

**The Treadmill of Destruction and Ecological Exchange in  
Comparative Perspective: A Panel Study of the Biological  
Capacity of Nations, 1961-2007**

John Hamilton Bradford, Ph.D.

&

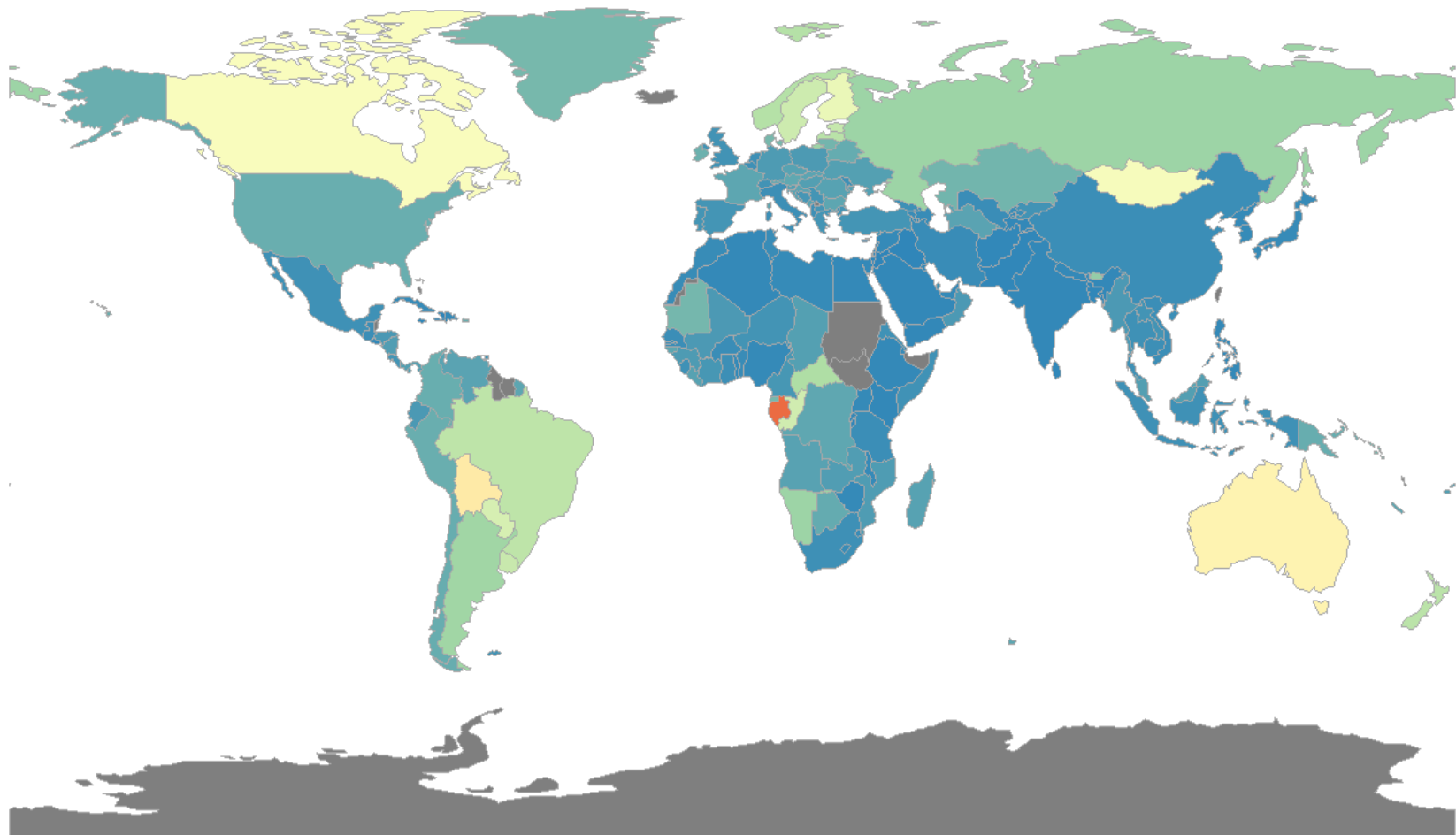
Alex M. Stoner, Ph.D.

# What is Biological Capacity?

- **Biocapacity**: an estimate of the quantity of ecosystem resources utilized in the production (rather than consumption) of final goods and services.

