

COST Action E27

Protected Forest Areas in Europe – Analysis and Harmonisation (PROFOR)

Country Report - Switzerland

Working Group 1 – Task 1.1.

Description of the historical background that has led to the development of particular national Protected Forest Area frameworks

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Abstract. The country report for Switzerland, a contribution to COST Action E27 – PROFOR, gives a broad overview of Swiss forests and describes the historical background which has led to the development of forest and nature protection legislation and to the establishment of protected forest areas (PFAs) in Switzerland. It provides information on the legislative basis of PFAs, financial aspects and organisations involved in the promotion, establishment and management of PFAs. The definitions and basic statistical data for all categories of protected areas of national importance for Switzerland, in which forests are an important ecological or landscape element, are given. The protection objectives and the restrictions on management or accessibility are described as well as resulting conflicts and future aims and development. Information is given on selection criteria for PFAs and on main surveys and monitoring. More than 25 % of the Swiss forest area is situated in some type of protected area. But only on 5.4 % of the forest area are restrictions on forest management stronger than the general management restrictions and obligations given by the Swiss forest legislation. In 2004, there were 671 forest reserves in Switzerland, which cover a total area of about 26,550 ha (2.19 % of the forest area). The aim of Swiss forest reserve policy is to increase the area of forest reserves within the next 20-30 years to 10 % (1,212 km²) of the total forest area.

Any views or opinions expressed in this document are those of the authors and not necessarily those of any official body within the signatory states.

Keywords: forest reserves, biodiversity conservation, nature protection policy, forest management, history

1. Introduction

Switzerland is an alpine country with an area of 41,285 km² and about 7.3 million inhabitants. Politically, it is a confederation of 26 cantons with a total of 2,880 municipalities (Swiss Federal Statistical Office 2004a). The cantons and municipalities have a high degree of autonomy and differ considerably in their organisation and policies.

According to the 1993-95 Swiss national forest inventory (Brassel & Brändli 1999), the total area of forest is 1.234 million hectares. Figure 1 shows the distribution of forest and other land use categories in Switzerland (Swiss Federal Statistical Office 2002).

The majority (73 %) of Swiss forests are in public ownership - 58 % are owned by municipalities, 8 % by (public) corporations and co-operatives, 5 % by the cantons and 1 % by the federal government. The remaining 27 % of Swiss forests are private property,

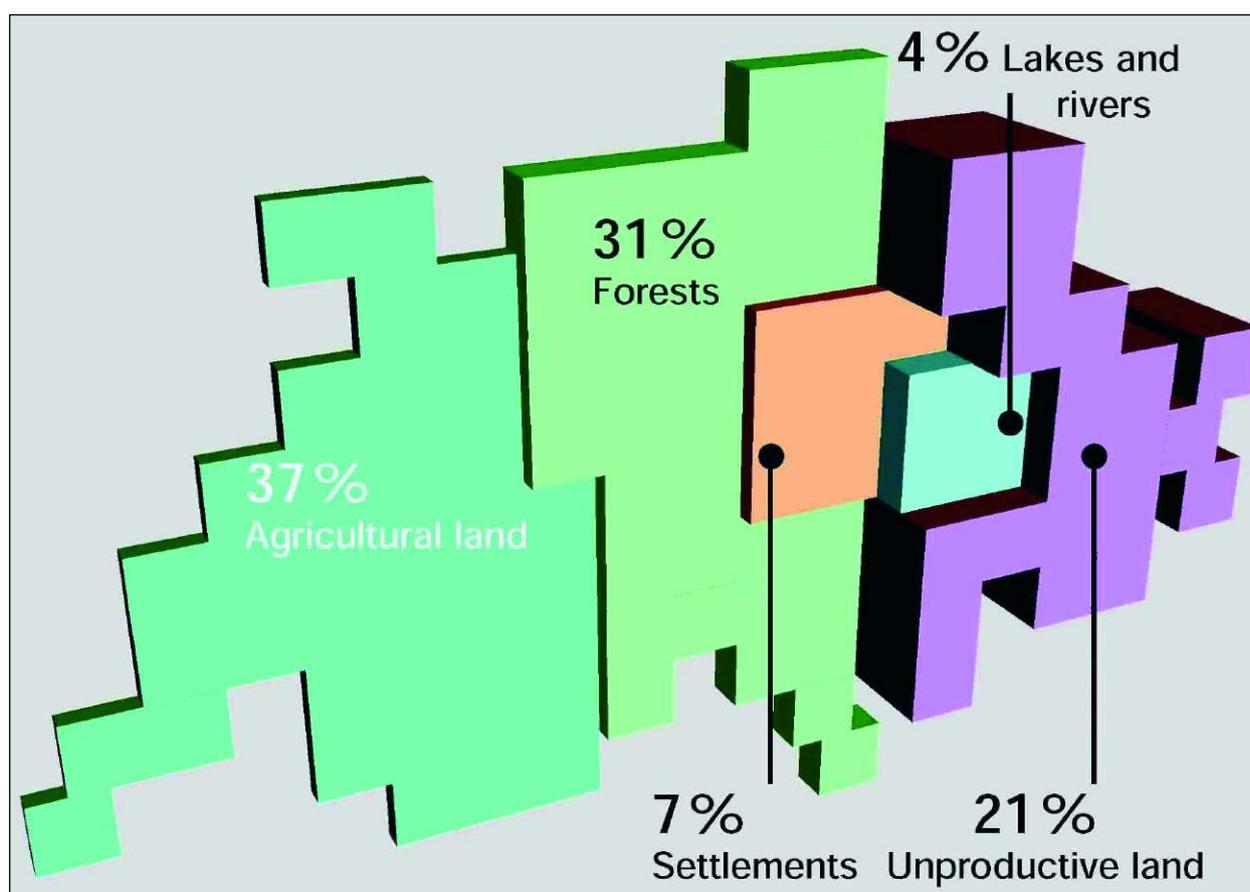


Figure 1:
Land use in Switzerland

(Source: Saeftl 2003)

with more than 240,000 owners. In private forests the average area of forest per owner is only 1.3 hectares (Swiss Federal Statistical Office 2004b).

According to the Federal Forest Law of 1991, all areas stocked with forest trees or shrubs fulfilling a forest function are considered to be forest, regardless of their origin, utilisation or cadastral registration (WaG 1991). Forest includes wooded pasture, chestnut or walnut groves and un-wooded areas within forests. Isolated groups of trees and shrubs, hedges, avenues, gardens and parks, and short-term tree cultures (e.g. Christmas trees) on agricultural land are not considered to be forest. The cantons define the criteria that have to be fulfilled for a forested area, in particular a newly-stocked area resulting from natural in-growth, to be considered as forest. The Federal Forest Ordinance of 1992 (WaV 1992) sets the following ranges, which the cantonal definitions have to obey:

- minimum area (including a functional forest edge): 200-800 m²;
- minimum width (including a functional forest edge): 10-12 m;

- age of natural in-growth on newly stocked areas: 10-20 years.

Wooded areas that fulfil a social or protective function of special importance are considered as forest irrespective of their area, width or age.

In the Swiss national forest inventory, forest and non-forest areas are distinguished using aerial photographs and several criteria including width of stocked area, crown coverage and dominant stand height (Keller 2001). Generally, a forested area with a minimum width of 50 m and 20 % crown coverage is considered to be forest. Smaller areas must have greater crown coverage. If there is 100 % crown coverage, the minimum width is 25 m. There must be a dominant stand height of at least 3 m, exceptions to this rule include areas of afforestation, regeneration, burnt, cut or storm damaged areas and shrub forest consisting of dwarf pine (*Pinus mugo prostrata*) and alpine alder (*Alnus viridis*).

The landscape of Switzerland is characterized by the Jura mountains, which run along the north-western border, the fairly flat, densely populated

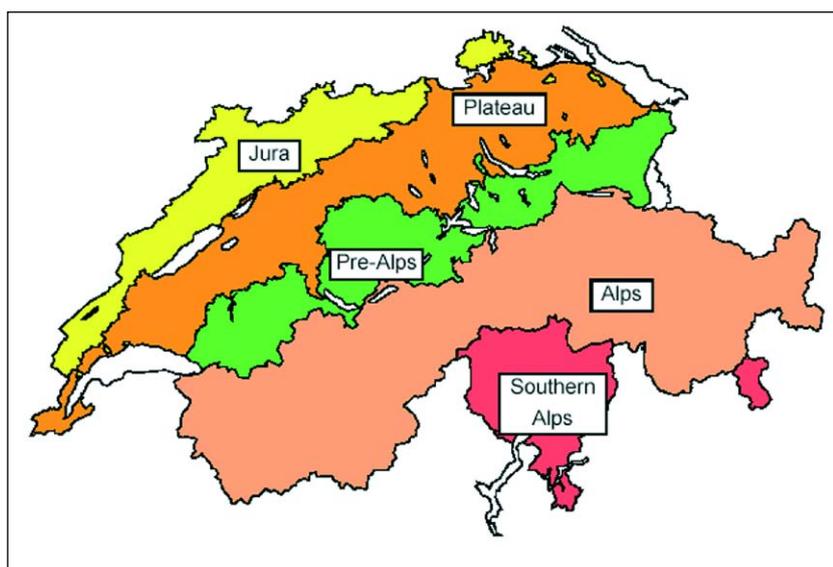


Figure 2:
Major regions of Switzerland
(Source: SAEFL 1997 in Schmidhüsen; Zimmermann 2002)

Central Plateau and the Alps, which form a distinctive dividing line (Figure 2). The altitude of Switzerland ranges from 193 m (Lago Maggiore) to 4,634 m above sea level (Dufourspitze).

The large climatic and edaphic differences result in pronounced altitudinal vegetation zones and high biodiversity. In the colline and submontane belt (below approx. 600-800 m) European beech forests would naturally dominate and in the montane belt (approx. 800-1,400 m) there would be mainly mixed forests with beech, silver fir, maple and, at higher altitude, Norway spruce. Above these belts are sub-alpine spruce forests, which form the timberline on the north flank of the Alps (1,700-1,900 m above sea level). In the Central Alps, where the climatic conditions are continental and the timberline reaches 2,300-2,400 m, there are sub-alpine spruce forests, followed by larch and stone pine forests (Steiger 1994). A few areas of Switzerland with a mild climate have forests of a sub-Mediterranean type, e.g. mixed oak-hornbeam forests, pubescent oak forests, mixed lime forests and, on the southern side of the Alps, chestnut forests. Ellenberg and Klötzli (1972) identified 71 forest associations (phytosociological communities) in Switzerland.

Most of the forests today are the result of a cultural process, which has lasted for centuries and has changed the natural species composition to a greater or lesser extent. The percentage of spruce is higher than under natural conditions, especially in the submontane and montane vegetation zones, mainly

to the detriment of beech and fir. Altogether spruce, beech and fir make up 80 % of the growing stock (Table 1).

The protective function of forests against natural hazards is very important in a densely populated, mountainous country such as Switzerland, which has extensive tourist infrastructure and trans-alpine roads and railways that are used intensively. About 25 % of Swiss forests directly protect humans or property from avalanches, rock-falls, landslides, erosion and mudflows. Another 25 % provide indirect protection by reducing the risk of torrents and flooding (BUWAL 2004). The Federal Forest Law of 1991

obliges the cantons to take measures to protect people and important infrastructure from avalanches, landslides, erosion, rock-falls and torrents. The cantons must ensure that minimum tending operations are carried out and that any areas destroyed by natural hazards or human intervention are reforested, where this is necessary to maintain protection. Several types of financial compensation are available

Table 1:
Distribution of tree species in Switzerland (1993-95 Swiss national forest inventory)

Species	Number of stems %	Growing stock %
<i>Picea abies</i>	39	48
<i>Abies alba</i>	11	15
<i>Pinus sylvestris</i> (and others)	4	3
<i>Larix decidua</i> / <i>L. kaempferi</i>	4	5
<i>Pinus cembra</i>	1	0.6
Other conifers	0.6	0.3
Total conifers (12 species)	60	72
<i>Fagus sylvatica</i>	18	17
<i>Acer pseudoplatanus</i> / <i>platanooides</i>	4	2
<i>Fraxinus excelsior</i>	4	3
<i>Quercus</i> sp.	2	2
<i>Castanea sativa</i>	3	1
Other broadleaves	9	3
Total broadleaves (over 40 species)	40	28

and are related to measures necessary to maintain protection by forests. The cantons must provide maps with risk areas and designate forests “with a special protective function”. In such forests, protection has priority over all other forest functions. Protective forests have no special nature protection status (WaG 1991).

One of the aims of the current version of the 1991 Federal Forest Law is to protect the forest as a near-natural ecosystem. Although the term “near-natural ecosystem” is not further defined by the legislation, the law contains many management restrictions and obligations that apply to the whole forest area (WaG 1991, WaV 1992):

- Deforestation is prohibited.
- Clear-cutting is prohibited.
- Any utilization endangering or harming the (protective, social and economic) functions of the forest is prohibited.
- The use of pesticides is prohibited within the forests (with some exceptions).
- The use of fertilizers is prohibited within the forests.
- Forests must be managed in such a way that they continuously fulfil their various functions (sustainability).
- The cantons must enact regulations for forest planning and management, which are compatible with the provision of a sustainable supply of wood, near-natural silviculture and the protection of nature and cultural heritage.
- Measures for the protection of people and of important infrastructure from natural hazards must be provided, as far as possible using near-natural methods.
- Forests may be left to develop naturally, if this does not endanger important functions of the forest (e.g. its protective function).
- Re-forestation by natural regeneration as much as possible, otherwise plantations must be planted with tree and shrub species adapted to the site conditions.
- Game control or protection measures have to be taken to ensure natural regeneration.
- Free access to the forest may be limited where necessary for the conservation of the forest or the protection of plants or wild animals.

The law also provides for the possibility of financial aid for silvicultural operations carried out for nature conservation purposes and for the establishment and maintenance of Forest Reserves.

2. History

The first records of protected forests date back to the Middle Ages (Schuler 2000a). From then until well into the 18th century, forestry was mostly regulated by the communes, by means of “rights of usage”. The right to cut down trees for fuel or for timber was usually linked to farms or families or owned by communities such as villages, towns, monasteries or other privileged groups. Often, the poorer classes had the right to cut off branches for fodder, to gather fallen wood for fuel and had grazing rights (von Arb and Zimmermann 2004). Starting in the 14th century, several “banning letters” (“Bannbriefe”) prohibited or restricted certain or all kinds of use of the forest within a defined area. Communes in mountainous regions often issued such “banning letters” to preserve forests that provided protection from avalanches, rockfalls and torrents. One example is the 1397 Andermatt “banning letter”, which banned any utilisation of wood or litter (Schuler 1987). Other “banning letters” were intended to ensure that there was an adequate supply of wood for a town or to protect the rights of usage of a privileged group. Some of these bans had a time limit and allowed the forest time to recover after exploitation.

In the 18th century, the increase in population, the need for fuel for mining and producing iron and the beginning of industrialisation all contributed to a scarcity of wood, especially in towns and cities. There was increasing conflict between cantonal authorities and rural communes about rights of usage. Consequently, the rights were divided up between the central authorities (representing the cantons) and the local communities and ownership replaced rights of usage. Many of the new communal and private forest owners took advantage of their new property rights - clear-cutting recklessly, disregarding any possible side effects and the preservation of resources (von Arb and Zimmermann 2004).

