December 2019

Climate, Nature and our 1.5°C Future

A synthesis of IPCC and IPBES reports

WWF is an independent conservation organization, with over 5 million supporters and a global network active in over 100 countries. WWF's mission is to stop the degradation of the Earth's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.
http://wwf.panda.org/our_work/climate_and_energy/climate_nature_future_report

WWF International
Rue Mauverney 28
1196 Gland
Switzerland

This report was made possible by the support of the **WWF-UK Science Team** and the **WWF Climate and Energy Practice**

Editor in Chief: Stephen Cornelius

Principal Writer: Sophie Yeo

Editorial Team: Christopher Weber, Fernanda Carvalho, Leanne Clare, Mandy Woods, Pauli Merriman, Roz Pidcock, Vanessa Perez-Cirera

Contributors: Anthony Pearce, Arjette Stevens, Christo Fabricius, Colman O'Criodain, David Edwards, David Tickner, Gavin Edwards, Günter Mitlacher, Hermine Kleymann, Huma Khan, Jamie Gordon, Jean François Timmers, Jeff Opperman, Jennifer Lenhart, Jessica Battle, Joao Campari, Julika Tribukait, Karen Douthwaite, Lauren Duvel, Linwood Pendleton, Luís Neves Silva, Mark Wright, Martin Sommerkorn, Martina Fleckenstein, Mike Barrett, Nikhil Advani, Olivia Suárez, Oscar Guevara, Oscar Rodas, Pablo Pacheco, Partha Ghose, Paul Gamblin, Peter McFeely, Richard Edwards, Richard Lee, Rod Downie, Scott Edwards, Shirley Matheson, Simon Walmsley, Suzie Hubbard, Tessa Francis, Valerii Schmunk, Will Baldwin-Cantello

With special thanks for critical review of this WWF report: Jim Skea, Raphael Slade and Valérie Masson-Delmotte

Design: Jo Curnow / 1tightship.co.za

Front Cover Photo Credit: © Morgan Heim / Day's Edge Productions / WWF-US
Back Cover Photo Credit: © naturepl.com / Sylvain Cordier / WWF

Contents

Foreword 4

Introduction 5

Polar Regions 8

Impacts and Risks 8

Solutions 9

Case study 11

Oceans 12

Impacts and Risks 12

Solutions 13

Case study 15

Freshwater 16

Impacts and Risks 16

Solutions 17

Case study 19

Grasslands and savannahs 20

Impacts and Risks 20

Solutions 21

Case study 23

Forests 24

Impacts and Risks 24

Solutions 25

Case study 27

Food 28

Impacts and Risks 28

Solutions 29

Case study 31

Multi-level Action and Decision-making 33

Cities 33

Governments 33

A New Deal for Nature and People 33

WWF's Summary and Recommendations 34

Summary 34

Our choices make a difference 35

Characteristics of systemic change 35

Nature-based solutions 36

Recommendations for policy-makers 37

Recommendations for non-state actors 37

FOREWORD

Nature is essential to humanity. From the frozen polar regions and mountains, to forests and grasslands, to oceans, rivers and wetlands, the earth's ecosystems provide the keys to our existence, as well as habitats for the millions of plant and animal species with which we share this planet. Nature provides us with food, energy, medicines, and genetic resources. We rely on it for fresh air, clean water and healthy soils, and for protection against floods and storms. The landscapes where we make our homes provide spiritual inspiration and form the basis of our cultural identities. The land, the oceans and the world's frozen places help regulate our climate.

Yet climate change is having irreversible impacts on nature. Frozen landscapes are melting, forests are burning, and coral reefs are dying – and the impacts are expected to get worse as temperatures rise to 1.5°C and beyond. Many of the activities that are currently central to human existence – agriculture, travel and energy – are directly driving the destruction of nature and contributing to climate change by unlocking the stores of carbon sequestered in the earth's soil and vegetation. The loss, degradation and conversion of these landscapes is having a catastrophic impact on the plants and animals with which we share this planet.

The rapid deterioration of biodiversity and ecosystems that we are witnessing today underscores the fact that, for too long, nature has been a peripheral part of the climate conversation.

Nature is a critical ally in the fight against climate change. To have a chance of meeting the 1.5°C target adopted under the Paris Agreement, we need an energy system that is based upon sustainable renewable technology, to transform how we travel and what we eat – but that is not enough. We also need to put nature at the heart of our decision-making, and to usher in a future of healthy forests, clean water and vibrant oceans.

This report by WWF, ***Climate, Nature and our 1.5°C Future***, connects the findings from four major recent scientific reports by the Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES). Between them, these reports highlight the systemic changes needed across energy, land (food and natural systems), urban and infrastructure (including transport and buildings), and industrial systems in order to limit global warming to 1.5°C, as well as drawing attention to the fundamental connections between nature and humanity.

Meanwhile, the impacts to nature described in these reports are playing out in real life. In August, more than 30,000 fire outbreaks were detected in the Amazon rainforest, with devastating impacts on the people and wildlife that live there. Hawaii recently suffered its third major coral bleaching event in six years. In February, the Australian government confirmed that climate change had claimed its first mammal extinction, the Bramble Cay melomys, a small rodent that lived only on a small island off Australia that was unable to survive the habitat loss resulting from rising sea levels.

We are not doing enough to prevent these changes. While nations have agreed to limit global temperature rise to below 1.5°C, actions to meet this goal are insufficient. Most pertinently for this report, nature remains undervalued and underutilised as a solution to both reduce emissions and adapt to the climate impacts that are already affecting communities around the world. By saving nature, we boost the chances of staying below 1.5°C while laying the foundations for lives that are happy, healthy, culturally enriched and socially connected. Which is why WWF is calling for a new deal for nature and people to put nature on a path to recovery.

The appetite for change is growing.
Citizens are taking to the streets in their millions demanding decision makers listen to the science.

It's time to place our natural world at the heart of this conversation and fight for this future together.

Manuel Pulgar-Vidal
Climate and Energy Practice Leader

Rebecca Shaw
Chief Scientist

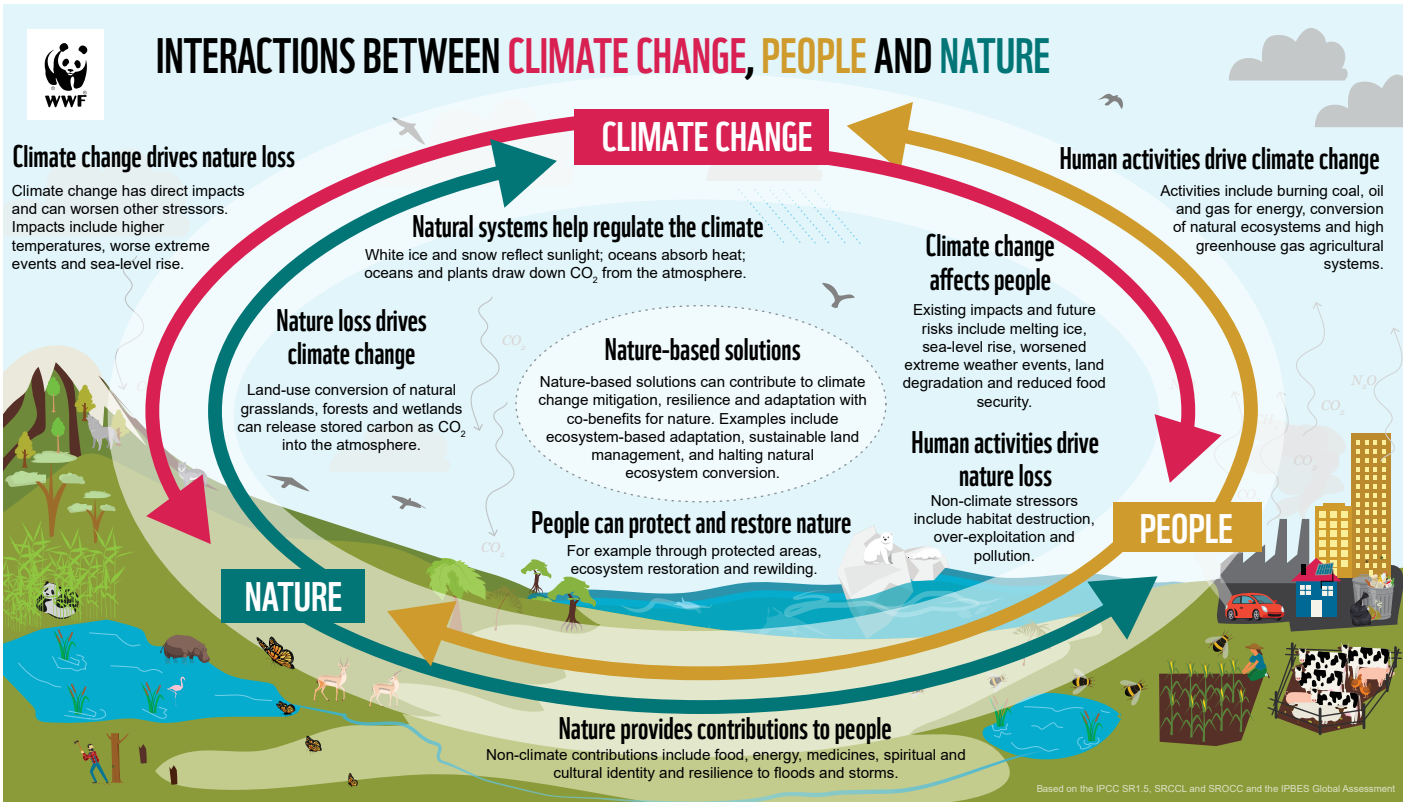
INTRODUCTION

The world we occupy today is very different to that of our ancestors. Once wild and untouched, the natural world now bears the fingerprints of humanity. For millennia, nature has fed and protected us and, as it bends beneath our weight, we are losing these contributions nature provides to people.

Over the past year or so, the IPCC has released three 'special reports'[1] [2] [3]. **These have emphasised some stark scientific findings about how human-caused greenhouse gas emissions have affected the oceans, frozen places and land across the globe – and that these negative climate risks will get worse as our planet heats.** The IPCC reports contain information on the key role that nature itself can play in addressing climate change. This work was complemented by some findings of the 'global assessment'[4] from the IPBES, which synthesised the scientific literature on the decline of nature and wildlife due to human interference and highlighted the many additional benefits that conserving nature has for sustaining human livelihoods and wellbeing in general. Between them, these four authoritative documents provide an extensive – and alarming – insight into the transformation that our planet and its ecosystems have undergone in the last century as well as the moral and economic imperative of halting nature decline.

This report, ***Climate, Nature and our 1.5°C Future***, pulls together the findings from the four UN reports with a focus on climate change as a key driver of nature loss and also the ways that nature can help humanity to mitigate, build resilience and adapt to climate change.

Essentially the IPBES global assessment and the three IPCC special reports are about **the interactions between climate change, nature and people** as outlined in the figure below.



1 Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty (October 2018) or 'SR1.5'

2 Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (August 2019) or 'SRCCL'

3 IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (September 2019) or 'SROCC'

4 IPBES Global Assessment on Biodiversity and Ecosystem Services (May 2019)

Nature and its contributions are essential for humanity to survive and thrive on this planet. Yet ecosystems and biodiversity are in rapid decline due to human activity. According to the IPBES global assessment, these declines have been driven by five factors, which are, in order of impact: changes in land and sea use, the direct exploitation of organisms, climate change, pollution, and invasive species. But many of these drivers are entwined with and aggravated by climate change: agriculture, for instance, is transforming ecosystems while also, in many cases, contributing to climate change, and many species have shifted or expanded their ranges in response to changing temperatures.

The approximately 1.0°C increase in global average temperatures that has occurred since pre-industrial times is already damaging the planet's ecosystems in ways that are harmful to biodiversity and dangerous to people. In the Arctic, which is warming by more than double the global average, sea ice is declining with impacts on ecosystem structure and the abundance and composition of marine life. On land, changes to Arctic hydrology and wildfires are impacting vegetation, water and food security, and communities are struggling to adapt. The ocean is warming and sea-level rise is accelerating, which is putting low-lying coastal communities at risk. Ocean acidification has affected over 95% of the near-surface open ocean and is a major threat to some marine species including corals. Freshwater ecosystems are also feeling the impacts of climate change, which is exacerbating the other numerous pressures that they face: today, they are showing among the highest rates of decline in nature.

