TransLinks Brownbag Seminar

2010

Washington, D.C.

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Biological Diversity and Climate Change: Twins Separated at Birth

Shahid Naeem and Paige Olmstead
TransLinks/USAID
CERC, Earth Institute, Columbia University, NYC
Washington DC, 9 June 2010

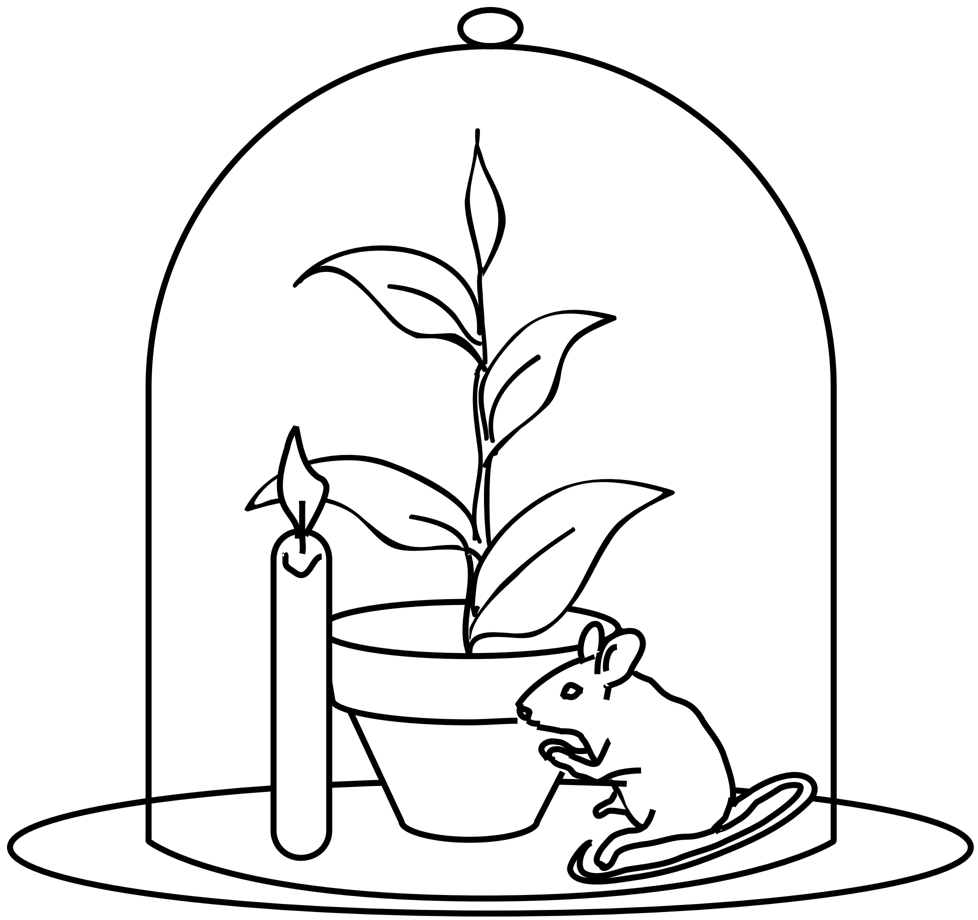
Abstract

- Both the UN Convention on Biological Diversity and the UN Framework Convention on Climate change were born in Rio at Earth Summit I in 1992 – sustainable development cannot be achieved in the absence of either. Climate change policy struggles because it is tied to industrial (fossil fuels) and agricultural development (deforestation, biofuels, etc.) while biodiversity struggles because it is tied to genetic resources. Yet, biodiversity is critical to climate change mitigation and adaptation and its conservation should be mainstreamed into climate change policy (and climate change be mainstreamed into biodiversity conservation policy). In this presentation, the speaker will make the case for integrating biodiversity conservation into climate change policy/actions, reviewing the scientific evidence for its potential as mitigation and adaptation.

Roadmap of Brownbag

- Background (Shahid)
  - The scientific basis for synthesizing biodiversity and conservation (4 studies, 2 meta-analysis, a modern synthesis)
  - The influence of this science on the real world
- Implementation (Paige)
  - What does this mean to people on the ground
    - TransLinks, CERC, Earth Institute, Columbia University
    - Millennium Villages

Study 1: Priestly's Bell Jar (modified)



Joseph Priestly

- it is: "highly probable, that the injury which is continually done to the atmosphere by the respiration of such a number of animals, and the putrefaction of such masses of both vegetable and animal matter, is, in part at least, repaired by the vegetable creation

