



TEN STRESSES ON THE PLANET

Loss of Biodiversity

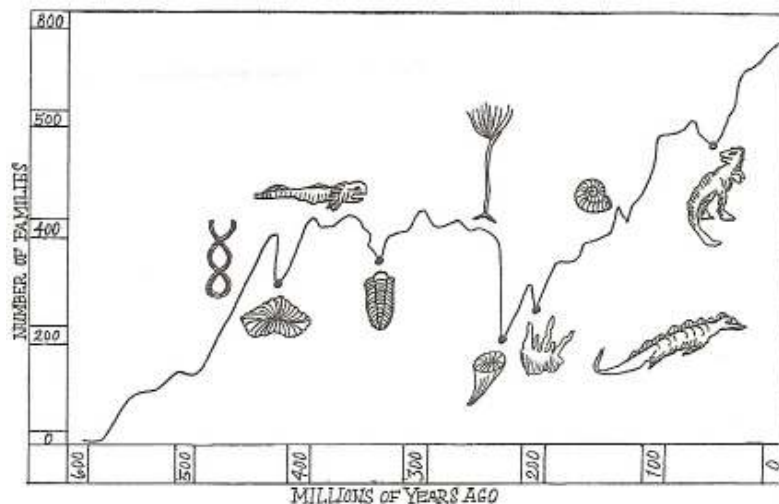
Biodiversity, the harvest of four billion years of evolutionary wisdom distilled into 5-15 million species that share the planet, is unraveling. Biologists now say that a sixth mass extinction is under way, and it is caused by humans.¹ The UN Convention on Biodiversity in 2006 estimated that average species abundance declined about 40 percent between 1970 and 2000. According to the 2005 Millennium Ecosystem Assessment involving more than 1300 scientists from 95 countries, humans have increased species extinction rates by as much as 100 times over background rates. These scientists estimate that 12 percent of remaining bird species, 23 percent of mammals, 25 percent of conifers, and 32 percent of amphibians are threatened with extinction.² Dr. Peter Raven, a world leader in plant conservation, has predicted that one-third to two-thirds of all species will be lost during the second half of this century. Based on the recovery rate of previous mass extinctions, it may take 50-100 million years for biological diversity to recover.³

DRIVING FORCES IN THE LOSS

The three primary drivers in the loss of biodiversity are habitat destruction and fragmentation, invasive species, and over fishing and hunting.⁴ (Invasive species and over fishing are covered in other fact sheets of *Stresses on the Planet*.) Habitat destruction results from farming, grazing, paving the land, cutting forests, and building dams. For example, the prairie dog population declined by 98 percent when the great grasslands, which once covered 40 percent of the US, were converted to farms.

The main cause of habitat destruction is the clear cutting of forests, particularly rain forests. One in eight plant species is at risk of extinction due to forest decline. Tropical rain forests are believed to support half the world's species.⁵ In some of these forests, the diversity of species is mind-boggling. In a study of ten 2.5-acre plots at a site in Indonesia, Harvard scientist Peter Ashton found 700 tree species—an amount equivalent to the total number of tree species native to North America. This abundance explains why there is such great concern about the clearing and burning of rain forests in the Amazon Basin. Edward O. Wilson, one of America's foremost experts on biodiversity, says we could be losing 4000-5000 species a year.⁶ In Wilson's view, with an increased knowledge of wild species and a modest effort, more income could often be extracted from the sustainable harvesting of natural forest products than from clear cutting forests for timber and crops. In addition, the "ecosystem services," like carbon storage and water purification provided by healthy ecosystems, have tremendous economic value (see below).

Five Great Extinctions



Dams destroy river habitats, trap nutrients that once flowed downriver to enrich the soils of deltas, and block fish migrations. In the Pacific Northwest, more than 25 percent of all juvenile salmon die going through the turbines of a dam. Salmon that do make it to the other side may suffer from “gas bubble disease” because the overflowing water becomes supersaturated with nitrogen. Furthermore, dams slow the flow of water behind them, increasing water temperature and delaying the movement of salmon smolts back to the sea.⁷ Wild salmon runs in the Columbia River Basin have dropped by 98 percent.⁸

Global warming is destined to become another major driver in the loss of biodiversity, especially in higher latitudes where temperature change is occurring most rapidly. As rising temperatures cause habitats to shift, many species will not be able to migrate fast enough to survive.

