



# **ECOLOGY AND TYPES OF HABITAT**

*From Genes to Ecosystems: How Coded Lives Survive in the Living World*

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**Course Code: BIO 101**

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# WHY THIS TOPIC?

- *Understanding Ecology and Habitats matters because:*
  - **It is the Context for All Life:** Genetics and evolution don't happen in a vacuum—they play out on the real-world stage of habitats.
  - **It Explains the World Around You:** From a city park to a deep-sea documentary, ecology gives you the lens to see how life is connected.
  - **It Is the Foundation for Solving Global Crises:** Climate change, biodiversity loss, and food security are, at their core, **ecological problems** requiring ecological understanding.

# CORE IDEA OF ECOLOGY

- ❑ **Ecology reveals that life is a system of interconnected relationships shaped by habitat.**
  - **Everything is connected:** Change in one part of an ecosystem affects others.
  - **Form follows function:** Organisms are adapted to their specific habitat and niche.
  - **Energy flows, matter cycles:** Sunlight fuels life; nutrients are recycled through air, soil, water, and organisms.

# WHAT IS ECOLOGY?

- **Ecology** is the scientific study of **interactions between organisms and their environment**, and **among organisms themselves**, across multiple levels of organization.
- It seeks to understand:
  - **Survival** – How do organisms meet their needs?
  - **Adaptation** – How do they adjust to environmental challenges?
  - **Continuity** – How do populations persist over time?
  - **Interdependence** – How are living things connected to each other and their surroundings?

# WHAT IS ECOLOGY?

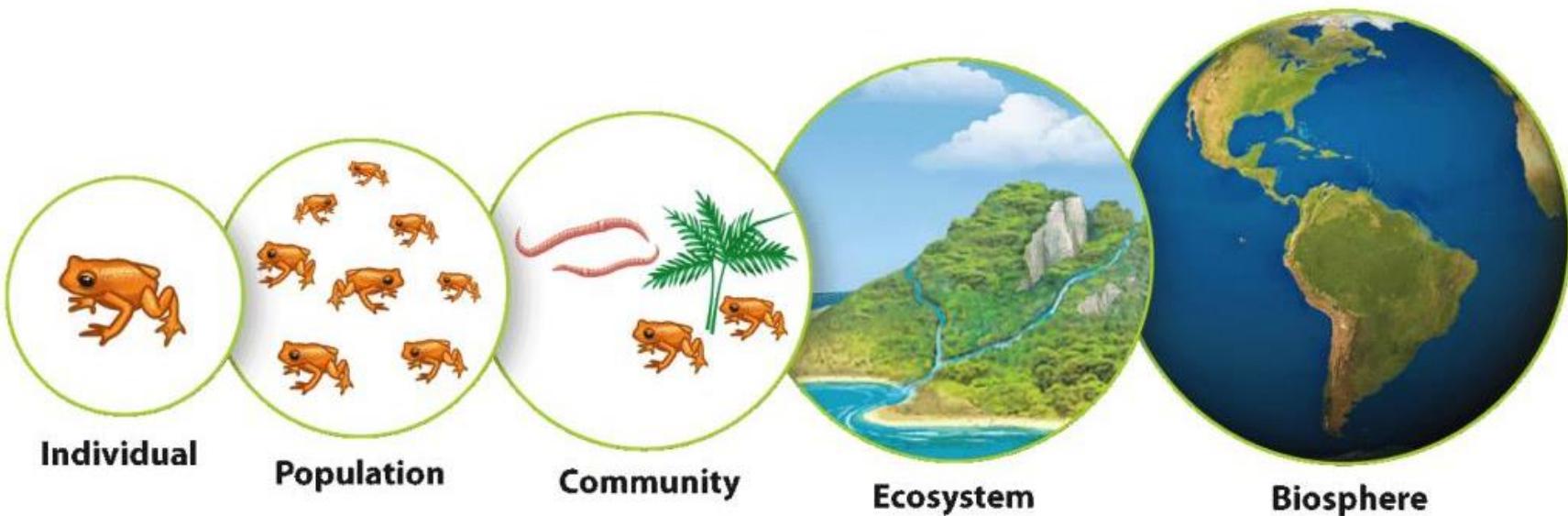
- **Ecology in Smart Caption**
- *Ecology asks:*
  - *Who lives here,*
  - *How do they live, and*
  - *How do they live together?"*

# THE PIONEERS OF ECOLOGY

- *Ecology emerged from the work of naturalists who first asked: “How does nature work together?”*
- **Ernst Haeckel (1834–1919):** He coined the term “ecology” (from Greek *oikos*, meaning "house").
- **Alexander von Humboldt (1769–1859):** The first true systems thinker in nature who mapped plant distributions across continents, showing how climate shapes vegetation zones—the foundation of biome science.

