> Biodiversity in Switzerland: Status and Trends

Results of the biodiversity monitoring system in 2016

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> Abstracts

Biodiversity describes the diversity of habitats, species and genes as well as their interactions. It is absolutely necessary for life on Earth. This report analyses the state of biodiversity in Switzerland. It is based on scientific studies and selected indicators resulting from the surveys of the federal biodiversity monitoring programmes. The data not only make it possible to determine the current state of biodiversity for species, habitats and genes, but also to identify trends.

Keywords:
Biodiversity, diversity, habitats, species, genes, monitoring, indicators

Biodiversität bezeichnet die Vielfalt der Lebensräume, der Arten und der Gene sowie deren Interaktionen. Sie ist unverzichtbar für das Leben auf der Erde. Der vorliegende Bericht analysiert den Zustand der Biodiversität in der Schweiz. Er basiert auf ausgewählten Kenngrössen (Indikatoren), die aus Erhebungen der verschiedenen Biodiversitäts-Monitoringprogramme des Bundes resultieren, sowie auf wissenschaftlichen Studien. Die Daten ermöglichen es, nicht nur den aktuellen Zustand der Biodiversität auf den Ebenen der Arten, der Lebensräume und der Gene zu erfassen, sondern auch Trends zu erkennen.

Stichwörter:
Biodiversität, Vielfalt, Lebensräume, Arten, Gene, Monitoring, Indikatoren

La biodiversité désigne la diversité des milieux naturels, la diversité des espèces et la diversité génétique ainsi que leurs interactions. Elle est indispensable à la vie sur terre. Le présent rapport analyse l'état de la biodiversité en Suisse. Il est fondé sur une sélection d'indicateurs alimentés par les différents programmes de monitoring de la biodiversité de la Confédération ainsi que sur des études scientifiques. Ces données permettent de décrire l'état actuel de la biodiversité aux plans des espèces, des milieux naturels et des gènes ainsi que de dégager des tendances.

Mots-clés:
Biodiversité, diversité biologique, milieux naturels, espèces, gènes, monitoring, indicateurs

La biodiversità designa la varietà degli degli habitat e delle specie, come pure la varietà genetica nonché le loro interazioni. Senza di essa non potrebbe esserci vita sulla Terra. Il presente rapporto analizza lo stato della biodiversità in Svizzera, basandosi su dati chiave selezionati (indicatori), emersi dalle rilevazioni effettuate nell'ambito dei programmi federali di monitoraggio della biodiversità, nonché su studi scientifici. Oltre a descrivere lo stato attuale della biodiversità delle specie, degli habitat e dei geni, i dati permettono anche di riconoscere le tendenze in atto.

Parole chiave:
Biodiversità, diversità, habitat, specie, geni, monitoraggio, indicatori

> Foreword

This report is based on the latest data from the Swiss federal government's biodiversity and impact monitoring programmes. It provides an overview of the current state of biological diversity in Switzerland and highlights the most important trends. The facts presented in this report make it clear that biodiversity in Switzerland is in an unacceptable state. Although species numbers in the last 15 years have remained steady, the quality and area of valuable habitats such as dry meadows and raised bogs continue to decline. Populations of typical species are suffering additional losses. The situation has worsened, especially for endangered species. 36 percent of the surveyed plant, animal and fungus species are assessed as "threatened", which is significantly more than in most EU countries.

The disappearance of biological diversity poses a threat to our prosperity and quality of life. We receive essential services of high ecological, economic and social value from our natural capital. A rich biodiversity provides, among other things, food, breathable air and clean water; it regulates climate and maintains nutrient cycling; it protects against floods and avalanches and steadies unstable terrain in the mountains. Finally, it promotes our well-being: multicolour flower meadows, chirping birds and fruit trees all elicit strong positive feelings and significantly define our landscape and identity. If biodiversity declines, there is a risk that these services will be adversely affected before long. Especially harmful is the fact that biodiversity loss is insidious and, as shown by a national survey, carries on unnoticed by the population. Society becomes accustomed to the changes before acknowledging the losses. That is why it is important to sharpen the perception of biodiversity and take action as soon as possible.

The Confederation and cantons have already taken several specific measures to conserve and promote biodiversity. Examples include the inventories taken of biotopes of national importance, the financing of forest reserves and biodiversity priority areas in agricultural areas and participation in the renaturation of bodies of water. Although these measures have helped slow the decline of biodiversity, they have not stopped it in all cases. Further efforts are necessary to secure Switzerland's natural capital. Switzerland's Biodiversity Action Plan is now being prepared based on Switzerland's Biodiversity Strategy, which was adopted by the Federal Council in 2012. The measures in the action plan should help ensure the survival of native species and the natural dynamic of habitats and thus conserve biological diversity, which is critical to the existence of humans, their living conditions and economies.

Franziska Schwarz
Vice Director
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> A summary of the key findings

Biodiversity is the foundation of life on Earth, which makes it absolutely necessary for human life. It encompasses the diversity of life at the level of ecosystems, species and genes, as well as the interactions occurring within and between these levels. It provides numerous services (so-called ecosystem services) that are essential to our society: It produces food, regulates the climate, preserves air and water quality, participates in soil formation and offers human beings a place of recreation and a source of inspiration. A decline in the state of biodiversity leads to a decrease in those benefits, which translates into high economic costs: In the EU, it has been estimated that the annual cost of ecosystem services that must be compensated as a result of biodiversity losses will reach up to around 4 % of the gross domestic product (GDP) by 2050. The quantity and quality of the ecosystem services provided in Switzerland are comparable to those in EU countries. Therefore, it can be assumed that non-action would also be much more expensive for Switzerland than the cost of effective protection and promotion of biodiversity today.

The Constitution of the Swiss Confederation (Article 78) and international agreements provide for the protection of biological diversity. Accordingly, as part of the international Convention on Biodiversity (CBD), Switzerland has committed to prevent the extinction of endangered species and improve the conservation situation by 2020, especially for the most critically endangered species. Further efforts are necessary to achieve these goals. After all, serious biodiversity losses have already occurred: Almost half of all types of habitats in Switzerland are assessed as threatened. Only residual areas remain from many valuable habitats; it will require great effort to restore them, if that is even possible. Furthermore, there is still a great deal of pressure on habitats and their typical species. The main causes are the intensive use of land and bodies of water, the spread of invasive alien species and atmospheric nitrogen inputs in the soil particularly from agricultural sources.

Challenges for agriculture

In the intensively farmed Central Plateau, many animal and plant species barely find suitable habitats nowadays. Important habitat structures such as groves, borders and buffer strips along cropland are disappearing due to structural improvements; soil has been degraded; streams and rivers have been obstructed and covered; small bodies of water and wetlands have been drained, low-nutrient sites fertilised, and dry sites irrigated. “Special sites” exist today only in small residual areas. The situation is better in the grasslands of mountainous regions, though their use has also intensified. Developed areas are now fertilised and irrigated more and mowed earlier. Meadows and pastures that were once dry are increasingly fertilised and the characteristic plants and animals (e.g. upright brome, quaking grass, whinchats, skylarks) are disappearing.

High fertilisation and pesticide use on cropland harms biodiversity. Regular herbicide use impoverishes the seed bank in the soil, resulting in species-poor weed communities. The flora associated with cropland is now one the most threatened plant groups in Switzerland: 42 % of these species are assessed as vulnerable. Plant protection products also reduce populations of invertebrates, birds and amphibians by decreasing their food sources. The widespread use of systemic insecticides causes these poisons to be transferred through the nectar and pollen of crop plants to many flower-visiting insects in the agricultural landscape. Residues from fertilisers and plant protection products also remain in the soil and can enter streams, rivers and lakes, where they harm soil and aquatic organisms.

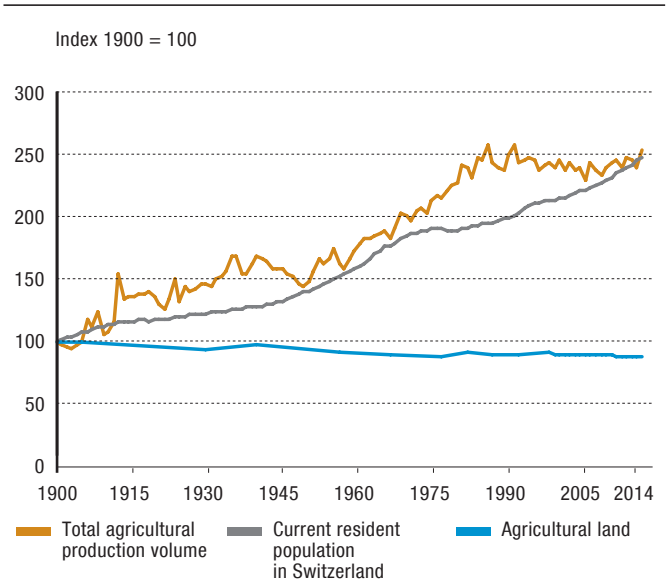

Fig. 1 *Between 1900 and 2014, the agricultural area in Switzerland decreased, while the production volume of agriculture and the resident population grew. Sources: FSO – LGR, STATPOP, Farm Structure Survey*

The federal government has taken different measures to counteract the decline of biodiversity on cropland. Thus, every enterprise that wants to receive direct payments must create biodiversity priority areas on at least 7 percent of the area used for agriculture. In addition, there are contributions for the interconnection of these areas and biological quality. Landscape quality contributions were also newly introduced with the Agriculture Policy 2014–2017.

Improvements, but also deficits in the forest

The biodiversity of forests is in relatively good condition compared to other ecosystems. Since the 1980s, natural regeneration of forests has been increasingly the rule, which promotes the growth of tree species adapted to local conditions and high genetic diversity. Swiss forests are home to extremely rich biodiversity. Around 40 percent of the species occurring in Switzerland spend time regularly in the forest, grow there or depend on the forest for at least one stage of development. The percentage of forest species among bats, longhorn beetles, large fungi and lichens is higher than average (Fig. 2). The species surveyed by the BDM (i.e. common and widespread species) show stable to positive development. Forest bird species have also increased since 1990. However, in individual species groups such as lichens, mosses, large fungi and beetles, the percentage of vulnerable and near threatened species is considerable. Many "primeval forest relic" species depend on old-growth wood and deadwood or open forest sites. Nevertheless, the middle succession stages dominate Swiss forests, while open pioneer, aging and decay stages are lacking. For the first time since the 1980s, the volume of deadwood is rising in Swiss forests, as a result of hurricane "Lothar" and other causes. However, there are large regional differences: The quantities of deadwood in the Jura and Central Plateau regions are only about half those in the Alps and the Pre-Alps.

Heavily damaged waterbodies and wetlands

The percentage of threatened habitats and species in bodies of water and wetlands is particularly high. Most bodies of water and mires in agricultural areas were drained in the last century, while rivers, streams and lakes were robbed of their natural dynamic: Around one-fifth of Swiss watercourses are today completely artificial, heavily damaged or culverted; just over one-third of watercourses in the Jura and Central Plateau regions are damaged. To avoid floods and overflows, lake water levels have been regulated more intensively in recent years, which is causing the natural water level fluctuations of waterbodies to be even lower on average and valuable periodically wet sites, such as marshes and alluvial zones, to disappear. Many watercourses are also impaired by artificial

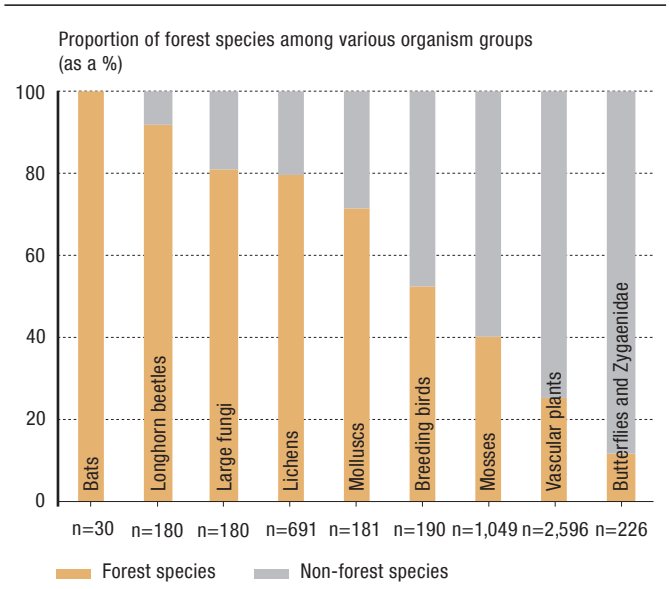

Fig. 2 *Percentage of forest species among the various organism groups that occur in Switzerland. n= Number of surveyed species. Source: Brändli & Bollmann 2015*

Fig. 3 *The renaturation of waterbodies has a positive impact on biodiversity as a whole, including humans.*

barriers that fish can hardly overcome and heavy water level fluctuations underneath river power plants. In many places, watercourses have been dug so deep that they are disconnected from exchanges with adjacent land habitats. Inputs from pesticides (plant protection products and biocides) and other micropollutants (fuel additives, medication, cosmetics, etc.) also damage water ecosystems. Several of these substances can cause damage to aquatic organisms even in low concentrations.

Habitats in the Alps increasingly under pressure

The Alps are home to a wide range of habitats and species. However, tourism and sports activities, sports infrastructures, hydropower use, structures protecting against natural hazards, intensive use at favoured locations as well as the abandoned use of remote meadows and pastures are putting Alpine habitats under increasing pressure. Biodiversity in the Alps is also particularly affected by climate change due to the intense altitudinal zonation and the related significance of temperature for the habitat. Climate changes displace the home ranges of species. The BDM shows that warmth-loving plants, butterflies and birds are spreading into areas at higher altitudes. The species that have lived in these regions up until now could be displaced and become extinct regionally over the longer term. Climate changes could also have an indirect impact on the biodiversity of the Alps because uses (sports, recreation, tourism, energy, agriculture) change or intensify as a result.

Settlements offer opportunities and risks for biodiversity

The growing population, desire for more living space, necessary densification and higher mobility increase the pressure on biodiversity in settlement areas. 60 percent of settlement areas are now sealed. In the last 10 years, the species diversity in settlements has continued to decrease, as shown by the BDM and long-term surveys in the Canton of Aargau. At the same time, settlement areas have huge potential as refuges and replacement habitats especially for animals and plants from the open country (Fig. 5). Unsealed settlement areas are significantly richer in species than agricultural areas, at least in terms of the specific animal and plant groups observed by the BDM. With its small spatially structured sites, highly structural dynamic and diverse climate conditions, urban space in particular offers specialised species (e.g. ruderal and pioneer plants) a refuge – though invasive alien species are also found in them and can continue to spread.

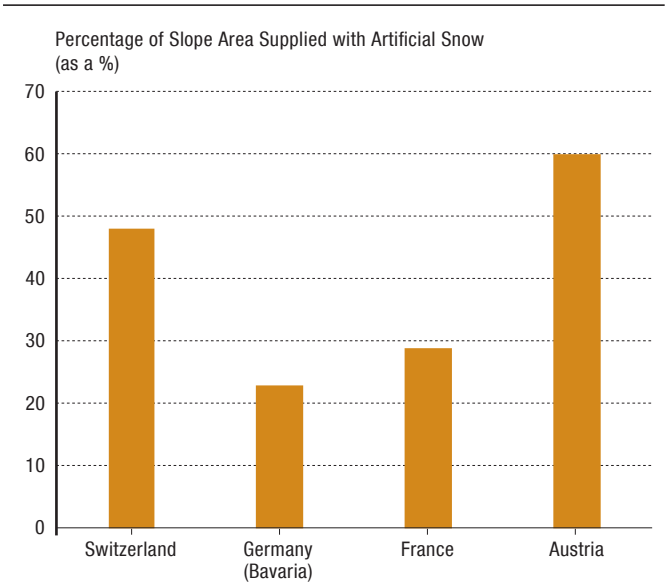

Fig. 4 *Percentage of slope area supplied with artificial snow out of the entire ski slope area in international comparison. Sources: SBS 2015, WKÖ 2015, VDS 2015, Domaines skiables de France 2015*

Fig. 5 *The common wall lizard* (Podarcis muralis) *finds suitable habitats in the old walls of our cities and towns.*

Generalists on the rise, specialists in decline

The ongoing loss of habitat quality and area can be seen in the dwindling populations of habitat specialists and the rising populations of generalists that have no particular demands on their habitat. Thus, vegetation in many habitats in Switzerland is becoming more and more similar across large geographical expanses: Common species are spreading, while the specialists are increasingly isolated and their populations are collapsing. The homogenisation of habitats and species communities is primarily attributable to the fact that land uses are becoming increasingly similar and intensive and higher nitrogen inputs are contributing to the over-fertilisation of near-natural ecosystems. For instance, the strong presence of dandelions in many plant populations and habitats suggests widespread rising nutrient input (Fig. 6). As rare species disappear, the typical regional and original diversity, and thus biological diversity, disappears in various habitats.

The situation of threatened species has not improved

The decline in populations of many animal, plant, fungus and lichen species is reflected in the Red Lists of threatened species. 3 percent (255) of the species assessed to date (10,350) are deemed to be "extinct in Switzerland", 5 percent (554) are considered "critically endangered", 11 percent (1,144) are assessed as "endangered" and 17 percent (1,788) are considered "vulnerable". 10 % (1,053) of species are assessed as "near threatened" and require special attention (Fig. 7). These groups may be moved into a higher category of threat in the future.

Along with the already endangered species, nearly half of all assessed native Swiss species are in an at-risk situation. The Red Lists of vascular plants (2016) and breeding birds (2010) have been updated in recent years, which makes it possible to estimate the changes. According to both lists, the overall situation has hardly improved for endangered species in the last 10 years. While the percentage of endangered species has stayed almost the same, many species are still experiencing shrinking ranges and thinning populations.

Fig. 6 *The massive presence of dandelions* (Taraxacum officinale) *is unfortunately a sign of less biodiversity in many cases.*

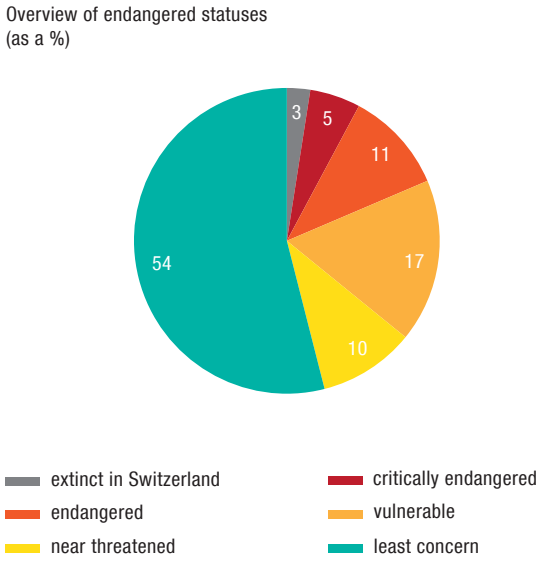

Fig. 7 *Overview (as a %) of the endangered statuses of 10,350 animal, plant and fungus species surveyed for the Red Lists. Source: FOEN.*

More designated biodiversity areas

In recent years, the federal government has stepped up its efforts to protect biodiversity, particularly by promoting designated biodiversity areas. In 2015, biodiversity priority areas covered about 15 percent of the area used for agriculture in Switzerland. However, there are large regional differences. In mountainous regions, the percentage is significantly higher than in valleys. It should also be noted that only around one-third of all priority areas have ecological quality (quality level 2). The overall area designated as forest reserve has also increased: The percentage of forest reserves in Switzerland's forest area amounted to 5.6 % in 2014. The total area of nationally designated biodiversity areas also increased; this also includes the inventoried alluvial zones, mires, amphibian spawning sites, dry meadows and pastures, Swiss game reserves, water and migratory bird reserves as well as the Swiss National Park. The area rose from 29,449 hectares in 1991 to 258,008 hectares in 2016 and now makes up around 6.2 percent of the national territory. Private nature conservation areas, biotopes of regional and local importance and the Ramsar and Emerald sites also help protect and promote biodiversity. Overall, about 12.5% of the land area is currently designated for the conservation of biodiversity.

