

# The fungal communities associated with the first UK breeding population of the bark beetle *Ips typographus* include potentially invasive pathogens

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# Ips typographus

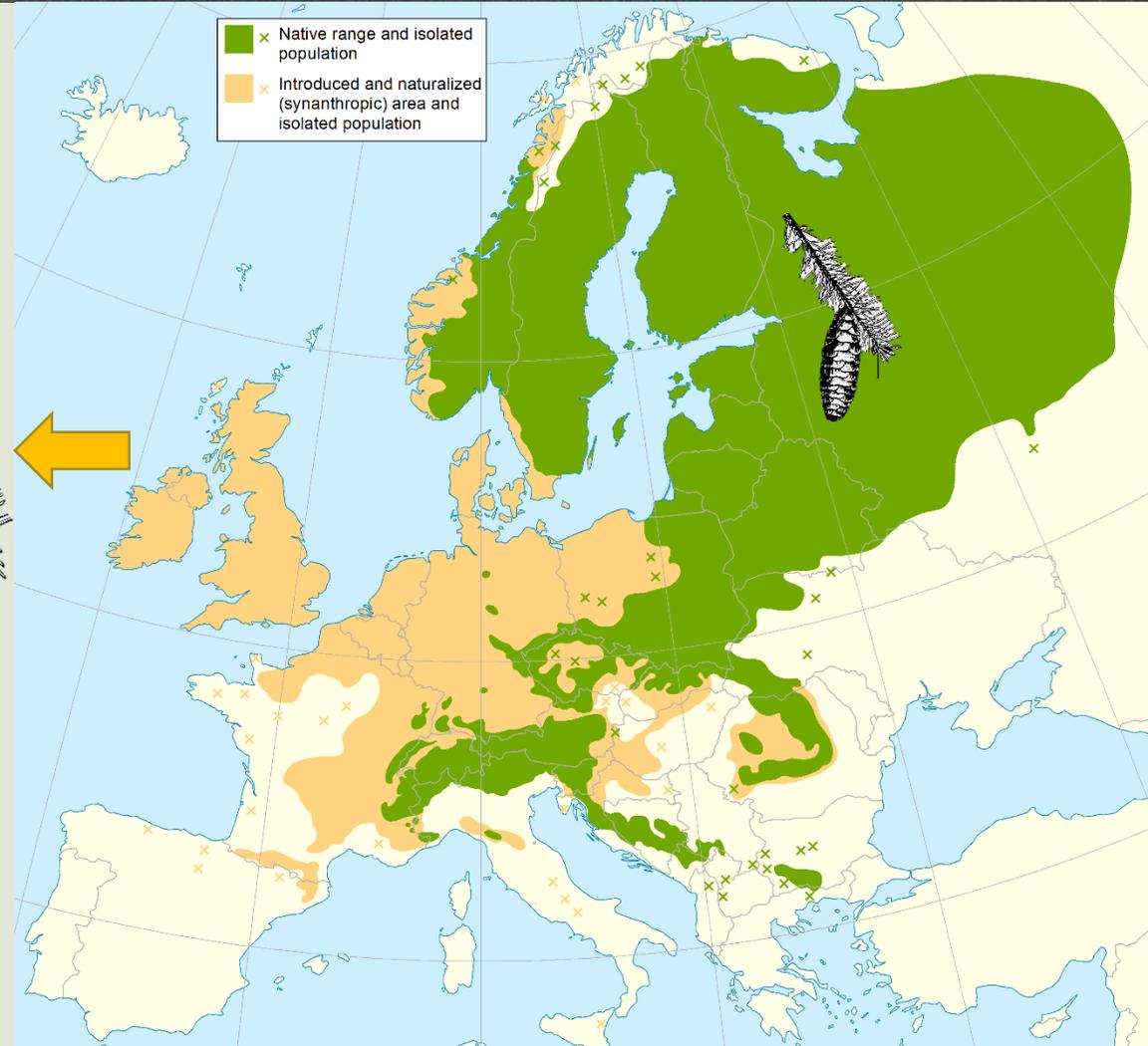
- The European spruce bark beetle kills millions of **spruce** trees across central Europe every year
- Non-native to the UK, first bred in **Kent** in 2018
- Associated fungi