**Ecological Footprint = Biocapacity + Net Exports  
+ Carbon Uptake Land**

Per Capita Biological Capacity of Nations, 2011

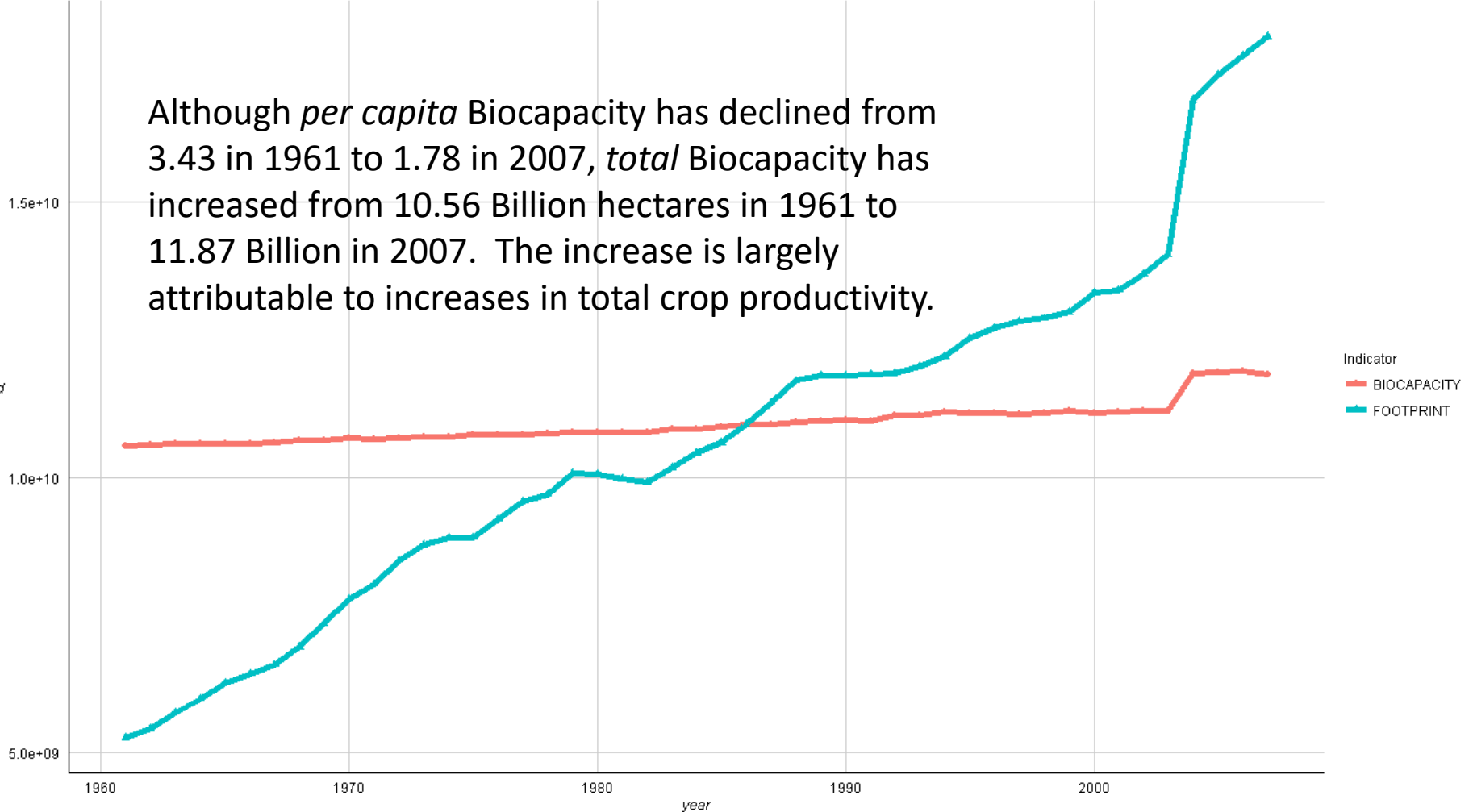


# What is Biological Capacity *NOT*?

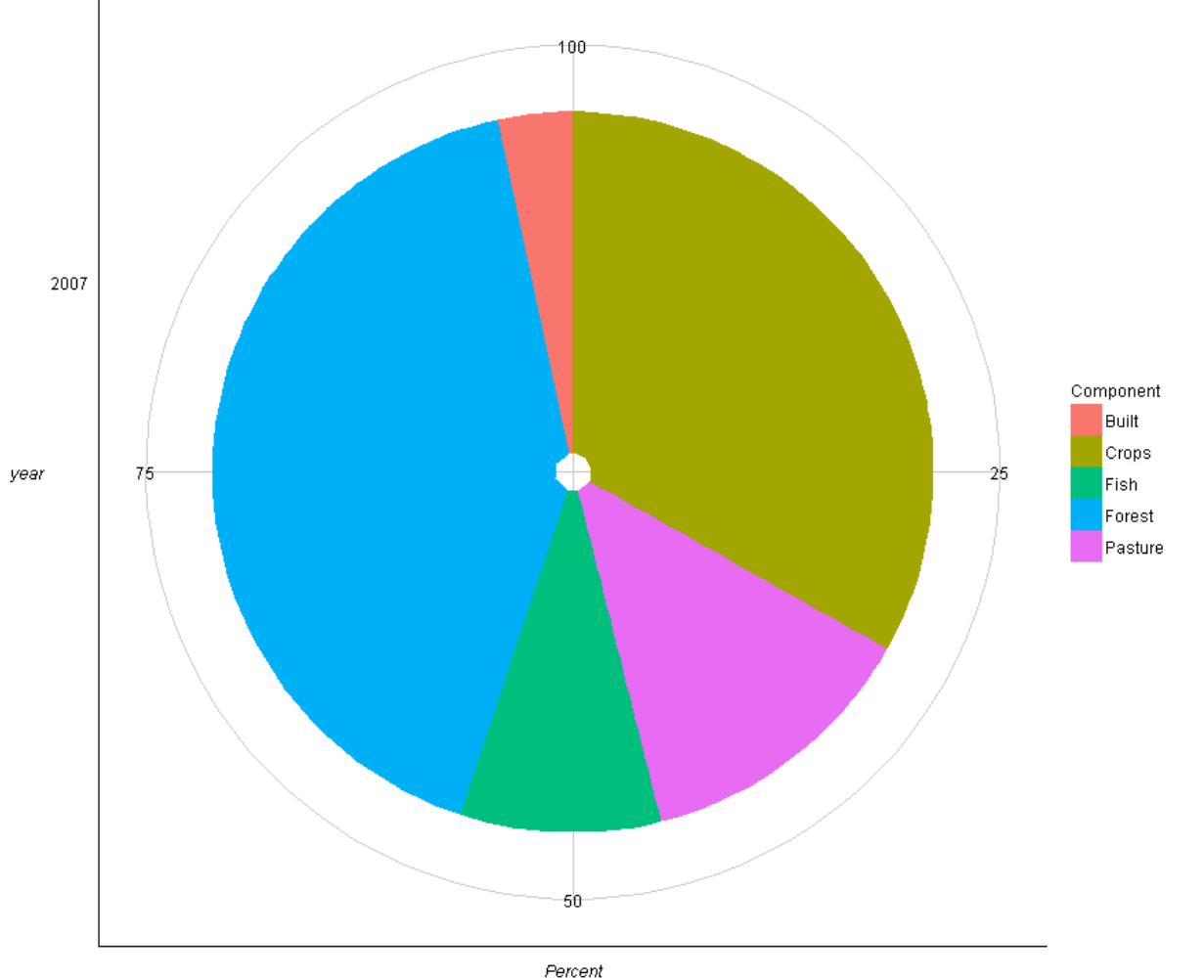
- Biocapacity is *not* a measure of **capacity** (or potential)
- Biocapacity does *not* quantitatively assess **carrying capacity**
  - maximum pop. of a species that can be supported indefinitely (Catton, 1980).
    - Measurements of Biocapacity contain **no assumptions** about how productive lands could or should be used; instead estimates are derived exclusively from *actual*, measurable land area required in a given country in a given year to supply over 60 categories of commodities...
- **IS BIOCAPACITY ONE PROXY MEASURE FOR BIOLOGICAL THROUGH-PUT?**

