Biodiversity

Biodiversity, or biological diversity, describes the variability among living organisms across terrestrial and aquatic ecosystems, and the ecological complexes of which they are part.[1] Biodiversity sustains the ecosystem services that support human well-being—material welfare, quality of life, sensory experiences, and social relations.[2] Biodiversity is considered on three levels: genetic diversity, species diversity, and ecosystem diversity.[2,3]

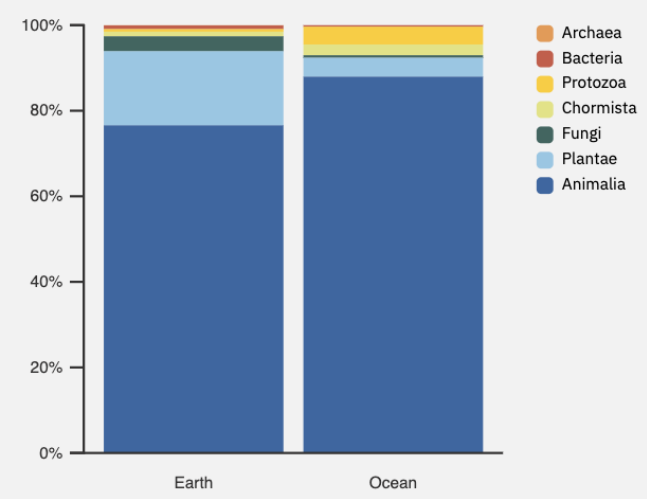
Genetic Diversity

- Genetic diversity refers to variation within species in the same population and across populations in different geographical areas. Individuals within a species have slightly different forms of genes, known as alleles, that arise through mutations and affect the species' physiology.[3]
- This variation provides resilience to disease, climate change, and other environmental stress, and maintains reproductive vitality in wild and domesticated populations.[2,3]
- Within-population genetic diversity has declined about 1% per decade since the mid-19th century, mostly in areas with intense human activity. Habitats affected by land-use change have 17% less genetic diversity than undisturbed areas.[2]
- More than 10% of genetic diversity in threatened and endangered species may already be lost.[4]

Species Diversity

- Species diversity—abundance and distribution of a species—can be measured using indices of richness and evenness, rank-abundance diagrams, and similarity indices.[2,5]

Cataloged Species[6]



- Biologists have taxonomically classified over 2.1M eukaryotic (complex celled) species on Earth;[39] up to 500M more are yet to be described.[8]
- There are 58,036 plant and animal species listed in the U.S.[7]
- Over half of the world's species are estimated to reside in tropical forests, with the Amazon rainforest alone containing more than 10% of global terrestrial biodiversity.[8,9] Nearly 25% of all marine fish (over 1M species) rely on coral reef ecosystems to survive.[10]
- While tropical reefs have more diverse fish communities, polar waters are hotspots of fish speciation (formation of new species)—contrary to previous evolutionary thought.[11]
- Freshwater habitats account for only 0.01% of the world's water and make up less than 1% of the planet's surface, but support one-third of all described vertebrates and nearly 10% of all known animal species.[12]

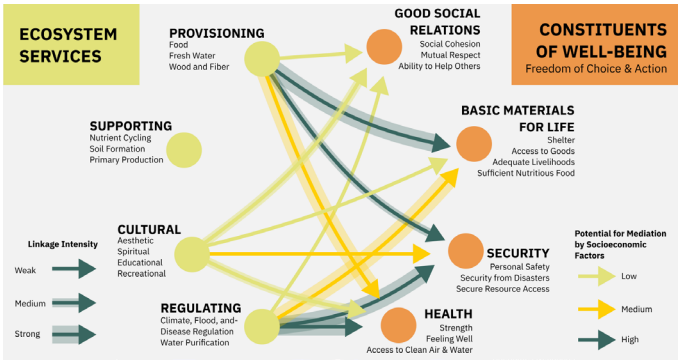
Ecosystem/Community Diversity

- Ecosystem diversity describes the variety of biological communities and their associations with their environment.[3]
- Within ecosystems, species play different roles and have distinct requirements—food, temperature, water, and resources—for survival. A decline in any of these requirements can limit a species' survival, restricting its population size.[3]
- Ecosystem diversity varies widely, shifting with latitude and altitude in both land and ocean environments—species richness is highest at the equator and lowest at the poles.[2]
- Since 1970, natural ecosystems have declined by at least 1% per decade. Only 13% of the ocean and 23% of land—mostly inhospitable—remain wild and largely free of human impact.[2]

Ecosystem Services

- Ecosystem services are the conditions and processes that enable natural ecosystems to sustain human life—air and water purification; flood and drought mitigation; waste decomposition; soil formation and fertility; crop pollination; seed dispersal and nutrient cycling; UV protection; climate regulation; and moderation of weather and temperature.[13]
- Biodiversity enhances ecosystem services improving crop and fishery yields, wood and fodder production, resistance to invasive species, carbon sequestration, and soil health.[14]
- Globally, 55% of GDP ($58T) is moderately or highly dependent on nature and its services.[15]

