Edge effect

Environment Class 03

24th February, 2024 at 9:00 AM

ECOTONE (09:18 AM)

- An ecotone is a **transition area** between two different ecosystems.
- It's where the edges of two adjacent ecosystems overlap and integrate.
- These areas often exhibit high diversity and unique species composition. It is called as **edge effect.**

ECOLINE (it is for features)

- It represents a **gradual continuous change** in plants along an environmental gradient.
- Thus ecotone represents a transition area that can be properly demarcated.
- while Ecoline represents a continuous change where marking a boundary is difficult.

FUNCTIONS OF AN ECOSYSTEM (09:30 AM)

1. Primary Production
2. Energy flow through the food chain/web
3. Nutrient cycle
4. Ecological Succession
5. Homeostasis of Ecosystem
6. Ecosystem Services

1. PRIMARY PRODUCTION

- It is the storage of energy through the formation of organic matter from inorganic compounds.
- It is done by autotrophic organisms.
- **Gross Primary Productivity:**
- It is defined for an ecosystem as the rate of production of organic matter during photosynthesis.
- It is measured in **Kg m^{-2} yr^{-1}**
- Productivity depends on the availability of water, and sunlight. and essential nutrients.
- Plants use 400-700nm wavelength of light for photosynthesis. (i.e. visible ray)
- This is photosynthetically active radiation.
- A considerable amount of GPP is utilized by plants in respiration.
- **Net Primary Productivity** is defined as gross primary productivity minus respiration losses.
- This is the available biomass for the consumption of heterotrophs.
- **Secondary productivity** is defined as the rate of formation of new organic matter by consumers.

(i.e. if NPP is more then Secondary production will also more or we can say the growth of consumers is directly based on growth of primary producers.)

-> Photosynthesis is not the only way of energy, some organisms also live in darker areas but still form energy rich bio molecules which is known as CHEMOSYNTHESIS.

CHEMOSYNTHESIS (10:00 AM)

- Certain microbes can produce energy-rich molecules from chemicals present in their environment typically in the absence of sunlight.

Ex:

- Deep-sea bacteria use **Hydrogen Sulphide** that rises from deep-sea hydrothermal vents.
- Hydrothermal vents are the result of sea water percolating down in the ocean crust.
- The cold seawater is heated by hot magma and re-emerges to form this vent.
- Chemosynthesis can also occur in **cave ecosystems.** , deep soil among others.

2. **ENERGY FLOW THROUGH FOOD CHAIN/WEB**

- The transfer of food energy from producers/plants through a series of organisms, that consume and are consumed is termed as **food chain.**
- It shows a movement of energy by indicating the path of food from producer to final consumer.
- Based on the source of nutrition, organisms occupy a specific place in the food chain, which is known as the **Trophic Level.**
- Within any ecosystem, there are two major food chains.
- **a. Grazing Food Chain**
- **b. Detritus Food Chain**
- The distinction between these two is the source of energy for primary consumers.
- In the grazing food chain, it is plant biomass. In the detritus food chain, it is dead organic matter.
- The detritus food chain includes detrivores and decomposers.
- Detrivores are organisms that consume Detritus by breaking it into smaller pieces.
- E.g. Earthworm, Millipeds, Woodlice, etc.
- Bacteria and fungi decompose at the molecular level into simple inorganic molecules.
- **Note: In aquatic ecosystems, the grazing food chain is a major conduit for energy flow, and in terrestrial ecosystems, the detritus food chain is a major conduit for energy flow.**
- **Ecological Efficiency:**
- It represents the percentage of energy in the biomass produced by one trophic level that is incorporated into the biomass produced by the next higher trophic level.
- On average, this efficiency is about 10 percent. This is called **Lindeman's rule.**

In oceans because of flow of water on surface organic matters can't remain stable so can't be decompose and at the bottom there is no sunlight since decomposition mainly requires room temperature so because of all these factors grazing food chain dominates in oceans but on the other hand in case of terrestrial ecosystem organic matter will remain stable in forest areas so there is detritus food chain dominates here.

ECOLOGICAL PYRAMID (10:37 AM)

- Ecological pyramids are graphic representations of trophic levels in an ecosystem.
- The producer makes the base of the pyramid and subsequent tiers represent herbivores, carnivores, and top carnivores.
- We can draw three types of pyramids:
- **i. Pyramid of Number** number of
- This represents ~~several~~ organisms at each trophic level. Generally, this pyramid is upright but in some cases, it can be inverted.
- There can be inverted pyramids. E.g. Big tree as an ecosystem. We can see many insects and parasites., caterpillars and hyperparasites. A hyperparasite is a parasite that infects another parasite. In simple terms, it is a "parasite of a parasite."
- **ii. Pyramid of Biomass**
- This represents ~~biomass at each level.~~ total biomass at each trophic level.
- It is measured in **kg m^{-2}.**
- In most terrestrial ecosystems, it is upright, in an aquatic ecosystem it is inverted.
- **iii. Pyramid of Energy**
- It represents the total amount of energy at each level.
- The energy pyramids are never inverted.