World Biological Capacity & Ecological Footprint: 1961-2007

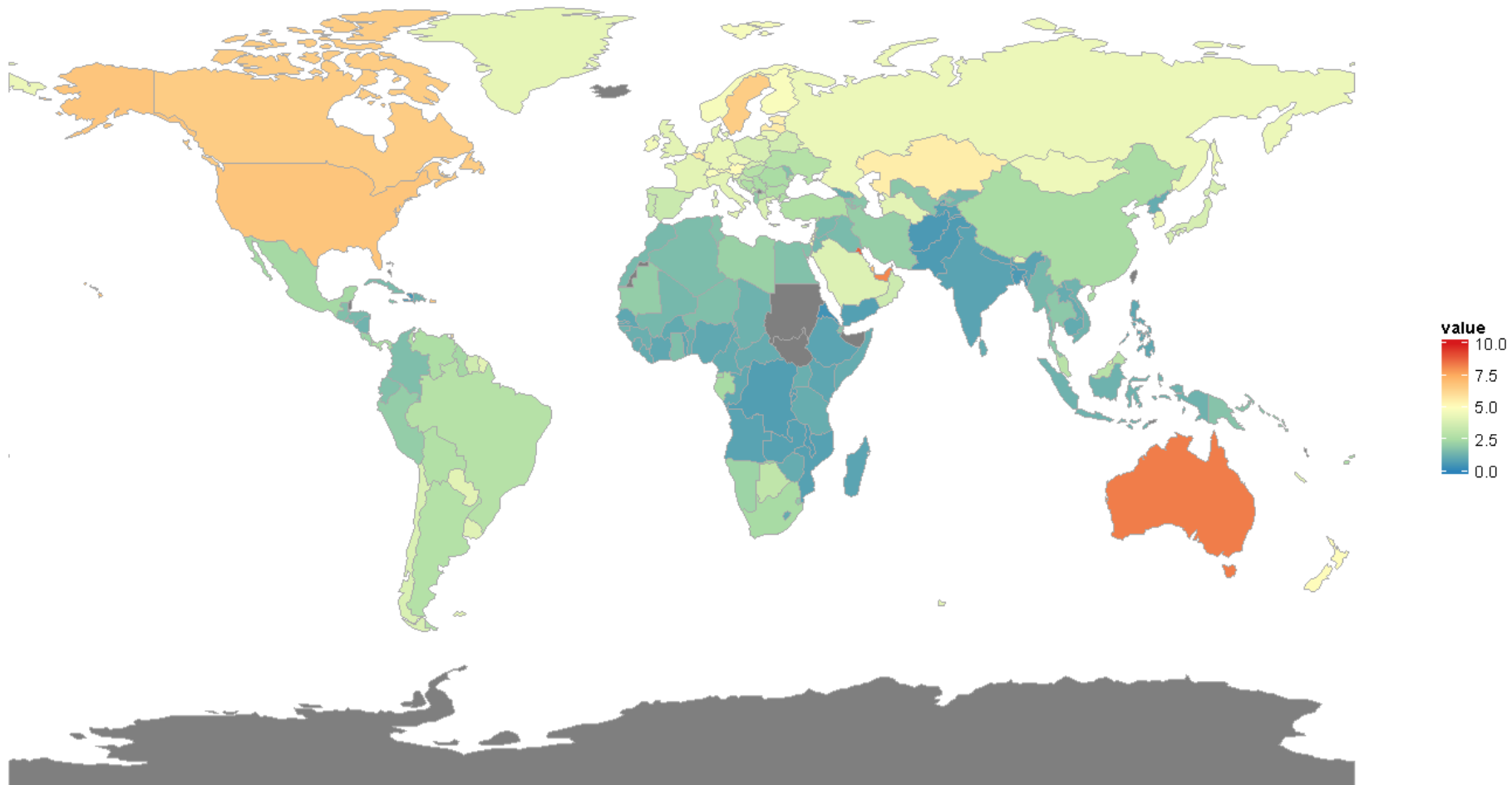
Although *per capita* Biocapacity has declined from 3.43 in 1961 to 1.78 in 2007, *total* Biocapacity has increased from 10.56 Billion hectares in 1961 to 11.87 Billion in 2007. The increase is largely attributable to increases in total crop productivity.



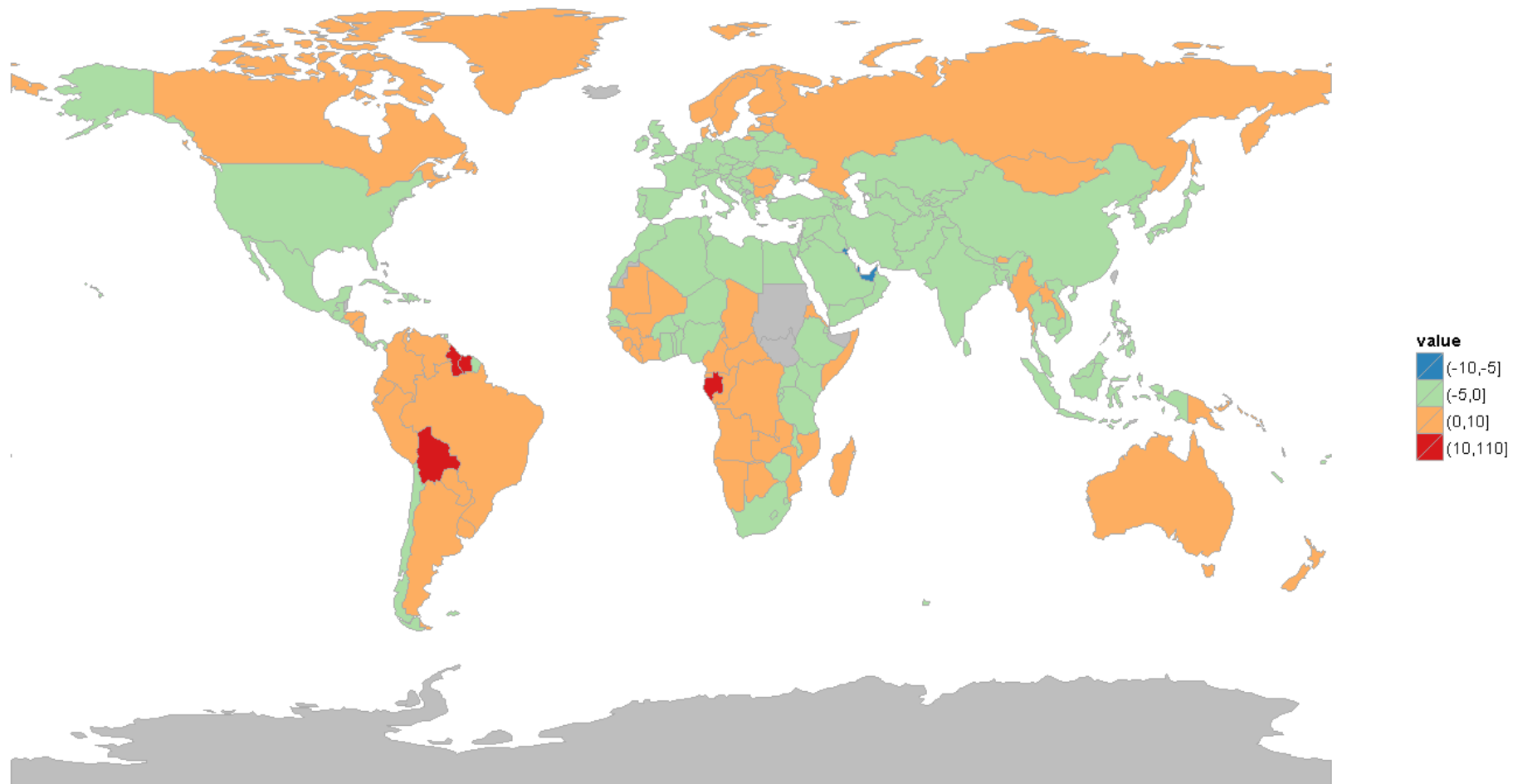
Components of World Biological Capacity, 2007



