lpr cover to pr 19/9/00 2:34 pm Page 1

WWF

UNEP WCMC

REDEFINING PROGRESS

CENTRE FOR SUSTAINABILITY STUDIES

LIVING PLANET REPORT 2000

CONTENTS

The material and the geographical designations in this report do not imply the expression of any opinion whatsoever on the part of WWF concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries.

THE UNEP WORLD CONSERVATION MONITORING CENTRE was established in 2000 as the world biodiversity information and assessment centre of the United Nations Environment Programme. The roots of the organisation go back to 1979, when it was founded as the IUCN Conservation Monitoring Centre. In 1988 the World Conservation Monitoring Centre was created jointly by IUCN, WWF-International and UNEP. The financial support and guidance of these organisations in the Centre's formative years is gratefully acknowledged. As an international conservation organisation, UNEP-WCMC provides objective, scientifically rigorous and focused information on global biodiversity.

REDEFINING PROGRESS is an Oakland, California based think-tank that works to expose the inadequacy of equating economic growth with progress; embrace's nature's limits as a path to true sustainability; promotes pricing systems that incorporate social and environmental costs; and advocates care-taking of common assets.

THE CENTRE FOR SUSTAINABILITY STUDIES of the An·huac University of Xalapa, Mexico, is a research institute that analyses human use of nature and offers workshops on sustainability.

AUTHORS
EDITOR: Jonathan Loh[1]

LIVING PLANET INDEX:
Martin Jenkins[2]
Val Kapos[2]
Neil Cox[2]
Janina Jakubowska[2]
Anna Morton[2]
Brian Groombridge[2]

ECOLOGICAL FOOTPRINT:
Mathis Wackernagel[3]
Alejandro Callejas Linares[4] Diana Deumling[3]
Niels B. Schulz[3]
María Antonieta Vásquez Sánchez[4]
Ina Susana López Falfán[4]

TECHNICAL ADVISER:
Jørgen Randers[5]

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

2. UNEP-WCMC
219 Huntington Road
Cambridge CB3 0DL, UK
www.unep-wcmc.org

3. REDEFINING PROGRESS
1904 Franklin Street, 6th Floor
Oakland CA 94612, USA
www.rprogress.org

4. CENTER FOR SUSTAINABILITY STUDIES
Obreros Textiles 57 dep.6, col. Marco Antonio Muños
91060 Xalapa, Mexico
www.edg.net.mx/~mathiswa

5. NORWEGIAN SCHOOL OF MANAGEMENT BI
Elias Smiths vei 15, Box 580,
N-1302 Sandvika, Norway
www.bi.no

Published in October, 2000 by WWF–World Wide Fund For Nature (formerly World Wildlife Fund), Gland, Switzerland.

Any reproduction in full or in part of this publication must mention the title and credit the above-mentioned publisher as the copyright owner. © text 2000 WWF. All rights reserved

ISBN: xxxxxx

A **BANSON** Production
3 Turville Street
London E2 7HX, UK

Picture researcher:
Michèle Dépraz
Designed by: Price Watkins
Diagrams and maps:
David Burles. Simon Blyth
Printed by: The KPC Group, UK

Picture credits:
Silvery gibbon: WWF/Rod Williams; sparrowhawk: P. de Meo/WWF/Panda Photo; lesser white-fronted goose: Claude Guihard/BIOS; gharial: WWF/Romulus Whitaker; Kemp's ridley turtle: WWF/P.C.H. Pritchard; bluefin tuna: WWF-Canon/J.P. Sylvestre/BIOS.

Printed on recycled paper (including 75% post-consumer waste) using vegetable-oil based inks. When disposing of this publication, please try to ensure that it is recycled.

INTRODUCTION

While the state of the Earth's natural ecosystems has declined by about 33 per cent over the last 30 years (see Figure 1), the ecological pressure of humanity on the Earth has increased by about 50 per cent over the same period (see Figure 2), and exceeds the biosphere's regeneration rate. These are the main conclusions of the *Living Planet Report 2000*, based on two indices, the Living Planet Index (LPI) and the Ecological Footprint. This report has two principal objectives: the first is to quantify changes in the state of the Earth's natural ecosystems over time; the second is to measure the human pressures on the natural environment arising from the consumption of renewable resources and pollution, and analyse the geographic patterns in those pressures.

In this year's report we have used more data to calculate the LPI, making the index more reliable. Because the volume of data used in the LPI is much larger than before, the index is now calculated regionally, or by ocean in the case of marine ecosystems. However, the overall conclusion remains unchanged: the natural wealth of the world's forests, freshwater ecosystems, and oceans and coasts has declined rapidly, particularly in freshwater and marine ecosystems. The Living Planet Index fell by 33 per cent between 1970 and 1999.

A new feature of this year's *Living Planet Report* is the index we use to estimate the pressure on the Earth resulting from humanity's natural resource consumption. This is the "Ecological Footprint", which measures a population's consumption of food, materials, and energy in terms of the area of biologically productive land or sea required to produce those resources and to absorb the corresponding waste. The calculation of the footprint leaves out some pressures for which data are incomplete such as water consumption and the release of toxic pollutants. This means that the results are underestimates of humanity's full impact.

We have calculated the Ecological Footprint for individual countries in 1996, as well as for the world population from 1961 to 1997.

The Ecological Footprint method allows us not only to estimate the human pressures on the Earth, but also to make comparisons between humanity's demands on nature and the capacity of the Earth to supply resources and assimilate waste.

In 1997, the Ecological Footprint of the global population was at least 30 per cent larger than the Earth's biological productive capacity. At some time in the 1970s, humanity as a whole passed the point at which it lived within the global regenerative capacity of the Earth, causing depletion of the Earth's natural capital as a consequence (although locally this has occurred many times and in many places throughout human history). This is the ultimate cause of the decline in the natural wealth of the world's forest, freshwater, and marine ecosystems, as indicated by the LPI.

Secondly, the preliminary conclusion from the regional LPI analysis is that the steepest declines in all three ecosystem types have taken place in southern temperate and tropical regions. This does not necessarily mean that the state of southern temperate and tropical ecosystems is worse than that of northern temperate ecosystems, but simply that the relative decline has been greatest in tropical ecosystems over the past 30 years. The loss of natural wealth in northern temperate ecosystems largely took place more than 30 years ago. By comparing the resource consumption patterns of different countries we conclude that, in 1996, the Ecological Footprint of an average consumer in the industrialized world was four times that of an average consumer in the lower income countries. This implies that rich nations (located mainly in northern temperate zones) are primarily responsible for the ongoing loss of natural wealth in the southern temperate and tropical regions of the world.

Fig. 1:
LIVING PLANET INDEX, 1970–99

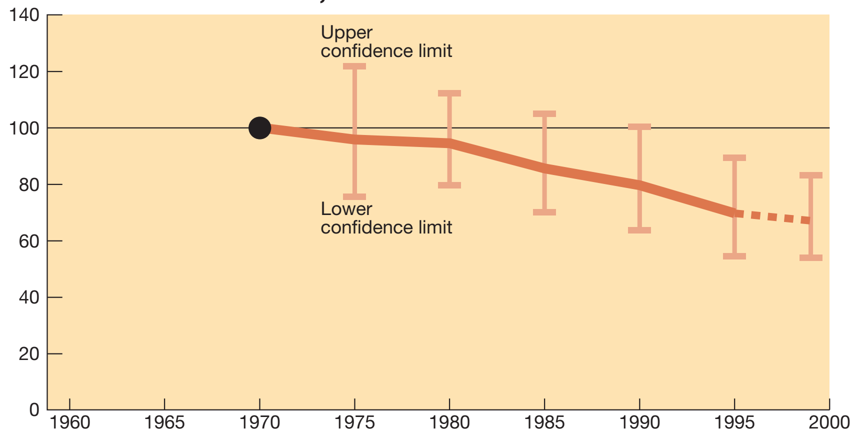
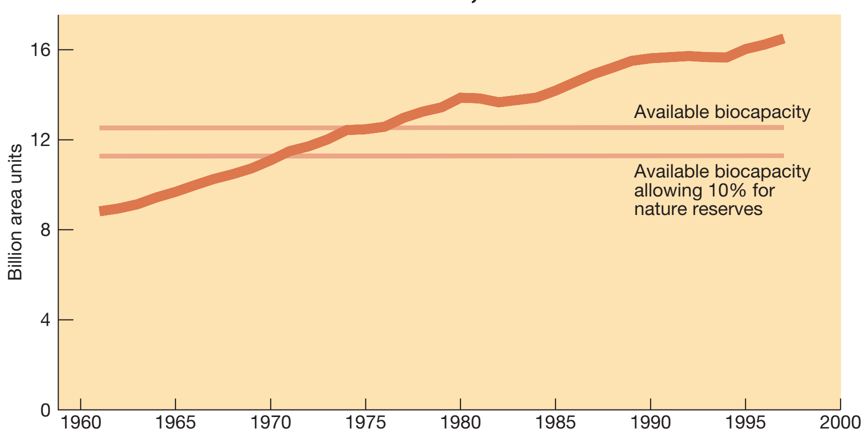


Fig. 2:
WORLD ECOLOGICAL FOOTPRINT, 1961–97



THE LIVING PLANET INDEX

The Living Planet Index is a measure of the natural wealth of the Earth's forests, freshwater ecosystems, and oceans and coasts. Figure 1 shows that the index fell by about 33 per cent between 1970 and 1999. The LPI is the average of three indices which monitor the changes over time in populations of animal species in forest, freshwater, and marine ecosystems respectively (see Figures 3-5). More details on how these indices are calculated are given on pages 4-9.

Each ecosystem index measures the change over time of a population that is typical of the sample of species in the index. The forest index includes 319 species populations, and shows a decline of about 12 per cent from 1970 to 1999. The freshwater index includes about 194 species populations and fell by about 50 per cent between 1970 and 1999. The marine index includes about 217 species populations which declined by about 35 per cent on average over the same period. These species were not selected as being the best indicators of their respective habitats, but represent all those for which time-series population data could be found.

Previous editions of the *Living Planet Report* used species populations to measure changes in freshwater and marine ecosystems, but not in forest ecosystems. Instead we used changes in forest area. In this report, all three ecosystem indexes are calculated in the same way. While this alteration improves the methodological consistency of the LPI, it does not significantly alter the overall result. The forest species population index declined by about 12 per cent between 1970 and 1999 while the forest area declined by approximately 11 per cent.

With the larger number of species included in the Living Planet Index, the three ecosystems indices are now calculated on a regional basis. The forest species population index is the average of separate trends in temperate and tropical forests. The freshwater species population index combines average trends from six continents, and the marine species population index is based on trends in six regional oceans. There is a difference between average trends of northern and southern species populations in the freshwater and marine indices, and between temperate and tropical populations in the forest indices. In all three ecosystem types, the most severe declines have been in the southern or tropical regions of the world.

This does not imply that the northern temperate ecoregions of the world are in a better state than tropical or southern temperate ecoregions, but that the northern temperate ecoregions have shown less change over the last 30 years (although there have been many examples of local declines). Much of the loss of biodiversity in northern temperate ecosystems took place prior to 1970, especially from the early 19th century onwards, and so is not recorded in the LPI. However, there are far fewer population data available for southern temperate and tropical species than northern temperate ones, and the trends shown in the regional sub-indices need to be corroborated by more data.

Boxes 1–6 on the opposite page give examples of a selection of species populations used in calculating the LPI.

Fig. 1:
LIVING PLANET INDEX, 1970–99

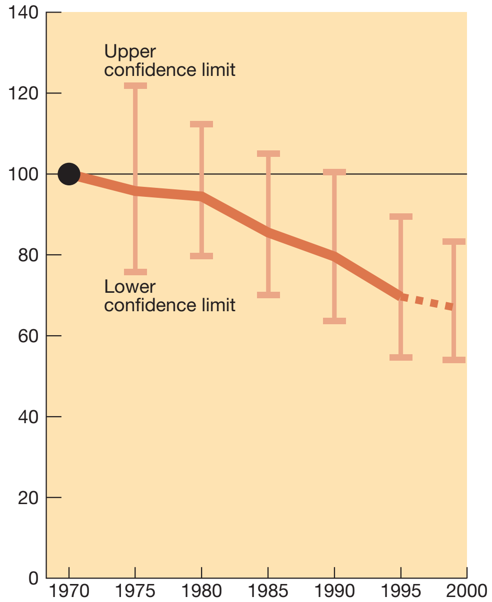


Fig. 3:
GLOBAL FOREST ECOSYSTEMS INDEX, 1970–99

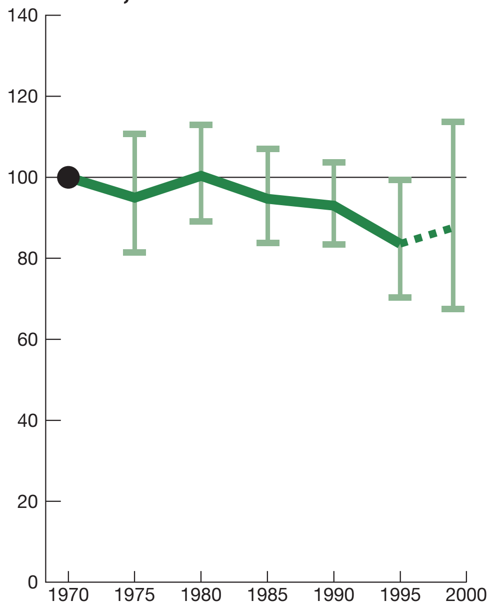


Fig. 4:
FRESHWATER SPECIES POPULATION INDEX, 1970–99

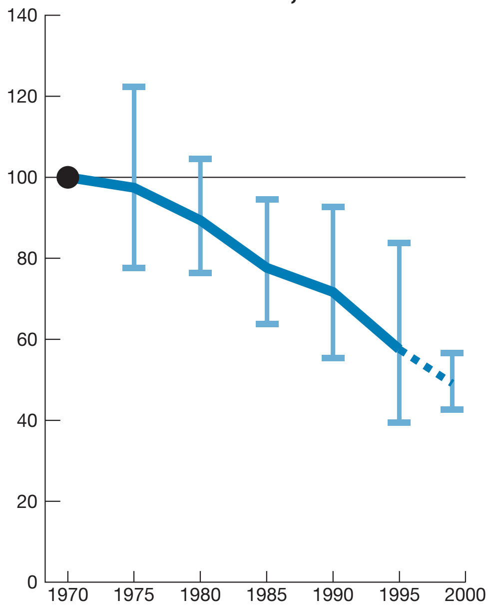
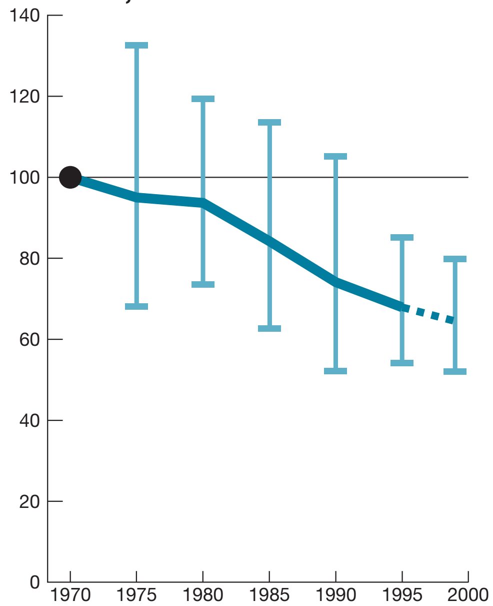
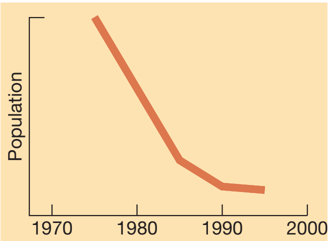


Fig. 5:
MARINE SPECIES POPULATION INDEX, 1970–99

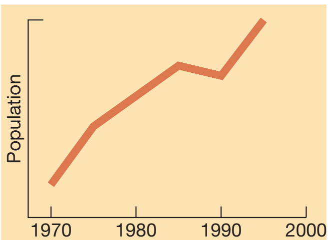


Box 1: SILVERY GIBBON
(*Hylobates moloch*) in Indonesia



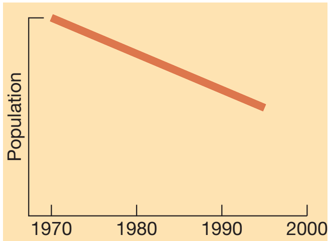
The silvery gibbon is endemic to the tropical rainforests of western and central Java, Indonesia. The species has declined through severe encroachment on forest habitats by Java's human population. There are possibly fewer than 3 000 silvery gibbons remaining, many of which occur in the reserves of Ujung Kulon and Gunung Halimun.

Box 2: SPARROWHAWK
(*Accipiter nisus*) in the UK



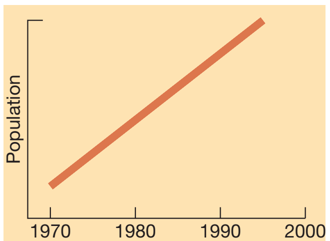
The sparrowhawk occurs throughout the forests and open woodland habitats of Eurasia and northern parts of Africa. The widespread use of organochlorine pesticides in Europe during the 1950s and 1960s killed many birds of prey and reduced their breeding success. These pesticides were banned in the 1970s in a number of countries, and several sparrow-hawk populations, such as those in the UK, have since shown a gradual recovery.

Box 3: LESSER WHITE-FRONTED GOOSE
(*Anser erythropus*) in Eurasia



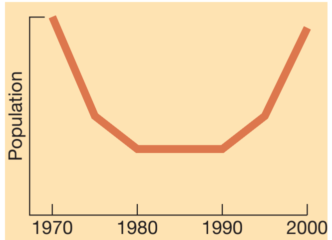
The lesser white-fronted goose breeds in the taiga and tundra zones of northern and western Eurasia and winters in the steppe zone of southeast Europe. It is believed that the main causes of its decline are the loss of its feeding habitat and hunting pressure at the staging and wintering grounds.
.

Box 4: GHARIAL
(*Gavialis gangeticus*) in southern Asia



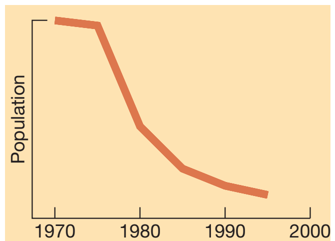
The gharial is one of the largest living crocodilians. The species is restricted to northern parts of the Indian sub-continent where it inhabits deep, fast-flowing rivers. While the gharial remains one of the most endangered crocodilians, its population has greatly increased since the 1970s, largely because of conservation programmes initiated over much of its range.

Box 5: KEMP'S RIDLEY TURTLE
(*Lepidochelys kempi*) in Mexico



Kemp's ridley is the most endangered sea turtle species. It generally occurs in the waters of the western Atlantic and almost exclusively nests at a single beach in Mexico. Predation on eggs, catching of adults, and incidental catch in fishing gear has greatly reduced the turtle's population. Ongoing intensive conservation measures appear to have stemmed the decline and numbers of nesting females are gradually increasing.

Box 6: BLUEFIN TUNA
(*Thunnus thynnus*) in the western Atlantic



The bluefin tuna is found on both sides of the Atlantic and both the eastern and western Pacific. Overfishing has led to a decline in tuna populations throughout the range. In the western Atlantic the population of fish over ten years old may have declined by up to 95 per cent since 1970.

FOREST SPECIES POPULATION INDEX

The Forest Species Population Index measures the average change over time in 319 forest species populations, and shows a decline of about 12 per cent from 1970–99. The index is the average of two sub-indices which relate to temperate and tropical forests, respectively. Figure 6 shows that the sub-index for tropical forest has declined by about 25 per cent over the period 1970-1999 while the sub-index for temperate forests increased slightly. This closely parallels the trends in the area of tropical and temperate forests over the same period (see Figure 7). The temperate and tropical forest components are given equal weighting in the overall forest index. This is because temperate and tropical forests currently occupy approximately equal areas of the Earth's surface.

Although there has been no overall decline in the temperate forests index since 1970, this does not imply that temperate forests are in a better state than tropical forests. It means that, on average worldwide, there has been little change in temperate forests over the last 30 years, although locally there are exceptions, such as the temperate rainforests on the Pacific coasts of Canada, the United States, and Chile. Most deforestation in temperate countries took place before the 20th century.

If the forest index could be extended back over 300 or 3 000 years rather than merely 30, a large overall decline for temperate forests would become apparent (see Figure 7). Before humans began modifying natural ecosystems to grow crops and graze animals around 8 000–10 000 years ago, the world's forests would have covered twice their current area, assuming that climatic conditions then were similar to today's. Both temperate and tropical forest areas have declined by about 50 per cent since the advent of agriculture. In contrast with temperate forests, however, most of the loss of tropical forests has taken place within the last 100 years, and is still continuing.

Species used in the index include antelopes, Asian elephant, Baird's tapir, brush-tailed possum, canids, cats, deer, flying foxes, giant panda, gibbons, great apes, hares and rabbits, kangaroos, jumping mouse, lemurs, mustelids, new world monkeys, old world monkeys, pipistrelle bat, rhinoceroses, shrews, sifaka, squirrels, tamarins, voles, bustards, creepers, cuckoos, doves, dunnock, falcons, finches, flycatchers, grouse, hawks, kinglets and thrushes, kiwis, jays and crows, mockingbirds and thrashers, new world warblers, nuthatches, old world warblers, owls, parrots and macaws, pheasants, sparrows, blackbirds, cowbirds and warblers, starling, tits, tree pipit, waxwing, woodcock, woodpeckers, wren, vireos, and several invertebrate species.

Map 1 shows the location of the world's forests, which currently cover approximately 30 million km^2, about one-fifth of the Earth's land surface.

