Weather effects in analyses of hoverfly trends and responses to new landscape elements

Eelke Jongejans,
Robin Lexmond, Caspar Hallmann,
Hans de Kroon, Theo Zeegers

RADBOUD
Institute for Biological and Environmental Sciences

Syrphids are catching up with bees … in going extinct

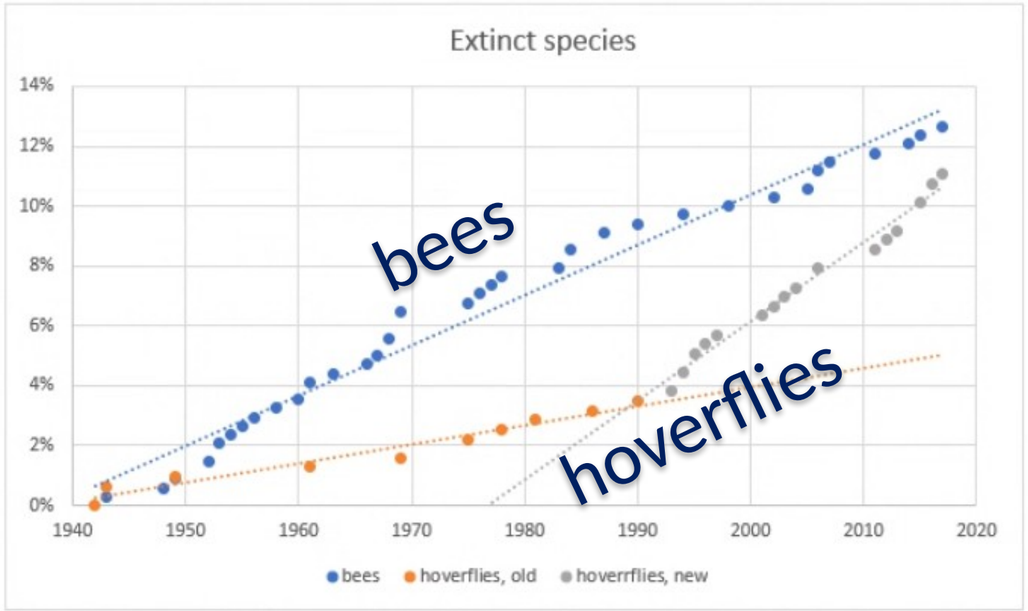
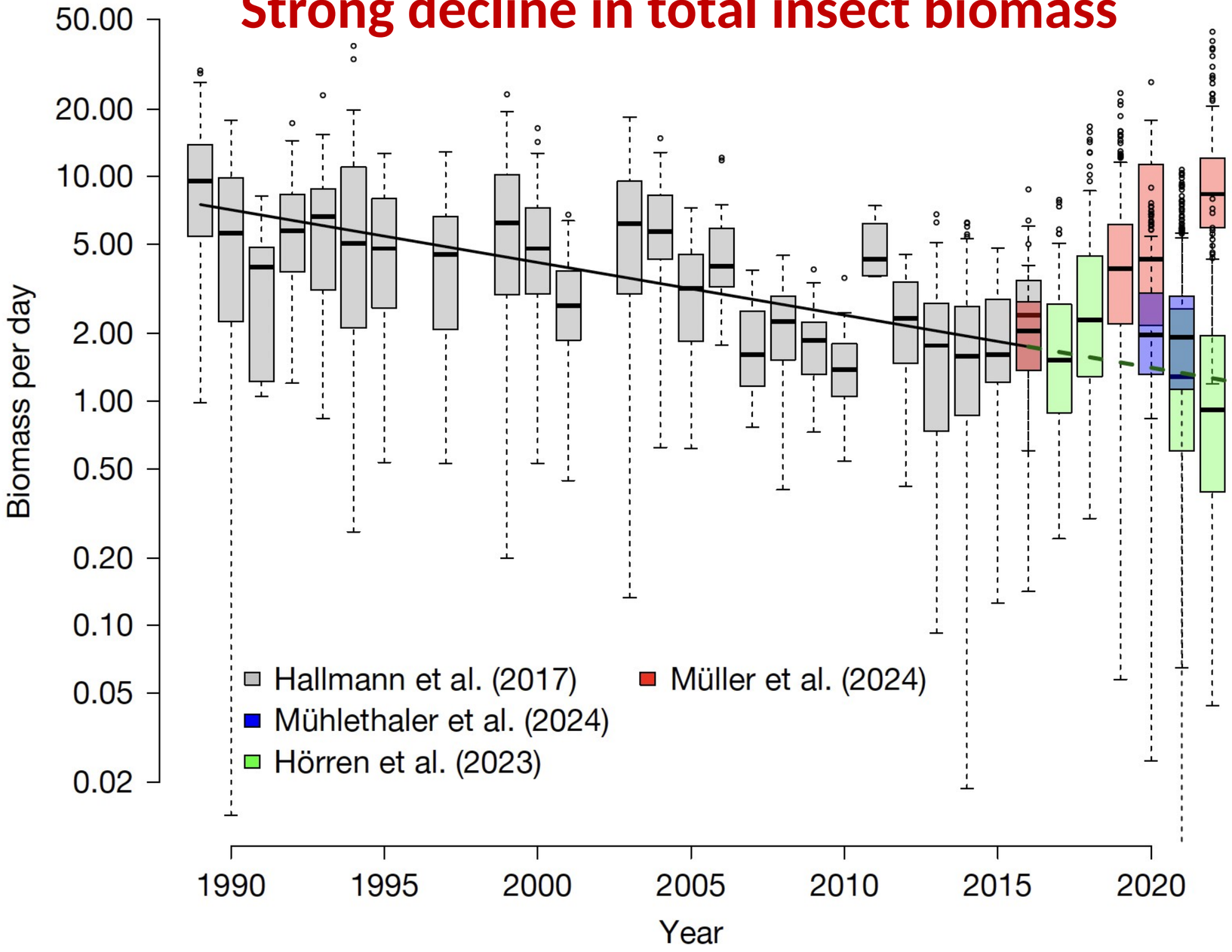


Figure 1: Cumulative fraction of extinct species over the years (relative to the number of indigenous species in 1941) for bees (blue), hoverflies before 1992 (orange) and hoverflies since 1993 (grey).

