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

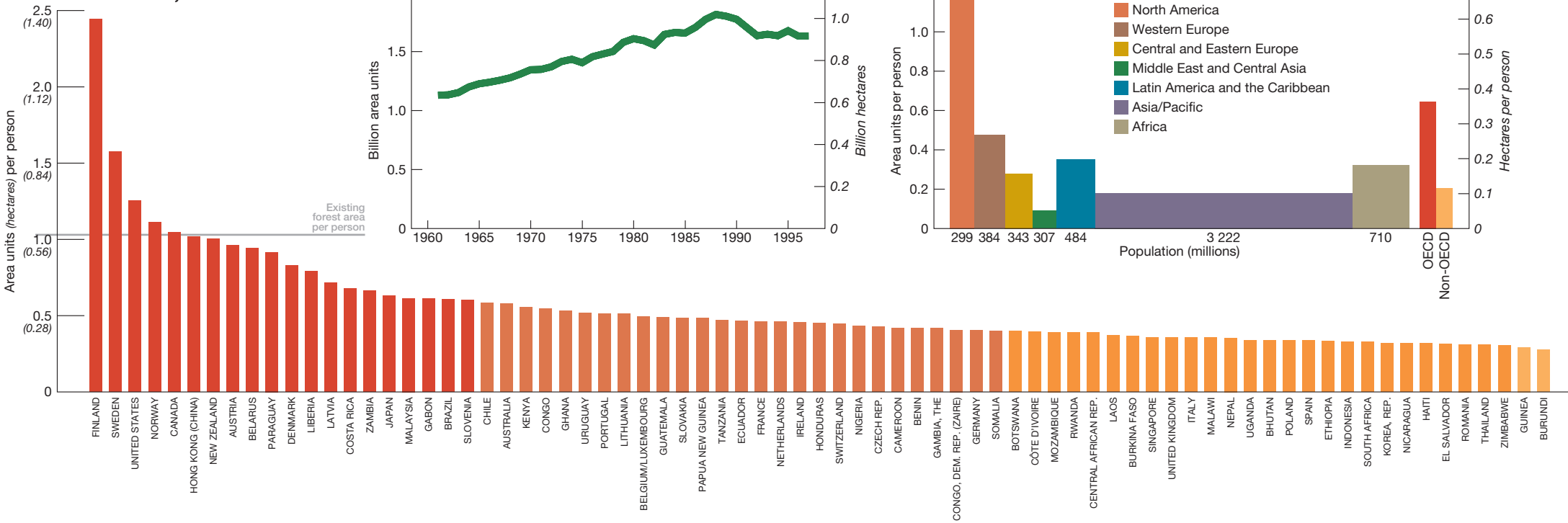
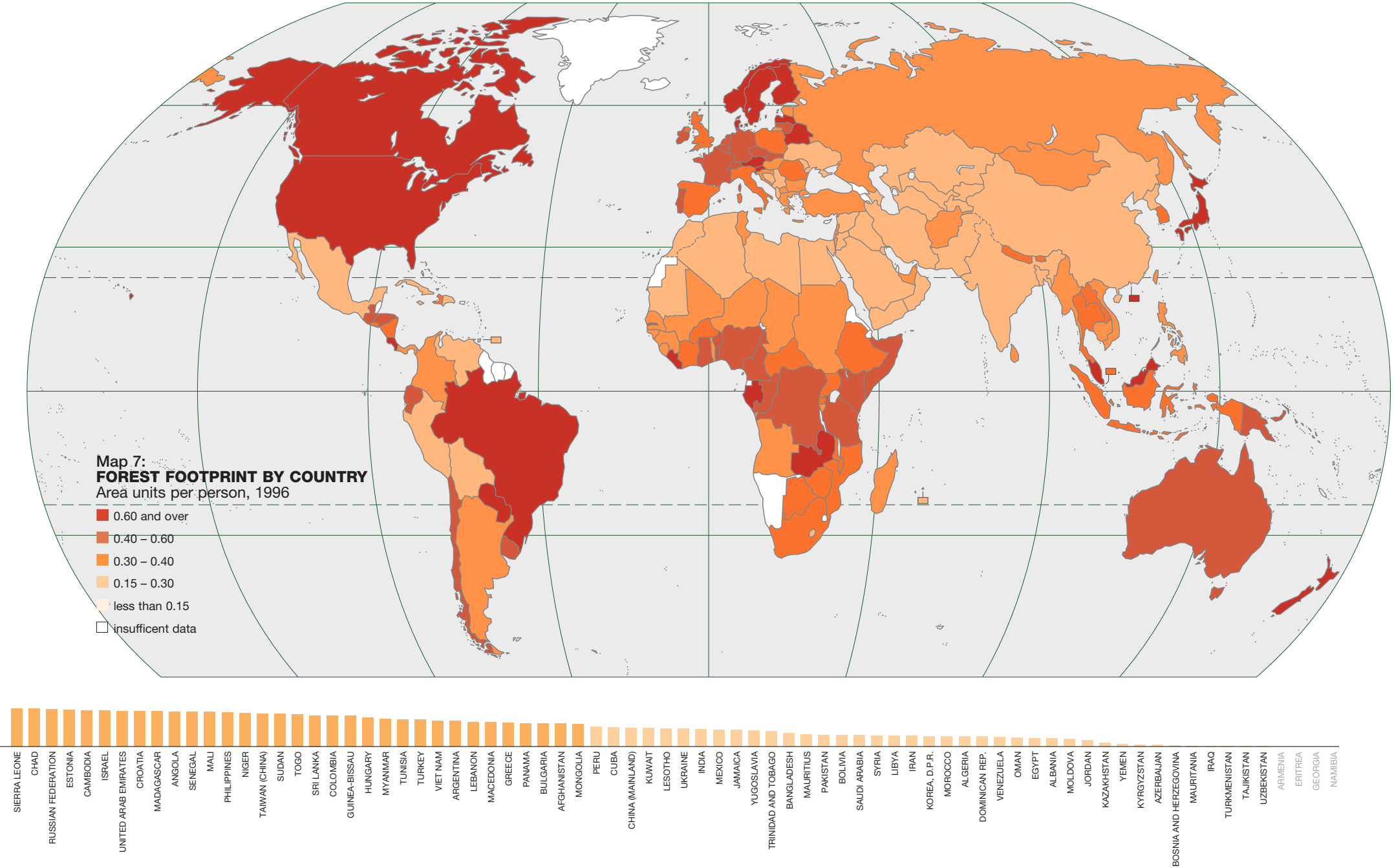


