Smaller microorganisms outcompete larger ones in resistance and functional effects under disturbed agricultural ecosystems

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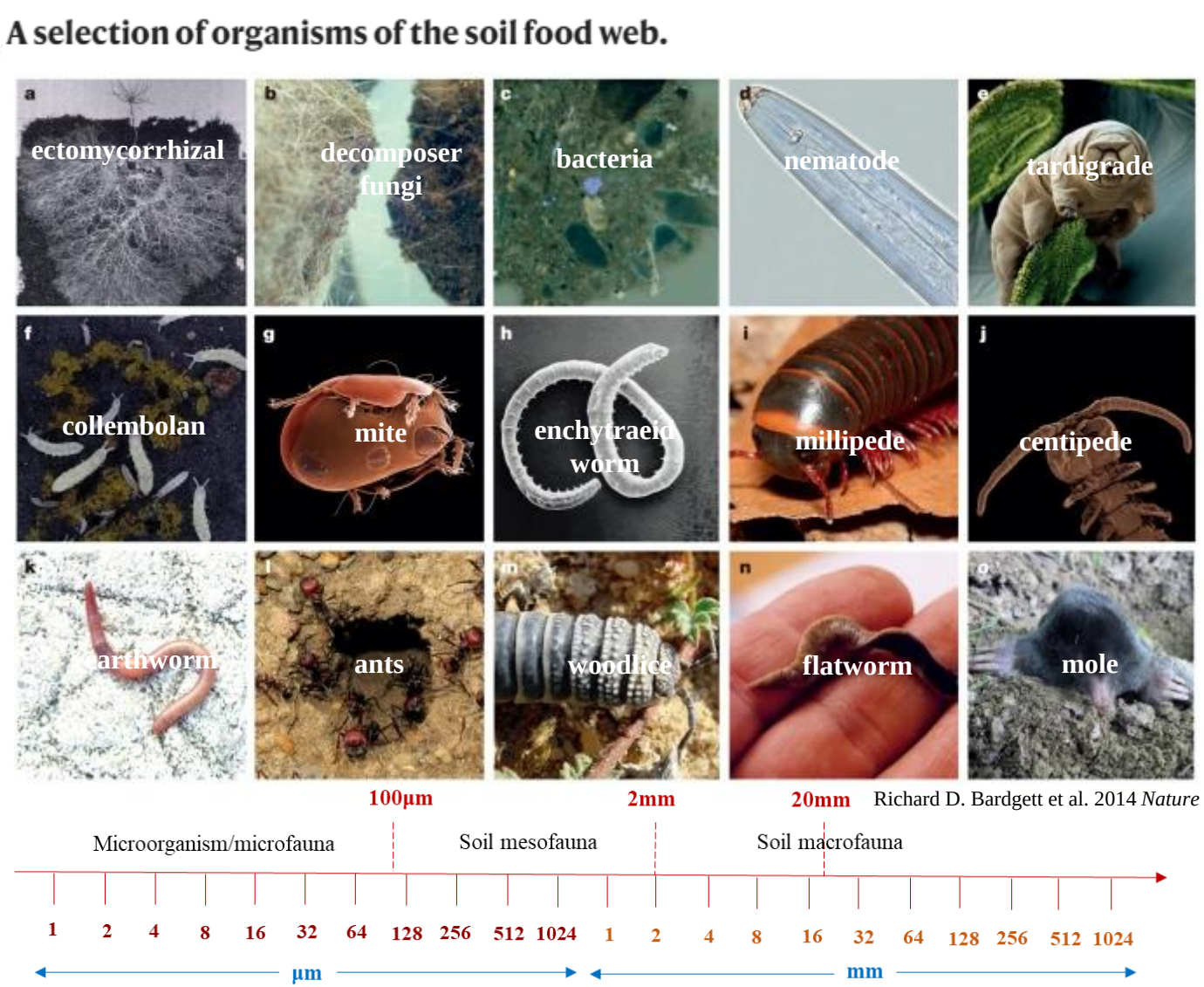
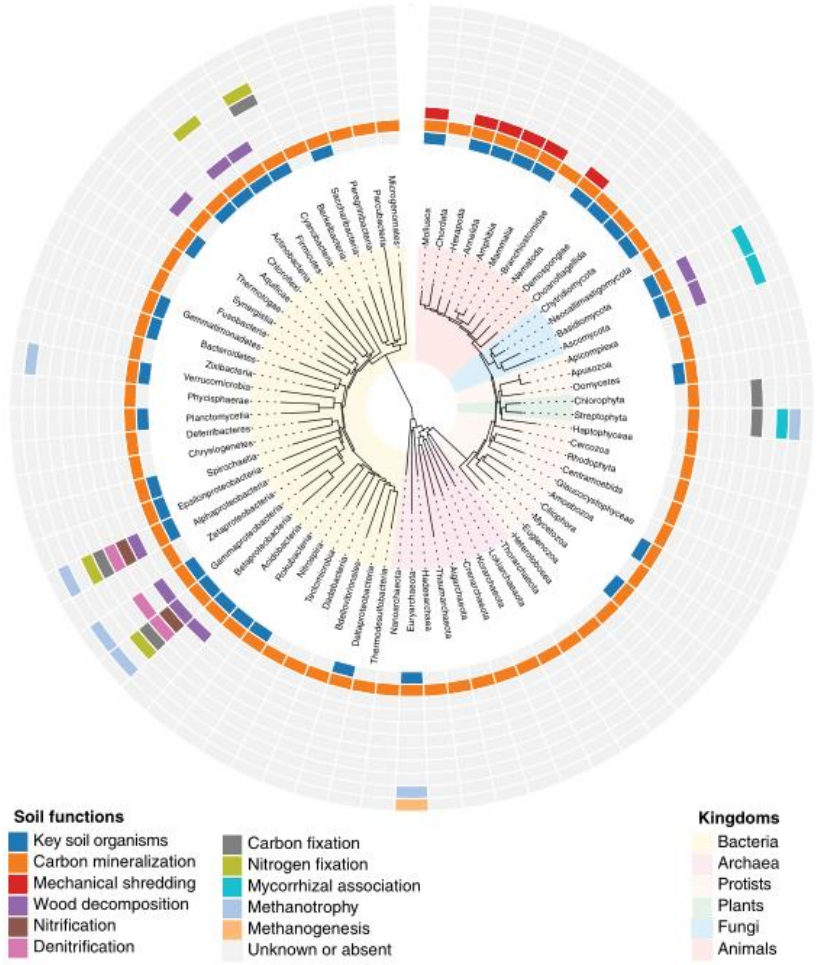
Introduction





