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Climate Changes & Biodiversity

Biodiversity is all the living things on our planet – from the smallest bacteria to the largest plants and animals. So far, we have identified around 1.6 million species but that is probably only a small fraction of the forms of life on Earth.

Biodiversity on Earth is the result of four billion years of evolution. Biodiversity is most commonly used to describe the variety of life in a particular area but it also refers to how those different species interact with each other in these areas, or ecosystems. These ecosystems can vary in size and complexity from a garden pond to the Amazon Rainforest but it is the biodiversity of each area – that variety of species and genes – and the environment in which they exist, that determines what happens in the ecosystem. How each species interacts with others, and the environment in which they exist, determines how each survives and grows. While many of these relationships are robust there are also many that can be fragile.

Why is biodiversity important?

Biodiversity is essential for the processes that support all life on Earth, including humans. Without a wide range of animals, plants and microorganisms, we cannot have the healthy ecosystems that we rely on to provide us with the air we breathe and the food we eat. And people also value nature of itself.

Some aspects of biodiversity are instinctively widely valued by people but the more we study biodiversity the more we see that all of it is important – even bugs and bacteria that we can't see or may not like the look of. There are lots of ways that humans depend upon biodiversity and it is vital for us to conserve it. Pollinators such as birds, bees and other insects are estimated to be responsible for a third of the world's crop production. Without pollinators we would not have apples, cherries, blueberries, almonds and many other foods we eat. Agriculture is also reliant upon invertebrates – they help to maintain the health of the soil crops grow in. Soil is teeming with microbes that are vital for liberating nutrients that plants need to grow, which are then also passed to us when we eat them. Life from the oceans provides the main source of animal protein for many people.

Trees, bushes and wetlands and wild grasslands naturally slow down water and help soil to absorb rainfall. When they are removed it can increase flooding. Trees and other plants clean the air we breathe and help us tackle the global challenge of climate change by absorbing carbon dioxide. Coral reefs and mangrove forests act as natural defences protecting coastlines from waves and storms.

Many of our medicines, along with other complex chemicals that we use in our daily lives such as latex and rubber, also originate from plants. Spending time in nature is increasingly understood to lead to improvements in people's physical and mental health. Simply having green spaces and trees in cities has been shown to decrease hospital admissions, reduce stress and lower blood pressure.

How do we measure biodiversity?

There is still much we do not know about the complexity of biodiversity on Earth. There are a number of ways that we measure it, with counting species the most common approach. So far, we have identified 1.6 million species but we do not know how many others there may be. It has been estimated that 84% of species may still be unidentified and with most species being rare, measurement can be difficult.
Scientists use different sampling techniques, surveys or ways of counting depending on the organisms of interest. Technology ranges from a simple hand-held magnifying lens to images of whole landscapes captured by satellites and from sampling and sequencing traces of DNA in soil, water and snow to acoustic monitoring. There are also large scale citizen science programmes such as the Reef Life Survey, Big Butterfly Count and Penguin Watch.

For the big animals, plants and ecosystems, we have well established measures of biodiversity, such as the Living Planet Index, which are used in large periodic reports of the state of life on Earth, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment. In places like Europe there are records from scientists and amateur naturalists going back hundreds of years that also help us judge how biodiversity has been changing.

For smaller creatures such as invertebrates and microbes, we have much less of an idea of how their populations may be changing, or indeed the number of species, although DNA sampling is leading to rapid advances in our appreciation of biodiversity at very small scales.

What is the scale of biodiversity loss?

The list of known recent extinctions is still a small fraction of all species on the planet but it is far above pre human levels and the evidence suggests it is rising fast. A recent report indicated that one million species could be threatened with extinction. Since 1500, 1.6% of birds, 1.9% of mammals and 2.2% of amphibians have been recorded as extinct. Between 1990 and 2020, around 420 million hectares of forest (mainly tropical forest) has been lost and a further 10 million hectares, an area the size of Scotland and Wales combined, is being lost each year.
Extinctions have always occurred but the rate at which they are happening now far exceeds the rates at which species have naturally gone extinct over the course of the fossil record.

