Uncovering the role of host control on microbiome

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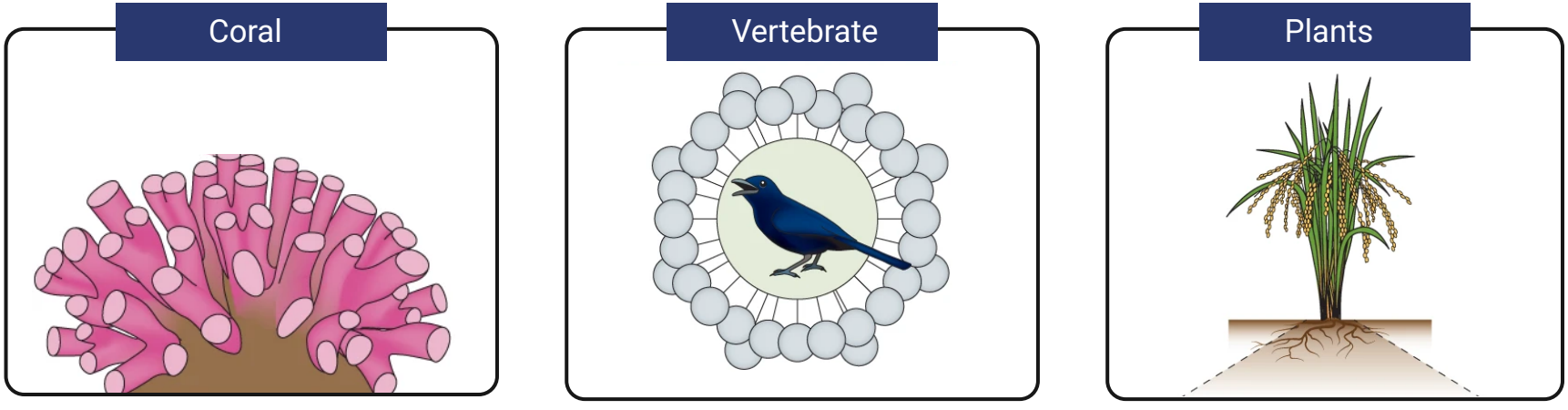
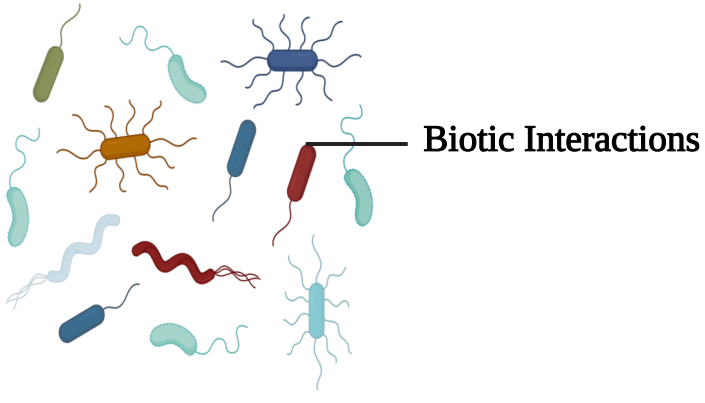
Motivation

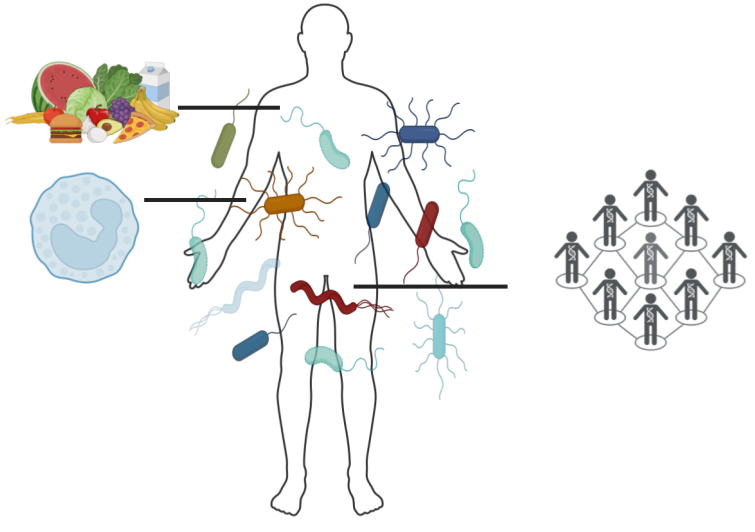
How does the balance of microbial species interaction types and the effect of host immune response drive community assembly and structure?

