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# LIVING PLANET REPORT 2020

## BENDING THE CURVE OF BIODIVERSITY LOSS

## SUMMARY

**WWF**
WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

**Institute of Zoology (Zoological Society of London)**
Founded in 1826, ZSL (Zoological Society of London) is an international conservation charity working to create a world where wildlife thrives. ZSL's work is realised through ground-breaking science, field conservation around the world and engaging millions of people through two zoos, ZSL London Zoo and ZSL Whipsnade Zoo.

ZSL manages the Living Planet Index® in a collaborative partnership with WWF.

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*Farmer Nancy Rono with a chameleon on her sleeve, Bomet County, Mara River Upper Catchment, Kenya.*

# 8 BILLION REASONS TO SAFEGUARD NATURE

As the world reels from the deepest global disruption of a lifetime, this year's *Living Planet Report* provides unequivocal evidence that nature is unravelling and that our planet is flashing red warning signs. Humanity's destruction of nature is having catastrophic impacts not only on wildlife populations but also on human health and all aspects of our lives.

A deep cultural and systemic shift is urgently needed, one that so far our civilisation has failed to embrace: a transition to a society and economic system that values nature. We must rebalance our relationship with the planet to preserve the Earth's amazing diversity of life and enable a just, healthy and prosperous society – and ultimately to ensure our own survival.

Nature is declining globally at rates unprecedented in millions of years. The way we produce and consume food and energy, and the blatant disregard for the environment entrenched in our current economic model, has pushed the natural world to its limits. COVID-19 is a clear manifestation of our broken relationship with nature, and highlights the deep interconnection between the health of both people and the planet.

It is time we answer nature's SOS. Not just to secure the amazing diversity of life we love and have the moral duty to coexist with, but because ignoring it puts the future of nearly 8 billion people at stake.

A better future starts with the decisions that governments, companies and people around the world take today. World leaders must take urgent action to protect and restore nature as the foundation for a healthy society and a thriving economy.

It's time for the world to agree a New Deal for Nature and People, committing to stop and reverse the loss of nature by 2030 and build a carbon-neutral and nature-positive society. This is our best safeguard for human health and livelihoods in the long term, and to ensure a safe future for our children.


Marco Lambertini,
Director General
WWF International

# SETTING THE SCENE

Nature is essential for human existence and a good quality of life, providing and sustaining the air, freshwater and soils on which we all depend. It also regulates the climate, provides pollination and pest control and reduces the impact of natural hazards. While more food, energy and materials than ever before are being supplied to people in most parts of the world, the overexploitation of plants and animals is increasingly eroding nature's ability to provide them in the future.

In the last 50 years our world has been transformed by an explosion in global trade, consumption and human population growth, as well as an enormous move towards urbanisation. These underlying trends are driving the destruction and degradation of nature, with the world now overusing natural resources at an unprecedented rate. Only a handful of countries retain most of the last remaining wilderness areas. As a result, our natural world is transforming more rapidly than ever before.

The 2020 global Living Planet Index shows an average 68% fall in monitored populations of mammals, birds, amphibians, reptiles and fish between 1970 and 2016. Species' population trends are important because they are a measure of overall ecosystem health. Measuring biodiversity, the variety of all living things, is complex, and there is no single measure that can capture all the changes in this web of life. Nevertheless, the vast majority of indicators show net declines over recent decades.

Can we reverse these trends of decline? This was the question posed in 2017 by the Bending the Curve Initiative – a consortium of WWF and more than 40 universities, conservation organisations and intergovernmental organisations – in order to research and model pathways to bend the curve of biodiversity loss.

Now, this pioneering modelling has provided 'proof of concept' that we can halt and reverse terrestrial biodiversity loss from land-use change. With an unprecedented and immediate focus on both conservation and a transformation of our modern food system, this gives us a roadmap to restore biodiversity and feed a growing human population.

To do this will require strong leadership and action by us all. To complement the voices of the Bending the Curve Initiative we also asked thinkers and practitioners, both young and established, from different countries and cultures around the globe to share with us how they picture a healthy planet for people and nature. Their thoughts are brought together in a first-time special supplement to the *2020 Living Planet Report*, 'Voices for a Living Planet.'

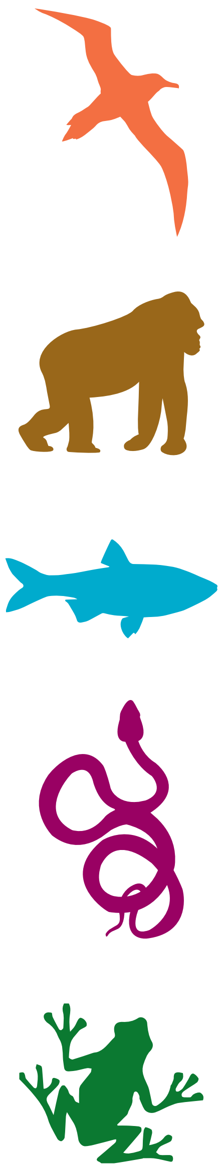
Recently, a series of catastrophic events – wildfires, locust plagues and the COVID-19 pandemic – have shaken the world's environmental conscience, showing that biodiversity conservation should be a non-negotiable and strategic investment to preserve our health, wealth and security. 2020 was billed as the 'super year' in which the international community, through an historic series of climate, biodiversity and sustainable development meetings, had great plans to take the reins of the Anthropocene – but, due to COVID-19, most of these conferences have been pushed into 2021.

The current state of our planet confirms that the world and its leaders should embrace a new global deal for people and nature that sets us on a path where both can thrive.

We know that this WWF *2020 Living Planet Report* is being published at a challenging time. As the world inevitably enters a period of greater turbulence, volatility and change, we have brought together information and knowledge that we hope will inspire action to address the critical global ecological, social and economic challenges of our time.

# AN SOS FOR NATURE

## Biodiversity as we know it today is fundamental to human life on Earth, and the evidence is unequivocal – it is being destroyed by us at a rate unprecedented in history [12].



Since the industrial revolution, human activities have increasingly destroyed and degraded forests, grasslands, wetlands and other important ecosystems, threatening human well-being. Seventy-five per cent of the Earth's ice-free land surface has already been significantly altered, most of the oceans are polluted, and more than 85% of the area of wetlands has been lost.

The most important direct driver of biodiversity loss in terrestrial systems in the last several decades has been land-use change, primarily the conversion of pristine native habitats into agricultural systems; while much of the oceans have been overfished. Globally, climate change has not been the most important driver of the loss of biodiversity to date, yet in coming decades it is projected to become as, or more, important than the other drivers.

The loss of biodiversity is not only an environmental issue but a development, economic, global security, ethical and moral one. It is also a self-preservation issue. Biodiversity plays a critical role in providing food, fibre, water, energy, medicines and other genetic materials; and is key to the regulation of our climate, water quality, pollution, pollination services, flood control and storm surges. In addition, nature underpins all dimensions of human health and contributes on non-material levels – inspiration and learning, physical and psychological experiences and shaping our identities – that are central in quality of life and cultural integrity.

# At a population level: in 2020 what does the Living Planet Index show?

## Species' population trends are important because they are a measure of overall ecosystem health. Serious declines are a proxy for the unravelling of nature.

The Living Planet Index (LPI) now tracks the abundance of almost 21,000 populations of mammals, birds, fish, reptiles and amphibians around the world. The building blocks for this indicator are wildlife population datasets. These population trends are brought together in the LPI to calculate the average percentage change in population sizes since 1970 using an index (Figure 1). This year's index includes almost 400 new species and 4,870 new populations.

Since the last Living Planet Index was released in 2018, the number of species represented has improved for the majority of regions and taxonomic groups, with the biggest boost being to amphibian species. At present the LPI contains data only for vertebrate species as, historically, these have been better monitored; but efforts to incorporate data on invertebrates are underway as we try to broaden our understanding of changes in wildlife populations.

The 2020 global Living Planet Index shows an average 68% (range: -73% to -62%) fall in monitored populations of mammals, birds, amphibians, reptiles and fish between 1970 and 2016 [1].

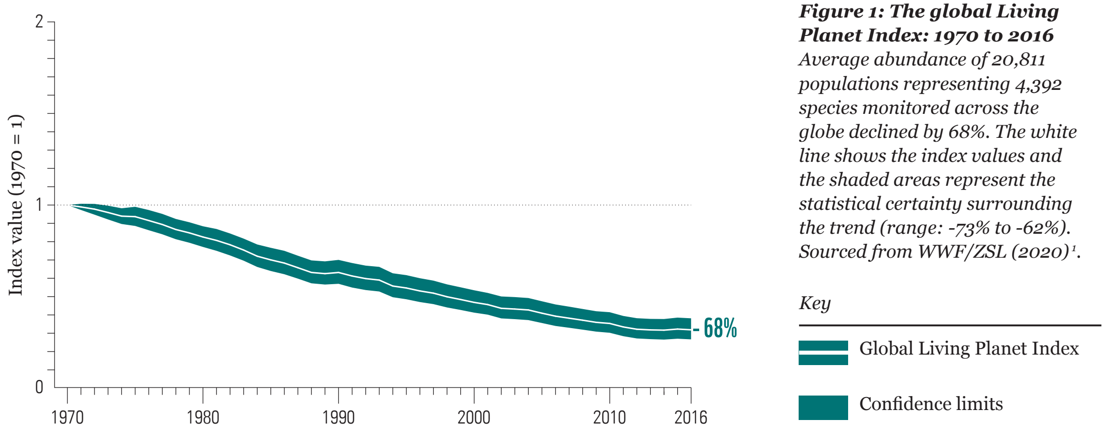



***Figure 1: The global Living Planet Index: 1970 to 2016***
*Average abundance of 20,811 populations representing 4,392 species monitored across the globe declined by 68%. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (range: -73% to -62%). Sourced from WWF/ZSL (2020)[1].*

# Biodiversity is declining at different rates in different places

The global LPI does not give us the entire picture – there are differences in abundance trends between regions, with the largest declines in tropical areas.

The 94% decline in the LPI for the tropical subregions of the Americas is the most striking result observed in any region. The conversion of grasslands, savannahs, forests and wetlands, the overexploitation of species, climate change, and the introduction of alien species are key drivers.

