

Ecological Footprint and carrying capacity

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Carrying Capacity (bio-capacity)

“Maximum population of a given species that can be supported indefinitely in a defined habitat without permanently impairing the productivity of that habitat”

(Rees, 1996)

It will depend on:

- Natural income
- Particular consumption of this population
- Technology used to obtain resources

If this population is over the carrying capacity, the territory will be unbalanced

Populations are considered as isolated





Appropriated Carrying Capacity

“The biophysical resource flows and waste assimilation capacity appropriated per unit time from global totals by a defined economy or population”

(Rees, 1996)





Ecological footprint

“The corresponding area of productive land and aquatic ecosystems required to produce the resources used, and to assimilate the wastes produced, by a defined population at a specified material standard of living, wherever on Earth that land may be located.”

Rees y Wackernagel

- It is the inverse of carrying capacity
- Not dependent on geographical areas
- Imports and exports are accounted as imported and exported territory





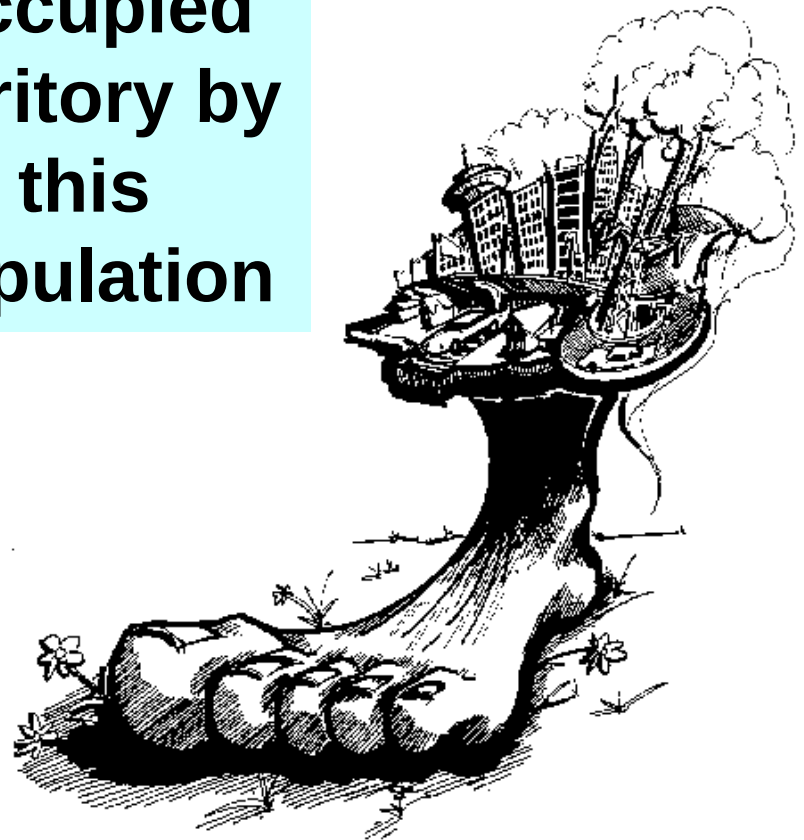
Ecological Deficit

**Total
ecological
footprint**



**Occupied
territory by
this
population**

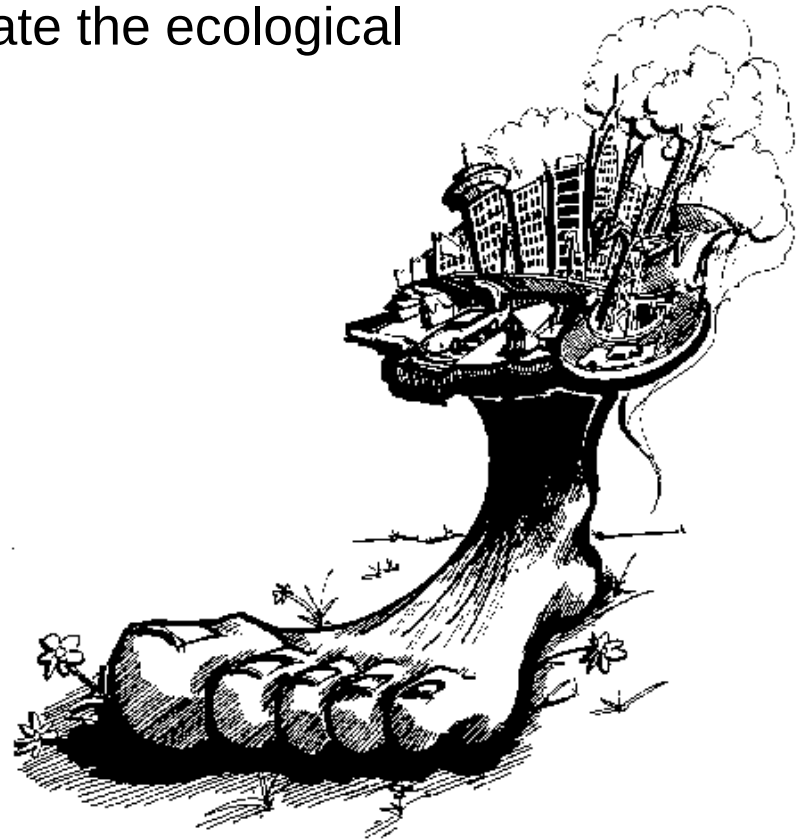
Ecological deficit shows
dependence on other
territories resources





Sustainability Gap

“A measure of the decrease in consumption (or increase in material efficiency) required to eliminate the ecological deficit.”





