Subject: Basic Ecology (ZOL-502)

(BS Zoology 6th Semester)

Terrestrial Ecosystems
(Tundra Ecosystem)

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Tundra Ecosystem

- **What is a Tundra Ecosystem?**
- The tundra ecosystem is a cold, treeless biome found in the Arctic and at high mountain altitudes.
- It has extremely low temperatures, a short growing season, and permafrost (a permanently frozen layer of soil).
- Despite these harsh conditions, a unique variety of plants and animals have adapted to survive here.

Key Characteristics of the Tundra

Feature	Description
Temperature	Very cold (as low as -50°C in winter)
Precipitation	Low (15–25 cm/year), mostly snow
Vegetation	No trees; mosses, lichens, grasses, and small shrubs
Soil	Poor in nutrients, permafrost prevents deep root growth
Biodiversity	Low, but highly specialized organisms
Growing Season	Very short (around 50–60 days)

Types of Tundra Ecosystems

- **A. Arctic Tundra**
- **Location:** Northern parts of North America, Europe, and Asia (above the Arctic Circle)
- **Climate:** Extremely cold winters, cool short summers
- **Sunlight:** Nearly 24-hour daylight in summer; long nights in winter
- **Vegetation:** Mosses, lichens, sedges, dwarf shrubs
- **Fauna:** Arctic foxes, caribou, polar bears, snowy owls

Types of Tundra Ecosystems

-  **B. Alpine Tundra**
- **Location:** High mountain tops above the tree line (e.g., Himalayas, Rockies)
- **Climate:** Cold and windy, but more sun exposure than Arctic tundra
- **Vegetation:** Similar to Arctic tundra but often more diverse
- **Fauna:** Mountain goats, marmots, snow leopards, eagles

Structure of the Tundra Ecosystem

- **Biotic Components (Living)**
- **i. Producers**
- Plants: Mosses, lichens, grasses, sedges, dwarf shrubs
- Adaptations: Low-growing, shallow roots, antifreeze-like chemicals
- **ii. Consumers**
- Primary Consumers (Herbivores): Caribou, lemmings, hares, musk oxen
- Secondary Consumers (Carnivores): Arctic foxes, owls, stoats
- Tertiary Consumers (Top Predators): Wolves, polar bears

Structure of the Tundra Ecosystem

- **iii. Decomposers:** Bacteria, fungi, and some invertebrates help decompose organic matter, though slowly due to cold
- **Abiotic Components (Non-living)**
- **Temperature:** Long, frigid winters and short summers
- **Sunlight:** Seasonal extremes (long summer days, long winter nights)
- **Soil:** Permafrost prevents water drainage and root penetration
- **Wind:** Strong and persistent, contributing to the harsh climate

Plant and Animal Adaptations

-  **Plant Adaptations**
- **Low growth form:**
- Protects from cold winds
- **Dark coloration:**
- Helps absorb heat
- **Short life cycle:**
- Completes during the brief summer
- **Hairy stems and leaves:** Insulate against cold

Plant and Animal Adaptations

-  **Animal Adaptations**
- **Thick fur or fat layers:**
- Insulate against freezing temperatures
- **Hibernation or migration:**
- To survive the extreme winters
- **White/gray coloring:**
- Provides camouflage in snow
- Low surface area to volume ratio: Helps retain body heat

Functions and Importance of Tundra Ecosystems

- ✅ **Ecological Functions**
- **Carbon storage:**
- Permafrost traps large amounts of carbon and organic material
- **Climate regulation:**
- Reflects sunlight due to snow cover (high albedo)
- **Supports unique biodiversity:**
- Crucial breeding ground for migratory birds

Functions and Importance of Tundra Ecosystems

- 💰 **Economic Importance**
- **Natural resources:**
- Oil, gas, minerals
- **Indigenous cultures:**
- Subsistence lifestyles based on reindeer herding, fishing, and hunting
- **Scientific research:**
- Indicator of climate change effects

Threats to the Tundra Ecosystem

- The tundra is fragile and highly vulnerable to human and environmental pressures:
- **Climate change:** Rising temperatures are thawing permafrost, releasing methane and CO_2
- **Oil and gas exploration:** Disturbs habitats and pollutes the environment
- **Pollution:** Airborne pollutants can settle and accumulate
- **Habitat loss:** Due to infrastructure development and melting ice
- **Slow recovery rate:** Disturbed tundra ecosystems take decades or centuries to regenerate

Conservation of Tundra Ecosystems

- Efforts to conserve tundra ecosystems include:
- Monitoring climate impacts and modeling future changes
- Establishing protected areas (e.g., Arctic National Wildlife Refuge)
- Regulating industrial development (mining, oil drilling)
- Supporting indigenous stewardship
- Research and education to raise awareness

THANK YOU