

Reconciling divergent effects of diversity on disease

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Acknowledgements

University of Colorado P&P group

Pieter Johnson's lab group, CU

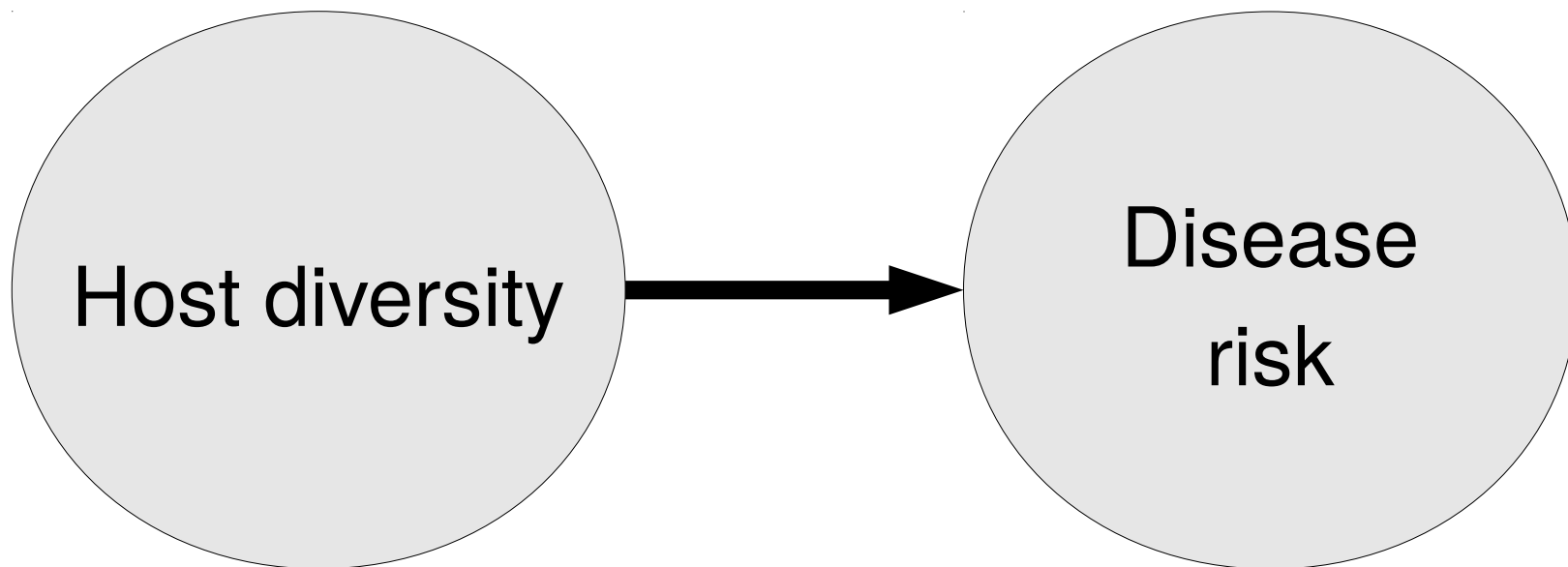
Kim Medley

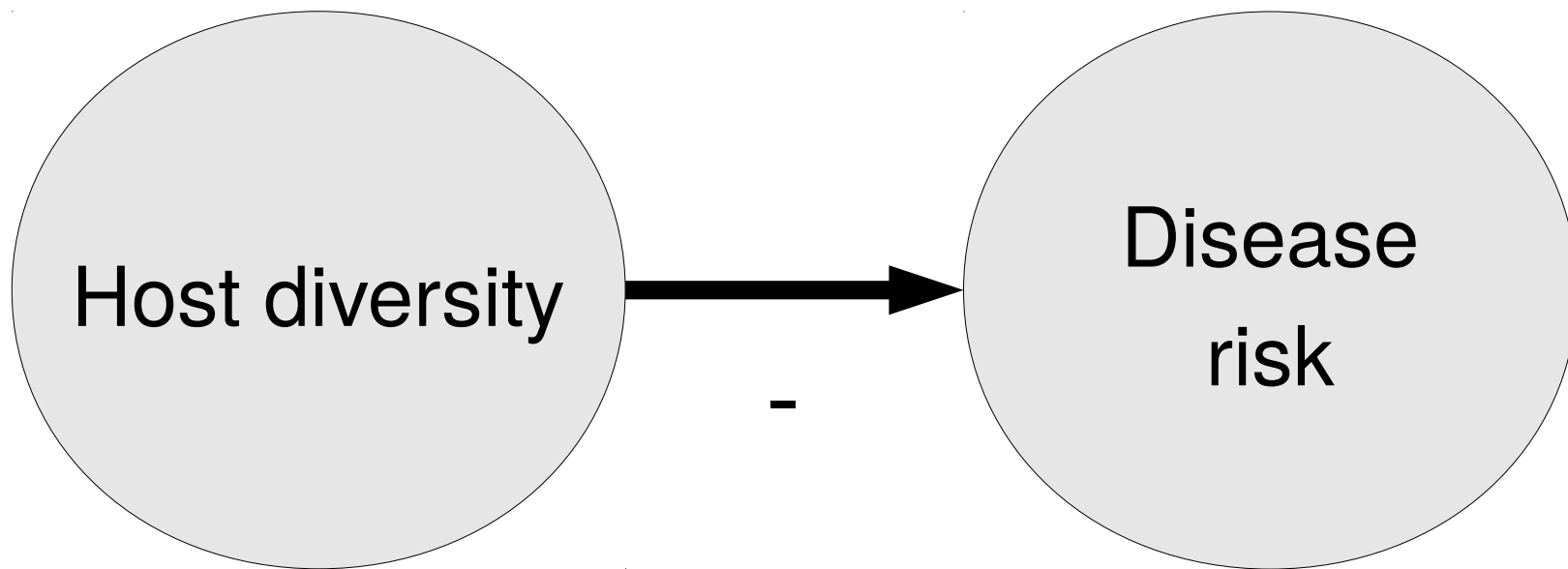
Amanda Hund

CU Research Computing

JANUS supercomputer

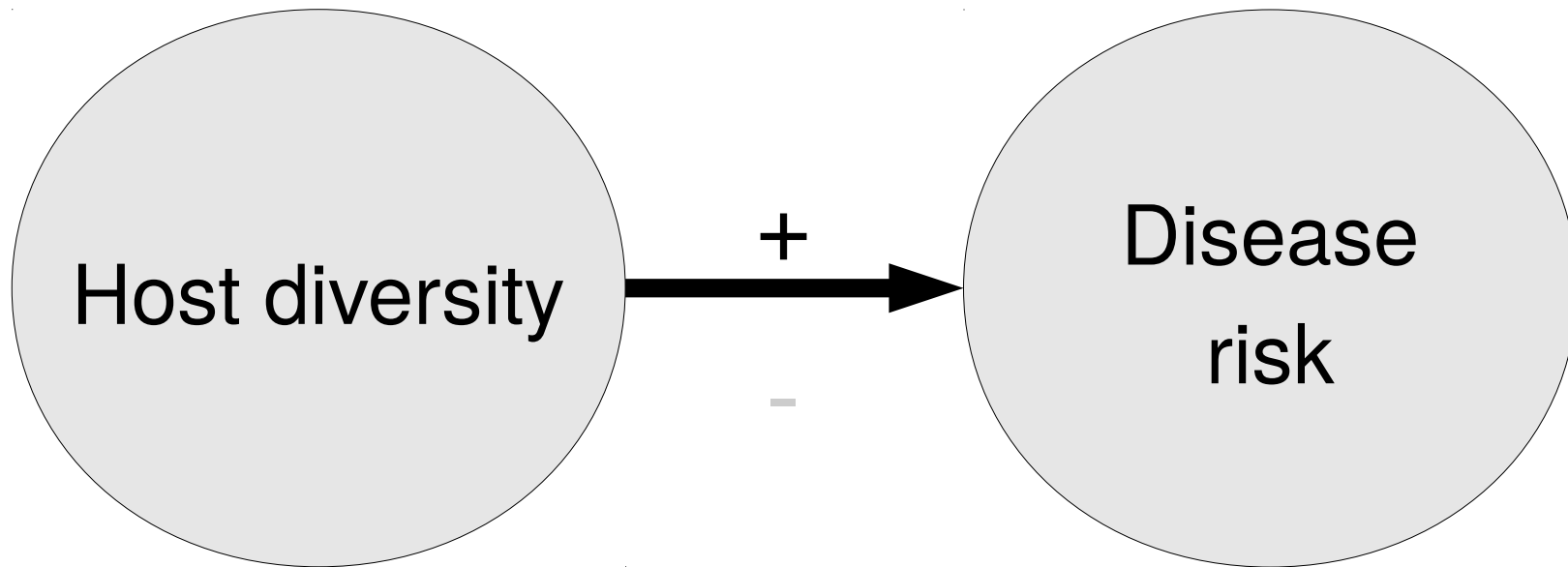






Dilution effect

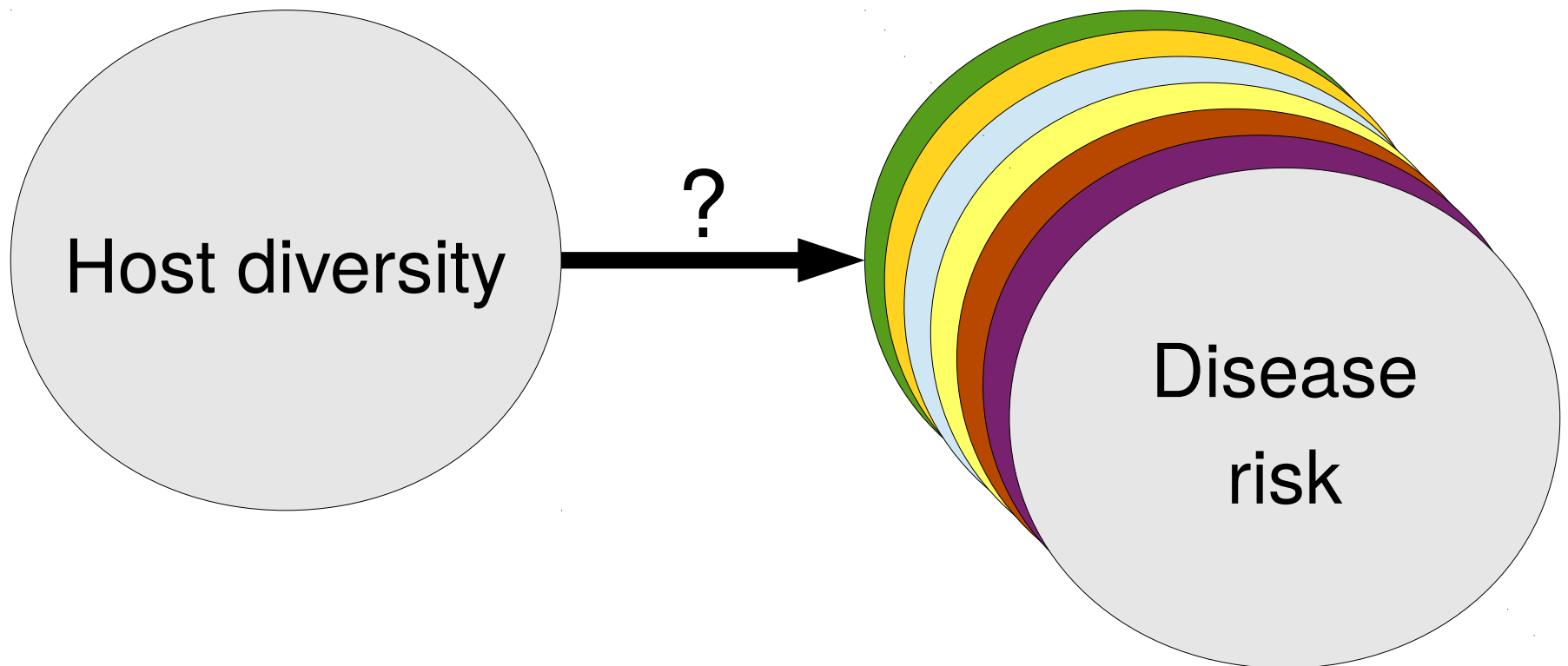
Amplification effect or ecological disservice

