Ecological Footprint Analysis of Fishing

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Hokkaido University, Japan

Shiva Niazi

Presentation Outline

- Ecological Footprint: method, purpose and limitations
- Comparison of regional and national Footprints
- Fisheries component: method and limitations
- Oak Foundation research to improve fisheries accounting
- Global Footprint Network – partnering for a research collaboration

Challenge of sustainability

How can we all live well on one planet?

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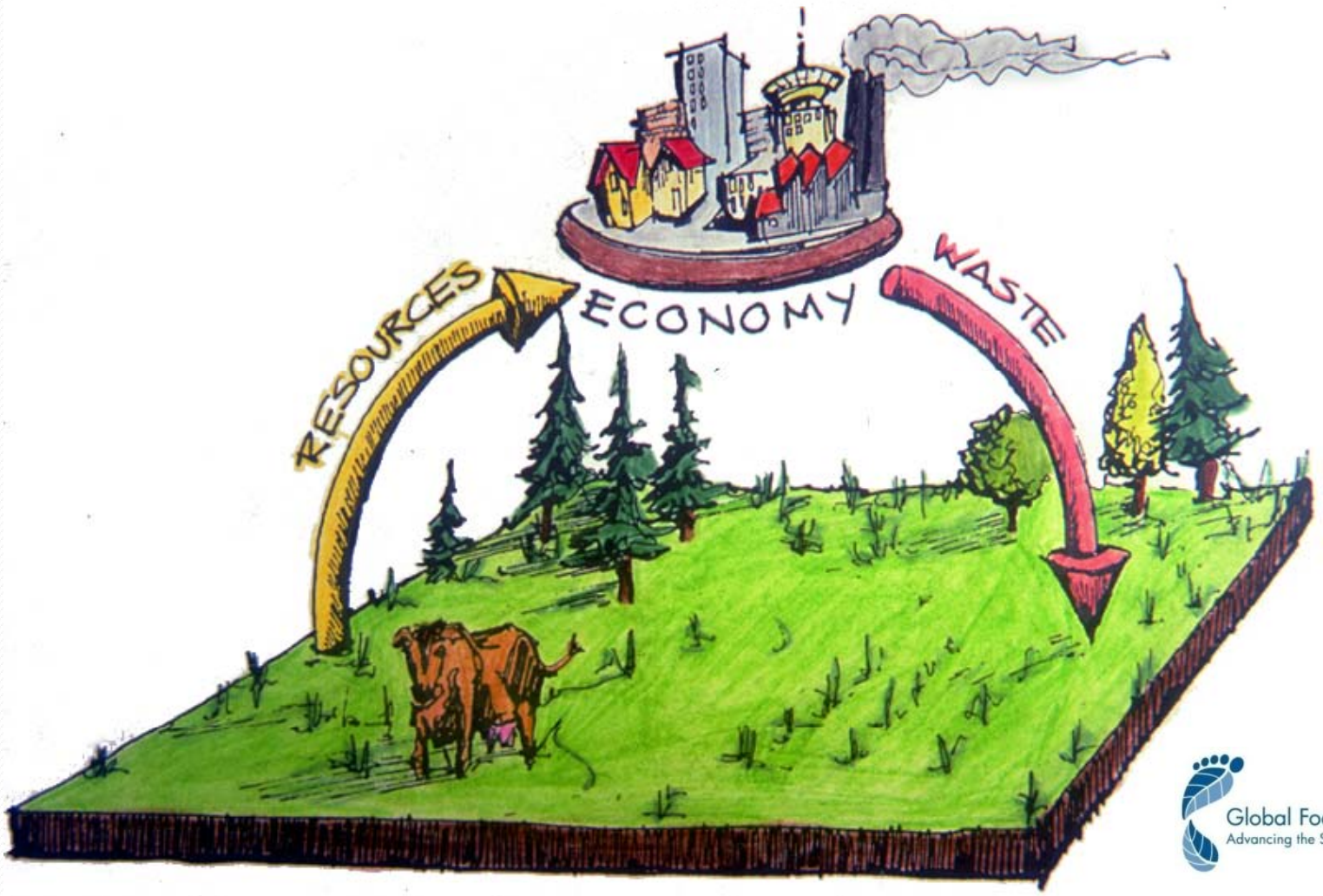
Society's Metabolism



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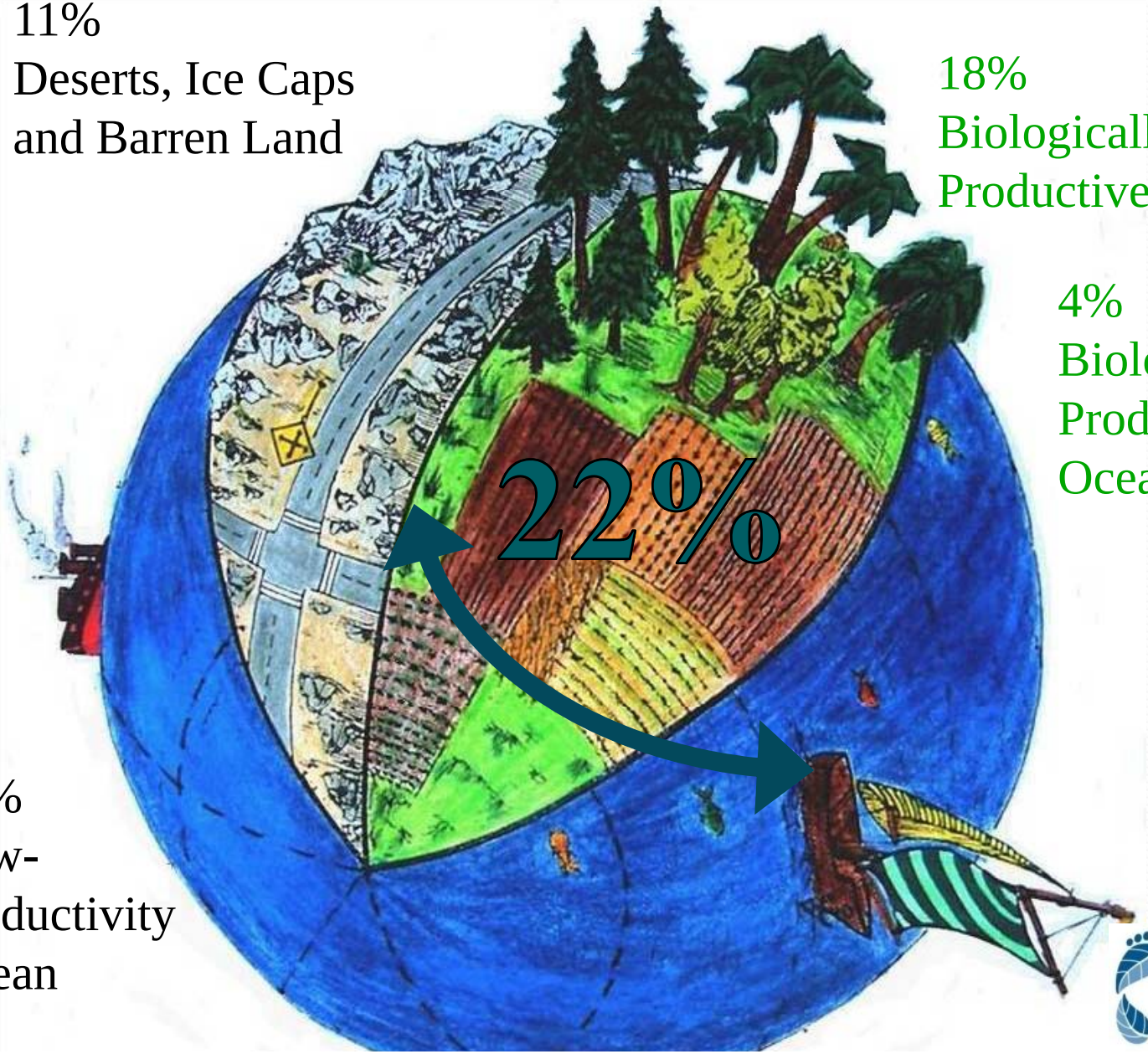
Ecological Supply (Biocapacity)

