

4th National Report on Implementation of the Convention on Biological Diversity in the Principality of Liechtenstein

December 2009



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Cover: Alpine Rhine Valley with the municipality of Balzers in the foreground (© Office of Forests, Nature and Land Management)

Summary

The evaluation of the status of biological diversity and its sustainable use in Liechtenstein does not paint a uniform picture. On the one hand, there are factors leading to the loss of habitats, such as the sprawl of built-up areas; on the other hand, efforts to protect and restore habitats have been intensified since 1990. Despite measures taken in various areas, Liechtenstein will not succeed overall in achieving the 2010 goal of stopping the loss of biological diversity. Some of the subordinate goals can be achieved, however.

Status, trends and threats

Nature and landscape

The protection of biological diversity, of natural landscapes, and of traditional cultural landscapes as well as the promotion of sustainable development constitute a horizontal task. The Nature and Landscape division serves to enforce the Law on the Protection of Nature and Landscape. Nature protection areas and forest protection areas are focused on the conservation of habitats for threatened species of flora and fauna. Together, they cover nearly 13% of the country's territory. Supplementing the protection areas, measures are also taken elsewhere to conserve habitats for animals and plants. These include the species-rich rough pastures – especially valuable habitats in the agricultural area for which cultivation payments are made. Despite the various measures, the existing biodiversity is still threatened. Liechtenstein maintains its own Red Lists containing 25% of all plants, 40% of birds, 71% of fishes, and 67% of reptiles and amphibians. Research indicates that particularly in the case of already threatened species, further encroachments are occurring.

Forest

Covering 43% of the country's territory, the forest is the largest contiguous ecosystem. A large part of the forests is situated in the mountains and on steep slopes. In many places, the forest protects settlements and transport routes at the foot of these slopes from avalanches, rockslides, and mud flows. The forest plays an important role both as a habitat and as a protection forest. Conservation of biological diversity is part of the forest management strategy. Implemented measures include natural forest management, the protection areas, and the conservation of microhabitats. The entire Liechtenstein forest is certified in accordance with the criteria of the Forest Stewardship Council (FSC). In forest protection areas, the nature conservation function enjoys priority (27% of the entire forest area). These areas are primarily in the mountains.

The evaluation of the local conditions in the forest is based on the National Forest Inventory of 1998, which will be repeated in 2010. The Liechtenstein forest is on the way toward being adapted to its natural local conditions. This is aided by natural regeneration, which is now the dominant form of forest regeneration. One consequence of this is the increase of mixed forest instead of the pure coniferous woods previously promoted at lower altitudes, even though they are not typical for those locations. The factors limiting the diversity of tree species include damage caused by game animals, which in many places interferes with or even prevents the growth of tree species typical for the location. One effect that is currently difficult to gauge is that of climate change on the composition of tree species.

Agriculture

Agriculture and alp cultivation take up most of the areas after forests, namely about 35% of the country's territory. The challenge in agriculture is posed by the segregation of utilization due to intensified use in favorable agricultural locations and the abandonment of use in less productive areas. Various measures have been undertaken to counter these developments. In the favorable agricultural settings, they aim to minimize environmental impact and to enhance extensive use. A balance of nutrients is a precondition for sustaining direct payments. 98% of farms comply with this precondition and with other provisions set out in the Proof of Ecological Performance for agriculture. The share of organic farms is 28%. To enhance the supply of less intensively utilized areas, ecological compensation areas are promoted. They cover 21% of farmland. An evaluation of the success of extensively utilized pastures has demonstrated the successes and deficits of the ecological compensation areas. To increase the positive effects on the diversity of species, it is necessary to expand the quality and networking of these areas.

In parallel with the extensification efforts in favorable agricultural settings, there is a goal of sustaining agricultural use at higher altitudes. This is aided by the cultivation of dry rough pastures and alp cultivation. Alp cultivation makes an important contribution to keeping the species-rich flower meadows of the mountain area free.

Inventories of local varieties are available to assess the conservation of the genetic diversity of cultivated plants. Conservation measures include variety-specific orchards, conservation cultivations, and seed storage. Public outreach also promotes sensitization on this topic.

Waters

The drainage of the Liechtenstein valley area in the first half of the 20th century was one of the greatest ecological changes in the country. Accordingly, it also gave rise to great remediation potential. Liechtenstein is characterized by streams, first and foremost the Alpine Rhine. The waters in the mountain area are mostly near-natural, while regulation and flood control structures and drainage of agricultural areas characterize the waters in the valley. Waste water sanitation and measures to eliminate migration obstacles have improved the situation in recent decades. The chemical quality of the water is predominantly high. Nevertheless, fish ecology studies in the valley area indicate disruptions of the species composition and population structure among indicator species, thus calling for action.

Deficits exist with respect to the runoff and structure of streams. The runoff is impacted by hydropower utilization especially in the Alpine Rhine. A drop in the groundwater table caused numerous domestic waters to dry up. Thanks to re-irrigation measures, most of these waters are now again permanent. Revitalization measures for upgrading the water morphology were also successfully implemented along numerous waters. Other improvements in this area call for social policy deliberations to balance the preservation of agriculturally useable soil and the availability of areas for water revitalization.

Mountains

The mountain area takes up a considerable part of Liechtenstein's territory. For a large number of animal and plant species, it is the only distribution area (e.g. Alpine plants, grouse, some forest communities, individual wild animal species). Since its dominant use is forestry and agriculture, mountain biodiversity is not considered separately by this report, but rather as a part of these two habitats.

Measures – Successes and obstacles

Liechtenstein is on the path toward development of a biodiversity strategy. The present report is intended to serve as a basis for preparing the biodiversity strategy. In the biodiversity-relevant sectors, development concepts and general principles already exist which take biological diversity into account. Examples include the Nature and Landscape Protection Concept for the Liechtenstein Forest, the Nature and Agriculture Development Concept, and – as an example of regional cooperation – the Alpine Rhine Development Concept.

The efforts on behalf of protection and sustainable use of biological diversity have been significantly intensified since 1990. New laws have been passed such as the Forestry Act, the Nature and Landscape Protection Act, and the Rough Pasture Ordinance.

Ordinances are used to create or expand the preconditions for paying financial compensation for services relating to the protection and use of biological resources. In agriculture, for instance, payments for ecological services have been introduced as a market-based incentive instrument. The designation of forest protection areas and the revitalization of numerous stream and river segments demonstrate Liechtenstein's efforts on behalf of protection and remediation of natural habitats. Natural cultivation in the forest is mandated by law, while it is promoted in agriculture by way of cultivation subsidies. Thanks to numerous nature studies, Liechtenstein now has sufficient basic knowledge on domestic species and habitats at its disposal. This knowledge will henceforth be used more intensively for habitat observation and monitoring.

Entrenching complex topics such as biodiversity and sustainable development in the population has proven to be difficult. Sustainable development in Liechtenstein had not yet been sufficiently discussed from an economic, social, and ecological perspective. In the field of biodiversity, understanding is lacking concerning the connection between biodiversity and ecosystem services that human beings depend on. A debate on sustainable development in Liechtenstein would be particularly important, since the overall economic framework determined by society has a greater impact on land use than isolated governmental incentive measures.

Future priorities

On the basis of the successes and deficits of existing measures to protect biological diversity, the following priorities arise for future activities:

- Develop a biodiversity strategy;
- Initiate societal debate about sustainability;
- Stronger consideration of the protection of biological diversity in land use planning;
- Expand public outreach to improve sensitization on the topic of biodiversity;
- Secure space for biodiversity (ecological core areas, networking axes);
- Evaluate international activities of Liechtenstein actors with respect to biodiversity impact.

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1 Status, developments, and threats to biological diversity

1.1 Introduction

On the occasion of the 1992 UN Conference on Environment and Development in Rio de Janeiro, Liechtenstein joined more than 150 other States in signing the Convention on Biological Diversity. Liechtenstein ratified the Convention on 18 September 1997.¹

Liechtenstein attaches great importance to international cooperation. In particular the imminent challenges relating to the protection and sustainable use of natural resources require cross-border measures in addition to national measures. Consistent implementation of measures on one's own territory plays an important role. The report illustrates what is being done in Liechtenstein, what successes have been achieved, but also what difficulties have been encountered. Liechtenstein is undertaking to develop a biodiversity strategy. The present report is intended to serve as a basis for preparing the biodiversity strategy.

1.2 Methodology

Since Liechtenstein does not yet have a definite set of biodiversity indicators, the analysis is undertaken on the basis of indicators for the individual topic areas. The report is structured according to the main habitat types in Liechtenstein (forest, farmland, waters, and mountains). In Chapters 1 and 2, the analysis is preceded by a discussion of "Nature and landscape". This section includes a cross-habitat discussion of biotopes and species that are already protected or deserving of protection. Chapter 3 first looks at economic sectors with a direct link to biodiversity as well as their sustainable use (forest, agriculture, land use planning, tourism). This discussion is followed by horizontal topics (interventions in nature and landscape, handling of genetically modified and alien species, research, education, international cooperation).

The report is based on the relevant legal texts, inventories, opinions, reports on performance reviews, research results, but also documentation on concepts and strategies in the various specialized areas.

¹ Convention on Biological Diversity (Liechtenstein Law Gazette, LGBl. 1998 No. 39)

1.3 Information on the country and biodiversity

Liechtenstein is situated between 47° 02' and 47° 16' north and between 9° 28' and 9° 38' east, on the northern edge approximately in the middle of the 1,200 km Alpine range (Fig. 1). The country is embedded between Switzerland and Austria. Natural boundaries are the Alpine Rhine to the west² and the Rätikon massif to the east. With its 160 km², Liechtenstein is the fourth-smallest sovereign State by area in Europe.

Structure of physical regions and diversity of species

Liechtenstein is structured into three physical regions with special characteristics in regard to geology, climate, exposure, and use: the Rhine Valley plain, the Rhine Valley slopes, and the mountain region (Fig. 1, Fig. 2). The Rhine Valley plain in the west covers about one third of the country's territory. It includes agricultural and settlement areas with intensively used agriculture. Adjoining the Rhine Valley plain are the Rhine Valley slopes with their steep forested mountain slopes and isolated settled terraces. They cover another third of the national territory. The final third is the mountain area behind the Rhine Valley watershed with its Alpine high valleys.

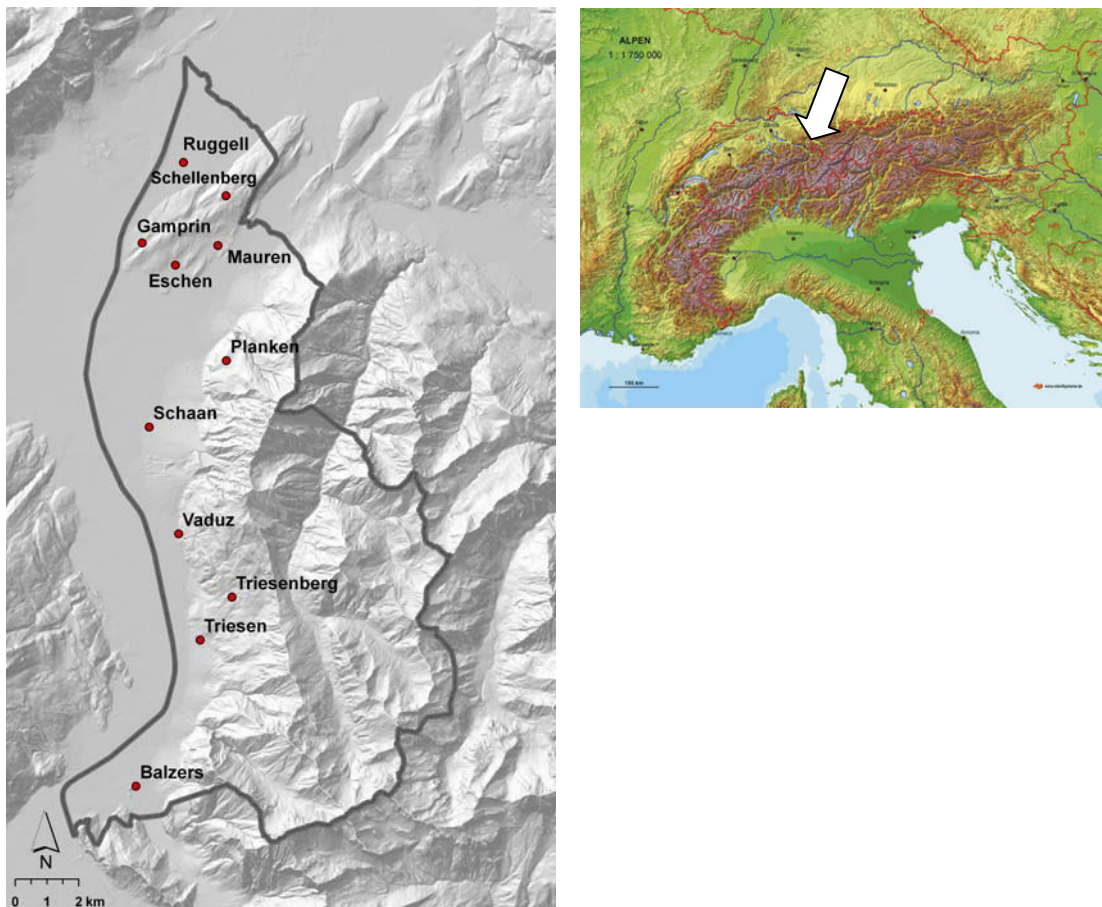


Fig. 1. The Principality of Liechtenstein (left) and its location in the Alpine range (top right) (Left figure: H. Schmuck, Data: AWNL; right figure: www.freytagberndt.de³).

² Rhine segment from Reichenau (Switzerland) to Lake Constance

³ Freytag-Berndt GmbH: http://www.freytagberndt.de/images/shop/big/LEN_ALP.JPG, 15 October 2009



Abb. 2. The physical regions of Liechtenstein: Rhine Valley plain and forested Rhine Valley slopes (left image), mountain region (right image) (Photographs: E. Ritter)

The relief in particular contributes to the diversity of the landscape. From west to east, an altitude gradient between 450 and 2,600 meters above sea level characterizes the landscape, so that plant communities occur at all altitude levels, between hilly and Alpine. Liechtenstein is located at the transition between the Eastern Alps and the Western Alps, which have different geologies. Climatically, the country is in the transition zone between the oceanic and continental climates, with about 1,000 mm of precipitation each year in Vaduz.⁴ These factors are responsible for the great diversity of flora and fauna.

⁴ Office of Statistics (2009). Statistical Yearbook of Liechtenstein 2009

Population and land use

At the end of 2008, Liechtenstein had a population of approximately 35,000. The population density was about 220 per km². The area of the country is 160 km², of which 43% are forests, 35% agricultural and alp areas, 10% settlement areas, and 12% non-productive land (Fig. 3)⁵. Not counting forests, non-productive areas, and alp pastures, about 52 km² are inhabitable, which increases the effective population density to about 680 per km².⁶ The population of Liechtenstein has more than doubled since 1960 (Fig. 4).

