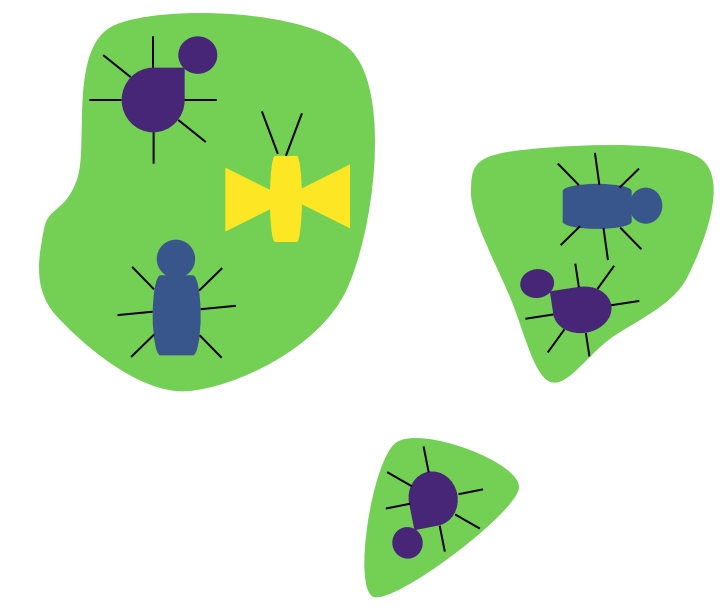


# Plant size-virus richness relationships depend on host species and nitrogen inputs

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## Introduction



Larger areas tend to be more diverse<sup>1</sup> because:

- they have more niches, allowing more species to arise and coexist<sup>2</sup>
- they support larger populations with lower extinction rates<sup>3</sup>
- more individuals colonize them<sup>4-5</sup>

