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Voluntary approaches in protection of forests in Austria

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Abstract

Voluntary contributions to biodiversity conservation efforts in private forests of Austria have a long tradition which dates back to the 19th century. The most important remnants of undisturbed forests of the Alps today owe their existence to these voluntary initiatives by forest owners. In this earlier period the protection of forest areas by decree or biodiversity conservation initiatives on public owned forests, did not play such a prominent role. But as well as national parks, Natura 2000 areas and other programmes based on protection by decree, significant new voluntary approaches have emerged recently. The Austrian Forest Reserves Programme started in 1995, as a specific approach to voluntary participation in biodiversity conservation by private landowners is discussed in detail. This programme is based on the concept of nature conservation by contracts under private law, agreed between the forest owners and the Republic of Austria. The main characteristics of the programme are presented and experiences gained during the establishment and the maintenance of the network are discussed. Other voluntary initiatives, such as an Austrian network of gene conservation forests, as well as an initiative of a forest owner's association, are also presented and discussed.

Keywords: Biodiversity conservation; Protected forest areas; Gene conservation forests; Compensation payments; Austria

1. Introduction

Three major characteristics of Central European forests need to be considered in terms of nature protection. Firstly, they are all more or less altered by man. Thousands of years of human activity caused many impacts on forests. Direct human use, which has occurred in an unsustainable way during many periods of history, has changed the distribution and the conditions of forests substantially. Secondly, forests are more or less artificially fragmented and interactions with agricultural or artificial habitat types overlap forest development inside the forest. When selecting protected forest areas (PFAs), the size and shape of the remaining forests often reduce the possibilities for their establishment. Thirdly, the ownership structure is very differentiated and dominated by small scale forestry. In Austria, only 20% of the forests are publicly owned, 49% of the forest properties are smaller than 200 ha. The average size of all forest properties is about 17 ha. This has a strong influence on the possibilities for voluntary approaches to any protection regime of forests. Nevertheless, voluntary contributions to nature protection including forests are not a new idea. Many PFAs have been designated and protected voluntarily, mainly on the initiative of scientists who realised the value of undisturbed or uninfluenced forests as objects in studying structures and processes undisturbed by man (Mayer et al., 1987; Leibundgut, 1982).

In this paper systematic approaches using voluntary contributions to build up networks of protected forest areas are presented. The characteristics and principles of three different programmes are described and compared. Forest history and the legal background of nature protection needs to be considered in explaining the specific approaches used in Austria. The selection process and other elements of co-operation between the managers of the programmes and the forest owners, especially the principles of contracts are analysed. Problem areas regarding the acquisition approach used and management requirements are critically discussed.

1.1. Characteristics of Austrian forests and history of forest protection

The state of biodiversity of Central European forests, in particular those of the Alpine region, cannot be fully understood without taking into consideration both the long-term forest succession and the history of settlement and human impact in the. Generally, the forests of Central Europe had undergone a reduction of one-third of the original area over only a few centuries during the Middle Ages (Plachter, 1991). It is no wonder that untouched forests which had

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been preserved in the Alpine region are limited to a few hundred hectares in unexploitable areas today (Diaci and Frank, 2001). Except in the Alps and the inaccessible mountains of the Carpathians (Korpel, 1995) and the Balkan range (Leibundgut, 1982), no true virgin forests have remained in Central Europe.

The protection of remaining virgin forests, which were located mainly in the Northern and Southern Limestone Alps, was initiated as early as in the last century by forest-tenants who were responsible for them. Maintenance of nature for future generations was a key priority at this time. From the very beginning, private forest-tenants have played a major role in the establishment of natural forest reserves, meaning that this did not take place exclusively in State forests (Frank and Koch, 1999; Zukrigl, 2001). The establishment and maintenance of natural forest reserves has been ongoing for several decades. The process was undertaken and promoted by a few outstanding scientists, forest owners, and forest practitioners, though not within the framework of a national programme. Since 1965, new activities have been undertaken in relation to scientific activities in reserves. Even at this early stage, efforts were made to build up a network of natural forest reserves, which would eventually represent all important forest communities in proportion to their significance. (Mayer et al., 1987; Zukrigl, 1990). Examples of outstanding initiatives included the designation of primarily small areas (termed natural forest stands), through private law-contracts concluded by the Foresters' Association of the Tyrol with private or communal forest owners. The establishment of natural forest reserves located close to the city, by the Forest Office of Vienna, was also a far-sighted achievement. In 1986 a contractual agreement, also based on private law, was arranged between the University of Agricultural Sciences and the Austrian State Forests, to make the reserves located on State forest properties available for research (Mayer et al., 1987).

