Background

Ecology is the scientific study of the interactions of living organisms and their environments. These interactions are studied with a view to discovering the principles which govern them.

It is important for humanity to understand its environment because we have the ability to modify the environment through the use of technology, and through overexploitation of natural resources as a result of greed or sheer pressure of numbers. Therefore, ecology is more than just the understanding of the interrelationships between organisms and their environment; it also has social, political, economic and technological dimensions.

Ecology is also the branch of biology that draws all of the other components together. It demands a synthesis of physiology, anatomy, morphology, genetics and other aspects of biology that have been studied in detail as separate entities throughout your first year course. Although ecology retains an analytical approach of its own, it also brings the pieces of the biological puzzle together in a synthesis.

Just as biology is assembled from various parts, so can ecology be studied at different levels, from organism to biome to biosphere. Most ecologists, however, work from the level of population through biome.

Some key concepts

A population is a group of individuals of the same species which can freely interbreed and are found together in a particular place. A key feature of populations is that members of a population are more likely to interact with other members of the same population than they are with members of a different population of the same species living in a different place.

An ecosystem is a more-or-less self contained ecological entity, consisting of both organisms and their complete biotic and abiotic environment found in a particular place. It is the smallest functional ecological unit within the biosphere. An ecosystem is a relatively independent, relatively self-contained, and more-or-less self sufficient unit. A key feature of ecosystems is that members of a particular ecosystem are more likely to interact with other members of the same ecosystem than they are with members of a different ecosystem of the same or different type found in a different place.

A community may be thought of as the living (biotic) component of the ecosystem. It consists of a number of populations of different species found in a particular place. The term 'community' is sometimes used in another, entirely different context; that of populations of similar organisms (e.g. the bird community of a lake, seashore or forest). The concept of community, however it is used, has as its main focus the study of biotic interactions.

A biome involves the linkage of ecosystems into regional classes, which have similar characteristics. For example, grassland biomes in similar climatic areas of the world have similar characteristics as pertains to temperature regimes, rainfall, fire cycles, etc.

The smallest biome in the world is the fynbos biome, which is found only in the southwestern part of South Africa. The biome concept has not been applied to groupings of ecosystems in aquatic environments, although it is possible to make such groupings.

Ecosystems

Ecosystems are the basic functional unit of the enviroment. It is difficult to define what an ecosystems precisely is, but the following definition is acceptable:

An ecosystem is a more-or-less self contained ecological entity, consisting of both organisms and their complete biotic (living) and abiotic (non-living) environment found in a particular place at a particular time.

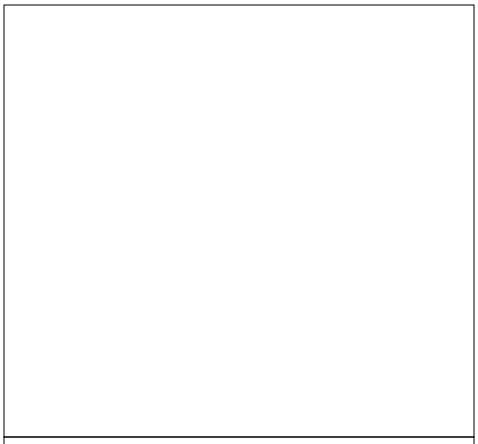
For convenience, fairly defined localities such as a forest ecosystem, pond ecosystem, a stream or a stretch of grassland are considered examples of ecosystems. A key feature is that members of a particular ecosystem are more likely to interact with members of the same ecosystem than they are with members of a different ecosystem.

A Stream Ecosystem	A Grassland Ecosystem

An ecosystem possesses both biotic (living) and abiotic non-living components. The abiotic components include soil, water, light, inorganic nutrients and weather. The biotic components of the ecosystem can be categorized as either producers or consumers. Producers are autotrophic organisms with the capability of carrying out photosynthesis and making food themselves, and indirectly for the other organisms as well. In terrestrial ecosystems the producers are predominantly green plants, while in freshwater and marine ecosystems the dominant producers are various species of algae. Consumers are heterotrophic organisms that used food that has already been performed by other organisms. It is possible to distinguish four types of consumers, depending on their food source.

- Herbivores

  Herbivores or plant eaters feed on plants. They are termed primary consumers. These animals range from aphids which suck plant juices, to large browsing animals like springbok, giraffes and elephants.



Elephants are good examples of herbivores

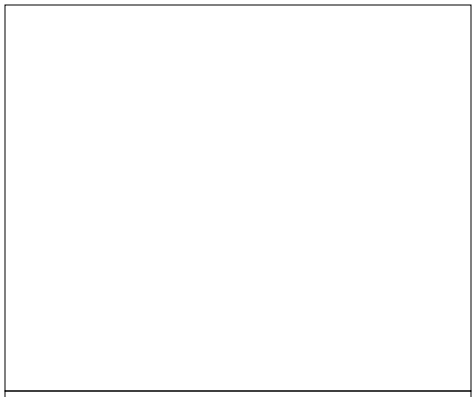
- Carnivores

  Carnivores or meat eaters feed only on other animals and are thus secondary or tertiary consumers such as lions, leopards, tigers, etc.

