

# The Guardian

# What is biodiversity and why does it matter to us?

The air you breathe, the water you drink and the food you eat all rely on biodiversity, but right now it is in crisis – because of us. What does this mean for our future and can we stop it?

by Environment editor

## **What is biodiversity?**

It is the variety of life on Earth, in all its forms and all its interactions. If that sounds bewilderingly broad, that's because it is. Biodiversity is the most complex feature of our planet and it is the most vital. "Without biodiversity, there is no future for humanity," says Prof David Macdonald, at Oxford University.

The term was coined in 1985 – a contraction of "biological diversity" – but the huge global biodiversity losses now becoming apparent represent a crisis equalling – or quite possibly surpassing – climate change.

More formally, biodiversity is comprised of several levels, starting with genes, then individual species, then communities of creatures and finally entire ecosystems, such as forests or coral reefs, where life interplays with the physical environment. These myriad interactions have made Earth habitable for billions of years.

A more philosophical way of viewing biodiversity is this: it represents the knowledge learned by evolving species over millions of years about how to survive through the vastly varying environmental conditions Earth has experienced. Seen like that, experts warn, humanity is currently "burning the library of life".



## Bugs are the base of the **gs really matter to me?**

many wild food chains

that support ecosystems.

Illustration: Frances

Marriott  
Many people in towns and cities, wildlife is often something you watch on television. In fact the air you breathe, the water you drink and the food you eat all ultimately rely on biodiversity. Some examples are obvious: without plants there would be no oxygen and without bees to pollinate there would be no fruit or nuts.

Others are less obvious – coral reefs and mangrove swamps provide invaluable protection from cyclones and tsunamis for those living on coasts, while trees can absorb air pollution in urban areas.

Others appear bizarre – tropical tortoises and spider monkeys seemingly have little to do with maintaining a stable climate. But the dense, hardwood trees that are most effective in removing carbon dioxide from the atmosphere rely on their seeds being dispersed by these large fruit-eaters.

When scientists explore each ecosystem, they find countless such interactions, all honed by millions of years of evolution. If undamaged, this produces a finely balanced, healthy system which contributes to a healthy sustainable planet.

The sheer richness of biodiversity also has human benefits. Many new medicines are harvested from nature, such as a fungi that grows on the fur of sloths and can fight cancer. Wild varieties of domesticated animals and crops are also crucial as some will have already solved the challenge of, for example, coping with drought or salty soils.

If money is a measure, the services provided by ecosystems are estimated to be worth trillions of dollars – double the world's GDP. Biodiversity loss in Europe alone costs the continent about 3% of its GDP, or €450m (£400m), a year.

From an aesthetic point of view, every one of the millions of species is unique, a natural work of art that cannot be recreated once lost. “Each higher organism is richer in information than a Caravaggio painting, a Bach fugue, or any other great work,” wrote Prof Edward O Wilson, often called the “father of biodiversity”, in a seminal paper in 1985.



75% of flying insects were lost in the last 25 years in Germany, according to a recent study. Illustration: Frances Marriott

## Just how diverse is biodiversity?

Mind-bogglingly diverse. The simplest aspect to consider is species. About 1.7 million species of animals, plants and fungi have been recorded, but there are likely to be 8-9 million and possibly up to 100 million. The heartland of biodiversity is the tropics, which teems with species. In 15 hectares (37 acres) of Borneo forest, for example, there are 700 species of tree - the same number as the whole of North America.

Recent work considering diversity at a genetic level has suggested that creatures thought to be a single species could in some cases actually be dozens. Then add in bacteria and viruses, and the number of distinct organisms may well be in the billions. A single spoonful of soil - which ultimately provides 90% of all food - contains 10,000 to 50,000 different types of bacteria.

The concern is that many species are being lost before we are even aware of them, or the role they play in the circle of life.

## How bad is it?

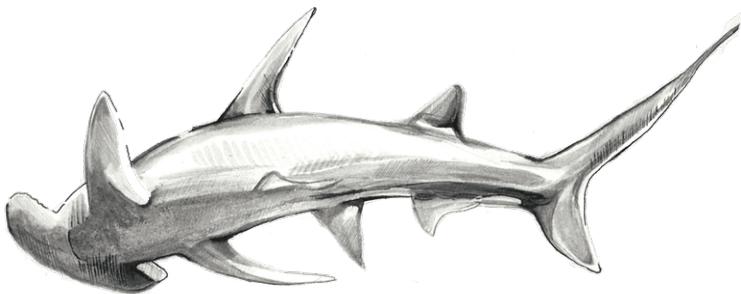
Very. The best studied creatures are the ones like us - large mammals. Tiger numbers, for example, have plunged by 97% in the last century. In many places, bigger animals have already been wiped out by humans - think dodos or woolly mammoths.

The extinction rate of species is now thought to be about 1,000 times higher than before humans dominated the planet, which may be even faster than the losses after a giant meteorite wiped out the dinosaurs 65m years ago. The sixth mass extinction in geological history has already begun, according to some scientists.

Lack of data means the “red list”, produced by the International Union for Conservation of Nature, has only assessed 5% of known species. But for the best known groups it finds many are threatened: 25% of mammals, 41% of amphibians and 13% of birds.

Species extinction provides a clear but narrow window on the destruction of biodiversity - it is the disappearance of the last member of a group that is by definition rare. But new studies are examining the drop in the total number of animals, capturing the plight of the world’s most common creatures.

The results are scary. Billions of individual populations have been lost all over the planet, with the number of animals living on Earth having plunged by half since 1970. Abandoning the normally sober tone of scientific papers, researchers call the massive loss of wildlife a “biological annihilation” representing a “frightening assault on the foundations of human civilisation”.



More than half the ocean **the sea?**

is now industrially fished.

