



# Haselwurz und Bärenklau



...THERE'S STILL MUCH  
TO LEARN...

## *IMPRESSUM*

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## GLOSSARY

biodiversity	Diversity of the living.
habitat, biotope	The physical environment an organism is found in, including biotical (living environment) and abiotical (non-living environment, i.e. rocks, climate) factors; e.g. the forest. Each habitat provides numerous niches.
minimum area	The minimum area needed for a species to survive and reproduce.
Ecological niche	The position an organism fills in its environment, comprising the conditions under which it is found, the resources it utilizes and the time it occurs there.
Habitat fragmentation and isolation	Habitat fragmentation reduces the habitat area, increases the distance between remaining patches, isolates patches and favours species found in edge habitats. Species are lost because of the overall loss of habitat area and as a result of increasing insularization.
Red List	Lists of rare, endangered or extinct species of an area.
Blue List	Lists of endangered or rare species that could be successfully protected.
Minimum viable population	Minimum number of individuals in a population to ensure reproduction and survival.
protection of species	Procedures specifically for the protection of endangered species.
protection of habitats	Management in habitats aiming the protection of the specific character of a biotope, i.e. debrushing in dry meadows, establishment of stone walls, haying in wet meadows, a.s.o.

## ◀HASSELWURZ UND BÄRENKLAU> – THERE'S STILL MUCH TO LEARN...

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## LINKS

Forum of Biodiversity Switzerland	<a href="http://www.biodiversity.ch">http://www.biodiversity.ch</a>
Ornithological Station Sempach	<a href="http://www.vogelwarte.ch">http://www.vogelwarte.ch</a>
Blue Lists	<a href="http://www.bluelists.ethz.ch">http://www.bluelists.ethz.ch</a>
Swiss Federal Research Station for Agroecology and Agriculture (FAL)	<a href="http://www.reckenholz.ch">http://www.reckenholz.ch</a>
Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)	<a href="http://www.wsl.ch">http://www.wsl.ch</a>
Research Institute of Organic Agriculture (FiBL)	<a href="http://www.fibl.ch">http://www.fibl.ch</a>
Federal Office for the Environment (FOEN)	<a href="http://www.umwelt-schweiz.ch/buwal/eng/">http://www.umwelt-schweiz.ch/buwal/eng/</a>
Fachstelle Naturschutz, Kt. Zürich	<a href="http://www.naturschutz.zh.ch">http://www.naturschutz.zh.ch</a>
Geobotanical Institute, ETH Zurich	<a href="http://www.geobot.ethz.ch">http://www.geobot.ethz.ch</a>
Institute of Environmental Sciences, University of Zurich	<a href="http://www.uwinst.unizh.ch">http://www.uwinst.unizh.ch</a>
Botanical Garden, Zurich	<a href="http://www.bguz.unizh.ch/">http://www.bguz.unizh.ch/</a>
Swiss Botanical Community	<a href="http://www.botanica-helvetica.ch/">http://www.botanica-helvetica.ch/</a>
Swiss Academy of Sciences	<a href="http://www.scnat.ch/">http://www.scnat.ch/</a>
Bird Life (SVS) Switzerland	<a href="http://www.birdlife.ch/">http://www.birdlife.ch/</a>
ProNatura Switzerland	<a href="http://www.pronatura.ch">http://www.pronatura.ch</a>
Fonds Environment Switzerland (FLS)	<a href="http://www.flis-fsp.ch">http://www.flis-fsp.ch</a>



## LITERATURE AND LINKS

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### INTRODUCTION

Despite many national and international conventions, biological diversity and the diversity of the landscape are endangered throughout the world. Many species need urgent protection, and even some more common species are in danger, especially those that depend upon many different types of habitats. Protection of the diversity of species also means protection of a diverse landscape structure, which – not at least – depends upon the range of habitats available within the landscape.

At the Geobotanical Institute at ETH ([www.geobot.ethz.ch](http://www.geobot.ethz.ch)), we study how biodiversity is affected by the structure of the landscape and the diversity of habitats. The game «Haselwurz und Bärenklau» was created to illustrate some of our results, showing in an easily understandable way how biological diversity can be promoted in the cultivated landscape. It was produced in collaboration with the game factory Murrel ([www.murrel.ch](http://www.murrel.ch)) on the occasi-

on of the 150th anniversary of the Swiss Federal Institute of Technology (ETH).

During the game, the players discover how important landscape structure can be for both plant and animal species. The pixies who accompany the players along the way point out that all species, both common and rare, have different requirements to their habitat, although some types of habitat are particularly valuable. For example, hedgerows, wildflower strips and groves are very useful because of the large number of species that they can support. And landscape elements that provide linear trails or stepping stones are also important because they allow plants and animals to disperse. In the game this is illustrated by the pixies, that can only move with the help of four animals (bird, dragonfly, grasshopper, badger); these in turn depend upon the presence of structures like hedgerows along rivers or forest edges.



## BIODIVERSITY — STRUCTURAL DIVERSITY — SPECIES DIVERSITY

BIODIVERSITY is a word that was coined to describe the diversity of life. This means not only the numbers of species within a habitat, but also the genetic diversity within populations of one species and the diversity of habitats. «Haselwurz und Bärenklau» is about both habitat and species diversity, and has one basic rule – the more species that live in a particular area, the more diverse that area is.

But why is biodiversity so important? Why do we have to know more about it? There are many arguments for protecting biodiversity, ranging from the ethical and aesthetic to the economic. Economic arguments are based upon the fact that

In Switzerland there are some 50'000 PLANT AND ANIMAL SPECIES. According to their habitat requirements – which are related with their frequency – they can be grouped into three categories: (1) specialized, often rare and endangered species, (2) species called «generalists» without strongly defined habitat requirements, and (3) common species and those adapted to cultivated habitats. The specialized species are restricted to habitats which provide specific environmental conditions. When these habitats are altered or destroyed, specialists may disappear.

In fact, many species in Switzerland are now endangered because human activities have disturbed or destroyed their habitats. One of the commonest types of change is the intensification of agricultu-

species in ecosystems provide many services that are essential for human existence. These services include providing clean water, controlling pests, preventing erosion and maintaining soil fertility. The total world value of these services was recently calculated by estimating the cost of replacing them by technology (though this is hardly realistic). The result was an astonishing US \$33'000 million per year! Recent research suggests that if we lose biodiversity then the ability of ecosystems to provide services will be impaired. It is therefore important to understand how species diversity affects the way that ecosystems work and also what can be done to protect biodiversity.

re. Venus's Looking-glass is a small annual plant that was once a common species in arable fields but today has almost vanished; in this case the reasons seem to be improved methods of cleaning grain before sowing as well as the greater use of fertilizer, making the crop more competitive. Many specialised species now only survive in protected areas where the specific environmental conditions they require still exist.

In contrast, there are also common species that can survive and proliferate in many different types of habitat. Most of these species can adapt their life-cycle to different forms of agricultural land use and can even benefit from intensification. Well-known examples are dandelions and green-shield bugs.

## BLUE LISTS: A LIST OF SUCCESSFULLY PROMOTED, ENDANGERED PLANT AND ANIMAL SPECIES

*A NEW AND ENCOURAGING TOOL FOR NATURE CONSERVATION*

One major task in nature conservation is, to raise public awareness and motivation for this topic. Conservationists often try to attract people by pointing out how endangered our natural surrounding is, especially how many species have been lost already. One tool often used is the «Red lists», lists of all endangered or extinct species in an area. Depending on a species frequency and the size of its population during a period of time it is estimated how threatened the species is. Red lists therefore show the decline in species richness in our landscapes. They are growing longer and longer, which is more discouraging than motivating. However, there are many examples of successful projects in nature conservation and especially in the protection of species, just hardly anybody knows about it.