Ecological footprint. Methodology

Previous considerations:

- It is a simplification of real life. Not an accurate estimation.
- Caution. Accounting of the smallest option in each case
- It is assumed that crops, forestry and livestock productions are sustainable, they do not produce any land losses nor contamination..
- Harvesting and extraction of resources are only accounted, together with some impacts about waste absorption and occupied land with infrastructures.
- Land contamination, ozone layer affection, erosion, water consumption, etc. are not accounted.
- For transformed raw materials it is only accounted the energy consumed, to avoid any double accounting.



Ecological footprint. Methodology

Six types of productive land

☐ Cropland

- Human consumption
- Livestock feeding
- biofuels

☐ Grazing land

- Less productive crops
- Harvesting
- Livestock feeding

☐ Forests

- Wood
- Biomass
- Paper

☐ Productive sea

- Fishing

☐ Built land

- Transport
- Residential
- Industry
- Infrastructures and services

☐ CO₂ Absorption

- Fossil fuels
 - Specific consumptions
 - Mobility
 - Other CO₂ productions



Ecological footprint. Methodology

Use categories

Every author establishes their own ones

Grouped per categories and sub-categories

- ☐ Food
- ☐ Forestry
- ☐ Goods
- ☐ Energy
- ☐ Infrastructures (accommodation)
- ☐ Services (energy consumption mainly)





Ecological footprint. Methodology

Calculus matrix

	Types of productive land				
Use categories					

The final result must be increased due to biodiversity maintenance to produce natural incomes (12%)



Ecological footprint. Methodology

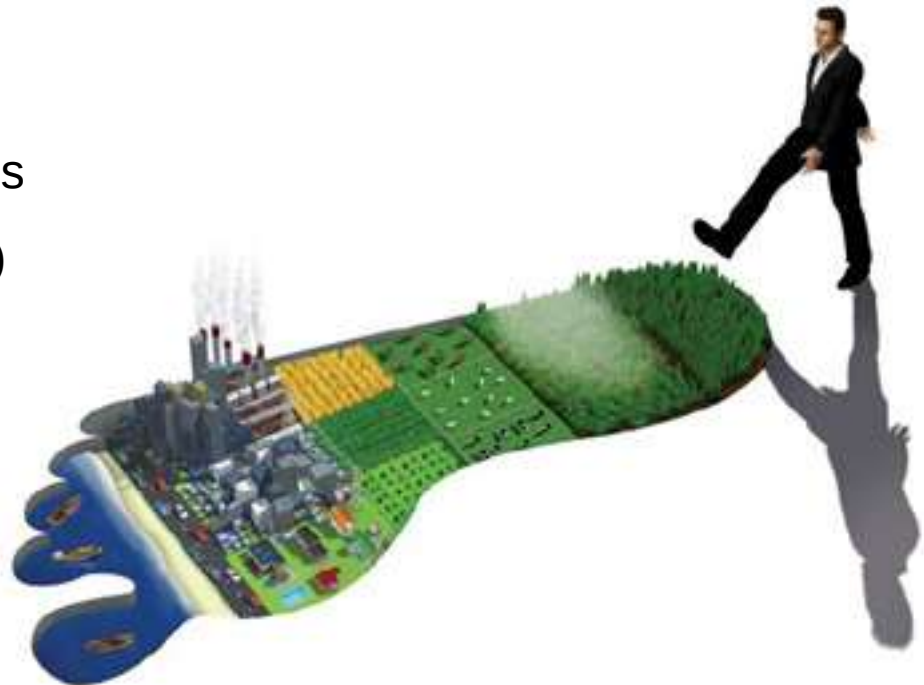
1st step. Consumptions estimation

$$\text{CONSUMPTION} = \text{PRODUCTION} + \text{IMPORTS} - \text{EXPORTS}$$

Units:

Food and goods in tonnes

Energy in Gigajoules (Gj)





Ecological footprint. Methodology

2nd step. Transformation in productive land

$$AA_i = C_i / P_i$$

AA: Appropriated area for production (ha)

C: Average annual consumption (Tn ó Gj)

P: Average annual production (Tn ó Gj / ha)

i: Each of the consumption categories





Ecological footprint. Methodology

Correction factors

$$HE = AA \times F_R \times F_E$$

□ Yield Factor (F_R)

Dependent on the land productivity in each territory

Reference respect to world productivity

Calculated every year

□ Equivalence Factor (F_E)

It allows adding different land categories

It transforms in the same unit of productive land

They are always the same (changes every year)

It punishes any land under-use

Equivalence Factors (2005)

