Rapid Biodiversity Assessment for the Alps Ecoregion

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Executive summary

The WWF Alpine Programme requires a quick but effective assessment of biodiversity at the different levels of organismic organisation (genetic, species, community, landscape diversity) found within the borders of the territory of the Alps. There is no other high mountain system in the world whose biodiversity is so well known, but synoptic attempts for the Alps as a whole are not available. A thorough study of all available data may take at least two years of intensive work. Nature conservation is well advanced too, but laws in the alpine countries are different, and the executive bodies are individually structured. Therefore, the members of the steering committee, the country co-ordinators, and the consultant agreed to start with an iterative process focusing at the first stage on the ad hoc expertise of the consultant.

Some basic statistics about the Alps

Geographical position: between latitudes 44^{o} and 48^{o} N, longitudes 5 and 16^{o} E, forming an arc of 1200 km length from Nice to Vienna. Different subdivisions exist; mostly used is the distinction between East and West Alps: The East Alps are characterised by a strict geological symmetry with Northern Limestone, Central Silicious, and Southern Limestone Alps. The West Alps are not symmetric, but higher in elevation (highest summits: in the west Mont Blanc -4807 m-, in the east Großglockner -3797 m-). The Alps cover about 181 000 to 190 000 km^{2}, belonging to Austria, Italy, France, Switzerland, Slovenia, Germany and Liechtenstein. The overall population amounts to 11,1 million.

Alpic versus alpine

Writing about the Alps from an ecological point of view always creates the problem of distinguishing between, for example, a plant species which occurs exclusively within the borders of the Alps, and thus could be called "alpine plant" or a plant species not only restricted to the Alps, but within the Alps, only occurring above tree-line (i.e. the zone which ecologists usually call "alpine"). This problem of a confusing terminology is solved here in the way that everything which is related to the Alps as a geographical unit is termed “ALPIC" (in German "Alpisch") if the zone above tree-line is considered the term “ALPINE” is used.

The environment

A global perspective

The Alps are an interzonal mountain system, situated between the temporal life zone of central Europe with deciduous forests as potential natural vegetation and the Mediterranean life zone with evergreen forests of sclerophyllous tree. The ecological patterns are not only determined by the abiotic environmental factors but also still reflect historical impacts such as the pleistocenic glaciation, as well as the human influence since neolithic times. The Alps and the other European mountain systems are rather unique environments on the globe.

Geomorphology

Geologically the Alps are very young. Lithologically, the bedrocks can be divided into calcareous and siliceous material, in hard rocks and deep-weathering layers. Many of the bedrocks are covered by diluvial, alluvial or colluvial deposits. The steplike alpine morphology was contoured by the pleistocene glaciation.

Climate and vegetation

The major part of the Alps is influenced by a cold temperate (=nemoral) climate characterised by sufficient precipitation during the warm periods, and winters cold enough to induce a winter dormancy in vegetation. As a consequence, the potential natural vegetation in the surrounding lowlands is deciduous forest. At higher elevations most of the steep slopes are covered with mixed forests (beech, fir) in the outer parts, and mixed coniferous forests (spruce, larch) in the drier interior. The forests at tree-line are: 1. Pure spruce forests or prostrate pine forests in the outer regions, 2. Mixed forests with larch and arolla pine in the inner parts, and 3. Mixed beech/fir forests in some of the most exposed southern mountains.
Above tree-line a girdle of dwarf shrub heath replaces the subalpine forests. A belt of alpine grasslands occupies the next 400 meters, followed by open herb fields. The uppermost record of vascular plants is at 4450 m.

Landscape pattern

3 general types:

1. *The deep main valleys (below 800m) represent narrow corridors. They have always been important migration corridors and provided a variety of specific habitats which have been reduced significantly (e.g. river beds, mires, steppes),*
2. *The tape-like corridors of the mountain forests (800-2000 m) which are still in a relatively natural state in spite of human influence since prehistoric times, and*
3. *The island-like patches of the areas above tree-line, surrounded by a "sea of forest".*

Species diversity

Plants

About 4500 species of vascular plants may be found in the Alps; about one-sixth may be restricted to high altitudes. Up to 400 species can be regarded as endemic to the Alps. The contribution of endemic plants to the diversity of the flora and fauna increases with increasing elevation whereas the overall diversity decreases with increasing elevation. Mosses (ca. 800), liverworts (ca. 300), lichens (ca. 2500) and fungi (>5000 species) contribute essentially to the overall floristic diversity. The most threatened species are those which are restricted to specific habitats in the densely settled valleys (synanthropic flora, wetland species, steppic flora). Lichens have suffered significantly from air pollution.

Animals

About 80 mammalian species, most of them small ones like bats, shrews, mice, and voles occur within the borders of the Alps (this figure includes those which only "touch" the Alps marginally). None of them can be regarded as strictly endemic. Though all of the typical mammals still exist in the Alps many of their populations, the large carnivores in particular,

have been reduced in size and/or have been disintegrated into small remaining subpopulations, or may suffer from increasing disturbance by tourism, expanding settlements and urbanisation.

The key problem for large carnivores is the availability of enough remaining wilderness areas or areas free of direct disturbance suitable to maintain viable populations. The large herbivores on the other hand are widely distributed and occupy most of their potential habitats in the Alps, even when their old migration routes from summer to winter pastures (and vice versa) have been interrupted and disturbed by roads and settlements.

Among the other groups, the bats and some shrew species deserve special attention, as many bat species have lost appropriate habitats or habitat quality has decreased significantly.

About 200 breeding birds might be registered for the Alps. At least the same figure may also be applied to those which migrate through the Alps (importance of large lakes around the fringe of the Alps as stepping stones for seasonal bird migration!), stay in the Alps during winter time, or occur accidentally. There exists no endemic bird species occurring exclusively in the Alps, but for some species their Alpic population is the largest. Similar to the large mammals, those birds which are somewhat in competition with man have suffered most from direct interference, especially predating birds, such as the golden eagle, peregrine, bearded vulture.

21 species of amphibians, one of them endemic (Salamandra lanzai), are Alpic. Most are severely threatened by destruction of their habitats. 15 species of reptiles have been recorded so far. Their habitats, mostly dry rocky areas, are less endangered than those of the amphibians.

About 80 fish species live in alpine lakes and rivers. Besides water pollution, in lakes the introduction of exotic species must be considered potentially the most disastrous impact of man into Alpic biota. The fish fauna of the rivers is threatened by damming the rivers for power plants and damming the river flooding areas.

Still completely insufficient is our knowledge about Alpic invertebrates, though some groups like the butterflies or the dragon flies are comparatively well known. Invertebrate diversity overrules that of the vertebrate species at least by a factor of twenty; an absolute value might be even more. About one third of the species are considered as threatened, mainly due to habitat loss and loss of habitat quality.

Habitat diversity, community diversity

Species diversity is related to habitat diversity. The loss of sufficiently represented small habitats is probably one of the major causes for the steady decline of biodiversity in the cultural landscapes.

Most of the habitats might be occupied by several plant community types, depending on slope, elevation, bedrock material etc. A rough estimate might end up with about 900 plant community types. About a quarter of the community diversity is man-made and can only be maintained by specific kinds of land use, especially the many types of mountain meadows.

Landscape diversity

The mountains as landscape units can be ecologically classified as follows:

1. *Calcareous rock mountains (chains, needle-like forms or plateau-mountains with huge karst areas)*
2. *Equivalent siliceous rock mountains (excl. karst)*
3. *Glacier mountains (large, predominantly siliceous mountain systems)*
4. *Siliceous highland (intermediate altitude and hilly appearance, occasionally with solitary glaciers)*
5. *Grass mountains (of "soft" materials with pyramid-shaped forms).*

Scenarios for the landscape of tomorrow have to be based on landscape classification. Satellite images, GIS-techniques and computer models provide new and spectacular opportunities for defining landscape types and scenario for future states.

The most severe threat to the Alpic landscapes, the rural landscapes in particular, is damage to their naturalness. Even densely populated valleys, such as the Montafon in western Austria, are occupied up to 90% by natural and seminatural habitats. To keep this high percentage is generally the goal for landscape protection.

Human use and impacts – the ecological perspective

The land use since early times for traditional agriculture and the different development after the Second World War formed specific cultural landscapes.

Alpine farming

Traditional alpine farming made a radical change during the last 50 years, leading to abandonment of settlements in the south, and industrial farming in the north. Both brought a decrease in species and community-type diversity and a severe threat, especially to alpine pastures and mountain meadows either disappearing or transforming to "green deserts".

Tourism

Besides trampling or disturbing animal life in subalpine forests, the most severe direct impact is the bulldozing of ski runs. The worst indirect effect is motor traffic.

Air pollution and related effects

Up to half of the forests of the Alps show suboptimal vitality, which is at least in part a consequence of air pollution. Pollutants are transported to the Alps from industrial centres far away (acid rain!) or are results of motor traffic and increasing settlements in the valleys.

Climate change

The greenhouse effect may affect the Alps in different ways. The most significant effects of warming may be extinction of summit plants and changes in species composition of Alpine plant communities.

Hunting

Man has influenced the natural wildlife substantially, shooting "competitors" like the brown bear, the lynx, the bearded vulture and the golden eagle to or close to extinction. Of the formerly widespread ibex, only a small herd survived in the Gran Paradiso area. Its reintroduction is an impressive success. On the other side, hunters have always kept an eye on maintaining good numbers of roe deer, red deer and chamois, which in some regions is a problem for the regeneration of subalpine forests.

Conclusions

The major threat to wildlife is a ***general disintegration and loss of habitats (small ones in particular) and populations****. The Alps have become unsuitable for large carnivores in many regions, or it is difficult to restore their populations. This is especially true for the north. In the south, recolonization of such species may be possible, and is already going on, but depends very much on the acceptance of the hunting society, and the remaining farmers.*

Over-exploitation *in and around tourist centres disturbs the appreciation by people, and has led to the widespread opinion that the Alps are "lost" and spoiled. This cannot be fully accepted from a biodiversity point of view as most wildlife still exists. However, many species are suffering from a decrease in their population, as quality and size of their habitats have been reduced. This is especially true for the valley bottoms, the large rivers, and the mountain forest belts.*

Threats *are also* ***related to agriculture*** *especially if introducing industrial agricultural practices. Many mountain meadows and pastures are replaced nowadays by "green deserts". Access roads are built to the uppermost reaches, and manure from the Alp-shelters is distributed over natural grasslands which are extremely sensitive to fertiliser.*

Abandonment of agricultural land *is not necessarily negative from an ecological point of view. Forests may reappear. In the alpine belts not much change is to be expected. The common opinion that abandonment might increase the danger of natural hazards has never been studied critically. Probably it is not as severe as is often stated.*

Probably ***in the worst situation is the fish fauna****. Introduction of exotic fish species in mountain rivers reduced the autochthonous populations. Electric power plants interrupt migration passways, and produce frequent floodings which decrease the biomass of the benthos fauna. Water pollution has made large rivers unsuitable for sensitive fish species. Damming rivers has destroyed the integrity of the river systems with sidearms and backwaters.*

Recommendations

The author suggests the following activities on which WWF should focus in descending priority:

1. The central conservation task for the Alps is saving its high degree of naturalness, saving the remaining intact wildernesses, and restoring wildernesses wherever it is possible. For a WWF campaign, the wilderness theme can be transported with the large carnivore project

*whereas "wilderness for man" as an adventurous enterprise should be presented as well. Motto: "**Making Alpine wilderness for all".***

*2. A campaign for supporting organic farming with special focus on the maintenance of typical mountain meadows and pastures is urgently needed. Motto: "**Producing beauty - a championship for alpine meadows".** This campaign could also be combined with a strategy to save old breeds.*

*3. An alpine fish strategy should be developed and implemented, also covering the large alpine rivers (Rhine, Rhone, Danube, Po) as long they are alpine in character. Motto: **"Look under the water".***

*4. An alpine wetland campaign should be launched to save and restore habitats for amphibians and wetland plants, wet meadows in particular. Motto: "**Alps on the wet side"***

The next two suggestions are for increasing awareness of the biodiversity problem, and for restoring admiration for mountains, and the Alps as a whole by local and urban people.

*5. A campaign could be started to document the value of mountains as a complex habitat for the organismic world, but also for recreation and education for people. Throughout the Alps communities should be asked for their "best" mountain. Those which have remained unspoiled should be declared sanctuaries for the future as symbols for life and nature thus contributing to a "new mountain ethic". Access to the summits should only be possible by walking and climbing from the very bottom. Motto: **"Our Holy Mountains".***

*6. Invertebrates are rarely recognised by people. Many of them are threatened by habitat loss. A campaign taking an invertebrate flagship species may help to draw attention of a broader public to this problem. Motto: "**Give a home to homeless butterflies**"*

7.** The integration of the knowledge on Alpic biodiversity is virtually not available. GIS-activities are restricted to national working groups. The development of an alpine GIS-biodiversity base is certainly the biggest task for the future, but not manageable in the short term. For the campaign, the author suggests looking for already available maps and data, and combining them into useful tools. Well-documented case studies for most of the cited facts should be selected and presented. Motto: **"From data basins to databases – structuring the Alps by GIS".

General Conclusions

*The Alps are **still a high mountain system of great beauty and naturalness** hosting a diverse flora and fauna. Cultural landscapes, the result of settlement for many generations, contribute essentially though the local people have not always interfered into their environment sustainably. **Modern trends** are: decreasing importance of agriculture, high intensity of tourism, expansion of urban centres and, in turn, development of commuter systems. The latter is supported by improved traffic facilities. Probably no community has remained in the Alps whose economy is exclusively based on agriculture. Electric power plants interrupt most of the large rivers, and have changed their hydrology. Tourist facilities, roads and cable cars in particular, have fragmented the mountain forest belt.*

From a socio-economic point of view, the Alps have two faces: the southern one, and the northern one. Whereas in the north, agriculture has been replaced by tourism or commuter systems, or is still in comparatively good shape, most former agriculture has disappeared in the south and south-west, having not been substituted by other economies. Large areas are abandoned and change to forests or natural grasslands. A loss of naturalness in the north is contradicted by an increase in the south.

Ecologically, conservation activities must consider the partitioning of the Alps into biogeographical units, each very different in character and conservation needs. The recommended campaigns for WWF are not necessarily to be applied to the whole of the Alps. Different approaches could concentrate on different regions. In general there is still much to protect in the Alps. Though their steepness, rockiness, and harsh environment are their own "best friends", maintenance of life in all its facets needs support.

From a political point of view, conservation measures based on the community approach should also be considered. It is a direct approach, which is closest to the local people without whose support most conservation approaches may fail. Nevertheless higher levels in the administrative and political hierarchy must be considered as well. The most recent issue might be supporting NATURA 2000.

Bibliography and sources

The relevant literature about the Alps fills libraries. Thus only a selection of literature can be mentioned here which must be somewhat subjective and arbitrary. The cited literature covers a broad spectrum of issues in response to the given terms of references by WWF. Only such papers or books are cited which have been published after 1980. Only in a few exceptional cases, older literature is cited. Most of the sources come from the listed literature. The sources are extensively commented on along the terms of references at the end of the assessment. Briefly, much is known but synoptic approaches for the Alps as a unit, and GIS work in particular, are lacking.

Introduction

The Alps are one of the most outstanding high mountain systems on the globe **(map 1**), and represent the richest biodiversity hot spot in Europe **(map 2**). Human use and impacts have altered the suitability of alpic habitats for many plants and animals since prehistoric times but have never been so severe as to destroy the beauty and richness of this mountain system. This statement holds true regardless of the fact that, historically, large carnivores and predatory birds have been pursued to – or close to – extinction, forests have been cleared for pastures, meadows and arable land, rivers have been dammed and polluted, or alien plants have changed natural species assemblages. However, the modern forms of global change such as climate change, air pollution, ozone effects, land-use change and biodiversity loss are going to affect the Alps with increasing intensity. A new vision for the Alps is needed, predominantly to preserve its beauty, high degree of naturalness, and diversity of life and cultures.

It is due to this background that WWF has decided to launch a programme for the Alps as a contribution to the world-wide living planet campaign. To be most effective a general strategy for the campaign has been designed whose initial activity is reconnaissance of the state of the living world for a particular target region, and the related problems. The reconnaissance phase includes the assessment of biodiversity and socioeconomics. Future scenarios should be explored, from which necessary actions could be derived. These actions should be based on common sense, and not implemented against the interests and feelings of the local people. They should provide options for a future which is in agreement with both the human desires, and the demands of the natural world.

This report is the first attempt to elaborate a reconnaissance for the Alps, which will provide the basis for targeted actions. It is a "first shot" based on the expertise of the authors, and the key literature having been published during the last decades.

Rationale for a rapid Biodiversity assessment

The WWF-Alpine Programme requires a **quick but effective assessment** of biodiversity at the different levels of organismic organisation (genetic, species, community, landscape diversity) found within the borders of the territory of the Alps. Members of the steering committee, the country co-ordinators, and the consultant agreed to start with an **iterative process** focusing at the first stage on the ad hoc expertise of the consultant. This agreement is based on the following considerations:

1. A thorough in-depth study of which data are available, and in what form, may take at least two years of intensive research and compilation. There is no doubt that no other high mountain system exists in the world whose **biodiversity is** so **well known** as that of the Alps. Unfortunately synoptic attempts for the Alps as a whole are **not available** (maybe a few in the next years; e.g. Flora Alpina project) either **as structured data sets** (as printed matter or in GIS-compatible form) or as comprehensive thematic maps. Synoptic work has to be encouraged as much as possible. Some basic activities, such as **providing maps of species richness** for vascular plants, mosses, lichens, mammals, birds, amphibians and reptiles on a grid basis, as well as for endangered species of these groups should be considered as the **most important** follow-up activities. Derived products could be based on political or functional units (e.g. communities, administrative units such as the Austrian "Bezirke").

2. **Nature conservation** has an old tradition in the Alps, and is well-advanced (**map 3**). However, each country has it organised in its own way; the laws are different and the executive bodies individually structured. Though co-ordinated approaches have been attempted by the Alpine Convention, conservation practice is still far from being in agreement with the ambitious goals of the convention. The NGO scenery, though effective in particular countries, is **extremely heterogeneous** regarding strength, size, goals, and basic attitudes.

3. Nevertheless basic patterns on animal diversity, flora, vegetation, and the general ecological problems are well known. The most important conservation issues are evident. A **vision for the Alps**, however, though appearing from the actual state of knowledge, is basically a matter of ethical background as well as individual anticipation. Of course, for WWF one might accept that vision which helps to maintain the biodiversity of the Alps in all its facets, and to support the natural dynamic and evolution as much as possible.

Some basic statistics about the Alps

The geographical position of the Alps can roughly be stated as between latitudes 44° and 48°N, and between longitudes 5° and 16° E, stretching from Nice to Vienna, measuring approximately 1200 km along its axis, and fitting into a **900 x 500 km rectangle (map 4**). Within this rectangle, the Alps form an arc with its widest points 240 km across. The regions **above 1800 (outer parts) – 2400m (inner parts)** is the **treeless alpine zone (map 5)**, which frequently extends up to 2800m. At this elevation which roughly corresponds to the permanent snowline (or better the permafrost limit) the alpine zone transgrades into the nival zone which expands over comparatively large areas, particularly in the Western Alps (map 6). The highest summits are Mont Blanc in the west (4807 m), Piz Bernina in the middle (4049 m), and the Grossglockner (3797 m) in the east.

The **Alps have been subdivided from physiographic, biogeographic points of view** in many ways. A classical one is the distinction between Eastern and Western Alps (**map 4**), the border between the two units set as a line connecting the Lake of Constance with the Lake of Como. The **Eastern Alps** are, for example, characterised by a strict geological symmetry with Northern Limestone, Central Silicious, and Southern Limestone Alps (**map 7**). The **Western Alps** are not symmetric but are higher in elevation if taking the average (**map 6**). Based on a combined approach considering geomorphology, geology, climate, vegetation, flora and fauna P.OZENDA defined 9 biogeographical (or ecological) sectors (**map 8**) which can be further subdivided. The principal divisions are: 1. Wet peripheral parts versus dry inner zones, 2. Areas with contact to the Mediterranean life zone in the south and south-west versus areas with contact to the continental, pannonic life zone to the east versus the "temporal" Alps in the north; and finally 3. Calcareous parent rock materials (dolomite, limestone etc.) versus siliceous ones (gneiss, granites, schists, phyllite etc.)

The **Alps cover** about **181 000 km^2** to **190 000 km^2** (according to different authors and the Alpine Convention). The largest part belongs to **Austria (30%) followed by Italy (28%), France (20%), Switzerland (15%), Slovenia (4%), Germany (3%), and Liechtenstein (<0,01%).** The overall **population amounts to 11,1 million**, the highest population density is found in Liechtenstein (180 inhabitants/km^2), followed by the German Alps (84 inhabitants/km^2), by the Italian part (75), by Switzerland (66), Slovenia (55), Austria (53), France (48). In the French and Italian Alps the population of the rural areas has decreased

significantly since the end of the 19th century, less in Switzerland and Slovenia, at a low rate in Austria (for more details see the Socio-economic assessment by BÄTZING). No decrease has been found in the German Alps and Liechtenstein. In broad terms, the areas **south of the main ridge, and in the Southwest Alps** have experienced a **depopulation** process leaving much agricultural land abandoned (note exceptions such as South Tirol, East Tirol, Carinthia), whereas in the north the population has increased. There, abandonment of agricultural land has been less pronounced.

Regardless of the population dynamics, **human impact decreases with altitude** which is in agreement with the fact that most land above altitudes of 1000 meters is in a fairly natural state (**map 9**) though some urban centres such as Davos, St. Moritz or tourist resorts such as Ischgl, Zermatt, Val d'Isere may spoil this positive conclusion from a conservationist point of view. Increasing naturalness with increasing altitude had also been evidenced by the comprehensive survey of the naturalness of the Austrian forests (**map 10**). The degree of naturalness is highest in the central Alps, still high in the northern and southern Alps (but note exceptions such as to the south-east) but low in the forelands **(fig.1)**. Above the low montane belt (above ca. 1000m) more than two thirds of the forests are only moderately altered, close to natural (i.e. species composition is generally close to the natural one) or natural, in the subalpine belt more than half of the forests are natural or close to a natural state. The results of the inventory of biotopes of high conservation value for the alpine country of Vorarlberg support this. The valuable biotope areas expand over more than 20% of the total area of most subalpine and alpine communities (i.e. communities which contain large areas of these zones; the centre can be lower down) (**map 11a,b**).

As a conclusion the most outstanding characteristic of the Alps from an ecological point of view is, still, its high degree of naturalness. Ahemerobic (= almost natural, pristine) areas exist, in the alpine zone in particular (about 15-20% of the total area). The **most severe threats** – besides global change effects such as air pollution or anthropogenic climate change – are **disintegration and disturbance of large natural areas** by roads, expanding tourist resorts, and access roads for forestry and alpine pasturing. Nature conservation should primarily concentrate on **protecting the remaining large wilderness areas** (for example as protected areas according to 1b of the IUCN categories), **and** on **restoration of wilderness areas** wherever possible (e.g. in valleys having been left abandoned; see also BÄTZING'S Socio-economic assessment).

The environment

A global perspective

Ecologically the Alps can be considered as an **interzonal mountain system** or orobiome, situated between the temporal life zone of central Europe with deciduous forests as potential natural vegetation and the Mediterranean life zone with evergreen forests of sclerophyllous trees. The transitional characteristic, but also the uniqueness of the Alps as an ecological unit, is impressively documented by the simple map of the start of flowering of lilac in Europe **(map 12**). Phenological maps like that combine the patterns of climate with the reaction of the plants (or animals). Other mountain systems close to this type are the Pyrenees, the Southern Carpathians, the mountains of the northern part of the Balkan Peninsula, and the Caucasus (**map 13**). No true equivalents can be found in other parts of either the Northern or the Southern Hemisphere. The "Japanese Alps" and the "Alps of New Zealand", for example, are

mountains on islands and therefore much more oceanic in character without contact with a semiarid environment of the Mediterranean type. Biogeographically, the flora and fauna of the Alps consist of a core of species endemic to central and southern Europe (see below). And, last but not least, man has influenced the high-mountain ecosystems of the Alps (e.g. in contrast to the Japanese Alps) since neolithic times with increasing intensity. The Alps and the other European mountain systems are, in fact, **rather unique environments on the globe**.

Geomorphology

Geologically, the Alps are **one of the youngest mountain systems** of the world, comparable with the Himalayas, the Andes, and other mountain systems which developed from the tertiary period up to the present. The process of upheaval has been interrupted several times by periods of stability during which the surfaces were eroded (fossil land surfaces are still recognisable around 1800m, 2500 m and 3000 m). Deep valleys were then cut by rivers and the sediments were deposited in the lowlands forming today an envelope of young sedimentary rocks (conglomerates, marl, sandstone) around the Alps, known as molassis.

The **steplike morphology was contoured by the glaciation** during the Pleistocene, when most parts of the Alps were completely covered by an enormous ice cap. Only in the south, the south-west, and the east were larger areas left free of a continuous glaciation (**map 14a**). The valley glaciers sharpened the contours of the slopes and left huge moraine deposits in the valleys and on the old land surfaces behind the valley shoulders that frequently coincide with the timberline. From the ecological point of view, it is important to note that the alpine environment occupies comparatively large areas (**map 5**). That might also have been the reason the higher altitudes could easily be used for summer farming up to the glaciers at about 2800 m even in prehistoric times.