The world's forests – from the cold boreal ecosystems in the north to the tropical ones in the south, and the temperate forests in between – are facing a number of climate-exacerbated threats, such as pests, diseases and wildfires. Meanwhile, the destruction of these forests, as well as the conversion of grasslands and savannahs into cropland and pasture, is contributing to climate change. More than 30% of global forest area has been destroyed since the pre-industrial era. While unsustainable agricultural systems are driving much of this destruction, food production is also vulnerable to the impacts of climate change, such as higher temperatures and changing precipitation patterns, which is undermining global food security.

Biodiversity is suffering as a direct response to climate change and due to the degradation and a transformation of habitats in which species have lived for thousands of years. There are an estimated eight million plant and animal species on this planet, and around one million of them are now threatened with extinction, many within decades. Indeed, humans have already driven at least 680 vertebrate species to extinction since 1500, including the Pinta Giant Tortoise in the Galapagos in 2012. The rate of introduction of invasive species is higher than ever before, thanks to climate change and other human interferences like the rise in travel by air and sea. These introductions can have a damaging effect on native biodiversity, which is outcompeted by the incomers, particularly on islands and in other places with high proportions of endemic species. Overall, this has contributed to the erosion of the differences between different ecological communities, a phenomenon known as the "anthropogenic blender".

Furthermore, the damage to nature is expected to become more severe as climate change gets worse. The IPCC's 1.5°C report spells out the intensifying risks if global temperature rise reaches 2°C compared to 1.5°C – the target that countries adopted in the Paris Agreement. Temporarily exceeding the 1.5°C limit (i.e. a so-called "temperature overshoot" pathway) increases the risk of losing some ecosystems, an impact that would be long-lasting and in some cases irreversible. There are greater risks to biodiversity at 2°C compared to 1.5°C, including local losses and extinctions, forest fires, extreme weather events, and the spread of invasive species, pests and diseases. Equally, the greater the temperature rise, the harder it becomes for both nature and humanity to adapt. Limiting global warming to 1.5°C is essential – this means urgent action through raising Nationally Determined Contributions (NDCs) under the Paris Agreement to put the world on a low-emissions pathway.

But protecting and restoring nature can also help to mitigate climate change, while also protecting humans against its impacts. Agriculture, forestry and other land use accounts for almost a quarter of global greenhouse gas emissions. Reducing these emissions while simultaneously managing the land sector to draw down carbon dioxide from the atmosphere is critical to limiting global warming to below 1.5°C. In addition, integrating nature into cities and along coastlines, such as the creation or restoration of wetlands, tidal marshes or mangroves, can protect residents from climate-related hazards like storm surges and erosion. Protecting and managing our ecosystems and biodiversity can be an inexpensive and sustainable way to improve resilience against climate change impacts, and ensure that the land can continue to provide food, water, security and other vital contributions to people for years to come.

Among the thousands of pages and dozens of narratives that make up the story of climate change, the IPBES and IPCC paint a detailed picture of how nature – ecosystems and biodiversity – will suffer at the hands of climate change, and also how strong and healthy ecosystems endow resilience and can help us adapt to climate impacts. ***Climate, Nature and our 1.5°C Future*** shines a spotlight on this picture. We look at the impacts and risks of climate change across six biomes and systems: the polar regions, freshwater, oceans, grasslands and savannahs, forests, and food and provide a top three recommendations from WWF to each. We also examine some of the nature-based solutions (see box) in the IPCC and IPBES reports, and how WWF is already implementing some of these interventions on the ground. Finally, we outline WWF's summary and recommendations to governments and non-state actors.

NATURE-BASED SOLUTIONS AND RELATED CONCEPTS

NATURE-BASED SOLUTIONS

"Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits."

The International Union for Conservation of Nature (IUCN)

'Nature-based solutions' are interventions which capitalise on the contributions of nature to achieve societal and human development goals, including environmental protection, tackling climate change and sustainable food production. Nature-based solutions can be implemented both on land and in the oceans, and benefit both human well-being and biodiversity. They are a critical component in taking on the triple challenge of climate change, nature loss and socio-economic development (particularly food security) in the context of a growing population.

The IPCC and IPBES do not use the term nature-based solutions consistently but describe similar concepts including sustainable land management and green infrastructure. For example, the IPCC Special Report on Climate Change and Land defines **sustainable land management** as **"*The stewardship and use of land resources, including soils, water, animals and plants, to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions*".**

NATURE-BASED CLIMATE SOLUTIONS

"Nature conservation interventions that are intentionally planned to deliver additional tangible and traceable climate adaptation and/or mitigation impacts that have positive implications for human development."

The World Wide Fund for Nature (WWF)

Nature-based solutions can be used to respond to climate change. This might include working with nature to prevent carbon emissions, drawing down carbon from the atmosphere, or improving resilience to climate risks. Examples include preventing natural peatlands being converted to industrial monoculture plantations, thus halting natural ecosystem conversion, more efficient agricultural practices, and mangrove restoration to improve coastal resilience. These 'nature-based climate solutions' should be socially, ecologically and economically beneficial to governments and co-designed with Indigenous peoples and local communities. They should be implemented in parallel to, and be additional to, systemic changes to our energy, urban, infrastructure and industrial systems.

The Convention on Biological Diversity (CBD) notes that **"*nature-based solutions with biodiversity safeguards are an essential component of ecosystem-based approaches to climate change adaptation, mitigation and disaster risk reduction*".**

Public institutions, businesses and the international community are increasingly considering nature-based solutions in their responses to the climate emergency, most recently through the UN Climate Action Summit and the Beijing Call for Biodiversity and Climate Change.

Photo: © National Geographic Creative / Paul Nicklen / WWF

POLAR REGIONS

Impacts and Risks

GLOBAL WARMING OF
1.5°C
COMPARED TO
2°C
REDUCES THE CHANCES OF AN ICE-FREE SUMMER IN THE ARCTIC OCEAN FROM ONCE IN THREE TO TEN YEARS TO ONCE IN A CENTURY

Climate change is already causing dramatic changes to polar landscapes and seascapes. Over the last two decades, Arctic temperatures have likely increased by more than double the global average. Both the Arctic and Antarctic are losing ice and their oceans are changing fast. Across land and sea, these changes are having dramatic repercussions for global climate as well as the plants, animals and Arctic peoples that have historically thrived at extreme latitudes.

Rising temperatures are driving major ice loss in both polar regions. The last five years have been the hottest on record in the Arctic and, in 2016 and 2018, winter temperatures rose to 6°C above the historical average. The oceans are absorbing a lot of excess heat trapped in the atmosphere, with the Southern Ocean taking up a disproportionately high amount. The loss of Arctic sea ice in summer is unprecedented in the last 1,000 years. Elevated air and sea temperatures are causing the ice sheets in both poles to shrink, which has accelerated global sea-level rise. While the Greenland ice sheet is currently melting faster than Antarctica, the risk of triggering irreversible changes in the latter has the potential to lead to sea-level rise of several metres within a few centuries. As the area of snow and ice decreases in the polar regions, so does its ability to reflect sunlight back into space. This amplifies local temperatures and accelerates global warming. Permafrost is thawing in response to record high temperatures, with the potential to release large amounts of its carbon stores into the atmosphere as carbon dioxide and methane.

Wildlife is suffering as polar habitats change. Ocean acidification is more pronounced in polar regions, as cooler waters take up more carbon dioxide. This will impact the growth and survival of shelled species, such as Arctic sea snails (pteropods), which has cascading impacts all the way up the marine food chain. Changes to the ocean and sea ice are thought to be driving Antarctic krill further south, a trend that is projected to continue, causing a decline in local populations of this small but vital crustacean. In the Arctic, retreating sea ice has been associated with the death of more walrus calves as mothers are forced to 'haul-out' on crowded land sites, raising the risk of young animals being trampled. Changes in sea surface temperature and sea ice are affecting seabirds such as black-legged kittiwakes by changing the distribution of their prey and altering their diets, which damages their chances of survival and reproductive success.

Species are seeking out cool lands and waters as the world warms. While all kinds of creatures, from polar bears to Arctic char, face challenges as their sea ice environment changes, the available

AROUND

4 MILLION PEOPLE

LIVE PERMANENTLY IN THE ARCTIC REGION, OF WHOM

10% ARE INDIGENOUS

space is also getting more crowded as other species expand their territories northwards. Atlantic mackerel has expanded its range by hundreds of kilometres, into the oceans around Iceland and Greenland, in search of cooler waters. But newcomers can be bad news for native animals, which may be outcompeted and have a very limited number of places where they can thrive.

Arctic vegetation is being transformed. The Arctic tundra region is expected to shrink by a quarter to half by 2050 due to the northward expansion of woody shrubs and trees alone, with other vegetation changes decreasing tundra areas even further. This vast ecosystem and habitat loss will affect migrating animals, including caribou, muskox and millions of geese, as well as foraging species and the animals that predate on them, such as wolves. The frequency of fires in the Arctic is unprecedented in the last 10,000 years. Swathes of tundra that have lain undisturbed for centuries are being burned, exacerbating the degradation of permafrost. It is very uncertain whether Arctic vegetation can continue taking up enough carbon in future to compensate for the permafrost losses, potentially shifting the extent to which the ecosystem acts as a carbon sink or a carbon source in years to come.

Arctic peoples are facing new challenges as the ecosystem changes around them. Travel has become more dangerous as snow conditions change and traditional navigational indicators, such as snow drifts, become less predictable. As habitats shift and animal populations move and shrink, food insecurity is rising for Indigenous peoples, for whom subsistence hunting, gathering and fishing remain important sources of nutrition. This is not only a problem for Arctic peoples' physical health, but also their well-being, livelihoods, and cultural identity; these food sources are intimately associated with their emotional and spiritual connection to the land and their absence (alongside other factors, such as globalisation) are contributing to an increase in expensive imported foods.

Solutions

KEEPING GLOBAL WARMING

BELOW 1.5°C CURBS

FUTURE CRYOSPHERE LOSSES AND RELATED IMPACTS ON BIODIVERSITY AND PEOPLE

Urgent and ambitious global action to cut greenhouse gas emissions is needed to keep the polar regions covered in snow, ice and permafrost. Limiting global temperature rise to 1.5°C compared to 2°C would avoid the thawing of approximately 1.5 to 2.5 million square kilometres of permafrost. By the end of the century, limiting temperature rise to 1.5°C would also reduce the chances of an ice-free summer in the Arctic Ocean to once in a century, compared to once every three to ten years if global warming reaches 2°C. But even global warming of 1.5°C (0.5°C above present-day) will affect the whole food chain, from phytoplankton to marine mammals, with the Arctic Ocean and western Antarctic Peninsula undergoing the most dramatic changes.

Adaptation helps protect people against the changes already taking place in the Arctic. Hunters and gatherers have adopted strategies to deal with the changing Arctic environment, such as using larger or safer vehicles and hunting alternative species. In Savoonga, Alaska, where thin ice conditions have made it more difficult to harvest larger bowhead whales, residents anticipate relying more on reindeer as a source of meat in the future. Combining western science with Indigenous and local knowledge, such as though community-based monitoring, can help Arctic residents to prepare for the challenges ahead. However, limits to financial resources, human capital and institutional support are still major barriers to how far communities are able to adapt.

Establishing networks of protected areas can help support biodiversity and resilience. Connected tracts of protected habitats can act as a refuge against the impacts of climate change, giving ecosystems and populations the space to adapt. International collaboration is already designating and extending protected areas in both the Arctic and the Antarctic, although progress can be slow due to competing interests for marine resources. It is also necessary to protect polar ecosystems from the negative impacts of increased shipping, tourism and mining as melting ice provides access to once remote routes, destinations and resources. Many polar ecosystems, particularly those in the Antarctic Peninsula, are vulnerable to the risk of introducing alien species, for example. More action is needed to enact management plans and regulations that limit, or at least keep pace with, increased human activity in these once-undisturbed polar regions.

