THE EFFECTS OF MICROCLIMATE CHANGE ON FOREST UNDERSTOREY FLOWERING PHENOLOGY

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INTRODUCTION

- Global climate warming causes shift in phenology
  - ➢ consequences for plant fitness, demography
    → community composition ➔ biodiversity & ecosystem functioning
- Forest understorey herb layer
  - ➢ ecological significance: harbours 80% vascular plant diversity
  - ➢ functional role: tree regeneration, nutrient cycling, water dynamics, …
  - ➢ **However:** often neglected when assessing impacts of climate change on forests
- Tree canopy affects understorey environment
  - ➢ **Light availability**
  - ➢ **Microclimate** – buffered temperatures

EXPERIMENTAL DESIGN

	PASTFORWARD	FORMICA
Established in	2016	2019
Warming	Open-top chambers	Heat lamps
		

EXPERIMENTAL DESIGN

- Phenological monitoring
  - February – October 2021
  - 9 forest understorey species
  - Counting number of open flowers, inflorescences or raceme per tray 2-3x/week
    - → Phenology **variables**: onset, peak, end and duration of flowering
- Microclimate data
  - TOMST TMS-4 Dataloggers (1 per plot; 15min. intervals)
    - → Daily mean air temperature in spring

STUDY SPECIES

PASTFORWARD

Ficaria verna

Galium odoratum

Vinca minor

