WWF

REPORT

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Global Footprint Network® Advancing the Science of Sustainability

# Living Planet Report 2016

## Summary

THE SIZE AND SCALE OF THE HUMAN ENTERPRISE HAVE
AS A RESULT, NATURE AND THE SERVICES IT PROVIDES
SCIENTISTS SUGGEST THAT WE HAVE TRANSITIONED
CALLING IT THE "ANTHROPOCENE". THE FUTURE OF
POPULATIONS OF VERTEBRATE ANIMALS HAVE
1970 AND 2012. THE MOST COMMON THREAT TO
DEGRADATION OF HABITAT. INCREASINGLY, PEOPLE ARE
WITHOUT ACTION THE EARTH WILL BECOME MUCH LESS
HUMANS HAVE ALREADY PUSHED FOUR PLANETARY
OPERATING SPACE. BY 2012, THE BIOCAPACITY
PROVIDE THE NATURAL RESOURCES AND SERVICES
NATURE IN ALL OF ITS MANY FORMS AND FUNCTIONS
A FINITE PLANET, A BASIC UNDERSTANDING MUST
MODELS, BUSINESS MODELS AND LIFESTYLE CHOICES:
CAPITAL IS LIMITED. A SHARED UNDERSTANDING OF
COULD INDUCE A PROFOUND CHANGE THAT WILL

GROWN EXPONENTIALLY SINCE THE MID-20TH CENTURY.
TO HUMANITY ARE SUBJECT TO INCREASING RISK.
FROM THE HOLOCENE INTO A NEW GEOLOGICAL EPOCH,
MANY LIVING ORGANISMS IS NOW IN QUESTION. SPECIES
DECREASED IN ABUNDANCE BY 58 PER CENT BETWEEN
DECLINING ANIMAL POPULATIONS IS THE LOSS AND
VICTIMS OF THE DETERIORATING STATE OF NATURE:
HOSPITABLE TO OUR MODERN GLOBALIZED SOCIETY.
SYSTEMS BEYOND THE SAFE LIMIT OF THEIR SAFE
EQUIVALENT OF 1.6 EARTHS WAS NEEDED TO
HUMANITY CONSUMED IN THAT YEAR. TO MAINTAIN
AND TO CREATE AN EQUITABLE HOME FOR PEOPLE ON
INFORM DEVELOPMENT STRATEGIES, ECONOMIC
WE HAVE ONLY ONE PLANET AND ITS NATURAL
THE LINK BETWEEN HUMANITY AND NATURE
ALLOW ALL LIFE TO THRIVE IN THE ANTHROPOCENE.

# LIVING ON THE EDGE

The evidence has never been stronger and our understanding never been clearer. Not only are we able to track the exponential increase in human pressure and the consequent degradation of natural systems, but we also now better understand the interdependencies of Earth's life support systems and their limits.

Lose biodiversity and the natural world including the life support systems as we know them will collapse. We depend on nature for the air we breathe, water we drink, the food and materials we use and the economy we rely on, and not least, for our health, inspiration and happiness.

For decades scientists have been warning that human actions are pushing life toward a sixth mass extinction. Evidence in this year's *Living Planet Report* supports this. Wildlife populations have already shown a concerning decline, on average by 67 per cent by the end of the decade. While environmental degradation continues, there are also signs that we are beginning a transition towards an ecologically sustainable future.

Despite 2016 set to be another hottest year on record, global $CO_2$ emissions have stabilized over the last two years, with some arguing they may even have peaked. Rampant poaching and wildlife trafficking is devastating ecosystems, but the U.S. and China have recently committed to a historic ban of domestic ivory trade.

Perhaps more importantly, the interdependence between the social, economic and environmental agendas is being recognized at the highest levels through the revolutionary approach adopted in defining the new set of the world's Sustainable Development Goals.

We need to transition to an approach that decouples human and economic development from environmental degradation—perhaps the deepest cultural and behavioural shifts ever experienced by any civilization.

These changes are upon us, and if we are awed by the scale of the challenges that this generation is facing, we should be equally motivated by the unprecedented opportunity to build a future in harmony with the planet.




Marco Lambertini,
Director General
WWF International

# RISK AND RESILIENCE IN A NEW ERA

Earth's ecosystems have evolved for millions of years. This process has resulted in diverse and complex biological communities living in balance with their environment. In addition to their intrinsic value, diverse ecosystems also provide the foundation for human livelihoods and well-being. However, the size and scale of the human enterprise have grown exponentially since the mid-20th century. As a result, nature and the services it provides to humanity are subject to increasing risk. To draw attention to our potentially perilous environmental situation, Nobel Prize winner Paul Crutzen and others suggest that we have transitioned from the Holocene into a new geological epoch, calling it the "Anthropocene".

During the Anthropocene, the climate is changing rapidly, oceans are acidifying and entire biomes are disappearing – all at a rate measurable during a single human lifetime. The future of many living organisms is now in question. And not only wild plants and animals are at risk: increasingly, people are victims of the deteriorating state of nature. Climate and other predictive models suggest that without action during the Anthropocene the Earth will become much less hospitable to our modern globalized society.

Given our current trajectory toward the unacceptable conditions that are predicted for the Anthropocene, there is a clear challenge for humanity to learn how to operate within the environmental limits of our planet and to maintain or restore resilience of ecosystems. Our central role as driving force into the Anthropocene also gives reason for hope. Not only do we recognize the changes that are taking place and the risks they are generating for nature and society, we also understand their causes. These are the first steps to identifying solutions for restoring the ecosystems we depend upon and creating resilient and hospitable places for wildlife and people. Acting upon this knowledge will enable us to navigate our way through the Anthropocene.

# THE GLOBAL LIVING PLANET INDEX

The Living Planet Index (LPI) measures biodiversity by gathering population data of various vertebrate species and calculating an average change in abundance over time. The LPI can be compared to the stock market index, except that, instead of monitoring the global economy, the LPI is an important indicator of the planet's ecological condition. The global LPI is based on scientific data from 14,152 monitored populations of 3,706 vertebrate species (mammals, birds, fishes, amphibians, reptiles) from around the world.

From 1970 to 2012 the LPI shows a 58 per cent overall decline in vertebrate population abundance (Figure 1). Population sizes of vertebrate species have, on average, dropped by more than half in little more than 40 years. The data shows an average annual decline of 2 per cent and there is no sign yet that this rate will decrease.

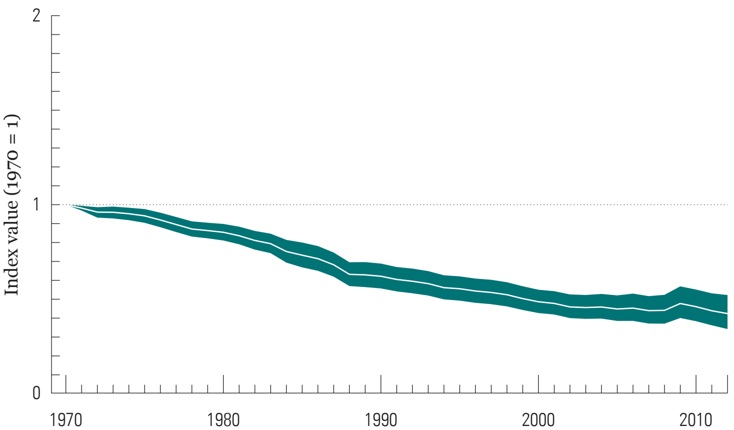



***Figure 1: The Global Living Planet Index shows a decline of 58 per cent (range: -48 to -66 per cent) between 1970 and 2012***
*Trend in population abundance for 14,152 populations of 3,706 species monitored across the globe between 1970 and 2012. The white line shows the index values and the shaded areas represent the 95 per cent confidence limits surrounding the trend (WWF/ZSL, 2016).*

*Key*

Global Living Planet Index

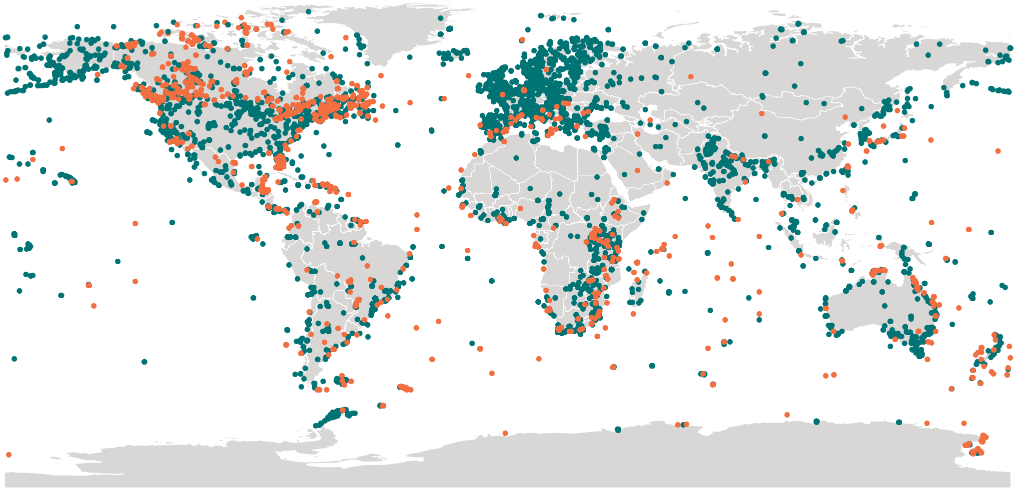
Confidence limits

## FROM 1970 TO 2012 THE GLOBAL LPI SHOWS A 58 PER CENT OVERALL DECLINE IN VERTEBRATE POPULATION ABUNDANCE

# MONITORING SPECIES

***Figure 2: The distribution of locations providing data for the Living Planet Index***
*Map showing the location of the monitored populations in the LPI. New populations added since the last report are highlighted in orange (WWF/ZSL, 2016).*

The LPI database is continually evolving and for each *Living Planet Report* a larger dataset is available to use for the analysis. Since the last *Living Planet Report*, 668 species and 3,772 different populations have been added to the LPI database (Figure 2). The dataset is currently limited to populations of vertebrate species. Methods to incorporate invertebrates and plants are now in development.




