WWF *for a living planet*®

LIVING PLANET REPORT 2008

Global Footprint Network

ZSL LIVING CONSERVATION

CONTENTS

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(also known as World Wildlife Fund in the USA and Canada) is one of the world's largest and most experienced independent conservation organizations, with almost 5 million supporters and a global network active in over 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

ZOOLOGICAL SOCIETY OF LONDON
Founded in 1826, the Zoological Society of London (ZSL) is an international scientific, conservation and educational organization. Its mission is to achieve and promote the worldwide conservation of animals and their habitats. ZSL runs ZSL London Zoo and ZSL Whipsnade Zoo, carries out scientific research in the Institute of Zoology and is actively involved in field conservation worldwide.

GLOBAL FOOTPRINT NETWORK
promotes a sustainable economy by advancing the Ecological Footprint, a tool that makes sustainability measurable. Together with its partners, the network coordinates research, develops methodological standards, and provides decision makers with robust resource accounts to help the human economy operate within the Earth's ecological limits.

EDITOR IN CHIEF
Chris Hails

EDITORS
Sarah Humphrey
Jonathan Loh
Steven Goldfinger

CONTRIBUTORS

WWF
Sarah Humphrey
Ashok Chapagain
Greg Bourne
Richard Mott
Judy Oglethorpe
Aimee Gonzales
Martin Atkin

ZSL
Jonathan Loh
Ben Collen
Louise McRae
Tharsila T. Carranza
Fiona A. Pamplin
Rajan Amin
Jonathan E.M. Baillie

GFN
Steven Goldfinger
Mathis Wackernagel
Meredith Stechbart
Sarah Rizk
Anders Reed
Justin Kitzes
Audrey Peller
Shiva Niazi
Brad Ewing
Alessandro Galli
Yoshihiko Wada
Dan Moran
Robert Williams
Willy De Backer

TWENTE
Arjen Y. Hoekstra
Mesfin Mekonnen

WWF INTERNATIONAL
Avenue du Mont-Blanc
CH-1196 Gland
Switzerland
www.panda.org

INSTITUTE OF ZOOLOGY
Zoological Society of London
Regent's Park
London NW1 4RY, UK
www.zoo.cam.ac.uk/ioz/projects/indicators_livingplanet.htm

GLOBAL FOOTPRINT NETWORK
312 Clay Street, Suite 300
Oakland, California 94607
USA
www.footprintnetwork.org

TWENTE WATER CENTRE
University of Twente
7500 AE Enschede
The Netherlands
www.water.utwente.nl

FOREWORD

The recent downturn in the global economy is a stark reminder of the consequences of living beyond our means. But the possibility of financial recession pales in comparison to the looming ecological credit crunch.

Whether we live on the edge of the forest or in the heart of the city, our livelihoods and indeed our lives depend on the services provided by the Earth's natural systems. The *Living Planet Report 2008* tells us that we are consuming the resources that underpin those services much too fast – faster than they can be replenished. Just as reckless spending is causing recession, so reckless consumption is depleting the world's natural capital to a point where we are endangering our future prosperity. The Living Planet Index shows that over the past 35 years alone the Earth's wildlife populations have declined by a third.

Yet our demands continue to escalate, driven by the relentless growth in human population and in individual consumption. Our global footprint now exceeds the world's capacity to regenerate by about 30 per cent. If our demands on the planet continue at the same rate, by the mid-2030s we will need the equivalent of two planets to maintain our lifestyles. And this year's report captures, for the first time, the impact of our consumption on the Earth's water resources and our vulnerability to water scarcity in many areas.

These overall trends have very concrete consequences, and we have seen them this year in daily headlines. Global prices for many crops have hit record highs, in large part due to surging demand for food, feed and biofuels, and, in some places, dwindling water supplies. For the first time in recorded history, this past summer the Arctic ice cap was surrounded by open water – literally disappearing under the impact of our carbon footprint.

The ecological credit crunch is a global challenge. The *Living Planet Report 2008* tells us that more than three quarters of the world's people live in nations that are ecological debtors – their national consumption has outstripped their country's biocapacity. Thus, most of us are propping up our current lifestyles, and our economic growth, by drawing (and increasingly overdrawing) upon the ecological capital of other parts of the world.

The good news is that we have the means to reverse the ecological credit crunch – it is not too late to prevent an irreversible ecological recession setting in. This report identifies the key areas where we need to transform our lifestyles and economies to put us on a more sustainable trajectory.

The scale of the challenge at times seems overwhelming, which is why we have introduced the concept of "sustainability wedges" to tackle ecological overshoot across different sectors and drivers. This wedge analysis enables us to break down the various contributing factors of overshoot and propose different solutions for each. For the single most important challenge, the WWF Climate Solutions Model uses a wedge analysis to illustrate how it is possible to meet the projected growth in demand for global energy services in 2050 while achieving significant reductions in global greenhouse gas emissions. Crucially, this model highlights the need to take immediate action to curb dangerous climate change.

As we act to reduce our footprint – our impact on the Earth's services – we must also get better at managing the ecosystems that provide those services. Success requires that we manage resources on nature's terms and at nature's scale. This means that decisions in each sector, such as agriculture or fisheries, must be taken with an eye to broader ecological consequences. It also means that we must find ways to manage across our own boundaries – across property lines and political borders – to take care of the ecosystem as a whole.

It is nearly four decades since the *Apollo 8* astronauts photographed the famous "Earth Rise", providing the first ever view of Planet Earth. In the two generations since, the world has moved from ecological credit to ecological deficit. The human species has a remarkable track record of ingenuity and problem solving. The same spirit that took man to the moon must now be harnessed to free future generations from crippling ecological debt.

James P. Leape
Director-General, WWF International

INTRODUCTION

We have only one planet. Its capacity to support a thriving diversity of species, humans included, is large but fundamentally limited. When human demand on this capacity exceeds what is available – when we surpass ecological limits – we erode the health of the Earth's living systems. Ultimately, this loss threatens human well-being.

This report uses complementary measures to explore the changing state of global biodiversity and of human consumption. The Living Planet Index reflects the state of the planet's ecosystems while the Ecological Footprint shows the extent and type of human demand being placed on these systems.

The Living Planet Index of global biodiversity, as measured by populations of 1,686 vertebrate species across all regions of the world, has declined by nearly 30 per cent over just the past 35 years (Figure 1). For the first time in this report, the volume of data in the Living Planet Index has allowed species population trends to be analysed by biogeographic realm and taxonomic group as well as by biome. While biodiversity loss has levelled off in some temperate areas, the overall Living Planet Index continues to show a decline. It appears increasingly unlikely that even the modest goal of the Convention on Biological Diversity, to reduce by 2010 the rate at which global biodiversity is being lost, will be met.

Humanity's demand on the planet's living resources, its Ecological Footprint, now exceeds the planet's regenerative capacity by about 30 per cent (Figure 2). This global overshoot is growing and, as a consequence, ecosystems are being run down and waste is accumulating in the air, land and water. The resulting deforestation, water shortages, declining biodiversity and climate change are putting the well-being and development of all nations at increasing risk.

Water shortages are of growing concern in many countries and regions. Therefore, this report includes a third measure, the water footprint, which captures the demand placed on national, regional or global water resources as a result of consumption of goods and services. Although water is not considered a scarce resource globally, its distribution and availability are very uneven, both geographically and through time. Around 50 countries are currently facing moderate or severe water stress and the number of people suffering from year-round or seasonal water shortages is expected to increase as a result of climate change. This has profound implications for ecosystem health, food production and human well-being.

Humanity's demand on the planet has more than doubled over the past 45 years as a result of population growth and increasing individual consumption. In 1961, almost all countries in the world had more than enough capacity to meet their own demand; by 2005, the situation had changed radically, with many countries able to meet their needs only by importing resources from other nations

Fig. 1: **LIVING PLANET INDEX,** 1970–2005

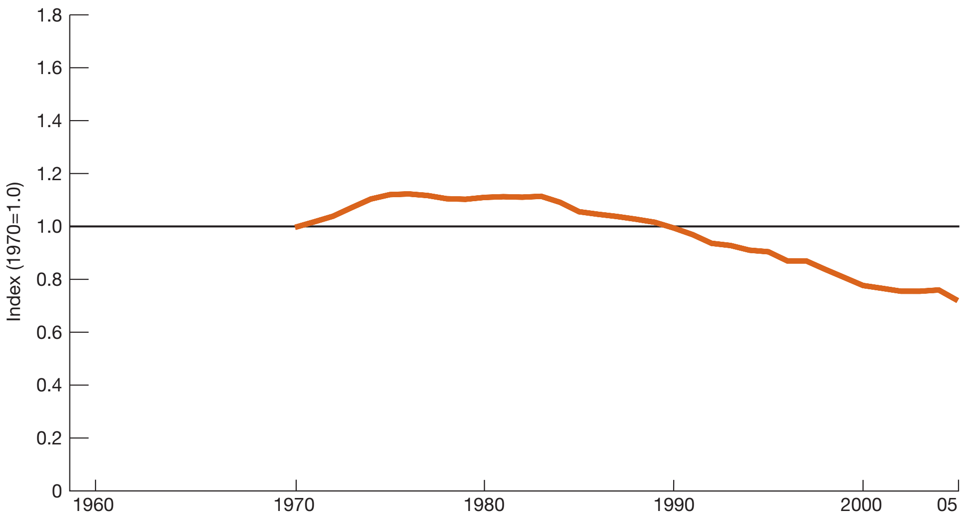
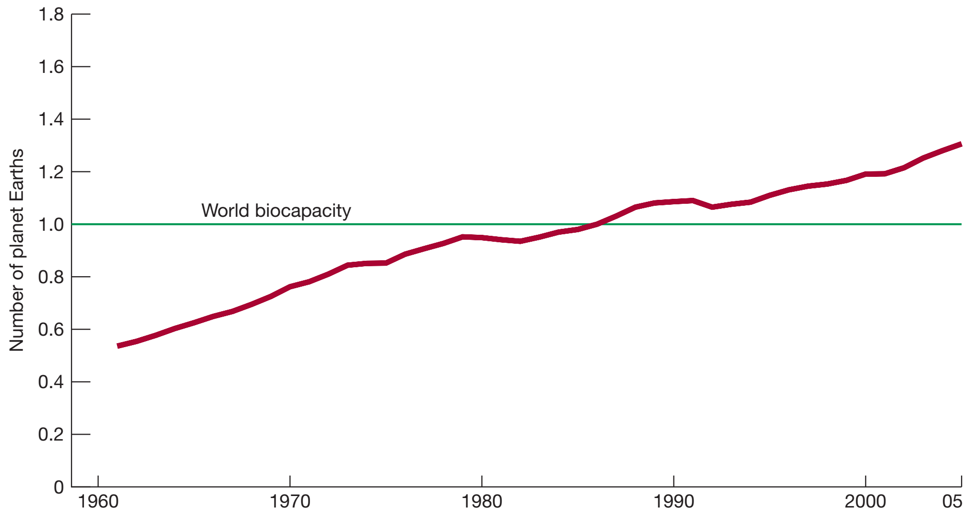


Fig. 2: **HUMANITY'S ECOLOGICAL FOOTPRINT,** 1961-2005



and by using the global atmosphere as a dumping ground for carbon dioxide and other greenhouse gases (Figure 3). In an overexploited world, ecological debtor nations are particularly at risk from local and global overshoot, and from the associated decline in ecosystem services, the life support system on which humanity depends.

If we continue with business as usual, by the early 2030s we will need two planets to keep up with humanity's demand for goods and services. But there are many effective ways to change course. While technological developments will continue to play an important role in addressing the sustainability challenge, much of what needs to be done is already known, and solutions are available today. As an example, this report uses a "wedge" approach to illustrate how moving to clean energy generation and efficiency based on current technologies could allow us to meet the projected 2050 demand for energy services with major reductions in associated carbon emissions.

Technology transfer and support for local innovation can help emerging economies maximize their well-being while leapfrogging resource-intensive phases of industrialization. Cities, which now house more than half the human population, can be designed to support desirable lifestyles while simultaneously minimizing demand on both local and global ecosystems. Empowerment of women, education and access to voluntary family planning can slow or even reverse population growth.

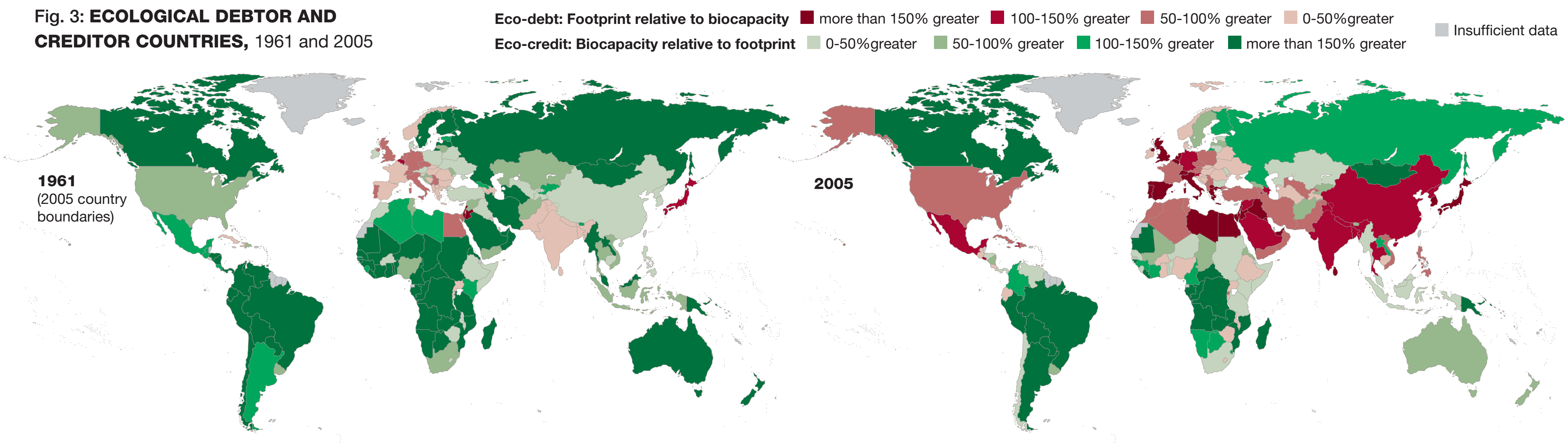
The Ecological Footprint – representing human demand on nature – and the Living Planet Index – measuring nature's overall health – serve as clear and robust guideposts to what needs to be done. If humanity has the will, it has the way to live within the means of the planet, while securing human well-being and the ecosystems on which this depends.

Figure 1: Living Planet Index. The global index shows that vertebrate species populations declined by nearly 30 per cent during the period 1970 to 2005.

Figure 2: Humanity's Ecological Footprint. Human demand on the biosphere more than doubled during the period 1961 to 2005.

Figure 3: Ecological debtor and creditor countries. Debtor countries have an Ecological Footprint greater than their own biocapacity; creditor countries have an Ecological Footprint smaller than their own biocapacity.

Fig. 3: **ECOLOGICAL DEBTOR AND CREDITOR COUNTRIES,** 1961 and 2005



BIODIVERSITY, ECOSYSTEM SERVICES, HUMANITY'S FOOTPRINT

The Living Planet Index shows that wild species and natural ecosystems are under pressure across all biomes and regions of the world. The direct, anthropogenic threats to biodiversity are often grouped under five headings:

- habitat loss, fragmentation or change, especially due to agriculture
- overexploitation of species, especially due to fishing and hunting
- pollution
- the spread of invasive species or genes
- climate change.

All five of these threats stem ultimately from human demands on the biosphere – the production and consumption of natural resources for food and drink, energy or materials, and the disposal of associated waste products – or the displacement of natural ecosystems by towns, cities and infrastructure (see Figure 4). Further, the massive flows of goods and people around the world have become a vector for the spread of alien species and diseases.

Natural habitat is lost, altered or fragmented through its conversion for cultivation, grazing, aquaculture, and industrial or urban use. River systems are dammed and altered for irrigation, hydropower or flow regulation. Even marine ecosystems, particularly the seabed, are physically degraded by trawling, construction and extractive industries.

Overexploitation of wild species populations is the result of harvesting or killing animals or plants for food, materials or medicine, at a rate above the reproductive capacity of the population. It has been the dominant threat to marine biodiversity, and overfishing has devastated many commercial fish stocks. However, overexploitation is also a serious threat to many terrestrial species, particularly tropical forest mammals hunted for meat. Overharvesting of timber and fuelwood has also led to loss of forests and their associated plant and animal populations.

Invasive species, introduced either deliberately or inadvertently to one part of the world from another, and which become competitors, predators or parasites of indigenous species, are responsible for declines in many native species populations. This is especially important on islands and in freshwater ecosystems, where they are thought to be the main threat to endemic species.

Pollution is another important cause of biodiversity loss, particularly in aquatic ecosystems. Excess nutrient loading as a result of the increasing use of nitrogen and phosphorous fertilizers in agriculture causes eutrophication and oxygen depletion. Toxic chemical pollution often arises from pesticide use in farming or aquaculture, from industry and from mining wastes. The increasing carbon dioxide concentration in the atmosphere is causing acidification of the oceans, which is likely to have widespread effects, particularly on shell- and reef-building organisms.

Potentially the greatest threat to biodiversity over the coming decades is climate change. Early impacts have been felt in polar and montane as well as coastal and marine ecosystems, such as coral reefs. Future impacts are difficult to predict at local scales, but any ecosystem may be susceptible to changing temperature or weather patterns.

Clearly, all of these threats or pressures are the effect of more distant, indirect drivers. These drivers of biodiversity loss stem from the human demands for food, water, energy and materials. They can be considered in terms of the production and consumption of agricultural crops, meat and dairy products, fish and seafood, timber and paper, water, energy, transport and land for towns, cities and infrastructure. As the world population and economy grow, so do the pressures on biodiversity. As technology and resource efficiency improve, so the pressure could be alleviated. The Ecological Footprint is an aggregate measure of the demands that resource consumption places on ecosystems and species. Understanding the interactions between biodiversity, the drivers of biodiversity loss and humanity's footprint is fundamental to slowing, halting and reversing the ongoing declines in natural ecosystems and populations of wild species.

ECOSYSTEM SERVICES

Humanity depends on healthy ecosystems: they support or improve our quality of life, and without them, the Earth would be uninhabitable. The Millennium Ecosystem Assessment (MA) describes four categories of ecosystem services, starting with the most fundamental:

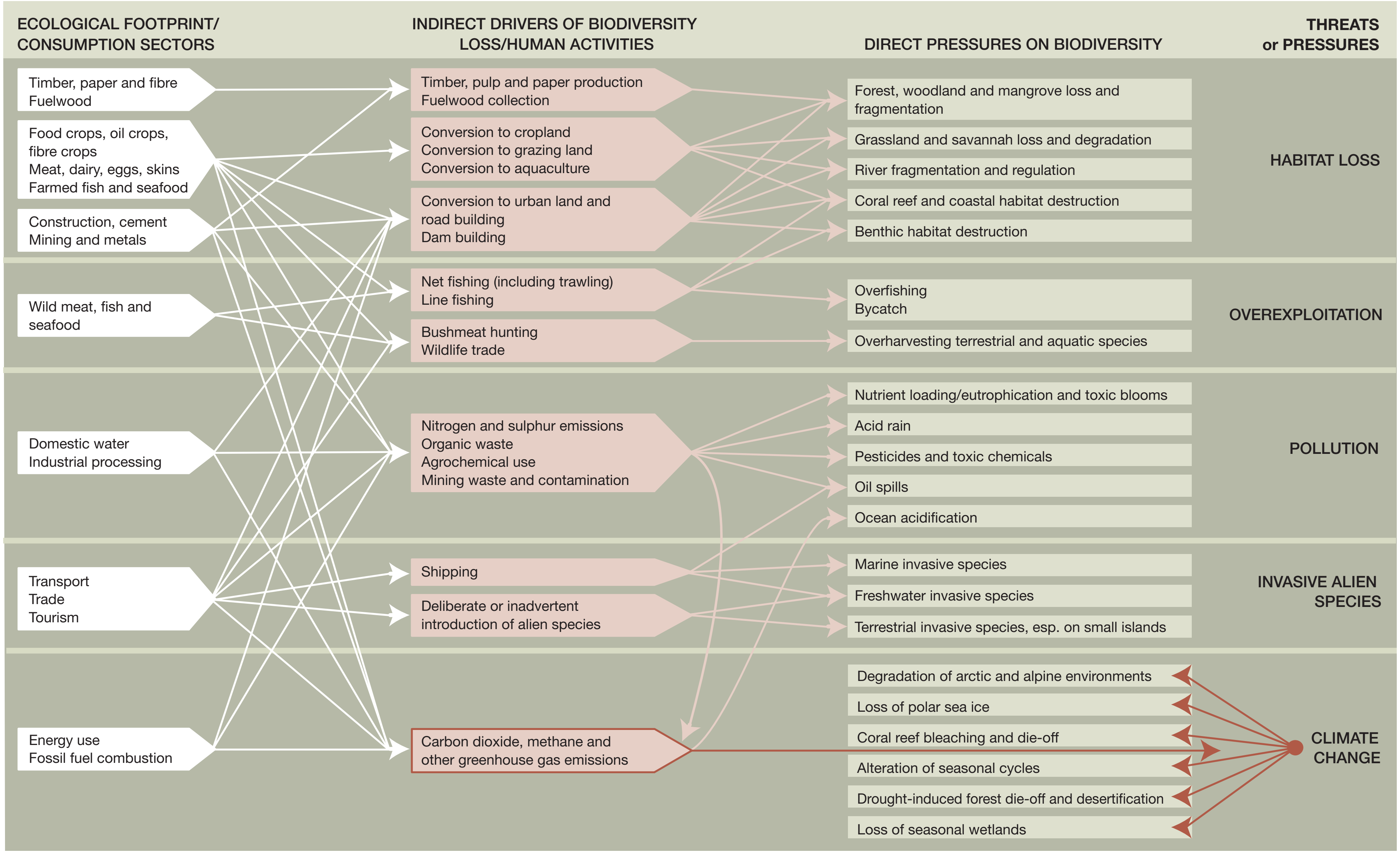
- supporting services such as nutrient cycling, soil formation and primary production
- provisioning services such as the production of food, freshwater, materials or fuel
- regulating services including climate and flood regulation, water purification, pollination and pest control
- cultural (including aesthetic, spiritual, educational and recreational) services.

Each of these services derives ultimately from living organisms. However, it is not biodiversity *per se* that underpins ecosystem services, but the abundance of particular species that are critical in maintaining habitat stability and providing those services. Decline in a critical species at a local scale will have an adverse impact on ecosystem services, even if that species is not threatened globally.

The MA reported that biodiversity loss contributes to food and energy insecurity, increased vulnerability to natural disasters such as floods or tropical storms, poorer health, reduced availability and quality of water, and the erosion of cultural heritage.

Most supporting, regulating and cultural ecosystem services are not bought and sold commercially, so have no market value. Their decline sends no warning signal to the local or global economy. Markets lead to decisions about resource use that maximize benefits to individual producers and consumers, but often undermine the biodiversity and ecosystem services on which the production and consumption ultimately depend. The value of biodiversity to human well-being, while not readily quantifiable in monetary terms, could be the difference between a planet that can support its human population and one which cannot.

Fig. 4: **BIODIVERSITY LOSS, HUMAN PRESSURE AND THE ECOLOGICAL FOOTPRINT,** cause-and-effect relationships



LIVING PLANET INDEX: GLOBAL

The Living Planet Index is an indicator designed to monitor the state of the world's biodiversity. Specifically, it tracks trends in a large number of populations of species in much the same way that a stock market index tracks the value of a set of shares or a retail price index tracks the cost of a basket of consumer goods. The Living Planet Index is based on trends in nearly 5,000 populations of 1,686 species of mammal, bird, reptile, amphibian and fish from around the globe. The changes in the population of each species are then averaged and shown relative to 1970, which is given a value of 1.0.

The global Living Planet Index is the aggregate of two indices – temperate (which includes polar) and tropical – each of which is given equal weight. In the tropical and temperate indices, the overall trends in terrestrial, freshwater and marine species are also each given equal weight.

The tropical index consists of terrestrial and freshwater species populations found in the Afrotropical, Indo-Pacific and Neotropical realms as well as marine species populations from the zone between the Tropics of Cancer and Capricorn.

The temperate index includes terrestrial and freshwater species populations from the Palearctic and Nearctic realms as well as marine species populations north or south of the tropics (see Figure 8).

The global index shows an overall decline from 1970 to 2005 of nearly 30 per cent (Figure 5). The tropical index fell by about 50 per cent while the temperate index showed little overall change over the same period (Figures 6 and 7).

This marked contrast in trends between temperate and tropical populations is apparent in terrestrial, freshwater and marine species. It does not necessarily imply, however, that tropical biodiversity is in a far worse state than temperate biodiversity. If the index were to extend back centuries rather than decades, it might well show a decline of equal or greater magnitude among temperate species populations. Whether or not this is the case, the index shows that there is a severe and ongoing loss of biodiversity in tropical ecosystems.

Figure 5: Global Living Planet Index. This shows an average trend of -28 per cent from 1970 to 2005 in 4,642 populations of 1,686 species*. Temperate and tropical average trends were given equal weight.

Figure 6: Temperate Living Planet Index. The index shows a +6 per cent average trend between 1970 and 2005 in 3,309 populations of 1,235 species*. Terrestrial, freshwater and marine species' average trends were given equal weight.

Figure 7: Tropical Living Planet Index. The index shows a -51 per cent overall trend from 1970 to 2005 in 1,333 populations of 585 species*. Terrestrial, freshwater and marine species' average trends were given equal weight.