Fig. 6:
FOREST SPECIES POPULATION INDICES,
1970–99

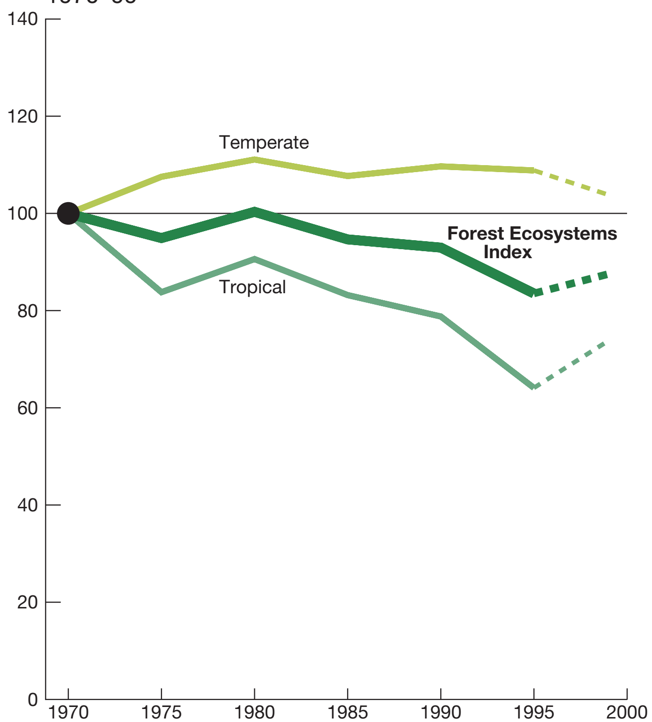
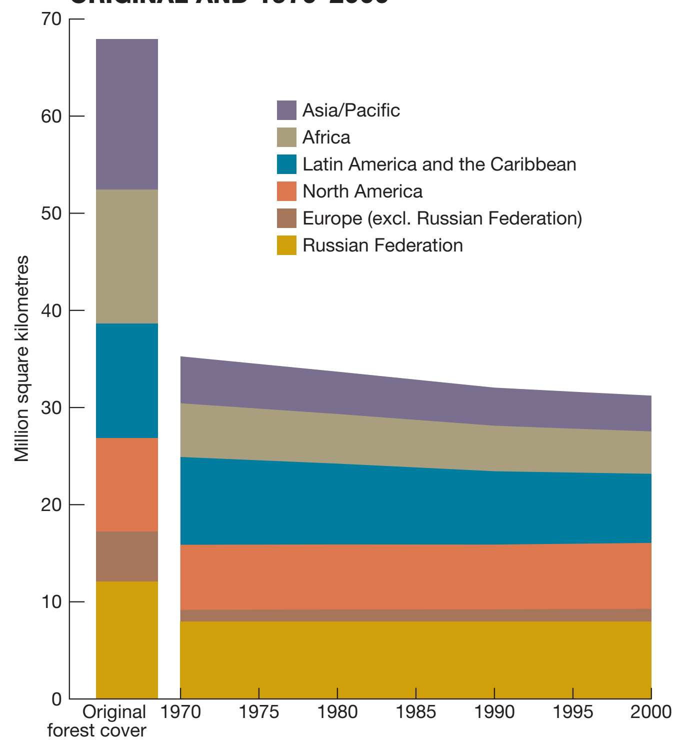
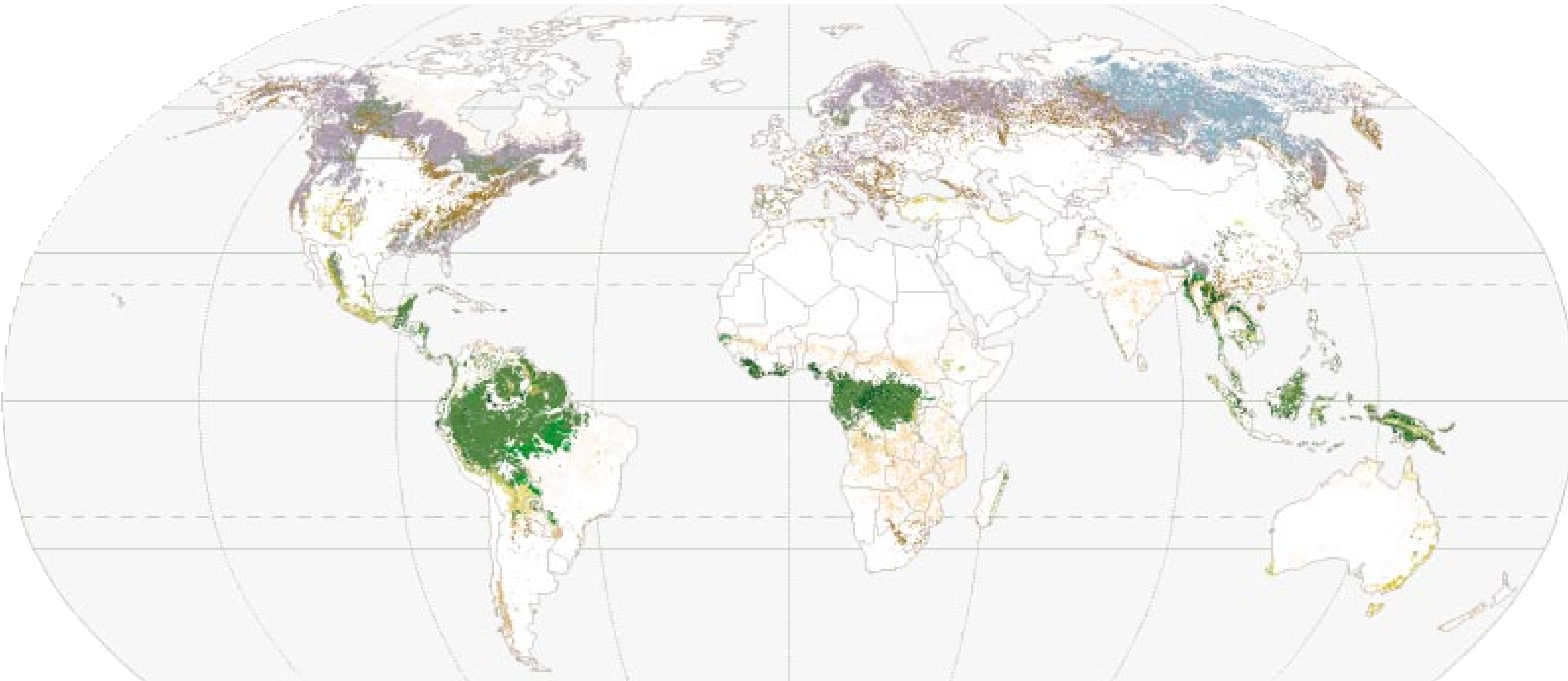


Fig. 7:
NATURAL FOREST COVER, ORIGINAL AND 1970–2000





Map 1:
CURRENT FOREST COVER

Tropical forests

- Montane forest
- Lowland evergreen broadleaf forest
- Semi-evergreen moist broadleaf forest
- Mixed needleleaf/broadleaf forest
- Needleleaf forest
- Sclerophyllous dry forest
- Deciduous/semi-deciduous broadleaf forest

Temperate and boreal forests

- Deciduous broadleaf forest
- Sclerophyllous dry forest
- Evergreen needleleaf forest
- Deciduous needleleaf forest
- Mixed broadleaf/needleleaf forest
- Broadleaf evergreen forest
- Disturbed natural forest

FRESHWATER SPECIES POPULATION INDEX

The Freshwater Species Population Index fell by about 50 per cent from 1970 to 1999 (see Figure 4), the most rapid decline of all three species population indices. It measures the average change over time in the populations of around 194 species of freshwater birds, mammals, reptiles, amphibians, and fishes. The index is the average of six sub-indices which relate to freshwater species populations from Africa, Asia-Pacific, Australasia, Europe, Latin America and the Caribbean, and North America respectively (see Figure 8).

Although the decline in European and North American freshwater species since 1970 has been much less severe than in other regions of the world, this does not imply that freshwater ecosystems in Europe and North America are in a better state than in other regions. It simply means that there has been less of a decline over the last 30 years. Much of the loss and degradation of freshwater ecosystems in the industrialized world took place prior to 1970.

The status of freshwater bird and mammal populations is better known than that of other groups, and waterfowl are among the most closely monitored of any wild species. Much less is known about population trends in freshwater fishes and amphibians, although many biologists believe these to be among the most threatened classes of species in the world. Recent evidence suggest that there has been a significant decline in amphibian populations in many parts of the world since the 1950s.

Species used in the index include European beaver, hippopotamus, Russian desman, river dolphins, saimaa seal, otter, reed bunting, cranes, ducks, geese and swans, flamingos, grebes, gulls and terns, eagles, herons and bitterns, ibises and spoonbills, common loon, pelicans, coots and swamphen, storks, snipe and redshank, South American river turtle, alligators and caimans, crocodiles, gharial, pond turtles, lungless salamanders, mole salamanders, narrowmouth toad, New Zealand frogs, newts, spadefoot toad, true toads, treefrogs, true frogs, ayu, carps and minnows, eel, galaxias, herrings and shads, perches, pike, salmons and trouts, splitfin, sturgeons, suckers, crayfish, and several other invertebrate species.

Map 2 shows the location of six major types of freshwater ecosystems around the world. Freshwater comprises only about 2.5 per cent of all water on Earth, and 99 per cent of that is locked up either in ice caps or below the ground. Freshwater ecosystems such as rivers, lakes, and wetlands occupy less than 2 per cent of the total land surface, yet they provide a wide range of habitat types for a significant proportion of the world's plant and animal species.

Fig. 4:
FRESHWATER SPECIES POPULATION INDEX, 1970–99

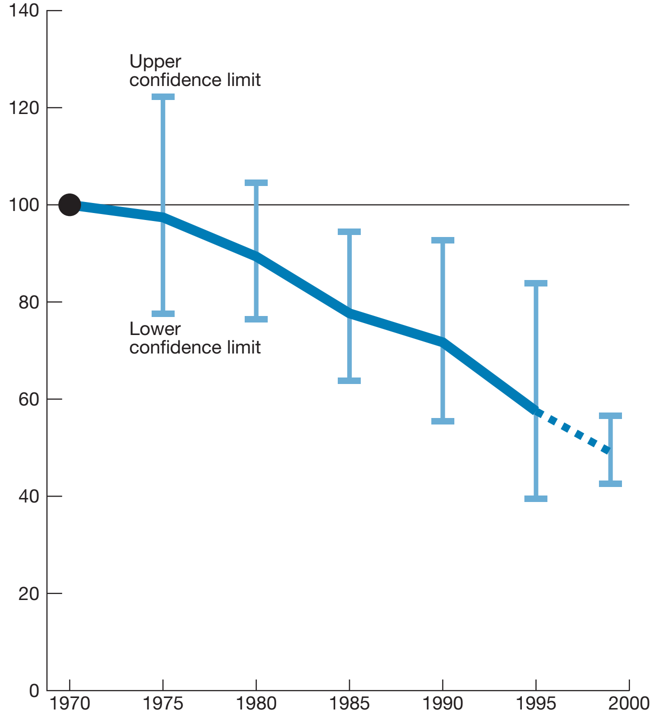
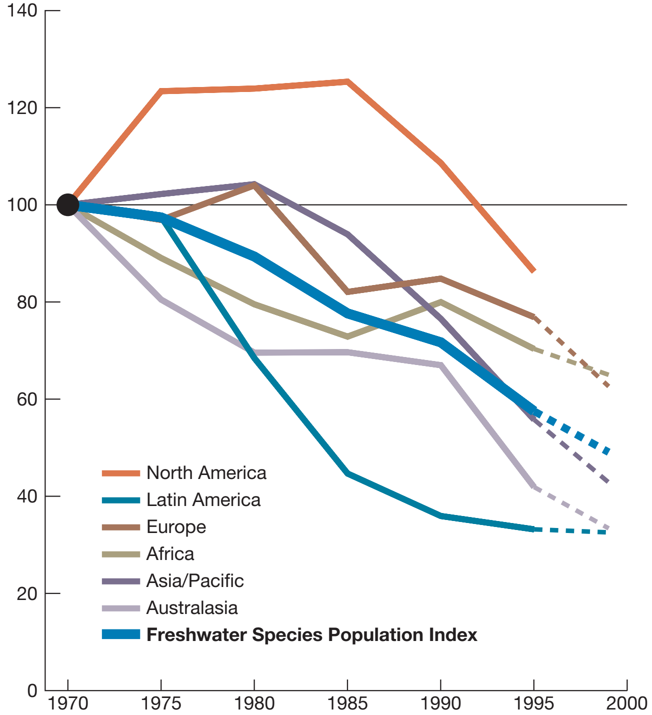
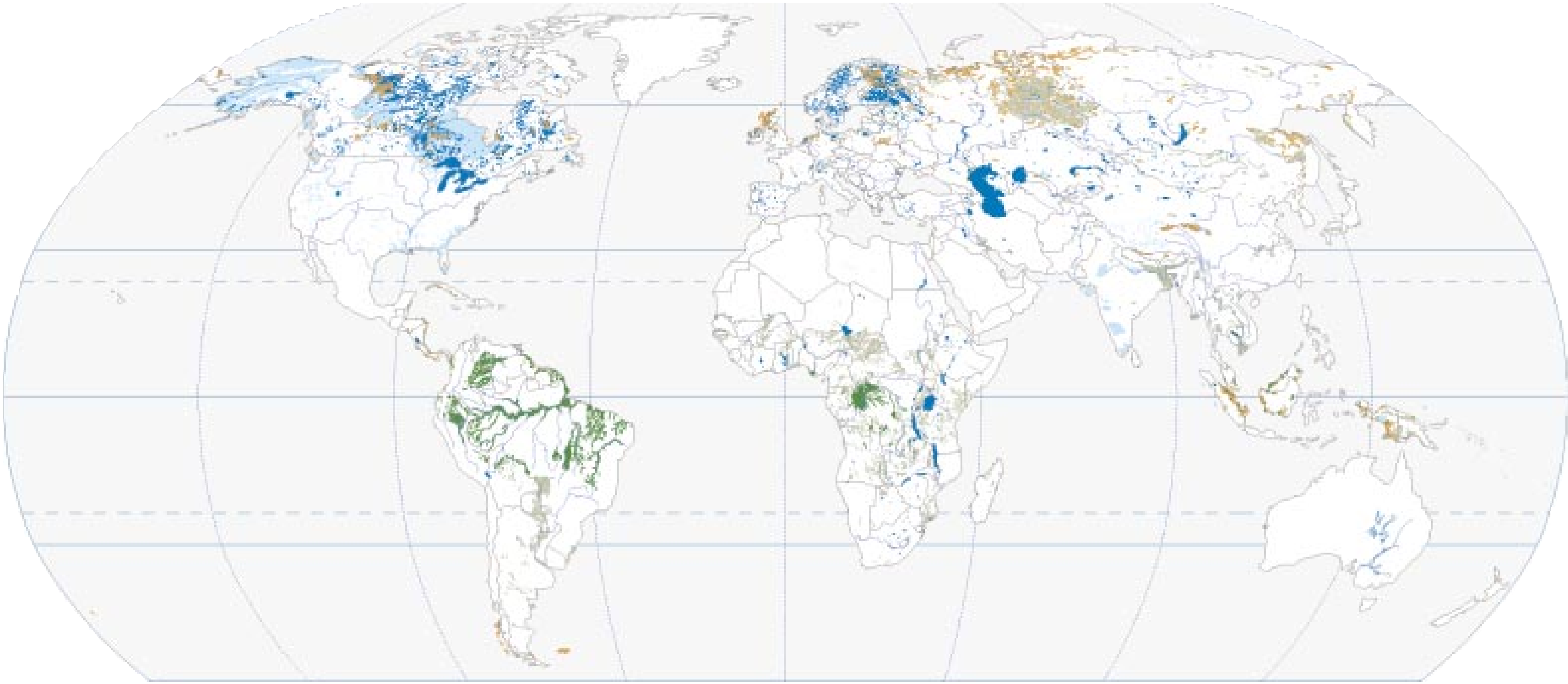


Fig. 8:
REGIONAL FRESHWATER SPECIES POPULATION INDICES, 1970–99





Map 2:
MAJOR FRESHWATER AREAS OF THE WORLD

- Freshwater marshes and floodplains
- Inland open waters
- Peatlands
- Seasonally flooding inland systems
- Swamp forest
- Unclassified wetland areas

MARINE SPECIES POPULATION INDEX

The Marine Species Population Index calculates the average changes in populations of 217 species of marine mammals, birds, reptiles, and fishes, and shows a decline of about 35 per cent from 1970 to 1999 (see Figure 5). The index is the average of six sub-indices which relate to the North Pacific, North Atlantic, Indian, South Pacific, South Atlantic, and Southern Oceans respectively (see Figure 9).

Like the forest and freshwater species, the marine species population declines have been more pronounced in the southern temperate and tropical oceans than in the northern temperate oceans. This does not mean that the northern oceans are in a better state, but simply that there has been a steeper relative decline in the southern and tropical oceans over the last 30 years than in the north.

Marine species are generally more difficult to monitor than terrestrial ones, and assessments are often based on catch sizes of harvested species. The exceptions are those species which nest or breed on land, such as seals and sea lions, seabirds, and marine turtles. Although fishes constitute over 90 per cent of marine vertebrate species, far more is known about the status of birds and mammals, and consequently these groups are over-represented in the index.

Species used in the marine index include beluga whale, bowhead whale, Caribbean manatee, dolphins, dugong, earless seals, fur seals and sea lions, grey whale, polar bear, rorqual whales, sea otter, sperm whale, vaquita, walrus, albatrosses, Bermuda petrel, boobies and gannets, brown pelican, cormorants and shags, eider duck, gulls and terns, parasitic jaeger, penguins, puffins, murrelets, auklets and guillemots, sandpipers, storm petrels, anchovies, atka mackerel, Bombay duck, capelin, cod icefishes, cods and haddocks, common sole, crocodile icefishes, dogfish, flathead mullet, goosefishes, herrings, shads, sardines and menhadens, jacks and pompanos, lane snapper, mackerels and tunas, merluccid hakes, porgies, righteye flounders, rockfishes, rockcods and thornyheads, sablefish, sandlance, scopthalmid flatfishes, summer flounder, swordfish, white hake, marine turtles, and several invertebrate species.

Map 3 and Figure 10 show the location and approximate areas of coral reef and mangrove ecosystems in the world's oceans. Coral reefs and mangroves are among the most productive, biologically diverse, and gravely threatened marine and coastal ecosystems.