- Omnivores

  Omnivores feed on both plant and animal material. Human beings are good

examples of omnivores.



Monkeys are good examples of omnivores

- Decomposers

Decomposers feed on food and decomposing matter or detritus. Detritus is the remains of plants and animals following their death and fragmentation by soil organisms, bacteria and fungi of decay are important decomposers, but so are other soil organisms, such as earthworms and small arthropods.

The word 'system' in ecosystem suggests an organized unit wherein all the parts, biotic and abiotic, are in constant interaction with one another. For example, consider a mosquito larva in a fresh-water ecosystem. It depends on the abiotic factor water to provide a medium in which to swim and it depends on the biotic microscopic algae for its food supply. In turn the predatory dragonfly nymph depends to some extent on the mosquito larva for food. The nymph is in turn eaten by fish. Other predators, such as the kingfisher bird, feed on the fish. The abiotic factor of light permits growth of the algae on which the larvae feeds.

In an ecosystem nothing is on its own. Ultimately everything is interdependent.

Abiotic components

The way in which plants and animals grow and carry out their different activities is a result of several abiotic factors. These factors are light, temperature, water, atmospheric gases, wind as well as soil (edaphic) and physiographic (nature of land surface) factors.

Light

Light energy (sunlight) is the primary source of energy in nearly all ecosystems. It is the energy that is used by green plants (which contain chlorophyll) during the process of photosynthesis; a process during which plants manufacture organic substances by combining inorganic substances. Visible light is of the greatest importance to plants because it is necessary for photosynthesis. Factors such as quality of light, intensity of light and the length of the light period (day length) play an important part in an ecosystem.

- Quality of light (wavelength or colour):

  Plants absorb blue and red light during photosynthesis. In terrestrial ecosystems the quality of light does not change much. In aquatic ecosystems, the quality of light can be a limiting factor. Both blue and red light are absorbed and as a result do not penetrate deeply into the water. To compensate for this, some algae have additional pigments which are able to absorb other colours as well.

- Light intensity ("strength" of light)

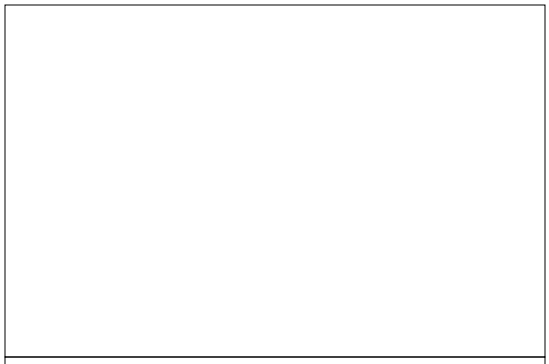
  The intensity of the light that reaches the earth varies according to the latitude and season of the year. The southern hemisphere receives less than 12 hours of sunlight during the period between the 21st March and the 23rd of September, but receives more than 12 hours of sunlight during the following six months.

- Day length (length of the light period):

  Certain plants flower only during certain times of the year. One of the reasons for this is that these plants are able to "measure" the length of the night (dark periods). However, it was thought that it is the day length (light periods) to which plants reacted and this phenomenon was termed photoperiodism. Photoperiodism can be defined as the relative lengths of daylight and darkness that effect the physiology and behaviour of an organism.

  - Short-day Plants

    These plants flower only if they experience nights which are longer than a certain critical length. The chrysanthemum (Chrysanthemum sp.), the poinsettia (Euphorbia pulcherrima) and the thorn-apple (Datura stramonium) are examples of short day plants.



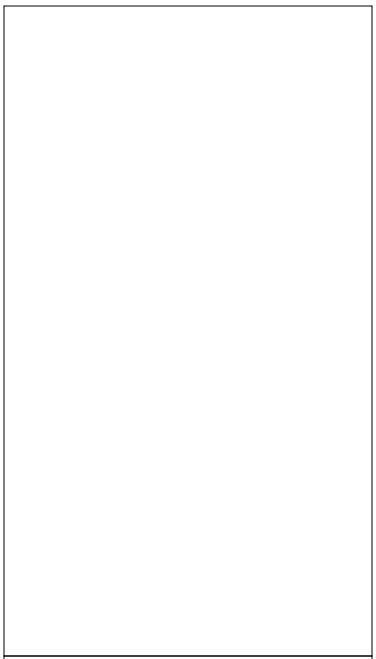
The Euphorbia plant flower only when the nights are longer than the days.

- Long-day plants

  These plants flower if they experience nights which are shorter than a certain critical length. Spinach, wheat, barley, clover and radish are examples of long plants.

- Day-neutral plants

  The flowering of day-neutral plants is not influenced by night length. The tomato (Lycopersicon esculeutum) and the maize plant (Zea mays) are examples of day-neutral plants.



The Maize plant is not influenced by night length.

The following definitions are also important:

- Phototropism
  Phototropism is the directional growth of plants in response to light where the direction of the stimulus determines the direction of movement; stems demonstrate positive phototropism i.e. they came towards the light when they grow.
- Phototaxis
  Phototaxis is the movement of the whole organism in response to a unilateral light source, where the stimulus determines the direction of movement.
- Photokinesis
  Variation in intensity of locomotory activity of animals which is dependent on the intensity of light stimulation, and not the direction, is called photokinesis.
- Photonasty
  Photonasty is the movement of parts of a plant in response to a light source, but the direction of the stimulus does not determine the direction of the movement of the plant.

