WWF® for a living planet®

LIVING PLANET REPORT 2006

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.

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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 London Zoo and Whipsnade Wild Animal Park, 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.

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FOREWORD

WWF began its Living Planet Reports in 1998 to show the state of the natural world and the impact of human activity upon it. Since then we have continuously refined and developed our measures of the state of the Earth.

And it is not good news. The *Living Planet Report 2006* confirms that we are using the planet's resources faster than they can be renewed – the latest data available (for 2003) indicate that humanity's Ecological Footprint, our impact upon the planet, has more than tripled since 1961. Our footprint now exceeds the world's ability to regenerate by about 25 per cent.

The consequences of our accelerating pressure on Earth's natural systems are both predictable and dire. The other index in this report, the Living Planet Index, shows a rapid and continuing loss of biodiversity – populations of vertebrate species have declined by about one third since 1970. This confirms previous trends.

The message of these two indices is clear and urgent: we have been exceeding the Earth's ability to support our life-styles for the past 20 years, and we need to stop. We must balance our consumption with the natural world's capacity to regenerate and absorb our wastes. If we do not, we risk irreversible damage.

We know where to start. The biggest contributor to our footprint is the way in which we generate and use energy. The *Living Planet Report* indicates that our reliance on fossil fuels to meet our energy needs continues to grow and that climate-changing emissions now make up 48 per cent – almost half – of our global footprint.

We also know, from this report, that the challenge of reducing our footprint goes to the very heart of our current models for economic development. Comparing the Ecological Footprint with a recognized measure of human development, the United Nations Human Development Index, the report clearly shows that what we currently accept as "high development" is a long way away from the world's stated aim of sustainable development. As countries improve the well-being of their people, they are bypassing the goal of sustainability and going into what we call "overshoot" – using far more resources than the planet can sustain. It is inevitable that this path will limit the abilities of poor countries to develop and of rich countries to maintain prosperity.

It is time to make some vital choices. Change that improves living standards while reducing our impact on the natural world will not be easy. But we must recognize that choices we make now will shape our opportunities far into the future. The cities, power plants, and homes we build today will either lock society into damaging overconsumption beyond our lifetimes, or begin to propel this and future generations towards sustainable living.

The good news is that this can be done. We already have technologies that can lighten our footprint, including many that can significantly reduce climate-threatening carbon dioxide emissions. And some are getting started. WWF is working with leading companies that are taking action to reduce the footprint – cutting carbon emissions, and promoting sustainability in other sectors, from fisheries to forests. We are also working with governments who are striving to stem biodiversity loss by protecting vital habitats on an unprecedented scale.

But we must all do more. The message of the *Living Planet Report 2006* is that we are living beyond our means, and that the choices each of us makes today will shape the possibilities for the generations which follow us.

James P. Leape
Director General, WWF International

INTRODUCTION

This report describes the changing state of global biodiversity and the pressure on the biosphere arising from human consumption of natural resources. It is built around two indicators: the Living Planet Index, which reflects the health of the planet's ecosystems; and the Ecological Footprint, which shows the extent of human demand on these ecosystems. These measures are tracked over several decades to reveal past trends, then three scenarios explore what might lie ahead. The scenarios show how the choices we make might lead to a sustainable society living in harmony with robust ecosystems, or to the collapse of these same ecosystems, resulting in a permanent loss of biodiversity and erosion of the planet's ability to support people.

The Living Planet Index measures trends in the Earth's biological diversity. It tracks populations of 1 313 vertebrate species – fish, amphibians, reptiles, birds, mammals – from all around the world. Separate indices are produced for terrestrial, marine, and freshwater species, and the three trends are then averaged to create an aggregated index. Although vertebrates represent only a fraction of known species, it is assumed that trends in their populations are typical of biodiversity overall. By tracking wild species, the Living Planet Index is also monitoring the health of ecosystems. Between 1970 and 2003, the index fell by about 30 per cent. This global trend suggests that we are degrading natural ecosystems at a rate unprecedented in human history.

Biodiversity suffers when the biosphere's productivity cannot keep pace with human consumption and waste generation. The Ecological Footprint tracks this in terms of the area of biologically productive land and water needed to provide ecological resources and services – food, fibre, and timber, land on which to build, and land to absorb carbon dioxide (CO_2) released by burning fossil fuels. The Earth's biocapacity is the amount of biologically productive area – cropland, pasture, forest, and fisheries – that is available to meet humanity's needs. Freshwater consumption is not included in the Ecological Footprint; rather it is addressed in a separate section of the report.

Since the late 1980s, we have been in overshoot – the Ecological Footprint has exceeded the Earth's biocapacity – as of 2003 by about 25 per cent. Effectively, the Earth's regenerative capacity can no longer keep up with demand – people are turning resources into waste faster than nature can turn waste back into resources.

Humanity is no longer living off nature's interest, but drawing down its capital. This growing pressure on ecosystems is causing habitat destruction or degradation and permanent loss of productivity, threatening both biodiversity and human well-being.

For how long will this be possible? A moderate business-as-usual scenario, based on United Nations projections showing slow, steady growth of economies and populations, suggests that by mid-century, humanity's demand on nature

Fig. 1: **LIVING PLANET INDEX,** 1970–2003

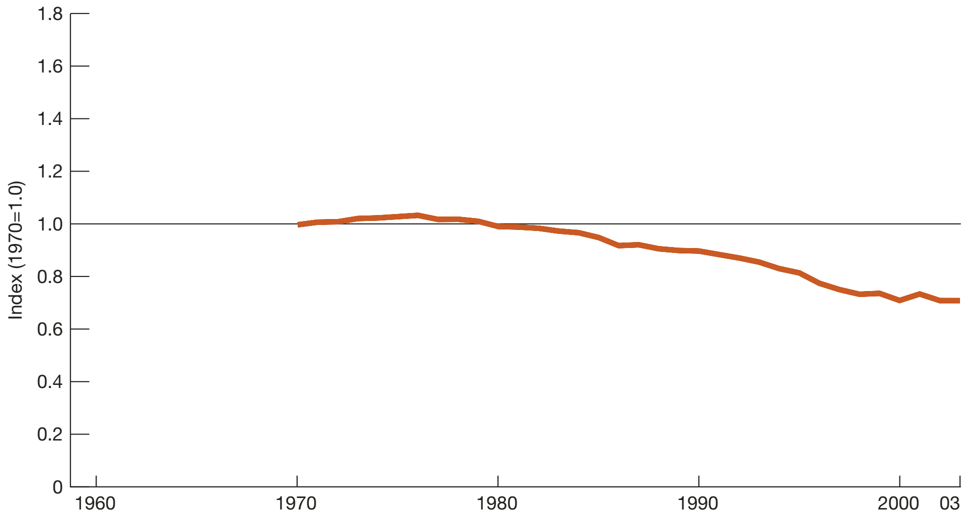
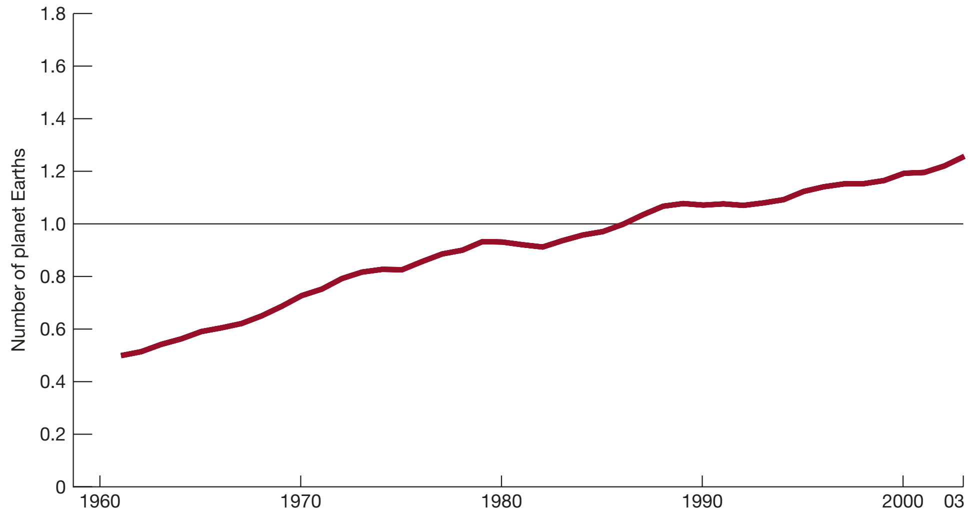


Fig. 2: **HUMANITY'S ECOLOGICAL FOOTPRINT,** 1961–2003



will be twice the biosphere's productive capacity. At this level of ecological deficit, exhaustion of ecological assets and large-scale ecosystem collapse become increasingly likely.

Two different paths leading to sustainability are also explored. One entails a slow shift from our current route, the other a more rapid transition to sustainability. The Ecological Footprint allows us to estimate the cumulative ecological deficit that will accrue under each of these scenarios: the larger this ecological debt, and the longer it persists, the greater the risk of damage to the planet. This risk must be considered in concert with the economic costs and potential social disruptions associated with each path.

Moving towards sustainability depends on significant action now. Population size changes slowly, and human-made capital – homes, cars, roads, factories, or power plants – can last for many decades. This implies that policy and investment decisions made today will continue to determine our resource demand throughout much of the 21st century.

As the Living Planet Index shows, human pressure is already threatening many of the biosphere's assets. Even moderate "business as usual" is likely to accelerate these negative impacts. And given the slow response of many biological systems, there is likely to be a considerable time lag before ecosystems benefit significantly from people's positive actions.

We share the Earth with 5–10 million species or more. By choosing how much of the planet's biocapacity we appropriate, we determine how much is left for their use. To maintain biodiversity, it is essential that a part of the biosphere's productive capacity is reserved for the survival of other species, and that this share is split between all biogeographic realms and major biomes.

To manage the transition to sustainability, we need measures that demonstrate where we have been, where we are today, and how far we still have to go. The Living Planet Index and the Ecological Footprint help to establish baselines, set targets, and monitor achievements and failures. Such vital information can stimulate the creativity and innovation required to address humanity's biggest challenge: how can we live well while sustaining the planet's other species and living within the capacity of one Earth?

Figure 1: Living Planet Index. This shows trends in populations of terrestrial, marine, and freshwater vertebrate species. It declined by 29 per cent from 1970 to 2003.

Figure 2: Humanity's Ecological Footprint. This estimates how much of the productive capacity of the biosphere people use.

Figure 3: Three Ecological Footprint scenarios. Two may lead to sustainability.

Table 1: Ecological demand and supply. Countries with the highest total footprints.

Fig. 3: **THREE ECOLOGICAL FOOTPRINT SCENARIOS,** 1961–2100

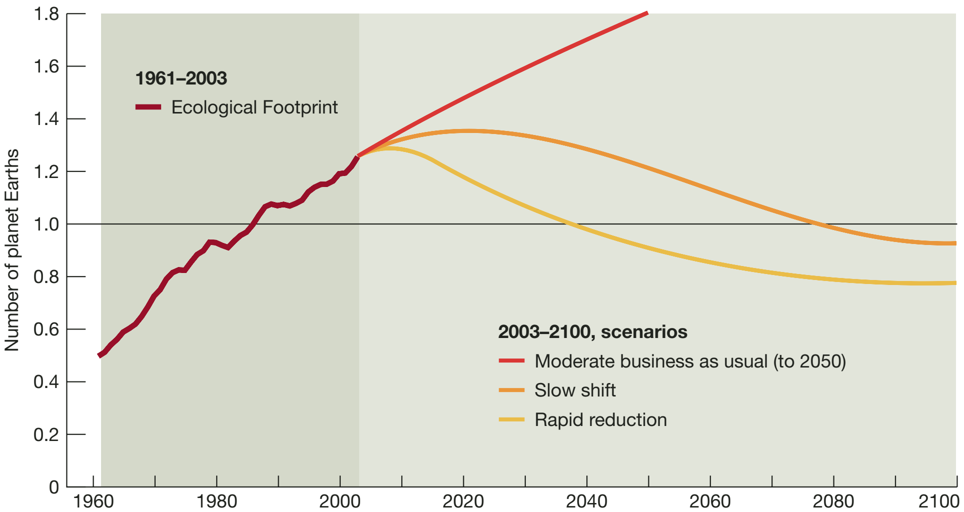


Table 1: **ECOLOGICAL DEMAND AND SUPPLY IN SELECTED COUNTRIES**, 2003

	Total Ecological Footprint (million 2003 gha)	Per capita Ecological Footprint (gha/person)	Biocapacity (gha/ person)	Ecological reserve/deficit (-) (gha/person)
World	*14 073*	*2.2*	*1.8*	*-0.4*
United States of America	2 819	9.6	4.7	-4.8
China	2 152	1.6	0.8	-0.9
India	802	0.8	0.4	-0.4
Russian Federation	631	4.4	6.9	2.5
Japan	556	4.4	0.7	-3.6
Brazil	383	2.1	9.9	7.8
Germany	375	4.5	1.7	-2.8
France	339	5.6	3.0	-2.6
United Kingdom	333	5.6	1.6	-4.0
Mexico	265	2.6	1.7	-0.9
Canada	240	7.6	14.5	6.9
Italy	239	4.2	1.0	-3.1

Notes: Totals may not add up due to rounding. For an explanation of global hectares (gha) see page 38.

LIVING PLANET INDEX

The Living Planet Index is a measure of the state of the world's biodiversity based on trends from 1970 to 2003 in over 3 600 populations of more than 1 300 vertebrate species from around the world. It is calculated as the average of three separate indices that measure trends in populations of 695 terrestrial species, 274 marine species, and 344 freshwater species.

The index shows an overall decline of around 30 per cent over the 33-year period, as do each of the terrestrial, marine, and freshwater indices individually. The decline in the indices, and in particular the freshwater index, is less than in previous reports, because the indices have been aggregated in a different way, designed to reduce the degree of uncertainty around them (see technical notes, page 37).

No attempt is made to select species on the basis of geography, ecology, or taxonomy, so the index dataset contains more population trends from well-researched groups, especially birds, and well-studied regions, particularly Europe and North America. In compensation, temperate and tropical regions are given equal weight (with equal weight to each species in each region) within the terrestrial and freshwater indices, and to ocean basins within the marine index (see pages 6–11).

The map opposite shows the Earth's surface divided into 14 terrestrial biomes, or habitat types, and eight biogeographic realms. The biomes are based on habitat cover (agricultural and urban land is classified according to potential vegetation type) and realms are defined according to biological evolutionary history. Although ecosystems within a single biome share the same ecological processes and vegetation types, their exact species composition varies depending on the realm in which they are found. Patterns in freshwater biodiversity follow similar distinctions based on biogeographic realms, but marine realms are less well defined, partly because marine species tend to be distributed more widely across the world's oceans.

Figure 4: Terrestrial Living Planet Index. The terrestrial species index shows a 31 per cent decline on average from 1970 to 2003.

Figure 5: Marine Living Planet Index. The marine species index shows an average decline of 27 per cent between 1970 and 2003.

Figure 6: Freshwater Living Planet Index. The freshwater species index declined by approximately 28 per cent between 1970 and 2003.

Map 1: Terrestrial biogeographic realms and biomes.

Fig. 4: **TERRESTRIAL LIVING PLANET INDEX,** 1970–2003

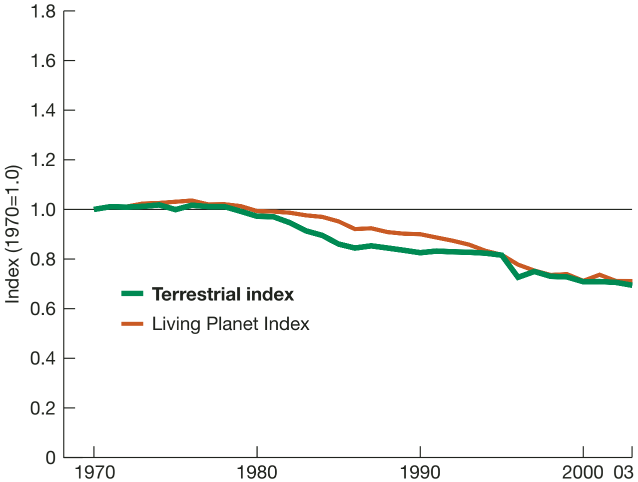


Fig. 5: **MARINE LIVING PLANET INDEX,** 1970–2003

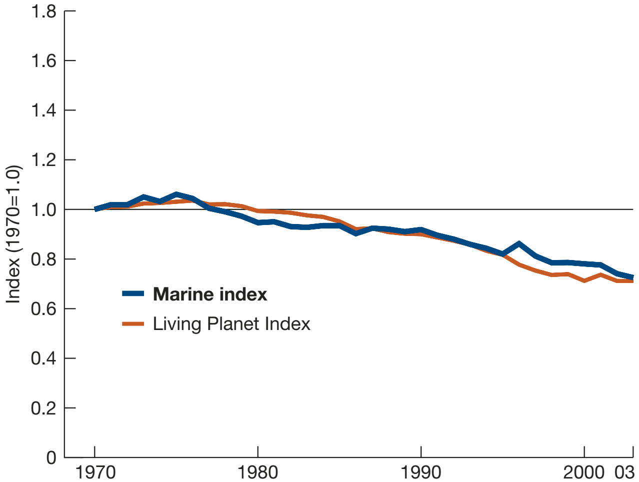
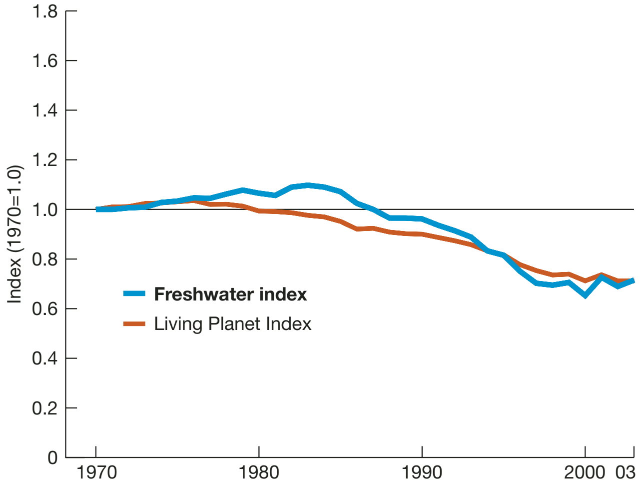
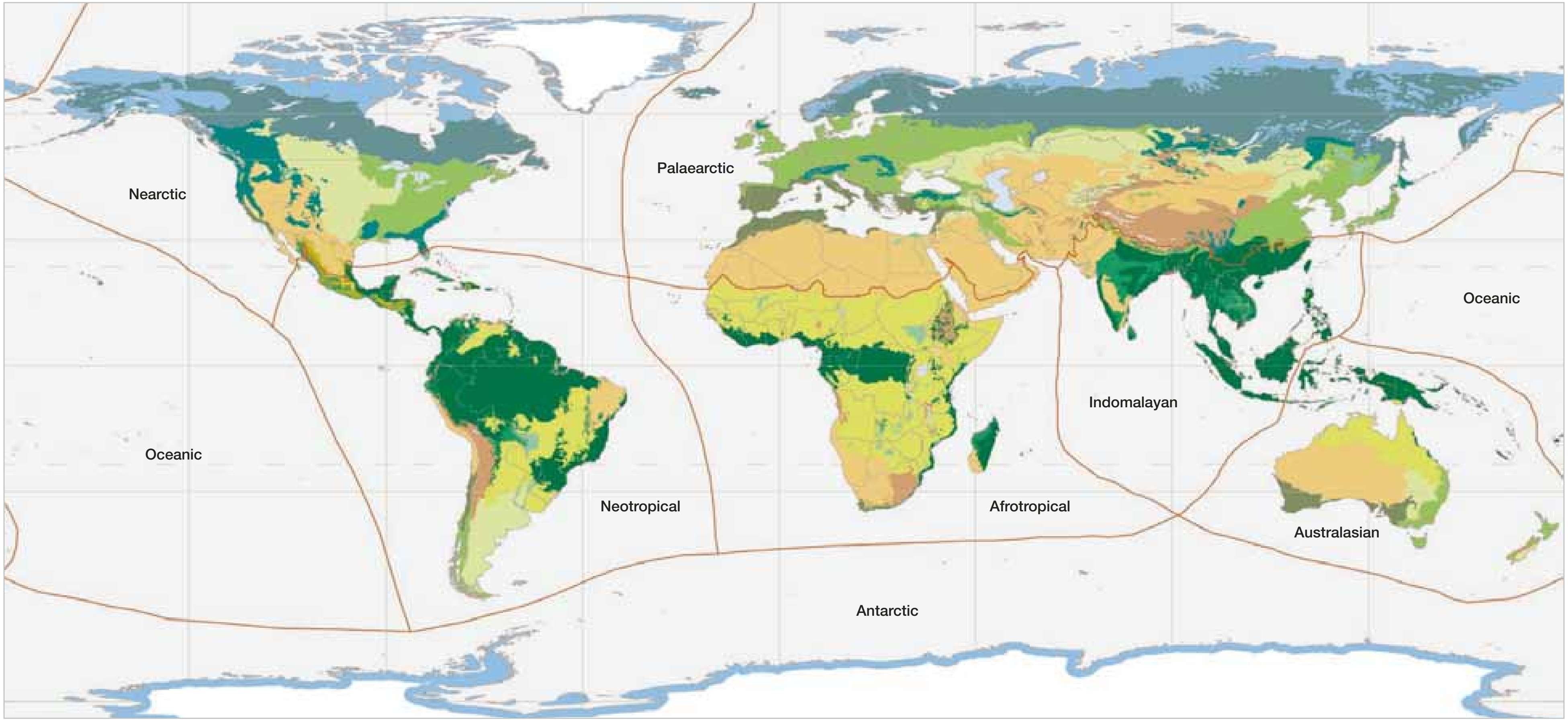


Fig. 6: **FRESHWATER LIVING PLANET INDEX,** 1970–2003





Map 1: **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

Populations of terrestrial species declined by about 30 per cent on average between 1970 and 2003. This decline hides a marked difference in trends between temperate and tropical species. Tropical species populations declined by around 55 per cent on average from 1970 to 2003, while temperate species populations, which would have shown marked declines prior to 1970, have shown little overall change since. Figure 7 shows average trends in populations of 695 temperate and tropical terrestrial species (of which 562 occur in temperate zones and 150 in tropical zones), indexed to a value of one in 1970.