Hyacinthoides non-scripta

Polygonatum multiflorum

PASTFORWARD & FORMICA

Carex sylvatica

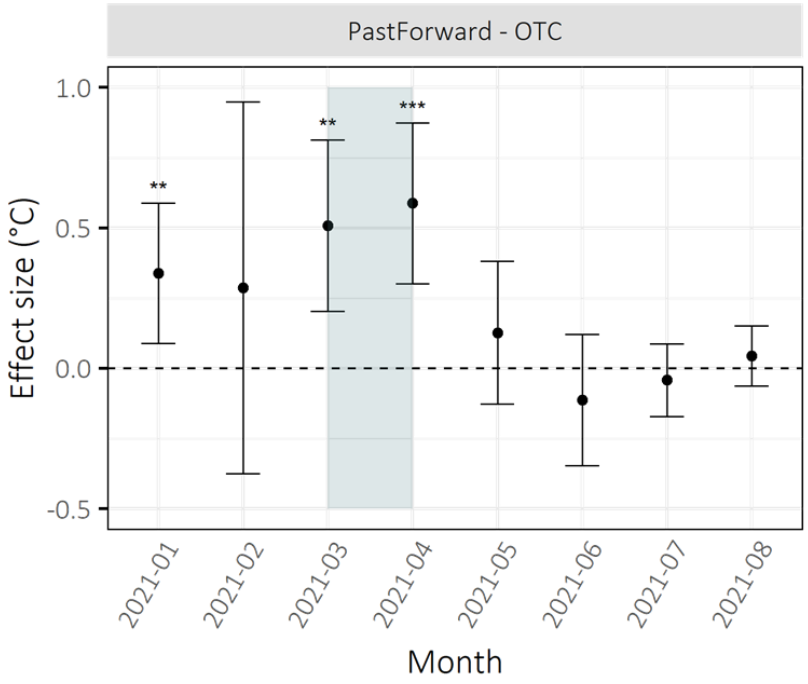
Anemone nemorosa

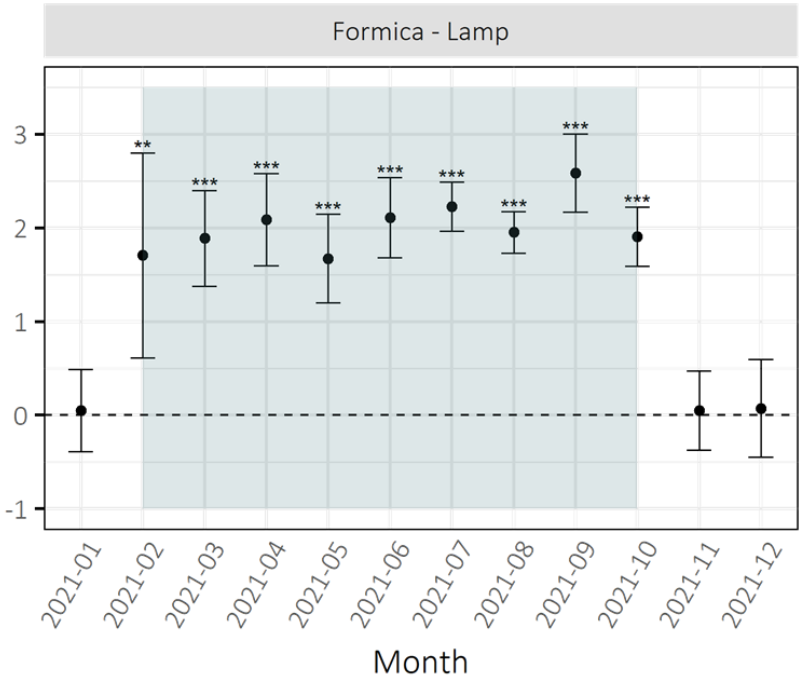
FORMICA

Allium ursinum

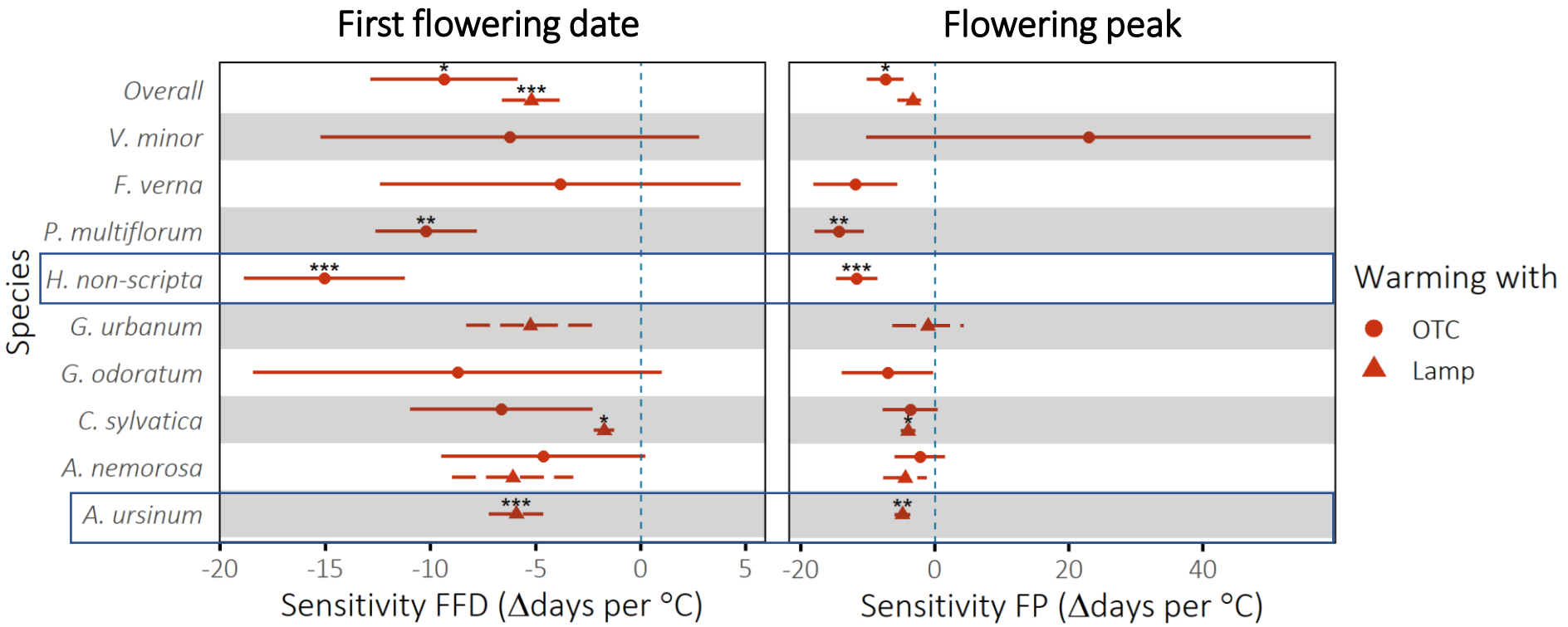
Geum urbanum

EFFECT SIZE OF WARMING TREATMENT



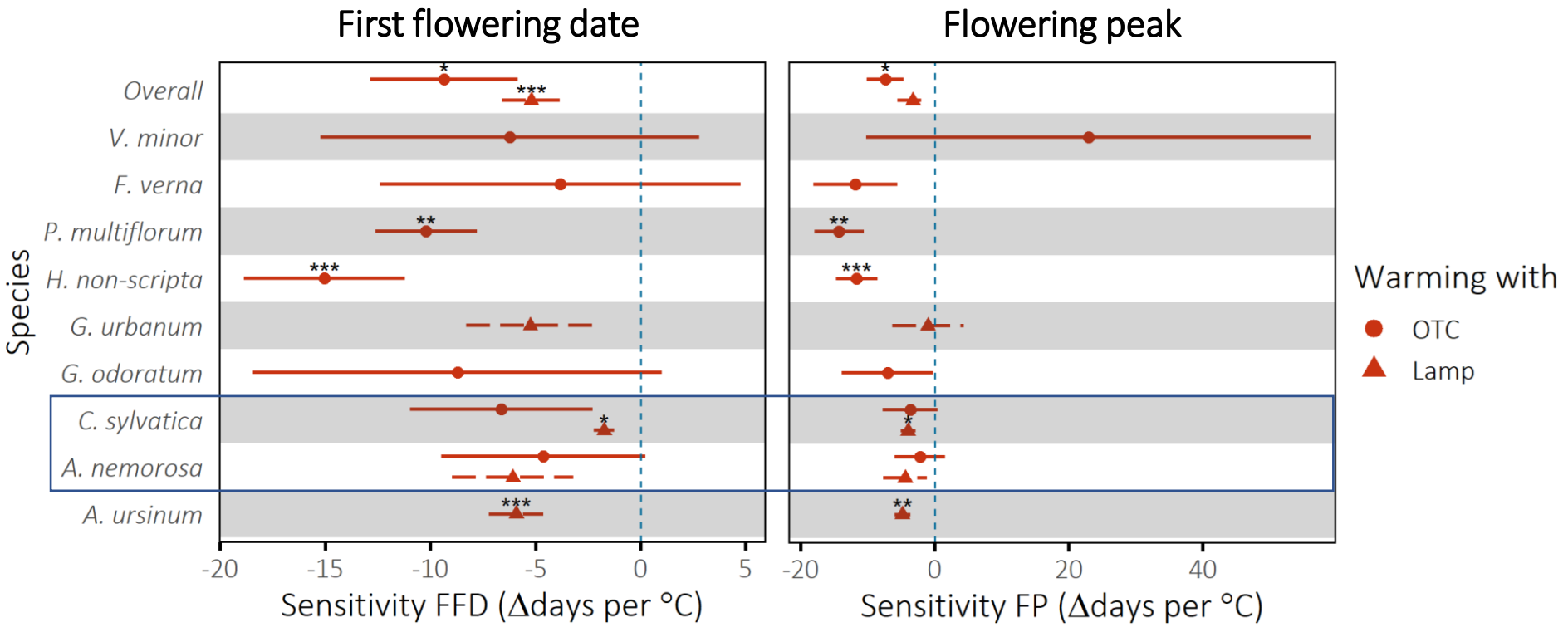


TEMPERATURE SENSITIVITY



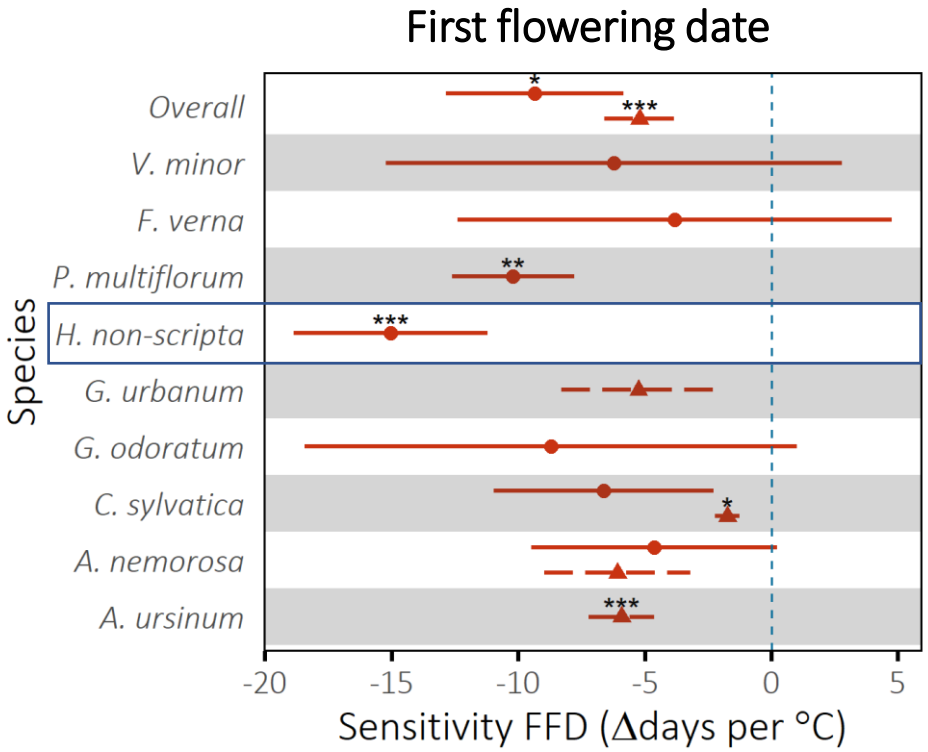
In general, there is an advance of FFD & FP. Some species are much more responsive to changes in temperature (→ **indicator species**?).

TEMPERATURE SENSITIVITY



Possible indication of **non-linear responses** to warming.