The worst impacts to fisheries can be avoided through reducing emissions and precautionary management. The polar regions support some of the world's largest commercial fisheries, but catch levels are at risk from changes to the oceans and sea ice. Several Arctic nations have signed the Oslo Declaration to prevent unregulated fishing in the Central Arctic Ocean until there is sufficient information to manage these resources sustainably, including additional knowledge on climate

change. In 2009, Norway passed the Marine Resources Act, which puts ecosystems at the heart of ocean management. In the western Canadian Arctic, Inuvialuit subsistence fishers developed an ecosystem-based fisheries management framework in response to melting ice cover, potentially expanding their fishing opportunities. But there are limits to how effective management plans can be in response to the rapid changes affecting the planet. Even with an ecosystems-based approach to fisheries management, it may not be possible to prevent the projected declines in some high-value species at high rates of global warming.

Improved governance and cooperation in the polar regions can help to preserve these landscapes and seascapes for future generations. Many proactive measures – establishing networks of protected areas and fisheries management plans, for example – can only be achieved with effective governance. This needs to take place at local, national, and regional levels, and encompass regulations, economic development strategies, tax incentives for alternative energy, permitting processes, resource management, and national security. The Arctic Council is one example of an intergovernmental forum that brings together Arctic nations and Indigenous peoples to bolster transboundary cooperation and globally-coordinated policy responses.

THREE RECOMMENDATIONS FROM WWF

Strengthen regional governance in the polar regions by prioritising the best science, precaution, and prevention to ensure the use of renewable natural resources is sustainable. In the Arctic, local and indigenous knowledge should be integrated into decision-making.

Designate and effectively manage representative networks of protected areas on land and in at least 30% of the polar oceans to strengthen the resilience of biodiversity and the services nature provides.

Enable climate resilient development in the Arctic by implementing science-based decarbonisation targets throughout the economy and strengthening collaborative governance across sectors, jurisdictions and timeframes.

Photo: © Morten Lindhard / WWF

CASE STUDY

*In the **Arctic** and **Antarctic,** WWF is working with ecologists, academics and Indigenous peoples to find effective ways to preserve these frozen landscapes.*

In Antarctica, technology is pushing the boundaries of science and conservation. Alongside the robotics lab at Duke University, WWF is photographing baleen whales using drones with onboard cameras to reveal useful information about the whales' foraging patterns, which can be fed into ecosystem management plans. The images have also raised some surprising questions about how wildlife is responding to climate change. In March 2019, one drone snapped a picture of a dwarf minke whale, which is rarely observed in the Antarctic. Is it possible that the species has already changed its distribution due to warming temperatures? Further research can help to answer these kinds of questions.

In the Arctic, WWF is working to identify a network of priority marine conservation areas. This endeavour is building upon the Arctic Council's decision in 2015 to approve a framework for a protected area network across the Arctic. Four years on, it is more urgent than ever that this becomes a reality. The goal of WWF's pan-Arctic project is to identify and map a network of connected and ecologically representative areas across the Arctic Ocean to reduce the loss of biodiversity and cultural identity in this vulnerable and rapidly changing part of the world.

Work is already underway in some Arctic nations. WWF-Russia has been working with the Russian Academy of Sciences and other marine experts since 2014 to identify 47 conservation priority areas in the Russian Arctic seas. In 2017, WWF-Canada began to identify priority areas for conservation the Arctic Basin, Arctic Archipelago, Eastern Arctic and Hudson Bay Complex and is working with governments and Indigenous organizations to discuss future planning.

Photo: © Troy Mayne

OCEANS

Impacts and Risks

ONLY
13% OF THE OCEAN
IS SUFFICIENTLY FREE FROM HUMAN IMPACTS TO BE CLASSED AS WILDERNESS

WARMER WATERS LEAD TO A
SHIFT IN MARINE SPECIES RANGES
AS THEY TRY TO TRACK THEIR FAVOURED CONDITIONS

The ocean is under pressure from numerous human activities. Despite its vastness, only 13% of the ocean, compared to 23% of land, is sufficiently free from human impacts to be classed as wilderness. Industrial fishing takes place across more than half the ocean, with four times the spatial footprint of agriculture. Fishing is penetrating ever deeper waters, and three-quarters of major fish stocks are now either fully- or over-exploited. An estimated 1.2-2.4 million tonnes of plastic flows from rivers into the ocean every year, where it is ingested by hundreds of ocean species. Onshore development, including land clearance and urban sprawl along coastlines, is also having a negative impact on marine ecosystems. The extraction of non-renewable resources in the ocean is increasing and is expected to expand into the polar regions as sea ice melts.

Oceans are absorbing the heat and are consequently becoming less hospitable for marine life. Both the surface and deep ocean are warming, and ocean heatwaves are becoming more frequent. This is the direct result of absorbing more than 90% of the excess heat accumulated in the earth system. Coral reefs, which make up some of the most species-rich habitats on Earth, are suffering heavily. Pollution, storms, overfishing and coastal development have already extinguished around half of live coral reef cover since the 1870s and these losses are accelerating as waters warm. In the Great Barrier Reef, back-to-back mass bleaching events between 2016 and 2018 meant the reefs had no time to recover and up to 50% of shallow corals were wiped out. Scientists expect major damage to reef-building corals with 1.5°C global warming and corals to all but disappear above 2°C. Warmer waters have led to a shift in marine species ranges as they try to track their favoured conditions – fish populations are projected to be pushed towards the poles at a rate of 16 kilometres on average, even if emissions reduce drastically, leading to local extinctions in the tropics and invasive species at higher latitudes.

The oceans are acidifying and oxygen is decreasing. The ocean has absorbed about 20 to 30% of the carbon dioxide produced by human activities since the 1980s. This has resulted in changes to ocean chemistry that are unprecedented in 65 million years. As seawater absorbs carbon dioxide, its pH reduces ('ocean acidification'), making it more difficult for many marine creatures to grow their shells and skeletons, while also affecting growth and reproduction. This has consequences all the way up the marine food chain. In addition, climate change is contributing to a decline in oxygen concentration in the ocean. Since the 1970s, "oxygen minimum zones" in the open ocean have

been increasing in volume and it is virtually certain that the risks of deoxygenation will increase as warming continues.

Coastal areas face increasingly destructive forces, while protection provided by ecosystems is threatened. Melting ice sheets in Greenland and Antarctica, combined with glacier mass loss, are now the main cause of sea-level rise. Today, oceans are, on average, around 16 centimetres higher than they were at the beginning of the 20th century, sea-level rise has accelerated to 3.6 millimeters per year with past and current emissions locking in further rises for centuries to come. Even in a best case scenario, where emissions are drastically reduced, global mean sea-levels could rise 43 centimeters by the end of the century compared to 1986-2005. Extreme sea-level events that were historically rare will become common by 2100. Alongside other exacerbating factors like storm surges, this threatens biodiversity, habitats and people in coastal areas. Marine turtles, for instance, risk losing their nesting places to rising oceans and extreme weather events, while those eggs that do hatch are more likely to be born female or with abnormalities due to future changes in temperature and rainfall.

NEARLY 50%

OF THE PRE-INDUSTRIAL EXTENT OF GLOBAL COASTAL WETLANDS HAS BEEN LOST SINCE THE 19TH CENTURY

Coastal societies will face numerous challenges and, unless emissions are reduced, the most vulnerable communities will struggle to maintain their homes and livelihoods. Some low-lying atoll islands and Arctic communities face very high risks from sea-level rise even if emissions are cut drastically. Without adaptation, coastal erosion from sea-level rise could displace up to 1.6 to 5.3 million people during the 21st century. Those that stay will be increasingly vulnerable to the elements: the loss of mangroves and coral reefs, which protect the coastline from waves, will expose communities to storms and flooding that are intensified by warmer ocean temperatures. The damage to these ecosystems has been exacerbated by the construction of human barriers, with vegetation and beaches squeezed by the cement and tarmac of urban development on one side preventing them from moving inland, and by rising sea levels on the other. Indigenous people and local communities that depend on the ocean for food will suffer, with environmental changes already reducing fisheries catches in many regions.

Even the deep sea is feeling the impacts of climate change. The warming-induced loss of biological activity closer to the surface means less of the food supply that helps sustain deep sea life is sinking to the bottom. Cold water corals, which form large reefs and important habitats on the deep seafloor, will be exposed to a number of climate-induced threats in the 21st century, and it is uncertain whether they will be able to adapt.

'Blue carbon' ecosystems, such as mangroves, seagrass beds and salt marshes, help to tackle climate change by sequestering emissions, but these too are under threat. Over the past century, around 25-50% of these habitats have been lost or degraded due to human disturbances, causing them to release a proportion of their stored carbon into the atmosphere.

Solutions

Limiting temperature rise by reducing global greenhouse gas emissions will avoid some of the worst risks to the oceans and coastal communities. This will reduce the chances of mass mortality events and disease outbreaks that are projected to increase in ocean ecosystems as sea temperatures rise, particularly to those organisms and ecosystems that are unable to move, such as kelp forests and coral reefs. Reducing other pressures, like coastal pollution, overfishing and destructive coastal development, will also increase the resilience of ocean ecosystems to the direct impacts of climate change. The protection and enhancement of coastal "blue carbon" ecosystems can help to combat climate change and contribute to the resilience and adaptation potential of key coastal habitats. But its contribution is likely to be modest and cannot replace the need for drastic emissions cuts.

Restoring ecosystems is generally the most effective way to protect coastal areas from storms and rising sea levels. Coastal protection can reduce the risk of flooding by two to three orders of magnitude during the 21st century, but will require tens to hundreds of billions of dollars in investments per year. Unlike human-built infrastructure, protective ecosystems like oyster banks, coral reefs and mangroves can, when healthy, repair themselves when damaged, which can make them more cost-effective than seawalls and dykes. Nature-based solutions also provide a number of co-benefits – sequestering carbon, generating income from tourism, enhancing fisheries production, improving water quality – that also ultimately help to increase the resilience

of communities vulnerable to rising sea levels. However, unlike hard structures like seawalls, nature-based protection requires space that is increasingly threatened by coastal development. It is possible, in some cases, to create a mixed portfolio of measures, such as planting mangrove forests in front of dykes.

There are options for restoring degraded ocean ecosystems. Various methods have been proposed for restoring coral reefs, including aquaculture and 'assisted evolution' to help corals better adapt to warming seas, although turning these into a cost-effective intervention to preserve coral reefs under rapid climate change will be challenging. Mangroves can be restored through community replanting programmes. Ecosystem-based approaches to adaptation can be more effective when they draw upon the knowledge of local communities and Indigenous peoples. Nonetheless, relying on nature to protect coastal communities against the impacts of climate change will not be effective unless emissions are also reduced; the pace of climate impacts may exceed the rate at which ecosystems themselves can adapt and repair themselves.

Ecosystems need to be protected as well as restored. Establishing effective networks of marine protected areas can help to preserve both biodiversity and contribute to food security. One innovative example of this is a debt swap in the Seychelles, which will result in 400,000 square kilometres of protected ocean area. However, it is not enough to create protected areas; they also need to be managed effectively, including both the regulation of legal activities, like tourism and recreation, and the effective halt of illegal encroachments, like poaching and industrial exploitation. Climate change can complicate a protected area approach, as species range shifts may require the protection of larger or entirely different areas. In countries where some ecosystems, like coastal wetlands, are already well protected by legislation, the main requirement may be better enforcement of existing regulations.

Better governance and more finance are needed to protect the oceans against climate change. Existing international governance regimes are ill-equipped to deal with complex ocean warming, acidification and deoxygenation, as they were established at a time when minimal attention was given to the issue of climate change. Improved cooperation at regional and global scales, as well as increasing the participation of society at large, including Indigenous peoples and labour organisations, could improve the ability of governance institutions to deal with this complex challenge. Financial support will also be required to protect marine biodiversity and ecosystems for future generations. This will require innovative solutions and market-based mechanisms, such as payments for ecosystem services and biodiversity offsets. At present, the majority of ocean conservation funding comes from public finance, which is affected by short-term political agendas and public opinion.

THREE RECOMMENDATIONS FROM WWF

Protect and restore 'blue carbon' habitats such as mangroves, seagrass beds and coastal and deep sea sediments.

Designate and manage effective, representative networks of marine protected areas covering at least 30% of the oceans to ensure food security, jobs and essential ecosystem services.

Manage all fisheries sustainably and equitably.

