Conservation of tropical biodiversity

Primary problem:

Growing human population

Secondary problems:

Habitat destruction and fragmentation
Environmental pollution [including global warming]
Non-sustainable use of renewable resources [freshwater, soil, marine fisheries]
Alien biota
... and others

Possible solutions:

☺Techno-optimism
[technological progress solves more problems than it causes]
☻Techno-pesimism
[technological progress in dangerous]

Scientists of "Club of Rome" modeled in 1968 the future of civilization and predicted increasing scarcity of non-renewable materials (oil, metals, etc.) followed by a collapse of industrial production, agriculture and finally human population size

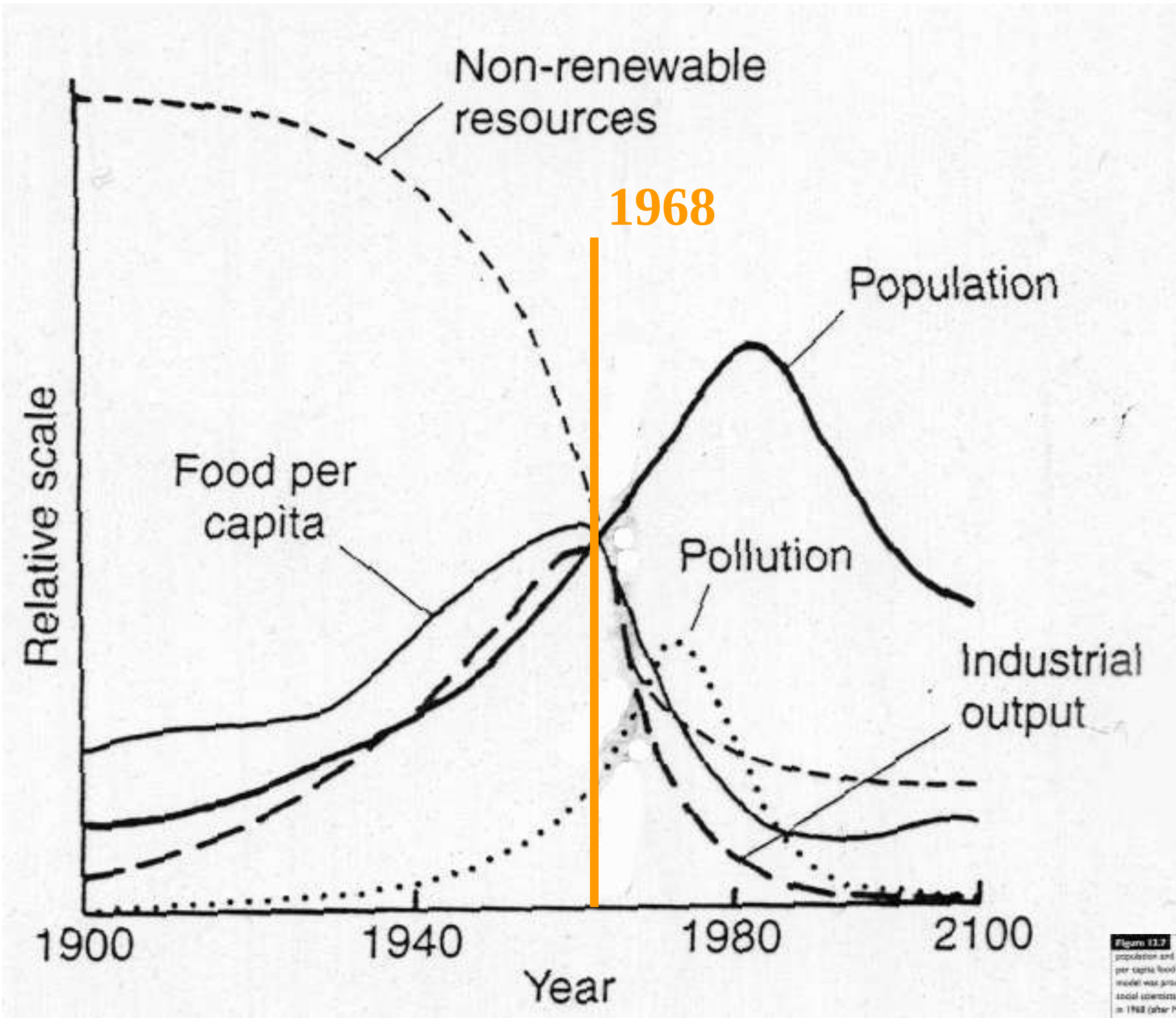
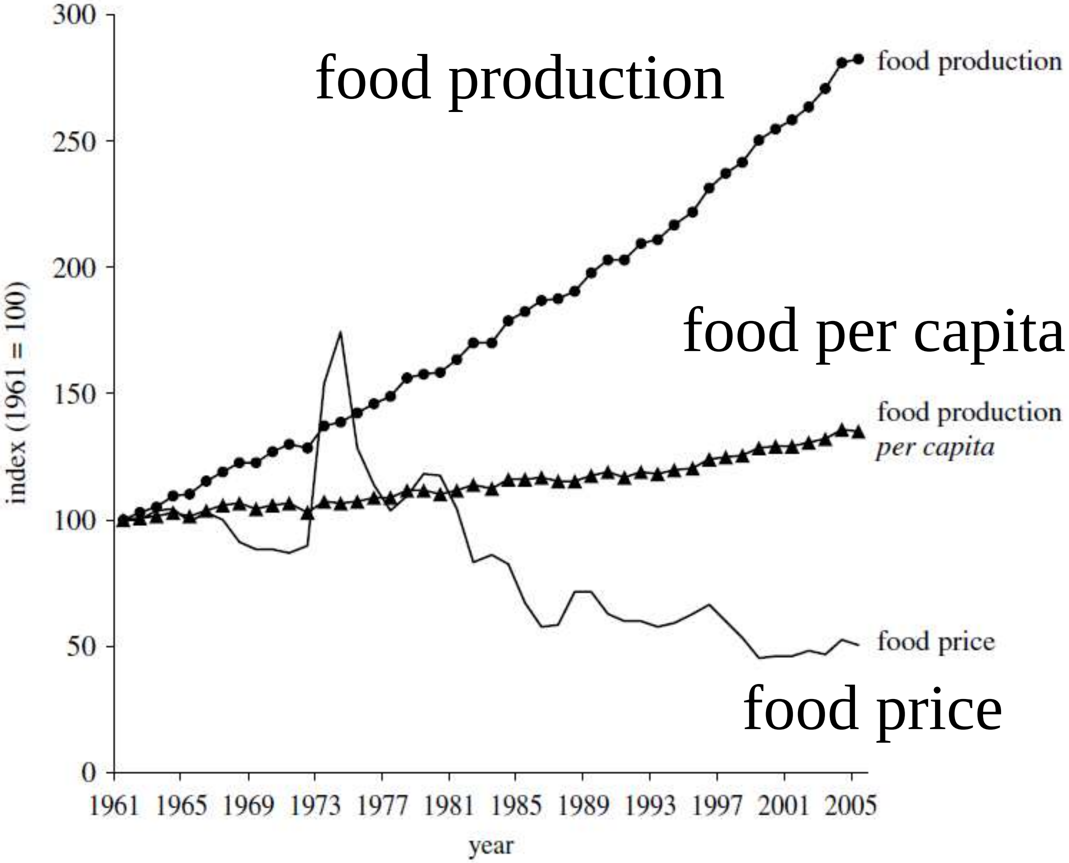


Figure 13.7 Computer model of the growth in the human population and its impact on resource availability, pollution, per capita food supply and per capita industrial output. This model was produced by a group of scientists, economists, social scientists, political scientists and industrialists who met in 1968 (after Meadows et al. 1972).

The reality has not been so disastrous…



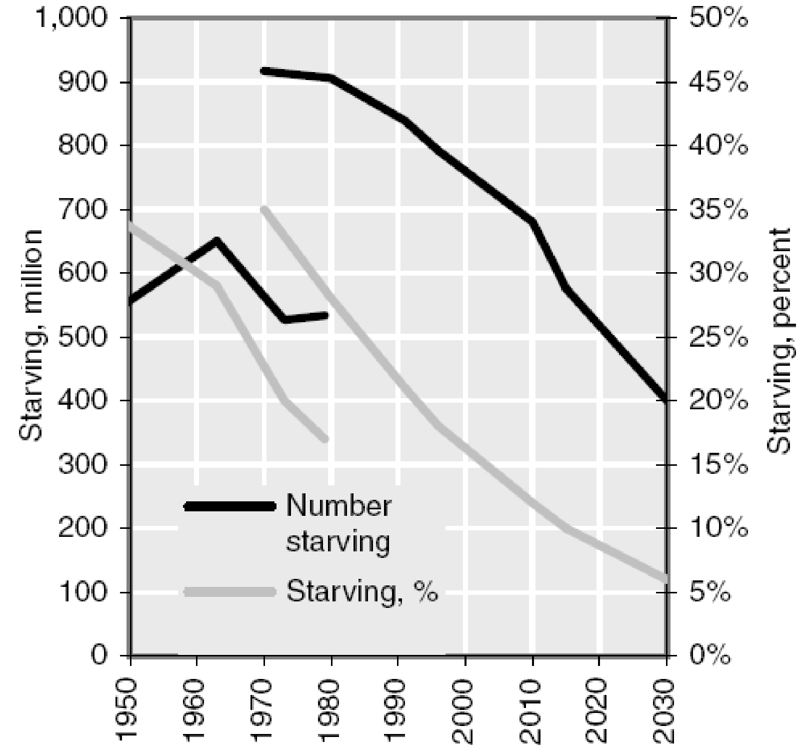
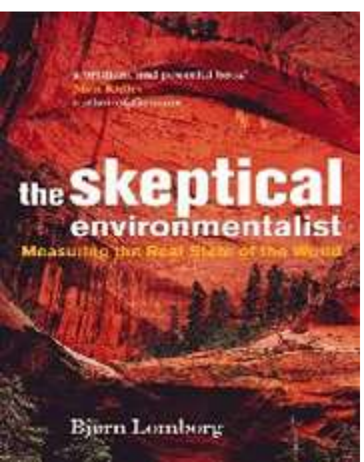
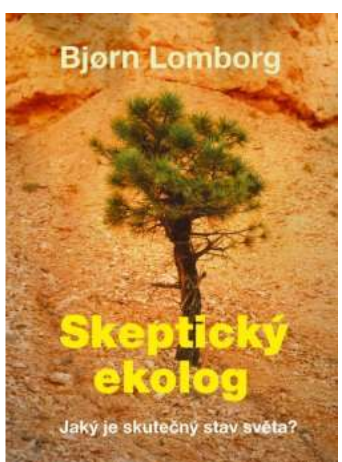
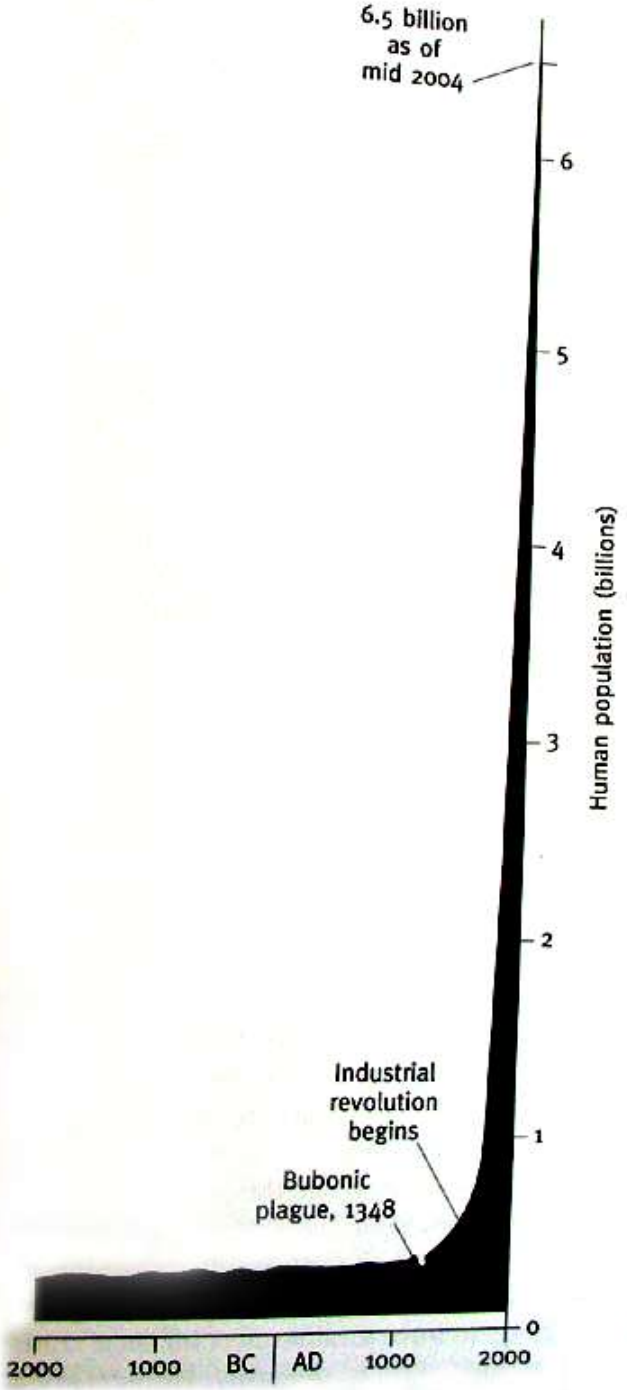


Figure 7 People undernourished, 1949–2030, in numbers (million) and percentage (of developing world). Prediction for 1998–2030. Estimates for





Human population size: key to all conservation considerations



Ecological footprint: when fossil fuels (= past biosphere production) are included, we have already exceeded the planetary capacity

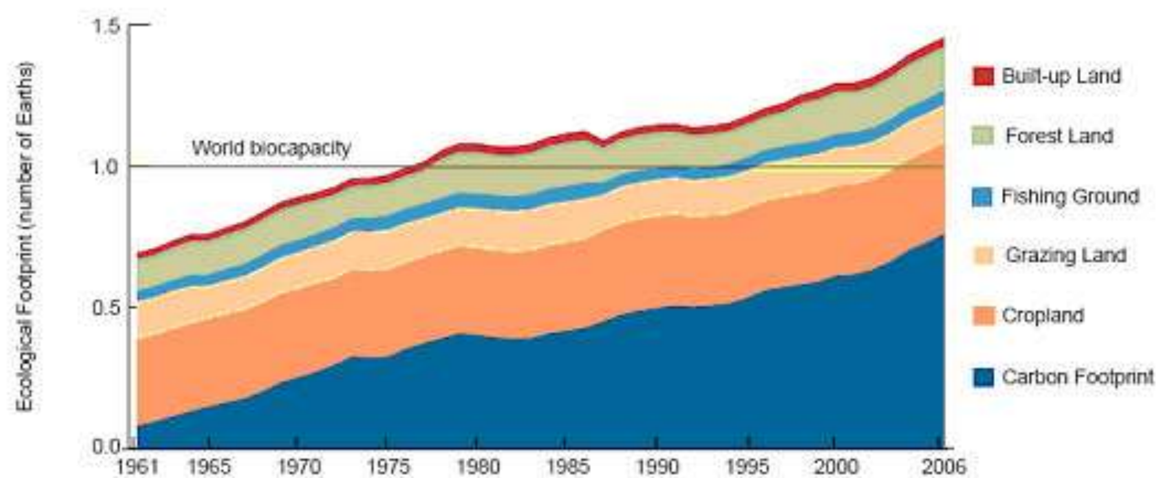
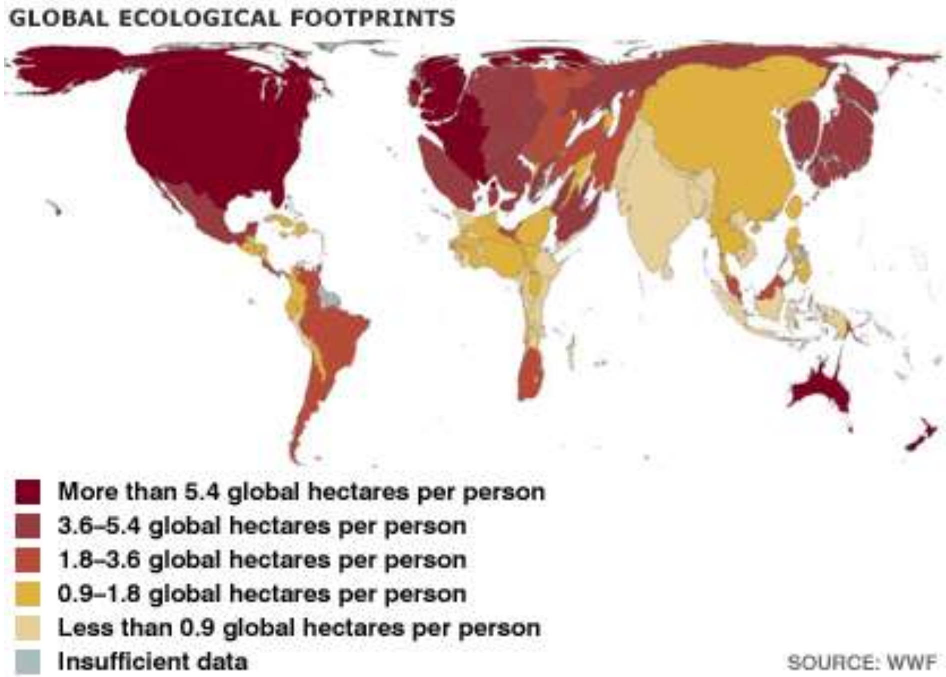


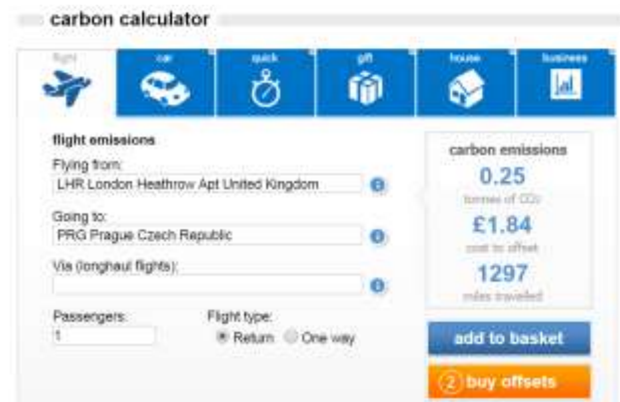
Figure x. Humanity's Ecological Footprint, 1961-2006

Source: Global Footprint Network, National Footprint Accounts, 2009 Edition.

We must develop conservation strategies for the world where everybody is (reasonably) rich



Voluntarily sustainable life styles failed to gain mass following or turned into a farce: e.g. pay GBP1.84 carbon credit for a Prague-London flight and – problem solved, conscience clear!



Ecological footprint: when fossil fuels (= past biosphere production) are included, we have already exceeded the planetary capacity

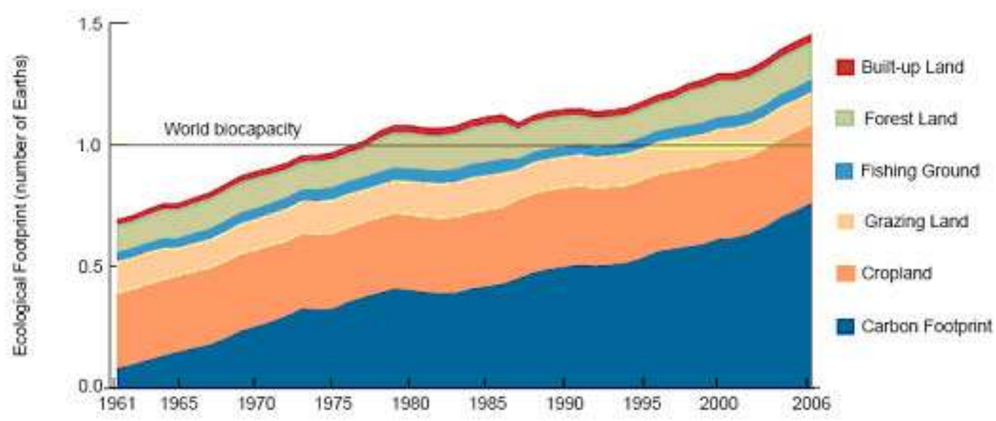
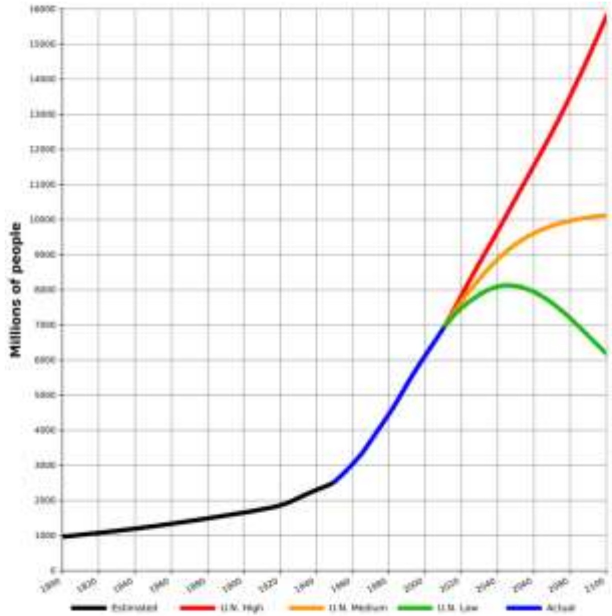
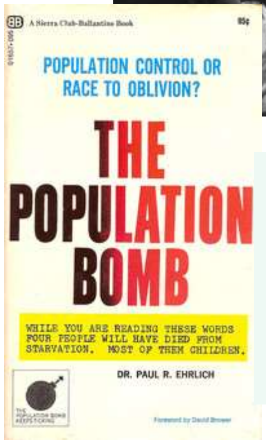


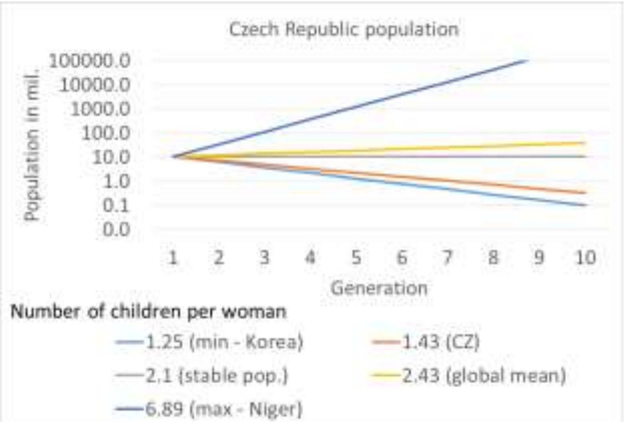
Figure x. Humanity's Ecological Footprint, 1961-2006

The population growth has been terrifying – but not any longer!



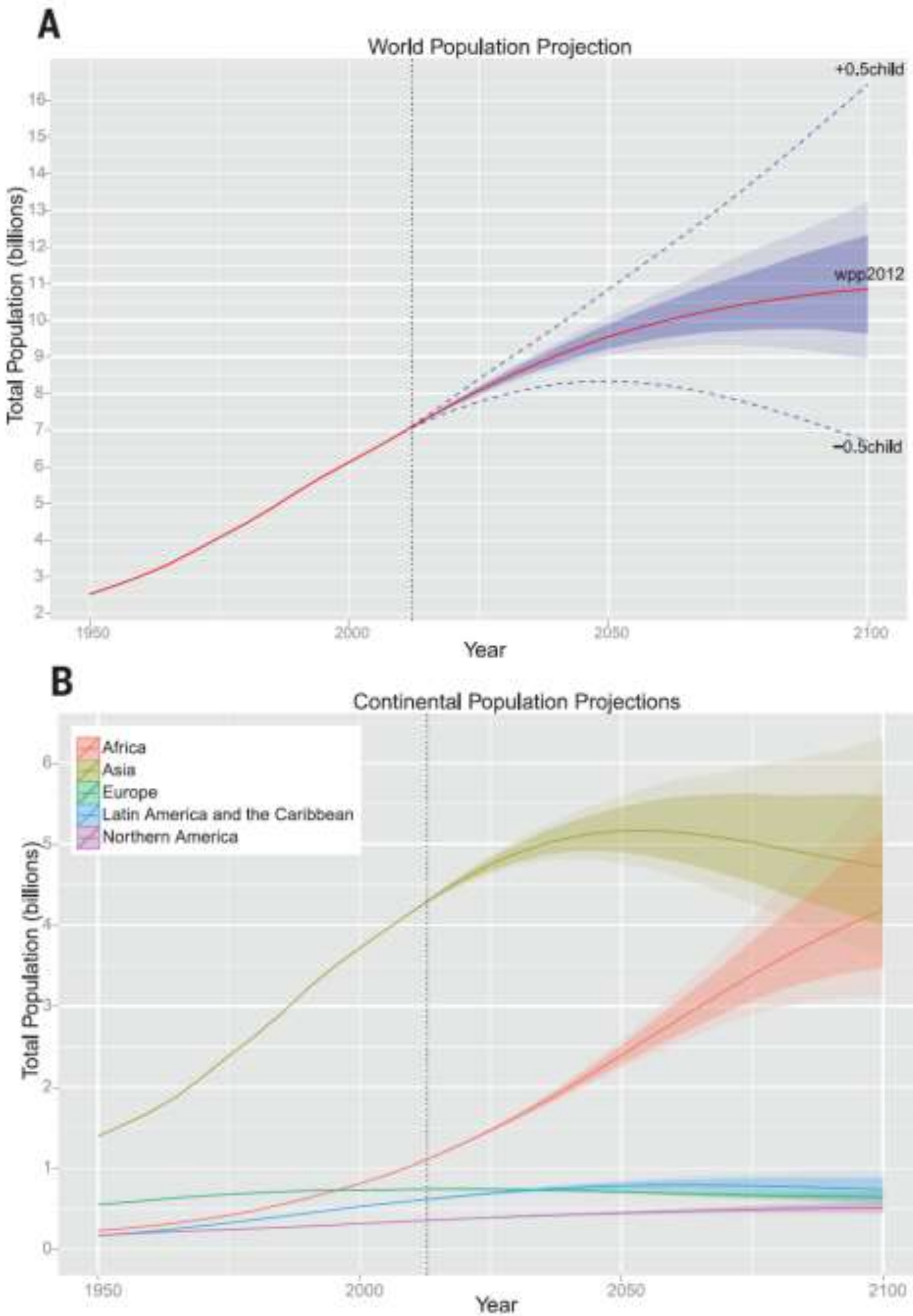
Population growth is **always** terrifying when extrapolated with constant fertility too far. There will be only 300,000 people in the Czech Republic 10 generations in the future at our current fertility (1.43 children per woman), 100,000 people at S. Korean fertility, but >100 billion people at Nigerian fertility….





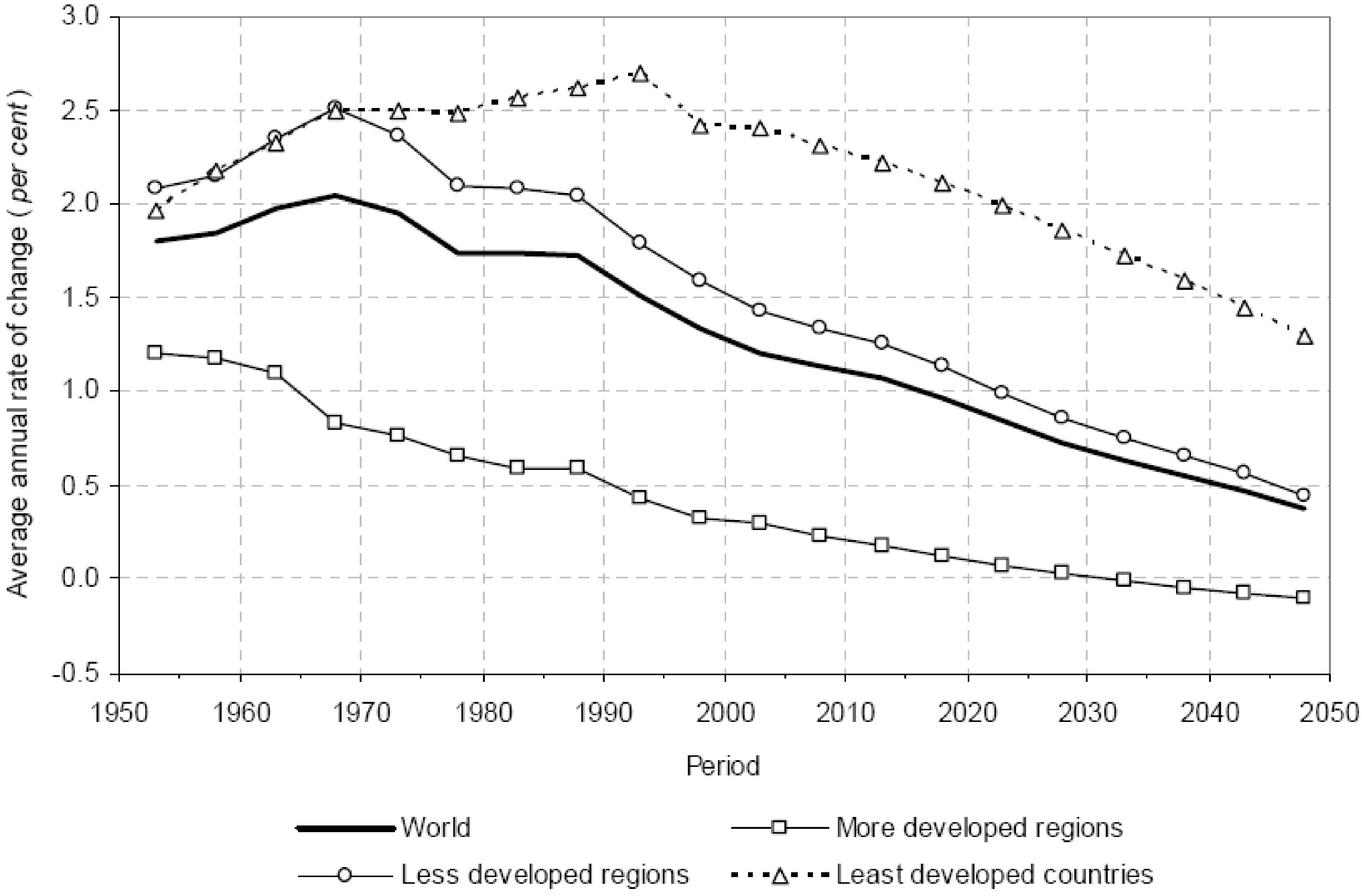
We failed to predict slowdown in exponential growth

Gerland et al. 2014. World population stabilization unlikely this century. Science 346: 234



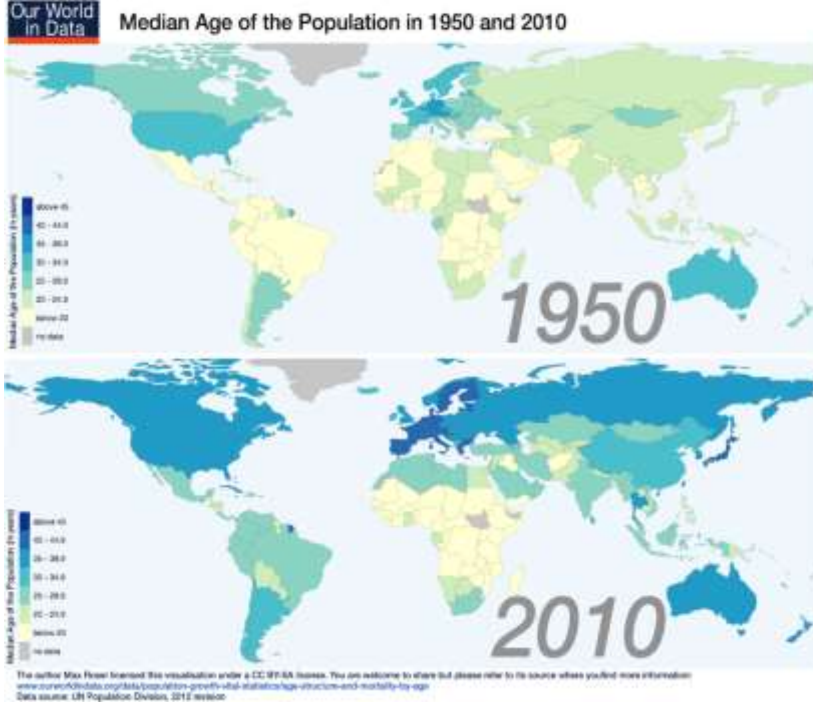
Growth in the 2nd half of the century will be driven entirely by Africa – but extrapolation from the current 1 billion people in Africa to 4 billions less than 100 years from now is highly uncertain

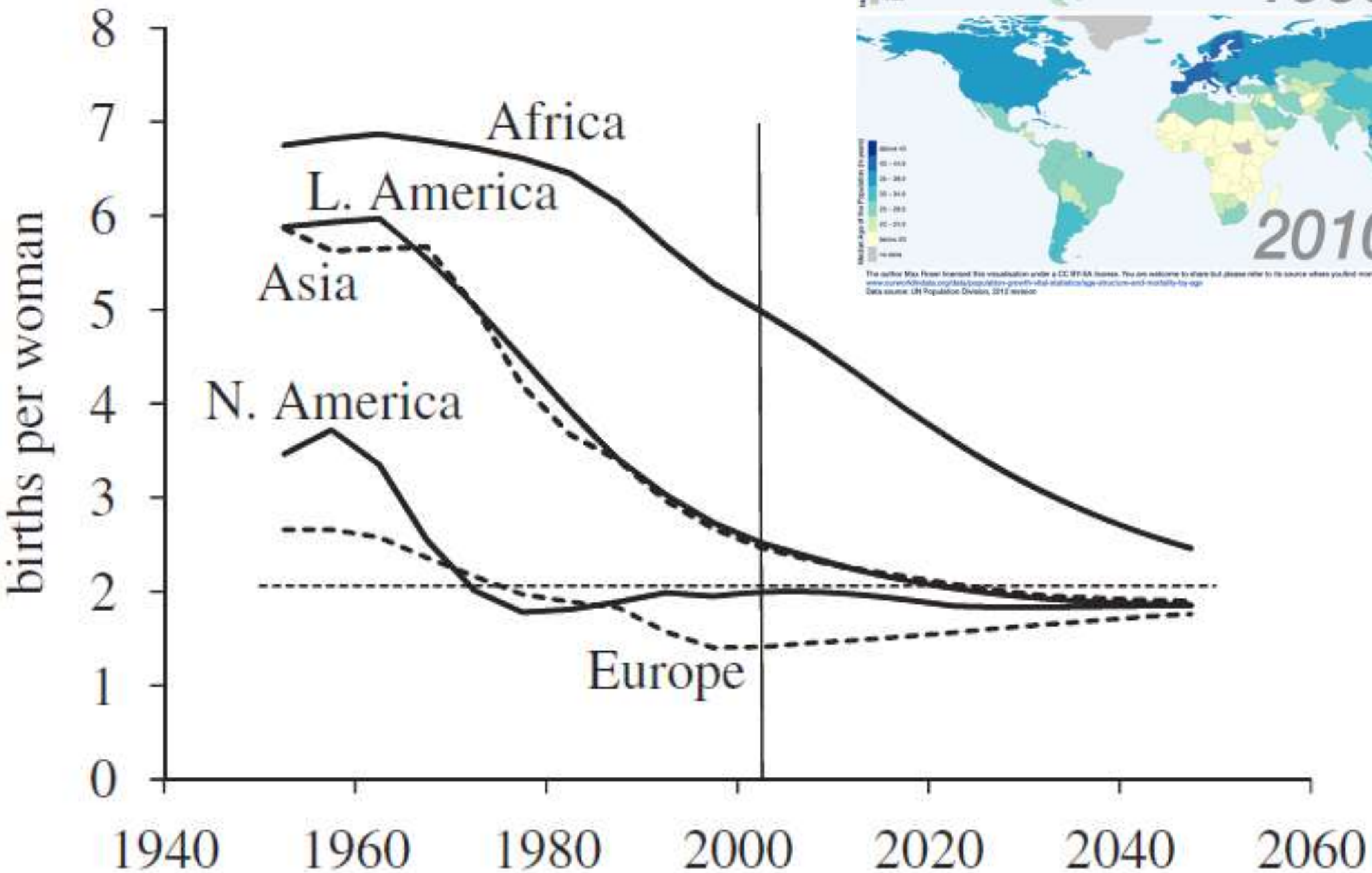
Global population: still growing, but at steadily diminishing rate



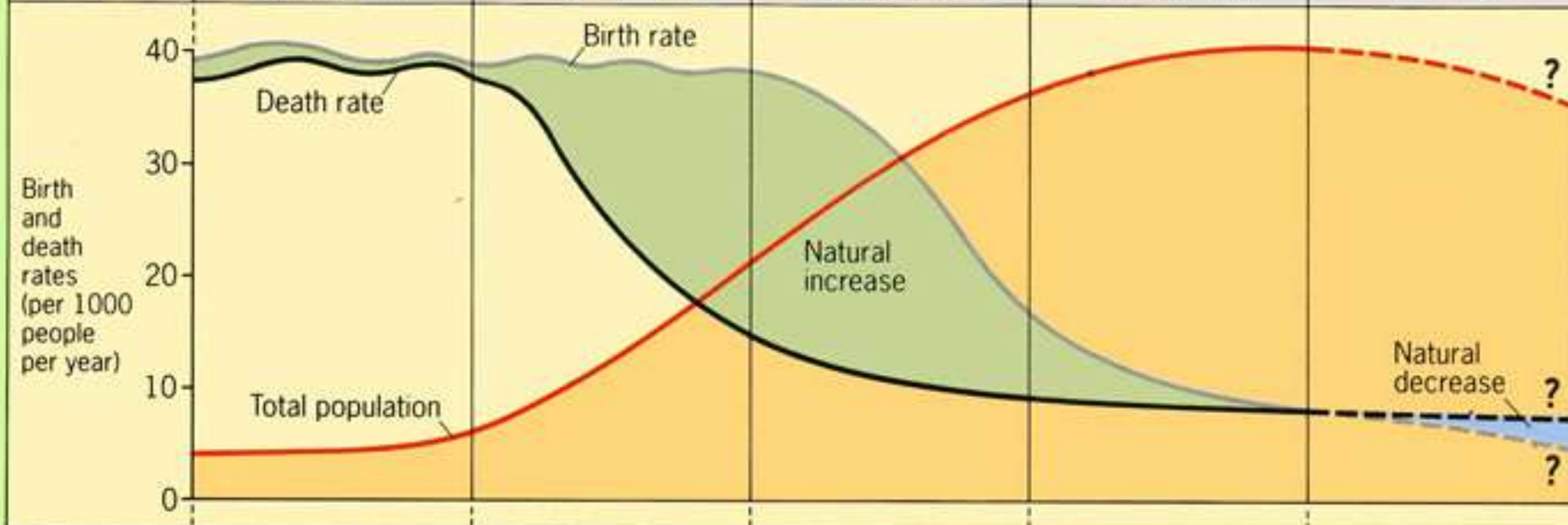
Constant population requires 2.1 births per woman

Population still growing in Asia and S. America, but already aging there – only Africa does not age





Demographic transition



Stage	1 High stationary	2 Early expanding	3 Late expanding	4 Low stationary	5 ? Declining?
Examples	A few remote groups	Egypt, Kenya, India	Brazil	USA, Japan France, UK	Germany
Birth rate	High	High	Falling	Low	Very low
Death rate	High	Falls rapidly	Falls more slowly	Low	Low
Natural increase	Stable or slow increase	Very rapid increase	Increase slows down	Stable or slow increase	Slow decrease
Reasons for changes in birth rate	Many children needed for farming. Many children die at an early age. Religious/social encouragement. No family planning.		Improved medical care and diet. Fewer children needed.	Family planning. Good health. Improving status of women. Later marriages.	
Reasons for changes in death rate	Disease, famine. Poor medical knowledge so many children die.	Improvements in medical care, water supply and sanitation. Fewer children die.		Good health care. Reliable food supply.	