Biotopes of national importance are losing quality

By placing national mires, alluvial zones, amphibian spawning and dry meadows and pastures under protection, area losses in these particularly valuable habitats have been slowed. However, quality losses are ongoing as a result of nitrogen inputs, changes in the water regime, abandoned use, improper management and other influences. The protected areas often need to be regenerated and enhanced in order to be able to fulfil their function. They also need to be properly maintained. Under the Federal Act on the Protection of Nature and Cultural Heritage, cantons must ensure that the protection requirements for landowners and long-term maintenance of national biotopes are guaranteed. A FOEN survey of the cantons shows that the legal protection and maintenance of only 58 % of the sites were guaranteed in 2014. The main reasons for the meagre biotope protection situation are the inadequate financial and human resources of the Confederation and cantons. The FOEN estimates that the necessary maintenance measures require twice the amount of funds currently used. One-time investments are also required to enhance and revitalise sites.

Fig. 8 *Biodiversity priority areas are often fragmented and small.*

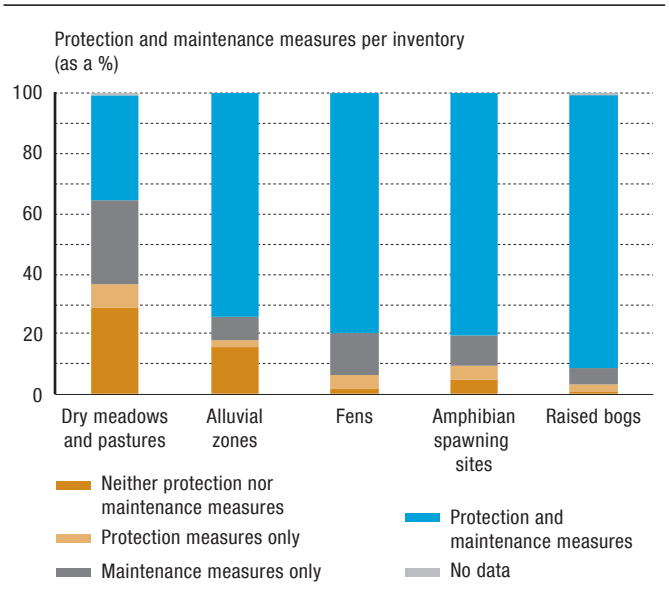

Fig. 9 *The implementation of biotope protection measures for raised bogs is the most advanced, while the implementation of protection measures for dry pastures and meadows is the least advanced. Source: FOEN*

1 > Introduction

Biodiversity describes the diversity of life at the ecosystem, species (animals, plants, fungi, micro-organisms) and genetic levels. The interactions that occur within and between these levels are also part of biodiversity. The individual elements and their interactions ensure the stability, resilience and capacity of biodiversity.

Biodiversity is a fundamental building block of our lives

In the last 100 years, biodiversity has massively declined both worldwide and in Switzerland.[1] These losses have a serious impact. After all, biological diversity and functioning ecosystems are our most important building blocks of life. They contribute significantly to our supply of food, air for breathing and drinking water. They regulate the climate and stabilise mountain slopes at risk of landslide. They protect against floods and avalanches and keep the nutrient cycle in operation. As biodiversity decreases, these functions may continue to be adversely affected.[2]

Ecosystem functions that serve people are known as ecosystem services.[3] For example, around 39,000 hectares of agricultural area benefitted from pollination by animals in 2014, which corresponds to 4%, of the area used for agriculture and 13% of cropland and permanent cropland.[4] The analysis of ecosystem services helps recognise and evaluate the benefits of biodiversity and ecosystem functions, and even some of their financial benefits. It helps reveal the consequences of consumption and investment decisions for nature, illustrate their repercussions on human well-being, and develop the policy instruments that secure their services.

Fig. 10 *The Damon blue* (Polyommatus damon) *has disappeared from the Jura and the Central Plateau regions because its host plant, the sainfoin* (Onobrychis spp)*, is rarely found in large populations.*

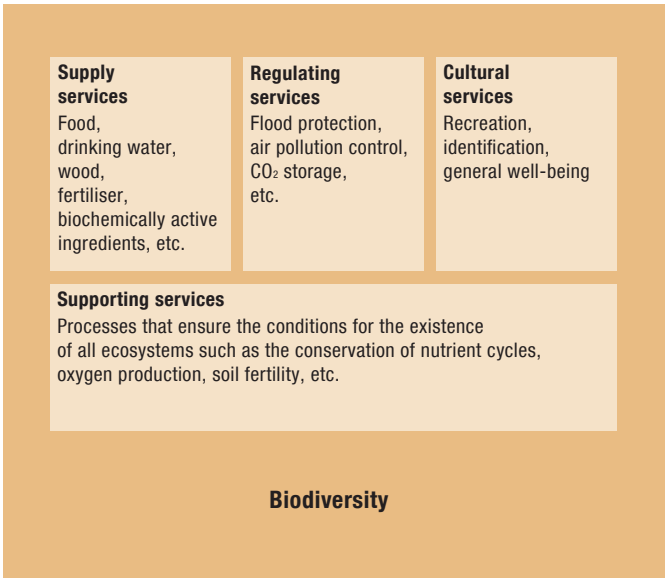

Fig. 11 *The various ecosystem services of biodiversity. Source: Millennium Ecosystem Assessment*

Most ecosystem services are public goods and are not traded on markets. Naturally, they are used for free. This circumstance leads to the over-utilisation of natural resources and a deterioration of natural capital and results in a decrease in the "dividends" (products and services) of natural capital that potentially benefit us. In the EU, it has been estimated that the annual cost of ecosystem services that must be compensated as a result of biodiversity losses will reach up to around 4 % of the gross domestic product (GDP) by 2050.[5] The quantity and quality of the ecosystem services provided in Switzerland are comparable to those in EU countries. Therefore, it can be assumed that non-action would also be much more expensive for Switzerland than the cost of effective protection and promotion of biodiversity today.

Biodiversity is also a necessary condition for ensuring basic individual rights to certain natural resources, such as the moral right to clean air or the right to clean drinking water. Furthermore, there is an ethical obligation to prevent the irreversible limitation of the range of potential choices and actions of future generations – such as by seriously damaging biodiversity. Ultimately, the value of biodiversity must be recognised – independent from its benefits for humans. This responsibility is specified in Switzerland's Federal Constitution.[6]

Biodiversity must be monitored

Switzerland's Federal Constitution requires long-term conservation of the natural building blocks of life. Biological diversity must be protected, and threatened species must be saved from extinction. In addition, biodiversity must be recorded and monitored. Data and facts concerning the state of and changes in biological diversity provide the basis for recognising problems early on, setting goals, taking proper protection and promotional measures and determining the impact of these measures. Biological diversity monitoring in Switzerland and its connection to other environmental monitoring programmes is required under the Ordinance on the Protection of Nature and Cultural Heritage (NCHO Art. 27a). By signing the Convention on Biodiversity (CBD) in Rio in 1992, Switzerland also committed to monitor its biological diversity over the long term.

The Confederation uses several monitoring programmes to observe various areas of the environment, such as soil, bodies of water, landscape, air and forest.[7] Four monitoring programmes are specifically focused on Switzerland's biodiversity:

> Biodiversity Monitoring Switzerland (BDM)
> Agricultural species and habitats monitoring (ALL-EMA)
> Monitoring the effectiveness of habitat conservation in Switzerland (WBS)
> Red Lists

Fig. 12 *"Green" alone does not indicate rich biodiversity. Homogenous plant composition and lacking small structures (shrubs, hedges) indicate rather poor species diversity.*

Fig. 13 *These flowering meadows at the foot of the Jura are home to a wide range of diverse animal species in addition to countless flowering plants.*

Swiss hunting and fishing statistics, the Swiss breeding bird atlas, the Swiss National Forest Inventory, the biological studies of the national soil monitoring programme, the national observation of surface water quality and collections of national data and information centres (Info Species) all contribute to the recording of biodiversity.

Because it is impossible to record biodiversity throughout Switzerland's entire territory, the biodiversity monitoring programmes concentrate mostly on measuring representative aspects. Examples of these indicators include the number of species on the Red Lists, the nutrient conditions in raised bogs or the area designated as biodiversity priority area. For that purpose, the focus is placed on informative and generally defined organism groups, such as plants or birds. Species is the focus of the surveys because it is the easiest unit to measure. But the number of species alone does not provide any comprehensive assessment of biodiversity. If, for example, the number of species rises due to the appearance of invasive alien species and the rarer specialised species decline, biodiversity sustains a loss despite the steady or increasing numbers of species. Only exact and statistically-based analyses of the different indicators for the various aspects of biodiversity make it possible to draw a conclusion on their general development.

The four national biological diversity monitoring programmes each examine different facets of biodiversity:

Biodiversity Monitoring Switzerland (BDM)

The Biodiversity Monitoring Switzerland (BDM) programme launched in 2001 focuses on the species in Switzerland's "normal landscape", which means the area that is used but not protected. It maintains two measurement networks to observe species diversity in landscapes and habitats: 450 one-square-kilometre sampling areas (Fig. 14) and 1,450 ten-square-metre sampling areas (Fig. 15) regularly distributed across Switzerland. It also has an aquatic insect measurement network that includes around 570 sections of waterbodies (Fig. 15).

The three measurement networks and the five-year survey cycle make it possible to recognise changes in breeding birds, vascular plants, aquatic insects, molluscs, mosses and butterflies and to derive three main indicators:

> The *"Species Diversity in Landscapes"* indicator shows how many different species of vascular plants, breeding birds and butterflies occur in Switzerland's landscapes.
> The *"Species Diversity in Habitats"* indicator documents how the species diversity of vascular plants, mosses, molluscs and aquatic insects changes in important habitats and at various altitudes of Switzerland.

Fig. 14 *The BDM's measurement network for the "Species Diversity in Landscapes" indicator. Source: BDM*

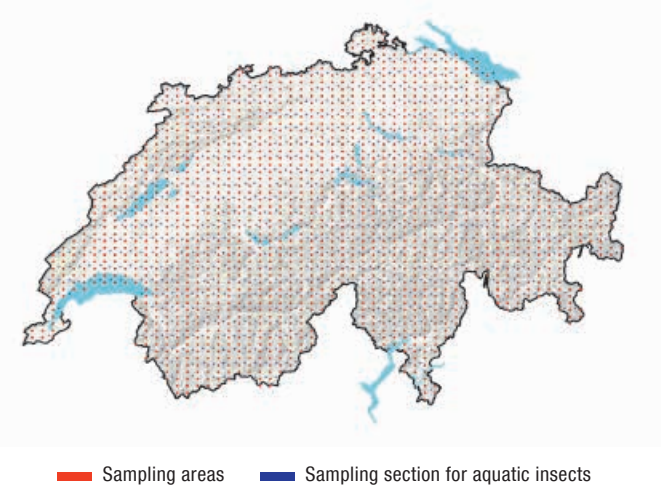

Fig. 15 *The BDM's measurement network for the "Species Diversity in Habitats" indicator. Source: BDM*

> The *"Diversity in Species Communities"* indicator shows how species compositions of breeding birds, butterflies and vascular plants change within particular types of use and different regions of Switzerland.

The BDM's strengths lie specifically in detecting the longer-term effect of large-scale general environmental changes (e.g. nitrogen inputs, land use intensity, climate change) on species communities.

Monitoring the effectiveness of habitat conservation in Switzerland (WBS)

The WBS programme documents the status of nationally important habitats. Launched in 2011 by the FOEN and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), it examines whether the alluvial zones, mires (fens and raised bogs), amphibian spawning sites and dry meadows and pastures listed in national inventories are changing in line with their protection goals and whether their area and quality are conserved (Fig. 16). The process used to record the vegetation in the various types of biotopes is the same one used by the BDM and makes it possible to compare changes in the normal landscape with those in the biotopes of national importance.

Agricultural species and habitats monitoring programme (ALL-EMA)

The ALL-EMA (Arten und Lebensräume Landwirtschaft – Espèces et Milieux Agricoles) programme launched in 2015 measures changes in species and habitat diversity through plant surveys of landscapes shaped by agriculture. The programme is integrated in the Federal Office for Agriculture's (FOAG) concept of agri-environmental indicators. It is based on the same measurement grid as the BDM and the same plant monitoring methods as the WBS, but focuses instead on 170 sections of landscape and semi-frequent habitats in agricultural areas (Fig. 17). The first survey cycle closes in 2019.

The Red Lists

The Red Lists contain information about endangered plant, animal and fungus species. They exist for 27 organism groups and include around one-third of all known species in Switzerland. The criteria for classifying species in the various categories of threat ("critically endangered", "endangered", "vulnerable") are based on a combination of factors that essentially determine the probability of extinction: the effectively colonised area, size and degree of isolation of the populations as well as population changes. These criteria were developed by the International Union for Conservation of Nature (IUCN). Its goal is to improve the objectivity of classification and the comparability of the Red Lists at the national and international levels through internationally supported guidelines.

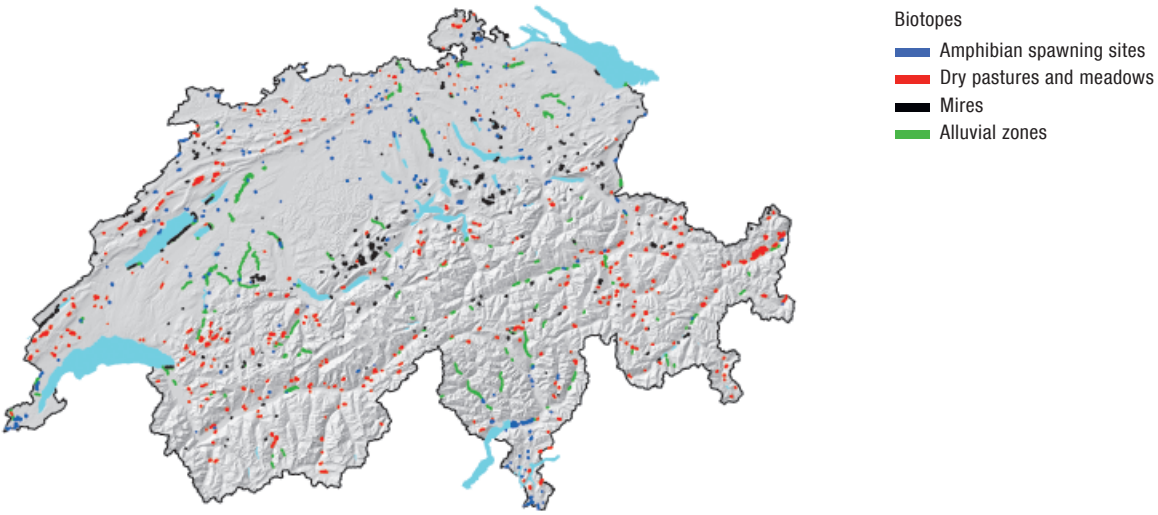

Fig. 16 *The sampling of the "Monitoring the effectiveness of habitat conservation in Switzerland" programme. Source: WBS*

The goal of the Red Lists is to track the changes in endangered species over a long period of time. They are regularly reviewed so that they can deliver this information. As part of the national priorities, a second expert report on the state of habitats was written in 2013 and will be recognised by the FOEN starting in 2017 as the Red List of endangered habitats.

Report content and structure

This report is based on the Confederation's monitoring data, statistical analyses and advanced studies. It analyses the state of the biodiversity in Switzerland at the "habitat", "species" and "gene" levels and describes the causes for the continuing losses. To obtain a differentiated picture, the report assesses the biodiversity situation in relation to different ecosystems. It shows the situation in agricultural areas, forests, bodies of water and wetlands, in the Alps as well as in settlement areas. The last chapter outlines biodiversity protection and conservation measures in Switzerland.

Fig. 17 *The measurement network of the "Agricultural Species and Habitats" monitoring programme. Source: ALL-EMA*

2 > Habitats under pressure

Habitat loss and the decline of habitat quality threaten biodiversity in Switzerland. The main causes of the negative trend are growing settlements and transport systems, in connection with land use, spatial fragmentation, intensive farming, as well as the spread of invasive alien species.

Switzerland's topography has huge variations in elevation, diverse geology, a heterogeneous rainfall distribution and a variety of traditional forms of management for a wide range of habitats that each have their own typical species. Research has described 235 different types of habitats, including, for example, moraines with pioneer vegetation, warmth-loving dry grasslands and downy oak forests.[8] However, this diversity is under tremendous pressure. Around half of the surveyed habitat types are deemed to be threatened.[9] Only remnants of many habitats still exist. These are serious losses because once they are destroyed or subject to a use change or intensification, many habitats cannot be restored, and if they can be restored, this can only be done to a limited extent and at great effort and cost. Since fens and raised bogs, alluvial zones, amphibian spawning sites and dry meadows and pastures of national importance are protected, the area loss sustained by these particularly valuable habitats has been slowed. However, their quality continues to decline due to nitrogen inputs, changes in the hydrological balance, abandoned use and other influences.

In most cases, the threat faced by habitats and their species communities cannot be attributed to one single factor, but rather the simultaneous occurrence of different causes whose effects may be reinforced by one another.

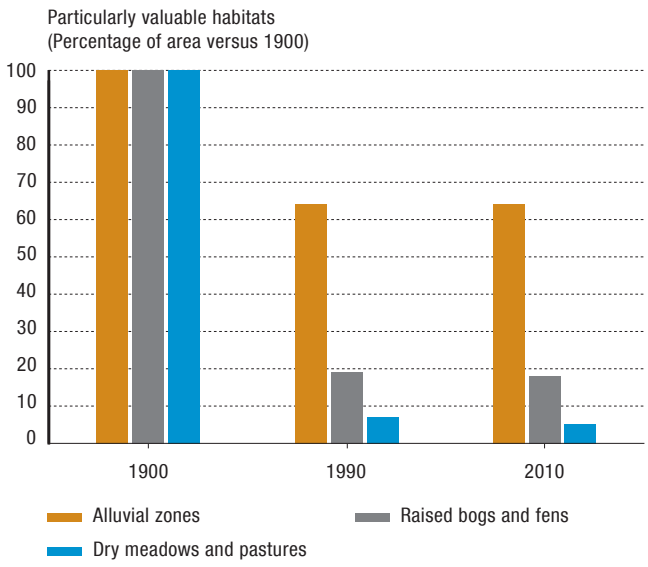

Fig. 18 *Land-use changes in alluvial zones, mires, dry meadows and pastures since 1900. Source: Lachat et al. 2010*

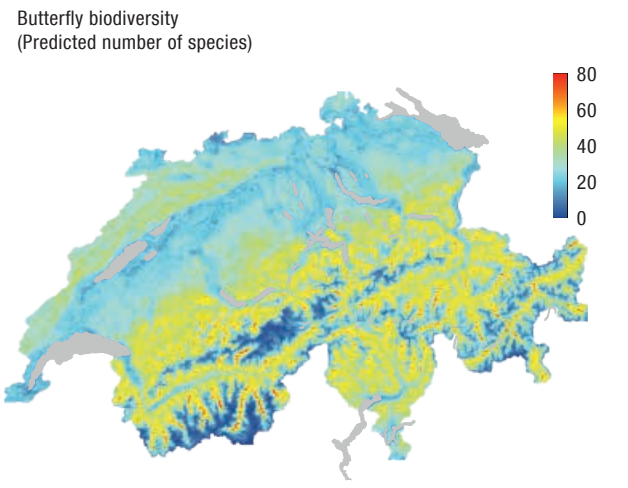

Fig. 19 *Swiss map showing the diversity of butterfly species, based on BDM data. The species are concentrated wherever land is not used very intensively. Source: BDM*

Intensive use of land and bodies of water

One of the reasons for the continuing loss of biodiversity is the strong growth of settlement areas. Between 1985 and 2009, the percentage of settlement area in Switzerland increased by 23 percent (Fig. 20).[10] Land use was particularly high in the valleys of Ticino, Valais and Grisons as well as in the Central Plateau, where the settlement percentage in that period grew twice as fast as the national average. This transformation is the expression of changing societal needs and demands. An ever larger area of living space is in demand per person, not to mention the share of space required for individual mobility. There is no end in sight to the growth, even though land use has been slowed in recent years. Today, 0.69 square metres are sealed per second or transformed in most cases into species-poor lawns (golf courses, sports facilities, etc.).[11]

The spread of settlements and infrastructures also causes the division of habitats into separate, disconnected areas and the isolation of animal and plant populations. Species populations and their genetic diversity are becoming smaller, which increases the risk of extinction. In the Central Plateau, landscape fragmentation has doubled in the last 30 years (Fig. 21).[12] The degree of fragmentation can be read from the "effective mesh size" value. This value expresses the probability that two randomly selected points in a region are connected and not separated by barriers such as transport routes or settlements. The value of the effective mesh size for Switzerland as a whole in 2007 was 282.9 km^2 - this corresponds to a regular grid of fragmentation elements with only 15 km of edge length.[13] Fragmentation is lowest in the Alpine regions, which must be qualified by the fact that they have large expanses of unused areas. Most of the existing fragmentation is concentrated in the valleys. The effective mesh size values in the three Alpine regions are ten to twenty times higher than the corresponding value in the Jura region; yet, this value is eight times higher than the value in the Central Plateau.

