SUSTAINABLE FOREST MANAGEMENT NETWORK
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Sustainable Forest Management and Protected Areas: Perspectives from Central Europe

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Relationships Between Protected Areas and Sustainable Forest Management: Many Shades of Green

A State of Knowledge Report
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2010

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Relationships Between Protected Areas and Sustainable Forest Management: Many Shades of Green

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by Yolanda F. Wiersma, Peter N. Duinker, Wolfgang Haider, Glen T. Hvenegaard and Fiona K. A. Schmiegelow

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1.0 Background and introduction

Europe has a long tradition of forestry and of protected areas. In some regions, these two land uses often occur in close proximity to each other, and may even overlap. This document will explore the relationship between forestry and protected areas in Central Europe. Much of this area is densely populated and developed, and the implementation of biodiversity goals in land management has posed serious challenges. Relationships between forestry and protected forested areas (protected areas containing forested land) were recently investigated in a large-scale EU project, COST Action 27 (Frank et al. 2007). Our report will build on that knowledge. We will identify and describe some unique and exciting examples of creative approaches to implementing sustainable forest management in conjunction with various types of protected areas. These examples, in turn, may help inform relationships between protected areas and sustainable forest management in Canada.

The report by Wiersma et al. (2010) suggests the need to think about protected areas and sustainable forest management along a continuum. While the geography of protected areas in Canada perhaps more resembles the Scandinavian situation, we feel the creative solutions found in Central Europe may be helpful for moving Canadian issues forward, particularly in those regions where goals for the forest industry and for biodiversity protection overlap.

1.1 Sustainable forest management in Europe

In Central Europe, "sustainable forest management" (in German: "Nachhaltige Waldbewirtschaftung" emerged as a concept at the beginning of the 1700s (Hasel 1985). In Germany, the term "sustainability" was first used in the context of forestry in 1713 by Hans Carl von Carlowitz, the godfather of European forestry. At that time most forests in Western and Central Europe had already been cleared. Initially, sustainability was thought of in an economic context only, as wood users and forest owners started to be concerned about long-term sustainability of the wood supply. However, by the early 1800s, one can identify components of modern applications of sustainable forest management in Central Europe, supported for instance by the research of Georg Ludwig Hartig (1819).

At the Second Ministerial Conference on the Protection of Forests in Europe (MCPFE), held in Helsinki in 1993, sustainable forest management was defined as "the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems" (Helsinki Resolution H1, www.mcpfe.org).

Over the past 15 years, this framework has led to rather specific national and regional applications of sustainable forest management. It has led to criteria and indicator frameworks based on six principles (Box 1), some quite similar to those developed by the Canadian Council of Forest Ministers (CCFM 2003). Progress has been made in integrating sustainable management into forestry across Europe.

BOX 1

Principles of sustainable forest management in Europe

1. Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.
2. Maintenance of forest ecosystem health and vitality.
3. Maintenance and encouragement of productive functions of forests (wood and non-wood).
4. Maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems.
5. Maintenance and appropriate enhancement of protective functions in forest management (notably soil and water).
6. Maintenance of other socioeconomic and cultural functions and conditions.

(Source: MCPFE 2007)

As described by the MCPFE (Ministerial Conference on the Protection of Forests in Europe) conference in Warsaw 2007, "Sustainability is given prominence in forest laws and other policy instruments. MCPFE countries are pursuing sustainable forest management through creating new policy instruments and adjusting existing ones" (MCPFE 2007). Important policy tools include financial incentives to landowners for implementing sustainable forest management measures, efforts by the various levels of government to strengthen the forest-related information base, and improved communication.

In addition to the challenge of integrating conservation concerns into the operationalisation of sustainable forest management, forestry must also address and co-exist with a sophisticated system of protected areas that have rather different and sometimes varied conservation mandates (e.g. BUWAL 1993). Europe has many types of protected areas, with diverse levels of protection. Forest management must adjust to the regulations of protected areas if it is to continue its operations on or adjacent to these lands. It is in this context that many innovative approaches have been developed; case studies will be described below.

1.2 Protected areas in Europe

Traditional types of protected areas

A number of protected areas already existed across Europe in the early 1800s. Their origin was often associated with the hunting interests of the local nobility. This is the case, for instance, with the Donauauen National Park near Vienna and the densely forested Bialowieski National Park in eastern Poland. Other areas were originally protected for their beautiful scenery or unique landscapes, such as Berchtesgaden National Park (Germany) with the Watzmann massif and the Königsee lake as its most famous landmarks. Only rarely did scientific reasons lead to the protection of valuable habitat or the habitat of rare and endangered species. Most of them are now protected as **National Parks**. The first National Parks were developed at the beginning of the 19th century and the designation of new parks continued until the late 1990s, with the last period coinciding with the opening of the Iron Curtain. In addition, **nature conservation areas** guaranteeing strict protection on a smaller scale were also established.

Despite the establishment of such designated protected areas, by the 1990s only a very small fraction of the total area of Central Europe (less than 5% on average) was protected under a strong protection regime. Worse, no scientifically based approach existed for the identification of areas that should be protected, and no international or continental concept for ecologically-based protection had been designed.

While these first types of European protected areas (e.g., national parks and nature conservation areas) had emphasized nature conservation, in post-war Europe new concepts of protection had also emerged. These included a focus on protecting beautiful and unique landscapes, or a focus on specific habitats for instance through landscape protection areas, nature parks and biosphere reserves. In many central European countries such as Italy, France, Germany and Austria, the **Nature Park** plays an important role in this context. The concept of the Nature Park, now

50 years old, is of particular interest for its application of sustainability principles, and in many locations it also includes forestry. By definition, Nature Parks are actively managed by humans. They encourage environmentally sound land uses and land management, including for instance recreation and forestry. The title "Nature Park" is a label of distinction for these landscapes and their residents, who maintain these values in local participatory decision making processes. For example, in Italy and Germany they encompass more than 25% of the total national area. They are located in representative and outstanding cultural landscapes, and usually serve as catalysts for regional development initiatives. As such they are shining examples of cultural landscapes implementing an integrated sustainable regional development strategy, which usually includes both forestry and conservation goals among others. In many regions the park name serves as a marketing label conveying quality and natural products, and is associated with increased quality of life to be enjoyed by residents and visitors alike. Many Nature Parks have now expanded into spheres beyond their original legal mandate (Pröbstl 2004), providing models for a sustainable land use and regional development. The integrated concept includes recreation, tourism, agriculture and forestry. It supports strongly the concept of protection via extensive forms of land use. In the process they have also developed skills to obtain financial assistance from state, national, and European governments.