Austria is a Central European forest country whose forests cover 47% of its territory. About two-thirds of the surface of Austria are covered by the Alps, a fact which brings about specific characteristics of forests and forest history, but requires also special protection measures. The Austrian Forest Development Plan of 1991 reflects the societal demands on forests (Frank et al., 1998). In total, 19% are "protective" forests (7% with commercial yield, 12% without). These are forests which have the function of protecting human settlements and infrastructure against natural hazards like avalanches, floods, rock fall or landslides. Because of the very steep terrain and harsh site conditions, 12% of the forested land is in protective forests without any commercial yield. Currently, they are totally unexploitable due to high harvesting costs. This means that 12% of the forests are equivalent to the same protection regime as totally protected forests. They are de facto left for free development, even if most of them were logged and altered in the past. But these forests represent by no means the large variety of forest types in Austria. It has been suggested to simply declare these unexploitable protective forests protection forests. Nevertheless, the proposed strategies have not been taken into consideration in the recent Natural Forest Reserves Programme (Frank, 1997).

1.2. The hemeroby or naturalness of Austrian forests

As in other European countries with large forested areas, the degree of "naturalness" of forests is an essential attribute used both in commercial forestry and in nature protection. In Austria in 1995 a project was launched with the aim of assessing the naturalness or vice versa the degree of human impact on the Austrian forest as a whole, as well as on forests of particular regions. Hemeroby, in this context, is defined as a measure of human caused impact on forest ecosystems, and naturalness vice versa as the absence of this impact (Koch and Grabherr, 1998). In order to determine the hemeroby or naturalness of native forests, the effects of silvicultural treatments, impacts of cattle grazing, browsing by game, tourism and other kinds of man-made impacts on forests were analysed. A specific catalogue of criteria was developed for this evaluation. It includes a set of indicators, such as current and potential tree composition, ground vegetation taking into consideration specific species which indicate human-induced disturbances, intensity of harvesting practices, amount of deadwood and others. Data collection was linked with the systematic sample grid of the national forest inventory. Using the method of logical combination the single characters were aggregated to a synoptic value referring to the degree of hemeroby of the site (Grabherr et al., 1998).

The results indicated that 3% of Austria's forests have not been subject to human impact and 22% can be classified as semi-natural (Grabherr et al., 1998). The natural forests are located in the Central Alps, as well as in the northern and southern peripheral zone of the Alps, with mainly limestone dominated sites. Forests classified as "moderately altered" cover a proportion of 41% of the forested land area. These forests are all commercially exploited, but the potential natural vegetation is at least partly present. 27% are classified as being "altered" and 7% as "artificial". These latter stands have been extensively exploited and their tree species composition by no means reflects the original natural conditions (Grabherr et al., 1998).

The same study also shows which regions have been affected most by human impact and where natural or semi-natural forests no longer remain. The latter category occurs mainly in the peripheral zone and outside of the Alps, where the potential natural forest communities would predominately be composed of mixed beech and oak forests, but also in areas potentially dominated by Silver Fir (*Abies alba* Mill.) (Mayer, 1974). These areas directly correspond to the areas where the establishment of representative natural forest reserves was insufficient until now. Specific constraints will be necessary to establish natural forest reserves in the biogeographic regions covered originally by forest communities dominated by Silver Fir.

