2.1 species & populations

IB ESS
P 64-78

Learning Objectives

- Define a species and a population
- Explain the terms ‘habitat’ and ‘niche’
- State what is meant by the abiotic and biotic components of an ecosystem
- Outline how a species interacts with its abiotic and biotic environment
- Describe and explain population interactions that take place between species
- Describe J- and S-curves, which show how populations respond in different conditions
- Describe how any system has a carrying capacity for the species it contains

Key Questions

1. How do species interact with their biotic and abiotic environment?
2. How do populations change and respond to interactions with their environment?
3. What is the significance of a system’s carrying capacity?

biotic vs **abiotic**

Living components in an ecosystem

Organisms like plants, animals, fungi, bacteria & algae

Nonliving components in an ecosystem

Physical components

Light, air, water, minerals & soil, temp & climate

- *Interact closely with each other*
- *Structure of whole system relies on the relationship between these*

Species -

Group of organisms that share common characteristics and can interbreed to produce fertile offspring

- Given a scientific name
  - Identifies it precisely & used by scientists all over the world
  - First part = genus, second part = species
  - First part = capitalized, second part = never capitalized
  - Handwritten = underlined, typed = italicized
    - Ex. *Homo sapiens* (human)
    - Ex. *panthera pardus* (leopard)

Niche -

Particular environment and ‘lifestyle’ that a species has

- Includes:
  - Where it lives & breeds
  - Its food & feeding method
  - Activity patterns & interactions with other species
- Is unique to each species
- Offers the exact conditions the species needs / has adapted to

Habitat - The environment in which a species usually lives

- A wider area providing living space to many organisms
- Comprises a number of niches
- Includes all of the physical factors (abiotic)
- EX. woodland (from ground cover to tree canopy)

Spatial habitat - every organism's own space in an ecosystem

- Modify the surroundings based on its presence
- EX. woodpecker lives in hollow trees → modified to provide them shelter & nesting places
- EX. rabbit burrows underground → affects soil and grass

Habitat vs Niche

Habitat

- The habitat is the place where an organism lives out its life.
  - It is where the organism finds food, shelter and mates.

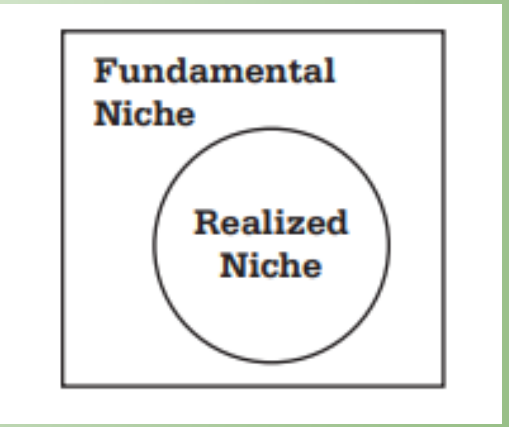
Niche

- A niche is its role in the community and how it interacts with the environment.
  - How it obtains food, mates and protection from predators.

Fundamental niche -

Potential mode of existence of the species, given its adaptation

- Matches the original definition of niche
- Special space inhabited by a particular



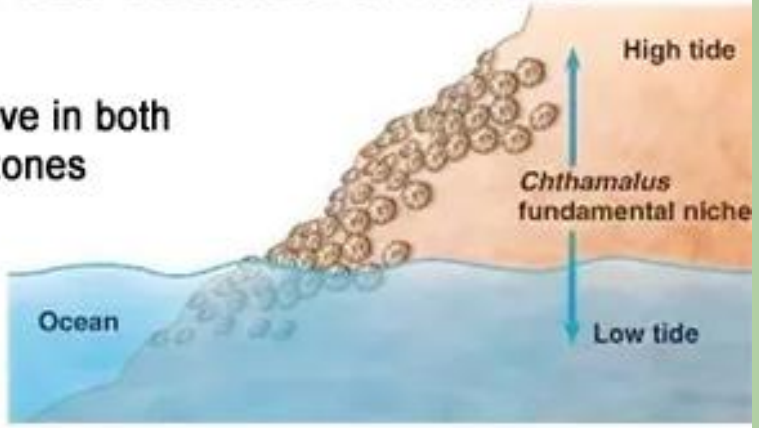
Realized niche -

Actual mode of existence of a species which results from its adaptation and competition from other species (it’s actual lifestyle due to biotic interactions)