Crowther et al., 2019 Science

The complex soil system holds a large number of soil organisms with different body sizes and serves as a regulatory center for most ecosystem functions.

Introduction

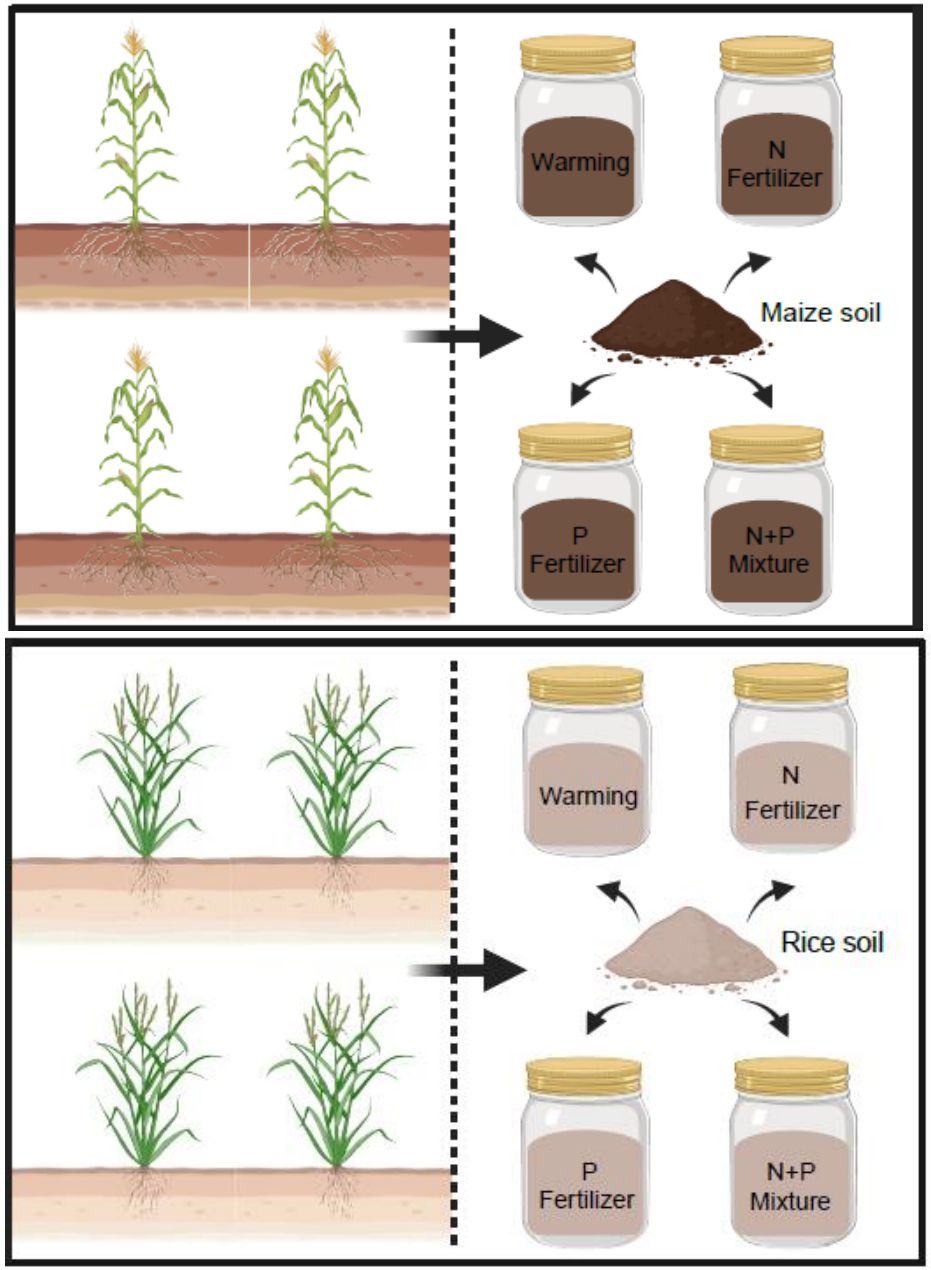
- The size-dispersal hypothesis predicts that smaller organisms are more likely affected by species sorting than dispersal limitation because they can disperse almost everywhere and thus only reflect the environmental effects.