1.3. Legal background—characteristics of contracts based on private law

The Austrian Federal Constitution does not charge one single authority with the responsibility of environmental protection. Environmental law still has a multi-sectoral character. Usually, the nine Federal Provinces have legal authority regarding legislation and implementation of provisions in the field of nature and landscape protection (Tiefenbach, 1993). Hence, Austria does not have one Federal law for the protection or conservation of nature but nine provincial jurisdictions; which means that, from a legal point of view, the Federal Government is not responsible for the protection of nature. The exceptions to this rule occur with respect to international agreements and relevant European Commission programmes. Apart from this, forest activities are entirely regulated by a Federal law.

It was only after Austria has signed the Resolutions of the Ministerial Conference for the Protection of Forests in Europe (in particular, Resolution H2, General Guidelines for the Conservation of the Biodiversity of European Forests) in 1993 in Helsinki (Anonymous, 1993; MCPFE, 2000), that a national programme for the establishment of Natural Forest Reserves was initiated. Under this programme, new reserves are generally not established by decree, but on the basis of private-law contracts (Mantau et al., 2001) between the Republic of Austria and forest-tenants.

In Austria, nature protection measures on the basis of private law contracts are voluntary agreements between the responsible nature protection authorities and the owners of areas which are designated as requiring protection. The owners commit themselves to abstain from further management of the areas or to take clear actions to manage the areas in a way which is suitable to reach the goals of protection. For these abstentions or active measures a compensation fee is calculated and agreed as part of the contract. In contrast to this partnership concept and under specific circumstances, nature protection by decree allows the declaration of specific habitats to become a protected area by law even without consent of the landowner.

2. The Austrian Natural Forest Reserves Programme

The “Natural Forest Reserves Programme” was initiated in 1995. The programme aims to systematically establish a representative network of natural forest reserves and can be regarded as a direct response to the Helsinki Resolution H2 “General Guidelines for the Conservation of Biodiversity in European Forests” (Anonymous, 1993). The resolution H2 of the Ministerial Conference on the Protection of Forests in Europe provides measures for the protection and improvement of the biological diversity of European forests, besides other measures, through the establishment of coherent networks of protected forest areas. In this context, the Natural Forest Reserves Programme essentially contributes to the implementation of the overall strategy of maintaining and improving forest biodiversity, which is considered a basic requirement of forest sustainability and effective forest functioning.

In addition, the “Mountain Forest Protocol” to the “Alpine Convention” involves the legally binding commitment to establish natural forest reserves (Scheiring, 1996; Schärer and Zürcher, 1997). In Article 10 the parties commit themselves to establish natural forest reserves in sufficient size and amount and to treat them in an appropriate way to ensure their natural dynamics. The “Mountain Forest Protocol” explicitly provides the legal basis for the necessary co-operation in planning and establishing of cross-border reserves.

2.1. Characteristics of the programme

The most important goal of the natural forest reserve idea is to maintain the biological diversity which is characteristic of the respective forest community. The main aim is not to preserve current forest conditions, but to allow the uninterrupted dynamics of all forest specific processes, including natural disturbances and catastrophes.

Secondly, natural forest reserves are particularly suited to long-term forest-ecological research, because the dynamics of these forests are not subject to human activities. At the outset of research into natural forests, vegetation and silvicultural aspects were primarily investigated. Today, investigations of biodiversity, of population genetic-connections, stress sensibility or the adaptive capacity of forest ecosystems to climate changes, are becoming increasingly important. Applied research specifically aims to develop ecologically-oriented silviculture. Natural forest reserves are examples of natural forest communities (natural forest associations) and can serve therefore as reference areas for biotope assessment and ecological monitoring (Frank and Koch, 1999). Thirdly, the areas are used more and more as illustrative subjects for basic education as well as professional training and university courses.

It should be noted that from the very beginning there has been a clear agreement in Austria to deal only with strictly protected forest reserves. Forest types which are dependent on a specific silvicultural treatment are deliberately not included in this programme. Special emphasis has been laid on developing a representative distribution of reserves, covering all forest communities occurring in Austria. Deliberately no absolute sizes, like a certain amount of hectares or percentage of the total forested area has been chosen as a “magic number”. On the contrary, the following very simple concept has been chosen, to allow a certain flexibility in drumming up of suitable areas. For each of the 22 biogeographic areas (Kilian et al., 1994), the forest communities occurring within them are known (Mucina et al., 1993). Each forest community has to be represented at least once in a reserve inside the defined biogeographic region.

