# Effects of N deposition and temperature on vegetation and potential consequences for butterfly diversity

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Lukas Kohli and Tobias Roth

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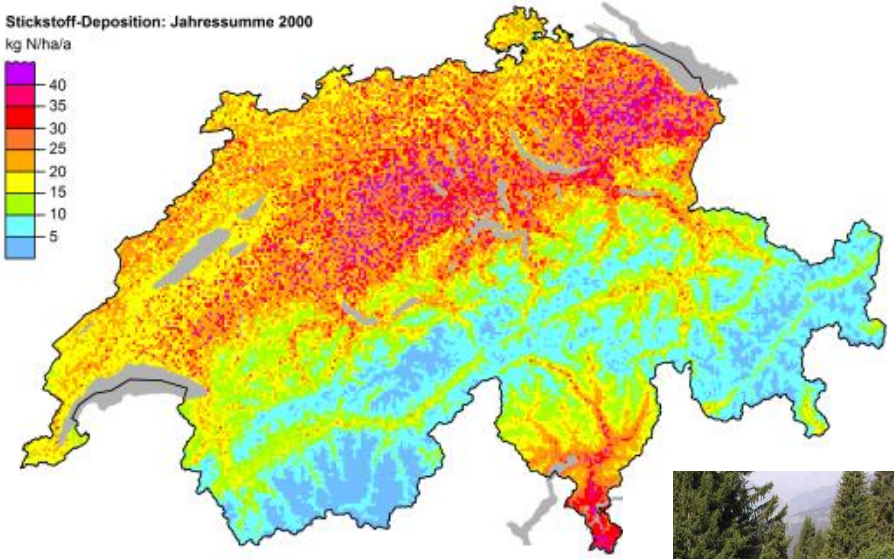
Ökologische Beratung, Planung und Forschung | Aarbergergasse 61| CH- 3011 Bern
Telefon +41 31 310 13 02 | kohli@hintermannweber.ch
Büros in Reinach BL / Bern / Montreux | Firmenmitglied SIA

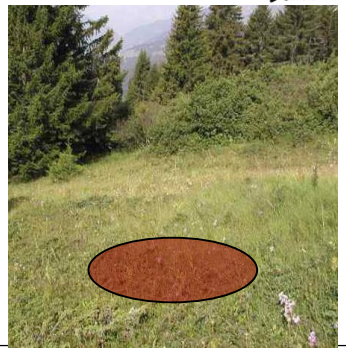
## Structure of my presentation

– How does the vegetation change under reduced N deposition?

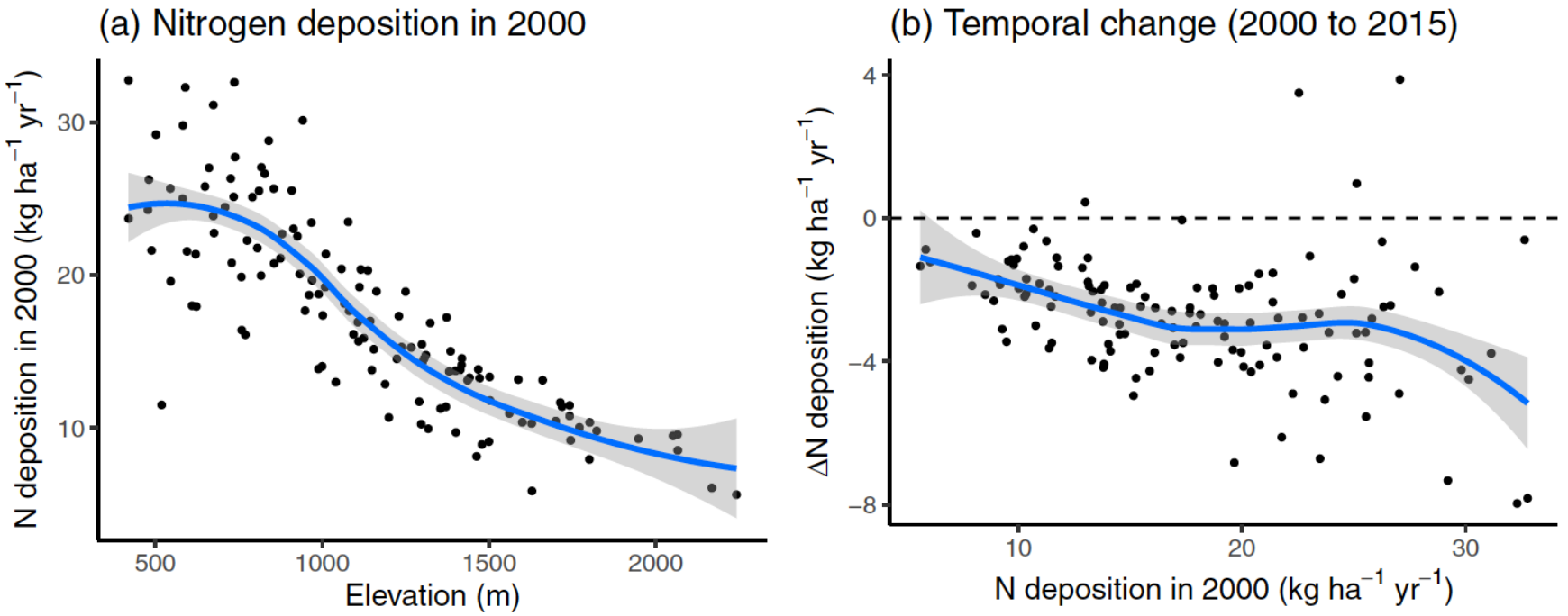
– What vegetation characteristics other than species richness explain the development of butterfly diversity?