Between 1985 and 2009, 54,516 hectares of agricultural area were transformed into settlement area (of which 60 % is sealed). This corresponds to two-thirds of the agricultural area that was lost during this period. Another 9,302 hectares moved to the "Forest and Semi-Natural Areas" category. Forest has spread, especially at higher elevations, into remote

Energy Strategy 2050

As part of the Energy Strategy 2050, installations are supposed to be created that interfere as little as possible with nature but are as useful as possible for electricity production. By providing implementation assistance for small hydropower plants, the FOEN, the SFOE and the ARE help the cantons deal with the somewhat contradictory statutory hydropower goals under the Energy Act as well as the water, species, habitat and landscape protection goals. The implementation assistance identifies where sensible and modest uses are possible, and where protection has priority.

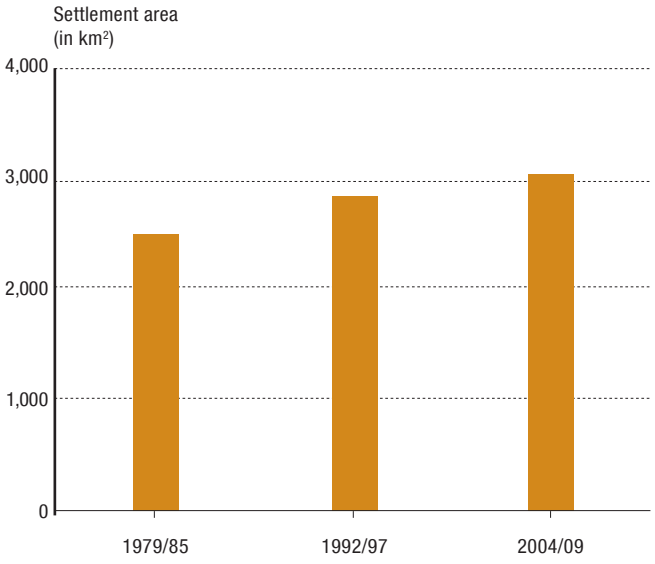

Fig. 20 *Settlement area. Source: FSO, Land Use Statistics*

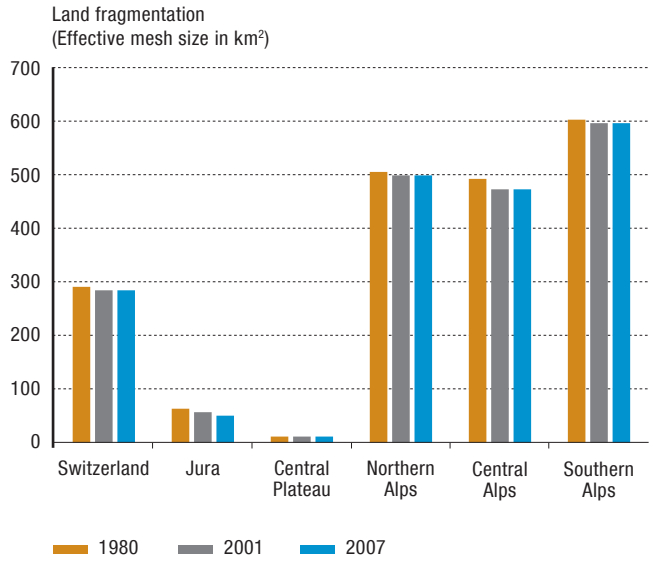

Fig. 21 *The effective mesh size in different regions of Switzerland. Source: Vector25, Swiss Federal Inventory*

and steep areas, due to the abandonment of agriculture. The remaining agricultural land is often farmed with large quantities of fertilisers and pesticides (see Chapter 2.1). These problematic substances not only remain in the soil, but can also enter soil and bodies of water, where they harm soil and water organisms and disturb the ecological balance. Small structures continue to be removed from agricultural land, causing countless species to lose their habitats. Wetlands are drained or filled in.

Swiss watercourses are also used intensively, particularly for electricity production or agricultural irrigation. Hydropower plants remove large quantities of water from rivers and streams. After the water is used, it is returned to another place in the same or different body of water.[14] Residual flow is the portion of water that remains between the extraction and return points in the bed of the watercourse. Around half of the approximately 1,500 water extraction points used for hydropower must be remediated due to inadequate residual flow quantities.[15] Many middle to large-sized watercourses in the Swiss Alpine and Pre-Alpine regions are also affected by hydropeaking. When water levels change rapidly (hydropeaking), hydropower use can significantly damage aquatic habitats. Around 100 power plant installations must be remediated. The cost-covering remuneration for feed-in to the grid for electricity from renewable energies has also triggered numerous projects for small hydropower plants, which may increase the pressure on water habitats.

Emissions reduction measures

Based on the legislation, the Confederation, cantons and communes have taken measures to reduce nitrogen inputs. Between 1990 and 2010, nitrogen oxide emissions (mainly from transport and industry) in the air fell by 47 percent.[16] While further progress has been made with nitrogen oxides since then, not much has changed for ammonia in recent years: Its emissions decreased between 1990 and 2010 by only 13 percent,[17] but this can be attributed mainly to decreasing cattle populations between 1990 and 2000. 93 % of ammonia emissions come from agriculture, where they are particularly created by keeping livestock in stables, storing farm manure and applying it in the fields. In the report discussing the Confederation's concept of air quality measures ("Konzept betreffend lufthygienische Massnahmen des Bundes", 2009), the Federal Council calls for an approximately 40 % reduction in ammonia emissions and notes that environmental pollution can only be reduced through measures at the source, i.e. by reducing pollution emission levels.

Agricultural areas, development of most important new uses 1985–2009

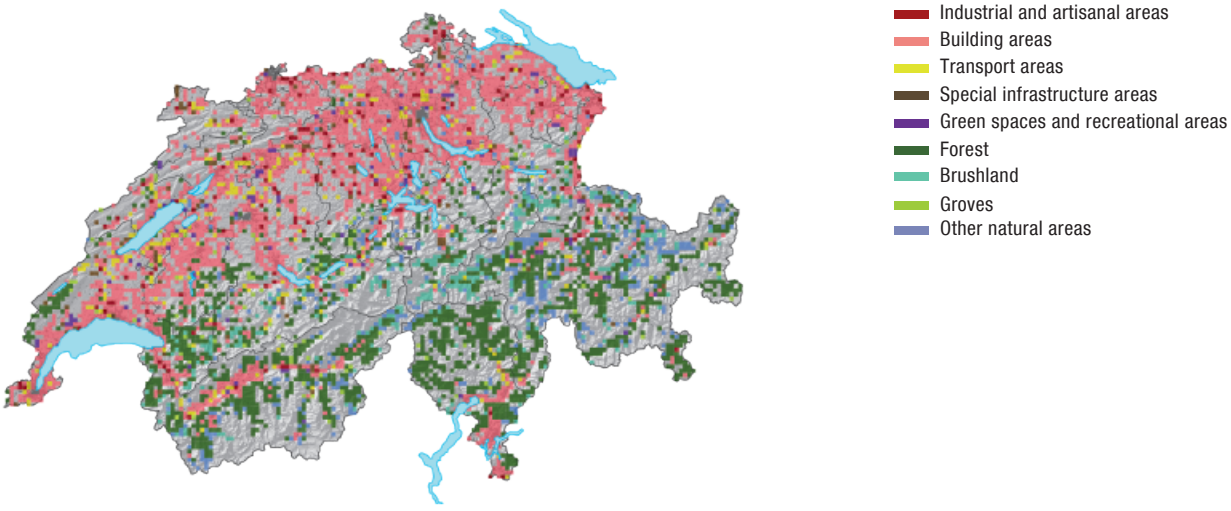

Fig. 22 *The most important new uses of land previously used for agriculture. Source: FSO – Land Use Statistics*

Local nitrogen inputs have a large-scale impact

The natural atmospheric input of biologically active nitrogen is 0.5 to 2 kilogrammes per hectare and year. However, an average of 19 kilogrammes of nitrogen per hectare currently enters the soil every year in Switzerland solely through atmospheric inputs. Depending on the site, this value fluctuates between 3 and 54 kg (Fig. 24).[17] Around one-third of the atmospheric nitrogen inputs come from nitrogen oxides released by combustion processes (transport, industry and heating), while about two-thirds are caused by ammonia emissions from agriculture, which are created particularly by keeping livestock in stables, storing liquid manure and applying farm manure in the fields. Reactive nitrogen compounds also enter distant, sensitive ecosystems through the air. For that reason, 100 % of all raised bogs, 84 % of fens, 42 % of dry meadows and pastures, and 95 % of forests are affected by excessive nitrogen inputs from the air.[18] This assessment was based on the critical loads for nitrogen set out in the UNECE Convention on Long-Range Transboundary Air Pollution.[19] Over-fertilisation with nitrogen causes specialised oligotrophic species to disappear in the medium and long term. The BDM data show that the nitrogen deposition in species-rich hayfields in mountainous regions allows plant species that are able to better exploit the high nutrient supply to grow faster and species that are not as competitive and rather adapted to a low food supply to be replaced.[20] In addition to direct habitat destruction, extensive nitrogen inputs have become one of the greatest threats to biodiversity in Switzerland.

Green economy

The FOEN is committed to the dissemination of environmentally-friendly and resource-efficient production and consumption patterns. It uses two approaches for that purpose: Product-oriented measures are intended to increase supply and demand for environmentally-friendlier products. Consumption-oriented measures are intended to encourage environmentally-friendly consumption decisions and lifestyles. In terms of economic development cooperation, Switzerland also has programmes that promote sustainable trade and investments in biodiversity products (e.g. food, pharmaceutical and cosmetic ingredients, ornamental flowers), the protection of tropical forests and the establishment of sustainability labels in the international commodity trade, among other things.

Consumption adversely affects biodiversity both in Switzerland and abroad

Since the middle of the last century, consumption in Switzerland has increased immensely. It affects biodiversity indirectly through land use, the demand for raw materials, environmental pollution from transport and energy demand as well as both upstream and downstream of the entire value chain. Switzerland's biodiversity footprint is far in excess

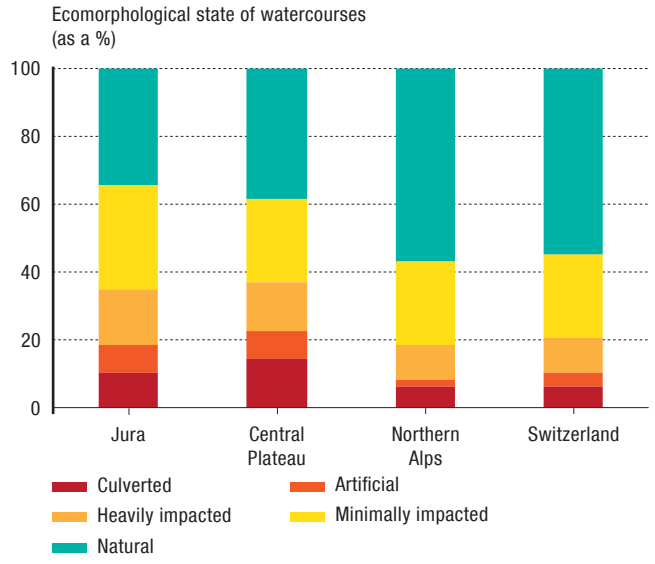

Fig. 23 *Regional and national ecomorphological state of watercourses. Source: FOEN*

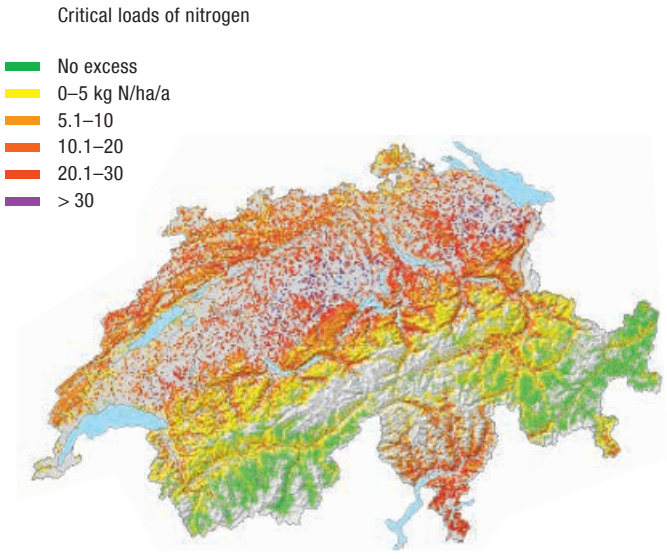

Fig. 24 *Exceedance of critical load limits for nitrogen in near-natural ecosystems for the year 2010. Grey: no ecosystem vulnerable to nitrogen. Source: FOEN/Meteotest*

of a level that can be accommodated by the planetary boundaries.[21] It has increased significantly in recent years. The rising resource consumption is causing an ever larger share of the consumption-based biodiversity footprint to take its toll abroad: It was just over half in 1996 and more than roughly two-thirds in 2011.[22] This high share is tied to the fact that Switzerland's small open economy is increasingly dependent upon imports. This can be illustrated by the consumption of a cup of coffee: The entire value chain includes everything from growing and harvesting the coffee plants, roasting and transporting the beans, producing the coffee machines themselves and consuming electricity and water for the beverage to disposing of the waste. It means that environmental pollution is caused at entirely different locations just to make one cup of coffee. The environmental pollution caused by Switzerland has not grown to the same extent as its economy in the last 15 years, which means that resource efficiency has improved. However, Switzerland still has a ways to go before it reaches environmentally-friendly resource consumption levels.

Swiss climate policy and biodiversity

In March 2012, the Federal Council adopted the first part of its climate change adaptation strategy for Switzerland. The strategy identifies areas of action for the various policy sectors. The following action was identified as necessary in the biodiversity management sector: Climate-related changes in genetic diversity, species and habitats must be investigated and monitored to a greater extent. Climate-sensitive species and habitats in particular must be identified and promotional measures must be geared toward climate-related changes. This primarily concerns water and wetland habitats as well as Alpine habitats for which Switzerland bears particular responsibility. Climate change also increases the need for action in the areas of connectivity, invasive alien species, genetic diversity conservation, monitoring and transnational cooperation.

Climate change

Biodiversity in Switzerland is also under pressure due to climate change. During the last 50 years, winter and spring precipitation quantities at most monitoring stations in Switzerland have decreased, while average temperatures have increased.[23] Species react differently to factors such as temperature and humidity. Climate changes can cause their natural ranges to shift. For instance, butterflies, dragonflies, birds and several plant species from the Mediterranean region are spreading into Switzerland. According to the BDM data,

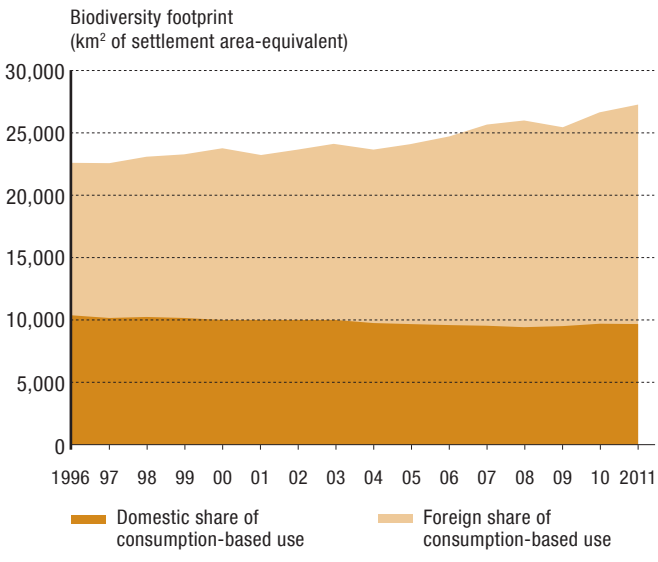

Fig. 25 *Biodiversity footprint. Sources: FOEN, Frischknecht et al. 2014*

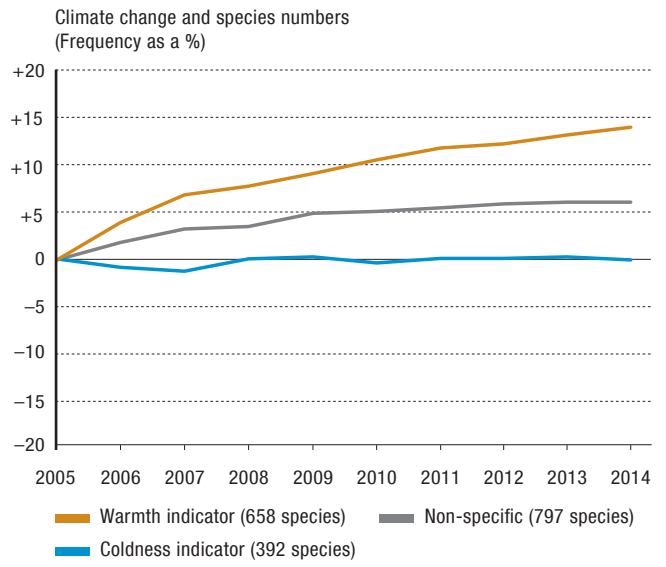

Fig. 26 *Warmth-loving vascular plants are increasing in Swiss landscapes. Source: BDM*

drought-resistant species and neophytes with short life spans have in particular increased significantly at lower altitudes. The BDM also shows that warmth-loving plants, butterflies and birds are moving into previously cooler areas, causing entire species communities to shift their altitudinal distribution. Within only eight years, plants have moved 8 metres higher on average, while birds and butterflies have moved 40 metres higher.[24] The displacement of vegetation areas is causing the alpine and nival altitudinal belts to shrink. Characteristic alpine plant species may be placed under greater pressure in the future.

Invasive alien species

Invasive alien species have become a growing problem (Fig. 27). This designation is given to species that are either already known or necessarily assumed ('potentially invasive') to adversely affect biological diversity, ecosystem services and their sustainable use or to threaten humans and the environment as a result of their spread in Switzerland. 107 of the more than 800 alien animal, plant and fungus species established in Switzerland are assessed as invasive (Fig. 27). They cause ecological damage by replacing native species, mixing genetically with them (see Chapter 4), causing illness (e.g. crayfish plague, death of ash trees, chytridiomycosis) or diseases and transferring parasites[25] to local species. Their emergence in valuable habitats such as alluvial zones or amphibian spawning sites is particularly problematic. For example, Japanese knotweed and goldfish cause ecological damage.[26] Invasive alien species may continue to increase in large numbers in the future because the transport of persons and goods is growing around the world and climate change is creating better environmental conditions for many of these species.[27]

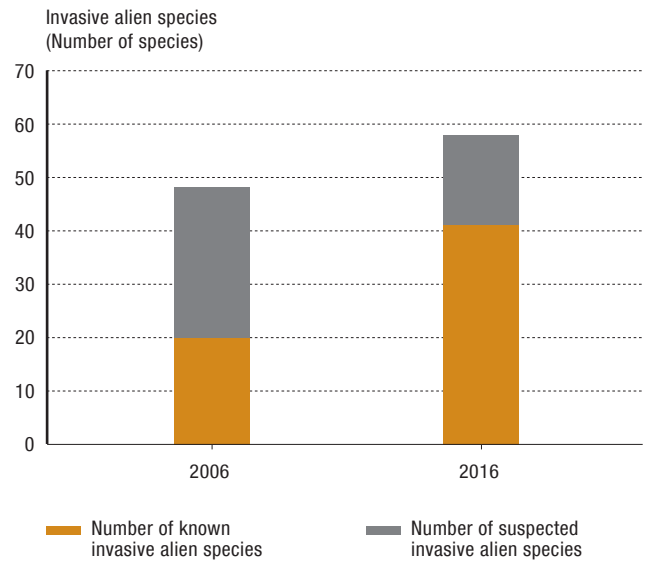

Fig. 27 *Invasive alien species. Number of known or suspected invasive alien plant species. Source: Info Flora*

Invasive alien species strategy

In May 2016, the Federal Council adopted the Swiss Invasive Alien Species Strategy.[28] It defines the principles, goals and measures for prevention and control of these species. A report on alien species in Switzerland published by the FOEN lists over 800 established alien species and provides data sheets for around 100 problem species. The lists are a tool for various public and private actors. They help them make decisions and set priorities in the prevention and control of invasive neophytes. The Confederation's Swiss crayfish action plan is the first implementation tool to be published that administers the conservation of native species and the control of alien crayfish species.