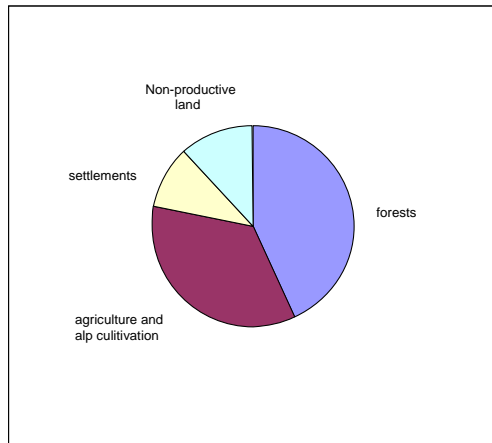


Fig. 3. Land use in Liechtenstein

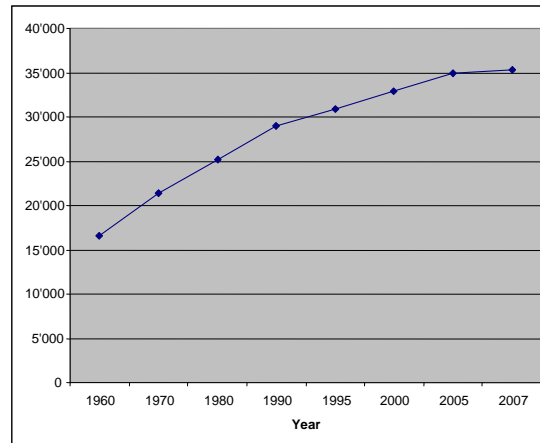


Fig. 4. Population development in Liechtenstein since 1960⁷

The landscape development differs heavily in the three physical regions of the Rhine Valley plain, the Rhine Valley slopes, and the mountain area. In the topographically and climatically favored Rhine Valley plain, the development since the Second World War has been marked by intensified and mechanized agriculture, sprawling construction for settlements and transport infrastructure, and regulation and flood control structures and drainage of agricultural areas. This development has also included the lower altitudes of the Rhine Valley slopes. The higher altitudes and the mountain region have largely been spared intensification, however. Threats to biological diversity in those areas instead tend to arise from abandonment of use and the resulting fallowing of marginal yield areas, since extensive agriculture heavily contributes to the conservation of biodiversity. With the segregation of use – intensification on the one hand and abandonment of use on the other – the situation in Liechtenstein is comparable to other regions in the Alps.

⁵ Ulmer (2000). Liechtenstein National Forest Inventory 1998; Office of Statistics (2007) Agricultural Statistics 2007; Government of the Principality of Liechtenstein (2002). Areal Statistics of the Principality of Liechtenstein

⁶ Government of the Principality of Liechtenstein (2009). Spatial Planning Report 2008

⁷ Office of Statistics (2009). Statistical Yearbook of Liechtenstein 2009

1.4 Nature and landscape

As is typical for the densely settled Alpine region, Liechtenstein's landscape presents itself as a cultural landscape influenced by human beings for centuries. The responsibility of nature and landscape protection today is not only to conserve the remaining natural landscapes, but also the cultural landscapes rich in structure and species. The protection of biological diversity, natural landscapes, and traditional cultural landscapes as well as the promotion of sustainable development are a horizontal task. The Nature and Landscape division of the Office of Forests, Nature and Land Management serves to enforce the Law on the Protection of Nature and Landscape.⁸ The concrete measures to protect biological diversity include the protection of biotopes in the form of protection areas, the conservation of habitats outside the protection areas, and measures to promote species. Hunting is used to regulate the population of huntable wild animals.

Status and trends

Protection areas

There are four categories of protection areas in Liechtenstein: nature protection areas, forest protection areas, the plant protection area, and landscape protection areas (Table 1). Nature and forest protection areas are the two most strictly protected categories, with a focus on the conservation of habitats for threatened animal and plant species. They are protected by law or ordinance and include the goals of conservation and development. They cover an area of 2,045 ha, which corresponds to 13% of Liechtenstein's territory.

The nine nature protection areas are largely wetlands and are situated in the Rhine Valley. They serve to protect swamps and waters. The largest nature protection area, the Ruggeller Riet (93 ha), is the most significant bird breeding area in Liechtenstein and is a wetland of international importance (Ramsar wetland no. 529, 06/08/1991).

The 30 forest protection areas, which include forest reserves and special forest areas (Chapter 1.5) are mainly located at higher elevations as well as along the Rhine (remainders of former alluvial forests) (Fig. 5).

The Liechtenstein mountain area is a contiguous plant protection area intended to help preserve mountain flora and the appearance of the landscape. The protection provisions are less stringent than in the nature and forest protection areas. In addition, 28 landscape protection areas are included in the Inventory of Nature Priority Areas.⁹ The inventoried landscapes are of exceptional importance due to their natural scenery or their cultural-historic value. The Inventory serves as instructions for authorities and must be taken into account by land use planning within the scope of responsibility of the municipalities and the State. They do not provide any more expansive legal protection, however (Tab. 1).

⁸ Law on the Protection of Nature and Landscape (LGBl. 1996 No. 117)

⁹ Broggi et al. (1992). Inventory of Nature Priority Areas

Table 1. Categories of protection areas in Liechtenstein.

Designation	Type of protection	Year of establishment	Area [ha]	Share of national territory [%]
Nature protection areas	Legal ¹⁰	1961 – 1978	166	1
Forest protection areas	Legal ^{11 12}	2000	1,879	12
Plant protection area	Legal ¹³	1989	6,246	39
Landscape protection areas	Inventory with instructions for authorities	1996	1,557	10

Except for isolated expansions, the nature protection areas were established in the 1960s and 1970s. The Inventory of Nature Priority Areas still includes various small-scale biotopes that should be placed under protection. There is no additional need for action with respect to the designation of forest protection areas. The forest areas included in the Inventory of Nature Priority Areas were almost all placed under protection by ordinance in 2000.

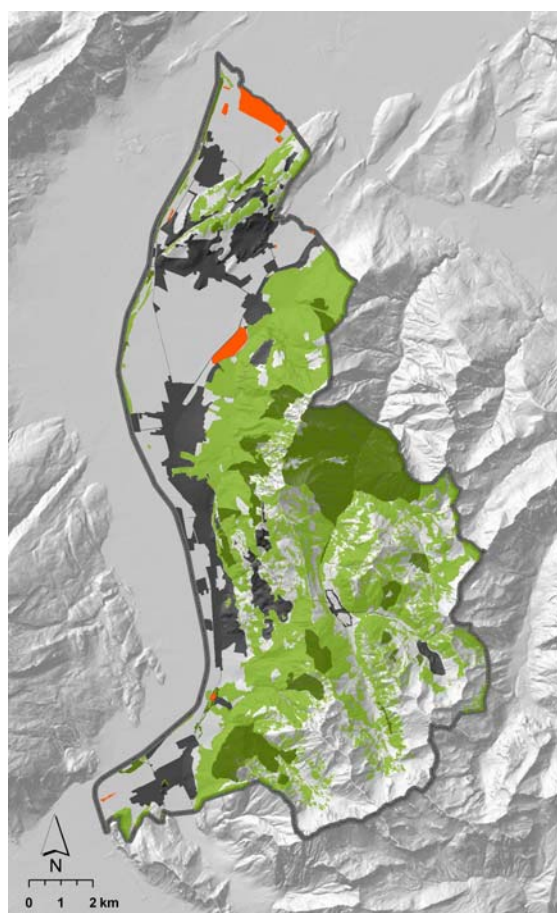


Fig. 5. Distribution of protection areas. Forest protection areas (dark green) are mainly in the mountains, nature protection areas (red) in the Rhine Valley plain (forest (light green), settlements (black)); Illustration by H. Schmuck, data: AWNL).

¹⁰ Law on the Protection of Nature and Landscape (LGBl. 1996 No. 117)

¹¹ Forestry Act (LGBl. 1991 No. 42)

¹² Ordinance on Forest Reserves and Special Forest Areas (LGBl. 2000 No. 230)

¹³ Ordinance on the Protection of Mountain Flora (LGBl. 1989 No. 49)

Rough pastures

Conservation of animal and plant species in Liechtenstein is not possible with protection areas alone. Accordingly, measures are also undertaken outside the protection areas to conserve habitats for animals and plants. The inventory of rough pastures worthy of conservation covers wet bedding meadows, moors, and dry meadows. The most important locations, other than the wet meadows, are the species-rich, dry, rough pastures. These are traditionally extensively-used, late-mown pastures on steep slopes. Nowadays, cultivation agreements are concluded on the basis of the Law on the Protection of Nature and Landscape. Of approximately 125 ha included in the inventory, 105 ha or 84% were covered by agreements for biotope-appropriate use in 2009.¹⁴

Species and habitat development

Liechtenstein has species-rich fauna and flora (Tab 2.). The richness in species is due to its location in the Alpine Rhine Valley. This valley is a border region in terms of geology, geobotany, and zoogeography. This is where the Eastern and Western Alps come together and the range of Eastern Alpine and Western Alpine flora and fauna overlap. Liechtenstein maintains its own Red Lists corresponding to the IUCN criteria and taking account of the particular small-scale circumstances. Despite the legal foundations, which have existed for decades and have repeatedly been adjusted, certain groups of species are threatened, some of which acutely: 25% of plants, 40% of birds, 71% of fishes, 67% of reptiles, and 67% of amphibians are included in the various categories of the Red List.

Table 2. Species numbers of selected plant and animal groups in Liechtenstein. For purposes of comparison, the corresponding species numbers in Switzerland are also provided (modified RENAT (2005), ENL Supplement 2).

Species group	Country	Species	Source
Plants	Liechtenstein	1,500	Waldburger et al. (2003)
	Switzerland	2,700	Landolt (1991)
Mammals	Liechtenstein	47	Estimated, updated inventory in preparation
	Switzerland	59	BDM (as of 2009) ¹⁵
Bats	Liechtenstein	19	Hoch (2001)
	Switzerland	30	BDM (as of 2009)
Breeding birds	Liechtenstein	134	Willi (2006)
	Switzerland	175	BDM (as of 2009)
Reptiles	Liechtenstein	7	Kühnis (2006)
	Switzerland	15	BDM (as of 2009)
Amphibians	Liechtenstein	10	Kühnis (2002)
	Switzerland	18	BDM (as of 2009)
Fishes	Liechtenstein	26	Bohl et al. (2001), Bohl et al. (2004)
	Switzerland	54	BDM (as of 2009)

Threats are becoming apparent due to an increase in settlement areas and infrastructure, as well as increasingly intensive use of the landscape for recreation and leisure. Consequences include the loss,

¹⁴ Verbal information by Josef Schädler (Office of Forests, Nature and Land Management)

¹⁵ Biodiversity Monitoring Switzerland: Knowledge, Species numbers, www.biodiversitymonitoring.ch, Status November 2009

dissection, and fragmentation of suitable habitats.¹⁶ It is also the case that changes in nature protection areas and other ecologically valuable areas are taking place that may mean a deterioration in quality for certain species. For instance, vegetation surveys in the largest nature protection area in Liechtenstein, the Ruggeller Riet wetland, show desiccation tendencies and an increase in eutrophication. This especially threatens nutrient-poor plant communities.

To counter these developments in the landscape, various measures have been undertaken in recent years to upgrade habitats (e.g. revitalization of streams, ecological compensation areas in agriculture). But despite these measures, a deterioration of the situation of threatened species and species with special habitat needs has been noted. Habitat upgrades tend to favor species that are not threatened.¹⁷

Birds are one example for which comprehensive data is available. Overall, the proportion of threatened breeding birds (RE-VU¹⁸) has declined, but a comparison of the individual threat categories shows a trend toward greater threat for the species listed. Accordingly, the number of extinct, critically endangered, and endangered species has risen, while the number of vulnerable species has declined.¹⁹ With respect to plants, the threat differs considerably depending on the habitat. The lowest proportion of species on the Red List can be found in the forest and the mountains. In contrast, the locations of marsh plants and rough pasture plants are significantly more isolated today than even 50 years ago.²⁰

Hunting

Huntible ungulates and other huntible animals should be preserved a part of the Liechtenstein living environment. Since the 1960s, the development and utilization of the landscape has steadily increased.²¹ Today, only the forest remains as a large-scale wild habitat. Despite the intensive use of the landscape, Liechtenstein has large populations of huntible ungulates (red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*) and chamois (*Rupicapra rupicapra*)). Particularly in the case of red deer, the observed browsing and peeling damage, despite hunting, indicates populations above the natural habitat capacity. Other information on the forest-game problem is included in the chapters on the forest (Chapters 1.5, 2.2).

¹⁶ RENAT (2005). Development Concept for Nature and Agriculture: Module 1, Nature and Landscape

¹⁷ RENAT (2005). Development Concept for Nature and Agriculture: Module 1, Nature and Landscape

¹⁸ IUCN categories: RE (extinct in Liechtenstein), CR (critically endangered), EN (endangered), VU (vulnerable)

¹⁹ Willi (2006). Birds

²⁰ Broggi et al. (2006). Red List of Vascular Plants

²¹ Government of the Principality of Liechtenstein (2004). Environmental Report 2004

1.5 Forest

The forest is of the utmost importance to Liechtenstein. With an area of 6,866 ha or 43% of the country's territory, it is the largest contiguous ecosystem.²² The forest area has grown over the last few decades due to restrictive legislation, including a prohibition of clearing, and the expansion of the forest area to steep slopes no longer used by agriculture or alp cultivation.

Due to the topography and special geology of the county at the transition between the Eastern and Western Alps as well as the small-scale climatic variation, 55 diverse forest communities thrive in Liechtenstein.²³ The forest is the ecosystem with the second-greatest diversity of vascular plant species. 338 species or 22% of the vascular plants living in Liechtenstein are found in the forest.²⁴ Liechtenstein's distinctive mountain character becomes apparent in the location of the forests. More than half are located above 1,200 meters elevation and in locations with a gradient of more than 60%. The location of settlements and other infrastructures at the foot of forested slopes explains the significance of the forest as protection: 27% of the forests play an important or very important protective role against rockslides, avalanches, and mud flows.²⁵

The wood volume is approximately 1.7 million m³ or an average of 340 m³/ha. In the period from 1986-1998, the annual increase was about 8.5 m³/ha. In the same period, the annual usage was 7.9 m³/ha. The entire Liechtenstein forest has been certified according to the criteria of the Forest Stewardship Council (FSC) since 2001.

Status and trends

The conservation and promotion of biodiversity in the forest rest on the three pillars of near-natural silviculture, forest reserves and special forest areas, as well as small habitats worthy of protection.²⁶ According to the Forestry Act, important elements of near-natural silviculture are natural regeneration with local tree species appropriate to the location, the promotion of graded forest stand structures, and the ecological improvement of the edges of forests. The use of pesticides and fertilizer is prohibited in the forest.

The promotion of biological diversity is playing an increasingly important role. Based on an Inventory of Nature Priority Areas in Liechtenstein²⁷, areas covering 1,879 ha or 27% of the total forest area were designated forest reserves or special forest areas in 2000. The overwhelming share of forest protection areas, namely 70%, consists of forest reserves, in which all types of cultivation are prohibited. The remaining 30% are special forest areas subject to specific nature conservation and tending measures.

²² Ulmer (2000). Liechtenstein National Forest Inventory 1998

²³ Näscher & Nigsch (2000). Nature and Landscape Protection Concept for the Liechtenstein Forest

²⁴ Broggi et al. (2006). Red List of Vascular Plants

²⁵ Nigsch (2009). The Protection Forest in Liechtenstein: Concept for Preserving and Improving the Protection Capacity of the Forest

²⁶ Näscher & Nigsch (2000). Nature and Landscape Protection Concept for the Liechtenstein Forest

²⁷ Broggi et al. (1992). Inventory of Nature Priority Areas

Supplementing the protection of habitats, there have also been initiatives in recent years to conserve and promote rare tree and shrub species (e.g. bladdernut (*Staphylea pinnata*), wild pear (*Pyrus pyraster*), yew (*Taxus baccata*), crab apple (*Malus sylvestris*)).

