

and in water (aquatic).

Examples of abiotic components:

- i. climatic factors, which include; Temperature, Light, Wind, Humidity, rainfall etc
- ii. soil (edaphic) factors e.g. Soil pH, Soil air, Inorganic particles, Soil water, Organic matter (dead organic matter and living organisms), Soil temperature etc
- iii. Topography
- iv. Other physical factors e.g fire and wave action etc

Question. How do abiotic factors affect the distribution and abundance of organisms?

(i) Climatic factors

Temperature

- Affects physiological processes (respiration, photosynthesis, and growth etc) in organisms which in turn influence their distribution.
- Ultimate heating and cooling of rocks cause air to break and crack into small pieces and finally form soil.
- These changes in turn may result into migration of organisms e.g birds to avoid over heating or freezing.
- Low temperatures inactivate enzymes while excessive temperatures denature enzymes.
- High temperature increase transpiration and sweating
- Low temperatures break dormancy of some plants.
- Temperatures stimulate flowering in some plants e.g cabbage (vernalisation)
- Exposure to low temperature(stratification) stimulate germination in some seeds after imbibitions.

Organisms have evolved to have structural, physiological and behavioral adaptations to maintain their temperature in an optimum range.

(i) adaptations of animals for life in hot and dry deserts.

Structural adaptations,

- ❖ Large body extremities e.g ear lobes ; to increase surface area over which heat is lost.
- ❖ Small sized; to increase the surface area to volume ratio, for heat loss
- ❖ Some animals like the camel, have long skinny non fatty legs to increase heat loss during locomotion
- ❖ Little or no fur to reduce on insulation, and increase amount of heat lost
- ❖ Thin subcutaneous fat layer under the skin to increase heat loss from the body
- ❖ Have tissues tolerant to extreme temperature changes, maintaining the body's main functions

Physiological adaptations

- ❖ Enzymes work under a high optimum temperature range to maintain metabolism during day and night.

Behavioral adaptations

- ❖ Most are nocturnal, i.e most active at night, when temperatures are relatively low
- ❖ Aestivation(seasonal response by animals to drought or excessive heat during which they become dormant, and the metabolic rate followed by body temperature fall to the minimum required for maintaining the vital activities of the body) ; allows them to survive extremes of hot temperatures e.g African lungfish burrows into mud till the dry season ends, earthworms, garden snails, desert rats, termites also aestivate
- ❖ Movement with some body parts raised to minimize direct contact with hot grounds e.g desert snakes
- ❖ Salivation of the neck and legs increasing heat loss by evaporation e.g in tortoise

(ii).adaptations of animals for life in cold environments

Structural adaptations

- ❖ Thick layer of fat under the skin; to increase on insulation by avoiding heat loss
- ❖ Small body extremities to reduce the surface area over which heat is lost
- ❖ Large sized; thus small surface area to volume ratio; reducing amount of heat lost to the surrounding
- ❖ Thick fur; to increase on insulation
- ❖ Tissues tolerant to extreme changes in temperature; maintaining their normal functions in the body

Physiological adaptations

- ❖ Enzymes work under a high optimum temperature range to maintain metabolism during day and night

Behavioral adaptations

- ❖ Hibernation(is seasonal response by animals to cold temperature during which they become dormant, body temperature and metabolic rate fall to the minimum required for maintaining the vital activities of the body) The animals, said to be in 'deep sleep' ably reduce energy needs to survive the winter when food is scarce allowing them survive extreme cold conditions eg in polar bears.
- ❖ Gathering in groups to warm themselves e.g penguins

Rain fall;

- Amount of rainfall in a given area determines the abundance, distribution and types of plants in the area

Ecological significances of water

- ✓ Habitat for many aquatic organisms e.g frogs, fish etc
- ✓ Raw material for photosynthesis; main energy source for body processes of other organisms
- ✓ High thermal capacities ; acting as cooling agent for terrestrial organisms e.g plants during transpiration, some animals during sweating.
- ✓ Agent for fruit, seed, spore, larva and gamete dispersal
- ✓ Condition for germination
- ✓ Highly transparent; therefore allowing light to reach aquatic organisms, for photosynthesis; and aquatic predators to locate their prey
- ✓ Important factor in decay and decomposition ; therefore increases in recycling of nutrients in an ecosystem.

Humidity;

Amount of water in the atmosphere;

- affects the rate at which water evaporates from organisms i.e Low humidity results to increasing evaporation while high humidity causes low rate of evaporation; through stomata of leaves in plants.

NB. Techniques used in constructing food webs and food chains

- ❖ Direct observation of organisms as it feeds so as to establish the organisms prey.
- ❖ Examination of stomach content through dissecting the animals' stomach
- ❖ Faecal method; observation of faecal materials egested by an animal.
- ❖ Use of radioactive tracers to label the environment from which organisms obtain their food and then trace them in the organisms gut.