CASE STUDY

Photo: © Jonathan Caramanus / Green Renaissance / WWF-UK

***Kenya's mangrove forests** have, to date, been overlooked as a way to meet the country's climate targets. With their ability to sequester carbon, these important coastal ecosystems could help the country meet its emission reduction goals, while also conserving biodiversity, providing local people with livelihoods, and protecting the coastal communities from storms and rising sea levels.*

Currently, the Kenyan government lacks information on the extent and distribution of mangroves, and on the amount of above- and below-ground carbon they store, and so cannot adequately represent the potential of this ecosystem in its climate targets under the Paris Agreement, known as "Nationally Determined Contributions" (NDCs). That could change when the government submits its revised pledge in 2020. WWF-Kenya, alongside the Kenya Marine and Fisheries Research Institute, is mapping mangrove forests in Lamu County – home to more than 60% of the nation's mangroves – and carrying out a carbon stock assessment, so that, next time around, the government has the information it needs to include mangroves in its NDC.

Already, WWF-Kenya has supported community schemes to protect and establish mangrove forests, including in the Gazi bay, where the Mikoko Pamoja Community Based Organisation was able to buy textbooks and clean water from the carbon revenues received through its conservation work. At the same time, this has improved the habitats of the fish upon which the local community depend.

"Since we started conserving the mangroves and established new plantations, our husbands have been able to return home with bigger fish of different kinds, for they now have a secure and habitable place to nest and enough food," says Mama Hafsa, who runs a local shop.

Working with the Kenyan government to recognise the value of mangrove forests could take these kinds of projects to the next level, leading to greater awareness and action around mangrove conservation and restoration in Kenya. Already, WWF-Kenya has worked with the government to integrate mangroves into domestic climate policy, paving the way towards mangroves' inclusion in the country's international commitments.

FRESHWATER

Impacts and Risks

Freshwater ecosystems are essential for people and nature. There are many different types of these ecosystems, including rivers, lakes, glaciers and other wetlands (for example, marshes, peatlands and deltas). Although wetlands cover just 6% of the world's surface, they support rich biodiversity and provide ecosystem services to people, such as clean water and flood protection, that are disproportionate to their size. They are also important for maintaining a stable climate: wetlands contain around 12% of the global carbon pool.

Freshwater ecosystems are faring badly, with declines in biodiversity even worse than those on land. In Europe, 59% of freshwater molluscs, 40% of freshwater fish and 23% of amphibians are threatened with extinction due to a combination of factors. Humans are also suffering from the loss of diverse freshwater ecosystems. For example, scientists estimate that up to 87% of wetlands were lost between 1700 and 2000, predominantly inland. Recent losses are mostly coastal and have been even faster, declining by 31% between 1970 and 2008. This is leaving people increasingly vulnerable to floods and storms.

Agriculture is a major threat to freshwater ecosystems. Globally, water withdrawals from underground aquifers rose from less than 600 km^3/year in 1900 to nearly 4,000 km^3/year in 2010, a proportionately faster rate of change than population growth. In more than half of aquifers in key river basins, such as the Indus and Nile, water is now being used at an unsustainable rate. As well as over a third of the world's land being devoted to producing crops or livestock, agriculture is responsible for 69% of this increased groundwater extraction, with industrial use and direct human consumption making up the rest. Drainage and conversion, mainly for agriculture and urban development, are directly driving the loss of inland wetlands.

THERE ARE CURRENTLY ABOUT

50,000 LARGE DAMS

ON THE WORLD'S RIVERS

Globally, hydropower is a growing source of renewable energy capacity but it can have large social and environmental impacts. Dams fragment rivers, interrupt the movement of organisms up and downstream, and change flowing river habitats into still pools. They also trap sand and gravel, depleting the amount of sediment delivered to downstream areas and accelerating erosion in deltas and estuaries. This compromises the ability of these ecosystems to support diverse freshwater habitats, productive agriculture and fisheries, and some of the most densely populated human settlements in the world. Some 172 of the world's 292 large river systems are affected by dams, with Europe laying claim to the fewest unfragmented river systems. Construction of dams is

taking place in some of the most biodiverse river basins in the world, including the Mekong, Congo and the Amazon.

Freshwater ecosystems and the communities they support are also at risk from climate change. In high mountain areas, snow cover, glaciers and permafrost have declined in recent decades due to climate change, and runoff is expected to peak at or before the end of the 21st century as they continue to melt; thereafter, runoff will decline. These are a crucial source of freshwater, and their decline will alter the flow of rivers, with significant impacts on ecosystems and livelihoods downstream, including for the farms, villages and cities that rely on this freshwater. Hydropower generation, tourism, and spiritual values are further casualties of the loss of snow and ice cover and changing river flows in mountain regions. Climate change is also causing structural changes to wetlands, influencing water volumes, temperature, invasive species, the balance of nutrients and the pattern, frequency and intensity of wildfire.

WETLANDS CONTAIN AROUND **12% OF THE GLOBAL CARBON POOL**

Climate-induced changes to freshwater availability are affecting biodiversity both on land and in water. The structure of some freshwater communities are already being markedly transformed. For example, brook trout are migrating further upstream in the summer to find cooler water, and their range is shrinking as a result. In the Arctic, discharge of freshwater from the Greenland Ice Sheet can impact the marine ecosystem with a knock-on effect on some commercially-harvested species. On land, shrinking ice means a loss of critical habitat for wildlife, with many mountain birds and mammals relying on seasonal snow and glaciers for foraging and nesting. Herders in Afghanistan, Nepal and Pakistan have noticed that vegetation is lower quality and less abundant, thanks to erratic snowfall patterns and decreasing rainfall.

The destruction of freshwater ecosystems is, in turn, contributing to climate change. Like forests and grasslands, wetlands sequester carbon. The loss or degradation of wetlands therefore means that more carbon collects in the atmosphere. The draining of peatlands to grow crops exposes the peat to the air and causes it to oxidise, releasing carbon dioxide. In Indonesia, the carbon dioxide emissions each year from draining peat to plant oil palm is equivalent to the annual emissions from burning fossil fuels in Canada.

Solutions

Combating climate change will help to preserve freshwater ecosystems. Human population and demand are likely to have the greatest effect on freshwater availability over the next few decades. Nonetheless, scientists say that limiting global temperature rise to 1.5°C compared to 2°C could reduce the pressure on water supply. At 1.5°C, less water is expected to be withdrawn globally for irrigation, projected changes to levels of runoff are smaller and hydropower generation may be more secure, though there will be regional differences. Rapid scale-up of wind and solar power can help to tackle climate change without causing the multiple harms to nature that are associated with hydropower. Avoiding the conversion of some ecosystems, particularly carbon-rich peatlands, will be crucial to limit further climate change.

Existing freshwater systems need to be protected and conserved for the benefit of people and nature. Limiting agricultural expansion and optimising water use, through sustainable intensification and improved technology, could reduce the impact that farming has on freshwater ecosystems. Freshwater consumption and waste can be reduced in other sectors, too, such as mining and industry. Incentives such as water pricing could help to improve water-use efficiency. Catchment areas – the land area that provides runoff to a river or reservoir – can be managed in ways that reduce freshwater pollution, improve water quality and regulate the quantity and timing of flow. This can mean limiting mining and industry in these areas, using sustainable farming practices, protecting healthy forests and soils, and planting indigenous species.

Degraded freshwater ecosystems can be restored. In the USA and Europe in particular, efforts to restore wetlands and rivers are on the rise, including managing water flow patterns in ways that promote ecosystem processes. There have also been meaningful efforts to restore peatlands. In higher latitudes, the most effective action is to rewet peatlands that have been drained; long-term monitoring has demonstrated that, once vegetation becomes re-established, this can even recreate a carbon sink, while also having benefits for biodiversity and human well-being. Restoring ecosystems can also act as a nature-based solution to other problems associated with climate

change. The creation or restoration of wetlands, mangroves and tidal marshes, for instance, can protect coastal cities from storm surges and erosion.

Communities can adapt to some climate change impacts – but not all of them. Rainwater harvesting, improved pasture management, water reuse, and more efficient management of soil and irrigation water will all reduce pressure on water supplies. But there are limits to how much a community can adapt. In mountainous areas, some communities have been displaced by changing conditions as life becomes too difficult or dangerous. In Nepal, for instance, three villages planned to relocate to a lower area after decreased snow cover dried up the springs that had traditionally provided them with water for irrigation.

Better governance can help to secure freshwater ecosystems into the future. Establishing a clear legal status for all types of water – including surface water, groundwater and wastewater – would make it clear who has rights to access these resources, as well as who is responsible for any pollution. It would also enable authorities to monitor losses, impose penalties, and decide upon response measures in times of severe water pressure or drought. Transboundary water management can help to minimise environmental, economic and social conflicts and risks. Economic mechanisms and incentives can also help to ensure a more sustainable future for freshwater ecosystems. Including Indigenous peoples and local communities in decision-making, and respecting their customary rights in water allocation decisions, will enhance equity and prevent conflicts. These communities can have an intimate connection with freshwater bodies, and may also view water as a spiritual resource.

THREE RECOMMENDATIONS FROM WWF

Put in place an emergency recovery plan for freshwater biodiversity.

Accelerate implementation of environmental flows, and safeguard and restore river connectivity, and restore wetlands.

Rapidly increase public and private investment in nature-based solutions for climate-related water risks, such as extreme floods and droughts.

CASE STUDY

Photo: © Jonathan Caramanus / Green Renaissance / WWF-UK

***South Africa's Riviersonderend** – or 'river without end' – is a crucial source of freshwater for Cape Town residents: it supplies the largest reservoir in the Western Cape, which holds 40% of the city's water supply. Yet the surrounding valleys and wetlands have been overrun by thirstier invasive species, like blue gums and black wattle, which suck up more water than native plants, reducing the flow of the river.*

As recent history has shown, protecting freshwater is vital: following years of drought, Cape Town came dangerously close to running out of water in 2018. WWF South Africa is helping to preserve the freshwater resources provided by the Riviersonderend by removing invasive species and replacing them with indigenous plants like palmiet – a nature-based solution to improving the region's water supply.

Palmiet is referred to as "wetland glue" – it stabilises the river banks, slows floods, purifies water, and helps to replenish the groundwater. Palmiet wetlands provide a habitat for freshwater fish, mammals, insects and birds, and also sequester carbon, helping to tackle climate change. But invasive species were out-competing the palmiet and undermining the healthy functioning of the Riviersonderend system.

WWF's project to restore the Riviersonderend began with mapping the area and meeting landowners and communities, while also raising funds from private and public sources. Aside from clearance of invasive species, the project has also funded a nursery where local landowners can buy plants like palmiet and other indigenous plants that have been cultivated for restoration work.

The aim now is to scale up the work and help restore the full length of the Riviersonderend, and to replicate the initiative in other river basins and critical water source areas since it is estimated that 1.4 billion cubic meters of water are lost to alien plants in South Africa each year. As the work in the Riviersonderend has shown, removing invasive plants and restoring indigenous vegetation not only helps to stop further degradation of water resources – at a cost comparable, or lower, than many other alternatives – but it also provides a boost to biodiversity and creates opportunities for sustainable livelihoods.

Photo: © naturepl.com / Andy Rouse / WWF

GRASSLANDS AND SAVANNAHS

Risks and impacts

Grasslands and savannahs harbour a wealth of biodiversity and help to tackle climate change – but they are under threat. These biomes are open plains of grass, or a combination of woodland, shrubland and grassland. They exist in both the tropics and the world's temperate zones, representing around a third of the world's land area, and host a number of iconic species, including elephants, rhinos, lions and tigers. The Eurasion steppes host the largest long-distance ungulate migrations on the planet. In the tropics, these ecosystems sustain the livelihoods of one-fifth of the world's population, and can be as rich in plant and animal species as forests. Despite their value, grasslands and savannahs are being lost and degraded faster than any other biome on the planet.

Misunderstanding of the value of grasslands and savannahs has led to poor management and conversion to other land uses. These are ancient ecosystems that have been around for eight to ten million years – but there is a tendency to see them as degraded landscapes that have emerged as a result of forest degradation and deforestation for agriculture. They can, as a result, suffer through afforestation, where trees are planted on historically non-forested land to reduce emissions – a method that is sometimes incorporated in scenarios designed to keep global temperature rise below 1.5°C. Efforts to tackle climate change by planting trees often fails to distinguish between degraded and old-growth grasslands and savannahs, therefore contributing to the conversion of these landscapes. Afforestation on native grassland and savannah ecosystems can have significant negative impacts on biodiversity, water resources and other ecosystem services. Conversion can even damage soil carbon stocks, which can reduce or negate the eventual carbon benefits that would otherwise be expected from increased tree planting.