The rapid rate of population decline in tropical species is mirrored by the loss of natural habitat to cropland or pasture in the tropics between 1950 and 1990 (Figure 9), agricultural conversion being the main driver. The tropical forests of Southeast Asia, part of the Indomalayan biogeographic realm, have seen the fastest conversion in the last two decades. In temperate ecosystems, the conversion of natural habitat to farmland largely took place before 1950, when populations of temperate species are likely to have declined, before stabilizing.

The biomes (see Map 1) with the fastest rate of conversion in the last half of the 20th century were tropical grasslands, flooded grasslands, and tropical dry forests (Figure 8). Temperate, tropical, and flooded grasslands, Mediterranean woodlands, temperate broadleaf forests, and tropical dry forests have all lost more than half of their estimated original habitat cover. The biomes least transformed by agricultural conversion are boreal forests and tundra.

Figure 7: Temperate and tropical terrestrial Living Planet Indices. Tropical terrestrial species populations declined by 55 per cent on average from 1970 to 2003; temperate species populations remained fairly stable.

Figure 8: Loss of natural habitat, by biome. With the exceptions of Mediterranean and temperate mixed forests, where extensive habitat loss stabilized after 1950 because most land suitable for agriculture had already been converted, the biomes which lost most habitat prior to 1950 continued to lose it rapidly between 1950 and 1990 (Millennium Ecosystem Assessment, 2005).

Figure 9: Loss of natural habitat to agriculture, by realm. The rate of natural habitat loss over this period was greatest in the tropics. Agriculture expanded in Australasia at a rate similar to the Neotropics, but there was a relatively low level of cultivation in 1950 (Millennium Ecosystem Assessment, 2005). See Map 1 for the boundaries of the realms.

Map 2: Trends in selected terrestrial species populations. These are not necessarily indicative of general species trends in each region, but illustrative of the kinds of data used in the terrestrial index.

Fig. 7: **TEMPERATE AND TROPICAL TERRESTRIAL LIVING PLANET INDICES,** 1970–2003

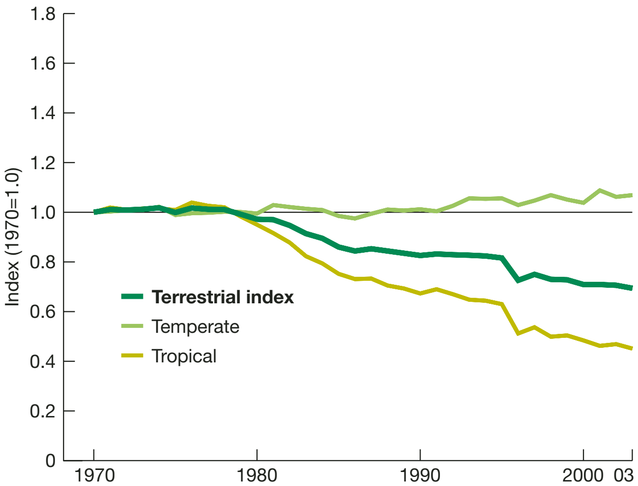


Fig. 8: **LOSS OF NATURAL HABITAT, BY BIOME,** to 1990 (as % of estimated original area)

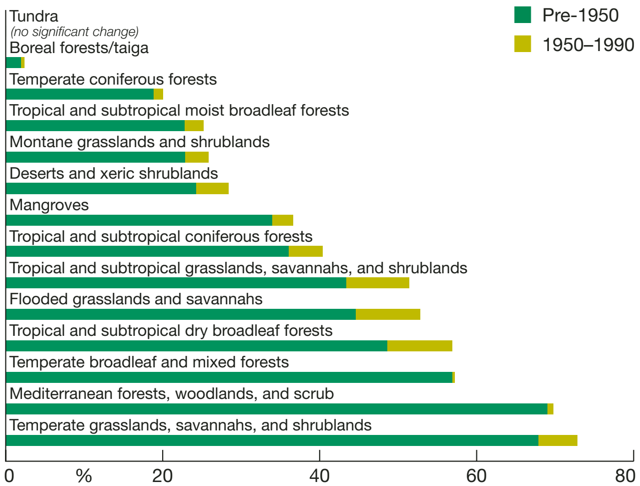
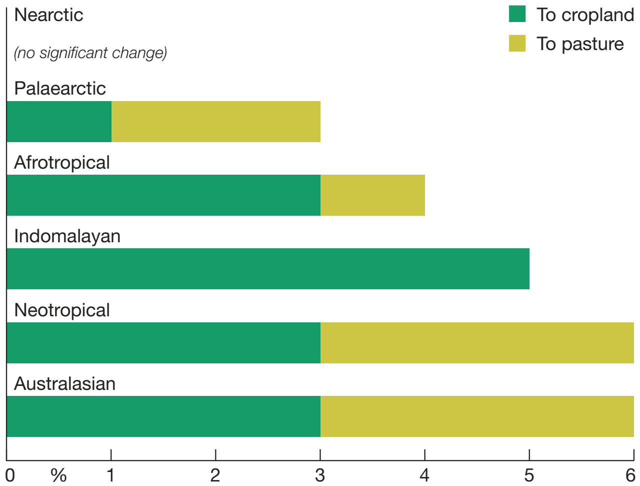
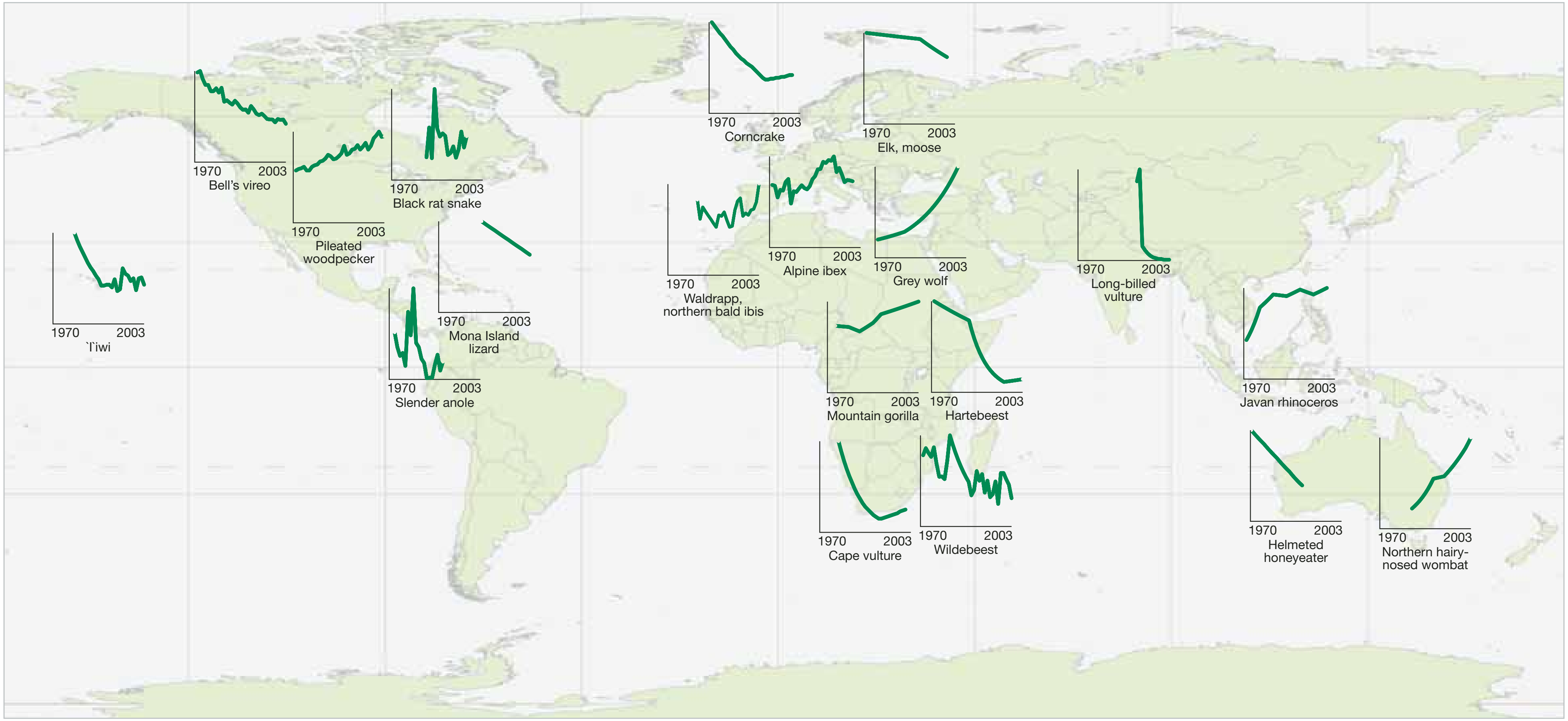


Fig. 9: **LOSS OF NATURAL HABITAT TO AGRICULTURE, BY REALM,** 1950–1990 (as % of 1950 area)





Map 2: **TRENDS IN SELECTED TERRESTRIAL SPECIES POPULATIONS,** 1970–2003

Common name	Species	Location of population surveyed
`I'iwi	*Vestiaria coccinea*	Hawaii, United States
Bell's vireo	*Vireo bellii*	United States and Canada
Black rat snake	*Elaphe obsoleta*	Hill Island, Ontario, Canada
Pileated woodpecker	*Dryocopus pileatus*	United States and Canada
Mona Island lizard	*Cyclura cornuta*	Mona Island, Puerto Rico
Slender anole	*Anolis limifrons*	Barro Colorado Island, Panama
Corncrake	*Crex crex*	United Kingdom
Elk, moose	*Alces alces*	Lithuania
Waldrapp, northern bald ibis	*Geronticus eremita*	Morocco
Alpine ibex	*Capra ibex*	Gran Paradiso National Park, Italy
Grey wolf	*Canis lupus*	Greece
Mountain gorilla	*Gorilla beringei*	Virunga range: Democratic Republic of the Congo, Rwanda, and Uganda
Hartebeest	*Alcelaphus buselaphus*	Uganda
Cape vulture	*Gyps coprotheres*	South Africa
Wildebeest	*Connochaetes taurinus*	Ngorongoro Crater, Tanzania
Long-billed vulture	*Gyps indicus*	Northern India
Javan rhinoceros	*Rhinoceros sondaicus*	Java, Indonesia
Helmeted honeyeater	*Lichenostomus melanops*	Australia
Northern hairy-nosed wombat	*Lasiorhinus krefftii*	Australia

The marine environment, which covers almost 70 per cent of the Earth's surface, includes some of the world's most diverse and productive ecosystems, but these were adversely affected by human action over the last half of the 20th century.

The marine index is split by ocean basin. The Pacific Ocean, the largest, covers more than a third of the planet's surface. The Atlantic Ocean includes the Arctic basin. The Indian Ocean includes the coastal seas of Southeast Asia for the purposes of the index. The Southern Ocean comprises the seas around Antarctica, its northern limit defined as the line of latitude 60ºS.

The marine index includes trends in 1 112 populations of 274 species between 1970 and 2003, and shows a greater than 25 per cent decline on average across the four ocean basins. Relatively stable trends are evident in the Pacific and in the Arctic/Atlantic Oceans, in comparison with dramatic declines in the Indian/Southeast Asian and Southern Oceans. Overall increases in the populations of sea birds and some mammal species in the Atlantic and Pacific Oceans since 1970, however, mask a decline in many fish species, especially those of economic importance such as cod and tuna, which are decreasing as a result of overfishing, as well as turtles and other species that are caught as by-catch. There are comparatively few data from the Southern and Indian Oceans, so those indices end in 1997 and 2000.

Mangroves – saltwater-tolerant, inter-tidal forests growing along tropical shorelines – are among the most productive ecosystems on Earth and critical to the health of tropical marine ecosystems. Mangroves provide nurseries for 85 per cent of commercial fish species in the tropics and are essential in maintaining fish stocks and hence food resources. Mangroves are being degraded or destroyed at about twice the rate of tropical forests. It is estimated that more than a third of the global area of mangrove forest was lost between 1990 and 2000 (Figure 12).

Figure 10: Arctic/Atlantic and Southern Ocean Living Planet Indices. Populations of Southern Ocean species declined by about 30 per cent between 1970 and 1998, while trends in the Arctic/Atlantic Ocean increased overall.

Figure 11: Indian/Southeast Asian and Pacific Ocean Living Planet Indices. The Indian Ocean and Southeast Asian seas saw average declines of more than half between 1970 and 2000, while trends in Pacific Ocean species remained stable overall.

Figure 12: Mangrove area, by region. More than a quarter of Asia's mangrove cover was lost in the ten-year period preceding 2000. In South America, almost half was lost over the same period (Mayaux *et al.,* 2005).

Map 3: Trends in selected marine species populations. These are not necessarily indicative of general species trends in each region, but illustrative of the kinds of data used in the Living Planet Index.

Fig. 10: **ARCTIC/ATLANTIC AND SOUTHERN OCEAN LIVING PLANET INDICES,** 1970–2003

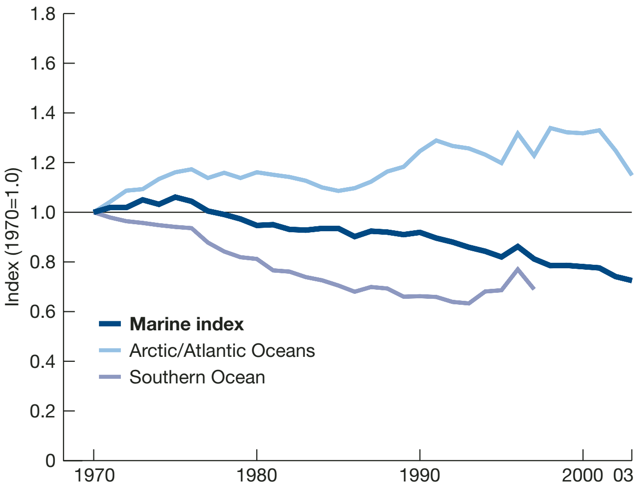


Fig. 11: **INDIAN/SOUTHEAST ASIAN AND PACIFIC OCEAN LIVING PLANET INDICES,** 1970–2003

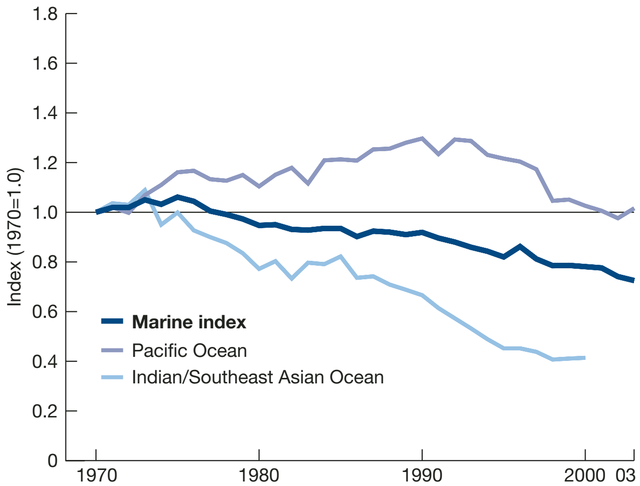
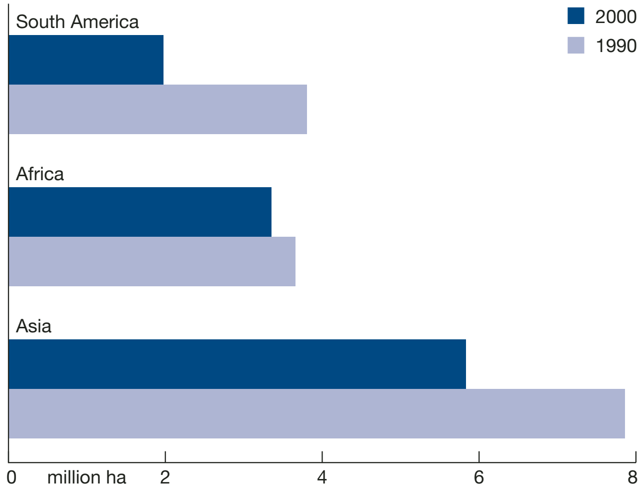
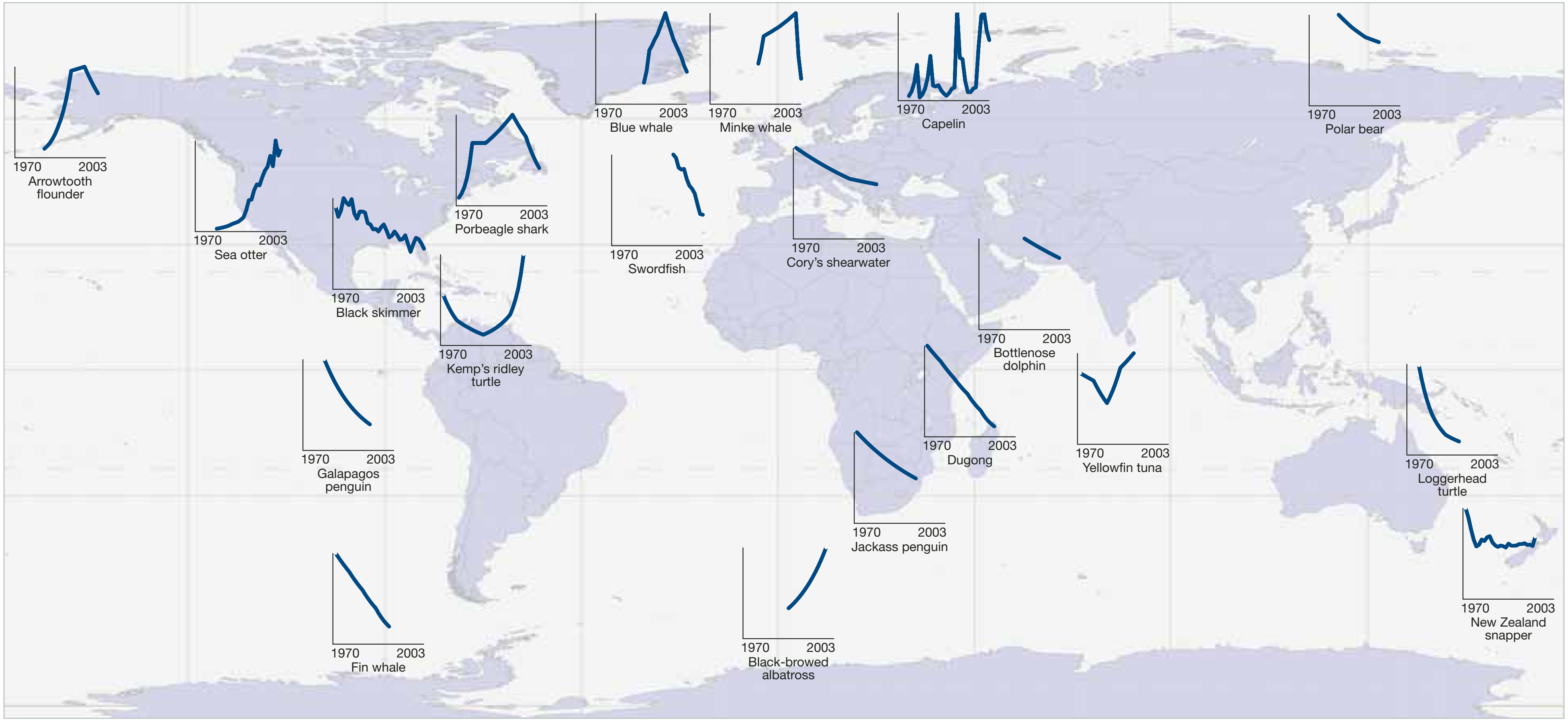


Fig. 12: **MANGROVE AREA, BY REGION,** 1990–2000





Map 3: **TRENDS IN SELECTED MARINE SPECIES POPULATIONS,** 1970–2003

Common name	Species	Location of population surveyed
Arrowtooth flounder	*Atheresthes stomias*	Aleutian Islands, Bering Sea, North Pacific
Sea otter	*Enhydra lutris*	Washington State, United States, North Pacific
Porbeagle shark	*Lamna nasus*	Canada, North Atlantic
Black skimmer	*Rynchops niger*	Caribbean Sea/Gulf of Mexico
Kemp's ridley turtle	*Lepidochelys kempii*	Mexico, Caribbean Sea/Gulf of Mexico
Galapagos penguin	*Spheniscus mendiculus*	Galapagos, Ecuador, South Pacific
Fin whale	*Balaenoptera physalus*	Southern Ocean
Blue whale	*Balaenoptera musculus*	Iceland, North Atlantic
Minke whale	*Balaenoptera acutorostrata*	Iceland, North Atlantic
Capelin	*Mallotus villosus*	Arctic Ocean

Common name	Species	Location of population surveyed
Swordfish	*Xiphias gladius*	North Atlantic
Cory's shearwater	*Calonectris diomedea*	Malta, Mediterranean Sea/Black Sea
Bottlenose dolphin	*Tursiops aduncus*	United Arab Emirates, Indian Ocean
Dugong	*Dugong dugon*	Kenya, Indian Ocean
Yellowfin tuna	*Thunnus albacares*	Indian Ocean
Jackass penguin	*Spheniscus demersus*	South Africa, South Atlantic
Black-browed albatross	*Thalassarche melanophris*	Southern Ocean
Polar bear	*Ursus maritimus*	Arctic Ocean
Loggerhead turtle	*Caretta caretta*	Wreck Island, Australia
New Zealand snapper	*Pagrus auratus*	Hauraki Gulf/Bay of Plenty, South Pacific

FRESHWATER SPECIES

An estimated 45 000 vertebrate species live in or around lakes, rivers, streams, and wetlands. Their population trends are indicative of the health of the world's freshwater ecosystems.

The freshwater index (Figure 13) shows average trends in 344 species (of which 287 occur in temperate zones and 51 in tropical zones). Species populations in both declined by about 30 per cent between 1970 and 2003. There is a difference in trends between freshwater birds, which appear to have been relatively stable, and other freshwater species, which have declined on average by about 50 per cent over the same period. The main drivers are habitat destruction, overfishing, invasive species, pollution, and the disruption of river systems for water supplies.