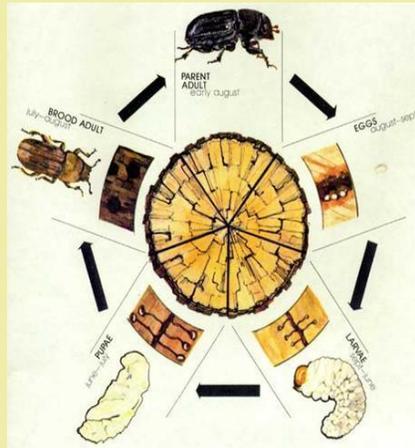
Sitka spruce



Norway spruce



# Beetle-fungi symbiosis



Scolytine life cycle (Photo: Logan Jackson)

## Beetles

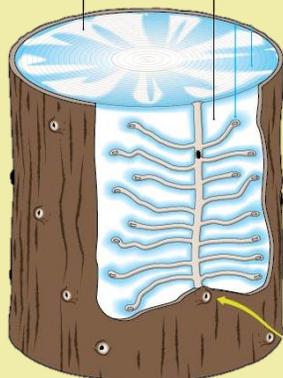
- **Bark beetles:**
  - Nutrients from wood
  - Higher host specificity
- **Ambrosia beetles:**
  - Nutrients from symbiotic fungi
  - Lower host specificity



*Fusarium* sp. spores

Complex morphology and cryptic nature: **Only a small percentage of fungal species have been described**

Fungus *Ips typographus* gallery



(Illustration: Chris Philpot)

## Fungi

- Establish symbiotic relationships with beetles
- Only some are pathogenic

**Risk of invasive species on naïve host trees**



Dutch elm disease (*Ophiostoma novo-ulmi*)

# Research questions

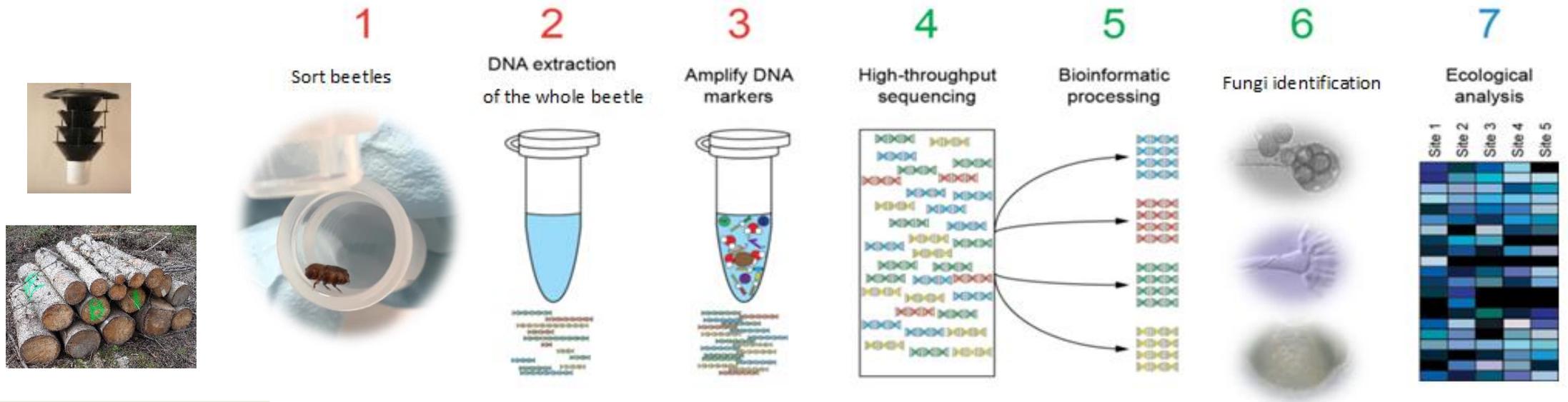
- ✓ Which fungi the beetle may vector?
- ✓ Compare fungal communities at different life stages of the beetle life cycle
- ✓ Compare fungi from the beetles collected from Norway vs Sitka spruce



# Study site



# Metabarcoding



+60 different fungal species can coexist in a single beetle specimen forming fungal communities

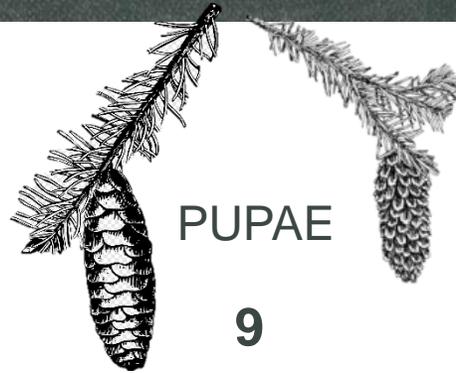
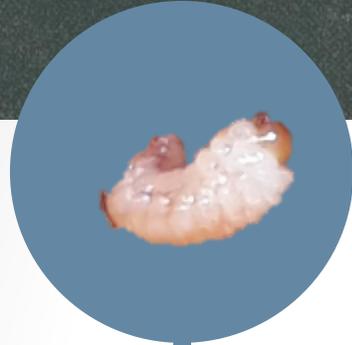
Operational Taxonomic Units = OTUs  $\approx$  species

