

# Kill'em all?

## Interactions of predatory Myxobacteria with soil microbes – an *in vitro* and microcosm perspective on their role in the soil microbial food-web

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### Introduction:

Soils hosts one of the most **complex communities** on Earth and are **vital resources** providing food and essential ecosystem services [1]. The **high complexity** of the soil food web and the **intricate organismic diversity** hindered the creation of **explicit links** between taxonomical (and functional) microbiome composition and **microbial physiology**, especially for **Myxobacteria**. We want to shed light on their **predatory life style** and their **influence on microbial death, growth and turnover** in the soil microbial food web.

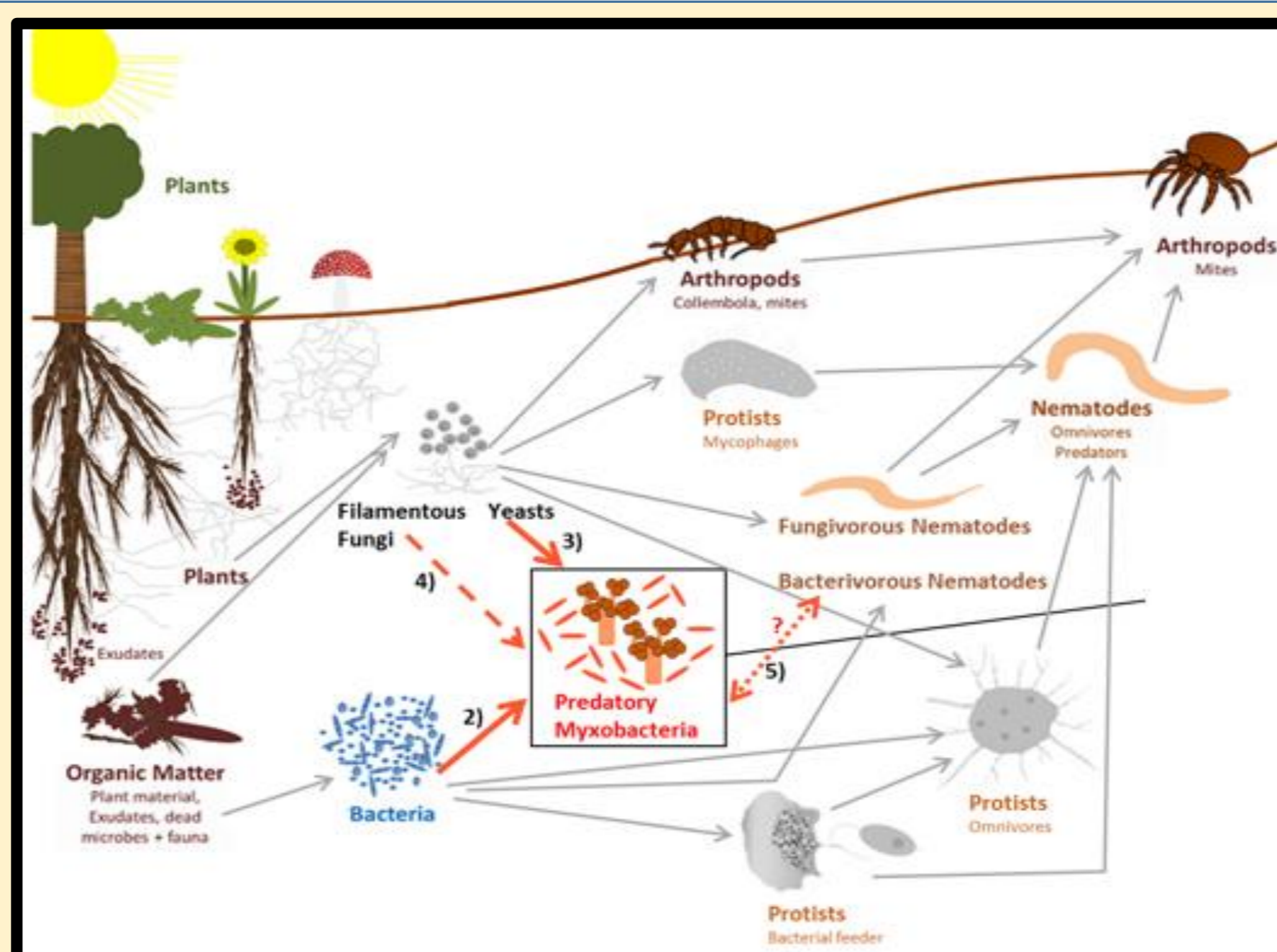


Figure 1: Position of myxobacteria in the soil food web [2]

