Indirect effects in plant community ecology

"Apparent competition"

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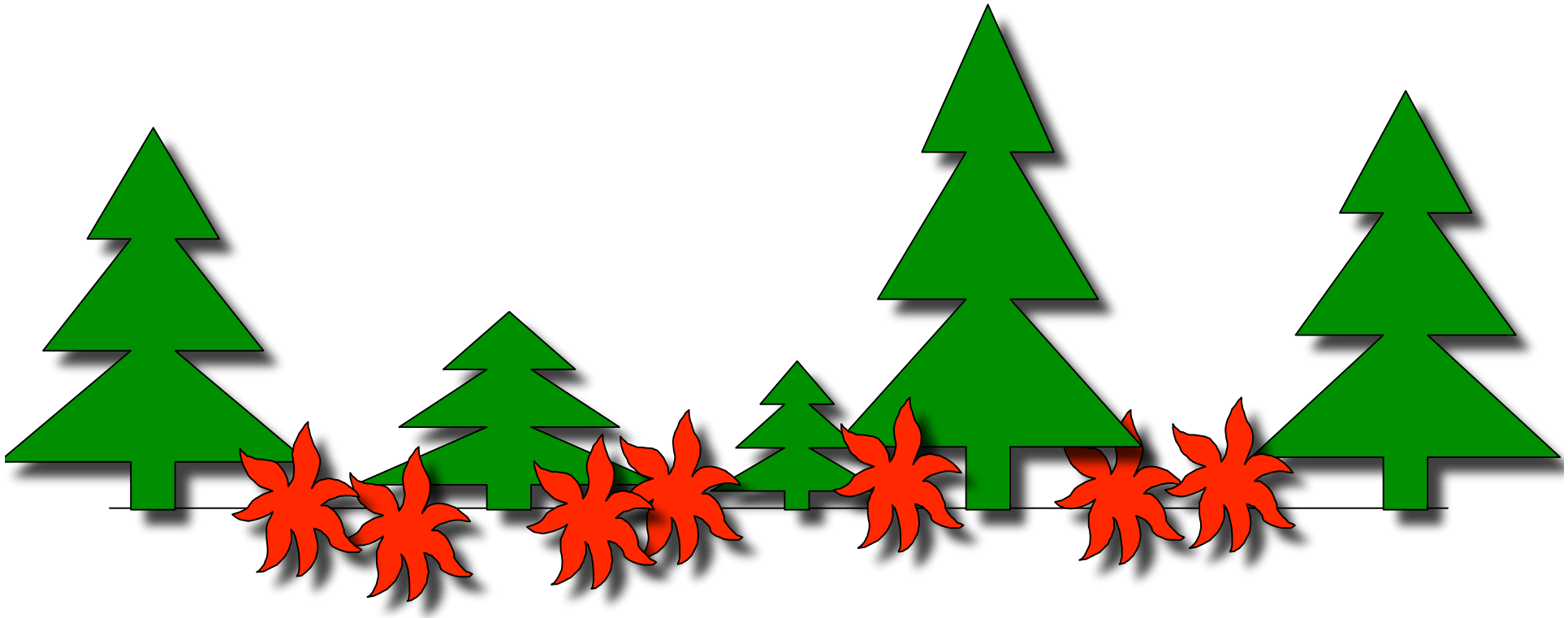
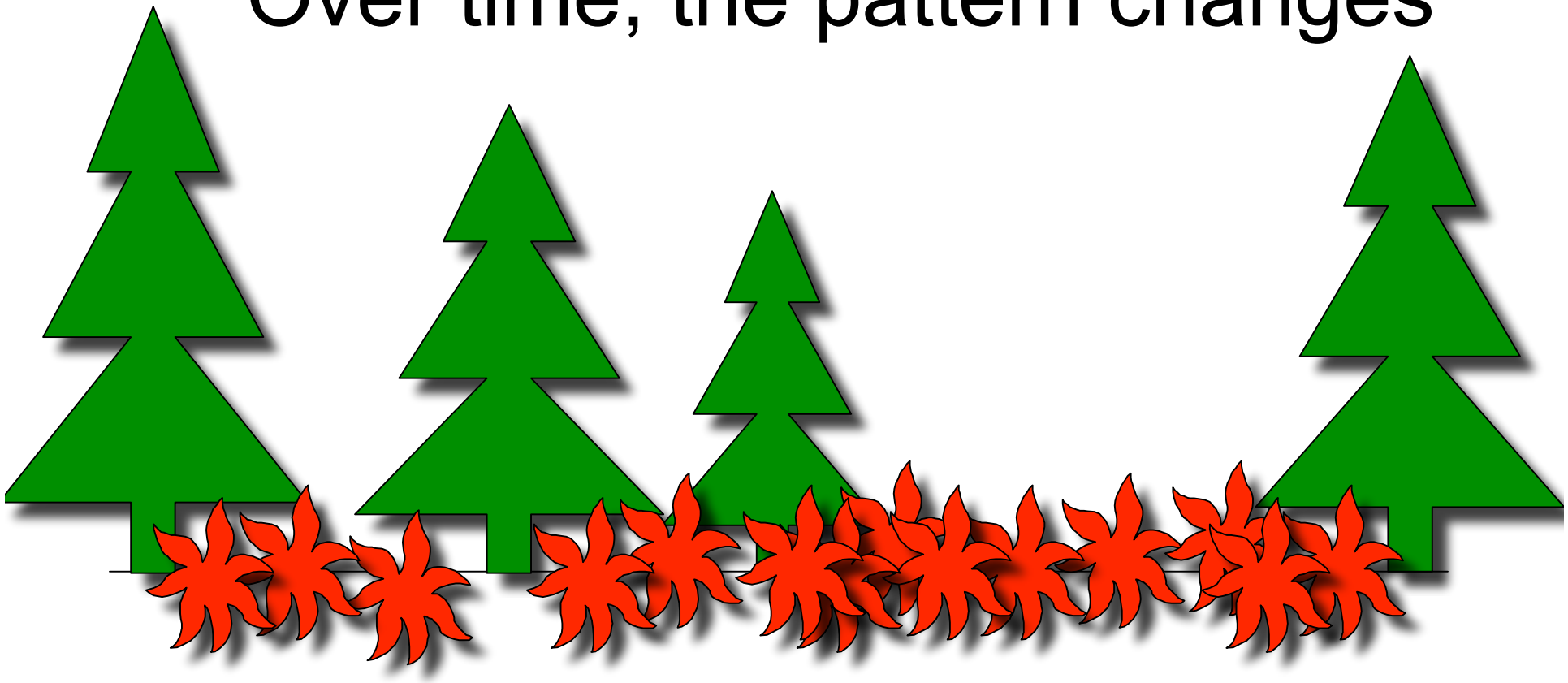
Consider this pattern