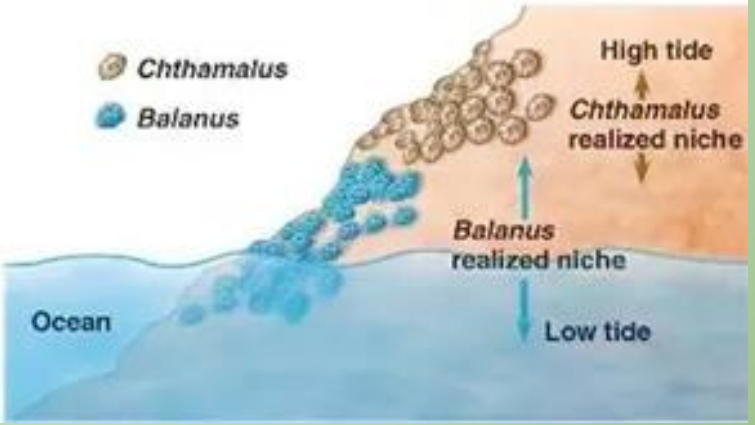
- If environment of a niche changes via natural phenomena, competition or human intervention
- Niche or spatial habitat becomes more restricted or overlaps another species
- Can only be the same size as or smaller than the fundamental niche

Fundamental vs. realized niche

Chthamalus barnacles can live in both deep and shallow intertidal zones (**fundamental niche**)



Competition from *Balanus* narrows *Chthamalus's* spatial range, forcing it to occupy a higher, drier zone. (**realized niche**)



Populations Interactions in an ecosystem

Population - group of organisms of the same species that live in the same area at the same time and are able to interbreed

- most important interactions = survival of pop (most involve feeding)
  - Competition
  - Predation
  - Herbivory
  - Parasitism
  - mutualism

Competition

(individuals) for resources (i.e. food & space)

Intraspecific competition - competition within a population

Interspecific competition - competition between members of different populations

- Example: Plants
  - Compete with each other for access to light & water
  - Fast-growing birch trees soon become established on an area of cleared land (but they require high levels of light)
  - Slower-growing oak trees grow alongside them for a short time (eventually overshadowing the birch trees and replacing them with taller oak trees)

Competition: which type do the pictures represent?

- Example: Animals
  - Birds (wren & robin) establish territory containing food & a nesting site
  - Males defend with displays of aggression or by singing from points on its boundary
  - Birds that don’t establish territories will be unable to find a mate & breed

Predation

- Interaction between species in which one species (predator) kills & eats another (prey)
- Predators (bald eagles, lions & sharks) adapted for efficient hunting
  - They must catch enough food to survive
- Prey (rabbits, antelope, small fish) adapted with camouflage or behaviors that allow them to escape their predators
  - Enough of them need to survive for the population to be maintained