Lithologically, the **bedrocks** of the Alps can be **divided into** two major types: **calcareous rocks and siliceous material (map 7,8)**. As a rule of thumb one can say that the enveloping outer chains are built of calcareous, the inner ones of siliceous materials. A further subdivision might be into hard rocks (limestone, dolomite, marble, granite, gneiss, amphibolites, porphyritic materials) and deep-weathering materials like marl, shale, phyllites, conglomerates, sandstone, and others. Calcareous materials are more diverse than siliceous ones, frequently arranged in complicated patterns. Last but not least, a series of intermediate rocks or special types should be mentioned: gypsum, slate, schists, greywacke, ophilites, gabbro, and serpentine.

As already mentioned, many of the bedrocks are covered by diluvial, alluvial, or colluvial deposits. Their lithological composition as well as their dispersion is important for soil formation, which has been active since the disappearance of glaciers and permanent snow fields. **Soils are** in very different stages of development depending on altitude, slope, exposure, and age of the deposits. Generally they are **very young** (e.g. compared to soils in tropical mountains**)**; the oldest ones in the alpine zone might be a few thousand years old. At the present-day timberline, charcoal layers indicate past burning activities, frequently dating back to the early settlements 2000 years and more ago (e.g. carbon-dated layers from Tirol). Erosion increased after burning, as indicated by sandy layers, above which are recent organic horizons if forest could reinvade the burned areas.

Climate and vegetation

With the exception of the south-westernmost Alps and some sheltered spots along the southern fringe (e.g. Lake of Garda), the major part of the area is influenced by a cold temperate (=nemoral) climate characterised by sufficient precipitation during the warm periods and winters cold enough to induce a winter dormancy in the vegetation (**map 15**). As a consequence, the **potential natural vegetation (map 16) in the surrounding lowlands is deciduous forest** (ref. Veg. map), mainly composed of beech, oaks (*Quercus robur*, *Q. petraea*, *Q. pubescens*), and other broad-leaved trees (various maple, ash, lime tree, and elm species) (**map 17**). Sclerophyllic evergreen Mediterranean trees (e.g. olive tree, evergreen oak = *Quercus ilex*) occur in the above-mentioned areas of Mediterranean character.

The climate varies remarkably from the outer regions to the valleys of the interior and from east to west. The **interior valleys can be very dry** (e.g. Val Venosta, Valais) (**map 18**), whereas the northern and southern slopes receive a relatively large amount of rain in summer and snow in winter (annual means up to 2500 mm) (**map 19**). Coniferous forests like **pine forests** (with *Pinus sylvestris*) **and mixed spruce forests** (with *Picea abies* and *Larix decidua*) are more prominent here than broad-leaved forests, which are restricted to the warmest parts (e.g. *Quercus pubescens* forests in the outer Vinschgau).

At higher elevations most of the steep slopes are covered with mixed forests (beech, fir) in the outer parts, and with mixed coniferous forests (spruce, larch) in the interior (**map 16, fig.2**). The forests at tree-line are: 1. Pure **spruce** forests or **prostrate pine** forests (with *Pinus mugo*, eastern Alps) in the outer regions, 2. Mixed forests with **larch** (*Larix decidua*) and **arolla** pine (*Pinus cembra*), in the inner parts, and 3. Mixed beech/fir forests in some of the most exposed southern mountains (e.g. Monte Baldo).

Above tree-line (**fig.2**) a girdle of **dwarf shrub heath** with Alpine roses (*Rhododendron ferrugineum*, *R. hirsutum*) and other ericaceous species replaces the subalpine forests. A belt of **alpine grasslands** occupies the next 400 metres towards higher elevations whereas grasslands on calcareous soils and those on siliceous soil can be clearly differentiated. In the Central parts these grasslands change to **open herb fields** at about 2800m (much lower in the outer chains) with many cushion plants. Vascular plants may then grow up to elevations higher than 4000m; the **uppermost record is at 4450m**. Mosses and lichens occupy even the uppermost summits.

Landscape patterns

Ecologically relevant patterns at the landscape level appear when viewing the Alps from above. **Three general types** can be distinguished: 1. The deep main valleys (= zone below 800m) representing **narrow corridors**; 2. The **tape-like corridors** of the mountain forests (=zone between 800 –2000m), and 3. The **island-like patches** of the areas above tree line.

The **deep valleys** (**map 20**) with their rivers have always been important migration corridors, however, also provide a variety of specific habitats (riverbeds, riverside forests, mires, alpine steppes etc.). Most of these habitats are small, and many have been destroyed by expanding settlements. Nowadays barriers such as urban centres occupying the whole valley bottom, electric power plants etc., frequently interrupt the migration corridors. The specific valley bottom habitats have been reduced significantly; the remaining sites are generally endangered

by expansion of the settlements, by changing agricultural use, by melioration, and by land use changes (e.g. replacing meadows and pasture by golf courses).

The **mountain forests** (**map 21**) cover the valley slopes like a girdle. Having always been considered as protecting the settlements in the valleys, they have been maintained in a relatively natural state despite being used for timber, fuel-wood, and forest pasturing. However, close to timberline, slash and burn for the creation of pastures has reduced the total area of subalpine forest since prehistoric time. Nevertheless, the mountain forests are still the most important habitat for the majority of the large herbivores and carnivores. The tape-like structure, however, requires long undisturbed sectors. Interruption of closed mountain forests by cable cars, skiing areas, and roads has led to the endangerment of sensitive species such as capercaillie.

The **alpine zones** (up to the highest summits) (**map 22)** are in the strict sense, that is the zone above tree-line, islands surrounded by a "sea of forest", or at least were in former times. Plant and animal species live in isolated populations; in fact, the high alpine areas of the Alps host many relictic species. Genetical drift may change the genetic variability of these populations that might result in new forms, varieties, subspecies, or even new species in the near or far future. The Alps – like other high mountain systems – have always acted as a kind of "evolutionary engine".

Species diversity

Plants

The present-day flora of **vascular plants** in the Alps can be estimated to contain about **4500 species**; about one-sixth may be restricted to high altitudes. Up to **400 species** can be regarded as **endemic to the Alps**, a large proportion belonging to the genera Campanula, Draba, Pedicularis, Phytheuma, Primula, Ranunculus, Saxifraga, and Viola (**map 14b,c**). There exists no endemic family, and only one endemic genus, i.e. Berardia. About 66 endemics are distributed throughout the Alps; the remainder are concentrated in areas which served as **refugia** during the Pleistocene glaciation: i.e. the **Alps Maritimes**, the **southern** and **south-eastern Alps**, and the eastern-, **north-easternmost Alps** (**map 23**) The number of endemics increases with increasing altitudes. Many of them are restricted to subalpine and alpine altitudes. They contribute about 15% of the whole alpine flora in the strict sense (i.e. the flora at and above the timberline). Another group includes species (about 35%) which occur not only in the Alps, but also in the surrounding mountain systems of central and southern Europe. This group is especially noteworthy, as the dominant graminoids which are the **key species** of the alpine grasslands belong to this group. Thus, up to **half of the high-altitude flora belongs to phytogeographically quite restricted types**. The other half invaded the Alps mainly during late- and postglacial times, migrating from the Arctic to the south, the highlands of central Asia to the west, from southern refugia to the north, from the Atlantic region to the east etc. (**map 24**).

Mosses (ca. 800), **liverworts** (ca. 300), **lichens** (ca. 2500), and **fungi** (>5000 species) contribute essentially to the overall floristic diversity. Most species are widespread, and not restricted to the Alps. Endemism is not very significant (<5%) among these groups though many species are to be considered as restricted to particular habitats or as sparsely distributed. Moss and lichen diversity is still high at the very high altitudes. Among the **algae** of the standing and running waters, as well as of wet rocks, soils, bark of trees etc. the few members

of the red and brown algae group deserve special attention. They occur in clean running waters of the low and middle altitudes. Another group of algae, the Desmidiaceae or Zieralgen, is specialised to dystrophic waters, and therefore to peatlands. It is a diverse and spectacular group of tiny plants whose beauty, however, can only be discovered under the microscope.

The **"hottest" spots of vascular plant diversity** as derived from the Flora Europaea mapping (i.e. >900 species per quadrat; a quadrat amounts to 36 km^2) are concentrated **south of the main ridge**, and to the fringe of the Alps, most significant in the east where the Alps join the pannonical lowlands, and in the far south-west where the Alps come in close contact with the Mediterranean life zone. The calcareous Alps are generally richer (>700 species per quadrat) than the siliceous Alps. A high variability in altitude is not closely correlated with a high diversity. **Mosses and lichens** show highest diversities **in the wetter parts** of the Alps. Regarding **fungi**, many of them are mycorrhiza partners of many trees of the mountain forest, thus **mountain forests** are the hot spots for this group of organisms. Their species richness (though not necessarily the abundance of particular species) is highest on calcareous soils. Above timberline only a few species of fungi occur.

Checking Red Lists which are available nowadays for all nations expanding to the Alps as well as for many regions (e.g. the counties of Austria, South Tirol etc.) it becomes evident that the **most threatened species** are those which are restricted to specific habitats in the densely settled valleys (**synanthropic flora, wetland species/ map 25,26,27, steppic flora**). The forest and alpine flora is less endangered (for an exception see **map 28**). The endemics are mainly listed under the category "potentially endangered", or rare, those in particular which are restricted to only a few sites. **Lichens have suffered from air pollution** significantly. Many sensitive species have disappeared from large areas in the Alps such as *Usnea longissima* or *Lobaria pulmonaria*. Air pollution, and the related acid rain, may **also** have **effected** the **mycorrhizas** of many fungi species. A general decrease of abundance of many species has been observed during the last years. Collecting mushrooms is considered as no real threat, though in some regions (Italian Alps in particular) overuse can result in local disappearance of fruit bodies. Among mosses those from peatlands and wetlands are generally highly endangered by habitat destruction. The same holds true for the Desmidiaceae.

Each responsible legal unit in the Alps (e.g. the counties of Austria) protects plant species by law. However most lists of **protected plant species** contain only ornamental or charismatic species such as Edelweiß. Only a few attempts have been made to include truly endangered or naturally rare species - noteworthy, the inclusion of the alpine species *Trifolium saxatile* in the list of protected species in the FFH-directive of the European Union. According to the experience of the author, direct species protection should not be underestimated. Collecting rare and ornamental species such as Edelweiß or alpine rose which had been a true danger to some local populations is virtually no problem anymore. Not to collect a plant such as the lady`s slipper is a signal for many people to become aware of the vulnerability of alpine plants and animals. As a consequence, the revision and expansion of the lists of protected plants and animals may improve this "direct" approach to conservation. **Starting an alpine-wide movement for establishing "TRUE LISTS" of endangered species for protection may** certainly be a fruitful activity. Of course this must be accompanied by activities for the protection and maintenance of appropriate habitats (see below). The same holds true for the cryptogams, especially those that are restricted to specific ecological niches.

Animals

About **80 mammalian species**, most of them small ones like bats, shrews, mice, and voles, can be found on the territory of the Alps. None of them can be regarded as strictly endemic though at a subspecific level typical alpine mammals such as marmot, ibex, snow hare, and snow mouse are genetically different to equivalent populations of other mountain systems in Europe, or the Arctic respectively. Though all of the typical mammals still exist in the Alps **many** of their **populations**, of the large carnivores in particular (**map 29**), have been **reduced in size** and/or have been disintegrated into small remaining subpopulations, or may suffer from increasing disturbance by tourism, expanding settlements and urbanisation. The **brown bear** is still **abundant in Slovenia**, less in Italy (a few individuals are also in France), and has been reintroduced in Austria (some individuals have arrived from Slovenia). It is still extinct from the Swiss and German Alps. The **wolf is recolonising the Alps coming from the Italian Apennine** and has appeared already in the south-western Alps; a small population lives in Slovenia**. Lynx has been reintroduced in Switzerland** and expands to the west but not to the east. Other efforts to reintroduce the lynx seem to fail, such as that in Austria. In Slovenia a small population has remained.

Threats to large **carnivores:** the **key problem** is, and will be, enough **remaining wilderness areas** or areas free of direct disturbance suitable to maintain viable populations. Specific conservation measures must be applied as included in the **large carnivore project** of the Alpine WWF. One of these specific problems will be acceptance by local inhabitants. According to investigations in Switzerland, local people resist the idea of wilderness much more than urban people. In a recent study only 20% of a sample of inhabitants of the Simmental would tolerate the reappearance of wolf, but more than 60% in Zürich. Still more than 30% wouldn't appreciate lynx to occur in the area of the Simmental. The success of re-establishing the large carnivores in most parts of their former habitats **depends**, besides availability of suitable large areas and creating corridors for migration between them, very much **on the support and acceptance of the local people.**

The **large herbivores**, such as red deer, roe deer, chamois, and ibex are **nowadays widely distributed**, and occupy most of their potential habitats in the Alps. The reintroduction of ibex has been probably one of the most successful attempts to restore the population of a once rare animal shot close to extinction. Nowadays hunters even tend to introduce ibex to unsuitable habitats. The populations of red deer nowadays depend significantly on winter-feeding as most of the **former migration routes** connecting the summer habitats in the mountain with winter habitats in valleys and lowlands are **interrupted** by roads and settlements. The winter pastures along the rivers have also been reduced in size and quality as a result of damming the rivers. Thus red deer is not endangered but depends very much on the feeding practice by hunters. Restoring old habitat networks for red deer might be a challenge for the future but it does **not** have to be considered of **high priority**.

Among the other groups, the **bats**, and some shrew species, **deserve special attention** as **many bat species have lost appropriate habitats**, or habitat quality has decreased significantly. For the bats a target species strategy is the most appropriate as it was recommended recently by the Council of Europe for the Greater Horseshoe Bat. Motto: **"No vampires for the Alps – but bats".**

About **200 breeding birds** might be registered for the Alps. At least the same figure may also be applied to those that migrate through the Alps, stay in the Alps during wintertime, or occur

accidentally. Species richness decreases with increasing altitude. About 50 species can be found breeding above 2000 m but much fewer have to be considered as truly alpine birds (i.e. their habitat being predominantly in the alpine environment above tree-line) such as ptarmegan, snowfinch, alpine Cough, alpine accentor, rock partridge, dotterel. These are the **"alpine species"** which have to be distinguished from those species which can be considered as typical for the Alps as a region (i.e. the **"Alpic species")** which, however, does not mean that they are restricted to Alps. There exists no endemic bird species occurring exclusively in the Alps. For some species the Alpic population is the largest (i.e. for wallcreeper, alpine accentor). Other remarkable species are those which are restricted to a particular habitat, e.g. to the montane forests such as capercaillie, black grouse, pygmy owl, tengmalm's owl, three-toed woodpecker, redpoll, citril finch, nutcracker, ring ouzel, or those living along the alpine rivers such as dipper, grey wagtail, goosander, little ringed plover, common sandpiper. Species that are generally rare, and of scattered distribution within the Alps, are e.g. rock partridge, cough, and rock trush. Special attention must also be drawn to the water fowl concentrated around the large lakes around the fringe of the Alps (e.g. Lake of Constance) which are also important stepping stones for the seasonal bird migration.

Similar to large mammals, those birds have suffered most from direct interference which are somewhat in competition with man. This is especially true for **bird of pray/or big birds** such as the golden eagle, peregrine, bearded vulture, griffon vulture (only occasionally as a breeding bird in the Alps). The population of the golden eagle has recovered up to the potential size due to conservation measures, and the bearded vulture has been reintroduced in an international effort, the latter probably the most ambitious restoration project for an extinct species in Europe. Also the peregrine population shows an encouraging increase.

Last but not least, the Alps experienced **expansion of bird populations** to its territory. The scarlet rosefinch has come from the north-east for 70 years, the blue throat has been discovered at several sites since the 1970's, and the collared dove (as a synanthropic species) occupies most of Europe nowadays, including the Alps, having expanded from the south-east.

Hotspots of bird species richness (**map 30**) will be found in areas with a high variety of habitats. As an example, the valley of the Alpine Rhine between Austria and Switzerland was found to host the highest density of breeding birds (159 species) in Austria for a grid size of 15x7,5 geogr. min., which is equivalent to 260 km^2. Similar numbers are typical for inner alpine large valleys with wetlands at the valley bottom, or along the fringe of the Alps where Alpic landscapes transgrade into pannonic or mediterranean lowlands.

Exactly **21 species of amphibians**, and **15 species of reptiles** are "Alpic", one of them is endemic and restricted to a small area in the Coptic Alps (*Salamandra lanzai*), none is strictly alpine, though *Salamandra atra* and *Vipera berus* prefer montane and low alpine habitats. The majority live either in the wetlands, in lakes or running waters, or in rocky, dry habitats respectively. Some of them are sparse, and restricted to the margins of the Alpic territory, others are widespread and common.

Most amphibians are severely threatened by destruction of their habitats, change of traditional agriculture, amelioration of wetlands, and interruption of migration routes (including the traffic kill). In some parts of the Alps the former widespread practice to "harvest" frogs as a special kind of food may have remained. A specific wetland campaign **("Alps on the wet side"**) for restoration of wetland networks, and wetlands as such, is recommended as **high priority** with a focus on the large valleys.

Reptiles such as *Natrix natrix* depend, like amphibians, on appropriate wetlands; the habitat requirement of the majority, however, is dry, and warm habitats such as vegetated screes etc. Especially disappearance of man-made habitats such as old walls has led to a **reduction of many populations** of lizards. *Vipera berus* was pursued by alpine farmers in former days, however, it has nowhere led to its extinction. Nowadays some populations have increased as this type of disturbance has disappeared in line with decreasing alpine pastoralism. Many alpine hay meadows have been left abandoned which may also have supported the reappearance of *Vipera berus*. A special activity for reptiles seems **not to be of high priority**.

Alpine lakes and rivers are habitats for a variety of **fish** species (about **80 species**) whereas species richness declines rapidly with increasing elevation. **Small lakes** are mainly restricted to the subalpine and alpine belt (e.g. >60% in Austria) many of them without any fish populations in former times. Since medieval times, fishermen have tried to establish fish populations in alpine lakes and running waters, and in so doing, have frequently disturbed a specialised and endemic invertebrate fauna and/or the local populations of trout (*Salmo trutta fario*, *Salmo trutta marmorata*). This introduction of exotics into many alpine waters must be considered as probably the most disastrous impact of man into Alpic biota. The **large lakes** at the north fringe of the Alps (e.g. Lake of Constance, Lake of Geneva) have suffered less, and are still famous for their specific fish faunas, the coregones (trout –like fishes) in particular. The latter are differentiated into genetically different types in relation to the within-lake variability of habitats, and to in-between variability of lakes. Speciation is still going on among this very interesting group of fish.

The **fish faunas of the large rivers** like the Danube, the Rhine, the Rhone, and the Po are very much determined by the fish fauna of their destination which means of those parts of the sea where they end. The Danube fish fauna show many relations to the Black Sea region, that of the Rhine to the North Sea where the salmon migration was once spectacular. That of the Rhone and Po is influenced by the Mediterranean Sea. This specificity, in connection with endemism makes the alpine rivers and lakes a focal point of biodiversity interest on the Alpic territory (including the river courses in the foothills of the alps as long they are of the character of a mountain river).

Threats to the fish fauna have resulted mainly from damming the rivers for electric power plants, and damming the rivers flooding areas, the latter destroying the habitat network (i.e. main course, sidearm, backwaters; **map 25**), and habitat quality, which is essential for high fish diversity (**map 31**). In the sixties, interrupting the Rhine course in Switzerland by such a dam led to a disastrous reduction of sea trout migrating from Lake of Constance to the breeding sites in the upper reaches of the Rhine and its tributaries (**fig. 3**). Even minor construction work changes the river continuum, and might influence the river benthos, and in response the whole food chain (**fig. 4**). Water pollution is a further threat to the Alpic fish faunas. The management practice of alpine waters for sports fishing is still not in agreement with ecological demands. Even minor impacts change the river continuum. Though many efforts have been made (e.g. saving the Danube trout, *Hucho hucho*, or the marmoratta trout), **a general fish biodiversity strategy** is **urgently** needed **("Look under the water"**). The Alpic rivers as living waters hosting a high variety of fish must be pushed to the public, as initiated by the WWF river programme in Austria (**map 32**).

Still completely insufficient is our knowledge about **Alpic invertebrates** though some groups like the butterflies or the dragon flies are comparatively well-known. Probably the best source for an overview is the recently published Red List of Endangered Animals of Carinthia compiled by a group of natural scientists familiar with the regional fauna. Carinthia is very

representative for the whole of the Alps. It covers most Alpic mountain types from the lowlands to the far top, and integrates the Central Alps with the Southern Alps. Considering the totals for species richness, given in this outstanding account, for the mammals the figure of 80 species comes up to the estimate for the Alps as a whole, the bird species richness of 174 for Carinthia is also close to the total number. That for the amphibians and reptiles is somewhat lower but not much. As a rule of thumb one may say that adding 10-20% to the Carinthian figures may come close to the Alpic total. In descending order the species richness of the different invertebrate groups in Carinthia are: **2549 butterflies**, 1325 Staphylinidae (rove beetles), **609 spiders**, 542 bugs, 360 hymenopters, **444** Carabidae (**ground beetles**), **413 bees**, 336 cicada, 285 mollusc, 221 caddis flies, 211 Ciliatae, 179 Rotatoria, 168 Cerambycidae (long-horned beetle), 99 orthopters, 97 neuropters, 92 Plecoptera (stoneflies), 92 Clodocera, Copepoda (water fleas), **82 ants**, **62 ladybirds**, 60 dragon flies, 57 mayflies, 52 harvestmen, 47 centipeds, 27 water beetles, **24 earthworms**, 20 leeches, 9 Tardigrada, 6 cancers, 3 scorpions.

This list makes it clear that **invertebrate diversity overrules that of the vertebrate species** at least by a factor of twenty. An absolute value might be even more. About 33% of the species are considered as threatened, mainly due to habitat loss, and loss of habitat quality. As an example: the catch of butterflies in a riverside forest at the Rhine valley close to Liechtenstein revealed more than 400 species; in an artificial spruce forest close by which was planted after clear-cutting the figure was about 40 species of butterflies. This result shows clearly that **even "comparatively soft" impacts may severely reduce the habitat quality** for many animals.

What can be done? The best way of course is setting aside and protecting suitable habitats. For a campaign, a group of attractive species could be used whereas the particular species need specific habitat requirements (e.g. ladybirds: **"Give a home to homeless butterflies"**).

Habitat diversity, community diversity

As ecological theory says, species diversity is related to habitat diversity. This certainly also holds true for the Alps. The total figure of 4500 vascular plants species is caused, at least partially by the high habitat diversity found in mountains. The already mentioned Red List of Carinthia lists more than **200 habitat types** which are classified as follows: running waters (7 types), lakes and temporary waters (7), vegetated waters (3), groundwater and waters in caves (3), reed beds (3), wet meadows (7), fens and wet forests (6), mires (2), alluvial habitats including riverside forests (14), mixed deciduous forests of the lowlands (2), beech forests (2), ravine forests (2), pine forests (3), spruce/fir forests (3), larch/arolla pine forests (2), early successional forests, hedgerows, orchards etc. (6), pastures (3), meadows (5), fields, incl. abandoned fields (2), field related structures (6), steppe meadows (2), dry shrublands (1), rock habitats and screes (3), alpine dwarf shrub heath (6), alpine grasslands (8), snow beds (2), alpine herb fields (2), vegetated screes (2), glacier and glacier forefields (2). As further habitat types intensively used meadows and pastures, artificial forests, traffic areas, buildings, waste grounds etc. are listed. For an Alpic account, some more habitat types should be added, those of the Mediterranean and submediterranean environments in particular. For example, around the Lake of Garda evergreen oak forests, which do not occur in Carinthia, are common.

Regardless of a total figure for all Alpic habitats it must be noted here that these **habitats may be small or large** which means expanding over small or large areas. A spring, a snow bed, a puddle will never expand over more than a few square metres. Forests, the climax forests in

particular, may cover square kilometres. Biodiversity very much depends on many small-sized habitats. An estimate for Austria revealed a figure of at least one third for vascular plants. Animals need them as important subhabitat. It is **the loss of** sufficiently represented **small habitats** which is probably one of **the major causes for the steady decline of biodiversity** in the cultural landscapes.

Most of these habitats might be occupied by several **plant community types** depending on slope, elevation, bedrock material as has been thoroughly documented by traditional phytosociology which has – as a science - its origin in the Alps. Looking at the floristic composition of plant communities, a closer view to biodiversity patterns is possible. In fact the number of plant community types may exceed that of pure habitat reconnaissance three-fold. Snowbeds for example occur at the siliceous as well as at calcareous bedrocks. They differ along the elevational gradient as well as biogeographically from west to east. A rough estimate might end up with about **900 plant community types**, forests as well as screes, rock communities, etc. They can be classified in **zonal communities** which are the key elements of the vegetation cover in a landscape (e.g. different types of beech forests, meadows, alpine grasslands), **extrazonal communities** such as the windswept vegetation on ridges which might be interpreted as an outpost of the Arctic, and finally, **azonal communities** which are characterised by a dominating ecological factor. This can be disturbance such as gravel rain on screes, avalanches, solifluction, can be limitation of space (e.g. rock communities), or surplus of snow (snow beds), water (fens, alluvials), nutrients (giant forb vegetation). Like small habitats the azonal vegetation contributes essentially to the overall diversity as can be demonstrated for the Austrian forests (**fig. 5**). Many Alpic endemics are rock plants or grow on screes.