THE TERRESTRIAL LPI SHOWS THAT POPULATIONS HAVE DECLINED BY 38 PER CENT OVERALL BETWEEN 1970 AND 2012


THE FRESHWATER LPI SHOWS THAT ON AVERAGE THE ABUNDANCE OF POPULATIONS MONITORED IN THE FRESHWATER SYSTEM HAS DECLINED BY 81 PER CENT BETWEEN 1970 AND 2012


THE MARINE LPI SHOWS A 36 PER CENT OVERALL DECLINE BETWEEN 1970 AND 2012

# A CLOSER LOOK AT THREATS

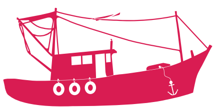
Whether or not populations are in trouble depends on species resilience, location, and the nature of what threatens them. Threat information is available for about one third of populations in the LPI (3,776 populations). Over half of these populations (1,981) are declining. The most common threat to declining populations is the loss and degradation of habitat.

## THREATS

### Habitat loss and degradation

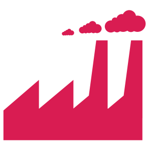
This refers to the modification of the environment where a species lives, by either complete removal, fragmentation or reduction in quality of key habitat characteristics. Common causes are unsustainable agriculture, logging, transportation, residential or commercial development, energy production and mining. For freshwater habitats, fragmentation of rivers and streams and abstraction of water are common threats.

### Species overexploitation



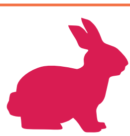
There are both direct and indirect forms of overexploitation. Direct overexploitation refers to unsustainable hunting and poaching or harvesting, whether for subsistence or for trade. Indirect overexploitation occurs when non-target species are killed unintentionally, for example as bycatch in fisheries.

### Pollution



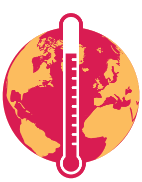
Pollution can directly affect a species by making the environment unsuitable for its survival (this is what happens, for example, in the case of an oil spill). It can also affect a species indirectly, by affecting food availability or reproductive performance, thus reducing population numbers over time.

### Invasive species and disease



Invasive species can compete with native species for space, food and other resources, can turn out to be a predator for native species, or spread diseases that were not previously present in the environment. Humans also transport new diseases from one area of the globe to another.

### Climate change



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

*Figure 3: Threat type frequency for 703 declining terrestrial populations in the LPI database showing 1,281 recorded threats*
*Each population has up to three threats recorded, so the total number of recorded threats exceeds the number of populations (WWF/ZSL, 2016).*

The LPI database contains threat information for 33 per cent of its declining **terrestrial populations** (n=703). Habitat loss and degradation are the most common threats to terrestrial populations (Figure 3), followed by overexploitation.

TERRESTRIAL SPECIES (703 populations)

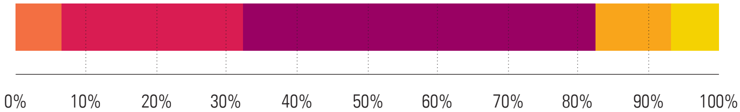



*Figure 4: Threat type frequency for 449 declining freshwater populations in the LPI database showing 781 recorded threats*
*Each population has up to three threats recorded, so the total number of recorded threats exceeds the number of populations (WWF/ZSL, 2016).*

The LPI database contains threat information for 31 per cent of its declining **freshwater populations** (n=449). Based on this information, the most common threats are habitat loss and degradation, mentioned in 48 per cent of analyzed population studies (Figure 4).

FRESHWATER SPECIES (449 populations)

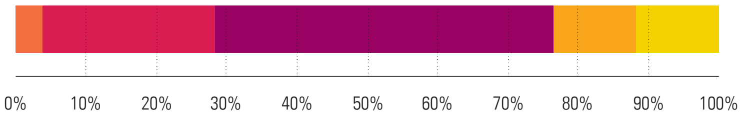
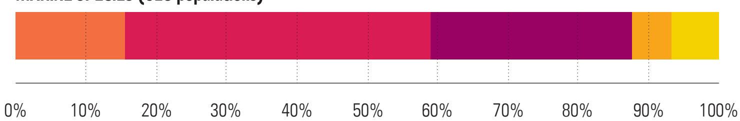



*Figure 5: Threat type frequency for 829 declining marine populations in the LPI database showing 1,155 recorded threats*
*Each population has up to three threats recorded, so the total number of recorded threats exceeds the number of populations (WWF/ZSL, 2016).*

Threat information is available for 29 per cent of declining **marine populations** (n=829). Data indicates that the most common threat for marine species is overexploitation, followed by loss and degradation of marine habitats (Figure 5).

MARINE SPECIES (829 populations)




*Key*

- Climate change
- Overexploitation
- Habitat loss / degradation
- Invasive species and disease
- Pollution

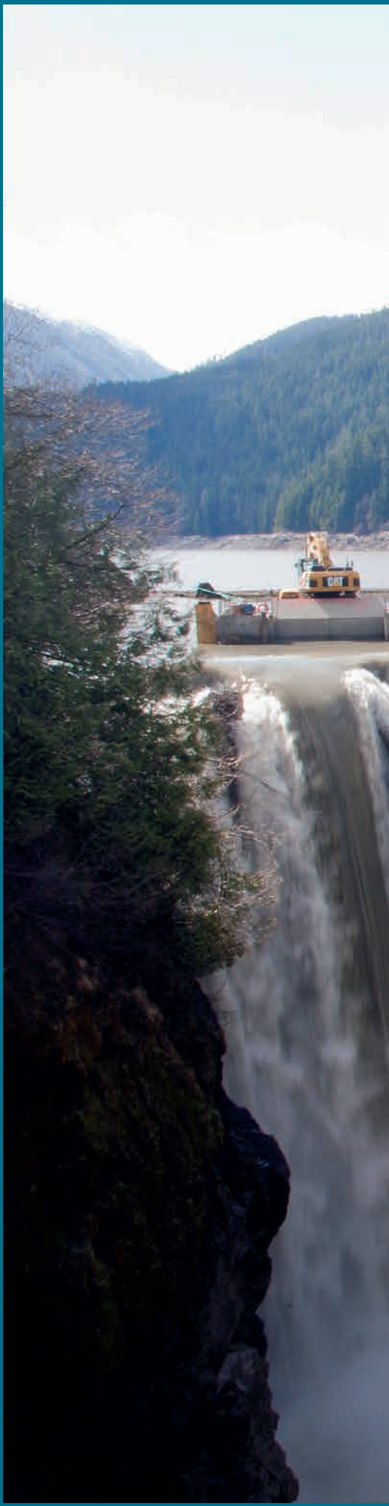
## THE MOST COMMON THREAT TO DECLINING POPULATIONS IS THE LOSS AND DEGRADATION OF HABITAT

# DAM REMOVAL FOR RIVER RESTORATION: THE ELWHA RIVER

Free-flowing rivers are the freshwater equivalent of wilderness areas. The natural flow variations of these rivers shape and form diverse riverine habitats, within and next to the river. In many places, connected, free-flowing rivers are crucial for carrying sediment downstream, bringing nutrients to floodplain soils, maintaining floodplains and deltas that protect against extreme weather events, and providing recreational opportunities or spiritual fulfilment. Almost everywhere that free-flowing rivers remain, they are home to vulnerable freshwater biodiversity. Dams and other infrastructure threaten these free-flowing rivers as they create barriers, causing fragmentation and alteration to flow regimes. Dams also affect long-distance migratory fishes by obstructing their migratory pathways, making it difficult or impossible to complete their life cycles.