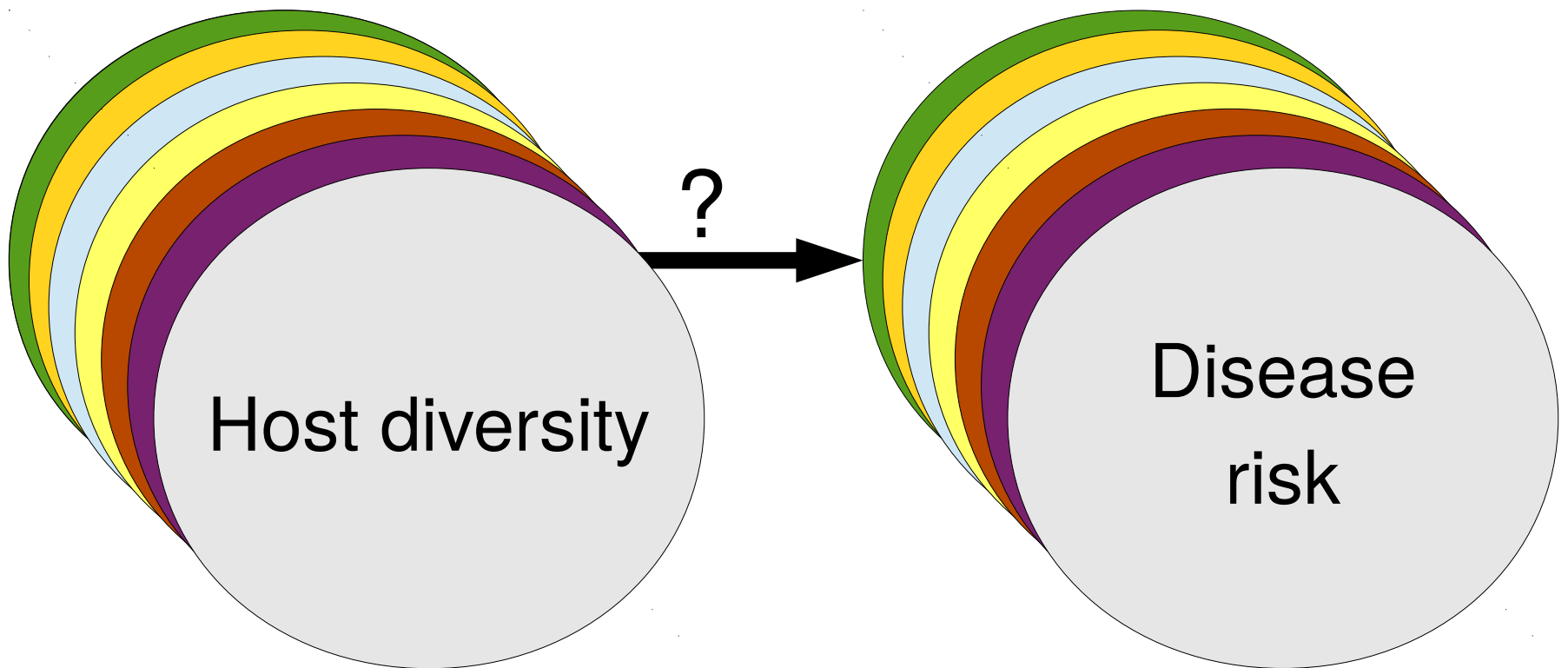


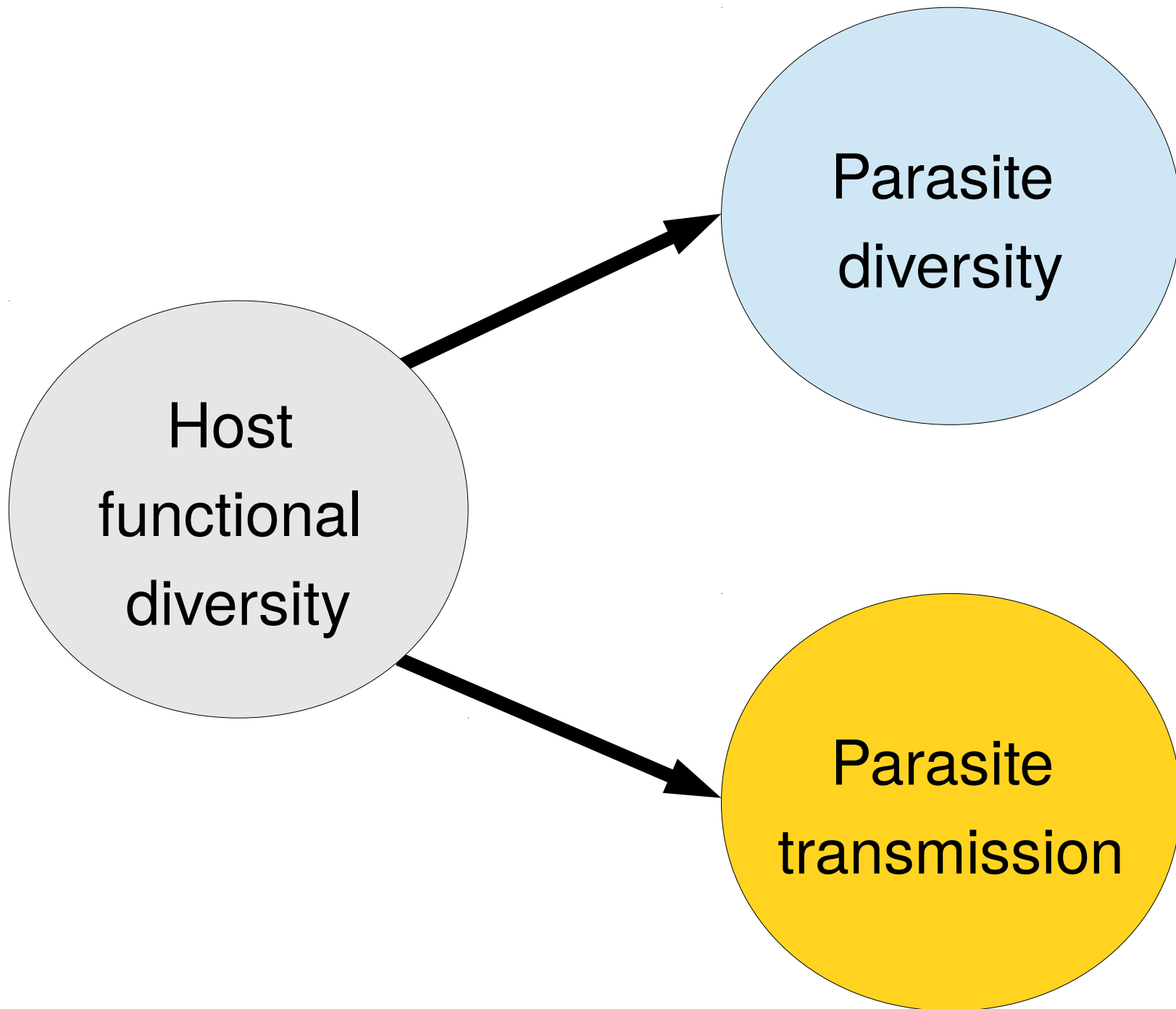
Dilution effect

Variable definitions of disease risk

- Density of infected vectors
- Density of infected reservoir hosts
- Rate of change in the density of infected hosts
- Human risk of zoonotic infection
- Parasite transmission rate
- Parasite prevalence in reservoir hosts
- Parasite prevalence in vectors
- Invasibility of a host community
- Probability that an individual will be infected with a disease agent