Living organisms can serve as habitats for communities comprised of insects, parasites, microbes, and other organisms. The diversity of these communities can have important consequences for the host.

Larger hosts may have more diverse communities because of the reasons above and<sup>6-7</sup>:

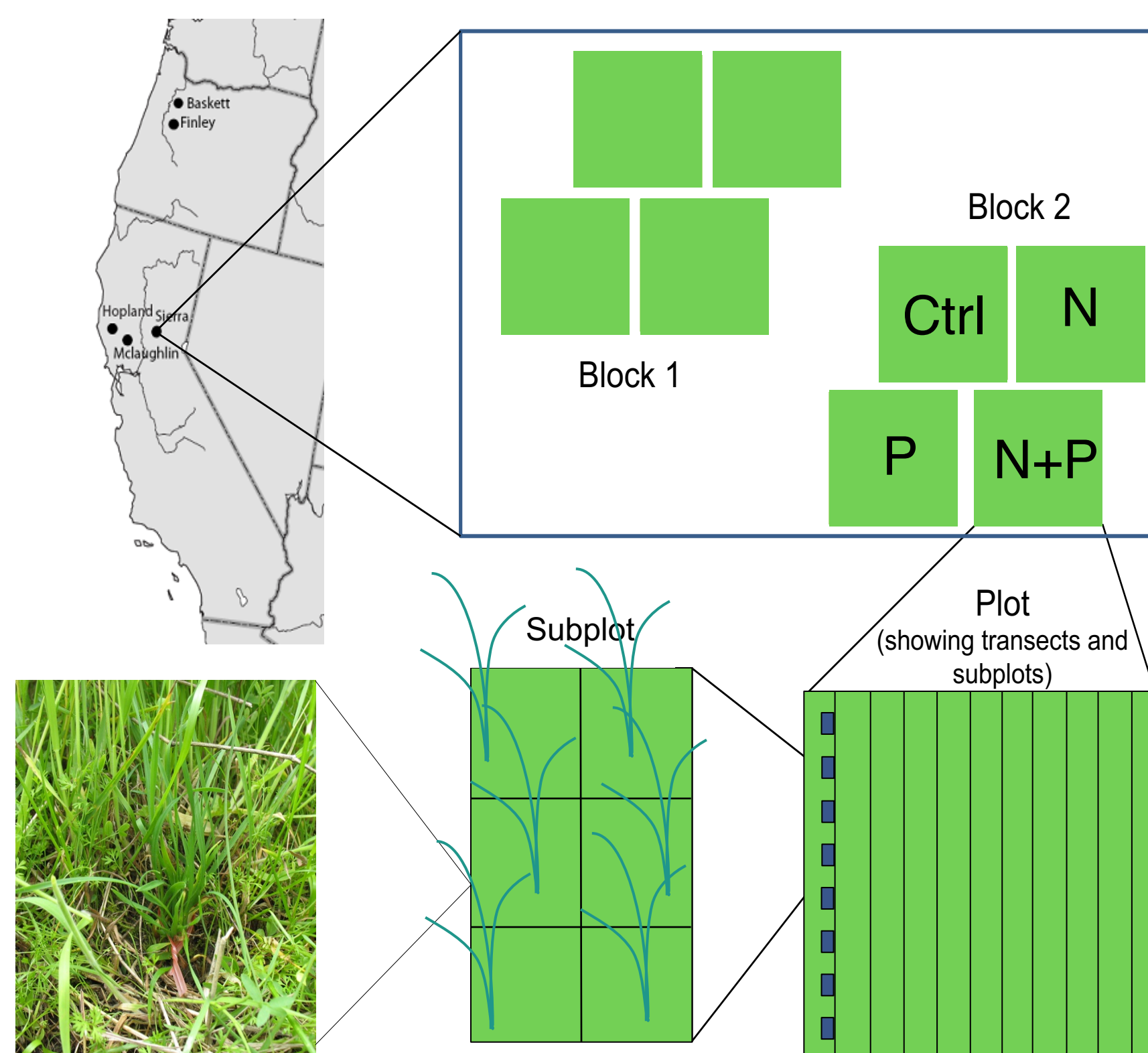
- they accumulate more organisms over time
- they allocate less to defense than smaller hosts
- they are preferred by vectors over smaller hosts