Leverage Community Ecology to Study Microbial Community

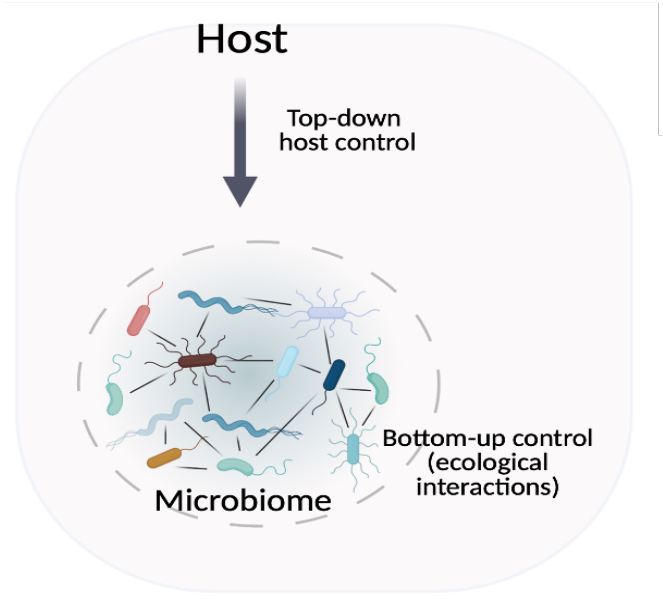


Mechanisms of Microbiome Assembly





Host Control and Species Interactions Determine Microbiome Assembly



$$\frac{dN_i}{dt} = N_i\left(r + \sum_j f(N_j)\right)$$

Lotka Voltera

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Integrate host control by varying the growth rate of the microbial species:

$$r_i = 1 - \mathrm{k}\ \left(\frac{\sum_{q=0}^{S} N_q}{I_m}\right)$$

Microbial community abundance

Host control strength

Host microbial load

Interaction matrix of community

Species	a	b	c	d	e	f
a	-	0	0	0	0	0
b	0	-	0	-0.5	0	0
c	0	-0.2	-	0	0	0
d	0.4	0	0	-	0	0
e	0	0	-0.4	0	-	0.2
f	0	-0.6	0.1	0	0	-

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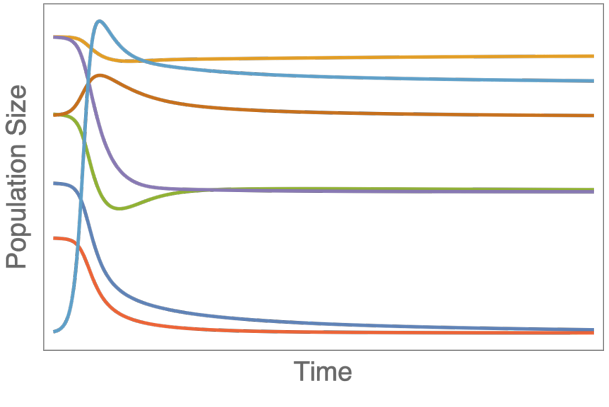
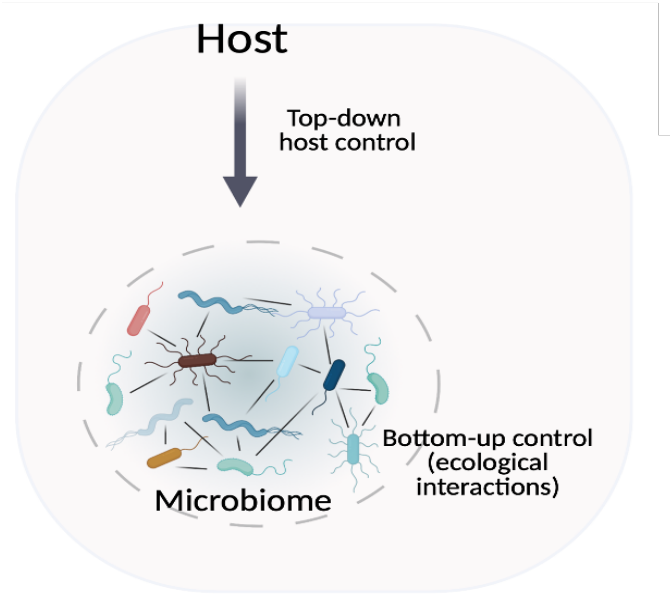


