Terms

Biodiversity: The range of variation found among microorganisms, plants, fungi, and animals. Also the richness of species of living organisms.

Community: Populations of organisms of different species that interact with one another.

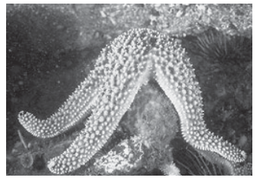
Ecosystem: Any geographic area with all of the living organisms present and the nonliving parts of their physical environment. Involves the movement and storage of energy and matter through living things and activities.

Gene: A unit of inherited material. An organism's collection of genes determines what it is, what it looks like, and often how it behaves.

Organism: An individual living thing.

Population: A group of individuals belonging to one species living in an area.

Species: A group of populations of similar organisms that reproduce among themselves, but do not naturally reproduce with any other kinds of organisms (e.g., *Haliaeetus leucocephalus*--bald eagle; *Quercus rubra*--red oak tree).



Where Can I Get More Information?

Ecological Society of America, 1707 H Street, NW, Suite 400, Washington, DC 20006. 202-833-8773. esahq@esa.org; http://www.esa.org.

U.S. Geological Survey, Biological Resources Division. biologywebteam@usgs.gov; http://biology.usgs.gov/.

U.S. Fish and Wildlife Service. Contact@fws.gov; http://www.fws.gov.

Marine Conservation Biology Institute, 15805 NE 47th Court, Redmond, WA 98052. 425-883-8914. mcbiweb@mcbi.org; http://www.mcbi.org.

Convention on Biological Diversity, Secretariat, 393, Saint Jacques Street, Suite 300, Montreal, Quebec, Canada H2Y 1N9. 1-514-288-2220. secretariat@biodiv.org; http://www.biodiv.org.

National Forum on BioDiversity. 1988. *BioDiversity*. Wilson, E.O., editor. National Academy of Sciences. Academy Press, Washington D.C.

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BIODIVERSITY

The concept of biodiversity has provoked considerable debate and misunderstanding among the general public, decision-makers, and even the scientific community. Much has been published on the subject since its first appearance at the National Forum on BioDiversity in September, 1986, the proceedings of which became the best-seller, *BioDiversity*. But what is biodiversity, what threatens it, why is it important, and what are ecologists doing to better understand it?

Ecological Society of America

What is Biodiversity?

Short for biological diversity, biodiversity includes all organisms, species, and populations; the genetic variation among these; and all their complex assemblages of communities and ecosystems. It also refers to the interrelatedness of genes, species, and ecosystems and their interactions with the environment. Usually three levels of biodiversity are discussed—genetic, species, and ecosystem diversity.

Genetic diversity is all the different genes contained in all *individual* plants, animals, fungi, and microorganisms. It occurs within a species as well as between species.

Species diversity is all the differences within and between *populations* of species, as well as between different species.

Ecosystem diversity is all the different habitats, biological communities, and ecological processes, as well as variation within individual ecosystems.

What are the Threats to Biodiversity?

The loss of biodiversity is a significant issue for scientists and policy-makers and the topic is finding its way into living rooms and classrooms. Species are becoming extinct at the fastest rate known in geological history and most of these extinctions have been tied to human activity.

- **Habitat loss and destruction**, usually as a direct result of human activity and population growth, is a major force in the loss of species, populations, and ecosystems.
- **Alterations in ecosystem composition,** such as the loss or decline of a species, can lead to a loss of biodiversity. For example, efforts to eliminate coyotes in the canyons of southern California are linked to decreases in song bird populations in the area. As coyote populations were reduced, the populations of their prey, primarily raccoons, increased. Since raccoons eat bird eggs, fewer coyotes led to more raccoons eating more eggs, resulting in fewer song birds.
- The **introduction of exotic (non-native) species** can disrupt entire ecosystems and impact populations of native plants or animals. These invaders can adversely affect native species by eating them, infecting them, competing with them, or mating with them.
- The **over-exploitation** (over-hunting, over-fishing, or over-collecting) of a species or population can lead to its demise.
- Human-generated **pollution and contamination** can affect all levels of biodiversity.
- **Global climate change** can alter environmental conditions. Species and populations may be lost if they are unable to adapt to new conditions or relocate.

courtesy NC Division of Marine Fisheries

Why is Biodiversity Important?

