

Unit Six: Population and natural resources

6.1 Population Ecology

Population Ecology is the study of how populations of organisms interact with their environment and change over time. It looks at factors affecting the size, density, and distribution of populations.

Key Terms:

- **Population:** A group of individuals of the same species living in a specific area.
- **Population Size:** The total number of individuals in a population.
- **Population Density:** The number of individuals per unit area or volume.
- **Population Dispersal:** The pattern of spacing among individuals within a population.

Studying Population Size and Density:

- **Population Size** is often estimated using sampling methods because counting every individual is impractical. For example:
 - **Quadrat Method:** Used for stationary organisms like plants. A square frame (quadrat) is placed on the ground, and the number of organisms within it is counted and extrapolated to estimate the total population.
 - **Mark-Recapture Method:** Used for mobile animals. A sample of individuals is marked and released, then another sample is captured to estimate the total population based on the proportion of marked individuals.

Dispersal Patterns:

- **Uniform Dispersion:** Individuals are evenly spaced.
- **Random Dispersion:** Individuals are distributed without a specific pattern.
- **Clumped Dispersion:** Individuals are grouped in clusters.

Population Growth Models:

1. **Exponential Growth:**
 - **Description:** Population increases at a constant rate with unlimited resources.
 - **Graph:** J-shaped curve.

- **Formula:** $\frac{dN}{dT} = rN$ (where r is the growth rate, N is the population size).
 - **Characteristics:** Rapid growth under ideal conditions.
2. **Logistic Growth:**
- **Description:** Population growth slows as it approaches the carrying capacity (the maximum number of individuals an environment can support).
 - **Graph:** S-shaped curve.
 - **Formula:** $\frac{dN}{dT} = rN \left(\frac{K-N}{K} \right)$ (where K is the carrying capacity).
 - **Characteristics:** Growth slows down as resources become limited.

Population Regulation:

- **Density-Dependent Factors:** These factors affect population size based on density, such as disease, competition, and predation.
- **Density-Independent Factors:** These factors affect populations regardless of density, such as climate and natural disasters.

Impacts of Human Activities:

- **Overexploitation of Resources:** Leads to depletion and habitat destruction.
- **Pollution:** Affects air, water, and soil quality.
- **Climate Change:** Alters habitats and affects species distributions.

Conservation:

- **Natural Resources:** Materials and components that can be found within the environment that are useful to humans, such as water, minerals, and forests.
- **Conservation:** The practice of protecting and managing natural resources to prevent their depletion and ensure sustainability.

Indigenous Conservation Practices in Ethiopia:

- Local communities often use traditional methods to manage and protect natural resources, reflecting their deep understanding and respect for their environment.

6.1.3 Demographic Structure

Population Size and Density vs. Demography

- **Population Size:** The total number of people in a specific area at a given time.

- **Population Density:** The number of people per unit area, like square kilometers.
- **Demography:** The study of population dynamics, including how populations change over time due to birth, death, migration, and other factors.

Key Demographic Parameters

- **Crude Birth Rate (CBR):** The number of live births per 1,000 people per year.
- **Crude Death Rate (CDR):** The number of deaths per 1,000 people per year.
- **Infant Mortality Rate:** The number of deaths of children under one year old per 1,000 live births per year.
- **Life Expectancy:** The average number of years a person can expect to live, based on current mortality rates.
- **Fertility Rate:** The average number of children born to a woman over her lifetime.
- **Mortality Rate:** The overall number of deaths in a population.
- **Migration:** The movement of people between regions.
 - **Immigration:** Moving into a new area.
 - **Emigration:** Leaving an area to live elsewhere.

Age-Sex Structure

- **Age-Sex Structure:** Shows the number of people in each age group and gender, influencing population growth. Younger people typically contribute more to population growth, while older people have higher death rates.

Population Pyramid

- **Population Pyramid:** A graph that displays the age and sex distribution of a population.
 - **Expansive Pyramid:** Broad base, indicating a high birth rate and a growing young population. Common in developing countries.
 - **Constrictive Pyramid:** Narrow base, indicating a lower birth rate and an aging population. Common in developed countries.
 - **Stationary Pyramid:** Even distribution across age groups, indicating a stable population size.

Drawing a Population Pyramid

1. Collect data by age and sex.
2. Calculate the percentage of each age group relative to the total population.

3. Plot these percentages on a graph, with males on one side and females on the other.

Interpreting Population Pyramids

- A large base indicates high birth rates.
- The shape of the pyramid can show whether a country's population is growing, stable, or declining.

Survivorship Curves

- **Type I:** High survival rate in early and middle life, typical of humans and large mammals.
- **Type II:** Constant mortality rate throughout life, seen in some birds.
- **Type III:** High mortality in early life but higher survival rates for those who make it to adulthood, common in many plants and fish.

