Competitive interactions

Competition: An interaction between individuals brought about by a shared requirement for a resource in limited supply, and leading to a reduction in the survivorship, growth and/or reproduction of the competing individuals.

I. General characteristics
   A. Some resources must be limiting or potentially limiting
   B. Competitors must have similar requirements
   C. Effect is density dependent
   D. Results in a decrease in average fitness (but one competitor will have a relative advantage)

II. The types of competition
   A. Exploitative versus interference competition
      1. Allelopathy as an example of interference competition
         a. the introduced species, knapweed, and its allelopathic effects.
         b. how widespread is allelopathy?
   B. Intraspecific (within species) versus interspecific (between species) competition

III. Intraspecific competition
   A. The law of constant yield
      1. yield (biomass- not numbers) will increase with increased density (# individuals per m\(^2\)) up to a maximum yield
      2. maximum depends on the resources (remember carrying capacity)
      3. constancy of yield at maximum results from death of individuals and/or a change in average size of individuals
   B. Self thinning
      1. The size of individuals and their density are related by the \(-3/2\) power law
      2. Examples
   C. The distribution of sizes in a population
      1. Populations initially show a normal distribution
      2. As time progresses the population becomes skewed--a few large and many small individuals --"L" or "inverse J"-shaped curve
         a. effect of competition?
         b. normal progression?
      3. Relationship to fitness

IV. Interspecific competition
   A. Mixtures of species result in a mixture of intra- and interspecific competition
   B. Depends on frequency (influenced by relative species composition)
   C. How do we study?
      1. Additive design
         a. add one species to a constant density of another
         b. density and frequency both change so effects can't be separated
         c. useful--e.g. study of the effects of weed density on crops
      2. Replacement design
         a. replace one species with another, keeping overall density constant.
b. The replacement series
c. ratio diagrams

3. Subtractive design
   a. remove competitors (either intra or interspecific) and measure effect on a target plant
   b. useful for established plants in the field
   c. an example involving competition of desert shrubs for water

4. Indirect design
   a. compare two species to a third target species
   b. an example involving competition for soil phosphorous

D. Is interspecific competition important in the field?
   1. Displacement of Typha latifolia and Typha angustifolia in the field

V. How do plants compete?
   A. The importance of being early
      1. a small difference in germination time can translate into a big competitive advantage
   B. Above versus below-ground competition (Tillman)
   C. Detecting your neighbor (and potential competitor)
      1. Phytochrome and reflected far-red light as a signal of neighbors
      2. Response is an elongation or change in growth direction to escape competition.
   D. Occupying space.

Readings:
TEXT: Chapter 10 (pages 185-211). This chapter is excellent but covers more than we will have time for. We will not cover modeling competition (pages 199-201) and will leave the section on effects of competition on community composition (pages 201-205) for later.
Silvertown and Lovett-Doust: Chapter 4. Presents a good discussion of yield-density interactions, self-thinning and effects of size on competitive interactions.

Study questions:
1. How does the law of constant yield relate to the concept of carrying capacity? What types of experiments show that the two might be related?
2. As planting density increases, you observe at the time of harvest that the total yield is constant. What changes in the plants or in the population demography could account for this constant yield? If you were to plot the frequency of plants as a function of plant weight what would curve look like?
3. What does the experiment showing data for the Typha species tell you about the controls of the distribution of these species in monospecific stands? In areas where both species occur how does competition alter these distributions?
4. Give an example of interference competition in plants. In this example discuss how this competition relates to the resources required by plants.
5. Contrast additive and subtractive designs for studying competition. What are some of the limitations of these designs in terms of their interpretation?
6. Drawing on the information on demography and on intraspecific competition, why do we think that the distribution of plant sizes is such an important characteristic? What factors are involved in shaping the observed distribution of plant sizes?