To change this and to document the successes in species protection, the Geobotanical Institute ETH together with the University of Zurich developed a new tool,

which is called the «Blue list». It's a list of all 'red-list species that could successfully be protected in a certain area (defined as a long-lasting stabilisation or increase in a species)'. Information on 217 animal species and 722 plant species in the cantons of Aargau, Zurich and Schaffhausen was collected. According to the Red Lists all these species are endangered in the corresponding canton. About a third of these species could successfully be protected during the last 10-15 years, meaning their population size was stable or even increased. They were put on the Blue lists. About a fifth of the species is declining and for nearly half of the species it is unknown, whether their populations decline, increase or are stable.

However, for most of the endangered species special measures and techniques for protection have been developed or even successfully tested at a local scale. If this knowledge would be applied more often, the decline of species could be reduced considerably.

In conclusion it is not the missing knowledge, that leaves many species unprotected, but the missing willingness of authorities and the public, to apply the existing knowledge!

In contrast to the Red lists, which document the alarming decline of species richness, the Blue lists show successes and possible applications. In this way they communicate positive information and can strengthen the public motivation to protect biodiversity.

[www.blauelisten.ch](http://www.blauelisten.ch)



## ROTATION FALLOWS FOR A HIGH BIODIVERSITY OF INSECTS AND SPIDERS AS WELL AS PLANT SPECIES IN WET MEADOWS

Traditional wet meadows were unfertilized and typically very rich in species; they were mown in small patches at different times during late summer/autumn, and the cut plant material was used as straw. Since the 1970s economic factors have led to changes in the management of wet meadows, and large areas are now mown at the same time. Such large scale mowing and removal of straw kills many small animals like spiders, grasshoppers and caterpillars. Moreover, mowing destroys the vertical structure of the vegetation, exposing some arthropod species to harsh conditions and predators, while their sources of food may be reduced. Also, the removal of old tussocks means many species have no habitat or winter habitats. To find a way to minimising the loss of animal species biodiversity while also protecting plant species diversity, the rotating fallows method was developed. This is a management system with alternating strips of unmown land (500-1000 m<sup>2</sup> in size). These strips are shifted from year to year in a rotation of 3-5

years. By the rotation of the strips, the wet meadows should be protected from the negative effects of self-fertilisation (eutrophication) by dead plant material and from shifts in the composition of plant species.

The aim of the new project is to study the effects of such one-year fallow strips on the composition and diversity of insects, spiders and plant species. In 2002, experiments were set up in the areas of Greifensee (ZH), Reusstal (AG) and at the upper Lake of Zurich near Schmerikon (SG) involving rotating fallows and annually mown control plots. The goal is to develop management proposals for wet meadows aimed at maintaining their traditionally high levels of biodiversity. The project is funded by the governmental agencies of Zurich, Aargau and St. Gallen.

Dissertation Sabine Rocker,  
ETH Zürich, ongoing



The third group of species are those that depend on more than one type of habitat; for some species, the existence of a habitat mosaic is important throughout their life history, while others use different habitats at different stages in their life cycle. The yellowhammer, for example, is a bird that uses open fields and also hedgerows, while many butterflies benefit from fields with wild flowers as well as from forest

edges. However, these combinations of different habitats are often lost as agriculture becomes more intensive, and so the species that depend upon them also disappear. Intensively used agricultural landscapes often contain large fields without connecting elements and island refuges, and species of this third group cannot survive under these conditions.

## CHANGING DIVERSITY OF SPECIES

Without human interference, most of the Swiss midlands would be covered by forests, floodplains and mires, except in a few patches with steep rocky slopes or very dry conditions. Only above the alpine tree limit would one find extensive natural grasslands with their special high mountain flora. The present distribution of many wild animal and plant species in the Swiss Midland, as it is in other parts of Central Europe, traces back to early human settlement and the beginning of agricultural land use. The first extensive clearings of forest were made after the Roman invasion. As the cultivated area and the variety of land use methods increased, the number of new, non-forested habitats also increased. Plant species from open, naturally non-forested vegetation types spread into the new habitats, with some of them being deliberately or accidentally transported from far away. Many of these found suitable habitats and persist to the present day, effectively enriching the indigenous flora.

Unfortunately, with increasing intensification of agriculture land use - which involves enlarging fields, removing structural elements such as hedgerows or fens and applying chemical fertilisers and herbicides - and with increasing urbanisation and other forms of land use (for tourism, sports facilities and others), the habitats of many plants and animals have declined or even disappeared. Today, half of native animal species and a third of plant species are listed as endangered or extinct (Red Lists). Laws have been passed aimed at protecting endangered species and many attempts have been made to improve habitat conditions for particular groups of species. But these measures alone are not sufficient; if we are to stop the loss of biodiversity we urgently need to change our habits and attitudes towards our environment. We need to develop sustainable management strategies and support a more extensive agriculture policy, one that leaves space for wild plants and animals.

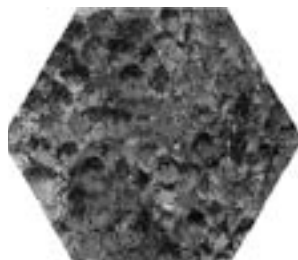
## LEBENSÄRÄUME UNSERER KULTURLANDSCHAFT UND IHRE TYPISCHEN ARTEN

### FOREST HABITATS

A forest is more than just a stand of trees; it is a diverse community that includes herb and shrub layers, many different animal species, and a vast range of soil organisms. A natural forest also has a spatial structure: it contains dead wood, open areas, and patches at varying stages of regeneration.

In the lowlands of Central Europe (up to 900 and 1300 m a.s.l.) deciduous trees dominate natural forests. Beech is usually the most common species, but it often grows mixed with oak, hornbeam, lime, alder or sycamore, depending on the local conditions. At higher altitudes, coniferous trees become more common, among them spruce, fir, larch and pine. A forest is also a complex ecosystem, including not only all the species but also their physical environment (soil, groundwater and air). Trees influence the environment for other organisms in many ways: for example, they lower the light and change its quality, reduce the wind, and provide more stable temperature and humidity.

Today, most forests are more or less intensively managed, and many of them are monotonous stands composed of a few species of conifers. Not only do plantations contain a different mix of species from natural forest, but they differ also in structure. For example, there are usually no large, old trees and little or no dead wood. In contrast, ancient woodlands have a complex structure and abundant decaying wood, and harbour many more typical forest species. This richness of structure can be seen in some forests reserves such as the Sihlwald near Zurich, a forest that is no longer used to produce timber.



nutrients). It was concluded that various forms of management are suitable to maximise biodiversity of plant and animal species, including mowing once a year in July, or every alternating year in July, or annual mowing in October. On plots which had been burned, most of the species were fast growing, spontaneous species from rural sites. In contrast, the abandoned plots with no management developed rather rapidly a dense vegetation dominated by fast-growing plant species, and smaller, light-demanding species from haymeadows were outcompeted. A useful adaptation to the nutrient-poor soil conditions are plant habits where the nutrient reserves within the plant are kept close to

the soil surface and therefore are not lost by mowing, i.e. plants with leaf whorls or nutrient storage in the roots. The best adaptation to dry conditions are protection from high water-loss (low transpiration) or organs for water capture, for example hairy leaves and stems, low transpiration rates or thick leaves.

Dissertation Barbara Köhler,  
ETH Zürich, Nr.14227, 2001



rather common generalist species. Such species often produce two or more generations in a year. These species were less frequent in other, less intensively managed meadows.

Many bug species are negatively affected by intensification of land use. In particular, species which develop in late spring or early summer cannot survive under intensive management. We also found that species requiring a warm, dry microclimate near the soil surface were lost under intensive management, apparently because they were unable to survive in the denser vegetation of more productive meadows.