Zeegers, van Steenis, Reemer, Smit (2024) Journaal van Syrphidae

Strong decline in total insect biomass

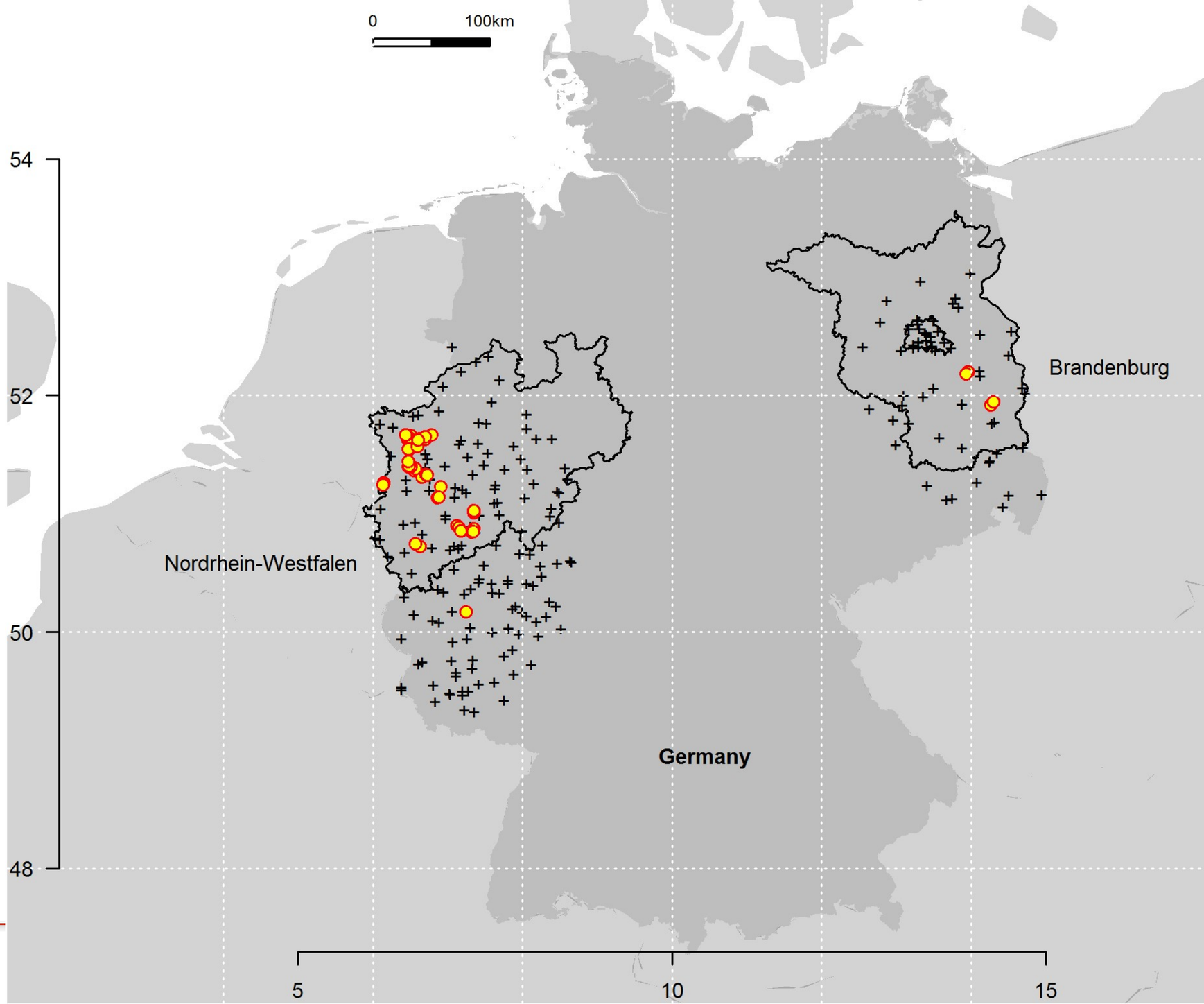


Hallmann, Jongejans, Hörren, Sorg, Siepel, Mühlethaler, Lehmann, de Kroon (2025) Nature

Explanatory variables

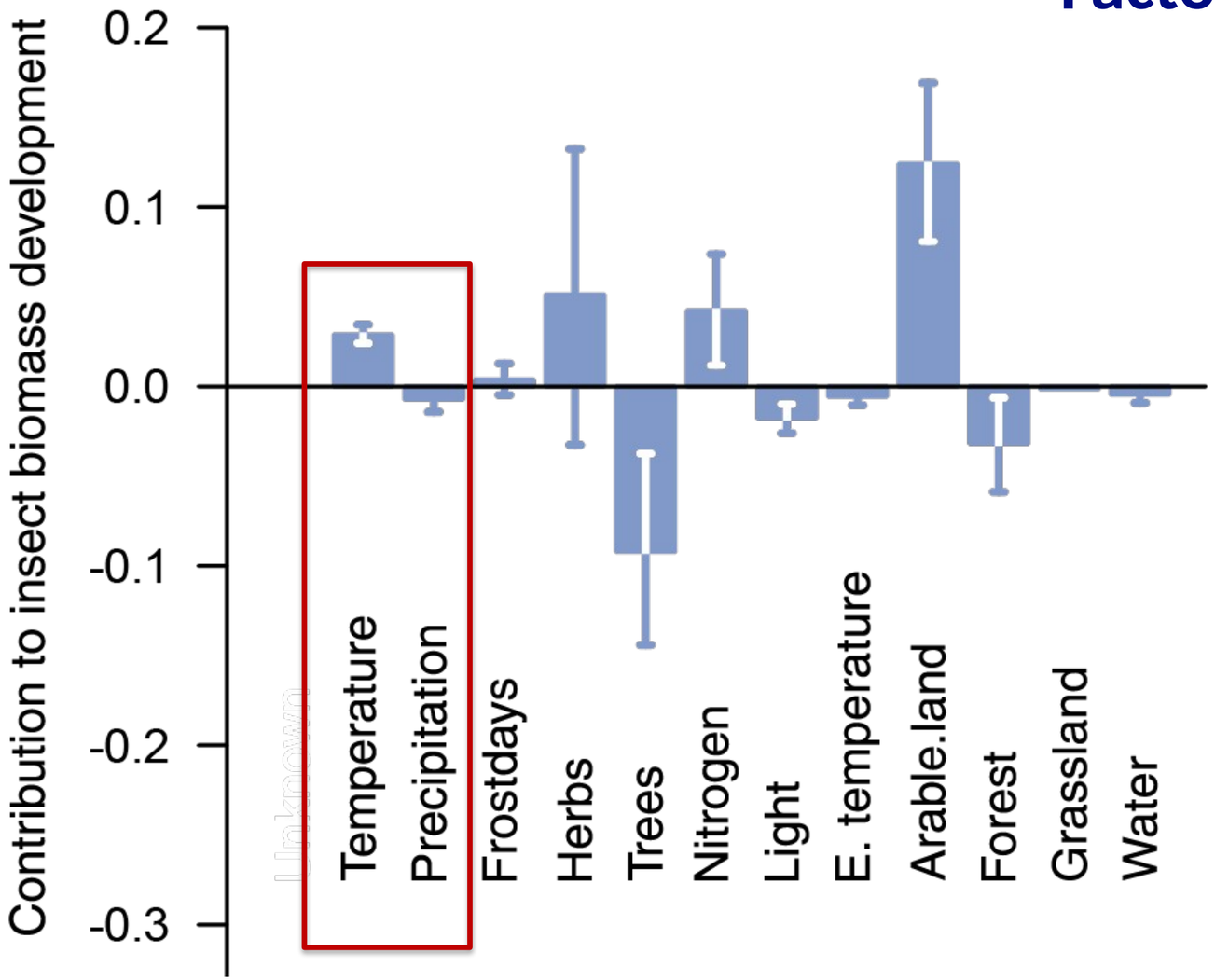
Daily weather variables:

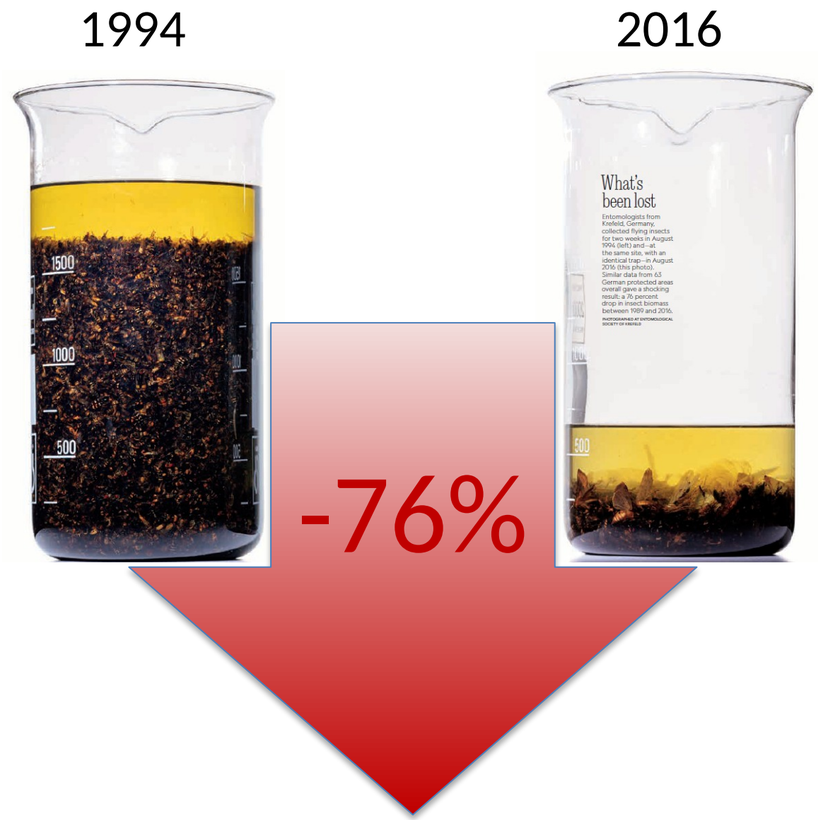
- Air temperature
- Precipitation
- Wind speed



