ECOLOGY

Ecology is the study of organisms in relation to their environment.

Definitions of terms used in ecology.

1. **Environment:** This refers to everything in the surrounding of an organism that influences its life. The environment of a tadpole for example is everything in the water where it lives.
2. **Biosphere:** This is the part of the earth and its atmosphere that is occupied by living things or where life exists. It's the largest habitat.
3. **Habitat:** This is a place where an organism lives. In the habitat, the organism obtains water, shelter and it is able to reproduce there. The habitat of a tapeworm is the mammalian intestines.
4. **Population:** This is the total group of organisms of the same species living in a particular place at a given time.
5. **Ecological niche:** This refers to a particular place an organism occupies within a habitat and the role it plays there.
6. **Community**: This is a collection of populations living and interacting with non-living components. It is therefore the total of all organisms in an area.
7. **Autecology:** This is the study of only one species of organism in relation to its environment, e.g. the study of a frog in relation to its habitat.
8. **Synecology**: This is the ecological study of a community of plants and animals in a particular area.
9. **Ecosystem:** This is a unit of the environment consisting of both living (biotic) and nonliving (abiotic) components interacting to form a self-sustaining unit. E.g. living things may include fish, cockroaches, and nonliving things may include lake, pond, forest, etc.

The two major factors within an ecosystem include:

- ✓ The flow of energy through an ecosystem.
- ✓ Cycling of matter within an ecosystem.

COMPONENTS OF AN ECOSYSTEM

The ecosystem is made up of two components;

1. The abiotic component (nonliving component)
2. The biotic component (living component)

THE ABIOTIC COMPONENT OF THE ECOSYSTEM

This is the non-living component of the ecosystem. Living organisms interact with the non-living components in their community to form a self-sustaining unit called an ecosystem.

The abiotic components in the ecosystem include the soil factors (edaphic factors).

Edaphic factors:

These are physical and chemical factors in soil and atmosphere that influence the life and activities of living organisms. These factors affect different organisms differently. Such factors include.

1) **Light intensity**. Light intensity affects the process of photosynthesis in plants, visibility in some animals and causes responses such as phototropism.
2) **Temperature**. This affects the activity of enzymes in the body of organisms and therefore determines the overall activity of an organism. Temperature also affects germination of seeds.
3) **Water**. This is a very important edaphic factor. Water is a component of the bodies of living organisms. It is a raw material for photosynthesis, it aids dispersal of seeds, it is an agent of pollination, it is a habitat for some organisms, it is a condition for germination, etc.
4) **Humidity**. This is the amount of water vapour in the atmosphere. Humidity affects the rate of transpiration in plants; it also affects the rate at which water is lost from the bodies of animals through evaporation.
5) **PH**. This is the alkalinity or acidity of soil. PH affects the dissolution of mineral elements in water; it affects growth of plants and microbes in an area, etc.
6) **Nutrients**. Presence or absence of a particular nutrient in soil determines the organisms, which can grow in that soil. Nutrients are required for proper growth of all organisms in the ecosystem.
7) **Oxygen concentration**. Most of the organisms are aerobic, i.e. they require oxygen for their respiration. Oxygen is abundant in air (21% by volume) however in water the concentration of oxygen varies due to factors that affect its dissolution in water and over exploitation by organisms. This affects the growth of organisms in water. In such a case anaerobic organisms can thrive and aerobic ones die.

BIOTIC COMPONENTS

This is made up of living organisms in the ecosystem. They are categorized into the following.

i) Producers

These are green plants and some bacteria that are able to manufacture their own food by use of light, chlorophyll, Carbon dioxide and water in the process called photosynthesis and chemosynthesis. They are nutritionally referred to as autotrophs.

ii) Consumers

These are organisms, which are not capable of manufacturing their own food. The consumers get their food by feeding on other organisms.

LEVELS OF CONSUMERS

Consumers are classified into feeding levels called trophic levels. The classification is based on the type of food they feed on.

The feeding levels/trophic levels of consumers include:

- ✓ Primary consumer
- ✓ Secondary consumer
- ✓ Tertiary consumer

The primary consumers (1st order consumers):

These are organisms that feed directly on plants (producers). They are called herbivores. Examples are cattle, grasshoppers, goats, sheep, etc.

The secondary consumers (2nd order consumers):

These are organisms that obtain their food by feeding on primary consumers. They are also referred to as carnivorous organisms since they feed on flesh. Examples include cats and reptiles.

The tertiary consumers (3rd order consumers):

These are organisms that obtain their food by feeding on the flesh of secondary consumers. These are usually big carnivorous animals like lions, crocodiles, vultures and tigers.

iii) The decomposers

These are organisms that feed on dead decaying organic matter. They are commonly called saprophytes. The major examples are bacteria and fungi. Decomposers are important because they bring about decay of plant and animal tissues. This helps in the recycling of materials in the soil.

They also reduce the amount if wastes and litter in the environment

BIOTIC INTERACTIONS

Each category of feeding is known as a trophic level. Feeding methods are useful in showing the relationship that exists in a community by means of food chains and food webs.

TYPES OF FOOD RELATIONSHIPS

FOOD CHAIN

This is a feeding relationship between organisms showing which organism feeds on what. It is always expressed in a linear fashion beginning with primary producers and ending with tertiary consumers.

Organisms at the beginning of a food chain are usually numerous while organisms at the end of the food chain are often large and few in number.

