## ECOLOGY

Ecology is a branch of biology that deals with the study of organisms in relation to their natural environment. The natural environment comprises of the living things and the non-living things.

**Definitions of terms used in ecology 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.

**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. **Habitat:**

This is a place where an organism lives. In the habitat, the organism obtains water, shelter and it is able to reproduce there.

**Population:**

This is the total number of organisms of the same species living in a particular place at a given time. **Ecological niche:**

This refers to a particular place an organism occupies within a habitat and the role it plays there. A niche is like the ‘profession’ of an organism. **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.

**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 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 in plants.
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. **iii) 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. **iv) 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.

**v) 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. **vi) 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.

**vii) 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. **1) Producers:**

These are green plants and some bacteria that make organic food by photosynthesis or chemosynthesis. They are nutritionally referred to as autotrophs.

**2) Consumers:**

These are organisms which eat other organisms.

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 are:

* 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.

**3) 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 nutrients in the soil.

They also reduce the number of wastes and litter in the environment.

### Types of food relationships Food chain

A food chain is a linear sequence of energy flow among organisms starting with the producers (plants). One of the ways in which the organisms of a community interact is by feeding on and providing food for each other. For example, on one abandoned school farm, hawks were found to feed on small snakes, the snakes on the lizards, the lizards on grasshoppers, and the grasshoppers on grasses. These relationships may be set out in the form of a food chain shown below:

Grass  grasshoppers  lizards  snakes  hawks

Energy from the sun is fixed by producers (plants), the herbivores eat the plants and obtain this energy and also the carnivores feed on herbivores to obtain this energy. At each successive trophic level, some energy is lost.

In a community of grasshoppers, dove and cat, the food chain would be as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 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.

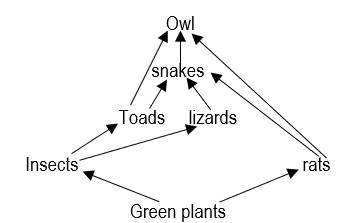
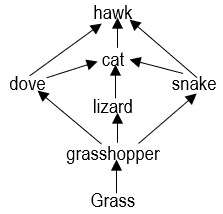
Exercise:

Draw a food chain for the following organisms;

1. Vegetation, beetle, owl and fox.
2. Cow, man, lion and grass.
3. Nile perch, algae, water flea and tilapia.

### Food web

A food web is a feeding inter-relationship of interlinked food chains whereby most animals have alternative sources of food. **Examples of food webs:**



**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.

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

* The grass grows and increases in number because the grasshopper that used to feed on it has been removed.
* The doves, lizards and snakes lack food because they feed on grasshoppers, which have been removed. This causes their numbers to drop.
* The cats also reduce in number because of the reduction of its source of food (doves, lizards and snakes).

Exercise: Construct a food web using the following organisms: phytoplanktons, mosquito larvae, small fish, large fish, and crocodiles.

### 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;

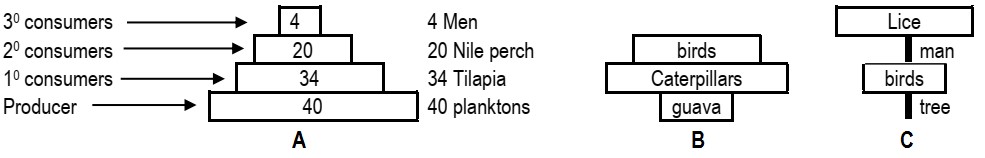
1. Pyramid of numbers
2. Pyramid of biomass
3. Pyramid of energy

### Pyramid of numbers

This is used to represent 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.

**Examples of pyramid of numbers:**



Pyramid ***A*** represents 20 nile perch, 40 planktons, 34 tilapia and 4 men

Pyramid ***B*** represents few birds feeding on the many caterpillars eating fruits on a single guava tree.

Pyramid ***C*** represents a big fruit tree having several birds feeding on a fruit, man being an immediate consumer of the birds while at the same time, several lice being parasites to man.

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.

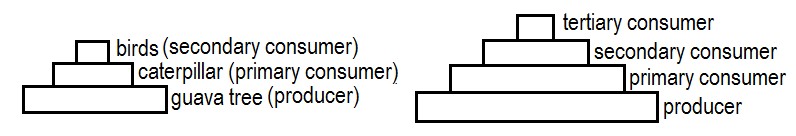
**Exercise:**

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.

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

### Pyramid of biomass

This represents of 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 pyramid of numbers ***B*** above, the pyramid of biomass would be.



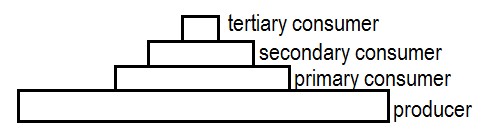
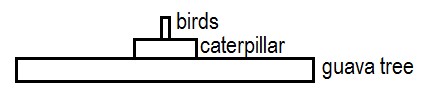
Even if the guava is one, it has a bigger biomass than caterpillars and caterpillars have a larger biomass than birds.

