Conflicts, Compatibilities, and Coherencies between Natural Science and Payment for Ecosystem Services

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Outline

1. The Chaotic Relay of the Millennial Grand Synthesis
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2. Looking for Sweetspot in a Scary Spectrum
   - Free-for-all vs. Regulatory Paralysis
3. Scale incompatablility
   - Local and global scales work in opposites
4. The anethema of ecological inequality
   - The fragility of the raison d'etre of PES

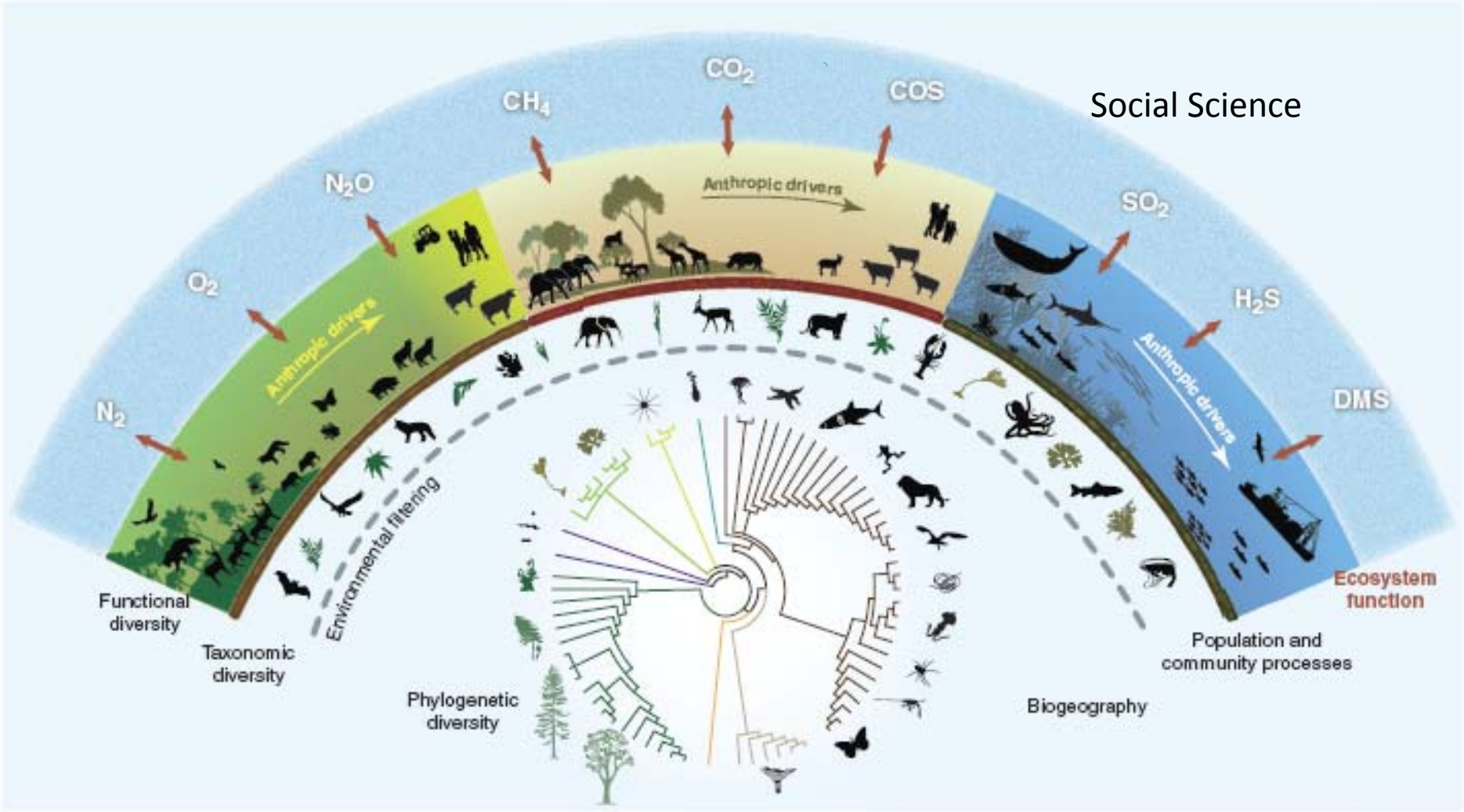
1. The Chaotic Relay of the Millennial Grand Synthesis

Natural and Social Science – Where's the baton?

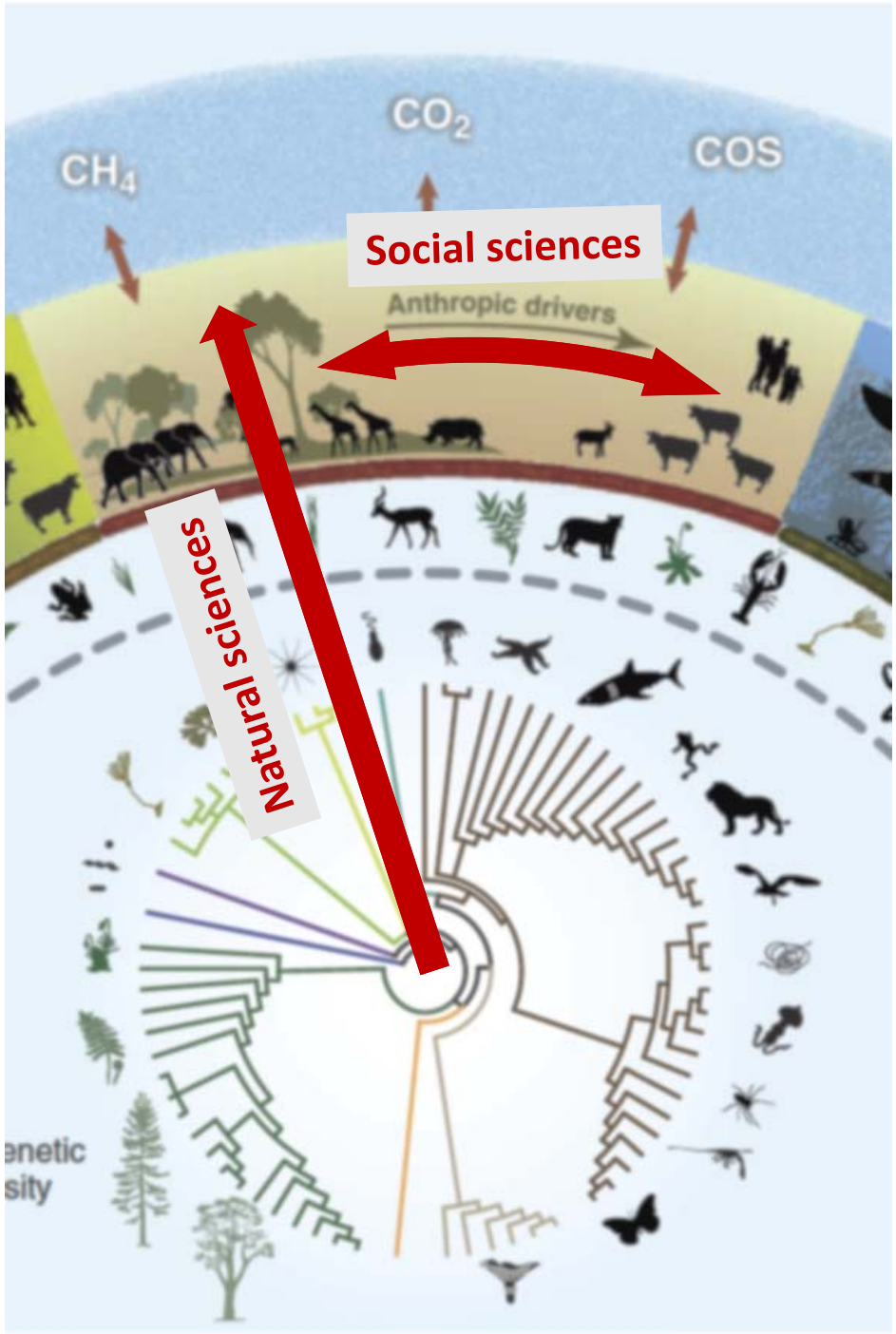
The Functions of Biological Diversity in an Age of Extinction