Demographic transition (Mauritius)

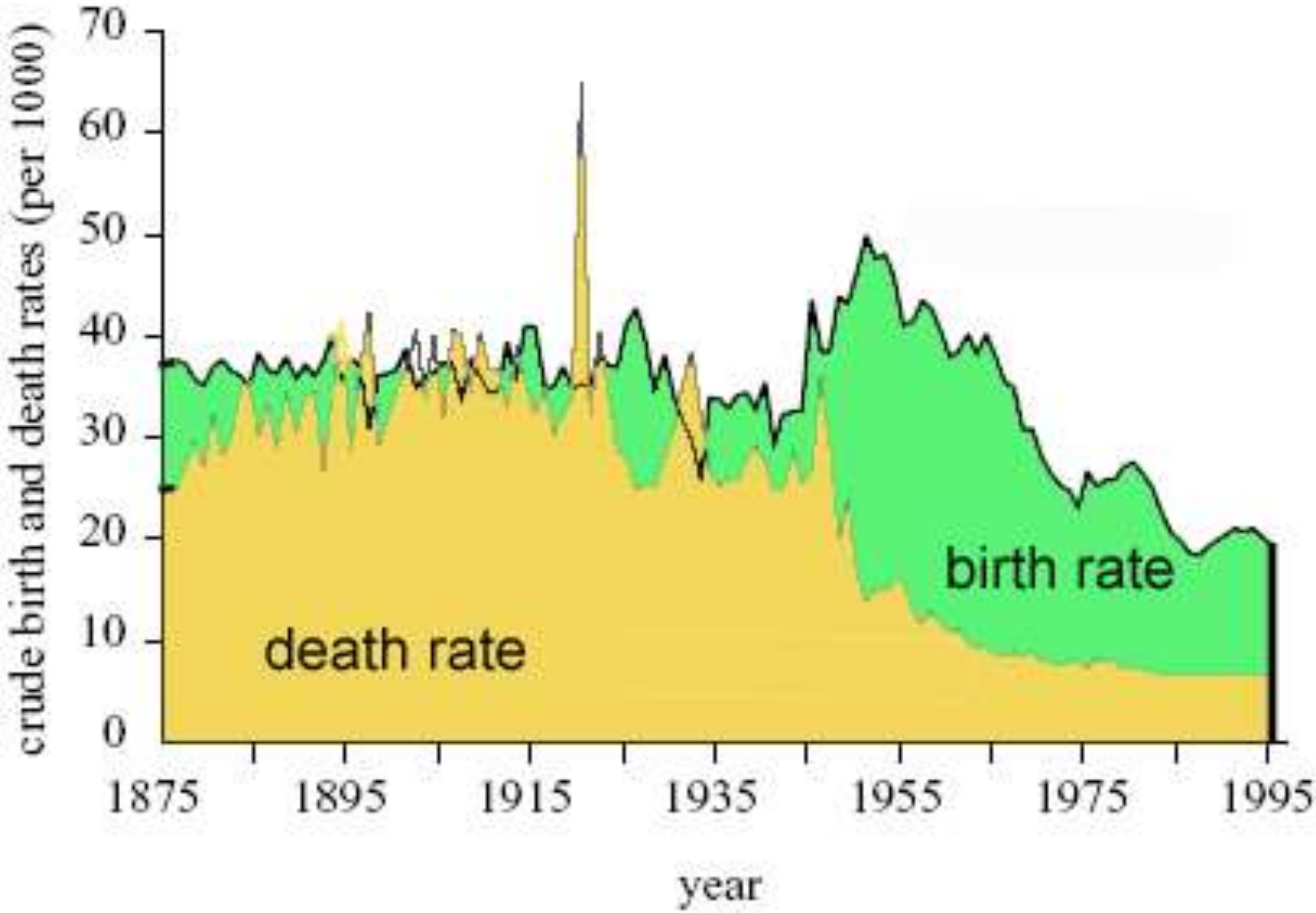
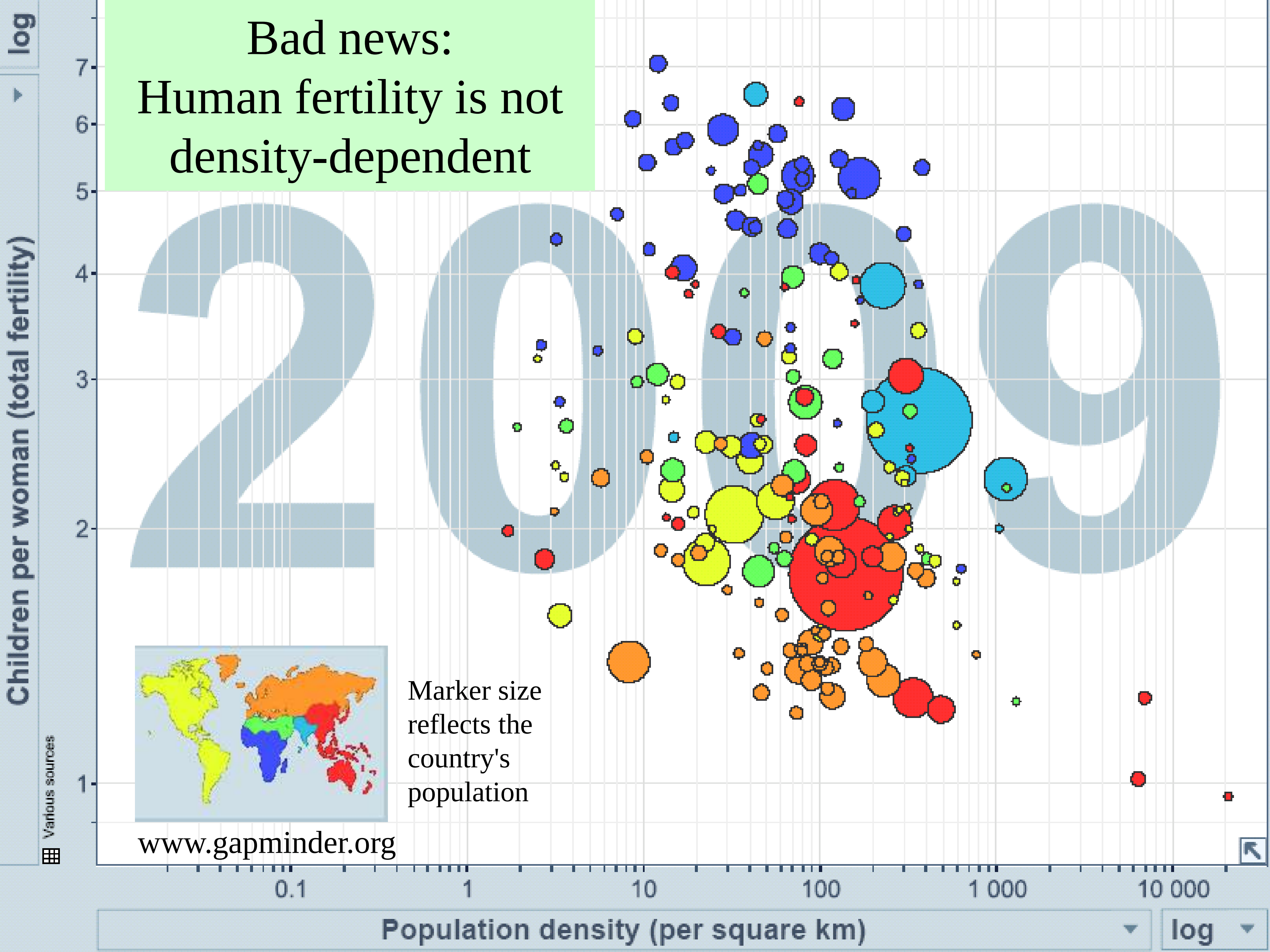
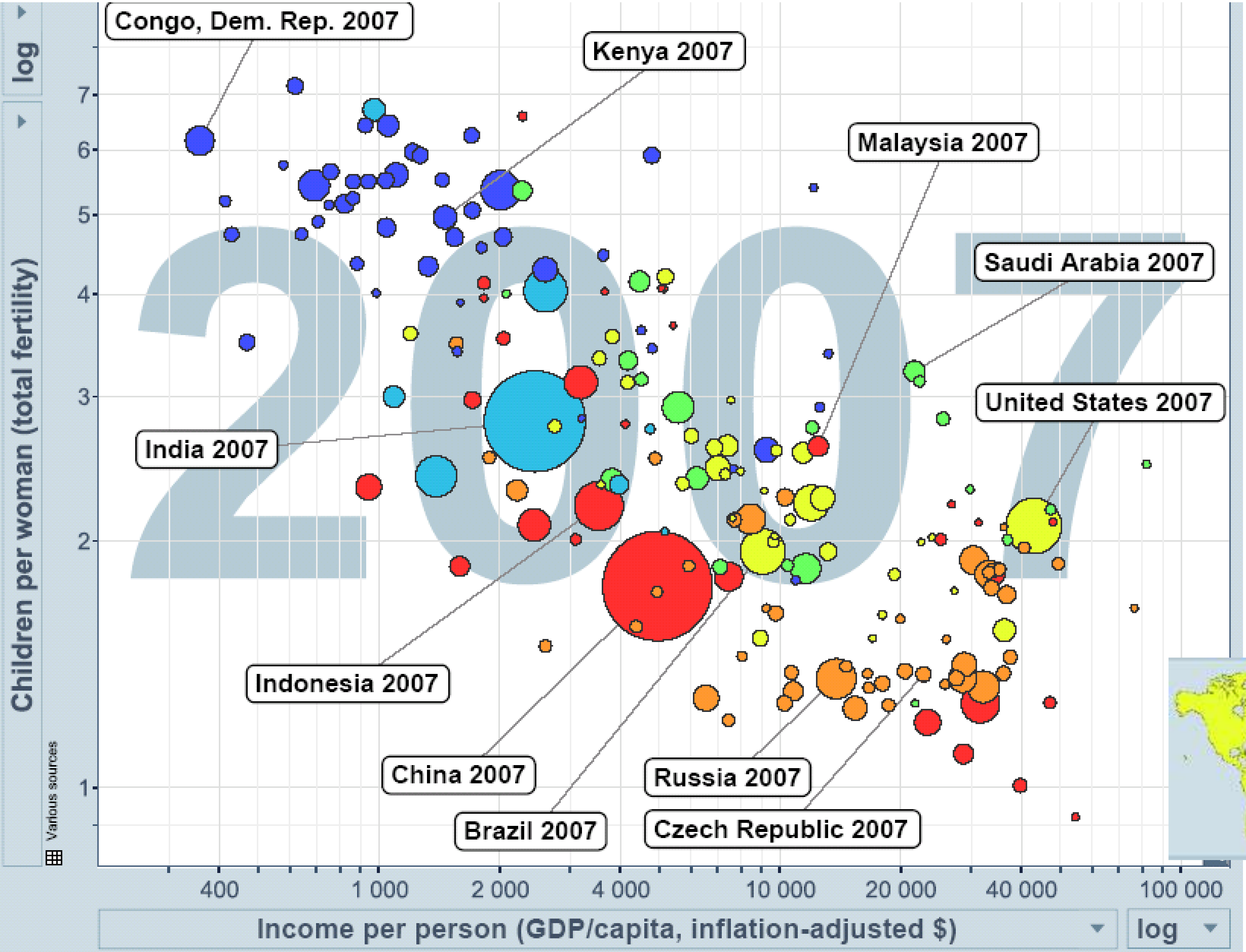


Figure 1. Birth and death rates in Mauritius since 1871. Grey line, crude death rate; black line, crude birth rate.

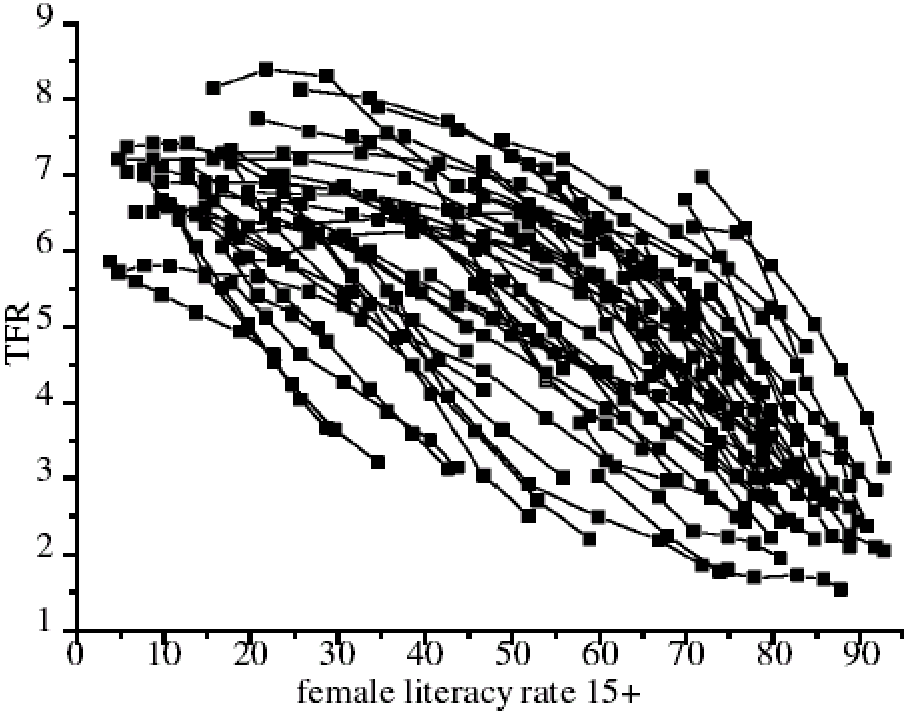
Bad news: Human fertility is not density-dependent



Life-time fertility of women decreases with income



Marker size reflects the country's population



Total fertility rate (children per female) related to female literacy rate and to per capita GDP: time series for different countries

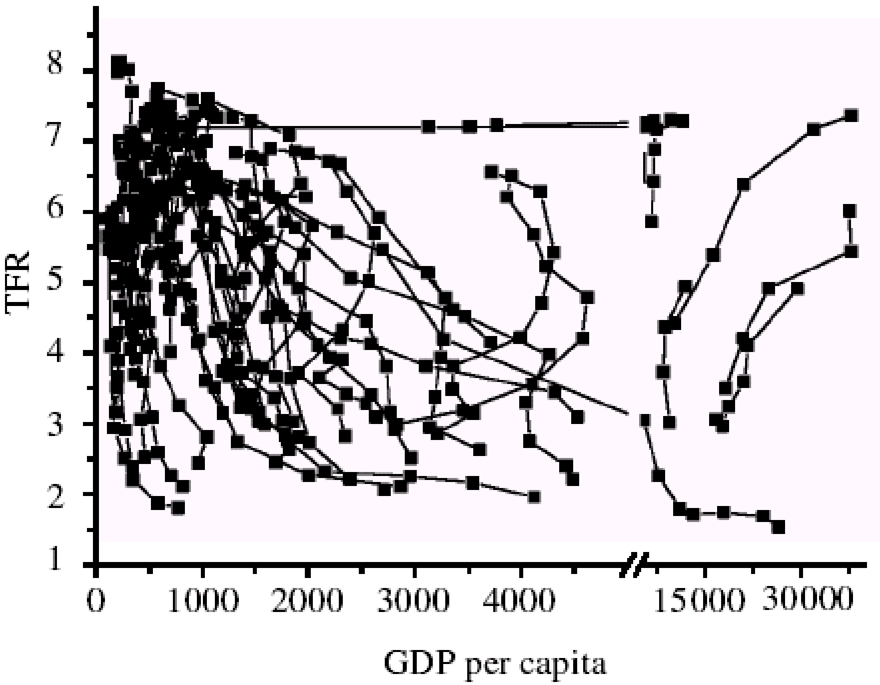
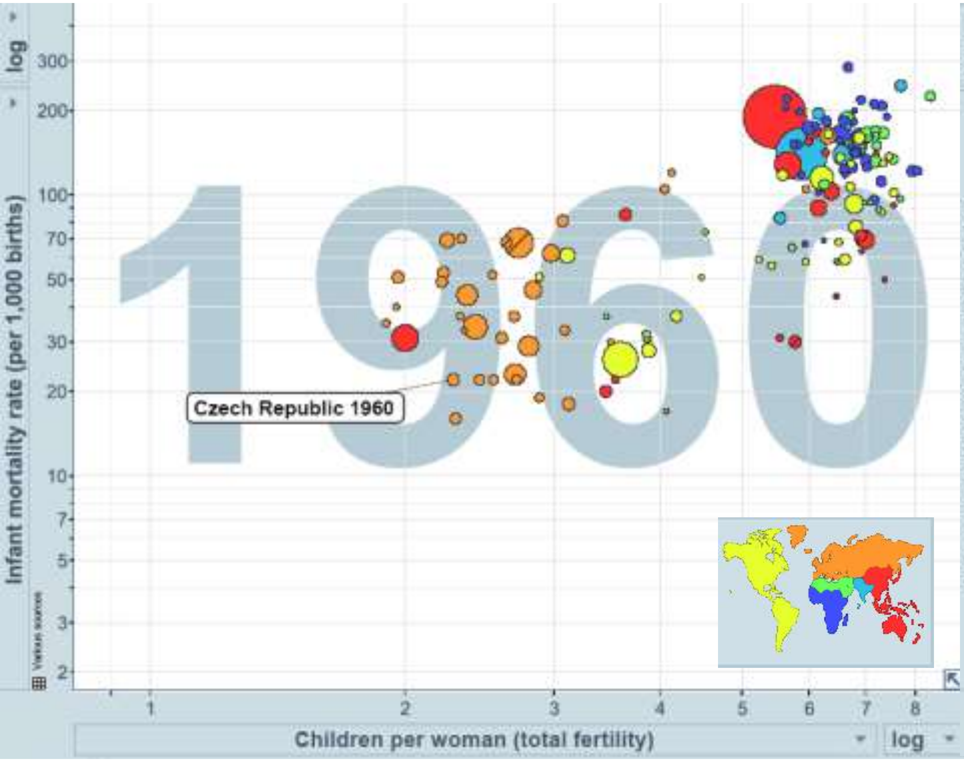


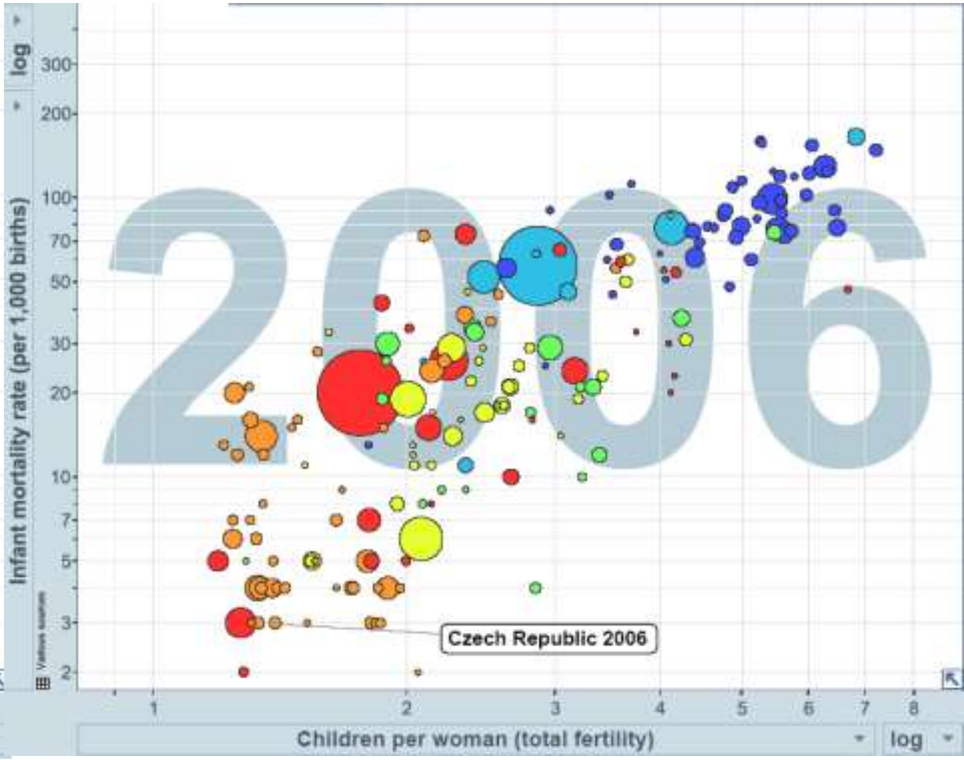
Figure 5. Bivariate relationship between literacy rates for females aged 15+ and total fertility rates for time-series of 65 developing countries, 1960–2000. Each line corresponds to the time-series of one country.

Figure 6. Bivariate relationship between GDP per capita (constant 1995 US$) and total fertility rate in 55 developing countries (same countries as in figure 5 with available income data), 1960–2000. Each line corresponds to the time-series of one country.

Lutz & Quiang 2002

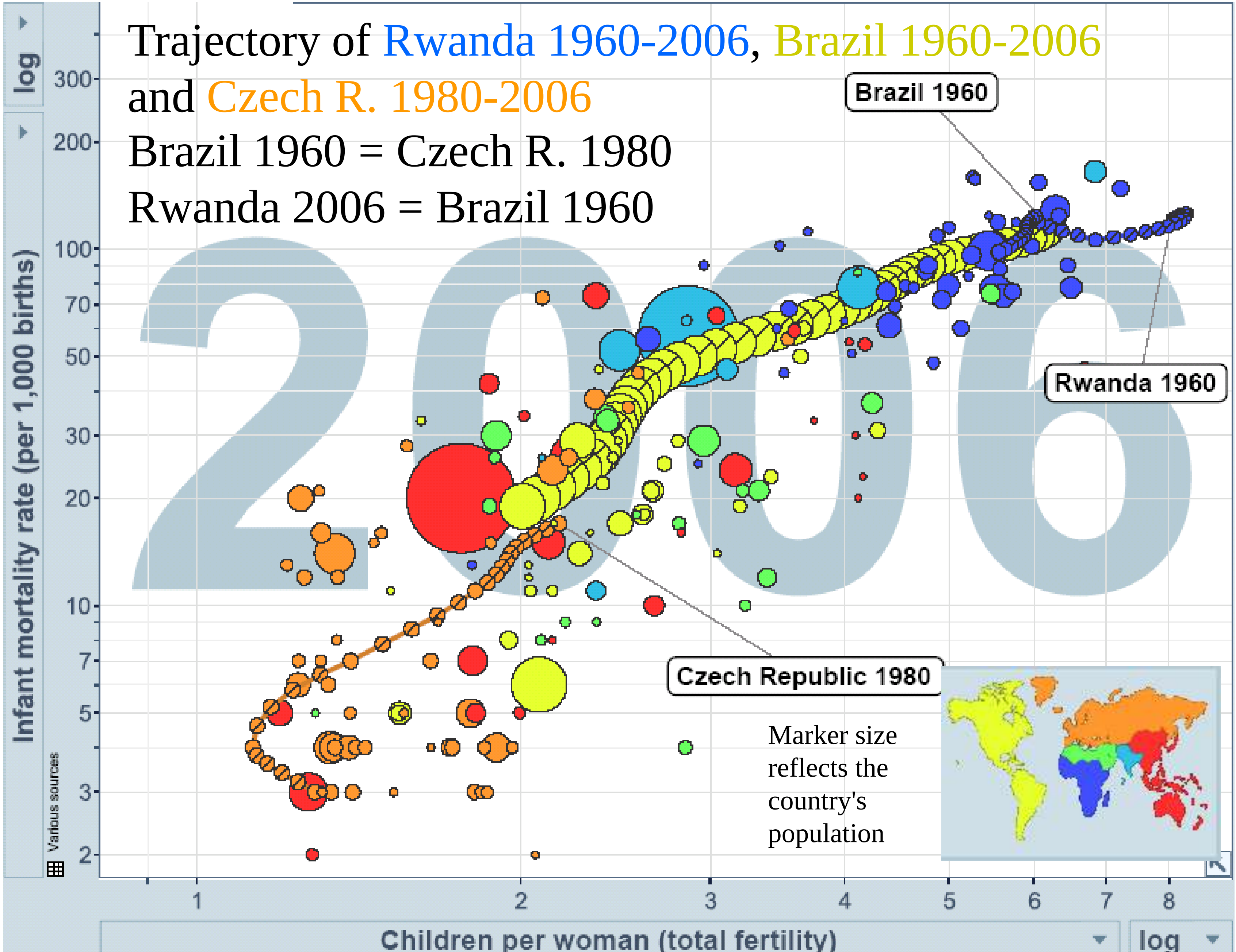
Life-time fertility is correlated with infant mortality



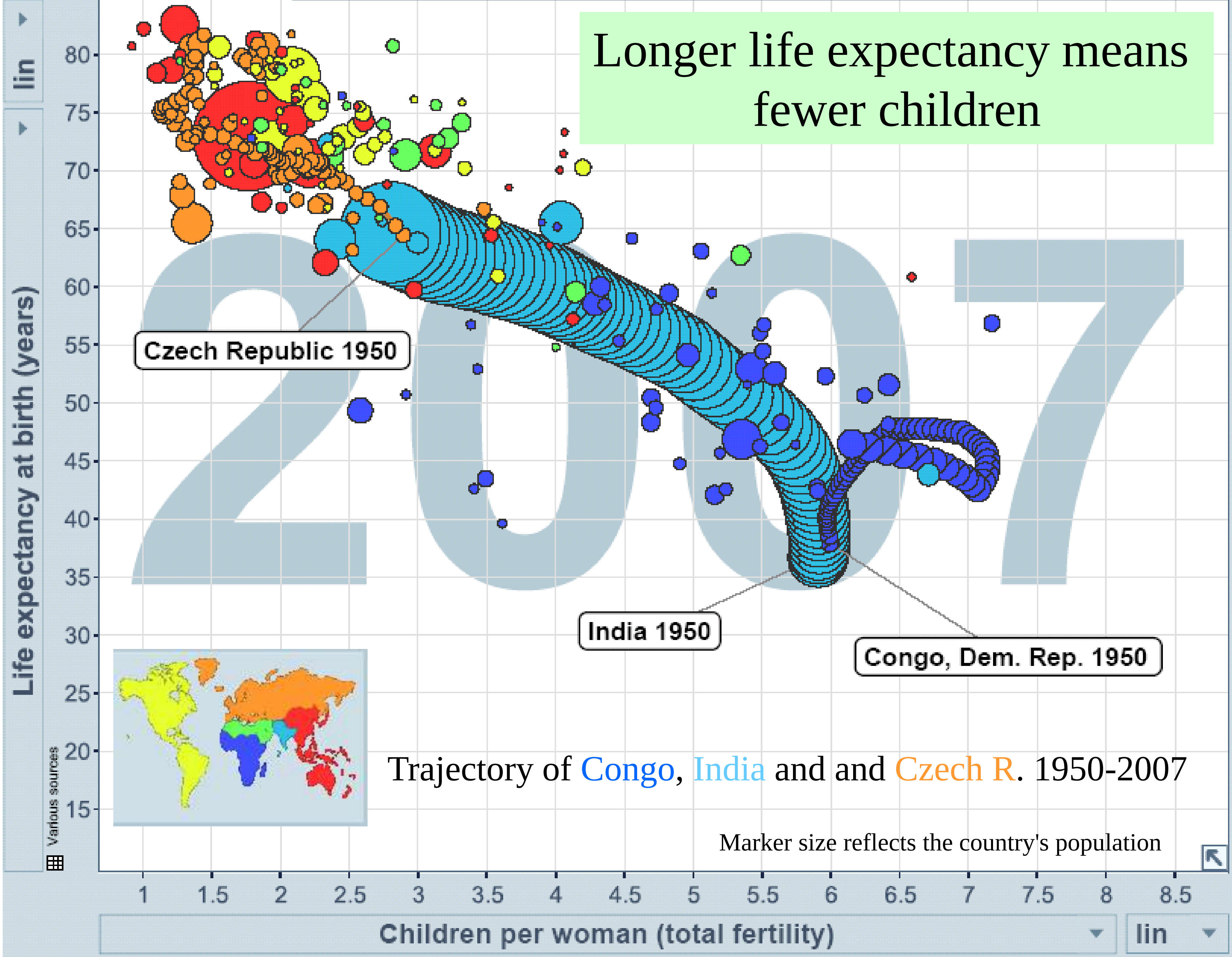


Demographic transition 1960 ------> 2006

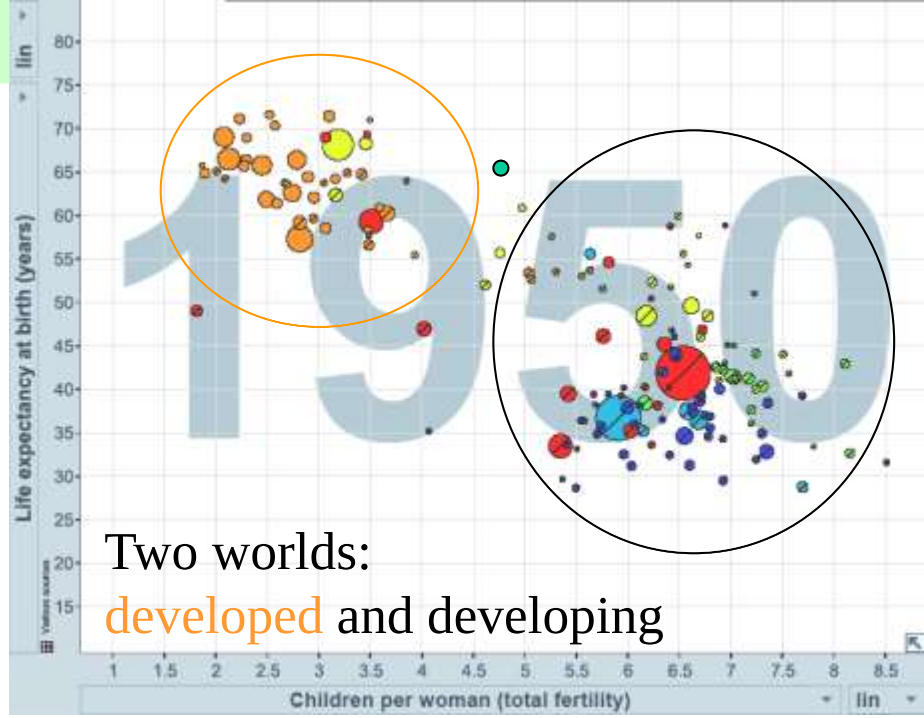
Life-time fertility is correlated with infant mortality

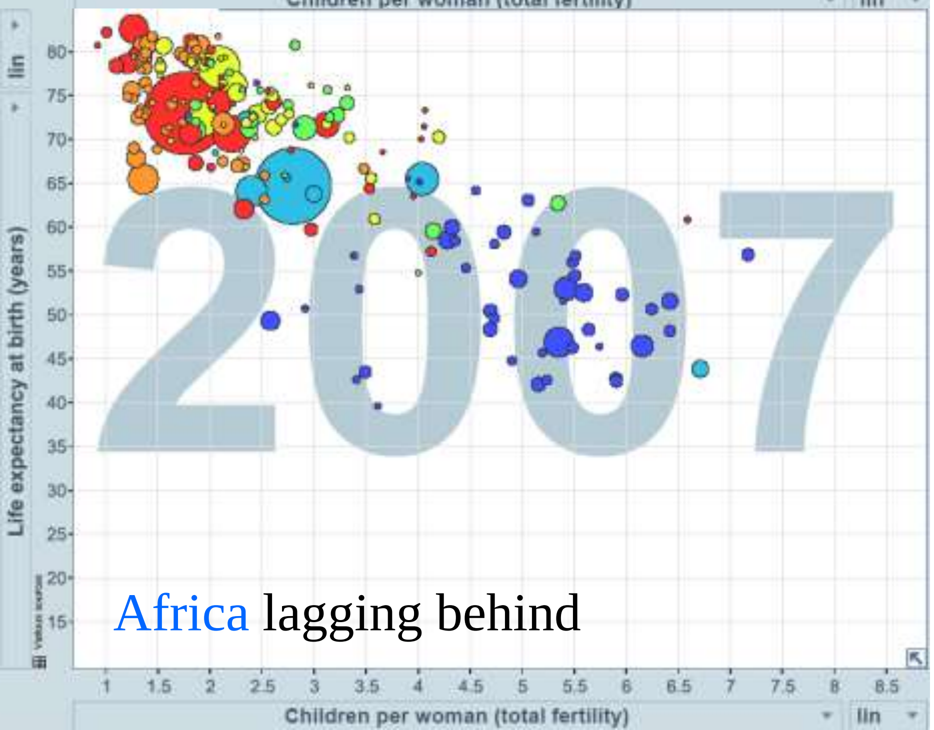


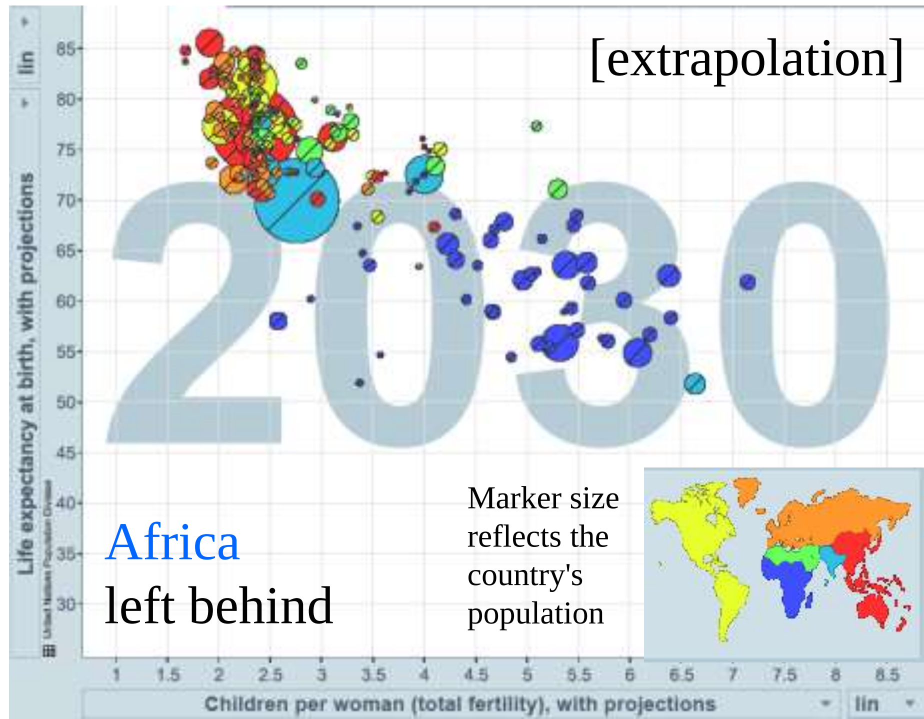
Longer life expectancy means fewer children

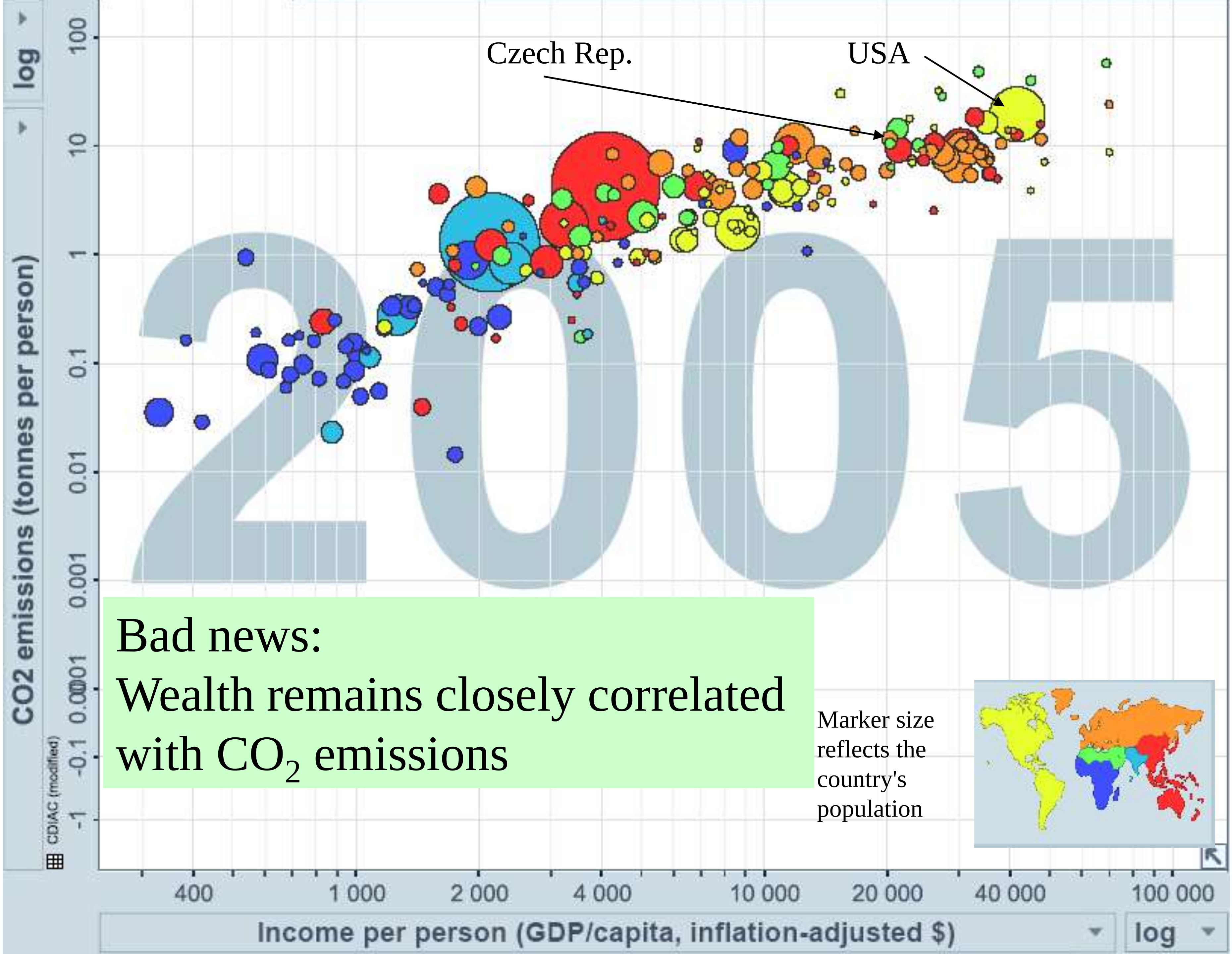


Long living people have fewer children

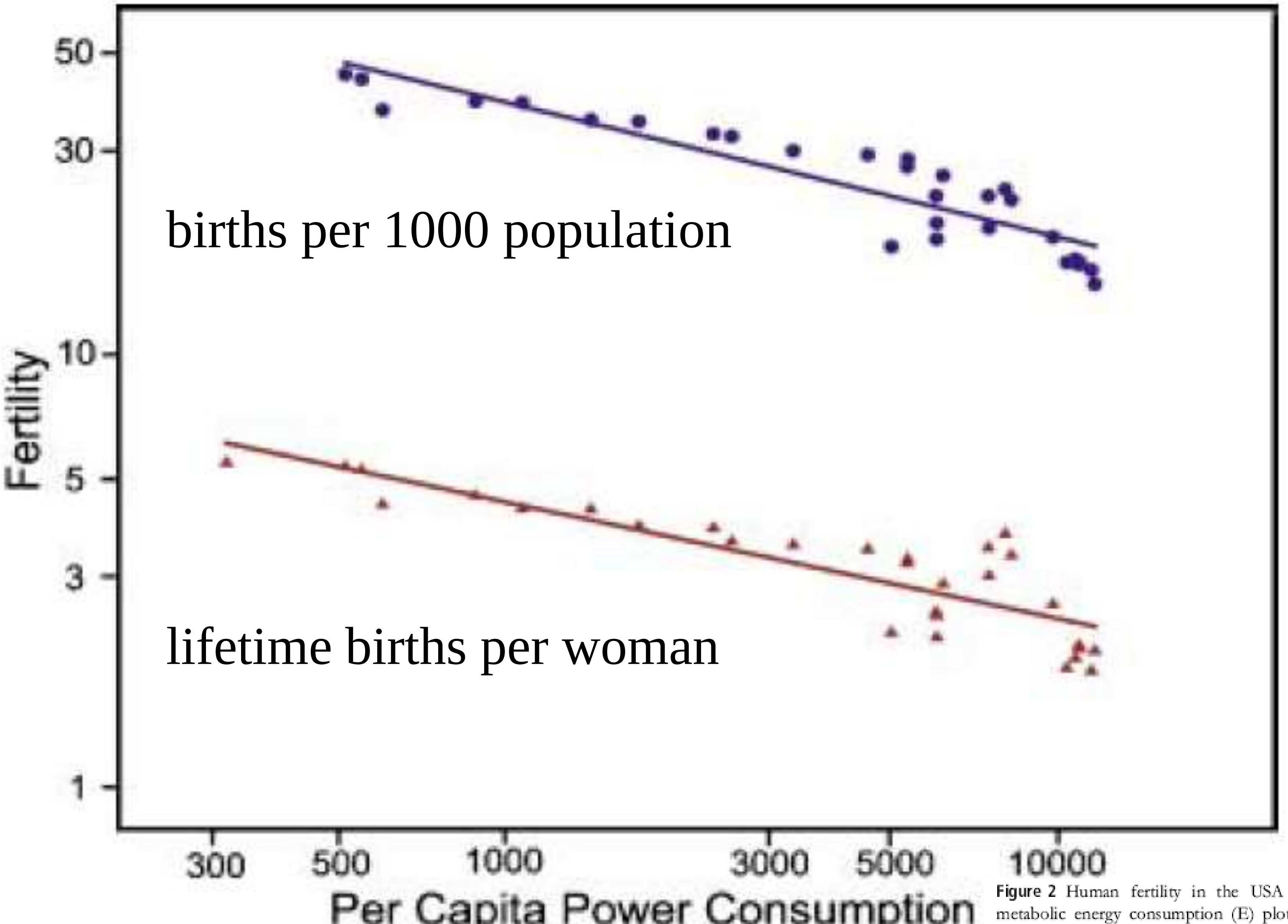







Czech Rep.
USA
2005
CO2 emissions (tonnes per person)
log
100
10
1
0.1
0.01
0.001
0.0001
0.0
-0.1
-1
CDIAC (modified)
400
1 000
2 000
4 000
10 000
20 000
40 000
100 000
Income per person (GDP/capita, inflation-adjusted $)
log
Bad news:
Wealth remains closely correlated with CO_2 emissions
Marker size reflects the country's population

Population growth rate is determined by energy consumption!