In the 1830s, Switzerland suffered a series of disastrous landslides and floods. This contributed to an increased awareness of the harmful consequences of thoughtless clear-cutting. Between 1834 and 1840, several cantons passed forestry laws prohibiting clear-cutting (Schuler 2000a). However, only a few cantons (mainly in the lowlands) were successful in implementing their laws to any degree. The Swiss Confederation was founded in 1848 but there was no particular reference to forestry in the initial constitu-

tion. In 1856, the Swiss Forestry Society, an association of forestry experts founded in 1843, sent a memorandum to the country's top officials, warning of the consequences that forest destruction would have for the water regime and flooding. The report of Landolt, commissioned by the Federal Council in 1858, showed the disastrous state of the Swiss mountain forests. However, it took further flooding catastrophes in 1868 before the federal government took action. A revision of the Federal Constitution in 1874 enabled the federal government to enact a law on forests in high mountain areas. In 1876, the first Federal Forest Act, which concentrated mainly on the preservation and restoration of protective forests in the mountains, was adopted. The constitutional restriction of federal competence to high mountain forests was abolished in 1897 and the revised Federal Forestry Law, valid for all forests, came into force in 1902. The main objectives of the law remained preserving the area of forest, restoring devastated forest and protecting people and property from natural disasters. The law stated the basic duty of public owners to plan and manage the forest according to the general principles of sustainability. The priority of the protective function of forests was established, as was the prohibition of clear-cutting in protective forests. Additional prescriptions included the compulsory re-forestation of destroyed forest areas, the discharge of harmful easements and the prohibition of harmful usage, especially grazing. The only restrictions that were immediately binding for private forest owners were the general prohibition of deforestation and of clear-cutting in protection forests. The federal law also gave detailed instructions on the organisation and training of the federal and cantonal forestry services (von Arb and Zimmermann 2004).

The total area of forest in Switzerland has increased considerably since the enactment of the Forest Law. This was supported by socio-economic change and progress, such as the development of the railways, starting in 1850, and the gradual replacement of wood by coal as a source of energy. The 1902 law remained the legal basis of federal forest policy until 1991. The aims of the 1991 law were not only to maintain the area of forest and the protective function of the forest but also to protect the forest as a near-natural ecosystem. All forest functions (protective, social, economic and nature protection) are considered equal. The term "sustainability" was extended to biodiversity aspects (WaG 1991).

In 1855, the Swiss Federal Institute of Technology (ETH) was established in Zurich, and from the beginning there was a forestry section. Sustainability was accepted as a fundamental principle of forest management (Schuler 2000b). Prior to 1855, Swiss foresters mainly studied at forestry schools in Germany. They were influenced by Hartig and Cotta, who considered that a schematic spatial structure of timber cutting was a precondition for sustainable use of the forests and sustainable wood production and that the planting of fast growing tree species was a means of meeting the demand for timber (Leibundgut 1990). Broadleaved forests in the Swiss lowlands had been managed mainly as coppice forest or coppice with standards prior to the 19th century, when they were gradually replaced by pure conifer forests (mainly spruce). Landolt, the first professor of silviculture at the ETH in Zurich was disillusioned by the damage caused by bark beetles, fungi, snow and windbreak and he disapproved of schematic clear-cutting and of pure spruce plantations. However, this system had been widely introduced and its sustainability was easy to control. The transition from schematic to so-called near-natural silviculture finally came with Engler, who was professor at the ETH from 1897 onwards, and was influenced by Gayer of Munich. As a result of new methods allowing sustainability to be controlled in selection forests (Biollay 1920), such silvicultural systems became accepted (Leibundgut 1990, Schuler 2000b). Schädelin and Leibundgut continued the work of Engler, focussing on small-scale natural regeneration and selective thinning. Near-natural silviculture became the norm.

Nature protection in Switzerland was strongly promoted by the Swiss Society of Nature Research (now the Swiss Academy of Sciences), which was founded in 1815 and based on existing cantonal societies (de Miller, 1999). Initially, it focussed its interest on the erratic blocks found on the Central Plateau of Switzerland and on the development of glaciers. In 1906, the Society founded the Swiss Commission for Nature Protection, with the aim of fostering the protection of geological, botanical, zoological and pre-historical natural monuments. Since 1896, the Federal Forest Inspectorate has been publishing the "Tree Album of Switzerland", which describes and documents remarkable individual trees and stands of trees (Schuler 1991). The Swiss Forestry Society initiated the idea of forest reserves. In 1906, the Society accepted a proposal to perma-

nently stop any human intervention in certain typical forest areas (of about 20 to 100 hectares) and allow them to develop naturally (Schmidhauser 1999; Leibundgut, 1957). In 1910, the first virgin forest reserve, a small reserve of less than 10 hectares, was established at Scattlé near Brigels (Matter 1999). The Swiss Commission for Nature Protection also adopted the idea of forest reserves, though it envisaged a national park as in America. A suitable area was soon found, and in 1908 negotiations began with the commune of Zernez in the Engadine valley. In 1909, the Swiss Association for Nature Protection (SBN, later Pro Natura) was founded, with the purpose of finding financial resources for the creation of a national park. In 1914, the Swiss National Park was officially founded with the participation of the Swiss federal government. From the very beginning, there was close co-operation between the SBN and the Swiss Forestry Society (SFV). In 1910, the SFV joined the SBN as a “life member” (Schuler 1991). After the establishment of the National Park, the SFV ceded its forest reserves to the SBN (Leibundgut 1957). In the following years, the SBN continuously bought land and signed land-lease contracts to establish protected areas (e.g. in 1933 a reserve was created in the “Aletschwald”) and supported the establishment of game sanctuaries and bird protection areas.

Around the middle of the 19th century, not only were the forests in decline, but ungulate game species such as roe deer, chamois, red deer and ibex had largely disappeared. Restrictions on the hunting season were first imposed in the Hunting Law of 1875 and the first game sanctuaries were established.

The idea of strict forest reserves was revived in the 1940s by Leibundgut, who was interested in the natural development of forests from the scientific point of view. In 1947 the Sylviculture Institute of the ETH Zurich established the first small Natural Forest Reserves (“Moos”) in Birmensdorf near Zurich. Several other Natural Forest Reserves were established for scientific purposes in the 1950s and later, with the support of the Federal Forest Agency (Leibundgut 1957, Matter 1999). The Swiss Agency for the Environment, Forests and Landscape (SAEFL), commissioned a plan for forest reserves, based on the Federal Forest Law of 1991 and on international agreements (Indermühle et al. 1998). In 2001, SAEFL and the cantonal forest directors adopted the “Terms of Reference for Switzerland’s Forest Reserve Policy” and declared the aim that

within the next 20 to 30 years 10 % of Switzerland’s forest was to be classified as forest reserve areas.

For a long period, the protection of nature and of landscape in Switzerland remained dependent on private associations such as the SBN, the Swiss Alpine Club (founded in 1863), Swiss Cultural Heritage (1905), the Swiss Committee for Bird Protection (1922), the Association of Swiss Bird Protection Societies (1928), the Rheinaubund (1960), the World Wildlife Fund WWF (1961), the Swiss Foundation for Landscape Protection (1970) and many others. The first Federal Law on the Protection of Nature and Cultural Heritage was enacted in 1966 and it was revised in 1995 (NHG 1966). In 1977, the Federal Ordinance on a federal inventory of landscapes and natural monuments of national importance (Verordnung über das Bundesinventar der Landschaften und Naturdenkmäler, VBLN 1977) came into force and in the 1990s, several ordinances for the protection of various types of biotope of national importance were passed. Since the 1970s, international conventions have had an increasing impact on nature conservation in Switzerland.

3. Current state

3.1. Main categories of protected forest area, responsible organisations and procedures

3.1.1 Legislative basis, organisation and financing

Legislative basis

The general principles for the protection of nature, cultural heritage, and biodiversity and for maintaining the forests and all their functions are stated in the Swiss Federal Constitution (Bundesverfassung 1999). The Constitution gives the federal government the competence to decree regulations for the protection of species and biotopes, to support activities for the protection of nature and cultural heritage and to acquire and protect sites of national importance by contract or expropriation. The protection of mires and of mire landscapes is explicitly mentioned. The cantons are given responsibility for the protection of nature and cultural heritage. This means that the cantons are responsible for the implementation, surveillance and law enforcement within the frame-

work provided by the federal legislation, which must be transposed into the legislation of each canton.

Based on the Constitution, three main fields of legislation developed, providing the basis for establishing protected areas: forest legislation, legislation on the protection of nature and cultural heritage and hunting legislation. This resulted in various types of protected (forest) areas, differing in their protection status, objectives, protection strategies, organisational structure and finances.

The Federal Forest Law (WaG 1991) and the related Federal Forest Ordinance (WaV 1992) provide the basis for the establishment of *Forest Reserves* and *Forests of Special Genetic Interest*. This ordinance states that “the cantons may establish forest reserves for the maintenance of the diversity of flora and fauna on appropriate sites”. A separate federal ordinance (VFVG 1994) requires the cantons to take measures to ensure that there is an adequate supply of seeds and seedlings for forestry by establishing *Stands for Seed Harvesting*.

At the cantonal level, cantonal forest laws provide the legal basis for *Forest Reserves*. Each cantonal forest agency defines its forest reserve policy in the cantonal strategy. The cantonal implementation of federal legislation is optional in the case of *Forest Reserves* and *Forests of Special Genetic Interest* but obligatory in the case of *Stands for Seed Harvesting*. The legal protection of *Forest Reserves* and *Forests of Special Genetic Interest* is usually based on decisions by the cantonal government and on voluntary contracts or agreements between the landowner and the canton. For *Natural Forest Reserves* such contracts are usually for a period of 50 to 99 years. In addition, *Forest Reserves* are included in regional forest management plans, which are binding for the public authorities.

The legal basis for establishing *Forest Reserves*, *Forests of Special Genetic Interest* and *Stands for Seed Harvesting* is rather weak and is primarily based on the goodwill of the owners and the cantonal forest agencies. Although the federal government cannot order *Forest Reserves* to be established, it supports and influences cantonal activities by means of financial incentives.

The Federal Law on the Protection of Nature and Cultural Heritage (NHG 1996) and the related ordinance (NHV 1991) provide the basis for the protection of specific biotopes and landscapes, such as *Alluvial Zones*, *Raised Bogs*, *Fenlands*, *Mire Landscapes*, *Amphibian Spawning Areas*, *Landscapes and Natural Monuments*, and rare forest associations.

Additional ordinances for these biotopes and landscapes define the conservation aims and measures to be taken and they give complete lists (federal inventories) of the protected sites of national importance. These federal inventories (lists of legally protected sites) should not be confused with inventories for monitoring described in section 3.3.

The requirements of federal legislation are transposed into cantonal legislation on the protection of nature and cultural heritage and into cantonal legislation on land-use planning. Sites are protected by cantonal protection decrees, cantonal master plans and land-use plans and often by contracts or agreements between the landowner and the canton. Protected forest areas are included in regional forest management plans. The cantons may impose penalties for violation of the regulations.

Until the sites listed in the federal inventories are protected by cantonal legislation, they must remain undiminished (NHG 1966). The federal government may buy or even expropriate sites of great national importance (Bundesverfassung 1999) but such cases are rare.

The Federal Constitution explicitly mentions the protection of species, biotopes and mire landscapes. There is a stronger legal basis for their protection than for landscape protection in general. The federal government has greater authority than the cantons with regard to these protection categories. The “National Inventory of Landscapes and Natural Monuments of National Importance” (FIL) has a weak legal protection status because the protection objectives are not specific (Parlamentsdienste 2003). The FIL is a binding instrument for federal tasks with implications for the landscape. It is only binding on cantons in cases where they are responsible for carrying out federal tasks.

The Federal Hunting Law (JSG 1986) and the related ordinances (JSV 1988, WZVV 1991) provide the legal basis for the establishment of *Game Sanctuaries* and *Reserves for Water Birds and Migratory Birds of national or international importance*. Specific regulations, including federal inventories (lists of legally protected areas), are given in separate ordinances.

At the cantonal level, the legal instruments and procedures are the same as for sites protected on the basis of the NHG.

The *Swiss National Park* is a special case, since a specific federal law was enacted (Nationalparkgesetz 1980). Detailed regulations covering the aims of protection, paths, prohibitions and penalties are laid

down within the cantonal ordinance. The Canton of Grisons (in which the park is situated) and the National Park Federal Commission (NPFC) are responsible for enforcing the legislation. The establishment of the National Park is based on land-lease contracts with five municipalities.

Biosphere Reserves and *UNESCO World Natural Heritage Sites* are not protected areas as such but provide a label for a region. They may include various types of protected areas. Regulations for landowners and managers are based on statutory rules for these sites according to the specific legislation mentioned above. The UNESCO labels provide some sort of informal protection (Küttel 2004, personal communication). The participation in and support of UNESCO Programmes is regulated in a specific convention (Bundesbeschluss UNESCO 1975).

Organisation

The Swiss Agency for the Environment, Forests and Landscape (SAEFL) is the federal authority for environmental protection, landscape and nature conservation. It is responsible for (SAEFL 2004a):

- defining the federal policy, aims and strategies for nature protection and for the establishment of protected areas¹
- drafting federal laws and ordinances and defining protected biotopes and landscapes of national importance (national inventories)
- implementing protection measures (in co-operation with cantonal authorities, non-governmental organisations (NGOs) and other players)
- providing support for enforcement by cantonal and communal authorities
- influencing cantonal activities by means of financial incentives
- assessing the requirements for federal financial contributions / compensations and controlling financial transactions
- running (or financing) advisory centres, such as the advisory centres for the protection of alluvial zones (“Beratungsstelle Auenschutz”; <http://auen.ch/>) and for mire conservation (“Beratungsstelle für Moorschutz”; <http://www.wsl.ch/land/inventory/mireprot/>), and for supporting the cantons by providing them with technical assistance
- supervising the enforcement of federal law by the cantons
- checking that protection measures have been implemented

- informing and advising the public
- promoting global co-operation through its involvement in international environmental bodies

Three divisions of the SAEFL deal with protected forest areas – the Swiss Forest Agency (SFA) deals with areas protected by forest legislation, the Division for Nature and Landscape deals with areas protected by federal legislation concerning nature and landscape protection and the Division of Species Management deals with all aspects of species protection, including areas protected by federal hunting legislation.

The SAEFL is supported by the Federal Commission on the Protection of Nature and Cultural Heritage, an advisory board of experts appointed by the federal government.

The relevant authorities at the cantonal level are the cantonal forest agencies (“Kantonsforstämter”), the cantonal offices for nature and landscape conservation (“Fachstelle Natur- u. Landschaftschutz”) and the cantonal hunting authorities (“Jagdverwaltungen”). These are responsible for the enforcement of national and cantonal legislation and the implementation of nature protection measures in co-operation with the municipalities, landowners, cantonal NGOs and other players. They are responsible for:

- proposing and establishing new protected areas (especially forest reserves)
- negotiating with landowners, preparing and signing contracts
- preparing and obtaining necessary protection decrees and decisions enacted by the cantonal governments
- implementing protection measures in cantonal law and integrating protected areas in cantonal planning instruments (land-use plans, master plans and regional forest management plans)
- providing plans for the management and tending of protected areas
- ordering and supervising the maintenance and management of reserves (including special measures for the protection of species and of biotopes)
- appointing gamekeepers for the surveillance of game sanctuaries and reserve managers;
- processing financial transactions related to protected areas;
- reporting to the SAEFL and informing the public.