11%
Deserts, Ice Caps and Barren Land



18%
Biologically Productive Land

4%
Biologically Productive Ocean

67%
Low-Productivity Ocean

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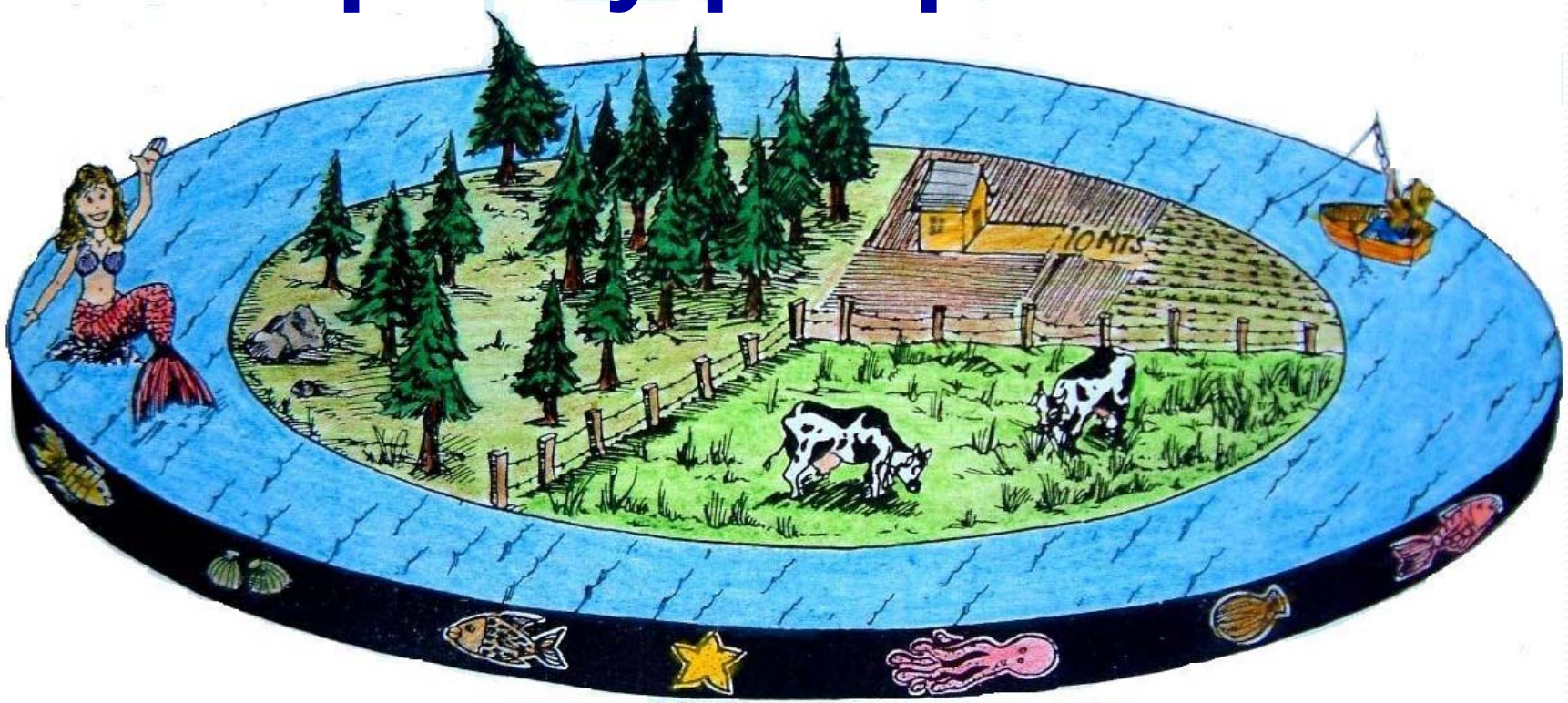
Biocapacity per person



Global average availability of bioproductive Land + Sea = **1.8 global hectares/person**

(in 2003)

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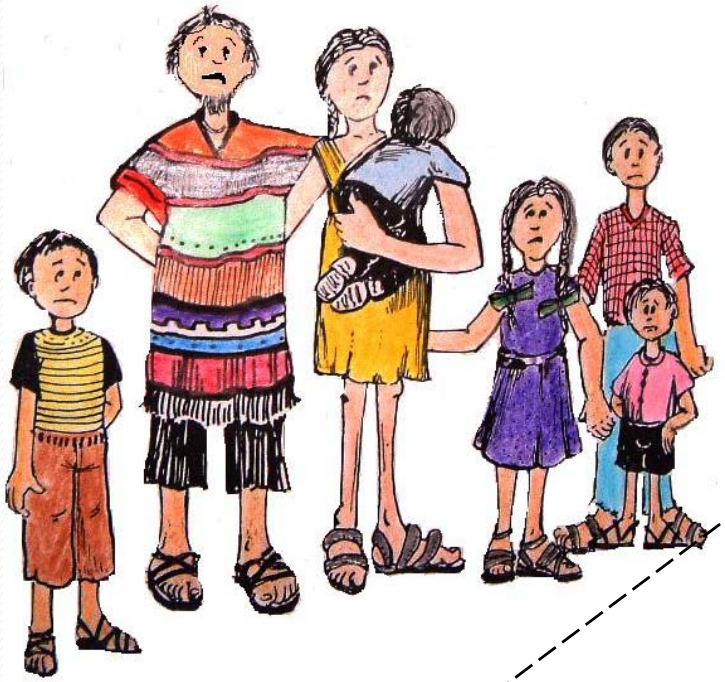

Human Demand (Ecological Footprint)

The Ecological Footprint

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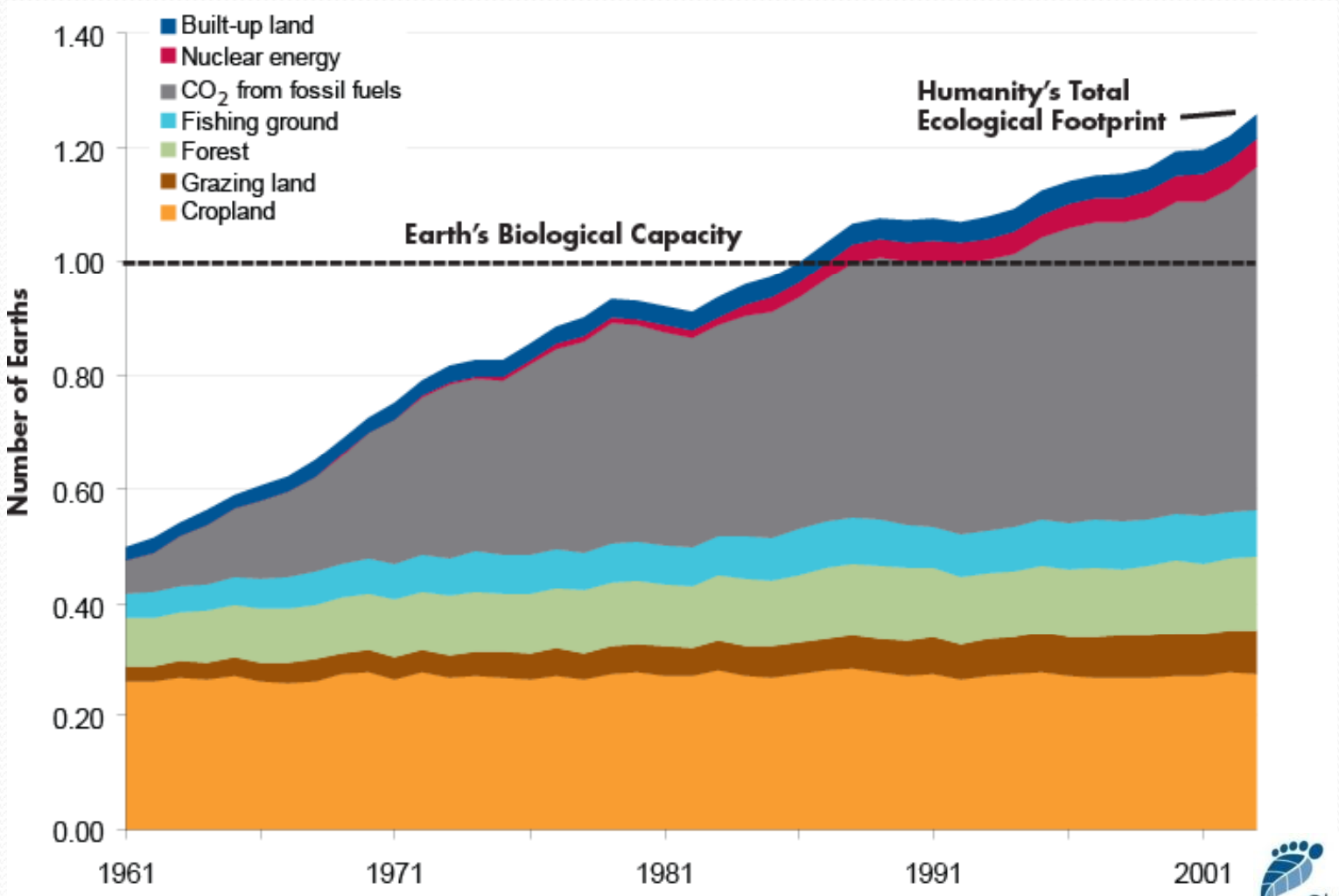
Energy Footprint Growing Rapidly



