Types of disease

- **Infectious: a disease that is caused by a pathogen which can spread from a diseased to a healthy host.**

- **Non-infectious: a disease that is caused by an environmental or host factor. It is not spread between a diseased and healthy individual.**

Native vs. emergent

- Native: coexistence of pathogen, hosts, and host communities for long periods of time

- Emergent: diseases that suddenly become significantly prevalent or more relevant

“Native diseases”:

- Indigenous microbes
- Plant ecosystems have co-evolved to resistance
- Native diseases are an important component of forest ecosystems

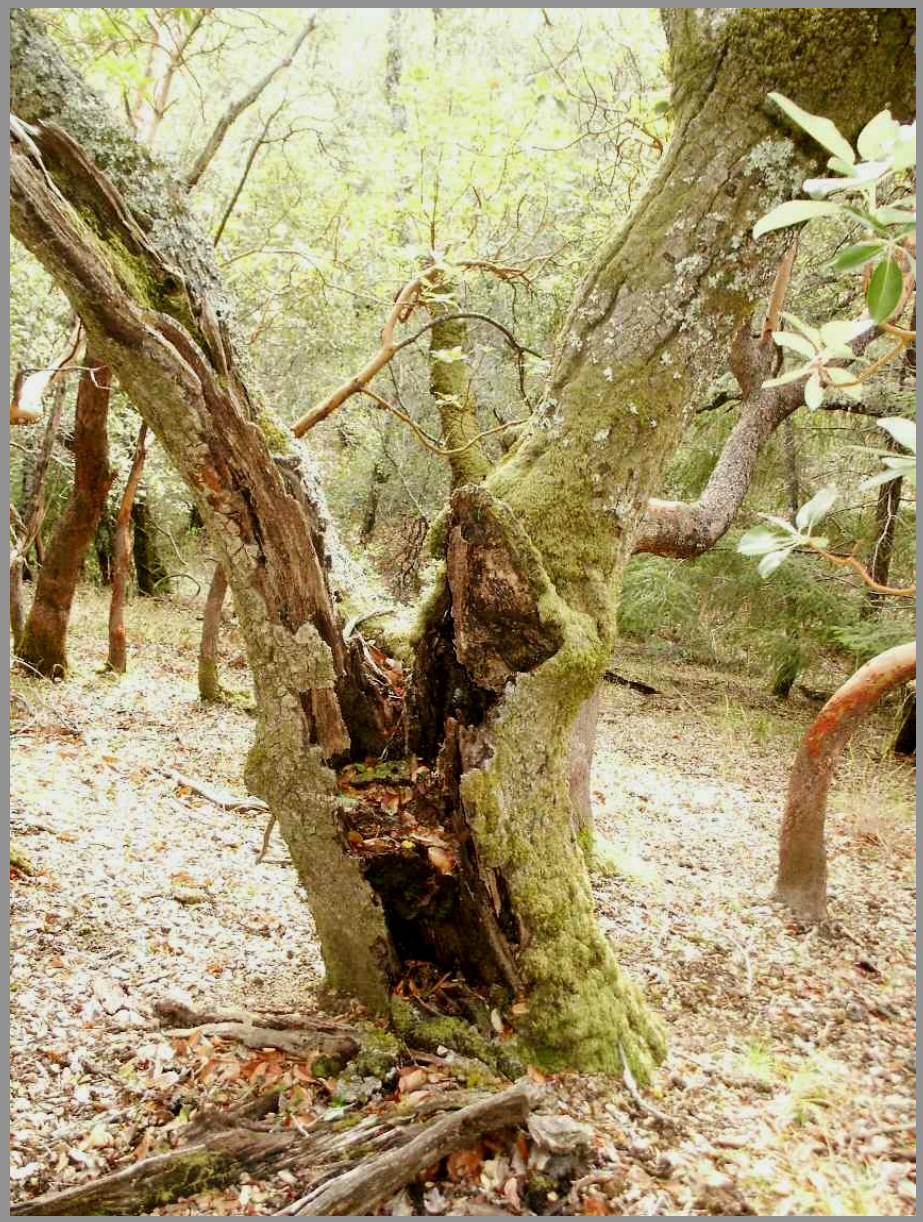
“Roles of native diseases”:

- Thin natural populations of trees
- Optimal allocation of resources
- Selection for a genetically diverse host population
- Maintain tree ranges
- Succession: nutrient cycling

