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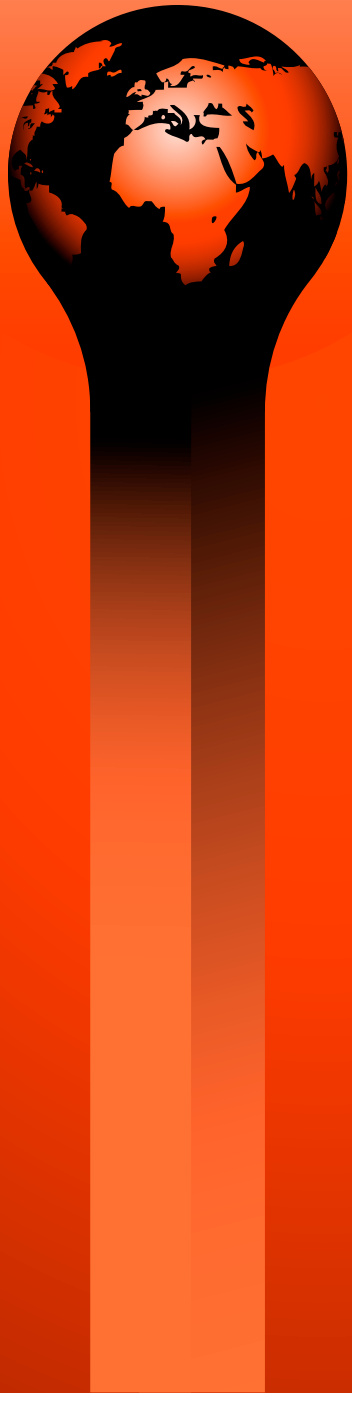
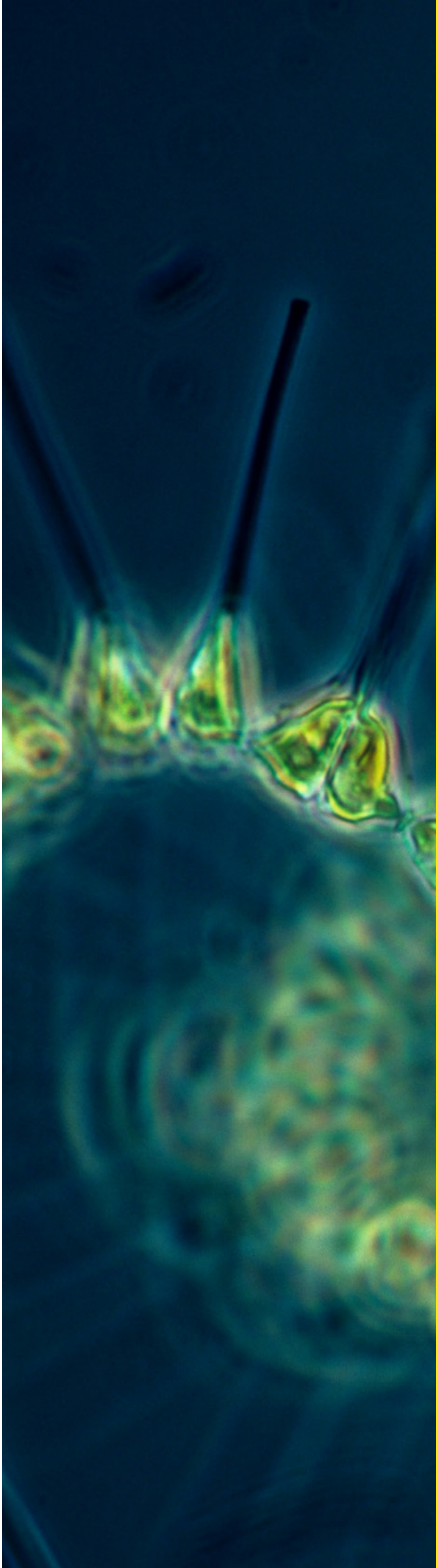


2024 LIVING PLANET REPORT

A System in Peril



WWF

WWF is an independent conservation organisation, with more than 38 million followers and a global network active through local leadership in over 100 countries. Our mission is to stop the degradation of the planet's natural environment and to build a future in which people 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.

ZSL (Zoological Society of London) Institute of Zoology

Founded in 1826, ZSL is an international conservation charity, driven by science, working to restore wildlife in the UK and around the world; by protecting critical species, restoring ecosystems, helping people and wildlife live together and inspiring support for nature. Through our leading conservation zoos, London and Whipsnade, we bring people closer to nature and use our expertise to protect wildlife today, while inspiring a lifelong love of animals in the conservationists of tomorrow.

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

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2024 LIVING PLANET REPORT

A System in Peril

EXECUTIVE SUMMARY

When cumulative impacts reach a threshold, the change becomes self-perpetuating, resulting in substantial, often abrupt and potentially irreversible change – a tipping point.

Nature is being lost – with huge implications for us all

Biodiversity sustains human life and underpins our societies. Yet every indicator that tracks the state of nature on a global scale shows a decline.

Over the past 50 years (1970–2020), the average size of monitored wildlife populations has shrunk by 73%, as measured by the Living Planet Index (LPI). This is based on almost 35,000 population trends and 5,495 species of amphibians, birds, fish, mammals and reptiles. Freshwater populations have suffered the heaviest declines, falling by 85%, followed by terrestrial (69%) and marine populations (56%).

At a regional level, the fastest declines have been seen in Latin America and the Caribbean – a concerning 95% decline – followed by Africa (76%) and the Asia and the Pacific (60%). Declines have been less dramatic in Europe and Central Asia (35%) and North America (39%), but this reflects the fact that large-scale impacts on nature were already apparent before 1970 in these regions: some populations have stabilized or increased thanks to conservation efforts and species reintroductions. Habitat degradation and loss, driven primarily by our food system, is the most reported threat in each region, followed by overexploitation, invasive species and disease. Other threats include climate change (most cited in Latin America and the Caribbean) and pollution (particularly in North America and Asia and the Pacific).

By monitoring changes in the size of species populations over time, the LPI is an early warning indicator for extinction risk and helps us understand the health of ecosystems. When a population falls below a certain level, that species may not be able to perform its usual role within the ecosystem – whether that's seed dispersal, pollination, grazing, nutrient cycling or the many other processes that keep ecosystems functioning. Stable populations over the long term provide resilience against disturbances like disease and extreme weather events; a decline in populations, as shown in the global LPI, decreases resilience and threatens the functioning of the ecosystem. This in turn undermines the benefits that ecosystems provide to people – from food, clean water and carbon storage for a stable climate to the broader contributions that nature makes to our cultural, social and spiritual well-being.

Dangerous tipping points are approaching

The LPI and similar indicators all show that nature is disappearing at an alarming rate. While some changes may be small and gradual, their cumulative impacts can trigger a larger, faster change. When cumulative impacts reach a threshold, the change becomes self-perpetuating, resulting in substantial, often abrupt and potentially irreversible change. This is called a tipping point.

In the natural world, a number of tipping points are highly likely if current trends are left to continue, with potentially catastrophic consequences. These include global tipping points that pose grave threats to humanity and most species, and would damage Earth's life-support systems and destabilize societies everywhere. Early warning signs indicate that several global tipping points are fast approaching:

- In the biosphere, the ***mass die-off of coral reefs*** would destroy fisheries and storm protection for hundreds of millions of people living on the coasts. The ***Amazon rainforest tipping point*** would release tonnes of carbon into the atmosphere and disrupt weather patterns around the globe.
- In ocean circulation, the ***collapse of the subpolar gyre***, a circular current south of Greenland, would dramatically change weather patterns in Europe and North America.
- In the cryosphere (the frozen parts of the planet), the ***melting of the Greenland and West Antarctic ice sheets*** would unleash many metres of sea level rise, while ***large-scale thawing of permafrost*** would trigger vast emissions of carbon dioxide and methane.

Global tipping points can be hard to comprehend – but we're already seeing tipping points approaching at local and regional levels, with severe ecological, social and economic consequences:

- In western North America, a combination of pine bark beetle infestation and more frequent and ferocious forest fires, both exacerbated by climate change, is pushing pine forests to a tipping point where they will be replaced by shrubland and grassland.
- In the Great Barrier Reef, rising sea temperatures coupled with ecosystem degradation have led to mass coral bleaching events in 1998, 2002, 2016, 2017, 2020, 2022 and 2024. Although the Great Barrier Reef has shown remarkable resilience to date, we will likely lose 70–90% of all coral reefs globally, including the Great Barrier Reef, even if we are able to limit climate warming to 1.5°C.
- In the Amazon, deforestation and climate change are leading to reduced rainfall, and a tipping point could be reached where the environmental conditions become unsuitable for tropical rainforest, with devastating consequences for people, biodiversity and the global climate. A tipping point could be on the horizon if just 20–25% of the Amazon rainforest were destroyed – and an estimated 14–17% has already been deforested.

In many cases, the balance is precarious – but tipping points can still be avoided. We have an opportunity to intervene now to increase ecosystem resilience and reduce the impacts of climate change and other stressors before these tipping points are reached.

We are falling short of our global goals

The nations of the world have set global goals for a thriving, sustainable future, including halting and reversing the loss of biodiversity (under the Convention on Biological Diversity, or CBD), capping global temperature rise to 1.5°C (under the Paris Agreement), and eradicating poverty and ensuring human well-being (under the Sustainable Development Goals, or SDGs). But despite these global ambitions, national commitments and actions on the ground fall far short of what's needed to meet our targets for 2030 and avoid the tipping points that would make achieving our goals impossible. As things stand:

- Over half the SDG targets for 2030 will be missed, with 30% of them stalled or getting worse from the 2015 baseline.
- National climate commitments would lead to an average global temperature increase of almost 3°C by the end of the century, inevitably triggering multiple catastrophic tipping points.
- National biodiversity strategies and action plans are inadequate and lack financial and institutional support.

Approaching climate, biodiversity and development goals in isolation raises the risk of conflicts between different objectives – for example, between using land for food production, biodiversity conservation or renewable energy. With a coordinated, inclusive approach, however, many conflicts can be avoided and trade-offs minimized and managed. Tackling the goals in a joined-up way opens up many potential opportunities to simultaneously conserve and restore nature, mitigate and adapt to climate change, and improve human well-being.

The scale of the challenge demands transformation

To maintain a living planet where people and nature thrive, we need action that meets the scale of the challenge. We need more, and more effective, conservation efforts, while also systematically addressing the major drivers of nature loss. That will require nothing less than a transformation of our food, energy and finance systems.

Transforming conservation

Despite the alarming overall decline in wildlife populations shown in the LPI, many populations have stabilized or increased as a result of conservation efforts. But isolated successes and merely slowing the decline of nature are not enough. Equally, conservation efforts that don't take account of the rights, needs and values of people are not likely to succeed in the long run.

Protected areas have been the cornerstone of traditional conservation efforts, and currently cover 16% of the planet's lands and 8% of its oceans – though their distribution is uneven and many are not effectively managed. Target 3 of the Kunming-Montreal Global Biodiversity Framework (GBF) calls for 30% of lands, waters and sea to be protected by 2030, while Target 2 aims to restore 30% of degraded areas by 2030. This is an unmissable opportunity to scale up effective conservation to unprecedented levels.

Countries need to extend, enhance, connect and properly fund their systems of protected areas, while respecting the rights and needs of the people affected. Formal protection is not always the best approach, however, which is why the GBF target also allows for other effective area-based conservation measures, or OECMs. Supporting the rights of Indigenous Peoples and local communities may be one of the most effective ways to conserve biodiversity at scale. A quarter of the global land area is traditionally owned, managed, used and/or occupied by Indigenous Peoples, which includes about 35% of the area formally in protected areas and 35% of the remaining intact terrestrial areas.

Working with nature to address specific societal issues – known as nature-based solutions – also holds great promise to advance on global goals on climate, nature and sustainable development. Nature-based solutions for climate mitigation have the potential to reduce annual greenhouse gas emissions by 10–19%, while also benefiting ecosystems and improving livelihoods.

Transforming the food system

The global food system is inherently illogical. It is destroying biodiversity, depleting the world's water resources and changing the climate, but isn't delivering the nutrition people need. Despite record production, some 735 million people go to bed hungry each night. Obesity rates are rising even as nearly a third of the world's population don't regularly get enough nutritious food. Food production is one of the main drivers of nature's decline: it uses 40% of all habitable land, is the leading cause of habitat loss, accounts for 70% of water use and is responsible for over a quarter of greenhouse gas emissions. The hidden costs of ill health and environmental degradation in the current food system amount to US$10–15 trillion annually, representing 12% of global GDP in 2020. Paradoxically, our food system is undermining our ability to feed humanity now and into the future.

Even though the food system is the number one driver of environmental degradation, it's not adequately addressed in major international environmental policy. We need coordinated action to:

1. Scale nature-positive production to provide enough food for everyone while also allowing nature to flourish – by optimizing crop yields, livestock productivity, wild fisheries harvest and aquaculture production in a sustainable way.

2. Ensure everyone in the world has a nutritious and healthy diet, produced without triggering tipping points – which will involve changing food choices, including eating a greater proportion of plant-based foods and fewer animal products in most developed countries while addressing undernutrition and food security.

3. Reduce food loss and waste – today, an estimated 30–40% of all food produced is never eaten, representing around a quarter of total global calories, one-fifth of agricultural land and water use, and 4.4% of global greenhouse gas emissions.

4. Increase financial support and foster good governance for sustainable, resilient, nature-positive food systems – including by redirecting environmentally harmful farming and fishing subsidies to support nature-positive production, reduce food loss and waste, improve consumption and keep food affordable for all.

Our food system is undermining our ability to feed humanity now and into the future.

Transforming the energy system

The way we produce and consume energy is the principal driver of climate change, with increasingly severe impacts on people and ecosystems. We know we must rapidly transition away from fossil fuels to renewable energy to cut greenhouse emissions in half by 2030 and keep 1.5°C within reach. The energy transition must be fast, green and fair, putting people and nature at its heart.

A faster transformation: In the last decade, global renewable energy capacity has roughly doubled and costs for wind, solar and batteries have fallen by up to 85%. But although energy trends are going in the right direction, the pace and scale are not yet near where they need to be. Over the next five years, we need to triple renewable energy, double energy efficiency, electrify 20–40% of light-duty vehicles, and modernize energy grids. This will require a tripling of investment, from an estimated US$1.5 trillion in 2022 to at least US$4.5 trillion annually by 2030.

A greener transformation: The energy transition must be consistent with the protection and restoration of nature. Without careful planning and environmental safeguards, hydropower development will increase river fragmentation, bioenergy development could drive significant land-use change, and transmission lines and mining for critical minerals could impact sensitive land, freshwater and ocean ecosystems. Careful planning is needed to select the right renewables in the right places, avoid negative impacts, and streamline energy development without diluting environmental safeguards.

A fairer transformation: Over 770 million people still lack access to electricity and nearly 3 billion people still burn kerosene, coal, wood or other biomass for cooking. A lack of access to modern renewable energy solutions significantly contributes to poverty, deforestation and indoor air pollution – a major cause of premature deaths that disproportionately impacts women and children. A just energy transition will need to ensure that people have access to modern and safe sources of energy, and that the benefits and burdens are equitably shared.

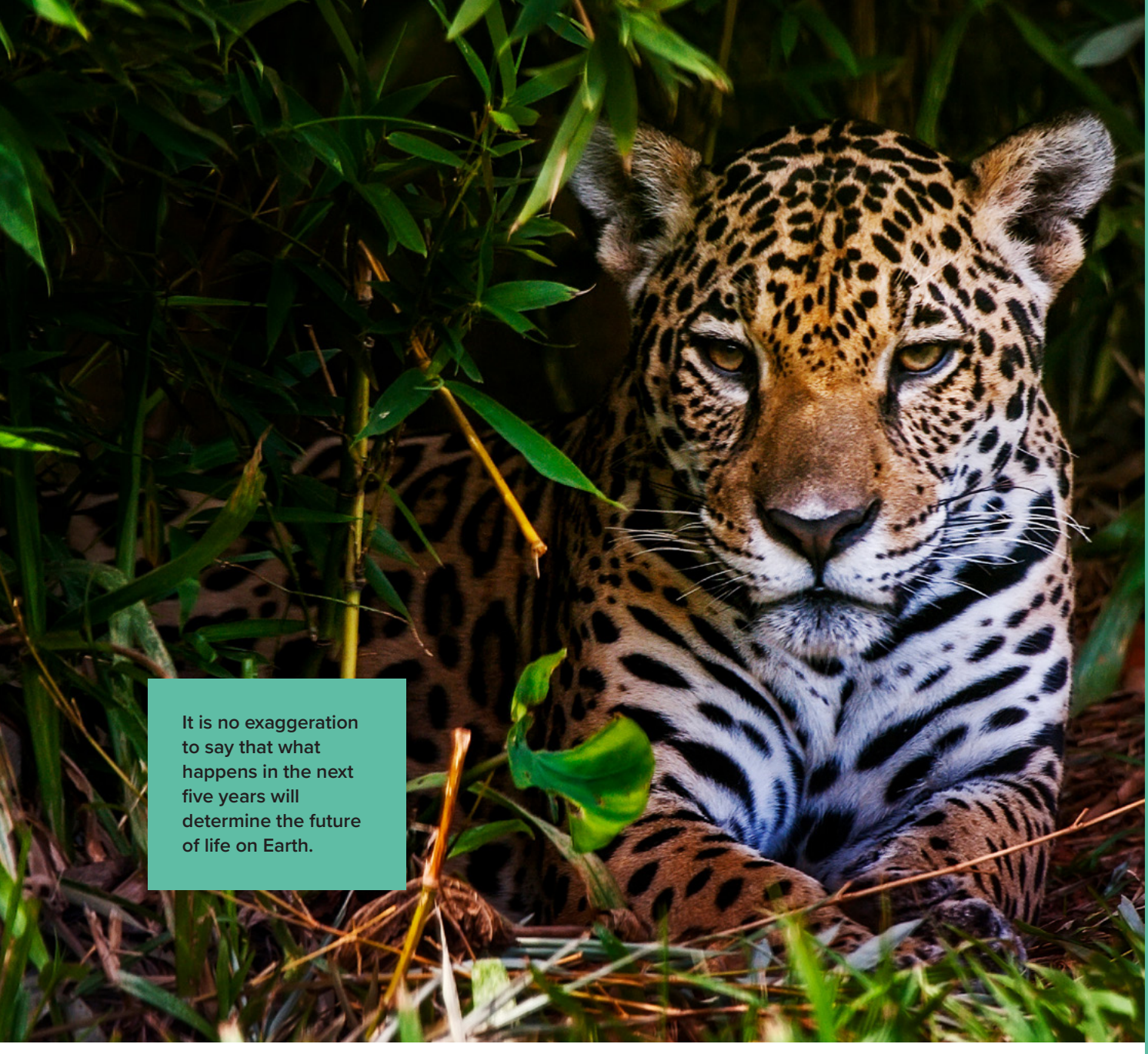
Globally, over half of GDP (55%) is moderately or highly dependent on nature and its services.

Transforming the finance system

Redirecting finance away from harmful activities and toward business models and activities that contribute to the global goals on nature, climate and sustainable development is essential for ensuring a habitable and thriving planet.

Globally, over half of GDP (55%) – or an estimated US$58 trillion – is moderately or highly dependent on nature and its services. Yet our current economic system values nature at close to zero, driving unsustainable natural resource exploitation, environmental degradation and climate change. Money continues to pour into activities that fuel the nature and climate crises: private finance, tax incentives and subsidies that exacerbate climate change, biodiversity loss and ecosystem degradation are estimated at almost US$7 trillion per year. The positive financial flows for nature-based solutions, in comparison, are a paltry US$200 billion. By redirecting just 7.7% of the negative finance flows, we could meet the funding gap for nature-based solutions and deliver nature, climate and human well-being benefits. While global climate finance for the energy sector approached US$1.3 trillion in 2021/22, the need is a staggering US$9 trillion annually for both mitigation and adaptation through 2030. Similarly, the transition to a sustainable food system needs a huge increase in spending to US$390–455 billion annually from public and private sources – still less than governments spend each year on environmentally harmful agricultural subsidies.

Filling these gaps demands a seismic shift at global, national and local levels to get finance flowing in the right direction, away from harming the planet and toward healing it. We can do this in two mutually reinforcing ways. *Financing green* involves mobilizing finance for conservation and climate impact at scale, which will require new green finance solutions involving the public and private sector – from conservation-focused funds, bonds, loans and insurance products to long-term investment in nature-positive businesses and enterprises. *Greening finance* involves aligning financial systems to deliver nature, climate and sustainable development goals, including by accounting for the value of nature and systematically addressing nature- and climate-related risks.



It is no exaggeration to say that what happens in the next five years will determine the future of life on Earth.

Making it happen

With every issue of the *WWF Living Planet Report*, we see a further decline in the state of nature and a destabilization of the climate. This cannot continue.

It is no exaggeration to say that what happens in the next five years will determine the future of life on Earth. We have five years to place the world on a sustainable trajectory before negative feedbacks of combined nature degradation and climate change place us on the downhill slope of runaway tipping points. The risk of failure is real – and the consequences almost unthinkable.

As a global community, we have agreed on a way forward. The global goals show where we want to be and the path we need to take. All of us – governments, companies, organizations, individuals – need to walk the walk, and be ready to hold to account those who fail to do so.

Together, we must be successful. We have just one living planet, and one opportunity to get it right.

A system in peril.

Kirsten Schuijt
Director General
WWF International

That's the stark conclusion of the Living Planet Report 2024, which reveals a catastrophic 73% decline in the average size of monitored wildlife populations over just 50 years. It's an alarming figure for all of us who care about the state of our natural world. But it is also another indicator of the unrelenting pressure caused by the dual climate and nature loss crises – and the threat of breakdown to the natural regulatory system that underpins our living planet.

Declines in monitored wildlife populations function as an early warning indicator of the potential loss of ecosystem function and resilience. This doesn't just affect the species concerned; as human beings, we rely on these ecosystems too. From the food and water we eat and drink, to the quality of the air we breathe, and the medicines we need: nature is our life support system.

Once ecosystems are damaged and degraded they can become more vulnerable to tipping points. That's when pressures such as habitat loss, land-use change, overharvesting or climate change push ecosystems beyond a critical threshold, resulting in substantial and potentially irreversible change. This report looks at regional and global tipping points beyond which ecosystems of global significance, such as the Amazon, could cease to function. What becomes clear is that the impacts would not only be devastating for local communities, but also for the global climate and food supplies, with societies and economies around the world affected.

Faced with the loss of nature, new climate temperature records being broken and multiple tipping points on the horizon, it could be easy to slip into despair. Fortunately, while time is running out, we are not yet past the point of no return. The power – and opportunity – are in our hands to change the trajectory.

The report acknowledges the progress humanity has already made, such as the doubling in global renewable energy capacity over the past decade and where conservation efforts have borne fruit. Governments have also succeeded in reaching global agreements, such as the Paris Agreement on climate change, the Global Biodiversity Framework and the UN Sustainable Development Goals, which point the way to a future that is safer, fairer, healthier and more prosperous.

These are significant achievements but there is still a huge gap between the finance and action needed, and what is currently being delivered, to meet targets and goals set for 2030. This makes what happens over the next five years crucial for the future of life on Earth. The decisions made between now and 2030 will determine whether we can avoid dangerous tipping points and learn to live in harmony with nature, not work against it.

To guide us in this endeavour, we can look to nature itself as well as to the Indigenous Peoples and local communities whose knowledge of and deep respect for nature guide their stewardship of it. A quarter of the global land area is traditionally owned, managed or used by Indigenous Peoples, and when these communities are engaged in or lead remedial action we see positive results. Nature-based solutions – approaches which benefit biodiversity, climate and human well-being at the same time – also hold significant potential to advance progress on the global goals.

These efforts can only succeed if we simultaneously tackle the drivers of nature loss and climate change by transforming our energy, food and finance systems in a coordinated way. Let's consider, for example, the food system: it is the leading cause of habitat loss, accounts for 70% of water use and is responsible for over a quarter of greenhouse gas emissions. Yet, nearly a third of the world's population don't regularly get enough nutritious food and many farmers are struggling to make ends meet. Scaling up nature-positive production and reducing waste could allow everyone access to a nutritious and healthy diet, produced without triggering tipping points.

These efforts can only succeed if we simultaneously tackle the drivers of nature loss and climate change by transforming our energy, food and finance systems in a coordinated way.

The opportunities are enormous across society and sectors, but only if finance is redirected away from fossil fuels, deforestation and unsustainable food production towards solutions that fairly address the challenges we face. The international biodiversity and climate summits taking place soon – COP16 and COP29 – are an opportunity for countries to rise to the scale of the challenge by making progress on actioning more ambitious national climate and nature plans and driving funding – public and private – to the people that need it most.

We know what needs to be done and how to do it but it will take bold leadership and a huge collective effort from governments, businesses and the whole of society to meet these global goals by 2030. We can avoid the tipping points, nature can start to recover and temperatures can be stabilized, but we must act now, push for change and hold each other accountable. By confronting this challenge together, we can secure a living planet for current and future generations.

We are at a moment where we must listen to science and take action to avoid collapse.

María Susana Muhamad González
Minister of Environment and Sustainable Development of Colombia; COP16 (Cali, Colombia) President Elect

The data shows a continuing dramatic trend, with wildlife populations still in decline, the risk of extinction increasing, and the health and integrity of our ecosystems getting worse and worse. Nature and biodiversity, in all its forms, will continue on this path of loss if we do not take ambitious measures.

Colombia is the second most megadiverse country in the world, with about 10% of the world's biodiversity. But with the species decline we see in this report, a critical home for this biodiversity – the Amazon – is at risk of reaching an irreversible tipping point where conditions become unsuitable for tropical forests. The impacts would not only be devastating for local communities and wildlife, but would also have global repercussions for the climate.

Globally, we are reaching points of no return and irreversibly affecting the planet's life-support systems. We are seeing the effects of deforestation and the transformation of natural ecosystems, intensive land use and climate change. The world is witnessing the mass bleaching of coral reefs, the loss of tropical forests, the collapse of polar ice caps and serious changes to the water cycle, the foundation of life on our planet.

Countries have made commitments to respond to the crises of biodiversity, climate change and pollution. In recent years, international cooperation has brought significant efforts to achieve the Sustainable Development Goals and other targets set for 2030. Long-term cooperation schemes are key to achieving results, recognizing the social and economic conditions that limit action.

Taking effective action to reduce these crises is not an easy task. International cooperation involves fighting together against illicit economies and transnational crime; joining efforts to transform trade chains that promote unsustainable production models; safeguarding the lives of environmental defenders; strengthening governance and empowering local communities; and halting the advance of economic models that drive pollution and deforestation, damage the integrity of ecosystems, and undermine human rights.

Addressing these global challenges requires us to strengthen our response. We need to increase transnational efforts, to have a different perspective and a different vision. We need a structural reform of the financial system so that countries have the financial mechanisms they need to respond to these crises. Food production must be an ally for the restoration of nature and creation of a life-sustaining economy. The energy transition and decarbonization must move forward without negative effects on ecosystems and local communities. The world must move towards a just transition that revives life and systematically restores what we have degraded.

Nature has to be seen as our main ally; we must look to nature for solutions. Technological solutions should not cloud our judgement or encourage the world to continue on the same destructive path. It is urgent that we address global problems in a comprehensive way – the struggles cannot be separated. Investments in conservation, restoration and environmental processes are futile if climate change continues to advance at the pace we are facing and economic systems do not substantially contribute to changing the trajectory.

