Previous Lecture

Population Dynamics

D. Intraspecific Competition

Lecture 7

- Population Dynamics
  - Interspecific competition - Chapter 13

Interspecific Competition: Exploitation

- **Exploitation competition -**

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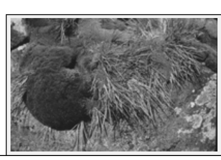
  - **plants** - *Deschampsia antarctica* and *Colobanthus quitensis (*and moss!) using water or nutrients from the same soil patch, and shading each other.



Exploitation Competition

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

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Interspecific Competition

- Interference competition -
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wolf

↔

grizzly bear

Lecture 7

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

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

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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:

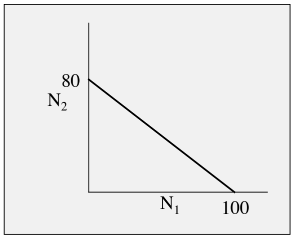
$$\frac{dN_1}{dt} = r_1\left(\frac{K_1 - N_1 - \alpha N_2}{K_1}\right)N_1$$

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

Determining The Outcome of Competition

"Zero-growth isolines" determined for each species

Determining the Outcome of Competition



If a 2-species community started at N_1=20, and N_2=20, how would N_1 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

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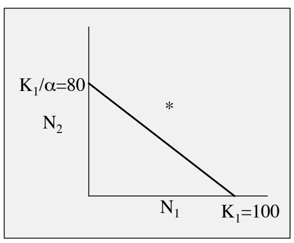
Determining the Outcome of Competition



If a 2-species community started at the asterisk, how would N_1 change? (A) N_1 would increase, (B) N_1 would decrease, (C) N_1 would stay the same, (D) It is impossible to tell.

Draw an arrow showing this change

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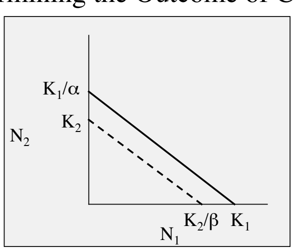
Determining the Outcome of Competition



Draw arrows in all 3 spaces defined by the lines

What is the ENDPOINT???

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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

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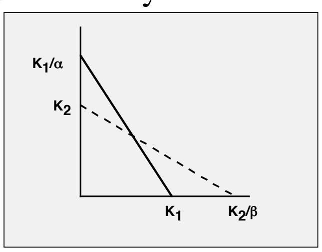
Case 3 - Try One Yourself!



Result? A. Species 1 wins B. Species 2 wins C. The two species coexist D. The outcome depends on the starting point.

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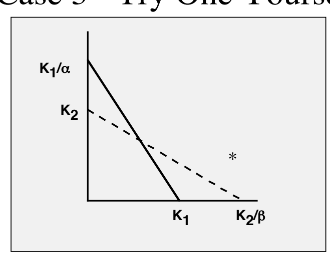
Case 3 - Try One Yourself!



Starting from the red asterisk, draw the two-species population trajectory to the ‘endpoint’ of competition

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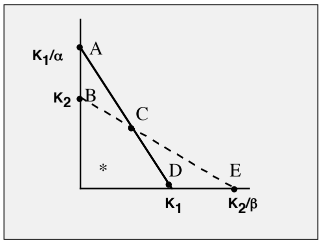
Case 3 - Try One Yourself!



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

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