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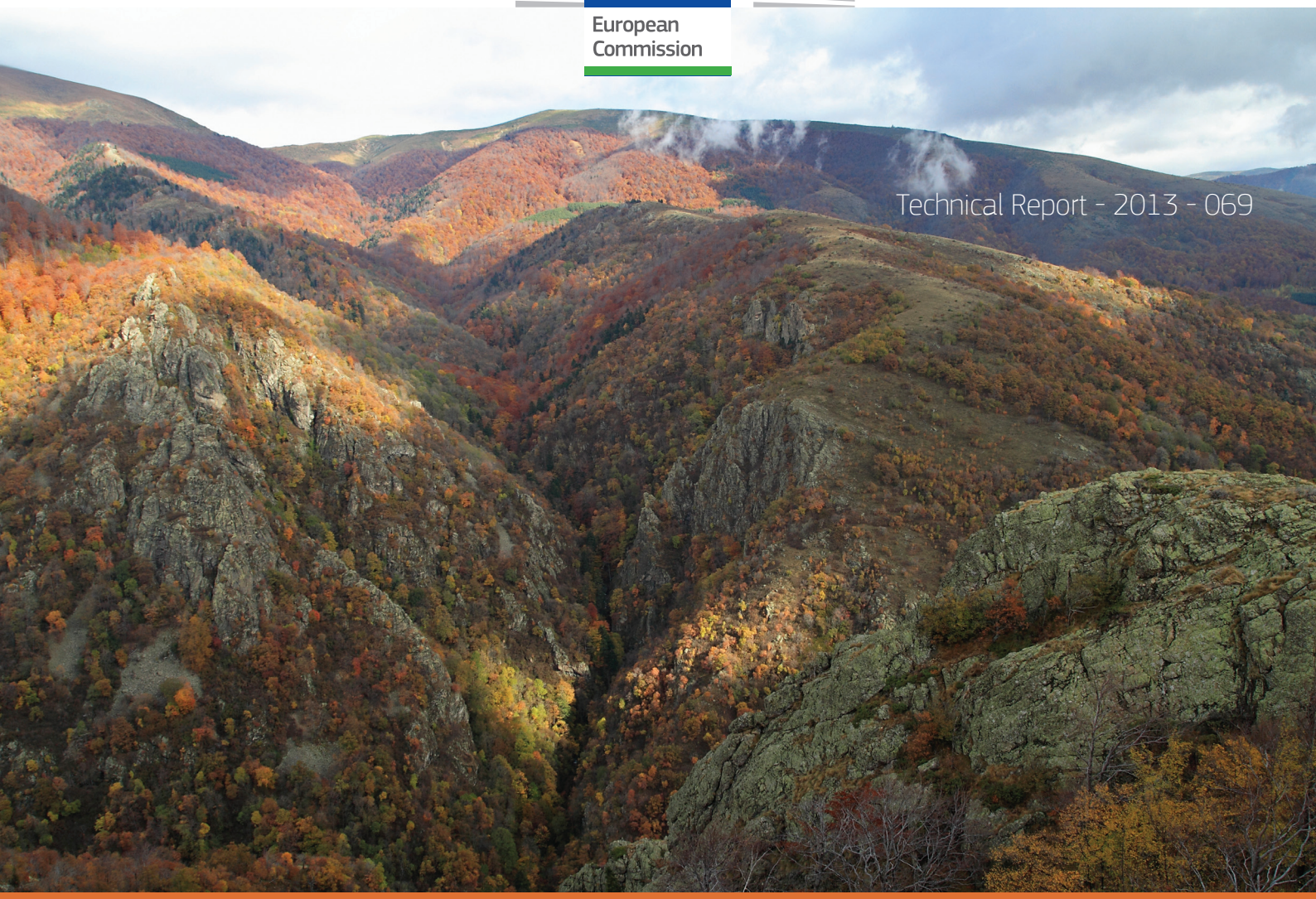

Technical Report - 2013 - 069

Guidelines on Wilderness in Natura 2000

Management of terrestrial wilderness and wild areas within the Natura 2000 Network

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Photograph cover page:
Central Balkan, Natura 2000 site number BG 0000494
©Svetoslav Spasov, who has kindly made this photo available to the European Commission for use in this guidance document

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Purpose of this Guidance

Background

Natura 2000 protects areas of high biodiversity value across the European Union. It is the largest co-ordinated multi-national network of protected areas in the world, covering more than 18% of the European terrestrial territory of the Member States as well as significant marine areas. As establishment of Natura 2000 nears completion the focus is increasingly shifting to the effective management and restoration of sites in the network. Ensuring a fully functional Natura 2000 network is central to achieving the EU target of halting and reversing the loss of biodiversity and ecosystem services in the EU by 2020[1].

Europe is one of the most densely populated areas in the world and European nature is to a large extent shaped by long-term human intervention. The sites in Natura 2000 reflect both historical and current human influences but the network also includes places that are in a relatively undisturbed natural state and where species and habitats of EU conservation concern are not dependent on human intervention. The management of the network will need to reflect the fact that human intervention has a key role to play in achieving conservation objectives for many of the sites whereas in specific cases non-intervention can be applied for the same purpose. There are also many degraded habitats which will require important investments and restoration measures in order to achieve the objective of favourable conservation status.

Natura 2000 is not a system aimed at providing a barrier to activities. Instead, human activities need to comply with the provisions outlined in Article 6 of the Habitats Directive, to ensure that these activities are in line with the conservation objectives of Natura 2000 sites.
Whereas Natura 2000 fully embraces the principles of conservation and sustainable use a variety of protection approaches can be applied to the sites by Member States at national or regional level. Several Member States apply strict protection in parts of their Natura 2000 network to protect sites' natural conditions. As a management measure this means ensuring minimal human intervention in order to allow natural processes to predominate. There are examples of such setting aside of areas for nature or non-intervention management in the Natura 2000 network. Natural processes require sufficiently large areas to allow for dynamic changes over time and space.

Natural areas, where natural processes predominate, which are sufficiently large and lack infrastructure, or are managed to achieve those qualities, are for the purposes of this guidance document being called wilderness areas. Many Member States designate areas with the purpose of preserving those qualities of wilderness, or a set of them, and may have a special class of protected areas for this purpose. However, it is important to note that occurrence of wilderness qualities is not limited to areas formally designated for their protection.

Protection and restoration of wilderness and wild areas has gained increasing attention in recent years (see text box: EP Resolution on wilderness in Europe). Wilderness and wild areas are not

[1] http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm

explicitly mentioned in the EU Birds and Habitats Directives but applying a wilderness approach to the management of Natura 2000 sites is seen compatible with the provisions of the Directives. Furthermore, scientific evidence shows that wilderness areas are resilient against pressures affecting biodiversity and should be considered important tool in helping achieve biodiversity targets. Wilderness areas inside and outside protected areas could e.g. deliver an important element of Green Infrastructure[2], by the amount of various ecosystem services these core areas could potentially deliver, and their function as reservoir of biodiversity that can be drawn upon to re-populate and revitalise degraded ecosystems.

EP Resolution on wilderness in Europe

In 2007, a broad coalition of NGOs in Europe addressed a resolution to the European Commission and the EU Member States on the preservation of wilderness areas. This was followed in December 2008 by a report drawn up by Gyula Hegyi[3], Member of the European Parliament, stressing the importance of wilderness in Europe to stop further loss of biodiversity. This report contained a motion on a European Parliament resolution on wilderness in Europe and was adopted by the Committee on the Environment, Public Health and Food Safety.

The vote on the special report on Wilderness in Europe provided the popular mandate for improving wilderness conservation in Europe as the report was adopted by the European Parliament on 3 February 2009. It was a non-legislative resolution bringing forward a range of recommendations, and stating the need for further action in several key areas - defining wilderness, mapping it, studying wilderness benefits, developing an EU strategy for wilderness, developing new wilderness areas, promoting them, bringing in effective protection of wilderness areas, accepting the Wild Europe Initiative, ensuring that wilderness zones are given special status and stricter protection for wilderness zones in the Natura 2000 network, getting Member States to set wilderness conservation as a priority in their strategy to address climate change and forward the resolution to the governments and parliaments of the Member States.

The 'Wilderness Report' adopted by the European Parliament states that the European Commission should develop appropriate recommendations that provide guidance to the EU Member States on the best way of ensuring protection of present and potential wilderness or wild lands and their natural processes, which are likely to be covered by the Natura 2000 network.

In 2009 a first conference on Wilderness and Large Natural Habitat Areas was organised through the Wild Europe initiative in close cooperation with the EU Czech Presidency and many other organisations. It brought together about 250 participants from 40 countries, including officials of government ministries, nature conservation agencies and NGOs, academics and interested partners from landholders, forestry, business and other sectors. This conference came up with an agenda for Europe's wilderness and wild areas, focusing on policy development, awareness building, information needs and supporting capacity (Poselství from Prague, 2009).
http://www.wildeurope.org/images/stories/article_pdf/agenda_for_wilderness.pdf

The EU Natura 2000 network is generally not a network of strictly protected areas in which no economic activities should take place. Therefore in most Natura 2000 sites, a wilderness approach will not be the most appropriate form of management. This guidance document should therefore not be interpreted as the Commission aiming to turn all Natura 2000 sites into wilderness areas. However, in specific cases, a wilderness approach can be the most appropriate or even necessary management approach for those specific Natura 2000 sites hosting habitat types and species of Community interest whose maintenance or restoration to a favourable conservation status is dependent on some degree of wilderness qualities and natural

[2] COM(2013) 249 final: Green Infrastructure (GI) — Enhancing Europe's Natural Capital: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52013DC0249:EN:NOT

[3] Gyula Hegyi (2008). Report on Wilderness in Europe. Committee on the Environment, Public Health and Food Safety. European Parliament, Session Document 2008/2210 (INI).

processes. And there will be sites for which a wilderness approach can be useful but not necessarily the only way to restore or maintain the species and habitats at a favourable conservation status. This guidance document is applicable to those specific Natura 2000 sites.

Purpose of this guidance document

The purpose of this document is to guide the management of those areas in Natura 2000 where the objective of management is to preserve wilderness qualities and consequently the chosen management method is non-intervention or set aside and to present the current knowledge on the benefits of such an objective. By looking at the different qualities of wilderness it aims to clarify the relevance of the Habitats and Birds Directives for wilderness areas, while taking into account other legal obligations such as the animal and plant health and the plant reproductive material regimes. It also aims to clarify and correct misunderstandings about certain key aspects of the management of wilderness areas.

It encompasses both non-intervention management and restoration measures in the Natura 2000 network because restoration is often needed in the initial phase of establishment of a non-intervention management regime. Restoration might also be needed in order to imitate natural disturbances that are missing for one or another other human induced reason.

The document is intended to guide site managers in using non-intervention and set aside methods and present ways to solve potentially emerging conflicts. The current knowledge about the benefits and feasibility of non-intervention and set aside management is discussed in the context of different parts of the EU. Best practice examples are presented, encompassing management of wilderness and restoration of natural processes, and establishing wilderness.

The document is designed for use by a multiple audience of national and local authorities, site managers and other practitioners who are involved in the planning and implementation of the Birds and Habitats Directives at both policy and field levels. It may also be of interest to other stakeholder groups such as NGOs and other international bodies involved in nature conservation.

Structure and contents

The document is set up in 5 main sections:

Chapter 1 provides a review of the literature on definitions of wilderness as well as existing initiatives and legislative and statutory measures in the EU Member States to protect wilderness qualities. It provides a working definition for wilderness, taking into account characteristics relating to biological and anthropogenic qualities of wilderness. The spatial link between wilderness and the Natura 2000 network is assessed.

Chapter 2 presents a concise outline of the EU policy framework on biodiversity and of the Birds and Habitats Directives in particular. Key-issues such as favourable conservation status, biogeographical regions, and management plans are briefly described. The position of wilderness and wild areas within the framework of international conventions and Natura 2000 is discussed.

Approaches for setting conservation objectives for wilderness areas in the Natura 2000 network are presented with a view to the qualities of wilderness. The structure and functions of natural habitats of Community interest and their typical species in the context of favourable conservation status is described. The measures essential for the maintenance or re-establishment of natural habitat types and species in wildernesses areas are presented.

Chapter 3 presents a brief overview of ecosystem theory on ecosystem resilience, and gives an overview of different kinds of pressures on wilderness and wild areas, based on the experience of site managers and a literature survey. It highlights important pressures on wilderness and wild areas such as habitat fragmentation, climate change, and the spreading of invasive species. Moreover, this chapter provides a description of the key ecosystem services provided by wilderness areas and their socio-economic benefits for local communities. Special attention is given to the impact of sustainable forms of ecotourism for local communities.

Chapter 4 presents a set of best practice examples of different types of wilderness and wild areas throughout the different biogeographical regions in the EU. Measures taken to ensure and improve wilderness qualities are described. Major potential conflicts between non-intervention management and natural hazards (e.g. bark beetles, forest fires, grazing/herding) are considered. The objectives involved and the feasibility of restoring wilderness within the framework of Natura 2000 are also described. Ecological connectivity, scale and zonation are key-topics highlighted.

Chapter 5 highlights stakeholder involvement as a key-element in the management of wilderness and wild areas. It emphasises that effective communication strategies are needed for different target groups, i.e. local stakeholders, decision and policy makers and visitors/tourists. Several recommendations are made about communication strategies based on best practices.

Information for most chapters was derived from a literature review and from a questionnaire, which was distributed among site managers in the EU27, managing wilderness and wild areas. Best practice examples on existing non-intervention management and restoration management were derived from the questionnaire, supplemented with additional information from interviews with site managers.

Limitations of the document

This guidance document is intended to be bound by, and faithful to the text of the Birds and Habitats Directives and to the wider principles underpinning EU policy on the environment. It is not legislative in character, it does not make new rules but rather provides further guidance on the application of those that already exist. As such, it reflects only the views of the Commission services and is not of a legally binding nature. It rests with the EU Court of Justice to provide definitive interpretation of a Directive.

The document does not replace the Commission's existing general interpretative and methodological guidance documents on the provisions of Article 6 of the Habitats Directive. This guidance document builds on the previous guidance and has its legal background especially in the Articles 6(1) of the Habitats Directive and Article 4(1) and 4(2) of the Birds Directive.

It seeks to clarify specific aspects of these provisions and place them in the context of wilderness management in particular. The present guide is therefore best read in conjunction with the existing general guidance and the two Directives.

Finally, this guidance document recognises that the two Nature Directives are enshrined in the principle of subsidiarity and it is for Member States to determine the management requirements arising from the Directives. The good practice procedures and proposed methodologies described in this document are not prescriptive in their intent; rather they aim to offer useful advice, ideas and suggestions based on an extensive review of existing experiences and good practices across the EU and beyond. For further reading, references to various documents and other sources of information are provided in the Annexes.

1 What is wilderness in the context of Natura 2000?

Qualities of wilderness are naturalness, free functioning natural processes, largeness and the absence of developments. Spatial analyses of wilderness qualities in EU show that areas with most wilderness qualities occur in the Boreal, Alpine and Mediterranean regions, whereas wilderness is largely missing in the Atlantic and Continental regions. A wide range of habitat types and species of Community interest benefits from wilderness management. Based on an analysis of the Common Database on Designated Areas (CDDA), around 4% of the Natura 2000 network is strictly protected (IUCN protected areas categories Ia and Ib, see chapter 1.4.1).

1.1 Introduction

This chapter provides an inclusive working definition for wilderness, taking into account aspects that are relevant for EU level guidance on management of Natura 2000 sites. It is divided into important biological and anthropogenic qualities of wilderness which can be considered management objectives of a given site. A review of the literature on definitions of wilderness, and legislative and statutory measures in use in the EU Member States to protect wilderness and wild areas is presented. Moreover, the link between Natura 2000 and wilderness areas is assessed and quantified based on European-wide datasets. The distribution of wilderness qualities in Europe is mapped using a wilderness quality index[4].

1.2 Definition of wilderness

For the purpose of this guidance document it is important to have a clear working definition on wilderness. The definition includes aspects that are relevant for EU level guidance on management in the context of the Natura 2000 framework, EU nature legislation and international commitments on protection of biodiversity. It aims to be applicable and relevant in all Member States and biogeographical regions and therefore concentrates on ecologically necessary elements.

It is created for the purpose of this management guidance document in order to a) define a general conservation objective for a group of existing protected areas and b) define the wild state of the natural environment at one end of the wilderness continuum. It is not meant to be used as qualification criterion for areas.

In this guidance document the below definition for wilderness is used:

A **wilderness** is an area governed by natural processes. It is composed of native habitats and species, and large enough for the effective ecological functioning of natural processes. It is unmodified or only slightly modified and without intrusive or extractive human activity, settlements, infrastructure or visual disturbance.

The definition includes four qualities of wilderness: a) naturalness, b) undisturbedness, c) undevelopedness and d) scale; an overarching and changing variable which by definition is central for the wilderness concept.

[4] Fisher, M., S. Carver, Z. Kun, R. McMorran, K. Arrell & G. Mitchell (2010). Review of status and conservation of wild land in Europe. Report: The Wildland Research Institute, University of Leeds, UK. 148 p.

1.2.1 Ecological aspects of the definition

Naturalness encompasses 1) the naturalness of the vegetation and associated species assemblages and 2) the natural processes involved.

Natural vegetation and its associated species are the result of biodiversity's unique evolutionary history with the local abiotic environment. Their preservation is not only important from a species protection point of view but also because it is important from the perspective of future evolution and adaptation to changing conditions.

It is important to identify the spatial and temporal scales at which the biologically relevant processes for different species and species groups take place in order to ensure that sufficient space is reserved for natural ecosystem's functions and formation of structures over time[5,6]. The minimum size differs between ecosystems and depends on the given geographic and habitat conditions. An area should be large enough for the effective functioning of natural processes.

Scale has a large impact on species diversity of natural ecosystems[7]. Larger areas offer opportunities for a more varied spectrum of habitats and habitat heterogeneity increases the number of species that will be supported by the area. Moreover, it is known that habitat patches support small local populations and the smaller the local population is the more likely it is to become extinct in the future. Lower densities of habitats also make it less likely for individuals of local populations to move successfully between the habitats and, therefore, less likely the network will support a viable metapopulation[8].

Scale is not only important from an ecological point of view but it can also be defined by anthropogenic factors. A certain size is also often required to enable the protection of whole landscapes. This is important as people identify spiritually with the wilderness and feel emotionally bound to the landscape. The size of the area often determines the perception of 'wildness', i.e. if a visitor can experience solitude, wholeness and other spiritual experiences.

The issue of sufficient scale must be considered with reference to the surrounding landscape as the quality of the surrounding landscape determines the ecological connectivity and the functioning of the ecosystems in the core area. The surrounding landscape also influences how the visitors experience the area. Therefore, wilderness is often related to remoteness, although this is not a strict prerequisite.

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5 Haila, Y., I.K. Hanski, J. Niemela *et al.* (1994). Forestry and the boreal fauna –Matching management with natural forest dynamics. Annales Zoologici Fennici 31: 187-202.

6 Kouki, J., S. Lofman, P. Martikainen *et al.* (2001). Forest fragmentation in Fennoscandia: Linking habitat requirements of wood-associated threatened species to landscape and habitat changes. Scandinavian Journal of Forest Research Suppl. 3: 27-37.

7 MacArthur, R.H. & E.O. Wilson (1967). The Theory of Island Biogeography. Princeton, N.J.: Princeton University Press. 203 p.

8 Hanski, I. (2005). The Shrinking World: Ecological Consequences of Habitat Loss. International Ecology Institute, Oldendorf. 307 p.

Undisturbedness/unhindered, means that nature is essentially unhindered and free from modern human control or manipulation. This quality is strongly related to ensuring that the natural conditions are not manipulated and therefore often refers to an administrative, statutory or legislative measure. The means to implement such measures vary between Member States and locally.

Undevelopedness is another important aspect of wilderness. Habitation, settlements or other human artefacts such as power lines, roads, railways, fences may hinder ecological processes directly or by promoting the likelihood of human interference.

1.2.2 Wilderness continuum

In Europe there are relatively few areas where all the aspects of wilderness as described above can be found in one place. More fragmented 'wild areas', however, can be found over a range of landscapes across the whole of Europe. In these areas natural processes may predominate and their habitats and species may significantly contribute to their favourable conservation status. However, the original natural ecological conditions have been slightly modified by extractive activities such as forestry and grazing, building of infrastructure or other extensive human activities. They are often relatively small in size which does not allow for a full range of natural processes and functions and consequently cannot be perceived as wilderness.

In the European context, and the Natura 2000 network in particular, it is important to notice that there is a spectrum of more or less wild areas according to the intensity of human interference. In that sense, wilderness is a relative concept which can be measured along a 'continuum', with wilderness at one end and marginal used land at the other[9]. Re-wilding is a process to move areas up towards a wilder state, where the final stage is wilderness[10].

1.2.3 Use of the definition in the guidance document

In this guidance document the term 'wilderness' is applied to protected areas where management objectives of the site aim at achieving those objectives. The term 'wilderness' is also used for areas outside protected areas where most of the wilderness qualities are found.

The term 'wild area' is used for sites in protected areas and outside protected areas where only some of the wilderness qualities are found, where the conservation objectives aim at achieving only part of the wilderness qualities, or where the objective is to fully restore natural processes and features with the aim to extend the wilderness core zone.

[9] See example of wilderness quality index in BISE: http://www.eea.europa.eu/data-and-maps/figures/wilderness-quality-index

[10] European Wilderness Working Group (2011). A Working Definition of European Wilderness and Wild Areas and its application. Discussion draft, 8 November 2011.

1.3 Other existing definitions

The word wilderness has different meanings and connotations in different contexts, languages and cultures. Therefore, it is highly useful to reflect on the definition used in this guidance and compare it with the most commonly used ones internationally. Table 1.1 gives an overview of definitions for wilderness and wild areas as used by organisations involved in wilderness protection and management.

Table 1.1. Comparison of various existing definitions for wilderness with key-biological features and anthropogenic qualities.

Definitions	Key-biological features	Anthropogenic qualities
1. A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognised as an area where the earth and its community of life are undisturbed by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.[11]	• untrammelled biophysical and biological elements • no human habitation or control • primarily affected by natural forces • at least 5,000 acres (~2,000 ha)	• outstanding opportunities for solitude or a primitive and unconfined type of recreation
2. A wilderness is a large area of unmodified or slightly modified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition[12].	• large area • unmodified • no permanent habitation • preservation of natural condition	
3. A wilderness is a landscape with a completeness of the native biophysical elements characteristic of the natural forces prevailing, as well as the geomorphological properties of the location such as water, geology, and land form[13].	• completeness of biophysical elements • completeness of geomorphological properties • natural forces prevailing	
4. Wildernesses are the most intact, undisturbed wild natural areas left on our planet – those last truly wild places that humans do not control and have not developed with roads, pipelines or other industrial infrastructure. A core aspect of wilderness is biological intactness[14].	• biological intactness • no human control • no infrastructure	
5. Wilderness areas are large unmodified or only slightly modified natural areas, governed by natural processes, without human intervention, infrastructure or permanent habitation, which should be protected and overseen so as to preserve their natural condition and to offer	• large natural area • predominance of natural processes • no human habitation • no intervention	• experience of spiritual quality

[11] US Wilderness Act (1964). http://www.wilderness.net/index.cfm?fuse=NWPS&sec=legisAct

[12] IUCN (2008). Guidelines for Applying Protected Area Management Categories; http://data.iucn.org/dbtw-wpd/edocs/PAPS-016.pdf

[13] Fisher, M., S. Carver, Z. Kun, R. McMorran, K. Arrell & G. Mitchell (2010). Review of status and conservation of wild land in Europe. Report: The Wildland Research Institute, University of Leeds, UK. 148 p.

[14] The Wild Foundation; http://www.wild.org

people the opportunity to experience the spiritual quality of nature[15].		
6. Wilderness areas can be described as large territories without major human interference, the lack of which allows for natural processes to occur and wildlife to thrive in their natural ecological state. The protected area has an ecologically unfragmented wilderness area of at least 10,000 hectares where no extractive uses are permitted and where the only management interventions are those aimed at maintaining or restoring natural ecological processes and the ecological integrity[16].	• large territory • no human interference • natural processes prevailing • unfragmented core area of at least 10,000 hectares • no extractive uses	
7. Wilderness areas are large natural areas free from human habitation and intervention, governed by natural processes, where people can experience the spiritual quality and sense of place in a manner that leaves the area unimpaired for future generations, areas unique to wildness, which represents a vital element of Europe's natural and cultural heritage. Wilderness areas can bring important economic, social and environmental services for local communities[17].	• large natural areas • no human habitation • no intervention • natural processes prevailing • environmental services	• experience of spiritual quality • vital element of natural and cultural heritage • socio-economic services
8. Wilderness areas are places where wilderness quality is recognised and valued by society and are defined using arbitrary thresholds of remoteness, naturalness and total area. Wilderness quality is the extent to which any specified unit area is remote from and undisturbed by the impacts and influence of modern technical society[18].	• naturalness • remoteness • undisturbed by impacts from modern society	• wilderness quality valued by society
9. A wilderness is an area governed by natural processes. It is composed of native habitats and species, and large enough for the effective ecological functioning of natural processes. It is unmodified or only slightly modified and without intrusive or extractive human activity, settlements, infrastructure or visual disturbance.	• predominance of natural processes • presence of native habitats and species • large natural area • no intrusive or extractive human intervention • little human habitation	

The key biological features of wilderness areas in these existing definitions are naturalness, the prevalence of natural processes, undisturbedness, largeness, remoteness, and the absence of developments. Anthropogenic qualities are related to solitude and experiencing spiritual, natural and cultural heritage qualities.

The ecologically important features of these definitions are covered by the scope of this guidance. Qualities perceived by man are not directly in the scope of this document as they are strongly dependent on cultural conditions, vary between Member States, and are not directly relevant for the achievement of the general objectives of the Directives. However, those qualities are of crucial importance when management methods are selected and they are referred to in the relevant chapters of the guidance.

[15] European Wilderness Working Group (2011). A Working Definition of European Wilderness and Wild Areas and its application. Discussion draft, 8 November 2011.

[16] PAN Parks (2009). As nature intended. Best practice examples of wilderness management in the Natura 2000 network. Report. 42 p.

[17] European Wilderness Working Group, Vienna, August 2010.