The food chain shows the passage of energy from producers to consumers. Energy from the sun is fixed by producers (plants). The herbivores eat the plants and obtain this energy. The carnivores feed on herbivores and obtain this energy. At successive levels some energy is lost. At the end of the food chain energy reduces.

Example 1:

Grass ⟶ grasshopper ⟶ dove ⟶ cat

In the food chain above, the grass is the primary producer, the grasshopper is the primary consumer, the dove is a secondary consumer and the cat is a tertiary consumer.

Arrows are used to show the movement of energy from one organism to another. Energy moves from the producers to tertiary consumers through the food chain.

Chemicals on the other hand accumulate in tissues and increase in succeeding levels in the food chain.

Elimination of one level from the food chain disrupts the food chain. For example in the above food chain, when the grasshoppers are eliminated from the ecosystem, the following occur.

1) The grass grows and increases in number because the grasshopper that used to feed on it has been removed.

2) The doves lack food because they feed on grasshoppers, which have been removed. This causes their numbers to drop.
3) The cats also reduce in number because as the doves die due to lack of food, the cats lack food and start to reduce because they feed on doves.

Example 2

Draw a food chain for the following organisms;

a) Vegetation, beetle, owl, fox

Vegetation → beetle → owl → fox

a) cow, man, lion and grass.

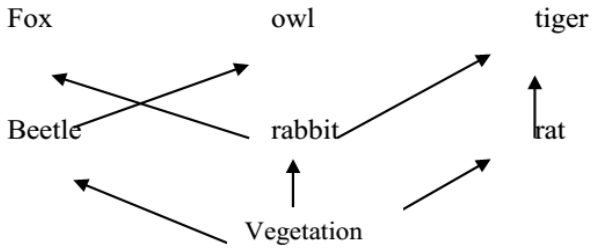
Grass → cow → man → lion

b) Nile perch, algae, water flea and tilapia

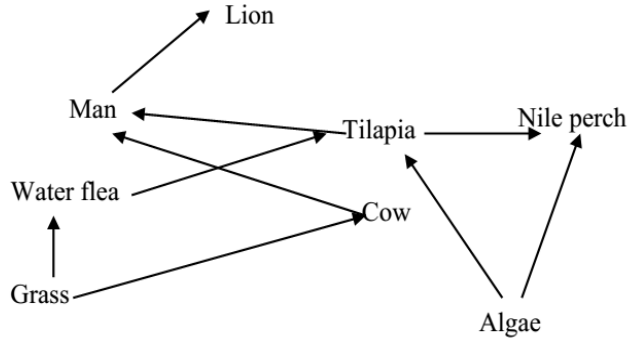
Algae → water flea → tilapia → Nile perch

FOOD WEB

A food web is a number of interlinked food chains. From the above food chains in example 1 and example 2a, the food web below can be obtained.



From the food chain b and c in example 2 above, the food web below can be drawn.



Note.

When drawing the food web, the organisms should be arranged in trophic levels. The produces should be at the bottom followed by primary consumers and tertiary consumers at the top of the food web.

ECOLOGICAL PYRAMIDS

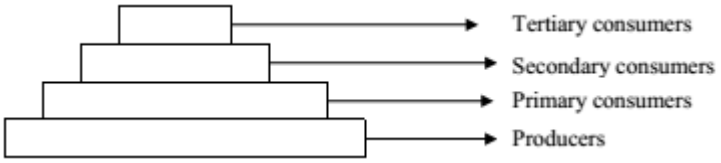
These are used to show either the number of organisms or energy present at each level in the food chain and food web. There are three types of pyramids namely;

1) Pyramid of numbers
2) Pyramid of biomass
3) Pyramid of energy

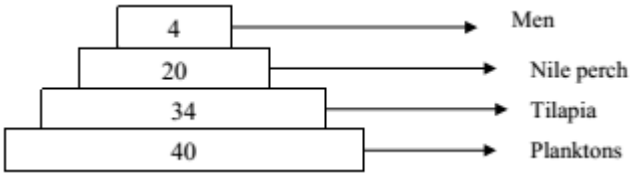
Pyramid of numbers

This is used to show the number of individuals at each trophic level.

The number of organisms at each trophic level is counted and a pyramid is drawn with the primary producers at the base. The width of each rectangle represents the number of organisms at each trophic level.

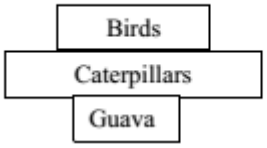


Example 1: Draw a pyramid of numbers for 20 Nile perch, 40 planktons, 34 tilapia, 4 men

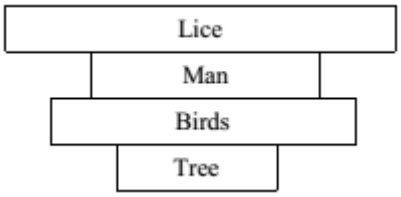


Example 2: Draw a pyramid of numbers for the food chain below.

1 Guava plant → 100 caterpillars → 20 birds



A big fruit tree may have several birds feeding on a fruit, man may be an alternate consumer of the birds while at the same time, several lice may be parasites to man. The pyramid of numbers of such a chain may have the following form.



The problem with the pyramid of numbers is that it does not account for size of the organism at each trophic level. For this reason the pyramid of biomass is used.

