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[Image of a bighorn sheep by the Oregon Department of Agriculture](#) | Flickr | CC BY-NC-ND 2.0

Update On the World's Diminishing Resources

Part II: Biodiversity

Gioietta Kuo

Oh, what a wonderful planet we have inherited and nature is unbelievably beautiful!! There are millions and millions of species on earth. Though it is impossible to catalogue them all, so far scientists have identified about 1.75 million different species. That includes 950,000 species of insects, 270,000 species of plants, 19,000 species of fish, 9,000 species of birds, and 4,000 species of mammals.

Why do we need so many species? Because we are all part of our ecosystem and all species are interconnected and depend on each other. Forests provide homes for animals. Animals need plants to eat. The plants need a healthy environment to grow and they provide food, shade, construction material, medicine, fiber for clothing and paper, etc. Two specific reasons why more biodiversity is better:

Powerful Pollinators

Bees, birds, and other creatures pollinate 75 percent of the world's major crops. In areas with high levels of biodiversity, insects and other creatures pollinate plants naturally. When biodiversity is low, farmers have to introduce large quantities of pollinators, such as honeybees to pollinate their commercial crops.

Medicine from Nature

About 25 percent of the medicines used today are taken from or modeled on chemicals found in plants, animals, and other living things. Many advances in genetic engineering in the form of the latest tools like CRISPR provide new opportunities for accessing naturally occurring RNA-DNA molecules that can hold clues to new medicines.

Yet, it is a sad fact that our planet is now in the midst of its sixth mass extinction of plants and animals — the sixth wave of extinctions in the past half-billion years. We're facing the worst die-offs of species since the loss of the dinosaurs 65 million years ago. Although extinction is a natural phenomenon, it happens at a natural "background" rate of about one to five species per year, and it is estimated that we're now losing species at 1,000 to 10,000 times the background rate, with literally tens of species going extinct every day.

In fact, the Living Planet Index shows a decline in biodiversity of 52% between 1970 and 2010. To put it more starkly: 1 in 5 species now face extinction and that will rise to 50% by the end of this century. This means that as many as 30 to 50 percent of all species today could be heading toward extinction by 2050.

The sad thing is, whereas past mass extinctions were caused by natural phenomenon like asteroid strikes, volcanic eruptions and natural climate shifts, the current crisis is almost completely caused by humans. Population growth is the basic reason for this. The ever increasing number of people and mouths to feed has led to our industrial agriculture with human encroachment on the lives of all species. Our activities have caused:

- 1) Habitat loss –forests and wetlands being cleared to build infrastructure for agriculture.
- 2) Introduction of exotic strange species into local ecosystems.
- 3) Pollution, overfishing and overhunting disturbing the natural balance of species in a local ecosystem
- 4) Global warming changing the temperature and climate of the environment.

In fact, 99% of currently threatened species are at risk from human activities. Ecosystems are complex and the extinction of one species is likely to lead to changes in other species, which can lead to other extinctions with effects easily amplified.

Biodiversity is closely connected to deforestation as 80% of Earth's land animals and plants live in forests. Biodiversity is the highest in tropical regions with biodiversity decreasing at higher latitudes and lower temperatures. The reason we need maximum diversity of species is because this promotes ecosystem resilience, which is a system's ability to withstand stress. All the species in a local ecosystem are interrelated, and when one species becomes extinct, other species through genetic mutations, migration, and other behavior means adapt to reach a new balance. In time, new species may evolve, but the time scale may be long.

No one really knows how many species are in danger of becoming extinct. We do know that in the past 500 years, approximately 1000 species have gone extinct. Conservation scientists in the US estimate that there are 14,000 to 35,000 endangered species, which is 7 to 18% of all flora and fauna. Worldwide, it is assessed that 17,000 species are threatened with extinction.

Here, I quote a forceful statement by Paul Ehrlich, a noted environmentalist at Stanford University who initiated MAHB - Millennium Alliance for Humanity and the Biosphere (see article "MAHB – A discussion forum to disseminate ideas on how to improve our environment" by Paul Ehrlich and Gioietta Kuo On World Environment in Chinese, Oct. 2012)

"Rich western countries are now siphoning up the planet's resources and destroying its ecosystems at an unprecedented rate. We want to build highways across the Serengeti to get more rare earth minerals for our cellphones. We grab all the fish from the sea, wreck the coral reefs and put carbon dioxide into the atmosphere. We have triggered a major extinction event. The question is: how do we stop it?"