There were interesting differences among

the bug communities of low intensity meadows in the four areas. Many species occurred in only one of the areas, suggesting that they had limited powers of dispersal. On the other hand the more intensively used sites were similar in their bug species composition.

We conclude that hay meadows under low intensity management contribute more to species diversity at a regional scale than do intensively used meadows. Regional species diversity can be preserved only by protection and promotion of low intensity hay meadows.

Dissertation Manuela Di Giulio,  
ETH Zürich, Nr. 13698, 2000

## THE EFFECTS OF MANAGEMENT ON THE DIVERSITY, COEXISTENCE AND ECOSYSTEMATICAL PROCESSES IN HAY MEADOWS

Plant species richness of limestone grasslands is very high, and within one site there may be as many as 100 species. As a semi-natural vegetation, limestone grasslands need regular management to maintain their high species diversity including rare and endangered species. But the traditional management, i.e. annual hay-making in July, is nowadays no longer economical for the farmers and they therefore receive subsidies from nature conservation authorities to continue mowing these grasslands. In order to find alternatives for maintaining limestone grasslands which are less costly but acceptable to farmers, the Geobotanical Institute established a long-term study with six different treatments of hay meadows,

including four different mowing regimes, one burning treatment (controlled burning in February/March) and one without any management (abandonment).

To assess the effects of the different management types on the vegetation, the number and abundance of plant species were recorded in experimental plots at intervals over a period of more than 20 years. Because of the length of the experiment, one can distinguish how far the differences are related to management or to other factors like weather conditions or animal activities. In addition, we examined plant characteristics which are useful for species survival under different management regimes and the local soil conditions (rather dry soils, rocky and poor in

### WOODRUFF (*GALIUM ODORATUM*)



The species grows up to 20 cm tall and has the typical appearance of its family: its fragrant, dark-green leaves are arranged in whorls of 5-8 leaves along the square stems. The small white flowers, also sweetly-scented, appear in loose umbels at the tops of the stems. Sweet woodruff is predominantly found in the understory vegetation of beech forests on calcareous soils and is characteristic of this forest community.

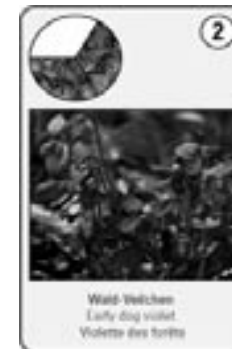
### Buttercups SLIGHTLY POISONOUS!

Liverleaf is an early spring-flowering species. The violet flowers appear with the first warming sunshine in March, before tree foliage shades the forest floor. The flowers close on cloudy days and also at night. Later in the summer only the characteristic leaves with three pointed lobes remain. The species grows in deciduous forests with a dense herb layer and also in shrubby vegetation. The seeds are dispersed by ants that collect them to feed on their nutrient rich appendages.

### LIVERLEAF (*HEPATICA NOBILIS*)



### EARLY DOG VIOLET (*VIOLA REICHENBACHIANA*)



Early dog violet/woodland violet is easily recognised from the basal leaf rosettes with their long-stalked, heart-shaped leaves. The completely violet flowers appear from April to May. The plant grows on humus-rich soils in herb-rich deciduous and mixed woodland.

Violets

### Honeysuckles **POISONOUS BERRIES!**

Fly honeysuckle is a shrub 1-2 m tall with pubescent twigs and leaves. The rather inconspicuous, yellow-white flowers are arranged in pairs. Bumblebees are their most common pollinators. It produces bright red berries that ripen in late summer. Although birds regularly feed on these fruit, they are toxic to humans. Fly honeysuckle grows in forests, forest edges and copses. It prefers warm locations and calcareous soils.

### FLY HONEYSUCKLE (*LONICERA XYLOSTEUM*)



Asarabacca

### EUROPEAN GINGER (*ASARUM EUROPAEUM*)



The European ginger is one of the few native plants with evergreen foliage. The heart-shaped leaves are shiny on the upper side and pubescent on the lower surface. The flowers are brownish-red and have twelve long stamens. They are rarely visited by insects and are mainly self-pollinated. The seeds are distributed by ants. Both the rhizomes and the aboveground parts of the plant have a peppery taste. Wild ginger favours moist, shaded sites with humus-rich soil.

### Buttercups **SLIGHTLY POISONOUS!**

The wood anemone sprouts from a long creeping rootstock and can form large colonies. It appears in early March before the trees produce their leaves. Each plant produces a single white flower. The leaves are dark green and split into three lobes that are themselves deeply divided. During cloudy weather conditions the flowers turn downwards and close. They are pollinated by beetles, flies and bees. The wood anemone grows in woodlands with a rich herb layer and also in montane meadows.

### EUROPEAN WOOD ANEMONE (*ANEMONE NEMOROSA*)



the proportion of grass in the vegetation. There were significant differences among all sites, suggesting that a high species richness at a landscape scale is only possible with a large number of sites spread over the whole area. The seed-bank in the soil increases with the establishment of wildflower strips. Environmental factors like soil conditions and the land-use management in the surrounding area become more important for the development of the vegetation with increasing age of a site. Attempts to steer the development of the vegetation by mowing or cultivation of the soil were mostly not successful in the long term. Sites with a high share of grasses and certain other 'critical' herbs were not suitable for new wildflower strips.

We found that most insects characteristic of arable landscapes had little problem in colonising wildflower strips. The numbers of species and also of individuals were small in the first year and increased with time. Both are influenced by the number of plant species and the structural diversity of the vegetation. Large numbers of generalist insects were associated with sites where there was a lot of grass.

In general, wildflower strips increase the diversity of plant and insect species in a landscape area. To increase this diversity as much as possible, the wildflower strips should be located across a large area and managed in contrasting ways.

Dissertation Karin Ullrich  
ETH Zürich, Nr. 14104, 2001

## INSECT DIVERSITY IN AGRICULTURAL GRASSLAND: THE EFFECTS OF MANAGEMENT AND LANDSCAPE STRUCTURE

In a project concerning species diversity in hay meadows on the Randen (Canton Schaffhausen) we investigated the environmental conditions which affect the diversity of insects in these meadows. We were also interested in how insect species diversity in cultivated landscape areas can be increased. As an indicator group for insect diversity we chose the bugs (Heteroptera). This is an ecologically very diverse group, and previous studies have shown strong correlations between the di-

versity of bugs and the insect diversity in general.

We investigated two management intensities (low and medium) in four different areas separated from each other by forests. In general the low intensity meadows have a higher species diversity than those used more intensively.

Because bugs respond to the intensity of landuse, these meadows differed in their bug species composition: the medium intensity sites were occupied mainly by

spiders the diversity of arable fields and crops was also important for their diversity: if there were many different crops on small fields, the whole area contained more species. It is interesting that these relationships were not only valid in a particular region, but applied across a large area of Europe.

The results of this large-scale investigation showed that extensively used areas and landscape structures do support species diversity of plants and animals. So it is important and useful to create such habitats and to maintain their intercon-

nectedness. Of course, not every species can be conserved in this way. To protect endangered species, more detailed and specialized methods are probably needed. A further conclusion of this study is that the likely species richness of an area can be rapidly assessed from rather simple parameters describing the large scale structure of the landscape.

Project management in Switzerland:  
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## THE EFFECT OF WILDFLOWER STRIPS ON SPECIES DIVERSITY OF PLANTS AND INSECTS IN THE CULTIVATED LANDSCAPE

Wildflower strips are widely sown in Switzerland and are intended to promote biodiversity of plant and animals in intensively used arable areas. They are at least 3 m wide strips and may be located either at the edge or within fields. Normally they are sown with a recommended seed mixtures of wildflower species characteristic of arable land, meadows and other rural areas. These strips are allowed to develop for 2-6 years, and after the second growing season a part of one strip or even the whole strip is mown, with the mown areas changing from year to year. One of our research projects investigated the factors affecting plant species diversity in wildflower strips, and how factors such as

the seed mixture, site management and environmental factors affect the development of the vegetation. We also investigated the colonization of wildflower strips by insects.