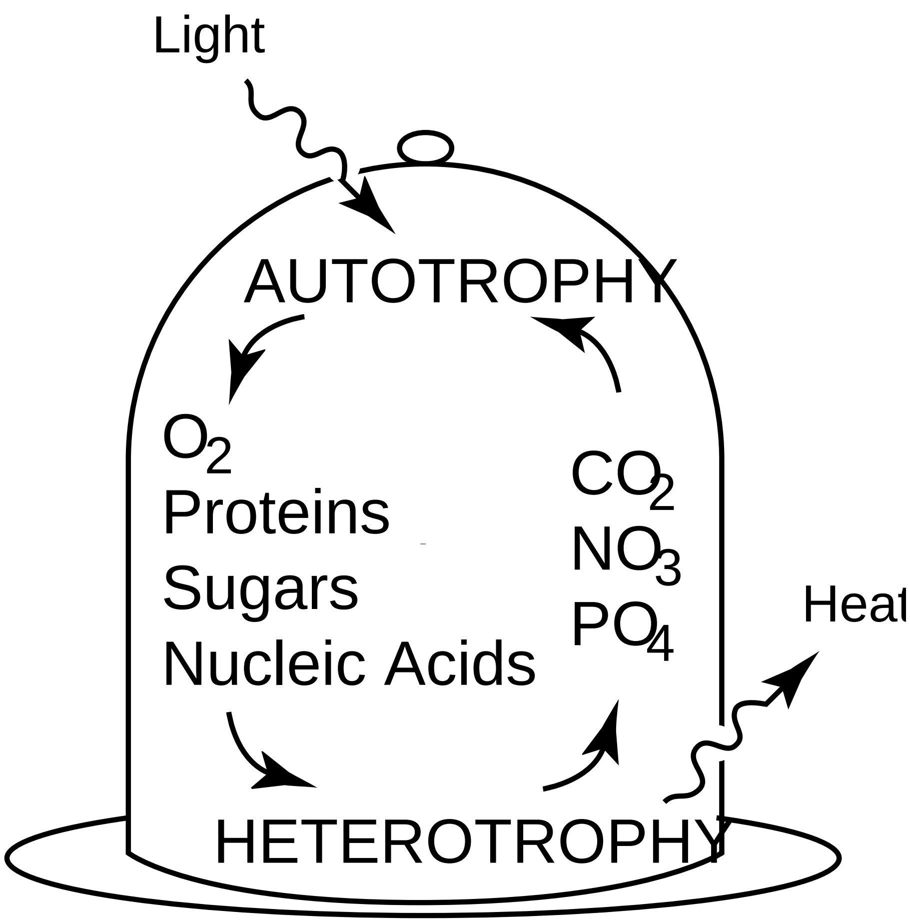
Gorham, E. 1991. *Biogeochemistry*

Joseph Priestly

- “… it seems to be extremely probable that the **putrid effluvium** [i.e., whatever it is that extinguishes candles and mice] is in some measure extracted from the air, by means of the leaves of plants, and therefore that they render the remainder more fit for respiration"