The decline in the freshwater index is less than previously, as it has been aggregated differently to bring it in line with the terrestrial index (see technical notes, page 37). It also contains a number of new species.

The alteration and damming of river systems for industrial and domestic use, irrigation, and hydroelectric power have fragmented more than half of the world's large river systems. Some 83 per cent of their total annual flow is affected – 52 per cent moderately; 31 per cent severely – with Europe's river flow being the most regulated and Australasia's the least (Figure 15). Worldwide, the amount of water stored in reservoirs behind dams is three to six times the quantity contained in rivers.

Fragmentation and alteration of natural river flows affects the productivity of wetlands, flood plains, and deltas, disrupts the migration and dispersal of fish, and causes declines in freshwater species.

Mediterranean woodlands, deserts and xeric shrublands, temperate broadleaved forests, and temperate, flooded, and montane grassland biomes all have more than 70 per cent (by catchment area) of their large river systems severely disrupted, primarily for irrigation (Figure 14). Tundra is the only biome where they are mainly unaffected.

Figure 13: Temperate and tropical freshwater Living Planet Indices. Temperate and tropical species populations declined by around 30 per cent overall from 1970 to 2003.

Figure 14: Fragmentation and flow regulation of large river systems, by biome. Percentage of the total area within catchments of 14 terrestrial biomes severely or moderately impacted by dams (Nilsson *et al*., 2005). See Table 6, page 37.

Figure 15: Fragmentation and flow regulation of large river systems, by region. Percentage of total annual discharge severely or moderately impacted by dams (Nilsson *et al.,* 2005). See Table 6, page 37.

Map 4: Trends in selected freshwater species populations. These are not necessarily indicative of general species trends in each region, but illustrative of the kinds of data used in the Living Planet Index.

Fig. 13: **TEMPERATE AND TROPICAL FRESHWATER LIVING PLANET INDICES,** 1970–2003

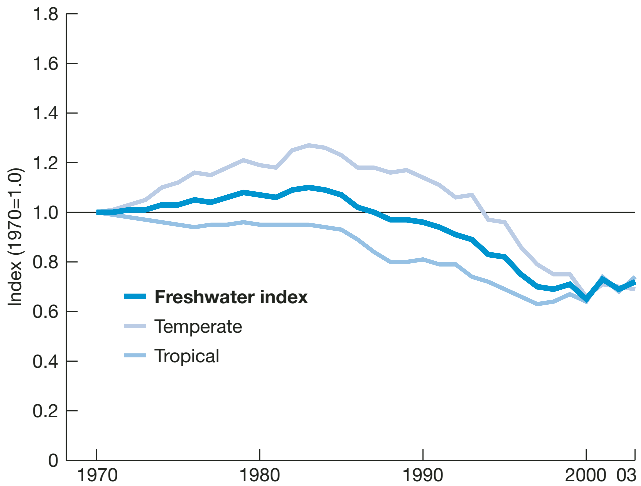


Fig. 14: **FRAGMENTATION AND FLOW REGULATION OF LARGE RIVER SYSTEMS, BY BIOME**

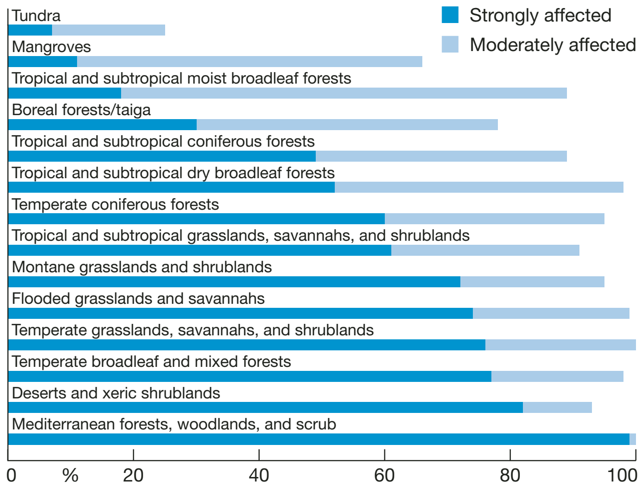
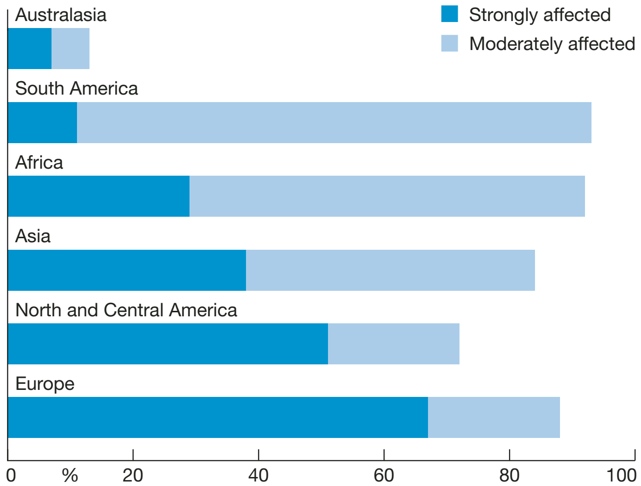
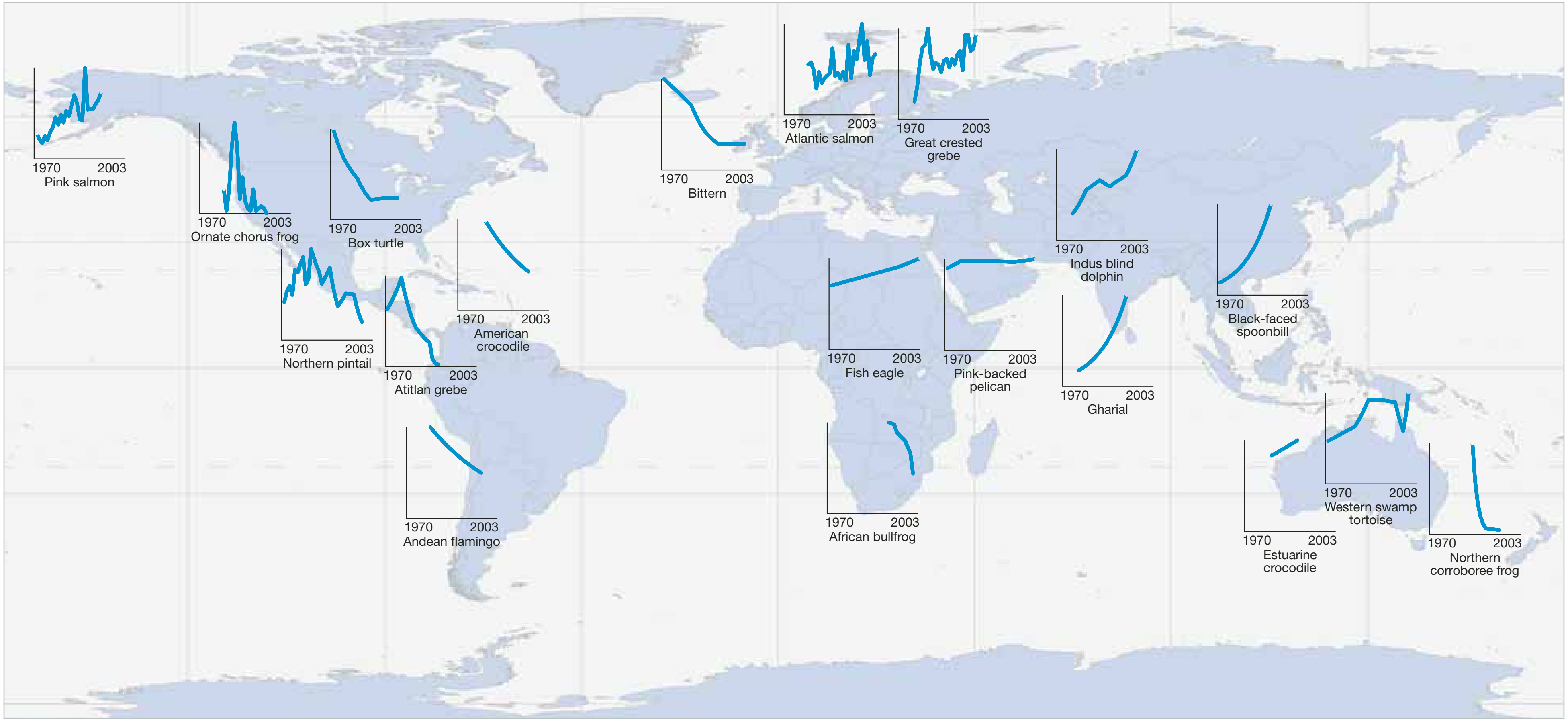


Fig. 15: **FRAGMENTATION AND FLOW REGULATION OF LARGE RIVER SYSTEMS, BY REGION**





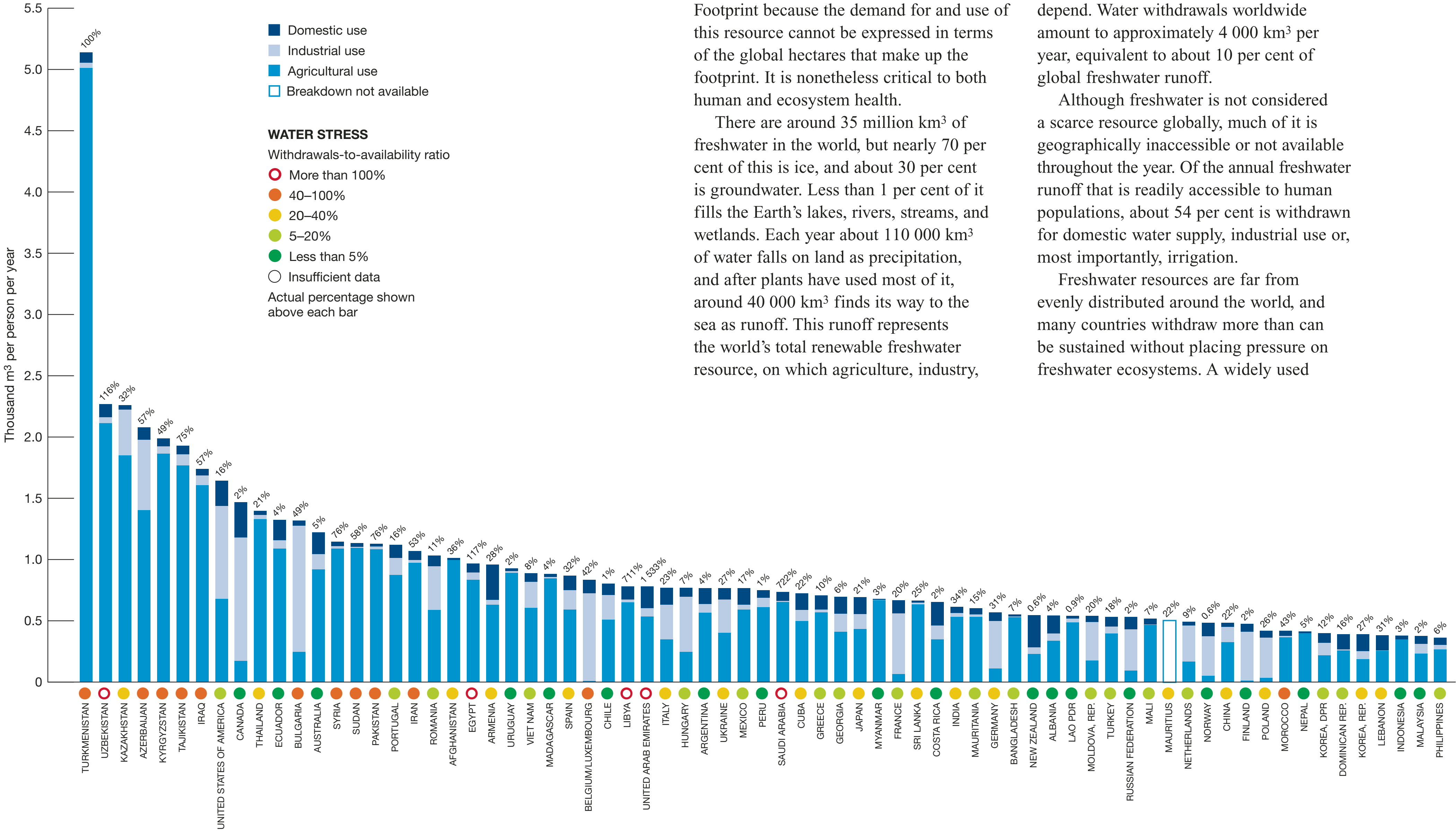
Map 4: **TRENDS IN SELECTED FRESHWATER SPECIES POPULATIONS,** 1970–2003

Common name	Species	Location of population surveyed
Pink salmon	*Oncorhynchus gorbuscha*	Alaska, United States
Ornate chorus frog	*Pseudacris ornata*	Rainbow Bay, S. Carolina, United States
Box turtle	*Terrapene carolina*	Maryland, United States
Northern pintail	*Anas acuta*	Mexico
Atitlan grebe	*Podilymbus gigas*	Guatemala
American crocodile	*Crocodylus acutus*	Lago Enriquillo, Dominican Republic
Andean flamingo	*Phoenicoparrus andinus*	Andes Mountains, South America
Bittern	*Botaurus stellaris*	United Kingdom
Atlantic salmon	*Salmo salar*	Norway
Great crested grebe	*Podiceps cristatus*	Sweden

Common name	Species	Location of population surveyed
Fish eagle	*Haliaeetus vocifer*	Uganda
Pink-backed pelican	*Pelecanus rufescens*	Uganda
African bullfrog	*Pyxicephalus adspersus*	Midrand, South Africa
Indus blind dolphin	*Platanista minor*	Indus River, Pakistan
Gharial	*Gavialis gangeticus*	India
Black-faced spoonbill	*Platalea minor*	Hong Kong, China
Estuarine crocodile	*Crocodylus porosus*	Australia
Western swamp tortoise	*Pseudemydura umbrina*	Ellen Brook Reserve, Perth, Australia
Northern corroboree frog	*Pseudophryne pengilleyi*	Ginini Flats, Australia

WATER WITHDRAWALS

Fig. 16: ANNUAL WATER WITHDRAWALS PER PERSON, BY COUNTRY, 1998–2002



Freshwater is not included in the Ecological Footprint because the demand for and use of this resource cannot be expressed in terms of the global hectares that make up the footprint. It is nonetheless critical to both human and ecosystem health.

There are around 35 million km³ of freshwater in the world, but nearly 70 per cent of this is ice, and about 30 per cent is groundwater. Less than 1 per cent of it fills the Earth's lakes, rivers, streams, and wetlands. Each year about 110 000 km³ of water falls on land as precipitation, and after plants have used most of it, around 40 000 km³ finds its way to the sea as runoff. This runoff represents the world's total renewable freshwater resource, on which agriculture, industry, and domestic water supply ultimately depend. Water withdrawals worldwide amount to approximately 4 000 km³ per year, equivalent to about 10 per cent of global freshwater runoff.

Although freshwater is not considered a scarce resource globally, much of it is geographically inaccessible or not available throughout the year. Of the annual freshwater runoff that is readily accessible to human populations, about 54 per cent is withdrawn for domestic water supply, industrial use or, most importantly, irrigation.

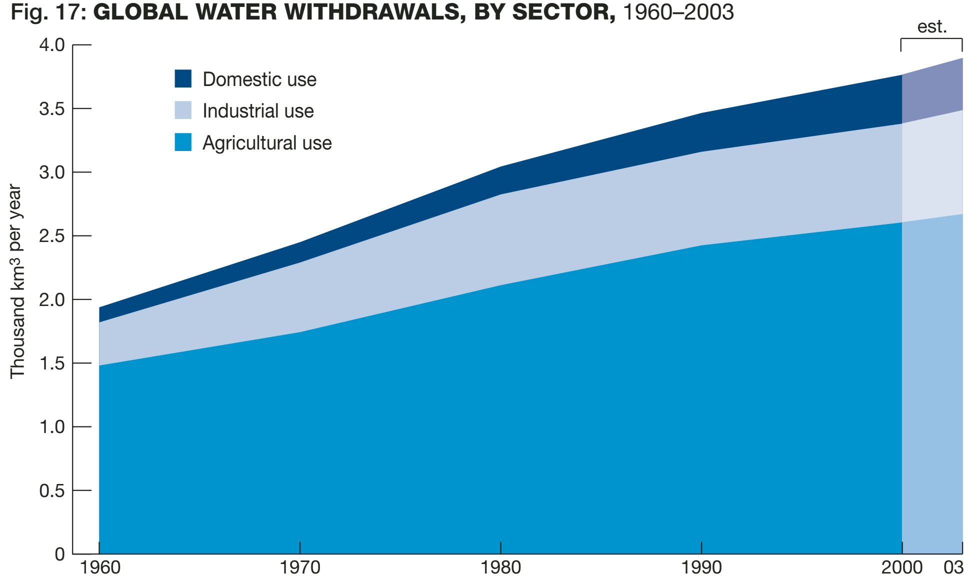
Freshwater resources are far from evenly distributed around the world, and many countries withdraw more than can be sustained without placing pressure on freshwater ecosystems. A widely used indicator of water stress is the withdrawals-to-availability (wta) ratio. This measures a population's total annual water withdrawals against the annual renewable water resource available to it: the higher the ratio, the greater the stress being placed on freshwater resources. According to this measure, withdrawals of 5–20 per cent represent mild stress, 20–40 per cent moderate stress, and above 40 per cent severe stress.

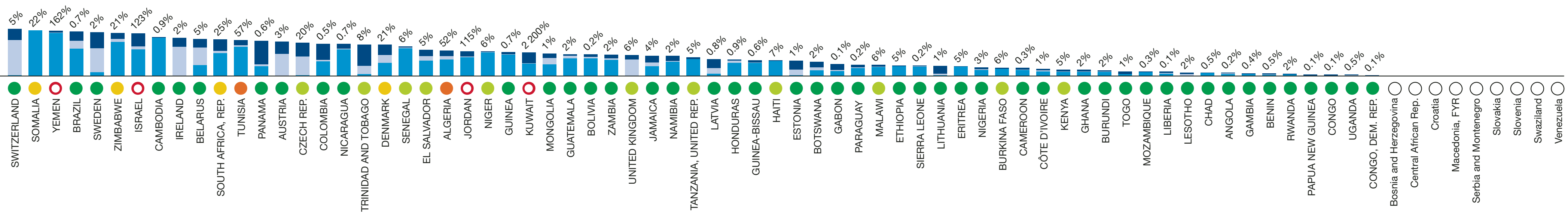
Where water use, particularly for irrigation, cannot be sustained by withdrawing surface runoff from rivers, groundwater sources are tapped. Increased pumping of groundwater resources is drawing down the water table in many parts of the world, especially in the western United States of America, northern China, and many parts of South Asia, at rates in excess of a metre per year. Globally, it is estimated that 15–35 per cent of irrigation withdrawals are not sustainable.

Figure 16: Annual water withdrawals per person, by country. More than 40 per cent, severe stress; 20–40 per cent, moderate stress; 5–20 per cent, mild stress (FAO, 2004; Shiklomanov, 1999).

Figure 17: Global water withdrawals, by sector. Water use doubled between 1960 and 2000, which means that average per person water use has remained constant. Agriculture uses about 70 per cent of global water withdrawals and industry about 20 per cent (FAO, 2004; Shiklomanov, 1999).

Fig. 17: **GLOBAL WATER WITHDRAWALS, BY SECTOR,** 1960–2003





ECOLOGICAL FOOTPRINT

Fig. 18: ECOLOGICAL FOOTPRINT PER PERSON, BY COUNTRY, 2003

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 2003 the global Ecological Footprint was 14.1 billion global hectares, or 2.2 global hectares per person (a global hectare is a hectare with world-average ability to produce resources and absorb wastes). The total supply of productive area, or biocapacity, in 2003 was 11.2 global hectares, or 1.8 global hectares per person.

The footprint of a country includes all the cropland, grazing land, forest, and fishing grounds required to produce the food, fibre, and timber it consumes, to absorb the wastes emitted in generating the energy it uses, and to provide space for its infrastructure.

People consume resources and ecological services from all over the world, so their footprint is the sum of these areas, wherever they may be on the planet.

Humanity's footprint first grew larger than global biocapacity in the 1980s; this overshoot has been increasing every year since, with demand exceeding supply by about 25 per cent in 2003. This means that it took approximately a year and three months for the Earth to produce the ecological resources we used in that year.

Separating the Ecological Footprint into its individual components demonstrates how each one contributes to humanity's overall demand on the planet. Figure 19 tracks these components in constant 2003 global hectares, which adjust for annual changes in the productivity of an average hectare. This makes it possible to compare absolute levels of demand over time. The CO_2 footprint, from the use of fossil fuels, was the fastest-growing component, increasing more than ninefold from 1961 to 2003.

How is it possible for an economy to continue operating in overshoot? Over time, the Earth builds up ecological assets, like forests and fisheries. These accumulated stocks can, for a limited period, be harvested faster than they regenerate. CO_2 can also be emitted into the atmosphere faster than it is removed, accumulating over time.

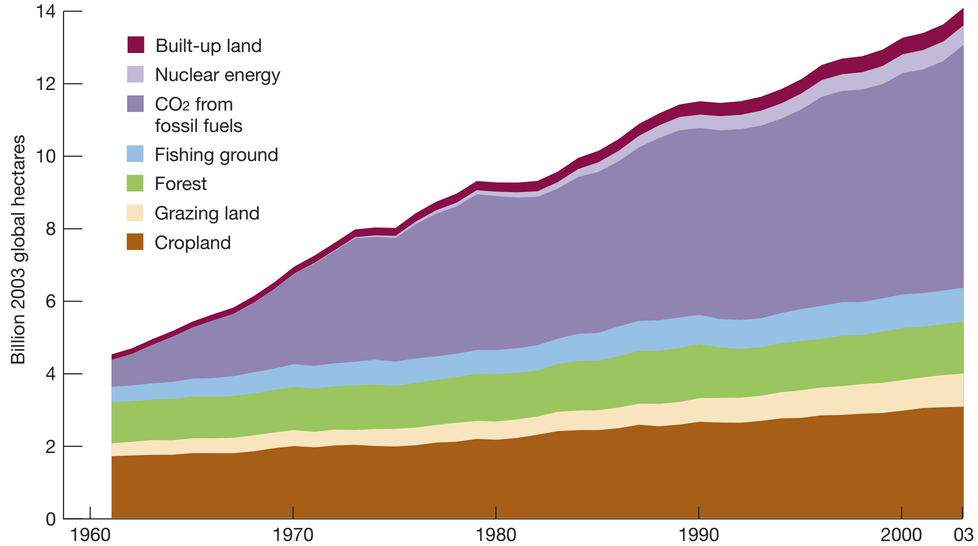
For three decades now we have been in overshoot, drawing down these assets and increasing the amount of CO_2 in the air. We cannot remain in overshoot much longer without depleting the planet's biological resources and interfering with its long-term ability to renew them.