### Myxobacteria:

- Myxobacteria are known **micropredators**
- Myxobacteria are **abundant** in soil [4]
- They are a **keystone taxon** in the microbial food web
- They have a major **influence** on the **prokaryotic community composition**

### Aims:

- unravel **role of Myxobacteria** in the soil food web
- investigate **predation patterns** and **prey preferences** for Myxobacteria
  - utilizing ***in vitro*** predation assays
- Interactions of Myxobacteria with bacterivorous **competition** in ***in vivo*** mesocosms
  - utilizing **metatranscriptomics** for **3-Domain SSU rRNA community profiling**

### *In vitro* predation Assays

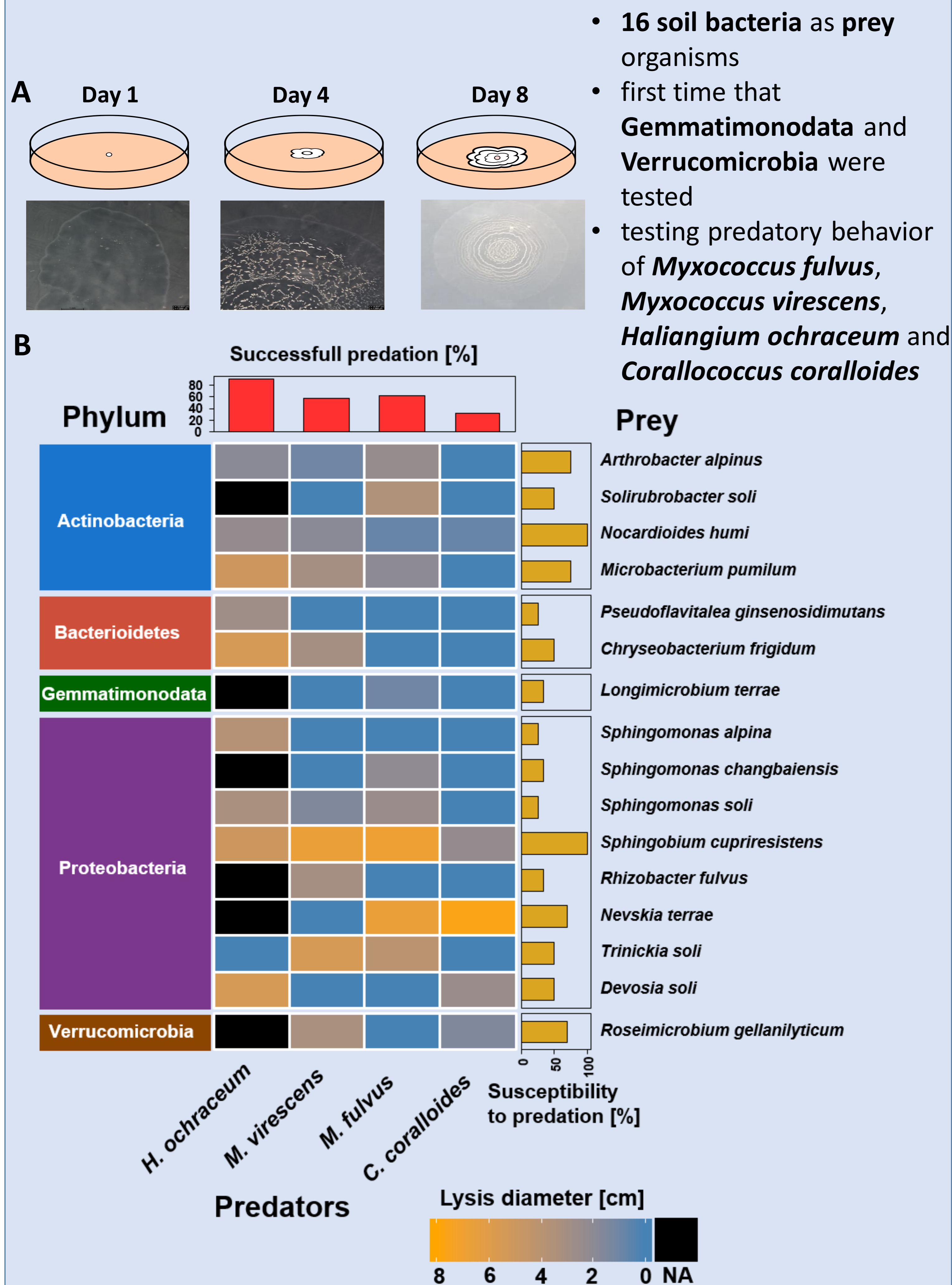


Figure 2: (A) Predation assay setup over eight days for *M. fulvus* on *N. terrae*, (B) Results of the *in vitro* predation Assays, showing lysis diameter in cm for corresponding predator-prey pairing

- All prey was lysed by at least one Myxobacterium
- Myxobacteria had different prey preferences
- *Haliangium ochraceum* has the broadest spectrum
- predation susceptibility of prey organisms differs greatly

### Conclusion:

- Myxobacteria killed all prey bacteria in *in vitro* assays
- Myxobacteria are highly abundant in soil and resistant to higher trophic level predation in the *in vivo* mesocosms
  - suggest an important role in agricultural soil micro food web

### *In vivo* mesocosms



Figure 3: Mesocosm setup with main soil chamber and connected CO<sub>2</sub> traps [3]

- Experiments with fertilized Dikopshof soil over 32 days
- Three consecutive Experiments with higher trophic level predators added:
- No nematodes, bacterivorous or fungivorous nematodes
- organic matter manipulation: no carbon source, maize litter and 13C-labelled maize litter
- Soil samples taken on five different time points
- extracted DNA and RNA