We evaluated the relationship between host size and virus community richness for grasses. The goals of this research were:

1. Determine whether larger plants have more virus species
2. Assess how relationships change with nutrient addition
3. Explore the role of vector preference in these relationships

## Methods

- Fertilizers were added to plots in five field sites
- Greenhouse-grown plants were set out in field to acquire infection
- At the end of the growing season, we measured plant mass and assessed infection by 5 viruses (PAV, MAV, RPV, RMV, and SGV)
  - Limitation: SGV was only assessed in about ½ of the plants
- Lab trials of aphid vector preference for each plant species
- Variance components analysis, generalized linear mixed effects models (glmer), and correlations in R



Plant species:

Af = *Avena fatua*  
Bh = *Bromus hordeaceus*

Km = *Koeleria macrantha*  
Bc = *Bromus carinatus*  
Tcm = *Taeniatherum caput-medusae*  
Eg = *Elymus glaucus*

## Results & Discussion

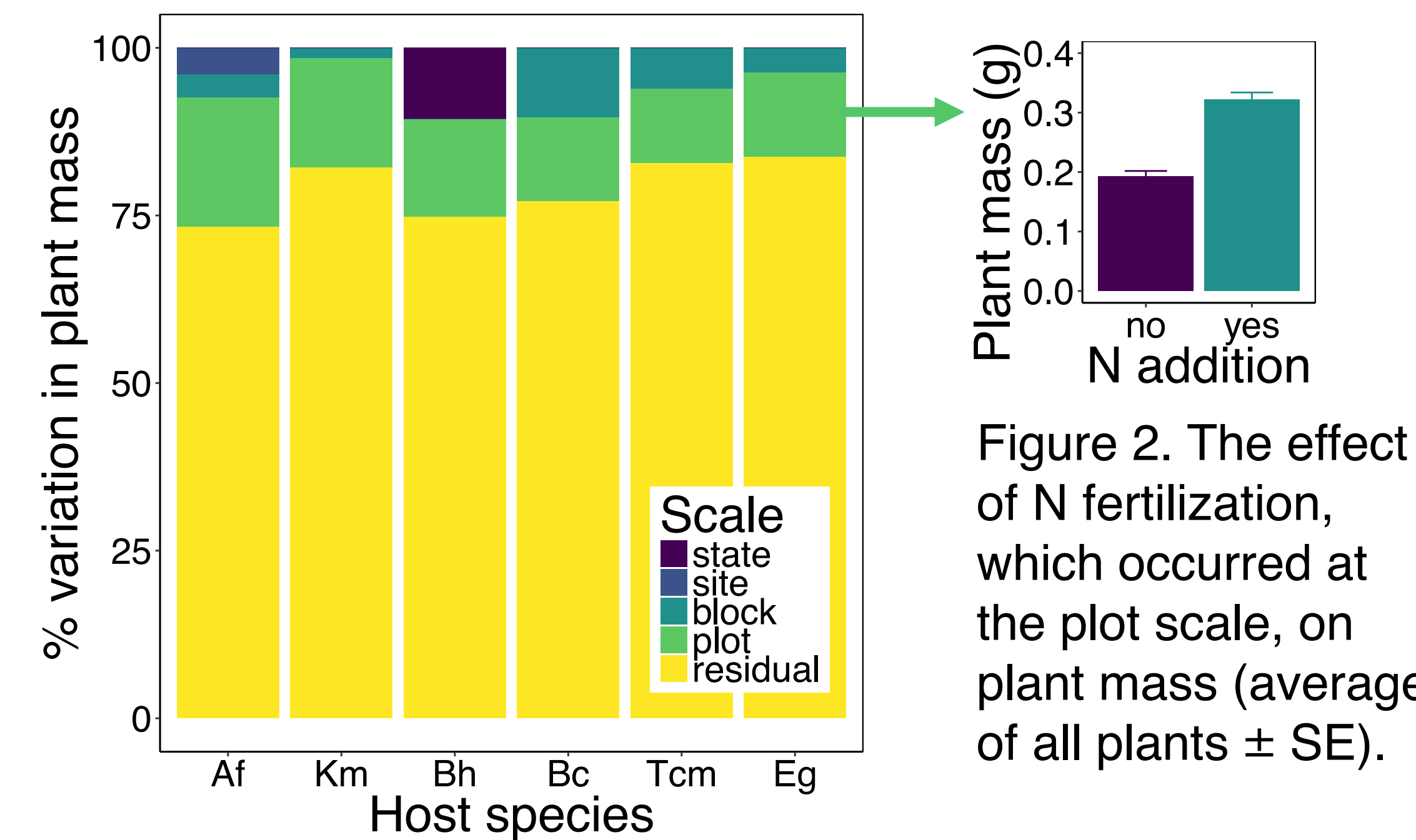


Figure 1. Variance components analysis of plant mass for each species across the spatial scales of the experiment.