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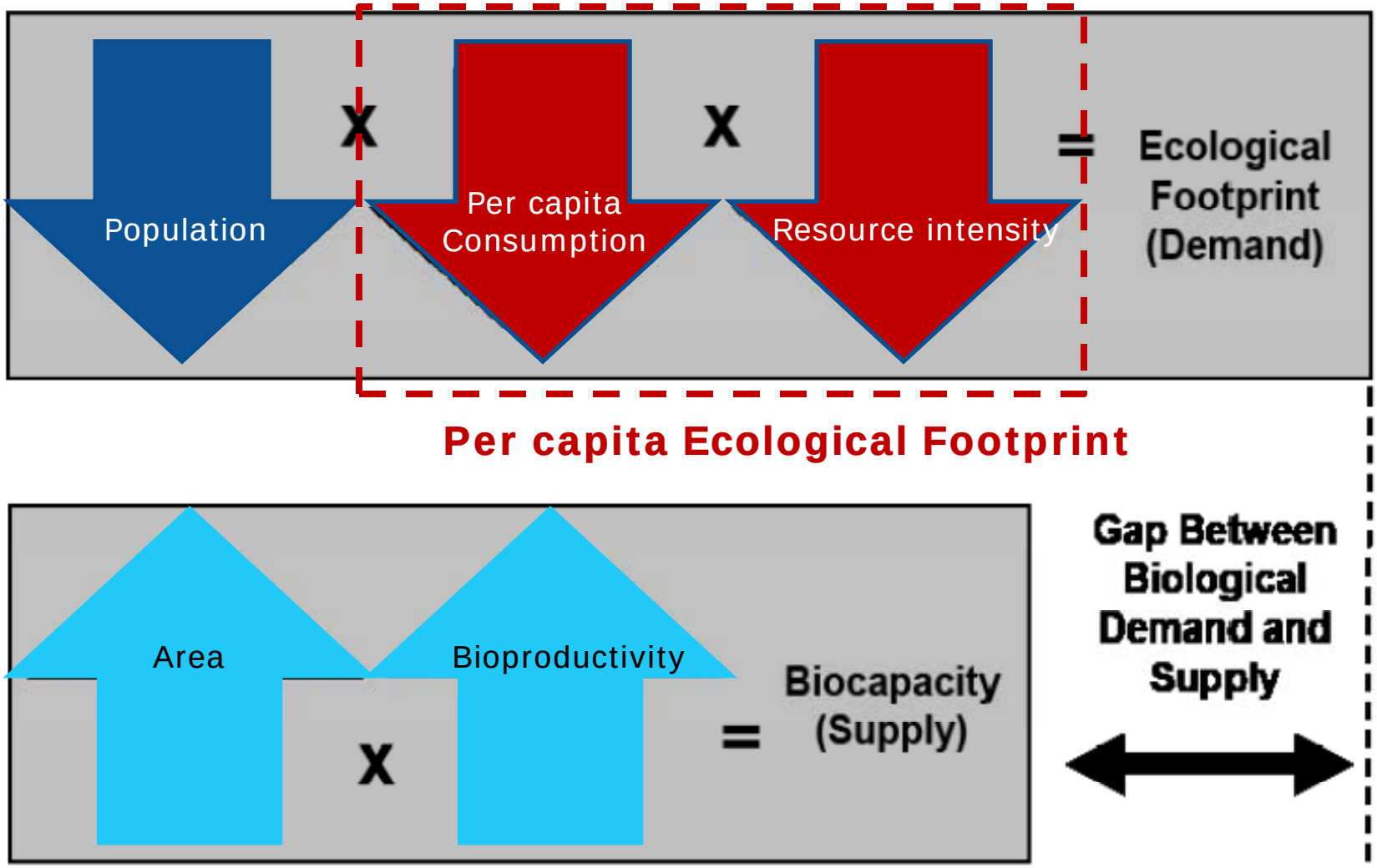
5 Factors Determine Overshoot



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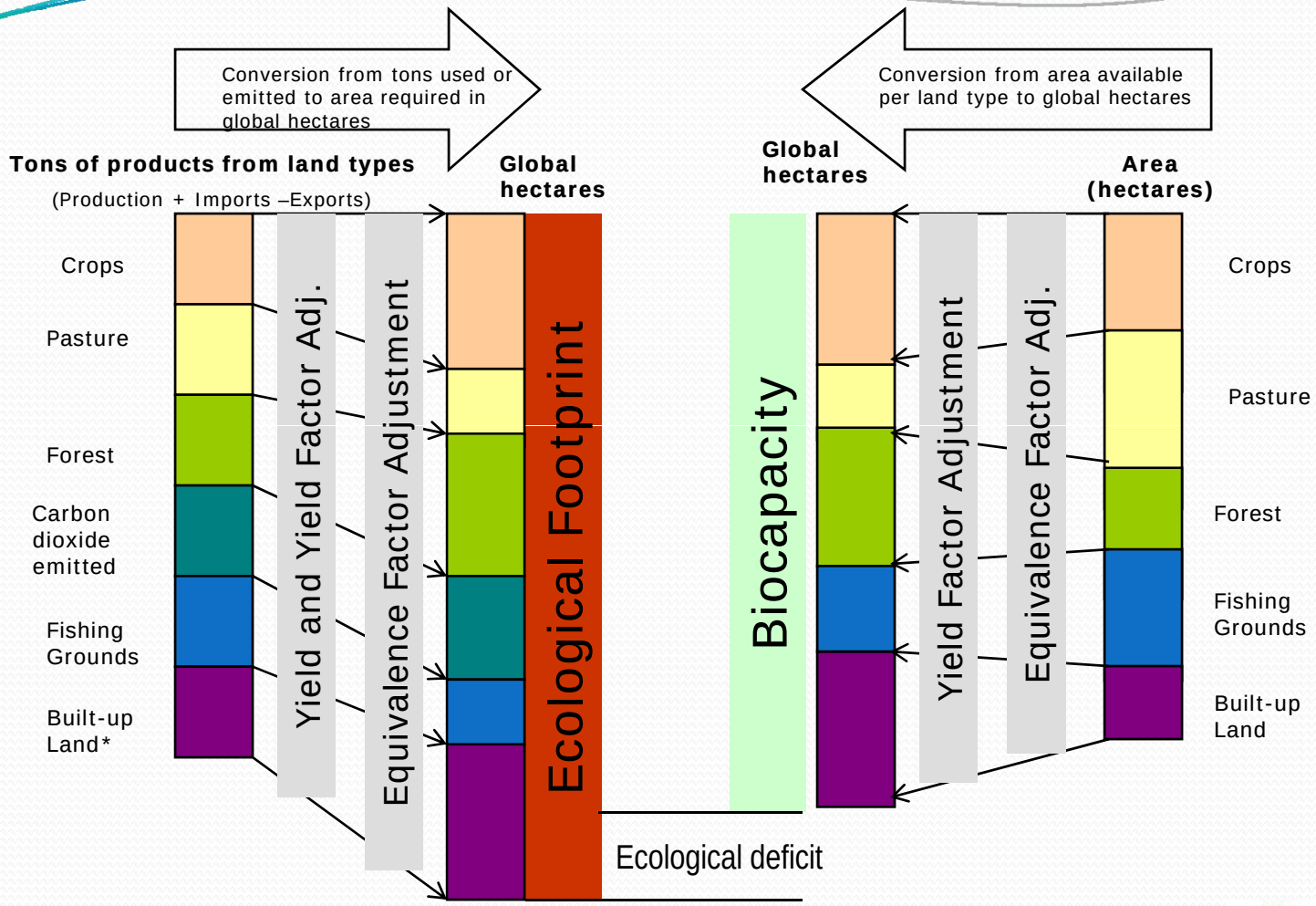

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* Built-up land is assumed to appropriate the biocapacity of cropland.

Equivalence Factors

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

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Global Ecological Balance Sheet

(global hectares/person, 2003 data)

Human Demand *(Ecological Footprint)*			Ecological Supply *(Biocapacity)*	
Footprint Areas for:		Demand Exceeds Supply By 25%	**Biocapacity Areas:**	
Growing Crops	0.49		Crop land	0.53
Grazing Animals	0.14		Grazing land	0.27
Settlements & infrastructure	0.08		Built-up area	0.08
Producing timber & fuelwood	0.23		Forest	0.78
Absorbing excess CO_2	1.14			
Harvesting Fish	0.15		Fishing Grounds	0.14
Total Global Demand	**2.2**	>	**Total Global Supply**	**1.8**

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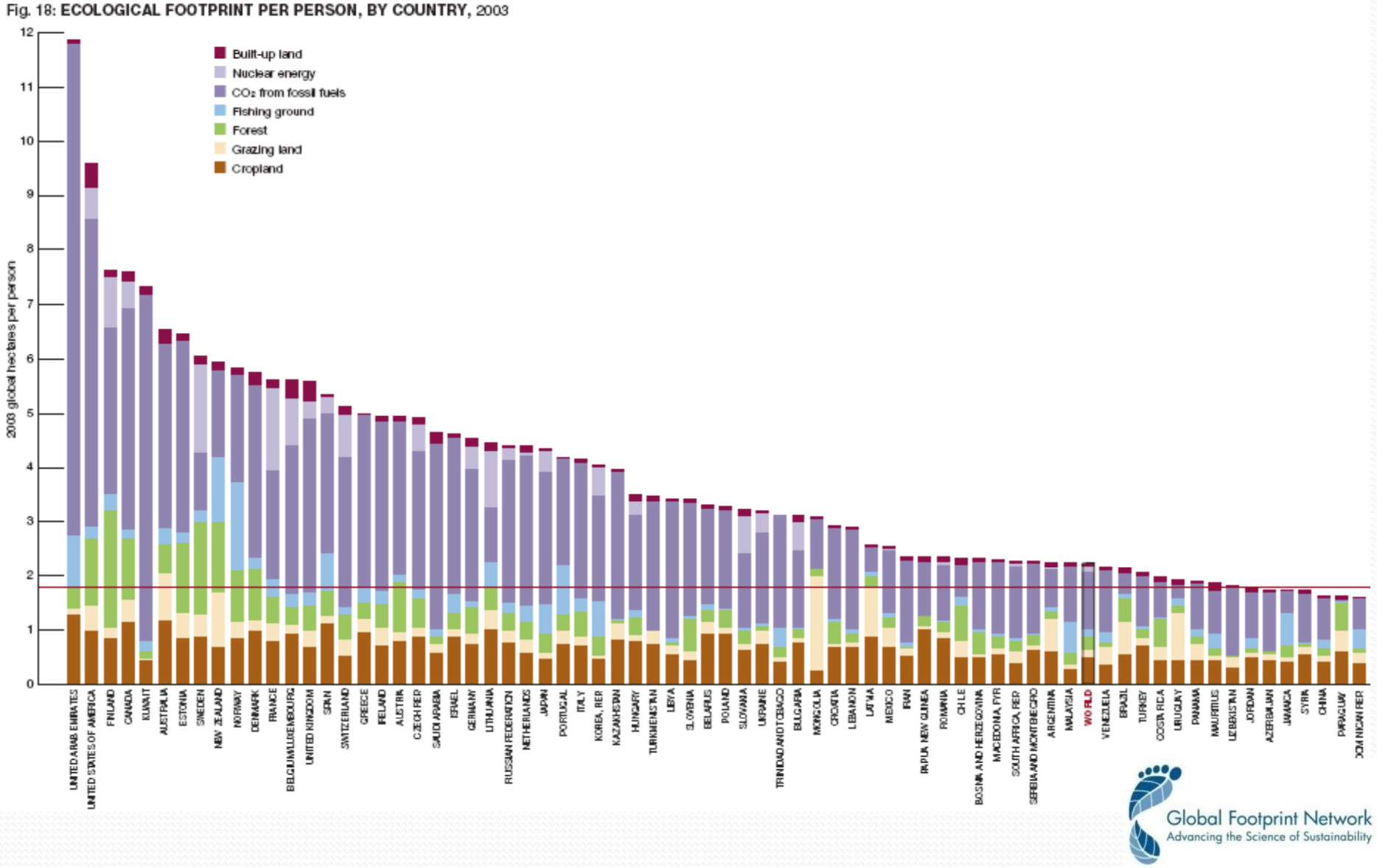
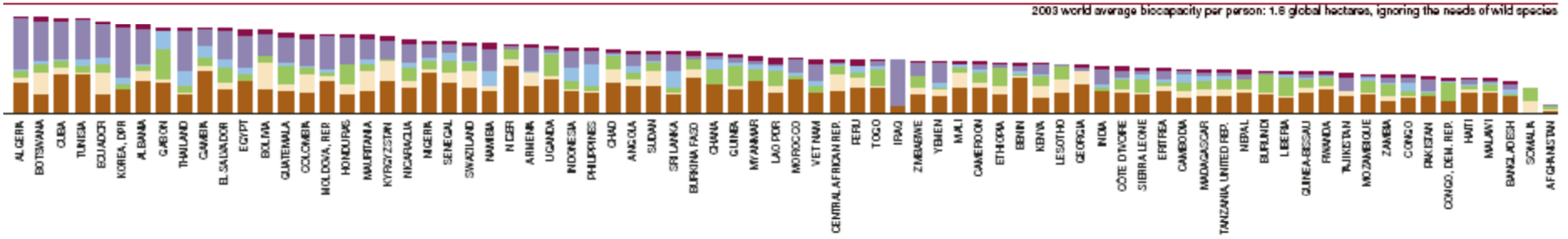
Ecological Footprint of Nations