The cantons constitute national working groups, such as the committee of the heads of the cantonal

¹ e.g. “Terms of Reference for Switzerland’s Forest Reserve Policy”, adopted by the SAEFL and the cantonal forest directors in 2001.

forestry services ("Kantonsoberförsterkonferenz"), to co-ordinate cantonal activities and to influence national policy on forestry and nature protection.

The municipalities consider aspects of conservation in land-use planning within their territory. Larger municipalities usually have committees for nature conservation and for forestry.

Non-governmental organisations (NGOs) have a strong influence on nature and landscape conservation in Switzerland. The largest conservation organisation is Pro Natura, which takes care of more than 700 nature protection reserves (<http://www.pronatura.ch>). A list of the main NGOs dealing with nature and landscape protection is given in appendix 3. Conservation organisations that operate on a national scale and have been in existence for some years have the right of appeal ("Verbandsbeschwerderecht"), as do the municipalities. The right of appeal means that objections can be filed against decisions relevant for nature conservation and environmental protection. The consequence of such appeals is that extrajudicial agreements are made or cases are investigated in administrative courts. The right of appeal is a means whereby NGOs can point out negative effects on nature and the environment and can use their expertise in these fields, thereby, providing an important counterbalance to strong economic interests in public and private projects (Schmithüsen 2001).

Various NGOs and other stakeholders lobby in favour of or against protected forest areas. In Switzerland the effect of lobbying is considerable because decisions on many political problems are taken by referendum. Thus, it is not only influential people in the government who are the target of lobbying but also the general public. For example, the NGO Pro Natura has launched a large-scale campaign for the establishment of additional national parks, offering 1 Million Swiss Francs to the first region that designates a new national park (Pro Natura 2004). WWF Switzerland promotes the certification of forests with the FSC label and, as a condition, the extension of natural forest reserves to 10 % of the total area of forest (Müller 2004). The association of forest owners ("Waldwirtschaft Schweiz") wants to reduce the strict regulations on forest management and conservation in order to make Swiss forestry competitive internationally.

Institutes, such as the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), the Swiss Federal Institute of Technology (ETH) and universities, conduct research related to protected

forest areas. Several institutes work on the co-ordination of conservation efforts and maintain databases about the distribution of specific taxonomic groups in Switzerland.

Financing

If the establishment of a forest reserve or the integration of a certain site in a protected area limits the utilisation of and profits from the forest or causes additional work or expense, landowners have the legal right to financial compensation (Bundesverfassung 1999). The federal government and the cantons provide financial resources for establishing and maintaining protected forest areas and for conservation measures.

Financial co-operation between the federal government and the cantons is based on the principle of "coupled contributions". This means that the federal government will only make a contribution for a certain purpose if the canton concerned makes a complementary contribution. The amount requested usually depends on the canton's financial strength (von Arb and Zimmermann 2004).

The amount of the financial contribution / compensation depends on the legislation on which a protected area is based. For protected areas established under the forest legislation, the federal government pays up to 50 % of the costs of establishing and maintaining the reserves. This, together with the cantonal contributions means that 70-100 % of the costs or losses may be compensated. Contributions / compensations are available for the loss of profit if timber harvesting ceases, for measures ordered to protect species and biotopes and for managing seed harvesting stands (WaG 1991, WaV 1992, BUWAL 1995).

In the case of biotopes of national importance, established under the protection of nature and cultural heritage legislation, the maximum federal contribution is normally 60-90 % but in special cases all costs are paid (NHG 1966, NHV 1991). The federal contribution depends on the importance of the site. Contributions are possible for the acquisition of protected areas and for maintenance, tending operations, research and documentation.

Based on the hunting legislation, the federal government supports the cantons in their expenses for *Game Sanctuaries* and the *Reserves for Waterbirds and Migratory Birds of national or international importance*. Federal contributions and compensations are provided for game keeping (including infrastructure, administration and wages for game-

keepers) and for the training of gamekeepers and supervisors (JSG 1986).

3.1.2 Overview of types of protected forest areas

General remarks

The data on protected areas in this publication are restricted to those of national importance. The exact figures for protected forest areas at the levels of the cantons and the municipalities are unknown at present.² The statistics for *Forest Reserves*, *Forest of Special Genetic Interest* and *Stands for Seed Harvesting* are based on information from the cantonal forest agencies.

The statistics on forest areas protected according to the legislation concerning nature and landscape protection or according to the federal hunting legislation, and forest areas protected based on international conventions are all based on information received from national inventories. These data are summarized in a national database (GIS database), available on the Web (<http://www.ecogis.admin.ch/>). About 10 % of the areas for the different protection categories overlap but it has not been possible to separate them (SAEFL 2004 unpublished). In the “ecoGIS” interactive database these types of protected areas can be displayed on a map (<http://www.ecogis.admin.ch/>). An extension of this service, the “nature and landscape data centre”, is currently under construction (http://www.wsl.ch/land/inventory/giv/dnl/dnl_ext.de.ehtml).

Forest Reserves

In Switzerland, a distinction is made between three types of Forest Reserve (SAEFL 2004b) namely:

- *Natural Forest Reserves* (“Naturwaldreservate”) are not subject to any form of human intervention and are thus allowed to develop naturally.
- In *Special Forest Reserves* (“Sonderwaldreservate”) targeted interventions are carried out for the conservation and promotion of biological and structural diversity or of endangered species.
- *Combined Forest Reserves* (“Kombinierte Waldreservate”) are designed to protect large forest areas, including *Natural Forest Reserves* and *Special Forest Reserves*.

The total number of *Forest Reserves* of national importance is 672 (July 2004). These reserves cover a

total area of 26,550 ha (2.19 % of the total area of forests in Switzerland). Of these reserves, 233 are *Natural Forest Reserves*, 302 are *Special Forest Reserves* and 136 are *Combined Forest Reserves*. These reserves range in size from 0.6 ha to 1,018 ha. Seventy five percent of the Forest Reserves are smaller than 20 ha and only six reserves are larger than 500 ha (Figure 3). The cantons are responsible for 584 reserves. Pro Natura owns or manages 62 reserves (Pro Natura 2004, personal communication) and the Swiss Federal Institute of Technology Zurich (ETH) is responsible for 36 *Natural Forest Reserves* (Matter 1999).

Natural Forest Reserves have the following objectives (SAEFL 2004 b):

- conserving habitats where there are few signs of human impact
- enabling natural processes and development to occur
- promoting dynamic processes typical of natural forests
- increasing structural and habitat diversity
- maintaining and promoting species that rely on old or dead wood.

The conservation objectives of *Special Forest Reserves* are:

- maintaining special habitats for the conservation and promotion of rare and threatened species;
- increasing habitat diversity;
- maintaining special (traditional) forms of forest management such as coppicing (coppice and coppice with standards), wooded pastures, chestnut groves, brushwood etc.

All types of *Forest Reserves* shall also serve as areas for ecological compensation, as connections between habitats and as areas for research and education.

The restrictions on forest management depend on the type of forest reserve. In *Natural Forest Reserves* commercial timber harvesting is not allowed. Silvicultural interventions to protect roads or paths or (exceptionally) to reduce the disastrous effects of bark beetles are allowed if natural forest development is still possible. In *Special Forest Reserves* the commercial harvesting of timber is restricted to specific, targeted interventions. These may be histo-

² This problem is evident in the field of nature protection with the type 'Nature Reserve'. In Switzerland, more than 6,000 sites are called 'Nature Reserves', but in only about 1,600 is there an obligation on land-owners (Hintermann et al. 1995). There was an attempt to specify all Swiss nature reserves by means of IRENA (“Inventar der rechtskräftig geschützten Naturschutzgebiete in der Schweiz”, Schenker 2004, personal communication). However, IRENA did not provide a reliable estimate of Swiss nature reserves, because the data were not sufficiently homogeneous in terms of quality and quantity.

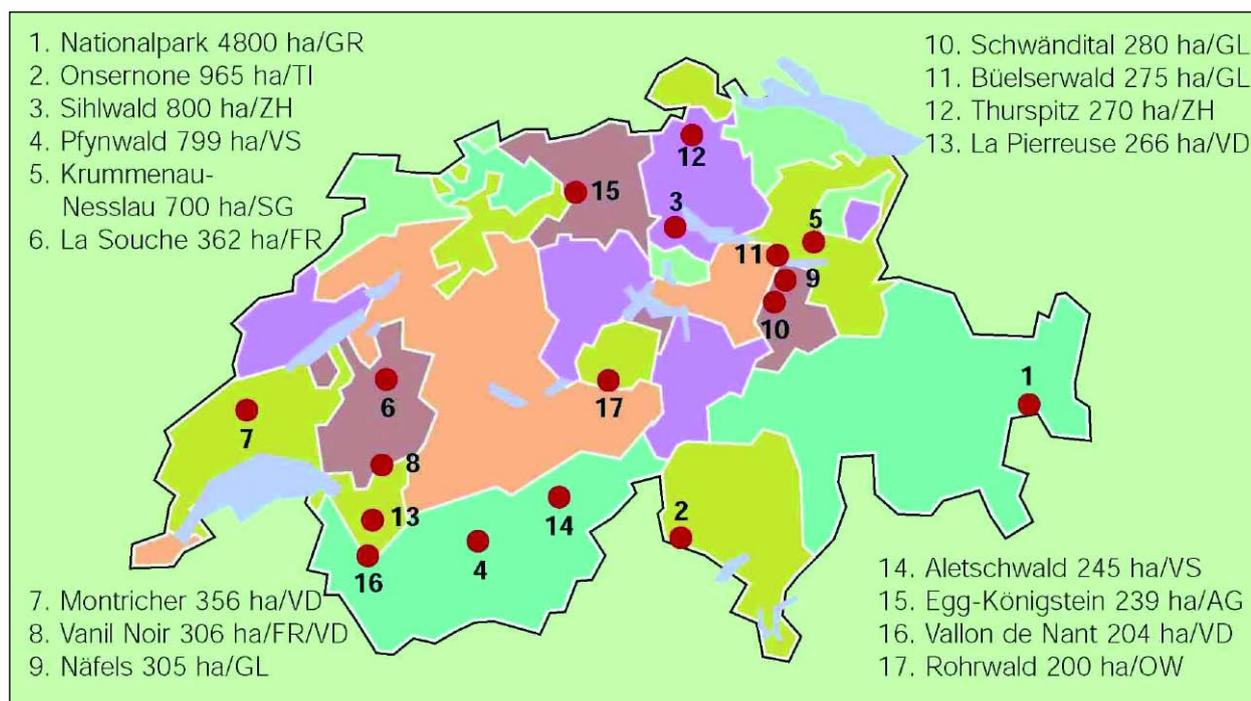


Figure 3:
Switzerland's largest Natural Forest Reserves (≥ 200 ha)

(Source: Saeftl 2003)

rical, traditional forest use or silvicultural measures aiming to conserve valuable biotic communities, for example orchid-rich pine forests, particularly species-rich stands, forests of special genetic interest in which rare tree species are encouraged, forest edges which require ecological improvement, and amphibian biotopes in alluvial forests.

In *Forest Reserves*, conflicts arise when some form of silvicultural intervention, which is not included in the conservation plan, is required for forest functions to continue or for forest maintenance. In protective forests the function of protecting roads and settlements from natural hazards (e.g. avalanches) has precedence over its status as a *Forest Reserve* (BUWAL 2001 a). Outbreaks of insects such as bark beetles may lead to conflicts because treatments against insects are generally not allowed in *Natural Forest Reserves*. However, potential conflicts are reduced by exceptions from this prohibition and the establishment of buffer zones. Finally, conflicts may arise if excessive deer populations threaten the conservation objectives (Indermühle et al. 1998).

There are two main aims for the future of Switzerland's Forest Reserves (BUWAL 2001b):

- Within the next 20-30 years, 10 % (1,212 km²) of Switzerland's forest area is to be classified as *Forest Reserves* and half of this as *Natural Forest Reserves* (Projektleitung WAP-CH et al. 2004). In 2004, this aim is still far from being achieved.

- Switzerland's large *Forest Reserves* are particularly valuable. However, they are too few in number. Within the next 20-30 years 30 large forest reserves with an area of more than 500 hectares are to be created.

Forests of Special Genetic Interest (FSGIs) and Stands for Seed Harvesting

Forests of Special Genetic Interest (FSGI) are reserves in which the maintenance and sustainable use of genetic resources of forest tree and shrub populations is given particular significance (Bonfils & Bolliger 2003). *Stands for Seed Harvesting* are characterised by trees with particular properties (e.g. high timber quality). In accordance with OECD two categories, "selected" and "source-identified" stands, are distinguished (OECD 2001).

In Switzerland there are five *FSGIs* of national importance for the target species spruce, fir and oak. There are 1,630 *Stands for Seed Harvesting* in the national inventory, with a total area of 3,380 ha and 33 tree species. In addition, there are 18 seed harvesting plantations for nine tree species.

The objective of *FSGIs* is to maintain any special genetic properties of the local populations on site (in situ). Additionally, the evolutionary adaptability of populations over different generations has to be maintained and promoted. *FSGIs* are supposed to represent as much genetic variation as possible in a

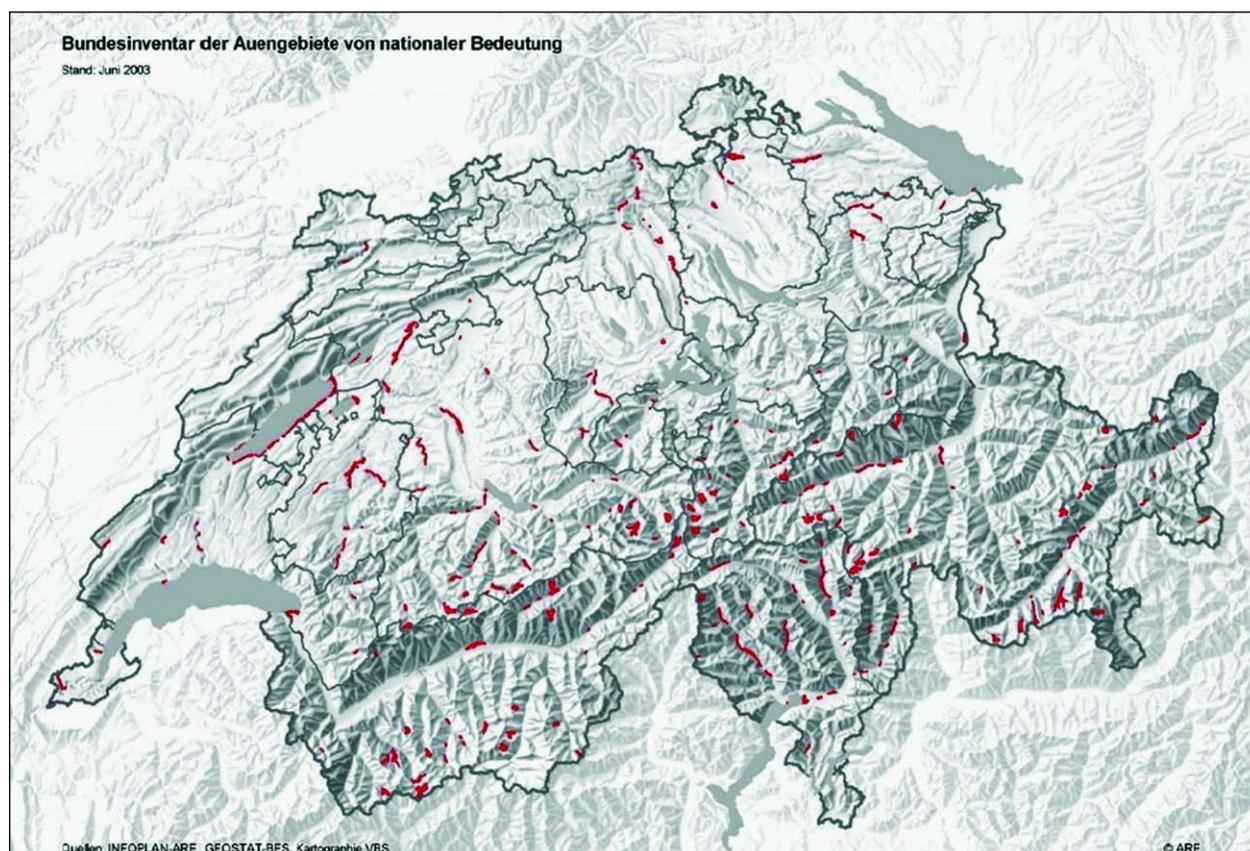


Figure 4:
Alluvial Zones of National Importance in Switzerland

Source: Bundesamt für Raumentwicklung (2004)

target species and should also account for special genetic variants. The objective of *Stands for Seed Harvesting* is to ensure that there are indigenous stands with high-quality timber or rare tree species to supply seeds for artificial regeneration (Bonfils & Bolliger 2003).