[18] Mackey, B., R. Lesslie, D. Lindenmayer, R. Incoll & H. Nix (1999). The role of wilderness and wild rivers in nature conservation. http://www.environment.gov.au/heritage/wwr/anlr 0999/code/pub.html; 108 p.;

1.4 Legislative and statutory measures in EU Member States to protect wilderness

Wilderness and wild areas across Europe receive protection through national legislation and statutory measures. The provisions for protection differ between the Member States, ranging from a total exclusion of all human presence, to selective presence for scientific research, educational reasons, or hiking and subsistence use of indigenous people.

For cultural, historical and ecological reasons the systems of protected areas vary between Member States. Based on analysis of the management objectives of the areas, the Member States' protected area schemes and their relevance for the protection of wilderness qualities can be analysed. The IUCN protected areas categorisation[19] is an established method for the categorisation of management objectives.

1.4.1 Strict nature reserve and wilderness (IUCN categories Ia and Ib)

Protected areas with wilderness qualities can most evidently be found classified under categories Ia and Ib (strict nature reserve and wilderness).

Twelve Member States of the EU 27 apply a type of protected area corresponding to 'strict nature reserve' (Ia) or 'wilderness' (Ib) area as described in IUCN protected areas categorisation and its interpretation guidelines (Belgium-Wallonia, Bulgaria, Estonia, France, Finland, Greece, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia). A list of legislation aiming at protection of wilderness by these Member States is given in Annex A3.

Comparison of national legislations for protected areas of category Ia/Ib shows that provisions for protection of 'strict nature reserves' and 'wilderness' differ between the Member States.

Naturalness: Most Member States state in their legislation that strict nature reserves are protected areas unaffected by direct human activity (e.g. Estonia), untouched or nearly natural (Latvia) or naturally preserved geotopes and habitats where natural processes take place without human influence (Slovenia). In some cases it is explicitly mentioned that restoration of natural development is allowed (Finland).

Scale: Some Member States define the minimum size of strictly protected areas, such as Finland (1,000 hectares), but most do not. Aspect, such as scale of natural processes, may be included in the designation processes but strict protection regimes as such in EU Member States would not seem to ensure that the scale of natural processes in strictly protected areas is considered.

Undisturbed: Some Member States (Bulgaria, Estonia, Slovenia) prohibit all human activities, except the presence of persons for supervision, rescue, scientific research or protection activities or visitors using marked hiking trails (Bulgaria, Estonia). Others are much less strict and allow restricted economic, recreational and educational activities (Latvia). Others may allow under certain conditions, i.e. if it does not endanger the objectives for which the site has been established,

[19] IUCN (2008). Guidelines for Applying Protected Area Management Categories; http://data.iucn.org/dbtw-wpd/edocs/PAPS-016.pdf

the picking of mushrooms and berries (Finland). Finland also may allow activities such as reindeer herding, ice fishing and angling with the same prerequisite. Most Member States don't allow any form of extractive use of resources (Bulgaria, Estonia, Slovenia).

Undeveloped: In some Member States (Finland) it may be allowed to build and restore accommodation for visitors, or the building and restoration of roads if necessary for guidance purposes, provided this does not jeopardise the purpose for which it was established.

While it is reasonable to assume that the strict statutory protection schemes described above are in most cases used to protected wilderness qualities, it must be kept in mind that the list is not complete and that that one Member State may be using other types of nationally protected areas to protect wilderness qualities. Some of the national schemes are flexible in terms of legal framework, but strict provisions for the protection of wilderness qualities are described e.g. on the level of decree, order, by law or agreement.

1.4.2 Other IUCN categories

Substantial areas for protection of wilderness qualities are protected in Member States by means other than assigning a strict protection status for the whole area. Wilderness qualities are often protected for instance in national parks (IUCN category II) where substantial areas can be set aside as strictly protected wilderness zones by means of management planning. National parks themselves are often not established primarily to ensure natural development but a non-intervention approach can be applied to part of the area, while visitor infrastructure is built, visitor flows steered and cultural landscapes managed in another part of the area.

Additionally, it is important to note in this context that the categorisation developed by IUCN is based on management objectives, it happens that protected areas are assigned to a certain category based on intended future use, rather than the present condition, or are sometimes not managed according to the objectives of their designations[20].

Finland has protected part of its wilderness areas with a unique system that merits categorisation under category VI.

Finland defines in its Act on Wilderness Reserves (1991) wilderness as those places established: "*to preserve the wilderness character of the areas, to protect Sami culture and the traditional subsistence of the areas, and to enhance possibilities for multiple use of nature*." The Finnish concept of wilderness is unique in Europe; human use is an essential part of the wilderness character of the areas. This type of Wilderness Reserves is classified under IUCN category VI (protected area with sustainable use of natural resources)[21] by Finland. The Finnish wilderness concept has its roots in ancient hunting and fishing culture. Finnish wildernesses are valued for livelihood, cultural tradition and recreation. They provide income through reindeer husbandry, fishing, hunting, picking cloudberries and nature tourism. They are intended to protect the

[20] Leroux, S.J., M.A. Krawchuk, F. Schmiegelow, S.G. Cumming, K. Lisgo, L.G. Anderson & M. Petkova (2010). Global protected areas and IUCN designations: do the categories match the conditions? Biological Conservation 143: 609-616.

[21] Kajala, L. (2004). Definition of wilderness and allowed uses in wilderness areas in Finland. Metsähallitus, 17 p.

character of the wilderness areas from road infrastructure and mining. The forests in wilderness areas are kept in a natural state.

1.5 Spatial link between wilderness and the Natura 2000 network

Many Member States apply a protection regime in parts of their Natura 2000 sites that focuses on the preservation of natural conditions by setting aside areas for nature, or non-intervention management. It was estimated that around 4% of the Natura 2000 network is protected under strict regime (IUCN protected areas categories Ia and Ib) (Fig. 1.1). It has been reported before that 99% of protected sites of IUCN category Ia/Ib showed an overlap with the Natura 2000 network[22]. As explained in the previous section, these figures do not cover all areas that effectively contribute to the protection of wilderness qualities. To get a comprehensive estimate of the *total* area of protected wilderness in EU27 we should also add (parts of) those national parks and nature parks which are managed as wilderness (as partly the case in France, Finland and Sweden, for instance). This, however, would need analyses of site level data, including management plans and site specific protection provisions.

Moreover, a 'size' parameter is difficult to include in this kind of spatial analysis. When discussing the sufficiency of size of wilderness, an understanding of the fundamental ecological processes and functions, along with their dynamic interaction with environmental changes and ecological disturbances typical for the area is crucial. Furthermore, the required size is relative, as the quality of the larger surrounding landscape must also be considered.

By using the existing datasets, i.e. CDDA, and combining it with the Natura 2000 database it is possible to give only an estimate of the magnitude of wilderness protection in the Natura 2000 network. The CDDA database (hosted by the European Environment Agency) of nationally designated areas holds information on protected sites and about the national legislative instruments, which create protected areas. However, the CDDA-data for category Ia/Ib are partly biased because not all Member States have the same interpretation of these categories. This may result in a false estimate of areas protected with the objective to protect wilderness qualities. Moreover, analyses have revealed that the spatial data in the CDDA-database are incomplete[22]. Therefore, using available databases to localise wilderness areas in Europe only gives a rough and far from complete overview.

An alternative approach is mapping, using a GIS-based approach. It is possible to map wilderness and wild areas by using attributes that indicate wilderness qualities: e.g. naturalness of vegetation, ruggedness of the landscape, road and railway density, population density and the presence of settlements.

A 'wilderness map' for Europe has been published by EEA (2010)[23]. This map was based on the work of the University of Leeds[22] and used a set of criteria linked to remoteness and naturalness. The maps show that the highest values of wilderness index may be found in the Boreal and Alpine

[22] Fisher, M., S. Carver, Z. Kun, R. McMorran, K. Arrell & G. Mitchell (2010). Review of status and conservation of wild land in Europe. Report. The Wildland Research Institute, University of Leeds, UK. 148 p.

[23] http://www.eea.europa.eu/data-and-maps/figures/wilderness-quality-index

regions, and to some extent in the Mediterranean region. Smaller and more isolated areas may also occur in other areas of Europe.

For marine areas it is rather difficult to find data related to their 'wilderness qualities'. Important attributes here might be: pelagic and demersal fishing activity, oil platform and mining activities, pollution (fertilizers, organic) and shipping activity[24].

[24] See e.g. Halpern, B.S. *et al*. (2008). A global map of human impact on marine ecosystems. Science 319: 948-952.

2 EU policy framework on biodiversity preservation

The EU Birds Directive (EC, 1979) and Habitats Directive (EC, 1992) committed the EU Member States to set up a 'coherent European ecological network of protected areas, named Natura 2000'. The Natura 2000 network aims to ensure biodiversity conservation beyond national boundaries. The legislation aims to achieve the favourable conservation status of habitats and species, according to Article 6(1) of the Habitats Directive and to Article 4(1) and 4(2) of the Birds Directive. The European Commission publishes guidance documents to assist in the application of the two Nature Directives.

2.1 EU Biodiversity strategy

The Convention on Biological Diversity (CBD, article 2) defines biological diversity as "the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species *and of ecosystems*". The conservation of whole ecosystems, including the characteristics and inherent natural processes, is an explicit aim of the CBD[25].

The EU is internationally committed to the protection of biodiversity, and to halting biodiversity and reversing loss within the EU by 2020[25]. In May 2011, the European Commission launched a new strategy to halt and reverse biodiversity loss by 2020[26]. The strategy includes six main targets, and twenty actions, which address the main drivers of biodiversity loss, and which will reduce the main pressures on nature and ecosystem services in the EU by anchoring biodiversity objectives in key sectoral policies. These include:

- full implementation of existing nature protection legislation and network of natural reserves, to ensure major improvements to the conservation status of habitats and species;
- improving and restoring ecosystems and ecosystem services wherever possible, notably by the increased use of green infrastructure;
- ensuring the sustainability of agriculture and forestry activities;
- safeguarding and protecting EU fish stocks;
- controlling invasive species, a growing cause of biodiversity loss in the EU;
- stepping up the EU's contribution to concerted global action to avert biodiversity loss.

The protection and, where necessary, restoration of Europe's last wilderness areas can significantly contribute to halting the loss of biodiversity. The benefits of these wilderness areas are significant, especially in terms of retaining biodiversity and for addressing the adverse effects of climate change[27].

[25] http://www.cbd.int/convention/articles/?a=cbd-02

[26] http://ec.europa.eu/environment/nature/biodiversity/policy/index_en.htm

[27] Locke, H. & B. Mackey (2009). The Nature of Climate Change, Reunite International Climate Change Mitigation Efforts with Biodiversity Conservation and Wilderness Protection. International Journal of Wilderness 15: 7-13.

This guidance document will directly contribute to the attainment of four of the six priority targets -Protecting and restoring biodiversity and associated ecosystem services (targets 1 and 2) and Reducing key pressures on EU biodiversity (target 3 and 5). Under target 2, action 6b on Green Infrastructure relies on wilderness areas hosting multiple ecosystem services as core areas, which could become instrumental e.g. in reducing fragmentation of ecosystems and improving the coherence of the Natura 2000 network. Under target 3, Action 10 aims to conserve Europe's agricultural genetic diversity which also includes the in situ conservation of crop wild relatives, and action 11 encourages forest holders to protect and enhance forest biodiversity. Action 12 aims to integrating biodiversity measures in forest management plans by ensuring that forest management plans as much as possible include a range of measures, one of which being the preservation of wilderness areas.

2.2 EU Nature Directives

At the core of EU biodiversity policy are the Birds and Habitats Directives, which provide the legal basis for the Natura 2000 network of protected areas. The ultimate objective is to ensure that the species and habitat types are maintained or restored to a favourable conservation status across their natural range[28].

In addition to designating sites under the Natura 2000 Network, Article 10 of the Habitats Directive also requires Member States to endeavour to improve the ecological coherence of the network across the broader countryside by maintaining and, where appropriate, developing features of the landscape which are of major importance for wild fauna and flora, such as wildlife corridors or stepping stones, which can be used during migration and dispersal[29].

For wilderness management, the most relevant provisions are those that relate to natural processes and allow sufficient scale for them, most prominently to the management of the Natura 2000 network and to Article 10 of the Habitats Directive.

[28] The concept of 'favourable conservation status' is not mentioned in the Birds Directive but there are analogous requirements, i.e. all SPAs must still be subject to special habitat conservation measures in order to ensure the survival and reproduction of the Annex I birds in their area of distribution.

[29] Kettunen, M. *et al.* (2007) for guidance on the maintenance of landscape features in consistency with Article 10 of the Habitats Directive and Article 3 of the Birds Directive; http://ec.europa.eu/environment/nature/ecosystems/docs/adaptation_fragmentation_guidelines.pdf

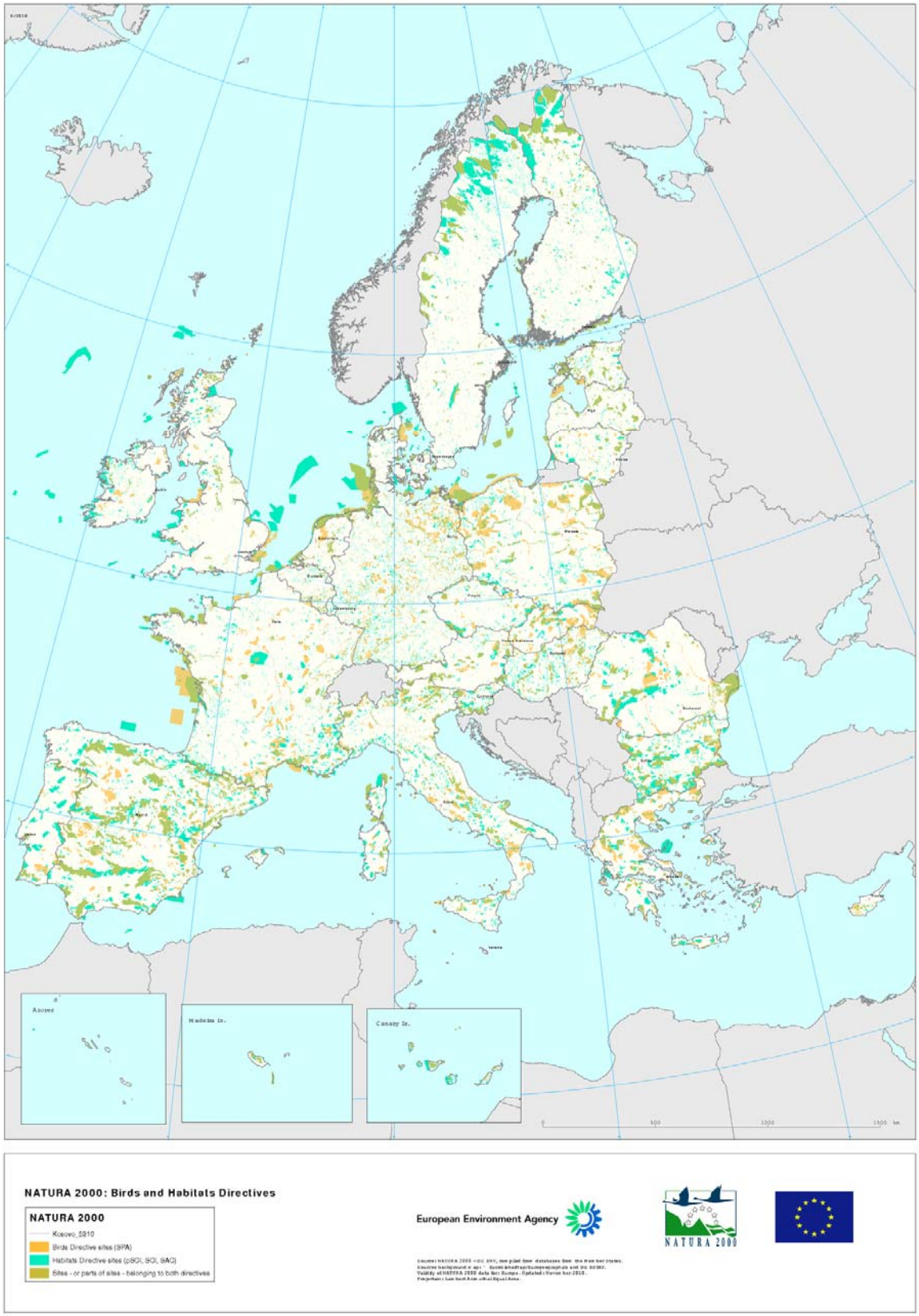

Figure 2.1 The Natura 2000 network across EU 27 (status November 2010; Source: EEA).

2.3 Managing and protecting Natura 2000 sites

The provisions of Article 6 of the Habitats Directive and Article 4(1) and 4(2) of the Birds Directive relating to the management and protection of Natura 2000 sites are explained in the Commission guidance ' Managing Natura 2000 sites: The provisions of Article 6 of the Habitats Directive 92/43/EEC'[30]. The guidance document describes in detail the requirements in relation to the protection and management of the sites; including statutory, administrative or contractual. Whereas Article 6(1) deals with pro-active conservation measures[31] that are required to be taken for Special Areas of Conservation (SACs), Article 6(2), 6(3) and 6(4) include measures to prevent deterioration of the sites as well as procedural safeguards to deal with plans and projects that may significantly affect the sites.

The Member States are responsible for the protection and management of the Natura 2000 sites and they may choose more stringent measures than those provided by the Nature Directives. Article 2(3) of the Habitats Directive states that measures taken pursuant to the Directive shall take account of economic, social and cultural requirements and regional and local characteristics. The Birds Directive has similar provisions in Article 2.

National systems of protected areas enable Member States to incorporate their regional and local characteristics along with economic, social and cultural requirements into their individual management strategies. The national systems of protected areas are often fine-tuned to be sensitive to such requirements and characteristics. Moreover, some systems were implemented already before the Birds and Habitats Directives came into force. Communities sometimes also attach particular values to various protected areas and individual sites. This may be the case for example with areas associated with national or regional identity, such as national parks and national landscapes.

According to Article 4(4) of the Habitats Directive Member States must designate their sites of Community importance as a special area of conservation as soon as possible and within six years at most. The competent authorities in each country should identify conservation targets and establish conservation measures for Natura 2000 sites at the moment of their designation as an SAC or SPA. The conservation targets and measures are to be based on the status and ecological requirements of the habitats and species for which the sites are designated in Natura 2000. The ultimate objective is to ensure that the species and habitat types are maintained or restored to a favourable conservation status across their natural range[32].

Objectives, targets and measures for the management of wilderness areas in Natura 2000 network are discussed in detail in Chapter 4.

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[30] Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC.

[31] Art. 6.1:"*For special areas of conservation, Member States shall establish the necessary conservation measures involving if need be, appropriate management plans specifically designed for the sites or integrated into other development plans and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the site.*"

[32] The concept of 'favourable conservation status' is not mentioned in the Birds Directive but there are analogous requirements, i.e. all SPAs must still be subject to special habitat conservation measures in order to ensure the survival and reproduction of the Annex I birds in their area of distribution.

2.4 Favourable conservation status

The ultimate objective of the Habitats Directive is to ensure that the species and habitat types covered reach what is called a '*favourable conservation status*' (FCS) and that their long-term survival is deemed secure across their entire natural range within Europe. The conservation status of natural habitat types and species present on a site is assessed according to a number of criteria established by Article 1 of the Directive. The assessment of the FCS is done at the biogeographical level. The effects of climate change on Natura 2000 are addressed in a special guidance document[33].

In simple terms, FCS could be described as a situation where a habitat type or species is doing sufficiently well in terms of quality and quantity and has good prospects of continuing to do so in the future. The fact that a habitat or species is not threatened, i.e. not faced with any direct extinction risk, does not necessarily mean that it has a favourable conservation status. The target of the Directive is defined in a positive way as a 'favourable' situation to be reached and maintained. Therefore, the obligation of a Member State is more than just avoiding extinction.

In the case of the *species* covered by the Directive this means that:

- populations are maintaining themselves over the long term and are no longer showing signs of continuing decline;
- their natural range is not being reduced;
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

In the case of a *habitat type*, a favourable conservation status is achieved when:

- its natural range and the areas it covers within that range are stable or increasing; and
- the specific structure and function which are necessary for its long-term maintenance are present and are likely to continue to exist in the foreseeable future;
- the conservation status of typical species that live in these habitat types is favourable as well.

The concept of FCS is not limited to the Natura 2000 network or to the species protected by this network (i.e. Annex II species). It applies to the overall situation of all species of Community interest (Annexes II, IV and V), which needs to be assessed and surveyed in order to determine their current conservation status. Assessing and evaluating the conservation status of habitats and species within the Natura 2000 network is therefore not always enough, especially when the occurrences of habitats or species are only partly covered by the network, maybe even in some cases only to a relatively small extent.

Wilderness areas play a significant role in achieving favourable conservation status of many species and habitats of Community importance. Wilderness qualities in a landscape contribute to the

[33] Managing climate change for the Natura 2000 network (available at http://ec.europa.eu/environment/nature/climatechange/))

resilience of ecosystems against disturbances (see paragraph 3.1) and hence to the long term survival of its habitats and species.

Wilderness areas are also important for the structures and functions and typical species of many habitat types of Community interest. Given the wide range of habitat types listed in Annex I and their inherent variability, it is not possible to give detailed guidance for each individual habitat type. However, it is clear that the various ecological processes essential for a habitat type must be present and functioning for the habitat type to be considered to be at favourable conservation status. Although, fragmentation is not mentioned in the Directive and can have some positive benefits in forest management (e.g. forest fire prevention) it can also disrupt habitat function and is a factor that should be taken into account when assessing the conservation status of habitats. The Directive uses the term 'typical species' but it does not give a definition, either for use in reporting or for use in impact assessments. In the guidance for Article 17 reporting it is advised to select typical species that reflect and are linked to favourable structure and functions of the habitat type, although it will not be possible to associate species with all aspects of structure and function. Given the variability of the Annex I habitats it is not realistic to have recommended lists of typical species, even for a biogeographical or marine region, indeed even within one country different species may be needed in different parts of the range of a habitat or for different subtypes[34].

2.4.1 Requirements under Article 6 of the Habitats Directive

Ecological requirements

As explained in the Commission guidance 'Managing Natura 2000 sites' conservation measures in Natura 2000 sites have to correspond to the ecological requirements of the natural habitat types of Annex I and the species in Annex II present on the site. These ecological requirements rest on scientific knowledge and can only be defined on a case-by-case basis, according to the natural habitat types of Annex I, the species of Annex II, as well as the sites which host them.

The ecological requirements can vary from one species to another but also for the same species from one site and biogeographical region to another.

The ecological requirements of habitats need to be reflected in relation to their typical species and the specific structure and function, as these are the aspects which define a habitat *per se*. These are also aspects that need to be considered in terms of favourable conservation status for habitats. Typical species of the habitat are not necessarily found in the Annexes to the Habitats Directive, but they usually include naturally occurring bird species and fall in the scope of Birds Directive.

Wilderness areas are potentially important for the favourable conservation status of a large set of habitats and species of Community interest. However, the identification of the ecological requirements of the natural habitat types of Annex I and the species of Annex II present on the sites is the responsibility of the Member States. The latter may wish to exchange their knowledge in

[34] European Topic Center (2011). Assessment and reporting under Article 17 of the Habitats Directive. Explanatory Notes & Guidelines for the period 2007-2012. Final Draft July 2011.

this field, with the support of the European Commission and the European Environment Agency/European Topic Centre for Nature Conservation. Some information about the characteristic species can also be found in the 'Interpretation manual of the European Union habitats'[35].

Article 6 of the Habitats Directive

1. For special areas of conservation, Member States shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites.

2. Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.

Article 4 of the Birds Directive

1. The species mentioned in Annex I shall be the subject of special conservation measures concerning their habitat in order to ensure their survival and reproduction in their area of distribution.

In this connection, account shall be taken of:
(a) species in danger of extinction;
(b) species vulnerable to specific changes in their habitat;
(c) species considered rare because of small populations or restricted local distribution;
(d) other species requiring particular attention for reasons of the specific nature of their habitat.

Trends and variations in population levels shall be taken into account as a background for evaluations.

Member States shall classify in particular the most suitable territories in number and size as special protection areas for the conservation of these species in the geographical sea and land area where this Directive applies.

2. Member States shall take similar measures for regularly occurring migratory species not listed in Annex I, bearing in mind their need for protection in the geographical sea and land area where this Directive applies, as regards their breeding, moulting and wintering areas and staging posts along their migration routes. To this end, Member States shall pay particular attention to the protection of wetlands and particularly to wetlands of international importance.

Habitat types of Community interest that benefit from wilderness management

Wilderness areas significantly contribute to the favourable conservation status of a large set of natural habitat types, i.e. primary habitats, and the species they host. These habitats are unmodified habitats that are maintained by the dynamic forces of nature. The management requirements of these habitats differ from those of *semi-natural* habitats which have arisen through human management and use of land, and their continued existence is dependent on that.

Examples of habitats that benefit from non-intervention management can be found under all habitat groups under Annex I to the Habitats Directive. Those habitat types are aquatic as well as terrestrial, or closed woodlands as well as open grasslands, dunes, peatlands or rocky habitats.

[35] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/2007_07_im.pdf

*Pannonic salt steppes and salt marshes (habitat type 1530), Alpine and subalpine calcareous and siliceous grasslands (6150, 6170), *Active raised bogs (7110), *Western Taiga (9010), *Bog woodland (91D0), and Riparian hardwood forests along rivers (91F0) are examples of habitats that can survive without human intervention as a result of abiotic conditions and natural disturbances. Large coastal dune complexes are formed by dynamic eolic processes resulting in the maintenance of a variety of dune habitats. River systems with intact natural hydromorphological processes are also examples of primary habitats with good conservation values maintained by the prevailing abiotic conditions and natural processes.

An approach that considers the scale of natural processes and dynamics of ecosystems is relevant for the natural regeneration of many habitats. The allowance of natural disturbances, the temporal and spatial variation in environmental conditions and the competition between individuals contribute to a diverse environment at many spatial scales and supports the prevalence of a wide range of their typical species. For instance, many rare and threatened plant, fungi and animal species depend on the natural developmental stages of forests, rich in veteran trees and decaying wood. These can develop only in forests subjected to a long-lasting regime of natural processes, including disturbances such as storms and wild fire[36].