The Federal Office and Research Centre for Forests was charged with the technical and scientific implementation of the programme. To 2002, 180 forest reserves, covering a total of 8272 ha, have been included in the network. This means a degree of implementation of about 60% of the intended total number of reserves and size of the network. The size of the reserves varies between as little as 1.0 ha, as a very specific stand type representing the species composition of the natural forest vegetation, surrounded by intensively managed forests, and much larger reserves of up to 967 ha, representing patterns of sub-alpine forest communities close to the upper timberline.

No absolutely fixed minimum area for each single reserve is used, instead the minimum area defined by Koop (1982, 1989) is used reflecting an equilibrium distribution of development phases. The minimum area is the area which is required to ensure the occurrence and balance of all stand development phases of a forest at a given site simultaneously and sustainably over the whole cycle of the stand development phases. However, to calculate this minimum area, empirical data is available only for mountainous mixed forest types (Korpel, 1995; Mayer et al., 1987). For all other forest types, the minimum area has to be estimated by following the idea of Koop (1982, 1989). In practice the minimum areas estimated for the Austrian Natural Forest Reserves Programme vary between 20 and 60 ha depending on the forest community (Frank, 1998). If a minimum area cannot be reached in highly fragmented landscapes with altered forests, a specific type of natural forest reserve is used. These are the Natural Forest Cells, which represent only the composition of the natural forest community but not their stand dynamics.

As the widely disseminated zonal forest communities often occur in several biogeographic regions, they are also represented by a number of natural forest reserves. Forest communities, which occur only in special natural environments, are rarely represented in the network. Formations of spruce-fir-beech forests constitute the biggest share of established natural forest reserves. As a rule, this type of reserve corresponds to the protection forests of the Northern and Southern Limestone Alps. Subalpine spruce and pine communities are strongly represented. In some regions, therefore, clustering is possible, e.g. in the southern and eastern peripheral zones of the Alps. This is in line with the fact that the forests in these natural areas show signs of naturalness which are above the average. There are, however, also forest associations, which were previously not represented in any natural forest reserve. These are predominantly rare forest types occurring only in small areas. Currently, 30 of the altogether 130 most important forest communities (forests and other wooded land) are generally not represented in the network.

2.2. Framework concept

The planning and establishment of a network of strict forest reserves in 1995 was laid down in the form of a "framework concept" similar to an "agreement of principles" negotiated by all stakeholders such as forest owner's associations, administration representatives, the Federal Forest Research Centre, forest authorities, managers of the Federal State forests, and representatives of large forest enterprises. Experiences from other countries have been taken into account (Broekmeyer et al., 1993; Kimmins, 1992; Noss and Cooperrider, 1994; Projektgruppe Naturwaldreservate, 1993; Schuck et al., 1994) and ongoing international programmes (European Commission, 2000; Parviainen et al., 1999, 2000a,b) were integrated into the concept. This unanimously approved framework concept is the basis for all further contract terminations and also for the selection process and the management of the reserves. Strictly following a bottom-up approach, all management measures and also research programmes and the utilisation of the reference areas for education and training purposes always take place in close co-operation with the individual forest owner.

2.3. Contract principles

The following principles were negotiated and agreed before the programme was started officially:

- Participation in the programme is strictly voluntary;
- Contracts are based on private law;
- Long-term commitments are mandatory: 20 year contracts including the right of extension;
- Possibility of opting out is allowed under defined circumstances;
- Compensation fee is calculated as an annually income value.