The Elwha River in the Pacific Northwest of the United States provides a striking example. Two hydroelectric dams – the Elwha Dam constructed in 1914 and the Glines Canyon Dam completed in 1927 – blocked passage for migratory salmon. Local people reported a huge decline in adult salmon returning to the river after the Elwha Dam was constructed. This heavily affected the Lower Elwha Klallam Tribe, who relied on the river's salmon and other associated species in the watershed for physical, spiritual and cultural reasons. Salmon are a keystone species in that they bring nutrients from the coast inland, nourishing both terrestrial and aquatic species that benefit from this supply of nutrients.

In the mid-1980s the Elwha Klallam Tribe and environmental groups started to push for the removal of the Elwha and Glines Canyon dams. Eventually the Elwha River Ecosystem and Fisheries Restoration Act of 1992 was put in place, mandating the "full restoration of the fisheries and ecosystem". After 20 years of planning, work to remove the Elwha Dam began in 2011, the largest dam removal in US history. The removal of the Glines Canyon Dam was completed in August 2014. Fish populations are expected to make a return to the river. Some chinook salmon already did in 2012, just after the Elwha dam came down.



# ECOSYSTEM SERVICES: LINKING NATURE AND PEOPLE

The observed decline in species populations is inextricably linked to the state of the ecosystems that sustain them. Destruction of these ecosystems represents a risk not just to resident plants and wildlife, but to humans as well. For ecosystems provide us with food, fresh water, clean air, energy, medicine, and recreation. In addition, we depend upon healthy and diverse natural systems for the regulation and purification of water and air, climatic conditions, pollination and seed dispersal, and control of pests and diseases (Figure 6).

The available stock of renewable and non-renewable natural resources that supports human life (e.g., plants, animals, air, water, soils, minerals) can be described as "natural capital". Natural capital delivers a flow of benefits to people both locally and globally. The benefits themselves are often referred to as "ecosystem services".

Natural capital assets evolved to be self-sustaining. But increased human pressure – such as conversion of natural habitat to agriculture, overexploitation of fisheries, pollution of freshwater by industries, urbanization and unsustainable farming and fishing practices – is diminishing natural capital at a faster rate than it can be replenished. We are already experiencing the consequences of natural capital depletion. These consequences are expected to grow over time, increasing food and water insecurity, raising prices for many commodities, and increasing competition for land and water. Greater competition for natural capital will exacerbate conflict and migration, climate change and vulnerability to natural disasters such as flooding and drought. There will be a general decline in physical and mental health and well-being and this will lead to more conflict and migration.

# HEALTHY ECOSYSTEMS ARE VITAL TO OUR SURVIVAL, WELL-BEING AND PROSPERITY

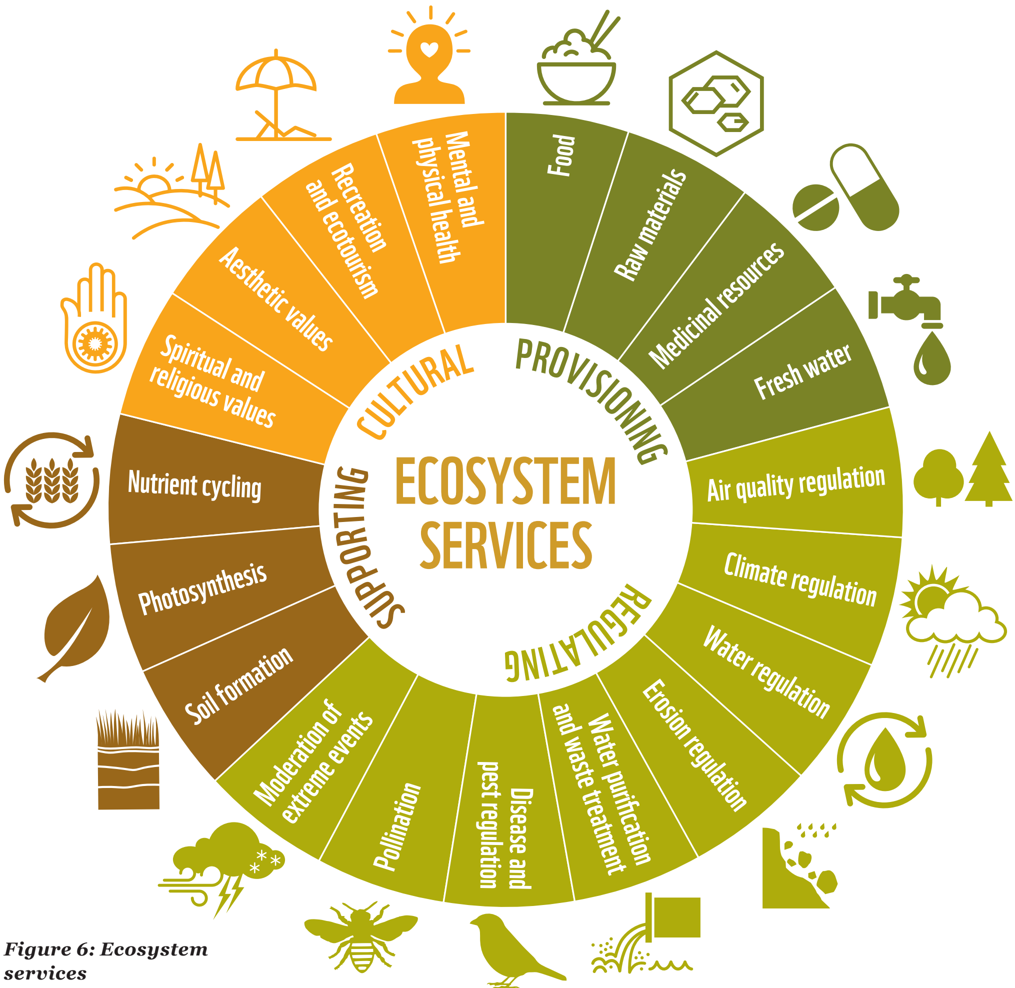



***Figure 6: Ecosystem services***
*Provisioning services are the products obtained from ecosystems, regulating services are the benefits obtained from the regulation of ecosystem processes, cultural services are the nonmaterial benefits people obtain from ecosystems and supporting services are those services that are necessary for the production of all other ecosystem services. Adapted from the Millennium Ecosystem Assessment, 2005.*

## INCREASED HUMAN PRESSURE IS DIMINISHING NATURAL CAPITAL AT A FASTER RATE THAN IT CAN BE REPLENISHED

# COMMUNITY MANGROVE RESTORATION MADAGASCAR

Mangroves protect and stabilize coastlines – particularly important as climate change brings more extreme storms and increased wave action. They also act as sinks, sequestering 3–5 per cent more carbon per unit area than any other forest system. But mangroves are disappearing, cleared for urban and tourism development or felled for fuel and building materials. Wise use of mangroves, such as creating coastal reserves and helping local communities develop livelihoods built on keeping them intact, is crucial for nature and people.

The most extensive mangrove cover, about a million hectares bordering the Western Indian Ocean, is found in the river deltas of Kenya, Madagascar, Mozambique and Tanzania. As an ecozone between land and sea, mangroves are home to a huge variety of creatures, from birds and land mammals to dugongs, five marine turtle species and many kinds of fish. And much of the economically important prawn harvest along this coast depends on mangroves for safe spawning and nursery grounds.

In the Melaky region on Madagascar's west coast, local people are taking action to remedy the loss of mangroves, which are crucial to their livelihoods. Since September 2015, men, women and children from the village of Manombo have become key players in mangrove conservation and restoration. Mangrove restoration benefits local communities by improving access to fish and crab stock, which provide a regular income, and builds resilience against climate change. The village community participated in a reforestation campaign, planting around 9,000 mangrove seedlings to restore degraded forests around their village. Next to Manombo, other communities have together planted 49,000 seedlings. For the local communities and the future of their forests, that equals a real success.

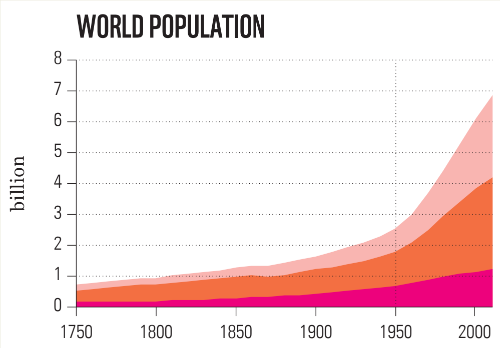
# HUMAN IMPACTS ON THE PLANET

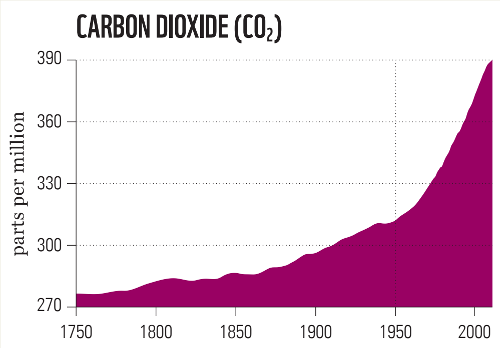
Throughout history there has been a limit to nature's capacity to absorb the impact of human development. In previous times, pollution and other pressures mainly resulted in the deterioration of local environments. But now we have strained the limits of natural resilience at the planetary level as well. The world's population has grown from about 1.6 billion people in 1900 to today's 7.3 billion. During this period, technological innovations and the use of fossil energy helped meet growing demand for resources.