Per Capita Ecological Footprint of Nations, 2011

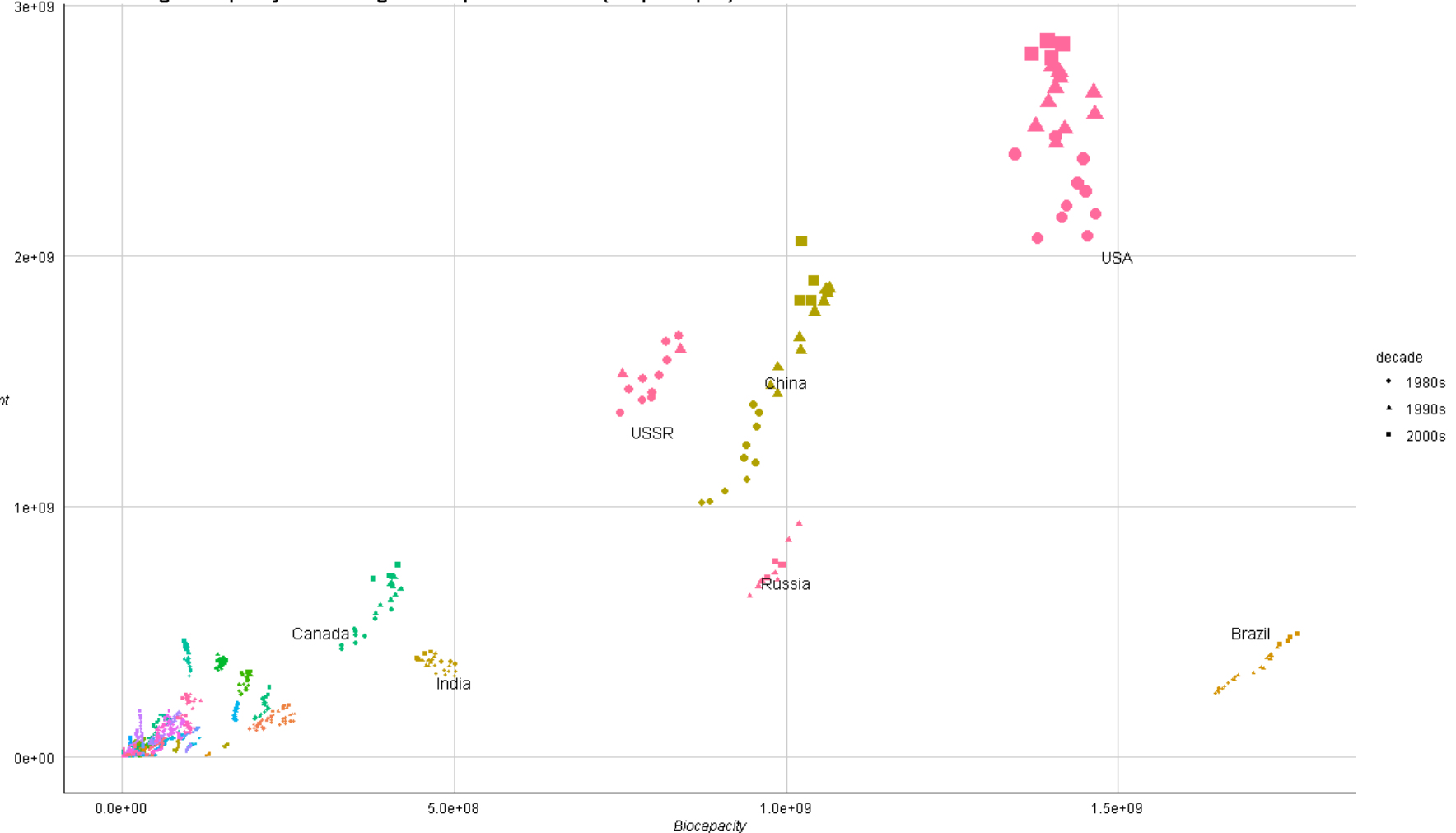


Per Capita Biocapacity Deficit/Reserve, 2011





Total Biological Capacity and Ecological Footprint 1961-2007 (not per capita)