The most important precondition to establish a natural forest reserve is the declaration of intent by its owner that no interventions of any kind will be made in the future and that the forest will become part of the reserve network. Forest owners, in many cases advised by professional foresters of the local forest service or agricultural chambers, propose areas which are, to their mind, suitable. After a preliminary examination of the proposed areas by experts of the Federal Office and Research Centre for Forests suitable reserves are selected. Criteria for selection and exclusion have been defined in the framework concept. Since the start of the programme in the year 1995, in total 850 sites were offered to the responsible forest research centre. After a pre-selection, done by local forest authorities, 450 sites were subject to detailed examination. At the end of the evaluation, 180 sites were approved.

The contract is based on an expert report and a survey, using a grid system of permanent sample plots for compensation assessment, which is suitable for future monitoring of stand development. The most important features of these surveys are: vegetation survey (using the method of Braun-Blanquet, 1964), determination and mapping of potential natural forest communities, stand parameters, Bitterlich sampling, overall site assessment and stand

characteristics. The expert report includes as well as a basic description of the area and the calculation of the compensation fee, a management plan, determining necessary measures, e.g. game control and but also the treatment of the buffer-zones and surrounding area.

The basic idea of the compensation remuneration is that its amount has to reflect the income value the forest owner could earn alternatively from his property. An additional bonus has been agreed in the framework concept. The calculation of the fee is based on basal area of the growing stock, yield class which reflects the annual increment, a factor which reflects the loss of value caused by harvesting, the timber price calculated as an average of the past 3–5 years, and the costs of harvesting. The compensation fee is calculated separately for each tree species occurring in the reserve: in most cases the area is divided into separate valuation units reflecting different site classes or harvesting conditions. All contracts are signed by the responsible Federal Minister and the forest owner.

2.4. Co-operation with forest owners and forest authorities

Looking back, we can say that the reason why the programme has been so successful so far is that from the very beginning all stakeholders have been involved in the conceptual process and therefore still bear part of and support the programme. To maintain the network in the long run the full acceptance of the programme and participation of the forest owners will be necessary. Already in the preparatory phase of the establishment of a reserve, detailed information about aims and goals of the programme is provided to the owner. The long-term success of the programme depends to a great extent on the identification of the owners with their reserves.

Therefore, all activities inside the reserves such as checking borders, repairing monitoring facilities are strictly co-ordinated with the forest owners. The continuous control of the areas is done by the forest owners and their professional staff. Officers of the forest authorities are involved in the planning process but also in the continued long-term management of the areas, in particular, regarding insect or ungulate control. Also, the use of the reserves for scientific purposes, education, training and public relations is organised strictly in co-operation with forest owners and forest authorities. Forest owners also expect information about the state and the results of the programme they participate in.

3. Other voluntary initiatives on protected forest areas

Already in the 1970s the Forester's Association of the Tyrol has started an initiative to establish mainly small scale forest reserves (Zukrigl, 1990). Most of these reserves are equivalent to natural forest stands. They are too small to ensure sustainable and balanced development phases and mainly serve as specimen stands of natural forest communities; moreover, they play an important role in the integration of habitats.

Owing to the initiatives of private forest owners it was possible to protect important remainders of virgin forests as early as the 19th century. Some of these very important habitats are still under the voluntary protection of the same family. In most cases, the owners avoid letting the existence of these important habitats from becoming known, seeing this as the best strategy to protect them.

BIOSA (Biosphere Austria) is a new initiative. It was founded as a non-profit organisation by an Austrian landowner's association in 1995. The members of BIOSA voluntarily contract their land to BIOSA. These areas are a specific type of biotope, a specific project for the development of new ecological ideas, or joint research projects with other NGO's (e.g. multi faceted forest structure, Natural 2000 management plans etc.). BIOSA and the landowner sign a voluntary management agreement. This contract is a way of leasing over a period of 20 years. The biotope management concept is part of the contract. BIOSA projects are financed from governmental and other public sources, sponsors, international programmes (e.g. Natura 2000, "Life") and membership subscriptions.

