Lecture 5 - Competition

Who competes?

- Species typically have slightly different habitat requirements
- Closer habitat requirements means that competition is more likely
- Closely-related species may compete more intensely than distantly-related species

Who doesn't? (much)

- When competitor densities are very low = competition is low
- Apex predators can use resources others can't

Types of competition:

1) Intraspecific competition – intra = within – competition within the same species

Exploited competition - Individuals of same species use common resources that are limited and potentially depleting. Often density dependent

- **Consumption use** (food), **preemptive/defensive use** (e.g. occupying nesting site)

Interference competition – Competition that occurs when individuals harm and/or exclude one another to obtain resources

Resources that may initiate intraspecific competition include:

- Food
- Shelter from weather or predators
- Nesting sites
- Space to set up territories
- Access to mates

Space

- Important and limited resource
- Strong competition for sessile (non-mobile) organisms e.g. Barnacles sessile from plankton on to rock surface, they can actively pry other individuals off by growing under them.

2) Interspecific competition - Occurs when individuals of different species use common resources that are limited. Usually one species uses resources better than another

Allelopathy – The chemical inhibition of one organism by another, due to the release of substances acting as germination or growth inhibitors into the environment.

- It is a means of survival in nature, reducing competition from plants nearby. This is why it can be known as 'chemical competition'
- Most allelopathic plants spread chemicals through the soil from their roots and will be absorbed by neighboring plants and inhibit them.
- These chemicals affect plants in different ways;
  - Some block the plants respiration
  - Some prevent the plants transfer of energy
  - Some stop growth or cell division by interfering with seed germination
  - And some interfere with a plants ability to take in water and nutrients.

Consequences of competition for populations

- Competition affects fitness of individuals

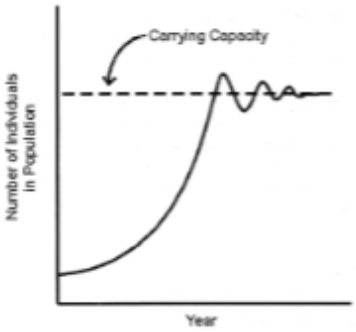
- Resource shortages affect growth, reproduction and/or survival
- Although overlap in resources may exist, competition cant be assumed without evidence resources are limited

When a population reaches K (carrying capacity) – the type of competition can affect population dynamics

- **Exploitation competition:** Equal resource sharing means that all get enough resources below K, but none get enough of N exceeds K; population crashes, cycles around K.

- Cycles persist even in a stable environment due to **the 'all winners' or 'all losers' affect**, can be seen in the overshoot curve that is above carrying capacity.

- **'Boom and bust'** pattern



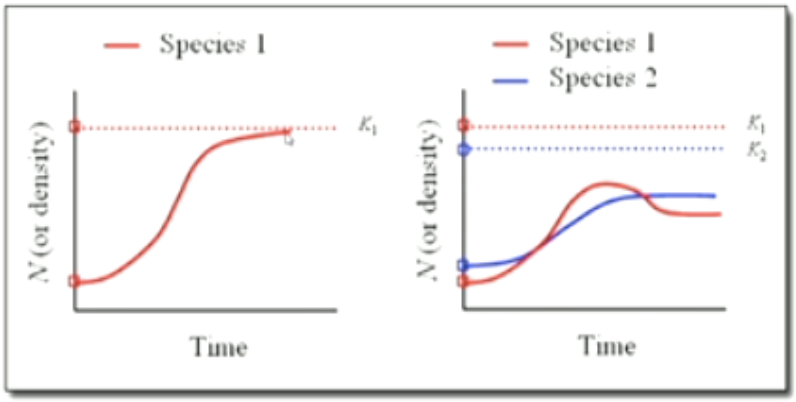
Interference competition

- Individuals are interfering with one another – competing for the same resource and going out of their way to stop individuals from accessing that resource.

- Shape of the curve is important because there are some winners and losers, because as you approach carrying capacity, competition intensifies and population growth slows down and they don't overshoot carrying capacity.

- There are 'losers' so unequal sharing prevents the overshoot of K, and population remains at a stable level.

Interspecific competition – the density of species 1 is expected to be reduced below that of its carrying capacity (K) by the impacts of competition with species 2.



Behavioral and evolutionary changes due to competition

- Resource partitioning – possums using one side of a tree and then greater gliders using another part of a tree ect. They are all in the same tree but they are using different parts – this may have occurred from competing with one another in the past but have adapted to slightly new niches so that there is less competition.
- Often seen at the level of habitat portioning (space and/or time)
- Can also occur through accessing the same resources but just in different areas

CASE STUDIES

Environmental conditions influence competition dynamics - E.g. two species may have the same niche, but operate more efficiently under different conditions

- Demonstrated in geographic distribution of red and arctic foxes.