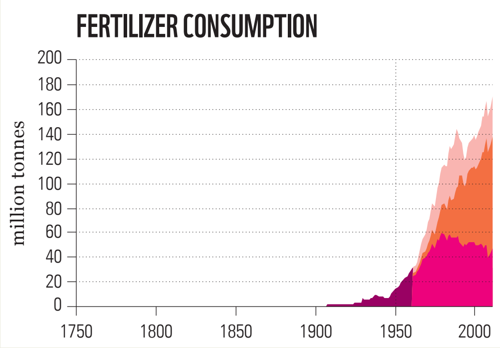
Most notably, in the early 1900s an industrial method was developed for fixing nitrogen into ammonia. The resulting synthetic fertilizer now sustains about half of the world's population but also causes pollution of air, water and soils. Readily available fossil fuels provide energy for domestic use and industrial production, enabling global trade. But only at the cost of rising atmospheric $CO_2$ concentrations and global warming (Figure 7).

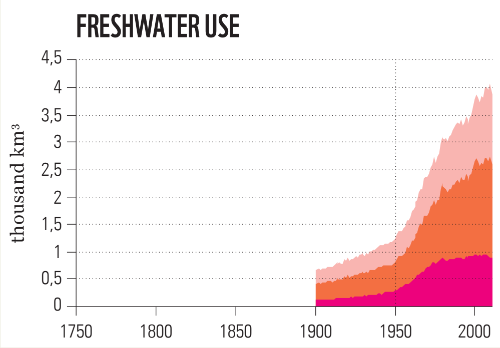
Human activities and accompanying resource uses have grown so dramatically, especially since the mid-20th century, that the environmental conditions that fostered our development and growth are beginning to deteriorate. It is clear that responding to risks at the planetary scale will be vastly more challenging than anything we have dealt with before. An Earth system perspective can help us to perceive complex relationships between human actions and global impacts that affect the natural state of the planet. It enables us to see how local changes have consequences that play out at other geographic scales, and to recognize that impacts that influence one system might affect other systems as well.

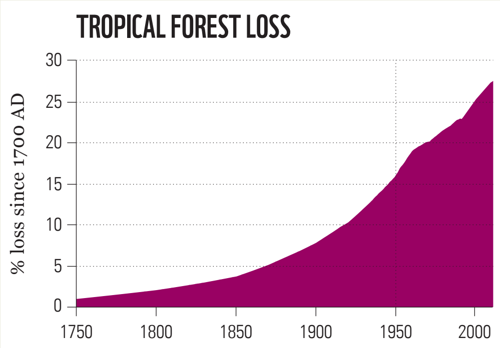
## HUMAN ACTIVITIES AND ACCOMPANYING RESOURCE USES HAVE GROWN SO DRAMATICALLY THAT THE ENVIRONMENTAL CONDITIONS THAT FOSTERED OUR DEVELOPMENT AND GROWTH ARE BEGINNING TO DETERIORATE



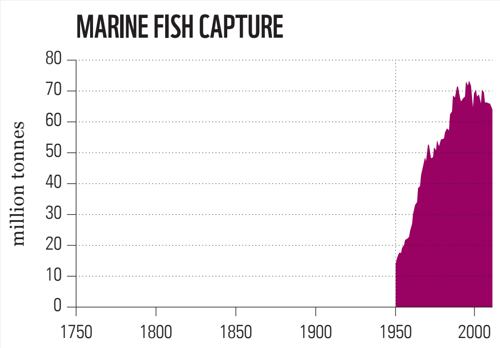
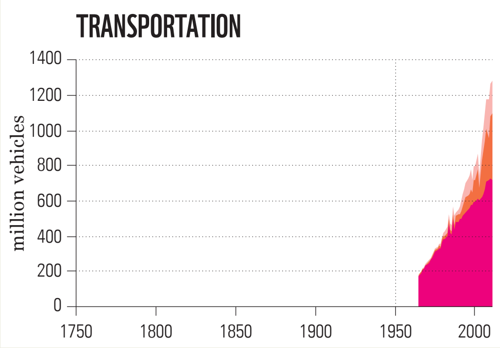




***Figure 7: The "great acceleration"***
*Figures illustrate trends and how the size and scale of events have changed. Source: IGBP, 2016. Plots based on the analysis of Steffen et al., 2015b.*

*Key*

- Rest of the world
- BRICS countries
- OECD countries
- World



# PLANETARY BOUNDARIES

The Planetary Boundaries framework exemplifies such an Earth system perspective. It illustrates how global patterns of consumption and production lead to increased risk for both natural and human systems.

Nine human-produced alterations to the functioning of the Earth system form the basis of the Planetary Boundaries (Figure 8). They are 1) biosphere integrity (or destruction of ecosystems and biodiversity), 2) climate change, and 3) its twin problem ocean acidification, 4) land-system change, 5) unsustainable freshwater use, 6) perturbation of biogeochemical flows (nitrogen and phosphorus inputs to the biosphere), 7) alteration of atmospheric aerosols, 8) pollution by novel entities, 9) stratospheric ozone depletion. Based on our evolving understanding of the functioning and resilience of the global ecosystem, the Planetary Boundaries framework delineates safe limits for the functioning of these critical Earth subsystems. Within defined safe operating spaces human societies can develop and thrive. When we push beyond these boundaries, we risk causing irreversible changes to resources that we depend upon.

**THE PLANETARY BOUNDARIES CONCEPT ILLUSTRATES THE RISKS OF HUMAN INTERFERENCE WITH THE EARTH SYSTEM**

Although there is some degree of scientific uncertainty regarding the biophysical and societal effects of exceeding the boundaries, current analysis suggests that humans have already pushed four of these systems beyond the limit of their safe operating space. Attributable global impacts and associated risks to humans are already evident for climate change, biosphere integrity, biogeochemical flows and land-system change. Other assessments suggest that freshwater use has also passed beyond a safe threshold.

The Planetary Boundaries concept is useful for framing our current understanding of potential tipping points. Furthermore, it underscores the importance of applying the precautionary principle in the management of natural systems. Determining and respecting Planetary Boundaries could greatly reduce the risk that the Anthropocene will become inhospitable to life as we know it.

**ANALYSIS SUGGESTS THAT HUMANS HAVE ALREADY PUSHED FOUR OF THESE SYSTEMS BEYOND THE LIMIT OF A SAFE OPERATING SPACE**

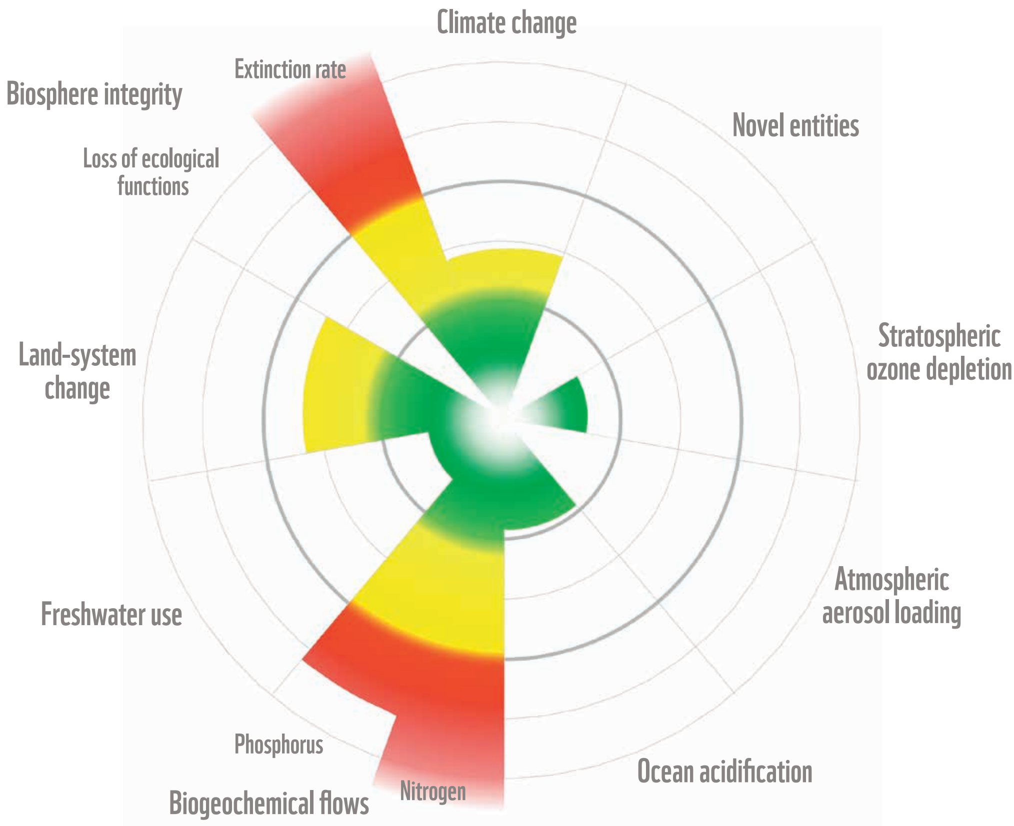



***Figure 8: Planetary Boundaries***
*The green zone is the safe operating space (below the boundary), yellow represents the zone of uncertainty, with an increasing risk of disrupting Earth system stability; and red is the high-risk zone, pushing the Earth system out of a stable Holocene-like state. The Planetary Boundary itself lies at the inner heavy circle (Steffen et al., 2015).*