# Mountain hay meadows (E2.3) in Swiss Biodiversitymonitoring



## N deposition in mountain hay meadows



**Method**

– Different drivers of plant community change: N deposition, climate warming and land-use change

➜ **No trends in species richness and mean indicator value for nutrients!**

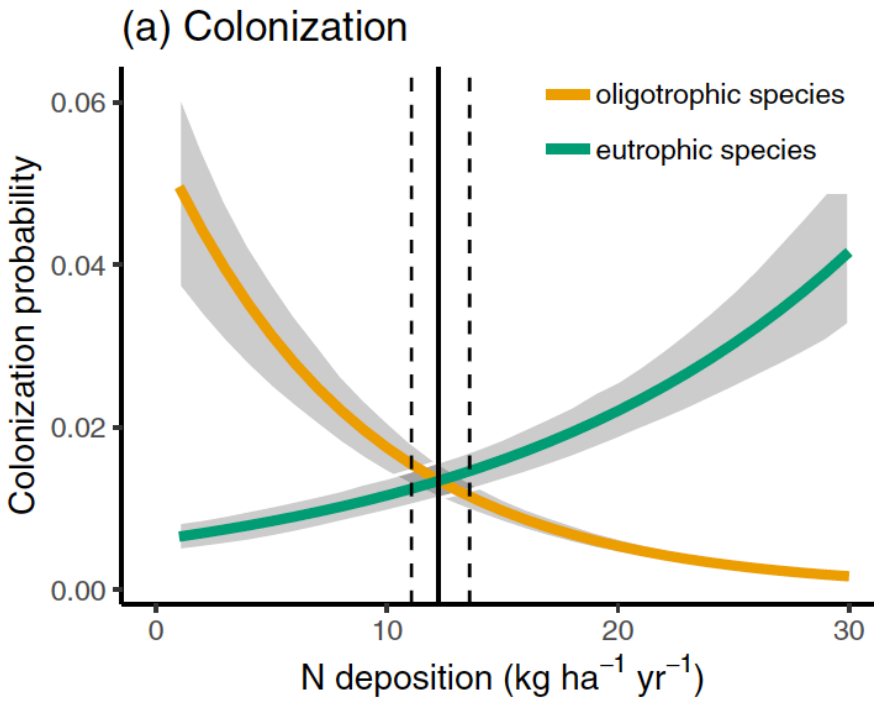
– We compared indicator values of species that colonized a site with the indicator values of randomly chosen species from the same site