Fig. 5:
MARINE SPECIES POPULATION INDEX, 1970–99

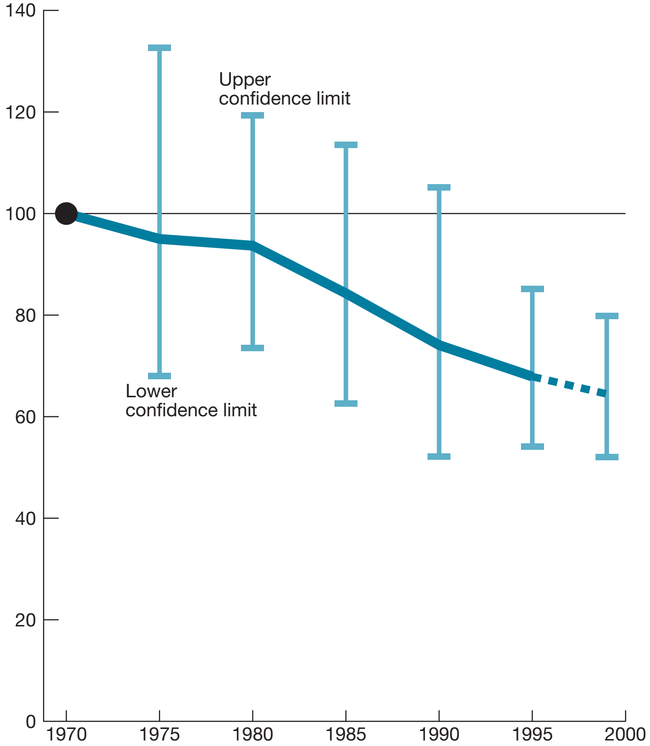


Fig. 9:
MARINE SPECIES POPULATION INDICES BY OCEAN, 1970–99

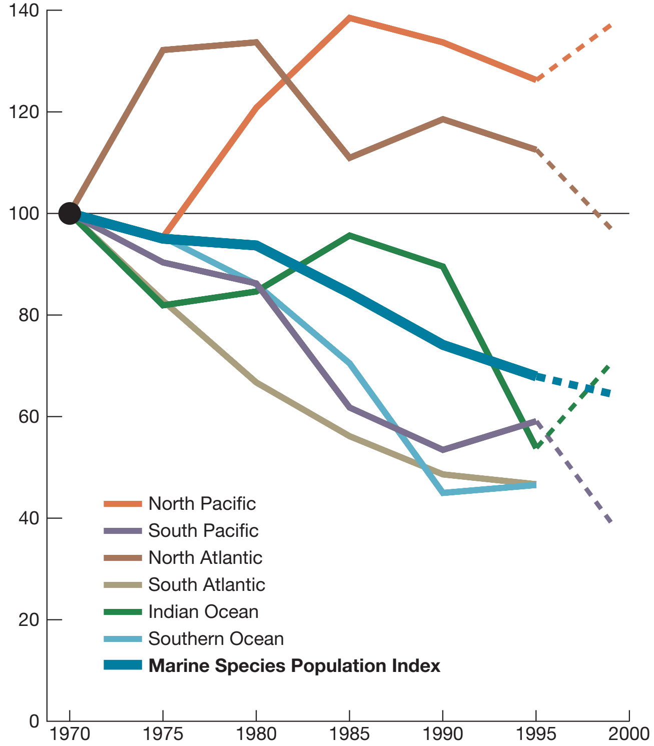
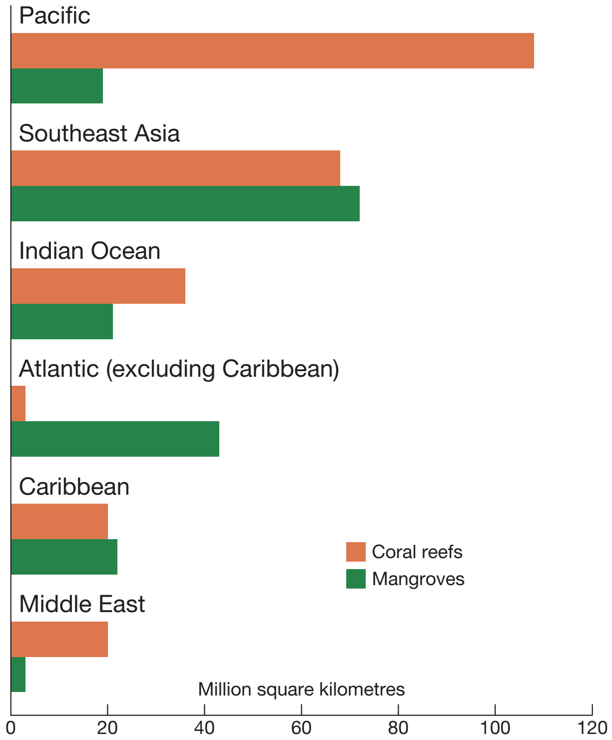
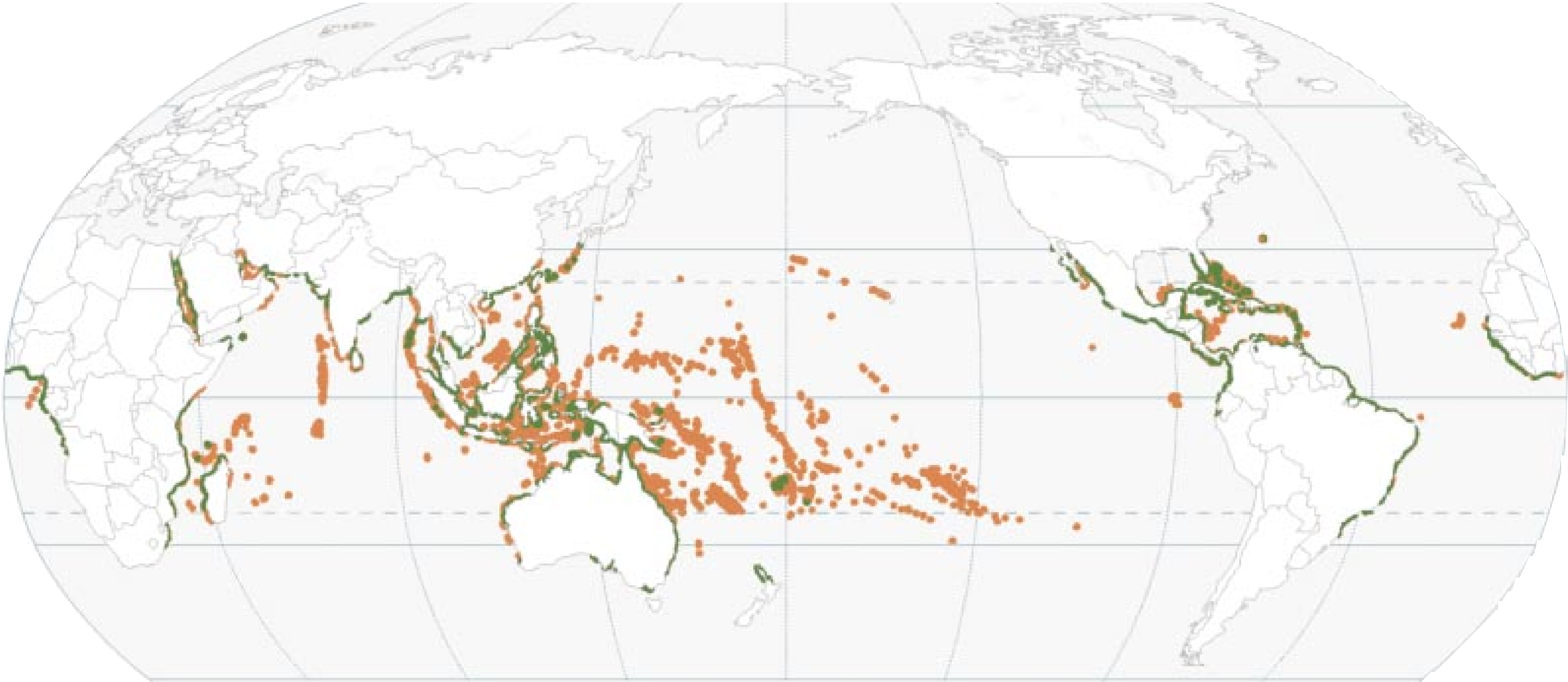


Fig. 10:
CORAL REEF AND MANGROVE ECOSYSTEMS





Map 4:
CORAL REEFS AND MANGROVE ECOSYSTEMS

Coral

Mangrove

THE ECOLOGICAL FOOTPRINT

The Ecological Footprint is a conservative estimate of human pressure on global ecosystems. It represents the biologically productive area required to produce the food and wood people consume, to give room for infrastructure, and to absorb the CO_2 emitted from burning fossil fuels, which is the primary cause of climate change, as explained further on the following pages. The Ecological Footprint is expressed in "area units". Each unit corresponds to one hectare of biologically productive space with "world average productivity" (see page 12 for a more detailed explanation). As people use resources from all over the world, and affect faraway places with their pollution, the footprint is the sum of these areas wherever they are on the planet.

The world's Ecological Footprint changes in proportion to global population size, average consumption per person, and the resource intensity of the technology being used. Technology can alter the productivity of land, or the efficiency with which resources are used to produce goods and services. The footprint calculations are conservative estimates of human impact since insufficient data are available on some uses of the biosphere. Also, the calculations assume that the technologies used in resource exploitation are the average of those prevailing in the world today, and do not make distinctions between the use of more sustainable exploitation in some places and less sustainable exploitation in others. This may distort the size of some countries' footprints, but does not affect the global result.

Figure 11 shows the growth of the Ecological Footprint of the world's population from 1961 to 1997. Figure 12 shows the size of the Ecological Footprints of seven regions of the world in 1996. The size of each box is proportional to the footprint of each region: the height of the box is proportional to the region's average Ecological Footprint per person and the width of the box is proportional to the population of the region. Figure 13 shows the size of the Ecological Footprint per person in all countries with populations greater than one million. The national and regional data relate to the year 1996, as this

Fig. 13:
ECOLOGICAL FOOTPRINT BY COUNTRY, 1996

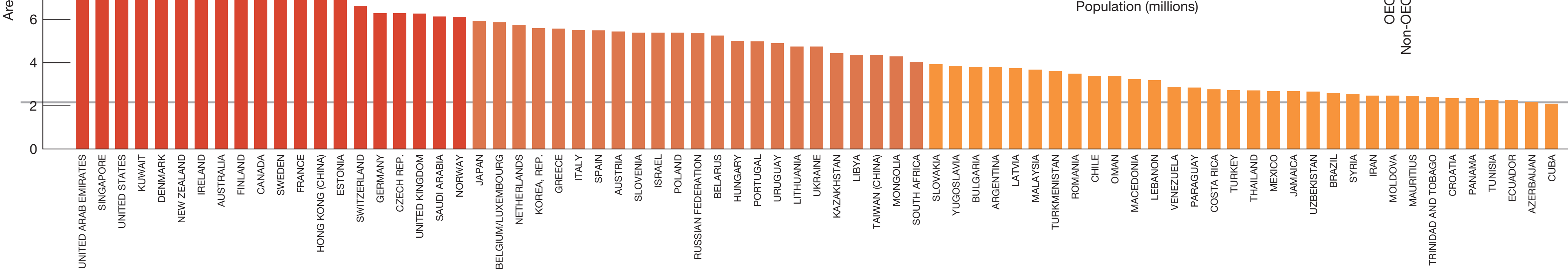


Fig. 11:
WORLD ECOLOGICAL FOOTPRINT, 1961–97

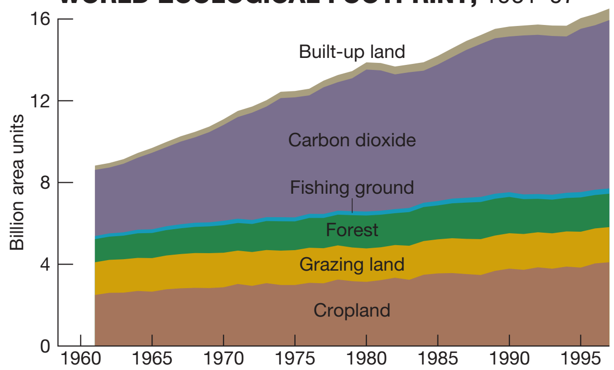
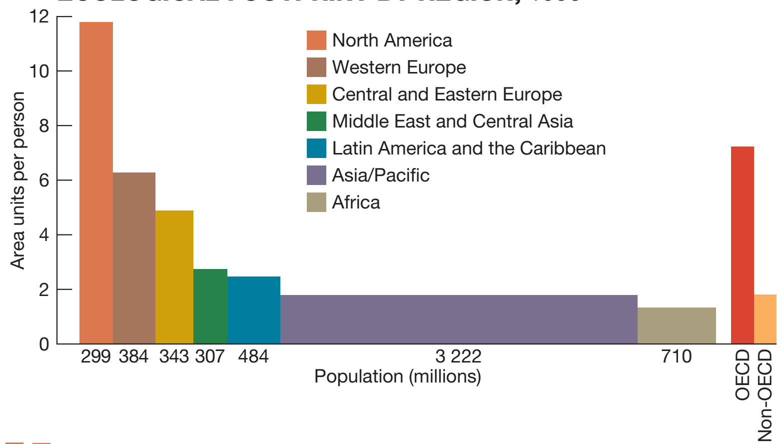
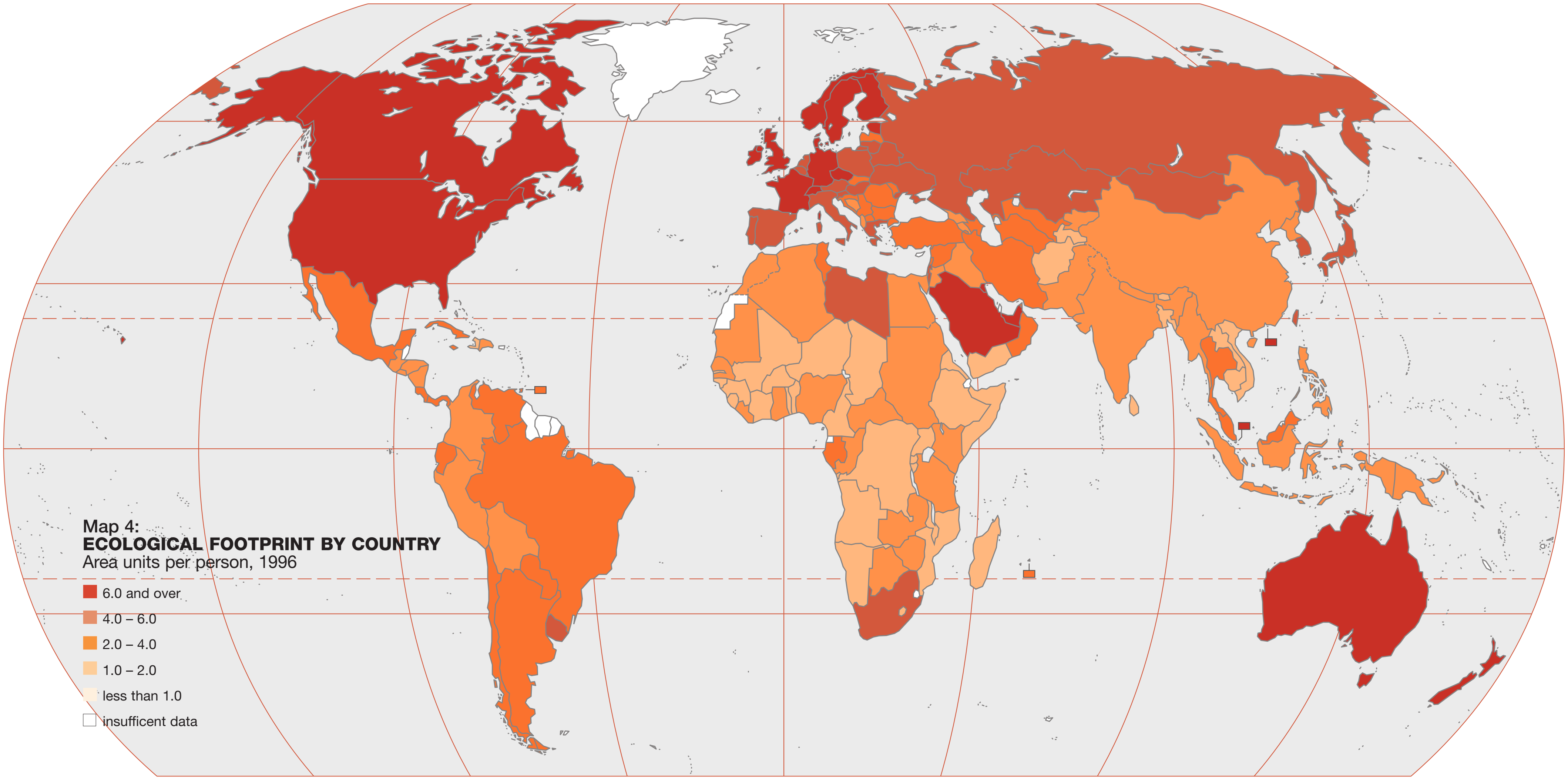
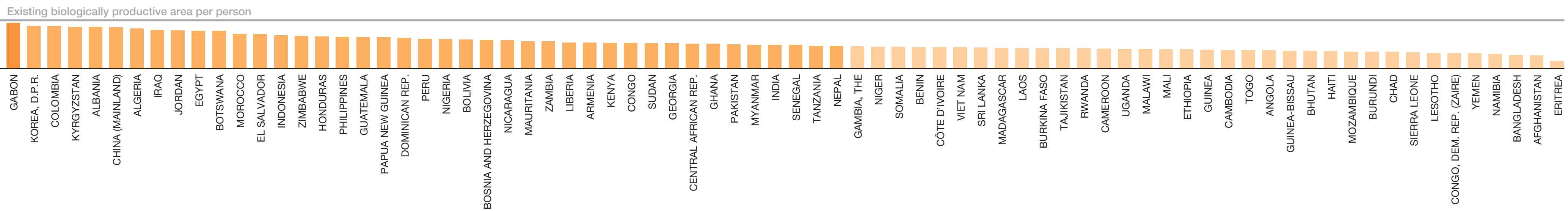


Fig. 12:
ECOLOGICAL FOOTPRINT BY REGION, 1996




Map 4:
ECOLOGICAL FOOTPRINT BY COUNTRY
Area units per person, 1996
6.0 and over
4.0 – 6.0
2.0 – 4.0
1.0 – 2.0
less than 1.0
insufficent data


Existing biologically productive area per person
GABON
KOREA, D.P.R.
COLOMBIA
KYRGYZSTAN
ALBANIA
CHINA (MAINLAND)
ALGERIA
IRAQ
JORDAN
EGYPT
BOTSWANA
MOROCCO
EL SALVADOR
INDONESIA
ZIMBABWE
HONDURAS
PHILIPPINES
GUATEMALA
PAPUA NEW GUINEA
DOMINICAN REP.
PERU
NIGERIA
BOLIVIA
BOSNIA AND HERZEGOVINA
NICARAGUA
MAURITANIA
ZAMBIA
LIBERIA
ARMENIA
KENYA
CONGO
SUDAN
GEORGIA
CENTRAL AFRICAN REP.
GHANA
PAKISTAN
MYANMAR
INDIA
SENEGAL
TANZANIA
NEPAL
GAMBIA, THE
NIGER
SOMALIA
BENIN
CÔTE D'IVOIRE
VIET NAM
SRI LANKA
MADAGASCAR
LAOS
BURKINA FASO
TAJIKISTAN
RWANDA
CAMEROON
UGANDA
MALAWI
MALI
ETHIOPIA
GUINEA
CAMBODIA
TOGO
ANGOLA
GUINEA-BISSAU
BHUTAN
HAITI
MOZAMBIQUE
BURUNDI
CHAD
SIERRA LEONE
LESOTHO
CONGO, DEM. REP. (ZAIRE)
YEMEN
NAMIBIA
BANGLADESH
AFGHANISTAN
ERITREA

THE ECOLOGICAL FOOTPRINT continued

was the most recent year for which UN statistics were available for all countries at the time of writing.

Extrapolating from the trend shows that, by the year 2000, the global footprint is likely to have increased slightly. This can be crudely estimated using population growth, assuming that the global average footprint per person has remained fairly constant (as it did from 1985 to 1996). As the world population has increased from 5.7 billion to 6.0 billion people since 1996, the global footprint is likely to have increased by about 5 per cent.

It is possible to compare the Ecological Footprint of a population with the biological capacity which is available to that population. In short, how much space does a population need compared with what is available?

In 1996 there were 12.6 billion hectares of biologically productive land on the planet, covering roughly one quarter of the Earth's surface. These consisted of 1.3 billion hectares of cropland, 4.6 billion hectares of grazing land, 3.3 billion hectares of forest land, 3.2 billion hectares of fishing grounds, and 0.2 billion hectares of built-up land (see Table 1 on opposite page). This amounts to 2.2 hectares for each of the world's 5.7 billion people in 1996: 0.2 hectares of cropland, 0.8 hectares of grazing land, 0.6 hectares of forests, and 0.5 hectares of productive ocean areas, most of which are located along coasts.

If we assume, for the sake of argument, that 10 per cent of all biologically productive space should be left undisturbed for other species, the available space per person shrinks from 2.2 to 2.0 area units. In contrast, the world average footprint was 2.85 area units per person in 1996. This exceeds the existing biologically productive space per person by about 30 per cent, or more if some space is reserved exclusively for other species. In other words, the area required to produce food and wood, to give room for infrastructure, and to absorb the CO_2 emissions associated with energy use was at least 30 per cent larger than the area available. This overshoot leads to the depletion of the Earth's natural capital stock, as reflected by the decline in the LPI.

Actions needed to reduce the Ecological Footprint: ■ Establish natural capital (or "biological capacity") accounts in each country, and set specific targets for natural capital use. ■ Phase out perverse subsidies that promote resource use, pollution, and population growth. ■ Encourage policies to incorporate environmental costs in the price of goods and services. ■ Promote the development of technologies that increase the efficiency of the use of resources. ■ Encourage educational initiatives that teach about opportunities to reduce human pressures on ecosystems. ■ Develop humane, equitable, and widely acceptable policies to reduce human population. ■ Establish international trade agreements which discourage countries from externalizing their ecological costs. ■ Redirect government procurement towards sustainable alternatives to set good examples and stimulate new markets.

key questions answered

WHAT ARE "AREA UNITS"?

The Ecological Footprint is measured in "area units". One "area unit" is equivalent to one hectare of biologically productive space with world average productivity. Land varies greatly in productivity; the most productive land is generally used to grow crops, while the least productive is used to graze animals.

One "area unit" is equivalent to about 0.3 hectares of cropland of world average productivity. It is also equivalent to 0.6 hectares of average forest, or 2.7 hectares of average grazing land, or 16.3 hectares of sea (coastal and upwelling zones) with average productivity. Thus a hectare of highly productive land represents more "area units" than the same amount of less productive land.

All land areas are scaled according to their capacity to produce biomass. Sea is measured in terms of its capacity to produce protein for human consumption. Area units allow the meaningful comparison of the Ecological Footprints of different countries, which use different qualities and mixes of cropland, grazing land, and forest.

HOW MUCH LAND IS NEEDED TO ABSORB CARBON DIOXIDE EMISSIONS?

The Ecological Footprint methodology asks how much bigger the biosphere would need to be in order to absorb the CO_2 emitted by burning fossil fuels. Alternatively we could ask how large an area would be needed to supply the same amount of energy using only biomass fuel.

Either method yields similar results (in fact, the one we use gives the lower estimate). By choosing a method that is based on present CO_2 sequestration rates, we are not advocating that forests should be planted to counteract increasing concentrations of CO_2 in the atmosphere. Rather, we show that sequestration can only be a partial solution at best, since there is not enough land on Earth available to provide this function. By expressing fossil fuel use in terms of CO_2 sequestration, we can compare the fossil fuel footprint with other human pressures on the biosphere, and aggregate them into a single index.

WHAT IS "APPARENT CONSUMPTION"?

The footprints presented in the Living Planet Report compare people's consumption in each country with the biosphere's ecological capacity. This means that a car produced in Germany, but sold in France, will be added to the French footprint. We estimate each country's consumption by adding its imports to its production, and subtracting its exports.

The resulting "apparent consumption" can be distorted since it does not distinguish between production waste and consumption. This explains irregularities, as in the case of Ireland's footprint. While consumption patterns in Ireland may be similar to those in the United Kingdom, Ireland, with a large agricultural sector and a small population compared to the UK, is charged with a footprint that corresponds to waste generated when producing food for export. But no official data exist to correct that error, or similar errors affecting other sectors. For example, in more detailed accounts, we would distinguish between types of fish imported and exported since the biological capacity needed to produce a given amount of fish protein can vary by orders of magnitude, depending whether the fish consumed are top predators such as tuna, or species that are low down in the food chain.

Tourism footprints, which are included in the destination country's footprint, should really be assigned to the tourist's country of residence. These footprint misallocations can distort national accounts and skew the distribution of the global footprint responsibility. However, these errors do not affect the overall global account (since there is no trade between the Earth and other planets).

ARE THE YIELDS BEHIND THE FOOTPRINT CALCULATIONS SUSTAINABLE?

In calculating the national footprints, we use yields for forests or fisheries that are optimistic estimates of the maximum amount of a single species stock that can be harvested without reducing the stock's productivity over time. Harvesting within this maximum level is a necessary, but not sufficient, criterion for sustainability.

Taking less can still cause ecological damage since the yield figures assume careful harvest practices with no collateral damage, no local overharvesting, and the safeguarding of protected areas.

WHICH COUNTRIES ARE SUSTAINABLE?

On pages 10–11, we compare each nation's Ecological Footprint per person with the world average biological capacity available per person. We have also compared each country's footprint with its own domestic biological capacity. The difference between a country's footprint and its biological capacity is its "ecological deficit", which is shown in Table 2. But these numbers do not indicate which countries are sustainable.

The minimum requirement for global sustainability is that humanity's footprint must be smaller than the biosphere's biological capacity. What does this mean for nations? Is Sweden, with a large footprint per person, but even larger biological capacity per person, ecologically sustainable? Is Egypt, which has a per person footprint smaller than the global average biological capacity, yet larger than its domestic biological capacity? Clearly, if everyone in the world led the same lifestyle as the average Swede, the Earth would not be able to sustain its human population for very long. Nor would humanity be sustainable if all countries ran an ecological deficit like Egypt.

Does this mean that people should live within the world's average biological capacity, or their national biological capacity? Footprint calculations do not answer these questions, but try to quantify the ecological challenges and conflicts humanity needs to resolve if it wants to achieve global sustainability.