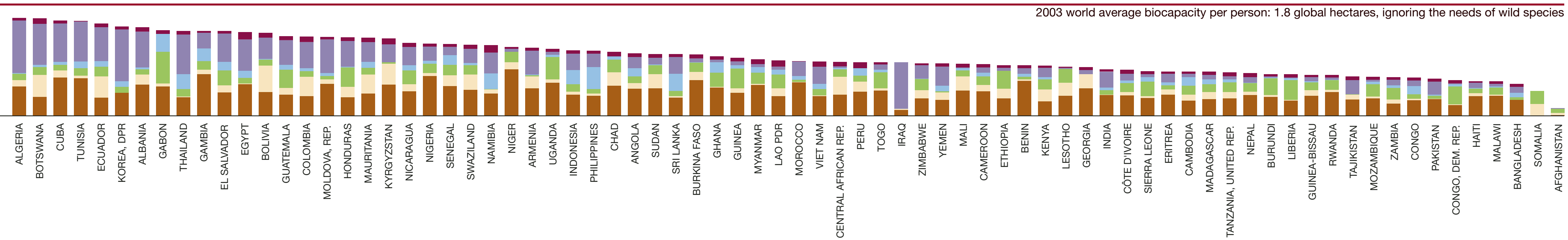
Figure 18: The Ecological Footprint per person, by country. This includes all countries with populations greater than 1 million for which complete data are available.

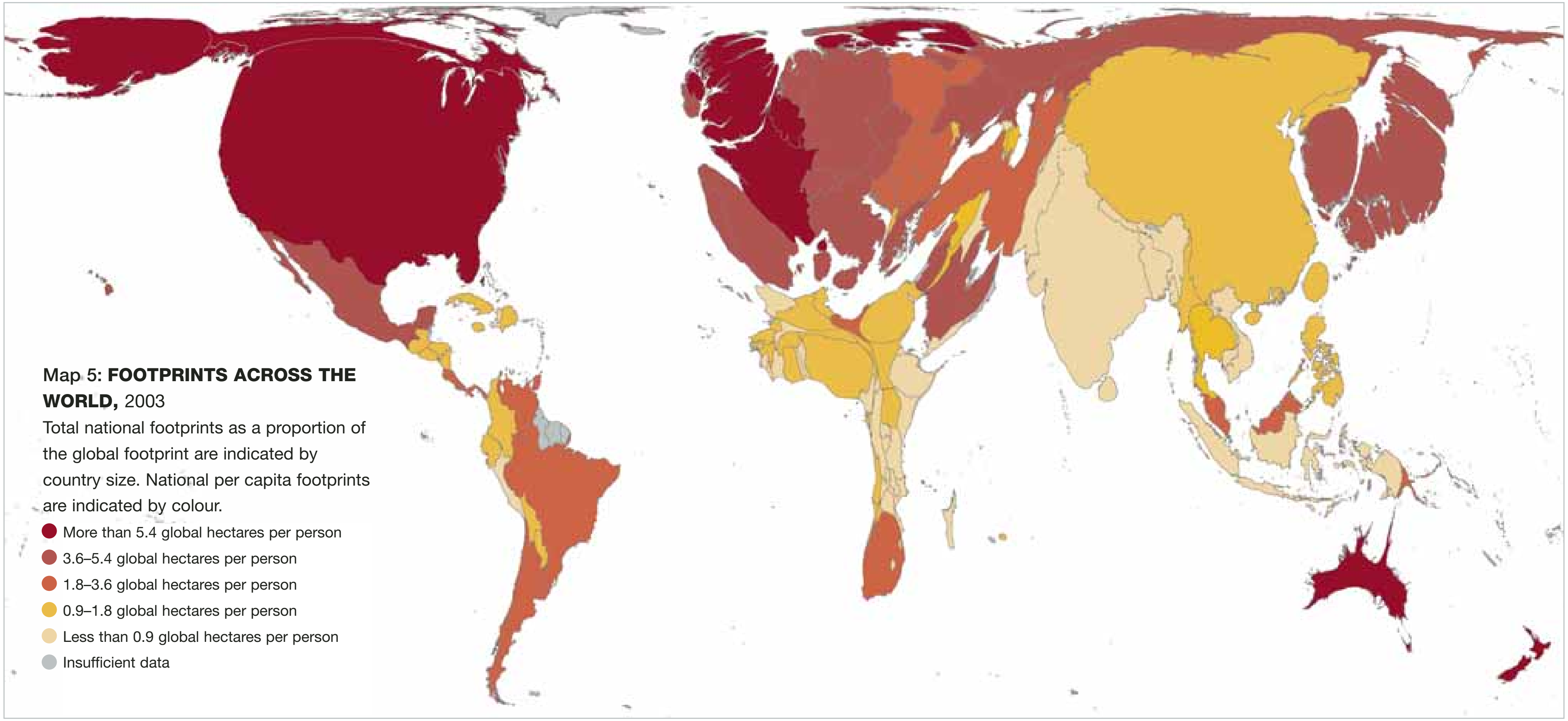
Figure 19: Ecological Footprint by component. The footprint is shown in constant 2003 global hectares.

In both diagrams, and throughout this report, hydropower is included in the built-up land footprint and fuelwood within the forest footprint.

Fig. 19: **ECOLOGICAL FOOTPRINT BY COMPONENT,** 1961–2003







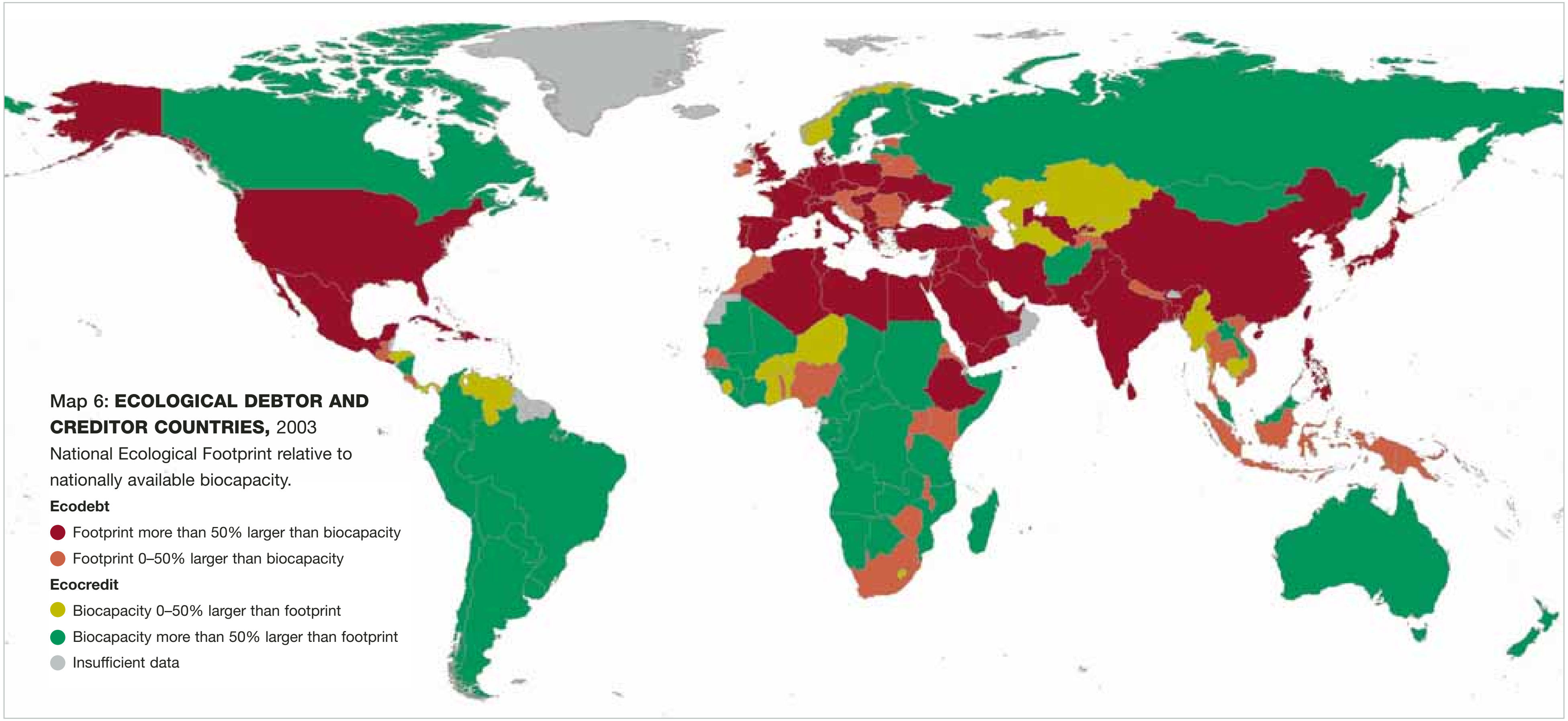
Map 5: **FOOTPRINTS ACROSS THE WORLD,** 2003
Total national footprints as a proportion of the global footprint are indicated by country size. National per capita footprints are indicated by colour.

A country's Ecological Footprint is determined by its population, the amount consumed by its average resident, and the resource intensity used in providing the goods and services consumed. It includes the area required to meet people's consumption from cropland (food, animal feed, fibre, and oil); grassland and pasture (grazing of animals for meat, hides, wool, and milk); fishing grounds (fish and seafood); and forest (wood, wood fibre, pulp, and fuelwood). It also estimates the area required to absorb the CO_2 released when fossil fuels are burned, less the amount taken up by the oceans. The footprint of nuclear power, about 4 per cent of the global footprint, is included by estimating the footprint for the equivalent amount of energy from fossil fuels. The area used for a country's infrastructure, including hydropower, is included as the built-up land footprint component.

A country's biocapacity is a function of the number and type of biologically productive hectares within its borders, and their average yields. More intensive management can boost yields, but if additional resources are used this also increases the footprint.

In Map 5, each country's size represents its share of the global Ecological Footprint. The colour of each country indicates the per capita footprint of its citizens.

Countries with ecological deficits use more biocapacity than they control within their own territories. Ecological creditor



countries have footprints smaller than their own biocapacity. Map 6 shows which countries are ecological debtors and which are ecological creditors, with the colour indicating footprint relative to biocapacity.

Countries running ecological deficits can maintain their resource consumption in several ways. They can use their own ecological assets faster than they regenerate each year – for example, depleting existing forest stocks rather than just harvesting the amount grown each year; they can import resources from other countries; or they can generate more wastes, such as CO_2, than can be absorbed by the ecosystems within their own borders.

Ecological creditors are endowed with ecological reserves, but this does not necessarily mean that all their assets are well managed and not subject to overharvesting or degradation.

With continuing global overshoot, debtor and creditor countries alike will realize the significance of ecological assets for both economic competitiveness and national security, and the value of curbing their footprints and maintaining their biocapacity.

As national ecological deficits continue to increase, the predominant geopolitical line may shift from the current economic division between developed and developing countries, to fall between ecological debtors and ecological creditors.

THE FOOTPRINT BY REGION AND INCOME GROUP

A region's demand on the biosphere is equal to its population times its per capita footprint. In Figure 20 the height of each bar is in proportion to a region's average footprint per person, the width to its population, and the area to the region's total Ecological Footprint.

A comparison of each region's footprint with its biocapacity shows whether that region has an ecological reserve or is running a deficit. Even with its considerable biocapacity, North America has the largest per person deficit, with the average person using 3.7 global hectares more than the region has available. The European Union (EU) is next: with a per person deficit of 2.6 global hectares, the region is using over twice its own biocapacity. At the other extreme is Latin America: with ecological reserves of 3.4 global hectares per capita, the average person's footprint in the region is only about a third of the biocapacity available in the region per person.

There is growing recognition that ecological deficits have serious implications for regions and nations. A 2003 Global Business Network report warned that:

As global and local carrying capacities are reduced, tensions could mount around the world... Nations with the resources to do so may build virtual fortresses around their countries, preserving resources for themselves. Less fortunate nations… may initiate struggles for access to food, clean water, or energy. Unlikely alliances could be formed as defense priorities shift and the goal is resources for survival rather than religion, ideology, or national honor.. (Schwartz and Randall, 2003).

In June 1992 in Rio de Janeiro, the United Nations Conference on Environment and Development reaffirmed the importance of ensuring healthy and productive lives for all, while not exceeding nature's limits. In the 11 years after Rio, between 1992 and 2003, measured in constant global hectares, the average per person footprint in low- and middle-income countries changed little, while the average per person footprint in high-income countries increased by 18 per cent. Over the last 40 years, the average footprint in low-income countries hovered just below 0.8 global hectares per person. The energy footprint shows the largest per person disparity between high- and low-income countries. This is in part because people can eat only a finite amount of food, while energy consumption is limited primarily by consumers' ability to pay.

Figure 20: Ecological Footprint and biocapacity by region. The difference between a region's footprint (solid bars) and its biocapacity (dotted line) is its ecological reserve (+) or deficit (-).

Figure 21: Footprint by national average per person income. High-income countries' average per capita footprint more than doubled between 1961 and 2003. (See footnote, page 34, for income groups.)

Fig. 20: **ECOLOGICAL FOOTPRINT AND BIOCAPACITY BY REGION,** 2003

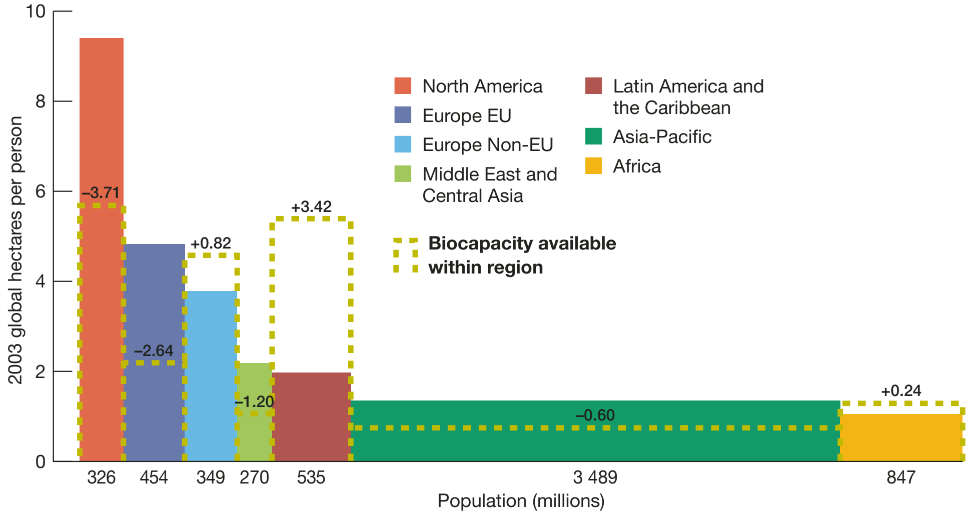
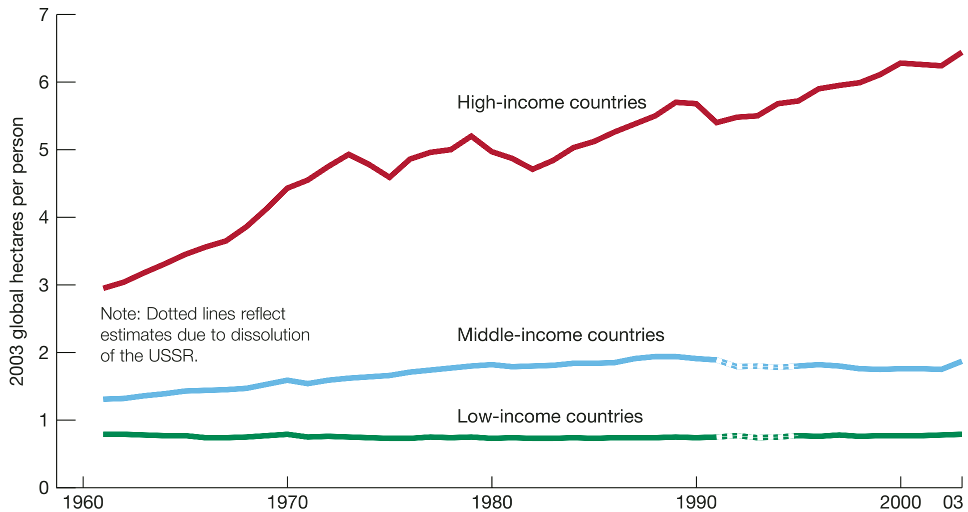


Fig. 21: **FOOTPRINT BY NATIONAL AVERAGE PER PERSON INCOME,** 1961–2003



Sustainable development is a commitment to "improving the quality of human life while living within the carrying capacity of supporting ecosystems" (IUCN *et al.*, 1991).

Countries' progress towards sustainable development can be assessed using the United Nations Development Programme's (UNDP) Human Development Index (HDI) as an indicator of well-being, and the footprint as a measure of demand on the biosphere. The HDI is calculated from life expectancy, literacy and education, and per capita GDP. UNDP considers an HDI value of more than 0.8 to be "high human development". Meanwhile, a footprint lower than 1.8 global hectares per person, the average biocapacity available per person on the planet, could denote sustainability at the global level.

Successful sustainable development requires that the world, on average, meets at a minimum these two criteria, with countries moving into the blue quadrant shown in Figure 22. As world population grows, less biocapacity is available per person and the quadrant's height shrinks.

In 2003, Asia-Pacific and Africa were using less than world average per person biocapacity, while the EU and North America had crossed the threshold for high human development. No region, nor the world as a whole, met both criteria for sustainable development. Cuba alone did, based on the data it reports to the United Nations. Changes in footprint and HDI from 1975 to 2003 are illustrated here for some nations. During this period, wealthy nations such as the United States of America significantly increased their resource use while increasing their quality of life. This did not hold for poorer nations, notably China or India, where significant increases in HDI were achieved while their per person footprints remained below global per person biocapacity.

Comparing a country's average per person footprint with global average biocapacity does not presuppose equal sharing of resources. Rather it indicates which nations' consumption patterns, if extended worldwide, would continue global overshoot, and which would not. The footprint and the HDI need supplementing by other ecological and socioeconomic measures – freshwater scarcity and civic engagement, for example – to more fully define sustainable development.

Fig. 22: **HUMAN DEVELOPMENT AND ECOLOGICAL FOOTPRINTS,** 2003

ECOLOGICAL FOOTPRINT

If we continue on our current trajectory, even optimistic United Nations projections with moderate increases in population, food and fibre consumption, and CO_2 emissions suggest that by 2050 humanity will demand resources at double the rate at which the Earth can generate them. This degree of overshoot risks not only the loss of biodiversity, but also damage to ecosystems and their ability to provide the resources and services on which humanity depends. The alternative is to eliminate overshoot. While increasing ecosystem productivity may help, reducing humanity's global footprint will be essential (Figure 23).

Costing sustainability

The sooner overshoot ends, the lower the risk of serious ecosystem disruption and its associated costs. Significant financial outlays are required for moving out of overshoot, but society will see substantial returns on these investments. To facilitate the flow of the necessary capital, several barriers must be recognized and overcome. These include the cash-flow problem inherent in needing investment now to avoid future costs; tight budgets being used for immediate crises, which divert attention from more systemic challenges; and insufficient returns to initial investors.

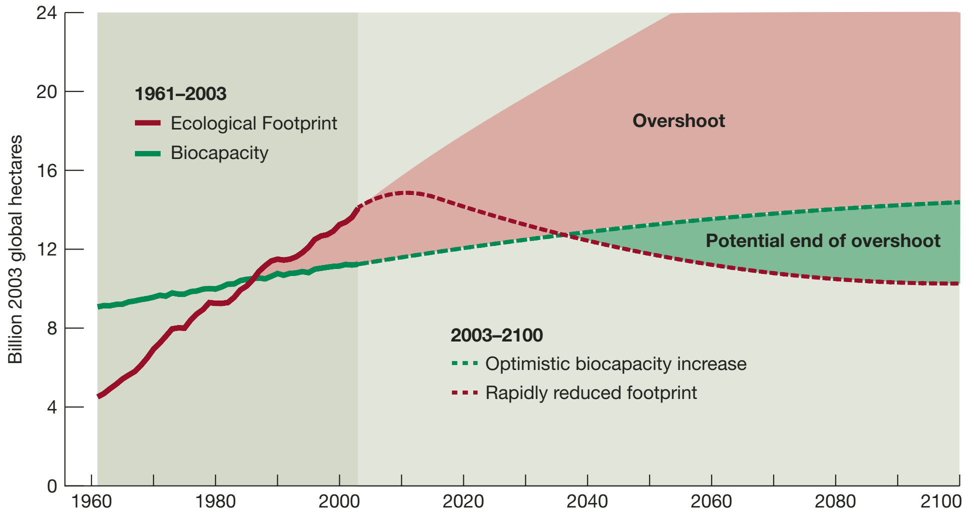
If overshoot is to end by a selected target date, economic analyses are needed to determine the percentage of world GDP that will have to be invested in reducing humanity's footprint and increasing biocapacity. Should it be 2 per cent of world GDP, or 10 per cent? Long-term investment will be required in many areas, including education, technology, conservation, urban and family planning, and resource certification systems, along with the development of new business models and financial markets. In the past, prolonged conditions of local overshoot have reduced resource availability and led to crashes in local economies (Diamond, 2005). If we are to avoid this pattern on a global scale, the relevant question may not be what it would cost to eliminate overshoot, but what it would cost not to.