## Indicator values for plants in Switzerland

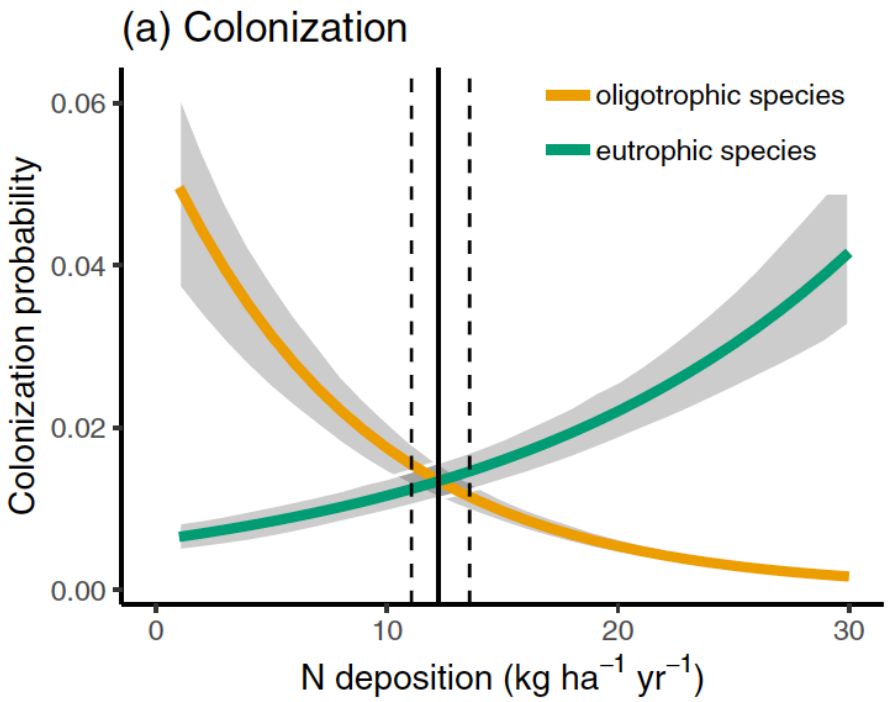
| Index | Temperature T | Light L | Nutrients N | |
|---|---|---|---|---|
| 1 | alpine and nival | deep shade | very infertile | oligotrophic |
| 2 | subalpine | schade | infertile | |
| 3 | montane | semi-shade | meadium infertile to medium fertile | |
| 4 | colline | well lit places | fertile | eutrophic |
| 5 | warmest places | full light | very fertile to overrich | |

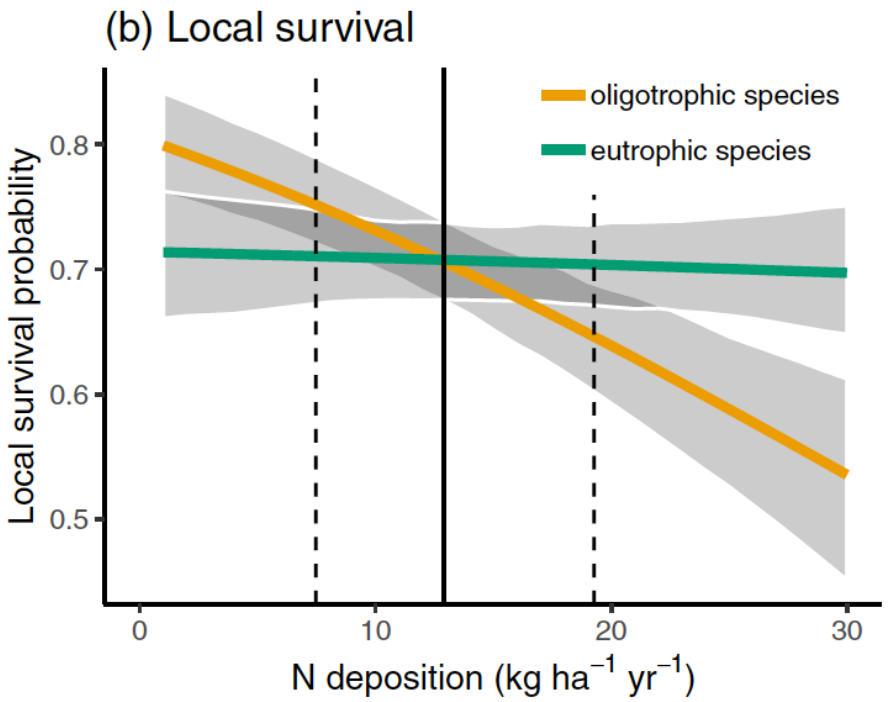
Flora indicativa by Landolt et al. 2010

## Probability of colonization



## Probability of colonization and local survival



**Summary**

– For oligotrophic and eutrophic species the probability of colonisation is related to N deposition