Impacts of diseases
Individual trees

- **Reduced growth**
- **Reduced fecundity**
- **Plant death**

Scale:
From one
Tree…



Impacts of diseases

Influences on forest stand dynamics

- **Competition**
- **Succession**
- **Diversity**

Nutrient cycling

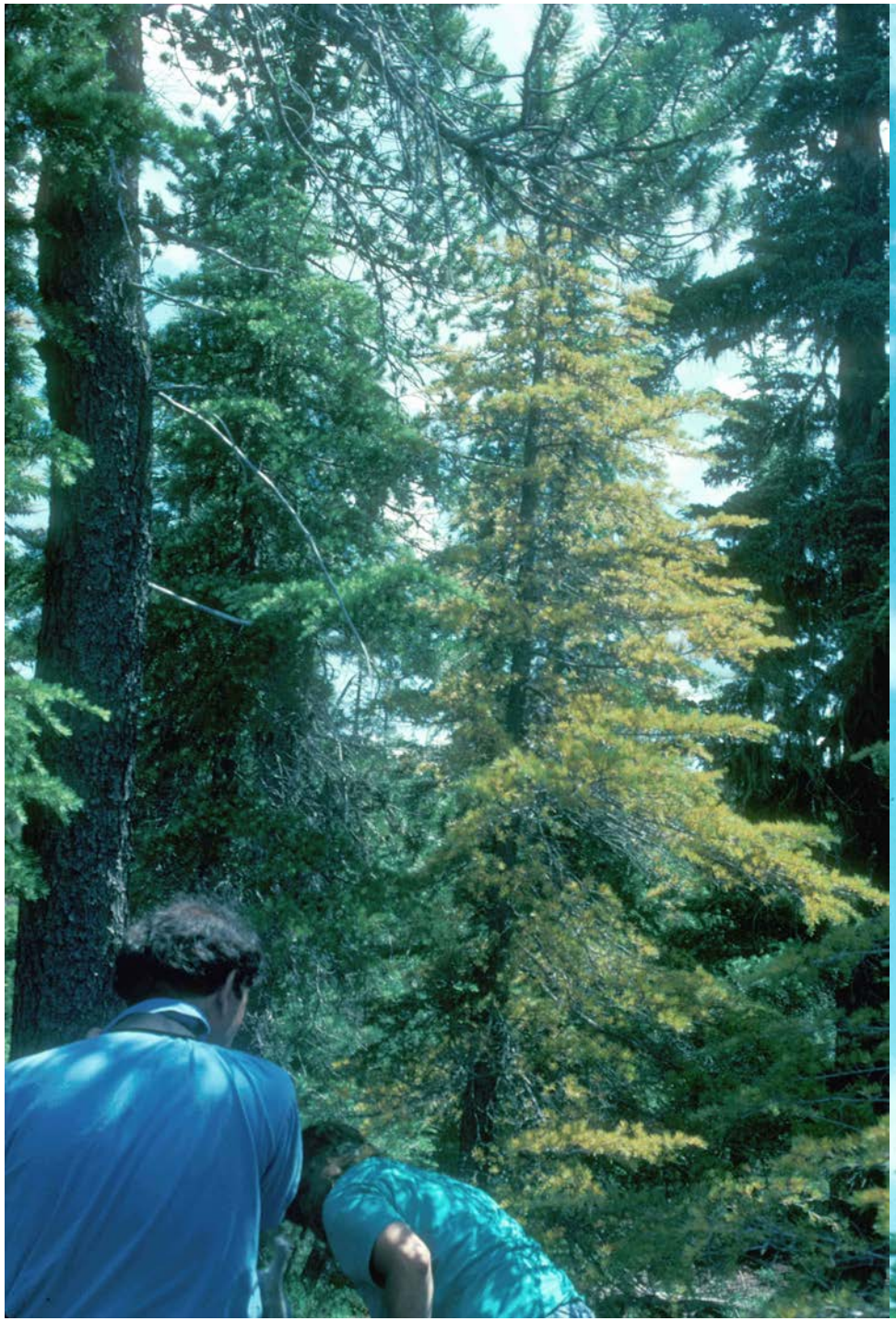