Table 1 provides an overview of these traditional types of protected areas in Europe and shows the required adaptation of forest management according to the specific conservation goals.

According to Frank et al. (2007) and the Ministerial Conference on the Protection of Forests in Europe (MCPFE), forest management in protected areas under IUCN categories I, II and IV focuses on the maintenance or enhancement of biodiversity and the protection of the natural integrity. In IUCN categories III, V and VI this is less dominant.

Natura 2000 sites

With new international calls to enhance conservation and biodiversity (Brundtland 1987, Rio 1992), the deficiency of biodiversity in most European nations became blatantly obvious, and supported a European-led initiative to address these concerns. The result was the **Natura 2000** concept. All member states must meet requirements of two European laws: the directive on the conservation of natural habitats and of wild fauna and flora (European Council Directive 92/43 EEC from 1992) and the directive on conservation of migratory birds (European Council directive 79/409 EEC from 1979).

This led to the establishment of "Natura 2000" sites across Europe. The selection of Natura 2000 sites is led by individual member states. The selection of the sites is guided by a red and blue list of species which is drawn up by scientists and which must be followed by the policy process. In Canada, the Species at Risk Act (SARA) fulfills a similar mandate. (For a comparison of SARA and Natura 2000, see Prutsch et al. 2008.) The crucial elements of the Natura 2000 network are habitats of endangered species (animals and plants), of migratory birds, and special biotopes. (We discuss Natura 2000 further in section 2.2.)

Table 1 **Forest management for biodiversity, adapted to various IUCN categories**

IUCN category	Typical example in Europe	Forest management related to biodiversity
I	Wilderness Area	No active intervention
II	National Park	Minimum intervention
IV	Nature Conservation Area	Conservation through active management if required
(III), V, VI	Landscape protection Area Nature Park	Protection of landscape beauty primarily and related biodiversity through active management

In summary, the European network of Natura 2000 sites constitutes an additional category of protected areas and should be perceived as a separate layer covering already existing traditional protected areas as well as unprotected land (including any kind of private land and various forms of productive land). Management objectives depend on site-specific goals and therefore differ from location to location.

Based on this background of both traditional and newer forms of protected areas and the new requirements based on NATURA 2000, we developed the conceptual framework described below (section 1.3).

1.3 A conceptual framework to link sustainable forest management and protected areas

Sustainable forest management (SFM) has to be adjusted (or be custom made) to the various requirements of the different types of protected areas. Compared to the North American situation, European research and practice focuses strongly on the definition of improvements and possible win-win solutions for both biodiversity and forest use. In order to discuss and illustrate some of these options, all of which are embedded in their respective IUCN categories, we present three different types of sustainable forest management in Figure 1.

Possible relationships between protected areas and forestry can be framed in a convenient framework by combining:

- the two categories of strictest protection (I and II),
- the two categories with significant conservation concern (III and IV)[1], and
- the two categories that allow many other land uses (V and VI).

The case studies below will describe how sustainable forest management can be in agreement with the objectives of protected areas under a range of IUCN categories. In all cases, it is the IUCN category that determines the appropriate type of forest management. In other words, forest management must adapt its practices to the rules and regulations of the respective protected areas in order to be regarded as sustainable, and must remain in compliance with the goals of the protected areas. The width of each arrow (Figure 1 and others) shows that forest management is rather miniscule in Type 1, becomes more prominent in Type 2, and might be a rather prominent land use in Type 3.

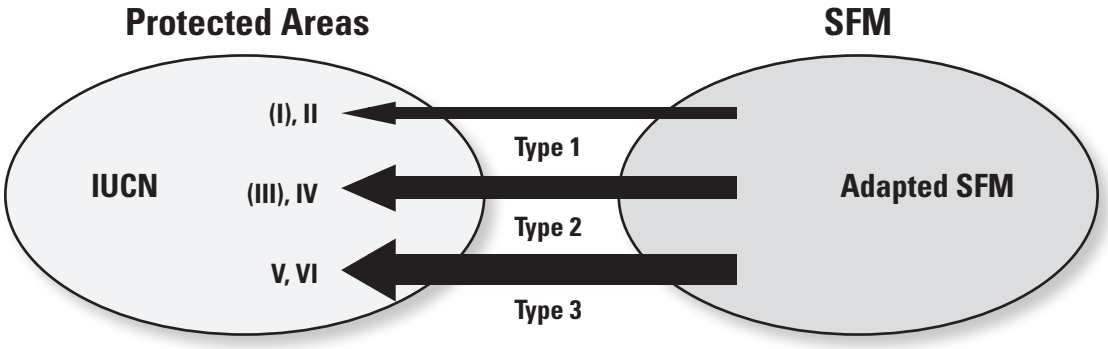

Figure 1. Conceptual framework illustrating the degree to which sustainable forest management must adapt to the level and type of protection associated with a specific category of protected forest area. The status of the protected area determines the amount and intensity of forestry possible, as symbolised by the width of the arrows. However, the three types should be regarded as parts of a continuum rather than as distinct categories.

[1] (Combining category III with category IV differs from the MCPFE's grouping, but should not be of concern; category III typically encompasses small areas with only a minor forest component.)

2.0 Examples of adaptation of sustainable forest management to conservation

2.1 Sustainable forest management in strongly protected areas (Type 1)

In strongly protected forest areas, only very select types of forest management practices are permitted. By definition, IUCN category I does not allow any human use, and category II allows hardly any human interventions[2]. "Best practices" prescriptions for these areas permit only management measures that protect and maintain biological diversity of the protected area, and defensive measures that prevent the spread of possible negative effects from protected areas to the surrounding forests.

