

Introduction to Plant Ecology

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Key concepts, major themes, and foundational principles

1. What Is Plant Ecology?

Aspect	Description
Definition	The study of how plants interact with each other, with other organisms, and with their physical environment.
Scope	• Population dynamics • Community composition • Ecosystem processes • Landscape-scale patterns
Goal	Explain the distribution, abundance, and functional role of plants in natural and managed systems.

2. Fundamental Ecological Units

Unit	Focus	Typical Questions
Individual	Physiology, morphology, life history traits	How does a plant acquire resources?
Population	Individuals of one species in a defined area	What controls population size and structure?
Community	Multiple species co-occurring	How do species interact (competition, facilitation, herbivory)?
Ecosystem	Community + abiotic environment	How do energy and nutrients flow through plant driven systems?
Landscape	Mosaic of ecosystems	How do spatial patterns influence plant distribution?

3. Core Ecological Processes for Plants

Process	Description	Example
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Photosynthesis & Respiration	Energy capture and conversion; carbon balance	C ₃ vs. C ₄ photosynthetic pathways
Water Relations	Uptake, transport, transpiration, drought tolerance	Stomatal regulation, root depth
Nutrient Acquisition	Mineral uptake, mycorrhizal symbioses, nitrogen fixation	Legume?rhizobia association
Reproduction & Dispersal	Sexual (seeds) and asexual (clonal) strategies; dispersal vectors	Wind?blown seeds, animal? mediated fruit dispersal
Growth & Allocation	Allocation of carbon to roots, shoots, storage, defense	Trade?offs between height growth and root depth
Mortality & Senescence	Causes of death (competition, pathogens, disturbance)	Fire?induced mortality in savannas

4. Plant?Environment Interactions

4.1 Abiotic Factors

Factor	Influence on Plants	Typical Adaptive Traits
Light (quantity & quality)	Photosynthetic rate, shade tolerance	Leaf size, chlorophyll content, phototropism
Temperature	Enzyme kinetics, phenology	Frost resistance, heat?shock proteins
Water availability	Turgor, photosynthesis, nutrient transport	Deep roots, succulent tissues, leaf waxes
Soil nutrients	Growth, reproduction	Mycorrhizal associations, root exudates
Atmospheric CO ₂	Photosynthetic efficiency	C ₃ vs. C ₄ pathways
Disturbance regimes (fire, flood, grazing)	Successional pathways	Resprouting ability, seed banks, fire? stimulated germination

4.2 Biotic Factors

Interaction	Effect on Plant	Representative Example
Competition (for light, water, nutrients)	Reduces growth, alters distribution	Tall canopy trees shading understory

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Interaction	Effect on Plant	Representative Example
Facilitation (positive neighbor effects)	Improves microclimate, nutrient access	Nurse plants in deserts
Herbivory	Tissue loss, induced defenses	Leaf-chewing insects triggering tannin production
Mutualism (mycorrhizae, pollinators)	Enhances resource acquisition, reproduction	Orchid