The study sites were located in Klettgau (Canton Schaffhausen) where wildflower strips were first established in 1991. We found a total of 234 plant species in wildflower strips in this area, most of which had established spontaneously (i.e. they were not in the original seed mixture). Species from the seed-mixture germinated from the second year on. The number of species was highest in one-year old strips and decreased with age and also

### BEAR'S GARLIC (*ALLIUM URSINUM*)

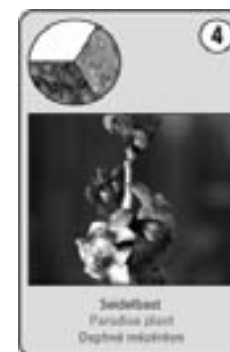


The leaves of ramsons (also called bear's garlic) have parallel veins and can thus be mistaken for lily of the valley (which is toxic!). Ramsons appears in spring and often forms large colonies. One cannot fail to notice the intense garlic-like odour. The plant prefers moist, loamy to sandy soils in deciduous forests. Bear's garlic – as the name suggests – can be used for pesto or salad.

### Thymelaeaceae HIGHLY POISONOUS!

Paradise plant is a deciduous shrub of 25-120 cm height. The pink, scented flowers are produced before the leaves, as early as February. The branches are yellow-grey, hairy and leafy only towards the tips. The leaves measure 2-6 cm long. The plant can easily be recognised in early summer by the scarlet fruits at the tip of the branches. Paradise plant grows up to the subalpine zone in deciduous forests, hedgerows, copses and on rocky debris.

### PARADISE PLANT (*DAPHNE MEZERUM*)



### DOG-ROSE (WILD-ROSE) (*ROSA CANINA*)



This species is conspicuous due to its pink flowers. These are attractive to insects, although they do not provide nectar to their pollinators. The wild rose often develops its fruits without the help of pollination by insects, because the seeds can develop without fertilization. The ripe fruits are distributed by birds and wild mammals. The species grows preferably on calcereous soils and can be seen at sunny sites at the edges of hay meadows, hedgerows and forests, and also within open woodland.

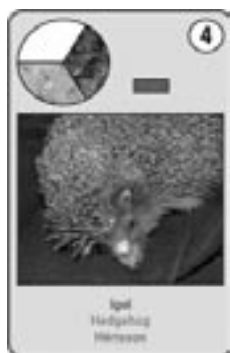
Roses

## Mammals

The hedgehog has 6000-8000 spines and protects itself from enemies by rolling up into a ball. It has a pointy snout and small round ears. Hedgehogs are active at dawn and night. They feed on insects, earthworms, eggs and fruits; in autumn they build up a reserve of fat for hibernation. Many of their former habitats, mainly hedgerows and copses, have disappeared but they have found alternatives in parks and gardens. In May they give birth to 2- 10 blind cubs. Their maximum age is about ten years.

### HEDGEHOG

(*ERINACEUS EUROPAEUS*)



### SILVER-WASHED FRITILLARY

(*ARGYNNIS PAPHIA*)

Fritillaries



The silver-washed fritillary is a rather large butterfly with a 5.5-6.5 cm wing-span. The ochre-yellow upper wing side exhibits three rows of black dots near its edge; the underside is dull green with three silvery stripes (giving the species its name). In summer it frequently flies along forest edges, clearings and meadows inside forests, where it feeds primarily on thistle flowers. It also deposits its eggs on these feeding-plants. These survive the winter and hatch in March. The caterpillars, which grow up to 5 cm long, feed on the leaves of raspberry and dog violet. They pupate in June and the butterfly hatches two weeks later.

## Woodpeckers

The black woodpecker is almost the size of a crow, and is completely black apart from a red hood (male, female with red nape only). Like other woodpeckers it is well adapted to living on trees and has a strong supporting tail and strong feet for climbing. The sturdy bill is used to chisel out insects hidden under the bark; these are then picked up with a long tongue. Black woodpeckers breed in nest holes in large, decaying trees. They are territorial, and the characteristic drumming on dead wood is their way of warning other birds to keep off their patch.

### BLACK WOODPECKER

(*DRYOCOPUS MARTIUS*)



## RELATIONSHIP BETWEEN SPECIES DIVERSITY, LANDSCAPE STRUCTURE AND INTENSITY OF LAND USE IN SEVEN EUROPEAN COUNTRIES

Extensive land-use and habitat-linking are known to be very important techniques to maintain biodiversity in arable areas. In many European countries programmes exist to support the establishment and the protection of existing structures. For example, farmers are subsidised to plant hedgerows or to leave a field fallow. But the question remains of how useful these methods are. It often takes several years until species establish in an area, so the evaluation of the outcome of such methods in a region takes many years of survey. However it would be useful to know more about the efficiency of these methods. One possibility to learn about this is to compare areas with different intensity of land use or with different degrees of cross-linking.

The European Research Project <Green-veins> examined how species diversity of plants and animals depends on the landscape structure and the intensity of land-use across seven countries (Switzerland, France, Germany, Belgium, The Nether-

lands, Czech Republic and Estonia). In total 25 sites (spread over all seven countries resulting in 3-4 testing areas per country) of 16 km<sup>2</sup> were chosen as test areas. With the help of aerial photographs and field surveys, maps of the elements of the landscape structure (fields, meadows, forests, hedgerows etc.) were drawn for each area. These elements were divided into natural elements (<greenveins>) and other habitats (mostly intensively agricultural areas) to calculate the relative area of natural habitats and their degree of interconnectedness (distance among the elements). To calculate an index of land-use intensity farmers were asked about their farming system and the amounts of fertilizer and pesticides they use. Standardized methods were used to survey species diversity of plants, birds, bees, true bugs, carabids, hover flies and spiders. With statistical models the relationships between species diversity and characteristics of the landscape were calculated.

For all groups of organism there was a positive correlation between species diversity and the amount of natural habitats: the more hedgerows, forest edges, extensively managed meadows, riverbanks and other natural elements there are, the more plant and animal species live there. For plant species and birds there was a negative correlation between species diversity and intensity of land use, i.e. fertilizer application; thus, the more the fields had been intensively fertilized the less species (plants, birds) were there. For insects and





## BIODIVERSITY IN THE AGRICULTURAL LANDSCAPE: RESEARCH PROJECTS AT THE GEBOTANICAL INSTITUTE

Despite national and international conventions and many attempts to raise public awareness to what is happening, biological diversity continues to be lost. But why do some species become extinct while others survive? How can we ensure the survival of endangered species? How can we best conserve intact ecosystems? These are fundamental questions for those concerned with practical conservation, but the knowledge available to answer them is limited. Scientists at the Geobotanical Institute at ETH conduct fundamental research aimed at understanding species diversity and the reasons for its loss. Other projects develop strategies to avoid further loss of species and landscape diversity.

The loss of habitat and the increasing isolation of remaining habitat fragments and biotic communities are among the most important reasons for the decrease of species biodiversity. For this reason the Geobotanical Institute investigates the relationships between landscape structure and landscape diversity on the one hand and species diversity and genetic diversity on the other.

Another important research topic concerns how plant and animal diversity can be promoted by establishing new habitats and structural elements in the cultivated landscape, and how far it is possible to reconnect isolated biotic communities. Within arable areas, hedgerows and strips

sown with wild flowers may serve as corridors and refuges for some plants and animals.