For example, deadwood may be removed only at the boundary of a protected area close to private forests to reduce the risk of very severe pest infestations. With the influence of climate change, questions arise as to whether forest management should act to eliminate newly introduced species (e.g., small palm trees in the south of Switzerland) or conversely should encourage the shift of species composition due to climate change.

Other sets of questions include whether protected areas should try to reduce the potential effects of natural disasters on the surrounding landscape (e.g., fire, avalanches, rock slides, pest infestations and others), and whether they should try to counteract the fertilizing effect caused by air pollution. In light of these fundamentally unresolved issues, the question of what might be an appropriate monitoring system has not been resolved either.

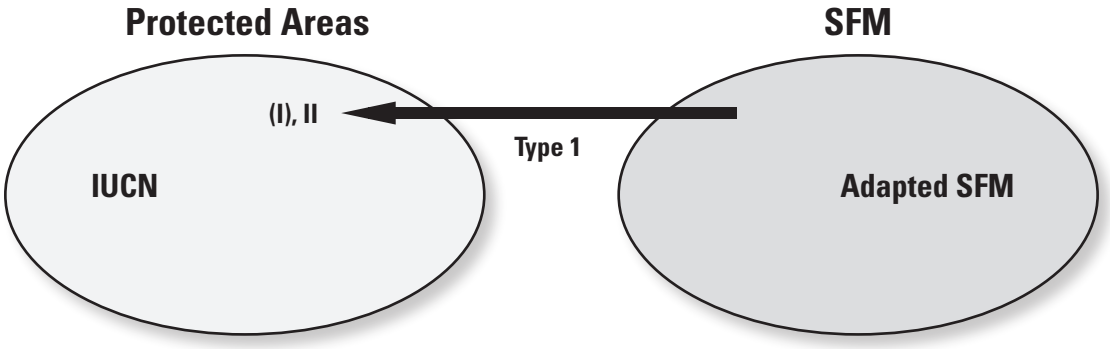

Figure 2. In strongly protected forest areas, only very select types of sustainable forest management are permitted, and they must be carefully designed. Appropriate monitoring should be included.

[2] (IUCN category I protected areas are managed mainly for science (Ia; Strict Nature Reserve) or for wilderness protection (Ib; Wilderness area). IUCN category II protected areas are managed mainly for ecosystem protection and recreation (National Parks; can also include other areas, e.g., provincial parks) (www.unep-wcmc.org/protected_areas/categories/eng/ii.pdf, in IUCN's Guidelines for Protected Areas Management)

2.2 Sustainable forest management in protected areas that enhance and maintain ecological integrity (Type 2)

Protected areas in IUCN category IV, described as Habitat/Species Management Areas, are by definition subject to active intervention to ensure the maintenance of habitats (also referred to as forest or ecosystem health, or enhancement of biodiversity).[3]

Thus, in forested protected areas of this category certain measures of forest management may be applied. These measures must be in agreement with the goals of conservation.

They may include ecological improvements such as regeneration of degraded forest swamps and bogs, renaturalisation of forested spring areas, aquifers and riparian areas, or elimination of harvest of old growth to support the establishment of ecologically desirable mature forests. Compensation measures that encourage agencies or land owners to work towards the conservation goals are considered as valid management tools, in addition to conventional regulation. Typical for this type of protected areas are Natura 2000-sites and nature conservation areas (see Table 1).

Type 2 example: Natura 2000 sites

About 15% of the total area of the European Union has been declared as Natura 2000 sites. This network of protected areas is crucial for species and habitat protection, and in many cases combines conservation and forest management. Natura 2000 sites may contain significant portions of managed forests. The goals of protection are defined separately for each site. In the case of private land, in most cases contracts with land owners ensure that specific goals with regards to species composition are met. These contracts also contribute to acceptance of the conservation goals by the landowners and the public. The goals differ enormously between sites, and may include specific measures such as leaving deadwood or increasing the rotation period.

Given the fact that many of the individual protected areas are rather small, the concept of a network is very important to counteract the phenomenon of island ecology and fragmentation. Such a network of mosaics is also well suited to collaboration between protected areas in several countries, allowing larger scale conservation goals to be met which would be next to impossible to achieve within each nation alone.

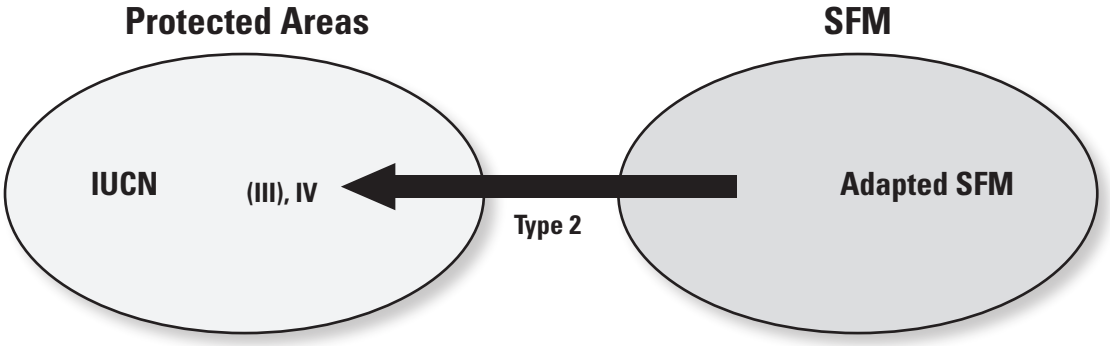

Figure 3. In protected areas with significant conservation concerns, sustainable forest management must be adapted; however, a wide range of measures will be appropriate.

[3] We have included IUCN category III areas in this grouping as well, but in practice they are not very significant in this context, as they are usually small in area and/or include little forested land.

The overall goal is to avoid further deterioration of the targeted species or habitats, and to achieve a "favourable" conservation status for them in the long term. The Habitat Directive prohibits further deterioration of the targeted species or habitats, implying that species cannot be disturbed further. While these goals are consistent across the entire EU, specific measures for achieving these goals are formulated and decided upon by the individual member states. Hence, voluntary agreements with landowners are possible.