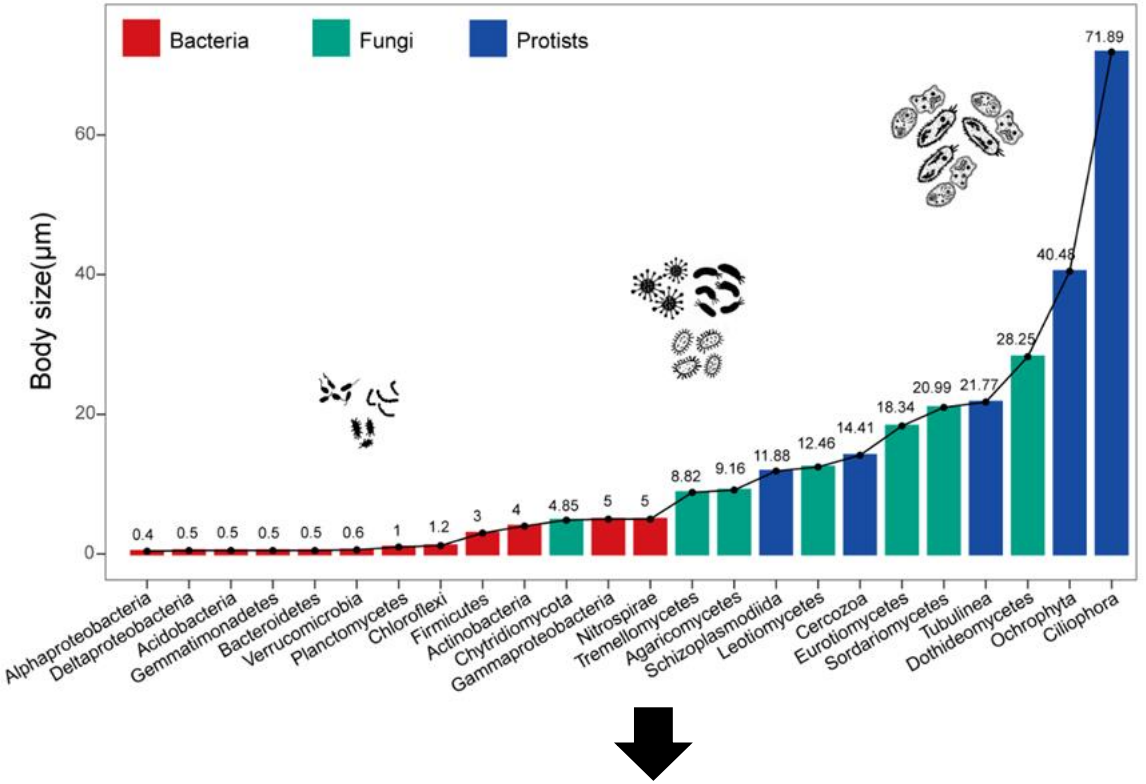
- The size-plasticity hypothesis argues that smaller organisms are less environment-filtered than larger organisms because they are more likely to have plasticity in their metabolic abilities and therefore exist widely in diverse habitats.

