Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Department of the Environment, Transport,
Energy and Communications DETEC
Federal Office for the Environment
Biodiversity and Landscape Division

Biodiversity Monitoring in Switzerland

Current State and insights into Plant-Pollinator Interactions

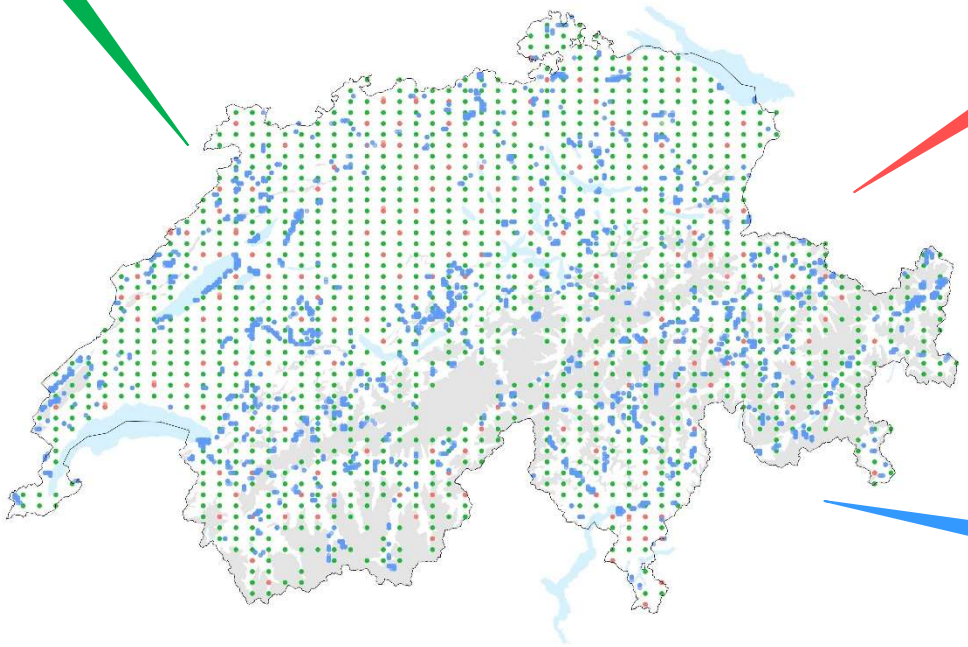
Dr. Jérôme Frei, Federal Office for the Environment
Dr. Tobias Roth, Hintermann & Weber AG

Biodiversity Monitoring in Switzerland

Relevant programs collecting data on plants and pollinators

Biodiversity Monitoring Switzerland (BDM)

- National overview/reference
- Common species and landscapes
- less suited for targeted policy evalulation



Farmland Biodiversity Monitoring (ALL-EMA)

- Focused on agricultural landscapes
- Target and flagship species
- Covering most important agroecosystems
- Evaluation of agrienvironmental policies

Monitoring of Effectiveness of Habitat Conservation (WBS)

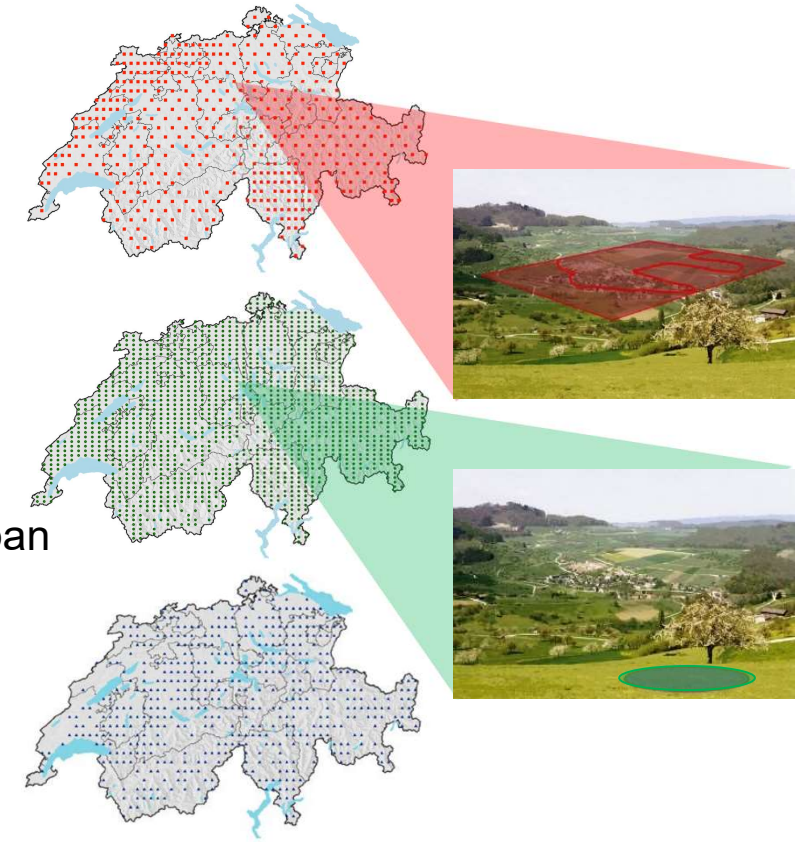
- Focused on protected habitat
- Covers rarer species and habitats
- Evaluation of protection policies
- Used by practice for early detection of changes

Biodiversity monitoring Switzerland (BDM)
The basic structure since 2001

«Landscape» sampling grid
- 450 x 1 km^2
- Transects of 2.5 km
- Organisms: **plants**, **butterflies** and breeding birds

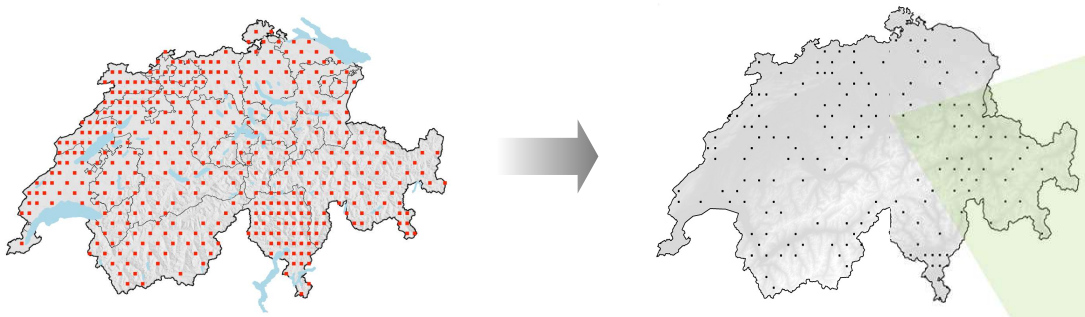
«Habitat» sampling grid
- 1'450 x 10 m^2
- Organisms: **plants**, mosses and molluscs
- Habitats: forests, meadows and pastures, urban areas, arable land, mountainous