Further information about Natura 2000 can be found on the Natura 2000 website: http://ec.europa.eu/environment/nature/Natura2000/. A guide about Natura 2000 and forests (European Communities 2003) is available in English and other languages: http://ec.europa.eu/environment/nature/info/pubs/docs/nat2000/n2kforest_en.pdf.

The challenge: understanding the risk of deterioration

A rule of "no deterioration" applies to all Natura 2000 sites. A key challenge is how to identify forest stands that require immediate measures to avoid any or further deterioration. This can be approached and visualized with a risk analysis (Figure 4).

After completion of a risk analysis to determine the risk of deterioration of the specific objects of conservation, the intensity of the effects and the likelihood that they are occurring is determined. Priorities can then be set regarding measures to be taken, and a plan designed for implementation (Ellmauer et al. 2006). The example below shows concretely how a region in Germany has applied such risk assessments in its forests.

Identifying priorities using the rapid action concept (SOMAKO): an example from northwest Germany

In Germany, the state of North Rhine-Westphalia defined 527 Natura 2000 sites covering a total of 279,000 ha (8.2% of the state's total area), including 144,000 ha of forests. The main goals of current management are to legally secure these areas and ensure appropriate management plans, including the completion of inventories and the establishment of monitoring frameworks. Some of these areas were already nature conservation areas before being designated as Natura 2000 sites, and therefore had management plans already. However, this was not the case for most of the forested areas.

A rapid action concept was designed to lead to "immediate conservation management plans" (Sofortmaßnahmenkonzept, SOMAKO). The purpose of the immediate measures was to identify short-term management actions, taking into consideration existing forest infrastructure and forest planning instruments,

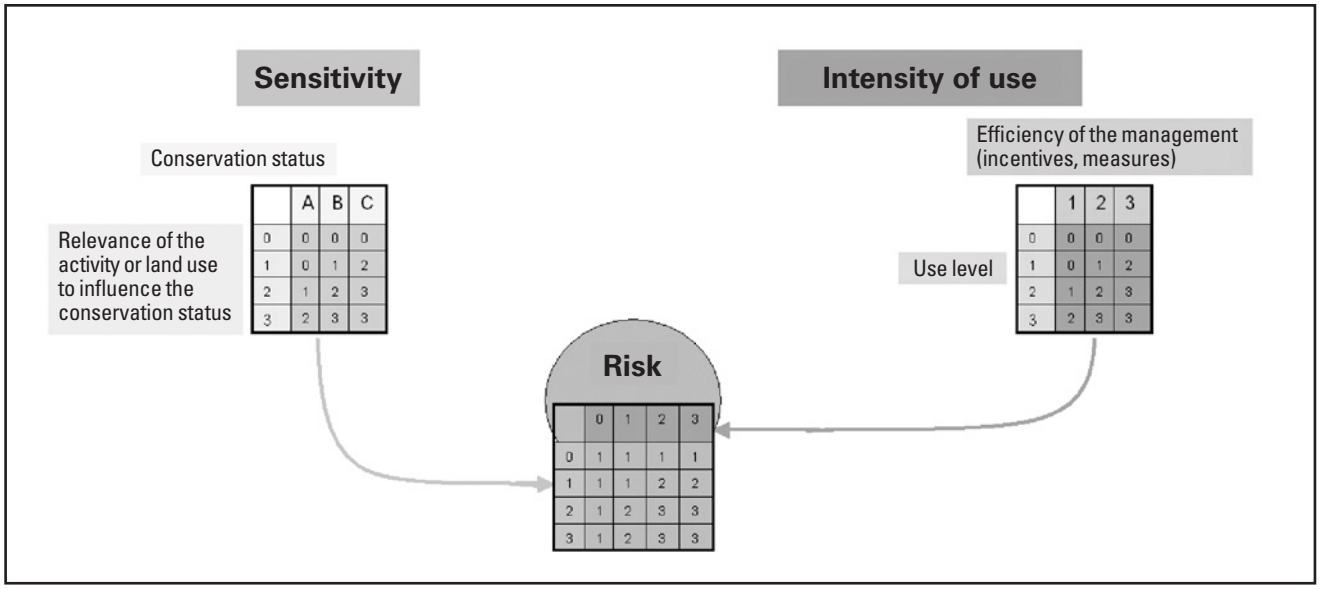

Figure 4. Basic framework for a risk analysis intended to detect and avoid the threat of deterioration (after Pröbstl and Sterl 2008).

and to integrate these management actions with the newly introduced conservation goals within Natura 2000. In other words, the immediate conservation management plans are a tool to quickly coordinate the most urgent actions between the conservation and the forest management agencies. The intent is to implement the first measures by the year 2012 in order to avoid immediate deterioration, to be followed by 12-year planning periods, with the ultimate goal of remediating deteriorated sites.

The rapid action concept (SOMAKO approach) is based on an inventory of Natura 2000 sites. It includes estimates of values for each site's components, lists existing conflicts, and defines the targets for the entire area and its components, which are supposed to be achieved by using ecologically sound measures (Schärpers 2006). These measures apply to specific sites where intervention is needed, as well as to non-spatial aspects of the overall Natura 2000 goals, such as species protection. The immediate measures are implemented by the respective local forest management offices with the already available planning instruments.

A geographic information system (GIS)-based inventory system contains all relevant information in spatial and tabular form. The entire site, or parts with specific conservation goals, can be shown (e.g. Figure 5) to identify areas that do not require any management measures for the next decade, and areas that require immediate measures. For areas that require attention, a special database summarizes information from forest and conservation inventories (Figure 6).

Such a framework allows the authorities to set clear priorities and to direct and concentrate on the most immediately essential measures according to the possible risks of deterioration. The database contains all collected information about the area, including size, number and name(s), information about trees (species distribution and abundance; stand composition) and on protected habitats, biotopes and species. Threats and possible risk of deterioration must be listed. Finally, each site-specific form describes the results of the planning process for each unit.

