2.1 Global Environmental Concerns

1. Global Warming

1. **Definition and Causes**
   - Global warming refers to the increase in Earth's average surface temperature due to the excessive accumulation of greenhouse gases (GHGs) such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).
   - Main contributors include burning fossil fuels, deforestation, and industrial activities.
2. **Effects on Climate and Environment**
   - Rising temperatures lead to more frequent and intense heatwaves, droughts, and wildfires.
   - Polar ice caps and glaciers are melting, causing sea level rise and coastal flooding.
3. **Impact on Human Life**
   - Extreme weather events like hurricanes, floods, and cyclones are becoming more common.
   - Food and water shortages due to changes in precipitation patterns.
4. **Economic Consequences**
   - Agriculture and fisheries are affected due to erratic weather patterns.
   - Increased costs for disaster recovery and adaptation measures.
5. **Mitigation Strategies**
   - Reduction of fossil fuel consumption and promotion of renewable energy.
   - Adoption of carbon sequestration techniques like afforestation and carbon capture.

2. Acid Rain

1. **Definition and Chemical Causes**
    - Acid rain is precipitation that contains high levels of sulfuric acid (H_2SO_4) and nitric acid (HNO_3), formed when sulfur dioxide (SO_2) and nitrogen oxides (NO_x) react with atmospheric moisture.
2. **Sources of Acid Rain**
    - Emissions from coal-fired power plants, vehicle exhaust, and industrial processes.
    - Volcanic eruptions and wildfires also contribute naturally.
3. **Effects on Ecosystem**
    - Acidifies lakes and rivers, harming aquatic life.
    - Damages forests by depleting essential nutrients from soil.
4. **Impact on Human-Made Structures**
    - Corrodes buildings, monuments, and bridges, especially those made of limestone and marble.
5. **Control Measures**
    - Implementation of clean energy sources like wind and solar.
    - Use of scrubbers in industries to reduce SO_2 emissions.

3. Ozone Depletion

1. **Definition and Causes**
    - The ozone layer protects Earth from harmful UV radiation.
    - Ozone depletion occurs due to chlorofluorocarbons (CFCs) and halons from refrigerants, aerosols, and industrial solvents.
2. **Formation of the Ozone Hole**
    - Detected mainly over Antarctica, thinning occurs due to the release of ozone-depleting substances (ODS).
3. **Effects of Ozone Layer Depletion**
    - Increased UV radiation leads to skin cancer and cataracts in humans.
    - Disrupts plant growth and marine ecosystems by damaging phytoplankton.
4. **Montreal Protocol and Global Efforts**
    - The **Montreal Protocol (1987)** aims to phase out ODS and promote eco-friendly alternatives.
5. **Preventive Measures**
    - Use of hydrofluorocarbons (HFCs) as substitutes for CFCs.
    - Stricter laws and regulations to monitor industrial emissions.

4. Hazardous Wastes and Industrial Disasters

1. **Types of Hazardous Wastes**
   - Includes chemical, biological, and radioactive wastes from industries, hospitals, and research labs.
2. **Major Industrial Disasters**
   - **Bhopal Gas Tragedy (1984):** Methyl isocyanate (MIC) gas leak from a pesticide plant killed thousands.
   - **Chernobyl Nuclear Disaster (1986):** A nuclear explosion led to radiation exposure affecting thousands.
3. **Environmental and Health Impacts**
   - Contamination of air, water, and soil leads to chronic health issues and genetic disorders.
4. **Waste Management Strategies**
   - Proper disposal and recycling of industrial waste.
   - Adoption of safer alternatives in production processes.
5. **Laws and Regulations**
   - Implementation of stringent environmental laws like the **Hazardous Waste Management Rules, 2016 (India)**.

5. Loss of Biodiversity and Endangered Species

1. **Definition and Causes**
   - Biodiversity loss occurs due to habitat destruction, climate change, poaching, and pollution.
2. **Effects on Ecosystem Stability**
   - Disrupts food chains and natural balance, leading to ecological imbalances.
3. **Endangered Species in India**
   - **Bengal Tiger, Indian Rhino, Ganges River Dolphin** are critically endangered due to poaching and habitat loss.
4. **Conservation Efforts**
   - **Wildlife Protection Act (1972)** and **Project Tiger** aim to protect endangered species.
5. **Sustainable Practices**
   - Promotion of eco-tourism and community-driven conservation initiatives.

2.2 Concepts of Ecology

1. Ecosystems and Interdependence Between Living Organisms

1. **Definition of Ecosystem**
   - An ecosystem consists of living organisms (biotic) and their physical environment (abiotic), interacting in a specific area.
2. **Types of Ecosystems**
   - **Terrestrial Ecosystems:** Forests, grasslands, deserts.
   - **Aquatic Ecosystems:** Freshwater (rivers, lakes) and marine (oceans, coral reefs).
3. **Interdependence Between Species**
   - Organisms depend on each other for food, shelter, and reproduction (e.g., bees pollinating flowers).
4. **Role of Decomposers in an Ecosystem**
   - Fungi and bacteria break down dead organisms and recycle nutrients.
5. **Ecosystem Services**
   - Provision of food, water, climate regulation, and soil fertility maintenance.

2. Habitat and Limiting Factors

1. **Definition of Habitat**
   - A habitat is a specific place where an organism lives and thrives.
2. **Types of Habitats**
   - **Terrestrial:** Forests, deserts, tundra.
   - **Aquatic:** Oceans, lakes, wetlands.
3. **Limiting Factors in an Ecosystem**
   - Factors such as availability of water, temperature, light, and food influence populatio growth.
4. **Carrying Capacity Concept**
   - The maximum population an environment can support without degradation.
5. **Human Impact on Habitats**
   - Urbanization, deforestation, and pollution are leading to habitat destruction.

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3. Food Chain and Trophic Levels

1. **Definition of Food Chain**
   - A sequence of organisms in which energy flows from one to another through consumption.
2. **Types of Food Chains**
   - **Grazing Food Chain:** Starts with plants (producers) → herbivores → carnivores.
   - **Detritus Food Chain:** Begins with decomposing matter → detritivores → predators.
3. **Trophic Levels in a Food Chain**
   - **Producers (Plants) → Primary Consumers (Herbivores) → Secondary Consumers (Carnivores) → Tertiary Consumers (Top Predators).**
4. **Energy Transfer in the Food Chain**
   - Follows the **10% Rule**, where only 10% of energy is passed to the next level.
5. **Disruptions in the Food Chain**
   - Overhunting, habitat loss, and pollution can cause imbalances in ecosystems.