Table 1: Biologically productive space

	Global area in 1996 (million hectares)	Area per person in 1996 (hectares/person)	Equivalence factor	Area per person in 1996 (area units/person)
Cropland	1 254	0.22	3.16	0.69
Grazing land	4 619	0.79	0.39	0.31
Forest land	3 333	0.58	1.78	1.03
Fishing grounds	3 200	0.55	0.06	0.03
Built-up land	200	0.04	3.16	0.12
Total	**12 606**	**2.18**	**1.00**	**2.18**

CROPLAND FOOTPRINT

The cropland footprint of an individual is the area (of "world average" cropland) required to produce all the crops which that individual consumes. This includes all cereals, fruit and vegetables, roots and tubers, pulses, nuts, tea and coffee, sugar, margarine, and vegetable oils, as well as tobacco, cotton, jute, and rubber. It also includes crops fed to poultry and pigs, which are converted to meat and consumed in the form of chicken or pigmeat.

To calculate the cropland footprint of a country, it is necessary to convert the dietary habits of the population into the area of average cropland required to produce this diet. This has been done for most of the world's countries and the results are shown in Figures 15 and 16, measured in both hectares of average crop land and "area units" per person (see more detailed explanation on page 12).

Figure 14 shows the growth in the world's cropland footprint since 1961. There were approximately 1.5 billion hectares of cropland available worldwide in 1996, of which about 1.3 billion hectares were used for growing crops, and the rest for grazing animals. Dividing 1.3 billion hectares by the world's population gives an average cropland footprint of 0.22 hectares, or 0.69 area units, per person.

The cropland footprint of the average North American was more than twice the world average, at 1.44 area units, whereas the cropland footprint of an average African or Asian was less than 0.60 area units. However, the cropland footprint shows less variance between nations than other components of the Ecological Footprint.

Actions needed to reduce the world's cropland footprint: ■ Move to sustainable farming systems that do not systematically degrade biological capacity; protect soil from erosion and degradation caused by intensive agriculture, overgrazing, or salinization. ■ Preserve existing croplands for agriculture, rather than urban and industrial development, road building, or non-essential crops such as tobacco. ■ Use agricultural chemicals in a way that takes account of the assimilative capacity of agro-ecosystems, stop the use of hazardous pesticides and increase the use of biological control and pest-resistant varieties. ■ Eliminate export subsidies.

Fig. 14:
WORLD CROPLAND FOOTPRINT, 1961–97

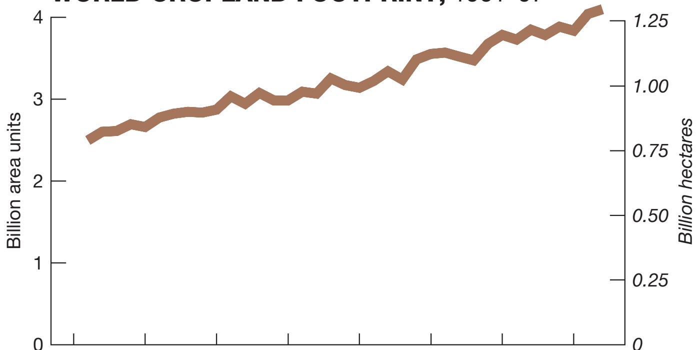


Fig. 15:
CROPLAND FOOTPRINT BY REGION, 1996

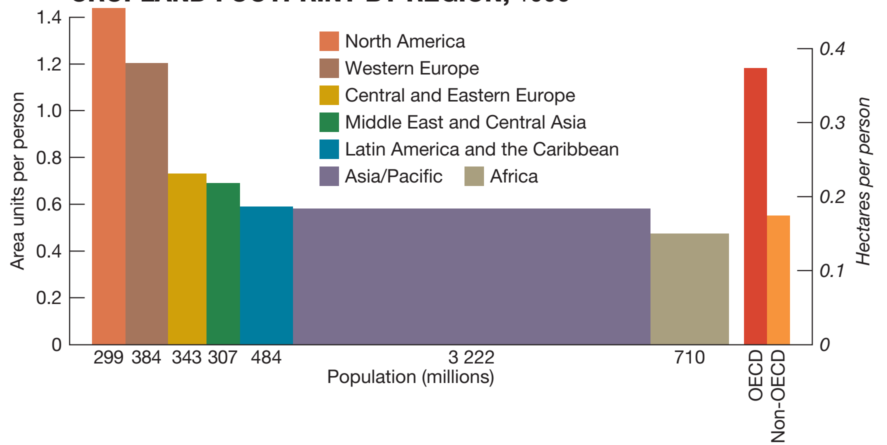
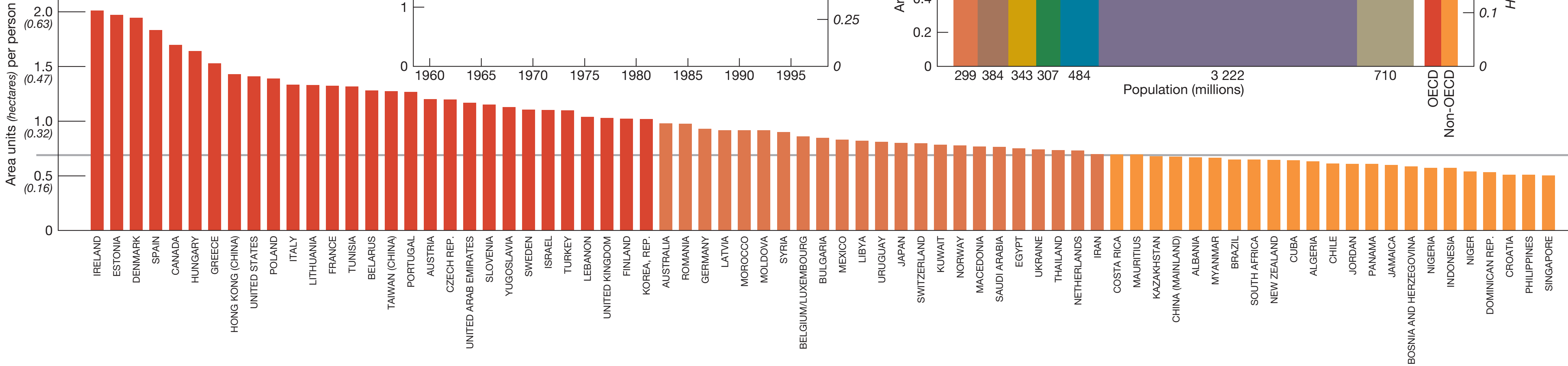
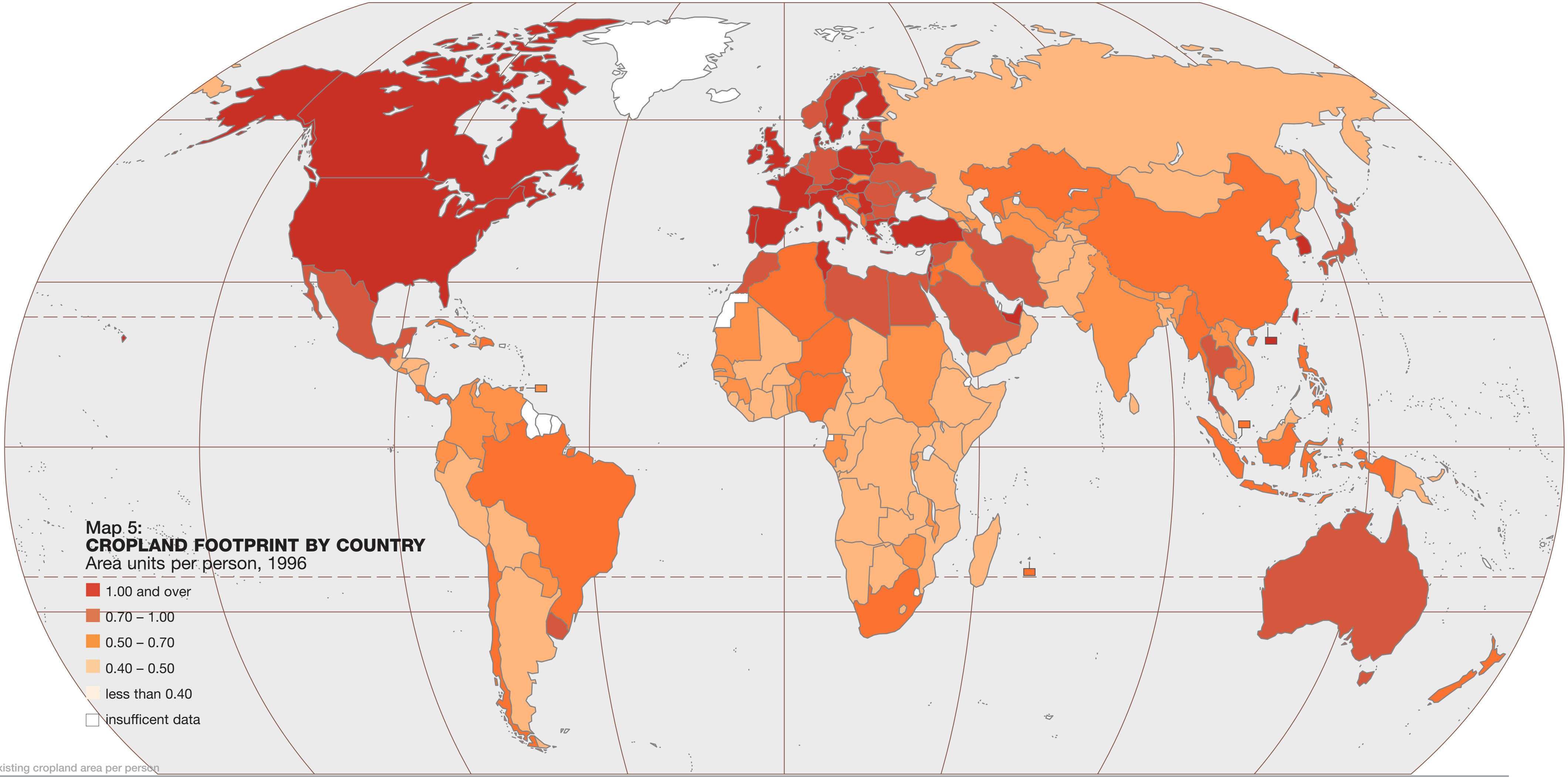
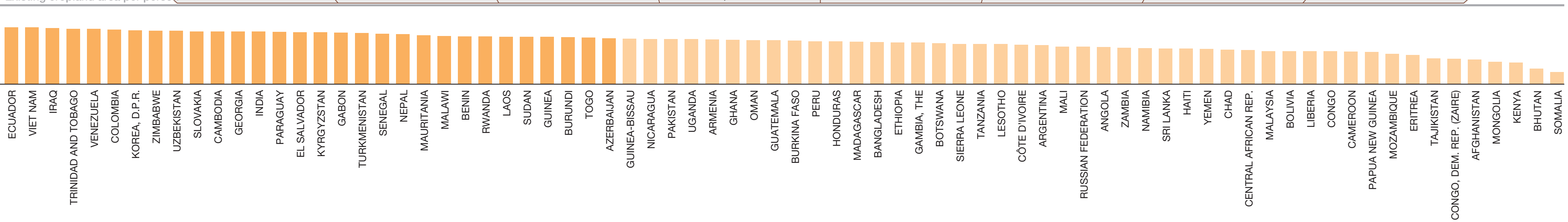


Fig. 16:
CROPLAND FOOTPRINT BY COUNTRY, 1996





Map 5:
CROPLAND FOOTPRINT BY COUNTRY
Area units per person, 1996



GRAZING LAND FOOTPRINT

The grazing land footprint of an individual is the area (of "world average" grazing land) that is required to produce the animal products which that individual consumes. This includes all meat and dairy products from cattle, sheep, and goats, as well as hides and wool (pigmeat and chicken are accounted for under the cropland footprint – see page 14).

To calculate the grazing land footprint of a country, it is necessary to convert the national consumption of animal products into the area of "average" grazing land required to produce them. The results are shown in Figures 18 and 19, expressed in hectares of average grazing land and "area units" per person.

Figure 17 shows that the size of the world grazing land has increased slowly since the 1960s. This is largely a result of clearing of forest land. There were approximately 4.6 billion hectares of grazing land on the Earth in 1996, giving a world average availability of about 0.79 hectares of grazing land, or 0.31 area units, per person. Assuming that this area was fully utilized, the world average grazing land footprint in 1996 was also 0.31 area units per person.

However, there was a fourfold disparity between the sizes of the grazing land footprints of consumers in OECD and non-OECD countries, because of the greater emphasis on meat and dairy products in the diets of the richer nations. The exceptions are the few lower-income countries, such as Mongolia, with less productive land that is only suitable for grazing.

Actions needed to reduce the world's grazing land footprint: ■ Reduce meat and dairy product consumption, especially in high-income countries. ■ Maintain traditional grazing systems that encourage and conserve biodiversity. ■ Change eating habits away from resource-intensive foods. ■ Eliminate export subsidies.

Fig. 19:
GRAZING LAND FOOTPRINT BY COUNTRY, 1996

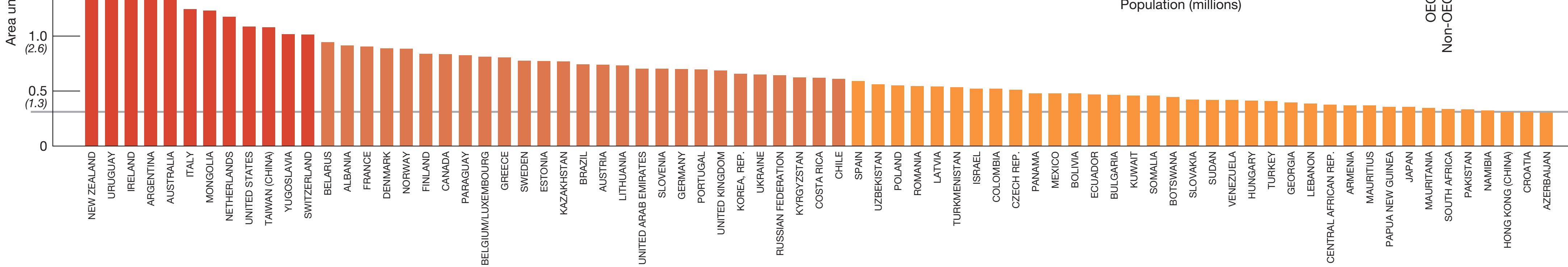


Fig. 17:
WORLD GRAZING LAND FOOTPRINT, 1961–97

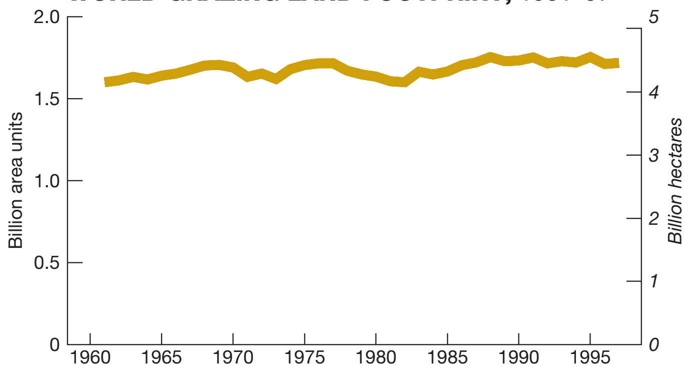
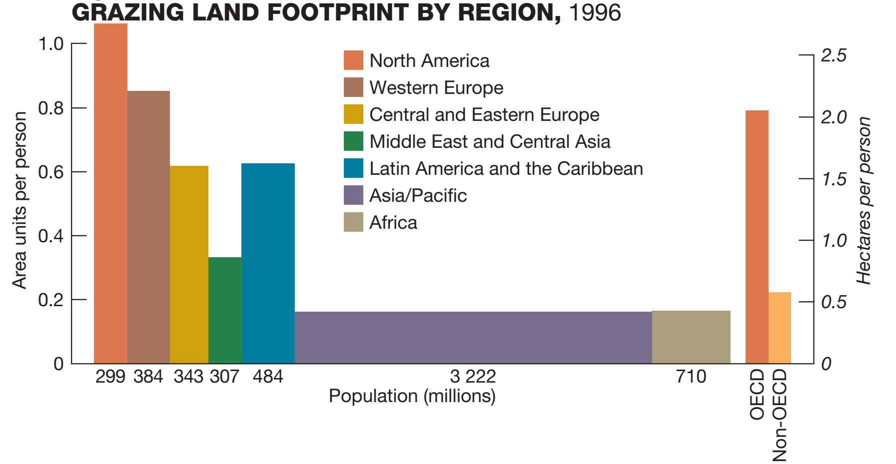
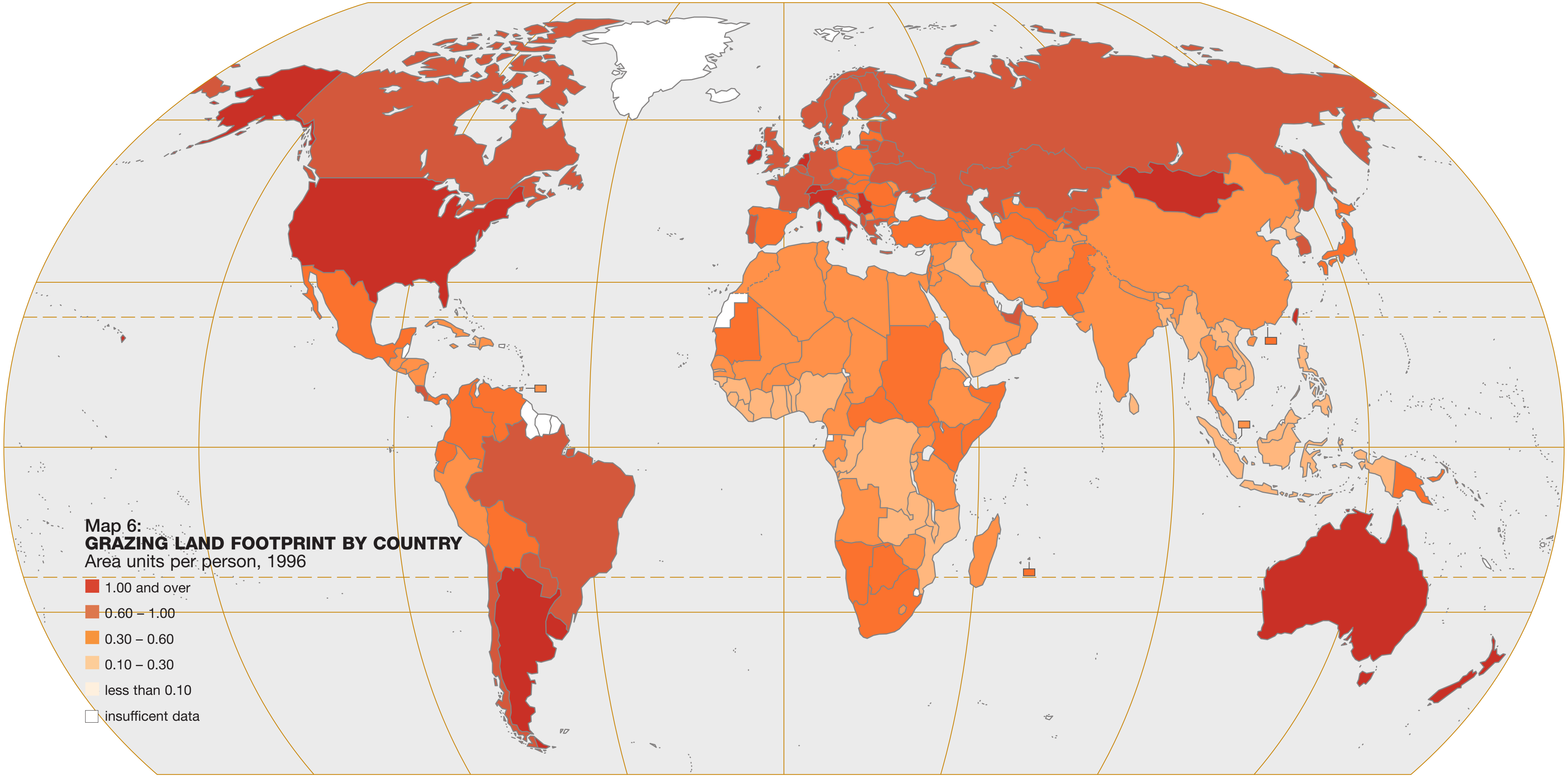
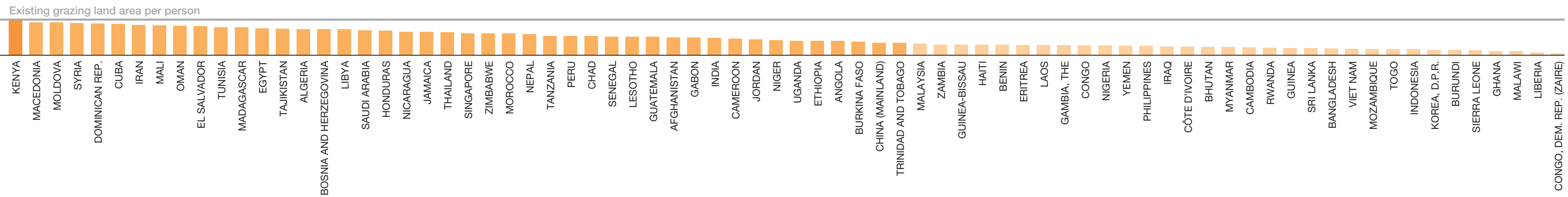


Fig. 18:
GRAZING LAND FOOTPRINT BY REGION, 1996





Map 6:
GRAZING LAND FOOTPRINT BY COUNTRY
Area units per person, 1996



FOREST FOOTPRINT

The forest footprint of an individual is the area (of "world average" forest land) required to produce the wood products which that individual consumes. This includes all the fuelwood and charcoal, roundwood (whether in the form of sawnwood, wood-based panels, or fibreboard), paper, and paperboard.

To calculate the national forest footprint, it is necessary to convert the national consumption of wood products into the area of "average" forest land required to produce those products. The results are shown in Figures 21 and 22, expressed in hectares of average forest land and "area units" per person. The ranking does not refer to the quality of forests or sustainability of forestry activities in each country; it only reflects each country's demand on forests worldwide.

There were approximately 3.3 billion hectares of forest in 1996, giving a world average availability of forest land of about 0.58 hectares per person. This translates into 1.03 area units per person. The world average wood product consumption in 1996 was 0.41 m^3 of wood raw material equivalent per person per year. At average forest productivity, this equates to a forest footprint of 0.28 area units per person. The forest footprint of consumers in OECD countries was, on average, over three times larger than that of consumers in non-OECD countries.

Figure 20 shows the growth of the world's forest footprint since 1961. The total forest footprint of the global population adds up to approximately 30 per cent of the world's current forest cover. However, industrial forestry, which produces most of the world's timber and pulp for paper, is concentrated in a few areas where the forest is not always managed sustainably.