2.1 Agricultural land

Habitat diversity on agricultural land has decreased considerably as a result of its intensive agricultural use; only small remnants of many habitats still exist. Mountainous regions are now increasingly subject to intensive use, which threatens species-rich dry meadows and pastures and reduces species diversity in the soil. This makes biodiversity promotional measures even more important.

Richly structured agricultural land and its fields, pastures, borders, shrubs, vineyards, lines of trees and vegetable gardens offer valuable substitute habitats for countless animal and plant species and soil organisms. However, the intensive use of land for agriculture has led to widespread uniform ecological conditions and huge habitat losses: Small structures that hinder equipment use have been cleared, wetlands have been drained or filled in, nutrient-poor sites have been fertilised, and dry sites have been irrigated. In addition, intensive soil use causes soil structure to deteriorate and reduces its biodiversity. "Special sites" exist today only in small residual areas. At this time, 35 percent of the habitat types in agricultural areas are assessed as threatened.[29] Dry meadows and oat-grass fields, which are less intensively used and fertilised only with manure, have decreased dramatically. In the Central Plateau, oat-grass fields have receded to merely two to five percent of their original area as a result of more intensive agriculture use;[30] and dry meadows and pastures in Switzerland lost around 95 % of their area between 1900 and 2010.[31] In the last 20 years, the remaining area has decreased again by about one-fifth.[32]

Negative developments in mountainous regions

The losses continue, especially in mountainous regions. Studies by the Swiss Ornithological Institute in Sempach show how Engadin has changed:[33] The area of intensively used meadows tripled in 38 of the areas surveyed between 1988 and 2010; fertile meadows decreased by 15 percent. These changes have impacted species-rich dry meadows, whose area has shrunk by 55 percent. Hard-to-access and low-yield meadows have been abandoned and the forest has spread over them, whereas meadows in (newly) developed regions have been intensively used, which means: artificially irrigated, more heavily fertilised, and cut earlier and more frequently. This is a fatal development for ground breeding birds: The number of whinchats (Fig. 30) has nearly halved in the survey area in the last 20 years; the species had to be given a higher classification on the revised Red List (2010). The loss of dry meadows and pastures also distresses many specialised plants. Around 30 % of all dry meadow species are vulnerable according to the new Red List of vascular plants.

Fig. 28 *Intensive soil use adversely affects biodiversity.*

Fig. 29 *Extensively farmed agricultural land benefits biodiversity.*

Vegetation is becoming increasingly similar

The BDM records show a continuing negative trend in the number of species of the grassland mosses group and stagnation in the vascular plants group. As regards plants, the increasing spread of forest species and nutrient-loving plant species has been observed, especially at middle altitudes. The species composition is increasingly poorer there (Fig. 31). The high nitrogen inputs from the air also contribute to the increasingly uniform vegetation and to the large-scale over-fertilisation of near-natural ecosystems. Around two-thirds of these inputs come from ammonia emissions (mainly from agriculture), while around one-third come from nitrogen oxide emissions (transport, industry, households). Some of the nitrogen introduced into the soil that is not absorbed by plants is leached as nitrate into the groundwater or released as nitrous oxide. The excess nitrogen, i.e. the quantity of nitrogen introduced into agricultural soil minus the quantity of nitrogen that is removed from the soil by agricultural products, has totalled around 100,000 tonnes per year since the mid-1990s.[34]

Environmental goals for agriculture

In 2008, the FOEN and the FOAG formulated environmental goals for agriculture.[35] These were derived from existing laws, ordinances, international agreements and Federal Council decisions. Accordingly, agriculture should "make a considerable contribution to the conservation and promotion of biodiversity". To achieve this goal, qualitative and quantitative targets were set in 2013 for the various agricultural zones and five main regions, which were chosen based on the potential spread of the target and index species.[36] In addition to biodiversity priority areas with environmental quality goals, specific promotional measures are required in all regions for target species and national priority index species.

Fig. 30 *The whinchat* (Saxicola rubetra) *establishes its breeding grounds on the ground of an extensively used meadow or pasture. The loss of such areas is causing a large decrease in the numbers of whinchats in Switzerland.*

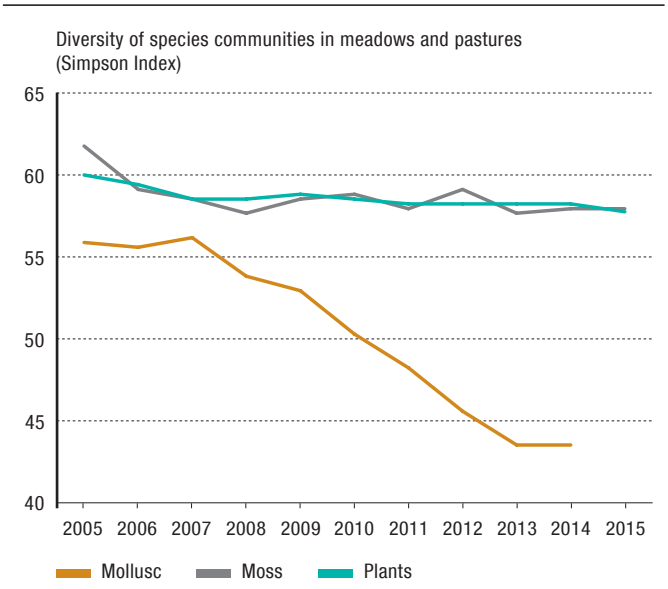

Fig. 31 *Diversity of species communities in meadows and pastures. Index of 0 (homogeneous) to 100 (diverse). Source: BDM*

Pesticides harm biodiversity

The intensive use of plant protection products harms biodiversity on cropland.[37] Regular herbicide use impoverishes the seed bank in the soil, resulting in species-poor, grass-dominated weed communities. The flora associated with cropland is now among the most threatened plant groups in Switzerland: 42 % of its species are considered threatened.[38] Plant protection products also reduce populations of soil organisms, invertebrates, birds and amphibians either directly (through their toxic effect) or indirectly (by reducing the food source). The widespread application of systemic insecticides (especially neonicotinoid) causes these poisons to be ingested by many flower-visiting insects in agricultural landscapes through the nectar and pollen of crop plants and enter the food chain. Pesticides can also enter streams, rivers and lakes, where they harm aquatic organisms. Eawag researchers have detected over 104 different plant protection products and biocides in five Swiss watercourses; the limits set out in the Waters Protection Ordinance were exceeded for 31 substances.[39]

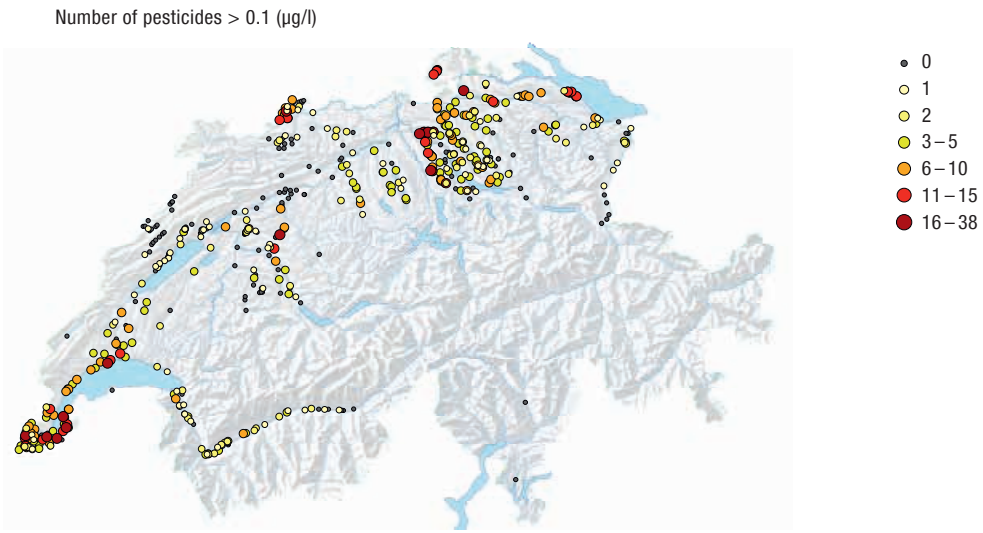

Fig. 32 *Number of different pesticides per site that were observed to have exceeded 0.1 µg/l at least once. Source: Munz & Wittmer 2012*

2.2 Forest

Switzerland's forest is of comparatively good ecological quality thanks to near-natural management. However, deficits exist in the open pioneer stages and the deadwood and old growth-rich later development stages of the forest. Alluvial forest, fen woodlands and coppices with standards have also become rare.

Forest currently covers 1.31 million hectares or around one-third of Switzerland's national territory.[40] The growing demand for wood and the wood that had to be used due to storm "Lothar" led to a more intensive use of the wood in Switzerland's forests in the 1990s. While this trend has eased slightly in the last 10 years, wood use remains high: Up to 90 percent of the annual net wood increment of 7.4 m³/ha has been used.[41] The total length of the forest roads travelled by trucks has also increased significantly: Since the second National Forest Inventory (1993–1995), 969 km of roads have been newly built or extended.

The Forest Act of 1991 requires owners and foresters to use near-natural forest management. Switzerland's forest is of comparatively good ecological quality thanks to near-natural silviculture and forest protection.[42] Natural regeneration is increasingly the rule, which enables growth in the number of tree species suited to their location and promotes high genetic diversity. The percentages of natural regeneration range from around 60 percent in the Central Plateau to 100 percent in the Central Alps and Southern Alps (Fig. 35).[43] Most of the trees are still planted only in managed forests, but some are also planted to promote rarer tree species.

Lack of open, damp, old-growth and deadwood-rich forests

The middle succession stages dominate Switzerland's managed forests. More specifically, deficits exist in the open pioneer stages and the deadwood and old-growth-rich later development stages of forests. Untouched forests virtually no longer exist. Forests that have "not essentially" been changed by humans, which include many small, inaccessible patches of forest on steep precipices and ridges, cover only 2.7 % of the forest area.[44] Likewise, alluvial and fen woodlands, human-created wide-open types of forest, such as coppice with standards, pastured woodlands and groves, wet forest sites, such as small bodies of water in the forest, and highly-structured forest edges with ecologically valuable, adjacent habitats have all become scarce.[45]

Fig. 33 *The artificial spruce pure stand leaves little room for biodiversity.*

Fig. 34 *This old sycamore maple provides a habitat for many species.*

The Confederation's promotional programme

The Forest Policy 2020 sets the goal of forest biodiversity conservation and targeted improvement. Based on the Swiss Biodiversity Strategy and the Forest Policy 2020, the FOEN has formulated concrete goals and measures aimed at conserving forest biodiversity.[46] The Confederation supports the cantons through programme agreements to promote forest biodiversity. Measures are principally aimed at creating forest reserves and old-growth islands, retaining biotope trees, enhancing edges and forest habitats and conserving species. The lists of national priority species and habitats developed by the FOEN are the bases for determining the forest biodiversity promotion goals and measures. To conserve more challenging species such as the fungi that live on wood, large old-growth stocks are required. The conditions are favourable in natural forest reserves: They have nearly three times more deadwood on average than the average Swiss forest. For several national priority species such as the capercaillie [47] and the middle spotted woodpecker,[48] the Confederation is developing specific action plans. Regional contributions to the achievement of these national implementation goals vary because each region of Switzerland has different natural values and forest use requirements.

Specialised forest species are endangered

The species surveyed by the BDM show stable to positive development: In the last 10 years, the number of species of vascular plants and mosses in forests has hardly changed, while the number of species of snails has slightly increased (though mollusc species communities in forests have become more similar in the past 10 years (Fig. 36)). Forest bird species have also increased since 1990.[49] As for endangered species, the percentage of species listed as vulnerable by the Red Lists is particularly high in the following species groups: the ecological group of light and warmth-loving species (e.g. orchids and butterflies, reptiles), the old-growth and deadwood group, and especially species that are dependent on the advanced stages of deterioration (lichens, a great many wood-decay fungi, many beetle species, especially longhorn beetles, all amphibians), as well as the mycorrhizal fungus group.[50]

The deadwood percentage is rising

For the first time since the 1980s, the volume of deadwood is rising in Swiss forests, as a result of hurricane "Lothar" and other causes. In forests where beeches and firs dominate, the quantity of deadwood has doubled in the last 17 years, whereas there is now over three times more deadwood in spruce-fir forests.[51] However, there are large regional differences. The quantities in the Jura and Central Plateau regions are only about half those in the Alps and Pre-Alps. Most deadwood and old-growth species require 30–50 m³/ha, while specialists require over 100 m³/ha. Specialists also require relatively special old-growth/deadwood qualities. For example, the

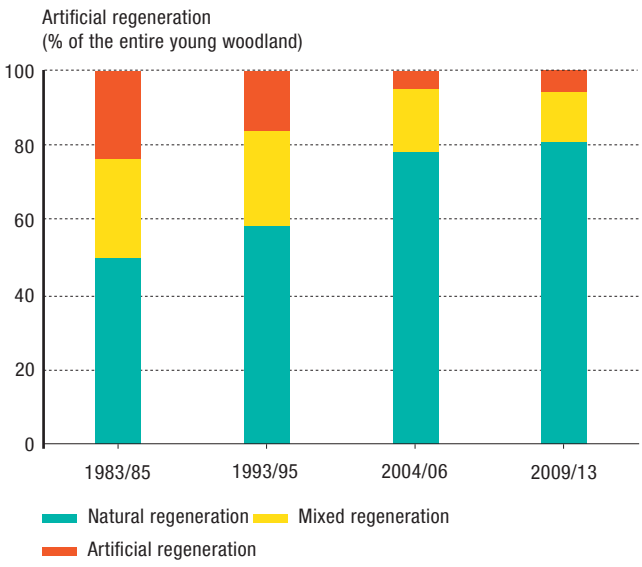

Fig. 35 *Area of artificially regenerated young woodland. Source: LFI1/2/3/4*

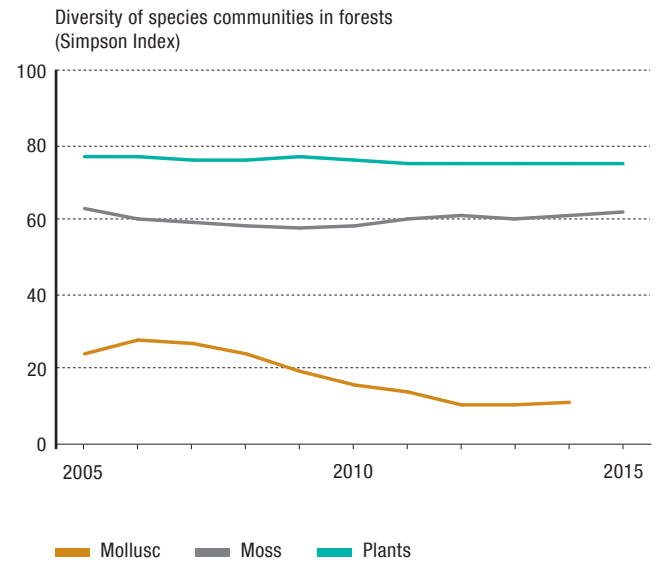

Fig. 36 *Diversity of species communities in forests. Index of 0 (homogeneous) to 100 (diverse). Source: BDM*

three-toed woodpecker's habitat requirements include at least 18 m³/ha of standing deadwood, i.e. snag (area of reference where this threshold value must be attained: 1 km²).[46]

The Confederation is striving for a threshold value of 20 cubic metres of deadwood per hectare for forests in the Jura, Central Plateau and the Southern Alps, and 25 cubic metres per hectare in the Central Alps.[52] According to the annual surveys from 2009 to 2013, these target values have been achieved only in the Northern Alps and in the western Central Alps. In the heavily used forests of the Central Plateau and Jura regions, there is currently not enough deadwood. But quality, not just quantity, is important too: The diversity of size categories or decomposition conditions determines the composition of the species communities. A network of large and small forest stocks with high quantities of deadwood and many habitat trees (trees that provide habitats to other species, such as woodpecker holes) is ideal for the biodiversity of the forest.

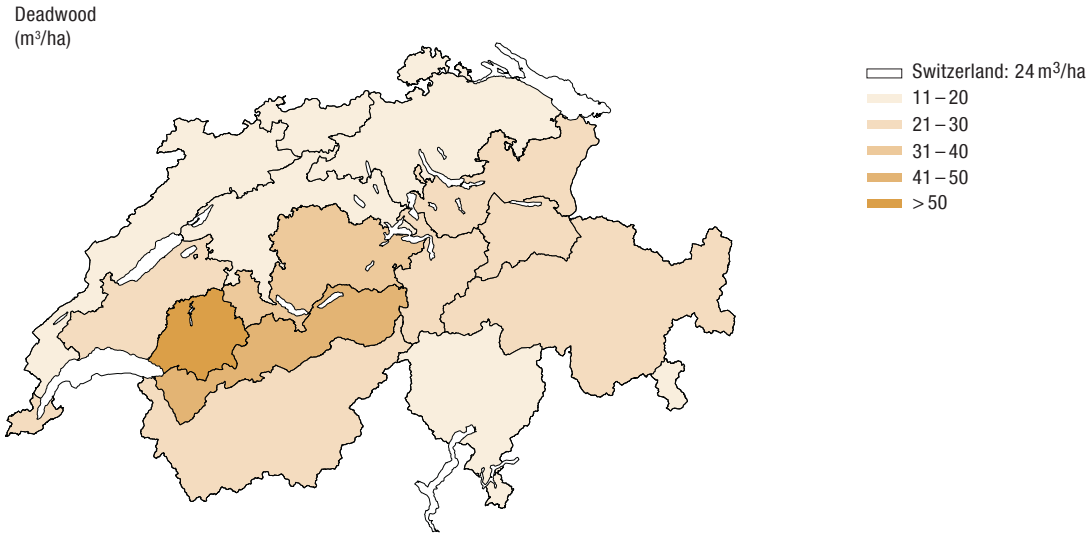

Fig. 37 *Proportion of deadwood in various economic regions of Switzerland. Source: NFI 4*

2.3 Waterbodies and wetlands

The increase in settlement and agricultural areas, damming and the use of watercourses to generate energy have had a huge influence on typical aquatic and wet habitats and the species that depend on them. Two-thirds of these habitats are currently considered threatened.

Sources, lakes, watercourses, alluvial zones, stagnant small bodies of water and wetlands, such as fens and raised bogs, are home to a large number of habitats and species. The expansion of this habitat has slowed considerably, especially in the densely settled areas of the Central Plateau. From 1900 to 2010, mires lost 82 % of their area and alluvial zones lost 36 % of theirs (see Fig. 18).[53] Many smaller stagnant bodies of water also disappeared from the landscape as a result of drainage and structural alterations. Rivers and streams were forced into corsets in order to create agricultural land and control flood runoff: Around one-fifth of Swiss sections of watercourses are today completely artificial, heavily damaged or culverted (see Fig. 23);[54] 14 percent of streams are culverted in the Central Plateau, which also has two times more underground sections of watercourses than the rest of Switzerland. The situation does not look better for the larger lakes: For instance, more than three-fourths of the shore of Lake Constance in Switzerland is damaged or entirely artificial.[55] Nearly all large lakes in Switzerland are regulated and no longer have natural water level fluctuations.

