Components of ecosysyem

- Term ecosystem was coined by A. G. Tansley in 1935
- An ecosystem is defined as a dynamic system in which includes both living things and non –living things which interact with each other to form the functional unit of nature
- Structure comprises the components of ecosystem
- Function involves the manner which these components interact with each other

Basic requirements of an ecosystem

- Cycling of materials and constant input of energy
- The exchange of materials between the living things and the environment is essential for the existence of an ecosystem
- This phenomenon is known as **cycling of materials**
- Energy fixed in an organism is passed on to other organisms
- This is known as energy flow

Characteristics of ecosystem

- Structural and functional unit of ecology
- Structure related to its species diversity
- Function is related to energy flow and material cycling
- Energy needed to maintain an ecosystem depends on its structure
- ecosystems mature by ecological succession
- Ecosystem exhibits homeostasis

Environmental factors

- environment of an organism refers to the complex set of conditions which surround it
- any external force substance or condition which surrounds and affects the life of an organism is termed the environmental factor

Edaphic factors- factors related to formation of soil an the physical and chemical properties of soil

Climatic factors -factors like light, temp, rainfall,humidity and atmospheric gases

Topographic or physiographic factors

- Factors related to physical geographic factors like altitude direction of mountain steepness and slopes

Biotic factors

- Include all types of interactions between different forms of life such as plants animals and microorganisms

Abiotic factors

- include edaphic factors and climatic factors

Edaphic factors

- the factors relating to the structure and composition of the soil

Soil profile

- Is the term used for the vertical section of the upper layers of soil

The **O** horizon

- is the uppermost horizon consisting of fresh and partially decomposed organic matter.
- Rich in life
- O 1 region- freshly fallen dead organic matter
- O2 decomposition has just begun

The **A** horizon

- below organic horizon

- Rich in organic matter and darker in colour and lighter in texture
- Zone of eluviation
- Div into A1,A2,A3

The **B** horizon

- is where chemical products of weathering accumulate in the soil
- Dark coloured and coarse textured

C horizon

- Mineral horizon composed of largely weathered parent material
- contain rich water content
- Known as subsoil

R-horizon

- Lowest horizon
- Parental rocks or bedrocks
- Impermeable and no biological activity
- Even the roots cannot reach the horizon
- The *Soil Texture* gives names associated with various combinations of sand, silt and clay
- **Soil chemistry** is affected by mineral composition, organic matter and environmental factors.
- **Soils** can process and contain considerable amounts of **water.**
- **Soil** gases are the gases found in the **air** space between **soil** components.
- The primary natural **soil** gases include nitrogen, carbon dioxide and oxygen. The oxygen is critical because it allows for respiration of both plant roots and **soil** organisms

Light in relation to Terrestrial habitat

- On the basis of relative preference for natural growth in different light intensities the plants categorized into two

Heliophytes require intense light for normal survival

- obligate heliophytes more rigid in preferencefor bright light
- Facultative heliophytes- grow well in shade and can also grow in bright light

Sciophytes require only diffuse light for survival

- obligate heliophytes
- Facultative heliophytes-

Light in relation to aquatic environment

Vertical stratification in fresh water habitat

Littoral zone

- Marginal areas in which the light penetrates to the bottom of the lake where aquatic plants animals and decomposers grow

Limnetic zone

- open sunlit water extending outward from the littoral zone
- Phytoplankton dominates

Profundal zone

- Too deep to be penetrated by light

The **benthic zone**

- Is the ecological region at the lowest level of a body of water

Vertical stratification in marine habitat

- Three different zone

Euphotic zone upto 80m

- Upper layer of water maximum light penetration is possible
- Autotrophs are abundant

Disphotic zone 80-100

- where light is highly modified
- Presence of diffuse light

Aphotic zone below 200 m

- Life adapted to survive in permanent darkness

Thermal stratification

Summer stratification in a lake

Three temperature zone

Epilimnon

- Upper warm waters with a vertically decreasing gradient of temperature from the surface
- Upper layers of water to 25^0c

Thermocline

- Transition zone with rapid vertical temperature changes

Hypolimnon

- Bottom cold zone where the temp is close to 5^0c

Winter stratification in a lake

- In the temperate region during winter the temp of top layers of water touches 0^0c and the lakes becomes ice covered
- just beneath the ice cover the temperature may be close to 2^oc
- Below this the temperature of the water is more or less uniform
- The ice cover on the surface obstructs the vertical stratification or winter stagnation