Forest management in *FSGIs* and *Stands for Seed Harvesting* has to be near-natural, as is generally the case in Swiss forests. In *FSGIs*, there are only two types of restriction: (1) the abundance of trees of the target species must be maintained or increased, (2) regeneration of the target species must be sufficient and should ideally be from natural regeneration. If artificial regeneration is necessary, then material of local origin must be used (Bonfils & Bolliger 2003). In *FSGIs*, there should be no selective thinning, as the whole gene pool should be maintained. In *Stands for Seed Harvesting*, silvicultural interventions must ensure the quality of the stand.

Conflicts related to these types of protected areas are rare because relatively few restrictions are imposed on landowners, managers or other interest groups.

The Swiss strategy for the maintenance of forest genetic diversity is embedded in EUFORGEN, a pan-european co-ordination programme (Rotach 2003). Switzerland has ratified the Convention on the Organisation for Economic Cooperation and Development of December the 14th, 1960 and is participating in the OECD Scheme for Forest Reproductive Material (http://www.oecd.org/departement/0,2688,en_2649_33918_1_1_1_1_1,00.html).

In the future, the natural regeneration of all forested areas, the regulation of detrimentally high densities of ungulates and the promotion of rare tree species will be of equal or of greater importance in ensuring the protection of the gene pool of Swiss forests than the designation of *FSGIs*³. There are plans to include *FSGI* sites within the natural forest reserve programme.

Alluvial Zones

Alluvial Zones are sites where there are interactions between water and the surrounding areas (fluctuations in water level, flooding, erosion and sedimenta-

³ According to the 1993-95 National Forest Inventory, about 80 % of the forest stands in Switzerland regenerate naturally (Brassel & Brändli 1999). Since 1965, artificial regeneration has decreased continuously. In 2001, 3.3 million trees were planted; this is only 10 % of the number planted 35 years earlier.

tion). *Lowland Alluvial Zones* include riverine floodplains, deltas and lacustrine floodplains. The typical habitats of these sites are alluvial forests (softwood and hardwood forests). Alpine alluvial zones include alpine alluvial plains and glacier forelands.

In Switzerland, 282 *Alluvial Zones* are protected according to the Federal Ordinance on the Protection of Alluvial Zones of National Importance (Auenverordnung 1992) (Figure 4). These sites cover a total area of 22,617 ha. As Alpine Alluvial Zones are not covered by forest, this report concentrates on *Lowland Alluvial Zones* (216 sites). *Lowland Alluvial Zones* cover a total area of 13,247 ha. Most of them include some forest and 25 % of the *Lowland Alluvial Zones* are completely covered by forest. The total area of forest on alluvial sites is 6,191 ha, ranging from 2 to 234 ha. Protected *Alluvial Zones* may overlap with the *Fenlands* and *Amphibian Spawning Area* protection types in riparian zones (Teuscher & Roulier 1994; BUWAL 2004, unpublished data).

The protection objectives for *Alluvial Zones* are (Auenverordnung 1992):

- maintaining and promoting flora and fauna typical of alluvial zones and their essential ecological conditions;
- maintaining the natural flows of water and sediments;
- restoring the natural dynamics of water and sediments, wherever this is reasonable and feasible.

Forest management is not generally restricted in protected *Alluvial Zones*. Hardwood alluvial forests must be managed in a near-natural way. Recommendations for forest managers are given in Teuscher et al. (1999). The harvesting of timber may be prohibited in certain areas. To modify the composition of tree species from species that do not occur naturally in alluvial zones (e.g. Norway spruce, poplar plantations) to more appropriate species, individual contracts are signed with the forest owners. There are also restrictions concerning hydraulic engineering and recreational use such as camping. Access to certain areas may also be limited (Teuscher et al. 1995, Teuscher et al. 1999).

In protected *Alluvial Zones*, conflicts arise mainly with intensive recreational use (e.g. sun bathing, rafting), the abstraction and diversion of waters and where there are landfill sites. Conflicts with forest management are of minor importance (Kohli 2004, personal communication). A poll, carried out in 1998, showed that although binding regulations with landowners protect 56 % of the alluvial sites, the

protection of only 35 % of the sites complies with the stipulations of the Ordinance on the Protection of Alluvial Zones (BUWAL 2003d). In many places gravel extraction, power plants and tourism prevent effective protection of *Alluvial Zones*.

Many Alluvial Zones of national importance are included in the Swiss "Emerald" network, a system comparable to Natura 2000 (Kohli 2004, personal communication).

The list of *Alluvial Zones of National Importance* in Switzerland is more or less complete. Future tasks will mainly be concerned with improving existing protected areas, for instance by revitalisation measures. It is also intended to incorporate *Alluvial Zones* into general plans for nature conservation and for sustainable land use, in particular Landscape 2020 and the new Swiss forest programme) (Kohli 2004, personal communication).

Raised Bogs, Fenlands and Mire Landscapes

In Switzerland, there are three types of protected mire area: *Raised Bogs*, *Fenlands* and *Mire Landscapes*. *Raised Bogs* are habitats dominated by *Sphagnum* mosses. They are raised above the groundwater table, so they are only supplied with water from precipitation. This situation results in relatively acidic, low-nutrient conditions for plant growth. *Fenlands* are grasslands with plant communities that indicate a surplus of water. The water source may be groundwater or from the slopes above the fenland. *Mire landscapes* are large areas dominated by mire habitats (BUWAL 1992-2002).

In Switzerland, 549 *Raised Bogs*, 1,163 *Fenlands* and 89 *Mire Landscapes* of national importance are protected. In *Raised Bogs* 2,472 ha of forest are protected. There may be forest in the core zone and in the buffer zone. Protected *Fenlands* have only 738 ha of forest. Eighty percent of all *Raised Bogs* and *Fenlands* border on to or are surrounded by forests (BUWAL 2004, unpublished data). *Mire Landscapes* include a large area of forest (23,962 ha) and many *Raised Bogs* and *Fenlands* are also part of protected *Mire Landscapes*, so there is considerable overlap. Some mires overlap with *Forest Reserves*, *Amphibian Spawning Areas* or protected *Alluvial Zones* (BUWAL 1990 and 1992; BUWAL 2004, unpublished data).

The general conservation objectives for *Raised Bogs* and *Fenlands* are (Hochmoorverordnung 1991, Flachmoorverordnung 1994):

- preserving the area and quality
- preserving and nurturing indigenous flora and fauna

- preserving typical topographical features
- enhancing and restoring mire areas that have been damaged.

The objectives of the protection of *mire landscapes* include aesthetic aspects such as (Moorlandschaftsverordnung 1996):

- preserving the beauty and diversity that account for the national importance of the landscape
- preserving all mire habitats
- preserving the characteristic elements of mire landscapes
- giving special consideration to rare and threatened species of flora and fauna
- supporting types of land use typical of mire landscapes.

As *Raised Bogs* are very sensitive to mechanical disturbance, access is denied to the core zones of these bogs. Forestry measures must be compatible with the objectives of protection. This means for instance that timber hauling is not allowed in raised bogs. *Fenlands* are managed non-intensively. They are usually the result of forest clearance and have to be cut at regular intervals. The forests around *Fenlands* and *Raised Bogs* should contain native and site adapted tree species (BUWAL 1992-2002). In *Mire Landscapes* restrictions only apply to the mire biotopes within the designated area. Otherwise ordinary forestry and agriculture is possible. In all mire biotopes forest roads must be planned in such a way that there are no negative impacts on the water regime (KBNL 2004).

Mires are faced with increasing pressure from people seeking recreation. Conflicts arise over trespassing by hikers and skiers and about the construction of tourist infrastructure and roads (including forest access roads). Conflicts over forest management concern timber transport in mire habitats causing soil disturbance and the storage of timber close to mire habitats resulting in soil compaction and eutrophication. The cessation of traditional land use in mountainous regions can lead to re-growth of forest and shrubs in mire biotopes. This affects fenlands, which need to be cut at regular intervals. The input of nutrients into mires has negative effects and can lead to their destruction. Inputs through atmospheric deposition are of particular importance (BUWAL 1992-2002).

The Advisory Centre for Mire Conservation (“Beratungsstelle für Moorschutz”, <http://www.wsl.ch/land/inventory/mireprot/>) is active in the

International Mire Conservation Group (IMCG, <http://www.imcg.net>).

Future efforts to protect mires are aimed at achieving better co-operation with forest management and agriculture, finding solutions for existing conflicts and revitalizing degraded mires.

Amphibian Spawning Areas

For the conservation of amphibians in Switzerland important spawning areas and their surroundings are protected. The sites are chosen where large populations of amphibians and rare species are to be found. Swiss efforts to protect amphibians take account of the rarity of and threat to amphibian species at the European level. Special attention is given to those species for which Switzerland has a particular international responsibility. Two types of protected area can be distinguished, stationary sites (which have a defined boundary) and moving sites (where the spatial extent changes, e.g. in gravel pits or quarries). In most sites, the terrestrial amphibian habitat, migratory corridor and buffer zone are forested or in agricultural use. Forests are an important habitat or hibernation area for various amphibian species.

There are currently 689 protected *Amphibian Spawning Areas* of national importance, covering a total of 11,673 ha, of which 4,648 ha are forested (BUWAL 1994; BUWAL 2004, unpublished data).

The objective of conservation is to maintain the suitability of these sites for the long-term survival of and re-colonisation by threatened amphibian species (AlgV 2001). Additional objectives are maintaining the sites as spawning areas, maintaining the populations of amphibians and maintaining these sites as part of the network of habitats.

In *Amphibian Spawning Areas*, management regulations and restrictions focus on the protection of amphibian populations. In forests any form of near-natural silviculture is allowed if the conservation objectives are not affected. An increase in the proportion of deciduous tree species, reduction of canopy cover and the establishment of highly structured forest edges is desirable (BUWAL 2002a). Forest roads have to be planned in such a way that they do not affect migratory corridors.

In *Amphibian Spawning Areas*, conflicts arise because of eutrophication by browsing animals or the use of fertilisers, high densities of fish, which reduce the success of amphibian reproduction, the spread of non-native animal species and the recreational use of water bodies (BUWAL 2002a).

The current inventory of protected *Amphibian Spawning Areas* of national importance is based on an evaluation of 8,000 sites. It can be assumed that the most important sites are well protected (Kohli 2004, personal communication). However, additional protection strategies are needed to tackle the worldwide decline in amphibians for unknown reasons (Houlahan et al. 2000).

Landscapes and Natural Monuments

The Swiss Federal Inventory of *Landscapes and Natural Monuments (FIL)* includes sites that are unique from a Swiss or European perspective by virtue of their beauty, individual character, or their scientific, ecological or cultural-geographical significance (unique sites), typical cultural landscapes, which are generally of a near-natural character and natural monuments, such as erratic blocks, exposed geological sections, exceptional trees and typical landscape forms (SAEFL 2004c).

Today, 162 sites of national importance are included in this inventory (Figure 5), and they cover a total area of 780,704 ha. This area includes 203,497 ha of forest (BUWAL 2004, unpublished data).

The general aim of this inventory is to preserve the sites included in the inventory or at least to minimize negative impacts on them. If conservation is not possible, restoration measures must be undertaken or compensation must be provided.

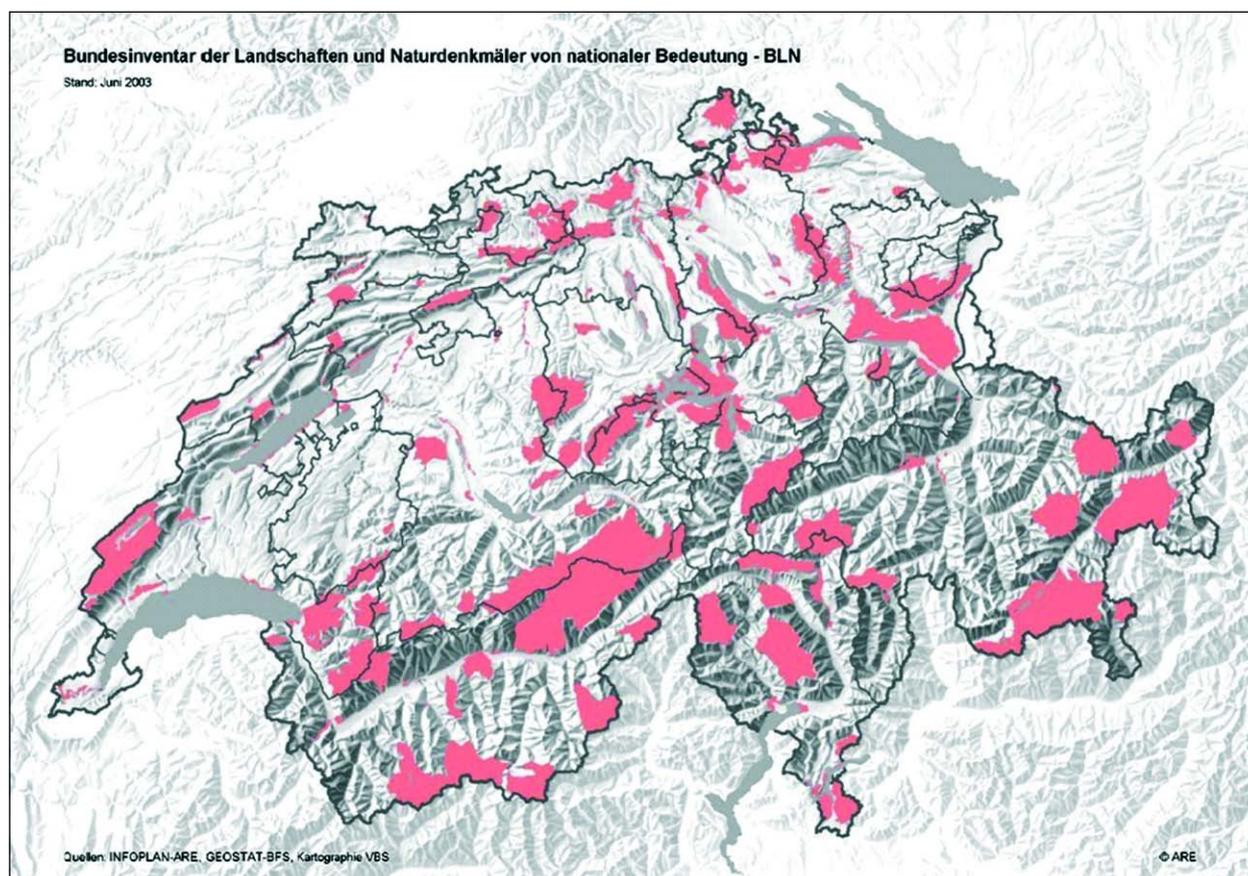
Restrictions are mainly concerned with constructions and installations (including forest infrastructure) that have implications for the landscape. Forest management is not restricted but should be near-natural. The inventory is only binding for activities undertaken at the federal level (SAEFL 2004d).