Assignment. State the advantages and limitations of the above methods

ECOLOGICAL PYRAMIDS

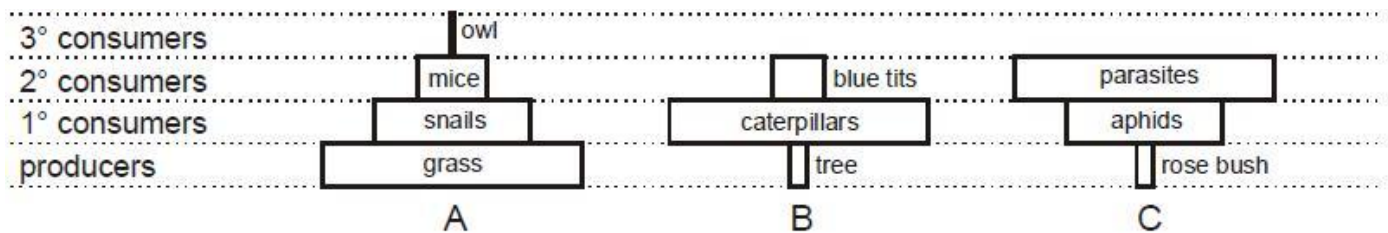
- ❖ These are histograms that provide information about feeding (trophic) levels in ecosystems.

Three types exist i.e

- pyramid of numbers
- pyramid of biomass
- pyramid of energy

NB. *Length of a given bar is proportional to the number, energy or biomass at a given trophic level in a given area.*

- pyramid of numbers.** It is a histogram representing the numbers of different organisms at each trophic level in an ecosystem at any one time.



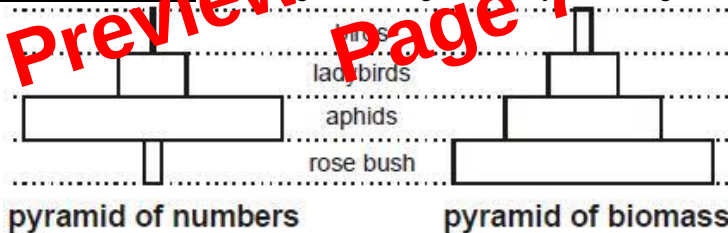
NB.

- As a pyramid is ascended, the number of organisms decreases but the size of each individual increases.
- In some cases, the consumers may be more than the producers e.g in a parasitic food chain, inverted pyramids B & C are obtained, because parasites progressively become smaller and many along a food chain.

Limitations of pyramid of number

- Drawing the pyramid accurately to scale may be difficult e.g. where there are a million plants.
- Pyramids may be inverted
- The trophic level of an organism may be difficult to ascertain.
- The young forms of species may have a different diet from adults.

- pyramid of biomass:** is a histogram showing the total dry mass of organisms present at each feeding level



Advantages

- ✓ Reduces the possibility of forming inverted pyramids because its construction depends on biomass of organisms

NB. Inverted pyramid of biomass is typical of an aquatic ecosystem, because diatoms (phytoplankton) have a lower biomass but with higher productive rate (caused by so rapid turnover rate), therefore capable of supporting a larger biomass of zooplanktons.

Disadvantages/limitations of pyramid of biomass

- ✓ Does not allow for changes in biomass at different times of the year e.g. deciduous trees have larger biomass in summer than in winter when they shed off leaves.
- ✓ Does not take into account rate at which biomass accumulates e.g. a mature tree has a large biomass which increases over many years.
- ✓ Impossible to measure exactly biomass of the organisms in an ecosystem, because the sample used may not be a true representation of the whole population.
- ✓ Results may not be accurate, e.g. where killing is not allowed, the results are obtained by estimating the fresh mass.

- pyramid of energy flow** it is a histogram showing the total amount of energy present at each feeding level.

- ✓ Because only a proportion of energy in a trophic level is transferred to the next, energy pyramids are never inverted nor do they have a central bulge.
- ✓ More informative than pyramids of numbers and biomass because it shows the amount of energy required to support each trophic level.
- ✓ Energy values may be expressed variously as $\text{kJ/m}^2/\text{yr}^1$ or $\text{kCal/m}^2/\text{yr}^1$.
- ✓ Explains why the earth can support more people if they eat at lower trophic level (by consuming grains, vegetables and fruits directly rather than passing such crops through another trophic level and eating grain eaters).

- ❖ Behavior of the organism e.g. their level of hostility and excitement when disturbed.
- ❖ Topography of the area
- ❖ Type of habitat, terrestrial/aquatic.
- ❖ Risks involved during the exercise.
- ❖ Seasonal changes and its effect on organisms.

METHODS OF DETERMINING POPULATION SIZE OF ORGANISMS

(a) Total count:

This is the physical counting of every individual of a population in a specified area of ground.

It is effective for large animals living in unconcealed (exposed) habitats. It includes; (i) **Direct counting method** (using a low flying aircraft) (ii) **Aerial photography** (iii) **Drive and count** (iv) **Strip census** (v) **Removal method**

(i) Direct counting method using a low flying aircraft

Used to determine population of large animals.

Requirements

(i) An air craft e.g. a helicopter (ii) Survey map of the area (iii) Stationary (iv) binoculars

Procedure

An air craft is flown at low altitude over the study area along several strips of known area.