*Key*

- Beyond zone of uncertainty (high risk)
- In zone of uncertainty (increasing risk)
- Below boundary (safe)

One thing is clear: we cannot tackle just one boundary without addressing the others. Changes in the Planetary Boundaries are not isolated from one another; changes in one can be amplified through changes to other boundary categories. If we seek to fix climate change by removing $CO_2$ from the atmosphere through new technologies and emission reductions, but fail to consider the role of land-system change, biogeochemical flows and the other subsystems on the integrity of the biosphere, we will fail to chart a sustainable course through the Anthropocene.

# ECOLOGICAL FOOTPRINT OF CONSUMPTION

Since the early 1970s, humanity has been demanding more than our planet can sustainably offer. By 2012, the biocapacity equivalent of 1.6 Earths was needed to provide the natural resources and services humanity consumed in that year. Exceeding the Earth's biocapacity to such a degree is possible only in the short term. Only for a brief period can we cut trees faster than they mature, harvest more fish than the oceans can replenish, or emit more carbon into the atmosphere than the forests and oceans can absorb. The consequences of this "overshoot" are already clear: habitat and species populations are declining, and carbon in the atmosphere is accumulating.

Even as the consequences of human pressure on the environment are increasingly acknowledged and observed, society has yet to make a rational economic response. According to Ecological Footprint data from the past four decades, the few instances of reductions in the total global Ecological Footprint do not correspond to intentional policies to limit human impact on nature. Rather they were reactions to major economic crises, such as the 1973 oil crisis, the deep economic recession in the USA and many of the OECD countries during 1980-1982 and the 2008-2009 global economic recession. Furthermore, the reductions in total Ecological Footprint were only temporary and were followed by a rapid climb.

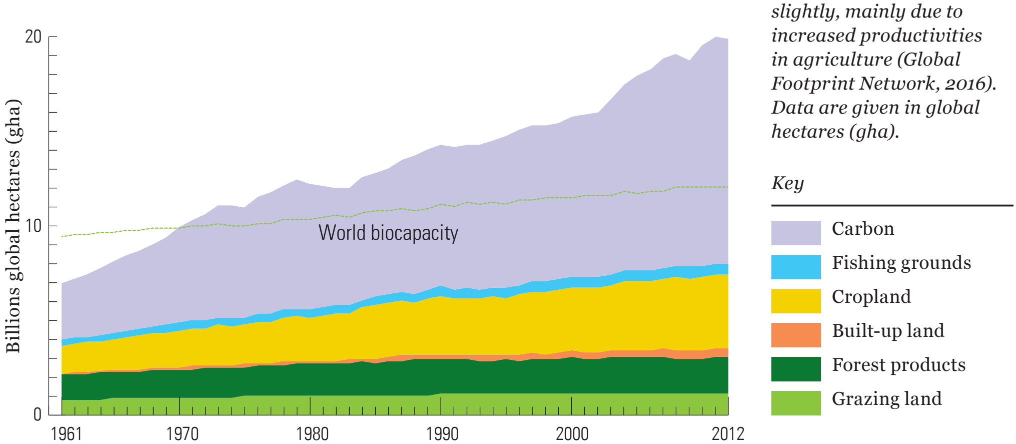


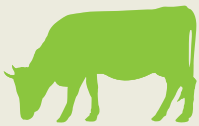

***Figure 9: Global Ecological Footprint by component vs Earth's biocapacity, 1961-2012***
*Carbon is the dominant component of humanity's Ecological Footprint (ranging from 43 per cent in 1961 to 60 per cent in 2012). It is the largest Footprint component at the global level as well as for 145 of the 233 countries and territories tracked in 2012. Its primary cause has been the burning of fossil fuels – coal, oil and natural gas. The green line represents the Earth's capacity to produce resources and ecological services (i.e., the biocapacity). It has been upward trending slightly, mainly due to increased productivities in agriculture (Global Footprint Network, 2016). Data are given in global hectares (gha).*

# Exploring the Ecological Footprint of Consumption

The Ecological Footprint equates humanity's demand on nature to the amount of biologically productive area required to provide resources and absorb waste (currently just carbon dioxide from fossil fuel, land-use change and cement). It considers six demand categories:

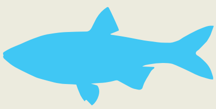
## CROPLAND FOOTPRINT

refers to the demand for land on which to produce food and fibre for human consumption, feed for livestock, oil crops and rubber.



## GRAZING LAND FOOTPRINT

refers to the demand for rangelands to raise livestock for meat, dairy, leather and wool products.



## FISHING GROUNDS FOOTPRINT

refers to the demand for marine and inland water ecosystems necessary to generate the annual primary production (i.e., phytoplankton) required to support seafood catch as well as aquaculture.

## FOREST PRODUCT FOOTPRINT

refers to the demand for forests to provide fuel wood, pulp and timber products.

## BUILT-UP LAND FOOTPRINT

refers to the demand for biologically productive areas needed for infrastructure, including transportation, housing and industrial structures.



## CARBON FOOTPRINT

refers to the demand for forests as the primary ecosystems available to long-term sequester carbon not otherwise absorbed by the oceans. It captures different rates of carbon sequestration depending on the degree of human management of forests and the type and age of forests, and includes the emissions related to forest wildfires, soil and harvested wood.

# MAPPING THE ECOLOGICAL FOOTPRINT OF CONSUMPTION

Average per capita Ecological Footprints differ among countries due to varying levels of total consumption. They also vary according to the demand for individual Footprint components. These components include the quantity of goods and services residents consume, natural resources used, and carbon generated to provide these goods and services. Figure 10 shows the average Ecological Footprint per person per country in 2012.