Light requirements of plants differ and as a result distinct layers, or stratification, can be observed in an ecosystem. Plants which grow well in bright sunlight are called heliophytes (Greek helios, sun) and plants which grow well in shady conditions are known as sciophytes (Greek skia, shade).

Temperature

The distribution of plants and animals is greatly influenced by extremes in temperature for instance the warm season. The occurrence or non-occurrence of frost is a particularly important determinant of plant distribution since many plants cannot prevent their tissues from freezing or survive the freezing and thawing processes. The following are examples of temperature effects with ecosystems:

- the opening of the flowers of various plants during the day and night is often due to temperature difference between the day and night;
- the seed of some plants (biennials) normally germinate in the spring or summer; this phenomenon is well observed in carrots and is called vernalization;
- some fruit trees such as the peach require a cold period each year so that it can blossom in the spring;
- deciduous trees lose their leaves in winter and enter into a state of dormancy, where the buds are covered for protection against the cold;
- the seeds of many plants, e.g. peach and plum, must be exposed to a cold period before they germinate; this chilling ensures that seeds don't germinate during autumn, but after winter, when the seedlings have better chances to survive;

- in animals, a distinction is made between ectothermic ("cold-blooded" or poikilothermic) animals and endothermic ("warm-blooded" or homothermic) animals although the difference is not clear cut;
- in desert conditions are a greater temperature variation between day and night and organisms have distinct periods of activity, for e.g. many cacti flower at night and are pollinated by nocturnal insects;
- seasonal changes have also a great influence on animal life in an ecosystem; torpor in winter is common in reptiles and some mammals in South Africa, but a winter sleep occurs in bears of the northern hemisphere; some animals collect fat or other resources during favourable periods (often summer and autumn) and become dormant (this is called hibernation), there are also animals that are dormant during warm and dry conditions and this is known as aestivation; examples of such animals are snails and the African lung-fish;
- seasonal movements occur in some animals; this phenomenon is called seasonal migration, examples of such animals are migratory locusts, butterflies and various marine animals like whales, penguins and marine turtles.

Water

Plant and animal habitats vary from entirely aquatic environments to very dry deserts. Water is essential for life and all organisms depend on it to survive in especially desert areas.

- Water requirements of plants
  Plants can be classified into 3 groups according to their water requirements:

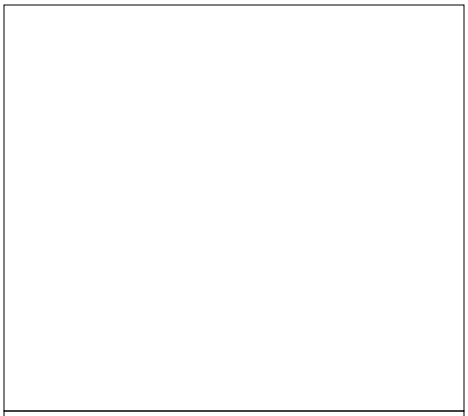
  o Hydrophytes
  Hydrophytes are plants which grow in water e.g. water-lilies and rushes.

  o Mesophytes
  Mesophytes are plants with average water requirements e.g. roses,sweetpeas.

Roses are mesophytes

- Xerophytes

  Xerophytes are plants which grow in dry environments where they often experience a shortage of water e.g. cacti and often succulents.



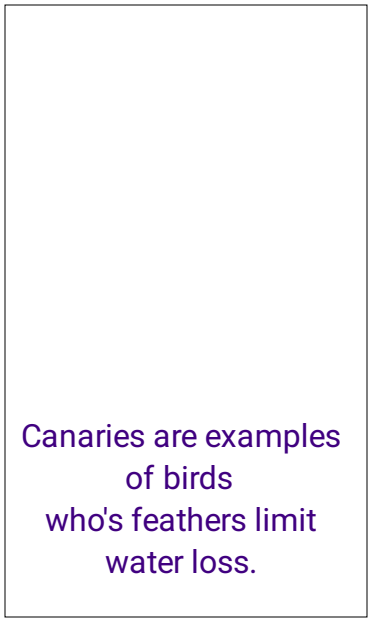
Aloes are xerophytes

Adaptations of plants to survive without water include reversed stomatal rhythms, sunken stomata, thick cuticles, small leaves (or the absence of leaves) and the presence of water-storage tissues.

- Water requirements of animals

Terrestrial animals are also exposed to desiccation and just a few interesting adaptations are mentioned here:

- the body covering limits water loss e.g. the chitinous body covering of insects, the scales of reptiles, the feathers of birds and the hair of mammals;



Canaries are examples of birds who's feathers limit water loss.

- some mammals have few or no sweat glands and use other cooling devices, less dependant or independent of evaporative cooling;

Springbok are mammals who use other forms of cooling devices.