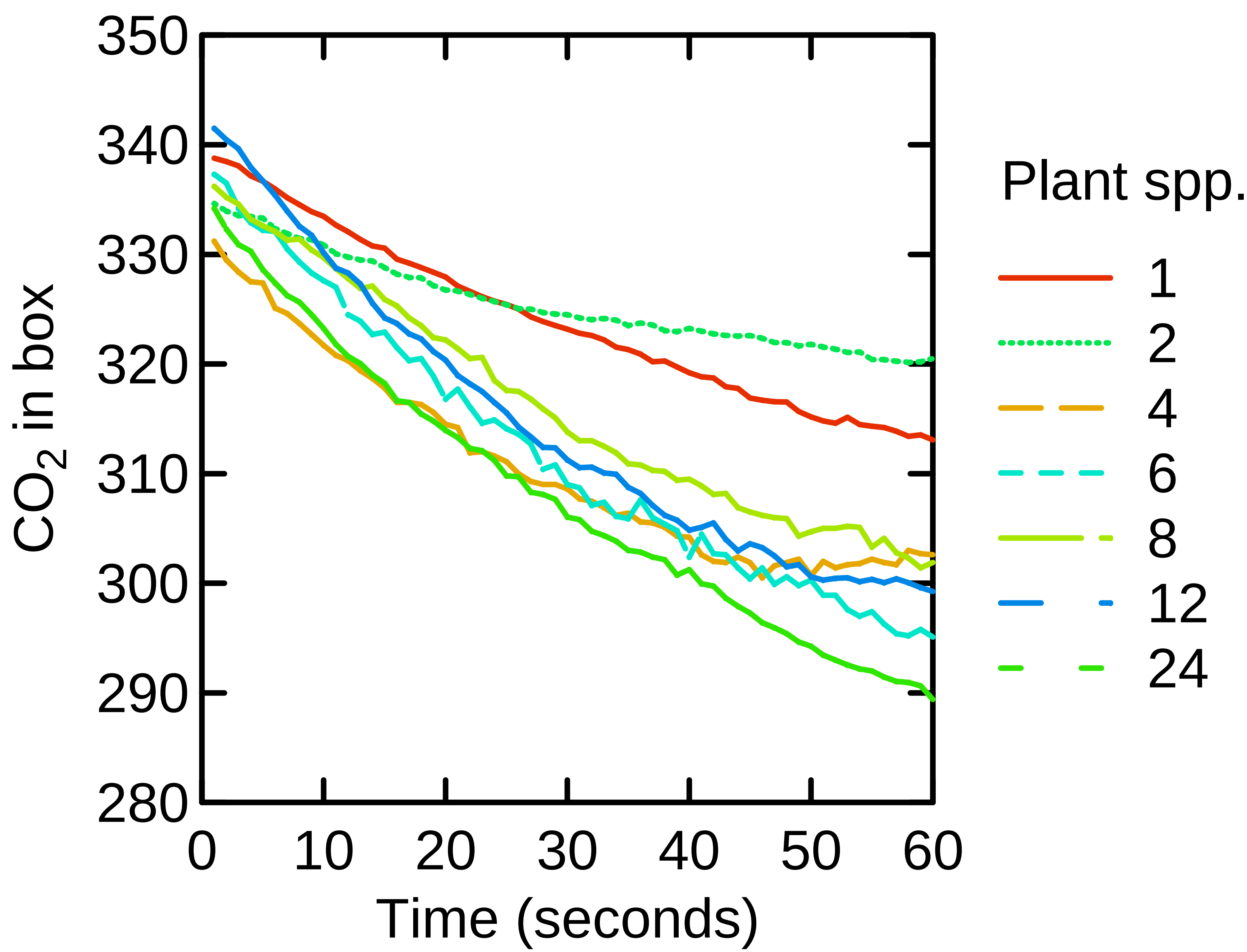
Gorham, E. 1991. *Biogeochemistry*

Priestly's Bell Jar (modified)



Study #2: A simple exercise


andge
luppe
amoca
petvi
lesca
asctu
anecy
schsc



350
340
330
320
310
300
290
280
CO_2 in box
0
10
20
30
40
50
60
Time (seconds)
Plant spp.
1
2
4
6
8
12
24