The "Diversity of Aquatic Insects" indicator of the BDM documents how watercourse control structures affect species diversity. It records the species diversity of three orders of insects: mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera). The greatest species diversity (16 species on average) was recorded in natural, near-natural and fairly undisturbed bodies of water (Fig. 40). Structurally rich shores and beds with no man-made structures on them are important habitats for aquatic insects. Fewer aquatic insect species occur in areas without these habitats. In general, the biological state of at least 30 % of the NAWA monitoring stations is inadequate.[56]

To avoid floods and overflows, lake water levels have been regulated more intensely in the last two decades, which is not only causing the natural seasonal water level fluctuations (spring floods / low water levels in winter) of waterbodies – in both waterbodies with control structures and those that are near-natural – to be even lower on average, but also valuable periodically wet sites, such as marshes and alluvial zones, to disappear. Yet, many watercourses are affected by water level fluctuations that are too heavy and artificially generated below power plants:[57] Hydropeaking can, for instance, wash away fish spawn or other animals, whereas receding water causes

Fig. 38 *Agricultural drainage can be clearly seen from a bird's eye view.*

Fig. 39 *Temporary bodies of water have become scarce in Switzerland.*

young fish to dry up. Power plants divert water from streams and rivers at over 1,400 sites. Eawag studies show that 375 residual flow sections have either very little residual flow or none at all.[58] In addition, around 101,000 artificial obstacles over 50 centimetres high separate Swiss watercourses into countless sections.[59] The average freely accessible shoreline of a stream or river totals only 650 metres. At many sites, fish cannot migrate freely.

Micropollutants harm water quality

The phosphate ban in laundry detergents and the construction of wastewater treatment plants starting in the 1960s led to a significant reduction in phosphate concentrations and other nutrient matter in most Swiss lakes and watercourses.[60] However, the water quality is adversely affected by micropollutants (e.g. biocides, plant protection products, fuel additives, medication) particularly in the Central Plateau region, where water is heavily used (Fig. 32). These substances are not adequately eliminated in the existing wastewater treatment plants and enter waterbodies either through them or through diffuse sources (agriculture, combined wastewater overflows, storm water channels, transport infrastructure, etc.). Several of these substances alone can cause harm to aquatic organisms in low concentrations.[61] Plant protection product inputs are especially problematic in small and medium-sized streams in areas used for intensive agriculture,[62] as the pollution loads spike after rainfall in the periods when these products are applied. Stud-

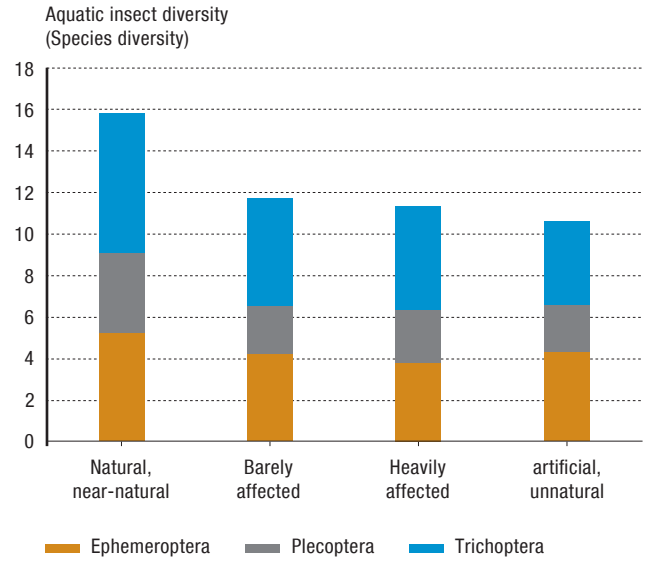

Fig. 40 *Number of species of aquatic insects at colline altitude by watercourse structure. Source: BDM*

Waters Protection Act

The Waters Protection Act revised in 2011 stipulates that watercourses should once again be given more space and structures. By 2018, the cantons must determine the prescribed space that will be designated for water along bodies of water; this space may be extensively managed at most. The partially implemented measures also improve flood protection in many cases. In the next 80 years, one-fourth of river and stream courses should also be revitalised. In addition, the negative impacts of hydropower use should be reduced. By 2030, the bedload budgets must be reactivated, where necessary, hydropeaking must be deactivated and fish mobility must be restored. Also, around half of the (pre-1992-licensed) water withdrawals must be remediated so that enough water flows again through river and stream beds below the withdrawal points. The Confederation has also taken measures to improve water quality. The action plan to minimise risk and ensure the sustainable application of plant protection products should reduce the input of plant protection products in bodies of water, among other things. In addition, micropollutants should be eliminated in wastewater. The Waters Protection Ordinance stipulates that around 100 wastewater treatment systems will be equipped with a fourth treatment level to eliminate micropollutants in the next 20 years. In addition to general habitat promotion, the FOEN has developed action plans that specifically promote national priority species in the area of waterbodies.

ies suggest that pesticide pollution is a key factor in the lacking biodiversity observed in bodies of water.[63]

Bodies of water are becoming warmer

A clear trend toward warmer temperatures can be seen when looking at the long-term changes in water temperatures in Swiss bodies of water.[64] In the section of the Rhine River at Basel, the temperature has risen by more than 2°C since the 1960s (Fig. 42). Similar temperature increases can also be observed in other bodies of water in the Central Plateau. Heated water discharged by cooling systems (e.g. for nuclear energy plants or industry) or wastewater treatment plants, for example, and climate change are contributing to these changes. Temperature changes are essentially affecting the development and composition of aquatic organisms. For example, higher summer temperatures give an advantage to carp-type fish and disadvantage salmon-type fish, whose metabolism is adapted to low temperatures.[65] Due to climate change, the temperature of surface waters can be expected to rise further. This will put more pressure on sensitive aquatic organisms in specific sections of watercourses and increasingly exacerbate the conditions they require for survival. These changes could lead to a higher risk of temperature-sensitive diseases for aquatic organisms, such as proliferative kidney disease, which is deadly for brook trout when the water temperature reaches 15 degrees or higher.[66]

High percentage of threatened species

The heavy damage to bodies of water and wetlands is reflected in the Red Lists. Over one-fifth of the critically endangered or already extinct species in Switzerland are linked to bodies of water, while another fifth are linked to shores and wetlands.[67] 60 % of aquatic plants are assessed as under threat – this is by far the highest value of all ecological plant groups.[68] In addition, only about one-fourth of fish and cyclostomes are considered "least concern", nine species are extinct, and five are "critically endangered".

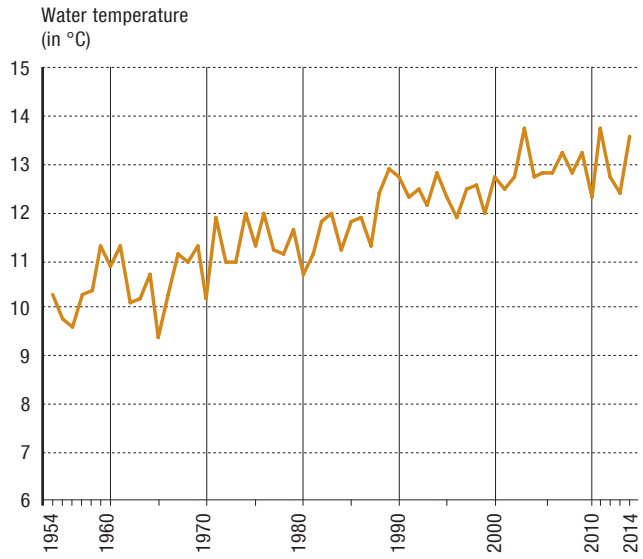

Fig. 41 *The mean annual temperature of the Rhine at Basel. Source: FOEN*

Fig. 42 *The marble trout is in one of the largest groups of critically endangered aquatic organisms.*

2.4 Alpine and sub-Alpine regions

The Alps are home to diverse habitats and a wide variety of species. Tourism and sports activities, sports infrastructures, hydropower use, abandoned use of remote meadows and pastures as well as more intensive use of favoured locations in the Alpine region are putting increasing pressure on Alpine habitats.

Due to their extreme topography and the close interconnection of natural and agricultural landscapes, the Alps have extremely rich species diversity: For instance, 600 species of flowering plants occur exclusively in the Alps or have their primary range there – which is one-fifth of all native plant species.[69] The diversity of butterfly species is just as rich since they depend on the supply of flowers and the presence of suitable host plants. The Alps boast significantly higher species diversity than the species diversity at lower elevations, not only in its meadows and pastures, but also in its forests. The Alpine region also has the largest share of mires, alluvial zones, dry meadows and pastures of national importance, in addition to the typical species in these habitats. As shown in an analysis of the BDM data, a huge number of the species for which Switzerland bears great responsibility are found in the Alps. The higher elevations are tremendously important for the species concerned, especially for plants and birds.

More artificial snow and levelling

The construction of artificial snow production facilities has increased significantly. In 2015, 48 percent of Swiss slopes were supplied with artificial snow (see Fig. 4). The area covered by artificially produced snow is nine times greater than it was in 1990.[70] The use of artificial snow influences the specialised flora in the Alps.[71] It leads to the input of nutrient matter and additional water and causes a decrease in undemanding and less competitive plant species. The use of artificial snow is particularly problematic in nutrient-poor mires and dry grasslands.[72] The water pipes and power lines that have to be laid and the reservoirs that have to be built cause structural interference in sensitive habitats. In addition, slope levelling is often also involved in the construction of artificial snow production facilities since levelled slopes are easier to cover with artificial snow. The structural measures cause damage to vegetation and soil.

Only 50 percent of the area of the Central Alps is "structure-free"

Settlement and infrastructure buildings as well as intensive recreational use can have a negative impact on local biodiversity. In the western and eastern Central Alps and in the Southern Alps, "structure-free areas" still make up about 50

Fig. 43 *Intensive use of the Alps in the winter and summer puts more pressure on biodiversity.*

Fig. 44 *Alpine meadows are home to countless species.*

percent of the entire area (areas that are 0.5 by 0.5 km in size and do not have any artificial structures on them are considered "structure-free") – these spaces benefit particularly animals that are sensitive to disruption (Fig. 45). Tourism structures promote outdoor activities, which contributes to more disruptions.

More intensive agricultural use

For a long time, there was less pressure on habitats and biological diversity in the Alps than on the habitats of the densely populated and intensively used plains. However, recent land-use change in the Alpine region has also disadvantaged biodiversity.[73] Due to structural improvements, many small structures (shrubs, lines of trees, stone walls, fieldstone piles, etc.) have disappeared. The construction of new roads and the extension of field paths result in a more intensive use of previously extensively used meadows and pastures outside villages and in summering pasture areas.[74] In addition to the more intensive agricultural use, the nitrogen input from the atmosphere also contributes to negative biodiversity changes in the grassland of the Alps.[75] The range of species is being displaced in favour of nitrophilous species and to the detriment of small, low-growth species (Fig. 46).

The forest is encroaching on summering pastures

At the same time, many farmers are abandoning the use of steep, harder to access areas. As a result, the forest is spreading over the meadows and pastures. The surveys of the Swiss National Forest Inventory (NFI 4) show that the forest increased by around 320 km^2 from 2006 to 2011. The numbers show that approximately 40 % of this area was previously used as summering pastures, particularly in the Central and Southern Alps (Fig. 48). Therefore, an area of summering pastures the size of Lake Walensee (around 2,400 ha) becomes forest every year. Reforesting can have a negative impact on species diversity if species-rich communities in the summering pastures are displaced by species-poor forest communities.

Climate change shifts the distribution ranges of species

It is already clear that many warmth-loving species are expanding their distribution ranges into higher altitudes:[76] In just eight years, plant communities have moved an average of 8 metres higher, while birds and butterflies have moved 40 m higher (see also Fig. 26). Some lower-altitude plants have even made their way to peaks.[77] As a result, the number of species may temporarily increase at higher altitudes. Over the long term, however, species that were previously located there will likely be displaced and become extinct in the region. After all, the displacement of vegetation causes Alpine and nival altitudes to shrink. Species for which Switzerland bears particular responsibility, due to their central position in the Alpine range, may be endangered as a result.[78]

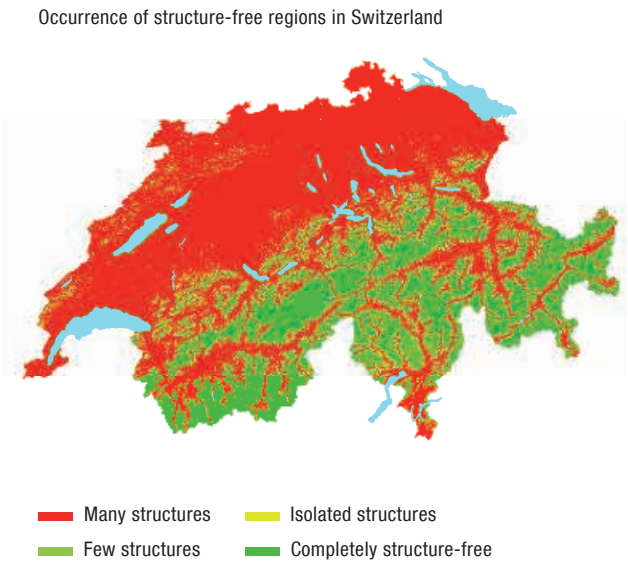

Fig. 45 *Distribution of artificial structures in Switzerland (2014). Source: LABES*

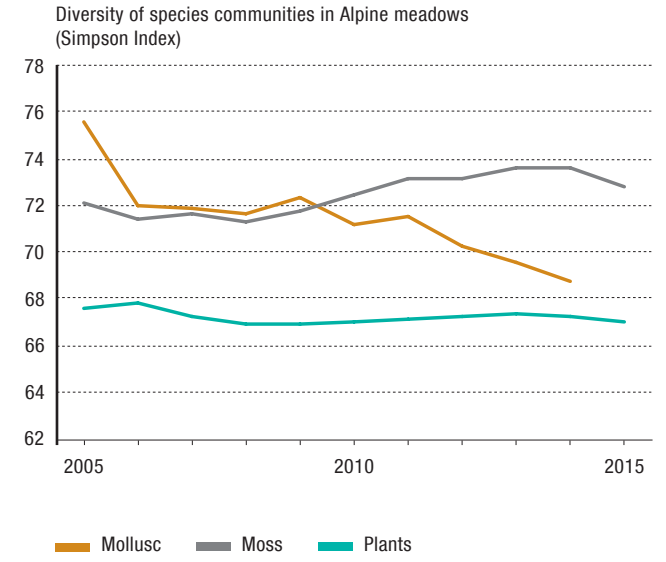

Fig. 46 *Diversity of species communities in Alpine meadows. Index of 0 (homogeneous) to 100 (diverse). Source: BDM*

Climate change can also influence the biodiversity of the Alps indirectly through land-use changes or more intensive use. This occurs especially when winter tourism infrastructure facilities move into ever higher, previously untouched areas due to the lack of a secure snow supply, or when agriculture is developed at higher altitudes or the areas there are used more intensively. The development of renewable energies can also be problematic. Many alpine aquatic habitats are already adversely affected by reservoirs, retaining dams, water withdrawal and hydropeaking.

Swiss Landscape Concept

In the Swiss Landscape Concept (1997), the Federal Council set goals, among other things, in the area of sports, recreation and tourism that also concern Alpine landscapes and habitats. In addition, it included the "conservation of habitat quality through the prevention of irreversible damage and the promotion of biodiversity-friendly use by sports and tourism within the entire national territory". The implementation progress report published in 2012 gave a positive review.[79] For instance, the planning of ski tourism developments was regulated in the Funicular Act and the Funicular Ordinance. In the area of outdoor sports, sensitization and information (e.g. "Respect to Protect" campaign) raise awareness of environmentally-friendly behaviour. The FOEN also supports the cantons in planning wildlife sanctuaries. A total of 619 legally protected wildlife sanctuaries have been established in 14 cantons to date. Just like in the game reserves and other areas of these types (e.g. water and migratory bird reserves, biotopes of regional and local importance, private conservation areas), the needs of wild animals are given priority in these areas.

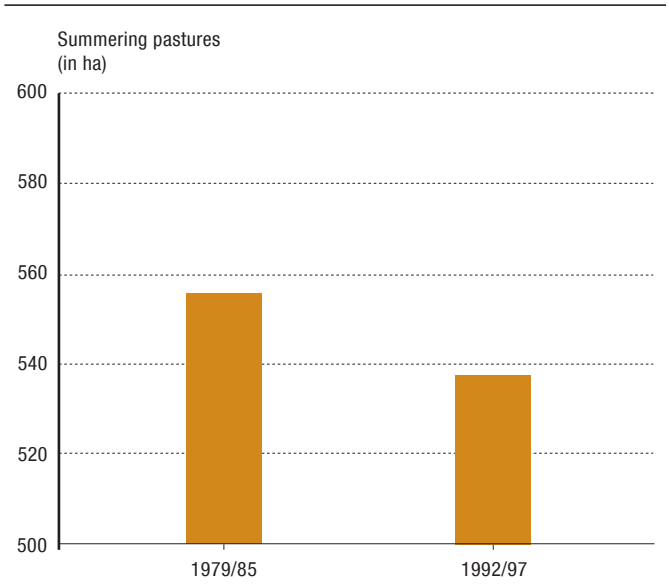

Fig. 47 *Summering pastures. Between 1979 and 1997, the total area of summering pastures in Switzerland shrank by 17,860 hectares. Source: LABES*

Fig. 48 *Lichens (*Caloplaca biatorina *pictured here) are even colonising regions with extreme climates like the peaks of the Alps.*

2.5 Settlements

Gradual soil sealing, habitat fragmentation, water and air pollution as well as the high levels of light emissions adversely affect biodiversity in settlement areas. Yet, urban conditions support a range of habitats that serve as refuges for species that have lost their natural habitat.

The growing population, desire for more living space, necessary densification and greater mobility increase the pressure on biodiversity in settlement areas. Meanwhile, 60 percent of the settlement area and 4.7 percent of the entire surface area of Switzerland is sealed.[80] Typical habitats for settlement areas such as fallow land, strips of pioneer vegetation, tree-lined avenues and old, near-natural garden spaces are noticeably disappearing. At over 80 percent, the percentage of structure-lined and culverted waterbodies in the settlement area is nearly four times higher than Switzerland's national average.[81] In the meantime, 26 percent of all habitat types in the settlement area are considered threatened.[82]

Species diversity is decreasing

According to the BDM, settlements have the highest percentage of surveyed area where absolutely no vascular plants, moss and molluscs have been found. These areas are mostly sealed or "dead" green spaces such as sports fields or football pitches. Increasing soil sealing may also be the main reason that the BDM observed a decline in the numbers of vascular plant species between 2004 and 2015. Surveys in the Canton of Aargau (Kessler Index) also show a significantly lower species diversity value for settlement areas than the average species diversity in all habitats. Since 1996, the species diversity in Aargau settlements has continuously decreased.[83]

However, the species diversity on unsealed soil in settlement areas is surprisingly high. According to the BDM, the average number of species of vascular plants, moss and molluscs in settlements is significantly higher than in agricultural areas (Fig. 51). The first inventory conducted within the territory of the city of Geneva in 2013 revealed some surprises:[84] In an area of 50 hectares (around 3 % of the commune's area), 771 species of plants, mosses and lichens were discovered. This equals 36 % of all known species in the Canton of Geneva, including many endangered species.

Fig. 49 *In these types of settlements, there is hardly any room for biodiversity.*

Fig. 50 *Green roofs provide important replacement habitats for plants and animals.*

Valuable replacement habitats

On occasion, settlement areas with small-scale structured sites, expansive transport infrastructures (railway lands, road shoulders), the dynamic of near-natural, unbuilt, built and unused areas as well as diverse climate conditions provide a refuge for species that have lost their natural habitat. For instance, the great capricorn beetle, whose original home was in old oak forests, is now found in parks with old oaks or beeches, which serve as valuable replacement habitats; low-growing, less competitive plants, such as pearlwort, can thrive in pavement cracks; certain bird and bat species (Fig. 52) find sanctuary in facades and roof structures, while several "hemerophile" species such as the common house martin, the black redstart or the greater mouse-eared bat even depend on temporary stays in buildings. However, due to the energy-efficiency renovations to buildings and low-energy new constructions, many potential nesting places and entrances to buildings have disappeared in recent years.

Invasive alien species on the rise

The species diversity of a place is also determined by its accessibility: The more isolated and harder to access a green space is, the fewer number of species can migrate from adjacent green areas. Mobile, opportunistic species that have no specific demands on their habitat take particular advantage of urban conditions. This includes many invasive alien species. Ruderal areas with only sparse vegetation due to frequent disruptions or droughts are especially rich in invasive neophytes: Railway and industrial lands are now often home to the most species-rich plant groups.[85] Settlement areas are therefore a potential source for invasive species, which can spread further into surrounding areas.