** Note: Some species occur in temperate and tropical regions.*

Fig. 5: **GLOBAL LIVING PLANET INDEX,** 1970–2005

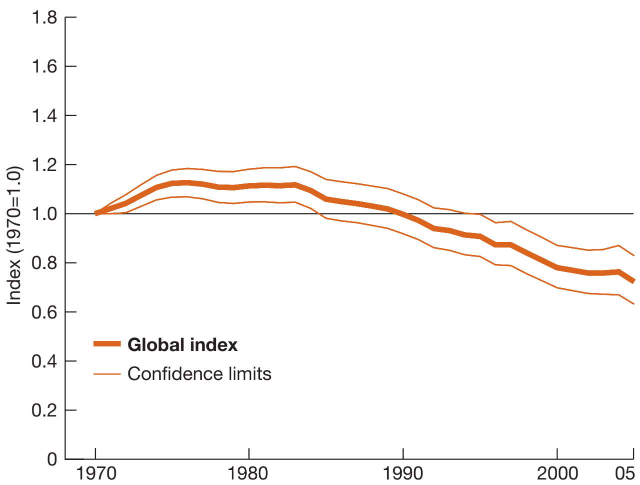


Fig. 6: **TEMPERATE LIVING PLANET INDEX,** 1970–2005

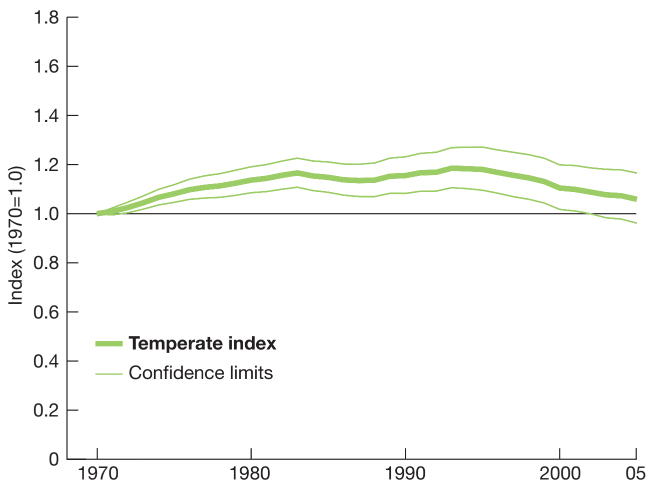
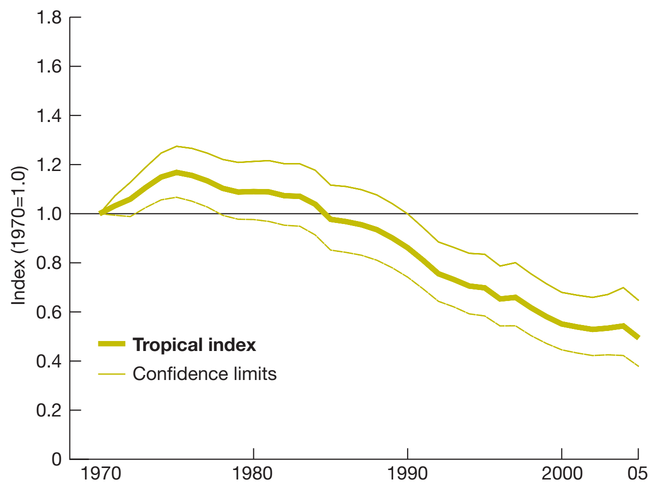


Fig. 7: **TROPICAL LIVING PLANET INDEX,** 1970–2005



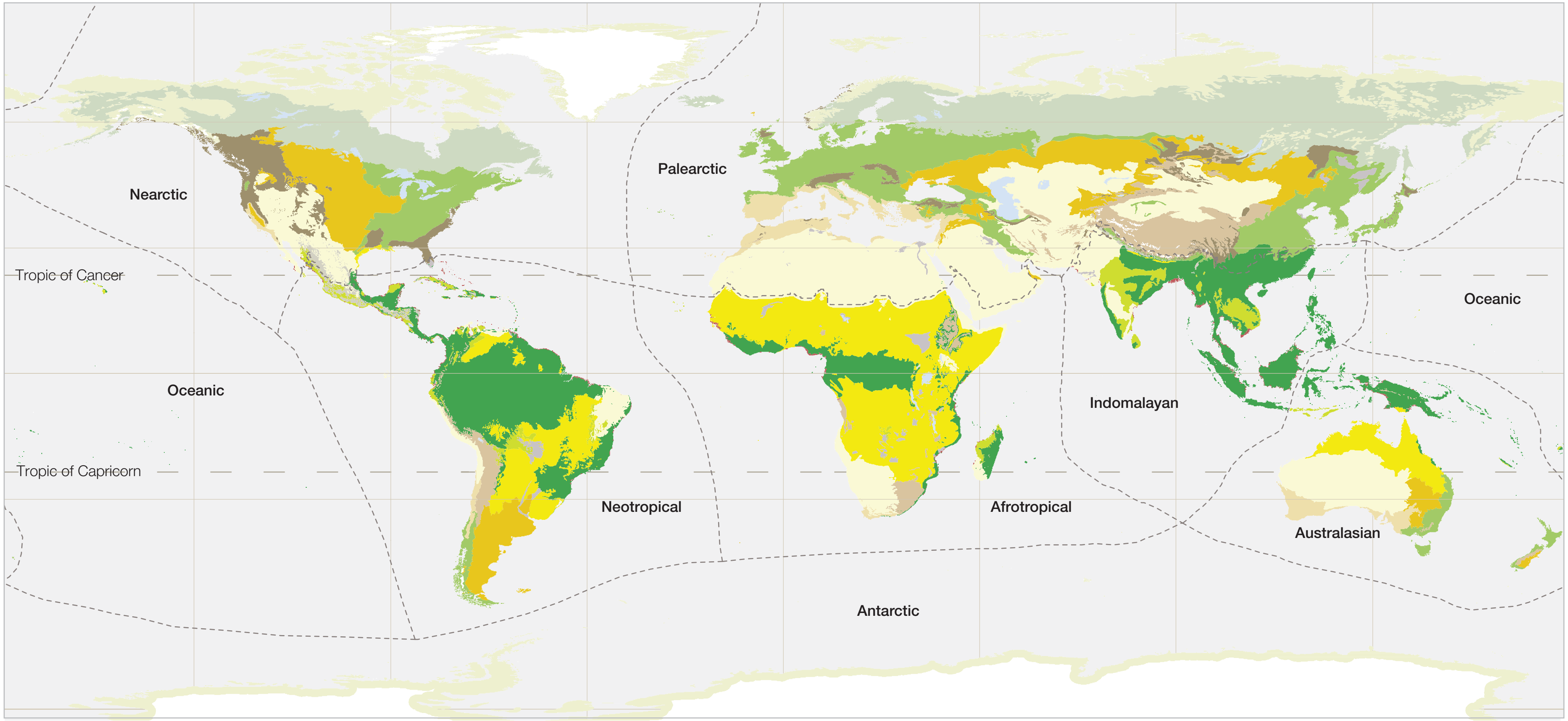


Fig. 8: **TERRESTRIAL BIOGEOGRAPHIC REALMS AND BIOMES**

- Tropical and subtropical moist broadleaf forests
- Tropical and subtropical dry broadleaf forests
- Tropical and subtropical coniferous forests
- Temperate broadleaf and mixed forests
- Temperate coniferous forests
- Boreal forests/taiga
- Tropical and subtropical grasslands, savannahs and shrublands
- Temperate grasslands, savannahs and shrublands
- Flooded grasslands and savannahs
- Montane grasslands and shrublands
- Tundra
- Mediterranean forests, woodlands and scrub
- Deserts and xeric shrublands
- Mangroves
- Water bodies
- Rock and ice

EVIDENCE

LIVING PLANET INDEX: SYSTEMS AND BIOMES

The terrestrial, freshwater and marine indices are each calculated as the average of two indices which separately measure trends in tropical and temperate vertebrate populations.

The terrestrial index has declined consistently since the mid-1970s (Figure 9), and shows an average 33 per cent decline in terrestrial vertebrate populations between 1970 and 2005. Most of this change took place in the tropics; there was little overall change in species populations in temperate regions. In the tropics, a combination of deforestation and other habitat destruction, driven by agricultural conversion and overexploitation from logging and hunting, are among the major causes of species population declines.

The marine index shows an average overall decline of 14 per cent between 1970 and 2005 (Figure 10). Rising sea temperatures, destructive fishing methods and pollution are responsible for some of the decline in marine life. A recent study shows that 40 per cent of the world's oceans are severely affected by human activities.

Overfishing is the major driver of this change, with most of the world's commercial marine fisheries believed to be fully exploited or overexploited. Oceans provide vital resources and ecosystem services upon which all life depends; however, marine protected areas currently cover less than 1 per cent of the world's seas. Recent assessments show that population declines extend beyond vertebrates. For example, decline in coral abundance due to bleaching and disease, driven by increasing sea surface temperatures, is of growing concern.

Inland waters are home to an enormous diversity of species and also provide resources and ecological services that are essential to human well-being. **The freshwater index** shows that populations of species in inland waters decreased on average by 35 per cent from 1970 to 2005 (Figure 11). It is estimated that wetland areas decreased in extent by 50 per cent during the 20th century as a result of a number of different threats. Loss and degradation of wetlands is caused by overfishing, invasive species, pollution, creation of dams and water diversion.

Figure 9: Terrestrial Living Planet Index. This index shows an average -33 per cent trend between 1970 and 2005 in 2,007 populations of 887 terrestrial species.

Figure 10: Marine Living Planet Index. The marine species index shows an average -14 per cent trend over 35 years in 1,175 populations of 341 marine species.

Figure 11: Freshwater Living Planet Index. The freshwater index shows an average -35 per cent trend from 1970 to 2005 in 1,463 populations of 458 species.

Fig. 9: **TERRESTRIAL LIVING PLANET INDEX,** 1970–2005

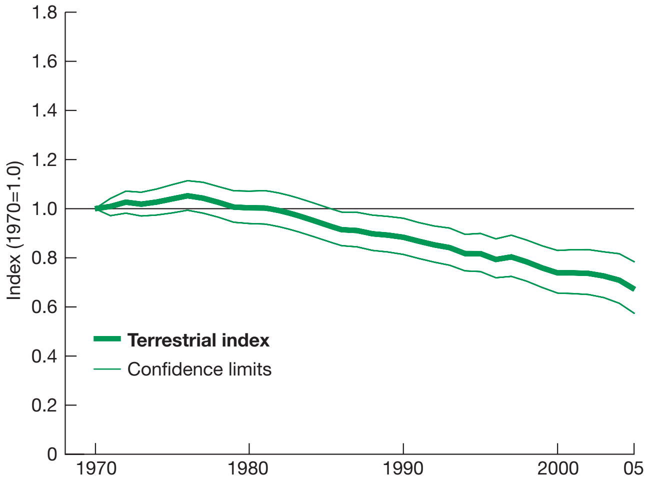


Fig. 10: **MARINE LIVING PLANET INDEX,** 1970–2005

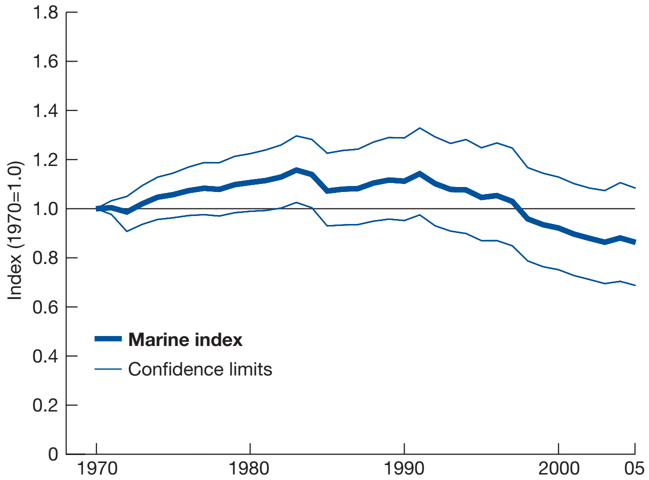
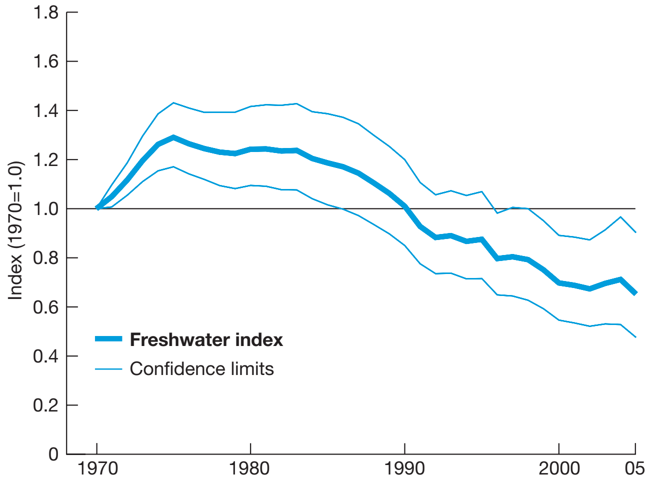


Fig. 11: **FRESHWATER LIVING PLANET INDEX,** 1970–2005



The indices below highlight species population declines in three groups of biomes that are subject to intense local and global pressures. If degradation continues at current rates, the loss of ecosystem services such as water purification and climate regulation will have serious repercussions for both human well-being and biodiversity.

Tropical forests support a wide diversity of species and provide globally and locally important ecosystem services. This habitat and its species are under threat from pressures such as deforestation, illegal logging, forest fire and climate change. Deforestation continues in the tropics, with primary forest disappearing at the rate of almost 3.5 million hectares per year in Brazil and 1.5 million hectares per year in Indonesia over the period 2000 to 2005. This is reflected in **the tropical forest index**, which reveals a decline of more than 60 per cent in animal populations (Figure 12).

Species populations in **dryland systems** have declined by about 44 per cent since 1970 (Figure 13). Drylands make up more than 40 per cent of the Earth's terrestrial system, including such diverse ecosystems as deserts, savannah and tropical dry woodlands. Drylands are also home to over 2 billion people whose livelihoods often depend directly on local ecosystem goods and services. While the addition of water points to dryland systems has permitted increased numbers of livestock for the short-term benefit of humans, this has had a negative impact on fragile systems, to the detriment of biodiversity. An estimated 20 per cent of dryland areas now suffer soil degradation.

Grasslands, found on all continents other than Antarctica, have declined in quality and extent over past decades with high rates of conversion to agriculture. Humans are reliant on grasslands both directly for food and indirectly through ecosystem services such as nutrient cycling. Grasslands also support a wide range of natural diversity, from endemic plant species to grazing mammals such as antelopes, populations of which are vital for sustaining many top predator species. There has been a 36 per cent decline in grassland vertebrate populations since 1970 (Figure 14). Grasslands are maintained by processes such as artificial and natural fires, grazing, droughts and rainfall. This creates a delicate balance of influences which can be easily disrupted, leading to the acceleration of processes such as desertification.

Figure 12: Tropical Forest Living Planet Index. The index shows an average -62 per cent trend between 1970 and 2005 in 503 populations of 186 species.

Figure 13: Dryland Living Planet Index. This shows an average -44 per cent trend between 1970 and 2005 in 476 populations of 149 species.

Figure 14: Grassland Living Planet Index. This shows an average -36 per cent trend between 1970 and 2005 in 703 populations of 309 species.

Fig. 12: **TROPICAL FOREST LIVING PLANET INDEX,** 1970–2005

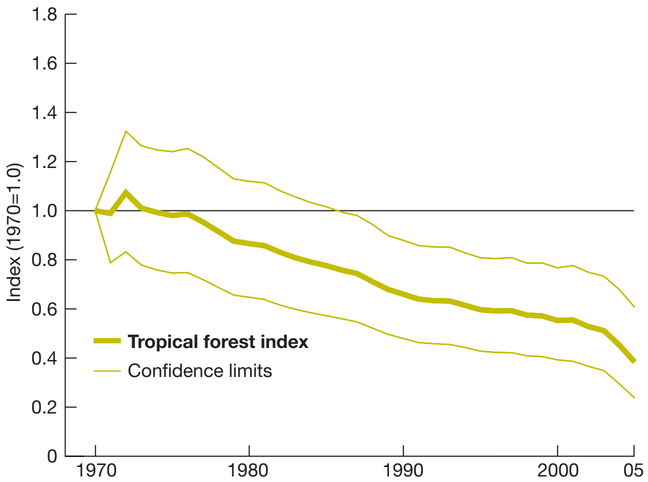


Fig. 13: **DRYLAND LIVING PLANET INDEX,** 1970–2005

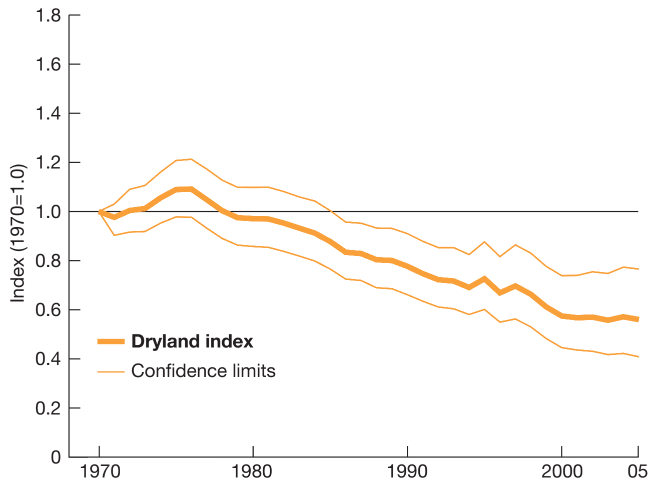
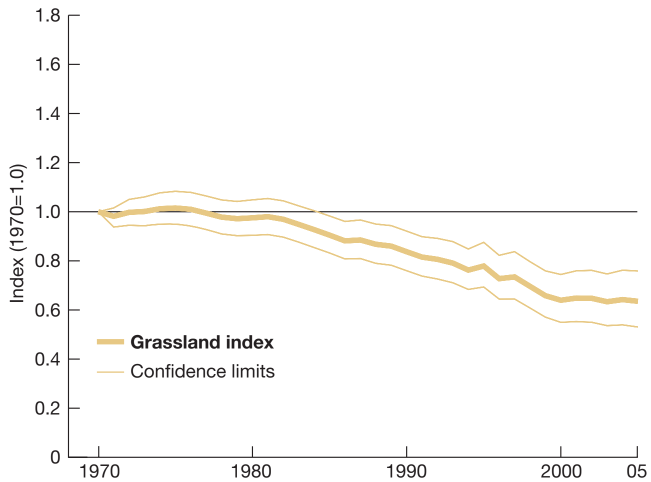


Fig. 14: **GRASSLAND LIVING PLANET INDEX,** 1970–2005



LIVING PLANET INDEX: BIOGEOGRAPHIC REALMS

The Earth's land surface can be divided into regions or realms characterized by distinct assemblages of animals and plants (Figure 8). Trends in species populations are different in each realm according to the intensity and history of the threats to their biodiversity. The following figures show trends in terrestrial and freshwater species populations in each realm.

Species in the **Nearctic realm** have been extensively monitored, providing a large amount of population trend data. Species population abundance from 1970 to 2005 shows no overall change (Figure 15).

By contrast, the **Neotropical index** shows a large decline from 1970 to 2004 (Figure 16). Whilst this index combines data from all vertebrate classes, the amount of population data available for the Neotropical index is small relative to the other realms. As a consequence, the magnitude of the trend is largely driven by catastrophic declines in a number of amphibian species such as the golden toad (*Bufo periglenes*) from Costa Rica, which is now thought to be extinct. Decreases in abundance are also apparent in other Neotropical species, but not at such a rapid rate.

The Neotropics contain 40 per cent of all plant and animal species on the planet, the most biodiverse of all the biogeographic realms. These species are under threat mainly from habitat loss. For example, between 2000 and 2005 the net loss of forests in South America was about 4.3 million hectares per year, exceeding that of all other regions.

In the **Palearctic realm**, the average trend in abundance from 1970 to 2005 increased (Figure 17). Most of the population data available are from Western Europe, the part of the world most affected by human activities over the past 300 years. More than 50 per cent of the land has been converted for agricultural use, so many species declines are likely to have occurred before 1970. The positive trend for the Palearctic realm since 1970 may, in part, reflect conservation successes resulting from habitat protection, reduction of pollution or other environmental improvements.

However, with globalization, pressure on the environment has shifted to the tropics and other regions. Trends in the Eastern Palearctic are less certain as fewer data are available. One species of concern is the **saiga antelope** (*Saiga tatarica*), populations of which have plummeted due to hunting pressure over the last 40 years (see opposite).

The **Afrotropical index** shows an average decline of 19 per cent over the 35-year period (Figure 18). Recent positive trends in the index could reflect some of the conservation efforts on species such as the **white rhino** (*Ceratotherium simum*). However, the northern subspecies has been extirpated from most of its historical range and is now on the brink of extinction (see opposite). This shows that although progress is being made towards recovery and protection of certain species in the Afrotropical realm, conservation action in the region is still essential for reducing the rate of decline.

The **Indo-Pacific index** combines species population data from three realms:

Fig. 15: **NEARCTIC LIVING PLANET INDEX,** 1970–2005

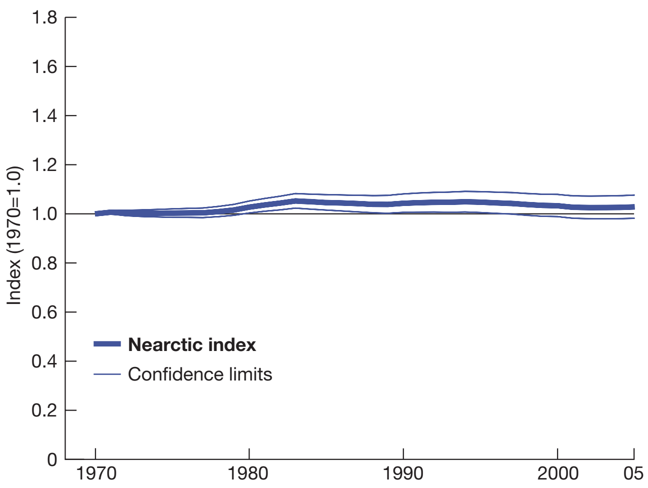


Fig. 16: **NEOTROPICAL LIVING PLANET INDEX,** 1970–2004

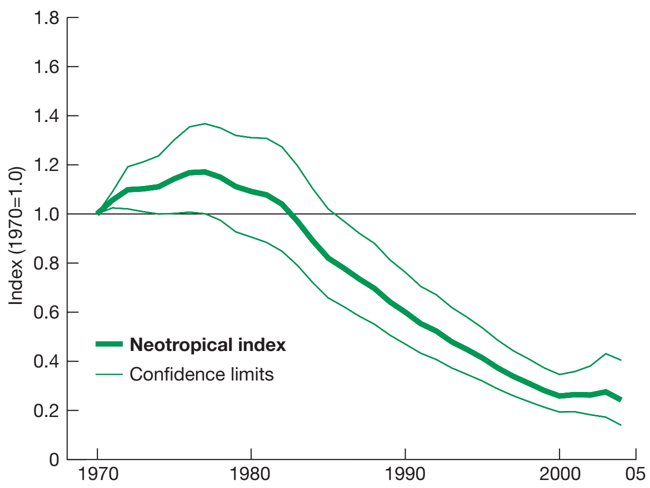
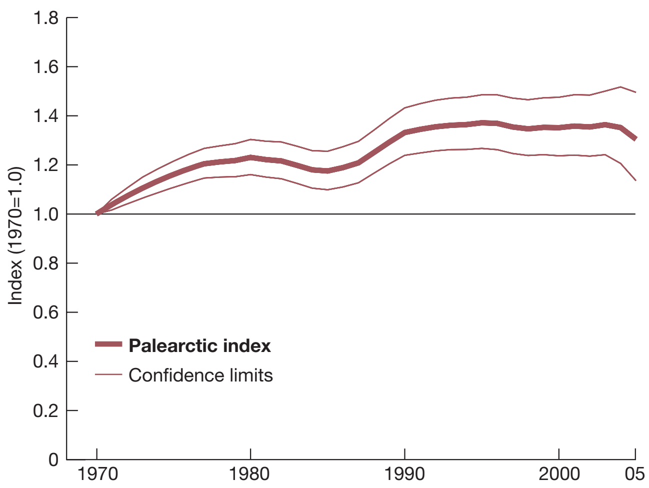


Fig. 17: **PALEARCTIC LIVING PLANET INDEX,** 1970–2005



Indomalaya, Australasia and Oceania, as there are insufficient data to produce individual realm results. The index reveals an average decline of about 35 per cent from 1970 to 2005, with a constant downward trend since the late 1970s (Figure 19). Tropical forest loss has been most severe in the Indo-Pacific realm, where much of the original forest has been cleared for agriculture or plantations, driven by the international demand for products such as palm oil.

Figure 15: Nearctic Living Planet Index.
This shows no overall change in 1,117 populations of 588 Nearctic species.

Figure 16: Neotropical Living Planet Index.
The index shows an average -76 per cent trend over 34 years in 202 populations of 144 Neotropical species.

Figure 17: Palearctic Living Planet Index.
This shows an overall +30 per cent trend over 35 years in 1,167 populations of 363 Palearctic species.

Figure 18: Afrotropical Living Planet Index.
This shows an average -19 per cent trend over 35 years in 552 populations of 201 Afrotropical species.

Figure 19: Indo-Pacific Living Planet Index.
This includes the Indomalayan, Australasian and Oceanic realms, and shows an average -35 per cent trend over 35 years in 441 populations of 155 species.

SAIGA ANTELOPE

The saiga (*Saiga tatarica*) is an antelope of the semi-arid grasslands of Central Asia that has been hunted for its meat, horn and hide for many centuries. In recent times, its decline has been compounded by the use of its horns in Chinese traditional medicine. Although hunting is now regulated in saiga range states (and no international trade is allowed), lack of funding and management infrastructure, combined with a weakened rural economy, has led to widespread poaching. This is the most likely explanation for the severe and ongoing decline of recent years, as witnessed by the large quantities of saiga meat on sale in Kazakhstan markets.

NORTHERN WHITE RHINO

The northern white rhino (*Ceratotherium simum cottoni*) was once abundant across North-Central Africa. Now the only known population is in the Democratic Republic of Congo, where numbers have dropped from 500 to 4. Small numbers, restricted geographic distribution and poaching pressure make this subspecies Critically Endangered. Recent surveys have failed to locate the last recorded individuals. Their closest relatives, the southern white rhinos (*Ceratotherium simum simum*), are increasing, and there has been significant progress towards conservation of the Critically Endangered black rhino (*Diceros bicornis*).

Fig. 18: **AFROTROPICAL LIVING PLANET INDEX,**
1970–2005

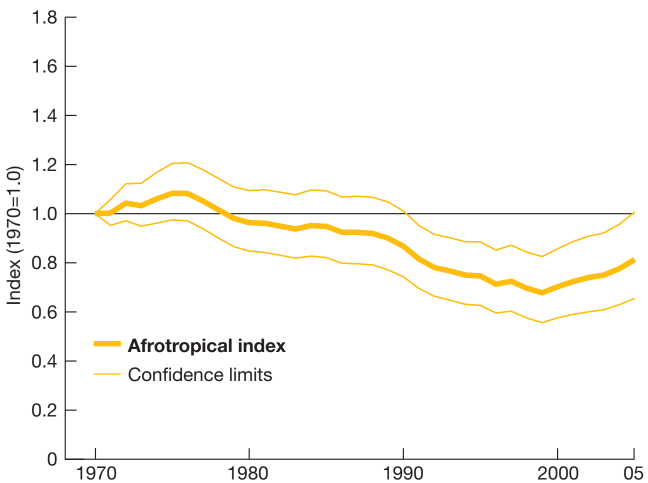
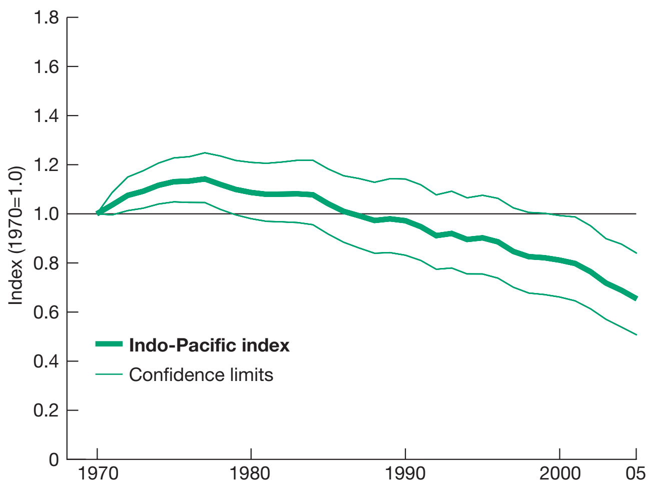
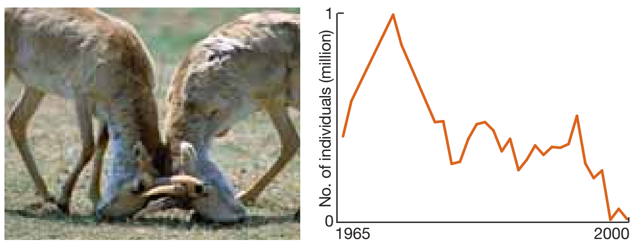
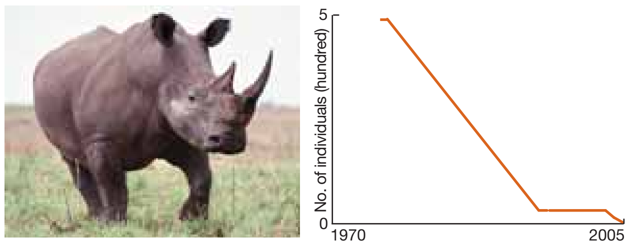


Fig. 19: **INDO-PACIFIC LIVING PLANET INDEX,**
1970–2005





Saiga antelope (*Saiga tatarica*)



Northern white rhino (*Ceratotherium simum cottoni*)

LIVING PLANET INDEX: TAXA

While broad trends across ecosystems provide an overview of changes in population numbers, they do not show the relative impacts of human pressures across different species and taxonomic groups.