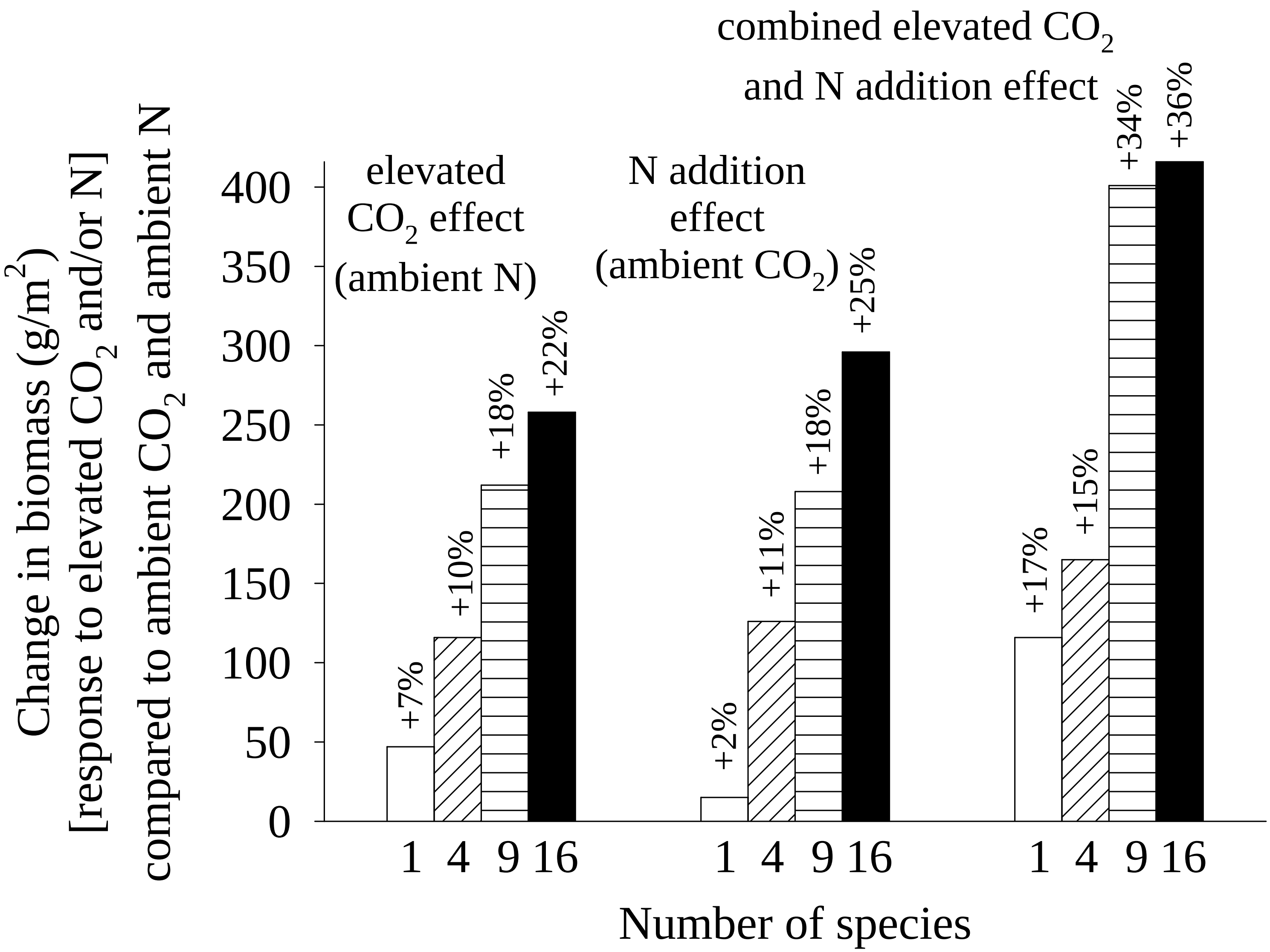
Study #3: An NSF-funded Study

BioCON

Biodiversity, CO_2, and Nitrogen

A study of ecosystem interactions

http://www.lter.umn.edu/biocon/



Reich et al. 2001 *Nature* 410 :809-812

Study #4: A modeling exercise

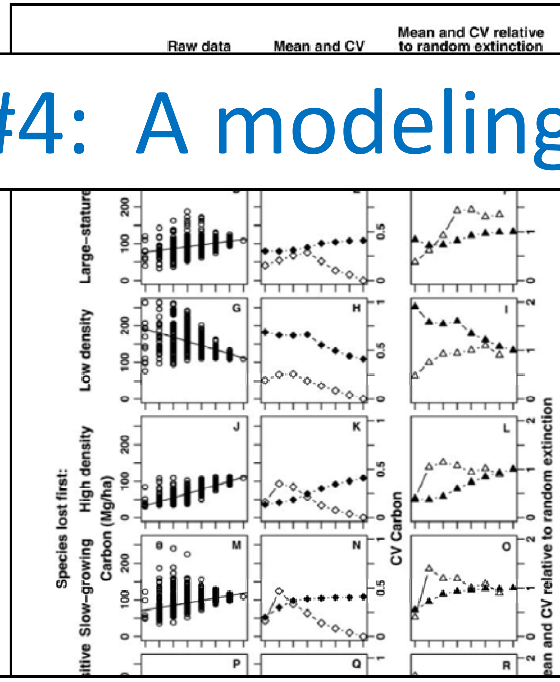


Fig. 2. Representative results of simulated influences of biodiversity on aboveground carbon storage in the 50-ha Forest Dynamics Plot on BCI, Panama. The intact community included 126 species; the *x* axes have a $\log_2$ scale. The left panels show simulation results (open circles) and linear fit (solid line) of the effect of $\log_2$ species richness on aboveground carbon storage. The center panels show the mean (solid diamonds) and coefficient of variation (CV) (open diamonds) of carbon storage. The right panels show the mean (solid triangles) and CV (open triangles) of carbon storage relative to random extinction. (**A** to **C**) Random extinction. (**D** to **F**) Large-statured species lost first. (**G** to **I**) Species with low wood density lost first. (**J** to **L**) Species with high wood density lost first. (**M** to **O**) Slow-growing species lost first. (**P** to **R**) Drought-sensitive species lost first. (**S** to **U**) Endemics lost first. (**V** to **X**) Widespread species lost first. Values are lower than those reported elsewhere because we excluded 101 species (21% of aboveground carbon) for which we lacked wood-density data.

Species Loss and Aboveground Carbon Storage in a Tropical Forest

Daniel E. Bunker,[1*] Fabrice DeClerck,[2] Jason C. Bradford,[3] Robert K. Colwell,[4] Ivette Perfecto,[5] Oliver L. Phillips,[6] Mahesh Sankaran,[7] Shahid Naeem[1]