Over time, the pattern changes

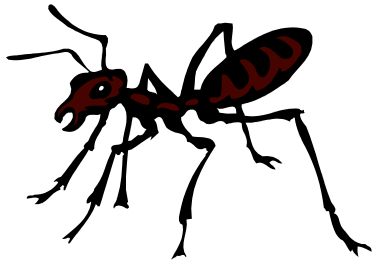


In ecology

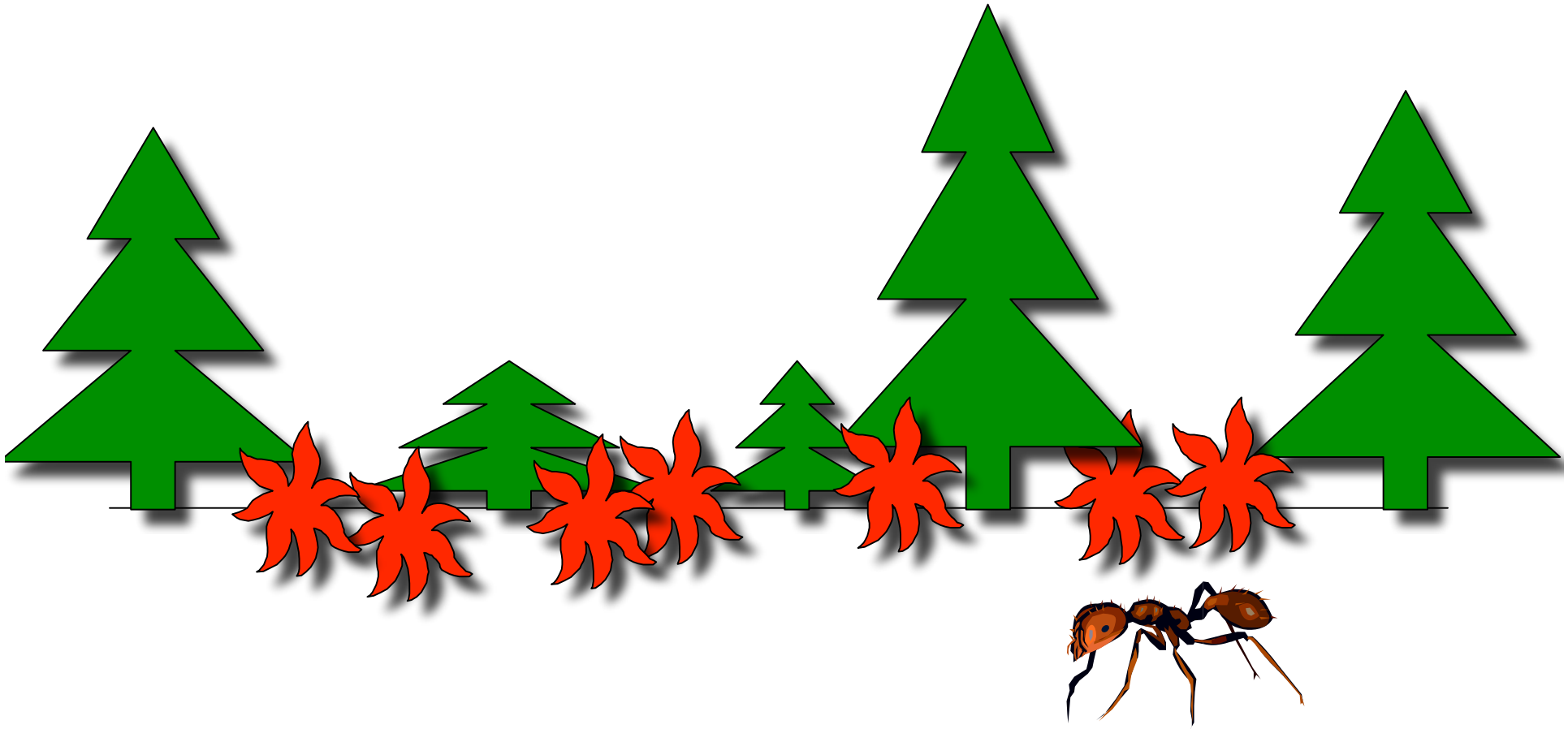
- Outcomes of **pairwise interactions** shape our thinking in community ecology e.g. competitive interactions and competitive hierarchies exist and the outcome is competitive exclusion (A>B) – linear or transitive

Indirect interactions?

- Multi-species interactions (A>B>C)



Ants harvest seeds



Indirect Interactions - Not a new idea

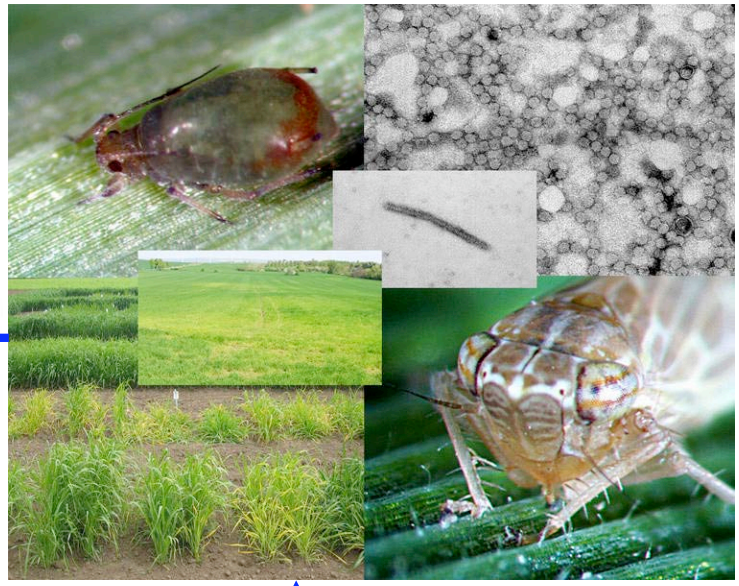
See reviews by:

- Strauss (1991) Indirect effects in community ecology: their definition, study and importance. *TREE* **6:** 206-210
- Wootton (1994) The nature and consequences of indirect effects in ecological communities. *Annu. Rev. Ecol. Sys.* **25:** 443-466

Gaining renewed interest:

- White et al. (2006) Biotic indirect effects: a neglected concept in invasion bioogy. *Diversity Distrib.* **12:** 443-455
- Meiners (2007) Apparent competition: an impact of exotic shrub invasion on tree regeneration. *Biol. Invasions* **9:** 849-855
- Seifan & Kadmon (2006) Indirect effects of cattle grazing on shrub spatial pattern in a mediterranean scrub community. *Basic and Applied Ecology* **7:** 496-506

Malmstrom et al. (2005) Invasive annual grasses indirectly increase virus incidence in California native perennial bunchgrasses. *Oecologia* **145,** 153-164



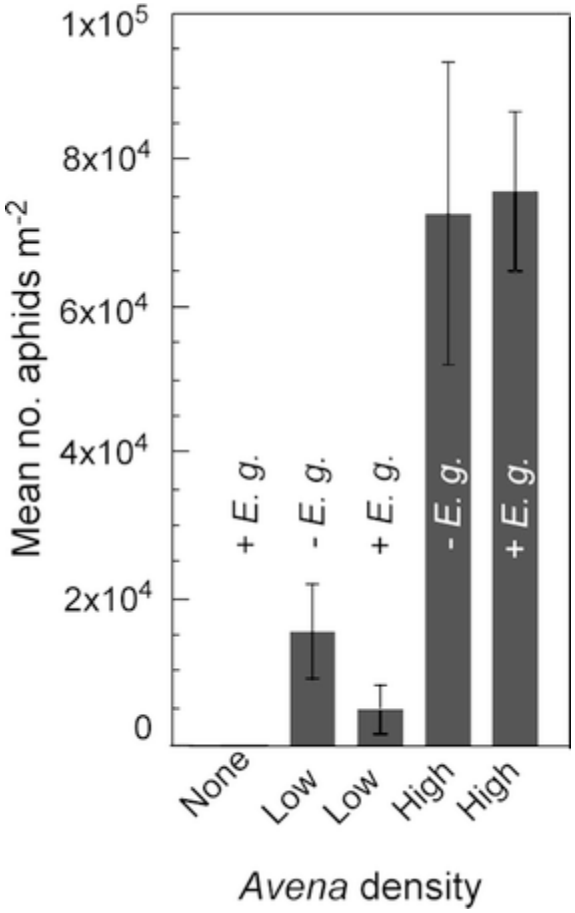


Fig. 2 Aphid densities in Yolo County experimental grass stands in late spring of the first growing season (April 2001). The five stand types are shown as a function of *Avena* density, with and without *E. glaucus (E.g.)*.
Means ± SEM, *n*=3.