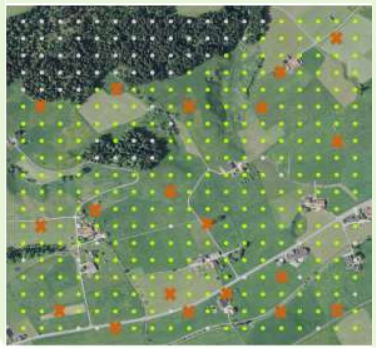
«Watercourse» sampling grid
- 500 sections from 5 to 100 m
- Aquatic insects (EPT)



Agricultural Species and Habitats (ALL-EMA)

Focus on farmland and agrienvironmental policies

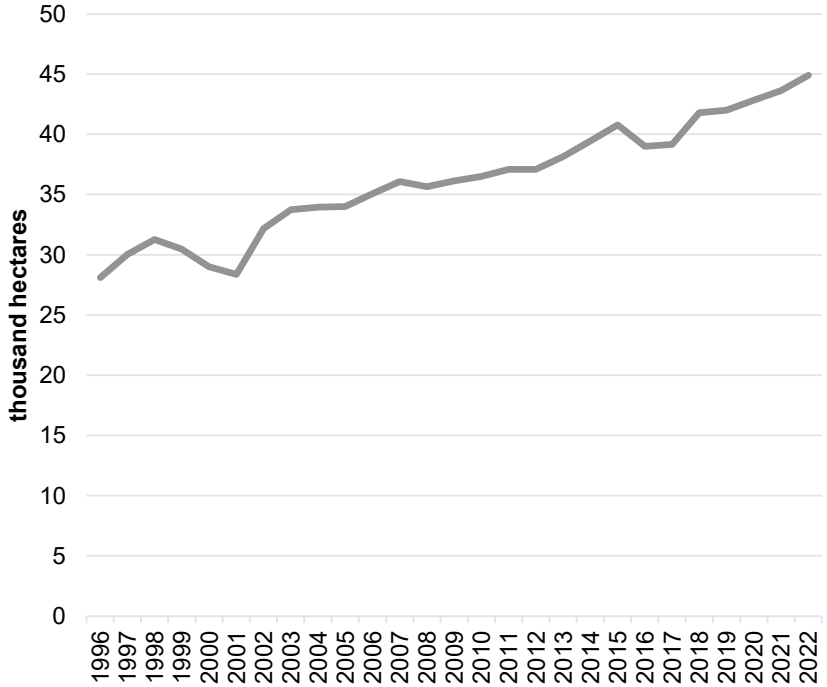


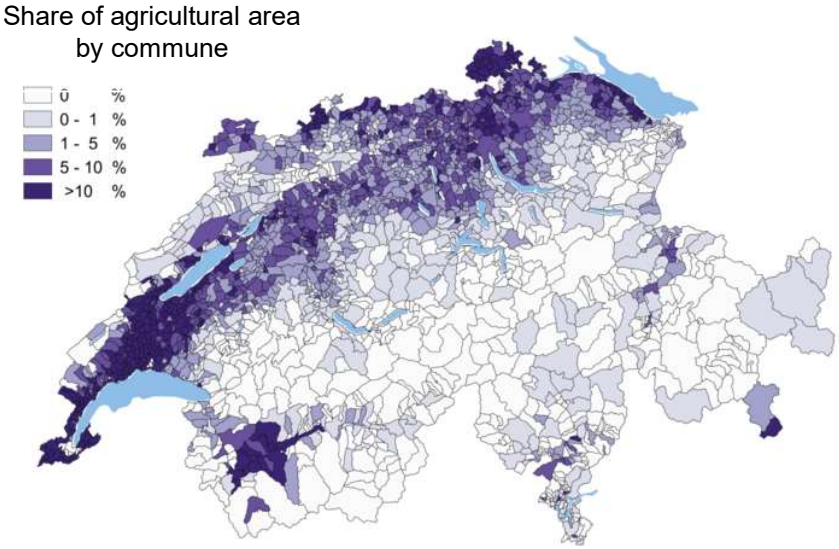


- Since 2015 every 5 years
- Targeted additional surveys in farmalnd of 170 x 1 km^2 of BDM
- Common data with BDM: butterflies and birds
- Additional surveys of plants and habitat types in the agricultural landscape
- Additional surveys for biodiversity promotion area (BPA)

National statistics can also help…

Agricultural areas whose production directly benefits from insect pollination



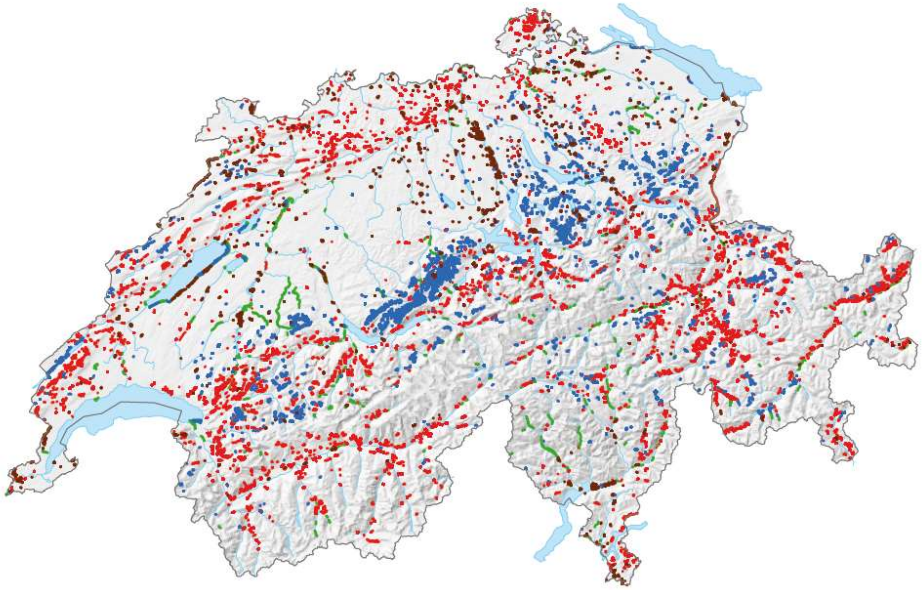


FSO and Sutter et al. 2017a

Monitoring of Effectiveness of Habitat Conservation (WBS)