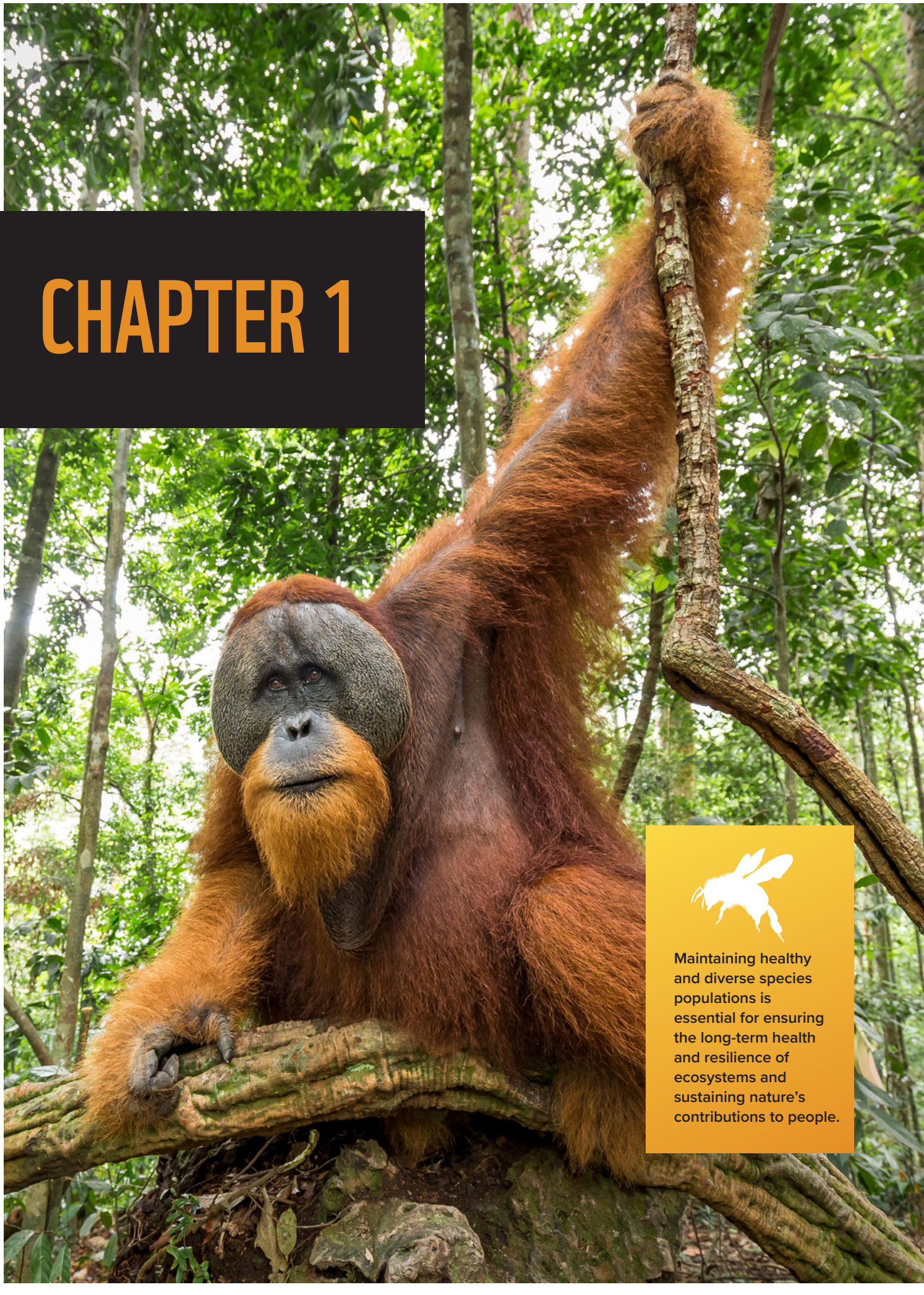
Conserving biodiversity requires the same commitment we must undertake to decarbonize economies. We are challenged to ensure that emission reduction targets and energy transition processes go hand in hand with nature conservation and restoration goals. The new economic models of transition cannot be the cause of a new era of extractivism and degradation; we must prove that we can do better. This is about establishing a new Commons-Public Partnership to value, learn and engage the active voice from traditional knowledge of ethnic communities, smallholders and grassroots. We must jointly develop and call for an innovative and transformative type of economic system that is built around the cycles of nature with people – an economy that reproduces life instead of destroying it. It is mandatory to shift the economic system and rules to a nature-positive and equitable finance one.

The world must move towards a just transition that revives life and systematically restores what we have degraded.

That is why Colombia wants to invite the world to make peace with nature. From our country's history we know conservation, human rights and peace must go hand in hand. Nature and conflict are increasingly interacting since environmental degradation and biodiversity loss are drivers for social inequalities. Conflict and insecurity contribute to degradation and these interactions form the nature and security linkages. Nature should be at the centre to promote peace, security, social welfare, and therefore, reduce biodiversity loss and climate change. Making peace with nature is about understanding and learning how we can achieve a way of living in all societies, in all cultures, in all countries without exceeding planetary limits.

At the COP16 UN biodiversity conference, we are encouraging the broadest possible participation of all society. We invite you all to Cali to discuss the reality of the crisis of nature and to put these reflections at the centre of the decisions we make. Colombia invites you to join us to create a new path together – a path to making peace with nature, to reclaiming our relationship with the living world, and to building the future we want.

CHAPTER 1



Maintaining healthy and diverse species populations is essential for ensuring the long-term health and resilience of ecosystems and sustaining nature's contributions to people.

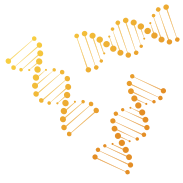
Measuring nature's decline

What is biodiversity and why is it important?

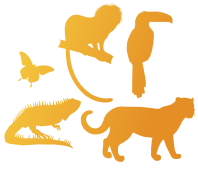
Biodiversity is the heartbeat of our living planet. The astonishing array of life on Earth is the greatest marvel in the known universe. It also, directly and indirectly, sustains human life – from the food we eat to the fuel and medicines we need for survival, from clean air and water to a stable climate. Our economies, our societies, our civilizations: biodiversity underpins them all.

Biodiversity is defined as "the variability among living organisms including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part"[1]. That variability includes differences within species and ecosystems, as outlined in Box 1.1. Biodiversity, in all its forms, has direct and indirect effects on our quality of life[2] – sometimes referred to as "nature's contributions to people".

Box 1.1 The diversity of biodiversity



- **Genetic diversity:** The variation of genetic information within a population, species or ecosystem including differences in genes, alleles and genetic traits. Genetic diversity is essential for evolution in response to change.



- **Species diversity:** The variation and abundance of different species within a specific area, encompassing both the number of species (species richness) and their relative abundance (species evenness). High species diversity indicates a healthy and resilient ecosystem capable of supporting various ecological functions and services. Loss of species diversity can disrupt ecosystem functioning and reduce overall ecosystem stability.

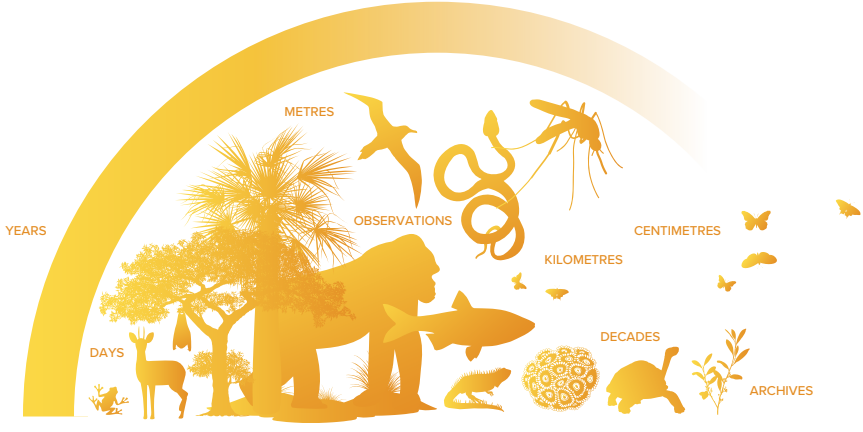
- **Population diversity:** The variation and distribution of individuals within a species across different geographic regions or habitats including differences in traits, behaviours and genetic composition among populations of the same species. Population diversity reflects the adaptability of a species to change and influences its ability to persist over time.

- **Ecosystem diversity:** The variation of ecosystems within a region including different types of terrestrial, marine and aquatic ecosystems, such as forests, grasslands, wetlands, coral reefs, rivers and lakes. Ecosystem diversity reflects the structural and functional complexity of landscapes and supports a wide range of species and ecological processes, enhancing overall ecosystem resilience and productivity.

- **Ecosystem functional diversity:** The variation in ecological processes, such as nutrient cycling, primary production and decomposition, and species' ecological roles, functions and contributions to these processes. High functional diversity enhances ecosystem resilience.

"Nature" is a more holistic term than biodiversity that has a multitude of meanings for different peoples and cultures around the globe, though the two terms are often used interchangeably. People perceive, experience and interact with nature in ways that shape their understanding of how it contributes to their quality of life. As the world's cultures are diverse, so too is the range of values related to nature.

Nature is increasingly managed and harvested to keep pace with rising global demands for food, water, energy, timber, fibre and more. This accelerating appropriation of nature is fraying the fabric of life on which we all depend[3]. Today's policies and practices often disregard the multiple values of nature in favour of a narrow set of market values focused on short-term economic growth. Non-market values associated with nature's contributions to people – like regulating the climate, providing water, healthy soils, or the joy and wonder that nature inspires – are overlooked and undermined. For our own sakes, we need to embrace the diverse values of nature and ensure these are reflected in public policy, private sector investments and individual actions at local, national and global scales[4].



How do we measure nature?

Measuring how and why nature is changing is critical if we are to effectively address the threats to our vital natural systems. Various biodiversity indicators have been developed to measure different facets of nature and to assess its status and change over time. While no single measure is sufficient to capture all aspects of nature, when used in combination these indicators can tell us how nature is changing globally and locally. They can also help us understand where and how to focus conservation efforts and to project how nature may change under different scenarios. This helps identify future risks and evaluate the best solutions to maintain the benefits of nature while minimizing negative impacts. All indicators that track the state of nature at a global scale, whether monitored by natural or social scientists, show a decline[3]. These losses have consequences for society, many of which are only now beginning to manifest themselves in the form of local and regional tipping points (see Chapter 2).

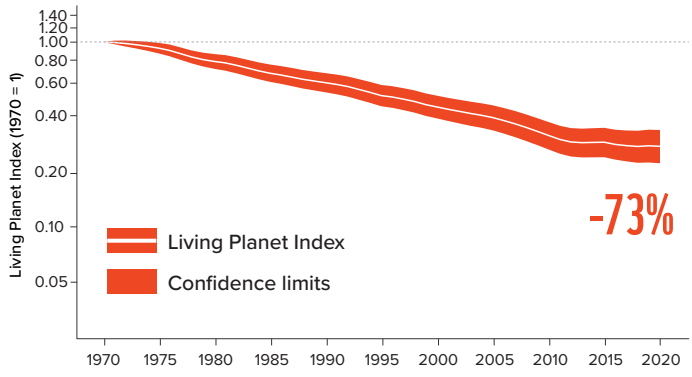
Nature narratives: Using indicators to understand change over different timescales

Some indicators reflect short-term trends, such as those measuring abundance and extinction risk, and may be used to predict near-term change. Others provide a longer view of past and future change, for example biodiversity intactness (or state of integrity) and the rate of extinctions[5,6]. Both types are important. Taken together, they provide vital information about the health and resilience of nature.

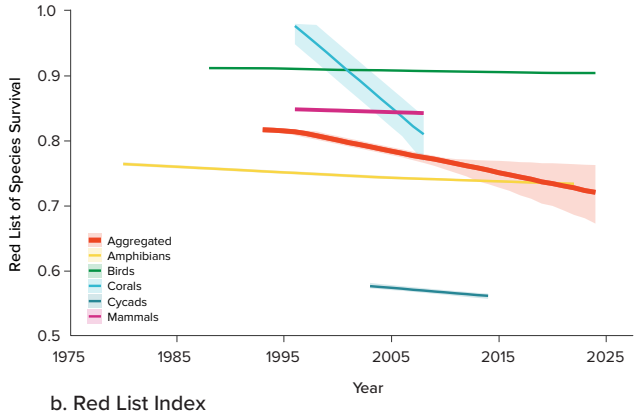
The Living Planet Index (LPI) helps us to see recent changes in nature from 1970 to the present by tracking the size of animal populations and how they are changing (Figure 1.1a). The LPI is an early warning indicator of increasing extinction risk and the potential loss of ecosystem function and resilience. It affords us an opportunity to intervene in time to reverse negative trends, recover species populations, and keep ecosystems functioning and resilient.

The Red List Index, an indicator of trends in the extinction risk of groups of species, also provides information about the changing state of nature. The IUCN Red List of Threatened Species assesses the likelihood that a species will go extinct across all its populations, based on past, current and projected future trends[7]. The index shows whether species in a group are becoming more (or less) at risk of extinction: the lower the value, the greater the risk that species in that group will go extinct. Extinction risk is increasing in all monitored species groups according to the Red List Index (Figure 1.1b): in other words, without significant intervention, it is highly probable that species will be lost. Species facing extinction may not be able to perform their usual role within their ecosystem, which can reduce the functioning and resilience of an ecosystem overall.

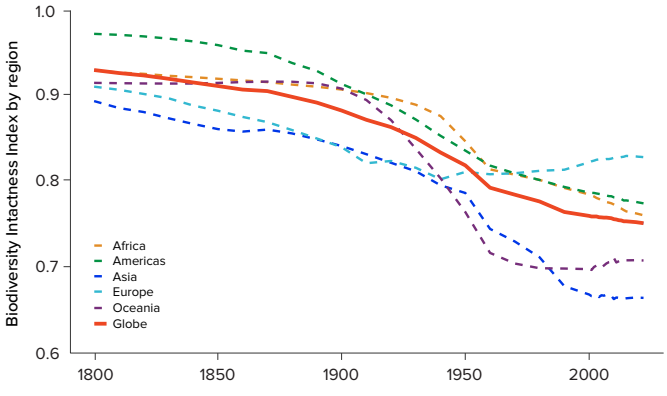
The Biodiversity Intactness Index is a long-term indicator that measures how much original biodiversity remains within terrestrial communities in a given region. The trajectory since 1800 shows the effect of agricultural expansion and intensification on terrestrial biodiversity around the world: although intactness has declined across all regions, Asia has shown the steepest and largest decline over the past century (Figure 1.1c). For another longer-term perspective (centuries), the outcome of continued declines in species abundance and population size can be seen in the number and rate of extinctions. With data reaching back as far as the 1500s, scientists have estimated that the extinction rate (the rate at which we lose species forever) is at least tens to hundreds of times higher than it would be in the absence of human activity (Figure 1.1d).



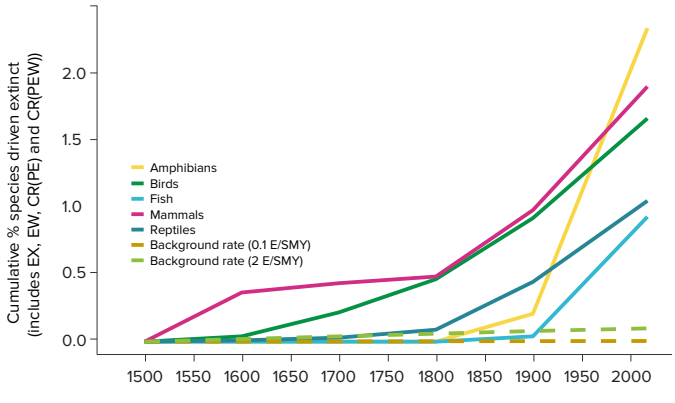
a. Global Living Planet Index



b. Red List Index



c. Biodiversity Intactness Index



d. Rate of extinctions

Figure 1.1 Indicators show changes in biodiversity across different timescales. Each tells a different story, but all are part of a larger narrative of nature's decline. The Living Planet Index (a) tracks animal populations and allows us to interpret recent changes in nature[8]. The Red List Index (b) shows extinction risk for groups of species and incorporates recent trends and future threats[7]. The Biodiversity Intactness Index (c) highlights long-term trends and shows how intact terrestrial biodiversity is compared to the year 1800[9]. The number of extinctions (d) shows a longer-term trend from 1500 and tracks the cumulative number of species known to have gone extinct[1].

Nature narratives: from populations to ecosystem function

Species populations contribute to the functioning of ecosystems and provide vital contributions to people through their interactions with each other and their environment (Box 1.2). Maintaining healthy and diverse populations is essential for ensuring the long-term health and resilience of ecosystems and sustaining nature's contributions to people.

Box 1.2 Ecosystem function, ecosystem services and nature's contributions to people

Ecosystem function refers to the processes that occur within an ecosystem. These processes are essential for the ecosystem's stability, productivity and resilience. Ecosystem functions include nutrient cycling, primary production, decomposition, water purification, pollination and climate regulation. Ecosystem services are the benefits that humans derive from ecosystems such as food, clean water and a stable climate. Ecosystem services result from ecosystem functions, but they are evaluated as services based on their value to humans rather than their importance to the ecosystem itself. Expanding on ecosystem services, the concept of nature's contributions to people, or NCP, emerged from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)[3] as a way to recognize and value the full range of interactions between people and nature, particularly the broader cultural, social and spiritual connections.

A study in the Atlantic Forest in Brazil of more than 2,000 tree species and more than 800 animal species provides an example[10]. Researchers found that when the forest loses populations of large fruit-eating animals (tapirs, toucans, tamarins, deer) due to hunting and illegal trade, it loses the seed dispersal function for large-seeded trees that these animals provide, and the composition of tropical tree species changes (Figure 1.2). Since the large-seeded trees are predominantly larger hardwood trees which store more carbon, the forest loses carbon storage capacity as it becomes dominated by smaller, softwood trees. This phenomenon has the potential to cause carbon storage losses of 2–12% across forests in Africa, Latin America and Asia[11], reducing tropical forest carbon storage capacity in the face of climate change.

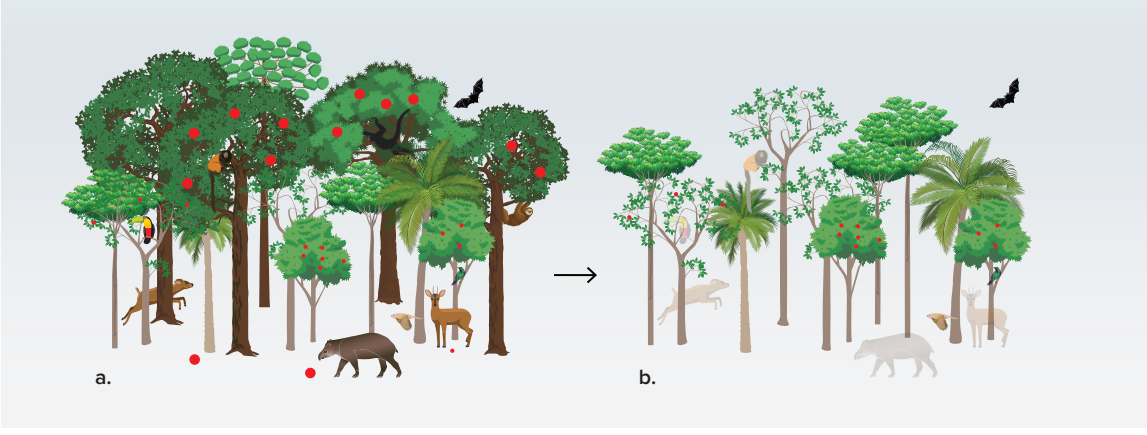


Figure 1.2 Losses of populations of large fruit-eating animals by hunting in tropical forests lead to a decline in forest carbon storage, exacerbating climate change. (a) When large animals such as the Brazilian tapir, the green-billed toucan, the black-faced lion tamarin, and the grey brocket deer that eat large fruit (indicated by red dots) are hunted and their populations decline, the large fruits and seeds that they eat are no longer dispersed throughout the forest. Since the trees in this forest that store more carbon also have larger fruits and seeds, the forest loses the carbon-dense, hardwood tree species over time (indicated in dark brown trunks). (b) The resulting forest is dominated by carbon-poor, softwood tree species with small fruits and seeds that store less carbon (indicated in light brown trunks). Figure adapted from Bello et al. 2015[10].

Similarly, the herbivorous parrotfish plays a crucial role in controlling coral-damaging algal growth on Mesoamerican coral reefs by grazing on the algae[12,13] (Figure 1.3). When parrotfish are overfished and their populations decline, algae can overgrow and outcompete corals for space, light and nutrients. This can lead not only to a decline in coral health and diversity, as corals struggle to survive in the presence of excessive algae, but also the decline of many other species that rely on the coral reef for habitat and food. Removing the parrotfish reduces the productivity of the coral, decreases the number and size of populations of other species it can support, and weakens its ability to withstand additional stressors such as climate change, pollution and disease. This leaves it more vulnerable to further degradation and potential collapse.

a.

b.

Figure 1.3 The stoplight parrotfish (a) grazes on the algae and microbes on the surface of the corals, allowing the corals access to space, light and nutrients to grow. This results in a healthy coral reef that supports many coral, fish and invertebrate populations. (b) When the parrotfish is overfished and its population declines, the coral reef becomes overrun by algal growth, the corals die, and the fish and invertebrate populations that depend on the corals decline.

The global Living Planet Index 2024

The Living Planet Index (LPI) tracks changes in the relative abundance of wild vertebrate species populations over time[14]. Relative abundance refers to the rate at which wildlife populations are changing over time, regardless of the size of that population. Populations may contain many individuals or very few: by measuring change in relative abundance, the LPI tracks the average trend rather than increases or declines in the total number of individual animals[15].

Despite 30 years of policy interventions to stop nature loss, the declines shown in previous reports continue. The global LPI 2024 shows a decrease of 73% between 1970 and 2020 (range: -67% to -78%), representing an average annual decline of 2.6% (Figure 1.4). This means that over 50 years, the size of monitored wildlife populations in the LPI has reduced, on average, by almost three quarters. Almost 35,000 population trends and 5,495 species are included in the LPI. These data are collected from monitoring sites around the world and include populations that are increasing, decreasing or stable over time. Not all the populations in the LPI are declining: many show positive or stable trends and this often varies according to the type of species and region of the world in which it lives[16].

This means that over 50 years, the size of monitored wildlife populations has reduced, on average, by almost three quarters.

By monitoring changes in the size of animal populations over time, the LPI helps us understand the health of ecosystems. Trends in the abundance of populations, or how many individual animals there are of each species at a particular location, show how well ecosystems are functioning[17]. Stable populations in the long term provide resilience against disturbances like disease and extreme weather events. A decline in populations, as shown in the global LPI, decreases resilience and threatens the stability of the ecosystem[18,19].

This global index is an average of the three indices that measure changes in ecosystems on land, in our rivers and lakes, and at sea (Figure 1.4). These results indicate that nature is declining on average across all systems: terrestrial (69% decline (range: -55% to -79%), representing an average annual decline of 2.3%), freshwater (85% decline (range: -77% to -90%), representing an average annual decline of 3.8%) and marine (56% decline (range: -43% to -66%), representing an average annual decline of 1.6%).

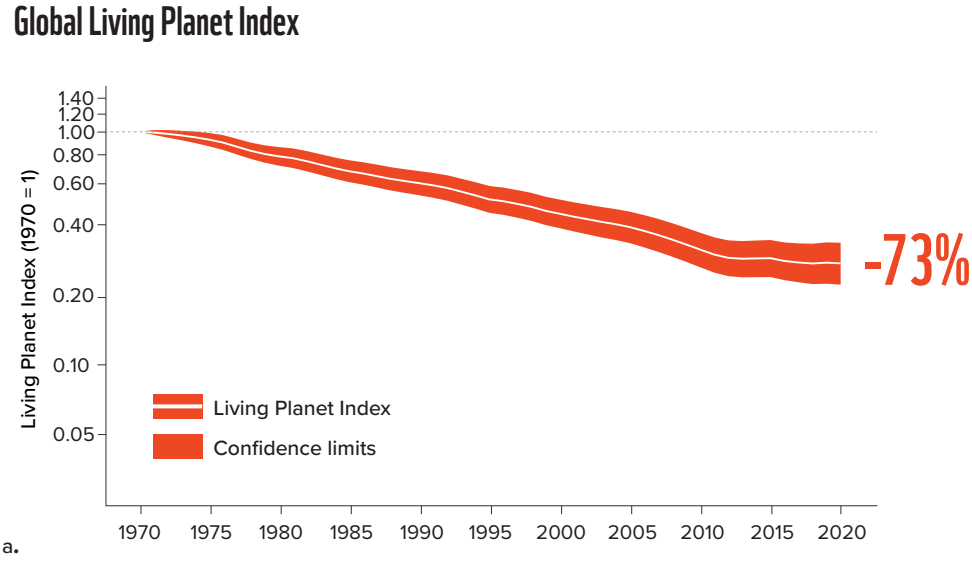
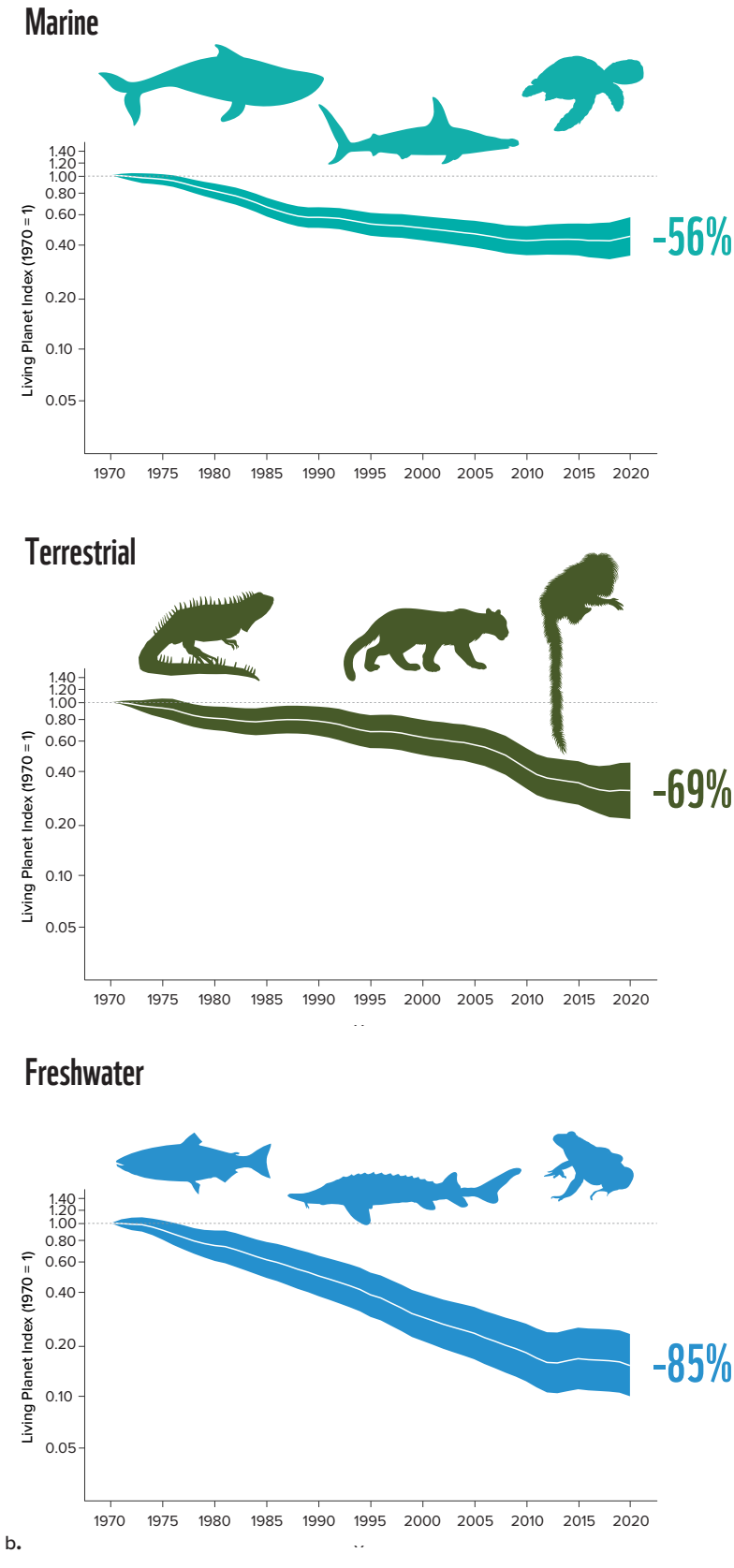


Figure 1.4 (a) The global Living Planet Index from 1970 to 2020 based on 34,836 monitored populations of 5,495 vertebrate species. The white line represents the index value, and the shaded areas represent the statistical uncertainty surrounding the value.

The marine index has declined the least out of the three systems over the 50-year period. This index is dominated by species of fish, many of which are managed to control the level of fishing pressure. Some managed fish stocks have shown recoveries in recent years, and others have shown stability which is reflected in the lower overall decline in the marine LPI[20,21]. However, other marine fish such as sharks and rays continue to show critical levels of decline[22,23].

The terrestrial index includes species from habitats such as forests, deserts and grasslands, and shows a trend of similar magnitude to the global index (69% decline).

The strongest decline is shown in the freshwater index and reflects the increasing pressure placed on freshwater habitats and species (85% decline). In particular, freshwater fish are often threatened by alterations to their habitat which can block essential migration routes. For example, the updated LPI for migratory freshwater fish shows a decline of 81% between 1970 and 2020[16].