Question:

Husnah carried out an ecological study in Kabowa. In one of the sections, she found 15 toads, 180 plants, 4 snakes and 120 grass hoppers. Use the information to answer the questions.

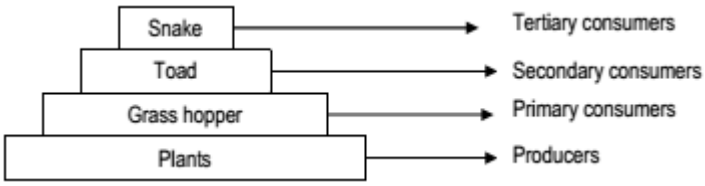
a) Construct a possible food chain for the above information.
b) State the trophic levels occupied by each of the organisms in the community.
c) Draw the pyramid of number for the community.
d) Explain what would happen to the rest of the organisms if all toads were destroyed.

Solution:

a) Plants grass hopper toad snakes

b) Plants – producers
Grass hopper – primary consumer
Toad – secondary consumer
Snake – tertiary consumer

c) Pyramid of numbers



d) The number of grass hopper increases and that of plants decreases due to the increase in the number of grass hopper.

Pyramid of biomass

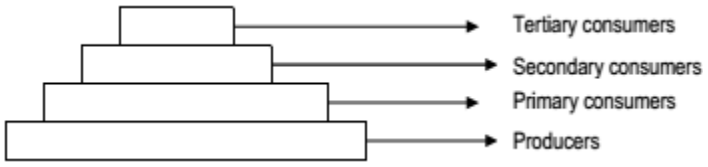
This gives the mass of the organism at each trophic level. Biomass refers to the mass of a living organism. Biomass decreases from producers to tertiary consumers. Producers have a higher biomass than all other trophic levels.

Considering the food chain in the **example 2,** above, the pyramid of biomass would be.

Even if the guava is one, it has a bigger biomass than caterpillars and caterpillars have a larger biomass than birds.

In most cases the pyramid of bio mass is constructed using dry weight of organisms. This is because the fresh mass of an organism varies so much with water content.

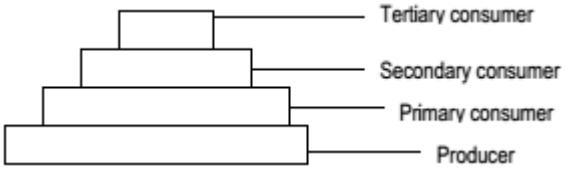
Dry weight is the mass of an organism without water.



The problem with biomass is that it varies greatly as the organism grows. Using a pyramid of energy can solve this problem.

Pyramid of energy

This shows the amount of energy at each trophic level. Energy decreases with succeeding trophic levels. Producers contain more energy than tertiary consumers. The pyramid of energy gives the most accurate representation.



Energy flow in an ecosystem

Energy flows through food chains and food webs. Energy is obtained from the sun by green plants.

The plants trap light energy and use it to carry out photosynthesis. During photosynthesis, light energy is converted into chemical energy. When primary consumers eat the plants, they obtain this energy. The energy is then passed on to other organisms through their feeding relationships.

At each trophic (feeding) level there is loss of energy because;

i) Some energy is used up during respiration.
ii) Some energy is lost from herbivores in form of indigestible plant material.
iii) Some organisms die before they are eaten.
iv) Some of the chemical energy is converted into other forms such as sound, light energy, heat energy, which easily escapes from the organisms.

At each trophic level, decomposers (saprophytes) such as bacteria and fungi break down dead organic matter to release some of the energy locked in it.

POPULATIONS

Population is the total number of organisms of same species living in a particular area at a given time.

Organisms live in a population in order to:

- ✓ Gain more protection as the population
- ✓ Have increased chances of gathering mates and breeding.
- ✓ Ability to get shelter

However organisms in a population face:

- ✓ High chances of overcrowding
- ✓ High competition among themselves for food, shelter, etc.
- ✓ Increased chances of predation.

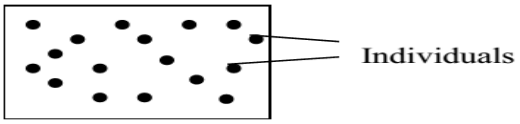
PATTERNS OF POPULATION DISPERSION

The distribution of individuals in an area is known as population dispersion. It refers to the way individuals in a population are distributed in a particular area in which they are living.

Types of population dispersion

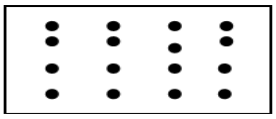
1. Random dispersion.

This happens when the environment is uniform throughout the area and therefore there is no tendency to aggregate. There is no particular order of distribution



2. Uniform dispersion.

This occurs when competition is very high due to scarcity of resources and the organisms are evenly distributed in all parts of the environment.



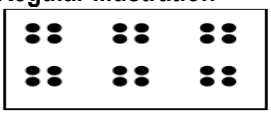
3. Clumped dispersion

Here organisms are found in high numbers in particular areas and low numbers in other areas. This results from:

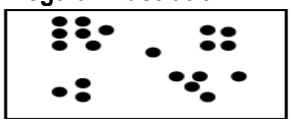
1. Self-dispersal
2. Resources being clumped
3. Tendency of individuals in an area to live together.
4. Territorial behaviour
5. Aggregate behaviour where organisms feed together in a group.