Predation

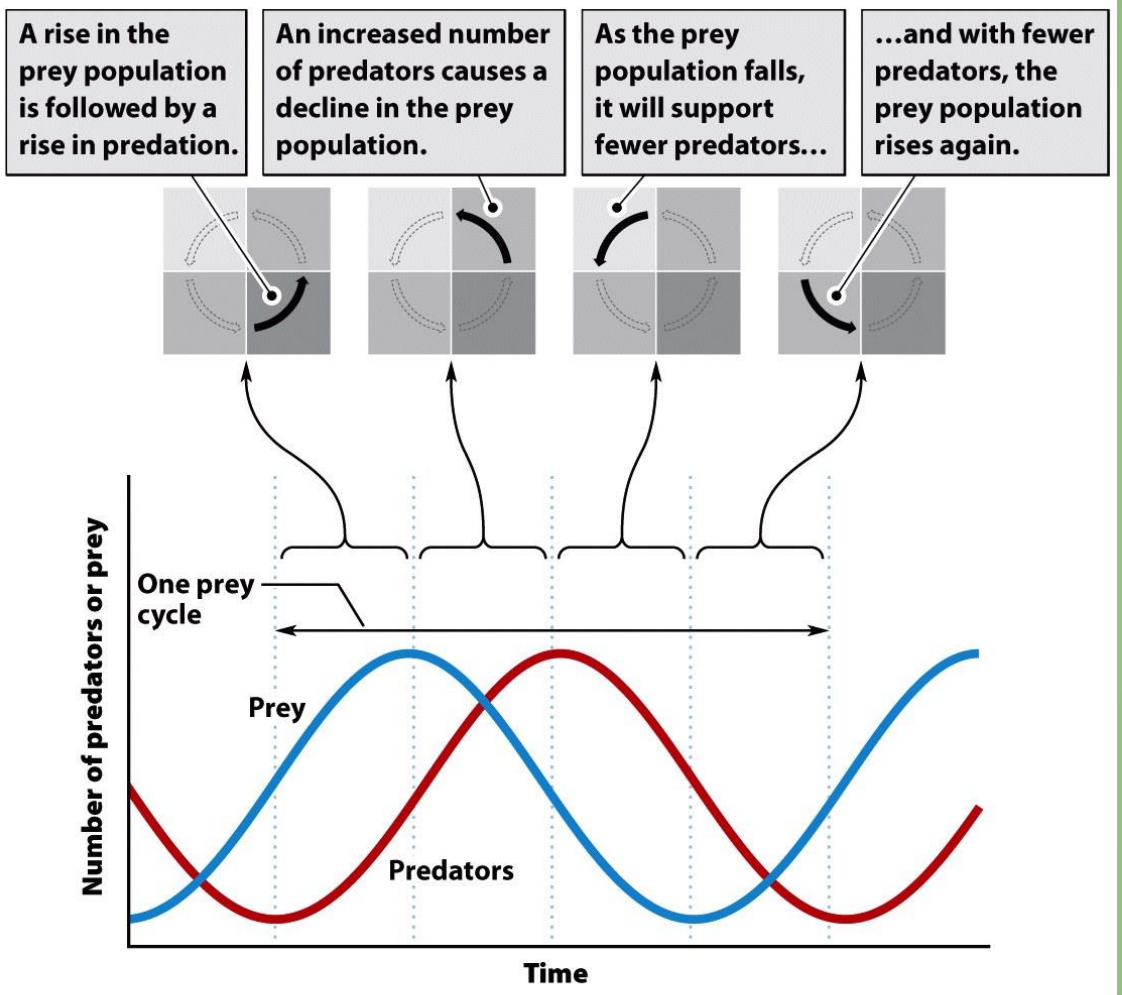


Figure 15.15
The Economy of Nature, Sixth Edition

Herbivory (animals)

- Feed on plants
- Single plant has
  - Leaves
  - Fruits
  - Seeds
  - Roots
- A single plant can feed MANY different kinds of animals
- CONSIDER THIS:
  - Herbivorous insects > 50% of species in a forest
  - Insect pest damage reduces productivity of forest by 20% per year
  - Researchers concerned: damage to forests will increase because many insects will benefit from global warming & drying

Parasitism

- Relationship where 1 organism (parasite) benefits from another (host) that may suffer from the parasite's presence
- Endoparasite - live inside the gut of their host where they feed on digested food
  - Tapeworms
- Ectoparasite - live on the outside of their host, piercing the host's skin to obtain a blood meal
  - Flees & ticks
- Can cause irritation and skin infection if host cannot remove them