– Only for oligotrophic species the probability of local survival is related to N deposition

– Eutrophic species have high local survival probabilities even at sites with low N deposition

– In addition species with lower indicator values for temperature are replaced with species with higher values

## Does vegetation change with decreasing N deposition?

# Species turnover reveals hidden effects of decreasing nitrogen deposition in mountain hay meadows

Tobias Roth[1,2], Lukas Kohli[2], Christoph Bühler[2], Beat Rihm[3], Reto Giulio Meuli[4], Reto Meier[5] and Valentin Amrhein[1]

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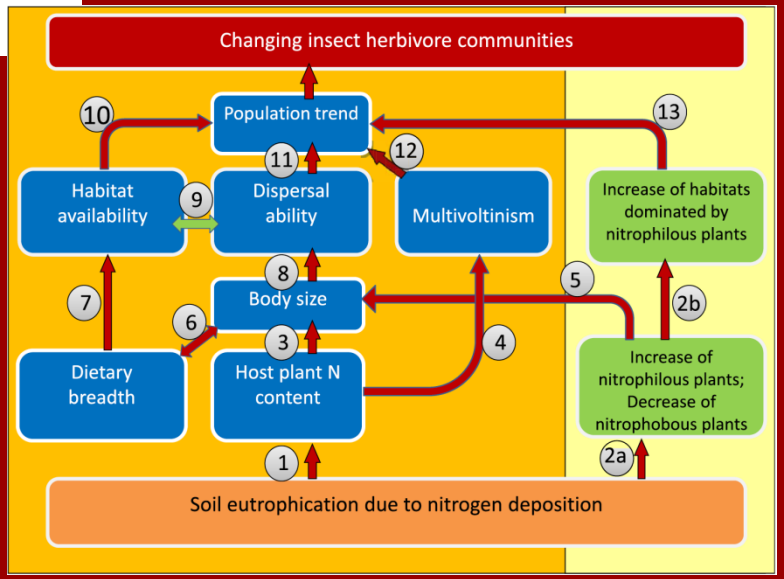
*Global Ecology and Biogeography, (Global Ecol. Biogeogr.)* (2016)

CONCEPT PAPER

# The effects of soil eutrophication propagate to higher trophic levels

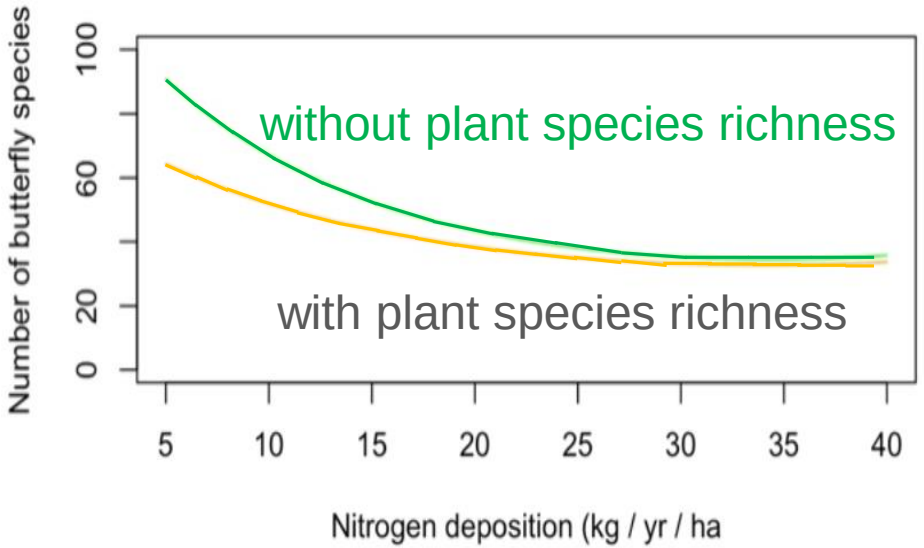
Juha Pöyry[1]*, Luísa G. Carvalheiro[2,3], Risto K. Heikkinen[1], Ingolf Kühn[4,5,6], Mikko Kuussaari[1], Oliver Schweiger[4], Anu Valtonen[7], Peter M. van Bodegom[8] and Markus Franzén[4]



## Wrap-up

Butterfly diversity in Switzerland is negatively related to N deposition. This is partially explained by the plant species richness, being also reduced when N deposition is excessive

What vegetation characteristics other than species richness explain the development of butterfly diversity?