Shahid Naeem,[1]* J. Emmett Duffy,[2] Erika Zavaleta[3]

cies, excluding primrose (*9*). Going further still, taxonomic diversity has been linked to interaction diversity, the complex web of interactions among species in a system. For example, in a grassland experiment, low-diversity plots (four plant species) produced lower interaction diversity among the 427 resident arthropod species than did high-diversity plots (16 plant species) (*12*). Taken to the extreme, the next step might



Social Science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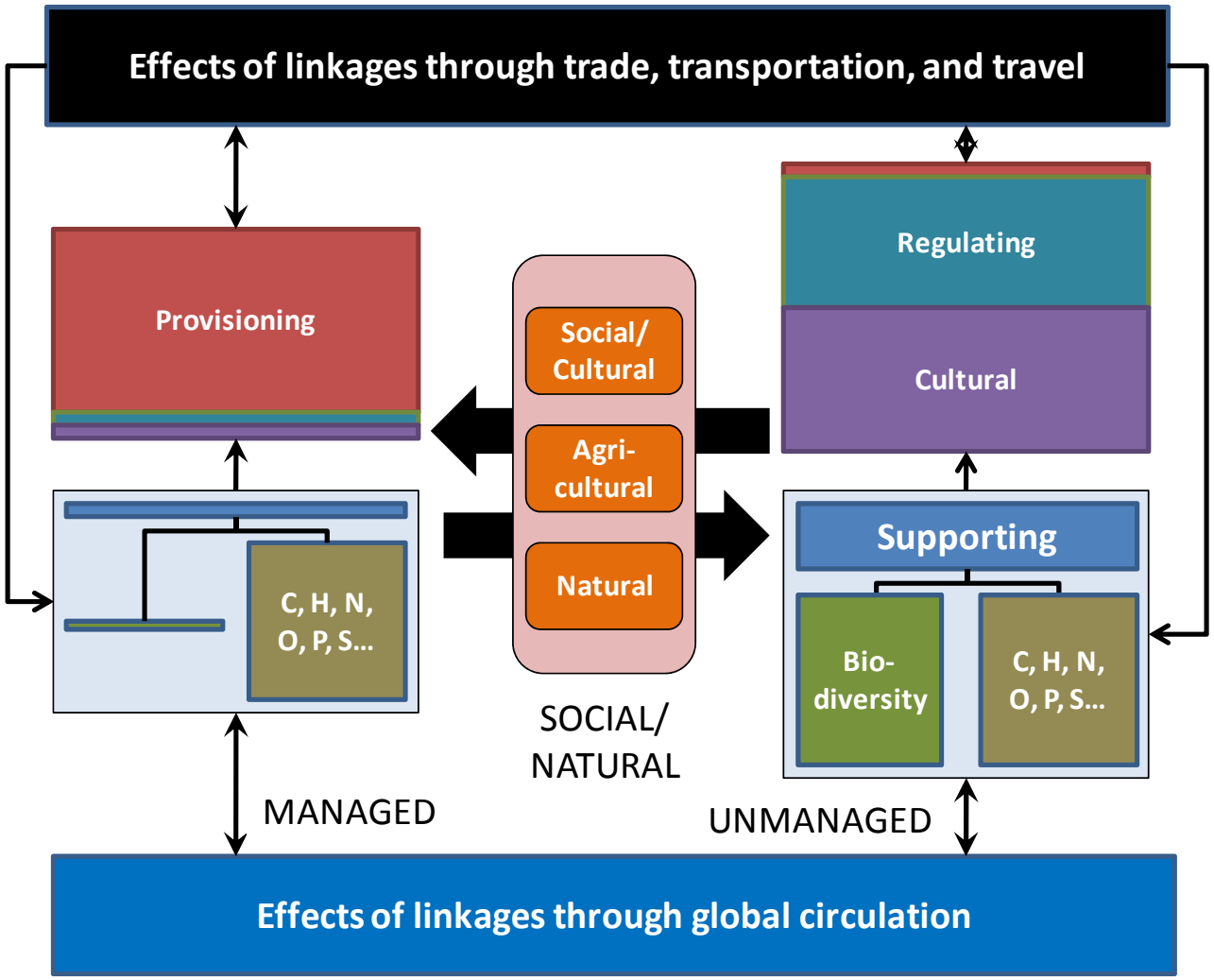
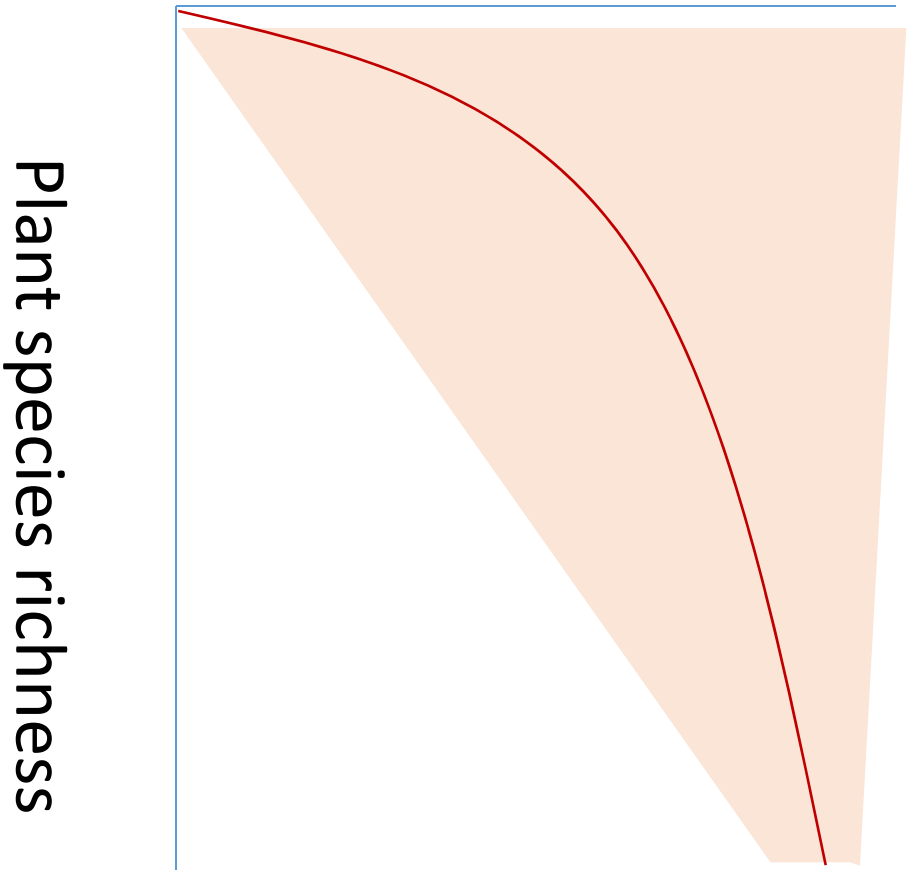
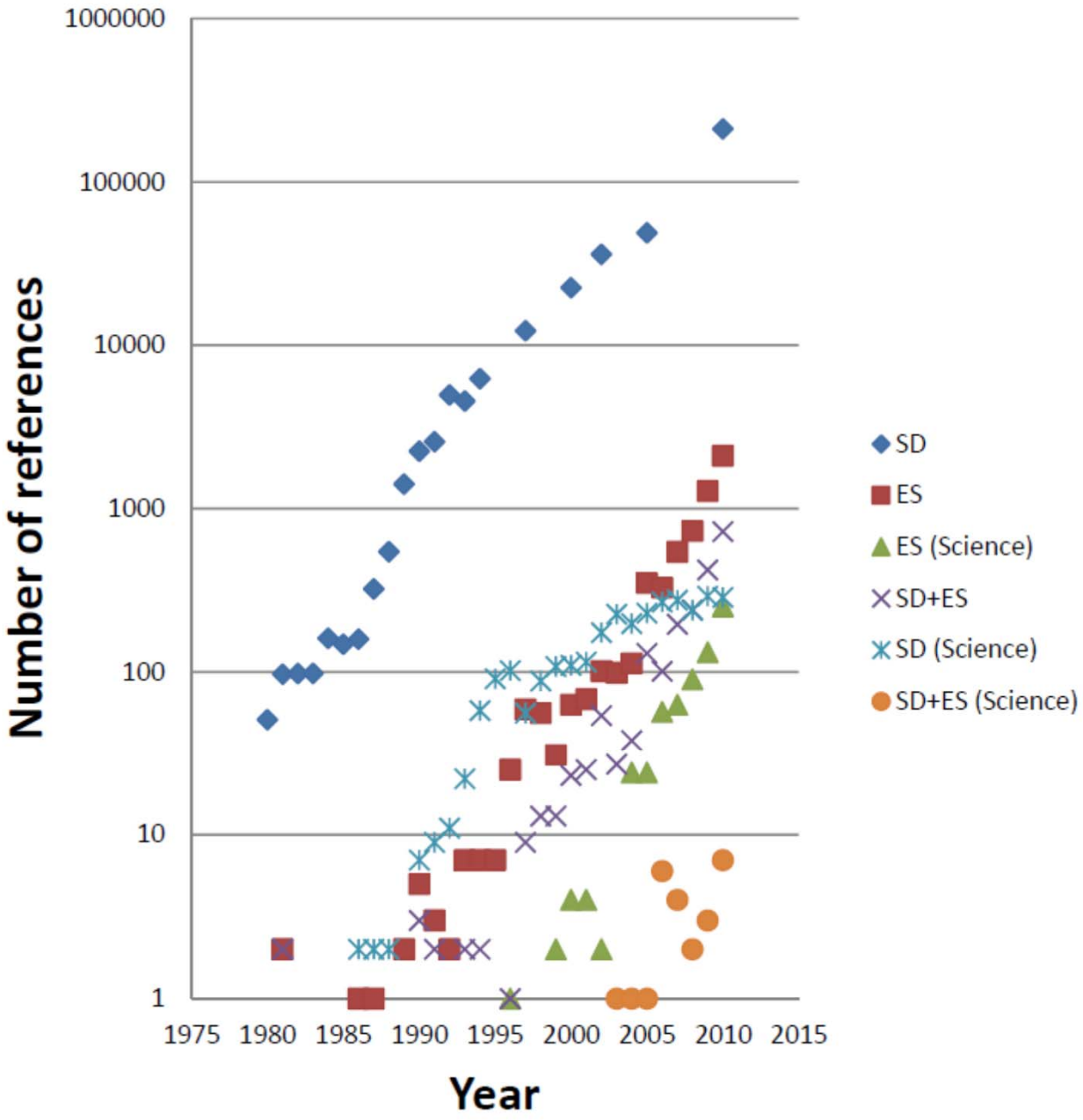


Rapidly increasing prevalence of allergies and other chronic inflammatory diseases among urban populations worldwide.