There are almost 10,000 species of bird inhabiting a diverse range of habitats. Their widespread distribution, plus the fact that extensive information has been collected on them, has enabled a robust indicator of bird trends to be produced. The decline of 20 per cent in **the bird index** (Figure 20) masks a more serious decline of 50 per cent experienced by surveyed populations of tropical and marine birds. Major threats include habitat loss, invasive alien species, overexploitation and pollution.

More than 5,400 mammal species have been described, of which 20 per cent are classified as threatened by the IUCN *Red List of Threatened Species*. **The mammal index** has decreased by about 20 per cent over the last decade (Figure 21), with the most serious declines in the tropical realms. Overexploitation is one of the principal threats to this group, extensively targeted by the bushmeat trade, notably in Africa and Southeast Asia.

While populations of species are increasing and decreasing in different areas of the globe (see opposite), and the threats resulting from humanity's growing footprint do not impact all species equally, the overwhelming picture that is seen from averaging these trends is one of global decline in species abundance. Apart from representing a regrettable loss in terms of global biodiversity, this trend has implications for human well-being. Humans depend on healthy ecosystems and thriving species populations to ensure the continued provision of ecological services.

Figure 20: Bird Living Planet Index.
This shows an average -20 per cent trend between 1970 and 2005 in 2,185 populations of 895 species. Temperate and tropical species have equal weighting to compensate for the much larger temperate data set.

Figure 21: Mammal Living Planet Index.
This shows an average -19 per cent trend from 1970 to 2005 in 1,161 populations of 355 species.

Fig. 20: **BIRD LIVING PLANET INDEX,**
1970–2005

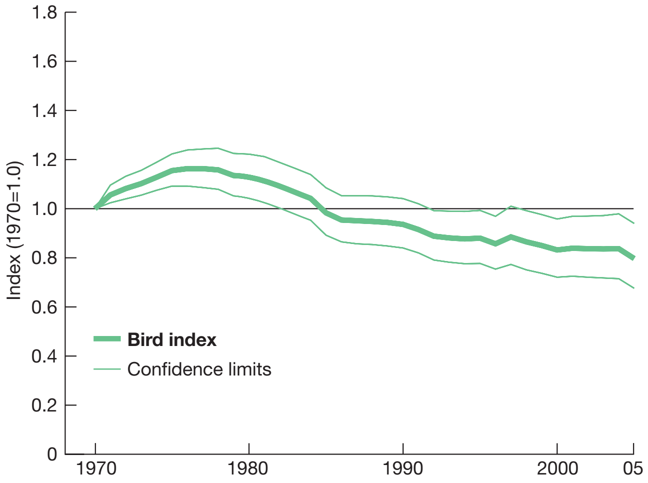
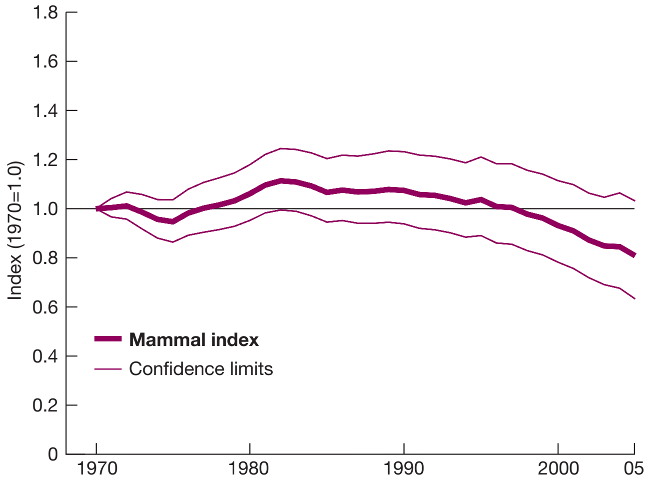


Fig. 21: **MAMMAL LIVING PLANET INDEX,**
1970–2005



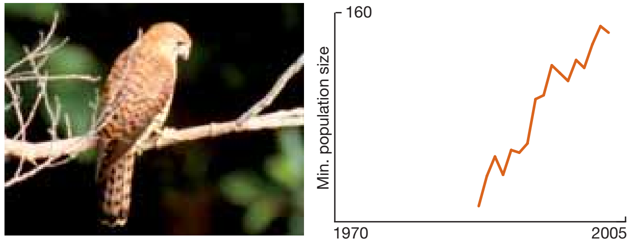
TRENDS IN SAMPLE POPULATIONS OF SELECTED SPECIES

The opposite page reveals population trends for 12 terrestrial, marine and freshwater species, illustrating the kinds of data that are used to calculate the Living Planet Index. The examples shown give an insight into trends in animal populations from different locations but do not necessarily represent the picture for the entire species.

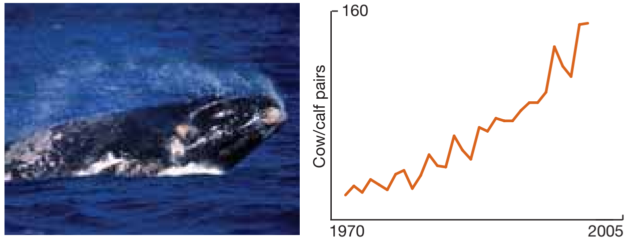
A positive sign is that some populations are either stable or increasing and these represent conservation successes from which we can learn, such as the reintroduction of the Mauritius kestrel.

Unfortunately the number of declining trends among these populations highlights key issues that still need to be addressed. One of the main threats impacting some of the sample populations is habitat degradation, as illustrated by the decline in the black-winged stilt. Another threat is the overexploitation of species either directly – through current hunting as in the case of the hippopotamus in the Democratic Republic of Congo or historical hunting in the case of the diamondback terrapin – or indirectly as the bycatch of certain fishing practices. Examples of the latter include the wandering albatross and the loggerhead turtle.

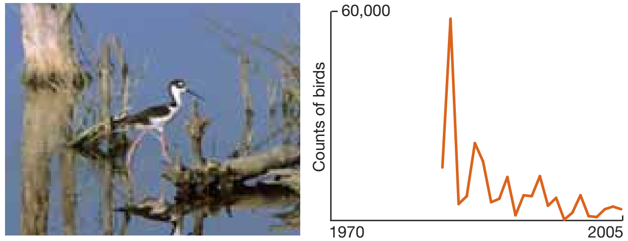
Note: the baseline on all sample species graphs is zero.



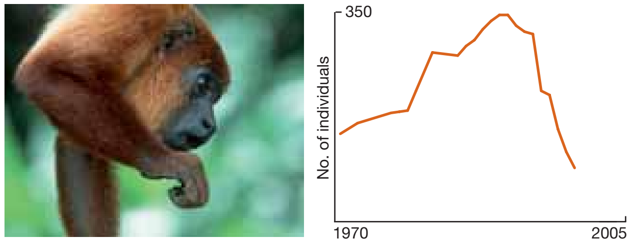
Mauritius kestrel (*Falco punctatus*)
Mauritius



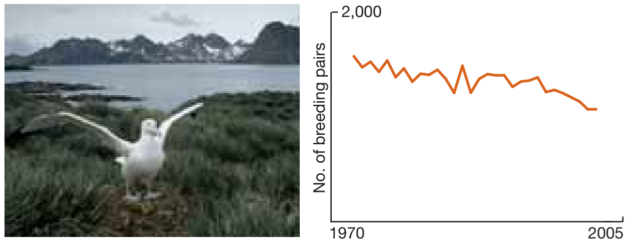
Southern right whale (*Eubalaena australis*), Indian Ocean
(southern coast of South Africa)



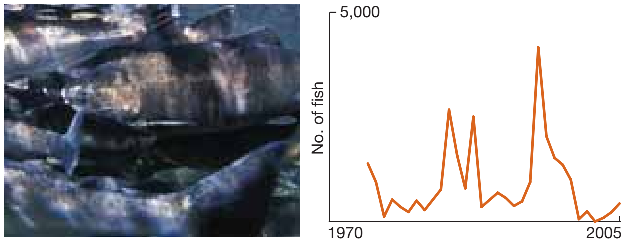
Black winged stilt (*Himantopus himantopus*), eastern Australia



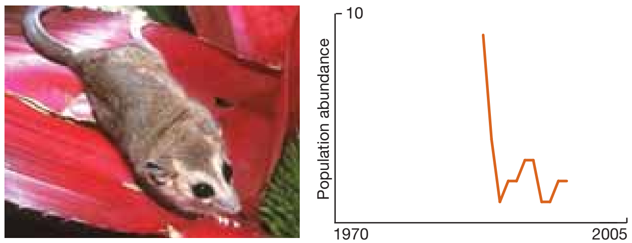
Red howler monkey (*Alouatta seniculus*)
Hato Masaguaral, Guarico state, Venezuela



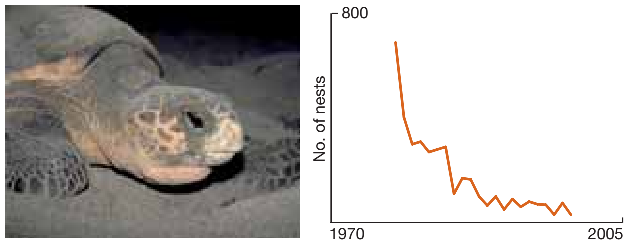
Wandering albatross (*Diomedea exulans*), South Atlantic Ocean
(Bird Island, South Georgia)



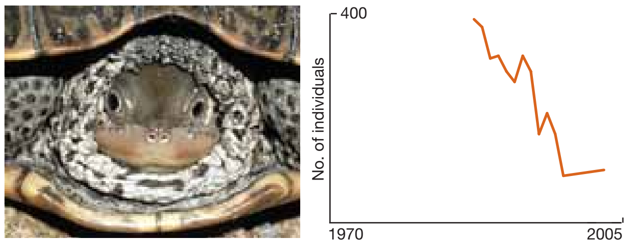
Coho salmon (*Oncorhynchus kisutch*), Yukon River,
Alaska, United States of America



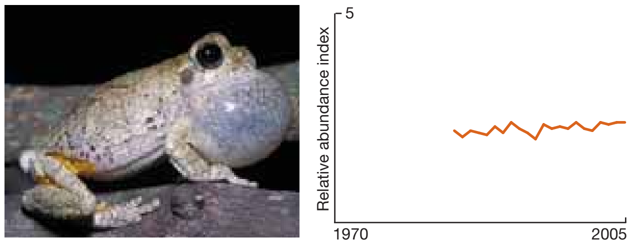
Elegant fat-tailed opossum (*Thylamys elegans*)
Las Chinchillas National Reserve, Auco, Chile



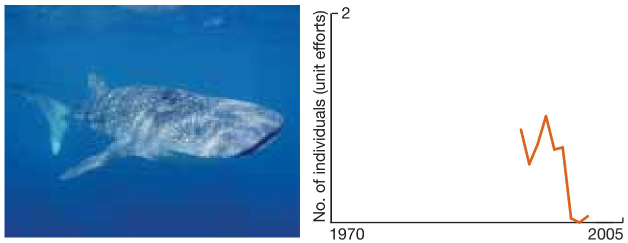
Loggerhead turtle (*Caretta caretta*), South Pacific Ocean
(Wreck Island, Australia)



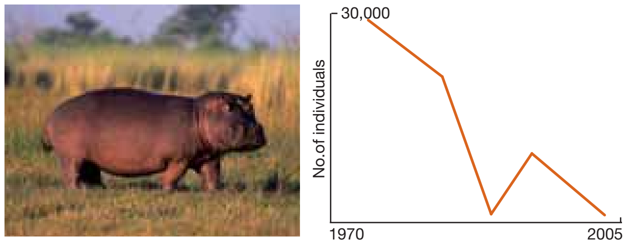
Diamondback terrapin (*Malaclemys terrapin*), Kiawa River,
South Carolina, United States of America



Grey treefrog (*Hyla versicolor*), Wisconsin, United States of America



Whale shark (*Rhincodon typus*), Indian Ocean (Andaman Sea, Thailand)



Hippopotamus (*Hippopotamus amphibius*), Democratic Republic of Congo

ECOLOGICAL FOOTPRINT OF NATIONS

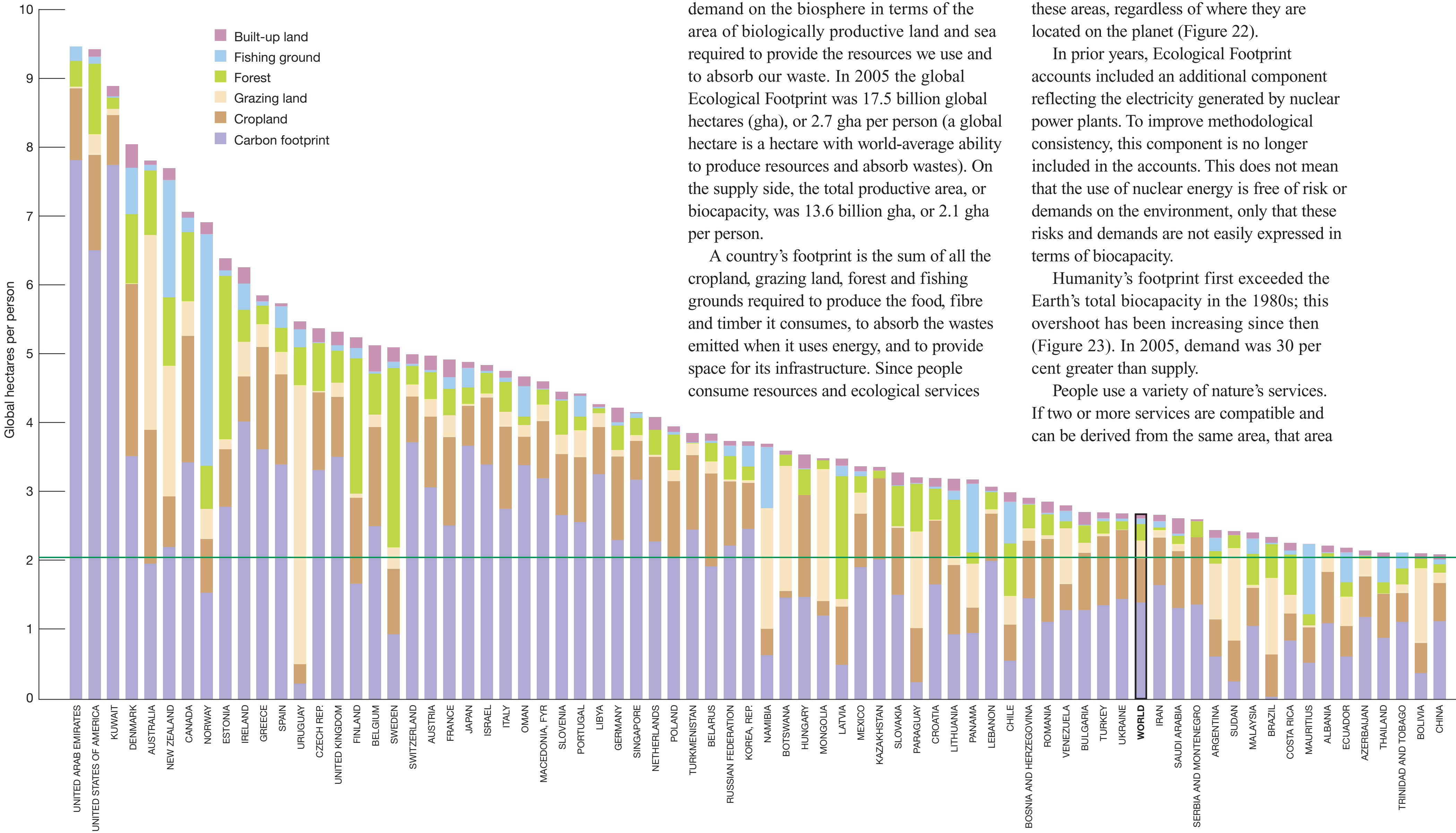


Fig. 22: **ECOLOGICAL FOOTPRINT PER PERSON, BY COUNTRY,** 2005

The Ecological Footprint measures humanity's demand on the biosphere in terms of the area of biologically productive land and sea required to provide the resources we use and to absorb our waste. In 2005 the global Ecological Footprint was 17.5 billion global hectares (gha), or 2.7 gha per person (a global hectare is a hectare with world-average ability to produce resources and absorb wastes). On the supply side, the total productive area, or biocapacity, was 13.6 billion gha, or 2.1 gha per person.

A country's footprint is the sum of all the cropland, grazing land, forest and fishing grounds required to produce the food, fibre and timber it consumes, to absorb the wastes emitted when it uses energy, and to provide space for its infrastructure. Since people consume resources and ecological services from all over the world, their footprint sums these areas, regardless of where they are located on the planet (Figure 22).

In prior years, Ecological Footprint accounts included an additional component reflecting the electricity generated by nuclear power plants. To improve methodological consistency, this component is no longer included in the accounts. This does not mean that the use of nuclear energy is free of risk or demands on the environment, only that these risks and demands are not easily expressed in terms of biocapacity.

Humanity's footprint first exceeded the Earth's total biocapacity in the 1980s; this overshoot has been increasing since then (Figure 23). In 2005, demand was 30 per cent greater than supply.

People use a variety of nature's services. If two or more services are compatible and can be derived from the same area, that area is only counted once in the footprint. When these services cannot co-exist in the same area, greater use of biocapacity to meet demand for one of the services means less biocapacity is available to meet demand for the others.

In 2005, the single largest demand humanity put on the biosphere was its carbon footprint, which grew more than 10-fold from 1961. This component represents the biocapacity needed to absorb CO_2 emissions from fossil-fuel use and land disturbance, other than the portion absorbed by the oceans.

Which countries as a whole place the greatest demand on the planet, and how has this changed over time? In 2005, the United States and China had the largest total footprints, each using 21 per cent of the planet's biocapacity. China had a much smaller per person footprint than the United States, but a population more than four times as large. India's footprint was the next largest; it used 7 per cent of the Earth's total biocapacity. Figure 24 shows how these national footprints have grown over time.

Figure 22: Ecological Footprint per person, by country. This comparison includes all countries with populations greater than 1 million for which complete data are available.

Figure 23: Ecological Footprint by component. The footprint is shown as number of planets. Total biocapacity, represented by the flat green line, always equals one planet Earth, although the biological productivity of the planet changes each year. Hydropower is included in built-up land and fuelwood in the forest component.

Figure 24: Ecological Footprint by country. Growth of the footprint over time for those countries with the largest total footprints in 2005.

Fig. 23: **ECOLOGICAL FOOTPRINT BY COMPONENT,** 1961-2005

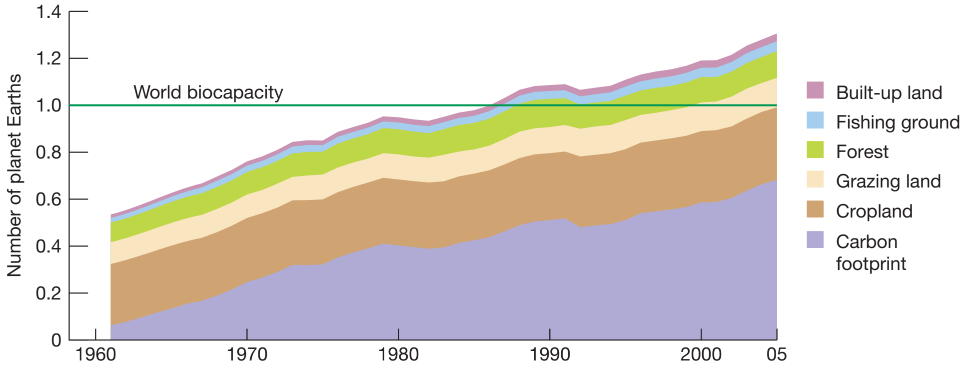
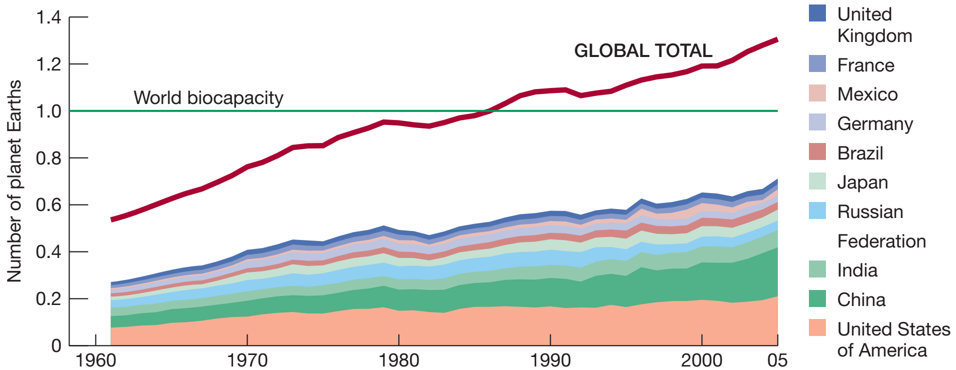
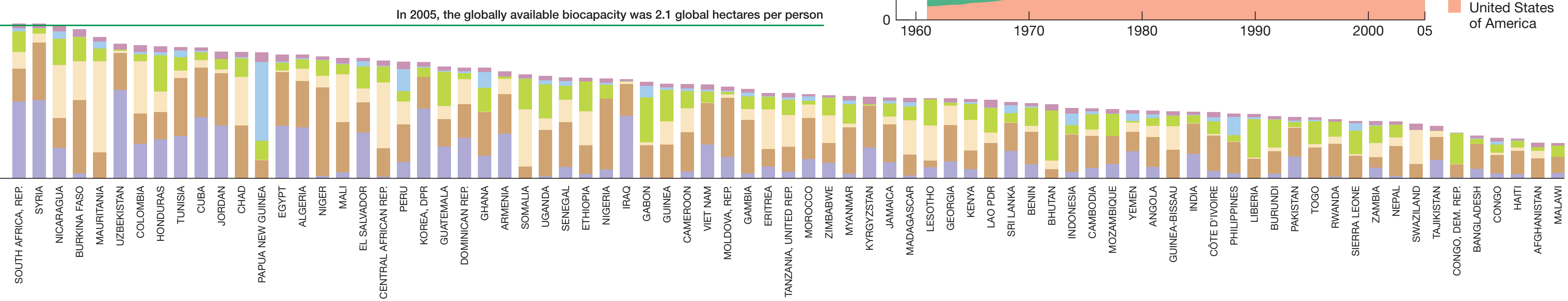


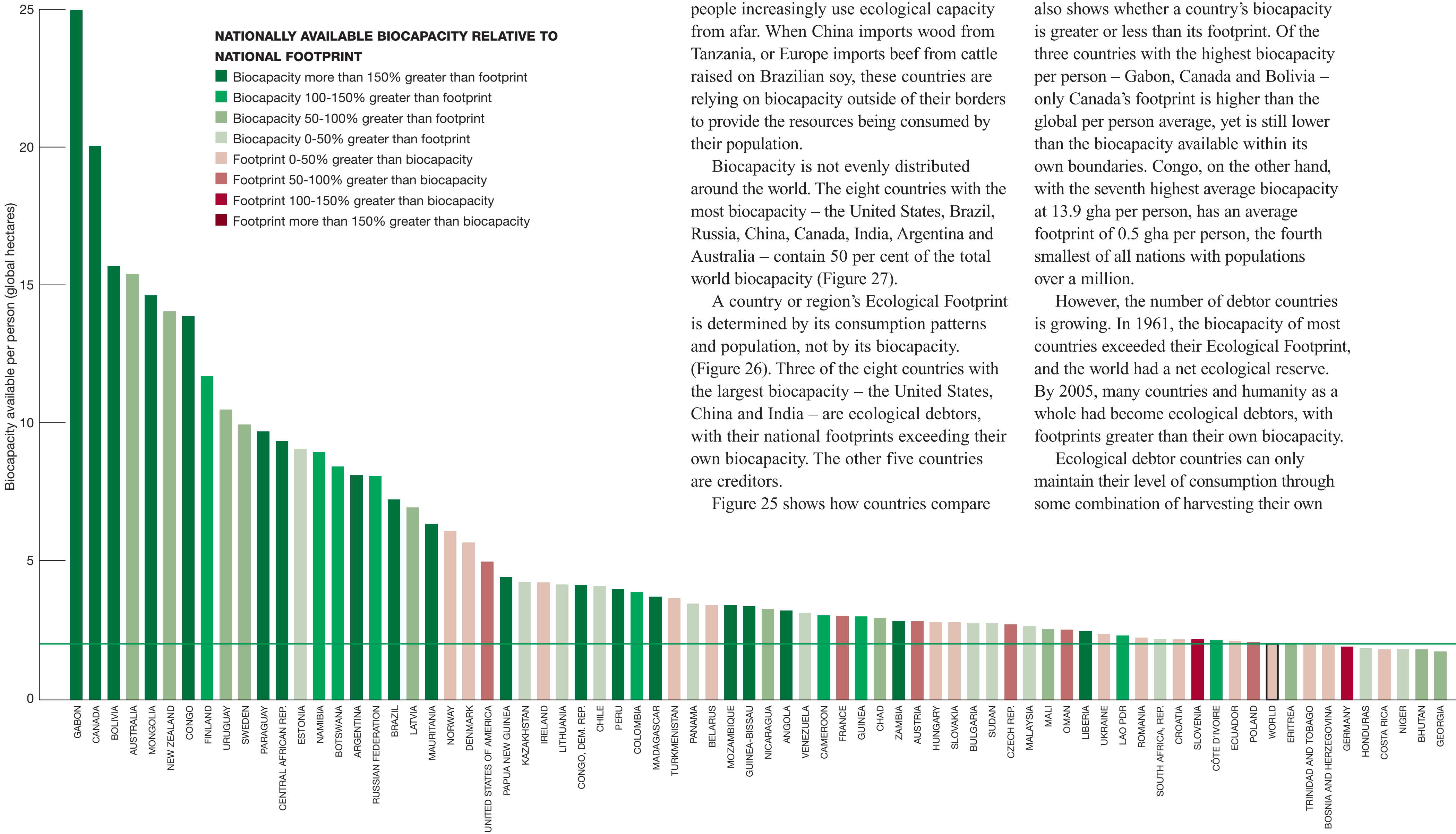
Fig. 24: **ECOLOGICAL FOOTPRINT BY COUNTRY,** 1961-2005





BIOCAPACITY

Fig. 25: **BIOCAPACITY PER PERSON BY COUNTRY, AND RELATIVE TO FOOTPRINT,** 2005



In a globally interdependent economy, people increasingly use ecological capacity from afar. When China imports wood from Tanzania, or Europe imports beef from cattle raised on Brazilian soy, these countries are relying on biocapacity outside of their borders to provide the resources being consumed by their population.

Biocapacity is not evenly distributed around the world. The eight countries with the most biocapacity – the United States, Brazil, Russia, China, Canada, India, Argentina and Australia – contain 50 per cent of the total world biocapacity (Figure 27).

A country or region's Ecological Footprint is determined by its consumption patterns and population, not by its biocapacity. (Figure 26). Three of the eight countries with the largest biocapacity – the United States, China and India – are ecological debtors, with their national footprints exceeding their own biocapacity. The other five countries are creditors.

Figure 25 shows how countries compare in terms of their biocapacity per person. It also shows whether a country's biocapacity is greater or less than its footprint. Of the three countries with the highest biocapacity per person – Gabon, Canada and Bolivia – only Canada's footprint is higher than the global per person average, yet is still lower than the biocapacity available within its own boundaries. Congo, on the other hand, with the seventh highest average biocapacity at 13.9 gha per person, has an average footprint of 0.5 gha per person, the fourth smallest of all nations with populations over a million.