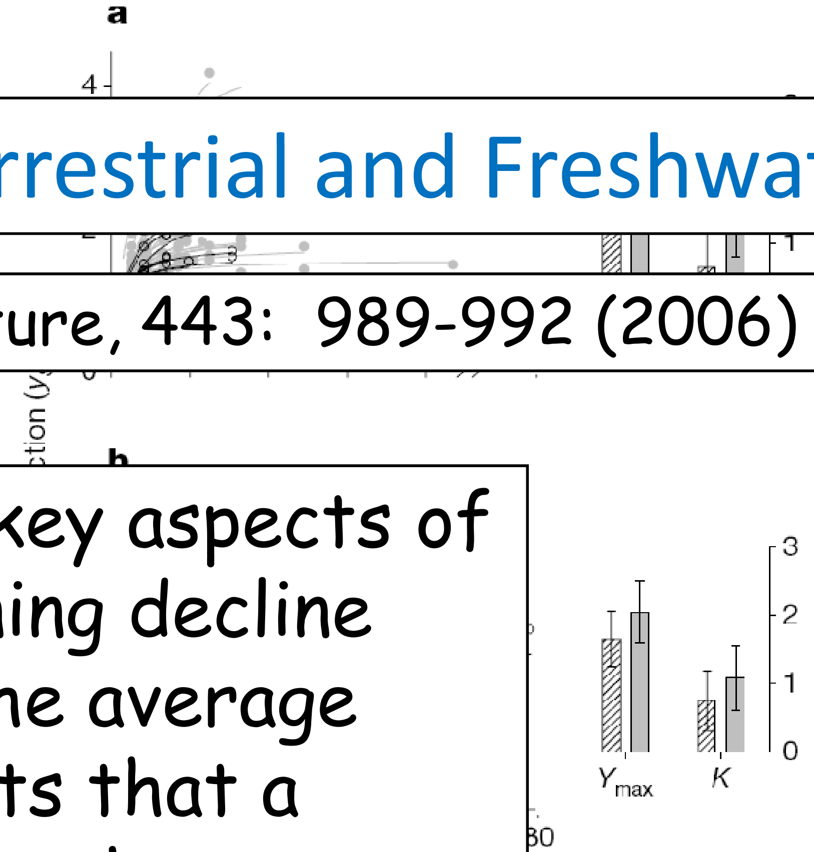
Tropical forest biodiversity is declining, but the resulting effects on key ecosystem services, such as carbon storage and sequestration, remain unknown. We assessed the influence of the loss of tropical tree species on carbon storage by simulating 18 possible extinction scenarios within a well-studied 50-hectare tropical forest plot in Panama, which contains 227 tree species. Among extinction scenarios, aboveground carbon sto
600%, and biological insurance varied by more tha
indicate that future carbon storage in tropical for
strongly by future species composition.

Bunker, D. E., F. DeClerck, J. C. Bradford, R. K. Colwell, I. Perfecto, O. L. Phillips, M. Sankaran, and S. Naeem. 2005. Species Loss and Aboveground Carbon Storage in a Tropical Forest. Science **310**:1029-1031.

Effects of biodiversity on the functioning of trophic groups and ecosystems

Meta-analyses: Terrestrial and Freshwater

Cardinale et al. Nature, 443: 989-992 (2006)

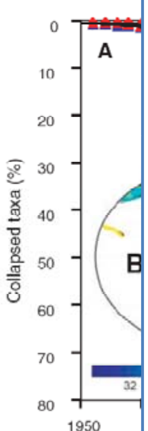


"…our finding that key aspects of ecosystem functioning decline consistently with the average species loss suggests that a precautionary approach to preserving as much biodiversity as possible is warranted."

…ty–function relationship. Effects … bundance or biomass of trophic … consumed by t (**b**). Each curve … ed to $Y = Y_{max}S/(K + S)$, where Y … variable with increasing richness S, Y_{max} is the asymptotic estimate of Y, and K is the value of S at which $Y = Y_{max}/2$. Sample sizes are 18 and 27 aquatic (black circles and lines), and 37 and 23 terrestrial studies (grey circles and lines) in **a** and **b**, respectively. Insets show the mean and 95% CI for the maximum-likelihood parameter estimates (hatched, aquatic; grey, terrestrial).