Population Regulation

- **Density-Dependent Factors:** Factors that affect population growth based on population density, such as competition, predation, and disease.
- **Density-Independent Factors:** Factors that affect population growth regardless of density, such as natural disasters and weather.

Conservation of Natural Resources in Ethiopia

Introduction: Natural resources are vital for human survival and development, but they are limited and can be depleted if not managed properly. Conservation is essential to ensure these resources remain available for future generations.

What is Conservation? Conservation refers to the careful management and protection of natural resources to ensure they are available for future generations. This includes preserving, managing, and restoring natural environments and ecosystems.

Why Conserve?

- **Limited Resources:** Many natural resources, like soil, water, and energy, are finite and can run out if overused.
- **Growing Population:** As Ethiopia's population increases, the demand for resources grows, making wise use and conservation even more critical.

Types of Natural Resources:

1. **Wildlife:** Includes animals living in natural habitats, such as the Lion, Walia Ibex, and Ethiopian Mountain Chameleon.
2. **Plants:** Ethiopia's diverse climate supports a wide range of plant species, some of which are unique to the country.
3. **Soil and Water:** Vital for agriculture, drinking, and various industrial uses. However, issues like soil erosion and water pollution threaten these resources.

Conservation Mechanisms:

1. **Wildlife Conservation:** Involves creating protected areas like national parks and wildlife reserves. Examples include:
 - **National Parks:** Bale Mountains, Simien Mountains
 - **Wildlife Sanctuaries:** Babile Elephant Sanctuary
 - **Community Conservation Areas:** Abune Yosef, Guassa Menz
2. **Plant Conservation:** Includes both traditional practices (sacred groves, selective harvesting) and modern practices (botanical gardens, seed banks).
3. **Soil and Water Conservation:** Uses mechanical methods (e.g., terraces, check dams) and biological methods (e.g., tree planting, agroforestry) to protect and restore soil and water quality.

Impact of Human Activities:

- **Deforestation:** Leads to soil erosion and loss of habitats.
- **Pollution:** Affects air and water quality, impacting all forms of life.
- **Industrialization:** Contributes to environmental degradation and resource depletion.

Conclusion: Conserving natural resources is crucial for maintaining the balance of our ecosystems and ensuring that future generations can meet their needs. By understanding and applying conservation methods, we can contribute to a sustainable future for Ethiopia.

Self-Reflection Questions:

1. What do you know about the conservation of natural resources?
2. What new information would you like to learn about conservation practices in your locality?

Climate Change and Its Effects

1. What is Climate Change?

- **Climate:** The usual weather patterns of a place, including temperature and rainfall, over a long period.
- **Climate Change:** A shift in these long-term weather patterns, which can lead to variations in temperature, rainfall, and other weather elements.

2. Causes of Climate Change:

- **Natural Causes:**
 - **Energy Exchange:** Variations in energy from the sun and changes in the Earth's atmosphere, oceans, land, and ice.
 - **Volcanic Eruptions:** Release of gases and particles that affect the climate.
- **Human Activities:**
 - **Burning Fossil Fuels:** Increased levels of carbon dioxide (CO₂) and other greenhouse gases.
 - **Greenhouse Gases:** CO₂, methane, nitrous oxide, and fluorinated gases trap heat in the atmosphere, leading to global warming.

3. Effects of Climate Change:

- **Global Warming:** Increase in Earth's average temperature due to greenhouse gases. This causes:
 - **Melting Ice Caps:** Contributes to rising sea levels.
 - **Extreme Weather:** More frequent droughts, heavy rainfall, and flooding.
 - **Health Problems:** Increased heat stress and related health issues.
 - **Biodiversity Loss:** Threatens many species with extinction.

Global Warming

1. What is Global Warming?

- A rapid increase in Earth's average temperature caused by elevated levels of greenhouse gases.

2. Major Causes:

- **Human Activities:** Burning fossil fuels and industrial processes that release greenhouse gases into the atmosphere.

3. Effects of Global Warming:

- **Environmental:** Flooding, ice cap melting, rising sea levels, and loss of species.

- **Health Issues:** Increased risk of heat-related illnesses.
- **Economic Impact:** Loss of agricultural productivity and increased costs due to climate-related disasters.

Ozone Layer Depletion

1. What is the Ozone Layer?

- A layer of ozone (O₃) in the stratosphere that protects Earth from harmful ultraviolet (UV) rays from the sun.

2. Causes of Ozone Depletion:

- **Chlorofluorocarbons (CFCs):** Chemicals used in refrigerators and fire extinguishers that break down ozone molecules.
- **Chemical Reactions:** Chlorine from CFCs reacts with ozone, reducing its ability to block UV radiation.