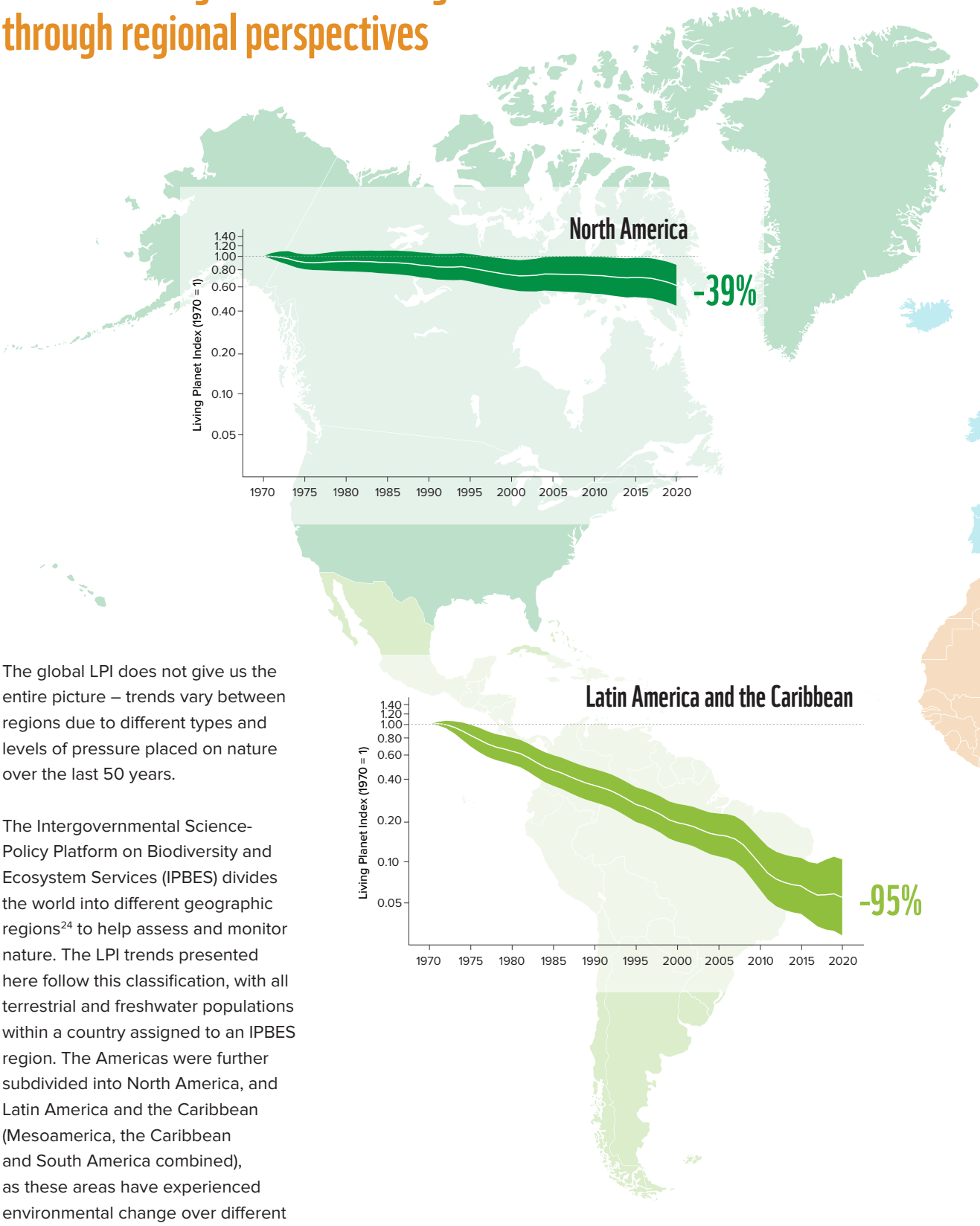


b.

Figure 1.4 (b) The Living Planet Index by ecosystem type from 1970 to 2020 based on 16,909 populations of 1,816 marine species, 11,318 populations of 2,519 terrestrial species, 6,609 populations of 1,472 freshwater species.

We use a logarithmic scale for the y-axis in the Living Planet Index charts which helps us show changes in the index more accurately[16].

Understanding drivers of change to nature through regional perspectives



The global LPI does not give us the entire picture – trends vary between regions due to different types and levels of pressure placed on nature over the last 50 years.

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) divides the world into different geographic regions[24] to help assess and monitor nature. The LPI trends presented here follow this classification, with all terrestrial and freshwater populations within a country assigned to an IPBES region. The Americas were further subdivided into North America, and Latin America and the Caribbean (Mesoamerica, the Caribbean and South America combined), as these areas have experienced environmental change over different time periods. Trends for each species group are weighted according to how many species are found in each IPBES region (Figure 1.5).

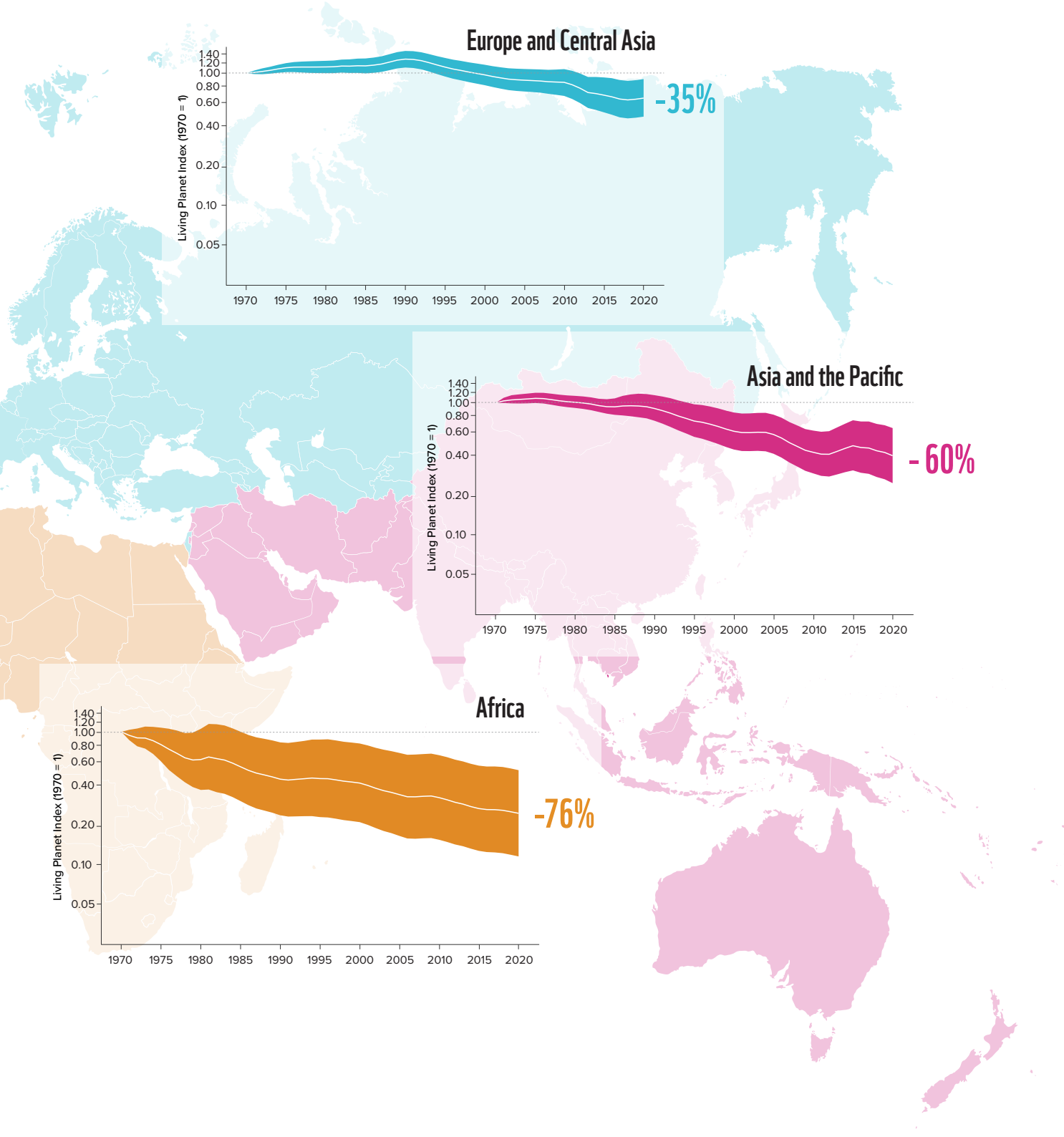


Figure 1.5 The Living Planet Index by IPBES regions for combined terrestrial and freshwater populations from 1970 to 2020, based on 2,449 populations and 935 vertebrate species in North America, 3,936 populations and 1,362 species in Latin America and the Caribbean, 4,615 populations and 619 species in Europe and Central Asia, 4,622 populations and 768 species in Asia and the Pacific and 2,304 monitored populations of 552 species in Africa. White lines represent the index value and the shaded areas represent the statistical uncertainty surrounding the value[8].

The indices for the IPBES regions show how trends in nature vary across regions, and help us understand the different drivers of change in populations (Figure 1.5). In the LPI, information on current threats is available for over 5,000 populations. This is summarized to show how frequently each threat type has been recorded for different species groups in each IPBES region (Box 1.3, Figure 1.6). Habitat degradation and loss is the most reported threat to vertebrate populations in each IPBES region, followed by overexploitation, invasive species and disease[16]. Climate change is more frequently cited for populations in Latin America and the Caribbean, and pollution is most reported in North America and Asia and the Pacific[16].

The steepest declines are seen in Latin America and the Caribbean, Africa and Asia and the Pacific (Figure 1.5). But pressures on nature in one region can be driven by forces from other regions through trade and resource extraction. For example, Europe and Central Asia has the highest ecological footprint of consumption (a measure of the natural resources and services a country consumes) of any IPBES region while also exceeding its biocapacity (the land available to produce these resources) by the largest amount; the region is therefore reliant on importing resources from nature-rich regions[25].

Box 1.3 Dominant drivers of change

- **Habitat loss/degradation:** This refers to the modification of the environment where a species lives, by either complete removal, fragmentation or reduction in quality of key habitat. Common changes in use are caused by unsustainable agriculture, logging, transportation, residential or commercial development, energy production and mining. For freshwater habitats, fragmentation of rivers and streams and abstraction of water are common threats. Marine habitats can be impacted by both activity on land, for example coastal development, and at sea, such as bottom trawling or dredging which can damage seabed habitats.

- **Overexploitation:** There are both direct and indirect forms of overexploitation. Direct overexploitation refers to unsustainable hunting and poaching or harvesting, whether for subsistence or for trade. Indirect overexploitation occurs when non-target species are killed unintentionally, for example as bykatch in fisheries.

- **Climate change:** As temperatures change, some species will need to adapt by shifting their range to track a suitable climate. The effects of climate change on species are often indirect. Changes in temperatures can confound signals that trigger seasonal events such as migration and reproduction, causing these events to happen at the wrong time. For example, misaligning reproduction and the period of greater food availability in a specific habitat.

- **Pollution:** Pollution can directly affect a species by making the environment unsuitable for its survival. This is what happens, for example, in the case of an oil spill. It can also affect a species indirectly, by affecting food availability or reproductive performance, thus reducing population numbers over time.

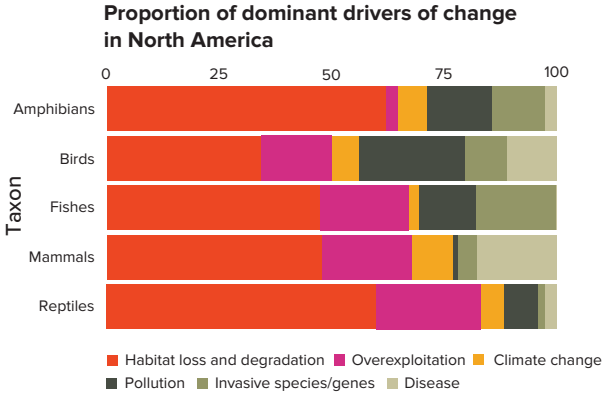
- **Invasive species/genes:** Invasive species can compete with native species for space, food and other resources; they can also be predators of native species.

- **Disease:** Species that expand their range or are introduced into a new area can transport diseases that were not previously present in the environment. Humans also transport new diseases from one area of the globe to another. Other threats such as climate change and habitat degradation can increase a species' susceptibility to disease.

- **North America** shows a 39% decline between 1970 and 2020 (range: -14% to -57%), which is equivalent to 1% decline per year (Figure 1.5). In North America, large-scale impacts on nature were already apparent before 1970, which partly explains why there is less of a negative trend than in other regions: many populations have stabilized but starting from a lower baseline[26]. There have also been some conservation successes for individual species, including certain mammals such as bighorn sheep[27], and groups such as raptors (birds of prey), many of which have recovered from historical declines[28]. The Americas are home to seven of the 17 megadiverse countries – countries that are especially rich in nature and endemic species (those found nowhere else)[29]. The differing trends for North America and for Latin America and the Caribbean reflect the difference in environmental conditions at the start of the indices in 1970.

- **Latin America and the Caribbean** show the fastest rate of decline of any region since 1970. The index declined by 95% between 1970 (range: -90% to -97%) and 2020, equivalent to 5.7% change per year (Figure 1.5). The conversion of grasslands, forests and wetlands, the overexploitation of species, climate change and the introduction of alien species have contributed to this precipitous decline[29]. In this region, climate change is more frequently reported as a threat to populations in the LPI[16]. For example, it has been suggested that climate change exacerbated the effects of a devastating fungus affecting some amphibian species in South America[30] and, in relatively undisturbed habitats, climate change may be driving the decline in some Amazonian forest birds[31]. As species populations decline, the Amazon basin, a critical system within this region, is facing the risk of reaching a tipping point (see Chapter 2).

Trends vary between regions due to different types and levels of pressure placed on nature over the last 50 years.



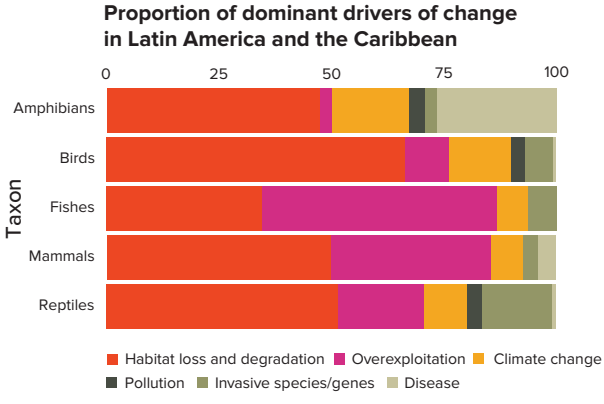
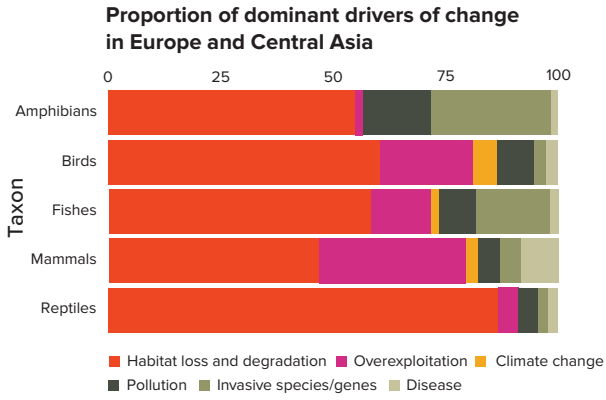


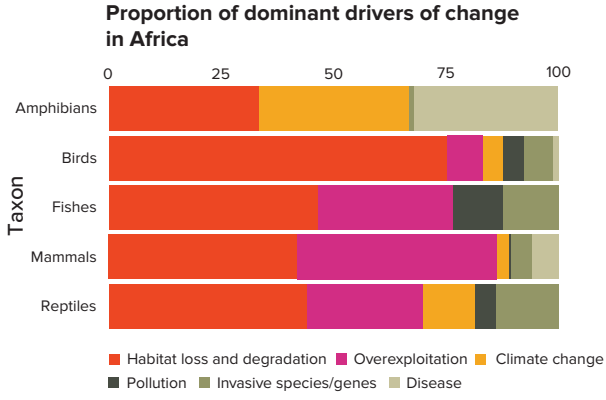
Figure 1.6 The proportion of the decline in vertebrate populations (amphibians, birds, fish, mammals and reptiles) due to the dominant drivers of change (habitat loss/degradation, overexploitation, invasive species/genes, pollution, disease, and climate change) by IPBES region[8].

- **Europe and Central Asia** is another region where nature was already in a poorer state in 1970, particularly in Western Europe. This is reflected in the index, which shows a relatively slow rate of decline at 35% (range: -10% to -53%), equivalent to 0.9% per year (Figure 1.5). Europe has also witnessed the comeback of a number of wildlife species such as the European bison and Dalmatian pelican[14], because of species reintroductions, legal protection and other conservation actions. However, average trends in freshwater fish, reptiles and amphibians are mostly negative, and these species groups are at a greater risk of extinction in Europe[32,33].

- **Africa** is unique as a region, home to significant numbers of large mammals[34] and incredibly rich in biodiversity. The LPI for Africa shows a decline of 76% (range: -49% to -89%), equivalent to 2.8% per year (Figure 1.5). Africa's biodiversity provides essential resources for many rural populations, as well as for the rest of Africa and globally[34]. Overexploitation is more commonly reported as a threat to LPI populations in Africa than other regions[16], and trends in populations that are used by people show greater declines than in other regions[35,36]. This highlights the urgent need to protect these vital resources.

- **Asia and the Pacific** comprises many varied land regions and habitats including small and large islands, home to many endemic species and unique ecosystems[37]. The LPI for this region declined by 60% (range: -76% to -36%), equivalent to 1.8% per year (Figure 1.5). The threat of invasive species and disease is frequently reported for populations in Asia and the Pacific; invasive species threaten many island endemics. For example, on the Pacific island of Guam, the accidentally introduced brown tree snake has put many bird species under threat of both local and global extinction[38]. Two species endemic to Guam – bridled white-eye and Guam reed-warbler – are already globally extinct[38]. The Mariana swiftlet, which is native to Guam and the Northern Mariana Islands, is threatened with extinction due to its small population size and threat from the invasive brown tree snake[39,40].





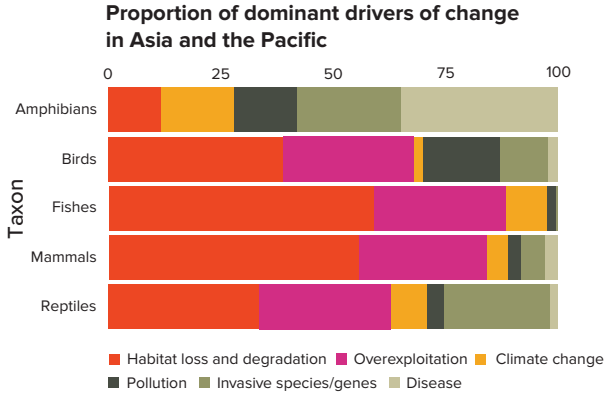


Figure 1.6 (continued) The proportion of the decline in vertebrate populations (amphibians, birds, fish, mammals and reptiles) due to the dominant drivers of change (habitat loss/degradation, overexploitation, invasive species/genes, pollution, disease, andclimate change) by IPBES region[8].

Vultures provide essential ecosystem services by removing carcasses, recycling nutrients and reducing transmission of some diseases. Their populations have been declining over three generations in Africa.

CASE STUDIES

These examples aim to illustrate the population trends as seen in the LPI data (increases and declines) and recent research and to give context to the drivers for the region.

Hawksbill turtle

Milman Island, northern Great Barrier Reef, northeast Queensland, Australia

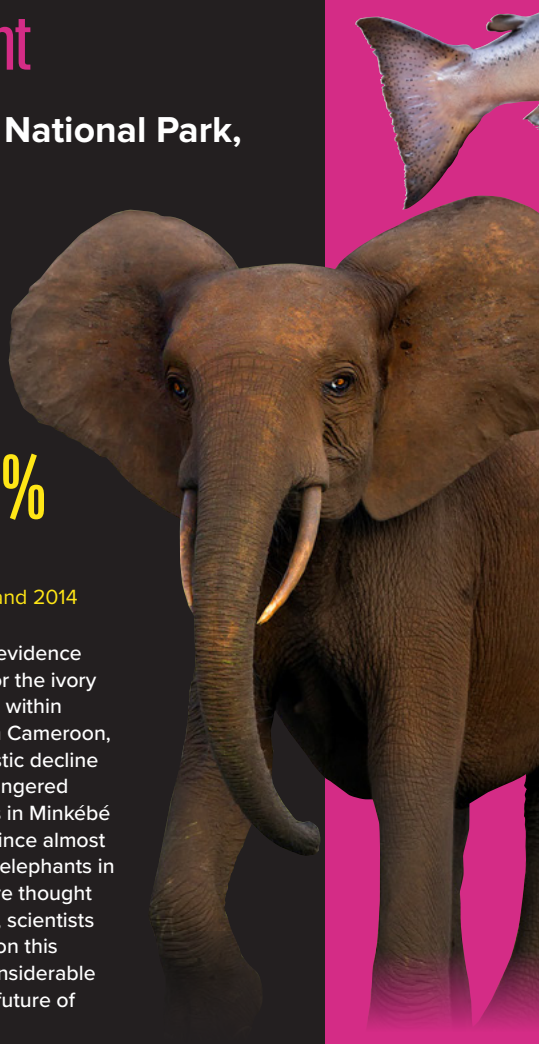
57% decline

in the number of nesting females over 28 years

Despite benefitting from the highest level of marine reserve protection within the Great Barrier Reef, there was an alarming decline in the important nesting population of critically endangered hawksbill turtles on Milman Island between 1990 and 2018. Scientists suggest this northeastern Australian population species could be locally extinct as early as 2036. Hawksbill turtles are vulnerable to habitat loss, climate change, legal and illegal harvesting, as well as entanglement in fishing nets[41,42].

African forest elephant

Minkébé National Park, Gabon



78-81% decline

between 2004 and 2014

There is strong evidence that poaching for the ivory trade, both from within Gabon and from Cameroon, caused this drastic decline in critically endangered forest elephants in Minkébé National Park. Since almost half of all forest elephants in Central Africa are thought to live in Gabon, scientists consider a loss on this scale to be a considerable setback for the future of the species[43].

Chinstrap penguin

in 94 colonies across the Antarctic

61% decline

on average between 1980 and 2019

The decline in chinstrap penguin colonies is thought to be linked to changes in sea ice and shortages of krill due to climate change and an increase in Antarctic krill fisheries. Warmer conditions with lower levels of sea ice cover result in fewer krill, the shrimp-like crustaceans which are the penguins' main food source. The penguins then spend more time foraging, which can increase the risk of breeding failure[44–46].

Chinook salmon

Sacramento River, California, United States

88% decline

since 1970

Numbers of Sacramento winter-run Chinook salmon dropped 88% from 1970 to 2022, fluctuating from year to year. The migratory route for this endangered population has been impacted by dams, which block access to their historical spawning habitat. The salmon require cold water for spawning and for the survival of their young, but they are now limited to a much smaller stretch of river, subject to low water levels and warm temperatures. Climate change is a major threat and their survival now depends on the release of cold water from the upstream dams[50–52].

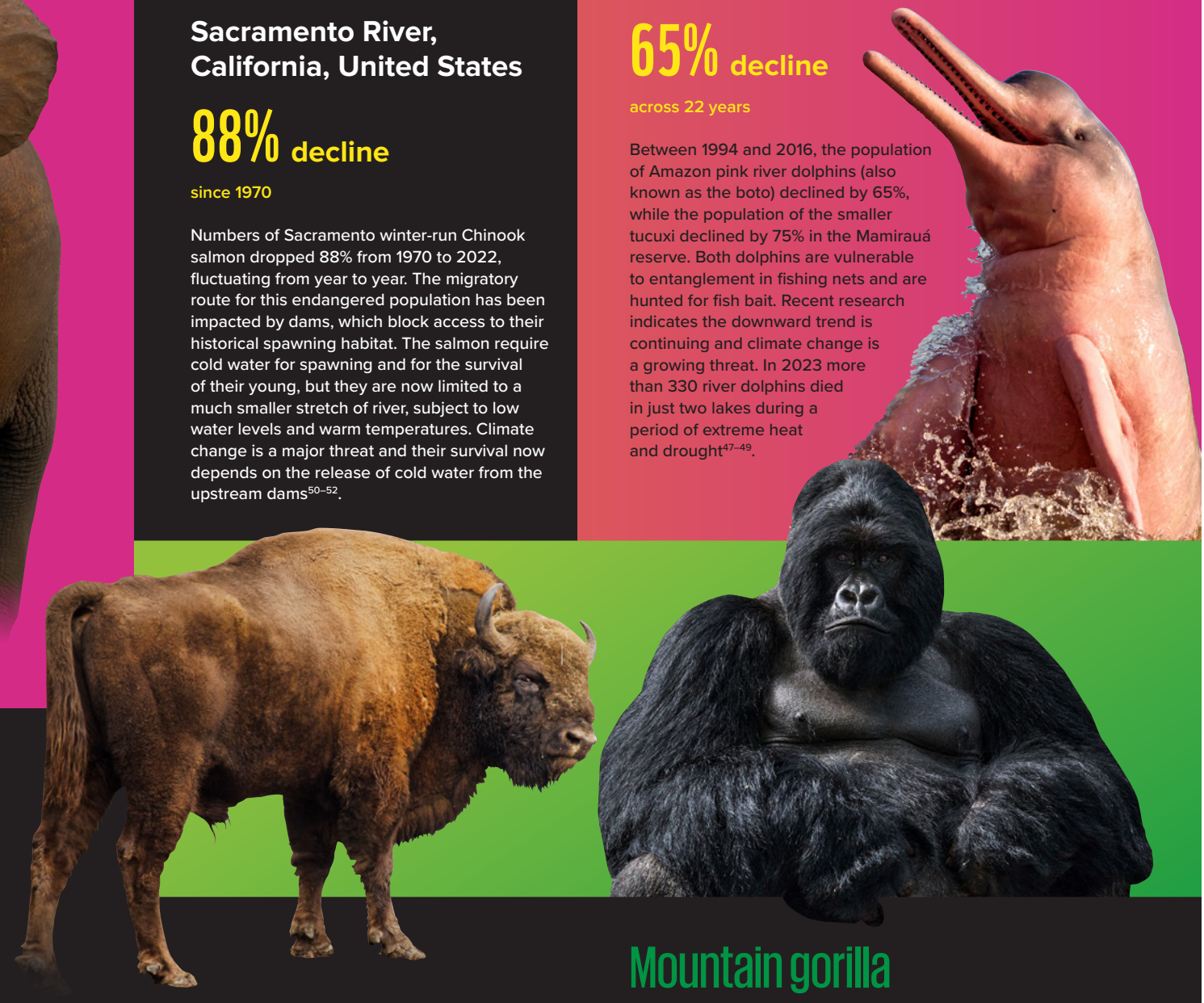
Boto or Amazon river dolphin and Tucuxi

Mamirauá Reserve, Brazil

65% decline

across 22 years

Between 1994 and 2016, the population of Amazon pink river dolphins (also known as the boto) declined by 65%, while the population of the smaller tucuxi declined by 75% in the Mamirauá reserve. Both dolphins are vulnerable to entanglement in fishing nets and are hunted for fish bait. Recent research indicates the downward trend is continuing and climate change is a growing threat. In 2023 more than 330 river dolphins died in just two lakes during a period of extreme heat and drought[47–49].



European bison

10 countries in Europe

0 to 6,800 bison

from 1950 to 2020

Following this species' extinction in the wild in 1927, this comeback is due to large-scale breeding, reintroductions and translocations. Most of the bison (91–100%) live in protected areas, and the species is protected throughout Europe[14].