Crop production and overgrazing are the other biggest threats to grasslands and savannahs. Beyond tree plantations, grasslands and savannahs can also be converted to cropland and pastures through ploughing and seeding. While natural temperate and tropical grasslands can host some level of grazing, they are being damaged by excess: these ecosystems are home to the majority of the world's livestock production. Between 1700 and 1992, 6.7 million square kilometres of savannah, grassland and steppe habitats were converted to croplands, with more than 80% of these habitats converted to settlements and farms by 2000. In North America, grasslands are disappearing at an equivalent rate to deforestation in the Amazon. Half of the Cerrado tropical savannah in Brazil has

been converted by extensive cattle ranching on planted pastures and by soybean expansion. These conversions are difficult to reverse: first, because the demand for beef and soy continues to grow, fuelling the expansion of crops and pastures onto pristine land, and second, because pasture and crop abandonment does not always lead to the spontaneous restoration of old-growth biodiverse savannah. Alongside habitat conversion and overgrazing, invasive species and fragmentation by transport infrastructure are also becoming increasingly problematic for temperate and tropical grasslands.

AROUND
36% OF SOIL CARBON STOCKS ARE LOST
AFTER 20 YEARS FOLLOWING THE CONVERSION OF GRASSLANDS TO PASTURE OR CROPLAND

Climate change is changing the composition of grasslands and savannahs. Rising levels of carbon dioxide are causing trees and shrubs to encroach on grassland areas. This can have opposing effects on the carbon sequestration potential of these biomes: while encroachment suppresses the growth of grass and savannah trees and may therefore lead to a decrease in below ground carbon stocks, the increase in other woody plant species can increase above-ground carbon stocks. Although grasslands and savannahs can prove relatively resilient and are capable of recovering from a moderately degraded state, exceeding certain tipping points can render restoration impossible. Heavy rainfall, which is increasingly likely given current and projected changes in the climate, may cause problems for some grassland species, such as Yorkshire Fog, that are unable to cope with water-saturated soil although overall productivity remains constant. Though it can be a threat to grasslands and savannahs, grazing is also vulnerable to the impacts of climate change, with warming and changes in rainfall leading to a decrease in forage quality.

Destruction and degradation of grasslands and savannahs will contribute to climate change. Temperate and tropical grasslands and savannahs store a huge amount of carbon in their soil – between 18 and 31% of total terrestrial carbon just for temperate grasslands, according to one estimate. Around 36% of soil carbon stocks are lost after 20 years following the conversion of grasslands to pasture or cropland. Nitrous oxide, another greenhouse gas, also typically increases following the conversion of grasslands to pastures or croplands, lasting from a few years to a decade or more.

Solutions

Reducing emissions will prevent further climate-related decline of grassland and savannah ecosystems. Already, trees and shrubs are increasing in density at the expense of grassland species, and this impact will be amplified as temperatures rise. The Fynbos biome in southwestern South Africa, which is made up of low scrubby plants and bushes, will lose 20% of its suitable climate area under 1°C of global warming, compared to 80% at 3°C.

More grasslands and savannahs need to be formally protected. Temperate grasslands are poorly protected compared to other major terrestrial biomes, with less than 5% receiving formal recognition. There are also concerns that attempts to prevent agricultural expansion in forests could damage savannahs and grasslands, with land conversion taking place in these ecosystems instead. Globally, there have been some governmental efforts to prevent farmers from unsustainably exploiting these ecosystems. Policies to deny crop insurance to US farmers who have converted grasslands to agriculture resulted in a 9% drop in conversion, and in 2003 the Chinese government launched the Returning Grazing Land to Grassland Project, designed to combat desertification and to adapt to and mitigate climate change.

Alongside legal protections, more sustainable farming can protect grasslands and savannah from further conversion. There remains a lot of pressure to convert grasslands to croplands, particularly if farmers face crop failures due to climate change and expand their holdings as a result. Humid savannahs are particularly vulnerable to future conversion into cropland or pasture, because they are climatically suitable for agriculture. Livestock grazing can be carried out more sustainably through measures such as rotational grazing and allowing spontaneous restoration by establishing enclosures. Instead of growing crops, retaining grass cover will reduce soil erosion and the loss of soil carbon, while also improving resilience to climate change.

Grasslands can help to combat climate change if they are managed in a way that increases carbon storage and improves biodiversity. Soil carbon sequestration in croplands and grasslands offers one of the highest potential options for carbon dioxide removal. As well as tackling climate

change, appropriate management can offer benefits to local communities. In rural areas in Western and Southern Africa, the high value of shea fruit offers an incentive to preserve and manage the tree on which it grows, which also sequesters carbon into the savannah. The indigenous knowledge behind this practice needs to be protected from growing pressure to chop shea trees down for fuel. Traditional knowledge on appropriate grazing and fire management is essential for grassland and savannah conservation and restoration. Prescribed regular burnings of dry grasslands can prevent larger fires and also help to restore habitats and landscape structure to recover its original biodiversity. Efforts to remove carbon dioxide from the air, such as afforestation, must also recognise the value of native grasslands and savannahs, and not take place within these ecosystems.

THREE RECOMMENDATIONS FROM WWF

Scale up the protection of grasslands and savannahs to prevent natural habitat conversion.

Ensure the integrity and connectivity of grasslands and savannahs, and distinguish them from degraded forests, to avoid their conversion by afforestation.

Improve grasslands management at scale to increase carbon storage, restore biodiversity and protect traditional livelihoods and cultures.

CASE STUDY

Photo: © Wild Wonders of Europe / Igor Shpilenok / WWF

***Saiga antelope** are ancient mammals, and were once common. Once upon a time, they would have lived alongside saber-toothed tigers and woolly mammoths, and roamed across a vast territory stretching from Britain to Alaska. Today, the species is critically endangered, with only a few populations remaining in the arid steppes and semi-deserts of Russia, Kazakhstan, Uzbekistan and Mongolia.*

The rise of the USSR had a devastating impact on Saiga numbers as the vast grasslands which were once home to the antelope were transformed into pastures and farms, fragmenting herds across Eurasia. Unsustainable irrigation systems caused severe damage to the ecosystem, which is still felt today. Saiga antelope are also facing the threat of climate change, which is drying up the watering holes of this already arid landscape.

In Russia's Stepnoi wildlife reserves, the remnants of the problem are proving to be the solution. Self-flowing wells, built by the Soviets to support intensive watermelon production, are still capable today of drawing up water from deep underground. But they were blocked up by sand, sediment and, in one case, a tree trunk.

Around the wells are farming areas, and WWF identified this as an opportunity to alleviate the competition between livestock and wildlife for water sources, particularly if unusual dry seasons occur in the next decades. WWF-Russia has unblocked three of these wells to create an artificial watering hole for the Saiga, through funding from the WWF Wildlife Adaptation Innovation Fund.

"It's adaptation to climate change," says Valerii Shmunk, head of WWF-Russia's Northern Caucasus office. "Around them are farming areas, and if we have much more dry seasons in the next decades, the problem of competition for water sources will be raised. This project is trying to decrease the competition between livestock and wildlife."

It seems to have worked. A Saiga census in June revealed that 30% of the Stepnoi population was calves – although the real test will be how many of these babies survive the hot, dry summer. Camera traps and visits from rangers have revealed that the new watering holes are not only attractive to Saiga, but also to wolves, foxes, wildcats, eagles, cranes, and other animals that live across the refuge. WWF-Russia hopes to fix at least another eight wells, building a hopeful legacy from a once destructive system.

Photo: © Luis Barreto / WWF-UK

FORESTS

Impacts and Risks

Forests are being destroyed at an alarming rate, particularly in the tropics. The global area of tree cover is only 54% of what it was at the dawn of civilisation. The loss of species-rich natural ecosystems is having devastating consequences for animals and ecosystems; the tropics, in particular, are home to the richest biodiversity on the planet. The destruction of forests is also contributing to climate change. Together, agriculture, forestry and other land use represent around 23% of human-caused greenhouse gas emissions.

40%

OF DEFORESTATION IS CAUSED BY LARGE-SCALE COMMERCIAL AGRICULTURE

The consumption and food production patterns of a growing human population are driving the destruction of forests. Since 1961, population growth and increases in per capita consumption of food, feed, fibre, timber and energy have put unprecedented pressure on the land, causing the loss of natural forests and biodiversity. Commercial agricultural expansion is by far the most widespread form of land cover change, and has changed the face of the planet. Across the tropics, farmland increased by over 100 million hectares between 1980 and 2000, half of which was at the expense of intact tropical forests. This was partly due to cattle ranching in Latin America and plantations in South-East Asia, 80% of which were for palm oil. Demand for commodities like soybeans and the ongoing global shift towards meat-based diets is a major driver of agricultural expansion, with a third of crop production used for livestock feed. This has consequences for nature, including forests.

Logging to produce timber and pulp for global markets is the main driver of forest degradation. Over a quarter of global fuelwood harvested in 2009 was deemed unsustainable. In some cases, logging can indirectly destroy areas of forest though interaction with fires or progressive intensification of land use. Other drivers of deforestation and forest degradation include urban expansion, mining, and expanding infrastructure such as roads, railways, dams and pipelines. The damage is not only to trees: these intrusions are causing reductions in species richness and abundance in the tropics and increased pressure on threatened plants.

Boreal and temperate forests are faring better than their tropical counterparts, but are nonetheless highly susceptible to climate change. Boreal forests are spread primarily across Canada, Russia and Scandinavia, while temperate forests grow in both hemispheres and are particularly productive in western North America, Chile, New Zealand and Australia. The area of boreal forest has remained steady since 1990, while temperate forest area has increased by about 67 million hectares, partly due to the regrowth of vegetation on abandoned land – although this

secondary growth is comparatively poor in biodiversity. But this shouldn't disguise the fact that temperate forests were already faring extremely badly by this point: China and Europe were already largely deforested by the 1500s, and many other countries have lost more than 90% of their forest cover. Hundreds of thousands of previously undisturbed primary forest across both boreal and temperate regions continue to be degraded. Indigenous peoples who inhabit boreal forests have reported changing animal populations – more moose and fewer caribou and bird species – and changing migration patterns due to climate change.

AGRICULTURE, FORESTRY AND OTHER LAND USE REPRESENT AROUND **23% OF HUMAN-CAUSED GREENHOUSE GAS EMISSIONS**

The destruction of the world's forests is contributing to climate change, while climate change, in turn, threatens to hasten the destruction of forests. Forests act as a carbon sink, sequestering carbon emissions in their vegetation, soil, roots, and fungi. Between 2007 and 2016, land (including all forest types but excluding agriculture) removed six billion tonnes of carbon dioxide from the atmosphere per year. However, these stores of carbon are not guaranteed to last into eternity. Warmer temperatures bring a number of threats, including moisture stress, invasive species and diseases, and wildfire. Rather than absorbing carbon dioxide, boreal forests could become a net source of greenhouse gases as they become warmer and drier, due to moisture stress.

Exceeding certain temperature limits could trigger forest dieback, causing dramatic changes to the landscape. Across Central America, dieback could lead to rainforest being replaced by degraded ecosystems resembling savannah and grassland. In the Amazon, scientists suggest this tipping point could occur at around 3-4°C of global warming. In boreal forests, dieback would result in large areas of open woodland and grassland, causing further regional warming and fires.

Solutions

Forests need to be protected for the biodiversity they harbour, the carbon they store, and the other ecosystem services that they offer. Responses range from protecting existing forests, halting deforestation and degradation, and expanding and restoring forests and tree cover. Halting tropical deforestation and degradation in tropical forests could avoid between 1.8 and 12.8 billion tonnes of carbon dioxide being released per year. Expanding forests could actively draw down more carbon dioxide from the atmosphere, potentially helping to keep temperature rise below 1.5°C – although this approach can have trade-offs with biodiversity and food security. The rate of forest loss has slowed globally since 2000, although efforts have been unevenly distributed across the planet and have had varied success in restoring biodiversity and ecosystem services to humans.