Fig. 20: WORLD FOREST FOOTPRINT, 1961–97

Fig. 21: FOREST FOOTPRINT BY REGION, 1996


Map 7:
FOREST FOOTPRINT BY COUNTRY
Area units per person, 1996
0.60 and over
0.40 – 0.60
0.30 – 0.40
0.15 – 0.30
less than 0.15
insufficent data
SIERRA LEONE
CHAD
RUSSIAN FEDERATION
ESTONIA
CAMBODIA
ISRAEL
UNITED ARAB EMIRATES
CROATIA
MADAGASCAR
ANGOLA
SENEGAL
MALI
PHILIPPINES
NIGER
TAIWAN (CHINA)
SUDAN
TOGO
SRI LANKA
COLOMBIA
GUINEA-BISSAU
HUNGARY
MYANMAR
TUNISIA
TURKEY
VIET NAM
ARGENTINA
LEBANON
MACEDONIA
GREECE
PANAMA
BULGARIA
AFGHANISTAN
MONGOLIA
PERU
CUBA
CHINA (MAINLAND)
KUWAIT
LESOTHO
UKRAINE
INDIA
MEXICO
JAMAICA
YUGOSLAVIA
TRINIDAD AND TOBAGO
BANGLADESH
MAURITIUS
PAKISTAN
BOLIVIA
SAUDI ARABIA
SYRIA
LIBYA
IRAN
KOREA, D.P.R.
MOROCCO
ALGERIA
DOMINICAN REP.
VENEZUELA
OMAN
EGYPT
ALBANIA
MOLDOVA
JORDAN
KAZAKHSTAN
YEMEN
KYRGYZSTAN
AZERBAIJAN
BOSNIA AND HERZEGOVINA
MAURITANIA
IRAQ
TURKMENISTAN
TAJIKISTAN
UZBEKISTAN
ARMENIA
ERITREA
GEORGIA
NAMIBIA