Biocides and plant protection products pollute waterbodies in settlements

Intensive use in settlements also causes air, soil and water pollution. Every year, approximately 2,000 tonnes of plant protection products and biocides enter the soil and waterbodies in settlement areas (not including alcohol and chlorine-based disinfection products) – this equals roughly the quantity of plant protection products used annually in agriculture in Switzerland.[86] Many private individuals still use herbicides on paths, open spaces, roofs, terraces and storage places, although this has been banned since 2001. These herbicide and biocide substances can be eco-toxic to algae, aquatic plants and animals if they exceed a specific threshold concentration.[87] Depending on the products used, high concentrations can occur, especially in the wastewater that results from cleaning the facades of newly built houses, so that the permitted reference value under the Waters Protection Ordinance is no longer met.

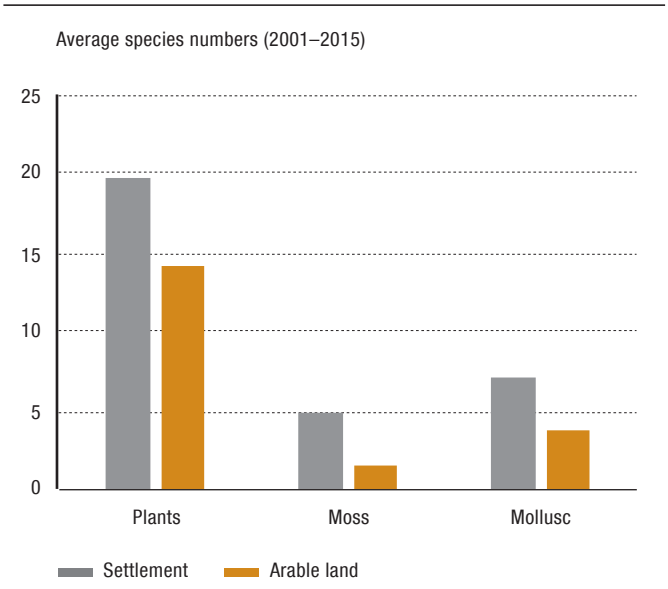

Fig. 51 *The average number of species of vascular plants, mosses and molluscs is significantly higher in settlements than in arable land. Source: BDM*

Fig. 52 *Although its home habitat is actually in open forests, the brown long-eared bat* (Plecotus auritus) *also colonises attics and cracks in building facades.*

Artificial light changes the behaviour of animals

The artificial light used in settlements also has negative impacts. Between 1994 and 2012, light emissions more than doubled in Switzerland.[88] The area with nocturnal darkness decreased from around 30 % (1994) to 20 % (2012; Fig. 53). Not a single square metre of the Central Plateau has had absolute darkness at night since 1996. Artificial lighting can alter the day-night rhythm of animals as well as their hunting and reproductive behaviour. Nocturnal animals wake later and hunt for prey later. As a result, competition between species and predator-prey relationships change, which may cause species composition to shift and become poorer.

Biodiversity promotion in settlement areas

With the support of the authorities, many green spaces in Swiss cities have been ecologically enhanced or redesigned in the last 20 years. For example, the percentage of ecologically valuable area in the city of Zurich is 15 %.[89] The city of Bern's biodiversity concept is the basis of its urban development approach, which also creates and conserves living spaces and effectively connected habitats for animals and plants. The city of Geneva uses a large number of instruments such as inventories, laws, action plans and concrete projects to protect and promote biological diversity. The GRÜNSTADT SCHWEIZ project developed a sustainable urban green space label. The awarding of this label is meant to enhance the image of a city and be a symbol of an innovative and long-term green space policy. GRÜNSTADT SCHWEIZ is supported by the Association of Swiss City Gardens and Parks Departments (VSSG).

Several Swiss cities have also developed concepts to curb the problem of high light emission levels: Zurich, Lucerne, Basel and Geneva are working toward environmentally-compatible night lighting in their municipal territories with a plan known as the "Plan Lumière". The FOEN has developed action plans that specifically promote national priority species in settlement and transport areas.

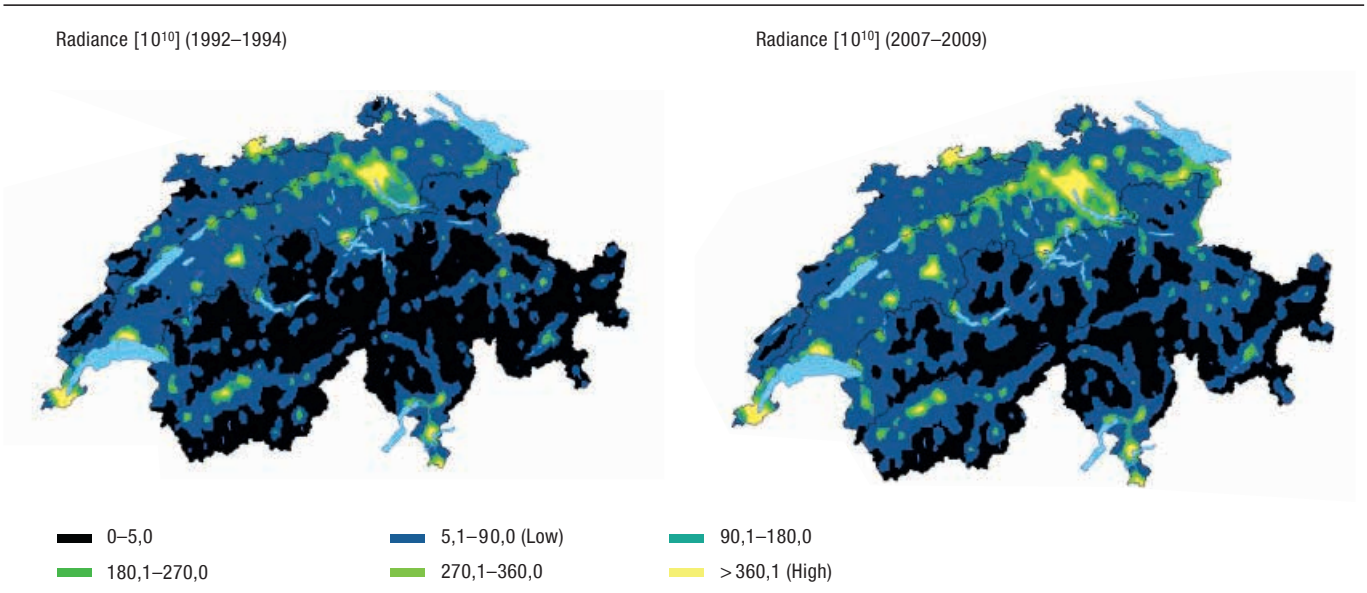

Fig. 53 *Light emissions from 1992 to 1994 (left) and 2007 to 2009 (right), calculated based on satellite images. Source: Defense Meteorological Satellite Program, taken with the Operational Linescan System, http://www.ngdc.noaa.gov/dmsp/*

3 > Species

Numerous species are critically endangered in Switzerland. For instance, four-fifths of its reptile species are found on Red Lists. Species diversity is largely stable on a national level. However, this positive review at first glance needs to be qualified by the fact that species communities are becoming increasingly more similar. Species without particular ecological demands are spreading to the detriment of habitat specialists. As a result, species communities that were once typical in our landscapes are disappearing.

In Switzerland, species that are currently common and do not have special habitat demands are spreading at an increasing rate, while the specialist populations are thinning out. 36 percent of the surveyed species are assessed as threatened, while 10 % are assessed as "near threatened" (Fig. 54).

The diversity of landscapes and habitats in Switzerland is reflected in high species diversity. To date, 46,000 plant, animal, fungus and lichen species have been identified in Switzerland. Experts estimate that around 20,000 other species occur here (microorganisms not included).[90] 49 species are not found in any other country,[91] including the copepod *Gelyella monardi,* whose distribution range is limited to the Areuse Gorge and the Combe-Garot source in the Neuchâtel Jura region. These species are considered Swiss endemics. 97 species have more than half of their distribution range in Switzerland. Switzerland bears international responsibility for endemics and partial endemics because their extinction in Switzerland would mean global extinction or an additional threat to the species. Endemics and partial endemics are found on the list of national priority species (see below).

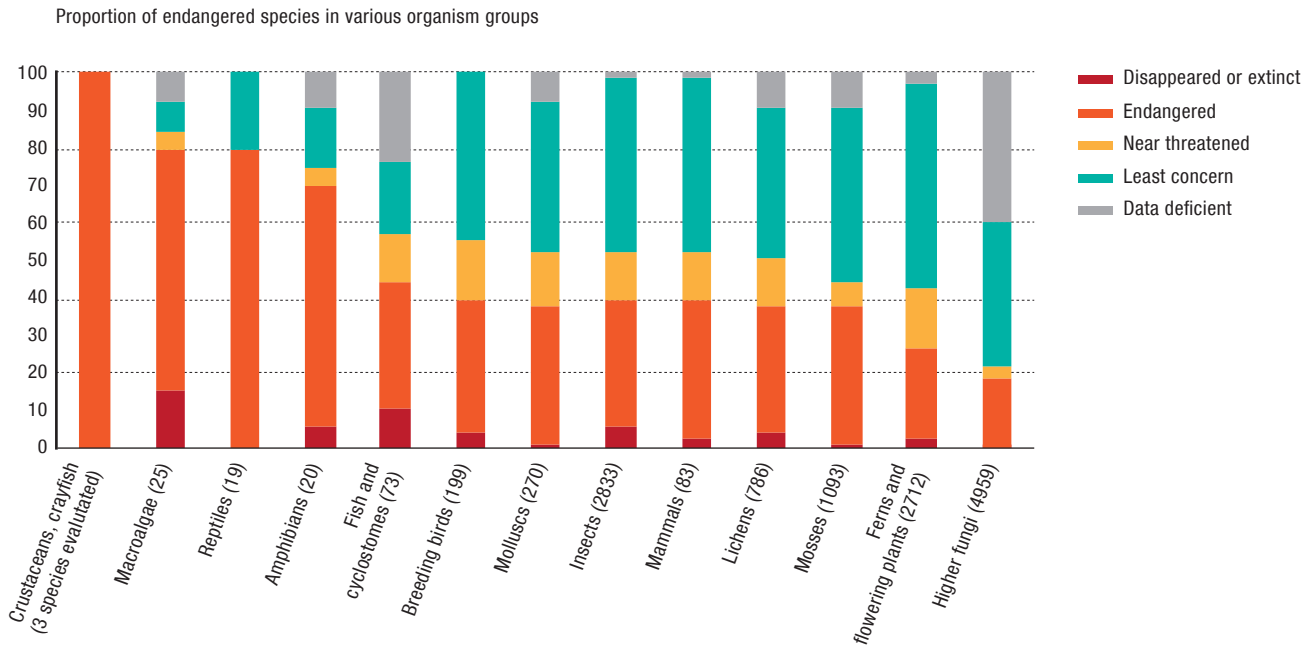

Fig. 54 *All species in the "extinct or disappeared in Switzerland", "critically endangered", "endangered" and "vulnerable" categories are considered "endangered". Source: FOEN*

Soil biodiversity

It is estimated that around half of the planet's 10 million plant, animal and insect species live in tropical forests. But the biodiversity in the soil is even more substantial: A few hundred thousand to millions of species, mainly microorganisms, occur in one handful of soil. Due to their small size and the shortage of methods for studying them, only a few groups of soil organisms have been basically studied. However, an increasing number of studies demonstrate the direct or indirect role of edaphic organisms in most ecosystem services, both at the local (food production) and global (carbon cycle in the soil that affects the climate) levels. The soil itself is the product of a tremendous abundance of bacteria, algae, microscopic small fungi and protozoa to which it provides a home. The FOEN and the cantonal departments responsible for soil protection have formed a work group in charge of preparing draft legislation aimed at conserving soil biodiversity.

3.1 Common and widespread species

The data for vascular plants during the observation period from 2005 to 2015 in several regions of Switzerland show a slight increase in the average number of species in the surveyed areas. An increase is statistically valid for the areas in the biogeographical regions of the Central Plateau, but also for Switzerland as a whole. The number of butterfly species per square kilometre has increased at least in the Central Plateau. Compared to all species, the species diversity of breeding birds has remained very steady within landscapes in past years. However, an increase at higher altitudes (Central Alps) can be observed.

At first glance, these results seem like positive developments. However, when an atypical species is found in a 1 km^2-sized survey area, it is merely an indication that at least one individual of that species has reached a previously unoccupied site. The population sizes and densities within a survey area are not considered. A detailed analysis, however, reveals that an all-clear signal cannot be given. Already widespread and common species without special demands on their habitat have increased in particular, in addition to alien species (neobiota).[92] This causes vegetation to become similar, or homogenised, over large geographical expanses of many Swiss habitats. The BDM's "Diversity of Species Communities" indicator actually shows that the species composition of vascular plants and molluscs in grasslands at middle altitudes are becoming increasingly similar. Biocenoses become more homogenous when their habitats are subject to increasingly similar or more intensive uses, or when the same species are introduced everywhere or transported with seeds. For instance, the strong presence of dandelions in many plant populations and habitats suggests widespread rising nutrient input. Because rare species are disappearing (see below) and already common species continue to spread, typical regional

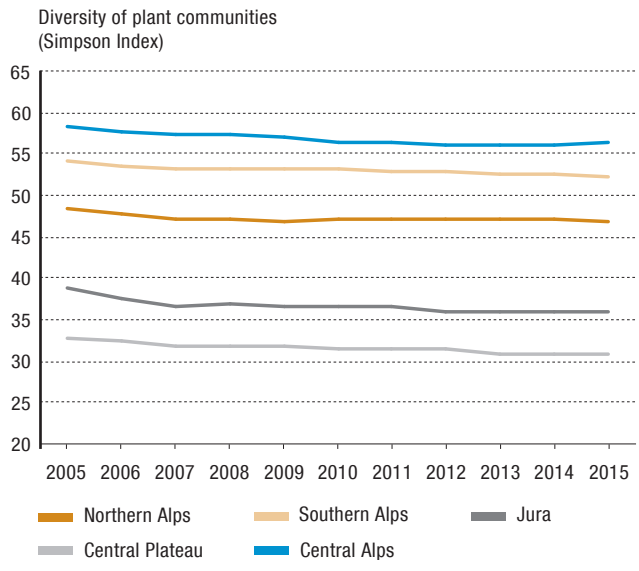

Fig. 55 *Diversity of plant communities in the regions. Index of 0 (homogeneous) to 100 (diverse). Source: BDM*

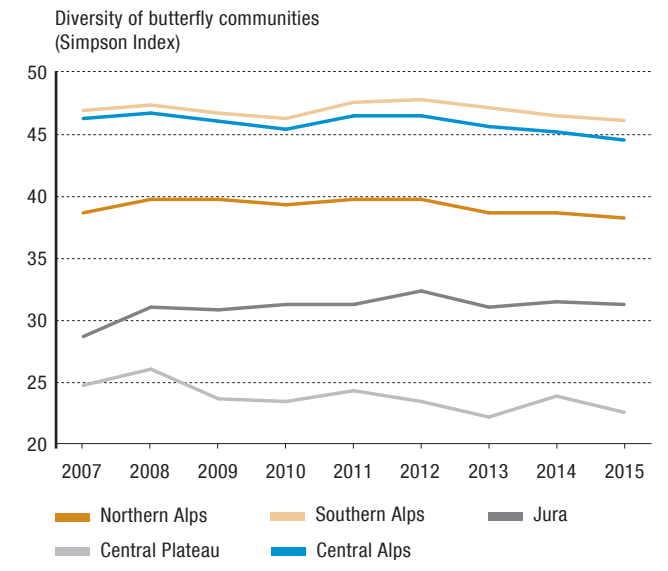

Fig. 56 *Diversity of butterfly communities in the regions. Index of 0 (homogeneous) to 100 (diverse). Source: BDM*

and original diversity, and thus biological diversity, are disappearing in various habitats.

Climate change has also influenced the results: Since 2001, plant species that require higher temperatures and dry conditions have been spreading at higher-than-average rates. Given the large biodiversity losses since 1900 and the currently low level of biodiversity in Switzerland,[93] slight positive developments are still not a synonym for ecological quality in habitats; the loss of habitat specialists are not compensated by these changes.

3.2 Threatened species

The degree to which native species are threatened is indicated in Red Lists. The smaller and more fragmented the area colonised by a species or the smaller its population and the more heavily its population declines, the more threatened it is.

The FOEN has released Red Lists for 27 organism groups in Switzerland. To date, one-fourth of the 46,000 known species have been assessed for the Red Lists. 36 % of these species are threatened – this percentage is significantly higher than the average in OECD countries. 3 % (255) of the surveyed species are "extinct in Switzerland". 10 % of the species are considered "near threatened" (NT) and require special attention because there is a risk that they could be moved to a higher category of threat in the future. The percentage of endangered species varies by organism group.[94]

Each Red List, which is issued according to IUCN (International Union for Conservation of Nature) criteria, documents changes in populations and areas. Thus, it indicates not only the current state, but also shows (negative and positive) changes in biodiversity. It is interesting to compare previous and updated versions of Red Lists for the same organism group. There are two Red Lists each for breeding birds and vascular plants that can be compared, and one is being prepared for dragonflies.

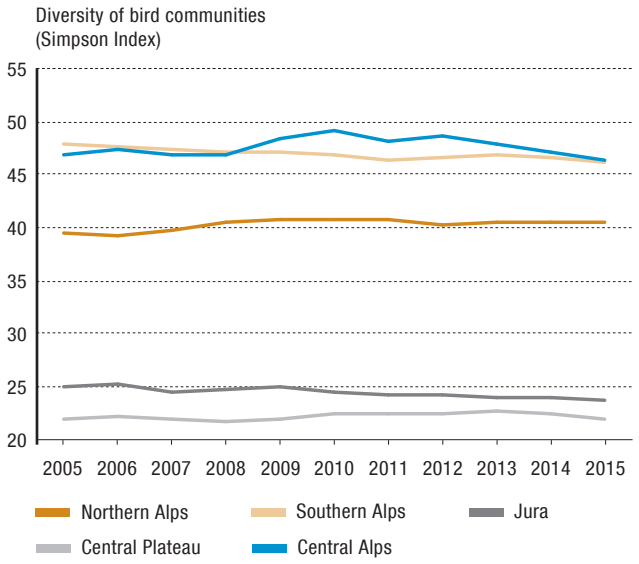

Fig. 57 *Diversity of bird communities in the regions. Index of 0 (homogeneous) to 100 (diverse). Source: BDM*

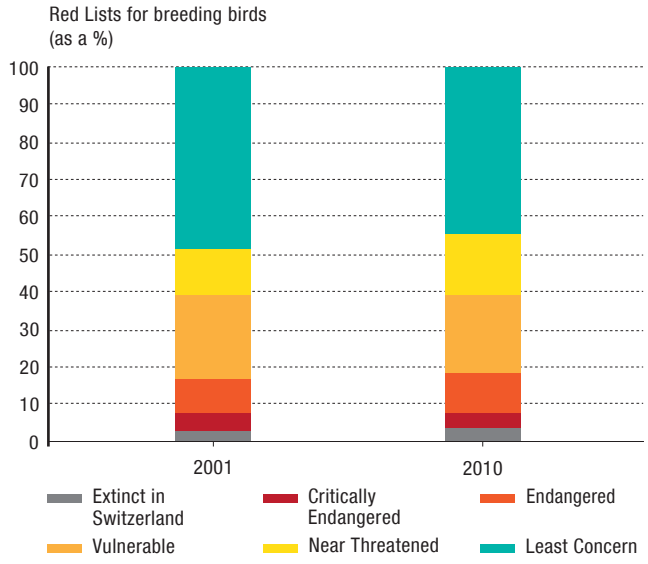

Fig. 58 *Comparison of the Red Lists for breeding birds in 2001 and 2010. Source: FOEN*

Threatened birds suffer continuous losses

When comparing the 2001 and 2010 Red Lists for breeding birds, it is clear that the threat status for breeding birds has generally not improved (Fig. 58).[95] The percentage of endangered species has stayed about the same, which means that many breeding birds are still subject to population losses and shrinking ranges. A differentiated analysis makes it clear that the situation has even worsened. The number of species that had to be classified in a higher category of threat is higher than the number of those species that were classified lower. Species that were classified in a higher category of threat owe their poorer status to strong population declines. Accordingly, the Swiss Bird Index for breeding bird species on the Red List has also shown a negative trend since 1990 (Fig. 59). However, in recent years, this sub-index seems to be stabilising slightly. The coming years will determine whether the trend can be effectively reversed for breeding birds.