It should be noted that a primary habitat in one biogeographical region may be a secondary habitat in another region, where it requires management for its maintenance. For instance many grassland and heathland habitats are likely to be primary habitats in the Alpine and Boreal biogeographical regions, but are mostly secondary habitats in the Atlantic or Continental regions[37].

Scientific knowledge on ecology of Habitats of Community importance, especially their structures and functions and typical species, is already vast but more research is needed even in relation to the most studied ones.

To collect examples of habitat types that are of particular importance in terms of wilderness, and whose favourable conservation status benefits from non-intervention management a questionnaire was sent to Natura 2000 site managers of wilderness areas throughout Europe. They were asked to mention the five most important habitat types in their areas representing wilderness value. This gave a list of 80 habitat types (see Annex A5). Although this list gives a picture of the types of habitats that benefit from wilderness management, it is not complete as some biogeographical regions were not represented in the questionnaire and not all potentially benefitting habitat types and species are included.

Species of Community interest that benefit from wilderness management, other than birds

It is suggested in the scientific literature[38] that the following traits are expected to make a species particularly sensitive to fragmentation: low population density, high-amplitude population

[36] Stachura-Skierczyńska, K. & M. Walsh (Eds.) (2010). Against the grain: Improving the management of NATURA 2000 sites and other forests in the EU. BirdLife European Forest Task Force. BirdLife International.

[37] Fisher, M., S. Carver, Z. Kun, R. McMorran, K. Arrell & G. Mitchell (2010). Review of status and conservation of wild land in Europe. Report: The Wildland Research Institute, University of Leeds, UK. 148 p.

[38] Henle, K., K. Davies, M. Kleyer et al. (2004). Predictors of species sensitivity to fragmentation. Biodiversity & Conservation 13: 207-251.

fluctuations, low reproductive potential, limited storage effects, intermediate or low dispersal capacity, and specialised habitat requirements.

Habitat fragmentation and reduced size of individual fragments often lead to adverse environmental changes[39, 40] which are likely to influence specialist species more than generalists[41]. This is true for example for habitat specialists such as several threatened polypore species that prefer large dead trees or old-growth forests and they are expected to have a higher extinction risk than habitat generalists[42].

Some saproxylic species such as *Phyto kolwensis* with its general ecological requirement of long continuum of deadwood can serve as an example (see next text box). For this species the necessary conservation measures include the insurance of a supply of deadwood. However, a single trait of ecological requirement cannot be treated in isolation. In the case of *P. kolwensis*, the poor dispersal capacity should be taken into account and a sufficient scale and network for a viable long-term metapopulation should be ensured.

Many other invertebrate species as well, such as saproxylic beetles, are dependent on non-managed forests with large amounts of lying dead wood and standing decaying veteran trees, which they need for their larval stage of their life cycle (see the example of Western Taiga hereafter). Scientific knowledge on such species and species groups is already vast and growing but more research is needed.

Large mammal species such as Brown Bear (*Ursus arctos*), Grey Wolf (*Canis lupus*), Eurasian Lynx (*Lynx lynx*), Elk (*Alces alces*), European Bison (*Bison bonasus*), and Beaver (*Castor fiber*) benefit from large scale natural areas[43]. They benefit from large areas as this helps to minimise any conflicts, but it is difficult to link them to any given wilderness related trait as they also thrive near human habitations. Large carnivore species have a role in natural ecosystems as top predators. They contribute to the regulation of herbivore density and therefore indirectly influence the grazing pressure. Carnivores can also influence herbivore pressure through behavioural modification, instilling fear and flight in their prey. For example, in Yellowstone National Park, behaviour modification gave rise to the spatially explicit regeneration of Aspen after the reinstatement of the Grey Wolf[44].

A list of species of Community interest representing wilderness values was compiled by asking site managers of wilderness areas to list the five most important species representing wilderness value. This gave a list of 72 species of the Habitat Directive and 59 of the Birds Directive (see Annex A6).

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39 Saunders, D.A., R.J. Hobbs & C.R. Margules (1991). Biological consequences of ecosystem fragmentation –A review. Conservation Biology 5: 18-32.

40 Harrison, S. & E. Bruna (1999). Habitat fragmentation and large-scale conservation: what do we know for sure? Ecography 22: 225-232.

41 Henle, K., D.B. Lindenmayer & C.R. Margules *et al.* (2004). Species survival in fragmented landscapes –where are we now? Biodiversity & Conservation 13: 1-8.

42 Penttilä, R., M. Lindgren, O. Miettinen, H. Rita & I. Hanski (2006). Consequences of forest fragmentation for polyporous fungi at two spatial scales. Oikos 114: 225-240.

43 Mills, L.S., M.E. Soulé & D.F. Doak (1993). The keystone-species concept in ecology and conservation. BioScience 43: 219-224.

44 Trophic Cascades Program, Oregon State University; http://www.cof.orst.edu/cascades/index.php

Although this list gives a good overview of species of Community interest for which wilderness management is important, it is far from complete.

Saproxylic species benefit from a wilderness approach

Example: **Western Taiga* (habitat type 9010)
Biogeographical region: *Boreal*

Western taiga is a complex forest habitat type, ranging from dry pine forest (*Pinus sylvestris*) to damp spruce forest (*Picea abies*). Much of its composition is dependent upon its history. Some stands may be quite young, having regenerated after a forest fire that would have occurred over a hundred years ago, whilst others will be significantly more mature. Natural undisturbed western taiga - i.e. not subjected to commercial forestry – is extremely rich, providing habitats for many threatened species of lichens, bryophytes, fungi, insects (mainly beetles, such as the threatened *Phyto kolwensis*) and birds. The dead wood, in particular, plays a central role in maintaining this high conservation value. The endangered White-backed Woodpecker (*Dendrocopos leucotos*) is an important umbrella species in this habitat type. The preferred habitat for the White-backed Woodpecker is also used by many other red-listed species favoured by high abundance of dead wood and high proportion of deciduous trees.

Fire with a cycle of 70-100 years is the most important natural disturbance for maintaining a mosaic of young and old succession stages which are important habitats to many endangered species. Wild fires open up the closed tree canopies, allowing sunlight to reach the forest floor and shaping optimal light condition for a rich herbaceous ground cover and associated fauna. For some species wild fires are a necessary part of the life cycle. Certain coniferous trees have cones which only open to release their seed after a fire and disperse their seed on a cleared soil characterised by a temporally flush of nutrients due to the burning. The taiga hosts large mammal species such as Brown Bear, Eurasian Lynx, Grey Wolf, Elk and Reindeer and a range of middle-sized mammal species such as Beaver (*Castor fiber*), Red Squirrel (*Sciurus vulgaris*) and Hare (*Lepus* spp.).

Direct and indirect effects of forest management have been identified as the primary threat to flora and fauna in forest habitats (e.g. Rassi *et al.,* 2010). Species inhabiting decaying wood, including many cryptogams, wood-decaying fungi and insects have suffered the most. Intensive forest management reduces the amount of dead wood at both the level of individual stands and the landscape. For instance, saproxylic beetles alone are represented by 800 species in Finland, of which 151 (19%) have been classified as threatened (Siitonen & Saaristo, 2000). *Phyto kolwensis* serves as an example of a species that requires fire refugia, i.e. forests with very long continuity. Non-intervention management in western taiga thus favours a broad spectrum of species, in particular species that depend on decaying wood for their life cycle.

Rassi, P., E. Hyvärinen, A. Juslen & I. Mannerkoski (Eds.) (2010). The 2010 Red List of Finnish Species. Ympäristöministeriö ja Suomen ympäristökeskus, Helsinki. 685 p .
Siitonen, J. & L. Saaristo (2000). Habitat requirements and conservation of *Phyto kolwensis*, a beetle species of old-growth boreal forest. Biological Conservation 94: 211-220.

2.4.2 Requirements under Article 4(1) and 4(2) of the Birds Directive

Article 4(1) and 4(2) of the Birds Directive require special conservation measures to be applied to habitats of the species mentioned in Annex I to the Birds Directive and regularly occurring migratory species not listed in the Annex I. As mentioned earlier, the content of these provisions is similar to those of Article 6(1) of the Habitats Directive but refer specifically to Special Protection Areas classified under the Birds Directive.

However, in terms of wilderness the provisions 4(1)b and 4(1)d deserve a closer look. Those provisions require that the measures take account of '*species vulnerable to specific changes in their habitat*' and '*species requiring particular attention for reasons of the specific nature of their habitat'*. Specific changes in a given habitat can be interpreted to mean changes that make the

habitat fail to correspond to the ecological requirements of a given species. Bird species requiring old-growth forest habitats and vulnerable to human interference, would serve as an example for this. With regard to wilderness relevant '*specific nature of habitat*', prevalence of deadwood and saproxylic beetles, can be taken as an example. However, Member States themselves should identify the most suitable and effective conservation measures. The exchange of knowledge regarding how to manage habitats for specific birds species is promoted by the European Commission and supported by EEA/ETC. Effective conservation of migratory birds in particular, mostly requires international cooperation.

Unlike those measures described above for the Habitats Directive, there is no obligation to take necessary special conservation measures for SPAs. However, management plans, statutory, administrative or contractual measures are appropriate special conservation measures. The application of measures is the responsibility of the Member States. Management plans can be developed up for Special Protection Areas (SPAs) and the same general principles shall apply as those existing for the management plans developed for SACs.

Bird species of Community interest that benefit from wilderness management

Bird species that are specialist of old-growth forest are important in terms of wilderness. Old-growth forest specialist species in boreal and temperate areas include Three-Toed Woodpecker *Picoides tridactylus* and Red-Breasted Flycatcher *Ficedula parva*[45]. Tucker *et al.* (1997) identified 27 (threatened and habitat depended) species in Europe that excavate their own or use natural or abandoned holes. All of these species would seem to benefit from a wilderness approach and from an increase in dead trees.

In the Mediterranean region species that need old, mature forest stands with dead or tall emergent trees include Black Stork (*Ciconia nigra)*, Semi-Collared Flycatcher (*Ficedula semitorquata)*, Krüper's Nuthatch (*Sitta krueperi)* and Corsican Nuthatch (*Sitta whiteheadi)*.

For some bird species the size of the habitat is important. Goshawk (*Accipiter gentilis*), *Hazel grouse* (*Bonasa bonasia)*, Black Woodpecker (*Dryocopus martius)*, Eurasian Nuthatch (*Sitta europea)*, Siberian Tit (*Parus cinctus)* and Siberian Jay (*Perisoreus infaustus)* are examples of species that need large areas[45]. Pristine riverine forests harbour some of the most diverse breeding bird fauna, which include species such as Black Stork (*Ciconia nigra*), White-tailed Eagle (*Haliaeetus albicilla*) and colonial breeders such as Little Egret (*Egretta garzetta*), Squacco Heron (*Ardeola ralloides*), Night Heron (*Nycticorax nycticorax*), and Cormorant (*Phalacrocorax carbo*). Other important species of taiga that benefit from the natural character of the forest include Siberian Jay (*Perisoreus infaustus*), Pygmy Owl (*Glaucidium passerinum*) and Nutcracker (*Nucifraga caryocatactes*)[46].

[45] Tucker, G.M. & M.I. Evans (1997). Habitats for birds in Europe. A conservation strategy for the wider environment. Birdlife Conservation Series No. 6. Cambridge , UK; 464 p.

[46] Tucker, G.M. & M.I. Evans (1997). Habitats for birds in Europe. A conservation strategy for the wider environment. Birdlife Conservation Series No. 6. Cambridge , UK; 464 p.

Grouse species assemblage in forests with non-intervention management

Capercaillie (*Tetrao urogallus*), Black Grouse (*Tetrao tetrix tetrix*) and Hazel Grouse (*Bonasa bonasia)* are adapted to different stages of succession in primeval forests. After wind fall or forest fire, the Black Grouse starts to inhabit the youngest stages of forest succession, followed by the Hazel Grouse which prefers forest stands of an age between 10 and 50 years. If the forest becomes more than 100 years old and gaps caused by windfall or insect calamities become more frequent in the forest canopy, the Capercaillie that is adapted to old growth forest finds its preferred habitat but also Hazel Grouse can live there if gaps will allow rejuvenation of a mixture of trees containing conifers, pioneer and other deciduous trees. Hazel Grouse, the smallest (350-400 g) of the Forest Grouse, is well adapted to the young stages of forest succession following natural events like fire, bark beetle attacks or other kinds of natural disturbances, and dense understory in multilayered old growth forests. Natural development instead of management activities is most favourable to Hazel Grouse. The home range size (10-50 ha, depending on habitat quality in mountain forests) is small and a national park of 10,000 ha has enough space for 200 to 1000 individuals. One necessary precondition for long-term survival is the protection of natural succession processes after wind fall, bark and beetle attacks, followed by the undisturbed development of pioneer trees like birch, willow, aspen, mountain ash and other deciduous trees together with the high diversity of ground vegetation. The removal of dead lying trees after wind fall has a negative impact on Hazel Grouse: valuable ground cover is reduced and the protection of pioneer tree succession from the impact of ungulates is diminished. Examples are well displayed in the Bavarian Forest National Park.

Klaus, S. (2009). Forest grouse and wilderness. Survival without management impacts; In: Europe's Wild Heart, Conference

2.5 Relevant guidance documents

The Commission services have developed a number of guidance documents to assist in the application of the two Nature Directives. This includes general guidance on the management and protection provisions of Article 6 of the Habitats Directive[47]. Article 6 is the central provision covering positive management and avoidance of negative influences to the network; it also deals with plans or projects likely to have a significant negative impact on certain sites.

EU guidelines for financing Natura 2000 management through EU financial instruments have also been published[48]. While the main responsibility for financing Natura 2000 lies with the Member States, Article 8 of the Habitats Directive explicitly links delivery of necessary conservation measures to the provision of the EU co-financing. This is to be achieved by way of the integration approach whereby funding opportunities for Natura 2000 are provided in key sectoral funds. The Commission has evaluated the success of this integration approach with a view to the multi-annual financial framework for 2014-2020[49]. This also explains how the "prioritized action frameworks" required under the Habitats Directive can serve as strategic planning tools to help strengthen the integration of Natura 2000 financing into the use of relevant EU financial instruments for the next programming period.

Article 10 of the Habitats Directive recognises that ecological coherence of the Natura 2000 network as well as habitat quality is essential for the long-term survival of many species and habitats. It is of particular relevance when considering the impacts of climate change. Coherence and interconnectivity in Europe involves the application of climate change adaptation tools for

47 http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm#art6

48 http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm#guidancehandbook

49 http://ec.europa.eu/environment/nature/natura2000/financing/docs/financing_natura2000.pdf

biodiversity, such as flyways, buffer zones, corridors and stepping stones (connecting where appropriate neighbouring and third countries). The European Commission has commissioned studies to prepare guidance on the maintenance of landscape connectivity features of major importance for wild flora and fauna[50].

The Commission has also provided guidance in relation to the strict protection of animal species under the Habitats Directive[51]. Articles 12 and 16 are aimed at the establishment and implementation of a strict protection regime for animal species listed in Annex IV(a) of the Habitats Directive within the whole territory of Member States.

The Commission has also developed sector-specific guidance in the following policy areas: non-energy extractive industries, wind farm development, ports and estuaries, inland waterway transport, aquaculture. The overall objective of these guidance documents is to establish a better understanding of how to apply the Article 6 procedure to development plans and projects in each of these sectors ,to provide further advice on how to carry out an Appropriate Assessment in particular[52] and to explain that human activities that are fully compatible with the sites conservation objectives can be carried out in Natura 2000 sites.

[50] http://ec.europa.eu/environment/nature/ecosystems/docs/adaptation_fragmentation_guidelines.pdf

[51] http://ec.europa.eu/environment/nature/conservation/species/guidance/index_en.htm

[52] http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

3 Ecosystem resilience, ecosystem services and benefits of wilderness areas

In this chapter the benefits that wilderness areas can provide for the protection of biodiversity are presented. A brief overview of the concept of ecological resilience and its importance in the context of Natura 2000 is provided. The various pressures on wilderness and wild areas, based on the experience of site managers and a literature survey is also presented. The important pressures on wilderness and wild areas are habitat fragmentation, illegal extraction of natural resources, and the spreading of invasive species.

This chapter also provides a description of the key ecosystem services provided by wilderness and wild areas and their benefits. Key-regulating services include carbon sequestration, flood mitigation, erosion control, air quality regulation and water purification. Most importantly, social and cultural benefits include (eco)tourism and the creation of job opportunities for local communities. Moreover, wilderness and wild areas have high landscape and amenity values and are an invaluable resource for science, scientific research, education and inspiring cultural and artistic expression. Their ability of delivering multiple services makes wilderness areas an integral component of Green Infrastructure (which however also covers urban and semi-natural ecosystems).

3.1 Wilderness areas as resilient ecosystems

Large-scale natural ecosystems, such as wilderness areas, are considered to have a high biological, functional and response diversity and therefore have a high capacity to adapt to changes in abiotic and biotic conditions, without shifting in a qualitatively different state. In other words, they are ecologically resilient. This important value is a great tool to fight identified threats to biodiversity and makes them unique in terms of provision of ecosystem services.

Natural ecosystems are affected by different drivers and pressures. They are affected by anthropogenic *pressures* i.e. human-induced changes of ecosystem functioning such as deforestation, desertification, eutrophication, habitat fragmentation, land use change and climate change. Natural disturbances such as wildfire, insect outbreaks, flooding, erosion and wind throw act as *drivers*.

Maintaining biological diverse communities in protected areas will help to maintain ecosystem resilience and its adaptive capacity (see text box). Ecosystem resilience is closely linked to the assessment of the role of biodiversity within ecosystems and the ability of ecosystems to cope with human induced impacts (e.g. climate change, habitat fragmentation, etc.). Consequently, understanding the role of biodiversity within ecosystems (e.g. trophic relations between species, functional traits, abundance and distribution) is more important than solely assessing species richness.

It is important to note that within an ecosystem, the capacity only to buffer negative effects is not enough (ecosystem resistance). The ecosystem must be able to reorganise after disturbance, adapt to the new situation, and sustain important supporting ecosystem services. In this context spatial scale is an important factor, with large systems being better able to cope with natural disturbances

than small systems, and the preservation of habitats and species in a favourable state of conservation.

Ensuring the sustainable persistence of species in a wilderness area by enabling the movement and spread of species within landscapes can increase ecosystem resilience. Consequently, securing ecological connectivity within natural landscapes can reduce the negative impacts of fragmentation and climate change[53].

The pressures outlined above do not act in isolation on biodiversity and ecosystems, but frequently, with one pressure exacerbating the impacts of another. For example:

- Climate change[54]
- Fragmentation of habitats may reduce the capacity of species to adapt to climate change, by limiting the possibilities of migration to areas with more suitable conditions;
- Increased levels of nutrients combined with the presence of invasive alien species can promote the growth of competitive, dominant plants at the expense of less competitive, native species. Climate change can further exacerbate the problem by making more habitats suitable for invasive species;
- Sea level rise caused by climate change combines with physical alteration of coastal habitats, accelerating change of coastal biodiversity[55].

Ecosystem resilience

Ecosystem resilience is defined as the amount of disturbance a system can absorb and still remain within the same state or domain of attraction[56]. This means that the system is undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks[57]. It is the capacity of an ecosystem to cope with disturbances without shifting into a qualitatively different state. It is considered that the high levels of diversity, i.e. biological, functional and response diversity, increase the resilience of an ecosystem.

The *biological* or *structural diversity* of an ecosystem is the diversity of physical structures within an ecosystem built up by species. This diversity forms important habitats for many other species and it also plays an important role in delivering different ecosystem services, e.g. regulating services.

Functional diversity is the diversity of species that perform different ecological functions (e.g. predators, herbivores, decomposers, water flow modifiers and nutrient transporters), or perform a same function in different ways (e.g. insect and bird pollinators). The functioning of an ecosystem is based on species / groups of species that perform certain functions.

Response diversity is the variability in response of species within one functional group to environmental change. That is, they all perform the same function, but they respond differently to changes in the environment[58].

53 Kettunen, M., A. Terry, G. Tucker & A. Jones (2007). Guidance on the maintenance of landscape features of major importance for wild flora and fauna –Guidance on the implementation of Article 3 of the Birds Directive (79/409/EEC) and Article 10 of the Habitats Directive (92/43/EEC). Institute for European Environmental Policy (IEEP), Brussels; 114 pp + Annexes.

54 Managing climate change for the Natura 2000 network (http://ec.europa.eu/environment/nature/climatechange/)

55 Convention on Biological Diversity (2010). Global Biodiversity Outlook 3. www.cbd.int/GBO3.

56 Holling, C.S. (1973). Resilience and stability of ecological systems. Annual Review of Ecology, Evolution and Systematics 4: 1-23.

57 Walker, B.H., C.S. Holling, S.C. Carpenter & A.P. Kinzig (2004). Resilience, adaptability and transformability. Ecology and Society 9:5.

58 Folke, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson & C.S. Holling (2004). Regime shifts, resilience, and biodiversity in ecosystem management. Annual Review of Ecology, Evolution and Systematics 35: 557-581.

Although the stability of an ecosystem depends to a large extent on the characteristics of the dominant species (such as life span, growth rate, or regeneration strategy), less abundant species also contribute to the long-term preservation of ecosystem functioning. There is evidence that a large number of resident species, including those that are rare, may act as "insurance" that buffers ecosystem processes in the face of changes in the physical and biological environment (such as changes in precipitation, temperature, pathogens). There is established but incomplete evidence that reductions in biodiversity reduce ecosystem resilience or the ability of an ecosystem to recover from a perturbation[59,60].

In the following paragraphs, important pressures on biodiversity, i.e. habitat fragmentation, climate change and invasive species, will be analysed in more detail, and the capacity of wilderness areas to counteract those pressures and their effects is explored in paragraphs 3.2.1, 3.2.2 and 3.2.3. Management practices in order to control the pressures on wilderness qualities in the Natura 2000 network are presented in Chapter 4 of this guidance document.

3.2 Pressures due to anthropogenic disturbances

Individual sites within the Natura 2000 network and their qualities of wilderness are often under pressure due to a variety of anthropogenic activities working at scales varying from the local, regional, national to the global scale. At the local and regional level for example elevated nitrogen deposition inputs may be a threat for the favourable conservation status of species and habitats. At the global scale the impact of climate change has an impact on ecosystem functioning.

According to the Global Biodiversity Outlook 3 (2010)[61], the most important pressures affecting biodiversity are: a) habitat loss and degradation, b) climate change, c) excessive nutrient load and other forms of pollution, d) over-exploitation of natural resources and e) invasive alien species.

Site managers identified a more detailed set of pressures, most likely affecting the favourable conservation status of species and habitat of Community interest in wilderness and wild areas (Fig. 3.1). The extraction of natural resources was most frequently mentioned as a potential pressure on wilderness and wild areas. It can be poaching, fishing or illegal logging of wood. Other pressures mentioned were non-sustainable forms of tourism and environmental pollution.

[59] Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC.

[60] Hooper, D.U., F.S. Chapin III, J.J. Ewel, A. Hector, P. Inchausti, S. Lavorel, J.H. Lawton, D.M. Lodge, M. Loreau, S. Naeem, B. Schmid, H. Setälä, A.J. Symstad, J. Vandermeer & D.A. Wardle (2005). Effects of biodiversity on ecosystem functioning: a consensus of current knowledge. Ecological Monographs 75: 3-35.

[61] Convention on Biological Diversity (2010). Global Biodiversity Outlook 3. www.cbd.int/GBO3.

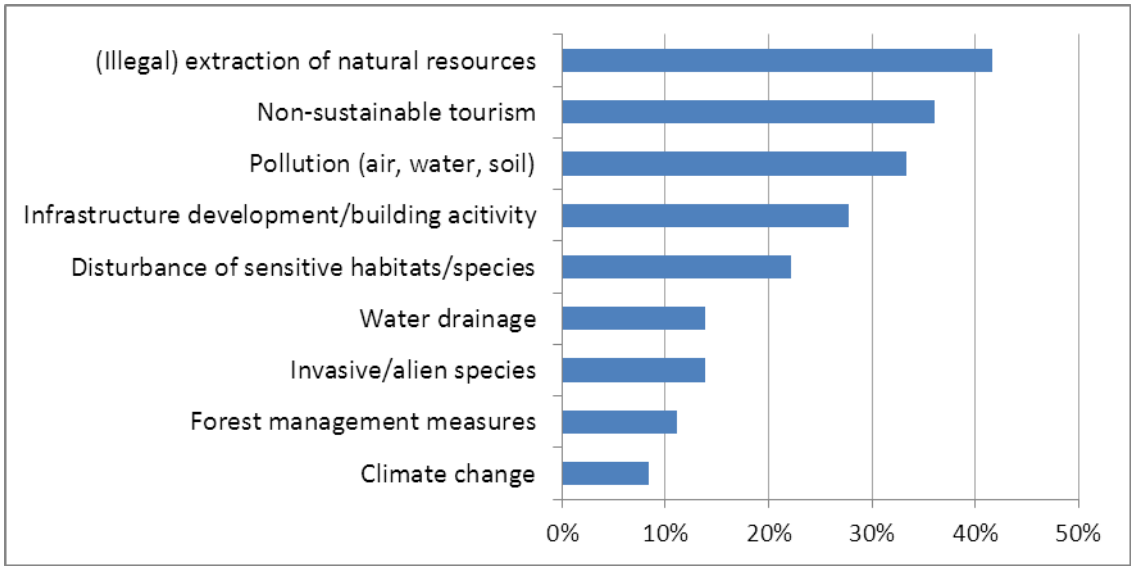

Figure 3.1. Major pressures for the favourable conservation status of habitats and species in wilderness/wild areas, as mentioned by site managers in the questionnaire (n=36 respondents).

Other pressures mentioned are isolation and fragmentation, lack of large predators resulting in uncontrolled bark-peeling and overgrazing of tree regeneration. Lack of public awareness is also mentioned, meaning that local people are not always aware of the special qualities of wilderness areas and their benefits.

3.2.1 Habitat fragmentation

Throughout the past centuries, many existing wilderness and wild areas have become fragmented and habitat loss and habitat fragmentation are ongoing. Simultaneously, large areas across Europe have become depopulated[62] which has created opportunities to restore connectivity and increase the viability of endangered species.