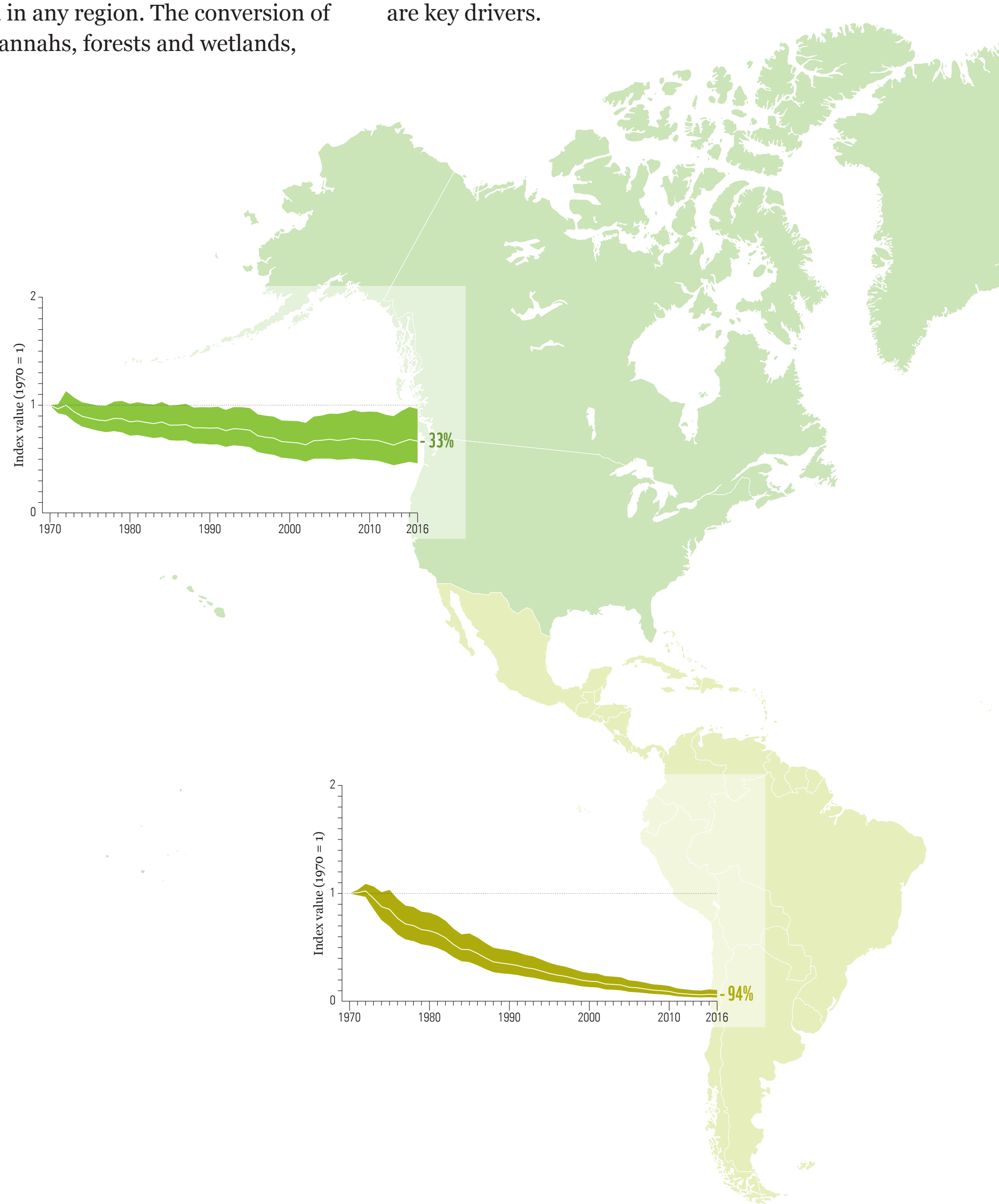
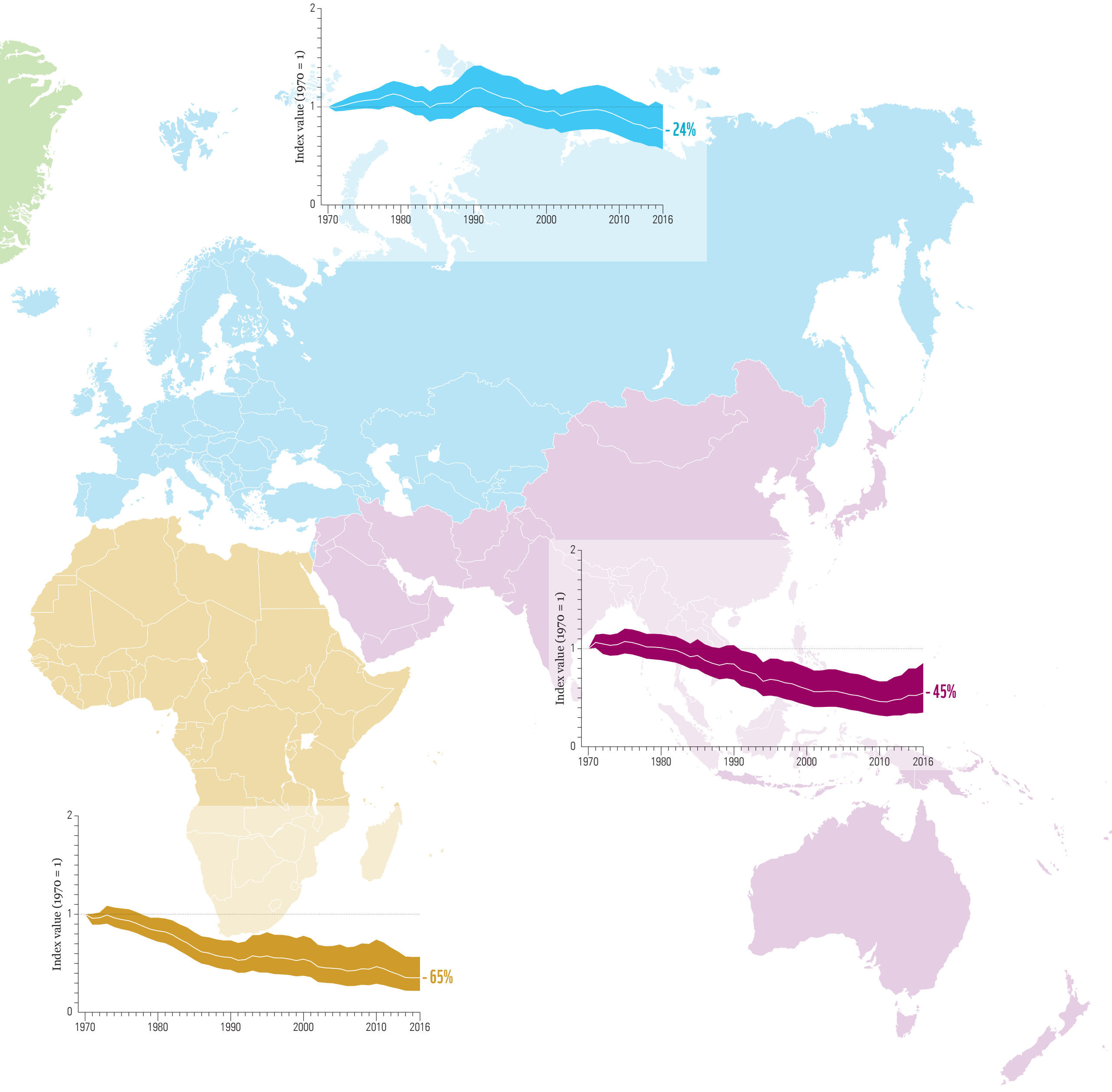


***Figure 2: The Living Planet Index for each IPBES region***
*The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (95%). All indices are weighted by species richness, giving species-rich taxonomic groups in terrestrial and freshwater systems more weight than groups with fewer species. Regions map: IPBES (2015)[2]. LPI data WWF/ZSL (2020)[1].*



# The Freshwater Living Planet Index

Freshwater biodiversity is declining far faster than that in our oceans or forests. Based on available data, we know that almost 90% of global wetlands have been lost since 1700 [83]; and global mapping has recently revealed the extent to which humans have altered millions of kilometres of rivers [84]. These changes have had a profound impact on freshwater biodiversity with population trends for monitored freshwater species falling steeply.

The 3,741 monitored populations – representing 944 species of mammals, birds, amphibians, reptiles and fishes – in the Freshwater Living Planet Index have declined by an average of 84% (range: -89% to -77%), equivalent to 4% per year since 1970 (Figure 3). Most of the declines are seen in freshwater amphibians, reptiles and fishes; and they're recorded across all regions, particularly Latin America and the Caribbean.

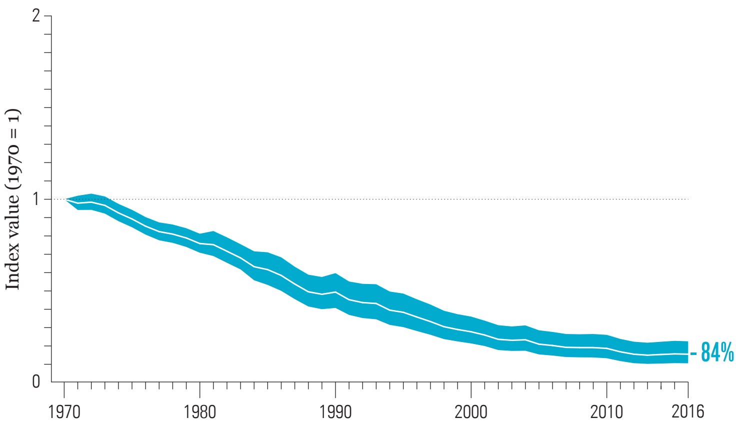



***Figure 3: The Freshwater Living Planet Index: 1970 to 2016***
*The average abundance of 3,741 freshwater populations, representing 944 species monitored across the globe, declined by 84% on average. The white line shows the index values and the shaded areas represent the statistical certainty surrounding the trend (range -89% to -77%). Sourced from WWF/ZSL (2020)[1].*

*Key*

Freshwater Living Planet Index

Confidence limits

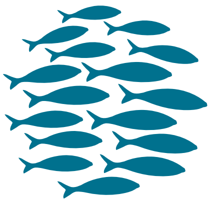
## The bigger the size, the bigger the threats

Species with a larger body size compared with other species in the same taxonomic group are sometimes referred to as 'megafauna'. In the freshwater system, megafauna are species that grow to more than 30kg, such as sturgeon and Mekong giant catfish, river dolphins, otters, beavers and hippos. They are subject to intense anthropogenic threats [3], including overexploitation [4], and strong population declines have been observed as a result [5]. Mega-fishes are particularly vulnerable. Catches in the Mekong river basin between 2000 and 2015, for example, have decreased for 78% of species, and declines are stronger among medium- to large-bodied species [6]. Large fishes are also heavily impacted by dam construction, which blocks their migratory routes to spawning and feeding grounds [7, 3].

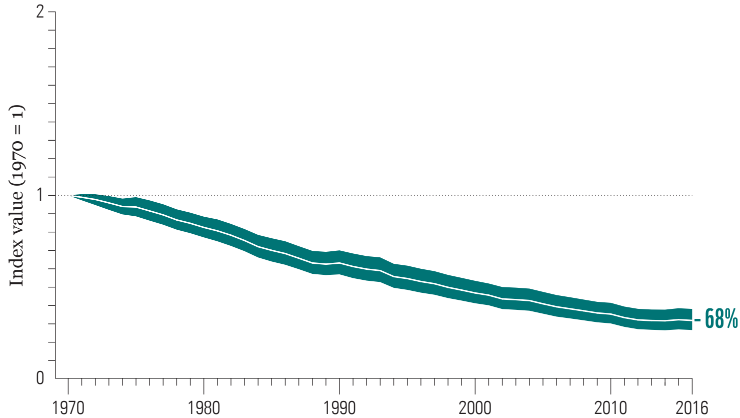
Photo right page:
A young Florida manatee (*Trichechus manatus latirostrus*) stays warm in a freshwater spring in winter, Three Sisters Spring, Florida, USA.