# *Ips typographus* – experimental design

COLONISERS

(or mature adults)

5



PUPAE

9



DISPERSERS

(or flying adults)

9

4

LARVAE

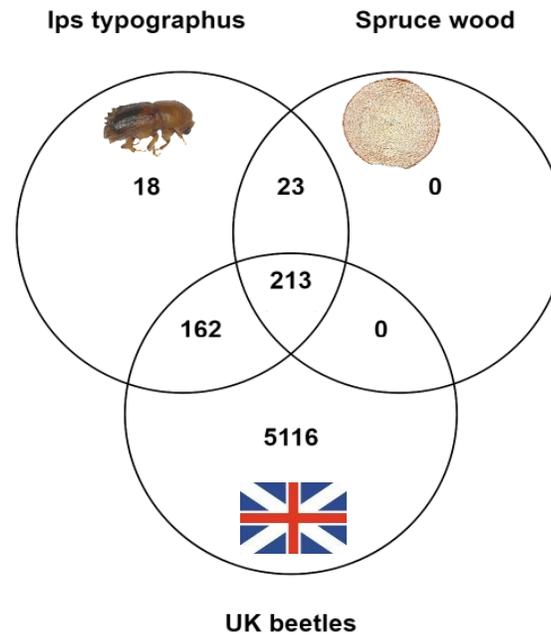
20

ADULTS



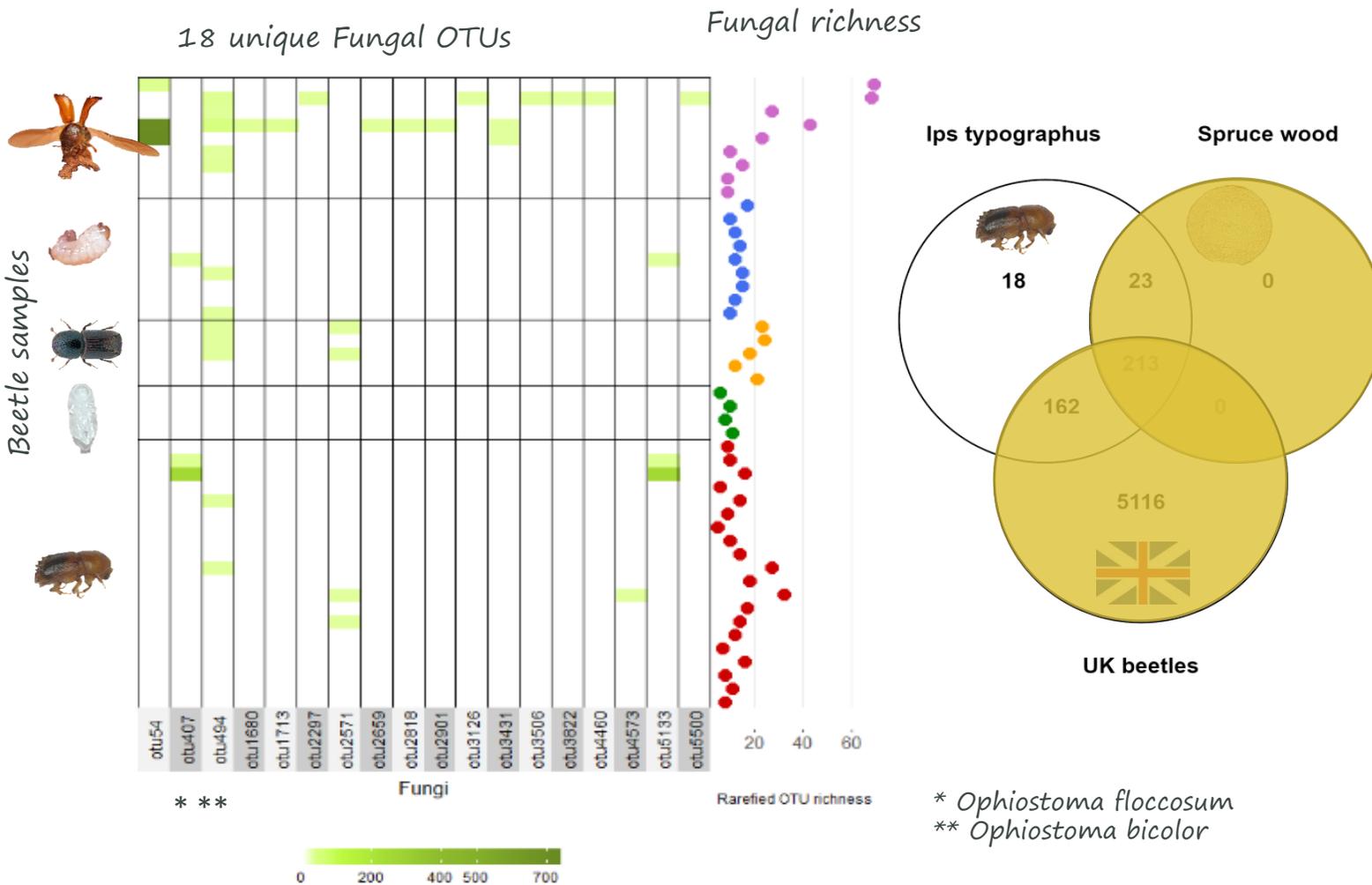
These 47 specimens were compared with those present in 1076 beetles trapped in 2017 in 20 different locations across the UK.