Five factors determine the extent of global overshoot or, for nations, their ecological deficit. Three of these factors shape the Ecological Footprint, or demand on biocapacity: population size, the average consumption per person in that population, and the average footprint intensity per unit of consumption.

1. Population. Increase in population can be slowed and eventually reversed by supporting families in choosing to have fewer children. Offering women access to better education, economic opportunities, and health care are three proven approaches to achieving this.

2. Consumption of goods and services per person. The potential for reducing consumption depends in part on an individual's economic situation. While people living at or below subsistence may

Fig. 23: **ENDING GLOBAL OVERSHOOT**



need to increase their consumption to move out of poverty, more affluent people can reduce consumption and still improve their quality of life.

3. Footprint intensity, the amount of resources used in the production of goods and services, can be significantly reduced. This takes many forms, from energy efficiency in manufacturing and in the home, through minimizing waste and increasing recycling and reuse, to fuel-efficient cars and a reduction in the distance many goods are transported. Business and industry do react to government policies that promote resource efficiency and technical innovation – where such policies are clear and long term – as well as to consumer pressure.

Two other factors determine biocapacity, or supply: the amount of biologically productive area available, and the productivity or yield of that area.

4. Bioproductive area can be extended: degraded lands can be reclaimed through careful management. Terracing has had historical success, and irrigation, too, can make marginal lands more productive, though the gains may not persist. Above all, good land management must ensure that bioproductive areas do not diminish, being lost, for example, to urbanization, salinization, or desertification.

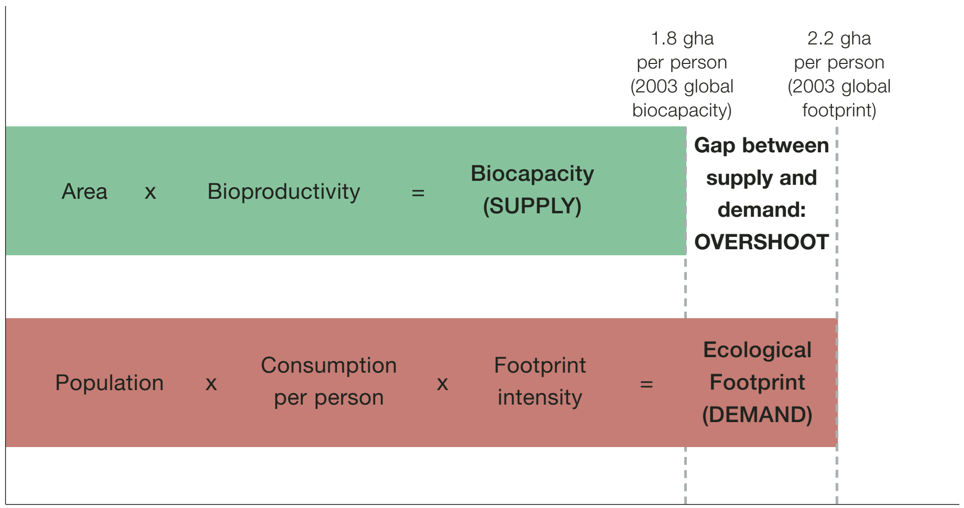
5. Bioproductivity per hectare depends both on the type of ecosystem and the way it is managed. Agricultural technologies can boost productivity, but can also diminish biodiversity. Energy intensive agriculture and heavy reliance on fertilizer may increase yields, but at the cost of a larger footprint associated with increased inputs, and may so impoverish soil that yields ultimately begin to fall.

Biocapacity can be preserved by protecting soil from erosion and other forms of degradation by safeguarding river basins, wetlands, and watersheds to secure freshwater supplies, and maintaining healthy forests and fisheries. Preventing or mitigating the impacts of climate change can also help maintain yields, as can eliminating the use of toxic chemicals that may degrade ecosystems.

How much overshoot should shrink, how the reductions are to be shared, and by when they are to be achieved are choices that have to be made by society. Footprint analysis helps to measure the consequences of choosing a particular path.

Three scenarios are explored in the pages that follow: a moderate business-as-usual scenario, based on United Nations projections; a slow-shift scenario, leading to the elimination of overshoot by the end of the century, with some biocapacity allowed for wild species as a buffer to slow biodiversity loss; and a rapid-reduction scenario, in which overshoot is ended by 2050, with a significant buffer to aid the restoration of wild species populations and their habitats.

Fig. 24: **FOOTPRINT AND BIOCAPACITY FACTORS THAT DETERMINE OVERSHOOT**



The business-as-usual scenario looks at the consequences if several moderate United Nations projections are combined. The increase in the footprint is driven by modest rates of growth in both population and demand for biocapacity. Biocapacity is initially assumed to continue increasing at the same rate that yields have risen over the past 40 years. Later, as continued overshoot impacts productive ecosystems, these gains are assumed to reverse.

By 2050, in this scenario, the total Ecological Footprints of cropland and CO_2 increase by 60 per cent, the demand for grazing land and fishing grounds by 85 per cent, and the use of forests by 110 per cent. Assuming moderate population growth, this means the average person's footprint would increase from 2.2 global hectares in 2003 to 2.6 global hectares by mid-century.

Through continuous overshoot, with its footprint each year exceeding the planet's biocapacity, humanity is accruing an ecological deficit. This debt accumulates as the sum of all the annual deficits. Thus by 2050 under the business-as-usual scenario, the debt would equal an amount corresponding to 34 years of the planet's entire biological productivity – and the years of overshoot would still be far from over.

This level of debt can be put into context by comparing it to the time it takes for a healthy forest to reach maturity: about 50 years. So a mature forest contains 50 years' worth of productivity which could, in theory, be harvested before standing stocks are totally exhausted. In practice, however, if overharvesting prevents the forest from maintaining its healthy and mature status, ecosystem degradation and collapse could result long before forest stocks have been totally used up.

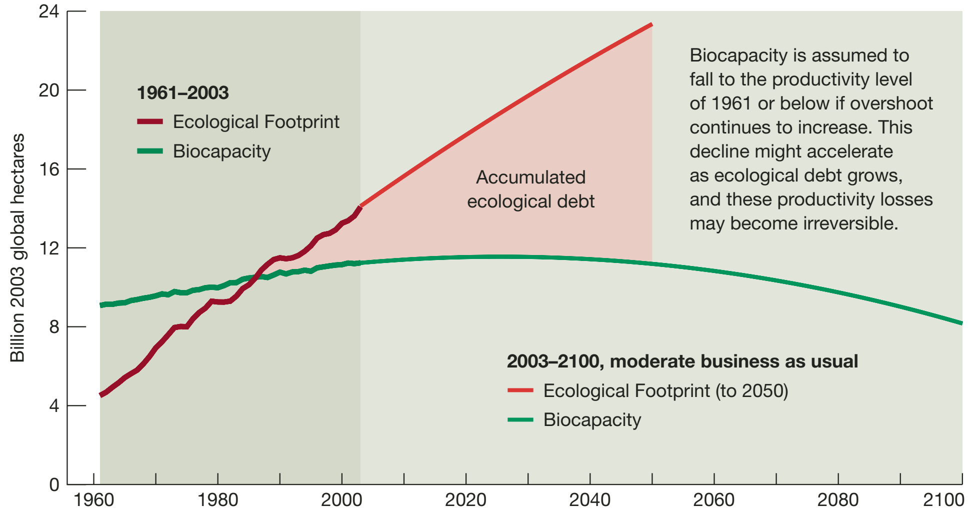
Most other productive ecosystems – cropland, grazing land, fisheries – have considerably lower standing stocks than forests, and could therefore tolerate less ecological debt accumulation before becoming depleted.

Ecological debt is therefore one measure of risk, namely that ecological resources and services will not be available in the future to meet humanity's demands.

Unlike financial capital, one type of which can easily be exchanged for another of matching monetary value, ecological assets are not readily interchangeable. The overuse of one ecological asset, such as fisheries, cannot always be offset by decreasing demand on another, such as forests.

Moreover, these asset types do not exist independently: cropland is often expanded at the expense of forest, making fewer trees available to provide wood, paper, and fuel, or to absorb CO_2. If fisheries collapse, more pressure may be put on cropland to feed humans and domestic animals. Scenarios that assume full substitutability between types of ecological assets will therefore underestimate the severity of overshoot.

Fig. 25: **BUSINESS-AS-USUAL SCENARIO AND ECOLOGICAL DEBT**



The slow-shift scenario shows the results of a concerted effort to gradually bring humanity out of overshoot by 2100, and establish a modest biocapacity buffer to slow biodiversity loss. To achieve this, global CO_2 emissions will have to be cut by 50 per cent by the end of the century. The harvest of wild fish needs to be reduced by 50 per cent in order to bring total wild catch down to a potentially sustainable level. Demand on cropland and grazing land is assumed, in this scenario, to increase at half the rate of population increase, in part due to a lower percentage of meat in the average person's diet. In contrast, consumption of forest products grows by 50 per cent in order to compensate for decreased use of fossil-based fuels, chemicals, and other materials. Compared with 2003, these combined changes result in humanity's total Ecological Footprint being 15 per cent smaller in 2100 than in 2003. If biocapacity gains can be sustained, resulting in a 20 per cent increase by 2100, and population growth remains moderate, the average person's Ecological Footprint would fall from 2.2 global hectares to around 1.5 global hectares. Overshoot would end about two decades before the close of the century, by which time about 10 per cent of the planet's biological productivity would have been allocated for the use of wild species.

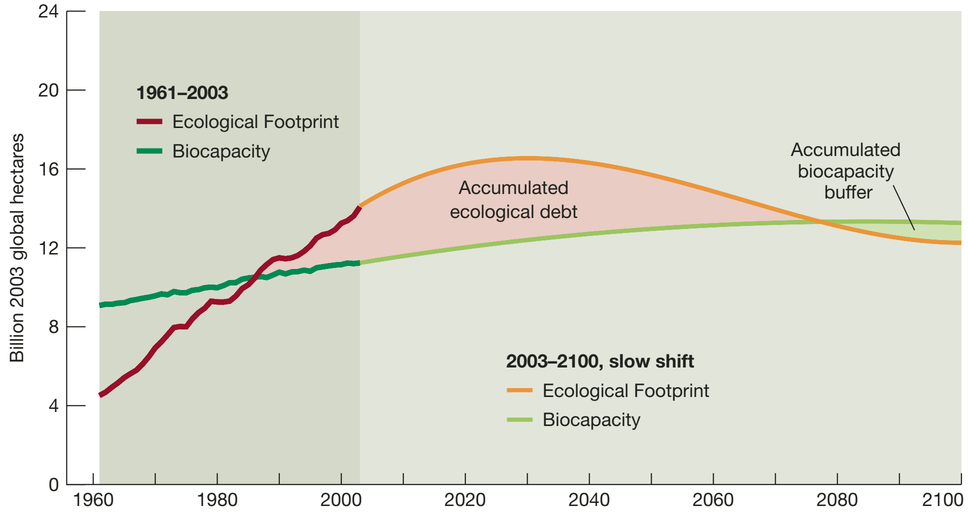
Energy for the future

The largest component of the 2003 Ecological Footprint is the demand placed on the biosphere by emissions of CO_2 from burning fossil fuels. Many geologists expect that peak production of oil may occur globally within the next two to three decades. Yet large reserves of coal, oil sands, and other more expensive carbon fuels exist which, without stringent controls, could lead to an emissions increase through the coming century.

What are the possibilities for reducing dependence on fossil fuels? A recent analysis suggests that a combination of seven major shifts, including a 25 per cent reduction in emissions from buildings, an increase in fuel economy in 2 billion cars from an average of 8 to 4 litres per 100 kilometres, a 50-fold increase in wind power, and a 700-fold increase in solar power would be necessary just to keep emissions in 2050 equal to their level today (Pacala and Socolow, 2004). These shifts, however, would not stabilize the CO_2 concentration in the atmosphere – just maintain the current rate of increase. Considerably stronger measures will be necessary to achieve the 50 per cent reduction included in this scenario.

The challenge is to increase energy supply whilst reducing CO_2 emissions without shifting the burden on to other parts of the biosphere. All energy sources, be they fossil fuels or renewables, have an Ecological Footprint. Changing the fuel mix can shift the burden from one part of the biosphere to another. The main forms of renewable energy in use today – hydropower, wind power, and biomass – all reduce CO_2 emissions when substituted for fossil fuels, but increase demand on land.

Fig. 26: **SLOW-SHIFT SCENARIO AND ECOLOGICAL DEBT**



RAPID REDUCTION

The rapid-reduction scenario depicts an aggressive effort to move humanity out of overshoot by 2050. By mid-century, the accumulated ecological debt would equal less than eight years of the Earth's biological productivity. The scenario also allows for 30 per cent of biocapacity to be used by wild species by 2100: according to some ecologists, however, this is still not enough to stem biodiversity loss (Wilson, 2002).

This scenario assumes a reduction in CO_2 emissions of 50 per cent by 2050 and 70 per cent by 2100. The absolute consumption of cropland and grazing land rises only 15 per cent by 2100. Under median population projections, this requires a 23 per cent decrease in the per person cropland and grazing land footprints. That is achievable without decreasing calorific intake or the nutritional value of food consumed by reducing the proportion of global crop used for animal feed.

It also assumes an optimistic growth in biocapacity – nearly 30 per cent by 2100 – brought about by increases in cropland, fisheries, and forest yields through improved technology and management.

The rapid-reduction scenario results in humanity's footprint being 40 per cent smaller in 2100 than in 2003. It requires the greatest initial economic investment, but in minimizing ecological debt the fastest, it carries the lowest ecological risk.

Biodiversity and human demand

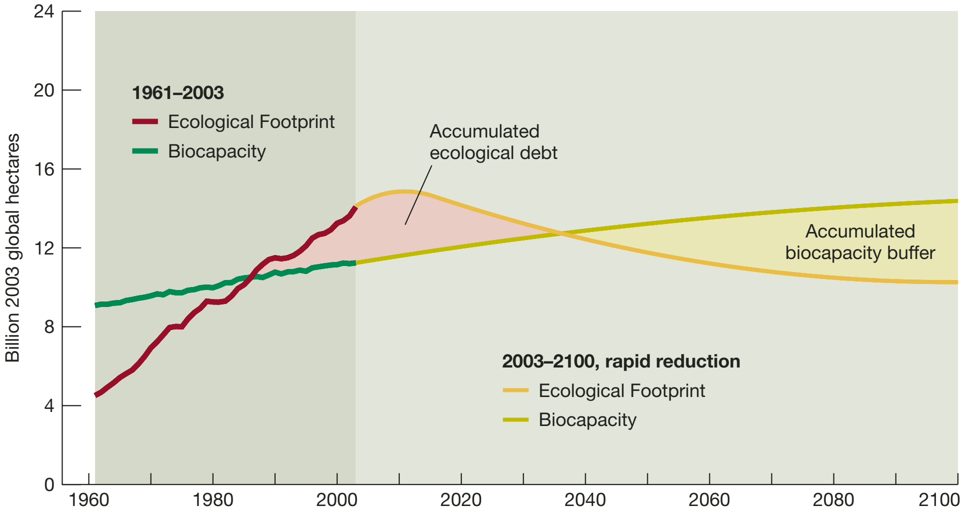
While significant effort will be required to bring human demand within the biosphere's productive capacity, securing biodiversity may require reducing pressure even further in order to leave a portion of the Earth's productivity for the use of wild species.

Animals compete with people for food and habitat. Plants can be crowded out by widespread cultivation of a limited set of domesticated species and by plantation forestry.

Increasing biocapacity – by expanding the productive area or boosting yields, for example through irrigation – can play an important role in bringing humanity out of overshoot. However, these increases may also have costs – energy intensive farming methods can add to the carbon footprint; expansion of grazing areas into forest can endanger wild plant and animal species; irrigation can lead to salinization or groundwater depletion, and the use of pesticides and fertilizers can negatively impact wildlife far downstream or downwind from where they are applied.

These biocapacity increases must therefore be carefully managed if they are to help reduce both overshoot and the threat to biodiversity.

Fig. 27: **RAPID-REDUCTION SCENARIO AND ECOLOGICAL DEBT**



SHRINK AND SHARE

Eliminating overshoot means closing the gap between humanity's Ecological Footprint and the planet's biocapacity. If the global community agrees in principle, decisions are then needed on how much to shrink its footprint, and how this reduction in aggregate human demand is to be shared between individuals and populations.

Possible allocation strategies could include an absolute allotment of footprint shares, or an initial distribution of rights or permits to consume, which could then be traded between individuals, nations, or regions. Any acceptable global strategy will be influenced by ethical and economic as well as ecological considerations.

The allocation strategies discussed here illustrate how the current regional distribution could change, based either on the relative proportion of current biocapacity or world population in each region. Allocations could be fixed, or varied in proportion to a region's changing percentage of either factor.

Targeted reductions for regional footprints might be set proportional to current baselines (Figure 28), in a similar way to the framework adopted by the Kyoto Protocol for greenhouse gases. Some might argue that this rewards regions with historically high levels of consumption and population, while penalizing those that have already begun to reduce their total demand on ecosystems.

A second option might see each region being allocated a share of the global footprint in proportion to its own biocapacity (Figure 29). Regions could augment their biocapacity through trade with regions that have biocapacity reserves. This strategy could be modified to address the very large discrepancies in available biocapacity that currently exist between regions and nations.

The global footprint could be shared on an equal per capita basis (Figure 30), with mechanisms established to enable nations and regions to trade their initial excess allocations. Similar to a proposal for sharing rights to greenhouse gas emissions (Meyer, 2001), such a strategy would in one sense be strictly egalitarian. But this approach, which is probably politically unrealistic, rewards countries with growing populations, ignores historical circumstance, and disregards varying needs in different parts of the world.

Negotiating, selecting, and combining these or other allocation schemes will require unprecedented global cooperation if the shrinking of humanity's footprint is to be achieved. Developing the logic behind frameworks for reducing human demand is straightforward when compared to the challenge of implementing the process.

In considering the costs and complexity of meeting this challenge, the global community may want to take into account not only how it will afford to undertake such a project, but also the ecological and human welfare consequences of failing to do so.

Fig. 28: **ECOLOGICAL FOOTPRINT BY CURRENT REGIONAL USE**

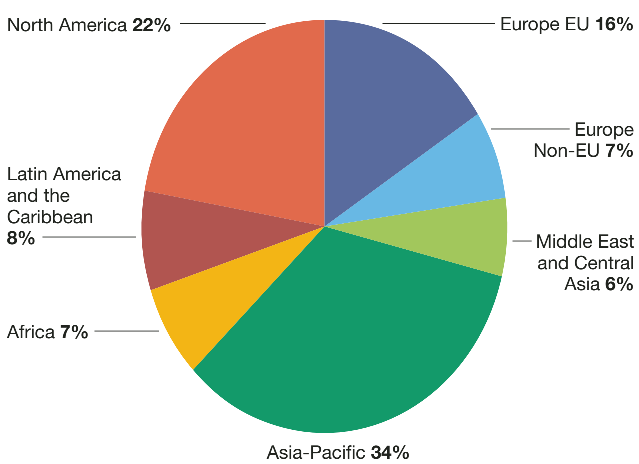


Fig. 29: **GLOBAL BIOCAPACITY BY REGION**

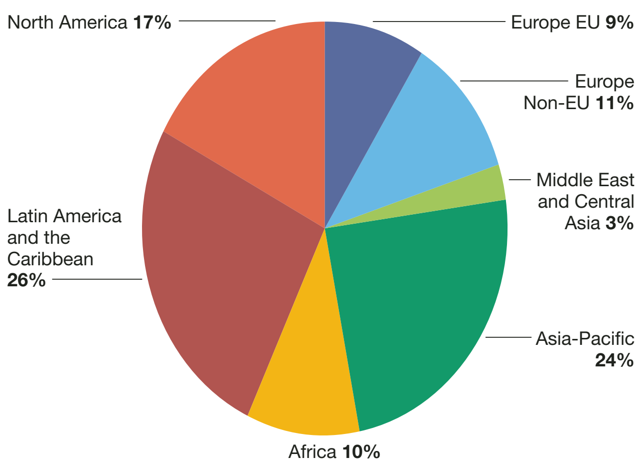
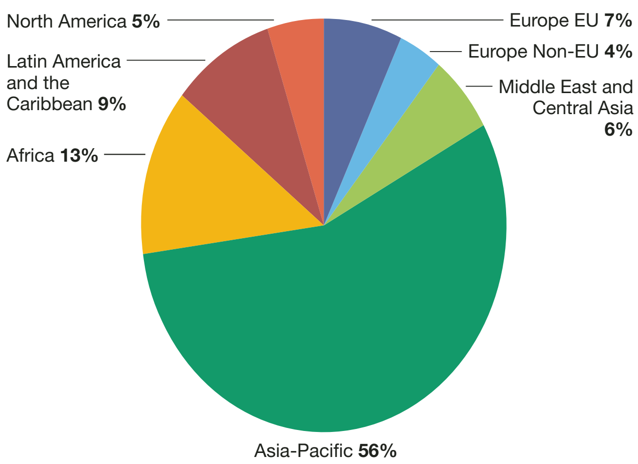


Fig. 30: **GLOBAL POPULATION BY REGION**



Focus on "slow things" first

Time is of the essence. Moderate United Nations projections for the growth of the world population and consumption show humanity using double the bioproductivity of planet Earth by 2050. Reaching this level of consumption may be impossible, however, as the natural capital being used to enable this overshoot may well be depleted before the mid-century mark.

Efforts to stem this rapid escalation of overshoot and avoid ecosystem collapse must take into account the slow response times of human populations and infrastructure. Even after birth rates fall below replacement levels, populations continue to expand for many years. Life expectancy has more than doubled in the 20th century alone – a child born today will, on average, consume resources for the next 65 years. Human-made infrastructure, too, can last many decades.

Figure 31 compares typical lifespans for some human and physical assets with the timeframe for the growth of overshoot in a future business-as-usual scenario based on the United Nations projections. Together, the people born and the infrastructure built today will shape resource consumption for much of the rest of the century.