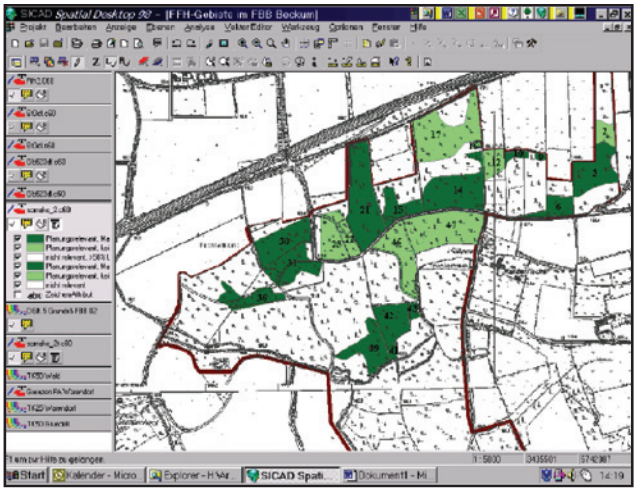

Figure 5. Section of GIS map used with the SOMAKO approach, showing the layer with the Natura 2000 site (delineated in red). Areas in **dark green** have specific conservation goals; areas in **light green** do not require any management for the next decade; areas in white require no management actions (Meissner 2007).

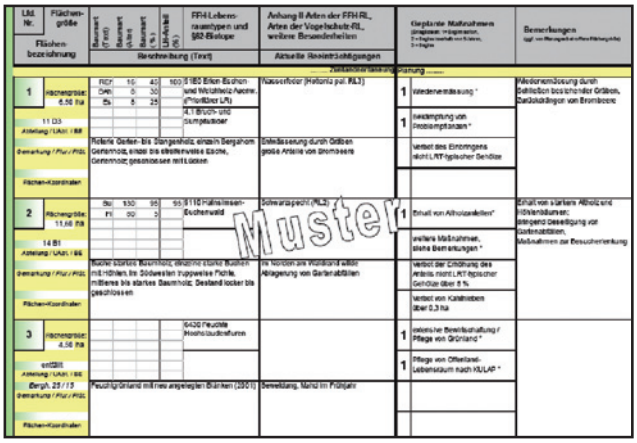

Figure 6. Example of a joint database containing information for forestry and conservation (SOMAKO approach; Meissner 2007).

2.3 Sustainable forest management in protected, but managed, landscapes (Type 3)

IUCN-Categories V and VI, Protected Landscape and Managed Resource Protected Areas, allow many forest management activities that are rooted in sustainable forest management (Figure 7).

IUCN Category V protected areas are managed mainly for landscape conservation and recreation. Their main goal is the maintenance of harmonious interaction between nature and culture. This is done through the protection of landscape and the continuation of traditional land uses and house construction, social and cultural manifestations, and to support lifestyles and economic activities that are in harmony with nature and the preservation of the social and cultural fabric of the communities concerned *(IUCN - Guidelines for Protected Area Management Categories)*.

Category VI focuses on the sustainable use of natural ecosystems while providing a sustainable flow of natural products and services for community needs. This is also consistent with the Man and Biosphere goal of enhancing social, economic and cultural conditions to ensure environmental sustainability, improve livelihoods and reduce biodiversity loss. The UNESCO's Draft Programme 2006-2007 gives special attention to cultural landscapes and their relationship to sustainable local use and biodiversity.

In these protected areas, the most common planning tools are the zoning of landscapes and the establishment of buffer zones and transition areas. These measures are also applied to forestry within the areas. Another common management tool is the provision of financial incentives.

Three examples or case studies will be presented for type 3:

- The zoning concept as used mainly in biosphere reserves;
- Specific management measures, including incentives, to promote improvements over the status quo; and
- Scientific based thresholds to ensure that conservation goals are met, even if a foreign tree species is introduced.

An interesting observation in the final report of COST Action 27 (Frank et al. 2007) is that in many situations good compromises between forestry and nature protection can indeed be reached (especially at low levels of protection), leading to a conflict-free co-existence of economic and protection goals.

Type 3 example 1: Zoning and UNESCO's Man and Biosphere (MAB) Programme

The UNESCO-MAB programme with its biosphere reserves (classified as IUCN Category VI) presents the challenge and opportunity of integrating forest management and protected areas concerns within an international framework. Its main goals are the protection of ecosystems and landscapes, the maintenance of biological, genetic, and cultural diversity, the creation and support of sustainable land uses, and the support of research and education about human –

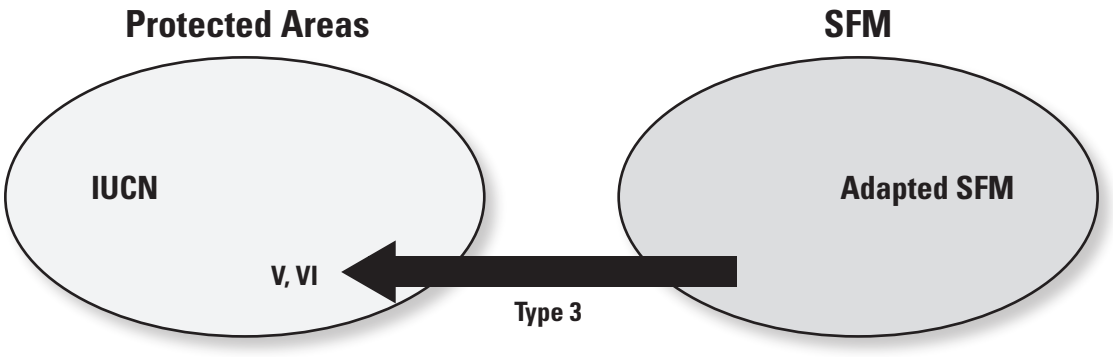

Figure 7. Type 3 allows many different land uses, including forestry, which must be adapted to some conservation concerns.

nature interactions. The MAB concept contains complex mechanisms for conservation and development and connects the two by including human activity explicitly in the equation. This category usually contains large ecosystems that are important for biodiversity. The concept is well suited for cultural landscapes in which conservation must be combined and integrated with many other uses.