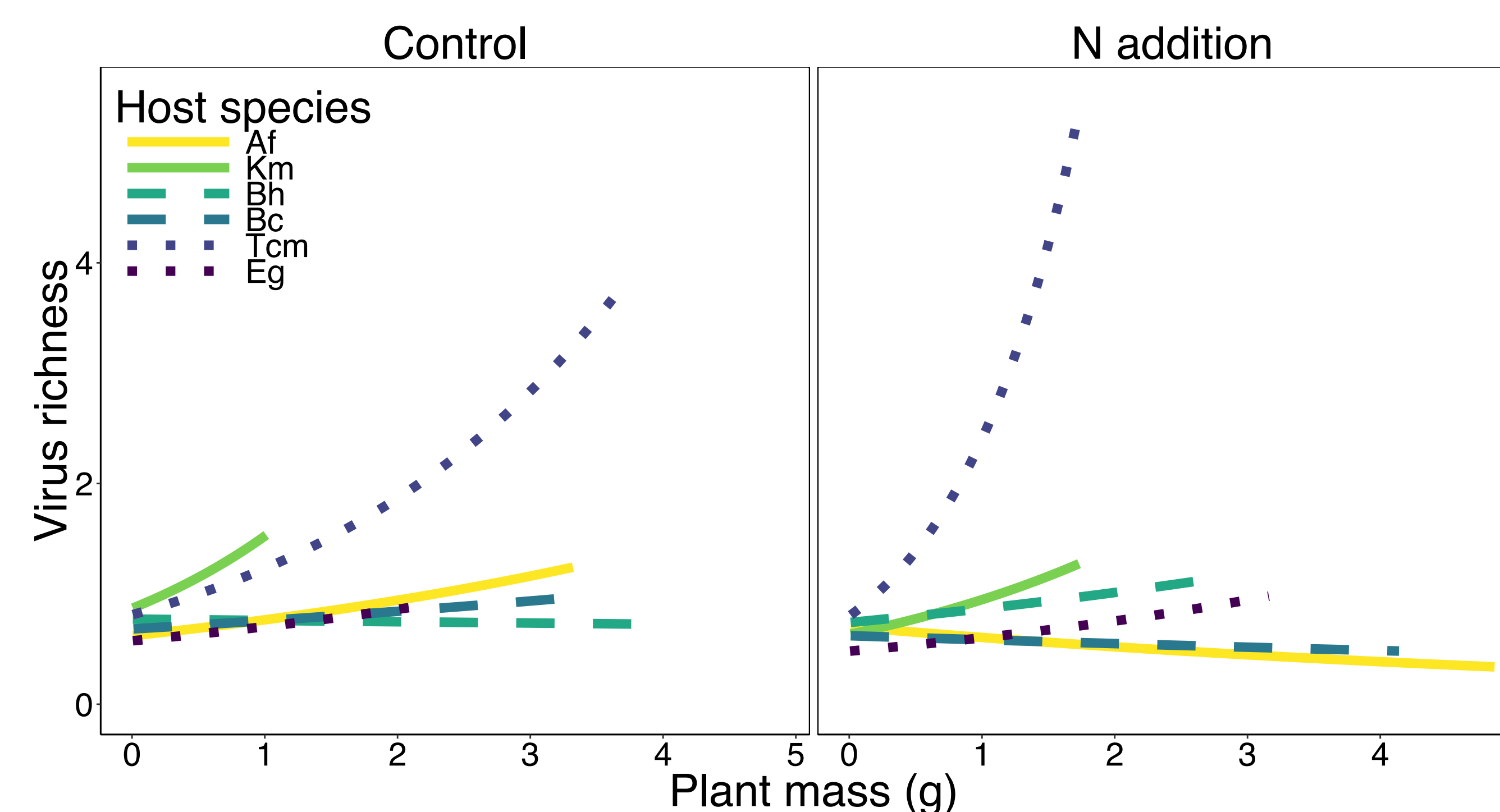


Figure 3. Model fits (Poisson glmer) for the relationship between virus richness (number of virus species per plant) and plant mass for each of the plant species in control plots and with N fertilization. Only plants assessed for all five viruses were included.