Actions needed to reduce pressure on forests: ■ Establish a network of ecologically representative protected areas covering at least 10 per cent of each forest type. ■ Ensure forests outside protected areas are well managed according to standards set by the Forest Stewardship Council. ■ Stop all illegal logging. ■ Develop ecologically and socially appropriate forest restoration programmes. ■ Reduce forest damage from pollution and climate change. ■ Promote the recycling and reuse of wood and paper products.

Fig. 22:
FOREST FOOTPRINT BY COUNTRY, 1996

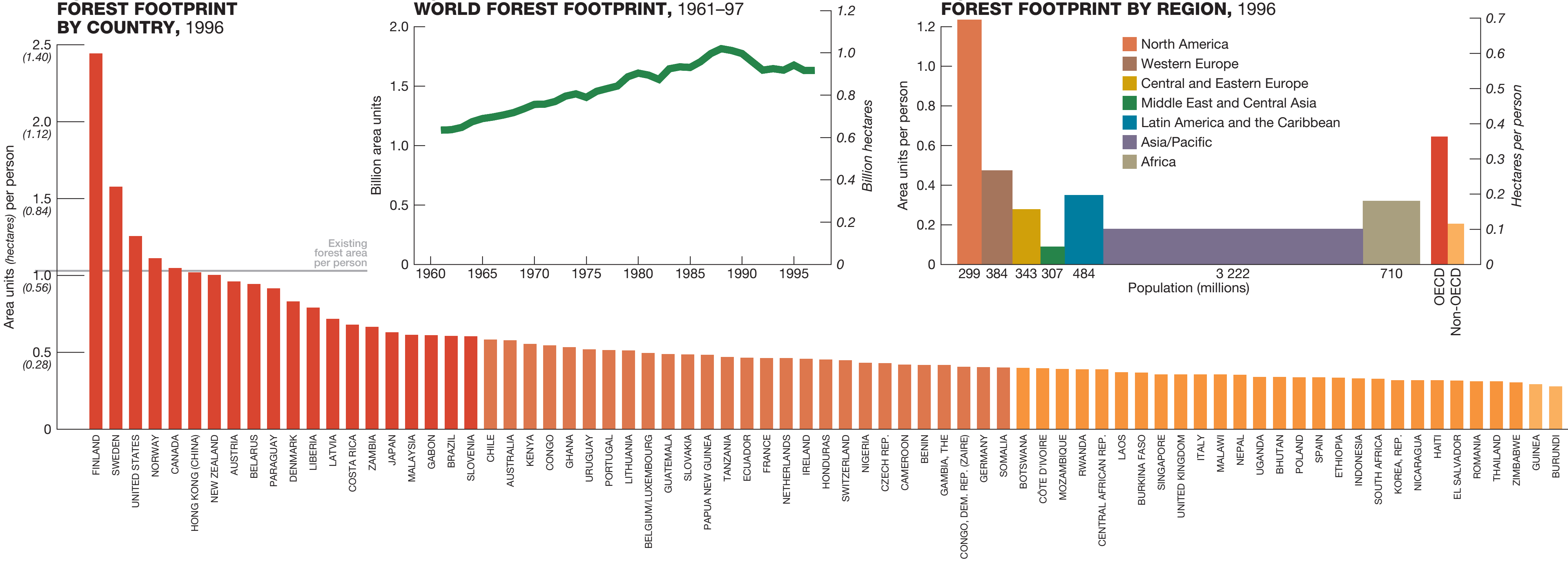
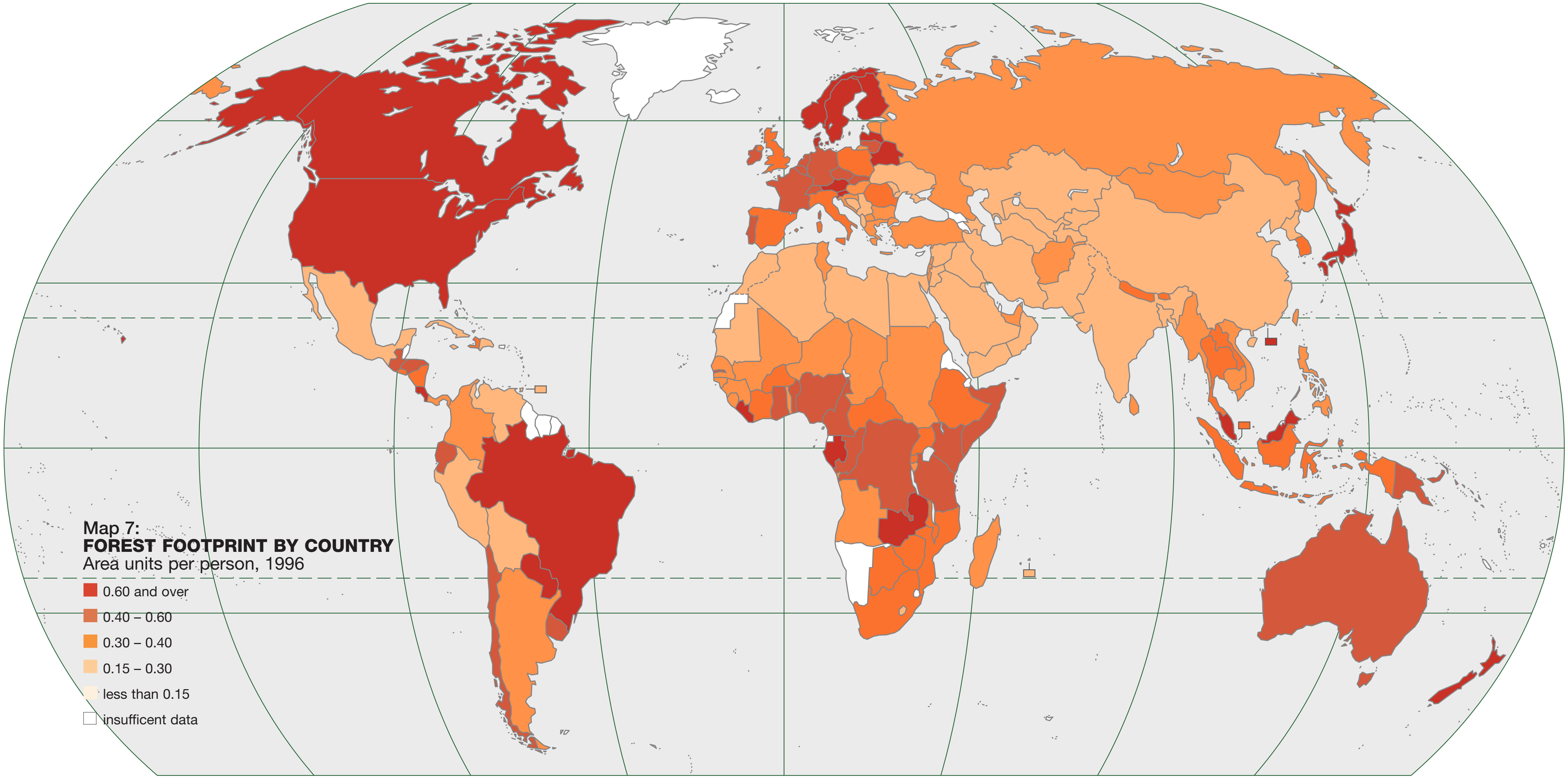
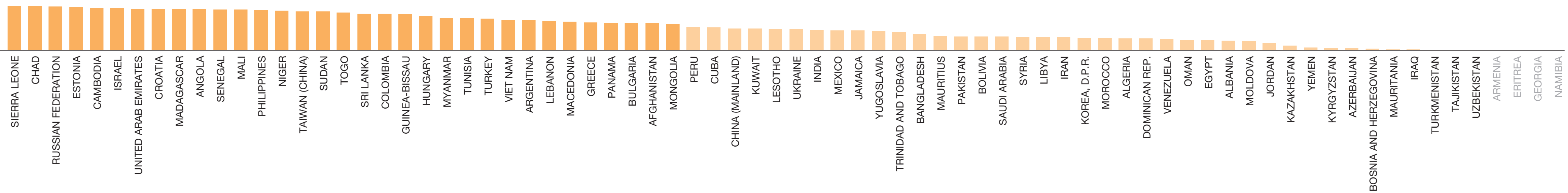


Fig. 20:
WORLD FOREST FOOTPRINT, 1961–97

Fig. 21:
FOREST FOOTPRINT BY REGION, 1996



Map 7:
FOREST FOOTPRINT BY COUNTRY
Area units per person, 1996



FISHING GROUND FOOTPRINT

The fishing ground footprint of an individual is the area (of "world average" fishing ground) required to produce the marine fish and seafood products which that individual consumes. This includes all the sea fish, crustaceans, and cephalopods, as well as all fishmeal and oils that are fed to animals. It also includes an additional 25 per cent to allow for bycatch, which is generally discarded back to the sea.

To calculate the fishing ground footprint of a country, it is necessary to convert the national consumption of marine fish and seafood into the area of "average" fishing grounds required to produce it. The results are shown in Figures 24 and 25, expressed in hectares of average fishing grounds and "area units".

There were approximately 3.2 billion hectares of fishing grounds in 1996, giving a world average availability of about 0.55 hectares, or 0.03 area units per person.

Figure 23 shows the growth in the world's fishing ground footprint since 1961. The world average marine fish and seafood consumption in 1996 was 23kg per person per year. At average productivity, this equates to a fishing ground footprint of 0.04 area units per person. The total fishing ground footprint of the world's population therefore exceeded the availability of the world's fishing grounds by approximately 30 per cent. In other words, the level of consumption exceeded the productive capacity of the world's fishing grounds by almost a third. The average fishing ground footprint of an OECD country consumer was about three times that of an average non-OECD country consumer.

Actions needed to reduce pressure on fisheries: ■ Reduce the incidental killing of unwanted fish and other marine wildlife that accounts for more than a quarter of the world catch. ■ Eliminate destructive fishing practices, such as cyanide and blast fishing on coral reefs. ■ Cut the government subsidies that contribute to overfishing. ■ Support management schemes that protect artisinal fisheries and local economies. ■ Promote market incentives for sustainable fishing, such as the Marine Stewardship Council. ■ Designate marine protected areas to safeguard marine ecosystems and give depleted fish populations a chance to recover.

Fig. 25:
FISHING GROUND FOOTPRINT BY COUNTRY, 1996

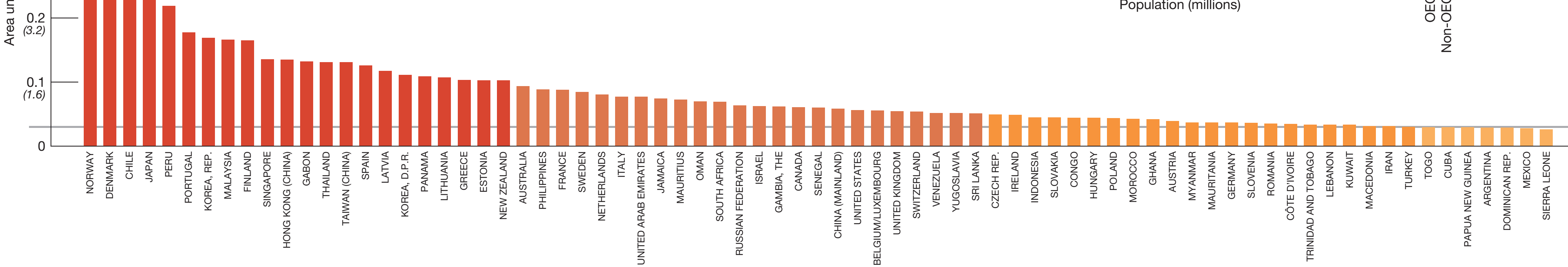


Fig. 23:
WORLD FISHING GROUND FOOTPRINT, 1961–97

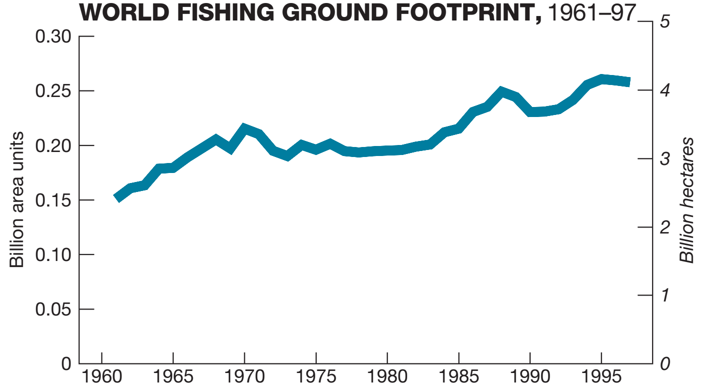
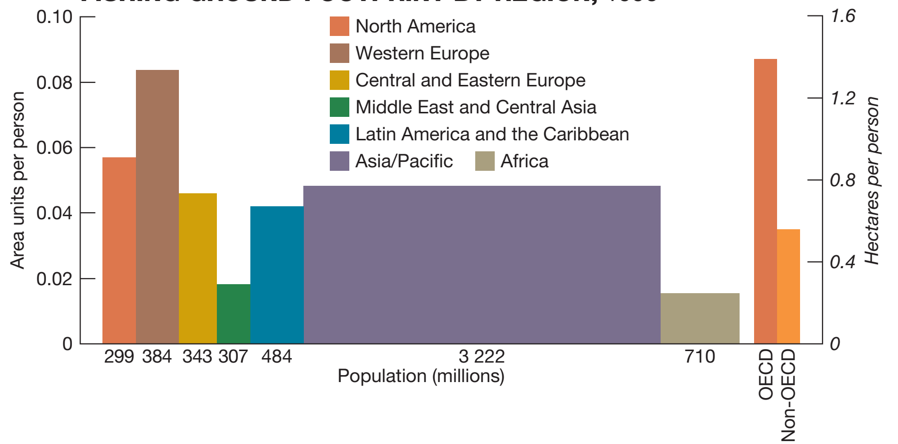
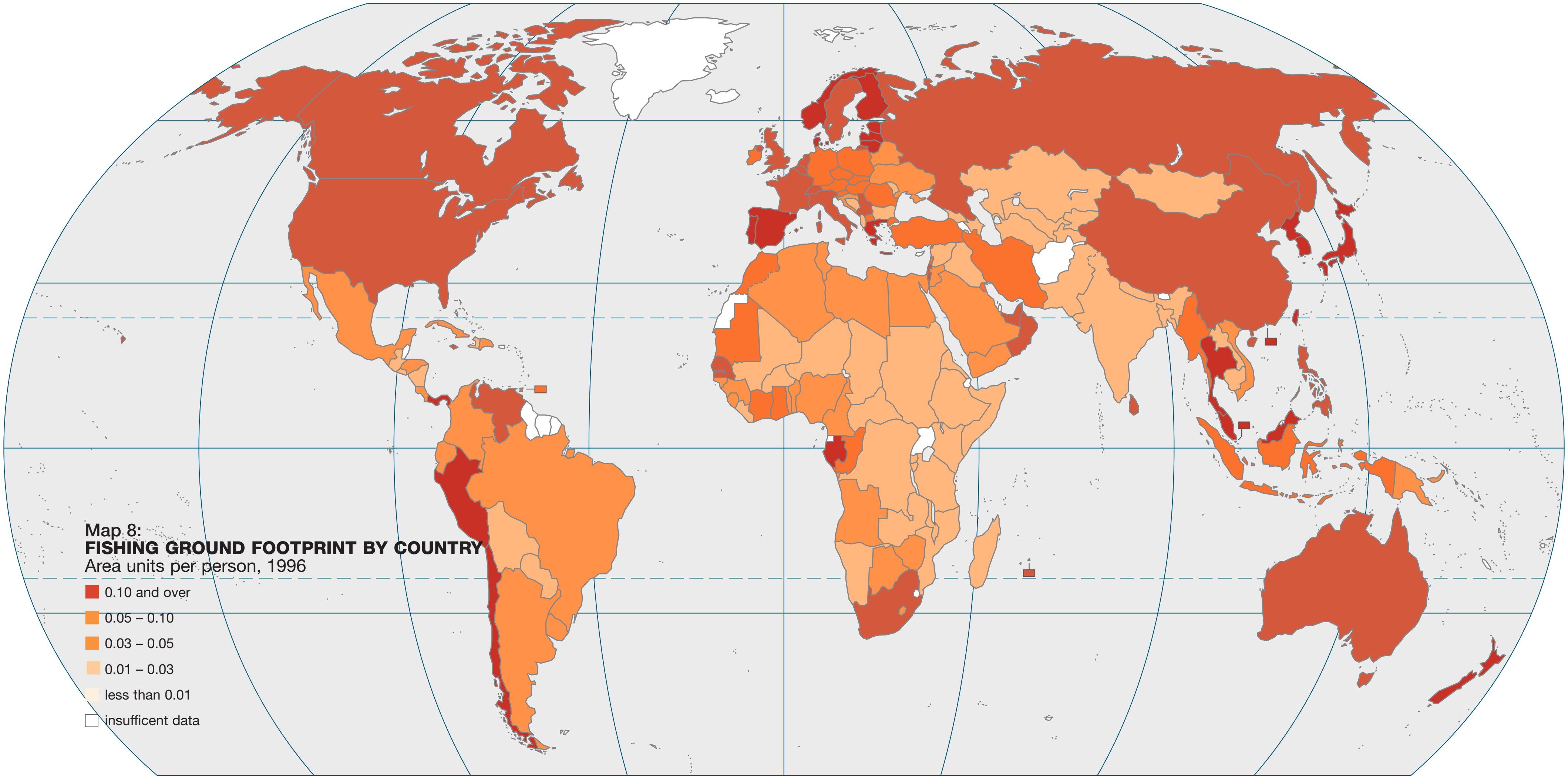


Fig. 24:
FISHING GROUND FOOTPRINT BY REGION, 1996





Map 8:
FISHING GROUND FOOTPRINT BY COUNTRY
Area units per person, 1996

CARBON DIOXIDE FOOTPRINT

The carbon dioxide (CO_2) footprint of an individual is the area (of "world average" forest) which would be required to absorb all CO_2 emissions resulting from that individual's energy consumption. This includes the direct use of coal, oil, or gas as fuel in the home or for private transport, and indirect use from the consumption of electricity (other than from renewable sources), public transport, manufactured goods, or other services.

To calculate the CO_2 footprint of a country, it is necessary to take the national consumption of energy from fossil fuels plus the net import of "embodied energy" in manufactured products. The total energy consumption is then converted into the area of average forest land required to absorb the resulting CO_2 emissions, using the present rate of carbon absorption by the world's forests. This has been done for most of the world's countries and the results are shown in Figures 27 and 28, measured in both tonnes of CO_2 emitted per person per year and "area units" per person. Scientists believe, however, that the CO_2 sequestration rate of forests will decline in future decades as the atmospheric CO_2 level and global temperature increase.

Figure 26 shows that global CO_2 emissions stood at 24 billion tonnes per year in 1996, a threefold increase since 1961. The world average CO_2 emission in 1996 was about 4 tonnes per person per year. At average forest productivity, this equates to a CO_2 absorption footprint of 1.41 area units per person. The Intergovernmental Panel on Climate Change has stated that global CO_2 emissions must be cut to at least 50 per cent of the 1990 level by the year 2050 in order to stabilize the atmospheric CO_2 concentration at its present level.

International disparities in per capita emissions are greater than in any other sector. The OECD consumer's average CO_2 footprint was more than five times that of the non-OECD consumer.

Actions needed to reduce energy consumption and CO2 emissions: ■ Increase the use of energy-saving technologies; eliminate wasteful energy consumption in transport, industry, and the home. ■ Increase the supply of energy from sources which reduce or eliminate pollution, especially renewable sources such as solar and wind. ■ Assist lower-income countries to invest in sustainable energy technologies. ■ Increase energy prices to cover the full environmental costs of energy use, and remove government subsidies on energy. ■ Stop deforestation and promote reforestation of deforested areas in an ecologically and socially appropriate manner.