Winter stratification in a marine habitat

- the temperature of surface is rarely higher than 27^0c
- In the deeper layers is uniformly 4^0c

Effect of temperature on morphology

Bergmann's rule

- Among birds and animals the same species living in cold regions tend to have larger body size than those in warmer regions
- The larger size of the body helps to conserve the body heat in homoeothermic animals living in colder climates
- Poikilotherms show a reverse trend thatthey be smaller in cold region

Allen rule

The extremities of the body such as tail,snout,ears and legs of mammals are relatively shorter in colder parts than in the warmer parts

Effect of seasonal changes in morphology

- Some planktonic animals exhibit seasonal changes in body form
- This cyclical change in body form in relation to the environmental temperature is called cyclomorphosis
- Eg Daphnia
- The form of head undergoes modification with changing season
- Head rounded in winter, helmet like in spring, in summer becomes extensively developed and in autumn the helmet become reduced and head become rounded

Biotic factors

- Autotrophs
- Photoautotrophs
- Chemoautotrophs
- Phagotrophs
- Saprotrophs

Pond as an ecosystem

- Are defined as small shallow land
- Standing water bodies where rooted plants can grow over most of the bottom

Characteristics of a pond

- Small shallow standing water bodies
- They have calm water
- Plants can grow on most of the bottom
- They have outlet of streams
- Movements of water are minimum
- Action of wave is slight
- Average depth is 8-10 feet
- Temperature of pond changes with that of atmosphere
- Light penetrate to the bottom

Zonation

- Based on the depth of water and availability of light three different zones can be recognized

Littoral zone

- shallow water edge of pond with plenty of light and rooted vegetation

Limnetic zone

- it is the open water zone reaching to the depth where light can easily penetrate
- This lower limit of this zone marks the compensation level where photosyntheic equals the rate of respiration of flora
- plankton, nekston, neuston exist

Profundal zone

- Deep water and bottom where effective light penetration is negligible

Classification of Aquatic organisms

- **Plankton**are microscopic organisms that float freely with oceanic currents and in other bodies of water. **Plankton** is made up of tiny plants (called **phytoplankton**) and tiny animals (called **zooplankton**).
- consisting chiefly of diatoms, protozoans, small crustaceans, and the eggs and larval stages of larger animals.
- **Neuston** is the collective term for the organisms that float on the top of water (epineuston) or live right under the surface (hyponeuston)
- **Periphyton** is a complex mixture of algae, cyanobacteria, heterotrophic microbes, and detritus that is attached to submerged surfaces in most aquatic ecosystems. It serves as an important food source for invertebrates, tadpoles, and some fish.
- N**ekton** is a grouping of water or marine organisms that travel together freely. These organisms can be fish, crustaceans or mollusks that live in an ocean or a lake. They tend to move without the help of the current.
- **Benthos** is the community of organisms which live on, in, or near the seabed, also known as the benthic zone. This community lives in or near marine sedimentary environments,

from tidal pools along the foreshore, out to the continental shelf, and then down to the abyssal depths.

Biogeochemical cycles

- may be defined as the cyclical manner in which the chemical elements in the biosphere are circulated through the non living and living components of the ecosystem

Gaseous cycle

- prominent gaseous phase
- Atmosphere serves as the reservoir pool

Sedimentary cycle

- The main reservoir is the lithosphere from which the nutrients are released largely by deep sediments
- eg. sulpher and phosphorous cycle

Perfect cycle

- the nutrients are replaced as fast as they are removed from the reservoir pools
- Most gaseous cycles

Imperfect cycle –most sedimentary cycle

- nutrient cycling is incomplete and the nutrients removed from the cycle are not fully compensated by their release