The Liechtenstein forest is developing into a forest appropriate to its natural local conditions; this is shown by comparisons of the second National Forest Inventory in 1998 with the first survey in 1986. The deadwood share in the Liechtenstein forest is 6% or 20m³/ha.²⁸ The most important component of forest regeneration is natural regeneration at 48% (Fig. 6), followed by 29% of mixed stands arising from natural regeneration and planting and 15% of planted stands.²⁹

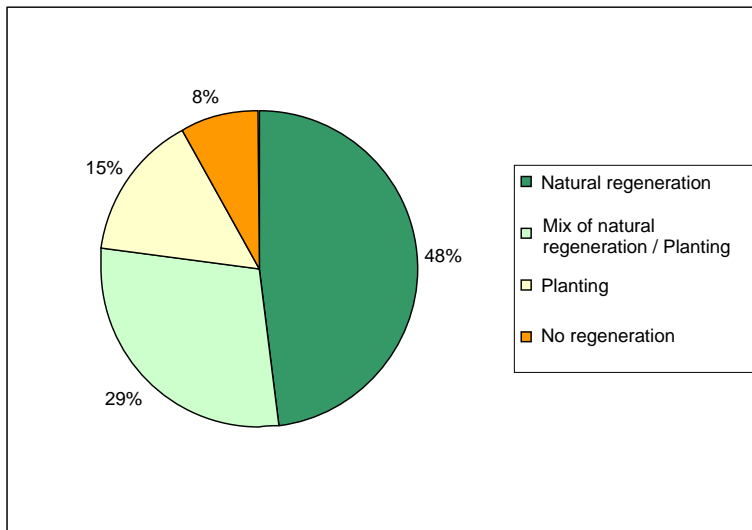


Fig. 6. Forest regeneration in Liechtenstein (as of 1998)³⁰

The 1998 inventory found 32 tree species, the most frequent of which was the spruce (*Picea abies*) with a share of 52%. The silver fir declined precipitously (*Abies alba*). Its number dropped by about 22% between 1986 and 1998, which surveys show to be due to browsing by roe deer (*Capreolus capreolus*), red deer (*Cervus elaphus*) and chamois (*Rupicapra rupicapra*).

Vegetational location mapping in 1988 assessed the share of the area covered by non-local tree species, primarily spruce grown in inappropriate locations. While the share was only 16% across the entire territory of Liechtenstein, it reached 40% in the natural deciduous forest areas.³¹ Over the last 20 years, measures have been undertaken to reduce the coniferous share in the naturally deciduous forest areas. The increase of mixed coniferous and deciduous stands at the expense of pure coniferous forests from 20% to 34% in the period from 1986-1998 confirms the effectiveness of the measures (Fig. 7).

²⁸ Research has found thresholds of 20-40 m³/ha for forest communities to conserve typical organism groups of the deadwood (Bütler et al., 2006).

²⁹ Ulmer (2000). Liechtenstein Natural Forest Inventory 1998

³⁰ Ulmer (2000). Liechtenstein Natural Forest Inventory 1998

³¹ Schmider & Burnand (1988). Forest Communities in the Principality of Liechtenstein

The share of pure coniferous forests declined from 68% to 53%, while the share of pure deciduous forests stayed the same (12%). In the same period, the share of multilayered stands rose from 25% to 56%, which underscores the structural richness. Another indication of the near-natural state of the forest is the share of red-listed vascular plant species, namely 17%, which is significantly below the average in other habitats of 36%.³²

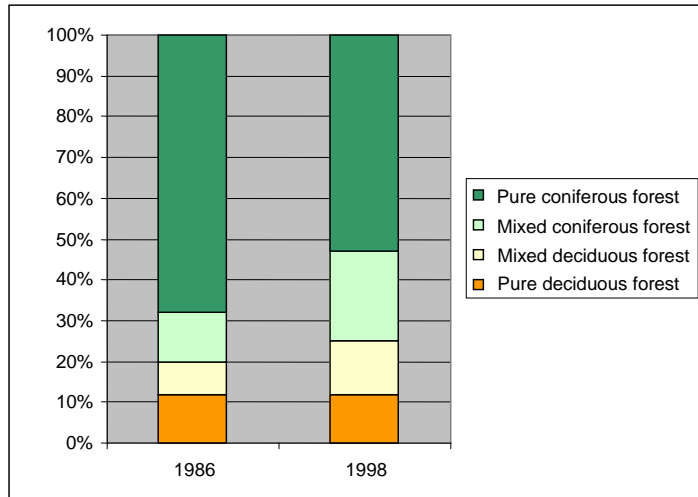


Fig. 7. Forest area by mix ratio 1986 and 1998³³

Threats

There are several threats to the near-natural forest and the sustainable performance of forest functions; of particular significance in Liechtenstein is the tendency toward overageing of stands and damage caused by browsing. Over the entire territory of the country, young forest stands are underrepresented and older stands overrepresented: the goal is to achieve a graded stand structure.

In many places, roe deer, red deer, and chamois browsing prevents the growth of silver fir (*Abies alba*) and of precious hardwoods (maple (*Acer sp.*), ash (*Fraxinus excelsior*), elm (*Ulmus glabra*), and others). The 1998 inventory, for instance, found no young silver firs in the regeneration-relevant stands in the protection forest.³⁴ The share of fir stands or stands rich in firs is far below the natural level.³⁵

There are currently hardly any difficulties with respect to invasive species. The share of alien tree species is vanishingly small (less than 0.5%). Since climatic changes only affect the forest very slowly, no immediate threat to the forest and forest functions is expected.

³² Broggi et al. (2006). Red List of Vascular Plants

³³ Ulmer (2000). Liechtenstein National Forest Inventory 1998

³⁴ Näscher (2000). National Forest Program for the Liechtenstein Forest

³⁵ Näscher & Nigsch (2000). Nature and Landscape Protection Concept for the Liechtenstein Forest

1.6 Agriculture

Agriculture utilizes a total of approximately 5,648 ha, consisting of farmland of 3,743 ha and alp pastures of 1,905 ha.³⁶ This corresponds to 35% of the country's territory. This consideration of farmland looks at alp pastures separately, since they are only used for summering during a limited part of the vegetation period. Liechtenstein agriculture is based primarily on livestock breeding, which generates 70% of agricultural revenue.³⁷ Because of cattle breeding, green areas make up the largest part of farmland at 74% (22% is open cropland).³⁸

Status und Trends

An agricultural reform was carried out in the 1990s, as a consequence of which price and income policy was decoupled and ecologizing measures were promoted. The legal foundations were created with the Direct Payments Act and the Direct Payments Ordinance.^{39 40} In addition to conservation of soil fertility, environmental impact is to be minimized and extensification achieved. In the field of ecology, the reform promotes sustainable farming, soil-conserving cultivation, and extensive cultivation of near-natural habitats.

Sustainable farming

The Proof of Ecological Performance (PEP) was introduced pursuant to the Customs Treaty with Switzerland (Chapter 3.9): a minimum share of ecological compensation area, a balance of nutrients, regular crop rotations, compliance with water protection requirements, and soil conservation measures are prescribed by PEP. This has improved the situation from the perspective of resource protection. PEP is the precondition for entitlement to direct payments and is implemented on 98% of the agricultural area (Tab. 3). In addition to the Proof of Ecological Performance, 28% of farms also meet the criteria of organic farming (as of 2007).

Table 3. Farms with Proof of Ecological Performance and organic production.

Measure	Area (ha)	Farms
Production with PEP	2630	85
Organic production	1048	35
Total areas/farms	3678	120
Farmland/farms in Liechtenstein	3743	127

³⁶ Office of Statistics (2007). Agricultural Statistics 2007

³⁷ Government of the Principality of Liechtenstein (2004). Environmental Report 2004

³⁸ Office of Statistics (2007). Agricultural Statistics 2007

³⁹ Law on Income-Supporting Direct Payments in Agriculture (Direct Payments Act) (LGBl. 1995 No. 34)

⁴⁰ Ordinance on the Direct Payments Act (Direct Payments Ordinance) (LGBl. 1996 No. 92)

Soil-conserving cultivation

Soil-conserving cultivation encompasses measures to protect soil from erosion, eluviation, and accumulation of mud as well as to protect moors and mixed soils. The measures set out in the Compensation Act⁴¹ have helped ensure that fewer moors and mixed soils are used for crops and that more soil-conserving cultivation methods are chosen.⁴²

Near-natural habitats

For the purpose of cultivating near-natural habitats, ecological compensation focuses on promoting extensive use of pastures, low-intensive use of pastures, floral fallows, bedding meadows, and rough pastures. These near-natural areas cover 789 ha and thus about 21% of farmland.⁴³ High-stem fruit trees are also supported.⁴⁴ Nearly 65% of the publically supported areas are extensive grasslands that are only allowed to be mowed after a certain date and on which the use of fertilizer and pesticide is not permitted. The ecological compensation areas were introduced into agriculture with the Soil Cultivation Act of 1992⁴⁵ and the Compensation Act of 1996. The number of ecological compensation areas then increased strongly until the end of the 1990s (Fig. 8). Since 2000, there has only been a modest increase and stabilization at around 21% of farmland.

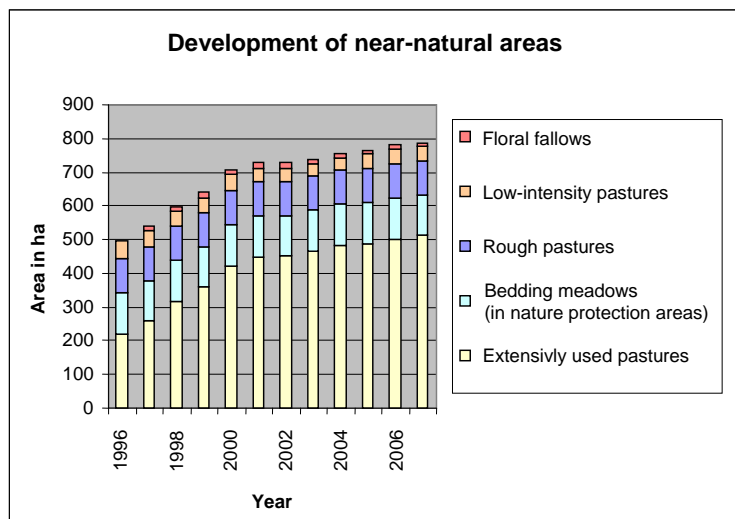


Fig. 8. Cultivated near-natural agricultural areas between 1996 and 2007 (the rough pasture and bedding meadow areas remained constant over the observed time period).⁴⁶

⁴¹ Law on Compensation for Ecological and Animal-Friendly Performance in Agriculture (LGBl. 1996 No. 70)

⁴² Government of the Principality of Liechtenstein (2004). Environmental Report 2004

⁴³ Office of Statistics (2007). Agricultural Statistics 2007

⁴⁴ Liechtenstein also has a high proportion of hedges in some parts of the valley area in the form of wind protection strips (110 ha, 2005). But only few hedges are registered for ecological compensation, since they are on public ground. Wind protection strips are therefore not included in the calculations, even though they contribute to the habitat networks.

⁴⁵ Law on the Payment of Contributions for Soil Cultivation (LGBl. 1992 No. 53)

⁴⁶ Government of the Principality of Liechtenstein (1997-2008). Annual Report of the Government (Years 1996 – 2007)

A performance review mandated by law was carried out on the extensive pastures, which make up the largest share of ecological compensation areas. The review indicates a modest improvement. The elimination of fertilizer made the pastures rougher. The diversity of plants and invertebrates increased. However, there were practically no positive effects on the rare and threatened plant and bird species.⁴⁷ The study made clear that there is still upgrade potential. In addition to the ecological quality of the areas, this also is true of their distribution. The reasons include the selection of ecological compensation areas. With the exception of the inventoried rough pasture areas, the selection is made on the proposal of farmers and in accordance with commercial considerations. A proposed measure to improve the effectiveness for species diversity is therefore to enhance the ecological quality of the compensation areas by introducing quality-dependent subsidies and better habitat networks. The habitat networks should be enhanced by coordinating the allocation of areas and by designating focus areas for the ecological continuum.

Alp pastures

Covering 1,905 ha, alp pastures take up a considerable part of the Alpine region. As near-natural habitats, they contribute to the conservation of the diverse fauna and flora. The alp pastures are situated within the plant protection area of the mountain area (Chapter 1.4). Liechtenstein's alps are well taken care of and accessible, thanks to financial subsidies for infrastructure and summering of livestock. Moreover, mountain area planning (Chapter 2.5) has led to a substantial reduction of grazing on extreme terrain and locations vulnerable to erosion. A review of grazing showed that stocking is appropriate to the terrain on nearly 90% of the areas.⁴⁸ Another positive development is the ban on nitrogenous mineral fertilizers. The previous ban on the use of herbicides was relaxed by way of ordinance to allow isolated treatment subject to approval.⁴⁹

Preservation of genetic diversity

In the field of preservation of genetic diversity, the State of Liechtenstein has supported the project "Preservation of the Genetic Diversity of Cultivated Plants in Liechtenstein" since 2001. Dedicated inventories were compiled for fruit varieties, grapevines, vegetable varieties, and specifically for "Rhine Valley corn", a regional corn variety. The focus is on fruit varieties and Rhine Valley corn as a regional specialty. 130 apple and 100 pear varieties were found in the fruit category alone. However, none of the varieties found are limited to Liechtenstein. The conservation of high-stem fruit trees is promoted via ecological compensation in agriculture. In 2007, 10,330 high-stem fruit trees were covered by cultivation agreements. Fruit varieties classified as threatened are conserved in variety-specific orchards. Corn and vegetable seed is regularly cultivated and stored in cold storage rooms. Some of the seed is also stored in the Swiss GenBank.

⁴⁷ RENAT (2008). Optimization of Ecological Compensation in Agriculture

⁴⁸ Stadler (2006). Location-appropriate Cultivation and Stocking of Alps in the Principality of Liechtenstein

⁴⁹ Alp Infrastructure Promotion Ordinance (AIFV) (LGBl. 2009 No. 198)

The HORTUS association provides a platform for variety-conservation activities. Financial support is provided by the Government and the municipalities of Liechtenstein. From 2004-2008, HORTUS was the project partner in the Interreg project "Conservation of Pomaceous Fruit Varieties in the Lake Constance Region (Switzerland, Bavaria, Baden-Württemberg, Vorarlberg) (Chapter 3.9). As part of this project, a transnational project team researched traditional regional mixed orchards and developed measures for their conservation.

Threats

Threats to biodiversity in the agricultural area arise from the potential for intensification due to good prices for products and possible expansion of infrastructures (e.g. industry, bypass roads) in the agricultural zone. The sprawl of settlements also represents a threat to the remaining high-stem fruit orchards. These orchards are often situated at the margins of today's settlements within the construction zones and are thus no longer enjoy long-term security.

1.7 Waters

In addition to the Alpine Rhine as the border river to Switzerland, three stream systems are important to Liechtenstein water management (Inland Canal, Samina, Spiersbach).⁵⁰ All three flow into the Alpine Rhine. The protection and use of the Alpine Rhine as a border river and main tributary of Lake Constance are governed by international agreements (Chapter 3.9). Other than a few small ponds (< 3 ha), there are no lakes in Liechtenstein. It is thus the streams that characterize the water system. In the mountainous part of the country, most of the streams are near-natural and oligotrophic, built up only near settlements and other infrastructures. In the valley area, regulation and structures for protection against flooding as well as the drainage of farmland have largely resulted in straight-lined streams, often with little connection to the surrounding land. For this reason, numerous measures have been undertaken in recent decades to revitalize the country's streams.

Status and trends

According to the Water Protection Act⁵¹, the goal of the country's approach to its waters is to transform them into a condition that is as near-natural as possible. In this way, the waters should be conserved as habitats for fish and other water organisms, as the Fishery Act sets out.⁵² About 80% of the standing waters, most of which are artificial, have been integrated into the nature protection areas.⁵³ In contrast, only few of the streams are included as part of the protection areas.