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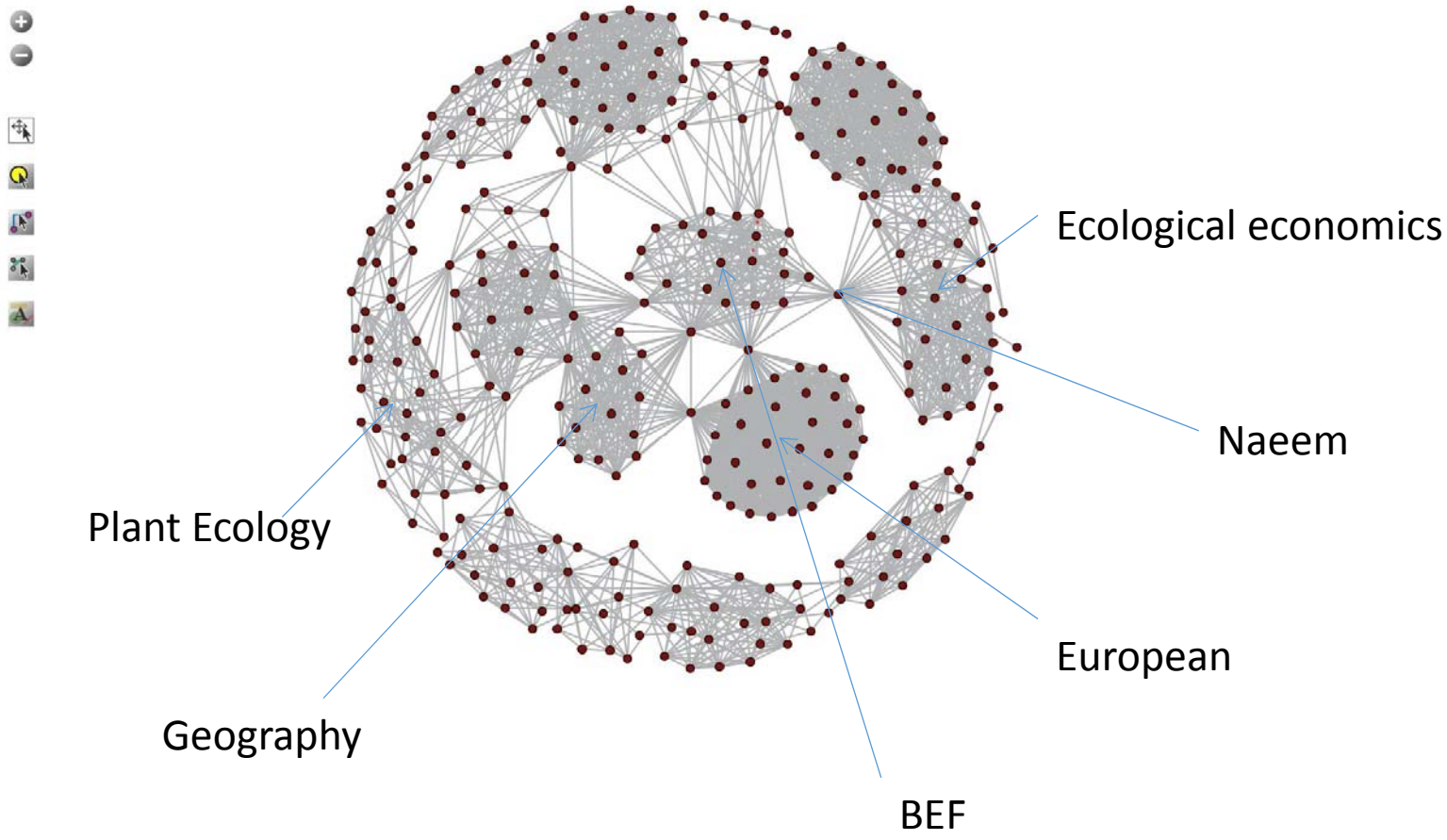
Central challenge: Science Silos

ISI Web of Science, co-author network



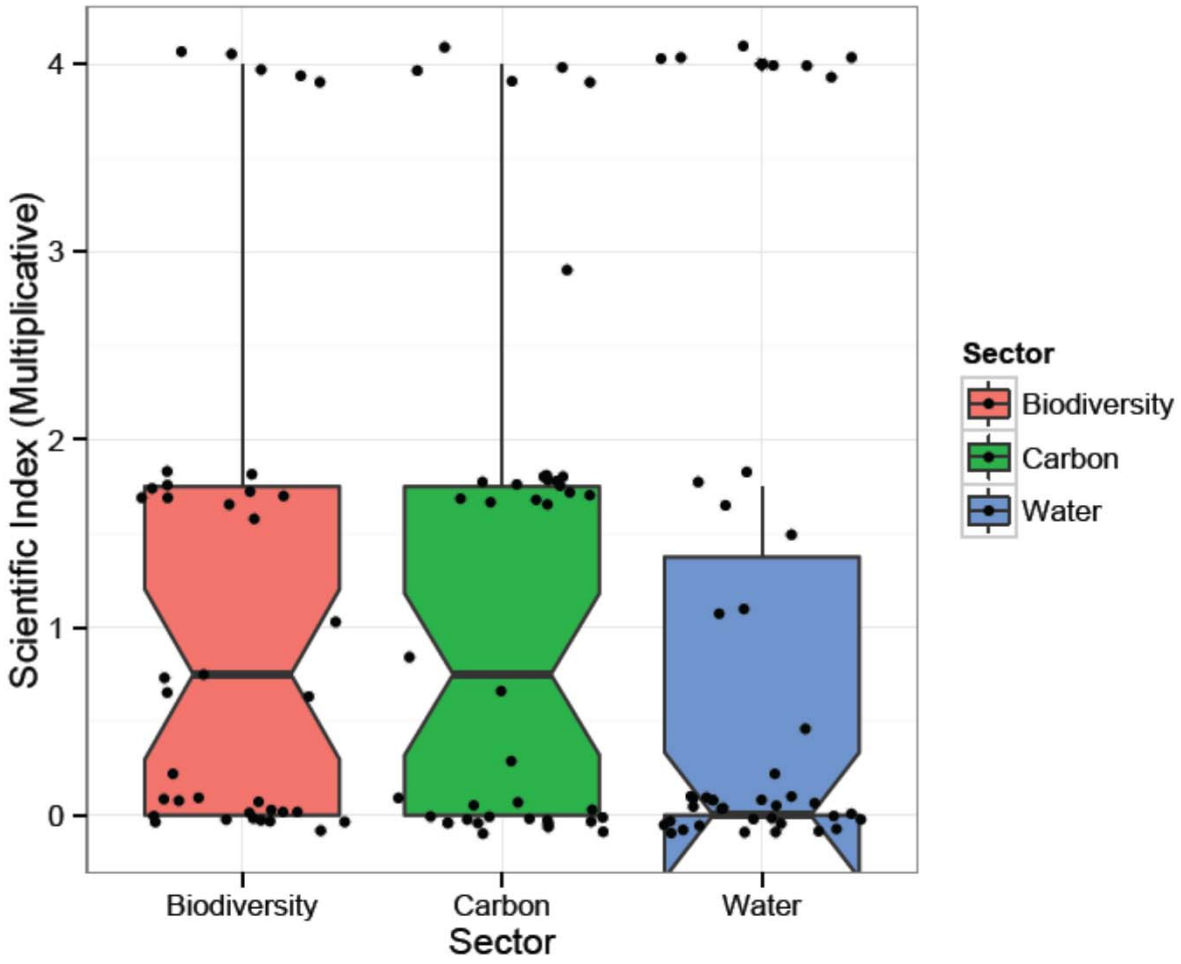
Where’s the baton?

