

# The Influence of Soilborne Pathogens on Seedling Mortality

Eric Sodja  
Dr. Noelle Beckman

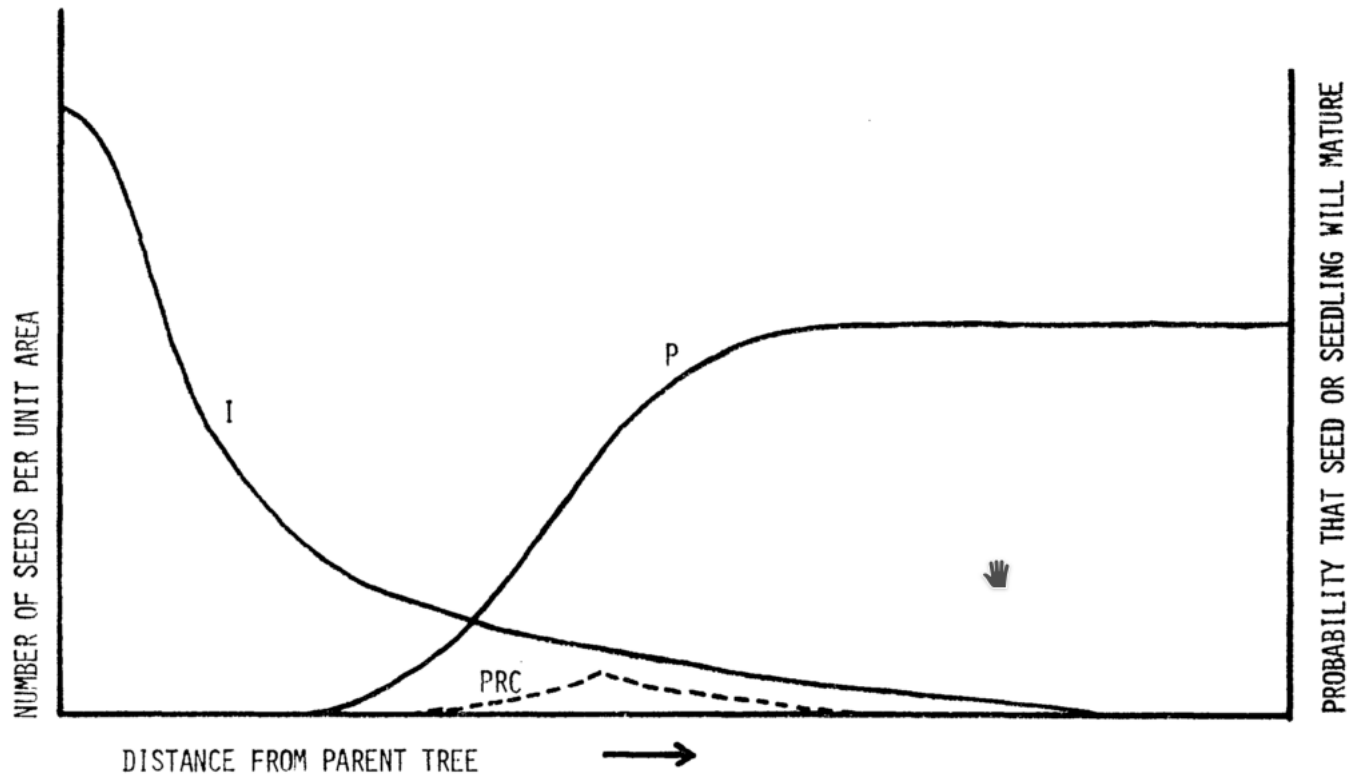


# Diversity

- **One of the fundamental questions of ecology**
- **Proposed contributors:**
  - Habitat complexity
  - Niche differentiation
  - Specialized predators and pathogens