Hallmann et al. (2017) PLoS ONE

Factors associated with the trend





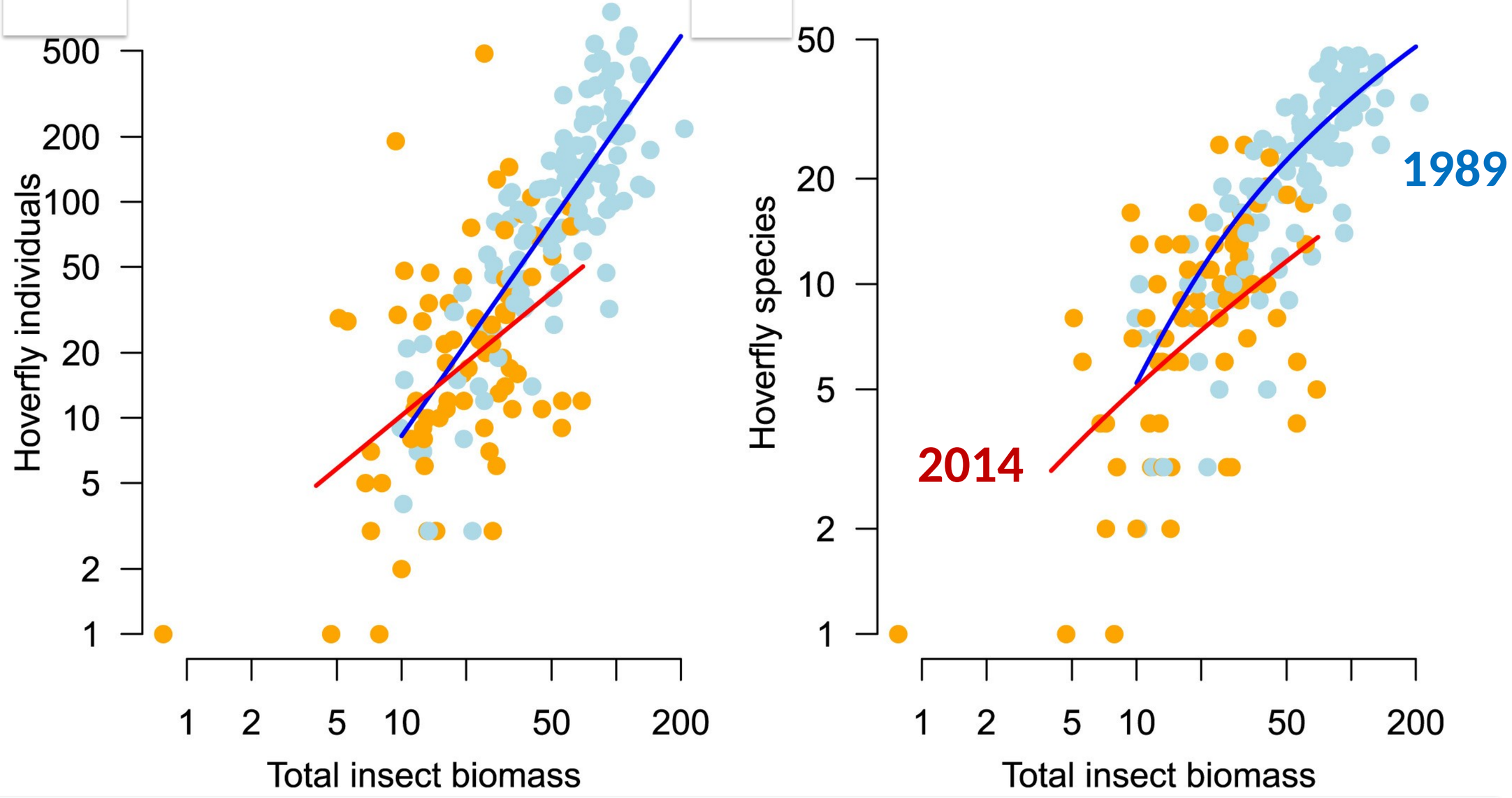
Hallmann, Sorg, Jongejans, Siepel, Hofland, Schwan et al (2017) PLoS ONE

Total insect biomass….

but what about the Syrphidae?