⁵⁰ Haidvogel & Kindle (2001). The Streams of Liechtenstein in the 19th and 20th Centuries

⁵¹ Water Protection Act (LGBl. 2003 No. 159)

⁵² Fishery Act (LGBl. 1990 No. 44)

⁵³ Broggi et al. (1992). Inventory of Nature Priority Areas

Flow, networks and morphology

A water ecology study in 1983 showed ecological deficits mainly with respect to migration obstacles, lack of flow, and insufficient water morphology.⁵⁴ In the 1990s, numerous remediation projects were carried out to eliminate migration obstacles and to rehydrate desiccated waters.⁵⁵ The result is a more continuous water system with numerous rehydrated parts. The reason for the desiccation was the dropping of the groundwater level as a consequence of intensive removal of gravel from the Alpine Rhine in the 1950s to 1970s and the resulting drop of the Rhine bed. The rehydrated stretches make up about one quarter of the permanently aquiferous water stretches in the valley area.⁵⁶ The potential for rehydration is thus largely exhausted.

The deficit today is primarily due to the low variability of the flow pattern, due to a monotone water morphology. Surveys also show that a need for action mainly exists in the valley area. Rectified streams with monotone cross-sections predominate, which is partly due to the fact that drainage trenches in agricultural areas make up the largest share of stream stretches. More than half of the streams in the valley area are heavily impacted in terms of water morphology or are even non-natural. In the rest of the country, especially in the mountain area, the predominant share of waters is in contrast near-natural or not heavily impacted (Fig. 9).

The water morphology deficits pertaining to the Alpine Rhine are a consequence of rectification and flood protection structures as well as impacts by hydroelectric power generation. Due to upstream hydroelectric plants, the water level fluctuates by up to a meter each day (downsurge/upsurge problem). Adequate residual flow volumes, also in the case of hydroelectric power generation, are specified by law (Water Protection Act).

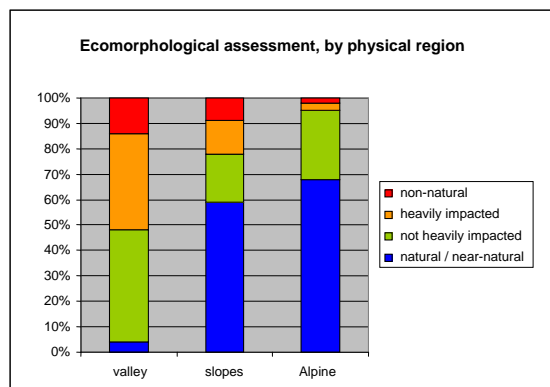


Fig. 9. Ecomorphological assessment of streams. In the valley area, 52% of the water stretches are heavily impacted or non-natural. This share declines from the slope areas to the mountain areas, where 95% of the water stretches are not heavily impacted or are near-natural.⁵⁷

⁵⁴ Broggi (1985). Ecological Inventory of Waters in the Valley Area of the Principality of Liechtenstein

⁵⁵ The desiccated waters were largely streams fed by groundwater in the area of the ballast body of the Rhine.

⁵⁶ RENAT (2006). Ecomorphology of the Streams in Liechtenstein

⁵⁷ RENAT (2006). Ecomorphology of the Streams in Liechtenstein

Chemical water quality

As a result of consistent implementation of waste water disposal, about 98% of all possible hookups are now connected to the central waste water treatment facility in Bendern. Additionally, special cultivation of stream shoulders has been carried out since 1994 with the goal of reducing the entry of nutrients from agriculture. Thanks to these measures, the ecological status of the chemical water quality of most waters is classified as high.^{58 59}

Biological water quality

Biological water status is assessed primarily on the basis of fishes, invertebrates (macrozoobenthos) and algae (phytobenthos). Phytobenthos was evaluated at two measurement points in the Liechtenstein valley area and Alpine Rhine. The Inland Canal and the Spiersbach, both inland streams, had a good ecological status with respect to phytobenthos.⁶⁰ The status of the Alpine Rhine along its Liechtenstein stretch is high. With respect to macrozoobenthos, both the Inland Canal and the Spiersbach as well as the Alpine Rhine have a moderate ecological status. Overall, deficits therefore still exist with respect to habitat quality in the valley area waters.

These findings are confirmed by surveys on the fish fauna in the valley area. The status of the surveyed inland waters in the valley area was poor.⁶¹ From a fish ecology standpoint, the Alpine Rhine in the territory of Liechtenstein and further downstream reaches the status of "bad". Although a good species spectrum exists, both the population structure and the size of the fish stock must be deemed bad.⁶²

Animal and plant species

The poor habitat quality of the waters in the valley area is seen in the threatened status of the animals and plants dependent on the water. In Liechtenstein, there are 26 fish species and 2 crayfish species as well as 54 vascular plants living in the water.⁶³ 71% of the domestic fish species and 61% of the water plants are on the Red List, and their stocks are thus threatened. A monitoring program for the fish stocks was launched in 2008.⁶⁴ For the time before that, the fishery statistics provide the most reliable information on the development trends of fish species used for fishery.

⁵⁸ The five ecological status categories according to the EU Water Framework Directive are: 1 = high, 2 = good, 3 = moderate, 4 = poor, 5 = bad.

⁵⁹ Office of Environmental Protection (2006). Chemical Water Quality of Liechtenstein Streams 2005/06

⁶⁰ Pfister & Hubmann (2008). Limnological Study of Selected Streams in Liechtenstein

⁶¹ Peter et al. (2009). Evaluation of Four Liechtenstein Water Stretches with Respect to Fish Fauna

⁶² Fishery Authorities on the Alpine Rhine (2005). Fish Ecology Survey of the Alpine Rhine 2005

⁶³ Bohl et al. (2001). Fish and Crayfish Atlas of Liechtenstein; Broggi et al. (2006) Red List of Vascular Plants

⁶⁴ Peter et al. (2009). Evaluation of Four Liechtenstein Water Stretches with Respect to Fish Fauna

The fish catch statistics show a decline in catches since the mid-80s in both of the important fishing streams, the Liechtenstein Inland Canal and the Alpine Rhine. Especially affected is the brown trout (*Salmo trutta fario*). The most prevalent fish species is still the imported American rainbow trout (*Oncorhynchus mykiss*), although its catch numbers have likewise been declining.⁶⁵

Revitalizations

Revitalizations to upgrade the water morphology have been carried out on numerous water stretches in the valley area. One milestone in regard to measures for the near-natural upgrading of streams was the revitalization of the outlets of the Liechtenstein Inland Canal (Box 1, Chapter 2.4) and the Spiersbach⁶⁶ into the Alpine Rhine. These revitalizations ensured that the connection between the inland streams and the Alpine Rhine was restored even for weak-swimming fish. Data surveys near the outlet of the Inland Canal clearly show the success of revitalization at this key spot: while only 6 fish species were recorded before the revitalization measures, the number rose to 16 in the space of less than 4 years.⁶⁷

Threats

Currently foreseeable changes and adverse effects to biodiversity mainly concern the field of hydrology. As the climate heats up, the outflow volumes may continue to decline and the water temperature may additionally rise in the summer. This leads to expectations of a shift in the species spectrum among water organisms.

1.8 Mountains

The mountain area takes up a considerable part of the Liechtenstein territory. It has maintained a large portion of its biodiversity, since the topography makes intensive use by humans more difficult. For a large number of animal and plant species, it is the sole distribution area (e.g. Alpine plants, grouse, some forest communities, some wild animal species). The mountain area is characterized by stocked areas, open farmland, and rock and detritus areas. Year-round settlements exist only in two locations. The use of the mountain area is predominantly characterized by forestry and agriculture. Accordingly, this report discusses the mountain ecosystem in the context of these two sectors. Forestry covers mountain silviculture (Chapter 1.5); agriculture covers alp cultivation and mountain agriculture (Chapter 1.6).

⁶⁵ Office of Environmental Protection (2002). Fish Catch Statistics 2002

⁶⁶ The outlet of the Spiersbach lies in the territory of the Austrian state of Vorarlberg. The revitalization was jointly planned and funded by the competent authorities in Vorarlberg and Liechtenstein.

⁶⁷ Bohl & Peter (2008). Fish Fauna Surveys for Redesigning the Outlet of the Liechtenstein Inland Canal into the Alpine Rhine

2 National biodiversity strategies and action plans

Article 6 of the CBD calls for the development of a national strategy for the conservation and sustainable use of biological diversity. Liechtenstein is undertaking to develop a biodiversity strategy. The present report is intended to serve as a basis. The legislation already in force defines strategic goals (Tab. 4). The pillars are the Law on the Protection of Nature and Landscape, the Forestry Act, the Water Protection Act, the Fishery Act, and the Agriculture Act. To implement their provisions, numerous instruments are used in the biodiversity-relevant sectors. Various inventories aim to conserve natural values. Red Lists provide information on the degree of threat to animal and plant species. Nature and forest protection areas are established to conserve flora and fauna as well as genetic diversity.

Table 4. Strategy goals for the conservation of nature and landscape pursuant to the laws in force. The list of laws is a selection (modified table according to RENAT, 2005).

Strategy goals	Provision and legal source
Conserve habitats	The habitats of all indigenous animal and plant species and of threatened species shall be conserved (Law on the Protection of Nature and Landscape, Forestry Act, Rhine Act, Bern and Bonn Convention generally, Fishery Act, Water Protection Act, Ordinance on Cultivation Subsidies for Rough Pastures, Ramsar Convention on Wetlands).
Promote/upgrade and create habitats	Promote and create habitats for indigenous species (Law on the Protection of Nature and Landscape and Bonn Convention generally; Water Protection Act; Fishery Act; Rough Pasture Ordinance).
Conserve species	All indigenous animal and plant species shall be conserved (Law on the Protection of Nature and Landscape generally; Ordinance on the Protection of Mountain Flora; Fishery Act for water fauna, Genetic Technology Act). Biological diversity shall be conserved and used sustainably (Convention on Biological Diversity).
Make processes/functions possible	Guarantee undisturbed natural process and dynamic developments (Forestry Act).
Aim for more nature in the utilized landscape	Nature-friendly forms of use shall be supported to ensure a smoothly functioning landscape household (Law on the Protection of Nature and Landscape). Near-natural habitats shall be promoted by compensating such services (Compensation Act).
Conserve landscape	The traditional landscape and near-natural landscape shall be conserved (Law on the Protection of Nature and Landscape generally, Rhine Act for the Rhine).
Conserve forest	The forest shall be conserved with respect to its area and spatial distribution (Forestry Act).
Conserve soil	The soil shall be conserved as a natural basis for life (Environmental Protection Act).

2.1 Nature and landscape

Liechtenstein has modern and comprehensive laws governing the protection and use of indigenous animal and plant species. Since 1990, numerous relevant legal provisions have been developed or modified in the field of biotope and species conservation. The main enforcement instrument in the field of nature and landscape is the Law on the Protection of Nature and Landscape of 1996 and supplementary ordinances especially on protected plant and animal species⁶⁸, the protection of mushrooms⁶⁹, the conservation of mountain flora, and the cultivation of rough pastures.

Strategies and plans

The following inventories and frameworks are available for implementation of the legal provisions:

- Inventory of Nature Priority Areas (Broggi et al., 1992);
- Rough Pasture Inventory (AWNLI, 2002);
- Habitats and Landscapes Worth Protecting within Settlements (Bolomey, 2005);
- Various species inventories (published in the series: "Nature Research in the Principality of Liechtenstein");
- Development Concept for Nature and Agriculture (RENAT, 2005);
- Forest-Game Strategy 2000 (Meile, 2000).

Development Concept for Nature and Agriculture

The Development Concept for Nature and Agriculture is being implemented as the framework for the development of natural values. The starting point for the development of the concept is the legal obligation for a nature and landscape protection concept. The goal is to present the policy tasks, development intentions, and positions in the two specialized areas of "nature and landscape" and "agriculture" and to jointly establish a vision for development.

In 2005 and 2006, the Office of Forests, Nature and Land Management and the Office of Agriculture in collaboration with external environmental specialists developed their respective policies and positions (Module 1, Nature and Landscape⁷⁰; Module 2, Agriculture⁷¹). With respect to nature, the goal was initially to illustrate tasks that arise from the nature protection legislation and the international obligations. Agriculture in turn made demands on land use. Once the foundations were established, Module 3 was initiated, which contains a synthesis of the results of Modules 1 and 2. Implementation of the projects set out therein is currently underway.

⁶⁸ Ordinance on Specially Protected Plant and Animal Species (LGBl. 1996 No. 136)

⁶⁹ Ordinance on the Protection of Mushrooms (LGBl. 2002 No. 84)

⁷⁰ RENAT (2005). Development Concept for Nature and Agriculture: Module 1, Nature and Landscape

⁷¹ Büchel (2006). Development Concept for Nature and Agriculture: Module 2, Agriculture

Consideration of successes and obstacles

Protection areas

In Liechtenstein, there are four categories of protection areas, which are weighted differently in accordance with their natural conservation value: nature protection areas, forest protection areas, the plant protection area, and landscape protection areas. Nature and forest protection areas mainly serve to protect habitats for threatened animal and plant species and are strictly protected. The plant protection area has a lower protection category (IUCN Category V) than the nature and forest protection areas (IUCN Category I-IV). The nationwide grazing of the species-rich, Alpine pastures does not meet the same nature protection requirements as the conservation measures in the nature and forest protection areas. The landscape protection areas are part of an inventory that is binding on authorities, but beyond this they are not protected by law. The two most important forms for the protection of rare and threatened species are nature protection areas and forest protection areas. Together, they cover 13% of the country's territory. In terms of area, the largest part is covered by the forest protection areas in the mountain area of Liechtenstein. In the densely settled valley area, primarily dedicated to settlements and agriculture, the density and size of the individual protection areas is significantly lower (Fig. 5).

Both nature protection areas and forest protection areas have been assigned conservation and development goals that are incorporated into the conservation plans. The forest areas included in the Inventory of Nature Priority areas were almost completely placed under protection in 2000. With respect to nature protection areas, the Inventory still includes various small biotopes that should be placed under protection. Also necessary would be measures to ensure networking axes.

Cultivation of rough pastures

The protection and cultivation of species-rich rough pastures on steep slopes and in wetlands has been successfully implemented. In the course of agricultural intensification and the concentration of agricultural activities in favorable locations, these areas which are difficult to cultivate are in danger of becoming forested. On the bases of the Rough Pasture Inventory⁷², cultivation agreements are concluded for roughly 84% of the available areas (as of 2009). The Rough Pasture Ordinance provides the basis of compensation for cultivation.⁷³ In 2008 and 2009, dry pastures throughout Liechtenstein were remapped; the project is currently being evaluated.

Nature research

The nature of Liechtenstein has been and continues to be researched intensively, even though there are no universities with natural science institutes. Since 1973, more than 60 nature research projects have been published. The focus has been on inventorying species groups in the plant and animal kingdoms and in describing landscape areas. Nature research is carried out by the Office of Forests, Nature and Land Management (AWNLM) on behalf of the Government, in close cooperation with private nature conservation organizations.

⁷² AWNL (2002). Rough Pasture Inventory

⁷³ Ordinance on the Payment of Cultivation Subsidies for the Conservation of Rough Pastures (LGBl. 1996 No. 187)

The AWNL also runs a Natural History Collection, which archives and describes all the indigenous species and collection inventories. The Development Concept for Nature and Agriculture concludes that the level of knowledge concerning species is sufficient, thanks to the nature research that has been conducted. In future, digital data management will be expanded, so that the existing knowledge can be used even better in planning and policy. Additionally, nationwide monitoring is planned on the basis of the research findings, in order to improve conclusions regarding the entire country.

