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
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
Proportion of diseased seedlings

Lower mortality away from parent tree

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

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Proportion of diseased seedlings

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 competitiveness, 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 the effect