Particularly diverse and sensitive agricultural habitats such as hay meadows and wetlands also need special protection. These habitats are characterized by a land-use of very low intensity (for example, they may be harvested only once per year and with little or no use of fertilizer); this is in contrast to most modern land-use, which is intensive and aimed at maximising short-term yields. Unless traditional forms of management are maintained, many species are likely to be lost, either through intensification of agriculture or through its abandonment. An important focus of research here is how these traditional habitats can best be managed to preserve their highly diverse communities.

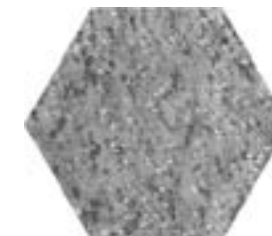
[www.geobot.ethz.ch/forschung](http://www.geobot.ethz.ch/forschung)



### GRASSLAND HABITATS I

Grasslands have been important since the beginning of agriculture, and varying environmental conditions, combined with different ways of using these areas, have produced many different plant communities.

**TRADITIONAL HAY MEADOWS** were not heavily fertilized and were usually mown only once, during mid-summer. These grasslands contained plant species whose life-cycles (i.e. growth, flowering, seed production) matched the traditional management. The remaining hay meadows are mainly located in areas of low productivity, where unfavourable conditions mean that the land cannot be used more intensively. Such conditions can be found on dry and rocky soils (dry meadows) as well as on moist or even wet soils on loamy ground or in the neighbourhood of lakes (wetlands, reeds). Hay meadows contain a mixture of perennial herbs and grasses and, due to low soil fertility and variable habitat conditions, can be very diverse. Dry meadows are particularly rich in flowers and thus attract numerous insect pollinators. Because disturbances are rare, mammals and ground-nesting birds also find suitable habitats there.



HAY MEADOW



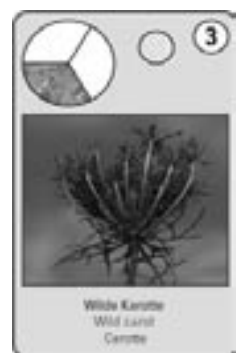
**COWSLIP***(PRIMULA VERIS)*

This is a perennial species that persists through the winter as a thick rootstock. It resprouts in early spring, and is one of the first flowering plants to appear after the snow has melted. Its leaves form a basal rosette; young leaves are rolled backward when they emerge and grow upward. A long pubescent stalk rises from the basal leaf rosette, and is crowned by an umbel of yellow flowers. The species occurs mostly on calcareous soils and can be found in dry meadows and along forest edges.

Primroses



Carrots

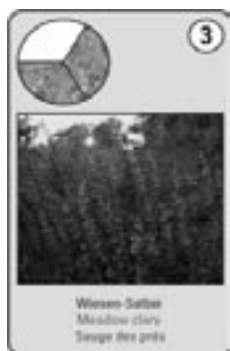
**WILD CARROT***(DAUCUS CAROTA)*

The root of the wild relative of the cultivated carrot releases the typical carrot scent. This biennial herb grows 30-100 cm high and forms large umbels of white flowers with very long involucre leaves. In the centre of each umbel is a single maroon-coloured flower. The leaves are finely divided. Wild carrots grow on dry, nutrient-poor soils in meadows and along waysides.

**MEADOW CLARY***(SALVIA PRATENSIS)*

The meadow clary is 30-60 cm high, and has a branched, partly pubescent, square stem. The basal leaves and the opposite upper leaves are lobed and wrinkled. The blue flowers are composed of an upper and a lower lip. The anthers are held beneath the upper lip and the pollen brushes onto the backs of pollinating insects. Meadow clary typically grows in unfertilized meadows, but also occurs on road-margins. It is often included in wildflower seed mixtures.

Mints

**GROVES AND WOODS**

Groves are small patches of woodland that are planted to provide firewood, to shade livestock, or to mark the boundaries of a property. Like hedgerows, they provide nesting and feeding sites for many species and a refuge for others. Groves and isolated trees within fields can also serve as stepping-stones, enabling some species to disperse more easily through the landscape.





## HEDGEROWS

Hedgerows are like double-sided forest edges that separate fields and provide structure in the cultivated landscape. In many regions, they traditionally served as

the boundaries between fields and estates. They also provide many useful products such as firewood, stakes, berries, nuts and herbs. More recently, many hedges have been removed, while others are no longer managed. In intensively cultivated landscapes, where the fields are large and uniform, hedges are very important as passageways between widely separated habitat patches. In some areas, new hedgerows are being planted in an attempt to enhance biodiversity. To keep their structural value they should be cut every three years.

## WILDFLOWER MEADOWS AND WILDFLOWER STRIPS

Fallow land was once an integral part of the cultivated landscape and contributed much to its biodiversity. However, with increasing use of fertilizers and herbicides, traditional rotations were no longer needed to maintain soil fertility and so this element of the agricultural landscape largely disappeared. Today, fallows have been reintroduced in some areas in an attempt to restore biological diversity that was lost through intensification. For this purpose various wildflower seed mixtures have been developed suitable for sowing under different site conditions.

Traditional meadows also contributed greatly to the biodiversity of the agricultural landscape, supporting many different plant and animal species. Assuming a

single plant species can be the host plant for some ten animal species, it is easy to understand how diverse such flower-rich grasslands can be. Today, flower-rich grasslands are being sown to promote species richness. If these are left unploughed for at least two years they can also offer a hibernation habitat for insects, birds and small animals.



## GREEN-WINGED ORCHID (*ORCHIS MORIO*)



Crickets

**ENDANGERED!**

The field cricket belongs to the suborder of crickets with long antennae and has a barrel-shaped body. It is brownish-black and has brown wings, yellow coloured at the base. The hind wings are vestigial and the insect cannot fly. Field crickets live in dry, sunny meadows, gardens and ruderal areas with low vegetation, where they burrow into the ground up to 30-40 cm deep. They can be easily detected from April to September because of their continuous chirping. The female uses her egg-laying tube to place the eggs one by one into deep holes in the soil. The larvae hatch after 2-3 weeks and hibernate after several moults. The new adult crickets emerge in spring.

## BEEWOLF (*TRICHODES APIARIUS*)



The green-winged orchid produces a long-lived root tuber and basal rosettes of lance-shaped leaves; these remain green during the winter. The flower stalks are 10-30 cm high. The flowers have a pair of green-striped sepals extending laterally like wings; the broad lip is pale in the centre with dark spots and the flower spur is straight. The green winged orchid grows in hay meadows and flowers from April to June. Once a common species, it is now rare in many areas due to changes in management and loss of habitat.

## FIELD CRICKET (*GRILLUS CAMPESTRIS*)



Carabids

With the shiny blue-red colour of its body and elytra, the bee wolf is amongst the most beautiful of native beetles. It prefers warm and sunny sites at forest edges, in natural meadows or fallow grasslands. The beetles are predatory, and can be found waiting for their prey in the flowers of various plant species. The females lay their eggs in the nests of wild bees, where the larvae later pupate. The larvae feed on bee larvae, but they do little harm to bee populations. Adult beetles partly feed also on pollen of the flowers. In Switzerland the species has become rare due to habitat destruction.

## Snails

This is the largest species of snail in Central Europe. The globular shell is whitish with broad stripes and fine spiral lines and grows to a diameter of 5 cm. It is a hermaphrodite species, meaning that one individual has both male and female reproductive parts. During copulation, two snails shoot small arrows into their partner's foot. The eggs are laid in small hollows. The escargot snail hibernates below-ground, protected by a calcareous cap. The escargot lives in forests, bushes and grasslands, and also occurs in vineyards and gardens.