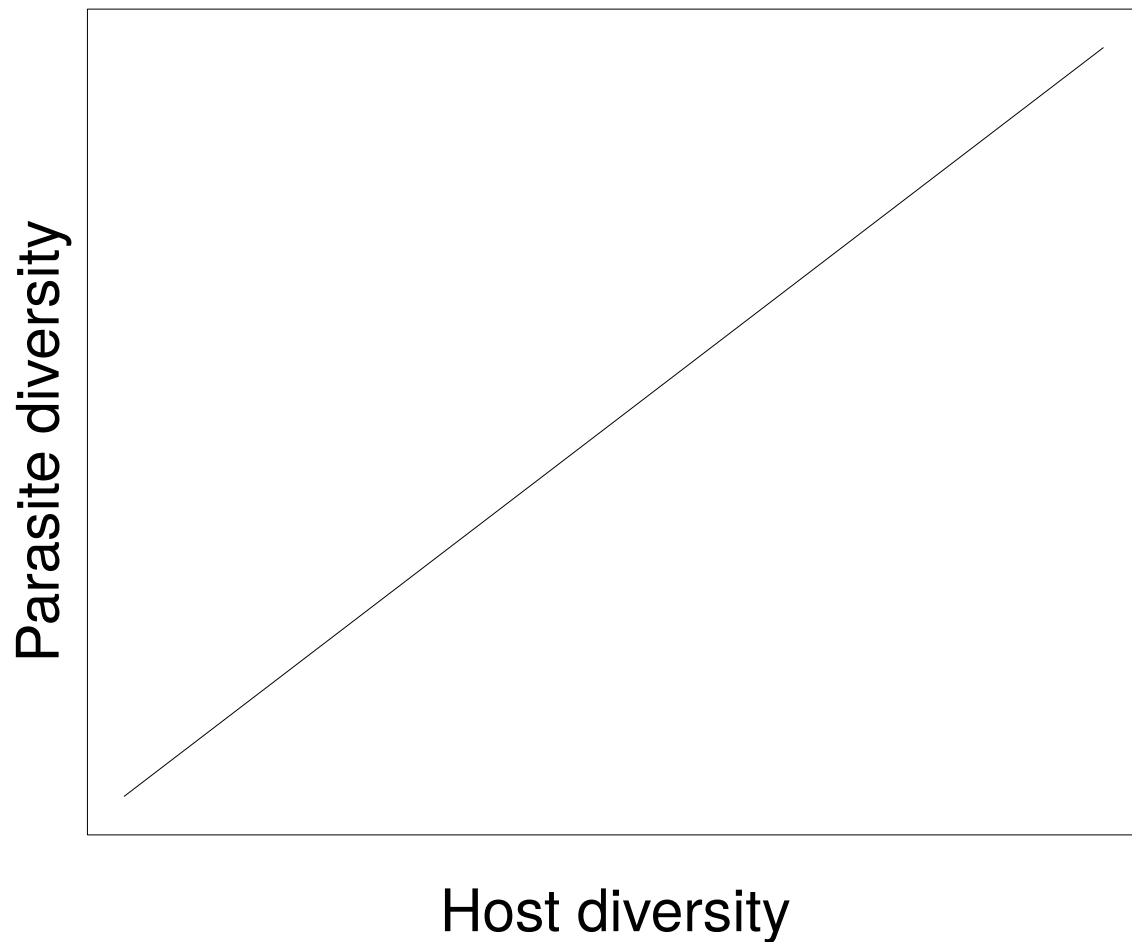






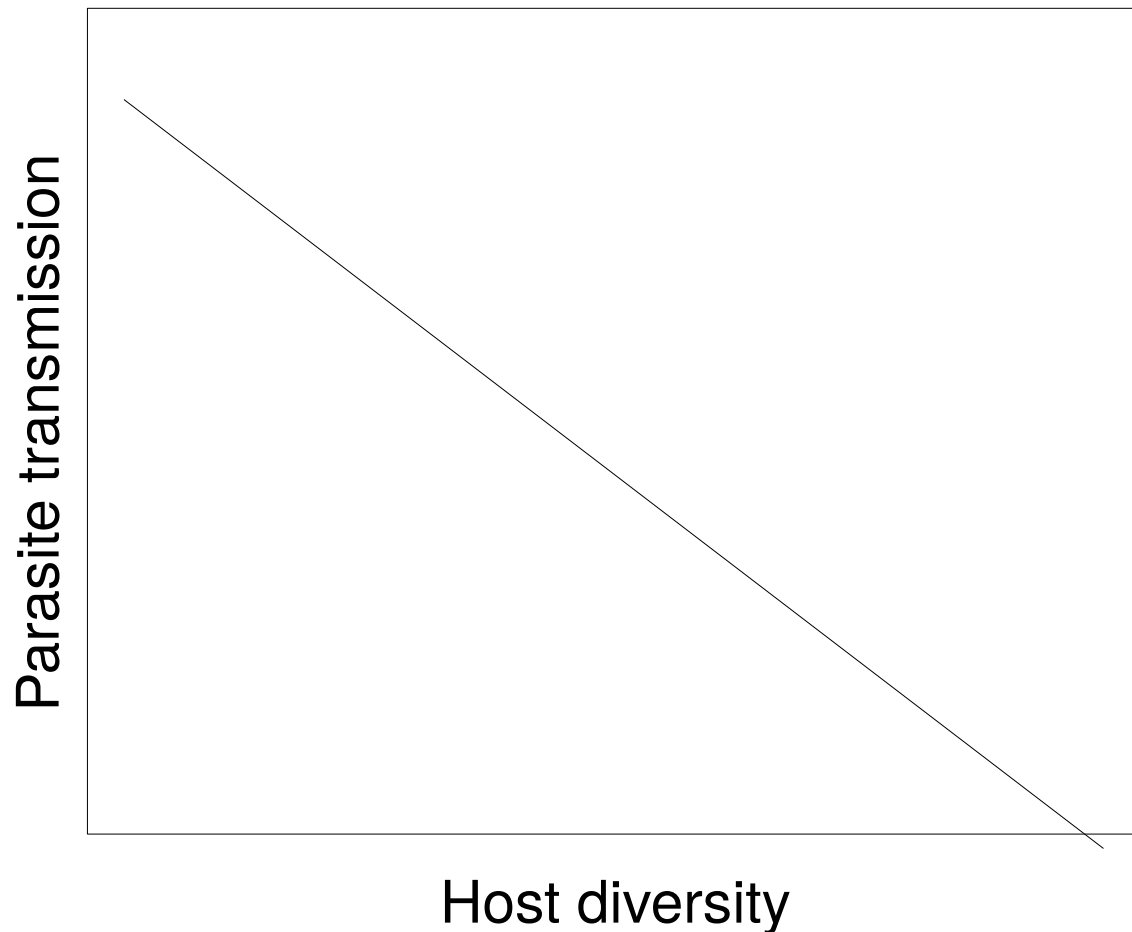
Expectations

Diversity begets diversity



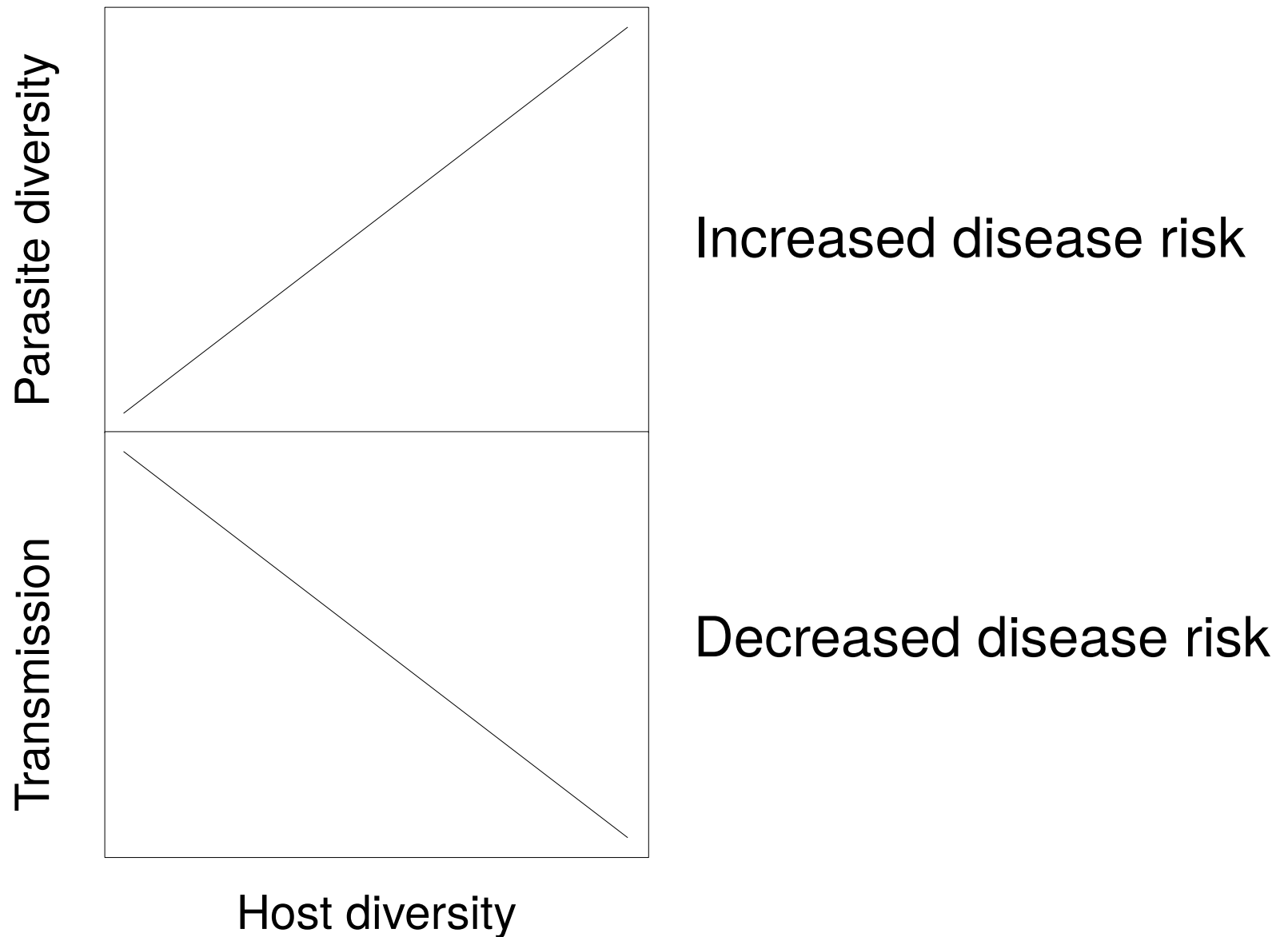
Expectations

Diversity reduces* transmission

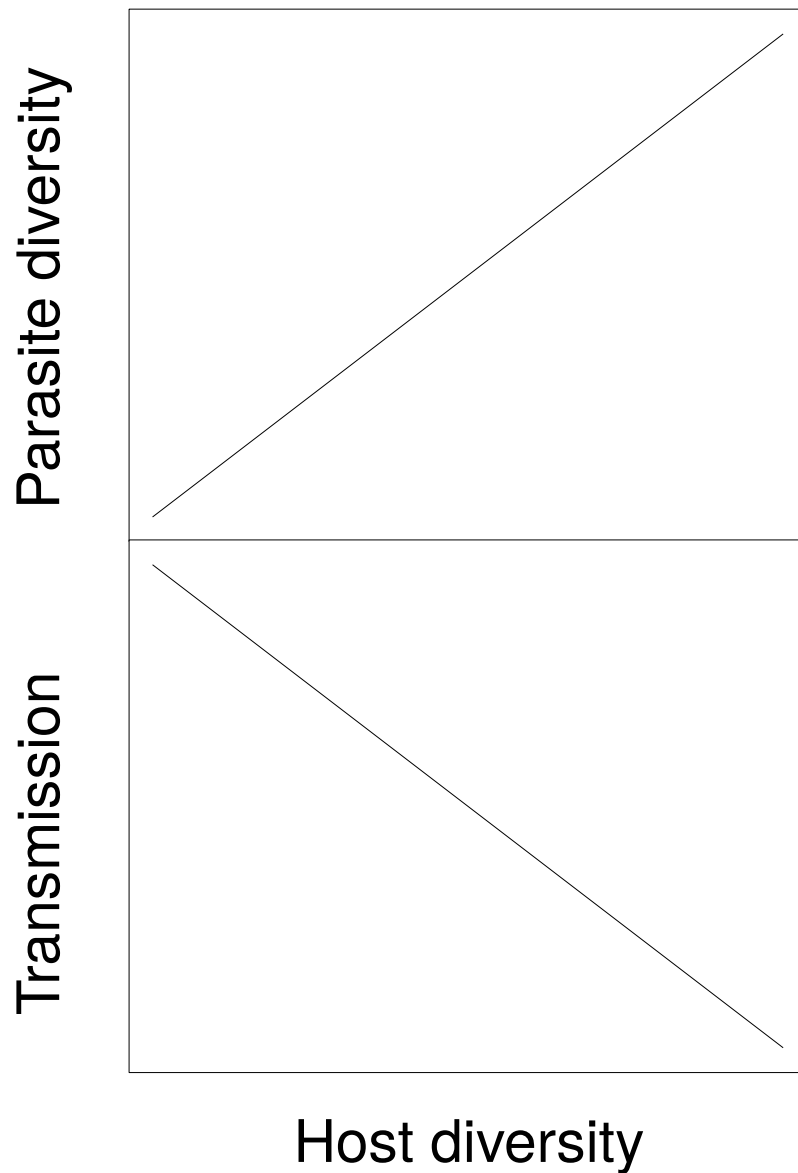


* on average, we think, theoretically, most of the time, when host community density is constant (Joseph et al. 2013)