# What else the beetle may vector?



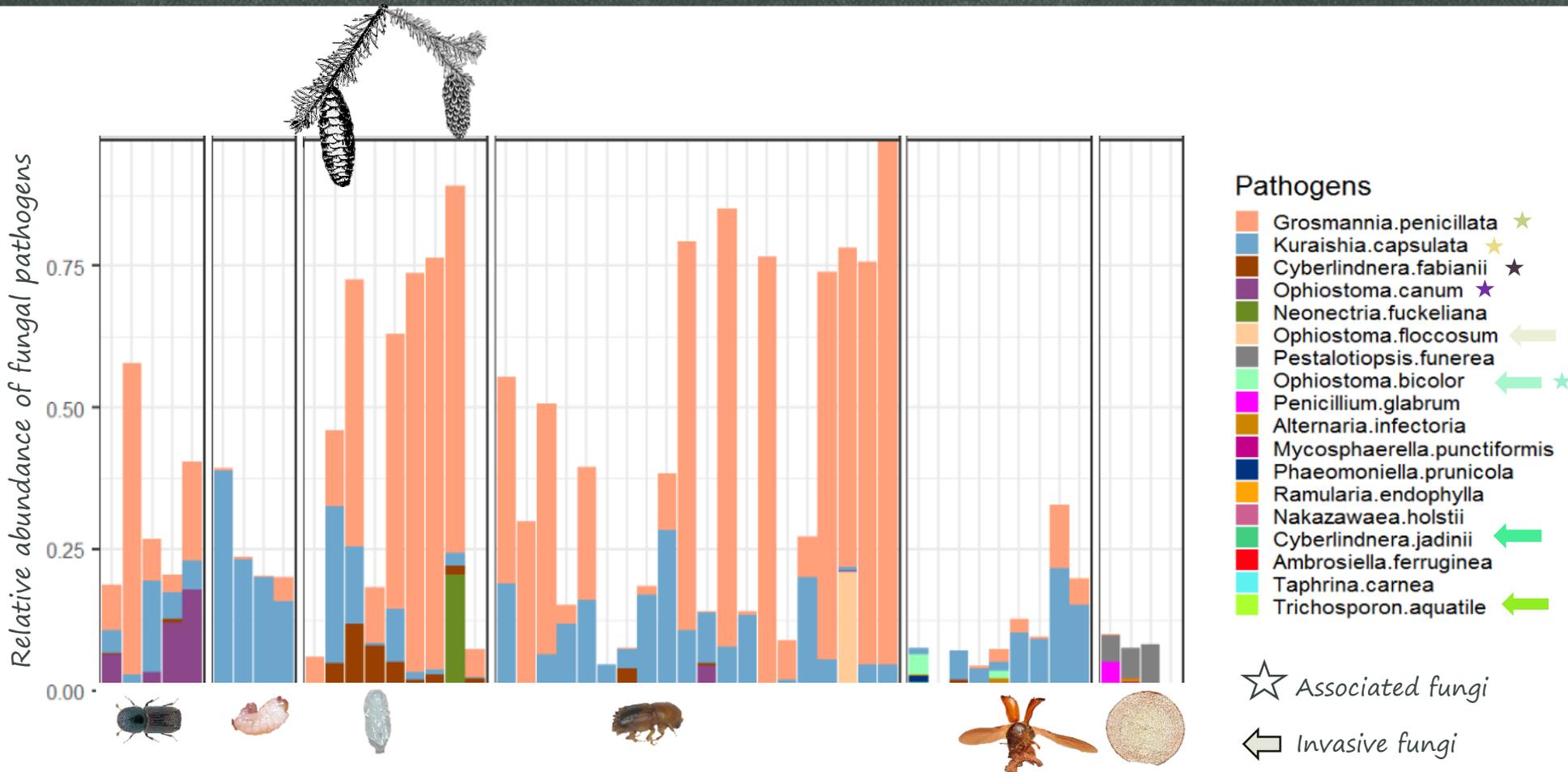
- 416 fungal OTUs obtained from the 47 *Ips typographus* specimens