Hunting

Hunting matters are governed by the Hunting Act⁷⁴ and the Gamekeeping Ordinance⁷⁵. According to the Gamekeeping Ordinance, the objective is to conserve the stock of huntable wild animals in a healthy condition. Additionally, the ordinance requires preservation of the habitat and protection of the conditions of life for huntable wild animals. Priority interests of agriculture and forestry must be respected in this regard. An important basis for hunting management is the Forest-Game Strategy 2000.⁷⁶ For instance, it has been used to develop measures for improving habitats⁷⁷ and a concept for emergency feeding of red deer in the winter.⁷⁸ The annual hunting quotas are governed by an ordinance. A count is used to estimate the stocks of huntable ungulates and to determine the hunting quotas.

Despite the high hunting quotas, browsing and peeling damage by red deer, roe deer, and chamois continues to occur (Chapter 2.2). The small size of Liechtenstein poses a challenge in this regard. Because of the ever-present border situation, Liechtenstein is unable to maintain its own red deer stock. The animals often migrate between Switzerland, Austria, and Liechtenstein. It is suspected that in the summer half-year, Liechtenstein becomes an immigration area for red deer from the bordering Austrian state of Vorarlberg. A study is underway to estimate the scope of these migrations. Field work with transmitters will begin in winter 2009/2010.

⁷⁴ Hunting Act (LGBl. 1995 No. 46)

⁷⁵ Gamekeeping Ordinance (LGBl. 2003 No. 198)

⁷⁶ Meile (2000). Forest-Game Strategy 2000

⁷⁷ AWNL (2004). Biotope Conservation: Simple Measures for the Hunting Practice

⁷⁸ AWNL(2008). Red Deer in the Winter: The Liechtenstein Emergency Feeding Concept

2.2 Forest

Sustainable forest management has played an important role already since the Forestry Code of 1865. However, that enactment only governed quantitative preservation of the forest with a ban on clearing and clear cutting. Qualitative forest preservation with near-natural forest management only became a topic in the second half of the 20th century.

Strategies and plans

The core aspect of Liechtenstein forest planning is forest function planning.⁷⁹ Under the Forestry Act, every forest area contains one of four priority functions: protection, wood usage, nature protection, or recreation. Numerous foundations are available for forest function planning:

- Nationwide map of vegetation locations (Schmider & Burnand, 1988);
- Map of natural hazards (Banzer et al., 2001);
- Inventory of Nature Priority Areas (Broggi et al., 1992);
- Usage plans of the municipalities.

The goals of the current Forestry Act are the qualitative and quantitative preservation of the forest stand (prohibition of clearing), the performance of priority functions, and the promotion of near-natural forest management. Strategic planning is covered by the Nature and Landscape Protection Concept for the Liechtenstein Forest and the National Forest Program.

Nature and Landscape Protection Concept for the Liechtenstein Forest⁸⁰

The core document for nature and landscape protection in the forest is the Nature and Landscape Protection Concept for the Liechtenstein Forest from the year 2000. The concept defines goal, strategies, and measures. In particular, it addresses forest reserves and special forest areas. The goals are:

- Promoting biodiversity:
 - o Preservation of especially ecologically-valuable natural forest communities;
 - o Protection of rare or threatened plant and animal species;
 - o Preservation of the genetic reservoir;
- Securing networks of ecologically significant living communities:
 - o Preservation of the most important natural forest communities;
 - o Establishment of a unified forest reserve system;
 - o Preservation of forest structures of special ecological significance;
- Preserving significant forest forms and types of usage;
- Utilizing the potential for knowledge and recreation.

⁷⁹ Terzer (1993). Liechtenstein Forest Function Planning.

⁸⁰ Näscher & Nigsch (2000). Nature and Landscape Protection Concept for the Liechtenstein Forest

National Forest Program 2002 – 2012: "Securing Regeneration and Remediation of the Protection Forest"⁸¹

In June 2001, a National Forest Program was published. With this program, Liechtenstein is responding to its international obligations to promote sustainable forest management. With a view to the intended sustainable development, the National Forest Program provides the conceptual framework for implementation of measures relevant to the forest.

As a distinctly mountainous country, Liechtenstein depends on the forest for protection. 27% of the forest area plays an important or even very important protection function for infrastructures.⁸² The National Forest Inventory of 1998 showed that in particular in the protection forest, regeneration was disproportionately rare.⁸³ The goals of the Forest Program include:

- Securing natural regeneration in the protection forest;
- Targeted measures in dealing with wild ungulates (red deer, roe deer, chamois);
- Preserving and promoting biodiversity;
- Creating framework conditions for sustainable forest development.

Consideration of successes and obstacles

Near-natural silviculture throughout the entire area

Near-natural silviculture is implemented throughout the entire cultivated area. Silviculture builds on various instruments including the nationwide map of vegetation locations.⁸⁴ Importance is attached to verifying the sustainability of silviculture, which is now part of the operation plans of the forestry operations. Since 2001, the entire Liechtenstein forest has been certified according to the criteria of the Forest Stewardship Council (FSC) (SGS-FM/COC-1299).

Forest reserves and special forest areas

The protection of forest reserves and special forest areas was implemented in 2000. Details are discussed in Chapter 1 (Chapter 1.5). The Protection Ordinance on Forest Reserves and Special Forest Areas provides legal protection for the registered forest areas of special ecological importance. Compensation for loss of income in forest reserves and costs for the cultivation of special forest areas are borne by the State in accordance with the applicable ordinance⁸⁵. The designation of protection areas underscores the enhanced efforts to secure existing, especially valuable habitats in the forest. A review of the protection and development goals took place in 2007 for the first time. The review showed that particularly in the special forest areas, deficits exist in reaching goals that can be remedied by introducing effective performance reviews.⁸⁶

⁸¹ Näscher (2000). National Forest Program for the Liechtenstein Forest

⁸² Nigsch (2009). The Protection Forest in Liechtenstein: Concept for Preserving and Improving the Protection Capacity of the Forest

⁸³ Ulmer (2000). Liechtenstein National Forest Inventory 1998

⁸⁴ Schmider & Burnand (1988). Forest Communities in the Principality of Liechtenstein

⁸⁵ Ordinance on the Scope and Payment of Compensation and Financial Aid pursuant to the Forestry Act (LGBI. 1995 No. 62)

⁸⁶ Government of the Principality of Liechtenstein (2008). Annual Report 2007

Difficulties in forest regeneration

The National Forest Inventory of 1998 showed that throughout the entire territory of the country, young forest stands are underrepresented and older stocks are overrepresented in comparison with ideal, graded stands. This problem is in part due to game browsing. The red deer stocks are far above their natural habitat capacity, which limits or even prevents the regeneration of certain tree species. In many places, the white fir is affected as well as precious hardwoods (maple, ash, elm, and others). A network of browsing control fences makes it possible to estimate the damage caused.⁸⁷ The data show that the reduction of wild animals stocks to a degree sustainable for the forest plays a key role in ensuring the sustainable provision of forest functions.

2.3 Agriculture

The strategic orientation of agriculture has been an important topic in recent years. A working group has prepared a new Agricultural Framework for the country⁸⁸. Parliament took note of the framework in November 2004. The framework is supplemented by the agriculture component (Module 2) of the Development Concept for Nature and Agriculture, where the agricultural demands concerning land use are spelled out.⁸⁹ The new Agriculture Act from 2008 serves as a framework law for agriculture, providing the basis for implementation of the measures contained in the Agricultural Framework.⁹⁰

Strategies and plans

Agricultural Framework 2004

The Agricultural Framework of 2004 defines general principles for six core areas in agriculture: soil, ecology, economy, markets, societies, education, and social affairs. Future agricultural policy should orient itself according to these guidelines. The new framework promotes Liechtenstein's trend toward ecologization of agriculture.

⁸⁷ Thöny (2004). Forest Regeneration Control in the Principality Liechtenstein

⁸⁸ Government of the Principality of Liechtenstein (2004). Agricultural Framework for Liechtenstein

⁸⁹ Büchel (2006). Development Concept for Nature and Agriculture: Module 2, Agriculture

⁹⁰ Agriculture Act (LGBI. 2009 No. 42)

The goals relating to ecology are:

- Farm production is environmentally friendly and animal-friendly. All farms fulfill the guidelines set out in the Proof of Ecological Performance or of organic farming;
- Ecological and animal-friendly services of agriculture going beyond the legal requirements will be compensated appropriately;
- Agricultural use is geared toward the long-term conservation of soil quality and other natural resources;
- Through the targeted use of technological progress, emissions from agriculture are continuously reduced.

Development Concept for Nature and Agriculture

The Development Concept for Nature and Agriculture aims to set out the positions in the two specialized areas and to develop common development visions. It is discussed above in the chapter on Nature and Agriculture (Chapter 2.1).

Consideration of successes and obstacles

Successful compensation for ecological and animal-friendly services

When ecological services are provided, the interests and concerns of economically productive agriculture must be taken into account. The payments for compensating ecological and animal-friendly services are an important tool to achieve the ecological goals.

In addition to conserving soil fertility, environmental impact should be minimized. Sustainable farming, soil-conserving cultivation, and cultivation of near-natural habitats are promoted. Alongside Switzerland, the Proof of Ecological Performance (PEP) has been instituted, which constitutes the preconditions for entitlement to direct payments (Chapter 1.6). A key element is the balance of nutrients, for which the requisite nitrogen and phosphorus supply on the farmland and the actual production by the animal stock is calculated. This allows the animal stock to be adjusted to the farmland so that primarily natural fertilizer can be used.

With the implementation of PEP on 98% of the farmland, the goal of implementing this minimal standard throughout the entire agricultural area has nearly been achieved. A similarly positive picture is seen in cultivation according to the standards of organic farming on nearly 28% of the farmland.

Cultivation of near-natural habitats

The cultivation of near-natural habitats is seen as one of the responsibilities of agriculture. The Proof of Ecological Performance requires at least 7% of ecological compensation area relative to the total farmland. The share of 21% ecological compensation area shows very clearly that farmers fulfill more than merely the minimum standard.

A performance review required by law was carried out on extensive pastures, which make up the largest share of ecological compensation areas. The review indicates a modest improvement of the situation of the investigated groups of species, but also draws attention to deficits (Chapter 1.6). As measures to improve the effectiveness of species diversity, an increase of the ecological quality of the compensation areas through introduction of quality-dependent subsidies as well as improved networking have been proposed.

Alp cultivation

Alp pastures are traditional cultural landscapes of interest to nature protection. To promote alp cultivation, the Alp Cultivation Act provides for financial promotion measures.⁹¹ These measures are intended to compensate the public service of alp cultivation for the preservation of the traditional landscape. This also secures the preservation of alp pastures for the long term.

A study from 2006 shows that stocking is appropriate to the terrain.⁹² Also positive is the prohibition of nitrogenous mineral fertilizers. The previous ban on the use of herbicides was relaxed by way of ordinance to allow isolated treatment subject to approval. This requires a remediation plan for problematic alp plants. What is important for the future is to protect alp pastures as a marginal yield region from further intensification trends.

⁹¹ Law on the Promotion of Alp Cultivation (Alp Cultivation Act) (LGBl. 1981 No. 9)

⁹² Stadler (2006). Location-appropriate Cultivation and Stocking of Alps in the Principality of Liechtenstein

2.4 Waters

According to the Liechtenstein Water Protection Act of 2003, there is an obligation for the municipalities and the State to develop an action plan to transform above-ground waters into a state that is as near-natural as possible. This obligation also is in line with the requirements of the EU Water Framework Directive (Directive 2000/60/EC of 23 October 2000)⁹³, which was incorporated into the EEA Agreement in 2007. The key elements of the Water Framework Directive include the following obligations for States parties:

- Incorporation of environmental goals for surface waters and groundwater;
- Comprehensive analysis of river basins;
- Preparation of river basin management plans with the participation of the public;
- Achievement of the goals by 2024.

Strategies and plans

Detailed foundations now exist concerning the current status of the Liechtenstein water system. These include studies focusing on ecomorphology (RENAT, 2006)⁹⁴, limnology⁹⁵ and fish ecology⁹⁶ as well as data on chemical water monitoring. On the basis of the available data, an assessment of the biological status of Liechtenstein streams was compiled in 2008/09. This was used to develop a program for future biological monitoring of streams.

Revitalization concepts

Liechtenstein is participating in the preparation of the interdisciplinary Development Concept for the Alpine Rhine, a project of the International Alpine Rhine Government Commission (IRKA), together with Switzerland and Austria.⁹⁷ The development concept outlines tasks that can only be solved in regional cooperation, such as revitalization measures, flood safety, and detrital management (Spiersbach Development Concept⁹⁸). The development concepts for the Inland Canal and the Samina will soon be prepared as part of implementation of the Water Framework Directive.

⁹³ Promulgation of the Decision of the EEA Joint Committee No. 125/2007 (LGBl. 2009 No. 109)

⁹⁴ RENAT (2006). Ecomorphology of the Streams in Liechtenstein

⁹⁵ Pfister & Hubmann (2008). Limnological Study of Selected Streams in Liechtenstein

⁹⁶ RENAT & EAWAG (2009). Biological Stream Monitoring in the Principality of Liechtenstein

⁹⁷ ARGE Rheinblick (2005). Development Concept for the Alpine Rhine

⁹⁸ Jehle et al. (2004). Water Development Concept for the Spiersbach

Consideration of successes and obstacles

Improvement of water quality

The goal with respect to water quality is in particular to avoid pollution, such as by settlement waste water and diffuse entries from agriculture. Consistent implementation of waste water management – 98% of all possible connections to the sewage system have been realized – has shown positive effects on chemical water quality.

The entry of nutrients from agriculture has also been reduced thanks to combined measures. First, the Proof of Ecological Performance (Chapter 1.6) and the Water Protection Act contain provisions on animal stocks and natural fertilizer storage and disposal. Second, unfertilized, extensively cultivated stream shoulders have been introduced. The shoulders were designated in 1994 by the Office of Agriculture and the Office of Environmental and have been mandated by the Water Protection Act along above-ground waters since 2003. Cultivation of the stream shoulders is compensated via the Compensation Act for agriculture. Both in the inland waters and in the Alpine Rhine, pollution by chemical substances is no longer critical.⁹⁹

Ecological upgrading of waters

In the 1990s, numerous remediation projects to eliminate migration obstacles for fish, rehydration projects, and water broadening projects have been carried out. The result is a continuous water system, even for weak-swimming fish, with numerous rehydrated stretches that make up about a quarter of the permanently aquiferous water stretches in the valley area.¹⁰⁰ With respect to optimization of water morphology, measures have been undertaken along numerous waters. The largest revitalization project was carried out along the Liechtenstein Inland Canal (Box 1, Fig. 10).

1997 to 2006 can be cited as an example of the financial expenditures on revitalization projects. Over these 10 years, the State and municipalities spent CHF 6.3 million on ecological upgrading of the water system.¹⁰¹ Further measures are also envisaged in future.

⁹⁹ Office of Environmental Protection (2006). Chemical Water Quality of Streams in Liechtenstein 2005/06

¹⁰⁰ RENAT (2006). Ecomorphology of the Streams in Liechtenstein

¹⁰¹ Government of the Principality of Liechtenstein (2008). Response to Postulate concerning Revitalization Measures for Inland Waters

Box 1. Case study of a revitalization project.