TEMPERATURE SENSITIVITY



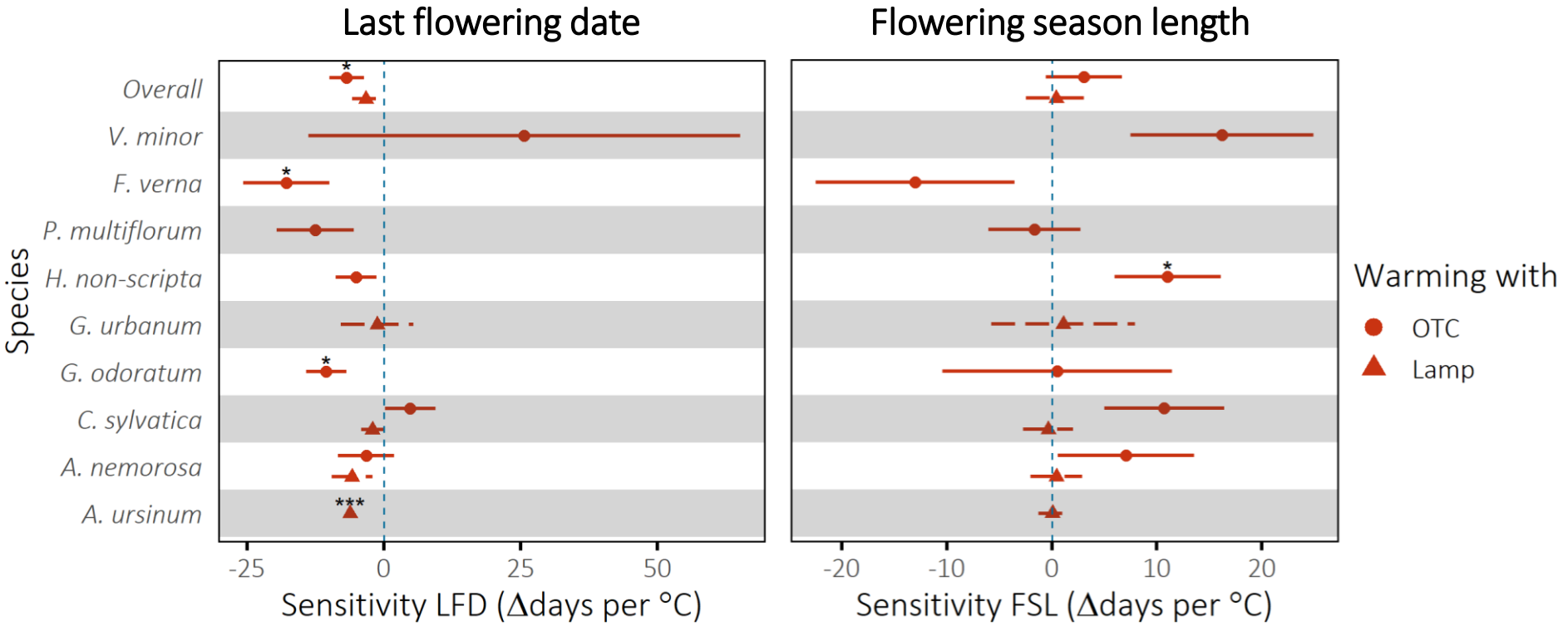
Comparison with previous research

Overall sensitivity European forest wildflowers: -3.6 (±0.2) days $°C^{-1}$ (Willems *et al.* 2022)