It is known that habitat patches support small local populations and the smaller the local population is the more likely it is to become extinct in the future. A lower density of habitats also makes it less likely that individuals of local populations move successfully between habitats and, therefore, less likely that the network will support a viable metapopulation. Furthermore, there are well documented species-area relationships, with species richness invariably increasing with the size of the area[63,64]. The protection of large natural areas from fragmentation, such as remaining wilderness areas is therefore of high importance.

Mitigating landscape fragmentation and restoring ecosystem connectivity (i.e. supporting the movement of species and the existence of viable populations within the wider ecosystem, as through Green Infrastructure) is seen as a key contributor in the maintenance of biodiversity, ecosystem functions and resilience in the long run[62]. Enlargement of wilderness areas by interconnecting wild areas and amalgamating at the landscape level, i.e. increasing the structural

[62] CBD (2010). Global Biodiversity Outlook 3. www.cbd.int/GBO3.

[63] Schoener, T.W. (1976). The species area relation within archipelagos: models and evidence from island land birds. In H.J. Frith & J.H. Calaby, (Eds.) Proceedings 16th International Ornithological Conference. Australian Academy of Science, Canberra; pp. 629-642.

[64] Wiens, J.A. (1989). The ecology of bird communities: foundations and patterns. Cambridge University Press, Cambridge.

and functional connectedness is a strategy counteracting the process of habitat fragmentation and destruction. By protecting existing wilderness and creating large-scale natural areas, systems will become more robust and more resilient which can effectively address the extinction-spiral of vulnerable species. Larger areas can host larger populations of vulnerable species and trophic chains can be restored because landscapes become suitable again for hosting large herbivorous mammal species and their predators.

3.2.2 Climate change

Climate change has emerged as the leading environmental issue of our time[65]. The cause of the rapid climate change is the result of two main kinds of anthropogenic actions: the large scale burning of fossil fuels and the conversion or degradation of natural ecosystems. These activities release carbon dioxide into the atmosphere from places on or under the Earth's surface where it was previously stored harmlessly or sequestered as one of a number of forms of carbon we call fossil fuels[66]. It is beyond the scope of this report to review all impacts of climate on natural ecosystems. Aspects of climate change and how to manage them in Natura 2000 are presented in another guidance document.

In general, climate change and the more frequently occurring extreme climate events will test the resilience of ecosystems, and their capacity for adaptation will be greatly affected by the intensity of other pressures that continue to be imposed. Those ecosystems that are already at, or close to, the extremes of temperature and precipitation tolerances are at particularly high risk. Resilient areas, such as wilderness, are important in order to allow species more time to adapt, to move to new areas and locations with emerging living conditions, to be replaced by other functionally similar species. However, in order to preserve particularly important species, the application of assisted migration should also be considered. The climate change process and the associated move of borders of zonal associations may create much higher migration pressure than the recorded highest migration speed after the last ice age. Because of the quick shift in site conditions "pioneer" or high adaptive capacity species may take relative advantage from the changes and even develop "invasive" characters. Buffer zones around wilderness areas may help to slow down the migration of new/old invasive species.

Resilient ecosystems help to cope with the impacts of climate change on habitats and species and on the services they provide for our societies. Climate regulation, flood control, erosion prevention and carbon sequestration are important services for societies (as promoted through Green Infrastructure). Therefore, wilderness management is considered an ecosystem-based approach for climate change mitigation and adaptation by maintaining and increasing ecosystem resilience.

Carbon sequestration

The protection of the carbon stored in bogs, mires, forests and other ecosystems by leaving them undisturbed will be important in the fight against climate change. About 30% of the total historic increase in greenhouse gas levels in the atmosphere is from deforestation. About 18% of annual global emissions come from disturbing ecosystems with large soil carbon storage, i.e. forests,

[65] IPCC (2007). Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.

[66] Locke, H. & B. Mackey (2009). The Nature of Climate Change: Reunite International Climate Change Mitigation Efforts with Biodiversity Conservation and Wilderness Protection. International Journal of Wilderness 15 (2): 7-13.

wetlands and peatland[67]. Therefore, the protection of natural ecosystems—and especially primary forests and other wild areas such as wetlands and peatlands—will help to achieve climate change goals.

The Commission has issued guidance on how to deal with the impacts of climate change within the context of management of the Natura 2000 Network. This has been prepared for site managers and policy makers and presents the latest scientific information on the risks posed by climate change to species and habitat types of EU conservation concern and provides advice, supported by good practice examples, on how to deal with the impact of climate change when managing Natura 2000 sites. It underlines the fact that an effectively managed, functionally coherent and well-connected Natura 2000 Network can play a vital role in helping society adapt to, and mitigate, the impacts of climate change. It also considers how to ensure that Natura 2000 sites, and the species and habitats they aim to protect, are managed in a way that is adapted to the potential effects of climate change[68].

3.2.3 Invasive alien species

The available information indicates that ecosystems in terrestrial, freshwater and marine environments have suffered from the impacts of invasive alien species,[69]. Invasive alien species represent a range of taxonomic groups including plants, invertebrates, vertebrates and fungi. They can threaten native species with extinction by a) predation; b) competitive exclusion; c) habitat change; d) hybridisation or e) impacts on native species' health through the transmission of pathogens or parasites (disease vector)[70].
Overall, invasive alien species are one of the main causes of biodiversity loss worldwide[71].
The DAISIE project (Delivering Alien Invasive Species Inventories for Europe) supported by the European Commission, provides consolidated information of invasive species that threaten European biodiversity. It is one of the databases that can be consulted through EASIN[72] (European Alien Species Information Network). This can be used as the basis for the prevention and control of biological invasions, to assess the ecological and socio-economic risks associated with the most widespread invasive alien species, and to distribute data and experience to Member States. Together with an underpinning surveillance and inspection system this would create a basis for an early warning system.

It has been found that modified environments are much more susceptible to the successful establishment of invasive alien species, compared to natural environments[73]. Based on the questionnaire, and supported by the ecological theory, in European wilderness areas invasive alien

67 IPCC (2007). Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007.

68 http://ec.europa.eu/environment/nature/climatechange/index_en.htm

69 http://www.europe-aliens.org/index.do

70 Convention on Biological Diversity (2010). Global Biodiversity Outlook 3. www.cbd.int/GBO3.

71 Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-Being. Biodiversity Synthesis. World Resources Institute, Washington DC.

72 http://easin.jrc.ec.europa.eu

73 Kettunen, M., P. Genovesi, P., S. Gollasch, S. Pagad, U. Starfinger, U., P. ten Brink & C. Shine (2008). Technical support to EU strategy on invasive species (IAS) -Assessment of the impacts of IAS in Europe and the EU (final module report for the European Commission). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 44 pp. + Annexes.

species are considered causing less problems than in modified ecosystems. However, in some cases established or extending invasive species in wilderness areas are controlled or eradicated. Examples are American mink (*Mustel neovison*), Sika deer (*Cervus nippon*), Racoon dog (*Nyctereutes procyonoides*), Nutria (*Myocastor coypus*) and plant species such as Giant knotweed (*Reynoutria sachalinensis*), Japanese knotweed (*Reynoutria japonica*) and Giant hogweed (*Heracleum mantegazzianum*). More information on the EU policy on Invasive Alien Species is available at http://ec.europa.eu/environment/nature/invasivealien/index_en.htm.

3.3 Ecosystem services and benefits of Natura 2000 and wilderness

Protected areas, such as Natura 2000 sites, contain biodiversity and ecosystems of high conservation value. In addition, these areas provide a range of benefits (direct and indirect) to our societies and economies. These benefits are often referred to as *ecosystem services*. Recent initiatives such as the study on The Economics of Ecosystems and Biodiversity (TEEB) have highlighted the importance of better understanding the economic value of ecosystem services and developing instruments to capture and reward these values, thereby encouraging the wiser and sustainable use of ecosystems[74].

A recent economic evaluation has shown investing in Natura 2000 provides multiple benefits to society and the economy at the local, regional, national and EU level[75]. The network is a major store of carbon rich habitats and has an important role to play in responding to the challenges we face from climate change, both through mitigation and adaptation. It also delivers other socio-economic benefits such as maintaining water flow and quality, conserving natural pollinators, preserving landscape and amenity values, and supporting tourism and recreation. According to this study, the benefits that flow from Natura 2000 are of the order of €200 to 300 billion/year. It is estimated that there are between 1.2 to 2.2 billion visitor days to Natura 2000 sites each year, generating recreational benefits worth between €5 and €9 billion per annum. Therefore, investing in Natura 2000 makes sense and is directly relevant to Europe 2020 objectives of growth and employment as it can be a motor for the local and regional economy. The costs of Natura 2000 per year have been estimated on 5,8 billion by MS (managing & restoring the network).

Natura 2000, as a key element of Green Infrastructure, also helps to safeguard the flow of ecosystem services that are otherwise at risk of degradation. Investment in management and restoration measures can increase the provision of a range of the services, from the scientific valuation of sites to flood control and water purification as the conservation status of the sites improves. The strong legal protection that applies to Natura 2000 also has an added benefit, providing long-term security to any financial investments to safeguard the sites it contains and the benefits they deliver.

Wilderness areas provide a wide set of ecosystem services common to most of the natural areas but they provide a set of services that are especially relevant to them. In terms of wilderness areas it is important to note that complete ecosystems, maintaining high levels of structural and functional diversity (see paragraph 3.1), are more resilient to external pressure and consequently better able to sustain the delivery of ecosystem services to human society. Moreover, it is equally important to

74 TEEB (2008). The Economics of Ecosystems & Biodiversity. Interim report. European Communities, Cambridge, UK.

75 http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm

note that wilderness areas, such as strictly protected areas and national parks, are often protected in response to a sense of collective heritage or patrimony, a perception of shared cultural or social value being placed on treasured landscapes, charismatic species or natural wonders, and are therefore likely to provide important social and cultural services[74].

Based on a literature review, the key-ecological services and socio-economic benefits of wilderness are described, especially with respect to their distinctive features within the context of Natura 2000. Special attention is given to the impact of sustainable forms of ecotourism for local communities. Non-intervention management would by its nature mean restrictions to extractive uses. Therefore, schemes of compensatory measures are taken into account using best practice examples as basis for this evaluation.

3.3.1 Key ecosystem services

European wilderness areas provide a set of ecosystem services such as a) a refuge for endangered species and a home to undiscovered species; b) habitats with highly adapted fauna and flora, which would be lost forever if they were modified by human interventions; c) reference laboratories where evolutionary processes still continue; d) addressing climate change through carbon sequestration and flood mitigation. Wilderness areas offer species opportunities to adapt and migrate in response to climate change. Table 3.1 gives an overview of potential ecosystem services provided by Natura 2000 sites with wilderness quality.

Ecosystem services

Ecosystem services are the benefits that people obtain from ecosystems. According to the widely used classification developed by the Millennium Ecosystem Assessment (2005) these services can be categorised as follows:

1. **Provisioning services,** or the supply of goods of direct benefit to people, and often with a clear monetary value, such as timber from forests, medicinal plants, and fish from the oceans, rivers and lakes;
2. **Regulating services**, the range of functions carried out by ecosystems which are often of great value but generally not given a monetary value in conventional markets. They include regulation of climate through the storing of carbon and control of local rainfall, the removal of pollutants by filtering the air and water, and protection from disasters such as landslides and coastal storms;
3. **Cultural services** not providing direct material benefits, but contributing to wider needs and desires of society, and therefore to people's willingness to pay for conservation. They include the spiritual value attached to particular ecosystems such as sacred groves, and the aesthetic beauty of landscapes or coastal formations that attract tourists;
4. **Supporting services**, not of direct benefit to people but essential to the functioning of ecosystems and therefore indirectly responsible for all other services. Examples are the formation of soils and the processes of biomass production and nutrient cycling.

Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Biodiversity Synthesis.* World Resources Institute, Washington, DC. 100 pp.

Several of the relevant ecosystem services in wilderness areas are hereafter described in more detail.

Supporting services

Supporting services of natural ecosystems are necessary for the production of all other ecosystem services. They are life-support functions and include processes such as primary production, production of atmospheric oxygen, soil formation, nutrient cycling, water cycling, and provisioning of habitat.

The conservation of natural processes and associated biodiversity in wilderness areas has a positive impact on most supporting services and leads to positive synergies with provisioning, regulating and socio-cultural services[76].

Provisioning services

Although the extractive use of natural resources is not compatible with the conservation objectives of wilderness areas, the availability of biodiversity resources outside the site can be strongly affected by the wilderness area. It can play an important role in contributing to the provisioning of these resources even though the actual harvesting of these resources takes place outside the area. This could be the case, for example, when a wilderness area functions as an important refuge or breeding place for *fish* or *game* species. Natura 2000 land users (e.g. fishermen, fish farmers, hunters and foresters) are the key stakeholders making use of the biodiversity resources outside the wilderness area (e.g. wild fish and game). Forest sites play a key role in providing game, whereas marine, coastal and inland water sites are sources for fish and other aquatic resources in the neighbourhood of the wilderness and wild areas (e.g. the example of Haddock[77]).

Table 3.1. An overview of ecosystem services as summarised in the TEEB report[78], with those relevant for protected sites with wilderness qualities.

Ecosystem services		**Relevant in wilderness areas**
Provisioning services	Food	-
	Raw materials	-
	Fresh water	x
	Medicinal resources	-
	Clean air	x
Regulating services	Local climate and air quality regulation	x
	Carbon sequestration and storage	x
	Moderation of extreme events (floods, storms, landslides etc.)	x
	Waste-water treatment	-
	Erosion prevention	x
	Pollination	x
	Biological control (regulating pests, etc.)	x
Social and cultural services	Recreation and mental and physical health	x
	Tourism	x
	Aesthetic appreciation and inspiration for culture, art, etc.	x
	Spiritual experience and sense of place	x
Supporting services	Habitats for species	x
	Maintenance of genetic diversity	x

[76] Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

[77] TEEB – The Economics of Ecosystems and Biodiversity for National and International Policy Makers – Summary: Responding to the Value of Nature 2009.

[78] TEEB (2010). The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature. A synthesis of the approach, conclusions and recommendation of TEEB.

Regulating services

Carbon sequestration and storage: A substantial amount of carbon dioxide is stored in ecosystems, especially forests, wetlands and peatlands, which function as a strong buffer in the regulation of the atmospheric level of carbon dioxide. The characteristics of the vegetation determine how much carbon is taken up from the atmosphere and how much is released. Important characteristics are the primary production, which governs carbon inputs, and woodiness, which enhances carbon sequestration. In forest ecosystems, carbon is stored in living and dead biomass and in the soil. For instance, bogs in northern boreal ecosystems have been shown to be cooling the climate through the uptake of carbon and will continue to do so if their hydrology is left undisturbed[79]. Plant species also strongly influence carbon loss via decomposition processes and through the effect of other ecosystem services, e.g. the regulation of fire (which in turn affects the amount of carbon released in the atmosphere)[80].

3.3.2 Social, cultural and economic benefits

Here, only the direct benefits through market processes are described. It is worth noting that all avoided costs by the above mentioned regulating services should to be taken in account as economic and social benefits when benefits of natural areas are assessed.

It is reasonable to assume that wilderness qualities are an additional asset in this regard, although, their added value is difficult to estimate. Wilderness areas have high landscape and amenity values. They are an invaluable resource for science, scientific research and education and inspire cultural and artistic expression. They mostly also represent a high cultural heritage and archaeological heritage value. Sometimes they are part of religious pilgrimages. Wilderness and wild areas in general play an important role in awareness raising regarding environmental issues and can offer visitors an arena to get a practical insight into natural processes[81]. Any Natura 2000/wilderness site protecting culturally important landscapes, habitats or species can be an integral part of the identity of a region. The vicinity of a wilderness site may make a region more desirable and attractive. It may also have a positive impact on land and property values for local communities and landholders.

Wilderness and wild areas have high landscape and amenity values and for their aesthetic benefits they are often highly preferred destinations for nature tourism, i.e. tourism relying primarily on the natural environment for its attractions or settings. The presence of flagship species, such as Grey Wolf, Brown Bear and Golden Eagle, can form a high attractive value for these areas. However, certain wilderness areas may not be suitable for recreation or ecotourism due to their fragile ecosystems.

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79 Frolking, S. & N.T. Roulet (2007). Holocene radiative forcing impact of northern peatland carbon accumulation and methane emissions. Global Change Biology 13: 1079–88.

80 Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

81 Kettunen, M. *et al.* (2009). Assessing socio-economic benefits of Natura 2000 –A Toolkit for practitioners.

Ecotourism is a fast-growing branch of the tourism industry. It will have financial and economic impacts, such as an increase in incomes, jobs and business opportunities at the local and regional level. These impacts further contribute to the economic and social development of the area and region.

The beneficiaries of this ecotourism include people working in the tourism sector, or those providing support services to tourists. Local and regional businesses might profit by providing services related to recreation and tourism and site management might also profit from entrance or excursion fees.

4 Management approaches for wilderness in Natura 2000

In this chapter management approaches for wilderness in Natura 2000 are presented based on best practice examples from different biogeographical regions. Non-intervention management aims to allow natural processes, prevents human interference and protects from human developments within a Natura 2000 site. It ensures a good degree of conservation of habitats and species by avoiding human intervention that could have significant negative effects. Management objectives and the related conservation measures are described below. Major potential conflicts between non-intervention management and natural hazards (e.g. bark beetles, forest fires, grazing/herding) are discussed. Objectives for the restoration of wilderness qualities in Natura 2000 are described and practical measures to reach these objectives presented.

4.1 Introduction

Building on the previous chapters, this chapter seeks to give guidance on how to manage wilderness areas in Natura 2000, to resist pressures and to increase wilderness qualities. It takes account of the provisions of the Habitats Directive and Birds Directive and gives guidance based on best ecological knowledge. It gives special attention to avoiding or solving potential management conflicts.

4.1.1 Best practice

Best practice examples of wilderness and restoration management in Europe were collected from different biogeographical regions (Table 4.1). The general information drawn from these examples is summarised. The results received from the questionnaire circulated among the site managers managing wilderness and wild areas throughout Europe also provided another source of information (Annex A4). The information was completed with interviews with several site managers.

The case study examples demonstrate through practical field examples of different habitats and biogeographical regions throughout Europe that a good degree of conservation of habitats and species of Community interest can be achieved in the Natura 2000 sites through management which pursues the preservation of wilderness qualities. The management authority of a particular site will decide whether non-intervention management is the right approach for its site. This chapter will provide tools and perspectives to assist with management decisions.

4.2 Planning non-intervention management

Non-intervention management aims, where necessary, to allow natural processes by preventing disturbance by human activities that would have significant effects on biodiversity. To be successful, the conservation of existing wilderness areas and the restoration of wild areas must be embedded within the social, cultural and historical context of the relevant region. In order to gain the support of local communities, it is important that they can understand the opportunities offered and the environmental, social and economic benefits resulting from non-intervention management.

Table 4.1 Case studies of wilderness management.

	Name of area	Code	Biogeographical region	Wilderness area (ha)
1	Kalkalpen National Park	AT31111000	Alpine	15,600
2	Soomaa National Park	EE0080574 SCI 01/02/2009 SPA 01/04/2004	Boreal	24,400
3	Archipelago National Park	FI0200090 SCI 01/08/1998 FI0200064 SCI 01/08/1998 SPA 01/08/1998	Boreal (marine)	10,600
4	Bavarian Forest National Park	DE6946301 SCI 01/03/2001 SPA 01/03/2001	Continental	12,875
5	Samaria National Park	GR4340008 SCI 01/09/2006 GR4340014 SCI 01/12/1995 SPA 01/10/1987	Mediterranean	19,253
6	Peneda-Gerês National Park	PTCON0001 SCI 01/06/1997	Mediterranean	5,000
7	Oulanka	FI1101645	Boreal	29,380

4.2.1 Conservation objectives for wilderness areas

Identifying the contribution that a particular site can make towards achieving national conservation targets for the habitats and species of Community interest present on the site provides a very good basis for setting the site level conservation objectives. Site level conservation objectives are a set of specified targets to be met in a site in order to ensure that the site contributes in the best possible way towards achieving favourable conservation status (FCS) at the appropriate level (biogeographical, national or regional level, taking into account the natural range of the respective species or habitat types). Site level objectives should be established not only for special areas of conservation (SACs) under the Habitats Directive but also for special protection areas (SPAs) under the Birds Directive with a view to achieve the conservation of bird species.

Favourable conservation status of habitats and species of Community interest has to be achieved at the appropriate regional, national or biogeographical level, but not necessarily at the level of each site. It may not always be indispensable to maintain each habitat type or species in each site in an optimal condition, but it is necessary to make sure that the conservation status of the habitats and species of Community interest will certainly not decrease but in the contrary, will maintain or achieve a favourable level at the appropriate regional or national level. Local fluctuations as a result of natural processes at the site level are therefore acceptable, provided the FCS status at the national and biogeographical level is ensured.

Ecosystems and habitat types are affected by internal dynamics. Structure and function are considered as inherent qualities of ecosystems and habitats. They are not stable *per se*, but are influenced by processes typical for living systems with the full variation of their ecosystem dynamics. Natural fluctuations at the individual site level following natural processes fit well within the Natura 2000 requirements, even if the area of some habitats types may locally and temporarily

decrease and while other habitats may develop or improve as a result of the same natural processes.

Therefore, the maintenance of the dynamic complexes of habitats, such as those in wilderness areas influenced only by natural processes with natural fluctuations, can be an appropriate conservation objective for particular Natura 2000 sites, provided FCS at regional, national or biogeographical level is guaranteed. Evidently, processes leading to a degradation of natural habitat types due to anthropogenic processes are not permitted.

In the case of species and habitats that benefit from or depend on natural processes, the targets for the protection of the relevant site can include the exclusion or reduction of human interference. The measures corresponding to the ecological requirements of such species and habitats can be selected accordingly.

Setting short- to medium-term targets may be necessary in order to monitor the impact and efficiency of the measures taken. Based on the results of the monitoring, measures can be adjusted to better correspond to the needs. The definition of a set of targets will also be necessary in those cases where the current conservation status is not the desired one and restoration is needed. This will involve an assessment at the site level of the degree to which the habitat or species concerned requires management, if any, and where restoration to a particular degree of conservation is needed. This is important in order to make sure that the site fully contributes towards achieving conservation targets that may exist at a higher level (regional, national, biogeographical region or EU).

In areas composed of both primary habitats, which benefit from non-intervention management, and secondary habitats, which often need active management measures, zonation can be a successful strategy to contribute to a good degree of conservation of all habitat types and species concerned. A non-intervention core zone with wilderness values can be distinguished from zones with active management where other ecological values or socio-economic factors are essential (see also paragraph 4.2.7).

Scale might also be a decisive factor in choosing the most appropriate management strategy in a Natura 2000 site. Taking into account the dimensions and scale implied by wilderness, restoring wilderness qualities would not be suitable in sites that are too fragmented or small-sized. Natural processes require sufficiently large areas to allow for dynamic changes to develop over time and space.

4.2.2 When is non-intervention management not appropriate?

In many Natura 2000 sites, non-intervention management or a set-aside approach may conflict with the ecological requirements of species or habitats of Community interest. Habitat types and species linked to traditional land-use practices, such as livestock grazing, hay-making, reed cutting, and wood-logging (coppice) can often only be maintained continuing these land-use practices[82] and their continued existence is dependent on that. Examples are semi-natural grassland complexes

[82] Halada, L., D. Evans, C. Romão & J.-E. Petersen (2011). Which habitats of European importance depend on agricultural practices? Biodiversity and Conservation 20: 2365-2378.

and hay-making meadows (e.g. habitat types 6210, *6270, 6310, 6410, 6510, 6520, *6530). A list of 63 habitat types dependent on agricultural activities has been identified in the Annex II to the EU Biodiversity baseline[83]. Furthermore, nearly 40 bird species and nearly 30 other species of Community interest are linked to agro–ecosystems[83]. Agro-ecosystems cover 38% of the surface of the Natura 2000 network[83] and agricultural intensification and land abandonment have been identified as the two main pressures on biodiversity linked to agro-ecosystems in Europe[84]. Therefore, these Natura 2000 sites are not usually suitable for the introduction wilderness and instead continued low intensity agriculture, in those parts where the secondary habitat types occur, is normally the adequate management approach.

In those situations where traditional forms of land use, such as grazing with livestock, are halted succession may become dominant process again. The abandonment of land creates a potential threat[85] to the maintenance and achievement of a favourable conservation status of many species and habitats of Community interest. However, it has been suggested that the impact of agricultural activities could be replaced in some instances by introducing wild herbivore species to the area (e.g. European bison, Red deer, Chamois, Ibex). If this is pursued, it is important to set up a good monitoring scheme to assess the impact of introductions on the habitats and species of Community interest at the landscape level.

Even in wilderness areas, it might be necessary in some extreme cases to intervene. For example in the case of outbreaks of alien (outside of Europe) forest pest species regulated by the EU plant health legislation. Several of these pests have a potential to severely damage European tree species, which lack natural resistance against them and natural enemies. In certain cases, tree species could disappear irreversibly. Protecting the Union's forests requires therefore also in wilderness areas surveillance for outbreaks of such new pests and their early eradication, even if the eradication would be locally very damaging to the forest. Member State authorities should also take adequate measures to avoid uncontrolled introduction of such pests from more intensively managed areas into wilderness areas. In coordination with plant health authorities, alternative measures may be developed according to the local situation, and providing sufficient guarantees for successful eradication. The procedures outlined in this paragraph do not apply to forest pest species, which are natural part (native) of European habitats, in line with natural dynamics of ecosystems as described earlier.

Similarly, the control of certain animal diseases regulated by either European or national legislation may include various measures (e.g. vaccination of foxes against rabies, of wild boars against classical swine fever, surveillance in presence of pathogens or to verify their absence, eradication thereof, culling of animals etc.) which, in order to be properly implemented, need close cooperation between authorities managing wilderness or wild areas and authorities implementing animal health measures. Management of the animal population on these areas may also involve awareness of and consideration for the European rules on animal by-products. Material from wild animals is largely excluded from the scope of the relevant legislation[86][87]. However, especially in

[83] http://www.eea.europa.eu/publications/eu-2010-biodiversity-baseline

[84] http://www.eea.europa.eu/publications/10-messages-for-2010-agricultural-ecosystems

[85] http://www.unep.org/pdf/GBO3-en.pdf

[86] Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption, OJ L 300, 14.11.2009, p. 1

case of grazing, pastoral activities, handling of managed or hunted/killed wild game and other animals, there can be instances when these rules must be complied with or specific derogation therefrom must be granted (e.g. collection and handling of such material or for feeding to vultures).