▲ Aphid densities rose 50- to 800-fold when the exotic grass was present

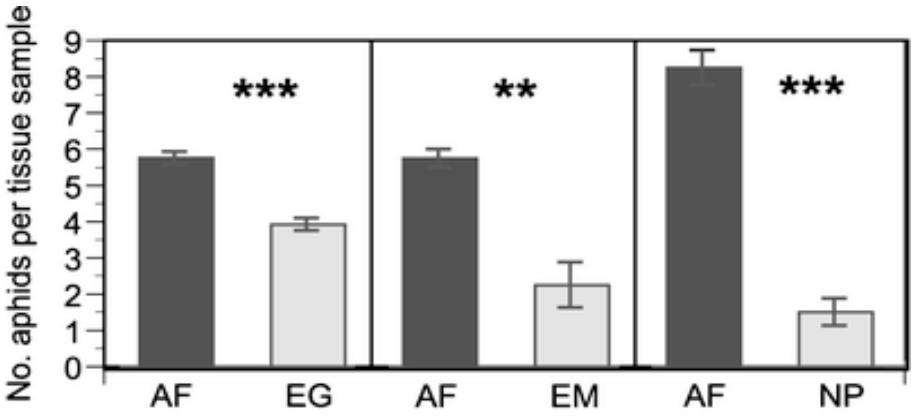
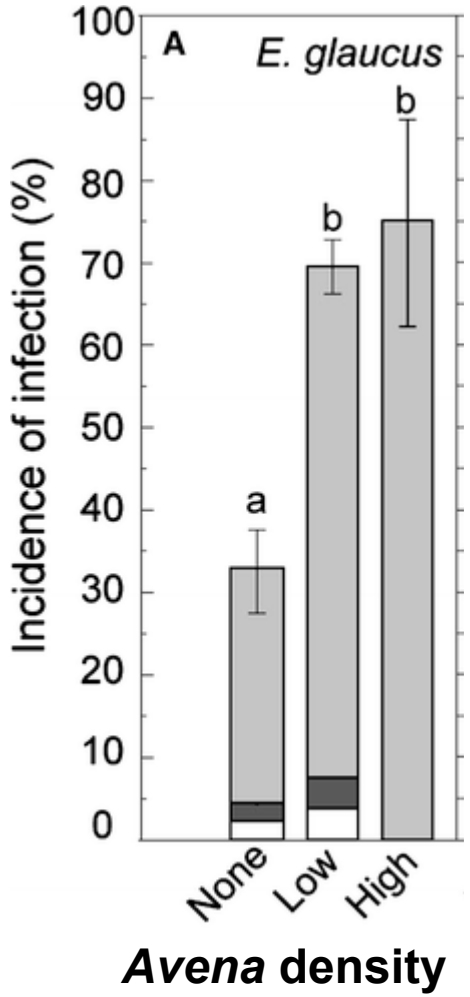


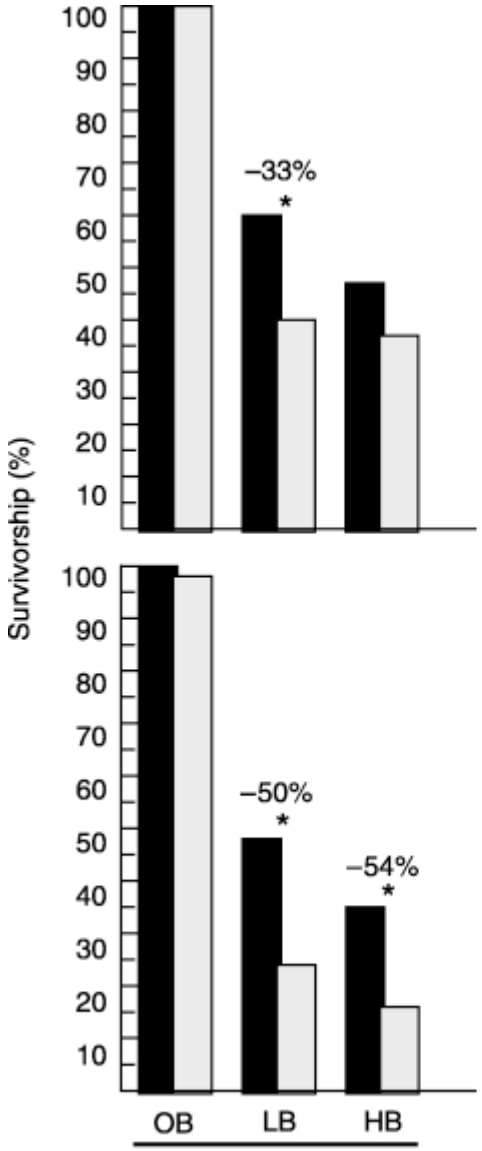
Fig 4. Feeding preference of *R. padi* apterous adults as determined in petri dish arenas with equal-area foliar tissue samples. Means ± SEM.

▲ Aphids preferentially select *Avena* as a host over native bunchgrasses in feeding trials

Fig. 1 Incidence of naturally acquired B/CYDV infection in Yolo County experimental grass stands in late spring of the second growing season (April 2002). Means ± SEM. **a** Incidence in *E. glaucus* grown with three densities of *A. fatua*.