Fire

Habitat creation

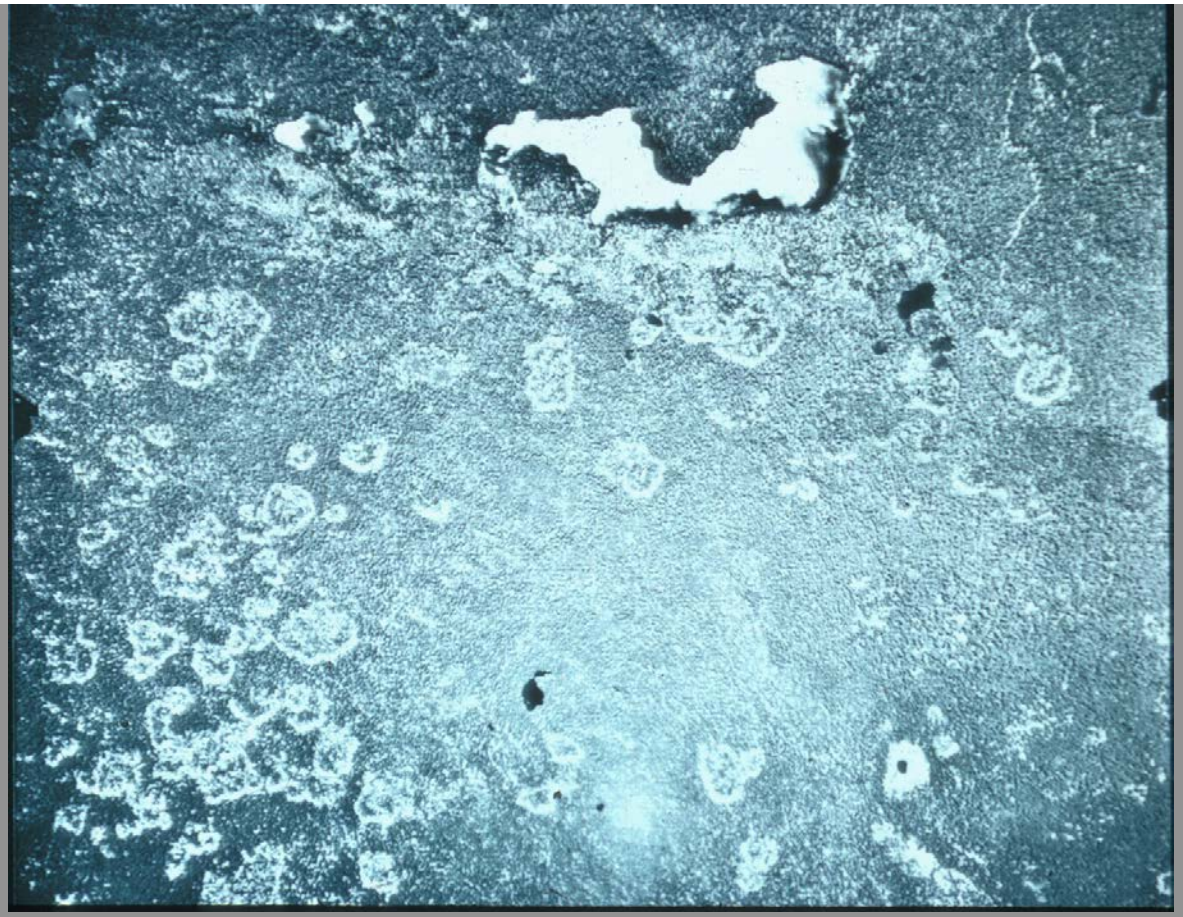
Mountain hemlock forest in Cascades of Oregon

Host: *Tsuga mertensiana*

Pathogen: *Phellinus weirii*



Regeneration of pines (firs, alder, etc.) in *P. weirii* infection center but not hemlock



