

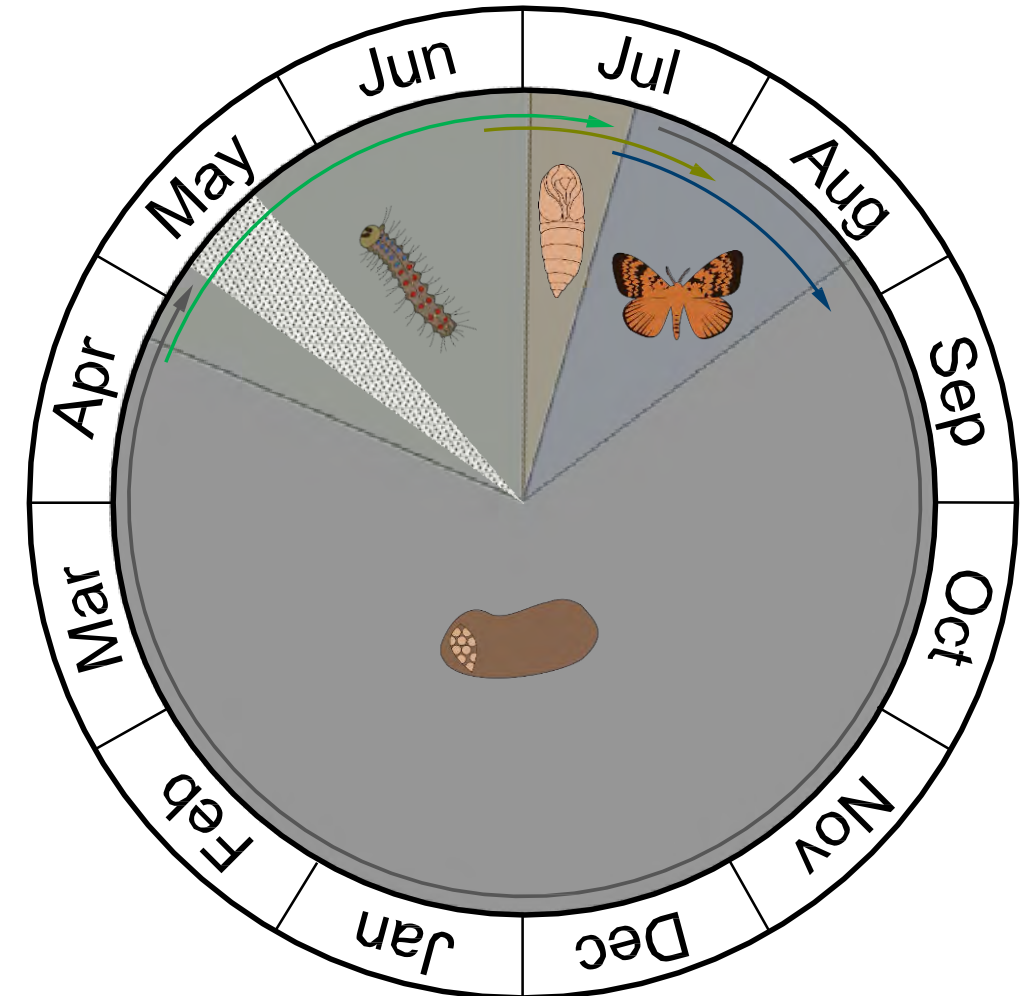
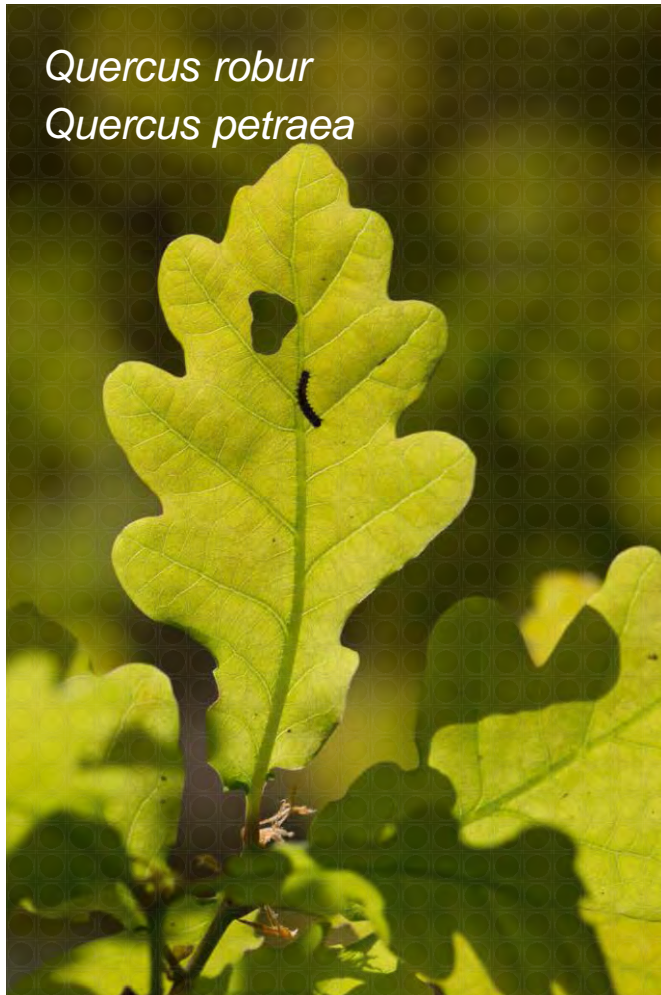


# Trade-offs of natural and anthropogenic disturbances

A large-scale experiment on gypsy moth outbreaks in oak forests

Leroy, B., Weisser, W., Lemme, H., Braumiller, P., Hahn, A., Hilmers, T., Jacobs, M., Pretzsch, H., Hochrein, S., Bae, S., Rabl, D., Müller, J., Stimm, K., Kienlein, S., Jaworek, J., Müller-Kroehling, S.