3. Effects of Ozone Depletion:

- **Health Risks:** Increased UV exposure leads to higher rates of skin cancer, cataracts, and weakened immune systems.
- **Environmental Impact:** Affects plant life and aquatic ecosystems, and contributes to smog formation.

Acid Rain

1. What is Acid Rain?

- Rain that has a lower pH than normal, making it more acidic.

2. Causes of Acid Rain:

- **Pollutants:** Emissions from burning fossil fuels, industrial activities, and vehicle exhausts release sulfur dioxide (SO₂) and nitrogen oxides (NO_x) into the atmosphere.
- **Chemical Reactions:** These pollutants combine with water vapor to form sulfuric and nitric acids.

3. Effects of Acid Rain:

- **Damage to Plants:** Strips away protective coatings from leaves and depletes soil nutrients.

- **Impact on Soil and Water:** Affects soil quality and aquatic ecosystems, harming fish and other aquatic organisms.
- **Human Health:** Reduces water quality and can cause respiratory problems.

Loss of Biodiversity

1. What is Biodiversity?

- The variety of life forms on Earth, including genes, species, and ecosystems.

2. Causes of Biodiversity Loss:

- **Habitat Destruction:** Deforestation and land conversion.
- **Overexploitation:** Overharvesting of resources.
- **Pollution:** Contamination of air, water, and soil.
- **Climate Change:** Alters habitats and conditions for many species.
- **Invasive Species:** Non-native species that disrupt local ecosystems.

3. Effects of Biodiversity Loss:

- **Ecosystem Services:** Reduces the ability of ecosystems to provide essential services like food, clean water, and disease regulation.
- **Economic Impact:** Threatens resources used for medicine, food, and building materials.
- **Cultural Impact:** Loss of species important to various cultures and traditions.

Toxic Bioaccumulation

1. What is Bioaccumulation?

- The build-up of toxic substances in an organism's body over time.

2. Causes:

- **Persistent Toxic Substances:** Chemicals like DDT and metals such as lead and mercury that do not easily break down and accumulate in fatty tissues.

3. Effects:

- **Health Risks:** Can cause cancer, neurological damage, reproductive issues, and developmental problems.

- **Environmental Impact:** Affects wildlife and ecosystems, with toxins becoming more concentrated as they move up the food chain.

These topics illustrate the significant impact of human activities and environmental changes on our planet, highlighting the need for concerted efforts to mitigate these effects and protect our ecosystems.

Resource Depletion

What is Resource Depletion?

Resource depletion happens when we use natural resources faster than they can be replenished. This results in a scarcity of these resources over time. Human activities are the primary cause of this issue. As the global population grows, the demand for resources increases, leading to faster depletion. Here are some key factors contributing to resource depletion:

1. **Overpopulation:** As the global population grows, so does the demand for resources like food, water, and energy. This increased demand speeds up the consumption of natural resources.
2. **Poor Farming Practices:** Ineffective irrigation, poor soil management, and excessive use of pesticides damage soil health and reduce its productivity. This can lead to a decrease in the quality and quantity of available agricultural resources.
3. **Overconsumption:** The industrial revolution led to extensive mining and oil drilling, which continues to grow. This overuse of minerals and fossil fuels depletes these resources faster than they can be naturally replenished.
4. **Industrial and Technological Development:** Industrial activities and technological advances often result in pollution and increased demand for raw materials, further accelerating the depletion of resources.

Indigenous Conservation Practices in Ethiopia

Indigenous Knowledge and Practices

Indigenous peoples have developed unique ways to manage and conserve natural resources based on their deep understanding of their environment. In Ethiopia, these practices include:

1. **Terracing:** Building terraces on hillsides to prevent soil erosion and manage water flow, as seen in the Konso people's practices.
2. **Contour Ploughing:** Farming along the contours of a hill to reduce water runoff and soil erosion.

3. **Crop Rotation:** Alternating different crops on the same land to improve soil fertility and reduce pests.
4. **Mixed Cropping:** Growing different crops together to maintain soil health and increase efficiency.
5. **Surface Mulching:** Applying a layer of material on soil to retain moisture, improve fertility, and reduce weed growth.
6. **Agro-forestry:** Integrating trees with crops to enhance soil conservation and provide additional resources.

Community-Based Conservation

In some areas, communities protect certain regions from use to allow natural recovery. For example, the Guassa community conservation area in Ethiopia is managed by a traditional system where the land is left undisturbed for several years to promote regeneration before it is used again.

Summary

Resource depletion is a critical issue driven by overpopulation, poor agricultural practices, overconsumption, and industrial development. Indigenous practices in Ethiopia, such as terracing and crop rotation, demonstrate effective ways to conserve resources and manage the environment sustainably.