Cropland	2.64
Forests	1.33
Grazing land	0.50
Productive sea	0.40
Built land	2.64



Ecological footprint

Positive aspects

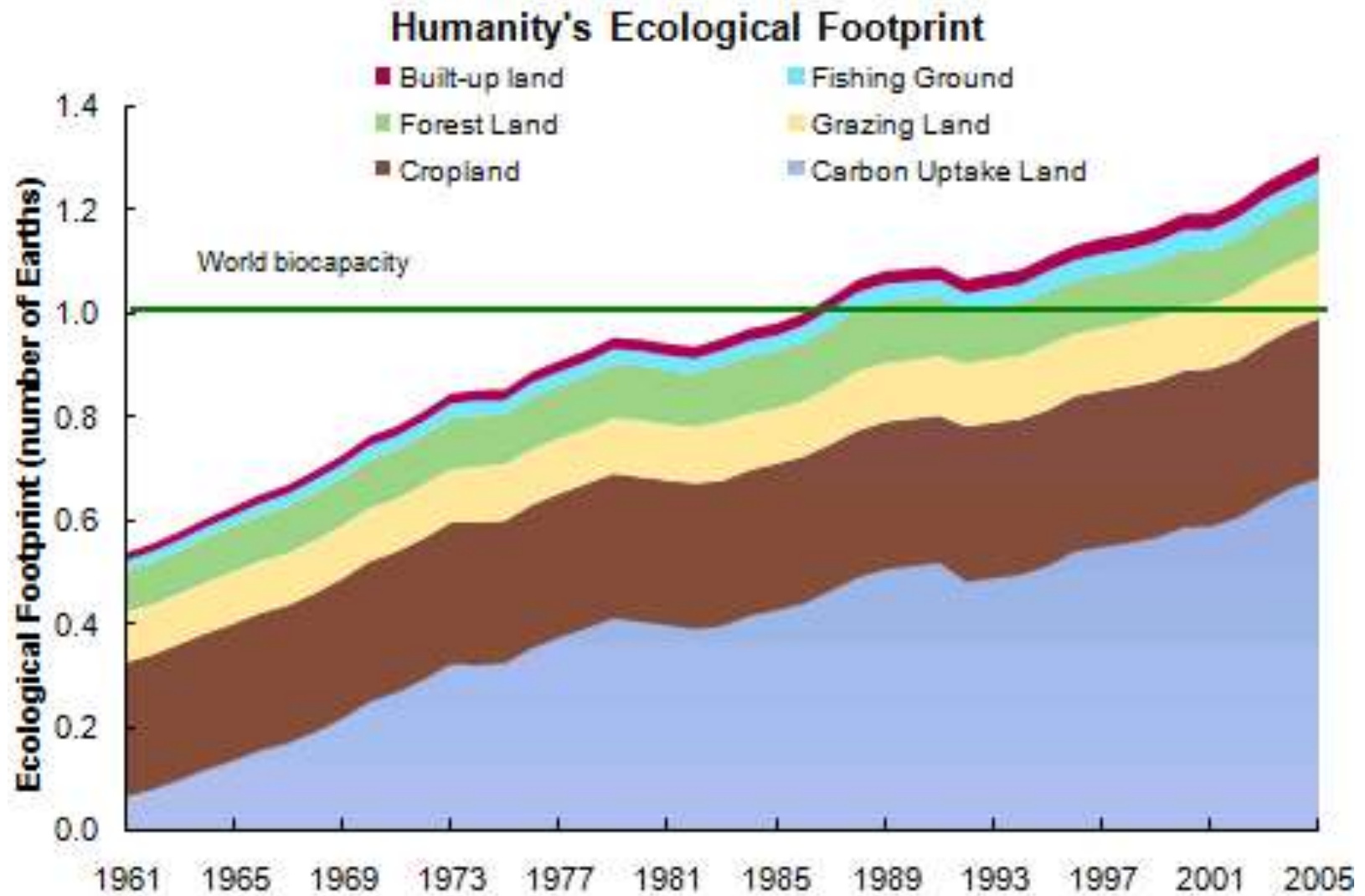
- Easy to explain and understand
- High pedagogical value, clear image of impacts due to populations over ecosystems
- Useful to explain a complex reality
- It is possible to follow progress along time
- It highlights the regeneration capacity of natural resources from natural capital incomes
- Applicable to different spatial and temporal scales



Ecological footprint

Drawbacks

- It does not account important impacts due to complexity to quantify
- Complex accounting process as we have to deal with big databases
- Complex data obtaining, the smaller scale the bigger complexity
- Accounting from a strict physic point of view, it does not consider other risks (weapons, transgenics, diseases, unequal distribution of resources, etc.)
- It does not quantify the consequences due to different consumption models