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; • Some energy is used up during respiration.

* Some energy is lost from herbivores in form of indigestible plant material i.e. the parts that can’t be digested.
* Some parts are not eaten by the consumers.
* Some organisms die before they are eaten.
* Some plants are not edible.
* 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.

### Changes in populations

Population is a group 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:

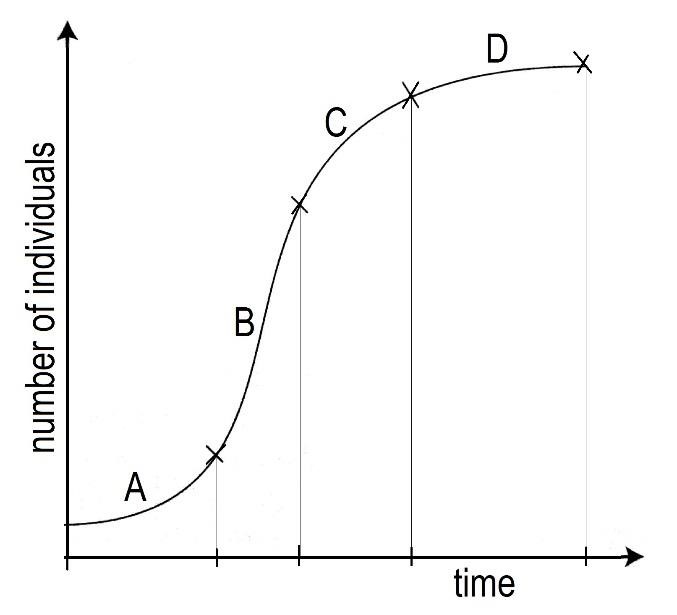
* High chances of overcrowding
* High competition among themselves for food, shelter, etc.
* Increased chances of predation.

Each population has specific characteristics which distinguish it from others. The characteristics are density, dispersion, age, sex ratio, birth rate and death rate (mortality) and population growth.

### Population growth

This refers to the increase in number of organisms of the same species. When organisms like bacteria, houseflies or cockroaches have a suitable environment, their population increases. Data on the growth rate can be obtained by counting the number of organisms per given time. When such data is plotted against time, an ***S***- shaped or ***sigmoid*** growth curve is obtained.

### The population growth curve



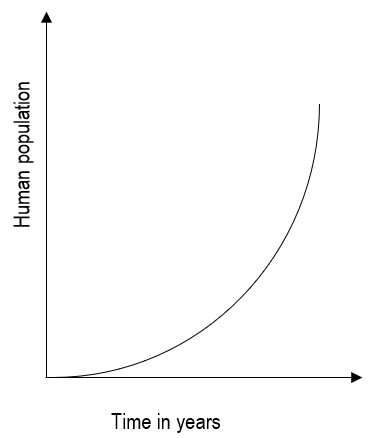
The growth curve is S-shaped and it is referred to as a sigmoid curve. It is divided into five phases.

1. **Lag phase:** During the lag phase, the population grows at a slow rate because the reproducing individuals/organisms are few and are also still adjusting to the environment. During this early period of growth, there is adequate supply of nutrients, oxygen and shelter/space.
2. **Exponential phase:** this is also referred to as the log phase. During this phase, there is rapid increase in the population size. This is because the organisms have adjusted to the environment, the number of reproducing organisms has increased and the supply of oxygen and nutrients is plentiful. The rate of birth is high and death rate is low.
3. **Decelerating phase:** The rate of growth starts to slow down as the organisms start to die. This is mainly due to overcrowding, accumulation of toxic waste products and shortage of food. Their number has become big and have started to compete for resources like food, shelter, mates and space. This therefore creates shortage of resources. The available resources cannot support a big number of organisms.
4. **Stationary phase:** In this phase, there is no further increase in the population. Most organisms are old are not capable of reproducing. The rate of birth is equal to the rate of death hence the rate of population growth remains constant.

At the stationery phase, the population is referred to as the carrying capacity. Carrying capacity is the maximum population the environment can support at a particular time without exhausting the resources.

### Growth of the human population

The population is presently growing exponentially (rapidly). 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

* **Natality** (birth rate). This is the frequency of birth. Increase in natality results into increase in population size.
* **Mortality** (death rate). This is the frequency of deaths. When the death rate increases, the population size decreases.
* **Emigration**. This is the movement of individuals out of the population. It results into a decrease in population size.
* **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.

1. **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.

1. **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 1m2. 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.

1. **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.

1. **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 (n1). 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 (n2).