### ESCARGOT SNAIL (*HELIX POMATIA*)



### SAND LIZARD (*LACERTA AGILIS*)



## Lizards

Sand lizards are 15-20 cm long, short-legged and rather plump with a rounded, thick head. The upper side is light brown, with a dark median line and a brown-white spotted pattern. During the mating season the males have light green sides. The species, which is active during daylight, lives in dry sites with low and open vegetation cover, in fields, along roadsides or at forest edges. They require some structural elements in their habitat such as trees, bushes, stones, walls or trunks of rotten trees. They hibernate between October and May.

### COMMON TREE FROG (*HYLA ARBOREA*)



## Hylidae

### HIGHLY THREATENED!

The Common (European) tree frog is a small frog; 3-5 cm long with long hind legs and sticky pads on its fingers and toes. Its skin is smooth. A black line from the eyes to the hips separates the leaf-green upper side from the pale yellow underside. Males have an inner resonator. At night tree frogs often sing in choirs and the metallic sound can be widely heard. The species lives in shallow lakes or ponds, in which the clumped frogspawn is laid in April. The tadpoles develop into adults within a short time ('metamorphosis'). They occur in marshy areas and on trees or bushes, and can sometimes be observed sitting on leaves in the sunshine.

## CONNECTING HABITATS IN THE CULTIVATED LANDSCAPE

Some elements of the landscape provide a link between different habitat patches that may allow organisms to disperse. Linear elements such as roads and tracks, hedgerows and forest margins can serve this purpose, while other types of habitat may offer stepping stones (e.g. groves, wildflower-meadows, fallow strips in fields, standard fruit trees, stone cairns or woodpiles). However, the value of these features varies according to species; a road, for example, may be a corridor for some animals but a barrier for others. As agriculture becomes more intensive, with larger and more uniform fields, the-

se connecting elements become increasingly important for maintaining species diversity. Hedgerows, for example, offer shelter and nesting sites for birds of farmland, and for many insects they serve as dispersal corridors. In addition, they are important as windbreaks and erosion controls, and contribute to the aesthetic appeal of the landscape.

The game 'Haselwurz und Bärenklau' uses three important types of connecting biotopes - hedgerows, fallow strips and groves.





## Songbirds

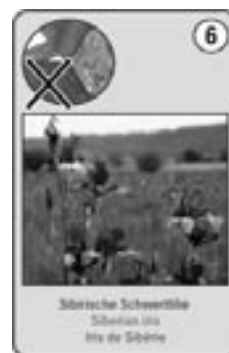
### ENDANGERED!!

The white stork has black and white plumage and a red bill and legs and is up to 102 cm tall. It is has adapted well to the presence of humans and often nests on houses and chimneystacks. It is well known for the rattling noise it makes in its nest. Storks lay 4-5 eggs, which hatch after a one month incubation. The nestlings then remain in the nest for another 60 days. The stork returns from its wintering sites in May and feeds in moist meadows and wetlands on a diet of frogs, worms and mice. Numbers of storks have dramatically decreased in recent decades, not only due to habitat destruction in the breeding range, but also due to increasing dangers while migrating to and from their winter refuges in tropical Africa.

### WHITE STORK (*CICONIA CICONIA*)



### SIBERIAN IRIS (*IRIS SIBIRICA*)



## Lilies

### ENDANGERED!!

The Siberian iris grows 50-80 cm high. The leaf blades are long and narrow (less than 1 cm). The flowers are mainly blue but the outer petals are whitish with blue veins. The species is rare in Switzerland and occurs mainly in the north-eastern midlands, where it can be found in small groups in nutrient-poor wetlands or fens.

### BARN SWALLOW (*HIRUNDO RUSTICA*)

## Songbirds

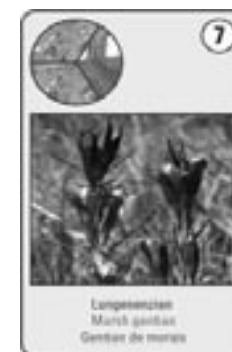


The barn swallow is easily recognized by its deeply forked tail and light brown throat and forehead. It feeds on insects that it catches in the air, and is a very versatile flier. In September swallows gather in large flocks to fly to Africa. The nests of barn swallows have an open top (whereas those of house martin are closed) and are often build under the eaves of barns and other buildings.

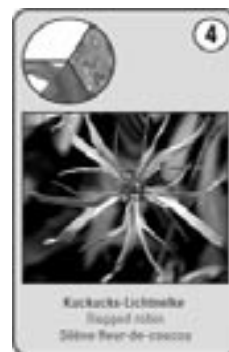
## Gentians

The shoots of the perennial marsh gentian grow 15-40 cm high. The oblong, narrow leaves (< 5 mm wide) are often recurved and have only a single vein. One to three large blue flowers grow in the axils of the uppermost leaves. They have green dotted lines on the inside and separate into five tips. Marsh gentian grows on moist bogs, heaths and reeds but has become scarce in the past few decades.

### MARSH GENTIAN (*GENTIANA PNEUMONANTHE*)



### RAGGED ROBIN (*LYCHNIS FLOS-CUCULI*)



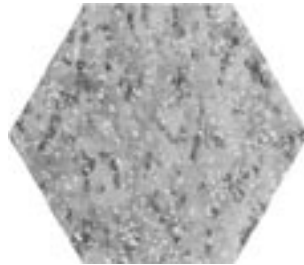
## Pinks

The herb, a member of the carnation family, produces a basal rosette and a branched flowering shoots 30-60 (-90) cm high. It flowers from May to July. The five pale pink petals are deeply divided. The nectar is concentrated in the receptacle and provides food to pollinating insects. Leaf hoppers are common on the stems of this species and produce a characteristic foam. The Ragged robin grows mainly in wet meadows, and it propagates mainly vegetatively by root suckers.



## GRASSLAND HABITATS II

Fertilizer increases the yield of grass, and heavily **FERTILIZED MEADOWS** can be mown twice or even three times a year. But many plants are lost when high amounts of fertilizer are used because they cannot compete in the tall, dense sward. Fewer plant species in fertilized grasslands also means fewer animal species; this is because many insects feed on only one or a few species of host plant, and even larger animals such as the hare may not find the variety of herbs they need for their diet. Furthermore, the frequent mowing of large areas is a danger to animals such as ground-nesting birds, fawns, and young hares because of the machinery used.



## VILLAGES

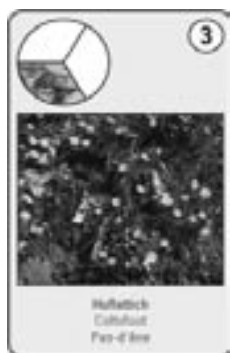
Today, rural villages provide habitats for numerous plant and animal species that were either introduced deliberately or have spread from the surrounding countryside. For example, the eaves of buildings and cracks in walls provide alternative resting or nesting sites for species of bats and birds. Some of the plant and animal species living in villages are highly specialised and therefore endangered.



## Daisy family

In the early spring, only the flower heads of coltsfoot are visible, emerging from the soil on scaly shoots. The flower heads contain yellow disk and ray flowers and mature into tufted seeds that are easily dispersed by the wind. True leaves only appear after the flowers fade. The large, heart-shaped leaves are at first felty. Coltsfoot grows in ruderal areas, such as along roads, in fields, embankments and in gravel pits.

### COLTSFOOT (*TUSSILAGO FARFARA*)



### MARGUERITE (*LEUCANTHEMUM VULGARE*)



Marguerites grow 20-80 cm tall and are in flower from May to October. The leafy stem terminates in a single daisy-like flower head composed of hundreds of tiny yellow disk florets surrounded by about 20 large white ray florets. The leaves are spatulate and have toothed margins. The marguerite is a common and variable species that grows in fertilized and natural meadows, on fallow land and on roadsides.