© naturepl.com / Alex Mustard / WWF

# The Living Planet Index is one indicator among many showing severe declines in recent decades

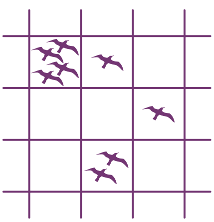


ABUNDANCE

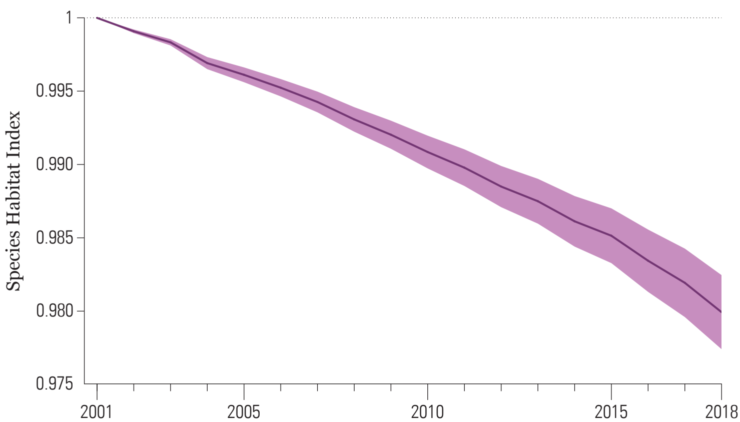



## Living Planet Index

*The Living Planet Index (LPI) now tracks the abundance of almost 21,000 populations of mammals, birds, fish, reptiles and amphibians around the world[1]. Using the data from 20,811 populations of 4,392 species, the 2020 global LPI shows an average 68% decline in monitored populations between 1970 and 2016 (range: -73% to -62%). The percentage change in the index doesn't represent the number of individual animals lost but reflects the average proportional change in animal population sizes tracked over 46 years.*



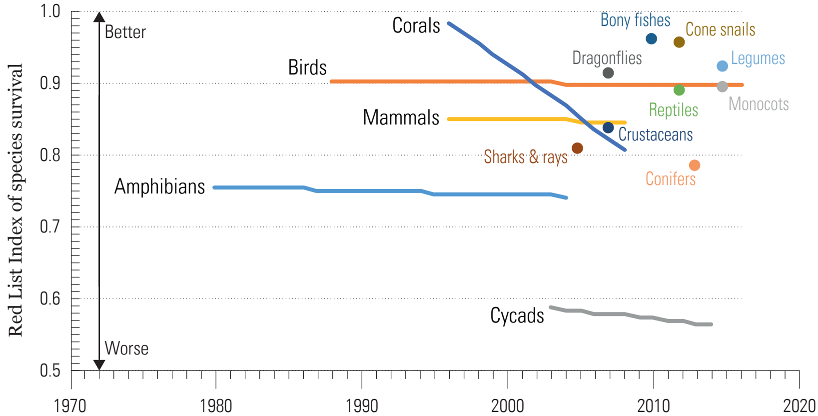
DISTRIBUTION




## Species Habitat Index

*Human land-use change, and increasingly climate change, are altering landscapes worldwide. Remotely sensed monitoring and model-based projections offer an increasingly strong and near-global capture of these changes to the land cover. The Species Habitat Index (SHI) quantifies the resulting implications for species populations[8,9]. For thousands of species with validated habitat associations worldwide the index measures the losses in habitat-suitable range from observed or modelled habitat change[10]. Between 2000 and 2018 the index has fallen by 2%, indicating a strong and general downward trend in habitat available to species. For select regions and species the SHI decrease is much steeper, with double-digit percentage losses suggesting extensive contractions in total population sizes and thus the ecological roles provided by species.*

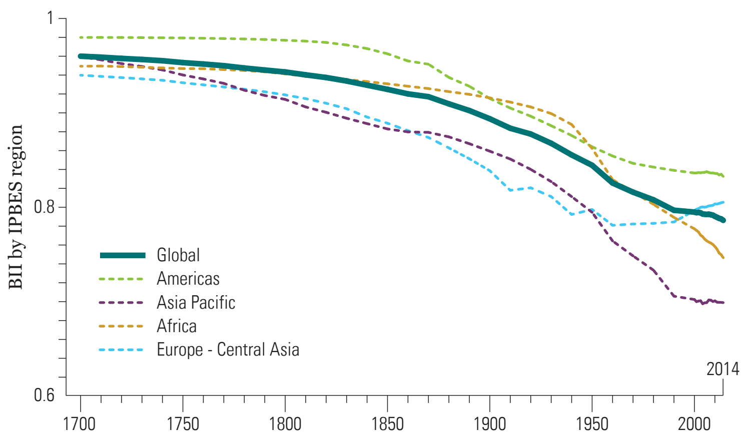
Humanity's influence on the decline of nature is so great that scientists believe we are entering a new geological epoch, the Anthropocene. Yet, measuring biodiversity, the variety of all living things, is complex, and there is no single measure that can capture all of the changes in this web of life. The vast majority of indicators show net declines over recent decades.




EXTINCTION RISK

## Red List Index

*The Red List Index (RLI), based on data from the IUCN Red List of Threatened Species [85], shows trends in survival probability (the inverse of extinction risk) over time [86]. A Red List Index value of 1.0 equates to all species within a group qualifying as Least Concern (i.e. not expected to become Extinct in the near future). An index value of 0 equates to all species having gone Extinct. A constant value over time indicates that the overall extinction risk for the group is unchanged. If the rate of biodiversity loss were reducing, the index would show an upward trend. A decline in the index means that species are being driven towards extinction at an accelerating rate.*




COMPOSITION

## Biodiversity Intactness Index

*The Biodiversity Intactness Index (BII) estimates how much originally present biodiversity remains on average across the terrestrial ecological communities within a region. It focuses on the effects of land use and related pressures, which have so far been the dominant drivers of biodiversity loss [11, 12]. Because it is estimated across a very large set of ecologically diverse animal and plant species, the BII is a useful index of ecosystems' ability to provide benefits to people (ecosystem services). For this reason, it is used in the Planetary Boundaries framework as an indicator of biosphere integrity [13]. The global average BII (79%) is well below the proposed lower safe limit (90%) and continues to fall, especially in Africa [14], suggesting that the world's terrestrial biodiversity is already dangerously compromised. The BII is very low in some regions, such as Western Europe, that have a long history of intensive use of the landscape.*

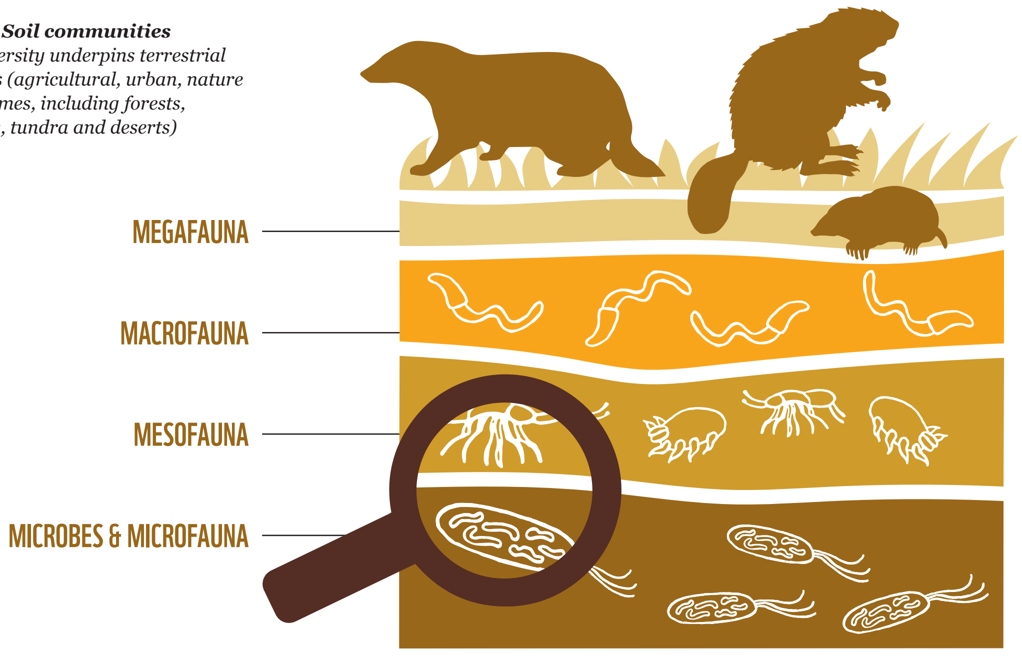
# Soil biodiversity: saving the world beneath our feet

Soil is a critical component of the natural environment – yet most people are totally unaware of, or underestimate, the vital role that soil biodiversity plays in the ecosystem services on which we depend.

Soil hosts one of the largest reservoirs of biodiversity on Earth: up to 90% of living organisms in terrestrial ecosystems, including some pollinators, spend part of their life cycle in soil habitats [75]. The variety of soil components, filled with air and water, create an incredible diversity of habitats for a myriad of different soil organisms that underpin our life on this planet.

Without soil biodiversity, terrestrial ecosystems may collapse. We now know that above- and belowground biodiversity are in constant collaboration [15-17], and an improved understanding of this relationship will help to better predict the consequences of biodiversity change and loss.

***Figure 4: Soil communities***
*Soil biodiversity underpins terrestrial ecosystems (agricultural, urban, nature and all biomes, including forests, grasslands, tundra and deserts)*



# Are "the little things that run the world" disappearing?

## There is evidence of recent, rapid declines in insect abundance, diversity and biomass, but the picture is complex and most evidence comes from a few taxa and a few countries in the northern hemisphere.

E.O. Wilson famously described them as "the little things that run the world"[18] and in Western Europe and North America, insect monitoring schemes and long-term studies show startlingly rapid, recent and ongoing declines in insect numbers, distributions or collective weight (biomass). Given that the spread of intensive agriculture occurred earlier in Western Europe and North America than in other regions[19], it seems likely that the insect losses being observed there provide a forecast of global insect losses if anthropogenic disturbance and land-use change continue worldwide. Initiating long-term and large scale monitoring is key to understanding current and future levels of insect population change.

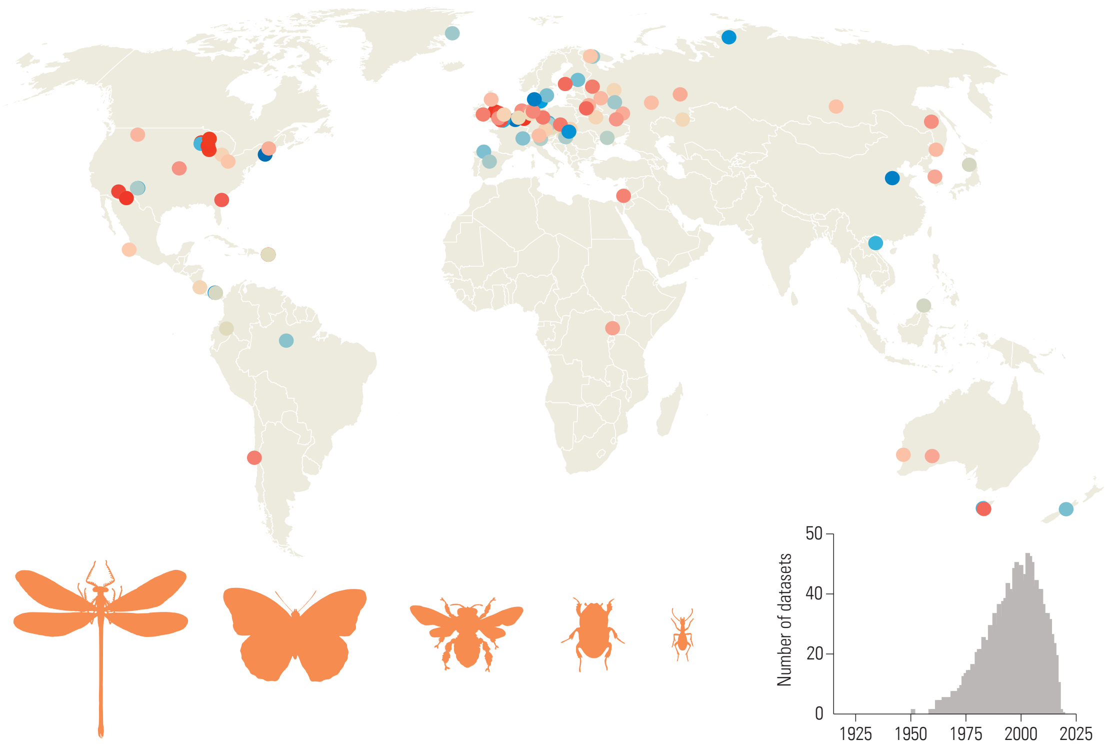




***Figure 5: Estimates of long-term change in terrestrial insect numbers (abundance or biomass),*** *from 103 studies reviewed by Van Klink et al (2020)[77]. Three-quarters of the studies (77/103) are from Europe and North America, with very few from Africa (1), Asia (5, excluding Russia and the Middle East) or South America (3). The inset shows a histogram of the number of datasets with at least one data point for each year.*

# Plant diversity is in serious decline

Plants are the structural and ecological foundation of virtually all terrestrial ecosystems and provide fundamental support for life on Earth. They are vital to human health, food and well-being [20].

*Nymphaea thermarum*, the world's smallest waterlily, known only from the damp mud created by the overflow from a single hot spring in Rwanda. The last plant desiccated and died when the stream feeding the hot spring was diverted for local agriculture in 2008. An *ex situ* collection is being maintained at the Royal Botanic Gardens Kew: in the hope of a possible reintroduction if this fragile habitat can be restored.