# LEVELS OF ECOLOGICAL ORGANIZATION

1. Organism → 2. Population →
3. Community → 4. Ecosystem → 5. Biosphere



# LEVELS OF ECOLOGICAL ORGANIZATION

1. **Organism** – An individual living thing.
2. **Population** – All individuals of the same species in an area.
3. **Community** – All populations (different species) living and interacting in an area.
4. **Ecosystem** – Community and its physical environment (soil, water, climate).
5. **Biome** – Large region with similar ecosystems (e.g., tropical rainforest).
6. **Biosphere** – The global sum of all ecosystems; where life exists on Earth.

# KEY ECOLOGICAL CONCEPTS

- **Adaptation to Habitat:**

- A camel lives in desert vs. a monkey lives in mangrove tree (estuary).
- *Form follows function shaped by habitat.*

- **Energy Flow:**

- Sun → Producers (Plants) → Consumers (Herbivores, Carnivores).

- **Interdependence:**

- This emphasises the idea that removing one species can ripple through a habitat.

# Habitat vs. Niche

- **Habitat:** The "address" – where an organism lives (forest, pond, desert).
- **Niche:** The "profession of functional unit" – its role in the habitat (what it eats, how it interacts).
- **Analogy:** A library (habitat) has librarians, students, security guards (each with a different niche).

# BIOMES:

## Earth's Major Habitat Types

- **Biome:** A very large ecological area on Earth's surface, defined by its:
  - **Climate** (temperature and precipitation)
  - **Vegetation** (dominant plant life)
  - **Adaptations** of its organisms
  - **Important note:** Climate is the master architect. It shapes the biome, which shapes the life within it.

# BIOMES: Terrestrial Habitats

1. **Tropical Rainforest** – High rainfall, biodiversity hotspot.
2. **Desert** – Low rainfall, extreme temperatures, specialized adaptations.
3. **Grassland** – Dominated by grasses; grazing animals and fire are key.
4. **Temperate Forest** – Distinct seasons, deciduous trees.
5. **Taiga (Boreal Forest)** – Cold, coniferous forests.
6. **Tundra** – Frozen subsoil (permafrost), low-growing vegetation.

- **Important note:** Its **division is based** on Climate and Vegetation features.

# BIOMES: Aquatic Habitats

1. **Freshwater** (Lakes, Rivers, Wetlands) – Low salt concentration.

2. **Marine** (Oceans) – High salt concentration.

**Zones:** Intertidal, Pelagic (open ocean), Benthic (ocean floor), Abyssal (deep sea).

3. **Estuaries** – The "nurseries of the sea" where freshwater meets saltwater.

- **Important note:** It covers **71% of the Earth and division is based on salinity** (salt concentration).

# THE EARTH BIOMES:

## Terrestrial Aquatic Habitats



# TERRESTRIAL BIOME: TROPICAL RAINFOREST

- **Climate:** Hot, humid, high rainfall year-round.
- **Vegetation:** Dense canopy of tall, broadleaf evergreen trees.
- **Key Adaptations:**
  - **Plants:** Large leaves to capture dim understory light; buttress roots for shallow soil.
  - **Animals:** Camouflage (e.g., panthers), arboreal (tree-dwelling) lifestyles (e.g., monkeys, sloths).
- **Biodiversity Fact:** Contains more than **half** of the world's known plant and animal species.

# **TERRESTRIAL BIOME: DESERT**

- **Climate:** Very low, unpredictable rainfall; extreme temperature swings (hot day/cold night).
- **Vegetation:** Sparse; cacti, shrubs, drought-resistant plants.
- **Key Adaptations:**
  - **Plants:** Water storage (succulence), reduced leaves (spines), deep/extensive roots.
  - **Animals:** Nocturnal behaviour, water conservation (e.g., kangaroo rat produces metabolic water), heat dissipation.