Zoning is a crucial concept in the implementation (Figure 8). The core zone enjoys very strict protection. It is frequently a national park, a nature conservation area, or equivalent. The maintenance zone surrounding the core zone has fewer restrictions, while the development zone allows most land uses.

The global network of biosphere reserves (507 reserves in 102 nations) also benefits from the cooperation between partners. Forestry, recreation and tourism are of course well suited land uses for both the maintenance and the development zones.

Conservation goals are achieved in the core zone, for which minimum size levels are defined. Forest use in the development zone is similar to that in other productive forests, while forestry in the maintenance zone is governed by somewhat stricter standards of sustainable forest management, e.g. a higher proportion of snags and deadwood, a more natural species composition, and the consideration of valuable biotopes (Jedicke 2008).

A biosphere reserve near Vienna

An example of a biosphere reserve is the Wienerwald Biosphere Reserve, west of the city of Vienna (2.5 million residents) in Austria. The Wienerwald (Vienna Woods) represents a unique natural and cultural landscape of extensive beech forest, with a complex climatic and geological regime leading to high biodiversity. This biosphere reserve was established in 2005 and covers a total of 105,600 ha. Its main goals are nature conservation and development.

Its 32 (!!) core zones, covering a total of 5,100 ha, are mostly forested and are partly in private and partly in public ownership. (Where core zones are on private land, property owners voluntarily agreed to the zoning.) The natural forests are composed of 20 different forest types, which are obviously significant for biodiversity and provision of habitat. These core zones are not marked or fenced, and will not be developed for tourism in the future. The goal simply is that over time these core zones will develop into old growth forests under natural regeneration regimes (www.biosphaerenpark-wienerwald.org). A stricter form of sustainable forestry is practiced in the maintenance zone, while the development zone sees regular forest operations.

The Biosphere Reserve Wienerwald has been criticized for the small size of its core areas, which continue to permit hunting. Only the future will prove their viability as high quality conservation areas.

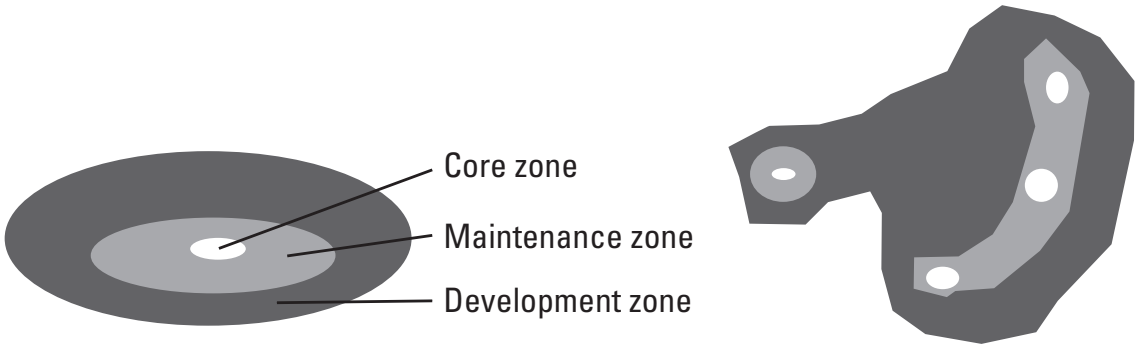

Figure 8. Zoning is one option to combine conservation goals and use in protected areas. Biosphere Reserves contain both zones of strict protection (one or several smaller core zones) and clusters of maintenance and development zones.

Type 3 example 2: Ecological improvements in forests, e.g., as "compensation" for development elsewhere

In any community-based land use decision in Germany increases in developed land (for residential or industrial use) will be approved only if appropriate compensatory measures are undertaken on site or somewhere else (Figure 9). Compensatory measures close to a subdivision are likely more expensive due to the price of land (Figure 9 left). Therefore other options such as compensation measures on agricultural land or in forests are often considered (Figure 9 right). Based on a specific guideline the community decides on the type and the amount of land where improvements need to occur. Their concept is controlled and advised by the government agency in charge of nature conservation and if improvements occur in forests, also by the forest authority. In many regions of Germany, clear standards and minimum requirements have been developed.

The overall goal of these regulations for compensation in forests is to improve the amount and quality of natural areas, and if possible even improve the quality of conservation areas. Initially, the main targets for these compensatory measures were agricultural lands, while the potential for the improvement of forests was largely ignored.

It was initially thought that "a close-to-nature" well managed forest, with rich flora and fauna over a larger tract of land, already meets the requirements of nature conservation (Leibundgut 1975). However, a more detailed analysis showed quickly that forests also offer many opportunities for ecological improvements. For example, periods of rotation may be extended, or the original species composition may become the management target (Kopp and Schwanecke 1994). Other measures might include enhancing the amount of standing deadwood, or phasing out clearcuts (Scherzinger 1996).

Many communities now target their forest areas for such compensatory measures. The challenge is to identify which forest improvements can be regarded as truly compensatory in this context, i.e., going beyond the standard forest management obligations already prescribed in forest management plans and exceeding the existing communal obligations of the forest owner. To qualify, forest areas have to be well defined in terms of location and legal title. Ecological improvements must be feasible, and they must be documented legally in the company's or community's periodic audits. Overall, the management goals must be in agreement with the natural ecology of the area and move it closer towards the "natural forest ecology". In the case of afforestation, the new forests must be desirable from a conservation point of view, must be an explicit goal in landscape plans, or they must be declared desirable by conservation authorities.