There are two types of clumped dispersal.

Regular illustration



Irregular illustration



Importance of distribution

- Individuals acquire themselves enough space within which they can live and breed i.e. a home with enough resources and suitable breeding resources.
- It improves on the chances of obtaining a mate.

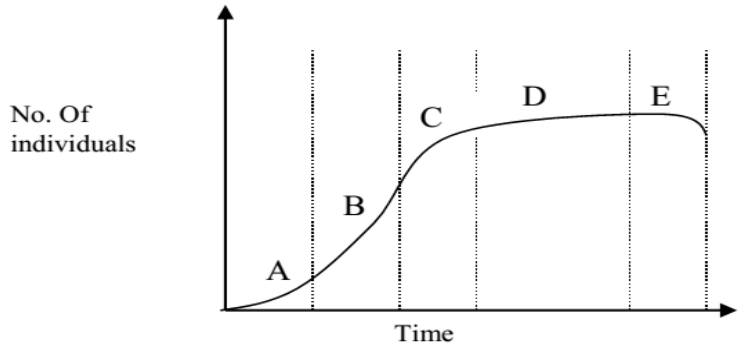
POPULATION GROWTH

This refers to the increase in number of organisms of the same species. Growth takes place when the birth rate is higher than the death rate. The increase in number over a period of time when plotted on a graph makes what is known as a growth curve.

Carrying capacity:

This is the total population the environment can support at a particular time without exhausting the resources.

The population growth curve



The growth curve is S-shaped and it is referred to as a sigmoid curve. It is divided into five phases.

Phase A: In this phase the rate of growth is low because the numbers of organisms multiplying are few and the organisms are still adapting to the conditions.

Phase B: The rate of growth increases because the number of reproducing organisms has increased and the organisms have adapted to the conditions.

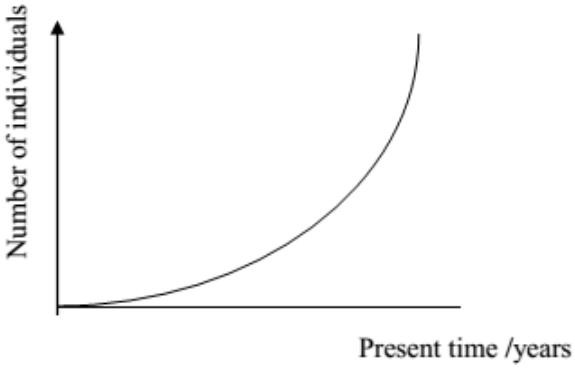
Phase C: The rate of growth starts to slow down as the organisms start to die. This is due to the fact that their number has become big and they have started competing for food, shelter, mates and space. The available resources cannot support a big number of organisms.

Phase D: In this phase, the rate of birth is equal to the rate of death hence the population remains constant.

Phase E: The population is declining because the rate of birth is lower than the death rate. The organisms die at a higher rate due to competition between them and the exhaustion of resources.

Growth of the human population

The population is presently growing exponentially. This is shown in the human population growth curve below:



The exponential human growth is usually due to:

- ✓ Advancement in science and technology leading to prevention of infectious diseases.
- ✓ Early warning on natural catastrophes.
- ✓ Proper nutrition.
- ✓ Decrease in infant mortality.
- ✓ Increase in life expectancy in developing countries.
- ✓ Increasing agriculture hence leading to more food.

Factors affecting population growth

These factors are grouped into two categories.

1. **Density dependent factors**; these are factors whose effect depend on the size of the population, e.g. food, diseases, space, pollution, predation, competition, light, etc.
2. **Density independent factors**; these are factors which affect the population regardless of the population size e.g. earth quakes, floods, droughts, thunderstorm, lightening, fire strong winds, etc.

POPULATION SIZE

This refers to the number of organisms of the same species in a particular area at a particular time.

Factors that determine the population size

1) **Natality** (birth rate). This is the frequency of birth. Increase in natality results into increase in population size.

2) **Mortality** (death rate). This is the frequency of deaths. When the death rate increases, the population size decreases.

3) **Emigration**. This is the movement of individuals out of the population. It results into a decrease in population size.

4) **Immigration**. This is the movement of individuals into the population. It causes the population to increase.

METHODS OF ESTIMATING POPULATION SIZE

1. Direct count

This is suitable for large organisms living in an open habitat, e.g. elephants, lions and buffaloes. In this method, one moves through the area along predetermined paths and counts the organisms in question. When counting aggressive animals, a low flying aircraft is used. Several counts are made and an average is taken to get an estimate of a particular area.

2. Aerial photography

This is suitable for large organisms living in an open area. Photographs are taken from a low flying aircraft over the study area. When the photographs are developed the number of organisms in the photographs is determined. The photographs are taken several times and the average number is taken for the population of that particular organism in the area.

3. The quadrat

This is a method used for small static organisms like plants or slow moving animals. A quadrat is a square metal or wooden flame of 1-meter long sides. It therefore encloses an area of $1m^2$. The quadrat is thrown at random in the study area and the individuals covered counted. Several quadrats are thrown at random and the average number of organisms is taken.
The average number is then multiplied by the total area of the study to get the estimated population.

4. Line transect method:

This method involves lying along measuring tapes along a selected strip within the habitat. A record is made of the organisms touching or covered by a line at all points at regular intervals.