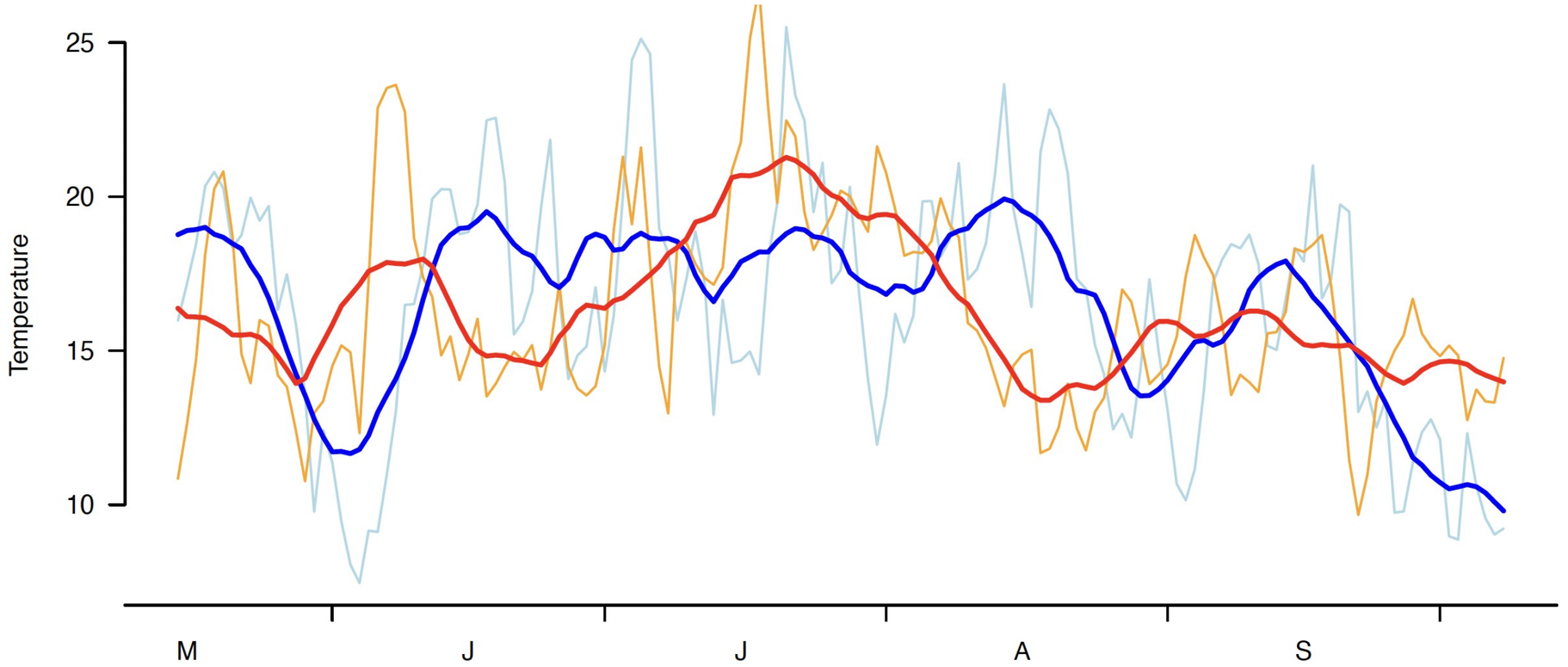
3.7 %

Number of Syrphidae individuals and species correlated with total insect biomass



Hallmann, Ssymank, Sorg, de Kroon, Jongejans (2021) PNAS

Weather data

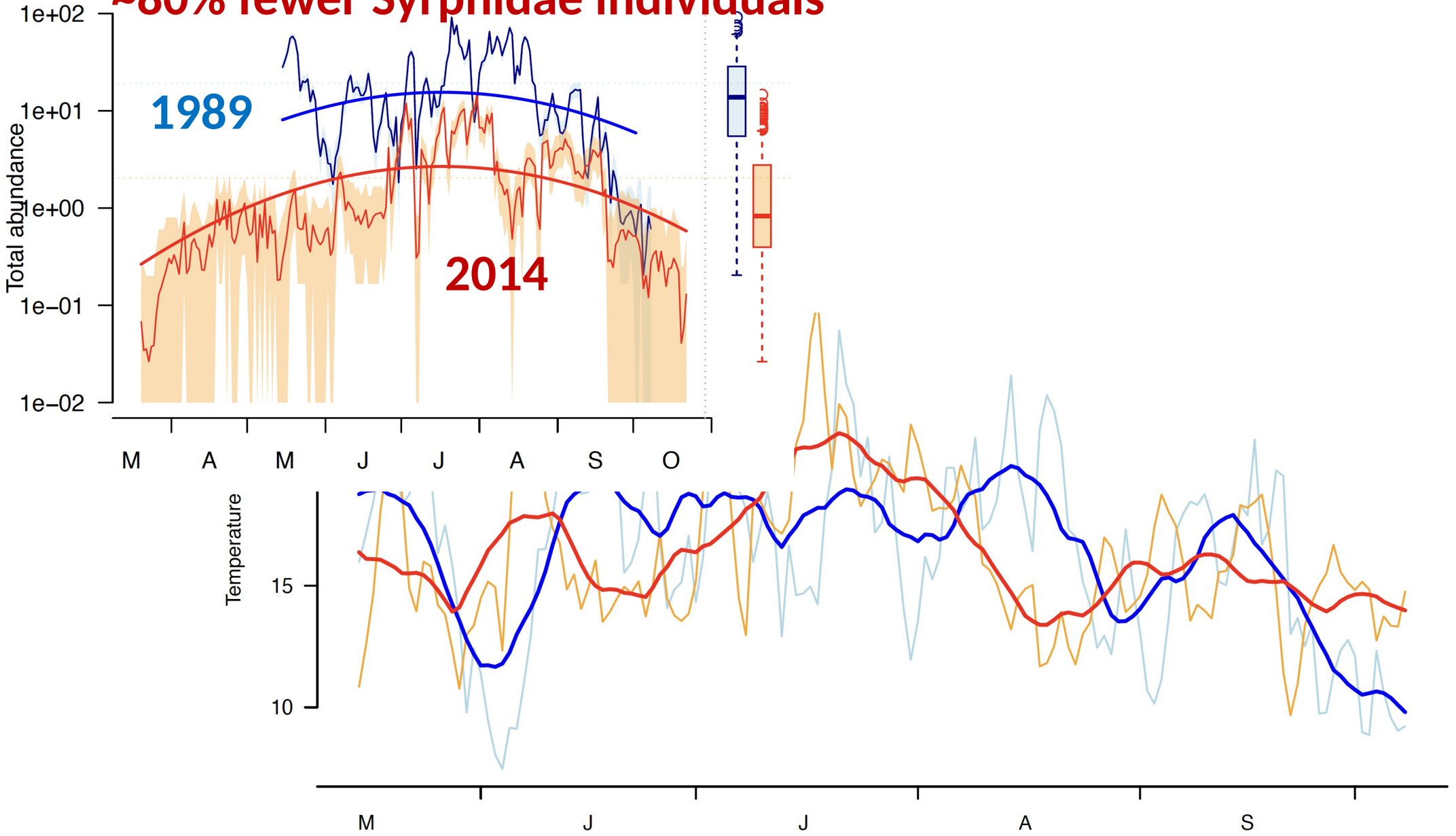


2014

1989

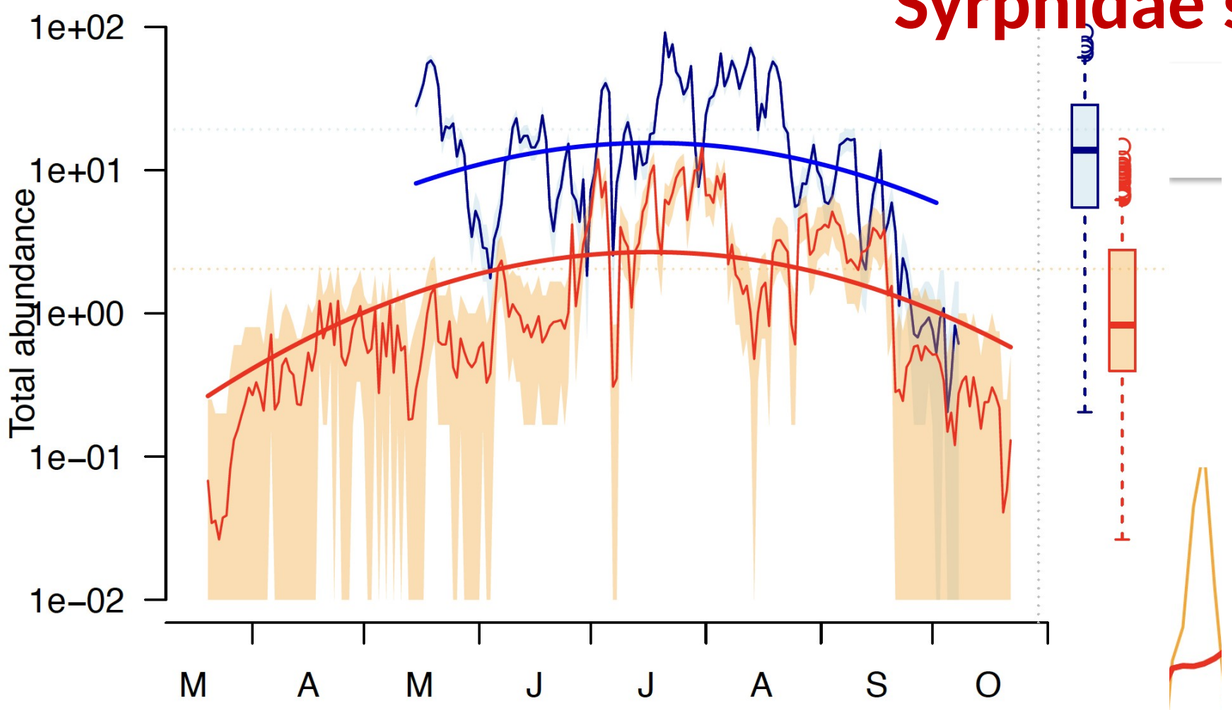
Hallmann, Ssymank, Sorg, de Kroon, Jongejans (2021) PNAS