**Characteristics of the vegetation**

– Plant data of kilometre squares of the years 2003 to 2007

– Influencing variables: N-deposition of 2007, mean annual temperature, mean annual precipitation, share of forest and of settlement and inclination

– Linear models with the mean indicator value as dependent variable

High N deposition leads to landscapes with shady vegetation and more eutrophic plant species

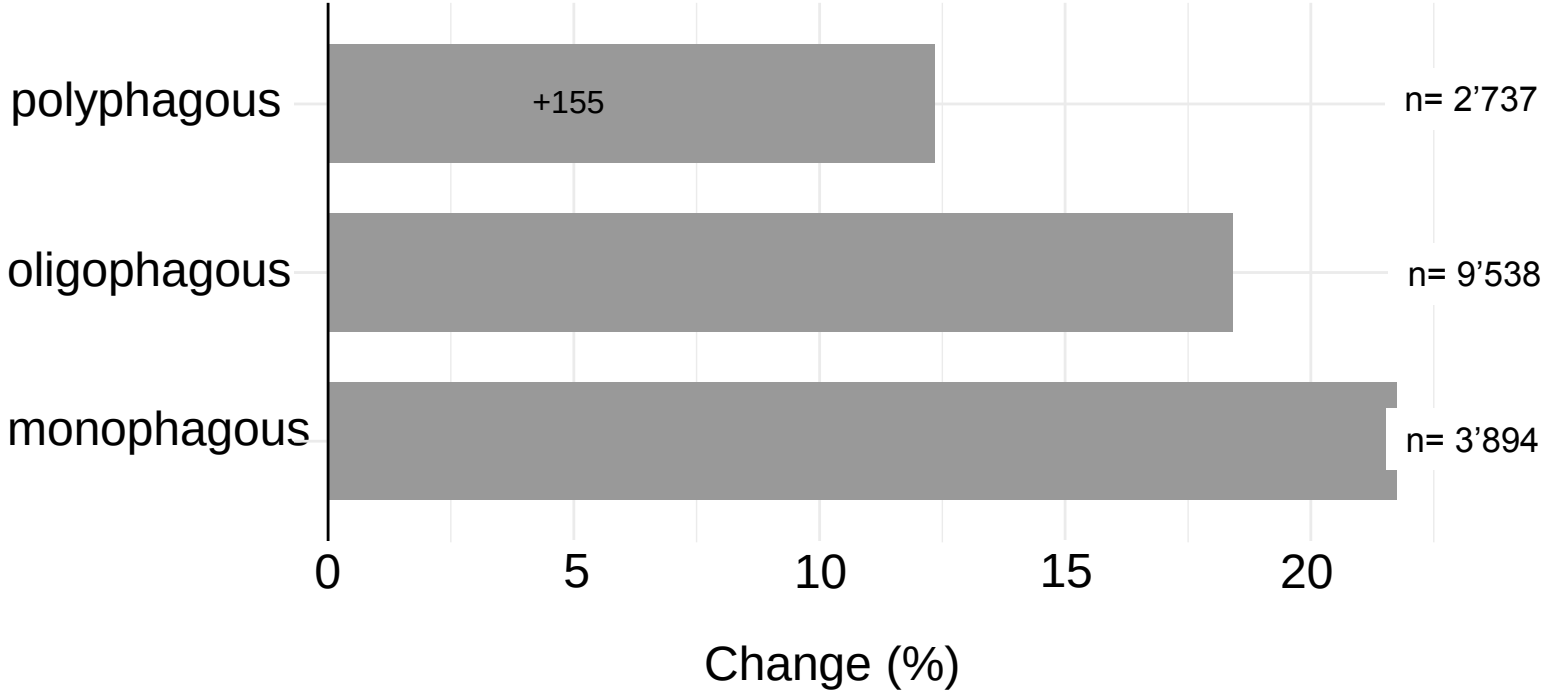
## Temporal change in butterfly diversity in low haltitudes (500 m)