The historical spread of humanity over the planet has been associated with waves of extinctions in other species. Key threats to date have been over-hunting and harvesting of species by people, habitat conversion and degradation, and the introduction of invasive species caused by human migration, settlement, trade, agriculture and resource extraction. These threats have been accelerating since 1500 alongside rapid growth in human populations and increasing growth in per capita consumption of resources. In addition, in the past few decades, climate change has become an increasingly important threat. Estimates suggest that extinction rates in the recent past have been running tens to hundreds of times faster than in pre-human times and that the pace is accelerating.

In those groups of plants and animals that have been systematically assessed under International Union for Conservation of Nature Red List criteria, about 25% are classified as threatened with extinction (that is, Critically Endangered, Endangered, or Vulnerable). Five groups (mammals, birds, amphibians, corals, and cycads) have been comprehensively assessed two or more times since 1980. In all cases the reassessments show an increasing trend in the proportion of species that are threatened.

Comparing the results of surveys of insects from the 1970s and 1980s to what we have now is helping to create a picture of changes in biodiversity. However, there is a lot more work required to understand these changes and their consequences.

Biodiversity loss has been most pronounced on islands and in specific locations around the tropics, where distinctive species often evolve in isolation from the rest of the world. The introduction of alien species along with hunting and the clearing of vegetation by humans on small, isolated islands account for around 80% of known extinctions. Wider problems such as climate change, pollution, over-exploitation, and land use change - often to make way for agriculture - are causing biodiversity to decline in other areas such as in the oceans and rainforests.

Compared to the 1.6 million species known about on Earth, the number of recorded extinctions can seem very low. Since 1500AD there have been 711 vertebrates, and around 600 invertebrates and plants known to have gone extinct but the actual number is likely to be considerably greater. In the future, it is predicted that extinction rates are likely to further increase more than ten-fold over coming decades.

Humans have been affecting global biodiversity for tens of thousands of years. There may have been extinctions which we do not know about. However, extinctions are now estimated to be occurring perhaps at least ten to a hundred times faster than they were in pre-human times. If that continues, the number of extinctions is likely to increase dramatically.

Currently 37,400 animal and plant species are known to be threatened with extinction – roughly 28% of the 134,000 assessed by the International Union for Conservation of Nature (IUCN) Red List. The true figure is expected to be far higher when accounting for the total number of species on the planet. One recent assessment by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services found that as many as 1 million animal and plant species are now threatened with extinction – more than ever before in human history.

Much of the reason for the acceleration in extinctions is the growing pressure on species from human-driven land and coastal use change, over-exploitation, climate change, pollution and invasive alien species.

Although there has been an expansion of protected areas both on land and in the oceans since 2000, this will not compensate for species already lost. According to the World Wildlife Fund's Living Planet Report 2020, the animal populations they assessed decreased by an average of 68% between 1970 and 2016.

Climate change is expected to place further pressure on these diminishing populations by altering habitats and triggering extreme events such as more frequent wildfires and flooding. It may also promote the spread of invasive species and diseases with the result that many already threatened species are likely to be pushed over the edge to extinction in the decades to come.

How do humans affect biodiversity?

Humanity impacts the planet's biodiversity in multiple ways, both deliberate and accidental. The biggest threat to biodiversity to date has been the way humans have reshaped natural habitats to make way for farmland, or to obtain natural resources, but as climate change worsens it will have a growing impact on ecosystems.