GAP DYNAMICS: many factors play a role

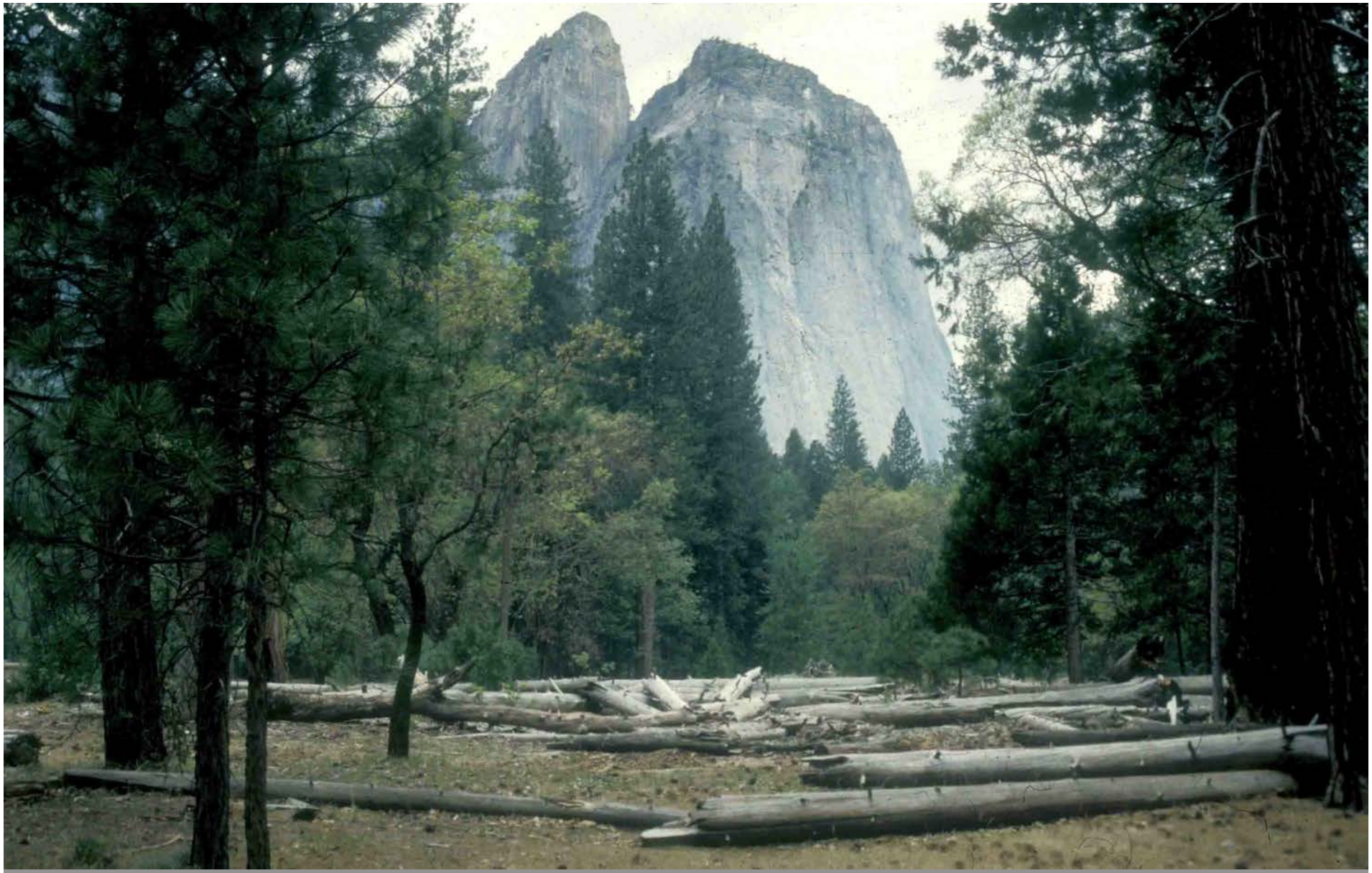
1- Often primary cause a pathogen

2- Secondary: insects---wind---fire

3- Gaps means light and space available for regeneration

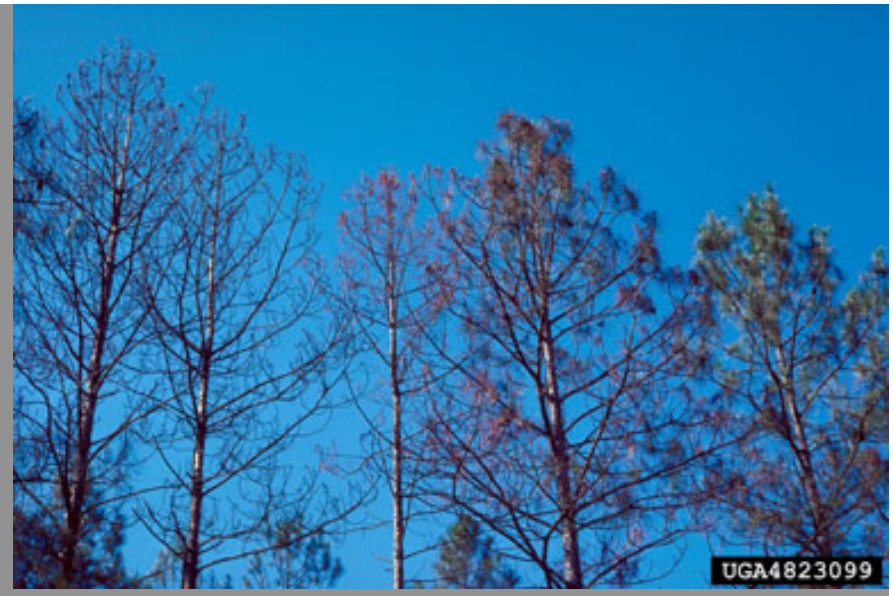
4- If pathogen is host specific then successional change

5- Fungal pathogens also good decomposers: nutrient recycling



Root Rots: Symptoms

- Thinning of crown
- Chlorosis
- Resinosis
- Distress cone crops
- Reduced Growth



Tree mortality

- Girdling of cambium
- Loss of roots
- Wind-throw
- Insect (Bark Beetle)