The number of organisms of given species under study is obtained by direct counting and recorded.

This is repeated several times. The average population density for all the sample is then calculated.

Advantages

- ❖ It gives a quick estimate of the population size
- ❖ Other studies on the population such as feeding habits, reproductive behavior, and predation can be carried out simultaneously.
- ❖ It reduces the risk of attacks from aggressive animals eg lions, buffalos, etc

Disadvantages

- ❖ It is expensive since it requires sophisticated air craft and skilled man power
- ❖ The sound made by the air craft may scare some animals which may hide in concealed areas eg under the trees.
- ❖ It's greatly hampered by some weather conditions e.g fog, misty or cloudy weather
- ❖ Can only be used on large animals and those in open grass lands
- ❖ Not easy in very hilly areas.
- ❖ calculations involved may cause inaccuracy

(ii) Aerial photography.

Requirements

(i) Low flying air craft (ii) Good camera

Procedure

Photographs are taken from a low flying air craft over the whole study area.

Photographs are then developed, printed and number of animals in each photograph counted

Population density is then expressed as number per unit area

NB; **advantages and disadvantages are as seen above (direct counting)**

(iii) Drive and count method

Requirements

(i) Man power (ii) Stationary

Procedure

A number of people drive animals into a particular space/area and count them.

Advantages

- It is quick and more accurate especially for slow moving animals and those that live in herds e.g. antelopes.
- There is reduced likelihood of not counting an animal or counting a given animal more than once.

Disadvantages

- It cannot be applied to aggressive animals e.g. lions, tigers, etc
- Limited to slow moving animals
- Restricted to animals moving in herds

(iv) Strip census

Requirements

(i) Map of the area (ii) Vehicle

Procedure

- ❖ While driving, animals are counted in a given strip /besides the road.
- ❖ The number of organisms in each strip is obtained by direct counting and the population density of the strip is obtained.
- ❖ Such is repeated for several strips and the average population density for the strips is calculated.
- ❖ The population of total population of the area given is calculated as ; **average population area of each strip x total area.**

Advantages

- ❖ It's quick
- ❖ It's cheap compared to aerial means

Disadvantages

- ❖ Moving vehicles scare away animals that may run into hiding
- ❖ Some animals avoid roads and paths commonly used by man in the park.
- ❖ There is increased likelihood of counting fast moving animals more than once.

Questions

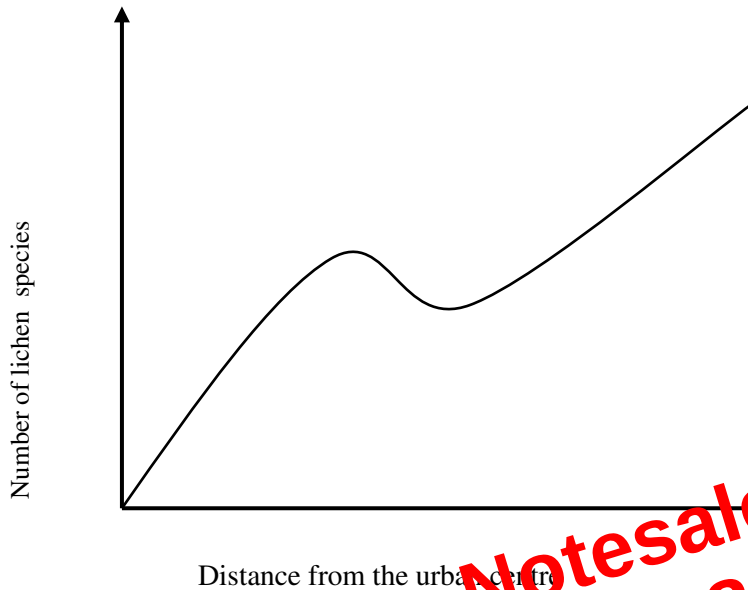
1. What are advantages and disadvantages of biological rather than chemical control of eutrophication?

Organisms live in their environment all the time; their presence (or absence) reflects the suitability of that environment for their living requirements at all times. A short-lived but severe pollution incident occurring at night would be reflected by the absence of sensitive organisms long after visible and chemical evidence of the pollution incident had disappeared. Biological indicators can therefore be a more sensitive and representative reflection of environmental conditions. Chemical monitoring all the time can only be done for small water courses e.g. small rivers, streams and remote areas. It also requires much time-consuming and, in the long term, expensive laboratory analysis. Biological control requires reasonable expertise at identification and is also affected by seasonal factors.

2. (a) State three ecological problems which arise from accumulation of domestic waste in urban communities.

(b) Give two ways of reducing domestic waste in urban communities

(c.) The figure below shows the lichen species along 20km transect from the urban centre.



(i) Explain the trend in the lichen species with distance from the urban centre.

(ii) Suggest an explanation for the observed number of lichen species at a distance of 10km from the urban centre.

3. (a). Describe the factors which influence the concentration of dissolved oxygen in a river.

(b). Explain the presence or absence of those organisms may be used as indicators of the concentration of dissolved oxygen

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