Contradiction

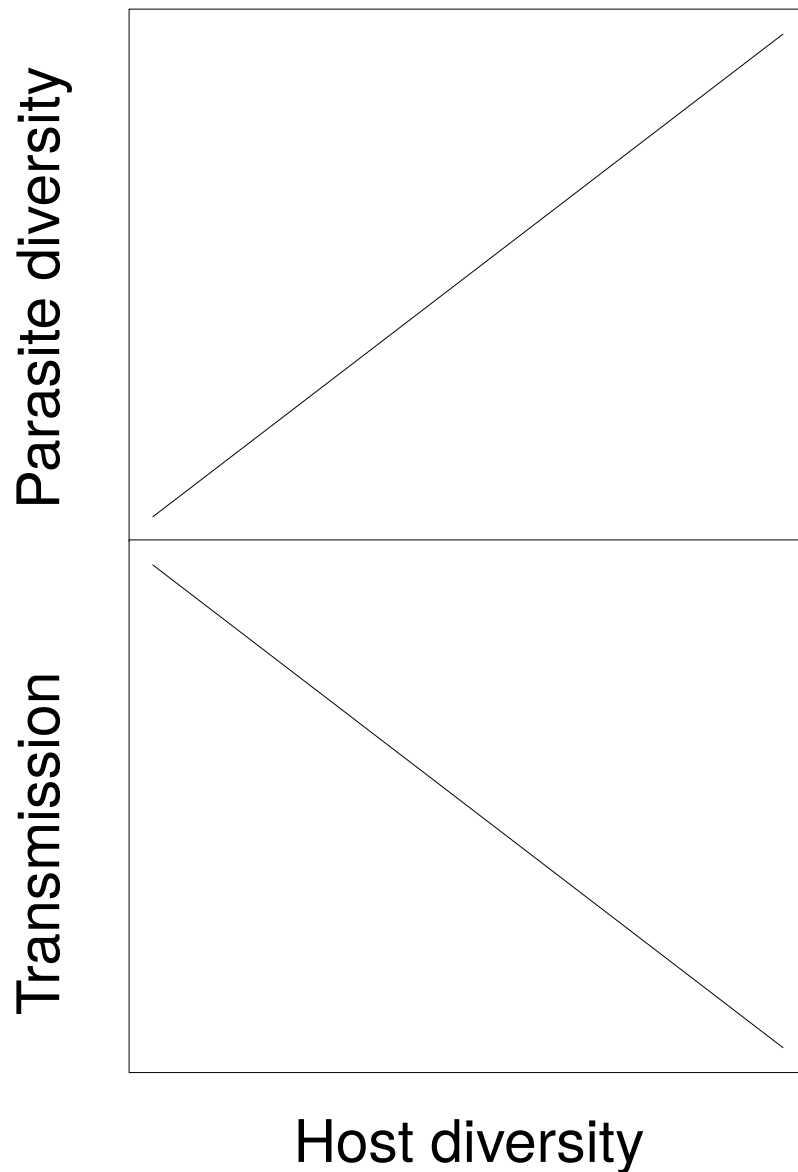


Reconciliation



Both patterns emerge from same mechanisms in a simple multi-host, multi-symbiont model

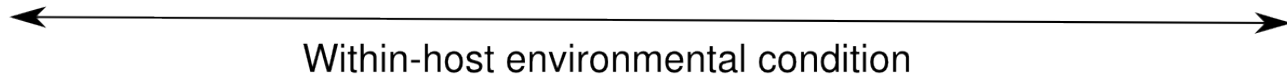
Reconciliation

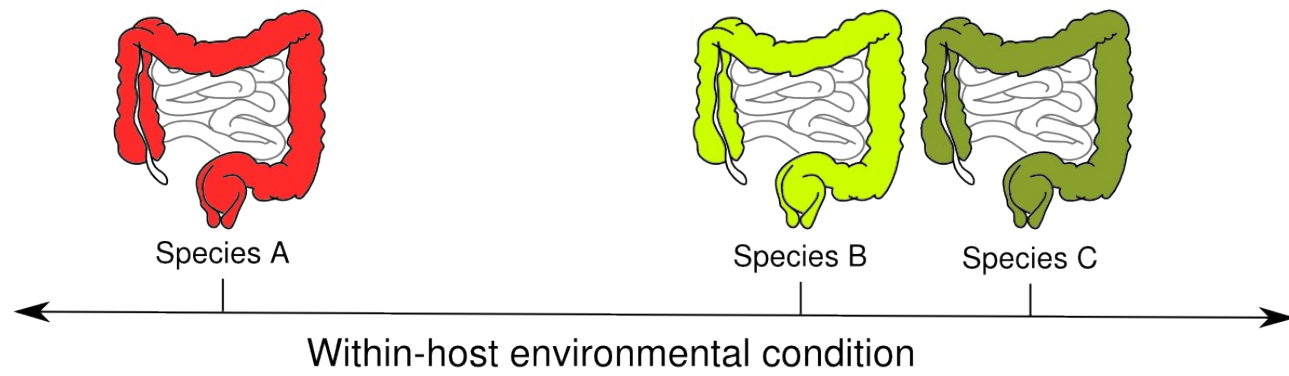


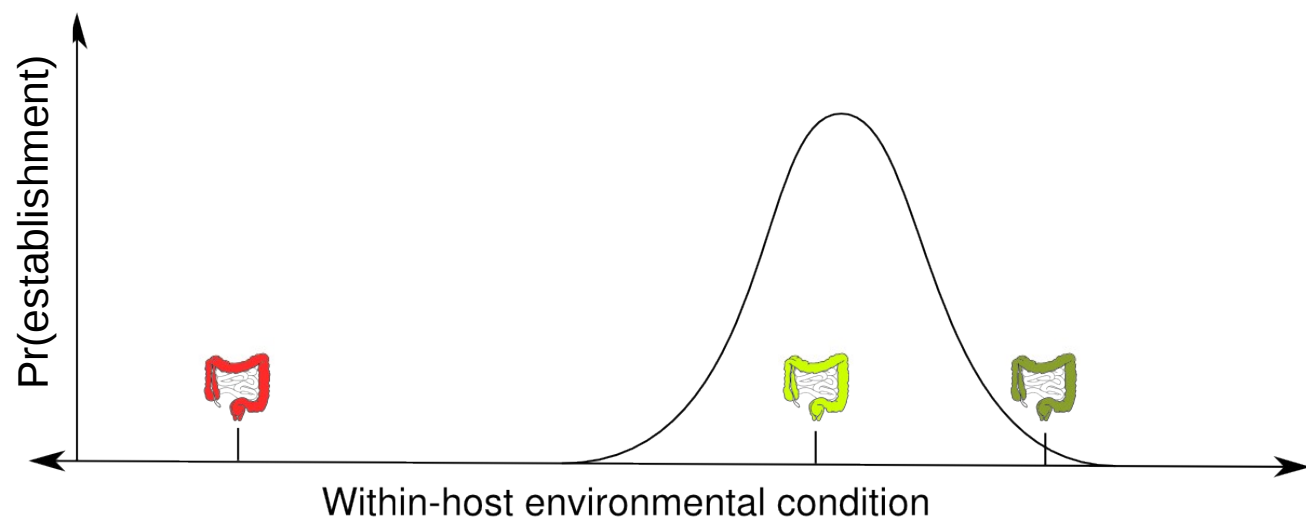
Both patterns emerge from same mechanisms in a simple multi-host, multi-symbiont model

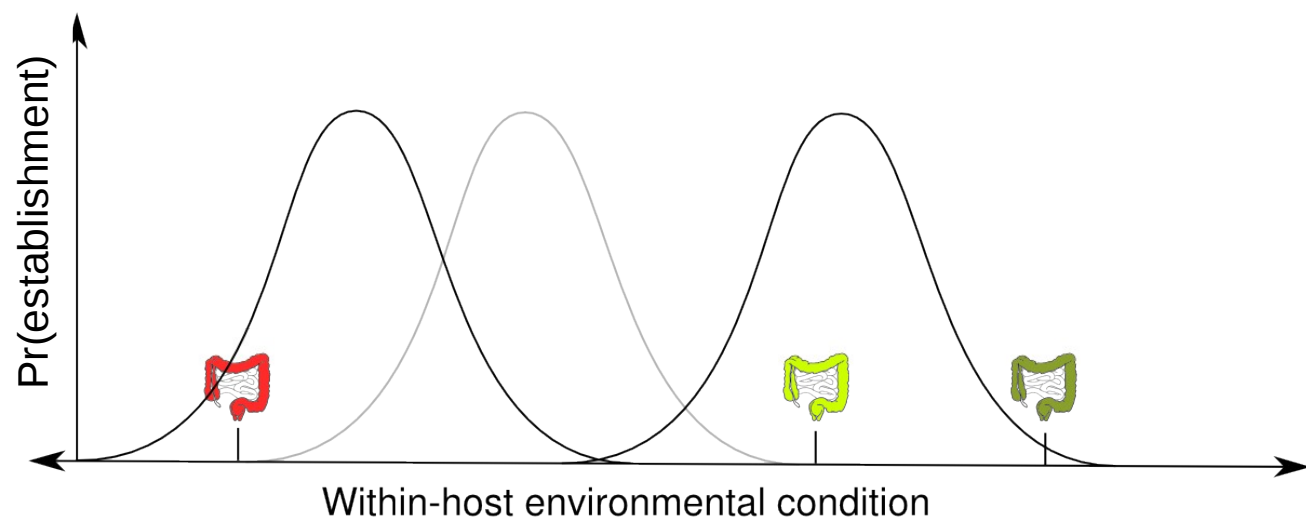
Apparent contradiction arises from multiple definitions of risk