However, the number of debtor countries is growing. In 1961, the biocapacity of most countries exceeded their Ecological Footprint, and the world had a net ecological reserve. By 2005, many countries and humanity as a whole had become ecological debtors, with footprints greater than their own biocapacity.

Ecological debtor countries can only maintain their level of consumption through some combination of harvesting their own resources faster than replacement rate, importing resources from other nations, and using the global atmosphere as a dumping ground for greenhouse gases.

Biocapacity is influenced both by natural events and human activities. Climate change, for instance, can decrease forest biocapacity as drier and warmer weather increase the potential for fires and pest outbreaks. Some agricultural practices can reduce biocapacity by increasing soil erosion or salinity. Overexploitation and depletion of natural resources may result in permanent loss of ecosystem services, increasing the likelihood of a country's dependence on imports from elsewhere and foreclosing future development options. In contrast, careful management of biocapacity allows countries to maintain their options, and provides insurance against future economic and environmental shocks.

In a world in overshoot, the uneven distribution of biocapacity raises political and ethical questions regarding sharing of the world's resources. Nevertheless, it is clear that ecological debtor countries face increasing risk from a growing dependence on the biological capacity of others. Conversely, countries with ecological reserves can view their biological wealth as an asset that provides an important competitive advantage in an uncertain world.

Figure 25: Biocapacity per person, by country. This comparison includes all countries with populations greater than 1 million for which complete data are available.

Figure 26: Biocapacity and Ecological Footprint by region. The difference between a region's biocapacity (solid bars) and its footprint (dashed line) is its ecological reserve (+) or deficit (-).

Figure 27: Top ten national biocapacities. Ten countries alone contain over 55 per cent of the planet's biocapacity.

Fig. 26: **BIOCAPACITY AND ECOLOGICAL FOOTPRINT BY REGION,** 2005

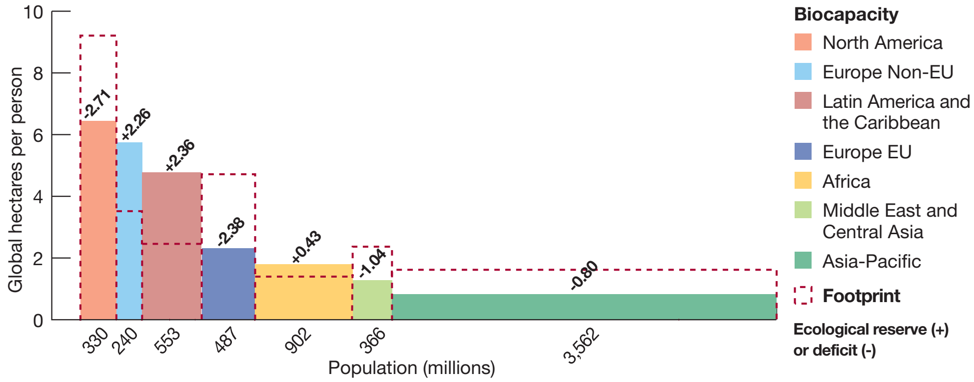
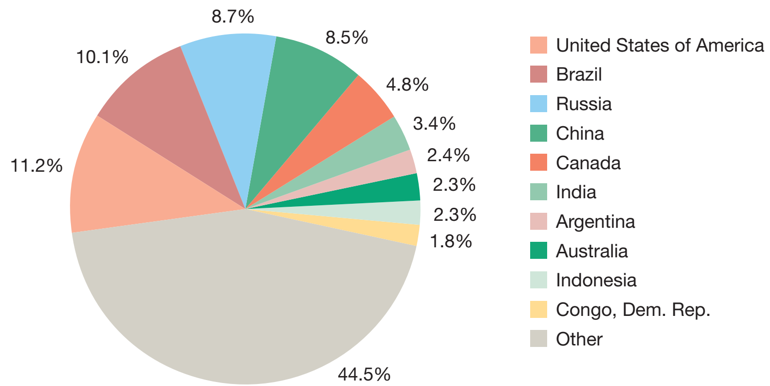
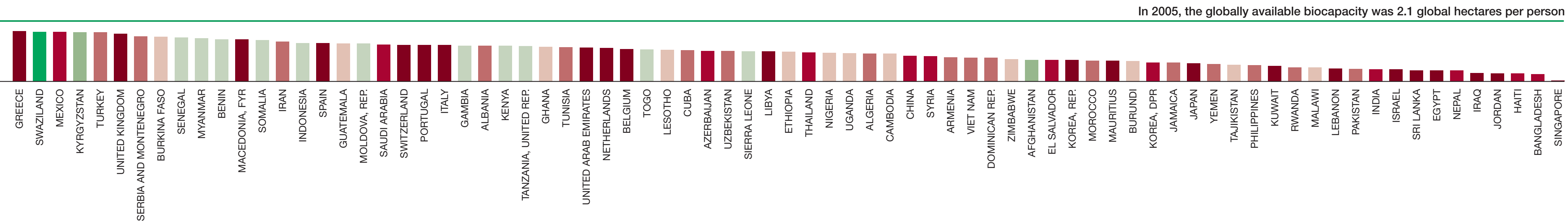


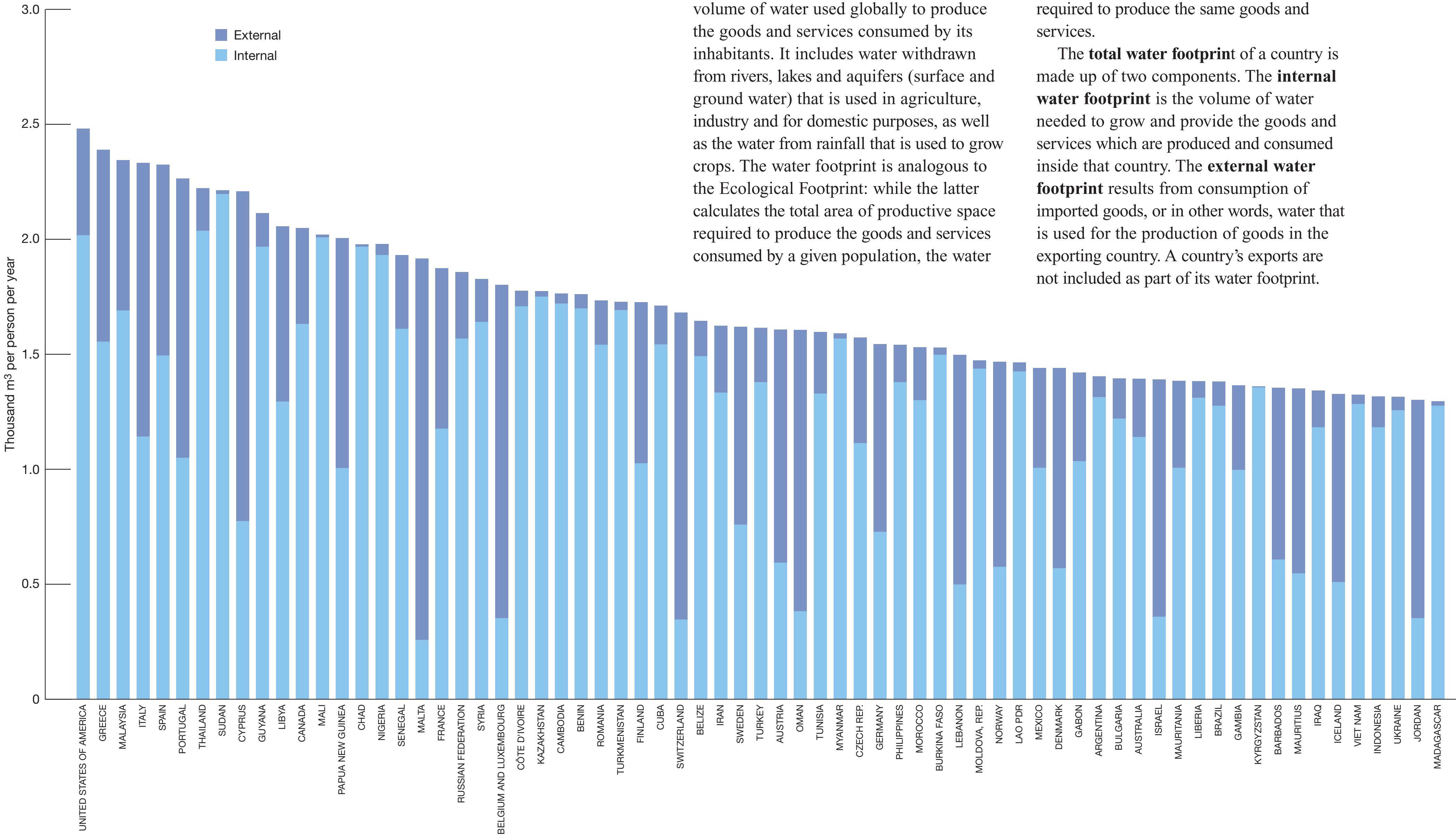
Fig. 27: **TOP TEN NATIONAL BIOCAPACITIES,** 2005





WATER FOOTPRINT OF CONSUMPTION

Fig. 28: WATER FOOTPRINT OF CONSUMPTION PER PERSON, BY COUNTRY, 1997–2001



The water footprint of a country is the total volume of water used globally to produce the goods and services consumed by its inhabitants. It includes water withdrawn from rivers, lakes and aquifers (surface and ground water) that is used in agriculture, industry and for domestic purposes, as well as the water from rainfall that is used to grow crops. The water footprint is analogous to the Ecological Footprint: while the latter calculates the total area of productive space required to produce the goods and services consumed by a given population, the water footprint calculates the volume of water required to produce the same goods and services.

The **total water footprint** of a country is made up of two components. The **internal water footprint** is the volume of water needed to grow and provide the goods and services which are produced and consumed inside that country. The **external water footprint** results from consumption of imported goods, or in other words, water that is used for the production of goods in the exporting country. A country's exports are not included as part of its water footprint.

Worldwide, the external water footprint accounts for 16 per cent of the average person's water footprint, though this varies enormously within and between countries. Twenty-seven countries have an external water footprint which accounts for more than 50 per cent of their total. The world average water footprint is 1.24 million litres per person per year; equivalent to half the volume of an Olympic swimming pool.

The impact of a water footprint depends entirely on where and when water is extracted. Water use in an area where it is plentiful is unlikely to have an adverse effect on society or the environment, whereas in an area already experiencing water shortages the same level of water use could result in the drying up of rivers and the destruction of ecosystems, with associated loss of biodiversity and livelihoods.

Externalizing the water footprint can be an effective strategy for a country experiencing internal water shortages but it also means externalizing environmental impacts. The virtual water trade is influenced by global commodity markets and agricultural policies which generally overlook the possible environmental, economic and social costs to exporting countries. This trade in virtual water further underscores the need for international cooperation on water resource management in a context where some 263 of the world's major rivers and lakes and many hundreds of aquifers cross borders.

THE WATER TRADE

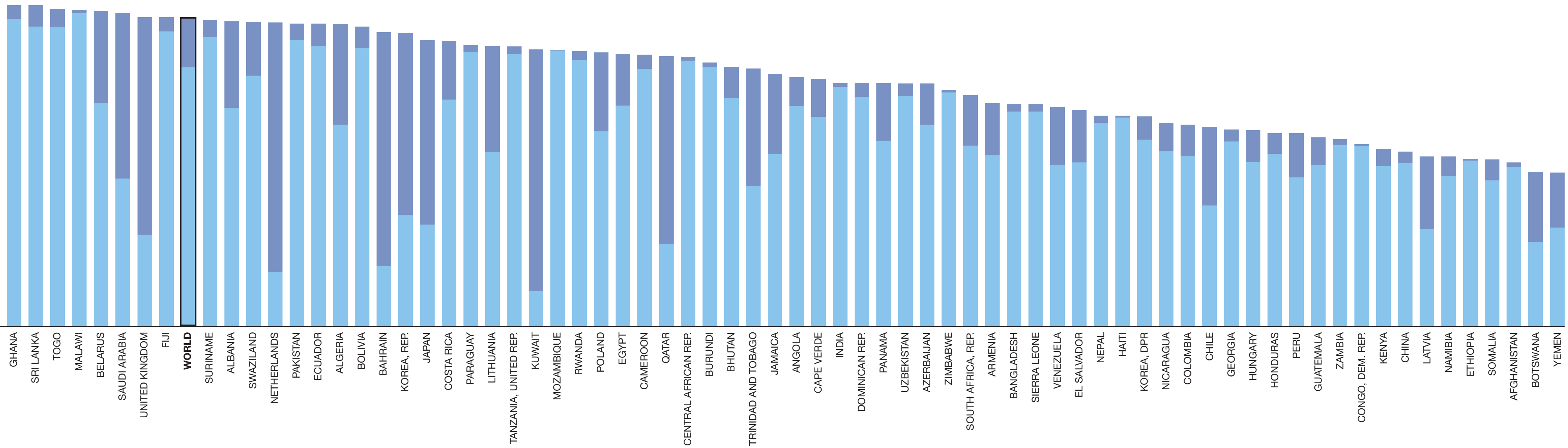
The water footprint of a product is the total volume of fresh water used to produce the product, summed over the entire production chain. This is sometimes referred to as the virtual water content of a product. Global pressure on freshwater resources is increasing as a result of growing demand for water-intensive products such as meat, dairy products, sugar and cotton.

- **2,900 litres per cotton shirt**
  3.7 per cent of the global water use in crop production goes to produce cotton, equivalent to 120 litres of water per person per day.

- **15,500 litres per kilogram of beef**
  Meat, milk, leather and other livestock products account for 23 per cent of global water use in agriculture, equivalent to more than 1,150 litres of water per person per day.

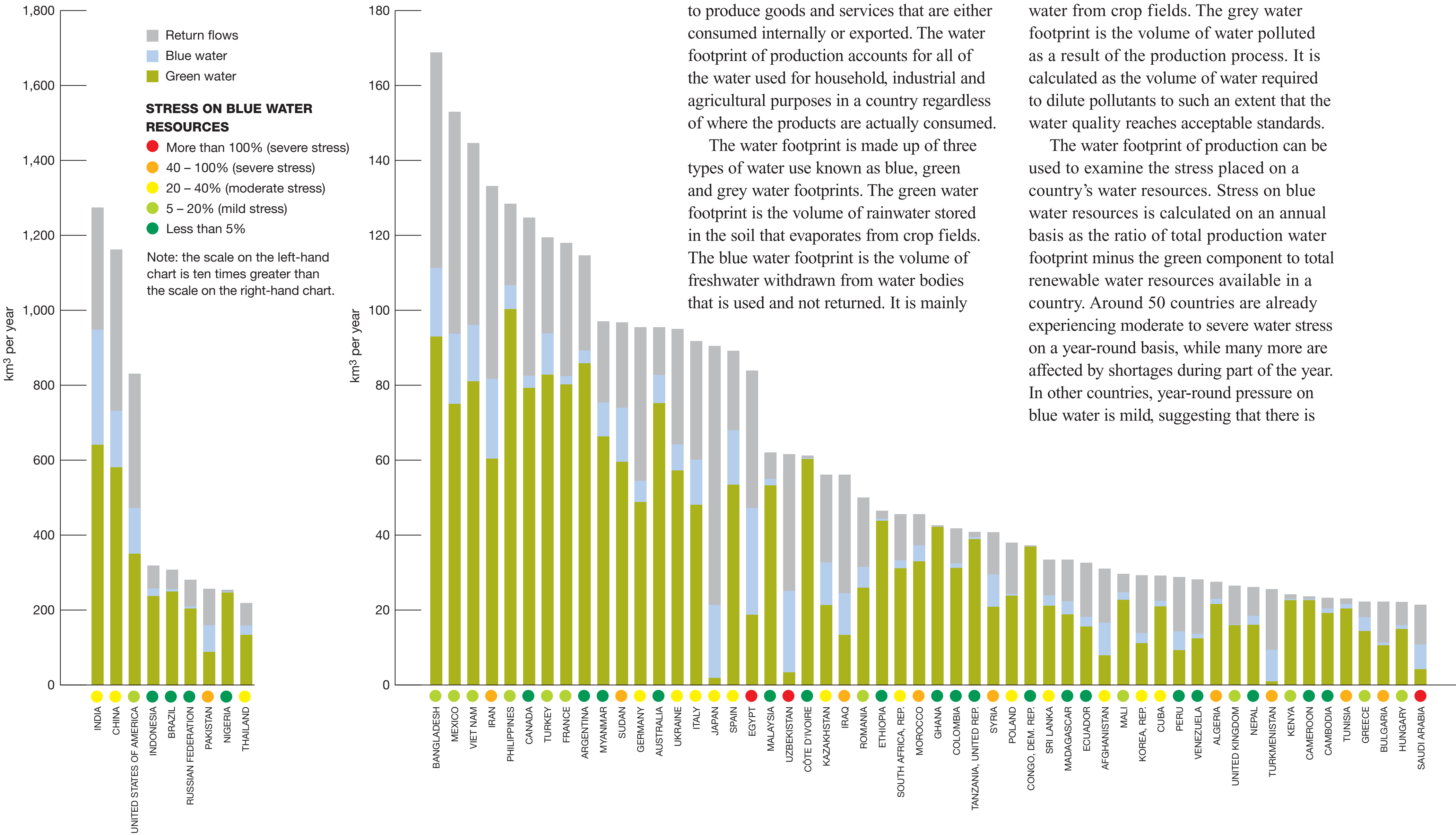
- **1,500 litres per kilogram of cane sugar**
  The average person uses 70 grams of sugar per day, equivalent to 100 litres of water. Cane sugar accounts for 3.4 per cent of global water use in crop production.

EVIDENCE



WATER FOOTPRINT OF PRODUCTION

Fig. 29: TOTAL WATER FOOTPRINT OF PRODUCTION, BY COUNTRY, 1997–2001



Within an individual country, water is needed to produce goods and services that are either consumed internally or exported. The water footprint of production accounts for all of the water used for household, industrial and agricultural purposes in a country regardless of where the products are actually consumed.

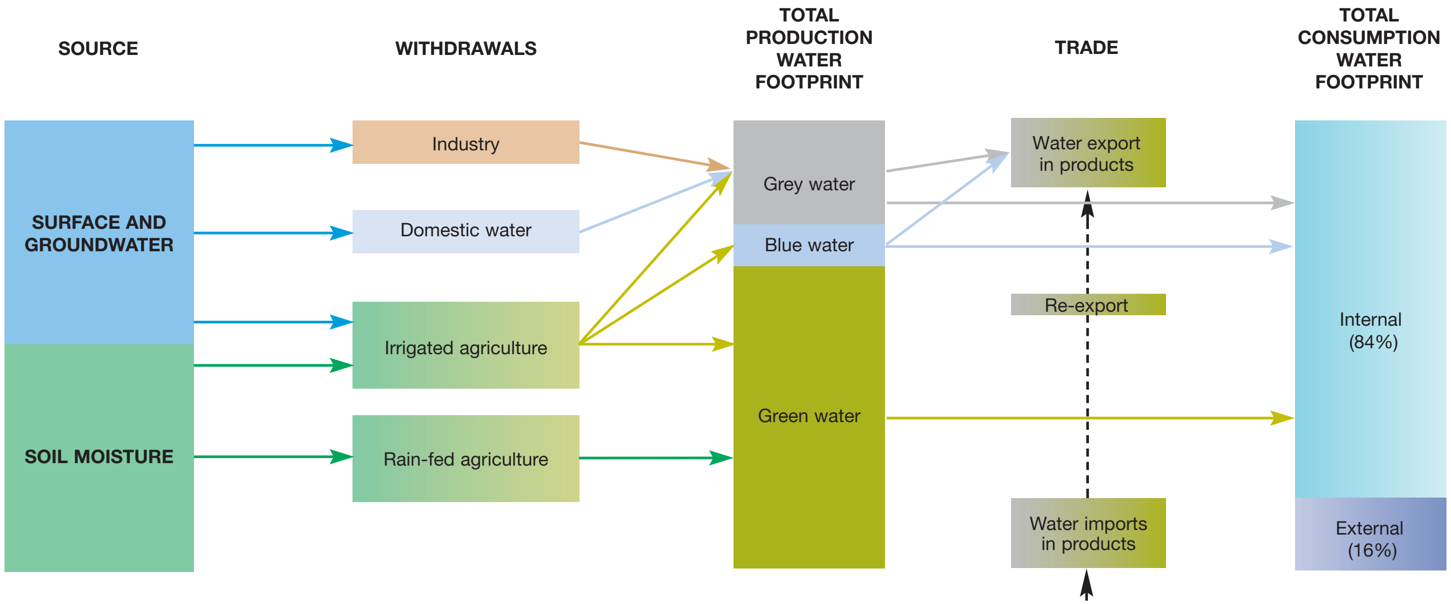
The water footprint is made up of three types of water use known as blue, green and grey water footprints. The green water footprint is the volume of rainwater stored in the soil that evaporates from crop fields. The blue water footprint is the volume of freshwater withdrawn from water bodies that is used and not returned. It is mainly accounted for by evaporation of irrigation water from crop fields. The grey water footprint is the volume of water polluted as a result of the production process. It is calculated as the volume of water required to dilute pollutants to such an extent that the water quality reaches acceptable standards.

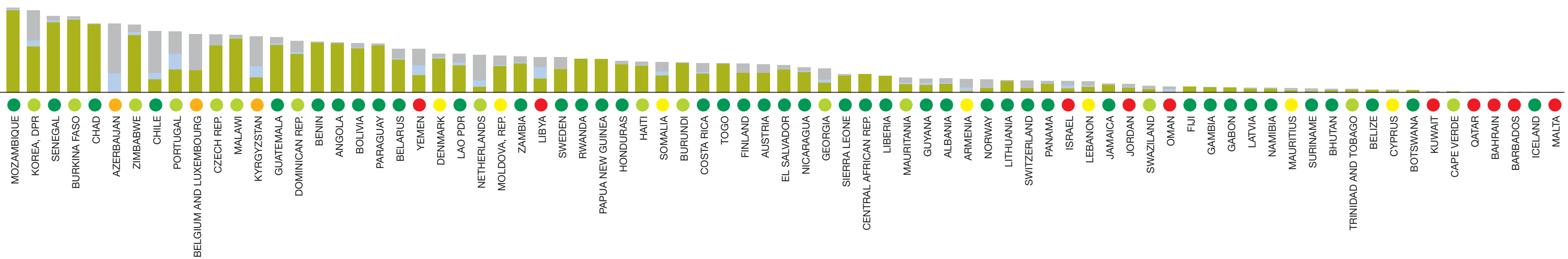
The water footprint of production can be used to examine the stress placed on a country's water resources. Stress on blue water resources is calculated on an annual basis as the ratio of total production water footprint minus the green component to total renewable water resources available in a country. Around 50 countries are already experiencing moderate to severe water stress on a year-round basis, while many more are affected by shortages during part of the year. In other countries, year-round pressure on blue water is mild, suggesting that there is potential to enhance agricultural productivity through irrigation in suitable areas. However, to be sustainable, additional water withdrawals must take account of seasonal water availability and potential impacts on downstream water users and ecosystems.

Globally, the number of people affected by absolute or seasonal water shortages is projected to increase steeply owing to climate change and increasing demands. In this context, understanding the impact that food and fibre production has on water resources is vital in order to secure adequate supplies of water for people and for ecosystems.

Note: In view of data limitations for many countries, grey water has been substituted in the calculation of production footprint by return flows: the volume of wastewater from agriculture, industry or households that is returned to surface water bodies after it has been used.

Fig. 30: COMPONENTS OF THE WATER FOOTPRINT





TURNING THE TIDE: TOWARDS SUSTAINABILITY

If overshoot continues to increase, what will the future hold?

Under assumptions of rapid global economic growth and a shift to a balanced mix of energy sources, the Intergovernmental Panel on Climate Change projects that annual carbon emissions will more than double by 2050. Moderate United Nations estimates show global population growing to 9 billion over the same period, while FAO projections show increasing consumption of food, fibre and forest products. Furthermore, if present management schemes persist, fisheries are projected to decline by more than 90 per cent by 2050.

Figure 31 shows the implications of these scenarios for humanity's footprint through to mid-century. The 2005 overshoot of 30 per cent would reach 100 per cent in the 2030s even if recent increases in agricultural yields continue. This means that biological capacity equal to two planet Earths would be required to keep up with humanity's resource demands and waste production.

This business-as-usual scenario is conservative as it assumes no unpleasant surprises: no biocapacity losses due to freshwater shortages, no feedback loops that cause a changing climate to reach tipping points, no damage by pollution, and no other factors that could cause biocapacity to decrease. But there are hints that such assumptions should not be taken for granted; for example, the current devastation of bee populations could cause worldwide declines of crops that require pollination.

The longer that overshoot persists, the greater the pressure on ecological services, increasing the risk of ecosystem collapse, with potentially permanent losses of productivity. Scientists cannot accurately predict the tipping point at which an ecosystem decline may suddenly accelerate, or cause a failure that cascades across other ecosystems. Most would agree, however, that ending overshoot as quickly as possible will reduce this risk, and will allow degraded ecosystems to begin their recovery.

Fortunately, humanity can change course. Instead of continuing business-as-usual, we should strive to end overshoot by mid-century. WWF is promoting this change through its various sustainability and market transformation activities, as well as by tackling energy use as the root cause of climate change. Figure 32 shows how a rapid transition out of overshoot would significantly shrink the magnitude and duration of ecological debt that will otherwise accrue. Such a path reduces the risk of ecosystem degradation and increases the probability that human well-being can be maintained or improved. It could also reduce and perhaps even reverse the current rapid rate at which biodiversity is being lost.

Ending overshoot means closing the gap between humanity's footprint and available biocapacity. Five factors determine the size of this gap (Figure 33).

On the demand side, the footprint is a function of population size, the goods and services each person consumes, and the

Fig. 31: **BUSINESS-AS-USUAL SCENARIO AND ECOLOGICAL DEBT**

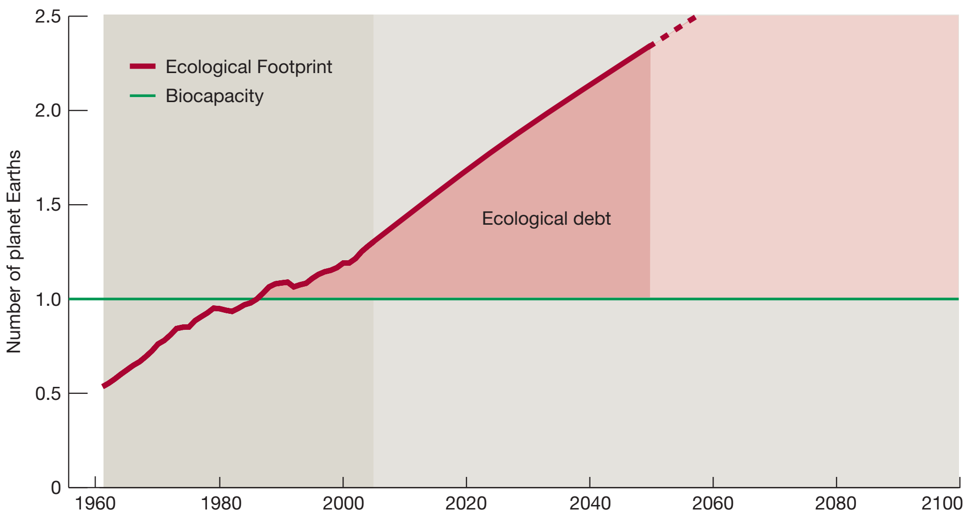
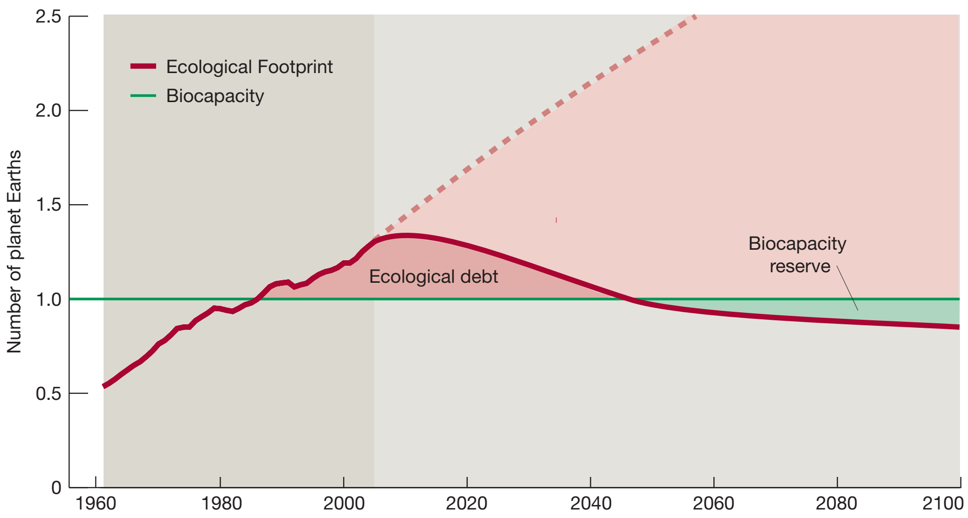


Fig. 32: **RETURN TO SUSTAINABILITY**



resource and waste intensity of these goods and services. Reductions in population, individual consumption, and the resources used or wastes emitted in producing goods and services all result in a smaller footprint.