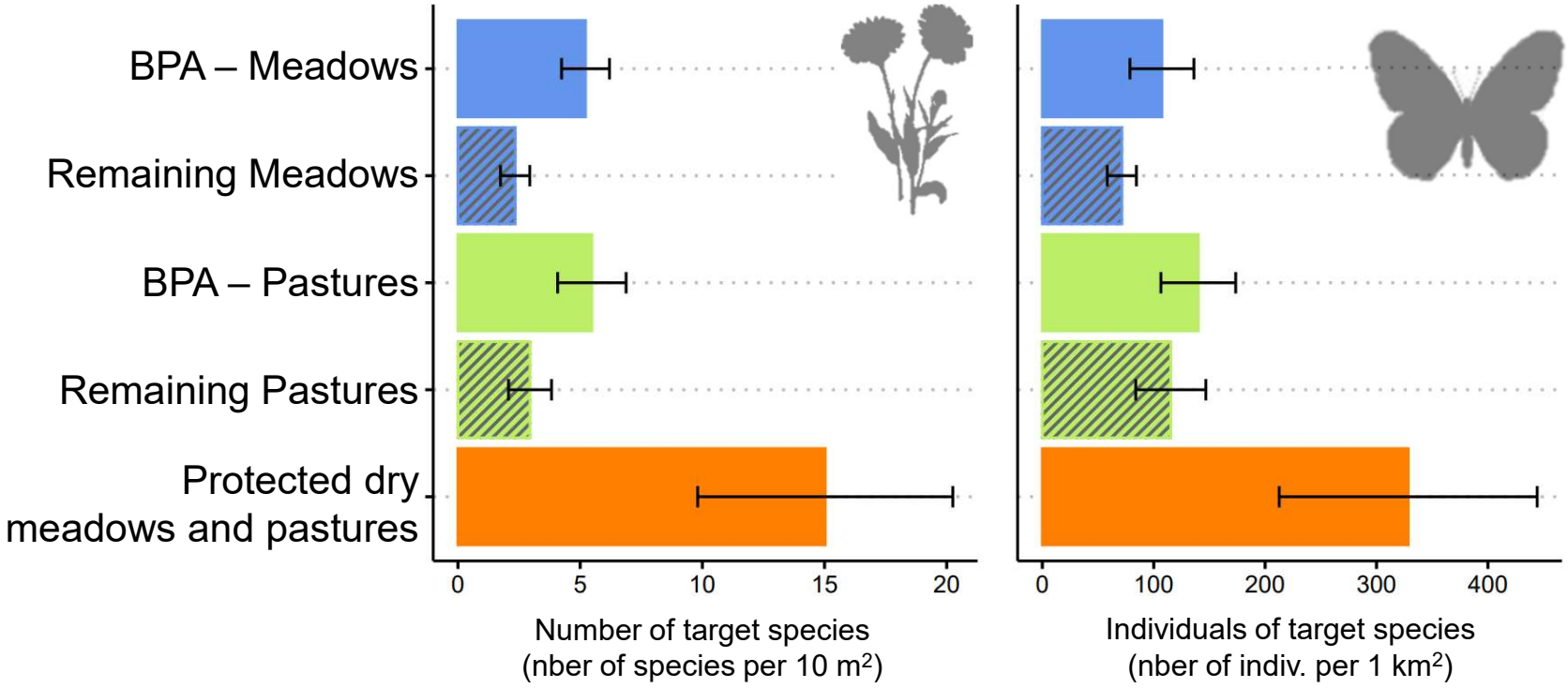
Targeted on protected habitat with rather rare species

- Since 2011 every 6 years
- 7000 objects are protected
- Only 2.3 % of area of Switzerland in which 30% of observations are
- One third of the observations concern threatened species
- 6’900 plots of 10 m^2 in 800 objects for vegetation sampling
- 260 breeding areas for amphibian sampling
- Aerial photos in all protected habitat



Plants and Butterflies in grassland

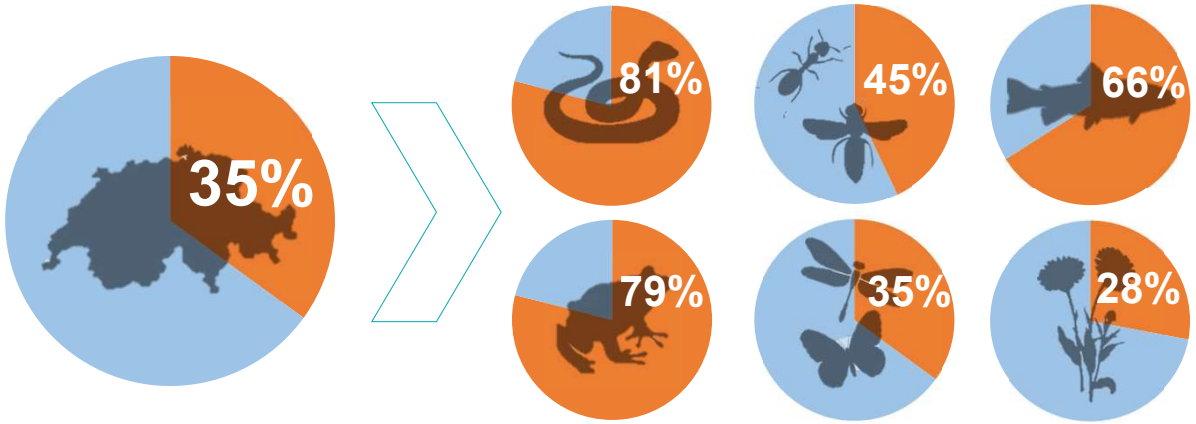
Added-value of analyses across the programs