5. Capture mark recapture method:

This is suitable for animals, which are fast moving. E.g. rats and grasshoppers.
In this method animals in an environment are captured and counted (n_1). They are then marked and released back into the environment.
The traps are then laid after a given period of time.
The organisms captured are counted (n_2).
The organisms that were marked and recaptured are also counted (n_3). The population is then calculated from:

Total population $= \frac{number\ of\ individuals\ in\ 1st\ capture \times number\ of\ individuals\ in\ 2nd\ capture}{number\ of\ individuals\ in\ 2nd\ capture\ with\ a\ mark}$

$P = \frac{n1 \times n2}{n3}$

Where;

P = population
n_1 = number in the first capture
n_2 = number in the second capture
n_3 = number in the second capture which are marked.

Examples

1. 30 rats were caught in the bush around the school. They were all marked with ink on the tails and released. After 3 days 20 rats were caught from the same area. 6 out of the 20 rats had a mark. Estimate the population of rats in this bush.

Solution.

Using $P = \frac{n1 \times n2}{n3}$

P = population.
n_1 = 30
n_2 = 20
n_3 = 6

$P = \frac{30 \times 20}{6}$

= 100 rats.

Assignment:

Arthur captured and marked and replaced 45 cockroaches on the first day. She captured 26 cockroaches from the same area 17 of which were not marked. Estimate the population in the area.

INTERACTIONS BETWEEN POPULATIONS

Individual organisms in the population do not live in isolation in a community. They are continuously interacting with each other in the following ways:

- ✓ Competition
- ✓ Predation
- ✓ Symbiosis

COMPETITION

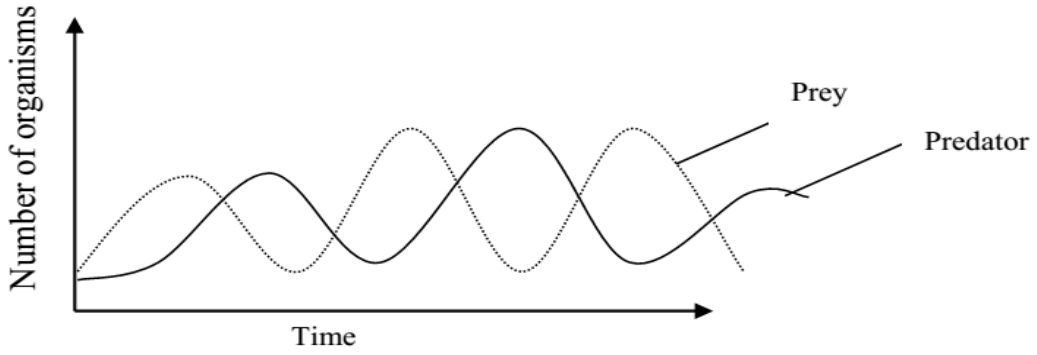
As the population of the individuals increase, the resources become limited and the organisms compete for them. Examples of resources competed for include, food, space, mates, etc. Competition is of two types;

1. **Interspecific competition**; this is the competition between organisms of different species, e.g. the competition between goats and cattle for pastures.
2. **Intraspecific competition**; this is the competition between organisms of the same species, e.g. the competition between goats for grass.

PREDATION

This is the relationship between a predator and the prey.
A predator is an organism that hunts and kills another organism (prey) for food.
A prey is an organism that is hunted and killed for food.

The graph showing the predator-prey relationship



Description and explanation of the graph:

The population of the prey is higher than that of the predator at the start. This leads to an increase in the number of predators.

The prey reaches a peak earlier than the predators. Further increase in the predator population leads to a decrease in the prey population due to the fact that they are being fed on by the predators. When the number of prey goes down, the predators starve and this makes their population to go down. When the predator number decreases below that of the prey, the population of the prey increases again due to the fact that the predators are few which would feed on them.

Note. Both the predator and prey control the population of each other.

Adaptations of predators that enable them to feed on prey

i) They have keen eyesight to see their prey.
ii) They have strong jaw muscles to tear flesh of the prey.
iii) They have sharp claws to hold and kill their prey.
iv) They move very fast to enable them chase the prey.
v) They have streamlined bodies to cut through air during movement.
vi) Some have very sharp canines to tear flesh of their prey.
vii) They have colours, which help them to camouflage.

Adaptations of the prey to avoid being eaten by predators

i) They perceive sound with high accuracy and are able to sense their predators at a distance.
ii) They are very fast in movement to escape from their predators.
iii) They have developed structures for defense such as horns.
iv) They normally move in groups to scare their predators.
v) They prefer to stay in areas, which give them good visibility such as grasslands.
vi) They have colours, which help them to camouflage.

vii) Mimicry; this is where a palatable harmless organism attains colours of an unpalatable harmful organism and it is confused for a harmful organism.

SYMBIOTIC FEEDING RELATIONSHIPS AMONG ORGANISMS

1. Mutualism:

This is the relationship between two organisms of different species in which both organisms derive benefits from the association.

Examples

i) In the stomach of cattle and sheep there are bacteria. These bacteria help to digest cellulose, which is used by the cow. The bacteria benefits by getting food and shelter from the cow.
ii) The nitrogen-fixing bacteria in root nodules of leguminous plants. The bacteria provide nitrates to the plant by converting nitrogen to nitrates and the bacteria are protected in the root nodules. The bacteria may also use sugars produced by the plant during photosynthesis.
iii) The lichen is composed of a fungus and filament of algae. The fungus provides water and mineral salts to the algae and the fungus benefits by using the sugars produced by the algae.