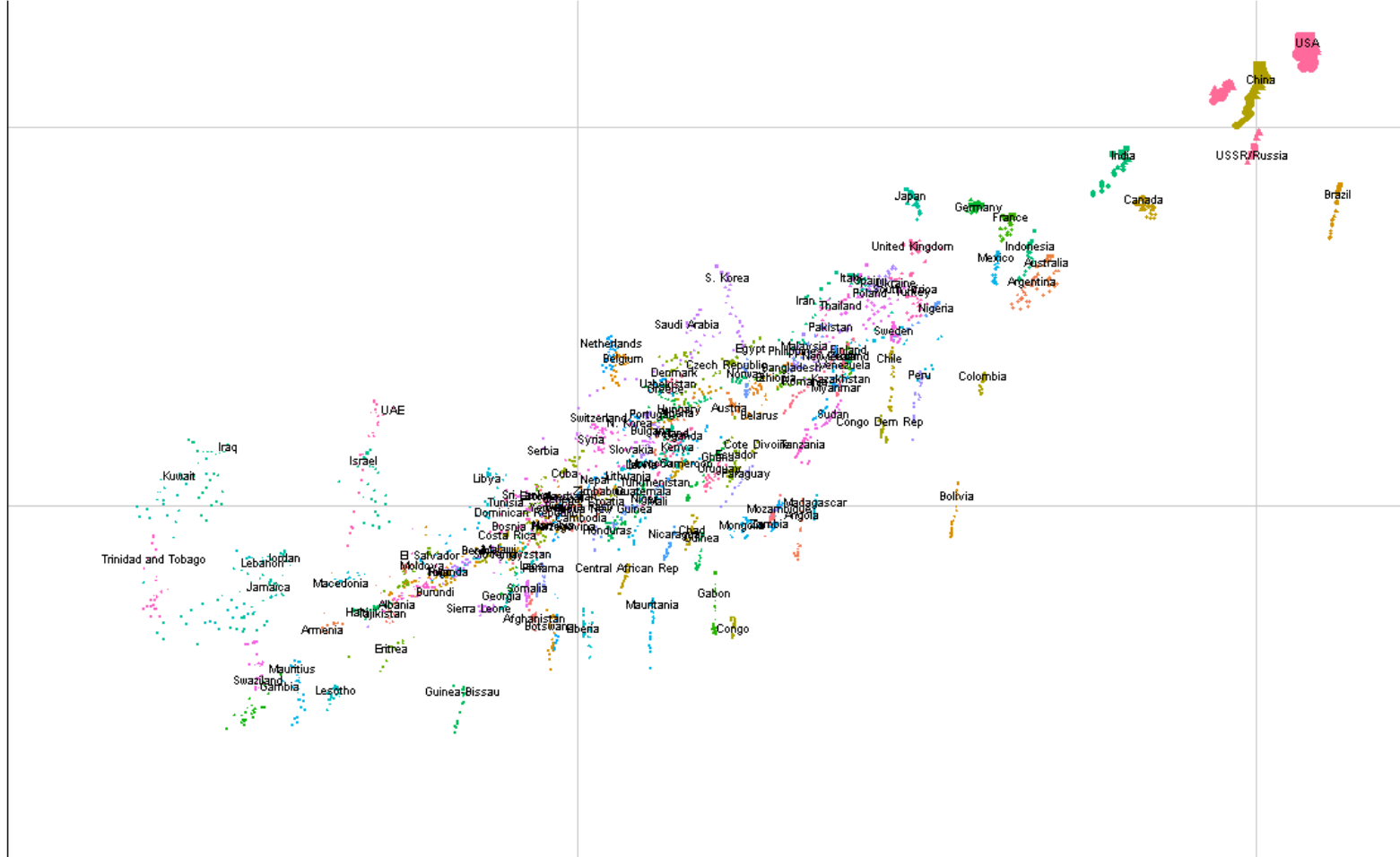


# Total Biological Capacity and Ecological Footprint 1961-2007 (not per capita)

*Eco. Footprint  
log10 scale*

1e+09

1e+07



decade

• 1980s

▲ 1990s

■ 2000s

1e+07

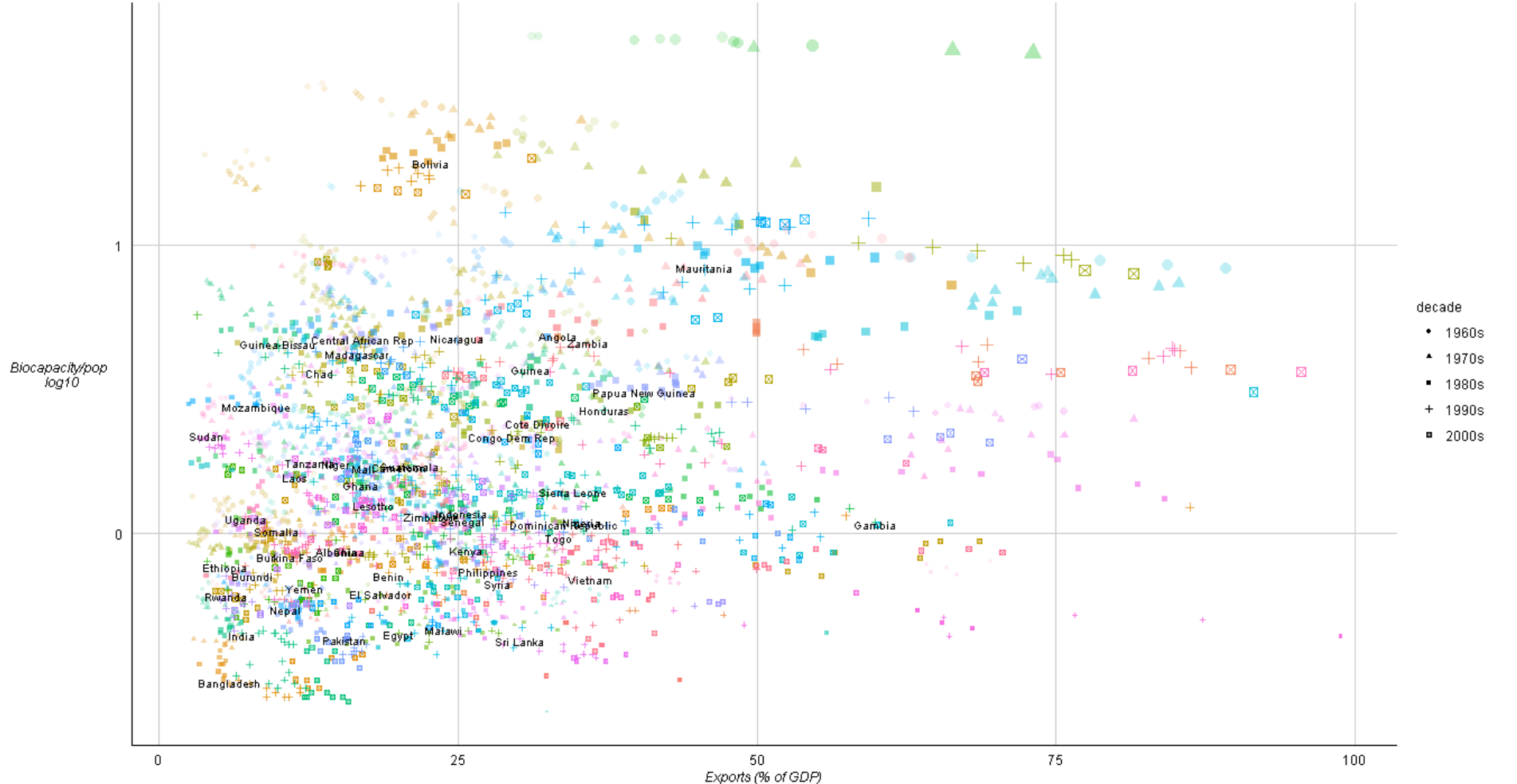
1e+09