Ending deforestation is a task for the entire planet. The problem cannot be solved by forest nations alone: forests are being destroyed and degraded to provide food, feed, fibre and energy to people around the world. Governments and businesses can build more sustainable supply chains by adopting new standards, certifications and zero-deforestation commitments that minimise the harm to forests and nature. While improvement is underway in many supply chains, the measures taken are still often insufficient to stop or reduce deforestation and degradation. In some cases, there can be unintended trade-offs. In the Amazon, for example, three major agro-businesses have agreed a Soy Moratorium, which substantially reduced deforestation in the Amazon but appears to have accelerated conversion in an area of tropical savannah called the Cerrado. But these are not the only methods to reduce the pressure on forests. For example, demand-side measures such as shifting towards more sustainable diets and reducing food loss and waste would reduce the pressure on land.

Supporting the rights of Indigenous peoples and local communities is increasingly recognised as important for conserving forest ecosystems. Areas of the planet that are traditionally viewed as "wilderness" or "untouched nature" are actually home to people who have lived off these landscape for generations. With their intimate knowledge of the land, these communities have a vital role in conserving and managing forests. T his can be either through the formal recognition of their customary tenure rights – studies have shown that deforestation rates are lower in tropical community-managed forests compared to protected forests – or by directly involving them in conservation schemes. Many communities are already taking determined action: for example, a global indigenous coalition from the Amazon, Central America, the Congo Basin and Indonesia has pledged to protect 400 million hectares of forest.

Forests can be used and conserved at the same time. Making use of the economic value of these biomes needn't be at the expense of the biodiversity and carbon contained within. Sustainable forest management aims to continue using forest products, through logging for example, while maintaining the biodiversity, productivity and vitality of the ecosystem. This can provide livelihoods for communities and reduce the risk that the forest will be converted to non-forest uses, such as settlements and crops. Agroforestry, where farmers plant trees among crops and livestock, is an important form of land management in the context of climate change, as it sequesters carbon in the soil and enhances the resilience of agricultural systems, as well as generating a source of income. Uptake, however, has been low and slow. Forest management decisions can also involve trade-offs. A management strategy that seeks to increase forest productivity by thinning trees that would otherwise die may reduce biodiversity by removing habitats of woody debris.

Expanding and restoring forests can help to tackle climate change. Restoration, afforestation and reforestation can help to limit global temperature rise by removing carbon dioxide from the atmosphere. Yet carbon dioxide removal measures can have negative impacts on biodiversity, food security, livelihoods and other ecosystem services – to limit temperature rise to below 1.5°C would require the conversion of millions of square kilometers of land, much of which is already used informally by poor communities. Forest restoration could make forests more resilient to climate change, through enhancing connectivity and conserving biodiversity hotspots, and could help to rehabilitate degraded lands. But it must be implemented in an ecologically and socially sensitive way. Planting native species can help biodiversity to recover, whereas monocultures of non-native trees can be harmful, and if inappropriate species are selected they could even introduce invasive species such as Acacia and Pinus. Badly planned and implemented large-scale afforestation, on the other hand, can cause land degradation and lead to rising food prices due to competition for land if not deployed sensitively. Large areas of land could potentially be freed up for carbon dioxide removal by increasing crop yields – but these scenarios, too, could fail to consider the environmental and social issues around agricultural intensification.

THREE RECOMMENDATIONS FROM WWF

Halt conversion and protect standing forests from deforestation and forest degradation.

Use the huge potential of trees for restoring productivity, biodiversity and carbon stocks in degraded landscapes that once had forests.

Ensure that the protection, restoration and sustainable management of forests are land-use options that are effective, inclusive, provide multiple benefits to society as a whole, and especially to Indigenous peoples and local communities.

CASE STUDY

Photo: © naturepl.com / Anup Shah / WWF

***Red pandas** live in the temperate forests of Sikkim, India. These remote ecosystems, with their understory of bamboo thicket, are the perfect habitat for a species that is known to be intolerant to disturbances. But climate change, and the demands of the outside world, are encroaching on the red pandas' home.*

Local communities depend on the forests for food and fuel, yet this resource extraction is disturbing and degrading the ecosystem. Red pandas have a better chance of adapting to climate change in the future if their habitats are intact, and WWF is working to ensure that the species has a healthy and peaceful environment into the future.

So far, this has included working with communities to encourage the use of efficient cooking devices and solar water heaters, which reduce the amount of fuel required and therefore prevent forest degradation and disturbance to the red pandas. To date, WWF has trained 23 families to manufacture improved cookstoves, which has cut fuelwood requirements by a third while also reducing indoor air pollution. The technology will now be rolled out to an additional 300 households.

"We also involve community groups, such as "Himal Rakshaks" or the Mountain Guardians, during our conservation initiatives," says Dr. Partha Sarathi Ghose, WWF-India's Senior Project Officer, as these can help with monitoring and awareness.

Additionally, WWF-India has undertaken a study on forest fire trends in Sikkim. This revealed a gradual rise in the percentage of fires in red panda habitat, and it is likely that these areas will become more vulnerable as temperatures rise. To make sure these species are protected into the future, WWF-India has recommended training firefighters in villages near the forests and reviving the practice of burning dry leaves in order to reduce the fuel loads that can exacerbate wildfires.

Photo: © Sam Hobson / WWF-UK

FOOD

Impacts and Risks

Agriculture has underpinned the development of civilisations, but has also led to vast nature loss and contributed to climate change. Since our early days in Africa, people have spread to all corners of the planet, learning to survive on mountain ranges and in jungles, in deserts and on ice. The food system later evolved as people exploited land and seas to feed a growing population, and has intensified in recent decades, with food supply per capita growing by 30% since 1961. This expansion is set to continue into the future – the global population is expected to swell to 9-12 billion people by 2050. Globally, the average calorie intake per person rose by 30% between 1966 and 2015, with people in high-income countries eating the most, yet 821 million people remain undernourished. Meanwhile, two billion are overweight or obese. Action is needed to ensure a future where enough healthy and nutritious food is available for everyone without overstepping planetary boundaries.

Many of today's methods of food production are harmful to nature. For millennia, clearing of land for food production and wood products have been the main drivers of land conversion. Since about 1850, about 38% of the planet's land area has been converted to agriculture. This conversion has often been at the expense of rich and valuable natural ecosystems. In recent decades, it has mostly affected forests, particularly old-growth tropical forests, and wetlands and grasslands. The most extreme recent natural ecosystem losses have occurred in the tropics, home to some of the highest levels of biodiversity on the planet, due to cattle ranching and soy cultivation in Latin America and plantations of mostly palm oil in South-East Asia – the temperate forests of Europe and China were already largely deforested by the 1500s.

UP TO A THIRD OF GLOBAL FOOD PRODUCTION IS LOST OR WASTED, AMOUNTING TO **8-10% OF GREENHOUSE GAS EMISSIONS**

The food system is responsible for up to a third of global emissions, which causes harm to nature by contributing to climate change. Agricultural emissions are the result of a variety of activities involved in getting food onto the plate. Activities within farm gates are responsible for 9 to 14% of global emissions, land use and land-use change are responsible for 5 to 14% of emissions, while food-related activities beyond the farm gate – such as transport, packaging, processing, retail and consumption – represent 5 to 10% of emissions. Livestock production is particularly land intensive, and requires more water and energy than plant-based foods. Cattle are responsible for up to 77% of global livestock emissions.

SINCE ABOUT 1850, ABOUT **38% OF THE PLANET'S LAND AREA** HAS BEEN CONVERTED TO AGRICULTURE

As well as contributing to climate change, food production is also vulnerable to climate impacts. These include rising temperatures, changing rainfall patterns and more extreme weather events. Future warming may have a severe impact on crop production, and is already causing reductions of some crops due to increasing extreme weather events such as droughts. Globally, one study calculated that average yields of maize and soybeans in the 30-year period from 1981-2010 were 4.1 and 4.5% lower, respectively, than they would be in a world that wasn't warming. Decreasing yields have a negative impact on food security, particularly for poor people, who may adapt by planting crops that are more resilient to change but also less nutritious.

Agricultural production is at risk from the decline in services that nature provides. Intensive agriculture has increased food production, but it has come at the expense of the natural world. Climate change, habitat destruction and agriculture are harmful to pollinators like bees and butterflies, with up to $577 billion in annual global crop output at risk. Agriculture is responsible for up to 90% of withdrawals from rivers, lakes and aquifers, which is damaging to both nature and society. The pressure on these freshwater systems interacts with climate change to alter hydrological regimes, induce land degradation and provoke conflicts. Intensive agriculture has also led to soil degradation and the loss of soil organic carbon – around 8% globally so far – which also contributes to climate change and reduced agricultural productivity.

The decline in diversity among domesticated plants and animals is undermining humanity's resilience to climate change. For millennia, people have bred species from their wild relatives, which have adapted well to local conditions and allowed agriculture to flourish. This process is now in reverse, as the modernisation of agriculture – alongside large-scale trade and market preferences – has caused many of these local breeds and varieties to go extinct. By 2016, some 9% of domesticated breeds of mammals had vanished, and at least 1,000 more are threatened. More generally, the loss of biodiversity could lead to the permanent eradication of wild species that may have been domesticated as new crops or used for genetic improvement in the future – essentially burning down the library of material upon which future discoveries can be based. Conserving these wild relatives is particularly important given the narrowness of the human diet overall: while two-thirds of the Earth's 400,000 plant species are thought to be edible, humans only regularly consume around 200 of them. Overall, less variety means that humanity will be more vulnerable to future climate change, pests and pathogens, and therefore to food insecurity.

Food loss and waste is putting unnecessary strain on the planet's natural resources. Agricultural pressure on nature is caused not only by what is eaten, but also by what is left over, both in the fields and on our plates. Today, a third of global food production is lost during production and processing, or simply thrown away at the point of consumption either by businesses like grocers and restaurants, or by the consumer themselves. This accounts for 8-10% of total greenhouse gas emissions, and costs around a trillion dollars per year.

Solutions

It is possible to both feed the world and use the planet's natural resources sustainably. But that means rethinking the way we farm and the food we eat. This will be challenging: projected increases in population and income, alongside changing consumption patterns, will increase food demand by 2050 (by about 50% according to the UN) while climate change impacts may mean that potential improvements to agriculture – which could, in theory, build resilience to future conditions – are less effective. Improved livestock management, for instance, may be challenging given the additional stress on animals from higher temperatures, water scarcity and diseases. Nonetheless, reduced demand and improved productivity have the potential to increase food security and, in some cases, even restore land to nature.

Farmers can approach agriculture in a more ecologically friendly way. One of the central debates is whether to pursue agriculture that promotes "land sharing" or "land sparing". Some argue it is possible to substantially increase yields without expanding agricultural area through intensification, meaning that land can be "spared" and set aside for conservation and carbon sequestration. Given the ecological dangers of agricultural intensification, many now advocate for a sustainable approach that enhances productivity while maintaining the land's ecosystem services. Another school of thought promotes the integration of farming and nature through wildlife-friendly techniques, so that the land can continue to provide other ecosystem services while also providing food. Whether land sparing or land sharing is best depends on the socioeconomic, cultural and

ecological characteristics of the region. For instance, in some cases, restoring degraded land specifically for food production could both increase production and boost carbon sequestration.

Other alternative systems of agriculture include agroecological practices and conservation agriculture. Although these systems are built around different narratives of what agriculture should look like, they involve complementary on-the-ground practices. These include the incorporation of traditional knowledge, increased diversity, enhancing soil organic matter, better fertiliser management, soil cover, minimum tillage, and more. There are also potential technical innovations, such as precision agriculture and water management, which rely on sensors and satellite guidance. As well as protecting nature and reducing carbon emissions, many of these techniques would also make farming more resilient to climate impacts.

While there are various practical ways to improve farming, they do not replace the need to change human consumption patterns. Increased yields will not be able to counteract damage that will be inflicted on the natural world by the needs of a growing, and increasingly wealthy, population. Current patterns of meat-eating are unsustainable, but are distributed unequally. Reducing animal products in the diets of people in high-income countries would reduce agricultural expansion as populations rise, while enabling more meat-eating in low-income countries, where it would have beneficial nutritional outcomes. Indeed, the impacts of ruminant animals can be mitigated when they are fed extensively on existing grasslands, and can even have a positive effect on the environment, including increased species diversity and soil carbon. In any case, a reduction in the consumption of animal-based products in any community can only be achieved when plant-based alternatives delivering the same nutrition benefits are readily available and affordable.