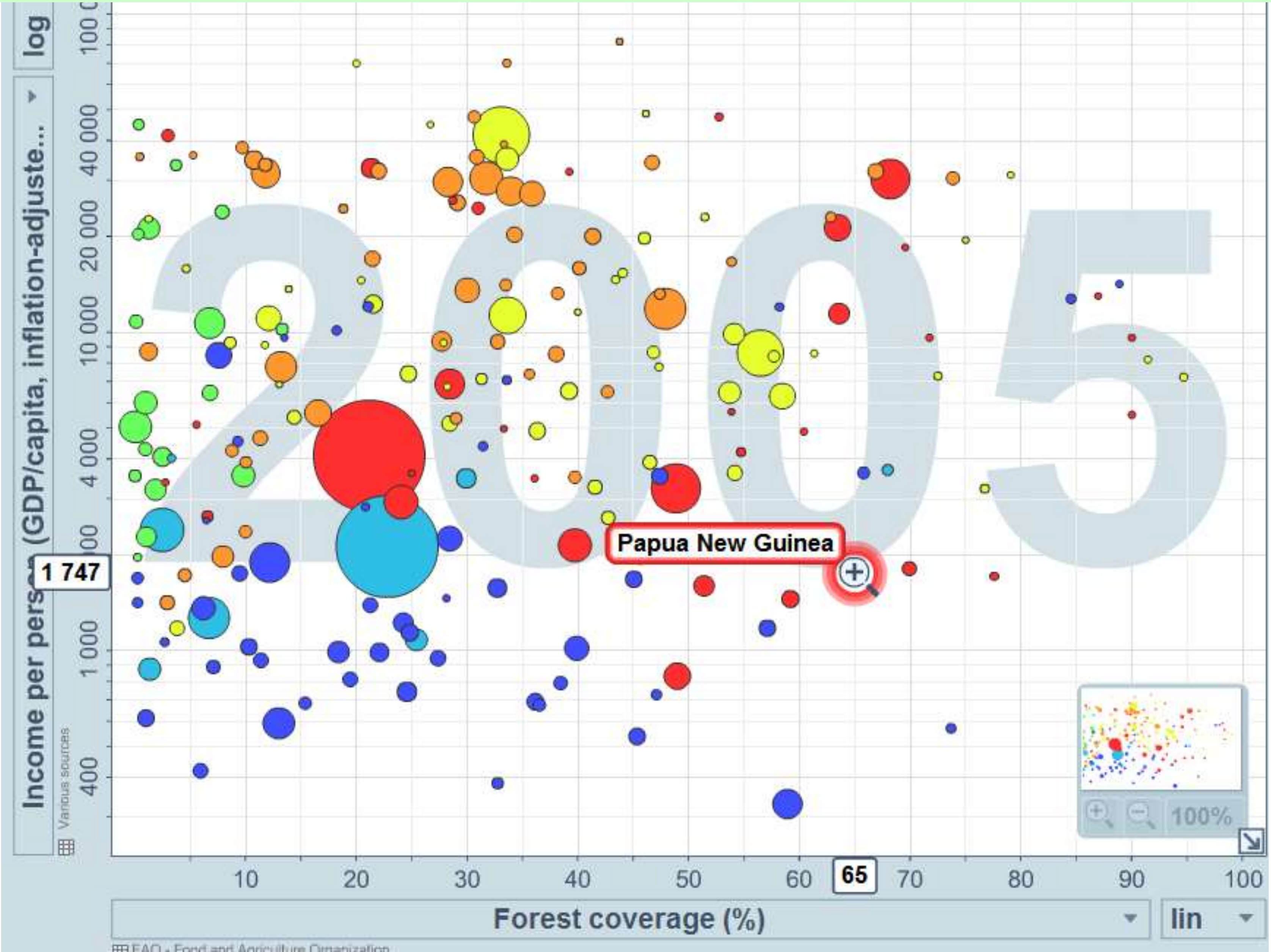


USA from 1850 to 2000

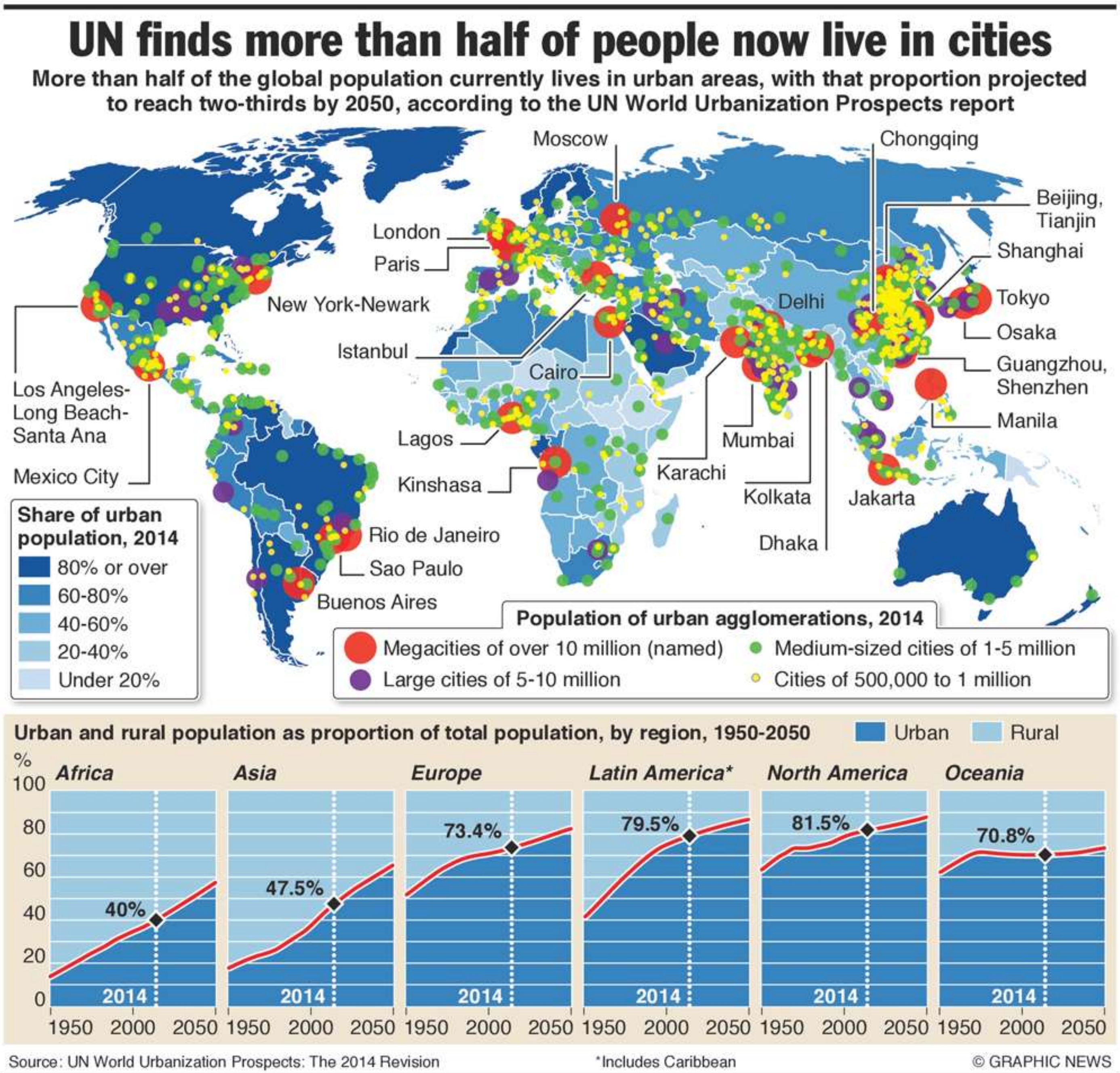
Figure 2 Human fertility in the USA as a function of extra-metabolic energy consumption (E) plotted on logarithmic axes. Data represent five-year intervals from 1850 through 2000. Circles represent crude fertility rate (births per thousand population) and triangles represent lifetime births per woman. The slope for crude fertility is −0.31 ($r^2 = 0.83$) and for total fertility is −0.27 ($r^2 = 0.76$).

Moses & Brown 2003

No correlation between wealth and forest cover: cutting forests does not necessarily make you rich



Good news for nature: people are increasingly living in cities

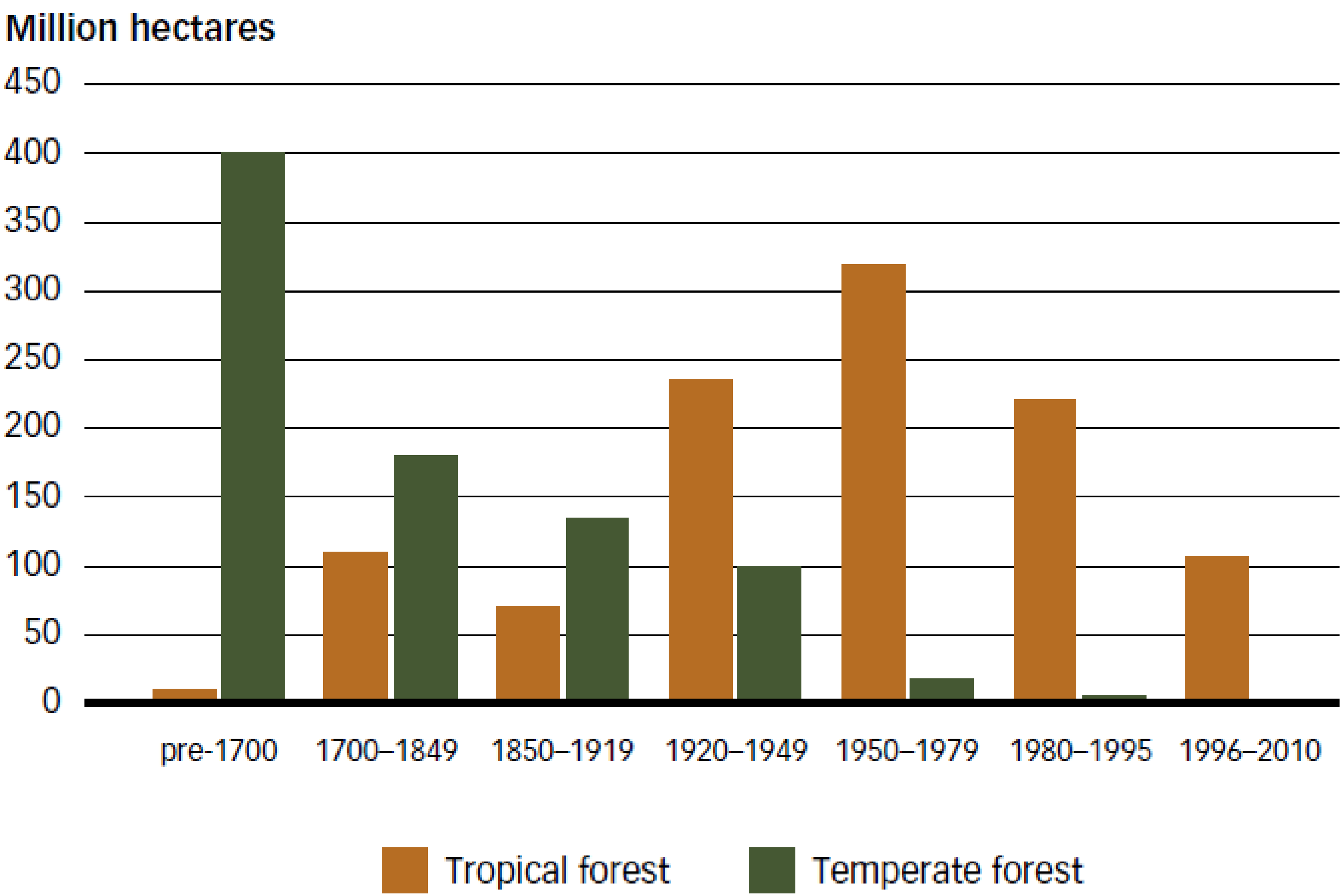


Good news for nature: people are increasingly living in cities

Tokyo (above), Trantor (right)

And now for something completely different:
habitat conservation

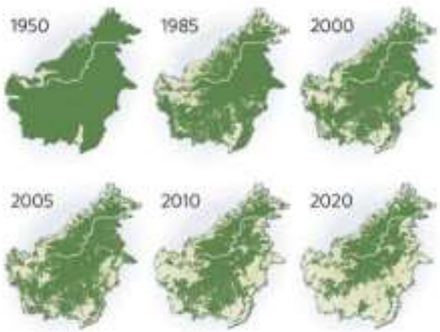
Figure 2: Estimated deforestation, by type of forest and time period



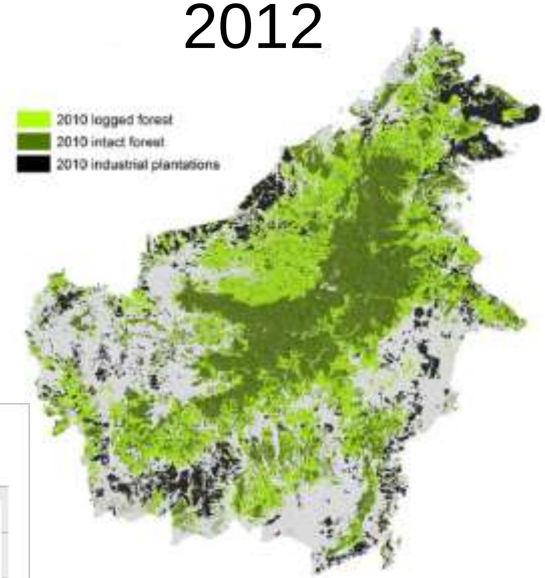
Source: Estimates based on Williams, 2002; FAO, 2010b.

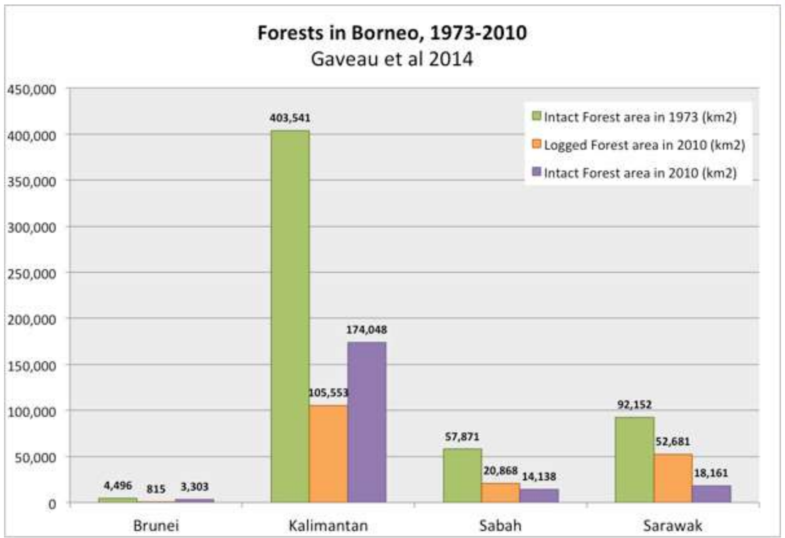
Borneo forests: in 1950 – 1973 – 2010 – 2012

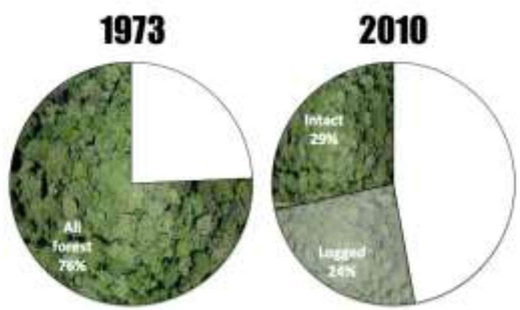
Borneo (extrapolated to 2020)

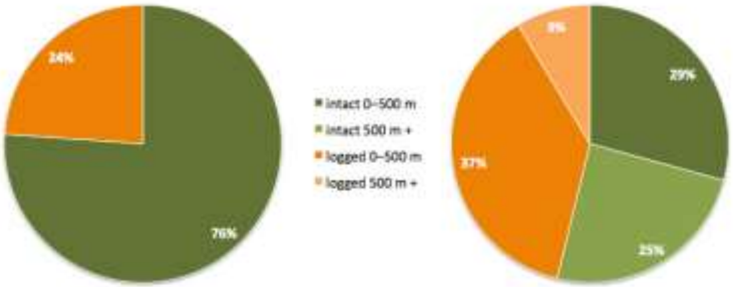


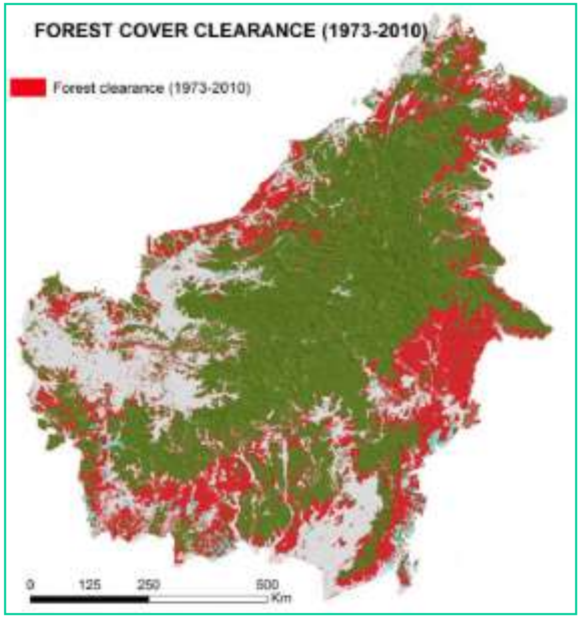
2012





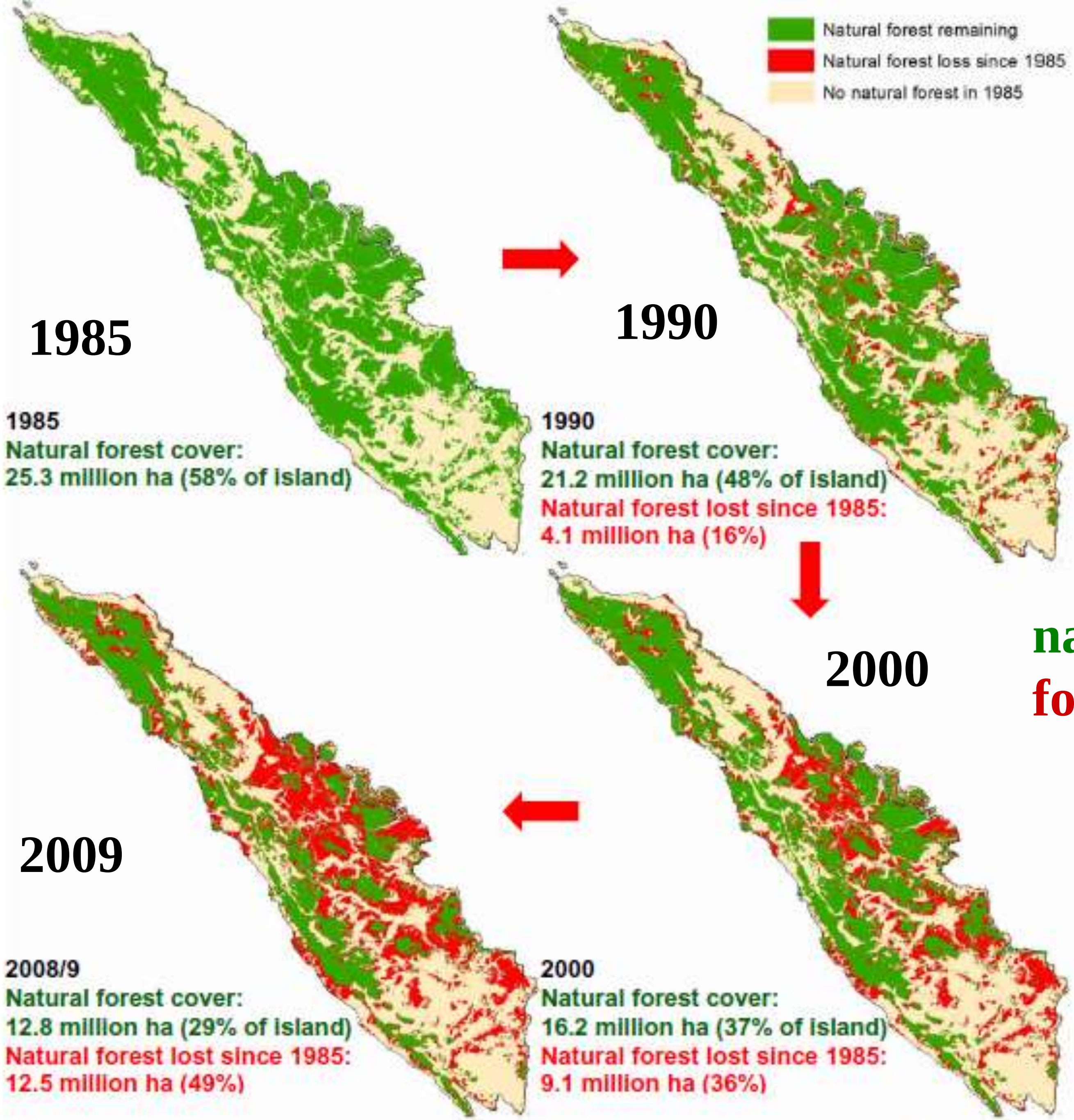






Gaveau et al. 2014

Sumatra



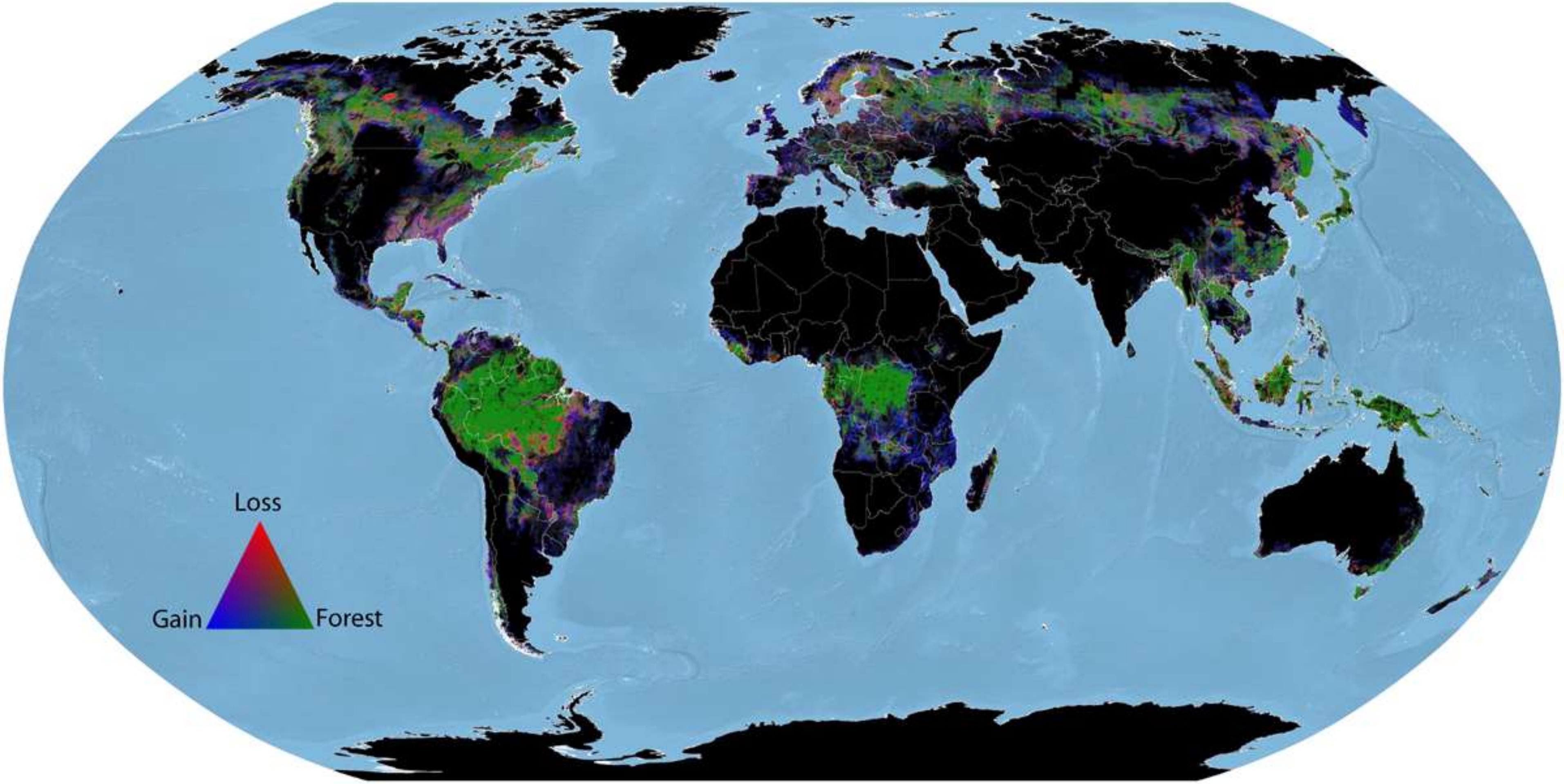
Map 4 a to d.—*Natural forest in Sumatra in 1985, 1990, 2000 and 2008/9 (green) and lost since 1985 (red).*

natural forest

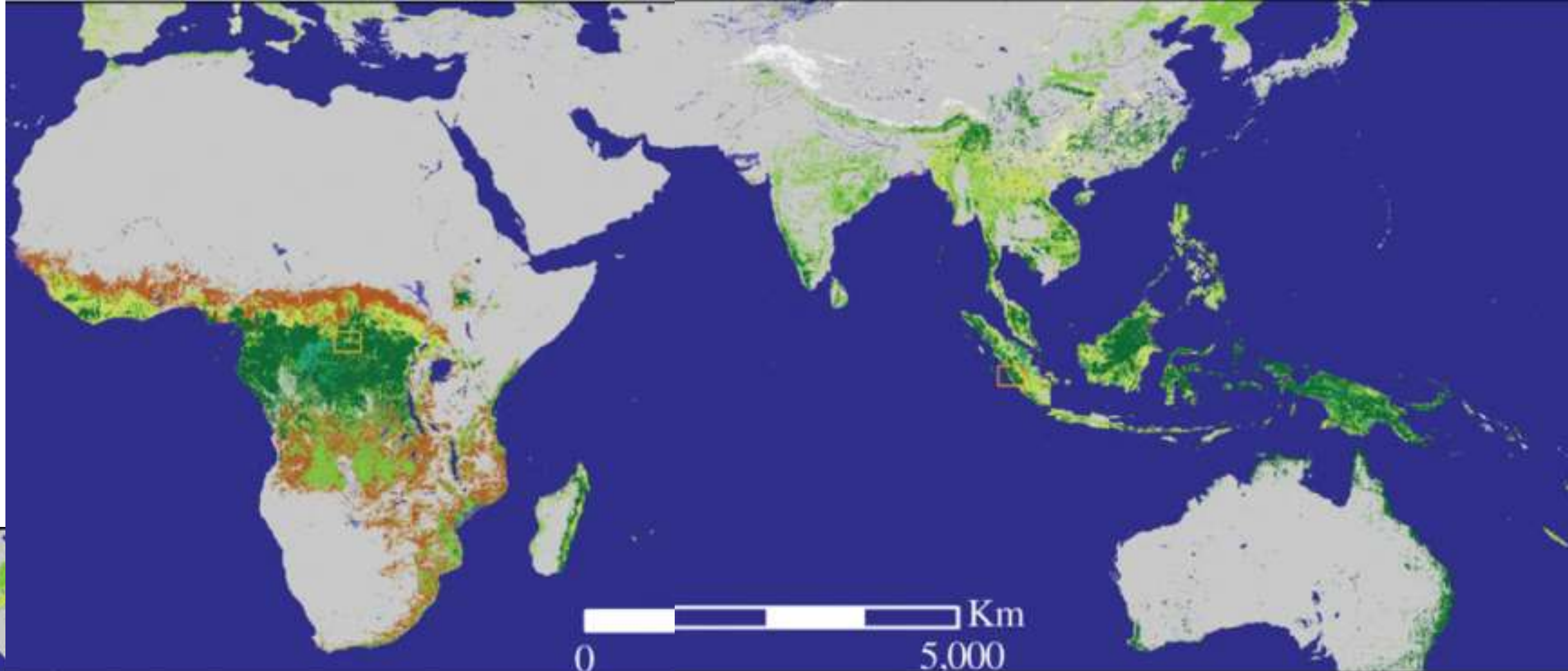
forest loss since 1985

WWF report on Sumatra, 2010

1990-2000

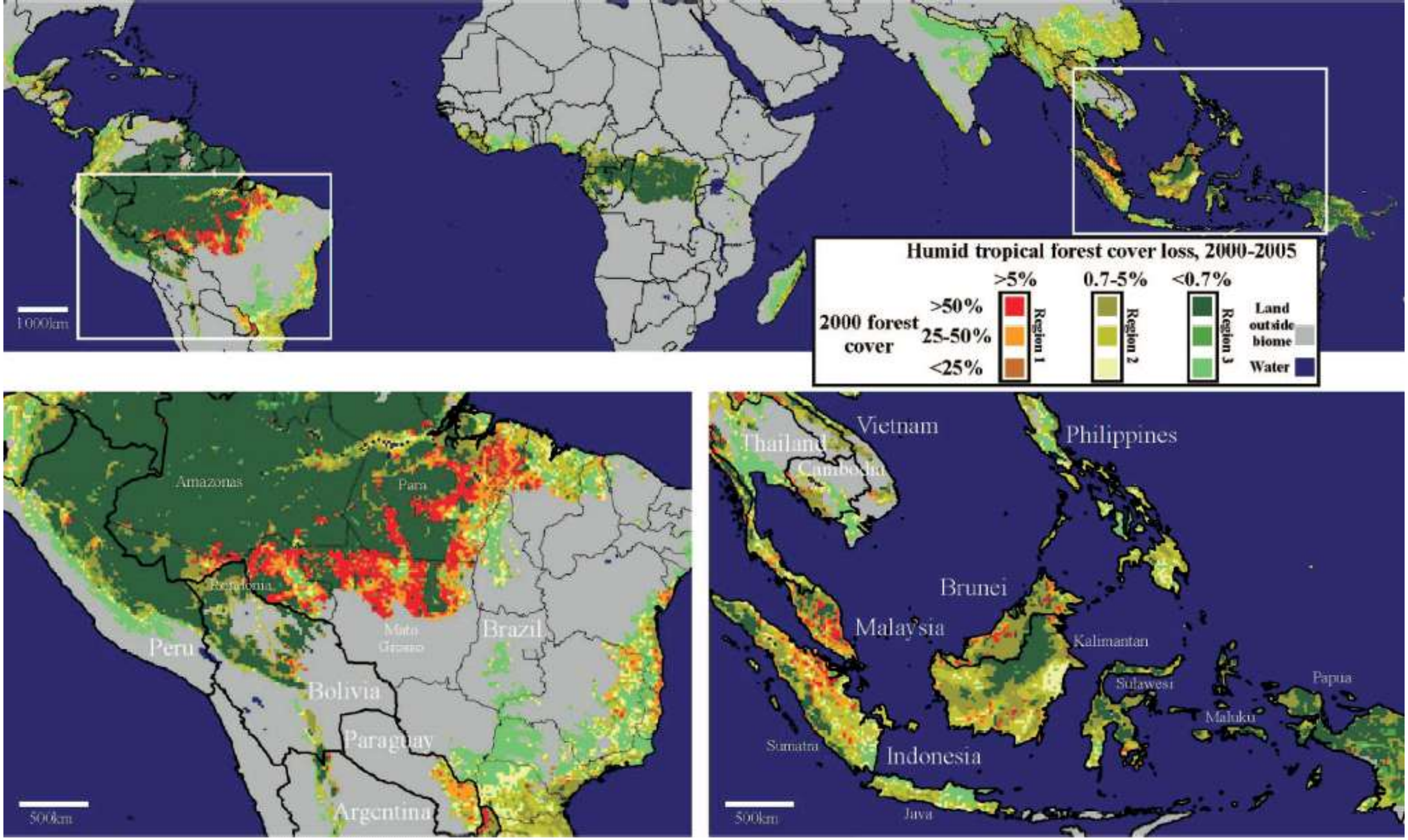


Kim et al. Remote Sensing of Environment DOI: 10.1016/j.rse.2014.08.017.



