Everwin Matric. Hr. Sec. School

STD:XII Material of Month - Biology

Ch.7-Ecosystem

Minimum Learning Material

A.G.Tansley – Term – Ecosystem:

The system resulting from the integration of all the living and non living factors of the environment.

Odum-defined Ecosystem as the structural and functional unit of Ecology.

Parallel terms for Ecosystem by Ecologists:

Biocoenosis	-	Karl mobius
Microcosm	-	S A Forbes
Geobiocoenosis	-	V V Dokuchaev, G F Morozov
Holocoen	-	Friedericks
Biosystem	-	Thienemann
Bioenert body	-	Vermadsky

Structure of Ecosystem - 2 major components

Climatic factors (air, water, temperature)	Plants
Edaphic factors tepography (soil water, P^H)	Animals
Organic and Inorganic compounds (C,H,O,N,P)	Fungi
	Bacteria

Standing quality/stage:

The total inorganic substances present in any ecosystem at a given time.

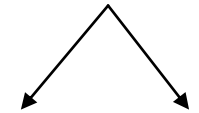
Autotrophic components

Organisms which can manufacture the organic compounds from simple in inorganic components.

Eg. All green plants manufacture their own food through photosynthesis

Heterotrophic components

Organisms consume the producers



Macro consumer (Herbivore carnivore omnivore)

Micro consumer (Decompose)

Bacteria actinomyetes fung

Standing crop: The amount of living materials present in a population at any given time.

Biomass can be measured as fresh weight or dry weight or carbon weight of organisms.

Functions of Ecosystem:

Energy creation

Cycling of materials between the living and non living component of an eco system

Quantity of sunlight and The production of energy by plants

PAR: (Photosynthetically Active Radiation)

The amount of light available for photosynthesis is called PAR

Range of PAR (400-700nm)

PAR is not constant because of clouds, tree shades, air, dust particles

Plants absorb more blue and red light for efficient photosynthesis

Of the total sunlight, 34 percent that reaching the atmosphere is reflected back into the atmosphere

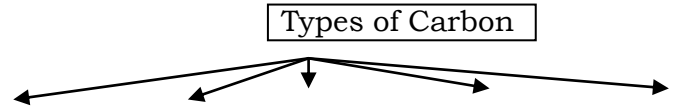
10% → held by ozone, water vapours

56% reaches earth's surface

2-10% of solar energy is used by plants

PAR is reported as sgm/sq sec/ millimole, by using silicon photovoltaic detectors, which detect 400-700nm

PAR is zero at night, often reaches 2000-3000 during midday in the summer



Green	Grey	Blue	Brown	Black
Stored in biosphere	Stored in fossil fuel	Stored in ocean and Atmosphere	Stored in industrialized forests	Emitted from gas, diesel engine, coal fired power plants

Productivity of an Ecosystem:

Rate of bio mass production/unit area in a unit time

Expressed in $gm/m^2/yr$

Classification of Productivity

Primary productivity	Secondary productivity	Community productivity
Chemical energy generated by autotrophy a. GPP (Grass Primary Productivity). Total amount of organic matter produced in an ecosystem. b. NPP (Net Primary Productivity) The proportion of energy remains after respiration loss. NPP-GPP-Respiration	Amount of energy stored in tissues of consumers. a. Gross secondary Productivity Total amount of plant material is ingested by herbivores minus faces b. Net Secondary Productivity: Storage of energy by consumer after respiration	Net synthesis of organic matter by a group of plants per unit area per unit time

Factors affecting primary productivity:

Availability of Nutrients

Solar radiation

Precipitation

Soil type

Topographic factors

Productivity of different Ecosystems:

Not determined by size and number of population

Determined by the rate of total fixation of radiant energy

Average world net productivities of open ocean and tropical rain forest are the maximum among aquatic and terrestrial ecosystem

Concept of trophic level in an ecosystem:

Trophic level → Position of an organism in the food chain

Number of trophic level is equal to the number of the steps in the food chain

Green plants occupying the first trophic level (T_1) → producers

Plant eaters (Herbivores)→primary consumers (T_2)