Below I take a closer look at biodiversity loss among certain classes of animals and plants.

Mammals

Interest in biodiversity loss is often first piqued by our emotional connection and thoughts often go to other mammals and our close ape relatives. Looking at the apes from an evolutionary point of view, they are our immediate predecessors and their disappearance would deprive us of this vital link in the understanding of how we humans evolved. The gene sequence of the chimpanzee has been decoded and compared with that of humans. It is interesting to note that the DNA differences between humans and chimpanzees is around 4%. To put this in perspective, the number of genetic differences between a human and a chimpanzee is about 10 times more than between any two humans. Human and chimpanzee DNA is so similar because the two species are so closely related with humans, chimpanzee and bonobos all being descendents from a single ancestor species that lived six or seven million years ago. As human and chimpanzee gradually evolved from a common ancestor their DNA passed from generation to generation, changed too. We do not quite understand the specific differences like humans having 3 times larger brain size, complex language skills and walking on 2 feet.



Figure 1. A photo of an ape –Chimpanzee. Ah, the great apes are so much like us the humans. Look at the intelligence radiating in the eyes of this chimpanzee!

[Image by Ronald Woan](#), Kibale National Park Chimpanzee Habituation Experience | Flickr | CC BY-NC 2.0

The International Union for Conservation of Nature, IUCN, estimates that almost 50% of the world's primate species are at risk of extinction. All great ape species –gorilla, chimpanzee, bonobo and orangutan– are classified as either Endangered or Critically Endangered. The main threats are human encroachment through industrial agriculture on their forest habitats, also poaching for meat, disease –including Ebola, and the pet trade. All great apes live in tropical forests, which are fast disappearing.

Overall IUCN estimates that half the globe's 5,491 known mammals are declining in population and a fifth are clearly at risk of disappearing forever with no less than 1,131 mammals across the globe classified as endangered, threatened, or vulnerable. In addition to primates, marine mammals — including several species of whales, dolphins, and porpoises — are among those mammals slipping most quickly toward extinction.

How can we allow this to happen? We should be ashamed! What will the future generations say about us for not being able to see these beautiful creatures in nature? First we need the collaboration of the government, the private sector, local communities and civil society to work out and integrate a plan to reconcile some of the conflicting agendas for the protection of mammals as well as the wellbeing of the human population. Given that tropical forest loss is a significant contribution to climate change, the conservation of these resources is critical to

protecting not only the great ape, but also other plants and animals, and the global human population.

Birds

[Birds](#) occur in nearly every habitat on the planet and are often the most visible and familiar wildlife to people across the globe. As such, they provide an important bellwether for tracking changes to the biosphere. Declining bird populations across habitats confirm that profound changes are occurring on our planet in response to human activities.

[A 2009 report on the state of birds in the United States](#) found that 251 (31%) of the 800 species in the country are of conservation concern. Globally, [BirdLife International](#) estimates that 12% of the known 9,865 bird species are now considered threatened, with 192 species, or 2%, facing an “extremely high risk” of extinction in the wild — two more species than in 2008. Again, habitat loss and degradation have caused most of the bird declines.

Reptiles

Globally, 21% of the total evaluated [reptiles](#) in the world are deemed endangered or vulnerable to extinction by the IUCN — 594 species — while in the United States, 32 reptile species are at risk, about 9% of the total. Island reptile species have suffered most, with at least 28 island reptiles having died out since 1600. But scientists say that island-style extinctions are creeping onto the mainland as human activities fragment continental habitats, creating “virtual islands” as they isolate species from one another, preventing interbreeding and hindering populations’ health. The main threats to reptiles are habitat destruction and the invasion of non-native species that prey on reptiles and compete with them for habitat and food.

Amphibians

[Amphibians](#) include various species of frogs and salamanders. They are one of the main links in many ecosystem food webs. Often unseen, they can be quite abundant in some habitats. In temperate and tropical regions, amphibians can exceed all other terrestrial vertebrates such as birds, mammals, and reptiles. Amphibians including their larvae are important predators of invertebrates. Removal of amphibians from particular habitat can have drastic consequences by increasing insect populations. Through metamorphosis, many species of frogs and salamanders are a link of transfer of nutrient from aquatic systems to terrestrial ones. Therefore, removing amphibians from a particular habitat can affect drastically algae communities, invertebrate populations, predator dynamics, leaf litter decompositions, and nutrient cycling. Preserving amphibian diversity is an important component for living in a healthy environment.