Simulate population dynamics

Host Control and Species Interactions Determine Microbiome Assembly



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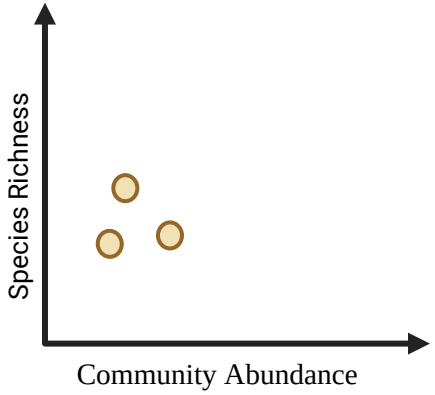

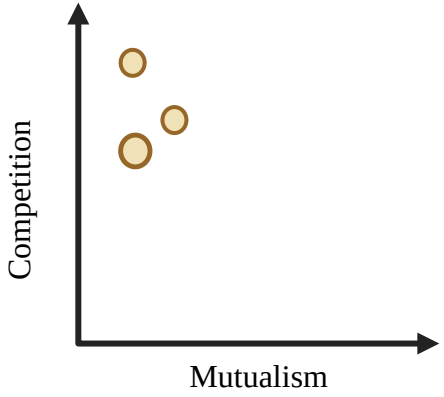

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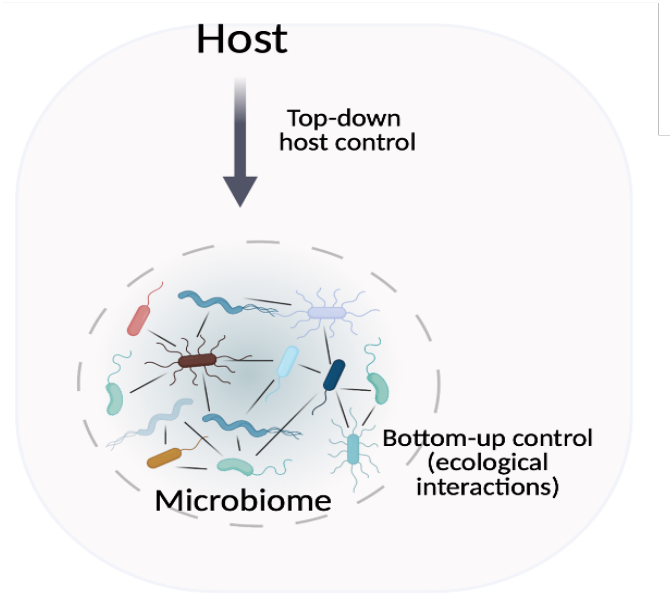
Host Control and Species Interactions Determine Microbiome Assembly



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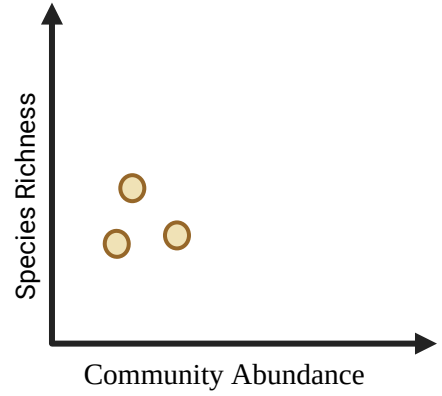

