

Biodiversity

Biodiversity, or biological diversity, is the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part.¹ Biodiversity shapes the ecosystem services that contribute to human well-being—material welfare, security, social relations, health, and freedom of choice.² Biodiversity is considered on three levels: species diversity, genetic diversity, and ecosystem diversity.³

Species Diversity

- Species diversity can be measured in several ways, including diversity indices (species richness and evenness), rank abundance diagrams, and similarity indices.⁴
- There are an estimated 8.7 million eukaryotic species on earth, of which 86% of land species and 91% of ocean species have not yet been described.⁵
- 1.2 million species have been described globally.⁵
- 53,695 plant and animal species are listed in the U.S.; top-ranking states for species diversity are CA, TX, AZ, NM, and AL, respectively.^{6,7}
- Freshwater habitats account for only 0.01% of the world's water and make up less than 1% of the planet's surface, but they support one-third of all described vertebrates and nearly 10% of all known animal species.⁸

Genetic Diversity

- Genetic diversity refers to the genetic variation within species (for both the same population and populations living in different geographical areas).³
- Individuals within a species have slightly different forms of genes through mutations, where alleles can code for different proteins and ultimately affect species physiology.³
- Genetic variations lead to differences in both genotype and phenotype, which are necessary for species to maintain reproductive vitality, resistance to disease, and the ability to adapt to changing conditions.⁹

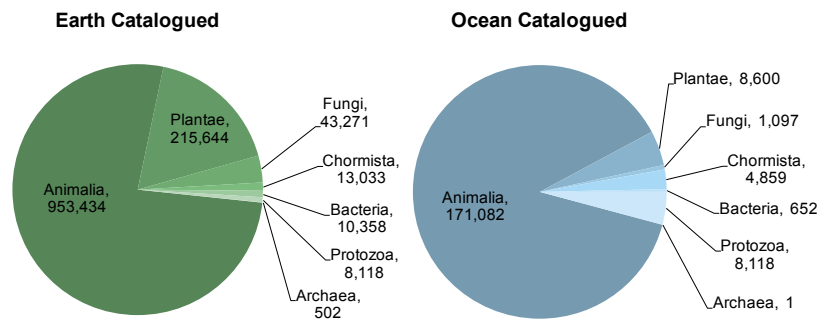
Community/Ecosystem Diversity

- Ecosystem diversity describes different biological communities and their associations with the ecosystem in which they are part.³
- Within these ecosystems, species play different roles and have different requirements for survival (i.e., food, temperature, water, etc.). If any of these requirements become a limiting resource, a species population size becomes restricted.³

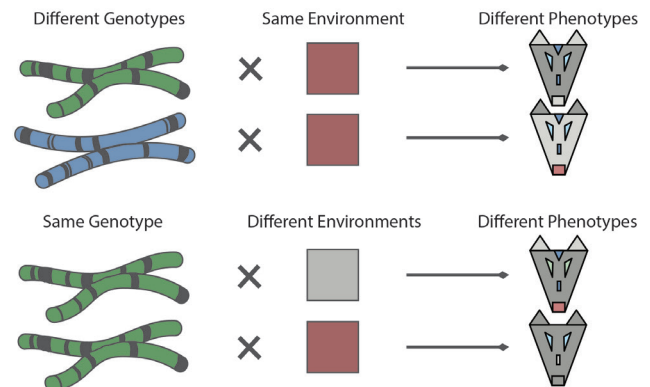
Goods & Services

- Ecosystem services are the conditions and processes that enable natural ecosystems to sustain human life.¹⁰
- Examples of ecosystem services include: purification of air and water; mitigation of floods and droughts; detoxification and decomposition of wastes; generation and renewal of soil and soil fertility; pollination of crops and natural vegetation; dispersal of seeds and translocation of nutrients; protection from the sun's harmful ultraviolet rays; partial stabilization of climate; and moderation of temperature extremes and the force of winds and waves.¹⁰
- Biodiversity increases several ecosystem services, including crop yields, stability of fishery yields, wood production, fodder yield, resistance to plant invasion, carbon sequestration, soil nutrient mineralization, and soil organic matter.¹¹
- These services provide us with goods, such as seafood, forage, timber, biomass fuels, natural fiber, pharmaceuticals, industrial products, and more.¹⁰