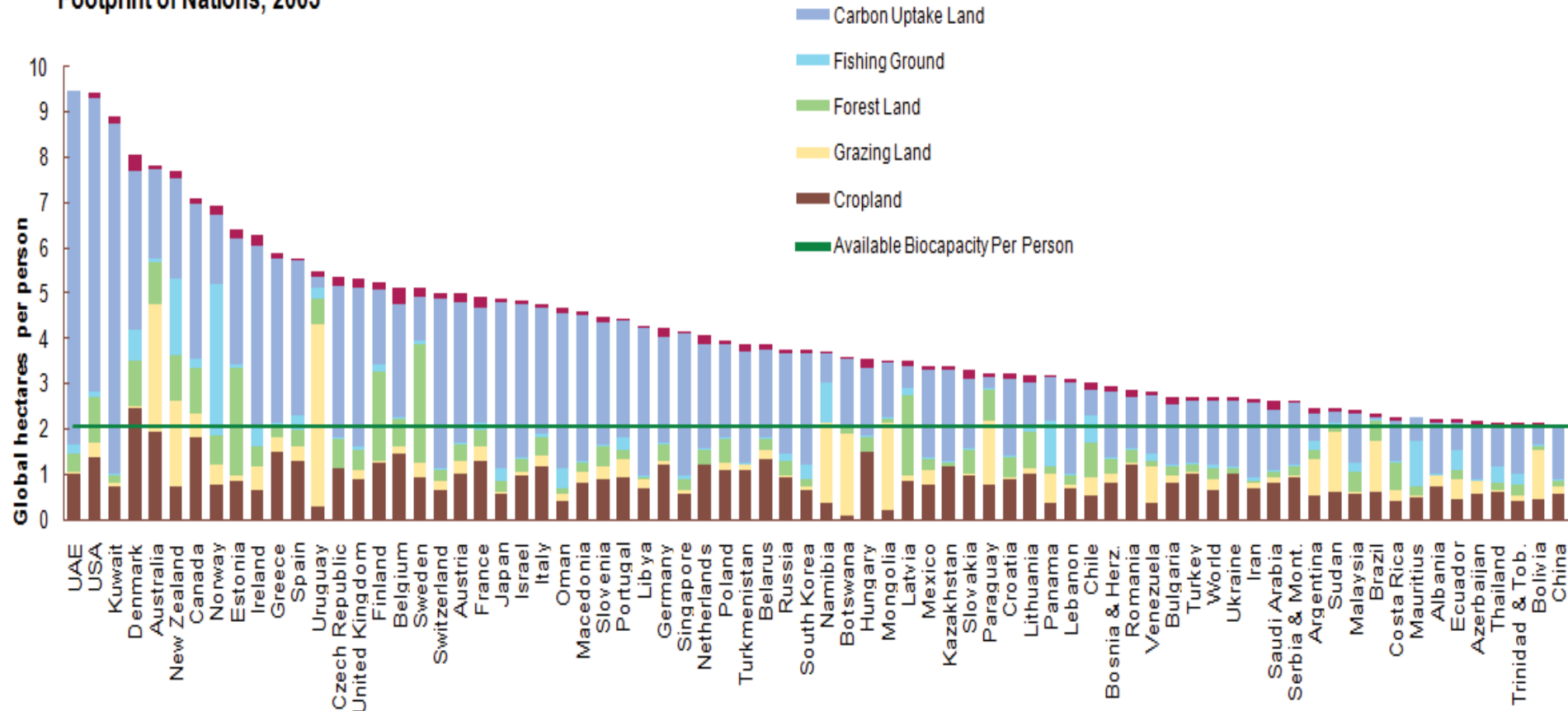


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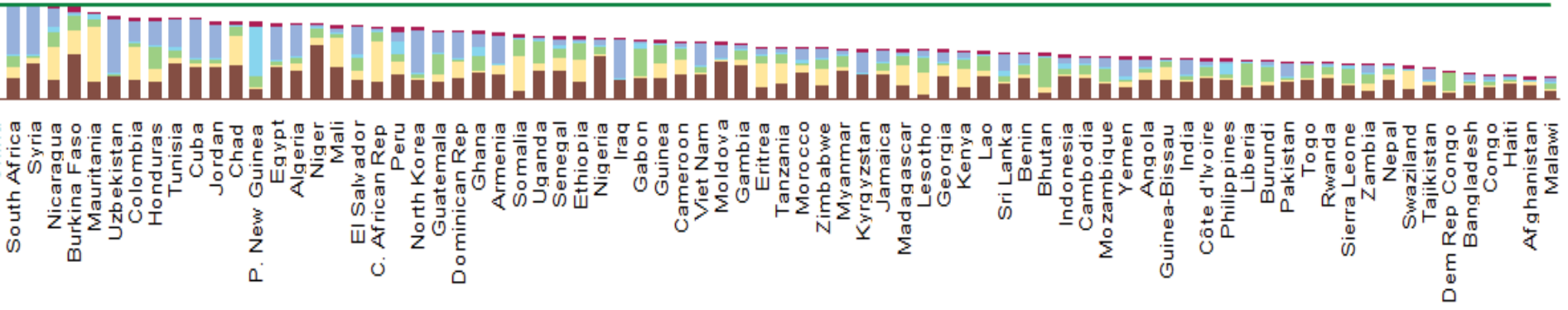
ECOLOGICAL FOOTPRINT