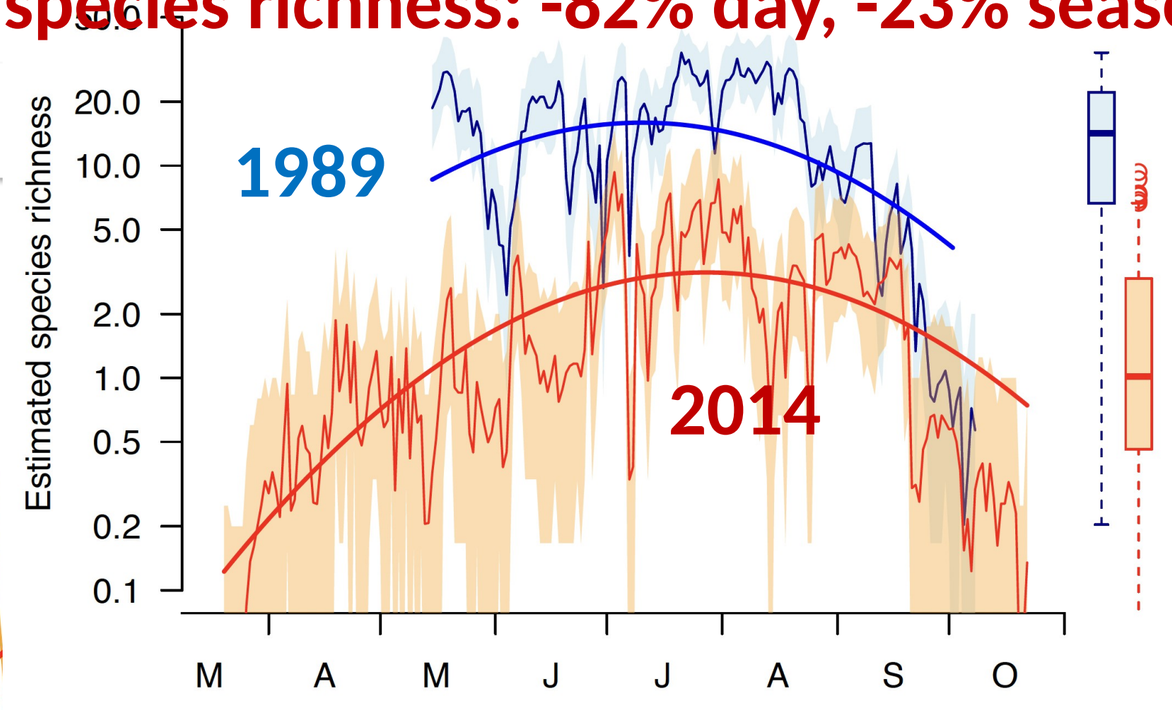
~80% fewer Syrphidae individuals

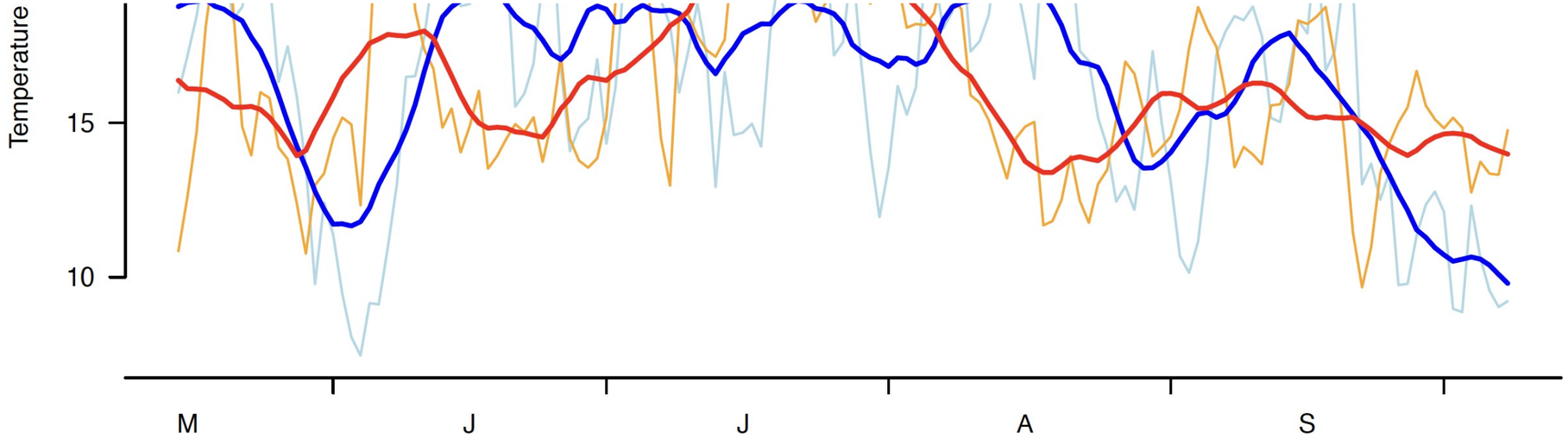


Hallmann, Ssymank, Sorg, de Kroon, Jongejans (2021) PNAS

Syrphidae species richness: -82% day, -23% season







Hallmann, Ssymank, Sorg, de Kroon, Jongejans (2021) PNAS

Living Lab Ooijpolder-Groesbeek



24 research locations



Hedgerow



Flower strip



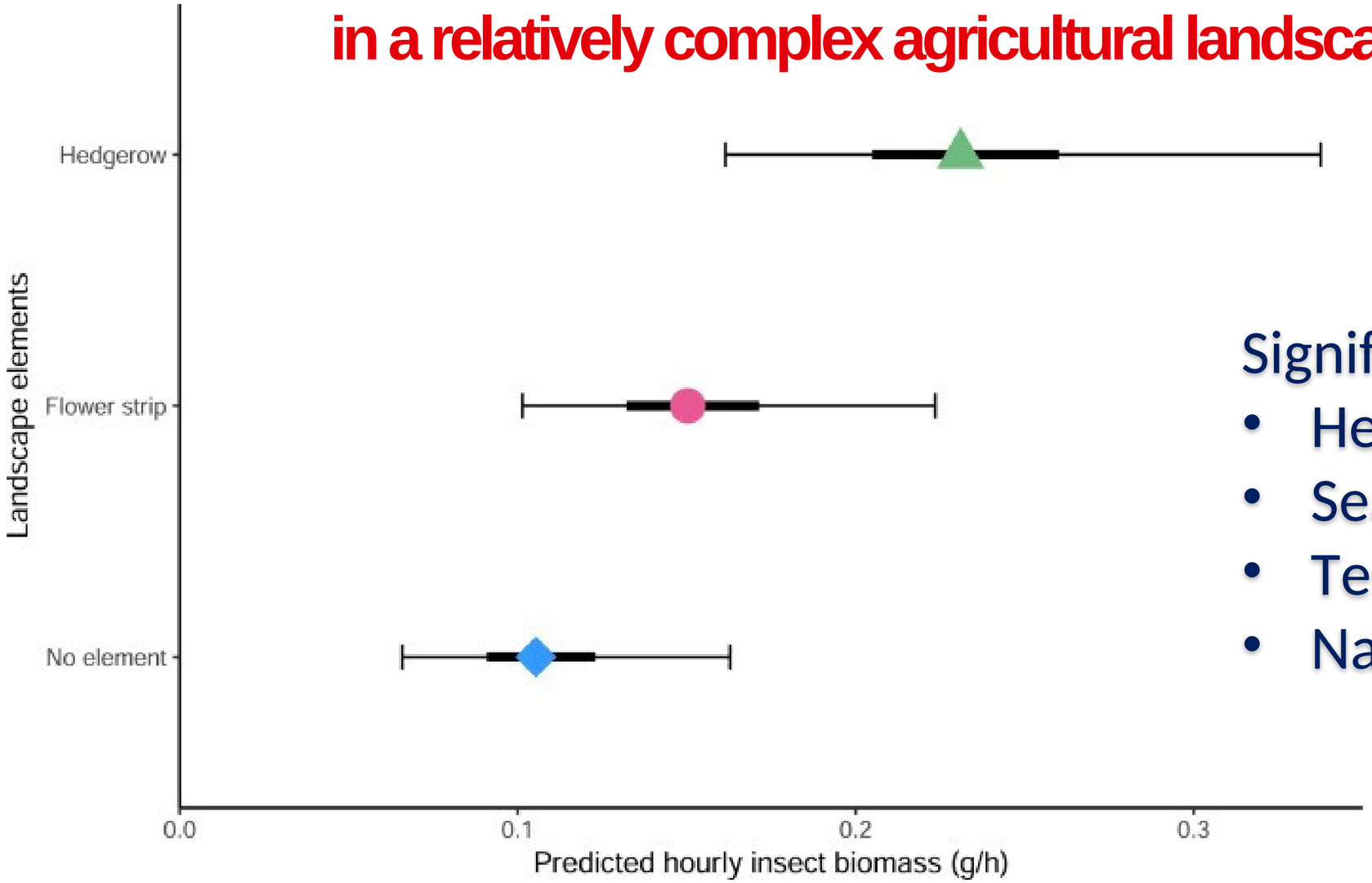
No landscape element



Lexmond, Jongejans, Zeegers, Climo, van der Putten, de Kroon (2026) Basic and Applied Ecology

Radboud University

More insect biomass near new hedgerows in a relatively complex agricultural landscape



Significant effects of

- Hedgerows
- Season
- Temperature anomaly
- Natural area with 500m

Lexmond, Jongejans, Zeegers, Climo, van der Putten, de Kroon (2026) Basic and Applied Ecology

