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1.4.11.H Ecological Relationships

Factors that control Population

1. Competition
2. Predation
3. Parasitism
4. Symbiosis

These factors help maintain *population* numbers and bring about a 'balance of nature'

Competition
When organisms of the same or different species 'fight' for necessary resources that are in short supply.

Intra-specific competition:
Between members of the **same species** i.e. within a species
Inter-specific competition:
Between members of **different species**

Plants
compete for light, water, minerals and space
Animals
compete for food, water, shelter, territory and mates

Two types of competition

1. Contest Competition
involves an active physical confrontation between two organisms – one wins

Example
Two dogs fighting over a bone. One may have stronger muscles and sharper teeth and so win the bone

2. Scramble Competition
This is where each organism tries to acquire as much of the resource as possible.

Example
An ivy plant and a hawthorn tree may compete for light. The ivy uses adventitious roots to grip the hawthorn and climb higher.

Competition & Population Size

- Restricts population size
- Only successful competitors will survive and reproduce
- Is a driving force behind evolution i.e. **adaptive techniques** (sharp teeth of carnivores or climbing abilities in ivy) develop in response to the need to survive competition

How do animals survive competition?
- They adapt to their environment by:
- Changing their feeding habits
- Camouflage
- Producing protective coats
- Moving away from over-populated areas
- Reproductive strategies e.g. Kangaroo can carry up to three offspring
  - Joey
  - New born baby (2.5 cm long)
  - Fertilized Egg sitting in tubes to go to womb

How do plants survive competition?

e.g. weeds (i.e. plants growing in a place where they are not wanted)
These compete with other plants for water, minerals and light and will survive because:
- They produce large numbers of seeds
- Seeds germinate quickly, even in poor soil
- Plants thrive even in poorer soil conditions

Predation

Predation: the act, of some animals (predators), of capturing and killing other animals for food.

Predator: animal that hunts, captures and kills other animals (prey) for food.
Predators have evolved adaptive techniques to survive, e.g. wolf has keen hearing and eyesight, strong muscles, sharp teeth, camouflage and hunts in packs.

Positive Effects of Predation

1. Predation stabilises the community
2. Predators control the number of herbivores and so prevent overgrazing
3. Predators eliminate the less well adapted (weaker) prey

Adaptations of Predators

Keen senses and sharp teeth
Catch easiest prey – old and sick (less energy used)
Change diet to suit prey available e.g. foxes
Live and hunt in packs
Migrate to where prey is plentiful
Camouflage

Three examples of Adaptations of Predators
1. Hawks have excellent eye sight
2. Ladybirds have strong mouth parts
3. Cheetahs can run at 60 km/h

Adaptations of Prey

Plants may have thorns, spines or stings
Nasty taste when eaten e.g. giant hogweed
Are faster than their predator
Staying in herds or flocks – safety in numbers
Camouflage – greenfly, stick insects

Three examples of Adaptations of Prey
1. Frogs are well camouflaged
2. Zebras have strips, when in a group lions can't distinguish where one ends & another begins.
3. Ladybirds contain large amounts of Formic acid so they are unpalatable to taste

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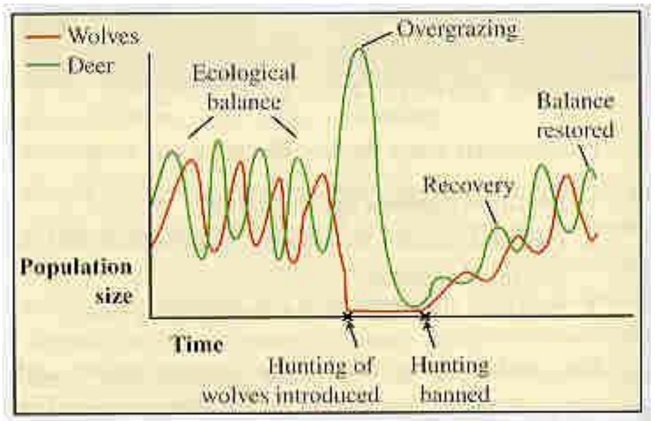
1.4.11.H Predator / Prey Relationship

Predator / Prey relationship

The populations of wolves and deer are interconnected. Both have evolved adaptive techniques to survive e.g.
wolves – keen hearing and eyesight, strong muscles, sharp teeth, camouflage and hunt in packs.
deer – keen hearing and eyesight, quick to turn and run and camouflage to evade the wolves.
Wolf / Deer in Alaska



- When the deer population increased, the wolf population had more food and increased too.
- As the wolf population increased, the number of deer being killed increased – graph resulting in a decline in the deer population
- When the deer population declined, there was less food for the wolves and they declined in numbers too.
- This led to an increase in the deer population.
- This cycle continued over years and had obviously found a natural balance to do with availability of food for both populations.
- When the wolf population was drastically reduced due to hunting, the resulting explosion of the deer population led to overgrazing of the vegetation.
- This produced huge mortality and emigration in the deer population with a collapse of the relationship.
- After the banning of hunting, a balance was slowly re-established in the two populations.

The populations are controlled by negative feedback, where a drop in numbers is generally self-correcting.

Over a long period of time, the deer evolve structures and behaviours to survive predation better, e.g. quicker reactions, etc.

The wolves also evolve better predation techniques to cope with the evolving prey.

Parasitism

One organism, the *parasite*, benefits from another, the *host*, and does harm to it

e.g. fleas **on** a dog (*ectoparasites*),

liverfluke **in** cattle/sheep (*endoparasites*).

Parasites do harm to their hosts but usually do not kill them too quickly.