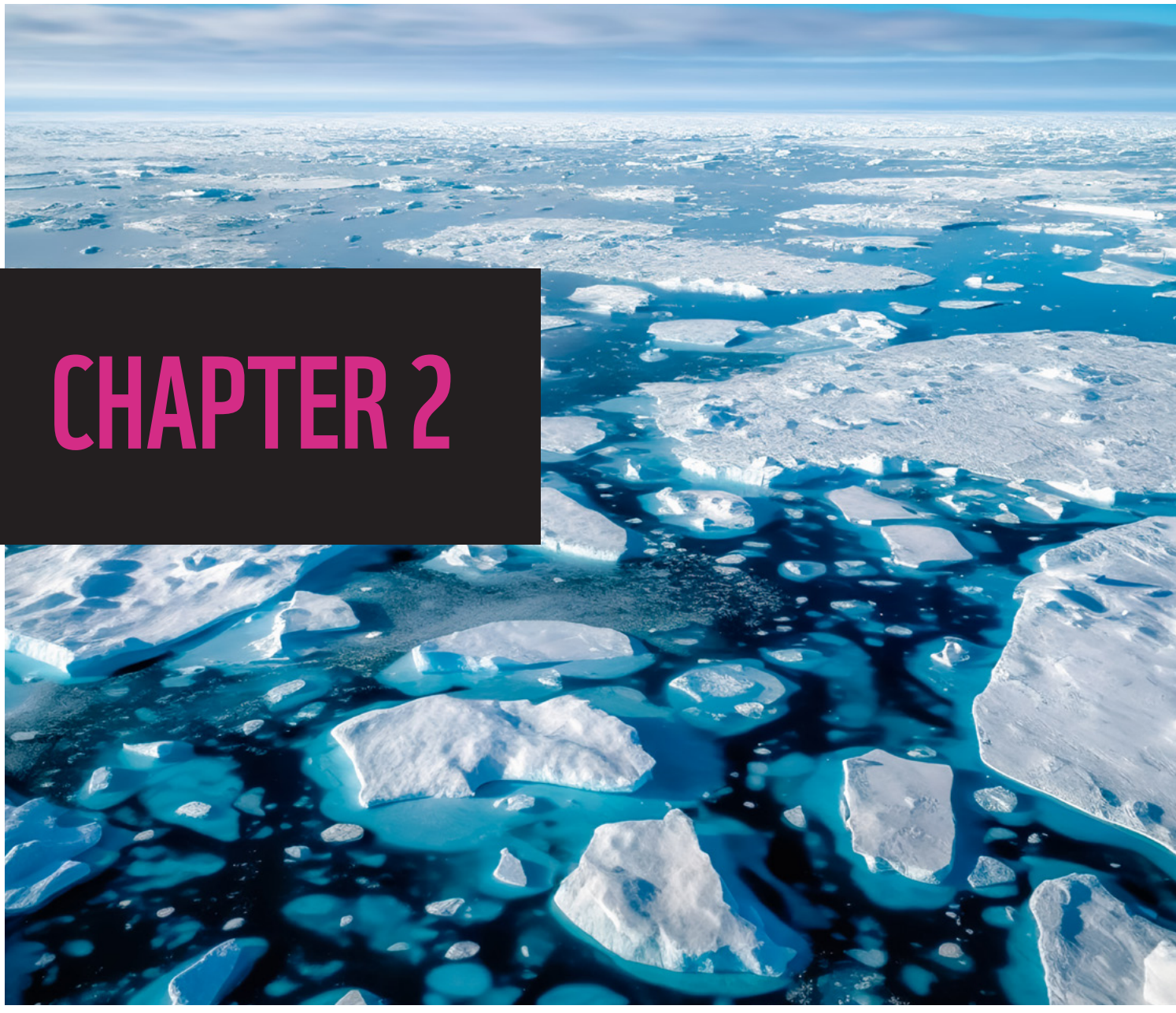
Mountain gorilla

Virunga Massif, Democratic Republic of the Congo, Uganda and Rwanda

3% increase

per year between 2010–2016

Conservation interventions such as dedicated management of protected areas, extensive engagement with communities surrounding parks, close monitoring of habituated gorilla groups and veterinary interventions where needed are thought to have driven the increase within the Virunga Massif. While the overall growth shows what is possible in primate conservation, the mountain gorilla is the only great ape globally that is not in steep decline, highlighting the urgent need for greater conservation of gorillas and other great apes[53].



CHAPTER 2

Tipping points

The Living Planet Index and other indicators discussed in the previous chapter all point to a decline in nature and biodiversity in all its forms. While some changes may be small and gradual, their cumulative impacts can add up to cause a larger, more important change. When cumulative impacts reach a threshold, the change becomes self-perpetuating, resulting in substantial, often abrupt and potentially irreversible change. This is called a tipping point[54] (Figure 2.1).

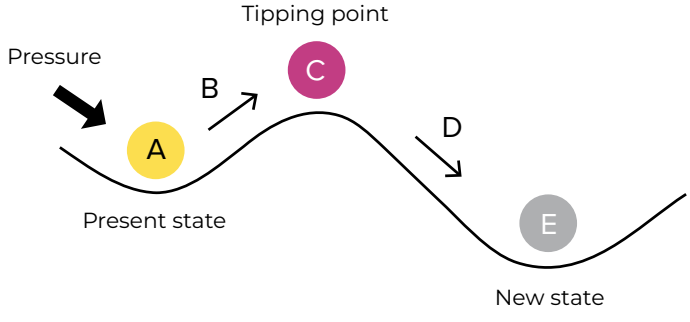


Figure 2.1 A system remains within its present state (A, yellow circle) even if small-scale changes continuously occur, as long as it can absorb the pressures (or drivers of change). However, the pressure (B) can either gradually, or through a shock, push a system to its limit or tipping point (C, pink circle). When a system reaches a tipping point change accelerates (D) until it reaches a new state (E, grey circle)[55].

Tipping points in the natural world occur when individual or combined pressures such as habitat degradation, land-use change, overharvesting or climate change push the system beyond a critical threshold. A number of tipping points are highly likely if current trends are left to continue, with potentially catastrophic consequences. These include global tipping points that pose grave threats to humanity and most species, and would damage Earth's life-support systems and destabilize societies everywhere[54]. Early warning signs from monitoring and scientific evidence indicate that six global tipping points are fast approaching (Figure 2.2):

- In the biosphere, the ***mass die-off of coral reefs*** would collapse fisheries and reduce coastal protection for hundreds of millions of people living on the coasts[56]. ***The Amazon rainforest tipping point*** would release tonnes of carbon into the atmosphere and disrupt weather patterns around the globe.
- In ocean circulation, the ***collapse of the subpolar gyre***, a circular current south of Greenland, would change weather patterns in Europe and North America. The gyre is linked to the Atlantic meridional overturning circulation (AMOC), the main ocean current system in the Atlantic, which if shut down would create a rapid decline in air temperatures in Europe, drying in the tropics and sea level rise.
- In the cryosphere (the frozen parts of the planet), the ***melting of the Greenland and West Antarctic ice sheets*** would unleash many metres of sea level rise, while ***large-scale thawing of permafrost*** would trigger vast emissions of carbon dioxide and methane.

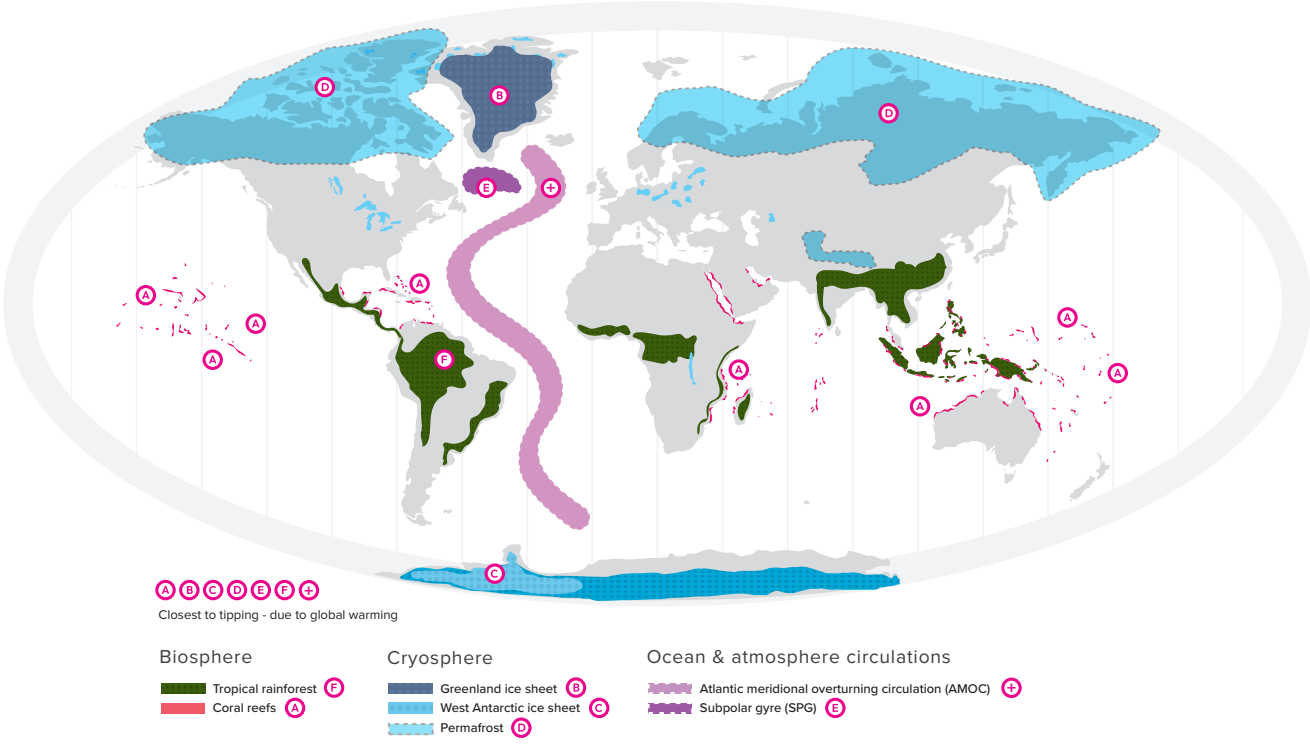


Figure 2.2 More than 25 Earth-system tipping points have been identified using evidence of past changes, observational records and computer models in four Earth-system types – the biosphere, cryosphere (ice), ocean circulations and atmosphere circulations. The six systems closest to tipping points are identified A-F in chronological order in the figure of their likely occurrence. The stability of the Atlantic meridional overturning circulation (AMOC) (+) is connected to the stability of the North Atlantic subpolar gyre (E). Figure adapted from Lenton et al. 2023[57].

Tipping points occur at local and regional as well as global levels. We read about them in the news on a regular basis. The crash of the chinook salmon fishery in North America[58], the runaway fires in parts of the European Mediterranean[59], coral bleaching in the Great Barrier Reef[60–62] and the accelerating dieback of the Amazon rainforest are examples of regional tipping points with significant ecological, social and economic consequences, including lost livelihoods, reduced security and well-being, and loss of life. All are a result of humanity's disregard for the complex interrelationships within ecosystems and the delicate balance between the biosphere and the atmosphere that have enabled us to thrive on this planet.

Early warning signals

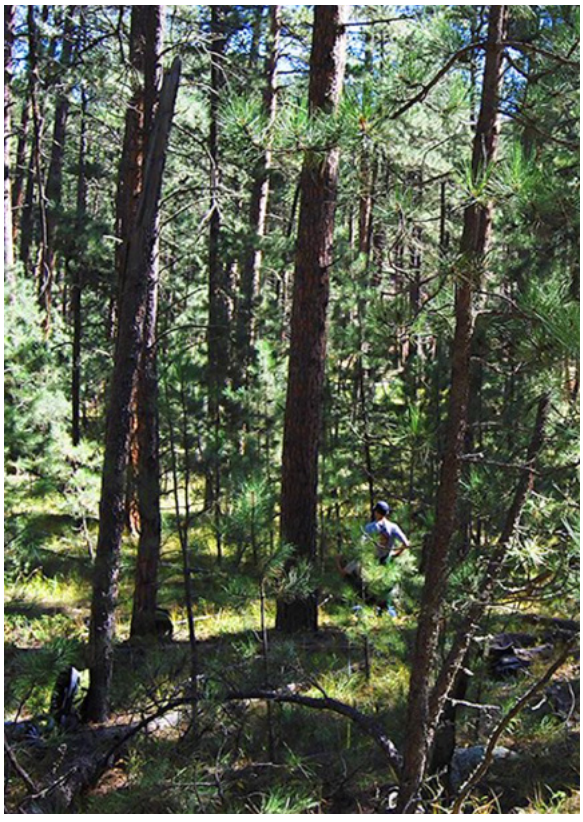
Crossing tipping points is not inevitable. Good monitoring can help us detect early warning signals – ecological, climatic and social – of tipping points ahead[54]. Monitoring populations of species is one way we detect disruptions in natural processes. When populations of animals and plants decline and disappear due to human activity, as discussed in Chapter 1, ecosystems can no longer function as they should, and the ecosystem loses resilience. In this degraded state, the ecosystem is more susceptible to natural and additional human disturbances, such as fire, invasive species, overharvest, pollution and climate change.

Ecological degradation combined with climate change increases the likelihood of reaching local and regional tipping points[54]. Climate-induced changes in atmospheric and water temperature, seasonality and species composition coupled with increasingly frequent extreme weather events such as storms, drought and floods can push degraded ecosystems into a new state. Forests can be replaced with grasslands, grasslands can become deserts, and coral reefs can become algal reefs. In many of these transitions, species population changes serve as early warning signals of reduced resilience in the ecosystem, making it more vulnerable to accelerating climate change. We are seeing these dynamics leading to tipping points in terrestrial, marine and freshwater ecosystems, as the following examples show.

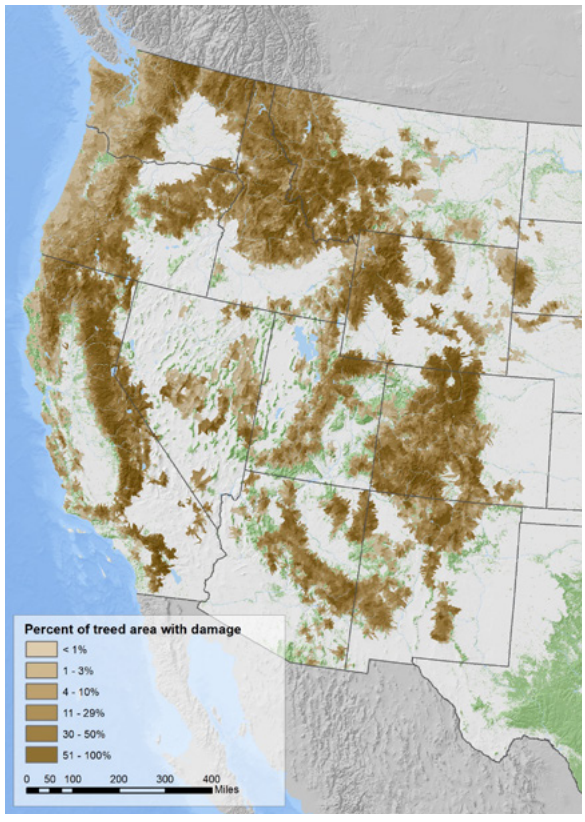
North America: fire suppression, drought and pest invasion

In western North America, a century of wildfire suppression allowed the forest understory to grow thick and dense. When a climate change-driven, multi-year drought took hold in the late 20th century, many adult pine trees and understory plants succumbed[63]. The pine trees that did survive the drought were weakened by it, making them more susceptible to infestation by the voracious growing populations of the pine bark beetle. As the climate warmed further, the pine bark beetle population expanded its range northward and upslope, killing 3.8 billion trees in its migration path and setting the stage for a new kind of fire (Figure 2.3)[64]. The subsequent firestorms burned the forests with such ferocity that the ecosystem is now irreparably altered, resulting in the loss of ecosystem function including water holding capacity and carbon storage[65]. Today, forest fires are more frequent, more intense and cover larger areas than at any point in the last 900 years for which records are available[66] (Figure 2.3). This dynamic, which has become self-driven, will eventually lead to western pine forests being replaced by shrubland and grassland[67]. The benefits that people received from those forests – wood, carbon storage for climate stabilization, clean air, water filtration and recreation – will be irretrievably lost.

Fire seasons are getting longer and extreme fire seasons more common, with recent years bringing catastrophic events in almost every region from the tropics to the Arctic Circle. Megafires of an intensity and extent unprecedented in recent history are becoming more common across the globe as ecosystem degradation combined with climate-induced changes in rainfall, heat, drought, pest infestations and invasive species propel ecosystems into a new state.



a.



b.

c.

d.

Figure 2.3 North American pine forest tipping point. (a) Western North American pine forest with dense understory from a century of fire suppression which provides increased fuel for wildfires. (b) Percentage of area with pine damage by watershed in the expanded range of the pine bark beetle infestation from 2000-2020. (c) Aerial photograph of dead pine trees (brown-orange trees) killed by the combination of pine bark beetle infestation and climate change-induced drought. (d) Aerial photograph of wildfire in the North American pine forest; fires burn more areas, hotter, and more completely due to increased fuel load from the combination of wildfire suppression, climate change-induced pine bark beetle expansion and drought[68,69].

The IPCC has predicted that 70–90% of coral reefs will die off with even 1.5°C of global warming.

Great Barrier Reef: overfishing, pollution and warming waters

In the ocean, underwater heatwaves driven by climate change lead to warmer surface waters and cause large-scale coral bleaching (Figure 2.4) – where heat stress causes the coral polyps to expel the symbiotic algae that live inside them and nourish them through photosynthesis. In Australia's Great Barrier Reef, mass bleaching events have been observed in 1998, 2002, 2016, 2017, 2020 and 2022. By the end of the summer of 2022, 91% of the reef had suffered bleaching. A further mass bleaching in 2024 was the most extensive in the Great Barrier Reef's recorded history, with widespread bleaching in the Reef's southern region – an area that has largely been unaffected by previous events.

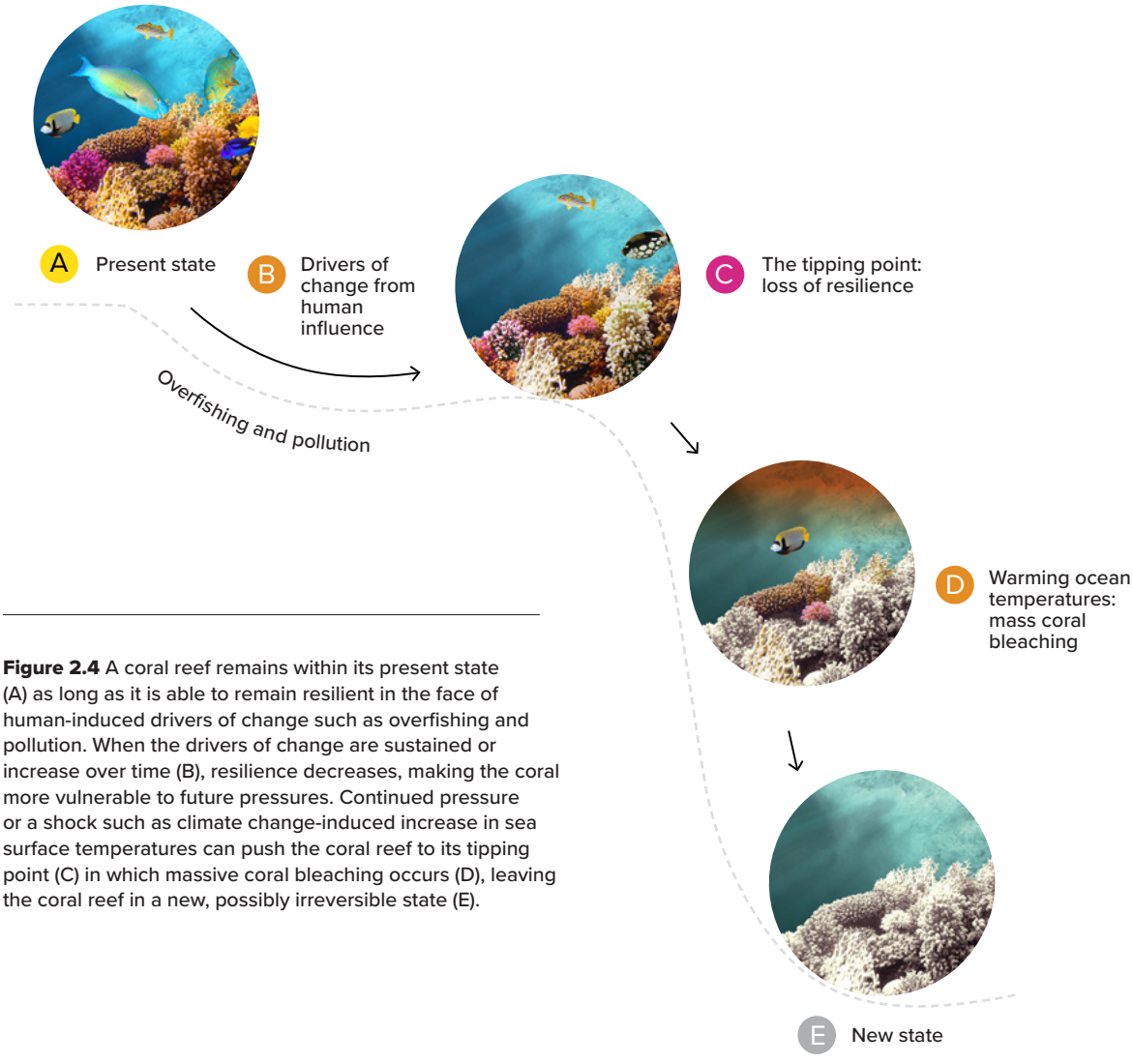


Figure 2.4 A coral reef remains within its present state (A) as long as it is able to remain resilient in the face of human-induced drivers of change such as overfishing and pollution. When the drivers of change are sustained or increase over time (B), resilience decreases, making the coral more vulnerable to future pressures. Continued pressure or a shock such as climate change-induced increase in sea surface temperatures can push the coral reef to its tipping point (C) in which massive coral bleaching occurs (D), leaving the coral reef in a new, possibly irreversible state (E).

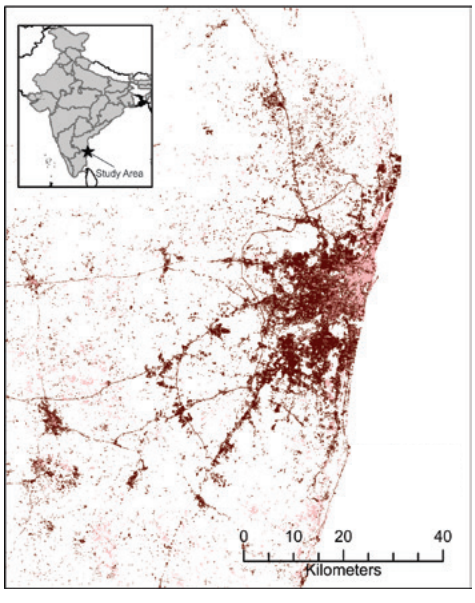
While some reef-building corals can recover from bleaching events, others cannot, shifting the composition of coral species on the reef and decreasing the diversity of corals and the ocean life that depend on them[70]. Each bleaching event makes it harder for corals to recover[71]. Their resilience and recovery are further weakened by other pressures, including pollution run-off from the land and overfishing of populations. The Great Barrier Reef has shown remarkable resilience in its recovery from previous coral bleaching events but as these events are becoming more frequent and severe, its ability will likely become increasingly impaired.

The same dynamics are playing out in other coral reefs around the globe. The Intergovernmental Panel on Climate Change (IPCC) has predicted that 70–90% of coral reefs will die off with even 1.5°C of global warming, though recent analysis suggests the outlook is even more dire[72-74]. The loss of some of the planet's most biodiverse ecosystems would have severe social and economic consequences. Approximately 330 million people depend directly on reefs for protection from storm surges, sources of food and livelihood, and other benefits[56]. Additionally, one billion people rely directly or indirectly on the global net economic value of coral reefs, which amounts to tens of billions of dollars per year and supports industries such as tourism, commercial fisheries and coastal development[75].

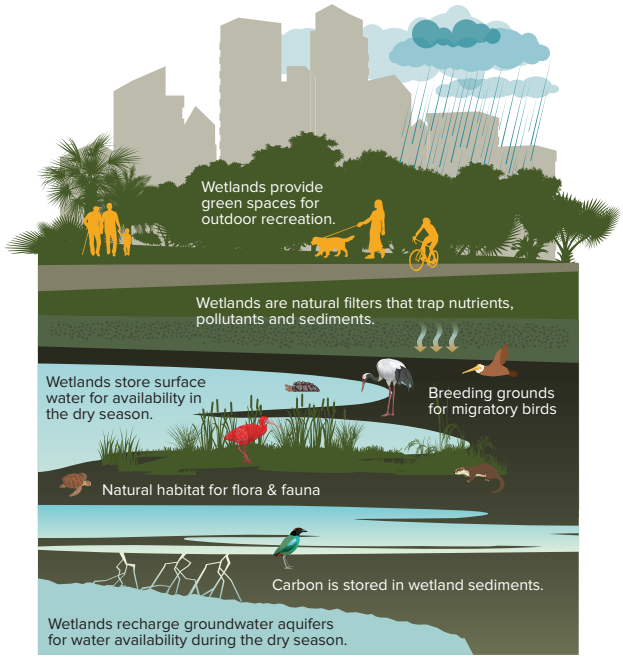
On 19 June 2019, dubbed “Day Zero”, the 11.2 million people of Chennai went without drinking water.

India: wetland loss, drought and flooding

In Chennai on the Bay of Bengal in eastern India, rapid urban expansion resulted in an 85% decline in the area of wetlands (Figure 2.5a). As a result, vital services that these ecosystems provide – including retaining water, recharging groundwater and flood regulation – were radically diminished, leaving the people of Chennai vulnerable to both droughts and flooding made worse by climate change (Figure 2.5b)[76]. When severe drought hit the region, it caused the city’s major reservoirs to run dry and groundwater levels to plummet in 2019. Without its wetlands to retain and recharge water supplies, the city of 11.2 million people was left vulnerable and forced to truck in water to meet basic needs like drinking, cooking and bathing[77]. Ironically, the loss of the region’s wetland ecosystems also exposed its inhabitants to flooding from extreme rainfall events in 2015 and 2023[76]. Although the amount of rainfall in 2015 was excessive, it was not unprecedented: the damage inflicted on the city was made worse by the destruction of species-rich wetlands and natural drainage systems, which used to shield people from the worst impacts of both droughts and floods. Recognizing their importance to the people of Chennai, the government is now restoring the wetlands and the services they provide.



a. Urban expansion in Chennai



b.

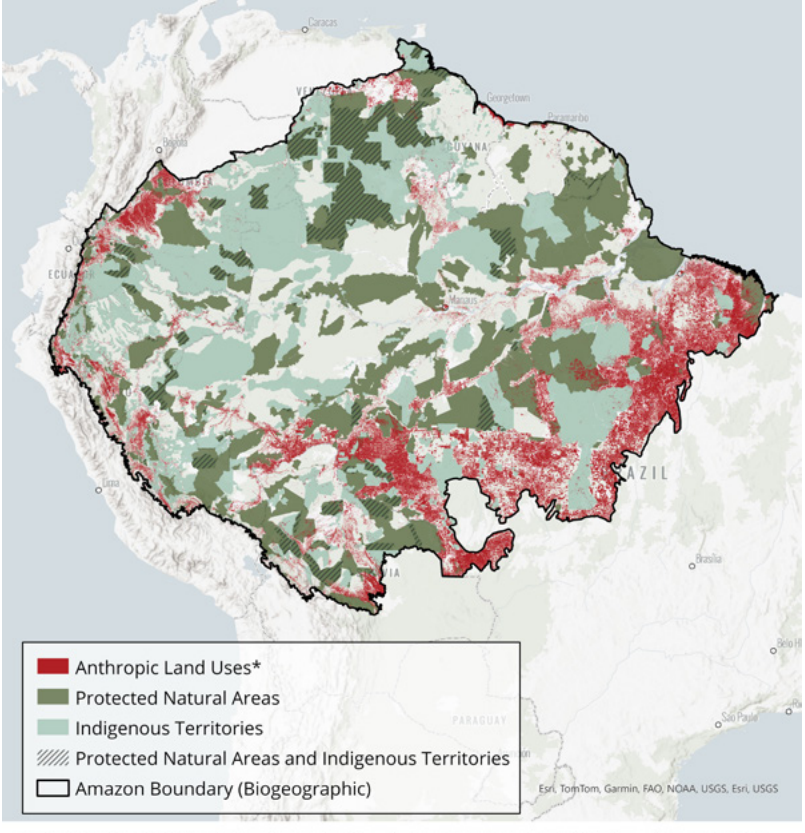
Figure 2.5 (a) Urban expansion and destruction of the wetland ecosystems in the city of Chennai between 1988 (light red) and 2019 (dark red) led to both widespread flooding and water depletion. (b) Wetlands and their plant and animal populations are important for storing surface water during monsoons, delivering water during the dry season, improving water quality and controlling floods. Figure adapted from TNC 2021[78].

Tipping points with global significance

Tipping points can have impacts that reverberate far beyond the region of origin. This is the fear for the Amazon rainforest (Figure 2.6).

The Amazon rainforest holds more than 10% of Earth's terrestrial biodiversity and 10% of all known fish species[79], stores 250–300 billion tons of carbon (equivalent to 15–20 years of global greenhouse gas emissions[80]), and contributes significantly to the rainfall to the southern Amazon, Pantanal and La Plata Basin where Rio de Janeiro, São Paulo and Buenos Aires sit[81]. The Amazon is also home to over 47 million people, including 2.2 million Indigenous and traditional inhabitants, whose cultures are deeply interwoven with nature and who depend on the sustainable use of its resources.

Transpiration, or water vapor released from the surface of plants, creates much of the rainfall that sustains the forest and makes it resilient to drought – as long as the rainforest remains largely intact[82]. But deforestation, forest degradation and disturbance are decreasing the resilience of the system, making it more vulnerable to future climatic change (Figure 2.7). Resilience will be further weakened by the mass mortality events – the sudden deaths of large numbers of animals of a single species – which large parts of the Amazon are expected to experience due to land-use and climate change[83,84].



*Anthropic land uses include the pasture, agriculture, silviculture, oil palm, mosaic of uses, urban infrastructure, and mining classes from the 2022 Land Cover and Land Use data from MapBiomas Amazonia Collection 5.