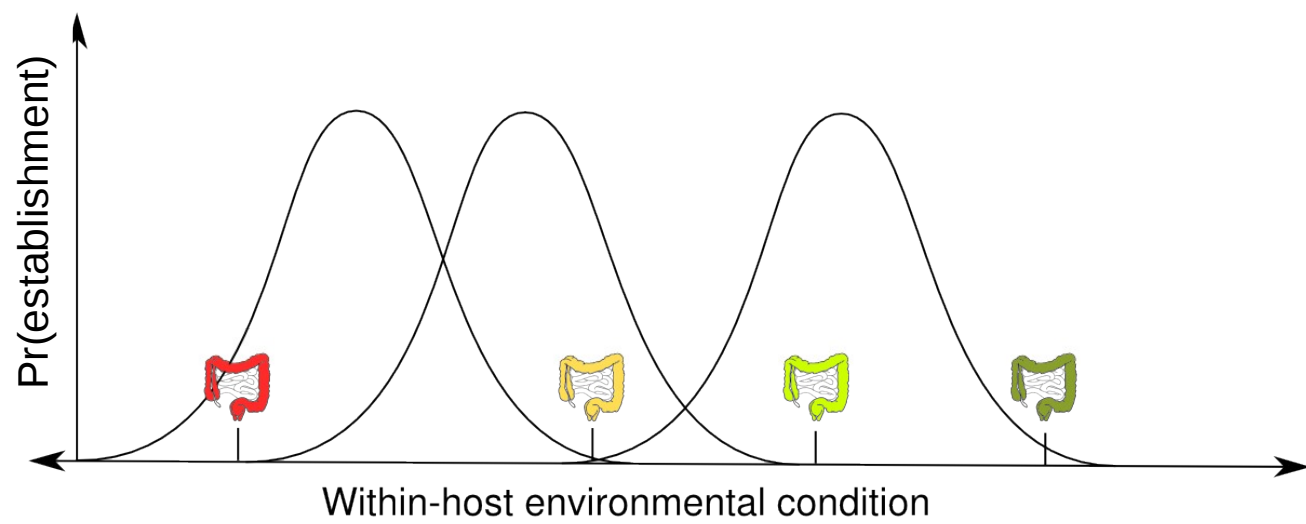
Model structure



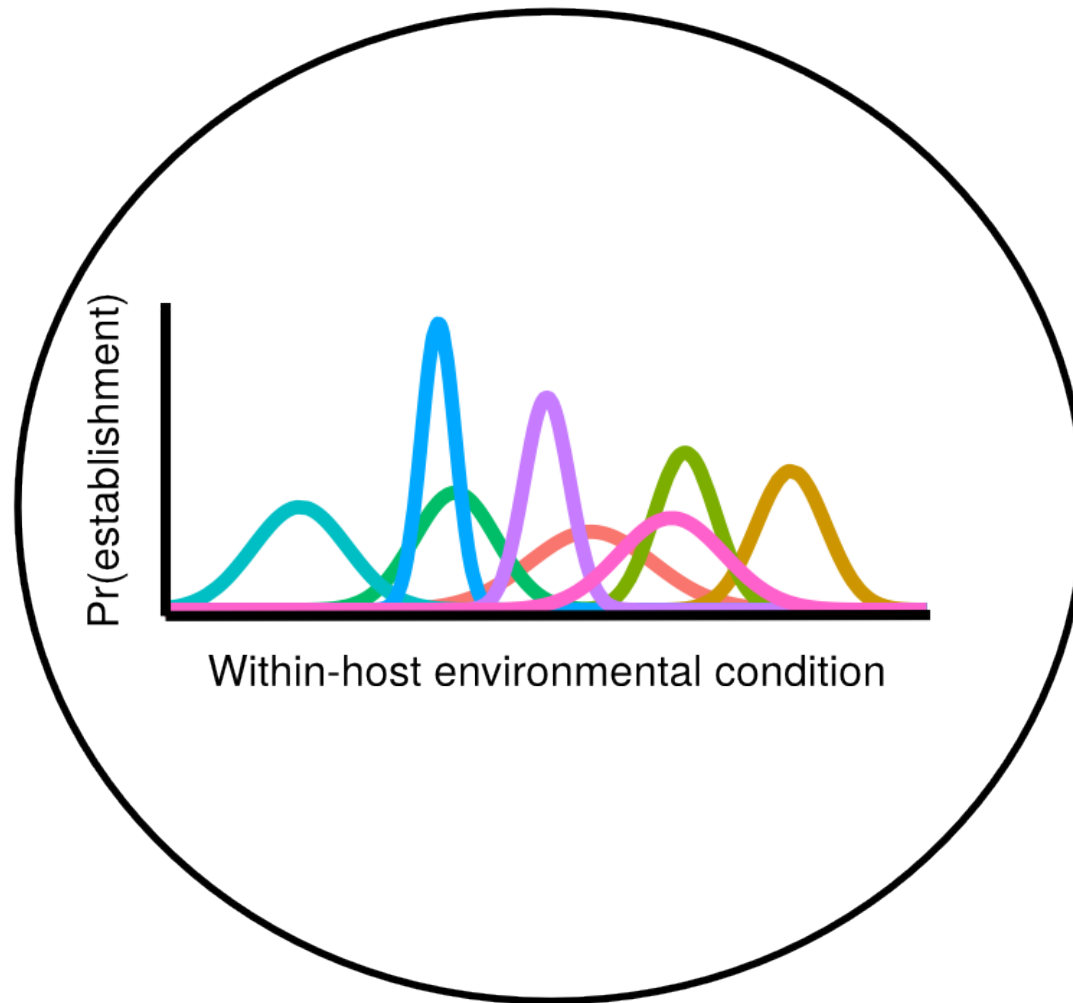






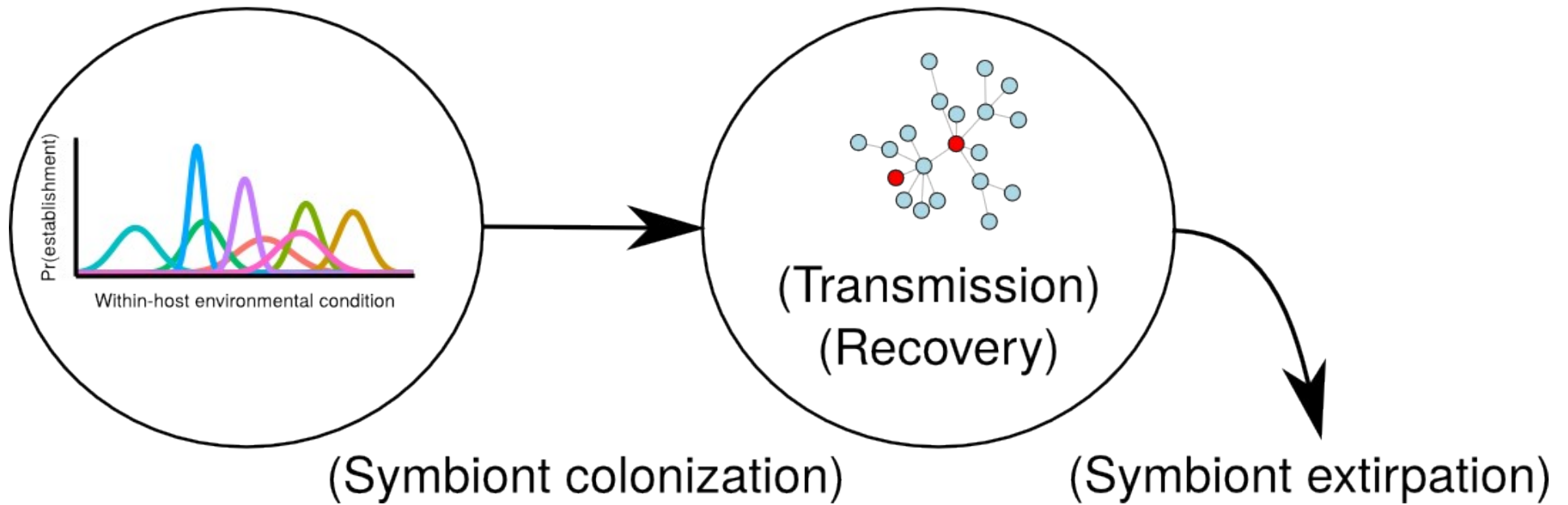


Regional symbiont pool



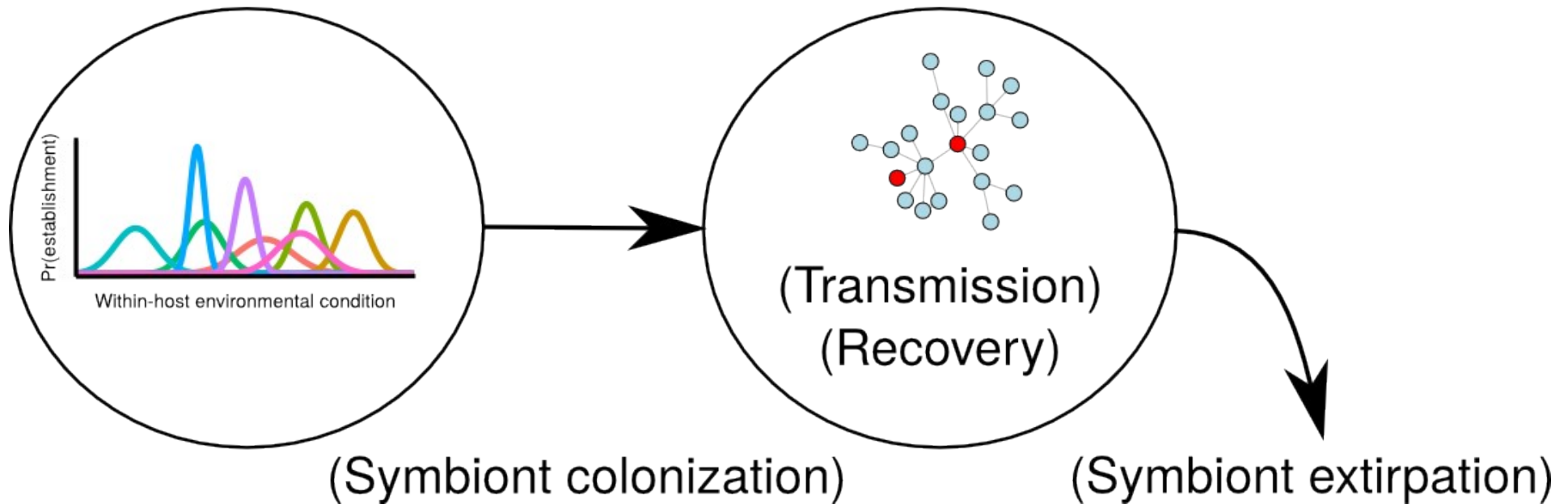
Regional symbiont pool

Local host community

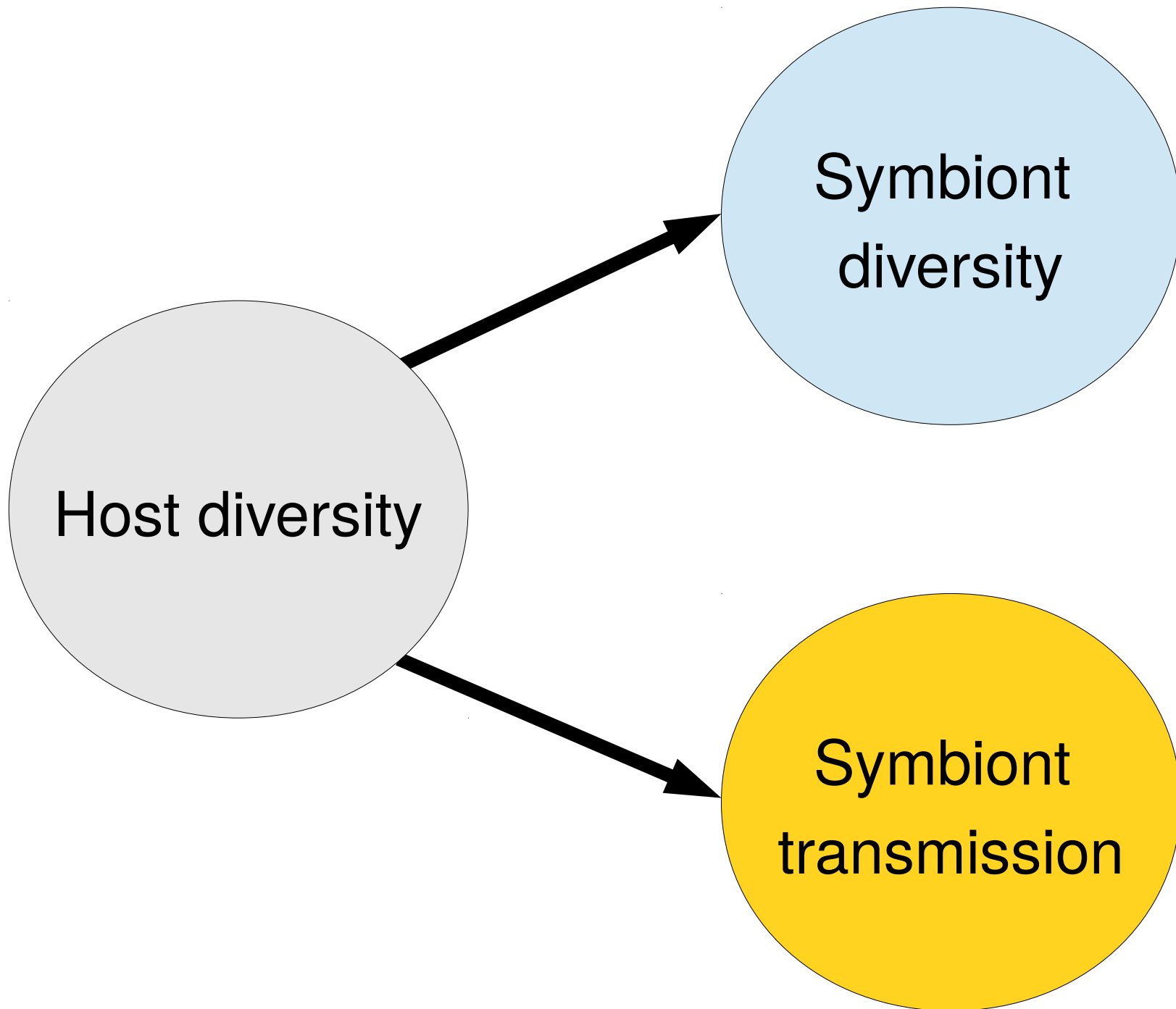


Regional symbiont pool