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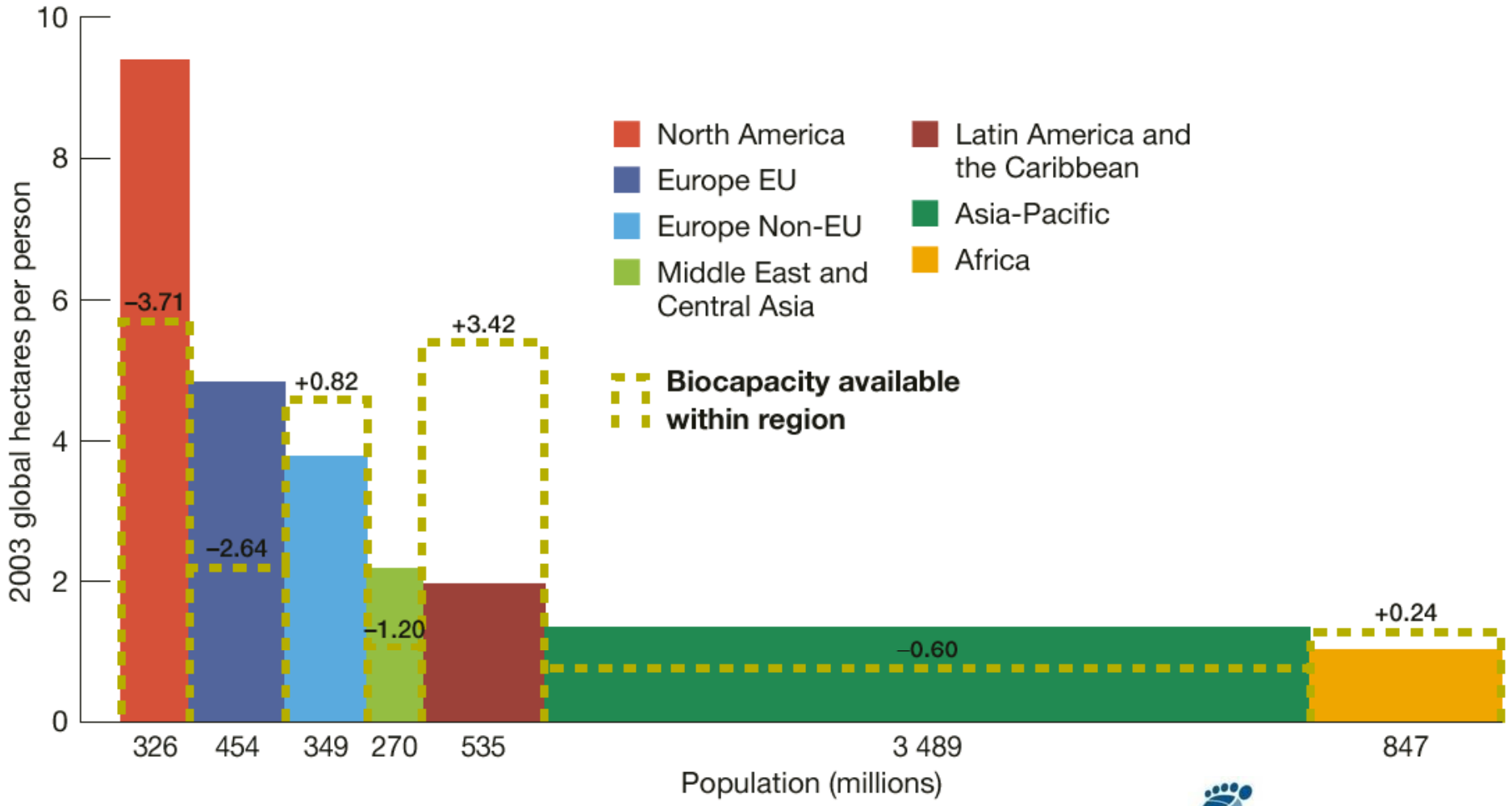

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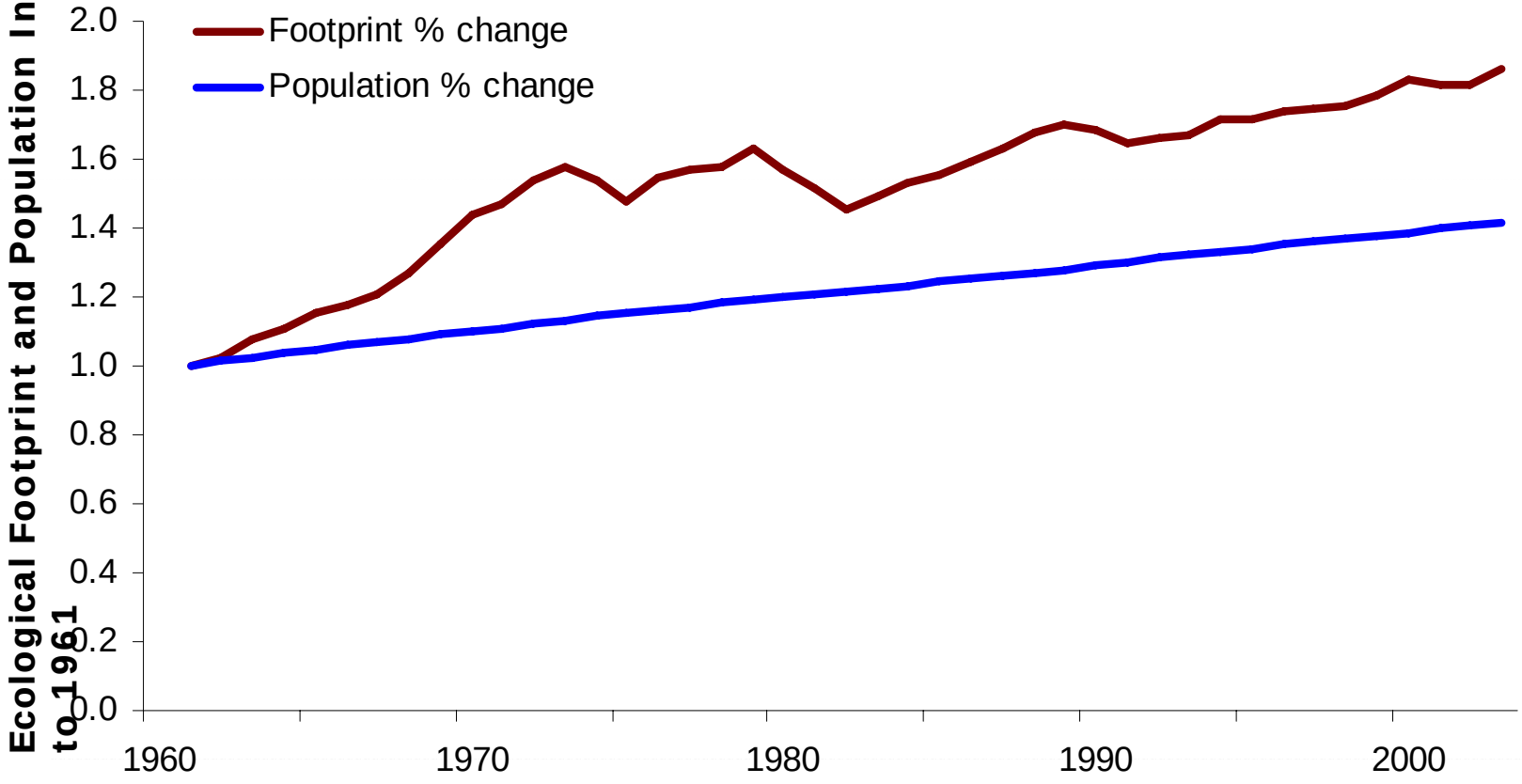
Source: WWF, 2006

Ecological Footprint per capita and Population increase, 1961-2003, High Income Countries.