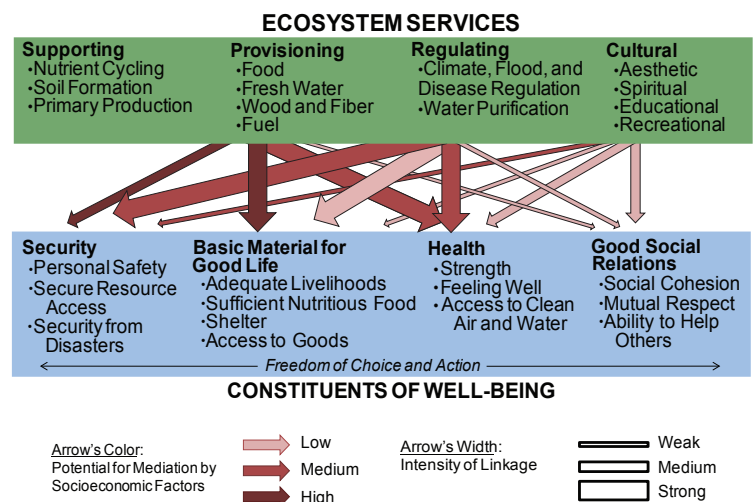
Catalogued Earth and Ocean Species⁵



Genotype vs. Phenotype³



Biodiversity, Ecosystem Services, and Human Well-Being²



Loss of Biodiversity

- In the last 50 years, alteration of biodiversity related to human activities was greater than any time in human history, driven by habitat loss from agriculture, infrastructure, over-exploitation, pollution, and invasive alien species.^{2,12}
- Climate change is potentially a pervasive threat to biodiversity, because it can affect areas uninhabited by humans.¹⁴ Higher temperatures could increase drying, resulting in dieback in the Amazon, which has the highest biodiversity of all forests.¹⁵
- Habitat loss can increase greenhouse gas emissions – 8% of global emissions derive from tropical deforestation.¹⁶
- Over-fishing and harvesting also contributes to a loss of genetic diversity and relative species abundance of individuals and groups.¹⁷

Biodiversity Loss Due to Agriculture

- Of the 30 mammalian and bird species used extensively for agriculture, half account for over 90% of global livestock production.¹⁸
- Genetic diversity within breeds is declining, and 17% of 8,774 livestock breeds identified are classified as at risk.¹⁹
- Of the 30,000 wild edible and 7,000 cultivated plants, only 30 crops provide 95% of dietary energy or protein. Wheat, rice, and maize provide more than half of the global plant-derived calories.²⁰
- In the last 100 years, about 75% of the genetic diversity of agricultural crops was lost.²¹

Extinction

- In earth's history, there have been five mass extinctions defined as time periods where extinction rates accelerate relative to origination rates such that over 75% of species disappear over an interval of 2 million years or less.²²
- Globally, 1% or less of assessed taxa have gone extinct. However, 20-43% of species in these taxa are labeled as threatened.²²
- 228 plants and animals have gone extinct in the U.S. and 2,331 are threatened or endangered.^{6,23}
- Current extinction rates are higher than those leading to the five mass extinctions, and could reach mass extinction magnitude in three centuries.²²

Sustainable Actions

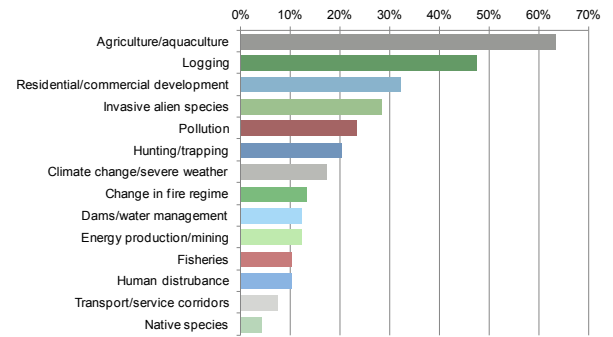
Policy

- Examples of treaties to protect species include: The International Convention for the Regulation of Whaling (1946); The International Convention for the Protection of Birds (1950); The Convention on Wetlands of International Importance (1971); The Convention of International Trade in Endangered Species (1973); The Convention of the Conservation of Migratory Species of Wild Animals (1979); and the Convention on Biological Diversity (CBD) (1992).²⁴
- The Endangered Species Act (1973), administered by the Interior Department's Fish and Wildlife Service and the Commerce Department's National Marine Fisheries Service, aims to protect and recover imperiled species and the ecosystems they depend on.²⁵
- 185 parties have National Biodiversity Strategic Action Plans for the conservation and sustainable use of biological diversity.²⁶
- Over 209,000 protected areas (such as national parks and reserves) have been established, 23 times more than in 1962, covering around 13% of the Earth's land surface and less than 1.5% of marine areas.^{12,27}

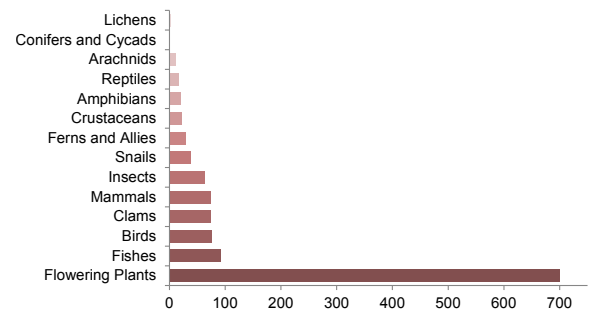
Global Initiatives

- The Strategic Plan for Biodiversity 2011-2020 is a framework of five strategic goals and twenty Aichi Targets adopted by the Convention on Biological Diversity in 2010.²⁸
- The International Union for the Conservation of Nature (IUCN) Species Program and the IUCN Species Survival Commission assess the conservation status of species, subspecies, varieties, and subpopulations on a global scale to identify threatened and endangered species and promote their conservation.²⁹
- The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) was established in 2012 to provide scientific information to guide policy decisions relating to biodiversity, human well-being and sustainable development.³⁰

Major Threats to Critically Endangered Vertebrates¹²



Federally Listed Endangered Species by Taxonomic Group¹³



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