Theme: Interrelationships

S4 New Curriculum Biology-Chapter 8– Associations in biological communities

Organisms in an ecosystem interact with each other in a variety of ways. These include competition, predation, symbiosis, parasitism, mutualism and commensalism.

Competitions

In an ecosystem, organisms compete because the environmental resources such food, shelter, water, light and nutrients are limited.

Types of competition

(i) **Intraspecific competition** is a type of competition among individuals of the same species such those between zebras. Organisms of the same species may compete for food, shelter, mates and space.

(ii) **Interspecific competition** is a type of competition among individuals of the different species such those between zebras and buffaloes. Organisms of the different species may compete for food, shelter and space but not mates.

Predation

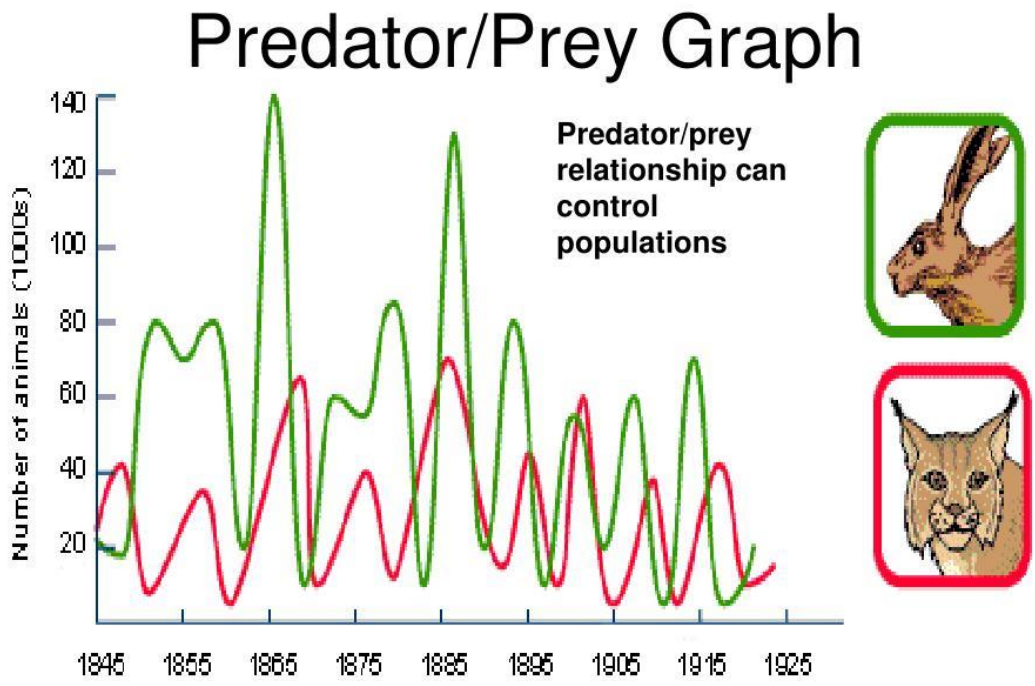
This relationship in which one organism lives the other dies instantly. For example lion the predator kills the zebra (prey) instantly.

A predator is an organism that hunts and kills another of different species for food .

A prey is an organism killed by another of different species for food.

Description of predator – prey relationship

The number of predators and prey often fluctuate in cycles. When prey populations increase, predator numbers may rise, but if prey decline, predators may struggle to find food and die off as illustrated in the graph below



Adaptations of predators to catch the prey

Physical Adaptations

- **Sharp Teeth & Claws** – Carnivores like lions, wolves, and eagles have strong jaws and sharp claws to grasp and kill prey.
- **Camouflage** – Some predators, like tigers and polar bears, blend into their environment to ambush prey unnoticed.
- **Powerful Muscles & Speed** – Cheetahs, for example, have specialized muscles for explosive speed to chase down prey.
- **Venom & Toxins** – Snakes, spiders, and some marine creatures like jellyfish inject venom to immobilize their prey.
- **Keen Senses** – Owls have exceptional night vision, sharks detect vibrations in water, and wolves use their acute sense of smell to locate prey.

Behavioral Adaptations

- **Pack Hunting** – Wolves, lions, and wild dogs hunt in groups to overwhelm larger prey.
- **Ambush Hunting** – Crocodiles and leopards lie in wait, using patience and stealth to launch surprise attacks.
- **Luring Techniques** – Some predators, like anglerfish, use bioluminescent "bait" to attract unsuspecting prey.
- **Trap Setting** – Spiders weave webs to capture insects, while pitcher plants use modified leaves to trap prey.