▲The presence of *Avena* more than doubled the incidence of infection by B/CYDV



Malmstrom et al. (2006) *J.Ecol*. **94:** 264-275

Fig 1. Influence of virus infection on survival (%) of native bunchgrass seedlings, as a function of *Bromus* density (low, high)

Black bars (controls), gray bars (innoculated); percentages above bars indicate relative virus effects

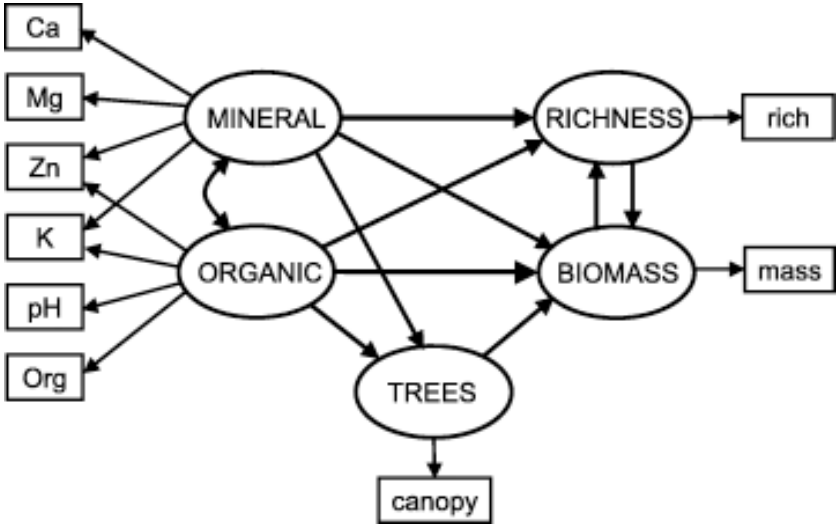
▲ Invasion impact is influenced by the capacity of exotic species to increase the pathogen load on native species with which they compete

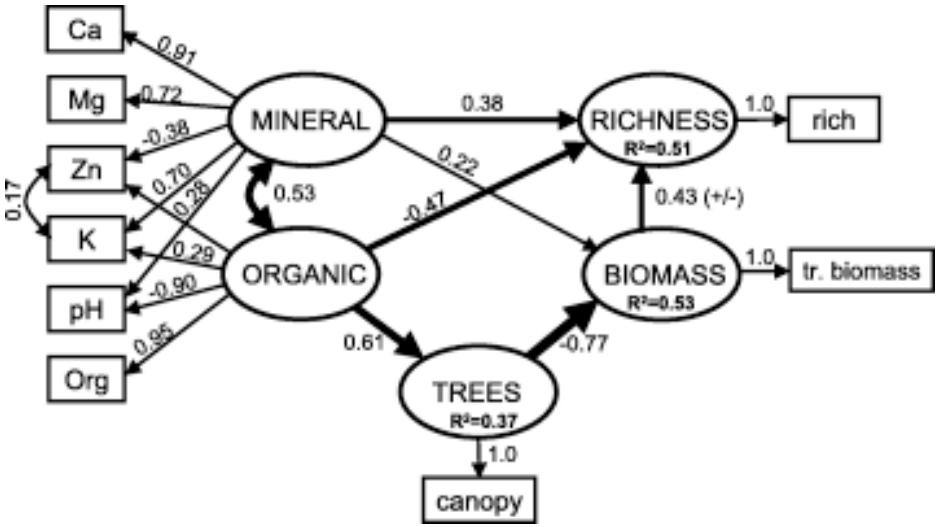
The way forward

- Path analysis? Builds on alternative causal hypotheses

- Scenario building of interactions in a multi-species community:

→ the degree to which changing a causal variable will affect a dependent variable through both direct and indirect pathways


Ca
Mg
Zn
K
pH
Org
MINERAL
ORGANIC
RICHNESS
BIOMASS
TREES
rich
mass
canopy


Ca
Mg
Zn
K
pH
Org
0.91
0.72
-0.38
0.70
0.28
0.29
-0.90
0.95
0.17
MINERAL
ORGANIC
0.53
0.38
0.22
-0.47
0.61
RICHNESS
R²=0.51
BIOMASS
R²=0.53
TREES
R²=0.37
-0.77
0.43 (+/-)
1.0
rich
tr. biomass
canopy