4.2.3 Management measures in wilderness areas

In order to achieve the targets set for the protection of a wilderness area, a management authority providing the stewardship of the area is needed. Preservation of wilderness qualities does not mean inaction. Various measures can and shall be taken in order to protect and maintain wilderness qualities, i.e. naturalness of the vegetation and associated species assemblages and the natural processes involved (for further explanation see paragraph 1.2.1). These measures include ensuring that the correct administrative, statutory and legislative measures are in place and followed. Management also involves management actions linked to visitors and local residents of the area as well as participating in the land use planning of the surrounding areas. To achieve the set objectives it may also be necessary to use restoration measures.

Management measures of terrestrial and marine wilderness areas do not differ greatly. However, when the management of marine wilderness areas is planned special attention to the undisturbedness and naturalness of the water column and bottom ecosystems needs to be paid. Moreover, certain issues like noise pollution or invasive species may be more difficult to manage in aquatic than in terrestrial environments. A comprehensive approach together with stakeholders may help finding relief to those issues on local level. Eutrophication can be dealt with stakeholders the same way and the most important local sources of nutrients identified and tackled.

4.2.4 Management plans

The Habitats Directive encourages the development of management plans which are specifically designed for the site in question or integrated into other development plans. The management plan should ensure a good degree of conservation of protected areas and "must be as clear as possible, realistic, quantified and manageable"[88]. In areas where management pursues preservation of wilderness qualities, management plans are a useful tool in order to:

- record the habitats and species for which the site has been designated as Natura 2000 site, so that it is clear what is being conserved;
- indicate the habitat types and/or species and their localities for which conservation measures are planned;
- identify the actual status of the habitat types and species and the desired status which should be reached through the conservation measures;
- define clear and achievable conservation objectives;
- explain how the selected approach i.e. non-intervention/set aside contributes to the achievement of a good degree of conservation of habitats and/or species of Community interest and favourable conservation status more widely;

[87] Commission Regulation (EU) No 142/2011 of 25 February 2011 implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal byproducts and derived products not intended for human consumption, OJ L 54, 26.2.2011, p. 1

[88] http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/provision_of_art6_en.pdf

- identify the necessary measures together with the means and a time schedule which can contribute to meeting those objectives;
- describe the protection provisions for the maintenance and use of the wilderness area;
- record other actions relevant to preservation of wilderness qualities;
- analyse the socio-economic and cultural context of the area and the interactions with surrounding area and identify practical management solutions that can help integrate conservation activities with other land-use in the surrounding area;
- safeguard measures against potential effects on surrounding areas (e.g. bark beetles, or fire);
- analyse and consider animal and plant health measures which may take place in the area in light of the presence of pathogens and pests of animal and plants.
- give access to other competent authorities or to those acting on their behalf, in particular in implementation of animal and plant health measures

The following factors will need special attention when conservation measures are selected:

- size of the area, whether the area is large enough to allow natural processes;
- connectivity, whether there are buffer areas around wilderness or ecological linkages;
- need for restoration/existence of natural processes;
- zonation;
- provisions of the national protected areas system;
- potential conflict(s) with traditional uses;
- potential conflict(s) with extractive uses of the site;
- invasive species;
- potential impact of climate change.

Additionally, the manager of a Natura 2000 site needs to consider the following options related to access to the site:

- visitor access (restrictions, steering of visitor flows);
- subsistence use by native/local people (typical in northern countries);
- access for only monitoring/research.

4.2.5 Compensatory measures to overcome limitations posed by wilderness

Communities living in the vicinity or buffer zones of wilderness or wild areas may depend on natural assets for livestock feed, fuel materials, fruits and medicines[89]. The establishment of a strict protection regime, such as a wilderness reserve, may affect their access to resources on which they were traditionally dependent. The establishment or extension of protected areas may also have an impact on indigenous customary rights, values and beliefs. Despite considerable success in establishing conservation areas and national parks in many countries, conflicts over the use and management of park resources are sometimes a complex item, difficult to solve. This is especially the case in areas where the use of resources is seen as incompatible with the pursued management objectives and the costs incurred from conservation to the local communities are more than the related incentives. In those cases compensatory measures could be considered in bringing a solution. This might be a decisive factor in wilderness planning projects to meet their intended

[89] In this document, local residents are people living permanently in the close vicinity of the protected area. The close vicinity might be very different and depends on the access and infrastructure around the wilderness area.

objectives. Therefore, local communities must be involved in wilderness planning, decision making and management processes, especially when their traditional land-use activities conflict with the non-extractive use of resources policy in the wilderness area to be established.

4.2.6 Measures taken to ensure and improve wilderness qualities

During the preparation of this guidance document, many management authorities responded to the questionnaire (Annex A4) and reported on their experiences and practices. Based on these, a set of general management measures is listed for wilderness areas. These are supported with examples throughout Europe.

Measure 1: *Zonation in order to combine protection of wilderness qualities and semi-natural nature and sustainable recreational activities*

Within one Natura 2000 site there are often areas that require different management measures. There might be a need to enable various management regimes within the same site in order to ensure the protection of both primary and secondary habitats. Although the measure can be applied in any Natura 2000 site, it is mainly linked to larger Natura 2000 sites. Zonation of the site is often determined in the management plan.

Non-intervention as a management tool is an integral part of the overall conservation strategy and visitor management in **Fulufjället National Park** (Sweden). The implementation of non-intervention management is supported by clear zonation. Zoning involves a pristine core zone where hunting, fishing and snowmobiling are forbidden. This is balanced by more intensively used recreational activity zones, where desires of locals can be fulfilled[90]. This kind of zoning is a highly effective method of protecting key natural features and processes, while also ensuring the protection of the various habitats and their typical species. These include mires, alpine and boreal grasslands and heaths, subalpine and subarctic forests with their typical species.

However, visitor pressure may be a controversial issue within the management authority of Natura 2000 sites. Visitors are seen not only as an opportunity to generate public support for protection, but also as a potential threat for the natural values. Such a threat must be considered in wilderness areas as well. The impact of tourism can be seen on soil (erosion), flora (e.g. illegal picking of specimens, trampling) and fauna (disturbance, modifying the behaviour of animals). Steering of recreational pressure, or in some cases even limiting it, may be needed. However, these issues can be tackled in many ways and the development of a zoning system to steer visitor pressure while still allowing visitors access to certain parts of the area with specific provisions such as trails, has proven to be a successful approach.

Soomaa National Park (Estonia) provides a good example of how zonation, as a management tool, makes it possible to simultaneously serve two purposes: organise public access to the park on duckwalks and protect the most sensitive areas. This, along with Soomaa's management tools to control visitor impact, has created a good balance between their two aims of strict conservation and raising public awareness of the importance of natural processes.

[90] Wallsten, P. (2003). The "Inside-Out" process. A Key Approach for Establishing Fulufjället National Park in Sweden. Mountain Research and Development 23: 227-229.

Zoning can take into account the distribution of recreational use, the access to the area, the carrying capacity of the area including seasonal and specific characters of tourism use. There are various methods to define the carrying capacity of an area, and the manager should select the most suitable method[91,92]. It should be noted, however, that the carrying capacity of an area might also be influenced by factors outside the wilderness area (access, tourism infrastructure, etc.).

Another example of a functioning zoning system is found in **Samaria National Park** (Greece). The Natura 2000 site is protected by creating a core wilderness zone with strict protection and a 'highest' quality of wildness which is surrounded by a buffer zone which protects the core zone and where some human intervention may occur. The main aim of restoration of the wild area is to preserve the natural environment and support local sustainable development. Here, an effective management relationship is being established between a core wilderness zone and surrounding wild areas. The wild area can be regarded as a buffer for the core wilderness, and both are being managed with respect to the other. Steps are being taken to rationalise existing practices across a spectrum of measures, especially in terms of managing external pressures, which are faced by the wild area – these include pressures from tourism and construction.

Logging and pastoral activities have been halted in core areas, leaving pine tree forests undisturbed to develop and expand. Furthermore, activities permissible in different parts have been organised into zones - the core zone, a species and habitats conservation zone and an ecological landscape zone. In the core zone, for example, there are no road constructions and the collection or removal of fire wood and foraging for mushrooms has been stopped, whilst in other areas this is allowed if for personal use.

There has been considerable progress towards achieving a good functioning and workable balance and interaction between people and nature. Working in ways that explicitly take into account the traditions and culture of the people attached to the area, the protection of the landscape, its natural resources and important habitat types, animal and plant species is being ensured. At the same time, re-wilding is enabling natural processes to establish in increasingly larger parts of the area.

Where a core zone is not large enough to allow full functioning of natural processes, plans can be made for appropriate expansion; where feasible, parts of the buffer zone can be restored and at a certain moment be incorporated into the core zone.

In **Gorczanski National Park** (Poland) the zone of strict protection regarded as wilderness has been extended on several occasions since 1981. Plans to enlarge the core wilderness area over the longer term involve steps to include the nearest most natural forest areas, which themselves, are important ecological corridors. Such measures will contribute to the favourable conservation status of the Natura 2000 habitats and species involved. Although within the core

[91] Jenner, P. & C. Smith (1992). The Tourism Industry and the Environment. The Economist Intelligence Unit, London.

[92] Karpaty, B. & D. Slavikova (2010). Recreation potential for static and dynamic recreation in protected area. Recreation and Environmental Protection 135-140.

wilderness zone most human activities are not allowed, there are facilities for visitors (hiking tracks and trails) and scientific research is permitted.

Measure 2: *Guaranteeing ecological connectivity with adjacent areas to support migratory movements of species*

A site manager may want to restore ecological functions and increase the connectivity of the landscape to support the natural distribution and migratory movements of species. The measure can be applied in any Natura 2000 habitat and, it is potentially linked to a large number of species and habitats. Removal of fences is clearly directed for the benefit of larger species whose migration they might hinder. Removal of roads, where appropriate, can be a relevant action to support smaller animals such as carabidae beetles or amphibians.

Large-scale restoration has been carried out in the **Bavarian Forest National Park** (Germany) for example by decreasing fragmentation in the park by applying restoration activities such as the removal of asphalt and gravel forest roads. In the past 10-15 years dozens of kilometres of roads have been removed or transformed, either by replacing asphalt with gravel or by allowing gravel roads to become overgrown.

In **Kalkalpen National Park** (Austria), 310 km of road was closed from motorised traffic or restored to natural state in a LIFE project 'Management of Natural Forests in National Park Kalkalpen' (Life 99Nat/A/005915).

The location and shape of the **Central Balkan National Park** (Bulgaria), as well as the long history of development of the reserves system, has resulted in a patchwork of wilderness areas. However, the management plan of Central Balkan National Park works towards more connectivity in the long run. It identifies not only the reserves zone but also a zone with limited human impact that is to act as a connecting area between individual reserves. The combination of the two types of land helps establish and maintain the ecological connectivity of wilderness areas on a total of over 21,000 ha of land.

Measure 3: *Restoration of modified habitats*

Setting aside man-made plantations combined with a controlled transition to natural vegetation composed of indigenous species is a measure to restore natural species composition and, eventually, natural structures and functions in both lowland and mountainous regions. Moreover, this measure will help increase the area where natural processes can function and it can be used to increase connectivity in the landscape.

Especially in central Europe there are large formerly managed areas that have been set aside. Areas include spruce plantations in beech forest sites at lower elevations (e.g. *Luzulo-Fagetum* beech forests (9110)). These spruce plantations are sensitive to bark beetle mass proliferations, and hence in dry summers, unless controlled, bark beetles will proliferate there. There is considerable danger that they will start spreading, including to areas with biologically valuable natural spruce forests at higher elevations (e.g. Acidophilous *Picea* forests of the montane to

alpine levels (9410)), if these are within reach. Normally, in-situ mass proliferations would be limited due to the colder temperatures at the higher elevations but the influx of bark beetles from spruce plantations may make the natural spruce forests suffer and they might be completely infested and broken down[93].

Therefore, it is important that the transition to natural vegetation dominated by indigenous species, especially in regions where bark-beetle creates problems, occurs gradually in order to prevent large-scale bark beetle infestations which can spread to natural conifer stands and cause unnecessary damage. A controlled transition of man-made conifer stands would be the best way to prevent these catastrophes. Once a forest is in a more natural state, infestations will occur only on much smaller spatial scales.

Sometimes restoration measures are taken in order to speed up the initiation of natural processes and creation of natural structures. This is considered ecologically sensible as restoration is likely to produce habitats for many endangered or locally extinct species typical for those natural habitat types and allow for their return at an accelerated rate. Typically, this kind of activities have been taken to restore e.g. the habitat type *Western taiga (9010) or *Bog woodlands (90D0).

Habitat types in the group 'Raised bogs, mires and fens' and some 'Forest' habitat types, e.g. *Bog woodlands (90D0) of the Annex I to the Habitats directive require intact hydrology in order to maintain a favourable degree of conservation. Restoration of hydrology is typically done by plugging ditches, within or outside the borders of the site, where the ditching has impact on the hydrology.

Measure 4: *Ensuring/establishing non-intervention management after natural disturbance*

Many managers of Natura 2000 sites with wilderness have seized the opportunity to change the management approach to non-intervention after a drastic natural disturbance in order to allow natural processes to start and ultimately create habitat for species dependent on those processes and enhance the quality of habitats.

This measure can be applied to any habitats appearing in their natural distribution range and benefits species that are dependent on natural processes. It mainly concerns primary habitats which persist independently of any human intervention and the species they host. In cases where the point of departure is not natural, special attention needs to be paid to ensure that the severity and magnitude of the disturbance does not cause conflicts with the land use of the surrounding areas or uncontrolled impacts to other habitat types within the Natura 2000 site (see paragraph 4.4).

A good example of a successful change of management approach was seen when the management authority of **Kalkalpen National Park** (Austria) decided not to conduct sanitary logging in its territory after several severe wind throws in the fir/spruce/beech forests

[93] Petercord, R. (2012). Waldschutzsituation in Schutzgebieten-Folgerungen für eine nachhaltige Forstwirtschaft. LWF Aktuell 87: 54-57.

(habitat types 9130, 9140, 9150, 9410). The results of the non-intervention management were monitored carefully. Monitoring so far revealed that an increase in volume of deadwood from 16 m^3 to 25 m^3/ha and some 80,000 m^3 wood lying on the ground since then has greatly contributed to viable populations of six different species of rare woodpeckers (*Picidae*) in these forests and their habitat quality.

Another example can be taken from **Bayerischer Wald National Park** (Germany), where the monitoring of bark beetle calamity has proven that abundant forest regeneration occurs naturally after old trees are killed by bark beetles. This disproves fears of the complete disappearance of forests in such areas. More of the actions taken by the park authority can be read in paragraph 4.3.1. Natural regeneration initiates the development of conditions similar to those of primeval forests. The natural vegetation is certainly a mosaic of mixed forest types dominated by spruce, fir and beech (habitat types 9110, 9130, 9410). At low elevation, on western and southern exposures, broadleaved trees occur more frequently, while at higher elevation and on eastern and northern exposures spruce still largely dominates the young forest stands.

Measure 5: *Re-introduction and eradication of species*

Often the functions and structures of a given habitat type are missing due to missing key-species. In those situations the only feasible way of restoration is often the reintroduction of the missing key-species. In other situations invasive alien species may be disturbing the ecosystems in an undesired way and the eradication of the species is needed. In both situations the re-establishment of structures and functions is pursued. This measure can be applied to any Natura 2000 habitat where the re-establishment of natural species composition is needed.

Since the beginning of the 20th century, the Eurasian Beaver (*Castor fiber*) has been reintroduced in many European countries to re-establish viable populations. Europe's largest rodent species was exterminated in large parts of its natural range due to overexploitation. The Beaver is classified as an ecosystem engineer, because its dam building activities can change, maintain or create habitats (e.g. ponds with stagnant water) which has a considerable impact on the course of succession, species composition and structure of plant and animal communities. As such it can be classified as a key-species in riverine flood plain, streams, brook valleys and wetland ecosystems[94]. The Beaver is a species of European interest listed in Annex II and IV of the EU Habitats Directive.

The reintroduction of Apennine Chamois (*Rupicapra pyrenaica ornata*) in the **Majella National Park** (Italy) is a good example of reintroduction of a species that naturally occurs in the area. With just a few hundred individuals remaining by the early 1990s, this invaluable species was one of the world's most endangered ungulate species. Due to the lack of an ecological corridor between their refuge area in Abruzzo National Park and the Majella mountains (where chamois had disappeared), human intervention was unavoidable. Over a several-year period about 22 animals were transferred to Majella National Park. Nowadays,

[94] Rosell, F., O. Bozsér, P. Collen & H. Parkere (2005). Ecological impact of beavers *Castor fiber* and *Castor canadensis* and their ability to modify ecosystems. Mammal Review 35: 248-276.

their population has reached over 500 individuals. The Apennine chamois is also a species listed in Annex II and IV of the Habitats Directive.

The **Central Balkan National Park** (Bulgaria) has started a reintroduction programme, which aims to release 150-200 Griffon Vultures (*Gyps fulvus*) in five years[95]. The reintroduction of raptors in the park contributes to the completion of food chains in ecosystems in Central Balkan. Carcasses of wild species such as chamois and deer species are food sources for vultures (besides carcasses of livestock). The park also takes part in the national strategy to reduce the threats on large vultures in Bulgaria, and to eventually attract them back as nesting species into the Balkan Mountains.

In **Oulanka National Park** (Finland) alien species, American mink (*Neovison vison*), are trapped mainly in order to improve the breeding success of several bird species (waterfowl). The activity must be continuous as the species is difficult to eradicate totally. It causes great harm to bird communities and is being trapped and exterminated in protected areas jointly with local hunters.

Measure 6: *Forest fire prevention through promoting native composition of forest habitats*

In the Mediterranean region, forest fires create a management problem in fire prone areas where the objective for management is to allow for natural mature vegetation with natural structures and functions. Although natural forest habitats (e.g. Galicio-Portuguese oak woods with *Quercus robur* and *Quercus pyrenaica* 9230 and Forest of *Ilex aquifolium* 9380) are more resilient to forest fires than monoculture plantations with high flammability species, the transition period from plantation to native forest is a challenging period when effective forest fire prevention might still be needed, particularly in the Mediterranean areas[96].[97]

Promotion of natively composed forest habitats is currently most relevant for forest habitats in the Mediterranean region. It should be noted, however, that climate change will create longer dry seasons, which will likely lead to forest fire challenges in other climatic regions too. Therefore, the experience and best practice of the Mediterranean region should be shared with Natura 2000 managers throughout the EU 27.

In **Peneda-Gerês National Park** (Portugal) fires are a major threat to conservation of fauna and flora. Outside the wilderness core zone, most occurrences are associated with grazing, i.e. fire is used to renew pastures. Therefore, the park management is taking steps to minimize the extent and effects of wild fires occurring outside the core zone of the park, including fuel management actions at the level of bush clearing in forest stands and conducting prescribed

[95] http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=3534

[96] Proença, V., H.M. Pereira & L. Vicente (2010). Resistance to wildfire and early regeneration in natural broadleaved forest and pine plantation. Acta Oecologica 36: 626-633.

[97] Forest Fire Damage in Natura 2000 sites 2000-2012
http://publications.jrc.ec.europa.eu/repository/handle/111111111/27318

burning in conjunction with the renovation of pastures for shepherds. When a fire occurs, it is always fought, or one is looking for extinction as soon as possible.

In order to manage wild fires and to prevent conflicts with adjacent areas, the national park also has its own fire fighting teams and it establishes partnerships with local teams of forest fire fighters in order to manage an early warning fire alarm system. In case forest fire threatens local residents the management authority cooperates with the fire brigades. The costs of fire prevention are covered from a centralised fund.

Majella National Park (Italy) also faces problems with fire management. According to the surveys and assessment of the park management, fires inside the park territory are almost exclusively linked to human actions, either intentional or accidental. Spontaneous wild fires in natural habitats are rather rare.

The forest fires are tackled as much as possible technically. The legal background is provided by the general law on wildfires (L. 353/2000). This establishes that the aerial operations concerning wildfire fight are competence of the civil defence Department, whilst the Forestry Corps, the Fire brigades and other corps operate in the field, coordinated by the Regional authorities, which have to create a permanently operative office for this purpose. The management authority is directly involved in this issue regarding forecast and prevention activities. The Park may also activate prevention patrols during the high risk season. The park management cooperates with fire brigades, civil defence Department and Forestry Corps in order to prevent fire damaging settlements.

Measure 7: *Monitoring and providing opportunities for research activities*

Monitoring in order to detect and prevent conflicts and unwanted impacts from outside and to the outside is an important management measure for any given wilderness area. The monitoring is important in order to know whether the conservation targets are being achieved and if the management needs to be adjusted. Monitoring is especially important in relation to restoration measures in order to record their progress and effectiveness. Monitoring programmes in several wilderness areas designated as Natura 2000 sites enable experts to carry out long-term observations and serve as reference areas for research.

Bialowieza Forest (Poland), is one of the largest remnants of pristine forest in Europe, and provides habitat for an almost complete assemblage of species characteristic for natural lowland forests. It hosts many rare species specialising on dead wood and large trees, typical for naturally dynamic stands. Bialowieza Forest has been used for scientific research over a long period of time. There are many permanent study plots, some established in the early 1930s[98]. The park facilitates studies on the structure and functioning of natural ecosystems, natural succession, population dynamics of mammals and their predators and the flow of substances and energy within ecosystems etc. Much research is carried out, not only on large mammals such as European bison, Grey wolf and Eurasian lynx, but also on the extremely species rich

[98] Falinski, J.B. (1986). Vegetation dynamics in temperate lowland primeval forest. Ecological studies in Bialowieza forest. Junk Publishers. 537 p.

groups of rodents, bats and predators[99]. Large datasets are available on the natural fluctuating population sizes of many plant and animal species, supplying valuable information on population regulating factors and species interactions in forests under non-intervention management[100]. There are five research institutions located in Bialowieza: Natural Forests Department of the Forest Research Institute, Mammal Research Institute of the Polish Academy of Sciences; Bialowieza Geobotanical Station of Warsaw University; Plant Demography Laboratory of the Institute of Botany of the Polish Academy of Sciences, and the Laboratory on the Ecology and Protection of Natural Habitats.

Recently, **Majella National Park** (Italy) has started several monitoring projects on vegetation dynamics and wildlife species. At higher altitudes (above the treeline) monitoring will lead towards an up-to-date mapping of high elevation pastures in the core zone. The study on these high-elevation pastures is also addressed to gain knowledge of the potential nutritional value of the pastures for the wild ungulate species. There is no intention to intervene on the ongoing dynamics in the core zone of the park.
The monitoring of the dynamics in the abandoned agricultural/grazing areas at lower altitudes, outside the core zone, is mainly focused on grasslands and shrubs and vegetation dynamics, i.e. forest/grassland cover. Chronologies from the 1950's to recent years will be compiled by comparing aerial pictures from different periods. Important habitat types include Semi-natural dry grasslands and scrublands (habitat type 6210), *Pseudo-steppe with grasses and annuals (habitat type 6220) and *Apennine beech forests (habitat type 9210).
Long-term monitoring programmes are also conducted for important wildlife species of the park such as Apennine Chamois, Grey Wolf, and Brown Bear.

Despite the long tradition of forestry in **Slovakia** and detailed knowledge on forests the first mapping of primeval forests in the national level was undertaken only recently (within the project financially supported from the EEA/Norway grants in 2009-2010). The main results are the following: 332 mapped sites (53 699 ha) including 122 pristine forests (10 120 ha), 169 pristine forest remnants (1 527 ha) and 696 sites (14 235 ha) with the potential to become wild areas; preparing documentation to designate 5 the important sites as nature reserves; several activities to increase public awareness including the case study on potential tourism in Carpathian primeval forests. Information is available on www.pralesy.sk or may be provided by the Ministry of the Environment of the Slovak Republic".

Measure 8: *Educational and interpretation services for visitors, schools and local communities*

It is important to generate public support for the enforcement of the management plan of each Natura 2000 site. The interpretation of conservation goals is important for generating the necessary wider public support for biodiversity protection. It may help to increase the public knowledge about the whole network of Natura 2000. This measure can be implemented in relation to any habitat type and can benefit the protection of any species occurring in areas with a non-intervention management regime.

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99 Jedrzejewska, B. & J.M. Wojcik (Eds.) (2004). Essays on Mammals of Bialowieza Forest. Mammal Research Institute, Polish Academy of Sciences. Bialowieza. 214 p.

100 Jedrzejewska, B. & W. Jedrzejewski (1998). Predation in vertebrate communities. The Bialowieza Primeval Forest as a case study. Springer Verlag, Berlin. 450 p.

As part of the comprehensive and concise non-intervention management approach **Fulufjället National Park** (Sweden) takes advantage of a natural disturbance event in Göljadalen Valley as a unique interpretation site. During the 1997 'centennial flood' approximately 10,000 cubic metres of trees were felled by flash flooding. The management of the nature reserve (status of the area at that time) decided to leave the large amount of wood untouched after the dramatic erosion that followed the extreme downpour. Today the site, covered with dead wood decaying naturally, is one of the biggest attractions of the national park, equipped with interpretation boards for visitors to learn about natural processes.

The interpretation of natural values requires innovative solutions. One such example is from **Archipelago National Park** (Finland) where an underwater snorkelling trail was built following the results of a detailed study on marine biodiversity. The interpretation service must ensure that visitors, domestic and international, receive a clear and simple message about the wilderness qualities of a protected area. Interpretation must be multilingual, based on an analysis of most frequent foreign visitors, and interactive. Visitor centres are only one way of communicating with visitors but there are other offline (information boards, leaflets) and online tools (see also paragraph 5.3).