Carbon cycle

- Carbon exists in all organic compounds such as carbohydrates proteins, lipids nucleic acids
- It is transferred through the food chain in the form of various organic compounds
- Is a gaseous cycle and perfect one
- Source
- living organism, dead organic material, fossil deposits co_2 in atmosphere,co_2 dissolved in oceans
- The ocean reservoirs tend to regulate the amount in the atmosphere
- Cycling of carbon
- first step is photosynthesis by green plants
- when animals feed upon plants these organic compounds reach the body of these animals
- the respiratory activity of producers and consumers returns a considerable amount of biologically fixed carbon back to atmosphere as gaseous co_2
- The carbon locked up in the animal wastes and in the dead protoplasm of the plants and animals released by the activities of organic matter also contribute to the atmosphere
- in aquatic environments the phytoplankton utilizes the dissolved co_2 and converts this into biomass of phytoplankton
- the phytoplankton is used as food by aquatic food chain
- part of organic carbon becomes incorporated in the earths crust as fossil fuel
- These are recycled to the atmosphere by weathering of rocks, burning of fossil fuel and volcanic activity
- the atmospheric gaseous co_2 is in dynamic equilibrium with aquatic dissolved co_2
- this cycle is a complicated one with many inlets and outlets
- It's a perfect one with no loss of carbon

Nitrogen cycle

- The cycling of N_2 between biotic and abiotic system is called N_2 cycle
- it is a gaseous cycle

1. **Flow of N_2 to biotic system**
   - N_2 is an important nutrient for plants
   - Plants cannot utilize free nitrogen of air
   - They obtain N_2 from ammonium salt, nitrates and nitrites
   - These compounds are formed from atmospheric N_2 by a process called N_2 fixation
   - It is a process by which atmospheric free N_2 is converted to solubile salts like nitrites and nitrates
   - It occurs in two ways non biological fixation and biological fixation

Non biological fixation

- a certain amount of freeN_2
- is fixed by the action of lightning, cosmic radiations volcanic eruptions or meteorites
- The resulting ammonia is brought to earth by rain water

Biological fixation

- It refers to the conversion of free $N_2$to soluble salts by the activity of certain organisms called N_2fixing organism
- biological N_2 involves reduction of atmospheric N_2 to ammonia
- symbiotic N_2 fixers and non symbiotic N_2 fixers
- The fixed $N_2$is absorbed by plants through the root system and incorporated into the proteins
- when herbivorous feeds on these plants,theN_2 flows into the body of herbivorous animals
- From herbivorous the N_2
- flows through the carnivorous food chain

2. Flow of N_2 to abiotic system

- The N_2 of biotic system flows into the abiotic system by four methods decomposition, excretion, denitrification and sedimentation

Decomposition

- plants and animals contain N_2 in their body protein
- After the death the protein of dead bodies are decomposed by decomposers into aminoacids and ammonia

Ammonification, Nitrification,Denitrification

- The conversion of protein from dead bodies into ammonia by decomposition is called ammonification
- This ammonia may be converted into free nitrates by nitrification or free N_2 bydenitrification

Excretion

- animals excrete nitrogeous waste products in the form of ammonia, urea,uric acids
- These compounds are decomposed to release N_2

Assimilation

- The plants absorb the nitrates and utilizes them for the synthesis of proteins

sedimentation

- Some amount of nitrate is lossed from the ecosystem the ecosystem by sedimentation
- The loss is compensated from by the nitrogen entering the air by volcanic eruptions and erosion of sedimentary rocks

Sedimentary cycle

- The cycling between biotic and abiotic system is called sulpher cycle
- It is a sedimentary cycle except for a short gaseous phase
- Sulphur is an important component of protein and aminoacids
- Sulphur exists as elemental sulphur,sulphites and sulphides
- The main reservoir is soil and deep sediments
- It is made available by weathering of rocks and erosion.it is carried to terrestrial and aquatic ecosystem
- It passes into animals through food chain
- By the death of plants and animals the decomposers again bring the sulphur to the soil for the use of plants
- sulphur enters the atmosphere as hydrogen sulphide and sulphur dioxide by combustion of fossil fuel, volcanic eruption and decomposition of organic matters
- it is carried back to soil by rain
- Sulphur is taken up by plants, followed by herbivores and carnivores it reaches the living world
- from the living organism sulphur is carried back to soil and to the bottom of ponds lakes and seas through excretions and decompositions of dead organic material by bacteria and fungi