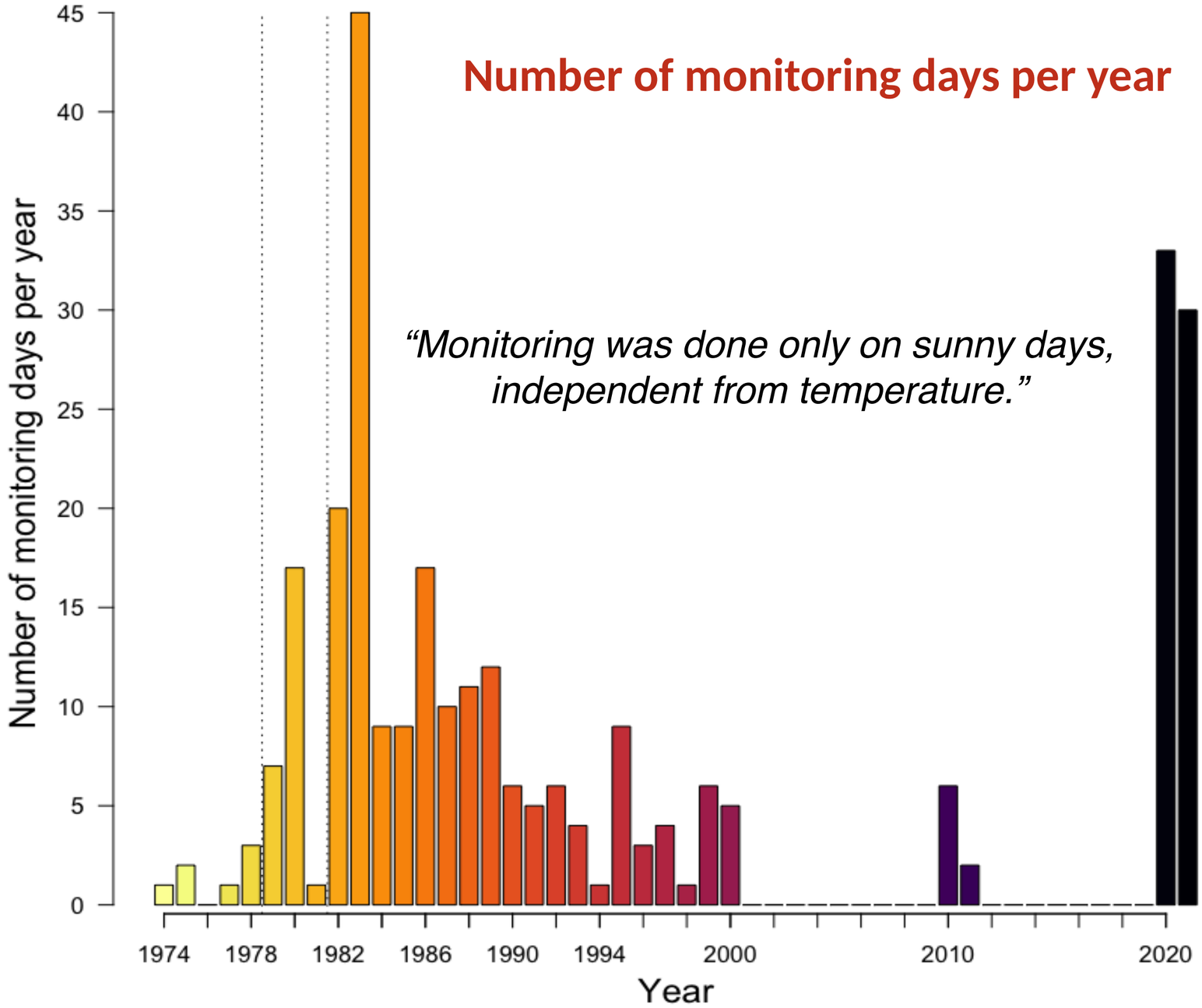
Boeschoten



dry nutrient-poor mixed forest



Number of monitoring days per year



"Monitoring was done only on sunny days, independent from temperature."

Barendregt, Zeegers, van Steenis, Jongejans (2022) Insect Conservation and Diversity