Fig. 26:
WORLD CARBON DIOXIDE FOOTPRINT, 1961–97

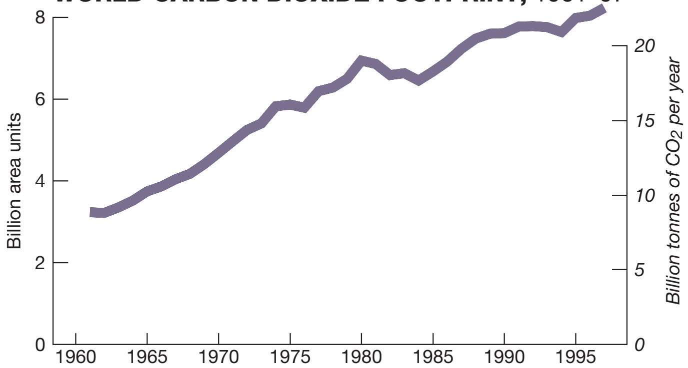


Fig. 27:
CARBON DIOXIDE FOOTPRINT BY REGION, 1996

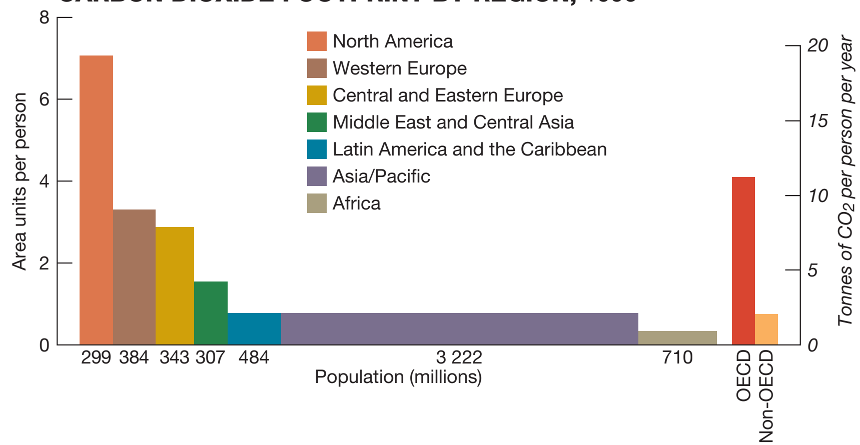
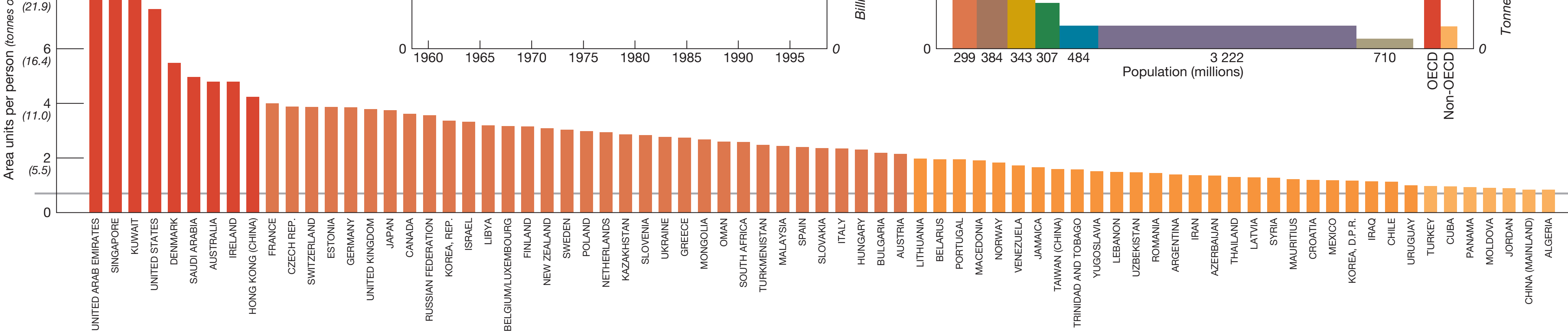
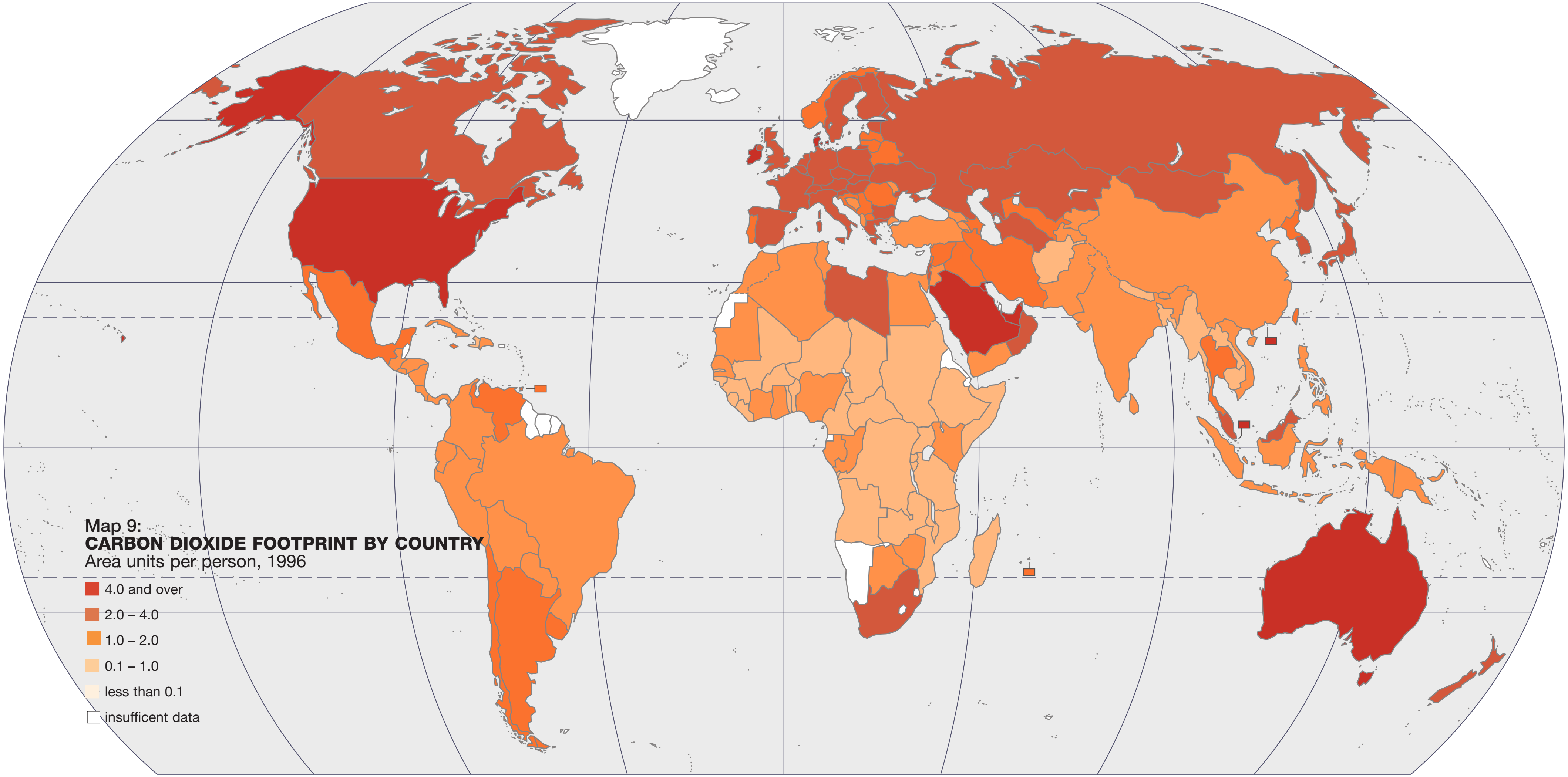


Fig. 28:
CARBON DIOXIDE FOOTPRINT BY COUNTRY, 1996





Map 9:
CARBON DIOXIDE FOOTPRINT BY COUNTRY
Area units per person, 1996

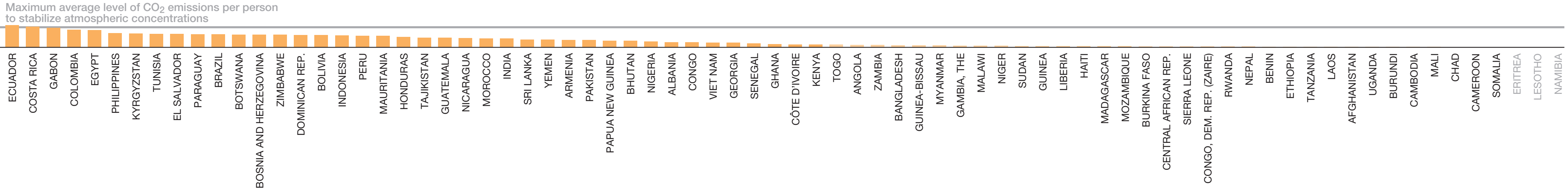


Table 2: ECOLOGICAL FOOTPRINT DATA, 1996

	Population (thousands)	Cropland footprint (area units per person)	Grazing land footprint (area units per person)	Forest footprint (area units per person)	Fishing ground footprint (area units per person)	CO_2 footprint (area units per person)	Built-up land footprint (area units per person)	Total ecological footprint (area units per person)	1 ha local cropland (in area units)	1 ha local grazing land (in area units)	1 ha local forest (in area units)	Existing biological capacity (area units per person)	National ecological deficit (area units per person)
World	**5 744 872**	**0.69**	**0.31**	**0.28**	**0.04**	**1.41**	**0.12**	**2.85**				**2.18**	
OECD	1 091 037	1.18	0.79	0.64	0.09	4.08	0.43	7.22				3.42	-3.80
NON-OECD	4 658 746	0.55	0.22	0.20	0.03	0.75	0.05	1.81				1.82	0.01
AFRICA	**709 988**	**0.48**	**0.16**	**0.32**	**0.02**	**0.34**	**0.01**	**1.33**				**1.73**	**0.40**
Algeria	28 719	0.63	0.23	0.07	0.01	0.84	0.01	1.79	1.67	0.17	1.08	0.58	-1.21
Angola	11 342	0.32	0.12	0.25	0.02	0.09	0.01	0.82	1.23	0.02	1.22	2.74	1.92
Benin	5 480	0.42	0.09	0.42	0.01	0.03	0.00	0.97	1.65	0.74	1.29	1.55	0.58
Botswana	1 509	0.36	0.44	0.40	0.02	0.45	0.02	1.68	0.56	0.02	0.61	1.92	0.24
Burkina Faso	10 704	0.38	0.12	0.37	0.00	0.04	0.00	0.90	1.07	0.08	0.99	0.79	-0.11
Burundi	6 265	0.41	0.04	0.28	0.00	0.02	0.00	0.75	2.66	0.24	1.11	0.50	-0.25
Cameroon	13 549	0.29	0.14	0.42	0.02	0.00	0.01	0.89	1.68	0.09	2.57	4.23	3.35
Central African Republic	3 354	0.30	0.38	0.39	0.00	0.03	0.02	1.12	1.14	0.06	1.56	14.51	13.38
Chad	6 899	0.30	0.17	0.28	0.00	0.00	0.00	0.75	0.84	0.02	0.89	1.54	0.79
Congo, Rep.	2 634	0.29	0.08	0.54	0.04	0.18	0.01	1.15	1.92	0.01	2.66	20.04	18.89
Côte d'Ivoire	13 816	0.34	0.08	0.40	0.03	0.10	0.00	0.95	1.29	0.08	1.75	2.00	1.05
Egypt	63 497	0.75	0.23	0.06	0.01	0.61	0.04	1.70	8.12	11.41	1.08	0.64	-1.06
Eritrea	3 300	0.26	0.09	I.D.	0.00	I.D.	0.00	0.35	0.80	0.05	n.a.	0.24	-0.11
Ethiopia	56 789	0.37	0.12	0.34	0.00	0.02	0.00	0.85	1.63	0.32	1.40	0.68	-0.18
Gabon	1 107	0.45	0.15	0.61	0.13	0.68	0.03	2.06	1.56	0.00	2.09	33.77	31.72
Gambia	1 150	0.36	0.09	0.42	0.06	0.06	0.00	0.99	1.30	0.41	1.14	0.40	-0.60
Ghana	18 154	0.39	0.03	0.53	0.04	0.11	0.01	1.12	1.95	0.06	1.51	1.20	0.08
Guinea	7 275	0.41	0.06	0.29	0.02	0.05	0.00	0.85	1.69	0.03	1.55	1.60	0.75
Guinea-Bissau	1 111	0.40	0.09	0.22	0.01	0.07	0.00	0.80	1.68	0.32	1.31	2.92	2.12
Kenya	27 851	0.19	0.30	0.55	0.00	0.10	0.01	1.15	1.87	0.22	1.52	0.57	-0.59
Lesotho	1 970	0.35	0.16	0.13	0.01	I.D.	0.04	0.70	1.56	0.21	n.a.	0.45	-0.24
Liberia	2 198	0.29	0.02	0.79	0.01	0.05	0.00	1.16	1.63	0.02	2.32	5.10	3.95
Libya	5 086	0.82	0.23	0.08	0.02	3.20	0.01	4.36	0.93	0.07	1.08	0.58	-3.78
Madagascar	14 183	0.37	0.24	0.26	0.01	0.05	0.01	0.93	2.25	0.11	2.08	2.93	2.00
Malawi	9 835	0.42	0.03	0.36	0.00	0.06	0.00	0.87	1.84	0.15	1.29	0.77	-0.10
Mali	10 186	0.33	0.26	0.25	0.00	0.02	0.00	0.86	0.95	0.08	0.90	1.27	0.41
Mauritania	2 394	0.43	0.35	0.00	0.04	0.41	0.00	1.22	1.07	0.02	n.a.	0.62	-0.60
Mauritius	1 124	0.70	0.37	0.09	0.07	1.22	0.01	2.45	3.17	0.61	n.a.	2.23	-0.23
Morocco	26 417	0.92	0.19	0.08	0.04	0.32	0.02	1.56	2.12	0.18	1.08	0.99	-0.57
Mozambique	17 950	0.26	0.05	0.39	0.00	0.04	0.00	0.76	1.11	0.02	0.90	1.11	0.35
Namibia	1 583	0.32	0.32	I.D.	0.00	I.D.	0.02	0.66	0.53	0.02	0.61	1.83	1.17
Niger	9 454	0.54	0.13	0.24	0.00	0.05	0.00	0.97	0.48	0.12	0.61	0.42	-0.56
Nigeria	101 413	0.58	0.08	0.43	0.01	0.20	0.00	1.31	1.76	0.19	1.70	0.88	-0.43
Rwanda	5 475	0.42	0.06	0.39	0.00	0.03	0.00	0.90	1.90	0.34	1.61	0.42	-0.48
Senegal	8 548	0.44	0.16	0.25	0.06	0.14	0.00	1.06	0.95	0.15	1.00	0.95	-0.11

0 = negligible I.D. = insufficient data n.a. = not applicable Totals may not add up due to rounding

	Population (thousands)	Cropland footprint (area units per person)	Grazing land footprint (area units per person)	Forest footprint (area units per person)	Fishing ground footprint (area units per person)	CO_2 footprint (area units per person)	Built-up land footprint (area units per person)	Total ecological footprint (area units per person)	1 ha local cropland (in area units)	1 ha local grazing land (in area units)	1 ha local forest (in area units)	Existing biological capacity (area units per person)	National ecological deficit (area units per person)
Sierra Leone	4 289	0.35	0.04	0.28	0.03	0.03	0.00	0.73	1.63	0.07	2.58	1.40	0.67
Somalia	8 467	0.11	0.46	0.40	0.00	0.00	0.00	0.97	0.50	0.07	n.a.	0.74	-0.23
South Africa	38 126	0.65	0.33	0.33	0.07	2.59	0.08	4.04	2.80	0.17	1.08	1.39	-2.65
Sudan	27 160	0.42	0.42	0.24	0.00	0.05	0.01	1.14	0.82	0.09	0.93	1.76	0.62
Tanzania	30 700	0.35	0.17	0.47	0.00	0.02	0.00	1.02	1.77	0.13	1.04	1.34	0.33
Togo	4 172	0.41	0.05	0.23	0.03	0.10	0.00	0.82	1.08	0.21	1.40	0.83	0.00
Tunisia	9 081	1.32	0.24	0.20	0.03	0.48	0.01	2.27	1.87	0.56	1.08	1.22	-1.05
Uganda	19 464	0.39	0.12	0.34	I.D.	0.02	0.00	0.88	1.47	0.69	1.58	1.01	0.13
Zaire (Congo, DR)	46 772	0.22	0.01	0.41	0.01	0.03	0.01	0.69	1.47	0.01	2.88	6.94	6.25
Zambia	8 389	0.32	0.09	0.67	0.00	0.08	0.05	1.21	2.20	0.02	1.06	4.24	3.03
Zimbabwe	11 045	0.47	0.19	0.30	0.01	0.44	0.04	1.45	1.88	0.11	0.02	0.68	-0.77
MIDDLE EAST AND CENTRAL ASIA	**307 001**	**0.69**	**0.33**	**0.09**	**0.02**	**1.55**	**0.06**	**2.73**				**0.91**	**-1.82**
Afghanistan	20 368	0.22	0.16	0.17	I.D.	0.02	0.02	0.58	1.44	0.10	0.16	0.38	-0.19
Armenia	3 564	0.39	0.37	I.D.	I.D.	0.26	0.14	1.16	2.34	1.13	0.19	0.69	-0.47
Azerbaijan	7 609	0.40	0.30	0.01	0.00	1.36	0.10	2.18	1.89	0.67	0.16	0.64	-1.54
Georgia	5 187	0.46	0.39	I.D.	0.00	0.16	0.11	1.14	2.02	1.00	0.64	1.22	0.08
Iran	63 469	0.70	0.26	0.08	0.03	1.37	0.02	2.47	2.27	0.27	1.08	0.76	-1.71
Iraq	20 608	0.49	0.08	0.00	0.00	1.14	0.02	1.73	1.13	0.30	1.08	0.35	-1.38
Israel	5 722	1.10	0.52	0.26	0.06	3.33	0.13	5.40	3.05	15.12	1.08	0.76	-4.64
Jordan	5 938	0.61	0.14	0.04	0.01	0.89	0.02	1.71	1.57	0.54	1.08	0.21	-1.50
Kazakhstan	16 436	0.68	0.77	0.03	0.00	2.87	0.11	4.45	0.81	0.08	0.15	2.05	-2.40
Kuwait	1 686	0.78	0.46	0.13	0.03	8.49	0.42	10.31	5.80	1.97	1.08	0.65	-9.67
Kyrgyzstan	4 596	0.45	0.62	0.01	0.00	0.48	0.29	1.87	2.64	0.36	0.16	1.50	-0.37
Lebanon	3 083	1.04	0.38	0.18	0.03	1.49	0.06	3.19	4.23	8.10	1.08	0.69	-2.50
Oman	2 230	0.39	0.26	0.06	0.07	2.60	0.02	3.39	2.90	0.30	n.a.	0.70	-2.69
Saudi Arabia	18 829	0.77	0.22	0.08	0.02	4.97	0.08	6.15	4.28	0.02	1.08	0.41	-5.74
Syria	14 571	0.90	0.28	0.08	0.00	1.28	0.02	2.56	2.35	0.48	1.08	1.10	-1.46
Tajikistan	5 836	0.23	0.23	0.00	0.00	0.34	0.11	0.90	2.04	0.30	0.16	0.47	-0.44
Turkey	62 332	1.10	0.41	0.20	0.03	0.97	0.03	2.73	2.80	0.76	0.98	1.49	-1.24
Turkmenistan	4 156	0.45	0.53	0.00	0.00	2.48	0.15	3.62	1.86	0.08	0.02	1.02	-2.60
United Arab Emirates	2 260	1.17	0.70	0.26	0.08	13.58	0.20	15.99	8.53	3.35	1.08	0.68	-15.31
Uzbekistan	22 848	0.47	0.56	0.00	0.00	1.47	0.16	2.65	2.82	0.81	0.01	0.96	-1.70
Yemen	15 674	0.31	0.08	0.01	0.02	0.27	0.00	0.69	1.44	0.08	1.08	0.27	-0.42
ASIA/PACIFIC	**3 222 295**	**0.58**	**0.16**	**0.18**	**0.05**	**0.78**	**0.03**	**1.78**				**1.11**	**-0.67**
Australia	18 141	0.98	1.60	0.58	0.09	4.79	0.44	8.49	2.63	0.11	1.08	9.42	0.93
Bangladesh	120 594	0.37	0.06	0.10	0.00	0.07	0.00	0.60	3.11	0.63	3.60	0.08	-0.52
Bhutan	1 893	0.14	0.07	0.34	I.D.	0.23	0.01	0.79	1.42	0.14	1.97	2.60	1.82
Cambodia	10 234	0.46	0.07	0.26	0.01	0.02	0.02	0.83	2.08	0.18	2.31	3.12	2.29
China (mainland)	1 232 456	0.68	0.11	0.13	0.06	0.84	0.02	1.84	5.77	0.36	1.08	0.89	-0.96
Hong Kong (China)	6 363	1.43	0.31	1.02	0.14	4.24	0.01	7.14	n.a.	19.45	n.a.	0.08	-67.07
India	949 997	0.46	0.15	0.12	0.01	0.31	0.01	1.06	2.64	4.25	2.30	0.74	-0.32

	Population (thousands)	Cropland footprint (area units per person)	Grazing land footprint (area units per person)	Forest footprint (area units per person)	Fishing ground footprint (area units per person)	CO_2 footprint (area units per person)	Built-up land footprint (area units per person)	Total ecological footprint (area units per person)	1 ha local cropland (in area units)	1 ha local grazing land (in area units)	1 ha local forest (in area units)	Existing biological capacity (area units per person)	National ecological deficit (area units per person)
Indonesia	200 415	0.58	0.05	0.33	0.05	0.42	0.06	1.48	4.70	0.32	4.84	3.18	1.70
Japan	125 769	0.80	0.35	0.63	0.23	3.75	0.18	5.94	7.35	20.89	1.08	0.86	-5.08
Korea, DPR	22 610	0.47	0.04	0.08	0.11	1.17	0.05	1.92	3.78	0.76	1.08	0.73	-1.19
Korea, Rep.	45 345	1.02	0.66	0.32	0.17	3.36	0.07	5.60	7.63	n.a.	1.08	0.74	-4.86
Lao PDR	4 902	0.42	0.09	0.37	0.00	0.02	0.01	0.91	3.01	0.26	2.69	7.29	6.39
Malaysia	20 549	0.29	0.10	0.61	0.17	2.45	0.07	3.68	3.44	0.03	4.89	3.97	0.29
Mongolia	2 495	0.20	1.23	0.16	0.00	2.68	0.02	4.30	0.90	0.67	1.08	5.67	1.37
Myanmar	43 393	0.67	0.07	0.20	0.04	0.07	0.02	1.07	3.39	0.50	2.97	2.71	1.65
Nepal	21 791	0.44	0.18	0.35	0.00	0.03	0.00	1.01	2.37	1.44	2.29	0.94	-0.07
New Zealand	3 720	0.65	3.39	1.00	0.10	3.09	1.31	9.54	6.63	2.02	1.08	15.80	6.26
Pakistan	140 055	0.39	0.33	0.08	0.01	0.26	0.01	1.09	2.63	4.12	1.19	0.68	-0.40
Papua New Guinea	4 399	0.28	0.36	0.48	0.03	0.23	0.01	1.40	1.75	0.01	3.79	31.60	30.20
Philippines	69 902	0.51	0.08	0.25	0.09	0.49	0.01	1.42	2.93	0.47	4.39	0.89	-0.54
Singapore	3 375	0.50	0.19	0.36	0.14	11.03	0.13	12.35	3.17	n.a.	4.91	0.13	-12.21
Sri Lanka	18 096	0.31	0.06	0.23	0.05	0.28	0.02	0.95	3.47	0.51	2.35	0.52	-0.43
Taiwan	21 471	1.28	1.08	0.24	0.13	1.60	0.02	4.34	3.17	0.32	1.08	0.20	-4.14
Thailand	59 172	0.74	0.20	0.31	0.13	1.30	0.03	2.70	2.94	0.57	2.55	1.35	-1.35
Viet Nam	75 159	0.50	0.05	0.19	0.02	0.17	0.02	0.95	4.09	2.06	1.91	0.65	-0.30
LATIN AMERICA AND THE CARIBBEAN	**483 837**	**0.59**	**0.62**	**0.35**	**0.04**	**0.77**	**0.08**	**2.46**				**6.39**	**3.93**
Argentina	35 219	0.34	1.68	0.18	0.03	1.39	0.17	3.79	3.40	0.37	1.08	5.10	1.31
Bolivia	7 593	0.29	0.48	0.08	0.00	0.42	0.02	1.29	2.12	0.08	2.05	13.25	11.96
Brazil	161 533	0.65	0.74	0.61	0.02	0.46	0.12	2.60	3.13	0.56	2.91	11.56	8.96
Chile	14 421	0.61	0.61	0.58	0.32	1.13	0.14	3.39	5.23	0.34	1.08	2.01	-1.38
Colombia	39 288	0.48	0.52	0.22	0.02	0.61	0.04	1.90	3.77	0.47	3.55	5.66	3.76
Costa Rica	3 652	0.70	0.62	0.68	0.01	0.72	0.04	2.77	4.68	0.87	2.73	2.16	-0.60
Cuba	11 018	0.64	0.27	0.14	0.03	0.96	0.05	2.10	2.33	0.56	1.69	1.11	-0.98
Dominican Republic	7 961	0.53	0.28	0.07	0.03	0.42	0.03	1.37	3.49	0.87	2.35	1.03	-0.34
Ecuador	11 699	0.50	0.47	0.46	0.02	0.77	0.03	2.26	2.30	0.54	3.10	4.00	1.74
El Salvador	5 789	0.46	0.25	0.32	0.01	0.46	0.05	1.55	2.76	1.59	2.37	0.68	-0.87
Guatemala	10 244	0.38	0.16	0.49	0.00	0.33	0.03	1.40	2.69	0.33	3.41	1.76	0.36
Haiti	7 689	0.31	0.09	0.32	0.01	0.05	0.00	0.78	1.39	1.08	2.09	0.30	-0.48
Honduras	5 816	0.37	0.21	0.45	0.01	0.37	0.02	1.43	2.12	0.25	2.37	2.26	0.83
Jamaica	2 495	0.60	0.20	0.12	0.07	1.66	0.03	2.68	3.41	0.95	2.67	0.73	-1.95
Mexico	92 718	0.83	0.48	0.12	0.03	1.19	0.04	2.69	3.06	0.40	1.29	1.65	-1.04
Nicaragua	4 552	0.40	0.20	0.32	0.01	0.32	0.02	1.26	2.36	0.27	3.04	4.22	2.96
Panama	2 677	0.61	0.48	0.17	0.11	0.94	0.05	2.35	2.49	0.57	3.00	4.18	1.82
Paraguay	4 957	0.46	0.83	0.92	0.00	0.46	0.18	2.84	2.89	0.20	1.53	5.53	2.68
Peru	23 944	0.38	0.17	0.14	0.22	0.41	0.02	1.33	3.26	0.08	3.17	9.23	7.90
Trinidad & Tobago	1 270	0.48	0.11	0.11	0.03	1.58	0.11	2.43	3.47	0.16	3.78	0.77	-1.66
Uruguay	3 242	0.81	2.37	0.52	0.02	1.00	0.19	4.91	3.79	0.82	1.08	5.13	0.22
Venezuela	22 311	0.48	0.42	0.07	0.05	1.73	0.13	2.88	3.41	0.36	2.68	5.89	3.01