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

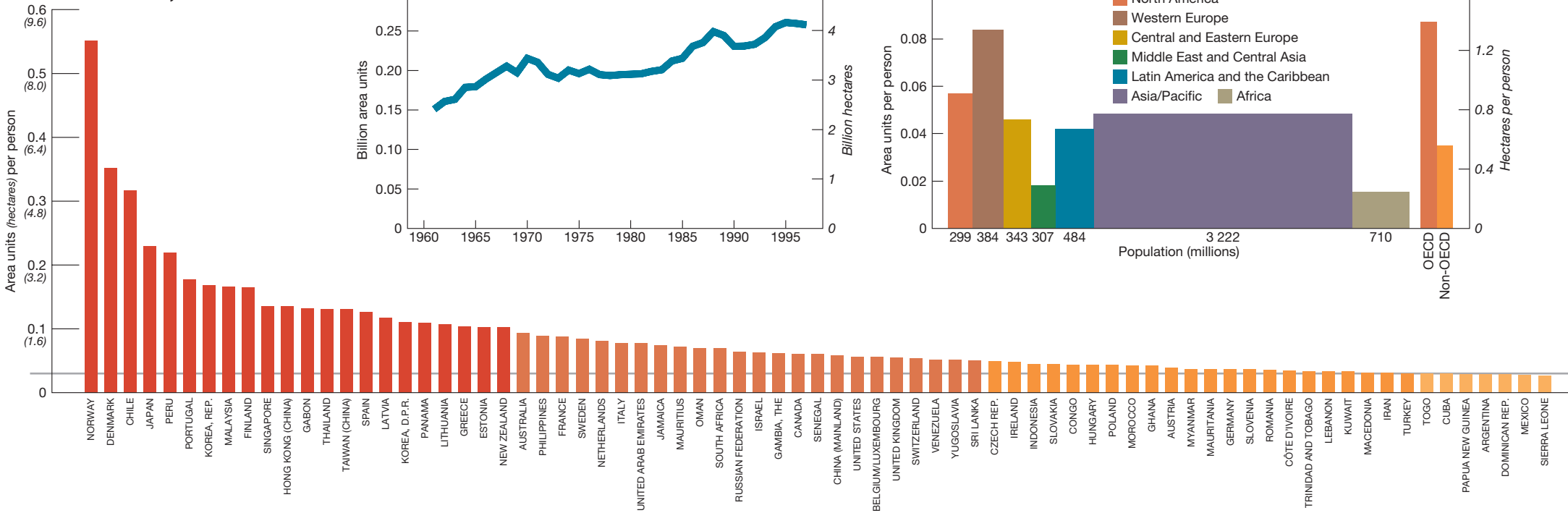
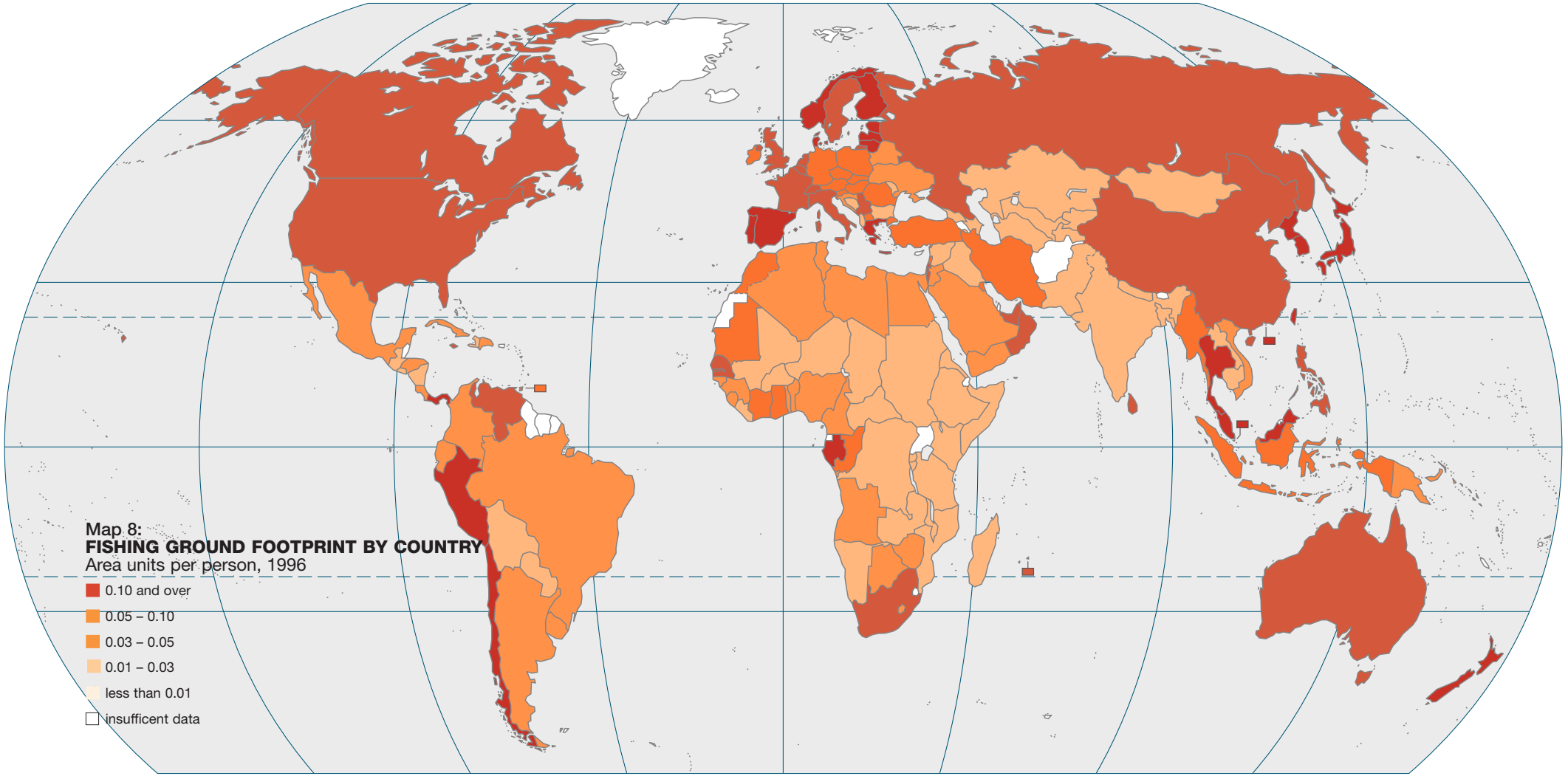