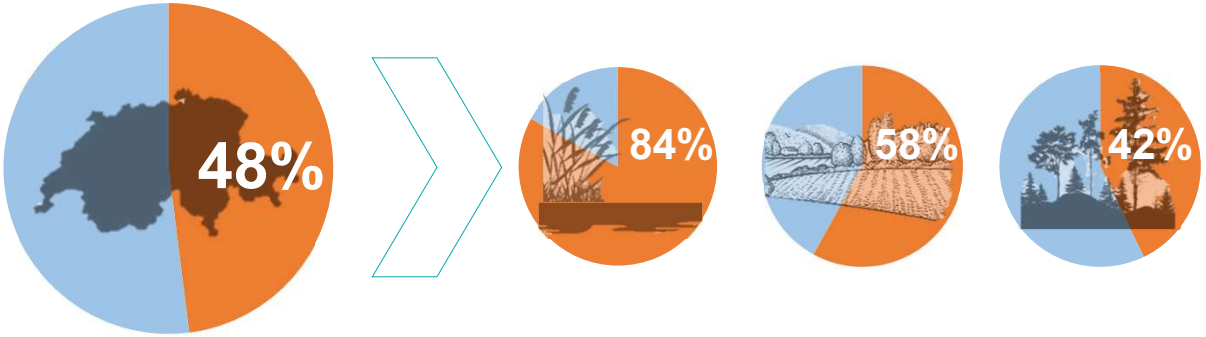
Additional surveys for Red Lists

Over 25 lists to evaluate the degree of threat on biodiversity

Share of threatened species



Share of threatened habitat



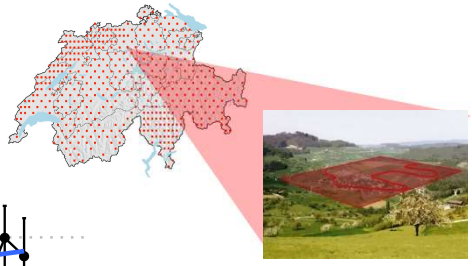
New:

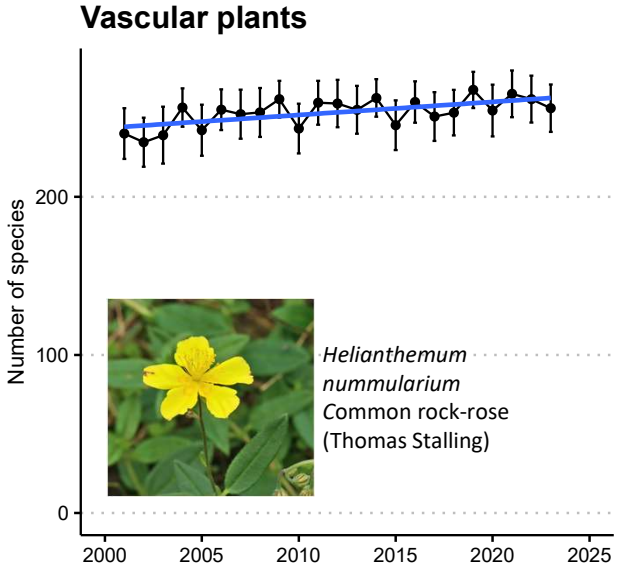
Monitoring plants and pollinators in Switzerland ?
Current data basis and outlook

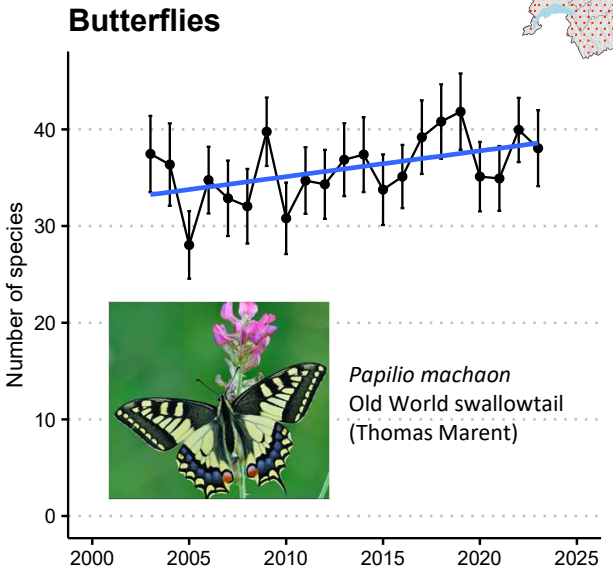
- There is no targeted monitoring program for pollinators
- Good plant and butterfly monitoring coverage
- It is important to integrate policy evaluation into monitoring programs from the beginning
- Developing and exploiting synergies between programs and other available data helps to fill gaps…
- Outlook:
  - Wild bees in farmland
  - Butterflies in protected habitats
  - Monitoring of genetic diversity

