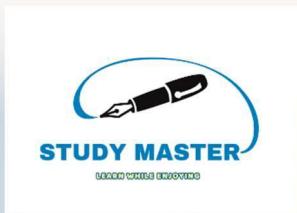


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NO PROGRESS”**

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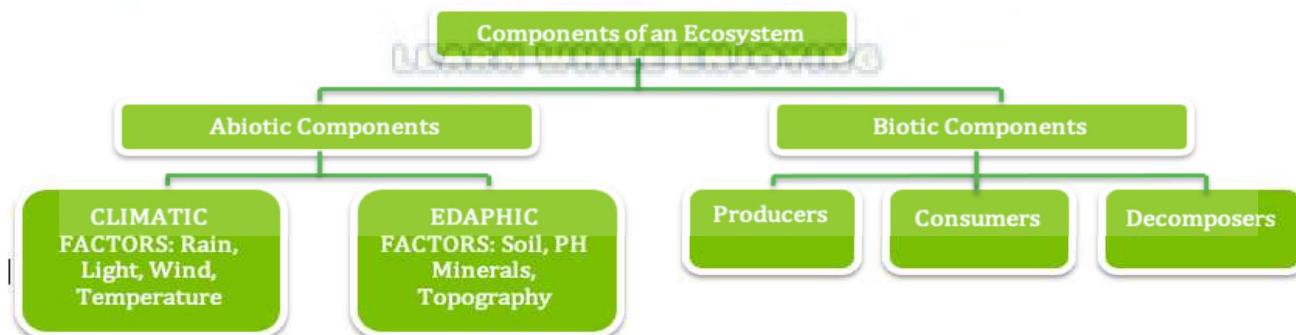
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## 1. ECOLOGY, ECOSYSTEM AND FUNCTIONS OF ECOSYSTEM

### BASIC DEFINITIONS

- **Environment:** the natural landscape together with all of its non-human features, characteristics and processes
- **Ecology:** Subject which studies the interactions among organisms and between the organism and its physical (abiotic) environment.
- **Biosphere:** The biosphere is the **biological component (supporting life)** of earth which includes the **lithosphere, hydrosphere and atmosphere**.
- **Habitat:** A habitat is a place where an organism makes its home. A habitat meets all the environmental conditions an organism needs to survive. (**All habitats are environments, but all environments are not habitats.**)
- **Ecosystem:** Structural and functional unit of biosphere consisting of community of living beings and the physical environment, both interacting and exchanging materials between them.
- **Ecotone:** An ""ecotone"" is a transition area between two biological communities, where two communities meet and integrate. E.g. Mangroves represents an ecosystem between marine and terrestrial ecosystem.
- **Niche:** Ecological niche is a term for the position of a species within an ecosystem, describing both the range of conditions necessary for persistence of the species, and its ecological role in the ecosystem. Ecological niche subsumes all of the interactions between a species and the biotic and abiotic environment, and thus represents a very basic and fundamental ecological concept.
- No two species have exact identical niche. Different types of niches are - **Habitat niche, Food niche, Reproductive niche, Physical and Chemical niche.**
- **Biomes:** A biome is a community of plants and animals that have common characteristics for the environment they exist in. They can be found over a range of continents. Biomes are distinct biological communities that have formed in response to a shared physical climate. Biome is a broader term than habitat; any biome can comprise a variety of habitats.

Well-developed ecotones contain some organisms which are **entirely different** from adjoining communities. When number of species is much greater than either community, it is called **edge effect**. E.g. density of birds is greater in the mixed habitat of ecotone between the forest and the desert.



### MAJOR ABIOTIC COMPONENTS

An abiotic factor is a non-living part of an ecosystem that shapes its environment. In a terrestrial ecosystem, examples might include temperature, light, and water. In a marine ecosystem, abiotic factors would include **salinity** and **ocean currents**.