Revitalization of the outlet of the Liechtenstein Inland Canal

The revitalization of the outlet area of the Liechtenstein Inland Canal has been the largest revitalization project in Liechtenstein. The Inland Canal is the stream in Liechtenstein with the largest catchment area (about 116 km²). The artificially created canal collects all the waters in the Liechtenstein valley area, except for a few creeks in the north of the countries. It was built in the 1930s to drain the valley in the wake of a major Rhine flood in 1927. With the Inland Canal, the number of outlets was reduced from 12 to a single outlet, which is why it plays an important ecological role. Digging of gravel in the Alpine Rhine between the 1950s and 1970s resulted in a lowering of the Rhine bed. As a consequence, the Inland Canal was separated from the Rhine by a 4 m high gradient. The trigger for efforts to improve the situation was the international program to save the threatened Lake Constance trout (*Salmo trutta lacustris*).

The fish pass built in 1981 enabled this strong-swimming fish to climb up into the Inland Canal. Opinions and initiatives by interest groups resulted in a decision to redesign the outlet area. The project was realized in several stages between 1989 and 2008 and is now complete. In total, the Inland Canal was revitalized along a stretch of 1.7 km. The project costs for the State of Liechtenstein and the Liechtenstein municipalities was about CHF 2 million. The goal of restoring the networking of Liechtenstein valley waters with the Alpine Rhine was achieved in 2000. At that time, the immediate outlet was rebuilt in such a way that the Inland Canal entered the Alpine Rhine on an even plain and without a gradient (Fig. 10). In addition to measures in the river bed, the goal was to improve the networking of aquatic and terrestrial habitats, in order to revitalize the original alluvial forest. Already since the 1980s, there has been a monitoring program which now encompasses fish fauna, flora, and birds. A socio-empirical study has also been conducted, since the region is an important recreation area for human beings. Visitors to the areas were surveyed with regard to their perception and assessment of the revitalization. The report shows that the new design has met with a positive response of the population.

Data surveys near the outlet of the Inland Canal impressively show the ecological success of the revitalization at this key spot: while only 4 fish species were recorded in the Inland Canal in 1980, the number increased to 6 thanks to the fish pass. The revitalization of the immediate outlet area in 2000 had the greatest impact. Fish samples show that the number of fish species increased to 16 in just under 4 years. The measures were also successful in regard to birds. The diversity of species and the number of overall ranges have increased to an astonishing extent. A special event, and expressive of the successful measures to improve habitats, was the appearance of beavers (*Castor fiber*) in the area in 2008.

Public outreach plays an important role as part of the redesign. The Inland Canal outlet was chosen by IRKA as one of four excursion points along the Alpine Rhine. Tours for school classes and other interest groups are offered.

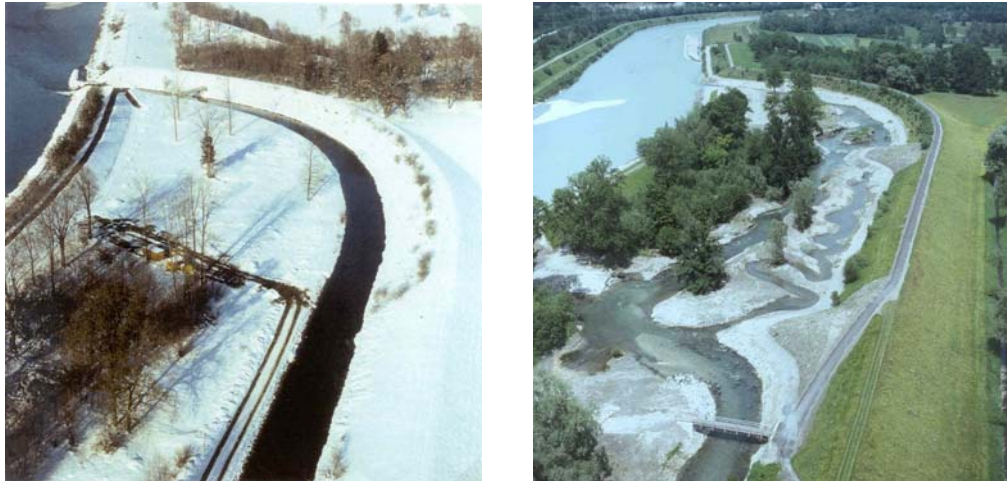


Fig. 10. The outlet of the Liechtenstein Inland Canal before (left) and after (right) the revitalization (Photos: E. Ritter (Office of Civil Engineering, 1999); Office of Environmental Protection, 2000).

Area conflict with agriculture

There is a legal obligation in Liechtenstein both to conserve and restore waters as habitats and also to quantitatively sustain farmland.¹⁰² It should be noted in this regard that the deficits today are primarily in regard to the water structures. This gives rise to a need to secure the spatial requirements of waters in order to broaden them. In many cases, additional space is needed both for flood safety and for the ecological function of the waters. A social policy balance must be struck between the concern of maintaining farmland and the provision of areas for the revitalization of waters.

¹⁰² Law on the Conservation and Securing of Agriculturally Usable Soil (LGBl. 1992 No. 41)

2.5 Mountains

The Liechtenstein mountain area is clearly delimited spatially. The conservation and development of this space is governed by ordinances. The ordinance currently in force on the Conservation and Development of the Mountain Area replaced the ordinance of 1968 which initiated the integral consideration of all usage interests in the mountain area.¹⁰³ The goal of mountain area planning is to preserve the agricultural, alp, and forestry status of the Liechtenstein mountain area and to guide its development.

Strategies and plans

The Development and Conservation Concept for the Mountain Area from 2000 serves as the planning instrument.¹⁰⁴ In terms of its conservation vision, the Concept relies on the Inventory of Nature Priority Areas. It proposes three strategies to achieve a development that strives to be compatible with nature and landscape:

- Secure existing values;
- Solve conflicts, avoid harmful activities;
- Ensure sustainable use that is spatially and environmentally compatible.

The Development and Conservation Concept for the Mountain Area shows that there are gaps at the conceptual level in four specialized areas (water use, transport, tourism, mountain/alp cultivation). In these areas, there are still no conceptually harmonized visions.

Consideration of successes and obstacles

Financial compensation and subsidies are used to implement the measures in the various subareas. Measures are implemented in connection with the alp cultivation usage of the species-rich, Alpine pastures (Chapter 2.3), the near-natural cultivation of forest areas (Chapter 2.2), and protection from natural hazards. The measures undertaken are discussed in the relevant chapters.

¹⁰³ Ordinance on the Conservation and Development of the Mountain Area (LGBl. 2008 No. 247)

¹⁰⁴ RENAT (2000). Development and Conservation Concept for the Mountain Area

3 Incorporation in the various sectors

The protection and use of biological diversity is affected by numerous economic sectors. This chapter of the report discusses forestry, agriculture, land use planning, and tourism. There are also horizontal topic areas with a direct or indirect impact on biological diversity, such as research, education and public outreach, as well as international cooperation. Finally, biodiversity is addressed in the assessment of interventions in nature and landscape and in the handling of genetically modified and alien species.

3.1 Forest

Liechtenstein has nationwide forest planning. Management of the forest areas is determined by the priority function (protection, wood use, nature protection, or recreation). Numerous foundations and control instruments are available to ensure the appropriate forest function (Chapter 2.2). The nine municipal forestry operations are responsible for management of the forest, more than 90% of which are owned by municipalities or cooperatives. Sustainability control is included in the plans of the forestry operations and is also ensured via the National Forest Inventory.

The following goals of the forest management strategy show how promotion of biodiversity is integrated in this strategy:¹⁰⁵

- Near-natural silviculture as basic use;
- Designation of forest reserves and special forest areas: ensuring natural dynamics in the forest, conservation/promotion of rare plant and animal species, protection of ecologically valuable forest forms and types of usage;
- Ecological upgrading of the edges of forests;
- Promotion of pioneer phases with plenty of light and structure;
- Promotion/conservation of forest meadows;
- Protection of small waters and wet locations in the forest.

Near-natural management has been incorporated in legislation (Forestry Act) and is manifested in the FSC certification of the entire Liechtenstein forest.

¹⁰⁵ Näscher & Nigsch (2000). Nature and Landscape Protection Concept for the Liechtenstein Forest

3.2 Agriculture

The Agricultural Framework 2004 (Chapter 2.3) states: "The use of the agricultural areas is in principle governed by the Development Concept for Nature and Agriculture, which also ensures preservation of biodiversity and resources." Agriculture recognizes the population's need for agricultural practices that attach great importance to ecology.

The direct protection of biodiversity is primarily achieved through voluntary measures that are compensated financially. These measures mainly concern the creation and management of near-natural habitats. A prerequisite for the financial incentives made possible in this area was the separation of price and income policy in the revision of agricultural policy in the 1990s (Chapter 1.6). This allowed adequate compensation of ecological services in agriculture that go beyond the legal requirements. To protect soil as a natural source, legal regulations exist that serve to guarantee soil fertility for the long term. These regulations are consistently implemented by the Proof of Ecological Performance as a general prerequisite for entitlement to direct payments.

3.3 Land use planning

In a densely settled country like Liechtenstein, land use planning is a crucial factor for the successful protection of biodiversity. Land use planning as municipal and national planning is executed in Liechtenstein via the Construction Act.¹⁰⁶ The 11 municipalities of Liechtenstein are responsible for communal planning, while the Government is responsible for transmunicipal and cross-border planning. Such planning must be undertaken in cooperation with the municipalities. In addition to the legal requirements, the basis for land use planning is made up of master plans and construction codes with zoning plans. The zoning plans include construction zones as well as agricultural and protection zones as the most important zones.

The Spatial Planning Report of 2008 outlines the situation of land use planning and spatial development in Liechtenstein as well the need for action.¹⁰⁷ The large and largely-developed construction zones offer space for about 70,000 to 100,000 people with a current population of 35,000. The generous designation of construction zones has led to spread-out settlements, resulting in sprawling and costly infrastructure facilities and a high level of private transport. In municipal and national planning today, the goal is to promote an inward movement of the increasing density of settlements.

The National Master Plan was adopted by the Government in 2007.¹⁰⁸ The National Master Plan outlines the long-term vision for spatial development in Liechtenstein. "Nature and landscape" is one of four areas spelled out in the National Master Plan (in addition to settlement, agriculture, and transport).

¹⁰⁶ Construction Act (BauG) (LGBl. 2009 No. 44)

¹⁰⁷ Government of the Principality of Liechtenstein (2009). Spatial Planning Report 2008

¹⁰⁸ Government of the Principality of Liechtenstein (2007). National Master Plan of the Principality of Liechtenstein

As a planning instrument binding on authorities, the National Master Plan – like the revised Construction Act – aims to improve coordination and harmonization among administrative offices engaged in spatial planning activities.

Many of the challenges facing a small country like Liechtenstein must be solved across national borders. An example of functional, cross-border planning is Liechtenstein's participation in the Swiss agglomeration program. Together with the adjoining region of Werdenberg, Liechtenstein is striving to achieve joint settlement and transport development (Werdenberg-Liechtenstein Agglomeration Program).

3.4 Tourism

The new Tourism Act of 2000¹⁰⁹ is guided by principles of sustainability and takes account of the concerns of the natural, societal and cultural environment. The law serves to promote tourism and governs the financing and organization thereof.

Tourism in Liechtenstein focuses on the capital Vaduz and the mountain area. With respect to diversity, the emphasis is on tourism in the mountain area. As illustrated in Chapter 1.8, the mountain area is of great significance to a large number of plant and animal species. Like local recreation, tourism is a leisure activity that may adversely affect this habitat. Both topics are discussed in the Development and Conservation Concept for the Mountain Area.¹¹⁰ Approaches to solving conflicts between recreational use and wild animals were discussed in the Forest-Game Strategy 2000.¹¹¹ One approach is to create quiet areas for wild animals, a concept for which is currently under development.

The conceptual work will continue by addressing the topic of tourism as part of a separate framework for tourism in the mountain area. On the basis of a suitability assessment for tourism, the framework will examine which forms of tourism are economical and sustainable in the Liechtenstein mountain area.

3.5 Biodiversity in the review of interventions

An important point regarding the protection of biological diversity is to avoid negative consequences for the environment arising from projects and programs. Evaluation of environmental effects is one of the overarching focus areas of the Convention on Biological Diversity. Three tools are available in this regard in Liechtenstein: the Strategic Environmental Assessment, the Environmental Impact Assessment, and intervention procedures under the Nature Protection Act. The assessment procedures have different fields of application, but their functions complement each other.

¹⁰⁹ Tourism Act (LGBI. 2000 No. 166)

¹¹⁰ RENAT (2000). Development and Conservation Concept for the Mountain Area

¹¹¹ Meile (2000). Forest-Game Strategy 2000

Strategic Environmental Assessment

Since May 2007, the Strategic Environmental Assessment Act (SUPG) has been in force in Liechtenstein.¹¹² It serves to implement Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (EEA Compendium of Laws: Annex XX – 2i.01). Until now, there has been no need to conduct a Strategic Environmental Assessment.

Environmental Impact Assessment

The goal of the Environmental Impact Assessment Act of 1999 is to assess the impact of a project on humans, animals and plants, soil, water, air, climate, landscape, and property and cultural assets.¹¹³ The law is based on two directives incorporated into the EEA Agreement that concern the Environmental Impact Assessment and the reduction of environmental pollution (Directives 85/337/EEC and 96/61/EC).

The statistics of the Office of Environmental Protection show 21 projects between 1999 and 2009 that were subject to an EIA. In the case of eight other projects, an exception under the Environmental Impact Assessment Act was granted after further clarifications.

Intervention procedures under the Nature Protection Act

Pursuant to the Law on the Protection of Nature and Landscape of 1996, interventions outside the construction area are subject to an assessment of impact on landscape, flora and fauna. The law is implemented by way of a procedure for the review and approval of interventions in nature and landscape (intervention procedure). Key to the assessment of nature and landscape are the Inventory of Nature Priority Areas as well as objects worthy of protection and habitats especially worthy of protection. As is the case for the EIA, entitled organizations have the right to object. Approvals are only granted if adverse impacts can be avoided or compensated. Replacement measures with the same area or function can be demanded. In 2008, 33 procedures were carried out. 15 of these required a decision by the Government, while the others were settled in simplified procedures for small and unobjectionable interventions.

¹¹² Law on the Strategic Environmental Assessment (SUPG) (LGBl. 2007 No. 106)

¹¹³ Law on the Environmental Impact Assessment (UVPG) (LGBl. 1999 No. 95)

3.6 Handling of genetically modified and alien species

In 1999, Parliament adopted a Law on the Handling of Genetically Modified or Pathogenic Organisms.¹¹⁴ Pursuant to the Customs Treaty with Switzerland, the relevant Swiss provisions also apply on a supplementary basis. One of the goals of the existing law is to preserve natural genetic diversity. It prohibits the manufacture of genetically modified or pathogenic organisms, release studies, and the handling of genetically modified or pathogenic organisms that, under international treaty law, are not admitted for circulation. An adjustment of these legal foundations is currently underway pursuant to the Deliberate Release Directive 2001/18/EC in the EEA Agreement.

The handling of alien and potentially invasive species is governed by the Law on the Protection of Nature and Landscape, the Fishery Act, the Hunting Act, and the relevant articles of the Swiss Deliberate Release Ordinance that also apply in Liechtenstein. According to the Nature Protection Act, the release or colonization of non-local plants or animals in the outdoors is prohibited. Options for combating invasive alien organisms are set out in the Deliberate Release Ordinance by way of the Customs Treaty with Switzerland. In the course of revision of the handling of genetically modified organisms, adjustments are also being made with respect to alien, invasive organisms by way of a separate Liechtenstein Deliberate Release Ordinance. As part of the series "Nature Research in the Principality of Liechtenstein", a publication on non-indigenous species appeared in 2006.¹¹⁵

3.7 Research

Basic research

The Institute of Architecture and Planning at the University of Liechtenstein does research on sustainable development. The Institute is participating in the project "Alpine Rhine Valley: Future Concepts for Settlement, Nature and Networking". The Institute does not carry out research work on ecology and species. Nature research is carried out by the Office of Forests, Nature and Land Management on behalf of the Government, in close cooperation with private nature protection organizations (Chapter 2.1).