About a **quarter of the community diversity is man-made** or depends on particular forms of agriculture. This is especially true for the many types of **mountain meadows (map 33)**. They are not only rich in species but also attractive as many of these meadow plants have showy flowers. Other synanthropic types are hedgerows with many wild rose species for which the central alpine ones are famous. Ruderals, wild flowers on fields, species rich pasture land, all this variety once formed an attractive cocktail of life. Maintenance of this treasure is certainly one of the most important problems in the Alps. On one hand, the decline of agriculture (especially in the south) left many meadows abandoned. They changed into shrubland and finally into climax forest. This is in principle not negative, however, the cultural heritage of diverse ecosystems as well as **much attractiveness has become - and will be - lost**. On the other hand the remaining farmers tend to follow industrial types of farming and implement practices developed for the lowlands. The mountain meadows in fact are the most endangered objects now. Encouraging organic farming in the mountains must be combined with the development towards sustainable practices which means saving diversity and beauty. The author favours the idea of a campaign for maintaining and restoring alpine meadows in all their beauty and diversity: **"The best mountain meadows – a championship for the diversity of life".**

Landscape diversity

An **ecological classification of mountains** and how they appear in the landscape may lead to the following types which can easily be recognised in nature: 1. **Calcareous rock mountains**, either chains (e.g. the calcareous north-eastern Alps), needle-like forms (e.g. the Dolomites in the southern Tirol), or plateau-mountains with huge karst areas (e.g. Totes Gebirge in Upper Austria); 2. Equivalent **siliceous rock mountains**, either of granite (e.g. Bergell, Italy),

amphibolite, orthogneiss, or granodiorite (e.g. summits of the lower Ötztal, the Silvretta); 3. **Glacier mountains**, defined as mostly large mountain systems (predominantly siliceous) covered by glaciers with nunataks in-between (all the big mountain formations along the main crest, e.g., the Hohe Tauern, Bernina, Alps of the Valais, Mont Blanc); 4. **Siliceous highland** (gneiss, phyllites, schists), mountain systems of intermediate altitude and hilly appearance, occasionally with solitary glaciers (e.g. the Tuxer Alps, Tirol; the Niedere Tauern, Austria); and 5. **Grass mountains**, consisting mainly of "soft" materials and shaped like a pyramid as a result of deep weathering; these can be subdivided into slate schist mountains (e.g. the Kitzbühler Schieferalpen, Austria), flysch mountains (e.g. the Prätigau mountains, Switzerland), and molassic mountains (e.g. Hochgrat, Germany).

Most **mountains have their own "personality"** which has been considered in many ways by the local people. Mountains as landmarks, clocks (e.g. "eleven o‘clock mountain"), holy mountains have always been of importance. It is this mystic and emotional attitude towards mountains which has been lost during the last years. Mountains have been degraded for sports such as skiing, snow boarding, mountain biking, parachuting. Of course, these developments cannot- and should not - be reversed, however, some mountains should be set aside which are virgin, unspoiled, saved for "eternity" in their natural character. The author is convinced that nearly in each community a mountain can be found which is still natural, an important landmark, and of specific value to the local people, and which is representative for the particular region regarding species, communities, and landscape character. A campaign at which as many as possible communities participate, with a motto such as **"Our holy mountains"** might be an initiative which puts new values on the beauty and personality of mountains.

Scenarios for the **landscape of tomorrow** have to be based on landscape classification, which is certainly a young discipline in landscape ecology. Satellite images and GIS-techniques provide new and spectacular opportunities for defining landscape types. Combining attributes such as geomorphology (elevation, slope, exposure to the sun etc.), bedrock material, climate, vegetation, and structural parameters such as patches, matrices, and corridors may help to get a clear image of a landscape (**map 34**). Computer models allow scenarios for future states which may help create visions for the future. Still, only first attempts have been made. The Großwalsertal in Vorarlberg was recently checked along these methodologies. Twenty units could be set up, among them: 1. Forested gorgelike landscapes along the main river, 2. Riverside landscapes, 3. Grass mountains, 4. Middle elevation landscape with alpine pastures, 5. Landscape of the villages, 6. Mixed forest landscape on the shady side of the main valley, 7. Subalpine landscape on sunny slopes, 8. Rock mountain landscapes etc. Each of these landscape types are characterised by presence or absence of specific habitats such as fertilised meadowland, dry pastures, orchards, hedgerows, rock faces, waterfalls, sources, particular forest types etc. Taken for biodiversity management, this approach allows handling whole landscapes. It should be improved, and generally applied.

Again the most severe threat to the Alpic landscapes, the rural landscapes in particular, is damage to their naturalness. Even densely populated valleys such as the Montafon in western Austria are occupied by **natural and seminatural habitats up to 90%.** To keep this high percentage is generally the goal for landscape protection.

Human use and impacts – the ecological perspective

The south and the large valleys of the interior, like the Brianconnais, the Valais, the Vinschgau, and the Engadin, were **settled long before the Romans** occupied the Alps ("old Alps" in the sense of BÄTZING, see his contribution). The others have been inhabited at least since medieval times by Germanic and Slav tribes ("new Alps"). Each group developed its own traditions of land use, impacting the natural ecosystems in different ways and intensities (**map 9**).

Alpine farming

Permanent settlements have been established **close to the timberline**; the uppermost ones are situated above 2000 m (e.g. Juf 2126 m, Switzerland; Rofen 2010 m, Austria; Rojen 2000m, Italy). Alpine pastoralism ("Alpwirtschaft"; **map 33**) as a special kind of **transhumance** has been developed in all parts of the Alps, with a high variety of local forms. Most populations in the alpine valleys depended on this kind of farming. Hay making on slopes too steep for pasturing was also very important (today degraded to a fan-job but almost completely lost). Thus, the pressure on the subalpine forest and the natural vegetation above the timberline has always been high. However, the alpine grassland above tree-line has not been altered by this type of land use. No change in species composition has been recorded in permanent plots in the Swiss national park after abandonment 80 years ago.

Much of the forests, however, have been cut and converted to pastures, meadowland and fields. As clearing and forest pasturing have not always been performed carefully, for example, expanding the clearing to steep slopes, the potential for avalanches has increased. The percentage of avalanches today which are man-made is estimated to be 50-60%. Even at the end of the medieval period, **erosion, catastrophic avalanche events, and poor harvests** led to early laws and agreements on how to use the mountain pastures (including forests) in a sustainable way. Most of these rules persisted up to recent times, until alpine agriculture declined rapidly after the Second World War. At the same time, tourism increased tremendously. That was the point at which development in the different countries diverged (see the Socio-economic assessment by BÄTZING).

The land use for traditional agriculture transformed the formerly completely forested valleys (except large river courses, lakes, backwaters and mires) into **specific forms of Alpine cultural landscapes** whose outstanding components were species rich meadows, extensive field cultures, and large pasturing areas. The myth of the Alps as a paradise of naturalness and beauty was certainly also influenced by these products of alpine agriculture which resulted in an **increase in species and community-type diversity**. The ambition of the alpine farmer, however, has never been the production of beautiful meadows and species-rich pastures. It is a hard life to produce the essential needs for everyday life in a harsh environment. This perspective has to be kept in mind when applying conservation measures to anthropogenic habitats. Nevertheless there is no doubt that **mountain meadows and alpine pastoralism need conservation actions.**

Tourism

There has also been much discussion about the effects of tourism. One must distinguish between **direct and indirect effects**. Classical impacts, like **trampling** or **disturbing animal life** in the subalpine forest, have been described and analysed several times. However, the most severe of these direct impacts is **bulldozing ski runs**. About 20.000 hectares of subalpine and alpine land have been prepared in this way, which involves the complete destruction of vegetation and soil as well as alterations of the local climate. Success of revegetation depends very much on elevation. Above tree-line, restoration of the natural vegetation in a period shorter than hundred years is impossible, regardless of the fact that progress in developing new revegetation methods cannot be overlooked.

Air pollution and related effects

Indirect effects may not impact the alpic ecosystems as drastically as direct effects. Most noteworthy is **air pollution**, to which the subalpine forest react very sensitively. Up to half of the forests of the Alps show suboptimal vitality, which might be in part a consequence of air pollution. A warning must be put here: alpic soils are frequently less productive though natural. Forests of low vitality might occur on shallow substrates, and are affected by water stress etc. Weak production does not necessarily mean low reproduction. Weak vitality could be an indication for high naturalness!! Among the active substances, the emission of sulfur dioxide has decreased, whereas nitrogen oxides and organic compounds have increased. Sources are the many new chalets, hotels, apartments, and supply buildings, but motor traffic is worst. However, many of the pollutants are transported to the Alps from industrial centres far away. Nowadays, probably the entire area of the Alps is exposed to acid rain. Analysis of rain in Austria revealed that the pH of 86% of the samples is below 5,1 (annual mean; unpolluted rain should have about 5,6). The values increase from 4,3 on the northern slope up to 5,0 and more in the interior of the eastern Alps, decreasing again toward the south down to 4,7. Though **damage to the forests is evident**, no substantial evidence has been presented until now, indicating that air pollution might affect the treeless vegetation above the timberline.

Climate change

Increased atmospheric carbon dioxide may not severely impact alpine vegetation which has proven very resilient in experiments. However, the related greenhouse effect which creates climate warming may effect the Alps significantly. The observed warming during the last century has already caused upward migration of alpine plants at a rate of 0,5 – 4m per decade (**fig. 5**). In the long-term, the **extinction syndrome,** in other words, the outcompeting of alpine plants by lowland plants or migration to "heaven" if summits are too low**,** might become reality.

Other impacts might be: Alpine plant communities may change their species composition which may influence herbivorous animals, and as a result, the whole food chain. Alpine passages will become penetrable for pathogenes from the south. **Exotic species may expand** from parks and gardens as is already observable in the Ticino region where evergreen trees (even palms) are invading the natural forests. This perspective may become a true challenge to all conservation measures in the future.

Hunting

Last but not least, attention must be drawn to man's attitude towards the wild animals in the high mountains. **Man has influenced the natural wildlife substantially** in the Alps, shooting "competitors" like the brown bear (*Ursus arctos*), the lynx (*Lynx lynx*), the bearded vulture (*Gypaetus barbatus*), and the golden eagle (*Aquila chrysaetos*) to or close to extinction. Of the formerly widespread ibex (*Capra ibex*), only a small herd survived in the Gran Paradiso area. It has been reintroduced today to many areas in the Alps where it occurred in former days, and it performs well; similarly, the eagle population has increased (the latter mainly as a result of being protected from hunting). Efforts have been made recently to reintroduce the brown bear, the lynx, and the bearded vulture.

Hunting animals that were considered competitors is one side of the story, but on the other side, hunters have always kept an eye on **maintaining good numbers of roe deer, red deer** (*Cervus elaphus*) **and chamois** (*Rupicapra rupicapra*). Nowadays, winter feeding of red deer is very common and results in the high numbers of these animals in the subalpine forests. The impact of the high density of deer is very severe in many localities, as this animal feeds on young trees, thereby interrupting the regeneration of the forests. In Austria, only one third of the mountain forests can be considered in equilibrium between forest regeneration and wildlife. In the German National Park "Berchtesgaden" the species list of shrubs and young trees in a fenced area in a forest clearing was eight times larger than outside. In addition to that, **modern kinds of sport** activities like skiing, mountain biking, and paragliding **disturb the animals** (deer and chamois) in their behaviour. Crowds of animals concentrate themselves now in the few remaining areas of undisturbed forest, causing even more damage. As BÄTZING states, this phenomenon is mainly a problem in the East Alps whereas in many parts of the West Alps public, but regulated, hunting keeps the numbers of animals at carrying capacity.

Conclusions

The major threat to wildlife is a **general disintegration and loss of habitats (small ones in particular) and population**s. The Alps have become unsuitable for large carnivores in many regions, or it is difficult to restore their populations. This is especially true for the north. In the south recolonization of such species may be possible, and is already going on, but it depends very much on the acceptance of the hunting society, and the remaining farmers.

Over-exploitation in and around tourist centres disturbs the appreciation by people, and has led to the widespread opinion that the Alps are "lost" and spoiled. This cannot be fully accepted from a biodiversity point of view as most wildlife still exists. However, many species are suffering from a decrease in their population, as quality and size of their habitats have been reduced (e.g. bats, amphibians, butterflies). This is especially true for the valley bottoms, the large rivers, and the mountain forest belts.

Threats are also **related to agriculture** especially when introducing industrial agricultural practices. Many mountain meadows and pastures are replaced nowadays by "green deserts". Access roads are built to the uppermost reaches, and manure from the Alp-shelters is distributed over natural grasslands which is extremely sensitive to fertiliser. As mentioned already, the former famous Seiser Alm in South Tirol lost more than 50 000 000 individuals of attractive flowering plants by this kind of intensivation.

Abandonment of agricultural land is not necessarily negative from an ecological point of view. Forest may reappear. In the alpine belts not much change is to be expected. The common opinion that abandonment might increase the danger of natural hazards has never been studied critically. Probably it is not as severe as is often stated.

Probably **in the worst situation is the fish fauna**. Introduction of exotic fish species in mountain rivers reduced the autochthonous populations. Electric power plants interrupt migration passways, and produce frequent floodings which decrease the biomass of the benthos fauna. Water pollution made large rivers unsuitable for sensitive fish species. Damming rivers destroyed the integrity of whole river systems with sidearms and backwaters.

Recommendations

The author suggests the following activities on which WWF should focus in descending priority:

1. The central conservation task for the Alps is saving its high degree of naturalness, saving the remaining intact wildernesses, and restoring wildernesses wherever it is possible. For a WWF campaign, the wilderness theme can be transported with the large carnivore project whereas "wilderness for man" as an adventurous enterprise should be presented as well. Motto: **"Making Alpine wilderness for all".**

2. A campaign supporting organic farming with special focus on the maintenance of typical mountain meadows and pastures is urgently needed. Motto: **"Producing beauty - a championship for alpine meadows".** This campaign could also be combined with a strategy to save old breeds.

3. An alpine fish strategy should be developed and implemented also covering the large alpine rivers (Rhine, Rhone, Danube, Po) as long as they are alpine in character. Motto**: "Look under the water".**

4. An alpine wetland campaign should be launched to save and restore habitats for amphibians and wetland plants, wet meadows in particular. Motto: **"Alps on the wet side".**

The next two suggestions are for increasing awareness of the biodiversity problem, and to restore admiration for mountains, and the Alps as a whole by local and urban people.

5. A campaign could be started to document the value of mountains as a complex habitat for the organismic world, but also for recreation and education for people. Throughout the Alps communities should be asked for their "best" mountain. Those which have remained unspoiled should be declared sanctuaries for the future and symbols for life and nature. Access to the summits should only be possible by walking and climbing from the very bottom. Motto: **"Our holy mountains".**

6. Invertebrates are rarely recognised by the people. Many of them are threatened by habitat loss. A campaign taking an invertebrate flagship species may help to draw attention of a broader public to this problem. Motto: "**Give a home to homeless butterflies**".

7. The integration of the knowledge on Alpic biodiversity is virtually not available. GIS-activities are restricted to national working groups. The development of an alpine GIS-biodiversity base is certainly the biggest task for the future, but not manageable in a short term. For the campaign, the author suggests looking for already available maps and data, and combining them into useful tools. Well-documented case studies for most of the cited facts should be selected and presented. Motto: **"From data basin to data base – structuring the Alps by GIS".**

General Conclusions

The Alps are **still a high mountain system of great beauty and naturalness** hosting a diverse flora and fauna. Cultural landscapes, the result of settlement for many generations, contribute essentially though the local people have not always interfered into their environment sustainably. **Modern trends** are: decreasing importance of agriculture, high intensity of tourism, expansion of urban centres and, in turn, development of commuter systems. The latter supported by improved traffic facilities. Probably no community has remained in the Alps whose economy is exclusively based on agriculture. Electric power plants interrupt most of the large rivers, and have changed their hydrology. Tourist facilities, roads and cable cars in particular, have fragmented the mountain forest belt.

From a socio-economic point of view the Alps have two faces, the southern one, and the northern one. Whereas agriculture has been replaced in the north by tourism or commuter systems, or being still in a comparatively good shape, most of former agriculture has disappeared in the south and southwest, having been not substituted by other economies. Large areas are abandoned and change to forests or natural grasslands. A loss of naturalness in the north is contradicted by an increase in the south.

Ecologically, conservation activities must consider the partitioning of the Alps into biogeographical units, each very different in character and conservation needs. The recommended campaigns for WWF are not necessarily to be applied to the whole of the Alps. Different approaches could concentrate on different regions. In general there is still much to protect in the Alps. Though their mountain nature, their harsh environment are their own "best friends", maintenance of life in all its facets needs support.

From a political point of view also those conservation measures should be considered which are based on the community approach. It is a direct approach which is closest to the local people without whose support most conservation approaches may fail. Nevertheless higher levels in the administrative and political hierarchy must be considered as well. The most recent issue might be supporting NATURA 2000.

Comments to the major sources and expertise

The core of this report is based on the knowledge of the author, his research work, and compilative activities, for example, see "The high-mountain ecosystems of the Alps", "Alpine vegetation in a global perspective", "Farbatlas Ökosysteme der Erde", "Ecosysteme de la Terre". Further sources which are also recommended for further reading, or to be consulted

for particular purposes, are listed in the bibliography, and are briefly annotated in the following. This part is **arranged according** to the "**terms of references**" provided by the WWF committee as a guideline for the biodiversity assessment.

Focussing on the Alps as a whole is a very new challenge to biologists and ecologists. Until recently researchers worked – and still predominantly do so - within the borders of their nation, country, county, department, and region. In France, Italy, and Germany (and Slovenia as long as linked to the former Yugoslavia) national approaches considered the Alps as peripheral though excellent accounts on the flora, fauna, vegetation are available for some parts of the French, Italian, German, and Slovenian Alps. For the "Alpic nations", for example, Switzerland, Liechtenstein, Austria, the Alps have always been in the centre of interest. Not surprisingly access to comprehensive data and information which allows putting the pieces to a whole is easiest for these countries. This might explain their dominance regarding the sources.

Species

What plant species occur on the territory of the Alps is very well known for vascular plants, mosses and liverworts, lichens, macrofungi, some groups of algae. Surprises, however, may still occur. Just recently a new species of Saxifrage (not previously described) was discovered in the Seckauer Alpen (Styria, Austria). A comprehensive approach to vascular plants is under preparation within the Flora Alpina project (ÄSCHIMANN 1997). A vascular plant flora of the Alps (with photographs of each species) is planned to be published in 2002 (ÄSCHIMANN et al. 2002). Most alpine vascular plant species are also treated in HEGI's "Illustrierte Flora von Mitteleuropa" which include distribution, biology, ecology, use, vernacular names). For identification, numerous keys are available for all Alpic countries or subregions (details given on request). National, regional, and local floras, old and recent ones, are available for many parts in the Alps. This is also true for the other plant groups such as mosses, liverworts, fungi, lichens, and algae.

Distribution patterns of plant species, vascular plants in particular, have been studied, analysed and summarised, since the beginning of phytogeography in the Alps. A comparatively recent documentation of principal patterns was provided by NIKLFELD (1972) for Austria, for the Alps as a whole some examples are given, for example, in HEGI, MERXMÜLLER & REISIGL (1977). A quantitative approach for endemic and subendemic vascular plants is that of PAWLOWSKI (1970). Distribution maps have been provided especially within the activities of the FLORA EUROPEA – a mapping initiative started about 35 years ago. It is based on a grid approach using pixels of about 6x6 km as the basic units. Maps on a larger scale are now available from the Atlas Europaea database (see homepages). On the 6x6km scale a few regional accounts are available (Germany, Carinthia). The already published "Verbreitungsatlas der Farn- und Blütenpflanzen der Schweiz" (WELTEN & SUTTER 1982) did not follow the international agreement for the grid approach. It is based on regional biogeographical units which are not compatible to the world outside Switzerland. This is probably the clearest example of all the problems one faces when trying to compile data for an Alpine approach though the atlas as such is scientifically sound and excellently researched. The Austrians haven't managed to finalise the Flora Europaea mapping for 35 years! No end in the next years is to be expected for other parts of the Alps (NIKLFELD 1997). The Swiss made it in 5 years! Flora mapping in relation to the Flora Europaea approach is also under way for cryptogamic groups.

National Red Lists for plant species are available now for all alpine countries but not separately treated for the Alpic parts of the particular nations (check bibliography). Only for Liechtenstein can the list be considered as exclusively Alpic. Many lists have also been prepared on smaller scales, for example, for Austrian Bundesländer such as Vorarlberg, Salzburg, Carinthia, Styria. That of Styria was published together with distribution maps (!) (map 35). The lists of Salzburg, Vorarlberg, and Bavaria also include an attempt to evaluate plant communities. A complete list of relevant Red Lists was compiled for this assessment by Dr. Köppel, Verlag für Interaktive Medien (see Appendix 1). A comparative analysis of the Red Lists (e.g. to find those species endangered everywhere) is very much recommended as a follow up activity to this report.

Among the different groups of **animals,** the species of mammals, birds, reptiles, amphibians, fishes, butterflies, some groups of beetles, spiders, molluscs are very well known; other groups of invertebrates much less. National accounts and lists exist mainly for the vertebrates often in combination with a red list evaluation (e.g. SPITZENBERGER et al. 1988, GEPP 1994, DUELLI et al. 1994), and for a few invertebrate groups (e.g. HUEMER & TARMANN 1993 - butterflies, MAURER & HÄNGGI 1990 - spiders, SCHWEIZ. BUND FÜR NATURSCHUTZ 1988, 1997 - butterflies). Accounts with a regional perspective are numerous and not treated in this assessment. However, two outstanding examples for a comprehensive treatment of the fauna on a regional scale have to be mentioned: that of Liechtenstein (check bibliography) and Carinthia (AMT DER KÄRTNER LANDESREGIERUNG 1999). Both regions can be taken as representing a kind of "alpine microcosm", Carinthia in particular. Carinthia covers a part of the central, high siliceous Alps, but also a part of the Southern Limestone Alps with many endemics, and contains inner alpine lowlands such as the Klagenfurt depression. The whole array of elevational zones are represented. The literature cited for the particular groups treated in this Red List will guide the user to other sources.

The principal **distribution patterns for animals** of short distance dispersal or immobile animals (e.g. snails, diplopods, spiders etc.) resembles that of vascular plants. The hot spots of endemism are the same. Mobile animals such as birds and mammals are distributed differently, and no endemics are known. Systematic fauna mapping concentrates mainly on these latter groups. The most advanced mappings are available for birds (e.g. DVORAK et al. 1993 – Austria; SCHIFFERLI et al. 1982 – Switzerland). On a European-wide scale, maps have been prepared for mammals, reptiles, amphibians, and birds by WCMC covering also the Alps (but on a very coarse spatial resolution). These maps (incl. vascular plants) have been combined into a biodiversity map of Europe which clearly documents the outstanding position for biodiversity of the Alps in a European context (**map 2**).

National Red Lists have been elaborated in all countries, with a focus on vertebrates. The most comprehensive approach in considering invertebrate groups as much as possible is probably that of Carinthia (AMT DER KÄRTNER LANDESREGIERUNG 1999). Most, national and regional, Red Lists for animal species are also included in Dr. Köppels compilation (see Appendix 1). Special attention should also be drawn to the new instrument of "Blue Lists" which include those species whose populations have increased due to conservation measures (GIGON et al. 1998), and therefore, have changed their position in the Red Lists.

Alpine plant life, from a functional point of view, is treated excellently by KÖRNER (1999) in his recent monograph. A wealth of information on how plants face the harsh environment above tree-line will be found in this book. Much information on alpine plant life

including forest plants can also be taken from ELLENBERGS (1996) classical account on the vegetation of Central Europe including the Alps. For animals, the best general introduction is still that of FRANZ (1979; Ökologie der Hochgebirge). "Biologies" of many vertebrate species, flagships such as the Brown Bear or the Lynx in particular have been elaborated during the last years, though, unfortunately, not comprehensively treated in a book which might serve as an introduction to the topic. A compilation of animal "biologies" is recommended as an urgent follow-up activity to this report.

Genetic diversity

All populations either of animal or plant **species are genetically diverse**. In the Alps speciation by hybridisation has led to a remarkable variety of specific and supraspecific plant taxa since the huge ice shield of the last ice age disappeared. Some well-documented examples might be that of the *Valeriana officinalis* or the *Ranunculus montanus* groups (TITZ, LANDOLT, details on request). The genetic difference between populations might be important for the reintroduction of extinct species, or must be considered for remaining populations such as that of the Brown Bear in the Italian Alps. Using the appropriate proveniences, for example of spruce, has always been evident for alpine reforestation activities. Though certainly important, no comprehensive account on genetic variability focused on the wild plants and animals is available.

Genetic diversity in the "Alps saving context" is frequently restricted to the existence of **specific alpine breeds**, animals as well as plants. The problem of disappearing genetic diversity among the livestock of alpine farmers, and plants used, has been one of the best documented throughout the Alps. Many initiatives have been active to save this remarkable cultural heritage (e.g. Pro Specie Rara in Switzerland).

Habitats/ landscapes

Vegetation as a tool to describe habitats, communities, ecosystems, landscapes has been studied in depth by many authors, and therefore, is probably the best documented among ecological units to be considered. In fact the standard for describing plant communities was developed in the Alps (e.g. BRAUN-BLANQUET 1948/1950, 1964). Not surprisingly plant community types are very well-known and serve as the basic units for extensive vegetation mapping (see bibliography). The knowledge about the vegetation of the Alps is comprehensively treated in the books of ELLENBERG (1996) and OZENDA (1985), and compared to the other mountain systems of Europe by OZENDA (1994). The reader of these books will also find much information about the physiography of the Alps. A very useful book in that context is also “Die Welt der Alpen“ (LADURNER et al.1993) in the opinion of the author still the best natural history on the Alps covering mineralogy, geology, as well as botany, zoology, and climate. It is written for a broad audience but scientifically sound.