Carnivores (T_3)→secondary consumers

Tertiary consumer (secondary carnivores T_4)

Omnivores may occupy more than one trophic level in the food chain

Energy flow:

Transfer of energy in an ecosystem between trophic levels

Key function in an exosystem

Always unidirectional in an ecosystem

Law of thermodynamics:

The storage and loss of energy in an ecosystem based on two laws:

First law of thermodynamics:

→ Energy cannot be destroyed or created

→ It can be transformed from one form to another Eg. the product of starch is formed by the combination of H_2O, CO_2, Chlorophyll in photosynthesis

$$6Co_2+6H_2O \xrightarrow[chlorophyll]{light} C_6H_{12}O_6+6O_2$$

Second law of thermodynamics:

→ The energy transformation results in the reduction of the free energy of the system.

→ Larger part of energy is dissipated as heat

Eg: Ten percent law

Food Chain:

→ Movement of energy from producers upto top carnivores

Types of food chain:

Grazing:

Eg: First link plants (producer)

Second link mouse (Primary consumer)

Third link snake (Secondary consumer)

Fourth link eagle (Tertiary consumer)

Detrites:

Begins with dead organic matter

Dead organic matter

Detritivores

Small carnivores

Top carnivores

Food Web:

→ Interlocking patter of a number of food chain

→ It is the basic unit of an ecosystem to maintain its stability in Nature is called homeostasis

Significance of food web:

→ To describe species interaction

→ To illustrate indirect interactions

→ Used to study bottom-upon top down control of community structure

→ Used to reveal different patterns of energy transfer

Ecological Pyramids:

→ Graphic representation of the trophic structure and function at successive trophic levels of an ecosystem

→ Introduced by Charles Elton (1927)

Eltonian Pyramids:

Pyramids

Pyramid of number	Pyramid of biomass	Pyramid of energy
A graphical representation of the number of oraganisms present at each successive trophic level in an ecosystem	A graphical representation of the amount of biomass present at each successive trophic level in an ecosystem	A graphical representation of energy flow at each successive trophic level in an ecosystem

Shapes of Pyramid:

Upright [Grassland, Forest ecosystem – Pyramid of biomass]

Spindle [Pyramid of number in forest ecosystem]

Inverted → Parasite ecosystem-Pyramid of number

Pond ecosystem-Pyramid of biomass

Pyramid of energy is always upright:

There is a gradual decrease in energy transfer at successive trophic

Decomposition:

A process in which the detritus are breakdown into simple organic matter by the decomposers.

Nature of decomposition:

It is based on the nature of the organic compounds.

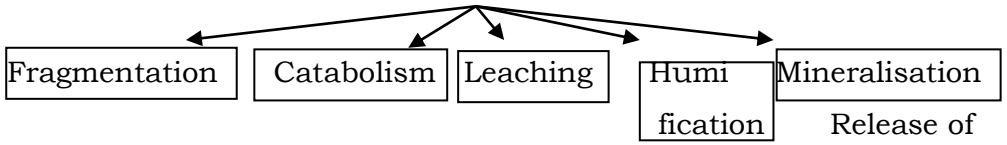
[Carbohydrate, fat and protein are decomposed rapidly than the cellulose, lignin, chitin, hair and bone]

Mechanism of decomposition:

→ Mediated by enzymatic reations

→ Detritus acts as a raw material for decomposition

Steps



Breaking down of detritus by detritivores	Decomposers Produce extra cellular enzymes to break organic compounds	(Eluviation) Movement of decomposed compounds from the surface to lower layer	Foramtion of dark substance humus, resistant to microbial action	Release of inorganic substance from humus

Humus → Reservoir of nutrients:

Highly resistant to Microbial action

Therefore decomposition is very slow

Factors affecting decomposition:

Temperature, soil P^H, moisture, oxygen, chemical quality of detritus

Biogeochemical cycle: (Nutrient cycle), cycling of materials:

Circulation of nutrients within the ecosystem

(i) Gaseous cycle: O_2, C, N

(ii) Sedimentary cycle: P,S,Ca

Carbon cycle:

→ Circulation of carbon between organisms and environment

→ Cycling of carbon between organisms and atmosphere is through photosynthesis and respiration

→ Releasing of carbon is due to burning of fossil fuels, deforestation, forest fire, volcanic eruption, decomposition

Phosphorus cycle:

→ Integral part of DNA, RNA, ATP, NADP and Phospholipid

→ Bulk quantity of phosphorus is present

Structure of pond ecosystem:

→ It is a classical example for natural, aquatic, freshwater, lentic type of ecosystem

→ It is a self sustaining and self regulatory freshwater ecosystem, which shows complex interaction between the abiotic and biotic components in it

Abiotic components: (CO_2, O_2, Ca, N, phosphate)

Organic substances (aminoacid, humicacid) PH, light temperature

Biotic components: Produces, consumers, decomposers

Producers: Phytoplanktons → oscillatoria, anabaena, volvox

Filamentous algae → spirogyra, clothrix

Floating plants → Salvia, pistia azolla

Submerged plants: Phragmitis

Rooted floating: Nelumbo

Macrophytes – Ipomoea, typha

b. Consumers:

Zooplanktons – paramecium

Benthos –Molluses, annelids

Secondary consumer – beetle, frog

Tertiary consumers – duck, crane

Top carnivore – Hawk, man

c. Decomposers/microconsumers:

Bacteria, Fungi;

Stratification of Pond ecosystem

Littoral	Limnetic	Profundal
Closest to shore	Open water of the pond	Deeper region
Easy penetration of light	Effective penetration of light	No effective light
eg:Rooted plants	Planktons	Heterotrophs

Ecosystem services: (Benefits)

Constanzaetal: Ecosystem services are the benefits provided to human through the transformation of resources into a flow of essential goods and services.

Anthropogenic Activities affect ecosystem Millenium Ecosystem Assessment (2005)

Over the past 50 years humans have changed the ecosystem more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, freshwater, medicine, timber fiber and fuel.

Human activities-re-engineer (Disturb) an ecosystem are as follows:

→ Habitat destruction

→ Deforestation and over grazing

→ Erosion of soils

→ Introduction of non native species

→ Over harvesting of plant material

→ Pollution of land, water and air

→ Run off pesticides, fertilizers and animal wastes

How to protect the ecosystem?

It is a practice of protecting ecosystem at individual, protecting ecosystem at individual organisation and governmental levels for the benefits of both nature and humans.

"If we fail to protect environment we will fail to save posterity".

→ Buy and use ecofriendly products

→ Grow more trees

→ Choose sustained farm products

→ Reduce consumption of water and electricity

→ Recycle the waste

→ Maintain cars and vehicles properly

→ Reduce the use of household chemicals and pesticides

→ Create awareness and educate about ecosystem

Reduce, Reuse, Recycle

Ways to go green:

→ Close the tap when not in use

→ Switch off the electrical gadgets when not in use

→ Always we ecofriendly products

→ Never use plastics and replace them with biodegradable products

Ecosystem management:

→ Integrates ecological, socio economic and institutional factors

→ Emphasis on human role in judicious use of ecosystem

Strategy of ecosystem management:

→ Used to maintain biodiversity

→ Helps in indicating flagship specis

→ Used to recognized the inevitability of ecosystem change

→ Helpful in identifying ecosystems which are in need of rehabilitation

→ Involves collaborative management with government agencies, NGO's

→ Used to build the capacity of local institutions and community groups

Plant sucession:

Successive replacement of one type of plant community by the other of the same area.

Pioneers → First Invaded plants

Seral community → Development of plant one after another

Climax community → Final plant community gets established

Characteristic of ecological succession:

→ Causes changes in specific structure of plant community

→ It is resultant of changes of biotic and abiotic factors

→ It transforms unsable community to stable community

→ Progresses from food chain to food web

→ Modifies the simple life form higher life forms

→ Creates Interdependence of plants and animals

→ Gradual progression in species diversity, niche specialization