# The gypsy moth (*Lymantria dispar*)



# Negative impacts of outbreaks



## Silvicultural impacts

- Growth reductions
- Increased mortality
- Altered regeneration

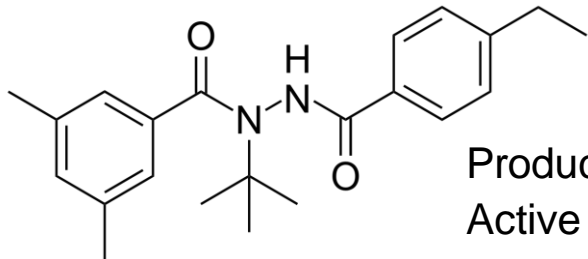
## Ecological impacts

- Habitat destruction
- Food web disruption

## Socio-cultural impacts

- Loss recreational value
- Nuisance

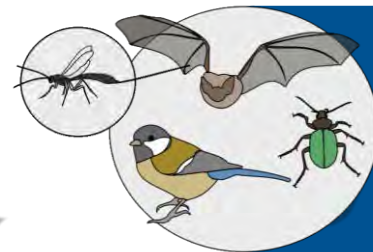
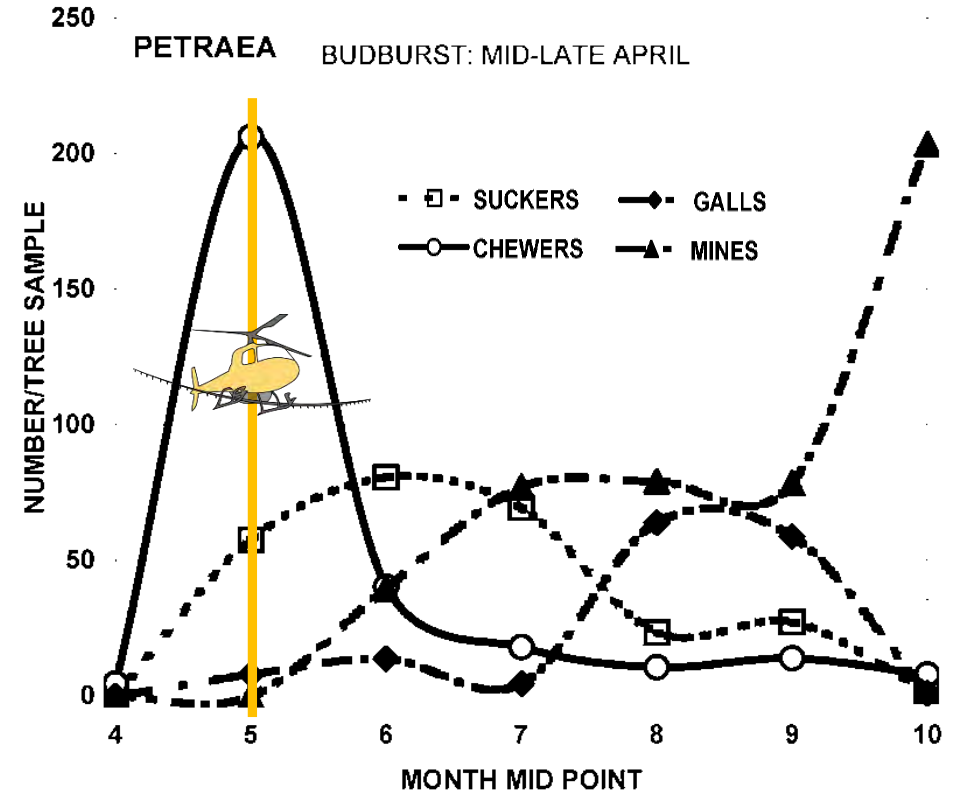
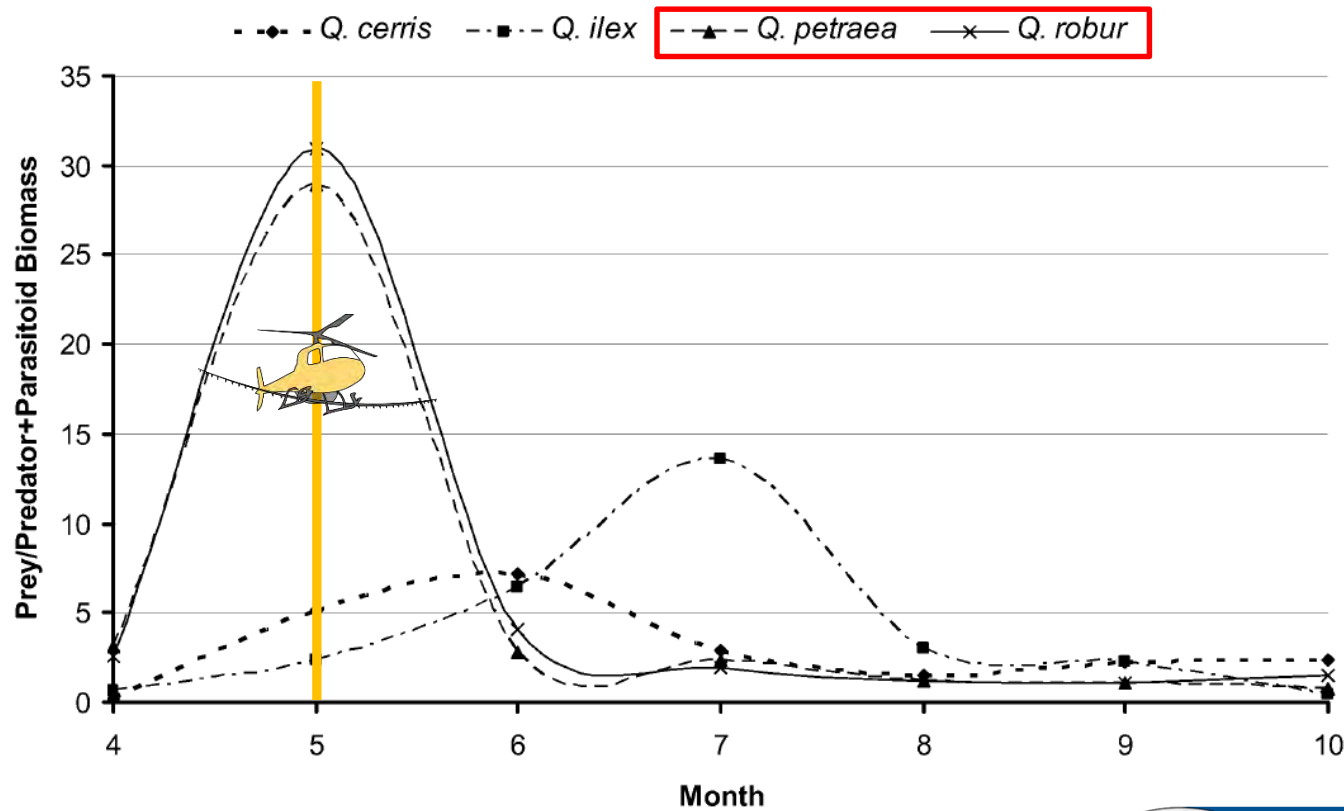
# Chemical management of outbreaks



Product: Mimic®  
Active substance: tebufenozide  
Lepidoptera-specific, non-systemic

The use of insecticides also has ecological impacts!

# Insect guild structure on oak



Caterpillars are a cornerstone of the trophic networks  
 → Potential indirect effects

# Research questions

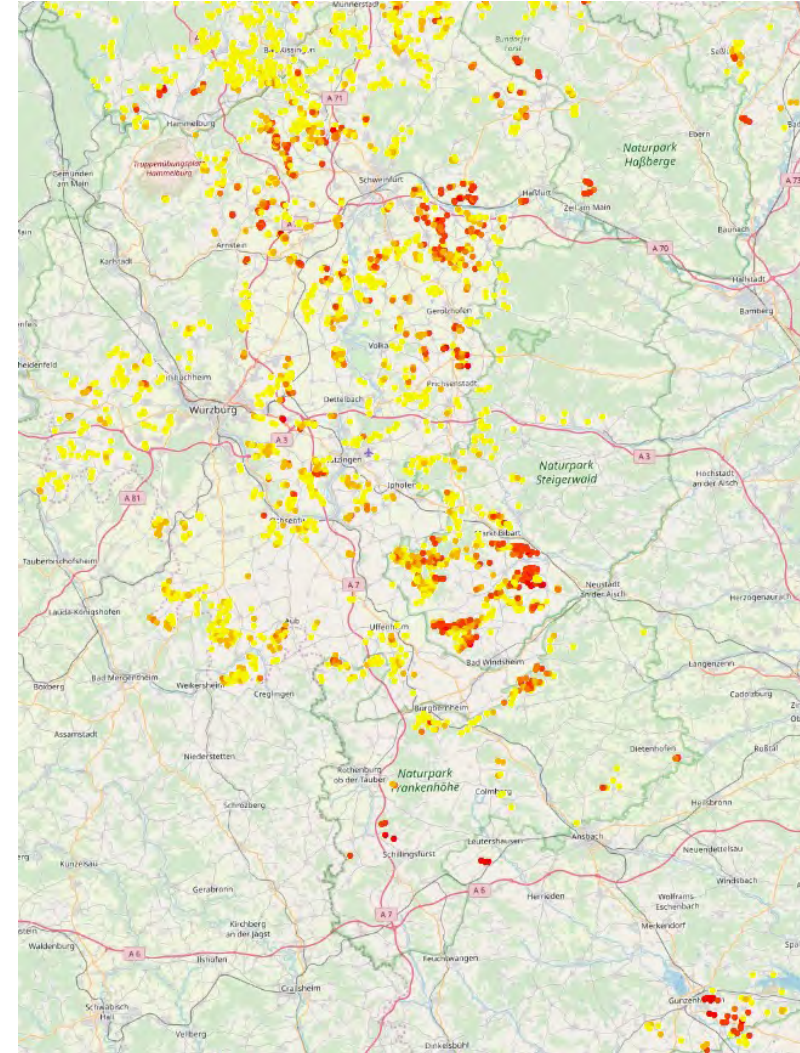
**What is the magnitude of the silvicultural impacts of *Lymantria dispar* outbreaks?**