2. Commensalism:

This is the relationship between the organisms of different species in which only one organism (commensal) benefits but the other organism neither benefits nor loses.

Examples.

i) The shark and the ramora. The ramora is a small fish that lives as a commensal attached to the shark by its sucker. When the shark feeds, the ramora feeds on left overs of the shark. The shark neither benefits nor loses.
ii) The cattle/buffalos and the egret. The egret gets food in form of insects forced to fly by grazing animals. The cattle do not gain and do not lose.

3. Parasitism:

This is the association between two organisms in which one (the parasite) is nutritionally dependent on the other (host). The host is harmed in the process.

Parasites are divided into two categories:

i) **Endo-parasites;** these are parasites that live inside the body of the host, e.g. plasmodium and HIV
ii) **Ecto-parasites;** these are parasites which live outside the body of the host, e.g. ticks, lice and flea.

Parasites can also be described as:

Obligate parasites; these are parasites which cannot live without their hosts. Examples of obligate parasites are plasmodium and HIV.

Facultative parasites; these are parasites that can spend some time outside the bodies of their hosts. E.g. Ticks.

Incidental parasites; these are organisms that are not usually parasite but may become parasitic due to factors like lack of their normal food, increase in their numbers, etc. an example is *Entamoeba gingivalis*.

Problems faced by parasites

i) Finding the host may be difficult since most hosts keep on moving from one place to another.
ii) Deficiency of food in case the host has similar deficiency.
iii) They may be killed by the hosts' immune reactions.
iv) Death of parasites incase the host dies due to starvation.
v) Inabilities to live in a wide range of environment since most of them have low power of locomotion i.e. they are not able to live freely.

To overcome some of these problems, the parasites have a number of adaptations so as to cope up with their mode of life.

General adaptations of parasites

i) They have means of attachment to the host.
ii) They have penetrative devices for entering and feeding on the host
iii) They show degeneration of unnecessary organs and systems to reduce on their body size in order to fit in the host. e.g. eyes
iv) They produce many eggs, seeds or spores to enhance their survival.
v) They have vector intermediate hosts
vi) They produce resistant stages to survive in periods when they are outside the host

Types of hosts

1. **Intermediate host:** This is the host in which the larvae stage of parasites develops from secondary host.
2. **Primary host (infinite host):** This is the host in which sexual reproduction of a parasite occurs from.

EXAMPLES OF PARASITES

1. PLASMODIUM

This is a protozoan parasite that causes malaria. It is transmitted from one person to another by the female anopheles mosquito. The mosquito acts as the vector.

Life cycle of plasmodium

- ✓ Mosquitoes bite a human and inject saliva to stop blood from clotting in its alimentally canal.
- ✓ In the process hundreds of parasites are moved from the mosquito into the person.
- ✓ The parasites move to the liver through the circulatory system.
- ✓ They burrow in the liver cells and reproduce very fast.
- ✓ Within one to two weeks, the daughter cells break out of the liver and move to invade the red blood cells.
- ✓ In the red blood cells they reproduce rapidly causing the cells to rapture and invade other red blood cells.
- ✓ They then attack new red blood cells causing them to rapture also.
- ✓ If a mosquito sucks blood from an infected person, it will take up these parasites in the red blood cells.
- ✓ The parasites reproduce in the mosquito and migrate to the salivary glands ready to infect the next person when that mosquito bites.

Note.

Each time the daughter cells of plasmodia are released, thousands of red blood cells rapture and the patient experiences chills accompanied by shivering and sweating. The patient may also become anemic due to loss of red blood cells.

2. TAPEWORM

These are flatworms belonging to phylum Platyhelminthes. There are two common species known.

i) Taenia sagnata (beef tape worm)
ii) Taenia solium (pork tape worm)

They live in the small intestine of humans attached to the wall of the small intestine by hooks and suckers. They absorb nutrients from the digested food.

Life cycle of a tapeworm

- ✓ Within the infected human being, the segments containing fertilized eggs break off and pass out in faeces.
- ✓ These eggs then tend to become attached to leaf blades of vegetation.
- ✓ When the eggs are eaten by the pig or cow depending on the species of the tapeworm, they develop into embryos.
- ✓ The released embryos burrow through the intestinal walls into the blood, which transports them to the muscles.
- ✓ If uncooked or partially cocked, meat from an infected cow or pig is eaten, the bladder worms are released in the intestines where they develop into tapeworms.
- ✓ Within the muscles they develop into bladder worms.

Control

1. Avoid eating raw or half cooked meat.
2. By regular de-worming of infected individuals
3. By proper disposal of wastes
4. Inspection of meat before it is considered fit for human consumption.

Adaptations of tapeworms to parasitic life

i) They have lost the alimentally canal hence absorb already digested food over the entire body surface by diffusion.
ii) They have a thick cuticle to prevent attack by digestive enzymes of the host.
iii) They produce substances that inactivate the enzymes of the host.
iv) Each mature proglotids of the tapeworm contains both male and female reproductive organs (hermaphrodites) hence fertilizes itself.
v) They produce large numbers of eggs to ensure their survival.
vi) They have suckers for attachment to intestinal walls. This prevents the tape worm from being dislodged by host peristaltic movements
vii) They have resistant stages in their lifecycles with secondary and intermediate hosts to ensure survival during adverse conditions.

viii) There is loss of unwanted organs like locomotive organs, eyes, etc. to ensure that they occupy as little space as possible within the host.
ix) They have the ability to respire anaerobically and can survive in an oxygen free environment.