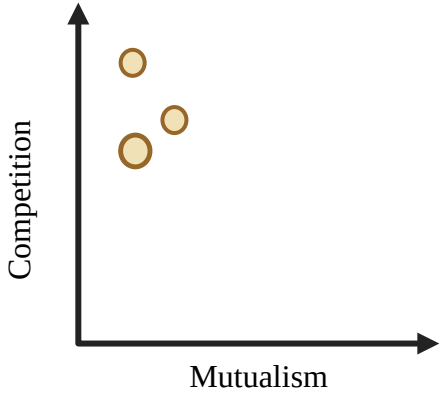

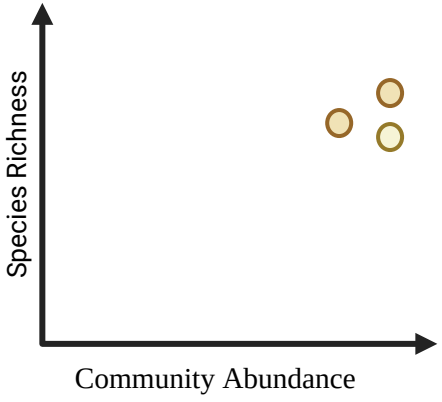

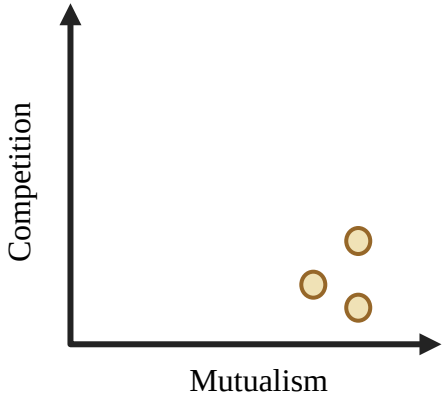

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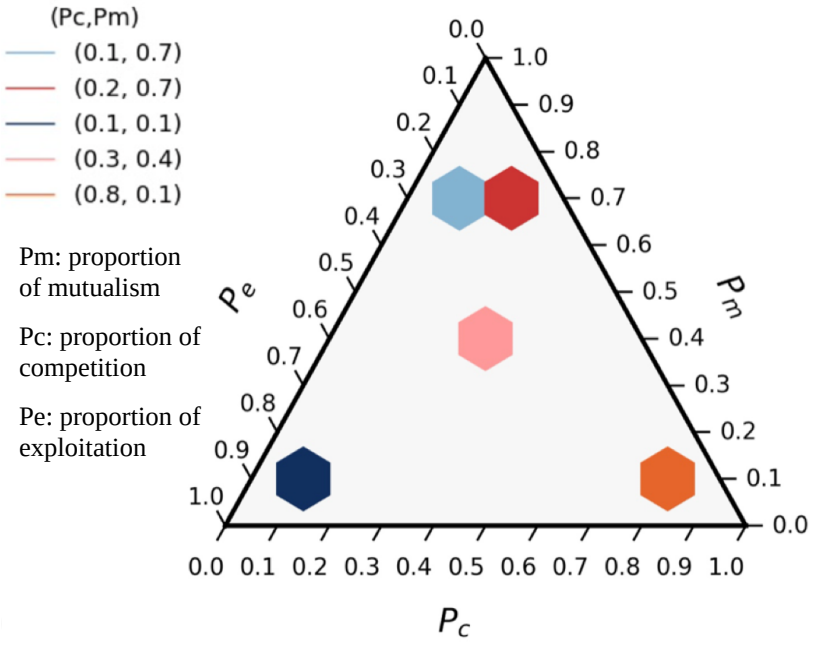
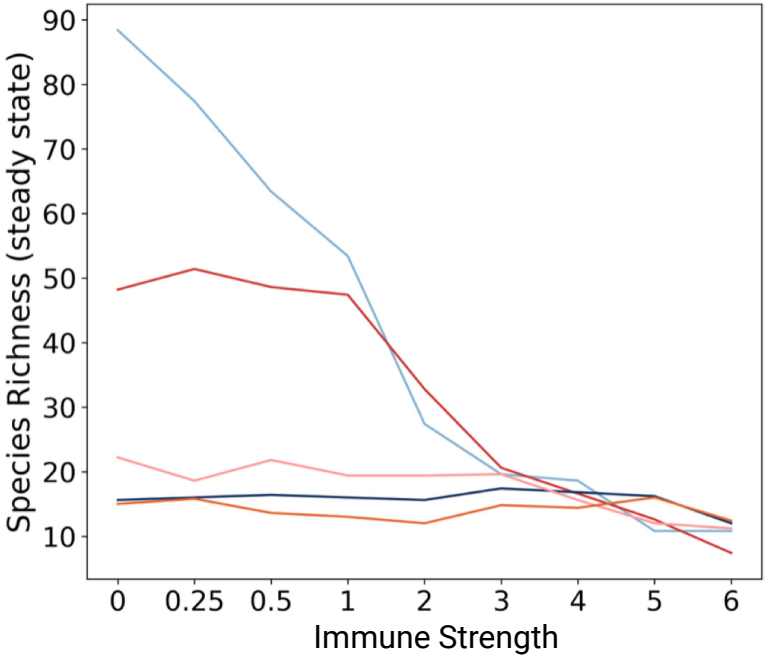
Microbial Interactions Shape the Impact of Host Immune Control on the Microbiome





Key Takeaways

- Highly mutualistic communities:
  - Characteristic of high species richness and abundance
  - Most susceptible to changes in the immune control
- Competitive communities remain stable to changes in the host immune control