Footprint of Nations, 2005





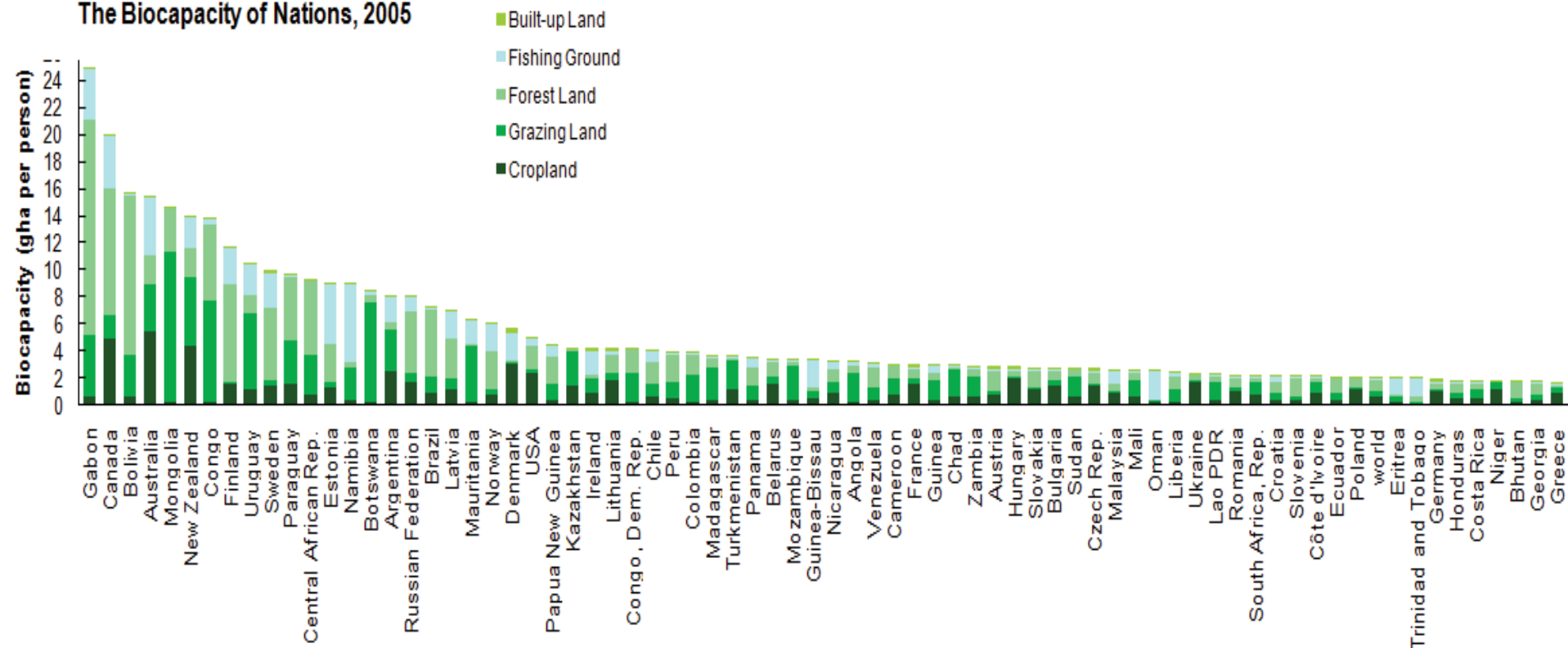
ECOLOGICAL FOOTPRINT





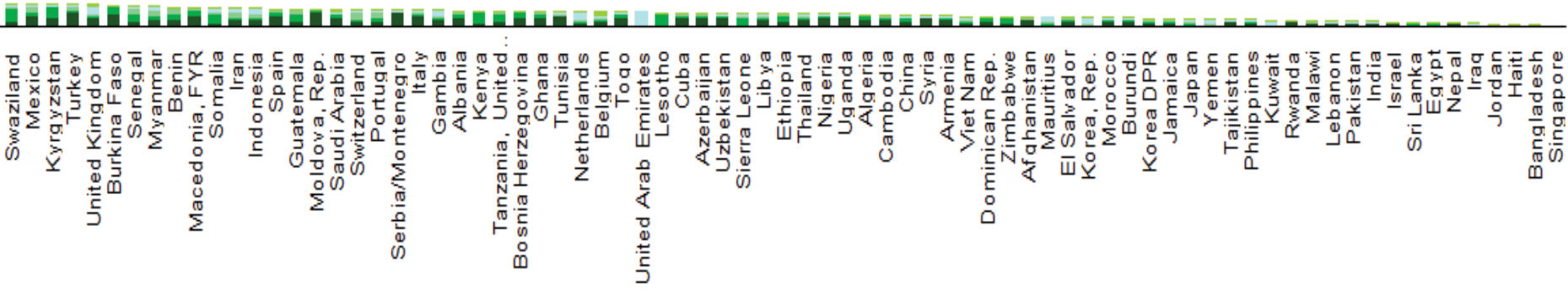
ECOLOGICAL FOOTPRINT

