

Introduction to Aquatic Ecology

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Key concepts, major components, and foundational principles

1. What Is Aquatic Ecology?

Aspect	Description
Definition	The study of interactions among organisms and their physical?chemical environment in freshwater (lakes, rivers, wetlands) and marine (oceans, estuaries) systems.
Scope	• Community structure (who is there) • Population dynamics (how numbers change) • Ecosystem processes (energy flow, nutrient cycling) • Human impacts (pollution, climate change)
Why It Matters	Provides the scientific basis for fisheries management, water?quality protection, habitat restoration, and climate?adaptation strategies.

2. Major Aquatic Habitats

Habitat	Typical Characteristics	Representative Organisms
Lentic (standing water)	Low flow, stratified temperature layers, often nutrient?rich	Phytoplankton, macrophytes, zooplankton, benthic invertebrates, fish (e.g., bass)
Lotic (flowing water)	Continuous current, high oxygen, substrate ranging from sand to boulders	Periphyton, macroinvertebrates (mayflies, stoneflies), rheophilic fish (trout)
Estuarine (brackish mixing zone)	Salinity gradient, high productivity, tidal influence	Spartina marshes, oysters, juvenile fish, migratory birds
Marine (open ocean & coastal)	Wide range of light, pressure, temperature; stratified water column	Phytoplankton (diatoms, cyanobacteria), zooplankton, nekton (tuna, sharks), benthic corals

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3. Fundamental Ecological Concepts Applied to Water

Concept	Aquatic Example
Energy Flow	Sunlight ? primary producers (phytoplankton, macrophytes) ? herbivores (zooplankton) ? secondary consumers (small fish) ? top predators (pike, sharks).
Nutrient Cycling	Nitrogen: N ₂ fixation (cyanobacteria) ? ammonification ? nitrification ? denitrification (anoxic sediments). Phosphorus: weathering ? runoff ? uptake by algae ? burial in sediments.
Trophic Levels & Food Webs	Simple lake food web: phytoplankton ? zooplankton ? small fish ? largemouth bass. Complex webs include omnivores, detritivores, and microbial loops.
Ecological Succession	Pioneer stage: colonization by algae and bacteria after a disturbance (e.g., flood). Intermediate stage: emergence of macrophytes. Climax stage: stable, diverse plant community (e.g., mature wetland).
Habitat Heterogeneity	Microhabitats (riffles, pools, leaf litter) support distinct assemblages; diversity often peaks where physical complexity is greatest.

4. Physical?Chemical Drivers

Driver	Influence on Biota
Temperature	Controls metabolic rates, dissolved?oxygen solubility, and species distribution (thermal niches).
Light (PAR)	Limits photosynthesis; depth of the euphotic zone determines where primary production occurs.
Dissolved Oxygen (DO)	Essential for aerobic respiration; low DO (hypoxia) can cause fish kills.
pH & Conductivity	