Vegetation units also served **as key elements** for biotope inventories either in the case of selective approaches (rare and endangered biotopes, specific types such as mires) or in the case of "total" approaches. Types and their distribution are very well known, for example, for the mires, fens, and riverside biotope in Austria, Switzerland and Liechtenstein (see bibliography "Inventories"). These inventories helped the designation of NATURA 2000 – sites and respond to the demands of the FFH-directive of the European Union. Unfortunately Switzerland, not a member of the European Union, does not fit into this context though preparations to join the conservation measures of the union are underway.

Landscape classification and inventories are a comparatively recent approach to the mountain world of the Alps. GRÜNWEIS et al. (1988) presented one of the first attempts for classifying the landscapes of an alpine nation (Austria) applying a unifying standardised method. Cultural landscape classification and analysis was further pushed by the Austrian research programme of "Cultural landscape research" launched by the Austrian Ministry of Science. Advanced landscape mapping using tools such as satellite images and GIS are still in status nascendi but will become an important activity for the next decades.

Quantitative biodiversity analysis has become a standard for responding to the demands of the biodiversity convention as well as other treaties. Numbers of species present in countries, regions, communities, numbers of plant communities, habitats, in landscapes etc. have been estimated frequently since "biodiversity" has become an issue of public recognition. Rarity as a specific character of biological systems found a new definition (fig. 4). Figures for total sums of species, communities can be found mainly in the Red Lists literature (see bibliography) or is given e.g. for Austria by GRABHERR (in MORAWETZ 1994). A comprehensive overview for the Alps as a whole is urgently demanded and should be put to the priorities for research work in the near future. As mentioned already the list of the fauna of Carinthia (see Red List bibliography) could be taken as a road map for the relative importance of particular higher animal taxa in the Alps.

A vast mass of literature has been published during the last decades on **how to "save" the Alps**, their environment, their culture, and biodiversity. Countless symposia and meetings tried to find solutions cumulating in the Alpine convention ratified by all Alpic nations as well as the European Union. Many useful guidelines can be derived from the convention, and most initiatives stimulated by the convention are focused on nature-, landscape conservation and management (see e.g. the "Alpenkonvention –Tatenbank"). CIPRA, the International Commission for the Protection of the Alps and probably the most important think-tank in this context, has found an excellent formula for the needs of action which is "Tun und Unterlassen im Alpenraum" best to be translated as "Action and laissez faire for the Alps". Action means supporting traditional ways of land use for protecting hemerobic but biodiverse systems such as mountain meadows. Laissez faire means protection of wilderness regions which – still – are one of the outstanding features of the Alps (!) or leaving formerly managed areas to natural succession giving free way to wilderness.

GIS-sources

Searching for appropriate **GIS-tools** to demonstrate ecological facts about the Alps as a whole is probably the **most frustrating activity**. Initiatives such as the ABIS system launched by the Alpine Convention commission or ALPMON, a project supported by the 4th R&D programme of the European Commission, have not even proceeded so far as to topographic maps of the Alps. Like ALPMON GIS-applications are still focused on particular regions or problems. The Alps as a unit can only be cut out of European GIS-approaches such as the CORINE-land cover system or the PELCOM project. Based on indicators for which spatial explicit data are available, some ecological maps can be produced for regions or – in

some particular cases – also for a whole nation. A few examples have been prepared or adapted for this report.

Ecological processes and phenomena

Among the ecological processes and phenomena only those are considered which are related closely to biodiversity and can be seen as a global issue (i.e. not only locally important).

Climate change has become an important issue during the last two decades. A series of almost exploratory accounts have been published (see bibliography) which predominantly focus on what might happen. However, it was in the Alps where the first clear evidence could be found that the observed warming during the last century was ecologically relevant (GRABHERR et al. 1994, GOTTFRIED et al. 1994). Subsequent modelling indicates that the extinction syndrome might not only be a vision, and that even weak climate changes might effect alpine plant and animal life (and that of Alpine people as well).

Land use change in the Alps is an obvious phenomenon, and it affects biodiversity significantly. Traditional agriculture whose "finger prints" are still recognisable throughout the Alps has been replaced by modern forms of agriculture, tourism, urbanisation and related infrastructures. This phenomenon is still best documented in BÄTZING & MESSERLI (1991) and FURRER et al. (1984). A very recent overview is that of the 1st Alpenreport represented by CIPRA (see bibliography). Unfortunately no thorough quantification of biodiversity loss has been presented so far. The author once tried to estimate the loss of beautiful alpine flowers due to fertilising in the region of the Seiser Alm in Südtirol which is still praised as a flower paradise. More than 50 000 000 individuals of beautiful flowering plants have disappeared since the fifties of the last century (GRABHERR et al. 1985), among them at least 6 000 000 Gentianas. Such kind of statistics would shed a clear light on the tremendous role which agriculture plays for maintenance of biodiversity, particularly in the Alps.

Landscape integrity

Landscape integrity, not to be confused with landscape coherence, is a term not broadly applied by European ecologists**. Naturalness or the reciprocal term "hemeroby**" are older, and can be related to well-defined criteria such as the occurrence of exotic species, alteration of soil profiles, eutrophication etc. The concept of hemeroby tries to define levels of different intensities of human interference as indicated by alterations of the natural state. Two examples are cited in the bibliography where the naturalness or hemeroby concept was applied. The most advanced and detailed is certainly the study of the naturalness (or hemeroby) of the Austrian forests based on 5000 (!) field plot studies. Still 25% of Austrian forests are natural or close to natural; about 50% are only moderately altered. Most of these forests will be found in the Austrian Alps. One must repeat it again and again: the Alps are still one of the most natural regions of Europe. Wilderness is still there, or can be restored easily. That man has been present since prehistoric times is no excuse to "allow everything".

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Bibliography

Only recent titles included (with a few exceptions, not published before 1980)

SPECIES

Plant ecology, biogeographic aspects, flora (national)

BURGA, C.A. & PERRET, R. 1998. Vegetation und Klima der Schweiz seit dem jüngerem Eiszeitalter. - Ott Verlag Thun, 805 S.
HEGI G. Illustrierte Flora von Mitteleuropa. Paul Parey, Berlin. Scd. Edtn. – not completed but some volumes – at least in part -available.
KÖRNER,C. 1999. Alpine plant life. Springer, Berlin, 338 S.
LOHMEYER W., SUKOPP,H. 1992. Agriophyten in der Vegetation Mitteleuropas. Schriftenreihe für Vegetationskunde, Landwirtschaftsverl., Münster, 185 S.
NIKLFELD H. 1973. Über die Grundzüge der Pflanzenverbreitung in Österreich und einigen Nachbargebieten. Verh.Zool.Bot.Ges. Wien, 113:53-69.
PAWLOWSKI B. 1970. Remarques sur l'endemisme dans la flore des Alpes et des Carpates. Vegetatio 21: 181-243.
SEITTER H. 1977. Die Flora des Fürstentums Liechtenstein. Bot.-Zool.Ges. Liechtenstein-Sargans-Werdenberg, Vaduz.
TÜRK R., POELT J. 1993. Bibliographie der Flechten und flechtenbewohnenden Pilze in Österreich. Biosystematics and Ecology Series, Bd.3, Österr. Akad. Wiss. Wien, 168 S.
WOHLGEMUTH T. 1996. Ein floristischer Ansatz zur biogeographischen Gliederung der Schweiz. Botanica Helv. 106:227-260.

Animal ecology, fauna

AUBRECHT, G. & BÖCK, F. 1985. Österreichische Gewässer als Winterrastplätze für Wasservögel. - Grüne Reihe des Bundesministeriums für Gesundheit und Umweltschutz, Wien, 3. 1-270 S.

AISTLEITNER E, AISTLEITNER U. 1996. Die Tagfalter des Fürstentums Liechtenstein (Lepidoptera: Papilionidae und Hesperioidae). Naturkundl. Forschung im Fürstentum Liechtenstein, Bd. 16, 159 S.
BAUER K. et al. 1988. Vögel und Säugetiere Österreichs. Österr. Ges. f. Vogelkunde, 58S.
SPINDLER, T. 1995. Fischfauna in Österreich. - Monographien des Umweltbundesamtes, Wien, 53. 1-120.
FRANZ H. 1979. Ökologie der Hochgebirge. Ulmer, Stuttgart, 495 S.
GAMAUF A. 1991. Greifvögel in Österreich. Bestand - Bedrohung – Gesetz. Umweltbundesamt, Monographien Bd. 29. Wien.
HUEMER, P. & TARMANN G. 1993. Die Schmetterlinge Österreichs (Lepidoptera). Systematisches Verzeichnis mit Verbreitungsangaben für die einzelnen Budesländer. - Beilageband 5 zu den Veröffentlichungen des Museum Ferdinandeum 73, pp. 1-224.
KINDLE T., AMANN E. 1984. Die Fische des Fürstentums Liechtenstein. Naturkundl. Forschung im Fürstentum Liechtenstein, Bd. 3.
MOSIMANN P., NAEF-DANZER B., BLATNNER M. 1987. Die Zusammensetzung der Avifauna in typischen Waldgesellschaften der Schweiz. Der Ornithologische Beobachter 84:275-299.
NIGG A. 1993. Die Reptilien des Fürstentums Liechtenstein. Bd.14.
MAURER R., HÄNGGI A. 1990. Katalog der schweizerischen Spinnen. Schweizerischer Bund Naturschutz/CSCF, Neuchatel.
SCHWEIZ. BUND FÜR NATURSCHUTZ 1988. Band 1. Tagfalter und ihre Lebensräume. Schweiz. Bund für Naturschutz, Basel, 561 S. (with distribution maps)
SCHWEIZ. BUND FÜR NATURSCHUTZ 1997. Schmetterlinge und ihre Lebensräume. Pro Natura – Schweiz. Bund für Naturschutz, Basel, 679 S.
THALER K. 1998. Die Spinnen von Nordtirol (Archnidae, Araneae): Faunistische Synopsis. Veröff. Tiroler Landesmuseum Ferdinandeum, 78:37-58.
TRÜB H. 1988. Die Schnecken und Muscheln des Fürstentums Liechtenstein, Bd. 9.
WAGNER B., LÖFFLER H., KINDLE T., KLEIN M., STAUB, E. 1993. Bondenseefischerei. Geschichte-Biologie und Ökologie – Bewirtschaftung. Jan Thorbecke, Sigmaringen.
WIEDERMEIER P. 1984. Die Fledermäuse des Fürstentums Liechtenstein. Naturkundl. Forschung im Fürstentum Liechtenstein, Bd. 2.
WILLI, G. 1984. Die Brutvögel des liechtensteinischen Alpenraumes – avifaunistische Untersuchungen mit Versuch der Bewertung ihrer Situation als Grundlage für Planungs- und Schutzmaßnahmen. Naturkundl. Forschung im Fürstentum Liechtenstein, Bd. 4.

Distribution maps

AESCHIMANN D. 1997. Information concernant la base de donnees sur la Flora des Alpes. Supplement a la Revue Valdotaine d'Histoire Naturelle, Bd. 51, Neuchatel.
AESCHIMANN D., LAUBER K., MOSER D.M. 2002 (announced). Flora Alpina. Atlas sämtlicher 4500 Gefäßpflanzen der Alpen. Haupt, Bern.
BOVIO M., DAL VESCO G., MONTACCINI F. (eds.) 1997. Actes du Deuxieme Colloque ecologie et biogeographie Alpines. Botanique et Zoologie. Supplement a la Revue Valdotaine d'Histoire Naturelle, Bd. 51.
DVORAK M., RANNER A., BERG H.-M. 1993. Atlas der Brutvögel Österreichs. Umweltbundesamt. Wien. 523 S.
HEGI G., MERXMÜLLER H., REISIGL H. 1977. Alpenflora. Paul Parey, Berlin. 194 S.
NIKLFELD H. 1972. Charakteristische Pflanzenareale. In: Österreich-Atlas IV/1a-i. Österr. Akademie Wiss., Wien, 5. Lieferung.

NIKLFELD H. 1972. Mapping the flora of the eastern Alps. Supplement a la Revue Valdotaine d'Histoire Naturelle, Bd. 51, Neuchatel.
PEDROLI J.-C., ZAUGG B., KIRCHHOFER A. 1991. Verbreitungsatlas der Fische und Rundmäuler der Schweiz. Documenta Faunistica Helvetiae 11: 1-207.
REICHL E.R. 1992. Verbreitungsatlas der Tierwelt Österreichs. Bd.1 Lepdoptera – Diurna, Tagfalter. Forschungsinstitut für Bioinformatik, Linz.
RHEINBERGER H.-J., RHEINBERGER B. 1991. Orchideen des Fürstentums Liechtenstein. Naturkundl. Forschung im Fürstentum Liechtenstein, Bd. 13.
SCHIFFERLI A., GEROUDET P., WINKLER R. 1982. Verbreitungsatlas der Brutvögel der Schweiz. Vogelwarte Sempach, 462 S.
WELTEN M., SUTTER R. 1982. Verbreitungsatlas der Farn- und Blütenpflanzen der Schweiz. Birkhäuser, Basel. 2 Bände.
WOHLGEMUTH T. 1996. Ein floristischer Ansatz zur biogeographischen Gliederung der Schweiz. Botanica Helv. 106:227-260.

Red Lists

A complete list of the RED LISTS of the alpic countries (Austria, France, Germany, Italy, Liechtenstein, Slovenia, Switzerland) including subunits, e.g. the counties of Austria, is added as Appendix 1 at the end of this text. The list was compiled by Dr. Christian Köppel, V.I.M. - Verlag für interaktive Medien Orchideenweg 2 D-76571 Gaggenau

NATURA 2000

DRUMEL B. 1993. Naturschutz in der EG – Handlungsbedarf für Österreich. WWF-Studie 11, Wien.
LUGHOFER S. 1999. NATURA 2000 in Europa – Chancen und Handlungsbedarf. WWF-Studie 34, Wien.
PAAR M., OBERLEITNER I., KUTZENBERGER H. 1998. Fachliche Grundlagen zur Umsetzung der Flora-Fauna-Habitat-Richtlinie. Schwerpunkt Arten (Anhang II). Umweltbundesamt. Wien.
SAUBERER N., GRABHERR G. 1995. Fachliche Grundlagen zur Umsetzung der FFH-Richtlinie in Österreich. Schwerpunkt Lebensräume (Anhang I). Umweltbundesamt, Wien.
SSYMANK A. 1998. Das europäische Schutzgebietssystem NATURA 2000. Bundesamt für Naturschutz. Bonn-Bad Godesberg, 560 S.
STADLER S., HINTERSTOISSER H. 1998. Die Natura 2000 Gebiete Salzburgs. Publ. Amt Natursch. Salzburg, Bd. 20.

HABITAT/ LANDSCAPES

Physiographie, land use, biodiversity (general accounts)

AMMANN B. 1995. Palaeorecords of plant biodiversity in the Alps. In: Chapin F.S., Körner,C. (eds.) Arctic and alpine biodiversity. Springer, Berlin-Heidelberg, 167-183.
BÄTZING, W. 1991. Die Alpen. Entstehung und Gefährdung einer europäischen Kulturlandschaft. Beck, München, 286 S.
DEVILLIERS P., DEVILLIERS-TERSCHUREN J. 1996. A classification of palaearctic habitats. Council of Europe. Straßbourg.
ELLMAUER T. 1993. Biodiversity hot spots in Österreich – eine erste Annäherung. Zeitschr. für Ökologie und Naturschutz 3:271-279.Erster Überblick zur Biodiversität Österreichs. WWF-Studien 12, Wien.

EUROPEAN COMMISSION 1991. CORINE biotopes manual. Habitats of the European Community. Brussels (EUR 1258/3 EN). 300 S.
FLIRI F. 1977. Die physiogeographischen Regionen des Alpenraumes. In: Wolkinger, F. (ed.) Natur und Mensch im Alpenraum. Ludwig Boltzmann-Inst. für Umweltwissenschaften und Naturschutz, Graz.
ELLMAUER, T., G. GRABHERR & H. NIKLFELD. 1993. Erster Überblick zur Biodiversität Österreichs. - WWF, Wien, 97 S.
GRABHERR, G. 1997. The high mountain ecosystems of the Alps. In: Wielgolaski F.E. (ed.) Polar and alpine tundra. Ecosystems of the world 3. Elsevier, Amsterdam. 97-121.
GRABHERR, G. 2000. Biodiversity of mountain forests. In: PRICE,M.F. & BUTT,N. (eds.) Forests in sustainable mountain development. A state of knowledge report for 2000. IUFRO Research Series 5, CABI Publishing, Oxford.
GRABHERR G., GOTTFRIED M., GRUBER A., PAULI H. 1995. Pattern and current changes in alpine plant diversity. In: Chapin F.S., Körner,C. (eds.) Arctic and alpine biodiversity. Springer, Berlin-Heidelberg, 167-183.
HOLZNER, W. (Hrsg.).1989. Biotoptypen in Österreich. Vorarbeiten zu einem Katalog. - Monographien des Umweltbundesamtes, Wien, 12. 233 S.
LADURNER, J., PURTSCHELLER F., REISIGL H. & TRATZ E. 1993. Die Welt der Alpen. Pinguin-Verlag, Innsbruck, 182 S.
MEYER E., THALER K. 1995. Animal diversity at high altitudes in the Austrian central Alps. . In: Chapin F.S., Körner,C. (eds.) Arctic and alpine biodiversity. Springer, Berlin-Heidelberg, 167-183.
MORAWETZ, W. (Hrsg.) 1994. Ökologische Grundwerte in Österreich. - Biosystematics and Ecology Series Supplement, 360 S.
ÖSTERREICHISCHER FORSTVEREIN (Hrsg.) 1994. Österreichs Wald. Vom Urwald zur Waldwirtschaft. - Eigenverlag Autorengemeinschaft "Österreichs Wald", 544 S.
POTT, R. 1996. Biotoptypen. Schützenswerte Lebensräume Deutschlands und angrenzender Regionen. - Eugen Ulmer, Stuttgart, 448 S.
WERNER P. 1981. Almen. Bäuerliches Wirtschaftsleben in der Gebirgsregion. Callwey, München, 220 S.

Vegetation, plant communities

BRAUN-BLANQUET J. 1948/1950. Übersicht der Pflanzengesellschaften Rätiens. Vegetatio, 1:29-41, 129-146, 285-316; 2: 20-37, 214-237, 341-360.
DIETL, W. 1995. Wiesen und Weiden im Berggebiet. - Montagna, 6. 1-8.
ELLENBERG H. 1996. Vegetation Mitteleuropas mit den Alpen. 5. Aufl., Ulmer, Stuttgart, 1095 S.
ELLENBERG H., KLÖTZLI F. 1972. Waldgesellschaften und Waldstandorte in der Schweiz. Schweiz. Anstalt für forstl. Versuchswesen, Bd. 48, 930 S.
GRABHERR G. 1995. Alpine vegetation in a global perspective. In: E.O. Box et al.
Vegetation Science in forestry. Kluwer, Dordrecht, 441-451.
GRABHERR G, MUCINA L. 1993. Die Pflanzengesellschaften Österreichs. Teil 2: Natürliche waldfreie Vegetation.
KELLER W., WOHLGEMUTH T., KUHN N., SCHÜTZ M., WILDI O. 1998. Waldgesellschaften der Schweiz auf floristischer Grundlage. Mitt. Eidgen. Forsch.anst. Wald, Schnee und Landschaft, 73:91-357.
MAYER H. 1974. Die Wälder des Ostalpenraumes. Fischer, Stuttgart.
MAYER H. 1984. Wälder Europas. Fischer, Stuttgart.
MUCINA L., GRABHERR G., ELLMAUER T. 1993. Die Pflanzengesellschaften Österreichs. Teil 1. Anthropogene Vegetation. Fischer, Jena, 578 S.

MUCINA L., GRABHERR G., WALLNÖFER S. 1993. Die Pflanzengesellschaften Österreichs. Teil 3. Gebüsche und Wälder. Fischer, Jena, 353 S.
MÜLLER, N. 1995. Wandel von Flora und Vegetation nordalpiner Wildflusslandschaften unter dem Einfluss des Menschen. - Berichte der ANL, 19. 125-187.
OBERDORFER E. 1977-1992. Süddeutsche Pflanzengesellschaften. Fischer, Stuttgart, Teil I 1977, 311S., Teil II 1978, 355S., Teil III 1983, 455S., Teil IV 1992 A:282S., B: 580 S. Fischer, Stuttgart,
OZENDA P. 1985. La Vegetation de la Chaine Alpine. Masson, Paris, 331 S. (deutsche Ausgabe bei Fischer, Stuttgart).
OZENDA, P. 1994. Vegetation du Continent Europeen. Delachaux et Niestle, Lausanne, 271 S.
POTT, R. 1995. Die Pflanzengesellschaften Deutschlands. - Eugen Ulmer, Stuttgart, 622 S.
REISIGL H, KELLER R. 1987. Alpenpflanzen im Lebensraum. Fischer, Stuttgart, 149 S.
REISIGL H., KELLER R. 1989. Lebensraum Bergwald. Fischer Stuttgart.
SCHMIDER, P. & J. BURNAND 1998. Waldgesellschaften im Fürstentum Liechtenstein. - Naturkundliche Forschung im Fürstentum Liechtenstein, 10. 1-188.
STEIGER, P. 1994. Wälder der Schweiz. Ott, Thun (Schweiz). 359 S. (with distribution maps).
STEINER, G.M. 1992. Österreichischer Moorschutzkatalog. - Grüne Reihe des BMUJF, Styria Medienservice Graz, 2.
STEINER, G.M., GRÜNIG A. 1999. Ökologie und Hydrologie der Moore/ Die hydrologischen Moortypen der Schweiz/ Moorhydrologie. In: Handbuch Moorschutz in der Schweiz 1. Bundesamt für Umwelt, Wald und Landschaft (BUWAL).
WOHLGEMUTH T., SCHÜTZ M., KELLER W., WILDI O. 1999. Berechnete Ökogramme für Schweizer Wälder. Bot. Helv. 109: 169-191.

Vegetation maps – Europe/Alps

BOHN,U. 1998. Karte der potentiellen Vegetation Europas.
OZENDA P., TONNEL A.M. 1984. Etages de Vegetation de la Chaine Alpine. Conseil de l'Europe, Strasbourg.

Vegetation maps - Alpine nations

GAUSSEN H., 1931. Carte du tapis vegetal de la France. Atlas de France, Comite National de Biogeographie, Paris.
MAYER H. 1974. Wälder des Ostalpenraumes. Gustav Fischer Verlag, Stuttgart (1:600.000).
PEDROTTI F. 1989. Carta della vegetazione potentiale dell'Italia.
PEDROTTI F. 1992. Carta della vegetazione reala d'Italia Scala 1:1.000.000. In: La vegetazione. Relazione sullo statu ambiente. Roma, Ministerio Ambiente: 94-100.
SCHMID E. 1939-1950. Carte de la vegetation de la Suisse au 1/200 000. Kümmerly et Frey, Berne.
SCHMID E. 1966. Vegetation Atlas de la Suisse.
SEIBERT P. 1968. Übersicht der natürlichen Vegetationsgebiete von Bayern 1/500 000 mit Erläuterungen. Bundesanstalt für Vegetationskunde, Naturschutz und Landschaftspflege, Bd3.
WAGNER H. 1971. Natürliche Vegetation. Österreich-Atlas IV-3 (1:1.000.000).
WAGNER H. 1985. Die Pflanzendecke Österreichs (Kommentar zur Karte). Österr. Akademie der Wissenschaften, Komm. Raumforschung, 63 S.

Vegetation maps - Alpine regions and counties

BARBERO M. & OZENDA P. 1979. Carte de la vegetation potentielle des Alpes piemontaises au 1/400.000. Doc. Carte Veg. Alp., 21: 139-162.
CARTE DE LA VEGETATION DE LA FRANCE (1:200.000; div. authors). C.N.R.S.: n° 48 Annecy-Geneve, n° 54 Grenoble, n°55/61 Tignes-Larche, n° 60 Gap, n° 67 Digne, n° 68 Nice, n° 75.
OZENDA P. et al. (1974) Carte de la vegetation potentielle des Alpes nord-occidentales (partie francaise). Doc. Carte Veg. Alp., 13: 9-27. (1.400.000).
PEDROTTI F. 1981. Carta della vegetatizione del foglio Trento. Consiglio Nazionale delle Richerche, Roma. (1:50.000)
CREDARO V., PIROLA A. 1975. La Vegetazione della Provinzia di Sondrio. Edizione Amministrazione Provinzia de Sondrio. (1:100.000).
PEER T 1980. Karte der aktuellen Vegetation Südtirols 1/100 000, Blatt Bozen. Doc. Carte Veg. Alp., 23:25-46.
SCHIECHTL H.M., STERN R., PITSCHMANN H., REISIGL H. et al. 1970-1988. Karte der aktuellen Vegetation von Tirol 1:100.000. Doc. Carte Veg. Alp., 8:7-34, 9: 109-132, 11: 33-48, 14:17-32, 15:9-72, 17: 73-84, 23:47-68, 25: 67-88, 26:29-48, 27:65-84, 30:3-24, 31:3-24.

Inventories of rare biotopes, protected areas etc.