Meta-analyses: Marine

Impacts of Biodiversity Loss on Ocean Ecosystem Services

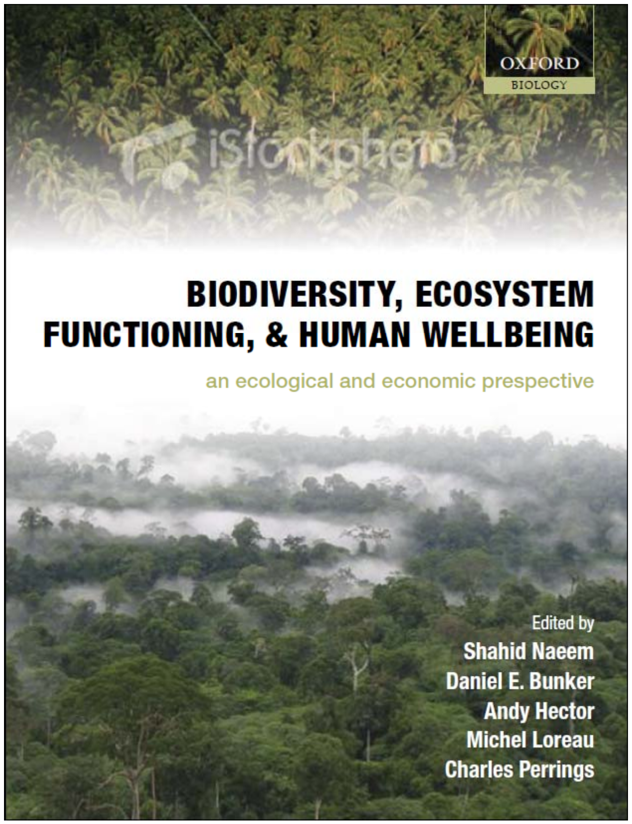


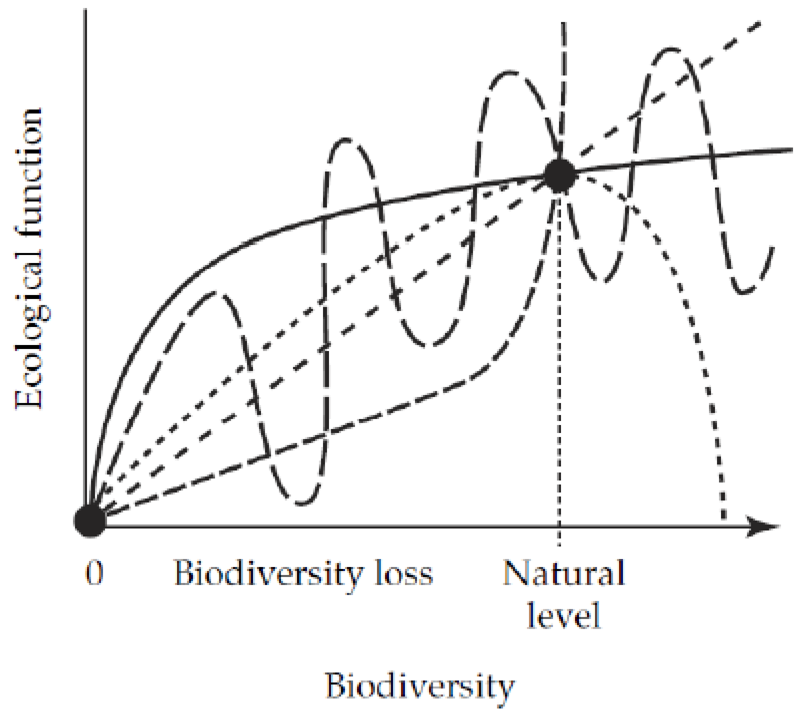
"Positive relationships between diversity and ecosystem functions and services were found using experimental and correlative approaches along trajectories of diversity loss and recovery.

Our data highlight the societal consequences of an ongoing erosion of diversity that appears to be accelerating on a global scale.

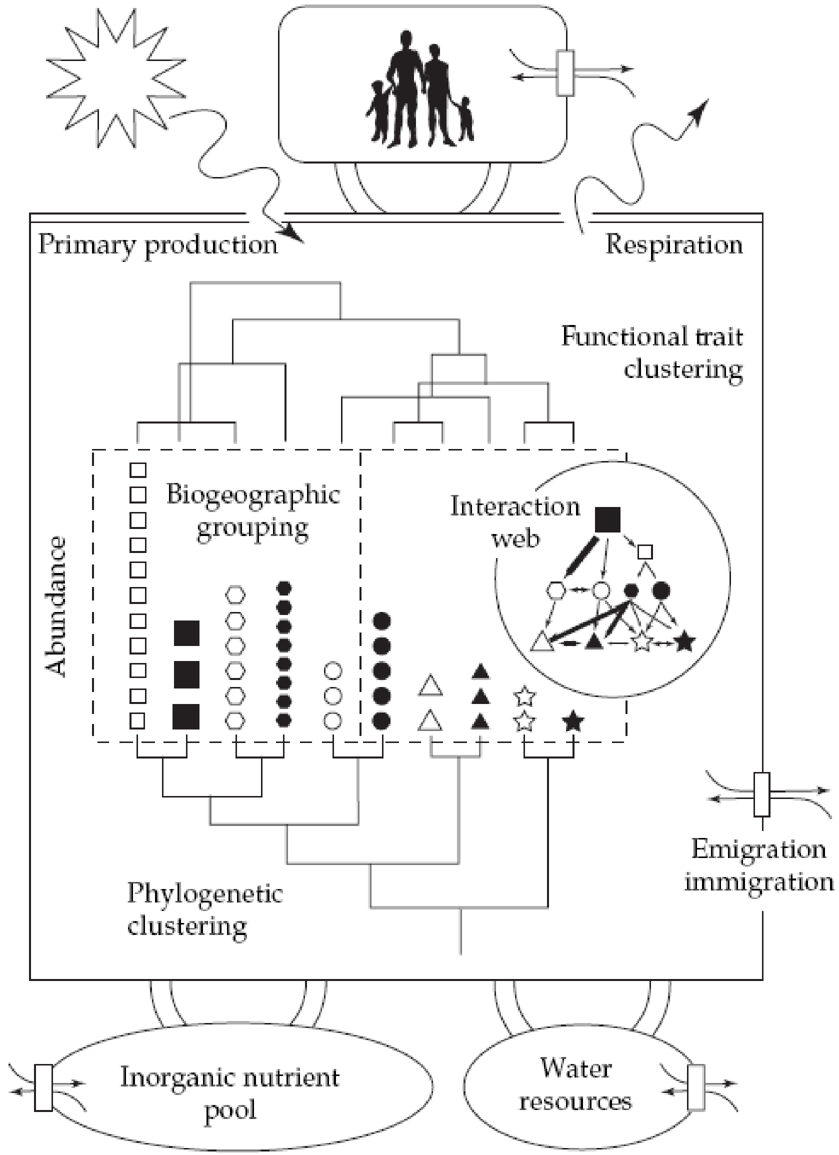
This trend is of serious concern because it projects the global collapse of all taxa currently fished by the mid-21st century (based on the extrapolation of regression in Fig. 3A to 100% in the year 2048)."

