Previous Lecture

Population Dynamics

D. Intraspecific Competition

Lecture 7 1

Lecture 7

- Population Dynamics
  - Interspecific competition - Chapter 13

Lecture 7 2

Interspecific Competition: Exploitation

- **Exploitation competition -**
- **plants** - *Deschampsia antarctica* and *Colobanthus quitensis* (and moss!) using water or nutrients from the same soil patch, and shading each other.

3

Exploitation Competition

- animals - goldfinches and house finches both eating thistle seeds in the same field.

↔

Interspecific Competition

- Interference competition -

____

____

wolf

↔

grizzly bear

Lotka-Volterra Model

- Premise: Adding individuals of another species is the same *kind* of density-dependent effect as adding individuals of the same species. But the magnitude may be greater (α>1) or less (α<1) than with interspecific competition

$$\frac{dN_1}{dt} = r_1\left(\frac{K_1 - N_1 - \alpha N_2}{K_1}\right)N_1$$

Competition Coefficient (a_{12})

- If $\alpha = 1$, then species 2 = species 1
- If $\alpha < 1$, sp. 2 has a smaller effect than sp. 1
- If $\alpha > 1$, sp. 2 has a greater effect on 1 than 1
- Note: if $\alpha = 0$, then sp. 2 has no effect on sp. 1.

- Note: in some sample exam problems, you may see: a_{12} (=α) and a_{21} (=β) for the competition coefficients

Review: Lotka-Volterra Competition

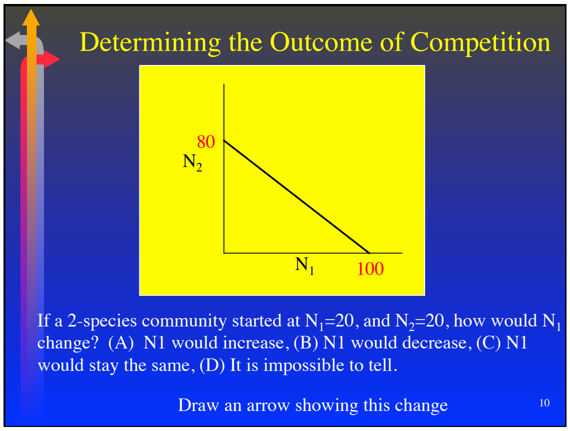
- For two species, L-V is two equations:

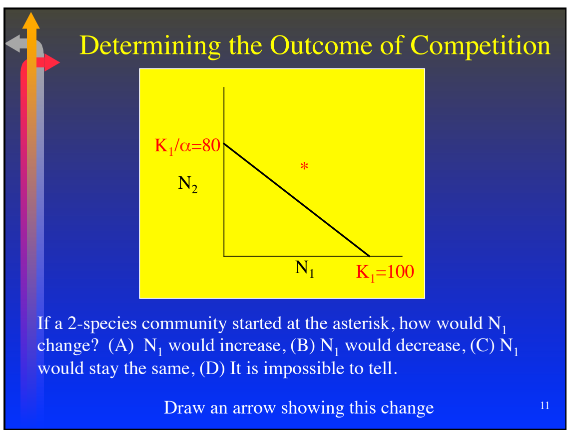
$$\frac{dN_1}{dt} = r_1\left(\frac{K_1 - N_1 - \alpha N_2}{K_1}\right)N_1$$

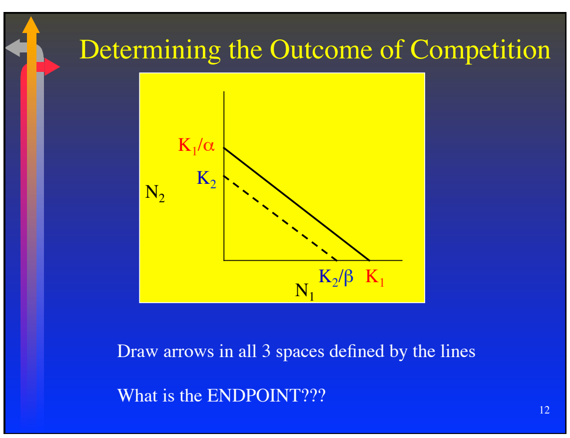
$$\frac{dN_2}{dt} = r_2\left(\frac{K2_1 - N_2 - \beta N_1}{K_2}\right)N_2$$

Determining The Outcome of Competition

"Zero-growth isolines" determined for each species


Determining the Outcome of Competition
80
N2
N1
100
If a 2-species community started at N1=20, and N2=20, how would N1 change? (A) N1 would increase, (B) N1 would decrease, (C) N1 would stay the same, (D) It is impossible to tell.
Draw an arrow showing this change
10


Determining the Outcome of Competition
K1/α=80
*
N2
N1
K1=100
If a 2-species community started at the asterisk, how would N1 change? (A) N1 would increase, (B) N1 would decrease, (C) N1 would stay the same, (D) It is impossible to tell.
Draw an arrow showing this change
11


Determining the Outcome of Competition
K1/α
K2
N2
K2/β
K1
N1
Draw arrows in all 3 spaces defined by the lines
What is the ENDPOINT???
12

Outcome of Competition

- Species 1 WINS!!! (where $K_1 > K_2/\beta$ AND $K_1/\alpha > K_2$)
- Endpoint: $N_1 = K_1$, $N_2 = 0$
- Endpoint is the same regardless of starting N.