¹¹⁴ Law on the Handling of Genetically Modified or Pathogenic Organisms (LGBl. 1999 No. 42)

¹¹⁵ AWNL (2006). Non-indigenous Species in the Principality of Liechtenstein

Liechtenstein supports research activities abroad by making an annual contribution of CHF 250,000 each to Switzerland (Swiss National Science Foundation, SNSF) and Austria (Austrian Science Fund, FWF).¹¹⁶ As an EEA member, Liechtenstein also participates in the 7th Framework Programme for Research and Technological Development, which runs from 2007 to 2013.¹¹⁷

Applied research

Interreg is a promotion program of the European Union for cross-border cooperation that is financed by the European Fund for Regional Development (EFRD). Interreg aims to promote a balanced development in cross-border regions, thus making a contribution to European integration. The new program Interreg IV runs from 2007 to 2015. Liechtenstein is part of the promotion region "Alpine Rhine-Lake Constance-High Rhine" in the Interreg IV A program (www.interreg.org).

On the basis of joint strategies for sustainable spatial development, the program promotes the creation of cross-border economic and social "poles". One of the thematic focuses is the preservation of natural resources and cultural heritage.

3.8 Education and public outreach

Education at schools

The Ministry of Education of the Liechtenstein Government is responsible for scholastic education. The legal basis consists of the School Act¹¹⁸ and the Vocational Training Act¹¹⁹ along with their associated ordinances. For education in the field of environment and sustainable development, the Law on the Protection of Nature and Landscape additionally requires the promotion of nature and environmental education. Today, the subject "Humans and Environment" is a fixed component of the curriculum for mandatory school education.

In addition, further measures at a staffing and project level have been implemented since the Rio Summit in 1992. Examples are:

- Appointment of environmental officers at schools: In the 1990s, each school had an environmental officer, who was mainly responsible for implementing environmental education. Since the creation of the new curriculum, however, environmental education is integrated into the school's normal curriculum. Schools may, however, decide themselves whether they want to give a teacher a special mandate in a given field, such as the environment.
- Environment Days: Another initiative is the Environment Days, which are held regularly at the country's schools. Sometimes in cooperation with local authorities, children's awareness of nature is raised (Box 2).

¹¹⁶ Government of the Principality of Liechtenstein (2009). Annual Report 2008

¹¹⁷ Office of Economic Affairs (<http://www.llv.li/amtsstellen/llv-avw-forschung.htm>; as of November 2009)

¹¹⁸ School Act (LGBl. 1972 No. 7)

¹¹⁹ Vocational Training Act (LGBl. 2008 No. 103)

- Environmentally friendly office and school material: A specific catalogue recommends environmentally friendly office and school material (paper, notebooks, writing utensils, etc.) to teachers.
- Excursions: Schools offer excursion and internship opportunities with specialists or institutions.

Box 2. Environment Days at schools.

Liechtenstein Forest Days

The Liechtenstein Forest Days were carried out for the third time in September 2009 by the Liechtenstein Forestry Service. The Forest Days are an event dedicated to the topic of forest and forest management. Its aim is to make students in Liechtenstein and the population more familiar with the forest. In 2009, a forest trail focused on the forest as recreation area, the forest as habitat, forest biodiversity, hunting, the forest as protection from natural hazards, forest maintenance, and timber. The origin of the Forest Days was the European Nature Conservation Year in 1995, when the Government issued the mandate to organize such an event for schools and the population. Since then, it has been carried out every seven years, with the goal of bringing every pupil into the forest once during his or her schooling period. Particularly noteworthy is the fact that within a single week, nearly all the pupils of the primary and secondary schools in Liechtenstein are able to participate. Together with other visitors, this adds up to more than 10% of the Liechtenstein population.

Public information

Public information falls within the competence and responsibility of the administrative offices working in the respective field. Examples of public outreach are:

- Public events such as annual forest tours conducted by the municipal forestry operations, actions of the environmental commissions of the municipalities;
- Reports in the Liechtenstein daily newspapers;
- Publications:
 - o Publication series "Nature Research in the Principality of Liechtenstein";
 - o Flora of the Principality of Liechtenstein in Pictures¹²⁰;
 - o Liechtenstein Environment Calendar: Issued annually since 1984 by the Government. Coordination is the responsibility of the Office of Environmental Protection. The 25th edition of the Environment Calendar in 2009 is dedicated to the theme "environmentally friendly". Each year, the calendar is designed by a school class which deals intensively with the assigned theme. The calendar is thus also an important instrument for raising children's awareness of environmental issues.
- Nature House in the Liechtenstein National Museum: Liechtenstein maintains its own Natural History Collection. Parts of this collection are shown at the National Museum in a permanent natural history exhibit. In addition, temporary exhibits are presented.

¹²⁰ Waldburger et al. (2003). Flora of the Principality of Liechtenstein in Pictures

Cooperation with private institutions and NGOs

Various Liechtenstein institutions are also engaged in information and education: the Liechtenstein Society for Environmental Protection, the Botanical-Zoological Society of Liechtenstein-Sargans-Werdenberg, the Fishing Club, the Liechtenstein Alpine Club, the Forestry Club, and the National Ornithological Association.

Together with associations pursuing similar goals, these organizations are members of the CIPRA Liechtenstein network. CIPRA Liechtenstein is one of the national committees of the non-governmental organization CIPRA (International Commission for Protection of the Alps), which is headquartered in Liechtenstein. Between 1998 and 2004, it conducted the annual summer academy "Focus on the Alps" in Liechtenstein, which engaged in an interdisciplinary, transnational analysis of the problems facing the Alps. The State of Liechtenstein provided financial support for this project.

Liechtenstein is also engaged in the public outreach of the International Government Commission on the Alpine Rhine (IRKA). In addition to various media work, IRKA's public outreach includes excursions and a rotating exhibit presenting findings from the Alpine Rhine Development Concept.

3.9 International cooperation

Despite the small size of the country, international cooperation plays an important role. Especially for a small state, regional and global cooperation for the protection of natural bases of life is indispensable. Liechtenstein is also aware of its responsibility toward disadvantaged regions, however. To the extent possible, Liechtenstein provides financial as well as practical support by seconding experts or carrying out concrete projects within the framework of multilateral cooperation. The Minister of Environmental Affairs, Land Use Planning, Agriculture and Forestry coordinates responsibilities on environmental issues and sustainable development. Regional cooperation with the neighboring countries Switzerland and Austria is especially important.

Relations with Switzerland

The relations between Liechtenstein and Switzerland are very close. The two countries have concluded numerous bilateral agreements. The most important of these is the Customs Treaty, which forms the basis for legal adjustments and harmonization that go far beyond its actual scope of application, including in economic and social law. The Customs Treaty is also relevant to the field of environmental protection. Many Swiss environmental standards also apply to Liechtenstein.

Liechtenstein and the EU

The relations with the EU are characterized by intensive cooperation. Since 1995, Liechtenstein has been linked with the European Union (EU) by an extensive association agreement – the Agreement on the European Economic Area (EEA). The agreement gives Liechtenstein access to the European single market. But it also governs flanking measures such as in the field of environmental protection. For this reason, many of the EU environmental standards also apply in Liechtenstein. One example is the EU Water Framework Directive, which was incorporated into the EEA Agreement in 2007. Liechtenstein also participates actively and regularly in bodies such as the EFTA Working Group on the Environment, the European Environment Agency, and programs within the framework of Interreg.

In the Council of Europe, Liechtenstein participates within the framework of the Bern Convention and the "Environment for Europe" process in the development of programs and realization of measures to conserve biodiversity.

Regional and global environmental agreements

Environmental foreign policy is one of five pillars of Liechtenstein's foreign policy. There is a large number of international agreements serving to conserve nature and the bases of life and to protect against harmful environmental impacts. Liechtenstein actively participated in the Rio Process and ratified all three of the major environmental agreements coming out of the Earth Summit – the Convention on Climate Change, the Convention on Biological Diversity, and the Convention to Combat Desertification. Of special importance to Liechtenstein is the Convention on the Protection of the Alps (Alpine Convention), which Liechtenstein ratified in 1994.

Liechtenstein ratified the Convention on Biological Diversity on 18 September 1997. The following list shows other important conventions ratified by Liechtenstein relating to the protection and sustainable use of the environment:

- Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention; LGBl. 1991 No. 87);
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention; LGBl. 1998 No. 156);
- Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention; LGBl. 1982 No. 42);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (Washington Convention; LGBl. 1980 No. 63);
- United Nations Framework Convention on Climate Change (Climate Change Convention; LGBl. 1995 No. 118);
- Kyoto Protocol to the Framework Convention on Climate Change (LGBl. 2005 No. 49);
- Vienna Convention for the Protection of the Ozone Layer (Vienna Convention; LGBl. 1989 No. 37);
- Montreal Protocol on Substances That Deplete the Ozone Layer (LGBl. 1989 No. 38);
- United Nations Convention to Combat Desertification (Desertification Convention; LGBl. 2000 No. 69);
- Convention on the Protection and Use of Transboundary Watercourses and International Lakes (LGBl. 1998 No. 22);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, (LGBl. 1992 No. 90);
- Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention; LGBl. 1998 No. 157);
- Convention on Long-Range Transboundary Air Pollution (Geneva Convention; LGBl. 1984 No. 3)
- Convention on the Protection of the Alps and the protocols on spatial planning and sustainable development, mountain farming, conservation of nature and landscape protection, mountain forests, tourism, soil conservation, energy, transport, and solution of litigations (Alpine Convention; LGBl. 1995 No. 186).

With respect to forests, Liechtenstein is engaged within the framework of the Ministerial Conference on the Protection of Forests in Europe (MCPFE).

It is a matter of particular importance to Liechtenstein to support governmental and non-governmental organizations as well as partnerships. For instance, Liechtenstein makes an annual contribution to the Secretariat of CIPRA (International Commission for Protection of the Alps), an NGO with headquarters in Liechtenstein.

At the regional level, protection of the Alpine Rhine constitutes a focus of cross-border cooperation: Liechtenstein is a member of the International Government Commission on the Alpine Rhine (IRKA) for the cross-border planning of water management measures along the Alpine Rhine, the International Conference of Commissioners for Lake Constance Fishery (IBKF), the International Water Protection Commission for Lake Constance (IGKB), and the International Coordination Group for the Alpine Rhine/Lake Constance.

International humanitarian cooperation

Conservation of the environment and promotion of a responsible and sustainable use of natural resources is one of the focuses of Liechtenstein's humanitarian cooperation. Liechtenstein's bilateral development cooperation focuses on the development of rural regions. It is carried out by the Liechtenstein Development Service (LED) on behalf of the Government of the Principality of Liechtenstein. One focus of the work is food security in rural areas. For this purpose, Liechtenstein works primarily with small farmers, who play an important role in most developing countries. One concern is the promotion of organic farming.

As an Alpine country, Liechtenstein is also engaged on behalf of the sustainable development of mountain regions. Its engagement includes financial but also staffing support by carrying out projects and providing experts in the Carpathians, the Caucasus, and Central Asia. In 2008, Liechtenstein spent about CHF 25 million on international humanitarian cooperation, with a forecast ODA percentage of about 0.6%.

4 Conclusions

Already when it ratified the Convention in 1997, Liechtenstein analyzed its existing legislation. The review showed that the legal foundations were sufficient to honor the obligations under the Convention. Since then, additional steps have been taken to expand the legal basis. A biodiversity strategy based on the extensive planning foundations in the individual sectors is currently being developed. In particular the findings arising from the present report will help formulate the strategy in a goal-directed way.

4.1 Progress toward 2010 goals

Protect the components of biodiversity

Goal 1: Promote the conservation of the biological diversity of ecosystems, habitats and biomes.

Target 1.1: At least 10% of each of the world's ecological regions effectively conserved.

Target 1.2: Areas of particular importance to biodiversity protected.

It is a matter of great concern to Liechtenstein to conserve its biological diversity. Liechtenstein's goal in this regard is set out in the Law on the Protection of Nature and Landscape: "The entire area of habitats shall be protected and restored where necessary." The Liechtenstein legislation does not specify minimum percentages for the placement of individual ecosystems under protection (with the exception of forests: 10% forest protection areas as a requirement for FSC certification).

Together, nature protection areas and forest protection areas take up 13% of the country's territory. The largest part of the protection areas is in Liechtenstein's mountain region (Fig. 5). As a basis for assessing the potential of near-natural areas worthy of protection, the Inventory of Nature Priority Areas (1992) is used. A comparison of the current status with the inventoried areas shows that there is still potential for placement under protection (Chapter 1.4). Especially in the valley area of Liechtenstein, there are still several ecologically important areas that are not yet under protection. Further measures are needed to network existing protection areas in Liechtenstein as well as with neighboring areas in Austria and Switzerland.

The goal will not be fully met by 2010.

Goal 2: Promote the conservation of species diversity.

Target 2.1: Restore, maintain, or reduce the decline of populations of species of selected taxonomic groups.

Target 2.2: Status of threatened species improved.

Comprehensive inventories of the plant and animal groups existing in Liechtenstein are available. For several groups of species, Liechtenstein maintains its own Red Lists compiled according to IUCN criteria, taking account of the especially small-scale circumstances. Due to the increased pressure of settlement, transport and recreational use, negative impacts on the diversity of species are probable. A worsening of the situation of threatened species and species with special habitat needs has been noted. On the other hand, non-threatened species benefit from the measures taken to upgrade habitats (e.g. ecological compensation areas). The existing monitoring of animal and plant species is limited to individual groups of species and habitats. The aim is to expand it in the future to improve nationwide statements about the development of stocks.

The goal will not be fully met by 2010.

Goal 3: Promote the conservation of genetic diversity.

Target 3.1: Genetic diversity of crops, livestock, and of harvested species of trees, fish and wildlife and other valuable species conserved, and associated indigenous and local knowledge maintained.

In the field of promoting genetic diversity, the State of Liechtenstein has supported the project "Conservation of the Genetic Diversity of Cultivated Plants in the Principality of Liechtenstein" since 2001. Dedicated inventories have been compiled for fruit varieties, grapevines, vegetable varieties, and specifically for "Rhine Valley corn", a regional corn variety. Since Liechtenstein is not a closed region with respect to the use of cultivated plants, but rather is part of the Lake Constance-Alpine Rhine region, regional cooperation is of particular importance. From 2004 to 2008, Liechtenstein participated in an Interreg project on the protection of pomaceous fruit varieties in the Lake Constance region. In addition to variety-specific orchards and conservatory planting of seeds, cooperation exists with the Swiss GenBank for the storage of seeds. The HORTUS association serves as a platform for coordinating the necessary activities.

With respect to organisms in the wild, measures exist for the conservation of genetic diversity primarily in the forests. With the goal of conserving the genetic diversity of local races of tree species used in forestry, the natural regeneration of the forest is preferred to planting. Where planting becomes necessary, the State of Liechtenstein ensures a supply of local seeds for the forests by operating a forestry seedling nursery. Additionally, the forest reserves help conserve the genetic reservoir.

The goal will be met by 2010.

Promote sustainable use

Goal 4: Promote sustainable use and consumption.

Target 4.1: Biodiversity-based products derived from sources that are sustainably managed, and production areas managed consistent with the conservation of biodiversity.

Target 4.2: Unsustainable consumption of biological resources, or that impacts upon biodiversity, reduced.