Sensitivity *H. non-scripta*: −6.2 (±1.2) days $°C^{-1}$ (Jönsson & Fox 2019)

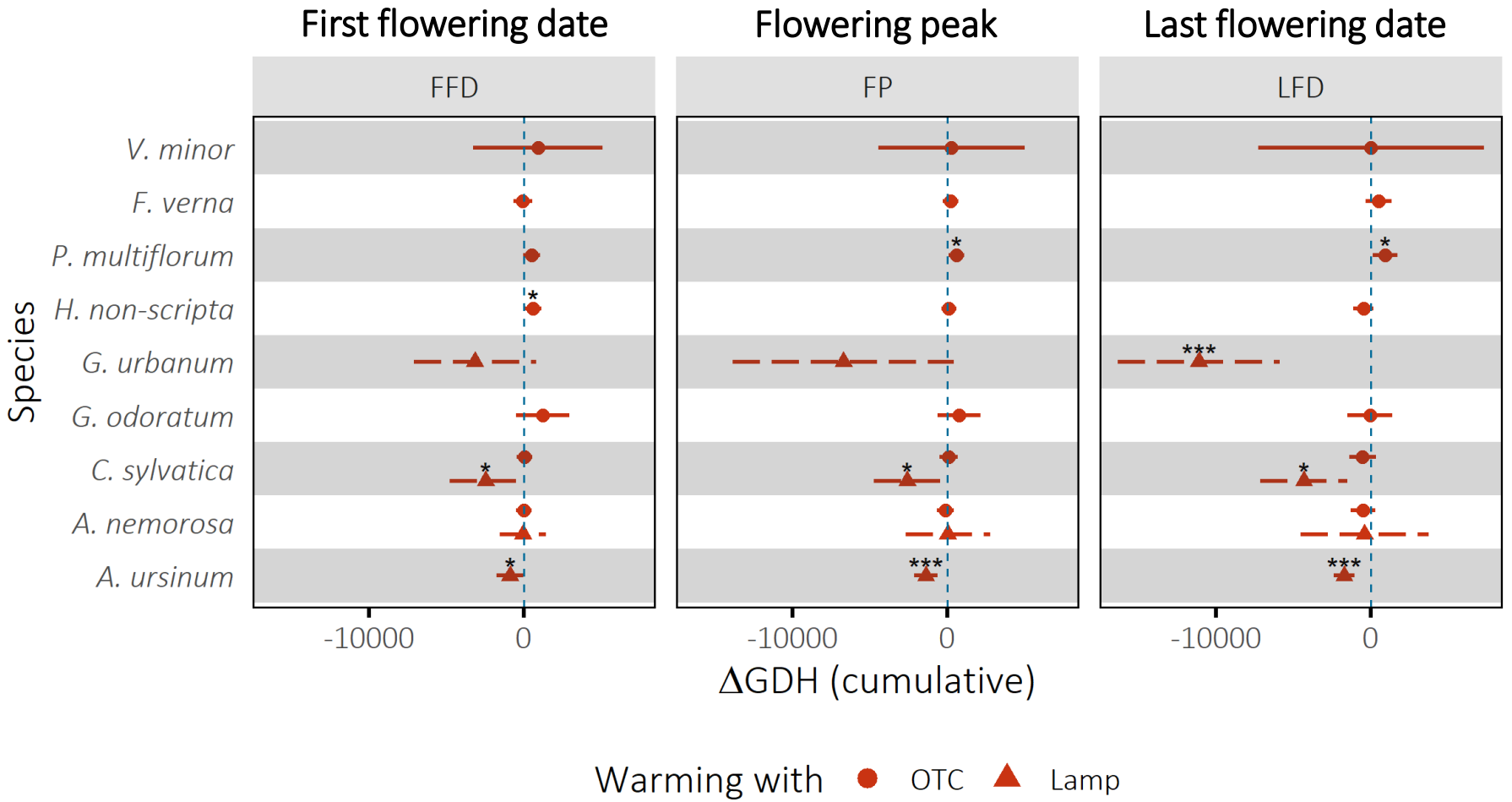
→ Response to **macroclimate** warming ≠ **microclimate** warming

