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Population Size of Common Species

The Z8 indicator "Population Size of Common Species" is designed to reveal long-time changes in the populations of common animals and plants of select species groups. It is based on surveys of individual species conducted in the two BDM sampling networks established for the "Species Diversity in Landscapes (Z7)" and "Species Diversity in Habitats (Z9)" indicators. Common species make up the major share of the living biomass, supplying an abundant food resource for other organisms. Characterized by large populations and wide distributions, common species shape the appearance not only of their habitats, but also of landscapes as a whole. For this reason, changes in their distribution as recorded by Z8 often reflect developments taking place in Switzerland's normal landscape, providing insights also revealed by other BDM indicators (such as the Z12 indicator "Diversity of Species Communities").

The latest results obtained for various taxonomic species groups suggest that in the 2005–2014 survey, especially species already widespread and making no particular demands on their habitat have become more common. In the vascular plant group, species typical of early stages of forestation have been increasing their populations. As regards butterflies, ubiquists in particular continue to enlarge their ranges. At the same time, however, special analyses indicate that threatened butterfly species and habitat specialists are on the decline. However, significant changes recorded for individual species cannot always be attributed to landscape transformation. Even mollusk experts, for example, have yet to find an explanation for the conspicuous increase in snails.

Status: August 2015

Contents

The Z8 indicator monitors the development of common species populations nationwide as well as in individual biogeographical regions and habitats. It is wholly based on data provided by BDM indicators “Species Diversity in Landscapes (Z7)” and “Species Diversity in Habitats (Z9)”.

A species’ population development is derived from its distribution within the extensive BDM sampling grid (occupancy rate) and its frequency within sampling areas (abundance). Distributions of vascular plants, breeding birds and butterflies in landscapes are computed based on data gathered in roughly 500 sampling areas covering 1 square kilometer each, while distributions of vascular plants, mollusks (snails) and mosses in habitats are computed based on data gathered in just under 1500 sampling areas covering 10 square meters each. Sampling areas are evenly spread over Switzerland’s expanse, covering both near-natural areas and areas subjected to land use.

While Z8 computations regarding vascular plants, mosses and breeding birds are solely determined by the presence or absence of a species in a sampling area, species frequency in individual sampling areas is also taken into consideration for mollusks and butterflies. Changes in the population sizes of common species are especially meaningful because in the long run, they may reshape whole habitats and even landscapes.

Delimitation of common and dominant species

Distributed across Switzerland in a regular grid, the sampling areas of BDM indicators “Species Diversity in Landscapes (Z7)” and “Species Diversity in Habitats (Z9)” above all capture common species. Less common species are not being registered as reliably, since sampling grids are not geared to their habitats and only cover just over 1% of the country's expanse as a whole. For this reason, Z8 can hardly offer any detailed insights into changes in the population sizes of rare species (cf. “Population Size of Endangered Species (Z6)”.

For any species to be considered “common”, it must occur in at least 20 sampling areas in the survey 2010-2014 (2009-2013 for mollusks). Figures 1 and 2 below illustrate the number of species recorded in at least 20 sampling areas using BDM methodology.

Of these “common species”, the most common 25% were then labeled to be “dominant species” by BDM. “Dominant species” distinctly mark the appearance of a landscape, as they are widespread and found in many diverse sampling areas.

Fig. 1: Shares of common species in Switzerland's landscapes (Z7)

Shares of common species evidenced in at least 20 BDM sampling areas, with 25% representing "dominant" species. All other species were found in fewer than 20 sampling areas.