The most severe conflicts in these sites are linked to infrastructure projects for transportation (including forest roads), communication and tourism (e.g. alpine ski-runs).

An evaluation of this inventory, published in 2003 showed that the overall objective has not yet been achieved (Parlamentsdienste 2003). The impact of the inventory should be improved in the future by more precise protection objectives, by linking sites to other federal fields of policy related to spatial planning and by new instruments for monitoring (UVEK 2003).

Figure 5:
Landscapes of National Importance of Switzerland

Source: Bundesamt für Raumentwicklung (2004)



National Game Sanctuaries

National Game Sanctuaries are areas of national importance where hunting is restricted. These sites can include forest, agricultural areas, alpine pasture and forested pasture.

There are 41 *Game Sanctuaries* of national importance in Switzerland covering 150,920 ha, including 25,651 ha of forests (BUWAL 2004, unpublished data).

Until 1988 the goal of *National Game Sanctuaries* was to increase game populations. Nowadays, the objective is to protect rare and threatened wild mammals, birds and their habitats. Additionally the aim is to maintain healthy and appropriate densities of game species (Ordinance for Swiss Federal Game Sanctuaries, VEJ 1991).

Hunting is generally prohibited in the strictly protected core zone. In the partly protected zone, ungulates may be hunted if high populations endanger natural forest regeneration in adjacent areas. Forests must be managed in a near-natural way, without interference with the overall objectives of the reserve. The natural regeneration of tree species must be ensured. Plans for the establishment of new infrastructure (e.g. forest roads and ski-lifts) must be submitted to the state. Measures to protect species such as the capercaillie include appropriate forest management. No restrictions are imposed on any form of agricultural land use (VEJ 1991).

The main conflicts in *Game Sanctuaries* are related to recreational activities (e.g. cross country skiing and hang-gliding). In some regions there are conflicts with sheep grazing in the summer. Sometimes, species protection measures (e.g. for the capercaillie) may be in conflict with traditional forest utilisation. In some areas, high densities of ungulates threaten the natural regeneration of forest stands not only within the *Sanctuaries* but also in adjacent areas. This may lead to conflicts with forest owners⁴.

In the future, these categories of protected areas will, like *Forest Reserves*, be used even more for species protection (Blankenhorn 2004, personal communication). *National Game Sanctuaries* will also be valuable for observing natural ungulate populations.

Reserves for Water Birds and Migratory Birds, and Ramsar Sites

Reserves for Water Birds and Migratory Birds are areas of national or international importance for the hibernation, gathering, feeding, breeding and moulting of birds. They include aquatic and terrestrial habitats (wetlands, *Alluvial Zones*, mires, agricultural sites and forests). International *Reserves for Water Birds and Migratory Birds* are the result of different international conventions (Convention on the Conservation of Migratory Species, CMS)⁵, the African-Eurasian Migratory Water Bird Agreement (AEWA)⁶ and the UNESCO Ramsar Convention⁷.

In total, 10 *Reserves for Water Birds and Migratory Birds* of international importance and 18 reserves of national importance cover 18,920 ha, including 960 ha of forest. Five reserves of international importance, two reserves of national importance and one new reserve are included in the list of *Ramsar sites* (Keller 1996).

The aim of *Reserves for Water Birds and Migratory Birds* is to protect important bird populations (WZVV 1991).

The cantons may limit access and recreational use in these areas. Forest management is not restricted but should be carried out in a near-natural way. The construction of forest roads or other infrastructure is only allowed under certain conditions.

In *Reserves for Water Birds and Migratory Birds* conflicts may arise over hunting (damage by wild boar) or fisheries (consumption of fish by cormorants).

Reserves for Water Birds and Migratory Birds of international importance will be integrated into the Emerald project (see below). Both categories will be included in the National Ecological Network REN⁸ (Lebeau 2004, personal communication).

Swiss National Park

Switzerland has only one national park, the *Swiss National Park*. It is situated in the Lower Engadine valley and the Münster valley in the Canton of Grisons. It was the first national park in the Alps (see chapter 2) and was founded in 1914 as the result of a private initiative.

⁴ In Switzerland, forest owners have no hunting rights and get no income from the rents of hunting. These belong to the cantons.

⁵ <http://www.cms.int/>

⁶ <http://www.unep-aewa.org/index2.html>

⁷ The 'Convention on Wetlands of International Importance especially as Waterfowl Habitat' was adopted in 1971 and ratified by Switzerland in 1976. This convention aims to preserve a world-wide network of wetlands where water birds and wading birds can rest, breed, and over-winter. An additional objective is the conservation and wise use of all wetlands (<http://www.ramsar.org>).

⁸ Réseau Ecologique National

The *Swiss National Park* is a reserve in which all fauna and flora are protected from human interference and are allowed to develop naturally (Nationalparkgesetz 1980). Although there has been no human intervention since 1914, the landscape in the Swiss National Park is not virgin territory. From the 14th to the 17th century the forests were exploited for local mining companies and later for the large salt works at Hall in Tirol (Austria). In 1835, the Canton of Grisons took the first measures to control deforestation (Parolini 1995).

The *Swiss National Park* has a total area of 17,240 ha. It includes a wide range of natural habitats ranging in altitude from 1,400 m to 3,174 m, a small area of agricultural and pastoral land and a few roads. The park is comprised of 28 % (4,800 ha) forest, 21 % alpine grassland and 51 % high mountains with bare rocks and scree (Nationalpark 2004). The 4,800 ha of forest within the *National Park* correspond to the *Natural Forest Reserve* category (see *Forest Reserves*).

The *Swiss National Park* has three main aims - nature protection (the conservation of species, habitats and natural processes), research and information (Nationalpark 2004).

Hunting, fishing, forest exploitation and the maintenance of meadows are prohibited within the park. Interference with natural processes is prohibited and interventions such as fire control are only allowed if the park is endangered. However, a few interventions for species encouragement are carried out, such as the reintroduction of the bearded vulture since 1991. The *National Park* is open to the public but visitors have to keep to the marked trails (80 km) and resting areas. The park is not inhabited (Nationalpark 2004).

The *Swiss National Park* is a state institution (public law foundation). The supervisory body is the National Park Federal Commission (NPFC), which is elected by the Federal Council. It deals with all administrative and legal duties, elects members of the Park's administrative body and is responsible for all financial aspects (Nationalparkgesetz 1980).

Scientific investigations take place in the park in the form of surveys of the plant and animal species, the examination and mapping of water bodies and of soil and rock formations (Swiss Alpine Studies 2004). Research is initiated and co-ordinated by the Research Committee (a section of the Swiss Academy of Sciences) and is conducted in co-operation between universities and research institutes (Cherix 1998).

The starting capital of the foundation consists of the National Park fund, established by the Swiss Association for Nature Protection. The federal government contributes 70-75 % to the park budget and the remaining costs are covered by interest on the fund capital and funding from other sources such as cantonal contributions, donations and merchandising (Nationalpark 2004).

In 1979, the *Swiss National Park* was accredited by IUCN as a Biosphere Reserve. However, it does not correspond to the current regulations of IUCN, as there is no buffer zone or transition area. The whole National Park is classified as a core area (UNESCO 2002). Plans to expand the National Park were set back when in December 2000 an initiative designed to extend the boundaries of the National Park within the territory of the commune of Zernez was comprehensively rejected by voters in a consultative referendum (SAEFL 2002).

Biosphere Reserves and UNESCO World Natural Heritage Sites

Biosphere Reserves and *World Natural Heritage Sites* are not protected areas as such but provide a label for a region. They are defined by the Biosphere Reserve guidelines of the Man and the Biosphere (MAB) Programme (<http://www.unesco.org/mab/wnbr.htm>) and the UNESCO World Heritage Site guidelines (<http://whc.unesco.org>).

Biosphere Reserves are areas of terrestrial ecosystems that demonstrate a balanced relationship between people and nature. They contain natural and nearly natural biotopes and traditionally cultivated cultural landscapes (SAEFL 2002). They consist of three zones – a (protected) core area, an ecologically managed buffer zone, with non-intensive forestry, ecological agriculture and low-impact tourism and an area of sustainable development, including businesses, industry and services. The purpose of *Biosphere Reserves* is to reconcile the conservation of biodiversity with the sustainable use of natural resources, resulting in development that is sustainable from both the socio-economic and the ecological points of view.

In Switzerland, two areas have been recognised by UNESCO as *Biosphere Reserves*: the Swiss National Park (recognised in 1979) and the Entlebuch Biosphere Reserve (recognised in 2001). Since the National Park does not correspond to the current criteria of Biosphere Reserves (it only consists of a core zone) it is described separately (see above). The

Entlebuch Biosphere Reserve comprises a core area of 39,659 ha, a buffer zone of 16,358 ha and a transition area of 20,000 ha. 14,366 ha are forested. The core zone includes Raised Bogs, Fenlands, Natural Monuments and Game Sanctuaries, whereas the buffer zone includes Mire Landscapes and other Game Sanctuaries (Biosphärenreservat Entlebuch 2004). Protection status and restrictions depend on these protection categories.

A *UNESCO World Heritage Site* is a specific site (such as a forest, mountain range, lake, desert, building, complex, or city) that has outstanding importance, either culturally or naturally, for the common heritage of humankind. It can contain agricultural, forest, urban landscapes and natural sites. Two sites in Switzerland have been included in the World Natural Heritage list: the Jungfrau-Aletsch-Bietschhorn region (2001) and the Monte San Giorgio (2003). The first is an extensively glaciated alpine landscape in the Canton of Berne and the Canton of Valais, and it covers an area of 53,888 hectares (<http://www.unep-wcmc.org/sites/wh/jungfrau.html>). It includes a natural forest reserve (the “Aletschwald”, with an area of 245 ha). The Monte San Giorgio site is a unique geological and palaeontological site with an area of 2,238 ha, situated in the Canton of Ticino, adjacent to the Italian border (<http://whc.unesco.org/sites/1090.htm>). Both sites are included in the inventory of landscapes and natural monuments of national importance. An extension of the Jungfrau-Aletsch-Bietschhorn site into the Aare Glacier and the Blüemlisalp mountains is planned. For the Monte San Giorgio site, an extension into neighbouring Italy is under discussion (Küttel 2004, personal communication). A third region of Switzerland has been proposed as a *UNESCO World Natural Heritage Site*, namely the “Glarner Hauptüberschiebung”, which is a 20 km long thrust fault of key importance for geological explanations of the genesis of the Alps.

3.2. Selection criteria and representativity

In the early days of nature conservation, under the influence of the movement for the protection of cultural heritage, aesthetic criteria were considered important for selecting protected sites. In those days, scientific criteria were not usually formulated explicitly, but were based on the opinion of experts. The experts who evaluated whether sites were to be considered worthy of and suitable for protection were

considered to be knowledgeable in their fields of study. Beginning in the 1980s, several federal inventories, such as those for alluvial sites and mires, were revised and the designated areas were analysed using more scientific criteria (Kohli 2004, personal communication; Küttel 2004, personal communication). The need for standardised scientific criteria as a basis for the evaluation and designation of protected areas has been stressed in recent literature on nature conservation (Scherzinger 1996).

Recently, the minimum area needed to ensure natural development and succession processes in *Natural Forest Reserves* has been discussed (Indermühle et al. 1998, Scherzinger 1996, Horat 2002). However, there is still only a weak scientific basis for defining the minimum area of *Natural Forest Reserves* in different types of forest. For Switzerland, Indermühle et al. (1998) defined the minimum area for natural forest reserves as 20 ha.

In recent studies GIS spatial data and GIS data on flora and fauna are used to localise biodiversity hotspots and to analyse sites for protected areas. Kienast (2003) used such an approach to find potential, unfragmented regions for new large-scale protected areas (“Grossschutzgebiete”) in Switzerland. A similar approach will be used in the Swiss Forest Programme (Projektleitung WAP-CH *et al.* 2004) to find priority sites for biodiversity enhancement (Bolliger 2004, personal communication).

As many protected areas were established before 1980, it is not always possible to quote a set of scientific criteria that led to their selection. The criteria for the different types of protected area, given in appendixes 1a and 1b, are therefore a mixture of “expert” criteria, scientifically based criteria and administrative / political criteria. The criteria are taken from the national protection ordinances and other legal documents. The application and weight of specific criteria depends on the local conditions and the authorities responsible. A poll carried out by the WWF revealed that the application of criteria for the selection of forest reserves varied considerably between cantons (WWF 2004).

The most important criterion used by all cantons to evaluate possible *Forest Reserves* is the vegetation type (forest association) (WWF 2004). In many cantons detailed maps of forest associations are available for the whole of the forest, in others mapping is in progress. Vegetation maps are one of the fundamentals for (regional) forest management plans and the basis for near-natural silviculture. It is an aim of Swiss policy on forest reserves that rare, typical and

widespread forest associations are to be represented in the protected areas. The application of other criteria depends on the type of forest reserve and on specific conservation aims (occurrence of rare species, special landscape features, traditional systems of forest use, undisturbed development). The weight given to the “minimum size” criterion depends particularly on the specific objectives.

3.3. Surveys and Monitoring

The main survey of the state of Swiss forests is the *National Forest Inventory* (NFI). In over 6,000 systematically distributed plots, information on the state of forest (excluding forest health) is recorded every 10 years (Brassel & Brändli 1999, <http://www.lfi.ch>).

Sanasilva assesses forest health on a yearly basis in a 16x16 km sub-grid of the National Forest Inventory (*Sanasilva*, <http://www.wsl.ch/forest/risks/ssi/ssireults/ssi02/ssi02-de.ehtml>). The NFI grid has also been used for soil and vegetation surveys (<http://www.wsl.ch/forest/risks/projects/chvege/chvege-de.ehtml>).

The *long-term WSL permanent growth and yield sites* provide data on long-term forest development. Periodically, 180 sites are assessed in various forest types under different silvicultural methods. Several sets of data date back to the 19th century (WSL 2002).