Plant diversity loss not only threatens plants and their ecosystems, but also the invaluable spectrum of services that plants provide to people and the planet.

Arabica coffee (*Coffea arabica*) is the world's most popular coffee bean. An extinction risk assessment which incorporated the likely effects of climate change categorised *C. arabica* as Endangered, with a predicted loss of more than half its natural population by 2088 [23].

Plant extinction risk is comparable to that of mammals and higher than for birds. The number of documented plant extinctions is twice as many as for mammals, birds and amphibians combined [21]. In addition, an assessment of a sample of thousands of species representing the taxonomic and geographic breadth of global plant diversity showed that one in five (22%) are threatened with extinction, most of them in the tropics [22].


The first Global Tree Assessment will cover all 60,000 known tree species across the planet to give us a complete picture of the conservation status of the world's trees [24]. Beyond trees, the results will also be vital for other biodiversity and ecosystems that depend on trees for their survival, to guide conservation action and ensure that biodiversity is managed, restored and saved from extinction.

*Terminalia acuminata*, commonly known as Guarajuba, is an Endangered tree endemic to Brazil. Previously thought to be Extinct in the Wild, it was rediscovered when reassessed for the Global Tree Assessment.


Seed banks worldwide hold around 7 million crop samples, helping to safeguard biodiversity and global nutritional security. In the past few decades hundreds of local, national, regional and international seed banks have been established. Perhaps the most well-known, the Svalbard Global Seed Vault in Norway, provides a back-up service for when things go wrong in other seed banks. Seed banks are used by researchers and plant breeders to develop new, improved crop varieties.

A view of the front of the Svalbard Global Seed Vault, Svalbard archipelago, Norway.

# OUR WORLD IN 2020

## In the last 50 years our world has been transformed by an explosion in global trade, consumption and human population growth, as well as an enormous move towards urbanisation, changing how we live unrecognisably. Yet this has come at a huge cost to nature and the stability of the Earth's operating systems that sustain us.

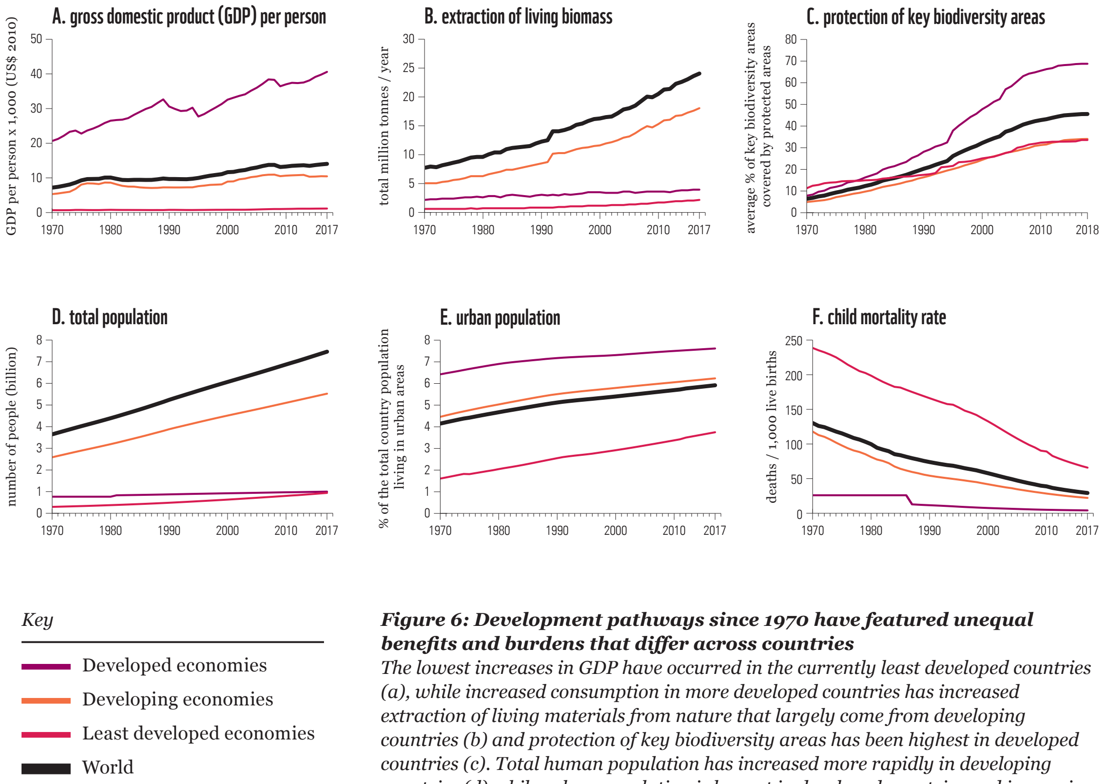



***Figure 6: Development pathways since 1970 have featured unequal benefits and burdens that differ across countries***
*The lowest increases in GDP have occurred in the currently least developed countries (a), while increased consumption in more developed countries has increased extraction of living materials from nature that largely come from developing countries (b) and protection of key biodiversity areas has been highest in developed countries (c). Total human population has increased more rapidly in developing countries (d) while urban population is largest in developed countries and increasing fastest in least developed countries (e). Child mortality has sharply decreased globally, though challenges remain for least developed countries (f).*
*Sources: modified from World Bank (2018)[27], IPBES (2019)[26].*

This collection of red plastic is just a small selection of the plastic pollutants collected by the Rame Peninsula Beach Care Group in Whitsand Bay, Cornwall.

© Sam Hobson / WWF-UK

# Humanity now overspends its biological budget every year

Since 1970, our Ecological Footprint has exceeded the Earth's rate of regeneration. This overshoot erodes the planet's health and, with it, humanity's prospects. Both human demand and natural resources are unevenly distributed across the Earth. The pattern of human consumption of these resources differs from resource availability, since resources are not consumed at the point of extraction. The Ecological Footprint per person, across countries, provides insights into countries' resource performance, risks and opportunities[28-30].

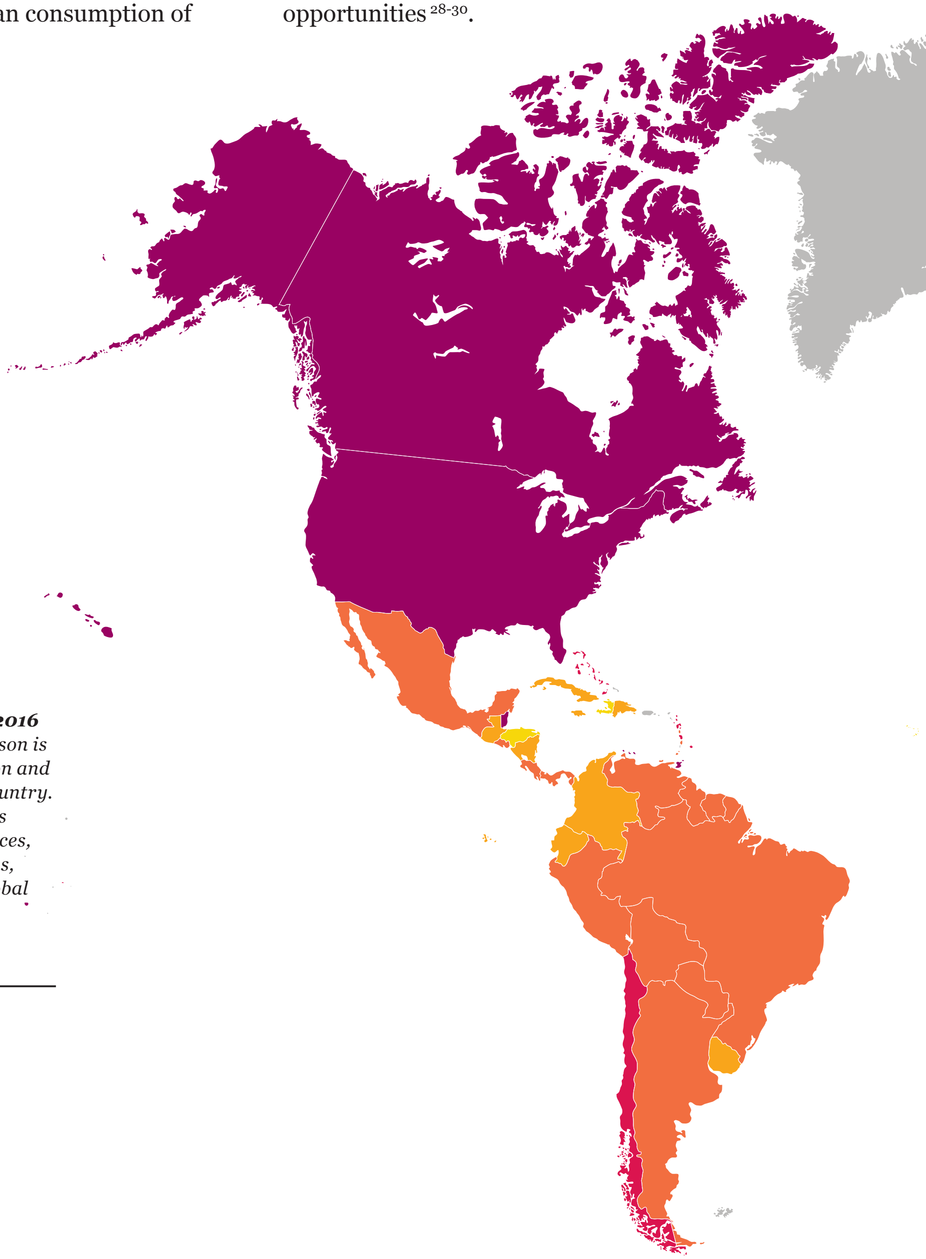
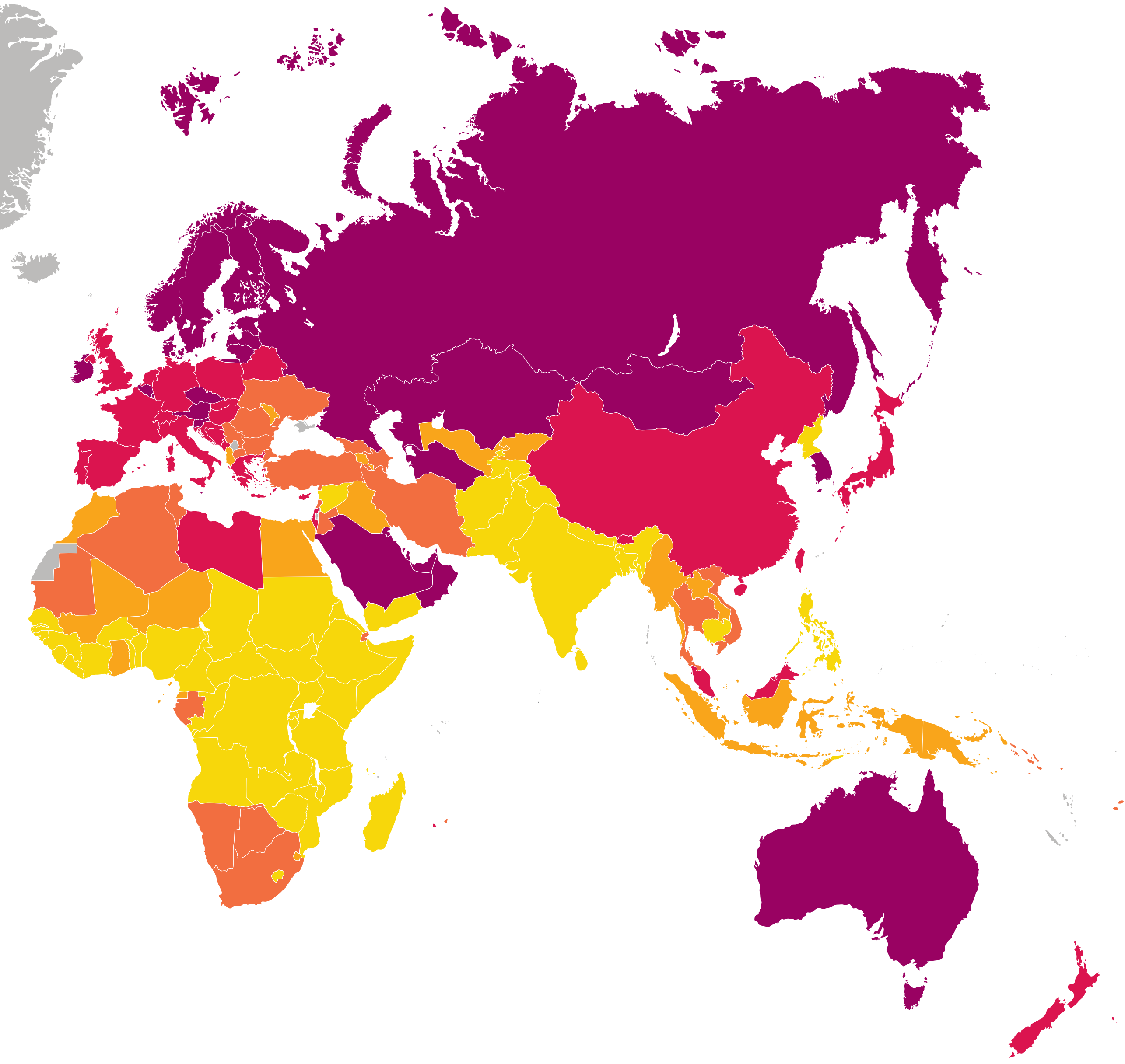