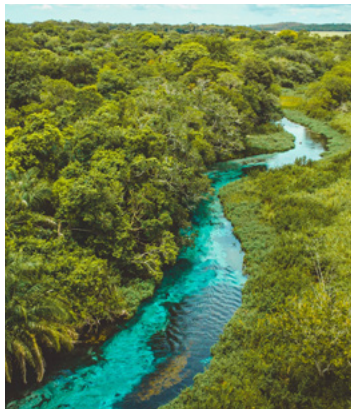
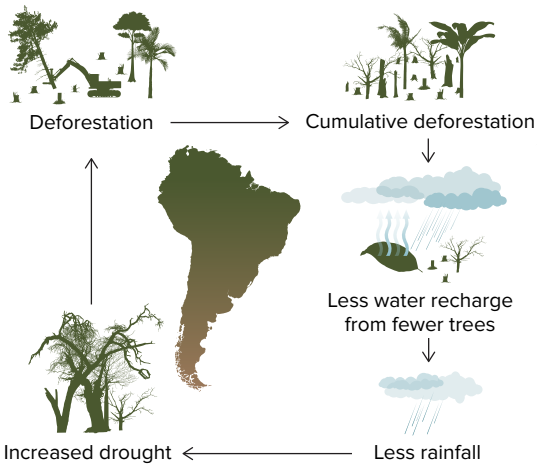


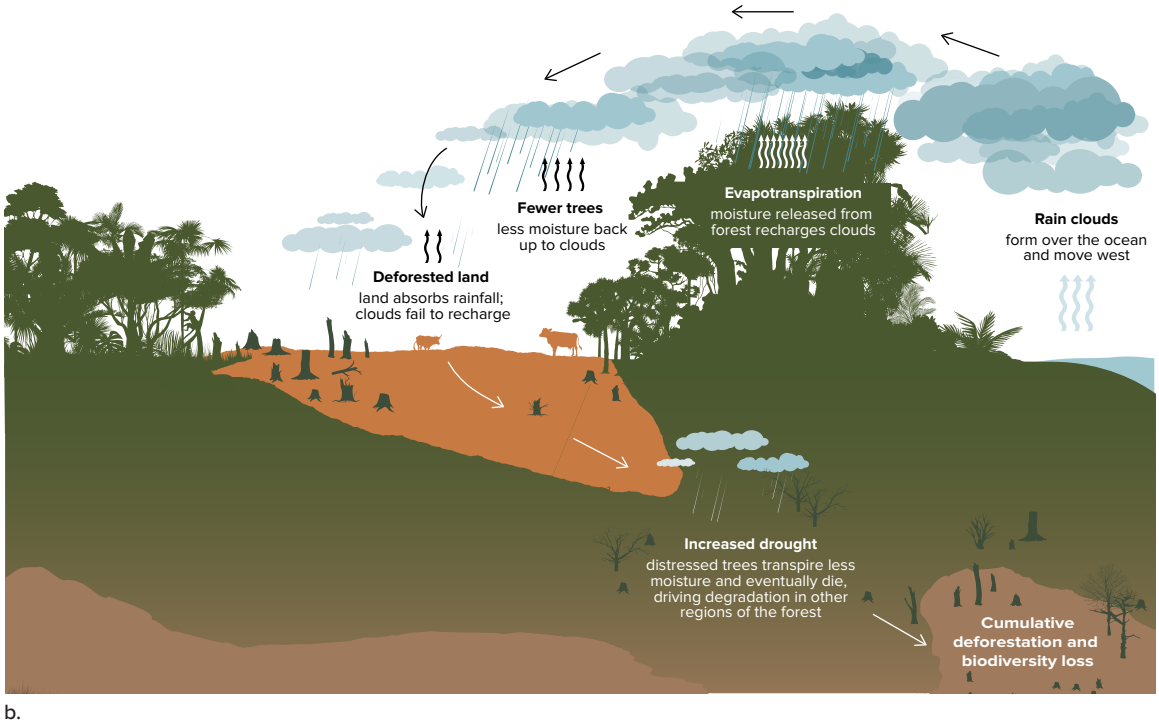
Figure 2.6 Current land occupied by anthropic land uses[85] (red) within the Amazon rainforest biogeographic boundary, which spans eight countries and one territory. Twenty-two per cent of the biome is in protected areas only (dark green), 25% is in Indigenous territories only (light green) and 6% is in both protected areas and Indigenous territories (hatch). Fourteen per cent of the original forested area of the biome was deforested by 2018[86]. Data from RAISG 2022[87], 2022[88], 2022[89].

As climate change and deforestation lead to reduced rainfall, a tipping point could be reached where the environmental conditions across much of the Amazon biome become unsuitable for tropical forest, triggering an irreversible change. The impacts would be devastating, with irreversible losses of biodiversity and cultural value, changes to regional and global weather patterns, and implications for agricultural productivity and global food supplies. A change of this magnitude would also accelerate global climate change, as the Amazon would shift from being a carbon sink to a source of emissions through fires and plants dying off. Up to 75 billion tons of carbon could be released into the atmosphere which would render the 1.5°C goal impossible to achieve[90].



a.

Are we close to an Amazon tipping point? This remains an active area of research, but several studies suggest a tipping point could be on the horizon if just 20–25% of the Amazon rainforest were destroyed. Approximately 14–17% of the original forested area of the Amazon biome has been deforested, with significant variation in deforestation rates across the nine Amazon countries[85,86,90]. And the Brazilian Amazon which encompasses 59% of the Amazon biome was 19% deforested in the same time period[85,86]. Deforestation and drought create a domino effect (Figure 2.7): fewer trees means less transpiration, which means less rainfall, reducing the availability of water elsewhere in the forest and causing more trees to die. This further reduces transpiration, and so on in a vicious circle. By 2050, up to 47% of the area of the Amazon rainforest will likely be exposed to simultaneous disturbances including warming temperatures, extreme droughts, deforestation and fires[92].



b.

Figure 2.7 (a) The Amazon Domino Effect: In a healthy, intact forest, rain clouds form over the ocean and travel west over the rainforest, releasing rainwater and recharging their moisture from the transpiring rainforest. This process continues as the clouds turn south, dropping more rain. (b) Fewer trees result in less transpiration by the rainforest, less cloud recharging and consequently less rainfall to the west and south. Less rain drives degradation in the forest to the west and south, further contributing to ecosystem change[91].

A wake-up call

From the ongoing decline in biodiversity to the creeping rise in global temperatures, it's all too easy to become accustomed to gradual change and to put off the action needed. Tipping points, whether local, regional or planetary, can initially be gradual, but then sudden and irreversible. Ecosystems will not instantaneously change from one state to another, but beyond a certain point of stress, change becomes unavoidable and rapid. Knowing this should serve as a wake-up call; we cannot put off the necessary action to avoid tipping points that will make global nature and climate goals impossible to achieve. In the case of the Amazon, current rates of deforestation could lead to such a tipping point within a decade. We do not currently have the policies or finance in place to end deforestation and degradation. And we know there will be a lag between deciding on action, implementing action and seeing resultant change. The only safe moment to act is now.

In many cases, the balance is precarious – but tipping points can still be avoided. We have an opportunity to intervene now to increase ecosystem resilience and reduce the impacts of climate change and other stressors before these tipping points are reached. This requires integrated solutions from local to global level that address multiple drivers of change simultaneously. And a framework already exists in the shape of the Global Biodiversity Framework, the Paris Climate Agreement and the Sustainable Development Goals, if we act on these together. This is the subject of the next chapter.

CHAPTER 3

Global goals provide an opportunity to reverse our current trajectory, step away from tipping points and put the world on a path to sustainability.

Global goals and progress

The nations of the world have set global goals for a thriving, sustainable future, including halting and reversing the loss of biodiversity (under the Convention on Biological Diversity, or CBD), capping global temperature rise to 1.5°C (under the United Nations Framework Convention on Climate Change, or UNFCCC), and eradicating poverty and ensuring human well-being (under the Sustainable Development Goals, or SDGs). But despite these global goals, national commitments and actions on the ground fall far short of what's needed to avoid the dangerous tipping points discussed in the previous chapter.

Figure 3.1 The goals and targets of the Kunming-Montreal Global Biodiversity Framework (GBF), under the CBD[93]. The GBF lists four goals and 23 targets for 2030 to conserve 30% of Earth's lands, oceans, coastal areas and inland waters and restore at least 30% of degraded lands and waters; to reduce pollution and invasive species by 50%; to make production systems sustainable and to ensure benefit sharing from those systems; and to reduce harmful government subsidies by US$500 billion annually and cut food waste by half.

The global goals for biodiversity, climate and sustainable development all recognize that nature underpins a stable climate and human well-being. The Kunming-Montreal Global Biodiversity Framework (GBF), under the CBD, includes targets to conserve 30% of land and waters, complete or begin the restoration of 30% of degraded areas, and bring human-induced species extinctions to zero by 2030[93] (Figure 3.1). The status check for the Paris Climate Agreement – known as the global stocktake – explicitly recognized the GBF and emphasizes the importance of conserving, protecting and restoring nature, including halting and reversing deforestation and managing ecosystems to absorb carbon from the atmosphere and to help people adapt to climate change[94]. The preamble to the SDGs states that "social and economic development depends on the sustainable management of our planet's natural resources", and 2 of the 17 goals specifically focus on conserving, restoring and sustainably using ecosystems and biodiversity in the ocean and on land.

In 2023, both the SDG Progress Report and the global stocktake of the Paris Agreement warned that none of the goals under the respective agreements would be met by 2030 without drastic action. Current actions would lead to a decidedly unsustainable, inequitable world by 2050[94,95] (Box 3.1). Over half the SDG targets for 2030 would be missed, with 30% of them stalled or getting worse from the 2015 baseline. And even though 74% of nations that signed onto the 2015 Paris Agreement have strengthened their commitments to reduce or limit greenhouse gas emissions by 2030, current commitments would lead to an average global temperature increase of almost 3°C by the end of the century, inevitably triggering multiple catastrophic tipping points[94].

Box 3.1 Addressing inequalities to achieve global goals

A small group of nations are responsible for the majority of global consumption[96], greenhouse gas emissions[97] and resource degradation. At the same time, there is growing poverty globally and many people do not have their basic needs met[98]. Poorer countries and poorer people bear the burden of wealthy nations' resource and energy use in the form of unsustainable development, environmental degradation and climate change impacts[99,100]. If we do not also address overconsumption, we will continue to use more resources than our planet has the capacity to provide[101], we will not be able to achieve conservation, climate and sustainability targets, and we will not be able to address poverty and inequality. Different approaches to economic growth will be necessary to address the global goals depending on a country's economic status. We need to move beyond economic wealth and GDP as the principal measures of progress, toward a well-being economy that promotes sufficiency, shared prosperity and living in a way that regenerates nature and stabilizes the climate.

The GBF, an action plan to protect, restore and sustainably use and manage ecosystems, was signed by 196 parties to the CBD in December 2022 to great fanfare. But like the Paris Agreement and the SDGs, little actual progress has been made. A recent analysis revealed that although there have been many high-level commitments, implementation rates are low and the promised finance isn't nearly enough (see Chapter 5). Most national biodiversity strategy and action plans – which countries have to produce to implement the GBF – are incomplete, lack adequate methods and data to measure progress, and suffer from a lack of coordinated institutional support[102].

Reaching 2030 on the pathway to a sustainable future

Fragmented governance systems at local, national and global levels are not designed to manage complex social and ecological systems[103,104] (Box 3.2). In almost every nation, a tangled web of laws, regulations and institutions inherited from the past presents a significant barrier to the coordinated action required today[105]. To achieve the global goals, we need to strengthen and align national laws and develop coordinated policies and actions to deliver better outcomes for people, nature and climate. Expanding civil society inclusion, enhancing private sector involvement and accountability and addressing pervasive issues like crime and corruption should complement these efforts. Environmentally harmful subsidies and other perverse incentives that undermine progress also urgently need to be addressed.

Progress on nature, climate and sustainable development goals is only possible with close coordination designed to exploit synergies and promote collaboration, and to identify and mitigate potential trade-offs (Box 3.3). Policies targeted to achieve only one goal can offset progress made toward others, leading to "winners" and "losers"[106,107]. Pursuing these goals in parallel without considering potential trade-offs and opportunities is not only likely to end in failure, but also risks undermining the social, political and financial support for pursuing the global goals[54,108].

Box 3.2 Inclusion and equity at the national level

Strategies and processes to achieve the global goals within countries must also be inclusive and deliver equitable outcomes that reduce social, economic and political disparities. When governments embrace consultative processes, encourage collaboration among agencies and promote public engagement in shaping strategies, they increase buy-in and the chances of success[107]. Comprehensive assessments of how actions will impact aspects of human well-being like health, wealth, livelihoods or culture can help design interventions with positive and enduring impacts[109,110] and avoid creating greater inequality or undermining human rights. Finally, accelerating formal recognition of tenure rights to lands and waters controlled by Indigenous Peoples and local communities[111] will ensure they can pursue the future they want. National laws, regulations and processes which formally acknowledge and integrate plural knowledge systems and practices and support fairness, rights and equity increase the shared understanding necessary to achieve shared outcomes[4,112].

Box 3.3 Trade-offs and synergies

Approaching climate, biodiversity and development goals in isolation raises the risk of conflicts between different objectives. Examples include:

- **Land-use conflicts:** Afforestation and biofuel production to mitigate climate change may threaten biodiversity conservation goals by encroaching on natural habitats, or undermine food security by displacing food crops.
- **Energy and conservation:** Expanding renewable energy to meet climate goals could have adverse impacts on biodiversity and ecosystems – including hydropower dams fragmenting freshwater ecosystems, mining for critical minerals and new power lines in ecologically sensitive areas.
- **Equity and justice:** Carbon taxes can be a way to reduce emissions – but poorly designed measures could place a disproportionate burden on low-income households. Protected areas created to conserve biodiversity could drive land grabs where land rights are not respected, and prevent neighbouring communities from accessing good farmland, fishing grounds, water sources and other natural resources.

With careful planning and coordination, many conflicts can be avoided and trade-offs minimized and managed. At the same time, tackling the goals in a joined-up way opens up many potential opportunities and synergies. Examples include:

- **Conservation and climate action:** Protecting biodiversity and ecosystems can help mitigate climate change by preserving carbon sinks such as forests and wetlands. Equally, efforts to mitigate climate change, such as reducing deforestation and promoting reforestation, can also contribute to biodiversity conservation and ecosystem resilience.
- **Clean energy access:** Solar power and other renewables can provide affordable, reliable and sustainable energy to communities who don't currently have access to modern energy sources, supporting socioeconomic development as well as climate goals. Energy efficiency measures can benefit people living in energy poverty.
- **Climate resilience and poverty reduction:** Adaptation measures to address climate change impacts can help alleviate poverty, particularly in vulnerable communities. Enhancing climate resilience through sustainable agricultural practices, access to clean water and infrastructure development can simultaneously support poverty reduction.

In the face of looming regional and global tipping points, it's never been more urgent to recognize the interconnectedness of nature, climate and human well-being and to tackle these goals in a coordinated way. In Chapter 4, we discuss key solutions that can help us meet the global goals: better conservation; a transformation in food production and consumption; the transition to a clean, renewable energy system; and redirecting finance to support climate, nature and sustainable development goals. If these solutions are integrated and coordinated across scales, there is tremendous potential to meet our 2030 global goals, avoid dangerous tipping points and set the world on course for a sustainable future.

Snow crab and red king crab stocks declined in 2022 due to a combination of factors, including warming from climate change, leading to early fisheries closures in Alaska for the year.

CHAPTER 4

To be enduring, all transformative solutions will need to be inclusive, just, equitable and grounded in human rights.

Sustainable solutions

To maintain and enhance species populations, ecosystem functions and nature's contributions to people, and to help ensure the stability of our climate and prosperity for all, we need conservation actions that meet the scale of the challenge. Halting and reversing nature loss by 2030 requires not only achieving traditional conservation at larger scales, but also systematically addressing the drivers of nature loss including food production, consumption and waste, the amount and types of energy we use, and the financing to support the transformations of these systems. To be enduring, all transformative solutions will need to be inclusive, just, equitable and grounded in human rights.

Nature conservation

The LPI and other indicators showing nature's decline present an uncomfortable truth. Our efforts to conserve species and ecosystems have not kept pace with the unrelenting pressures at the heart of their decline. To halt and reverse the loss of nature will require fundamental changes in our societies and economies to address these pressures. It will also require new approaches to conservation, recognizing that looking after nature isn't optional but is critical to everybody's well-being.

Evolving approaches to conservation

Historically, conservation has focused on protecting threatened species and habitats. These efforts have brought many successes. Despite the alarming overall decline in species populations shown in the LPI, the data also includes many populations that have stabilized or increased as a result of conservation efforts. Protected and conserved areas have slowed the extinction rate for mammals, birds and amphibians by an estimated 20–29%[3] and a recent analysis showed that conservation actions have had a net positive effect[113]. But isolated successes and merely slowing the decline of nature are not enough.

The traditional approaches of the conservation sector are limited, and can even be counter-productive. A narrow focus on species neglects the diversity of ways in which cultures around the globe understand, value, depend on and care for nature. It also fails to account for the full range of ecosystem functions and the benefits they provide to people. At worst, attempts to protect nature from people can infringe on human rights and lead to conflict. The creation of protected areas, for example, has in numerous cases displaced Indigenous Peoples and local communities from their land and deprived them of access to natural resources[114].

Conservation efforts that don't take account of the rights, needs and values of people will not succeed in the long run. There is increasing recognition of the importance of people-centred and locally led conservation that respects people's rights, embraces diverse values and cultural perspectives and ensures benefits are equitably shared. The British ecologist Georgina Mace describes this transition as a series of shifts from "nature for itself" (protecting wilderness) to "nature despite people'' (reducing pollution and overexploitation), "nature for people" (maintaining ecosystem services) and "nature and people" (managing socio-ecological systems)[115].

In the following sections, we describe a range of approaches that can support effective conservation at the scale needed to halt and reverse the loss of nature and the benefits it provides to people.

Transforming conservation

More – and more effective – protected areas

There are nearly 300,000 designated protected areas globally, covering 16% of the planet's lands and 8% of its oceans[116] (Figure 4.1). They range from strict nature preserves, national parks and wildlife reserves to areas with sustainable use of natural resources[117]. Despite a significant expansion over recent years, protected areas are not representative of the ecological diversity on Earth – freshwater systems, for example, are not well covered[118]. Their distribution remains uneven, and overall coverage is not sufficient to deliver the full range of nature's contributions to people.

Simply designating a protected area is no guarantee that nature will be protected. Many remain vulnerable to persistent threats and lack the capacity to ensure effective management[119]. In reality, some areas receive only limited protection. In addition, the rate of loss of legal protection for established land and marine protected areas has accelerated in the 21st century, with 247 million hectares lost globally, equivalent to 8% of current protected areas[120].

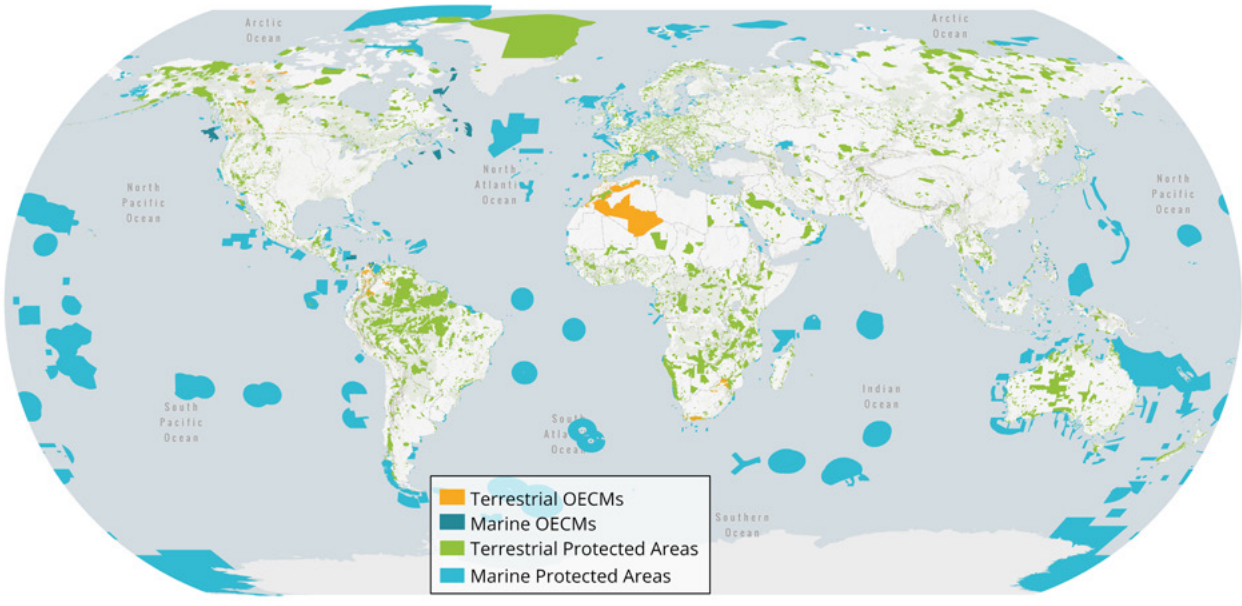
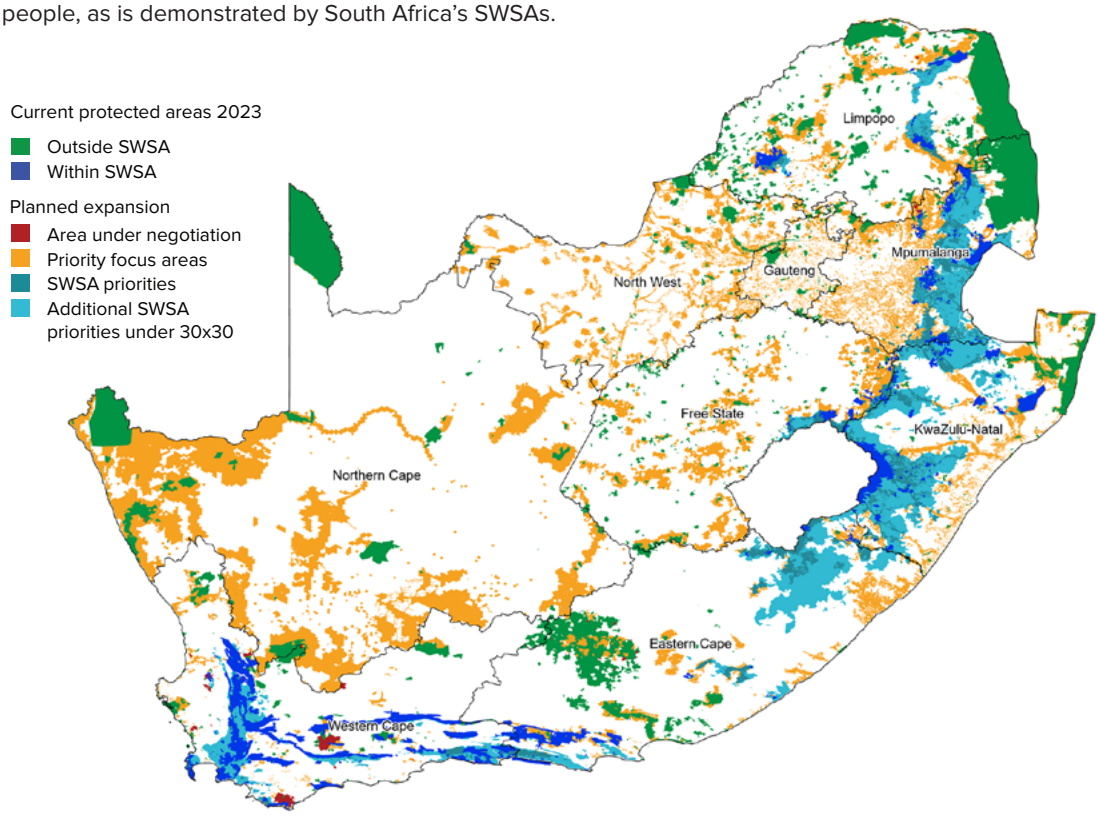


Figure 4.1 Protected and conserved areas cover 27.3 million km^2 of terrestrial ecosystems, including land and inland water, and 36 million km^2 of marine ecosystems. Additionally, reported other effective area-based conservation measures (OECMs) cover 2.19 million km^2 of terrestrial ecosystems and 422,294.82 km^2 of marine ecosystems. Figure adapted from UNEP-WCMC and IUCN 2024[116].

Achieving the global goals will require a huge increase in effective protected area coverage over the next five years. Target 3 of the GBF, the so-called 30x30 target, calls for 30% of lands, waters and sea to be protected by 2030 "through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing indigenous and traditional territories where applicable"[93]. Target 2 aims to restore 30% of degraded areas by 2030, which will include restoring converted areas back to natural states, and rehabilitating and improving the ecological integrity of degraded natural areas, which can all be used to strengthen networks of protected areas and their connectivity. This is an unmissable opportunity to scale up effective conservation to unprecedented levels – and it must be done in ways that avoid the mistakes of the past and respect the rights of Indigenous Peoples and local communities (Box 4.1).

Box 4.1 Protected area expansion in South Africa

Recognizing that their nation's protected area system fell short of what was needed to represent ecosystems, achieve ecological sustainability and increase resilience to climate change, the South African government applied systematic conservation principles to develop its protected areas expansion strategy[121]. The most recently published plan[122] includes areas of intact ecosystems for human livelihoods and well-being. Care was taken to ensure the expansion of protected areas would contribute to South Africa's development goals by providing important ecosystem services to people. For example, the plan prioritized areas of land that provide water security, called strategic water source areas (SWSAs), which cover just 10% of the region's surface area but provide over 50% of the surface water supporting over two-thirds of the nation's economy. In response to the GBF's 30x30 challenge, there will need to be increasing emphasis on strengthening the use of other effective conservation measures to deliver multiple benefits to people, as is demonstrated by South Africa's SWSAs.



Box Figure 4.1 South Africa expanded its protected area system to include areas of multiple benefits for people including strategic water source areas (SWSAs), according to the South African National Protected Area Expansion Strategy (NPAES) under 30x30[122-124].

A greater variety of conservation options: OECMs

In some places, formal protection is not necessarily the best approach to conserving ecosystems and biodiversity, which is why the GBF also talks about other effective area-based conservation measures, or OECMs (Figure 4.2). The OECM framework is a way of accounting for activities on private, community and state lands that provide long-term conservation benefits, even though biodiversity conservation may not be the primary objective[125]. Examples include set-asides within agricultural systems or managed forests, conserved water catchments, locally managed marine areas and sacred sites. OECMs have the potential to conserve ecosystems and species populations and maintain ecosystem function and services while providing other productive uses[126], ensuring that conservation efforts are both effective and inclusive. Currently, there are 856 OECMs recognized and reported in 10 countries[116] (Figure 4.1) and there is potential for OECMs to make a growing contribution to biodiversity conservation while supporting the livelihoods and cultural practices of local communities[127]. The full extent of their benefits and associated costs will rely on robust policies and regulations that need to be further defined, underscoring the need for ongoing evaluation to optimize their contribution to global conservation objectives.

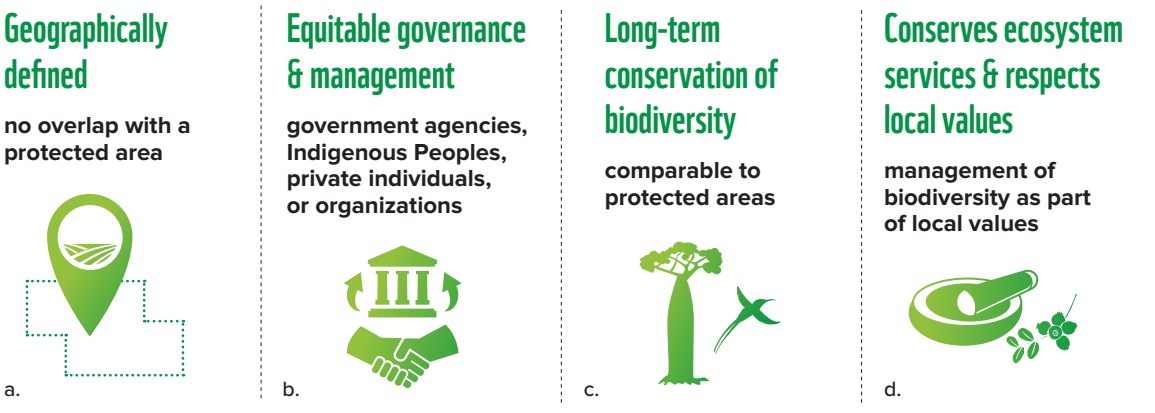


Figure 4.2 The four core criteria of an OECM: (a) OECMs should be spatially delineated with agreed-upon boundaries and can include land, inland waters, and marine and coastal areas. OECMs and protected areas cannot overlap; (b) OECMs can be governed in several ways, including by government agencies; private individuals, organizations or companies; Indigenous Peoples and/or local communities; and shared arrangements; (c) OECMs must be effective at delivering positive, long-term outcomes for the conservation of biodiversity; and (d) Conservation and sustainable management of biodiversity are achieved as part of cultural, spiritual, socioeconomic, and other locally relevant values and practices[128].