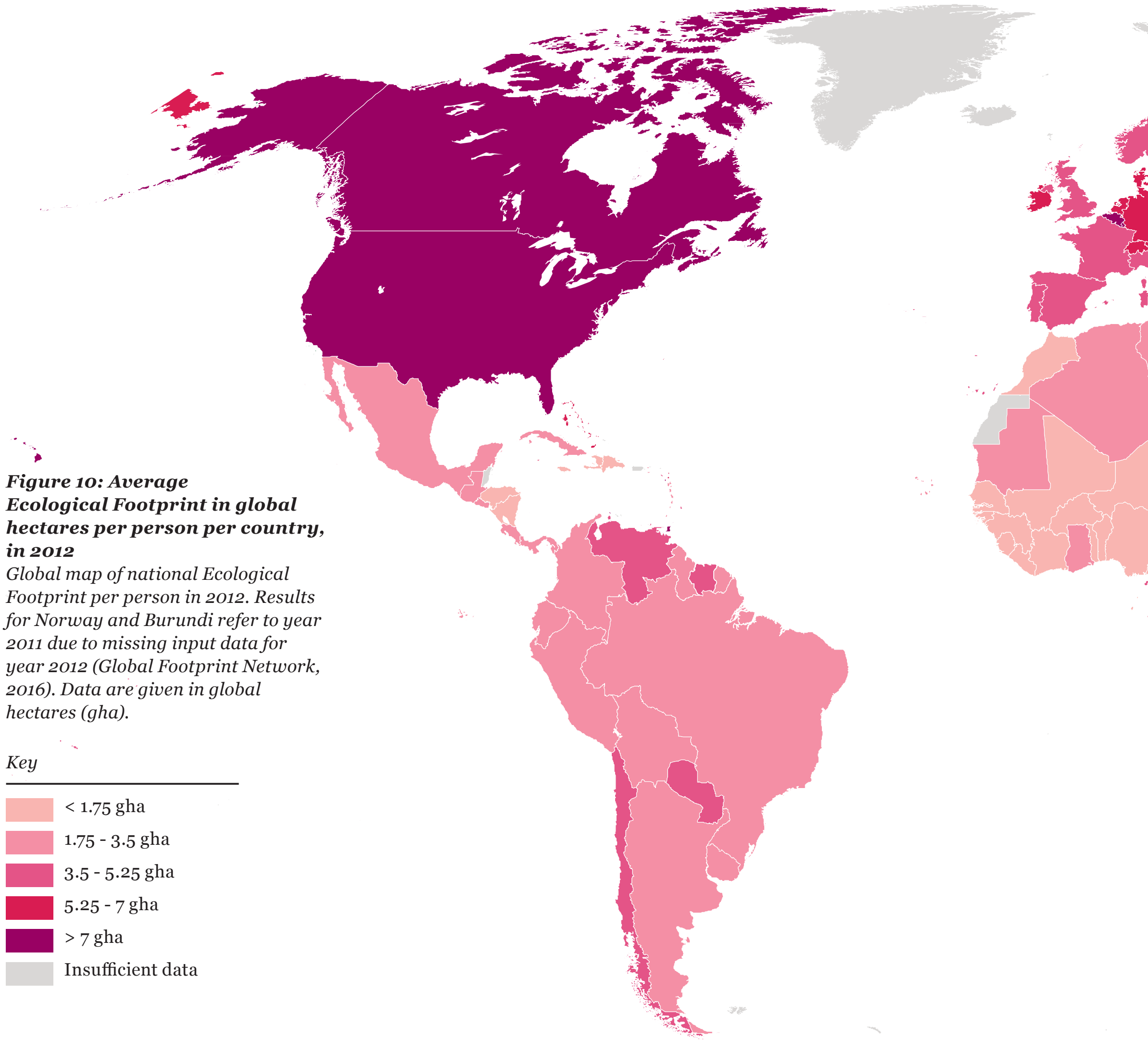
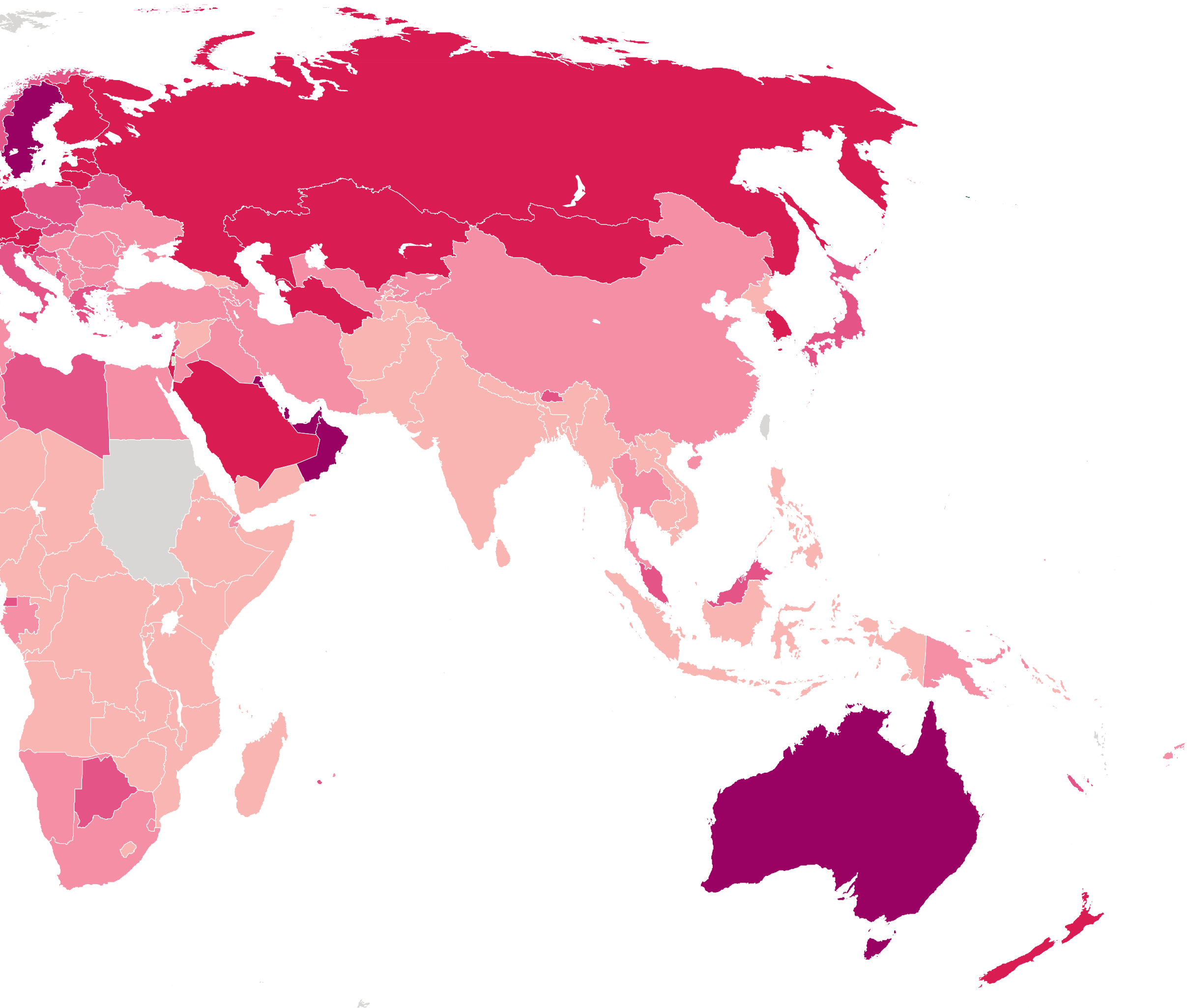


***Figure 10: Average Ecological Footprint in global hectares per person per country, in 2012***
*Global map of national Ecological Footprint per person in 2012. Results for Norway and Burundi refer to year 2011 due to missing input data for year 2012 (Global Footprint Network, 2016). Data are given in global hectares (gha).*

*Key*

- < 1.75 gha
- 1.75 - 3.5 gha
- 3.5 - 5.25 gha
- 5.25 - 7 gha
- > 7 gha
- Insufficient data

Among countries with large per capita Ecological Footprints, the carbon component is particularly high due to both fossil fuels consumption and the use of energy-intensive goods. Per capita Ecological Footprints of several countries are as much as six times larger than the available per capita share of global biocapacity (1.7 gha). This implies that residents of these countries are placing disproportionate pressure on nature as they appropriate more than their fair share of the Earth's resources. At the other end of the scale, some of the world's lowest-income countries have per capita Ecological Footprints that are less than half the per capita biocapacity available globally, as many people in these countries struggle to meet basic needs.



# ECOLOGICAL RESTORATION OF THE LOESS PLATEAU IN CHINA

China's Loess Plateau, the birthplace of the largest ethnic group on the planet, was once an abundant forest and grassland system. One of the central civilizations on Earth grew on the plateau while simultaneously reducing biodiversity, biomass and accumulated organic matter. Over time, the landscape lost its ability to absorb and retain moisture, causing an area the size of France to dry out. Without the constant nutrient recycling from decaying organic matter, the soil lost its fertility and was eroded away by the wind and water, leaving a vast barren landscape. By 1,000 years ago the site of the magnificent early dynasties in China had been abandoned by the wealthy and powerful. By the mid-1990s the plateau was mainly famous for the recurrent cycle of flooding, drought and famine known as "China's Sorrow".

Today, large areas of the Loess Plateau have been restored. The changes have been brought about by differentiating and designating ecological and economic land, terracing, sediment traps, check dams and other methods of infiltrating rainfall. At the same time, efforts have been made to increase biomass and organic material through massive planting of trees in the ecological land and using sustainable, climate-smart agricultural methods in the economic lands.

The crucial step toward restoration was the understanding that, in the long run, safeguarding ecosystem functions is vastly more valuable than the production and consumption of goods and services. It therefore made sense to designate as much of the land as possible as ecological land. This also led to a counter-intuitive outcome: concentrating investment and production in smaller areas was found to increase productivity. It's a clear illustration of how functional ecosystems are more productive than dysfunctional ones.

The work on China Loess Plateau shows that it is possible to restore large-scale degraded ecosystems. This helps us adapt to climate impacts, makes the land more resilient and increases productivity. The Loess Plateau also shows that valuing ecosystem function higher than production and consumption provides humanity with the logical framework to choose to make long-term investments and see the positive results of trans-generational thinking.

# PROBLEM SOLVING IN A COMPLEX WORLD

It is clear that we need to steer the course of socio-economic development onto a pathway that does not conflict with the welfare of people and the biosphere. But the increased risk associated with exceeding Planetary Boundaries, the expansion of consumption footprints, and the continuous decline of Living Planet Indices signal that sustainability efforts to date have been far from sufficient. So how can we begin to affect development in a way that will make essential changes at a relevant magnitude?

IN SPITE OF THE COMPLEXITY, WE OFTEN TURN TO SUPERFICIAL SOLUTIONS WHEN TRYING TO SOLVE COMPLEX PROBLEMS

A prerequisite for affecting significant change in human systems is to understand the nature of the decision-making that results in environmental, social and ecological degradation. Trillions of decisions and actions take place every day, resulting in both visible and invisible impacts on society and the Earth system. In spite of the complexity that defines our problems, we often turn to superficial solutions when trying to solve them.