Current distribution of tropical forests

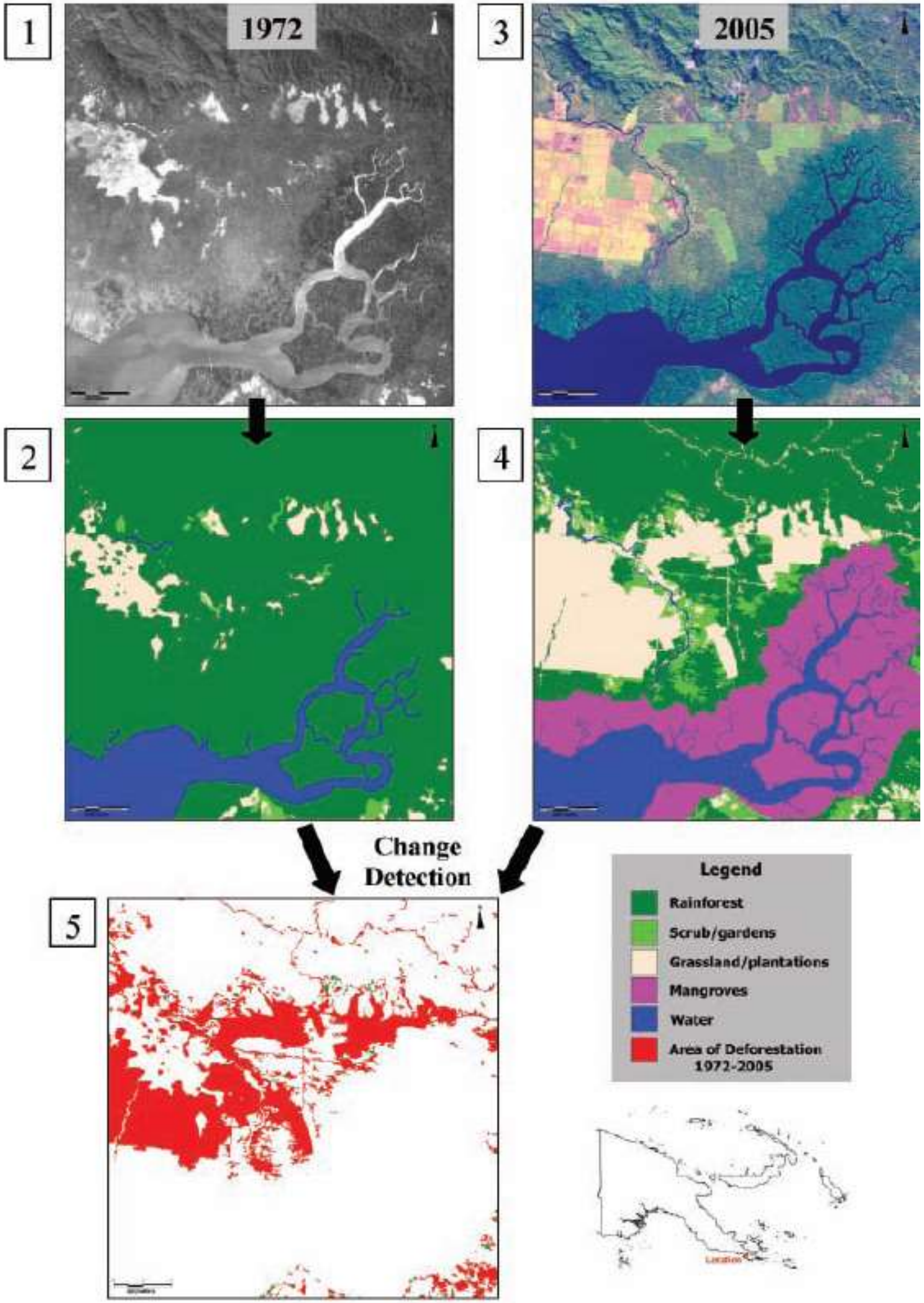
Mayaux et al., Phil. Trans. R. Soc. B (2005) 360, 373–384



Humid tropical forests cover loss 2000-2005

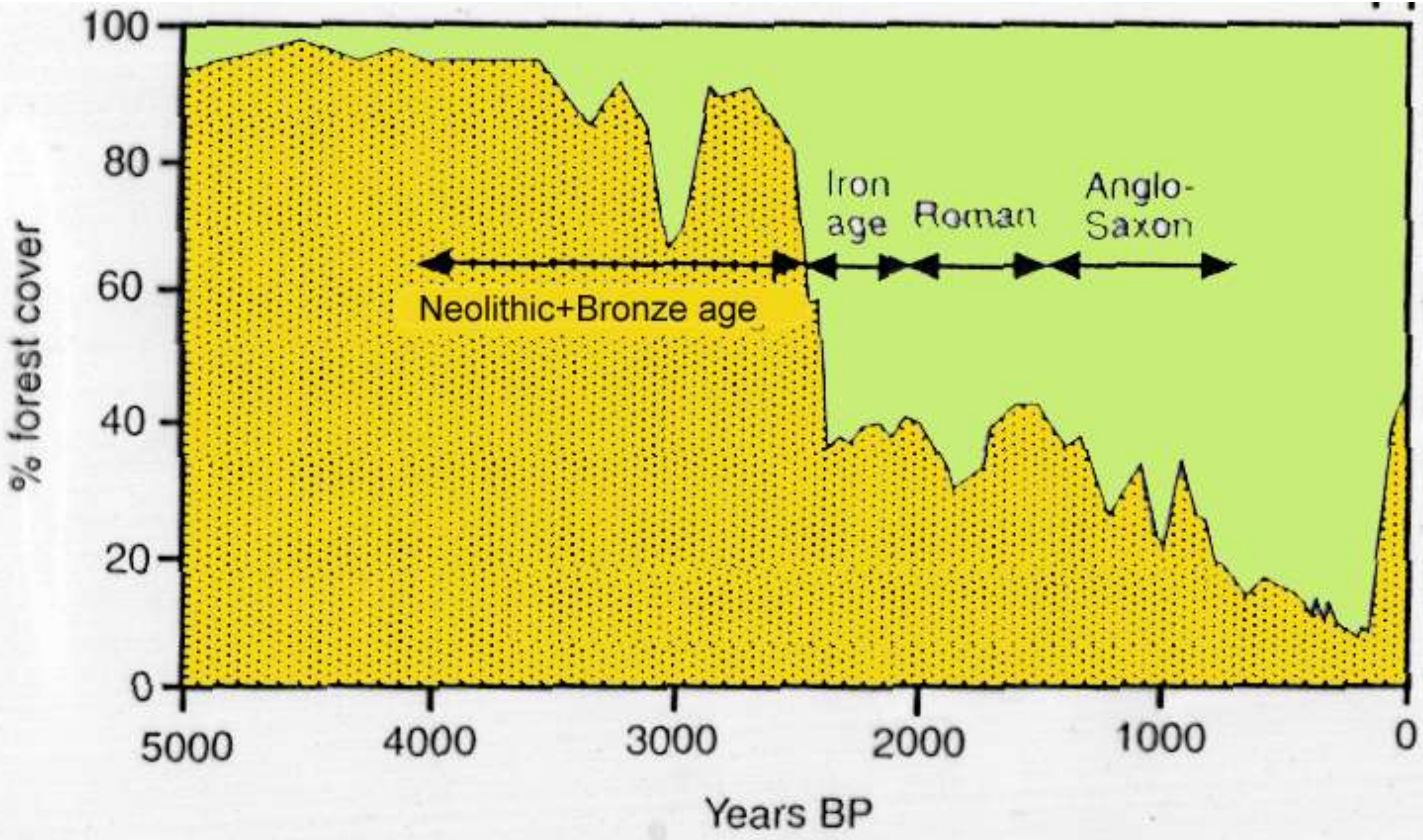
Hansent et al., PNAS 2008, 105: 9439–9444

How to monitor changes in vegetation cover



Recent tropical deforestation is still less severe than historical deforestation in Europe

Forest cover in Europe



Logging of tropical forests is almost always selective

Logged dipterocarp forests

Lowland dipterocarp forest 5 years after selective logging

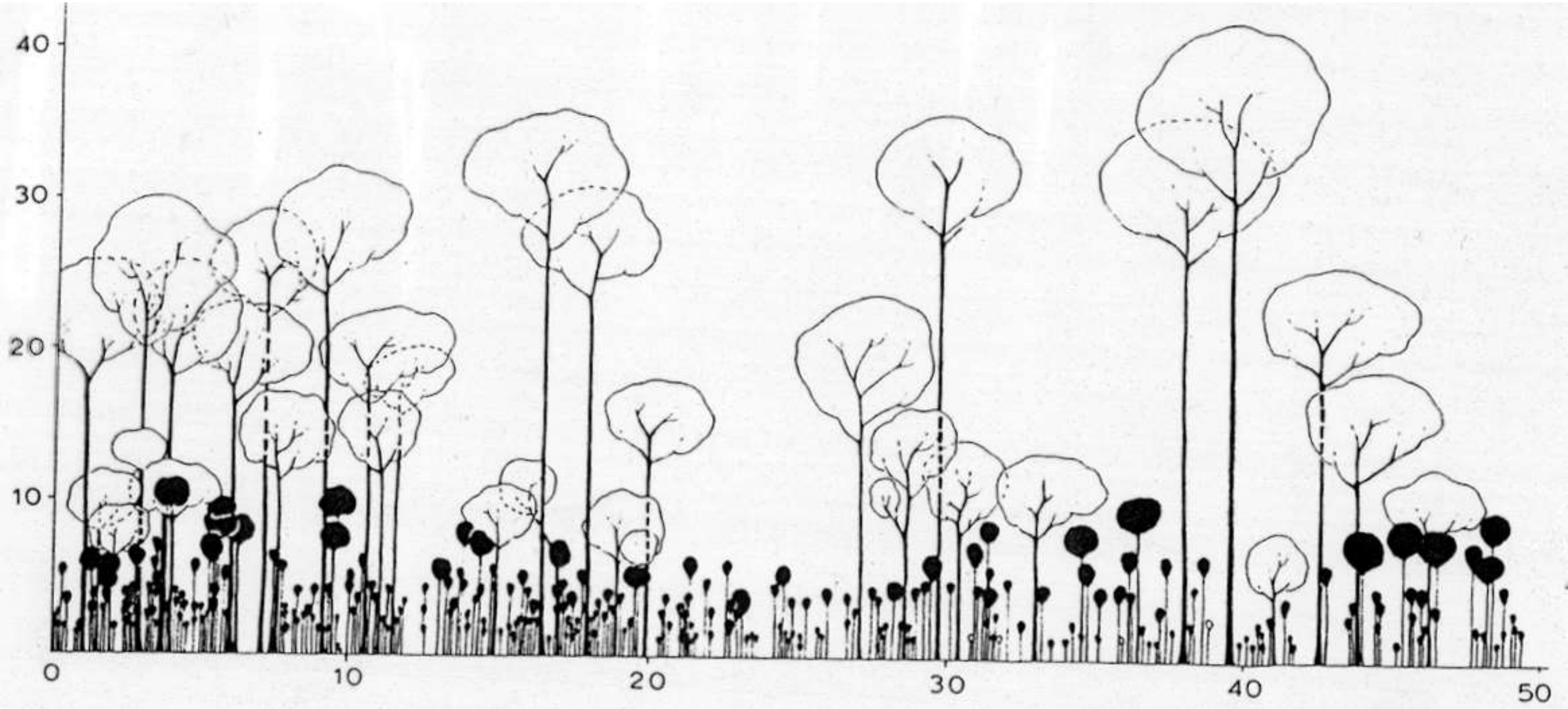
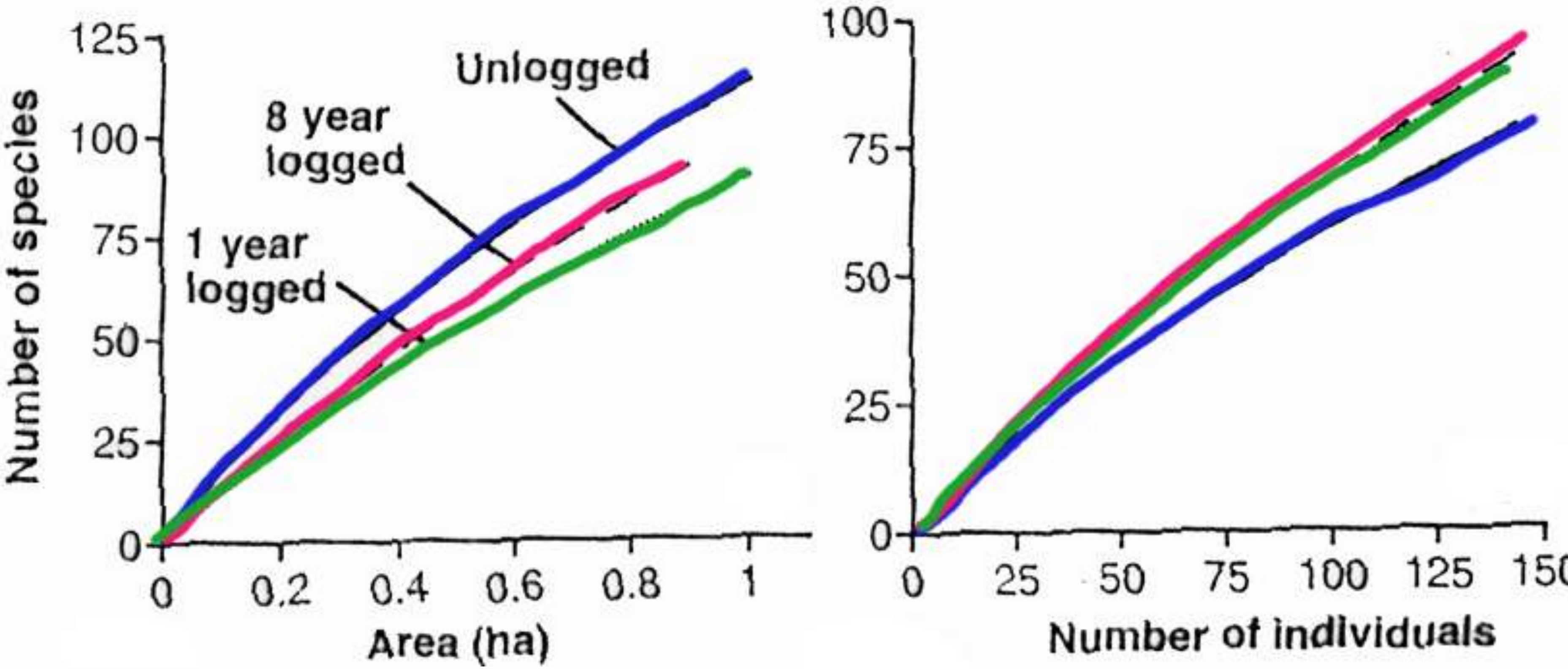


Fig. 34.4. A profile diagram of a lowland mixed dipterocarp rain forest five years after selective and mechanized logging at Sekundur, northern Sumatra, Indonesia. The diagram was made within the two-hectare block shown in Fig. 34.3. Note the wide gaps with a low developing sapling layer (shaded black). (After Abdulhadi et al., 1985.)

Logged forest: equally species-rich per individual as the primary forest



First selective logging does not lead to loss plant species diversity, but the problem is repeated logging

Third forest cut in Borneo

Fig. 1. Cumulative species-area relationships for (A) all trees >20 cm in diameter and (B) small trees 20 to 30 cm in diameter. Cumulative species-individual relationships for (C) all trees >20 cm in diameter and (D) small trees 20 to 30 cm in diameter. See (16) for details.

Problem of tropical forestry:
too many tree species, often at low population densities

Table 10.8 Numbers of timber species in the top five end-use classes and their share of total log production

	Number of species	% Total log production	Production* ($m^3 \times 10^6$)
Southeast Asia†	195	59	50
Africa	7	45	10
South America	13	40	31

Extracting timber from tropical forests: large collateral damage

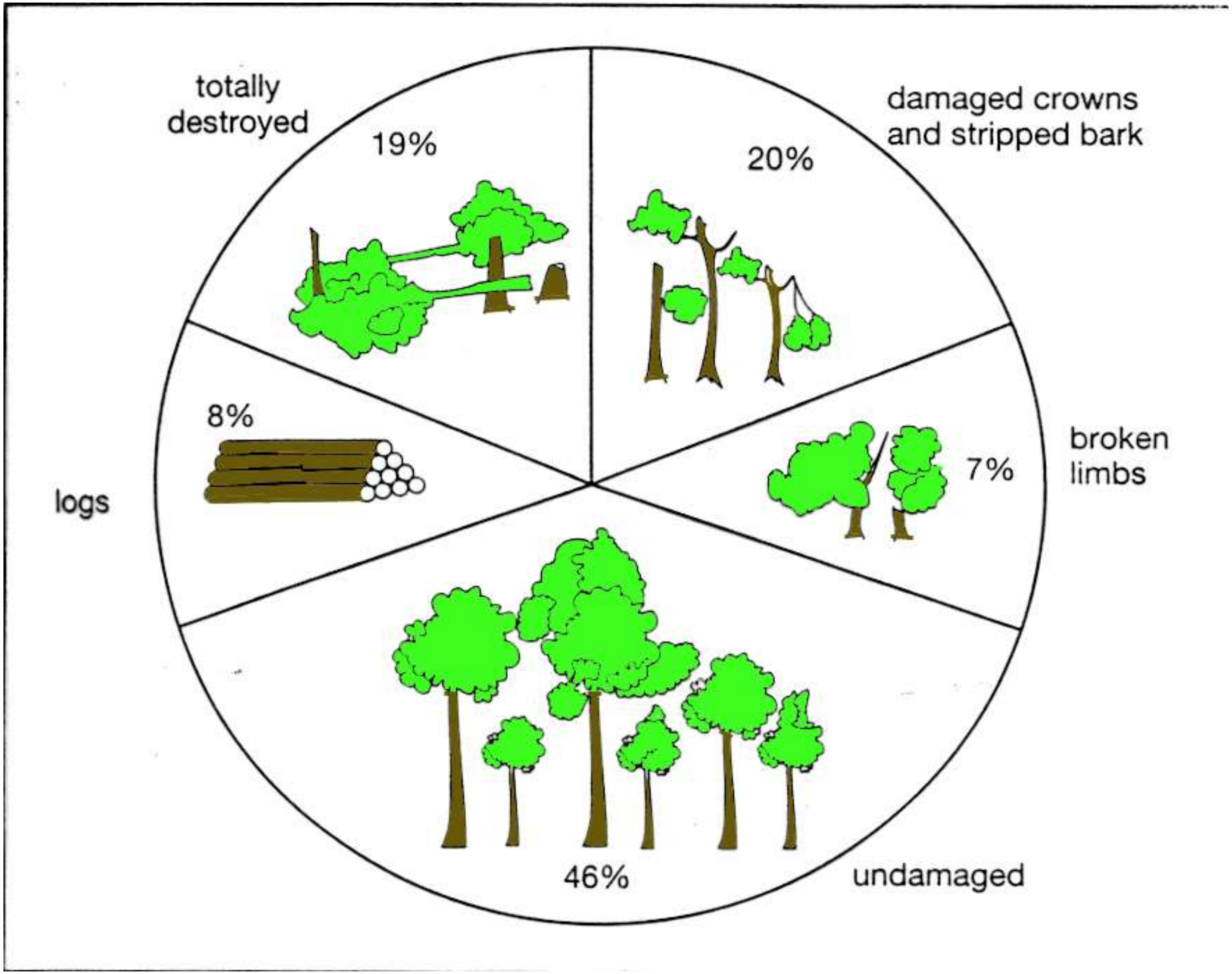


Figure 9.5. The effect of extracting 8% of trees by selective logging on an area of forest on South Pagai, Mentawai, West Sumatra. (After Alrasjid and Effendi 1979.)

Production, consumption, export and import of tropical logs

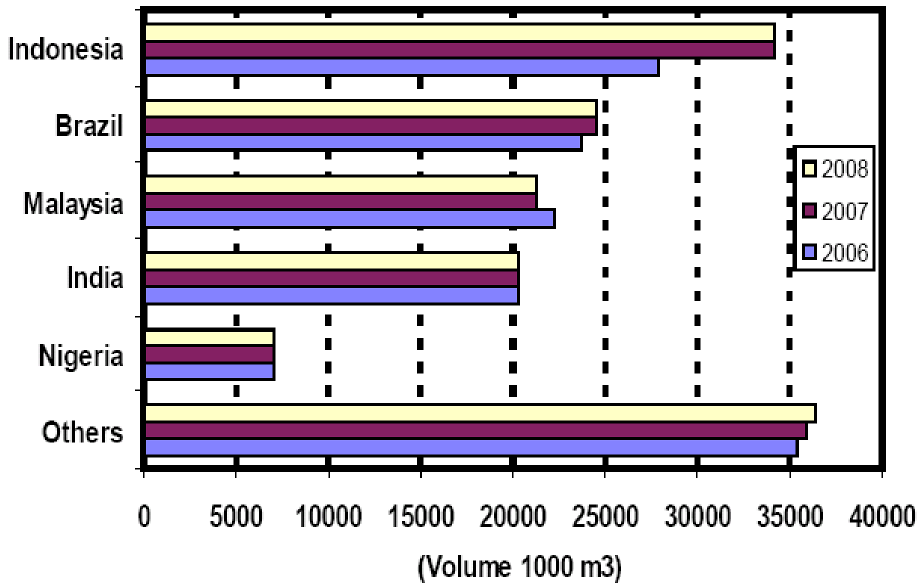


Fig. 9: Major Tropical Log Producers

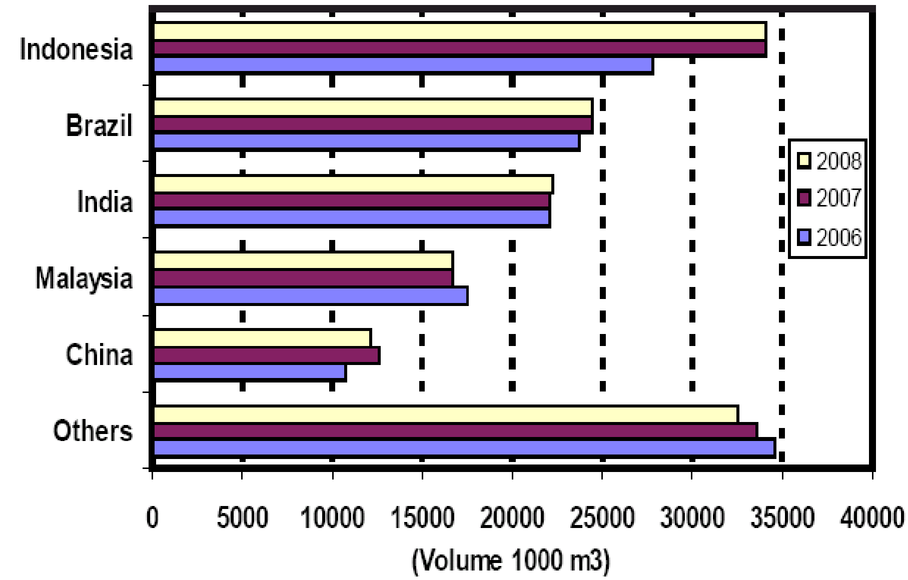


Fig. 10: Major Tropical Log Consumers

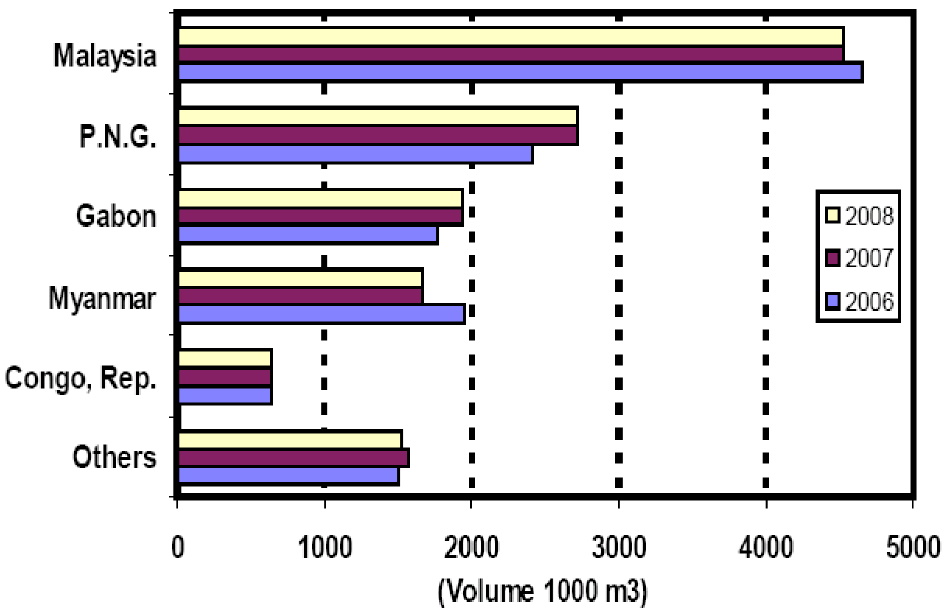


Fig. 12: Major Tropical Log Exporters

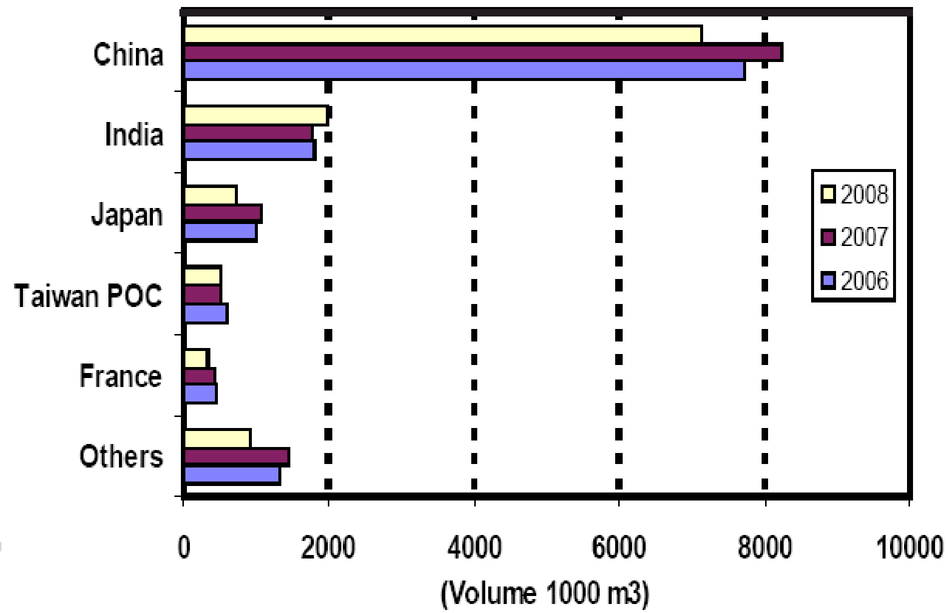
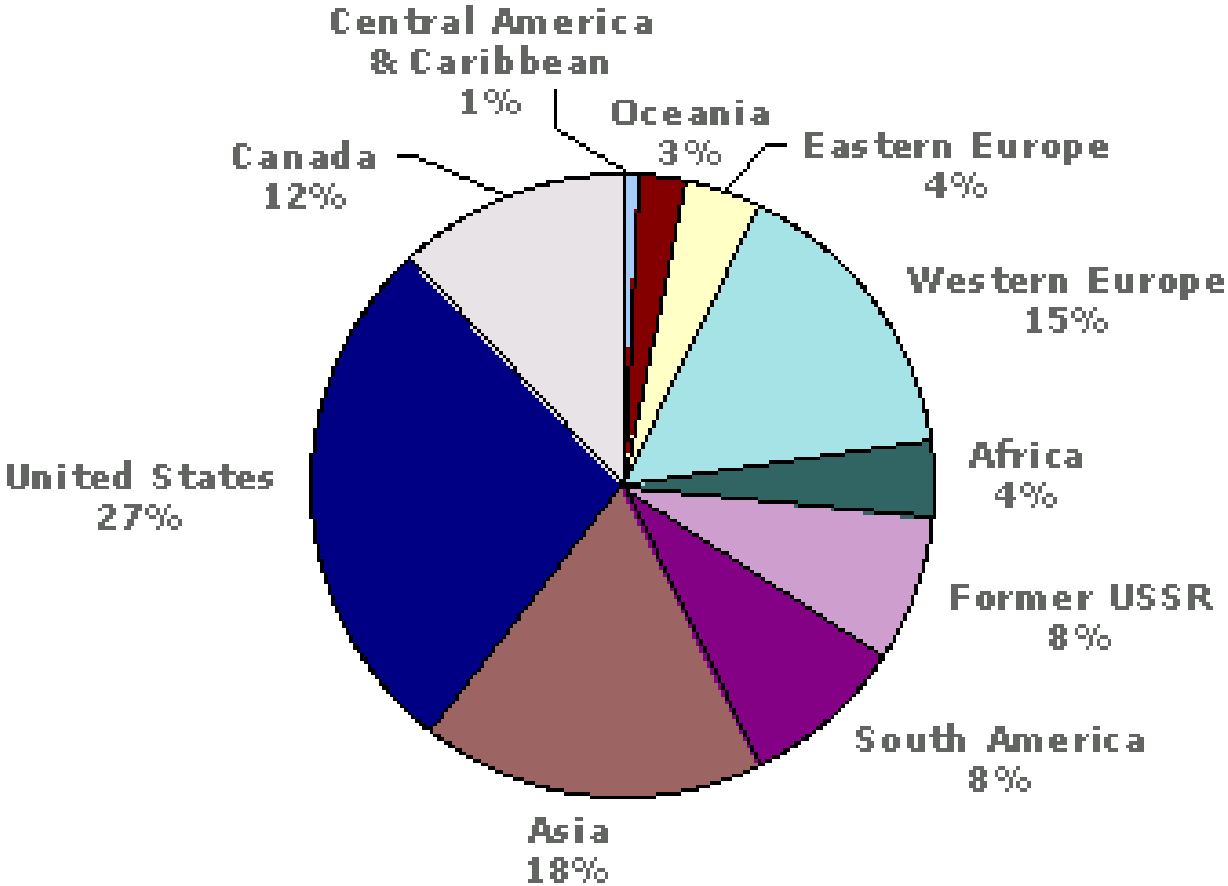


Fig. 11: Major Tropical Log Importers

Top timber exporters are developed temperate countries

High-Income Countries Produce and Use Most of the World's Wood

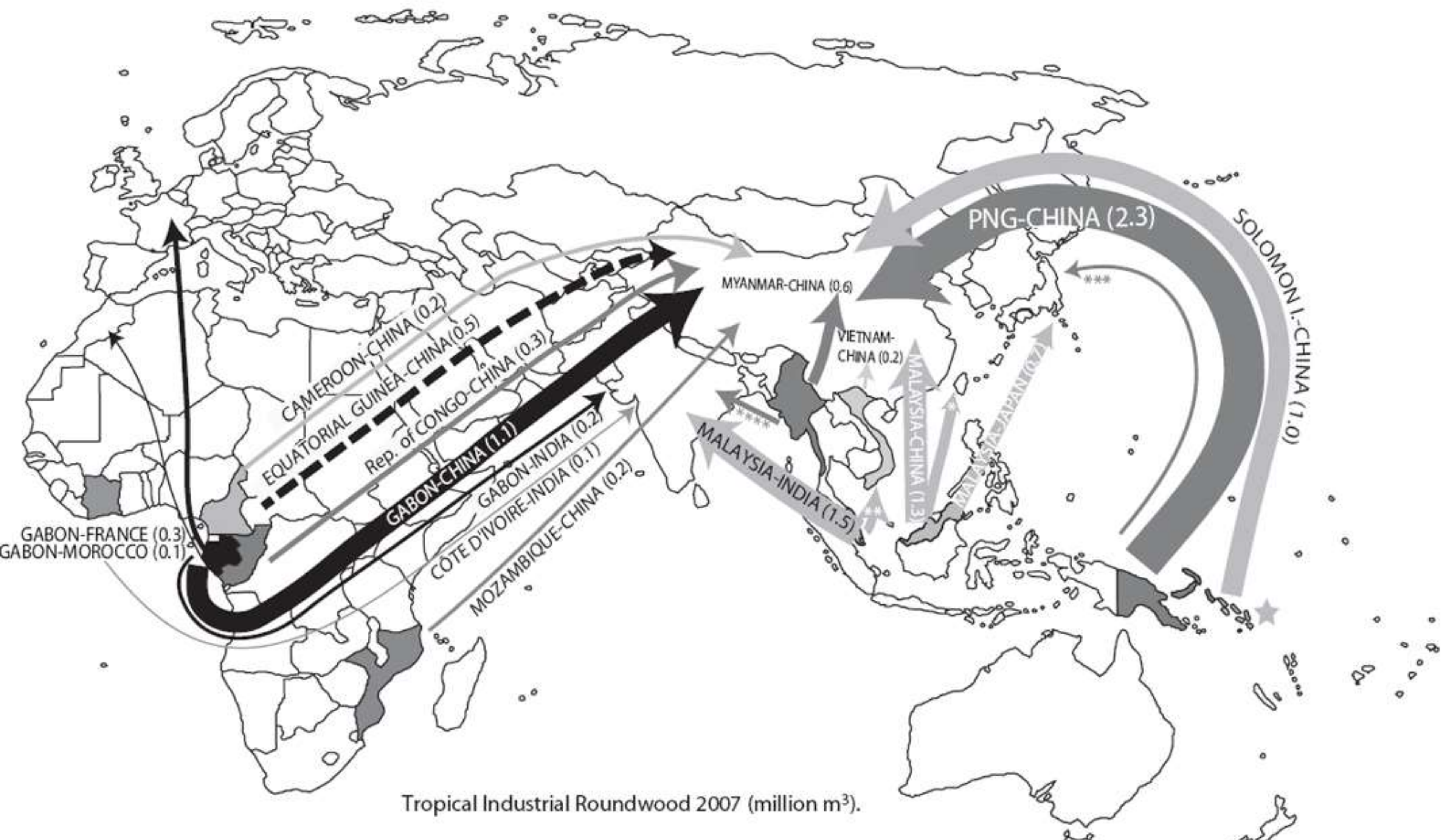
Figure 1: Global Industrial Roundwood Production, 1998



Source: FAOSTAT

Note: Industrial roundwood production in 1998 totaled 1.5 billion cubic meters

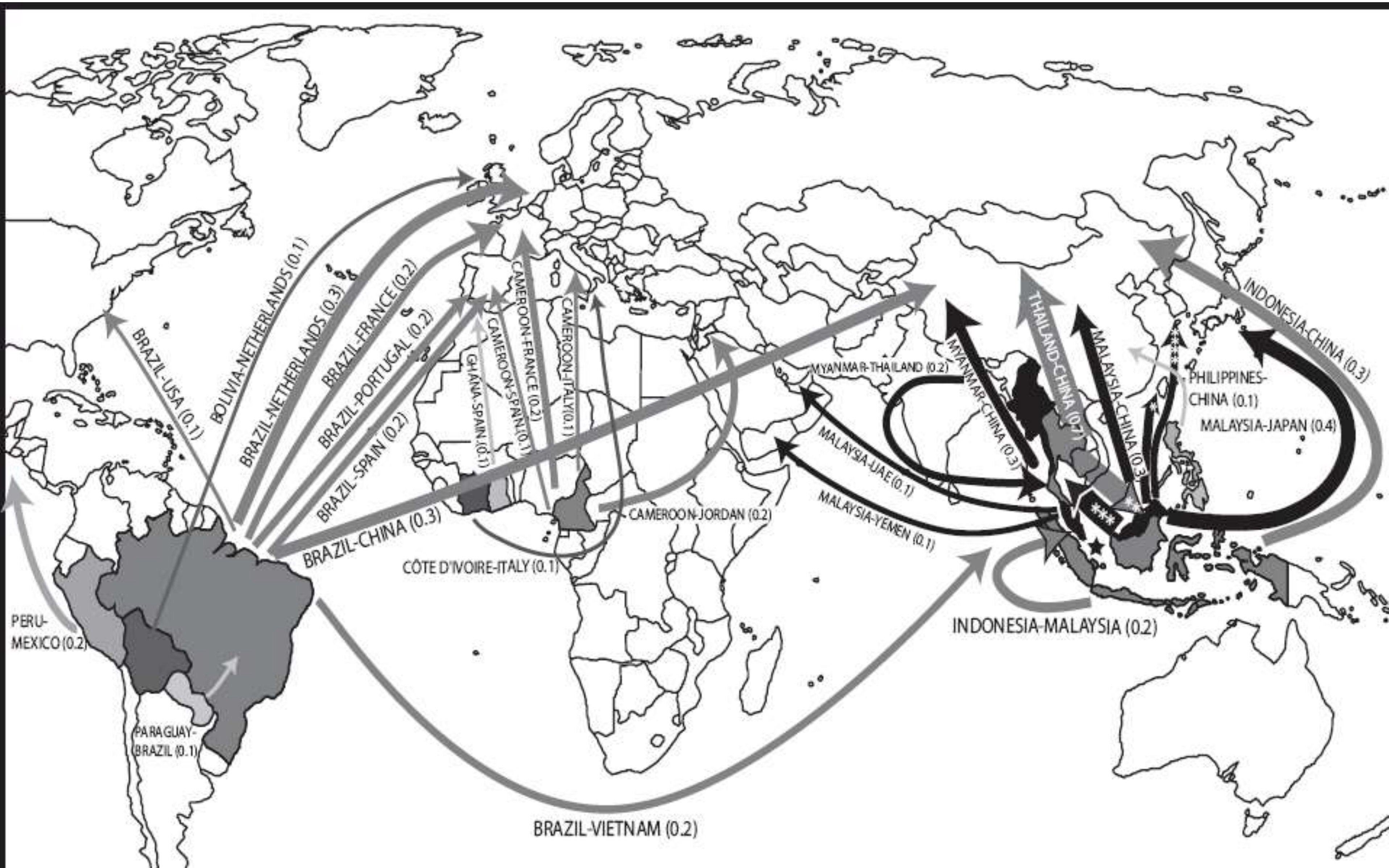
Trading in tropical logs [2007]
more sophisticated countries do not export unprocessed logs



Tropical Industrial Roundwood 2007 (million m^3).

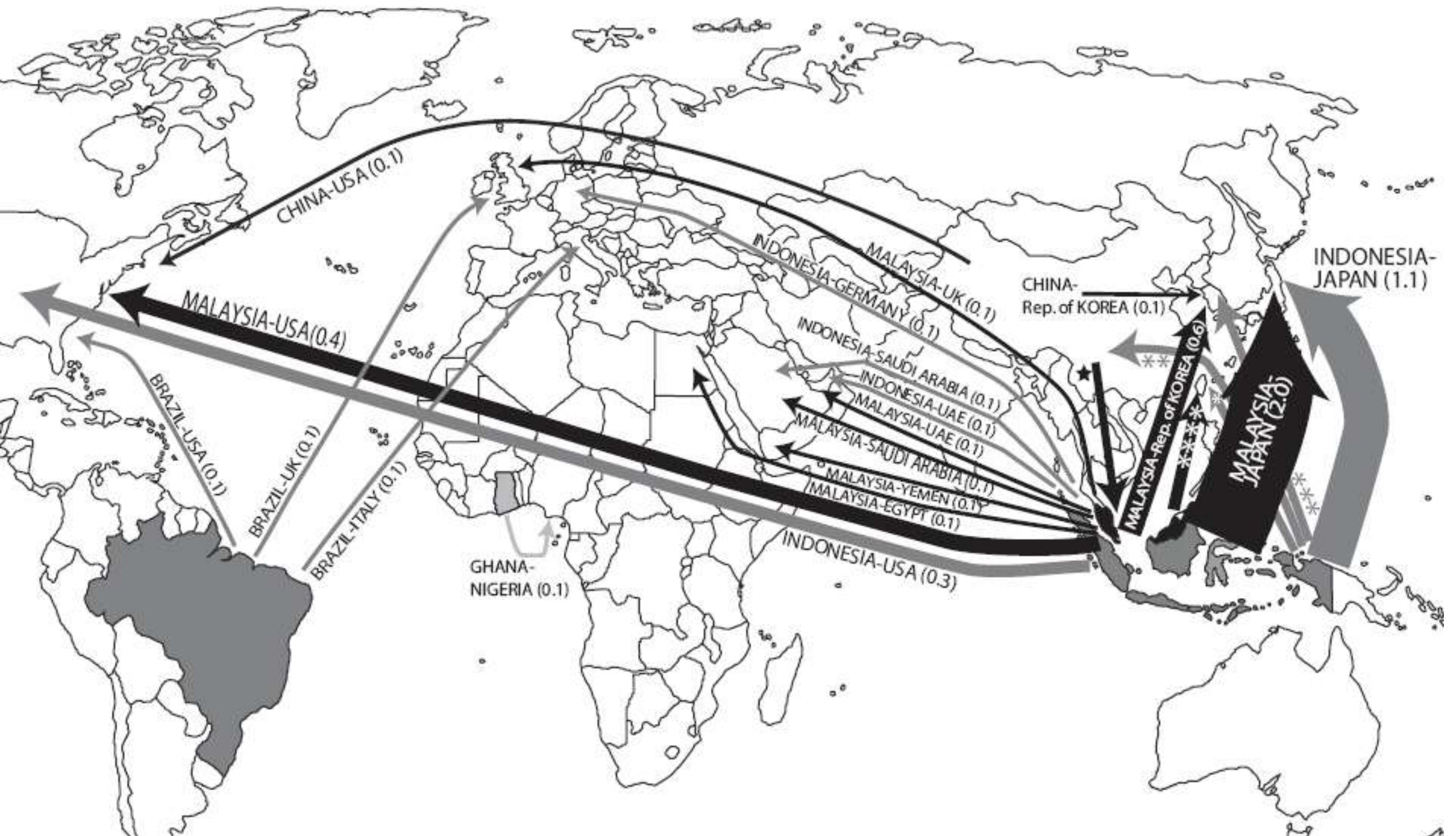
Note: no exports of raw logs from S. America

Trading in tropical sawnwood [2007]



Tropical Sawnwood 2007 (million m^3)

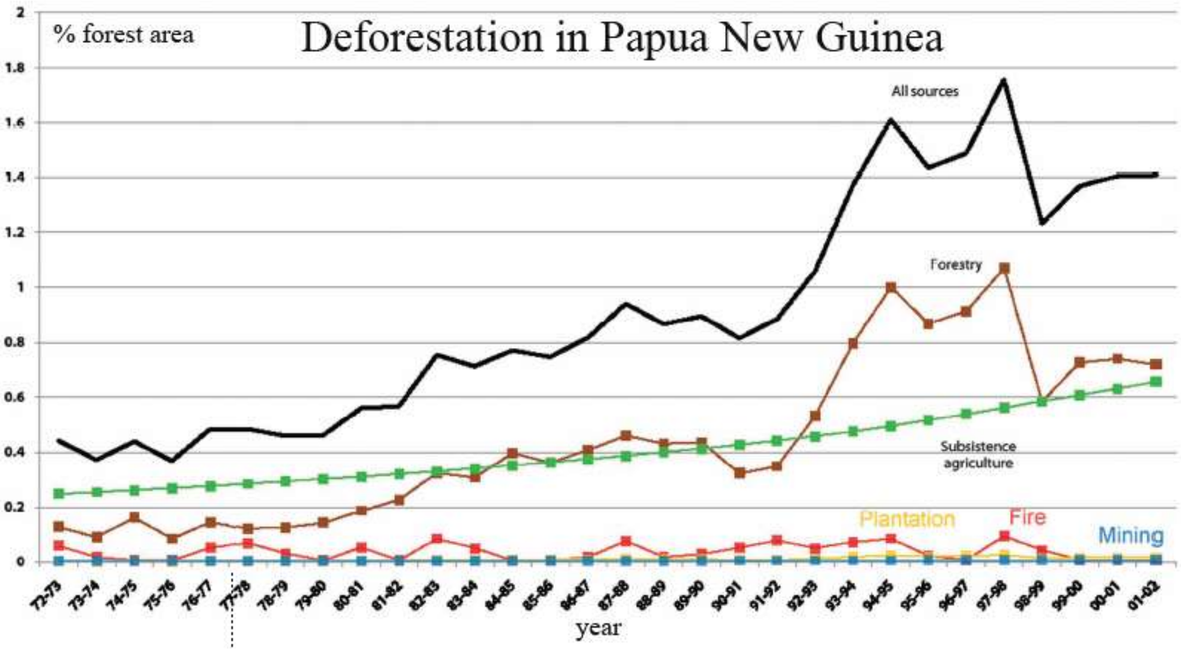
Trading in tropical plywood [2007]

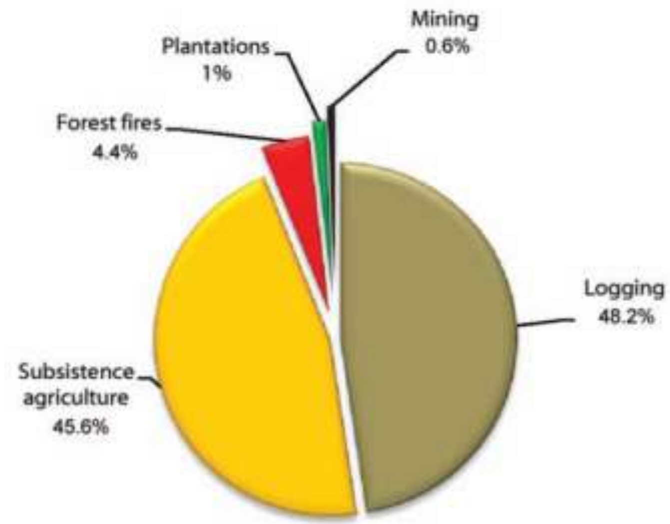


Tropical Plywood 2007 (million m³).