<b>Temperature</b>	<ul style="list-style-type: none"> <li>• Affects the kinetic of enzymes and through its basal metabolism, activity and other physiological functions of the organism.</li> <li>• Level of thermal tolerance determine, geographical distribution of an organism.</li> <li>• <b>Eurythermal</b> (Organism that can tolerate wide range of temperature)</li> <li>• <b>Stenothermal</b> (Organism that are restricted to narrow range of temperature)</li> </ul>
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Water	<ul style="list-style-type: none"> <li>Productivity and distribution of plants is heavily dependent on water.</li> <li><b>Euryhaline</b>- Organism that can tolerate wide range of salinities (Note: Salt concentration measured in parts per thousand)</li> <li><b>Stenohaline</b>- Organism that are restricted to narrow range of salinities.</li> <li>Many freshwater animals can't live for long in sea water and vice versa due to osmotic problem.</li> </ul>
Light	<p><b>For Plants:</b> Photosynthesis + Photoperiodic requirement for flowering.</p> <p><b>For Animals:</b> Diurnal and seasonal variation in light, intensity and duration (photoperiod) determines animal's foraging, reproductive and migratory activities. UV component of the spectrum is harmful to many organisms. Not all the colour components of visible spectrum are available for marine plants living at different depths of the ocean. E.g. red, green, brown algae inhabit sea at different depths.</p>
Soil	<p><b>Vegetation in any area are determine by-</b> Soil composition, Percolation and Grain size, Water holding capacity.</p> <p><b>Aggregation of soil are determined by:</b> PH, Mineral composition, Topography.</p>

### RESPONSE TO ABIOTIC FACTORS:

How do organisms living in extreme environment cope or manage with stressful conditions?

Regulate	<ul style="list-style-type: none"> <li>Homeostasis (maintaining constancy of internal body) by physiological (sometimes behavioral also) like ensuring constant body temperature (<b>Thermoregulation</b>). E.g. in summer outside temperature is more than our body temperature, we sweat profusely. In winter we shiver, which produces heat and raises body temperature.</li> <li>Constant osmotic concentration (<b>Osmoregulation</b>)</li> <li>Success of mammals is largely due to their ability to maintain a constant body temperature.</li> </ul>
Conform	<ul style="list-style-type: none"> <li>99% of animals and nearly all plants can't maintain constant internal environment.</li> <li>Thermoregulation is energetically expensive for many organisms. For e.g. shrews and humming birds.</li> <li>Heat loss and gain is function of surface area.</li> <li>Small animals have larger surface area relative to their volume so they tend to lose body heat very fast when it is cold outside.</li> <li>They have to expend much energy to generate body heat through metabolism - this is the reason small animals are not found in polar regions.</li> <li>In aquatic organisms, the osmotic concentration of the body fluids changes with that of the ambient water osmotic concentration.</li> </ul>
Migrate	<ul style="list-style-type: none"> <li>The organism moves away temporarily from the stress habitat to more hospitable area and return when stressful period is over. E.g. Keoladeo National Park (Bharatpur) Rajasthan, host thousands of migratory birds from Siberia during winter months.</li> <li>Examples of it are important: Siberian Cranes, Amur Falcon, Greater Flamingo</li> </ul>
Suspend	<ul style="list-style-type: none"> <li><b>Thick walled spores' formation</b> → In bacteria, Fungi and lower plants.</li> <li><b>Dormancy</b> → Plants: Reduction of metabolic activity in higher plants in stressful environment</li> <li><b>Hibernation</b> → Hibernation is when an animal slows its heart rate to save energy and survive the winter without eating much. e.g. bear, bat, rodents etc.</li> <li><b>Aestivation</b> → Aestivation is a state of animal dormancy, similar to hibernation, although taking place in the summer rather than the winter. Aquatic animals: E.g. Snail, Fish.</li> <li><b>Diapause</b> → Zooplankton species in lakes and ponds- a stage of suspended development.</li> </ul>

### ADAPTATIONS

- Adaptation is any attribute of the organism (Morphological, Physiological, Behavioral) that enables organism to survive and reproduce in its habitat. Adaptedness is the state of being adapted: the degree to which an organism is able to live and reproduce in a given set of habitats
- Example:** Kangaroo rat in North American Deserts: in absence of water, has ability to meet its requirement through internal fat oxidation and has ability to concentrate its urine.

<b>Morphological Adaptations:</b>	<ul style="list-style-type: none"> <li>Desert plants have thick cuticle on their leaf surface and stomata arranged in deep pits to minimize water loss through transpiration.</li> <li>Some desert plants like Opunita have no leaves and photosynthetic function is taken over by flattened stems.</li> <li>Mammals from colder climates have shorter ears and limbs to minimize heat loss. This is called Allen's Rule.</li> </ul>
<b>Physiological Adaptations</b>	E.g. altitude sickness: Our body compensate low Oxygen availability by increasing red blood cell production, decreasing the binding affinity of hemoglobin and by increasing breathing rate.
<b>Biochemical Adaptation:</b>	Many fish and invertebrates live at great depths in the ocean, where pressure could be >100 times than the normal atmospheric pressure that we experience.
<b>Behavioural Adaptations</b>	E.g. Lizard they bask in the sun when body temperature drops, but moves to shade when ambient temperature starts increasing.