Phosphorus cycle

- The cycling between biotic and abiotic environment is called phosphorus cycle
- Sedimentary cycle the main source is soil, rivers, lake ocean, rocks and ocean sediments
- significant quantity is seen in DNA and teeth and bones
- through erosion and weathering phosphorus reach soil
- Plants absorbs ionic phosphate through roots and incorporate into protoplasmic components
- From plants it passes into herbivores and animals
- the organic molecule containing phosphates are decomposed and phosphate is liberated as inorganic ionic phosphates
- Phosphate is also released to the soil through the combustion of forest trees and grasses
- A large amount of phosphate is lost in the ocean floor by sedimentation

Recycling pathways

Decomposition pathway

- Major recycling pathway in all biogeochemical cycles
- Bacteria and fungi are chief decomposer organisms in the ecosystem

Excretion and respiration

- in a grass land the grazing food chain necessarily involves extensive recycling by way of excretion

Recycling by solar energy

- water recycling occurs mainly by the action of solar energy

Fossil fuel mediated recycling

- anthropogenic recycling pathway chiefly involves the consumption of fossil fuel

Volcanic activity

- mobilizes the sedimented materials and bring back to the cycling pathway

Recycle index

- Is a measure of relative amount of recycling in different ecosystems
- It is the ratio of the amount of a material cycling between the compartments within the global system and total through flow

Limiting factors

- limiting factor are environmental conditions that limit the growth, abundance, or distribution of an organism or a population of organisms in an ecosystem
- It states that growth is controlled not by the total of resources available, but by the scarcest resource
- may be physical and biological

Physical factors

- factors that limit growth of an individual or population include climate and weather availability of water and edaphic factors

Biological factors

- Involve competition, predation parasitism disease and other interactions or within a species

Liebig's Law of the minimum

Justus von Liebig in 1840

- The success of an organism depends on several requirements.
- If one of these is present in minimal quantities this will limit the organism regardless of the abundance of the others

Shelford 's Law of Tolerance (victor shelford in 1911)

- Modification of Law of minimum
- Organism have an ecological maximum and minimum, with a range in between which represents the limits of tolerance

Combined concept of limiting factors

- combination of law of minimum and law of tolerance
- In an ecosystem one factor usually abiotic, limit the growth of organism (limiting factor)
- It become primary determinant for growth when lies in the range of minimum and maximum
- Any factor that is in excess may be detrimental for the living organism

Population Ecology

Refers to a group of organism of the same species living in a particular area at a given time

Features of population

- All the species of a population belongs to one species
- The individuals are morphologically and physiologically similar
- Individuals are genetically similar
- The individuals are reproductively isolated from other species

Each population has the following characters

- density
- Natality
- Mortality
- Age distribution
- population growth
- population equillibrium
- Population fluctuation
- Biotic potential
- dispersal dispersion

1.Density

- Population density refers to the total number of individuals in a unit area/a unit volume at a given time
- It may be expressed as various parameter
- Eg., the number of bacteriain a liter of water
  The number of plants /area of land
  The number of people/per square /mile
- Density, D = n/a

t

D =density

N= number of individuals

T=time

A=area

2. Natality /Birth rate

- Refers to average number of new individuals produced by a population in a given time
- Natality is due to birth, hatching germination or fission
- The size of population increases because of natality
- It is of two types
  Potential natality/maximum natality
- Maximum possible rate of reproduction for a population under optimal condition are called potential natality
- It is not attained in nature
  Realisednatality/ecological natality
- it refers to the actual number of new individuals added to the population in agiven time
- It is less than potential natality
  Natality =Number of birth/unit area
  Average population

3. Mortality

- it refers to the number of individuals dying in a population at a given time
- The size of population gets decreases
- Two aspects of mortality
  Potential mortality/minimal mortality
- It refers to the number of death due to oldage
  Realised mortality
- It is the number of death occurs due to all ages from gamete to adults due to environmental factors like predation diseases and other hazards
  Mortality = Number of death/unit time
  Average population

4.Age distribution

- A population id formed of individuals in different age groups
  The individuals in a population can be classified into three groups according to their ages
- the **pre-reproductive group** which includes immature animals
- The **reproductive group** comprising sexually mature individuals
- the **post reproductive group** comprising old animals where the reproductive ability has been stopped
- when a population is formed pre-dominantly of pre-reproductive age group it is in a state of growth
- In a growing population the birth rate is high
- When a population is formed pre-dominantly of post reproductive age group ,it is said to be declining
- when a population containing predominantly pre-reproductive and reproductive age group, it is said to be in a stable condition.