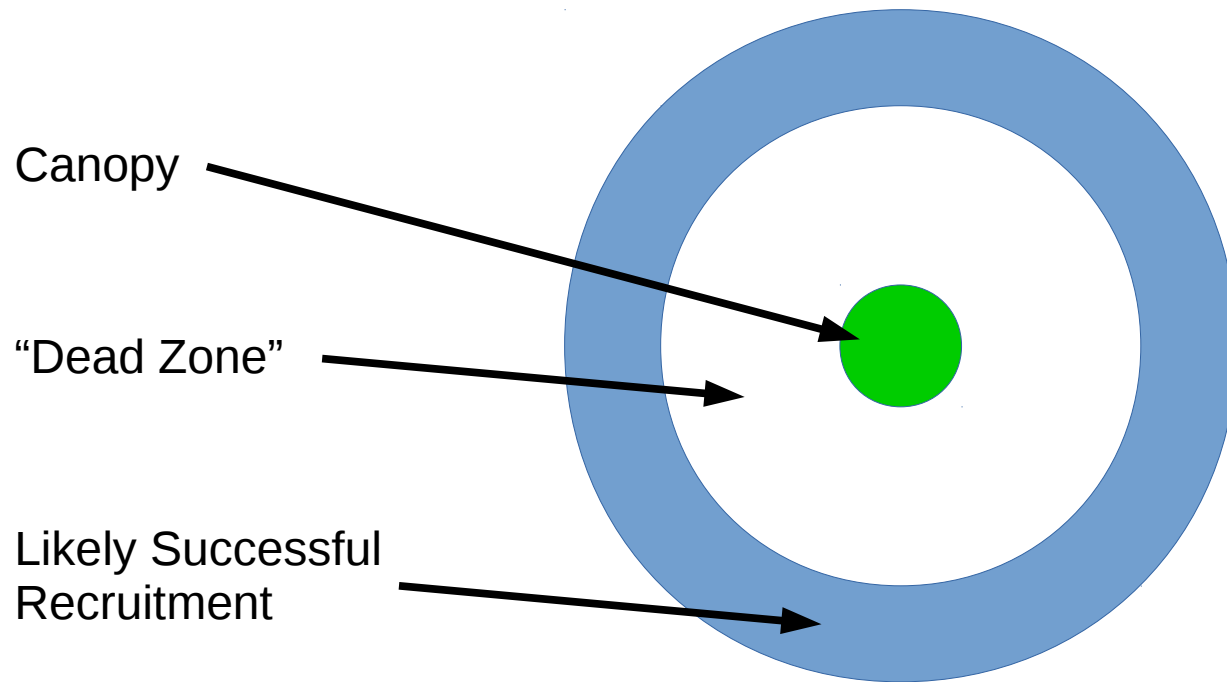
# Janzen-Connell Effect



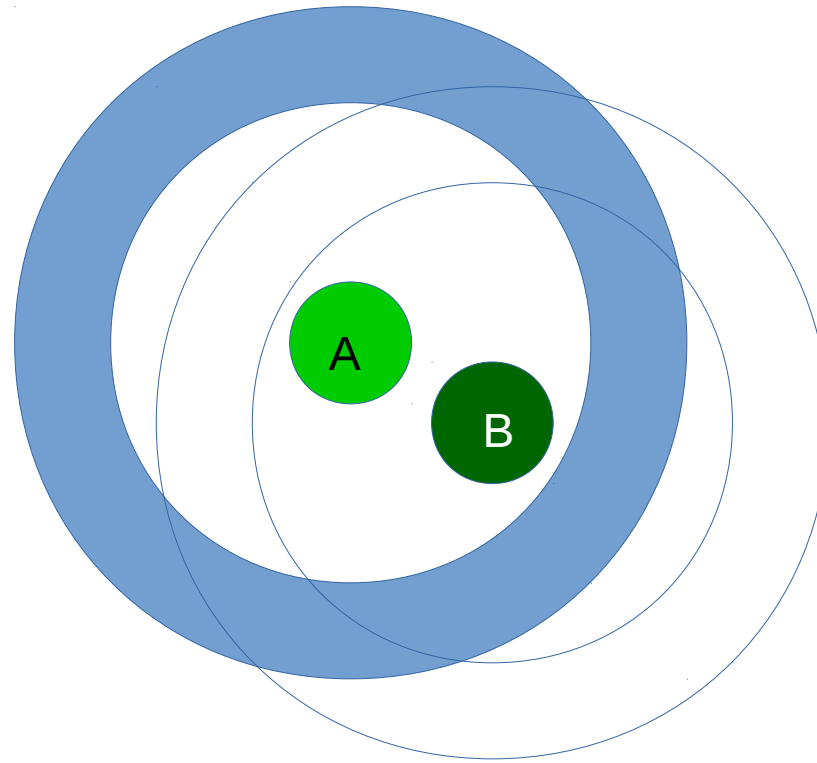
(Janzen, 1970)