Spread

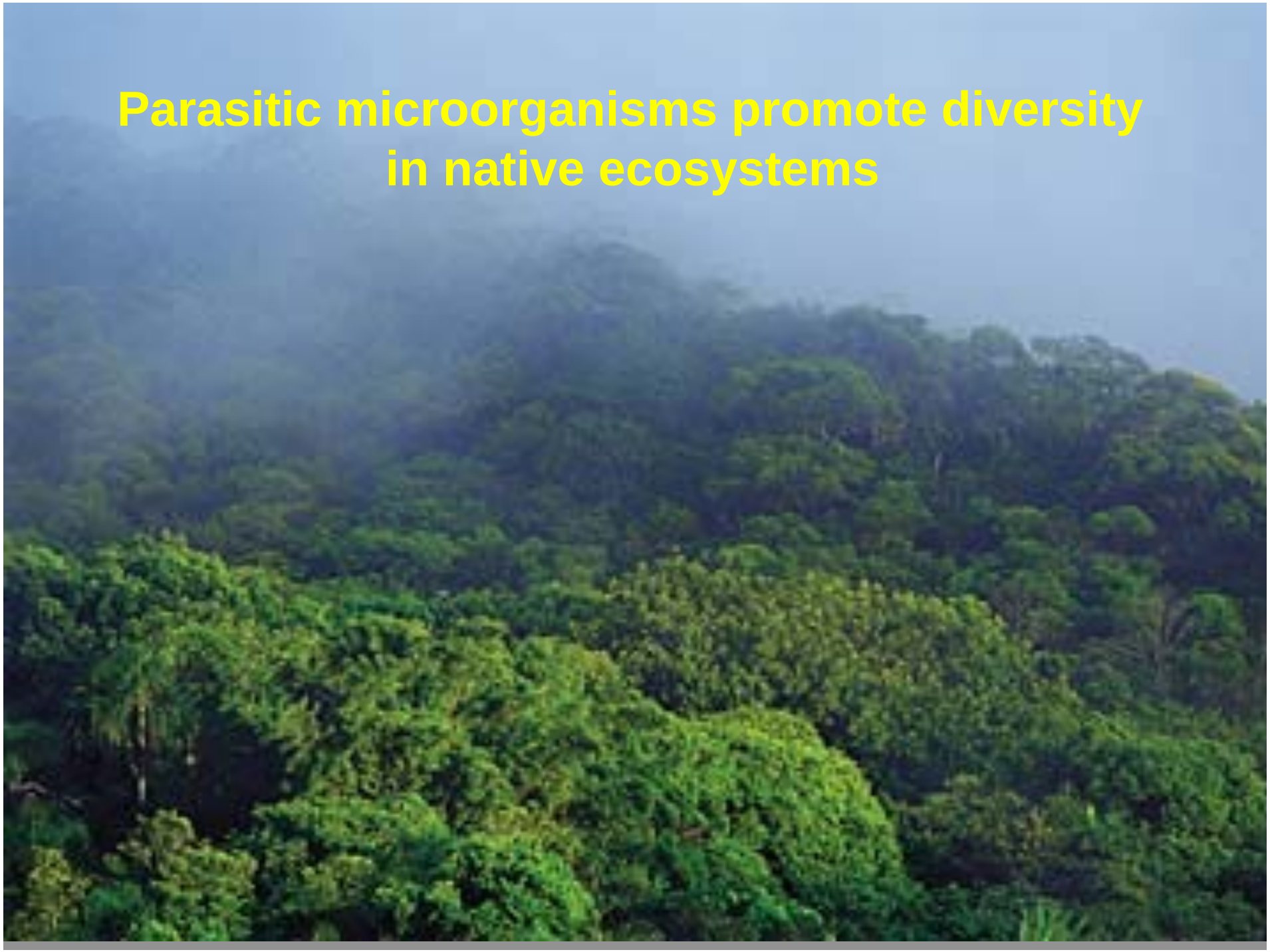
- From original infection, disease moves to susceptible adjacent trees by mycelial growth through root to root contact
- Results in a slowly enlarging disease center
  - Characterized by oldest mortality in the center, new mortality, and surrounding border of declining hosts

Root Disease Centers

- **Only a few trees, or multiple hectares**
  - **Pathogen Species**
  - **Host species**
  - **Host Size**
  - **Environmental and stand conditions**
- **Through alternation of parasitic and saprobic stages, root diseases persist over time and spread across the landscape in slowly expanding gaps**

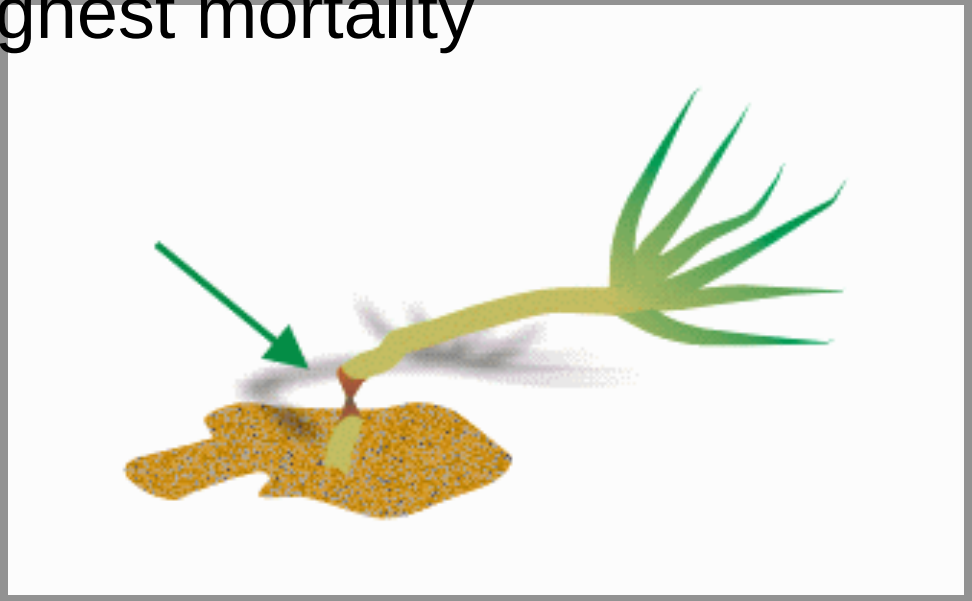
How do native diseases enhance diversity