### CRESTED NEWT (*TRITURUS CRISTATUS*)



### Salamanders **HIGHLY ENDANGERED!!**

The crested newt has a brownish-black skin with bright orange underside with indistinct rounded black spots and a silver strip on each side of the tail. In contrast to lizards, they have a moist skin. Only breeding males have the characteristic high crest from behind the head to the end of their body and continuing less toothed along the tale. In spring and early summer crested newts live in still or slow-flowing shallow water. Afterwards they live on land near their breeding places and are active at night.

## Daisies

Dandelions form basal rosettes with sinuated-dentated leaves with a single hollow flowering stalk emerging from its centre. All parts of the plant contain a milky white latex. The yellow flower heads appear in April / May and are made up of a large number of ray florets. Although the flower heads are visited by insects, the seeds ripen without being pollinated. With their downy appendage the seeds are easily dispersed by the wind (<blowball>). Dandelions have deep taproots which can be as much as 2 m long. Dandelion is a very common species, especially in fertilized meadows, along waysides and on waste-ground.

### DANDELION (*TARAXACUM OFFICINALE*)



### SIX-SPOT BURNET (*ZYGAENA SPEC.*)



The six-spot burnet is named after the six red spots on its black-bluish coloured forewings. These striking colours warn predators that this insect is not good to eat. The transparent hind wings are visible only during take-off and landing and when the insects adopts an alarm position. The antennae are thickened towards the tips. The species is active during daylight and can be observed throughout the summer in flower-rich, sunny sites. Eggs are laid individually on the food plants, particularly on field scabious and thistles. The caterpillar feeds mainly on plantain and birdsfoot trefoil. In late spring the adults emerge from parchment-like cocoons fastened to plant stalks.

## Burnets

## Cabbage family

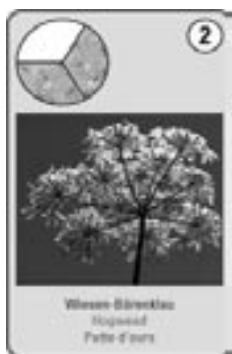
The cuckoo flower or lady's smock is a common spring flower in nutrient rich, moist grasslands and around springs. The flowers with their four white or pale pink petals are organised in a loose terminal spike on stems 20-30 cm tall. The leaves of the basal rosette and the flowering stalk are pinnately divided, with a larger apical leaflet and several pairs of smaller lateral leaflets. Cuckoo flower has a typical cress-like smell. Leaf hoppers are common on the stems.

## CUCKOO FLOWER (*CARDAMINE PRATENSIS*)



Carrot family

## HOGWEED (*HERACLEUM SPHODYLIUM*)

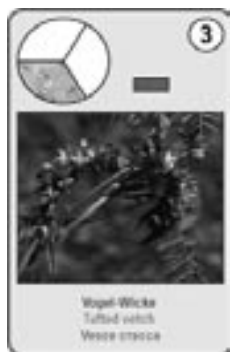


«If the stems are chiselled and scrabous, then it is clearly hogweed» (German proverb). The large umbel with numerous white flowers open in late summer (June-September). Young leaves are tasty for cattle, but the older ones become too prickly and tough. Hogweed grows in meadows on nutrient rich, fresh soils, along watersides and on embankments.

## Pea family

The tufted or bird vetch has the typical leaves of all vetches, divided into 5-15 opposite pairs of leaflets and with a tendril at the tip. Their violet blue flowers are arranged in a crowded, one-sided spike with a long stalk. The fruit is a pod containing 2-8 seeds; these are scattered when the pod dries out and opens. The species is common in meadows, hedgerows and field margins.

## TUFTED VETCH (*VICIA CRACCA*)



## GRAVEL PITS

Gravel pits may seem like lesions in the landscape but they can support a large number of species, some of them endangered. Large machines produce a mosaic of different types of habitat such as ditches and depressions, banks, stone cairns, sand heaps and gravel flats. Because of the disturbance from digging they are dynamic habitats, and it is not surprising that many of the species living there originate from flood plains. Gravel pits that are still in use show the early stages of ecological succession and are colonised by typical pioneer species. Amphibians in particular benefit from these conditions, because they need flat, open waters for spawning, as well as hiding sites covered by vegetation. Many bird species also do well in gravel pits; these include the sand martin, that nests in sandy cliffs, and the little ringed plover, a species that has almost disappeared from natural habitats.





## Cattail family



## CATTAIL (*TYPHA LATIFOLIA*)

Common cattail is a tall aquatic perennial, growing 2.5 m high in favourable conditions. The flowers are arranged in dense spikes and there are no petals. The upper part of the spike is composed of male flowers, while the lower part is the female portion. Seeds are tiny nutlets dispersed by the wind. The 1-2 cm wide leaves grow taller than the flowering spikes. Cattail is regarded as an indicator of high nutrient conditions in wet meadows and lakes.

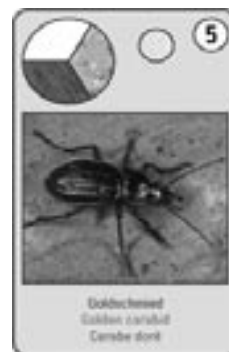
## WATER CROWFOOT (*RANUNCULUS FLUITANS*)

The water crowfoot grows up to 6 m long and occurs in fast flowing, mostly cool and shallow rivers (no deeper than 2 m). The submersed leaves are finely divided, long stemmed and up to 30 cm long. The white flowers reach out of the water. Seeds are mainly distributed by waterfowl.

## Buttercups



## GOLDEN CARABID (*CARABUS AURATUS*)



## Carabids

This 2-3 cm long beetle belongs to the group of metallic shining day-active carabids. Conspicuous features are the longitudinal stripes on the outer wings and the large, wide shield. It is a flightless species and the outer wings are fused together. The first individuals can be seen in April in fields and meadows where they mate and lay their eggs. The predatory larvae hatch after 3-10 days; they moult three times before they pupate belowground. The adult beetles emerge in autumn. The golden carabid is a voracious predator that feeds mainly on snails and other insects. It is a useful species because it reduces the numbers of various pests such as the potato beetle.

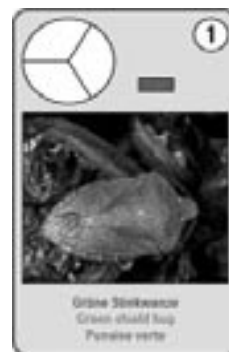
## Beetles

This 1 cm long beetle can hardly be seen during the day. Both sexes have light-emitting organs, glowing at dawn to attract the other sex. However, in dense populations the insects apparently find their partners without glowing, and so these populations can easily be overlooked. While males have fully developed wings, the flightless females have only rudiments. The body of glow-worms is covered with dark hair. Their preferred habitats are meadows, forest edges, hedges and gardens. Both the adult beetle and the larvae feed on snails.

## COMMON GLOW-WORM (*LAMPYRIS SPLENDIDULA*)



## GREEN SHIELD BUG (*PALOMENA PRASINA*)



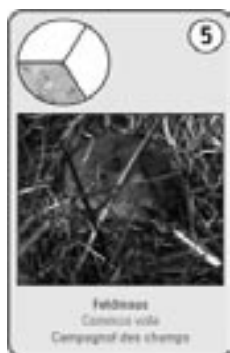
## Bugs

As the name green shield bug suggests, this 1-1.4 cm long bug with has a flattened shield-shaped body. In summer it is bright green but it darkens to a brown colour in autumn. For protection it releases a stinking scent. With its long sucking mouthparts the insect feeds on plant sap; when not in use these structures are hidden underneath the body. To find mating partners, shield bugs makes grinding sounds with the hind legs. Eggs are deposited on the upper sides of grass leaves and larvae hatch and are sexually mature after five moults. Green shield bugs can be found in bushes and flower umbels and are common in meadows, forest edges and hedgerows.