THE BENEFITS OF A BIO-DIVERSE PLANET

As we go about our daily lives, it’s hard for us to have the same sense of urgency scientific researchers have about the loss of species, especially if they are insects or plants. Yet biodiversity makes ecosystems resilient, giving them the ability to rebound from shocks of fires, floods, diseases, and droughts. As systems are simplified by monoculture or fragmented by roads, the webs that link them become disconnected and more vulnerable to catastrophic, irreversible decline. For example, mixed-perennial native prairies have root systems at various levels, some of them quite deep. They can therefore capture enough water to withstand droughts whereas human-planted annual grasses cannot. Diverse ecosystems have built-in redundancy. If one species dies off due to a disease, another may be able to take over its functions in the system.⁹

Biodiverse ecosystems also provide many services that humans are not able to provide, or that would be outrageously expensive, such as purification of air and water and regulation of Earth’s temperature.¹⁰ The most obvious service of a biodiverse ecosystem is pollination of plants. Scientists estimate that approximately 150,000 animal species including bees, beetles, butterflies, flies, birds, and bats provide this service. In dollars, honeybee pollination services are up to 100 times more valuable than the honey itself. Unfortunately, in the US more than 50 percent of the honeybee colonies have disappeared in the last 50 years.¹¹ We also rely on birds, spiders, parasitic wasps, and ladybugs to keep pests in check and to disperse seeds. In fact, the white-bark pine tree cannot reproduce successfully without Clark’s Nutcracker, which buries its seed.¹²

A team of international researchers in 1997 determined that nature’s services were worth around \$33 trillion per year, exceeding the global GNP of \$25 trillion.¹³ A single example of the cost of ecosystem services is illustrated by the Catskills Watershed that supplies water to New York City. In the 1990s, the drinking water was below standard. The watershed had been overburdened by new homes, dairies, and failing septic systems. The watershed development corporation determined that a filtration plant to bring the water up to standard would cost \$7 billion over ten years. Restoration of the watershed, on the other hand, would cost \$1-1.5 billion. The corporation is now buying up and restoring land, paying people to upgrade sewage, getting farmers and foresters to sign up for sustainability plans, and getting cattle owners to fence cattle from streams.¹⁴

TUGGING AT THREADS

Each species plays some role in the web of an ecosystem. For example, marine researchers found that when humans decimated otter populations for their fur, kelp forests disappeared. (Kelp is a giant, rubbery seaweed stretching from the sea floor to the surface.) A primary food source of the otter is the sea urchin, whose favorite food is kelp. With their predator gone, sea urchins overpopulated, consuming all the kelp and leaving barren areas where biodiverse forests once thrived.¹⁵

Wolves have long been hunted by humans trying to protect their cattle. After wolves were eradicated from Yellowstone National Park, scientists noticed that aspens, cottonwoods, and willows stopped growing. Research scientists theorize that the elk, no longer fearful of their predator, spent more time browsing in the open stream areas. Now that wolves have been returned to Yellowstone, willows and cottonwoods are returning. Because more trees are available, beavers are re-colonizing and creating wetlands, which in turn are creating habitat for native trout and songbirds.¹⁶

In an ecosystem, it is not clear which species, if any, is expendable. To quote Carl Sagan, former director of the Laboratory for Planetary Studies at Cornell University, “We are ignorant about the complex mutual dependencies of the beings on Earth, and what the sequential consequences will be if we wipe out some especially vulnerable microbes on which larger organisms depend. We are tugging at a planet-wide biological tapestry and do not know whether one thread only will come out in our hands, or whether the whole tapestry will unravel before us.”¹⁷

HUMAN DEPENDENCE

Perhaps it is easiest for us to understand the importance of preserving species when we consider our reliance on their diversity for food, fiber, fuel, and medicines. Future medicines are likely to be found in the many thousands of plants we have not yet studied. About 25 percent of the pharmaceuticals we use today contain ingredients originally derived from wild plants.¹⁸ And of the plants useful in cancer treatment, about 70 percent are found only in rainforests. Of 3000 antibiotics, 2000 come from soil bacteria.¹⁹