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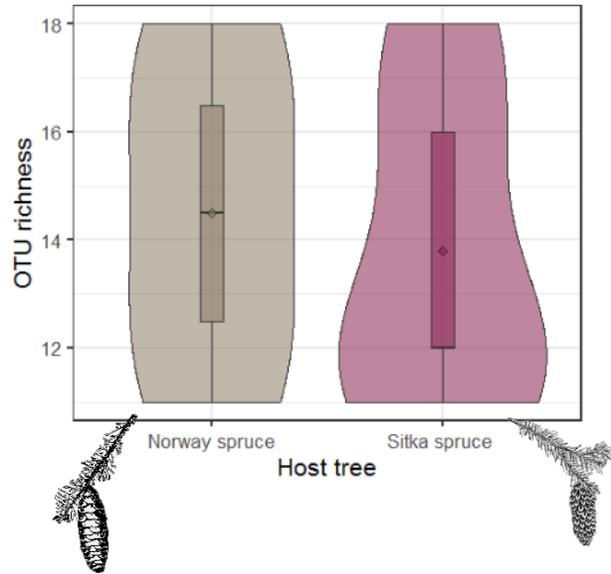
- 416 fungal OTUs obtained from the 47 *Ips typographus* specimens
- 18 OTUs were only present in the *Ips typographus* beetles
- These OTUs included four fungal pathogens, including *Ophiostoma floccosum* and *Ophiostoma bicolor*, which were present in three and 12 samples respectively.
- *Most of the fungal pathogens present in flying beetles*

# Compare fungal communities at different life stages of the beetle life cycle



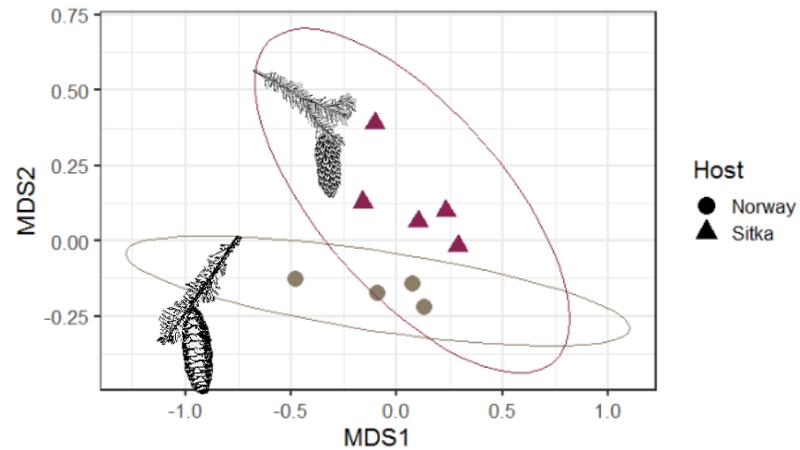
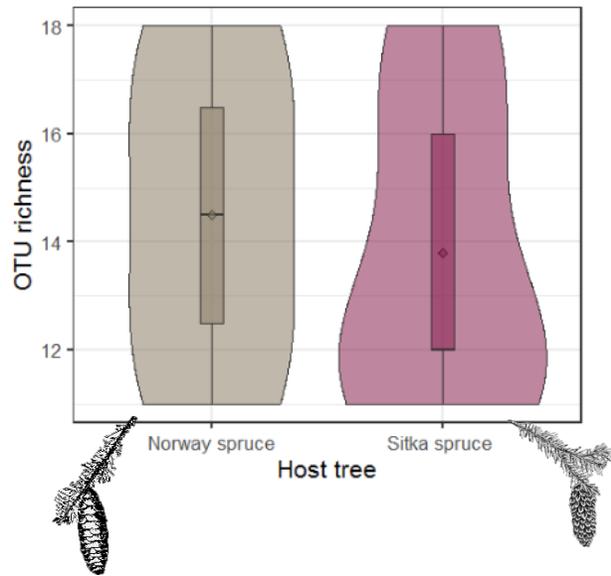
- The Ophiostomatoid fungi *Grosmannia penicillata* dominated in most of the samples found in the galleries, with the exception of the larvae.
- The yeast *Kuraishia capsulata* was present in all the developmental stages
- Some fungi associates with certain life stages- for example, *Ophiostoma canum* in old adults