Local host community

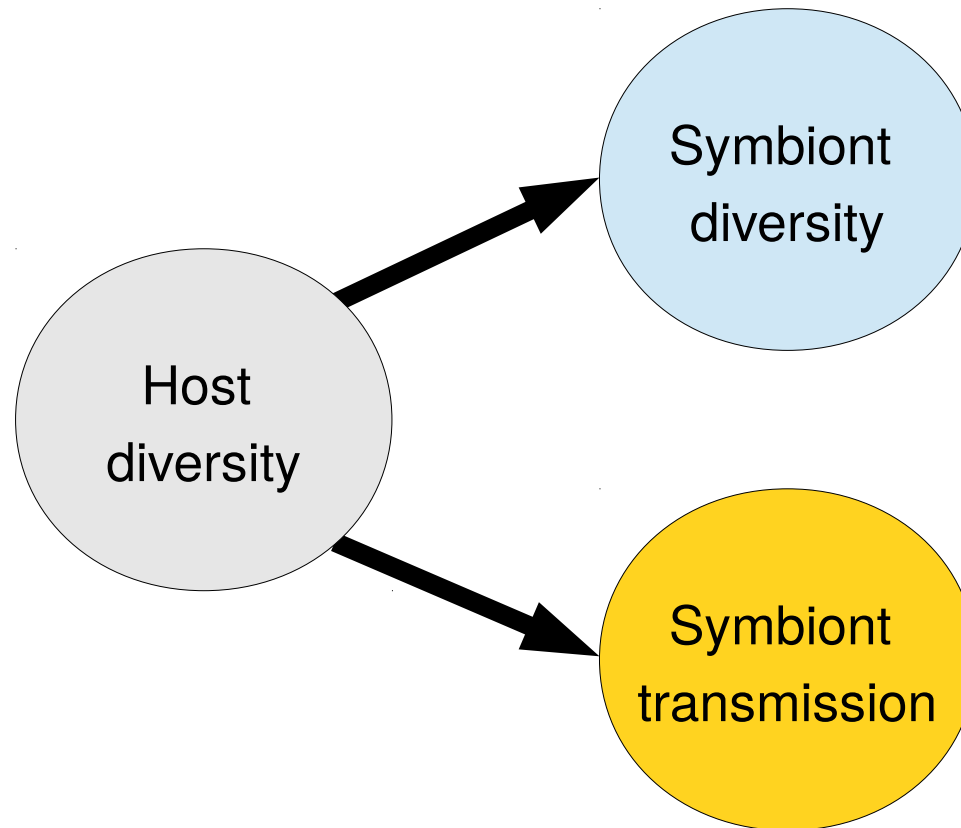


**Simplifying assumption:
no cost of infection**



Benefits of considering symbionts

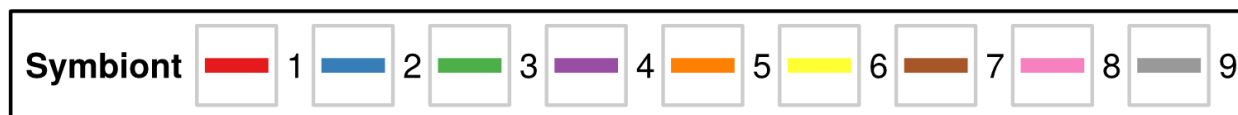
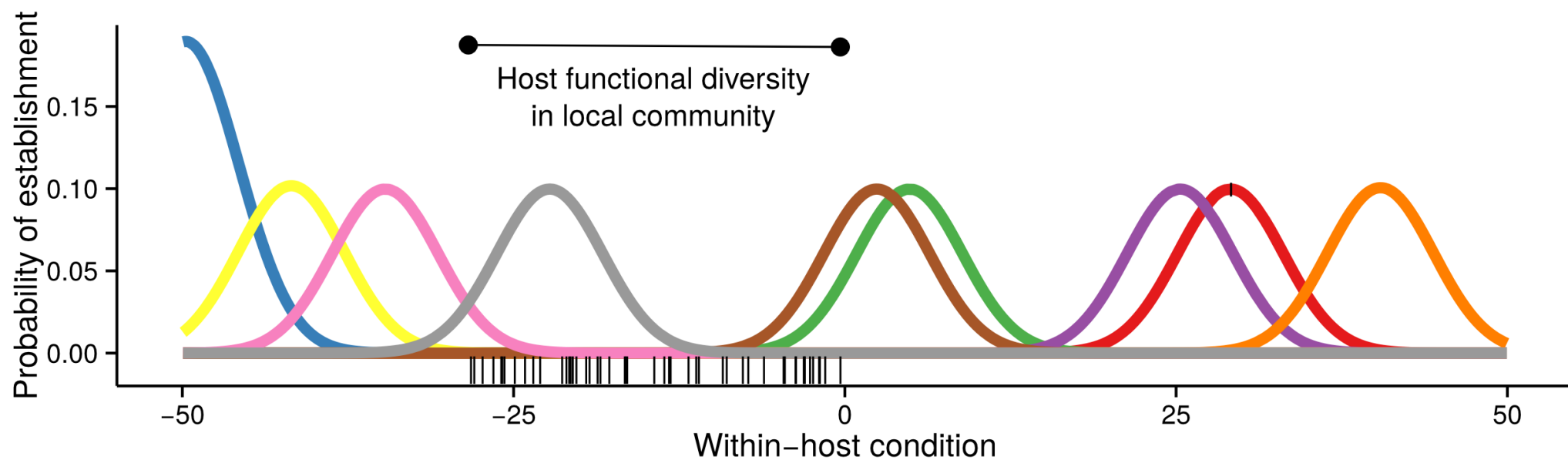
- Data availability
- Generality
- Explicit distinction between infection and disease