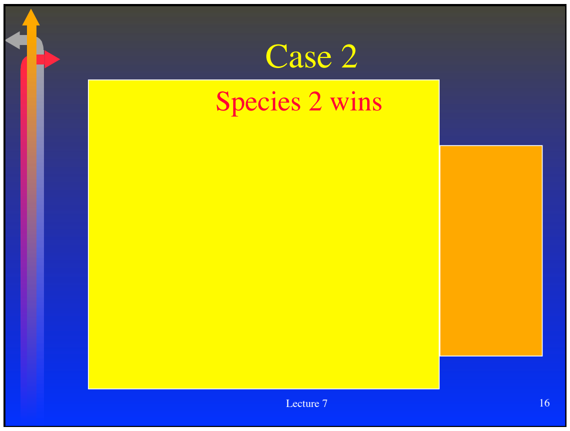
Why are we doing this?

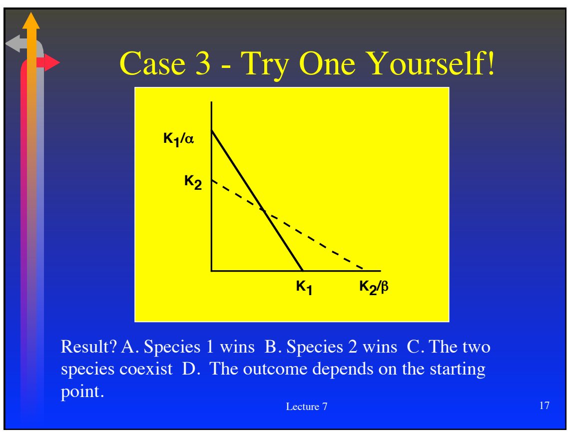
- New parameters important: K, α
- Defines:
  - conditions for coexistence,
  - the limiting similarity
- Predicts character displacement in zones of sympatry for competing species

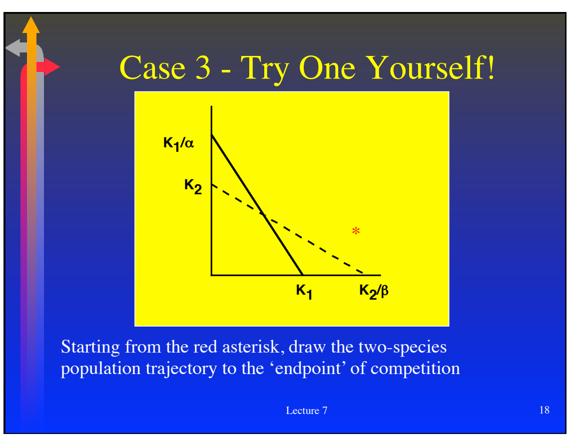
Graphical analysis - Case 1

Species 1 Wins

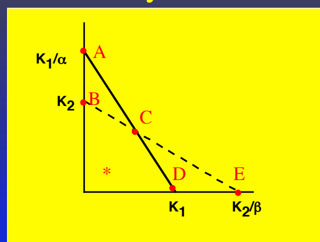
Conditions:


Case 2
Species 2 wins
Lecture 7
16


Case 3 - Try One Yourself!
K1/α
K2
K1
K2/β
Result? A. Species 1 wins B. Species 2 wins C. The two species coexist D. The outcome depends on the starting point.
Lecture 7
17


Case 3 - Try One Yourself!
K1/α
K2
*
K1
K2/β
Starting from the red asterisk, draw the two-species population trajectory to the 'endpoint' of competition
Lecture 7
18

Case 3 - Try One Yourself!



If competition started at the *, where would it eventually end up? Does any species end up at its carrying capacity?

Case 4 - Conditional competitive exclusion

Graphical analysis - conclusions

- There are four possible outcomes of competition
- Qualitative outcome =f(K, α)
- r does not influence the outcome (exc. Case 4)
- Initial N does not influence the outcome (exc. Case 4)
- We can define the boundary conditions of stable coexistence - VERY IMPORTANT!

Summary

- Competition theory emphasizes the importance of competitive ability and carrying capacity in determining the outcome of competition
- Next time: The theory predicts the conditions required for coexistence, defines the limiting similarity, and predicts character displacement in zones of sympatry for competing species