Addressing the amphibian extinction crisis represents the greatest species conservation challenge in the history of humanity. One third to one half of all amphibian species are threatened with extinction, with probably more than 120 already gone in recent years. These declines are known as one of the most critical threats to global diversity and several causes are

believed to be involved, including disease, habitat destruction and modification, exploitation, pollution, pesticide use, introduced species and ultraviolet-B radiation.

Fish

Increasing demand for water, the damming of rivers throughout the world, the dumping and accumulation of various pollutants, ocean acidification, and invasive species make aquatic ecosystems some of the most threatened on the planet; thus, it's not surprising that there are many [fish species](#) that are endangered in both freshwater and marine habitats.

The [American Fisheries Society](#) identified 700 species of freshwater or anadromous fish in North America as being imperiled, amounting to 39% of all such fish on the continent. In North American marine waters, at least 82 fish species are imperiled. Across the globe, 1,851 species of fish — 21% of all fish species evaluated— were deemed at risk of extinction by the [IUCN](#) in 2010, including more than a third of sharks and rays.

These declines hold important implications for human society including a diminishing supply of food for the growing overpopulation.

Invertebrates

[Invertebrates](#) are estimated to account for about 97% of the total species of animals on Earth though no one knows just how many invertebrate species exist. Invertebrates, from butterflies to mollusks to earthworms to corals, are vastly diverse. Of the 1.3 million known invertebrate species, the IUCN has evaluated about 9,526 species, with about 30% of the species evaluated at risk of extinction. Freshwater invertebrates are severely threatened by water pollution, groundwater withdrawal, and water projects, while a large number of invertebrates of notable scientific significance have become either endangered or extinct due to deforestation, especially because of the rapid destruction of tropical rainforests.

In the ocean, we are very much aware of the beauty of coral reefs in The Great Barrier Reef of Australia and Raja Ampat of Indonesia and those in the Caribbean. As the temperature of marine waters increases, stressed corals expel their algae resulting in coral bleaching. These reef-building corals are declining at an alarming rate. The first-ever comprehensive global assessment of these animals in 2008 revealed that a third of reef-building corals are threatened. What is at stake is that though these reefs only take up about 1% of the ocean floor, they host about 25% of all ocean species! They provide complex, three-dimensional habitat for a huge variety of plants and animals (large and small!) and protect many young fish species as they grow. They are vital to the world's fisheries and food systems. Ocean

acidification, resulting from increased atmospheric CO₂ being absorbed by the ocean, also poses a serious threat to marine biodiversity.



Figure 2: **Left**, A healthy coral of Egypt's Port Ghalib. [Image by J. Hutsch, 2006](#) | Wikimedia Commons | CC BY-SA 2.5; **Right**, A part of Moofushi's bleached coral reef of the Maldives' Alifu Dhallu Atoll. Image by [Bruno de Giusti, 2006](#) | Wikimedia Commons | CC BY-SA 2.5

Plants

Through photosynthesis, [plants](#) provide the oxygen we breathe and the food we eat and are thus the foundation of most life on Earth. They are also the source of a majority of medicines in use today. Of the more than 300,000 known species of plants, the IUCN has evaluated only 12,914 species, finding that about 68% of evaluated plant species are threatened with extinction.

Unlike animals, plants cannot readily move as their habitat is destroyed, making them particularly vulnerable to extinction. Indeed, [one study](#) found that habitat destruction leads to an "extinction debt," whereby plants that appear dominant will disappear over time because they are not able to disperse to new habitat patches. Global warming will likely exacerbate this problem. Already, scientists say, warming temperatures are causing quick and dramatic changes in the range and distribution of plants around the world. Rising global temperatures are even impacting human agriculture as the growing moves to higher latitudes. With plants making up the backbone of ecosystems and the base of the food chain, that is very bad news for all species, which depend on plants for food, shelter, and survival.

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The above article is Part II of a three-part series in which Gioietta Kuo surveys some of the major losses we have caused, some of which are irreversible while others may be fixed if we have the determination. [Part I explored the challenge of deforestation](#) and Part III will consider melting ice sheets and rising sea levels.

The MAHB Blog is a venture of the Millennium Alliance for Humanity and the Biosphere. Questions should be directed to joan@mahbonline.org

MAHB Blog: mahb.stanford.edu/blog/diminishing-resources-biodiversity/