→ Available data comes almost exclusively from the invasive range of the species

**What are the ecological tradeoffs of chemical vs. „hands-off“ management?**

**How do the impacts of both disturbances (defoliation vs. spraying) develop over time?**

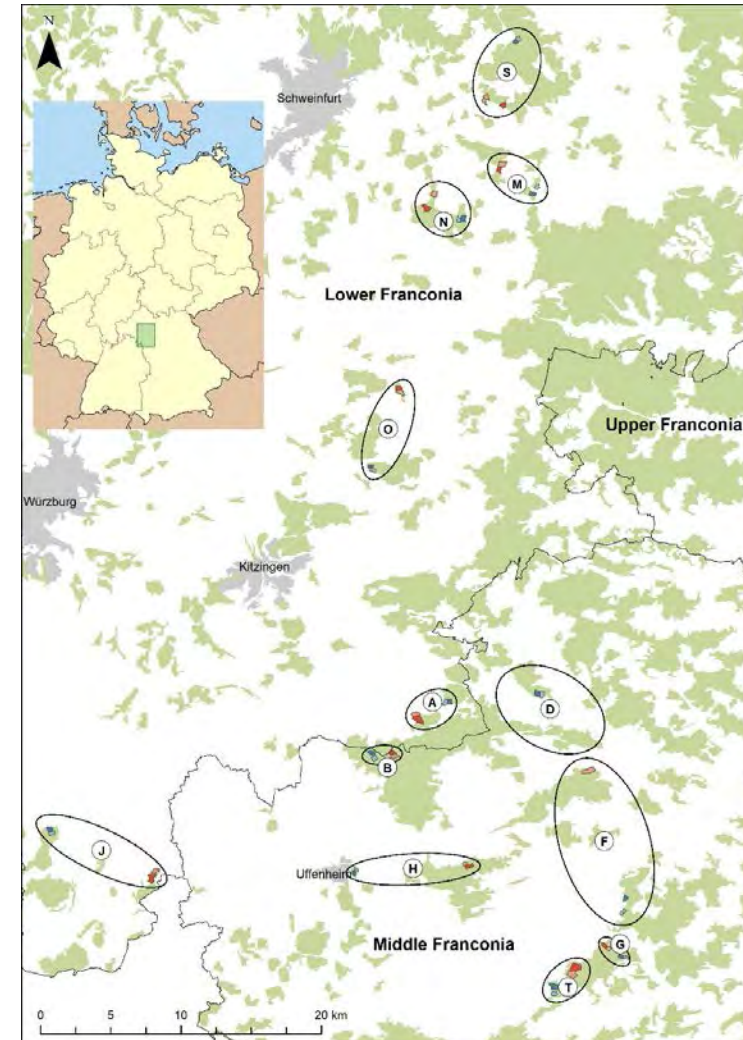
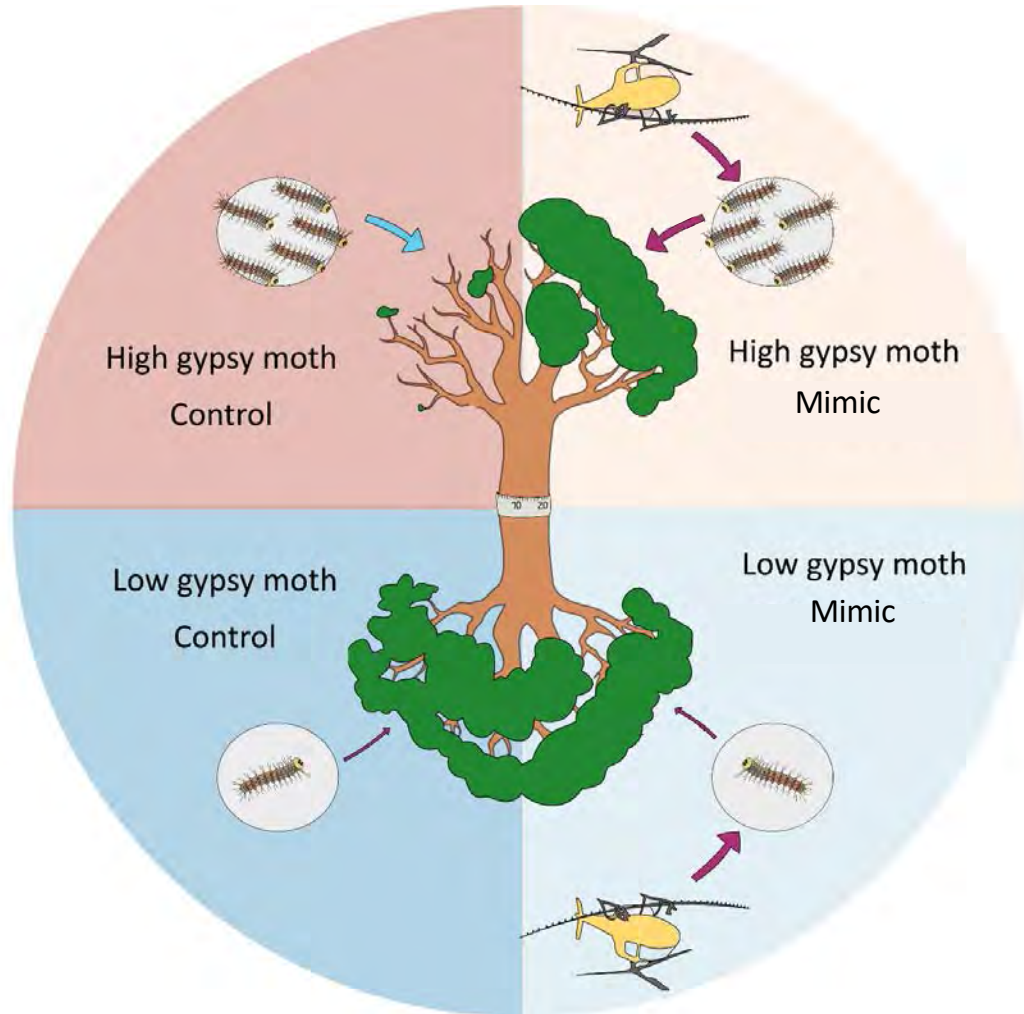
# The experiment – Site selection