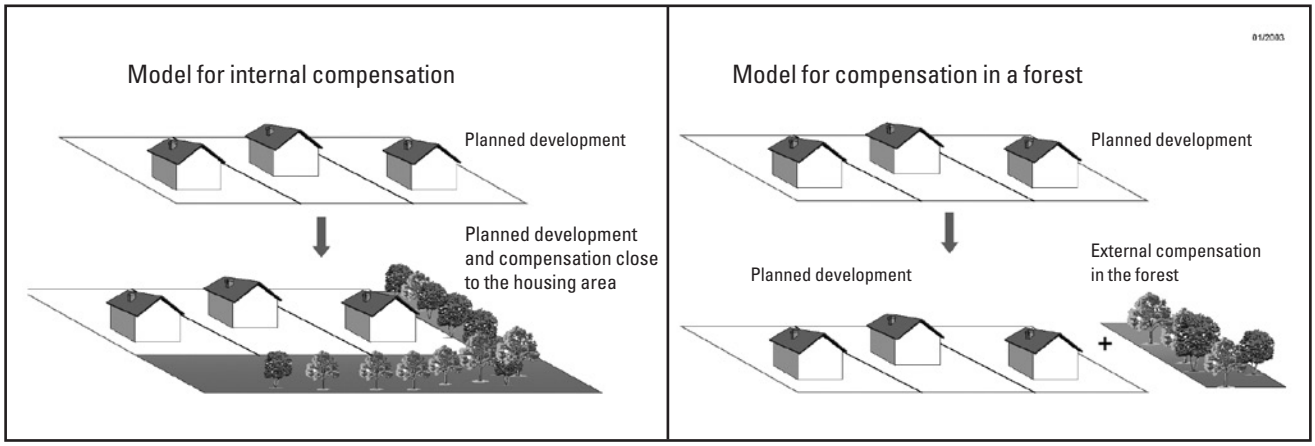

Figure 9. For any new residential or industrial subdivision in Germany, compensatory measures must be undertaken either on-site or off-site. The overall goal is to improve the amount and/or quality of natural areas. The compensation may occur right in the development zone (left example), or it may occur elsewhere (right example).

Table 2. **Typical forest improvement measures (Busse et al. 2005)**

Introduction of near-natural ecologically appropriate forest
Increase of site-appropriate deciduous components, or of white spruce in mountainous areas
Introduction of rare or endangered tree species
Improvement of edge habitat
Creation of multi-tiered near-natural forests
Increasing the presence of deadwood
Letting succession run its course
Water logging of forest stands and development of flood plain forests
Establishing forest clearings and forest meadows
Creation and long-term maintenance of snags
Restoration of former historic forest uses
Establishment of biotopes and measures to protect endangered species
Measures to enhance a network of biotopes
Decommissioning and dismantling of infrastructure
Implementation of appropriate measures in Natura 2000 sites, according to site specific goals

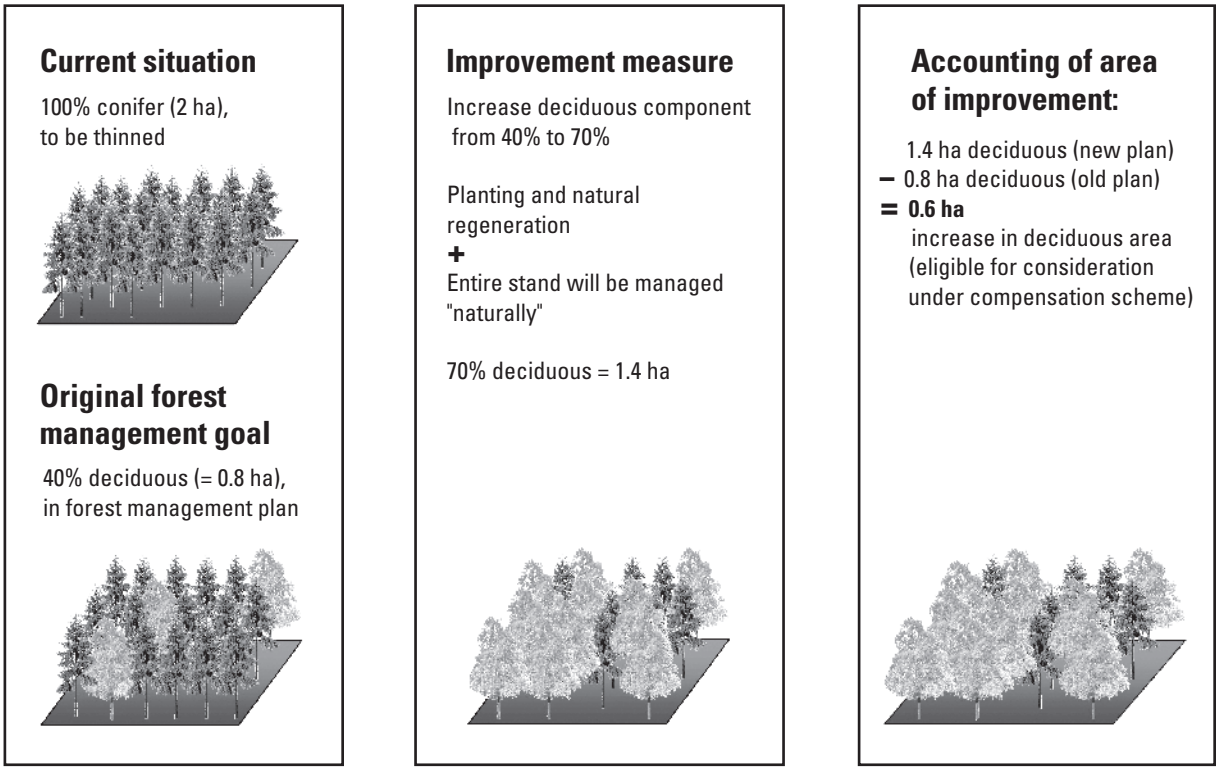

Figure 10. An example for calculating the actual forest improvements associated with a compensation scheme: only the additional proportion of deciduous forest that goes beyond the amount of 40% improvement already committed in the current forest management plan must be considered as an "improvement" or compensatory measure.

Table 2 lists possible forest improvement measures that may be considered. These are typically operationalized much more precisely in a site-specific context (see Figure 10 for an example). The measures shown in Table 2 have been developed in several cases across Germany and illustrate the range of compensatory activities in forests that may be undertaken (Busse et al. 2005).

Type 3 example 3: Science-based thresholds to ensure conservation goals: sustainable forest management using introduced tree species

Germany now has a well defined understanding of "nature-based forest management", documented by ecological research since the 1970s. Its goal is to achieve economic gains while managing productive forest stands sustainably, taking into consideration their flora, fauna and soils (Pröbstl 2007). New management questions and critical voices emerged when new tree species were introduced. The following example shows that in this situation, the question of whether the anticipated forest use is still sustainable must be determined by scientific studies.