Farjalla et al. 2012 *Ecology*

Smaller organisms may have greater environmental tolerance

Experiment design



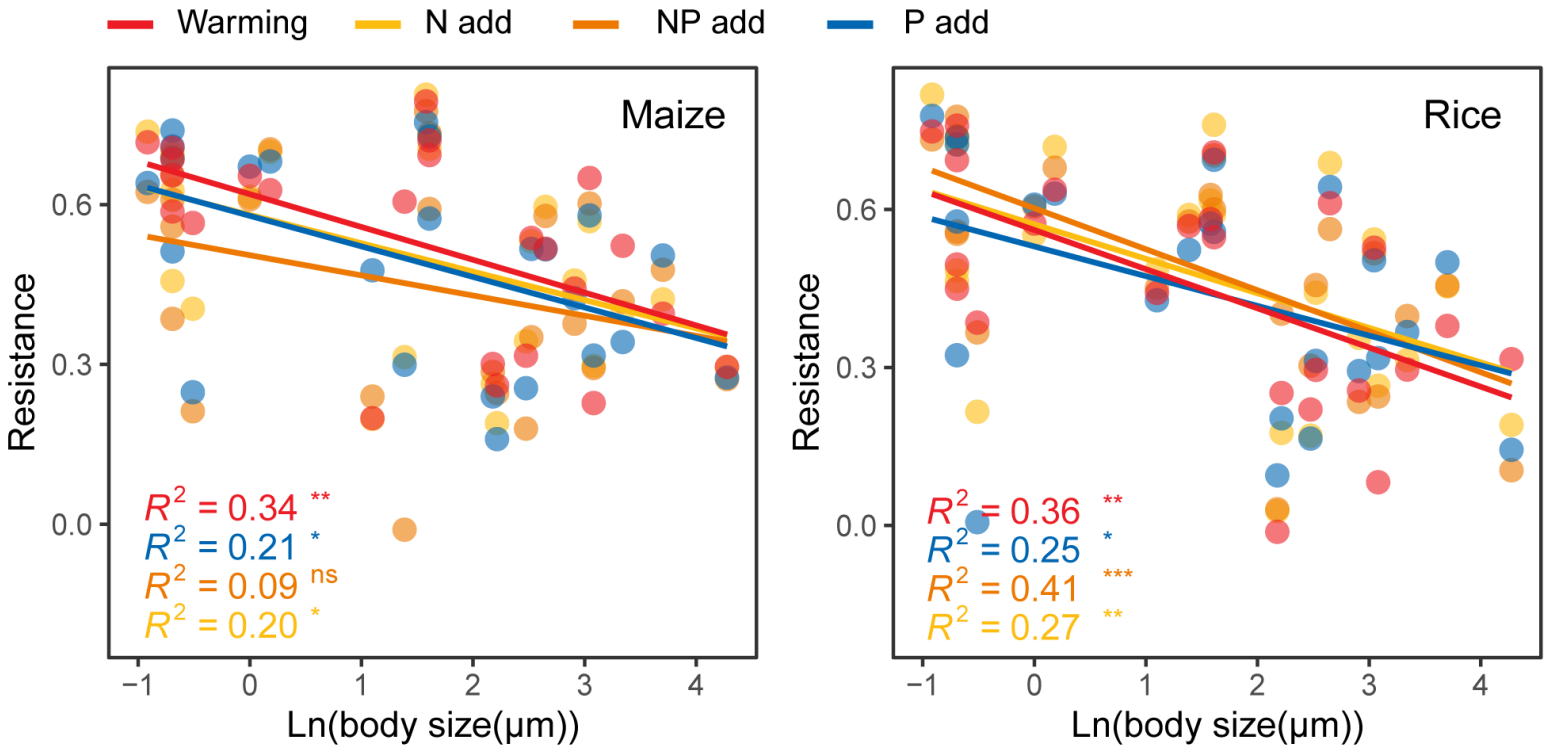


Scientific question

- Are smaller microorganisms in disturbed environments more resistant than larger organisms?
- When disturbances cease, does the maintenance of ecosystem functions depend largely on the smaller microorganisms?