*Biocapacity log10 scale*

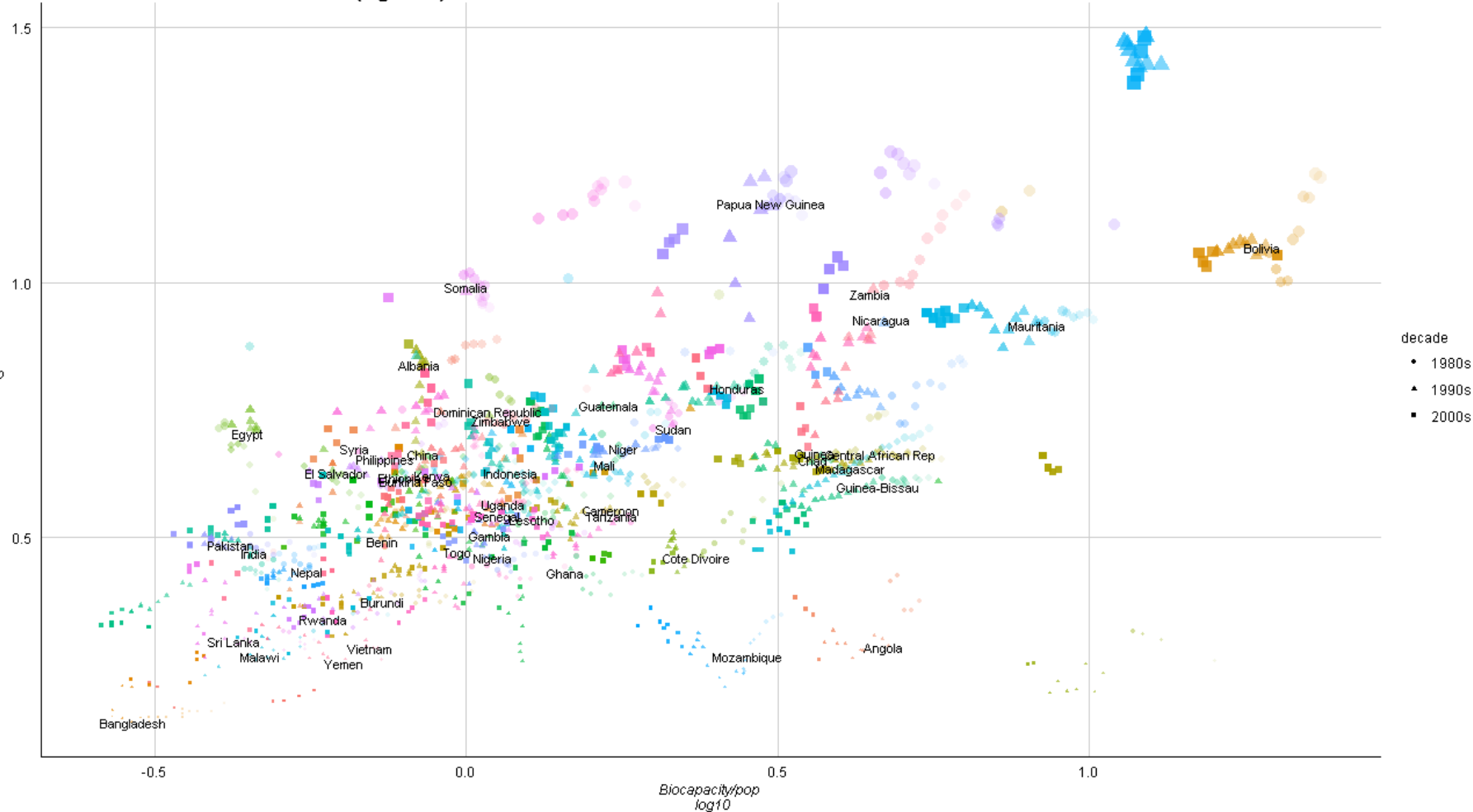
Per Capita Biological Capacity and Per Capita Ecological Footprint, 1961-2007



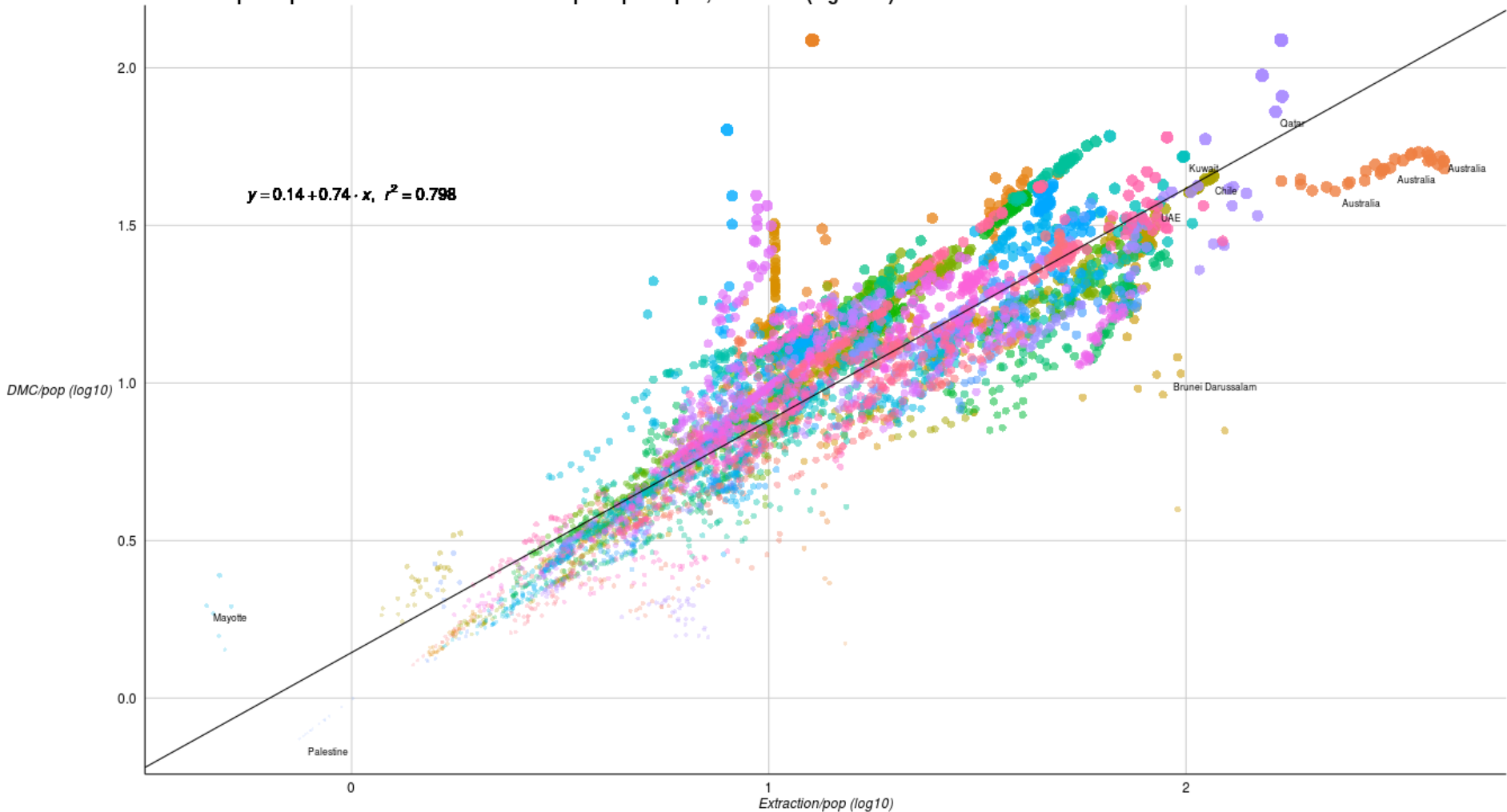
Export Dependence and Biological Capacity per capita,  
 Low Income Countries: 1961-2007