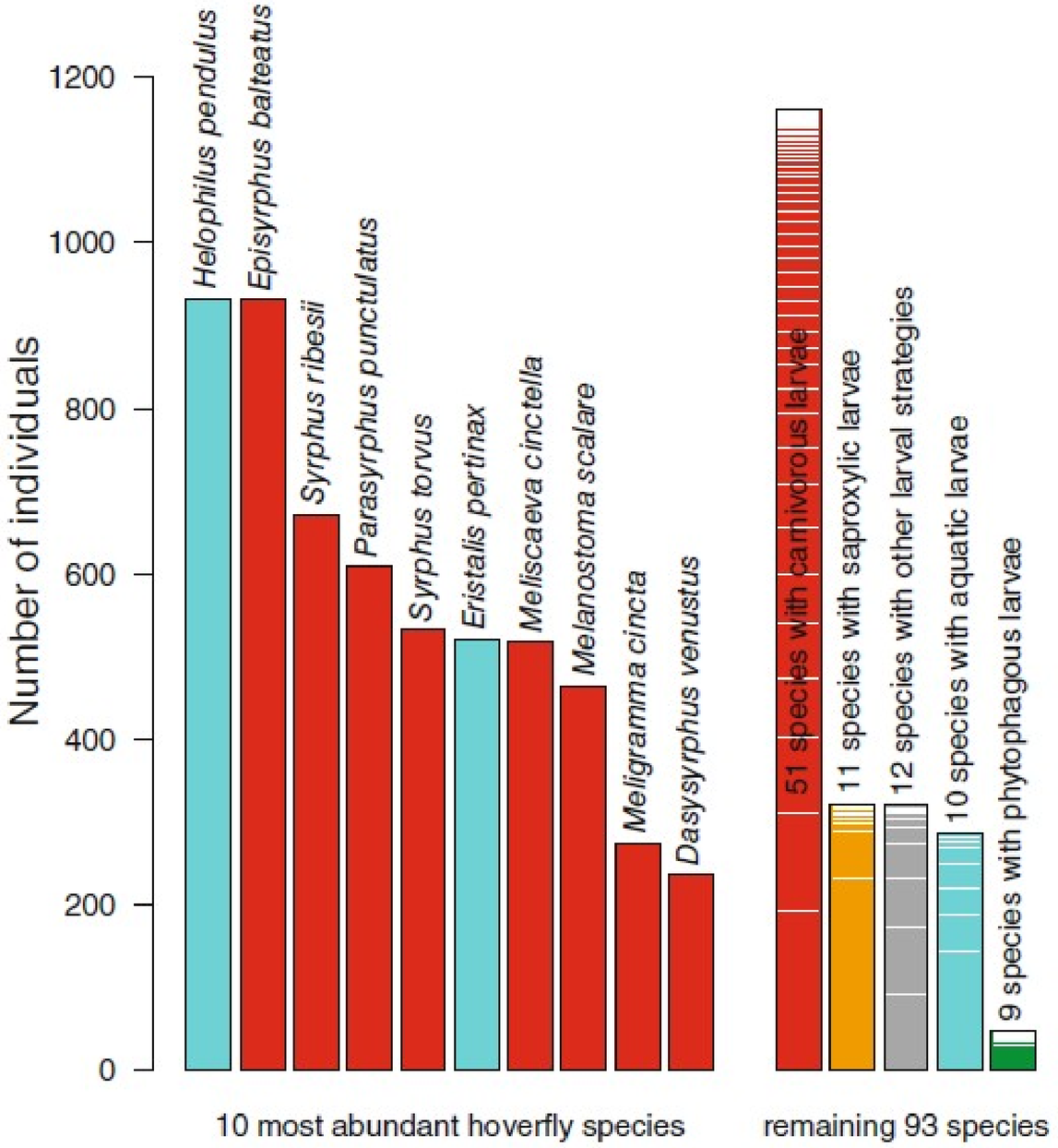
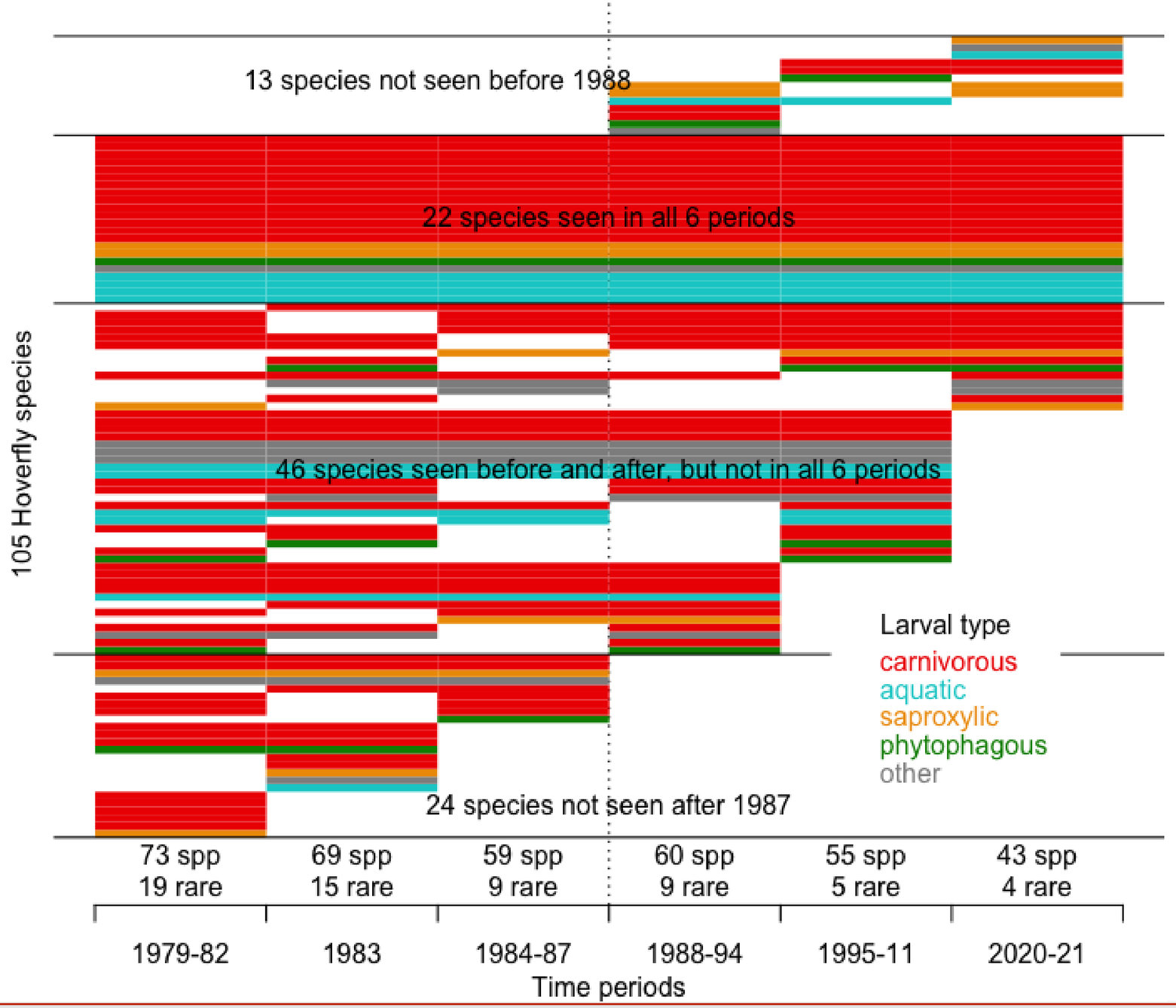
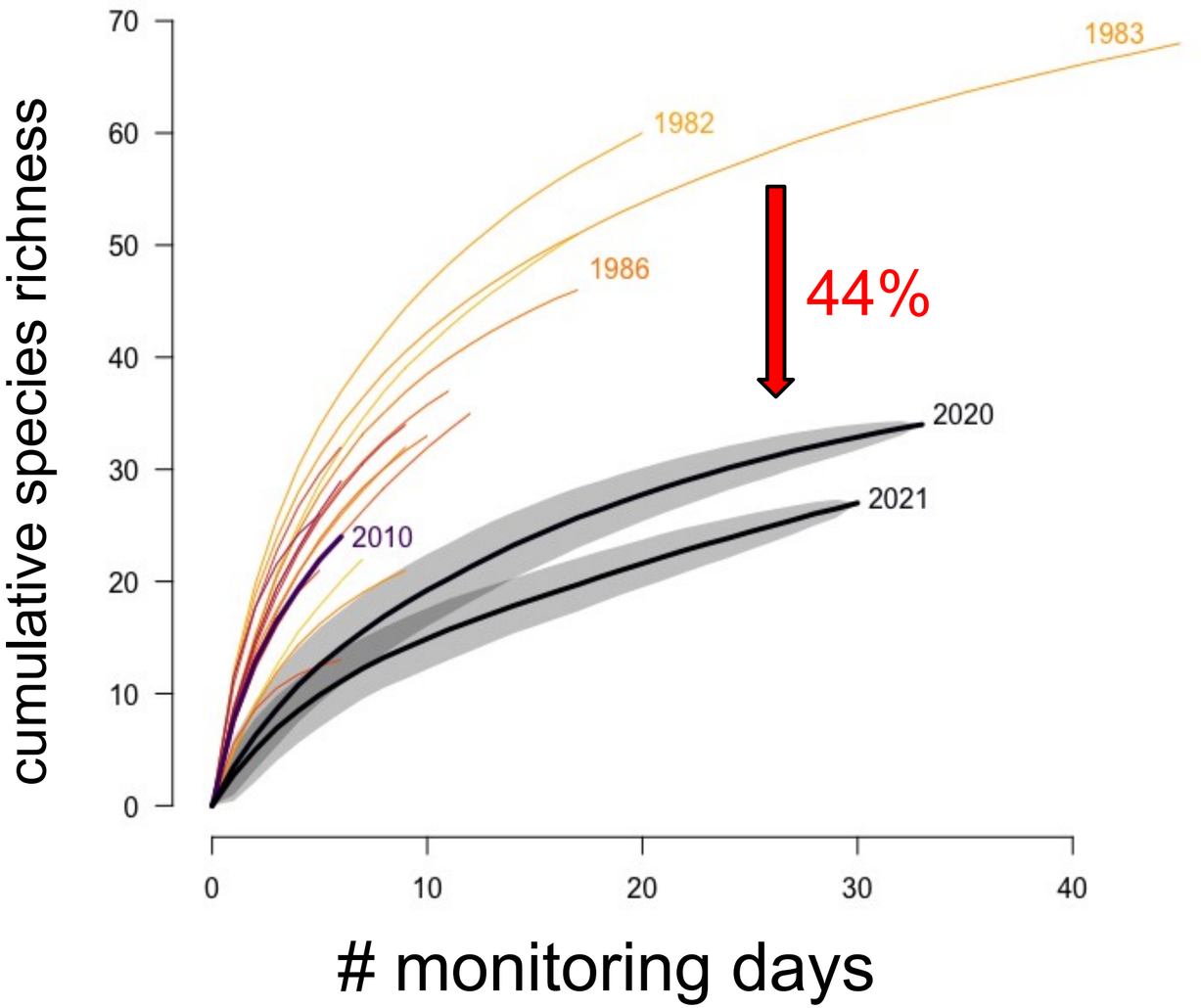