Change in number of individuals between 2004–2008 and 2014–2018

| term | estimate | std.error | statistic | p.value |
|---|---|---|---|---|
| Δ T-value | -7.10 | 5.57 | -1.27 | 0.203 |
| Δ F-value | 0.15 | 0.10 | 1.48 | 0.140 |
| Δ L-value | **0.37** | 0.13 | 2.89 | 0.004 |
| Δ R-value | 0.00 | 0.11 | 0.02 | 0.981 |
| Δ N-value | **-0.38** | 0.16 | -2.46 | 0.014 |

## Temporal change in butterfly communities (below 1500 m)

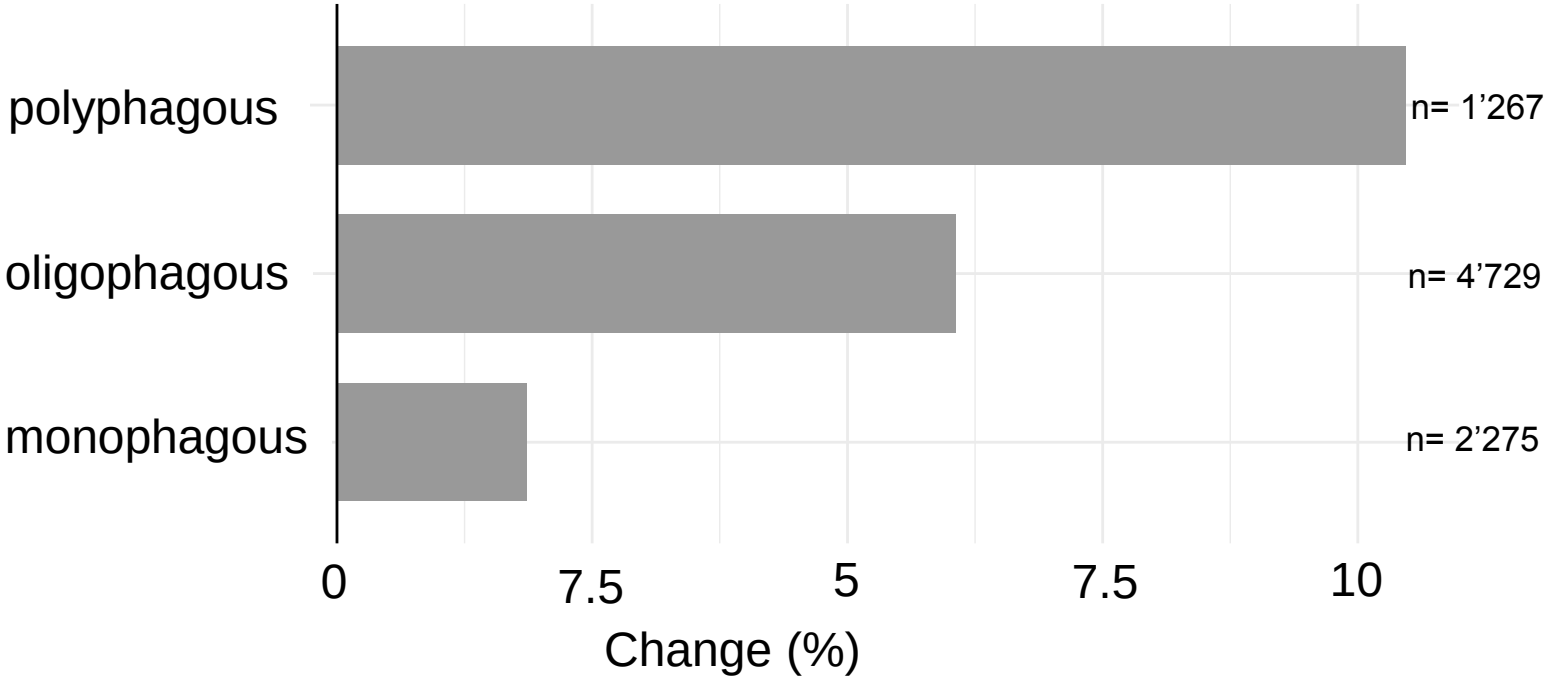
Change of proportion of records between 2004–2008 and 2014–2018