The *Long-term Forest Ecosystem Research project* was established in 1994 and is a monitoring and research network with special emphasis on ecosystem functioning. Research and monitoring is carried out jointly by WSL and the SAEFL. Its mission is to improve the understanding of forest ecosystem processes through the long-term study of selected forest plots (17 research platforms). Particular emphasis is placed on the possible effects of air pollution and climate change on forest ecosystem processes (Thimonier et al., 2001; <http://www.lwf.ch/>).

The *Spatial Statistics* and *Landscape under Pressure* programmes periodically analyse land use changes using aerial photographs and topographical maps.

The main national programme for monitoring biodiversity is *Biodiversity monitoring Switzerland* (BDM-CH). It provides information on the occurrence of and threat to plant and animal species in forest and agricultural habitats (http://www.biodiversitymonitoring.ch/eng/hauptseite_frameset.html).

All the monitoring programmes mentioned above treat protected and unprotected areas the same. In

addition, there are monitoring programmes for specific types of protected areas. The *monitoring of ETH Forest Reserves* was established primarily to determine appropriate techniques for near-natural silviculture from the dynamics of unmanaged forests (Leibundgut 1966). For mires (*Raised Bogs and Fenlands*) an extensive monitoring programme of field investigations started in 1997 (WSL 2004). In the *Swiss National Park*, long-term studies by researchers from different disciplines ensure that there is detailed monitoring (Swiss Alpine Studies 2004). In *Game Sanctuaries*, the densities of game species are counted annually. The densities of selected groups of animals (especially birds) are also counted regularly in *Reserves for Water Birds and Migratory Birds* and on *Ramsar sites*.

For certain other types of protected area, monitoring programmes have not yet been established but they are in the planning stage and will be launched within the next few years. This applies to *Forest Reserves* (Liechti & Burger 2004), *Alluvial Zones* (co-ordinated by the Advisory centre for the protection of *Alluvial Zones*, <http://www.auen.ch>) and *Amphibian Spawning Areas* (Co-ordination centre for the protection of amphibians and reptiles, <http://www.karch.ch/>).

Some types of protected area do not have a monitoring programme (with a standardised set of parameters) but there are periodical assessments (*Stands for Seed Harvesting*: reporting to the OECD; *FSGIs*: evaluated by the forest authorities; *FIL sites*: evaluated by federal agencies⁹). For *Biosphere Reserves* and *UNESCO World Natural Heritage Sites* reporting to UNESCO is required every 10 years.

Biological assessments and monitoring programmes with a focus on specific taxonomic groups are important for species protection. They are not limited to protected areas but can be used for the management or evaluation of protected (forest) sites. An example is the monitoring of breeding birds co-ordinated by the “Schweizerische Vogelwarte Sempach” (<http://www.vogelwarte.ch/>). The collection of data on the distribution of animals throughout Switzerland is co-ordinated by the “Centre Suisse de Cartographie de la Faune” (<http://www.cscf.ch/anglais/1WELCOME.ASP>). Data on plant distribution is collected by the “Centre du Réseau Suisse de Floristique” (<http://www.cjb.unige.ch/rsf/deu/maindeu.htm>). Distribution maps of more than 2,600 plant species are displayed in the Swiss Web Flora (<http://www.wsl.ch/land/products/webflora/welcome-en.ehtml>), a product of

⁹ see Parlamentsdienste 2003

WSL. The maps are based on an inventory conducted in 1967-79, which collected information of species occurrences in 593 contiguous mapping areas nationwide.

The main national surveys relevant for protected forest areas are listed in appendix 2.

3.4. Landscape, spatial relationships, and other considerations

Forests are a major element of Swiss landscapes. The maintenance of their spatial extent and quality is ensured by the Federal Forest Law (WaG 1991). The primary importance of maintaining the total area of forest, as stipulated in the Forest Law, has effects on spatial planning and the character of the landscape, particularly in densely-populated parts of Switzerland.

The area of forest in Switzerland has increased in recent decades (Brassel & Brändli 1999), due to factors such as a reduction in the intensity of agriculture in the Alps. This may have a detrimental effect on the appearance of the landscape or certain types of biotope. Therefore, the need to maintain the area of forest is currently under discussion (Projektleitung WAP-CH *et al.* 2004).

Some aspects of landscape protection are regulated in the laws on nature and landscape. These laws consider landscape and all its components, including forests. Forest is conserved in different types of protected area such as *Landscapes and Natural Monuments of National Importance*, *Alluvial Zones*, *Mire Landscapes*, *Biosphere Reserves* and *UNESCO World Natural Heritage Sites*. These protection categories cover a substantial proportion of Switzerland and of the Swiss forest. However, the legal protection is rather weak and, in some cases, the separation of nature and landscape conservation from forestry, in the legislation and within the administration, inhibits the use of an integrated approach.

Two instruments, the Swiss Forest Programme (Projektleitung WAP-CH *et al.* 2004) and Landscape 2020 (BUWAL 2003c), are used to overcome shortcomings resulting from legislative and administrative separations and to provide general guidelines. The Swiss National Forest Programme is a federal action programme that defines and coordinates the Swiss Confederation's forest-related activities for the period 2004-2015. Protective forests and the conser-

vation of biodiversity in clearly defined areas are among the priorities. Currently criteria and indicators for aspects of biodiversity are being developed and regional hotspots for biodiversity protection will be defined. The federal government will use its financial resources to support conservation in these hotspots. Landscape 2020 is an integrated strategy for the development of Swiss landscapes until the year 2020 (BUWAL 2003c). It is binding for governmental bodies at the federal level. Changes in the landscape are monitored using a set of criteria and indicators. Forests are included in this strategy.

In practice, various instruments for landscape planning exist. The legal basis is the Federal Law on Spatial Planning, which came into force in 1980 (RPG 1979). It commits the federal government, the cantons, and the municipalities to a foresighted use of land and controlled planning of settlements in Switzerland (BUWAL 2003a). The cantons have to present the targeted spatial development within the canton and the co-ordination between cantons in their cantonal master plans ("Richtpläne"). The area of forest, valuable habitats and migratory pathways for animals are considered (BUWAL 2003a). In landscape development plans ("Landschaftsentwicklungskonzept") regions and municipalities (and in some cases cantons) present guidelines for landscape development.

The aims of the national ecological network REN (Réseau écologique national) and of the Emerald programme are to integrate sites of different protection categories. REN was launched in 1999. Its aim is to pinpoint and ensure the spatial connections between areas that are valuable for nature conservation. The ecological corridors for migrating animals¹⁰ and the whole forest area of Switzerland have been integrated in this project. The network provides guidelines for cantonal authorities in nature conservation and helps them to spread financial support for landowners effectively. It forms a basis for the master plans and landscape development plans with regards to spatial aspects of nature conservation (BUWAL 2003b). Whereas the network focuses on the spatial links between protected areas, Emerald provides the nodes of the network. "The aim of the Emerald programme is to designate a network of areas of special significance for the conservation of habitats threatened within Europe and of the species whose habitats require special protection" (Delarze *et al.* 2003). The Emerald

¹⁰ In a recently published study 303 ecological corridors for migrating animals were described (BUWAL 2001 c). These corridors are considered in transport planning and road maintenance (BUWAL 2003 a). Since the 1990s, "overpasses" and underground crossings for migrating animals have been built in Switzerland.

programme is conducted in countries of the European Council, which are not part of the European Union (EU). In EU countries there is the Natura 2000 programme, which differs only in minor points from the Emerald programme. The Emerald programme and REN are the Swiss contributions to the Pan-European Ecological Network (PEEN). The results of REN will be published in 2004.

The mosaic of land-use forms and a dense population results in conflicts between different interest groups. Tourists and sportsmen cause the most relevant conflicts in Swiss protected forests. Intensive recreational use is a serious problem, especially in scenic parts of the Alps. The establishment of a new protected area often leads to conflicts with the local population, tourism, industry and agriculture. Conflicts can arise between representatives of nature conservation and of forestry because timber extraction is often restricted in protected forests. On the other hand, in many protected areas the only restriction on forestry is that management must be near-natural, which is not a severe restriction for forest owners. The building of forest roads was the source of much discussion in the past. Nowadays most roads are built, thus this conflict is less significant. There is a classical conflict between hunters, who want to maintain high densities of game, and foresters, who need low ungulate densities for natural regeneration to occur. This has been a problem, especially in and around *Game Sanctuaries* and may be a problem in *Natural Forest Reserves*. Another type of conflict may arise in sites belonging to more than one type of protected area. Different conservation objectives may cause conflicts in forests that are both *Amphibian Spawning Areas* and *Alluvial Zones*, or *Forest Reserves* and protective forests. Regardless of the reason for conflicts, in all cases information and negotiations are the first step before any form of lawful regulation is established. The payment of compensation and agreements between interest groups (e.g. marked tracks for cross-country skiing) are often sufficient to resolve conflicts. Instruments to solve these conflicts include landscape development plans and regional forest management plans. These plans are developed with the participation of all stakeholders.

3.5. Future developments

The future development of protected forest areas in Switzerland will be determined by the implementa-

tion of the new national strategies for nature conservation and forestry, which have been introduced in recent years. The Swiss National Forest Programme makes detailed recommendations for forests and the new subsidy regulation will be used to push forest management in a direction that is beneficial for nature conservation and the maintenance of biodiversity (BUWAL 2002b). Other recommendations include a further increase in the area of forest reserves to 10 % of the total area of Swiss forest, the establishment of forest areas where biodiversity has priority and the definition of standards for near-natural forest management in the forest legislation.

Landscape 2020 (BUWAL 2003c) gives overall guidelines and a vision of the future development of the Swiss landscape.

There are plans to create new types of protected area during a revision of the Federal Law for the Conservation of Nature and Cultural Heritage. The planned *Regional Nature Parks* will be selected according to the criteria of natural scenery, cultural value and ecological diversity. The proposed *Nature Experience Parks* will be close to urban areas and have a core zone with a high degree of naturalness. New *National Parks* are planned, consisting of a core zone where nature is left to itself and a surrounding zone where the cultural landscape is managed in a near-natural way. The proposed revision of the Federal Law on the Conservation of Nature and Cultural Heritage was rejected in spring 2004 but it is scheduled to be discussed again in the current legislative period. The designation of new protected areas belonging to these categories allows financial support to be provided for large protected areas. In general, the revision will improve the existing legal basis for protected areas in Switzerland.

New impetus for protected forest areas in Switzerland is given by international programmes such as the Emerald network, the initiative of Pro Natura to create a new National Park and the certification of forest and timber. The political and financial situation will determine whether planned activities can be put into practice.

Currently, budgets for forestry and for the protection of nature and of landscape are being cut drastically at the national, cantonal and communal levels. This will lead to delays in the implementation of new protected forest areas and the maintenance of existing protected forest areas. As diverse legislations and different administrations deal with protected forest areas, there is no consistent national strategy. A co-ordinated strategy regarding protected forest

areas, the protection of biodiversity and efficient monitoring of the effects of protection measures will be necessary to ensure political support and the necessary finances. To minimise the negative effects of the financial cuts, it is crucial that national activities be co-ordinated and priorities set.

4. References

Laws and ordinances

- AlgV, 2001: Verordnung vom 15. Juni 2001 über den Schutz der Amphibienlaichgebiete von nationaler Bedeutung (Amphibienlaichgebiete-Verordnung; AlgV), SR 451.34.
- Auenverordnung, 1992: Verordnung vom 28. Oktober 1992 über den Schutz der Auengebiete von nationaler Bedeutung (Auenverordnung), SR 451.31.
- Bundesbeschluss UNESCO, 1975: Bundesbeschluss vom 19. Juni 1975 über zwei Übereinkommen der UNESCO betreffend Schutz des Kultur- und Naturgutes und Erhaltung der Feuchtgebiete, SR 451.41.
- Bundesverfassung, 1999: Bundesverfassung der Schweizerischen Eidgenossenschaft vom 18. April 1999, SR 101.
- Flachmoorverordnung, 1994: Verordnung vom 7. September 1994 über den Schutz der Flachmoore von nationaler Bedeutung (Flachmoorverordnung), SR 451.33.
- Hochmoorverordnung, 1991: Verordnung vom 21. Januar 1991 über den Schutz der Hoch- und Übergangsmoore von nationaler Bedeutung (Hochmoorverordnung), SR 451.32.
- JSG, 1986: Bundesgesetz vom 20. Juni 1986 über die Jagd und den Schutz wildlebender Säugetiere und Vögel (Jagdgesetz, JSG), SR 922.0.
- JSV, 1988: Verordnung vom 29. Februar 1988 über die Jagd und den Schutz wildlebender Säugetiere und Vögel (Jagdverordnung, JSV), SR 922.01.
- Moorlandschaftsverordnung, 1996: Verordnung vom 1. Mai 1996 über den Schutz der Moorlandschaften von besonderer Schönheit und von nationaler Bedeutung (Moorlandschaftsverordnung), SR 451.35.
- Nationalparkgesetz, 1980: Bundesgesetz vom 19. Dezember 1980 über den Schweizerischen Nationalpark im Kanton Graubünden (Nationalparkgesetz), SR 454.
- NHG, 1966: Bundesgesetz vom 1. Juli 1966 über den Natur- und Heimatschutz, SR 451.
- NHV, 1991: Verordnung vom 16. Januar 1991 über den Natur- und Heimatschutz (NHV), SR 451.1.
- RPG, 1979: Bundesgesetz vom 22. Juni 1979 über die Raumplanung (Raumplanungsgesetz, RPG), SR 700.
- VBLN, 1977: Verordnung vom 10. August 1977 über das Bundesinventar der Landschaften und Naturdenkmäler (VBLN), SR 451.11.

VEJ, 1991: Verordnung vom 30. September 1991 über die eidgenössischen Jagdbanngebiete (VEJ), SR 922.31.

VFVG, 1994: Verordnung über forstliches Vermehrungsgut vom 29. November 1994, SR 921.552.1.

WaG, 1991: Bundesgesetz vom 4. Oktober 1991 über den Wald (Waldgesetz, WaG), SR 921.0.

WaV, 1992: Verordnung vom 30. November 1992 über den Wald (Waldverordnung, WaV), SR 921.01.

WZVV, 1991: Verordnung vom 21. Januar 1991 über die Wasser- und Zugvogelreservate von internationaler und nationaler Bedeutung (WZVV), SR 922.32.

All laws and ordinances are available in German, French and Italian from the Confoederatio Helvetica database, the Federal Authorities of the Swiss Confederation, Systematische Sammlung des Bundesrechtes: <http://www.admin.ch/ch/d/sr/45.html>.