# **TERRESTRIAL BIOME: GRASSLAND (SAVANNA & TEMPERATE)**

- **Climate:** Seasonal rainfall (wet/dry seasons); frequent fires.
- **Vegetation:** Dominated by grasses and herbs; scattered trees in savannas.
- **Key Adaptations:**
  - **Plants:** Fire-resistant roots, wind-pollinated grasses.
  - **Animals:** Migratory herds (wildebeest), burrowing (prairie dogs), fast-running predators (cheetah).
- **Human Connection:** The birthplace of large-scale agriculture; our breadbaskets.

# **TERRESTRIAL BIOME: TEMPERATE DECIDUOUS FOREST**

- **Climate:** Moderate, with four distinct seasons; ample rainfall.
- **Vegetation:** Broadleaf trees that lose leaves in autumn (deciduous).
- **Key Adaptations:**
  - **Plants:** Seasonal leaf loss to conserve water in winter.
  - **Animals:** Hibernation, migration, food storage (squirrels), seasonal camouflage.

# TERRESTRIAL BIOME: BOREAL FOREST (TAIGA)

- **Climate:** Long, cold winters; short, mild summers.
- **Vegetation:** Coniferous (evergreen) trees like spruce, fir, pine (needle leaves).
- **Key Adaptations:**
  - **Plants:** Needle leaves reduce water loss; conical shape sheds snow.
  - **Animals:** Thick fur/feathers (moose, snowy owl), hibernation, changing coat colour (snowshoe hare).

# TERRESTRIAL BIOME: TUNDRA

- **Climate:** Extremely cold, dry; permanently frozen subsoil (**permafrost**).
- **Vegetation:** Low-growing mosses, lichens, grasses, dwarf shrubs.
- **Key Adaptations:**
  - **Plants:** Grow low to the ground to avoid wind; shallow roots above permafrost.
  - **Animals:** Thick insulation (musk ox), migration (caribou), counter-current heat exchange in limbs.

# TERRESTRIAL BIOME



# **TERRESTRIAL BIOME:**

## **MICROHABITATS: WORLDS WITHIN WORLDS**

### **❑ Example: A Forest Biome Contains:**

- **Canopy (Arboreal Layer):** Sunlit, windy, drier.
- **Understory:** Shaded, sheltered, humid.
- **Forest Floor:** Dark, damp, rich in decomposers.
- **Soil and Root Zone:** Underground network.
- Important note: Organisms adapt to their *microhabitat*, not just the general biome.
- The Arboreal Lifestyle: An Adaptation to a Microhabitat

