/environmental effects. **FP7** Transnational Cooperation, theme Environment, could finance control of IAS as part of a research projects on biodiversity threats.
Monitoring and surveying (refers mainly to one-off costs related to monitoring and surveying activities, e.g. development of monitoring plans, methods and equipment; training of personnel.)	**EAFRD** **LIFE+ Nature and biodiversity** component **FP7** Transnational Cooperation, theme Environment **ERDF** **CF** in "Convergence" regions

Types of activities	EU fund concerned
Habitat management and monitoring	
Risk management (fire prevention and control, flooding etc.). Includes the preparation of wardening and fire-control plans, development of relevant infrastructures, and the acquisition of equipment.	**FP7** Transnational Cooperation, theme Environment **ERDF** at local/regional/transnational level **LIFE+ Nature and Biodiversity** component
Provision of information and publicity material (including establishing communication networks, production of newsletters and awareness and information materials, setting-up and maintenance of internet pages, workshops, training, etc.)	**EAFRD** **LIFE+ Nature and biodiversity** and **Information and Communication** components **ERDF** at local/regional/transnational level **ESF** could finance elaboration of information for training programs to strengthen institutional capacity and the efficiency of public administrations.

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