More inclusivity: Indigenous and community territories

Much of intact biodiversity is in the territories of Indigenous Peoples and local communities who have sustainably managed it for decades. When they are marginalized, protected areas can not only cause social harm but compromise the long-term viability of biodiversity goals[129]. By contrast, conservation approaches that are equitable and inclusive, foster the rights and roles of Indigenous Peoples and local communities, and empower their environmental stewardship more often result in effective, long-term biodiversity conservation[130].

Formal support for and recognition of the rights and territories of Indigenous Peoples and local communities may be one of the most effective ways to conserve biodiversity at scale. Recent analyses have shown one quarter of the global land area is traditionally owned, managed, used and/or occupied by Indigenous Peoples, which includes about 35% of the area formally in protected areas and 35% of the remaining intact terrestrial areas[131] (Figure 4.3). In many cases, Indigenous Peoples and local communities have sustainably managed species and ecosystems over long timescales[132]. Recent studies have shown positive ecological and social outcomes when Indigenous Peoples and local communities lead or are engaged in natural resource management and conservation efforts[132-135].

Indigenous values and philosophies are often characterized by a lack of division between the concepts of nature and culture, which contributes to sustainable management of wild and domesticated species, often weaving these management systems together in the same landscapes and seascapes. Along with this concept is belief in a deep kinship between humans and non-human entities, or again a lack of division between them. This has led to the granting of legal rights to mountains and rivers in places such as Peru, Ecuador and Bolivia[136].

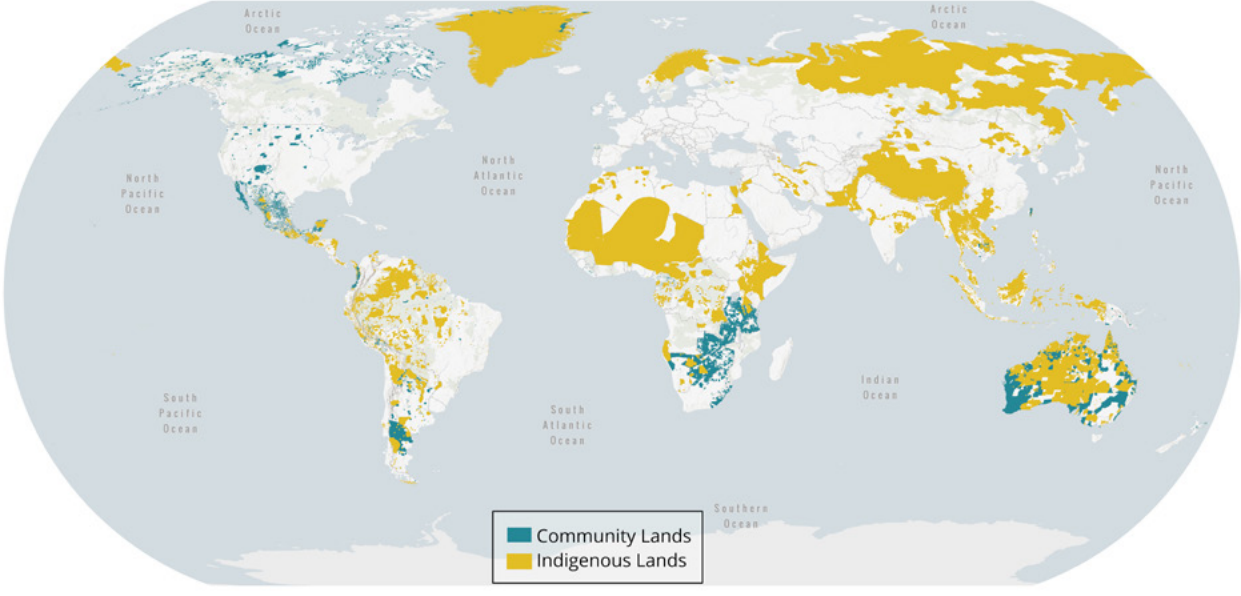


Figure 4.3 Indigenous territories and traditional community lands, both recognized and unrecognized by government. Figure adapted from WWF et al. 2021[137].

Nature's contributions to people

Upscaling protected areas, OECMs and systematically taking a human-rights based approach to conservation are urgent priorities if we are to reverse the decline in nature and avoid dangerous tipping points. Among the challenges are identifying the most important areas and mobilizing support for these efforts. Focusing on nature's contributions to people is one promising approach.

With satellite data, biophysical models, and socioeconomic and cultural information, we can estimate where and how nature supports people in meeting material needs, sustaining livelihoods, pollinating crops, regulating and purifying water, storing carbon, providing protection from flooding, coastal storms and other hazards, and providing opportunities and experiences we value culturally. An analysis of 14 of nature's contributions to people shows that 90% are provided by 30% of the planet's lands and 24% of its coastal waters[138] (Figure 4.4). Conserving these areas would directly benefit 87% of the world's population. These critical areas also intersect with 96% of Indigenous and community territories, 80% of the areas most important for climate regulation through carbon storage, and the habitats of 60% of land mammals, birds, reptiles and amphibians.

In other words, to achieve the global goals, these areas are obvious places to amplify good stewardship and urgently address threats to nature loss – though closer to half of Earth's land surface needs to be appropriately managed to provide these benefits to the total population, conserve terrestrial biodiversity and maintain ecosystem stores of carbon[139]. This will require us to look beyond protected areas as a tool to maintain nature's contribution to people to other opportunities – such as strengthening Indigenous and local land tenure, payments for ecosystems services, and sustainable management. While global analyses can support preliminary assessments and context setting, ensuring strategies for sustainable development and conservation must be grounded in the perspectives and realities of places and communities to be effective. Many of the diverse values of nature have yet to be mapped, and many others defy generalizations required for global mapping, though they should still be understood and incorporated into local decision-making for conservation[140].

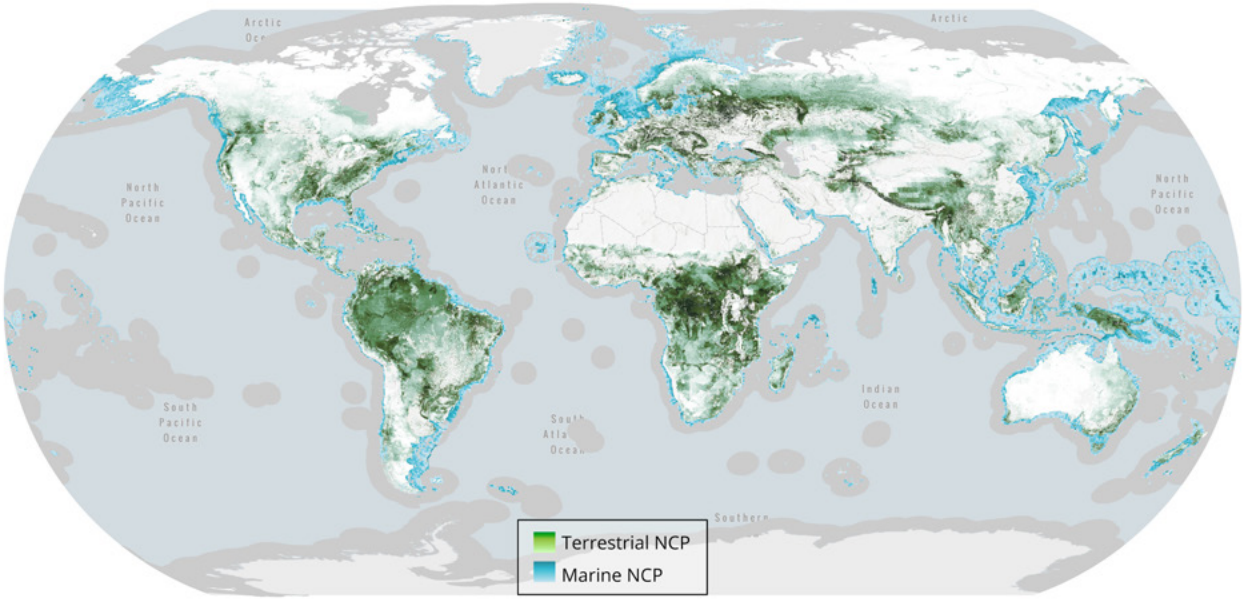


Figure 4.4 Nature's contributions to people, covering 12 local and 2 global contributions, 12 on land and 3 in the sea (with coastal risk reduction shared by both). Darker values indicate higher levels of contributions to more people. Thirty per cent of the planet's lands and 24% of its coastal waters provide 90% of these 14 benefits to people. Figure adapted from Chaplin-Kramer et al. 2023[138].

Analyses of nature's contributions to people also highlight what's at stake for the future of conservation. One-third of these critical natural areas are also highly suitable for development – agriculture, renewable energy, oil and gas, mining or urban expansion[139]. It's vital that planning systems take full account of the value of nature to transparently manage benefits and trade-offs in the design of multifunctional landscapes to meet the needs of people while conserving nature (Box 4.2).

Box 4.2 Land sharing for the energy transition

Nearly 20% of critical areas for nature's contributions to people also have high potential for wind and solar power. We can't afford not to ramp up the energy transition, but we have to find ways to equitably meet shared objectives. Promising examples include combining solar arrays with wildflowers and resources for pollinators, or interspersing solar or wind with crops and livestock to provide shade and cooling that can even boost production. We need to test and grow these innovations so they can begin to deliver the multifunctionality we need at scale.

Using nature's benefits to solve societal challenges: nature-based solutions

While conserving nature benefits society by maintaining and enhancing nature's contributions to people, there is also increasing interest in working with nature to address specific societal issues – including climate mitigation, climate adaptation, disaster risk reduction, food security, water security and human health[141]. Known as nature-based solutions, these approaches seek to simultaneously deliver benefits for biodiversity, climate and human well-being[142] (Figure 4.5). Reforestation, reconnecting floodplains, agroforestry, wetland and mangrove restoration, and regenerative agriculture are just some examples of nature-based solutions that have been deployed to deliver carbon sequestration, improved livelihoods, food yields, erosion control, water quality and quantity, air quality, flood and drought mitigation, coastal protection and more, while also benefiting biodiversity.

Nature-based solutions hold great promise to advance on global goals on climate, nature and sustainable development. Nature-based solutions for climate mitigation have the potential to reduce greenhouse gas emissions by 6–11 Gt CO_2eq per year, or 10–19% of current annual anthropogenic greenhouse gas emissions (Figure 4.6, calculation based on Roe et al. 2021[143]; Nabuurs et al. 2022[144]). Conservation, sustainable management and restoration of ecosystems can also help people – and other species – to adapt to the impacts of climate change[145].

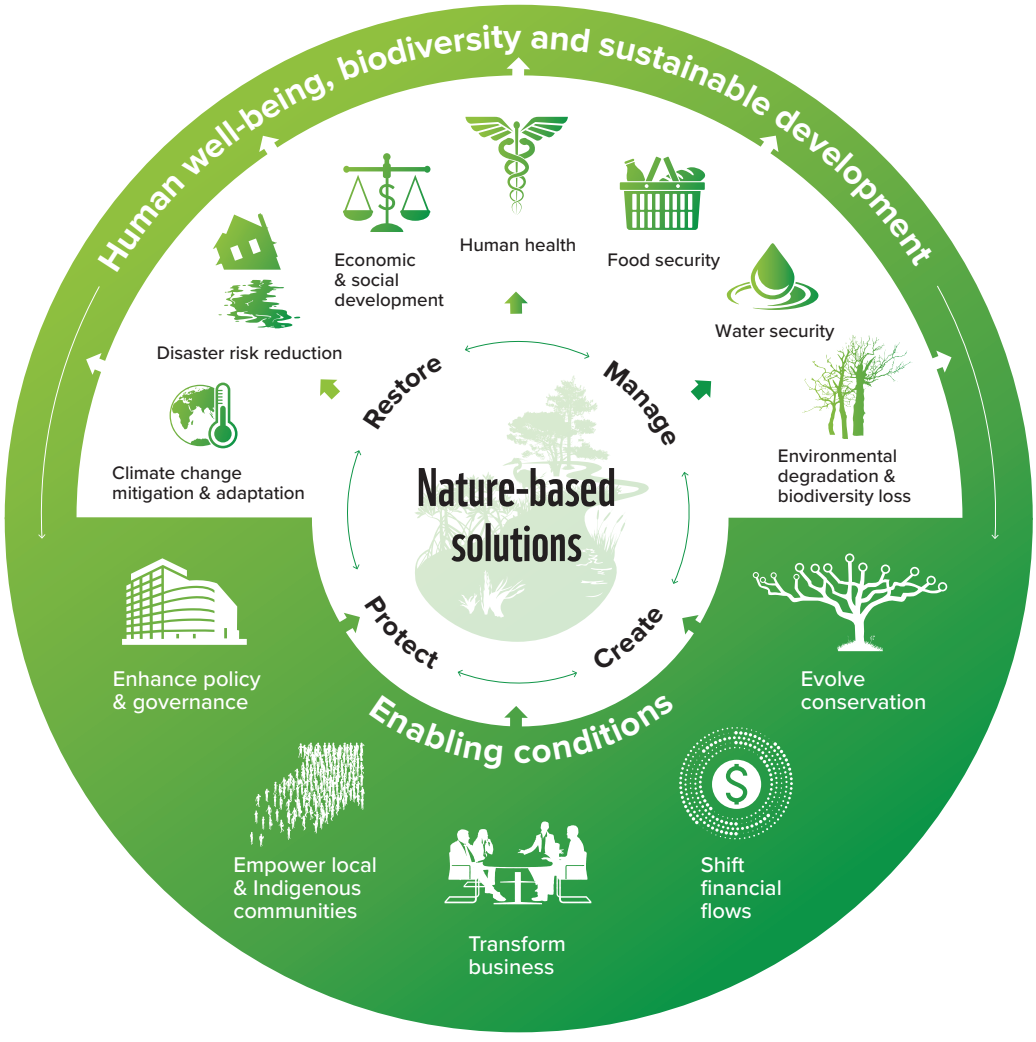


Figure 4.5 Nature-based solutions contribute to human well-being, biodiversity and sustainable development, by addressing specific issues through protecting, restoring and sustainably managing ecosystems.

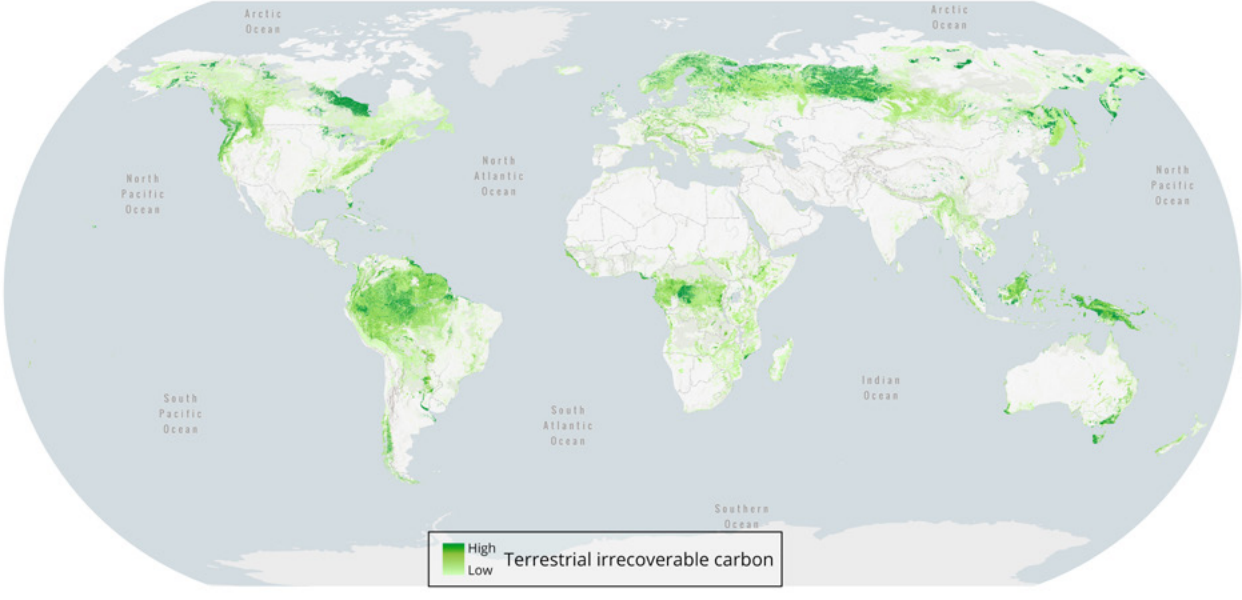


Figure 4.6 Distribution of irrecoverable carbon. If these high-carbon ecosystems are converted, even with restoration it won't be possible to recover the carbon they store by 2050. Protecting these ecosystems should be a priority for nature-based solutions for climate mitigation. These represent priority terrestrial areas for protection and nature-based solutions for mitigation. Darker colours indicate areas with higher carbon density, with a maximum of 895 tons/hectare. Data draws from Noon et al. 2021[146].

Managing tipping points

Tipping point management involves identifying and taking action to address critical transitions or abrupt changes that result in tipping points (see Chapter 2). This could include actions to maintain ecosystem function such as reducing the drivers of change (e.g. climate change, land-use change, pollution and harvesting), enhancing ecosystem resilience through restoration and conservation efforts, and adaptive management strategies[147]. Methods for identifying local and regional tipping points include monitoring ecological indicators like the LPI and conducting modelling studies to understand the relationships between drivers of change and ecosystem responses[148,149]. Tipping point management has been used in a handful of cases, including managing fish populations to avoid runaway algal growth on coral reefs, managing freshwater ecosystems in the face of climate change, and avoiding desertification in Mediterranean ecosystems by limiting habitat conversion, but will become more common as the need and our capabilities grow[150-152]. It may even allow us to manage important ecosystems threatened by climate change and avoid tipping points until atmospheric warming stabilizes in the latter half of the century[153].

Addressing drivers across all sectors for a sustainable future

All of these approaches can help deliver more effective conservation and stewardship of nature. However, none can be successful if we don't address the root causes of nature degradation. These include consumption and production patterns, human population dynamics and trends, trade, technological innovations, and inadequate or failed local to global governance[3] (Box 4.3). Three of the most important systems transformations required for achieving the global goals are explored in the following sections.

Box 4.3 Equitable transformations at the local level

Actions to deliver global goals must be locally relevant. Embracing diverse values and perspectives for managing land, forests, fisheries, water, agriculture and other natural resources contributes to co-developing equitable and durable local solutions[1,4]. Valuing Indigenous and local knowledge can guide more effective landscape and seascape conservation[132].

For conservation interventions to reach their full potential, they need to benefit the people involved. This could include ensuring local communities, smallholder farmers, small-scale fishers and other natural resource users have access to markets and financial services tailored to meet their needs, and support to adopt technologies and develop effective business models[154]. When market-based approaches aren't applicable, benefit-sharing mechanisms[155] and compensation for nature stewardship[156] can contribute to lasting positive outcomes for people and nature.

Food production is the leading cause of habitat destruction on land, driving biodiversity loss and greenhouse gas emissions.

The food system

The global food system is inherently illogical. It is destroying biodiversity, depleting the world's water resources and changing the climate, but isn't delivering the nutrition people need. Despite record production, some 735 million people go to bed hungry each night[157]. Obesity rates are rising even as nearly a third of the world's population don't regularly get enough nutritious food[158]. Food production is one of the main drivers of nature's decline: it's the leading cause of habitat loss, accounts for 70% of water use and is responsible for over a quarter of greenhouse gas emissions[159,160]. The hidden costs of ill health and environmental degradation in the current food system amount to US$10–15 trillion annually, representing 12% of global GDP in 2020[161,162]. Paradoxically, our food system is undermining our ability to feed humanity now and into the future. It makes no sense.

Challenges with the current food system

Food production has changed the face of our planet. Today, 40% of all habitable land (~4.2 billion hectares) is used to feed humans[163]. Of that 40%, 71% (3 billion hectares) is used for livestock grazing and ~1.2 billion hectares to grow crops. On top of the 4.2 billion hectares, another 460 million hectares are used to grow feed for livestock production (red meat, dairy and poultry) resulting in 82% of all agricultural lands used to feed livestock[163] (Figure 4.7). The diversity of what we produce has also decreased over the last hundred years. More than 90% of crop varieties have disappeared from farmers' fields and half of the breeds of many domestic animals have been lost, so that just 10 major global crops—barley, cassava, maize, oil palm, rapeseed, rice, sorghum, soybean, sugar cane and wheat—account for ~83% of all harvested food calories[164]. Industrial fishing takes place across more than half of the ocean (>55%)[165], though most fishing is concentrated in shallow and coastal zones, leading to increasing habitat degradation and risks to threatened species[166]. In addition, over 3 million hectares of mangroves and other coastal habitats have been converted to support aquaculture, particularly shrimp and tilapia farming, and the conversion continues[167].

Current global food systems:

Responsible for

27%

of greenhouse gas emissions

Responsible for

70%

of freshwater withdrawals

A main threat to

86%

of species at risk of extinction

Agriculture drives

90%

of tropical deforestation

~82%

of all agricultural lands are used for grazing and producing feed for livestock

Figure 4.7 Food production is the largest cause of global environmental change and is the main contributor to our rapidly deteriorating environment[159,163,168,169].

Deforestation and habitat conversion

Food production is the leading cause of habitat destruction on land[159,169], driving biodiversity loss and greenhouse gas emissions. Around 90% of deforestation is the result of converting forests into farmland[168] mostly in the biodiverse tropics and sub-tropics[169]. This is reflected in the steep declines in vertebrate populations in the regional LPI for Latin America, Africa and Asia and the Pacific.

Deforestation and habitat conversion risk undermining food production in the long term. For example, continued deforestation in the Amazon – mainly for cattle ranching[170] – could lead to significantly drier conditions and the risk of passing a tipping point, as discussed in Chapter 2[92,171]. The ensuing heatwaves and lack of water would severely compromise agricultural production[172,173]. In the neighbouring Cerrado biome, increased conversion of forest and savannah has impacts on regional climate and water cycles[174]. Given that Brazil is the world's largest net exporter of agricultural products[175], decreased productivity in these two regions would disrupt food supply chains worldwide.

Freshwater depletion and habitat modification

Globally, agriculture accounts for 70% of all freshwater withdrawals[176]. In many places, unsustainable withdrawals have depleted groundwater levels[177] and contributed to reduced surface water levels – more than half the world's lakes have experienced a drop in water levels[178] – and reduced river flows. Along with freshwater depletion, food production has resulted in the widespread modification of river systems by agricultural infrastructure (e.g. irrigation dams, levees to secure floodplain fields), conversion of wetlands for agriculture and aquaculture, and pollution. Together these agricultural impacts drive the loss of freshwater biodiversity, reflected in the steep decline of the LPI for freshwater vertebrate populations (Chapter 1). The unsustainable use of fresh water for food production could dramatically impact food production itself, particularly as climate change disrupts rainfall patterns and exacerbates droughts. For example, in the western United States, agriculture uses 80% of the Colorado River's water to irrigate 15% of the nation's farmland, with irrigation for cattle-feed crops accounting for 55% of all water consumption in the Colorado river basin[179]. With this level of withdrawals and continued drought, the river could lose 30% of its flow by the middle of the century and 55% by end-century[180].

Fisheries harvest

Each year, about 90 million tons of seafood is harvested from wild-capture marine and freshwater fisheries. That production is an incredibly important source of nutrition to the world: over 3 billion people get vital nutrients and at least 20% of their animal protein from so-called blue foods (food derived from aquatic animals, plants or algae[181]). Over 500 million people are considered "highly dependent" on marine ecosystems for nutrition[182] and 160 million people depend on freshwater fisheries for their dietary needs[183].

But fisheries have been pushed to the limit. Globally, 37.7% of marine fish stocks are classified as overfished[181]. While overexploitation directly threatens fish populations, it can also undermine the resilience of whole marine ecosystems, making them more susceptible to crossing regional tipping points: the way that overfishing of parrotfish has reduced the resilience of coral reefs and fisheries production in the Caribbean, as discussed in Chapter 1, is just one example. Climate change is also pushing some regional fish stocks toward tipping points[184]: in the western Baltic, unsustainable exploitation and changing environmental conditions have led to the collapse of cod stocks, with little hope of a rebound for a fish that is not adapted to waters warmed by climate change[185]. Freshwater fisheries are also under pressure. Populations of migratory fishes, which make up the main volume of freshwater catch, have declined by an average of 81% since 1970[186] due to habitat alteration, overharvest, pollution and climate change[183].

Species extinctions

Our global food system is a primary driver of biodiversity loss[159]. Habitat loss driven by agriculture is a threat to over 80% of all threatened terrestrial bird and mammal species[187] (Figure 4.8), while overfishing is the leading cause of biodiversity loss in marine ecosystems[36]. The loss of wildlife poses a threat to the food system itself. The near extinction of certain pollinators, for example, jeopardizes 5–8% of agricultural production worth US$235–577 billion annually[188]. Crop diversity is declining too: 86% of humanity's energy intake globally comes from just 17 crop plants[189]. The loss of diversity in food crops decreases agriculture's resilience and leaves it more vulnerable to pests and local weather extremes[1].

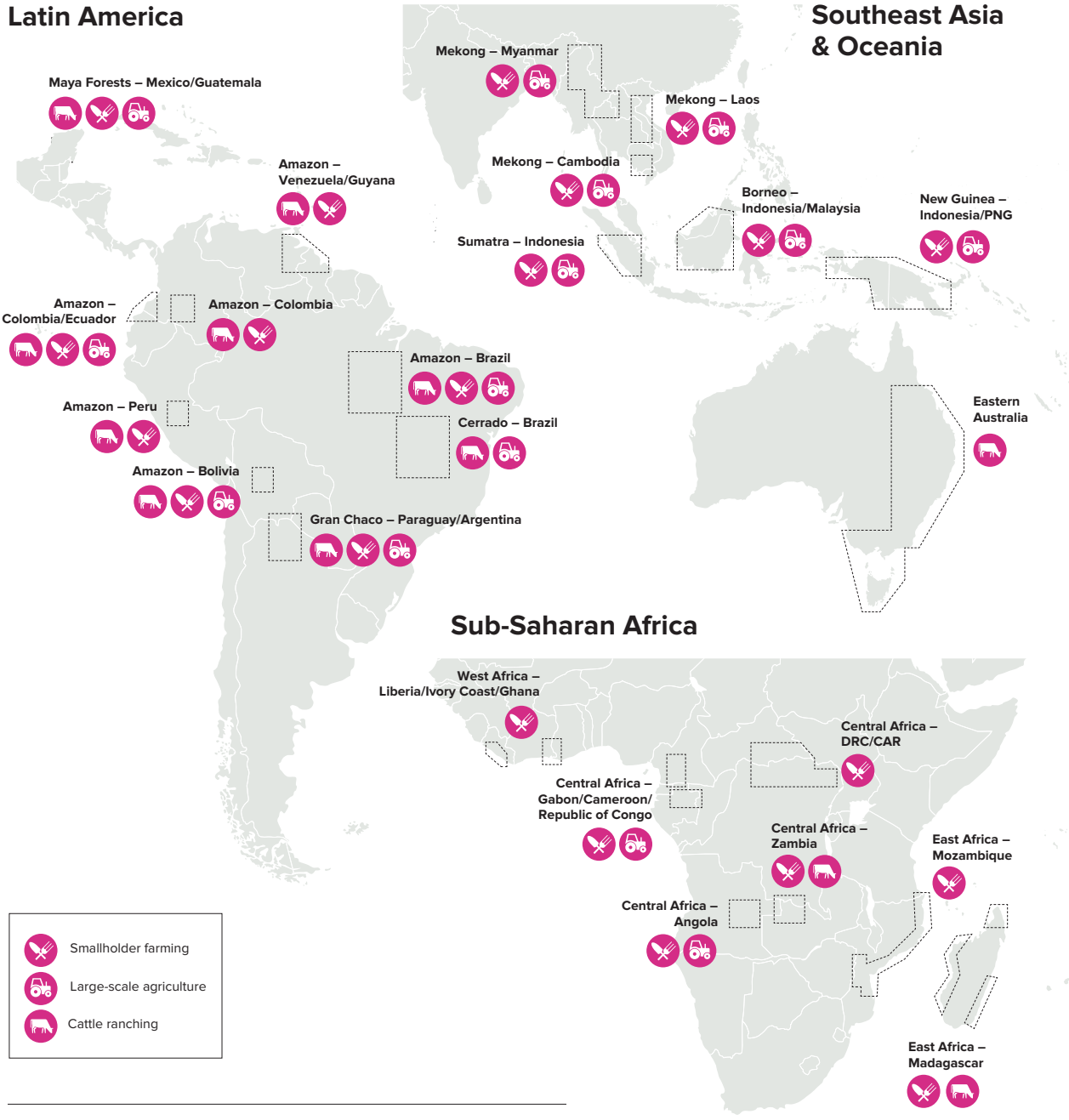


Figure 4.8 Food production is the leading driver of conversion. Commercial agriculture, cattle ranching and smallholder farming all play a role, though their relative impact varies between regions. Over 80% of all threatened terrestrial bird and mammal species are threatened by habitat loss driven by agriculture[169].