4. Austrian Programme on Gene Conservation Forests

4.1. In situ conservation of genetic resources

The Programme on Gene Conservation Forests was established in 1986 as part of a comprehensive programme of conservation of forest genetic resources (Müller, 1993). The background at this time was not conservation of forest biodiversity, but primarily problems with regeneration and supply of reproductive material caused by forest die-back, which was a serious threat at this time. The Austrian Programme on Gene Conservation Forests is directly linked to the European Genetic Resources Programme (EUFORGEN) which is a collaborative programme among European countries aimed at ensuring the effective conservation and the sustainable utilisation of forest genetic resources in Europe (Turok et al., 1998) and was established to implement Resolution S2 of the Strasbourg Ministerial Conference on the Protection of Forests in Europe (MCPFE, 2000).

Genetic variation is a prerequisite for the adaptability of forest ecosystems. Adaptability means the ability of a population to constantly adapt itself to changes in environmental conditions through changing its gene frequency. Due to expected climate change, the direction and intensity of which cannot be predicted with certainty, the adaptability of forest trees will play a major role in the future sustainable development of forests. To maintain the potential for adaptation, the unrestricted transmission of genetic variety to following

generations must be ensured and the possibility of the further development of the genetic structures must not be prevented or affected (Gregorius, 1997).

Due to strong anthropogenic impacts on forests since the end of the 18th century and even earlier, the natural development of the genetic structure of forest stands and their ability to withstand stress caused by environmental conditions has been altered. Especially clear-cutting along with artificial regeneration had two main effects. Reproductive material produced from relatively small collecting units was used for artificial regeneration with the result of a restricted genetic amplitude of the following generation in comparison to the full genetic information of natural regeneration. Autochthonous populations have been replaced by non-autochthonous, with in many cases even unknown unsuitable provenances of seeds. An additional long-term effective process of tree-species decomposition takes place because of artificial regeneration practices which promote specific, light dependent species and at the same time hamper the growth of shade dependent species. This process of decomposition is strengthened by selective browsing due to game pressure of specific broad-leaved species and especially of Silver Fir (*Abies alba* Mill.).

Other reasons for the necessity of gene conservation measures are: considerable changes in tree species composition, loss of potential living space especially for rare and vulnerable species, as a consequence loss of local populations, reduced or interrupted gene transfer caused by loss or fragmentation of areas and insufficiencies concerning artificial regeneration, including insufficient supply of suitable provenances to the market.

Altogether, the forest die-back of the 1980s and the concerns about the restricted ability of regeneration of Austrian forests, amplified by already occurring critical supply situations, led to the introduction of a comprehensive programme “Contributions to the Maintenance of Forest Genetic Diversity” by the Federal Forest Research Centre in 1986. The primary goal of this conservation concept is to combine maintenance of genetic resources and sustainable use of forests. The concept of this specific gene conservation programme has three pillars:

1. Selection of gene conservation units at the resource-site (in situ conservation strategy)—the genetic information of forest-tree populations should be fully inherited by using natural regeneration.
2. Establishment of seed banks—seed collection of several hundred trees at least from each biogeographic region and storage of seeds.
3. Establishment of conservation orchards and clone archives (ex situ conservation).

4.2. Selecting process of gene conservation forests

Because of the specific characteristics of forest trees in situ conservation strategies are preferred to maintain genetic diversity. While doing so, tree populations are part of natural selection and evolution processes. In situ conservation is the most suitable one—in a rather fragmented landscape—only for the main tree species with their population on large, connected areas. For rare tree species active reproduction and artificial re-application is seen in the medium term as the more effective strategy.

When selecting forest stands for in situ conservation it is important to take into consideration all natural forest associations of the biogeographic regions. Populations at the edge of their area and relict populations should be overrepresented because there is a great danger of loss of rare gene combinations. Also the best possible distribution over all growth regions and altitudinal zones is sought. Selected stands have to be autochthonous or well adapted to site conditions, no impediments against natural regeneration are allowed. Their management and silviculture treatment follows the principles of close-to-nature silviculture: permanent stocking, all age stand structure, long regeneration periods, permanent regeneration by simultaneous reproduction of overlapping generations, support of self-differentiation processes in all growing phases. In this context, multilayered mixed forest communities have to be distinguished from natural pine and spruce forests, which tend inherently to form homogeneous and single layered stand structures (Mayer, 1974; Mayer and Ott, 1991). The declared goal is the establishment of up to 3–5% of Austrian forests as gene conservation forests (Müller, 1993).