# Do beetle-fungal communities differ in Norway vs Sitka spruce?



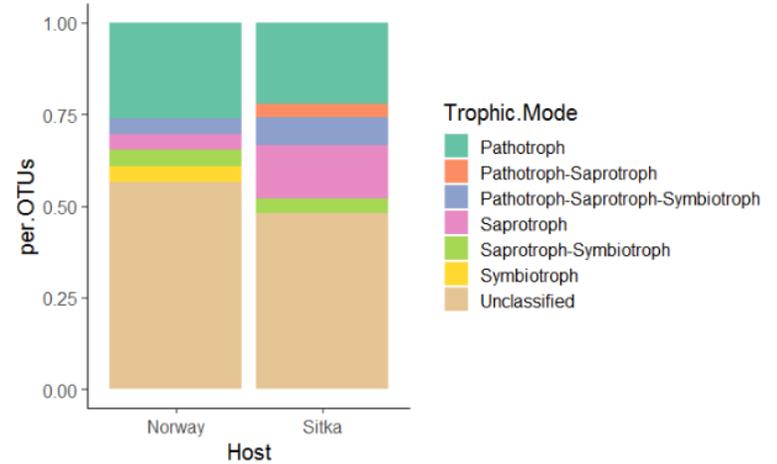
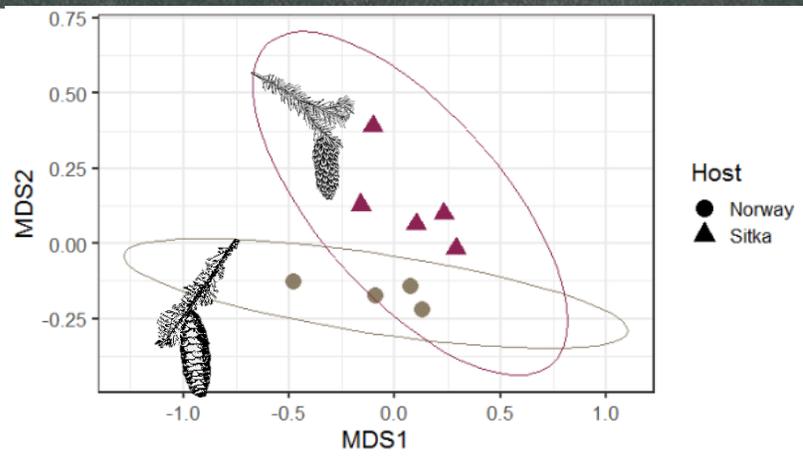
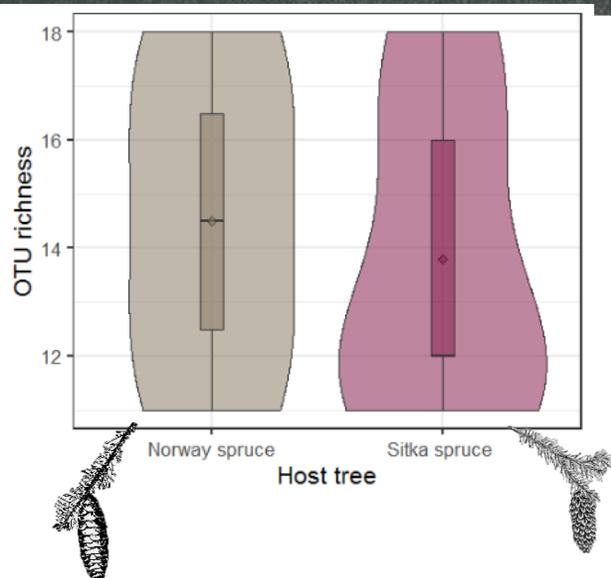
- Beetles collected from Norway spruce host slightly more fungal species