The assets we create can be future-friendly, or not. Transport and urban infrastructures become traps if they can only operate on large footprints. In contrast, future-friendly infrastructure – cities designed as resource efficient, with carbon-neutral buildings and pedestrian and public-transport oriented systems – can support a high quality of life with a small footprint. If, as is now predicted, the global population grows to 9 billion, and if we want to leave a minimal buffer for the preservation of some biodiversity, we need to find ways for the average person to live well on less than half the current global average footprint.

The longer infrastructure is designed to last, the more critical it is to ensure that we are not building a destructive legacy that will undermine our social and physical well-being. Cities, nations, and regions might consider how economic competitiveness will be impacted if economic activity is hampered by infrastructure that cannot operate without large resource demands.

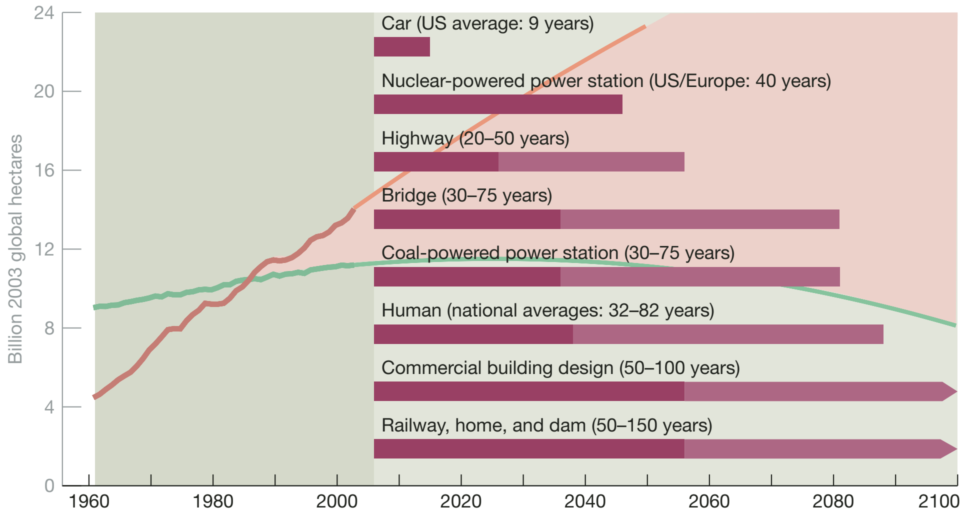
Accurate and relevant information

If we do not measure, we cannot effectively manage. Without financial accounting, businesses would operate in the dark, risking bankruptcy. Without resource accounting, ecological deficits and overshoot go unnoticed and are likely to persist. By the time the effects of overshoot become apparent, it may be too late to change course and avoid ecological bankruptcy. The collapse of fisheries off the east coast of Canada and the severe effects of deforestation in Haiti are two unfortunate examples.

Resource accounting and reporting are essential to combating climate change, the preservation of fisheries stocks, and international agreements for sharing water

Figure 31: Moderate United Nations projections suggest that humanity's footprint will grow to double the Earth's capacity within five decades. The lifespan of infrastructure put in place today to a large extent determines resource consumption for decades to come, and can lock humanity into this ecologically risky scenario.

Fig. 31: **LIFESPANS OF PEOPLE, ASSETS, AND INFRASTRUCTURE**



rights. These and other measures designed to protect ecological assets help prevent and mitigate environmental crises and their socioeconomic consequences. They can be used to establish baselines, set targets, and monitor success or failure of sustainability strategies, as shown in Figure 32.

The managerial usefulness of accounting measures like the Living Planet Index and the Ecological Footprint is attested to by their recent adoption as indicators for the 2010 targets of the Convention on Biological Diversity. Complemented by measures that track other key aspects of the biosphere and human well-being, they help provide the full set of information needed to keep us on target as we invent the path to a sustainable future.

Driving sustainability through innovation

Which strategies will succeed? Effective sustainability strategies invite participation and stimulate human ingenuity. Such strategies evoke images of an attractive future and work to build consensus. These are the common features of successful pioneering urban designs such as Curitiba in Brazil, Gaviotas in Colombia, and BedZED in the United Kingdom.

Innovative approaches to meeting human needs are called for if we are to move beyond the belief that greater well-being necessarily entails more consumption, especially in societies where basic needs are already being met. Systems thinking plays a key role: it helps to identify synergies and ensure that proposed solutions bring about an overall footprint reduction, rather than simply shifting demand from one ecosystem to another.

Experts from many disciplines have important roles to play in the transition to a sustainable society. Social scientists can study institutional arrangements to determine how to effectively facilitate and move forward the necessary global dialogue and decision-making process. Engineers, architects, and urban planners can contribute knowledge on ways to transform human infrastructure and the built environment so that they enable a high quality of life while keeping ecological demand within the available resource budget. Research and planning into ways to appropriately decelerate and eventually reverse continuing population growth will also play a key role.

Ecologists, biologists, farmers, and resource managers can find ways to increase the Earth's biocapacity without putting further pressure on biodiversity, while avoiding technologies that risk significant negative consequences in the future. The development of low-impact energy sources will play an important role, as will a shift to sustainable agricultural and food production and distribution systems.

Economists in particular are needed to estimate how much of our global financial, human, and ecological resource base will be required to shift humanity's current trajectory on to a path that will remain within the biological capacity of the planet.

Fig. 32: **CATALYSING THE TRANSITION TO SUSTAINABILITY**

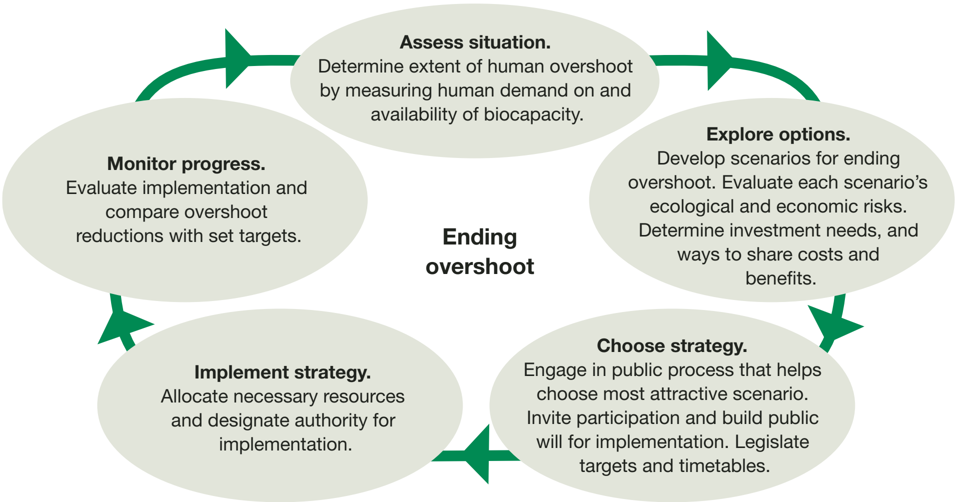


Figure 32: Catalysing the transition to sustainability depends on continuous feedback and improvement.

Table 2: **THE ECOLOGICAL FOOTPRINT AND BIOCAPACITY,** 2003

		Ecological Footprint (global hectares per person, in 2003 gha)									
Country/Region	**Population** (millions)	**Total Ecological Footprint**	Cropland	Grazing land	Forest: timber, pulp, and paper	Forest: fuelwood	Fishing ground	CO_2 from fossil fuels	Nuclear	Built-up land[1]	**Water withdrawals per person** ('000 m^3/year)[2]
WORLD	**6 301.5**	**2.23**	**0.49**	**0.14**	**0.17**	**0.06**	**0.15**	**1.06**	**0.08**	**0.08**	**618**
High-income countries	**955.6**	**6.4**	**0.80**	**0.29**	**0.71**	**0.02**	**0.33**	**3.58**	**0.46**	**0.25**	**957**
Middle-income countries	**3 011.7**	**1.9**	**0.47**	**0.17**	**0.11**	**0.05**	**0.15**	**0.85**	**0.03**	**0.07**	**552**
Low-income countries	**2 303.1**	**0.8**	**0.34**	**0.04**	**0.02**	**0.08**	**0.04**	**0.21**	**0.00**	**0.05**	**550**
AFRICA	**846.8**	**1.1**	**0.42**	**0.09**	**0.05**	**0.13**	**0.05**	**0.26**	**0.00**	**0.05**	**256**
Algeria	31.8	1.6	0.47	0.10	0.05	0.05	0.02	0.85	0.00	0.04	194
Angola	13.6	1.0	0.44	0.09	0.06	0.05	0.13	0.18	0.00	0.05	27
Benin	6.7	0.8	0.57	0.02	0.04	0.00	0.05	0.09	0.00	0.05	20
Botswana	1.8	1.6	0.30	0.36	0.06	0.07	0.04	0.66	0.00	0.10	110
Burkina Faso	13.0	1.0	0.58	0.13	0.06	0.09	0.01	0.06	0.00	0.06	63
Burundi	6.8	0.7	0.31	0.03	0.03	0.24	0.01	0.02	0.00	0.04	44
Cameroon	16.0	0.8	0.39	0.10	0.02	0.12	0.06	0.08	0.00	0.06	63
Central African Rep.	3.9	0.9	0.34	0.29	0.02	0.10	0.02	0.03	0.00	0.07	–
Chad	8.6	1.0	0.49	0.22	0.06	0.15	0.05	0.00	0.00	0.07	28
Congo	3.7	0.6	0.25	0.03	0.01	0.06	0.13	0.09	0.00	0.05	13
Congo, Dem. Rep.	52.8	0.6	0.17	0.01	0.03	0.26	0.03	0.02	0.00	0.05	7
Côte d'Ivoire	16.6	0.7	0.33	0.06	0.04	0.10	0.05	0.11	0.00	0.07	57
Egypt	71.9	1.4	0.51	0.01	0.04	0.05	0.11	0.51	0.00	0.12	969
Eritrea	4.1	0.7	0.34	0.09	0.00	0.06	0.05	0.13	0.00	0.04	75
Ethiopia	70.7	0.8	0.28	0.16	0.03	0.26	0.00	0.05	0.00	0.04	81
Gabon	1.3	1.4	0.47	0.05	0.35	0.16	0.29	0.00	0.00	0.06	92
Gambia	1.4	1.4	0.67	0.07	0.06	0.09	0.20	0.26	0.00	0.03	22
Ghana	20.9	1.0	0.45	0.02	0.03	0.20	0.17	0.04	0.00	0.05	48
Guinea	8.5	0.9	0.37	0.07	0.05	0.27	0.06	0.06	0.00	0.06	181
Guinea-Bissau	1.5	0.7	0.32	0.09	0.07	0.06	0.02	0.06	0.00	0.04	121
Kenya	32.0	0.8	0.23	0.20	0.04	0.13	0.03	0.15	0.00	0.04	50
Lesotho	1.8	0.8	0.32	0.21	0.00	0.23	0.00	0.01	0.00	0.02	28
Liberia	3.4	0.7	0.24	0.01	0.00	0.32	0.04	0.01	0.00	0.06	34
Libya	5.6	3.4	0.54	0.17	0.04	0.02	0.08	2.53	0.00	0.04	784
Madagascar	17.4	0.7	0.27	0.11	0.01	0.12	0.08	0.07	0.00	0.06	884
Malawi	12.1	0.6	0.32	0.02	0.03	0.08	0.02	0.04	0.00	0.04	85
Mali	13.0	0.8	0.40	0.23	0.02	0.08	0.04	0.01	0.00	0.06	519
Mauritania	2.9	1.3	0.36	0.31	0.00	0.11	0.10	0.32	0.00	0.07	606
Mauritius	1.2	1.9	0.44	0.07	0.14	0.00	0.28	0.77	0.00	0.17	504
Morocco	30.6	0.9	0.54	0.00	0.04	0.00	0.06	0.23	0.00	0.00	419
Mozambique	18.9	0.6	0.28	0.03	0.02	0.18	0.05	0.03	0.00	0.04	34
Namibia	2.0	1.1	0.36	0.06	0.00	0.00	0.26	0.34	0.00	0.12	153
Niger	12.0	1.1	0.75	0.11	0.03	0.14	0.00	0.05	0.00	0.03	189
Nigeria	124.0	1.2	0.64	0.05	0.05	0.10	0.05	0.22	0.00	0.05	66
Rwanda	8.4	0.7	0.38	0.04	0.04	0.12	0.00	0.03	0.00	0.04	18
Senegal	10.1	1.2	0.48	0.18	0.07	0.10	0.15	0.13	0.00	0.04	225

Biocapacity (global hectares per person, in 2003 gha)											
Total biocapacity[3]	Cropland	Grazing land	Forest	Fishing ground	Ecological reserve or deficit (-) (gha/person)	Footprint change per person (%) 1975–2003[4, 5]	Biocapacity change per person (%) 1975–2003[4, 5]	Human Development Index, 2003[6]	Change in HDI (%) 1975–2003[6]	Water withdrawals (% of total resources)[2]	Country/Region
1.78	**0.53**	**0.27**	**0.78**	**0.14**	**-0.45**	**14**	**-25**	**0.74**	**–**	**10**	**WORLD**
3.3	**1.10**	**0.19**	**1.48**	**0.31**	**-3.12**	**40**	**-14**	**0.91**	**–**	**10**	**High-income countries**
2.1	**0.50**	**0.31**	**1.05**	**0.15**	**0.18**	**14**	**-11**	**0.77**	**–**	**5**	**Middle-income countries**
0.7	**0.31**	**0.17**	**0.12**	**0.05**	**-0.09**	**8**	**-48**	**0.59**	**–**	**10**	**Low-income countries**
1.3	**0.37**	**0.51**	**0.27**	**0.08**	**0.24**	**-2**	**-42**	**–**	**–**	**4**	**AFRICA**
0.7	0.29	0.35	0.00	0.01	-0.9	51	-45	0.72	43	52	Algeria
3.4	0.24	2.35	0.29	0.44	2.4	35	-51	0.45	–	0	Angola
0.9	0.64	0.06	0.09	0.04	0.1	-7	-1	0.43	42	0	Benin
4.5	0.30	3.04	1.11	0.00	3.0	70	-51	0.57	12	2	Botswana
1.0	0.59	0.23	0.11	0.00	0.0	19	1	0.32	25	6	Burkina Faso
0.6	0.28	0.21	0.06	0.01	-0.1	-28	-44	0.38	33	2	Burundi
1.3	0.59	0.14	0.43	0.07	0.4	-16	-46	0.50	19	0	Cameroon
3.7	0.61	0.71	2.26	0.00	2.8	-5	-38	0.36	35	–	Central African Rep.
2.5	0.48	1.81	0.13	0.05	1.5	6	-45	0.34	27	1	Chad
7.8	0.20	3.88	3.52	0.15	7.2	-34	-54	0.51	13	0	Congo
1.5	0.16	0.36	0.90	0.02	0.9	-19	-52	0.39	-7	0	Congo, Dem. Rep.
2.0	0.74	0.74	0.40	0.03	1.2	-28	-43	0.42	3	1	Côte d'Ivoire
0.5	0.30	0.00	0.00	0.06	-0.9	49	1	0.66	50	117	Egypt
0.5	0.09	0.30	0.00	0.08	-0.2	-17	-53	0.44	–	5	Eritrea
0.5	0.23	0.16	0.11	0.00	-0.3	-5	-51	0.37	–	5	Ethiopia
19.2	0.47	4.80	12.16	1.69	17.8	6	-50	0.64	–	0	Gabon
0.8	0.33	0.15	0.07	0.25	-0.5	64	-53	0.47	65	0	Gambia
1.3	0.49	0.34	0.35	0.07	0.3	1	-36	0.52	18	2	Ghana
2.8	0.28	1.10	0.97	0.35	1.8	-13	-45	0.47	–	1	Guinea
2.9	0.37	0.43	0.56	1.49	2.2	-17	-52	0.35	36	1	Guinea-Bissau
0.7	0.20	0.35	0.04	0.03	-0.2	-5	-50	0.47	3	5	Kenya
1.1	0.14	0.91	0.00	0.00	0.3	-16	-34	0.50	8	2	Lesotho
3.1	0.20	0.83	1.75	0.27	2.4	-20	-50	–	–	0	Liberia
1.0	0.34	0.27	0.02	0.31	-2.4	13	-43	0.80	–	711	Libya
2.9	0.25	1.16	1.23	0.21	2.2	-19	-49	0.50	24	4	Madagascar
0.5	0.27	0.11	0.03	0.02	-0.1	-33	-39	0.40	3	6	Malawi
1.3	0.43	0.76	0.03	0.04	0.5	-13	-39	0.75	–	7	Mali
5.8	0.17	4.15	0.00	1.37	4.5	31	-44	0.33	45	15	Mauritania
1.2	0.20	0.00	0.01	0.82	-0.7	80	-16	0.48	40	22	Mauritius
0.8	0.40	0.00	0.11	0.27	-0.1	4	-31	0.63	47	43	Morocco
2.1	0.21	1.39	0.40	0.03	1.4	-3	-38	0.38	–	0	Mozambique
4.4	0.60	1.98	0.00	1.74	3.3	26	-48	0.63	–	2	Namibia
1.5	0.80	0.67	0.04	0.01	0.4	-17	-43	0.28	29	6	Niger
0.9	0.53	0.23	0.09	0.03	-0.2	4	-32	0.45	42	3	Nigeria
0.5	0.31	0.09	0.08	0.00	-0.1	-19	-32	0.45	32	2	Rwanda
0.9	0.33	0.26	0.09	0.14	-0.3	-19	-56	0.46	47	6	Senegal

Country/Region	Population (millions)	Total Ecological Footprint	Cropland	Grazing land	Forest: timber, pulp, and paper	Forest: fuelwood	Fishing ground	CO_2 from fossil fuels	Nuclear	Built-up land[1]	Water withdrawals per person ('000 m^3/year)[2]
		Ecological Footprint (global hectares per person, in 2003 gha)									
Sierra Leone	5.0	0.7	0.29	0.03	0.02	0.22	0.08	0.04	0.00	0.05	80
Somalia	9.9	0.4	0.01	0.18	0.01	0.21	0.00	0.00	0.00	0.00	347
South Africa, Rep.	45.0	2.3	0.38	0.23	0.12	0.05	0.05	1.35	0.06	0.05	279
Sudan	33.6	1.0	0.44	0.23	0.05	0.10	0.01	0.11	0.00	0.07	1 135
Swaziland	1.1	1.1	0.42	0.25	0.05	0.10	0.03	0.23	0.00	0.06	–
Tanzania, United Rep.	37.0	0.7	0.28	0.11	0.04	0.12	0.04	0.05	0.00	0.07	143
Togo	4.9	0.9	0.41	0.04	0.03	0.23	0.04	0.08	0.00	0.04	35
Tunisia	9.8	1.5	0.61	0.04	0.08	0.04	0.11	0.65	0.00	0.01	271
Uganda	25.8	1.1	0.53	0.05	0.09	0.28	0.04	0.05	0.00	0.05	12
Zambia	10.8	0.6	0.19	0.07	0.05	0.13	0.04	0.09	0.00	0.05	163
Zimbabwe	12.9	0.9	0.28	0.13	0.05	0.13	0.01	0.22	0.00	0.03	328
MIDDLE EAST AND CENTRAL ASIA	**346.8**	**2.2**	**0.49**	**0.13**	**0.07**	**0.00**	**0.07**	**1.35**	**0.00**	**0.07**	**1 147**
Afghanistan	23.9	0.1	0.01	0.04	0.05	0.01	0.00	0.01	0.00	0.00	1 014
Armenia	3.1	1.1	0.44	0.19	0.02	0.00	0.01	0.39	0.00	0.04	960
Azerbaijan	8.4	1.7	0.44	0.09	0.05	0.00	0.00	1.09	0.00	0.07	2 079
Georgia	5.1	0.8	0.44	0.23	0.00	0.00	0.00	0.07	0.00	0.04	697
Iran	68.9	2.4	0.52	0.13	0.04	0.00	0.08	1.52	0.00	0.09	1 071
Iraq	25.2	0.9	0.10	0.02	0.00	0.00	0.00	0.75	0.00	0.00	1 742
Israel	6.4	4.6	0.88	0.12	0.29	0.00	0.37	2.88	0.00	0.07	325
Jordan	5.5	1.8	0.49	0.07	0.08	0.01	0.20	0.82	0.00	0.09	190
Kazakhstan	15.4	4.0	0.82	0.30	0.05	0.00	0.02	2.72	0.00	0.05	2 263
Kuwait	2.5	7.3	0.42	0.05	0.12	0.00	0.19	6.38	0.00	0.18	180
Kyrgyzstan	5.1	1.3	0.50	0.34	0.02	0.00	0.00	0.29	0.00	0.10	1 989
Lebanon	3.7	2.9	0.68	0.07	0.18	0.00	0.08	1.85	0.00	0.05	384
Saudi Arabia	24.2	4.6	0.56	0.18	0.11	0.00	0.15	3.43	0.00	0.20	736
Syria	17.8	1.7	0.54	0.14	0.05	0.00	0.03	0.90	0.00	0.07	1 148
Tajikistan	6.2	0.6	0.26	0.08	0.01	0.00	0.00	0.22	0.00	0.06	1 931
Turkey	71.3	2.1	0.70	0.13	0.15	0.01	0.06	0.93	0.00	0.08	534
Turkmenistan	4.9	3.5	0.74	0.23	0.01	0.00	0.01	2.39	0.00	0.09	5 142
United Arab Emirates	3.0	11.9	1.27	0.12	0.39	0.00	0.97	9.06	0.00	0.07	783
Uzbekistan	26.1	1.8	0.30	0.19	0.02	0.00	0.00	1.25	0.00	0.07	2 270
Yemen	20.0	0.8	0.26	0.12	0.01	0.00	0.09	0.31	0.00	0.05	343
ASIA-PACIFIC	**3 489.4**	**1.3**	**0.37**	**0.07**	**0.07**	**0.04**	**0.15**	**0.57**	**0.02**	**0.06**	**583**
Australia	19.7	6.6	1.17	0.87	0.53	0.03	0.28	3.41	0.00	0.28	1 224
Bangladesh	146.7	0.5	0.25	0.00	0.00	0.04	0.07	0.09	0.00	0.05	552
Cambodia	14.1	0.7	0.24	0.10	0.01	0.14	0.14	0.06	0.00	0.04	295
China	1 311.7	1.6	0.40	0.12	0.09	0.03	0.17	0.75	0.01	0.07	484
India	1 065.5	0.8	0.34	0.00	0.02	0.06	0.04	0.26	0.00	0.04	615
Indonesia	219.9	1.1	0.34	0.05	0.05	0.07	0.23	0.26	0.00	0.06	381
Japan	127.7	4.4	0.47	0.09	0.37	0.00	0.52	2.45	0.38	0.07	694
Korea, DPR	22.7	1.4	0.37	0.00	0.05	0.05	0.09	0.84	0.00	0.05	400
Korea, Rep.	47.7	4.1	0.46	0.06	0.35	0.01	0.63	1.96	0.52	0.05	392
Lao PDR	5.7	0.9	0.32	0.13	0.01	0.21	0.08	0.05	0.00	0.10	543