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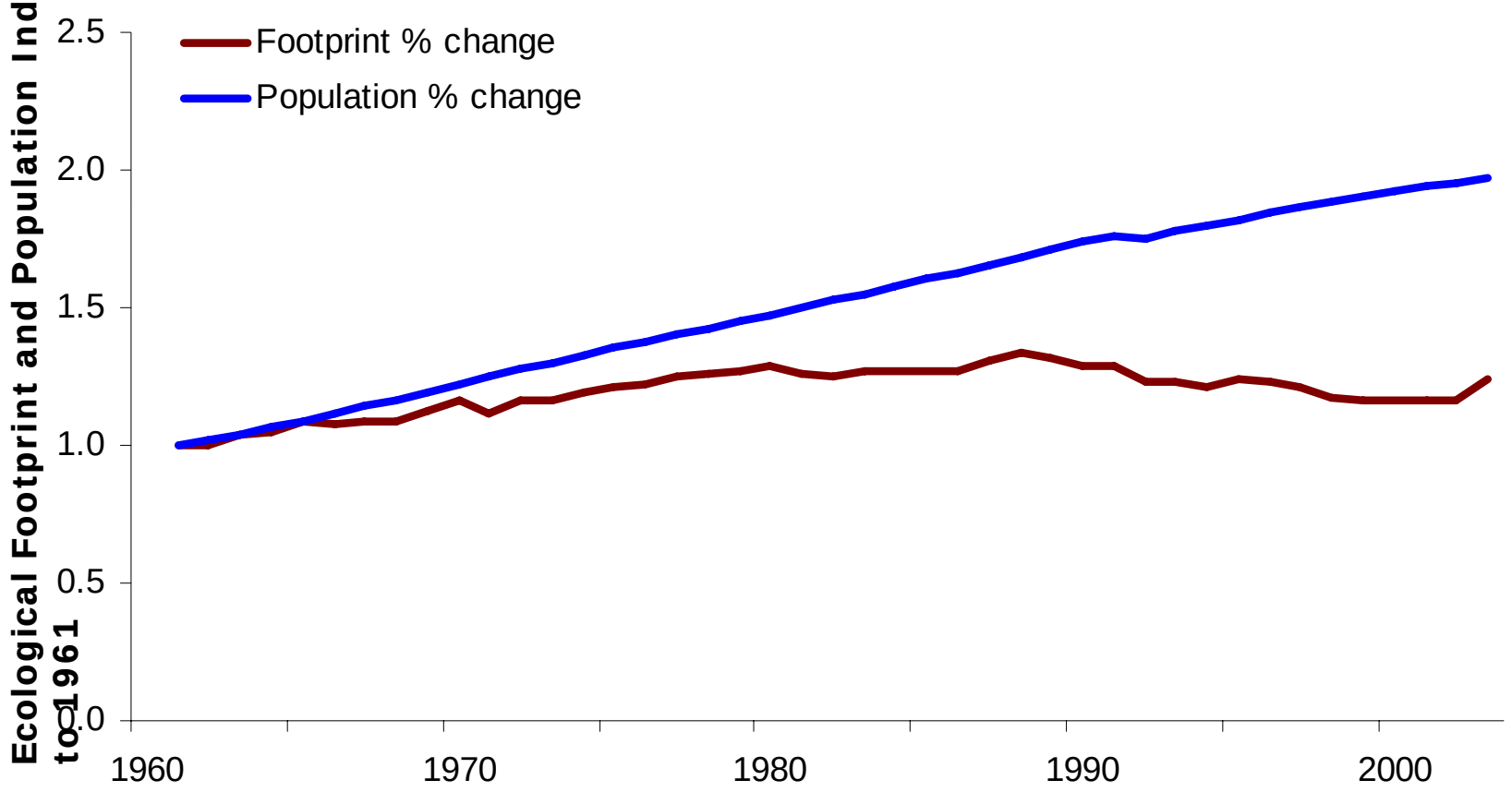
Ecological Footprint per capita and Population increase, 1961-2003, Middle Income Countries



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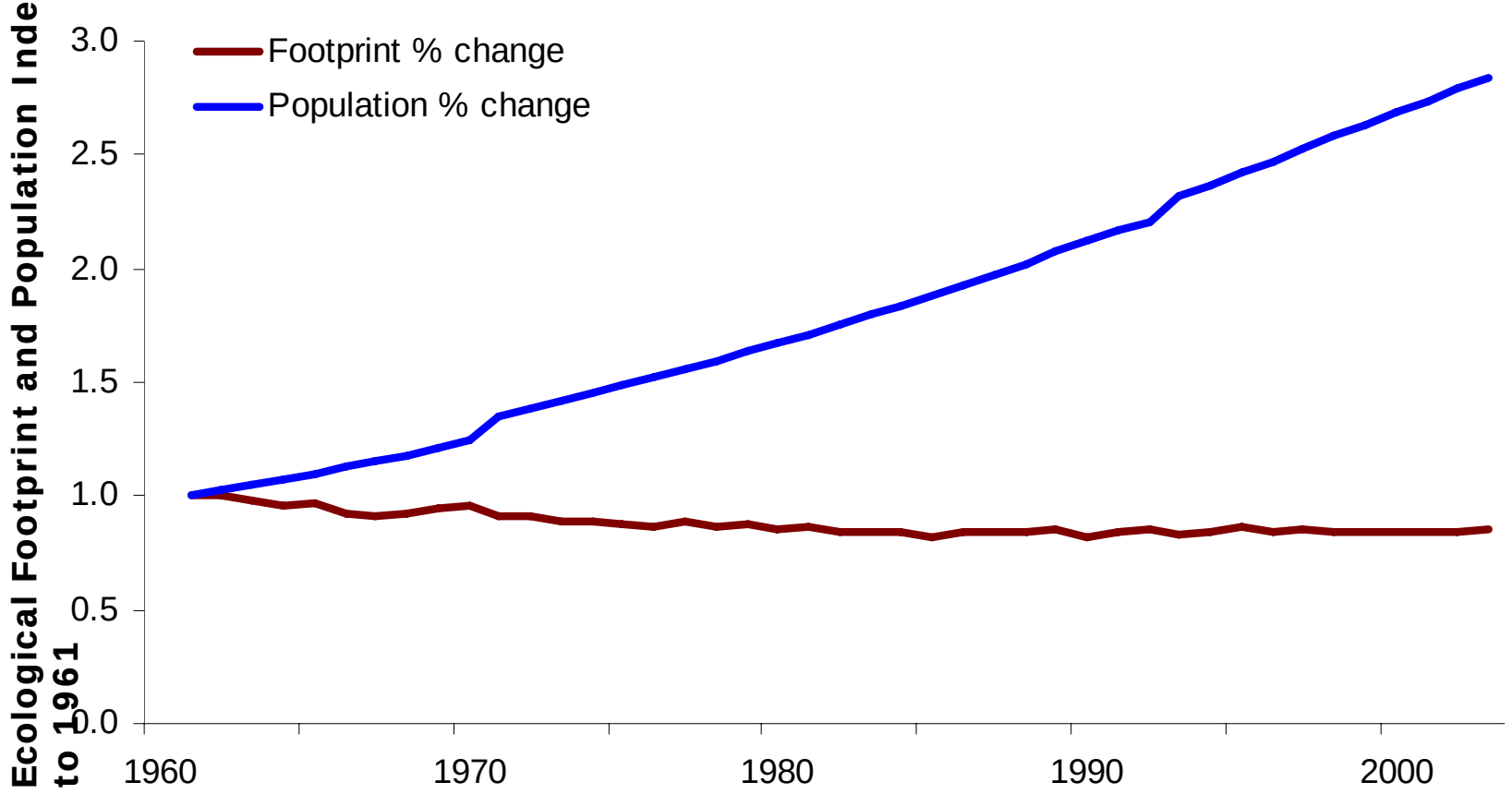
Ecological Footprint per capita and Population increase, 1961-2003, Low Income Countries