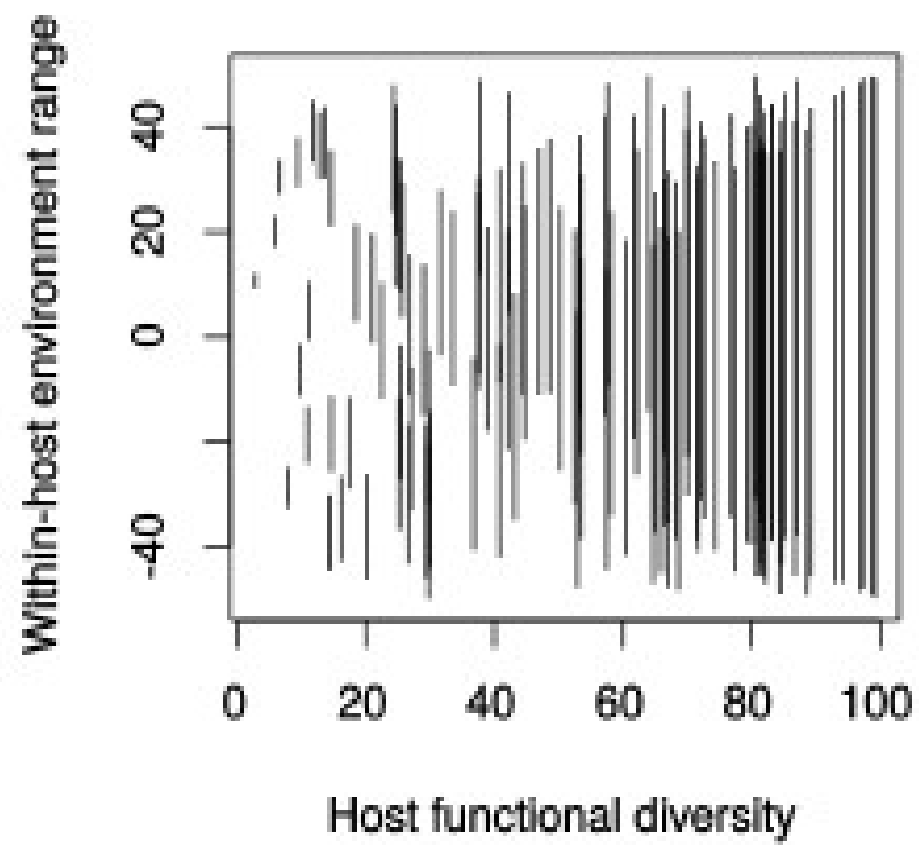


Analysis

Iteratively

- Vary host functional diversity

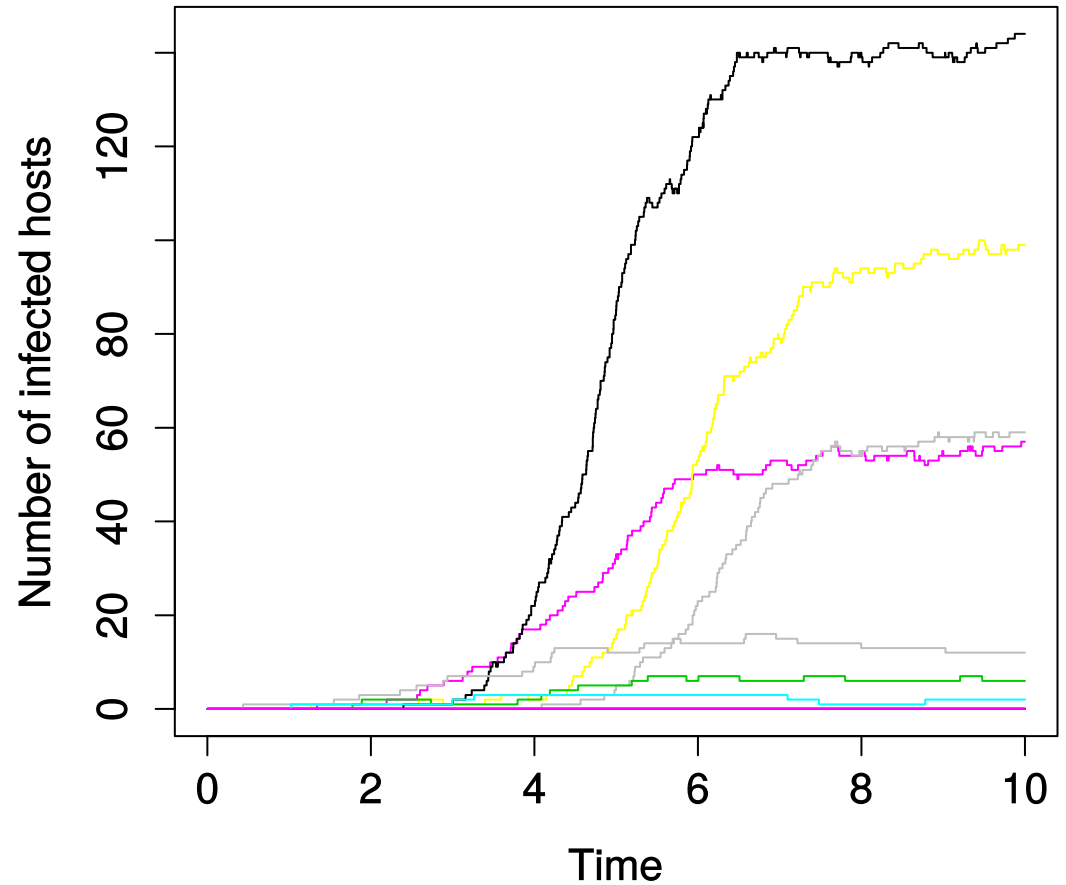




Analysis

Iteratively

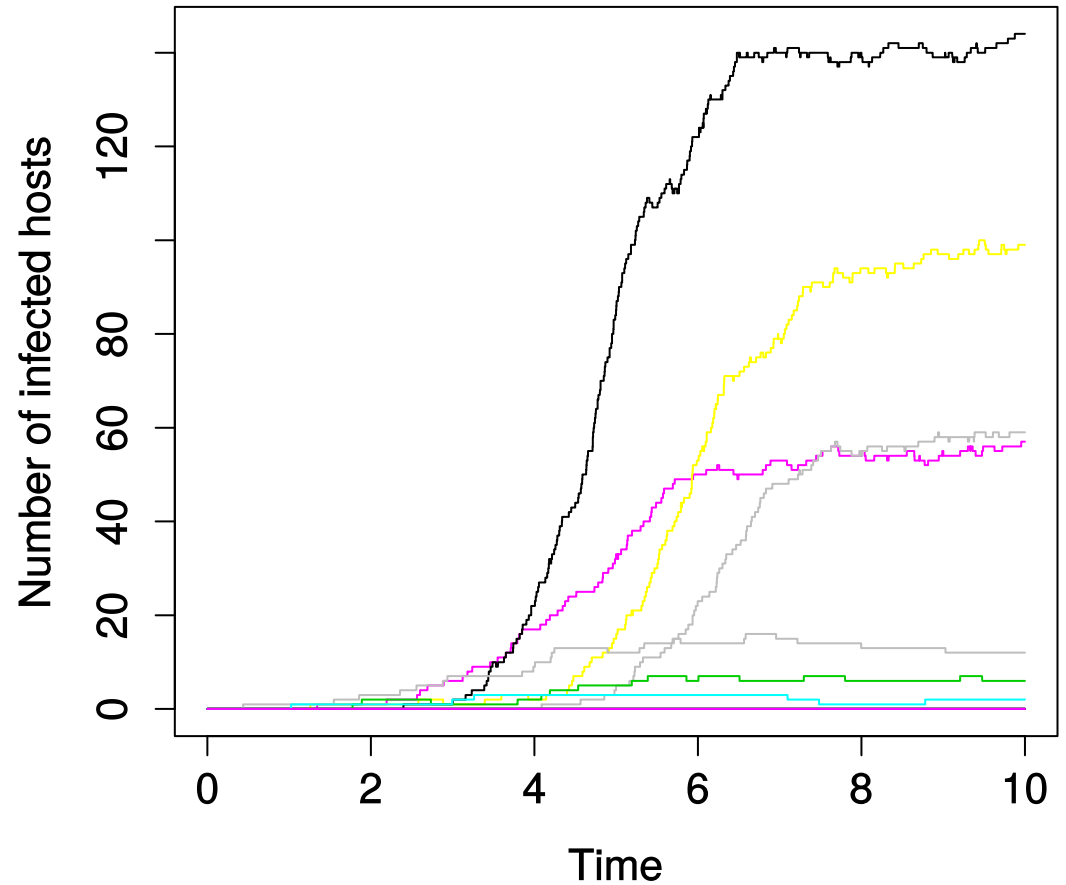
- Vary host functional diversity
- Simulate local infection trajectories



Analysis

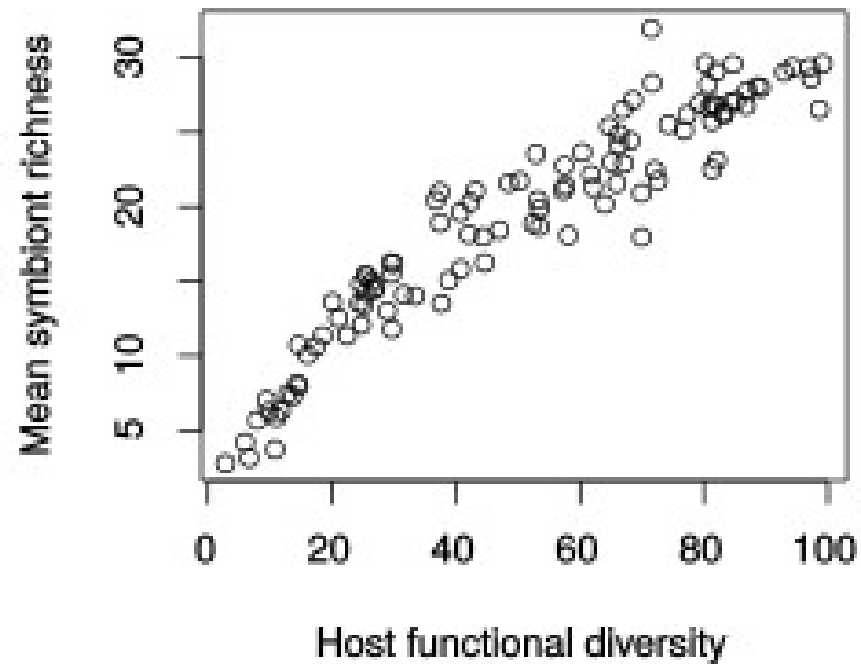
Iteratively

- Vary host functional diversity
- Simulate local infection trajectories
- Quantify symbiont richness and transmission