On the supply side, biocapacity is determined by the amount of biologically productive area available, and the productivity of that area. However, increases in productivity may come at the expense of greater resource use or waste production. If so, the degree to which biocapacity gains are offset by an increased footprint must be taken into account in determining the net impact on overshoot.

There are many different strategies that could reduce the gap between human demand on nature and the availability of ecological capacity. Each of these strategies can be represented as a sustainability wedge that shifts the business-as-usual path towards one in which, when these wedges are combined, overshoot is eliminated (Figure 34).

One way of organizing wedges is to link them to the three factors that determine footprint. Some strategies in the per person consumption and technology wedges, such as insulating buildings, produce quick results for shrinking overshoot. Other strategies, such as those that would reduce and eventually reverse population growth, may have less impact in the short term, but lead to large cumulative declines in overshoot in the longer term.

Within a wedge, many interventions are possible. Individual consumption can be reduced by designing cities in which walking is preferable to driving. Technological innovations can increase the efficiency of resource use, such as meeting communication needs with cellular phones rather than landlines. Rehabilitation of degraded lands can increase agricultural yields while minimizing increases in footprint associated with agricultural expansion.

Alternatively, wedges can also be organized around major consumption categories such as food, shelter, mobility, goods and services, along with population size. The footprint of food, for example, might be reduced by optimizing the relationship between the distance it is transported and the efficiency with which it can be locally produced. The energy efficiency of residential and commercial buildings can often be dramatically increased, and utilities supporting them can be integrated so that wastes from one system serve as inputs for another.

Individual wedges typically overlap, creating opportunities for synergistic solutions that can bring about even greater reductions in overshoot. Energy conservation measures and the development of alternatives to fossil fuels will greatly facilitate the effectiveness of almost all sustainability wedges. While some wedges may primarily address short-term goals, those that span longer periods of time will determine the extent to which reductions in overshoot can be sustained.

Fig. 33: **FOOTPRINT AND BIOCAPACITY FACTORS THAT DETERMINE OVERSHOOT**

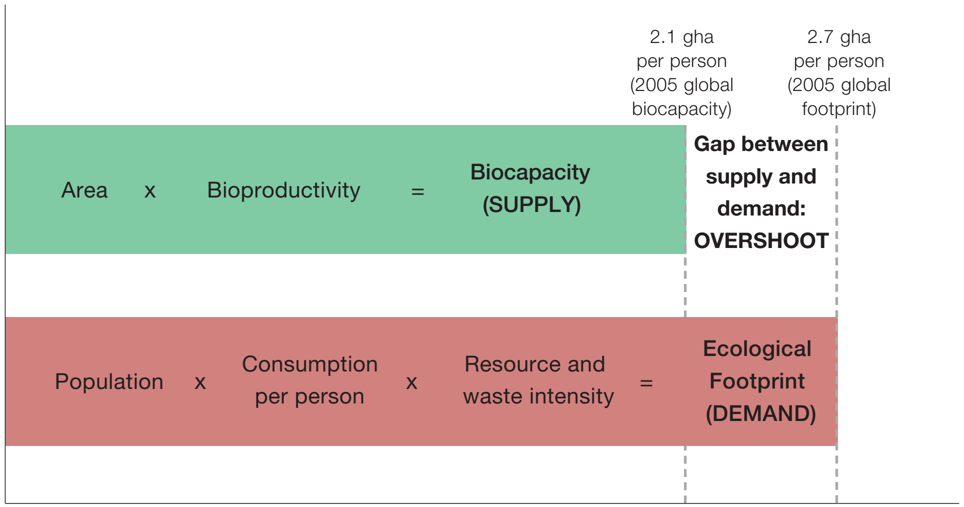
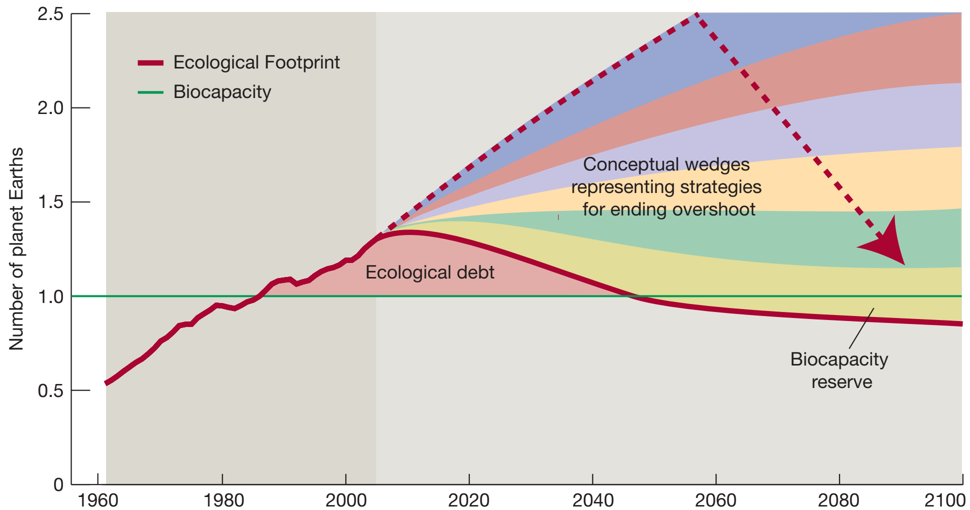


Fig. 34: **SUSTAINABILITY WEDGES AND AN END TO OVERSHOOT**



THE ENERGY CHALLENGE

Energy production from the burning of fossil fuels such as coal, oil and natural gas accounted for nearly 45 per cent of the global Ecological Footprint in 2005. Substantial cuts in the burning of fossil fuels and associated carbon dioxide emissions are vital in order to avoid dangerous climate change of more than 2ºC above pre-industrial levels.

The WWF Climate Solutions Model uses a wedge analysis to explore whether it is possible to meet the projected 2050 demand for global energy services while achieving significant reductions in global greenhouse gas emissions through a concerted shift to already-available and more sustainable energy resources and technologies.

The model embraces three parallel strategies: **expansion of energy efficiency** in industry, buildings, and all forms of transport to stabilize the overall energy demand by 2025; **growth in the use of renewable energy** such as wind, hydro, solar and thermal, and bio-energy; and the phasing out of remaining emissions from conventional fossil fuels used for power and industrial processes by **an expansion of carbon capture and storage**. In addition, an increase in the use of gas is proposed as an interim measure, creating a gas bubble which extends from 2010 to 2040 (see box opposite).

By including only energy sources that are currently available and that are commercially competitive or are likely to be so in the near term, the choice of energy wedges is deliberately conservative. The impacts and risks associated with each technology, potential obstacles to implementation, likely social acceptability and relative costs are used to limit or guide the choice of improved technologies.

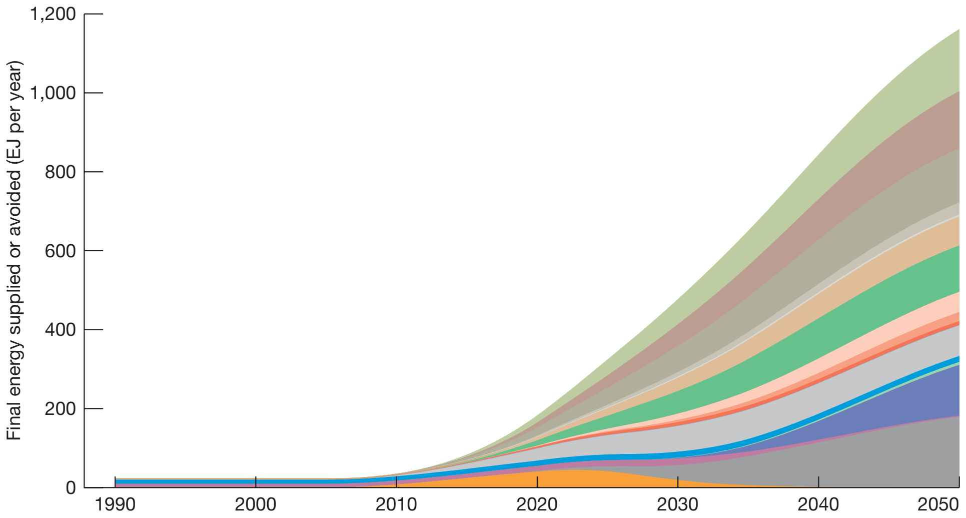
Figure 35 shows a representative scenario of the Climate Solutions Model depicting technology wedges designed to meet projected energy demands up to 2050 while achieving reductions in carbon dioxide emissions of 60 to 80 per cent. The projected three-fold increase for energy services is based on the IPCC's A1B scenario (IPCC 2000).

Figure 36 shows how the output is achieved through a combination of energy savings and introduction of zero- and low-emission energy technologies.

The Climate Solutions Model illustrates that it is technically possible to dramatically reduce climate-threatening emissions from energy services while expanding energy supplies to meet the needs of both the developing and developed worlds in the 21st century. However, there are three further imperatives if the required technology, systems, infrastructure and resource exploitation are to be sufficient to ensure that global greenhouse gas emissions from energy services peak and start to decline within 10 years. These are:

Leadership: Action is needed by the governments of the world to agree on clear and ambitious targets, to collaborate on effective strategies, and to influence

Fig. 35: **REPRESENTATIVE SCENARIO OF THE CLIMATE SOLUTIONS MODEL**



Key to Fig. 35 and Fig. 37

- Industrial energy efficiency and conservation
- Efficient buildings
- Efficient vehicles
- Reduced use of vehicles
- Aviation and shipping efficiency
- Repowering hydro
- Traditional biomass
- Biomass
- Wind power
- Solar photovoltaics
- Solar thermal power
- Solar thermal heat
- Small hydro
- Geothermal (power and heat)
- Large hydro (existing plus sustainable)
- Sea and ocean energy
- Hydrogen from renewables
- Nuclear (commissioned plants only)
- Fossil fuel used with carbon capture and storage
- Natural gas instead of coal for baseload
- Residual fossil fuels (Fig. 37 only)

Note

Since energy-efficiency technologies which reduce final energy demand are shown alongside energy supply from low-emission sources, the results are expressed as final energy supplied or avoided (rather than primary energy production).

Some wedges are small in percentage terms and therefore difficult to identify on the graph.

Source, Figs 35, 36 and 37: Mallon et al. 2007 and coordinate the investments in energy developments in the coming decades, so that future needs are met safely and sustainably.

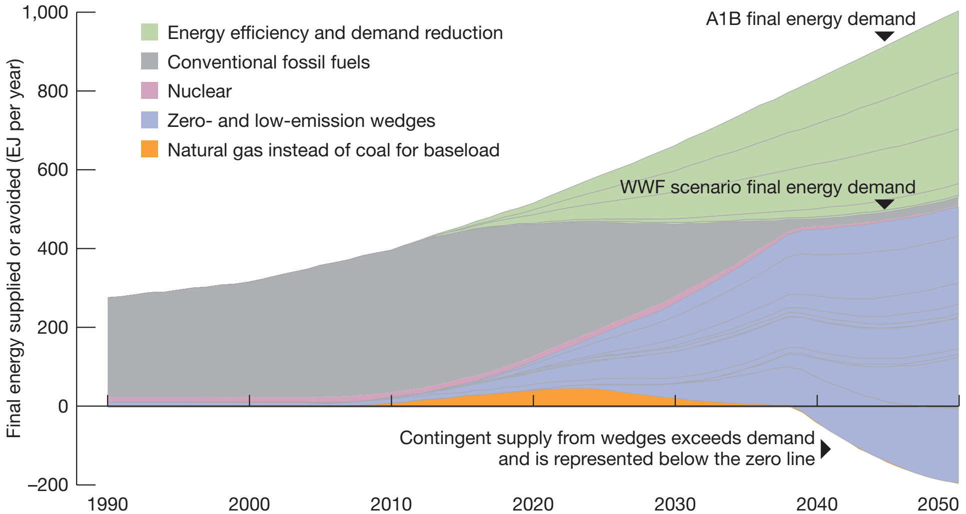
Urgency: With real-world constraints on the speed of industrial transition and the risks of becoming locked in to energy-intensive infrastructure through investments in unsustainable technologies, time is of the essence. Delays will make the transition to a low-carbon economy increasingly expensive and difficult, with greater risks of failure.

A global effort: Every country has a role to play in responding to the scale and the type of challenges arising in its territory in accordance with its capacity to act.

Figure 35: Representative scenario of the Climate Solutions Model depicting technology wedges designed to meet projected energy demands for 2050.

Figure 36: Output of the WWF Climate Solutions Model. Energy efficiency and demand reduction (green) largely stabilize energy demand by c.2020. Zero- and low-emission energy sources are built up (blue) until c.2040. Fossil-fuel use (grey) is reduced to a residual level for applications which are hard to substitute. The scenario provides spare capacity as a contingency, represented by energy supply shown below the x-axis.

Fig. 36: **OUTPUT OF THE WWF CLIMATE SOLUTIONS MODEL**



THE ENERGY WEDGES

Extending pioneering work by Pacala and Socolow (2004), the WWF Climate Solutions Model is built around three principal strategies to reduce carbon emissions while increasing energy services:

Breaking the link between energy services and primary energy production: By 2025, energy efficiencies (getting more energy services per unit of energy used) will make it possible to meet increasing demand for energy services within a stable net demand for primary energy production. Projected demand is reduced by 39 per cent, avoiding 9.4Gt of carbon emissions annually.

Concurrent growth of low-emissions technologies: Deep cuts in the burning of fossil fuels are achieved by rapid and parallel pursuit of a full range of technologies that meet environmental and social sustainability criteria. By 2050, available technologies could meet 70 per cent of the remaining demand, avoiding a further 10.2Gt of carbon emissions annually.

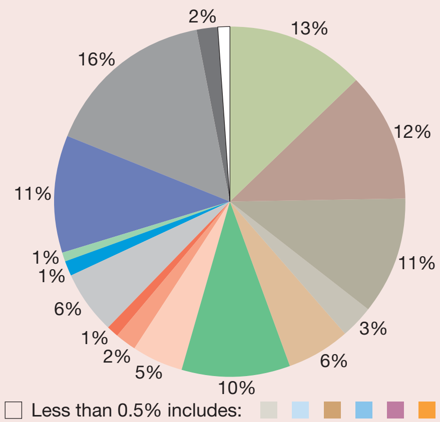
Carbon capture and storage (CCS): A further 26 per cent of primary production in 2050 is met by fossil-fuel plants with carbon capture and storage technology, avoiding 3.8Gt of carbon emissions per year. This strategy has immediate implications for the planning and location of new plants since transport of carbon dioxide to distant storage sites would be very costly.

Two complementary measures are required:

The development of flexible fuels and energy storage to enable energy from intermittent sources like wind and solar to be stored and transformed into transportable fuels and fuels that meet the thermal needs of industry. New fuels, such as hydrogen, that meet these requirements will need major new infrastructure for their production and distribution.

The substitution of high-carbon coal with low-carbon gas as a bridging measure from 2010 to 2040, averting investment in new coal-fired power stations and providing significant carbon savings in the short term.

Fig. 37: **PRINCIPAL ENERGY WEDGES,** percentage of energy supplied or avoided in projected 2050 energy demand



TURNING THE TIDE

POPULATION AND CONSUMPTION

A nation's total Ecological Footprint is determined by its population, and by its residents' average footprint. The latter is a function both of the quantity of goods and services the average resident consumes, and the resources used or waste generated in providing those goods and services. On a global scale, both population and the average footprint have increased since 1961. Since around 1970, however, the global average per person footprint has been relatively constant, while population has continued to grow. Figures 38 and 39 show the change from 1961 to 2005 in the average footprint and population for each of the world's regions, with the area shown for each region representing its total footprint.

Nations at different income levels show significant disparities in the extent to which population and average per person footprint are contributing to the growth of their overall demand on the world's biocapacity. Figure 40 shows the relative contribution of these two factors from 1961 to 2005 for nations grouped in income categories, with the world as a whole shown for comparison. Countries were assigned to high-, middle- or low-income categories based on World Bank income thresholds and each country's average per person gross national income in 2005. The middle-income category combines the bank's upper-middle and lower-middle categories.

Population has increased in all three income groups since 1961, but the rate of increase differs across the three categories. In the low-income countries, an almost three-fold population increase since 1961 was the primary factor driving up demand for resources and for waste assimilation.

Rapidly growing populations not only add to the challenge of ending overshoot, but also create barriers to achieving development goals in many low-income nations. As populations rise, less biocapacity is available to meet the needs of each individual, increasing a nation's dependence on biocapacity from elsewhere or the likelihood of local overshoot and an associated decline in ecosystem services. The citizens of low-income countries, on average, have a smaller footprint today than they did in 1961. In Africa, for example, where the population has tripled over the past 40 years, the biocapacity available per person has declined by more than 67 per cent, and the average person's footprint has dropped by 19 per cent. In contrast, for the globe as a whole, the drop in biocapacity per person was 49 per cent. In both cases this decline is primarily due to more people sharing the same amount of biocapacity, rather than a decline in the Earth's productivity.

In middle-income nations, both population and per person footprint growth are contributing to increased demand on the biosphere. While some countries in the middle-income category have seen a slowing of population growth, overall the number of people living in middle-income countries has doubled since 1961. In addition, the per person footprint in these nations increased by 21 per cent over the same time period. Growing affluence in this income category

Fig. 38: ECOLOGICAL FOOTPRINT AND POPULATION BY REGION, 1961

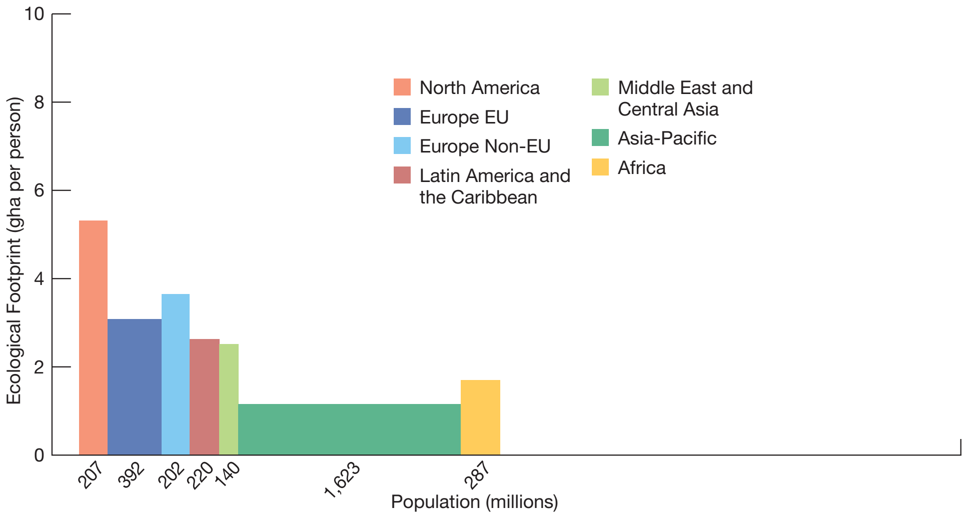
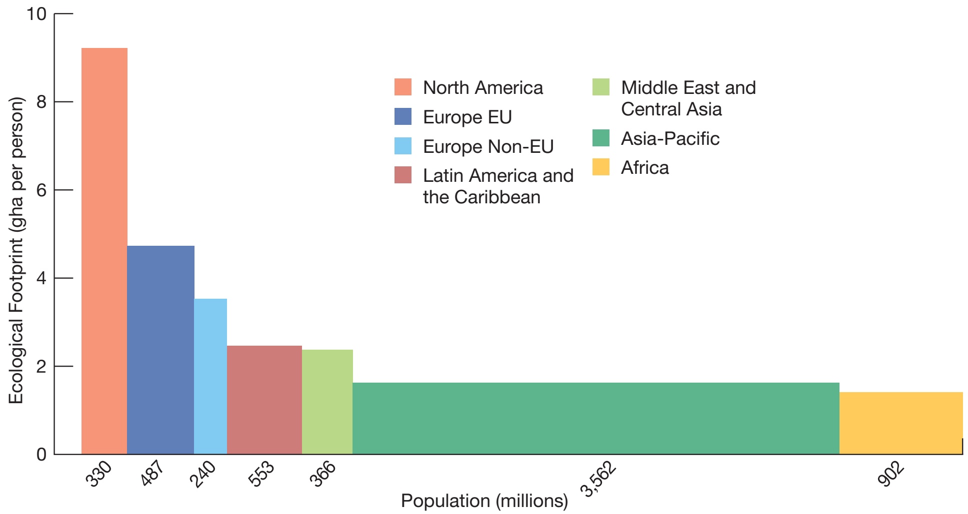


Fig. 39: ECOLOGICAL FOOTPRINT AND POPULATION BY REGION, 2005



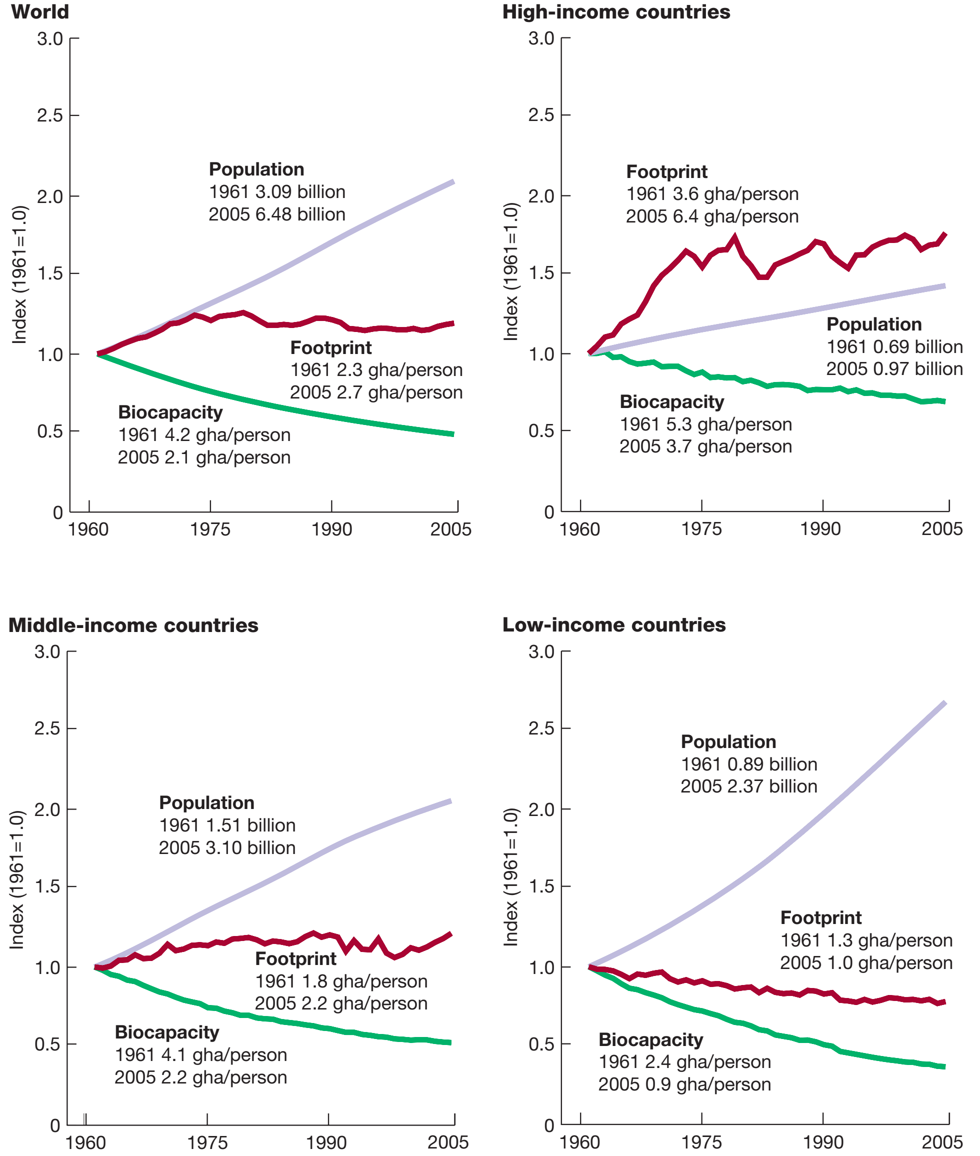
is associated with a significant increase in fossil-fuel use and in the consumption of resource-intensive dairy and meat products. Many of the world's emerging economies are included in this group of nations, and their rising per person footprint is associated with an accelerated industrialization pathway similar to that seen earlier in many high-income nations. In China, for instance, the per person footprint and population both doubled between 1961 and 2005, producing a more than four-fold increase in its total Ecological Footprint. With a moderate per person footprint and the largest population of the three income groups, the middle-income nations' demand on the biosphere in 2005 was the largest of the three groups, with their consumption accounting for 39 per cent of humanity's total footprint.

Rising demand on the biosphere from the high-income countries has been driven principally by an increase in per person footprint, which grew by 76 per cent from 1961 to 2005. The majority of this was due to a nine-fold growth in the carbon component of their footprint. Although population growth in the high-income nations has been slower than in the other categories, this rapid growth in per person footprint resulted in the high-income nations, with just 15 per cent of global population, accounting for 36 per cent of humanity's 2005 total footprint. This is 2.6 times the total of the low-income nations.

With the world already in ecological overshoot, continued growth in population and per person footprint is clearly not a sustainable path. Fortunately, these consumption drivers can be addressed by strategies that can simultaneously reduce overshoot and enhance human well-being. The efficiency with which resources are used to provide goods and services can be greatly improved both through local innovation and through the adoption of resource management strategies and technology from other countries. Transfers of technology from high-income countries can often help middle- and low-income countries leapfrog past resource-intensive phases of industrial development. And with more than half the world's population now living in cities, the infrastructure decisions that cities make will greatly influence future demand on local and global biocapacity. Choosing to invest in resource-efficient infrastructure, much of which may last well into the next century, will improve cities' resilience in the face of growing resource constraints, ensure better lives for their residents, and minimize their contribution to global overshoot.

Throughout the developing world, girls on average receive significantly less education than boys. High levels of unmet need for basic health services and family planning contribute to high fertility rates in many low-income countries. Rapid population growth can be slowed and its negative impacts on human well-being alleviated by empowering women with greater education and economic opportunities, and improving access to voluntary family planning counselling and services for women who want to delay, space or limit births. Promoting good governance, alongside adoption of these strategies, leads to smaller, healthier and better educated families.