The Biocapacity of Nations, 2005





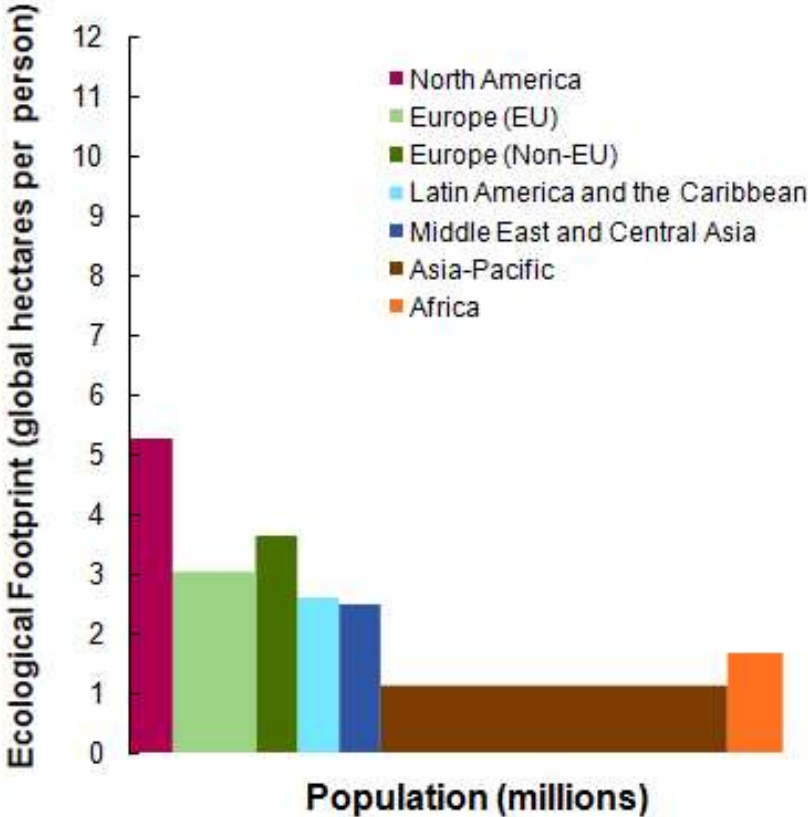
ECOLOGICAL FOOTPRINT



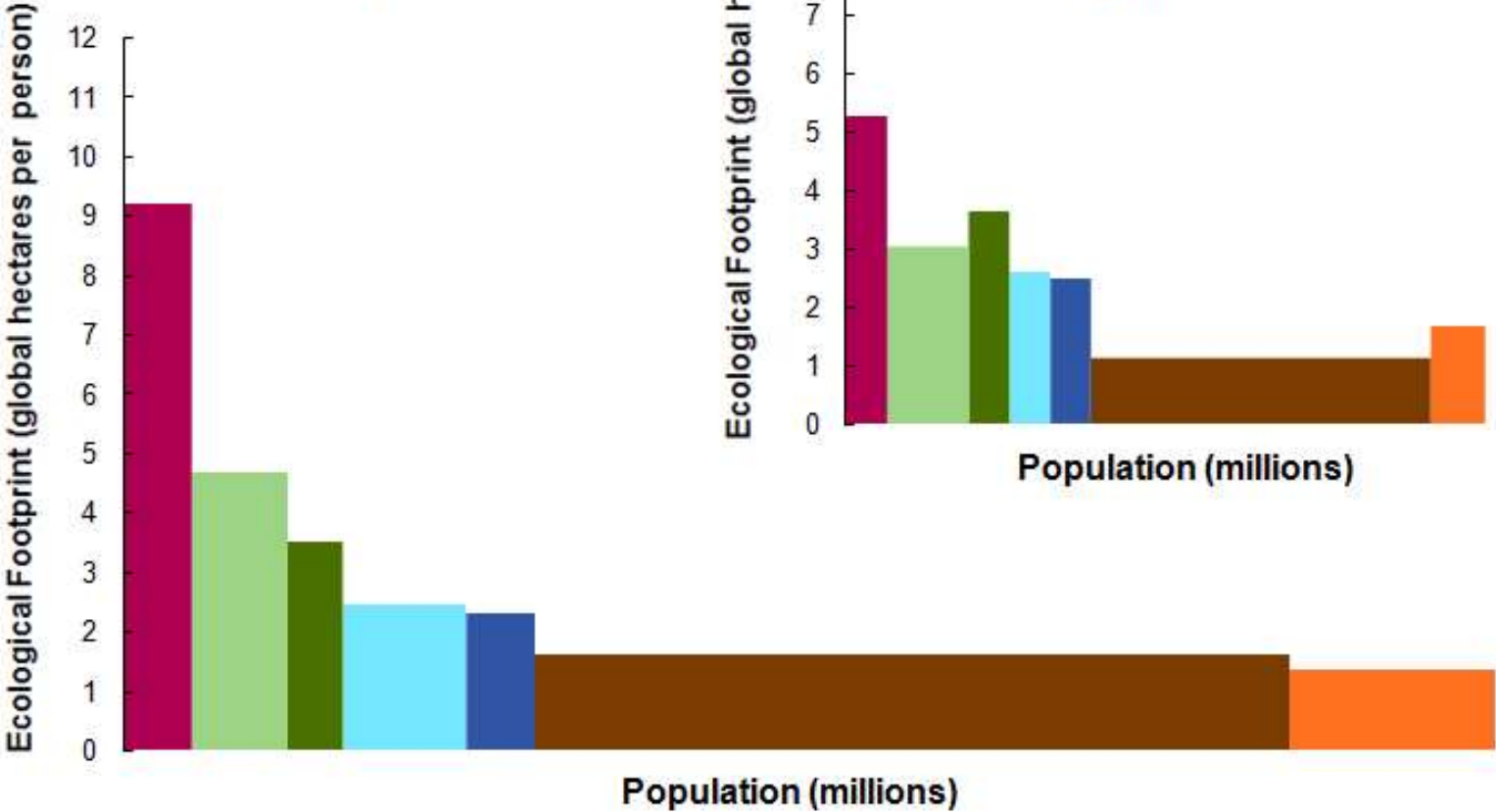


ECOLOGICAL FOOTPRINT

Footprint of Regions, 1961