Adding a greater diversity of species to our diets could also reduce the environmental impacts of farming. Preserving genetic diversity and cultivating local varieties of crops will also help to preserve food security in the face of environmental threats, such as pathogens. Indigenous peoples and local communities play an essential role in maintaining these pools of diversity. Increasing proportions of plant-based proteins, such as beans and nuts, can also help to achieve food security under climate change, while also reducing emissions and pressure on land and water. Research shows that consumers have sympathy to the idea of reducing meat consumption for environmental reasons, which has not yet been exploited. Increasing the share of insects in diets could reduce the emissions associated with livestock products. While approximately 1,900 insect species are already eaten worldwide, mainly in developing countries, it has yet to enter the mainstream as a meat substitute elsewhere.

Reducing food waste can reduce food insecurity, agricultural expansion, cut greenhouse gas emissions, and save money. This is something that needs to be addressed across the supply chain, requiring technical solutions, such as better harvesting techniques at the farm level, and behavioural change from shops and consumers to waste less food. While some measures may incur extra costs, others have multiple benefits. Surplus food supplies can, for instance, be distributed to those suffering from food poverty or converted into animal feed.

THREE RECOMMENDATIONS FROM WWF

Eliminate natural habitat conversion from food supply chains (e.g. deforestation and grassland conversion).

Transform diets globally to provide better nutrition while having lower environmental impact.

Eliminate loss and waste in food supply chains.

CASE STUDY

Photo: © yaninaamira / Shutterstock

*In **Paraguay's Atlantic Forest,** rural farmers have found an alternative to the soybean monoculture that dominates their surroundings: the native yerba mate tree.*

For the last two years, WWF-Paraguay has been working with around 250 families to grow yerba mate trees and harvest the leaves, which can be ground into mate powder. The product is akin to the fashionable matcha powder, and is around ten times more valuable than the unprocessed leaves and branches, and can potentially be sold to markets in Europe and beyond.

"We are organising the communities and providing technical assistance, in order to process the yerba mate leaves and branches to produce high quality food," says Oscar Rodas, climate change manager at WWF-Paraguay. "The families, from the very beginning, they asked us to incorporate food security element in our approach, because they rely on the climate for agriculture. Smallholders in Paraguay don't have any kind of technology for climate adaptation."

The native trees have been planted using an agroforestry system, with crops and beans planted between the trunks.

As well as bringing social and economic benefits to the community, it has numerous environmental advantages. As a native species, the tree is more resilient to the impacts of climate change, and can provide homes for birds and other small animals. It restores degraded land, protects the soil and water, and connects fragmented patches of forest to build a healthier ecosystem.

What's more, it provides an incentive for smallholders to preserve their forested land, rather than selling it to producers of large-scale agricultural commodities – or, indeed, from clearing the trees to grow these products themselves.

"It's a new way of giving the forest monetary value," says Olivia Suárez, Atlantic Forest programme assistant at WWF-Paraguay. "Everything was always cattle production and soya production. This is a way of getting some money from the forest, from an agroforestry system, and therefore helping to maintain the forest.

Portrait of a local fishermen. Mafia Island, Tanzania

This project is part of WWF-UK's partnership with seafood brand John West and its parent company Thai Union Europe. We've been working with them since 2014 on a journey to ensure that all of their products are environmentally sustainable.

Photo: © Green Renaissance / WWF-UK

MULTI-LEVEL ACTION AND DECISION-MAKING

Cities

More than **50% of the world's population** lives in cities, and urbanisation in the global south is growing at an unprecedented rate. While this can be damaging for biodiversity and ecosystem services, it also presents an opportunity. When planned well, cities can reduce humanity's environmental impacts as they can meet human needs more efficiently. Green infrastructure and other nature-based approaches can help to create **sustainable urban development**, while also meeting climate adaptation and mitigation goals. Solutions include creating and maintaining green spaces and biodiversity-friendly water bodies, urban agriculture, rooftop gardens and expanded vegetation cover. As well as helping biodiversity to thrive and human habitats to become more resilient, building nature into cities improves their livability, particularly for the economically vulnerable, by reducing temperatures and cleaning air. It could also help to combat feelings of loneliness that have been linked to the decline of green space in urban areas.

Governments

Governments are acting to address the climate and biodiversity crises, but **action to date has been insufficient** against the scale of the problems. In 2010, at a conference of the UN Convention on Biological Diversity, nations agreed upon 20 nature-themed goals, known as the Aichi Biodiversity Targets, that they would try to achieve between 2011 and 2020. However, too little money has been put towards meeting these targets, and it now looks likely that most of them will be missed. Similarly, the Nationally Determined Contributions that nations have submitted under the **UNFCCC's Paris Agreement**, which establish domestic emission reductions goals, are not stringent enough to meet the **1.5°C temperature goal** set out in the Agreement itself. Full implementation of unconditional targets (i.e. not subject to financial help from other nations) will likely lead to a temperature increase of 2.9 to 3.4°C above pre-industrial levels by 2100.

A New Deal for Nature and People

World leaders need to set ambitious global nature targets, matched with ambitious national biodiversity commitments and, on the climate side, strong nature-based solutions in climate pledges (NDCs) and country plans, that can halt and reverse the catastrophic loss of biodiversity and put nature on a path to recovery.

Ensure zero loss of natural habitats by protecting and conserving at least 30% of the planet – land and sea – and ensuring an additional 20% at least is effectively restored and sustainably managed in a natural state, while ensuring Indigenous peoples' lands are appropriately recognised and collectively secured.

Zero human-induced extinction and ensuring that wildlife populations are stable or increasing. Including concerted efforts to prevent poaching, end the illegal wildlife trade and halt the introduction of invasive alien species.

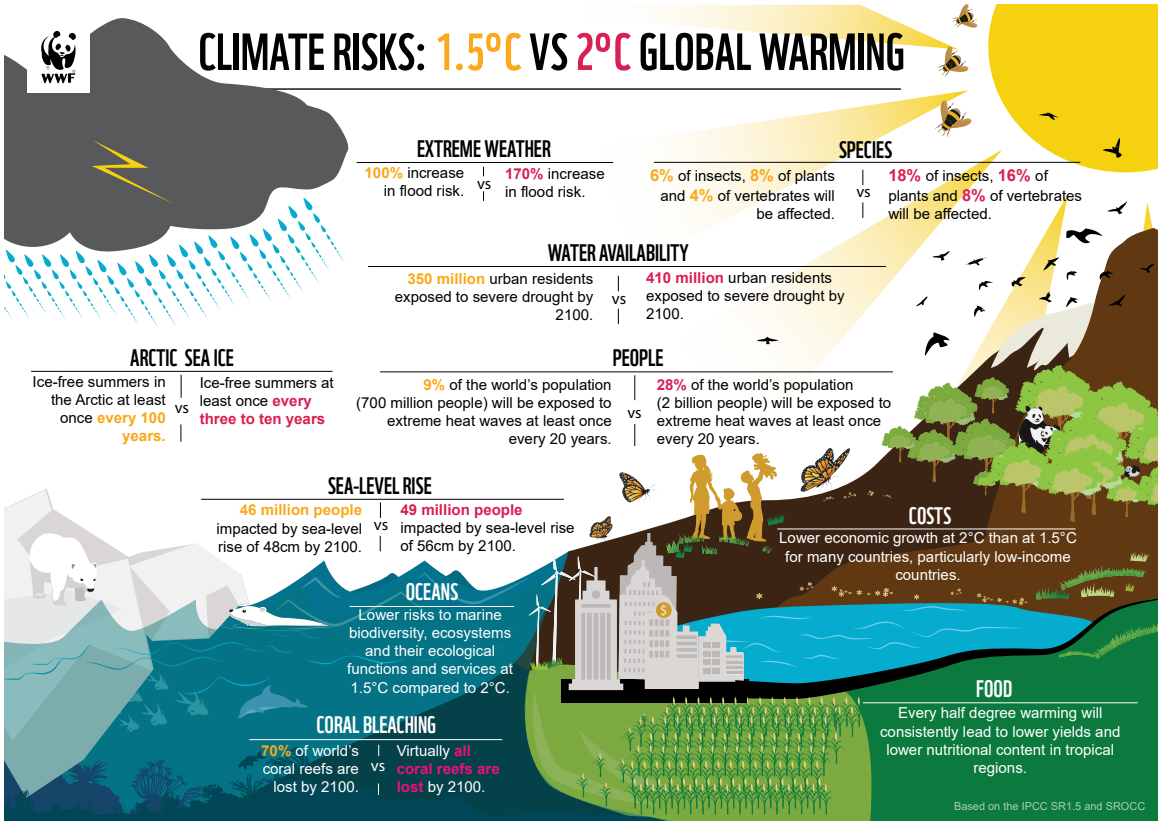
Halve the negative ecological impacts of production and consumption by making production and consumption sustainable especially for food and energy systems, with a focus on efforts to tackle the main sectors responsible for biodiversity and nature loss: agriculture, fishing, forestry, extractives and infrastructure.

Photo: © naturepl.com / Sylvain Cordier / WWF

WWF'S SUMMARY AND RECOMMENDATIONS

Summary

The science is clear. From burning fossil fuels to extensive land conversion and degradation, human activities have caused a crisis for the climate and biodiversity. Rising temperatures are already having significant negative impacts on the planet's land, oceans and frozen places, and these risks are growing with the global heating of our planet. The destruction of natural ecosystems has caused biodiversity to decline at an alarming rate. These threats to the natural world are not happening in isolation: each exacerbates the other. In ***Climate, Nature and our 1.5°C Future***, we



The figure here illustrates how even the half-a-degree between 1.5 and 2°C greatly increases climate risks for people and nature

look at the IPCC and IPBES reports released over the past year or so and connect their findings, showing how climate change is having a profound and growing impact on nature, and how the degradation and destruction of nature is, in turn, contributing to climate change. The conclusion is stark: **limiting global warming to 1.5°C is essential, and nature needs protection more than ever.**

Our choices make a difference

If we continue with business-as-usual, the impacts on nature will be dire. But the science also paints a vision of a better future: one where we make choices that avert the worst impacts of climate change, and where humanity, wildlife and ecosystems are allowed to thrive. This future requires systemic change – variously referred to as 'transformational change' and 'system transitions' in the IPBES and IPCC reports – with huge shifts across society at large. To achieve this, governments and businesses will have to step up with decisive leadership, enact ambitious policies, and implement meaningful regulations. Individuals can also play a critical role by making sustainable choices around diets, consumption and travel.

The future will depend on the actions we take today. Leaders will need to make hard decisions about how to keep temperatures below 1.5°C, and these will inevitably include some trade-offs. Nonetheless, the IPCC shows that delaying action will only make these decisions harder and the trade-offs worse.

Characteristics of systemic change

Systemic change at the speed and scale required to limit global warming to 1.5°C has several characteristics:

Characteristic	What	Why
Urgency	Rapid and deep cuts to global greenhouse gas emissions, as well as the other drivers of biodiversity loss (e.g. direct exploitation of the biosphere, invasive species, pollution).	Delayed climate and biodiversity action increases costs and risks; including of irreversible losses for some natural systems.
Universality	Strong contributions from all actors and delivering on all system transitions simultaneously.	Action is needed from government, consumers, the private and financial sectors, cities, and scientific organisations. Change in one system alone will not solve the climate crisis – change is needed in energy, land (food and natural systems), urban and infrastructure (including transport and buildings), and industrial systems.
Synergy	Putting nature at the heart of decision-making and prioritising actions to benefit nature, climate change (mitigation, resilience, adaptation) and people, while minimising tradeoffs.	Win-win-win actions exist; for example, nature-based solutions to climate in land, sea and food systems can also reduce pressure on land and coastal conversion.
Adaptability	Strategies that are dynamic and adaptable in a changing climate.	We know some level of climate risk is locked in, which requires flexible action that can adapt over time.