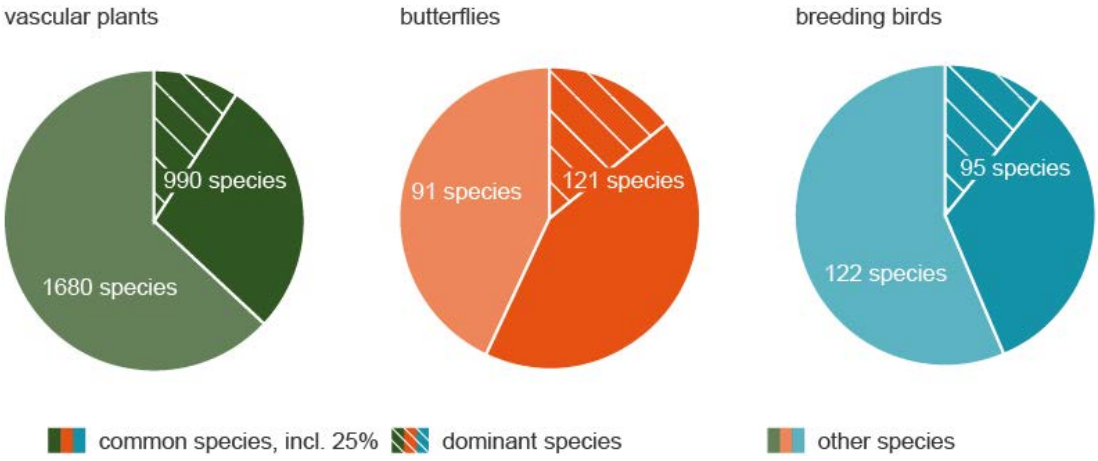

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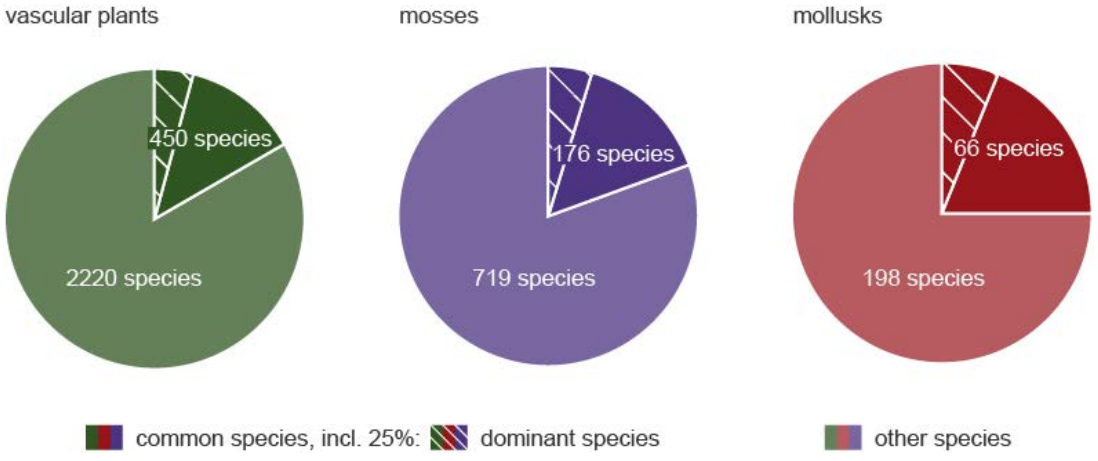
Fig. 2: Shares of common species in Switzerland's habitats (Z9)

Shares of common species evidenced in at least 20 BDM sampling areas, with 25% representing "dominant" species. The statistical populations consist of the numbers of species allowed to be recorded using BDM methodology.



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Development of dominant species

Human activities often cause common species to expand their ranges even more. Figures 3 and 4 below illustrate the development of dominant species.

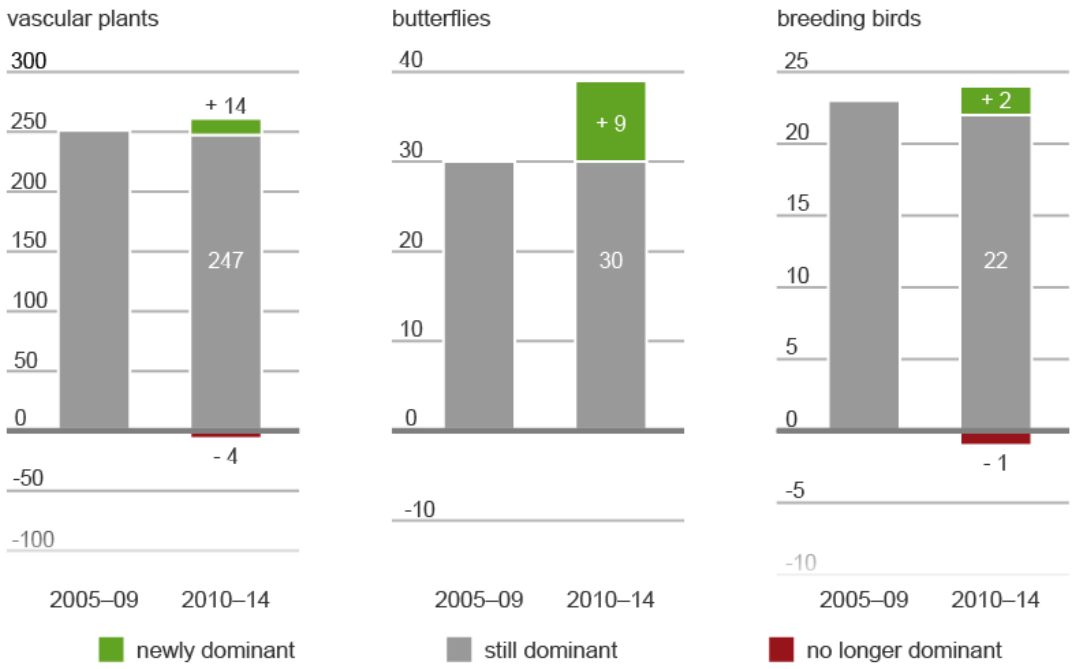
The baseline is established by the numbers of dominant species found in the 2005-2009 survey. Figures 3 and 4 show how many species were still, newly or no longer as widespread in the following 2010-2014 survey.

In the 2005-2009 reference period, a dominant (as defined above) vascular plant species occurred in at least 33%, a dominant butterfly species in at least 34% and a dominant breeding bird species in at least 51% of sampling areas in Switzerland's landscapes (Z7 indicator).

As regards habitats (Z9 indicator), a plant species was considered dominant if it was recorded in at least 5.9% of sampling areas, with the corresponding shares for mosses and mollusks amounting to 6.7% and 9% respectively.

Fig. 3: Development of dominant species numbers in landscapes (2005–14)

Column charts show the numbers of species still (gray), newly (green) or no longer (red) being part of the dominant species in the 2010-2014 surveys. Baselines are provided by the frequencies recorded in the 2005-2009 surveying period (see running text above).