Results

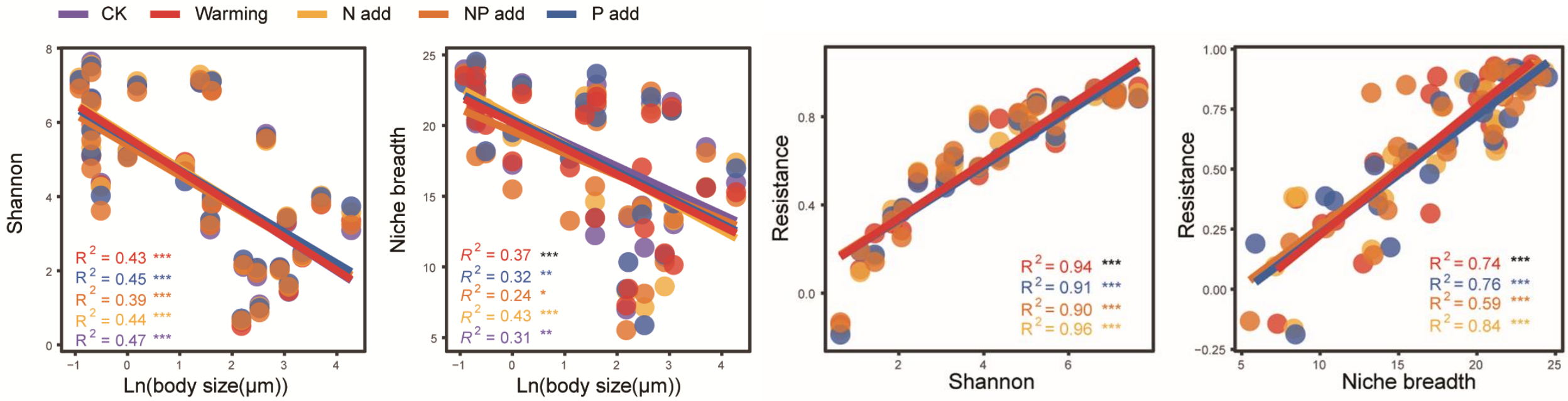
- Smaller microorganisms outcompete larger ones confronting environmental changes



In both maize and rice soil, the resistance was significantly and negatively related to body sizes across 24 selected organism groups.

Results

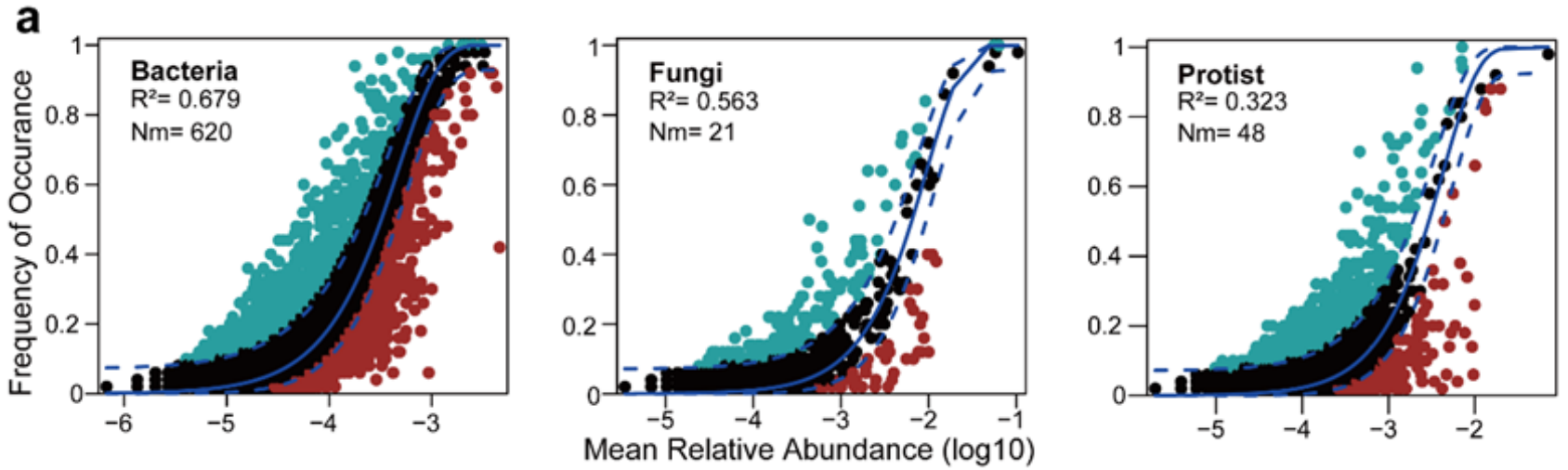
- Smaller microorganisms hold higher species diversity and wider niche breadth