Food system transformation: what's needed?

Ultimately, what we eat and how we produce it will determine the fate of humanity. But even though the food system is the number one driver of environmental degradation, it's not adequately addressed in major international environmental policy. In 2019, the IPCC and IPBES highlighted the central importance of food systems change in achieving climate and biodiversity goals by 2030[1] – but food is largely neglected within the Paris Agreement and the Global Biodiversity Framework. Some countries mention agriculture in their climate plans, but very few set targets on other aspects of the food system, such as reducing food loss and waste, sustainable diets, or food consumption[190].

The last few years have brought a wave of reports, roadmaps and initiatives that offer positive ways to improve food systems to meet nature, climate and development goals – from how to provide healthy diets for 10 billion people within planetary boundaries[191] to how agriculture can transition from being a source of greenhouse gas emissions to a carbon sink[192]. What's still missing, though, is a coordinated global agenda for food systems transformation with clear, science-based goals and targets for 2030 and beyond. This would provide coherent direction for action at national and local level in line with global goals on climate, biodiversity and sustainable development, as well as helping to guide private sector efforts and mobilize the necessary finance.

Below, we propose four goals of this agenda:

1. Scale nature-positive production to provide enough food for everyone while also allowing nature to flourish.
2. Ensure everyone in the world has a nutritious and healthy diet, produced without triggering tipping points.
3. Reduce food loss and waste so that more of the food that's produced gets eaten.
4. Increase financial support and foster good governance for sustainable, resilient, nature-positive food systems.

Success on all four aims is needed in order to achieve global goals (e.g. for greenhouse gas emissions reductions, Figure 4.9). While global goals can set the direction, local food systems vary dramatically around the world. Solutions must be responsive to the environmental, cultural and socioeconomic conditions in that place. And, importantly, people must be at the centre – especially the farmers and fishers who may be only one lost harvest away from financial ruin.

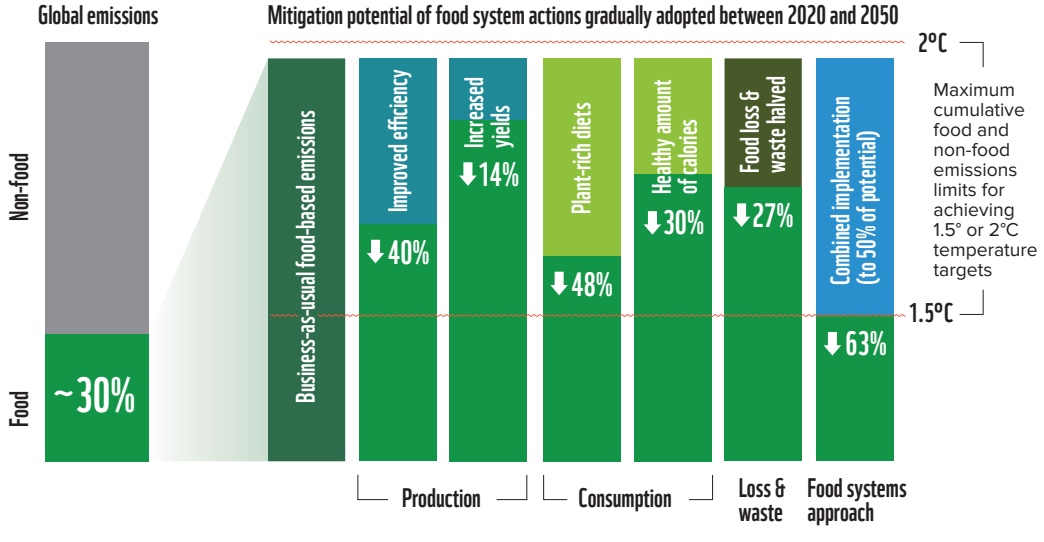


Figure 4.9 Mitigation potential of shifting to nature-positive production (Production), ensuring nutritious and healthy diets for all (Consumption), and reducing food loss and waste (Loss & waste) compared against the remaining carbon budget for keeping global warming below 2°C and 1.5°C. Business as usual (i.e. no action taken on food systems) uses the entire remaining carbon budget while only a food systems approach (adopting all three actions simultaneously) that is sufficiently financed and supported by good governance will be enough to limit warming to 1.5°C. Figure adapted from WWF 2022[193].

Nature-positive production

Avoiding further expansion means optimizing crop yields and livestock productivity in a sustainable way. In many regions, there are opportunities to improve yields (Figure 4.10) – but this must be done in ways that avoid putting additional stress on freshwater resources, increasing greenhouse gas emissions or exacerbating nitrogen and phosphorus pollution. In some places, nature-positive production practices – such as agroecology, regenerative agriculture, conservation agriculture and climate-smart farming – can increase yields without additional inputs, while increasing diversity on the farm, restoring biodiversity and increasing carbon storage[194]. Where inputs are required, we need to better understand the capacity of natural systems to absorb them with little or no consequences. Although research on nature-positive practices is still emerging, early findings from studies show promising potential. One study found that farmers stand to see increased crop yields and profits with 15–25% return on investment by transitioning to regenerative farming practices[195] (Box 4.4). A suite of other studies has found similar results[196].

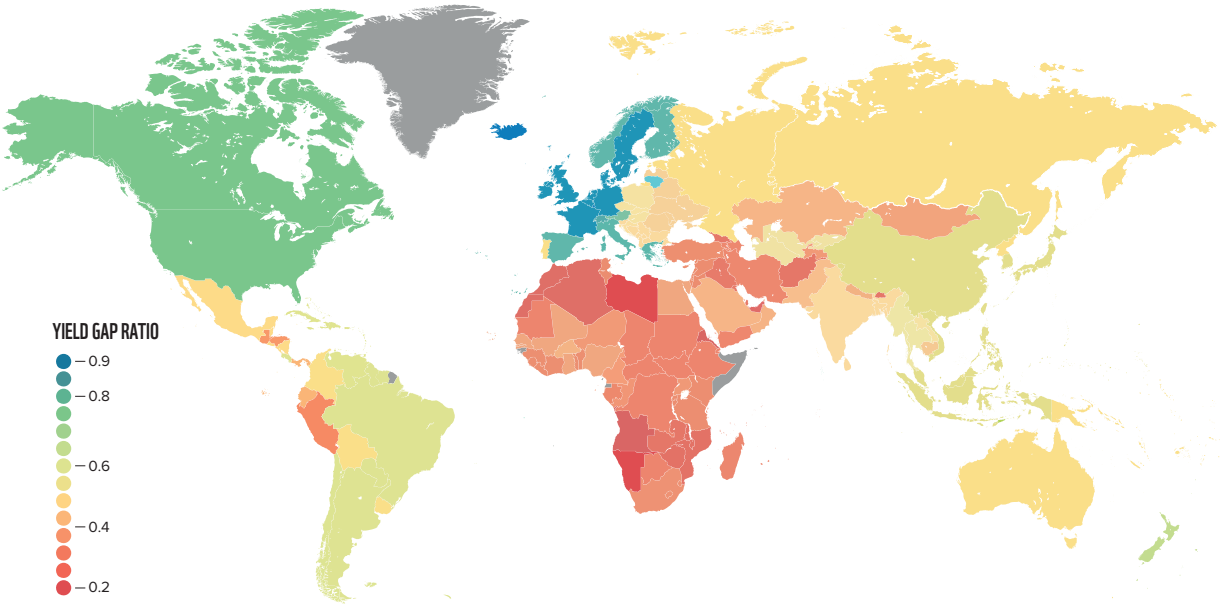
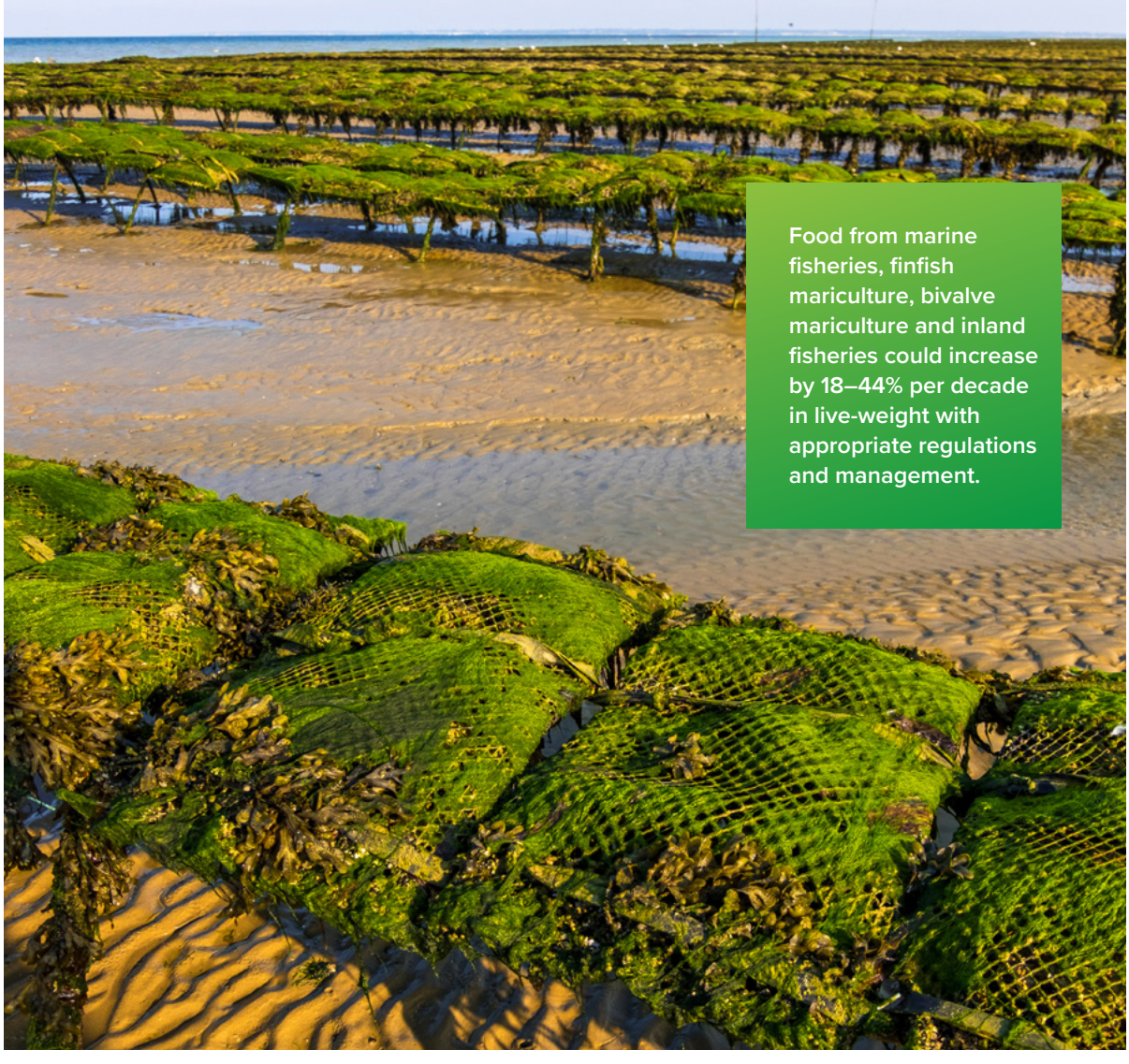


Figure 4.10 Yield gap ratios by country. Yield gap refers to the difference between current crop yields and potential crop yields. Low ratios indicate large yield gaps. For example, a ratio of 0.2 indicates that a country, on average, has crop yields that are 20% of what it is capable of producing. Green and blue represent high yields and low yield gaps while countries in red and orange have high yield gaps. Figure adapted from Clark, Hill and Tilman 2018[197].

Box 4.4 Sustainable increases in yield

The Andhra Pradesh Community-Managed Natural Farming (APCNF) initiative in southern India is a good example of the positive socio-economic impacts of nature-positive food production. APCNF is a state-wide effort to support farmers to adopt agroecological practices to address multiple challenges such as rural livelihoods, access to nutritious food, biodiversity loss, climate change, water scarcity and pollution. It is the largest transition to agroecology in the world, involving 630,000 farmers. The impacts have been impressive: crop diversity has doubled, yields of prime crops increased by on average 11%, farmers' net income increased by 49% and household dietary diversity increased[198].

In fisheries, nature-positive practices have the potential to increase production in the long term. However, achieving this potential will only be possible if we also limit warming to 1.5°C as the impacts of ocean warming and acidification will undermine fisheries health and production[199]. One global analysis suggests that if all fisheries were managed sustainably, an extra 16 million tonnes of seafood could be harvested from the ocean annually, increasing the total wild catch by around one-sixth[200]. Food from the sea from wild fisheries, finfish mariculture, bivalve mariculture, and inland fisheries could increase by 18–44% per decade in live-weight with appropriate regulations and management in all fisheries[201]. As aquaculture continues to grow around the world, the potential for lower trophic species such as molluscs and seaweed to contribute to nutritional security is yet to be realized[202].



Food from marine fisheries, finfish mariculture, bivalve mariculture and inland fisheries could increase by 18–44% per decade in live-weight with appropriate regulations and management.

Nutritious and healthy diets without triggering tipping points

Any gains from more sustainable food production will count for little if we don't also address food consumption. If everyone in the world adopted the current food consumption patterns of the world's major economies by 2050, we exceed the 1.5°C climate target for food-related greenhouse gas emissions by 263% and require one to seven Earths to support us[203] (Figure 4.11). There are also compelling public health reasons to address unsustainable diets. Overconsumption, especially of fats and sugars, is driving a worldwide obesity epidemic: over 2.5 billion adults are overweight, including 890 million living with obesity[204].

It's possible to provide a growing global population with enough nutritious, healthy food – but it will require different dietary shifts depending on current levels of nutrition and consumption[206,207]. For developed countries, dietary shifts need to include a greater proportion of plant-based foods and fewer animal products[163,191]. At the same time, for countries facing significant burdens of undernutrition, hunger and food insecurity, achieving nutritious diets may require increasing consumption, including of animal-source foods[163].

Eating more sustainable diets would reduce the amount of land needed to produce food: grazing land, in particular, could be freed up for other purposes, including nature restoration and carbon sequestration[163]. Seafood choices can make a difference too: for example by prioritizing farmed species low on the aquatic food chain, such as bivalves (like oysters, mussels and scallops), that produce food more quickly and with fewer inputs, and excluding long-lived, slow-growing species (such as Chilean sea bass, Atlantic halibut, bluefin tuna and swordfish). These choices have the added benefit of high levels of micronutrients and lower levels of bioaccumulated toxins.

Achieving healthy and nutritious diets will be heavily influenced by local cultural traditions, individual choice and available food. WWF's Solving the Great Food Puzzle is dedicated to finding local solutions to local challenges[193]. In some countries, promoting traditional foods will be an important lever to shift diets. For example, the National Millett Campaign in India is designed to increase national consumption of this ancient grain, which is good for health and highly resilient in the face of climate change[208]. In other countries, an important area of focus is developing and promoting healthy alternative protein sources such as legumes and nutri-cereals, plant-based meat alternatives, and algal species high in nutritional value. Finally, financial incentives are needed to increase the availability, affordability and appeal of nutritious foods and support healthy food imports and exports, especially in countries with limited natural resources to grow their own food.

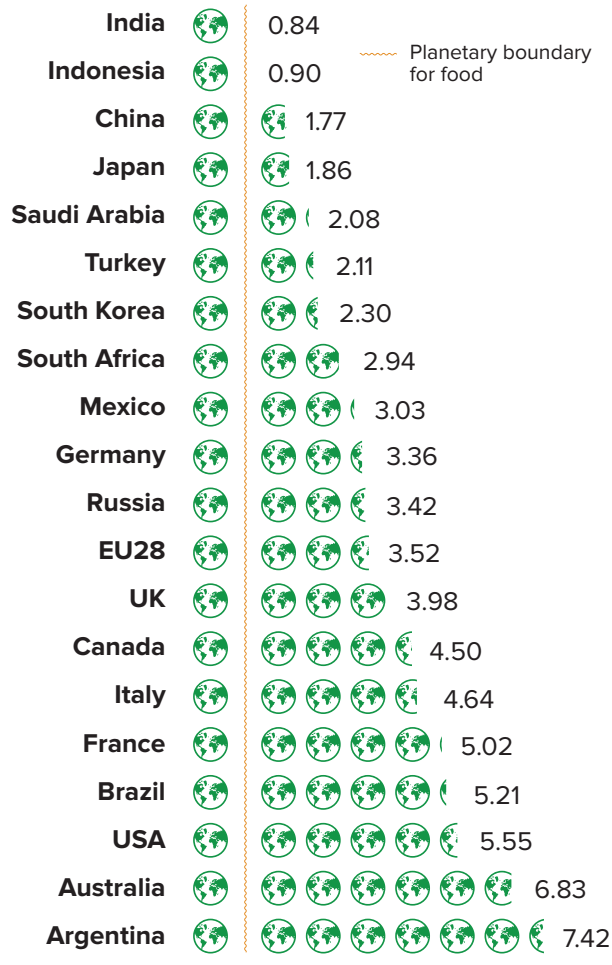


Figure 4.11 The number of Earths that would be needed by 2050 to support food production if all countries globally adopted the current consumption patterns of the individual countries listed. The orange vertical line is the planetary climate boundary for food, indicating the maximum amount of greenhouse gas emissions that food systems can emit to stay within 1.5°C of warming. Figure adapted from WWF 2020[163] and data from Springmann et al. 2020[205].

Food loss and waste

An estimated 30–40% of all food produced is never eaten[209], representing around a quarter of total global calories. Embedded in lost or wasted food are one-fifth of agricultural land and water used for crops, as well as 4.4% of global greenhouse gas emissions[210]. In fishing, the incidental catch of non-target species (commonly referred to as bycatch) results in 9 million tonnes of dead sea life (over 10% of total ocean catch) being discarded, as well as posing a major threat to many species[211].

These numbers are staggering, but also highlight the immense environmental, economic and human health opportunities of addressing food loss and waste. In countries where farm and fishery losses are high due to poor infrastructure, investing in supply chain infrastructure – such as post-harvest storage technologies, processing techniques and packaging – can make huge reductions in food loss and waste[212]. For example, in Lake Naivasha in Kenya, poor supply chain infrastructure and coordination led to nearly 50% of post-harvest food being lost. With the construction of a fresh vegetable shop equipped with solar-powered cooling facilities and collectively owned by 146 farmers, food loss has dropped below 10%[212].

Finance and governance

Reducing the environmental impact of food production and harvest, improving diets, and reducing food loss and waste will require significant finance. The Food System Economics Commission estimates that US$200–500 billion a year is needed between now and 2050[161]. Of this, US$200 billion would cover investments in developing supply chain infrastructure, extension services to support small-scale farmers, land restoration, reduction of food loss and waste, and dietary shifts, while US$300 billion would provide financial incentives to improve consumption and keep food affordable for the poorest. Currently, only 4% of global climate finance or US$28.5 billion on average per year is allocated to food systems, even though they account for a third of emissions[213]. Food systems will require US$212 billion annually to just achieve the Paris Agreement[214].

While these are huge sums, more than enough finance could be made available by reallocating existing resources. In agriculture, direct subsidies of more than US$635 billion a year are driving the excessive use of inputs that degrade soil and water and harm human health. Subsidies for products such as soybeans, palm oil and beef cause farmers to push into the forest frontier and are responsible for 14% of forest loss every year[215]. Fisheries subsidies are a key driver of overfishing, with an estimated US$22.2 billion of total annual subsidies of US$35.4 billion going toward increasing the capacity of fishing fleets[216]. Along with redirecting farming and fisheries subsidies from environmentally harmful practices to increasing nature-positive production of nutritious food, public food procurement programmes can be used to promote healthy and sustainable production and consumption[215].

At the same time, governance needs to be strengthened. Governments need to integrate nature, climate and nutrition into other policy areas, including agriculture, land use, health, finance and trade. Private companies also have a critical role to play by encouraging sustainability and nature-positive practices along their value chains, including eliminating deforestation and conversion, and tackling food loss and waste. Finally, governments need to step up support – such as development and extension programmes and investment in infrastructure – for small-scale farmers and fishers to enable them to participate in and benefit from sustainable, resilient, nature-positive food systems.

The energy system

The way we produce and consume energy is the principal driver of climate change, with increasingly severe impacts on people and ecosystems. We know we must rapidly transition away from fossil fuels to renewable energy to cut greenhouse emissions in half by 2030 and keep 1.5°C within reach. Yet even though renewable energy technology costs have dropped dramatically[160], and wind and solar now represent 80% of new electricity capacity additions[217], this transition is still not moving fast enough. Over the next five years, we need to triple renewable energy, double energy efficiency, electrify 20–40% of light-duty vehicles, and modernize energy grids around the world to achieve the 1.5°C target[160,218,219]. This will require a massive mobilization of investment, critical materials and infrastructure.

An accelerated transition that achieves climate targets will produce a dramatically better future for people and nature. Yet how that transition unfolds also poses risks for the planet's lands, oceans and rivers. We cannot repeat the mistakes of our current energy system. The energy transition must be fast, green and fair, putting people and nature at its heart (Figure 4.12).

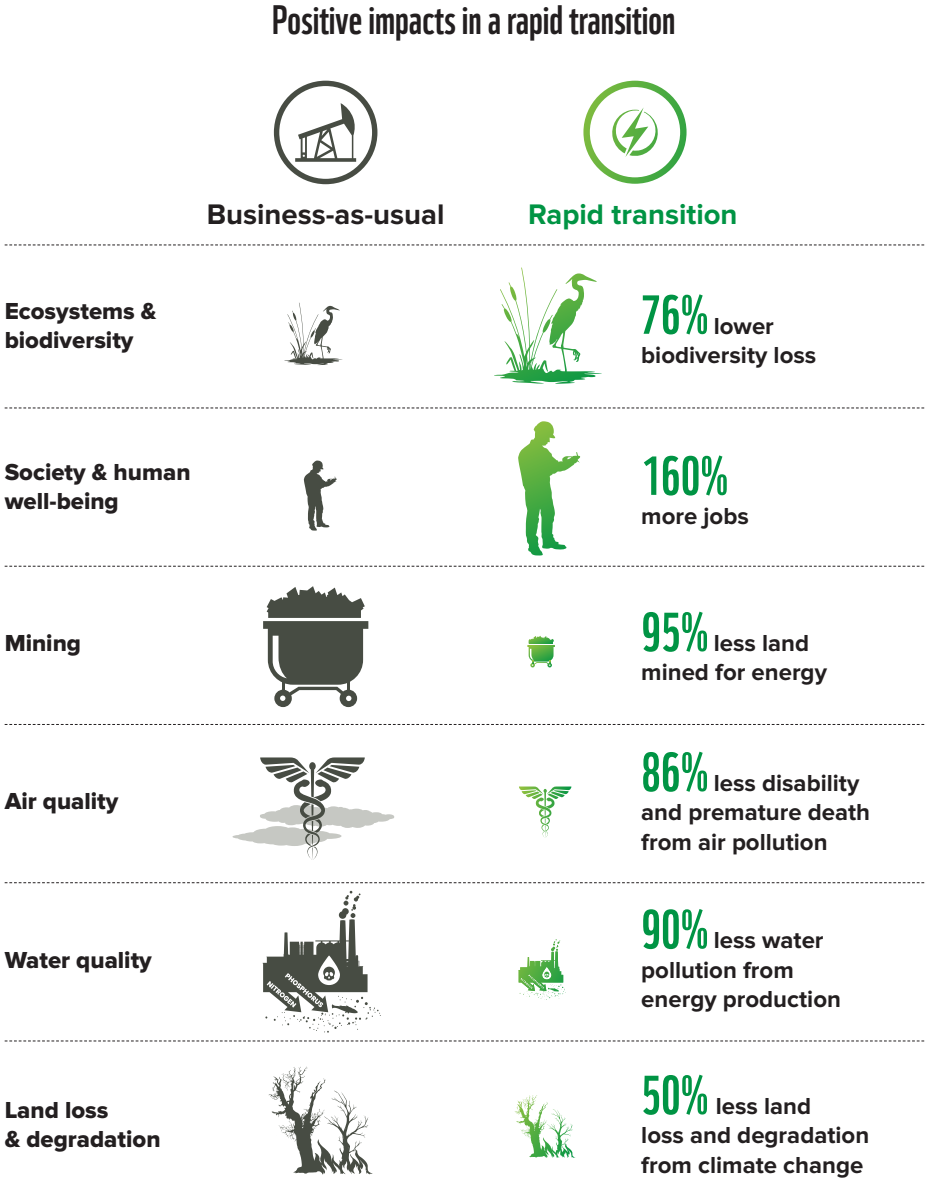


Figure 4.12 A rapid transition to renewable energy is dramatically better for nature and society across a range of economic, social and environmental metrics, compared to a business-as-usual approach that does not meet climate targets. Figure adapted from WWF and BCG 2023[220].

Over the next five years, we need to triple renewable energy, double energy efficiency, electrify 20–40% of light-duty vehicles, and modernize energy grids around the world to achieve the 1.5°C target.

Challenges with the current energy system

Energy from fossil fuels has underpinned economic growth since the industrial revolution – but at a significant cost to the climate, people's health and nature[160,221]. Our current energy system is the primary driver of climate change, with fossil fuels contributing approximately 70% of greenhouse gas emissions today[160]. Air pollution from fossil fuels is also responsible for one in five deaths worldwide, making it one of the leading causes of global mortality[222]. In addition, fossil fuel production and consumption cause harm to wildlife and ecosystems[223,224].

Our energy system is also vulnerable to the climate change it is causing, with demand for energy projected to increase at the same time that power generation and transmission will be challenged[225]. Cooling systems for thermal power plants will be stretched by increasing temperatures and strained water resources, and renewable energy sources will face increased variability of solar radiation, wind and precipitation[225] with hydropower being particularly exposed to increases in both floods and droughts[226]. More frequent and severe extreme weather events will affect energy infrastructure, including transmission lines[227]. In the last year (2023), we've seen many of these impacts unfold, including an 8.5% decline in global hydropower generation due to droughts[228].

Areas that will generally have very low negative impacts to ecosystems and communities include rooftops, parking lots, reservoirs and abandoned mines for solar PV and pastures or other agricultural land for wind turbines.

Energy transformation: what's needed?

A fundamental transformation of the energy system is essential if we are to have any hope of limiting warming to 1.5°C and avoiding the worst effects of climate change. Meeting the scope and scale of the climate and nature crises will require going beyond local, regional and national transitions from fossil fuels to renewable energy. It demands a broader transformation of our global energy system that not only reduces emissions faster, but does so in a way that helps reverse the trend of biodiversity loss and is fair to everyone.

A faster transformation

In the last decade, global renewable energy capacity has roughly doubled and costs for wind, solar and batteries have fallen by up to 85%[160]. More recent growth in renewables has vastly exceeded projections, with 50% more renewable electricity capacity added in 2023 than in 2022[229]. But although energy trends are going in the right direction, the pace and scale are not yet near where they need to be.