- the tissues of animals may be tolerant to water loss e.g. a camel can live without water for long periods because its body tissues have this adaptation;
- there are also known cases where insects are able to absorb water in the form of water vapour directly from the atmosphere for example the dew from the coastal fog is an important source of moisture for insects of the Namib.

- The Water Cycle in Nature

Water cycles through the biosphere in the manner is described in the figure below. Freshwater is distilled from salt water. The sun's rays cause fresh water to evaporate from sea water and the salts are left behind. Vapourized fresh water rises into the atmosphere, cools and falls as rain over the oceans and the land. A smaller amount of water also evaporates from bodies of fresh water. Since land dies above sea level, gravity eventually returns all fresh water to the sea, but in the meantime, it is contained within the standing waterbodies such as lakes and ponds, flowing water (streams and rivers) and groundwater.

When rain falls, some of the water sinks or percolates into the ground and saturates the earth to a certain level. The top of the saturation level is called the groundwater table or simply the water table. Ground water is also sometimes located in a porous layer, called an aquifer, that lies between two sloping layers of impervious rock. Wells can be used to extract some of this water for human consumption.

The Water Cycle in Nature

Atmospheric gases.

The most important gases used by plants and animals are oxygen, carbon dioxide and

nitrogen.

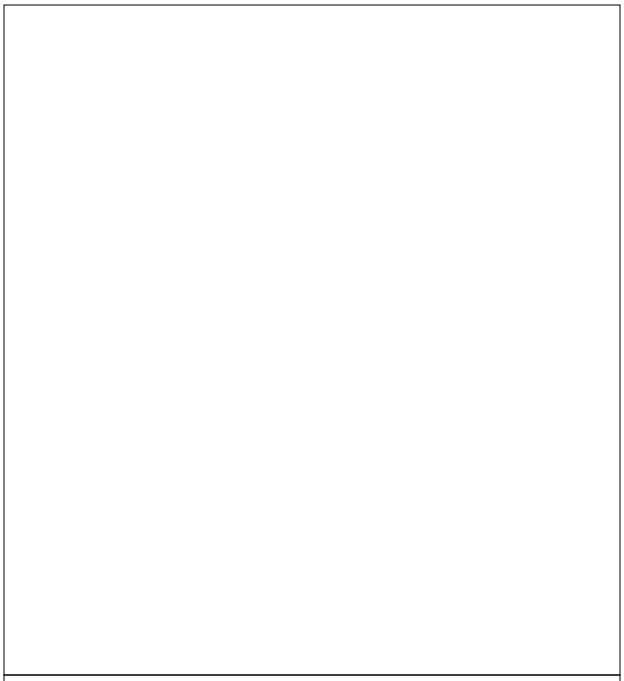
- Oxygen
  Oxygen is used by all living organisms during respiration.
- Carbon Dioxide
  Carbon dioxide is used by green plants during photosynthesis.
- Nitrogen
  Nitrogen is made available to plants by certain bacteria and through the action of lightning.

Wind

Winds or air currents arise on a world-wide scale as a result of a complex interaction between hot air expanding and rising (convection) in the mid latitudes. This has various effects on the rotation of the earth and results in a centrifugal force which tends to lift the air at the equator. This force is known as the Coriolis force and tends to deflect winds to their left of the southern hemisphere and to the right in the northern hemisphere. Winds carry water vapour which may condense and fall in the form of rain, snow or hail. Wind plays a role in pollination and seed dispersal of some plants, as well as the dispersal of some animals, such as insects. Wind erosion can remove and redistribute topsoil, especially where vegetation has been reduced. Warm bergwinds results in desiccation which creates a fire hazard. If plants are exposed to strong prevailing winds are they usually smaller than those in less windy conditions.

Soil (edaphic factors)

These factors include soil texture, soil air, soil temperature, soil water, soil solution and pH, together with soil organisms and decaying matter.



The main Soil Factors

- Soil texture
  The size of soil particles varies from microscopic particles called clay to larger particles called sand. Loam soil is a mixture of sand and clay particles. Sandy soils are suitable for growing plants because they are well aerated, excess water drains away quickly, they warm up quickly during the day and is easy to cultivate. Sandy soils is unsuitable because they do not retain much water and soon dry out and contain few soil nutrients required for plant growth. Clay soils are suitable for plant growth because they hold large quantities of water and are rich in mineral nutrients. They are unsuitable in that they are badly aerated, soon becomes waterlogged and is difficult to cultivate; it also cold during winter. Loam soils possess desirable properties of both sand and clay - it has a high water retaining capacity, good aeration, good nutrient content and is easily cultivated.
- Soil air
  Soil air is found in those spaces between the soil particles that are not filled with soil water. The amount of air in a soil depends on how firmly the soil is compacted. In well-aerated soil at least 20% of its volume is made up of air.
- Soil temperature
  Soil temperature is an important ecological factor. It has been found that the temperature of soil below a depth of about 30cm is almost constant during the day but seasonal temperature differences do occur. At low temperature there is little decay by decay-causing micro-organisms.
- Soil water
  Soil water can be classified into three types, namely hygroscopic, capillary and gravitational water. Hygroscopic water occurs as a thin film of water around each

soil particle. Capillary water is that water held in the small spaces between the soil particles and gravitational water is the water which drains downwards through the soil.