Defoliation risk index

- < 0.2
- 0.3 - 0.6
- 0.7 - 1.0
- 1.1 - 4.0
- > 4

# The experiment - Study design





# Methods – defoliation and tree growth



Sentinel-1 satellite imagery



Terrestrial laser scanning



Girth tapes

# Methods – non-target fauna



Canopy fogging

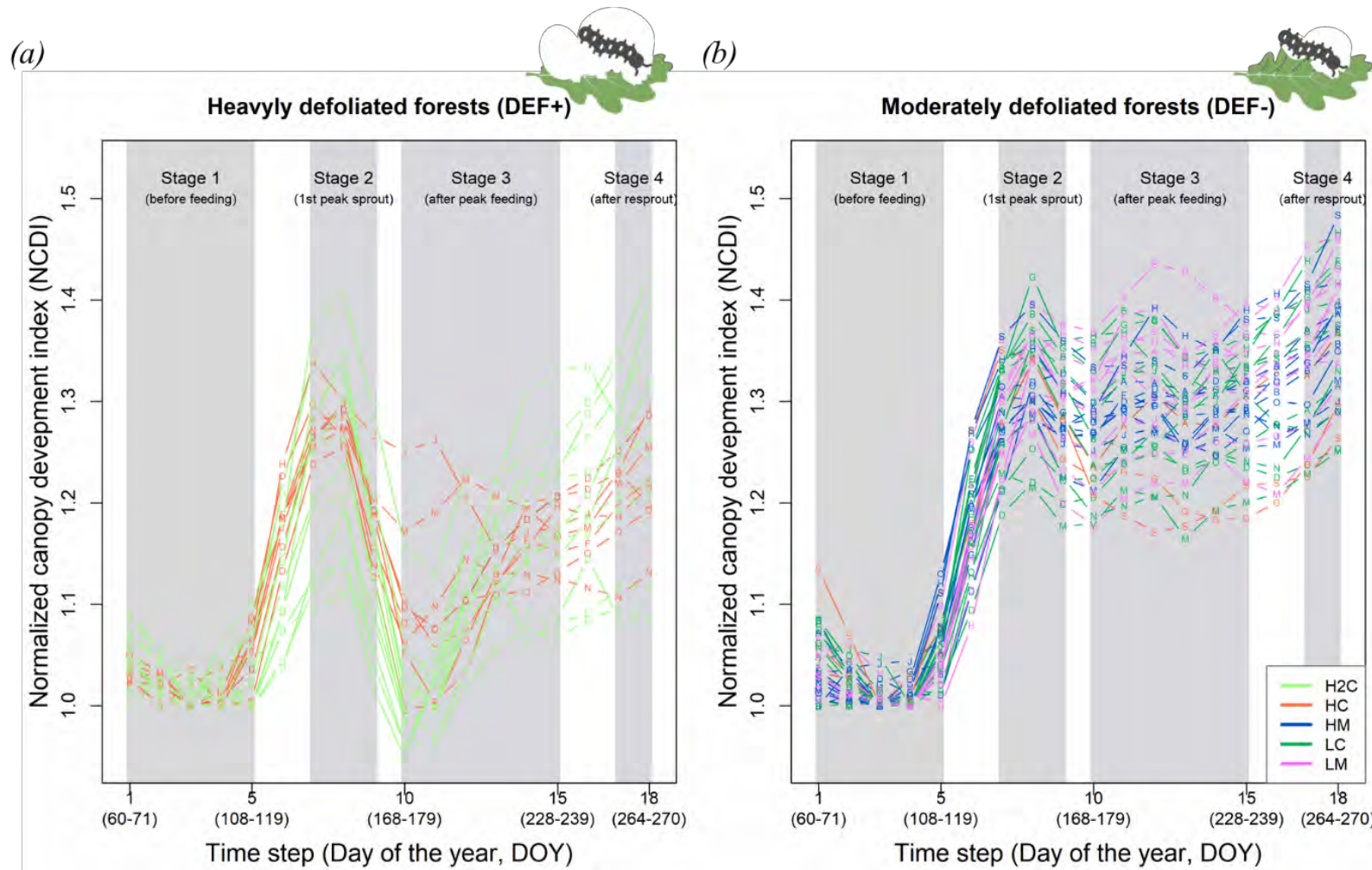


Nest boxes



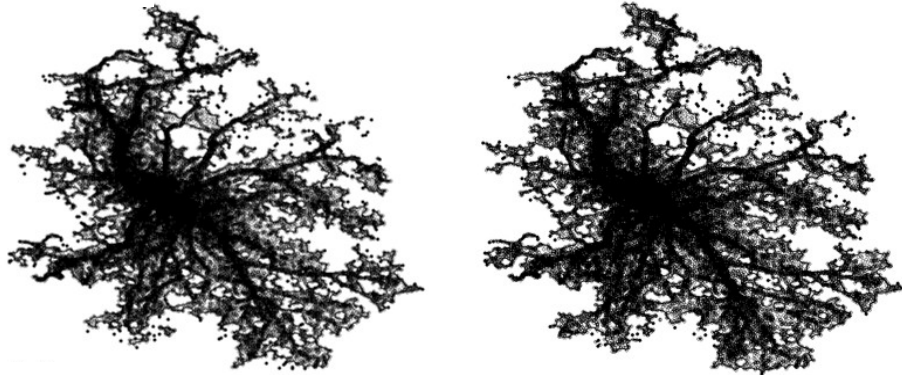
Audio recorders