Key areas of human activity causing biodiversity loss include:

- Deforestation. Tropical rainforests are particularly rich in biodiversity and are being destroyed
- Habitat loss through pervasive, incremental encroachment such as that caused by urban sprawl
- Pollution such as that associated with widespread pesticide use and overuse of fertilizer which are 6 and 12 times greater than they were before 1961 respectively
- It is estimated that half of the species at risk are threatened by agriculture
- Water use in some of the largest water catchments in the world where dams and irrigation reduce water flows
- Hunting and the over-exploitation of species such as in wild capture fisheries but also for wildlife trade
- Spread of invasive species and diseases through trade and travel

- Climate change, as warming and changing rainfall patterns alters species ranges and the underlying water and chemical cycles which define current ecosystems
- Pollution from plastic waste although its long-term effects on biodiversity are far from clear

How does climate change affect biodiversity?

The environmental changes being driven by climate change are disturbing natural habitats and species in ways that are still only becoming clear. There are signs that rising temperatures are affecting biodiversity, while changing rainfall patterns, extreme weather events, and ocean acidification are putting pressure on species already threatened by other human activities.
The threat posed by climate change to biodiversity is expected to increase, yet thriving ecosystems also have the capacity to help reduce the impacts of climate change.

If current rates of warming continue, by 2030 global temperatures could increase by more than 1.5°C (2.7°F) compared to before the industrial revolution. A major impact of climate change on biodiversity is the increase in the intensity and frequency of forests fires, storms or periods of drought.

Rising global temperatures also have the potential to alter ecosystems over longer periods by changing what can grow and live within them. There is already evidence to suggest that reductions in water vapor in the atmosphere since the 1990s has resulted in 59% of vegetated areas showing pronounced browning and reduced growth rates worldwide.

Rising temperatures in the oceans affect marine organisms. Corals are particularly vulnerable to rising temperatures and ocean acidification can make it harder for shellfish and corals in the upper ocean to form shells and hard skeletons. We have also seen changes in occurrence of marine algae blooms. Despite the threats posed by climate change to biodiversity, we also know that natural habitats play an important role in regulating climate and can help to absorb and store carbon. Mangroves are significant sinks for carbon and the Amazon is one of the most biologically diverse places on the planet and is an enormous store of carbon – up to 100 billion tons, although a recent study has suggested the Amazon may now be emitting more carbon than it absorbs. Safeguarding these natural carbon sinks from further damage is an important part of limiting climate change.

What can we do to protect biodiversity?

loss of natural habitats has been taking place over thousands of years, but scientists are confident that we have ways to help biodiversity recover. Global efforts so far have been insufficient. We must produce food much more efficiently using less land and with less waste. We must also change how and where we urbanize and industrialize landscape and the ocean, and how we produce energy. Paying more attention to the multiple values of nature, including placing a financial value on nature, might also help us to avoid losing more biodiversity.

The world's nations could improve the situation at the United Nations Convention on Biological Diversity Fifteenth Conference of the Parties (COP15) to be held in Kunming, China. Ours is the

first generation that understands in detail the damage that it is causing to biodiversity – and the last with the time to make a difference.

Growing populations and the even faster growing rates of consumption are a major threat to biodiversity. Half of the Earth's ice free and otherwise habitable land is now occupied by cropland and pastures, and it is estimated that half of the species at risk are threatened by agriculture. We need new ways of farming, using land for different purposes. Exactly how we do that is currently much debated.

Deforestation, often linked to agriculture, is also a major problem, bringing about the destruction of habitats. It is essential to protect forests. A growing threat is climate change, which is both driven by and drives biodiversity loss. Reducing emissions and absorbing carbon will be an essential route to reducing biodiversity loss. Nature-based solutions for climate change include methods which could enhance biodiversity at the same time as tackling climate change.

We will also need new ways to value and account for nature that put a price on its destruction so that we take this into account when assessing the overall cost and value of what we produce. We also need a global monitoring network that allows us to hold countries to account for failures to tackle biodiversity loss.

And finally, we need to do more to support the Indigenous peoples and local communities on whose land biodiversity is thriving, but who are struggling to protect it against the pressures of external developers and extractive industries. Strengthening their land rights will help protect them as well as protecting biodiversity.

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