Competition and Coexistence….Bleiker and Six

* Bark beetles live in a symbiotic relationship with different fungi (beetles spread spores)
* Article discusses competition between the fungi
* Fungi share the same resources so they would be expected to compete
* Studies show that the dominant competitor is usually the species with the fastest intrinsic growth rate (r)
* This study determines how fungi grow and interact in trees over one year
* In summer 2003 (the year the trees were attacked) only 1% of beetles had both types of fungi
* Competitive exclusion did NOT occur over the 1 year time period
* Direct competition (deadlock, combative, or replacement-type interactions) did not occur between the two species
* However, the study does indicate exploitation (indirect) competition of the two species but was limited (coexistence can occur if the species’ maintain exclusive areas or have another mechanism for partitioning resources
* **Environment variability may promote coexistence of similar species by differentially affecting their growth rates and competitive abilities. Conditions in beetle-attacked trees change considerably over time, and fungi may be differentially affected by water availability, temperature, tree defensive chemicals, and the presence of other microorganisms.**

Attenuation of Fungal Virulence by Synthetic Infectious Hypovirus Transcripts

* Hypovirus mediates affects of fungus
* Dr. Baines??

Models for Improving the Targeting and Implementation of Biological Control of Weeds

* Discusses how to choose between agents that target different life-history stages or transitions
* Is the objective to suppress population growth or control population spread?
* Combination of two agents may provide less effective control than a simple agent
* Larger introductions (of insects) have a higher probability of establishment, but eventually increasing release sizes will generate diminishing returns. There is usually an optimal release size (but it’s hard to know exactly what that is). To find the optimal size, AAM can be used (release various sizes and find the smallest one that is still effective)

A spatially-structured stochastic model to simulate heterogenous transmission of viruses in fungal populations

* ~~Note this is not density dependent (the number of trees infected with virus does not change the probabilities)~~
* Genetic variation reduce disease severity
* Used an interacting particle system (spatially explicit, individual-based model). Can model both biological features and spatial relationships
* One hypothesis is that north American populations of C. parastiica is that vegetative incompatibility inhibits horizontal transmission of viruses
* vc (vegetative compatibility)- more similar -> higher levels of transmission
* In asexual spores, viruses can be transmitted vertically. However, in sexual populations virus transmission may be limited because viruses inhibit female fertility
* Asexual spores (conidia) are more likely to disperse viruses on the same tree because only limited dispersal BETWEEN trees
* Sexual spores (ascospores) have long distance wind dispersal but viruses are not transmitted through ascospores
* Model
* Probability of transitions (including death)
* Probability of transmission is based on numbers of vic genes in common (table 1)
* Initial conditions were divided between uninfected, virus-free and virus-infected fungi
* Time unit is 1 year (modeled for 3000 time steps)
* Model results=the probability of successful virus invasion was high when the initial vc type diversity was low, but virus invasion did not occur at high diversities;
* Virus invasion decreased as ascospores, which are virus-free, dispersed farther, presumably escaping local virus outbreaks. In contrast, as dispersal distance increased for conidia, which disseminate viruses, virus invasion increased.
* Viruses are more likely to invade asexual populations
* To enhance disease control in populations where vc type diversity is high, as in most populations in the North America, one potential strategy is to repeatedly and intensively release a mixture of transgenic?? strains with both mating types but only one vc type. Furthermore, by producing an abundant source of conidia (male gametes) in a single vc type to mate repeatedly with the resident population, the diversity of vc types could conceivably be reduced over time (analogous to recurrent backcrossing).
* The success of pathogen invasion is usually determined by a key parameter defined as the potential number of secondary infections per infectious individual (In mean field model, pathogen invasion will succeed if this parameter has a value greater than one; however, systems without homogeneous modeling, the critical value will be higher because ‘waste infections’ (contacts w already infected individuals))
* Failing to consider heterogeneity can lead to overestimates of viral spread
* Spatial structure of fungal population is important!! (Dispersal of sexual and asexual spores)
* Transgenic strains may improve biological control to a limited extent
* Transgenic strains produced virus-infected ascospores that were dispersed; however, the transgenic strains were not self sustaining in the untreated area. (termination 🡪 transgenic strains died out…meaning transgenic strains need to be repeatedly released over time)
* In order for the hypovirus to be transmitted horizontally, it must merge with another fungus. If the two fungi have identical genotypes, they will always transmit. If there is one difference in the genotype, the probability goes down to 0.45 etc.
* Transmission vertically means that the virus is found in the spores which sprout from the fungi.

The Acquisition of Hypovirulence in Host‐Pathogen Systems with Three Trophic Levels (Taylor Model)

Effects of Branch Size and Pathogen Virulence on Canker Development and Branch Mortality-Baines, Jarosz and Fulbright

* dsRna reduces canker growth rates and also may delay mortality of medium-sized branches and potentially of large branches
* larger branches have the highest proportion of callused cankers
* the presence of dsRNA was not a good predictor of canker morphology (callused or not callused)
* Small branches are most likely not going to survive whether they are infected with dsRNA or not

PCA (principle component analysis) combine lots of variables into one

Ecology of Survival and Recovery from Blight in American Chestnut Trees (Castaneadentata (Marsh.) Borkh.) in Michigan (Anita is not a huge fan of this article, especially the part where the dsRNA particle that causes hypovirulence exists in some soil fungi)

* Article discusses the natural recovery of chestnut trees in Michigan. The hypovirus has begun to spread.
* The blight was first discovered in 1904 and traveled 10-15 miles per year. Blight spreads southeast to northwest and tends to find the largest concentration of trees first. “Locations with larger number of trees had a higher incidence of blight than those with few trees.” (p. 43)
* Hypovirus first appears in SW Mighigan and gradually appear further north. No preference for sites with greater number of trees
* Trees with abnormal cankers growing in open areas were more successful than those that were growing in mesic forests
* there is a latency period before hypovirulence develops on American chestnut trees. As a result, American chestnut trees that are under less stress and are able to stay alive longer have a better chance of developing hypovirulence (p. 53)
* Sites with sandy soil were recovering faster than other sites. 3 Hypotheses:
* Chestnut trees compete better in sandy areas than mesic forests because
* Origin of the dsRNA particle which causes hypovirulence exists in some soil fungi and that the transfer of this particle happens after C. parasticia enters (this explains the lag). To test this hypothesis, one could determine where healing cankers first appear (this hypothesis would suggest they should first appear near the ground)
* More dispersing agents of hypovirulent strains on sandy textured soil (ie: ants)

Stochastic spatial models: a use in ecological applications

The sexual ascospores tend to be windborne while the asexual conidiospores tend to be dispersed by rain or vectored by a wide variety of animals.