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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 Damian Carrington Environment editor

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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”.

Do animals and bugs really matter to me?

For many people living in towns and cities, wildlife is often something you watch on television. But the reality is that 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.

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”.

What about under the sea?

Humans may lack gills but that has not protected marine life. The situation is no better – and perhaps even less 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.

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 CO2 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 footprint.

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.

1- O termo Biodiversidade, vem da contração de quais palavras?

2- Segundo o texto: **What is biodiversity and why does it matter to us?** Biodiversidade representa o conhecimento adquirido pela evolução das espécies ao longo de milhões de anos sobre como sobreviver às condições ambientais muito diferentes que a terra tem experimentado. O que os experts advertem que a humanidade está fazendo hoje em dia?

3- De que maneira as plantas e animais são importantes para nós?

4- O pronome *these*, na frase: *But the dense, hardwood trees that are most effective in removing carbon dioxide from the atmosphere rely on theirs seeds being dispersed by **these** large fruit-eaters* se refere a quais palavras?

5- O que o Prof. Edward O Wilson, frequentemente chamado de o “pai da biodiversidade”, escreveu no periódico em 1985?

6- Qual das alternativas melhor descreve a passagem do texto que fala sobre quão diversificada é a biodiversidade?

- () Aproximadamente 1.7 milhões de espécies de animais, plantas e fungos têm sido gravados, mas provavelmente há mais de 8-9 milhões e possivelmente mais de 100 milhões.
- () Aproximadamente 1.7 milhões de espécies de animais, plantas e fungos têm sido gravados, mas provavelmente não há mais de 8-9 milhões e nem tão pouco mais de 100 milhões.
- () Aproximadamente 1.7 milhões de espécies de animais, plantas e fungos ainda nem foram gravados, e, provavelmente há mais de 8-9 milhões e possivelmente mais de 100 milhões.
- () Aproximadamente 1.7 milhões de espécies de animais, plantas e fungos têm sido gravados, mas provavelmente há mais de 8-9 milhões e possivelmente menos de 100 milhões.

7- Qual a tradução do seguinte parágrafo do texto em questão?

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.

Read the text below and answer the questions.

THIRD WORLD RESURGENCE

Brazilian mine disaster releases dangerous metals

The collapse in November of a mining dam in the Brazilian state of Minas Gerais, which resulted in the inundation of a whole town under a sea of mud contaminated with toxic iron ore waste and silica, was one of the country's worst environmental disasters.

Luisa Massarani

Both the mine operator (a joint venture between mining giants BHP Billiton and Vale) and the Brazilian authorities have come under fire from UN rapporteurs for their negligence in failing to take measures to avert the accident.

THE environmental disaster that has followed the collapse of a dam at a Brazilian mine on 5 November has caused unprecedented damage in that country and will have irreversible negative effects on human health and the environment, according to experts.

The accident buried the small historic town of Bento Rodrigues, a subdistrict of Mariana, under mud. At least 11 people have died and more than 600 were displaced. In addition, the water supply

of more than 250,000 people in the area was interrupted as it was contaminated with heavy metals.

Tonnes of mud made up of iron ore waste and silica, originally estimated to be about 25,000 Olympic swimming pools in volume, have spread over 800 km and reached one of the largest Brazilian rivers, the Rio Doce. The contaminated mud, in which the Minas Gerais Institute of Water Management has found toxic substances like mercury, arsenic, chromium and manganese at levels exceeding drinking water limits, has reached the coast of the state of Espírito Santo. It could potentially impact the wider marine ecosystem.

The risks go beyond the particular chemical elements found in this mud. Dam water was also contaminated with harmful bacteria.

Many are blaming the disaster on Samarco, which is the Brazilian mining company in charge of the dams. The company is a joint venture between the mining giants Vale of Brazil and BHP Billiton of Australia.

More dams at risk

Although it was initially announced that two dams had collapsed in the mine, representatives of the

National Department of Mining Production surveyed that area by air and have confirmed that only the Fundão dam collapsed. They warned, however, that Samarco's Santarém dam has been 'overrun' and remains at risk of collapse, as does the company's Germano dam.

'As there was never an environmental incident of this magnitude, it is impossible to calculate the real impact right now,' says Klemens Laschefski, a researcher at the Federal University of Minas Gerais.

'The changes in the flow of the river in respect to the currents and the new geochemical conditions in the sediments will bring profound ecosystem changes, which will also influence the species, including with the possibility of disappearance of endemic species,' Laschefski warns. In addition, he says water plants in the area are endangered because the mud that now covers them will

eventually harden like cement, due to its high iron content.

Aloysio da Silva Ferrão Filho, a researcher at the Oswaldo Cruz Foundation, agrees that the situation is dire. 'The entire ecosystem is under threat and the impacts can even reach the marine food chain, possibly even the Abrolhos coral reefs, which are quite sensitive to sedimentation of inorganic material,' he told Chemistry World.

Ferrão says these effects can last for decades. He says the high concentrations of heavy metals in the water samples from the Rio Doce could lead to the bioaccumulation of metals in the food chain, and possibly reach toxic levels in some organisms.

Available at
<http://twn.my/title2/resurgence/2015/303-304/eco2.htm>

08. What happened in Bento Rodrigues?

09. What damage did this disaster cause to the population and to the environment?

10. What could the future consequences of this disaster be?