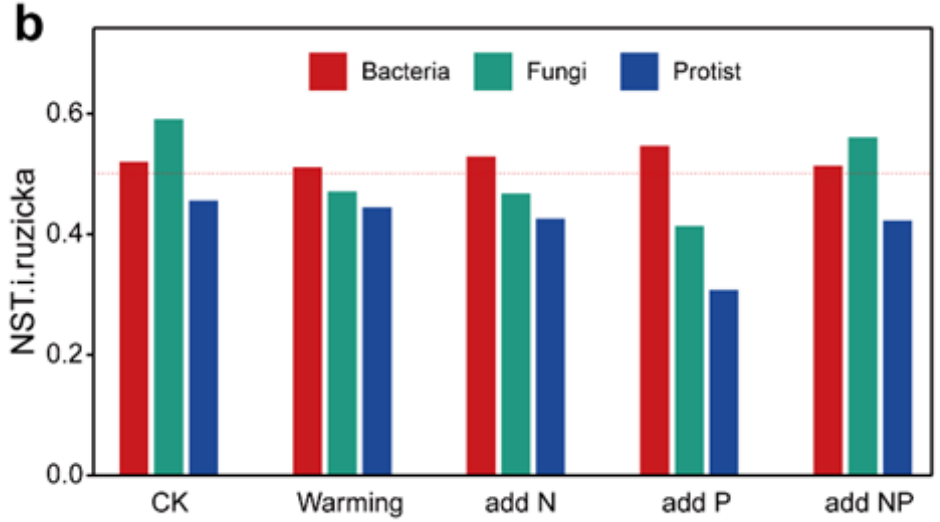


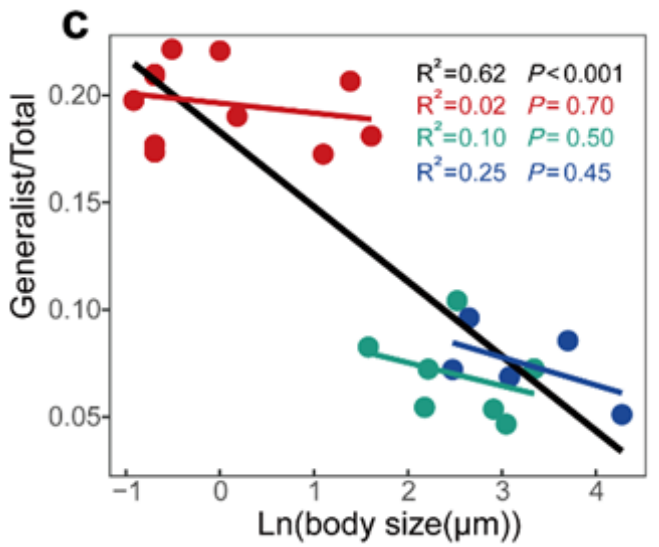
Body size significantly negatively correlated with the Shannon index and niche breadth, while community resistance positively correlated with both.