Other references

- BIOLLAY, H., 1920: L'aménagement des forêts par la méthode expérimentale et spécialement la méthode du contrôle. Neuchâtel, Paris, Attinger Frères.
- Biosphärenreservat Entlebuch, 2004: Information on the Entlebuch biosphere reserve is available from: <http://www.biosphaere.ch/>; accessed 14 July 2004.
- BONFILS, P.; BOLLIGER, M. (Eds), 2003: Wälder von besonderem genetischem Interesse (BGI-Wälder). Bundesamt für Umwelt, Wald und Landschaft, BUWAL, Bern, 60 pp.
- BRASSEL, P.; BRÄNDLI, U.-B. (Eds), 1999: Schweizerisches Landesforstinventar. Ergebnisse der Zweitaufnahme 1993-1995. Birmensdorf, Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft. Bern, Bundesamt für Umwelt, Wald und Landschaft. Verlag Paul Haupt, Bern, Stuttgart, Wien, 442 pp.
- BROGGI, M. F., 1990: Inventar der Flachmoore von nationaler Bedeutung: Entwurf für die Vernehmlassung. BUWAL (Bundesamt für Umwelt, Wald und Landschaft), Bern, 79 pp.
- Bundesamt für Raumentwicklung, 2004: Übersicht über die raumwirksamen Tätigkeiten des Bundes 2004. Bern, 210 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 1990: Inventar der Flachmoore von nationaler Bedeutung: Entwurf für die Vernehmlassung. Bern, 79 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 1992: Inventar der Moorlandschaften von besonderer Schönheit und von nationaler Bedeutung. Final report by U. Hintermann. Schriftenreihe Umwelt Nr. 168, Bern, 215 pp. + appendix.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 1992-2002: Handbuch Moorschutz in der Schweiz. Bundesamt für Umwelt, Wald und Landschaft, Bern, 2 volumes.

- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 1993: Kartierung der Auengebiete von nationaler Bedeutung. Durchgeführt von J.-D. Gallandat, J.-M. Gobat, C. Roulier. Schriftenreihe Umwelt Nr. 199, Natur und Landschaft, 115 pp. + appendix.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 1994: Inventar der Amphibienlaichgebiete von nationaler Bedeutung - Schlussbericht. Schriftenreihe Umwelt Nr. 233, Natur und Landschaft, Bern, 75 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 1995: Kreisschreiben Nr. 19. Available from the Swiss Forest Agency, web site "Kreisschreiben": http://www.umwelt-schweiz.ch/buwal/de/fachgebiete/fg_wald/rubrik1/2001-09-21-7/; accessed 13 July 2004.
- BUWAL, 2001a: Schreiben der Eidgenössischen Forstdirektion an die kantonalen Forstdienste vom November 2001, Bern.
- BUWAL, 2001b: Zehn Prozent der Schweizer Wälder sollen Reservate werden - Medienmitteilungen. Available from the BUWAL website "Medienservice": <http://www.umwelt-schweiz.ch/buwal/de/medien/presse/artikel/20010320/312/index.html>; accessed 13 July 2004.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2001c: Korridore für Wildtiere in der Schweiz. Grundlagen zur überregionalen Vernetzung von Lebensräumen. Bern, 116 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2002a: Bundesinventar der Amphibienlaichgebiete von nationaler Bedeutung - Vollzugshilfe. Vollzug Umwelt, Bern, 75 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2002b: effort 2 Konzeptbericht: Wirkungsorientierte Subventionspolitik im Rahmen des Waldgesetzes. Umwelt Materialien Nr. 145, Wald, Bern, 118 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2003a: Umwelt 4/2003 - Planen für die Umwelt. Bern, 63 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2003b: REN - Die Vision für einen landesweit vernetzten Lebensraum Schweiz. BUWAL informiert. Faltblatt, Bern.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2003c: Landschaft 2020. Leitbild des BUWAL für Natur und Landschaft; Bundesamt für Umwelt, Wald und Landschaft, Bern, 25 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2003d: Stand der Umsetzung der Auenverordnung. Resultate der Auswertung der Kantonsbefragung Ende 2002. Leslie Bonnard und Ralph Thielen, Auenberatungsstelle. Bern und Yverdon-les-Bains, 30 pp.
- BUWAL (Bundesamt für Umwelt, Wald und Landschaft) (Ed), 2004: Strategie der Naturgefahrabwehr, unpublished report.
- CHERIX, D., 1998: Die Wissenschaftliche Nationalpark-Kommission (WNPK). Leitung und Koordination der Forschung im Nationalpark. SANW INFO 1/98. Available from the Swiss Academy of Sciences (SAS): <http://www.sanw.ch/root/presse/info/198/info198.2d.html>; accessed 14 July 2004.
- DELARZE, R.; CAPT, S.; GONSETH, Y.; GUISAN, A., 2003: Smaragd-Netz in der Schweiz – Ergebnisse der Vorarbeiten. Schriftenreihe Umwelt Nr. 347. Swiss Agency for the Environment, Forests and Landscape, Bern, 52 pp.
- DE MILLER, R., 1999: Matériaux pour l'histoire de l'environnement en Suisse. Patrimoine, écologisme et environnement (1815-1998): chronologie commentée. Documents environnement 106. Office fédéral de l'environnement, des forêts et du paysage (OFEFP), Berne. 549 pp.
- ELLENBERG, H.; KLÖTZLI, F., 1972: Waldgesellschaften und Waldstandorte der Schweiz. Mitt. Eidgenöss. Forsch. Anst. Wald Schnee Landsch., 48, 4: 587-930.
- HINTERMANN, U., BROGGI, M.F., LOCHER, R., GALLANDAT, J.-D. (1995): Mehr Raum für die Natur: Ziele, Lösungen, Visionen im Naturschutz. Ott Verlag, Thun.
- HORAT, S., 2002: Beitrag der forstlichen Planung zur Erhaltung der ökologischen Stabilität in schweizerischen Wäldern. Professur Forsteinrichtung und Waldwachstum, Departement Forstwissenschaften, ETH Zürich, 42 pp.; Available from the Swiss Federal Institute of Technology Zurich database ETH e-collection: <http://e-collection.ethbib.ethz.ch/cgi-bin/show.pl?type=bericht&nr=267>; accessed 13 July 2004.
- HOULAHAN, J.E.; FINDLAY, C.S.; SCHMIDT, B.R.; MEYER, A.H.; KUZMIN, S.L., 2000: Quantitative evidence for global amphibian population declines. *Nature* 404: 752-755.
- INDERMÜHLE, M.; KAUFMANN, G.; STEIGER, P., 1998: Konzept Waldreservate Schweiz. Schlussbericht des Projektes Reservatspolitik der Eidgenössischen Forstdirektion. 102 pp. + appendix
- KBNL, 2004: Schutzziele und mögliche Nutzungen. Available from "Konferenz der Beauftragten für Natur- und Landschaftsschutz": http://www.kbnl.ch/site/e/lebensraume/moorlandschaften/moor_dok/dok07.pdf; accessed 14 July 2004.
- KELLER, M., 2001: Aerial Photography. - In: Brassel, P.; Lischke, H. (Eds.) Swiss National Forest Inventory: Methods and Models of the Second Assessment. Birmensdorf, Swiss Federal Research Institute WSL. 45-64.
- KELLER, V., 1996: Ramsar-Bericht Schweiz. Eine Standortbestimmung zur Umsetzung des Übereinkommens über Feuchtgebiete, insbesondere als Lebensraum für Wasser- und Watvögel, von internationaler Bedeutung. Schriftenreihe Umwelt 268, Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern, 112 pp.
- KIENAST, F., 2003: Gesucht: grosse Schutzgebiete. Hotspot 7: 10-11.
- LEIBUNDGUT, H., 1957: Waldreservate in der Schweiz. *Schweiz. Z. Forstwes.* 108: 417-421.
- LEIBUNDGUT, H., 1966: Waldreservate Schweiz. *Schweiz. Z. Forstwes.* 117: 900-907.
- LEIBUNDGUT, H., 1990: Entwicklungslinien zum naturnahen Waldbau. *Schweiz. Z. Forstwes.* 141: 491-498.

- LIECHTI, T.; BURGER, T., 2004: Monitoringkonzept für Naturwaldreservate in der Schweiz (unpublished). Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern. 58 pp.
- MATTER, J.-F., 1999: Forest Reserve Research in Switzerland. In: Diaci J. (Ed.), 1999: Virgin Forests and Forest Reserves in Central and East European Countries, COST E4 Meeting, Ljubljana: 133-143.
- MÜLLER, D., 2004: Kantone zögern beim Waldschutz. WWF Magazin 2/2004: 20-21.
- Nationalpark, 2004: Information on the Swiss National Park is available from: <http://www.nationalpark.ch/snp.html>; accessed 14 July 2004.
- OECD, 2001: OECD scheme for the control of forest reproductive material moving in international trade. Available from: <http://www.oecd.org/dataoecd/23/16/2734540.pdf>; accessed 13 July 2004.
- Parlamentsdienste, 2003: Evaluation des Bundesinventars der Landschaften und Naturdenkmäler von nationaler Bedeutung (FIL). Bericht zuhanden der Geschäftsprüfungskommission des Nationalrates, Bern, den 14. Mai 2003.
- PAROLINI, J. D., 1995: Zur Geschichte der Waldnutzung im Gebiet des heutigen Schweizerischen Nationalparks. Diss. Techn. Wiss. ETH Zuerich, Nr. 11187, 227 pp.
- Pro Natura, 2004: Pro Natura Kampagne: Gründen wir einen neuen Nationalpark! – und ein Netz von grossen Schutzgebieten. Available from the website of Pro Natura: <http://www.pronatura.ch/content/nationalpark/DE/page1.html>; accessed 16 July 2004.
- Projektleitung WAP-CH; BHP - Brugger & Partner, 2004: Waldprogramm Schweiz (WAP-CH). Handlungsprogramm 2004-2015. Schriftenreihe Umwelt Nr. 363. Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern, 119 pp, Available from the website of SAEFL: <http://www.umwelt-schweiz.ch/buwal/shop/files/pdf/phpWdEobS.pdf>
- ROTACH, P., 2003: EUFORGEN - Technical guidelines for genetic conservation and use for service tree (*Sorbus domestica*). International Plant Genetic Resources Institute, Rome, Italy, 6 pp.
- SAEFL (Swiss Agency for the Environment, Forests and Landscape) (Ed), 2002: Environment-Switzerland 2002 – Policies and Outlook. Berne.
- SAEFL (Ed), 2003: Forests and Wood in Switzerland. SAEFL information. Berne.
- SAEFL, 2004a: Authorities. Available from the SAEFL website: <http://www.umwelt-schweiz.ch/buwal/eng/info/buwal/index.html>; accessed 13 July 2004.
- SAEFL, 2004b: Biological diversity / Forest reserves. Available from the SAEFL website "Forest and Timber": http://www.umwelt-schweiz.ch/buwal/eng/fachgebiete/fg_wald/rubrik2/waldinfos/vielfalt_waldreservate/index.html; accessed 13 July 2004.
- SAEFL, 2004c: Swiss federal inventory of landscapes and natural monuments (BLN) sites. Available from the SAEFL website: http://www.umwelt-schweiz.ch/buwal/eng/fachgebiete/fg_land/bln/objekte/index.html; accessed 14 July 2004.
- SAEFL, 2004d: Protective function of BLN. Available from the BUWAL website: http://www.umwelt-schweiz.ch/buwal/eng/fachgebiete/fg_land/bln/schutzwirkung/index.html; accessed 14 July 2004.
- SCHERZINGER, W., 1996: Naturschutz im Wald. Ulmer Verlag. Stuttgart. 447 pp.
- SCHMIDHAUSER, A., 1999: Entwicklung und Aktivitäten wichtiger Naturschutzorganisationen von gesamtschweizerischer Bedeutung: von ihren Anfängen bis zur Verabschiedung des Waldgesetzes 1991. Grundlagen und Materialien 99/2. Forest Policy and Forest Economics, Department of Forest Sciences, ETH Zurich, 101 pp. Available from the Swiss Federal Institute of Technology Zurich database ETH e-collection: <http://e-collection.ethbib.ethz.ch/cgi-bin/show.pl?type=incoll&nr=263>; accessed 13 July 2004.
- SCHMITHÜSEN, F., 2001: Wald- und Naturschutzpolitik: Gesellschaftliche Regelungsprozesse, politikwissenschaftliche Grundlagen und Akteure der schweizerischen Wald- und Naturschutzpolitik. Forest Policy and Forest Economics, Department of Forest Sciences, ETH Zurich, 262 pp. Available from the Swiss Federal Institute of Technology Zurich database ETH e-collection: <http://e-collection.ethbib.ethz.ch/cgi-bin/show.pl?type=lehr&nr=28>; accessed 13 July 2004.
- SCHMITHÜSEN, F.; ZIMMERMANN, W., 2002: Forests, Forestry and Forest Policy in Switzerland. Basic Information and Institutional Framework. Working Papers International Series 99/1. Forest Policy and Forest Economics, Department of Forest Sciences, ETH Zurich.
- SCHULER, A., 1987: Der Bannwald gestern und heute. Wald und Holz 68, 8: 554-558.
- SCHULER, A., 1991: Naturschutz und Forstwirtschaft: Zur geschichtlichen Entwicklung in den letzten 100 Jahren. Schweiz. Z. Forstwes. 142: 713-719.
- SCHULER, A., 2000a: Wald- und Forstgeschichte. Skript zur Vorlesung 60-316. ETH-Zürich, Departement Forstwissenschaften, Professur für Forsteinrichtung und Waldwachstum, Arbeitsbereich Wald- und Forstgeschichte. 148 pp.
- SCHULER, A., 2000b: Von der Nachhaltigkeit als Beschränkung zur nachhaltigen Entwicklung als Programm. Schweiz. Z. Forstwes. 151: 497-501.
- STEIGER, P., 1994: Wälder der Schweiz. Ott Verlag Thun. 359 pp.
- Swiss Alpine Studies, 2004: Projects. A list of research projects in the Swiss National Park is available from: <http://www.alpinestudies.unibe.ch/inhalt.html>; accessed 15 July 2004.
- Swiss Federal Statistical Office, 2002: Statistisches Jahrbuch der Schweiz 2002.
- Swiss Federal Statistical Office, 2004a: Key data. Available from the Swiss Federal Statistical Office web site: http://www.statistik.admin.ch/stat_ch/ber00/dkan_ch.htm; accessed 13 July 2004.

- Swiss Federal Statistical Office, 2004b: Swiss Statistics - 7 Agriculture and forestry. Available from the Swiss Federal Statistical Office web site: http://www.statistik.admin.ch/stat_ch/ber07/etfr07d.htm; accessed 13 July 2004.
- TEUSCHER, F.; ROULIER, C., 1994: Bundesinventar der Auengebiete von nationaler Bedeutung. Bundesamt für Umwelt, Wald und Landschaft, BUWAL, Bern.
- TEUSCHER F.; ROULIER C.; LUSSI S., 1995: Vollzugshilfe zur Auenverordnung. Vollzug Umwelt. Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern.
- TEUSCHER F.; ROULIER C.; WEBER B., 1999: Bewirtschaftungskonzept für Auenwälder. Vollzug Umwelt. Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern.
- Thimonier A., Schmitt M., Cherubini P., Kräuchi N., 2001. Monitoring the Swiss forest: building a research platform. In: T. Anfodillo, V. Carraro (eds), Monitoraggio ambientale: metodologie ed applicazioni. Atti del XXXVIII Corso di Cultura in Ecologia, 2001. S. Vito di Cadore, Centro Studi per l'Ambiente Alpino, Università degli Studi di Padova, pp. 121-134.
- UNESCO, 2002: Biosphere Information Switzerland, Parc Suisse. Available from UNESCO - MAB Biosphere Reserves directory: <http://www2.unesco.org/mab/br/brdir/directory/biores.asp?code=SWI+01&mode=all>; accessed 14 July 2004.
- UVEK, 2003: Die Wirkung des Bundesinventars der Landschaften von nationaler Bedeutung soll verbessert werden. Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation (UVEK), Pressedienst. Available from: Confoederatio Helvetica, die Bundesbehörden der Schweizerischen Eidgenossenschaft: http://www.admin.ch/cp/d/3fdd8339_1@presse1.admin.ch.html; accessed 14 July 2004.
- VON ARB, C.; ZIMMERMANN, W., 2004: Federalism. A Characteristic Element of Swiss Forest Policy. ETH Zürich, 48pp. Available from the Chair of Forest Policy and Economics, Department of Environmental Sciences, Swiss Federal Institute of Technology Zurich: <http://www.fowi.ethz.ch/ppo/PDF-Dateien/Federalism1.pdf> accessed 14 July 2004.
- WSL, 2002: Policy Paper of the Section "Silvicultural Strategies", WSL March 2002. Available from the website of the Swiss Federal Institute for Forest, Snow and Landscape Research WSL: http://www.wsl.ch/forest/waldman/Policy_Paper_Silvicultural_Strategies.pdf; accessed 16 July 2004
- WSL, 2004: Mire monitoring. Available from the Information Centre for Mire Protection, Swiss Federal Institute for Forest, Snow and Landscape Research (WSL): <http://www.wsl.ch/land/inventory/mireprot/besmos/projekte/projekte-en.ehtml>; accessed 15 July 2004
- WWF, 2004: Waldreservate: Die Kantone im Vergleich. Available from the WWF Switzerland web site: http://www.wwf.ch/images/progneut/upload/2004_06_08_Bericht%20Waldreservate_def.pdf; accessed 13 July 2004.