***Figure 7: Global map of the Ecological Footprint of consumption per person in 2016***
*The Ecological Footprint per person is a function of both total population and rates of consumption within a country. A country's consumption includes the Ecological Footprint it produces, plus imports from other countries, minus exports. Sourced from Global Footprint Network (2020)[31].*

*Key*

- > 5 gha/person
- 3.5 - 5 gha/person
- 2 - 3.5 gha/person
- 1.6 - 2 gha/person
- < 1.6 gha/person
- Insufficient data

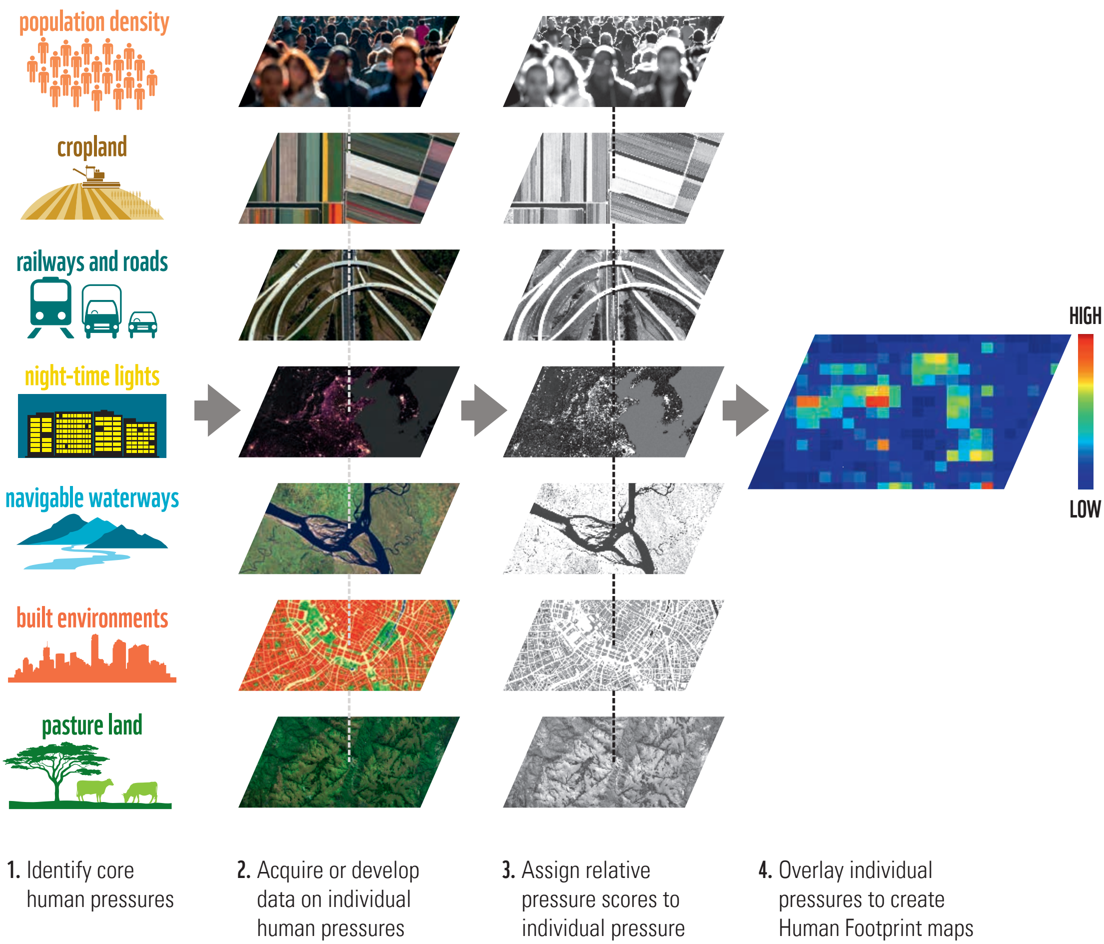
Varying levels of Ecological Footprint are due to different lifestyles and consumption patterns, including the quantity of food, goods and services residents consume, the natural resources they use, and the carbon dioxide emitted to provide these goods and services.



# Mapping the last wilderness areas on Earth

Advances in satellite technology allow us to visualise how the Earth is changing in real time. Human footprint mapping then shows where we are and aren't impacting land on Earth. The latest map

***Figure 8:***
*The broad methodological framework used to create a map of cumulative human pressure – adapted from Watson and Venter (2019)*[33].

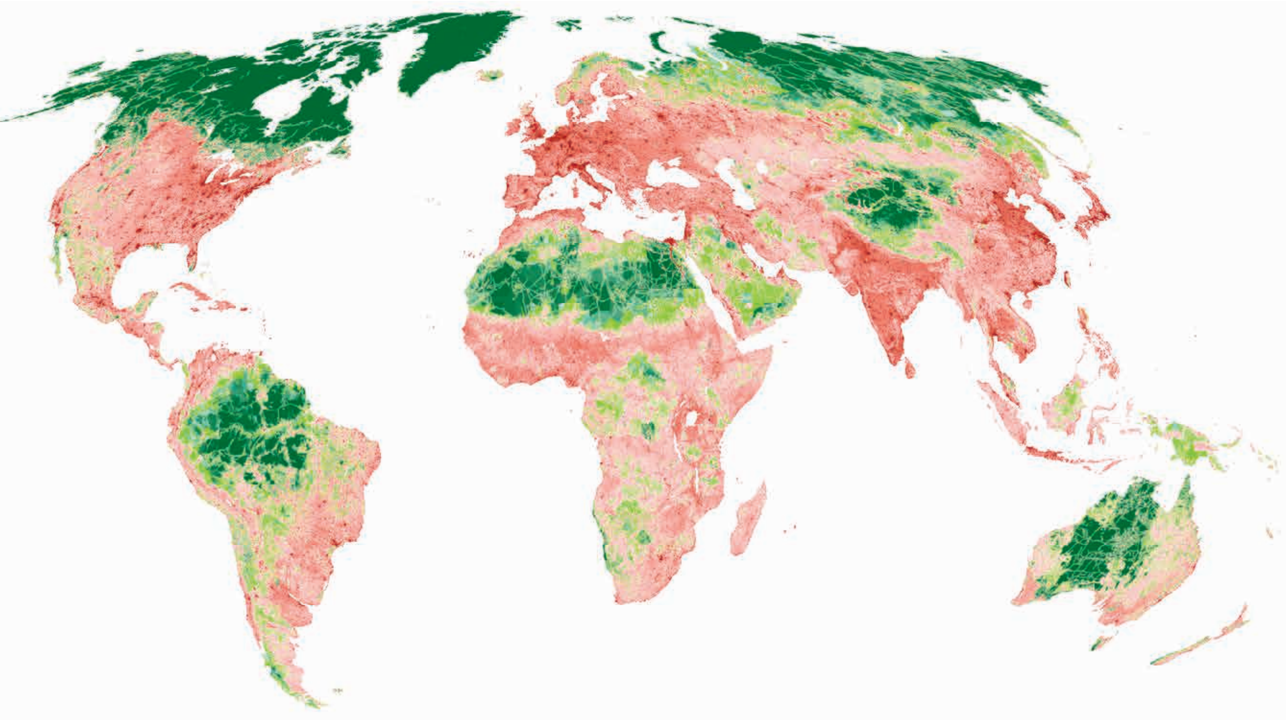


reveals that just a handful of countries – Russia, Canada, Brazil and Australia – contain most of the places without a human footprint, the last remaining terrestrial wilderness areas on our planet [32].

*Key*

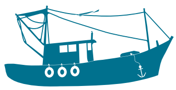
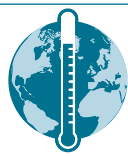
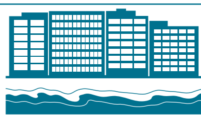
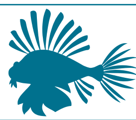
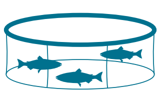
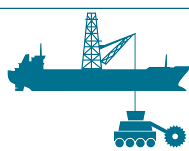
| Damaged | Intact | Wilderness |
| --- | --- | --- |
| High: 50 | High: 1 | High: 0 |
| Low: 4 | Low: 4 | Low: 1 |

***Figure 9:***
*The proportion of each terrestrial biome (excluding Antarctica) considered wilderness (dark green, human footprint value of <1), intact (light green, human footprint value of <4), or highly modified by humanity (red, human footprint value of > or equal to 4). Adapted from Williams et al. (2020)* [32].



# Our ocean is in 'hot water'

Overfishing, pollution and coastal development, among other pressures, have impacted the entire ocean, from

| DRIVER OF CHANGE | | POTENTIAL NEGATIVE IMPACTS |
|---|---|---|
| **Fishing** |  | Overexploitation, bycatch of non-target species, seafloor habitat destruction from seafloor trawling, illegal, unregulated, and unreported (IUU) fishing, gathering of organisms for the aquarium trade. |
| **Climate change** |  | Warming waters, ocean acidification, increased oxygen minimum zones, more frequent extreme events, change in ocean currents. |
| **Land-based pollution** |  | Nutrient run-off, contaminants such as heavy metals, micro- and macro-plastics. |
| **Ocean-based pollution** |   | Waste disposal, fuel leaks and dumping from ships, oil spills from offshore platforms, noise pollution. |
| **Coastal development** |  | Destruction of habitats, increased pressure on local shorelines, increased pollution and waste. |
| **Invasive alien species** |  | Invasive species accidentally (e.g. through ballast water) or deliberately introduced; more climate-driven invasions likely. |
| **Offshore infrastructure** |  | Physical disturbance of the seafloor, creation of habitat structure. |
| **Shipping** |  | Vessel strikes, pollution from dumping. |
| **Mariculture** (aquaculture of marine organisms) |  | Physical presence of aquaculture facilities, pollution. |
| **Deep-sea mining** |  | Seafloor destruction, settlement plumes on seabed, potential for leakages and chemical spills, noise pollution. |

shallow waters to the deep sea, and climate change will continue to cause a growing spectrum of effects across marine ecosystems.

## EXAMPLES OF ECOLOGICAL CONSEQUENCES

Reduced population sizes, ecosystem restructuring and trophic cascades, reductions in body size, local and commercial extinction of species, 'ghost-fishing' due to lost or dumped fishing gear.

Reef die-off through bleaching, species moving away from warming waters, changes in ecological interactions and metabolism, changes in interactions with human activities (e.g. fishing, vessel strikes) as organisms alter their location and space use, changes in ocean circulation patterns and productivity, changes in disease incidence and the timing of biological processes.