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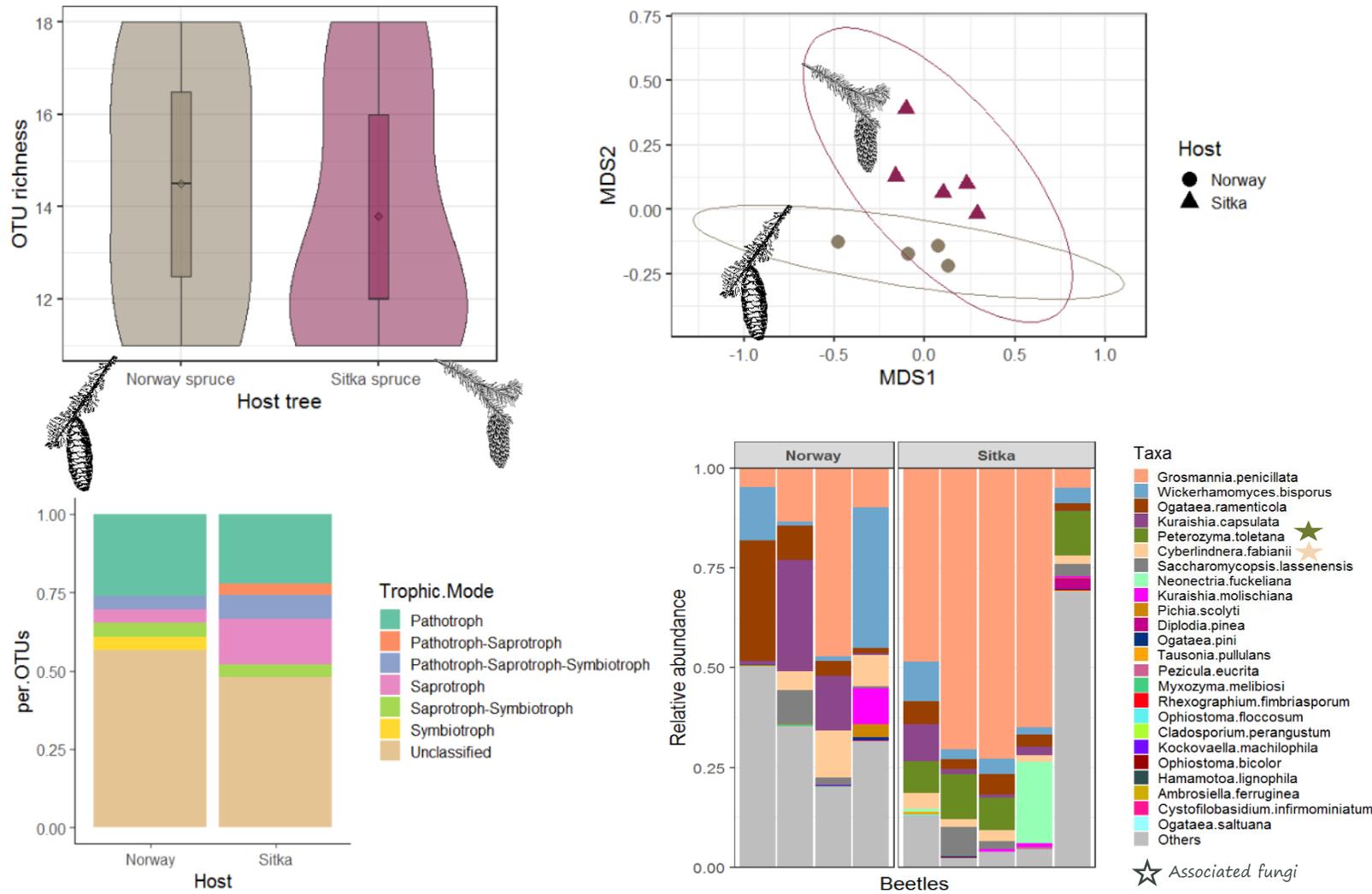
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- Ips beetles seem to transport a greater numbers of **symbiotrophs** in Norway spruce, while **saprotrophs** were more abundant in Sitka.
- The yeast *Peterozyma toletana* was significantly more frequent in Sitka than in Norway spruce.