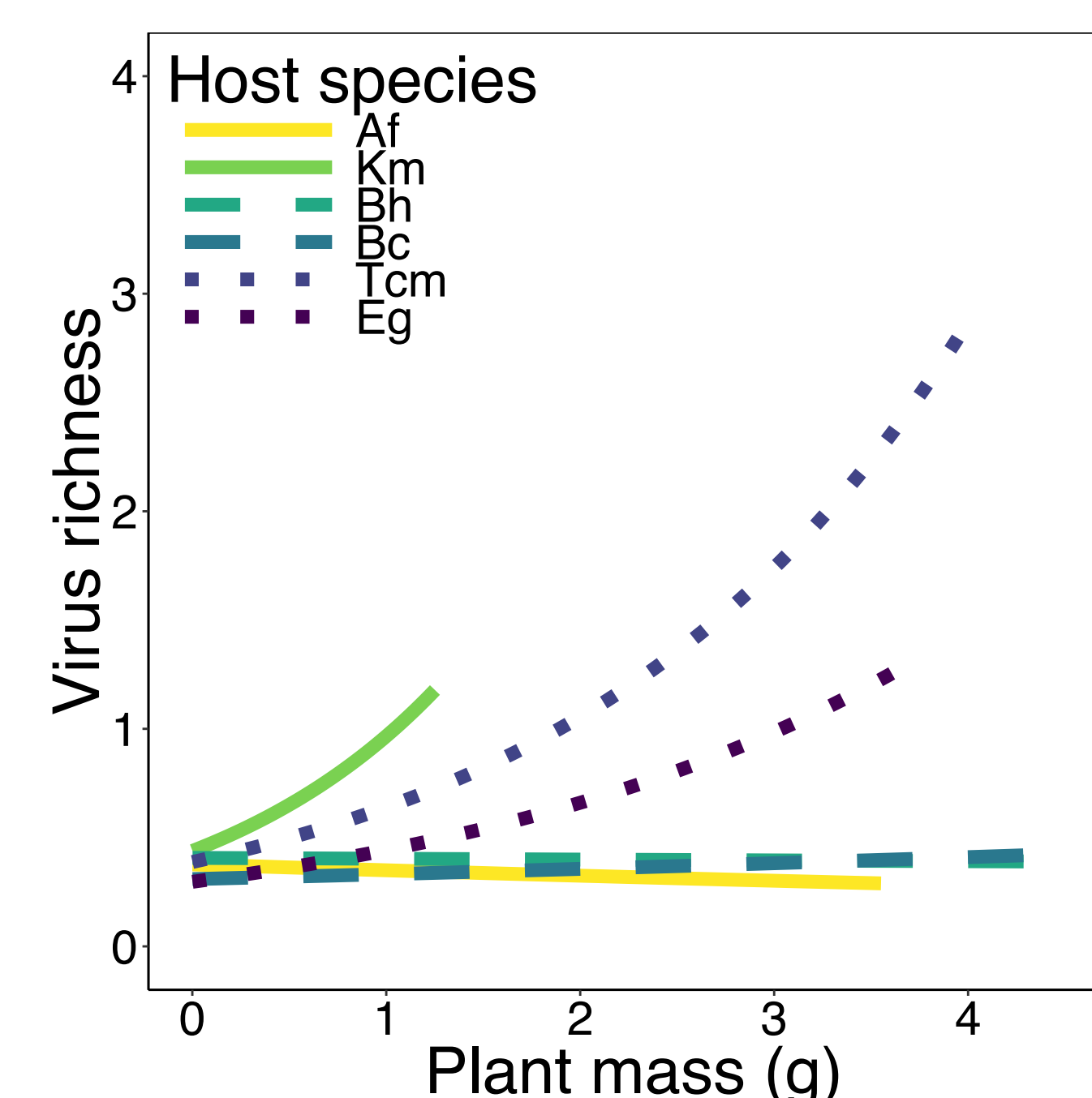


Figure 4. Fig. 3 with the larger dataset (no SGV).