Local processing of timber is preferable to export of raw logs, but not always such a good deal socially as often thought

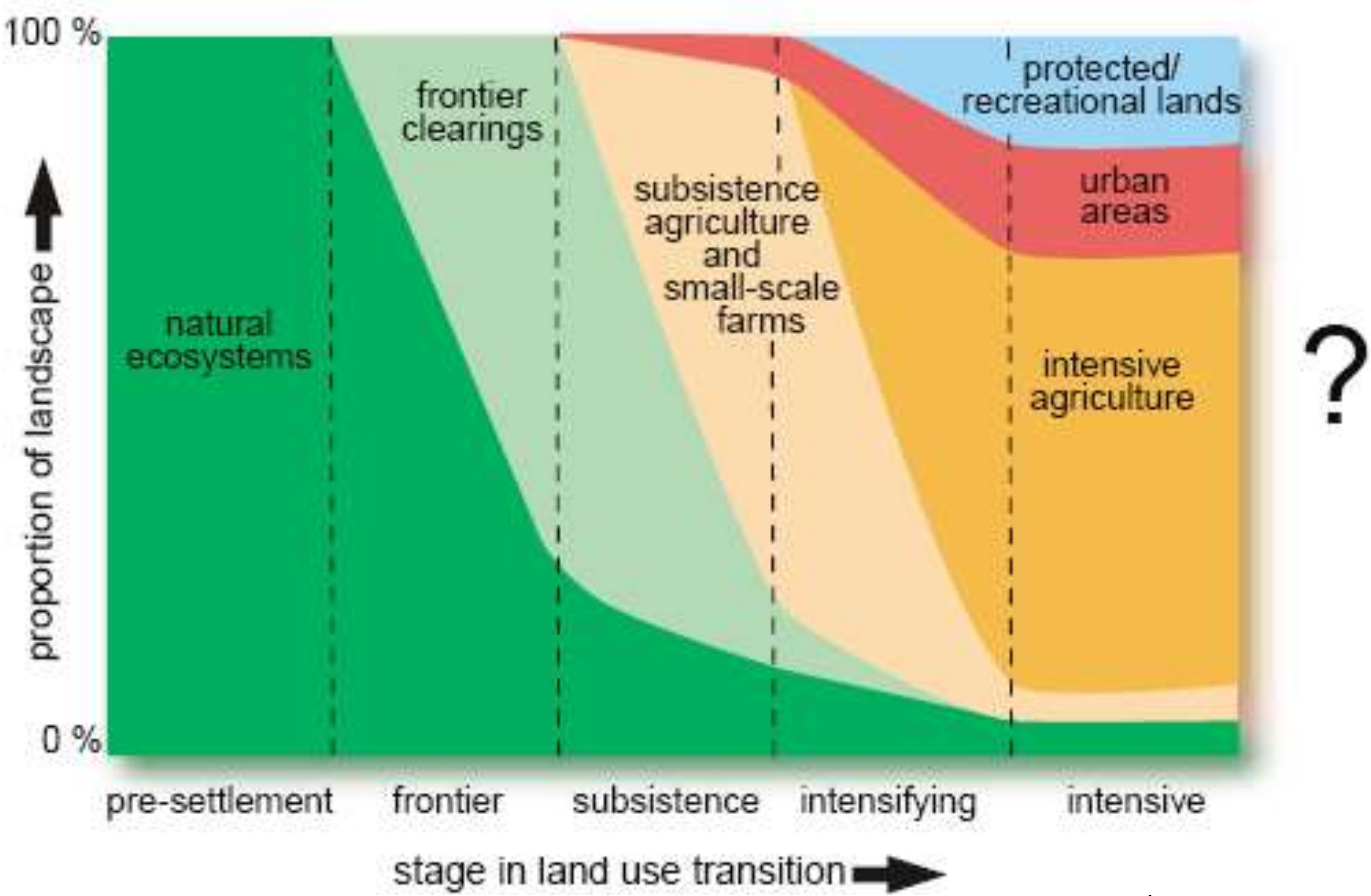
Papua New Guinea: "old" pressures on tropical forests: subsistence agriculture by local population and commercial logging





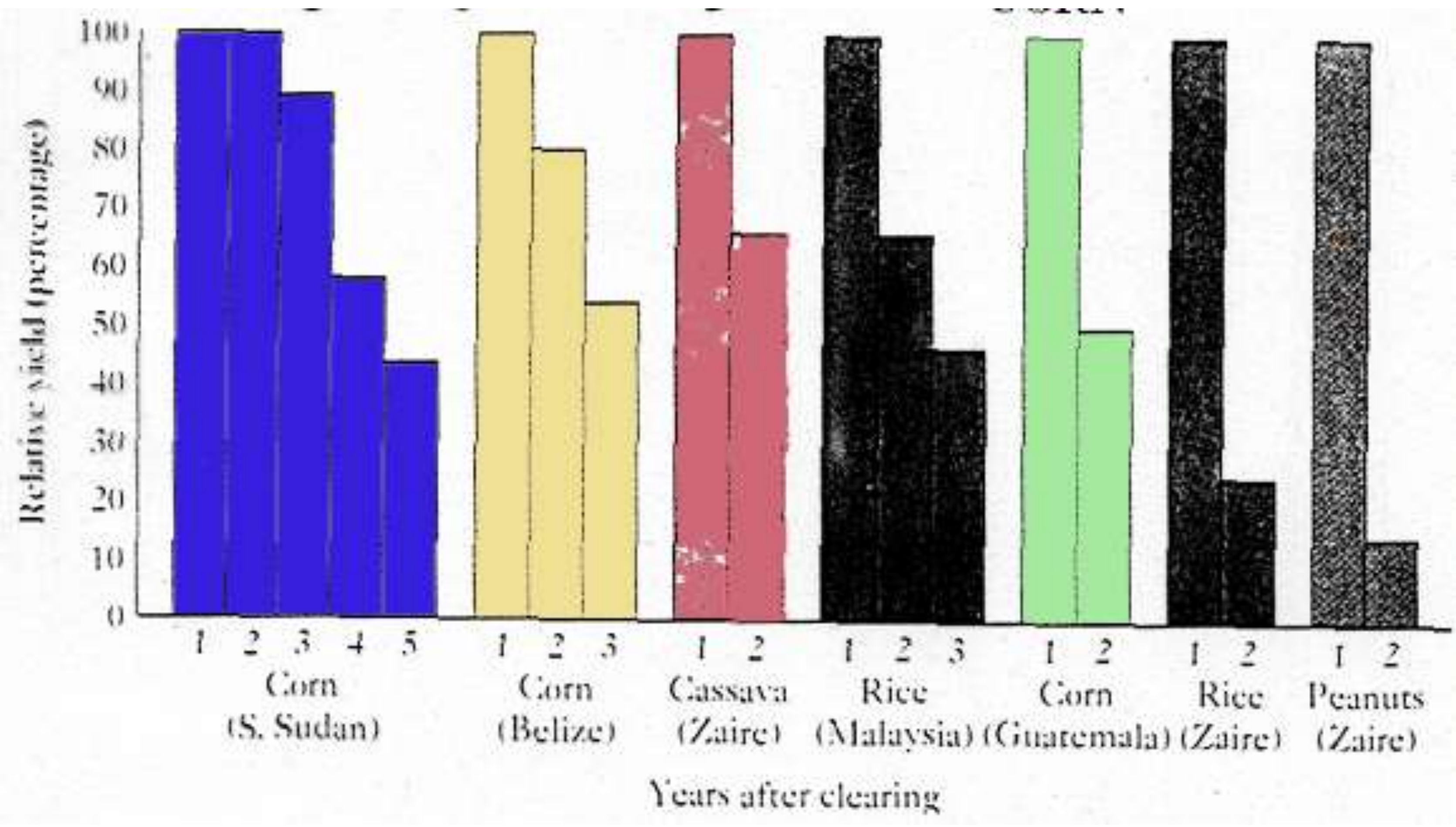
Deforestation in Papua New Guinea 1972-2002

Civilization land use development



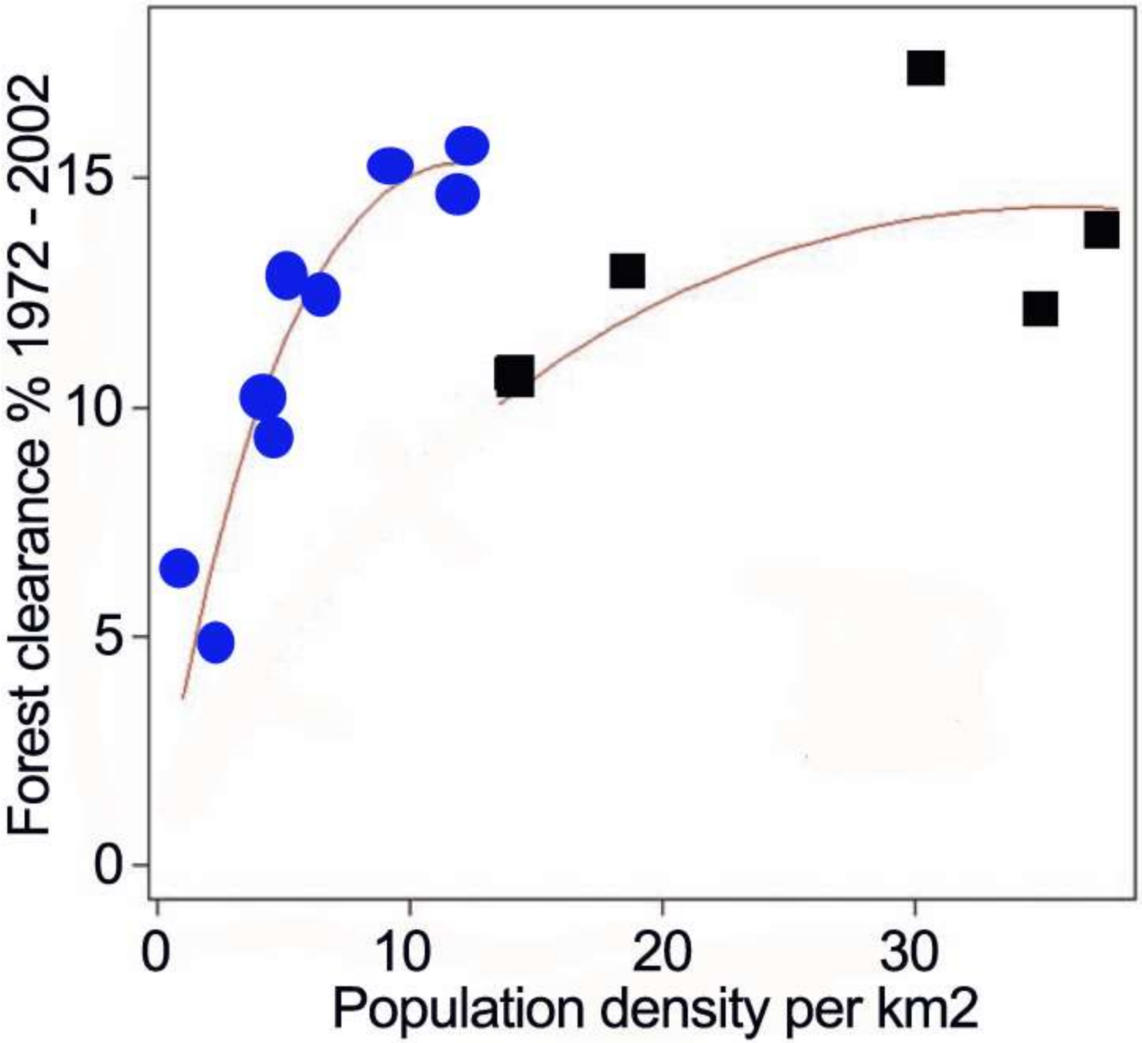
Jonathan A. Foley,[1*] Ruth DeFries,[2] Gregory P. Asner,[3] Carol Barford,[1] Gordon Bonan,[4] Stephen R. Carpenter,[5] F. Stuart Chapin,[6] Michael T. Coe,[1†] Gretchen C. Daily,[7] Holly K. Gibbs,[1] Joseph H. Helkowski,[1] Tracey Holloway,[1] Erica A. Howard,[1] Christopher J. Kucharik,[1] Chad Monfreda,[1] Jonathan A. Patz,[1] I. Colin Prentice,[8] Navin Ramankutty,[1] Peter K. Snyder[9]

Sustained agriculture in tropical lowlands requires additional inputs (energy, fertilizers, …) to sustain productivity
without them, shifting slash-and-burn agriculture has to be "shifting" to new forest areas every few years



Decrease in yields in slash-and-burn agriculture

Papua New Guinea 1972-2002



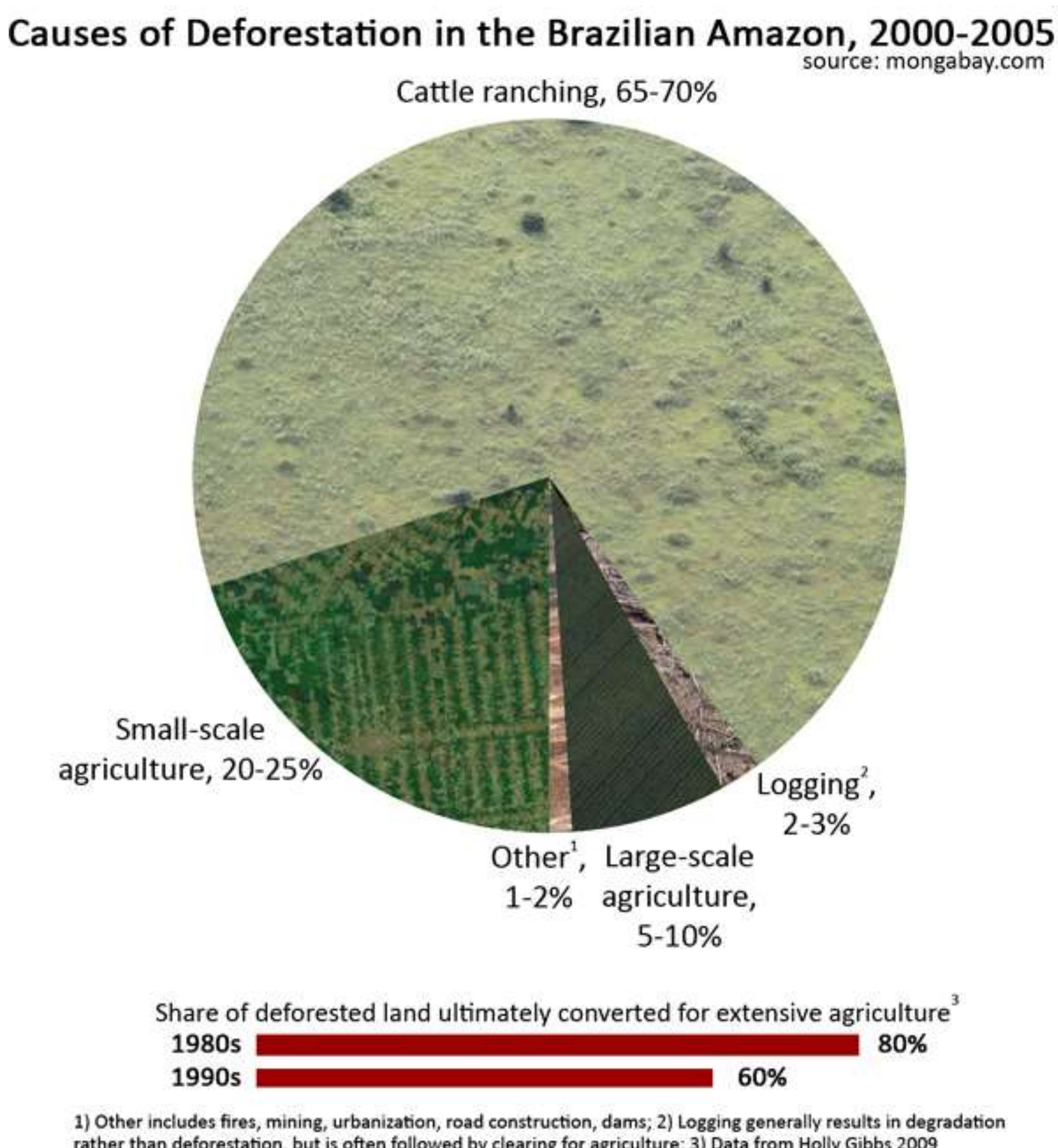
lowland populations, with shifting agriculture, cause higher per capita deforestation than lowland populations where agriculture land can remain productive much longer.

Shearman et al. 2008

Slash-and-burn [swidden] shifting agriculture in tropical lowlands

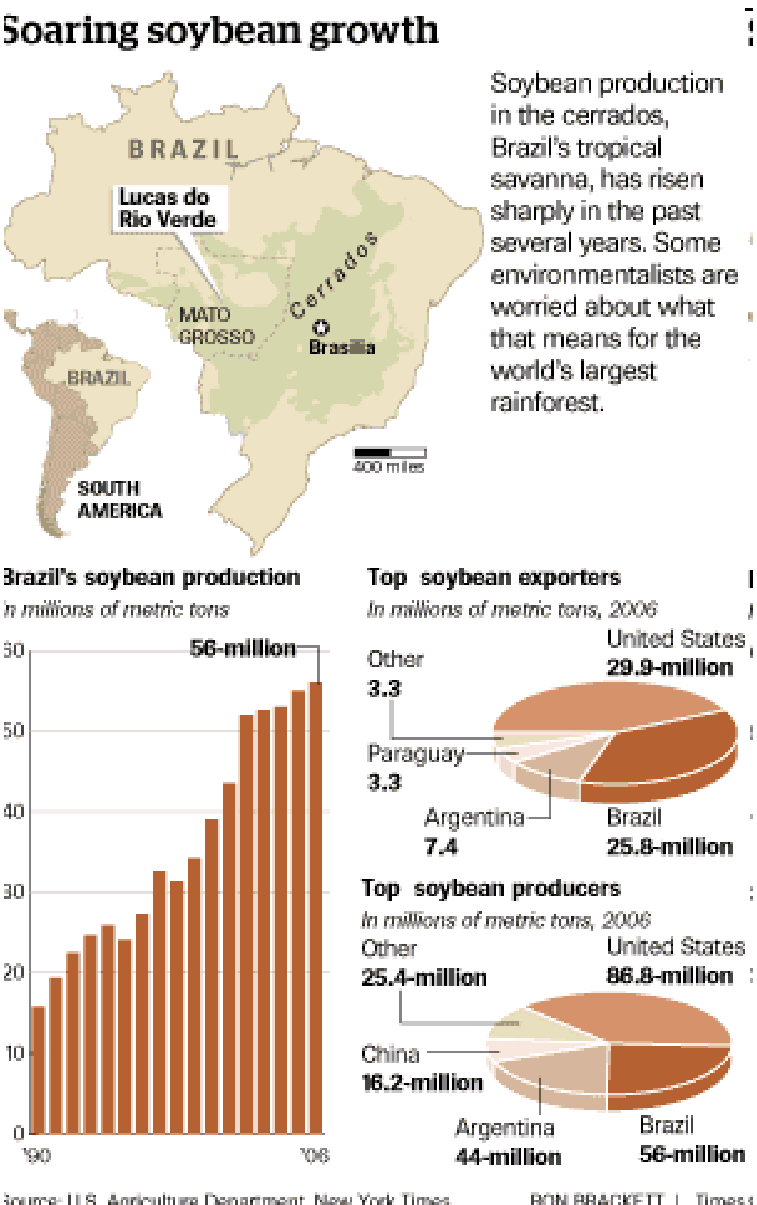
High-intensity subsistence agriculture in the mountains
(sweet potato in New Guinea)

Brazil: "new" pressures on tropical forests: land conversion to agriculture



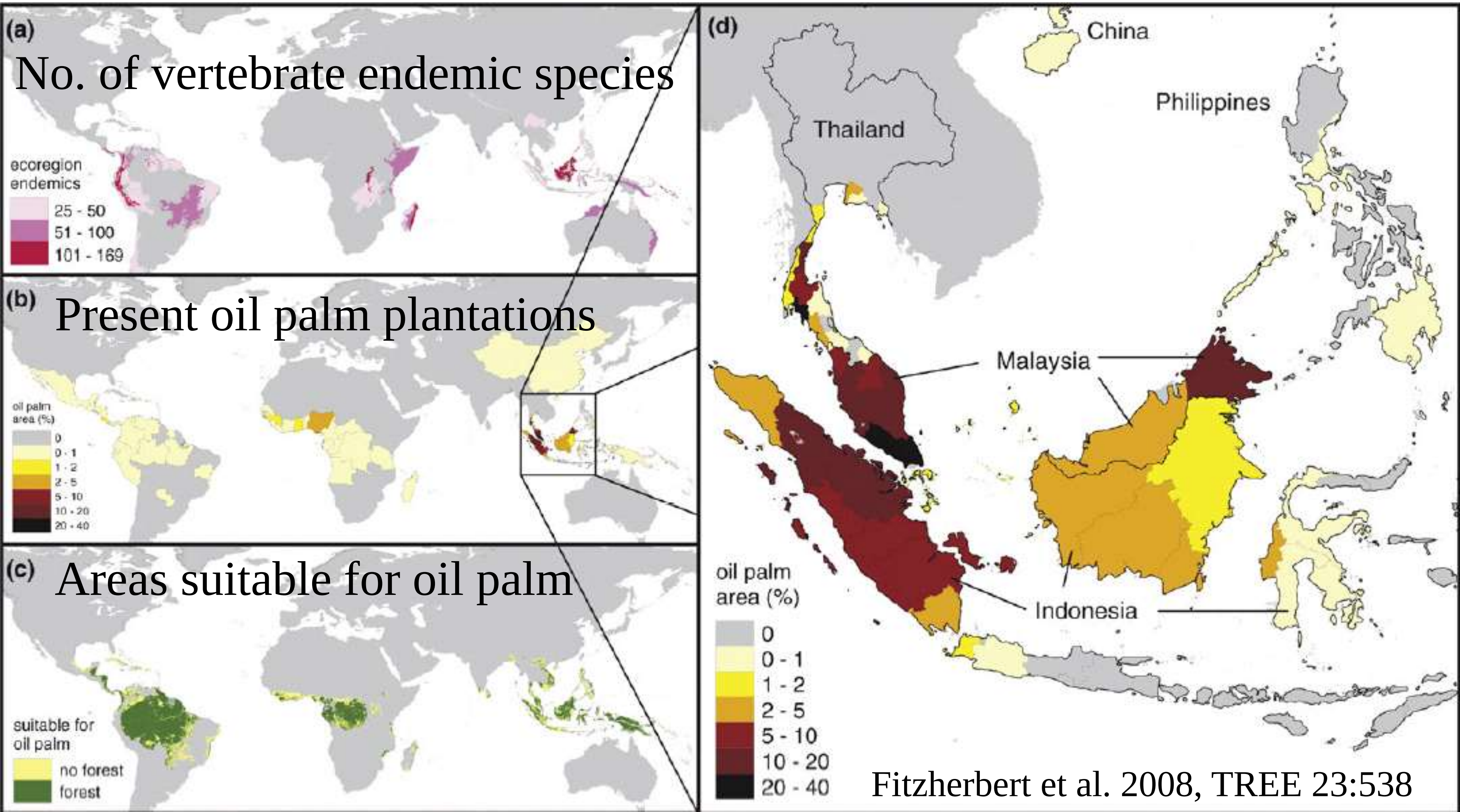
Cattle pastures:
the most common reason for forest clearance in South America

Land use in Amazon:
rainforest ---> cattle pasture ---> soy plantations



Oil palm: the fastest expanding plantations in the tropics

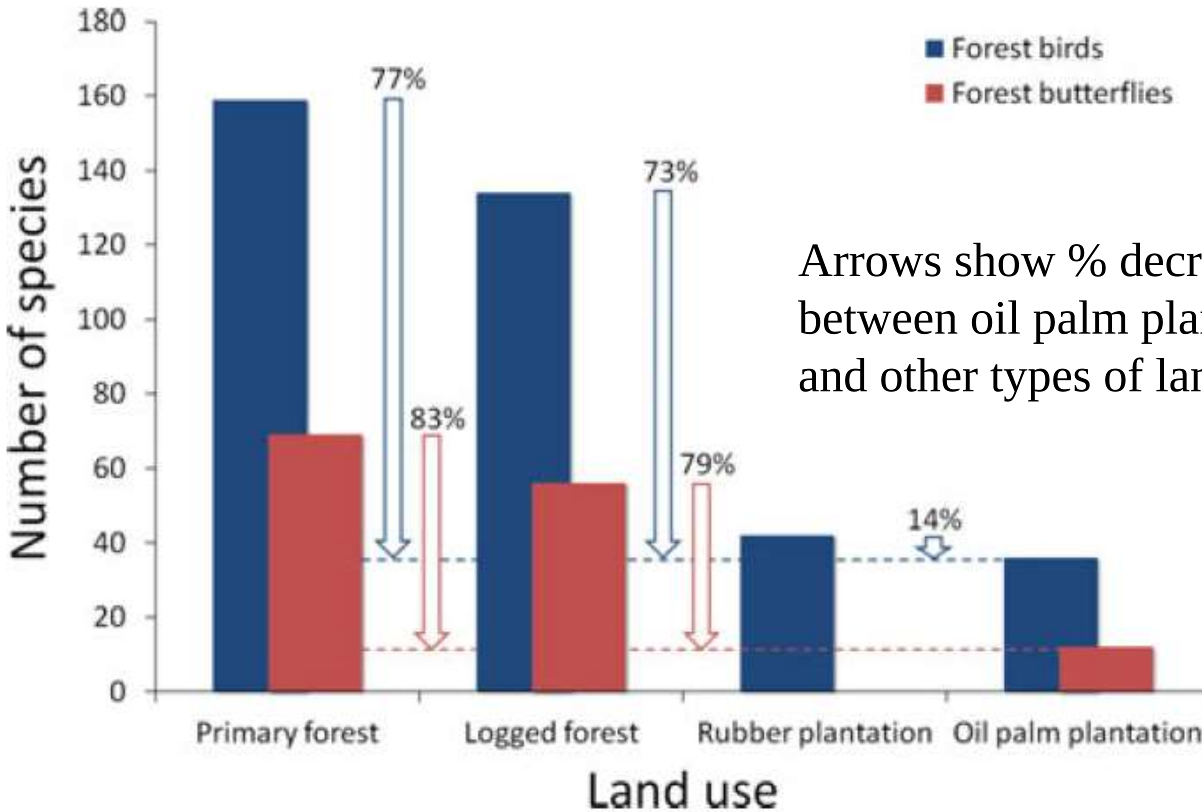
Oil palm: rapidly growing plantation areas, great potential for conflict with natural forests



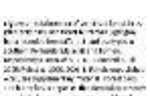
Fitzherbert et al. 2008, TREE 23:538

Oil plam plantations: biological deserts?

Number of forest birds and butterflies recorded in Malaysia
for various types of land use



Arrows show % decrease
between oil palm plantations
and other types of land use



Koh & Wilcove, Conservation Letters 2008

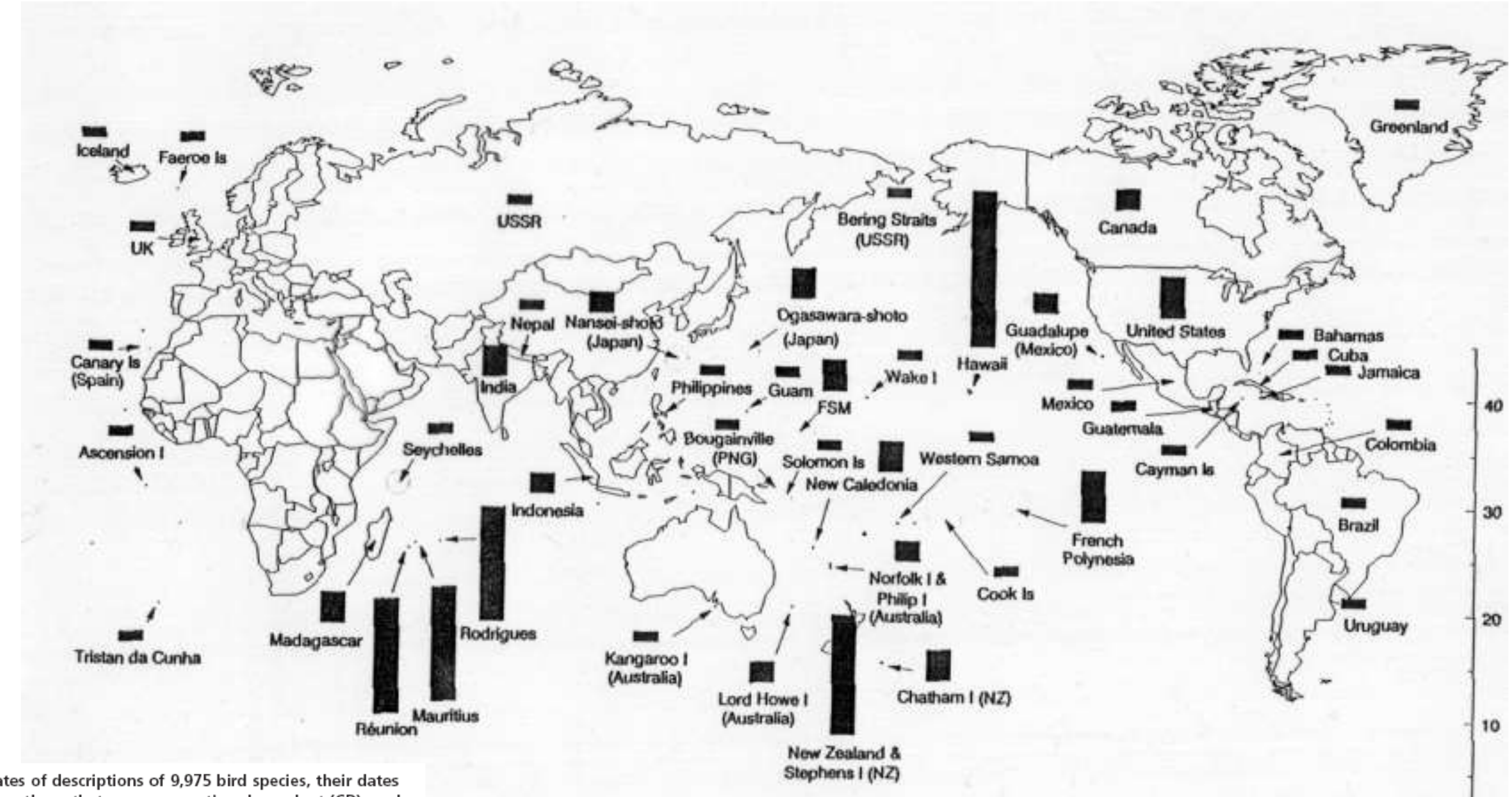
Coconut and cacao: another biological desert

A man-made landscape: intensive paddy fields around Hanoi

What is a realistic "best case scenario" for tropical rainforest landscapes?

And now for something completely different: species conservation

Species extinctions of birds to date: mostly on oceanic islands



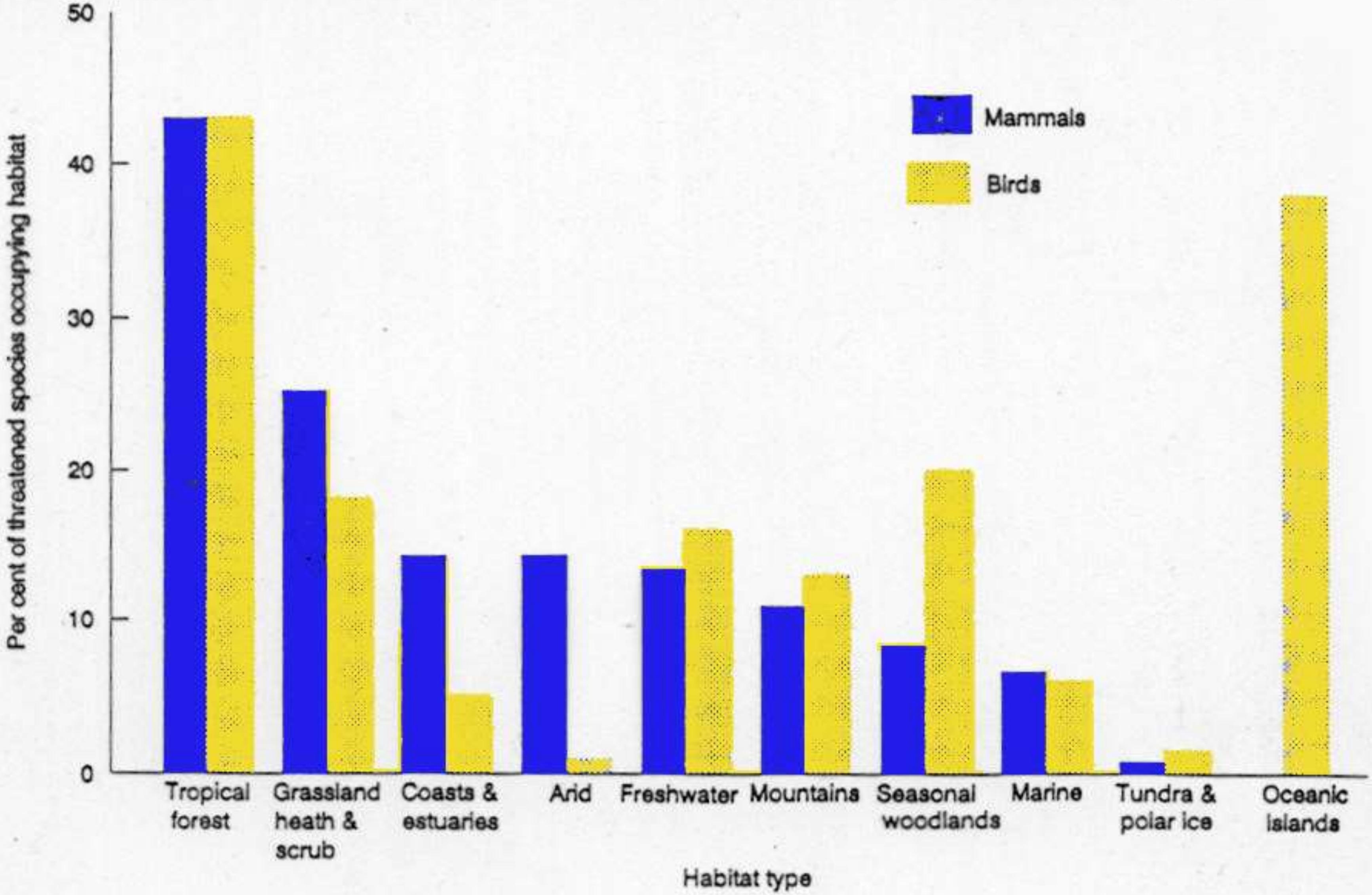
Known animal extinctions since c. 1600: Birds

Table 1. Dates of descriptions of 9,975 bird species, their dates of extinction, those that are conservation-dependent (CD), and additional species that are critically endangered

	Description					
	Before				After	
	<1600	<1700	<1800	<1900	1900	Sum
Extinction date						
Before						
1600	0	0	0	0	6	6
1700	0	0	2	4	4	10
1800	0	0	4	10	13	27
1900	0	0	10	37	1	48
After 1900	0	0	12	39	12	63
Sum	0	0	28	90	36	154
CD	0	0	5	16	4	25
Critically endangered	0	0	13	91	53	157
All	0	0	1,689	7,079	1,207	9,975

From 9,875 described species went 154 species extinct, and 157 are now critically endangered

Figure 17.6 Habitat distribution of threatened mammals and birds



Note: Mammal data for Australasia and the Americas, excludes Cetacea; bird data are global.