BROGGI M., WILLI G. 1996. Inventar der Naturvorrangflächen im Fürstentum Liechtenstein. Naturkundl. Forschung im Fürstentum Liechtenstein, Bd. 15.
BROGGI M., GRABHERR G. 1991. Biotope in Vorarlberg. Endbericht zum Biotopinventar Vorarlberg. Natur und Landschaft in Vorarlberg, Bd.4, Vorarlberger Landschaftsfonds, Bregenz.
EIDGEN. BUNDESAMT FÜR UMWELT, WALD UND LANDSCHAFT (BUWAL) 1990. Inventar der Flachmoore von nationaler Bedeutung. Basel. 79 S.
ELLMAUER T. 1993. Erster Überblick zur Biodiversität Österreichs. WWF-Studien 12, Wien.
FÜRNKRANZ D., HEISELMAYER, HINTERSTOISSER H. 2000. Biotopkartierung im Alpenraum und anderen Bergregionen. Publ. Amt Naturschutz Salzburg, Bd.22.
GALANDAT J.-D., GOBAT J.-M., ROULIER 1993. Kartierung der Auengebiete von nationaler Bedeutung. Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern. 115 S.
GEPP J. et al. 1985. Auengewässer als Ökozellen. Grüne Reihe des Bundesministeriums für Gesundheit und Umweltschutz, Wien. 322 S.
GIGON A., LANGENAUER R. MEIER C., NIEVERGELT B. 1998. Blaue Listen der erfolgreich erhaltenen und gefördeten Tier- und Pflanzenarten der roten Listen: Methodik und Anwendung in der nördlichen Schweiz. Veröff. Geobot. Inst. ETH, Stiftung Rübel, 129, 137
HEGG O., BEGUIN C., ZOLLER H. 1993. Atlas schutzwürdiger Vegetationstypen der Schweiz. Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern , 160 S.
HOLZNER W. et al. 1986. Österreichischer Trockenrasenkatalog. Grüne Reihe des Bundesministeriums für Gesundheit und Umweltschutz, Bd. 6, 380 S.
KLAFFL I., OBERLEITNER I., TIEFENBACH M. 1999. Biogenetische Reservate und Biosphärenreservate in Österreich. Umweltbundesamt. Report 161. Wien.
KUHN N., AMIET R. 1988. Inventar der Auengebiete von nationaler Bedeutung. Eidgen. Department für Inneres, 41 S.
LIEBEL, G., FARASIN K., SCHRAMAYR G., SCHANDA F. & STÖHR B. 1987. Biotopkartierung. Stand und Empfehlungen. - Monographien des Umweltbundesamtes, Wien, 3. 1-153.

STEINER G.M. 19.. Österreichischer Moorschutzkatalog. 2.Aufl.
ZUKRIGL K. 1990. Naturwaldreservate in Österreich. UBA Monographien 21, Wien.

Conservation measures (ideas, proposals, reports)

ARGEALP 1989. Arten- und Biotopschutzbericht der Arbeitsgemeinschaft Alpenländer, Kommission II. Herausgegeben v. Bayr. Staatsministerium f. Landesverteidigung und Umweltfragen, München.
BROGGI, M.F., KUSSTATSCHER K. & SUTTER. R. 1997. Ökologisch motivierte Direktzahlungen in der Berglandwirtschaft des Alpenbogens. - Europäische Akademie Bozen, Fachbereich Alpine Umwelt, Blackwell, Berlin, 223 S.
BROGGI M., STAUB R., RUFFINI F.V. 1999. Großflächige Schutzgebiete im Alpenraum. Daten, Fakten, Hintergründe. Europ. Akad. Bozen. Blackwell, Berlin. 241 S.
BROGGI M., WILLI G. 1993. Waldreservate und Naturschutz. Schweiz. Bund für Naturschutz, Basel 78 S.
DRUMEL B. et al. 1995. Gemeinsam handeln – Das WWF-Programm für den Naturschutz in Österreich 1995-2000. WWF-Österreich. Wien.
EURONATUR 2000. 2000. Problemkreis Pflichtwasserabgabe - Ökologisch begründete Mindestabflüsse in Ausleitungsstrecken von Wasserkraftwerken. - natur+wissenschaft. Schriftenreihe der Stiftung Europäisches Naturerbe (EURONATUR), 1/2000. 1-192.
HAMILTON L. 1999. Conserving mountain biodiversity in protected areas. IUCN, unpubl. manuscript.
HINTERMANN U., BROGGI M., LOCHER R., GALLANDAT J.-D. 1995. Mehr Raum für die Natur. Schweiz. Ziele, Lösungen, Visionen im Naturschutz.Bund für Naturschutz, Ott, Thun, 351 S.
JESSEL, B. 1997. Wildnis als Kulturaufgabe? - Nur scheinbar ein Widerspruch! Zur Bedeutung des Wildnisgedankens für die Naturschutzarbeit. - Laufener Seminarbeiträge, ANL Laufen/Salzach, 1/97. 9-20.
ÖSTERREICHISCHE BUNDESREGIERUNG (HRSG.) 1995. NUP. Nationaler Umwelt Plan. - Styria Graz, 324 S.
PARVIAINEN et al. 1999. Research in forest reserves and natural forests in European countries. EFI Proceedings No. 16.
PLACHTER, H. 1997. Gebirgsflüsse - Naturschutz und Ökologie (Zusammenfassung). - Laufener Seminarbeiträge, ANL Laufen/Salzach, 4/97. 35.
SCHRÖDER W. 1995. Nationalparkgerechtes Wildtiermanagement. WWF-Studie 21, Wien.
RANSOME R.D., HUTSON A.M. 1999. Revised action plan for the conservation of the greater horseshoe bat (Rhinolophus ferrumequinum) in Europe. Council of Europe, Strasbourg.
SCHIEMEL, H.-J. 1997. Erholung in "wilder" Landschaft. die neue Flächenkategorie "Naturerfahrungsraum". - Laufener Seminarbeiträge, ANL Laufen/Salzach, 1/97. 141-147.
SUTER W. et al. 1998. Ein Planungsauftrag des Übereinkommens von Rio'92: Die Biodiversitätsstrategie als Naturschutzkonzept auf nationaler Ebene. Gaia 7:174-183.
WWF-Österreich 1997. Zukunft für gefährdete Baumarten ? Bericht der Fachtagung am 1. Oktober in der FBVA Mariabrunn. Wien. 67 S.

GIS - sources

BRZEZIECKI B., KIENAST F., WILDI O. 1993. A simulated map of the potential natural forest vegetation of Switzerland. J.Veg.Science 4: 499-508.
PELCOM – Pan-European Land Cover Monitoring ; Final Report and digitised map; European Union, DG XII.

CORINE – Landcover – Klassifikation
WILDI O., BRASSEL P. 1999. Die Landschaftsinventur – ein Informationssystem für die „Landschaft der Schweiz“. Eidg. Forschungsanstalt für Wald, Schnee und Landschaft, Inf.bl. Forschungsbereich Landschaft 44:1-4.
WOHLGEMUTH T. 1999. Pflanzenverbreitung im Internet. Inf.bl. Forschungsbereich Landschaft, 41:1-3.
ZIMMERMANN N.E., KIENAST F. 1999. Predictive mapping of alpine grasslands in Switzerland: Species versus community approach. J.Veg.Sci. 10: 469-482.

Detailed information on request.

ECOLOGICAL PROCESSES AND PHENOMENA

Climate change

BENISTON M. 1994. Mountain environments in changing climates. Rouledge, London, 461 S.
GRABHERR G., GOTTFRIED M., PAULI H. 1994. Climate effects on mountain plants. Nature, 369:448.
GOTTFRIED M., PAULI H., GRABHERR G. 1994. Die Alpen im „Treibhaus“. Jahrbuch zum Schutz der Bergwelt, 59:13-27.
GUISAN A., HOLTEN J.I., SPICHIGER R., TESSIER L. 1995. Potential ecological impacts of climate change in the Alps and Fennoscandian mountains. Cons. Jard. Bot. Geneve, Publ. hors-serie 8. 194 S.

Cultural landscapes/ land use change and related problems

BÄTZING W, Messerli P. 1991. Die Alpen im Europa der neunziger Jahre. Geographia Bernensia P22. Geogr. Inst. Univ. Bern, Bern, 315 S.
BRUGGER E., FURRER G., MESSERLI B., MESSERLI P. 1984. Umbruch im Berggebiet – die Entwicklung des schweizerischen Berggebietes zwischen Eigenständigkeit und Abhängigkeit aus ökonomischer und ökologischer Sicht. Paul Haupt, Bern, 1079 S.
CIPRA – Internationale Alpenschutzkommission 1998. 1. Alpenreport. Haupt, Bern, 472 S.
FINK, M.H., GRÜNWEIS F.M., T. WRBKA. 1989. Kartierung ausgewählter Kulturlandschaften Österreichs. - Monographien des Umweltbundesamtes, Wien, 11. 335 S.
PRICE, M.F. 1995. Mountain research in Europe. An Overview of MAB Research from the Pyrenees to Siberia. The Parthenon Publishing Group, Oxford, 230p.
MESSERLI B., IVES J.D. 1997. Mountains of the world. A global Priority. The Parthenon Publishing Group, New York, 495p.

LANDSCAPE INTEGRITY

GRABHERR, G., G. KOCH, H. KIRCHMEIR & K. REITER. 1995. Hemerobie österreichischer Waldökosysteme - Vorstellung eines Forschungsvorhabens im Rahmen des österreichischen Beitrages zum MAB-Programm der UNESCO. - Zeitschrift für Ökologie und Naturschutz, 4. 105-110.
GRABHERR G., KOCH G., KIRCHMEIR H., REITER K. 1998. Hemerobie österreichischer Waldökosysteme. Österr. Akad. Wiss., Veröff. Österr. MAB-Programm, Wien. Bd. 17.

MINGHETTI,P. 1999. Naturalita della vegetazione del Trentino –Alto Adige (con carta 1:250.000). Report Centro Ecologia Alpina, 20:1-35. (Karte der Natürlichkeit der Vegetation; 6 Klassen).

List of Internet –Addresses consulted

Alpine Convention
http://www.buwal.ch/ (Eidgen. Bundesamt für Umwelt, Wald und Landschaft)
http://www.helsinki.fi/kmus/afe/database.html (Atlas Flora Europaea data base)
http://www.bgbm.fu-berlin.de/biodivinf/ (Bot. Garten und Bot. Museum Berlin Dahlem)
http://dib.joanneum.ac.at/dib_main.ht (Inst. of Digital Image Processing, Joanneum,Graz)
http://www.land-sbg.gv.at/ (Amt der Salzburger Landesregierung)
http://www.oestat.gv.at/ (Österr. Statistisches Zentralamt)
http://www.ubavie.gv.at/ (Österr. Umweltbundesamt)
http://www.wsl.ch/ (Eidgen. Forschungsanstalt für Wald, Schnee und Landschaft)
http://www.buwal.ch/ (Eidgen. Bundesamt für Umwelt, Wald und Landschaft)

Appendix 1

Red Lists
Bibliography of the Alps

Plants – Plant Communities – Biotopes – Animals

Germany

France

Italy

Liechtenstein

Austria

Switzerland

Slovenia

Prepared by Christian Köppel

August, 2000

Germany

Plants:

Bennert, H.W. (1999): Die seltenen und gefährdeten Farnpflanzen Deutschlands. - Bonn-Bad Godesberg, 382 pp.
Taxonomic groups: Vascular Plants

Bundesamt für Naturschutz (BfN, ed.) (Redaktion: Ludwig, G. & M. Schnittler) (1996): Rote Liste gefährdeter Pflanzen Deutschlands. - Bundesamt für Naturschutz (BfN) (ed.), Bonn-Bad Godesberg, 744 pp.

Benkert, D., H. Dörfelt, H.-J. Hardtke, G. Hirsch, H. Kreisel, G. J. Krieglsteiner, M. Lüderitz, A. Runge, H. Schmid, J. A. Schmitt, W. Winterhoff, K. Wöldecke, H. D. Zehfuss, A. Einhellinger, G. Gross, H. Grosse-Brauckmann, I. Nuss & G.K. Wölfel (1996): Rote Liste der Großpilze Deutschlands. - pp.377-426. -

Taxonomic groups: Fungi (incl. Slime Moulds)

Foitzik, O. (1996): Provisorische Rote Liste der phytoparasitischen Pilze (Erysiphales, Uredinales et Ustilaginales) Deutschlands. - pp.427-480. -

Taxonomic groups: Fungi (incl. Slime Moulds)

Gutowski, A. & D. Mollenhauer (1996): Rote Liste der Zieralgen (Desmidiales) Deutschlands. - pp.679-708. -

Taxonomic groups: Algae (incl. Blue-Green Algae)

Knappe, J., U. Geissler, A. Gutowski & G. Friedrich (1996): Rote Liste der limnischen Braunalgen (Fucophyceae) und Rotalgen (Rhodophyceae) Deutschlands. - pp.609-623. -

Taxonomic groups: Algae (incl. Blue-Green Algae)

Korneck, D., M. Schnittler & I. Vollmer (1996): Rote Liste der Farn- und Blütenpflanzen (Pteridophyta et Spermatophyta) Deutschlands. - pp.21-187. -

Taxonomic groups: Vascular Plants

Lange-Bertalot, H. & A. Steindorf (1996): Rote Liste der limnischen Kieselalgen (Bacillariophyceae) Deutschlands. - pp.633-677. -

Taxonomic groups: Algae (incl. Blue-Green Algae)

Ludwig, G., R. Düll, G. Philippi, M. Ahrens, S. Caspari, M. Koperski, S. Lütt, F. Schulz & G. Schwab (1996): Rote Liste der Moose (Anthocerophyta et Bryophyta) Deutschlands. - pp.189-306. -

Taxonomic groups: Mosses and Liverworts

Mollenhauer, D. & T. A. Christensen (1996): Rote Liste der Schlauchalgen (Vaucheriaceae) Deutschlands. - pp.625-632. -

Taxonomic groups: Algae (incl. Blue-Green Algae)

Schmidt, D., K. van de Weyer, W. Krause, L. Kies, A. Garniel, U. Geissler, A. Gutowski, R. Samietz, W. Schütz, H.-Ch. Vahle, M. Vöge, P. Wolff, & A. Melzer (1996): Rote Liste der Armleuchteralgen (Charophycea) Deutschlands. 2. Fassung, Stand: Februar 1995. - pp.547-576. –

Taxonomic groups: Algae (incl. Blue-Green Algae)

Schnittler, M., L. Krieglsteiner, H. Marx, L. Flatau, H. Neubert, W. Nowotny & K. Baumann (1996): Vorläufige Rote Liste der Schleimpilze (Myxomycetes) Deutschlands. - pp.481-525. -

Taxonomic groups: Fungi (incl. Slime Moulds)

Schories, D., W. Härdle, E. Kaminski, V. Kell, E. Kühner & H. Pankow (1996): Rote Liste und Florenliste der marinen Makroalgen (Chlorophyceae, Rhodophyceae et Fucophyceae) Deutschlands. - pp.577-607. -

Taxonomic groups: Algae (incl. Blue-Green Algae)

Wirth, V., H. Schöller, P. Scholz, G. Ernst, T. Feuerer, A. Gnüchtel, M. Hauck, P. Jacobsen, V. John & B. Litterski (1996): Rote Liste der Flechten (Lichenes) der Bundesrepublik Deutschland. - pp.307-368. -

Taxonomic groups: Lichens

Riecken, U., U. Ries & A. Ssymank (1994): Rote Liste der gefährdeten Biotoptypen der Bundesrepublik Deutschland. - Bundesamt für Naturschutz (BfN) (ed.), Bonn-Bad Godesberg, 184 pp.

Riecken, U., U. Ries & A. Ssymank (1994): III. Rote Liste der Biotoptypen (unter Verwendung des vollständigen Biotoptypenverzeichnisses für die Bundesrepublik Deutschland) und Rote Liste der Biotopkomplexe des Binnenlandes jeweils mit Angaben zur Regenerationsfähigkeit. - pp.41-73. -

Taxonomic groups: Habitat Types

Riecken, U., U. Ries, A. Ssymank, T. Merck & H. von Nordheim (1994): II. Rote Liste der Biotoptypen (unter Verwendung des vollständigen Biotoptypenverzeichnisses für die Bundesrepublik Deutschland) und Rote Liste der Biotopkomplexe der Meere und Küsten jeweils mit Angaben zur Regenerationsfähigkeit. - pp.37-40. -

Taxonomic groups: Habitat Types

Animals:

Binot, M., R. Bless, P. Boye, H. Gruttke & P. Pretscher (zusammengestellt und bearbeitet) (1998): Rote Liste gefährdeter Tiere Deutschlands. - Bundesamt für Naturschutz (BfN) (ed.), Bonn-Bad Godesberg, 434 pp.

Bellstedt, R. & R. Wagner unter Mitarbeit von A. Stark (1998): Rote Liste der Langbeinfliegen (Diptera: Dolichopodidae) (Bearbeitungsstand: 1995). - pp.73-76. -

Taxonomic groups: True Flies

Beutler, A., A. Geiger, P. M. Kornacker, K.-D. Kühnel, H. Laufer, R. Podloucky, P. Boye & E. Dietrich unter Mitarbeit von E. Andrä, O. Assmann, A. Bitz, U. Dierking, U. Fritz, U. Geise, J. Gerstner, W.-R. Grosse, H.-J. Gruber, U. Gruber, ... (1998): Rote Liste der Kriechtiere (Reptilia) und Rote Liste der Lurche (Amphibia) (Bearbeitungsstand: 1997). - pp.48-52. -

Taxonomic groups: Amphibians and Reptiles

Bless, R., A. Lelek & A. Waterstraat (1998): Rote Liste der in Binnengewässern lebenden Rundmäuler und Fische (Cyclostomata & Pisces). - pp.53-59. -

Taxonomic groups: Fishes and Lampreys

Bliss, P., J. Martens & T. Blick unter Mitarbeit von T. Baumann, H. Hiebsch, J. Holstein, S. Malt, A. Malten, R. Platen, F.-O. Vytrisal & I. Weiss (1998): Rote Liste der Weberknechte (Arachnida: Opiliones) (Bearbeitungsstand: 1996, 2. Fassung). - pp.276-277. -

Taxonomic groups: Spiders

Boye, P., R. Hutterer, H. Benke unter Mitarbeit von M. Braun, D. Heidecke, G. Heidemann, H. Meinig & G. Schlapp (1998): Rote Liste der Säugetiere (Mammalia) (Bearbeitungsstand: 1997). - pp.33-39. -

Taxonomic groups: Mammals

Drogla, R. & T. Blick unter Mitarbeit von V. Duchac, M. Kreuels, V. Mahnert & P. Sacher (1998): Rote Liste der Pseudoskorpione (Arachnida: Pseudoscorpiones) (Bearbeitungsstand: 1996, veränd. 1. Fassung). - pp.278-279. -

Taxonomic groups: Spiders

Fricke, R., R. Berghahn, O. Rechlin, T. Neudecker, H. Winkler, H.-D. Bast & E. Hahlbeck (1998): Rote Liste der in Küstengewässern lebenden Rundmäuler und Fische (Cyclostomata & Pisces). (Bearbeitungsstand: 1994). - pp.60-64. -

Taxonomic groups: Fishes and Lampreys

Geiser, R. (Bearbeiter) unter Mitarbeit von F. Apfelbacher, M. Balke, R. Bellstedt, U. Bense, D. Braasch, P. Brandl, R. Buck, H. Bußler, M. Döberl, J. Frank, R. Frieser, F. Fritzlar, H. Fürsch, R. Gerstmeier, M. Grünwald, S. Gürlich, P. Haase, (1998): Rote Liste der Käfer (Coleoptera) (Bearbeitungsstand: 1997) (excl. Laufkäfer (Carabidae)). - pp.168-230. -

Taxonomic groups: Beetles

Günther, H., H.-J. Hoffmann, A. Melber, R. Remane, H. Simon & H. Winkelmann (1998): Rote Liste der Wanzen (Heteroptera) (Bearbeitungsstand: 1997). - pp.235-242. -

Taxonomic groups: Plant and Water Bugs, Flees

Havelka, P. (1998): Rote Liste der Gnitzen (Diptera: Ceratopogonidae) (Bearbeitungsstand: 1997). - pp.80-83. -

Taxonomic groups: True Flies

Ingrisch, S. & G. Köhler unter Mitarbeit von H. Beutler, J. Börner, H. Bohn, M. Braune, R. Brocksieper, A. Bruckhaus, M. Buchweitz, H.-J. Clausnitzer, A. Coray, G. Deckert, P. Detzel, D. Dorda, R. Dülge, G. Grein, K. K. Günther, K. Harz, ... (1998): Rote Liste der Geradflügler (Orthoptera s. l.) (Bearbeitungsstand 1993, geändert 1997). - pp.252-254. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Joost, W. & R. Wagner (1998): Rote Liste der aquatischen Tanzfliegen (Diptera: Empididae) (Bearbeitungsstand: 1997). - pp.77-79. -

Taxonomic groups: True Flies

Jungbluth, J. H. & D. von Knorre unter Mitarbeit von G. Falkner, K. Groh & G. Schmid (1998): Rote Liste der Binnenmollusken [Schnecken (Gastropoda) und Muscheln (Bivalvia)] (Bearbeitungsstand: 1994). - pp.283-289. -

Taxonomic groups: Molluscs

Klima, F. unter Mitarbeit von R. Bellstedt, H.-W. Bohle, R. Brettfeld, A. Christian, R. Eckstein, R. Kohl, H. Malicky, W. Mey, T. Pitsch, H. Reusch, B. Robert, C. Schmidt, F. Schöll, W. Tobias, H.-J. Vermehren, R. Wagner, A. Weinzierl & W. Wichard (1998): Rote Liste der Köcherfliegen (Trichoptera) (Bearbeitungsstand: 1994, mit Ergänzungen bis 10/1997). - pp.112-118. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Malzacher, P., U. Jacob, A. Haybach & H. Reusch (1998): Rote Liste der Eintagsfliegen (Ephemeroptera) (Bearbeitungsstand: 1997). - pp.264-267. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Niehuis, O. unter Mitarbeit von F. Burger, D. Doczkal, M. Hauser, P. X. Kunz, K. Mandery, C. Saure, C. Schmid-Egger, J. van der Smissen, R. Theunert, J. Voith & K.-H. Wickl (1998): Rote Liste der Goldwespen (Hymenoptera: Chrysididae) (Bearbeitungsstand: 1997). - pp.134-137. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Ott, J. & W. Piper (Bearbeiter) unter Mitarbeit der AG Rote Liste der Gesellschaft Deutschsprachiger Odonatologen GdO e.V.: R. Altmüller, T. Brockhaus, R. Buchwald, K. Burbach, H.-J. Clausnitzer, F. Eislöffel, J. Kuhn, A. Martens, ... (1998): Rote Liste der Libellen (Odonata) (Bearbeitungsstand: 1997). - pp.260-263. -

Taxonomic groups: Dragonflies

Platen, R., T. Blick, P. Sacher, A. Malten (Bearbeiter) unter Mitarbeit von B. Baehr, B. Balkenhol, E. Bauchhenss, H.-J. Beck, P. Beck, H. Bellmann, P. Bliss, B. von Broen, K. Bruhn, D. Cordes, H.-C. Fründ, C. Gack, J. Grabo, K. H. Harms, ... (1998): Rote Liste der Webspinnen (Arachnida: Araneae) (Bearbeitungsstand: 1996, 2. Fassung). - pp.268-275. -

Taxonomic groups: Spiders

Pretscher, P. (Bearbeiter) unter Mitarbeit von D. Bartsch, E. Bettag, F. A. Bink, R. Bläsius, E. Blum, O. Blochwitz, R. Bolz, M. Binot, M. Brau, E. Brockmann, M. Bücker, O. Czadek, D. Doczkal, G. Ebert, G. Embacher, R. Feldmann, K. Fiedler, P. Föhst, ... (1998): Rote Liste der Großschmetterlinge (Macrolepidoptera) (Bearbeitungsstand: 1995/1996). - pp.87-111. -

Taxonomic groups: Butterflies and Moths

Rachor, E. unter Mitarbeit von G. Arlt, A. Bick, R. Bönsch, F. Gosselck, J. Harms, W. Heiber, I. Kröncke, J. Kube, H. Michaelis, K. Reise, V. Schroeren, K.-H. van Bernem & J. Voss (1998): Rote Liste der bodenlebenden wirbellosen Meerestiere (Bearbeitungsstand: 1997). [Schwämme (Porifera), Polypentiere (Hydrozoa), Blumentiere (Anthozoa), Käferschnecken (Polyplacophora), Schnecken (Gastropoda), Muscheln (Bivalvia), Vielborster (Polychaeta), Wenigborster (Oligochaeta), Krebse (Decapoda), Asseln (Isopoda), Stachelhäuter (Echinodermata), Igelwürmer (Echiurioidea), Manteltiere (Tunicata)]. - pp.290-300. -

Taxonomic groups: Crustaceans, Molluscs, "Lower animals"

Remane, R., R. Achtziger, W. Fröhlich, H. Nickel & W. Wittsack unter Mitarbeit von R. Emmrich, J. Hildebrandt, R. Niedringhaus & S. Walter (1998): Rote Liste der Zikaden (Homoptera, Auchenorrhyncha) (Bearbeitungsstand: 1997). - pp.243-249. -

Taxonomic groups: Plant and Water Bugs, Flees

Reusch, H. & A. Weinzierl (Bearbeitung) unter Mitarbeit von R. Bellstedt, D. Blanke, D. Böhme, D. Braasch, R. Brettfeld, R. Brinkmann, H. Dittmar, J. M. Fey, F. Gohr, A. Haybach, M. Hohmann, W. Joost, M. Marten, H. Mendl, M. Otte, C.-J. Otto, ... (1998): Rote Liste der Steinfliegen (Plecoptera) (Bearbeitungsstand: 1997). - pp.255-259. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Röhricht, W. & E. J. Tröger unter Mitarbeit von P. Ohm (1998): Rote Liste der Netzflügler (Neuropteroidea) (Bearbeitungsstand: 1997). - pp.231-234. -