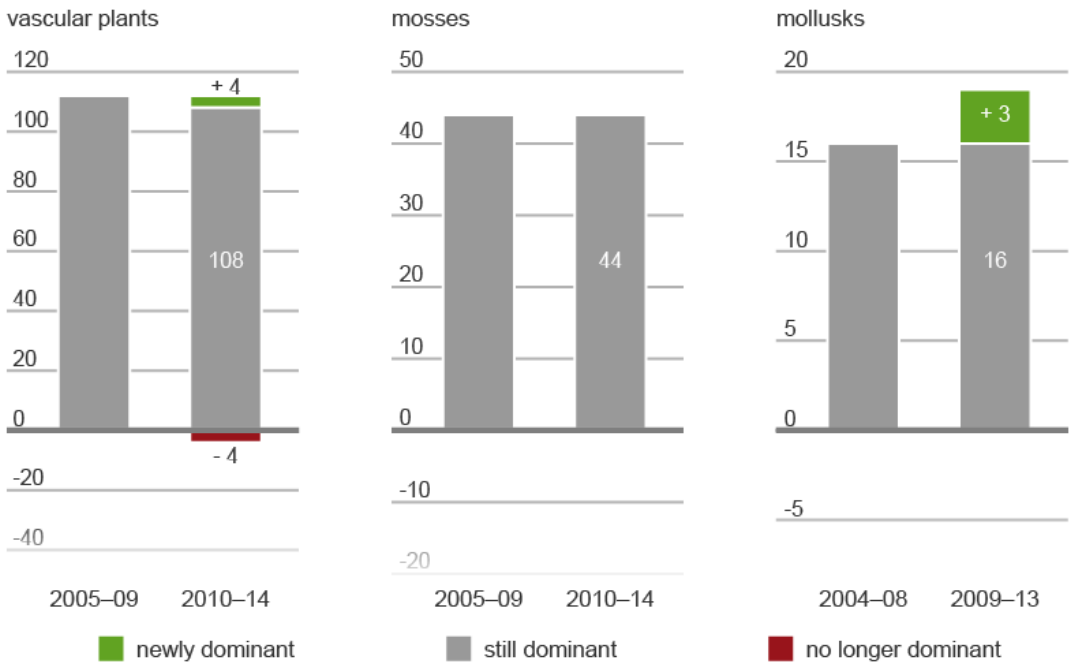


Interpretation example

In the 2005-2009 surveying period, the criterion established for dominant species was met by 251 vascular plant species occurring in at least 33% of BDM sampling areas (see above). 247 species remained dominant, still being registered in at least 33% of sampling areas in the 2010-2014 period. In the meantime, 14 species crossed the threshold to be newly considered dominant species, whereas 4 species disappeared from previously occupied areas, failing to meet the criterion as a result.

Fig. 4: Development of dominant species numbers in habitats (2005–14)

Column charts show the numbers of species still (gray), newly (green) or no longer (red) being part of the dominant species in the 2010-2014 surveys (2009-2013 for mollusks). Baselines are provided by the frequencies recorded in the 2005-2009 surveying period (see running text above).



Comments

- While surveys for the Z7 indicator “Species Diversity in Landscapes” are conducted in sampling areas covering 1 square kilometer each, sampling areas used for the Z9 indicator “Species Diversity in Habitats” only encompass 10 square meters. For this reason, landscapes hold a higher share of common species than habitats, which explains the differing species numbers observed for vascular plants as a species group monitored by both indicators.
- On the whole, butterflies feature a higher share of common species than breeding birds or vascular plants. Yet the dominant species among breeding birds can be found in considerably more sampling areas than dominant butterfly or vascular plant species. Some breeding birds, such as the Chaffinch or the Black Bird, occur in all of Switzerland’s major habitat types (forests, agricultural land, settlements). Such extreme generalists are hardly found among butterflies (see also “Development of select species” below).
- It seems that overall, more and more common species are extending their ranges in Switzerland, since the total numbers of dominant vascular plant (in landscapes), butterfly, breeding bird and mollusk species have been increasing between 2005 and 2014. This partly contradicts the findings of a much noticed study by Inger et al. (2015) putting forward that common species in Europe are distinctly on the decline, whereas rare species numbers tend to rise.