System thinking can help us ask the right questions by examining complex problems layer by layer and then analyzing the connections between these layers. A common tool used in systems thinking is the "four levels of thinking" model. It is designed to identify root causes and basic dynamics of complex problems.

The first level events represents only the "tip of the iceberg" phenomena within a system. Because events are tangible or visible and immediate, most policy discussion and problem-solving interventions occur at this level. But when addressing events we are treating symptoms but not the source of a problem. By applying the four levels of thinking it becomes clear why tip-of-the-iceberg solutions may not have long-lasting effects. If the issue has deep roots within our socio-economic system, it will simply re-emerge at different times or in different places.

## FINDING SOLUTIONS REQUIRES A MUCH DEEPER UNDERSTANDING OF PRESSURES, DRIVERS, ROOT CAUSES AND THE BASIC DYNAMICS OF SYSTEMS

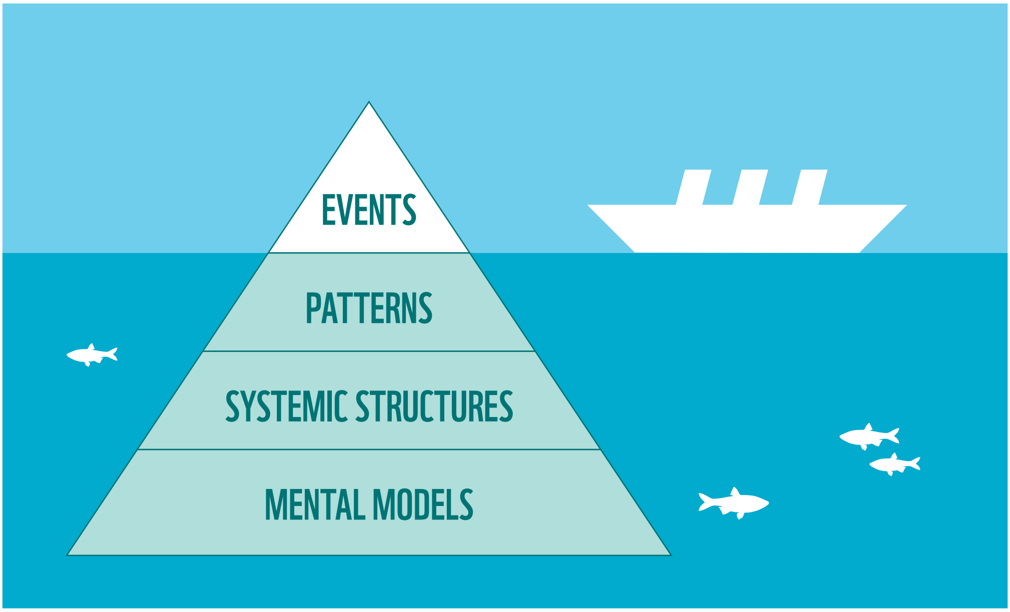



***Figure 11: An illustration of the "four levels of thinking" model***
*showing that events or symptoms are only the tip of the iceberg in the overall dynamics of a system. Meanwhile the underlying determinants of the system's behaviour are less apparent. The deeper we go below the surface events, the closer we get toward "root causes". Adapted from Maani and Cavana (2007).*

The second level of thinking concerns the patterns that emerge when a set of events repeatedly occurs to form recognizable behaviours or outcomes. For instance, a single event can be an individual choice about what to buy in the supermarket. Only when these events are grouped together and arranged on a timeline can we see the bigger pattern forming from the choices of many individuals in the supermarket.

The third level of thinking reveals systemic structures, which are the political, social, biophysical or economic structures that constrain the way different elements in the system can behave and interact. It is at this level that we truly begin to understand the causal relationships between events and various actors within the system. One of these constraining systemic structures is our prevailing global economic model.

At the fourth and deepest level of thinking are the mental models of individuals and organizations that reflect the beliefs, values and assumptions that we personally hold. Mental models – which can vary across cultures – are rarely taken into account in decision-making. However, belief systems – "we need to get richer in order to be happier", "people are poor because they don't try hard enough" – significantly affect all levels above. Mental models influence the design of system structures, the guidelines and incentives that govern behaviours, and ultimately, the individual events that make up the flow of daily life.

# A RESILIENT PLANET FOR NATURE AND PEOPLE

The 21st century presents humanity with a dual challenge: to maintain nature in all of its many forms and functions and to create an equitable home for people on a finite planet. The UN 2030 Agenda for Sustainable Development combines the economic, social and ecological dimensions necessary to sustain human society through the Anthropocene. These dimensions are all interconnected and must therefore be addressed in an integrated manner. Furthermore, a basic understanding must inform development strategies, economic models, business models and lifestyle choices: we have only one planet and its natural capital is limited.

The WWF "One Planet Perspective" outlines better choices for governing, using and sharing natural resources within the Earth's ecological boundaries. Adoption of this perspective will help nations meet their Sustainable Development Goals commitments by aligning individual initiative, corporate action and government policy in order to attain a sustainable global society.

When applied to business, "One Planet Thinking" encourages companies to align their operations so that they are actively contributing to a healthy and resilient planet for future generations. Minor changes to improve efficiency in resource use or to reduce pollution through end-of-pipe solutions will not bring about the magnitude of needed change.

The idea behind making better choices is to create a situation where food, energy and water is available to all, biodiversity is maintained, and ecosystem integrity and resilience are ensured. Resilient ecosystems would be able to absorb and recover from shocks and disturbances, maintain functionality and service by adapting to disruptions, and transform when necessary.

## A BASIC UNDERSTANDING MUST INFORM OUR STRATEGIES: WE HAVE ONLY ONE PLANET AND ITS NATURAL CAPITAL IS LIMITED


***Figure 12: WWF One Planet Perspective***
*The better choices outlined in the figure lead to ecosystem integrity, biodiversity conservation and food, water and energy security.*

## THE WWF "ONE PLANET PERSPECTIVE" OUTLINES BETTER CHOICES FOR GOVERNING, USING AND SHARING NATURAL RESOURCES WITHIN THE EARTH'S ECOLOGICAL BOUNDARIES

# TRANSITIONING THE GLOBAL ECONOMIC SYSTEM

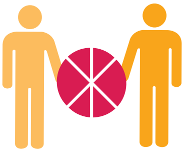
How do we define what constitutes a better choice? Systems thinking can help us understand the underlying causes of unsustainable development. Once the patterns, systemic structures and mental models that shape the destructive aspects of the human enterprise are identified and analysed, leverage points are easier to perceive. Leverage points are those places in a system where a given amount of change can result in the largest possible impact. Common leverage points for sustainability include government and corporate planning efforts, technological innovation, trade agreement negotiations, and the influence of large social organizations.

Changing the global economic system would entail a transformation in which human development is decoupled from environmental degradation and social exclusion. For this to occur, a number of significant changes – both incremental and radical – would need to take place in the areas of natural capital protection, governance, financial flows, markets, and the energy and food systems.

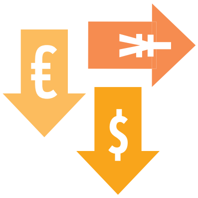
## Preserving natural capital

To adequately protect natural capital, resources need to be used sustainably, and the global network of protected areas needs to be expanded. Adequate funding mechanisms are needed if protective area management is to be effective.

## Equitable resource governance

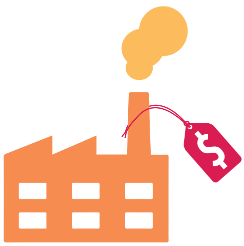


Legal and policy frameworks should support equitable access to food, water and energy, and stimulate inclusive processes for sustainably managed land and sea use. This also requires an evolved definition of well-being and success that includes personal, societal and environmental health. Decision making should consider future generations as well as the functional value of nature.



# Redirecting financial flows

Sustainable financial flows that support conservation and sustainable ecosystem management are an essential enabling condition for both preserving natural capital and promoting resilient and sustainable markets. Still, many financial institutions continue to invest substantially in harmful and unsustainable activities such as coal mining, environmentally-destructive agriculture and oil drilling.

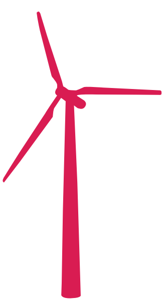


# Resilient markets for production and consumption

Producing better and consuming more wisely are key to establishing resilient markets that operate within our planet's safe operating space, safeguard our natural wealth, and contribute to our economic and social well-being. Sustainable resource management and incorporation of the true costs of production in the value chain represent better choices in this regard.

# Transformation of energy and food systems

Redirecting our path toward sustainability requires fundamental changes in two important systems: energy and food. Current structures and behaviours within these two systems have a tremendous impact on biodiversity, ecosystem resilience and human well-being.