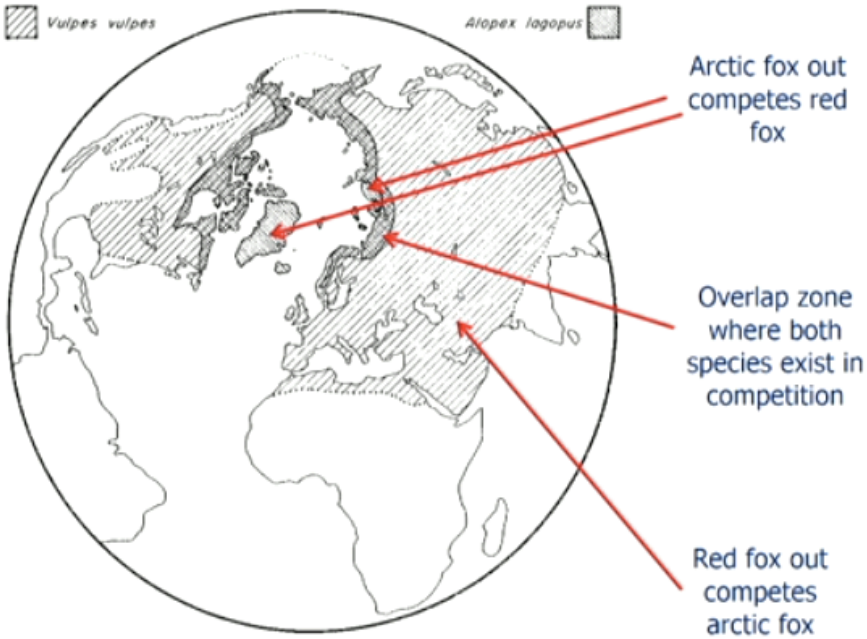


Fig. 1. A map showing the geographical distribution of red and arctic foxes.

Arctic fox adapted to very cold conditions

- Dense fur, smaller body size
- Lower energetic requirement than the red fox
- In cold conditions where mammalian prey is at low abundances, red foxes can not gain enough energy to sustain populations
- In areas where conditions are warmer and prey is more abundant, red fox can effectively out compete the arctic fox.

Wildlife applications
Important to understand how species interact in the field, in conservation we may need to protect an endangered species from competition with another dominant species
Examples:

- Lord Howe Island Woodhen
- Yellow Footed Rock Wallaby

Lord Howe Island Woodhen

- About the size of a chicken
- Humans arrived on Lorde Howe Island in 1788
- Woodhen numbers crashed with introduction of pigs, rats, goats, dogs and cats
- 8 breeding pairs became restricted to the summit of Mount Gower
- Limited breeding in suboptimal habitat.
- As with many bird extinctions, ship rats (*Rattus rattus*) were blamed but rats dont live on the summit and don't seem to cause woodhens major problems
- However, although pigs don't occur on the summit, they have similar food preferences to woodhens. Competitions with pigs suggested as a threatening process (also goats and cats).
- So pigs were systematically exterminated from the island and woodhens started to spread across the island and back into previous habitats
- 2002 populations sat at about 147-157 individuals.

Yellow footed rock wallaby

- Numbers fell rapidly in Flinders ranges in South Australia in late 19th century. Concluded decline was due to excessive hunting
- Solution: Species fully protected against hunting (1919)
- Result: Species did not recover
- Wallabies live in rock shelters – depend on food within short distance of shelters
- Introduced goats also use rock shelters and food resources near shelters
- However, when food is in short supply, goats can travel further from shelters to get food.

The Ecological Answer – Yellow footed rock wallaby vs. Goats

- Goats compete for food with rock wallabies – wallaby populations limited by food resources close to rock shelters
- Goats not limited by distance to these resources however rock wallabies are.
- Time for a goat cull – operation Bounce Back initiated in part to reduce competition between goats and rock wallabies in Flinders Ranges

Lecture 6 – Dispersal and Metapopulations

Dispersal

- One-way movement away from home range or natal area (area you were born in – philopatric animals). Dispersal is not migration
- Animals either remain within their maternal home range (philopatric) or they disperse
- May move to next unoccupied and suitable area, or may move great distances
- To survive, **most** species must contain at least some individuals capable of dispersing from one area of habitat to another.

Immigration: Dispersing animals moving into an area

Emigration: Dispersing animals moving out of an area

The survival of a species is as dependent on dispersal as it is on reproduction.
Why?

- Genetic diversity
- Reducing competition

Reading – Causes and consequences of animal dispersal strategies: relating individual behaviour to spatial dynamics

- Through simply moving from one habitat to another, the dispersal of an individual has consequences not only for individuals but also for population dynamics and genetics and species' distributions.
- Due to this link between dispersal and population dynamics, understanding its causes and consequences vital for population management and predicting the population response to change in the environment.
- Number of potential driving forces have been identified for evolutionary dispersal: kin competition, inbreeding, resource competition and environmental stochasticity.
- Dispersal can have both beneficial and detrimental effects on the persistence of spatially structured systems. Extinction risks can be decreased through the colonization of empty habitat, which may balance the loss of other local populations. This effect is particularly central to metapopulation theory.