# **TERRESTRIAL BIOME:**

## **MICROHABITATS: WORLDS WITHIN WORLDS**

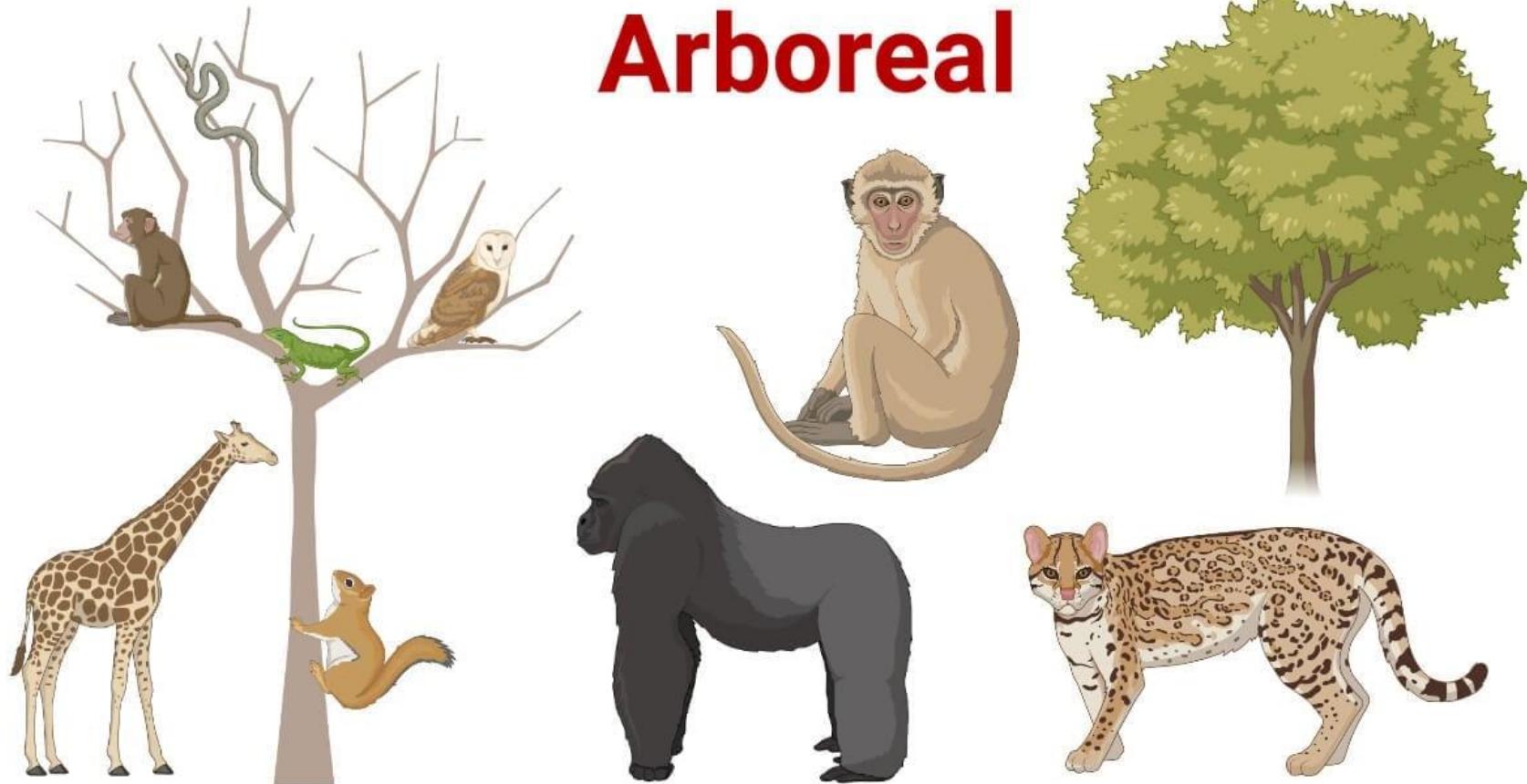
### **❑ Adaptations for an Arboreal Life:**

- **Grasping:** Prehensile tails, opposable thumbs, gripping pads.
- **Movement:** Lightweight bodies, long limbs for brachiation (swinging), gliding membranes.
- **Survival:** Camouflage against bark/leaves, nesting in tree hollows.
- **Important note:** "Arboreal" describes **how** an organism lives in its biome, not the biome itself. It's a niche strategy within a larger habitat.

# TERRESTRIAL BIOME:

## MICROHABITATS: WORLDS WITHIN WORLDS

### Arboreal



# AQUATIC BIOME: FRESHWATER - LAKES AND PONDS

- **Still or standing water.** Defined by zones:
  - **Littoral Zone:** Shallow, sunlit, rooted plants.
  - **Limnetic Zone:** Open, sunlit water away from shore.
  - **Profundal Zone:** Deep, dark, cold.
- **Key Adaptations:**
  - **Plants:** Rooted in littoral zone (lily pads), floating algae.
  - **Animals:** Gills for respiration (fish, insect larvae); varied feeding strategies from surface to bottom.

# AQUATIC BIOME: FRESHWATER - RIVERS AND STREAMS (LOTIC SYSTEMS)

- **Flowing water.** Characterized by **current**.
  - **Upstream:** Often colder, faster, more oxygenated.
  - **Downstream:** Warmer, slower, more sediment/nutrients.
- **Key Adaptations:**
  - **Attachment:** Suckers, hooks, sticky threads (e.g., blackfly larvae).
  - **Streamlining:** Sleek body shapes to reduce drag (trout).
  - **Anchoring:** Roots and heavy stems (river plants).

# AQUATIC BIOME: FRESHWATER - WETLANDS

- **Land saturated with water** (marshes, swamps, bogs).
- **Ecological Powerhouses:**
  - **"Kidneys of the Landscape"**: Filter pollutants and excess nutrients.
  - **"Cradles of Biodiversity"**: Nurseries for many species.
  - **Flood Control & Carbon Sinks.**
- **Key Adaptations:**
  - **Plants**: Aerial roots for oxygen (mangroves, cypress knees), tolerance to waterlogged soils.
  - **Animals**: Wading birds (herons), amphibians.

