

Introduction to Conservation Biology

Introduction to Conservation Biology
Key concepts, goals, and tools for preserving biodiversity

1. What Is Conservation Biology?

Aspect	Description
Definition	The scientific study of protecting and restoring Earth's biodiversity and the ecological processes that sustain it.
Scope	Species, populations, communities, ecosystems, and genetic diversity.
Interdisciplinary	Integrates ecology, genetics, evolution, sociology, economics, law, and policy.
Goal	Maintain the ability of natural systems to provide ecosystem services and support life-supporting processes now and in the future.

2. Why Conservation Biology Matters

Reason	Example
Biodiversity loss	~1 million species face extinction in the next few decades (IPBES 2020).
Ecosystem services	Pollination, water purification, carbon sequestration, climate regulation.
Human well-being	Food security, medicines, cultural values, recreation.
Ethical responsibility	Stewardship of Earth's living heritage for future generations.

3. Core Concepts

Concept	Explanation	Typical Metric
Species richness	Number of different species in a defined area.	Species count
Species evenness	How equally individuals are distributed among species.	Shannon's evenness index
Genetic diversity	Variation of genes within and among populations.	Heterozygosity, allelic richness

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Concept	Explanation	Typical Metric
Population viability	Likelihood a population will avoid extinction over a given time.	Extinction probability, Population Viability Analysis (PVA)
Habitat fragmentation	Breaking of continuous habitat into smaller, isolated patches.	Edge-to-core ratio, connectivity indices
Ecological resilience	Capacity of an ecosystem to absorb disturbance and retain function.	Recovery time, resistance thresholds

4. Threats to Biodiversity

Category	Main Drivers	Representative Examples
Habitat loss & degradation	Agriculture expansion, urbanization, mining.	Deforestation in the Amazon
Overexploitation	Hunting, fishing, logging, wildlife trade.	Overfishing of Atlantic cod
Invasive species	Non-native organisms outcompeting natives.	Cane toads in Australia
Pollution	Chemical runoff, plastic debris, air pollutants.	Coral bleaching from nutrient enrichment
Climate change	Temperature rise, altered precipitation, sea-level rise.	Range shifts of alpine plants
Disease	Emerging pathogens affecting wildlife.	White-nose syndrome in bats

5. Conservation Strategies

5.1 In-situ Conservation

Protect species and ecosystems in their natural habitats.

Tool	Description	Typical Application
Protected Areas (PAs)	National parks, reserves, wildlife sanctuaries.	Preserve core habitats; often 15–17% of land surface.

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Tool	Description	Typical Application
Habitat Restoration	Reforestation, wetland creation, coral reef transplantation.	Reconnect fragmented landscapes.
Ecological Corridors	Linear habitats linking isolated patches.	Facilitate gene flow for large mammals.
Species Management Plans	Targeted actions (e.g., captive breeding, translocation).	Recovery of the California condor.
Community-Based Conservation	Involves local people in stewardship and benefit-sharing.	Community forest management in Nepal.

5.2 Ex-situ Conservation

*Maintain