# Defoliation – Satellite-borne radar



# Defoliation – Terrestrial Laser Scanning

Defoliated



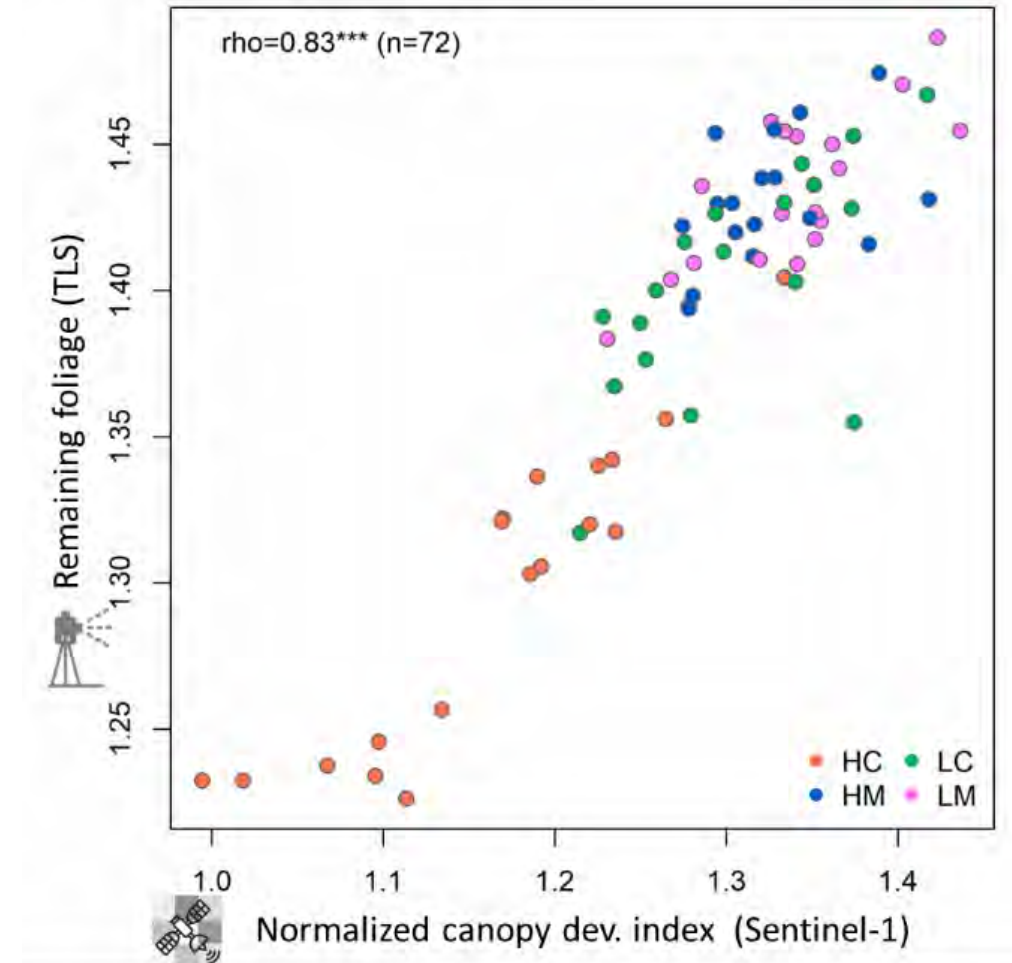
Non-defoliated



Winter

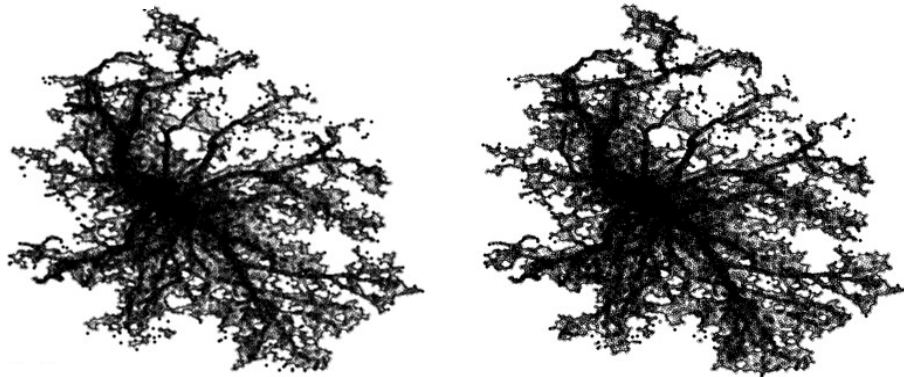
Summer

Foliation ratio



# Defoliation – Terrestrial Laser Scanning

## Defoliated



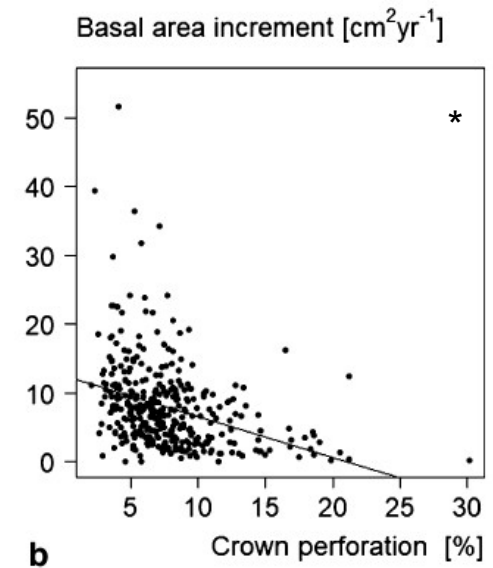
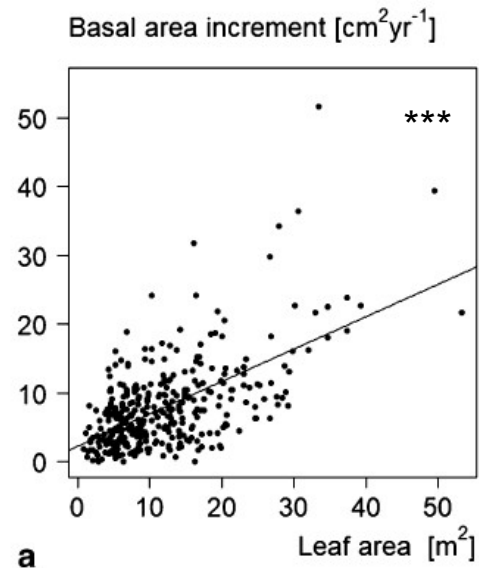
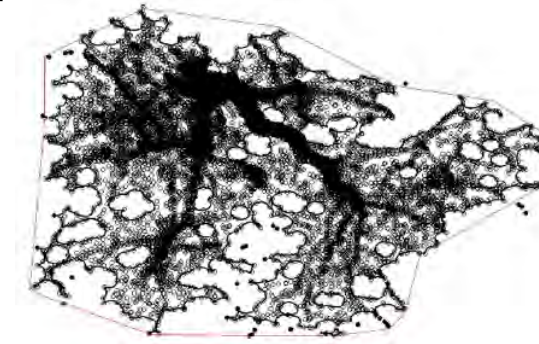
## Non-defoliated