TEMPERATURE SENSITIVITY

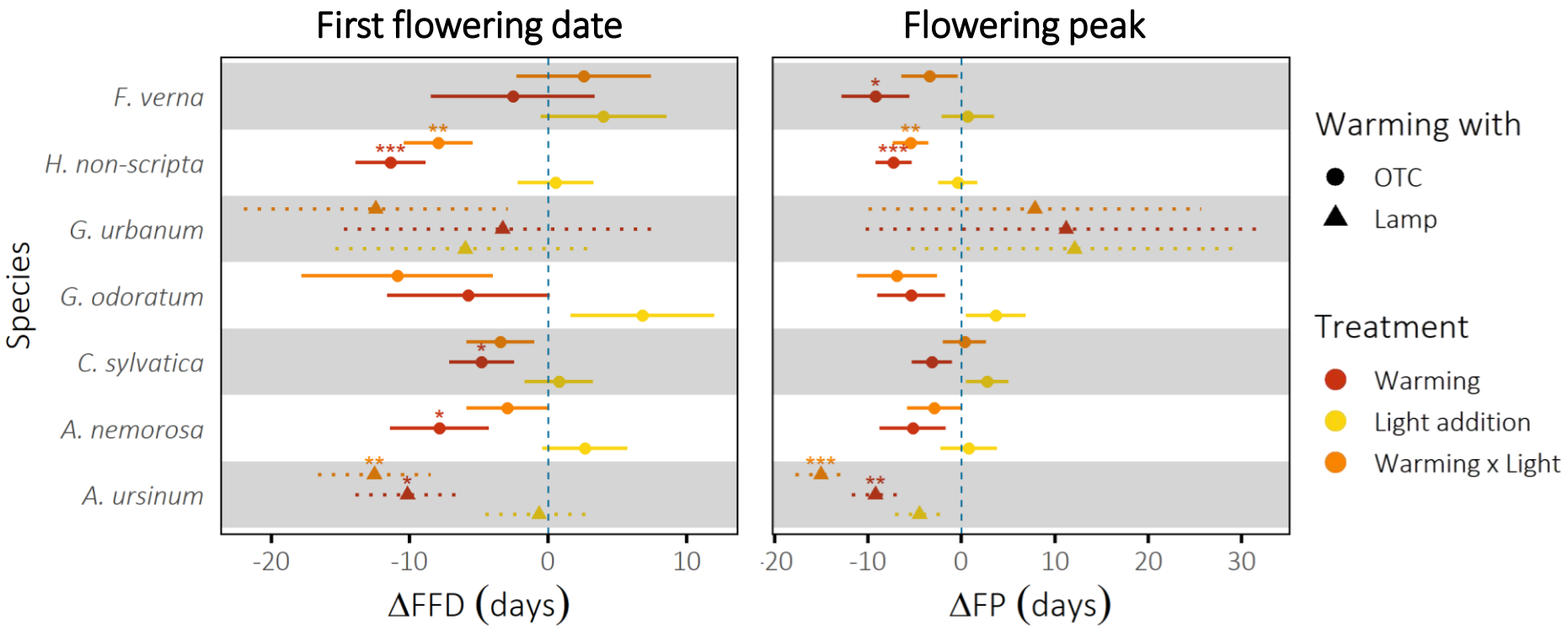


In general, LFD appears less sensitive to climate warming. Together with advancing FFD leads to prolonged flowering season. Otherwise, with uniform shift FSL remains unchanged

