

Introduction to Ecology

Introduction to Ecology – Study Notes

1. What Is Ecology?

- **Definition:** Ecology is the scientific study of interactions among organisms and between organisms and their environment.
 - **Scope:** Ranges from microscopic bacteria in soil to the dynamics of entire biomes and the planet as a whole.
 - **Goal:** Understand patterns and processes that shape the distribution, abundance, and diversity of life.
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2. Levels of Ecological Organization

Level	Description	Example
Organism	Individual living being	A single oak tree
Population	Group of individuals of the same species in a given area	A herd of white-tailed deer
Community	All populations that interact in a location	Forest understory plants, insects, birds, and mammals
Ecosystem	Community + physical (abiotic) environment	A lake with its fish, algae, water chemistry, and shoreline
Biome	Large geographic area with characteristic climate & life forms	Temperate deciduous forest, tropical rainforest
Biosphere	All ecosystems on Earth; the global sum of life	The planet's combined terrestrial and marine ecosystems

3. Core Ecological Concepts

1. Habitat vs. Niche

- *Habitat*: Physical place where an organism lives.
- *Niche*: The organism's functional role (resources used, activities, interactions).

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2. Energy Flow

- **Sun ? Producers (photosynthesis) ? Primary consumers ? Secondary/tertiary consumers ? Decomposers**
- Energy is lost as heat at each trophic transfer (~10% efficiency).

3. Matter Cycling

- Elements (C, N, P, S, etc.) cycle through biotic and abiotic components.
- Key cycles: **Carbon, Nitrogen, Phosphorus, Water.**

4. Population Dynamics

- **Growth models:**
 - *Exponential*: ($N_{t+1} = rN_t$) (ideal, unlimited resources)
 - *Logistic*: ($N_{t+1} = rN_t \left(1 - \frac{N_t}{K}\right)$) (carrying capacity (K))
- **Regulating factors:** birth/death rates, immigration/emigration, resource availability, predation, disease.

5. Community Interactions

- **Competition** (interspecific & intraspecific)
- **Predation & herbivory**
- **Mutualism, commensalism, parasitism**
- **Facilitation** (one species improves conditions for another)

6. Succession

- **Primary succession:** starts on bare substrate (e.g., volcanic lava).
- **Secondary succession:** follows disturbance where soil remains (e.g., after fire).
- **Climax community:** historically viewed as a stable endpoint; now seen as a dynamic mosaic.

7. Biodiversity

- **Alpha diversity** – species richness within a site.
- **Beta diversity** – turnover of species between sites.
- **Gamma diversity** – total diversity across a landscape or region.

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4. Major Ecosystem Types

Ecosystem	Dominant Climate	Characteristic Producers	Typical Consumers
Terrestrial Forest	Varies (tropical, temperate,		