The situation has worsened for vascular plants

The Red List for vascular plants was revised by Info Flora after 14 years and replaces the 2002 issue. The current data show that the situation for vascular plants has not improved (Fig. 60).[96]

Most of the species already endangered in 2002 and around 50 additional species were unable to stop their negative trend and thus remain endangered. In the 2016 Red List, around 44 % of the 2,700 native plant species are listed as vulnerable or near threatened. The number of disappeared and near threatened plant species has actually further increased.

Endangered species can be found in all habitats. Their percentage (of the typical species in each habitat) is however particularly high in bodies of water, shores and mires, dry meadows at lower altitudes as well as cropland and vineyards. The percentage is lowest in forests, Alpine habitats and fertile meadows, which is a clear indication that habitat loss, or poorer habitat quality, is primarily responsible for the decrease in vascular plant species.

More than one-third of mosses are listed as vulnerable

In Switzerland's 2004 Red List of mosses, a total of 1,093 species and subspecies were assessed. 416 of them were classified as vulnerable, which is 38.1 %. 15 of those are considered extinct in Switzerland, while 61 are critically endangered and 58 are endangered. Species in dry meadows and pastures and field mosses are the most endangered. Cropland is now more intensively farmed and most of it is ploughed and fertilised right after the harvest. The absence of stubble fields eliminates a natural habitat for specialised species.

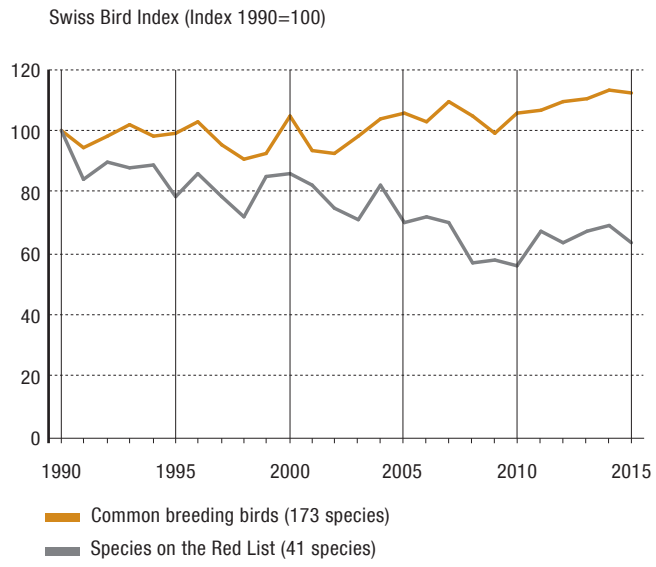

Fig. 59 *Changes in common and threatened breeding bird species in Switzerland. Source: Swiss Ornithological Institute*

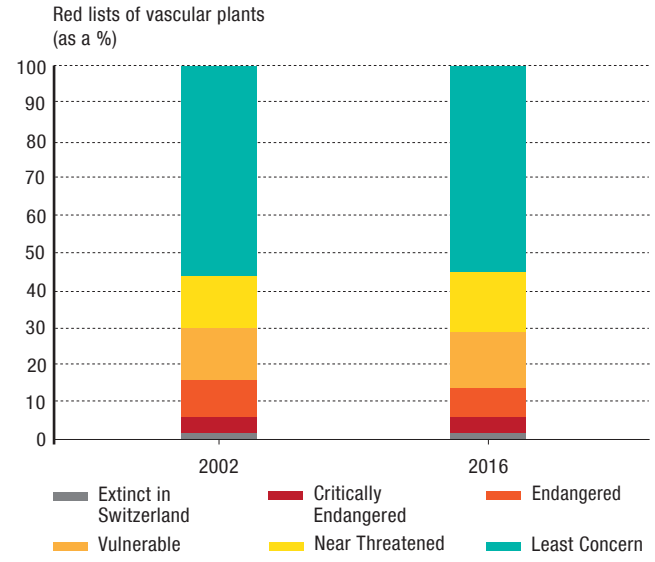

Fig. 60 *Comparison of the Red Lists for vascular plants in 2002 and 2016*

Lichens withstand drought, but not the loss of their habitats

Their considerable tolerance to their environment has enabled lichens to colonise regions with extreme climate conditions. However, even their extraordinary robustness does not protect lichens from extinction. 36 percent of the 786 species surveyed in Switzerland are found on the Red List published in 2002. The main causes of the decline of lichens are the destruction and alteration of their habitats and air pollution. In addition, species with low ecological demands spread to the detriment of specialised species.

Old-growth forests promote fungi diversity

In the species-rich fungus organism group, data on the spread and ecology of large fungi has been primarily collected, as knowledge of most small fungi species is already quite advanced. 2,956 species were classified for the Red List and 32 % of them had to be counted as vulnerable species. However, while vulnerable species of fungi can be found in all habitats, most of them occur in nutrient-poor meadows and pastures since such sites continue to disappear due to vegetation encroachment or the side effects of fertilisers caused by more intensive farming. Among the forest species, there are many vulnerable species of fungi that depend on a sufficient supply of deadwood, but nutrient inputs from the air also adversely affect the mycorrhizal fungi that forest trees need to thrive. Forest reserves help conserve the immense diversity of fungi in old-growth forests.

Amphibians under pressure

There is a particularly high number of threatened amphibian species: 14 (70 %) of the 20 species native to Switzerland are on the Red List; another species (5 %) is near threatened.[97] With the exception of the Italian agile frog, all species have suffered population losses in the ten-year period considered (see Chapter 4). The situation is particularly critical for species occurring in waterbodies that dry out intermittently (i.e. bodies of water that dry out every year or at least every couple of years). A decrease in the inventoried amphibian spawning sites of national importance can also be seen. On average, each site has lost one species of amphibian since being inventoried (1994–2007) – all biogeographical regions and cantons are affected to nearly the same degree (Fig. 62).

Reptiles lack habitats

In recent years, native reptile populations have declined in most of Switzerland. 79 percent of the 19 surveyed groups appear on the Red List.[98] Species connected to bodies of water are above all seriously threatened (*Natrix maura* and *N. tessellata*). The decrease in reptiles is often a consequence of poorer habitat quality and heavy habitat fragmentation. Because dynamic landscape processes (rockfalls, floods, etc.) are supressed in many places, there is also an absence of naturally created habitats that are suitable for reptiles.

Fig. 61 *Orange mosscap* (Rickenella fibula) *is found in forests at lower altitudes.*

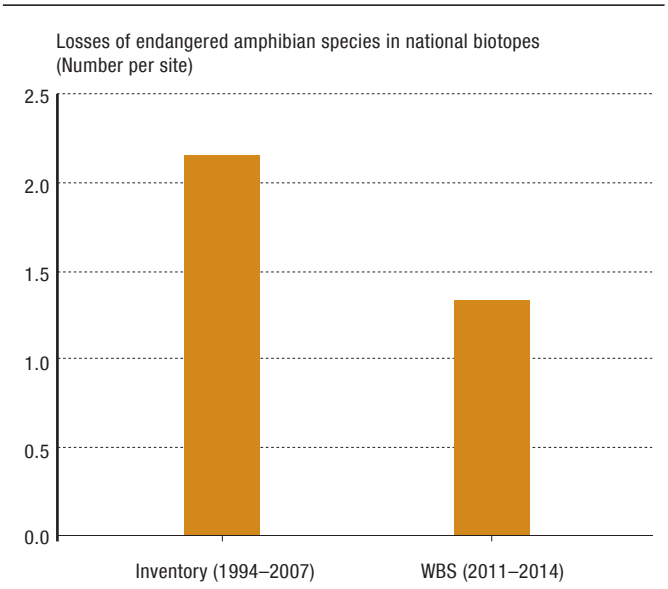

Fig. 62 *Number of endangered amphibian species in biotopes of national importance. On average, each site lost one species of amphibian. Source: WBS*

Fish require connected habitats

Over 58 percent of fish species in Switzerland are on the Red List.[99] The more specialised a species is, the greater the risk of its extinction. The greatest threats to fish are chemical cocktails in bodies of water (see Fig. 32) and the poor eco-morphological state of watercourses (see Fig. 23). Many artificial barriers and obstacles prevent fish from migrating (six of the seven large migratory species that were once native to Switzerland are now extinct). The obstacles also separate fish populations, which weakens their genetic diversity.

Invertebrates are very fragile

It is estimated that there are around 100 times more invertebrates (> 40,500) than vertebrates (396) in Switzerland.[100] Unfortunately, the level of knowledge varies greatly depending on the group. 40.7 percent of the invertebrate species that were surveyed for the Red Lists are assessed as threatened.[50] The decrease in invertebrates is mainly caused by the smaller quantity of habitats and their poorer quality (hedges, bushes, deadwood, natural watercourses), the disappearance of host plants, and pesticides. In addition, many invertebrates have an extremely limited capacity and ability to establish a new settlement. If a habitat is incorrectly maintained, this can have disastrous consequences for the established populations.

National priority species

The FOEN's species promotion concept [101] assumes that all species should be basically conserved in their natural home range. Specific promotional measures focus on species which are endangered in Switzerland, for which Switzerland bears particular responsibility at the international level, and which require urgent measures for their conservation. The basis for these measures is the list of national priority species.[102] It currently includes around 3,600 species and is used as a tool to promote species and habitats. There are four priority levels. Accordingly, around 10 % of these species are given very high priority (priority 1), 20 % high priority (priority 2), 30 % middle priority (priority 3) and 40 % moderate priority (priority 4). Similar to the Red Lists, the list of national priority species is periodically updated. The Swiss species promotion concept has six principles and twenty measures to demonstrate how national priority species should be conserved. The measures should be implemented by 2020.

4 > Genes

Genetic diversity is a key factor in the adaptability and long-term survival of species. To conserve it, sufficiently large populations and genetic exchanges between sub-populations are required. Populations kept in zoos, botanical gardens and other breeding institutions (ex situ) *are supplementary measures. While the significance of genetic diversity is known today, an overview of the state of this diversity and its changes is lacking in Switzerland because there is no appropriate monitoring programme for it.*

In addition to habitat and species diversity, genetic diversity is the third pillar of biodiversity. It can be simply described as the total number of "blueprints" for the design and functioning of organisms within a species or population. Different populations of the same species often exhibit variations of specific characteristics or genes. A spruce in the plains with a broad crown is, for instance, genetically non-identical to a spruce in the mountains with a thin crown, which protects it from being broken by the weight of the snow.

Genetic diversity determines adaptability

When different individuals of a species possess different alleles of a gene, it is called genetic variability. Alleles are created by random mutations and can be common or rare in a population. Genetic diversity determines the adaptability of a species, as populations can "create" from their allele reserves and react to changing environmental conditions. The more genetically diverse populations are, the greater their chances will be of successfully dealing with new climate conditions, soil conditions, parasites or diseases and of entire species surviving. Genetically homogeneous species and populations are also at greater risk due to inbreeding. This applies particularly to small and spatially isolated populations. As a result, many large, connected and stable or growing populations are extremely important if a species is to survive.[103]

Genetic diversity is also the basis for creating new species. Without genetic diversity, the evolutionary process would not be possible – natural selection is based on this diversity. For that reason, protecting genetic diversity not only gives species a better chance to survive the current pressures, but also makes it possible for new species of organisms to appear in the future.

Alien species and races

The genetic composition of a population can also be altered by the introduction or dissemination of non-native species and races. For instance, unwanted genetic combinations are caused by non-native seeds,[104] earth material that is transported over great distances with seeds and small invertebrates or fish populations from different water catchment areas. In this way, native and adapted taxa can become displaced or extinct. Regional adaptability is thus lost because the newly created hybrids usually deal less well with the local conditions (e.g. soil, climate, waterbodies, diseases).

Red Lists indicate huge genetic losses

Figures are scarce on the development and state of genetic diversity in wild plants and animals in Switzerland because there are no appropriate monitoring programmes. However, it must be assumed that the population loss and decline experienced by many species due to the destruction, damage and fragmentation of their habitats has caused a loss of genetic diversity. The large number of species on the Red Lists may be a clear sign that genetic diversity is steadily disappearing. Researchers are acting on the assumption that climate change is also a threat to the genetic diversity within species.[105]

In situ and *ex situ*

Genetic diversity can be conserved primarily by protecting habitats and the connections between the remaining habitat islands. In accordance with the Swiss Species Promotion Concept,[106] native flora and fauna should be conserved in their original habitats *(in situ)* in stable, wild populations. Furthermore, the remaining habitat islands should be effectively connected with each other. Species that occur in the wild guarantee a typical local gene pool, are exposed to natural evolutionary mechanisms and demonstrate real survival skill. Populations kept in zoos, botanical gardens and other breeding institutions *(ex situ)* are supplementary measures.

They can be useful when the wild populations are critically endangered at the national or regional level. For example, when it comes to wild plants, endangered wild plants have been increasingly conserved *ex situ* and planted in natural habitats in the last several years in Switzerland. The Global Strategy for Plant Conservation (GSPC), which Switzerland ratified under the Convention on Biodiversity, requires 75 % of endangered plant species to be conserved *ex situ*, and 20 % of them made available for planting in the wild.

Genetic diversity conservation

The Confederation is committed to protecting and promoting genetic diversity in crop plants by implementing the "National Action Plan for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture" (NAP-PGREL). As for animal genetic resources, a concept has been developed to conserve agricultural livestock. The Confederation supports and promotes various measures and projects to conserve and sustainably use genetic diversity in the forest, such as the implementation of near-natural silviculture with natural regeneration, the conservation of locally adapted populations and their potential adaptability in forests of particular genetic interest, or the use of locally adapted reproductive material (seeds, seedlings) for the artificial regeneration of populations. As for microorganisms, the Confederation contributes to the development of a national collection of microorganisms. The FOEN also supports the "Swiss Barcode of Life" (SwissBOL) network, whose goal is to record Switzerland's biodiversity through DNA barcodes. This knowledge is used for national monitoring of biological diversity and, by extension, the improvement of protection strategies.

A

B

Fig. 63 *Small pool frogs (*P. lessonae*; photo A) and Italian pool frogs (*P. Bergeri*; photo B).*

The genetic identification of water frogs has revealed some surprises

The identification of a species based on its moprhological features can be deceitful and even misleading. After all, species can belong to a group that is hardly different from a morphological perspective and/or can show great design variations within their populations. In these cases, genetic analyses are an additional aid. They were also recently used in two studies on the identification of water frogs of the pelophylax genus in Switzerland.[107, 108]

European water frogs form a complex of several closely-related species and hybrids. The Red List of threatened amphibians (2005) lists an invasive marsh frog *(P. ridibundus)* and common water frog *(P. esculentus)* in addition to the native pool frog (*Pelophylax lessonae*; Fig. 63). The latter is a hybrid of the two other species. The pool frog is widely distributed in Northern Europe, but south of the Alps, it is now limited to the Po Valley, Slovenia and Ticino, as well as a few locations in Valais and on Lake Geneva. The marsh frog, which was widely distributed in Eastern Europe in the 1960s, was imported into Western Europe for consumption and entered into the wild. Now the species has spread to the lower altitudes in Switzerland to the detriment of the critically endangered yellow-belied toads and midwife toads.[109] Due to its size, it is also a serious predator of the pool frog. In western Switzerland, the marsh frog has quickly established itself to the detriment of *P. lessonae*, and it is very possible that this process is occurring in north-eastern Switzerland.

Genetic analyses have now shown that there are still other invasive species of the *Pelophylax* genus in addition to the marsh frog *(P. ridibundus)* in Switzerland: the Balkan frog *(P. kurtmuelleri)*, the levant water frog *(P. bedriagae)* and the Italian pool frog *(P. bergeri)*. The strong morphological similarity between *P. ridibundus*, *P. kurtmuelleri* and *P. Bedriagae* as well as between *P. lessonae* and *P. bergeri* was the reason that these three species were not recognised previously. It is now topical that nearly all surveyed populations that were previously attributed to the small pool frog *(P. lessonae)* were composed of individuals of the *P. bergeri* species and/or hybrids of *P. bergeri* and *P. lessonae* (Fig. 64). Only the populations in Ticino and a very small population in the Jura may be counted as the *P. lessonae* species (Fig. 65). The endangered status of the small pool frog must also be reassessed and the protection concept adapted accordingly.

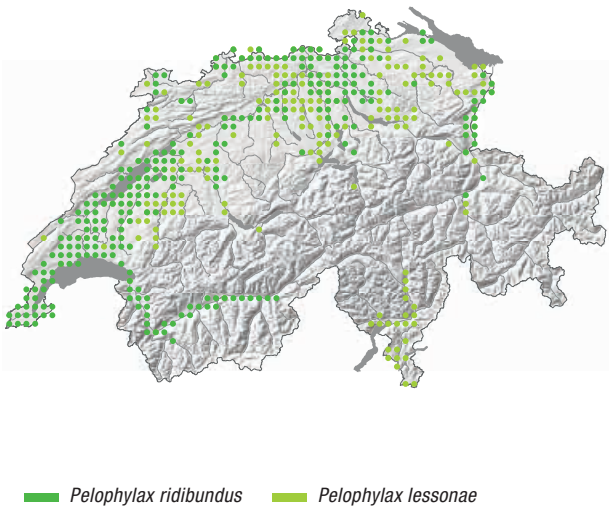

Fig. 64 *Distribution of the marsh frog* (P. ridibundus) *and the small pool frog* (P. lessonae) *based on morphological identification. Source: CSCF*

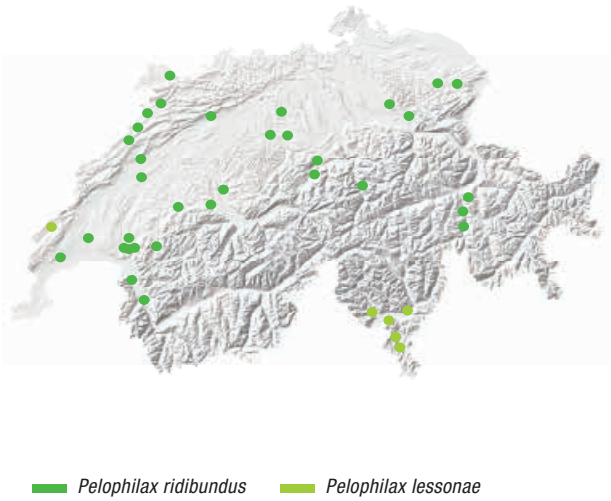

Fig. 65 *Distribution of the marsh frog* (P. ridibundus) *and the small pool frog* (P. lessonae) *based on genetic identification. Source: Dufresnes et al. 2017*

5 > Measures

Biodiversity in Switzerland depends on protected areas, priority areas and sustainable land use. The area designated for biodiversity has been increased in the last 25 years. But it is still not large enough to stop the population losses of endangered species and the decline of rare habitats.

In Switzerland, the protection of biodiversity is mainly ensured through habitat protection instruments. A limited number of particularly endangered species are also supported by the Confederation and cantons through species promotion programmes. In addition, measures to enhance bodies of water and promote sustainable land use are supported or implemented, especially in forest and agricultural areas.

The area under protection remains stable

The area designated as biodiversity conservation area – which includes the inventoried alluvial zones, raised bogs, fens, amphibian spawning sites, dry meadows and pastures, as well as water and migratory bird reserves, Swiss game reserves and the Swiss National Park – has (except for the water and migratory bird reserves, which were revised in 2001 and 2009) remained stable in the last five years (Fig. 67). It corresponds to 6.2 percent of the national territory - which is rather low in international comparison (Fig. 66). In addition, there are regional, local and private nature conservation areas, forest reserves and areas of international importance, such as the 37 Emerald sites under the Bern Convention and the 11 sites under the Ramsar Convention. There is often some overlapping between protected areas since different items may be protected in them and the information on cantonal conservation status is incomplete. Furthermore, only partial information exists on cantonal and local protected areas. When quality level 2 biodiversity priority areas in agricultural areas and buffer zones are added to these, around 12,5 % of the national territory is currently designated for the conservation of biodiversity.

Protected areas are important refuges for threatened species. In fact, national biotope inventory sites, which make up around 1.8 percent of the national territory, are home to about half of the species with the highest national priority (priority levels 1 and 2). However, the populations of threatened species are also decreasing in the protected areas.[110] The existing areas are often too small and not sufficiently connected, which causes a limited or total absence of individual exchanges between populations or the re-colonisation of abandoned areas. In many cases, inadequate ecological quality is also a problem.