5. Population growth

- The increasing size of population is called population growth
- A population grows when the birth rate is high and death rate is low
- It is also aided by immigration
- When the increase in number of animals plotted against time factor a curve is obtained it is called growth curve
- The pattern of growth curve is different for different population
- Mainly two types of growth curves are significant
- S shaped growth curve
- J shaped growth curve
  Sigmiod curve/ 'shaped' growth curve
  lag phase
- When a few organism are introduced into an un occupied are, the population there grows gradually . This phase is called lag phase
  positive acceleration phase
- In the beginning the growth is low and this stage of growth is called positive acceleration phase
- Then the growth is rapid and the population increases steeply

negative acceleration

- After reaching maximum size the growth rate is low due to environmental resistance. this stage is negative acceleration
  stationary phase
- After this the population reaches an equilibrium level or stationary phase in which neither increase or decrease
  Pic from text

Carrying capacity

- The upper level beyond which no more increase can occur in a population is called carrying capacity or upper asymptote
- carrying capacity is defined as the maximum number of individuals of a population that can be supported in a habitat at a given time
- Once a population reaches the carrying capacity it fluctuates it till it reaches the equilibrium

J-shaped curve

- In certain population the growth is very rapid and the number of organism increases in exponential fashion and then the growth stops abruptly and the population declines sudden
- The decline is caused by environmental resistance or other factors
- This type of growth pattern gives a J shaped curve and it is exhibited by lemmings and certain insects
- This curve indicates the adverse conditions

6. Population equilibrium

- When a few animals are introduced in a new habitat, they increase in number and the population grows
- At the beginning the growth is low and later it increases in geometric ratio
- After reaching the maximum number the population remains at hat level for a long period
- This is called population equilibrium
- at the equilibrium level, there is no change in the size of population and the death rate are ore or less equal
- The population remains in the equilibrium as long as the biotic and abiotic factors are equilibrium
- When there is slight change in the environment the population adjust itself by fluctuating above or below the equilibrium
- If the changes are great, the population declines resulting in the extinction

7. Population fluctuation

- When a population is exposed to favorable environmental condition it grows and establish an equilibrium
- It remains in the equilibrium level continuously if conditions are suitable
- From time to time the number of individuals increase or decrease

- As a result the curve moves up or down from the equilibrium level this is called population fluctuation
- If these changes are small and negligible, the population curve is said to be flat
- If changes re larger and regular the curve is said to be cyclic
- If the changes are irregular the curve is said to be irruptive
- These fluctuations are caused by either extrinsic or intrinsic factor
- Extrinsic factors are the factors of the environment such as space, temperature, rainfall, food etc.
- Extrinsic factors cause irregular fluctuations
- Intrinsic factors arise inside the population such as density, interaction and so on
- They cause cyclic fluctuation

8. Biotic potential

- It refers to the inherent ability of a population to increase in number
- When the age ratio is stable and all the environmetal conditions are favorable
- The biotic potential is much greater than what is realized
- It may also defined as the slope of the population curve during the logarithmic phase growth
- It is reduced when the environmental conditions are not optimal

Environmental resistance

- It will be low when a population is first introduced into a new territory
- But as the population increases in the form of competition, predation, parasitism, scarcity for food so on

9.Dispersal

- it is the phenomenon where the individuals of a population moves into or out of the population

Three kinds

Migration

- It is the periodic movement of animals from one place to another and back for breeding feeding shelter

Eg., fishes, mammals, birds

Emigration

- It is the outward migration from a population
- It is the one way migration and the migrants never returned to starting place
- Is induced by many factors of which high density over population and scarcity of food are significant.
- After some organism move away from the population, in the remaining population, age distribution birth rate and death rate are affected

Immigration

- It is the in ward migration
- It is also one way migration
- It leads to loss of individual from one population and addition of individual to another population
- Hence mass migration may change the structure of a stable population

10 .Dispersion

- It refers to the distribution of individuals with in a population
- The individuals are distributed in a population in three different pattern

Uniform distribution

- the individuals are uniformly distributed through out the population

Clumped distribution

- the individuals aggregated to group

Random distribution

The individuals are randomly distributed

pic from text

Community ecology

Biotic community

- Biotic community or biococenosis is a natural assemblage of mutually supporting natural population living together in a same are or habitat with mutual tolerance beneficial interactions and constant fixation and decepation of energy