Fig. 23: WORLD FISHING GROUND FOOTPRINT, 1961–97

Fig. 24: FISHING GROUND FOOTPRINT BY REGION, 1996


Map 8:
FISHING GROUND FOOTPRINT BY COUNTRY
Area units per person, 1996
0.10 and over
0.05 – 0.10
0.03 – 0.05
0.01 – 0.03
less than 0.01
insufficent data


Existing fishing ground area per person
TUNISIA
GUINEA
LIBYA
ECUADOR
COLOMBIA
ANGOLA
VIET NAM
SAUDI ARABIA
BELARUS
BRAZIL
CAMEROON
YEMEN
URUGUAY
BOTSWANA
CROATIA
NIGERIA
UKRAINE
GUINEA-BISSAU
JORDAN
EGYPT
COSTA RICA
LESOTHO
ZIMBABWE
BENIN
ALGERIA
HONDURAS
MADAGASCAR
CAMBODIA
BULGARIA
CONGO, DEM. REP. (ZAIRE)
LIBERIA
INDIA
EL SALVADOR
PAKISTAN
HAITI
NICARAGUA
BANGLADESH
MOZAMBIQUE
GUATEMALA
TANZANIA
SOMALIA
ALBANIA
ERITREA
GEORGIA
BOSNIA AND HERZEGOVINA
ZAMBIA
KAZAKHSTAN
SYRIA
PARAGUAY
LAOS
BOLIVIA
MOLDOVA
BURKINA FASO
KENYA
KYRGYZSTAN
SUDAN
MALI
NIGER
MALAWI
BURUNDI
NAMIBIA
CENTRAL AFRICAN REP.
IRAQ
RWANDA
CHAD
UZBEKISTAN
TURKMENISTAN
MONGOLIA
TAJIKISTAN
AZERBAIJAN
NEPAL
ETHIOPIA
AFGHANISTAN
ARMENIA
BHUTAN
UGANDA

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. 28: CARBON DIOXIDE FOOTPRINT BY COUNTRY, 1996