BIOACCUMULATION AND BIOMAGNIFICATION (11:07 AM)

- Bioaccumulation occurs when pollutants build up in a single organism's body over time.
- **E.g. Mercury Poisoning in Fish.**
- Biomagnification occurs when the concentration of toxins increases as these toxins are passed up the food chain.
- E.g. **Poly-Chlorinated biphenyl** can be observed by phytoplankton, zooplankton eats large quantities of phytoplankton, and fish eats large quantities of zooplankton, thus the concentration of PCB further increases up the food chain.
- For biomagnification to occur, pollutants should be long-lived, and soluble in fat, mobile, and biologically active.

Despite all the limitations in Ecological pyramid it is quite useful to understand Bioaccumulation and Biomagnification.

Main Marine Autotrophs:

Phytoplankton (Microscopic algae, diatoms, dinoflagellates)

Seaweed & Macroalgae (Kelp, red and green algae)

Seagrass (Eelgrass, turtle grass)

Cyanobacteria (Blue-green algae like Prochlorococcus)

Chemosynthetic Bacteria (Hydrothermal vent bacteria using chemicals instead of sunlight)

Main Marine Primary Consumers:

Zooplankton (Tiny drifting animals like krill and copepods)

Small Herbivorous Fish (Anchovies, parrotfish)

Marine Invertebrates (Sea urchins, shrimp, mollusks)

Large Grazing Animals (Green sea turtles, manatees, dugongs)

Vertebrates are animals that have a backbone (vertebral column) or spine. They belong to the phylum Chordata and subphylum Vertebrata.

3. **NUTRIENT CYCLING (11:29 AM)**

- **Gaseous Cycle**: Water, Carbon and Nitrogen
- **Sedimentary Cycle:** Phosphorus and Sulfur

CARBON CYCLE

- Carbon is a vital component of life.
- It is found in all organic molecules.
- The atmosphere contains a significant amount of carbon in the form of **CO_2 and CH_4.**
- Plants and animals store carbon in their tissues.
- Dead organic matter and soil also hold significant amounts of carbon.
- Oceans absorb atmospheric CO_2. Marine organisms utilize carbon to build shells.
- Carbon is also stored in the earth's crust as fossil fuel and sedimentary rock layers such as limestone.
- **Processes in the carbon cycle:**
- **1. Photosynthesis** (capturing of CO2 and making carbohydrates.)
- **2. Respiration** (utilizing that energy (i.e. carbohydrates) to fulfill their requirements but in this process energy will lose and CO2 will get release.)
- **3. Decomposition:** It releases CO_2 in the air. In the absence of oxygen, organic matter decomposes into methane.
- **4. Burning of organic matter** ~~or fossil fuels~~ such as coal petroleum natural gas releases CO_2 in the atmosphere. (such as wood or burning of organic matter)
- Fossil fuel burning is the biggest reason for the recent build-up of CO_2 in the atmosphere.
- **5. Ocean uptake and release:**
- Oceans constantly absorb CO_2 and release it slowly.
- All the places where carbon is stored are called carbon sinks.
- The process by which carbon is stored is called carbon sequestration.
- Marine organisms dissolve CO_2 to form limestone shells, when these organisms die, shells accumulate on the sea floor forming carbon-rich sedimentary rocks.

The topic for the next class: Wetlands, Corals and Mangroves

6. Shell formation:

-> Terms will be used specifically like bio accumulation will only be used for pollutants.
-> Because of rice cultivation methane is release because rice is mostly gets submerged into water and water has bacteria because of which anaerobic decomposition happens and hence release of methane happens.
-> Even after we stopped releasing carbon then also earth will remain hot for decades because of sink of carbon in ocean, forest and in wetlands so when we talk about controlling global warming we talk about increasing of forests so that carbon sinks can be increased.

Q: Each year a large amount of plant material cellulose is deposited on the surface of planet earth. What are the natural processes this cellulose undergoes through before yielding CO2, water and other end products. (UPSC 2022, 10 marks)

Hint: Cellulose (C6H10O5)n
-> This question is of Carbon cycle so we first write about how this organic matter forms through photosynthesis, then about once this organic matter dies it goes to aerobic or anaerobic decomposition.