phagy according to Fauna indicativa

**Temporal change in butterfly communities (above 1500 m)**

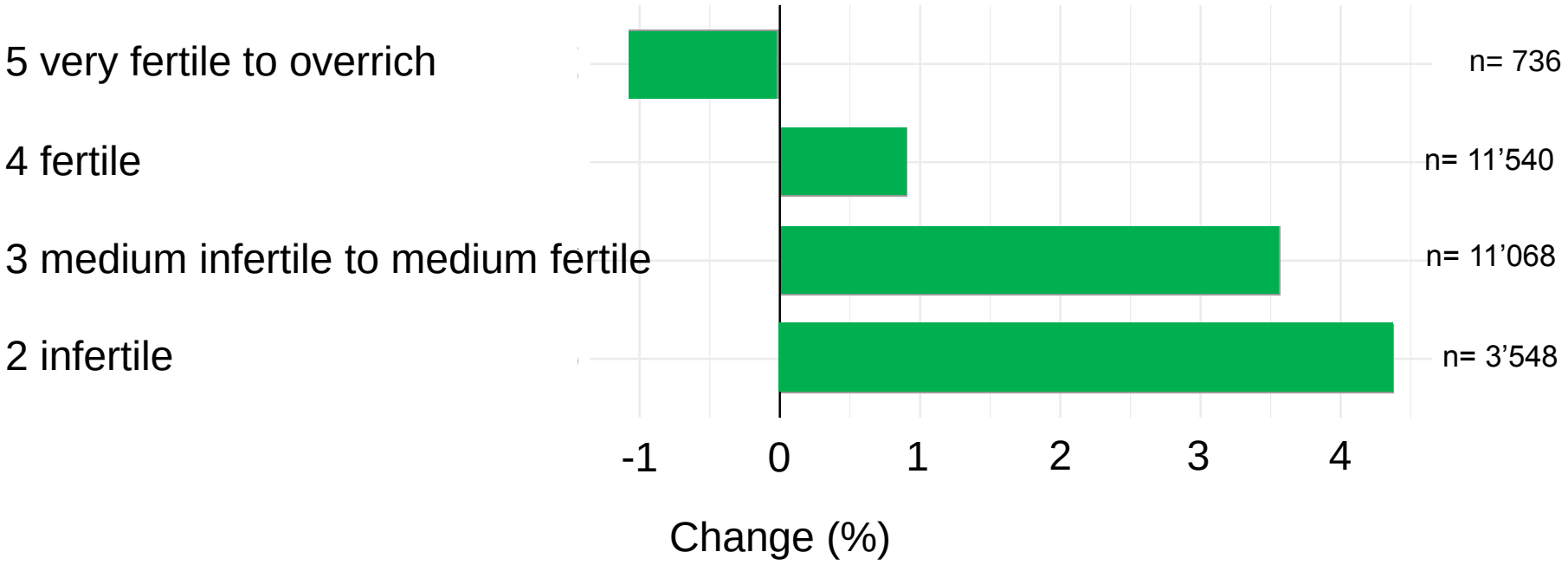
Change of proportion of records between 2004–2008 and 2014–2018




phagy according to Fauna indicativa

**Temporal change in plant communities in low altitudes (below 500m)**

Change of proportion of records between 2004–2008 and 2014–2018




Indicator values according to Flora indicativa

## Summary

– high N deposition leads to landscapes with shady vegetation and more eutrophic plant species

– butterfly diversity increases when vegetation becomes less shady or the proportion of eutrophic species decreases

– monophagous butterfly species profit from to changes in vegetation at low altitudes

– polyphagous butterfly species benefit from the increase in temperature at high altitudes

**Thanks**

– the BDM field team

– S. Birrer + M.Plattner, Jeannine Klaiber, Heiner Ziegler

– Reto Meier FOEN

– Thank you