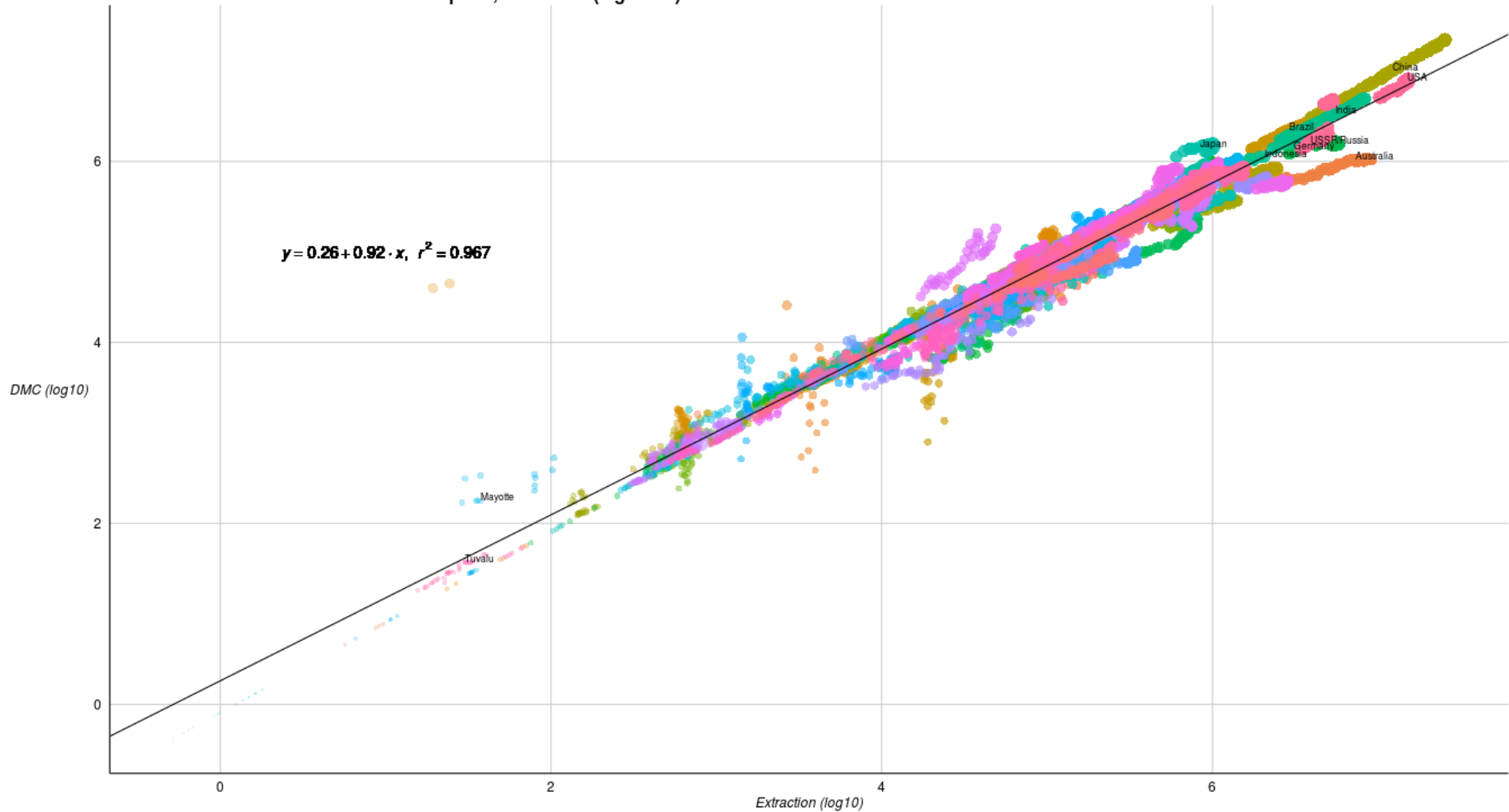
Biological Capacity per capita and Domestic Material Consumption per capita,  
 Low Income Countries: 1980-2007 (log scale)



Extraction per capita & Domestic Material Consumption per capita, 1980-2009 (log scale)



Extraction & Domestic Material Consumption, 1980-2009 (log scale)



# How does Ecological Unequal Exchange Work?

- Do export dependent, low income countries consume fewer resources because they **export away** the resources they would have otherwise consumed?
- (Apparently, NO)



**Table 2.** Unstandardized Coefficients for the Regression of Per Capita Biological Capacity on Selected Predictor Variables: Fixed Effects and Prais-Winsten with panel-corrected standard errors (PCSEs) estimates, utilizing AR(1) correction for 142 countries, 1961-2007

VARIABLES	(1) Fixed Effects	(2) Fixed Effects	(3) PCSE	(4) PCSE
Military expenditures (ln)	-0.0153*** (0.00425) <i>[1.31]</i>	-0.0154*** (0.00425) <i>[1.32]</i>	-0.0388*** (0.00649) <i>[1.31]</i>	-0.0374*** (0.00639) <i>[1.32]</i>
War	-0.0146** (0.00731) <i>[1.12]</i>	-0.0174** (0.00764) <i>[1.16]</i>	-0.0168 (0.0122) <i>[1.12]</i>	-0.0196 (0.0125) <i>[1.16]</i>
GDP per capita (ln)	0.00658 (0.0162) <i>[1.07]</i>	0.00488 (0.0163) <i>[1.07]</i>	0.147*** (0.0161) <i>[1.07]</i>	0.146*** (0.0164) <i>[1.07]</i>
GDP per capita squared (ln)	-1.723*** (0.462) <i>[1.09]</i>	-1.701*** (0.464) <i>[1.11]</i>	1.725*** (0.463) <i>[1.09]</i>	1.683*** (0.470) <i>[1.11]</i>
Exports (% of GDP) (ln)	-0.0282*** (0.00952) <i>[1.16]</i>	-0.0135 (0.0118) <i>[1.42]</i>	-0.0245* (0.0139) <i>[1.16]</i>	-0.0102 (0.0169) <i>[1.42]</i>
Urban population (ln)	-0.494*** (0.0452) <i>[1.17]</i>	-0.494*** (0.0454) <i>[1.23]</i>	0.0891 (0.0609) <i>[1.17]</i>	0.0858 (0.0612) <i>[1.23]</i>
High Income x War		0.0345 (0.0259) <i>[1.04]</i>		0.0327 (0.0328) <i>[1.04]</i>
Low income x Exports		-0.0422** (0.0199) <i>[1.38]</i>		-0.0405 (0.0248) <i>[1.38]</i>
Constant	0.677*** (0.0218)	0.689*** (0.0217)	-0.362*** (0.139)	-0.358** (0.141)
Observations	4,722	4,722	4,865	4,865
R-squared (overall)	0.0020	0.0026	0.153	0.152
R-squared (within)	0.0380	0.0391	--	--
R-squared (between)	0.0178	0.0196	--	--
Number of id	142	142	143	143

Coefficients flagged for statistical significance. Standard errors in parentheses. Variance Inflation Factors are in italics and brackets. Two-tailed tests: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

- Negative Association between Biocapacity and Export Dependence, at least for Low Income Countries.
- This result is stable across multiple model specifications:
  - When analyzing *within-country variation over time* (Models 1-2), *controlling for unobserved time-invariant factors.*
  - When analyzing both *within and between-country variation over time* (Models 3-4), *correcting for AR(1) disturbance and heteroskedasticity (cf. Jorgenson and Clark 2012)*
  - *We also conducted Random Effects Regression as well as a Regression on the ‘First-Differences’ (of the standard deviations) of our independent variables...*