- Soil solution

  Soil solution is the decaying remains of plants and animals, together with animal excretory products and faeces, form humus. This increases the fertility of the soil.

- pH

  Acidity or alkalinity of soil (the pH of the soil) influences the biological activity in soil and the availability of certain minerals. Thus the pH of soil has a greater influence on the growth and development of plants. Some plants e.g.azaleas, ericas, ferns and many protea species grow best in acid soils (soils with a pH below 7), while lucerne and many xerophytes grow better in alkaline soils (soils with a pH above 7).

Physiographic factors

These factors are those associated with the physical nature of the area, such as altitude, slope of land and the position of the area in relation to the sun or rain-bearing winds. Altitude plays a role in vegetations zones. Slopes are important when considering the temperature of the soil surface on land with a northern slope, on level and on land with south facing slopes. In South Africa the south-eastern slopes face the rain-bearing winds and in some areas are covered with forest, whilst the slopes on the leeward side are in a rain-shadow and thorn scrub is often found growing on these slopes. A very good example of this is the South Eastern Wind blowing in Cape Town.

Biotic components

The Biotic enviroment involves all the living organisms that come regularly into contact with each other, how they interact and their mutual influences. An ecosystem consists basically of the following:

Producers | Consumers | Decomposers| Biological Rhytms |

- Producers

  Producers are organisms which are able to manufacture organic compounds from inorganic substances from their enviroment. Green plants are able to do this by means of photosynthesis, where the sun provides the necessary energy. Therefore these green plants are the autotrophic organisms or primary producers in most ecosystems.

- Consumers

  This component is made up of organisms which cannot make organic compounds from inorganic substances. They are dependant upon autotrophic

oraganisms and are the consumers or heterotrophic organisms in an ecosystem. The consumers are further subdivided according to their diet, into:

- o herbivores or plant eaters which are the primary consumers eg. cows, giraffes, elephants, etc;
- o carnivores or meat eaters which are the secondary consumers; some carnivores are called predators (eg. lions, leopard, fish eagle, etc) which catch their prey, kill it and then eat it; others are called scavengers (eg. vultures) which usually eat what is left by the predators;
- o omnivores eat plant and animal material and can be primary, secondary and tertiary consumers simutaneously; a human beings is a good example of an omnivore.

The main consumers of an Ecosystem.

- Decomposers

These are usually saprophytic organisms such as bacteria and fungi and that obtain their energy by decomposing the corpses and other dead parts of organisms. They break down all the organic material of the bodies of producers and consumers into inorganic materials that are restored to the soil or water to be reused by producers.

Biological Rhythms (Biorhythms)

Regular rhythmic changes occur in the activities of plants and animals. These are caused by factors such as light and heat from the sun, the tides, seasons, phases of the moon and the rotation of the earth. These regular, rhythmic changes are called biorhythms and they can be divided into:

• Lunar and Tidal rhythms • Seasonal rhythms	

- Daily rhythms

The daily rhythm of light and darkness which repeats every 24 hours as a result of the rotation of the earth, has influences on many organisms.

Examples:

- o some animals are more active during the day because of the light and temperature eg. springbok, some birds, etc, while others are active during the night eg. lions, owls and bats;
- o green plants photosynthesize only in daylight;
- o the leaves and flowers of some plants react to light and darkness, eg. the drooping of thorn tree leaves as it gets dark and the flowers of vygies which open as the intensity of the light and temperature inceases;
- o zooplanton in the sea and lakes show daily rhythmic movements; during day they move vertically deeper into the water, away from the light; during the night they come to the surface where they feed on the drifting phytoplankton.

- Lunar and Tidal rhythms

The phases of the moon have an influence on the tides in the sea which, in their turn, influence the behaviour of the marine animals which live in the intertidal zone.

Examples:

- o many littoral crabs rhythmically change colour from dark at high tide to pale at low tide;

- intertidal crustaceans and the eel-like grunion have activities which match the activities of the sea. During the spring tides from March to August, these fish swim in pairs (male and female) onto the beaches a couple of days after each high spring tide. While the female lays her eggs, the male curls around her and immediately releases his sperm cells which then fertilize the eggs. The fish then return to the sea on the next wave. Because the eggs are laid while the tides are gradually lessening, the waves will not reach them until the next high spring tide two weeks later. During this time the eggs develop and hatch and the baby fish are then carried back to the sea on the high spring tide.

- Seasonal rhythms

The behaviour of plants and animals is usually suited to withstand the seasons.

Examples:

- deciduous trees lose their leaves during winter and become dormant;
- annual plants form seeds which survive the winter or the dry season and germinates after the first spring rains;
- certain animals hibernate i.e. their heart beat slowly and respiration decreases so that the winter can passed in a type of unconsciousness, eg. bats;
- adult insects die when the frosts arrive; many spent the winter in the form of eggs and pupae;
- many animals migrate during the winter to where the weather is warmer eg. swallows; various marine mammals also migrate, mainly between feeding and breeding grounds, eg. wilde beest migrate in response to seasonal rainfall and food availability.