4.3. Difference between gene conservation forests and natural forest reserves

Gene conservation forests may not need to be identical with natural forest reserves. While gene conservation forests serve primarily for the maintenance of the genetic diversity of forest trees, natural forest reserves are aimed at the maintenance of the biological diversity of entire forest ecosystems in a broader way and have to fulfil further functions for science and education.

The objective of gene conservation forests aims at the maintenance of the genetic variety and the adaptation potential of tree populations very concretely. In order to reach this goal, active measures (e.g. introduction and fostering of natural regeneration, selective protection of jeopardised tree types, pre-commercial thinning and other tree type specific silvicultural measures) are not only allowed, but rather are desired or even required. In contrast to gene conservation forests, in natural forest reserves, from the start of their establishment, no active measures (with the exception of hunting and game regulation, fire control, and under special circumstances pest control) are allowed since the objective of natural forest reserves is the totally undisturbed, natural development of forest ecosystems. Natural forest reserves, showing a sufficient size and in which, based on their structural development the continuous regeneration is ensured, correspond in most cases also to the criteria of gene

conservation forests. On the other hand, gene conservation forests do not fulfil necessarily the more comprehensive criteria of natural forest reserves.

4.4. Voluntary contributions to the Programme on Gene Conservation Forests

Participation in the Gene Conservation Forests programme is strictly voluntary and follows clearly a bottom-up approach. The programme is based on the information and motivation of the forest owners. Interested forest owners contact the Federal Office and Research Centre for Forests. Specially trained experts of the Federal Office and Research Centre for Forests check the designated forest area and form expert opinion which is the basis of the further management and silvicultural treatment of the stands. All necessary measures and specific treatments which aim at the maintenance of genetic diversity of forest trees are discussed and formally agreed in a documentation file. At regular intervals of 5–10 years, through a repeated check, the results of the measures are evaluated and are re-defined if necessary. The registration of the gene conservation unit may be cancelled in the database, if the forest owner wishes to drop out of the programme, if the state of conditions of the unit do not meet the goals of gene conservation or agreed measures could not be realised.

Forest owners who contribute to this programme do not request a direct subsidy or compensation fee for designating their forest stands. However, as an incentive, subsidies (e.g. for fencing against browsing or special silvicultural treatments) can be claimed easily. No formal contracts are signed—the "handshake contracts" are more or less an informal agreement between the two partners, without long-term binding commitment. One important outcome of this approach is that this type of protected forest area cannot be accepted by international classification schemes.

5. Concluding reflections—lessons learned from voluntary programmes

The acquisition approach used in the Forest Reserves Programme has been successful and efficient when selecting widespread zonal vegetation types during the starting phase of the programme, but becomes less effective in respect of rare and vulnerable forest communities (Essel et al., 2002). This is a direct result of the specific selection approach used, testing offered sizes for their practicability. After covering the main forest communities it will be necessary to modify the acquisition approach using more target-oriented techniques, including remote sensing. Presently, rare azonal or extra zonal forest communities are lacking. Also forest types with already endangered species like Silver Fir (*Abies alba* Mill.) are under-represented in the network. Specific efforts to represent these forest types in the network will have to be made.

Currently, the Natural Forest Reserves Programme covers only 0.2% of the total forested area of Austria. Even if all forest types are represented in all biogeographic regions, no more than 0.35% will be reached. This inadequate figure is the result of using the scientifically based concept of minimum area of Koop (1982, 1989), but it is in line with the overall goal of the "agreement of principles" of the programme. Nevertheless, it should be recognised that the Natural Forest Reserves Programme covers only a part of protected forest areas in Austria and represents only one of various other categories of protection regimes (Frank and Koch, 1999).

Currently, scientifically based estimates of the amount of each specific forest type that need to be protected, or minimum proportions of total forested area that needs to be protected as is done in boreal countries (e.g. Angelstam and Andersson, 2001; van Kooten, 1998; Niemelä et al., 2001) are simply not available. Also critical habitat threshold values (e.g. Jansson and Angelstam, 1999) do not necessarily reflect the needs of areas to be protected because required habitat conditions are at least partially given in the matrix outside of protected forest areas.