Total biocapacity[3]	Biocapacity (global hectares per person, in 2003 gha): Cropland	Grazing land	Forest	Fishing ground	Ecological reserve or deficit (-) (gha/person)	Footprint change per person (%) 1975–2003[4, 5]	Biocapacity change per person (%) 1975–2003[4, 5]	Human Development Index, 2003[6]	Change in HDI (%) 1975–2003[6]	Water withdrawals (% of total resources)[2]	Country/Region
1.1	0.17	0.46	0.10	0.29	0.4	-26	-39	0.30	–	0	Sierra Leone
0.7	0.00	0.63	0.02	0.07	0.3	-38	-54	–	–	22	Somalia
2.0	0.53	0.73	0.52	0.21	-0.3	-13	-23	0.66	0	25	South Africa, Rep.
1.8	0.53	1.07	0.10	0.01	0.8	-6	-44	0.51	47	58	Sudan
1.1	0.25	0.74	0.00	0.00	-0.1	-35	-46	0.50	-6	–	Swaziland
1.3	0.22	0.85	0.11	0.04	0.6	-20	-51	0.42	–	5	Tanzania, United Rep.
0.8	0.50	0.18	0.05	0.01	-0.1	-4	-56	0.51	21	1	Togo
0.8	0.56	0.00	0.02	0.18	-0.8	38	-36	0.75	47	57	Tunisia
0.8	0.47	0.22	0.06	0.04	-0.2	-27	-50	0.51	–	0	Uganda
3.4	0.41	1.99	0.95	0.03	2.8	-30	-49	0.39	-2	2	Zambia
0.8	0.19	0.52	0.03	0.01	-0.1	-12	-54	0.50	-7	21	Zimbabwe
1.0	**0.46**	**0.27**	**0.11**	**0.08**	**-1.2**	**-19**	**20**	**–**	**–**	**46**	**MIDDLE EAST AND CENTRAL ASIA**
0.3	0.00	0.27	0.04	0.00	0.2	-45	-32	–	–	36	Afghanistan
0.6	0.27	0.20	0.09	0.00	-0.5	-76	-78	0.76	–	28	Armenia
1.2	0.44	0.25	0.13	0.34	-0.5	-62	-56	0.73	–	57	Azerbaijan
1.2	0.26	0.33	0.58	0.01	0.5	-83	-55	0.73	–	6	Georgia
0.8	0.49	0.13	0.01	0.09	-1.6	62	-35	0.74	30	53	Iran
0.0	0.00	0.03	0.00	0.00	-0.8	30	-51	–	–	57	Iraq
0.4	0.23	0.01	0.04	0.03	-4.2	35	-45	0.92	15	123	Israel
0.3	0.14	0.02	0.00	0.00	-1.5	77	19	0.75	–	115	Jordan
4.1	1.21	2.19	0.30	0.34	0.1	-14	48	0.76	–	32	Kazakhstan
0.3	0.03	0.01	0.00	0.09	-7.0	44	-28	0.84	11	2 200	Kuwait
1.4	0.52	0.74	0.01	0.00	0.1	-73	-50	0.70	–	49	Kyrgyzstan
0.3	0.21	0.00	0.00	0.01	-2.6	141	-2	0.76	–	31	Lebanon
1.0	0.45	0.15	0.00	0.14	-3.7	203	-22	0.77	28	722	Saudi Arabia
0.8	0.59	0.13	0.00	0.00	-0.9	32	-36	0.72	34	76	Syria
0.5	0.31	0.16	0.01	0.00	-0.1	-86	-80	0.65	–	75	Tajikistan
1.4	0.77	0.12	0.38	0.02	-0.7	10	-39	0.75	28	18	Turkey
3.6	0.72	2.18	0.02	0.54	0.1	-24	29	0.74	–	100	Turkmenistan
0.8	0.14	0.00	0.00	0.62	-11.0	205	-77	0.85	26	1 533	United Arab Emirates
0.8	0.43	0.23	0.00	0.04	-1.1	-60	-72	0.70	–	116	Uzbekistan
0.4	0.11	0.11	0.00	0.12	-0.5	20	-60	0.49	–	162	Yemen
0.7	**0.34**	**0.08**	**0.17**	**0.11**	**-0.6**	**38**	**-18**	**–**	**–**	**13**	**ASIA-PACIFIC**
12.4	4.26	1.83	3.34	2.73	5.9	-7	-28	0.96	13	5	Australia
0.3	0.19	0.00	0.00	0.06	-0.2	-1	-20	0.52	51	7	Bangladesh
0.9	0.32	0.12	0.18	0.21	0.1	-7	0	0.57	–	1	Cambodia
0.8	0.34	0.12	0.16	0.09	-0.9	82	-3	0.76	44	22	China
0.4	0.29	0.00	0.02	0.03	-0.4	16	-23	0.60	46	34	India
1.0	0.36	0.07	0.26	0.27	0.0	36	-20	0.70	49	3	Indonesia
0.7	0.13	0.00	0.41	0.13	-3.6	30	-16	0.94	10	21	Japan
0.7	0.24	0.00	0.29	0.09	-0.8	-19	-30	–	–	12	Korea, DPR
0.5	0.13	0.00	0.08	0.27	-3.5	143	-35	0.90	27	27	Korea, Rep.
1.3	0.33	0.21	0.64	0.07	0.4	1	-24	0.55	–	1	Lao PDR

		Ecological Footprint (global hectares per person, in 2003 gha)									
Country/Region	**Population** (millions)	**Total Ecological Footprint**	Cropland	Grazing land	Forest: timber, pulp, and paper	Forest: fuelwood	Fishing ground	CO_2 from fossil fuels	Nuclear	Built-up land[1]	**Water withdrawals per person** ('000 m^3/year)[2]
Malaysia	24.4	2.2	0.28	0.06	0.21	0.03	0.58	1.01	0.00	0.09	376
Mongolia	2.6	3.1	0.25	1.72	0.12	0.01	0.00	0.93	0.00	0.05	172
Myanmar	49.5	0.9	0.50	0.02	0.02	0.15	0.09	0.04	0.00	0.08	680
Nepal	25.2	0.7	0.33	0.06	0.04	0.10	0.01	0.09	0.00	0.07	414
New Zealand	3.9	5.9	0.68	1.01	1.30	0.00	1.19	1.60	0.00	0.16	549
Pakistan	153.6	0.6	0.27	0.00	0.02	0.03	0.02	0.21	0.00	0.05	1 130
Papua New Guinea	5.7	2.4	0.99	0.05	0.00	0.19	0.00	1.02	0.00	0.11	13
Philippines	80.0	1.1	0.33	0.03	0.04	0.03	0.35	0.22	0.00	0.05	363
Sri Lanka	19.1	1.0	0.29	0.03	0.02	0.06	0.28	0.27	0.00	0.05	667
Thailand	62.8	1.4	0.30	0.02	0.05	0.06	0.24	0.64	0.00	0.06	1 400
Viet Nam	81.4	0.9	0.32	0.01	0.05	0.05	0.09	0.28	0.00	0.08	889
LATIN AMERICA AND THE CARIBBEAN	**535.2**	**2.0**	**0.51**	**0.41**	**0.17**	**0.10**	**0.09**	**0.59**	**0.01**	**0.09**	**482**
Argentina	38.4	2.3	0.60	0.59	0.12	0.02	0.08	0.69	0.04	0.11	769
Bolivia	8.8	1.3	0.38	0.43	0.05	0.05	0.01	0.34	0.00	0.08	166
Brazil	178.5	2.1	0.55	0.60	0.29	0.15	0.06	0.37	0.02	0.10	336
Chile	15.8	2.3	0.48	0.30	0.51	0.16	0.15	0.60	0.00	0.14	804
Colombia	44.2	1.3	0.32	0.31	0.05	0.05	0.05	0.42	0.00	0.09	246
Costa Rica	4.2	2.0	0.43	0.25	0.35	0.17	0.05	0.64	0.00	0.11	655
Cuba	11.3	1.5	0.62	0.11	0.06	0.03	0.05	0.62	0.00	0.05	728
Dominican Rep.	8.7	1.6	0.37	0.19	0.07	0.01	0.34	0.57	0.00	0.05	393
Ecuador	13.0	1.5	0.29	0.34	0.08	0.08	0.09	0.55	0.00	0.06	1 326
El Salvador	6.5	1.4	0.38	0.12	0.11	0.13	0.14	0.46	0.00	0.04	200
Guatemala	12.3	1.3	0.34	0.11	0.04	0.25	0.08	0.40	0.00	0.06	167
Haiti	8.3	0.6	0.32	0.05	0.02	0.05	0.01	0.08	0.00	0.02	120
Honduras	6.9	1.3	0.30	0.17	0.06	0.25	0.01	0.41	0.00	0.07	127
Jamaica	2.7	1.7	0.42	0.07	0.16	0.04	0.59	0.41	0.00	0.04	156
Mexico	103.5	2.6	0.69	0.34	0.12	0.07	0.08	1.18	0.02	0.06	767
Nicaragua	5.5	1.2	0.40	0.11	0.01	0.22	0.09	0.29	0.00	0.07	244
Panama	3.1	1.9	0.44	0.29	0.04	0.08	0.15	0.83	0.00	0.06	268
Paraguay	5.9	1.6	0.60	0.38	0.32	0.20	0.02	0.01	0.00	0.09	85
Peru	27.2	0.9	0.39	0.16	0.04	0.05	0.12	0.00	0.00	0.10	752
Trinidad and Tobago	1.3	3.1	0.42	0.07	0.18	0.01	0.38	2.08	0.00	0.00	239
Uruguay	3.4	1.9	0.43	0.86	0.05	0.09	0.15	0.22	0.00	0.12	929
Venezuela	25.7	2.2	0.35	0.34	0.04	0.03	0.18	1.15	0.00	0.09	–
NORTH AMERICA	**325.6**	**9.4**	**1.00**	**0.46**	**1.20**	**0.02**	**0.22**	**5.50**	**0.55**	**0.44**	**1 630**
Canada	31.5	7.6	1.14	0.40	1.14	0.02	0.15	4.08	0.50	0.18	1 470
United States of America	294.0	9.6	0.98	0.46	1.21	0.03	0.23	5.66	0.56	0.47	1 647
EUROPE (EU)	**454.4**	**4.8**	**0.80**	**0.21**	**0.48**	**0.02**	**0.27**	**2.45**	**0.44**	**0.16**	**551**
Austria	8.1	4.9	0.79	0.17	0.85	0.08	0.13	2.82	0.00	0.11	260
Belgium/Luxembourg	10.8	5.6	0.91	0.17	0.32	0.01	0.24	2.75	0.88	0.34	836
Czech Rep.	10.2	4.9	0.87	0.15	0.53	0.02	0.17	2.56	0.48	0.13	252
Denmark	5.4	5.8	0.99	0.19	0.90	0.04	0.21	3.17	0.00	0.25	237

Biocapacity (global hectares per person, in 2003 gha)											
Total biocapacity[3]	Cropland	Grazing land	Forest	Fishing ground	**Ecological reserve or deficit (-)** (gha/person)	**Footprint change per person** (%) 1975–2003[4, 5]	**Biocapacity change per person** (%) 1975–2003[4, 5]	**Human Development Index,** 2003[6]	**Change in HDI** (%) 1975–2003[6]	**Water withdrawals** (% of total resources)[2]	**Country/Region**
3.7	0.87	0.02	2.32	0.42	1.5	77	-35	0.80	29	2	Malaysia
11.8	0.30	11.04	0.45	0.00	8.7	-12	-46	0.70	–	1	Mongolia
1.3	0.57	0.01	0.46	0.20	0.4	36	-6	0.58	–	3	Myanmar
0.5	0.27	0.05	0.08	0.01	-0.2	9	-19	0.53	78	5	Nepal
14.9	3.34	4.40	6.59	0.45	9.0	28	-9	0.93	10	1	New Zealand
0.3	0.24	0.00	0.02	0.03	-0.3	-1	-41	0.53	45	76	Pakistan
2.1	0.29	0.05	0.72	0.91	-0.3	88	-41	0.52	23	0	Papua New Guinea
0.6	0.28	0.02	0.11	0.12	-0.5	6	-40	0.76	16	6	Philippines
0.4	0.21	0.02	0.04	0.05	-0.6	43	-20	0.75	24	25	Sri Lanka
1.0	0.57	0.01	0.23	0.13	-0.4	60	-4	0.78	27	21	Thailand
0.8	0.40	0.01	0.14	0.16	-0.1	40	12	0.70	–	8	Viet Nam
5.4	**0.70**	**0.96**	**3.46**	**0.21**	**3.4**	**21**	**-30**	**–**	**–**	**2**	**LATIN AMERICA AND THE CARIBBEAN**
5.9	2.28	1.91	1.02	0.53	3.6	-18	-14	0.86	10	4	Argentina
15.0	0.59	2.89	11.48	0.00	13.7	22	-37	0.69	34	0	Bolivia
9.9	0.86	1.19	7.70	0.09	7.8	30	-27	0.79	23	1	Brazil
5.4	0.51	0.49	2.51	1.73	3.0	54	-27	0.85	21	1	Chile
3.6	0.24	1.42	1.83	0.01	2.3	19	-35	0.79	19	1	Colombia
1.5	0.41	0.69	0.24	0.04	-0.5	13	-25	0.84	12	2	Costa Rica
0.9	0.52	0.10	0.15	0.04	-0.7	-2	4	0.82	–	22	Cuba
0.8	0.30	0.25	0.20	0.03	-0.8	60	-36	0.75	21	16	Dominican Rep.
2.2	0.33	0.40	1.15	0.30	0.7	31	-36	0.76	20	4	Ecuador
0.6	0.26	0.14	0.09	0.02	-0.8	73	-27	0.72	22	5	El Salvador
1.3	0.36	0.30	0.53	0.01	0.0	42	-32	0.66	29	2	Guatemala
0.3	0.14	0.04	0.03	0.03	-0.3	-10	-44	0.48	–	7	Haiti
1.8	0.34	0.28	1.01	0.06	0.5	10	-49	0.67	29	1	Honduras
0.5	0.19	0.04	0.11	0.09	-1.3	-2	6	0.74	7	4	Jamaica
1.7	0.50	0.30	0.58	0.24	-0.9	50	-33	0.81	18	17	Mexico
3.5	0.62	1.02	1.74	0.09	2.4	-14	-47	0.69	18	1	Nicaragua
2.5	0.30	0.57	1.50	0.10	0.6	10	-36	0.80	13	1	Panama
5.6	1.24	3.59	0.64	0.02	4.0	-3	-54	0.76	13	0	Paraguay
3.8	0.33	0.55	2.45	0.39	3.0	-11	-34	0.76	19	1	Peru
0.4	0.13	0.01	0.04	0.24	-2.7	43	-24	0.80	7	8	Trinidad and Tobago
8.0	1.01	5.66	0.71	0.52	6.1	-30	5	0.84	11	2	Uruguay
2.4	0.25	0.73	1.28	0.04	0.2	-4	-42	0.77	8	–	Venezuela
5.7	**1.87**	**0.28**	**2.68**	**0.43**	**-3.7**	**35**	**-21**	**–**	**–**	**9**	**NORTH AMERICA**
14.5	3.37	0.26	9.70	1.08	6.9	11	-26	0.95	9	2	Canada
4.7	1.71	0.28	1.93	0.36	-4.8	38	-20	0.94	9	16	United States of America
2.2	**0.82**	**0.08**	**1.02**	**0.12**	**-2.6**	**31**	**0**	**0.92**	**–**	**14**	**EUROPE (EU)**
3.4	0.66	0.10	2.59	0.00	-1.5	46	-3	0.94	11	3	Austria
1.2	0.40	0.04	0.41	0.01	-4.4	38	5	0.95	†	42	Belgium/Luxembourg
2.6	0.92	0.02	1.53	0.01	-2.3	-3	19	0.87	–	20	Czech Rep.
3.5	2.02	0.01	0.45	0.80	-2.2	26	-2	0.94	8	21	Denmark

Country/Region	Population (millions)	Ecological Footprint (global hectares per person, in 2003 gha)									Water withdrawals per person ('000 m3/year)[2]
		Total Ecological Footprint	Cropland	Grazing land	Forest: timber, pulp, and paper	Forest: fuelwood	Fishing ground	CO_2 from fossil fuels	Nuclear	Built-up land[1]	
Estonia	1.3	6.5	0.83	0.47	1.04	0.27	0.19	3.54	0.00	0.13	118
Finland	5.2	7.6	0.83	0.20	2.02	0.15	0.29	3.07	0.93	0.14	476
France	60.1	5.6	0.80	0.33	0.46	0.01	0.33	2.02	1.50	0.17	668
Germany	82.5	4.5	0.73	0.18	0.48	0.01	0.12	2.45	0.41	0.17	571
Greece	11.0	5.0	0.95	0.24	0.29	0.02	0.28	3.17	0.00	0.05	708
Hungary	9.9	3.5	0.78	0.11	0.29	0.05	0.11	1.79	0.24	0.12	770
Ireland	4.0	5.0	0.70	0.33	0.45	0.00	0.24	3.12	0.00	0.12	289
Italy	57.4	4.2	0.71	0.17	0.42	0.02	0.25	2.52	0.00	0.07	772
Latvia	2.3	2.6	0.87	0.91	0.16	0.04	0.10	0.45	0.00	0.06	129
Lithuania	3.4	4.4	1.01	0.36	0.32	0.09	0.49	1.00	1.02	0.16	78
Netherlands	16.1	4.4	0.58	0.23	0.32	0.00	0.30	2.78	0.05	0.13	494
Poland	38.6	3.3	0.93	0.09	0.31	0.02	0.03	1.83	0.00	0.07	419
Portugal	10.1	4.2	0.73	0.24	0.31	0.01	0.91	1.96	0.00	0.04	1 121
Slovakia	5.4	3.2	0.62	0.12	0.23	0.02	0.06	1.39	0.66	0.13	–
Slovenia	2.0	3.4	0.44	0.14	0.58	0.05	0.03	2.10	0.00	0.07	–
Spain	41.1	5.4	1.13	0.11	0.45	0.01	0.71	2.58	0.31	0.05	870
Sweden	8.9	6.1	0.87	0.42	1.58	0.13	0.22	1.06	1.63	0.17	334
United Kingdom	59.5	5.6	0.68	0.30	0.46	0.00	0.25	3.21	0.31	0.38	161
EUROPE (NON-EU)	**272.2**	**3.8**	**0.74**	**0.20**	**0.21**	**0.05**	**0.15**	**2.11**	**0.22**	**0.07**	**583**
Albania	3.2	1.4	0.50	0.16	0.08	0.01	0.03	0.58	0.00	0.07	544
Belarus	9.9	3.3	0.91	0.23	0.19	0.02	0.11	1.77	0.00	0.08	281
Bosnia and Herzegovina	4.2	2.3	0.49	0.06	0.36	0.06	0.04	1.27	0.00	0.06	–
Bulgaria	7.9	3.1	0.75	0.09	0.12	0.06	0.01	1.45	0.50	0.13	1 318
Croatia	4.4	2.9	0.69	0.04	0.38	0.04	0.06	1.67	0.00	0.07	–
Macedonia, FYR	2.1	2.3	0.54	0.11	0.16	0.07	0.05	1.31	0.00	0.08	–
Moldova, Rep.	4.3	1.3	0.52	0.07	0.05	0.00	0.05	0.55	0.00	0.04	541
Norway	4.5	5.8	0.86	0.29	0.87	0.06	1.63	1.98	0.00	0.15	485
Romania	22.3	2.4	0.86	0.09	0.17	0.03	0.02	1.05	0.05	0.10	1 035
Russian Federation	143.2	4.4	0.76	0.23	0.24	0.06	0.19	2.64	0.22	0.06	532
Serbia and Montenegro	10.5	2.3	0.61	0.09	0.14	0.04	0.05	1.29	0.00	0.06	–
Switzerland	7.2	5.1	0.52	0.30	0.44	0.03	0.14	2.77	0.79	0.16	358
Ukraine	48.5	3.2	0.72	0.25	0.06	0.03	0.06	1.66	0.36	0.05	767

NOTES

World: Total population includes countries not listed in table.

Table includes all countries with populations greater than 1 million, except Bhutan, Oman, and Singapore, for which insufficient data were available to calculate Ecological Footprint and biocapacity figures.

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

Middle-income countries: Albania, Algeria, Angola, Argentina, Armenia, Azerbaijan, Belarus, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Chile, China, Colombia, Costa Rica, Croatia, Cuba, Czech Rep., Dominican Rep., Ecuador, Egypt, El Salvador, Estonia, Gabon, Georgia, Guatemala, Honduras, Hungary, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Latvia, Lebanon, Libya, Lithuania, Macedonia, FYR, Malaysia, Mauritius, Mexico, Morocco, Namibia, Panama, Paraguay, Peru, Philippines, Poland, Romania, Russian Federation (and USSR in 1975), Serbia and Montenegro, Slovakia, South Africa, Rep., Sri Lanka, Swaziland, Syria, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Ukraine, Uruguay, Venezuela.