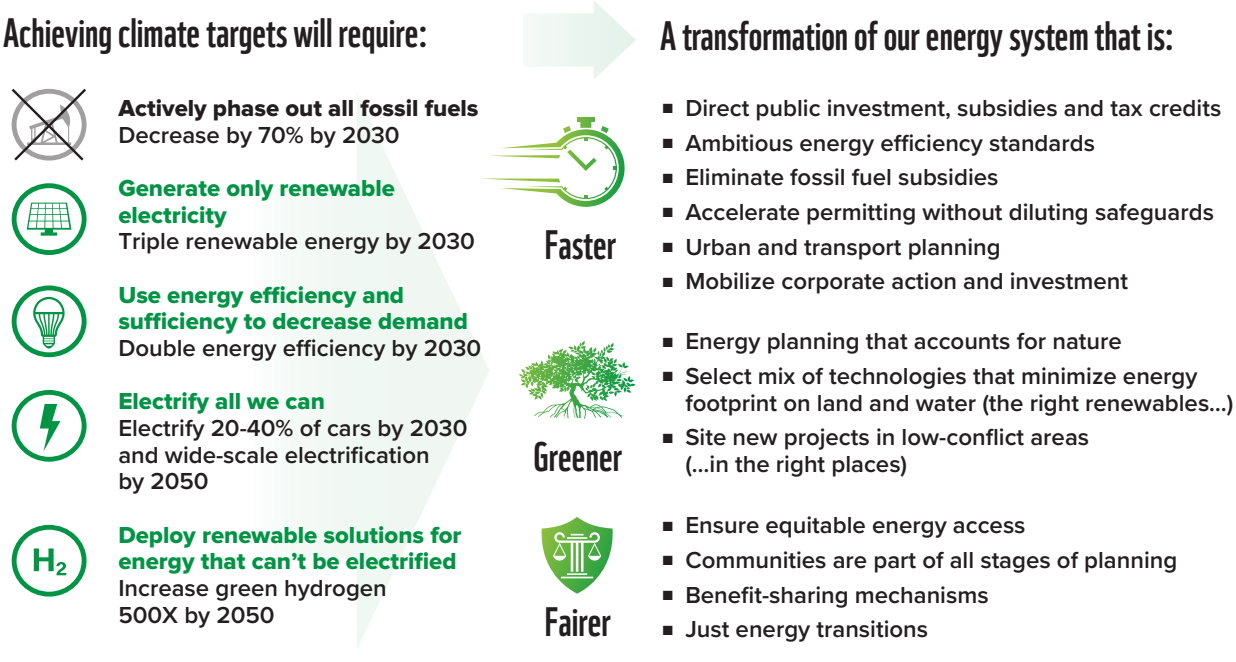


Figure 4.13 The path to transforming global energy systems to meet climate targets through actions that are fast, green and fair. Data from IPCC 2023[160], UNFCCC GST 2023[218], IEA 2023[219], ETC 2023[203,230].

According to the IPCC[160] and the global stocktake of the UNFCCC[218], limiting warming to 1.5°C will require a tripling of renewable energy and doubling of energy efficiency by 2030. Total fossil fuel supply would need to decrease by about 70% by 2030, the share of renewables in global electricity generation would need to increase from 30% in 2022 to 60% in 2030, and annual energy efficiency gains would need to increase from 2% in 2022 to over 5% in 2030[219] (Figure 4.13). The power sector would need to reach net zero carbon dioxide emissions by about 2040, and we would need wide-scale electrification and the near decarbonization of the global vehicle fleet by 2050[160]. For sectors which are hard to electrify and can't rely on renewable energy, like aviation, shipping, and industrial processing of steel and cement, energy innovations must be rapidly accelerated[160]. Reaching these milestones would involve a massive mobilization of policy, investment and infrastructure[160] – projections include a major expansion of electricity grids from approximately 75 million kilometres of transmission lines to over 200 million by 2050, increasing green hydrogen 500-fold and production of critical minerals (copper, aluminium, lithium, nickel, cobalt, manganese, graphite and rare earth elements) from 2 to 15 times, the addition of about 1.5 billion electric passenger cars, 200 million electric trucks and buses, and total battery capacity of up to 150TWh by 2050[230].

A greener transformation

A renewable energy transformation is crucial to maintaining a safe climate – but it will also be far better for people's health and safety and for nature compared to our fossil energy system. For example, air pollutants and death and disability due to air pollution will be up to 90% lower; infrastructure damage, poverty risk and food supply costs will be up to 70% lower; and biodiversity loss will be 75% lower without climate change impacts projected under a business-as-usual scenario[220,223].

However, poorly planned development of renewable energy could still have considerable negative impacts on ecosystems and communities. Hydropower expansion at the level of current forecasts would be the leading driver of river fragmentation and cause further decline of freshwater ecosystems[231]. If not carefully planned, additional bioenergy crops could drive significant land-use change, water use and biodiversity loss[232], and transmission lines and mining for critical minerals could impact sensitive land, freshwater and ocean ecosystems[233].

Given these potential impacts on land, ocean and river habitats, the renewable transition needs to happen in a way that's consistent with other objectives for sustainable development and nature conservation. But avoiding harm to nature and people is not the only reason to pursue a just and nature-positive energy transformation. Negative impacts from the energy transition can trigger conflicts, including protests, regulatory delays and litigation, all of which will slow the transition[234]. There is not a trade-off between a transition that is rapid and one that is careful: to be rapid, the transition must also be careful.

A fairer transformation

The transformation of our energy system is deeply dependent on societal acceptance and change, so it must be fair, just and equitable to be effective and enduring[235]. Over 770 million people still lack access to electricity and nearly 3 billion people still burn kerosene, coal, wood or other biomass for cooking[236]. A lack of access to modern renewable energy solutions significantly contributes to poverty, deforestation and indoor air pollution – a major cause of premature deaths that disproportionately impacts women and children[237]. A just energy transition will need to ensure that people have access to modern and safe sources of energy.

Too often, the negative impacts of energy development and operations like mines and power plants have fallen on low-income and marginalized communities[238]. Transformational change must address and avoid recreating the longstanding injustices and inequalities inherent in our current energy system[239]. Our future energy system will need to carefully manage the effects of change on people, and ensure that the benefits and burdens are equitably shared.

With two-thirds of the infrastructure we need by 2050 yet to be built, cities present an enormous opportunity to reduce energy-related emissions through improved urban and transport planning, building materials and efficiency.

How do we achieve a transformation that is faster, greener and fairer?

The renewable transformation cannot repeat the mistakes of the past. Building on existing energy transformation roadmaps (e.g. IPCC 2022[160], IEA Net Zero Roadmap 2023[240], REN21 2024[241], State of Climate 2023[242], ETC 2023[243]), we can achieve a transition that is simultaneously fast, green and fair.

Ways to go faster

Accelerating the transition will require much stronger energy policies across all levels of government. Although the costs of renewables have dropped dramatically, governments will need to provide the necessary incentives and financial support for a rapid transition. Examples of key policies include (1) direct public investment, subsidies and tax credits (e.g. for renewable generation, electrification of heating and transportation, technology innovation, energy grids and public transport infrastructure); (2) ambitious energy efficiency standards and regulations for industrial sectors, technologies and buildings; (3) financing changes to prioritize renewable energy systems; (4) eliminating fossil fuel subsidies and making polluters pay for mitigation of harmful emissions; (5) banning methane flaring and venting, and exploration of new oil and gas reserves; and (6) speeding up permitting processes without undermining safeguards (see next section).

A fast transition will also require buy-in from cities, companies and citizens. Cities occupy 3% of the Earth's land, but are home to more than half of the world's population and are responsible for about three-quarters of energy-related greenhouse gas emissions[160]. With two-thirds of the infrastructure we need by 2050 yet to be built, cities present an enormous opportunity to reduce energy-related emissions through improved urban and transport planning, building materials and efficiency[160]. Companies are also critical and will need to invest in and support technology and infrastructure development, in addition to reducing emissions in their own value chains[160].

Finance is also key. Faster action will not be possible without committing large capital investment for clean energy. To transition to net-zero emissions globally, the world needs to be investing at least US$4.5 trillion annually by 2030 in energy efficiency, renewables and low-carbon energy, and supporting infrastructure. In 2022, an estimated US$1.5 trillion was spent in these areas globally[236]. In other words, we need to triple our efforts.

Ways to go greener

While the energy transition will require considerable investment in new infrastructure, there are a number of ways to ensure the transition is consistent with the protection and restoration of nature.

Energy planning that accounts for nature is central to guiding the right renewables. Planning processes that optimize energy, nature and social objectives can select the right mix of renewable sources for a particular energy grid, identifying options that minimize or avoid the most significant risks and impacts on land, oceans and rivers. For example, energy system modelling can identify low-carbon and low-cost options that avoid hydropower dams with large negative impacts on rivers[244,245] and bioenergy with negative impacts on land conversion, water and biodiversity[232]. Countries can use this type of planning to identify portfolios of energy technologies consistent with sustainable development objectives. For example, the Costa Rican Electricity Institute developed a multi-decade energy expansion plan to guide investments in the country's power system[246]. The plan calls for expansion of wind, solar and geothermal projects and does not include additional hydropower, reflecting recent decisions in Costa Rica to cancel hydropower dams with large negative impacts on rivers and Indigenous communities[247].

After selecting the right renewables, it is crucial to put them in the right places. Global-scale mapping studies have found that much of the needed expansion of renewable energy infrastructure can occur on sites that will cause minimal disruption to nature and communities[248,249]. Areas that will generally have very low negative impacts include rooftops, parking lots, reservoirs and abandoned mines for solar PV and pastures or other agricultural land for wind turbines. Using available roof space alone would generate 26,800TWh, comparable to global electricity demand in 2021[250]. Regional planning processes can direct development away from areas with value for conservation and toward these areas of low conflict [248]. This can be formalized through the creation of "renewable energy zones" which are pre-selected as appropriate for renewable development, based both on the suitability of the resource (e.g. wind or sun) and their limited potential for conflicts with people and nature. Examples include:

- **The Africa Clean Energy Corridor.** This regional initiative ranked areas based on resource suitability and environmental and social risks to prioritize a set of renewable energy zones in eastern and southern Africa. Countries can use these zones to facilitate strategic planning within their own borders while strengthening interconnections with regional grids[251].
- **Renewable acceleration areas in the European Union.** EU member states are required to identify "renewable acceleration areas" that avoid sensitive environmental resources and will feature shorter approval periods[251].
- **Solar energy zones in the southwestern United States**. Regional planning for solar expansion in the desert southwest region of the United States led to the establishment of 17 solar energy zones. Permitting times have been reduced by more than half for projects within these zones, from an average of two years to about ten months. This process also created "no go" areas to protect the most important habitats, contributing to the conservation of large blocks of high-quality habitat[252].

In many countries, environmental safeguards are criticized for slowing down energy development and there are frequent calls to reform permitting processes[234,243]. There are a number of ways to streamline aspects of the permitting process without diluting safeguards for people and nature. These include digitization, assigning priority status to renewable projects, and better coordination between agencies or levels of government (e.g. see Planning for Climate Commission 2023[251]). The strategic planning described above can also result in faster permitting times for projects (as in the solar expansion zones in the southwestern US) while also promoting more integrated protections for biodiversity.

Ways to be fairer

The policies, investments and good governance practices that go along with a faster and greener transition will also need to embed equity and inclusion for a fairer transition. Everyone should have access to affordable, reliable, sustainable and modern energy. This will require enhanced and targeted finance from richer countries toward renewable energy systems in developing countries, as well as financial assistance and education in underserved communities to increase uptake of renewable technologies. Communities should have energy technologies that match their needs, and the capacity to manage and generate income from their energy resources[253].

A just transition must ensure that the benefits and burdens are equitably shared. This requires community engagement at every stage of the process to ensure people have a say in the decisions that affect them. Enabling people to raise concerns at the planning stage can help avoid or reduce negative impacts for people and nature, reducing risk for developers and facilitating a faster transition – though there is also a need for support and access to justice for communities who are negatively affected. Benefit-sharing mechanisms can be an effective way to build community support. For example, in Colombia, a 2019 law requires that solar and wind projects transfer a percentage of their sales to communities within the project's "area of influence" while the Philippines' Renewable Energy Act requires that 80% of project royalties be directed toward subsidizing power costs in affected communities[251].

Green finance

Economic activities have a tremendous impact on nature, the climate and human well-being. The finance sector drives the economy and is an extremely powerful lever for changing how it operates and who it benefits. Redirecting finance away from harmful activities and toward business models and activities that contribute to the global goals on nature, climate and sustainable development is essential for ensuring a habitable and thriving planet for generations to come (Box 4.5).

Box 4.5 Mainstreaming nature and climate in laws and regulations

National governments need to align their own conservation, climate and development priorities with the global goals on biodiversity, climate and sustainable development. The goals need to be placed into legal, policy, planning and budgeting processes, and achieving them will require coordination across ministries and state agencies. Revising their national plans for implementing their climate and biodiversity commitments by 2025 provides an opportunity for governments to better integrate their climate and nature agendas[254]. They also need to integrate nature- and climate-related goals in other areas of policy and decision-making such as finance, commerce and trade[255] and to allocate the resources required[256]. Environmentally harmful subsidies will need to be removed or substantially redesigned[215]. Policies to address poverty and inequality should also support climate and biodiversity objectives – and vice versa.

Globally, over half of GDP (55%) – or an estimated US$58 trillion – is moderately or highly dependent on nature and its services[257]. Yet our current economic system values nature at close to zero, driving unsustainable natural resource exploitation, environmental degradation and climate change. Money continues to pour into activities that fuel the nature and climate crises: negative finance flows in the form of private finance, tax incentives, and subsidies that exacerbate climate change, biodiversity loss and ecosystem degradation are estimated at almost US$7 trillion per year, or 7% of global GDP[258] (Figure 4.14). The positive financial flows for nature-based solutions, in comparison, are a paltry US$200 billion[258] (Figure 4.14). By redirecting just 7.7% of the negative finance flows, we could meet the funding gap for nature-based solutions and deliver nature, climate and human well-being benefits from protection, restoration and sustainable management of our lands and waters[258] (Figure 4.15). The funding gap for an energy transition to keep the world within the 1.5°C target is even larger. While global climate finance for the energy sector approached US$1.3 trillion in 2021/22, largely due to an increase in finance for renewable energy and transport, the need is a staggering US$9 trillion annually through 2030 to finance both the mitigation of greenhouse gas emissions and the adaptation to the impacts of climate change[214]. Similarly, the transition to a sustainable food system needs a huge increase in spending to US$390–455 billion annually from public and private sources[259] – still less than governments spend each year on environmentally harmful agricultural subsidies[260].

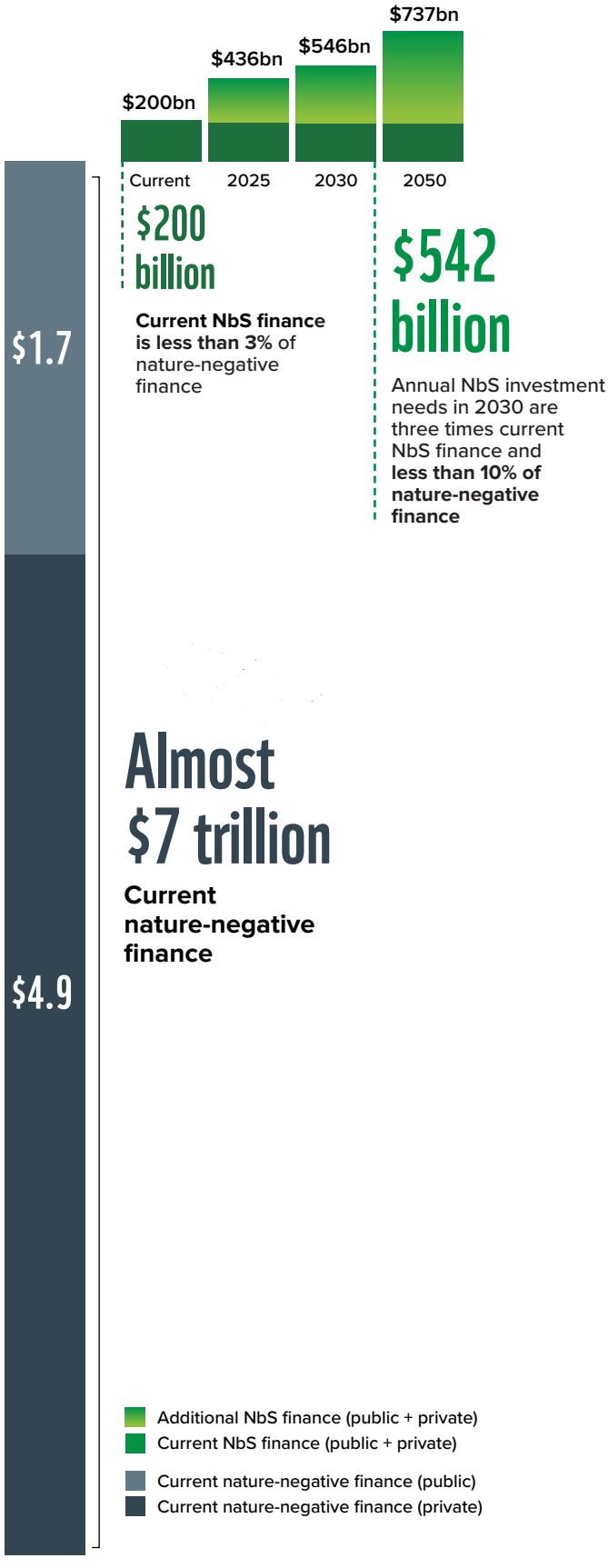


Figure 4.14 Current and future finance for nature-based solutions (NbS). Currently, US$7 trillion per year in nature-negative finance (e.g. perverse subsidies) undermines efforts to conserve nature, while positive financing for NbS is US$200 billion per year. Nature-positive finance needs to increase drastically to meet the global goals. Figure adapted from UNEP 2023[258].

Filling these gaps demands a seismic shift at global, national and local levels to get finance flowing in the right direction, away from harming the planet and toward healing it. We can do this in two mutually reinforcing ways: *financing green*, or mobilizing finance for conservation and climate impact at scale, and *greening finance*, or aligning financial systems to deliver nature, climate and sustainable development goals.

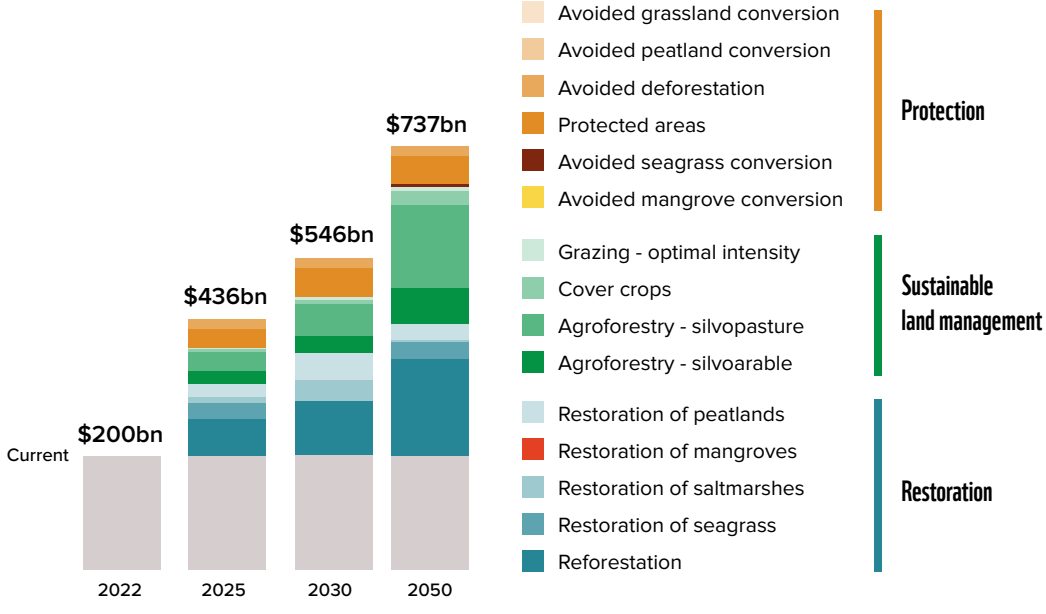


Figure 4.15 Additional annual investment by activity to reach global goals. Future finance needed for protection, sustainable management and restoration through nature-based solutions each year from 2025–2050 to meet global goals. Figure adapted from UNEP 2023[258].

Financing green

Avoiding dangerous tipping points, meeting the global goals and transitioning to an equitable, sustainable economy requires investment on a vast scale. Current levels of government funding and philanthropic support for nature and climate are not nearly sufficient. There's an urgent need to reallocate capital to institutions, projects and activities that contribute to restoring nature and its benefits to people, tackling the climate crisis, and reducing poverty and inequality[261].

This will require new green finance solutions involving the public and private sector that can be replicated and scaled – from conservation-focused funds, bonds, loans and insurance products that mitigate risk and build resilience, to long-term investment in nature-positive businesses and enterprises. Some examples are included in Box 4.6.

Box 4.6 Examples of initiatives for financing green

- **Equity funds:** The RobecoSAM Biodiversity Equities Fund from global asset manager Robeco, with a portfolio of around 40 companies, invests in technologies, products and services which support the sustainable use of natural resources and ecosystem services in four areas: sustainable land use, freshwater networks, marine systems and traceable products. Specific investments include reforestation, wastewater treatment, hazardous waste management, aquaculture and sustainable fishing. Robeco seeks advice from NGOs and wider partnerships to integrate biodiversity into asset management[262].
- **Bankable Nature Solutions:** Financially viable enterprises and projects can help restore ecosystems and biodiversity, combat climate change and contribute to people's well-being, while also attracting commercial investment that allows them to grow to scale; WWF refers to these as Bankable Nature Solutions[263]. These projects may need support before they can leverage commercial finance. For instance, the Dutch Fund for Climate and Development (DFCD) enables private sector investment in large-scale climate adaptation and mitigation projects that help strengthen ecosystem and community resilience in developing countries vulnerable to climate change. With an initial investment of €160 million from the Dutch Ministry of Foreign Affairs, DFCD has leveraged over €1 billion in blended finance[264]. DFCD supports projects like Concepta, part of the Brazilian company Sabará, which sources and processes native products like açai, Brazil nuts and babassu from the Amazon, Cerrado and Caatinga biomes, providing an economic incentive to conserve the natural ecosystems where these plants grow[264].
- **Debt-for-nature swaps:** Debt-for-nature swaps involve forgiving a portion of a low- or middle-income country's sovereign debt in exchange for financing conservation in that country[265]. They include bilateral swaps as well as debt conversions that raise fresh capital which is then used to repurchase and retire existing, more expensive debt. For example, the Tropical Forest and Coral Reef Conservation Act in the US offers eligible countries official debt relief to support tropical forest and coral reef conservation, and to strengthen civil society. It's been used to conclude 21 debt-for-nature agreements worth US$273 million in 15 countries[266].
- **Project finance for permanence (PFP):** PFP is an approach designed to secure the long-term funding, capacity, partnerships and policies necessary to conserve nature and its benefits for people[267]. For example, in Colombia, the government, the private sector and civil society partners developed Herencia Colombia, a PFP initiative that secured US$245 million in public and private finance to permanently protect 32 million hectares of iconic landscapes and seascapes, achieving Colombia's goal of protecting 30% of its lands and seas by 2030[268].

There are, of course, many challenges to overcome. Investors often perceive green initiatives to be high risk. Many potential business cases are small scale, and rural communities often lack access to finance. One way to mitigate perceived risk is to combine sources of funding, so public funding goes first and private capital enters when the risk is lower. Integrated landscape management approaches – which bring together multiple conservation, sustainable management and restoration interventions in a single landscape – hold potential for financing green at scale by channelling funding from a range of public, private and civil society investors into a portfolio of projects and enterprises in different sectors within the landscape[269]. This approach could include tailored financial instruments for different rights-holders, farmers and other stakeholders[270].

Greening finance

Our economies and our financial systems are embedded in nature and could not survive without functioning ecosystems, biodiversity, water and a stable climate[271]. For prosperity in the long term, nature needs to be accounted for in all financial decision-making. Not doing so will make it impossible to avoid the short- and long-term impacts of climate change and biodiversity loss in the economy and financial systems.

Our financial system impacts our ecosystems while being dependent on them. This so-called double materiality affects both financial and price stability. A study published by the European Central Bank in June 2023 showed that 75% of all bank loans in Europe are to companies that are highly dependent on at least one ecosystem service (e.g. erosion control, water supply, flood and storm protection, carbon uptake and storage, pollination) to continue producing their goods or providing their services[272].

Nature loss poses multiple financial risks. Changes in ecosystems and how they function present physical risks to businesses. These risks may be acute, like wildfires, floods or natural disasters, or chronic – as with the effects on food production of the progressive degradation of pollinator populations and soil biodiversity. As societies and economies transition to a low-carbon and nature-positive future, businesses are also exposed to transition risks – for example, as new regulations are brought in. Finally, systemic risks arise from the breakdown of an entire system when a tipping point is reached.

Financial institutions, central banks and financial regulators are increasingly aware of these risks and developing initiatives to address them (Box 4.7). This positive trend needs to be globalized and mainstreamed as quickly as possible.

Policymakers, regulators, asset owners, asset managers and leading global companies are all increasing their focus on nature-related risk management and the necessity of mobilizing private sector engagement and finance to tackle nature loss and scale nature-based solutions.

Box 4.7 Examples of finance-related initiatives to address risk

- **Sustainable Financial Regulation Initiative:** Since 2021, the Sustainable Financial Regulations and Central Bank Activities (SUSREG) Tracker has evaluated how central banks and financial regulators are making progress with integrating nature loss and climate change risks into their operations and activities on an annual basis. The SUSREG Tracker 2023 shows that several central banks and financial regulators are making progress in "greening" their financial regulation and supervision[273]. Worryingly, however, high-income countries, countries with the highest greenhouse gas emissions and countries with the greatest biodiversity are lagging significantly behind. Increasingly, financial regulators and central banks are taking action on climate, but they do not yet take into account nature loss and the consequences for businesses, communities and people's livelihoods.

- **Network for Greening the Financial System (NGFS):** In September 2023 the NGFS, a coalition comprising more than 140 central banks and financial supervisors, published a conceptual framework on nature related-risks. This recognizes that "the twin crisis of environmental degradation and climate change poses a significant threat to stability, sustainable prosperity, and life on this planet" and that "central banks and supervisors have clear reason to be concerned and involved". The conceptual framework provides a structured approach to understand and integrate nature-related risks[271].

- **Taskforce on Nature-related Financial Disclosures (TNFD):** This initiative has produced a set of recommendations for companies and financial institutions for disclosing and addressing risk associated with nature loss and degradation, building on other initiatives, notably the Task Force on Climate-related Financial Disclosures (TCFD). Its 14 disclosure recommendations provide nature-related guidance to enable organizations to meet their reporting requirements across jurisdictions[274]. Policymakers, regulators, asset owners, asset managers and leading global companies are all increasing their focus on nature-related risk management and the necessity of mobilizing private sector engagement and finance to tackle nature loss and scale nature-based solutions[274]. By January 2024, 320 financial and non-financial companies had already signalled their commitment to use the TNFD framework to report on their nature-related risks by 2025[275].

The examples above show that change is happening, albeit not at the pace we need to stay clear of dangerous tipping points and address the existential crises that climate change and biodiversity loss pose to human societies. While policies should guide the change needed to transition our economies to a net-zero and nature-positive future, finance can and must accelerate it.

CHAPTER 5

Facing nature's tipping points, it's never been more urgent to tackle global goals in a coordinated way.

Making it happen

With every issue of the *WWF Living Planet Report*, we see a further decline in the state of nature and a destabilization of the climate. This cannot continue.

The global goals offer a vision of a better future, where a stable climate and recovering nature support fairer societies where all people can prosper. They are ground-breaking in their ambition and the overwhelming buy-in from nations, the private sector and civil society. They provide an opportunity to reverse our current trajectory of nature and climate degradation, step away from global tipping points and put the world on a path to sustainability.

To do this, we need governments and the private sector to make credible commitments and plans to achieve the goals. We need concrete actions at the pace and scale required to fully meet the targets on time. We need the finance to make it happen. And we need to ensure the outcomes are effective, equitable and enduring. There is no time to waste.

Tracking progress

Right now, commitments, actions and outcomes across government, the private sector and civil society are insufficient, disjointed and siloed. Many lack credibility: we have seen governments pledge new finance for climate and nature initiatives, only for subsequent analyses to reveal they are simply rebranding existing commitments, or corporations proudly announce their commitment to carbon neutrality, when this is based on carbon offsets of dubious value. Cynical commitments and actions that achieve nothing are worse than useless in the face of ecological and climatic tipping points: they sow confusion and undermine momentum.

Collectively, we need to understand what we're doing: what's working, what isn't and what still needs to be done. We need to transparently evaluate which actions across sectors and countries are delivering against the global goals, and how public and private sectors are contributing to or undermining progress. We need to do a better job of identifying cost-saving synergies and managing trade-offs. We need to be able to take a pulse check rapidly and credibly report back on where we are and where we need to be. Doing so can motivate change, and strengthen innovation, collaboration and adaptive learning to meet our goals for 2030 and beyond.

Over the last few years, there's been a proliferation of trackers, gap reports, disclosure frameworks and other initiatives providing parts of this information. We're calling now for nature and climate organizations to align around a system that pulls all this information together to answer the following questions:

- Are the collective actions taken by governments and the private sector delivering the necessary progress against the global goals and lowering the probability of reaching dangerous tipping points?
- Are these actions mutually reinforcing progress or are they likely to cause trade-offs or backsliding for a subset of goals or people?
- Is the world transitioning toward sustainable food, energy and finance systems that will deliver a sustainable and thriving future for all?

The final push

It is no exaggeration to say that what happens in the next five years will determine the future of life on Earth. We have five years to place the world on a sustainable trajectory before negative feedbacks of combined nature degradation and climate change place us on the downhill slope of runaway tipping points. The risk of failure is real – and the consequences almost unthinkable.

Each government, company, organization and individual will need to decide what they will do in the race to the deadline. But all will have to do something radically different. Incremental improvements will not suffice.

Together, we must be successful. We have just one living planet, and one opportunity to get it right.

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