Taxonomic groups: Alderflies and Snakeflies

Schliephake, G. & R. zur Strassen (1998): Rote Liste der Fransenflügler (Thysanoptera) (Bearbeitungsstand: 1997). - pp.250-251. -

Taxonomic groups: Thrips

Schmid-Egger, C., K. Schmidt, D. Doczkal, F. Burger, H. Wolf & J. van der Smissen unter Mitarbeit von M. Hauser, A. Jakubzik, K. Mandery, O. Niehuis, C. Saure, R. Theunert, S. Tischendorf, K.-H. Wickl, R. Witt, J. Voith & K. Weber (1998): Rote Liste der Grab-, Weg-,

Faltenwespen und "Dolchwespenartigen" (Hymenoptera: Sphecidae, Pompilidae, Vespidae, "Scolioidea") (Bearbeitungsstand: 1997). - pp.138-146. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Seifert, B. unter Mitarbeit von A. Buschinger, W. Dorow, G. Heller, W. Münch & W. Rohe (1998): Rote Liste der Ameisen (Hymenoptera: Formicidae) (Bearbeitungsstand: 1997). - pp.130-133. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Simon, L. unter Mitarbeit von D. Flössner, D. Heidecke & J. Martens (1998): Rote Liste ausgewählter Gruppen der Blattfußkrebse (Branchiopoda: Anostraca; Notostraca, Conchostraca) (Bearbeitungsstand: 1994). - pp.280-282. -

Taxonomic groups: Crustaceans

Ssymank, A. & D. Doczkal unter Mitarbeit von I. Duty, M. Hauser, J. Hembach, F. Malec, A. Precht, U. Schmid, J.-H. Stuke & D. Wolff (1998): Rote Liste der Schwebfliegen (Diptera: Syrphidae) (Bearbeitungsstand: 1998). - pp.65-72. -

Taxonomic groups: True Flies

Taeger, A., S. M. Blank, E. Jansen, M. Kraus & C. Ritzau (1998): Rote Liste der Pflanzenwespen (Hymenoptera: Symphyta) (Bearbeitungsstand: 1997). - pp.147-158. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Trautner, J., G. Müller-Motzfeld & M. Bräunicke unter Mitarbeit von E. Arndt, T. Aßmann, D. Eisinger, M.-A. Fritze, R. Geiser, E. Grill, S. Gürlich, K. Handke, M. Hartmann, F. Hieke, U. Irmler, K.-H. Kielhorn, A. Lompe, W. Lorenz, S. Maas, ... (1998): Rote Liste der Sandlaufkäfer und Laufkäfer (Coleoptera: Cicindelidae et Carabidae) (Bearbeitungsstand: 1996). - pp.159-167. -

Taxonomic groups: Beetles

Wagner, R. & R. Bellstedt (1998): Rote Liste der Schmetterlingsmücken (Diptera: Psychodidae) (Bearbeitungsstand: 1994). - pp.84-86. -

Taxonomic groups: True Flies

Westrich, P., H. R. Schwenninger, H. H. Dathe, H. Riemann, C. Saure, J. Voith & K. Weber (1998): Rote Liste der Bienen (Hymenoptera: Apidae) (Bearbeitungsstand: 1997). - pp.119-129. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Witt, K., H.-G. Bauer, P. Berthold, P. Boye, O. Hüppop & W. Knief (Nationales Gremium Rote Liste Vögel) (1998): Rote Liste der Brutvögel (Aves) - korrigierte 2. Fassung (Bearbeitungsstand: 1996). - pp.40-47. -

Taxonomic groups: Birds

Hess, M., D. Spitzenberg, R. Bellstedt, U. Heckes, L. Hendrich & W. Sondermann unter Mitarbeit von M. Balke, H. Bussler, P. Haase, F. Hebauer, B. Klausnitzer, F. Köhler, J. Schmidl, A. Skale, T. Tolasch & W. Ziegler (1999): Artenbestand und Gefährdungssituation der Wasserkäfer Deutschlands. Coleoptera: Hydradephaga, Hydrophiloidea part., Dryopoidea part.; Microsporidae, Hydraenidae, Scirtidae. - Naturschutz und Landschaftsplanung, 31, 7, pp.197-211, Stuttgart (Hohenheim).

Taxonomic groups: Beetles

Germany - Bavaria

Plants:

Milbradt, J. & A. Reif (1995): Rote Liste der Prunetalia-Gesellschaften Bayerns. - Berichte der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora, Vol.65, pp.43-49, München.
Taxonomic groups: Plant Communities

Schmid, H. (1990): Beiträge zum Artenschutz 14. Rote Liste gefährdeter Großpilze Bayerns. - Schriftenreihe des Bayerischen Landesamtes für Umweltschutz, 106, pp.1-138, München.
Taxonomic groups: Fungi (incl. Slime Moulds)

Schönfelder, P. (1993): Rote Liste gefährdeter Farn- und Blütenpflanzen Bayerns, Neubearbeitung 1986 - Kurzfassung. - Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen (ed.), München, 66 pp.
Taxonomic groups: Vascular Plants

Walentowski, H., B. Raab & W. A. Zahlheimer (1990): Vorläufige Rote Liste der in Bayern nachgewiesenen oder zu erwartenden Pflanzengesellschaften. - I. Naturnahe Wälder und Gebüsche. - Berichte der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora, Beiheft, Vol.61, 1, pp.1-62, München.
Taxonomic groups: Plant Communities

Walentowski, H., B. Raab & W. A. Zahlheimer (1991): Vorläufige Rote Liste der in Bayern nachgewiesenen oder zu erwartenden Pflanzengesellschaften. - II. Wirtschaftswiesen und Unkrautgesellschaften. - Berichte der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora, Beiheft, Vol.62, 1, pp.1-85, München.
Taxonomic groups: Plant Communities

Walentowski, H., B. Raab & W. A. Zahlheimer (1991): Vorläufige Rote Liste der in Bayern nachgewiesenen oder zu erwartenden Pflanzengesellschaften. - III. Außeralpine Felsvegetation, Trockenrasen, Borstgrasrasen und Heidekraut-Gestrüppe, wärmebedürftige Saumgesellschaften. - Berichte der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora, Beiheft, Vol.62, 2, pp.1-63, München.
Taxonomic groups: Plant Communities

Walentowski, H., B. Raab & W. A. Zahlheimer (1992): Vorläufige Rote Liste der in Bayern nachgewiesenen oder zu erwartenden Pflanzengesellschaften. - IV. Wasser-, Verlandungs- und Moorgesellschaften, Vegetation oberhalb der alpinen Waldgrenze und alpigene Schwemmlingsfluren (mit Gesamtübersicht Teil I bis IV). - Berichte der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora, Beiheft, 7, pp.1-170, München.
Taxonomic groups: Plant Communities

Animals:

Bayerisches Landesamt für Umweltschutz (ed.) (1992):
Beiträge zum Artenschutz 15. Rote Liste gefährdeter Tiere Bayerns. - München, 288 pp.

Achtziger, R. (1992): Rote Liste gefährdeter Singzikaden (Homoptera, Auchenorrhyncha, Cicadidae) Bayerns. - pp.99. -

Taxonomic groups: Plant and Water Bugs, Flees

Achtziger, R., W. Scholze & G. Schuster (1992): Rote Liste gefährdeter Landwanzen (Heteroptera, Geocorisae) Bayerns. - pp.87-95. -

Taxonomic groups: Plant and Water Bugs, Flees

Adam, G., A. Weinzierl & E. Mauch (1992): Rote Liste gefährdeter Eintagsfliegen (Ephemeroptera) Bayerns. - pp.73-75. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Bauschmann, G. & A. Buschinger (1992): Rote Liste gefährdeter Ameisen (Formicoidea) Bayerns. - pp.169-172. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Bausenwein, D. (1992): Rote Liste gefährdeter Goldwespen (Chrysididae) Bayerns. - pp.148-151. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Blick, T., M. Scheidler, B. Baehr, E. Bauchhenss, H.-J. Beck, P. Beck, I. Kühn, A. Lehna, D. Leipold, G. Schmidt, V. Slembrouck-Wolf, H. Stumpf, G. Töpfer-Hoffmann, H. Uhlenhaut, F.-O. Vytrisal & D. Weickmann-Zwörner (1992): Rote Liste gefährdeter Spinnen (Araneae) Bayerns. - pp.56-66. -

Taxonomic groups: Spiders

Bliss, P., T. Blick, H. Rausch & A. Malten (1992): Rote Liste gefährdeter Weberknechte (Opiliones) Bayerns. - pp.67-68. -

Taxonomic groups: Spiders

Bohl, E. (1992): Rote Liste gefährdeter Fische (Pisces) Bayerns. - pp.42-46. -

Taxonomic groups: Fishes and Lampreys

Bohl, E. (1992): Rote Liste gefährdeter Großkrebse (Decapoda) Bayerns. - pp.pp. 69. -

Taxonomic groups: Crustaceans

Burmeister, E. G. (1992): Rote Liste gefährdeter Limnischer Krebse Bayerns. - pp.70-71. -

Taxonomic groups: Crustaceans

Burmeister, E.-G. (1992): Rote Liste gefährdeter Wasserwanzen (Hydrocorisae, Gerromorpha) Bayerns. - pp.96-98. -

Taxonomic groups: Plant and Water Bugs, Flees

Dunk, K. von der (1992): Rote Liste gefährdeter Wollschweber (Bombyliidae) Bayerns. - pp.183-184. -

Taxonomic groups: True Flies

Dunk, K. von der (1992): Rote Liste gefährdeter Raubfliegen (Asilidae) Bayerns. - pp.185-186. -

Taxonomic groups: True Flies

Dunk, K. von der (1992): Rote Liste gefährdeter Dickkopffliegen (Conopidae) Bayerns. - pp.199-200. -

Taxonomic groups: True Flies

Falkner, G. (1992): Rote Liste gefährdeter Schnecken und Muscheln (Mollusca) Bayerns. - pp.47-55. -

Taxonomic groups: Molluscs

Geiser, R. (1992): Rote Liste gefährdeter Kurzflüglerartiger (Staphylinoidea) und Stutzkäferartiger (Histeroidea) Bayerns. - pp.118-122. -

Taxonomic groups: Beetles

Geiser, R. (1992): Rote Liste gefährdeter Blatthornkäfer (Lamellicornia) Bayerns. - pp.123-126. -

Taxonomic groups: Beetles

Geiser, R. (1992): Rote Liste gefährdeter Bockkäfer (Cerambycidae) Bayerns. - pp.127-131. -

Taxonomic groups: Beetles

Geiser, R. (1992): Rote Liste gefährdeter Marienkäfer (Coccinellidae) Bayerns. - pp.132-133. -

Taxonomic groups: Beetles

Gerstmeier, R. (1992): Rote Liste gefährdeter Buntkäfer (Cleridae und Korynetidae) Bayerns. - pp.135-136. -

Taxonomic groups: Beetles

Geyer, A., M. Bücker, H.-J. Beck, A. Bischof, J.de Freina, S. Dierkschneider, W. Dierl, U. Eitschberger, E. Garthe, W. Geghardt, G. Heigl, K. Heuberger, W. Hundhammer, W. Kaesweber, G. Kleinecke, H. Kolbeck, K. Lackerbeck, D. Müting, K.-H. Müller-Köll... (1992): Rote Liste gefährdeter Tagfalter (Rhopalocera) Bayerns. - pp.206-213. -

Taxonomic groups: Butterflies and Moths

Grünwald, M. (1992): Rote Liste gefährdeter Landasseln (Isopoda: Oniscidea) Bayerns. - pp.pp. 72. -

Taxonomic groups: Crustaceans

Havelka, P. (1992): Rote Liste gefährdeter Gnitzen (Ceratopogonidae) Bayerns. - pp.173-175. -

Taxonomic groups: True Flies

Hebauer, F. (1992): Rote Liste gefährdeter Wasserkäfer (Hydradephaga, Palpicornia, Dryopoidea) Bayerns. - pp.110-115. -

Taxonomic groups: Beetles

Heusinger, G., J. E. Krach, G. Scholl & H. Schmidt (1992): Rote Liste gefährdeter Kriechtiere (Reptilia) Bayerns. - pp.35-37. -

Taxonomic groups: Amphibians and Reptiles

Krach, J. E., G. Heusinger, G. Scholl & H. Schmidt (1992): Rote Liste gefährdeter Lurche (Amphibia) Bayerns. - pp.38-41. -

Taxonomic groups: Amphibians and Reptiles

Kraus, M. (1992): Rote Liste gefährdeter Blatt-, Halm- und Holzwespen Bayerns. - pp.140-145. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Kraus, M., G. Heusinger & G. Nitsche (1992): Rote Liste gefährdeter Säugetiere (Mammalia) Bayerns (ohne Fledermäuse). - pp.21-24. -

Taxonomic groups: Mammals

Kriegbaum, H., DGfO, U. Arnold-Reich, G. Banse, H.-J. Beck, H. Bellmann, P. Detzel, O. Fischer-Leipold, D. Förster, R. Geiser, K. Hanschitz, K.-G. Heller, G. Heusinger, S. Ingrisch, H. Kriegbaum, K. Kuhn, G. Lang, G. Merkel-Wallner, R. Mertel, A. Mesched (1992): Rote Liste gefährdeter Springschrecken (Saltatoria) und Schaben (Blattodea) Bayerns. - pp.83-86. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Kuhn, K., U. Arnold-Reich, G. Banse, P. Beck, H. Bellmann, E.-G. Burmeister, L. Dirnfelder, F. Grimmer, S. Kognitzki, G. Lang, K. Mandery, O. Muise, M. Reich, F. Reißenweber, K. Roth, J. Sachteleben, R. Seidenbusch, H. Schlumprecht, R. Weid, J. Werzinger (1992): Rote Liste gefährdeter Libellen (Odonata) Bayerns. - pp.76-79. -

Taxonomic groups: Dragonflies

Lorenz, W., F. Apfelbacher, D. Förster, R. Geiser, M. Grünwald, D. Heimbucher, C. Hirgstetter, A. Korell, K. Lackerbeck, D. Leipold, D. Müting, H. Rebhan & H.-W. Scheloske (1992): Rote Liste gefährdeter Laufkäfer (Carabidae) Bayerns. - pp.100-109. -

Taxonomic groups: Beetles

Nitsche, G. (1992): Rote Liste gefährdeter Vögel (Aves) Bayerns. - pp.28-34. -

Taxonomic groups: Birds

Pitsch, T. & A. Weinzierl (1992): Rote Liste gefährdeter Köcherfliegen (Trichoptera) Bayerns. - pp.201-205. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Pröse, H. (1992): Rote Liste gefährdeter Netzflügler (Neuropteroidea) Bayerns. - pp.137-139. -

Taxonomic groups: Alderflies and Snakeflies

Pröse, H., K. Burmann, G. Derra, T. Grünewald, R. Keller, H. Kolbeck, L. Neumayr, E. Schwerda, A. Segerer & A. Speckmeier (1992): Rote Liste gefährdeter Kleinschmetterlinge Bayerns. - pp.237-255. -

Taxonomic groups: Butterflies and Moths

Richarz, K. & G. Schlapp (1992): Rote Liste gefährdeter Fledermäuse (Chiroptera) Bayerns. - pp.25-27. -

Taxonomic groups: Mammals

Röder, G. (1992): Rote Liste gefährdeter Schwebfliegen (Syrphidae) Bayerns. - pp.189-198. -

Taxonomic groups: True Flies

Uhmann, G. (1992): Rote Liste gefährdeter Blumen- oder Blütenmulmkäfer (Anthicidae) Bayerns. - pp.134. -

Taxonomic groups: Beetles

Wagner, R. (1992): Rote Liste gefährdeter Schmetterlingsmücken (Psychodidae) Bayerns. - pp.176-177. -

Taxonomic groups: True Flies

Wagner, R. (1992): Rote Liste gefährdeter Dunkelmücken (Thaumaleidae) Bayerns. - pp.178. -

Taxonomic groups: True Flies

Wagner, R. (1992): Rote Liste gefährdeter Tanzfliegen (Empididae) Bayerns. (Unterfamilien Hemerodromiinae und Clinocerinae). - pp.187-188. -

Taxonomic groups: True Flies

Warncke, K. & M. Kühbandner (1992): Rote Liste gefährdeter Waffenfliegen (Stratiomyidae) Bayerns. - pp.179-180. -

Taxonomic groups: True Flies

Warncke, K. & W. Schacht (1992): Rote Liste gefährdeter Bremsen (Tabanidae) Bayerns. - pp.181-182. -

Taxonomic groups: True Flies

Warncke, K., K. Mandery, J. Voith, W. Völkl, K. Weber & K. Wickl (1992): Rote Liste gefährdeter Bienen (Apidae) Bayerns. - pp.162-168. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Weber, K. (1992): Rote Liste gefährdeter Faltenwespen (Vespoidea) Bayerns. - pp.152-154. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Weber, K. (1992): Rote Liste gefährdeter Wegwespen (Pompiloidea) Bayerns. - pp.155-157. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Weinzierl, A. (1992): Rote Liste gefährdeter Steinfliegen (Plecoptera) Bayerns. - pp.80-82. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Wickl, K.-H. (1992): Rote Liste gefährdeter Keulen-, Dolch-, Rollwespen und Trugameisen (Scolioidea) Bayerns. - pp.146-147. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Wickl, K.-H. (1992): Rote Liste gefährdeter Grabwespen (Sphecidae) Bayerns. - pp.158-161. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Wolf, H., G. Behounek, A. Beyerl, A. Bischof, J. Bittermann, G. Brückner, G. Derra, S. Dierkschnieder, W. Dierl, U. Eitschberger, G. Embacher, J. de Freina, A. Geyer, H. Hacker, A. Hausmann, G. Heusinger, P. Huemer, W. Hundhammer, W. Kaesweber, ... (1992): Rote Liste gefährdeter Nachtfalter Bayerns. - pp.214-236. -

Taxonomic groups: Butterflies and Moths

Burmeister, E.-G. (1994): Die limnischen Feenkrebse (Anostraca), Schildkrebse (Notostraca), Muschelschaler (Conchostraca), Asseln (Isopoda limn.) und Flohkrebse (Amphipoda) in Bayern. (Crustacea). Kommentar und Stoffsammlung zur "Roten Liste" der limnischen Krebse in Bayern. - Berichte der ANL, Vol.18, pp.61-69, Laufen.
Taxonomic groups: Crustaceans

Röder, G. (1998): Kommentierte Artenliste der Schwebfliegen Bayerns (Diptera: Syrphidae) mit Gefährdungsstufen der Roten Liste. - Goecke & Evers Verlag, Keltern, 136 pp.
Taxonomic groups: True Flies

France:

Plants:

Olivier, L., J.-P. Galland, H. Marin (Coord.), J.-P. Roux (Réd.) (1995): Livre rouge de la Flore menancée de France. Tome 1: Espèces prioritaires. - Collections patrimoines naturels, Vol.20, pp.1-486 + CLIX + (2) pp., Paris.
Taxonomic groups: Vascular Plants

Animals:

Beaufort, F. de (ed.) & J.-C. Lacaze (coord.) et al. (1983): Livre Rouge des espèces menacées en France; tome 1: vertébrés. - Secrétariat de la Faune et de la Flore, Museum National d'Histoire Naturelle (ed.), Paris, 1-236.
Taxonomic groups: Mammals, Birds, Fishes and Lampreys, Amphibians and Reptiles

Duquet, M. (1995): Oiseaux menacés. Vont-ils disparaître ? - L'oiseau magazine, Vol.39, 2, pp.26-32.
Taxonomic groups: Birds

Keith, P., J. Allardi & B. Moutou (1992): Livre Rouge des espèces menacées de poissons d'eau douce de France. - Collection patrimoines naturels, Vol.10, pp.1-111, Paris.
Taxonomic groups: Fishes and Lampreys

Muséum national d'histoire naturelle & Fonds mondial pour la nature (WWF-France) (1995): Le Livre Rouge. Inventaire de la faune menacée en France. - pp.176 pp., Paris.
Taxonomic groups: Mammals, Birds, Amphibians and Reptiles, Fishes and Lampreys, Dragonflies, Grasshoppers, Crickets, Earwigs, Stick-insects, Beetles, Butterflies and Moths, Molluscs, Crustaceans, "Lower animals"

Speight, M. C. D. (1993): Révision des syrphes de la faune de France : I - Liste alphabétique des espèces de la sous-famille des Syrphinae (Diptera, Syrphidae). - Bulletin de la Société entomologique de France, Vol.98, 1, pp.35-46, Paris.
Taxonomic groups: True Flies

Speight, M. C. D. (1994): Révision des syrphes de la faune de France : II - Les Microdontidae et les Milesiinae (in part.) (Diptera, Syrphidoidea). - Bulletin de la Société entomologique de France, Vol.99, 2, pp.181-190, Paris.
Taxonomic groups: True Flies

Speight, M. C. D., C. Claussen & W. Hurkmans (1998): Révision des syrphes de la faune de France : III - Liste alphabétique des espèces des genres Cheilosia, Eumerus et Merodon et Supplément (Diptera, Syrphidae). - Bulletin de la Société entomologique de France, Vol.103, 5, pp.401-414, Paris.
Taxonomic groups: True Flies

Italy

Plants:

Conti, F., A. Manzi & F. Pedrotti (1992): Libro rosso delle piante d'Italia. - WWF, Associazione Italiana per il World Wildlife Fund in collaborazione con la Società Botanica Italiana (ed.), Roma, 637 pp.
Taxonomic groups: Vascular Plants, Lichens, Mosses and Liverworts

Conti, F., A. Manzi & F. Pedrotti (Coordinatori) (1997): Libro rosso regionali delle piante d'Italia. - WWF, Associazione Italiana per il World Wildlife Fund in collaborazione con la Società Botanica Italiana (ed.), Camerino, 139 pp.
Taxonomic groups: Vascular Plants

Animals:

Bulgarini, F., E. Calvario, F. Fraticelli, F. Petretti & S. Sarrocco (Eds.) (1998): Libro Rosso degli Animali d'Italia - Vertebrati. - WWF Italia (ed.), Roma, 210 pp.
Taxonomic groups: Fishes and Lampreys, Amphibians and Reptiles, Birds, Mammals

Pavan, M. (a cura di) (1992): Contributo per un "Libro Rosso" della Fauna e della Flora minacciate in Italia. - Instituto di Entomologia dell'Università di Pavia (ed.), Pavia, 719 pp.

Frugis, S. (1992): Uccelli minacciati della fauna italiana. [Aves]. - pp.81-132. -

Taxonomic groups: Birds

Groppali, R. (1992): Pesci, Anfibi, Rettili e Mammiferi minacciati della fauna italiana. [Pisces, Amphibia, Reptilia, Mammalia]. - pp.133-182. -

Taxonomic groups: Mammals, Amphibians and Reptiles, Fishes and Lampreys

Groppali, R. & M. Priano (1992): Invertebrati non troglobi minacciati della fauna italiana. - pp.183-426. -

Taxonomic groups: "Lower animals", Molluscs, Spiders, Crustaceans, Primitive Wingless Insects, Caddisflies, Mayflies, Stoneflies, Dragonflies, Grasshoppers, Crickets, Earwigs, Stick-insects, Plant and Water Bugs, Flees, Alderflies and Snakeflies, Beetles, Scorpionflies, True Flies, Wasps, Bees, Ants and Sawflies, Butterflies and Moths

Pavan Arcidiaco, L. & G. Pavan (1992): Flora italiana minacciata. - pp.503-636. -

Taxonomic groups: Vascular Plants

Priano, M. (1992): Invertebrati troglobi minacciati della fauna italiana. - pp.427-502. -

Taxonomic groups: "Lower animals", Crustaceans, Primitive Wingless Insects, Myriapods, Thrips, Beetles, Spiders, Molluscs

Pavlicek-van Beek, T., A. H. Ovaa & J. G. van der Made (Ed.) (1992): Future of butterflies in Europe. Proceedings of an International congress, held at Wageningen during April 12-15, 1989. - Department of Nature Conservation, Agricultural University Wageningen (ed.), Wageningen, 327 pp.

Balletto, E. (1992): Butterflies in Italy: Status, problems and prospects. - pp.53-64. -

Taxonomic groups: Butterflies and Moths

Prola, G. & C. Prola con la collaborazione di F. Cassola (1990): Libro rosso delle farfalle italiane. - Vol.13, WWF - Fondo Mondiale per la Natura (ed.), Roma, 71 pp.
Taxonomic groups: Butterflies and Moths

Italy-South Tirol

Animals:

Gepp, J. (Projektleitung) (1994): Rote Liste gefährdeter Tierarten Südtirols. - Abteilung für Landschafts- und Naturschutz der Autonomie Provinz Bozen - Südtirol (ed.), Bozen, 420 pp.