3. SCHISTOSOMES

These are flat worms known as flukes. They are parasites that cause bilharzia (schistosomiasis)

Control

i) Boil all the water for drinking and bathing
ii) Proper disposal of faeces and all wastes
iii) Kill snails using chemicals
iv) Treatment of water in swimming pools
v) Drain water around homes.

ECOLOGICAL SUCCESSION

This is the successive replacement of organisms in a community from simple one to the most complex ones gradually. This is a gradual change in the composition of organisms in the area. There are two types of succession i.e. Primary succession and Secondary succession

Primary succession

This is a type of succession where life begins from a bare rock or new pond, which has never been occupied by living organisms before. The pioneer plants in such areas are those, which can with stand dry conditions with low water content and high temperatures. The first organisms to inhabit such an area are called pioneer organisms.

Stages of succession on a bare rock

Stage 1: The lichens grow on bare rock. When they die, they decompose to form a thin layer of soil, which traps some moisture.
Stage 2: Mosses start growing on the soil formed by the decayed lichens. When the mosses die, they decay to form more soil.
Stage 3: The soil formed favours the growth of ferns.
Stage 4: Grasses start to grow due to coming in of favourable conditions such as moisture, enough soil for anchorage of the plants. During this stage some rodents may start coming in.
Stage 5: Shrubs are formed and they finally develop into trees. The trees form the climax community after which no other changes take place.

Lichens. Pioneer → Mosses → Ferns → Grasses → Shrubs → Trees. Climax community

Succession in a new water pond

Floating plants → Papyrus → Trees (forest)

It takes several years for a climax community to be established. Any disturbance at any one level causes the process of succession to go back to the initial stages and it later on re -establishes. The ability of the community to re-establish after a disturbance is known as **resilience**.
A **climax community** is the final steady community that develops at the end of the succession process.

Characteristics of primary succession

- ✓ A pioneer community has very few species of plants and animals.
- ✓ The pioneer vegetation is shallow rooted
- ✓ The pioneer community colonizes a bare rock.
- ✓ It takes a long time to reach the climax community.

Secondary succession

This is a type of succession, which takes place in an area, which has ever been occupied by organisms and destroyed by disasters like fire, floods and human activities. This type of succession is faster than primary succession.

Characteristics of secondary succession

- ✓ The pioneer community has a variety of plant and animal species.
- ✓ It takes a short time to reach the climax community

- ✓ The pioneer vegetation is of higher plants which are deep rooted.

FIRE AS AN ECOLOGICAL FACTOR

Effects of fire to the ecosystem

This is measured in the destruction made and it depends on the following factors.

1. Kind and amount of burning fuel e.g. grass generates less heat compared to wooden materials hence is less destructive.
2. Weather conditions. Fire is spread very fast in dry conditions and thus destroying a wide area of the eco system than in cold conditions. In cold conditions, fire spreads very slowly due to the high humidity hence causing less destruction.
3. Direction of wind. The effect of fire is great to the ecosystem if it's burning against the direction of wind (back fire) because it burns in a particular area for a long period of time compared to forward fire.

Merits of fire

- ✓ It breaks seed dormancy due to hard seed coat leading to fast germination.
- ✓ It increases recycling of nutrients in an ecosystem.
- ✓ It is used in selective weeding.
- ✓ It controls pests and diseases.
- ✓ It improves on herbage in an area.
- ✓ It improves on light penetration leading to rapid under growth in the forest.
- ✓ It improves on the visibility of the prey to predators by burning the vegetation cover down.

Demerits of fire

- ✓ It destroys the habitat of animals which may cause extinction of some animals.
- ✓ It causes air pollution
- ✓ It destroys green plants which are producers of the community.
- ✓ It destroys animals in the ecosystem.
- ✓ It increases predation due to improved visibility.
- ✓ It leads to loss of some nutrients from the soil by decomposition e.g. humus and nitrates.

Forests as a renewable resource

Forests are renewed by afforestation and avoiding deforestation.

Ecological importance of forests

- ✓ They act as habitats of organisms.
- ✓ Source of food to organisms.
- ✓ Used in rain fall formation, this improves on the climate of an ecosystem.
- ✓ It forms soil by dropping litter which helps in decomposition into humus.
- ✓ Maintains plants and animal diversity.

Ecological effects of deforestation

- ✓ Destruction of habitats of animals.
- ✓ It leads to soil erosion
- ✓ It leads to desertification.
- ✓ It increases CO_2 content in the atmosphere.
- ✓ Increases predation due to removal of vegetation cover.

Importance of forests to wild life conservation

- ✓ They are sources of food to animals
- ✓ They are habitats to animals.
- ✓ Formation of rain falls to prevent drought.
- ✓ Reduces soil erosion thereby conserving soil fertility.
- ✓ Maintains the bio diversity for a variety of plant and animal species.
- ✓ Purifies the environment by removing CO_2 and adding oxygen.
- ✓ Provides a variety of litter that decomposes to form humus.
- ✓ Reduces predation of some wild animals.