Adaptations of prey to avoid predators

Physical Defenses

- **Camouflage** – Many animals blend into their surroundings to avoid detection. Examples include chameleons, leaf insects, and Arctic foxes in snowy environments.
- **Mimicry** – Some species imitate dangerous or toxic organisms to deter predators, such as harmless butterflies resembling poisonous species.
- **Protective Structures** – Armored bodies, spikes, and tough shells help prevent attacks. Examples include porcupines, pangolins, and tortoises.

Behavioral Strategies

- **Speed & Agility** – Many prey animals, like gazelles and rabbits, rely on quick movements to escape from predators.
- **Herding & Flocking** – Group behavior helps animals avoid predators through confusion and collective defense, seen in zebras, fish schools, and bird flocks.
- **Playing Dead** – Some animals, like opossums, pretend to be lifeless to discourage predators that prefer live prey.

Chemical & Sensory Defenses

- **Venom & Toxins** – Some prey species release toxic chemicals or venom to repel attackers, like poison dart frogs and skunks.
- **Emitting Sounds** – Some animals, such as warning calls in meerkats or ultrasonic distress signals in insects, communicate danger to deter predators.
- **Bad Tasting or Smelly Secretions** – Certain prey, like millipedes and sea cucumbers, produce foul-tasting or stinky substances to avoid being eaten.

Mutualism

Examples of mutualism associations

Root nodules of a legume Micorrhiza and tree roots Lichen

Mutualism is an association between two organism of different species in which both organisms benefit. Sometimes both organisms become so dependent on each other that they are unable to survive independently. Examples of mutualism associations are nitrogen-fixing bacteria in legumes, lichen and mycorrhiza.

(i) The nitrogen-fixing bacteria (Rhizobium) are found in the root nodules of leguminous plants. In this association, the Rhizobium obtain food, shelter and protection from leguminous plant while plant get nitrates fixed by bacteria.

(ii) Bacteria and protozoa in the rumen of ruminant animals: These microorganisms secrete cellulose digesting enzyme that breakdown cellulose to glucose in the rumen of ruminant. In return, the micro-organisms get shelter and also use part of the digested food in the rumen.

(iii) **Mycorrhiza** refers to the symbiotic association between fungi and plant roots, benefiting both organisms. The fungi help the plants absorb nutrients, especially phosphorus, while the plants provide carbohydrates to the fungi.

(iv) **Lichen** is an association between algae and fungi. In this association, the fungi depends on oxygen and carbohydrates produced by algae during photosynthesis. On the other hand, the algal gets water, carbon dioxide, mineral salt and protection from dessication, from the fungi

Commensalism

Examples commensalism

Barnacles on Whales | Epiphytic Plant on Tree | Nest on a tree | Cattle Egrets & cows

This is a relationship between two organisms. One of the two organisms, the commensal benefits from the association, while the other organism usually the larger partner, neither lose nor gain. Examples of commensalism include

Barnacles on Whales – Barnacles attach to the skin of whales, gaining transportation and access to nutrient-rich waters, while the whale remains unaffected.

Epiphytic Plants & Trees – Some plants, like orchids and bromeliads, grow on trees for support and access to sunlight without taking nutrients from the tree.

Birds Nesting in Trees – Birds build nests in tree branches for shelter, but the tree itself experiences no harm or benefit.

Cattle Egrets & Livestock – Egrets follow grazing cattle, feeding on insects stirred up by the animals' movements without affecting the cattle.

Parasitism;

A parasite is an organism that lives on or in another organism from which feed. A parasite which lives on the surface of its host is called an **ecto-parasite** and that lives inside it's called an **endoparasite**. Most species, including human, harbor parasites that reduce their health and may cause death.

Challenges faced by a parasite

(i) Locating a new host
(ii) Overcoming host rejection
(iii) Entering a host

Parasitic adaptations

Parasite show many different adaptations of overcoming these challenges, depending on whether they are ecto-parasites (e.g. tick)or endo-parasites (tapeworm).

(i) Many endoparasites show degeneration, or even total loss of certain organs which reduces their energy and material requirements and hence a reduced

burden on their host. For example, gut parasites like the tapeworms lack an alimentary canal.

(ii) Many parasites especially ecto-parasites have attachment devices such as sucker, hooks or anchors enabling them to cling to the host. Tapeworm has hooks and suckers to anchor on host digestive canal.

(iii) Some parasites have penetrative devices for gaining entrance into the host and its cells. For example, miracidum larva of the liver fluke, has a slender tip on to which open a group of glands which secrete tissue- digesting enzymes. By softening the tissue, the enzyme enables the larva to bore into the foot of a freshwater snail the intermediate host.

(iv) Gut parasite live in a particularly hazardous environment. They typically have protective device which protects their being harmed by the host's digestive processes. These devices include the possession of a thick protective cuticle, the secretion of large quantities of mucus and the production of inhibitory substances which locally inactivate the host's digestive enzymes.