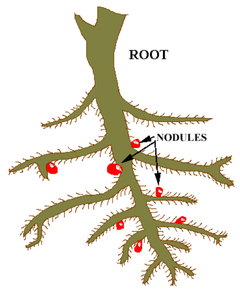
Symbiosis

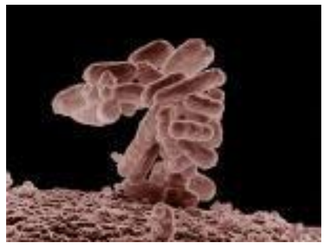
Symbiosis ('living together') – where two organisms of different species have a close, specific relationship with each other where at least one of them benefits.

Parasitism is a form of symbiosis

Examples
A lichen is composed of an alga and a fungus intertwined.
The alga obtains support and a mineral supply from the fungus; the fungus obtains food from the alga.

Nitrogen-fixing bacteria in the nodules of leguminous plants (below left):
The bacteria make nitrogen compounds needed by the plant and the plant makes carbohydrates and other food material needed by the bacteria





Bacteria living in the colon (above right) produce vitamin B_2 and vitamin K. The body absorbs these vitamins.

1.4.12.H Population Dynamics

Factors that contribute to Predator-Prey relationships

1. **The availability and abundance of food**
   Large number of deer will increase the number of wolves.
   This will decrease the number of deer and then wolves.
   When wolves decrease deer will increase again.

2. **Concealment**
   When there is less prey they can hide better, this allows population of prey to survive and increase.

3. **Movement of Prey & Predators**
   If there is not enough food the prey will move to a more abundant location;
   predator moves to area with more prey.

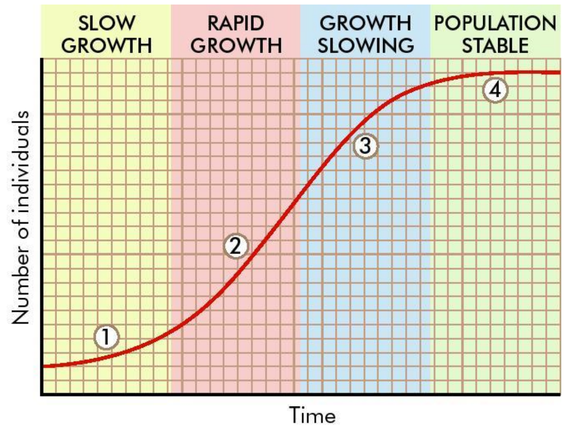
Population Dynamics

A ***population*** is a group of organisms of the one species.
Population density is a measurement of the numbers of a species over a stated area.
Population increases are due to increases in the birth rate and immigration.
Population decreases are due to increases in the mortality rate and emigration.

Most population numbers tend to fluctuate in the short term, but find an overall balance in the long term where births and immigrations are equal to deaths and emigrations.

Mortality rates are high in nature – many organisms die before they can reproduce.
Deaths are usually due to predation, parasites and lack of food rather than old age.
A high mortality rate is important to populations because it protects the stock of food and eliminates the less well-adapted organisms.

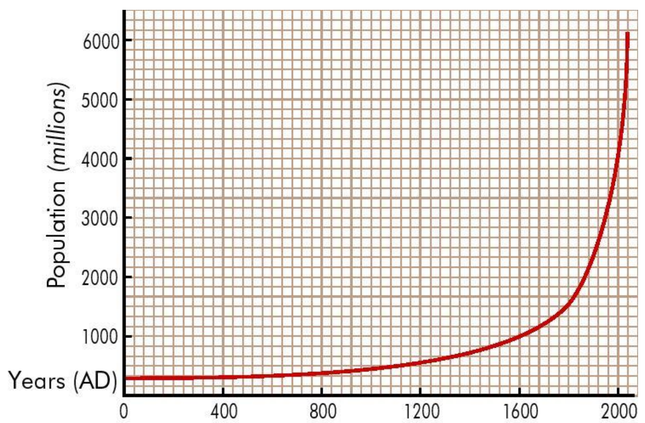
Normal Population Curve



1. Organisms arrive and then adapt to their new environment
2. Growth takes place rapidly due to newly-available food
3. Growth constraints are felt – predation, overcrowding, available food, etc.
4. Growth settles at a level that the environment can support.

Human Population Curve

Has not been susceptible to the normal constraints of nature and looks very different



The increase in the human population is not due to an increase in birth rates, but is caused by reduced death rates.

Factors affecting Human Population Numbers

Famine

A lack of food leads to malnutrition and death due to disease or starvation e.g.
Great Irish Famine of 1845 – 47, about one million people died.
Some countries still suffer from famine, but it is often a problem of food distribution rather than food shortages.
Advances in agricultural techniques have so far allowed food supplies to match population growth.

Disease

Vaccines – reduce the incidence of diphtheria, whooping cough, tetanus, polio, meningitis, TB, etc.
Sanitation + insecticides – have controlled malaria, yellow fever and sleeping sickness.
Anaesthetics have improved surgical methods & new drugs have saved many lives.
Antibiotics have prevented deaths that would have been caused by bacteria.

War

Reduces the human population.
Effects can be temporary.
Increased birth rates (baby booms) often follow wars.

Contraception

Increased availability has reduced birth rates since the 1960s. Evident in *developed* countries e.g. in Western Europe and USA the average family size = 2.1.
This is close to the level needed to ensure the pop remains constant.

The fertility rate in *developing* countries has fallen from 6.1 in 1970 to 3.5 today, due to contraception.