Fig. 40: **ECOLOGICAL FOOTPRINT, BIOCAPACITY AND POPULATION FOR THE WORLD, AND FOR HIGH-INCOME, MIDDLE-INCOME AND LOW-INCOME COUNTRIES,** 1961-2005



TURNING THE TIDE

GLOBAL TRADE

Tracking the Ecological Footprint of international trade flows reveals both the magnitude of demand on foreign biocapacity and the location of the ecological assets on which products and services depend. It also helps connect local consumption to distant biodiversity threats.

In 1961, the first year for which full data sets are available, the footprint of all goods and services traded between nations was as much as 8 per cent of humanity's total Ecological Footprint. By 2005, this had risen to more than 40 per cent. Both ecological debtor and creditor countries are increasingly relying on the biocapacity of others to support their consumption patterns and preferences. Some imported resources are consumed in the importing country, while others are processed and re-exported for economic gain. Carbon emissions associated with the production of imported goods and services are included in the footprint of imports.

The extent to which countries are meeting their demand for resources through imports varies according to their wealth. In 2005, the footprint of imports in high-income countries was as much as 61 per cent of their total consumption footprint, up from 12 per cent in 1961. In middle-income countries, the import footprint was equivalent to 30 per cent of their total footprint in 2005, whilst in 1961 it was 4 per cent. The footprint of imports in low-income countries equalled 13 per cent of their consumption footprint in 2005, increasing from only 2 per cent in 1961.

The United States of America had the largest export footprint of any nation in 2005, followed by Germany and China. It also had the largest import footprint, with China second and Germany third.

While the European Union contains less than 8 per cent of the world's population, in 2005 its imports from the rest of the world accounted for 13 per cent and its exports for 10 per cent of the footprint of all internationally traded goods. The footprint of the EU's net imports in 2005 was 199 million global hectares, equivalent to more than 18 per cent of its total domestic biocapacity. Counting only the EU member countries for which data are available in both 2005 and 1961, the footprint of net imports increased by 73 per cent. Figures 41 and 42 show the footprint of imports and exports between the EU and its major trading partners.

Although China has a much smaller per person footprint than the EU, both are consuming at more than twice the rate at which their domestic biocapacity can regenerate resources. China, like the EU, partially covers this ecological deficit by importing resources from other countries and, through emissions of CO_2 into the atmosphere, by relying on the global commons. In 2005, China had a negative trade balance of 165 million global hectares, more than the entire biocapacity of Germany or Bolivia. Figures 43 and 44 show the footprint of imports and exports between China and its major trading partners. In 2005, China's imports accounted for 9 per

Fig. 41: FOOTPRINT OF IMPORTS TO EU 27 FROM TOP 20 TRADING PARTNERS, 2005

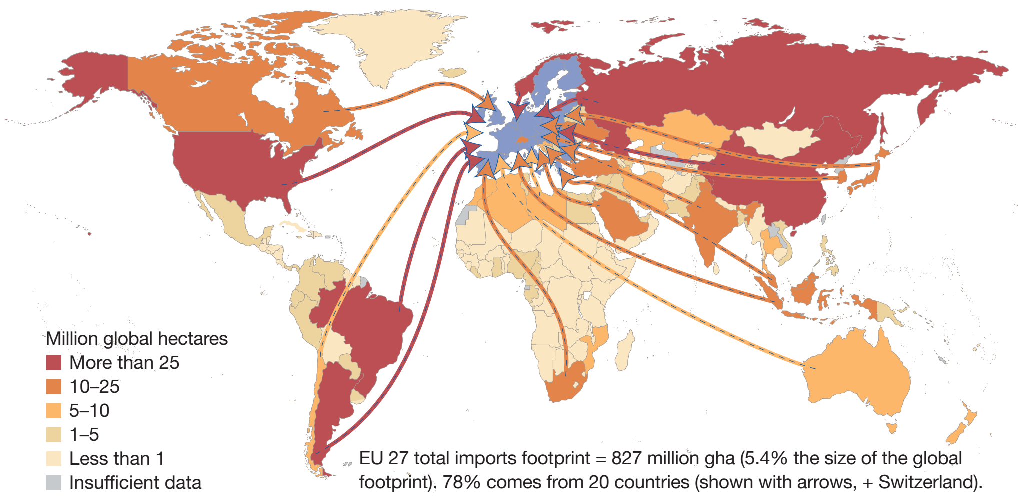
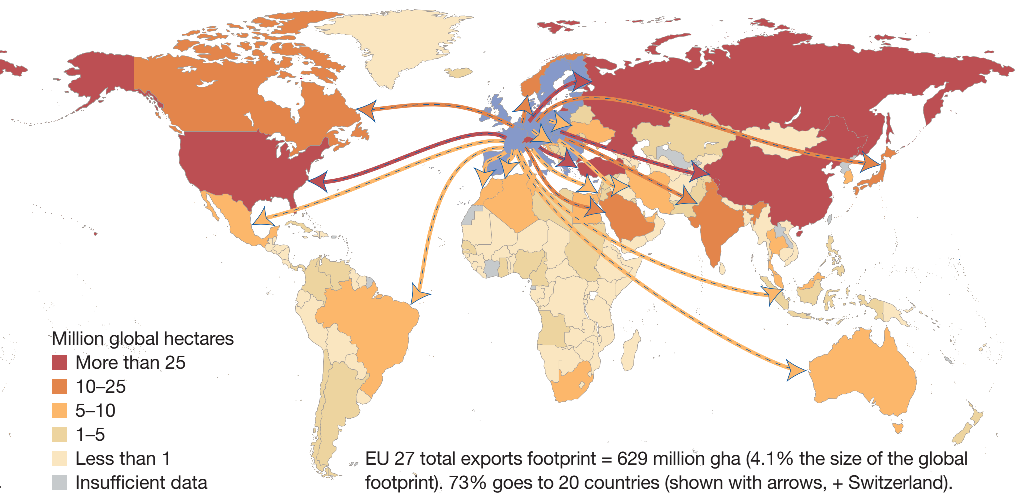


Fig. 42: FOOTPRINT OF EXPORTS FROM EU 27 TO TOP 20 TRADING PARTNERS, 2005



cent and exports for 6 per cent of the footprint of international trade. This is a dramatic increase from 5 per cent and less than 1 per cent, respectively, in 1961.

As globalization accelerates, nations are increasingly relying on one another's natural resources and ecosystem services to support preferred patterns of consumption. This brings both opportunities and challenges. Trade can enhance quality of life by providing goods that are unavailable in a particular area, or that can be produced more efficiently elsewhere. For example, with current technology it may require less fuel to grow tomatoes in a warm climate and ship them to a cooler one, than to grow tomatoes locally in the cooler area using artificially heated greenhouses. But trade also means that countries are externalizing their footprint to other parts of the world, often without regard for the environmental, economic and social consequences in the country of origin.

Consumer awareness and interest in sustainability are now creating market opportunities for commodity producers who commit themselves to minimizing environmental impacts from both locally and internationally sourced products. Pioneering work on managing fisheries and forest products has paved the way for a wide range of initiatives to reduce the environmental and social externalities associated with international trade and to establish new markets for sustainable products (see box, right).

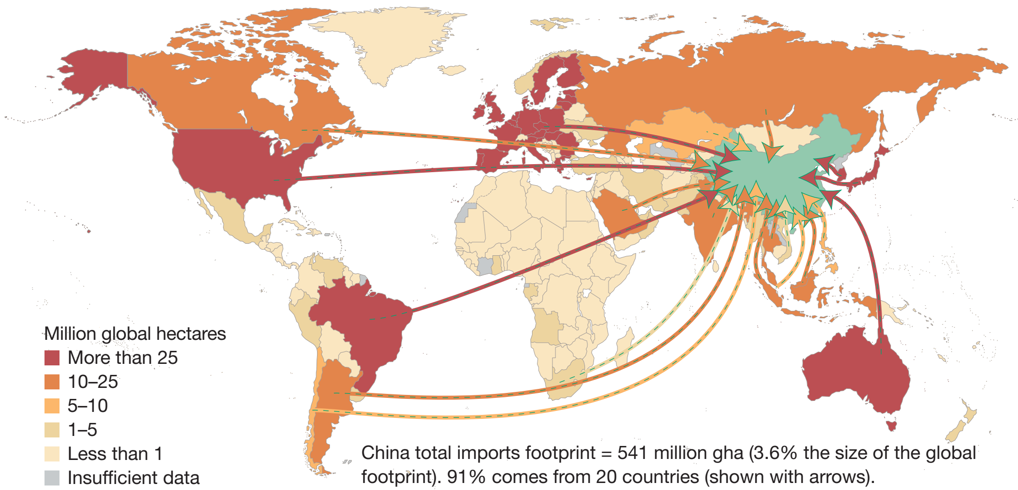
Ever more suppliers and manufacturers are making committments to responsible and sustainable trading principles and standards. Labels and certification schemes assure compliance with such standards, and cover issues such as natural resource and energy use, hazardous waste and social equity.

Further efforts are needed to increase the market share of ecologically and socially sustainable goods and services. These include developing positive incentives for production and trade of these goods and services, removing trade-distorting and environmentally harmful subsidies, and establishing disincentives for producing goods and services that impede the long-term goal of ending overshoot.

The Forest Stewardship Council, set up in 1992 to promote responsible management of the world's forests, now has more than 100 million hectares of forest in 70 countries certified to FSC standards, the equivalent of 7 per cent of all production forests. Sales of FSC-labelled products are worth over US$20 billion per year. www.fsc.org

The Marine Stewardship Council, set up in 1997 to promote solutions to overfishing, is the leading environmental certification and eco-labelling programme for wild capture fisheries. The retail value of MSC-labelled seafood products is approaching US$1 billion annually. www.msc.org

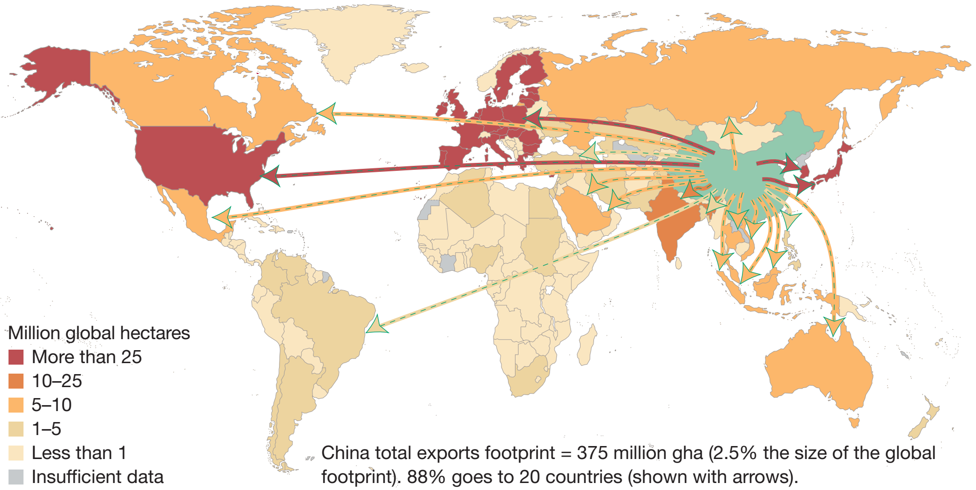
Fig. 43: **FOOTPRINT OF IMPORTS TO CHINA FROM TOP 20 TRADING PARTNERS,** 2005



Million global hectares
- More than 25
- 10–25
- 5–10
- 1–5
- Less than 1
- Insufficient data

China total imports footprint = 541 million gha (3.6% the size of the global footprint). 91% comes from 20 countries (shown with arrows).

Fig. 44: **FOOTPRINT OF EXPORTS FROM CHINA TO TOP 20 TRADING PARTNERS,** 2005



Million global hectares
- More than 25
- 10–25
- 5–10
- 1–5
- Less than 1
- Insufficient data

China total exports footprint = 375 million gha (2.5% the size of the global footprint). 88% goes to 20 countries (shown with arrows).

MANAGING BIOCAPACITY: AN ECOSYSTEM APPROACH

In the face of growing populations, uneven distribution of biocapacity and water resources, and the effects of climate change now being felt, the current rising oil and food prices have brought into sharp focus some of the stark choices that may face decision makers in the decades to come as they try to improve the quality of human life whilst remaining within the capacity of supporting ecosystems.

While managing humanity's footprint will be vital to slowing and reversing overshoot, the gap between footprint and biocapacity can be also be reduced by using the bioproductivity potential of the planet wisely in order to maximize its contribution to human needs whilst not diminishing its ability to provide the ecological services on which we depend. The recent policy confusion regarding the promotion of biofuels has highlighted the complex trade-offs that decision makers need to consider when making policy or structural changes that encourage particular development patterns.

Biofuels have been identified as a valuable energy source in view of their versatility, renewability and supposed carbon neutrality. Unlike some other types of renewable energy they are readily stored to be used when required and can substitute solid, liquid and gaseous fuels. As renewable fuels they were expected to produce significant carbon savings compared to the use of fossil fuels, since the carbon dioxide released by burning is recycled and absorbed into the next biofuel crop.

Yet recent research has shown that converting tropical forests, peatlands, savannahs or grasslands to biofuels based on food crops can generate 17 to 420 times the annual carbon emissions supposed to be saved as the biofuels replace fossil fuels. Deforestation and land-use change currently account for around 20 per cent of annual CO_2 emissions, and there is growing understanding of the need to manage this component if dangerous climate change is to be avoided.

While managing the bioproductivity of the planet could narrow the gap to be addressed in overshoot, this is not without risk. Increasing the area under agriculture destroys ecosystems that provide vital services such as the regulation of water supplies, pollination, protection of coastal areas and provision of sustainable supplies of food and fibre. The assets that make up biocapacity do not exist independently and are not readily interchangeable, meaning gains in one area may be offset by losses elsewhere.

Similarly, increasing the yield, or intensity, of agricultural and livestock production often requires energy-intensive farming methods associated with an increased carbon footprint. High levels of fertilizer and pesticide use as well as irrigation can result in far-reaching downstream impacts ranging from pollution to loss of fisheries, damaging human health and livelihoods as well as biodiversity.

The "ecosystem approach" (see boxes below) is now a widely acknowledged and internationally accepted approach to this. Sustainable management of the planet can

EXTERNALITIES AND SPILLOVERS

"Ecosystems don't obey the rules of private property. What one farmer does – in fencing his land, blocking animal migrations, spraying crops, introducing new crop varieties, hunting and fishing, logging, pumping groundwater or managing livestock diseases – has ramifications far beyond the farm. What economists call "externalities" or "spillovers" mark the very essence of ecosystems. For these reasons, sound environmental management requires rules of the game – an "ecosystem approach" – that go far beyond private property. Governments, as part of national, regional and international law, need to determine safe practices for food production, energy consumption, water use, species introduction and land-use change. Private businesses need to partner with governments to define sustainable practices aimed at using resources at sustainable rates and with environmentally sound technologies".

Jeffrey D. Sachs, Director, The Earth Institute

www.earth.columbia.edu

THE ECOSYSTEM APPROACH

The ecosystem approach is defined by the Convention on Biological Diversity as a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.

The ecosystem approach recognizes the relationships between healthy and resilient ecosystems, biodiversity conservation and human well-being. It sets out a series of 12 principles for decision making and action spanning the environmental, economic and social dimensions of sustainability.

It can be applied on any scale from local to global, and encompasses initiatives ranging from large-scale regional planning, such as integrated river basin management, to sustainable commodities management at the farm level.

www.cbd.int/ecosystem/principles.shtml

only be carried out within the constraints of the natural cycles and systems which evolved over millennia, and it is recognized that ecosystems are the basic units that we have to be able to live within. In order for the ecosystem approach to succeed, new types of collaboration and partnership will be necessary – between civil society, the private sector and governments:

- **Governments** set the policy and economic frameworks within which people must live and the private sector must operate; these must encourage and reward sustainability and promote population stabilization
- The **private sector** must be committed to good stewardship of the planet, should be committed to the "triple-bottom-line" approach of economic, social and environmental success, and must provide people with solutions that enable them to live sustainably
- **Civil society** needs to be aware of the challenges, elect governments who will set policies in their best long-term interests, and exercise personal choice that demands and favours sustainable produce and products from the private sector.

The human species is remarkably adept at both creating and solving problems. A sustainable world is not an unachievable goal: the solutions are there before us and within our grasp given the personal and political commitment of individuals.

Ecosystem-based management in marine capture fisheries

Ecosystem-based management (EBM) is an integrated approach that encompasses the complexities of ecosystem dynamics, the social and economic needs of human communities, and the maintenance of diverse, functioning and healthy ecosystems.

EBM in marine capture fisheries takes account of the condition of ecosystems that may affect fish stocks and their productivity and of the ways fishing activities may affect marine ecosystems, for example as a result of overfishing, bycatch and damaging fishing techniques.

The 1995 FAO Code of Conduct for Responsible Fisheries encompasses many of the principles of EBM. However the code, which is voluntary, has not yet achieved the degree of change required of the fisheries sector to ensure that fisheries resources are used sustainably in the long-term.

www.panda.org/about_wwf/what_we_do/marine/our_solutions/index.cfm

Roundtable on Sustainable Palm Oil

The Roundtable on Sustainable Palm Oil (RSPO) was established to promote the growth and use of sustainable palm oil through cooperation within the supply chain and open dialogue between its stakeholders. The RSPO promotes projects that support the production and use of sustainable palm oil, addressing issues such as:

- plantation management practices – implementation of better management practices in existing plantations
- development of new plantations – improvement of land-use planning processes for the development of new oil palm plantations
- responsible investment in oil palm – improvement of decision-making tools for banks and investors
- chain of custody – creating links between the oil palm plantation and the consumer.

www.panda.org/about_wwf/what_we_do/forests/our_solutions/index.cfm

Table 1: **THE ECOLOGICAL FOOTPRINT, BIOCAPACITY AND WATER FOOTPRINT**

		Ecological Footprint[1] 2005 (global hectares per person)							Water footprint of consumption 1997-2001		
Country/region	**Population[2]** (millions)	**Total Ecological Footprint**	Carbon[3]	Cropland	Grazing land	Forest[4]	Fishing ground	Built-up land[5]	**Total** m³/person/yr	**Internal** m³/person/yr	**External[6]** m³/person/yr
WORLD	**6,476**	**2.7**	**1.41**	**0.64**	**0.26**	**0.23**	**0.09**	**0.07**	**1,243**	**1,043**	**199**
High-income countries	**972**	**6.4**	**4.04**	**1.15**	**0.28**	**0.61**	**0.17**	**0.13**	**–**	**–**	**–**
Middle-income countries	**3,098**	**2.2**	**1.00**	**0.62**	**0.22**	**0.18**	**0.09**	**0.08**	**–**	**–**	**–**
Low-income countries	**2,371**	**1.0**	**0.26**	**0.44**	**0.09**	**0.15**	**0.02**	**0.05**	**–**	**–**	**–**
AFRICA	**902.0**	**1.4**	**0.26**	**0.54**	**0.25**	**0.24**	**0.03**	**0.05**	**–**	**–**	**–**
Algeria	32.9	1.7	0.69	0.62	0.17	0.13	0.01	0.05	1,216	812	405
Angola	15.9	0.9	0.15	0.40	0.15	0.11	0.05	0.05	1,004	887	117
Benin	8.4	1.0	0.19	0.44	0.08	0.24	0.02	0.04	1,761	1,699	62
Botswana	1.8	3.6	1.48	0.09	1.81	0.16	0.00	0.05	623	340	283
Burkina Faso	13.2	2.0	0.07	0.99	0.52	0.33	0.00	0.10	1,529	1,498	31
Burundi	7.5	0.8	0.07	0.30	0.05	0.37	0.01	0.04	1,062	1,042	20
Cameroon	16.3	1.3	0.09	0.53	0.33	0.23	0.03	0.06	1,093	1,037	56
Cape Verde	0.5	–	–	–	–	–	–	–	995	844	151
Central African Rep.	4.0	1.6	0.02	0.38	0.88	0.22	0.01	0.07	1,083	1,070	14
Chad	9.7	1.7	0.00	0.71	0.66	0.25	0.01	0.08	1,979	1,967	11
Congo	4.0	0.5	0.07	0.24	0.03	0.11	0.04	0.05	–	–	–
Congo, Dem. Rep.	57.5	0.6	0.01	0.18	0.00	0.41	0.01	0.00	734	725	9
Côte d'Ivoire	18.2	0.9	0.10	0.48	0.02	0.17	0.05	0.07	1,777	1,708	69
Egypt	74.0	1.7	0.71	0.72	0.02	0.11	0.01	0.10	1,097	889	207
Eritrea	4.4	1.1	0.16	0.24	0.53	0.17	0.01	0.04	–	–	–
Ethiopia	77.4	1.4	0.06	0.38	0.46	0.40	0.00	0.05	675	668	7
Gabon	1.4	1.3	0.01	0.43	0.04	0.60	0.15	0.06	1,420	1,035	385
Gambia	1.5	1.2	0.07	0.72	0.15	0.17	0.05	0.05	1,365	998	367
Ghana	22.1	1.5	0.30	0.59	0.00	0.33	0.21	0.06	1,293	1,239	53
Guinea	9.4	1.3	0.00	0.45	0.32	0.42	0.03	0.05	–	–	–
Guinea-Bissau	1.6	0.9	0.00	0.39	0.31	0.14	0.00	0.06	–	–	–
Kenya	34.3	1.1	0.12	0.25	0.41	0.22	0.02	0.04	714	644	70
Lesotho	1.8	1.1	0.15	0.09	0.47	0.35	0.00	0.02	–	–	–
Liberia	3.3	0.9	0.00	0.26	0.01	0.52	0.03	0.05	1,382	1,310	73
Libya	5.9	4.3	3.27	0.68	0.21	0.07	0.02	0.04	2,056	1,294	762
Madagascar	18.6	1.1	0.04	0.28	0.46	0.19	0.06	0.06	1,296	1,276	20
Malawi	12.9	0.5	0.07	0.21	0.00	0.15	0.00	0.03	1,274	1,261	13
Mali	13.5	1.6	0.08	0.67	0.64	0.13	0.01	0.08	2,020	2,008	12
Mauritania	3.1	1.9	0.00	0.35	1.23	0.17	0.10	0.06	1,386	1,007	378
Mauritius	1.2	2.3	0.53	0.51	0.03	0.16	1.02	0.00	1,351	547	804
Morocco	31.5	1.1	0.26	0.55	0.18	0.05	0.06	0.03	1,531	1,300	231
Mozambique	19.8	0.9	0.19	0.37	0.00	0.30	0.00	0.06	1,113	1,110	3
Namibia	2.0	3.7	0.64	0.38	1.75	0.00	0.89	0.05	683	606	77
Niger	14.0	1.6	0.04	1.19	0.15	0.21	0.01	0.04	–	–	–
Nigeria	131.5	1.3	0.12	0.95	0.00	0.19	0.02	0.06	1,979	1,932	47
Rwanda	9.0	0.8	0.03	0.44	0.09	0.20	0.00	0.03	1,107	1,072	35
Senegal	11.7	1.4	0.15	0.60	0.30	0.19	0.06	0.05	1,931	1,610	321
Sierra Leone	5.5	0.8	0.00	0.30	0.02	0.32	0.10	0.03	896	865	31
Somalia	8.2	1.4	0.00	0.16	0.77	0.41	0.01	0.06	671	588	84

Biocapacity[1] 2005 (global hectares per person)					Ecological reserve or deficit (-) (gha/person)	Water footprint of production 1997-2001					
Total biocapacity[7]	Cropland	Grazing land	Forest	Fishing ground		Total km³/yr	Green water km³/yr	Blue water km³/yr	Return flows km³/yr	Stress on blue water resources (%)	Country/region
2.1	**0.64**	**0.37**	**0.81**	**0.17**	**-0.6**	**8,999.74**	**5,295.12**	**1,096.27**	**2,608.36**	**–**	**WORLD**
3.7	**1.42**	**0.33**	**1.20**	**0.58**	**-2.7**	**–**	**–**	**–**	**–**		**High-income Countries**
2.2	**0.62**	**0.40**	**0.83**	**0.23**	**0.0**	**–**	**–**	**–**	**–**		**Middle-income Countries**
0.9	**0.35**	**0.28**	**0.13**	**0.07**	**-0.1**	**–**	**–**	**–**	**–**		**Low-income Countries**
1.8	**0.45**	**0.82**	**0.35**	**0.13**	**0.4**	**–**	**–**	**–**	**–**	**–**	**AFRICA**
0.9	0.42	0.37	0.08	0.01	-0.7	27.53	21.63	1.46	4.45	41.24	Algeria
3.2	0.26	2.03	0.60	0.31	2.3	12.38	12.05	0.04	0.29	0.18	Angola
1.5	0.53	0.39	0.48	0.03	0.5	12.54	12.29	0.06	0.19	0.98	Benin
8.5	0.21	7.31	0.55	0.34	4.8	0.71	0.58	0.02	0.11	0.90	Botswana
1.6	0.89	0.52	0.09	0.00	-0.4	18.70	17.93	0.21	0.56	6.16	Burkina Faso
0.7	0.29	0.33	0.01	0.01	-0.1	7.48	7.25	0.06	0.17	6.42	Burundi
3.1	0.73	1.16	0.94	0.16	1.8	23.70	22.71	0.22	0.77	0.35	Cameroon
–	–	–	–	–	–	0.38	0.35	0.01	0.02	9.01	Cape Verde
9.4	0.72	2.91	5.68	0.00	7.8	4.59	4.57	0.00	0.02	0.01	Central African Rep.
3.0	0.62	1.93	0.25	0.10	1.3	17.02	16.80	0.07	0.16	0.53	Chad
13.9	0.23	7.48	5.66	0.46	13.3	37.29	36.92	0.03	0.34	0.03	Congo
4.2	0.17	2.16	1.78	0.06	3.6	–	–	–	–	–	Congo, Dem. Rep.
2.2	0.86	0.84	0.37	0.04	1.3	61.26	60.37	0.17	0.72	1.09	Côte d'Ivoire
0.4	0.25	0.00	0.00	0.02	-1.3	83.93	18.75	28.58	36.60	111.79	Egypt
2.1	0.14	0.58	0.07	1.22	0.9	–	–	–	–		Eritrea
1.0	0.32	0.46	0.12	0.05	-0.3	46.61	43.89	0.54	2.17	2.47	Ethiopia
25.0	0.55	4.65	15.86	3.86	23.7	1.35	1.23	0.02	0.10	0.07	Gabon
1.2	0.45	0.18	0.08	0.45	0.0	1.40	1.37	0.01	0.02	0.34	Gambia
1.2	0.58	0.32	0.14	0.06	-0.3	42.65	42.19	0.07	0.39	0.86	Ghana
3.0	0.28	1.55	0.58	0.57	1.8	–	–	–	–	–	Guinea
3.4	0.53	0.50	0.26	2.06	2.5	–	–	–	–	–	Guinea-Bissau
1.2	0.26	0.86	0.01	0.02	0.1	24.21	22.68	0.30	1.23	5.08	Kenya
1.1	0.10	0.94	0.00	0.00	0.0	–	–	–	–	–	Lesotho
2.5	0.23	0.86	0.97	0.39	1.6	4.27	4.16	0.02	0.09	0.05	Liberia
1.0	0.41	0.27	0.00	0.27	-3.3	8.77	3.50	2.82	2.45	878.04	Libya
3.7	0.29	2.49	0.70	0.21	2.7	33.48	18.87	3.58	11.03	4.33	Madagascar
0.5	0.24	0.10	0.02	0.08	0.0	14.25	13.28	0.20	0.77	5.62	Malawi
2.6	0.62	1.25	0.56	0.06	0.9	29.68	22.76	2.06	4.86	6.92	Mali
6.4	0.20	4.26	0.01	1.85	4.5	3.71	2.04	0.44	1.23	14.60	Mauritania
0.7	0.25	0.01	0.05	0.42	-1.5	1.15	0.62	0.13	0.40	24.09	Mauritius
0.7	0.30	0.20	0.06	0.11	-0.4	45.58	33.09	4.23	8.27	43.07	Morocco
3.4	0.31	2.58	0.27	0.20	2.5	20.89	20.26	0.21	0.41	0.29	Mozambique
9.0	0.38	2.39	0.43	5.74	5.3	1.25	0.99	0.07	0.19	1.44	Namibia
1.8	1.11	0.67	0.01	0.00	0.2	–	–	–	–	–	Niger
1.0	0.61	0.24	0.02	0.03	-0.4	254.86	247.27	1.65	5.94	2.65	Nigeria
0.5	0.33	0.09	0.02	0.01	-0.3	8.39	8.31	0.01	0.07	1.41	Rwanda
1.5	0.39	0.43	0.44	0.21	0.2	18.85	17.28	0.43	1.14	3.98	Senegal
1.0	0.13	0.49	0.14	0.21	0.2	4.63	4.25	0.11	0.27	0.24	Sierra Leone
1.4	0.14	0.77	0.06	0.39	0.0	7.52	4.22	0.98	2.32	24.46	Somalia