Low-income countries: Afghanistan, Bangladesh, Benin, Burkina Faso, Burundi, Cambodia, Cameroon, Central African Rep., Chad, Congo, Congo, Dem. Rep., Côte d'Ivoire, Eritrea, Ethiopia, Gambia, Ghana, Guinea, Guinea-Bissau, Haiti, India, Kenya, Korea, DPR, Kyrgyzstan, Lao PDR,

Total biocapacity[3]	Biocapacity (global hectares per person, in 2003 gha): Cropland	Grazing land	Forest	Fishing ground	Ecological reserve or deficit (-) (gha/person)	Footprint change per person (%) 1975–2003[4, 5]	Biocapacity change per person (%) 1975–2003[4, 5]	Human Development Index, 2003[6]	Change in HDI (%) 1975–2003[6]	Water withdrawals (% of total resources)[2]	Country/Region
5.7	1.06	0.09	4.23	0.21	-0.7	41	108	0.85	–	1	Estonia
12.0	1.04	0.00	10.68	0.15	4.4	57	-4	0.94	12	2	Finland
3.0	1.42	0.14	1.17	0.10	-2.6	51	-1	0.94	10	20	France
1.7	0.66	0.06	0.83	0.03	-2.8	6	2	0.93	–	31	Germany
1.4	0.90	0.01	0.26	0.24	-3.6	101	-21	0.91	9	10	Greece
2.0	0.96	0.07	0.79	0.01	-1.5	-5	-22	0.86	11	7	Hungary
4.8	1.45	0.96	0.67	1.59	-0.2	46	-10	0.95	17	2	Ireland
1.0	0.51	0.01	0.37	0.05	-3.1	60	-15	0.93	11	23	Italy
6.6	2.06	0.20	4.21	0.09	4.0	-44	141	0.84	–	1	Latvia
4.2	1.80	0.15	2.10	0.02	-0.2	-3	54	0.85	–	1	Lithuania
0.8	0.32	0.05	0.11	0.17	-3.6	28	0	0.94	9	9	Netherlands
1.8	0.84	0.08	0.85	0.01	-1.4	-24	-20	0.86	–	26	Poland
1.6	0.36	0.06	1.06	0.08	-2.6	73	-3	0.90	15	16	Portugal
2.8	0.68	0.04	1.90	0.00	-0.5	-36	26	0.85	–	–	Slovakia
2.8	0.29	0.06	2.41	0.00	-0.6	40	96	0.90	–	–	Slovenia
1.7	1.07	0.04	0.55	0.04	-3.6	97	-4	0.93	11	32	Spain
9.6	1.11	0.04	8.15	0.12	3.5	16	-2	0.95	10	2	Sweden
1.6	0.54	0.15	0.19	0.36	-4.0	33	6	0.94	11	6	United Kingdom
4.6	**0.98**	**0.25**	**3.02**	**0.26**	**0.8**	**-11**	**-12**	**0.79**	**–**	**3**	**EUROPE (NON-EU)**
0.9	0.42	0.12	0.24	0.05	-0.5	0	-18	0.78	–	4	Albania
3.2	0.93	0.32	1.91	0.00	-0.1	-28	18	0.79	–	5	Belarus
1.7	0.34	0.26	1.07	0.00	-0.6	-4	19	0.79	–	–	Bosnia and Herzegovina
2.1	0.79	0.04	1.12	0.04	-1.0	-18	-21	0.81	–	49	Bulgaria
2.6	0.64	0.34	1.26	0.28	-0.3	21	79	0.84	–	–	Croatia
0.9	0.52	0.24	0.07	0.00	-1.4	-5	-38	0.80	–	–	Macedonia, FYR
0.8	0.69	0.07	0.01	0.00	-0.5	-72	-71	0.67	–	20	Moldova, Rep.
6.8	0.57	0.03	4.03	2.00	0.9	37	-3	0.96	11	1	Norway
2.3	0.72	0.01	1.41	0.03	-0.1	-20	-8	0.77	–	11	Romania
6.9	1.15	0.37	4.91	0.40	2.5	-4	150	0.80	–	2	Russian Federation
0.8	0.61	0.09	0.00	0.00	-1.5	-6	-48	–	–	–	Serbia and Montenegro
1.5	0.29	0.17	0.92	0.00	-3.6	39	-9	0.95	8	5	Switzerland
1.7	1.03	0.13	0.47	0.05	-1.5	-30	-37	0.77	–	27	Ukraine

Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Moldova, Rep., Mongolia, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Rwanda, Senegal, Sierra Leone, Somalia, Sudan, Tajikistan, Tanzania, United Rep., Togo, Uganda, Uzbekistan, Viet Nam, Yemen, Zambia, Zimbabwe.

1. Built-up land includes hydropower.

2. Water withdrawals and resource estimates from FAO, 2004 and Shiklomanov, 1999.

3. Biocapacity includes built-up land (see column under Ecological Footprint).

4. Changes from 1975 are calculated based on constant 2003 global hectares.

5. For countries that were formerly part of Ethiopia PDR, the Soviet Union, former Yugoslavia, or Czechoslovakia, 2003 per capita footprints and biocapacity are compared with the per capita footprint and biocapacity of the former unified country.

6. UNDP HDI Statistics, http://hdr.undp.org/statistics/ (August 2006).

† Increases over 1975 for Belgium and Luxembourg are respectively 12 and 13 per cent.

– = insufficient data.

0 = less than 0.5; 0.0 = less than 0.05; 0.00 = less than 0.005.

Totals may not add up due to rounding.

Table 3: **THE LIVING PLANET THROUGH TIME,** 1961–2003

	Global population (billion, 2003)	Ecological Footprint (billion 2003 global hectares)								Total Biocapacity (billion 2003 gha)	Living Planet Index	Living Planet Indices		
		Total Ecological Footprint	Cropland	Grazing land	Forest	Fishing ground	CO_2 from fossil fuels	Nuclear	Built-up land			Terrestrial	Marine	Freshwater
1961	3.08	4.5	1.70	0.36	1.13	0.42	0.74	0.00	0.15	9.0				
1965	3.33	5.4	1.79	0.41	1.15	0.49	1.41	0.00	0.16	9.2				
1970	3.69	6.9	1.98	0.44	1.19	0.63	2.49	0.01	0.19	9.5	1.00	1.00	1.00	1.00
1975	4.07	8.0	1.97	0.49	1.19	0.66	3.41	0.06	0.22	9.7	1.03	1.00	1.06	1.03
1980	4.43	9.3	2.16	0.50	1.30	0.67	4.24	0.12	0.26	9.9	0.99	0.97	0.95	1.07
1985	4.83	10.1	2.42	0.55	1.37	0.76	4.44	0.26	0.32	10.4	0.95	0.86	0.93	1.07
1990	5.26	11.5	2.65	0.65	1.49	0.80	5.15	0.37	0.37	10.7	0.90	0.83	0.92	0.96
1995	5.67	12.1	2.76	0.77	1.36	0.88	5.50	0.44	0.40	10.8	0.85	0.82	0.82	0.82
2000	6.07	13.2	2.96	0.85	1.44	0.93	6.10	0.52	0.46	11.1	0.71	0.71	0.78	0.65
2003	6.30	14.1	3.07	0.91	1.43	0.93	6.71	0.53	0.48	11.2	0.71	0.69	0.73	0.72
Moderate business-as-usual scenario														
2025	7.8	**19**	3.8	1.3	2.0	1.3	9.3	0.6	0.5	**12**				
2050	8.9	**23**	4.9	1.7	3.0	1.7	10.8	0.6	0.6	**11**				
Slow-shift scenario														
2025	7.8	**16**	3.6	1.1	1.9	1.0	7.6	0.7	0.6	**12**				
2050	8.9	**16**	3.7	1.1	2.0	0.8	6.8	0.6	0.6	**13**				
2075	9.3	**14**	3.8	1.1	2.1	0.6	4.6	0.7	0.6	**13**				
2100	9.5	**12**	3.8	1.1	2.2	0.5	3.4	0.7	0.6	**13**				
Rapid-reduction scenario														
2025	7.8	**14**	3.6	1.1	2.0	0.8	5.0	0.6	0.6	**12**				
2050	8.9	**12**	3.4	1.0	2.0	0.7	3.4	0.6	0.5	**13**				
2075	9.3	**11**	3.3	1.0	2.1	0.5	2.7	0.6	0.5	**14**				
2100	9.5	**10**	3.5	1.1	2.2	0.5	2.0	0.5	0.5	**14**				

Notes: Totals may not add up due to rounding. All time trends reported in constant 2003 global hectares. For more information about scenario projections, see pages 20–25.

Table 4: **NUMBERS OF SPECIES CONTRIBUTING TO THE TERRESTRIAL, MARINE, AND FRESHWATER LIVING PLANET INDICES WITHIN EACH VERTEBRATE CLASS**

	Mammals	Birds	Reptiles	Amphibians	Fish	Total
Terrestrial	171	513	11			**695**
Marine	48	112	7		107	**274**
Freshwater	11	153	17	69	94	**344**
Total	230	778	35	69	201	**1 313**

Table 5: **TRENDS IN THE LIVING PLANET INDICES BETWEEN 1970 AND 2003, WITH 95 PER CENT CONFIDENCE LIMITS**

	Living Planet Index	Terrestrial Living Planet Indices			Marine Living Planet Indices					Freshwater Living Planet Indices		
		All species	Temperate	Tropical	**All species**	Arctic/Atlantic	Southern[1]	Pacific	Indian[2]	**All species**	Temperate	Tropical
Per cent change in index	**-29**	**-31**	7	-55	**-27**	15	-31	2	-59	**-28**	-31	-26
Upper confidence limit	**-16**	**-14**	22	-34	**6**	55	19	77	-22	**-1**	1	26
Lower confidence limit	**-40**	**-44**	-7	-70	**-42**	-14	-61	-43	-82	**-48**	-53	-57

1. 1970–1997; 2. 1970–2000

Data collection
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. Any data used in constructing the index has to be a time series of either population size or a proxy of population size. Some data are total population estimates such as counts of an entire species; others are density measures, for example the number of birds per kilometre of transect; some are biomass or stock estimates, particularly for commercial fish species; and others are proxies of population size, such as the number of nests of marine turtle species on various nesting beaches.

All population time series have at least two data points, and most have more than two, collected by methods that are comparable across years, so that it is possible to determine a trend. A population estimate taken at one point in time would not be used with a second estimate from another survey of the same population at another point in time, unless it was clear that the second was meant to be comparable with the first. Plants and invertebrates were excluded, as few population time series data were available. It is assumed that trends in vertebrate populations are indicative of overall trends in global biodiversity.

Calculation of the indices
Before calculating the Living Planet Index, species were first divided according to whether their principal habitat is terrestrial, marine, or freshwater and then, because many more population data are available from temperate regions of the world than tropical (whereas species richness is higher in the tropics), terrestrial and freshwater species populations were divided into temperate and tropical, and marine species populations were divided according to the ocean basin they inhabit: Atlantic/Arctic, Pacific, Indian, or Southern. If the Living Planet Index data were not grouped in this way, then the index would be dominated by temperate terrestrial species, and unrepresentative of global biodiversity.

An index was calculated for each of the sets, representing the average change of all species populations within that group. The Terrestrial Living Planet Index was then calculated as the geometric mean of the temperate and tropical terrestrial indices, likewise for the Freshwater Living Planet Index. The Marine Living Planet Index was calculated as the geometric mean of the four ocean indices. The terrestrial index includes 695 species of mammals, birds, and reptiles found in forest, grassland, savannah, desert, or tundra ecosystems worldwide. The freshwater index comprises 344 species of mammals, birds, reptiles, amphibians, and fish living in rivers, lakes, or wetland ecosystems. The marine index includes 274 species of mammals, birds, reptiles, and fish from the world's oceans, seas, and coastal ecosystems. The Living Planet Index is the geometric mean of the terrestrial, marine, and freshwater indices. The hierarchy of indices in shown in Figure 33.

Confidence intervals for the Living Planet Index were obtained by a bootstrap method and shown in Table 5. A detailed description of the Living Planet Index calculations can be found in Loh *et al.,* 2005.

Figure 33: 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 realms or within each ocean basin; temperate and tropical realms or ocean basins, carry equal weight within each system; each system carries equal weight within the overall Living Planet Index.

Fig. 33: **HIERARCHY OF INDICES WITHIN THE LIVING PLANET INDEX**

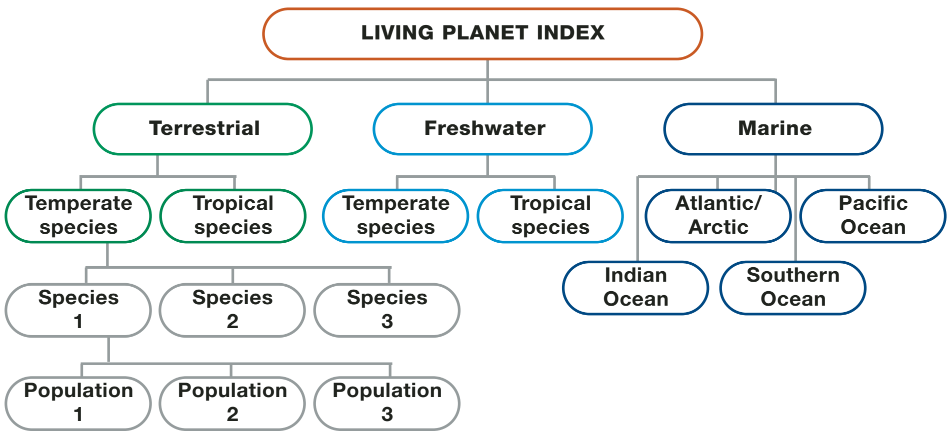


Table 6: **CLASSIFICATION OF FRAGMENTATION AND FLOW REGULATION IN LARGE RIVER SYSTEMS** (Figures 14 and 15, page 10)

Per cent of main channel free flowing	Major tributary dams	Minor tributary dams only	Flow regulation (% of total annual discharge that could be held back and released by dams) 0–1	1–2	2–5	5–10	10–15	15–20	20–25	25–30	>30
100	No	Yes	U	U	M	M	M	M	M	M	M
100	Yes	No	U	M	M	M	M	M	M	M	M
75–100	No	No	M	M	M	M	M	M	M	M	S
75–100	No	Yes	M	M	M	M	M	M	M	S	S
75–100	Yes	No	M	M	M	M	M	M	S	S	S
50–75	No	No	M	M	M	M	M	M	S	S	S
50–75	No	Yes	M	M	M	M	M	S	S	S	S
50–75	Yes	No	M	M	M	M	S	S	S	S	S
25–50	No	No	M	M	M	M	S	S	S	S	S
25–50	No	Yes	M	M	M	S	S	S	S	S	S
25–50	Yes	No	S	S	S	S	S	S	S	S	S
<25			S	S	S	S	S	S	S	S	S

U: unaffected; M: moderately affected; S: severely affected (Nilsson *et al*., 2005)

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 they generate, given prevailing technology and resource management. This area is expressed in global hectares (gha), hectares with world-average biological productivity (1 hectare = 2.47 acres). Footprint calculations use yield factors (Table 7) to take into account national differences in biological productivity (for example, tonnes of wheat per United Kingdom or Argentinian hectare versus world average) and equivalence factors (Table 8) to take into account differences in world average productivity among land types (for example, world average forest versus world average cropland).

Table 7: **YIELD FACTORS,** selected countries

	Primary cropland	Forest	Pasture	Ocean fisheries
World	*1.0*	*1.0*	*1.0*	*1.0*
Algeria	0.6	0.0	0.7	0.8
Guatemala	1.0	1.4	2.9	0.2
Hungary	1.1	2.9	1.9	1.0
Japan	1.5	1.6	2.2	1.4
Jordan	1.0	0.0	0.4	0.8
Lao PDR	0.8	0.2	2.7	1.0
New Zealand	2.2	2.5	2.5	0.2
Zambia	0.5	0.3	1.5	1.0

Table 8: **EQUIVALENCE FACTORS,** 2003

	gha/ha
Primary cropland	2.21
Marginal cropland	1.79
Forest	1.34
Permanent pasture	0.49
Marine	0.36
Inland water	0.36
Built-up land	2.21

Table 9: **CONVERSION FACTORS**

	2003 gha/gha
1961	0.86
1965	0.86
1970	0.89
1975	0.90
1980	0.92
1985	0.95
1990	0.97
1995	0.97
2000	0.99
2003	1.00

Footprint and biocapacity results for nations are calculated annually by Global Footprint Network. The continuing methodological development of these National Footprint Accounts is overseen by a formal review committee (www.footprintstandards.org/committees). A detailed methods paper and copies of sample calculation sheets can be obtained at www.footprintnetwork.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, freshwater withdrawals are not included in the footprint, although the energy used to pump or treat them is.

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 present degradation of ecosystems, if persistent this is likely to 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, nor do they pinpoint specific biodiversity pressures. Finally, the Ecological Footprint, as a biophysical measure, does not evaluate the essential social and economic dimensions of sustainability.

How have the footprint calculations been improved since the last *Living Planet Report*?
A formal process is in place to assure continuous improvement of the National Footprint Accounts methodology. Coordinated by Global Footprint Network, this process has been supported by the European Environment Agency and Global Footprint Network partner organizations, among others.

The most significant change since the *Living Planet Report 2004* has been the incorporation of a new dataset, the United Nations COMTRADE database, to track flows between nations of more than 600 products. This allows more accurate allocation of the footprint embodied in traded goods. Other revisions have improved the accuracy of cropland and forest sections of the calculations.

In previous Living Planet Reports, we reported global hectares specific to each year, as both the total number of bioproductive hectares and world average productivity per hectare change annually. To simplify comparison of footprint and biocapacity results from year to year, in this report all time trends are given in constant 2003 global hectares. Similar to the use of inflation-adjusted dollars in economic statistics, the use of a fixed global hectare shows how absolute levels of consumption and bioproductivity, rather than just the ratio between them, are changing over time. Table 9 shows the conversion of global hectares of selected years into constant 2003 global hectares.

How does the Ecological Footprint account for the use of fossil fuels?
Fossil fuels – coal, oil, and natural gas – are extracted from the Earth's crust rather than produced by ecosystems. When burning this fuel, CO_2 is produced. In order to avoid carbon accumulation in the atmosphere, the goal of the United Nations Framework Convention on Climate Change, two options exist: human technological sequestration, such as deep well injection; or natural sequestration. Natural sequestration corresponds to the biocapacity required to absorb and store the CO_2 not sequestered by humans, less the amount absorbed by the oceans. This is the footprint for CO_2. Although negligible amounts of CO_2 are currently sequestered through human technological processes, these technologies will lower the carbon footprint associated with burning fossil fuels as they are brought online.

The sequestration rate used in Ecological Footprint calculations is based on an estimate of how much carbon the world's forests can remove from the atmosphere and retain. One 2003 global hectare can absorb the CO_2 released by burning approximately 1 450 litres of petrol per year.

The CO_2 footprint does not suggest that carbon sequestration is the key to resolving global warming. Rather the opposite: it shows that the biosphere does not have sufficient capacity to cope with current levels of CO_2 emissions. As forests mature, their CO_2 sequestration rate approaches zero, and they may even become net emitters of carbon.

How does the Ecological Footprint account for nuclear energy?

The demand on biocapacity associated with the use of nuclear power is difficult to quantify, in part because many of its impacts are not addressed by the research question underlying the footprint. For lack of conclusive data, the footprint of nuclear electricity is assumed to be the same as the footprint of the equivalent amount of electricity from fossil fuels. Global Footprint Network and its partners are working to refine this assumption. Currently, the footprint of nuclear electricity represents less than 4 per cent of the total global Ecological Footprint.

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 the Indian, not the Japanese, consumption footprint.

The resulting national footprints can be distorted, since the resources used and waste generated in making products for export are not fully documented. This affects the footprints of countries whose trade-flows are large relative to their overall economies. These misallocations, however, do not affect the total global Ecological Footprint.

Does the Ecological Footprint take other species into account?

The Ecological Footprint describes human demand on nature. Currently, there are 1.8 global hectares of biocapacity available per person on Earth, less if some of this biological productivity is allocated for consumption by wild species. The value society places on biodiversity will determine how much productivity is reserved as a buffer. Efforts to increase biocapacity, such as monocropping and the application of pesticides, may also increase pressure on biodiversity; this can increase the size of the buffer required to achieve the same conservation results.

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

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

Does the Ecological Footprint matter 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 those demands? Footprint analysis reflects both increases in the productivity of renewable resources (for example, if the productivity of cropland is increased, then the footprint of 1 tonne of wheat will decrease) and technological innovation (for example, if the paper industry doubles the overall efficiency of paper production, the footprint per tonne of paper will be cut by half). Ecological Footprint accounts capture these changes as 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 reduction in human demand due to technological advances or other factors, footprint accounts will show this as the elimination of global overshoot.

Does the Ecological Footprint ignore the role of population growth as a driver in humanity's increasing consumption?

The total Ecological Footprint of a nation or of humanity as a whole is a function of the number of people consuming, the average amount of goods and services an average person consumes, and the resource intensity of these goods and services. Since footprint accounting is historical, it does not predict how any of these factors will change in the future. However, if population grows or declines (or any of the other factors change), this will be reflected in future footprint accounts.

Footprint accounts can also show how resource consumption is distributed among regions. For example, the total footprint of the Asia-Pacific region, with its large population but low per person footprint, can be directly compared to that of North America, with its much smaller population but much larger per person footprint.

How do I calculate the Ecological Footprint of a city or region?

While the calculations for global and national Ecological Footprints have been standardized within the National Footprint Accounts, there are a variety of ways used to calculate the footprint of a city or region. The family of "process-based" approaches use production recipes and supplementary statistics to allocate the national per capita footprint to consumption categories (such as for food, shelter, mobility, goods, and services). Regional or municipal average per capita footprints are calculated by scaling these national results up or down based on differences between national and local consumption patterns. The family of input-output approaches use monetary, physical, or hybrid input-output tables for allocating overall demand to consumption categories.

There is growing recognition of the need to standardize sub-national footprint application methods in order to increase their comparability across studies and over time. In response to this need, methods and approaches for calculating the footprint of cities and regions are currently being aligned through the global Ecological Footprint Standards initiative. For more information on current footprint standards and ongoing standardization debates, see www.footprintstandards.org.

For additional information about footprint methodology, data sources, assumptions, and definitions please visit: www.footprintnetwork.org/2006technotes

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Additional references can be found at:
www.footprintnetwork.org/2006references

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