Algal blooms and fish kills, accumulation of toxins up the food web, ingestion of and entanglement in plastic and other debris.

Toxic impacts on marine organismal physiology, noise pollution impacts on marine animal behaviour.

Reduction in area of habitats such as mangroves and seagrasses, limits the ability of coastal habitats and organisms to shift and migrate to adapt to climate change.

Invasive species can outcompete native species, disrupt ecosystems and cause local or global extinctions.

Local seafloor habitat destruction, provision of structures for organisms to colonise and aggregate around.

Impacts on population sizes of endangered marine mammals hit by vessels, physiological and physical impacts of pollution.

Potential for nutrient build-up and algal blooms, disease, antibiotic use, escape of captive organisms and impacts on local ecosystem, indirect impact of capture fisheries to source fishmeal as foodstuff.

Destruction of physical habitat (e.g. cold-water corals) and benthic layer, potential smothering of organisms by settlement plumes.

***Figure 10:***
*Anthropogenic drivers of change in marine ecosystems, types of negative impact that can arise from them, and examples of potential ecological consequences. It is important to recognise that negative impacts can be mitigated and must be weighed against societal benefits in some cases. For deep-sea mining, impacts are projected since it is not yet applied at scale. Note that impacts for individual drivers can vary from very local to global scales. Sourced from IPBES (2019)[26] and references therein.*

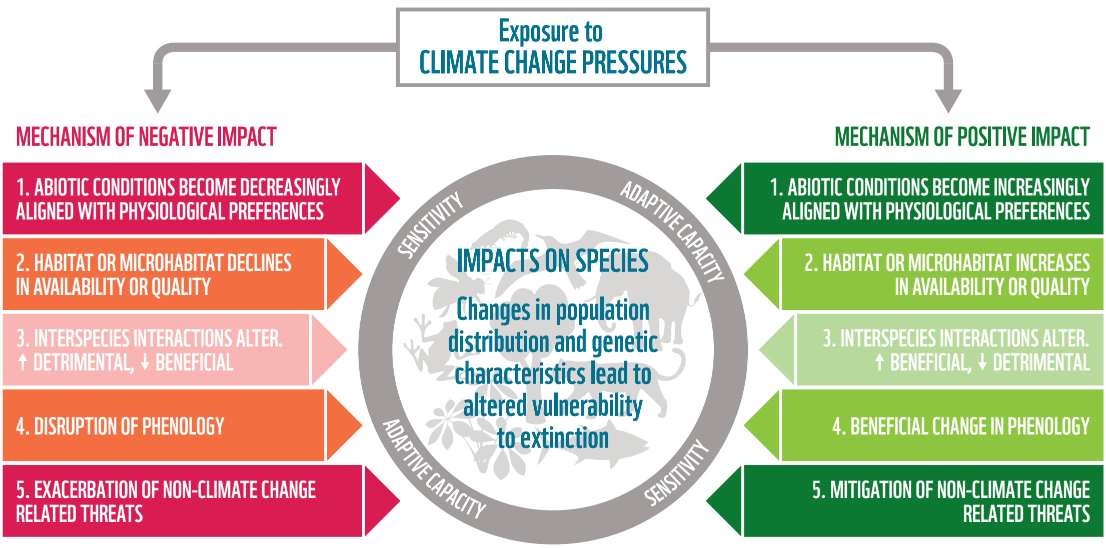
# CLIMATE CHANGE RISKS TO BIODIVERSITY

Up to one-fifth of wild species are at risk of extinction this century due to climate change alone, even with significant mitigation efforts, with some of the highest rates of loss anticipated in biodiversity 'hotspots'.

Just 30 years ago, climate change impacts on species were extremely rare, but today they are commonplace. Some species are relatively buffered from changes (e.g. deep-sea fishes), but others (e.g. Arctic and tundra species) already face enormous climate change pressures. Such pressures impact species through various mechanisms including direct physiological stress, loss of suitable habitat, disruptions of interspecies interactions (such as pollination or interactions between predators and prey), and the timing of key life events (such as migration, breeding or leaf emergence) (Figure 11)[34].

Recent climate change impacts on flying foxes and the Bramble Cay melomys show how quickly climate change can lead to drastic population declines, and warn of unseen damage to less conspicuous species (see boxes).

***Figure 11: Species exposed to climate change pressures may be impacted through five mechanisms, in positive, negative or combined ways***
*Each species' sensitivity and adaptive capacity to these impacts is influenced by its unique biological traits and life history. Together, these pressures, mechanisms, sensitivities and adaptive capacity affect each species' vulnerability to extinction (Figure adapted from Foden et al. (2018)[34]).*



# The first mammal extinction from climate change


The Bramble Cay melomys (*Melomys rubicola*), the first mammal to become extinct as a direct result of climate change, Bramble Cay, Torres Strait Islands, Australia.

The Bramble Cay melomys, *Melomys rubicola*, made headlines in 2016 when it was declared extinct following intensive surveys of the 5-hectare coral cay in Australia's Torres Strait where the species lived. It is the first known mammal extinction to be linked directly to climate change [35]. This rodent has been lost. It will, however, remain immortalised as a stark reminder that the time to act on climate change is now [36].

# Temperatures rise, bats fall


A spectacled flying fox (*Pteropus conspicillatus*) colony leaving roost at sunset, Australia. Flying foxes roost en masse, making detection of population-level impacts of extreme events easier than for solitary species.

Flying foxes (genus *Pteropus*) are not physiologically capable of tolerating temperatures above 42°C [37]. At these temperatures, their usual coping behaviours – such as shade-seeking, hyperventilation and spreading saliva on their bodies (they can't sweat) – are insufficient to keep them cool, and they begin to clump together in a frenzy to escape the heat. As they drop from the trees, many are injured or become trapped and die. Between 1994 and 2007, more than 30,000 flying foxes from at least two species, from a global population of less than 100,000, are thought to have died during heatwaves [37, 38].

# STRETCHING OUR SAFETY NET ALMOST TO BREAKING POINT

## People value nature in many different ways, and bringing these together can be used to shape policies that will create a healthy and resilient planet for people and nature.

Nature's contributions to People refers to all the contributions, both positive and negative that nature makes to people's quality of life[40]. The Nature's Contributions to People concept includes a wide range of descriptions of human dependence on nature, such as ecosystem goods and services, nature's gifts, and many others. It recognizes the central role that culture plays in defining all links between people and nature. It also elevates, emphasises and operationalises the role of indigenous and local knowledge[40,26]. This table represents the global trends for some of these contributions from 1970 to the present day and it was included in the IPBES Summary for Policy Makers[26].

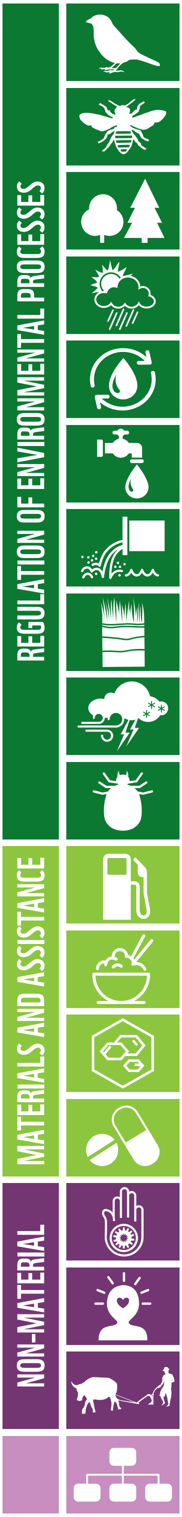
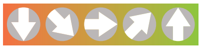



***Figure 12:*** *Global trends from 1970 to the present of the 18 categories of Nature's Contributions to People: 14 of the 18 categories analysed have declined since 1970 (Figure adapted from Díaz et al. (2019)[11], IPBES (2019)[26]).*

*Key*

**Global trends**

Decrease  Increase

**Levels of certainty**

- Well established
- Established but incomplete
- Unresolved

| NATURE'S CONTRIBUTION TO PEOPLE | 50-YEAR GLOBAL TREND | SELECTED INDICATOR |
|---|---|---|
| HABITAT CREATION AND MAINTENANCE | ↓<br>↓ | • Extent of suitable habitat<br>• Biodiversity intactness |
| POLLINATION AND DISPERSAL OF SEEDS AND OTHER PROPAGULES | ↓<br>↓ | • Pollinator diversity<br>• Extent of natural habitat in agricultural areas |
| REGULATION OF AIR QUALITY | ↘ | • Retention and prevented emissions of air pollutants by ecosystems |
| REGULATION OF CLIMATE | ↘ | • Prevented emissions and uptake of greenhouse gases by ecosystems |
| REGULATION OF OCEAN ACIDIFICATION | → | • Capacity to sequester carbon by marine and terrestrial environments |
| REGULATION OF FRESHWATER QUANTITY, LOCATION AND TIMING | ↘ | • Ecosystem impact on air-surface-ground water partitioning |
| REGULATION OF FRESHWATER AND COASTAL WATER QUALITY | ↘ | • Extent of ecosystems that filter or add constituent components to water |
| FORMATION, PROTECTION AND DECONTAMINATION OF SOILS AND SEDIMENTS | ↘ | • Soil organic carbon |
| REGULATION OF HAZARDS AND EXTREME EVENTS | ↘ | • Ability of ecosystems to absorb and buffer hazards |
| REGULATION OF DETRIMENTAL ORGANISMS AND BIOLOGICAL PROCESSES | ↓<br>↘ | • Extent of natural habitat in agricultural areas<br>• Diversity of competent hosts of vector-borne diseases |
| ENERGY | ↗<br>↘ | • Extent of agricultural land – potential land for bioenergy production<br>• Extent of forested land |
| FOOD AND FEED | ↗<br>↓ | • Extent of agricultural land – potential land for food and feed production<br>• Abundance of marine fish stocks |
| MATERIALS AND ASSISTANCE | ↗<br>↘ | • Extent of agricultural land – potential land for material production<br>• Extent of forested land |
| MEDICINAL, BIOCHEMICAL AND GENETIC RESOURCES | ↘<br>↓ | • Fraction of species locally known and used medicinally<br>• Phylogenetic diversity |
| LEARNING AND INSPIRATION | ↓<br>↓ | • Number of people in close proximity to nature<br>• Diversity of life from which to learn |
| PHYSICAL AND PSYCHOLOGICAL EXPERIENCES | ↘ | • Area of natural and traditional landscapes and seascapes |
| SUPPORTING IDENTITIES | ↘ | • Stability of land use and land cover |
| MAINTENANCE OF OPTIONS | ↓<br>↓ | • Species' survival probability<br>• Phylogenetic diversity |

# Intrinsically interlinked: healthy planet, healthy people

The past century has seen extraordinary gains in human health and well-being. Child mortality among under-5s has halved since 1990[42], the share of the world's population living on less than $1.90 a day fell by two-thirds over the same period[43], and life expectancy at birth is around 15 years higher today than it was 50 years ago[44]. This is rightly celebrated, but it has been achieved alongside the exploitation and alteration of the world's natural systems, which threatens to undo these successes.

The links between **BIODIVERSITY** and **HEALTH** are diverse, from traditional medicines and pharmaceuticals derived from plants to water filtration by wetlands[26, 47, 48].

**HEALTH** is *"A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. The enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic or social condition."* The World Health Organization, WHO (1948)[45].

**BIODIVERSITY** is *"The fruit of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans. It forms the web of life of which we are an integral part and upon which we so fully depend. It also encompasses the variety of ecosystems such as those that occur in deserts, forests, wetlands, mountains, lakes, rivers, and agricultural landscapes. In each ecosystem, living creatures, including humans, form a community, interacting with one another and with the air, water, and soil around them."* The Convention on Biological Diversity, CBD (2020)[46].