Liechtenstein attaches great importance to the sustainable use of natural resources. Within the utilized areas in Liechtenstein, agriculture and forestry are the most important sectors (Chapters 1.5 and 1.6). All the Liechtenstein forests are now certified according to FSC guidelines. The measures of near-natural silviculture in cultivation areas are supplemented by protection areas that cover the inventoried nature priority areas in the forest. Difficulties arise for sustainable forest regeneration due to marked browsing and peeling damage by wild ungulates. Especially the red deer stocks are far greater than their nature habitat capacity and interfere with the regeneration of certain tree species.

In agriculture, farmers cultivate more than one quarter of the areas in accordance with organic farming guidelines. Additionally, the Proof of Ecological Performance is a prerequisite for entitlement to direct payments. This Proof of Ecological Performance includes measures such as a balance of nutrients, regular crop rotations, and soil conservation.

This information only refers to factors within the Principality of Liechtenstein. But Liechtenstein is in particular also an import country, which raises the question of whether the environmental impacts are exported. Unlike the assessment of exports, imports are difficult to gauge due to Liechtenstein's participation in the Swiss customs areas. No survey of the sustainability of Liechtenstein imports has thus been undertaken so far. Due to the economic similarity, it must be assumed that the consumption of imported goods and the ecological footprint are at about the same level as in Switzerland.

The goal will not be met by 2010.

Target 4.3: No species of wild flora or fauna endangered by international trade.

For indigenous species, this goal has already been achieved. The import and export of threatened species are governed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), to which Liechtenstein is party.

The goal will be met by 2010.

Address threats to biodiversity

Goal 5: Pressures from habitat loss, land use change and degradation, and unsustainable water use, reduced.

Target 5.1: Rate of loss and degradation of natural habitats decreased.

The characteristic developments of habitats in Liechtenstein are the expansion of settlements and infrastructures and the large-scale recreational use. In the valley area, it is primarily the sprawl of built-up areas (settlements, transport infrastructures) that exerts pressure on the landscape. The expansion of settlements is mainly at the expense of the agricultural areas. The Development Concept for Nature and Landscape concludes that the numerous habitat improvements are not able to compensate for the creeping loss of habitats in the Liechtenstein valley area. In the mountain area, large-scale recreational use plays an important role for habitat quality. Additional steering measures are necessary in this regard.

Coordinated land use planning is laid out in the National Master Plan of 2007. However, the Master Plan only offers approaches to solutions, but no concrete solutions for the imminent problems caused by settlement, transport and recreational use.

The goal will not be fully met by 2010.

Goal 6: Control threats from invasive alien species.

Target 6.1: Pathways for major potential alien invasive species controlled.

Target 6.2: Management plans in place for major alien species that threaten ecosystems, habitats or species.

Guidelines exist for invasive species that threaten food plants, livestock or human health. Pursuant to the joint customs areas with Switzerland, the same import provisions apply.

To protect wild plants and animals, the Nature Protection Act prohibits the release of alien plants and animals in the outdoors. Non-indigenous species occur in Liechtenstein, as in the surrounding countries. Due to the locally clustered, but not nationwide appearance of potentially invasive species, the priority is to observe these species. Prevention is closely coordinated with the Swiss authorities. Due to the small size of the country of Liechtenstein, the possibilities for controlling the pathways of alien invasive species are very limited.

The goal will not be met by 2010.

Goal 7: Address challenges to biodiversity from climate change and pollution.

Target 7.1: Maintain and enhance resilience of the components of biodiversity to adapt to climate change.

As a party to the Climate Change Convention and the Kyoto Protocol, Liechtenstein is engaged on behalf of the reduction of carbon dioxide emissions. Liechtenstein relies on research findings with forecasts for the northern edge of the Alps and participates actively in processes under the aegis of the Alpine Convention. Changes in the forest are important to Liechtenstein in that one quarter of the forest in the steep slope settings plays a direct role in the protection of human infrastructures. Near-natural silviculture is used as a method so that the forest vegetation can adapt to the climatic changes.

Target 7.2: Reduce pollution and its impacts on biodiversity.

Avoiding pollution was important with respect to waters in order to ensure today's water quality. Measurements of the chemical water quality show that it is high. Extensive measures have been undertaken in recent decades to treat waste water. The entry of nutrients from agriculture has also been reduced thanks to the following measures: legal provisions governing animal stocks and natural fertilizer storage, conversion of numerous farms to organic farming, and extensive cultivation of stream shoulders without fertilizer and pesticides.

Liechtenstein has also undertaken efforts to limit sulphur oxide and nitric oxide emissions. Liechtenstein participates in the European Monitoring and Evaluation Programme (EMEP) concerning long-range transboundary air pollution. The air pollution emissions are monitored via a regional observation program. Additionally, waste management is carried out.

The goal will not be fully met by 2010.

Maintain goods and services from biodiversity to support human well-being

Goal 8: Maintain capacity of ecosystems to deliver goods and services and support livelihoods.

Target 8.1: Capacity of ecosystems to deliver goods and services maintained.

Target 8.2: Biological resources that support sustainable livelihoods, local food security and health care, especially of poor people, maintained.

Maintaining ecosystem capacities is a clear legal mandate that is being implemented. Accordingly, agriculture is required to maintain soil fertility, which is verified using a nationwide soil measurement network. Maintenance of the quality of drinking water is achieved by way of groundwater protection areas. These services are not directly connected with biodiversity, however. There exists a need to clarify the importance of biodiversity in this connection. Predictions concerning the long-term maintenance of services are not possible given today's state of knowledge.

It cannot be said with certainty whether this goal will be achieved.

Protect traditional knowledge, innovations and practices

Goal 9: Maintain socio-cultural diversity of indigenous and local communities.

Target 9.1: Protect traditional knowledge, innovations and practices.

Target 9.2: Protect the rights of indigenous and local communities over their traditional knowledge, innovations and practices, including their rights to benefit sharing.

Liechtenstein has no indigenous or local communities within the meaning of the Convention. The protection of traditional knowledge and cultivation practices is promoted through development cooperation.

Liechtenstein contributes to fulfillment of this goal through development assistance.

Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources

Goal 10: Ensure the fair and equitable sharing of benefits arising out of the use of genetic resources.

Target 10.1: All transfers of genetic resources are in line with the Convention on Biological Diversity, the International Treaty on Plant Genetic Resources for Food and Agriculture and other applicable agreements.

Target 10.2: Benefits arising from the commercial and other utilization of genetic resources shared with the countries providing such resources.

Commercial use of genetic resources from other countries has not taken place in Liechtenstein so far.

Ensure provision of adequate resources

Goal 11: Parties have improved financial, human, scientific, technical and technological capacity to implement the Convention.

Target 11.1: New and additional financial resources are transferred to developing country parties, to allow for the effective implementation of their commitments under the Convention, in accordance with Article 20.

Target 11.2: Technology is transferred to developing country parties, to allow for the effective implementation of their commitments under the Convention, in accordance with its Article 20, paragraph 4.

Conservation of the environment and promotion of the responsible and sustainable treatment of natural resources is one of the focus areas of Liechtenstein's humanitarian cooperation. The Liechtenstein Development Service (LED) engages in development cooperation in the rural regions of several focus countries. The goals are to improve rural development and food security through sustainable farming methods.

Liechtenstein's engagement includes financial but also staffing support by carrying out projects and providing experts in the Carpathians, the Caucasus, and Central Asia. In 2008, Liechtenstein spent about CHF 25 million on international humanitarian cooperation, with a forecast ODA percentage of about 0.6%.

The goal will be met by 2010.

4.2 Progress toward Strategic Plan for the Convention

Liechtenstein supports enforcement of the Convention on Biological Diversity at the national and international level. Liechtenstein takes account of the goals set out in the Strategic Plan of the Convention by way of numerous measures as described in the following:

Biodiversity concerns have been incorporated into relevant sectoral programs and plans as well as in the formulation of laws. A cross-sectoral biodiversity strategy will be prepared on the basis of this report. Liechtenstein has adequate capacities to implement priority measures at the national level. Moreover, Liechtenstein's international development cooperation supports the targeted enhancement of capacities in partner countries. Information on Liechtenstein's expenditures for international humanitarian cooperation and for international programs is provided in Chapter 3.9.

So far, Liechtenstein has not signed the Cartagena Protocol.

4.3 Conclusions

Impact of implementation of the Biodiversity Convention

The Convention on Biological Diversity has strengthened the protection and sustainable use of biodiversity in Liechtenstein. The Convention represents global goals and principles that can also serve as guideposts at the regional level. This process of translating global goals into locally implementable, operational goals is currently underway in Liechtenstein. The Biodiversity Convention has put concepts such as sustainable use, the precautionary principle, the ecosystem approach, and ecosystem services on the political agenda. It has also contributed to expanding the focus from species diversity to include genetic diversity and ecosystem diversity.

Liechtenstein will not meet the 2010 goal of stopping the loss of biodiversity. The analysis in this report makes clear, however, that several subgoals have been achieved. In the case of others, measures have already been initiated. Even if overall, sustainable use of biological diversity by 2010 has not been achieved, the process of incorporating this principle has begun. This is shown by measures taken in the two largest economic sectors by area, forestry and agriculture. In the forest, the entire area is certified according to FSC criteria. In agriculture, organic farming is practiced on 28% of farmland.

Measures – Successes and obstacles

Liechtenstein is on the path toward development of a biodiversity strategy. The present report is intended to serve as a basis for preparing the biodiversity strategy. In the biodiversity-relevant sectors, development concepts and general principles already exist which take biological diversity into account. Examples include the Nature and Landscape Protection Concept for the Liechtenstein Forest, the Nature and Agriculture Development Concept, and – as an example of regional cooperation – the Alpine Rhine Development Concept.

The efforts on behalf of protection and sustainable use of biological diversity have been significantly intensified since 1990. New laws have been passed such as the Forestry Act, the Nature and Landscape Protection Act, and the Rough Pasture Ordinance. Ordinances are used to create or expand the preconditions for paying financial compensation for services relating to the protection and use of biological resources. In agriculture, for instance, payments for ecological services have been introduced as a market-based incentive instrument.

The designation of forest protection areas and the revitalization of numerous stream and river segments demonstrate Liechtenstein's efforts on behalf of protection and remediation of natural habitats. Natural cultivation in the forest is mandated by law, while it is promoted in agriculture by way of cultivation subsidies. Thanks to numerous nature studies, Liechtenstein now has sufficient basic knowledge on domestic species and habitats at its disposal. This knowledge will henceforth be used more intensively for habitat observation and monitoring.

Entrenching complex topics such as biodiversity and sustainable development in the population has proven to be difficult. Sustainable development in Liechtenstein had not yet been sufficiently discussed from an economic, social, and ecological perspective. In the field of biodiversity, understanding is lacking concerning the connection between biodiversity and ecosystem services that human beings depend on. A debate on sustainable development in Liechtenstein would be particularly important, since the overall economic framework determined by society has a greater impact on land use than isolated governmental incentive measures.

Future priorities

At the strategic level, the development of a biodiversity strategy is a high priority for the country of Liechtenstein. The strategy will help make harmonization of policies in the environmentally relevant specialized areas even better. In this regard, it will be unavoidable to discuss certain conflicting goals between the areas of settlement, transport, agriculture, water protection, and nature conservation.

The biodiversity strategy should help deepen the societal debate about sustainability. The focus will be on spatial development in Liechtenstein. Questions of future settlement development and transport must be answered. One goal of the protection of biological diversity will be to better utilize construction zones that have already been allocated and to limit to the extent possible the expansion of sprawling settlements and transport infrastructures at the expense of agriculturally used cultivated land. For this purpose, the concerns of protecting the diversity of species and landscapes must be integrated better into land use planning.

An expansion of public outreach can help improve sensitization and strengthen the concern of preserving biological diversity as a common commitment. In parallel, additional measures to protect near-natural habitats are necessary. A revision of existing inventories, especially the Inventory of Nature Priority Areas, should help protect the ecological core areas and the networking axes between them in an even more targeted manner. The establishment of a nationwide monitoring program for selected animal and plant species will allow verification of the measures taken.

At the international level, the priority will be to consider activities such as trade or participation in major projects by Liechtenstein actors with greater attention to the impact on biological diversity.

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Kyoto Protocol to the Framework Convention on Climate Change (LGBI. 2005 No. 49)

Vienna Convention for the Protection of the Ozone Layer (Vienna Convention; LGBI. 1989 No. 37)

Montreal Protocol on Substances That Deplete the Ozone Layer (LGBI. 1989 No. 38)

United Nations Convention to Combat Desertification (Desertification Convention; LGBI. 2000 No. 69)

Convention on the Protection and Use of Transboundary Watercourses and International Lakes (LGBI. 1998 No. 22)

Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (LGBI. 1992 No. 90)

Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention; LGBI. 1998 No. 157)

Convention on the Protection of the Alps and the protocols on spatial planning and sustainable development, mountain farming, conservation of nature and landscape protection, mountain forests, tourism, soil conservation, energy, transport, and solution of litigations (Alpine Convention; LGBI. 1995 No. 186)

Promulgation of 17 March 2009 of the Decision of the EEA Joint Committee No. 125/2007 (LGBI. 2009 No. 109)

6 Abbreviations

AWNL – Office of Forests, Nature and Land Management

CIPRA – International Commission for Protection of the Alps

FSC – Forest Stewardship Council

IRKA – International Government Commission for the Alpine Rhine

PEP – Proof of Ecological Performance

7 Annex I: Information on the State Party and preparation of the report

State Party

State Party	Principality of Liechtenstein
National Focal Point	
Name of institution	Office of Forests, Nature and Land Management (AWNLI)
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Submission of report	
Signature of person responsible for National Report	
Date of submission	

This report was compiled by the Office of Forests, Nature and Land Management (AWNLI) in collaboration with other Government offices, especially the Office of Environmental Protection and the Office of Agriculture.

8 Annex II: Progress relating to Global Strategy for Plant Conservation

Protection

The plants in Liechtenstein have been researched thoroughly, so that one can assume that all existing plant species have been classified. Flora of the Principality of Liechtenstein serves as a reference work on vascular plants in Liechtenstein. The Natural History Collection maintains a herbarium. The Red List of Vascular Plants was revised in 2006, including adjustment of threat categories to the IUCN criteria. Of the total of 1,531 evaluated vascular plant species, 379 (25%) were included in the various categories of the Red List (categories RE, CR, EN, VU, R). 56 species are considered extinct, 68 species (4%) critically endangered, 61 species (4%) endangered, and 110 species (7%) vulnerable. 84 species (6%) were classified as very rare in view of their area of distribution.

Nature and forest protection areas are the two categories of protection area that focus on the conservation of habitats for threatened plant and animal species. They cover 2,045 ha or 13% of the territory of Liechtenstein. The Liechtenstein mountain area is also a contiguous plant protection area covering 6,246 ha. To protect Alpine plants, it is prohibited to pick them in the plant protection area. On the other hand, grazing is allowed and promoted. The alp cultivation of unforested areas helps keep the species-rich flower meadows of the mountain area free.

Sustainable use

Sustainable agriculture is pursued by promoting sustainable farming and extensive cultivation of near-natural areas. 28% of Liechtenstein farms meet the standards of organic farming. The extensively cultivated near-natural areas cover 789 ha or 21% of the farmland. While sustainable use in agriculture is promoted via financial incentives, it is legally mandated in forest management. The Forestry Act specifies that near-natural silviculture constitutes the basic use. The entire Liechtenstein forest is certified according to the criteria of the Forest Stewardship Council (FSC).

Conservation of genetic diversity

Conservation of the genetic diversity of cultivated plants has been ensured by the project of the same name since 2001. The focus is on fruit varieties and a regional corn variety. Various conservation measures are taken (variety-specific orchards, conservation cultivations, and seed storage). An association provides the platform for activities relating to the conservation of varieties and engages in public outreach.