Very few species extinctions have been actually documented

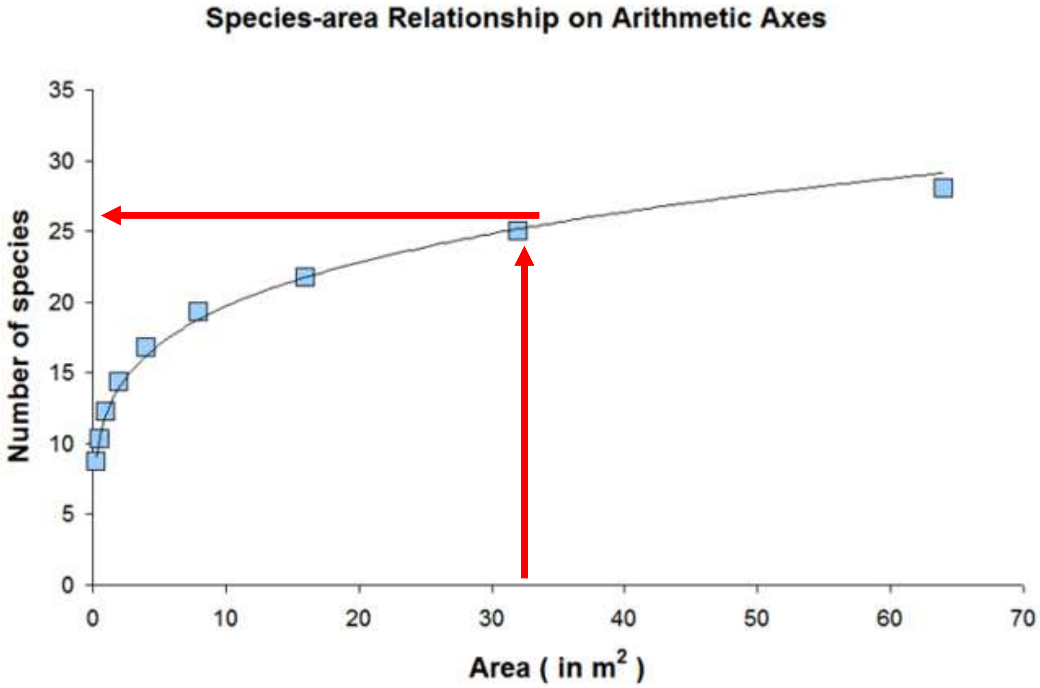
Table 12.3 Recorded extinctions of various groups of terrestrial organisms since 1600

Taxon	Continental	Island	Per cent of species
Mammals	30	51	2.1
Birds	21	90	1.3
Reptiles	1	20	0.3
Amphibians	2	0	0.01
Fish	22	1	0.1
Invertebrates	49	48	0.01
Vascular plants	245	139	0.2

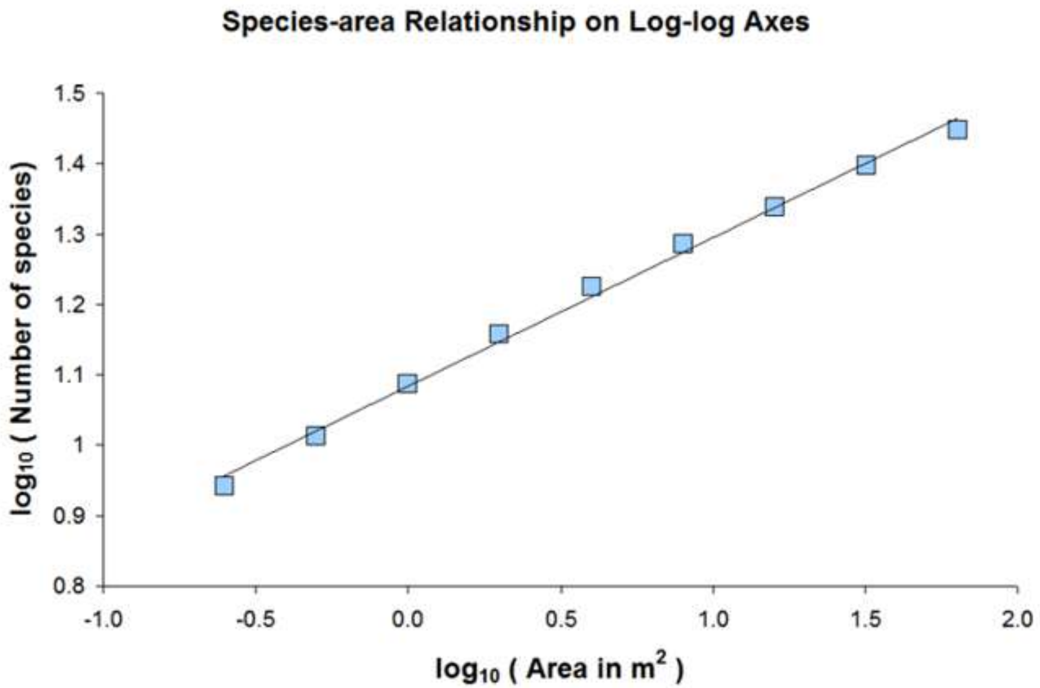
Source: Primack 1998. Many more species have presumably gone extinct without being recorded by biologists.

Estimated rates of extinction

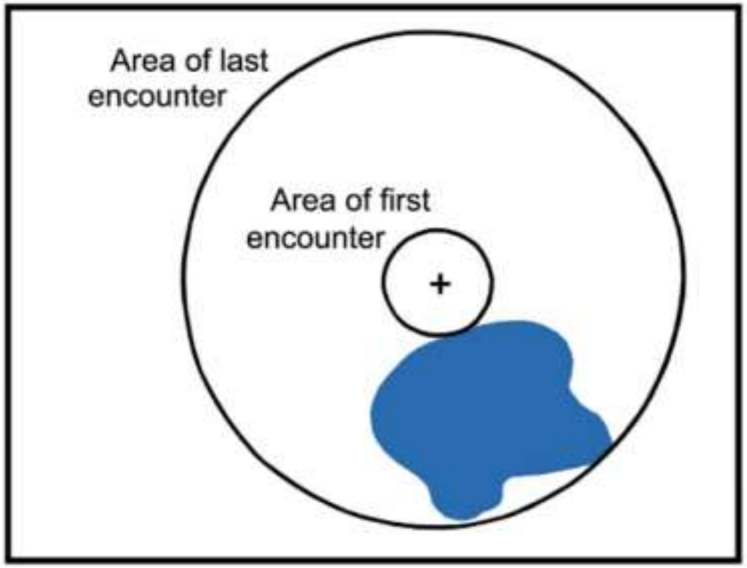
ESTIMATE	% GLOBAL LOSS PER DECADE	METHOD OF ESTIMATION	REFERENCE
One million species between 1975 and 2000	4	Extrapolation of past exponentially increasing trend	Myers (1979)
15-20% of species between 1980 and 2000	8-11	Estimated species-area curve; forest loss based on Global 2000 projections	Lovejoy (1980)
12% of plant species in neotropics. 15% of bird species in Amazon basin	-	Species-area curve ($z = 0.25$)	Simberloff (1986)
2000 plant species per year in tropics and subtropics	8	Loss of half the species in area likely to be deforested by 2015	Raven (1987)
25% of species between 1985 and 2015	9	As above	Raven (1988a.b)
At least 7% of plant species	7	Half of species lost over next decade in 10 'hot spots' covering 3.5% of forest area	Myers (1988)
0.2-0.3% per year	2-3	Half of rain forest species assumed lost in tropical rain forests to be local endemics and becoming extinct with forest loss	Wilson (1988, 1989)
5-15% forest species by 2020	2-5	Species-area curve ($0.15 < z < 0.35$); forest loss assumed twice rate projected by FAO for 1980-85	Reid and Miller (1989)
2-8% loss between 1990 and 2015	1-5	Species-area curve ($0.15 < z < 0.35$); range includes current rate of forest loss and 50% increase	Reid (1992)

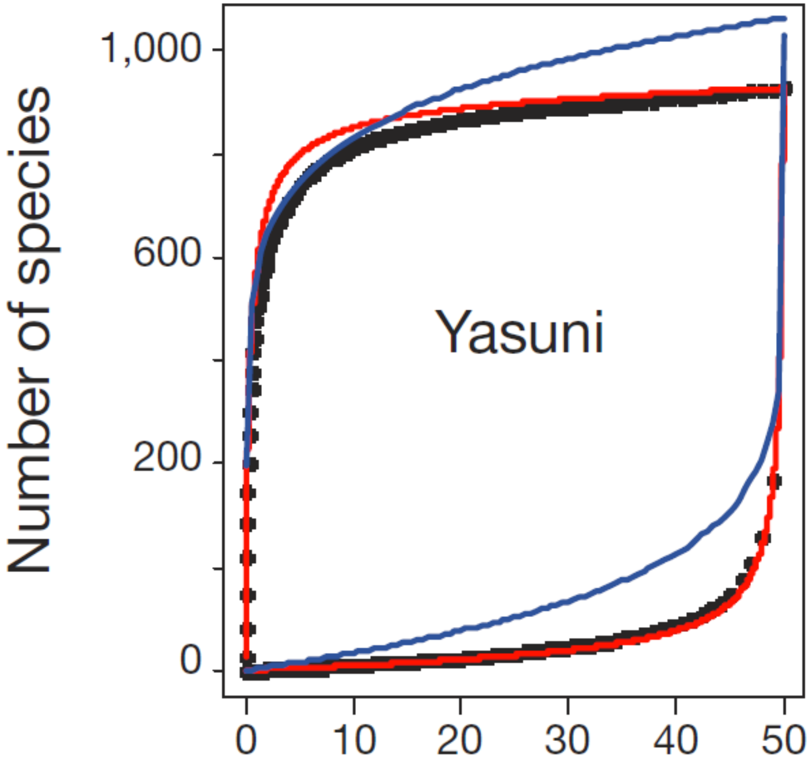


Extinction (decrease in number of species) is estimated from reduction in habitat area, using species-area relationship



Species–area relationships always overestimate extinction rates from habitat loss

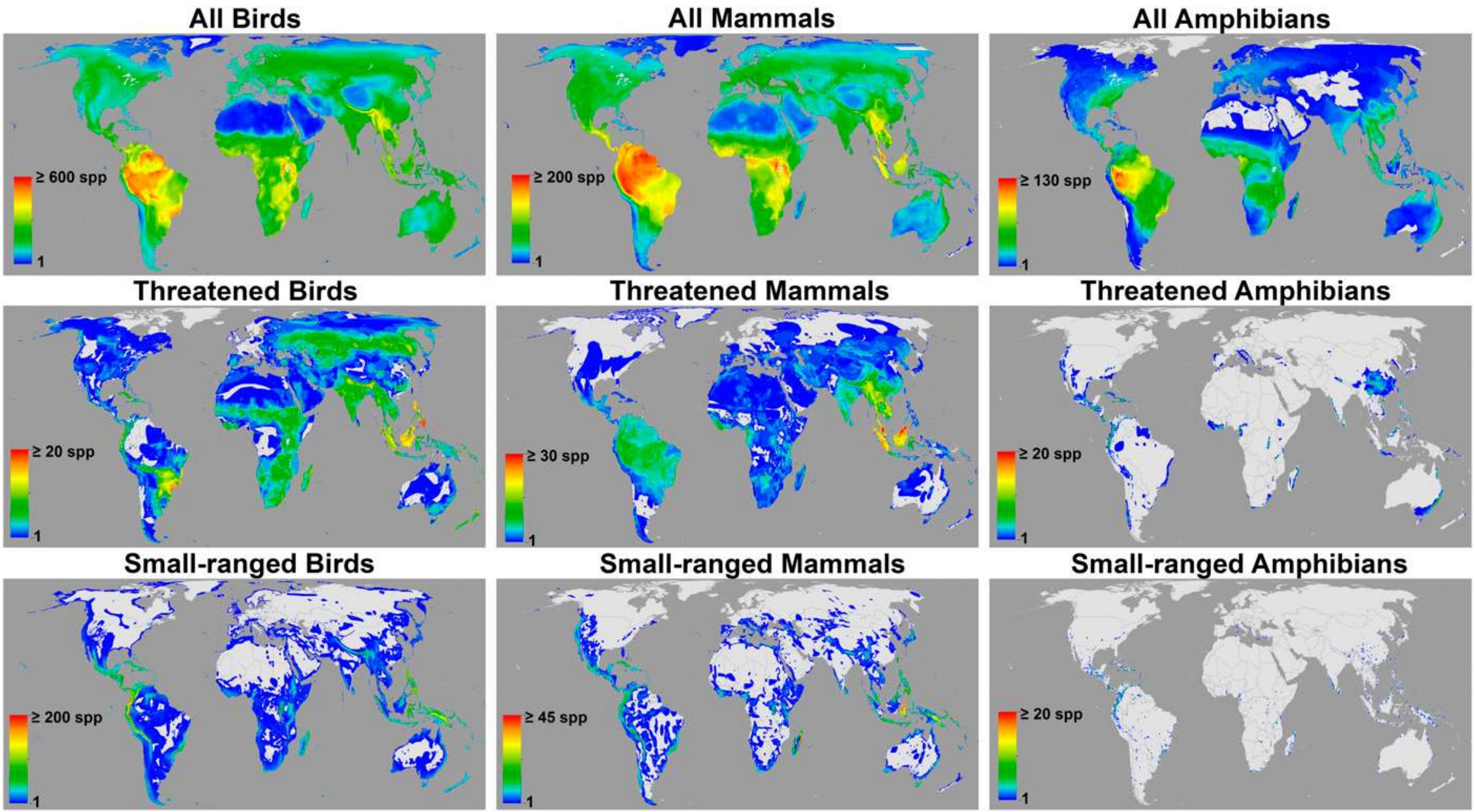




The upper and lower blue curves are the fits of the power-law SAR and EAR, the red curves are for the random placement SAR and EAR.

Yasuni [Ecuador] Lowland tropical forest, 50 ha plot, 307,279 stems 1,128 species
z[SAR] = 0.126 z[EAR] = 0.0623
SAR overestimates species loss for 25% area reduction by 100.4%

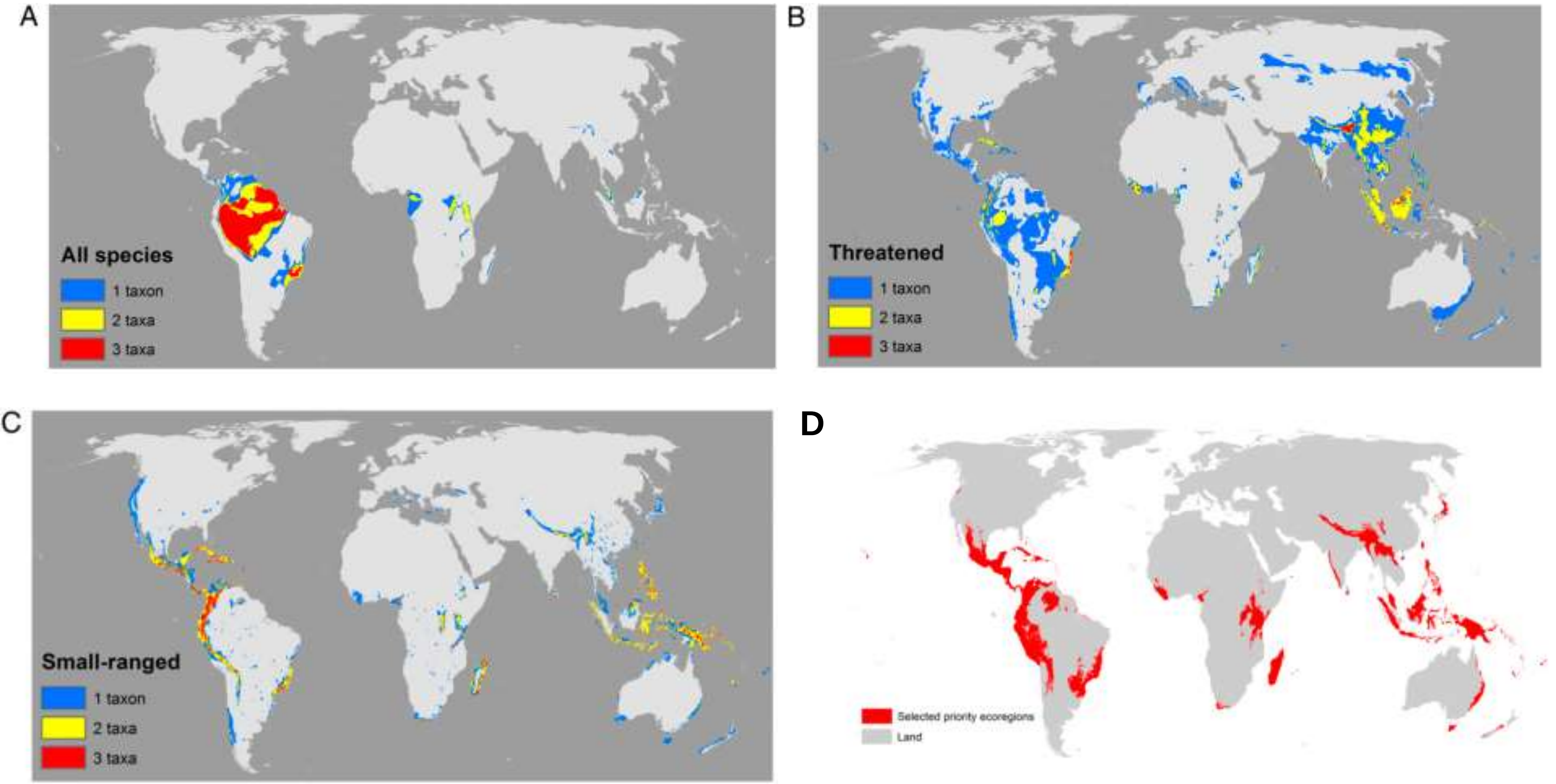
Biodiversity distribution in birds, mammals and amphibians



Threatened species: vulnerable, endangered, or critically endangered in the IUCN Red List.
Small-ranged species: geographic ranges are smaller than the median range size for that ta

Jenkins et al. 2013, PNAS

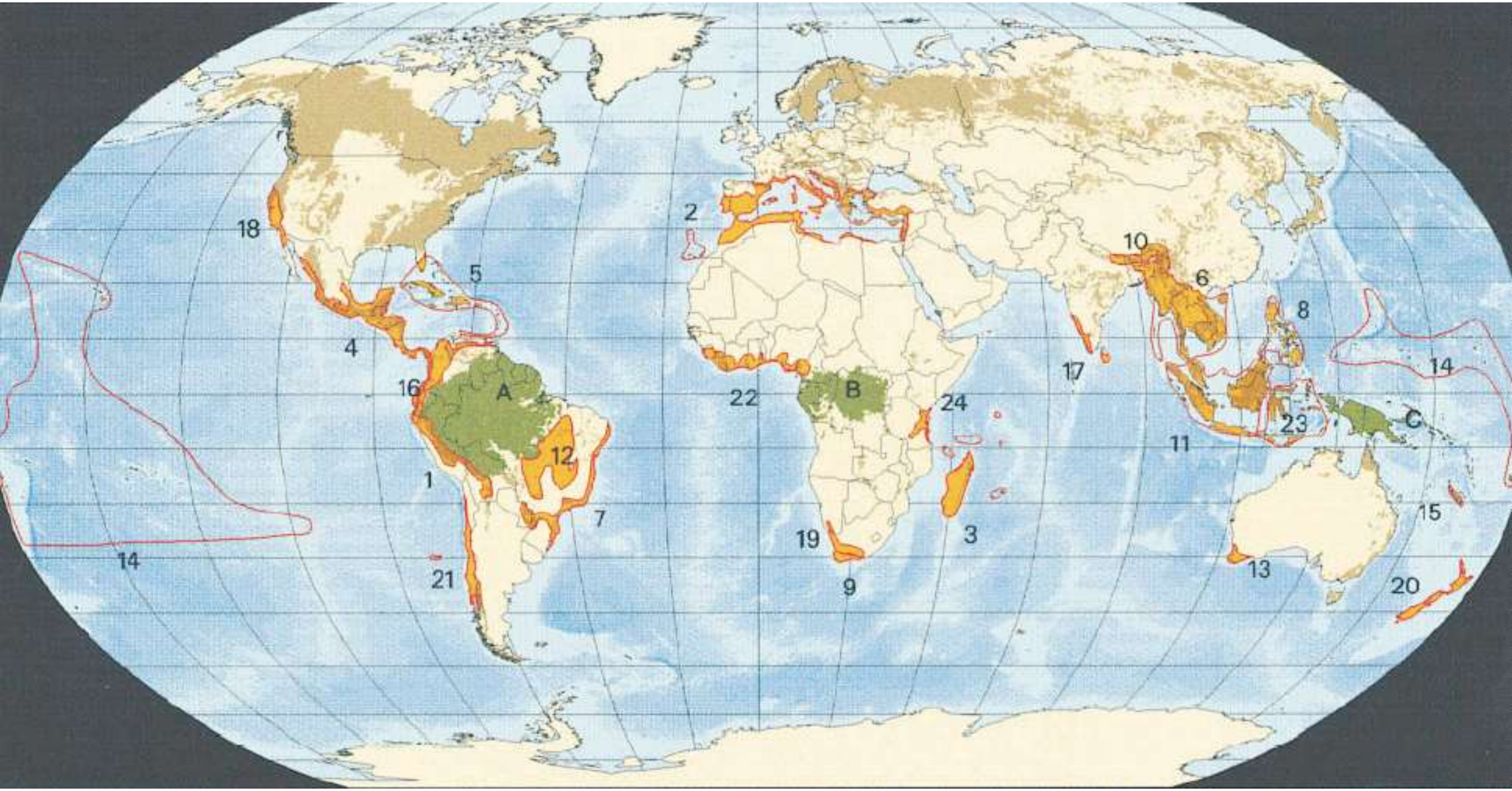
Overlap in biodiversity centers in birds, mammals and amphibians



Overlap of species richness centers (centers are among the richest 5% of cells for at least one of the taxa): A: All species, B: IUCN threatened species, C: Small-ranged species. D:.Priority ecoregions based on small-ranged vertebrates

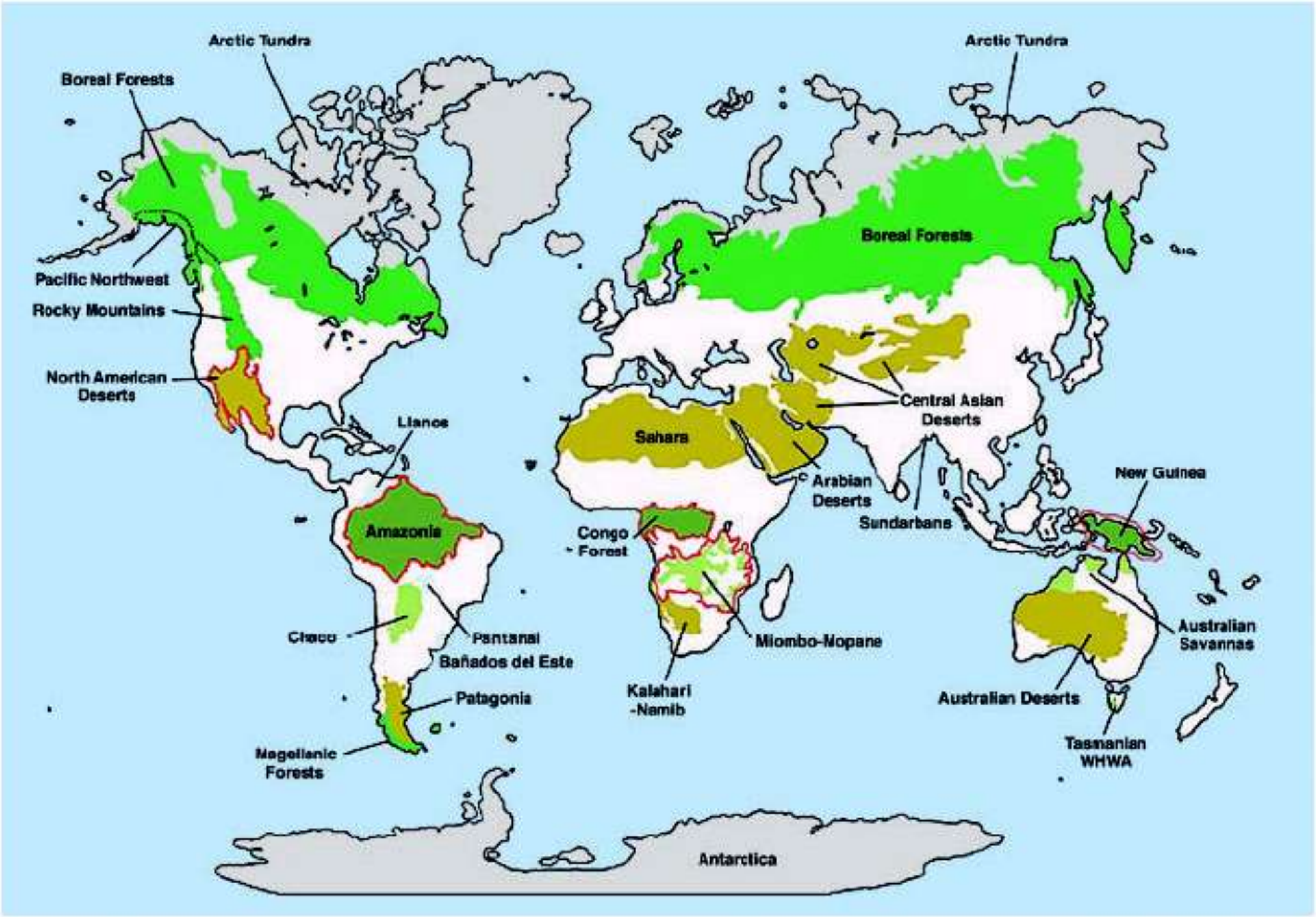
Jenkins et al. 2013, PNAS

Biodiversity hotspots and tropical wilderness areas



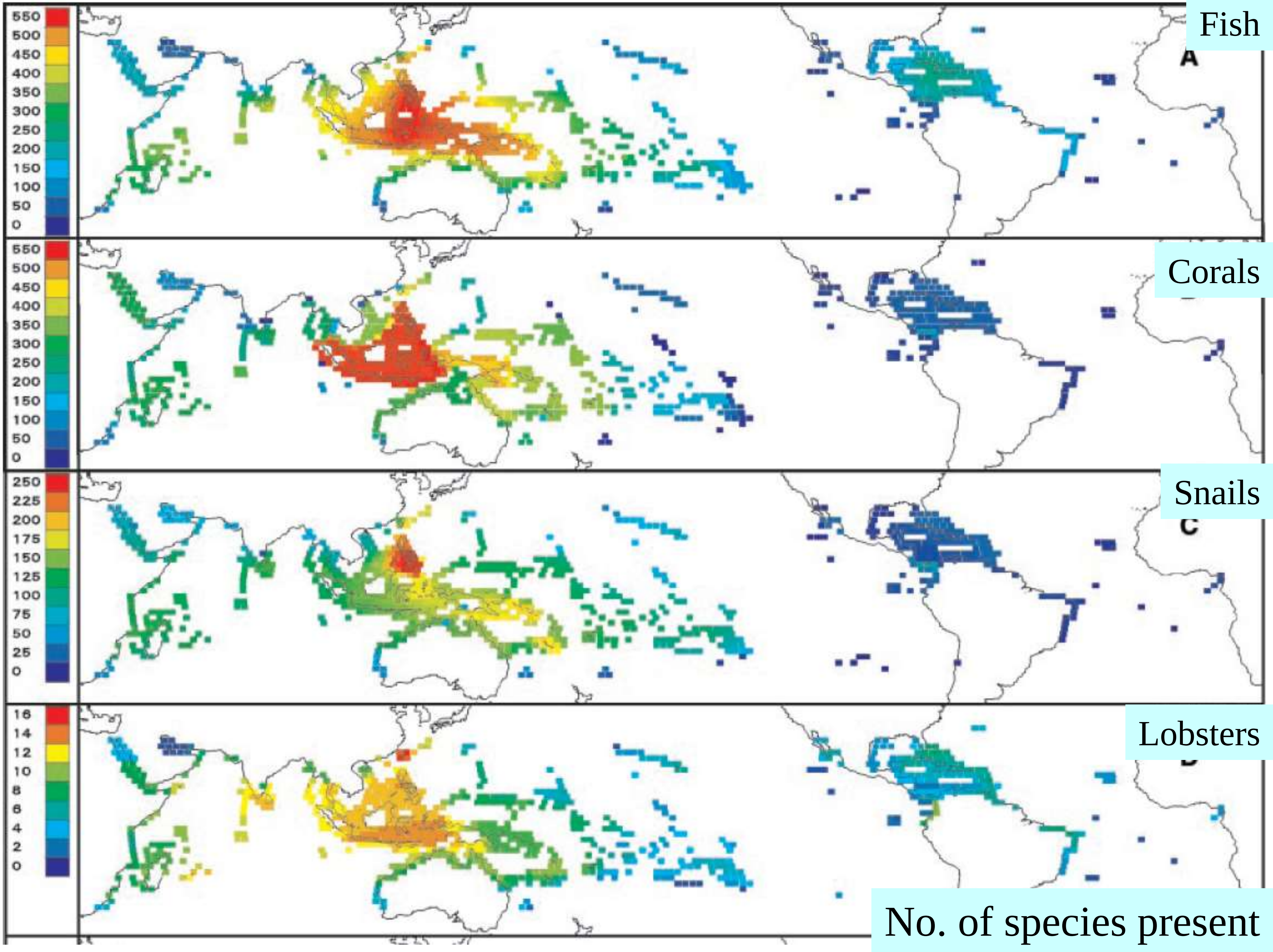
Hotspots: 0.5% of land area includes 20% of global diversity (plants)

Wilderness area: >1 million ha, >70% intact, human population <5 people/km^2

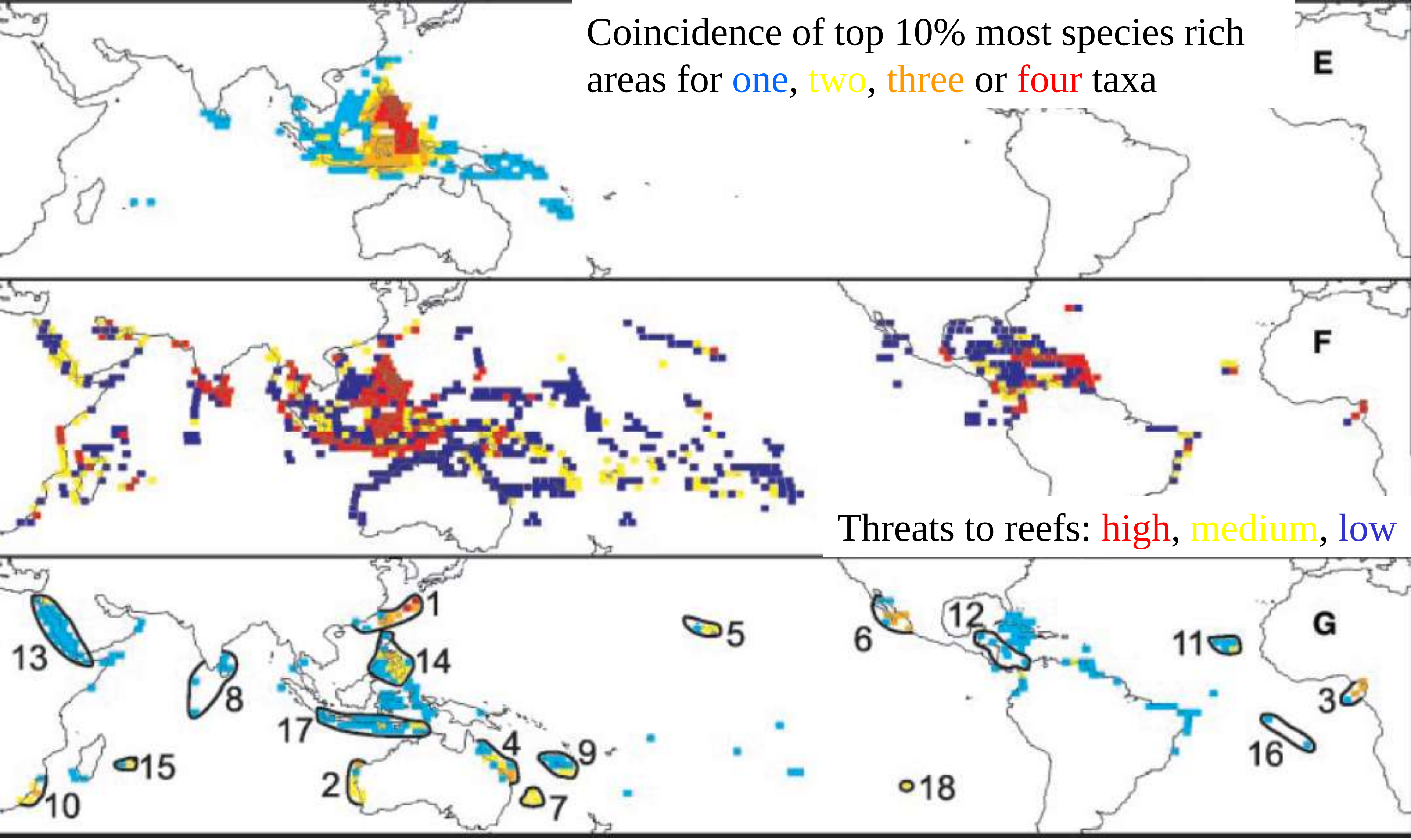


24 wilderness areas cover 44% of land and are inhabited by 3% of human population

Mittermeier et al. (2003)



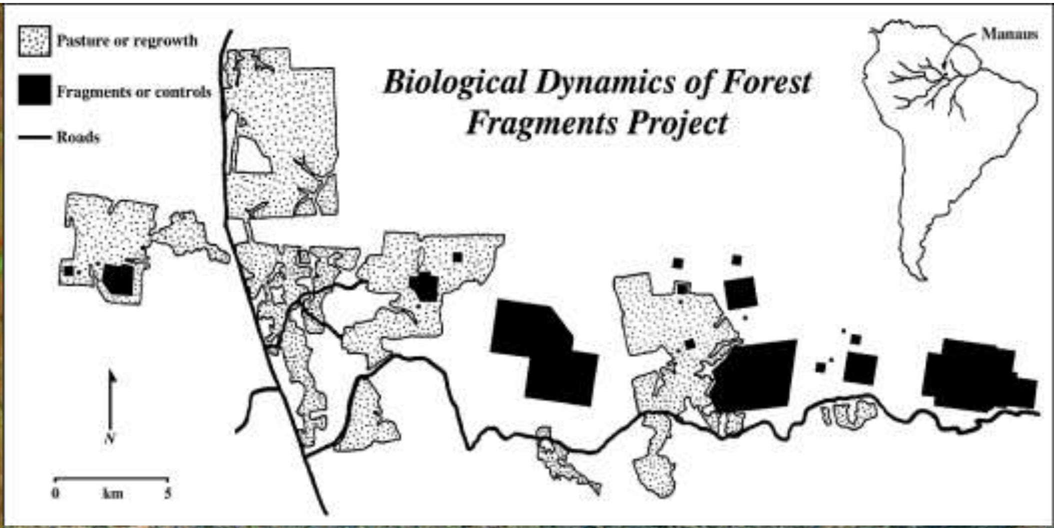
Fish
A
550
500
450
400
350
300
250
200
150
100
50
0
Corals
550
500
450
400
350
300
250
200
150
100
50
0
Snails
C
250
225
200
175
150
125
100
75
50
25
0
Lobsters
16
14
12
10
8
6
4
2
0
No. of species present



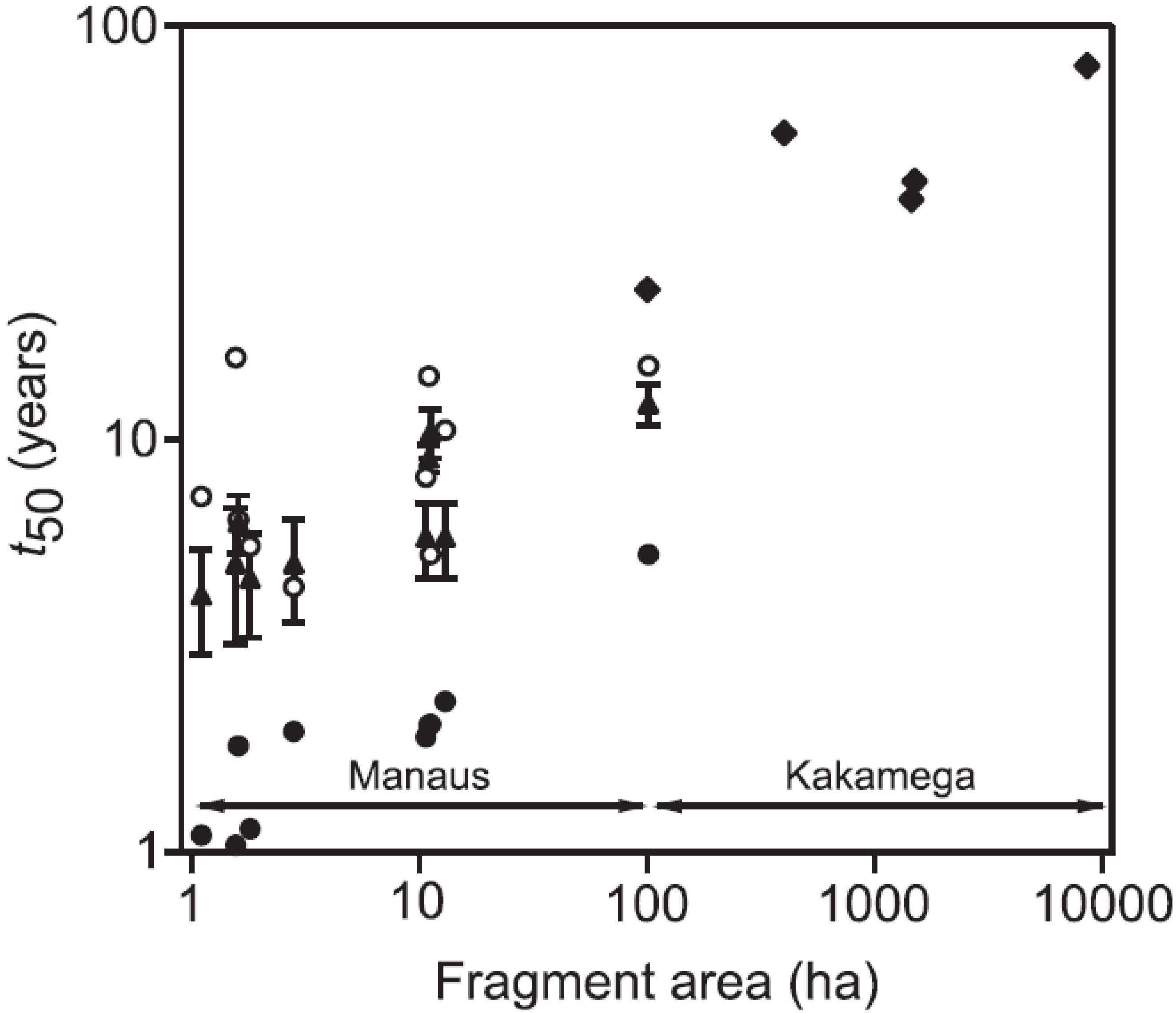
Centres of endemism for one, two, three or four taxa

Fig. 1. Global clines in species richness of fish (**A**), corals (**B**), snails (**C**), and lobsters (**D**). Scales show number of species present. (**E**) Concordance of the top 10% most species-rich cells among taxa. Red cells were included for all four taxa, orange for three, yellow for two, and blue for one. (**F**) Threats to reefs in each grid cell, calculated using data from Bryant *et al.* (*3*, *13*). Blue represents low risk (average threat score between 1 and 1.67); yellow, medium risk (score between 1.68 and 2.33); and red, high risk (score ≥2.34). (**G**) Concordance in patterns of range rarity among the top-scoring 10% of cells for each taxon. Color codes are as in (E). Places outlined show multitaxon centers of endemism (*13*) [Web table 2 (*8*)], numbered as in Table 2.