# Janzen-Connell Effect



# Janzen-Connell Effect



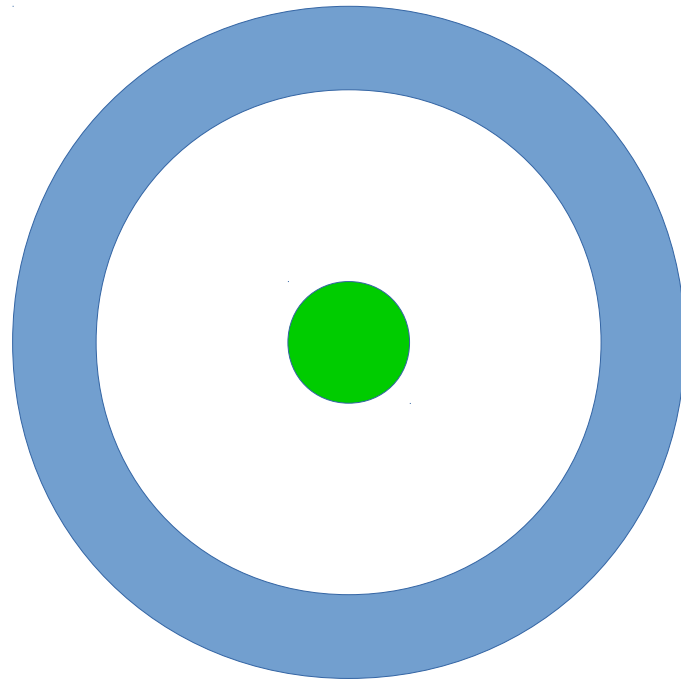
The “Dead Zone” of species A opens a gap for species B



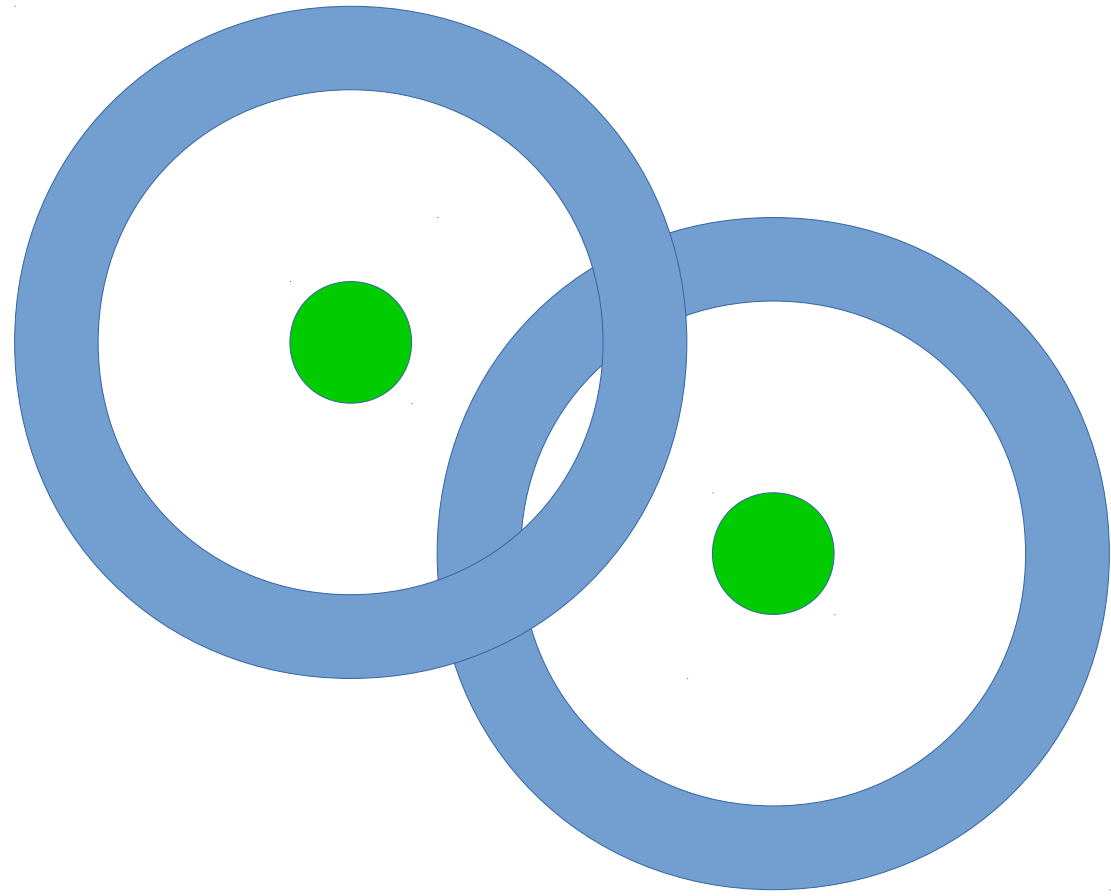
**How do emergent patterns at the population level affect patterns of seedling recruitment?**



