Competition
Limiting resources

Lecture outline
- Competition as a potentially important density-dependent factor
- Intraspecific competition in animals and plants
- The niche and competition
  - Gause’s principle
  - Hutchinson’s n-dimensional hypervolume
- Competition and math—Lotka-Volterra equations
- Evidence for interspecific competition in the field

Competition
- Only occurs when …
- Intraspecific vs. Interspecific competition
- Types of competition:
  - Exploitative vs.
  - Interference

Potential outcomes
- Types of interspecific interactions

Types of interaction | Species 1 | Species 2 |
--- | --- | --- |
Neutral | 0 | 0 |
Mutualism | + | + |
Commensalism | + | 0 |
Amensalism | - | 0 |
Parasitism | + | - |
Predation | + | - |
Competition | - | - |

How would you test for competition?

Effects of intraspecific competition on animals

Prokelesia marginata on Spartina

Fig. 13.6
Effects of intraspecific competition on plants

- Picture yourself as a pine tree through time...
- What happens?

The niche

- Incorporates many ideas over the years
- Niche consists of...
- Some interpretations:
  - E.P. Odum (1959):
    - Address vs. profession
    - Resource vs. impact niche

Self-thinning

- Fig. 13.5
- Alfalfa
- M. sativa planted at high density initially.

Linking niches and competition

- Gause’s or competitive exclusion principle
- Do we ever see this principle in action?

n-dimensional hypervolume

- Hutchinson (1957)
Effects of competition on the niche

Bluegill + Green sunfish

What about the reverse?

- Are there interactions that expand the hypervolume?

Bruno et al. (2003)

An example of the reverse

Fig. 11.13

A reminder…

- Another form:

$$\frac{dN}{dT} = rN \left( \frac{K - N}{K} \right)$$

Competition theory

- Lotka-Volterra model
  - Species 1: \( \frac{dN_1}{dt} = r_1N_1((K_1-N_1-\alpha N_2)/K_1) \)
  - Species 2: \( \frac{dN_2}{dt} = r_2N_2((K_2-N_2-\beta N_1)/K_2) \)

- If \( \alpha N_2 \) or \( \beta N_1 = 0 \), then population shows ? population growth

Lotka-Volterra competition outcomes

- Four possibilities:
  - Species 1 wins, species 2 goes extinct/excluded
  - Species 2 wins, species 1 goes extinct/excluded
  - It depends
  - Coexistence

- A reality check
Evidence for interspecific competition in the field

- Two older meta-analyses:
  - Connell (1983): 40% of studies; 50% of species
  - Schoener (1984): 90% of studies; 76% of species

Competition in the field

- James Brown et al.
  - 20 ha study site
  - 24 plots
  - Each plot is 50 m x 50 m

Competition in the (really big) field

- 20 ha study site
- 24 plots
- Each plot is 50 m x 50 m

Chihuahuan Desert, AZ

Any other reasons to do long-term studies of rodents?

- Yates et al. (2002)
- Michener et al. (2009)