**Toward sustainable renewable energy sources**
As fossil-fuel burning is the largest manmade driver of climate change, the vast majority of fossil fuels would be best left in the ground. Fortunately, renewable energy alternatives are becoming more and more competitive. Further development and rapid widespread adoption of renewable energy innovations are expected to reduce climate risks, while improving human health, boosting our economies, and creating jobs to replace those in fossil-based industries. While the global transition toward sustainable renewable energy sources such as wind and solar remains an immense task, many countries are already committed to transforming their traditional energy supply systems.

**Toward resilient food systems**

Food production is one of the primary causes of biodiversity loss through habitat degradation, overexploitation of species such as overfishing, pollution and soil loss. It is also a primary force behind the transgression of the Planetary Boundaries for nitrogen, phosphorus, climate change, biosphere integrity, land-system change and freshwater use. Even though its environmental impacts are immense, the current food system is expected to expand rapidly to keep up with projected increases in population, wealth and animal-protein consumption.

Transitioning toward an adaptive and resilient food system that provides nutritious food for all within the boundaries of a single planet is a daunting but essential goal. Various structures within the current industrialized global food system reinforce the status quo, including agricultural subsidies, governmental research programmes, and metrics that do not consider the environmental, social, ethical and cultural impacts in the costs of production. Imperfect as they are, these same structures also represent leverage points for change.

TRANSITIONING TOWARD AN ADAPTIVE AND RESILIENT FOOD SYSTEM THAT PROVIDES NUTRITIOUS FOOD FOR ALL WITHIN THE BOUNDARIES OF A SINGLE PLANET IS A DAUNTING BUT ESSENTIAL GOAL.

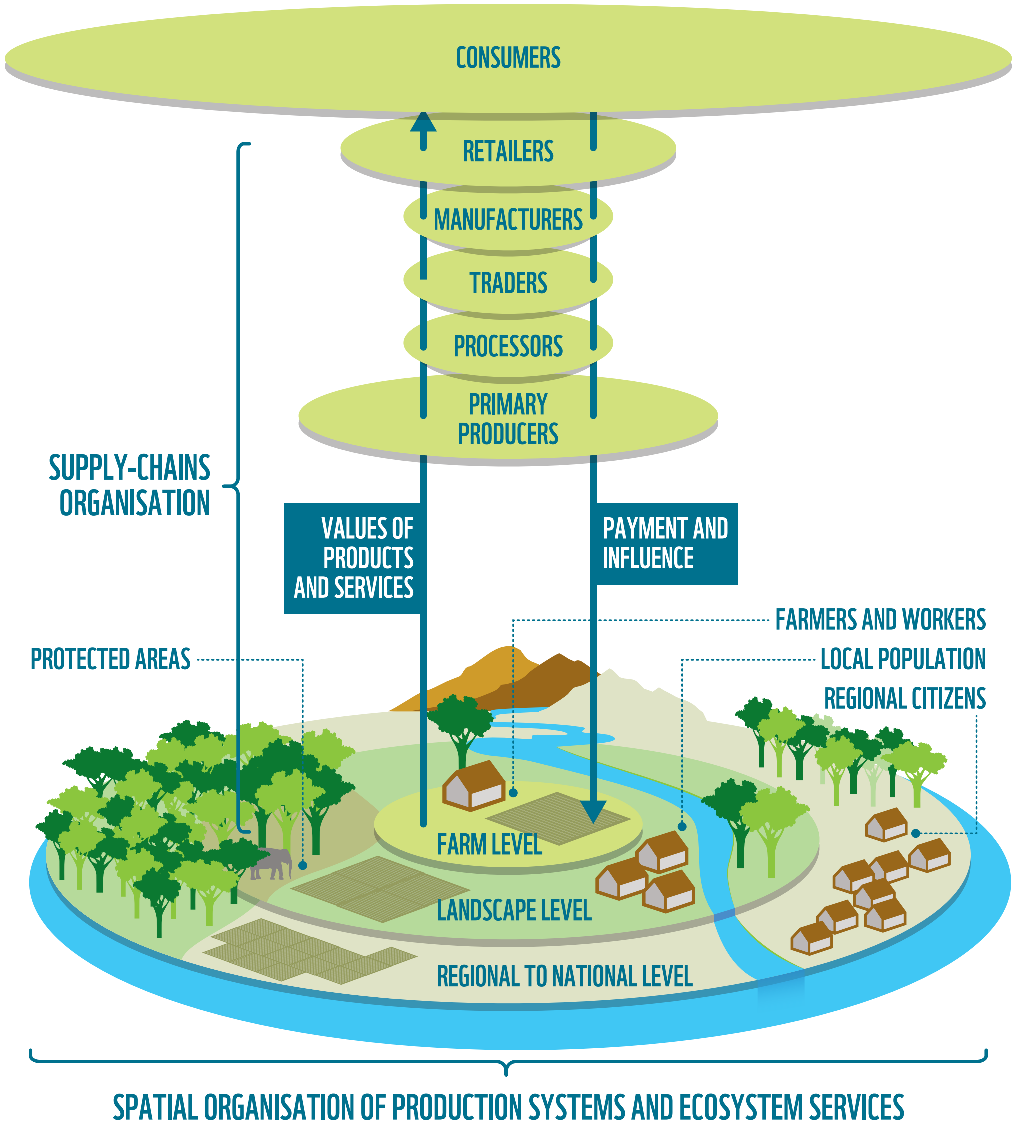
Agricultural production is highly influenced by consumption choices, lifestyles, waste and distribution. So, while reducing agriculture's environmental impacts and reducing waste along the food chain will be instrumental in meeting future needs, reducing the footprint of food consumption can make a significant contribution as well.

Optimizing productivity by diversifying farms and farming landscapes, increasing biodiversity and stimulating interactions between different species can be part of holistic strategies to build healthy agro-ecosystems, secure livelihoods, protect natural systems and preserve biodiversity. Diversified farming is applicable to all types of agriculture, including highly specialized industrial agriculture and subsistence farming.

In addition to farmers, other stakeholders along the food supply chain can contribute to and promote sustainable agricultural practices at the landscape level. For example, food retailers can influence production practices at the landscape scale and – through prices – they can alert consumers to the environmental costs of production, thereby shifting demand for sustainable products.

Companies in the supply chain could encourage landscape-scale diversification as it will reduce variability in supply and improve recovery from shocks, making their own business interests more resilient to risk. Moreover, landscapes that integrate crop, livestock and forestry systems with natural areas experience a higher, and more resilient, provision of ecosystem services such as crop pollination and pest control by natural enemies.

***Figure 13: Interaction between supply-chain and integrated landscape approach***
*Adapted from Van Oorschot et al., 2016; WWF MTI, 2016.*



# THE PATH AHEAD

The facts and figures in the *Living Planet Report* tend to paint a challenging picture, yet there is still plenty of room for optimism. If we manage to undergo the critical transitions necessary, the reward will be immense. Fortunately, we are not starting from scratch. There are several countries that have managed to raise the standards of living for their populations while using resources at much less intensity than industrial countries. Furthermore, the world is reaching a solid consensus regarding the direction we must take. In 2015, the 2030 Sustainable Development Goals were adopted. And at the Paris climate conference (COP21) in December 2015, 195 countries adopted a global agreement to combat climate change, and to accelerate and intensify the actions and investments needed for a sustainable low-carbon future. Finally, we have never before had such an understanding of the scale of our impact on the planet, the way the key environmental systems interact or the way in which we can manage them.

Ultimately, addressing social inequality and environmental degradation will require a global paradigm shift toward living within Planetary Boundaries. We must create a new economic system that enhances and supports the natural capital upon which it relies.

The speed at which we transition to a sustainable society is a key factor for determining our future. Allowing and fostering important innovations and enabling them to undergo rapid adoption in a wider arena is critical. Sustainability and resilience will be achieved much faster if the majority of the Earth's population understand the value and needs of our increasingly fragile Earth. A shared understanding of the link between humanity and nature could induce a profound change that will allow all life to thrive in the Anthropocene.

**SUSTAINABILITY AND RESILIENCE WILL BE ACHIEVED MUCH FASTER IF THE MAJORITY OF THE EARTH'S POPULATION UNDERSTAND THE VALUE AND NEEDS OF OUR INCREASINGLY FRAGILE EARTH**

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# LIVING PLANET REPORT 2016

100% RECYCLED

## BIODIVERSITY

The Living Planet Index, which measures biodiversity abundance levels based on 14,152 monitored populations of 3,706 vertebrate species, shows a persistent downward trend.

## RISKS

Our use of natural resources has grown dramatically, particularly since the mid-20th century, so that we are endangering the key environmental systems that we rely upon.

## ANTHROPOCENE

Scientists propose that, as a result of human activity, we have transitioned from the Holocene into a new geological epoch: the "Anthropocene".

## RESILIENCE

The 21st century presents humanity with a dual challenge to maintain nature in all of its many forms and functions and to create an equitable home for people on a finite planet.

WWF

**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.

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