Winter

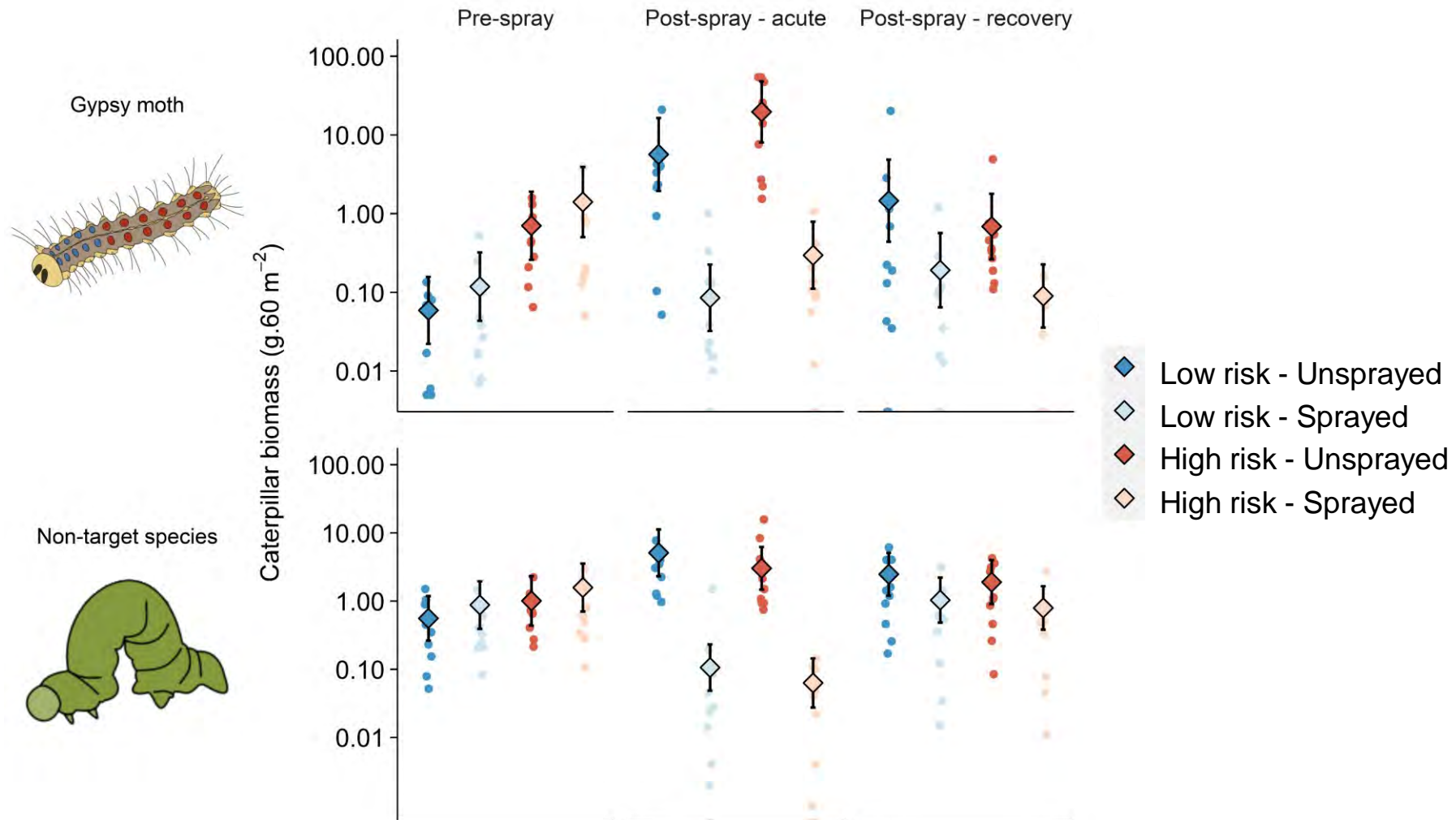
Summer

Crown perforation

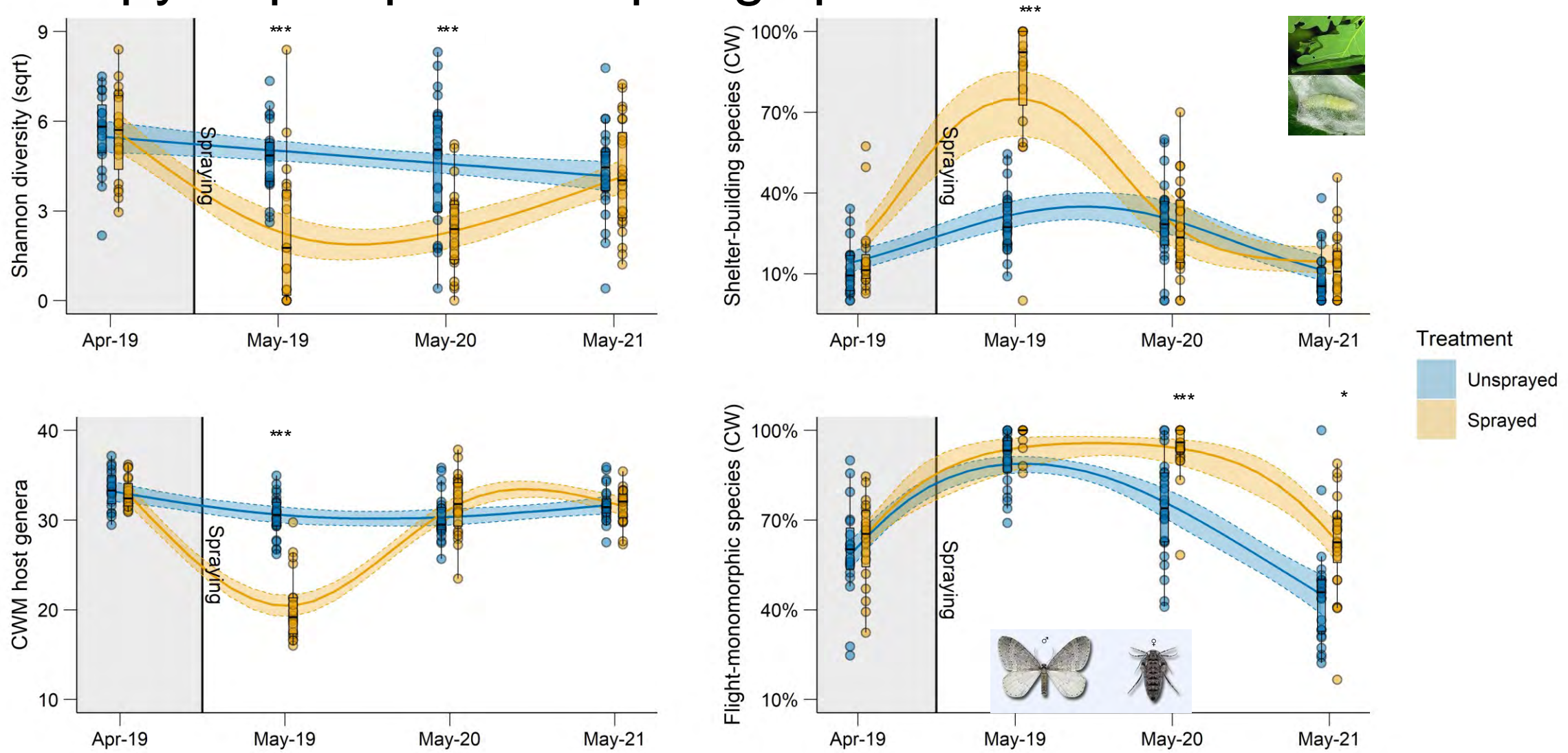


Silvicultural impact of defoliation already visible in the outbreak year!