- If host-specific, diversity is enhanced
- If resistance to pathogen is quantitative, there will be an interaction between microhabitat and fitness, plants that are not as healthy will be taken out early, increasing system productivity in the long run
- Even if plant specifically resist pathogen, R gene has a cost and even if strongly selected, almost never is it exclusively selected
- Mother contagious to progeny: Janzen-Connell

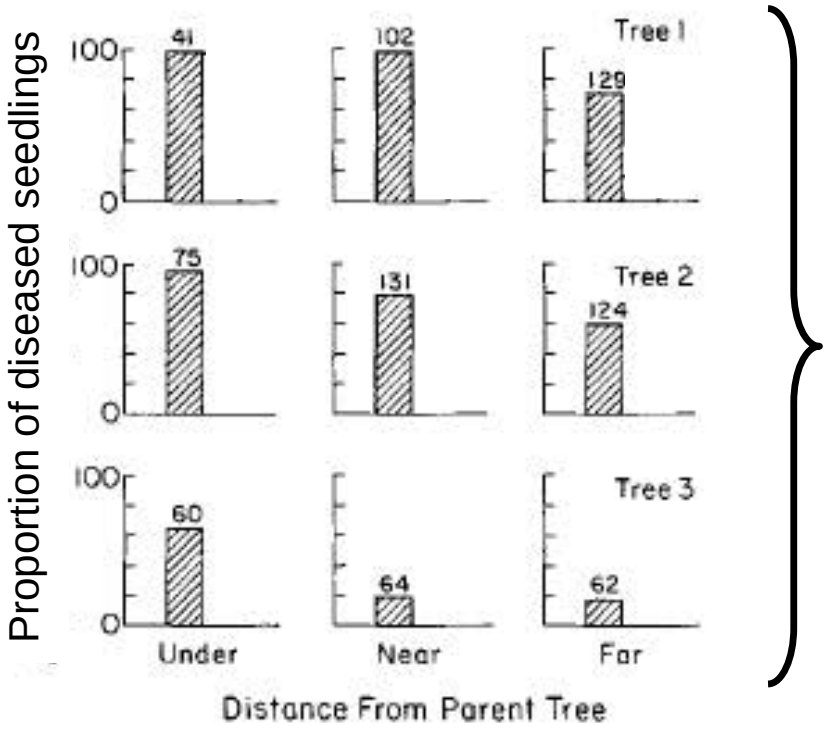

Parasitic microorganisms promote diversity
in native ecosystems

Seed → **Seedling** → **Sapling** → **Mature tree**

Highest mortality



Damping-off



Lower mortality away from parent tree

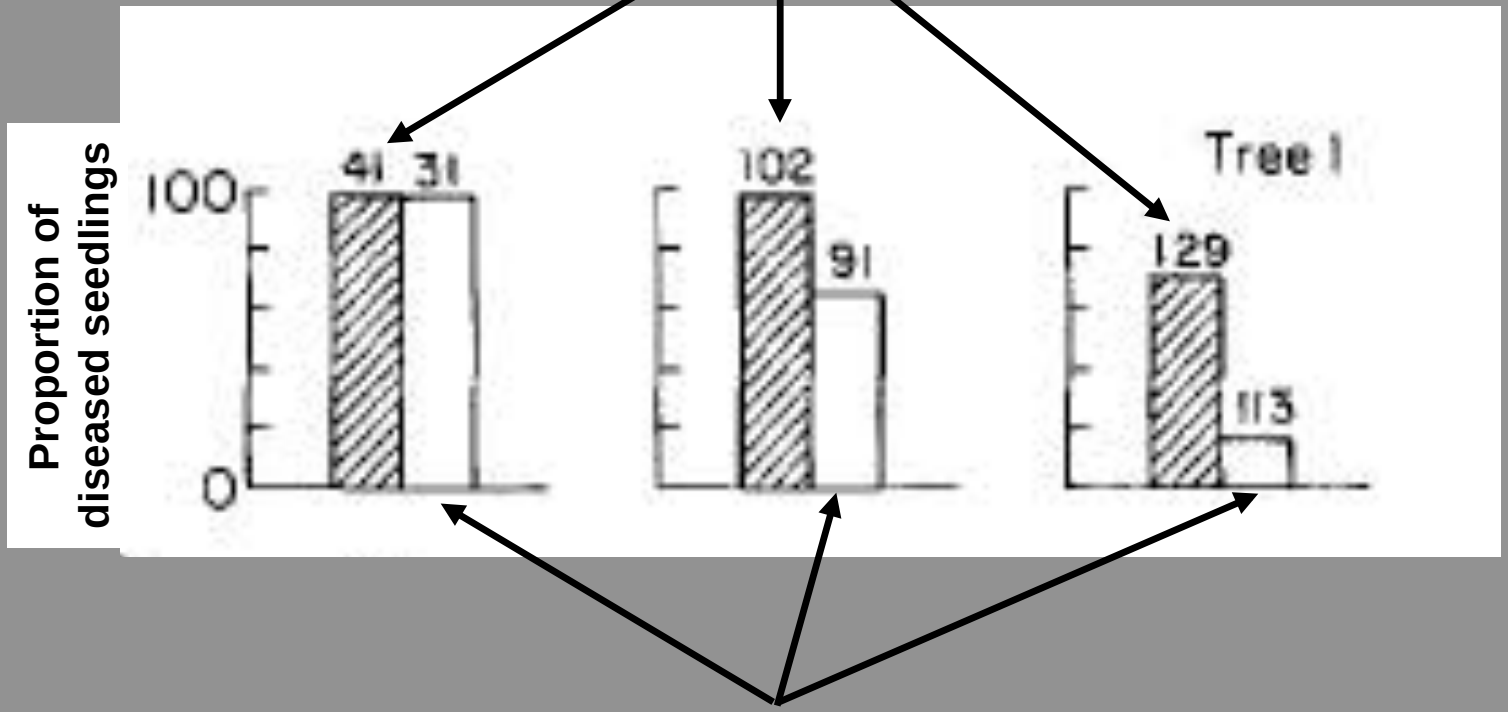
Fig. 2. The proportion of seedlings of *Platypodium elegans* dying from damping-off disease in the distance-density experiment. Values represent totals summed for 4 replicates of a given treatment. The total number of seeds germinating is given above each bar. Shaded bars represent high density quadrats; unshaded bars represent low density quadrats