Development of select species

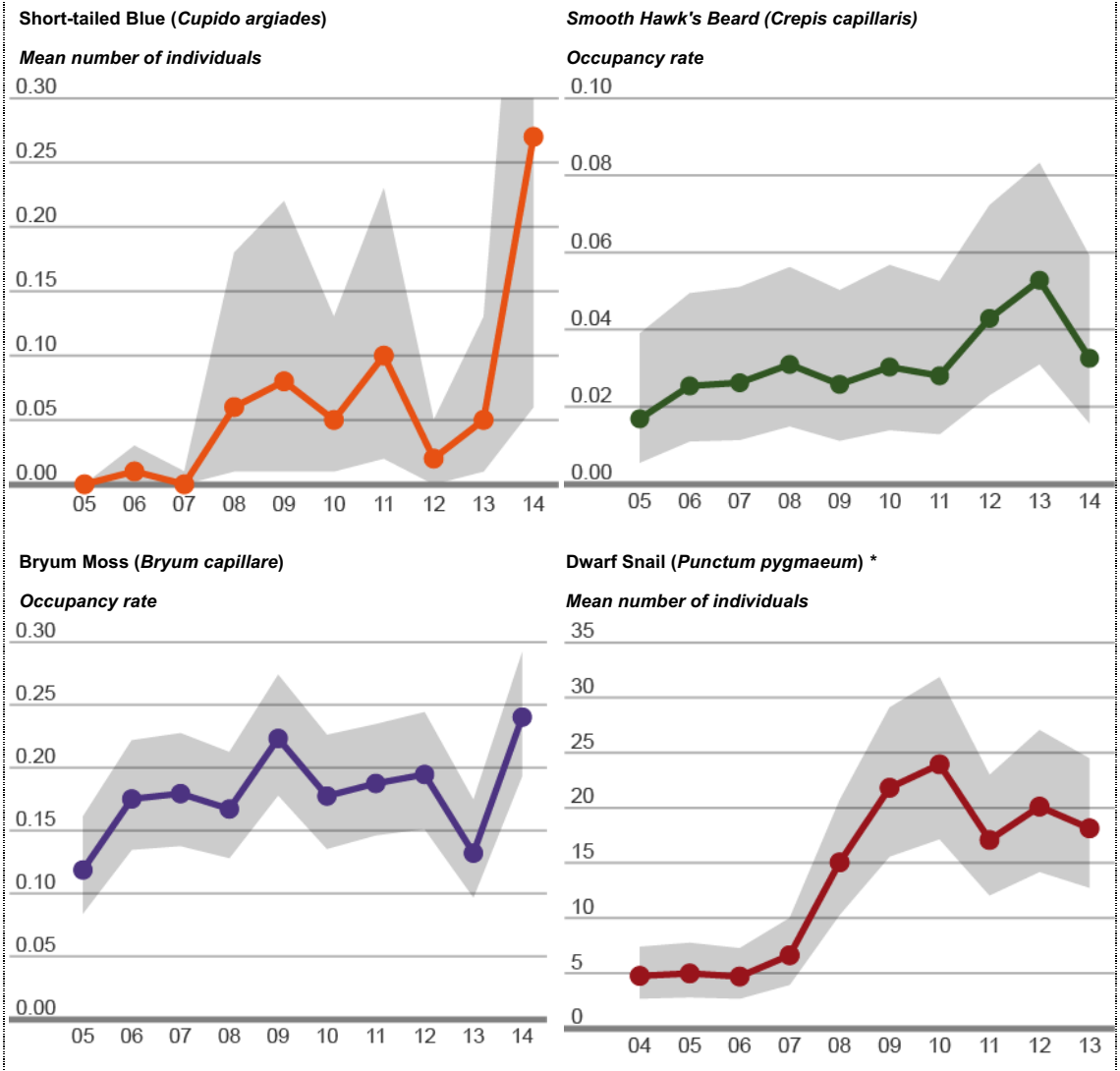
The previous chapter has been dealing with numbers and population changes of common and dominant species as a group. Below we will take a look at changes in the populations of select individual species.

Figure 5 shows the development of four select individual species over ten years. The four diagrams illustrate changes in the occupancy rates of a butterfly species, a vascular plant species, a moss species and a mollusk species in BDM sampling areas during this period of time.

For complete figures on the development of all species covered by BDM, please refer to attachments 3 to 7. Whether or not a population change may be considered to be statistically ascertained has only been tested for species observed in at least 20 sampling areas. Results would not be reliable enough for species recorded less frequently by BDM.

Fig. 5: Population size developments of select individual species (2005–2014)

Colored curves indicate shares of occupied BDM sampling areas, which supplied the base for nationwide estimates of corresponding occupancy rates of vascular plants and mosses as well as mean numbers of individual butterflies and mollusks. Gray shaded areas represent the 95% confidence interval of these estimates



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* Mollusk data refer to the 2004-2013 surveying period.

Comments regarding breeding birds

- One fifth of the species covered by BDM underwent statistically ascertained changes in distribution over the 2005–2014 survey. In this period of time, 22 species increased their ranges. The largest increase in frequency was recorded for the Eurasian Treecreeper (*Certhia familiaris*), which was observed in 27 additional sampling areas. The Song Thrush (*Turdus philomelos*) and the Mistle Trush (*Turdus viscivorus*) are also much more widespread than they used to be. On the other hand, 11 breeding bird species have been losing ground. With 15 sampling areas each found abandoned by the species, the Barn Swallow (*Hirundo rustica*) and the Common House Martin (*Delichon urbicum*) were affected by the biggest decline. 14 sampling areas no longer harbor the Common Swift (*Apus apus*).
- Major changes in distribution often lack statistical significance because large numbers of newly colonized sampling areas are offset by an equally large number of abandoned sampling areas. For example, the Common Kestrel (*Falco tinnunculus*) and the Black Woodpecker (*Dryocopus martius*) were recorded in 16 and 15 additional sampling areas respectively, without the statistical test yielding any change in occupancy rate. The same applies to the Common Cuckoo (*Cuculus canorus*) and the Common Buzzard (*Buteo buteo*), who were found to be missing from 16 sampling areas each.
- Note: Having built an even more extensive database, the Swiss Ornithological Institute is able to provide even longer-term population size trends of breeding birds (see link under “Further information”).