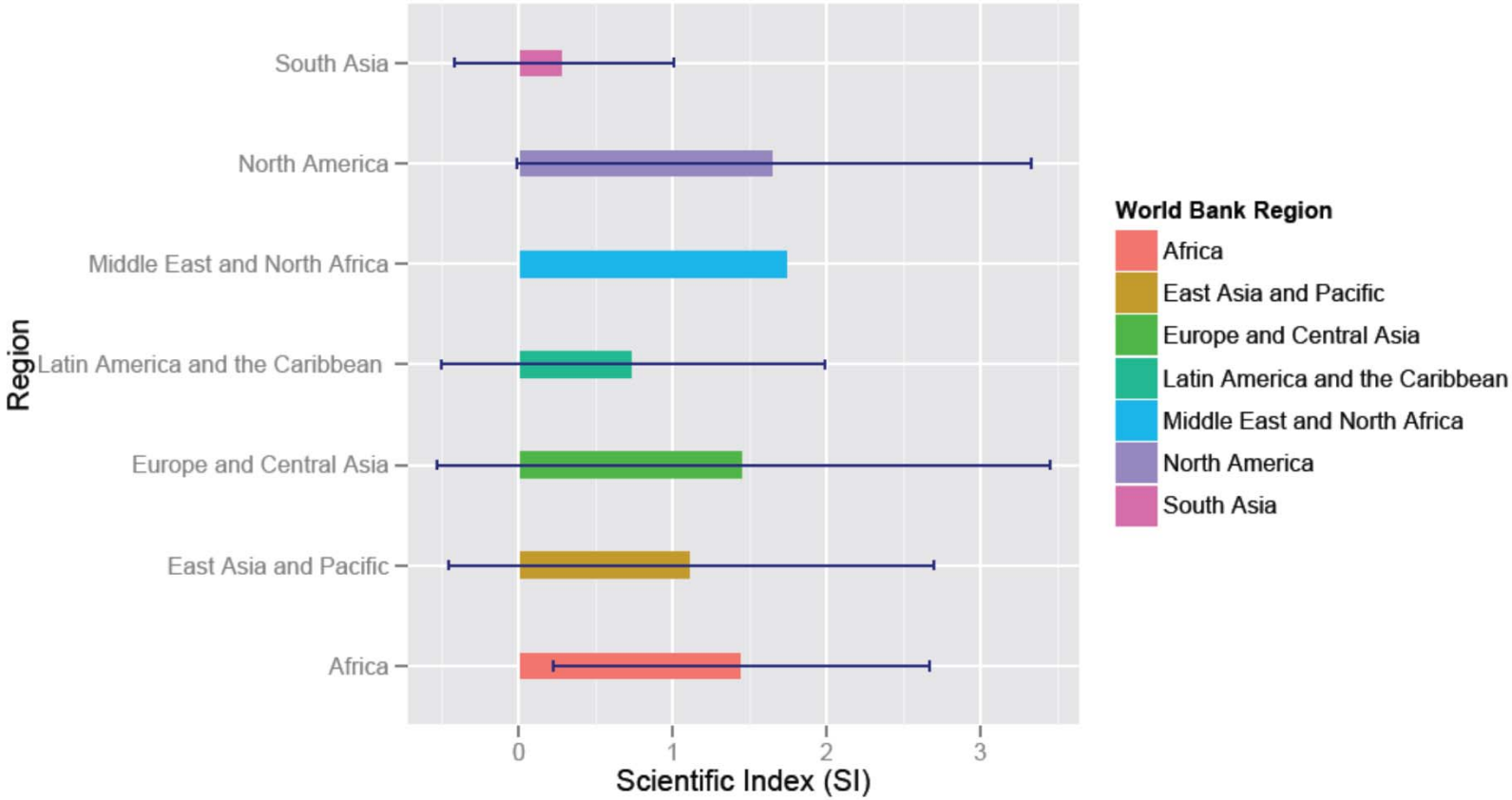
							Predicted	Actual
Provisioning								
Crops	Crop yield	Plants	Genetic	DS	Exp	575		
			Species	DS	Exp	100		
Fisheries	Stability of fisheries yield	Fish	Species	PS	Obs	8		
Wood	Wood production	Plants	Species	DS	Exp	53		
Fodder	Fodder yield	Plants	Species	DS	Exp	271		
Regulating								
Biocontrol	Control of herbivorous pests (bottom-up effect of plant diversity)	Plants	Species	DS*	Obs	40		
		Plants	Species	DS†	Exp	100		
		Plants	Species	DS‡	Exp	287		
		Plants	Species	DS§	Exp	100		0
	Control of herbivorous pests (top-down effect of natural enemy diversity)	Natural enemies	Species/trait	DS*	Obs	18		
		Natural enemies	Species	DS†	Exp/Obs	266		
		Natural enemies	Species	DS‡	Exp	38		
	Resistance to plant invasion	Plants	Species	DS	Exp	120		
	Disease prevalence (on plants)	Plants	Species	DS	Exp	107		
	Disease prevalence (on animals)	Multiple	Species	DS	Exp/Obs	45		
Climate	Primary production	Plants	Species	DS	Exp	7		0
	Carbon sequestration	Plants	Species	DS	Exp	479		
	Carbon storage	Plants	Species/trait	PS	Obs	33		
Soil	Soil nutrient mineralization	Plants	Species	DS	Exp	103		
	Soil organic matter	Plants	Species	DS	Exp	85		
Water	Freshwater purification	Multiple	Genetic/species	PS	Exp	8		0
Pollination	Pollination	Insects	Species	PS	Obs	7		