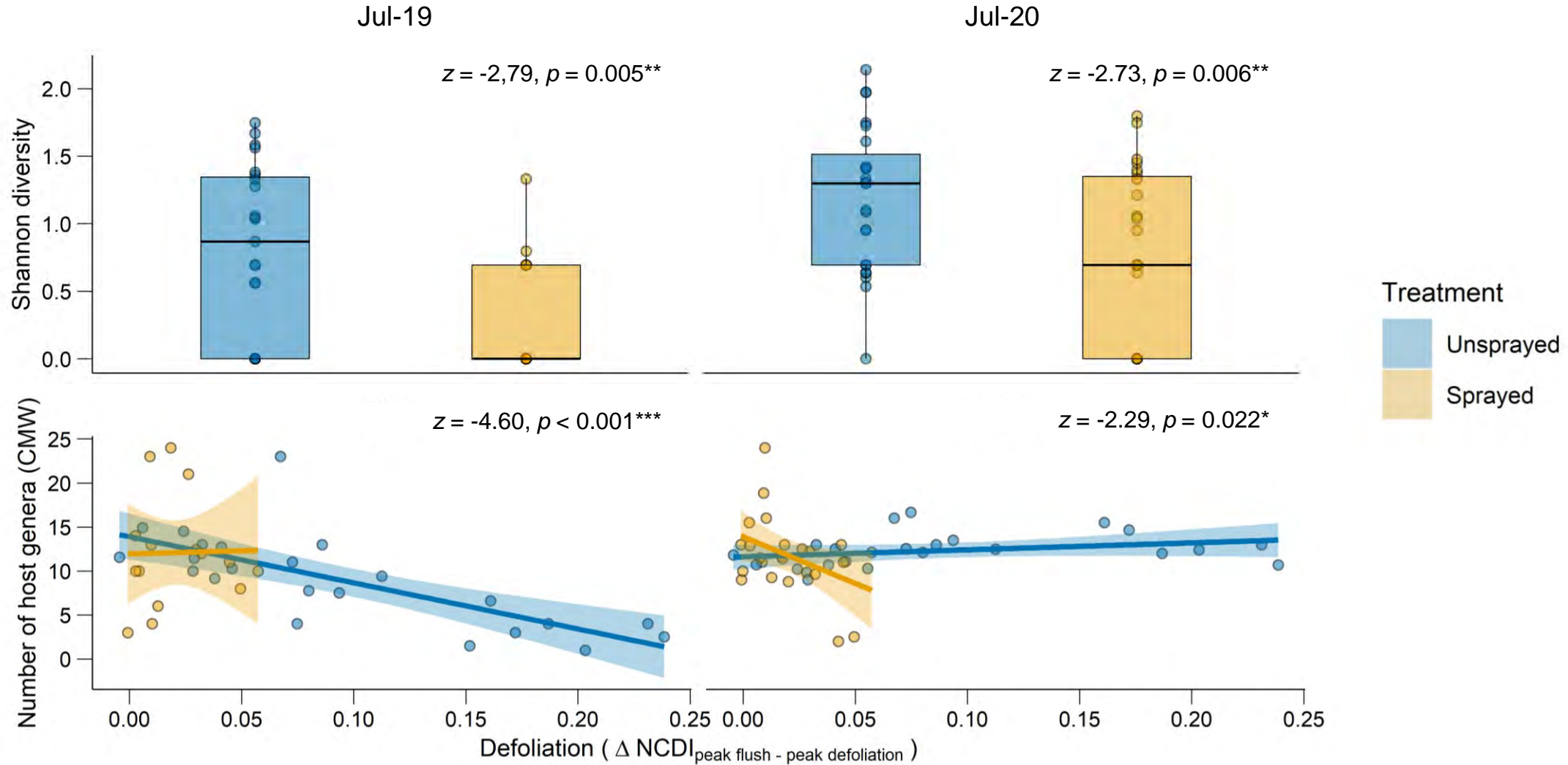
# Canopy Lepidoptera – Biomass



# Canopy Lepidoptera – Spring species

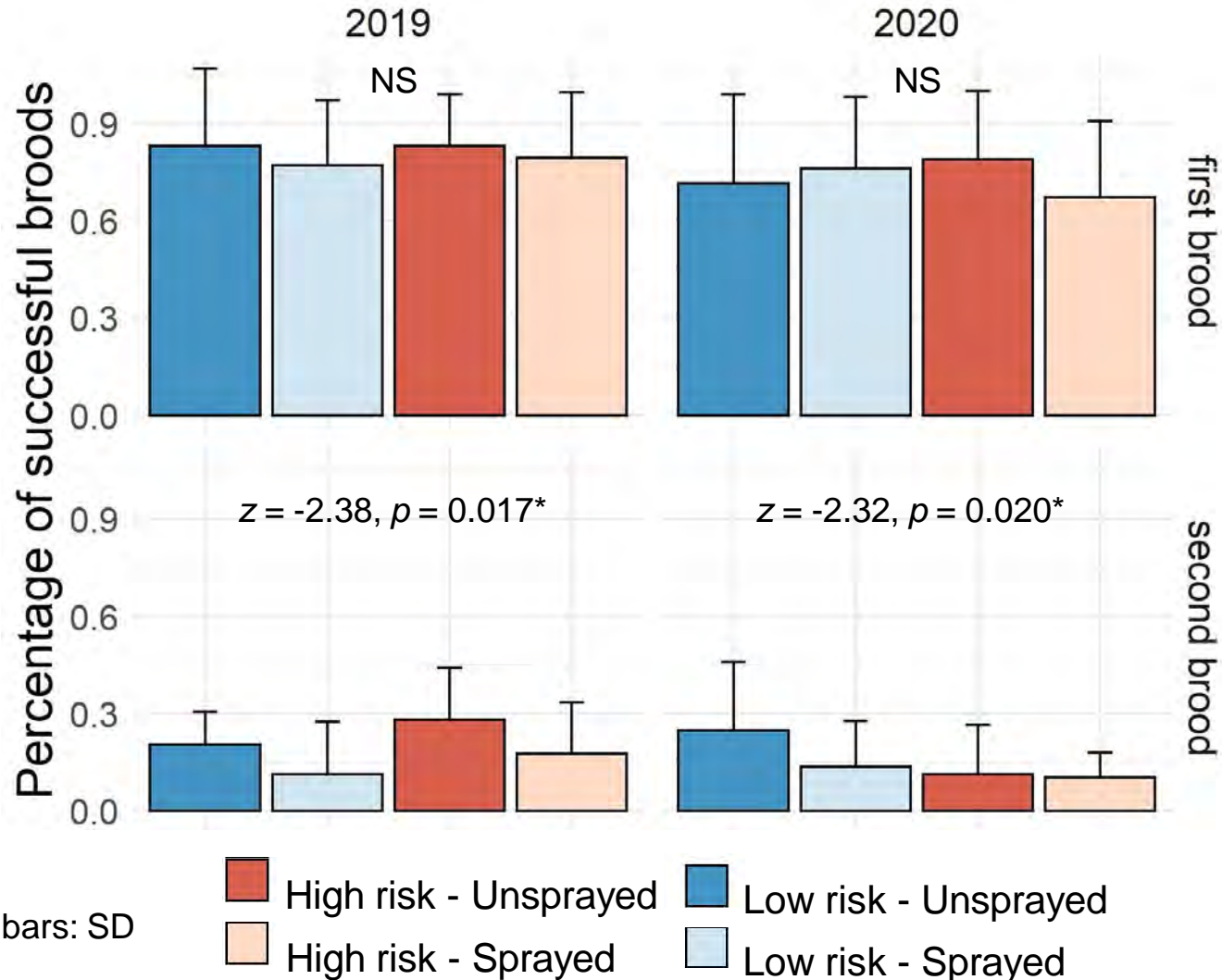


# Canopy Lepidoptera – Summer species

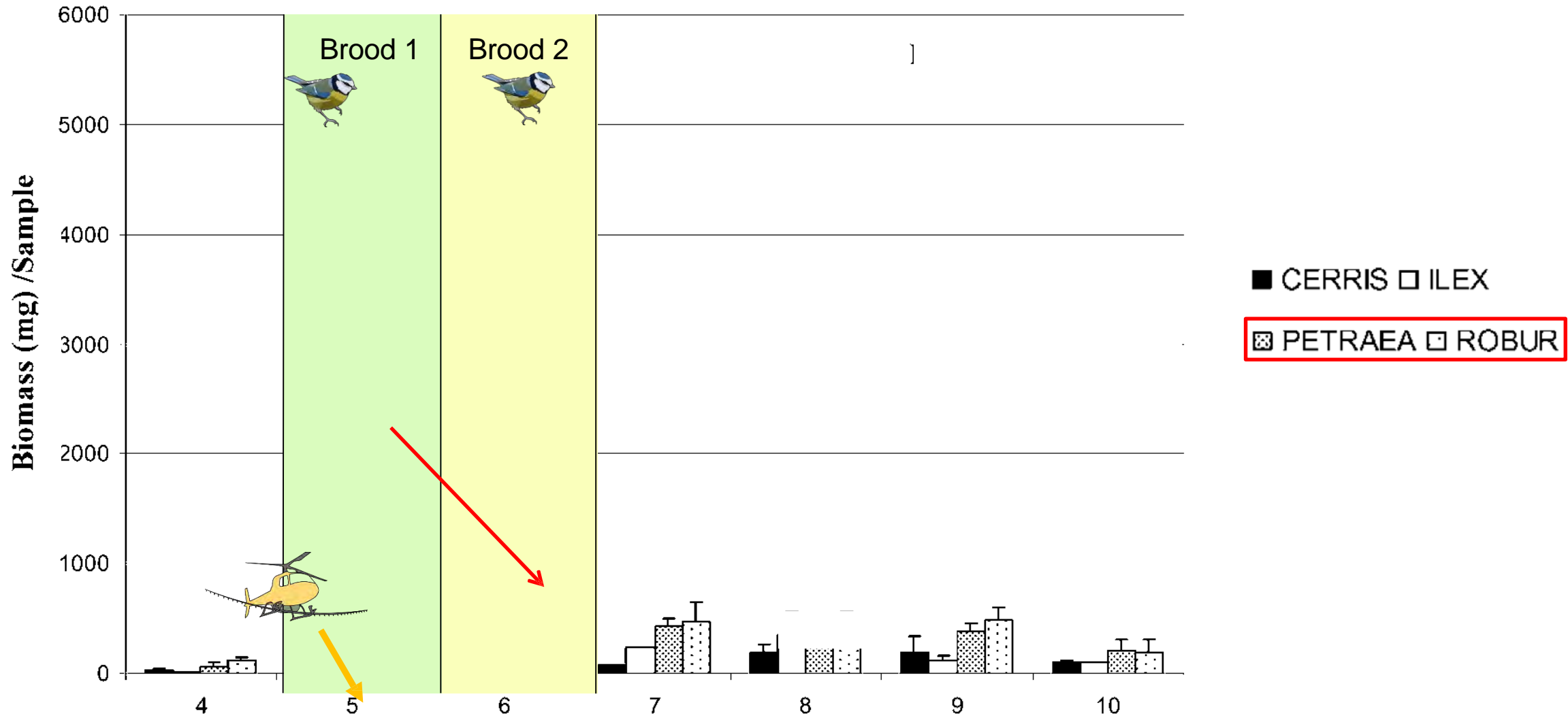




# Cavity nesting bird – breeding success



# Insect biomass variation in oak forests



# Summary

**A single year of severe defoliation caused measurable tree growth reduction**

**Spraying tebufenozide prevents defoliation and causes a considerable decrease in caterpillar biomass**

**Disturbance impacts on Lepidoptera vary with species biology**

Shelter-building species partly avoid exposure

Flight-dimorphic species remain impacted year up to 2 years after the treatment

Polyphagous species avoid defoliated areas

**Depressed caterpillar biomass leads to increased failure of the summer brood of tits**

Indirect effects arise from the combined action of insecticide-induced and seasonal reductions in caterpillar biomass