Pathogen mortality of tropical tree seedlings: experimental studies of the effects of dispersal distance, seedling density, and light conditions

Carol K. Augspurger and Colleen K. Kelly
Department of Plant Biology, University of Illinois, Urbana, IL 61801, USA

Oecologia (Berlin) (1984) 61:211–217

High density

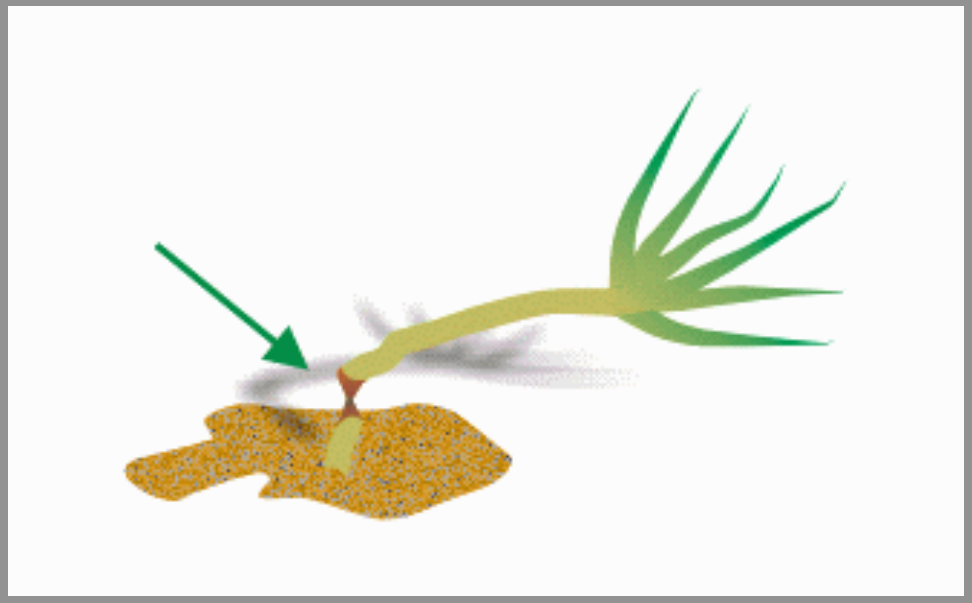


Low density

Significant effect of density only away from the parent

Significant interaction

Why does seedling density affect the incidence of damping-off?



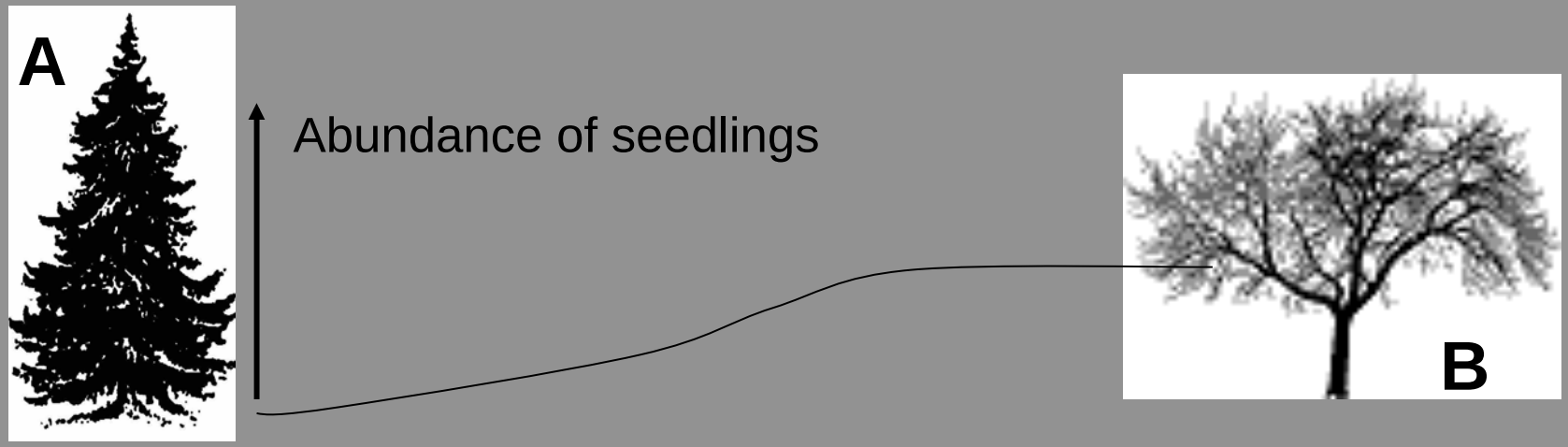
Infected seedlings are a secondary source of inoculum