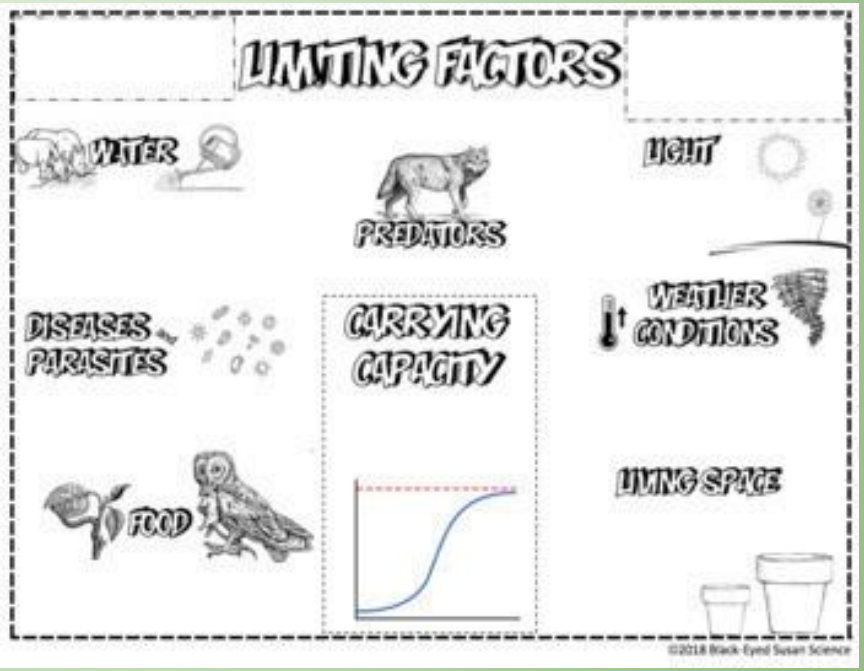
Mutualism

- A relationship between 2 organisms that gives benefit to both
- Example: Lichens
  - Lichens = union between fungus & algae
    - Fungus absorbs minerals & protect algae from intense light & desiccation (drying out)
    - Algae photosynthesizes to provide sugars for both organisms
- Example: Animals
  - Egyptian plovers & Nile crocodiles
    - Plovers feed on parasites & food particles in the crocodile's mouth
    - Crocodile's teeth keep clean & plover gets food

Population Changes

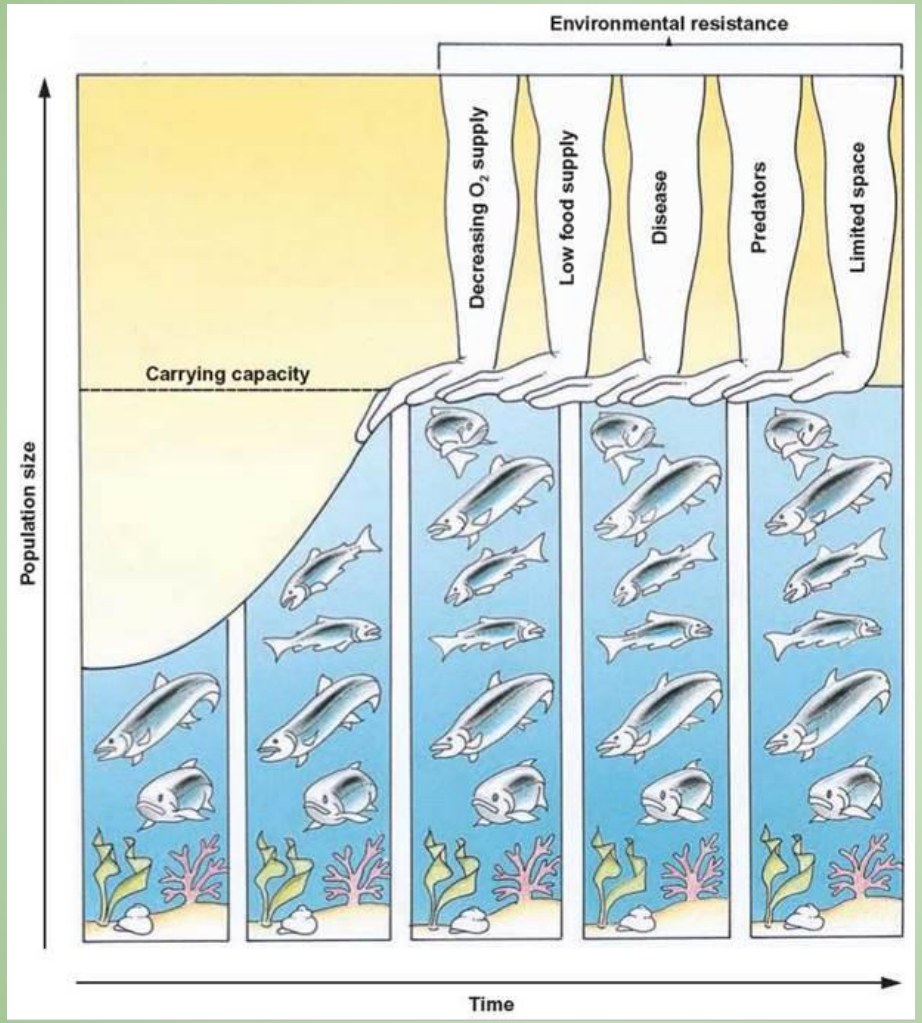
Limiting factor A resource in limited supply that can affect the growth of a population when the demand for a