# AQUATIC BIOME: MARINE - ZONATION IN THE OCEAN

- **Intertidal Zone:** Where ocean meets land; twice-daily exposure to air and submersion. *High stress, high adaptation.*
- **Neritic Zone:** Shallow water over continental shelf. *Most biologically productive.*
- **Oceanic Zone:** Open ocean.
- **Pelagic Zone:** The "water column" itself (any open water).
- **Benthic Zone:** The ocean floor.
- **Abyssal Zone:** Deep, dark, high-pressure ocean floor. 28

# AQUATIC BIOME: MARINE – CORAL REEFS

## □Coral Reefs:

- **"Rainforests of the Sea"** – Built by tiny coral animals (polyps).
- **Require:** Warm, shallow, clear, sunlit water.
- **Symbiosis is key:** Coral polyps + photosynthetic algae (zooxanthellae).

# AQUATIC BIOME: MARINE – THE DEEP SEA

## □ Deep Sea/Vents:

- **No sunlight.** Extreme pressure, cold (except at hydrothermal vents).
- **Adaptations:** Bioluminescence ("living light"), giant mouths, slow metabolism.
- **Energy Source:** At vents, chemosynthesis (using chemicals, not sunlight) supports life.

# AQUATIC BIOME: ESTUARIES

- **The Vital Interface:** Where a freshwater river meets the salty ocean.
- **Conditions: Constantly changing** salinity, temperature, and sediment levels.
- **Adaptation Challenge:** Organisms must be **eurhaline** (tolerant of wide salinity ranges).
- **Ecological Role: Critical nursery habitats** for many fish and shellfish.

# AQUATIC BIOME: ESTUARIES

- Major Estuaries
  - **Gulf of St. Lawrence (Canada)**: Often considered the world's largest estuary by surface area, connecting the Great Lakes to the Atlantic Ocean.
  - **San Francisco Bay (USA)**: A large and urbanized estuary on the West Coast, serving as a critical hub for both economy and wildlife.
  - **Amazon River Estuary (Brazil)**: The mouth of the Amazon is so vast that it forms both an estuary and a delta system.
  - **Gironde Estuary (France)**: The largest estuary in Western Europe.
  - **Thames Estuary (UK)**: A key shipping route in the UK that runs through London to the North Sea.

# AQUATIC BIOME: ESTUARIES



# HUMAN IMPACT: THE DOMINANT ECOLOGICAL FORCE

- **Anthropocene:** The epoch where human activity is the dominant influence on climate and environment.
- **Major Impacts:**
- **Habitat Loss/Fragmentation:** Result in biodiversity loss.
- **Pollution:** Plastics in oceans, chemicals in freshwater, particles in air.
- **Climate Change:** Altering temperature and precipitation patterns, shifting biomes.
- **Overexploitation:** Overfishing, overhunting, unsustainable logging.

# HUMAN IMPACT: THE DOMINANT ECOLOGICAL FORCE



# CONSERVATION ECOLOGY: THE SCIENCE OF REPAIR

**Conservation:** Protecting habitats to protect the web of life.

**Goal:** To protect and restore habitats, species, and ecological processes.

## Key Strategies:

- **Protected Areas** - National Parks, Marine Reserves
- **Restoration Ecology** - Replanting forests, restoring wetlands
- **Sustainable Resource Use** - Certified forestry, responsible fisheries
- **Policy and Education**
- **Hopeful Case Reference:** *The recovery of the ozone layer shows global action is possible when science guides policy.*

# CONSERVATION ECOLOGY: THE SCIENCE OF REPAIR



# RECAP AND KEY SUMMARY

- **Ecology** studies interactions at levels from **organisms to the biosphere**.
- **Habitats** (from rainforests to deep sea vents) shape life through their physical conditions.
- **Adaptations** are the magnificent solutions life has evolved to survive in specific habitats.
- **Humans** are part of—and powerfully alter—these ecological networks.

# RECAP AND KEY SUMMARY

- Understanding ecology is the first step toward stewardship.
- **The Big Picture:** You now hold a map—not just of places, but of the living, breathing, interconnected systems that make life on Earth possible.



THANK  
YOU