Species richness in common Swiss landscapes

Plant and butterfly richness is increasing, albeit at a low level

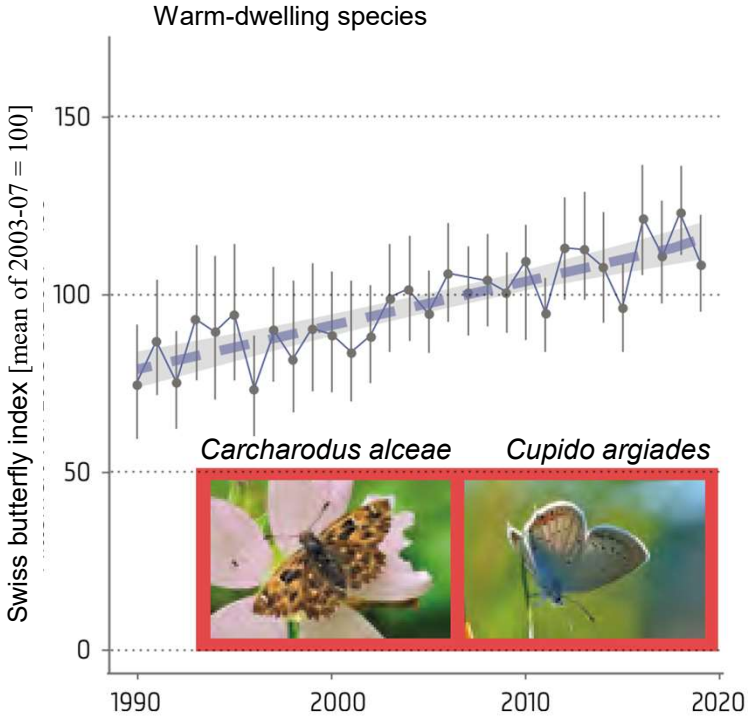


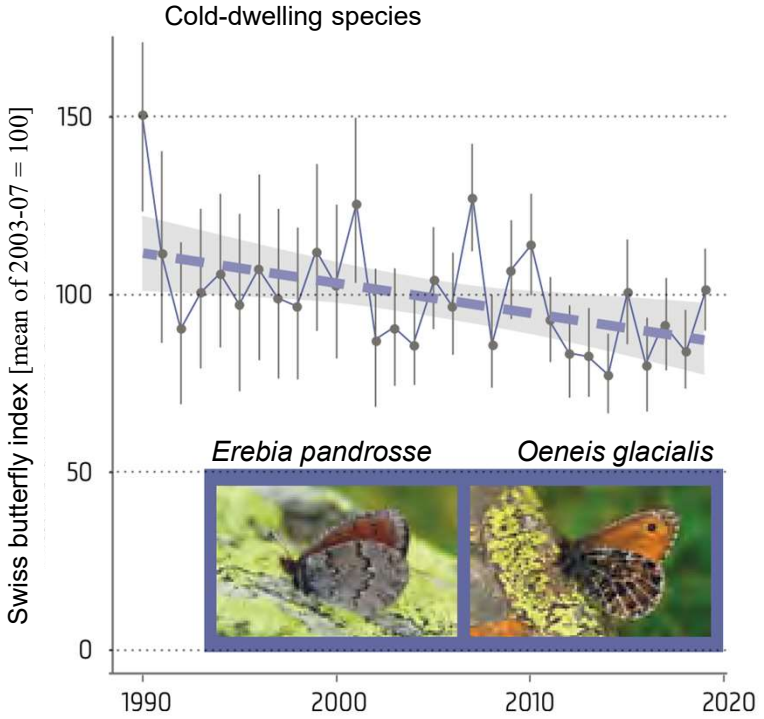




Climate warming as a driver for community change

Some species benefit, others face challenges

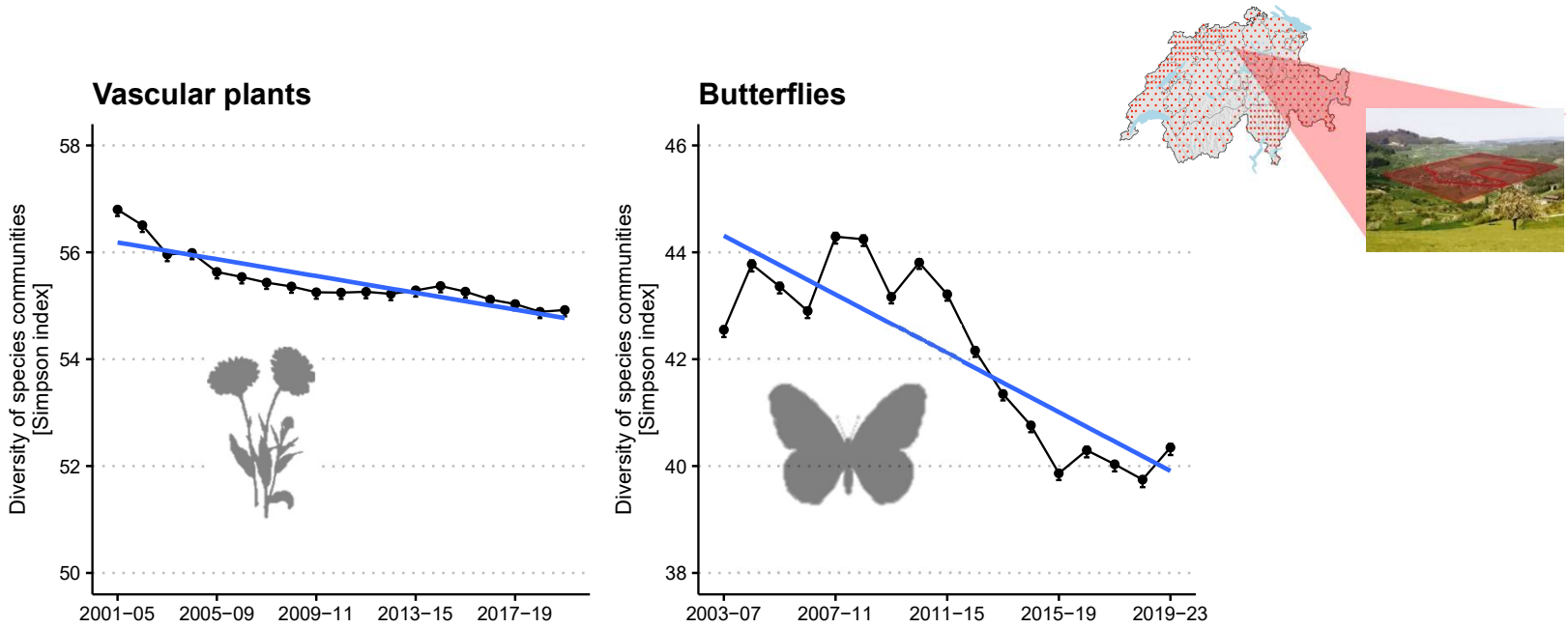




HOTSPOT 43 (2021)

Diversity of species communities (beta-diversity)