Illustration: Frances Marriott  
gills but that has not protected marine life. The situation is no better - and understood - in the two-thirds of the planet covered by oceans. Seafood is the critical source of protein for more than 2.5 billion people but rampant overfishing has caused catches to fall steadily since their peak in 1996 and now more than half the ocean is industrially fished.

### **What about bugs - don't cockroaches survive anything?**

More than 95% of known species lack a backbone - there are about as many species in the staphylinidae family of beetles alone as there are total vertebrates, such as mammals, fish and birds. Altogether, there are at least a million species of insect and another 300,000 spiders, molluscs and crustaceans.

But the recent revelation that 75% of flying insects were lost in the last 25 years in Germany – and likely elsewhere – indicates the massacre of biodiversity is not sparing creepy crawlies. And insects really matter, not just as pollinators but as predators of pests, decomposers of waste and, crucially, as the base of the many wild food chains that support ecosystems.

“If we lose the insects then everything is going to collapse,” says Prof Dave Goulson of Sussex University, UK. “We are currently on course for ecological Armageddon.”

Even much-loathed parasites are important. One-third could be wiped out by climate change, making them among the most threatened groups on Earth. But scientists warn this could destabilise ecosystems, unleashing unpredictable invasions of surviving parasites into new areas.



A single spoonful of soil contains 10,000 to 50,000 different types of bacteria. Illustration: Frances Marriott

## What's destroying biodiversity?

We are, particularly as the human population rises and wild areas are razed to create farmland, housing and industrial sites. The felling of forests is often the first step and 30m hectares - the area of the Britain and Ireland - were lost globally in 2016.

Poaching and unsustainable hunting for food is another major factor. More than 300 mammal species, from chimpanzees to hippos to bats, are being eaten into extinction.

Pollution is a killer too, with orcas and dolphins being seriously harmed by long-lived industrial pollutants. Global trade contributes further harm: amphibians have suffered one of the greatest declines of all animals due to a fungal disease thought to be spread around the world by the pet trade. Global shipping has also spread highly damaging invasive species around the planet, particularly rats.

The hardest hit of all habitats may be rivers and lakes, with freshwater animal populations in these collapsing by 81% since 1970, following huge water extraction for farms and people, plus pollution and dams.

## Could the loss of biodiversity be a greater threat to humanity than climate change?

Yes - nothing on Earth is experiencing more dramatic change at the hands of human activity. Changes to the climate are reversible, even if that takes centuries or millennia. But once species become extinct, particularly those unknown to science, there's no going back.

At the moment, we don't know how much biodiversity the planet can lose without prompting widespread ecological collapse. But one approach has assessed so-called "planetary boundaries", thresholds in Earth systems that define a "safe operating space for humanity". Of the nine considered, just biodiversity loss and nitrogen pollution are estimated to have been crossed, unlike CO<sub>2</sub> levels, freshwater used and ozone losses.

### What can be done?

Giving nature the space and protection it needs is the only answer. Wildlife reserves are the obvious solution, and the world currently protects 15% of land and 7% of the oceans. But some argue that half the land surface must be set aside for nature.

However, the human population is rising and wildlife reserves don't work if they hinder local people making a living. The poaching crisis for elephants and rhinos in Africa is an extreme example. Making the animals worth more alive than dead is the key, for example by supporting tourism or compensating farmers for livestock killed by wild predators.

But it can lead to tough choices. "Trophy hunting" for big game is anathema for many. But if the shoots are done sustainably - only killing old lions, for example - and the money raised protects a large swath of land, should it be permitted?

We can all help. Most wildlife is destroyed by land being cleared for cattle, soy, palm oil, timber and leather. Most of us consume these products every day, with palm oil being found in many foods and toiletries. Choosing only sustainable options helps, as does eating less meat, particularly beef, which has an outsized environmental hoofprint.

Another approach is to highlight the value of biodiversity by estimating the financial value of the ecosystem services provided as "natural capital". Sometimes this can lead to real savings. Over the last 20 years, New York has spent \$2bn protecting the natural watershed that supplies the city with clean water. It has worked so well that 90% of the water needs no further filtering: building a water treatment plant instead would have cost \$10bn.

### What's next?

Locating the tipping point that moves biodiversity loss into ecological collapse is an urgent priority. Biodiversity is vast and research funds are small, but speeding up analysis might help, from automatically identifying creatures using machine learning to real-time DNA sequencing.

There is even an initiative that aims to create an open-source genetic database for all plants,

animals and single-cell organisms on the planet. It argues that by creating commercial opportunities - such as self-driving car algorithms inspired by Amazonian ants - it could provide the incentive to preserve Earth's biodiversity.

However, some researchers say the dire state of biodiversity is already clear enough and that the missing ingredient is political will.

A global treaty, the Convention on Biological Diversity (CBD), has set many targets. Some are likely to be reached, for example protecting 17% of all land and 10% of the oceans by 2020. Others, such as making all fishing sustainable by the same date are not. The 196 nations that are members of the CBD next meet in Egypt in November.

In his 1985 text, Prof E O Wilson, concluded: "This being the only living world we are ever likely to know, let us join to make the most of it." That call is more urgent than ever.

## Further reading

*The Biological Diversity Crisis* (1985). Edward O Wilson. *BioScience* (Vol 35)

*The Sixth Extinction: An Unnatural History* (2014). Elizabeth Kolbert (Bloomsbury)

*What Has Nature Ever Done for Us?* (2013) Tony Juniper (Profile)

*The Economics of Ecosystems and Biodiversity* (2010). Pushpam Kumar et al. (Earthscan)

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*Thomasine F-R.*

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By weight, 97% of the world's vertebrate land animals are humans or their livestock – just 3% are thought to be wild.

Illustration: Frances Marriott

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