POLLUTION

This is the addition of substances to the environment to levels that harm or destroy living components of the environment (ecosystem). Substances that can cause pollution to the environment are called **pollutants**. E.g. sewerage, fertilizers, oil links, etc.

Types of pollution

1. Water pollution
2. Air pollution
3. Noise pollution
4. Radioactive pollution
5. Sound pollution

Air pollution

The main pollutants of air or atmosphere are poisonous gases e.g. SO_2, CO_2, NO_2, and CO.

Some of these gases e.g. SO_2, CO_2, and CO form acidic components that destroy vegetation. Another air pollutant is smoke that causes poor vision, reduced light penetration, and reduction of photosynthesis by coating on plant leaves. Excess gases in the atmosphere e.g. CO_2 and CFC^s (Chloro Floro Carbon) used in fridges cause global warming.

Water pollution

This is as a result of addition of excess nutrients e.g. nitrates, phosphates, potassium to water bodies making them too nutritive leading to increased productivity of water. The highly productive lake is called eutrophic lake and the process of

polluting water bodies by adding excess nutrients is called eutrophication. The main pollutants that cause eutrophication are fertilizers.

Domestic wastes drained in water bodies, industrial wastes e.g. detergents which contain a lot of phosphates and nitrates also cause eutrophication in the lake.

Eutrophication:

This is the accumulation of nutrients (nitrates and phosphates) in a water body leading to increased growth of aquatic plants e.g. algae which decompose after death leading to a decrease of oxygen contents as a result of being utilized by decomposers of dead plants. Due to the decrease of oxygen content, in water, aquatic animals that need oxygen for respiration e.g. fish suffocate and die.

Soil pollution

Use of excess fertilizers, herbicides, insecticides pollutes the soil. Excess herbicides and insecticides lead to death of living organisms in the soil there by reducing the rate of decomposition of dead matter. Non degradable insecticides do not break down but accumulate in animals along the food chain to poisonous levels that can kill.

Activities of man that have led to the degradation of soil

i) Over stocking leading to over grazing that reduces the amount of vegetation cover to expose the soil there by encouraging soil erosion.
ii) Deforestation exposing soil to agents of soil erosion.
iii) Use of insecticides, pesticides and herbicides which cause the death of soil organisms hence affecting the rate of decomposition.
iv) Burning of vegetation that removes the vegetation cover which encourages surface run off hence leading to soil erosion.
v) Mining, construction, quarrying leads to the destruction of soil structure which encourages soil erosion.
vi) Digging or cultivating down slope also encourages soil erosion.

Radioactive pollution

This is the release of radioactive chemicals into the environment in large amounts e.g atomic substances are from atomic bombs.

Human activities that lead to environmental pollution

i) Drainage of excess untreated sewage into the water bodies causing eutrophication.
ii) Application of excess fertilizers that are later eroded in water bodies.
iii) Burning of vegetation that exposes the soil to erosion agent and it also leads to the emission of smoke which causes air pollution.
iv) Emission of excess poisonous gases in the atmosphere e.g. SO_2, CO_2 and CO form industries and automobiles which cause acidic rains.
v) Use of excess herbicides and insecticides which kill the soil organisms leading to decreased rate of decomposition.
vi) Spilling of oil onto water bodies which leads to suffocation of aquatic animals.
vii) Construction of noisy industries in town which cause sound pollution that can damage the hearing process of man.
viii) Decomposition of non-biodegradable materials into the soil e.g. plastics, glass, etc. which destroy the soil structure.
ix) Deforestation
x) Monoculture
xi) Over stocking

UGANDA'S WATER BODIES

The major water bodies in Uganda are lakes and rivers. They are pollution by sewage from industries; fertilizers used by man, oil from machines e.g. boat engines.

Water bodies are also invaded by water weeds especially water hyacinth which is a flowering plant which can also reproduce asexually and with a high rate of reproduction.

Effects of water hyacinth on water bodies

- ✓ They hinder navigation
- ✓ They habour dangerous animals e.g. snakes
- ✓ Reduction in the amount of fish in water bodies as some dies due to starvation.
- ✓ They reduce on the amount of light penetration in water column.
- ✓ Siltation of water bodies i.e. they become shallow as a result of death and decomposition of water hyacinth.
- ✓ Reduction in the amount of water in lakes as a result of increased rate of transpiration.

- ✓ They hinder smooth flow of water in lakes since they block the drainage channels.
- ✓ It has caused economic injuries to the country especially when trying to eradicate it.

Uses of water hyacinths

- ✓ Production of biogas
- ✓ Feeds for cattle and pigs.
- ✓ A good fertilizer when used as mulches.
- ✓ A good raw material for art and craft.
- ✓ Raw material for making manure.

Methods of controlling the water hyacinth

i) Physically or removing it manually by hand picking however it is not effective.
ii) By use of machines (mechanical control) however the method is effective but expensive.
iii) By using biological control methods e.g. use of bottles.
iv) Use of herbicides (chemical control) and it involves the spraying of herbicides directly onto the weed. The method is quick but has the following demerits:
    - ✓ It contaminates water
    - ✓ Destruction of aquatic life especially fish
    - ✓ Pollution of water since the weed is not completely removed but decomposes in water.
    - ✓ It is expensive since it involves the use of space air crafts to apply it.

To be completed by You