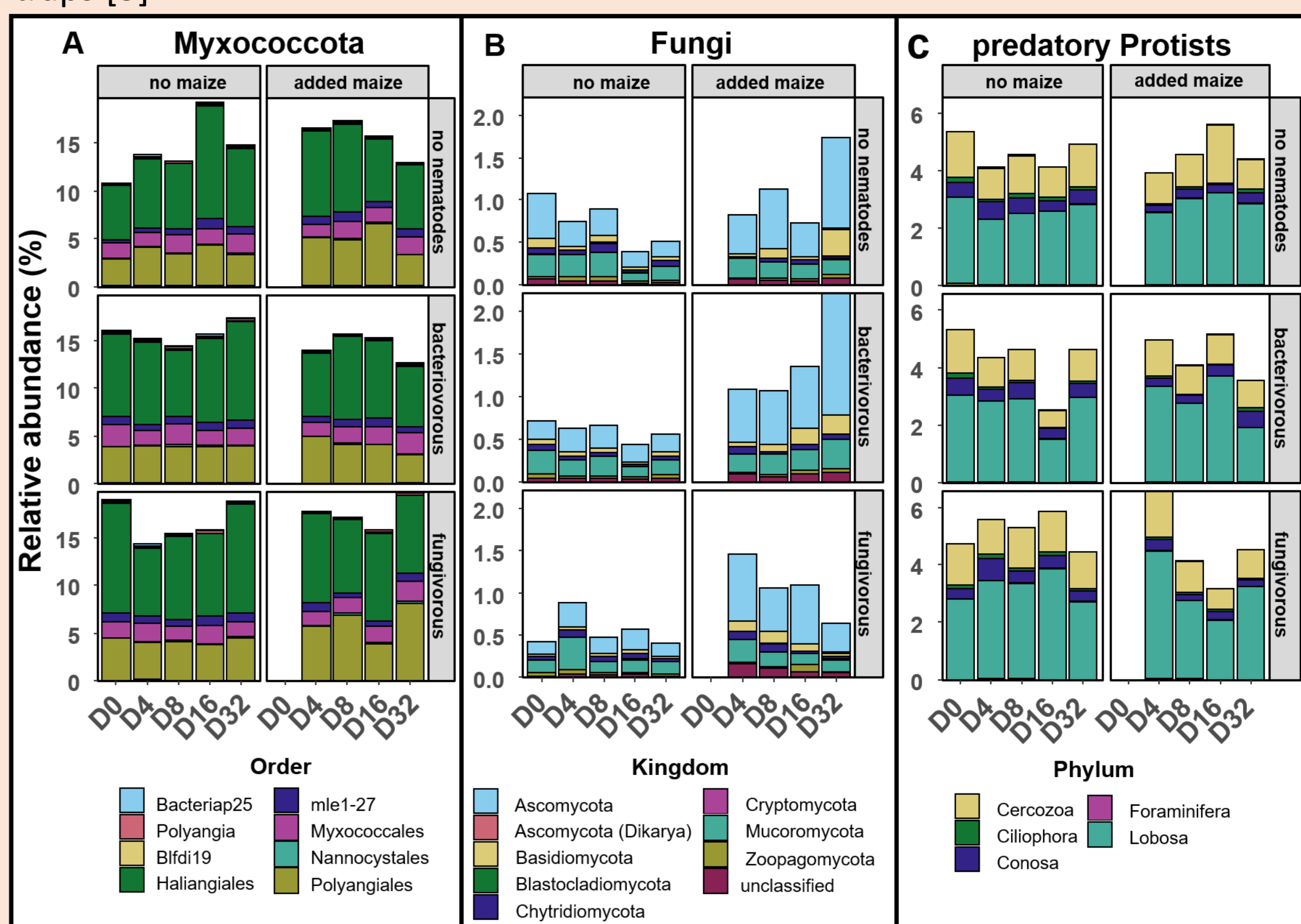


Figure 4: 3-Domain SSU rRNA community profiles of the microcosm experiment. Depicted are taxon relative abundance [%], C-source manipulation, the addition of nematodes and the sampling dates (D0-D32) for selected groups: (A) Myxococcota (order level), (B) Fungi (kingdom level), (C) predatory Protists (phylum level).

### Quantitative metatranscriptomics:

- Bacteria are the most abundant domain (90 %)
- Myxobacteria highly abundant (11-20 %) in microbiome and not strongly affected by Nematode grazing
- Predatory bacterivorous Protists were the most abundant Eukaryotes (5-6 %) → large, but rather unresponsive bacterial channel
- Fungi had a low relative abundance (1 %) in soils without additional C-source
  - relative abundance doubled with addition of maize litter → Small fungal channel, but responsive to C-source manipulation
- They were prone to predation by fungivorous Nematodes

[1] Thompson, L.R., Sanders, J.G., McDonald, D., Amir, A., Ladau, J., Locey, K.J., et al. (2017) A communal catalogue reveals Earth's multiscale microbial diversity. *Nature* 551: 457–463

[2] Stefan Geisen, Robert Koller, Maik Hünninghaus, Kenneth Dumack, Tim Urich, Michael Bonkowski, The soil food web revisited: Diverse and widespread mycophagous soil protists, *Soil Biology and Biochemistry*, Volume 94, 2016, Pages 10-18, ISSN 0038-0717, <https://doi.org/10.1016/j.soilbio.2015.11.010>, modified by Gross, 2020

[3] Courtesy of Miriam van Bommel, Humboldt Universität, Berlin.

[4] Petters, S., Groß, V., Söllinger, A. et al. The soil microbial food web revisited: Predatory myxobacteria as keystone taxa? *ISME J* 15, 2665–2675 (2021). <https://doi.org/10.1038/s41396-021-00958-2>