(v) To protect themselves from the host's immune system, some parasites such as the blood fluke, schistosoma, that cause, bilharzia, synthesizes chemicals, which switch of the host's immune system; The parasite coat's itself with molecules which the host recognizes as self.

(vi) Parasite overcome a problem of moving from one host to another by a number of strategies, one of which is to wait until the host mates. The various organism responsible for sexually transmitted diseases in human spread in the same manner

(vii) Many parasites employ a secondary or intermediate host which conveys the parasite from one primary host to another. Thus, the Anopheles mosquito transfers the malaria parasites from one person to another.

(viii) To raise the probability of success vast number of offspring are produced

(ix) The parasites may have a dormant resistant stage in its life cycle to survive adverse conditions until a suitable host is found.

(x) Some parasites are closely linked with their host that their tissue are actually interconnected.

E.g., certain plant parasites such as mistletoes plug into other plants and tap off nutrients from the host's tissue.

Importance of parasites

Parasites might have a bad reputation, but they play crucial roles in ecosystems and even benefit human health in some ways. Here's why parasites are important:

Ecological Balance

- **Regulate Populations** – Parasites help control host populations, preventing species from becoming overly dominant.
- **Increase Biodiversity** – By influencing food chains and predator-prey interactions, parasites contribute to greater ecosystem diversity.
- **Drive Evolution** – Host species develop adaptations to resist parasites, leading to evolutionary changes and stronger immune systems.

Medical & Scientific Benefits

- **Potential Treatments** – Some parasites, like hookworms, are studied for their ability to modulate the immune system and could help treat allergies and autoimmune diseases.
- **Research in Disease Control** – Parasites help scientists understand disease transmission, aiding in the fight against malaria, sleeping sickness, and other illnesses.
- **Diseases:** Some parasites cause diseases for example malaria, bilharzia, nagana and sleeping sickness.

Environmental Role

- **Decomposers & Nutrient Cycling** – Some parasites contribute to breaking down dead material, playing a role in nutrient recycling.
- **Indicators of Ecosystem Health** – The presence or absence of certain parasites can signal environmental changes, helping scientists monitor ecological health.

Questions

1. Match the associations with their correct meaning using line

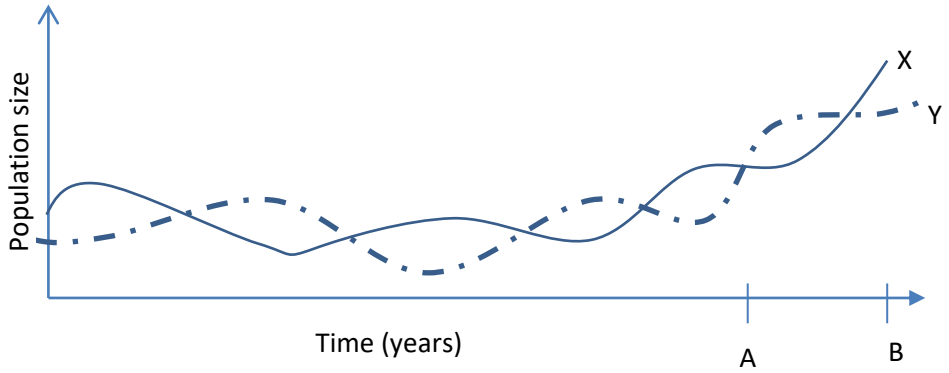
Parasitism	is an intimate association or relationship between two or more organisms of different species
Commensalism	is an association between two organisms of different species in which both organisms benefit
Mutualism	is a relationship between organisms of different species in which one benefits and the other organism neither benefits of is harmed.
Symbiosis	is an association between two organisms of different species in which one organism obtains nourishment from another organism which suffers harm

2. The population of two animal species A and B in a game park was monitored by a warden, after four weeks, for a period of thirty-two weeks. The population of each animal species was recorded in the table below. Use the information in the table to answer the questions that follow.

Time (weeks)	4	8	12	16	20	24	28	32
Population of animal A	10	20	28	330	20	10	22	32
Population of animal B	5	10	15	25	28	15	11	20

(a) Represent the above information on a suitable graph.
(b) Identify the animal which represents a prey and one that represents predator.
(c) Give reasons for your answers in (b) above
(d) Explain the changes in animal population with time

3. Figure 6 shows changes in the size of a population of a producer and consumer in a lake over time.



(a) State which curve represents the

(i) Producer

(ii) Consumer

(b) Explain the interaction between the two populations before point A.

(c) Suggest how human activities could result in the interaction of the population between points A and B