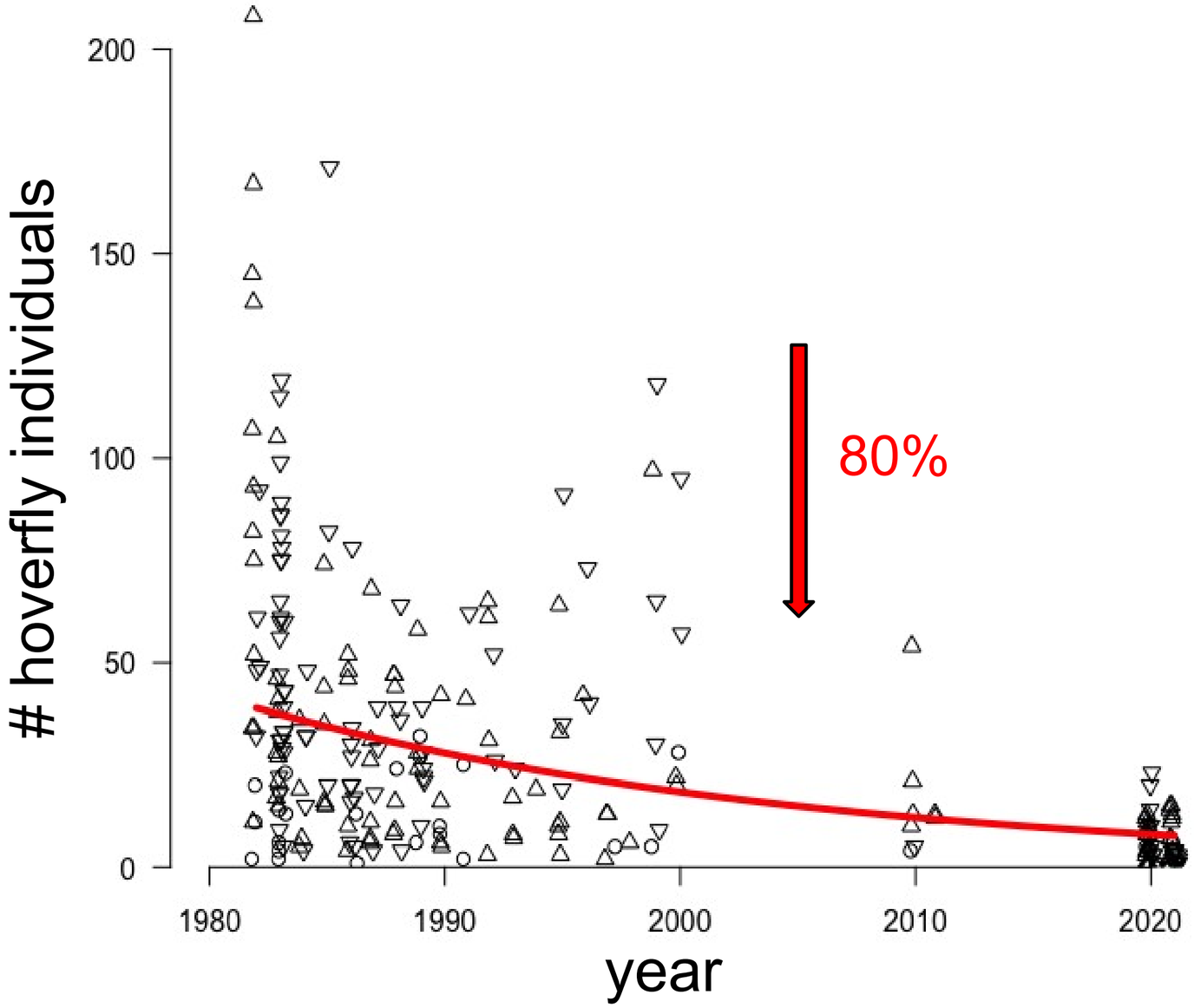
FIGURE 1 Distribution of 7832 observed individuals over 103 hoverfly species, based on monitoring in 1982–2021. Separately shown are the top 10 most abundant species (together 72.7% of the individuals; red bars indicate species with carnivorous larvae, cyan bars species with aquatic larvae). The remaining 93 species are grouped per larval type. White lines separate those remaining species within their groups. Counts per species can be found in Appendix E of Data S1



Barendregt, Zeegers, van Steenis, Jongejans (2022) Insect Conservation and Diversity



Barendregt, Zeegers, van Steenis, Jongejans (2022) Insect Conservation and Diversity



Significant effects of

- Year ↓
- Season (bimodal)
- Temperature anomaly ↓
- Sunshine anomaly ↑

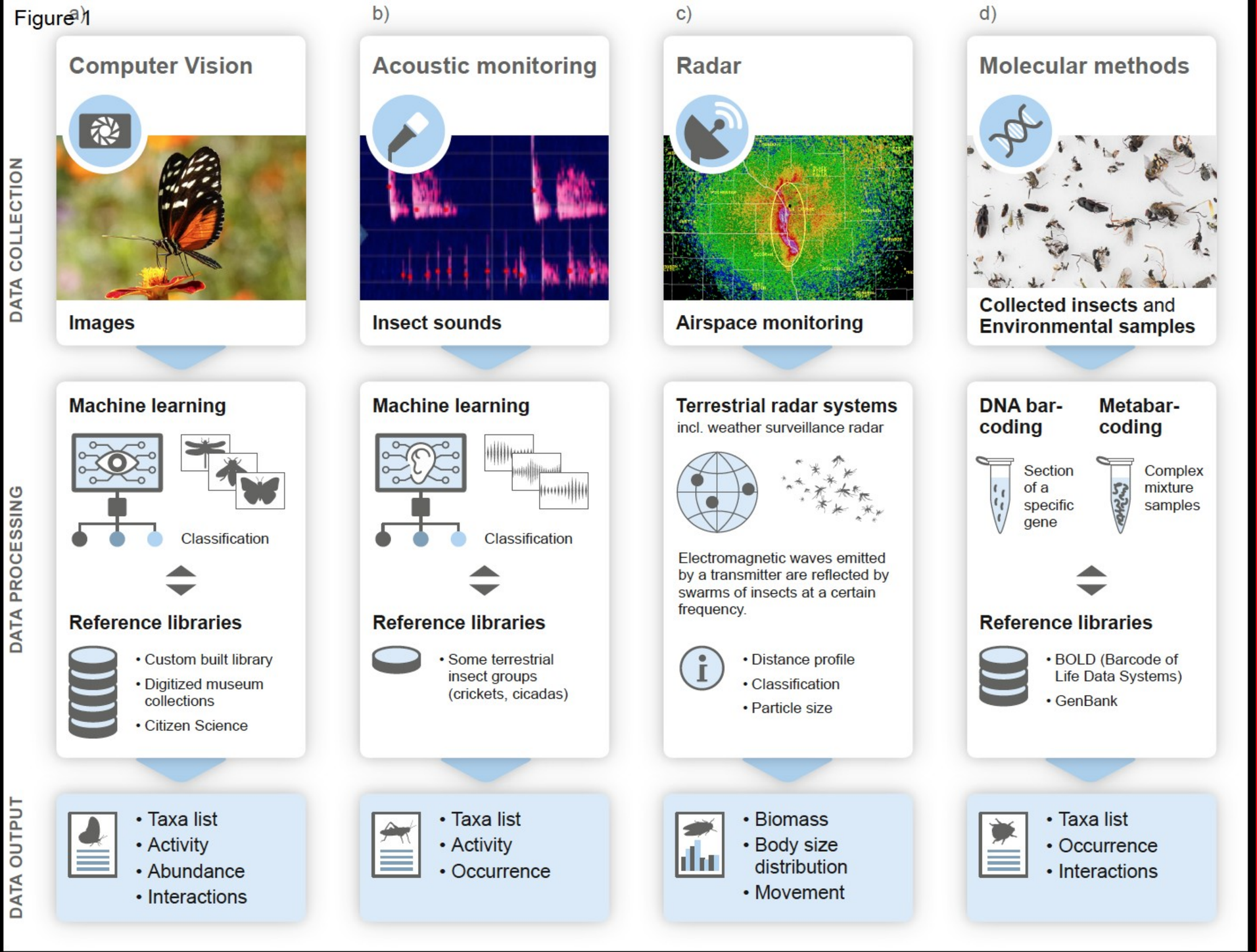
Barendregt, Zeegers, van Steenis, Jongejans (2022) Insect Conservation and Diversity

Emerging technologies revolutionise insect ecology and monitoring

van Klink et al 2022 Trends in Ecology & Evolution



Figure 1



Digital
Identification
Of
Photographically
Sampled
Insect
Species

DIOPSIS



> 300 thousand hours of data

> 4 million individual insects

















Weather affects measurements of insect abundance, regardless of sampling methodology

Include season and weather variables in analyses, especially when you

- have uneven sampling within and between years,
- have less than decades of data, and/or
- are interested in weather effects on Syrphid flies!