Characteristics

- Species composition
- Species abundance
- Species diversity
- Species dominance
- Keystone species
- Trophic organization
- Growth form and structure
- Stratification
- Community periodicity
- Community succession

1.Species composition

- It is the number and kinds of the constituent species of a community
- It may be different in different community and also different in same community during different season
- It is the nature of species composition that makes a community distinct from others

2. Species abundance

- species abundance or species richness is the number of species compared to the number of individuals in a community
- It refers to the total number of species and total number of individual organism

3. Species diversity

- It refers to the number of rare or unrelated species present in a biotic community
- so the higher the number of rare and unrelated species the greater would be the species diversity

4.Species dominance

- in a biotic community all species are equally important in determining its nature and functions
- A few species or specieses growth exerts some regulatory influences on the functioning of the community as a whole
- They control energy flow and nutrient cycling

- They also modify the environment of all other species
- Such 'controlling' or 'ruling' species of a community are called as dominant species or ecological dominant
- They can regulate the over all functioning of community and determine and modify the environmental condition under which other species can grow
- The total removal of dominant species may result in abrupt abnormal, and unpredictable changes in the community and their partial removal may cause slow and gradual changes

5. keystone species

- These are the species which have low abundance in the community, but have high influence on community characteristics
- Their presence or abundance plays a vital role in controlling the relative abundance of other species
- Removal of keystone species seriously disrupts the functioning of the community
- The number of keystone species will be very few in a community

6.Trophic structure

- This is hierarchical organization of a community for nutritional and energetic self sufficiency for food and energy relation.
- Organisms of a community form successive nutritional groups known as trophic level
- The first and lowest trophic level comprises the photosynthetic and chemosynthetic producers
- phototrophs are specially significant in that they bring about the fixation of solarenergy and there by initiates energy flow within the community
- Second trophic level includes primary consumers
- The third trophic level is represented by primary carnivors
- the last trophic level by the decomposers

7. Growth form and structure

- A community is characterized by several growth forms such as mosses, grasses, herbs, shrubs, trees and various taxonomic group of animals
- Each growth form in turn will have several morphological variants which is characterized by a particular community
- The different growth forms of a community determine its stratification

8. Stratification

- Is the vertical layering of organisms or environmental condition within a biotic community
- The spacial distribution of organism in vertical and horizontal planes, thus there are two patterns of stratification vertical and horizontal
- horizontal layering is more specifically called zonation, segregation and distribution of organism into several sub communities
- vertical stratification is typically the vertical layering of organism

9.Periodicities

- Refers to the regularity and rhythmicity in the activities of organisms
- Periodicities are the results of environmental and physiological rhythm
- The major community periodicies include daily, seasonal and lunar periodicities

Daily or diel periodicity

- is 24 hr. regularity and rhythmicity in the day to day routine activities of organisms
- It is also called circadian rhythm

- Animals active during night-nocturnal
- Active during day time-diurnal
- Active during twilight hours of dawn and dusk-crepuscular
  Seasonal periodicities
- refers to the activities of organism regulated by seasonal rhythm by changing seasons
  Lunar periodicities
- Activities regulated by lunar rhythm and tidal cycles
- Usually shown by marine animals

10. biotic stability

- stability in organization and function of a community
- It is maintained by the interaction between its constituent species
- Higher the number of interacting species in a community and the greater the intensity of their interaction,the maximum would be stability of the community
- The interaction between different species increase their adaptability.
- fitness and survival value and thereby makes the community more stable

11. Community succession

- is the appearance and disappearance of biotic community in regular succession in a particular area or habitat
- This is a slow, steady and continuous process
- Each community first gets established in a habitat
- Then it become successful and gradually modifies the environment
- Finally it disappears, paving away for the colonization of a new community
- First community to colonize a habitat is know as pioneer community
- Succession starts from this pioneer community, proceeds through several unstable intermediate or transient community and finally ends in amore stable final community
- The intermediate community are called series or seral community and the final community is known as climax community
- Succession taking place in a previously uninhabited area is known as primary succession
- The succession occurring in a area where the previous community has become completely vanished is known as secondary succession
- Succession in an aquatic habitat is known as hydrosere
- In a dry terrestrial habitat is known as xerosere
- In a moist soil is called mesosere and in saline water is called halsosere