resource is greater than the supply



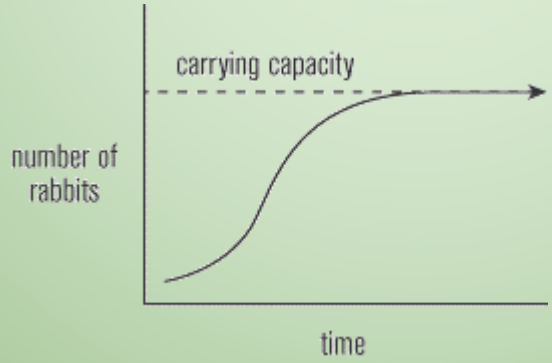
Carrying capacity

- As population # increases, so does intraspecific competition
- Leads to **carrying capacity** - # of individuals in a population that the resources in the environment can support for an extended period
  - Population growth rate slows down
    - organisms dying from lack of resource
    - failing to breed & birthrate falls
  - Every species is different on how they respond
    - EXAMPLE: frogs
      - Reduce their rate of growth & reach maturity at a smaller size than normal when food resources become a limiting factor
    - EXAMPLE: Birds
      - Maintain nests in specific territories do not compete directly, but only those whose territories contain sufficient food will breed successfully


Environmental resistance
Decreasing O_2 supply
Low food supply
Disease
Predators
Limited space
Carrying capacity
Population size
Time

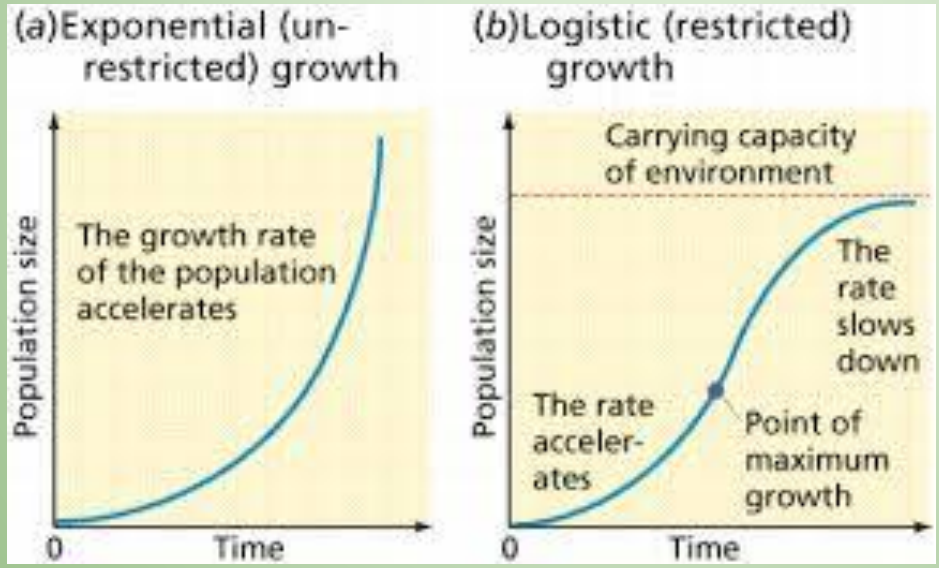
Carrying capacity

- EXAMPLE: plants
  - Most often limited by light, temperature and carbon dioxide (basic requirement for photosynthesis)
  - Compete for space because they need to extend their roots to obtain water & nutrients from the soil
  - In limited light they grow faster & taller
  - Flower early to complete life cycle before tall trees come into leaf



S- and J-curves

- Population growth curves that show 2 different ways populations may change over time
- SEE pg 63 Figures 2.1.9 - 2.1.12



Population growth curves compared

J-Curve

- Growth of a pop that doesn’t slow down
- Established in a new habitat
- Rapid exponential growth
- Abundant resources
- Birth rate high/death rate low
- Continue as long as resources not limited
- Rare in natural situations

S-Curve

- Rapid, exponential growth initially
- As pop grows, its increase slows
- Resources become limiting
- Eventually pops stabilize at a level that the environment can support = carrying capacity
- Curve is J shape...starts with slow growth, rises sharply

Phases of the growth curves

1. **Exponential growth phase**
    a. Period of no limiting factors
    b. Pop can double in size in set time periods (depends on species)
        i. EXAMPLE: slow-breeding pop of dolphins might double every 2 years
        ii. EXAMPLE: fast-breeding rabbits might double in a few months
2. **Transition phase**
    a. Begins as resource starts to become limiting
    b. Rate of growth decreases
        i. When too many individuals in an area
        ii. Increase in # predators
        iii. Increase in disease & mortality due to overcrowding

Phases of the growth curves

3. **Plateau phase**

a. Pop has reached stable, sustainable #s
b. Births & immigration approximately equal to deaths & emigration
c. Occurs as carrying capacity of environment is reached
d. May show fluctuations in pop #s above & below carrying capacity
    i. Negative feedback will ensure it corrects itself