2. Looking for Sweetspot in a Scary Spectrum

Free-for-all vs. Regulatory Paralysis

The science of PES

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Latin America and the Caribbean
Middle East and North Africa
North America
South Asia

Title: Getting the Natural Science Right when

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Table 1. Principles and guidelines for PES interventions. All PES interventions should be designed in light of six natural-science principles. Within each principle, basic guidelines (green) and desirable guidelines (yellow) should be followed. For an intervention to be successful, basic guidelines must be followed.

PRINCIPLES	OBJECTIVE	SCIENTIFIC GUIDELINES
1. Dynamics	Intervention must be dynamic in response to natural and anthropogenic exogenous and endogenous factors.	Identify key services for each type[1] beyond target[2] services.
		Identify the spatiotemporal scales[3] of targeted services.
		Identify data needs, resources, and data gaps.
		Identify stressors[4] and their spatiotemporal variability.
		Identify and forecast trends in endogenous and exogenous threats.
		Identify the services' production functions[5] and sensitivities.
		Determine tradeoffs and synergies[6] among services.
		Determine how functional diversity influences resilience.
2. Baseline	Document initial conditions.	Measure influences of interventions on services.
		Measure status and trends of non-target services.
		Ensure that measurements are feasible given resources.
		Assess initial state of exogenous and endogenous threats to services.
		Measure factors important for forecasting service trends.
3. Monitoring	Keep track of factors necessary for management, trade, forecasting, and assessment.	Quantify deliverables[7] associated with target services.
		Identify spatiotemporal scales in advance of implementation.
		Use established methods/protocols and best practices for monitoring.
		Estimate uncertainties.
		Monitoring should inform decision-making.
		Monitoring should detect potential changes in baseline conditions.
		Monitor non-target services that influence target services[8].
4. Metrics	Use robust, efficient, and versatile methods for procuring data.	Must be relevant, reliable, and appropriate in scale.
		Should comply with voluntary standards, certification and regulations[9].
		Should reflect the spatiotemporal scales as identified in Dynamics.
		Optimize balance between precision and simplicity.
		Assess progress (in conjunction with Baseline and Monitoring).
		Establish benchmarks (in conjunction with Baseline and Monitoring).
		Should measure both absolute changes and changes in trends.
		Preferentially selected to allow comparisons across service types[1].
		Assess how services influence each other[6].
5. Multiple Services	Recognize tradeoffs and synergies among services.	Assess how intervention influences the other services[6].
		Avoid "double counting[10]."
		Assess impacts of intervention on non-target services[8].
6. Ecological Sustainability	Insuring project durability and sustainability.	Estimate short-term and long-term project or program performance.

1-10 See supplemental information for definitions and examples.