Results

- High stochastic changes in smaller microorganisms



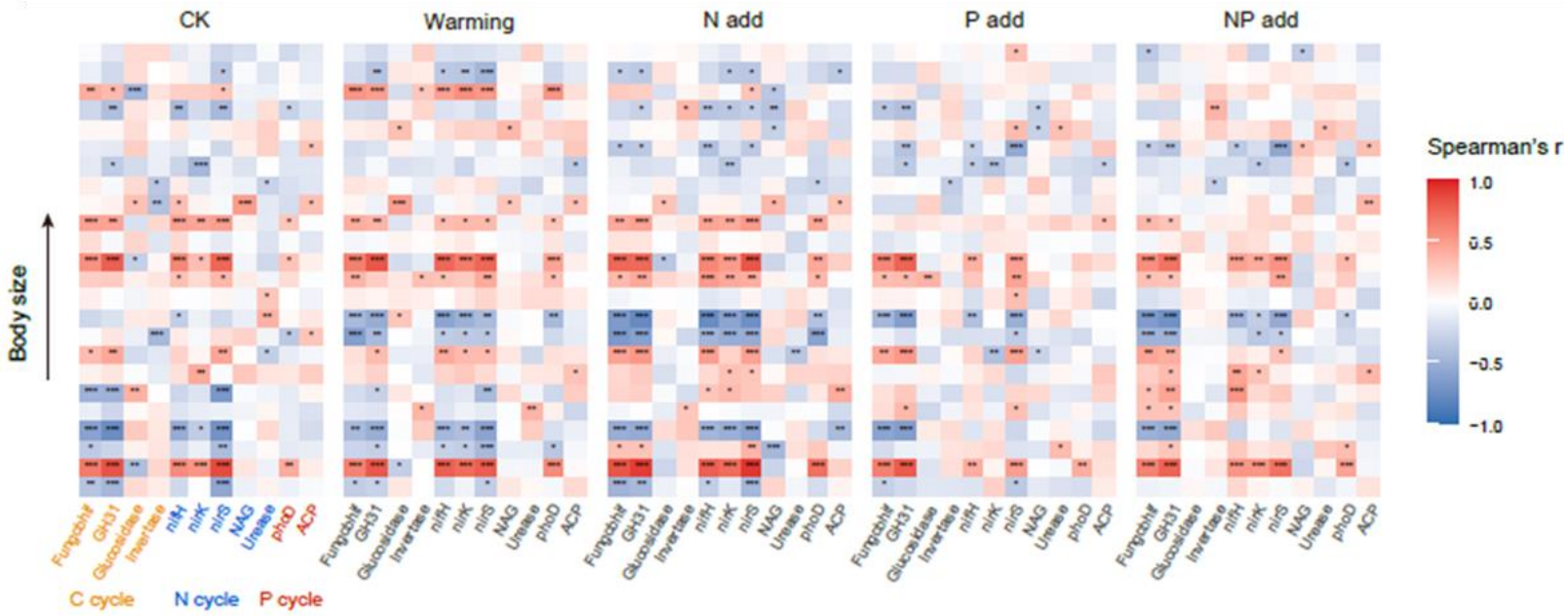


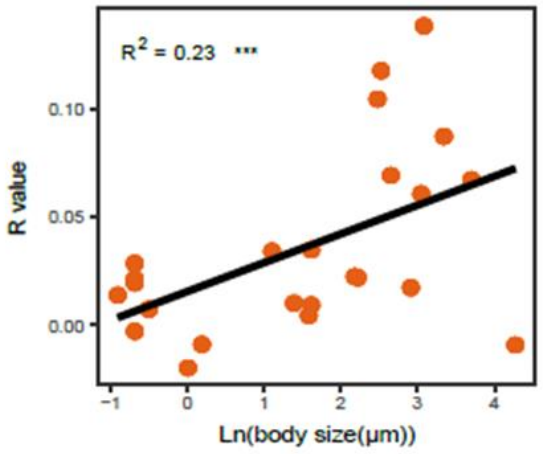


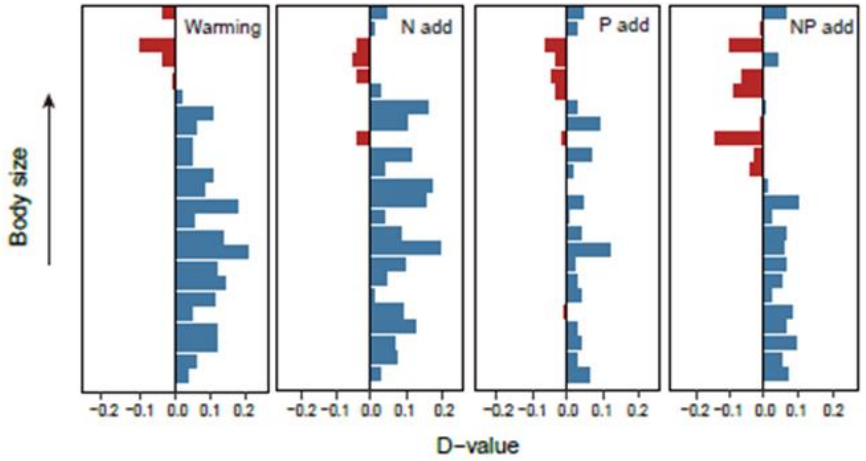
- The community stochasticity gradually decreased with increasing organism body size.
- The linear fitting model showed a negative correlation between the proportion of generalists and body size.

Results

➢ Stronger functional effect of smaller microorganisms in changeable environments