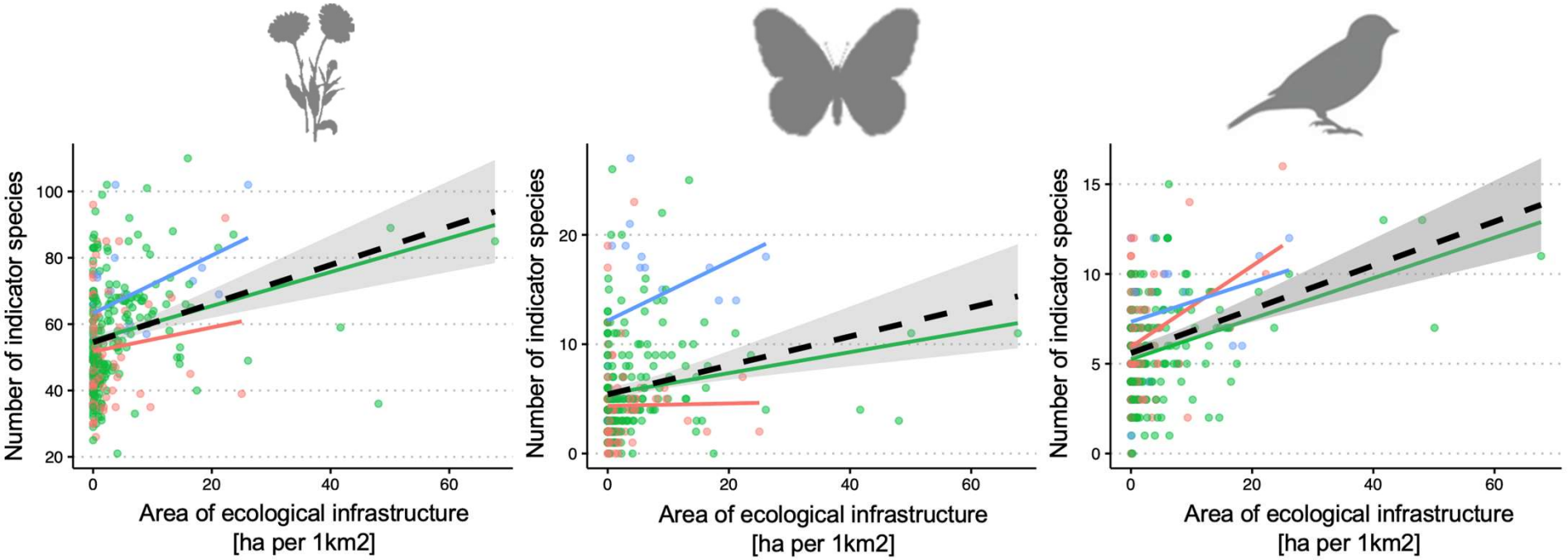
Plant and butterfly species communities are becoming more similar



→ Probably a combined effect of climate change and land use intensity

Species richness and ecological infrastructure

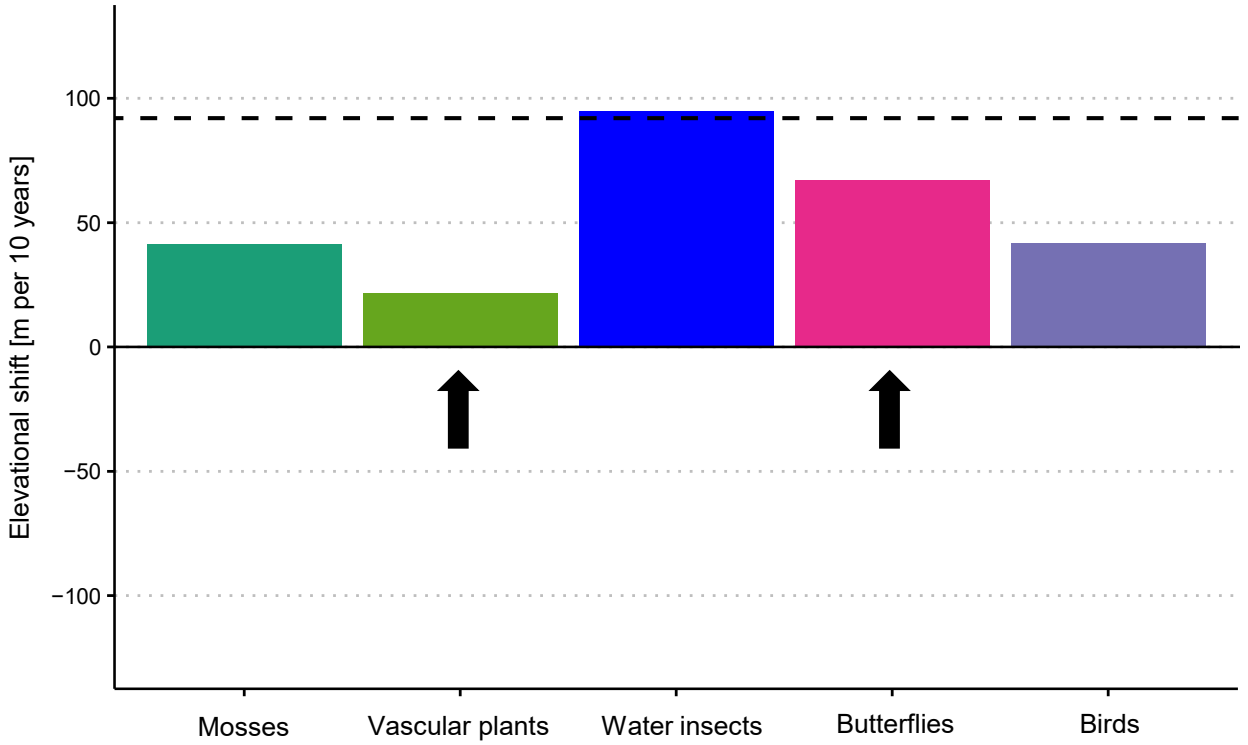
Conservation measures help promote species diversity.



Ecological infrastructure:
Protected areas and biotopes of national, regional and local importance, biodiversity promotion areas in farmland

Climate warming as a driver for community change

Responses to climate warming varies between species groups



Roth et al., (2014)