Comments regarding butterflies

- There was no significant change in population size registered for most of the close to 190 butterfly taxa included in BDM surveys. Still, 42 species presented significant changes in the 2005–2014 survey, the majority being increases. Only 15 species have declined in numbers. Whether or not these changes in population size reflect a longer-term trend, however, remains to be seen.
- Among the species distinguished by marked increases in range, fieldworkers identified two closely related heat-loving Blues: the Short-tailed Blue (*Cupido argiades*, see fig. 5) and the Provençal Short-tailed Blue (*Cupido alcetas*). Starting out from Western Switzerland, these two species have been greatly extending their areas of occupancy on the Central Plateau and in lowland Jura sites. Another butterfly now distinctly more widespread is the Six-Spot Burnet (*Zygaena filipendulae*), a species typical of poor grassland
- Butterfly populations respond more susceptibly to environmental factors such as annual weather conditions than bird and plant populations. For this reason, positive or negative trends are mainly determined by environmental and living conditions for butterflies being good or bad in any two surveying years compared. Regarding individual butterfly species, sustained trends relevant for the development of biodiversity are expected to emerge after extended periods of time only.
- Overall, current increases in population size are mostly being evidenced for common and widespread butterfly species. Focusing on threatened butterfly species as classified in Switzerland's latest Red List, however, reveals a significant decline in population sizes of this “species group” so important to nature conservation politics. At the same time, it becomes obvious that there are distinctly more red-listed and national priority species declining than increasing in numbers (cf. Z7 indicator).

Comments regarding vascular plants

- Between 2005 and 2014, population sizes of most vascular plant species remained unaffected by detectable changes. Whenever changes have been found, though, increases in population size distinctly exceed declines. Species displaying obvious changes make widely differing ecological demands on their habitat and cannot be attributed to any specific group. For example, increases have been recorded for several species typical of early stages of forestation, among them the Common Ash (*Fraxinus excelsior, +7%*), the Silver Birch (*Betula pendula*, +59%) and the Mountain Ash (*Sorbus aucuparia, +9%*). Trends observed for the Common Hazel (*Corylus avellana*, +12%) and

the Raspberry (*Rubus idaeus*, +4%) complement this picture. At the other end of the spectrum, ground has been lost by several alpine species like the Alpine Bistort (*Polygonum viviparum*, -9%) and the Small Alpine Lovage (*Ligusticum mutellinoides*, -41%), to name but two examples. The causes for their decline remain unknown for the time being.

Comments regarding mosses

- Population sizes of 86 moss species—corresponding to 17% of 506 species in total—are statistically ascertained to have been undergoing changes in the 2005–2014 survey. Increases and declines are observed with roughly the same regularity.
- A special analysis of BDM data shows that above all moss species growing on rock (lithophytes) such as *Heterocladium dimorphium* as well as moss species growing on other plants (epiphytes) such as *Bryum capillare** (cf. fig. 5) are on the upturn. These species might benefit from an increase in humidity and airborne nutrient supply. Unlike ground mosses, epiphytic mosses do not have to compete with vascular plants and may gain from the additional entry of nitrogen. The decline in sulfur dioxide air pollution has a positive impact on epiphytic mosses as well (Frahm, 2009).
- In settlements, typical concrete colonizers such as *Ceratodon purpureus**, *Syntrichia ruralis* and *Entodon concinnus* have been increasing at the expense of partially widespread moss species such as *Hypnum cupressiforme*, Switzerland's most common moss (cf. fig. 7b). This must (at least partially) be put down to the soil surface of settlement sampling areas being newly built on or paved. Sealed soil-surface sampling areas have increased by 16% within 10 years.
- For reasons of methodology, evidencing population size trends for individual species is harder when dealing with mosses. Particularly species being split into microspecies causes taxonomic classifications to keep changing, which makes precise identification tricky. Hence, BDM bases its reports about moss population size trends on the joint analysis of whole groups distinguished by similar ecological qualities rather than on changes registered for individual species.

Comments regarding mollusks

- Between 2004 and 2013, a total of 60 of the 168 snail species evidenced by BDM have significantly grown in population size (which corresponds to an increase of 36%). In the same period of time, however, not a single species has become significantly rarer. Increases primarily concern widespread species not making particular demands on their habitats (ubiquists) and snail species living in forests. Mollusk species already found to be widespread in the first surveys (2003-2007) tended to be identified in even more sampling areas when these were surveyed for the second time (2008-2012). These very common snails include a few species preferring warm climates.
- The most striking change recorded by the Z9 indicator "Species Diversity in Habitats" is the increase in both mollusk species and specimen numbers found in BDM sampling areas. This development is also made clearly apparent by the Z8 indicator (cf. fig 7c). However, no sound data analyses investigating the causes of this change have been published so far. According to a BDM poll among various mollusk experts, a general increase in mollusk population sizes might be caused by warmer, more humid conditions in their habitats. Such large-scale microclimatic improvements for snails could be the effect of denser vegetation, intensified moss growth, and more deadwood and leaf litter in forests. Climate changes might play a role in growing mollusk populations as well. For example, an experiment in the U.K. showed that milder winter temperatures result in an increase in specimen numbers of various mollusk species in grassland (Sternberg, 2010).