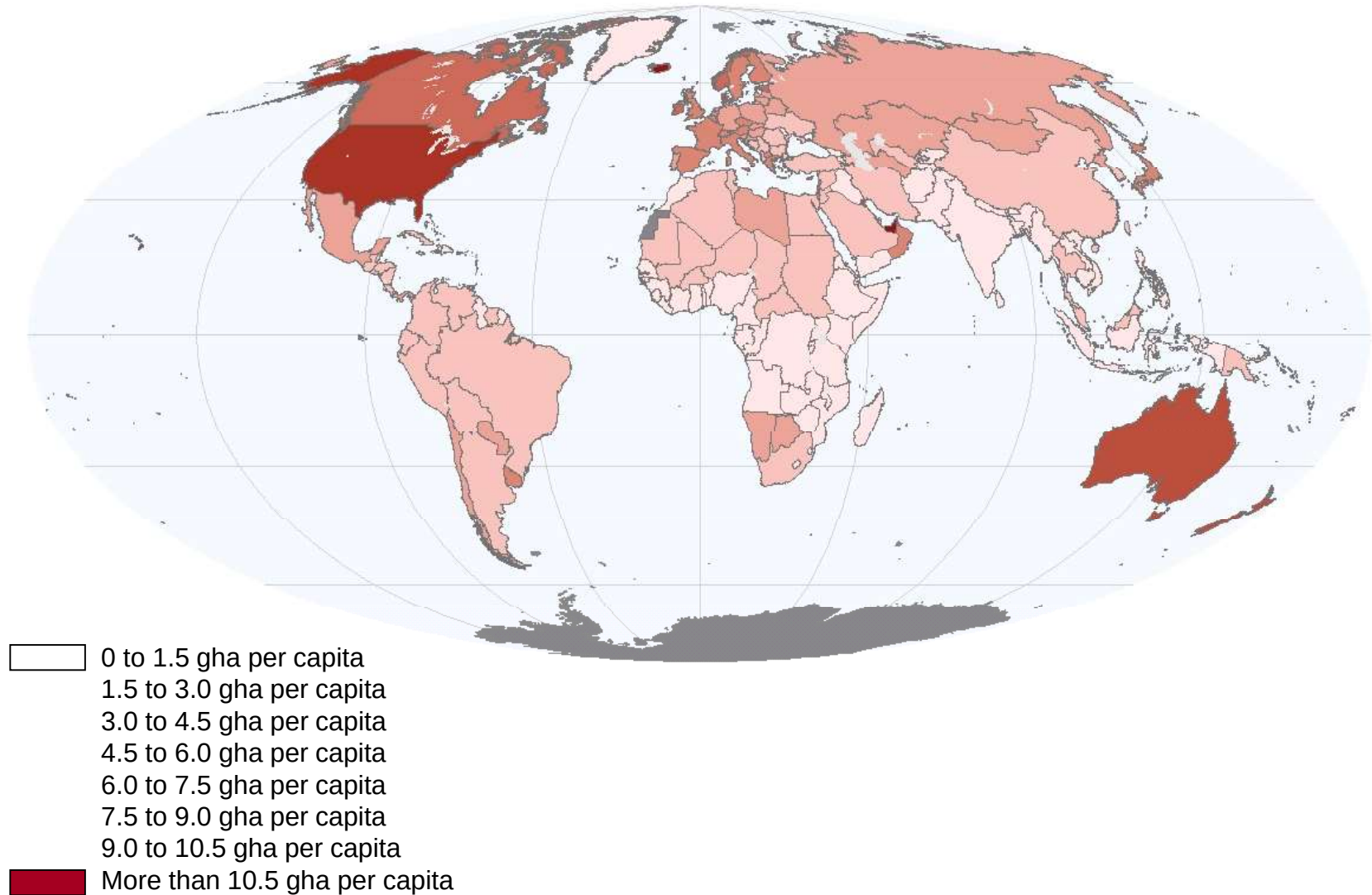


Footprint of Regions, 2005



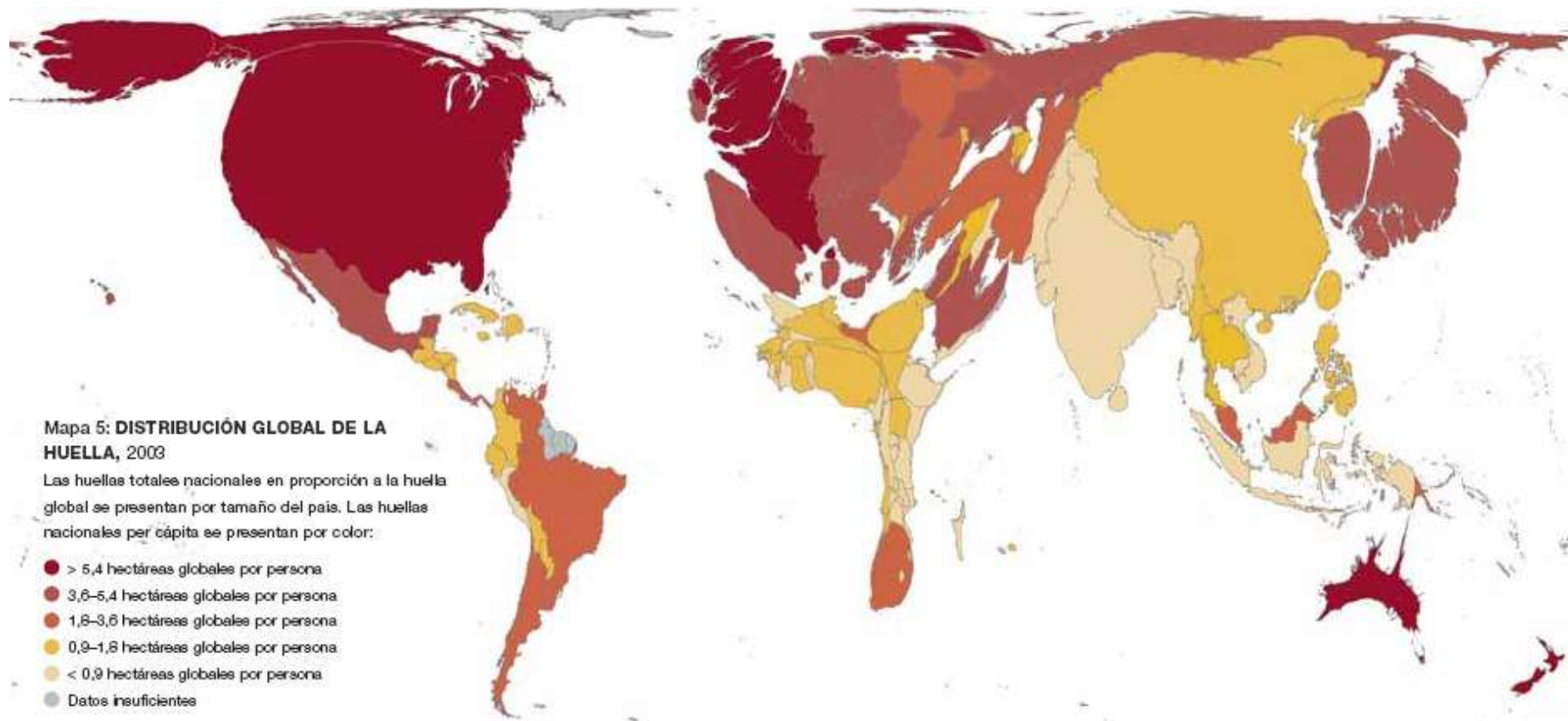


Ecological footprint per country (2005)