Forest fragmentation experiment in Manaus



Diversity half-life:
time needed to lose 50% of species from a forest fragment



st fragments in Manaus
The graph shows three
95% bounds (triangles),
ars (empty circles), and
cay (filled circles).

Loss of bird species from rainforest fragments since isolation

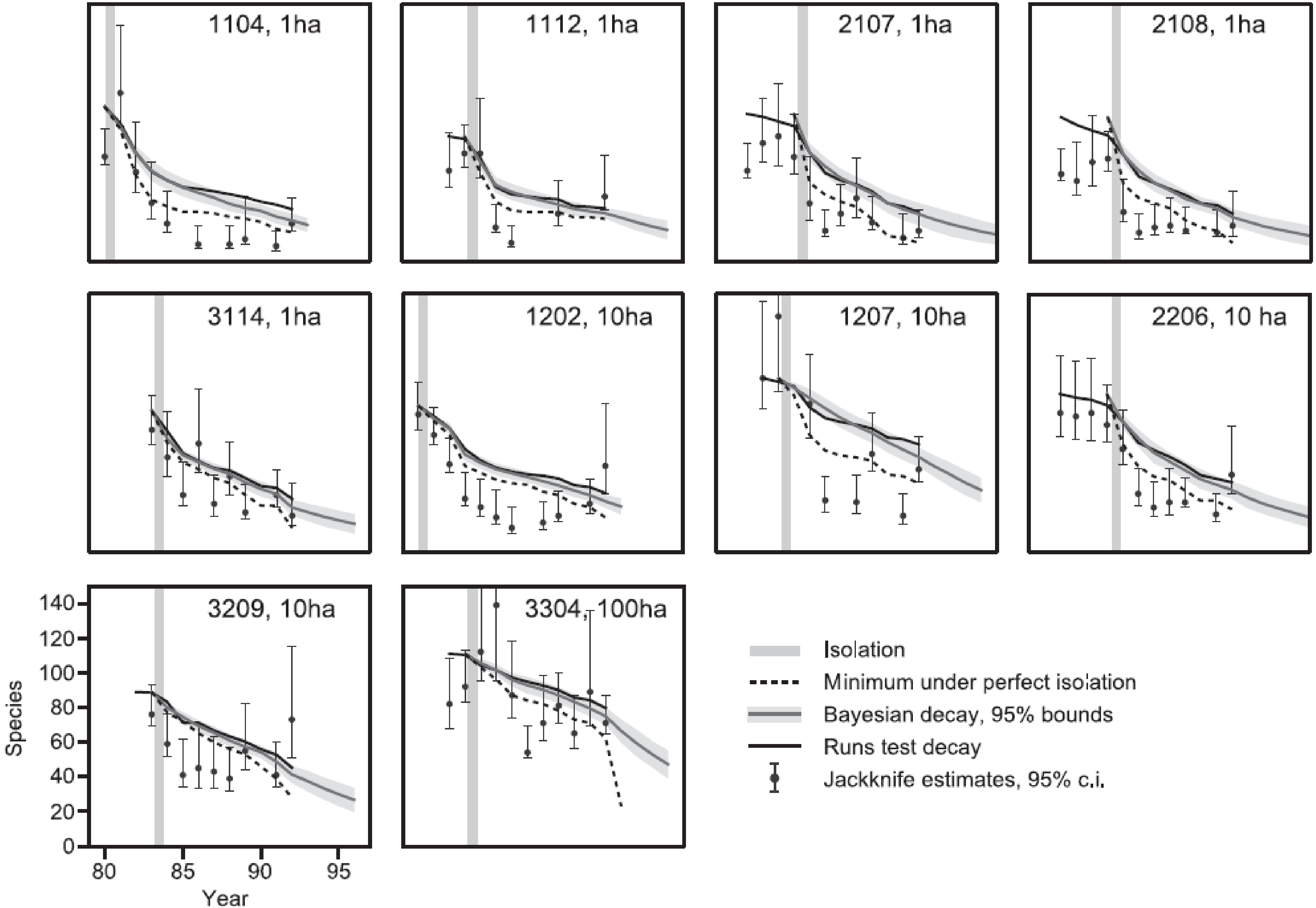
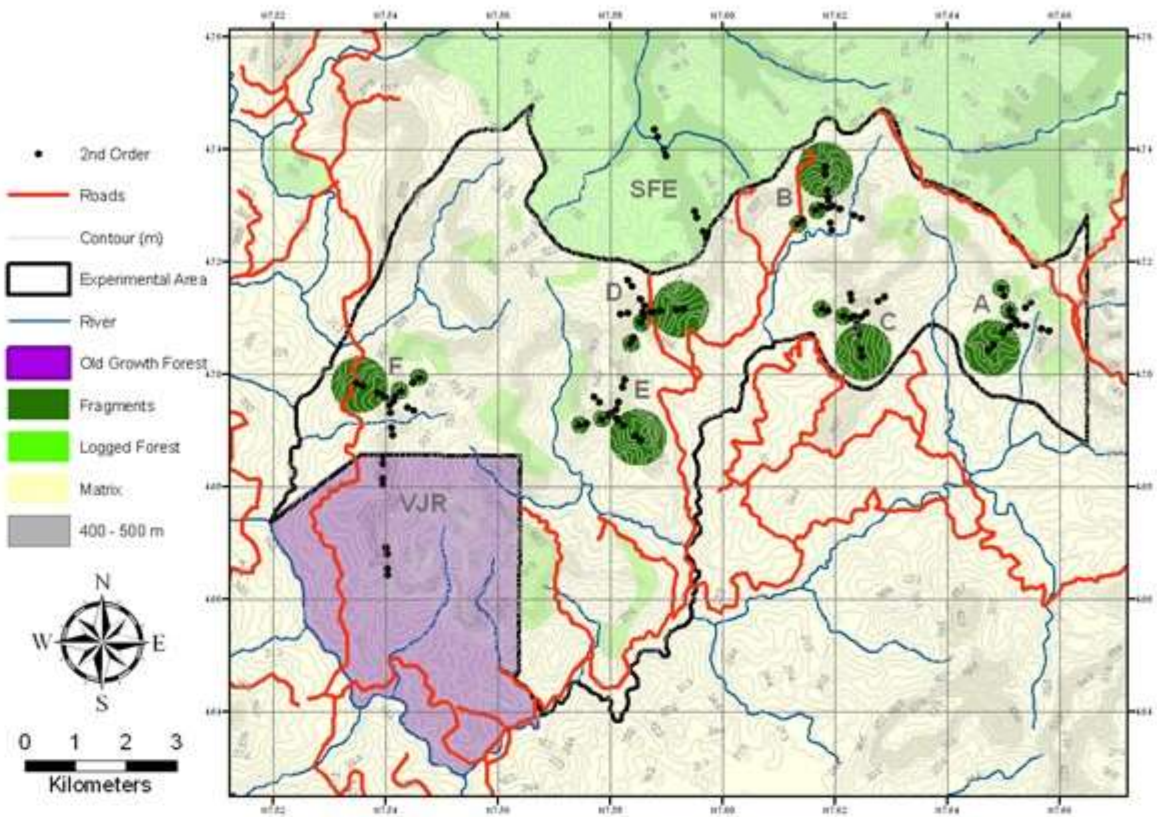


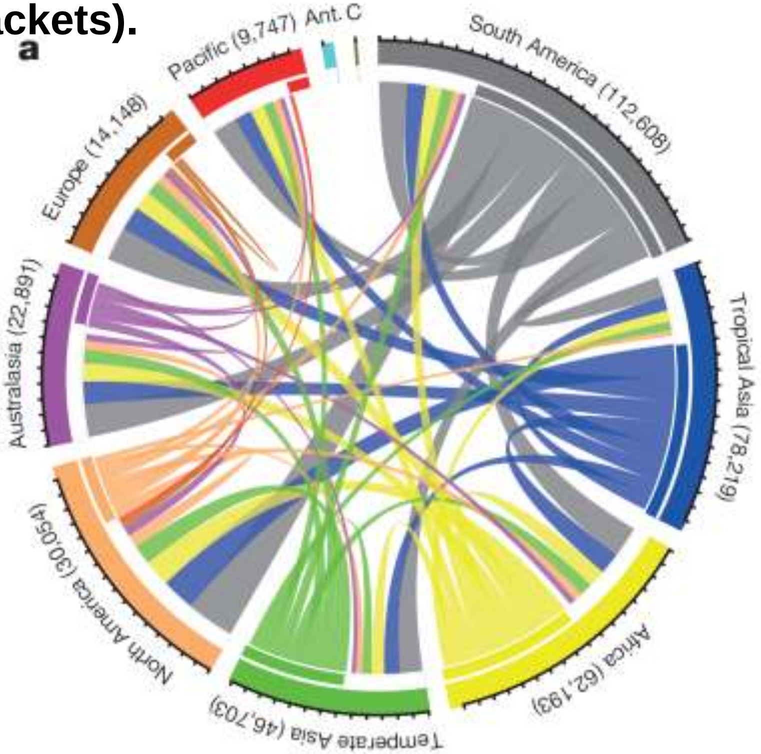
Fig. 1. Plots of species loss for all fragments according to four different methods: minimum under perfect isolation, Bayesian with $\mu = 0.1$ and step-decay, runs-test, and jackknife estimates. The gray bars indicate the timing of isolation.

SAFE: Stability of Altered Forest Ecosystems
(replicated fragments of lowland rainforest in an oil palm matrix in Borneo

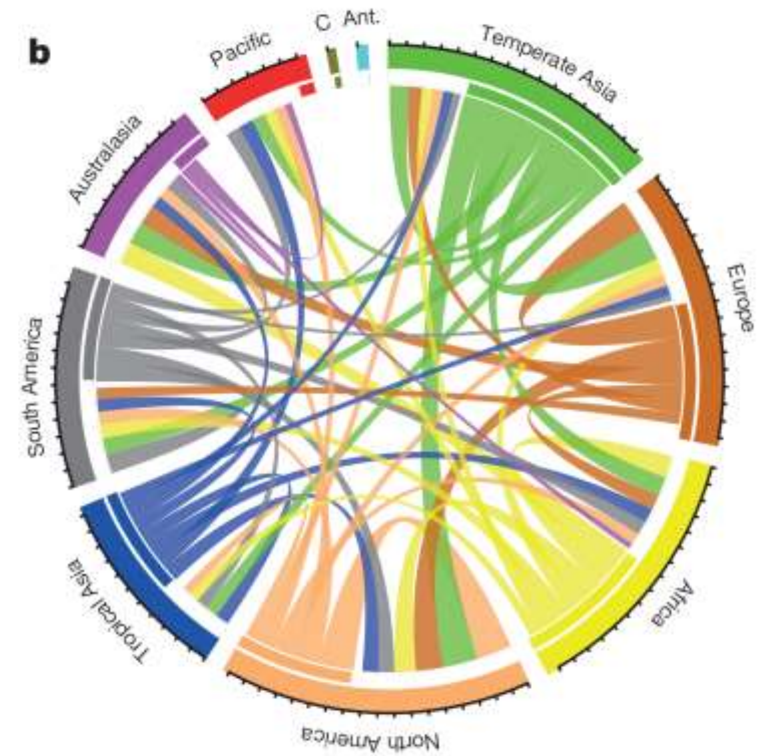


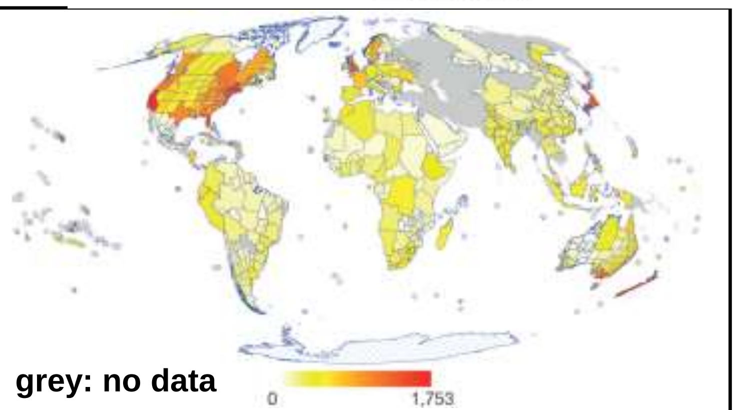
Sources and destinations of alien plant species

A: Expected flow of naturalized plant specie based on the numbers of native species (in brackets).



B: Observed flow of naturalized plant species





grey: no data

Number of naturalized plant

Each tick along the outer circle corresponds to 1,000 species. Left (white) parts of inner bars along the circle represent flows of imported species; right (coloured) parts represent exported species.

Van Kleunen et al. 2015, Nature 525: doi:10.1038/nature14910

Invasive species – one of the most serious threats to biodiversity

Eichhornia crassipes (water hyacinth), Lake Victoria, Madagascar (and elsewhere)

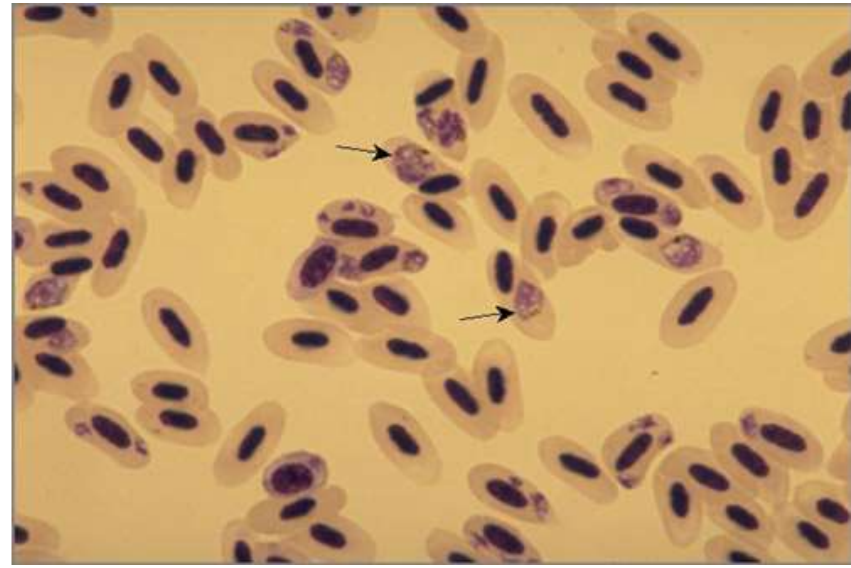
Lates niloticus, Lake Victoria

Boiga irregularis, Guam island

Avian malaria introduced to Hawaii: contributed to several extinctions

1830 Culex quinquefaciatus introduced

1900's Plasmodium relictum introduced



Hemignathus munroi limited by malaria to montane areas

Malamprosops phaeosoma reported extinct in 2004

An alien landscape in Tanzania: tea plantation with introduced *Eucalyptus* plantation flanked by *Montanora hypiscifolia* alien

Global traffic is ever increasing: daily air passengers

Forecast and control of epidemics in a globalized world

L. Hufnagel, D. Brockmann, and T. Geisel

Biodiversity and human cultural diversity are spatially correlated

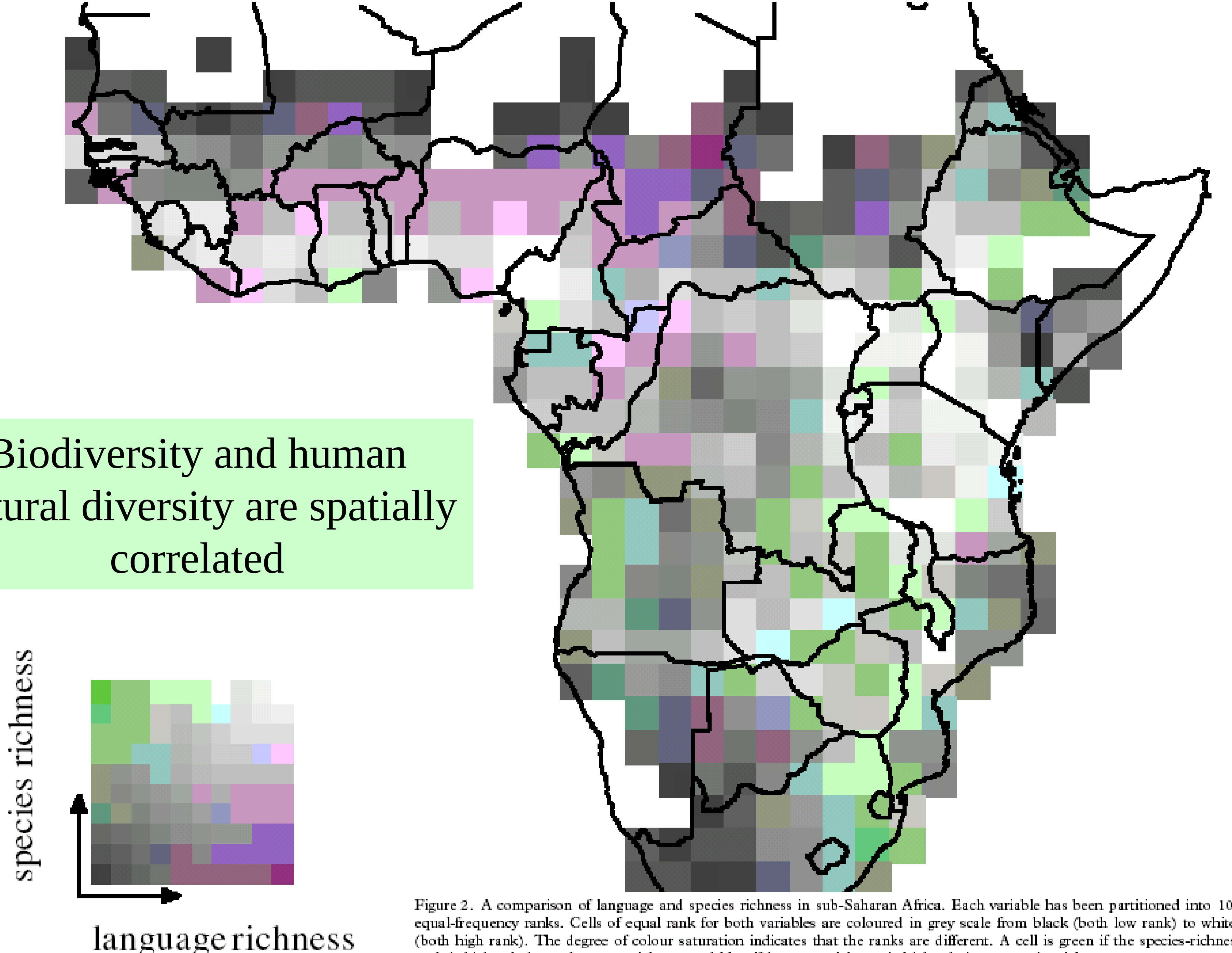
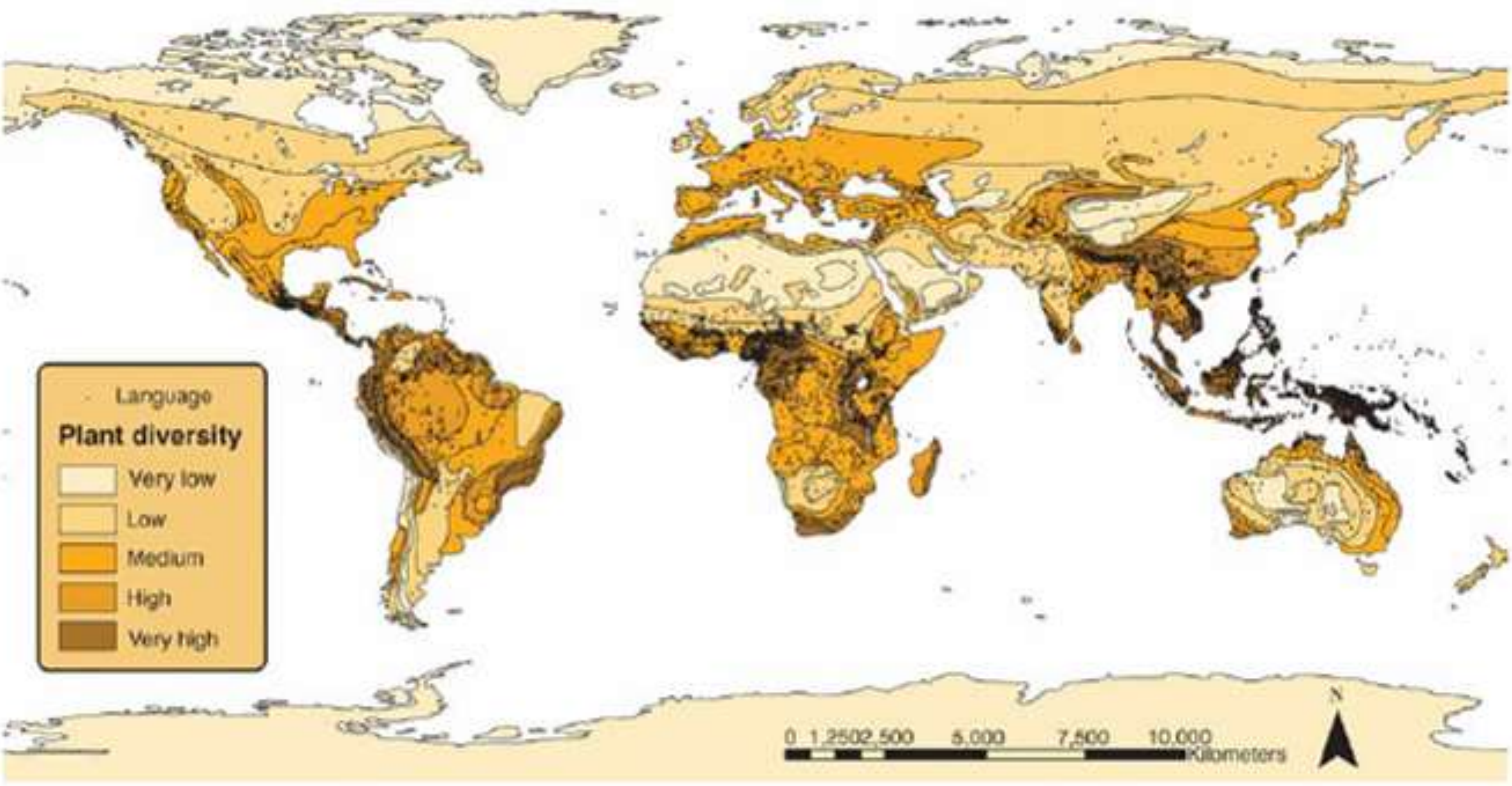


Figure 2. A comparison of language and species richness in sub-Saharan Africa. Each variable has been partitioned into 10 equal-frequency ranks. Cells of equal rank for both variables are coloured in grey scale from black (both low rank) to white (both high rank). The degree of colour saturation indicates that the ranks are different. A cell is green if the species-richness rank is high relative to language richness and blue if language richness is high relative to species richness.

Plant and language diversity distribution

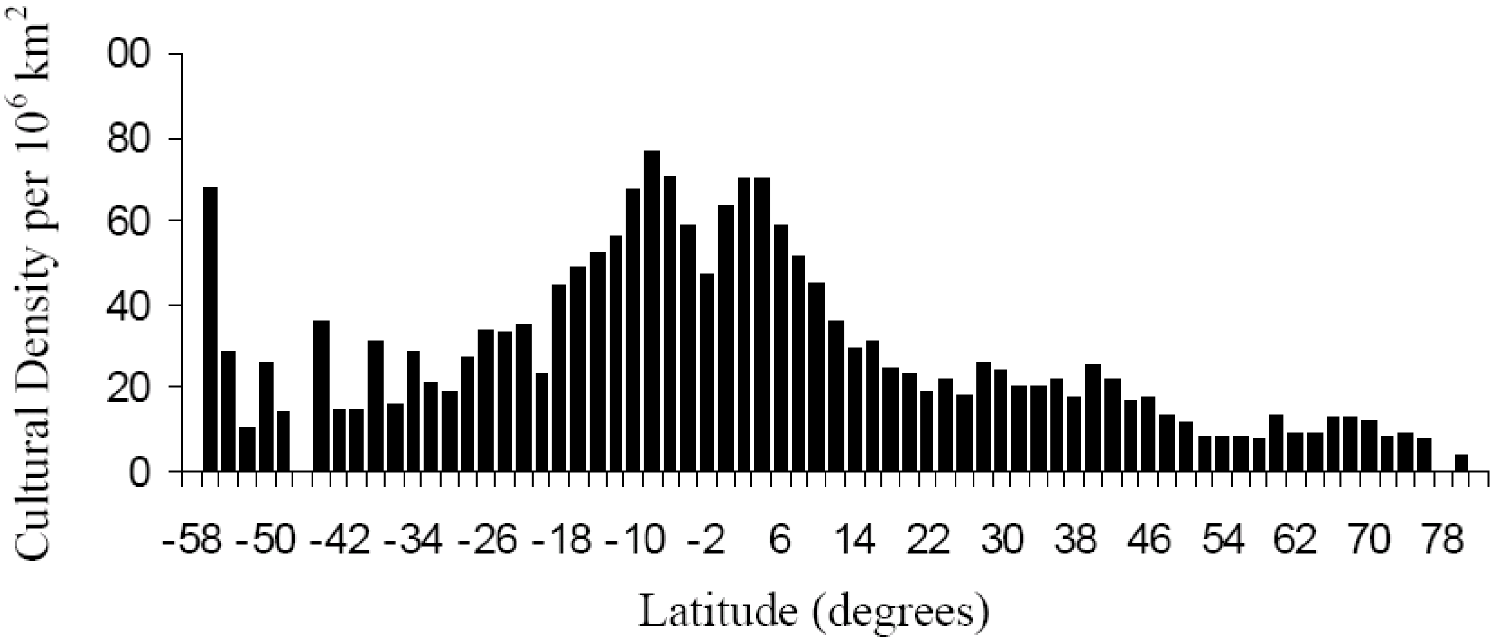


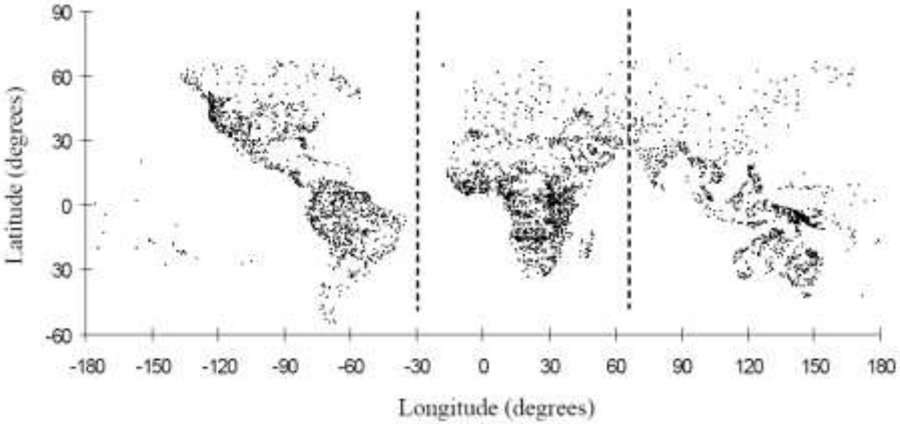
Maffi 2005, Annu. Rev. Anthropol. 34: 599

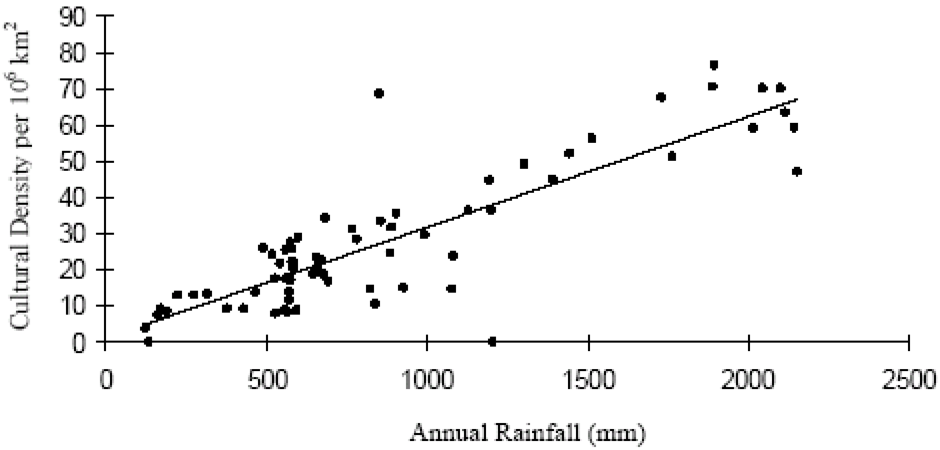
Figure 2

Plant diversity and language distribution. From Stepp et al. 2004. Used with permission.

Global distribution of human cultures





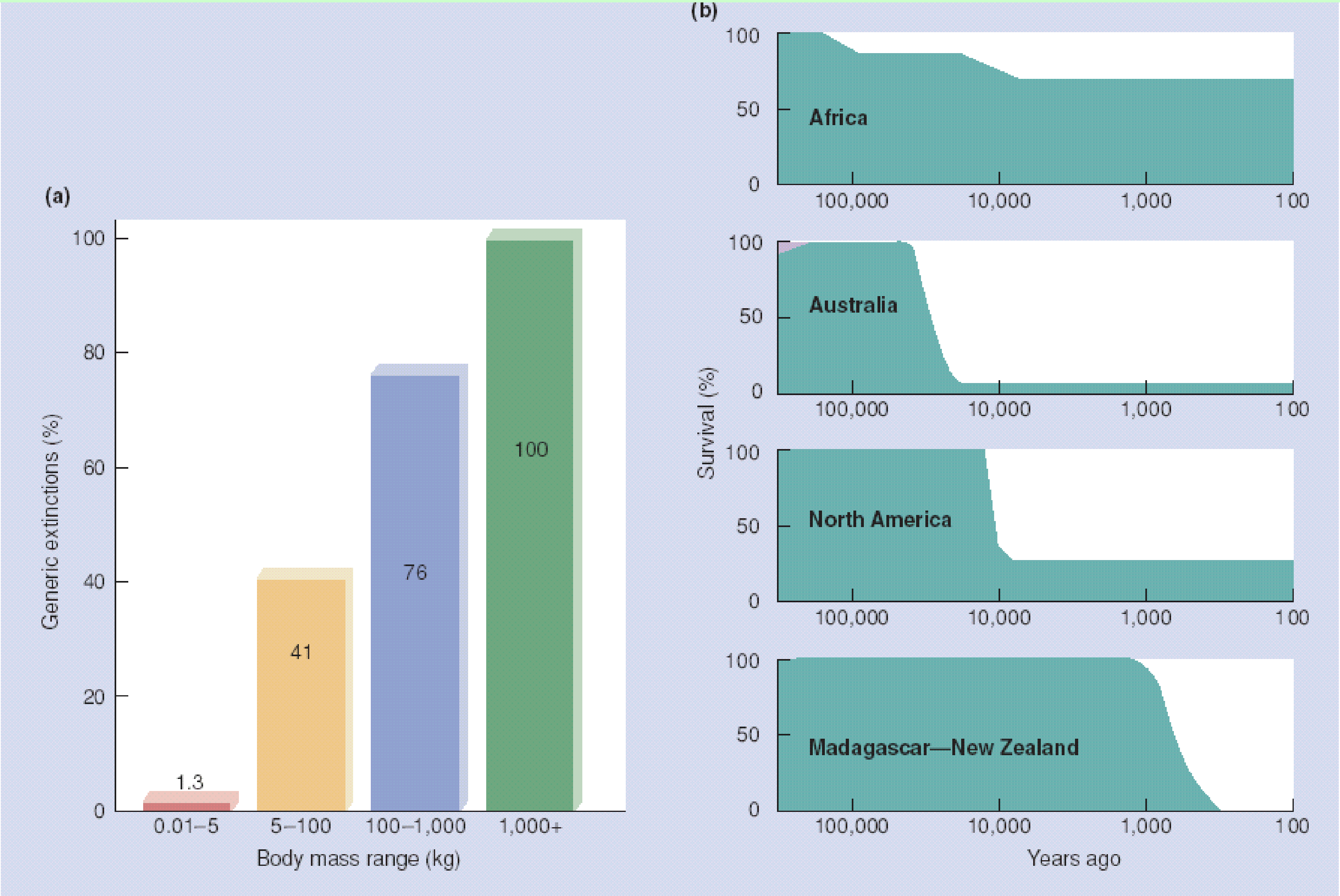


Collard and Foley

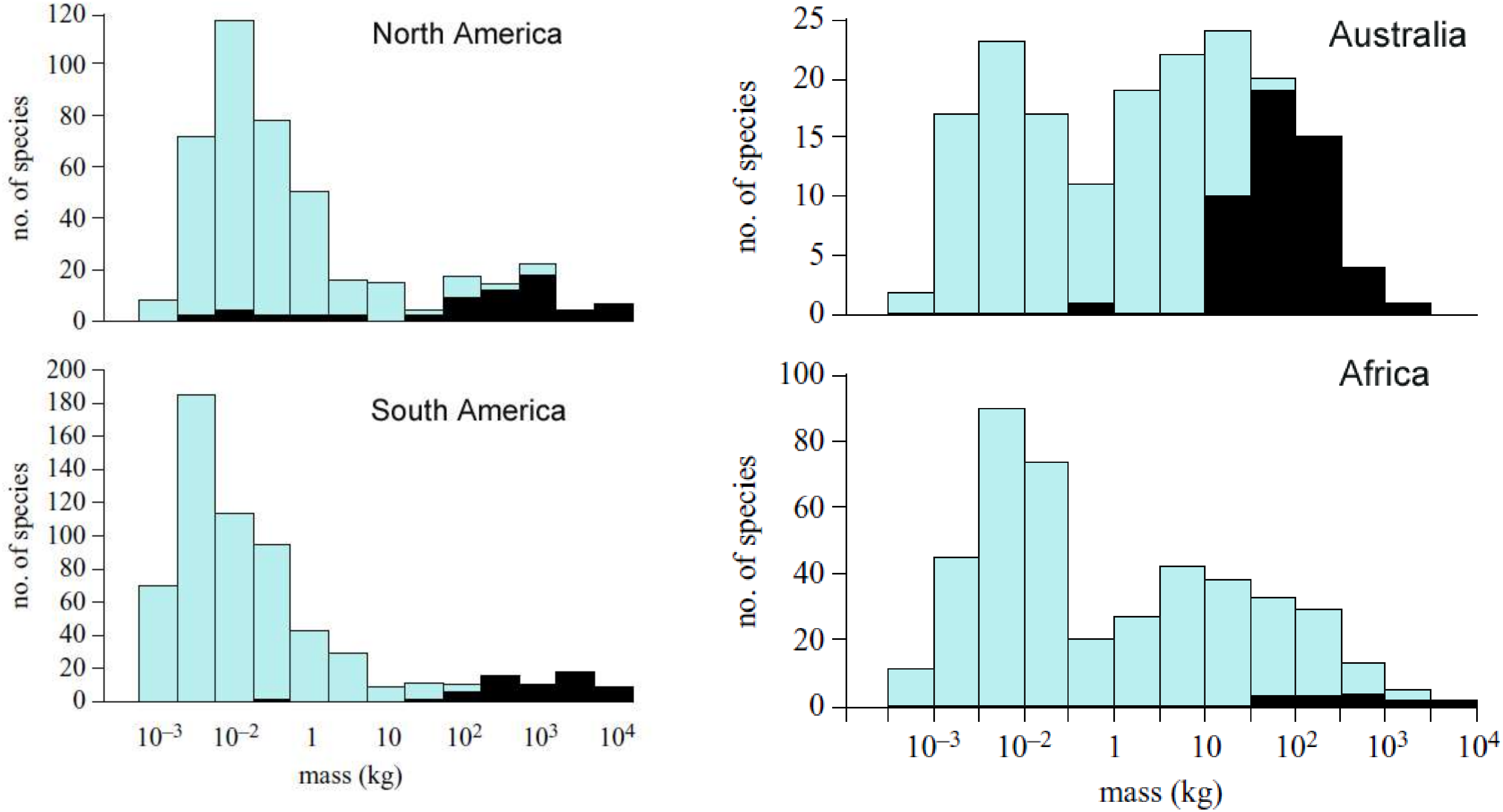
And now for something completely different: rainforests and their inhabitants

Do traditional forest societies know secret of nature conservation?

Extinction of large mammalian herbivores in past 130,000 years: hunting humans are the prime suspects

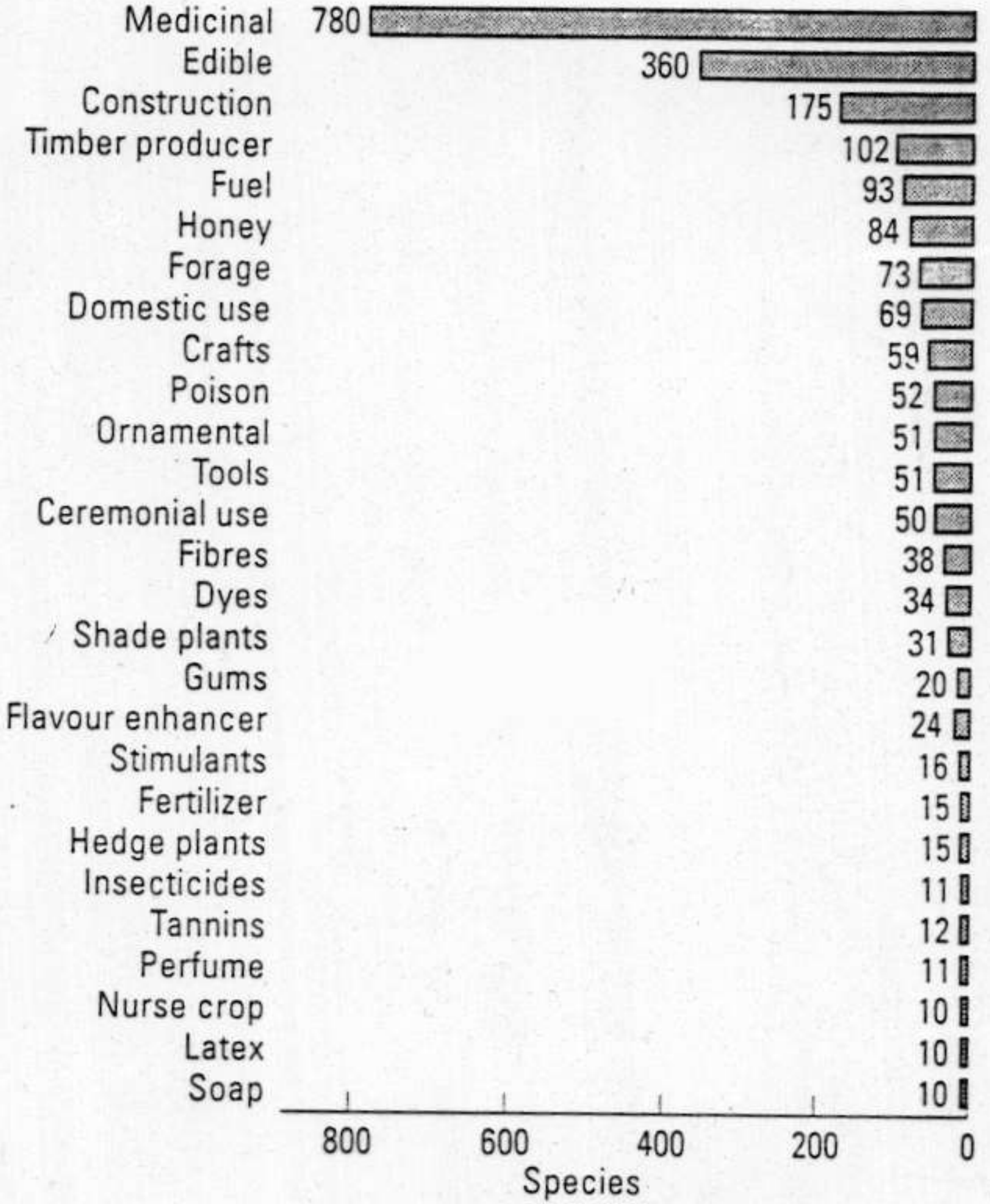


(a) The percentage of genera of large mammalian herbivores that have gone extinct in the last 130,000 years is strongly size dependent (data from North and South America, Europe, and Australia combined). (After Owen-Smith, 1987.) (b) Percentage survival of large animals on three continents and two large islands (New Zealand and Madagascar). (After Martin, 1984.)