The quality of national biotopes is in decline

Analyses of the programme for monitoring the effectiveness of habitat conservation in Switzerland (WBS) show that the state of around one-third of the surveyed amphibian spawning sites does not meet the statutory goals.[111] The water supply is assessed as “insufficient” for 61 % of the sites with pioneer species. Since the inventories were taken (1994–2007), one amphibian species per site has disappeared on average regardless of the region. The species concerned is primarily an endangered species, such as midwife toads, natterjack toads, or the northern crested newt. At the sites where the species still occur, a decrease in the population size was detected, which indicates that species are gradually disappearing. As the causes for this decrease, specialists point to the biotopes themselves (lack of temporary bodies of water, lacking dynamic, ingrowth of open spawning sites) and the quality of the landscape around the biotopes (heavy fragmentation, large-scale pesticide inputs). The ecological state of the majority of the 283 alluvial sites of national importance also does not meet the statutory requirements.[112] The dynamic and geomorphology of the rivers in the Central Plateau and the Southern Alps are particularly heavily damaged. But there are positive developments as well: 49 alluvial zones in the inventory are in “good condition”.

Drainage ditches and draining disrupts the hydrological balance in many of the protected mires. The vegetation in mires that have sustained slight hydrological changes is already being largely displaced. Plant species from dryer sites are spreading into the disturbed habitats and changing the typical mire vegetation. Excessive nitrogen inputs from the air and adjacent agricultural areas are speeding up these changes.[113] When monitoring the effectiveness of mire protection efforts, it was noted that over one-fourth of mires had become significantly dryer between the monitoring periods of 1997/2001 and 2002/2006, the nutrient supply had increased significantly in one-fourth of the mires, more woody plants were growing in nearly one-third of the mires, and the humus content of the soil had decreased in around one-fifth of the mires. The area occupied by raised bogs in the entire mire area has decreased by 10 % due to these quality losses in the same period. The preliminary findings of the programme for

The population rates the state of biodiversity (too) positively

Most of the Swiss population is familiar with the term “biodiversity”. This is shown by a survey conducted in 2013.[114] Two-thirds of the respondents had heard or read the term “biodiversity” at least once. The necessity of conserving biodiversity is unchallenged. The main reasons given by respondents for this were “duty to future generations”, “connection” to nature, its “beauty” and a "moral obligation". Surprisingly, the Swiss rate the state of native biodiversity too positively. 74 % of the respondents assume that the state of biodiversity is “fairly good” (65 %) or even “very good” (9 %). This rating is quite different from the actual state of biodiversity, as explained in comprehensive studies[115] and this report.

monitoring the effectiveness of habitat conservation in Switzerland indicate that this negative trend is continuing: Mires are becoming richer in nutrients, dryer and more compacted. Bush encroachment is on the rise in around two-thirds of fens, and this process is particularly noticeable at sites located at higher altitudes (over 1,000 m.a.s.l.): Bushes are encroaching those sites five times faster on average than sites at lower altitudes. Bush encroachment indicates non-use or non-adapted use.

Many dry meadows and pastures of national importance are still not being used in accordance with the legislation. Bush encroachment has increased at over 600 of the surveyed dry meadow and pasture sites (1,358) since the inventory period (1994–2004), and very heavily at some sites. But there are also many cases (approximately 350 sites) where bush encroachment has decreased. The biotopes of national importance tend to be rather small (Fig. 69), which is why uses or abandoned use in the direct vicinity affect them even more heavily when a sufficient buffer zone is lacking.

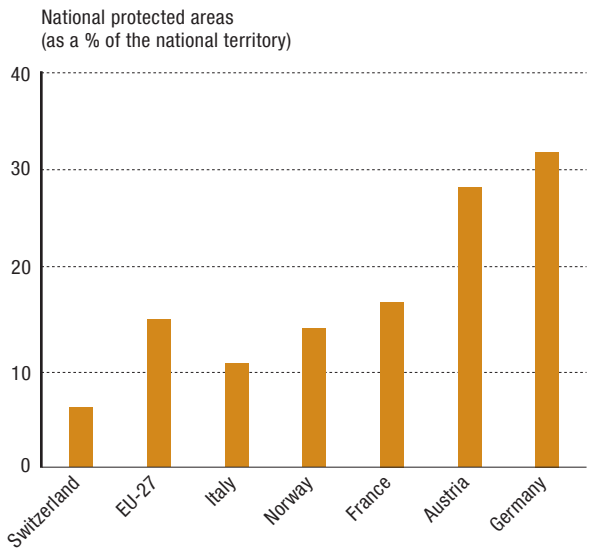

Fig. 66 *Percentage of national protected areas in the national territory. Source: CDDA 2013, Eurostat*

Biodiversity protection agreements

To conserve and sustainably use global species diversity and ecosystems, many global and regional agreements have been created, such as the Convention on Biological Diversity (CBD), the Cartagena Protocol on Biosafety and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization. In this decade, all efforts deployed under these agreements – which Switzerland has also signed – are aimed at implementing the international Strategic Plan for Biodiversity 2011–2020 and achieving the 2020 Biodiversity Targets. Switzerland wants to continue its involvement in the area of biodiversity so that the international Strategic Plan is implemented by all relevant actors. For instance, Switzerland is helping to develop the IPBES platform, which informs the public and policymakers about the state of and changes in biodiversity as well as the measures required to achieve the 2020 Biodiversity Targets. In addition, it is committed to improving the financial resources of the Global Environment Facility Fund (GEF) for biodiversity so that adequate financial assistance can be ensured.

Protection and maintenance deficits

To be able to fulfil their function, protected areas often need to be regenerated and enhanced.[116] Experts estimate that 79 % of raised bogs, 30 % of fens, 30 % of alluvial zones, 25 % of amphibian spawning sites and 20 % of dry meadows and pastures of national importance need to be remediated. It is also important for biotopes to be properly maintained. Under federal law, cantons must ensure that protection requirements for landowners and long-term maintenance of national biotopes are guaranteed. The implementation deadlines have since expired, with the exception of the inventory of dry meadows and pastures, which should be implemented by 2020. A FOEN survey of the cantons in 2014[117] shows that the legal protection and maintenance of only 58 % of the inventoried sites were guaranteed. Implementation efforts for mires are the most advanced: 94 % of raised bogs and 79 % of fens now have protected status and a maintenance plan (Fig. 9). However, the statutory buffer zones are insufficient in many places. According to the cantonal survey, 11 % of fens and 7 % of raised bogs still do not have sufficient nutrient buffer zones. In addition, there are no protection requirements for landowners or maintenance agreements for 16 percent of

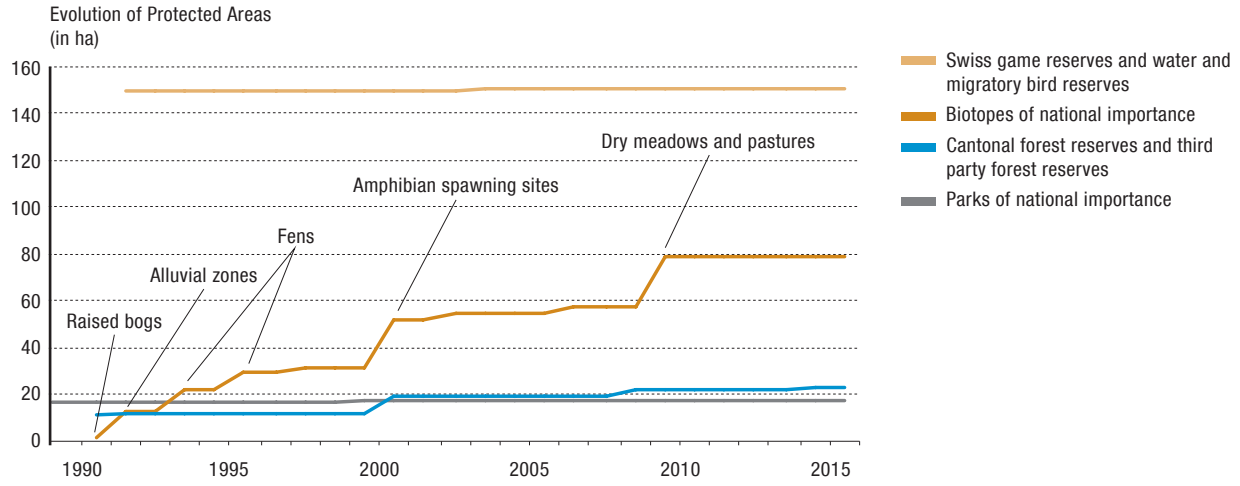

Fig. 67 *The area of nationaly protected sites over time: The years in which the five national biotope inventories began is indicated in the chart. Source: FOEN*

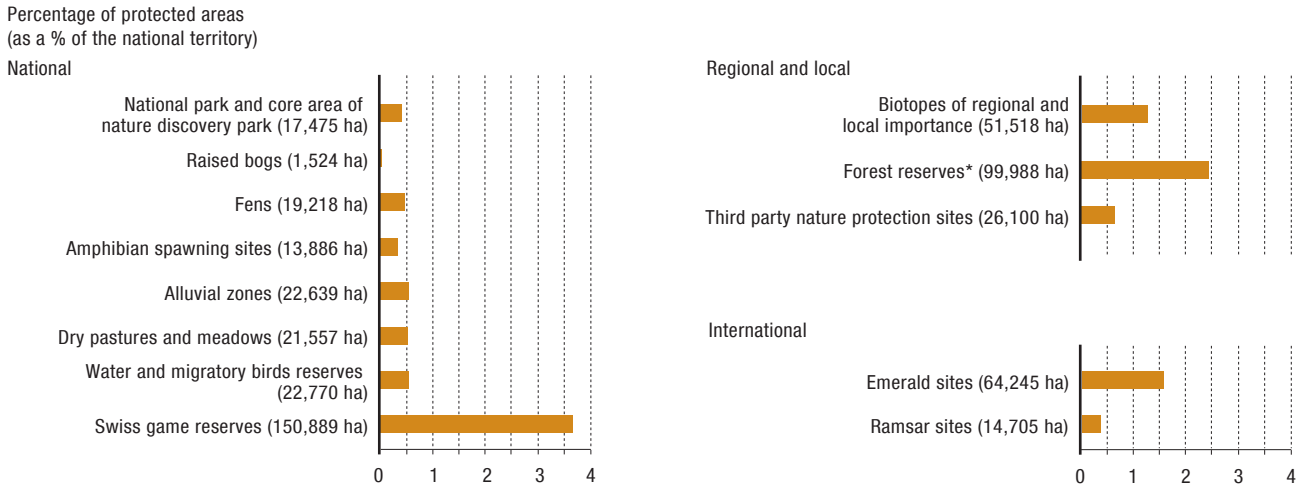

Fig. 68 *Percentage of protected areas (national, regional, local protected areas and areas protected under international agreements). Source: FOEN*

***** *The area of forest reserves (99,988 ha) includes 67,854 ha forested area.*

alluvial zones, 5 percent of amphibian spawning sites and 29 percent of dry meadow and pasture sites. Management contracts are lacking for dry meadows and pastures, especially in summering pastures.

The main reasons for the meagre biotope protection situation are the inadequate financial and human resources of the Confederation and cantons. Biotope protection takes a great deal of effort and is expensive. The negotiations for a maintenance contract are often long and complicated. Another hurdle is the high cost of maintenance since the objects are often located in difficult terrain or on steep slopes. These tasks can only be fulfilled if the available resources match the size and diversity of the natural habitats. Furthermore, more financial resources are required than previously.[118] The FOEN estimates that the necessary maintenance measures require twice the amount of funds than are currently used. One-time investments are also required to enhance and revitalise sites.

Measures promoting biodiversity in agriculture

Swiss agricultural policy has developed various instruments to promote biodiversity in grasslands and croplands. Thus, to obtain direct payments for proof of ecological performance, the federal government requires 7 % of the area used for agriculture (3.5 % for special crops) to be designated as area reserved for promoting biodiversity. At the end of 2015, this area covered approximately 15 percent of the area used for agriculture in Switzerland (which corresponds to 3.9 % of the national territory). However, there are large regional differences. In mountain zones III and IV as well as in the summering pasture region, the proportion of area reserved for promoting biodiversity is significantly higher than in valley zones. Fortunately, the proportion of area reserved for promoting biodiversity with quality level 2 has increased significantly: Around one-third of areas reserved for promoting biodiversity now exhibit biological quality. The Confederation wants to increase this proportion. The Agricultural Policy 2014–2017 increased incentives for high-quality areas reserved for promoting biodiversity in valleys. Additionally, the list of eligible items for a contribution to promote biodiversity has been expanded to include summering pastures.

Furthermore, the Confederation promotes organic agriculture as a particularly near-natural and environmentally-friendly form of production. In order to receive contributions, the organic production requirements under the Organic Agriculture Ordinance must be met. Organic farming produces food using environmentally-friendly methods and closed cycles to the extent possible. Chemically-synthesised fertilisers and plant protection products are banned. An increase in organic agriculture is therefore beneficial for biodiversity. The percentage of organically farmed areas has increased slightly since 2005 and totalled around 13 % of the area used for agriculture in Switzerland in 2015.[119]

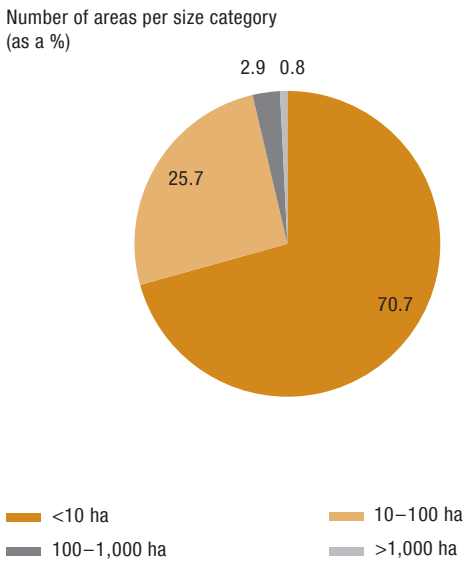

Fig. 69 *Around three-fourths of the national conservation sites are smaller than 10 hectares. Source: FOEN*

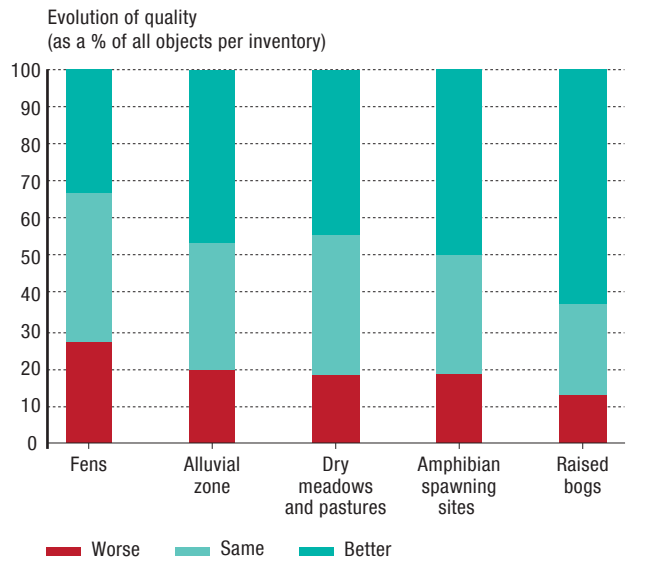

Fig. 70 *Data from the cantons on the quality of individual inventories (FOEN survey). Source: FOEN*

Forest reserves have increased significantly

One of the main goals of the federal government's Forest Policy 2020 is to ensure sustainable forest management. Promoting biodiversity is also part of this goal. Among other things, the Forest Policy 2020 aims to increase[120] the current area occupied by forest reserves within Switzerland's total forest area to 8 % (and to 10 % by 2030), which corresponds to 2.4 % and 3 %, respectively, of the national territory. Since 2001, the percentage of nature forest reserves has increased significantly.[121] Together with special forest reserves,[122] the cantons successfully established 5.6 % of Switzerland's forest area, or an area of 67,854 ha, as forest reserves by 2015. The reserves vary in size: 21 reserves cover an area larger than 500 ha. Reserves with smaller areas of up to 20 hectares, which are too small for long-term process protection, predominate particularly in the Jura and the Central Plateau regions. The cantons are mandated with the task of establishing reserves under the Forest Act. The Confederation promotes cantonal reserve programmes with financial assistance and provides them with strategic and specialised information.

Near-natural forest management is promoted in Switzerland through two labels: FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification Schemes). The criteria for both certificates were harmonised in 2009 with the FOEN's concepts on basic requirements for near-natural forest management. FSC certificates are awarded when 10 % of the forest area is designated as forest conservation area, biotope trees are left standing, nature is generally regenerated, planting is done as an exception, a high percentage of deadwood exists, environmentally-damaging substances are no longer used (e.g. synthetic motor oil) and other criteria are met. Over 600,000 ha of forest in Switzerland are already FSC-certified.[125] This equals over 50 percent of the entire forest area.

Successful promotional measures

There are many examples of consistent biotope protection and targeted promotional measures that can lead to growing populations of threatened species. In lower Aaretal (AG), for instance, thanks to various promotional measures and close cooperation between the canton, communes, nature conservation organisations, gravel pit owners and farmers, the yellow-bellied toad *(Bombina variegata)* was successfully "brought back". Four surveys between 1999 and 2008 reveal a constant rise from the previous 5 to the now 15 occurrences.[123] This means that the 1992 level has been achieved again. On a positive note, two isolated populations of European tree frogs *(Hyla arborea)* in Saanetal (cantons of Fribourg and Bern), which were separated by more than 10 km, have been successfully reconnected to each other by creating 14 new bodies of water for reproduction at 7 sites, which has significantly increased the entire population.[124]

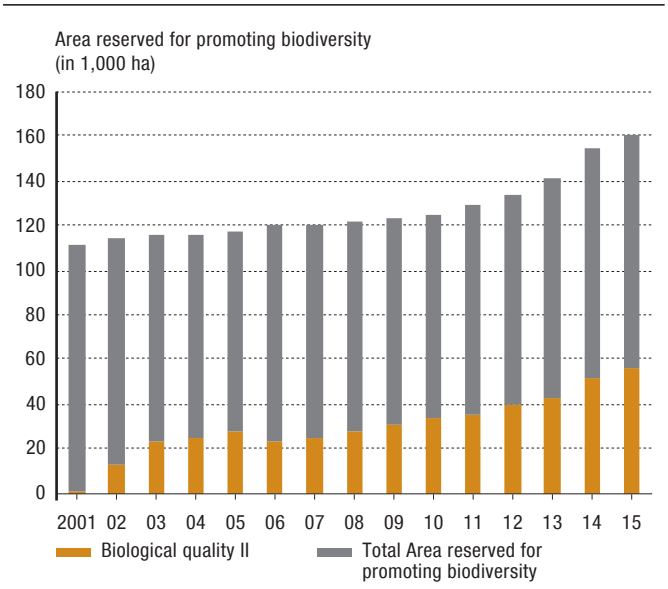

Fig. 71 *Total area reserved for promoting biodiversity (prior to 2012: ecological compensation areas). Source: FOAG*

Fig. 72 *Yellow-bellied toad* (Bombina variegata)

Large-scale revitalisation of bodies of water

The Waters Protection Act, which was revised in 2011, provides for the restoration of the natural functions of streams, rivers and lakes. In the next 80 years, approximately 4,000 kilometres of river and stream courses will need to be revitalised. The partially implemented measures also improve flood protection in many cases and create attractive recreational spaces. There are roughly 1,500 withdrawal sites used for hydropower in Switzerland. About half of these must be remediated due to inadequate residual flow quantities.

Further efforts are urgently required

The need for action and financing was recognised when the Swiss Biodiversity Strategy was adopted. The development of an ecological infrastructure composed of all protected and connected areas is established as a national priority of the Federal Council in the Swiss Biodiversity Strategy. For that purpose, protected areas should be enhanced and remediated, area loss and fragmentation slowed, and habitat functionality increased. Current instruments should be expanded so that species promotion in Switzerland can be specifically supported.

It is also important to raise awareness. The state of biodiversity is much too positively rated by the public, as revealed in a national survey (see box). The goal of conserving biodiversity over the long term can only be achieved in partnership with all actors concerned – from landowners to consumers. It is a task that concerns society as a whole and spans generations.

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