3. Scale incompatablility

- Local and global scales work in opposites

Rockström et al. 2009

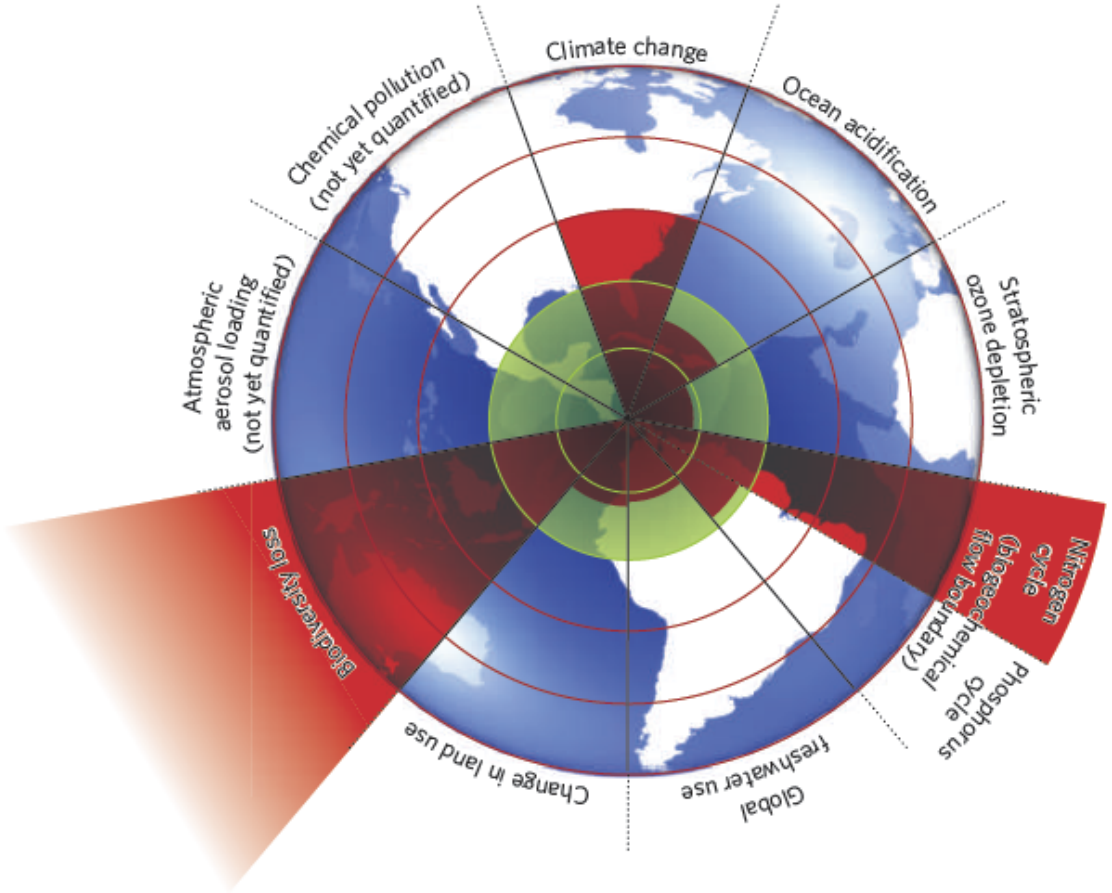
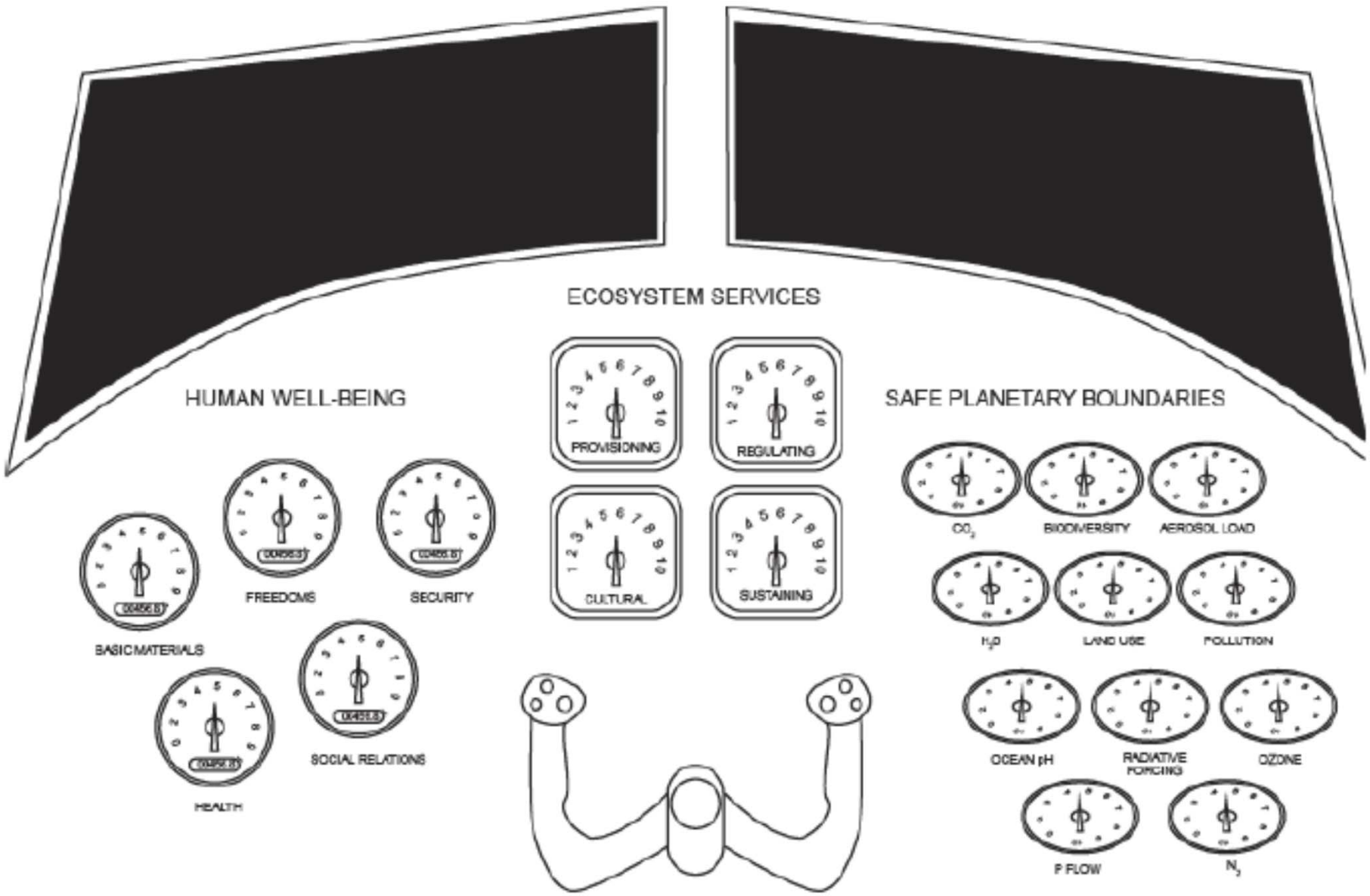


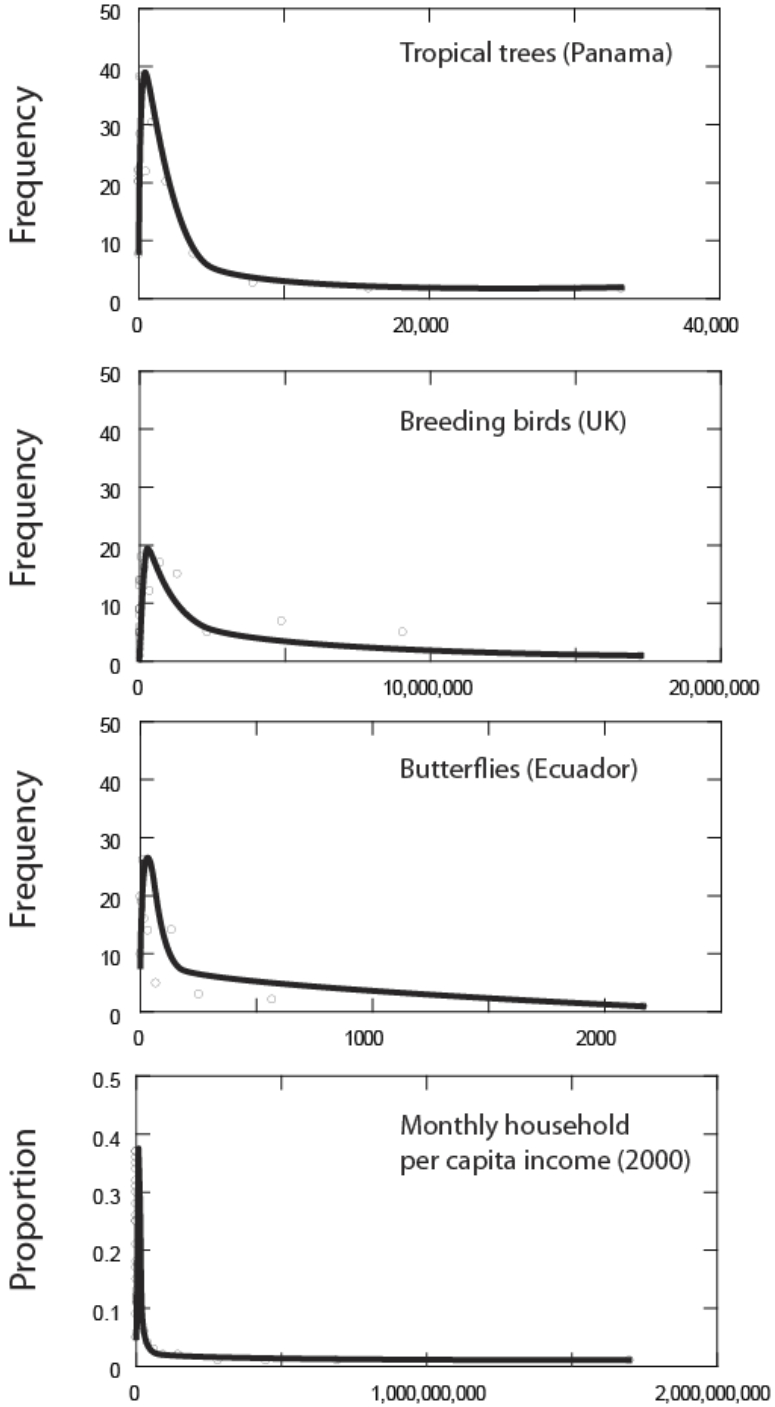
Figure 1 | Beyond the boundary. The inner green shading represents the proposed safe operating space for nine planetary systems. The red wedges represent an estimate of the current position for each variable. The boundaries in three systems (rate of biodiversity loss, climate change and human interference with the nitrogen cycle), have already been exceeded.