Trophic levels

Trophic levels are the feeding position in a food chain such as primary producers, herbivore, primary carnivore, etc. Green plants form the first trophic level, the producers. Herbivores form the second trophic level, while carnivores form the third and even the fourth trophic levels. In this section we will discuss what is meant by food chains, food webs and ecological pyramids.

- Food Chains.

The feeding of one organism upon another in a sequence of food transfers is known as a food chain. Another definition is the chain of transfer of energy (which typically comes from the sun) from one organism to another. A simple food chain is like the following:

rose plant -- aphids -- beetle -- chameleon -- hawk.

In this food chain, the rose plant is the primary producer. The aphids are the primary consumers because they suck the juice from the rose plant. The beetle is the primary carnivore because it eats the aphids. The chameleon, a secondary carnivore, eats the beetle. The hawk is the tertiary carnivore because it eats the secondary carnivore, the chameleon. The hawk eventually dies and its remains are broken down by decay-causing bacteria and fungi.
Except in deep-sea hydrothermal ecosystems, all food chains start with photosynthesis and will end with decay.

- Food Webs

In an ecosystem there are many different food chains and many of these are cross-linked to form a food web. Ultimately all plants and animals in an ecosystem are part of this complex food web.

- Ecological Pyramids

Trophic levels and the energy flow from one level to the next, can be graphically depicted using an ecological pyramid. Three types of ecological pyramids can usually be distinguished namely:

o Number pyramid.

It is easily understood that many grass plants are needed to feed fewer snails on which, in turn, even fewer chickens would be able to feed. This in turn requires only a few people to eat the chickens that ate the snails. The Number pyramid shows the number of organisms in each trophic level and does not take into consideration the size of the organisms and over-emphasizes the importance of small organisms. In a pyramid of numbers the higher up one moves, so each consecutive layer or level contains fewer organisms than the level below it.

The Number Pyramid

o Biomass pyramid.

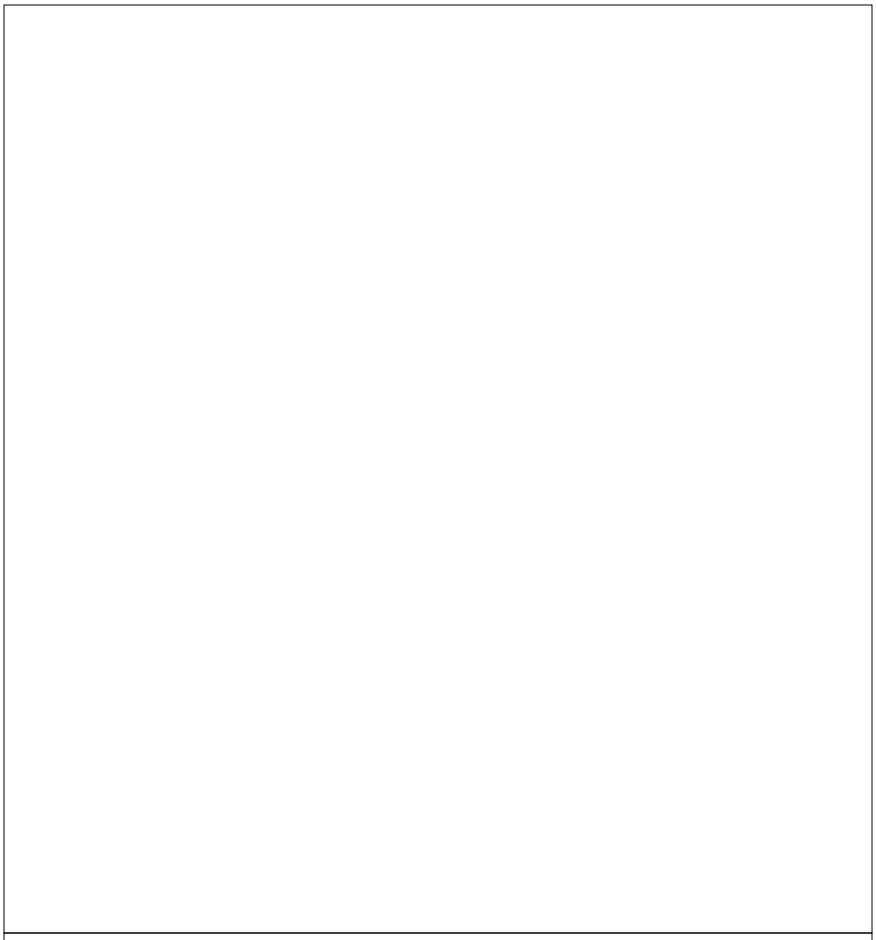
This pyramid indicates the total mass of the organisms in each trophic level. The size of the organism is over-emphasized and it can happen that the mass of level 2 is greater than that of level 1, because the productivity of level 1 is not taken into consideration. Thus an enormous mass of grass is required to support a smaller mass of buck, which in turn would support a smaller mass of lions.

The Biomass Pyramid

o Energy pyramid.

The Energy pyramid indicates the total amount of energy present in each trophic level. It also shows the loss of energy from one trophic level to the next. An energy pyramid shows clearly that the energy transfer from one

trophic level to the next is accompanied by a decrease due to waste and the conversion of potential energy into kinetic energy and heat energy. The energy pyramid is more widely used than the others because comparisons can be made between trophic levels of different ecosystem. It is, however, more difficult to compile an energy pyramid than it is compile the other types of pyramids.