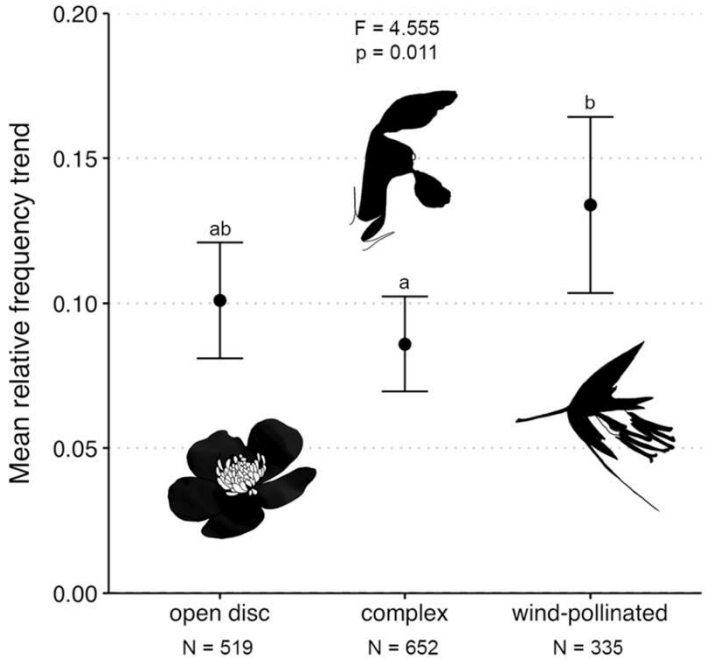
Summary so far…

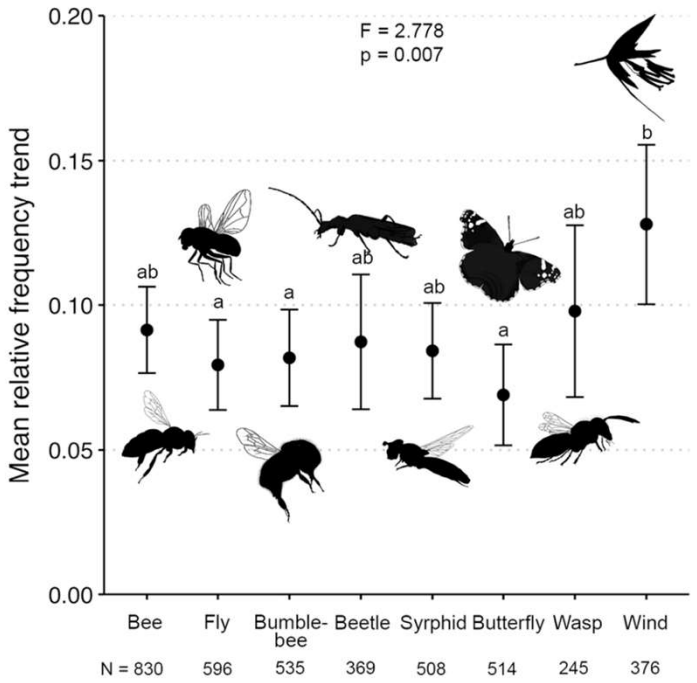
- Increase of species richness in Swiss landscapes since 2001.
- Large change in species communities that became more similar over time (biotic homogenization).
- Conservation measures help to promote species diversity, but climate warming is the main driver.
- Pace of community change varies among species and between species groups.

→ How does this affect interaction between plant and pollinators?

Which plant groups benefit?

Common wind-pollinated species increase more strongly than insect-pollinated species





Abrahamczyk et al., (2022)

Host plant availability and climate change

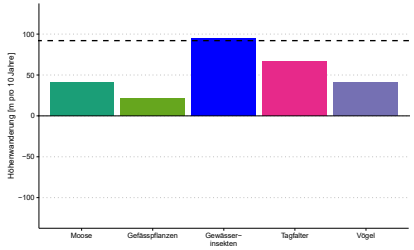
50% of butterfly species are limited by their primary host plant at the upper range limit

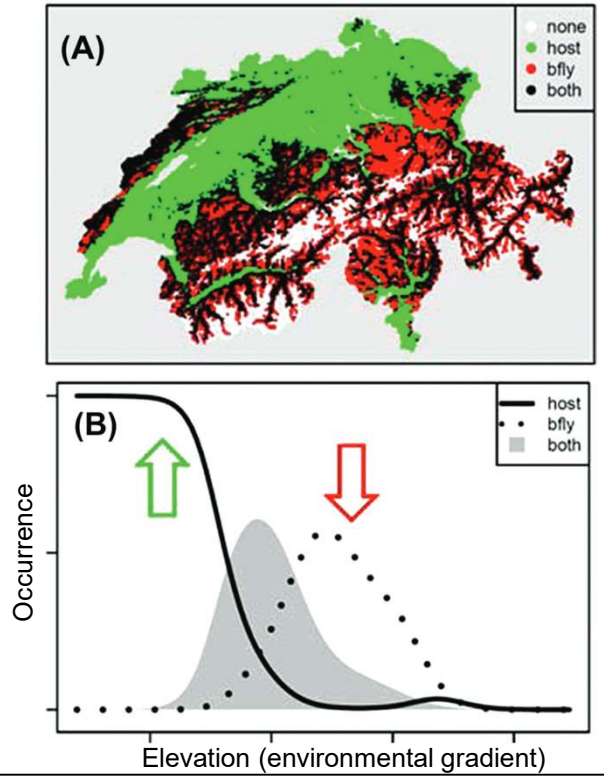
Host:
Trifolium pratense

Foto: Ivar Leidus (CC BY-SA 4.0)

Butterfly species:
Polyommatus semiargus

Foto: Harald Süpfle (CC BY-SA 3.0)



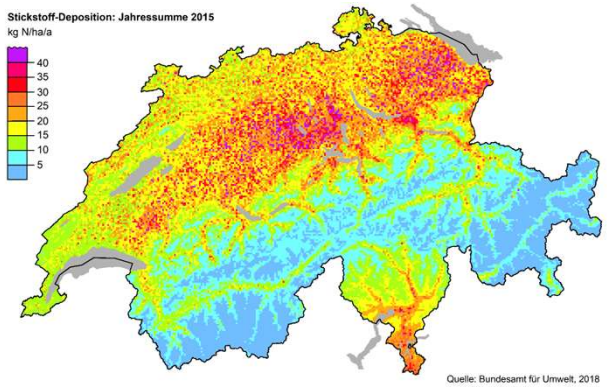


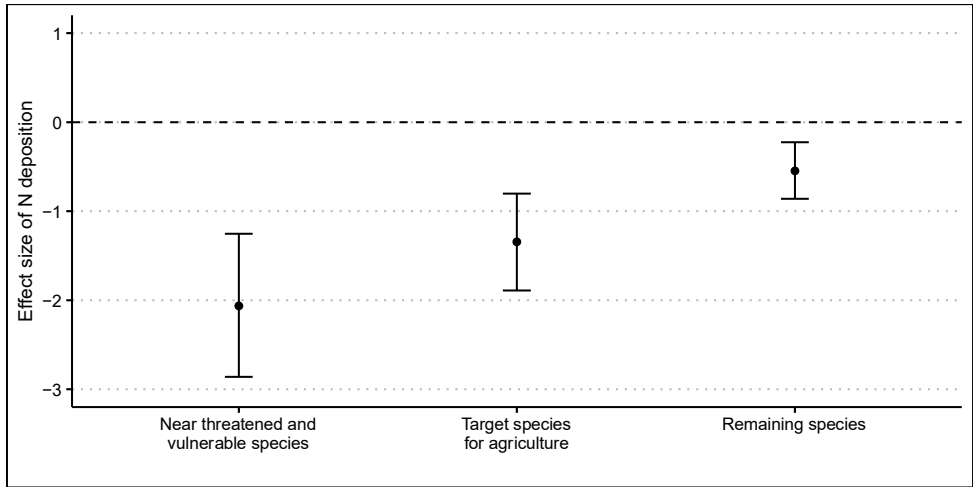
Hanspach et al. (2014)

Host plant availability and nitrogen (N) deposition

Cascading effects of nitrogen deposition on butterflies

- Loss of plant diversity due to increased N availability may negatively affect the diversity of butterflies, because caterpillars often feed on one or a few plant species.
- Increased N availability may alter microclimatic conditions through increased plant growth.