	Population (thousands)	Cropland footprint (area units per person)	Grazing land footprint (area units per person)	Forest footprint (area units per person)	Fishing ground footprint (area units per person)	CO_2 footprint (area units per person)	Built-up land footprint (area units per person)	Total ecological footprint (area units per person)	1 ha local cropland (in area units)	1 ha local grazing land (in area units)	1 ha local forest (in area units)	Existing biological capacity (area units per person)	National ecological deficit (area units per person)
NORTH AMERICA	**299 385**	**1.44**	**1.06**	**1.23**	**0.06**	**7.06**	**0.91**	**11.77**				**6.13**	**-5.64**
Canada	29 947	1.70	0.84	1.05	0.06	3.62	0.40	7.66	3.55	0.11	0.78	11.16	3.50
United States of America	269 439	1.41	1.09	1.26	0.06	7.45	0.97	12.22	6.29	0.76	1.37	5.57	-6.66
WESTERN EUROPE	**384 458**	**1.20**	**0.85**	**0.47**	**0.08**	**3.30**	**0.37**	**6.28**				**2.93**	**-3.35**
Austria	8 053	1.20	0.74	0.96	0.04	2.15	0.36	5.45	6.81	4.61	3.88	4.15	-1.30
Belgium-Luxembourg	10 521	0.86	0.81	0.49	0.06	3.17	0.49	5.88	9.60	12.63	3.01	2.30	-3.58
Denmark	5 241	1.95	0.89	0.83	0.35	5.48	0.38	9.88	7.55	10.19	3.67	5.68	-4.19
Finland	5 126	1.02	0.84	2.44	0.17	3.16	0.82	8.45	4.16	1.06	1.79	9.77	1.32
France	58 251	1.32	0.91	0.46	0.09	4.00	0.50	7.27	9.11	3.66	2.42	4.27	-3.01
Germany	81 909	0.93	0.70	0.40	0.04	3.85	0.39	6.31	7.65	7.27	3.52	2.48	-3.83
Greece	10 532	1.53	0.81	0.17	0.10	2.75	0.23	5.58	4.36	2.68	0.27	2.31	-3.27
Ireland	3 634	2.01	1.87	0.46	0.05	4.79	0.24	9.43	8.71	3.83	2.73	6.71	-2.72
Italy	57 366	1.33	1.24	0.36	0.08	2.34	0.16	5.51	5.98	4.04	2.50	1.92	-3.59
Netherlands	15 541	0.73	1.18	0.46	0.08	2.95	0.36	5.75	9.69	18.09	3.23	2.41	-3.35
Norway	4 372	0.78	0.88	1.11	0.55	1.83	0.98	6.13	4.81	5.23	1.54	6.14	0.01
Portugal	9 859	1.27	0.69	0.51	0.18	1.95	0.38	4.99	2.59	1.84	1.95	2.23	-2.76
Spain	39 593	1.83	0.59	0.34	0.13	2.40	0.21	5.50	4.08	0.88	1.58	2.52	-2.98
Sweden	8 832	1.10	0.78	1.58	0.08	3.04	0.96	7.53	6.08	1.19	1.91	8.02	0.48
Switzerland	7 198	0.80	1.01	0.45	0.05	3.87	0.45	6.63	8.74	4.33	2.82	2.31	-4.33
United Kingdom	58 431	1.03	0.69	0.36	0.05	3.80	0.37	6.29	8.95	2.73	2.22	1.83	-4.46
CENTRAL AND EASTERN EUROPE	**342 817**	**0.73**	**0.62**	**0.28**	**0.05**	**2.87**	**0.34**	**4.89**			**2.96**	**3.14**	**-1.75**
Albania	3 151	0.67	0.91	0.06	0.00	0.18	0.03	1.86	3.01	3.48	0.46	1.38	-0.48
Belarus	10 379	1.28	0.95	0.94	0.02	1.96	0.12	5.27	3.08	2.13	1.60	3.47	-1.80
Bosnia and Herzegovina	3 422	0.59	0.23	0.01	0.00	0.45	0.02	1.29	3.32	0.83	0.97	1.39	0.10
Bulgaria	8 448	0.85	0.46	0.17	0.01	2.19	0.13	3.81	2.33	1.02	1.82	2.01	-1.80
Croatia	4 488	0.51	0.31	0.26	0.01	1.20	0.07	2.35	5.07	0.70	2.30	2.19	-0.17
Czech Rep.	10 316	1.20	0.51	0.43	0.05	3.88	0.24	6.30	5.25	3.18	3.72	2.93	-3.37
Estonia	1 466	1.97	0.77	0.27	0.10	3.87	0.15	7.12	2.68	1.14	1.73	4.03	-3.10
Hungary	10 193	1.64	0.41	0.21	0.04	2.31	0.39	5.01	4.92	1.38	2.85	3.07	-1.94
Latvia	2 499	0.92	0.54	0.72	0.12	1.28	0.17	3.74	2.65	1.42	2.25	4.08	0.33
Lithuania	3 715	1.33	0.73	0.51	0.11	1.98	0.10	4.76	3.05	1.71	2.85	3.72	-1.04
Macedonia	1 975	0.77	0.29	0.18	0.03	1.91	0.06	3.24	3.12	0.66	0.48	1.19	-2.05
Moldova	4 376	0.92	0.29	0.06	0.00	0.91	0.30	2.47	2.71	1.56	1.27	1.70	-0.77
Poland	38 659	1.39	0.55	0.34	0.04	2.98	0.09	5.40	3.80	3.04	2.45	2.35	-3.05
Romania	22 633	0.98	0.55	0.31	0.04	1.45	0.17	3.49	2.95	1.42	2.65	2.39	-1.10
Russian Federation	147 876	0.33	0.64	0.27	0.06	3.56	0.49	5.36	3.37	0.46	0.52	4.09	-1.26
Slovakia	5 365	0.46	0.42	0.49	0.04	2.36	0.17	3.94	5.49	1.22	2.83	2.02	-1.92
Slovenia	1 995	1.15	0.70	0.60	0.04	2.84	0.07	5.40	5.34	2.70	2.35	2.63	-2.77
Ukraine	51 254	0.74	0.65	0.13	0.01	2.77	0.45	4.76	2.67	1.54	1.08	2.26	-2.49
Yugoslavia	10 607	1.13	1.02	0.12	0.05	1.52	0.01	3.85	3.85	2.38	1.08	1.84	-2.01

LIVING PLANET INDEX

Table 3: LIVING PLANET INDEX: 1970-1999

Year	1970	1975	1980	1985	1990	1995	1999
Forest Species Population Index	100.0	95.0	100.4	94.7	93.0	83.6	87.6
upper confidence limit		110.7	113.0	107.0	103.6	99.4	113.7
lower confidence limit		81.5	89.1	83.8	83.4	70.3	67.5
Freshwater Species Population Index	100.0	97.4	89.4	77.7	71.7	57.5	49.1
upper confidence limit		122.3	104.5	94.5	92.7	83.8	56.5
lower confidence limit		77.6	76.4	63.8	55.4	39.4	42.6
Marine Species Population Index	100.0	95.0	93.7	84.3	74.1	67.9	64.5
upper confidence limit		132.6	119.4	113.5	105.2	85.1	79.8
lower confidence limit		68.0	73.5	62.6	52.2	54.2	52.1
Living Planet Index	100.0	95.8	94.5	85.5	79.6	69.7	67.0
upper confidence limit		121.9	112.3	105.0	100.5	89.4	83.3
lower confidence limit		75.7	79.7	70.1	63.7	54.6	54.0

TECHNICAL NOTES

LIVING PLANET INDEX

The LPI is generated by averaging three separate indices for forest, freshwater, and marine species populations. Each is set at 100 in 1970 and given an equal weighting. The species population data used in Boxes 1-6 (page 3) come from the following sources. The silvery gibbon comes from Nowak and Paradiso (1983), Kool (1992), and Nijman and van Balen (1998); Kemp's ridley turtle from Marquéz et al. (1999); lesser white-fronted goose from Scott and Rose (1996); sparrowhawk from Crick et al. (1997); gharial from Crocodile Specialist Group (1996), Groombridge (1987), Groombridge (1982), and Thorbjarnson (1992); bluefin tuna from Ransom Myers fish population database online. The population data for all other species used in the LPI come from data sources too numerous to include in this report, but a full list can be found on the WCMC website at www.unep-wcmc.org.

FOREST SPECIES POPULATION INDEX

The forest species population index is the average of two indices relating to temperate and tropical forests, respectively. The temperate forest component of the index is calculated from the change over time in the populations of 275 temperate forest species. The tropical forest component is based on the change over time in populations of 44 tropical forest species. The species in the index are predominantly birds and mammals. These 319 species represent all those for which we were able to find population estimates for more than one point in time. The bias in the data towards temperate forests and birds and mammals reflects the concentration of research effort over the past 30 years. In many cases the data are not for an entire species, but just one sub-population of that species.

The last four years of the index, 1995-99, are based on far fewer population datasets than the part of the index covering 1970-95. The reliability of this recent part of the index is therefore much lower. It will improve as new data become available in future years. The upturn in the tropical forest index from 1995 to 1999, and the downturn in temperate forests, could be an artefact of the small number of datasets available for this period.

Deforestation. Data for 1990 are WCMC figures for current forest area for each region. These come from a variety of national and international sources, including remote sensing, and a variety of dates. Forest cover is defined as closed forest, which in general refers to canopy cover of more than 30 per cent.

Time series data were generated by projecting deforestation rates back and forward from 1990. For Africa, Asia/Pacific, and Latin America and the Caribbean, deforestation rates for 1980–95 are from the Forest Resources Assessment of the United Nations Food and Agriculture Organization (FAO) (1995) and *State of the World's Forests* (FAO 1997). For 1970–80, deforestation rates from Singh and Marzoli (1995) have been applied to each region. The latter only applied to the tropical parts of these regions. For Europe, changes are taken from the *Dobris Assessment* (European Commission 1995) which has figures for changes in forest extent for 29 European countries, including Eastern Europe, for the decades between 1960 and 1990. Figures for changes in Australasia and North America are from the FAO (1995). Data are missing for forest changes in North America before 1980 so it is assumed that no overall change has taken place. It is also assumed that there was no change in forest area in the Russian Federation from 1980 to 1990. The deforestation rates for the period 1995 to 2000 are estimates based on regional changes in forest cover from 1990 to 1995 according to the FAO (1997). These numbers may well underestimate the actual extent of deforestation as there has been an increase in the number and severity of forest fires over the last five years, especially in the tropics.

Original forest cover was compiled from six potential vegetation datasets which, between them, cover the globe (Bohn and Katenina 1994, Carnahan n.d., Dinerstein et al. 1995, Kuusela 1994, Milanova and Kushlin 1993, and White 1983). The map of current forest cover is adapted from WCMC (2000).

FRESHWATER SPECIES POPULATION INDEX

The freshwater species population index is the average of six regional indices relating to Africa, Asia/Pacific, Australasia, Europe, Latin America and the Caribbean, and North America, respectively. The six indices between them contain time series data on 194 species populations, comprising 7 African species, 32 Asia-Pacific species, 8 Australasian species, 55 European species, 11 Latin American and Caribbean species, and 81 North American species. These include all those for which time series data could be found. In many cases the data are not for an entire species, but just one sub-population of that species. More data are available from Europe and North America than any other region of the world, which is a reflection of research effort over the past 30 years. The index is the average of all six regional sub-indices, with equal weight given to each region. The last four years of the index, 1995–99, are based on far fewer population datasets than the part of the index relating to the years 1970–95. The reliability of this part of the index is therefore much lower. It will improve as new data become available in future years. Some of the species used in calculating the index are given on page 6.

Evidence for global amphibian population declines comes from Houlahan et al. (2000). The map of freshwater ecosystems of the world is adapted from WCMC (2000).

MARINE SPECIES POPULATION INDEX

The Marine Species Population Index is the average of six sub-indices which relate to the North Pacific, North Atlantic, Indian, South Pacific, South Atlantic, and Southern Oceans, respectively. The six indices contain time series data on 217 species populations, comprising 72 North Pacific species, 65 North Atlantic species, 16 Indian Ocean species, 17 South Atlantic species, 35 South Pacific species, and 12 Southern Ocean species. The 217 species in the index include all those for which time series population data could be found. In many cases, the data are not for an entire species, but just one sub-population of that species. Inevitably, the index is dominated by those species which researchers have an interest in monitoring. Far more data are available on populations from northern temperate waters than from southern temperate or tropical waters. To give equal weight to data from different oceans, the Marine Species Population Index is the average of all six ocean sub-indices. The last four years of the index, 1995–99, are based on fewer populations datasets than the part of the index relating to the years 1970–95. The reliability of this part of the index is therefore much lower. Reliability will improve as new data become available in future years. Some of the species in the index are given on page 8.

The areas of coral reef and mangrove ecosystems in the world's oceans are taken from WCMC (2000) and Spalding et al. (1997); the map is adapted from WCMC (2000).

ECOLOGICAL FOOTPRINT

The Ecological Footprint analysis measures the amount of the globe's biological productivity an individual or a country occupies in a given year. The analysis is based on data published by United Nations agencies and the Intergovernmental Panel on Climate Change.

The method achieves this by measuring the ecological impact of humanity in terms of the biologically productive land and water area required to produce the resources consumed and to assimilate the wastes generated by humanity, using prevailing technology. This area, called the Ecological Footprint, represents the fraction of the biosphere necessary to maintain the current material throughput of the human economy, under current management and production practices.

Ecological Footprint calculations are based on five assumptions:

- it is possible to keep track of most of the resources people consume and many of the wastes people generate;
- most of these resource and waste flows can be converted into the biologically productive area that is required to maintain these flows;
- these different areas can be expressed in the same unit once they are scaled proportionally to their biomass productivity. In other words, each particular hectare can be expressed as the equivalent area of world-average land productivity;
- since these areas stand for mutually exclusive uses, and each standardized hectare represents the same amount of biomass productivity, they can be added up to a total – this total represents humanity's demand;

- this area for total human demand can be compared with nature's supply of ecological services since it is also possible to assess the area on the planet that is biologically productive.

The results underestimate human impact and overestimate the available biological capacity by:

- counting each area only once, even if the area provides two or more ecological services at once;
- choosing the more conservative estimates when in doubt;
- including current agricultural practices as if current industrial yields would not cause any significant long-term damage to the soil productivity;
- leaving out some human activities for which we have insufficient data;
- excluding those activities that systematically erode nature's capacity to regenerate. They consist of:
  - uses of materials for which the biosphere has no significant assimilation capacity (e.g. plutonium, polychorinated biphenyls (PCBs), chlorofluorocarbons (CFCs)).
  - processes that irreversibly damage the biosphere (e.g. species extinction, aquifer destruction, deforestation, desertification).

A nation's consumption is calculated by adding imports to, and subtracting exports from, domestic production. To put it in mathematical terms: apparent consumption = production + imports – exports (see explanation of apparent consumption on page 13). This balance is computed for 72 categories, such as cereals, timber, fishmeal, coal, and cotton. These resource uses are translated into area units by dividing the total amount consumed in each category by its ecological productivity (or yield). In the case of CO_2 emissions, the total is divided by the assimilation capacity of forests. Some of the resource and waste categories are primary resource uses (such as raw timber or milk), while others are manufactured products that are derived from the primary ones (such as paper or cheese). For example, if one tonne of pork meat is exported, the amount of cereals and energy required to produce this tonne of pork is translated into a corresponding biologically productive area and then subtracted from the exporting country's footprint. This amount is added to the importing country's ecological footprint.

Biomass yields, measured in dry weight, are taken from statistics from the FAO. In the case of sea space, the production of fish protein is directly compared to the animal protein production of grain-fed poultry. World-average space has consequently an equivalence factor and a yield factor of 1. Thus, the physical extensions of the global areas of biologically productive space and those areas adjusted with the equivalence and yield factors add up to the same global total. Every year has its own set of equivalence factors since land-use productivities change over time.

The land-use types of the ecological footprint

Our accounts include six land-use types for human activities. All compete for biologically productive space. They are:

- growing crops for food, animal feed, fibre, oil crops, and rubber
- grazing animals for meat, hides, wool, and milk
- harvesting timber for wood fibre and fuelwood
- fishing
- accommodating infrastructure for housing, transportation, capturing solar, wind, and hydro energy, and industrial production
- burning fossil fuel.

Once the human impacts are expressed in the standardized area units, these footprint components are added up.

Growing crops occupies arable land, the most productive land of all. The FAO estimates that today there are about 1.3 billion hectares of arable land worldwide – not including arable land used as pasture. Using FAO harvest and yield data for 18 categories of crops, we traced the use of arable land for crop production (FAO1998 (3), 1997 (4), 1999 (8)). These accounts are underestimates since due to lack of consistent datasets other impacts from current agricultural practices are not accounted for; these include long-term damage from topsoil erosion; salination; and contamination of aquifers with agro-chemicals.

Grazing animals requires pastures. We combine pasture and wooded (= lightly forested) area into one land-use type, and assume that deforestation increases the size of this type. Worldwide, there are 4.6 billion hectares of pasture and wooded area, including the arable land used as pasture. We calculated the demand for pasture using FAO data (1998(3), 1997(4), 1999(8)).

Harvesting timber requires natural forests or plantation forests. Worldwide there are 3.3 billion hectares of such forests according to current FAO land-use statistics. We estimated forest areas and productivities using a variety of sources (IPCC 1997, FAO 1997b, Dixon et al. 1994, FAO 1997c). Consumption figures for timber and fuelwood come from FAO (1998 (5)).

Fishing requires productive fishing grounds. Of the total ocean area, the 8 per cent concentrated along the world's continental coasts provides over 95 per cent of the marine catch (Pauly and Christensen 1995). This translates into 3.2 billion biologically productive hectares of sea space out of the 36.3 billion hectares of ocean area that exist on the planet. We used FAO fish catch figures (1999 (8)), and compared them with FAO's "sustainable yield" figure of 93 million tonnes per year. The accounts include both fish catch for fishmeal as well as fish for direct human consumption. Conversion ratios from fresh fish to fishmeal were calculated from input to output data provided by FAO (1999 (8)). Where insufficient data were available to calculate a local conversion ratio, we used the global average. Also, we assumed an additional bycatch of 25 per cent for all countries, except Norway, where fishing vessels are required to land their bycatch.

Accommodating infrastructure for housing, transportation, industrial production, and capturing hydro energy occupies built-up land. This space is the least well documented, since satellite images often do not have the necessary resolution to capture dispersed infrastructure. We used the global total of 0.2 billion hectares of built-up land, consulting a variety of sources including data from Digital Chart of the World (ESRI 1993), Eurostat (2000), the World Resources Institute (1994), and Costanza et al. (1997). As most human settlements are located in the most fertile areas of a country, we assume that built-up land uses arable land.

Burning fossil fuel adds CO_2 to the atmosphere. We calculate the CO_2 footprint by estimating the biologically productive area which would be needed to sequester enough carbon emissions to avoid an increase in atmospheric CO_2. Since the world's oceans absorb CO_2 equivalent to about 35 per cent of the emissions from fossil fuel combustion (Watson et al. 2000), we account only for the remaining 65 per cent, based on each year's capacity of world-average forests to sequester carbon. This capacity is estimated by taking a weighted average across 26 main forest biomes (IPCC 1997, FAO 1997b, Dixon et al. 1994).

Sequestration capacity is expected to decline as the atmospheric CO_2 level and global temperature increase over the next century. Alternatively, we could calculate the space requirement for a fossil fuel substitute provided by biomass, but such an approach would lead to even larger space demands. Apart from fossil fuel, nuclear power is the other commercial energy that is included in this category. To simplify, we calculate thermal nuclear at par with thermal fossil energy. The net embodied trade is calculated by trade statistics broken down into 109 categories. The energy intensities used for calculating the embodied energy stem from a variety of sources (IVEM 1999, Hofstetter 1992).

