

FOUNDATIONS OF BIODIVERSITY SCIENCE: PATTERNS, SCALES AND EVOLUTIONARY PERSPECTIVES

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Abstract

Biodiversity is essential for maintaining ecosystem integrity and sustaining human societies. This chapter outlines biodiversity patterns, definitions, and conservation relevance. It further focuses on the hierarchical levels of biodiversity, ranging from genetic diversity to species and entire ecosystems. Understanding this hierarchy helps in identifying the different layers at which biodiversity must be preserved. Global biogeographical patterns reveal how species are distributed, with hotspots of biodiversity indicating points of unparalleled value for conservation. These hotspots are not only rich in endemic species but also highly threatened due to human activities, making their protection a global priority. The chapter also examines the broad scope of ecosystem services offered by biodiversity, such as pollination, nutrient cycling, climate regulation, and cultural benefits, all of which are crucial to ecological processes and human well-being. Knowledge of these interwoven elements provides a broad framework for understanding biodiversity richness and informing effective conservation strategies and sustainable use practices essential for future resilience.

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1. Introduction

Biodiversity science is the science that unites many disciplines to comprehend the origin, distribution and functions of life's diversity on the planet. It integrates concepts from ecology, evolution and genetics to study natural patterns and processes that shapes biodiversity. Offering a unifying framework to comprehend the complexity and interconnectedness of terrestrial life, it aims at preserving life's diversity and enhancing sustainable development. The notion of biodiversity is multidimensional which emphasizes staggering diversity of life forms on our Earth, encompassing all the plants, animals, microorganisms and the environments they live in. Diversity is considered at all levels—from genetic diversity and individual species to entire ecosystem. This diversity is closely linked with human well-being by offering crucial services such as clean air and water, food production, climate control and pollination. Its distribution is uneven with some regions naturally more favourable to the development and flourishing

of biodiversity than others. For instance, Tropical islands support an exceptional variety of ecosystems including tropical rainforests, freshwater bodies, open woodlands, grasslands, salt marshes, mangroves, coastal forests, coral reefs and even deep-sea environments (SPREP, 2012).

Unfortunately, biodiversity faces serious threats from human-driven changes including loss of natural habitats, rising pollution levels and climate change. Since global biodiversity declines, protecting it is crucial to safeguarding the planet's natural balance and ensuring the survival of future generations. To understand biodiversity loss, the Drivers–Pressures–State–Impact–Response (DPSIR) framework developed by the European Environment Agency in 1999, is particularly valuable. It emphasizes cause-and-effect relationships, allowing researchers and policymakers to identify root causes of biodiversity decline and track the effectiveness of interventions. It supports integrated environmental assessment by combining ecological, socio-economic and policy perspectives.