# Emergent Patterns

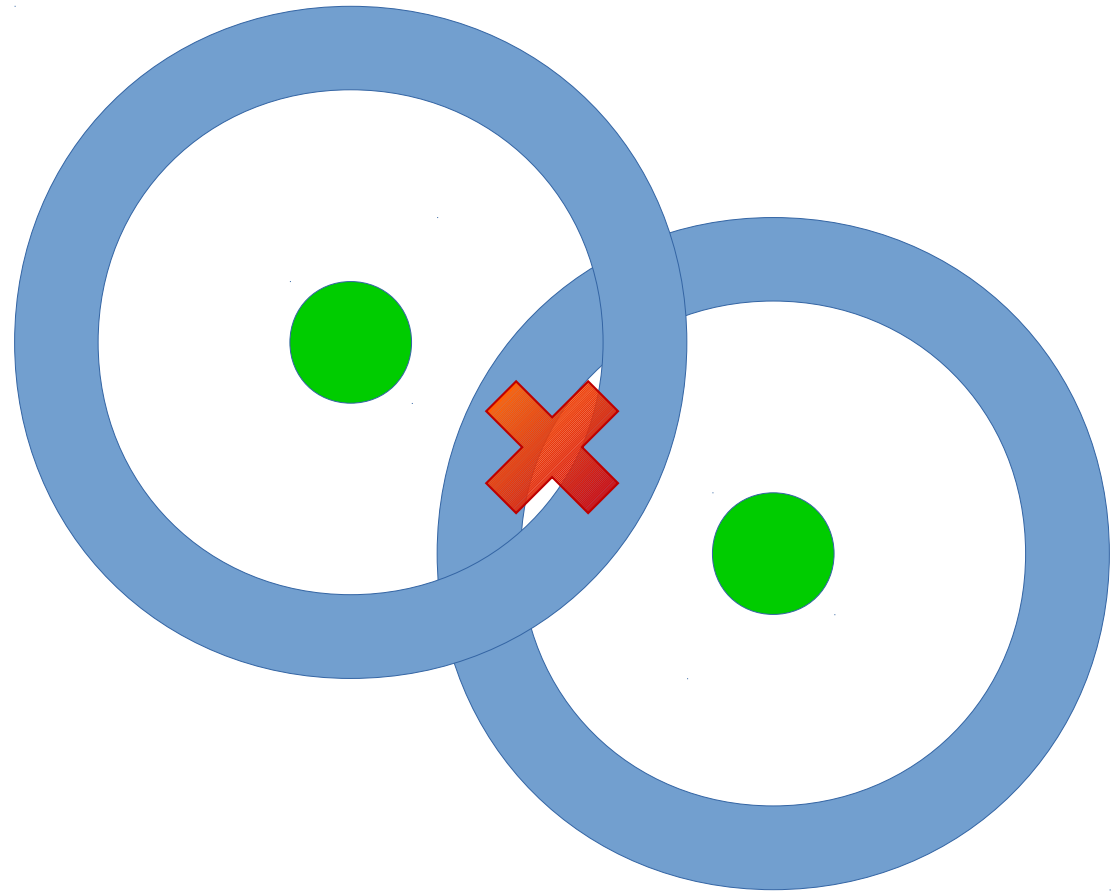


# Emergent Patterns

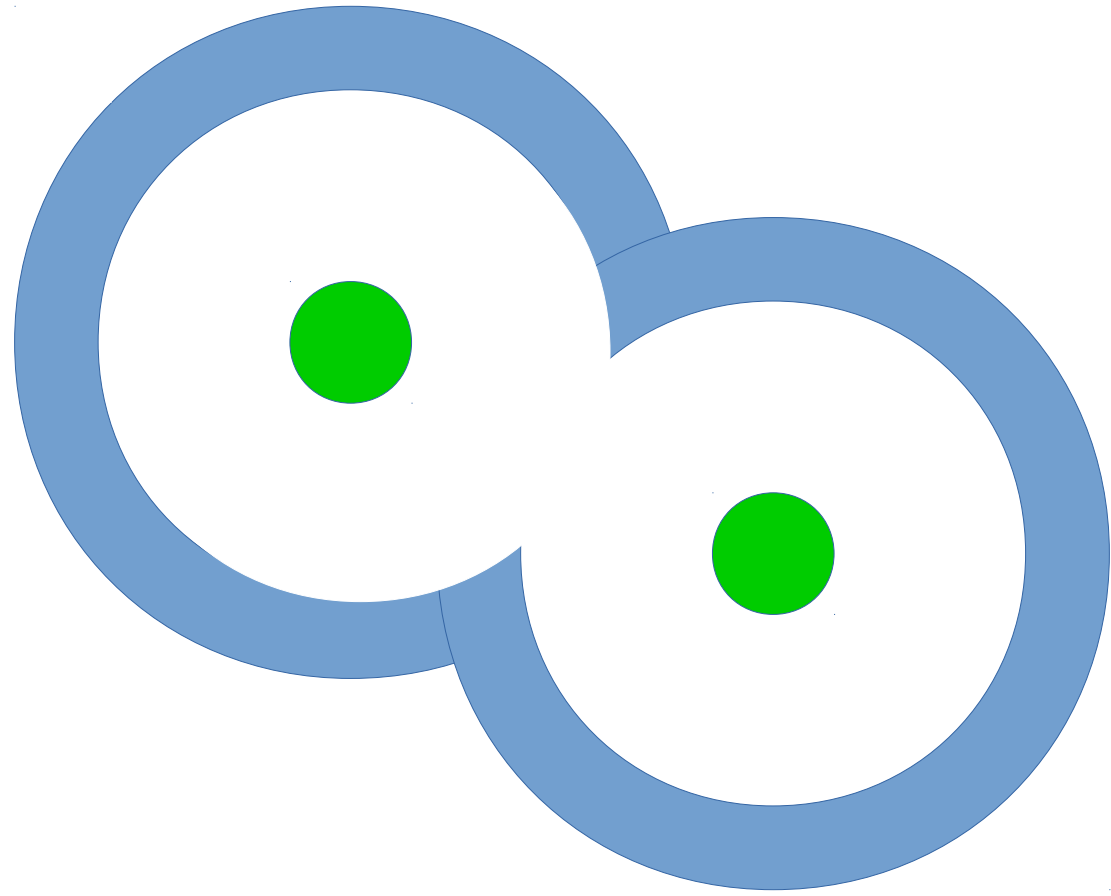




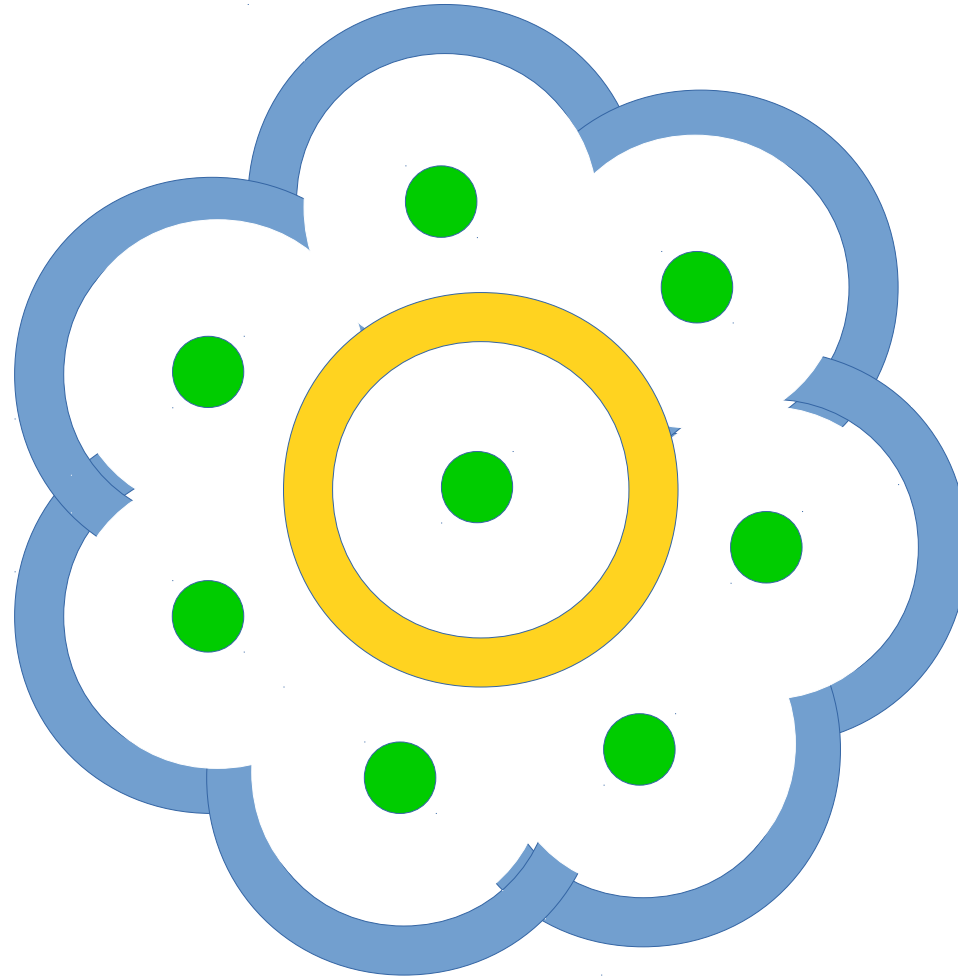