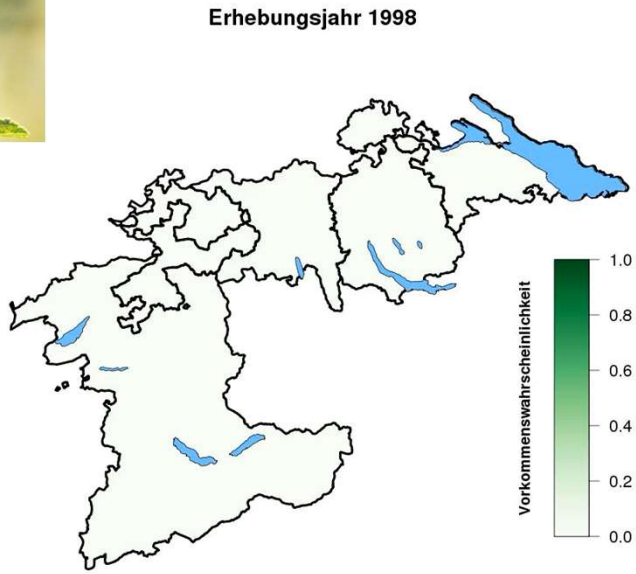


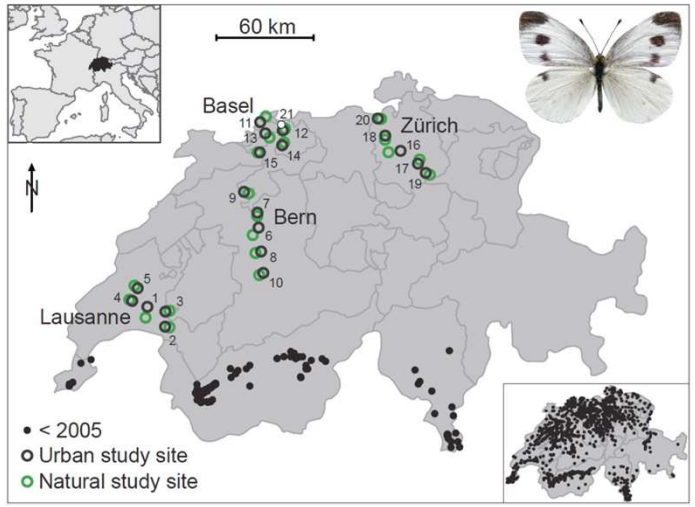
Roth et al. (2021)

Range explosions of some species

Preadaptation to urbanized environments may lead to unexpected population increases of specialized species

Cupido argiades





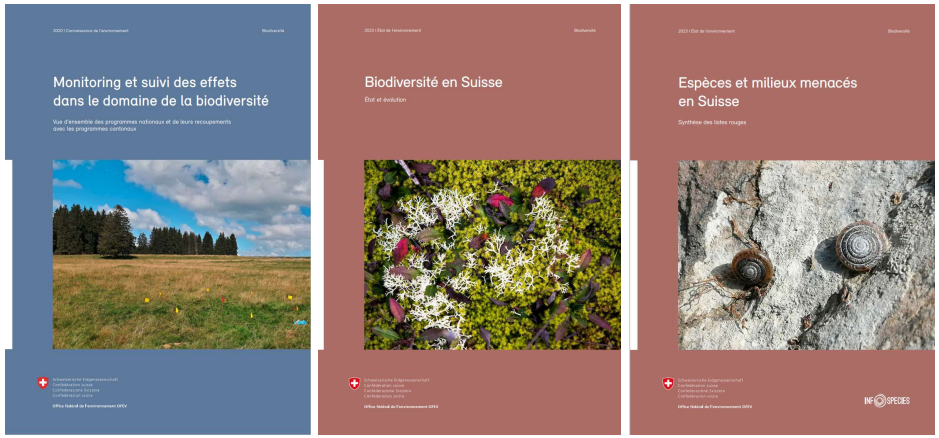
Ruffener et al. (2024)

Summary

- Climate change is having a profound effect on species communities with winning and losing species.
- Cascading effects on butterflies through change in plant communities.
- Butterfly species with extreme distributional changes show that at least some species may adapt in unexpected ways.
- Butterflies are only a small fraction of insects and by far not the most important pollinators.
- How global change will affect plant-pollinator interactions is difficult (impossible?) to predict. Targeted monitoring is needed to document change in plant-pollinator interactions.

Thanks for your attention…

Further information:
[Biodiversität: Monitoringprogramme (admin.ch)]



Bibliography

Abrahamczyk, S., Kessler, M., Roth, T., & Heer, N. (2022). Temporal changes in the Swiss flora: Implications for flower-visiting insects. BMC Ecology and Evolution, 22(1), 109.

Hanspach, J., Schweiger, O., Kühn, I., Plattner, M., Pearman, P. B., Zimmermann, N. E., & Settele, J. (2014). Host plant availability potentially limits butterfly distributions under cold environmental conditions. Ecography, 37(3), 301–308.

HOTSPOT 43 (2021). Biodiversität und Klimawandel.

Roth, T., Plattner, M., & Amrhein, V. (2014). Plants, Birds and Butterflies: Short-Term Responses of Species Communities to Climate Warming Vary by Taxon and with Altitude. PLoS ONE, 9(1), e82490.

Roth, T., Kohli, L., Rihm, B., Meier, R., & Amrhein, V. (2021). Negative effects of nitrogen deposition on Swiss butterflies. Conservation Biology, 35(6), 1766–1776.

Ruffener, S. C., Matthey-de-l'Endroit, N., & Berner, D. (2024). Invasion of *Pieris mannii* butterflies across Central Europe facilitated by urbanization. Urban Ecosystems.

Sutter, L., Dietemann, V., Charriére, J.-D., Herzog, F. & Albrecht, M. (2017a) Nachfrage, Angebot und Wert der Insektenbestäubung in der Schweizer Landwirtschaft. Agrarforschung Schweiz, 7.