		Ecological Footprint[1] 2005 (global hectares per person)							Water footprint of consumption 1997-2001		
Country/region	**Population[2]** (millions)	**Total Ecological Footprint**	Carbon[3]	Cropland	Grazing land	Forest[4]	Fishing ground	Built-up land[5]	**Total** m^3/person/yr	**Internal** m^3/person/yr	**External[6]** m^3/person/yr
South Africa, Rep.	47.4	2.1	1.03	0.44	0.23	0.27	0.04	0.07	931	728	203
Sudan	36.2	2.4	0.26	0.59	1.34	0.19	0.00	0.05	2,214	2,196	18
Swaziland	1.0	0.7	0.00	0.19	0.45	0.00	0.00	0.08	1,225	1,009	217
Tanzania, United Rep.	38.3	1.1	0.09	0.34	0.42	0.21	0.03	0.06	1,127	1,097	30
Togo	6.1	0.8	0.00	0.41	0.04	0.30	0.02	0.04	1,277	1,203	75
Tunisia	10.1	1.8	0.57	0.78	0.10	0.18	0.09	0.05	1,597	1,328	269
Uganda	28.8	1.4	0.03	0.62	0.15	0.46	0.06	0.06	–	–	–
Zambia	11.7	0.8	0.14	0.14	0.19	0.24	0.01	0.05	754	729	25
Zimbabwe	13.0	1.1	0.21	0.26	0.37	0.24	0.00	0.03	952	942	10
MIDDLE EAST AND CENTRAL ASIA	**365.6**	**2.3**	**1.34**	**0.69**	**0.08**	**0.08**	**0.04**	**0.08**	**–**	**–**	**–**
Afghanistan	29.9	0.5	0.00	0.27	0.10	0.05	0.00	0.06	660	642	18
Armenia	3.0	1.4	0.60	0.53	0.21	0.03	0.00	0.07	898	689	209
Azerbaijan	8.4	2.2	1.20	0.58	0.26	0.04	0.00	0.07	977	812	165
Bahrain	0.7	–	–	–	–	–	–	–	1,184	243	941
Georgia	4.5	1.1	0.23	0.49	0.26	0.04	0.01	0.06	792	744	48
Iran	69.5	2.7	1.66	0.69	0.11	0.04	0.09	0.09	1,624	1,333	291
Iraq	28.8	1.3	0.84	0.42	0.03	0.01	0.00	0.03	1,342	1,182	160
Israel	6.7	4.8	3.40	0.97	0.06	0.30	0.03	0.08	1,391	358	1,033
Jordan	5.7	1.7	0.71	0.70	0.05	0.14	0.00	0.10	1,303	352	950
Kazakhstan	14.8	3.4	2.03	1.18	0.00	0.11	0.01	0.05	1,774	1,751	23
Kuwait	2.7	8.9	7.75	0.71	0.10	0.17	0.02	0.15	1,115	142	973
Kyrgyzstan	5.3	1.1	0.41	0.56	0.01	0.01	0.00	0.10	1,361	1,356	5
Lebanon	3.6	3.1	2.01	0.68	0.07	0.25	0.02	0.06	1,499	498	1,000
Oman	2.6	4.7	3.40	0.41	0.17	0.13	0.44	0.14	1,606	382	1,224
Qatar	0.8	–	–	–	–	–	–	–	1,087	333	755
Saudi Arabia	24.6	2.6	1.33	0.82	0.11	0.12	0.03	0.22	1,263	595	668
Syria	19.0	2.1	1.05	0.78	0.12	0.07	0.00	0.06	1,827	1,640	187
Tajikistan	6.5	0.7	0.25	0.30	0.08	0.01	0.00	0.06	–	–	–
Turkey	73.2	2.7	1.37	1.00	0.04	0.17	0.05	0.08	1,615	1,379	236
Turkmenistan	4.8	3.9	2.46	1.08	0.17	0.00	0.01	0.14	1,728	1,692	36
United Arab Emirates*	4.5	9.5	7.82	1.03	0.03	0.37	0.21	0.00	–	–	–
Uzbekistan	26.6	1.8	1.19	0.50	0.04	0.01	0.00	0.08	979	926	52
Yemen	21.0	0.9	0.36	0.26	0.13	0.02	0.10	0.05	619	397	222
ASIA-PACIFIC	**3,562.0**	**1.6**	**0.78**	**0.49**	**0.08**	**0.13**	**0.07**	**0.06**	**–**	**–**	**–**
Australia	20.2	7.8	1.98	1.93	2.82	0.94	0.08	0.06	1,393	1,141	252
Bangladesh	141.8	0.6	0.13	0.33	0.00	0.07	0.01	0.04	896	865	31
Bhutan	2.2	1.0	0.00	0.12	0.12	0.67	0.00	0.09	1,044	920	124
Cambodia	14.1	0.9	0.14	0.44	0.08	0.21	0.04	0.04	1,766	1,720	45
China	1,323.3	2.1	1.13	0.56	0.15	0.12	0.07	0.07	702	657	46
Fiji	0.8	–	–	–	–	–	–	–	1,245	1,187	58
India	1,103.4	0.9	0.33	0.40	0.01	0.10	0.01	0.04	980	964	16
Indonesia	222.8	0.9	0.09	0.50	0.00	0.12	0.16	0.08	1,317	1,182	135
Japan*	128.1	4.9	3.68	0.58	0.04	0.24	0.28	0.08	1,153	409	743
Korea, DPR	22.5	1.6	0.94	0.43	0.00	0.12	0.02	0.06	845	752	93
Korea, Rep.	47.8	3.7	2.47	0.66	0.04	0.19	0.31	0.06	1,179	449	730
Lao PDR	5.9	1.1	0.00	0.48	0.14	0.33	0.01	0.10	1,465	1,425	39

Biocapacity[1] 2005 (global hectares per person)						Water footprint of production 1997-2001					
Total biocapacity[7]	Cropland	Grazing land	Forest	Fishing ground	Ecological reserve or deficit (-) (gha/person)	Total km³/yr	Green water km³/yr	Blue water km³/yr	Return flows km³/yr	Stress on blue water resources (%)	Country/region
2.2	0.77	0.87	0.25	0.25	0.1	45.68	31.15	2.22	12.31	29.06	South Africa, Rep.
2.8	0.67	1.47	0.43	0.17	0.4	96.85	59.66	14.43	22.76	57.66	Sudan
1.7	0.36	0.96	0.27	0.01	0.9	1.68	0.88	0.12	0.68	17.80	Swaziland
1.2	0.39	0.55	0.11	0.08	0.1	40.95	38.99	0.55	1.41	2.15	Tanzania, United Rep.
1.1	0.60	0.32	0.11	0.02	0.3	7.23	7.08	0.02	0.13	1.06	Togo
1.1	0.71	0.10	0.02	0.28	-0.6	23.13	20.48	1.20	1.45	58.15	Tunisia
0.9	0.57	0.24	0.02	0.06	-0.4	–	–	–	–	–	Uganda
2.9	0.58	1.46	0.73	0.03	2.1	8.92	7.19	0.25	1.47	1.64	Zambia
0.7	0.22	0.37	0.11	0.01	-0.4	16.71	14.16	0.67	1.88	12.78	Zimbabwe
1.3	**0.61**	**0.29**	**0.16**	**0.14**	**-1.0**	–	–	–	–	–	**MIDDLE EAST AND CENTRAL ASIA**
0.7	0.44	0.22	0.01	0.00	0.3	31.16	7.97	8.68	14.50	35.67	Afghanistan
0.8	0.44	0.21	0.07	0.02	-0.6	3.37	0.43	0.78	2.16	27.92	Armenia
1.0	0.59	0.25	0.09	0.02	-1.1	16.97	0.08	4.66	12.24	55.82	Azerbaijan
–	–	–	–	–	–	0.29	0.00	0.04	0.24	247.15	Bahrain
1.8	0.37	0.40	0.89	0.05	0.7	6.02	2.44	0.75	2.84	5.66	Georgia
1.4	0.55	0.10	0.36	0.31	-1.3	133.25	60.48	21.28	51.49	52.92	Iran
0.3	0.21	0.03	0.00	0.01	-1.1	56.21	13.46	11.03	31.72	56.68	Iraq
0.4	0.26	0.01	0.03	0.02	-4.4	2.93	1.05	0.78	1.10	112.28	Israel
0.3	0.14	0.03	0.00	0.00	-1.4	2.23	1.22	0.30	0.71	114.94	Jordan
4.3	1.45	2.49	0.22	0.07	0.9	56.22	21.38	11.41	23.43	31.79	Kazakhstan
0.5	0.04	0.01	0.00	0.33	-8.4	0.43	0.00	0.07	0.36	2148.57	Kuwait
1.7	0.61	0.75	0.13	0.06	0.6	13.78	3.72	2.84	7.23	48.89	Kyrgyzstan
0.4	0.31	0.03	0.02	0.01	-2.7	2.82	1.40	0.39	1.03	32.29	Lebanon
2.6	0.15	0.13	0.00	2.14	-2.1	1.59	0.26	0.61	0.71	134.63	Oman
–	–	–	–	–	–	0.29	0.00	0.12	0.17	546.23	Quatar
1.3	0.63	0.18	0.00	0.24	-1.4	21.44	4.21	6.63	10.59	717.81	Saudi Arabia
0.8	0.64	0.13	0.01	0.00	-1.2	40.81	20.96	8.52	11.33	75.62	Syria
0.6	0.31	0.16	0.01	0.02	-0.1	–	–	–	–	–	Tajikistan
1.7	0.98	0.23	0.31	0.05	-1.1	119.53	82.86	10.99	25.67	15.99	Turkey
3.7	1.18	2.22	0.00	0.15	-0.2	25.64	1.05	8.41	16.17	99.46	Turkmenistan
1.1	0.13	0.00	0.00	0.94	-8.4	–	–	–	–	–	United Arab Emirates*
1.0	0.63	0.25	0.03	0.03	-0.8	61.62	3.42	21.75	36.45	115.44	Uzbekistan
0.6	0.13	0.12	0.00	0.29	-0.3	10.79	4.27	2.50	4.03	159.21	Yemen
0.8	**0.39**	**0.11**	**0.13**	**0.13**	**-0.8**	**–**	**–**	**–**	**–**	**–**	**ASIA-PACIFIC**
15.4	5.47	3.41	2.22	4.26	7.6	95.50	75.29	7.41	12.79	4.11	Australia
0.3	0.14	0.00	0.01	0.06	-0.3	168.85	93.04	18.32	57.50	6.26	Bangladesh
1.8	0.18	0.32	1.25	0.00	0.8	1.00	0.58	0.14	0.27	0.44	Bhutan
0.9	0.46	0.14	0.15	0.14	0.0	23.30	19.24	1.20	2.86	0.85	Cambodia
0.9	0.39	0.15	0.16	0.08	-1.2	1,162.54	581.16	151.49	429.89	20.07	China
–	–	–	–	–	–	1.56	1.50	0.02	0.05	0.24	Fiji
0.4	0.31	0.01	0.02	0.04	-0.5	1,274.73	641.41	307.58	325.74	33.39	India
1.4	0.56	0.07	0.22	0.46	0.4	319.42	237.68	21.17	60.57	2.88	Indonesia
0.6	0.16	0.00	0.27	0.08	-4.3	90.53	1.90	19.47	69.16	20.61	Japan*
0.6	0.31	0.00	0.19	0.08	-0.9	20.22	11.31	1.49	7.42	11.54	Korea, DPR
0.7	0.16	0.00	0.07	0.40	-3.0	29.37	11.18	2.69	15.50	26.09	Korea, Rep.
2.3	0.39	1.25	0.55	0.04	1.3	9.55	6.67	0.79	2.09	0.86	Lao PDR

Country/region	Population[2] (millions)	Total Ecological Footprint	Ecological Footprint[1] 2005 (global hectares per person): Carbon[3]	Cropland	Grazing land	Forest[4]	Fishing ground	Built-up land[5]	Water footprint of consumption 1997-2001: Total m³/person/yr	Internal m³/person/yr	External[6] m³/person/yr
Malaysia	25.3	2.4	1.07	0.55	0.04	0.44	0.23	0.09	2,344	1,691	653
Mongolia	2.6	3.5	1.22	0.21	1.91	0.12	0.00	0.03	–	–	–
Myanmar	50.5	1.1	0.06	0.62	0.05	0.26	0.05	0.06	1,591	1,568	23
Nepal	27.1	0.8	0.03	0.40	0.12	0.17	0.00	0.04	849	819	30
New Zealand	4.0	7.7	2.22	0.73	1.90	0.99	1.70	0.17	–	–	–
Pakistan	157.9	0.8	0.30	0.39	0.01	0.07	0.02	0.05	1,218	1,153	65
Papua New Guinea	5.9	1.7	0.00	0.24	0.01	0.26	1.06	0.13	2,005	1,005	1,000
Philippines	83.1	0.9	0.07	0.42	0.01	0.08	0.25	0.04	1,543	1,378	164
Singapore	4.3	4.2	3.19	0.56	0.08	0.25	0.07	0.01	–	–	–
Sri Lanka	20.7	1.0	0.37	0.37	0.01	0.13	0.11	0.04	1,292	1,207	85
Thailand	64.2	2.1	0.89	0.64	0.01	0.16	0.37	0.06	2,223	2,037	185
Viet Nam	84.2	1.3	0.46	0.56	0.00	0.15	0.03	0.07	1,324	1,284	40
LATIN AMERICA AND THE CARIBBEAN	**553.2**	**2.4**	**0.65**	**0.57**	**0.72**	**0.32**	**0.10**	**0.08**	**–**	**–**	**–**
Argentina	38.7	2.5	0.63	0.53	0.81	0.18	0.20	0.11	1,404	1,313	91
Barbados	0.3	–	–	–	–	–	–	–	1,355	607	748
Belize	0.3	–	–	–	–	–	–	–	1,646	1,491	154
Bolivia	9.2	2.1	0.38	0.44	1.09	0.13	0.00	0.08	1,206	1,119	88
Brazil	186.4	2.4	0.04	0.61	1.11	0.49	0.02	0.08	1,381	1,276	106
Chile	16.3	3.0	0.56	0.52	0.41	0.77	0.60	0.13	803	486	317
Colombia	45.6	1.8	0.46	0.41	0.71	0.09	0.03	0.09	812	686	126
Costa Rica	4.3	2.3	0.86	0.39	0.27	0.59	0.05	0.11	1,150	913	237
Cuba	11.3	1.8	0.82	0.67	0.10	0.11	0.02	0.05	1,712	1,542	170
Dominican Rep.	8.9	1.5	0.54	0.46	0.33	0.08	0.02	0.05	980	924	56
Ecuador*	13.2	2.2	0.62	0.44	0.43	0.21	0.44	0.06	1,218	1,129	89
El Salvador	6.9	1.6	0.61	0.41	0.19	0.30	0.07	0.04	870	660	210
Guatemala	12.6	1.5	0.43	0.36	0.18	0.46	0.01	0.06	762	649	112
Guyana	0.8	–	–	–	–	–	–	–	2,113	1,967	147
Haiti	8.5	0.5	0.06	0.31	0.04	0.09	0.00	0.03	848	840	8
Honduras	7.2	1.8	0.53	0.36	0.28	0.49	0.04	0.08	778	695	82
Jamaica	2.7	1.1	0.22	0.51	0.10	0.18	0.03	0.05	1,016	693	324
Mexico	107.0	3.4	1.92	0.77	0.31	0.23	0.07	0.08	1,441	1,007	433
Nicaragua	5.5	2.0	0.41	0.40	0.71	0.35	0.10	0.07	819	706	113
Panama	3.2	3.2	0.97	0.36	0.63	0.17	1.00	0.06	979	745	234
Paraguay	6.2	3.2	0.25	0.78	1.41	0.69	0.01	0.08	1,132	1,105	27
Peru	28.0	1.6	0.22	0.51	0.31	0.14	0.29	0.10	777	599	178
Suriname	0.4	–	–	–	–	–	–	–	1,234	1,165	69
Trinidad and Tobago	1.3	2.1	1.13	0.41	0.13	0.24	0.22	0.00	1,039	565	473
Uruguay	3.5	5.5	0.23	0.28	4.04	0.56	0.25	0.11	–	–	–
Venezuela	26.7	2.8	1.30	0.37	0.81	0.10	0.16	0.07	883	651	232
NORTH AMERICA	**330.5**	**9.2**	**6.21**	**1.42**	**0.32**	**1.02**	**0.11**	**0.10**	**–**	**–**	**–**
Canada	32.3	7.1	3.44	1.83	0.50	1.00	0.21	0.09	2,049	1,631	418
United States of America	298.2	9.4	6.51	1.38	0.30	1.02	0.10	0.10	2,483	2,018	464
EUROPE (EU)	**487.3**	**4.7**	**2.58**	**1.17**	**0.19**	**0.48**	**0.10**	**0.17**	**–**	**–**	**–**
Austria	8.2	5.0	3.07	1.02	0.26	0.39	0.03	0.21	1,607	594	1,013
Belgium[8]*	10.4	5.1	2.51	1.44	0.18	0.60	0.03	0.38	1,802	353	1,449

Total biocapacity[7]	Cropland	Grazing land	Forest	Fishing ground	Ecological reserve or deficit (-) (gha/person)	Total km³/yr	Green water km³/yr	Blue water km³/yr	Return flows km³/yr	Stress on blue water resources (%)	Country/region
Biocapacity[1] 2005 (global hectares per person)						Water footprint of production 1997-2001					
2.7	1.00	0.02	0.56	1.00	0.3	62.16	53.36	1.68	7.12	1.52	Malaysia
14.6	0.25	11.12	3.25	0.00	11.2	–	–	–	–	–	Mongolia
1.5	0.48	0.20	0.44	0.32	0.4	97.08	66.34	9.08	21.67	2.94	Myanmar
0.4	0.17	0.11	0.04	0.01	-0.4	26.21	16.08	2.45	7.67	4.82	Nepal
14.1	4.40	5.06	2.08	2.35	6.4	–	–	–	–	–	New Zealand
0.4	0.32	0.01	0.01	0.04	-0.4	257.04	88.93	71.39	96.72	75.50	Pakistan
4.4	0.37	1.22	2.02	0.71	2.8	8.31	8.24	0.00	0.06	0.01	Papua New Guinea
0.5	0.28	0.07	0.07	0.08	-0.3	128.46	100.37	6.33	21.76	5.86	Philippines
0.0	0.00	0.00	0.00	0.02	-4.1	–	–	–	–	–	Singapore
0.4	0.19	0.02	0.07	0.05	-0.6	33.53	21.16	2.85	9.52	24.74	Sri Lanka
1.0	0.65	0.01	0.09	0.16	-1.2	219.00	134.35	24.31	60.34	20.65	Thailand
0.8	0.33	0.05	0.12	0.24	-0.5	144.75	81.08	15.07	48.60	7.14	Viet Nam
4.8	**0.79**	**1.15**	**2.46**	**0.32**	**2.4**	**–**	**–**	**–**	**–**	**–**	**LATIN AMERICA AND THE CARIBBEAN**
8.1	2.49	3.08	0.58	1.87	5.7	114.72	85.90	3.44	25.38	3.54	Argentina
–	–	–	–	–	–	0.22	0.14	0.01	0.07	102.87	Barbados
–	–	–	–	–	–	0.80	0.69	0.00	0.11	0.59	Belize
15.7	0.65	3.05	11.86	0.06	13.6	12.20	10.86	0.26	1.07	0.21	Bolivia
7.3	0.90	1.15	4.96	0.18	4.9	308.55	250.12	6.18	52.25	0.71	Brazil
4.1	0.63	0.97	1.60	0.80	1.1	15.16	3.25	1.59	10.31	1.29	Chile
3.9	0.26	1.89	1.61	0.04	2.1	41.88	31.25	1.23	9.40	0.50	Colombia
1.8	0.50	0.67	0.45	0.11	-0.4	7.29	4.68	0.35	2.25	2.32	Costa Rica
1.1	0.63	0.09	0.15	0.14	-0.7	29.25	21.05	1.41	6.79	21.50	Cuba
0.8	0.31	0.33	0.09	0.02	-0.7	12.71	9.45	0.55	2.70	15.48	Dominican Rep.
2.1	0.39	0.50	0.99	0.19	-0.1	32.61	15.61	2.65	14.35	3.93	Ecuador*
0.7	0.31	0.17	0.09	0.11	-0.9	6.84	5.65	0.18	1.01	4.73	El Salvador
–	–	–	–	–	–	13.64	11.68	0.40	1.55	1.76	Guyana
1.3	0.37	0.49	0.32	0.05	-0.2	3.52	1.89	0.56	1.07	0.68	Guatemala
0.3	0.16	0.04	0.01	0.02	-0.3	7.63	6.64	0.19	0.80	7.02	Haiti
1.9	0.49	0.40	0.65	0.25	0.1	7.78	6.95	0.17	0.66	0.86	Honduras
0.6	0.23	0.08	0.27	0.00	-0.5	2.29	1.88	0.05	0.36	4.32	Jamaica
1.7	0.70	0.37	0.36	0.16	-1.7	153.04	75.03	18.71	59.31	17.06	Mexico
3.3	0.82	0.89	0.95	0.55	1.2	6.30	5.01	0.29	1.00	0.66	Nicaragua
3.5	0.38	1.02	1.34	0.69	0.3	2.96	2.19	0.05	0.73	0.52	Panama
9.7	1.55	3.18	4.84	0.06	6.5	12.09	11.63	0.12	0.34	0.14	Paraguay
4.0	0.42	1.26	1.98	0.26	2.5	28.90	9.32	5.09	14.50	1.02	Peru
–	–	–	–	–	–	1.07	0.41	0.22	0.45	0.55	Suriname
2.1	0.13	0.08	0.35	1.49	-0.1	0.95	0.65	0.00	0.30	7.84	Trinidad and Tobago
10.5	1.13	5.63	1.29	2.34	5.0	–	–	–	–	–	Uruguay
3.2	0.32	0.99	1.44	0.34	0.3	28.21	12.47	1.23	14.51	1.28	Venezuela
6.5	**2.55**	**0.43**	**2.51**	**0.88**	**-2.7**	**–**	**–**	**–**	**–**	**–**	**NORTH AMERICA**
20.0	4.89	1.80	9.30	3.96	13.0	124.85	79.31	3.25	42.29	1.57	Canada
5.0	2.30	0.29	1.78	0.55	-4.4	830.94	351.05	122.15	357.74	15.63	United States of America
2.3	**1.00**	**0.21**	**0.64**	**0.29**	**-2.4**	**–**	**–**	**–**	**–**	**–**	**EUROPE (EU)**
2.9	0.67	0.27	1.70	0.00	-2.1	7.00	4.86	0.01	2.13	2.75	Austria
1.1	0.40	0.12	0.23	0.00	-4.0	14.36	5.48	0.07	8.81	41.49	Belgium[8]*

			Ecological Footprint[1] 2005 (global hectares per person)						Water footprint of consumption 1997-2001		
Country/region	**Population[2]** (millions)	**Total Ecological Footprint**	Carbon[3]	Cropland	Grazing land	Forest[4]	Fishing ground	Built-up land[5]	**Total** m^3/person/yr	**Internal** m^3/person/yr	**External[6]** m^3/person/yr
Bulgaria	7.7	2.7	1.30	0.83	0.14	0.25	0.01	0.18	1,395	1,220	175
Cyprus	0.8	–	–	–	–	–	–	–	2,208	775	1,433
Czech Rep.	10.2	5.3	3.33	1.12	-0.02	0.69	0.01	0.20	1,572	1,114	458
Denmark	5.4	8.0	3.53	2.49	0.01	1.00	0.67	0.34	1,440	569	871
Estonia	1.3	6.4	2.79	0.84	0.14	2.37	0.08	0.18	–	–	–
Finland*	5.2	5.2	1.68	1.24	0.06	1.96	0.15	0.16	1,727	1,026	701
France	60.5	4.9	2.52	1.28	0.32	0.39	0.17	0.25	1,875	1,176	699
Germany*	82.7	4.2	2.31	1.21	0.09	0.36	0.04	0.21	1,545	728	816
Greece	11.1	5.9	3.63	1.48	0.33	0.27	0.06	0.09	2,389	1,555	834
Hungary	10.1	3.5	1.49	1.48	0.00	0.38	0.01	0.20	789	662	128
Ireland*	4.1	6.3	4.03	0.65	0.50	0.46	0.38	0.24	–	–	–
Italy	58.1	4.8	2.77	1.19	0.22	0.43	0.06	0.10	2,332	1,142	1,190
Latvia	2.3	3.5	0.51	0.84	0.11	1.77	0.16	0.10	684	391	293
Lithuania	3.4	3.2	0.95	1.00	0.13	0.81	0.14	0.17	1,128	701	427
Malta	0.4	–	–	–	–	–	–	–	1,916	257	1,659
Netherlands	16.3	4.0	2.29	1.22	-0.03	0.36	0.00	0.18	1,223	220	1,003
Poland	38.5	4.0	2.06	1.10	0.16	0.52	0.04	0.08	1,103	785	317
Portugal	10.5	4.4	2.58	0.93	0.40	0.20	0.30	0.04	2,264	1,050	1,214
Romania	21.7	2.9	1.13	1.20	0.05	0.31	0.02	0.17	1,734	1,541	193
Slovakia	5.4	3.3	1.52	0.96	0.03	0.58	0.01	0.19	–	–	–
Slovenia	2.0	4.5	2.68	0.87	0.29	0.50	0.01	0.11	–	–	–
Spain	43.1	5.7	3.41	1.30	0.33	0.35	0.31	0.04	2,325	1,494	831
Sweden	9.0	5.1	0.95	0.95	0.31	2.59	0.10	0.20	1,621	759	861
United Kingdom	59.9	5.3	3.51	0.87	0.21	0.46	0.08	0.20	1,245	369	876
EUROPE (NON-EU)	**239.6**	**3.5**	**2.00**	**0.94**	**0.04**	**0.29**	**0.17**	**0.07**	**–**	**–**	**–**
Albania	3.1	2.2	1.11	0.74	0.21	0.06	0.01	0.10	1,228	880	348
Belarus	9.8	3.9	1.93	1.34	0.17	0.27	0.03	0.10	1,271	899	372
Bosnia and Herzegovina	3.9	2.9	1.47	0.82	0.18	0.35	0.01	0.09	–	–	–
Croatia	4.6	3.2	1.67	0.92	0.02	0.45	0.03	0.12	–	–	–
Iceland	0.3	–	–	–	–	–	–	–	1,327	509	818
Macedonia, FYR	2.0	4.6	3.21	0.82	0.24	0.22	0.01	0.10	–	–	–
Moldova, Rep.	4.2	1.2	0.29	0.79	0.04	0.04	0.01	0.06	1,474	1,437	37
Norway	4.6	6.9	1.55	0.78	0.44	0.63	3.35	0.17	1,467	576	891
Russian Federation	143.2	3.7	2.24	0.92	0.03	0.34	0.15	0.06	1,858	1,569	289
Serbia and Montenegro	10.5	2.6	1.37	0.98	0.00	0.23	0.01	0.03	–	–	–
Switzerland**	7.3	5.0	3.73	0.66	0.18	0.27	0.03	0.14	1,682	346	1,336
Ukraine	46.5	2.7	1.46	1.00	0.00	0.12	0.04	0.08	1,316	1,256	60

NOTES TO TABLES 1–3

World population includes countries not listed in table.