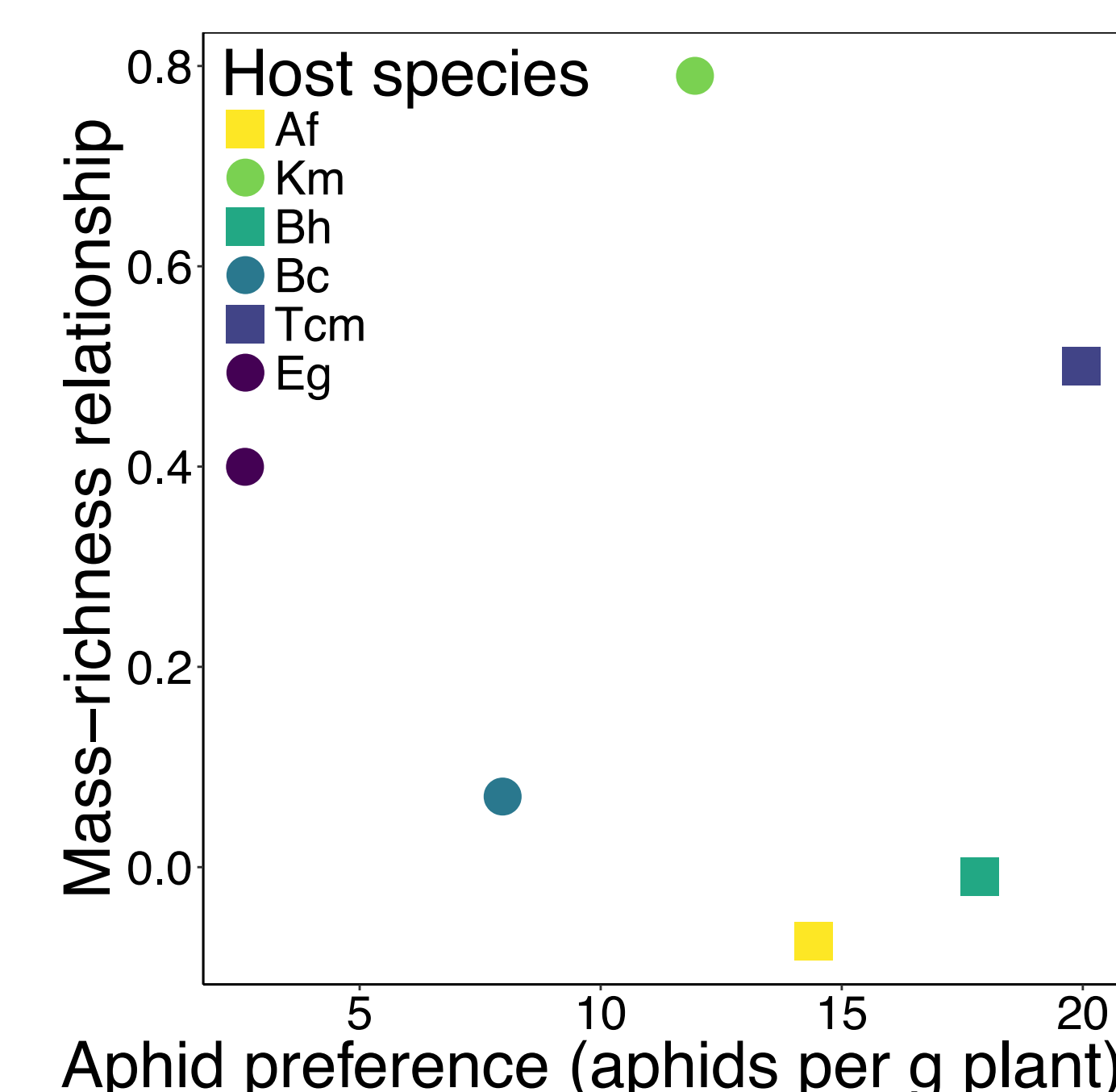


Figure 5. The coefficient of the plant mass-virus richness relationships in Fig. 4 against scores from aphid preference trials.

### N addition and local environmental variation drove differences in plant mass

- Most of the variance in plant mass occurred within plots (residual in Fig. 1).
- N fertilizer added to plots increased plant mass for all of the species (Fig. 2), suggesting that it could change virus replication (and within-host titer), allocation to defense, or vector preference.
- We included N addition in our statistical models.

### Larger plants of *T. caput-medusae* were infected with more viruses, especially with N addition

- The relationship between virus richness and plant mass was significantly positive for Tcm, but not the other species (Fig. 3).
- This relationship strengthened with N addition (Fig. 3).
- The linear model for Tcm was significantly better or equal to a model with log-transformed plant mass and the power function (functions frequently used to describe species-area relationships).

- Virulence (reduced host mass) may negate the host size-virus richness relationship for the species other than Tcm.
- Higher resource availability may reduce the chance of within-plant virus extinction due to larger titer or longer aphid feeding time.
- This would need to interact with another mechanism, such as lower defenses or vector preference, to disproportionately affect larger plants.
- With N addition, there are more large plants, so the number of samples increases, and we might be more likely to find a plant with more viruses.

### Positive size-richness patterns for more species with more data, but no effect of vector preference

- When a larger dataset (more plants, only four viruses) was used, Tcm, Km, and Eg had significantly positive relationships (Fig. 4).
- There was no correlation between the strength of the relationship between host mass and virus richness and aphid preference score (Fig. 5), except that Tcm was the most preferred species (same for Fig. 3 control plants).
- Aphids did not prefer larger plants (data not shown).

- Theories meant to understand species-area relationships are relevant to some host species.
- Larger hosts may be more susceptible to coinfection, and could experience more severe disease symptoms.
- Species-specific host-pathogen (or microbe, insect, etc.) interactions should be considered because they can determine the strength of the host size-community richness relationship.
- Designing experiments to assess the relative influence of different mechanisms on this pattern is a promising future direction.

## Acknowledgements & References

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