HEAT ACCUMULATION

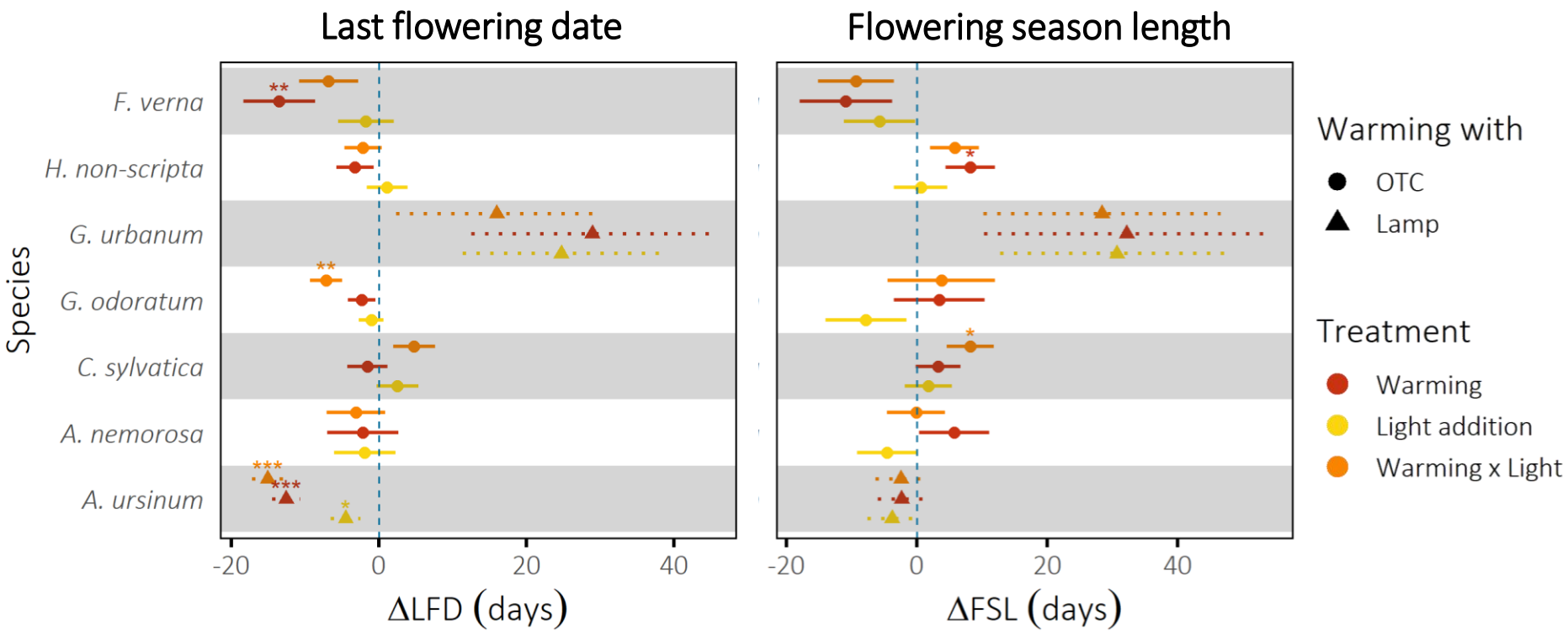


INFLUENCE OF ILLUMINATION

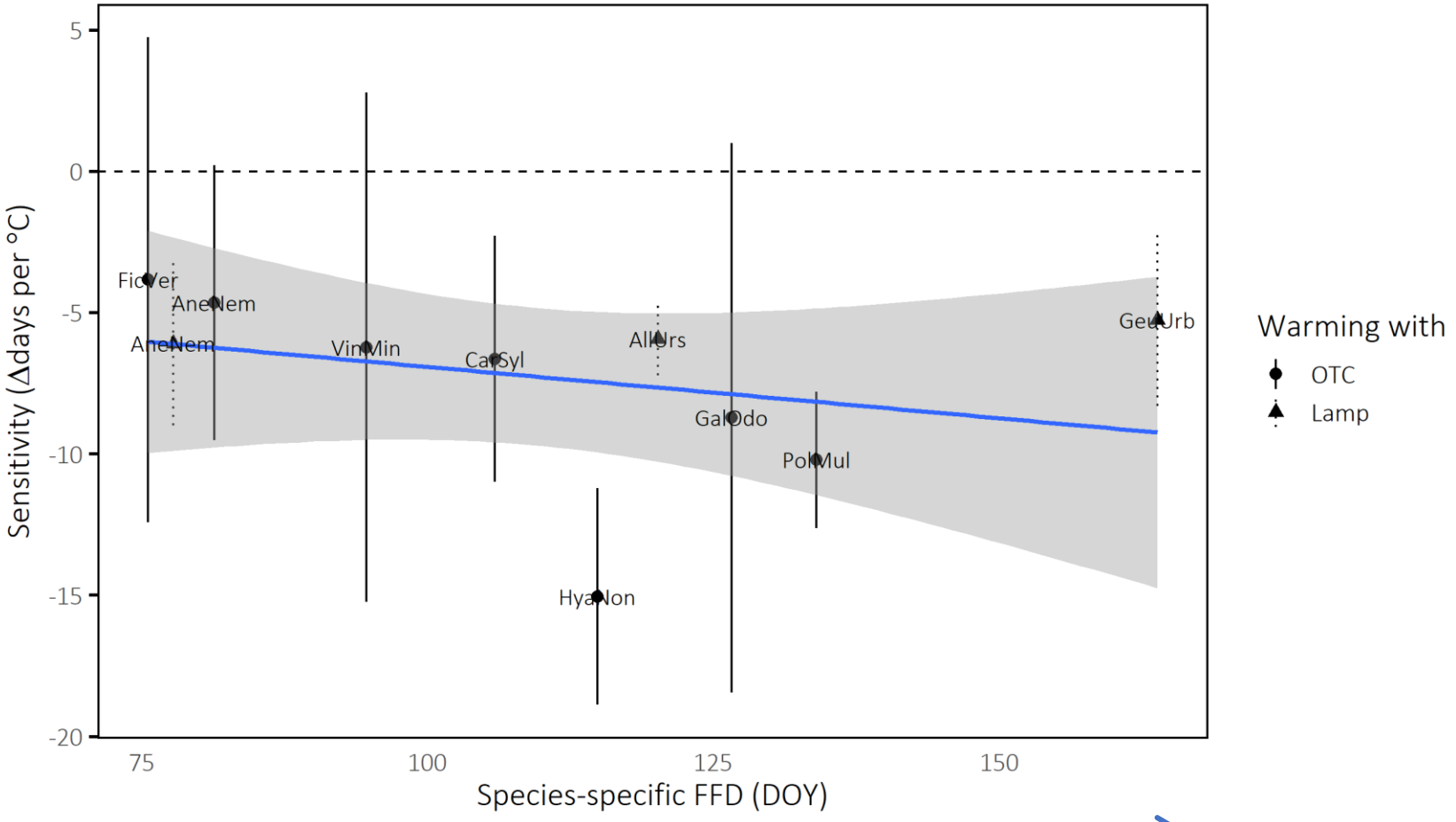


In general, only an additive effect of illumination: reduction of the magnitude of the phenological advance.

INFLUENCE OF ILLUMINATION



TEMPERATURE RESPONSE VS TYPICAL PHENOLOGY



Early-flowering

"Late"-flowering

CONCLUSION

- Forest understorey flowering phenology is **affected by climate warming**
  - Responses to temperature may be **non-linear** (Jochner *et al.* 2016)
  - **Earlier phenophases** are more sensitive (Stuble *et al.* 2021)
    - ➔ Prolonged flowering
  - **Interspecific variability** in responses and their intraspecific variation
    - ➢ Might lead to altered community organization after prolonged period
- Higher light availability reduces magnitude of the warming-induced advance
- Very sensitive species could be proposed as indicators of biological responses to climate change
- Important to study forest flowering phenology in relation to **microclimate**

Thank you for your attention!

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