The challenge is to find the balance between strictly protected forest areas and well managed forests, considering biodiversity as an integral part of the management objectives. Forests are not a closed system, but an element of the landscape interacting with other elements (Simberloff, 2001). Interactions can occur in the transition zones between forests and urban areas, between forests and agricultural land, or between managed forests and protected areas (Schläpfer and Elliot, 2000) and on many other borderlines inside of the forests. Functions of forest ecosystems are taking place at different spatial or temporal scales. There is no optimal strategy for maintaining biodiversity that can be applied everywhere, because the very act of applying a strategy everywhere leads to the homogeneity that reduces biodiversity (Bunnel and Huggard, 1999; Niemelä, 1999). In the authors' opinion, the approach used in the Austrian Forests Reserves Network meets the requirements for the establishment of a coherent and representative network. Further research is needed to answer the question of what percentage of each forest type occurring in each of the 22 biogeographic regions of Austria still needs to be protected.

The establishment of a network is the first and initial step—to maintain the network over a long period in a sufficient condition is also critical. Without controlling measures of the reserves and regular maintenance of monitoring facilities the network risks being neglected. This may not have consequences in terms of biodiversity (on the contrary, the more running wild the better), but it may have fatal consequences in terms of documentation and monitoring. Co-operation with the forest owners from the early beginning, in negotiating the agreement of principles and the framework concept, has been an essential feature of the programme. This contrasts to the implementation of the Natura 2000 network according to the EU Habitats Directive

92/43/EEC and Birds Directive 79/409/EEC, where, at least in Austria, the forest owners have not been involved directly in the selection process and the designation of sites. Furthermore the question of appropriate compensation payments has not been solved yet. The acceptance of the Natural Forest Reserves Programme by the landowners is therefore much higher than that of Natura 2000.

Comparable types of strictly protected forest reserves, in most cases small-scale reserves, have also been established in other Central European countries (Parviainen et al., 1999; European Commission, 2000), but mainly on state or community owned land. For example in the Federal states of Germany, similar principles of establishment and management of natural forest reserves have been used (Bücking and Schmidt, 1999). The main difference between the Austrian programme and these technically comparable programmes lies in the approach of voluntary participation and the disposable regular income of the private owners from the protected areas. Landowners take part in the management process and receive a continuous annual income. Their participation in the management process and their identification with the whole programme has always been seen to be of vital importance for the long-term success of the network.

The necessarily intensive co-operation with the landowners; both in case of the Natural Forest Reserves Programme and the Programme on Gene Conservation Forests, requires substantial human resources by the managing organisation. Without personal contacts and continuous information from the partners the motivation of the owners for long-term maintenance of the reserves could be not ensured. In only very few cases contract violation created difficulties in terms of new calculation of the compensation remuneration and contract alteration. Since 1996, only one contract had to be terminated by the government, because of an unacceptable breach of contract. No comparable network based on non-voluntary approaches exists in Austria which would allow a comparison of the costs of controlling measures, but we suspect that that the low rate of contract violation corresponds to effective co-operation with forest owners.

As with the gene conservation forests, the protected areas of BIOSA (as a voluntary programme of a forest owner's association) rarely fulfil the criteria of international classification systems like the "MCPFE Assessment Guidelines for Protected and Protective Forests and Other Wooded Land in Europe" (adopted at the 4th session of the Ministerial Conference on the Protection of Forests in Europe in April 2003 in Vienna, publication in preparation) because of the obscurity or absence of contracts. It is also not clear which areas and how many areas, sites and forest types are covered by the programme. This may be an unavoidable consequence of the philosophy of a strictly voluntary programme. In this respect the voluntary contribution of forest owners to in situ gene conservation strategies without direct financial support or subsidies is not as successful in establishing a coherent network as the Natural Forest Reserves Programme, which includes fair compensation remunerations.

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