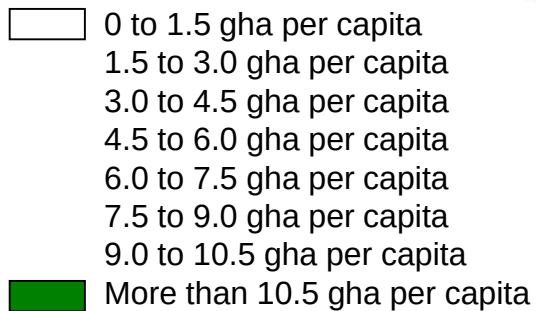
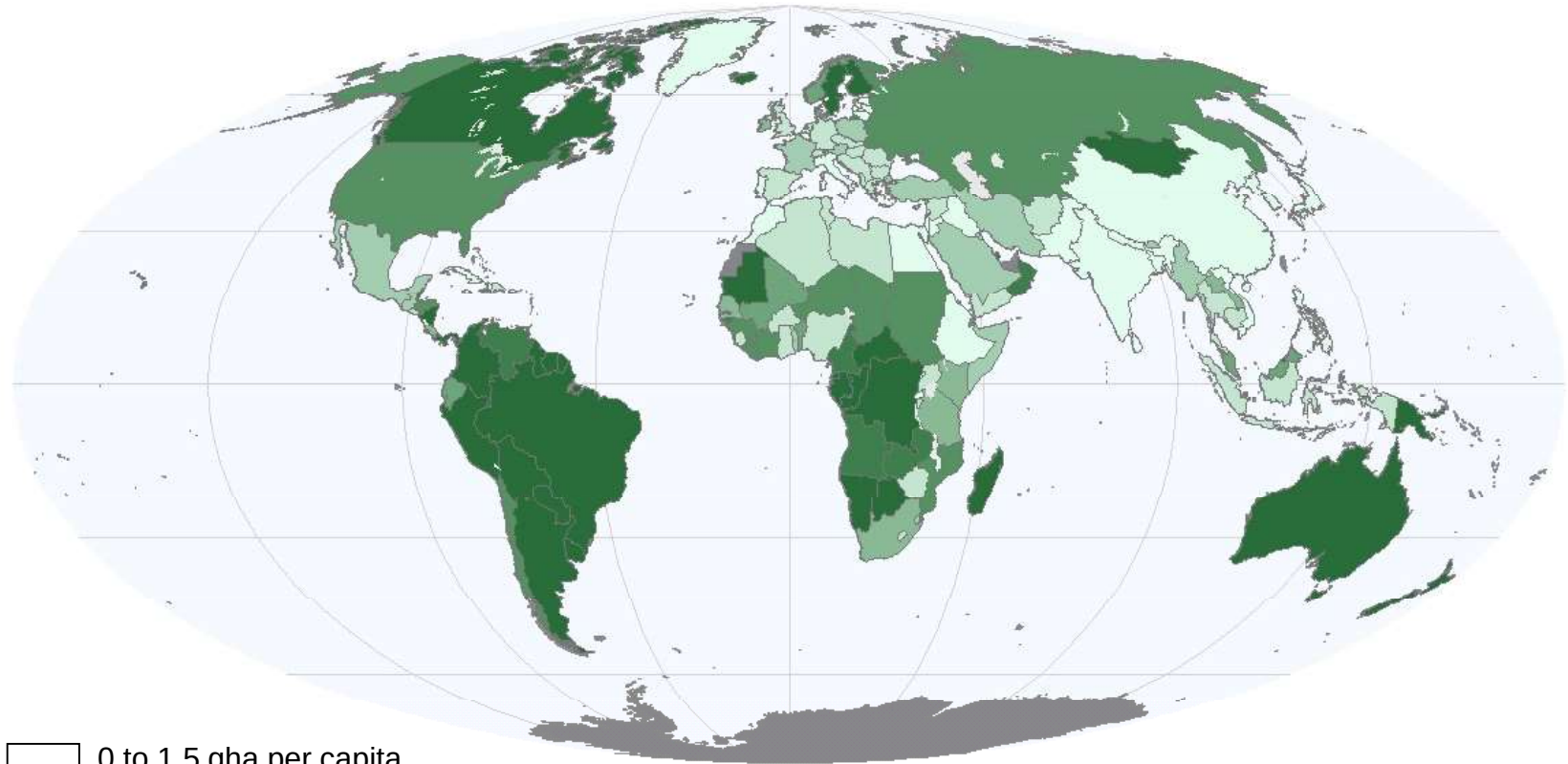


Ecological footprint in the world





Bio-capacity per country (1961)





Bio-capacity per country (2005)