Widespread/common species

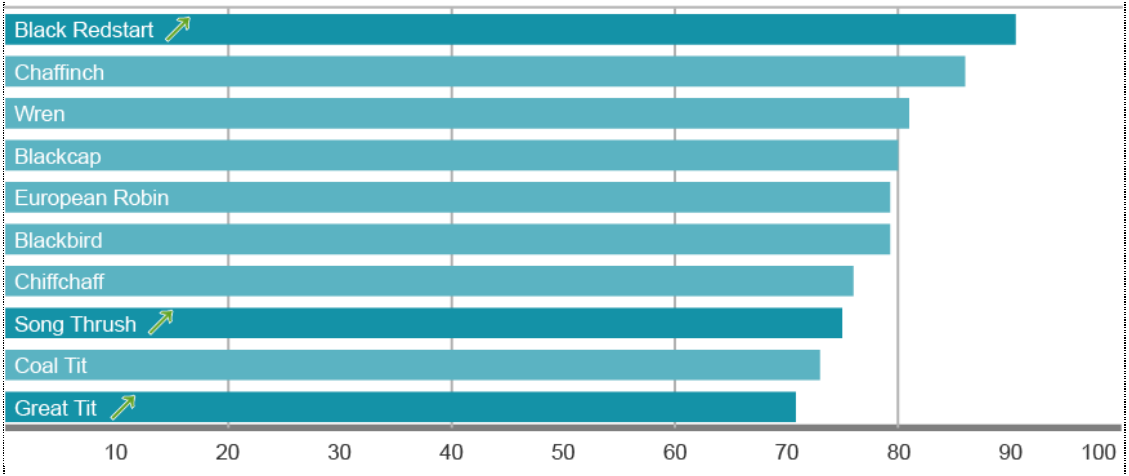
The bar charts below each show the ten breeding bird, butterfly, vascular plant, moss and mollusk species evidenced most frequently in BDM sampling areas. Extracted from the indicators “Species Diversity in Landscapes (Z7)” and “Species Diversity in Habitats (Z9)”, data refer to records gathered nationwide during the surveying period of 2010 to 2014 (2009 to 2013 for mollusks). Species having undergone significant changes are emphasized in darker color.

BDM uses aggregates and species complexes, grouping similar species in order to avoid misidentification. It comes as no surprise, then, that some of these aggregates and complexes (marked by an asterisk *) have been found to be particularly common.

For complete data tables and additional information please refer to Appendices 1 and 2.

Fig. 6a: Widespread breeding bird species in Switzerland’s landscapes (2010–2014)

Percentages of 393 one-square-kilometer sampling areas harboring a particular species

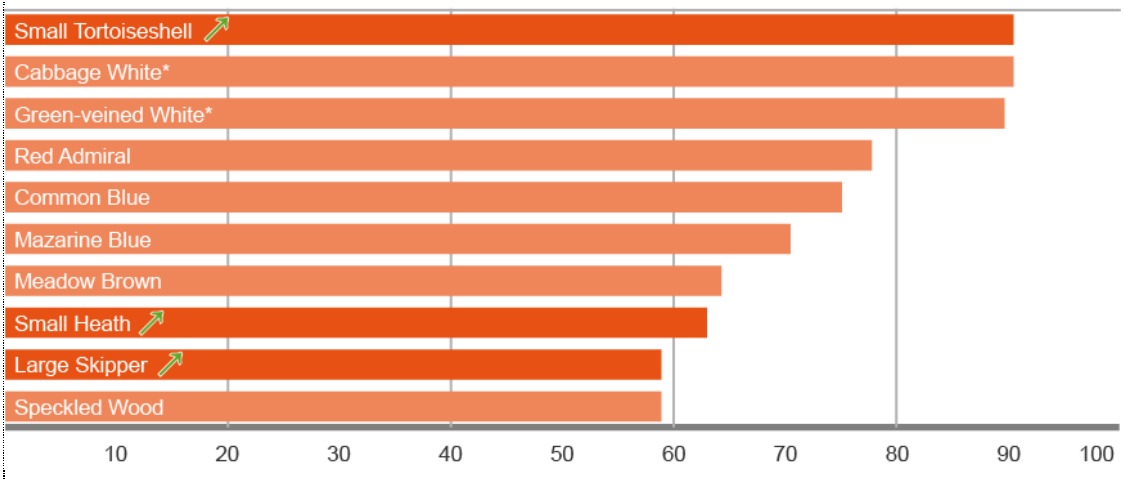


Comments

- Being a synanthropic species, the Black Redstart (*Phoenicurus ochruros*) benefits from urbanization. Since its range also extends into the high mountains, it has now become Switzerland’s most widespread breeding bird. The country’s other common breeding bird species mostly live in simple woody clump structures in the forest or in the vicinity of settlements. Breeding birds typical of agricultural land are hardly represented among the most common species anymore, as the intensification of agriculture has caused their populations to shrink considerably in past decades.

Fig. 6b: Widespread butterfly species in Switzerland's landscapes (2010–2014)

Percentages of 370 one-square-kilometer sampling areas harboring a particular species



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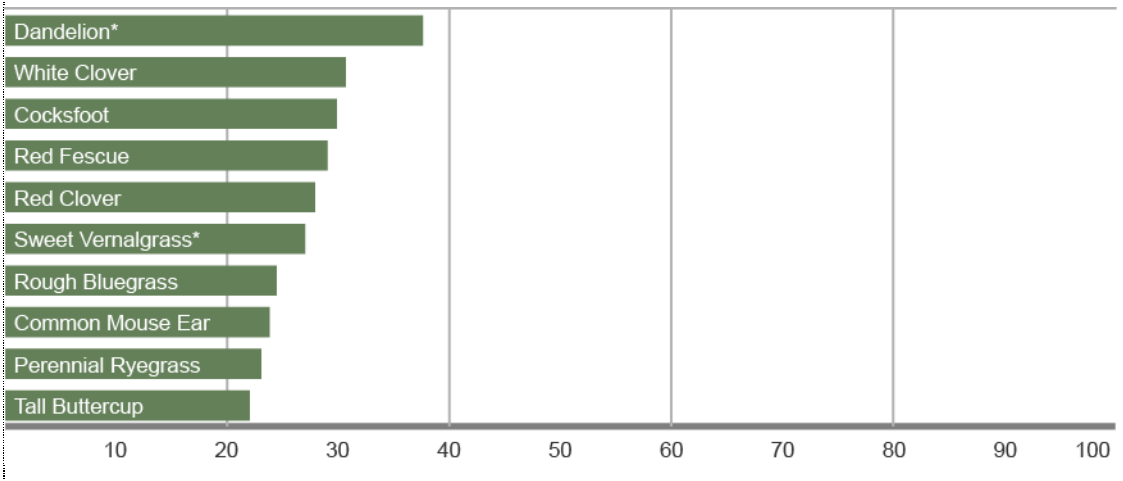
* Aggregates and complexes