Enhancing the awareness of local communities and their sense of ownership is important. The sense of ownership is especially important when a new management approach is to be introduced. **Fulfujället National Park** (Sweden) was the first national park in the Swedish protected area system where the new designation title (upgrading from nature reserve to national park) was introduced only after a consultative process with the local communities[101]. The new designation resulted from a five-year process that involved a cooperation board including representatives of the relevant municipalities, local businesses, etc. The so-called Fulufjallsringen aimed to increase awareness about the future national park. In a so-called 'inside-out process', local people received support from the Swedish Environmental Protection Agency (SEPA) and received information about how a national park could bring social economic and other benefits, thus making it a source of opportunities rather than a source of restrictions. The focus was on how to obtain benefits from outside the borders of a national park rather than on the design inside the park. A vision emerged of a new visitor centre with local employees, new tourism facilities outside the park, and better infrastructure with improved roads and telecommunications. The "loss" was clear: a national park would bring some restrictions. But now, at last, the gains were also clear: a new future and opportunities for people to remain and find jobs in the area. Confidence replaced mistrust. This improved "inside-out" planning process created a basis for making the national park a reality. Local residents accepted the new national park with a zonation which led to more restrictive land use, for instance limiting 'traditional activities' such as hunting or using snowmobiles.

Measure 9: *Minimise illegal and unwanted human intervention through law enforcement and providing a ranger service for strict protection zones*

[101] Wallsten, P. (2003). The "Inside-Out" process. A Key Approach for Establishing Fulufjället National Park in Sweden. Mountain Research and Development 23: 227-229.

There are great differences in the need for a measure to minimise illegal and unwanted human intervention in wilderness and wild areas. Visitor pressure, location of the site and effectiveness of the general law enforcement defines what kind of measure is needed. In certain regions, a ranger service may be essential in order to ensure the favourable degree of protection of the site but in other regions ranger services may be more focused on guiding and maintenance of visitor infrastructure. It is a decision of the manager to evaluate whether ranger service is needed or not.

In **Majella National Park** (Italy), in cooperation with Corpo Forestale, a ranger service operates to guarantee law enforcement. The rangers also act as the representatives of the management authority in the local communities. Rangers in Majella National Park have a main role in controlling activities in forest areas. The continuous improvement of staff capacities is indispensable. A total of about 30 park employees (guards and other staff members) and volunteers participated in a course to achieve the licence of Volunteer Environmental Guard.

4.3 Management challenges

Response to bark beetle calamities is a challenge as it may cause economic losses in the forests surrounding wilderness. Forest laws often require managers to intervene even in nature protection areas where non-intervention is practiced. There is a clear difference between the northern and southern Member States regarding this problem. In Northern countries this is a hypothetical problem, whereas in more southern countries this represents a management issue. However, scientific research strongly suggests that natural forests are more resilient to natural disturbances in general and that semi-natural and managed forests are more prone to extreme calamities. A non-intervention strategy often causes conflict during the bark beetle outbreaks (see paragraph 4.3.1).

There is a clear difference between the northern and southern Member States in their relation to forest fires. There are fires launched in the Northern countries in order to imitate its effect on the habitats. However, wild fires represent a huge social and economic problem in the southern countries, creating a practical problem for wilderness managers (see paragraph 4.3.2). However studies show that natural forests are more resilient to forest fires[102].

Reindeer herding by indigenous people is a specific challenge appearing in the northern countries. This herding is often seen as an activity that has minimal effect on the biological diversity of a protected area. Therefore it is suggested that wilderness can co-exist with reindeer herding in the northern countries (see paragraph 4.3.3).

Despite being mentioned often as the biggest challenge for protected areas, climate change does not yet appear among the top problems recognised by the Natura 2000 managers applying a wilderness approach in the management of their sites. This might be due to the high resilience of the natural areas or lack of knowledge on the potential and complex effects of the climate change process.

[102] Proença, V., H.M. Pereira & L. Vicente (2010). Resistance to wildfire and early regeneration in natural broadleaved forest and pine plantation. Acta Oecologica 36: 626-633.

Three potentially conflicting issues and best practice examples to solve them are addressed below i.e. bark beetle outbreaks mainly occurring in the Continental and the Alpine region in Central Europe, forest fires in Boreal and Mediterranean regions, and managing grazing pressure in the Boreal zone.

4.3.1 Bark beetles as key species in areas with non-intervention management

In natural areas bark beetles are key species affecting forest dynamics. Bark beetles are small insects, about 2-6 mm long, depending on the species. Examples are the European Spruce Bark Beetle (*Ips typographus*), the smaller Eight-Toothed Spruce Bark Beetle (*Ips amitinus*), and the Six-Toothed Spruce Bark Beetle (*Pityogenes chalcographus*). Some species kill trees. These beetles bore into mature trees and feed on the tissue that transports nutrients and water to the tree, thus interrupting the flow of water and killing the tree. Most, however, live in dead, weakened, or dying host trees.

Bark beetles are usually present in forests in low numbers, often confined to single tree populations or small clusters of attacked trees widely scattered across the landscape. Like many other insects, bark beetles emit pheromones to attract conspecifics, which are thus drawn to trees already colonised by bark beetles. This can result in heavy infestations and eventually the death of the tree. In natural forests these outbreaks usually remain relatively small scale and die out after a couple of years, because dead trees are inhabited by insects antagonistic to cambio- and xylophages[103]. Under certain semi-natural and managed conditions, however, they can develop large outbreaks that kill thousands of trees. This process of sporadic outbreaks is an integral constituent of natural forest ecosystems. Bark beetles are a natural disturbance agent that forests have coevolved with and a major force determining successional patterns and ecosystem dynamics.

Bark beetles have a large ecological impact in forest ecosystems:

- they initialise decomposition of wood and bark for further breakdown by fungi and other microorganisms;
- numerous organisms inhabit bark beetle galleries, where they scavenge for food, hide, hibernate or reproduce. Resulting dead wood is the livelihood of various plants and animal species including endangered species protected by the Habitats Directive, such as: *Boros schneideri, Cucujus cinnaberinus*, *Phryganophilus ruficollis*, *Pytho colwensis*, *Rhysodes sulcatus*[104]*;*
- they are a food source for other animals: bark beetles and their larvae are parts of food webs; predators range from insects to birds such as woodpecker species;
- in natural forests generally weak trees are infested; dead trees allow light to pass down to the forest floor, enabling forest regeneration.

Climate change prospects

There is growing evidence that climate change will increase the potential for bark beetle outbreaks. Population models predict more generations of adult beetles per year in certain regions related to

[103] Hilszczański, J.(2008). Bark of dead infected spruce trees as an overwintering site of insects predators associated with bark and wood boring beetles. Forest Research Papers 69: 15-19.

[104] Nieto, A. & K.N.A. Alexander (2010). European Red List of Saproxylic Beetles. Luxembourg: Publications Office of the European Union.

higher mean annual temperatures. Moreover, some bark beetle species migrate to higher altitudes and settle where they would not have been able to survive previously. Therefore bark beetles will gain further importance in mountainous and northern areas as well[105].

Best practice: buffer zones

When forests are varied in age and structure, such as primeval forest, they are much more likely to be able to withstand a bark beetle attack. Planted mono-species, single-aged stands are much more vulnerable. Environmental factors, particularly drought, can weaken whole stands, making a large number of trees vulnerable for infestation by bark beetles. Massive reproduction of bark beetles in non-intervention zones may nevertheless occur, particularly in previously managed forests which are by non-intervention management in transition towards more close-to-nature forests.

In order to protect the stands adjacent to the areas where non-intervention is practiced, classic forest protection measures against bark beetles need to be applied in buffer zones which are under active nature protection[106]. There are effective measures which do not require the use of insecticides, as use of insecticides might have unexpected consequences to other species and the ecosystem.

The creation of a buffer zone of at least 300 m broad outside the non-intervention area is recommended. Recent studies in Germany have proved that 95% of spreading bark beetles settle on new host trees within an area of 300 m[107]. Additionally, controlled trapping of bark beetles in the buffer zone by trap trees (trees which are artificially weakened) can be a measure to prevent spreading to adjacent managed forest stands.

Regular monitoring of infested trees by bark beetles in the outer zone of wilderness areas is a good practice. The management of wilderness areas should work together with landowners of adjacent areas to control infestations from spreading to adjacent forests. Infested trees may be removed in localised areas along the park boundary upon request by adjacent landowners. Only beetle-infested trees near to the park boundary would be considered for removal in the first stage of infesting. Removing trees killed by bark beetle and debarking of stumps during autumn and winter could have negative effects on insect predators overwintering in bark under the snow level. Moreover spruces primarily infested by bark beetle might later be colonised by protected cambiophage beetles[108]. This means creating a buffer zone between the non-intervention zone and the surrounding territories open for forestry activities. The creation of such a buffer helps to reduce the conflict opportunities with forest owners.

Bark beetles as a political issue in non-intervention areas: the example of Bavarian Forest National Park

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[105] Jönsson, A.M., S. Harding, P. Krokene, H. Lange, A. Lindelow, B. Okland, H.P. Ravn & L.M. Schroeder (2011). Modelling the potential impact of global warming on *Ips typographus* voltinism and reproductive diapause. Climate Change 109: 695-718.

[106] Grodzki, W. & R. Jakus (2009). Management of bark beetle outbreaks. In: Europe's Wild Heart. Conference Report, Srní, Czech Republic; pp. 32-33.

[107] http://www.wildnisgebiet.at/en/projects/bark-beetle/buffer-zones.html

[108] Hilszczański, J.(2008). Bark of dead infected spruce trees as an overwintering site of insects predators associated with bark and wood boring beetles. Forest Research Papers, 69:15-19.

Bark beetle outbreaks often lead to controversy in the public opinion on forest management as shown by the well-documented example of the **Bavarian National Forest**[109]. After the major wind throw events in the 1980s, the management of the Bavarian Forest National Park adopted a new conservation policy, i.e. non-intervention in the core zone of the national park. While the bark beetle was still controlled through regular screening of stands and immediate sanitary logging of infested trees in the management zone, 'leaving nature to its own devices' became the management policy for the core zone. As a consequence of this new policy, the wind throw stems were not removed from the forest and the coarse woody debris provided favourable breeding habitat for the spruce bark beetle (*I. typographus*).

Above-average seasonal temperatures and a series of severe wind throw events facilitated the spread of the bark beetle between 1990 and 2000, leading to a massive reproduction during which trees on an area of more than 6,000 ha were killed – more than a quarter of the park's total area of 24,250 ha. Whereas the disturbance itself was considered natural, its scale and velocity were at least partly human-induced, because of the large scale presence of plantations. Additionally, climate change increased the incidence of hot and dry summers that affect tree vitality and milder winters reduced beetle mortality.

The major change in the visual appearance of the post-disturbance landscape stirred widespread public resentment among residents in the Bavarian Forest[110]. Significant parts of the population pressed for actions to control bark beetle outbreaks. This example shows that landscape change as a consequence of non-intervention management leading to natural disturbances, such as caused by massive bark beetle outbreaks, is not only an ecological issue, but also a cultural and political issue[110]. A good communication plan is indispensable to inform local communities, tourists and the broad public on the ecological significance of cyclic outbreaks of bark beetles and how these fit in the non-intervention management strategy.

Finally, as explained in Section 4.2.2, it should be recalled that, in the case of outbreaks of pathogens alien to European habitats (origin from outside Europe), regulated by the EU plant health legislation, immediate intervention may be necessary to eradicate them. Non-intervention would result in the establishment of those pests, which could cause irreversible and unacceptable damage to Europe's tree species in long term.

Forest ecosystem resilience

The available scientific evidence strongly supports the conclusion that the capacity of forests to resist change, or recover following disturbance, is dependent on biodiversity at multiple scales. Maintaining and restoring biodiversity in forests promotes their resilience to human-induced pressures and is therefore an essential 'insurance policy' and safeguard against expected climate change impacts. The resilience of a forest ecosystem to changing environmental conditions is determined by its biological and ecological resources, in particular (i) the diversity of species, including micro-organisms, (ii) the genetic variability within species (i.e., the diversity of genetic traits within populations of species), and (iii) the regional pool of species and ecosystems. Resilience is also influenced by the size of forest ecosystems (generally, the larger and less fragmented, the better), and by the condition and character of the surrounding landscape. It is known that e.g. primary forests are generally more resilient (and stable, resistant, and adaptive) than modified natural forests or plantations.

[109] Müller, M. (2011). How natural disturbance triggers political conflict: Bark beetles and the meaning of landscape in the Bavarian Forest. Global Environmental Change 21: 935-946.

[110] Müller, M. (2011). How natural disturbance triggers political conflict: Bark beetles and the meaning of landscape in the Bavarian Forest. Global Environmental Change 21: 935-946.

Therefore, policies and measures that promote their protection yield both biodiversity conservation and climate change mitigation benefits, in addition to a full array of ecosystem services[111].

4.3.2 Forest fires in Boreal and Mediterranean forests

Forest fires are a threat for the forest and natural areas in Europe. Over 65 000 fires take place every year in the European Union, burning, on average, half a million hectares of the European landscape. Economic losses due to forest fires in the European Union territory are estimated in over 2 billion Euros every year. Areas protected under the Natura 2000 scheme are no exception to the damage caused by forest fires. Every year, approximately 80 000 ha are burned within the Natura 2000 sites.[112]

At the same time, in many ecosystems fire is a natural process and an important disturbance factor that essentially contributes to ecosystem processes. At the landscape level, wild fires create diversity in stand structure, thereby increasing the variety of habitats. Moreover, wild fires have a role in maintaining the vital habitat for species dependent on burned and decaying wood, such as saproxylic beetles.

Taking into account the large areas affected, in particular in the Mediterranean region, and the associated environmental and economic losses, wild fire is prevented and extinguished. In most northern European countries wildfires are almost completely eradicated as a result of the extremely efficient fire suppression systems. After a long suppression period fire is now again reintroduced there at certain places, by using controlled burning.

Boreal forests: reburning as best practice

Under natural conditions, wild fires ignited by lightning occur in boreal forests approximately once in every 50 years on dry soil conditions, and once in every 100-150 years on moist sites or even 200 years on wet soils. It helps the shifting between successional stages and increases biodiversity at the landscape scale.

In most boreal forests, fire suppression is still an important management aim often prescribed by national law. Fire suppression is not restricted only to the managed production forests but fires are eliminated also from the forest conservation areas. As a consequence, forest dwelling species that are dependent on fires or on the ecological patterns and forest structures created by fires may not find suitable habitats in the protected forest areas. These observations have led to major efforts in Fennoscandia recently that aim to restore fire in these ecosystems[113]. Not only the pyrophilous species but also hundreds of other species, in particular those dependent on dead wood, benefit from burning. Reburning also prevents the long term accumulation of 'fuel load', which otherwise

[111] Thompson, I., B. Mackey, S. McNulty & A. Mosseler (2009). Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43, 67 p.

[112] Forest Fire Damage in Natura 2000 sites 2000-2012. JRC, 2012

[113] Esko, H., J. Kouki & P. Martikainen (2009). Prescribed fires and retention trees help to conserve beetle diversity in managed boreal forests despite their transient negative effects on some beetle groups. Insect Conservation and Diversity 2: 93-105.

would lead to unnatural large-scaled, very intense fires with a large impact on regeneration of the ecosystem.

Interactions with bark beetle outbreaks

Although major disturbances in forest ecosystems such as fire or insect outbreaks may appear to be independent events, they are often causally related. Such interactions certainly occur in many northern and boreal forest ecosystems. There is increasing recognition that fire suppression or control policies substantially alter forest composition, structure, and vulnerability to damaging insect pests[113]. This may be due to the effects of fire suppression resulting in higher tree densities and a more suitable distribution of large diameter trees[114]. On the other hand, increased amounts of host material (slash and stumps) in burned stands can also attract bark beetles. The interaction of bark beetles, fuels and fire in forest systems, is inherently complex and much remains unknown[114].

Mediterranean forests and shrublands

Fire is a key factor in Mediterranean forests and open and closed shrublands (garrigue and maquis, respectively). Shrublands in particular, are the land cover most prone to fire. Forests are usually less susceptible than shrublands. Summer fires occur frequently leading to vegetation composed of a mosaic of recently burned, regenerated secondary vegetation and unburned areas. Most fires (>98%) are started by man[115], either planned or accidentally. Consequently, the fire-interval is shortened to about five years in many areas. The European Forest Fire Information System (EFFIS) supports the services in charge of the protection of forests against fires in the EU countries and provides with updated and reliable information on forest fires in Europe. Rural development policy contributes to restoring forestry production potential damaged by natural disasters and fire and introducing appropriate prevention instruments.
Fire spread rate is facilitated or retarded by landscape heterogeneity. Therefore, the spatial pattern of fire ignition and spread across landscapes is affected by fire proneness, i.e. the differential fire behaviour in various land cover types, such as vegetation composition and heterogeneity that are not equally fire prone[116]. Studies in Portugal suggest that mature forests of broadleaved deciduous and mixed forests generally have a low fire hazard compared to pure pine forests, eucalypt plantations, or mixed pine and eucalyptus stands[116]. In general, native (evergreen) mixed broadleaved forests (often dominated by *Quercus* spp.) have a higher resistance and are more resilient to fire, compared to planted coniferous forests (often dominated by *Pinus* spp.)[117]. Consequently, fire spreads more slowly and burns with less intensity and severity in natural broadleaved forests. There is evidence that mature evergreen oak forests can even become 'self-protective' against wildfires, to the point of fire self-extinction[118].

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114 Jenkins, M.J., E. Hebertson, W. Page & C.A. Jorgensen (2008). Bark beetles, fuels, fires and implications for forest management in the Intermountain West. Forest. Ecology and Management 254: 16-34.

115 Trabaud, L. & R. Prodon (Eds.), (1993). Fire in Mediterranean ecosystems. Commission of the European Communities. Ecosystems report 5, Brussels.

116 Moreira, F., O. Viedma, M. Arianoutsou *et al.* (2011). Landscape- wildfire interactions in southern Europe: Implications for landscape management. Journal of Environmental Management 92: 2389-2402.

117 Proença, V., H.M. Pereira & L. Vicente (2010). Resistance to wildfire and early regeneration in natural broadleaved forest and pine plantation. Acta Oecologica 36: 626-633.

118 Fernandes, P.M., A. Luz & C. Loureiro (2010). Changes in wildfire severity from maritime pine woodland to contiguous forest types in the mountains of northwestern Portugal. Forest Ecology and Management 260: 883-892.

Best practice: promoting native species to reduce fire risks

Restoration management aiming to restore natural mixed broadleaved forests is a successful strategy to reduce fire risks in Mediterranean regions[117]. Transition of planted coniferous forests, which are very sensitive to hot and intense fires, to more natural more fire resistant, mixed broadleaved forests decreases the chance for large-scale forest fires. In wild areas, natural succession can be used where site conditions enable it to promote a mixture of species and to favour mature stages. This naturally slow process can be somewhat speeded up with some selective thinning favouring broadleaved species. During the transition period, intense fire prevention is still needed.

4.3.3 Reindeer herding and wilderness management: seeking the balance

Reindeer herding as cultural heritage

Wild reindeer have lived in the Nordic region for more than 10,000 years, since the end of the Ice Age. In Northern Scandinavia and Northern Finland domesticated or semi-domesticated reindeer have been herded by the Sámi people since the 9th century, or even earlier. Intensive reindeer herding has been practiced for more than 100 years and the number of reindeers has doubled since the 1970's[119]. Reindeer are today grazed in the northern regions of Norway, Sweden and Finland on natural pastures located mainly in forests and on treeless fells.

Reindeer herding by the indigenous Sámi people in the northern part of Fennoscandia and Russia represents a cultural heritage value of natural areas in these regions. However in many areas, overgrazing by reindeer is regarded as a threat in several strictly protected areas, including some wilderness reserves[120].

Local Sámi reindeer herders often find themselves caught between the expectation placed upon them by the majority of society to engage in environmentally friendly reindeer herding, and the existing requirement to engage in rational reindeer herding[121].

The Finnish Act on Wilderness Reserves (1991) brought a new perspective on the management and traditional forms of use of northern wild nature. It prohibited heavy development that would change nature significantly, yet it aimed at improving possibilities for traditional uses of nature. Therefore, reindeer herding is seen as a legal form of land use in wilderness areas. The management objectives of many protected areas are to preserve the pristine character of these areas, and to protect the Sámi culture and their traditional subsistence uses.

The impact of overgrazing

Northern fell biotopes are particularly sensitive to intense grazing, since they are characterised by harsh climatic conditions, thin soils, slow soil formation, intense erosion by wind and water, low

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119 Suominen, O. & J. Olofsson (2000). Impacts of semi-domesticated reindeer on structure of tundra and forest communities in Fennoscandia: a review. Annales Zoologica Fennici 37: 233–249.

120 RAPPAM assessment; Management Effectiveness Evaluation –MEE- of Finnish protected areas administered by Metsähallitus, Finland. http://www.metsa.fi/sivustot/metsa/SiteAttachments/a147liitteetpdf.pdf).

121 Dahlström, A.N. (2003). Negotiating Wilderness in a Cultural Landscape: Predators & Sámi Reindeer Herding in the Laponian World Heritage Area.

vegetation productivity rates, and in many places also steeply sloping terrain. Problems arise when the semi-domesticated reindeer herds become overabundant. The impact of grazing is clear but its importance and the optimal amount of reindeers are still disputed[119]. Overgrazing leads ultimately to the degradation of lichen-dominated habitats and leads to an increase in the uniformity of vegetation and a decrease in biodiversity[122]. Alternating periods of intense and light grazing together with moderate trampling create the best conditions for many characteristic plant species of these habitats, as long as periods of intense grazing are not too long. In winter, grazing reindeer primarily rely on easily digestible lichens, grasses and dwarf shrubs for foraging, while in summer they feed more on forbs and leaves. Overgrazing results in the spread of plants avoided by reindeer due to their indigestibility, such as tough grasses, forbs, sedges and mosses. If the animals cannot move to new pastures, these plants will also be eaten, leaving patches of land devoid of vegetation and vulnerable to erosion. Pastures are generally able to recover fairly rapidly when grazing pressure decreases, except for lichen pastures, which only regenerate very slowly.

The sizes of reindeer herds were formerly limited mainly by weather conditions and the carrying capacity of the pastures used for winter grazing. During periods with heavy snow cover, reindeer may starve when lichen become inaccessible. Some herders in Finland today put out silage and hay for their reindeer herds. Such winter feeding and the medication of reindeer against parasites enable herders in many regions to keep larger herds than natural pastures could sustain. The erection of fences to limit the movements of reindeer has also resulted in local overgrazing.

Reindeer herding is one of the oldest traditional livelihoods of the peoples of the Nordic region, and its survival is necessary to preserve an essential part of the cultural heritage. But it remains vital to harmonise both reindeer herding with nature conservation. Reducing the numbers of grazing animals is a social issue that directly affects the livelihoods of herders and farmers. If pastoral farming and the numbers of grazing animals need to be reduced significantly, society could provide alternative sources of income for such groups[123].

Best practice example from Oulanka National Park (Finland)

The overall objective of non-intervention management in **Oulanka National Park** is the maintenance and preservation of biodiversity and natural ecological processes. This should be combined with ecologically sustainable reindeer herding. Reindeer herding is allowed in the national park and necessary work connected to the herding is possible regardless of the restrictions. For example, the use of snowmobiles is permitted when needed. The management of the national park cooperates with herding associations to avoid possible conflicts between herding and conservation or other interests such as recreation and nature-oriented tourism.

Large herbivores are integral part of the taiga ecosystem. Before the reindeer husbandry was introduced, the Oulanka National Park was populated by wild forest reindeer. Nowadays, the reintroduction of wild forest reindeer is impossible due to interbreeding with semi-domesticated reindeer. Moreover, the size of Oulanka National Park is too small to support a natural population of wild forest reindeer.

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[122] Olofsson, J., H. Kitti, O. Rautiainen, S. Stark & L. Oksanen (2001). Effect of summer grazing by reindeer on composition of vegetation, productivity and nutrient cycling. Ecography 24: 13-24.

[123] www.environment.fi/nordicnature > Fact sheets > Reindeer and sheep grazing

The management of the Oulanka National Park cooperates with local reindeer herding associations to regulate the presence of reindeer in the park's core zone. The long term aim of the management is to stabilise the grazing pressure of reindeer in the core zone and to reflect the natural situation as much as possible. The park management will estimate the desired level of grazing based on best knowledge and habitat mapping. This requires close cooperation with research institutes. The park management developed a programme to monitor the effects of a decrease in the grazing pressure of the reindeer.

4.4 Concluding remarks

While wilderness and wild areas are not explicitly mentioned in the EU Birds and Habitats Directives and would not be necessary or required in many Natura 2000 sites, there are particular cases where management aiming at the preservation and restoration of wilderness qualities can be compatible with the objectives of the EU nature legislation or even necessary to maintain or restore a favourable conservation status of several species and habitats of European importance. In those cases, the following conclusions and recommendations can be made:

1. Wilderness qualities make ecosystems resilient against most of the important pressures affecting biodiversity and help achieving favourable conservation status of many species and habitats of Community interest.
2. The most appropriate management for Natura 2000 sites should be developed in view of the general objective to ensure a favourable conservation status of the species and habitats for which the sites have been designated. I.e. identifying workable targets for wilderness maintenance or restoration measures, which are designed and devised to bolster natural processes, must take into account the context in which many Natura 2000 sites exist.
3. Non-intervention management implies that dynamic processes leading to habitat changes will occur. These should be monitored and management adapted accordingly.
4. Non-intervention management can be relevant for various habitat groups listed in the Habitats Directive Annex I. Along with several forest habitats; a non-intervention management approach can be applied to certain open habitats such as temperate heath and scrub, natural grassland formation habitats and bogs, fens and mires.
5. Besides preserving ecological values and conserving biodiversity, wilderness areas offer the opportunity to learn about natural ecosystem dynamics, and offer a venue for visitors to gain first-hand experience about natural processes and experience the spiritual values of these places.
6. Wilderness areas provide reference areas for human influenced areas. They represent open air laboratories for natural dynamics.
7. Establishing the regime and suitable management within Natura 2000 sites is only the first step when protecting the qualities of wilderness. The management authorities should consider the larger scale outside the managed areas. There are effects from outside the Natura 2000 sites, influencing the wilderness qualities.
8. Nature conservation and ecological requirements of conservation objectives sometimes conflict with other land management. This conflict may require input from the Natura 2000 site managers and practical solutions can usually be found. Restoration measures involve making management choices that enable natural processes to become re-established and that, in turn, involves taking management actions to support them.