The diversity of life enriches the quality of our lives in ways that are not easy to quantify. Biodiversity is intrinsically valuable and is important for our emotional, psychological, and spiritual well-being. Some consider that it is an important human responsibility to be stewards for the rest of the world's living organisms.

Diversity breeds diversity. Having a diverse array of living organisms allows other organisms to take advantage of the resources provided. For example, trees provide habitat and nutrients for birds, insects, other plants and animals, fungi, and microbes.

Humans have always depended on the Earth's biodiversity for food, shelter, and health. Biological resources that provide goods for human use include:

- **food**—species that are hunted, fished, and gathered, as well as those cultivated for agriculture, forestry, and aquaculture;
- **shelter and warmth**—timber and other forest products and fibers such as wool and cotton;
- **medicines**—both traditional medicines and those synthesized from biological resources and processes.

Biodiversity also supplies indirect services to humans which are often taken for granted. These include drinkable water, clean air, and fertile soils. The loss of populations, species, or groups of species from an ecosystem can upset its normal function and disrupt these ecological services. Recent declines in honeybee populations may result in a loss of pollination services for fruit crops and flowers

Biodiversity provides medical models for research into solving human health problems. For example, researchers are looking at how seals, whales, and penguins use oxygen during deep-water dives for clues to treat people who suffer strokes, shock, and lung disease.

The Earth's biodiversity contributes to the productivity of natural and agricultural systems. Insects, bats, birds, and other animals serve as pollinators. Parasites and predators can act as natural pest controls. Various organisms are responsible for recycling organic materials and maintaining the productivity of soil.

Genetic diversity is also important in terms of evolution. The loss of individuals, populations, and species decreases the variety of genes—the material needed for species and populations to adapt to changing conditions or for new species to evolve.

What are Ecologists Doing to Better Understand Biodiversity?

Knowledge of biodiversity has increased in the last ten years, as has the realization that something must be done to counteract the loss of species, populations, and ecosystems. There is still much to be learned about biodiversity and its relationship to the functioning of our world, so scientific research and debate continues. And results are being applied to efforts to conserve biodiversity now.

courtesy U.S. Fish and Wildlife Service

Ecologists conduct research to better understand biodiversity, quantify its loss, and develop strategies for conserving and using it. Much is still unknown as to what species exist, where they occur, and the relationships between them. By inventorying and monitoring biodiversity, ecologists study species abundance, functions, interactions, and importance to maintaining or enhancing the quality of human life. Questions to which ecologists are seeking answers include:

- How fast and in what locations is biodiversity being lost? And why?
- What are the secondary consequences of those losses?
- What management interventions will prove most effective in preventing the loss of biodiversity?

Ecologists study the natural changes in biodiversity at the genetic, species, and ecosystem levels. This allows them to evaluate human impact by comparing natural processes to human-induced changes. Recent work suggests that the loss of populations are of greater consequence than the loss of species and are occurring at a faster rate.

Ecologists also play a prominent role in researching the conservation, restoration, and use of biodiversity and related ecosystem processes. Some ecologists investigate the effects of different land uses and management practices. Restoration ecologists are developing rationale and methodologies for rehabilitating or restoring damaged habitats and for reintroducing native species. Another important area of ecological research is understanding the implications of global climate change for biodiversity conservation.

A new challenge for ecologists is determining the relationship between biodiversity and ecosystem functioning. This issue was identified as one of the top research trends for 1998 by *Science* magazine. Some of the questions ecologists are exploring include:

- What are the ecological consequences of the loss of species, populations, or groups of species which perform a common function?
- Are the services that healthy ecosystems provide humans diminished with a loss of biodiversity?
- What effects do biodiversity and biogeochemical processes (such as nutrient cycling) have on each other?

Ecologists are working with other biological scientists, as well as social scientists, policy-makers, and economists. Such an interdisciplinary approach is necessary to develop strategies to conserve Earth's biodiversity.