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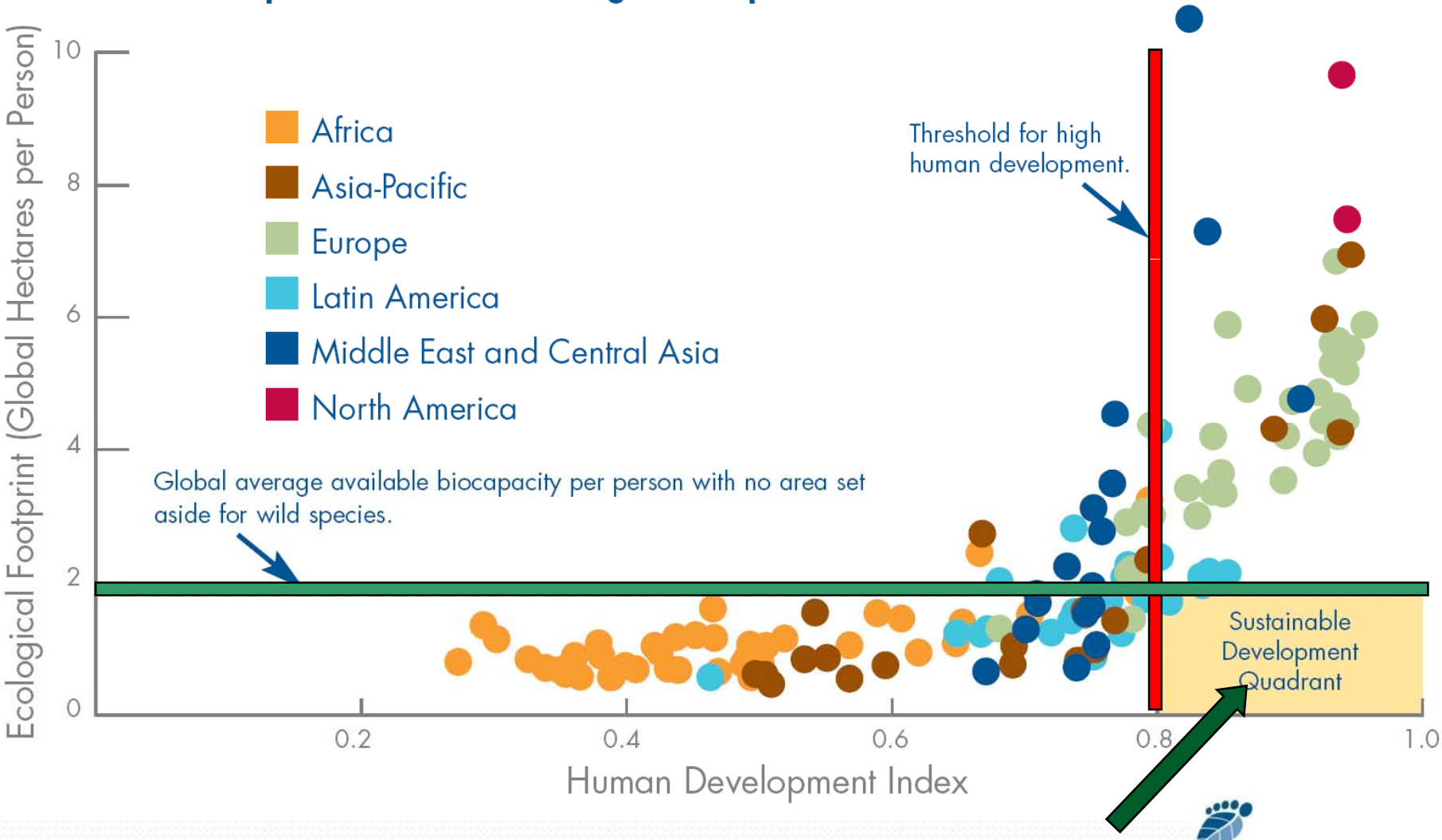
SUSTAINABLE DEVELOPMENT: WHERE ARE WE TODAY?

Human Development Index and Ecological Footprint of Nations



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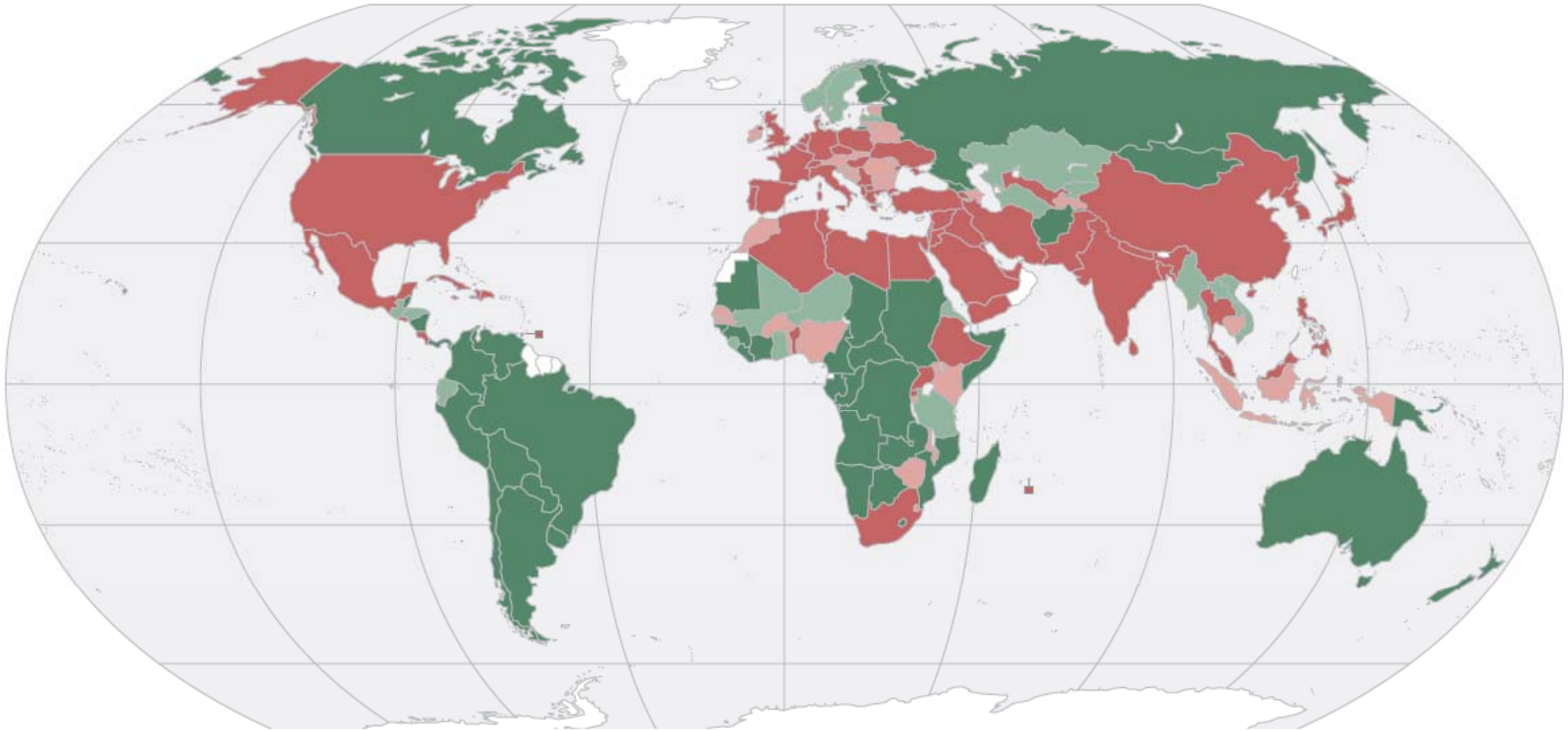
Ecological Creditors and Ecological



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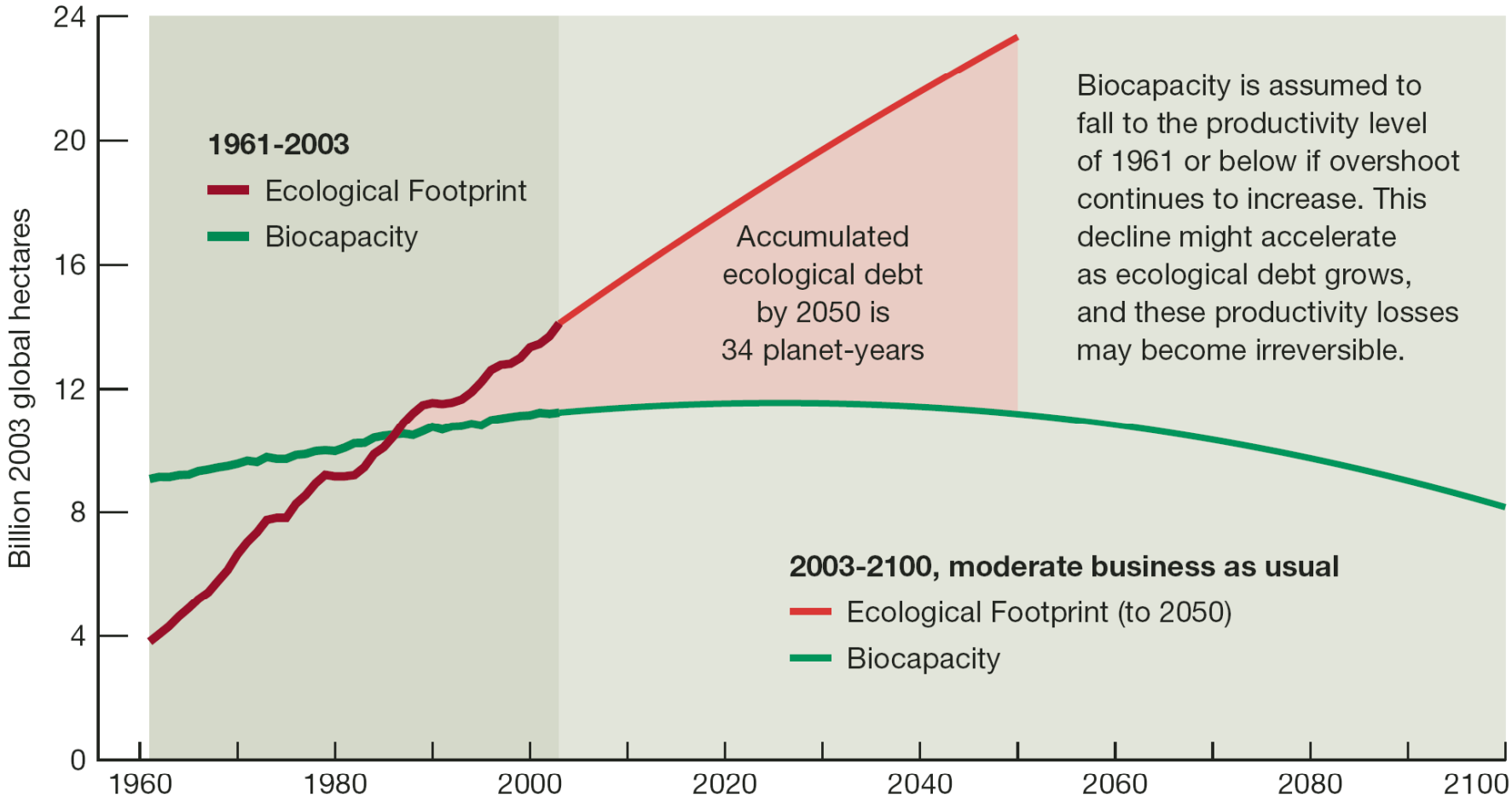
When will an "overshoot" economy collapse?