# Ongoing research

**Long-term silvicultural impacts and their implication for timber economy**

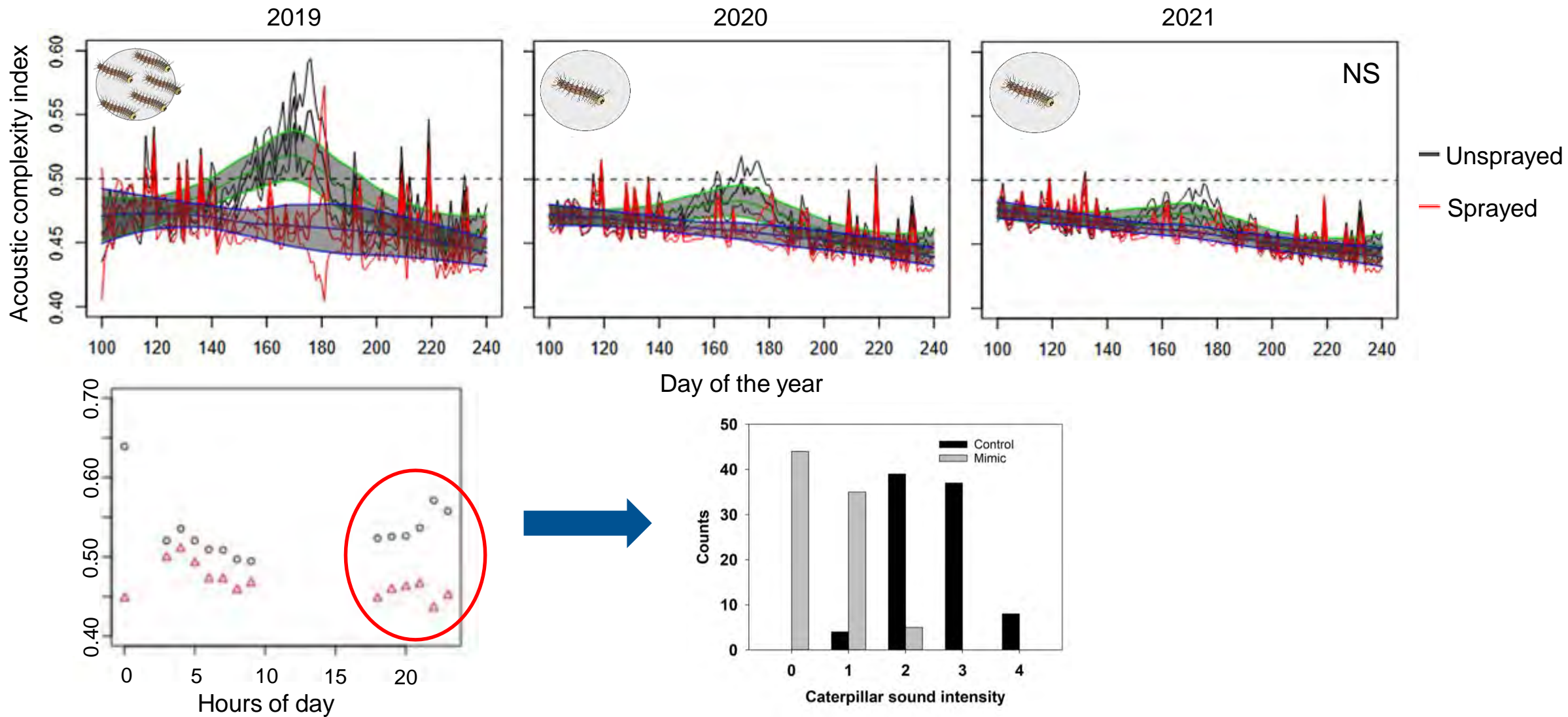
**Upscaling satellite data: can it be used to improve defoliation risk assessment?**

Potential to improve the scale and accuracy of predictions compared to labour-intensive egg-mass surveys

Early detection could allow more sustainable management strategies, such as the use of mating disruption or target spraying on pre-outbreak populations

**Non-target impact assessment on various taxa: arthropods, bats, parasitoids...**

# Forest acoustic complexity



A photograph of a forest with tall trees and dense foliage. A white rectangular box is overlaid in the center, containing the text "Thank you for your attention!".

Thank you for your attention!