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Appendix 1a

Main selection criteria for PFA dedicated to biodiversity conservation

	A	B	C	D	E	F	G	H	I	K	L	M
1/ Composition												
1A. Habitat representativity	1	1	1	1	2	2	2	3	2	3	3	3
1B. Threatened and rare habitats	1	1	2	3	1	1	1	1	1	1	2	2
1C. Phytocoenotic integrity	1	1	1	1	1	1	1	2	3	3	3	3
1D. Presence of signal species	2	1	3	3	2	2	2	3	3	1	1	2
1E. Presence of red listed species	2	1	3	3	2	1	1	1	1	1	1	2
2/ Structure and function												
2A. Vertical and age structure	2	2	3	2	3	3	3	3	3	3	3	3
2B. Natural regeneration	2	2	1	1	2	2	3	3	3	1	3	3
2C. Old-growth stages	1	2	3	3	3	3	3	3	3	3	3	3
2D. Soil and hydrology integrity	3	3	3	3	1	1	2	3	2	2	3	3
3/ Landscape ecological context												
3A. Forest cover continuity over time	2	3	3	3	3	3	3	3	3	3	3	3
3B. Old-growth continuity over time	2	2	3	3	3	3	3	3	3	3	3	3
3C. Minimal area for PFA designation	1	1	1	2	1	1	1	3	3	3	3	1
3D. PFA environment and buffer area	3	2	1	2	1	1	1	2	2	3	3	2
3E. Habitat diversity within individual PFA	2	2	2	3	2	2	2	2	2	2	3	1
3F. Landform and topography	3	3	3	3	2	2	2	1	3	3	3	1
A Natural Forest Reserves, B Special Forest Reserves, C Forest of Special Genetic Importance, D Stands for Seed Harvesting, E Alluvial Zones, F Raised Bogs, G Fenlands, H Mire Landscapes, I Amphibian Spawning areas, K Game Sanctuaries, L Reserves for Water Birds and Migratory Birds, M National Park, Regional Nature Park, Nature Experience Park (Future)												
Grading: (1) primary importance, (2) incidental importance and (3) not taken into consideration												

Appendix 1b

Main selection criteria for PFA dedicated to conservation and scientific purposes

	Importance	Method for quantitative assessment (with references)
1/ Composition		
1A. Habitat representativity	1-3	Representativity is used as a major selection principle in the Forest Reserves Programme, in the Forest of Special Genetic Importance Programme and in the Stands for Seed Harvesting Programme. (Indermühle et al. 1998, Bonfils & Bolliger 2003). All forest associations in Switzerland should be represented depending on their occurrence in the biogeographical units. The forest associations in Switzerland are described and defined in Ellenberg & Klötzli (1972). In many cantons, detailed phytosociological maps - sometimes completed with soil data - are available for the whole forest area, in other cantons mapping is in progress.
1B. Threatened habitats	1(2)	"Threatened and rare habitats" is the most important criterion in all types of protected forest area. The PFA categories E, F, G, H, I, K, L are based on Federal Inventories. The biotopes were mapped and assessed in the field. Explanations on methodology can be found in the Technical Reports. The threatened and rare forest associations in Switzerland are listed in Indermühle et al. (1998).
1C. Phytocoenotic integrity	1(3)	Phytocoenotic integrity is important in Forest Reserves, Forest of Special Genetic Importance, Stands for Seed Harvesting, Alluvial sites and Raised Bogs. It involves estimating to what extent the existing composition of the vegetation corresponds to the most natural and least destroyed stands. In Forest Reserves, Alluvial Sites and Raised Bogs the evaluation is based on species occurrence and representativity (Indermühle et al. 1998, BUWAL 1993, BUWAL 1992-2002). In Forest of Special Genetic Importance the evaluation is based on genetic analysis (Bonfils & Bolliger 2003).
1D. Signal species	2-3(1)	-
1E. Red listed species	1(2/3)	The presence of red listed species is an important criterion in the designation of Special Forest Reserves and the protected forest areas mentioned in the Federal Law on the Protection of Nature.
2/ Structure and function		
2A. Vertical structure and age structure	2-3	Vertical structure and age structure are considered in the evaluation of Forest Reserves, but these criteria are not of decisive importance.
2B. Natural regeneration	1-3	Natural regeneration has to be ensured in Forest of Special Genetic Importance and in Stands for Seed Harvesting (Bonfils & Bolliger 2003). Natural regeneration is one element of near-natural silviculture in Switzerland.
2C. Old-growth stages	3(1/2)	Old-growth stages can be a decisive criterion in the designation of Natural Forest Reserves. In Special Forest Reserves this can be an important criterion in species protection programmes e.g. in protection programmes for woodpeckers.
2D. Soil and hydrology integrity	3(1/2)	-
3/ Landscape ecological context		
3A. Forest cover continuity	3(2)	-
3B. Old-growth continuity	3(2)	-
3C. Minimal area for PFA designation	1(2/3)	The minimum area for the designation of a protected forest area is used in evaluating Forest Reserves (20 hectares) and Forest of Special Genetic Importance (depending on genetic variation). In Alluvial sites (2-5 hectares), Raised Bogs (> 625 m ²), Fenland (1 hectare) and large-scale protected areas (National Park 50-100 km ² , Landscape Park 100 km ² , Nature Parks 4-6 km ² (future projects)) the minimum area contains not only forest sites but the whole habitat or landscape type (Indermühle et al. 1998; Bonfils & Bolliger 2003; BUWAL 1993; BUWAL 1992-2002, Broggi 1990; UVEK 2003).
3D. PFA environment and buffer area	1-3	The establishment of Forest of Special Genetic Importance and Stands for Seed Harvesting is also based on a sufficient distance from non autochthonous stands or from stands with timber of substandard quality (Bonfils & Bolliger 2003). In the Alluvial sites, Raised Bogs and Fenland protection types, the buffer area is an important criterion to minimize negative impacts (BUWAL 1993; BUWAL 1992-2002).
3E. Habitat diversity within individual PFA	2(1/3)	This criterion is considered in the evaluation of potential sites, but is not of decisive importance.
3F. Landform / topography	3(1/2)	This criterion is considered in the evaluation of Mire Landscapes and FIL-sites.
Grading: (1) primary importance, (2) incidental importance and (3) not taken into consideration.		

Appendix 2

Swiss national surveys relevant for protected forest areas

name	description	reference area	treatment of PFAs	spatial data	based on a national grid	permanent plots	responsible organisation	date of first inventory	frequency for repeat of survey	maps available	web-link
Swiss national forest inventory	monitoring of state and of changes in the forest	country-wide, forest area	included but not analysed in detail	yes	yes	yes	Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)	1982-1986	approx. every 10 years	yes	http://www.lfi.ch
Biodiversity monitoring Switzerland	monitoring of changes in biodiversity	country-wide, agricultural and forested land	included but not analysed in detail	yes	yes	yes	Swiss Agency for the Environment, Forests and Landscape (SAEFL)	2001	5 years	no	http://www.biodiversitymonitoring.ch
Land-use statistics	assessment of land-use using aerial photographs	country-wide	-	yes	yes	no	Swiss Federal Statistical Office	1979-1985	every 12 years, in some cases every 6 years	yes	http://www.statistik.admin.ch/statistik.admin.ch/at_ch/ber02/asch/dframe1.htm
Landscape under pressure	assessment of changes in land use using topographical maps	results from sample areas, extrapolated to the whole country	-	yes	no	no	Federal Office for Spatial Development	1972-1983	every 6 years	yes	http://www.are.admin.ch/imperia/md/content/are/are/rez/publikationen/deutsch/17.pdf
Long-term forest ecosystem research	long-term response of forests to stress	17 plots of 2 ha (case studies)	some plots are in PFAs	yes (everything with GPS reference)	no	yes	WSL	1994	continuous measurements (minutes, days, years, decades)	yes including aerial photos	http://www.wf.ch
Monitoring of long-term forest development	assessment of long-term forest development	180 selected sites	some	yes (small scale)	no	yes	WSL	19th century, depending on site	approx. 10 years but intervals differ between sites	yes	
Monitoring and evaluation of protected mires	assessment of conservation in mire biotopes	135 selected raised bogs and fenlands	yes	yes	no	yes	WSL	1997-2001	every 5 years	yes	http://www.wsl.ch/land/inventory/mireprot/besmos/projekte/versuchsanordnung-en.html
Monitoring of ETH forest reserves	assessment of forest dynamics in unmanaged forests	36 Natural Forest Reserves	yes	yes (small scale)	no	yes	Swiss Federal Institute of Technology Zurich, Department of Environmental Sciences	for selected sites first inventories in the 1950s	approx. 10 years but intervals differ between sites	yes	http://www.fowi.ethz.ch/pwb/D_PROF/englisch/index.htm

Appendix 3

Contact information about organisations dealing with protected forest areas (compiled August 2004)

Federal and cantonal governmental organisations		
Type and name of organisation	Responsibility	Link
Bundesamt für Umwelt, Wald und Landschaft (BUWAL) / Swiss Agency for the Environment, Forests and Landscape (SAEFL):	national legislation; national strategies; federal financial contributions / compensations	http://www.umwelt-schweiz.ch
Eidg. Forstdirektion / Swiss Forest Agency (SFA)	federal authority for forestry	http://www.umwelt-schweiz.ch/buwal/eng/info/buwal/organisation/abteilungen/abt_forst/index.html
Abteilung Natur- und Landschaft / Division for Nature and Landscape	federal authority for nature and landscape protection	http://www.umwelt-schweiz.ch/buwal/eng/fachgebiete/fg_land/index.html
Abteilung Artenmanagement / Division of Species Management	federal authority for species management, protection and hunting	http://www.umwelt-schweiz.ch/buwal/de/fachgebiete/fg_wild/index.html
Beratungsstelle Auenschutz / Advice center for the protection of alluvial zones	technical and scientific support for the cantons monitoring	http://auen.ch
Beratungsstelle für Moorschutz / Advice center for mire conservation	technical and scientific support for the cantons monitoring	http://www.wsl.ch/land/inventory/mireprot/
Cantonal authorities:	cantonal legislation; cantonal strategies; cantonal contributions / compensations; implementation of protected forest areas; supervision and management of protected forest areas	http://www.admin.ch/ch/e/schweiz/kantone/index.html http://www.schweizerseiten.ch/kantone.htm
Kantonsforstdienste / Cantonal forest agencies	cantonal authority for forestry	
Kantonale Fachstellen Naturschutz / cantonal offices for nature and landscape conservation	cantonal authority for nature and landscape protection	
Kant. Jagdverwaltungen / Cantonal authorities for hunting	cantonal authority for hunting	
Municipalities	planning of land use on their territory; implementation of forest and nature protection areas	http://www.schweizerseiten.ch/kantone.htm
Eidgenössische Nationalpark-Kommission / National Park Federal Commission	supervisory body of Swiss National Park	http://www.nationalpark.ch

Research organisations		
Type and name of organisation	Responsibility, activities	Link
ETH Zürich, Departement Umweltwissenschaften / Swiss Federal Institute of Technology, Department of Environmental Sciences	research monitoring	http://www.env.ethz.ch http://www.fowi.ethz.ch/
Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft (WSL) / Swiss Federal Research Institute WSL	research monitoring	http://www.wsl.ch
Universities	research monitoring	http://www.switch.ch/edu/educ_orgs.html
Schweizerische Akademie der Naturwissenschaften / Swiss Academy of Sciences	platform for multidisciplinary research and information exchange and communication among scientists, practitioners, policy-makers, and the public	http://www.sanw.ch/
Forschungskommission des Schweizerischen Nationalparks	co-ordination of research in the Swiss National Park	
Schweizerische Alpenforschung / ICAS	platform for alpine research	http://www.alpinestudies.unibe.ch/
Swiss Biodiversity Forum	platform for biodiversity research	http://www.biodiversity.ch/
Centre du Réseau Suisse de Floristique	monitoring flora and red lists	http://www.cjb.unige.ch/rsf/fra/mainfra.htm
Centre Suisse de Cartographie de la Faune	monitoring fauna and red lists	http://www.cscf.ch/anglais/2INFO_EN.HTML

Private organisations and NGOs		
Type and name of the organisation	Responsibility, activities	Link
all NGOs	lobbying in favour of or against protected forest areas; administrative appeals against decisions with negative impact for nature or environment protection	
Pro Natura	takes care of more than 700 nature protection reserves, including 62 forest reserves; lobbying for large-scale protected areas	http://www.pronatura.ch
WWF Switzerland	leadership in FSC certification; lobbying for large-scale protected areas	http://www.wwf.ch
Schweizer Heimatschutz	lobbying for landscape protection; financial support for projects	http://www.heimatschutz.ch
Schweizer Vogelschutz SVS – BirdLife Schweiz	takes care of nature protection reserves; lobbying for large-scale protected areas	http://www.birdlife.ch
CIPRA Switzerland / Swiss Commission for the Protection of the Alps	lobbying for the alpine region, the preservation of alpine natural and cultural heritage and for the Alpine Convention	http://www.cipra.org
Fonds Landschaft Schweiz	lobbying for landscape protection; financial support for projects	http://www.flis-fsp.ch
Greenpeace Switzerland	lobbying for environment and nature protection	http://www.greenpeace.ch
Mountain Wilderness Schweiz (MW)	lobbying for mountain wilderness areas	http://www.mountainwilderness.ch
Schweizerische Vogelwarte	lobbying for bird protection; monitoring bird populations	http://www.vogelwarte.ch
Schweizerischer Forstverein	lobbying for forests and multi-functional forest use	http://www.forest.ch/
Stiftung Landschaftsschutz Schweiz (SL)	lobbying for landscape protection; financial support for projects	http://www.sl-fp.ch
Waldwirtschaft Verband Schweiz	lobbying for the interests of forest owners	http://www.wvs.ch
Swiss and cantonal hunting societies	lobbying for the interests of hunters	http://www.jagd.ch/