Adami, V. & M. Gasser (1994): Rote Liste der gefährdeten Fische (Pisces) Südtirols. - pp.92-99. -

Taxonomic groups: Fishes and Lampreys

Adami, V. & M. Gasser (1994): Rote Liste der gefährdeten Zehnfußkrebse (Decapoda) Südtirols. - pp.348-349. -

Taxonomic groups: Crustaceans

Gepp, J., K. Hellrigl & H. Hölzel (1994): Rote Liste der gefährdeten Netzflügler (Neuropteroidea) Südtirols. - pp.302-307. -

Taxonomic groups: Alderflies and Snakeflies

Hellrigl, K. (1994): Kommentar zur Roten Liste: Stechwespen (Aculeata) Südtirols. [incl. Rote Liste der gefährdeten Hautflügler (Hymenoptera: 8 Fam.) in Südtirol]. - pp.152-169. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Hellrigl, K. (1994): Rote Liste der gefährdeten Schabenartige (Blattoidea) Südtirols. - pp.332-333. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Hellrigl, K. (1994): Rote Liste der gefährdeten Ohrwürmer (Dermaptera) Südtirols. - pp.334-335. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Hellrigl, K. & G. von Mörl (1994): Rote Liste der gefährdeten Springschrecken (Saltatoria) Südtirols. - pp.322-331. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Hellrigl, K. & H. Wassermann (1994): Rote Liste der gefährdeten Libellen (Odonata) Südtirols. - pp.336-347. -

Taxonomic groups: Dragonflies

Hofer, E. (1994): Rote Liste der gefährdeten Tagfalter (Diurna) Südtirols. - pp.132-145. -

Taxonomic groups: Butterflies and Moths

Huemer, P. (1994): Rote Liste der gefährdeten Schmetterlinge (Macrolepidoptera) Südtirols. - pp.102-145. -

Taxonomic groups: Butterflies and Moths

Kahlen, M., K. Hellrigl & W. Schwienbacher (1994): Rote Liste der gefährdeten Käfer (Coleoptera) Südtirols. - pp.178-301. -

Taxonomic groups: Beetles

Niederfriniger, O. (1994): Rote Liste der gefährdeten Fledermäuse (Chiroptera) Südtirols. - pp.54-63. -

Taxonomic groups: Mammals

Niederfriniger, O. (1994): Rote Liste der gefährdeten Vögel (Aves) Südtirols. - pp.64-79. -

Taxonomic groups: Birds

Nisters, H. (1994): Rote Liste der gefährdeten Schnecken (Mollusca) Südtirols. - pp.376-391. -

Taxonomic groups: Molluscs

Noflatscher, M.-T. (1994): Kommentar zur Gefährdungssituation der Skorpione (Scorpiones) Südtirols. - pp.350-351. -

Taxonomic groups: Spiders

Noflatscher, M.-T. (1994): Rote Liste der gefährdeten Spinnen (Arachnida: Aranei) Südtirols. - pp.352-375. -

Taxonomic groups: Spiders

Ortner, P. (1994): Rote Liste der gefährdeten Säugetiere (Mammalia excl. Chiroptera) Südtirols. - pp.46-53. -

Taxonomic groups: Mammals

Remane, R. (1994): Rote Liste der gefährdeten Kleinzikaden (Auchenorrhyncha: Cicadina) Südtirols. - pp.312-321. -

Taxonomic groups: Plant and Water Bugs, Flees

Schedl, W. (1994): Rote Liste der gefährdeten Sing- und Buckelzikaden (Cicadidae, Tibicinidae und Membraciae) Südtirols. - pp.308-311. -

Taxonomic groups: Plant and Water Bugs, Flees

Schwienbacher, W. (1994): Rote Liste der gefährdeten Kriechtiere (Reptilia) Südtirols. - pp.80-85. -

Taxonomic groups: Amphibians and Reptiles

Schwienbacher, W. (1994): Rote Liste der gefährdeten Lurche (Amphibia) Südtirols. - pp.86-91. -

Taxonomic groups: Amphibians and Reptiles

Liechtenstein

Plants:

Broggi, M. F. & E. Waldburger (1984): Rote Liste der gefährdeten und seltenen Gefäßpflanzen des Fürstentums Liechtenstein. - Berichte der Botanisch-Zoologischen Gesellschaft Liechtenstein-Sargans-Werdenberg, Vol.13, pp.7-40, Vaduz.
Taxonomic groups: Vascular Plants

Rheinberger, H.-J. & B. Rheinberger (1992): Orchideen des Fürstentums Liechtenstein. - Berichte der Botanisch-Zoologischen Gesellschaft Liechtenstein-Sargans-Werdenberg, Vol.19, pp.7-235, Vaduz.
Taxonomic groups: Vascular Plants

Animals:

Aistleitner, E. & U. Aistleitner (1996): Die Tagfalter des Fürstentums Liechtenstein (Lepidoptera: Papilionoidea und Hesperioidea). - Naturkundliche Forschung im Fürstentum Liechtenstein, Vol.16, pp.1-159, Vaduz.
Taxonomic groups: Butterflies and Moths

Bernhardt, K.-G. (1995): Rote Liste der Wanzen (Heteroptera) im Fürstentum Liechtenstein. - Berichte der Botanisch-Zoologischen Gesellschaft Liechtenstein-Sargans-Werdenberg, Vol.22, pp.179-186, Vaduz.
Taxonomic groups: Plant and Water Bugs, Flees

Kindle, T. & E. Amann (1991): 13 von 21 Fisch- und Krebsarten gefährdet. Fisch- und Krebsarten in Liechtenstein. Vorkommen. Gefährdungsgrad. - Liechtensteiner Umwelt-Bericht, Vol.29, pp.8-10.
Taxonomic groups: Fishes and Lampreys, Crustaceans

Nigg, A. (1993): Die Reptilien des Fürstentums Liechtenstein. - Vol.19, Vaduz, 7-63.

Broggi, M. F. (1993): Rote Liste der gefährdeten und seltenen Reptilien Liechtensteins. - pp.51-60. -

Taxonomic groups: Amphibians and Reptiles

Schmutz, S. & J. Eberstaller (1993): Die Fischfauna des Alpenrheins und der Nebengewässer. - Berichte der Botanisch-Zoologischen Gesellschaft Liechtenstein-Sargans-Werdenberg, Vol.20, pp.133-158, Vaduz.
Taxonomic groups: Fishes and Lampreys

Willi, G. (1997): Rote Liste der Brutvögel des Fürstentums Liechtenstein. - Berichte der Botanisch-Zoologischen Gesellschaft Liechtenstein-Sargans-Werdenberg, Vol.24, pp.173-184, Schaan.
Taxonomic groups: Birds

Austria

Plants:

Niklfeld, H. (Gesamtleitung) (1999): Rote Liste gefährdeter Pflanzen Österreichs. 2., neu bearbeitete Auflage. - Vol.10, Bundesministerium für Umwelt, Jugend und Familie (ed.), austria medien servive GmbH, Graz, 292 pp.

Grims, F. & H. Köckinger unter Mitarbeit von R. Düll, G. Grabherr, P. Gruber, H. Hagel, R. Krisai, W. Maurer, H. Niklfeld, P. Pilsl, J. Saukel, W. Strobl, M. Suanjak & H. Zechmeister (1999): Rote Liste gefährdeter Laubmoose (Musci) Österreichs. 2. Fassung. - pp.157-171. -

Taxonomic groups: Mosses and Liverworts

Krisai-Greilhuber, I. unter Mitarbeit von W. Dämon, A. Hausknecht, W. Klofac, A. Mader, K. Mader, M. Moser, T. Rücker (1999): Rote Liste gefährdeter Großpilze Österreichs. 2. Fassung. - pp.229-266. -

Taxonomic groups: Fungi (incl. Slime Moulds)

Lenzenweger, R. (1999): Rote Liste gefährdeter Zieralgen (Desmidiales) Österreichs. 2. Fassung. - pp.276-291. -

Taxonomic groups: Algae (incl. Blue-Green Algae)

Niklfeld, H. & L. Schratt-Ehrendorfer unter Mitarbeit von T. Barta, P. Buchner, D. Ernet, F. Essl, M.A. Fischer, W. Forstner, G. Grabherr, J. Greimler, F. Grims, W. Gutermann, M. Haberhofer, W. Holzner, E. Hörandl, G. Karrer, G. Kniely, H. Köckinger, ... (1999): Rote Liste gefährdeter Farn- und Blütenpflanzen (Pteridophyta und Spermatophyta) Österreichs. 2. Fassung. - pp.33-151. -

Taxonomic groups: Vascular Plants

Saukel, J. & H. Köckinger unter Mitarbeit von G. Grabherr, F. Grims, P. Gruber, H. Hagel, R. Krisai, W. Maurer, H. Niklfeld, P. Pilsl, W. Strobl, M. Suanjak & H. Zechmeister (1999): Rote Liste gefährdeter Lebermoose (Hepaticae) und Hornmoose (Anthocerotae) Österreichs. 2. Fassung. . - pp.172-186. -

Taxonomic groups: Mosses and Liverworts

Türk, R. & J. Hafellner (1999): Rote Liste gefährdeter Flechten (Lichenes) Österreichs. 2. Fassung. - pp.187-228. -

Taxonomic groups: Lichens

Animals:

Gepp, J. (Redaktion) (1994): Rote Listen gefährdeter Tiere Österreichs (5. Auflage, Bearbeitungsstand 1990). - Vol.2, Wien, 355 pp.

Adlbauer, K. & A. Kaltenbach (1994): Rote Liste gefährdeter Heuschrecken und Grillen, Ohrwürmer, Schaben und Fangschrecken (Saltatoria, Dermaptera, Blattodea, Mantodea). - pp.83-92. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Bauer, K. (1994): Rote Liste der in Österreich gefährdeten Vogelarten (Aves). - pp.57-65. -

Taxonomic groups: Birds

Bauer, K. & F. Spitzenberger (1994): Rote Liste der in Österreich gefährdeten Säugetierarten (Mammalia). - pp.35-39. -

Taxonomic groups: Mammals

Dollfuss, H. (1994): Rote Liste gefährdeter Grabwespen (Hymenoptera, Sphecidae). - pp.95-104. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Frank, C. & P. L. Reischütz (1994): Rote Liste gefährdeter Weichtiere Österreichs (Mollusca: Gastropoda und Bilvalvia). - pp.283-316. -

Taxonomic groups: Molluscs

Gepp, J. (1994): Rote Liste der gefährdeten Netzflügler Österreichs (Neuropteroidea: Megaloptera, Raphidioptera und Planipennia). - pp.201-204. -

Taxonomic groups: Alderflies and Snakeflies

Gepp, J. (1994): Rote Liste der gefährdeten Schnabelfliegen Österreichs (Mecoptera). - pp.205-206. -

Taxonomic groups: Scorpionflies

Gusenleitner, J. (1994): Rote Liste gefährdeter Faltenwespen Österreichs (Vespoidea). - pp.93-94. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Herzig-Straschil, B. (1994): Rote Liste gefährdeter Fische und Rundmäuler Österreichs (Pisces und Cyclostomata). - pp.75-82. -

Taxonomic groups: Fishes and Lampreys

Huemer, P., E. R. Reichl, C. Wieser, E. Aistleitner, K. Burmann, G. Embacher, H. Habeler, F. Kasy, & S. Komarek (1994): Rote Liste der gefährdeten Großschmetterlinge Österreichs (Macrolepidoptera). - pp.215-264. -

Taxonomic groups: Butterflies and Moths

Jäch, M. A., R. Geiser, E. Geiser, W. Barries, H. Franz, G. Novak, E. Kirschenhofer, P. Reiser, K. Adlbauer, C. Holzschuh, P. Zabransky, J. Probst, H. Schillhammer, E. Kreissl, W. Suppantschitsch, G. Wewalka, P. Cate, S. Schödl, W. Zelenka & H. Schmid (1994): Rote Liste der gefährdeten Käfer Österreichs (Coleoptera). - pp.107-200. -

Taxonomic groups: Beetles

Malicky, H. (1994): Rote Liste der gefährdeten Köcherfliegen (Trichoptera) Österreichs. - pp.207-214. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Pretzmann, G. (1994): Rote Liste der Zehnfüßigen Krebse (Decapoda) und Schwebegarnelen (Mysidacea) Österreichs. - pp.279-282. -

Taxonomic groups: Crustaceans

Scherabon, B. (1994): Zur Gefährdung von Skorpionen in Österreich. - pp.275-278. -

Taxonomic groups: Spiders

Strassen, R. zur (1994): Gefährdete Fransenflügler-Arten Österreichs (Thysanoptera). - pp.269-273. -

Taxonomic groups: Thrips

Tiedemann, F. & M. Häupl (1994): Rote Liste der in Österreich gefährdeten Kriechtiere (Reptilia) und Lurche (Amphibia). - pp.67-74. -

Taxonomic groups: Amphibians and Reptiles

Schiemer, F., M. Jungwirth & G. Imhof (1994): Die Fische der Donau - Gefährdung und Schutz. Ökologische Bewertung der Umgestaltung der Donau. - Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie, Vol.5, pp.1-160, Wien.
Taxonomic groups: Fishes and Lampreys

Spindler, T. (1997): Fischfauna von Österreich. Ökologie - Gefährdung - Bioindikation - Fischerei - Gesetzgebung. 2. erweiterte Auflage 1997. - Vol.87 (M-087), Umweltbundesamt; Bundesministerium für Umwelt, Jugend und Familie (ed.), Wien, 140 pp.

Spindler, T., G. Zauner, E. Mikischi, H. Kummer, A. Wais & R. Spolwind (1997): Gefährdung der heimischen Fischfauna. - pp.54-75. -

Taxonomic groups: Fishes and Lampreys

Spindler, T. & A. Chovanec (1995): Fischfauna in Österreich. Ökologie - Gefährdung - Bioindikation - Fischerei - Gesetzgebung. - Vol.53, Umweltbundesamt (ed.), Wien, 120 pp.
Taxonomic groups: Fishes and Lampreys

Austria-Burgenland

Plants:

Biologische Station Neusiedler See (ed.) (1997): Rote Liste Burgenland. - Biologisches Forschungsinstitut Burgenland (ed.), Illmitz, 33 pp.

Weber, E. (1997): Rote Liste gefährdeter Gefäßpflanzen des Burgenlandes. - pp.5-14. -

Taxonomic groups: Vascular Plants

Animals:

Biologische Station Neusiedler See (ed.) (1997): Rote Liste Burgenland. - Biologisches Forschungsinstitut Burgenland (ed.), Illmitz, 33 pp.

Biologische Station Neusiedler See (1997): Rote Liste gefährdeter Tiere des Burgenlandes. 02. Vögel (Aves). - pp.15-16. -

Taxonomic groups: Birds

Biologische Station Neusiedler See (1997): Rote Liste gefährdeter Tiere des Burgenlandes. 05. Rundmäuler (Cyclostomata) und Fische (Pisces). - pp.17-18. -

Taxonomic groups: Fishes and Lampreys

Herzig, A. (1997): Rote Liste gefährdeter Tiere des Burgenlandes. 14. Krebstiere. - pp.31. -

Taxonomic groups: Crustaceans

Schweiger, H. (1979): Rote Liste der in der Region Wien, Niederösterreich, Burgenland gefährdeten Sandlaufkäfer (Cicindelidae) und Laufkäferarten (Carabidae). - Wissenschaftliche Mitteilungen aus dem niederösterreichischen Landesmuseum, 1, pp.11-38, Wien.
Taxonomic groups: Beetles

Austria-Carinthia

Plants:

Kniely, G., H. Niklfeld, L. Schratt-Ehrendorfer, W. R. Franz, H. Hartl, G. H. Leute, M. Perko, W. Petutsching & H. Zwander (1995): Rote Liste der gefährdeten Farn- und Blütenpflanzen Kärntens. - Carinthia II, 185/105, pp.353-392, Klagenfurt.
Taxonomic groups: Vascular Plants

Petutschnig, W. unter Mitarbeit von G. Egger, W. R. Franz, U. Fritzl, W. Holzinger, W. Honsig-Erlenburg, C. Komposch, J. Kowatsch, K. Krainer, P. Mildner, (1998): Rote Liste der gefährdeten Biotoptypen Kärntens. - Carnthia II, Vol.188, 1, pp.201-218, Klagenfurt.
Taxonomic groups: Habitat Types

Animals:

Holzinger, W.E., P. Mildner, T. Rottenburg & C. Wieser (Hrsg.) (2000): Rote Listen gefährdeter Tiere Kärntens mit Artenverzeichnissen aller bearbeiteten Tiergruppen. Amt der Kärntner Landesregierung, Naturschutz in Kärnten, Band 15, Klagenfurt. 718 S.
[wird aktuell von V.I.M. ausgewertet]

Honsig-Erlenburg, W. (1997): Gefährdete und seltene Fischarten in Kärnten (Österreich). [Threatened and rare fishes in Carinthia (Austria)]. - Fischökologie Aktuell, pp.10-14, Advanced Biology, Petersberg.
Taxonomic groups: Fishes and Lampreys

Austria-Niederösterreich / Wien

Plants:

Schratt, L. (1990): Rote Liste gefährdeter Farn- und Blütenpflanzen Niederösterreichs. 1. Fassung. - Institut für Botanik der Universität Wien (ed.), Wien, 57 pp.
Taxonomic groups: Vascular Plants

Türk, R., O. Breuss & J. Üblagger (1998): Die Flechten im Bundesland Niederösterreich. - Wissenschaftliche Mitteilungen aus dem Niederösterreichischen Landesmuseum, Vol.11, pp.7-313, St. Pölten.
Taxonomic groups: Lichens

Animals:

Amt der Niederösterreichischen Landesregierung - Abteilung Naturschutz (ed.) (2000): Rote Listen ausgewählter Tiergruppen Niederösterreichs. - St. Pölten, 80 pp.

Hödl, W. & E. Eder (2000): Urzeitkrebse (Branchiopoda: Anostraca, Notostraca, Conchostraca) - 1. Fassung 1999. - pp.4-33. -

Taxonomic groups: Crustaceans

Pekny, R. & M. Pöckl (2000): Flusskrebse und Süßwassergarnelen (Decapoda, Mysidacea). - pp.34-76. –

Taxonomic groups: Crustaceans

Berg, H-M. & A. Ranner (1997): Rote Listen ausgewählter Tiergruppen Niederösterreichs - Vögel (Aves), 1. Fassung 1995. - Amt der Niederösterreichischen Landesregierung - Abteilung Naturschutz (ed.), Wien, 184 pp.
Taxonomic groups: Birds

Berg, H.-M. & T. Zuna-Kratky (1997): Rote Listen ausgewählter Tiergruppen Niederösterreichs - Heuschrecken und Fangschrecken (Insecta: Saltatoria, Mantodea), 1. Fassung 1995. - Amt der Niederösterreichischen Landesregierung - Abteilung Naturschutz (ed.), Wien, 112 pp.
Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Cabela, A., H. Grillitsch & F. Tiedemann (1997): Rote Listen ausgewählter Tiergruppen Niederösterreichs - Lurche und Kriechtiere (Amphibia & Reptilia). 1. Fassung 1995. - Amt der Niederösterreichischen Landesregierung, Abt. Naturschutz & Österreichische Gesellschaft für Herpetologie (ÖGH) (ed.), Wien, 88 pp.
Taxonomic groups: Amphibians and Reptiles

Höttinger, H. & J. Pennerstorfer (1999): Rote Listen ausgewählter Tiergruppen Niederösterreichs - Tagfalter (Lepidoptera: Rhopalocera & Hesperiidae). 1. Fassung 1999. - pp.128 pp., St. Pölten.
Taxonomic groups: Butterflies and Moths

Mikschi, E. & A. Wolfram-Wais (1999): Rote Listen ausgewählter Tiergruppen Niederösterreichs - Fische und Neunaugen (Pisces, Cyclostomata). 1. Fassung 1996. - Amt der NÖ Landesregierung, Abteilung Naturschutz & Abteilung Agrarrecht in Zusammenarbeit mit der Fischsammlung des Naturhistorischen Museums Wien (ed.), St. Pölten, 136 pp.
Taxonomic groups: Fishes and Lampreys

Raab, R. & E. Chwala (1997): Rote Listen ausgewählter Tiergruppen Niederösterreichs - Libellen (Insecta: Odonata), 1. Fassung 1995. - Amt der Niederösterreichischen Landesregierung - Abteilung Naturschutz (ed.), Wien, 91 pp.
Taxonomic groups: Dragonflies

Schweiger, H. (1979): Rote Liste der in der Region Wien, Niederösterreich, Burgenland gefährdeten Sandlaufkäfer (Cicindelidae) und Laufkäferarten (Carabidae). - Wissenschaftliche Mitteilungen aus dem niederösterreichischen Landesmuseum, 1, pp.11-38, Wien.
Taxonomic groups: Beetles

Austria-Oberösterreich

Plants:

Grims, F., A. Kraml, F. Lenglachner, H. Niklfeld, L. Schratt-Ehrendorfer, F. Speta, F. Starlinger, M. Stauch & H. Wittmann (1997): Rote Liste gefährdeter Farn- und Blütenpflanzen Oberösterreichs und Liste der einheimischen Farn- und Gefäßpflanzen Oberösterreichs. - Beiträge zur Naturkunde Oberösterreichs, Sonderdruck, Vol.5, pp.3-63, Linz.
Taxonomic groups: Vascular Plants

Animals:

Hauser, E., F. Hofmann, H. Kutzenberger, F. Lichtenberger, F. Pühringer, A. Pürstinger & J. Wimmer (1996): Rote Liste der Groß-Schmetterlinge Oberösterreichs (Stand 1995). - Beiträge zur Naturkunde Oberösterreichs, Vol.4, pp.53-66, Linz.
Taxonomic groups: Butterflies and Moths

Laister, G. (1996): Verbreitungsübersicht und eine vorläufige Rote Liste der Libellen Oberösterreichs. - Naturkundliches Jahrbuch der Stadt Linz, 1994/95, Vol.40/41, pp.307-388, Linz.
Taxonomic groups: Dragonflies

Austria-Salzburg

Plants:

Türk, R. (1996): Rote Liste der Flechten Salzburgs. - Naturschutz-Beiträge, 18, pp.1-47, Salzburg.
Taxonomic groups: Lichens

Wittmann, H. & W. Strobl (1990): Gefährdete Biotoptypen und Pflanzengesellschaften in Salzburg - Ein erster Überblick. - Naturschutzbeiträge, Vol.9, pp.1-81, Salzburg.
Taxonomic groups: Plant Communities

Wittmann, H., P. Pilsl, G. Nowotny, V. Grass, B. Griesher, R. Krisal, R. Perl, I. Stadler & W. Strobl (1996): Rote Liste gefährdeter Farn- und Blütenpflanzen des Bundeslandes Salzburg. 5. neubearbeitete Auflage. - Naturschutzbeiträge, Vol.8, pp.1-83, Salzburg.
Taxonomic groups: Vascular Plants

Animals:

Embacher, G. (1996): Rote Liste der Großschmetterlinge Salzburgs. 3. völlig neu bearbeitete Auflage. - Naturschutz-Beiträge, 7, pp.1-43, Salzburg.
Taxonomic groups: Butterflies and Moths

Austria-Steiermark

Plants:

Klein, E. & H. Kerschbaumsteiner (1996): Die Orchideen der Steiermark. Eine Ikonographie und Verbreitungsübersicht. - Mitteilungen der Abteilung für Botanik am Landesmuseum Johanneum, Vol.23/24, pp.1-148, Graz.
Taxonomic groups: Vascular Plants

Zimmermann, A., G. Kniely, H. Melzer, W. Maurer & R. Höllriegl (1989): Atlas der gefährdeten Farn- und Blütenpflanzen der Steiermark. - Amt der Steiermärkischen Landesregierung, Fachstelle Naturschutz, Graz & Steiermärkisches Landesmuseum

Joanneum, Abt. für Botanik, Graz & Institut für Umweltwissenschaften und Naturschutz der Österreichischen Akademie der Wissenschaften, Graz (ed.), Graz, 302 pp.
Taxonomic groups: Vascular Plants, Plant Communities

Zimmermann, A., G. Kniely, H. Melzer, W. Maurer & R. Höllriegl (1989): Liste verschollener und gefährdeter Farn- und Blütenpflanzen für die Steiermark (2. Fassung vom April 1987). - pp.283-296. -

Animals:

Adlbauer, K. (1990): Die Bockkäfer der Steiermark unter dem Aspekt der Artenbedrohung (Col., Cerambycidae). - Mitteilungen des Naturwissenschaftlichen Vereines für Steiermark, Vol.120, pp.299-397, Graz.
Taxonomic groups: Beetles

Gepp, J. (Projektleitung) (1981): Rote Liste gefährdeter Tiere der Steiermark. 1. Fassung, November 1981. - Österreichischer Naturschutzbund, Landesgruppe Steiermark (ed.), Graz, 162 pp.