Figure 4. Marginal effect of Exports on Biocapacity, conditional on GDP. Fixed Effects, Model 2

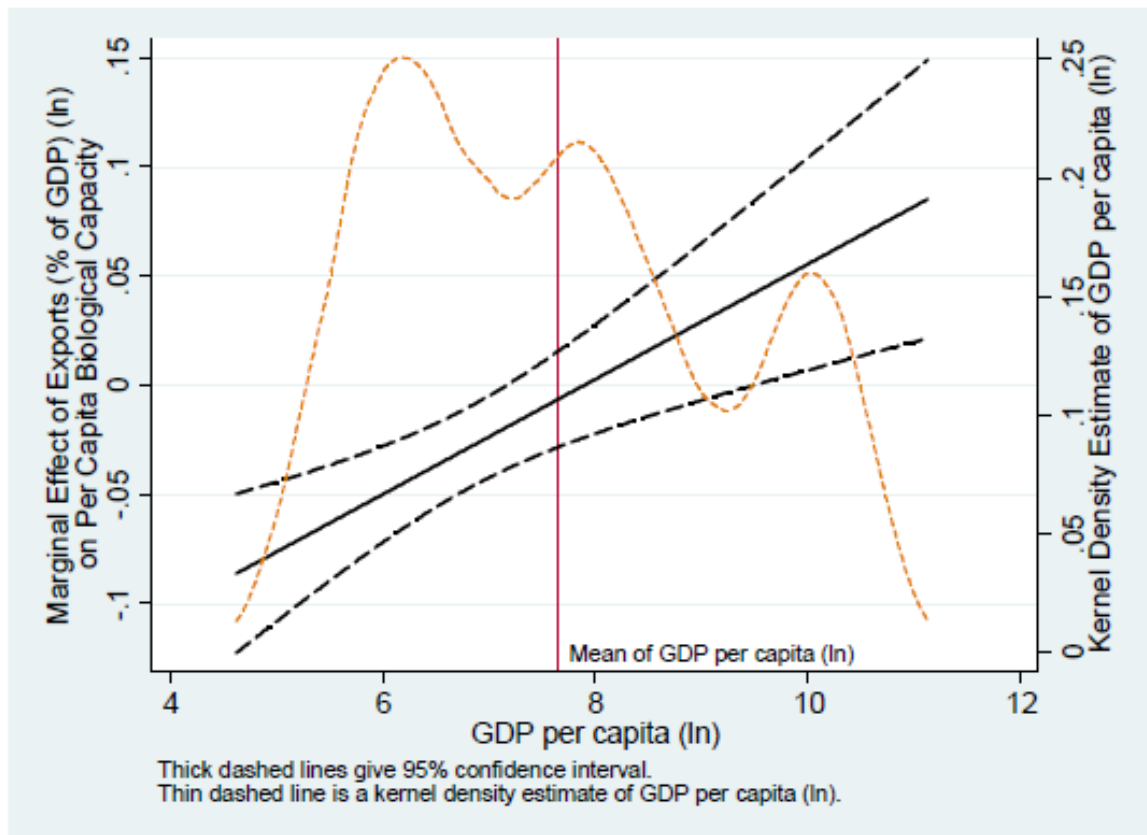
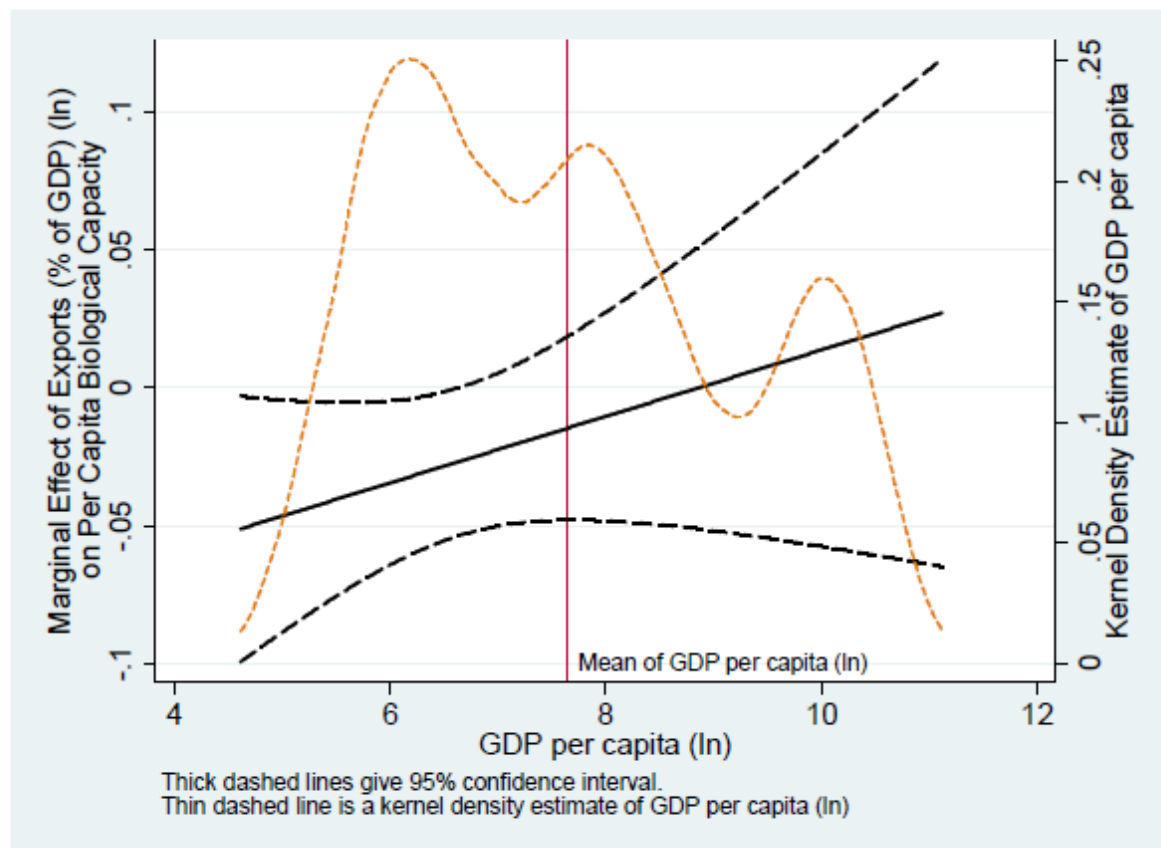


Figure 6. Marginal Effect of Exports on Biocapacity, conditional on GDP. Prais-Winsten, Model 4



# How does Ecological Unequal Exchange Work?

- **Primary Finding:** export-dependent, low income countries tend to consume fewer material resources (as measured by Biological Capacity) in large part *because they produce, prior to exchange, relatively fewer domestic material resources to consume.*