Douglas-fir plantations were introduced in the alpine foothills of Central Europe. This raised concerns as to whether nature conservation and the economic goals of forest productivity could be reconciled in the most productive forests. In the past, introduced tree species, such as the Douglas-fir, were simply considered to be associated with negative ecological effects. One four year study investigated the ecological quality and biodiversity of different types of stands by monitoring birds, insects (e.g., beetles, bugs and diptera), snails, and macrosaprophages under various treatments, together with a control site (Ammer and Utschik 2002, Goßner and Ammer 2006, Pröbstl 2007).

The study showed that on one hand pure conifer stands should be avoided, but on the other hand under strict forestry and landscape protection regimes a high level of biodiversity can be reached despite a significant component of conifers (Figure 11). The study defined specific preconditions under which no significant deterioration might occur. It also reported differences between local conifers and introduced conifers:

- If local spruce is combined with deciduous trees (about 30-40% deciduous trees and 60-70% spruce) the deciduous trees should occur in groups of at least 0.3 ha each, to maintain populations of small fauna typical of deciduous stands. Individual (i.e., dispersed) deciduous trees should be added (as was done in earlier days) only when the deciduous component is over 50%.
- Commercial trees, such as the Douglas-fir, should generally not be introduced as monocultures. In stands of beech forest, up to a maximum of 30% of Douglas-fir is recommended.

Such a management approach can be maintained over the long term and is characterized by high economic productivity, while still accommodating several crucial conservation concerns (Pröbstl 2007). This is important, because according to some experts the Douglas-fir might become a more important commercial forestry species in the future under conditions of climate change.

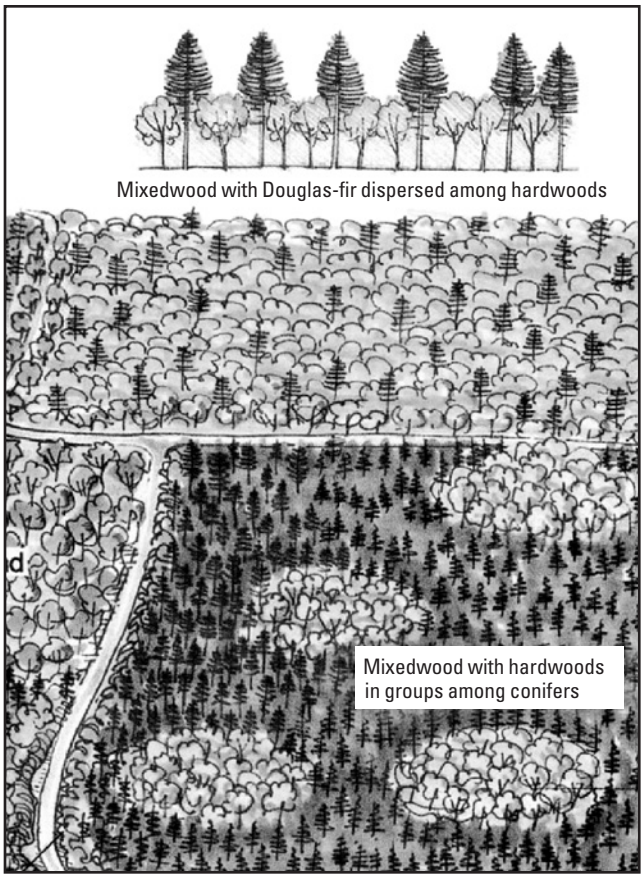

Figure 11. Examples of scientifically defined forest management regimes in the alpine foothills of Central Europe, with natural and introduced tree species in mixtures that maintain biodiversity (Ammer and Utschick 2002, Goßner and Ammer 2006).

3.0 Summary and conclusions

Across Europe, forests have been recognized as an important land use contributing to biodiversity and conservation. A European-wide initiative, COST 27, explored the relationship between protected areas and forests. Their final report observed that in most, if not all, forests in Europe sustainable forest management is practiced (Frank et al. 2007).

Central Europe does not have the space to establish large strictly protected areas in the form of parks to the same extent as Canada. However, many countries and the European Union itself have developed interesting alternatives for improving biodiversity conservation, while at the same time allowing other uses.

Many countries have introduced protected areas like the "Nature Park" for natural and cultural landscape protection. No similar concepts exist in Canada. Parts of Canada, particularly in those areas that overlap with the Acadian Forest and Great Lakes-Saint Lawrence Lowland forest regions are quite heavily populated. Thus, they do not have opportunities for the establishment of large national or provincial parks since most land is under private ownership. Numerous assessments have highlighted these parts of Canada as underrepresented in terms of biodiversity within protected areas (Gauthier et al. 1995, Parks Canada 1997, Wiersma and Nudds 2009). Some of the alternatives for biodiversity conservation that accommodate other uses, such as those described here, might be useful to emulate in parts of southern Canada.

For the purpose of furthering biodiversity protection, the European Union legislated the Natura 2000 framework for species and habitat protection. While its overall goals are similar to Canada's Species at Risk Act, the two differ remarkably in their implementation and their application also on public land.

Since neither of these types of protected areas is a strictly protected area, forest management is one among several land uses, and sustainable forest management has a prominent role to play. The case studies shown in this document made it very clear that in Europe, forestry must subordinate itself to the type of land use acceptable under the respective type of protected area. Sustainable forest management is also an important component of municipal planning and land use zoning, as forests may be the beneficiaries of compensatory measures when land is subjected to development on other sites.

Although the context in Canada is quite different, the range of innovative relationships between forest management and alternative types of protected areas may be usefully applied in parts of Canada. The concept of forest management as part of municipal planning and land use zoning is inherent in the Muskwa-Kechika management plan in northern British Columbia. Although some have questioned the effectiveness of the Muskwa-Kechika project, the framework applied in British Columbia is unique within Canada. Lessons learned from integrating planning activities there and across Europe might facilitate planning for forestry, land use and biodiversity in Canada as well.

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