***Pythium* spp.**

Conclusion:

Plant pathogens cause seedling mortality that is inversely proportional to distance from parent

If: Pathogens are host-specific

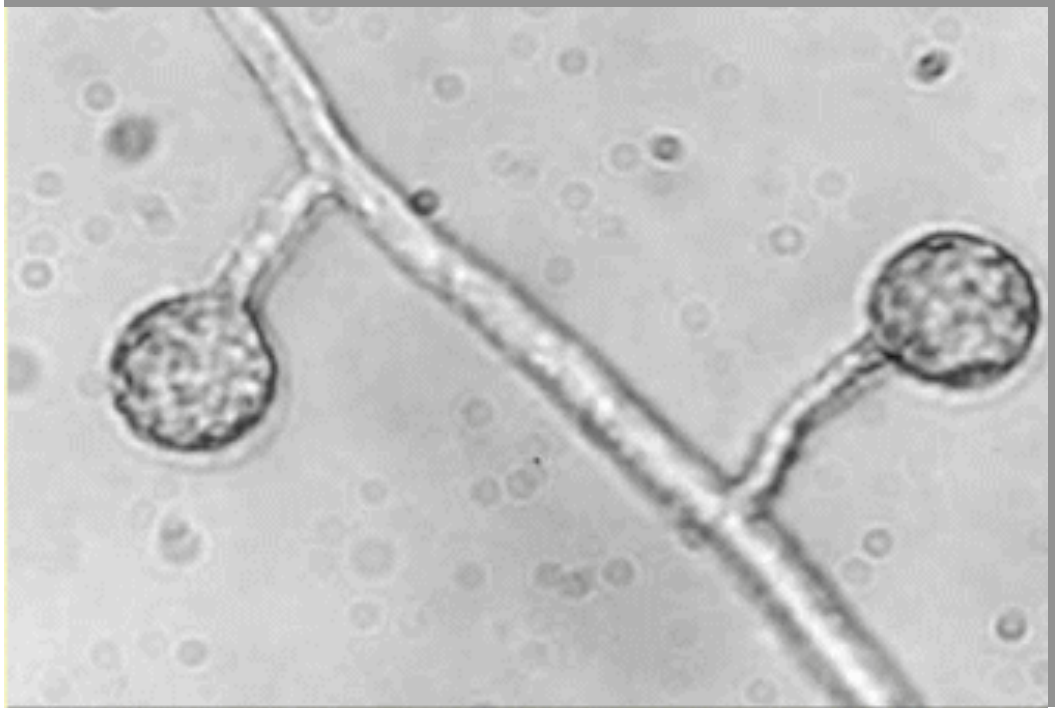


Conclusion:

Plant pathogens cause seedling mortality that is inversely proportional to distance from parent

If: Pathogens are host-specific

Non- host species are favored



More Ecology of Forest Diseases (Gilbert 2002)

- Density Dependence
- Counterweights to numerical effects
- Disease and competition
- Dispersal and Local Adaptation

Density Dependence

- Most studies have shown a positive relationship between density and disease incidence
  - Shorter distance to be covered
  - Potentially limiting resources
  - However there are examples that show a different pattern, in particular for diseases that are vectored, and for diseases that require an alternate host

Counterweights to numerical effects

- Disease = damage, but communities will compensate
  - Disease reduced number and size of survivors, but at maturity disease-infested plots had the largest trees
  - Survivors produce more seed
- Cross generational effects
  - Diseased mothers will produce inferior seed
  - Diseased mothers will generate progeny that is more resistant to that disease

Disease and Competition

- More competition = more stress=more disease
- Disease reduces competitivity, by reducing growth and ability to use light. Effect is larger than damage
- Apparent Competition: a generalist pathogen reduces growth of two hosts, but allows for the second host to coexist
- Soil feedbacks: Negative feedbacks: build-up of soil pathogens with growth of same species (reason behind need for crop rotation. The more limited the dispersal of the pathogen, the stronger the effect (that's why effect is measurable for soil pathogens). The more important sexual reproduction is in hosts , the slower theeffect