### MAJOR BIOTIC COMPONENTS

PRODUCER	CONSUMER	DECOMPOSER
<ul style="list-style-type: none"> <li>Producers are organisms that create food from inorganic matter.</li> <li><b>Example:</b> Plants, lichens and algae, which convert water, sunlight and carbon dioxide into carbohydrates.</li> </ul>	<ul style="list-style-type: none"> <li>Consumers have to feed on producers or other consumers to survive.</li> <li>If they feed on the producers, the plants, they are called <b>primary consumers</b>, and if the animals eat other animals which in turn eat the plants (or their produce) they are called <b>secondary consumers</b>.</li> <li>The consumers that feed on herbivores are <b>carnivores</b>, or more correctly <b>primary carnivores</b> (though secondary consumers). Those animals that depend on the primary carnivores for food are labelled <b>secondary carnivores</b>.</li> <li><b>Example:</b> Deer, Bear, Human beings, etc.</li> </ul>	<ul style="list-style-type: none"> <li>An organism that primarily feeds on dead organisms or the waste from living organisms.</li> <li><b>Detritivores:</b> Some organisms perform a similar function as decomposers, and are sometimes called <b>detritivores</b>.</li> <li>The difference lies in the way decomposers and detritivores break down organic material. Detritivores must digest organic material within their bodies in order to break it down and gain nutrients from it.</li> <li>Decomposers do not need to digest organic material internally in order to break it down.</li> <li><b>Scavengers:</b> Scavengers are the first to arrive at a dead organism's remains. It includes lions, jackals, wolves, raccoons, and opossums.</li> <li><b>Example:</b> Bacteria, fungi</li> </ul>

**Vertical distribution** of different species occupying different levels is called **stratification**. (For example, trees occupy top vertical strata or layer of a forest, shrubs the second and herbs and grasses occupy the bottom layers.)

### COMPONENTS AND FUNCTIONS OF ECOSYSTEM

- **Four basic components of ecosystem**- (i) Productivity; (ii) Decomposition; (iii) Energy flow; and (iv) Nutrient cycling.

#### (i) Productivity:

- **The rate of biomass production is called productivity.**
- **Primary production** is defined as the amount of biomass or organic matter produced per unit area over a time period by plants during photosynthesis.
- **Gross primary productivity** of an ecosystem is the rate of production of organic matter during photosynthesis.
- A considerable amount of GPP is **utilized** by plants in **respiration**.
- Gross primary productivity minus respiration losses (R), is the **net primary productivity (NPP)**.  $GPP - R = NPP$ .
- **Secondary productivity is defined as the rate of formation of new organic matter by consumers.**

Land Type	Average NPP (tons per km sq. per year)
Algal beds and reefs	2500
Tropical rainforest	2200
Tundra and alpine	140
Open ocean	125
Desert and semi desert	90

#### (ii) Decomposition:

- Decomposers break down complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition.
- The important steps in the process of decomposition are **fragmentation, leaching, catabolism, humification and mineralization**.
- **Detritivores** (e.g., **earthworm**) break down detritus into smaller particles. This process is called **fragmentation**
- By the process of **leaching**, water-soluble inorganic nutrients go down into the soil horizon and get precipitated as unavailable salts.
- Bacterial and fungal enzymes degrade detritus into simpler inorganic substances. This process is called as **catabolism**.
- All the above steps in decomposition **operate simultaneously** on the detritus
- **Humification and mineralization occur during decomposition in the soil**
- **Humification** is accumulation of a dark colored amorphous substance called humus that is highly resistant to microbial action and undergoes decomposition at an extremely slow rate. It **colloidal in nature** it serves as a **reservoir of nutrients**.
- Humus is further degraded by some microbes and release of inorganic nutrients occur by the process known as **mineralization**

Decomposition is largely an **oxygen-requiring process**. **Temperature** and **soil moisture** are the most important climatic factors that regulate decomposition. Decomposition - slower- if detritus rich in lignin and chitin; and quicker- if detritus rich in nitrogen and water.

#### (iii) Energy Flow:

- There is **unidirectional movement of energy towards the higher trophic levels** and its dissipation and loss as heat to the environment.
- Of the incident solar **radiation less than 50 per cent of it is photosynthetically active radiation (PAR)**
- **Plants capture only 2-10 per cent of the PAR** and this small amount of energy sustains the entire living world.