The Energy Pyramid

Nutrient cycling

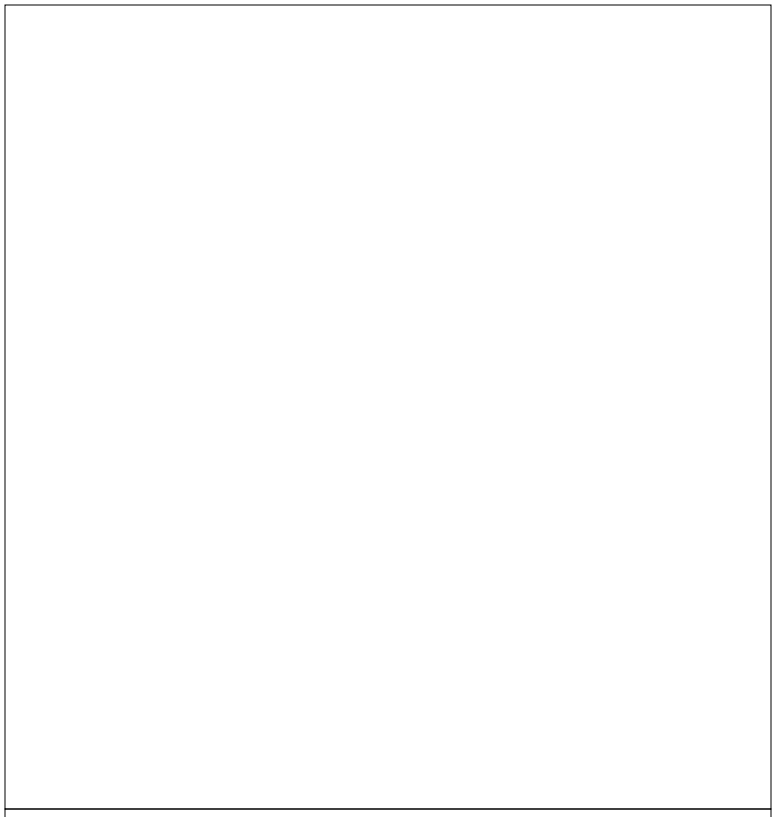
Inorganic nutrients occur in limited quantities and their loss to an ecosystem or retention and re-use is of great importance. The cycles of chemical elements in an ecosystem are known as nutrient cycles. If there is no loss to the ecosystem the cycle is said to be a 'perfect cycle' and if loss does occur the cycle is said to be 'imperfect'. The decomposers play an important role in these cycles because they break down dead organisms and make the nutrient components available once more to other organisms.

The carbon and nitrogen cycle are two such cycles.

- The Carbon Cycle

All organic compounds contain carbon and the most important sources of all inorganic carbon is carbon dioxide in the atmosphere.

- carbon dioxide is taken up by autotrophic organisms during photosynthesis and the carbon is incorporated into carbohydrates and other compounds , such as proteins and fats;
- consumers (heterotrophic organisms) feed on plants, and their bodies assimilate carbon compounds derived from the plants;
- all organisms, including plants, release carbon dioxide during respiration as a by product. (Fermentation releases of carbon dioxide);
- when autotrophic and heterotrophic organisms die or lose body parts such as leaves, carbon dioxide is released as a result of decomposition;
- combustion of dead animal and plant material also releases carbon dioxide;
- under high pressures, dead plants and animals are carbonized, forming fossil-fuels, such as coal and crude-oil. These release carbon dioxide during combustion.



A Diagrammatic representation of the Carbon Cycle

- The Nitrogen cycle

Nitrogen is an element essential in all organisms, occurring in proteins and other nitrogenous compounds, e.g. nucleic acids. Although organisms live in nitrogen-

rich environments (78% of the atmosphere is nitrogen) the gaseous forms of nitrogen can only be used by certain organisms. Free nitrogen must first be fixed into a useable form.

- o free nitrogen in the atmosphere is mainly fixed by two groups of bacteria, nl. Azotobacter and Clostridium. The nitrogen is then used to manufacture proteins in their bodies, when they die, their proteins are broken down by decomposers (mainly bacteria and other micro-organisms), and converted into ammonia (blue-green algae, cyanobacteria, can also be use free nitrogen from the atmosphere);
- o during electrical changes in the atmosphere(e.g. lightning), free nitrogen is fixed (combined) finally forming nitrate;
- o nitrates are taken up by plants which use them to manufacture proteins;
- o animals (herbivores) eat plants and convert plant proteins to animal proteins, while carnivores obtain their plant proteins by indirect means (by eating herbivores);
- o when plants and animals die, the proteins in their bodies are broken down into ammonia by decomposers. The process is known as ammonification;
- o ammonia is converted to nitrites by nitrite bacteria (Nitrosomonas and Nitrosococcus). Nitrites are again converted to nitrates by nitrate bacteria (Nitrobacter)This process is known as nitrification;
- o different types of bacteria are also able to break down nitrates, nitrites and ammonia which results in the release of nitrogen. This process is known as denitrification.