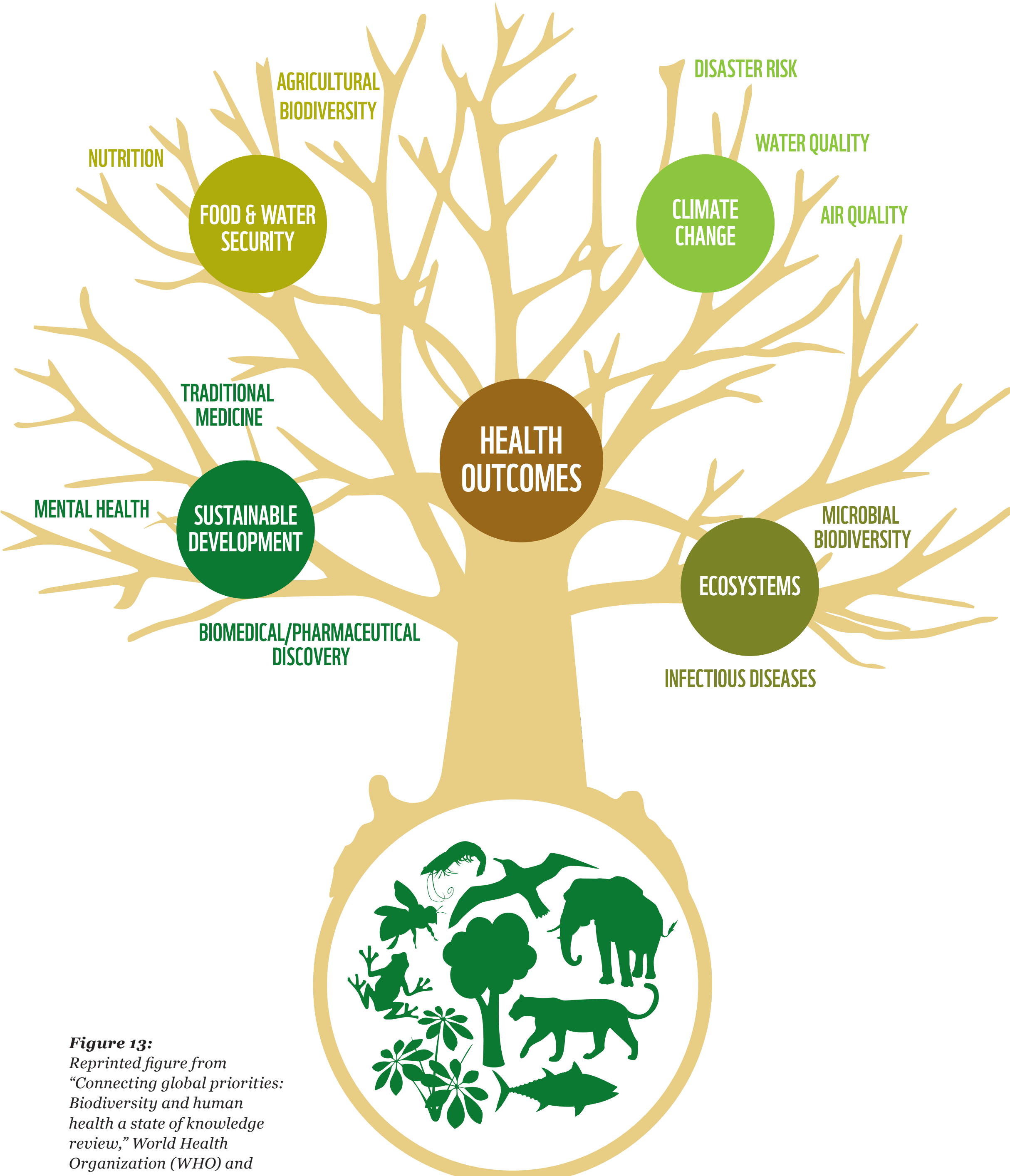



***Figure 13:***
*Reprinted figure from "Connecting global priorities: Biodiversity and human health a state of knowledge review," World Health Organization (WHO) and Secretariat of the Convention on Biological Diversity (CBD), Copyright (2015)*[49]

# Human wealth depends on nature's health

## Our economies are embedded within nature, and it is only by recognising and acting on this reality that we can protect and enhance biodiversity and improve our economic prosperity.

COVID-19 is nature sending us a message. In fact, it reads like an SOS signal for the human enterprise, bringing into sharp focus the need to live within the planet's 'safe operating space'. The environmental, health and economic consequences of failing to do so are disastrous.

Now more than ever before, technological advances allow us to listen to such messages and better understand the natural world. We can estimate the value of 'natural capital' – the planet's stock of renewable and non-renewable natural resources, like plants, soils and minerals – alongside values of produced and human capital – for example, roads and skills – which together form a measure of a country's true wealth.

Data from the United Nations Environment Programme shows that, per person, our global stock of natural capital has declined nearly 40% since the early 1990s, while produced capital has doubled and human capital has increased by 13% [82].

But too few of our economic and finance decision-makers know how to interpret what we are hearing, or, even worse, they choose not to tune in at all. A key problem is the mismatch between the artificial 'economic grammar' which drives public and private policy and 'nature's syntax' which determines how the real world operates.

The result is that we miss the message.

So, if the language of economics is failing us, how and where do we begin to find better answers? Unlike standard models of economic growth and development, placing ourselves and our economies within nature helps us to accept that our prosperity is ultimately bounded by that of our planet. This new grammar is needed everywhere, from classrooms to boardrooms, and from local councils to national government departments. It has profound implications for what we mean by sustainable economic growth, helping to steer our leaders towards making better decisions that deliver us, and future generations, the healthier, greener, happier lives that more and more of us say we want.

From now on, protecting and enhancing our environment must be at the heart of how we achieve economic prosperity.


Salima Gurau picks vegetables from the gardens of the homestay her family runs in Nepal.

# Biodiversity is fundamental to food security

Urgent action is needed to address the loss of the biodiversity that feeds the world.

LIVELIHOODS

FOOD SECURITY

DIRECT: BIODIVERSITY USED AS FOOD

## Domesticated

### TERRESTRIAL PLANTS

Around 6000 species [61] of which 9 account for 2/3 of crop production [67]

Thousands of varieties, landraces and cultivars (exact numbers unknown) [57] - some 5.3 million samples are stored in gene banks [66]

### TERRESTRIAL ANIMALS

About 40 species of birds and mammals, of which 8 provide more than 95% of the human food supply from livestock [59]

About 8800 breeds (distinct within-species populations) [65]

### AQUATIC ANIMALS AND PLANTS

Almost 700 species used in aquaculture, of which 10 account for 50% of production [64]

Few recognised strains (distinct within-species populations) [64]

### MICRO-ORGANISMS AND FUNGI

Thousands of species of fungi and micro-organisms essential for food processes such as fermentation [55]

Around 60 species of edible fungi commercially cultivated [60]

## INDIRECT: BIODIVERSITY THAT CREATES THE COND

### GENES, SPECIES AND ECOSYSTEMS

Thousands of species of pollinators, soil engineers, natural enemies of pests, nitrogen-fixing bacteria, and wild relatives of domesticated species.

In 2019, the UN Food and Agriculture Organization (FAO) launched the first report on *The State of the World's Biodiversity for Food and Agriculture*[55]. Five years in the making, the report was prepared under the guidance of FAO's Commission on Genetic Resources for Food and Agriculture. It details the many benefits that biodiversity brings to food and agriculture, examines how farmers, pastoralists, forest dwellers, fishers and fish farmers have shaped and managed biodiversity, identifies major drivers of trends in the status of biodiversity, and discusses trends in the use of biodiversity-friendly production practices.

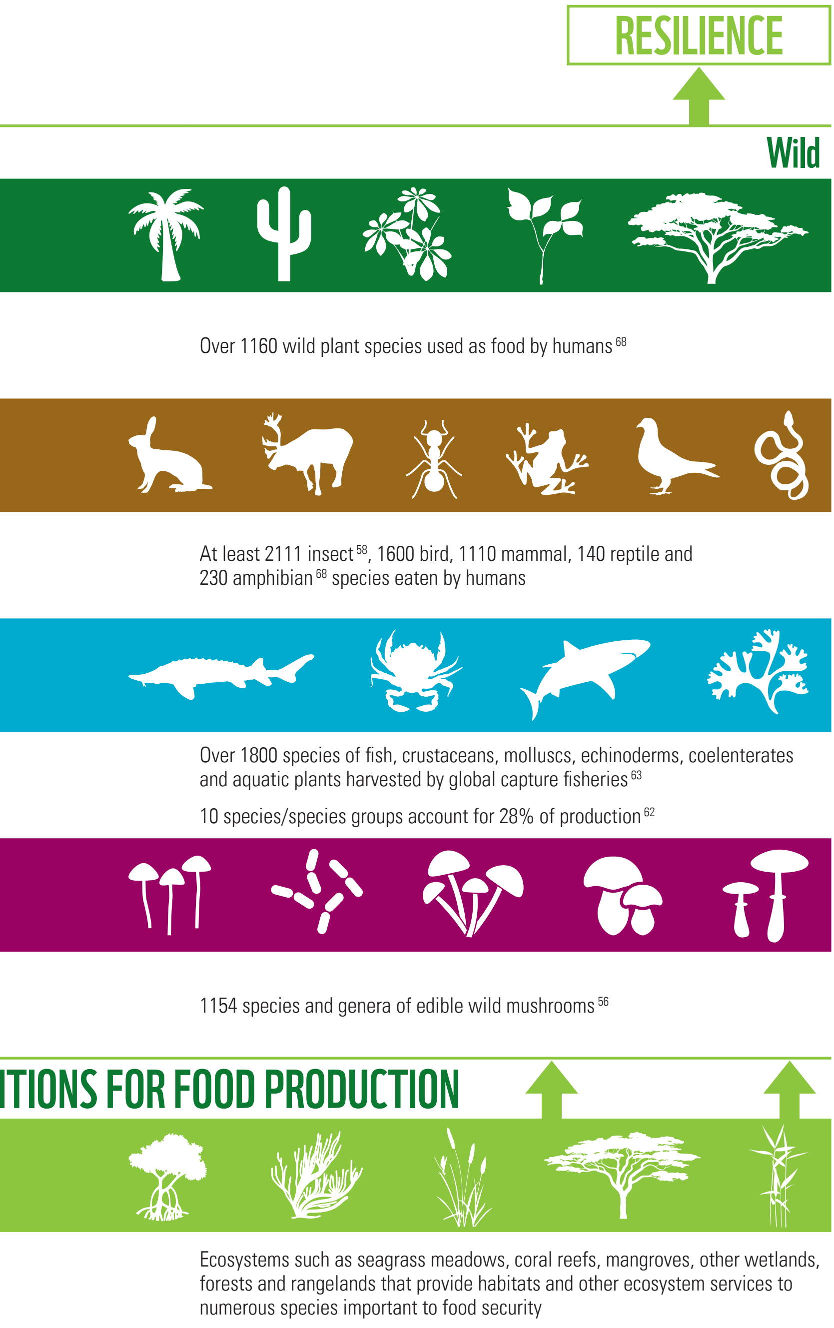



***Figure 14: Key direct and indirect contributions of biodiversity to food security***
*Information for this figure was drawn from a number of sources:*[55-68].

# IMAGINING A ROADMAP FOR PEOPLE AND NATURE

Pioneering modelling has provided the 'proof of concept' that we can halt, and reverse, terrestrial biodiversity loss from land-use change. With an unprecedented and immediate focus on both conservation and a transformation of our modern food system, the Bending the Curve Initiative gives us a roadmap to restore biodiversity and feed a growing human population.

Modelling isn't magic. It is used around the world every day, to plan traffic, forecast population growth areas to understand where to build schools – and, in conservation, to understand, for example, how our climate will continue to change into the future. Now, the remarkable rise in computing power and artificial intelligence allows us, with ever-increasing sophistication, to look at a range of complex possible futures asking not 'what?', but 'what if?'