## Mammals

The light brown common vole has a shorter tail and smaller ears than the house mouse. The species prefers open habitats (fields, meadows, pastures). It digs a branched runway system with tunnels just beneath the soil surface. It feeds mainly on roots, but also on grass shoots and seeds. Predators are raptors, foxes and cats. Common voles reproduce rapidly with 3-7 litters a year with each 4-13 naked blind pups. The pups are independent and sexually mature after three weeks and may thus lead to vole population outbreaks.

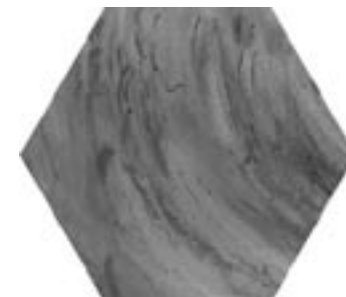
### COMMON VOLE (*MICROTUS ARVALIS*)



## LAKE AND RIVER HABITATS

Lakes are standing water bodies and provide two strongly contrasting types of habitat, the water body and the shoreline. Water level, water quality and wave motion are the decisive factors determining which species of plants and animals live in these habitats. Many lake organisms are very sensitive to water quality, and are easily killed if the water becomes contaminated with nutrients or pesticides originating from cultivated land.

The floodplains of rivers are unstable environments that are affected by the rapid changes in flow. At times of low water, a floodplain can be a very dry place, but when the river floods the whole area is submerged and banks of gravel and sand may be deposited or swept away. Natural shoreline vegetation and alluvial forests are now rare because of engineering works to control the flow of rivers. Today, many floodplain habitats such as gravel banks, undercut slopes and forested islands are absent from most larger streams and rivers.



## Mammals

### ENDANGERED!!

The dawn and night active hare can be distinguished from rabbits by its larger size (50-70 cm), longer hind legs and longer ears. As a typical inhabitant of open sites, hare populations markedly decreased in recent times due to habitat destruction from the intensification in agriculture. It is vegetarian and feeds on plants. It is a prey to raptors, martens and foxes. Population sizes fluctuate considerably from one year to the next: while 3-4 litters with 2-4 pups can survive in dry, warm springs and summers, few offspring survive when the weather is rainy or cold.

## EUROPEAN HARE

(*LEPUS EUROPAEUS*)



Song birds

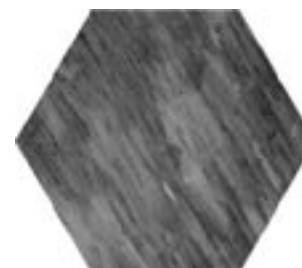
## COMMON KESTREL

(*FALCO TINNUNCULUS*)



The kestrel is a raptor with a reddish-brown upper side and with a blue-grey head and tail. It is often seen in stationary flight, with quivering wings and depressed tail, as it searches the ground for prey (small mammals, birds and insects). The kestrel is still quite common, but populations are declining due to habitat destruction and shortage of prey. For nesting, kestrels use the deserted nests of crows, or find sites in church towers and hollow trees. The 4-6 eggs hatch after about one month and young birds are fed for another month before leaving the nest. Kestrels are flexible birds that are able to adapt to rapidly changing landscapes.

## ARABLE HABITATS



The impact of management is strongest in arable habitats. The diversity of wild animal and plant species strongly depends on which crop species is planted and the way it is cultivated. In most arable fields, conditions for rapid plant growth are favourable because of irrigation and fertilization but there is an annually recurring sequence of disturbance (sowing, soil working, harvest). The habitat is suitable for undemanding species – ubiquists – with

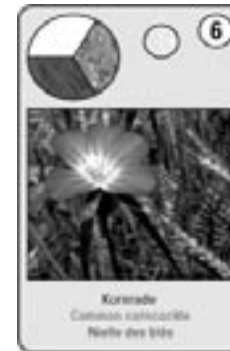
no special habitat requirements, and for specialists adapted to particular crops. Many of these species were introduced by the import of seeds from South Eastern Europe and Asia when agriculture began in Central Europe and have since become naturalised.

Recently, some of these traditional arable species, such as crown-of-the-field or Venus's looking-glass, have become rare or disappeared due to improved methods for cleaning grain. Others, like the poppy and cornflower, have declined because of the use of herbicides. Yet other reasons why species have been lost include the removal of accompanying habitats such as hedgerows, which are important for many insects, birds and small mammals.

## Daisy family

This annual plant with its typical smell has long been appreciated as a medicinal herb due to its high contents of essential oils. It is native in Southern Europe and Asia Minor. Leaves are finely dissected. It can be distinguished from similar species by the prominent yellow flower heads, which are concave under the disk flowers, and the downwardly bent white ray flowers. It occurs in fields and ruderal areas and along roadsides, and flowers between May and September.

**CAMOMILE**  
(*MATRICARIA RECUTITA*)

**COMMON CORNCOCKLE**  
(*AGROSTEMMA GITHAGO*)

 Pink family  
**ENDANGERED!! POISONOUS!**

The corn cockle came originally from eastern Mediterranean areas. It has conspicuous purple flowers borne individually on stems 90 cm high and covered in silky hairs. The flower has long pointed sepals that project beyond the petals, and these may account for the name 'puck needles' sometimes used for this species. The corncockle grows in arable fields and in ruderal sites. In the past it was a common species because farmers distributed its seeds when they sowed cereals. However, because of more effective seed cleaning methods, it is now scarce. The seeds are poisonous.

**CORNFLOWER**  
(*CENTAUREA CYANUS*)


## Daisy family

Cornflower is an annual plant introduced from the Mediterranean with other agriculturally used species. It is 30-60 cm high, and has a whitish pubescent stem and narrow elongated leaves. The flower heads are composed only of disk flowers. The outer ones do not produce seeds but are enlarged asymmetrically and bright blue in colour. The cornflower grows in sandy fields and ruderal areas. Its seeds were distributed in the grain of cereals, and it was formerly much commoner than it is today.

 Bellflowers  
**ENDANGERED!**

The Venus' looking glass is 10-40 cm tall, and its roots extend up to 15 cm into the soil. The stalk is glabrous and branched with oblong entire leaves. The bell-shaped calyx with its fused petals is dark purple and whitish-green towards the base; sepals project out beyond the petals. Venus's looking-glass originally came from the Mediterranean area. It prefers base-rich, calcareous soils in fields. The species is endangered throughout Switzerland.

**VENUS' LOOKING GLASS**  
(*LEGOUSIA SPECULUM-VENERIS*)


## Daisy family

This is a deep rooting species (up to 2.8 m) that spreads by means of underground rhizomes. It is very unpopular among farmers because it resprouts vigorously after cutting, making it difficult to eliminate. The leaves of the Canada (or Creeping) thistle are covered with numerous marginal spines, whereas the branched stems are not conspicuously spiny-winged. Individual plants are either male or female (i.e. dioecious) but both sexes bear purple flower heads of similar appearance. The downy seeds are wind-dispersed. The creeping thistle is a very common agricultural weed and is also found on roadsides.

**CANADA THISTLE**  
(*CIRSIIUM ARVENSE*)

**SKYLARK**  
(*ALAUDA ARVENSIS*)


## Songbirds

This small migratory bird returns from its wintering grounds in South-eastern Europe in March. Its plumage is grey-brown streaked and lighter-coloured on the underside and it has a small crest of feathers on the head. In summer, skylarks are easily seen because of their singing flights which last for several minutes. In summer they mainly eat insects but in winter seeds are an important part of their diet. The females lay 3-5 eggs in a nest on the ground, and these hatch after two weeks. The nestlings are fully fledged after 8-10 days, and the adults start a new breeding season. Skylarks mainly occur in structured agricultural landscapes, and can also be seen in meadows or fallow lands.