Comments

- The Small Tortoiseshell (*Aglais urticae*) commonly occurs wherever its caterpillars find stinging nettles to feed on, be that at the forest edge, in a settlement or on an alpine pasture. The Red Admiral (*Vanessa atalanta*) is a migratory butterfly, making it liable to visit almost any region. Other common species include those able to reproduce in grassland and cropland subjected to normal use, such as the Small White (*Pieris rapae* complex*), the Common Blue (*Polyommatus icarus*) or the Small Heath (*Coenonympha pamphilus*), or those equally at ease in the fringe habitats of transitional areas close to forests, such as the Meadow Brown (*Maniola jurtina*) and Large Skipper (*Ochlodes venata*).

Fig. 7a: Most common vascular plant species in Switzerland's habitats (2010–2014)

Percentages of 1440 ten-square-meter sampling areas harboring a particular species



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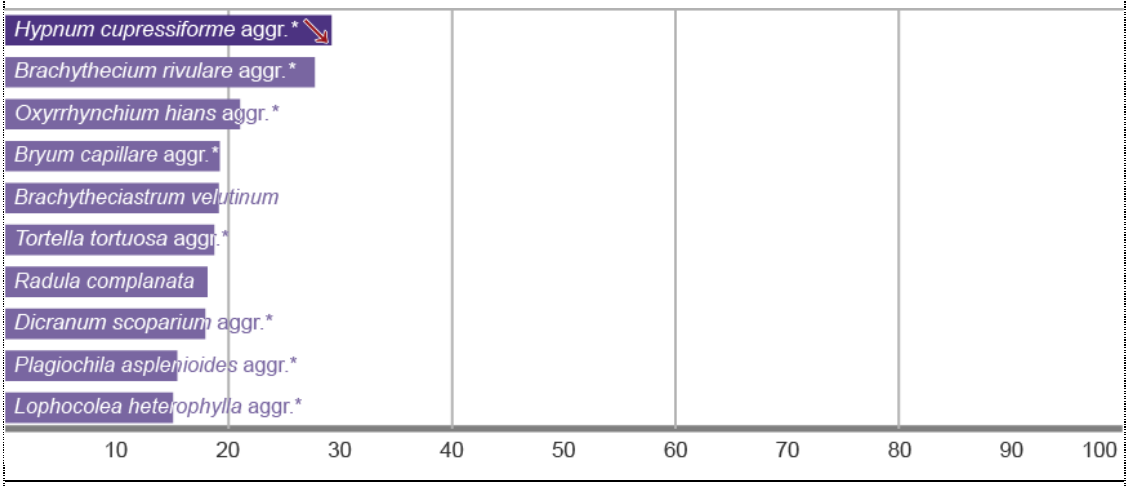
* Aggregates and complexes

Comments

Regardless of the predominant type of land use, Dandelion (*Taraxacum officinale**) is listed among the most common species in almost all regions and at almost any elevation. Dandelion has been identified in 38% of all sampling areas, with rankings by land use revealing it to be a dominant species not only on arable land and grassland, but also in settlements. Like Dandelion, Switzerland's most common plant species are mainly nitrogen indicators, doing best where soils are rich in nutrients. Accordingly, the common nature of such species indicates that this country's soils tend to be nutrient-rich.

Fig. 7b: Most common moss species in Switzerland's habitats (2010–2014)

Percentages of 1431 ten-square-meter sampling areas harboring a particular species



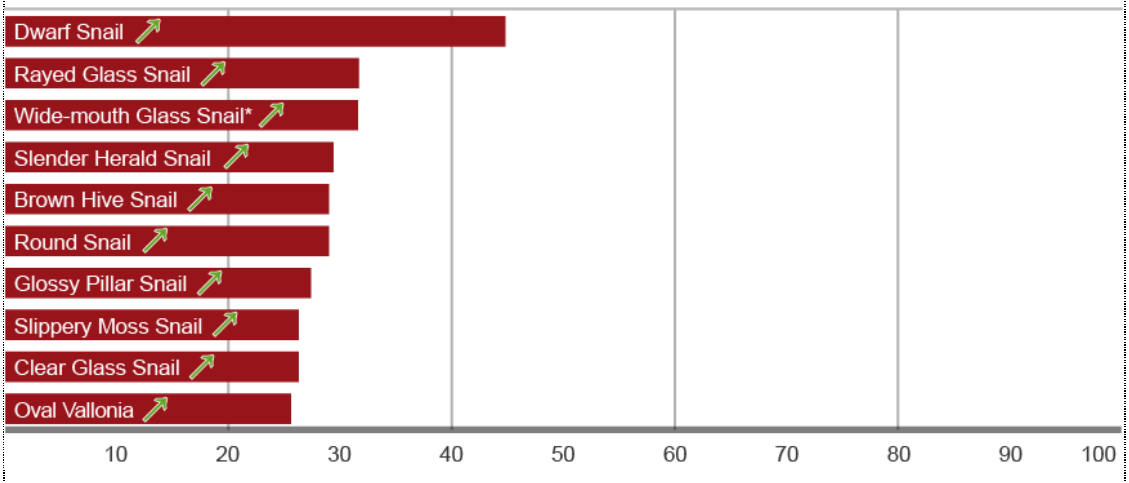
* Aggregates and complexes

Comments

- The ten most common moss species are almost exclusively forest mosses that occur at low altitudes up to the subalpine level. Most of them grow on humus-rich or clayey soils, with some occurring on rock or qualifying as deadwood specialists such as *Lophocolea heterophylla*. Switzerland's most common moss, *Hypnum cupressiforme*, is very adaptable, growing on soil, rock, deadwood, and living trees.