Table includes footprint data for all countries with populations greater than 1 million.

EU 27: The EU 27 are shown throughout as one region although accession dates vary: 1957: Belgium, France, Germany, Italy, Luxembourg, Netherlands; 1973: Denmark, Ireland, United Kingdom; 1981: Greece; 1986: Portugal, Spain; 1995: Austria, Finland, Sweden; 2004: Cyprus, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia; 2007: Bulgaria, Romania.

Countries were assigned to high-, middle- or low-income categories based on World Bank income thresholds calculated using 2005 GNI per capita, Atlas method.

High-income countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Japan, Korea, Rep., Kuwait, Netherlands, New Zealand, Norway, Portugal, Saudi Arabia, Singapore, Slovenia, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom and United States of America.

Middle-income countries: Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Belarus, Bolivia, Bosnia Herzegovina, Botswana, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Congo, Costa Rica, Croatia, Cuba, Czech Rep., Dominican Rep., Ecuador, Egypt, El Salvador, Estonia, Gabon, Georgia, Guatemala, Honduras, Hungary, Indonesia, Iran, Iraq, Jamaica,

Biocapacity[1] 2005 (global hectares per person)						Water footprint of production 1997-2001					
Total biocapacity[7]	Cropland	Grazing land	Forest	Fishing ground	Ecological reserve or deficit (-) (gha/person)	Total km³/yr	Green water km³/yr	Blue water km³/yr	Return flows km³/yr	Stress on blue water resources (%)	Country/region
2.8	1.44	0.31	0.76	0.10	0.1	22.28	10.63	0.79	10.87	54.72	Bulgaria
–	–	–	–	–	–	0.77	0.54	0.10	0.13	29.98	Cyprus
2.7	1.38	0.16	1.00	0.00	-2.6	14.31	11.66	0.03	2.62	20.18	Czech Rep.
5.7	3.03	0.05	0.25	2.02	-2.3	9.59	8.34	0.33	0.93	20.86	Denmark
9.1	1.33	0.41	2.69	4.48	2.7	–	–	–	–	–	Estonia
11.7	1.53	0.10	7.22	2.73	6.5	7.19	4.85	0.04	2.30	2.13	Finland*
3.0	1.55	0.34	0.73	0.17	-1.9	118.02	80.23	2.24	35.55	18.55	France
1.9	1.01	0.11	0.53	0.08	-2.3	95.58	48.89	5.59	41.10	30.32	Germany*
1.7	0.93	0.32	0.11	0.24	-4.2	22.31	14.44	3.71	4.16	10.60	Greece
2.8	1.99	0.15	0.47	0.01	-0.7	22.23	15.01	0.98	6.24	6.95	Hungary
4.3	0.89	1.08	0.19	1.86	-2.0	–	–	–	–		Ireland*
1.2	0.70	0.14	0.22	0.06	-3.5	91.87	48.17	12.00	31.70	22.85	Italy
7.0	1.11	0.85	2.92	2.00	3.5	1.30	1.01	0.01	0.27	0.82	Latvia
4.2	1.81	0.57	1.35	0.28	1.0	3.09	2.82	0.01	0.26	1.07	Lithuania
–	–	–	–	–	–	0.11	0.05	0.01	0.05	117.22	Malta
1.1	0.31	0.08	0.08	0.48	-2.9	9.29	1.39	1.62	6.28	8.68	Netherlands
2.1	1.14	0.17	0.59	0.11	-1.9	38.10	23.86	0.54	13.70	23.12	Poland
1.2	0.28	0.36	0.47	0.08	-3.2	15.07	5.74	3.73	5.60	13.58	Portugal
2.3	1.01	0.23	0.76	0.09	-0.6	50.08	26.05	5.49	18.55	11.34	Romania
2.8	1.14	0.18	1.31	0.00	-0.5	–	–	–	–	–	Slovakia
2.2	0.27	0.32	1.49	0.00	-2.3	–	–	–	–	–	Slovenia
1.3	0.73	0.32	0.18	0.06	-4.4	89.24	53.47	14.54	21.23	32.08	Spain
10.0	1.42	0.34	5.39	2.63	4.9	8.70	5.75	0.16	2.79	1.69	Sweden
1.6	0.64	0.17	0.09	0.55	-3.7	26.63	16.00	0.17	10.46	7.23	United Kingdom
5.8	**1.51**	**0.49**	**2.97**	**0.77**	**2.3**	**–**	**–**	**–**	**–**	**–**	**EUROPE (NON-EU)**
1.2	0.65	0.20	0.16	0.09	-1.0	3.51	2.13	0.36	1.02	3.31	Albania
3.4	1.60	0.42	1.30	0.00	-0.4	10.80	8.09	0.29	2.41	4.67	Belarus
2.0	0.67	0.42	0.81	0.00	-0.9	–	–	–	–		Bosnia and Herzegovina
2.2	0.31	0.61	0.81	0.33	-1.0	–	–	–	–		Croatia
–	–	–	–	–	–	0.15	0.00	0.00	0.15	0.09	Iceland
1.4	0.80	0.28	0.25	0.01	-3.2	–	–	–	–		Macedonia, FYR
1.3	1.01	0.07	0.13	0.01	0.0	9.16	6.53	0.27	2.36	22.57	Moldova, Rep.
6.1	0.78	0.43	2.78	1.96	-0.8	3.26	1.12	0.14	2.00	0.56	Norway
8.1	1.66	0.67	4.56	1.16	4.4	280.89	204.73	5.50	70.66	1.69	Russian Federation
1.6	1.07	0.12	0.41	0.01	-1.0	–	–	–	–		Serbia and Montenegro
1.3	0.31	0.18	0.64	0.01	-3.7	3.06	1.18	0.03	1.85	3.52	Switzerland**
2.4	1.70	0.14	0.34	0.14	-0.3	95.12	57.29	6.95	30.88	27.11	Ukraine

Jordan, Kazakhstan, Latvia, Lebanon, Lesotho, Libya, Lithuania, Macedonia, FYR, Malaysia, Mauritius, Mexico, Moldova, Rep., Morocco, Namibia, Nicaragua, Panama, Paraguay, Peru, Philippines, Poland, Romania, Russian Federation, Serbia and Montenegro, Slovakia, South Africa, Rep., Sri Lanka, Swaziland, Syria, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Ukraine, Uruguay and Venezuela.

Low-income countries: Afghanistan, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Central African Rep., Chad, Congo, Dem. Rep., Côte d'Ivoire, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, India, Kenya, Korea DPR, Kyrgyzstan, Lao PDR, Liberia, Madagascar, Malawi, Mali, Mauritania, Mongolia, Mozambique, Myanmar, Nepal, Niger, Nigeria, Pakistan, Papua New Guinea, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tajikistan, Tanzania, United Rep., Togo, Uganda, Uzbekistan, Vietnam, Yemen, Zambia and Zimbabwe.

For the following countries, IPCC data supplemented FAO data for forest biocapacity calculation: Algeria, Bangladesh, Benin, Bosnia and Herzegovina, Burundi, Chad, Egypt, El Salvador, Eritrea, Ethiopia, Gambia, Georgia, Haiti, Iran, Iraq, Jamaica, Jordan, Kuwait, Kyrgyzstan, Lebanon, Lesotho, Libya, Mali, Mauritania, Mauritius, Mongolia, Namibia, Oman, Rwanda, Senegal, Serbia and Montenegro, Singapore, Somalia, South Africa, Rep., Sri Lanka, Sudan, Swaziland, Syria, and Thailand.

1. Ecological Footprint and biocapacity data from 2008 Edition, National Footprint Accounts. For additional data, see www.footprintnetwork.org/atlas.
2. FAOSTAT, 2006.

Continued overleaf

Table 2: **THE LIVING PLANET INDEX, ECOLOGICAL FOOTPRINT, BIOCAPACITY AND WATER FOOTPRINT THROUGH TIME,** 1961–2005

Year	1961	1965	1970	1975	1980	1985	1990	1995	2000	2005
Global population (billions)	3.09	3.35	3.71	4.08	4.45	4.85	5.29	5.70	6.10	6.48
LIVING PLANET INDEX: Global	–	–	1.00	1.12	1.11	1.06	1.00	0.91	0.78	0.72
Temperate	–	–	1.00	1.08	1.14	1.15	1.16	1.18	1.10	1.06
Tropical	–	–	1.00	1.17	1.09	0.98	0.86	0.70	0.55	0.49
Terrestrial	–	–	1.00	1.04	1.00	0.93	0.88	0.82	0.74	0.67
Marine	–	–	1.00	1.06	1.11	1.07	1.11	1.05	0.92	0.86
Freshwater	–	–	1.00	1.29	1.24	1.19	1.01	0.88	0.70	0.65
Tropical forests	–	–	1.00	0.98	0.87	0.78	0.66	0.60	0.55	0.38
Grasslands	–	–	1.00	1.02	0.98	0.90	0.84	0.78	0.64	0.64
Drylands	–	–	1.00	1.09	0.97	0.88	0.78	0.73	0.57	0.56
Nearctic	–	–	1.00	1.00	1.03	1.05	1.04	1.05	1.03	1.03
Neotropical	–	–	1.00	1.14	1.09	0.82	0.60	0.41	0.26	0.24*
Palearctic	–	–	1.00	1.16	1.23	1.18	1.33	1.37	1.35	1.30
Afrotropical	–	–	1.00	1.08	0.96	0.95	0.87	0.75	0.70	0.81
Indo-Pacific	–	–	1.00	1.13	1.09	1.04	0.97	0.90	0.81	0.65
Birds	–	–	1.00	1.15	1.13	0.98	0.94	0.88	0.83	0.80
Mammals	–	–	1.00	0.95	1.06	1.07	1.07	1.04	0.93	0.81
ECOLOGICAL FOOTPRINT (billion gha): Total	7.0	8.2	10.0	11.2	12.5	13.0	14.5	14.9	16.0	17.5
Cropland	3.40	3.47	3.57	3.63	3.69	3.75	3.81	4.06	4.08	4.13
Grazing land	1.21	1.27	1.31	1.39	1.41	1.36	1.48	1.66	1.64	1.69
Forest	1.09	1.16	1.25	1.27	1.40	1.49	1.60	1.40	1.45	1.52
Fishing ground	0.25	0.29	0.35	0.37	0.38	0.40	0.45	0.52	0.53	0.56
Carbon	0.83	1.74	3.23	4.22	5.29	5.61	6.83	6.86	7.85	9.11
Built-up land	0.20	0.21	0.24	0.27	0.29	0.31	0.34	0.39	0.41	0.44
BIOCAPACITY: Total	13.0	13.0	13.0	13.1	13.1	13.2	13.4	13.4	13.4	13.4
WATER FOOTPRINT OF CONSUMPTION (km^3): Total	–	–	–	–	–	–	–	–	–	11,158**

* 2004 data ** per year for the period 1997–2001

Table 3: **THE LIVING PLANET INDEX: NUMBERS OF SPECIES WITHIN EACH VERTEBRATE CLASS,** 2005

		SYSTEM			TERRESTRIAL BIOMES			TERRESTRIAL AND FRESHWATER							MARINE	
	Global	Terrestrial	Marine	Freshwater	Tropical forests	Grasslands	Drylands	Temperate	Tropical	Nearctic	Neotropical	Palearctic	Afrotropical	Indo-Pacific	Temperate	Tropical
Fish	272		148	124				87	41	49	12	40	29	2	127	35
Amphibians	118	14		104	6			72	46	55	31	10	1	20		
Reptiles	46	16	7	23	8	3	3	16	23	13	7	2	7	11	2	12
Birds	895	565	137	193	66	168	43	622	181	400	59	236	79	64	113	59
Mammals	355	292	49	14	106	138	103	147	168	71	35	75	85	58	49	20
TOTAL	1,686	887	341	458	186	309	149	944	459	588	144	363	201	155	291	126

3. Carbon footprint of a country's consumption includes direct carbon dioxide emissions from fossil fuel combustion, as well as indirect emissions for products manufactured abroad. World carbon footprint also includes consumption-related emissions not allocated to individual countries, such as from flaring of gas or oil, cement production, and tropical forest fires.

4. Forest footprint includes fuelwood.
5. Built-up land includes areas dammed for hydropower.
6. Return flows from agriculture are not included in the external water footprint due to data limitations.
7. Biocapacity includes built-up land (see column under Ecological Footprint).

8. Figures for the Ecological Footprint and biocapacity are for Belgium only; for the water footprint they are for Belgium and Luxembourg.
***** Government review of National Footprint Accounts partial or in process.
****** Government review of National Footprint Accounts completed.
0.0 = less than 0.05. Totals may not add up due to rounding.

Global Living Planet Index
The species population data used to calculate the index are gathered from a variety of sources published in scientific journals, NGO literature, or on the worldwide web. All data used in constructing the index are time series of either population size, density, abundance or a proxy of abundance. The period covered by the data runs from 1960 to 2005. Annual data points were interpolated for time series with six or more data points using generalized additive modelling, or by assuming a constant annual rate of change for time series with less than six data points, and the average rate of change in each year across all species was calculated. The average annual rates of change in successive years were chained together to make an index, with the index value in 1970 set to 1. Confidence limits on all LPI graphs denote the degree of certainty in the index: the narrower the limits, the higher the confidence. The global, temperate and tropical LPIs were aggregated according to the hierarchy of indices shown in Figure 45. Temperate and tropical zones for terrestrial, freshwater and marine systems are shown in Figure 8 (page 7).

System and biome indices
Each species is classified as being terrestrial, freshwater or marine, according to which system it is most dependent on for survival and reproduction. Populations in tropical forest and grassland biomes, and dryland systems were also recorded. Biomes are based on habitat cover or potential vegetation type. The indices for terrestrial, freshwater and marine systems were aggregated by giving equal weight to temperate and tropical species within each system, i.e. a tropical index and a temperate index were first calculated for each system and the two were then aggregated to create the system index. The grassland, tropical forest and dryland indices were calculated as an index of populations found in these biomes. Tropical and temperate species were given equal weighting in the grassland index; no weighting was applied to the tropical forest and dryland indices.

Realm indices
Each species population was assigned to a biogeographic realm. Realms are geographic regions whose species have relatively distinct evolutionary histories from one another. Each terrestrial and freshwater species population in the LPI database was assigned to a realm according to its geographic location. Realm indices were calculated by giving equal weight to each species. The data from Indomalaya, Australasia and Oceania were insufficient to calculate indices for these realms, so they were combined into a super-realm, Indo-Pacific. The index for the Neotropics was calculated up until 2004 as no data were available after this year.

Taxonomic indices
Separate indices were calculated for bird and mammal species to show trends within those vertebrate classes. Equal weight was given to tropical and temperate species for the bird index to account for the large number of temperate species within this data set.

Individual species graphs
Individual species graphs show trends in a single population time series to illustrate the nature of the data from which the indices are calculated.

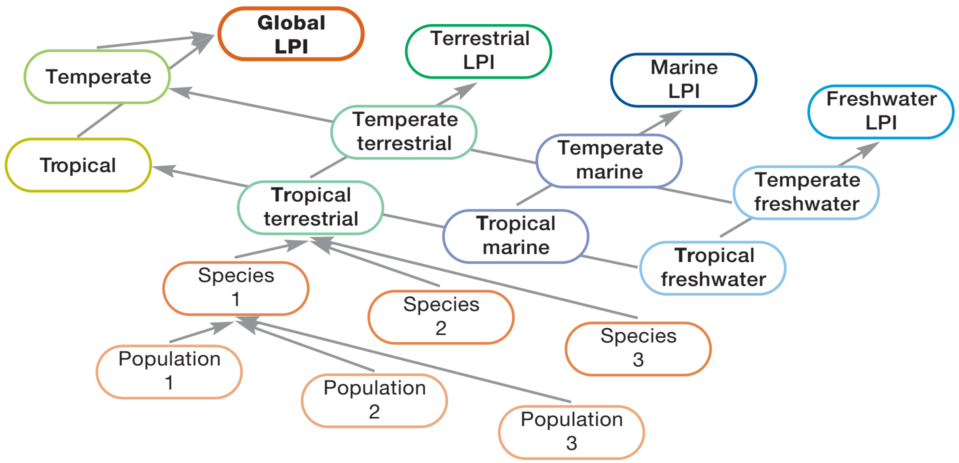
Figure 45: Hierarchy of indices within the Living Planet Index. Each population carries equal weight within each species; each species carries equal weight within tropical and temperate terrestrial, freshwater or marine indices; temperate and tropical indices carry equal weight within the global and system-level indices.

Table 4: **TRENDS IN THE LIVING PLANET INDICES BETWEEN 1970 AND 2005, WITH 95 PER CENT CONFIDENCE LIMITS**

		Number of species	Change (%) 1970-2005*	95% confidence limits Lower	Upper
Global	Global	1,686	-28	-37	-17
	Temperate	1,235	6	-4	17
	Tropical	585	-51	-62	-35
System and biome	Terrestrial	887	-33	-43	-22
	Marine	341	-14	-31	8
	Freshwater	458	-35	-52	-10
	Tropical forests	186	-62	-76	-39
	Grasslands	309	-36	-47	-24
	Drylands	149	-44	-59	-23
Realm	Nearctic	588	3	-2	8
	Neotropical	144	-76	-86	-60
	Palearctic	363	30	14	50
	Afrotropical	201	-19	-35	1
	Indo-Pacific	155	-35	-49	-16
Taxonomic	Birds	895	-20	-32	-6
	Mammals	355	-19	-37	3

*1970-2004 for the Neotropical LPI

Fig. 45: **HIERARCHY OF INDICES WITHIN THE LIVING PLANET INDEX**



DATA AND TABLES

ECOLOGICAL FOOTPRINT: FREQUENTLY ASKED QUESTIONS

How is the Ecological Footprint calculated?
The Ecological Footprint measures the amount of biologically productive land and water area required to produce the resources an individual, population or activity consumes and to absorb the waste it generates, given prevailing technology and resource management. This area is expressed as global hectares, hectares with world-average biological productivity. Footprint calculations use yield factors to take into account national differences in biological productivity (e.g. tonnes of wheat per UK hectare versus per Argentine hectare) and equivalence factors to take into account differences in world average productivity among land types (e.g. world average forest versus world average cropland).

Footprint and biocapacity results for nations are calculated annually by Global Footprint Network. Collaborations with national governments are invited, and serve to improve the data and methodology used for the National Footprint Accounts. To date, Switzerland has completed a review, and Belgium, Ecuador, Finland, Germany, Ireland, Japan and the UAE have partially reviewed or are reviewing their accounts. The continuing methodological development of the National Footprint Accounts is overseen by a formal review committee. A detailed methods paper and copies of sample calculation sheets can be obtained from www.footprintnetwork.org.

Footprint analyses can be conducted at any scale. There is growing recognition of the need to standardize sub-national footprint applications in order to increase comparability across studies and longitudinally. Methods and approaches for calculating the footprint of municipalities, organizations and products are currently being aligned through a global Ecological Footprint standards initiative. For more information on Ecological Footprint standards see www.footprintstandards.org.

What is included in the Ecological Footprint? What is excluded?
To avoid exaggerating human demand on nature, the Ecological Footprint includes only those aspects of resource consumption and waste production for which the Earth has regenerative capacity, and where data exist that allow this demand to be expressed in terms of productive area. For example, toxic releases are not accounted for in Ecological Footprint accounts. Nor are freshwater withdrawals, although the energy used to pump or treat water is included.

Ecological Footprint accounts provide snapshots of past resource demand and availability. They do not predict the future. Thus, while the footprint does not estimate future losses caused by current degradation of ecosystems, if this degradation persists it will be reflected in future accounts as a loss of biocapacity.

Footprint accounts also do not indicate the intensity with which a biologically productive area is being used. Being a biophysical measure, it also does not evaluate the essential social and economic dimensions of sustainability.

How is international trade taken into account?
The National Footprint Accounts calculate each country's net consumption by adding its imports to its production and subtracting its exports. This means that the resources used for producing a car that is manufactured in Japan, but sold and used in India, will contribute to India's rather than Japan's consumption footprint.

National consumption footprints can be distorted when the resources used and waste generated in making products for export are not fully documented for every country. This can significantly bias the footprints of countries with large trade-flows relative to their overall economies, but does not affect the total global footprint.

How does the Ecological Footprint account for the use of fossil fuels?
Fossil fuels such as coal, oil and natural gas are extracted from the Earth's crust and not renewable in ecological time spans. When these fuels burn, carbon dioxide (CO_2) is emitted. To keep CO_2 levels in the atmosphere from rising, only two options exist: human technological sequestration of these emissions, such as deep-well injection; or natural sequestration. Natural sequestration occurs when ecosystems absorb CO_2 and store it in standing biomass such as trees. Currently, negligible amounts of CO_2 are sequestered by human means.

The carbon footprint is calculated by estimating how much natural sequestration is necessary in the absence of sequestration by human means. After subtracting the amount of CO_2 absorbed by the oceans, Ecological Footprint accounts calculate the area required to absorb and retain the remaining carbon based on the average sequestration rate of the world's forests. In 2005, 1 global hectare could absorb the CO_2 released by burning approximately 1,450 litres of gasoline.

Calculating the footprint of carbon emissions in this way does not imply that biomass carbon sequestration is the key to resolving global climate change. Rather the opposite: it shows that the biosphere has insufficient capacity to cope with current levels of CO_2 emissions. As forests mature, their CO_2 sequestration rate approaches zero. If these forests are degraded or cleared, they become net emitters of CO_2.

Carbon emissions from sources other than fossil-fuel combustion are now incorporated in the National Footprint Accounts. These include fugitive emissions from the flaring of gas in oil and natural gas production, carbon released by chemical reactions in cement production and emissions from tropical forest fires. In addition, the carbon emitted when extracting and refining fossil fuels is now attributed to the country where the fossil fuel is being consumed.

Why is nuclear electricity no longer a separate Ecological Footprint component?
Nuclear power has been included as a separate footprint component in the *Living Planet Report* since 2000. Because it is difficult to calculate the extent of the nuclear demand on the biosphere, it was assumed that one unit of nuclear electricity had an equivalent footprint to one unit of electricity produced with a world average mix of fossil fuels.

After extensive discussions and consultations, Global Footprint Network's National Accounts Committee recommended eliminating the nuclear land component from the National Footprint Accounts in order to increase their scientific consistency. This change has been implemented in the 2008 edition of the National Footprint Accounts.

The National Accounts Committee concluded that the emissions proxy approach for calculating the footprint of nuclear electricity was not scientifically sound because:

1. There is no scientific basis for assuming parity between the carbon footprint of fossil-fuel electricity and demands associated with nuclear electricity.

2. The primary concerns related to nuclear electricity are often cited as costs and undue subsidies, future waste storage, the risk of plant accidents, weapons proliferation and other security risks. Ecological Footprint accounts are designed to be historical rather than predictive, and thus consideration of potential future impacts on biocapacity should not be included.

Actual carbon emissions associated with nuclear electricity are included in the National Footprint Accounts. However these emissions are only one among many environmental considerations relevant to nuclear power.

In the National Footprint Accounts for the year 2003, the nuclear footprint represented approximately 4 per cent of humanity's total footprint. Therefore, for most nations, the effect of this methodological change on their 2005 results reported here will negligible. However, for countries with significant nuclear power supply such as Belgium, Finland, France, Japan, Sweden and Switzerland, the method change influences their national footprint values to a greater extent.

This exclusion of the nuclear footprint component does not reflect a stance on nuclear energy. It simply acknowledges that only some aspects of nuclear energy are easily measured in terms of demand on regenerative capacity, the research question addressed by the Ecological Footprint.

How else have Ecological Footprint calculations been improved since *Living Planet Report 2006*?

A formal process is in place to assure continuous improvement of the National Footprint Accounts methodology. This process has been supported by Global Footprint Network's partner organizations, among others.

The most significant revision of the National Footprint Accounts since the *Living Planet Report 2006* was in response to changes in the structure of the UN FAO's Corporate Statistical Database (FAOSTAT). Most notably, the aggregation of all products into 10 groups, called Food Balance Sheets, were no longer reported in the new FAOSTAT database covering 1961 to 2005. This required the incorporation of raw data in place of the Food Balance Sheets in the current edition of the National Footprint Accounts. Additional research was then required to locate and apply new extraction rates to convert processed products into primary product equivalents. These extraction rates were compiled from a variety of FAO and other UN sources. Using raw rather than aggregated data improved the resolution of the accounts. Crops expanded from 80 to 180 product categories, livestock from 10 to 20, and forests from 6 to 30. Fifteen hundred species of fish are now tracked in the accounts, rather than just the 10 that were previously included. These changes are now documented in a detailed methodological guidebook available from Global Footprint Network.

The grazing module has also been improved. The accounts now employ a net primary productivity (NPP) methodology developed by IFF Social Ecology Institute in Vienna. In addition, 'Other wooded land' is now included in grazing land.

FAO land-use statistics are used to determine which areas are considered productive. In this edition, productive area has been expanded to include some lower-productivity forest. This previously excluded area is primarily comprised of tundra. The additional hectares of productive area now included in the accounts resulted in an increase of global per person biocapacity to 2.1 gha. However, because this change similarly affects the global per person footprint, inclusion of these additional hectares had little impact on the ratio of supply to demand, and thus on the extent of overshoot.

Does the Ecological Footprint take into account other species?

The Ecological Footprint compares human demand on nature with nature's capacity to meet this demand. It thus serves as an indicator of human pressure on local and global ecosystems. In 2005, humanity's demand exceeded the biosphere's regeneration rate by more than 30 per cent. This overshoot results in depletion of ecosystems and fill-up of waste sinks. This ecosystem stress can negatively impact biodiversity. However, the footprint does not measure these latter impacts directly, nor does it specify how much overshoot must be reduced if these negative impacts are to be avoided.

Does the Ecological Footprint say what is a "fair" or "equitable" use of resources?

The footprint documents what has happened in the past. It can quantitatively describe the ecological resources used by an individual or a population, but it does not prescribe what they should be using. Resource allocation is a policy issue, based on societal beliefs about what is or is not equitable. While footprint accounting can determine the average biocapacity that is available per person, it does not stipulate how this biocapacity should be allocated among individuals or nations. However, it does provide a context for such discussions.

How relevant is the Ecological Footprint if the supply of renewable resources can be increased and advances in technology can slow the depletion of non-renewable resources?

The Ecological Footprint measures the current state of resource use and waste generation. It asks: in a given year, did human demands on ecosystems exceed the ability of ecosystems to meet these demands? Footprint analysis reflects both increases in the productivity of renewable resources and technological innovation (for example, if the paper industry doubles the overall efficiency of paper production, the footprint per tonne of paper will halve). Ecological Footprint accounts capture these changes once they occur and can determine the extent to which these innovations have succeeded in bringing human demand within the capacity of the planet's ecosystems. If there is a sufficient increase in ecological supply and a reduction in human demand due to technological advances or other factors, footprint accounts will show this as the elimination of global overshoot.

For additional information about current Ecological Footprint methodology, data sources, assumptions and results, please visit:
www.footprintnetwork.org/atlas

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WWF International
Avenue du Mont-Blanc
CH-1196 Gland
Switzerland
Tel: +41 22 364 9111
Fax: +41 22 364 8836