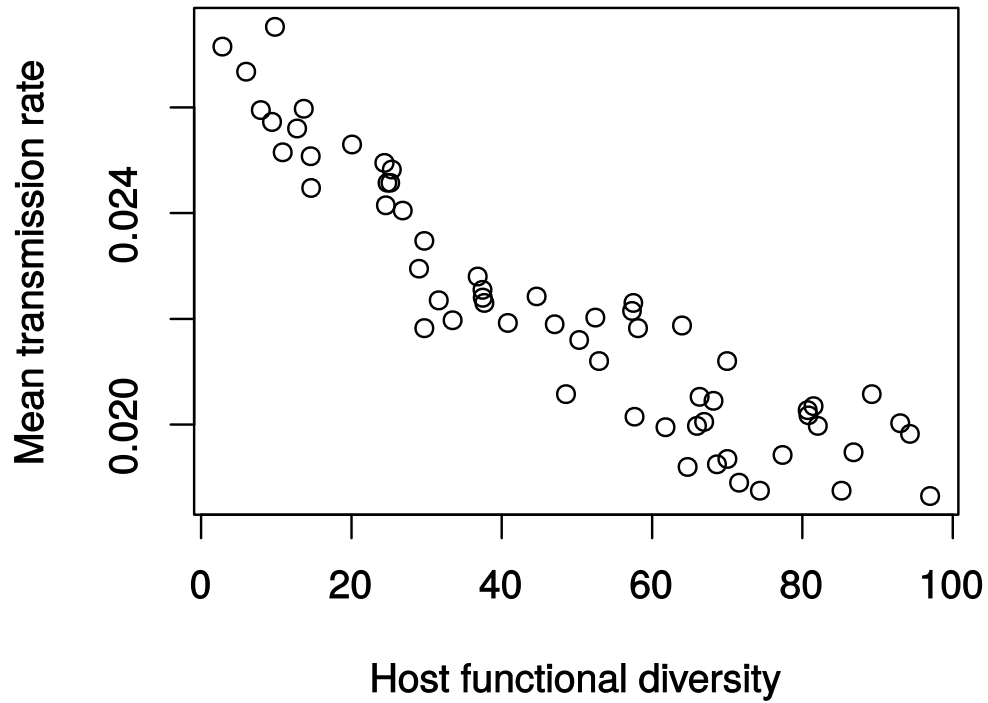
Results

Diversity begets diversity



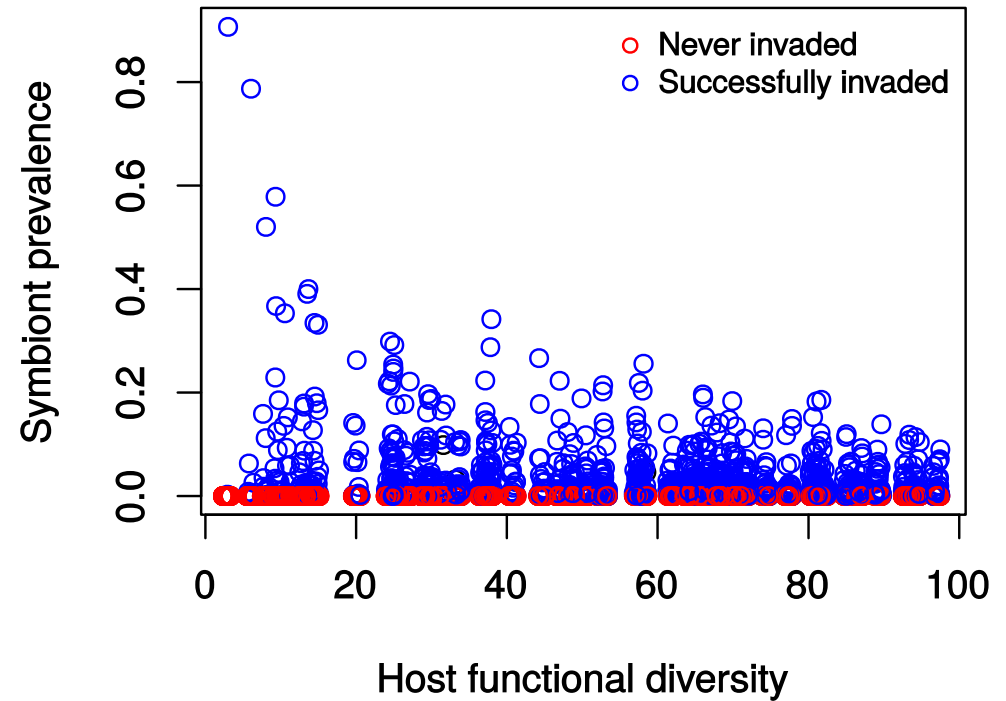
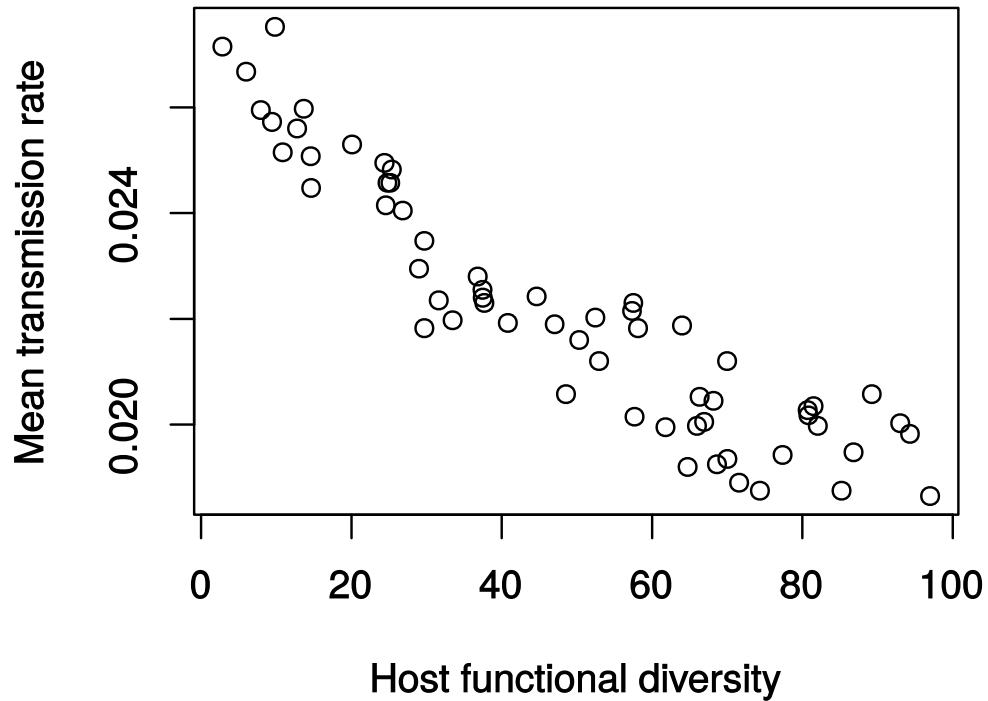
Results

Diversity reduces transmission

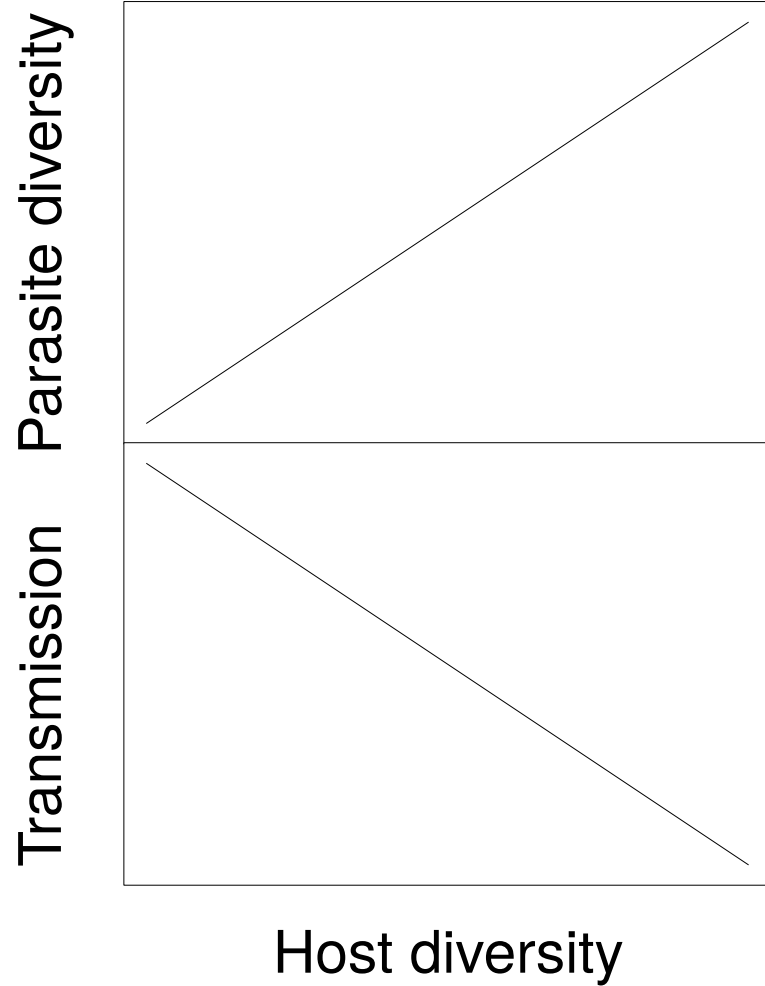


Results

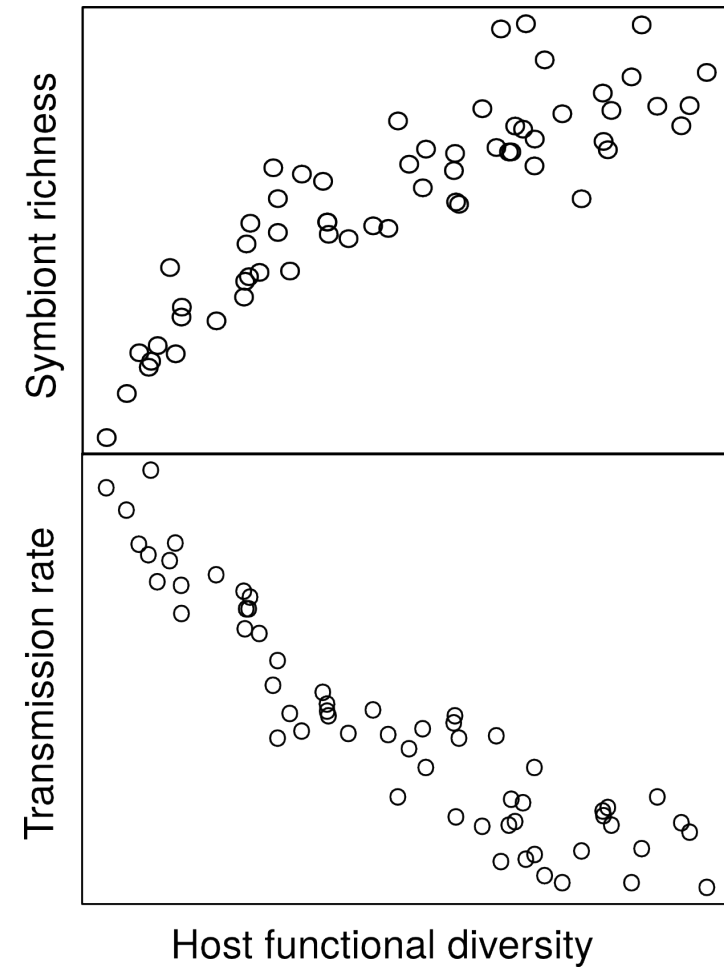
Diversity reduces transmission



Expectations



Results



Take home

Diverse host communities:

- Rich symbiont communities, lower prevalence

Depauperate host communities:

- Depauperate symbionts, high prevalence

What about disease risk?

Still important, but integrates many factors

- Focal host choice
- Transmission potential
- Exposure
- Diversity of infectious agents

i.e. more complicated than constituent parts

What about management?

- Management goals
 - High symbiont richness & low transmission or low symbiont richness & high transmission?

Parallels

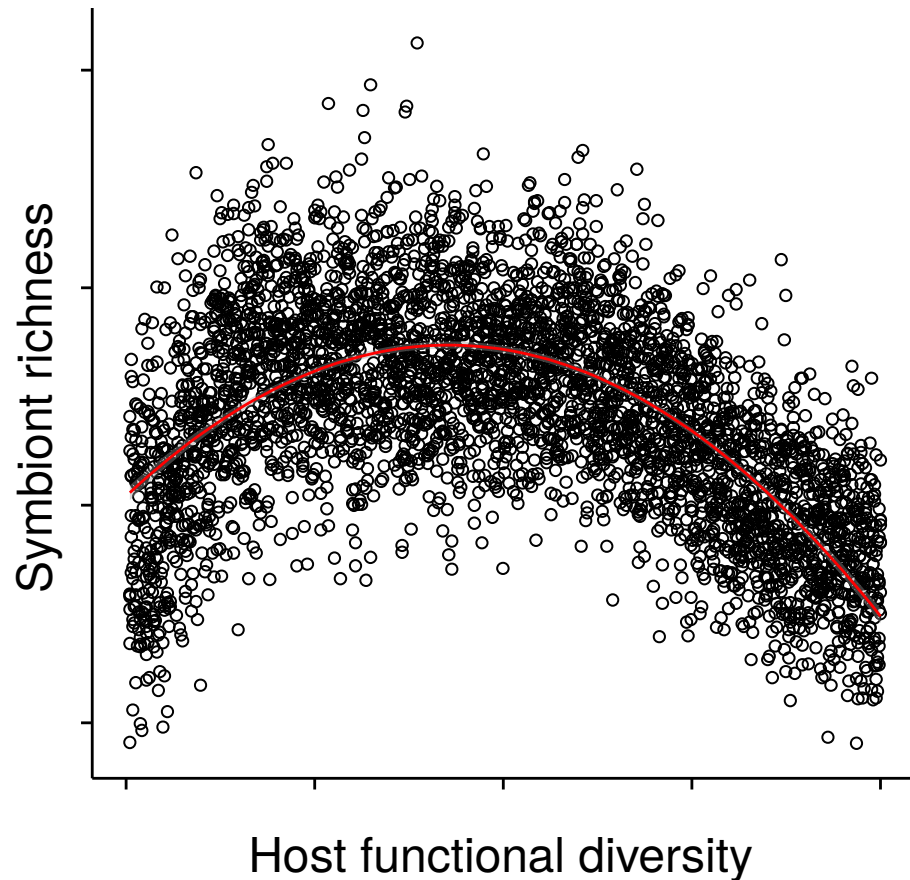
Habitat area-heterogeneity trade-off (Allouche et al. 2012)

Host abundance-diversity trade-off

Parallels

Habitat area-heterogeneity trade-off (Allouche et al. 2012)

Host abundance-diversity trade-off



Extremely high host diversity:

- low abundance of each host species
- larger pool of potential symbionts
- transmission and persistence unlikely following colonization

Thank you