Systemic change must simultaneously:

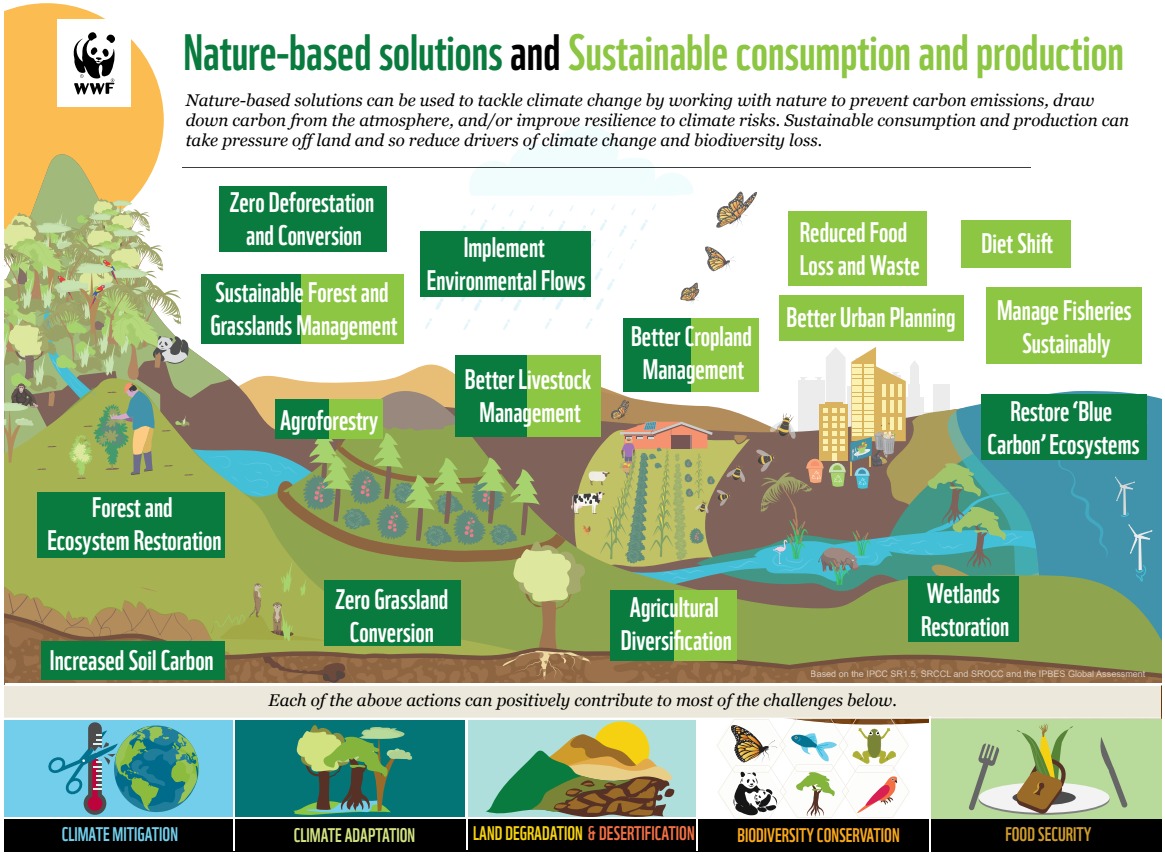
- **Tackle climate change:** We must limit global warming below 1.5°C through rapid and deep cuts to global greenhouse gas emissions. This must include nature-based solutions both to increase climate ambition and to build socio-ecological resilience to current impacts and future risks.
- **Conserve and restore nature:** We must 'bend the curve' on nature loss, halting further degradation and restoring existing ecosystems.
- **Improve people's lives:** We should promote sustainable, inclusive and equitable human development that is aligned with the UN's Sustainable Development Goals.

Nature-based solutions

Decarbonising the global economy – including its energy, industrial and urban systems – is key to achieving a 1.5°C trajectory. Better management and protection of land and oceans is also crucial to this decarbonisation.

Nature-based solutions play an important role, simultaneously benefitting nature, people and the climate as illustrated in the previous sections of this report.

The IPCC and IPBES have assessed our broad scientific understanding of many types of nature-based solutions. Yet there is still an important scientific and political work to be done, including identifying the most impactful and synergistic nature-based solutions, and scaling them up by overcoming the various technological, institutional and financial barriers. Several nature-based solutions are illustrated in the figure below.



Recommendations for policy-makers

National governments must take a leading role in fighting climate change. We recommend that policymakers do the following:

- **Make climate pledges consistent with the 1.5°C goal:** All countries must significantly enhance their Nationally Determined Contributions (NDCs) by the end of 2020 to close the gap between what has been pledged so far under the Paris Agreement and what is needed to limit global warming to 1.5°C. Nations should also submit long-term zero-emission strategies, which include transformative actions across multiple systems.

- **Make nature-based solutions part of their countries' climate commitments:** Nature-based solutions can have a synergistic role for climate change mitigation, reducing the vulnerability of people, nature and human development. As such, countries must include nature-based solutions in their NDCs and long-term strategies. These must acknowledge the importance of protecting and restoring terrestrial and marine ecosystems, including halting the loss of biodiversity, building resilience and storing carbon.

- **Coordinate climate, biodiversity and sustainable development policies:** Governments have already committed to tackling the climate and biodiversity crises on several fronts, including through NDCs under the Paris Agreement, National Biodiversity Strategies and Action Plans under the UN Convention on Biodiversity, and the Sustainable Development Goals. But these policies need to be better planned and coordinated at country level. Policies should be designed alongside subnational governments and other stakeholders, such as Indigenous peoples and local communities.

- **Align financial flows with the needed systems transformations:** Huge volumes of finance, both public and private, are needed to scale up nature-based solutions and deliver systemic change. Early action should focus on innovative projects that deliver benefits for nature, climate and development. There also needs to be better regulations to guide private investment, as public finance alone cannot deliver the scale of change required. Financial institutions should avoid financing activities that are harmful to nature.

- **Address the international impacts of domestic policies:** Countries will not truly stop contributing to climate change unless they also consider the emissions embedded in their trade and supply chains. While production-based reporting and accounting are important, these must be supplemented with a consumption-based approach to account for emissions that may be leaking into other countries.

Recommendations for non-state actors

National governments alone cannot limit global warming to 1.5°C. Climate leadership by non-state actors, including cities and businesses, will be crucial to delivering systemic change. WWF recommends that these actors do the following:

- **Align with a 1.5°C and net-zero emissions world:** Businesses, investors, and local and regional governments should reduce emissions to net-zero consistent with a 1.5°C pathway. There are various international initiatives that can help these actors on their way, including Science-Based Targets, Under 2 MOU, Asset Owner Alliance on Net Zero, and the One Planet City Challenge. Important initiatives relating to nature-based solutions include Business For Nature, CitiesWithNature, Nature4Climate, the Friends of Nature-Based Solutions, and the Network for Greening the Finance System. Actors must prioritise adaptation and mitigation actions within their value chains over offsetting activities.

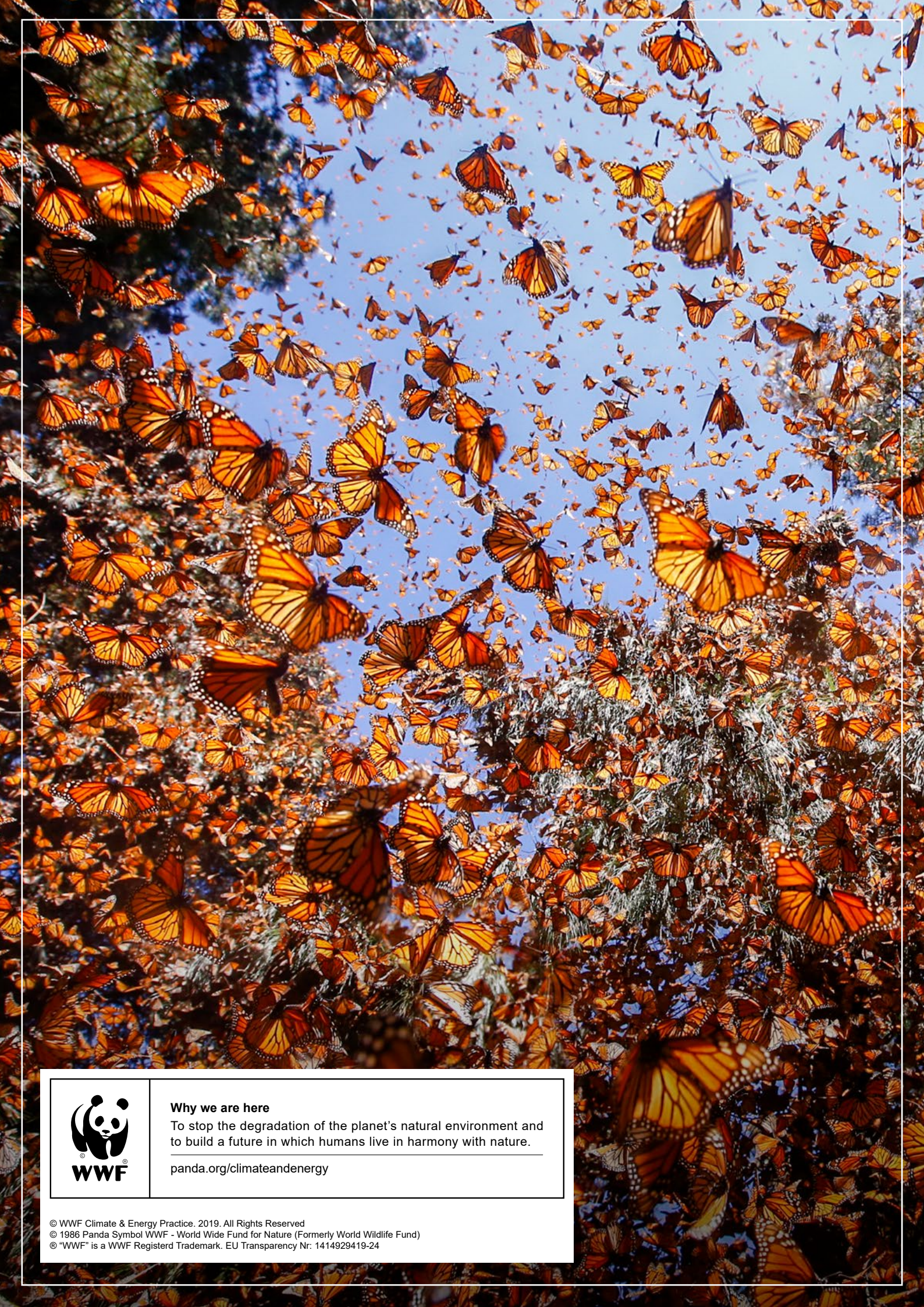
- **Advocate for governments to enact enabling policies:** Non-state actors, and the private sector in particular, can only achieve so much with voluntary action – particularly as some actors may be unwilling to do their fair share. Therefore, as well as aligning their own activities with a 1.5°C pathway, non-state actors should advocate for national and global policies that bring others along with them. In particular, this should include pushing for more ambition in their countries' climate pledges, and advocating for a new deal for nature and people in 2020.

- **Advance the science on nature-based solutions:** We need to get better at measuring the impacts of various nature-based solutions on climate, nature and people. In future, the IPCC and IPBES should work on overcoming evidence gaps, while local scientific institutions should produce case studies that highlight effective solutions.

Limiting global warming to 1.5°C and reversing the alarming loss of nature are both moral and economic imperatives. By making rapid and deep cuts to greenhouse gas emissions where governments, businesses and individuals have key roles to play, and taking decisions based on and for nature, humanity stands a chance of avoiding the worst impacts of climate change and maintaining our life support systems.

The Muni Seva Ashram in Goraj, near Vadodara, India

The Muni Seva Ashram in Goraj, near Vadodara, India, is a tranquil haven of humanitarian care. The Ashram is hugely sustainable, next year it will be completely carbon neutral. Its first solar panels were installed in 1984, long before climate change was on any agenda. Their energy is provided from solar panels, and wood grown on the estate. Waste food and animal manure is turned into biogas to run the estates cars and also used for cooking. Solar cookers are also used, and the air conditioning for the hospital is solar run. 70 % of the food used is grown on the estate. They provide an orphanage, schools for all ages, vocational training, care for the elderly, a specialist cancer hospital with state of the art machinery, and even have a solar crematorium. This shot shows a cook preparing chapatis on a biofuel stove.



Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

panda.org/climateandenergy