The Bending the Curve Initiative [69] used multiple state-of-the-art models and scenarios to investigate whether we can reverse terrestrial biodiversity declines – and if so, how. Building on pioneering work that modelled pathways to achieve sustainability objectives [70] and recent efforts by the scientific community for the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [71-73], seven different future what-if scenarios were developed.

The reference what-if scenario is based on the IPCC's 'middle-of-the-road' scenario (SSP2 in Fricko *et al.* (2017) [74]), and assumes a business-as-usual future, with limited efforts towards conservation and sustainable production and consumption. In this model, human population peaks at 9.4 billion by 2070, economic growth is moderate and uneven, and globalisation continues. In addition to the reference scenario, six additional what-if scenarios were developed to explore the potential effects of different actions.

Just as with modelling for climate change, or indeed COVID-19, interventions to determine possible future pathways were broken into action ‘wedges’. These include measures around increased conservation as well as reducing the impact of our global food system on terrestrial biodiversity, in terms of both production and consumption.

## Scenario’s aimed at bending the curve

Three of the scenarios picture single types of interventions aimed at bending the curve:

1. **The increased conservation efforts (C) scenario** included an increase in the extent and management of protected areas, and increased restoration and landscape-level conservation planning.
2. **The more sustainable production (supply-side efforts or SS) scenario** included higher and more sustainable increases in both agricultural productivity and trade of agricultural goods.
3. **The more sustainable consumption (demand-side efforts or DS) scenario** reduced waste of agricultural goods from field to fork and included a diet shift to a lower share of animal calories in high meat-consuming countries.

The three other scenarios modelled different combinations of these increased efforts:

4. The fourth looked at **conservation and sustainable production (C+SS scenario).**
5. The fifth combined **conservation and sustainable consumption (C+DS).**
6. The sixth scenario investigated interventions in all three sectors at once. This was known as the **‘integrated action portfolio’ of interventions, or IAP scenario.**

# Bending the curve

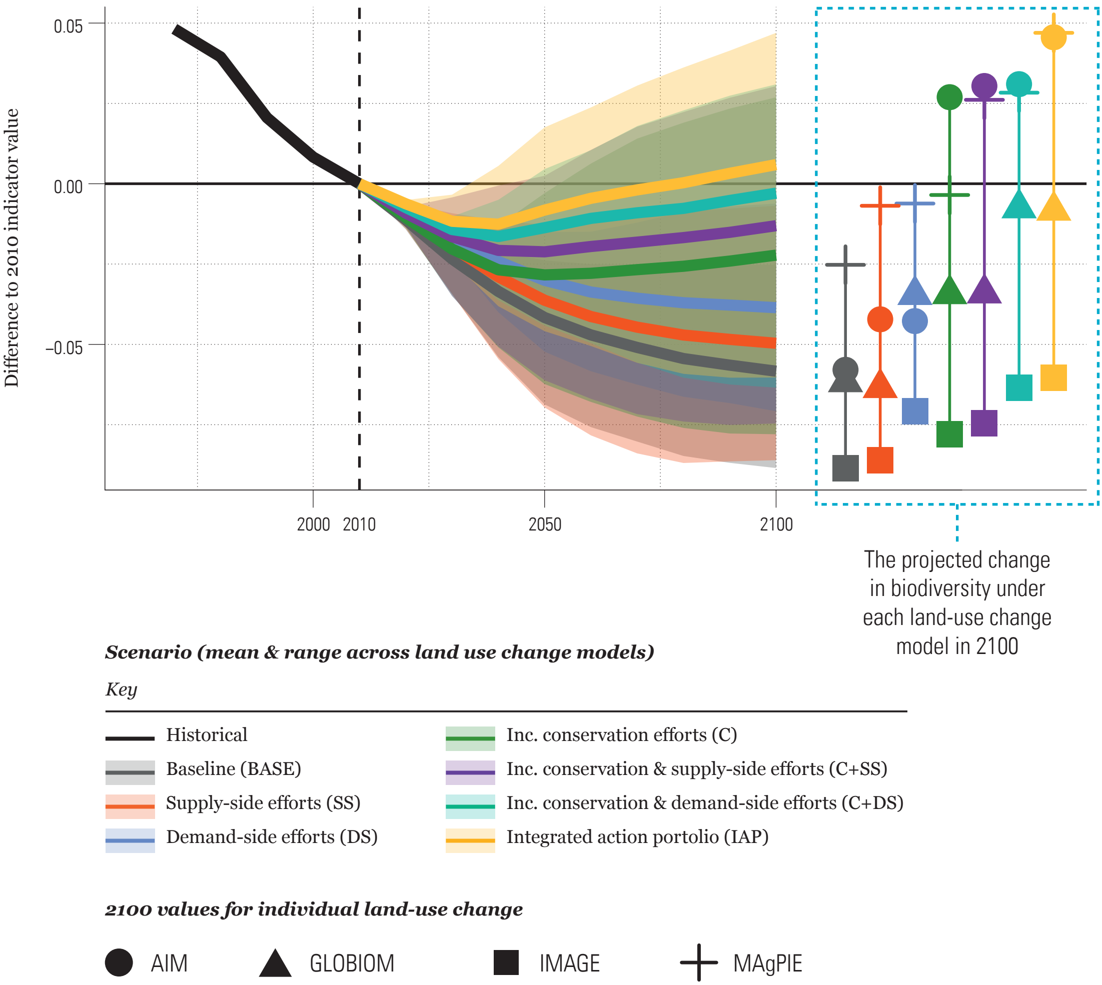



***Figure 15: Projected contributions of various efforts to reverse biodiversity trends from land-use change.***
*This illustration uses one biodiversity indicator to show how future actions to reverse biodiversity trends have varying results across the seven scenarios indicated by different colours. The line and shaded area for each scenario represent the average and range of the projected relative changes across four land-use models (compared to 2010). This graph shows the projected response of one of the biodiversity indicators – mean species abundance, or MSA – using one of the biodiversity models (GLOBIO – more details about all the biodiversity indicators and models can be found in the technical supplement). Sourced from Leclère et al. (2020)*[69]

The thick coloured lines on the graph show how biodiversity is projected to respond under each scenario. As four land-use models were used, this shows the average value across all of them.

The grey line shows that in the reference baseline 'business-as-usual' scenario, global biodiversity trends continue declining throughout the 21st century, with a speed similar to recent decades until 2050.

**Single interventions:**
- The red line shows the effect of putting in place sustainable production measures alone.
- The blue line shows the effect of putting in place sustainable consumption interventions alone.
- The green line shows the effect of putting in place more ambitious conservation measures alone.

**Integrated interventions combine these three in different ways:**
- The purple line shows how biodiversity is projected to respond if increased conservation measures are combined with more sustainable production efforts.
- The light blue line shows how biodiversity is projected to respond if increased conservation measures are combined with more sustainable consumption efforts.
- The yellow line shows how biodiversity responds under the 'integrated action portfolio' that combines all three single interventions: increased conservation measures and more sustainable production and consumption efforts.

## Conservation is critical but not enough – we must also transform food production and consumption patterns

This research shows that bolder conservation efforts are key to bending the curve: more than any other single type of action, increased conservation was found to limit further biodiversity losses in the future and to set global biodiversity trends on a recovery trajectory. Only an integrated approach, combining ambitious conservation with measures targeting the drivers of habitat conversion – such as sustainable production or consumption interventions, or preferably both – will succeed in bending the curve of biodiversity loss.

# THE PATH AHEAD

The *Living Planet Report 2020* is being published at a time of global upheaval, yet its key message is something that has not changed in decades: nature – our life-support system – is declining at a staggering rate. We know that the health of people and that of our planet are increasingly intertwined; the devastating forest fires of the past year and the ongoing COVID-19 pandemic have made this undeniable.

The Bending the Curve modelling tells us that, with transformational change, we can turn the tide of biodiversity loss. It is easy to talk about transformational change, but how will we, living in our complex, highly connected modern society, make it a reality? We know that it will take a global, collective effort; that increased conservation efforts are key, along with changes in how we produce and consume our food and energy. Citizens, governments and business leaders around the globe will need to be part of a movement for change with a scale, urgency and ambition never seen before.

We want you to be part of this movement. For ideas and inspiration, we invite you to explore our *Voices for a Living Planet* supplement. We have invited thinkers and practitioners from a range of fields in many countries to share their views on how to bring about a healthy planet for people and nature.

*Voices for a Living Planet* complements the themes of the *Living Planet Report 2020* by reflecting a diversity of voices and opinions from all over the globe. Covering ideas ranging from human rights and moral philosophy to sustainable finance and business innovation, it provides a starting point for hopeful conversations, food for thought and ideas for a future in which people and nature can thrive.

We hope it will inspire you to be part of the change.

Children walking in the Forest Landscape Restoration HQ and nursery in Rukoki Sub-County, Kasese District, Rwenzori Mountains, Uganda.

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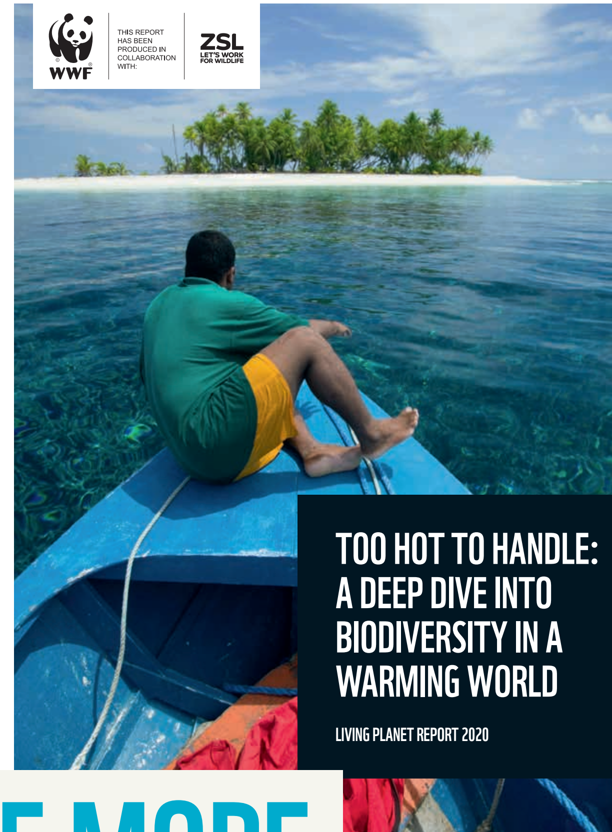


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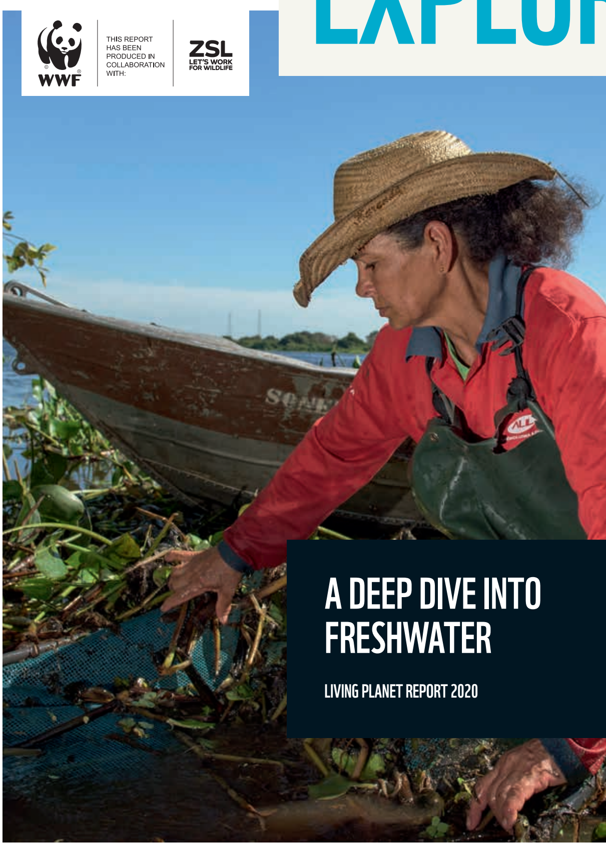


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