Body size distribution of herbivorous mammals in Late Pleistocene
[black – species now extinct, blue – species surviving]

Johnson 2009, Proc. R. Soc. B 2009 **276**, 2509-2519



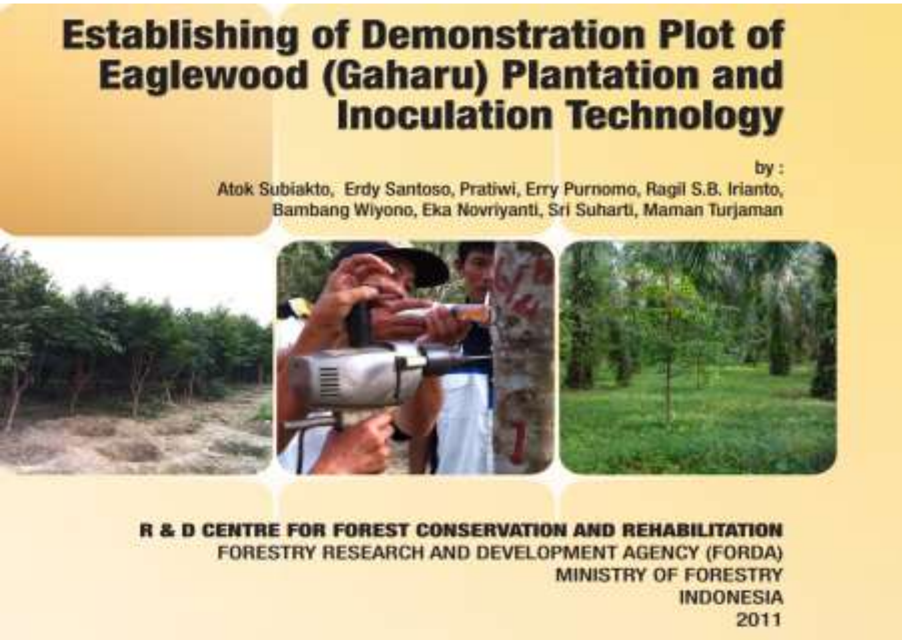
Traditionally used plants from a tropical forest in Mexico

Fig. 10.3. Useful plants from the tropical rain forests of Mexico. (Toledo *et al.* 1995 fig. 4.)
The 1330 useful species, 1052 from primary forests, yield 3173 products.

Gaharu fever in the Hotmin village

Agarwood (gaharu) tree
[*Aquilaria*, Thymeleaceae]

Economically successful rainforest products create demand for unsustainable harvest and their mass agricultural production



Market valuation of fruits and latex produced by 1 ha forest in Peru: USD 698 per ha and year

TABLE 1 Annual yield and market value of fruit and latex produced in one hectare of forest at Mishana, Rio Nanay, Peru

Common name	Species	No. trees	Annual production per tree	Unit price (US$)	Total value (US$)
Aguaje	*Mauritia flexuosa* L.	8	88.8 kg	10.00/40 kg	177.60
Aguajillo	*Mauritiella peruviana* (Becc.) Burrett	25	30.0 kg	4.00/40 kg	75.00
Charichuelo	*Rheedia* spp.	2	100 fruits	0.15/20 fruits	1.50
Leche huayo	*Couma macrocarpa* Barb. Rodr.	2	1,060 fruits	0.10/3 fruits	70.67
Masaranduba	*Manilkara quianensis* Aubl.	1	500 fruits	0.15/20 fruits	3.75
Naranjo podrido	*Parahancornia peruviana* Monach.	3	150 fruits	0.25/fruit	112.50
Sacha cacao	*Theobroma subincanum* Mart.	3	50 fruits	0.15/fruit	22.50
Shimbillo	*Inga* spp.	9	200 fruits	1.50/100 fruits	27.00
Shiringa	*Hevea quianensis* Aubl.	24	2.0 kg	1.20/kg	57.60
Sinamillo	*Oenocarpus mapora* Karst.	1	3,000 fruits	0.15/20 fruits	22.50
Tamamuri	*Brosimum rubescens* Taub.	3	500 fruits	0.15/20 fruits	11.25
Ungurahui	*Jessenia bataua* (Mart.) Burret	36	36.8 kg	3.50/40 kg	115.92
Totals		117			697.79

Fruit yields measured for *M. flexuosa*, *J. bataua*, *P. peruviana* and *C. macrocarpa*: estimated yields for other fruit trees based on interviews with local collectors.

Logging income valuation of the same 1 ha forest in Peru: USD 1,000 per ha for forest logging

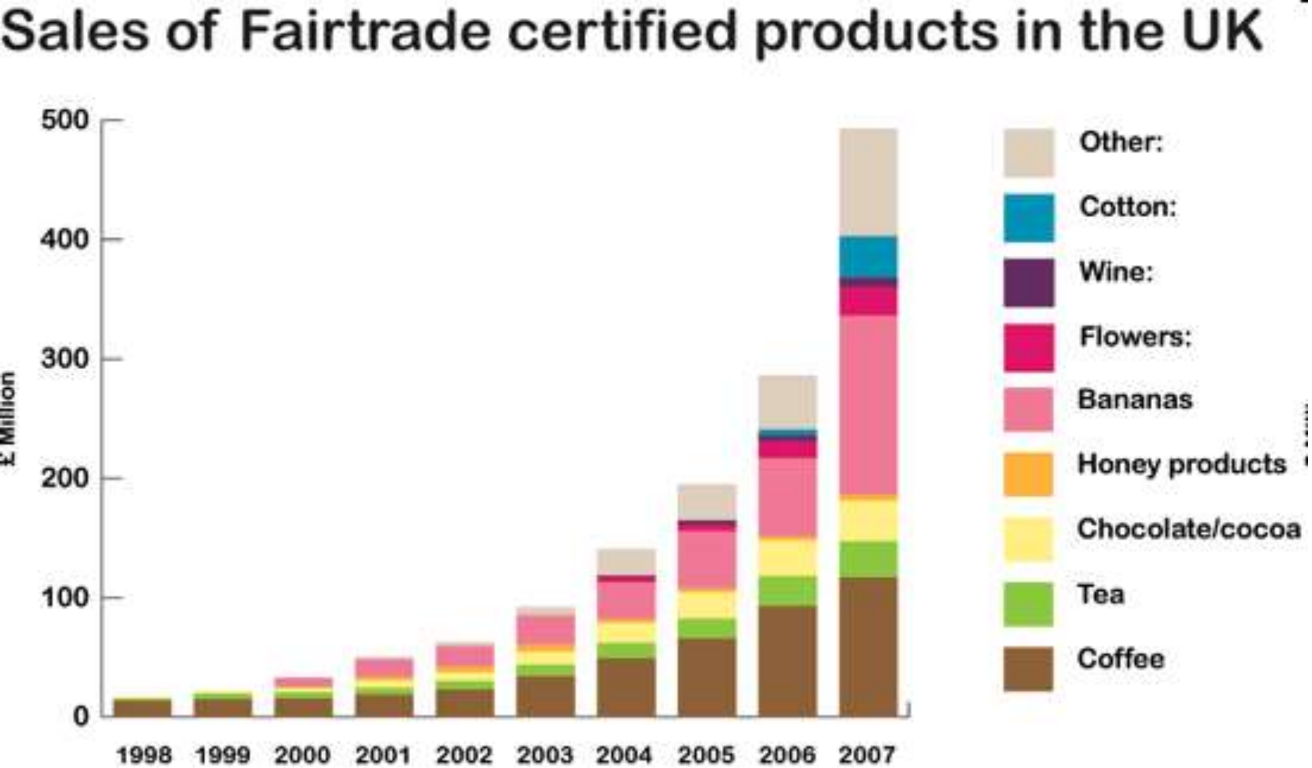
TABLE 2 Merchantable volume and stumpage value of the commercial timber tree in one hectare of forest at Mishana, Rio Nanay, Peru

Commercial name	Genera included	No. trees	Wood volume (m^3)	Mill price (per m^3) (US$)	Stumpage value (US$)
Aguano masha	*Trichilia*	4	0.55	14.80	4.88
Almendro	*Caryocar*	1	0.08	14.80	0.71
Azucar huayo	*Hymenaea*	1	0.10	14.80	0.89
Cumala	*Iryanthera, Virola*	83	19.77	19.00	225.38
Espintana	*Guatteria, Xylopia*	7	1.47	21.00	18.52
Favorito	*Osteophloeum*	2	3.90	14.80	34.63
Ishpingo	*Endlicheria*	4	0.82	14.80	7.28
Itauba	*Mezilaurus*	3	0.29	14.80	2.57
Lagarto caspi	*Calophyllum*	2	0.25	40.30	6.04
Loro micuna	*Macoubea*	1	1.37	14.80	12.17
Machimango	*Eschweilera*	5	0.76	20.15	9.19
Machinga	*Brosimum*	10	24.61	14.80	218.53
Moena	*Aniba, Ocotea*	6	0.75	42.00	18.90
Palisangre	*Dialium*	1	0.27	14.80	2.39
Papelillo	*Cariniana*	1	1.19	14.80	10.57
Pashaco	*Parkia*	19	4.19	14.80	37.21
Pumaquiro	*Aspidosperma*	12	10.22	14.80	90.75
Quinilla	*Chrysophyllum, Pouteria, Manilkara*	34	9.18	31.80	175.15
Remo caspi	*Swartzia, Aspidosperma*	28	11.65	14.80	103.45
Requia	*Guarea*	4	1.06	14.80	9.41
Tortuga caspi	*Duquetia*	1	0.13	14.80	1.15
Yacushapana	*Terminalia*	2	0.71	14.80	6.31
Yutubanco	*Heisteria*	2	0.53	14.80	4.70
Totals		233	93.85		1.000.78

Twenty-three commercial names represent 28 genera and 60 tree species.

Galip nut (Canarium indicum):
great market potential, but probably
unavailable in your supermarket

Fair trade certification



Payment for rainforest conservation to forest owners: direct vs. indirect approaches

Potential Investments for Biodiversity Conservation

(Least direct)

Investment	Examples
Support for the use/marketing of extracted biological products	Logging, nontimber forest product extraction, and hunting
Subsidies for reduced-impact land and resource use	Sustainable agriculture on already cultivated lands, "alternative income generation"
Support for the use and or marketing of biodiversity within relatively intact	Eco-tourism, sport hunting, bioprospecting, wild honey production
Payment for other environmental services (generating biodiversity conservation as a side benefit)	Watershed protection, carbon sequestration
Payment for conservation land or "retirement" of biodiversity use rights	Easement, "nonlogging" concessions
Performance-based payment for biodiversity conservation	Paying for bird breeding success, paying for occupied wolf dens

(Most direct)

Ferraro & Kiss, 2002, Science 298: 1718

REDD: reducing emissions from deforestation and degradation

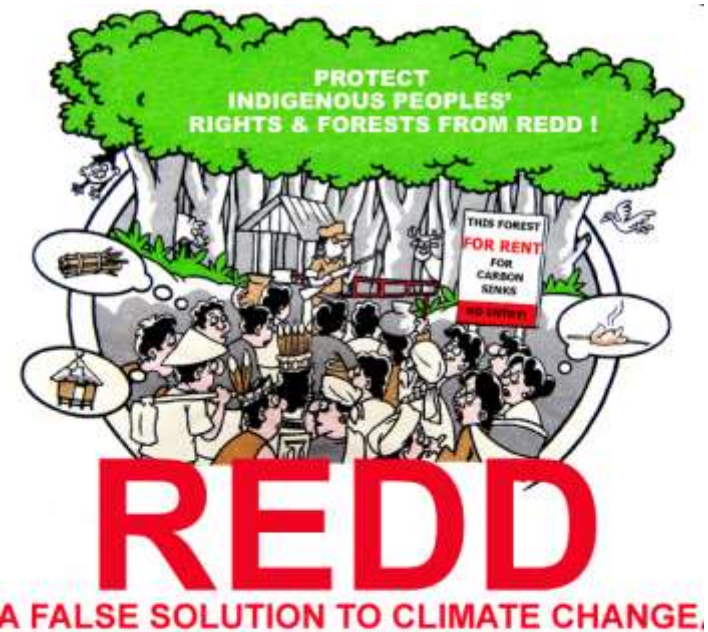
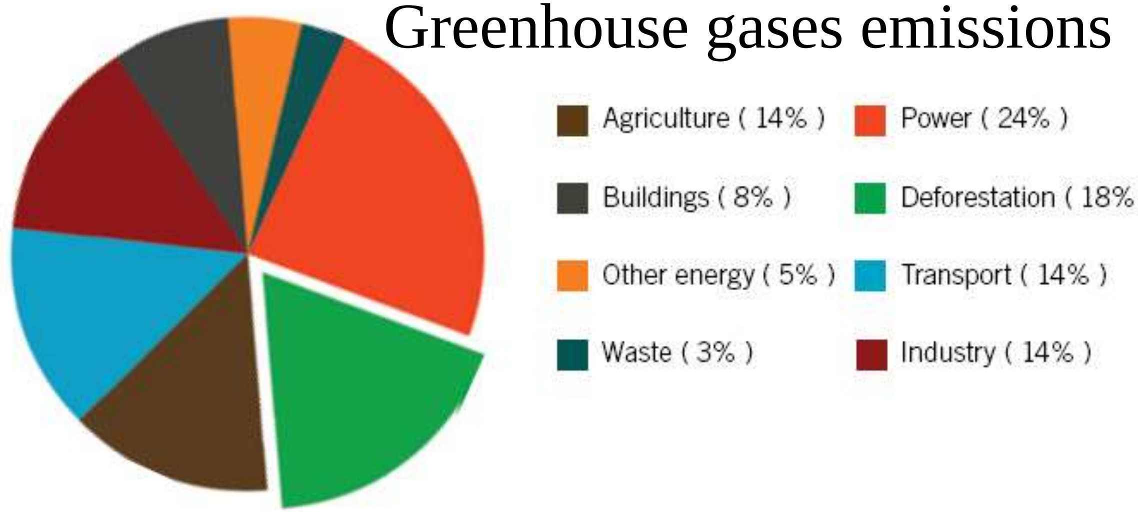
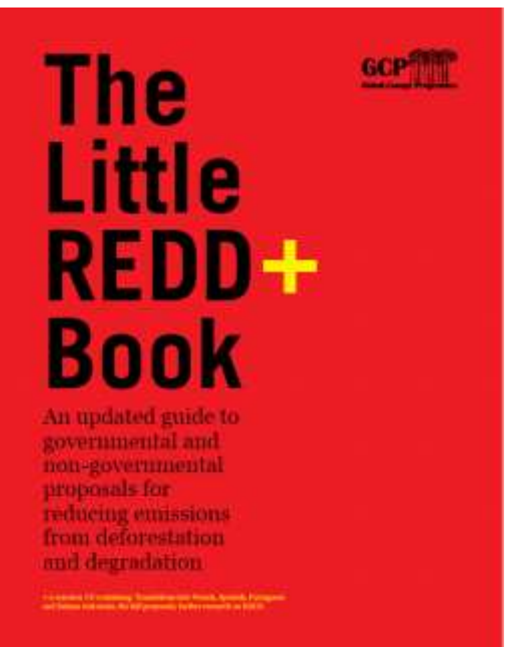
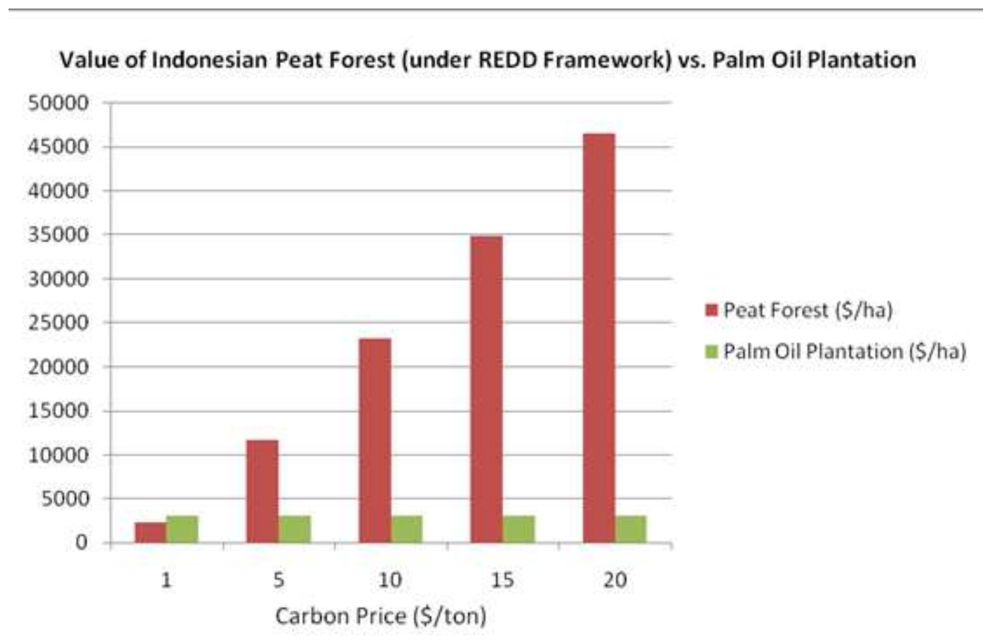


Figure 1. GHG emissions in 2000 by source[5]: From 'Stern Review on the Economics of Climate Change'. In the rest of this report, the IPCC's estimate of deforestation as 20% of global emissions has been adopted.

Greenhouse gases emissions



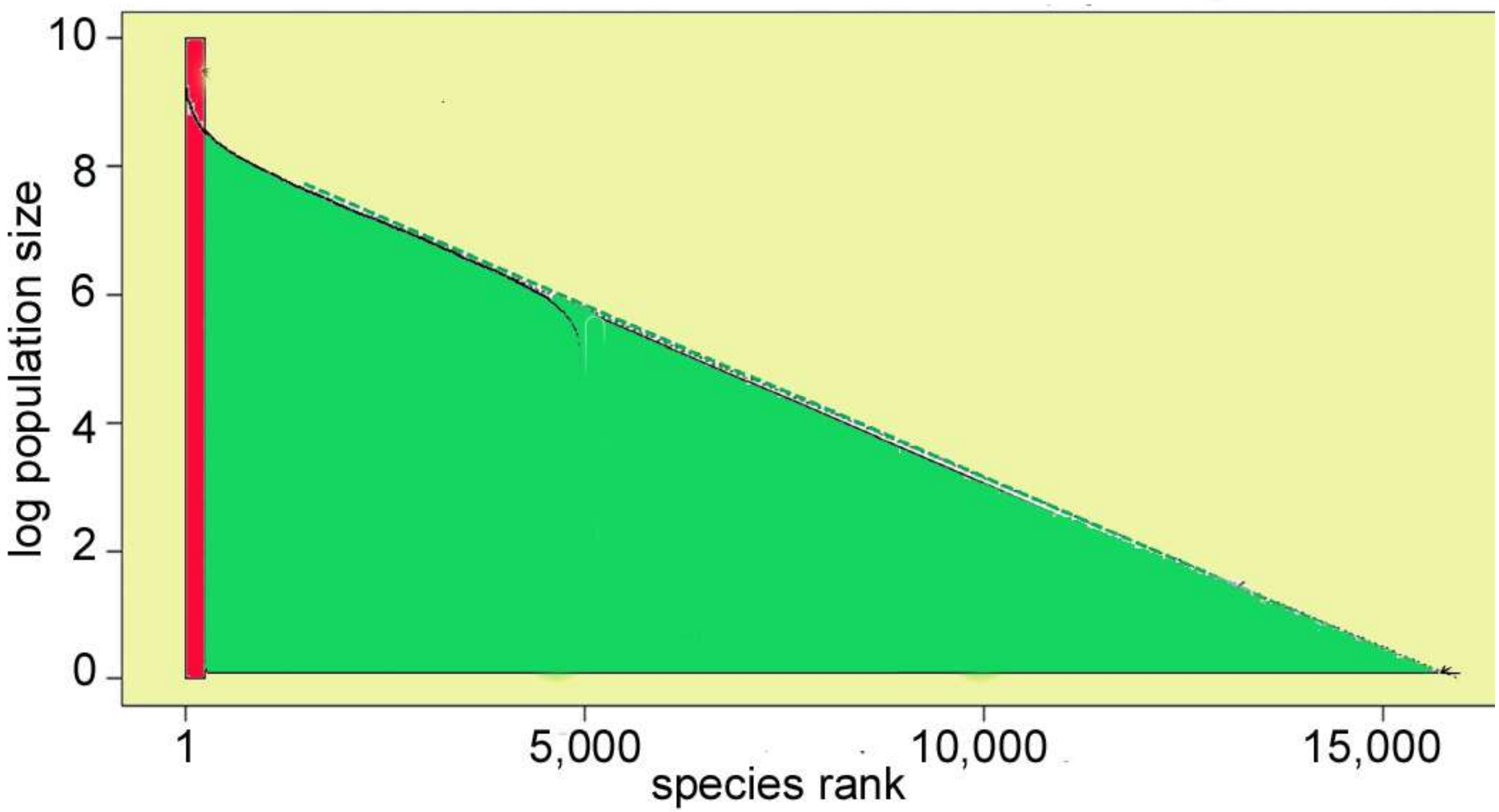




Functional arguments (“ecosystem services”) to protect tropical biodiversity are dangerous

16,000 tree species in Amazonia

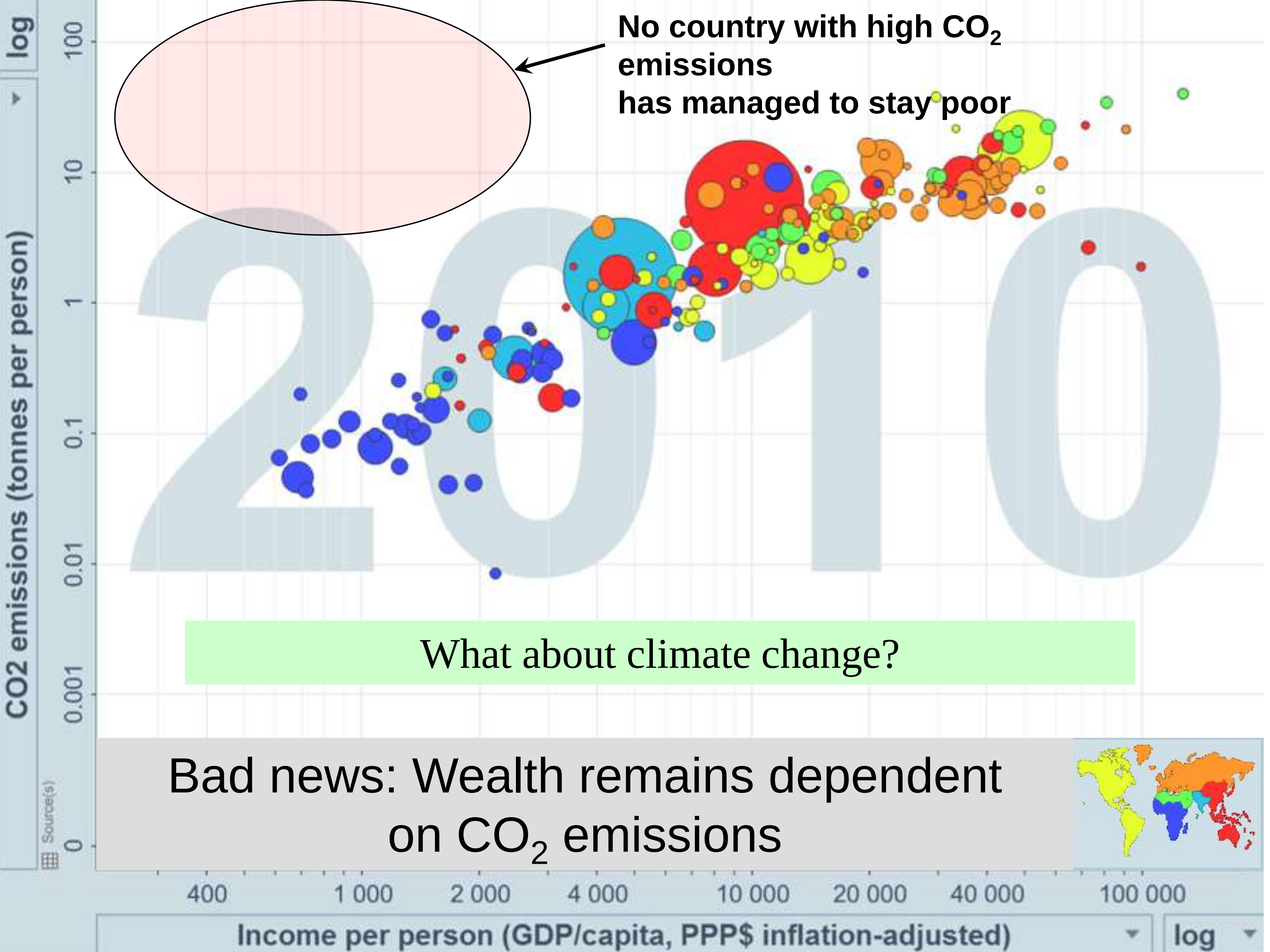
227 hyper-dominant species comprising 50% of all trees



Surely the 227 spp. will be able to provide most services so we do not need to worry about the remaining 15,773 spp.

Science
AAAS

Hyperdominance in the Amazonian Tree Flora
Hans ter Steege *et al.*
Science **342**, (2013);
DOI: 10.1126/science.1243092


No country with high CO_2 emissions has managed to stay poor
What about climate change?
Bad news: Wealth remains dependent on CO_2 emissions
2010
CO2 emissions (tonnes per person)
log
100
10
1
0.1
0.01
0.001
0
Source(s)
400
1 000
2 000
4 000
10 000
20 000
40 000
100 000
Income per person (GDP/capita, PPP$ inflation-adjusted)
log

- **Apocalypse is coming (and it feels good)**

Waiting for a happy apocalypse has a long (religious) tradition

- **Apocalypse is coming – to stop it, anything goes**

End of the world is nigh – justifying the end to democracy and/or capitalism

- **Climate change is a serious problem (as many others)**

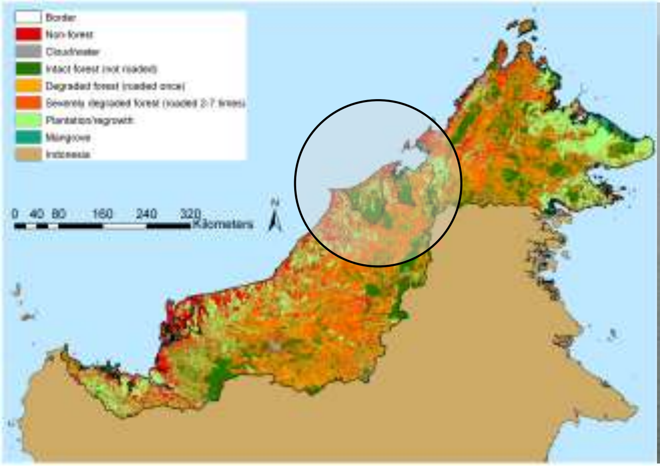
Unfortunately there is only one IPCC – monopolies are not good

- **Climate change (semi-)sceptics**

Treatment of heterodox views in climate science – not a pretty pictur

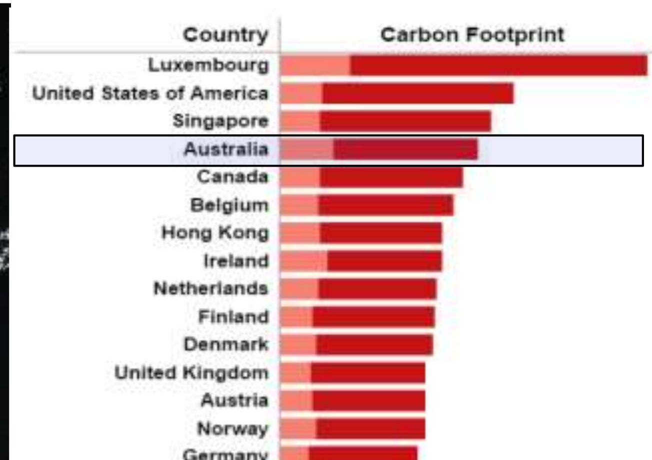
- **Climate change a priori deniers**

Non-scientific advocacy for commercial interests does exist



Brunei: rainforest protection bought by oil

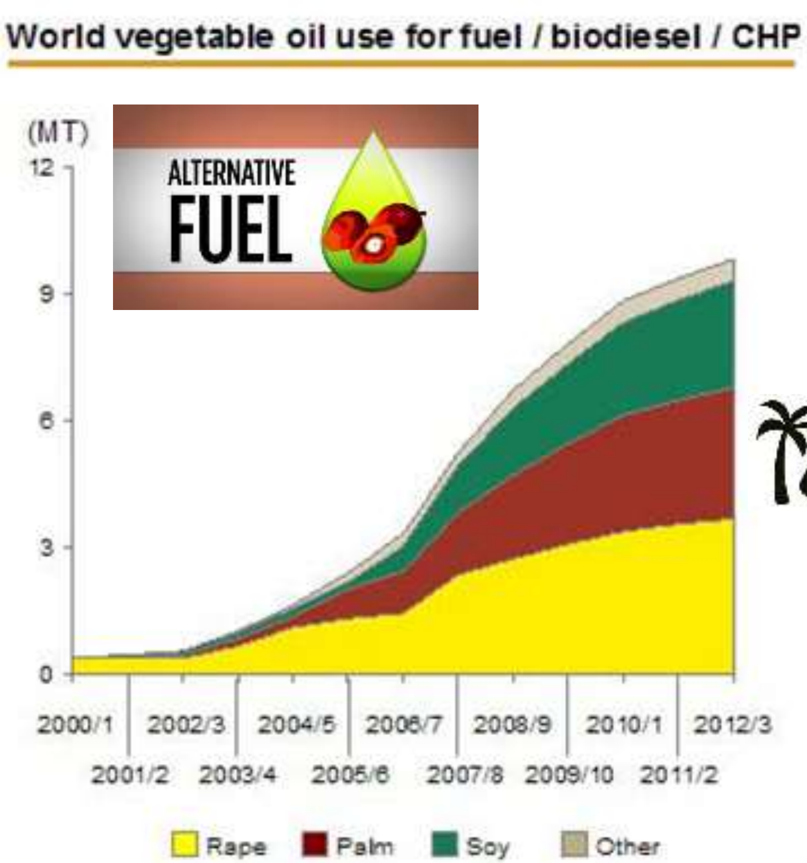
French Guyana: the best EU rainforest sustained by aerospace industry

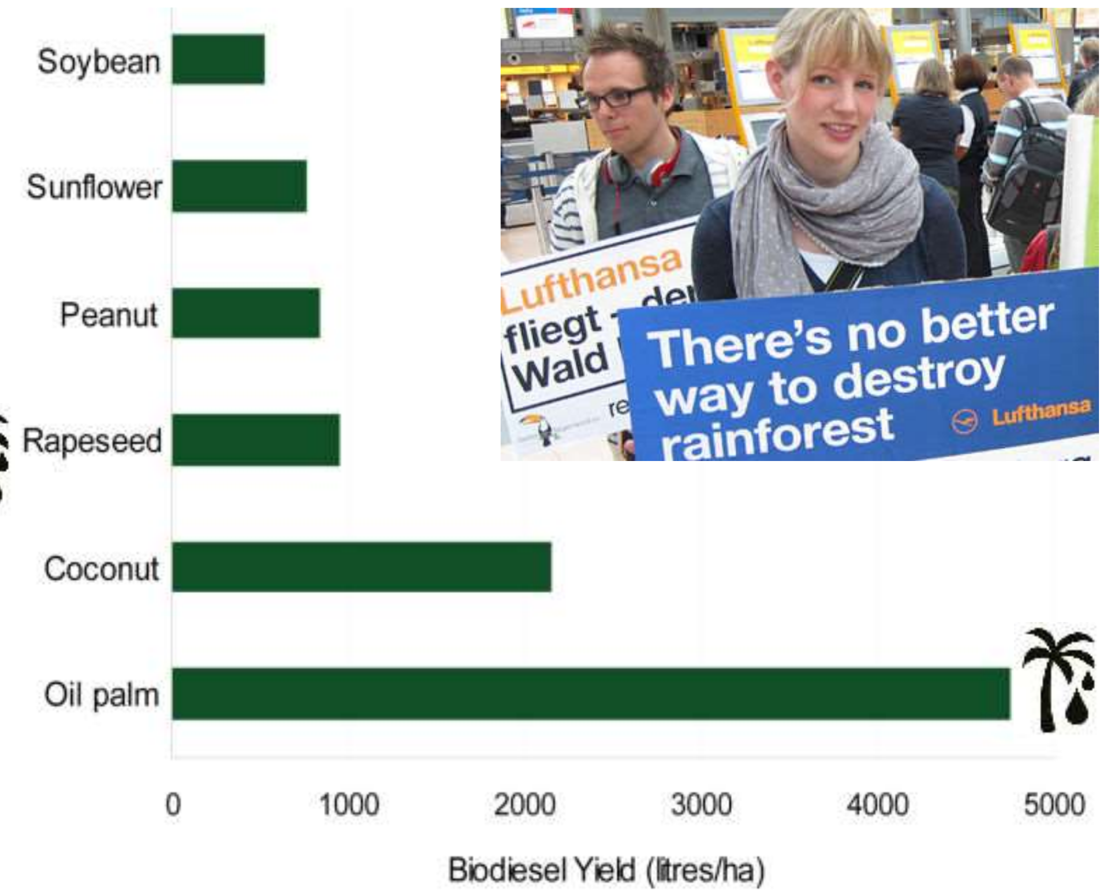


Australia: excellent rainforest protection & huge carbon footprint & highest per capita coal exporter

Biofuels : how we (biologists) screwed up in a big way

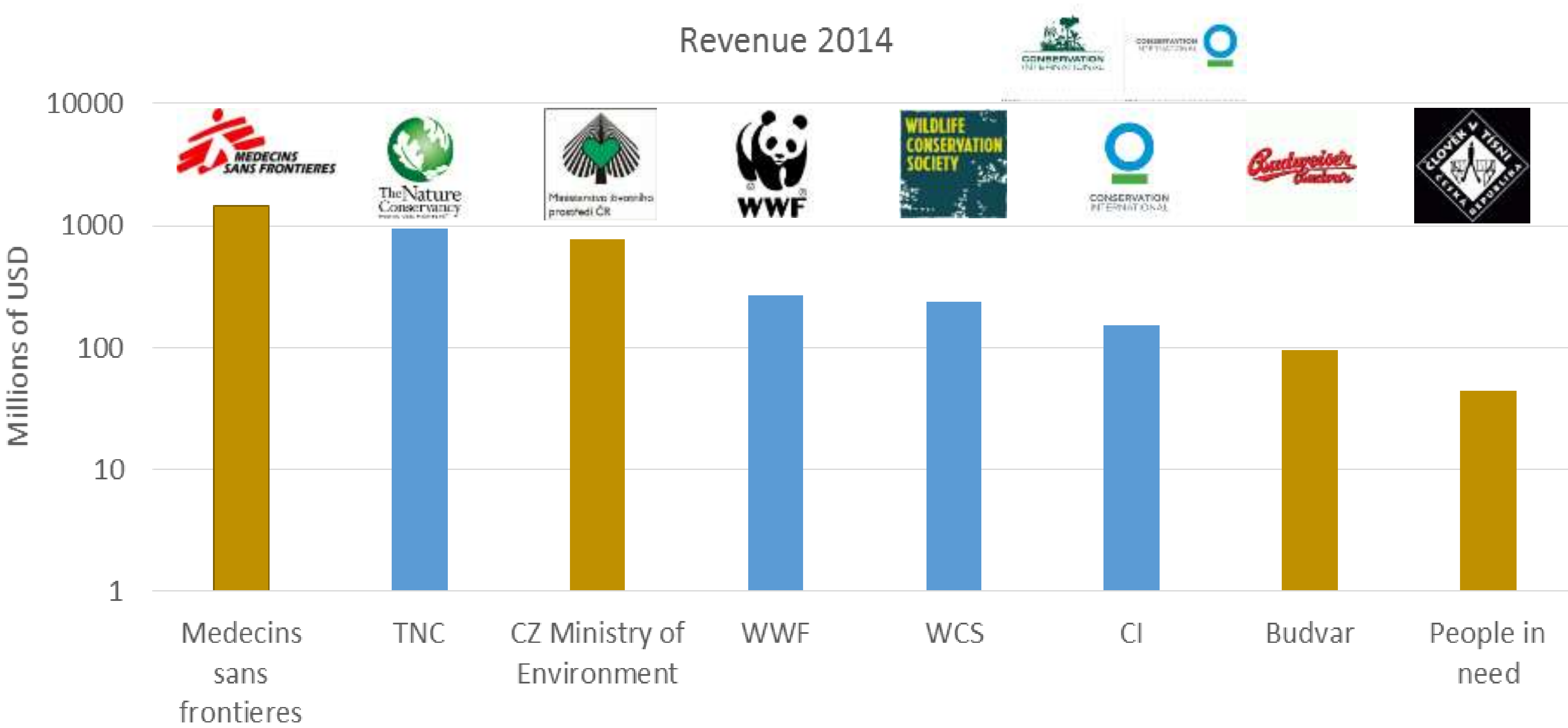
Biofuels from palm oil: we are burning SE Asian rainforests (sustainable certification notwithstanding)





Energetically, palm oil makes sense as a source of biofuels

The big four: The Nature Conservancy, World Wildlife Fund, Wildlife Conservation Society, Conservation International



Clovek v tisni “made it”: but where is a Czech conservation NGO with a global reach?

Can NGOs save tropical biodiversity?

International NGOs are remarkably ineffectual in tropical countries

They often operate in intellectually and socially unreceptive environment (cf. introduction of democracy by the Czech Army to Afghanistan)

Emergence of the local middle class and educated elites is the key for

In conclusion: what to do and where to go?

• how much biodiversity should be conserved is a cultural choice, not a results of any objective scientific calculation

• how to conserve biodiversity is a social, not a biological problem

• wisdom on traditional societies is not terribly relevant to current conservation problems