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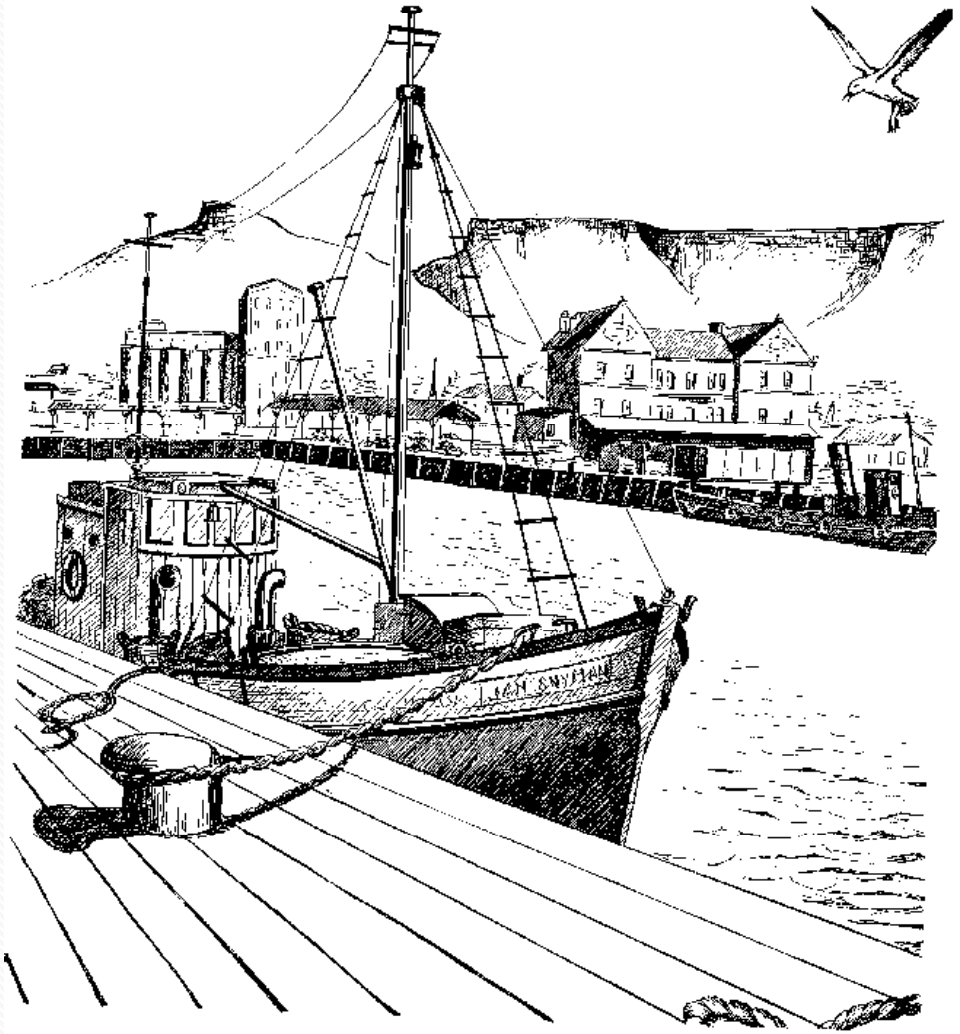
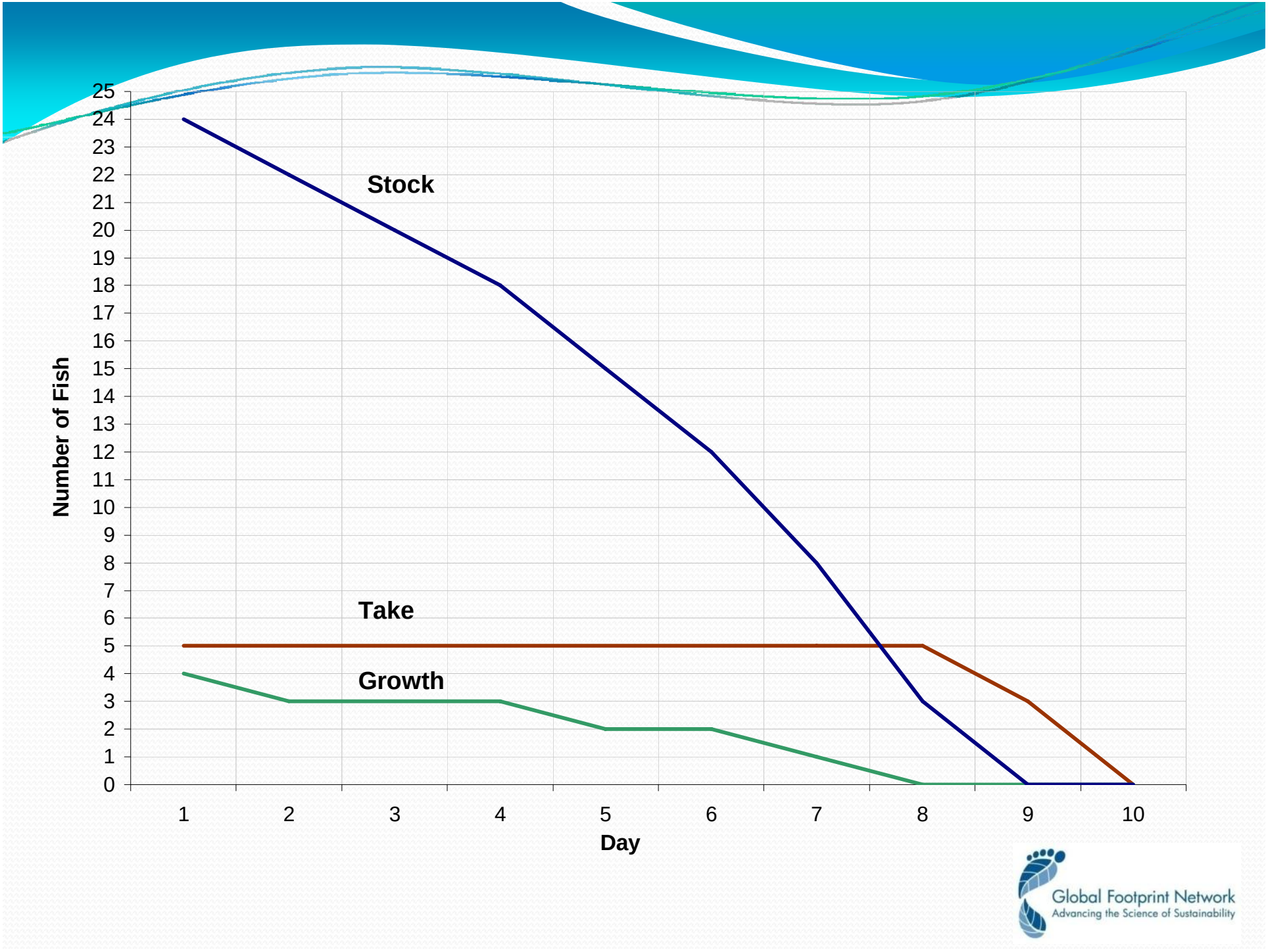
FISHERIES