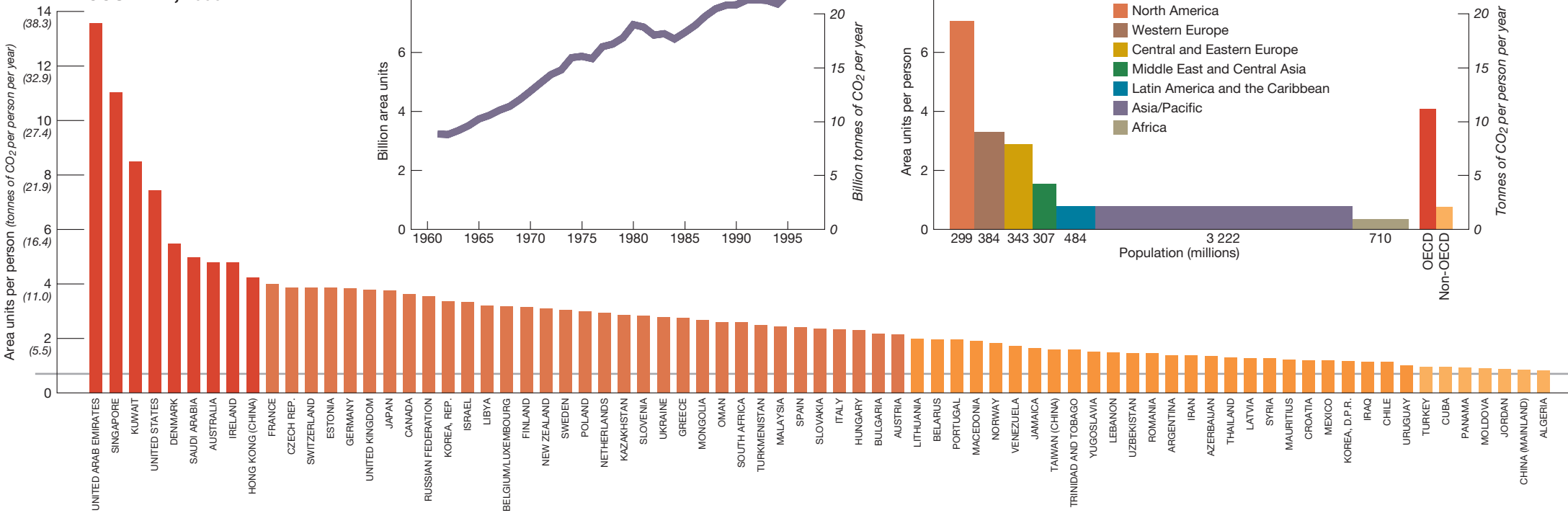
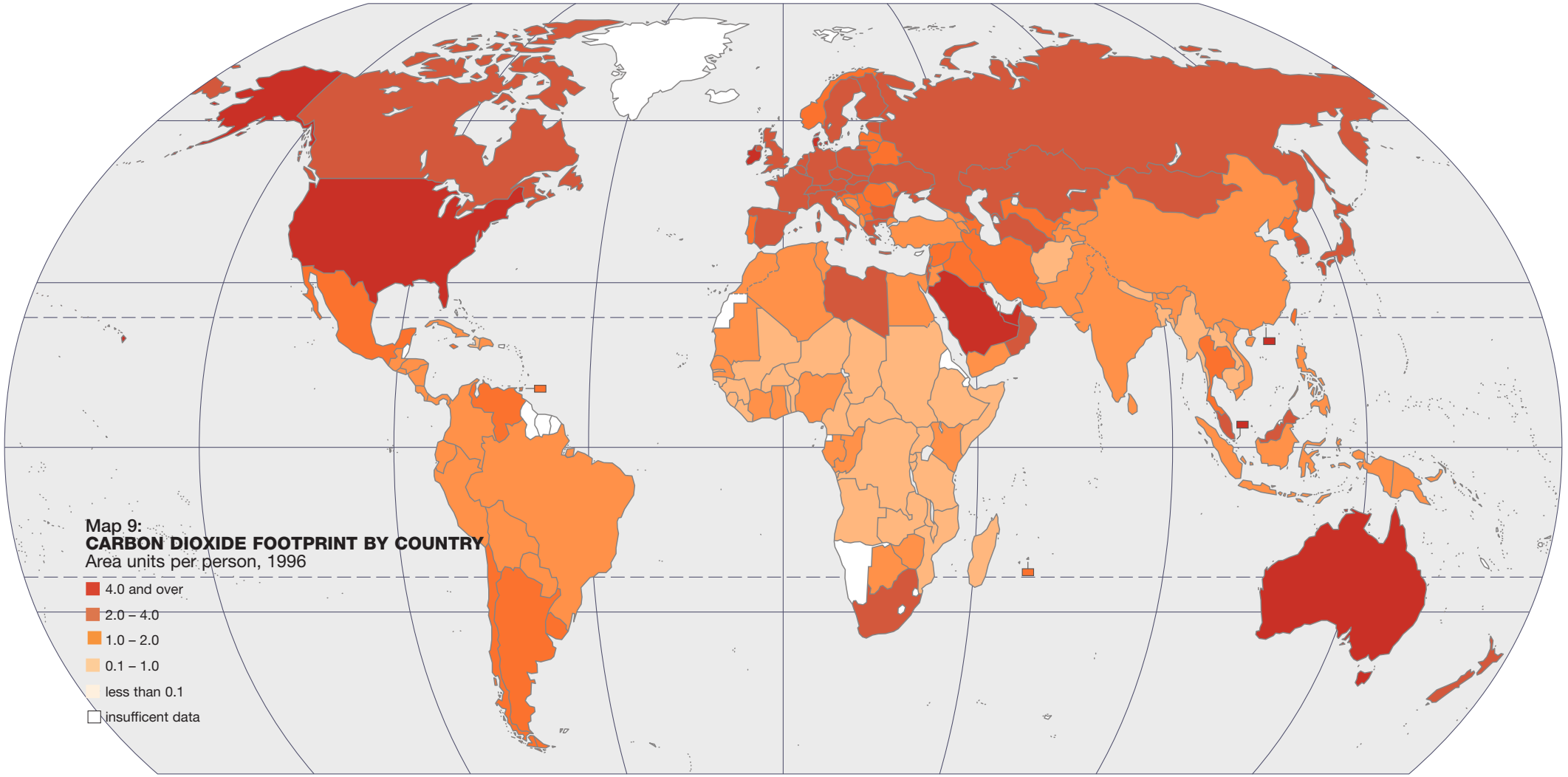


