

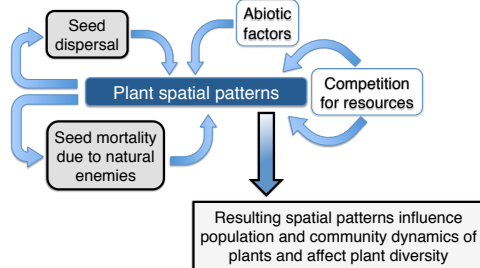
# The interacting effects of clumped seed dispersal and distance- and density-dependent mortality on seedling recruitment patterns

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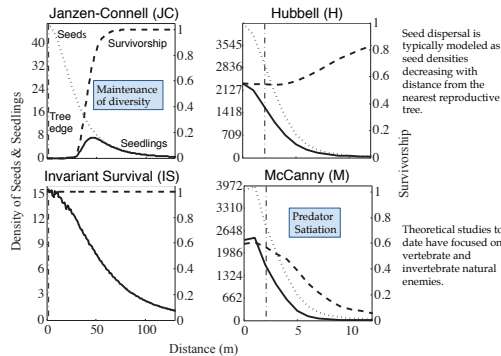
## INTRODUCTION

Processes that contribute to spatial patterns of tree species

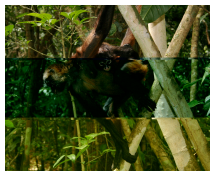


**Question:** How do patterns of seed dispersal and patterns of seed mortality by natural enemies influence spatial patterns of plants?

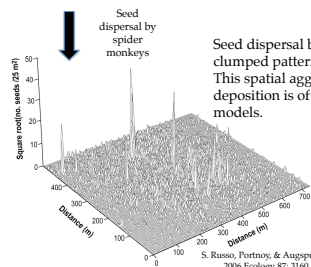
Recruitment patterns resulting from natural enemy attack



Seed dispersal by vertebrates.



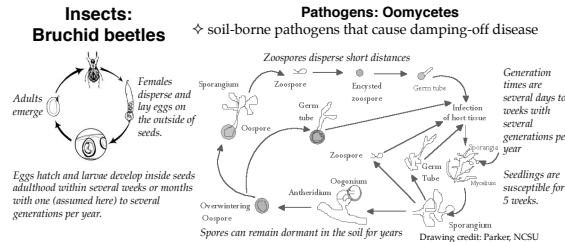
80-90% of tropical plants vertebrate-dispersed  
60% of all angiosperms are dispersed by biotic means



Differences in the life histories and movement of natural enemies determine their ability to track seeds and seedlings through space and time. Specialized natural enemies are hypothesized to be critically important for shaping plant spatial patterns and maintaining plant diversity. Although soil-borne pathogens have been found to play a critical role in seedling survival, previous studies have not determined their influence on seedling recruitment patterns.

## MODEL ORGANISMS

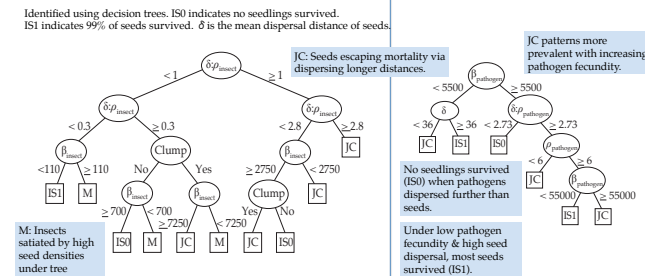
Both bruchid beetles and oomycetes are a major cause of plant mortality in agricultural and natural systems and tend to have a narrow range of hosts.



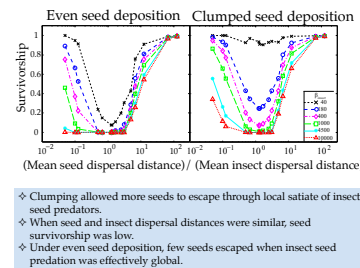
## RESULTS

**Insects**      **Pathogens**

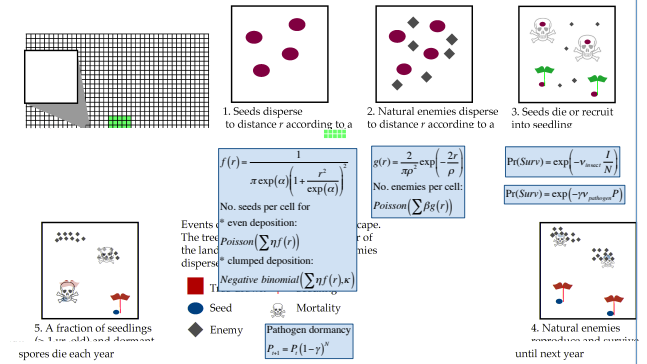
Factors important for recruitment patterns



Survivorship of seeds



## MODEL PROCESSES: A spatially explicit simulation model



## PARAMETER DESCRIPTIONS

| Model Organism | Parameters   | Values                                       |
|----------------|--|--|
| Plant          | Crown area   | 25 m <sup>2</sup>                            |
|                | $\alpha$ , Seed dispersal distance parameter*            | 2.3 (5, 4.7), 7.5 (67, 49), 8.75 (125, 72) m |
|                | $\beta_{max}$ , Dispersion parameter for seed deposition | 0.1  |
|                | $\eta$ , Tree fecundity                                  | 10,000 m <sup>-2</sup>                       |
|                | $\delta$ , Annual seedling mortality                     | 0.5  |
| Insect         | $\beta_{max}$ , Mean dispersal distance*                 | 1 (1.1), 10 (9.7), 40 (39), 50 (48), (76) m  |
|                | $\beta_{seed}$ , Fecundity                               | 40, 180, 400, 1000, 4500, 10000 eggs         |
|                | $\nu_{insect}$ , Infectivity                             | 0.2  |
| Pathogen       | Dispersal events within a fruiting season                | 4  |
|                | $\beta_{pathogen}$ , Mean dispersal distance*            | 0.1 (0.14), 1 (1.1), 10 (9.7) m              |
|                | $\beta_{seed}$ , Fecundity                               | 1000, 10000, 100000, 200000 spores           |
|                | $\nu_{pathogen}$ , Infectivity                           | 0.01   |
|                | $\gamma$ , Probability of encountering one seed          | 0.0001                                       |
|                | $\mu$ , Annual mortality of dormant spores               | 0.9  |

## CONCLUSIONS

- Our modeling study suggests that the relative dispersal distances of seeds and natural enemies are crucial to determining establishment rates and spatial patterns of seedlings.
- Better characterization of the movement and natural histories of natural enemies is critical to improving our understanding of seedling distributions and plant-enemy interactions.

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