# Emergent Patterns



# Emergent Patterns



# Emergent Patterns

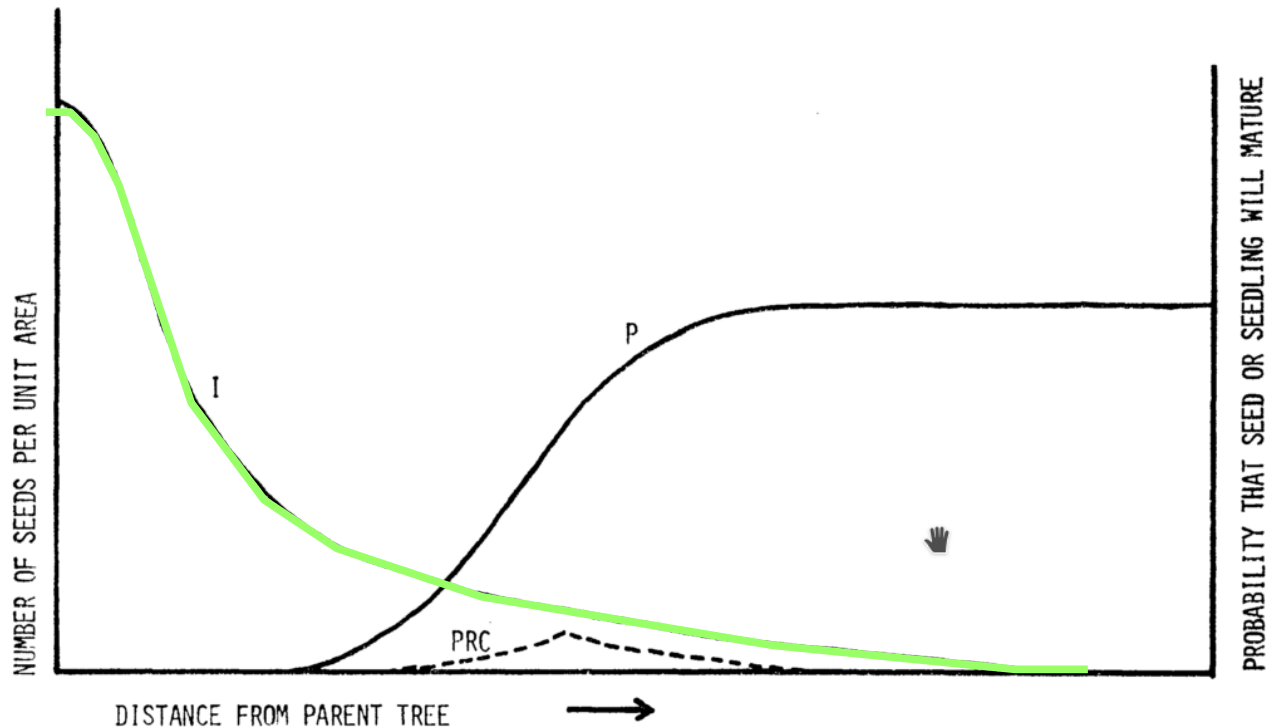


**How does an extreme spatio-temporal life cycle mismatch between consumer and producer affect Janzen-Connell patterns?**



# Model Tree Life Cycles

- **Mature trees disperse seeds once a year according to a dispersal kernel**



(Janzen, 1970)