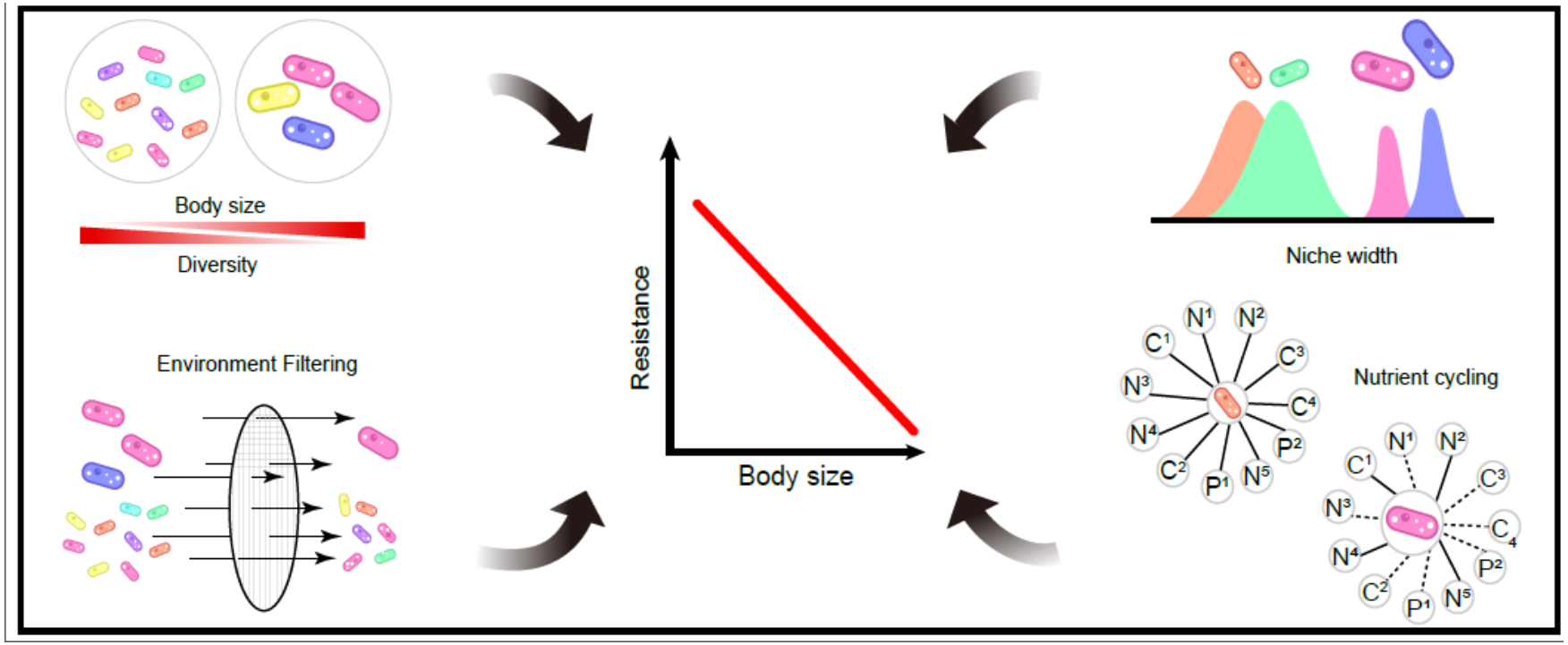






- Similar strong correlation patterns were observed for smaller microorganisms and ecosystem functions in all treatments.
- In the control group, the smaller the body size, the weaker the relationship of soil microorganisms and ecosystem functions.
- After suffering various environmental changes, the relationship between smaller microorganisms and ecosystem functions improves, but that in larger organisms diminishes distinctly.

Summary



- Smaller microorganisms exhibit stronger resistance to the disturbed environments of agricultural soil and generally outcompete larger organisms.
- Smaller microorganisms utilize more species diversity and a wide niche breadth to deploy survival strategies, making them less affected by environmental selection and thus existing steadily in a complicate and various environment.
- The strong correlation between smaller microorganisms and ecosystem functions reflects their greater metabolic flexibility and illustrate their significant roles in adaptation to continuously changed environments.

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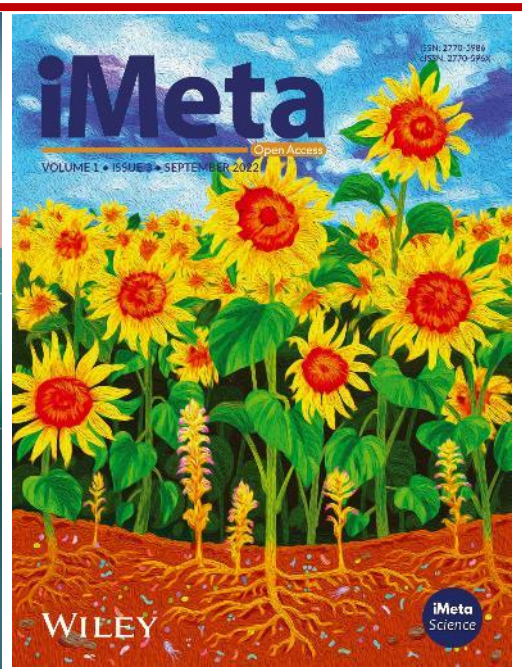

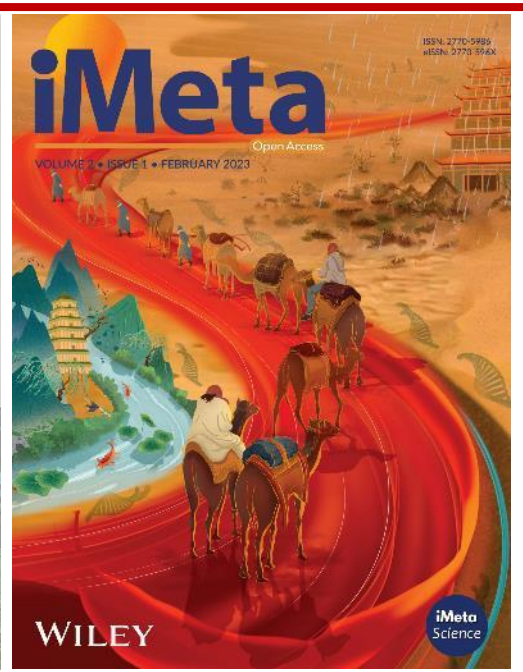

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