The organisms that were marked and recaptured are also counted (n3). The population is then calculated from:

Total population =𝑛𝑢𝑚𝑏𝑒𝑟 𝑜𝑓 𝑖𝑛𝑑𝑖𝑣𝑖𝑑𝑢𝑎𝑙𝑠 𝑖𝑛 1𝑠𝑡 𝑐𝑎𝑝𝑡𝑢𝑟𝑒 x 𝑛𝑢𝑚𝑏𝑒𝑟 𝑜𝑓 𝑖𝑛𝑑𝑖𝑣𝑖𝑑𝑢𝑎𝑙𝑠 𝑖𝑛 2𝑛𝑑 𝑐𝑎𝑝𝑡𝑢𝑟𝑒

𝑛𝑢𝑚𝑏𝑒𝑟 𝑜𝑓 𝑖𝑛𝑑𝑖𝑣𝑖𝑑𝑢𝑎𝑙𝑠 𝑖𝑛 2𝑛𝑑 𝑐𝑎𝑝𝑡𝑢𝑟𝑒 𝑤𝑖𝑡ℎ 𝑎 𝑚𝑎𝑟𝑘

P = 𝑛1 x 𝑛2 𝑛3

|  |  |
| --- | --- |
| Where; |  |
| P = | population |
| n1 = | number in the first capture |
| n2 = | number in the second capture |
| n3 = | number in the second capture which are marked. |

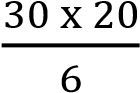
**Examples**

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 = 𝑛1 x 𝑛2

𝑛3

P = population. n1 = 30 n2 = 20 n3 = 6

P = 

= 100 rats.

**Assignment:**

Arthur captured and marked and replaced 45 cockroaches on the first day. He 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.

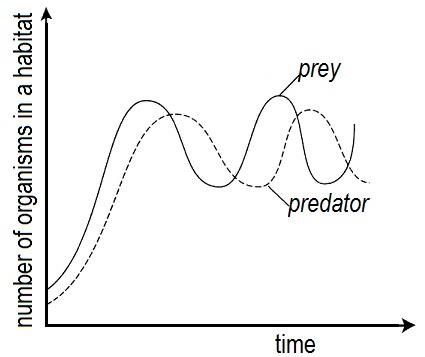
### Predation

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 preys 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

1. They have keen eyesight to see their prey.
2. They have strong jaw muscles to tear flesh of the prey.
3. They have sharp claws to hold and kill their prey. iv) They move very fast to enable them chase the prey.
4. They have streamlined bodies to cut through air during movement.
5. Some have very sharp canines to tear flesh of their prey.
6. They have colours, which help them to camouflage.

### Adaptations of the prey to avoid being eaten by predators

1. They perceive sound with high accuracy and are able to sense their predators at a distance.
2. 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**

1. 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.
2. 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:**

1. 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
2. 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.

**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:

1. **Endo-parasites;** these are parasites that live inside the body of the host, e.g. plasmodium and HIV
2. **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.

1. They may be killed by the hosts’ immune reactions.
2. Death of parasites incase the host dies due to starvation.
3. 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

1. They have means of attachment to the host.
2. They have penetrative devices for entering and feeding on the host
3. They show degeneration of unnecessary organs and systems to reduce on their body size in order to fit in the host. e.g. eyes
4. 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

1. They have lost the alimentally canal hence absorb already digested food over the entire body surface by diffusion.
2. They have a thick cuticle to prevent attack by digestive enzymes of the host.
3. They produce substances that inactivate the enzymes of the host.
4. Each mature proglotids of the tapeworm contains both male and female reproductive organs (hermaphrodites) hence fertilize itself.
5. 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
6. They have resistant stages in their lifecycles with secondary and intermediate hosts to ensure survival during adverse conditions.
7. 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.

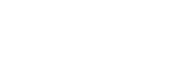
**Stage 3:** The soil formed favours the growth of ferns.

**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.

**Succession in a new water pond**



Pioneer



Mosses



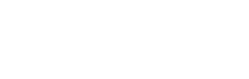
Ferns



Grasses



Shrubs



Trees. Climax

community



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.

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 CO2 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 CO2 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. SO2, CO2, NO2, and CO.

Some of these gases e.g. SO2, CO2, 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. CO2 and CFCs (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.

1. Mining, construction, quarrying leads to the destruction of soil structure which encourages soil erosion.
2. 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.

1. Emission of excess poisonous gases in the atmosphere e.g. SO2, CO2 and CO form industries and automobiles which cause acidic rains.
2. Use of excess herbicides and insecticides which kill the soil organisms leading to decreased rate of decomposition.
3. Spilling of oil onto water bodies which leads to suffocation of aquatic animals.
4. Construction of noisy industries in town which cause sound pollution that can damage the hearing process of man.
5. Decomposition of non-biodegradable materials into the soil e.g. plastics, glass, etc. which destroy the soil structure.
6. 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

1. Physically or removing it manually by hand picking however it is not effective.
2. By use of machines (mechanical control) however the method is effective but expensive.
3. By using biological control methods e.g. use of bottles.
4. 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.

***Congratulations for completing the syllabus***