# Conclusion

## ✓ What else the beetle may vector?

- 18 potentially invasive fungi, which were mainly located in flying adults
- A wide range of fungal pathogens, including several Ophiostomatoids

## ✓ Compare fungal communities at different life stages of the beetle life cycle

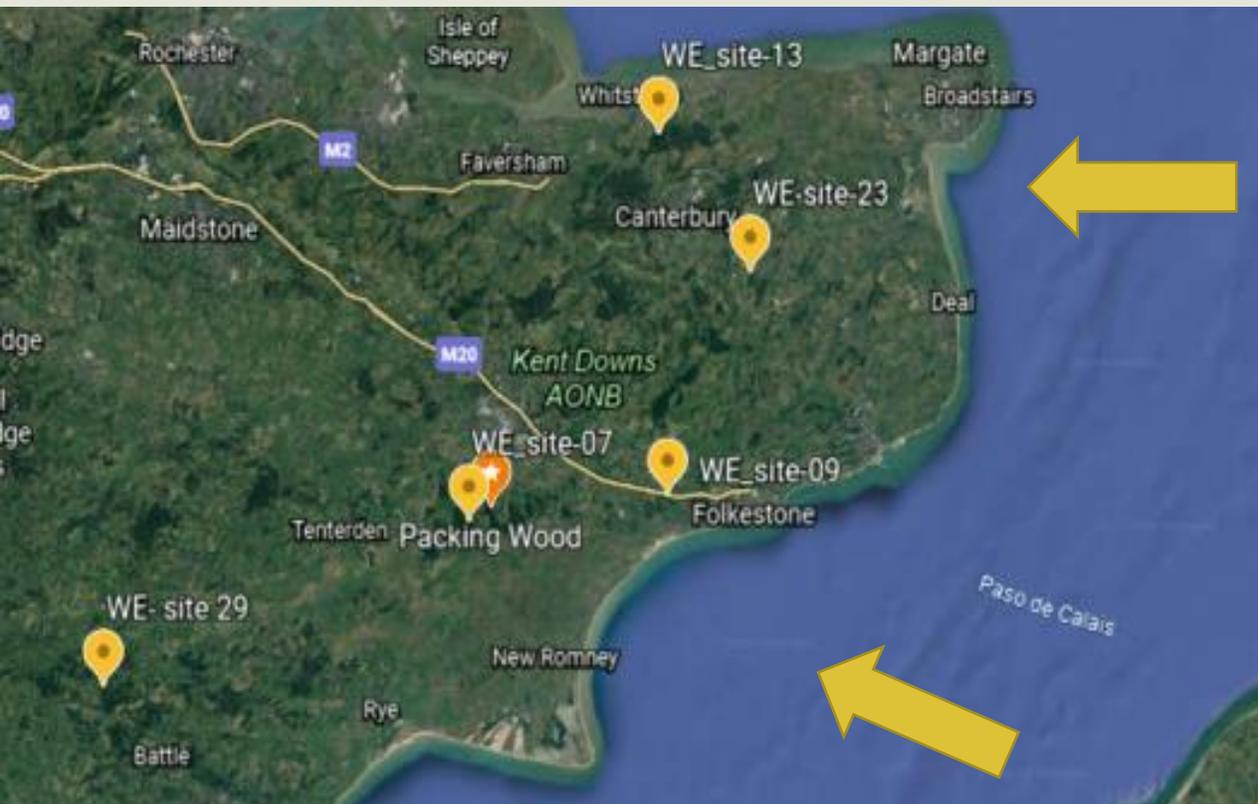
- Fungal communities in some of the flying and mature adults differ the most
- Some fungi more frequently associated with certain life stages: play key roles on beetle performance?
- Some fungal associates persist through the whole life cycle

## ✓ Compare fungi from the beetles collected from Norway vs Sitka spruce

- NS beetles harbours slightly more fungi than SS
- NS and SS hosts slightly different fungal communities
- SS pupae hold an extra fungal associate, the yeast *Pterozyma toletana*

# Future work

Are these beetles (and fungi!) coming from different pathways?



- Second generation Ips (laboratory breeding)
- Specimens from each of 5 different locations in Kent
- Specimens from continental Europe: Belgium, Romania...
- Different species: *Ips sexdentatus*...

Thank you...Questions?

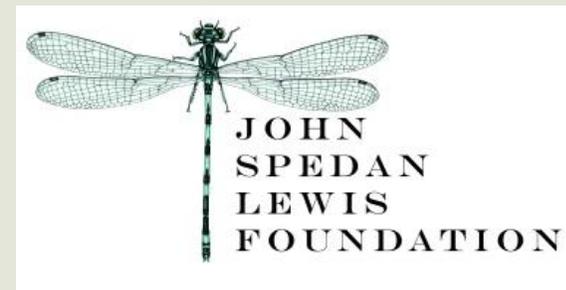
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Please, follow me in Twitter! [@AngelinaCE](https://twitter.com/AngelinaCE)

**To my PhD supervisor Prof Alfried Vogler**