9. The management authorities should always keep in mind the existence and relevant elements of the European and national animal and plant health and plant reproductive materials' regimes and related areas (e.g. rules for the handling of animal by-products), as well as closely cooperate with the competent authorities implementing those.

5 Communication strategies

In relation to the management of wilderness and wild areas, stakeholder involvement is a key-element. A sense of 'ownership' is very important for good cooperation with local stakeholders. It is essential to work with different stakeholder groups and embrace their contributions to the site. Different communication and promotional strategies are needed for different target groups, i.e. local stakeholders, decision and policy makers and visitors/tourists. Much of the restoration effort within Natura 2000 sites must also involve (re-)building relationships with people, either living in, working on or visiting the site and communicating the merits and purposes of non-intervention management and restoration/re-wilding management.

5.1 Involvement of stakeholders

It is very important that the management authority of a wilderness and wild area ensures stakeholder involvement in relation to the management of the area. The better the cooperation with local stakeholders, the easier it will be to implement wilderness protection measures. A way to organise this is to make delegates of the most relevant stakeholder-groups members of a local consulting body. The managing authority should regularly explain and discuss all aspects of non-intervention or restoration management with these stakeholders. Best practices show that this method of cooperation can be very successful. It is very important that stakeholders have a sense of 'ownership' of the wilderness or wild area.

Main stakeholders groups might include:

- land managers/land owners (state and private);
- local officials, such as provincial government and municipalities;
- local communities;
- local businesses;
- tourism organisations;
- fire brigades (Mediterranean regions);
- herding organisations (Fennoscandia regions);
- external land users (i.e. visitors, climbers, bird watchers);
- national, regional or local nature conservation NGOs;
- agriculture, forestry, fisheries, extractive industry and interest groups and businesses;
- European bodies supporting and promoting non-intervention management;
- national central and local animal and plant health and plant reproductive material competent authorities

5.2 Importance of effective communication

As a policy, Natura 2000 is about protecting nature with people, i.e. people are specifically expected to be integrated and involved in the management processes. Similarly, restoration approaches for wilderness are obviously confronted by the fact that many Natura 2000 sites occur within areas, which are densely populated and often have multiple human uses.

Local people with a close association with an area, may struggle with concepts of 'wilderness' and may even perceive it as being 'dangerous' or 'out of control'. A main concern is often that

restoration to enable natural processes to become more dominant on a site may close their access to nature: they may associate non-intervention strategies as lack of management and even neglect. Some may think of wild areas as being less valuable, non-productive and 'less useful' for man. Local people may actually prefer to live in a traditional, agricultural, rural landscape: for them, basically, re-wilding can appear to involve the gradual destruction of nature or land as it is left-over to natural processes. They do not see a steady progression of improvement *for* nature and land, but rather a loss of what is familiar, known and 'safe'. Incentive and compensation measures can be used to overcome limitations of non-intervention management for local communities.

It is essential to work with farmers, landowners, community-based volunteers, bird-watchers, cyclists, walkers and the wider public and embrace their contributions to each site, whether that be in pursuit of economic gain, leisure, enjoyment of nature or realisation of biodiversity priorities. The important aspect here is that the legal protection afforded through being designated as a Natura 2000 site, often also embodied as part of local or national protection scheme, is designed to improve ecological, social and economic sustainability. Natura 2000 is not a barrier to activities, which also respect and protect an area's natural resources. In fact, it can be a significant supporting resource to address and resolve tensions.

5.3 Communication strategies and actions

Different communication strategies are needed for different target groups (i.e. local stakeholders, decision and policy makers and visitors/tourists). Different stakeholder groups have different interests.

Several recommendations can be made about communication strategies based on best practices:

- A good communication plan is indispensable to explain how important natural disturbance events are for non-intervention management and biodiversity conservation.
- A clear 'wilderness' message is needed, including a clear definition of wilderness, and an explanation of the ecological and socio-cultural benefits.
- It is important to improve the ecological awareness of local communities through meetings, publications, educational events and presence in media.
- Management bodies should be as transparent as possible about their management approach and should share monitoring results with the broad public.
- In cases of conflicts with certain stakeholders, management bodies should be patient and persistent in their strategic management, as many set goals will only arise on the long term in these kinds of areas.
- Cooperation with local businesses. If businesses have an ownership feeling towards the nature value, they are willing to contribute towards its preservation. The challenge here is to find sufficient resources to involve the local businesses and create benefits for them.

A marketing strategy might be effective in supporting wilderness areas. Promotion of (eco)tourism is an important element of this. Helpful tools include:

- *Sponsoring* will promote the area and will create the necessary financial support.
- *Visitor centres* are excellent places to promote and communicate non-intervention or restoration management to a broad public in the form of permanent or special/thematic

exhibitions. They are often good starting points for excursions, led by a well-trained dedicated staff of rangers.

- *Development and promotion of tourism products:* programmes to promote an area as a tourism destination and to coordinate and initiate development projects, sometimes financed through European Union funding.
- *Website*: every wilderness or wild area should have a well-designed website with opportunities for interactive participation (forum pages).
- *Publication materials*: Publishing scientific and public documents and brochures about interesting or new developments in the area, such as major disturbing events and their consequences, or the newly establishment of important and endangered species.

ANNEXES

A1 Glossary

CBD	Convention on Biological Diversity
DG	Directorate-General of the European Commission
EC	European Commission
EEA	European Environment Agency
EU	European Union
FCS	Favourable Conservation Status
MA	Millennium Ecosystem Assessment
MS	Member States
NGO	Non-Governmental Organisation
IAS	Invasive Alien Species
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LIFE	Financial Instrument for the Environment
pSCI	Proposed Site of Community Importance
SAC	Special Area for Conservation
SCI	Site of Community Importance
SPA	Special Protected Area
TEEB	The Economics of Ecosystems and Biodiversity

A2 Definitions of technical terms

Table A2.1 Definition of technical terms (source: Kettunen et al. (2007[124]).

Term	Definition	Source
ECOSYSTEM CHARACTERISTICS		
biodiversity	Variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems	Convention on Biological Diversity (CBD) (Article 2) http://www.cbd.int/convention/articles/?a=cbd-02 Corresponding definition also, for example, by: Meffe, G. K. and Carroll, C. R. 1997. Principles of Conservation Biology (second edition). Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts. 729 pp.
carbon sequestration	The process of increasing the carbon content of a carbon reservoir other than the atmosphere. Biological approaches to sequestration include direct removal of carbon dioxide from the atmosphere through land-use change, afforestation, reforestation, and practices that enhance soil carbon in agriculture. Physical approaches include separation and disposal of carbon dioxide from flue gases or from processing fossil fuels to produce hydrogen- and carbon dioxide-rich fractions and long-term storage in underground in depleted oil and gas reservoirs, coal seams, and saline aquifers.	IPCC Glossary of Terms (as used in the IPCC Third Assessment Report 2001) (http://www.ipcc.ch/pub/gloss.htm); Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx)
connectivity – structural and functional	Structural connectivity is equal to habitat continuity and is measured by analysing landscape structure, independent of any attributes of organisms. This definition is often used in the context of metapopulation ecology. Functional connectivity is the response of the organism to the landscape elements other than its habitats (i.e. the non-habitat matrix). This definition is often used in the context of landscape ecology.	*According to*: Tischendorf, L. and Fahrig, L. 2000. On the usage and measurement of landscape connectivity. Oikos 90: 7-19.
ecological network	A coherent system of natural and/or semi-natural landscape elements that is configured and managed with the objective of maintaining or restoring ecological functions as a means to conserve biodiversity while also providing appropriate opportunities for the sustainable use of natural resources (Bennett 2004). Typically ecological networks are implemented through a planning approach that identifies core areas (protected areas), buffer zones of mixed land use and connective structures that enable	Bennett, G. 2004. Integrating Biodiversity Conservation and Sustainable Use: Lessons Learned From Ecological Networks. IUCN, Gland, Switzerland, and Cambridge, UK. vi + 55 pp. Bruszik, A., Rientjes, S., Delbaere, B., van Uden, G., Richard, D., Terry, A. and Bonin, M. 2006. Assessment of the state of affairs concerning the Pan-European Ecological Network (Final draft – 31 August 2006) 79 pp.

[124] Kettunen, M.A., G. Terry, G. Tucker & A. Jones (2007). Guidance on the maintenance of landscape features of major importance for wild flora and fauna. Guidance on the implementation of Article 3 of the Birds Directive (79/409/EEC) and Article 10 of the Habitats Directive (92/43/EEC). Institute for European Environmental Policy (IEEP), Brussels; 114 p + Annexes.

	the movement of organisms between core areas (e.g. ecological corridors and/or permeable landscapes) (Bruszik *et al.* 2006, Bennett 2004).	
ecological stability	Ability of a community or ecosystem to withstand or recover from changes or stress imposed from outside. Within the concept of stability there are a number of terms and types that warrant further discussions. Generally ecologists have included the concepts of resilience and resistance of communities within the concept of stability. In this case resilience is the speed with which a community can return to its original state after being perturbed and resistance is the ability to avoid the perturbation in the first place (See '*ecosystem resilience*'). These ideas are now generally subsumed with the definition of ecosystem resilience.	Begon, M., Harper, J.L., and Townsend, C.R. 1996. Ecology: individuals, populations and communities (3rd ed.). Blackwell, Oxford, UK. 1068 pp + xii.
ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. The ecosystem boundaries are defined by the dynamic interactions, sometimes termed ecosystem processes, among the components of an ecosystem (i.e. plants, wildlife, climate, landforms and human activities). The ecosystem boundaries are irrespective of scale or location for ecosystem processes occur at a multitude of scales. Generally ecologists take a pragmatic approach that looks for assemblages of strong links between components within an ecosystem compared to weak interactions with components outside them. As biological diversity relates to the sum of the variability within species (e.g. genetic), between species and between ecosystems, it can be seen as a key structural feature of ecosystems	Convention on Biological Diversity (CBD) (Article 2) (http://www.biodiv.org/convention/articles.shtml?lg=0&a=cbd-02) Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx)
ecosystem functions / functioning	Ecosystem functions are defined as the capacity of natural [ecosystem] processes and components to provide goods and services that satisfy human needs, directly or indirectly. These functions have been broadly grouped into four categories: 1) regulation, 2) habitat, 3) production and 4) information (de Groot *et al.* 2002). In short, ecosystem functions can be seen as an observable outcome (a subset) of *ecosystem processes* and *ecosystem structure*. Out of the group of ecosystem functions, a set of *ecosystem services* having visible benefits to human society can be identified.	De Groot, R.S., Wilson, M.A., Boumans, R.M.J. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services Ecological Economics, 41/3: 367-567.
ecosystem services	Ecosystem services are the benefits people obtain from ecosystems. These include four different categories, namely *provisioning services* such as food, water, timber, and fibre; *regulating services* that affect climate, floods, disease, wastes, and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits; and *supporting services* such	Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx) This definition also adopted by the European Commission 'Halting the loss of biodiversity by 2010 – and beyond' (COM/2006/216)

	as soil formation, photosynthesis, and nutrient cycling. Please note: provisioning ecosystem services can also be referred to as *ecosystem goods*. Therefore, the term '*ecosystem goods and services*' is also often used in literature (particularly prior to the Millennium Ecosystem Assessment (MEA)). The term '*ecosystem goods and services*' is equivalent to the MEA four-category definition of ecosystem services (above).	(http://ec.europa.eu/environment/nature/biodiversity/current_biodiversity_policy/biodiversity_com_2006/index_en.htm)
ecosystem process	An intrinsic ecosystem characteristic whereby an ecosystem maintains its integrity. Ecosystem processes include decomposition, production, nutrient cycling, and fluxes of nutrients and energy.	Millennium Ecosystem Assessment (MEA). 2005. Our human planet: summary for decision-makers. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx)
ecosystem resilience	The capacity of a system to absorb disturbance and reorganise while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks (Walker at al. 2004). Resilience depends on ecological dynamics as well as the organisational and institutional capacity to understand, manage and respond to these dynamics.	Millennium Ecosystem Assessment (MEA). 2005. Our human planet: summary for decision-makers. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx) Walker, B. H., C. S. Holling, S. C. Carpenter and Kinzig, A. P. 2004. Resilience, adaptability and transformability. Ecology and Society 9:5.
ecosystem structure	Attributes related to the instantaneous physical state of an ecosystem; examples include species population density, species richness or evenness, and standing crop biomass.	US Environmental Protection Agency Glossary of terms (http://www.epa.gov/OCEPAterms/eterms.html)
PRESSURES ON ECOSYSTEMS (including those of climate change)		
disturbance	A discrete event, either natural or human induced, that causes a change in the existing condition of an ecological system. In community ecology, disturbance generally relates to the interruption of, or interference with, interspecific competition and the settled state the community structure would assume if the conditions remained constant. Therefore a disturbance is a discrete event in time that removes organisms or otherwise disrupts the community by influencing the availability of space and/or food resources, or by changing the physical environment. A general consequence of this is that space or resources become available to new individuals. The most commonly identified causes of disturbance are predators, parasites, disease, temporal heterogeneity and changes to physical structures. Changes to each of these factors can be naturally occurring or anthropogenically induced (Begon et al. 1996).	Kaufmann, M. R., Graham, R. T., Boyce, D. A., Jr., Moir, W. H., Perry, L., Reynolds, R. T., Bassett, R. L., Mehlhop, P., Edminster, C. B., Block, W. M., and Corn, P. S. 1994. An ecological basis for ecosystem management. Gen. Tech. Rep. RM 246. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 22 pp. Begon, M., Harper, J.L., and Townsend, C.R. 1996. Ecology: individuals, populations and communities (3rd ed.). Blackwell, Oxford, UK. 1068 pp + xii.
disturbance regime	Frequency, intensity, and types of disturbances, such as fires, insect or pest outbreaks, floods, and droughts.	IPCC Glossary of Terms (as used in the IPCC Third Assessment Report 2001) (http://www.ipcc.ch/pub/gloss.htm)
fragmentation /habitat fragmentation	The breaking up of extensive landscape features into disjunctive, isolated, or semi-isolated patches as a result of land-use changes. Fragmentation has two negative components for	General definition: European Community Biodiversity Clearing House Mechanism Glossary of Terms (http://biodiversitychm.eea.europa.eu/nyglossary_terms/)

	biota: loss of total habitat area and the creation of smaller, more isolated, remaining habitat patches (Meffe & Carroll 1997).	Meffe, G. K. & Carroll, C. R. 1997. Principles of Conservation Biology (second edition). Sinauer Associates, inc. Publishers, Sunderland, Massachusetts. 729 pp.
invasive alien species	An alien species whose introduction and/or spread threaten biological diversity. See also: *alien species*	Convention on Biological Diversity, CBD Guiding Principles (CBD Decision VI/23) (http://www.biodiv.org/decisions/default.aspx?dec=VI/23)
ECOLOGICAL RESPONSES		
favourable conservation status	*Habitats*: The conservation status of a natural habitat will be taken as 'favourable' when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable as defined below (as in Habitats Directive Article 2 (i)). *Species*: The conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in the Habitats Directive's Article 2. The conservation status will be taken as 'favourable' when: population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis. Please note: favourable conservation status was initially introduced by the Habitats Directive, i.e. its origins are in political, not ecological, literature.	Article 2 of the habitat Directive (92/43/EEC)
ECOSYSTEM MANAGEMENT		
buffer zone	Zone / area around the network (i.e. around core areas and, if necessary, around linkage elements) which protects the network from potentially damaging external influences and which are essentially transitional areas characterised by compatible land uses.	Bennett, G. 2004. Integrating Biodiversity Conservation and Sustainable Use: Lessons Learned From Ecological Networks. IUCN, Gland, Switzerland, and Cambridge, UK. vi + 55 pp. Corresponding definition also, for example, by: Meffe, G. K. and Carroll, C. R. 1997. Principles of Conservation Biology (second edition). Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts. 729 pp.
core area	Area where the conservation of biodiversity takes primary importance, even if the area is not legally protected.	General definition: Bennett, G. 2004. Integrating Biodiversity Conservation and Sustainable Use: Lessons Learned From Ecological Networks. IUCN, Gland, Switzerland, and Cambridge, UK. vi + 55 pp.
ecological	Landscape elements which serve to maintain	Bennett, G. 2004. Integrating Biodiversity

corridors	vital ecological or environmental connections by providing physical (though not necessarily linear) linkages between the core areas. The ecological functions of corridors are to enable species dispersal, migration, foraging and reproduction. Individual corridors are not necessarily linear features, but can be grouped in several ways according to their shapes (diffuse, belt-like, line-like, etc.), structure (continuous or interrupted like stepping stones), spatial position to the core area (conjunctive corridor or blind corridors), or by their services like migration corridors, commuting corridors and dispersal corridors. In practice, ecological corridors can be established at different scales, e.g. regional, national or local. At regional and national level ecological corridors refer to continuous habitat stretches (such as river valleys and water courses) and/or mosaic of habitat types that allow movement of species within the landscape. At local level corridors can consist of landscape elements such as hedgerows, dikes and road verges. It is to be noted that the proper scale of implementation is to a large extent species dependent and these aspects should be, therefore, taken into consideration.	Conservation and Sustainable Use: Lessons Learned From Ecological Networks. IUCN, Gland, Switzerland, and Cambridge, UK. vi + 55 pp. *Further elaborated in:* Bruszik, A., Rientjes, S., Delbaere, B., van Uden, G., Richard, D., Terry, A. and Bonin, M. 2006. Assessment of the state of affairs concerning the Pan-European Ecological Network (Final draft - 31 August 2006) 79 pp. (*and the references within*); and Meffe, G. K. and Carroll, C. R. 1997. Principles of Conservation Biology (second edition). Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts. 729 pp.
Green Infrastructure	A strategically planned network of natural and semi-natural areas but also other environmental features designed and managed so as to deliver a wide range of ecosystem services. It incorporates green spaces (can also be blue where aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in both rural and urban settings.	COM(2013)2013 Green Infrastructure – Enhancing Europe's Natural Capital. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52013DC0249:EN:NOT
protected area	A geographically defined area which is designated or regulated and managed to achieve specific conservation objectives	Convention on Biological Diversity (CBD) (Article 2) (http://www.biodiv.org/convention/articles.shtml?lg=0&a=cbd-02)
restoration	The return of an ecosystem or habitat to its original community structure, natural complement of species, and natural functions.	IUCN / World Conservation Monitoring Centre Glossary of Biodiversity Terms (http://www.unepwcmc. org/reception/glossaryA-E.htm). The SER International Primer on Ecological Restoration. 2004. Society for Ecological Restoration International, Science & Policy Working Group (Version 2: October, 2004) (http://www.ser.org/pdf/primer3.pdf)
wilderness area	A wilderness is an area governed by natural processes. It is composed of native habitats and species, and large enough for the effective ecological functioning of natural processes. It is unmodified or only slightly modified and without intrusive or extractive human activity, settlements, infrastructure or visual disturbance.	See Chapter 1 of this guidance document. Definition of a protected area category adopted by IUCN (Category Ib) (http://www.unepwcmc.org/protected_areas/categories/index.html)
wild area	Wild areas are often smaller than wilderness areas. Here the original natural ecological	See Chapter 1 of this guidance document.

	conditions have been slightly modified by extractive activities such as forestry or other extensive human activities. These fragmented areas can support natural processes typical for larger areas if they are connected through functional ecological corridors to the surroundings. Wild areas sometimes have the potential to become wilderness by the process of restoration.	Wild area and wildland are synonymous terms.
SPECIES / HABITAT ECOLOGY		
alien species	Alien species refers to a species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce.	Convention on Biological Diversity, CBD Guiding Principles (CBD Decision VI/23) (http://www.biodiv.org/decisions/default.aspx?dec=VI/23)
ecological community	An assemblage of species occurring in the same space or time, often linked by biotic interactions such as competition or predation.	Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx)
keystone species	A species whose impact on the community is disproportionately large relative to its abundance. Effects can be produced by consumption (trophic interactions), competition, mutualism, dispersal, pollination, disease, or habitat modification (non-trophic interactions).	Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx) Corresponding definition also, for example, by: Meffe, G. K. and Carroll, C. R. 1997. Principles of Conservation Biology (second edition). Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts. 729 pp.
species range (natural)	The spatial limits within which the habitat or species occurs. A natural range is not static but dynamic: it can decrease and expand.	Guidance document on the strict protection of animal species of Community interest provided by the 'Habitats' Directive 92/43/EEC, European Commission (autumn 2006 draft).
vulnerability – species and ecosystems/habitats	Exposure to contingencies and stress, and the difficulty in coping with them. Three major dimensions of vulnerability are involved: exposure to stresses, perturbations, and shocks; the sensitivity of people, places, ecosystems, and species to the stress or perturbation, including their capacity to anticipate and cope with the stress; and the resilience of the exposed people, places, ecosystems, and species in terms of their capacity to absorb shocks and perturbations while maintaining function. In the context of climate change: The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.	General definition: Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC. (http://www.maweb.org/en/index.aspx) Definition in the context of climate change: IPCC Glossary of Terms (as used in the IPCC Third Assessment Report 2001) (http://www.ipcc.ch/pub/gloss.htm); Secretariat of the Convention on Biological Diversity. 2003. Inter-linkages between biological diversity and climate change. Advice on the integration of biodiversity considerations into the implementation of the United Nations Framework Convention on Climate Change and its Kyoto protocol. Montreal, SCBD, 154 pp. (CBD Technical Series no. 10);

A3 Legislation and protection provisions in EU Member States

IUCN Management categories

IUCN protected area management categories classify protected areas according to their management objectives. The categories are recognised by international bodies such as the United Nations and by many national governments as the global standard for defining and recording protected areas and as such are increasingly being incorporated into government legislation (IUCN, 1994). These categories are summarised in Table A3.1. The strictest protection regime clearly intended to protect wilderness qualities is defined by category Ia/Ib and partly by category II and VI.

Table A3.1. The IUCN definitions for categories of protected areas, after Dudley (2008), where the degree of naturalness ranging from most natural to least natural conditions is Ia = Ib > II = III > IV = VI > V.

Category	Title	Description
Ia	Strict nature reserve	• Strictly protected • Set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of conservation values • Can serve as indispensable reference areas for scientific research and monitoring
Ib	Wilderness area	• Large unmodified or slightly modified areas, retaining natural character and influence, without permanent or significant human habitation • Protected and managed so as to preserve natural condition
II	National Park	• Large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area • Provide a foundation for environmentally and culturally compatible spiritual, scientific, education, recreational and visitor opportunities
III	Natural monument or feature	• Set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove • Generally quite small areas and often have high visitor value
IV	Habitat/species management area	• Protect particular species or habitats, and management reflects this priority • May need regular, active interventions to address requirements of particular species or to maintain habitats
V	Protected landscape/seascape	• Interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value • Safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values
VI	Protected area with sustainable use of natural resources	• Conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems • Generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area

Table A3.2. Legislation on strict nature reserves in Member States of EU27, with key-biological features and protection provisions.