ECOSYSTEM SERVICES
HUMAN WELL-BEING
PROVISIONING
REGULATING
CULTURAL
SUSTAINING
SAFE PLANETARY BOUNDARIES
FREEDOMS
SECURITY
BASIC MATERIALS
SOCIAL RELATIONS
HEALTH
CO_2
BIODIVERSITY
AEROSOL LOAD
H_2O
LAND USE
POLLUTION
OCEAN pH
RADIATIVE FORCING
OZONE
P FLOW
N_2

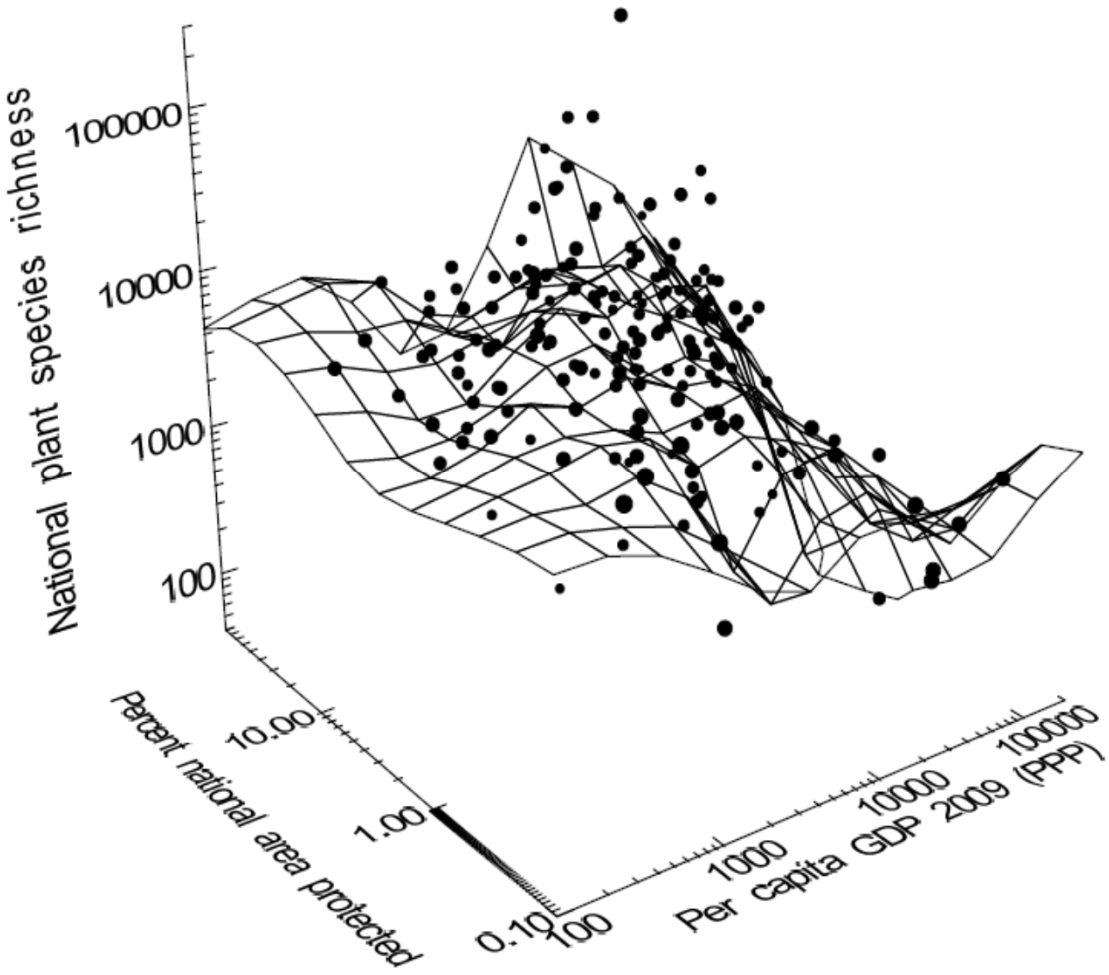
4. The anethema of ecological inequality

The fragility of the raison d'etre of PES

Nature is inherently 1 vs. 99%



Wealth, diversity, and conservation.



Payment for ecosystem services: The Saudi Prince and the Houbara Bustard

- Permit for 100
- Take was 2,100
- Pakistan needs the funds
- Saudi's want to preserve cultural tradition of falconry
- The tradition was that of the impoverished Bedu who hunted while travelling to supplement their diet and had little impact
- Houbara is endangered and an aphrodisiac

Conclusions

- This is the millennium of the Grand Synthesis – social and natural sciences coming together.
- The baton isn't being passed between social and natural scientists
- PES – at the cusp of a synthesis
  - natural science principles are proposed
  - next - social science principles=
  - next … something new – a hybrid
- Remember - natural science processes - are orthogonal to social science and activities at different scales are incompatible
  - Don't assume one (good social or natural) leads to the other (synergies are elusive)
- Solution – scientists and practitioners (across all sectors) work across scales and systems work together