Adlbauer, K. (1981): Rote Liste der in der Steiermark gefährdeten Bockkäfer (Coleoptera, Cerambycidae). - pp.79-84. -

Taxonomic groups: Beetles

Anschau, M. J. & E. Hable (1981): Rote Liste der in der Steiermark gefährdeten Vogelarten (Aves). - pp.43-46. -

Taxonomic groups: Birds

Bregant, E. (1981): Rote Liste der in der Steiermark gefährdeten Prachtkäfer (Coleoptera, Buprestidae). - pp.85-90. -

Taxonomic groups: Beetles

Elsasser, H. & S. Elsasser (1981): Rote Liste der gefährdeten Tachinen Steiermarks (Diptera, Tachinidae). - pp.131-134. -

Taxonomic groups: True Flies

Fachbach, G. (1981): Rote Liste der in der Steiermark gefährdeten Kriechtiere (Reptilia). - pp.47-48. -

Taxonomic groups: Amphibians and Reptiles

Fachbach, G. (1981): Rote Liste der in der Steiermark gefährdeten Lurche (Amphibia). - pp.49-50. -

Taxonomic groups: Amphibians and Reptiles

Gepp, J. (1981): Rote Liste der in der Steiermark gefährdeten Netzflüglerarten der Steiermark (Megaloptera, Raphidioptera und Planipennia). - pp.91-96. -

Taxonomic groups: Alderflies and Snakeflies

Gepp, J. (1981): Rote Liste der gefährdeten Schnabelfliegen der Steiermark (Mecoptera). - pp.97-98. -

Taxonomic groups: Scorpionflies

Habeler, H. (1981): Rote Liste der in der Steiermark gefährdeten Großschmetterlinge (Makro-Lepidoptera). - pp.99-112. -

Taxonomic groups: Butterflies and Moths

Habeler, H. (1981): In der Steiermark bereits ausgestorbene oder verschollene Großschmetterlinge (Makro-Lepidoptera). - pp.113-124. -

Taxonomic groups: Butterflies and Moths

Habeler, H. (1981): Rote Liste der Mikrolepidopteren für die Steiermark. Als Beispiel: Familie Crambidae. - pp.125-130. -

Taxonomic groups: Butterflies and Moths

Igler, K. & E. Kreissl (1981): Rote Liste der in der Steiermark gefährdeten Fische (Pisces). - pp.51-54. -

Taxonomic groups: Fishes and Lampreys

Kepka, O. (1981): Rote Liste der in der Steiermark gefährdeten Säugetiere (mit einer Ergänzungsliste der bisher in der Steiermark nachgewiesenen Säugetiere) (Mammalia). - pp.37-42. -

Taxonomic groups: Mammals

Kreissl, E. (1981): Rote Liste der in der Steiermark gefährdeten Käferarten (Coleoptera). - pp.63-78. -

Taxonomic groups: Beetles

Kreissl, E. (1981): Rote Liste der in der Steiermark gefährdeten Schnecken und Muscheln (Mollusca). - pp.137-148. -

Taxonomic groups: Molluscs

Pretzmann, G. (1981): Gefährdete Arten decapoder Krebse in der Steiermark. - pp.135-136. -

Taxonomic groups: Crustaceans

Stark, W. (1981): Rote Liste gefährdeter und seltener Libellenarten der Steiermark (Odonata). - pp.59-62. -

Taxonomic groups: Dragonflies

Tiefenbach, O., N. Baumann & F. Matzold (1981): Rote Liste der im Raabflußsystem (Abschnitt Gleisdorf - Jennersdorf) gefährdeten Fischarten und Rundmäuler (Pisces). - pp.55-58. -

Taxonomic groups: Fishes and Lampreys

Kreissl, E. (1991): Erläuterungen zur Roten Liste gefährdeter Fische und Neunaugen der Steiermark (Pisces u. Cyclostomata). - Mitteilungen der Abteilung für Zoologie am Landesmuseum Johanneum, 44, pp.17-32, Graz.
Taxonomic groups: Fishes and Lampreys

Austria - Tirol

Plants:

Polatschek, A. unter Mitarbeit von M. Maier & W. Neuner (1997): Flora von Nordtirol, Osttirol und Vorarlberg. - Vol.1, Tiroler Landesmuseum Ferdinandeum (ed.), Innsbruck, 1024 pp.

Neuner, W. & A. Polatschek (1997): Rote Listen der gefährdeten Farn- und Blütenpflanzen von Nordtirol, Osttirol und Vorarlberg. - pp. -

Taxonomic groups: Vascular Plants

Animals:

Tiroler Landesmuseum Ferdinandeum (ed.) (1989): Wo sind sie geblieben? Artenrückgang in Tirol. - Innsbruck, 128 pp.

Gstader, W. (1989): Rote Liste der gefährdeten Brutvogelarten Tirols. - pp.71-87. -

Taxonomic groups: Birds

Austria-Vorarlberg

Plants:

Grabherr, G. & A. Polatschek (1986): Lebensräume und Lebensgemeinschaften in Vorarlberg. Ökosysteme, Vegetation, Flora mit Roten Listen. - Vorarlberger Verlagsanstalt, Dornbirn, 263 pp.

Grabherr, G. (1986): Die Vegetations- und Ökosystemsystematik. - pp.237-261. -

Taxonomic groups: Plant Communities

Grabherr, G. & A. Polatschek (1986): Die Florenstatistik. - pp.197-236. -

Taxonomic groups: Vascular Plants

Pfefferkorn, V. & R. Türk (1997): Rote Liste der im Bundesland Vorarlberg aktuell gefährdeten Flechtenarten. - Vorarlberger Naturschau - forschen und entdecken, Vol.3, pp.217-229, Dornbirn.
Taxonomic groups: Lichens

Polatschek, A. unter Mitarbeit von M. Maier & W. Neuner (1997): Flora von Nordtirol, Osttirol und Vorarlberg. - Vol.1, Tiroler Landesmuseum Ferdinandeum (ed.), Innsbruck, 1024 pp.

Neuner, W. & A. Polatschek (1997): Rote Listen der gefährdeten Farn- und Blütenpflanzen von Nordtirol, Osttirol und Vorarlberg. - pp. -

Taxonomic groups: Vascular Plants

Animals:

Aistleitner, E. (1999): Die Schmetterlinge Vorarlbergs. Band 1. Gebietsbeschreibung, Tagfalter, Spinner und Schwärmer (Lepidoptera, Diurna, Bombyces et Sphinges sensu classico). - Vorarlberger Naturschau, Vol.5, pp.7-390, Dornbirn.
Taxonomic groups: Butterflies and Moths

Blum, V. & R. Kilzer (1993): Rote Liste der gefährdeten Brutvögel Vorarlbergs. Stand März 1993. - BirdLife Österreich, Gesellschaft für Vogelkunde, Landesgruppe Vorarlberg (ed.), Dalaas, 2 pp.
Taxonomic groups: Birds

Switzerland

Plants:

Camenzind-Wildi, R., E. W. Camenzind & L. Liebendörfer (1996): Schutz stark gefährdeter Flechten der Schweiz. 1. Serie 1996. - Vollzug Umwelt - Merkblätter, Bern.
Taxonomic groups: Lichens

Clerc, P., C. Scheidegger & K. Ammann (1992): Liste rouge des macrolichens de la Suisse. - Botanica Helvetica, Vol.102, 1, pp.71-83, Basel, Schweiz.
Taxonomic groups: Lichens

Landolt, E. (1991): Gefährdung der Farn- und Blütenpflanzen in der Schweiz mit gesamtschweizerischen und regionalen Roten Listen. - Bundesamt für Umwelt, Wald und Landschaft (BUWAL) (ed.), Eidgenössische Drucksachen- und Materialzentrale (EDMZ), Bern, 185 pp.
Taxonomic groups: Vascular Plants

Marggi, W. A. (1992): Faunistik der Sandlaufkäfer und Laufkäfer der Schweiz (Cicindelidae & Carabidae) Coleoptera unter besonderer Berücksichtigung der "Roten Liste". Teil 1 / Text. - Documenta Faunistica Helvetiae, Vol.13, pp.1-477, Neuchâtel.
Taxonomic groups: Beetles

Ritter, M. & R. Waldis (1983): Uebersicht zur Bedrohung der Segetal- und Ruderalflora der Schweiz. Mit Roter Liste der Segetal- und Ruderalflora. Vue dénsemble des périls menacant la flore ségétale et rudérale en Suisse. Avec la "Liste rouge de la flore ségétale et rudérale". - Beiträge zum Naturschutz in der Schweiz. Contributions à la protection de la nature de Suisse, Vol.5, pp.1-33, Basel, Bâle.
Taxonomic groups: Vascular Plants

Steiger, P. unter Mitwirkung von G. Carraro, H.-U. Frey & A. Frick (1998): Wälder der Schweiz. Von Lindengrün zu Lärchengold. Vielfalt der Waldbilder und Waldgesellschaften in der Schweiz. 3. aktualisierte Auflage. - Ott Verlag Thun, 361 pp.
Taxonomic groups: Plant Communities

Urmi, E., I. Bisang, P. Geissler, H. Hürlimann, L. Lienhard, N. Müller, I. Schmid-Grob, N. Schnyder & L. Thöni (1991 [1992]): Rote Liste. Die gefährdeten und seltenen Moose der Schweiz. (Zweite Fassung, 1991). - Bundesamt für Umwelt, Wald und Landschaft (BUWAL) (ed.), Bern, 56 pp.
Taxonomic groups: Mosses and Liverworts

Animals:

Bundesamt für Umwelt, Wald und Landschaft (BUWAL, ed.) (1994): Rote Liste der gefährdeten Tierarten in der Schweiz. - Eidgenössische Drucksachen- und Materialzentrale (EDMZ), Bern, 97 pp.

Agosti, D. & D. Cherix (1994): Rote Liste der gefährdeten Ameisen der Schweiz. - pp.45-47. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Amiet, F. (1994): Rote Liste der gefährdeten Bienen der Schweiz. - pp.38-44. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Brancucci, M. (1994): Rote Liste der gefährdeten Wasserkäfer (nur Hydradephaga) der Schweiz. - pp.60-63. -

Taxonomic groups: Beetles

Duelli, P. (1994): Rote Liste der gefährdeten Netzflügler der Schweiz. - pp.64-65. -

Taxonomic groups: Alderflies and Snakeflies

Dufour, C. (1994): Rote Liste der gefährdeten Schnaken der Schweiz. - pp.52-54. -

Taxonomic groups: True Flies

Gonseth, Y. (1994): Rote Liste der gefährdeten Tagfalter der Schweiz. - pp.48-51. -

Taxonomic groups: Butterflies and Moths

Grossenbacher, K. (1994): Rote Liste der gefährdeten Amphibien der Schweiz. - pp.33-34. -

Taxonomic groups: Amphibians and Reptiles

Grossenbacher, K. & U. Hofer (1994): Rote Liste der gefährdeten Reptilien der Schweiz. - pp.31-32. -

Taxonomic groups: Amphibians and Reptiles

Kirchhofer, A., B. Zaugg & J.-C. Pedroli (1994): Rote Liste der gefährdeten Fische und Rundmäuler der Schweiz. - pp.35-37. -

Taxonomic groups: Fishes and Lampreys

Maibach, A. & C. Meier (1994): Rote Liste der gefährdeten Libellen der Schweiz. - pp.69-71. -

Taxonomic groups: Dragonflies

Marggi, W. (1994): Rote Liste der gefährdeten Laufkäfer und Sandlaufkäfer der Schweiz. - pp.55-59. -

Taxonomic groups: Beetles

Nadig, A., P. Thorens, E. Blank, A. Coray, W. Sauter, H. Schiess & T. Walter (1994): Rote Liste der gefährdeten Heuschrecken der Schweiz. - pp.66-68. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Nievergelt, B., J. Hausser, A. Meylan, U. Rahm, M. Salvioni & P. Vogel (1994): Rote Liste der gefährdeten Säugetiere der Schweiz (ohne Fledermäuse). - pp.20-21. -

Taxonomic groups: Mammals

Sartori, M., P. Landolt & A. Zurwerra (1994): Rote Liste der gefährdeten Eintagsfliegen der Schweiz. - pp.72-74. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Schweizerische Koordinationsstellen für Fledermausschutz Ost und West, E. Auf der Maur, R. Arlettaz, J. Barandun, A. Beck, W.-D. Burkhard, P.F. Flückiger, J. Gebhard, S. Gloor, M. Graf, R. Güttinger, M. Haffner, A. Keller, R. Kistler, M. Lutz, ... (1994): Rote Liste der gefährdeten Fledermäuse der Schweiz. - pp.22-23. -

Taxonomic groups: Mammals

Turner, H., M. Wüthrich & J. Rüetsch (1994): Rote Liste der gefährdeten Weichtiere der Schweiz. - pp.75-79. -

Taxonomic groups: Molluscs

Zbinden, N., U.N. Glutz von Blotzheim, H. Schmid & L. Schifferli (1994): Liste der Schweizer Brutvögel mit Gefährdungsgrad in den einzelnen Regionen. - pp.24-30. -

Taxonomic groups: Birds

Thorens, P. & A. Nadig (1997): Atlas de distribution des orthopteres de Suisse. Sauterelles, Grillons, Griquets (Orthoptera), Manta religieuse (Mantodea). - Verbreitungsatlas der Orthopteren der Schweiz. Laubheuschrecken, Grillen, Feldheuschrecken (Orthoptera), Gottesanbeterin (Mantodea). - Documenta Faunistica Helvetiae, Vol.16, pp.1-236, Neuchâtel.
Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Turner, H., J.G.J. Kuiper, N. Thew, R. Bernasconi, J. Ruetschi, M. Wüthrich & M. Gosteli (1998): Atlas der Mollusken der Schweiz und Liechtensteins. - Vol.2, Centre suisse de cartographie de la faune (CSCF/SZKF) & Schweizerische Entomologische Gesellschaft & Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (ed.), 527 pp.
Taxonomic groups: Molluscs

Velthuis, H.H.W. (ed.) (1986): Proceedings of the 3rd European Congress of Entomologie (Amsterdam 1986, 24-29 August). - Amsterdam.

Cherix, D. & C. Maddalena-Feller (1986): Disappearance of Swiss ant species or the need for new data. - pp.413-416. -

Taxonomic groups: Wasps, Bees, Ants and Sawflies

Switzerland-Regional

Plants:

Brodtbeck, T., M. Zemp, M. Frei, U. Kienzle & D. Knecht (1997): Flora von Basel und Umgebungen, Teil I. - Mitteilungen der Naturforschenden Gesellschaften beider Basel, Vol.2, pp.543 pp., Liestal.
Taxonomic groups: Vascular Plants

Holderegger, R. (1994): Zur Flora und Vegetation des Küsnachtertobels: Veränderungen innerhalb der letzten fünfzig Jahre. - Botanica Helvetica, Vol.104, 1, pp.55-68, Birkhäuser Verlag, Basel, Schweiz.
Taxonomic groups: Vascular Plants, Mosses and Liverworts

Werner, P., B. Bressoud & R. Delarze (1983): Situation des plantes rares et de leurs milieux en Valais. - Bulletin de la Murithienne, Vol.100, pp.195-211, Sion.
Taxonomic groups: Vascular Plants

Wyß, P. (1985): Bedrohte Pflanzenwelt des Kantons Zug. - Zuger Neujahrsblatt, pp.88-98.
Taxonomic groups: Vascular Plants

Zoller, H. & C. Wagner (1986): Rückgang und Gefährdung von Mesobromion-Arten im Schweizer Jura. - Veröffentlichungen des Geobotanischen Institutes der ETH, Stiftung Rübel, 87, pp.239-259, Zürich.
Taxonomic groups: Vascular Plants

Animals:

Beck, A. & B. Schelbert (1994): Die Fledermäuse des Kantons Aargau - Verbreitung, Gefährdung und Schutz. - Mitteilungen der Aargauischen Naturforschenden Gesellschaft, Vol.34, pp.1-56, Aarau.
Taxonomic groups: Mammals

Dusej, G. & H. Billing (1991): Die Reptilien des Kantons Aargau - Verbreitung, Ökologie und Schutz. - Mitteilungen der Aargauischen Naturforschenden Gesellschaft, Vol.33, pp.233-335, Aarau.
Taxonomic groups: Amphibians and Reptiles

Dusej, G. & P. Müller unter Mitarbeit von H. Billing, H. Bolzern, D. Kaden & R. Neumeyer (1998): Reptilieninventar des Kantons Zürich. - Neujahrsblatt, pp.1-47, Zürich.
Taxonomic groups: Amphibians and Reptiles

Eigenheer, K. (1993): Die Heuschrecken im Bezirk Wasseramt (Kanton Solothurn). Inventaraufnahme 1988 bis 1992. - Mitteilungen der Naturforschende Gesellschaft des Kantons Solothurn, 36, pp.35-43, Olten.
Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Hofer, U., U. Balsiger, B. Baur, C. Bürki, S. Capt, S. Clavien, B. Droz, K. Grossenbacher, D. Külling, J.-C. Monney, N. Rossier, J. Ryser, J. Schindler & A. Vasella (1991): Die Reptilien des Kantons Bern. - Mitteilungen der Naturforschenden Gesellschaft in Bern, N.F., Vol.48, pp.153-200, Bern.
Taxonomic groups: Amphibians and Reptiles

Hostettler, K. (1988): Libelleninventar des Kantons Thurgau (1984-1988). - Mitteilungen der Thurgauischen Naturforschenden Gesellschaft, Vol.49, pp.21-49, Frauenfeld.
Taxonomic groups: Dragonflies

Imbeck-Löffler, P. (1989): Natur aktuell. Lagebericht zur Situation der Natur im Kanton Basel-Landschaft im Jahre 1988. Grundlagen für ein Natur- und Landschaftsschutzkonzept. - Verlag des Kantons Basel-Landschaft, Liestal.

Bruderer, B. (1989): Vögel. - pp.255-267. -

Taxonomic groups: Birds

Keller, H. & J. Hartmann (1986): Ausgestorbene, gefährdete und seltene und seltene Farn- und Blütenpflanzen im Kanton Aargau: Rote Liste Aargau. - Mitteilungen der Aargauischen Naturforschenden Gesellschaft, Vol.31, pp.189-216, Aarau.
Taxonomic groups: Vascular Plants

Küry, D. & P. Morel (1995): Die Fauna der Rundmäuler und Fische von Basel und Umgebung mit spezieller Berücksichtigung der Rheinseitengewässer und einer regionalen Roten Liste. - Mitteilungen der Naturforschenden Gesellschaften beider Basel, Vol.1, pp.13-29.
Taxonomic groups: Fishes and Lampreys

Lüthy, M. (1989): Ornithologisches Inventar des Kantons Aargau 1985-1987. - Mitteilungen der Aargauischen Naturforschenden Gesellschaft, Vol.32, pp.167-215, Aarau.
Taxonomic groups: Birds

Meier, C., E. Knapp, A. Krebs, H. Schiess, H. Wildermuth, M. Wolf & weitere Mitarbeiter des Zürcher Libellenforums. (1989): Die Libellen der Kantone Zürich und Schaffhausen. - Neujahrsblatt der Naturforschenden Gesellschaft Schaffhausen, Vol.41, pp.1-124, Schaffhausen.
Taxonomic groups: Dragonflies

Schiess-Bühler, C. (1993): Tagfalter im Schaffhauser Randen. - Neujahrsblatt der Naturforschenden Gesellschaft Schaffhausen, Vol.45, pp.1-73, Thayngen-Schaffhausen.
Taxonomic groups: Butterflies and Moths

Schneppat, U. & H. Schmocker (1983): Die Verbreitung der Reptilien im Kanton Graubünden. Ein Bericht über das Reptilienprojekt Graubünden für den Untersuchungszeitraum 1978-1982. - Jahrbücher der Naturforschenden Gesellschaft Graubünden, Vol.100, pp.47-133.
Taxonomic groups: Amphibians and Reptiles

Turner, H. (1991): Die Weichtiere (Mollusca) des Kantons Zürich: Arteninventar und Gefährdung. - Vierteljahresschrift der Naturforschenden Gesellschaft in Zürich, Vol.136, 3, pp.163-181, Zürich.
Taxonomic groups: Molluscs

Walter, J., R. Keller & E. Seeger (1996): Fische und Fischerei im Kanton Schaffhausen. - Neujahrsblatt der Naturforschenden Gesellschaft Schaffhausen, Vol.48, pp.1-59, Schaffhausen.
Taxonomic groups: Fishes and Lampreys

Weibel, U., B. Egli & P. Rüegg (1997): Amphibien und Reptilien der Region Schaffhausen. - Neujahrsblatt der Naturforschenden Gesellschaft Schaffhausen, Vol.49, pp.1-52, Schaffhausen.
Taxonomic groups: Amphibians and Reptiles

Slovenia

Plants:

Martincic, A. (1992): Rdeci seznam ogrozenih listnatih mahov (Musci) v Sloveniji. - The Red List of Threatened Mosses (Musci) in Slovenia. - Varstvo Narave [Nature Conservation], Vol.18, pp.7-166, Ljubljana.

Taxonomic groups: Mosses and Liverworts

Wraber, T. & P. Skoberne (1989): Rdeciseznam ogrozenih praprotnic in semenk SR Slovenije. [The Red Data List of Threatened Vascular Plants in Socialistic Republic of Slovenia]. - Varstvo Narave [Nature Conservation], Vol.14-15, pp.9-429, Ljubljana.
Taxonomic groups: Vascular Plants

Animals:

Carnelutti, J. (1992): Popravki in dotatek k pispevku Jana Carneluttija: Rdeci seznam ogrozenih metuljev (Macrolepidoptera) v. Sloveniji. - Corrections and additional new species for The Red List of Endangered Macrolepidoptera. - Varstvo Narave, Vol.18, pp.189-190.
Taxonomic groups: Butterflies and Moths

Celik, T. & F. Rebeuser (1996): Atlas of threatened Butterflies of Slovenia. - Slovensko Entomolosko Drustvo, Stefana Michielija v Ljubljani (ed.), Ljubljana.
Taxonomic groups: Butterflies and Moths

Gregori, J. & S.D. Matvejev (1987): Predlog rdecega seznama pticev Slovenije. - Proposal of the Bird Red Data List of Slovenia (Yugoslavia). - Varstvo Narave [Nature Conservation], Vol.13, pp.1-124, Ljubljana.
Taxonomic groups: Birds

Kotarac, M. (1997): Atlas of the Dragonflies (Odonata) of Slovenia with the Red Data List. A project of the Slovene Dragonfly Society. [Besedilo v slov. in angl.]. - Atlas faunae et florae Sloveniae, Vol.1, pp.205 pp., Ljubjana.
Taxonomic groups: Dragonflies

Vidic, J. (Ed.) (1992): Rdeci seznami ogrozenih zivalskih vrst v Sloveniji. [Red Lists of Endangered Animal Species in Slovenia]. - Vol.17, Zavod Republike Slovenije za varstvo naravne in kulturne dediscine [Institute for the Conservation of Natural and Cultural Heritage of Slovenia] (ed.), Ljubljana, 224 pp.

Bole, J. (1992): The Red List of Terrestrical and Freshwater Mollusca in Slovenia. - pp.183-189. -

Taxonomic groups: Molluscs

Carnelutti, J. (1992): Rdeci seznam ogrozenih metuljev (Macrolepidoptera) v. Sloveniji. The Red List of Endangered Macrolepidoptera in Slovenia. - pp.61-104. -

Taxonomic groups: Butterflies and Moths

Devetak, D. (1992): The Red List of Endangered Mecoptera in Slovenia. - pp.109-110. -

Taxonomic groups: Scorpionflies

Devetak, D. (1992): The Red List of Endangered Neuroptera s.l. in Slovenia. - pp.111-115. -

Taxonomic groups: Alderflies and Snakeflies

Gogala, A. (1992): The Red List of Endangered Heteroptera in Slovenia. - pp.117-121. -

Taxonomic groups: Plant and Water Bugs, Flees

Gregori, J. & S. D. Matvejev (1992): The Red List of Endangered Aves in Slovenia. - pp.29-39. -

Taxonomic groups: Birds

Kos, I. (1992): The Red List of Endangered Chilopoda in Slovenia. - pp.137-146. -

Taxonomic groups: Myriapods

Krusnik, C. (1992): The Red List of Endangered Trichoptera (Insecta) in Slovenia. - pp.105-108. -

Taxonomic groups: Caddisflies, Mayflies, Stoneflies

Krystufek, B. (1992): The Red List of Endangered Mammalia in Slovenia. - pp.19-27. -

Taxonomic groups: Mammals

Matvejev, S. D. (1992): The Red List of Endangered Orthopteroidea in Slovenia. - pp.123-129. -

Taxonomic groups: Grasshoppers, Crickets, Earwigs, Stick-insects

Mrsic, N. (1992): The Red List of Endangered Reptilia in Slovenia. - pp.41-44. -

Taxonomic groups: Amphibians and Reptiles

Mrsic, N. (1992): The Red List of Endangered Diplopoda (Myriapoda) in Slovenia. - pp.131-136. -

Taxonomic groups: Myriapods

Mrsic, N. (1992): The Red List of Endangered Lumbricidae (Oligochaeta) in Slovenia. - pp.179-181. -

Taxonomic groups: "Lower animals"

Polenec, A. (1992): The Red List of Endangered Aranea in Slovenia. - pp.173-176. -

Taxonomic groups: Spiders

Potocnik, F. (1992): The Red List of Endangered Isopoda terrestrica (Crustacea) in Slovenia. - pp.157-164. -

Taxonomic groups: Crustaceans

Povz, M. (1992): The Red List of Endangered Pisces and Cyclostomata in Slovenia. - pp.51-59. -

Taxonomic groups: Fishes and Lampreys

Sket, B. (1992): The Red List of Endangered Amphibia in Slovenia. - pp.45-49. -

Taxonomic groups: Amphibians and Reptiles

Sket, B. (1992): The Red List of Endangered Freshwater Malacostraca (Isopoda aquatica, Amphipoda, Decapoda) in Slovenia. - pp.147-156. -

Taxonomic groups: Crustaceans

Sket, B. (1992): The Red List of Endangered Hirudinea in Slovenia. - pp.177-178. -

Taxonomic groups: "Lower animals"

Sket, B. (1992): The Red List of the Inhibitants of Hypogean Waters in Slovenia. - pp.193-204. -

Taxonomic groups: "Lower animals", Molluscs, Crustaceans, Caddisflies, Mayflies, Stoneflies, Amphibians and Reptiles

Sket, B. & A. Brancelj (1992): The Red List of Freshwater Entomostraca (Anostraca, Cladocera, Copepoda, Ostracoda) in Slovenia. - pp.165-172. -

Taxonomic groups: Crustaceans

Velikonja, M. (1992): The Red List of Endangered Freshwater Hydrozoa in Slovenia. - pp.191-192. -

Taxonomic groups: "Lower animals"

Appendix 2

Appendix 2 includes 35 maps and 6 figures. About half of them has have been designed and prepared by Prof. Grabherr and his staff members and are available as digitised versions by request. These maps are indicated with GIS in the list at the beginning.