Biodiversity, Ecosystem Services, and Well-Being[16]



Biodiversity Loss

- Since 1955, biodiversity loss due to human activities was greater than at any time in human history, driven by habitat loss from land-use change, agriculture, over-exploitation, pollution, invasive species, and climate change.[16,17]
- Climate change is becoming the largest threat to biodiversity as it affects areas uninhabited by humans. Some ecosystem impacts are nearing irreversibility, with heat extremes and mass mortality events causing species loss.[17,18]
- The Amazon has the highest biodiversity of all forests and sequesters the equivalent of 15-20 yrs of global CO_2 emissions.[9] Rising temperatures increase drying and fire risk, resulting in dieback. Deforestation in the Amazon in 2016-2020 increased 92% compared to 2005-2010.[19,20]
- 11% of global GHG emissions result from deforestation.[21] Over-fishing and -harvesting also contribute to a loss of genetic diversity and species abundance.[22]
- During Canada's 2023 record-breaking fire season over 18M ha burned, an area roughly half the size of California.[23,24]
- Land degradation and pollinator loss has reduced productivity across 23% of terrestrial areas, putting $577B in annual global crop output at risk.[2]

Global Trends in Ecosystem Services[2]

Biodiversity Loss due to Agriculture

- Food production is the leading cause of habitat loss—it uses 40% of all habitable land and costs $15T/yr in environmental degradation.[15] Mass production of cultivated breeds reduces biodiversity by crowding out other genes and species.[2]
- Seven agricultural commodities (cattle, oil palm, soy, cocoa, rubber, coffee, wood fiber) accounted for 26% of global tree cover lost from 2001-2015, replacing 71.9M ha of forest.[25]
- Of the 50,000 known mammalian and bird species, only 14 account for over 90% of global livestock production.[26] Genetic diversity within breeds is declining; 24% of the 8,803 known livestock breeds are at risk of disappearing.[27]
- Of the 30,000 edible plants, only 30 provide 95% of dietary energy. Wheat, rice, and maize provide over 50% of plant-derived calories globally.[28] Between 1900 and 2000, 75% of genetic diversity from crops was lost.[29]

Extinction

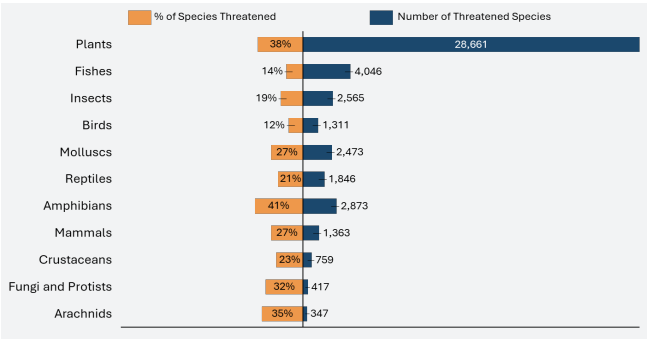
- In Earth's history there have been 5 mass extinctions; periods where over 75% of species disappeared in under 2M years.[30]
- Globally, the relative abundance of monitored wildlife populations has declined 73% since 1970; mostly in freshwater (85%) and terrestrial (69%) species.[15] As of 2025, 214 plant and animal species are extinct in the U.S.—1,684 are threatened or endangered.[7,31]
- The current rate of extinction is 100–1,000 times higher than pre-human rates.[32] Around 25% of all species face extinction in coming decades.[2]

Sustainable Actions

Policy

- The Endangered Species Act (ESA) (1973), administered by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, protects and recovers imperiled species and the ecosystems they depend on.[33]
- As of 2024, 194 countries have National Biodiversity Strategic Action Plans for the conservation and sustainable use of biological diversity.[34] Globally, over 300,000 protected areas cover 21M mi²—18% of land and 8% of marine and coastal areas—a 1M mi² increase from 2020.[35]
- In 2021, an executive order set a goal to conserve 30% of U.S. lands and oceans by 2030.[36] In 2025, the White House directed agencies to bypass standard ESA procedures[37] and revoked prior climate and environmental executive orders.[38]

Threatened Species by Taxonomy[39]



Global Initiatives

- The UN developed a list of Sustainable Development Goals (SDGs) including commitments to preserving biodiversity.[40]
- The Convention on Biological Diversity adapted the Kunming-Montreal Global Biodiversity Framework, including 23 targets to reverse habitat and species loss—among them, the goal to protect 30% of land and marine areas by 2030 ("30x30").[41]
- More progress is needed—50% of SDG targets for 2030 are projected to be missed, with 30% stalled or worsening compared to the 2015 baseline.[15] To meet 30% coverage, an additional 10M mi² of land and 49M mi² of marine and coastal areas must be designated as protected.[35]

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Sources for this factsheet are here, help with units and abbreviations is here.