The footprint and biodiversity?

Conservationists should be suspicious when they see the ecological systems of the world being reduced to a few ecosystem categories, as in the Ecological Footprint analysis. The calculations' crude simplifications aim to obtain a first-order estimate of humanity's ecological demand on nature and measure it in units that can be compared with the biosphere's supply of ecosystem services. The footprint shows the extent to which people appropriate nature's productivity. By reducing nature to biomass production, many essential features of the natural world are lost or blurred. Nevertheless, drawing on biomass only to the extent that nature can regenerate is a necessary condition for sustainability.

Quantitative footprint accounts need to be accompanied by qualitative assessments. Still, footprints tell a story about the human threat to biodiversity. They document the dominance of the human species on this planet. The critical consequence is that people's consumption takes available space away from other species.

The footprint of non-renewable resources, toxic substances and water
Non-renewable resources from the Earth's crust are included in these accounts only to the extent that their use damages the biosphere, for instance through mining, processing, and burning of fossil fuels. We classify these non-renewable resource stocks as financial rather than ecological assets, because they do not add ecological capacity to the biosphere. After all, non-renewable resources are not used up. They are only diluted and dispersed. Ultimately, it would be a matter of investing energy to concentrate themagain. Therefore, embodied energy is a good proxy measure of their Ecological Footprint (as long as the substances are not toxic).

Two significant categories of human demands on nature are not included in the presented accounts: the use of freshwater and the release of solid, liquid, and gaseous waste (apart from CO_2). Freshwater collection and waste assimilation can be secondary functions of land areas. But in many cases they are not. In arid parts of the world where water is a limiting factor, water use competes directly with other primary ecosystem functions. Similarly, excessive waste emissions can start to compromise primary functions. However, we have not been able to identify reliable data sources that document this impact and have therefore not included them. This leads to a further underestimate of the true impact of human activities on the planet.

GLOSSARY

area unit one hectare of biologically productive space with world-average productivity. In 1996 the biosphere had 12.6 billion hectares of biologically productive space corresponding to roughly one quarter of the planet's surface. These 12.6 billion hectares of biologically productive space include 3.2 billion hectares of ocean and 9.4 billion hectares of land. The land space is composed of 1.3 billion hectares of cropland, 4.6 billion hectares of grazing land, 3.3 billion hectares of forest land, and 0.2 billion hectares of built-up land.

available biological capacity the amount of biologically productive space that is available for human use.

biological capacity the total biological production capacity per year of a biologically productive space, for example inside a country. It can be expressed in "area units", i.e. the equivalent area of space with world-average productivity.

biologically productive space the land and water area that is biologically productive. It is land or water with significant photosynthetic activity. Marginal areas with patchy vegetation and non-productive areas are not included.

ecological deficit the amount by which the ecological footprint of a population (e.g. a country or region) exceeds the biological capacity of the space available to that population.

ecological footprint a measure of how much productive land and water an individual, a city, a country, or humanity requires to produce all the resources it consumes and to absorb all the waste it generates, using prevailing technology. This land could be anywhere in the world. The ecological footprint is measured in "area units".

equivalence factor a factor which translates the specific land use (such as world-average cropland) into a generic biologically productive area (global average space) by adjusting for biomass productivity (see also "yield factor").

overshoot the situation when human demand exceeds nature's supply at the local, national, or global scale.

yield factor a factor which describes the extent to which a local land-use category (e.g. cropland) is more productive than the world average in that same category (see also "equivalence factor").

REFERENCES

LPI DATA SOURCES

WWF and UNEP-WCMC gratefully acknowledge the invaluable assistance of many researchers who contributed species population data for the LPI. The list is too long to mention each individually, but a full list is provided at www.unep-wcmc.org.

Bohn, U. and Katenina, G.D. 1994. *Map of Natural Vegetation.* Scale 1:2,500,000. Komarov Botanical Institute, St Petersburg, Russian Federation.

Carnahan, J.A. n.d. *Australia – Natural Vegetation.* Australian Surveying and Land Information Group, Department of Administrative Services. 1:5 million scale.

Crick, H.Q.P., Baillie, S.R., Balmer, D.E., Bashford, R.I., Dudley, C., Glue, D.E., Gregory, R.D., Marchant, J.H., Peach, W.J., and Wilson, A.M. 1997. *Breeding birds in the wider countryside: their conservation status (1971–1995).* BTO Research Report No.187. British Trust for Ornithology, Norfolk, UK. pp165.

Crocodile Specialist Group. 1996. *Status Survey and Conservation Action Plan: Revised Action Plan for Crocodiles 1996*. J.P. Ross (ed). IUCN-The World Conservation Union, Gland, Switzerland. World Wide Web Edition.

Dinerstein, E., Olson, D.M., Graham, D.J., Webster, A.L., Primm, S.A., Bookbinder, M.P., and Ledec, G. 1995. *A Conservation Assessment of the Terrestrial Ecoregions of Latin America and the Caribbean*. Published in association with The World Wildlife Fund. The World Bank, Washington, DC, USA.

European Commission. 1995. *Europe's Environment: Statistical Compendium to the Dobris Assessment*. Office for Official Publications of the European Communities.

Food and Agriculture Organization of the UN (FAO). 1995. *Forest Resources Assessment 1990; Global Synthesis*. FAO Forestry Paper 124. FAO, Rome, Italy.

Food and Agriculture Organization of the UN (FAO). 1997. *State of the World's Forests 1997*. FAO, Rome, Italy.

Gaston, K.J. (ed) 1996. *Biodiversity: A Biology of Numbers and Difference*. Blackwell Science, Oxford, UK.

Groombridge, B. 1987. The distribution and status of world crocodilians. In: Webb, G.J.W., Manolis, S.C., and Whitehead, P.J. (eds). 1987. *Wildlife Management: Crocodiles and Alligators*. Surrey Beatty & Sons Pty Limited, New South Wales, Australia.

Groombridge, B. (ed). 1982. *The IUCN Amphibia-Reptilia Red Data Book Part 1: Testudines, Crocodylia and Rhynchocephalia*. IUCN, Gland, Switzerland.

Houlahan, J.E., Findlay, C.S., Schmidt, B.R., Meyer, A.H., and Kuzmin, S.L. 2000. Quantitative evidence for global amphibian population declines. *Nature* 404: 752-755.

Kool, K.M. 1992. The status of endangered primates in Gunung Halimun Reserve, Indonesia. *Oryx* 26: 29.

Kuusela, K. 1994. *Forest Resources in Europe, 1950-1990*. European Forest Research Institute Research Report 1. Cambridge University Press, Cambridge, UK.

Marquéz, R., et al. 1999. Results of the Kemp's ridley nesting beach conservation efforts in Mexico. *Marine Turtle Newsletter* 85: 2-4.

Milanova, E.V. and Kushlin, A.V. (eds). 1993. *World Map of Present-Day Landscapes. An Explanatory Note.* Prepared by Moscow State University and the United Nations Environment Programme.

Nijman, V. and van Balen, S. 1998. A faunal survey of the Dieng Mountains, Central Java, Indonesia: Distribution and conservation of endemic primate taxa. *Oryx* 32: 145.

Nowak, R.M. and Paradiso, J.L . 1983. *Walker's Mammals of the World, vols. 1 and 2. 4th edition*. Johns Hopkins University Press, Baltimore, MD, USA.

Ransom Myers fish population database on line (http://www.mscs.dal.ca/~myers/about_site.html).

REFERENCES

Scott, D.A. and Rose, P.M. *1996. Atlas of Anatidae Populations in Africa and Western Eurasia*. Wetlands International Publication No. 41, Wetlands International, Wageningen, The Netherlands.

Singh, K.D. and Marzoli, A. 1995. *Deforestation Trends in the Tropics: a Time Series Analysis*. Paper presented at WWF Conference on the Potential Impacts of Climate Change on Tropical Forests, Puerto Rico, April 1995.

Spalding, M.D., Blasco, F., and Field, C.D. (eds). 1997. *World Mangrove Atlas*. The International Society for Mangrove Ecosystems, Okinawa, Japan.

Thorbjarnson, J. 1992. *Crocodiles. An Action Plan for their Conservation*. H. Messel, F.W. King and J.P. Ross (eds). IUCN-The World Conservation Union, Gland, Switzerland.

White, F. 1983. *The Vegetation of Africa.* UNESCO, Paris, France.

World Conservation Monitoring Centre. 1992. *Global Biodiversity: Status of the Earth's Living Resources*. Chapman and Hall, London, UK.

World Conservation Monitoring Centre. 2000. *Global Biodiversity: Earth's living resources in the 21st century*. By: Groombridge, B. and Jenkins, M.D. World Conservation Press, Cambridge, UK.

ECOLOGICAL FOOTPRINT DATA SOURCES

A book of spreadsheets contains all the calculations and can be downloaded from the Redefining Progress website (www.rprogress.org).

All the main sources used in the calculations are United Nations' documents. The codes in the spreadsheet reference columns point to the publication used. The first number of the reference code indicates the data source (see below), the second the page and the third the classification number within the data source. The data sources are:

(1) **United Nations**. 1998. *1996 International Trade Statistics Yearbook, Vol. 1*. Department for Economic and Social Information and Policy Analysis, Statistical Division, New York, USA.

(2) **United Nations Conference on Trade and Development (UNCTAD)**. 1996. *UNCTAD Commodity Yearbook 1996*. United Nations, New York, USA, and Geneva, Switzerland.

(3) **Food and Agriculture Organization of the United Nations (FAO)**. 1998. *FAO Yearbook: Production 1997, Vol. 51*. FAO, Rome, Italy.

(4) **Food and Agriculture Organization of the United Nations (FAO)**. 1997. *FAO Yearbook: Trade 1996, Vol. 50*. FAO, Rome, Italy.

(5) **Food and Agriculture Organization of the United Nations (FAO).** 1998. *FAO Yearbook: Forest Production 1996.* FAO, Rome, Italy.

(6) **United Nations.** 1998. *1996 Energy Statistics Yearbook*. Department for Economic and Social Information and Policy Analysis, Statistical Division, New York, USA.

(7) **International Energy Agency (IEA)**. 1998. *CO_2 Emissions from Fossil Fuel Combustion 1971-1996*. OECD/IEA, Paris, France.

(8) **Food and Agriculture Organization of the United Nations (FAO).** 1999. FAOSTAT 98 CD-ROM. (FAO Statistical Databases). FAO, Rome, Italy, or see http://apps.fao.org.

(9) **United Nations Population Division.** 1998. *Annual Populations, 1950-2050 (The 1998 Revision)*. Dataset on diskette. United Nations, Department of Social and Economic Affairs, New York, USA.

(10) **World Resources Institute (WRI)**. 1998. *World Resources 1998-1999*. World Resources Institute, UNEP, UNDP, The World Bank, Washington DC, USA.

Further, we used:

Costanza, R., et al. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253-260.

Council of Agriculture. 1996. *Basic Agricultural Statistics.* Council of Agriculture, Executive Yuan, Taipei.

Dixon, R. K., et al. 1994. Carbon pools and flux of global forest ecosystems. *Science* 263: 185-190.

ESRI. 1993. Digital Chart of the World (DCW) Database.

European Commission. 2000. *Towards Environmental Pressure Indicators for the EU*. Eurostat.

Food and Agriculture Organization of the United Nations (FAO). 1997a. *The State of the World's Fisheries and Aquaculture 1996*. FAO Fisheries Department, Rome, Italy.

Food and Agriculture Organization of the United Nations (FAO). 1997b. *State of the World's Forests 1997*. FAO, Rome, Italy.

Food and Agriculture Organization of the United Nations (FAO). 1997c. *Forest and Forest Industries, Country Fact Sheets*. Timber Section, UN-ECE/FAO Secretariat, New York, USA, and Geneva, Switzerland.

Hofstetter, P. 1992. *Personliche Energie und CO_2 Bilanz*. (Personal Energy and CO_2 Balance), Second draft. Büro für Analyse und Okologie, Zurich, Switzerland.

Intergovernmental Panel on Climate Change (IPCC). 1997. *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook. Volume 2*. UK Meteorological Office: IPCC, Organisation for Economic Cooperation and Development (OECD) & International Energy Agency (IEA).

IVEM (Interfacultaire Vakgroep Energie en Milieukunde, Center for Energy and Environmental Studies). 1999. Groningen, Netherlands.

Pauly, D. and Christensen, V. 1995. Primary production required to sustain global fisheries. *Nature* 374: 255-257.

Watson, R., et al. (eds). 2000. *Land Use, Land-use Change, and Forestry*. Cambridge University Press, Cambridge, UK.

World Resources Institute (WRI), United Nations Environment Programme (UNEP), United Nations Development Programme (UNDP). 1994. *World Resources 1994-95: A Guide to the Global Environment*. Oxford University Press, New York, USA.

For further reading on the Ecological Footprint:

Chambers, N., Simmons, C., and Wackernagel, M. 2000. *Sharing Nature's Interest*. Earthscan, London, UK.

Sturm, A., Wackernagel, M., and Müller, K. 2000. *The Winners and Losers in Global Competition: Why Eco-Efficiency Reinforces Competitiveness: A Study of 44 Nations*, Verlag, Rüegger, Chur/Zurich, Switzerland.

Wackernagel, M., Lewan, L., and Borgström Hansson, C. 1999. Evaluating the use of natural capital with the ecological footprint: applications in Sweden and subregions. *Ambio* 28 (7): 604-612.

Wackernagel, M., et al. 1999. National natural capital accounting with the ecological footprint concept. *Ecological Economics* 29 (3): 375-390.

Wackernagel, M. and Rees, W. 1996. *Our Ecological Footprint: Reducing Human Impact on the Earth.* New Society Publishers, Gabriola Island, B.C.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge Simon Blyth, Wim Braakhekke, John Cederroth, Michel Chevallier, Chris Elliott, Anton Fernhout, Biksham Gujja, Chris Hails, Christine Hawkins, Jenny Heap, Martin Hiller, Makoto Hoshino, Jean-Paul Jeanrenaud, Uwe Kievelitz, Tim Johnson, Tom Lippman, Tony Long, Richard Mott, Yaa Ntiamoa-Baidu, Lennart Nyman, Julian Scola, Stephan Singer, Magnus Sylvén, Chris Tydeman, Bart Ullstein, and Alex Yau for their help. We would also like to thank Columbia Foundation, Merck Family Fund, and Union Bancaire Privée for their support of the Ecological Footprint analysis. Any errors, however, remain the responsibility of the authors.

W W F

WWF INTERNATIONAL
Avenue du Mont-Blanc
CH-1196 Gland, Switzerland
Tel: +41 22 364 91 11
Fax: +41 22 364 53 58
E-mail: infobox@wwfint.org
Website: www.panda.org

NATIONAL ORGANIZATIONS

WWF-AUSTRALIA
GPO Box 528, Sydney NSW 2001
Tel: +61 2 9281 5515

WWF-AUSTRIA
Postfach 1, 1162 Vienna
Tel: +43 1 488 170

WWF-BELGIUM
608 Chaussée de Waterloo
1050 Brussels
Tel: +32 2 340 09 99

WWF-BRAZIL
SHIS EQ QL 6/8
Conjunto E – 2° andar
71620-430 Brasilia
Tel: +55 61 248 2899

WWF-CANADA
245 Eglinton Avenue East
Suite 410, Toronto
Ontario M4P 3J1
Tel: +1 416 489 8800

WWF-DENMARK
Ryesgade 3 F,
2200 Copenhagen N
Tel: +45 35 36 36 35

WWF-FINLAND
Lintulahdenkatu 10
00500 Helsinki 50
Tel: +358 9 774 0100

WWF-FRANCE
188 rue de la Roquette, 75011
Paris
Tel: +33 1 55 25 84 84

WWF-GERMANY
PO Box 190 440, Rebstocker Str. 55
60326 Frankfurt a/Main
Tel: +49 69 79 14 40

WWF-GREECE
Filellinon St 26, 10558 Athens
Tel: +30 1 331 4893

WWF-HONG KONG
GPO Box 12721, Hong Kong
Tel: +852 2526 1011

WWF-INDIA
172-B Lodi Road
New Delhi 110 003
Tel: +91 11 469 1760-62

WWF-INDONESIA
PO Box 5020 JKTM
12700 Jakarta
Tel: +62 21 576 1070

WWF-ITALY
Via Po 25/c, 00198 Rome
Tel: +39 06 844 971

WWF-JAPAN
Nihonseimei Akabanebashi
Building
3-1-14 Shiba, Minato-ku
Tokyo 105-0014
Tel: +81 3 3769 1711

WWF-MALAYSIA
49 Jalan SS23/15
47301 Petaling Jaya
Tel: +60 3 703 3772

WWF-NETHERLANDS
Postbus 7, 3700 AA Zeist
Tel: +31 30 6937 333

WWF-NEW ZEALAND
PO Box 6237, Wellington
Tel: +64 4 499 2930

WWF-NORWAY
Postboks 6784
St Olavs plass, 0130 Oslo
Tel: +47 22 03 65 00

WWF-PAKISTAN
PO Box 5180, Ferozepur Road
Lahore 54600
Tel: +92 42 586 2360/9429

WWF-PHILIPPINES
No 23-A Maalindog Street
UP Village, Diliman
Quezon City 1101
Tel: +632 433 3220-22

WWF-SOUTH AFRICA
PO Box 456
Stellenbosch 7599
Tel: +27 21 887 2801

WWF-SPAIN, ADENA
Santa Engracia 6-2°Izd
28010 Madrid
Tel: +34 91 308 23 09/10

WWF-SWEDEN
Ulriksdals Slott, 170 81 Solna
Tel: +46 8 624 74 00

WWF-SWITZERLAND
Postfach
8010 Zürich
Tel: +41 1 297 21 21

WWF-UNITED KINGDOM
Panda House, Weyside Park
Godalming
Surrey GU7 1XR
Tel: +44 1483 426 444

WWF-UNITED STATES
1250 24th Street, NW
Washington, DC 20037-1175
Tel: +1 202 293 4800

ASSOCIATES

ARGENTINA
FUNDACION VIDA SILVESTRE
Defensa 245/51, 6 Piso
1065 Capital Federal
Buenos Aires
Tel: +54 114 343 3778

ECUADOR
FUNDACION NATURA
Casilla 17-01-253, Quito
Tel: +593 2 503 369/370

NIGERIA
NIGERIAN CONSERVATION FOUNDATION
PO Box 74638
Victoria Island, Lagos
Tel: +234 1 2642 498/ 2600 600

TURKEY DHKD
PK 971, Sirkeci 34436, Istanbul
Tel: +90 212 528 20 30

VENEZUELA FUDENA
Apartado Postal 70376
Caracas 1071-A
Tel: +58 2 238 2930/1720/1761/
1793/235 9454

PROGRAMME OFFICES

BHUTAN
Post Box 210, Thimphu
Tel: +975 2 323 528/316

BOLIVIA
PO Box 1633, Calle Guemes No 4
Barrio Equipetrol, Santa Cruz
Tel: +591 3 365326/378317

CAMEROON
BP 6776, Yaoundé
Tel: +237 21 70 83/84

CENTRAL AFRICA
BP 9144, Libreville, Gabon
Tel: +241 73 00 28

CENTRAL AMERICA
Turrialba
7170 CATIE, Costa Rica
Tel: +506 556 1383/1737

CHINA
Room 701, The Gateway
No 10 Yabao Road
Chaoyang District, Beijing 100020
Tel: +86 10 6591 5732-38

COLOMBIA
Carrera 35 No 4A-25
San Fernando, Cali, Valle
Tel: +57 2 558 2577/86/87

DANUBE/CARPATHIAN
Postfach 1, 1162 Vienna
Austria
Tel: +431 488 17 253

EASTERN AFRICA
PO Box 62440, Nairobi, Kenya
Tel: +254 2 577 355

EUROPEAN POLICY
36, Avenue de Tervuren - B12
1040 Brussels, Belgium
Tel: +32 2 743 88 00

HUNGARY
Németvölgyi út 78/b
1124 Budapest
Tel: +36 1 214 5554/212 3041

INDOCHINA
International PO Box 151
Hanoi, Vietnam
Tel: +84 4 8220 640/641

MACROECONOMICS FOR SUSTAINABLE DEVELOPMENT
1250 24th Street, NW
Washington, DC 20037-1175
USA
Tel: +1 202 778 9752

MADAGASCAR
BP 738 Antananarivo 101
Tel: +261 20 22 34885/
30 23 88805/6/7

MEDITERRANEAN
Via Po 25/c
00198 Rome, Italy
Tel: +39 06 844 97227

MEXICO
Ave Mexico No 51
Col Hipodromo Condesa
06170 Mexico, DF
Tel: +525 286 5631/5634

NEPAL
Post Box 7660
Lal Durbar, Kathmandu 2
Tel: +977 1 434820/434970

PERU
Casilla Postal 11-0205
Lima 11
Tel: +51 1 261 5300/5301

RUSSIA
From Europe:
Account No WWF 232
PO Box 289
Weybridge
Surrey KT 13 8WJ
United Kingdom
From the USA:
Account No WWF 232
208 East 51st Street
Suite 295
New York, NY 10022, USA
Tel: +7 095 727 0939

SOUTHERN AFRICA
PO Box CY 1409
Causeway, Harare
Zimbabwe
Tel: +263 4 252533/
252534/703902

SOUTH PACIFIC
Private Mail Bag
GPO Suva, Fiji
Tel: +679 31 55 33

TANZANIA
PO Box 63117
Dar es Salaam
Tel: +255 22 2700077/2772455

THAILAND
Asian Institute of Technology
104 Outreach Building
Bangkok 10501
PO Box 4
Klong Luang 12120
Tel: +66 2 524 6129

WESTERN AFRICA
08 BP 1776
Abidjan 08
Côte d'Ivoire
Tel: +225 44 87 86

lpr cover to pr 19/9/00 2:34 pm Page 2

WWF is the world's largest and most experienced independent conservation organization. It has 4.7 million regular supporters and a global network active in 96 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 by:

– conserving the world's biological diversity
– ensuring that the use of renewable natural resources is sustainable
– promoting the reduction of pollution and wasteful consumption.

Let's leave our children a living planet

WWF

WWF International

Avenue du Mont-Blanc
1196 Gland
Switzerland

Tel: +41 22 364 9111
Fax: +41 22 364 5829
www.panda.org

© 1986, WWF–World Wide Fund For Nature (Formerly World Wildlife Fund) ® WWF Registered Trademark owner 09.00(6)