Fig. 7c: Most common mollusk species in Switzerland's habitats (2009–2013)

Percentages of 1396 ten-square-meter sampling areas harboring a particular species



* Aggregates and complexes

Comments

- Of the ten most widely distributed mollusks, the majority are small snail species (under six millimeters in length) occurring in all of Switzerland's regions. Generally rather undemanding in their choice of habitat, they live in both forest and open-land soils. In the survey, all ten species have been continuing their significant increase in frequency.

Widespread/common species in regions and habitats

Most species that are widely distributed in Switzerland overall rank among the most common species in the country's individual biogeographical regions as well. For detailed data on individual regions (diversity in landscapes) and habitat types (diversity in habitats) please refer to Appendices 3 to 7.

Significance for biodiversity

Common species are of great ecological importance because they make up the major share of the living biomass, supplying an abundant food resource for other organisms. Ecosystem services are primarily provided by common species as well. Furthermore, common species shape the character of individual habitats and even whole landscapes (Gaston & Fuller, 2008). The most frequent plant species define a habitat's typical appearance: Rich pastures, for example, get their typical structure from only a few grasses and herbs.

Common species mostly colonize habitats which are part of the "normal landscape", or they are so undemanding that they are able to live in a wide range of different habitats. Changes in the populations of common species point to the appearance of habitats and even landscapes as a whole being transformed. Modified grassland management, for example, can markedly change the species mixture

and the look of cultivated land, be it through increased or decreased liquid manuring, changes in the timing of grass cuts or in the stocking of pastures, or choosing a different crop rotation. Establishing ecological compensation areas can impact species diversity as well.

Small populations of rare or threatened species largely depend on the fortuity of the weather or the reproductive success of one single year. Conversely, the populations of common species are robust, tending to respond to change in a sluggish manner. For this reason, common species act as reliable indicators of change in the normal landscape. But except for bird and forest tree species, common species used to be hardly monitored at all. BDM has closed this gap, at least as far as vascular plants, butterflies, snails and mosses are concerned.

If common species become more common and more widely distributed at the expense of rare species, this development has a negative impact from a biodiversity point of view, since it trivializes and standardizes species communities in habitats. Whether or not this is actually happening in Switzerland is monitored by the indicator “Diversity of Species Communities (Z12)”.

Definition

Changes over time in the frequency (vascular plants, mosses and breeding birds) or abundance (mollusks and butterflies) of select widespread and common species occurring in BDM sampling areas.

Surveying methods

The indicator “Population Size of Common Species (Z8)” uses data gathered for the indicators “Species Diversity in Landscapes (Z7)” and “Species Diversity in Habitats (Z9)”, taking into account only species evidenced in at least 20 sampling areas in the 10 surveying years (2005–2014). Such species are referred to as “Z8 species”.

Whether or not the population sizes of Z8 species have undergone significant changes in the 10 surveying years is assessed by means of generalized linear mixed models (GLMM). As regards vascular plants, mosses and breeding birds, these assessment focus on the occurrence (i.e. the presence or absence of a species in a sampling area), while mollusks and butterflies are registered by frequency (i.e. the number of individuals). Accordingly, BDM uses a GLMM with binominal distribution for vascular plants, mosses and breeding birds, and a GLMM with Poisson distribution for mollusks and butterflies. Significant changes ($0 \leq p < 0.05$) are reported as increases or declines.

Further information

In charge of this indicator

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Related indicators

> "Diversity of Species Communities (Z12)"

Additional sources of information

> Comprehensive information on the Federal Office for the Environment FOEN: http://www.bafu.admin.ch/?lang=en

> Comprehensive information on the Swiss National Forest Inventory: www.lfi.ch

> Distribution maps of Swiss vascular plant species (in German): www.wsl.ch/land/products/webflora

> Inventory of the Swiss moss flora (in German): www.nism.unizh.ch

> Comprehensive information on the Swiss Association for the Protection of Birds (mostly in French and German): www.birdlife.ch

> Comprehensive information on the Swiss Ornithological Institute Sempach: www.vogelwarte.ch

> Comprehensive information on Switzerland's bird species recovery program (in German and French): http://www.artenfoerderung-voegel.ch

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Appendices

> Appendix 1: Widespread species in Switzerland's landscapes

> Appendix 2: Common species in Switzerland's habitats

> Appendix 3: Population sizes of surveyed species: breeding birds

> Appendix 4: Population sizes of surveyed species: butterflies

> Appendix 5: Population sizes of surveyed species: vascular plants

> Appendix 6: Population sizes of surveyed species: mosses

> Appendix 7: Population sizes of surveyed species: mollusks

This information is based on the German-language document 1360_Z8_Basisdaten_2014_dt_v1.docx dated May 26th, 2016.