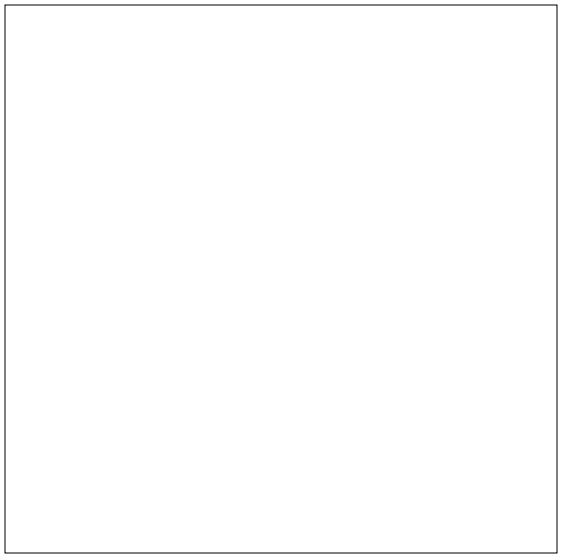
A Diagrammatic Representation of the Nitrogen Cycle.

These two cycles emphasizes the mutual interdependence of producers, consumers and decomposers in an ecosystem.

The Biosphere

The Biosphere, or living world, consists of the water, air and soil that surround living organisms and is the thin layer at the surface of the earth that supports living organisms. The components of the biosphere are:

- the atmosphere,
- the lithosphere and
- the hydrosphere.



- The Atmosphere.

The atmosphere is the vast body of air above and around us. About 95% of the mass of air is concentrated in the first 11km above the earth's surface. Water vapour and impurities vary from place to place. At sea-level the proportions of the main gases are 78% nitrogen, 21% oxygen and 0.03% carbon dioxide. The greatest abundance of life in the atmosphere is on the surface of the earth. Pollen grains and spores and other bacterial material occur throughout the 9km of air above the surface of the earth, but came in highest concentrations near the ground.

Functions of the Atmosphere.

- o provides the necessary gases for metabolic processes such as respiration, etc;
- o filters sunlight, deflecting the blue and violet rays (giving the sky its blue colour);
- o responsible for determining weather conditions such as storms, wind and lightning.

A view of the Atmosphere from Space.

- The Hydrosphere.

This is the earth's water system. The water of the hydrosphere forms a single, vast circulating system involving evaporation, condensation and precipitation.

Functions of the Hydrosphere.

- o contains many living organisms - organisms are found in freshwater and marine biomes;
- o essential for the functioning of all living organisms as the greater proportion

of their bodies is formed by water.

- The Lithosphere.

The Lithosphere is the outermost crust of the earth's surface. The continents or land masses are formed by granite-like rocks resting on heavy basaltic rock. Soil is the product of the weathering of the rock. The soil, together with air and water, forms the basis of terrestrial life.

Function of the Lithosphere.

o it is an important source of minerals that are essential for the survival of organisms.

Terrestrial and aquatic ecosystems

|Introduction |Similarities |Differences |

Introduction

It is not easy to compare terrestrial and aquatic systems because there is such a large variety of these environments. It is possible to recognize in the terrestrial part of the biosphere a small number of units with distinctive vegetation and climate, each with a complex of communities of large extent. These units are known as biomes and six major biomes are usually recognized, namely the:

1. Tundra,
2. Taiga (coniferous forests),
3. Deciduous Forests,
4. Grasslands,
5. Tropical Rain Forests,
6. Deserts.

The Major Biomes of the World:		

In this section we will focus on the similarities and differences between terrestrial and aquatic ecosystems.

Back to Top

Similarities between Terrestrial and Aquatic systems

- in both terrestrial and aquatic environments the ecosystems include communities made up of a variety of species,
- within both terrestrial and aquatic communities there are populations at the different trophic levels,
- a great deal of mutual interdependence exists between species in both terrestrial and aquatic environments,
- in undisturbed terrestrial and aquatic ecosystems equilibrium is reached, i.e. very few major changes are observed over a period of time,
- in both ecosystems stratification (vertical zonation) occurs.

The Knysna forest in South	A marine aquatic ecosystem

Africa, an example of an terrestrial ecosystem.	

Back to Top

Differences between Terrestrial and Aquatic systems

- because aquatic environments are so rich in nutrients they support more live than equivalent terrestrial ecosystems. The small drifting photosynthetic organisms of the oceans, referred to collectively as phytoplankton are regarded as the major photosynthesizers, or primary producers, of the earth,
- aquatic environments are much more stable than terrestrial environments, with smaller fluctuations in temperature and other variables,
- aquatic organisms are seldom exposed to desiccation while terrestrial organisms are often exposed to desiccation and are usually relatively resistant to drying out,
- oxygen (because there is very much less present) is sometimes a limiting factor an aquatic habitats but this is seldom the case in terrestrial habitats,
- light can be a limiting factor in some aquatic habitats, but in most terrestrial environments there is hardly ever a a shortage of light,
- terrestrial animals are influenced far more by gravity, while water supports aquatic organisms.