Member State	Legislation on strict nature reserves[125]	Key-features	Protection provisions
Belgium-Wallonia Law on Conservation of Nature (MB 09/11/1973)	*Integral nature reserve:* is a protected area created in order to let the natural phenomena evolve according to their laws (Art. 7).	• development through natural processes only	
Bulgaria Protected Areas Act (11 Nov 1998 amended, SG No. 91/2002 (effective 1.01.2003; Article 5, 8, 16, 17)	*Strict nature reserve*: There shall be the following categories of protected areas: 1. *strict nature reserve*; 2. national park; 3. natural monument; 4. managed nature reserve; 5. natural park; 6. protected site. The nature reserves shall be areas referred to in *Items 1* and 4 of Article 5 herein, hosting examples of natural ecosystems whereof the conservation shall require that the said areas be free of human intervention or be minimally affected by such intervention. *Strict nature reserves* shall be managed for the purpose of: 1. retention of the natural character thereof; 2. scientific research and education and/or eco-monitoring; 3. conservation of genetic resources; 4. conservation of natural habitats and of populations of protected rare, endemic and relict species; 5. development of a network of ecosystems and threatened habitats representative of Bulgaria and Europe. *Protection provisions*: Any activities shall be prohibited in strict nature reserves with the exception of: 1. physical security of the said reserves; 2. visits for the purpose of scientific research; 3. pedestrian traffic movement on marked hiking trails, including such traffic for educational purposes; 4. collection of seeds, wild plants and animals for the purpose of scientific research or for repopulating other sites in quantities, manner and time excluding disturbance of the ecosystems; 5. (New, SG No. 28/2000, amended, No. 77/2002) extinguishment of fires and environmental harvesting in the forests damaged in consequence of natural disasters and calamities.	• no human intervention	• all human activities prohibited, except scientific research and education/ monitoring • only pedestrian movements on marked trails • collection of seeds, wild plants, animals for scientific research or repopulation elsewhere
Estonia Nature Conservation Act (21 April 2004; Article 29)	*Strict nature reserve:* 1. A strict nature reserve is a land or water area of a protected area whose natural status is unaffected by direct human activity and where the preservation and development of natural biotic communities is ensured only through natural processes. 2. All types of human activity is prohibited within a strict nature reserve, and persons are prohibited from staying in such reserves, except in cases specified in subsections (3) and (4) of this section. 3. Persons may stay in a strict nature reserve only for the purposes of supervision, rescue work or administration and organisation of the protection of the natural object. (21.02.2007 entered into force 01.04.2007 - RT I 2007, 25, 131). 4. People may stay in a strict nature reserve for the purpose of monitoring and assessment of the status of the natural object only with the	• natural status unaffected by direct human activity • preservation and development only through natural processes	• all human activities prohibited • presence of persons only for rescue or protection work

[125] http://www.lexadin.nl/wlg/legis/nofr/oeur/lxwelat.htm#Environmental%20Law

	consent of the administrative authority of the protected area. (18.12.2008 entered into force 01.02.2009 - RT I 2009, 3, 15)		
Finland Nature Conservation Act (December 20, 1996; Section 12)	*Strict nature reserves*: The designation and objectives of a strict nature reserve shall be prescribed by law if the site is at least 1,000 hectares in size and otherwise by decree. A strict nature reserve can only be established on State-owned land. A strict nature reserve should hold significance as a means of safeguarding undisturbed natural development, or for scientific research or education. *Protections provisions*: Any action altering the natural surroundings is prohibited in a national park or strict nature reserve. The following is thus prohibited in these areas: 1) the construction of buildings and other fixed installations, and the building of roads; 2) the extraction of sand and stone materials and minerals, and any action that damages the soil or bedrock; 3) drainage; 4) the removal or destruction of fungi, trees, bushes and other plants or parts thereof; 5) the capture, killing and disturbance of wild vertebrates, the destruction of nests, burrows, etc., and the capture and collection of invertebrates; and 6) any other action which may have a detrimental impact on the natural conditions and the landscape, or on the preservation of fauna and flora. Any action necessary for the appropriate maintenance and use of a nature reserve is permissible in a national park or strict nature reserve, provided this does not jeopardise the purpose for which it was established. The following is thus permissible: 1) the construction, restoration and repair of any buildings, fixed installations and paths necessary for the management of the site, surveillance, research, public orientation, and hiking, or of other visitors' facilities; 2) the upkeep and restoration of natural habitats and natural heritage types, and steps taken to restore the natural ecological balance; 3) the building of roads necessary for public orientation; 4) the picking of berries and mushrooms used for human consumption and other practical purposes; 5) angling and ice fishing; 6) reindeer farming as specified in the Reindeer Husbandry Act (848/90); 7) the use and repair of roads, power lines, telephone lines and associated equipment within the area; 8) the repair of waterways and installations essential for safe navigation, and any minor land clearing required for the installation of navigational aids; and 9) mapping and surveying. Conditions for the maintenance and development of the Sámi culture shall be secured in national parks and strict nature reserves located in the Sámi homeland, referred to in section 4 of the Act on the Sámi Parliament (974/1995).	• at least 1,000 ha • undisturbed natural environment • undisturbed natural development	• any action altering surroundings is prohibited • no road or settlement building • no extraction of soil, stones, etc. • no extraction of biotic resources • no disturbance of biota Permissible are: • actions for the maintenance and use of a strict nature reserve • restoration of natural habitats • picking of berries and mushrooms • angling and ice fishing • reindeer farming • repair of road, power and telephone lines • repair of waterways and installations for safe navigation • mapping and surveying Conditions for the maintenance and development of the Sámi culture shall be secured.
France **Environment code**	*Integral nature reserves:* strictly protected core zones in national parks (Art. L331-16)		

Greece Law on conservation of biodiversity (2011)	*Areas of absolute nature protection*: strict nature reserve (Art. 5.1)		
Latvia Law on Specially Protected Nature Territories (May 10, 2007; Section 3)	*Strict nature reserves*: (1) Strict nature reserves are territories untouched by human activities or nearly natural, in which territories unhindered development of natural processes shall be ensured in order to protect and study rare or typical ecosystems and parts thereof. *Protections provisions*: (2) Strict nature reserves shall have zones in which all natural resources are completely excluded from economic and other activities. In the territories of strict nature reserves there may be zones in which restricted economic, recreational, educational or other activities are permitted, provided that such activities do not endanger the preservation of nature standards and do not contradict protection and use regulations and the goal of the establishment of the reserve.	• territories untouched by human activities or nearly natural • unhindered development of natural processes	• no economic activities • zones with restricted recreational/ educational activities
Lithuania Environmental Protection Law (As amended by 28 May 1996; Article 12)	*Protected Areas and Nature Frame*: Protected areas shall be as follows: 1) conservation areas - *strict reserves*, other reserves and protected landscape; 2) preservation areas -protected zones of various purpose; 3) natural resource restoration areas - protected sites of natural resources; 4) areas of complex purpose - state (national and regional) parks, biosphere monitoring territories - biosphere reserves and biosphere polygons. *Protection provisions*: The nature frame shall link protected areas of natural character and other areas which are important from the environmental protection point of view and sufficiently natural to ensure the general stability of the landscape, to form a general landscape management system of ecological compensation zones. The preservation of protected areas and use of their natural resources shall be regulated by the Law on Protected Areas of the Republic of Lithuania, other laws and legal acts. (Amended 28 May 1996).	• strict reserves	• regulated use of natural resources
Poland Polish Nature Conservation Act (2004) (Article 5)	*Strict protection*: with a total and permanent cessation of human intervention in ecosystems, natural features and components of the nature and in natural processes on protected areas"	• no human intervention	• forms of conservation of the strictly protected areas consist of identifying, monitoring and eliminating or reducing the risks of anthropogenic threats and allowing the course of natural processes.
Romania Law on protected natural areas, conservation of natural habitats, flora and wildlife (2007)	*Scientific reserves:* a strict reserve to protect habitats that are kept in an undisturbed state as possible (Annex 1).	• undisturbed	
Slovakia Law on Nature Conservation and Landscape (2002)	*"Nature reserve (Art. 22) A locality, usually up to 1,000 ha representing predominantly original or those natural habitats of European or national interest or habitats of species of European or national interest which have not been generally affected by human activities, may be designated by the regional environmental office under a*		

	generally binding order as a nature reserve... The Ministry may designate a nature reserve that usually represents a national biocentre as part of the most significant natural heritage of the state by a generally binding regulation as a national nature reserve... The nature protection body may decide to close a nature reserve or a national nature reserve or their parts to the public or temporarily restrict entry in case of endangerment by a large number of visitors. The nature protection body is obliged to discuss, in advance, prohibition or restriction of the entry with affected municipalities... The fourth (§ 15) or fifth (§ 16) levels of protection are valid in the territory of a nature reserve". The fifth level means „non-intervention" and may apply in the other categories of protected areas if they are designated in the first level of protection.		
Slovenia Nature conservation Act (Article 65)	*Strict nature reserve*: (1) A strict nature reserve shall be an area of naturally preserved geotopes, habitats of endangered, rare or representative plant or animal species or an area important for biodiversity conservation where natural processes take place without human influence. *Protection provisions*: (2) In the protected area it shall be prohibited to carry out activities which threaten the conservation of the protected area; to intentionally destroy plants and animals; and to stay in the area, except for the persons conducting surveillance. (3) Notwithstanding the prohibition referred to in the preceding paragraph, the ministry may, by way of exception, permit the staying in the protected area for the purpose of research and education. (4) The detailed rules of conduct in the area of a natural reserve shall be laid down by the instrument of protection.	• naturally preserved geotopes, habitats • area important for biodiversity conservation • natural processes without human influence	• presence of persons only for conservation reasons • permits only for research/ education reasons

A4 Responses to the Questionnaire

Table A4.1. List of Natura 2000 sites with wilderness/wild areas qualities for which information is provided by site managers (through the questionnaire).

Site name	Code	SPA	SCI	SAC	Country code	Biogeographical region	Wilderness	Wild area	LIFE/LIFE+	Total area	Category area	Managed part	Wilderness	%
Hohe Tauern	AT321 AT322		✓		AT	ALP	y	y	y	80,514	II	26,714	53,800	67
Kalkalpen NP	AT31111000		✓		AT	ALP	y	y	y	21,454	II	5,854	15,600	73
Majella NP	IT7140129	✓			IT	ALP	y	n	y	74,095	II	57,095	17,000	23
Central Balkan NP	BG0000494	✓	✓		BG	ALP	y	n	y	72,021	II	51,002	21,019	29
Rila NP	BG0000495	✓	✓		BG	ALP	y	n	n	81,046	I/II	64,824	16,222	20
Tatra NP	SKUEV0307		✓		SK	ALP	y	y	n	61,735	II	29,835	31,900	52
Retezat NP	RO0217 RO0084	✓	✓		RO	ALP	y	n	y	81,207	Ia/II	70,207	11,000	14
Hohe Tauern Carinthia	AT2101000 AT2129000		✓		AT	ALP	y	y	y	33,447	II	754	32,693	98
Gorczanski NP	PLB120001; PLH120018	✓	✓	✓	PL	ALP	y	y	n	24,822	II	9,822	15,000	60
Bieszczady NP	PLC180001	✓	✓		PL	ALP	y	y	n	111,520	II	92,966	18,554	17
Magurski NP	PLH180001		✓		PL	ALP	n	y	n	20,085	II	20,085		
Tatra NP	PLC120001	✓	✓		PL	ALP	n	y	n	21,018	II	21,018		
Oulanka NP	FI1101645	✓	✓		FI	BOR	y	y	y	29,390	II	10	29,380	100
Soomaa	EE0080574	✓	✓		EE	BOR	y	n	n	40,033	Ia/Ib/II	15,633	24,400	61
Komosse	SE 0310072	✓	✓		SE	BOR	y	n	y	1,450	?	450	1,000	69
Sällevadsån	SE0310407		✓		SE	BOR	y	y	n	264	II	64	200	76
Archipelago NP	FI0200090 FI02000164	✓	✓		FI	BOR	y	n	y	50,219	II	39,619	10,600	21
Brötarna	SE0720215	✓	✓		SE	BOR	y	n	y	3,628	Ia	0	3,628	100
Brandenburg sites	DE 4051301 and others	✓	✓	✓	DE	CON	n	y	n	190,177	IV	190,177		
Sumava NP	CZ0314024		✓		CZ	CON	y	y	n	171,866	II	158,806	13,060	8
Bavarian Forest NP	DE6946301	✓	✓		DE	CON	y	y	n	24,218	II	11,343	12,875	53
NP Unteres Odertal	DE2951-302 DE2951-4		✓	✓	DE	CON	y	n	n	10,056	II	7,808	2,248	22
Wigry NP	PLH 200004 PLB 200002	✓	✓		PL	CON	y	y	n	134,378	II	119,390	14,988	11
Łysogóry	PLH260002				PL	CON	n	y	n	8,090	II	8,090		
Narew NP	PLH200002 PLB200001	✓	✓		PL	CON	n	y	n	23,471	II	23,471		
Wielkopolski NP	PLH300010		✓		PL	CON	y	n	n	8,427	II	8,167	260	3
Kampinoska NP	PLC140001	✓	✓		PL	CON	y	y	y	37,640	II	33,004	4,636	12
Karkonosze NP	PLH020006		✓		PL	CON	y	n	n	18,204	II	12,619	5,585	31
Ojców NP	PLH120004		✓		PL	CON	y	y	n	2,146	II	1,896	250	12
Poleski NP	PLB 060001 PLB 060019 PLH 060013	✓	✓		PL	CON	y	n	y	20,218	II/IV	10,454	9,764	48
Slowinski NP	PLB 220003 PLH 220023	✓	✓		PL	CON	n	y	n	216,746	II	216,746		

	PLB 990002													
Amvrakikos Wetlands NP	GR2110001 GR2110004 GR2310006 GR2310014	✓	✓		GR	MED	y	y	y		II			
Limnes Vistonis, Ismaris Limnothalasses, Porto Lagos, Alyki Ptelea, Xirolimni Karatza	GR1130010	✓			GR	MED	y	y	y		I/II			
Voreia Karpathos Kai Saria	GR4210003	✓			GR	MED	y	y	y	8,300	?	6,000	2,300	28
Samaria NP	GR4340008 GR4340014	✓	✓		GR	MED	y	y	y	58,484	II	58,484		
Oostvaardersplassen	NL9802054		✓		NL	ATL	n	y	n	5,501	IV	5,501		

Note: The questionnaire revealed that, despite the provided clear definition of wilderness as used in this guidance document, the practical application and interpretation varied among site managers.

A5 Habitat types representing wilderness value

*Table A5.1. Habitat types representing wilderness value; based on the response of 36 site managers of wilderness/wild areas on the questionnaire. Biogeographical regions: ATL = Atlantic, ALP = Alpine, BOR = Boreal, CON= Continental, MED = Mediterranean. *Priority habitat types.*

Code	Common name	ATL	ALP	BOR	CON	MED
CONTINENTAL AND HALOPHYTIC HABITATS						
1120	* Posidonia beds (*Posidonion oceanicae*)					✓
1150	* Coastal lagoons				✓	✓
1170	Reefs			✓		
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts			✓		
1420	Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)					✓
1610	Baltic esker islands with sandy, rocky and shingle beach vegetation and sublittoral vegetation			✓		
1620	Boreal baltic islets and small islands			✓		
1630	* Boreal baltic coastal meadows			✓		
1640	Boreal Baltic sandy beaches with perennial vegetation			✓		
COASTAL SAND DUNES AND INLAND DUNES						
2120	Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)				✓	
2130	*Fixed coastal dunes with herbaceous vegetation (grey dunes)				✓	
2180	Wooded dunes of the Atlantic, Continental and Boreal region				✓	
2310	Dry sand heaths with *Calluna* and *Genista*				✓	
2330	Inland dunes with open *Corynephorus* and *Agrostis* grasslands				✓	
FRESHWATER HABITATS						
3140	Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.				✓	
3150	Natural eutrophic lakes with *Magnopotamion* or *Hydrocharition* - type vegetation				✓	
3160	Natural dystrophic lakes and ponds			✓	✓	
3190	Lakes of gypsum karst					✓
3210	Fennoscandian natural rivers			✓		
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation			✓	✓	
3270	Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation				✓	
TEMPERATE HEATH AND SCRUB						
4030	European dry heaths			✓	✓	
4060	Alpine and Boreal heaths		✓	✓		
4070	* Bushes with *Pinus mugo* and *Rhododendron hirsutum* (*Mugo-Rhododendretum hirsuti*)		✓		✓	
4080	Sub-Arctic *Salix* spp. scrub		✓			
4090	Endemic oro-Mediterranean heaths with gorse					✓
SCLEROHPHYLLOUS SCRUB (Matorral)						
5210	Arborescent matorral with *Juniperus* spp.		✓			
5420	*Sarcopoterium spinosum phryganas*					✓
5430	Endemic phryganas of the *Euphorbio-Verbascion*					✓
NATURAL AND SEMI-NATURAL GRASSLAND FORMATIONS						
6120	* Xeric sand calcareous grasslands				✓	

6150	Siliceous alpine and boreal grasslands		✓	✓		
6170	Alpine and subalpine calcareous grasslands		✓			
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates(*Festuco-Brometalia*) (* important orchid sites)		✓		✓	
6220	* Pseudo-steppe with grasses and annuals of the *Thero-Brachypodietea*		✓			
6230	* Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)		✓		✓	
6230	Species-rich *Nardus* grassland, on silicious substrates in mountain areas				✓	
62D0	Oro-Moesian acidophilous grasslands		✓			
6410	*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)				✓	
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels		✓			
6440	Alluvial meadows of river valleys of the *Cnidion dubii*				✓	
6450	Northern boreal alluvial meadows			✓		
6510	Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*)		✓		✓	
6520	Mountain hay meadows		✓		✓	
RAISED BOGS AND MIRES AND FENS						
7110	* Active raised bogs			✓	✓	
7140	Transition mires and quaking bogs			✓	✓	
7230	Alkaline fens			✓	✓	
7240	* Alpine pioneer formations of *Caricion bicoloris-atrofuscae*			✓		
7310	* Aapa mires			✓		
ROCKY HABITATS AND CAVES						
8110	Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsetalia ladani*)		✓	✓	✓	
8120	Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii)*		✓			
8160	* Medio-European calcareous scree of hill and montane levels				✓	
8210	Calcareous rocky slopes with chasmophytic vegetation		✓			
8220	Siliceous rocky slopes with chasmophytic vegetation		✓			
8340	Permanent glaciers		✓			
FORESTS						
9010	* Western Taiga			✓		
9020	* Fennoscandian hemiboreal natural old broad-leaved deciduous forests (*Quercus*, *Tilia*, *Acer*, *Fraxinus* or *Ulmus*) rich in epiphytes			✓		
9040	Nordic subalpine/subarctic forests with *Betula pubescens* ssp. *Czerepanovii*			✓		
9050	Fennoscandian herb-rich forests with *Picea abies*			✓		
9080	*Fennoscandian deciduous swamp woods			✓		
9110	*Luzulo-Fagetum* beech forests		✓		✓	
9130	*Asperulo-Fagetum* beech forests		✓		✓	
9140	Medio-European subalpine beech woods with *Acer* and *Rumex arifolius*		✓			
9150	Medio-European limestone beech forests of the *Cephalanthero-Fagion*		✓			
9170	*Galio-Carpinetum* oak-hornbeam forests		✓		✓	
9180	* *Tilio-Acerion* forests of slopes, screes and ravines		✓			
9190	Old acidophilous oak woods with *Quercus robur* on sandy plains				✓	
91BA	Moesian silver fir forests		✓			
91D0	* Bog woodland		✓	✓	✓	
91E0	* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae, Salicion albae*)		✓		✓	
91F0	Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsio*r or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)				✓	

91P0	Holy Cross fir forests (*Abietetum polonicum*)				✓	
91W0	Moesian beech forests		✓			
9210	* Apennine beech forests with *Taxus* and *Ilex*		✓			
9290	Cupressus forests (*Acero-Cupression*)					✓
92D0	Southern riparian galleries and thickets (*Nerio-Tamaricetea* and *Securinegion tinctoriae)*					✓
9320	*Olea* and *Ceratonia* forests					✓
9410	Acidophilous *Picea* forests of the montane to alpine levels (*Vaccinio-Piceetea*)		✓		✓	
9420	Alpine *Larix decidua* and/or *Pinus cembra* forests		✓			
9430	Subalpine and montane *Pinus uncinata* forests (* if on gypsum or limestone)		✓			
9540	Mediterranean pine forests with endemic Mesogean pines					✓

A6 Species of the Habitat and Birds Directives with wilderness values

Table A6.1. Species of Community interest representing wilderness value; based on the response of 36 site managers of wilderness/wild areas on the questionnaire. Biogeographical regions: ATL = Atlantic, ALP = Alpine, BOR = Boreal, CON= Continental, MED = Mediterranean.

Species	Common name	Code	ATL	ALP	BOR	CON	MED
Gavia stellata	Red-throated Diver	A001			✓		
Podiceps auritus	Horned Grebe	A007			✓		
Pelecanus crispus	Dalmatian Pelican	A020					✓
Botaurus stellaris	Eurasian Bittern	A021					✓
Ciconia nigra	Black Stork	A030		✓	✓	✓	
Cygnus cygnus	Whooper Swan	A038			√		
Aythya nyroca	Ferruginous Duck	A060					✓
Pernis apivorus	European Honey Buzzard	A072				✓	
Haliaeetus albicilla	White-tailed Eagle	A075			✓	✓	
Gypaetus barbatus	Bearded Vulture	A076		✓			✓
Circus aeruginosus	Western Marsh-Harrier	A081				✓	
Circus cyaneus	Hen Harrier	A082			✓		
Accipiter gentilis	Northern Goshawk	A085				✓	
Gyps fulvus	Griffon Vulture	A087					✓
Aquila pomarina	Lesser Spotted Eagle	A089		✓	✓		✓
Aquila clanga	Greater Spotted Eagle	A090			✓	✓	✓
Aquila chrysaetos	Golden Eagle	A091		✓	✓		✓
Hieraaetus fasciatus	Bonelli's Eagle	A093					✓
Falco columbarius	Merlin	A098			✓		
Falco biarmicus	Lanner Falcon	A101		✓			
Falco rusticolus	Gyrfalcon	A102			✓		
Falco peregrinus	Peregrine Falcon	A103				✓	
Bonasa bonasia	Hazel Grouse	A104		✓	✓	✓	
Tetrao tetrix	Black Grouse	A107		✓			
Tetrao urogallus	Western Capercaillie	A108		✓	✓	✓	
Crex crex	Corncrake	A122		✓	✓	✓	
Gallinula chloropus	Common Moorhen	A123					✓
Grus grus	Common Crane	A127			✓	✓	
Burhinus oedicnemus	Stone Curlew	A133			✓		
Charadrius morinellus	Eurasian Dotterel	A139		✓			
Pluvialis apricaria	Golden Plover	A140			✓		
Vanellus vanellus	Northern Lapwing	A142					✓
Philomachus pugnax	Ruff	A151			✓		
Limosa limosa	Black-tailed Godwit	A156					✓
Numenius phaeopus	Whimbrel	A158			✓		
Tringa totanus	Common Redshank	A162					✓
Tringa glareola	Wood Sandpiper	A166			✓		
Phalaropus lobatus	Red-necked Phalarope	A170			✓		
Larus ribidundus	Black-headed Gull	A179					✓

Sterna paradisaea	Arctic Tern	A194			✓		
Buteo buteo	Common Buzzard	A215				✓	
Glaucidium passerinum	Eurasian Pygmy Owl	A217		✓		✓	
Strix aluco	Tawny Owl	A219				✓	
Strix uralensis	Ural Owl	A220		✓		✓	
Asio otus	Long-eared Owl	A221				✓	
Asio flammeus	Short-eared Owl	A222			✓	✓	
Aegolius funereus	Tengmalm's Owl	A223		✓	✓	✓	
Alcedo atthis	Kingfisher	A229				✓	
Picus viridis	Green Woodpecker	A235				✓	
Dryocopus martius	Black Woodpecker	A236		✓	✓		
Dendrocopos leucotos	White-backed Woodpecker	A239		✓		✓	
Picoides tridactylus	Three-toed Woodpecker	A241		✓		✓	
Luscinia svecica	Red spotted Blue-throat	A272	✓	✓	√		
Acrocephalus paludicola	Aquatic Warbler	A294				✓	
Ficedula parva	Red-breasted Flycatcher	A320				✓	
Phalacrocorax pygmeus	Pygmy Cormorant	A393					✓
Aquila heliaca	Imperial Eagle	A404		✓			
Tetrao tetrix tetrix	Black Grouse	A409			✓		
Perisoreus infaustus	Siberian Jay	A548			✓		
Margaritifera margartifera	Freshwater Pearl Mussel	H1029			✓		
Unio crassus	Thick-Shelled River Mussel	H1032				√	
Ophiogomphus cecilia	Green Snaketail	H1037				✓	
Leucorrhinia pectoralis	Large White-faced Darter	H1042				✓	
Euphydryas maturna	Scarce Fritillary	H1052		✓	✓		
Maculinea teleius	Scarce Large Blue	H1059				✓	
Lycaena dispar	Large Copper	H1060				✓	
Euphydryas aurinia	Marsh Fritillary	H1065		✓		✓	
Dytiscus latissimus	*Dytiscus latissimus*	H1081			✓	✓	
Osmoderma eremita	Hermit Beetle	H1084				✓	
Cucujus cinnaberinus	*Cucujus cinnaberinus*	H1086				✓	
Rosalia alpina	Alpine Longhorn Beetle	H1087		✓			
Lampetra fluviatilis	European River Lamprey	H1099				✓	
Aspius aspius	Asp	H1130				✓	
Rhodeus amarus	European Bitterling	H1134				✓	
Cobitis taenia	Spined Loach	H1149			✓	✓	
Cottus gobio	European Bullhead	H1163			✓	✓	
Triturus cristatus	Great crested Newt	H1166				✓	
Salamandrina terdigitata	Spectacled Salamander	H1175		✓			
Bombina bombina	Fire-bellied Toad	H1188				✓	
Bombina variegata	Yellow-bellied Toad	H1193		✓			
Pelobates fuscus	Common Spadefoot toad	H1199				✓	
Emys orbicularis	European Pond Turtle	H1220				✓	
Vipera ursinii	*Vipera ursinii*	H1298		✓			
Rhinolophus hipposideros	Lesser Horseshoe Bat	H1303		✓		✓	

Rhinolophus blasii	Blasius's Horseshoe Bat	H1306					✓
Myotis blythii	Lesser Moused-ear Bat	H1307					✓
Barbastella barbastellus	Western Barbastelle	H1308				✓	
Myotis dasycneme	Pond Bat	H1318				✓	
Myotis bechsteinii	Bechstein´s Bat	H1323				✓	
Myotis myotis	Greater Mouse-eared Bat	H1324		✓		✓	
Spermophilus citellus	European Ground Squirrel	H1335		✓			
Castor fiber	European Beaver	H1337		✓		✓	
Canis lupus	Grey Wolf	H1352		✓	✓		
Ursus arctos	Brown Bear	H1354		✓	✓		
Lutra lutra	Eurasian Otter	H1355		✓	✓	✓	
Lynx lynx	Eurasian Lynx	H1361		✓	✓	✓	
Halichoerus grypus	Grey Seal	H1364			✓	✓	
Monachus monachus	Mediterranean Monk Seal	H1366					✓
Rupicapra rupicapra balcanica	Balkan Chamois	H1371		✓			
Capra aegagrus cretica	Wild Goat of Crete	H1372					✓
Rupicapra pyrenaica ornata	Apennine Chamois	H1374		✓			
Dicranum viride	*Dircranum* Moss	H1381				✓	
Buxbaumia viridis	Green Shield-Moss	H1386		✓	✓	✓	
Drepanocladus vernicosus	Slender Green Feather Moss	H1393		✓		✓	
Scapania carinthiacia (incl. S. massalongi)	Liverwort'	H1394		✓			
Tayloria rudolphiana	Bryophyte'	H1399		✓			
Zelkova abelicea	Cretan Zelkova	H1436					✓
Silene holzmannii	Holzmann's Silene	H1459					✓
Bupleurum kakiskalae	Bupleurum kakiskalae	H1606					✓
Angelica palustris	Angelica palustris	H1617				✓	
Cypripedium calceolus	Yellow Lady's Slipper	H1902			✓	✓	
Liparis loeselii	Yellow Widelip Orchid	H1903				✓	
Gulo gulo	Wolverine	H1912			✓		
Carabus menetriesi pacholei	Ground Beetle	H1914				✓	
Phoca hispida botnica	Ringed Seal	H1938			✓		
Calypso bulbosa	Calypso	H1949			✓		
Pulsatilla slavica	Slovak Pasqueflower	H2094		✓			
Linaria loeselii	Linaria loeselii	H2216				✓	
Pedicularis sudetica	Sudetic Lousewort	H2217				✓	
Bison bonasus	European Wisent	H2647		✓			
Marmota marmota latirostris	Alpine Marmot	H4003		✓			
Rupicapra rupicapra tatrica	Tatra Chamois	H4006		✓			
Rupicapra rupicapra tatrica	Tatra Chamois	H4006		✓			
Phoxinus percnurus	Swamp Minnow	H4009				✓	
Carabus variolosus	Carabus variolosus	H4014		✓			
Rhysodes sulcatus	Rhysodes sulcatus	H4026				✓	
Lycaena helle	Violet Copper	H4038			✓		
Campanula bohemica	Campanula bohemica	H4069				✓	
Campanula serrata	Bellflower	H4070		✓			

Cochlearia tatrae	Tatra Scurvy Grass	H4090		✓			
Galium sudeticum	Galium sudeticum	H4113				✓	

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