Because of hybridization and the Green Revolution of the 1960s, our sources of food come from fewer and fewer varieties, increasing their vulnerability to disease. In 1970, a leaf fungus swept through uniform fields of the US Corn Belt. The disease destroyed 15 percent of the entire corn crop, pushing corn prices up 10 percent and causing losses of more than \$2 billion. The solution turned out to be blight-resistant genetic material from an ancient variety of corn from Mexico.²⁰

Today humans rely on about 20 species of plants, like wheat, rice, and corn, for most of their calories, while thousands of other calorie sources are ignored.²¹ These 20 crops are bred for high yields and ease of farming, weakening their ability to overcome diseases or changes in climate.²² In Mexico, four-fifths of the varieties of corn that existed in the 1930s have disappeared. China, which once had 10,000 wheat varieties, now has one-tenth that number. Seventy-five percent of the genetic diversity of crops has been lost since the beginning of the 20th century.²³

As scientists breed resistance into new varieties, diseases and insects adapt. More than 400 species of pests are now resistant to one or more pesticides, and the proportion of crops that are

lost to insects has doubled since 1940. No one knows when we might need the genetic material from a plant that we have inadvertently driven to extinction.²⁴

Loss of species and genetic diversity within species may preclude human use of nature's library of products, some with millions of years of evolutionary wisdom. As Edward O. Wilson has said, "No artificially selected genetic strain has ever out-competed wild variants of the same species in the natural environment."²⁵

WHAT IS BEING DONE?

Some species that were almost lost in the US have made comebacks as a result of the Endangered Species Act of 1973. The bald eagle and peregrine falcon have made remarkable recoveries; the grey wolf introduced in Yellowstone is expanding to other states; even the California condor, which was down to 21 individuals, now numbers over 150 birds as a result of a captive breeding program.²⁶ Since the Endangered Species Act, improved science about what it takes to keep ecosystems intact has enabled governments and nonprofit organizations to give highest priority to saving the most sensitive habitats and the species that have strong influence over other plants and animals such as bears and wolves. For example, the organization Wildlands Project is working to link vast corridors that connect natural places so that wildlife can travel freely from place to place.

¹ DeWeerd, Sarah, "Bye Bye, Birdie," *Worldwatch*, July/Aug 2006

² Global Millennium Assessment, www.millenniumassessment.org, May 2005

³ Steiner, Richard, *Seattle Post-Intelligencer*, 5/30/04

⁴ Lubchenco, Jane, *Open Spaces*, 1998

⁵ *The Amicus Journal*, Winter 2000

⁶ Wilson, Edward O., "Threats to Biodiversity," *Scientific American*, September 1989

⁷ Columbia River United, *The Columbia River in Crisis*, October 1996

⁸ Northwest Environment Watch, *The Oregonian*, 1990

⁹ Baskin, Yvonne, *The Work of Nature*, 1997

¹⁰ Raven, Peter, presentation, Portland, OR, 1994

¹¹ Abramovitz, Janet, "Putting a Value on Nature's Services," *WorldWatch*, January/February 1998

¹² "Ecosystem Services," *ibid.*

¹³ Abramovitz, Janet, *ibid.*

¹⁴ Daily, Gretchen, presentation, Portland, OR, 2000

¹⁵ Forte Netting, Jessa, "Sea Otters, Kelp, and Killer Whales," Science News for Kids Web site, 3/24/04

¹⁶ "The Ecology of Fear," *E Magazine*, March/April 2006

¹⁷ Sagan, Carl, "A Piece of the Sky Is Missing," *Parade Magazine*, 9/11/88

¹⁸ "Planet of the Year," *Time*, 1989

¹⁹ Raven, Peter, *ibid.*

²⁰ Myers, Norman, *Scientific American*, December 1988

²¹ Karaim, Reed, *The Washington Post*, 1999

²² Global Biodiversity Assessment for UN Environment Program, April 2005

²³ Karaim, Reed, *ibid.*

²⁴ Karaim, Reed, *ibid.*

²⁵ Wilson, Edward O., *ibid.*

²⁶ www.birds.cornell.edu/AllAboutBirds/conservation/success/California_condor, accessed July 18, 2006