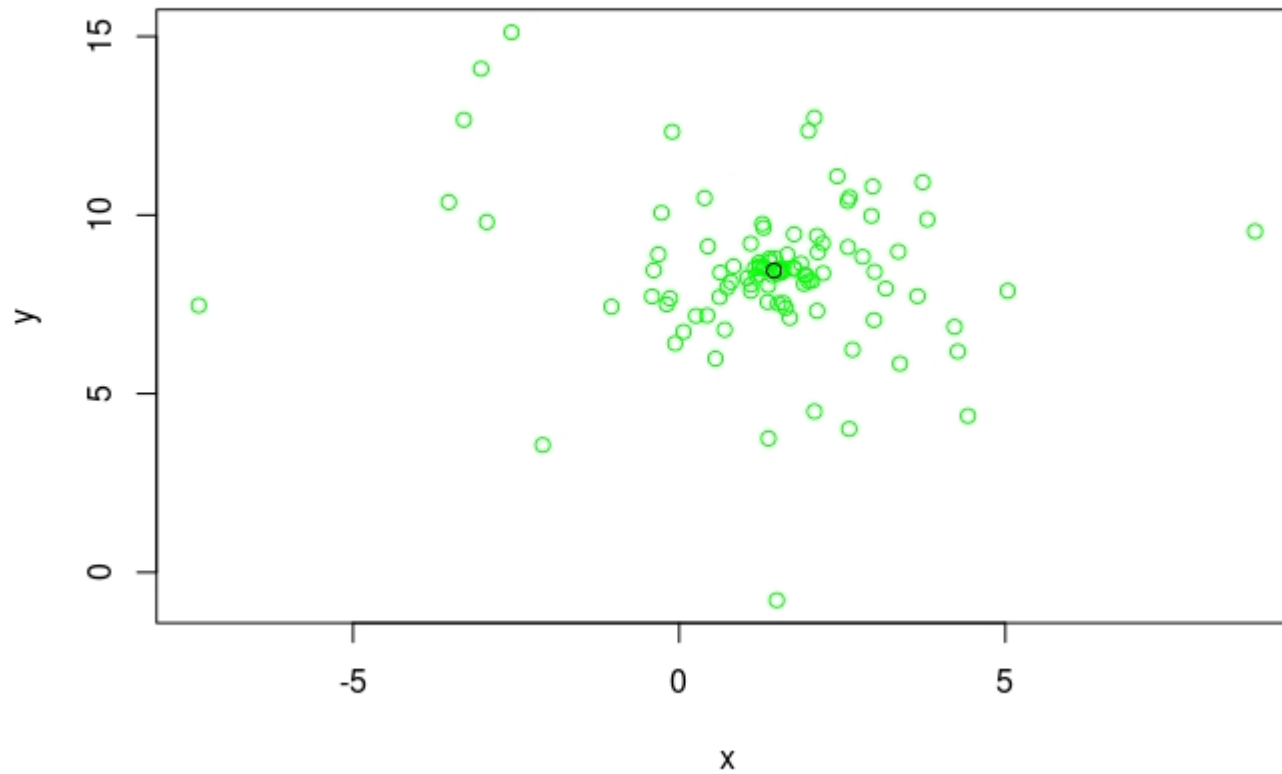


# Model Pathogen Life Cycles

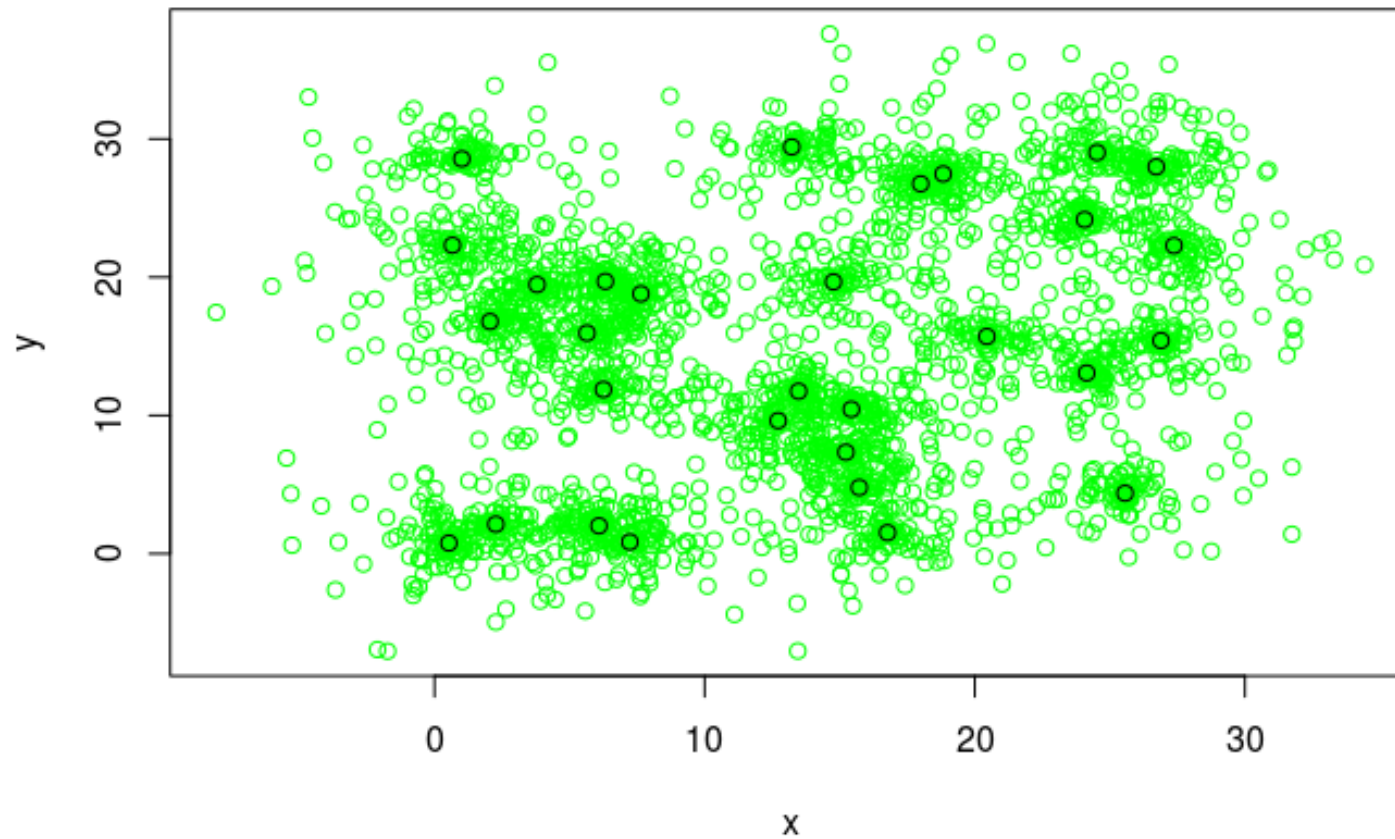
- **Oomycetes**
- **2 modes of reproduction**
  - Zoospores – flagellated for movement through soil water
  - Oospores – long term dormancy, local hyphal colonization
- **Reproduction several times a year, depending on conditions**
- **Zoospore dispersal on much smaller scale**
- **Long-term colony in roots of parent trees**



# Individual-scale Models



# Population Models



Black = trees  
Green = seeds





# Population Models

- **A seed survives pathogen infection according to:**

$$P(\textit{survival}) = e^{(-\gamma v d)}$$

$\gamma$  = probability a seed will encounter a spore

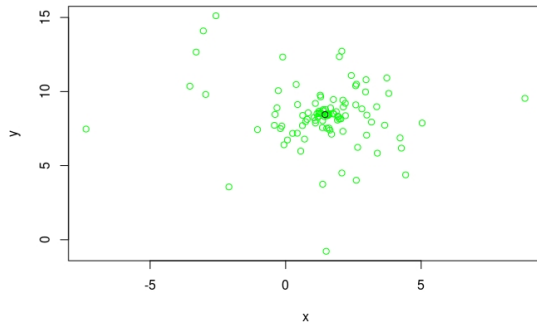
$v$  = infectivity

$d$  = density of spores

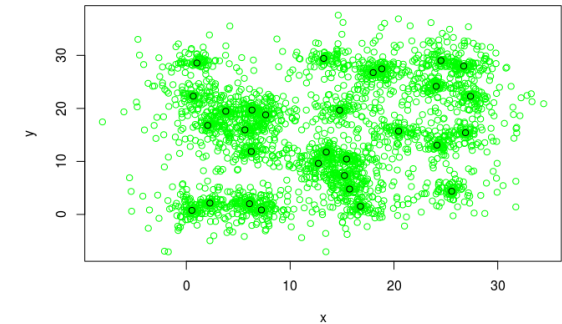


# Hybrid Modeling

Individual Model



Tree Population Model



$$P(\text{survival}) = e^{(-\gamma v d)}$$

Seedling Survival



# Outputs

- **Demographics of trees**
  - Lifespan, age distribution, infection rate
  - Cause of mortality (intraspecific competition vs. pathogen infection)
  - Seedling survival rate
- **Spatial distribution of trees**
  - Regularity of arrangement
  - Average distance between neighbors



# Analysis

- **Sensitivity Analysis**

- Test various parameter combinations
- Which parameters have the biggest effect?



# Expected Results

- **More active fungi will create larger gaps in tree population because of increased seed mortality**
- **Density-dependent mortality will increase with decreasing pathogen activity**
- **Increased lifespan of infected living trees contributes to pathogen mortality**



# Questions?