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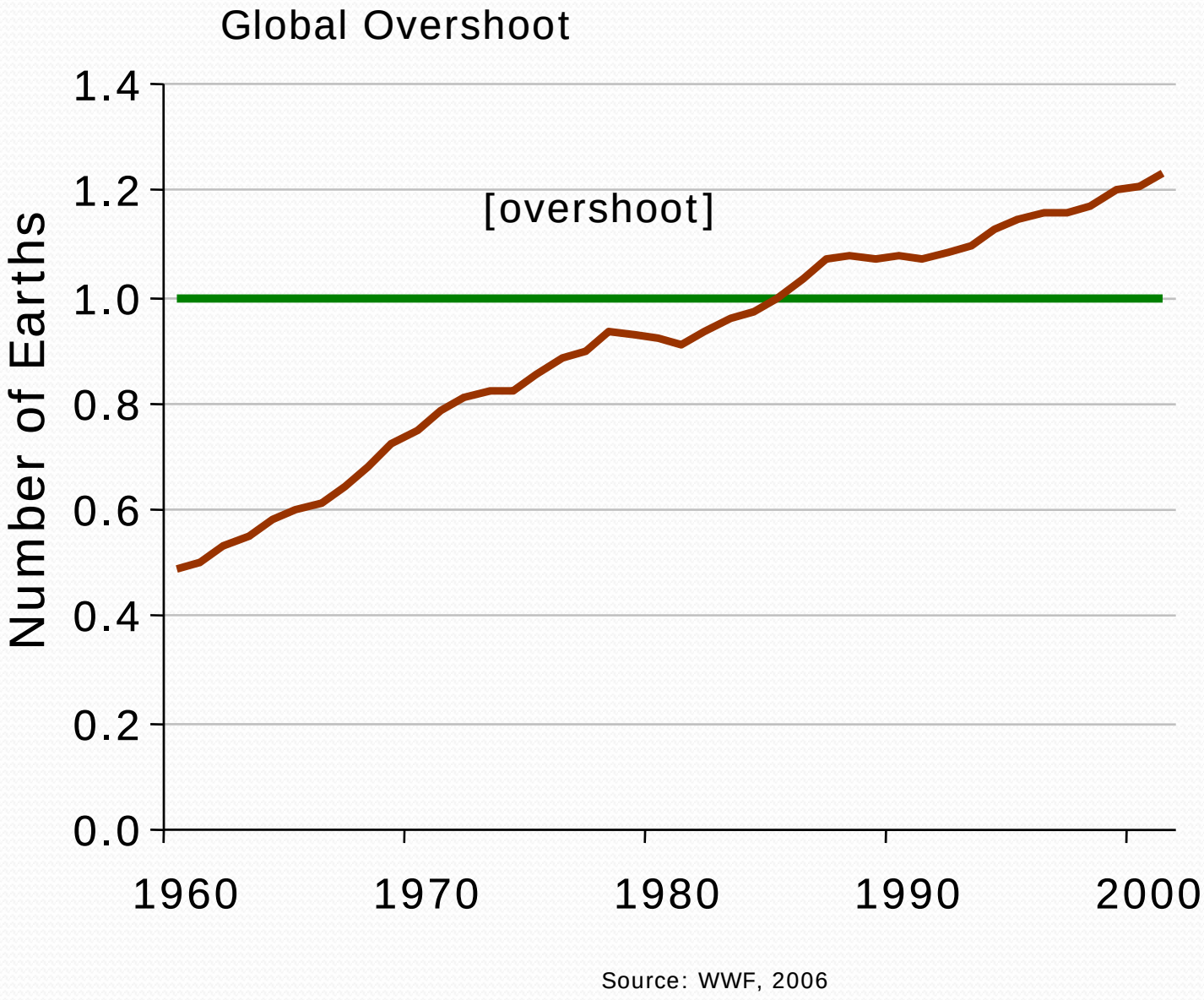

Source: WWF, 2006

Methods

Past Studies

- Spatial→Spatial: Compare area for cultivation to area required for sustainable cultivation
- Weight→Spatial: Determine area required for sustainable production for a set amount of fish, compare this to biocapacity.

- Most studies are spatial→spatial and look at case studies of specific fisheries.
- Footprint is weight→spatial and look at worldwide fish catch.

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Overview of Calculation

DEMAND

How much area is required to "sustainably" harvest the amount of fish we are consuming?

Footprint =Fish (tons)/Yield*EQF

SUPPLY

How much area of fishing grounds does each nation have "access" to?

Biocapacity = Continental Shelf Area*Yield Factor*EQF

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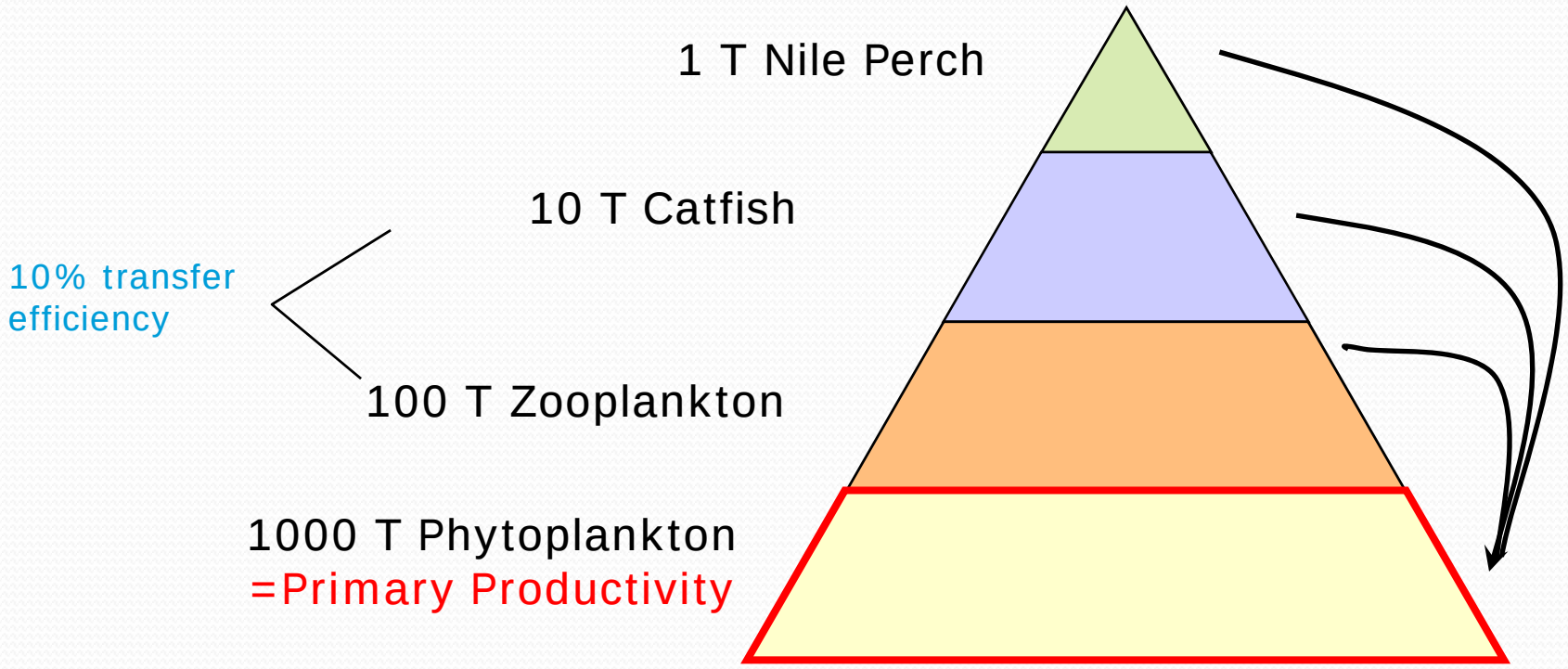
Demand (Ecological Footprint)



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

Footprint =Fish (tons)/Yield*EQF

(1) Calculate the amount of primary productivity necessary to support each ton of fish catch, the primary productivity required (*PPR)*.

$$PPRn = \frac{\text{discard rate}}{9} * \left(\frac{1}{\text{transfer efficiency}} \right)^{(\text{Trophic Level-1})}$$

$$\text{discard rate} = \frac{\text{catch} + \text{discarded bycatch}}{\text{catch}} (tons)$$

9:1 ratio for the conversion of wet weight to carbon

Assumed to be a world mean of 10% per trophic level for all species

(2) Yield compares calculates the area needed to sustainably harvest

$$\text{Yield} = \frac{PPRw * FAOestimateofsustainableharvest}{\text{PPRn} * \text{Area of world continental shelf}}$$

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Biocapacity = Continental Shelf Area*Yield Factor*EQF

- Yield Factor for Biocapacity calculation is based on primary productivity in the EEZ area

$$\text{Yield Factor} = \frac{\text{Primary Productivity (National)}}{\text{Pr}\,imary\ \text{Pr}\,oductivity(World)}$$

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Equivalence Factor (EQF)

Ecological Footprint & Biocapacity

- Most equivalence factors in the model are based on the Global-Agro-Ecological Zones model, which assigns a suitability score to all land based on its most productive use. There is no GAEZ number available for marine areas.
- The equivalence factor for marine area is calculated such that one gha of pasture produces the calories of beef equal to the amount of calories of salmon produced in a gha of marine area.

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Sources of Error in Current Calculation

- Yield Factor in biocapacity calculation is based on primary productivity rather than fishing yields, often hiding large changes in fish populations due to over-fishing.
- No aquaculture
- Assume same bycatch rate for all species
- EQF based on assumption about productivity rather than data.

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Research objectives

- Oak Foundation grant to review following:
  - Equivalence Factor
  - Catch data- Sea Around Us
  - Aquaculture calculations
  - Data -Maximum sustainable yields
  - Data for harvestable biomass
  - Conceptual model: Pauly and Christensen trophic model

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Global Footprint Network

- Ecological Footprint concept developed by William Rees at University of British Columbia and Mathis Wackernagel
- Global Footprint Network- est. 2003
- Currently have 75 organizations
- Fisheries section of the Footprint- Prof. Yoshihiko Wada of Doshisha University , Justin Kitzes
- Current researcher on fisheries is Sarah Rizk

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Who is using the Footprint?

- International: Convention on Biodiversity, EU
- National: Switzerland, Japan, Belgium, UAE
- Regions and Cities: Utah, London, Cape Town
- Media: Economist, Fox, Al Jazeera
- NGOs: WWF Living Planet Reports
- Business: BC Hydro, GPT, US Health Care Sector

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Questions?

- Please visit us at : www.footprintnetwork.org
- Previous publications (Living Planet Report, China Report)
- Personal calculator
- Academic publications on methods
- Partner Network members and how to become a partner
- Contact me: shiva@footprintnetwork.org

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