Fig. 26: WORLD CARBON DIOXIDE FOOTPRINT, 1961–97

Fig. 27: CARBON DIOXIDE FOOTPRINT BY REGION, 1996


Map 9:
CARBON DIOXIDE FOOTPRINT BY COUNTRY
Area units per person, 1996
4.0 and over
2.0 – 4.0
1.0 – 2.0
0.1 – 1.0
less than 0.1
insufficent data

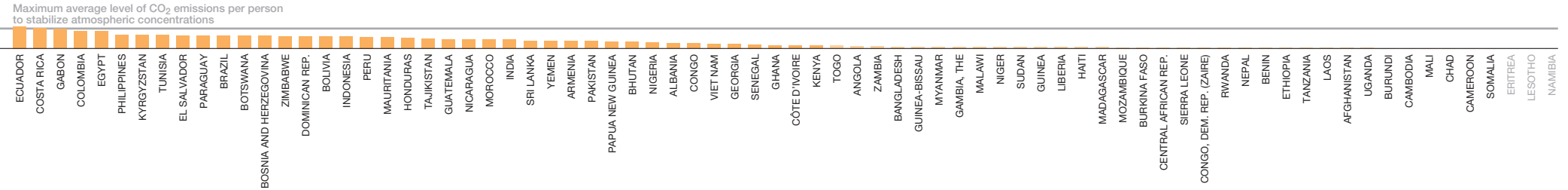

Maximum average level of CO_2 emissions per person to stabilize atmospheric concentrations
ECUADOR
COSTA RICA
GABON
COLOMBIA
EGYPT
PHILIPPINES
KYRGYZSTAN
TUNISIA
EL SALVADOR
PARAGUAY
BRAZIL
BOTSWANA
BOSNIA AND HERZEGOVINA
ZIMBABWE
DOMINICAN REP.
BOLIVIA
INDONESIA
PERU
MAURITANIA
HONDURAS
TAJIKISTAN
GUATEMALA
NICARAGUA
MOROCCO
INDIA
SRI LANKA
YEMEN
ARMENIA
PAKISTAN
PAPUA NEW GUINEA
BHUTAN
NIGERIA
ALBANIA
CONGO
VIET NAM
GEORGIA
SENEGAL
GHANA
CÔTE D'IVOIRE
KENYA
TOGO
ANGOLA
ZAMBIA
BANGLADESH
GUINEA-BISSAU
MYANMAR
GAMBIA, THE
MALAWI
NIGER
SUDAN
GUINEA
LIBERIA
HAITI
MADAGASCAR
MOZAMBIQUE
BURKINA FASO
CENTRAL AFRICAN REP.
SIERRA LEONE
CONGO, DEM. REP. (ZAIRE)
RWANDA
NEPAL
BENIN
ETHIOPIA
TANZANIA
LAOS
AFGHANISTAN
UGANDA
BURUNDI
CAMBODIA
MALI
CHAD
CAMEROON
SOMALIA
ERITREA
LESOTHO
NAMIBIA

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").

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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.

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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.

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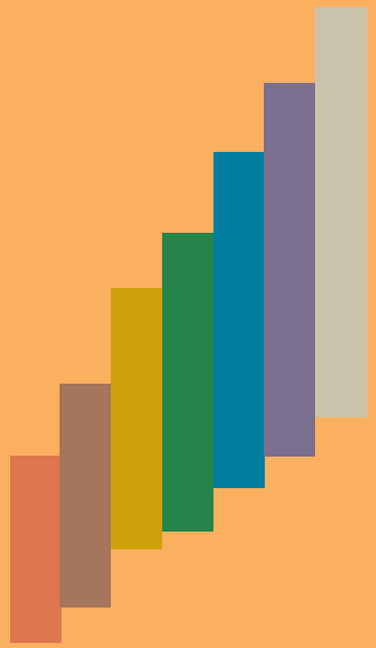

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