Worm et al., Science 314, 787 (2006)


OXFORD
BIOLOGY
iStockphoto
BIODIVERSITY, ECOSYSTEM FUNCTIONING, & HUMAN WELLBEING
an ecological and economic prespective
Edited by
Shahid Naeem
Daniel E. Bunker
Andy Hector
Michel Loreau
Charles Perrings


Ecological function
0
Biodiversity loss
Natural level
Biodiversity

Biodiversity and Ecosystem Function (BEF) Framework



CHAPTER 3

Biodiversity-ecosystem function research and biodiversity futures: early bird catches the worm or a day late and a dollar short?

Martin Solan, Jasmin A. Godbold, Amy Symstad, Dan F. B. Flynn, and Daniel E. Bunker

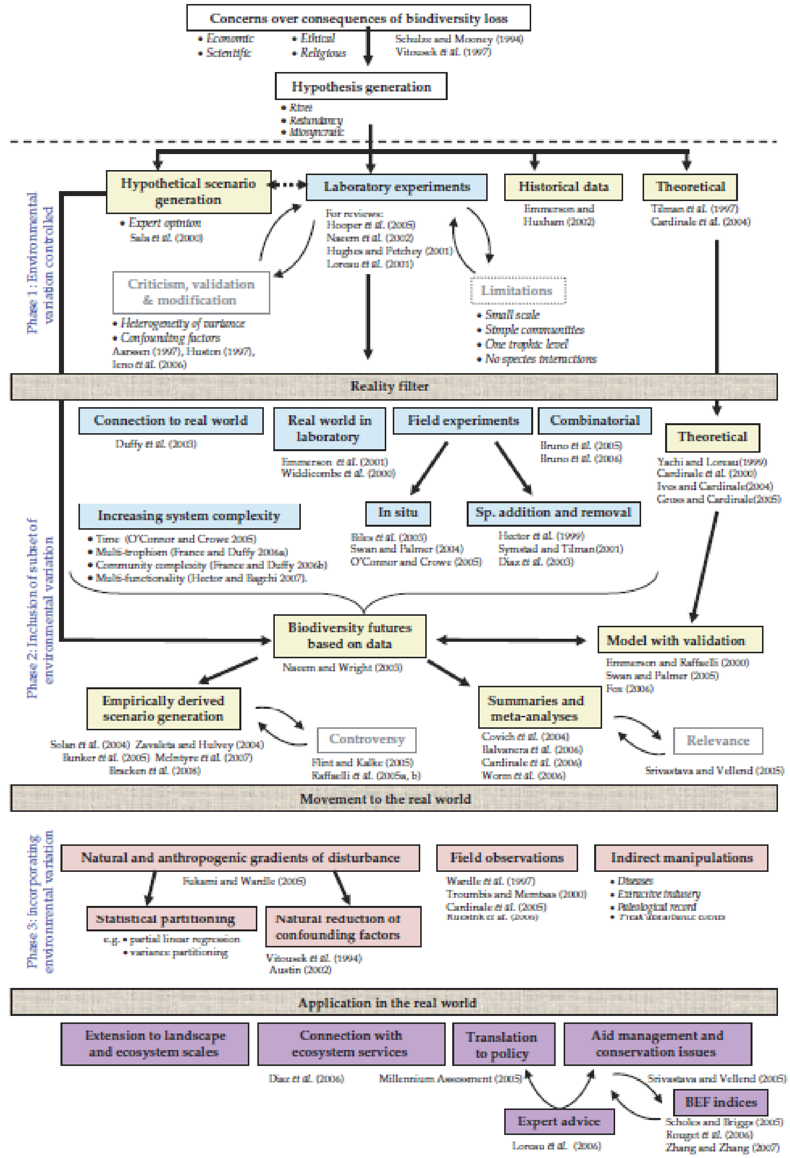


Plate 1. Summary of the research approaches adopted to address the relationship between biodiversity and ecosystem function in the peer-reviewed scientific literature. Modified from Godbold (2008). See page 32.

Solan et al. 2009

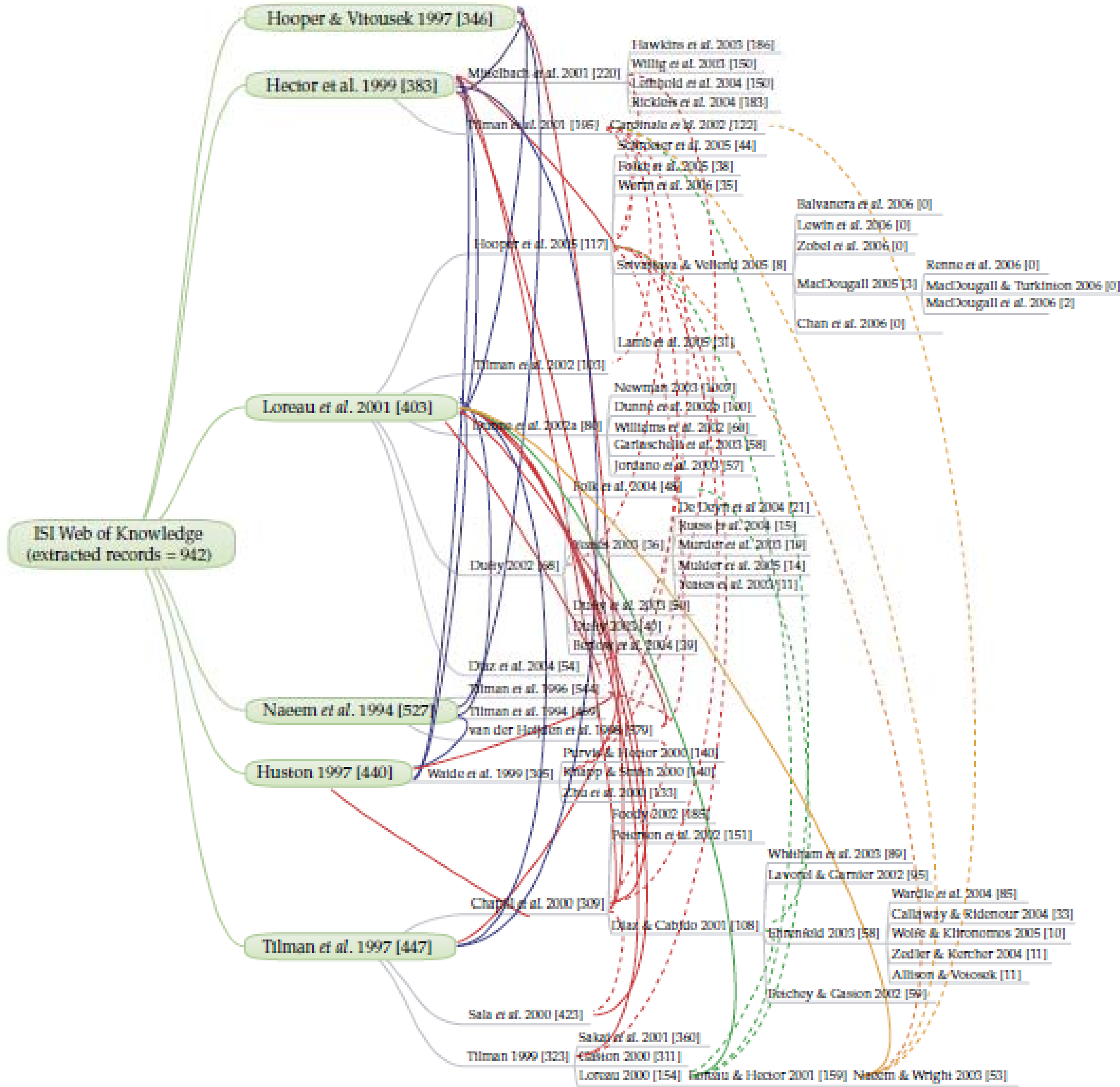
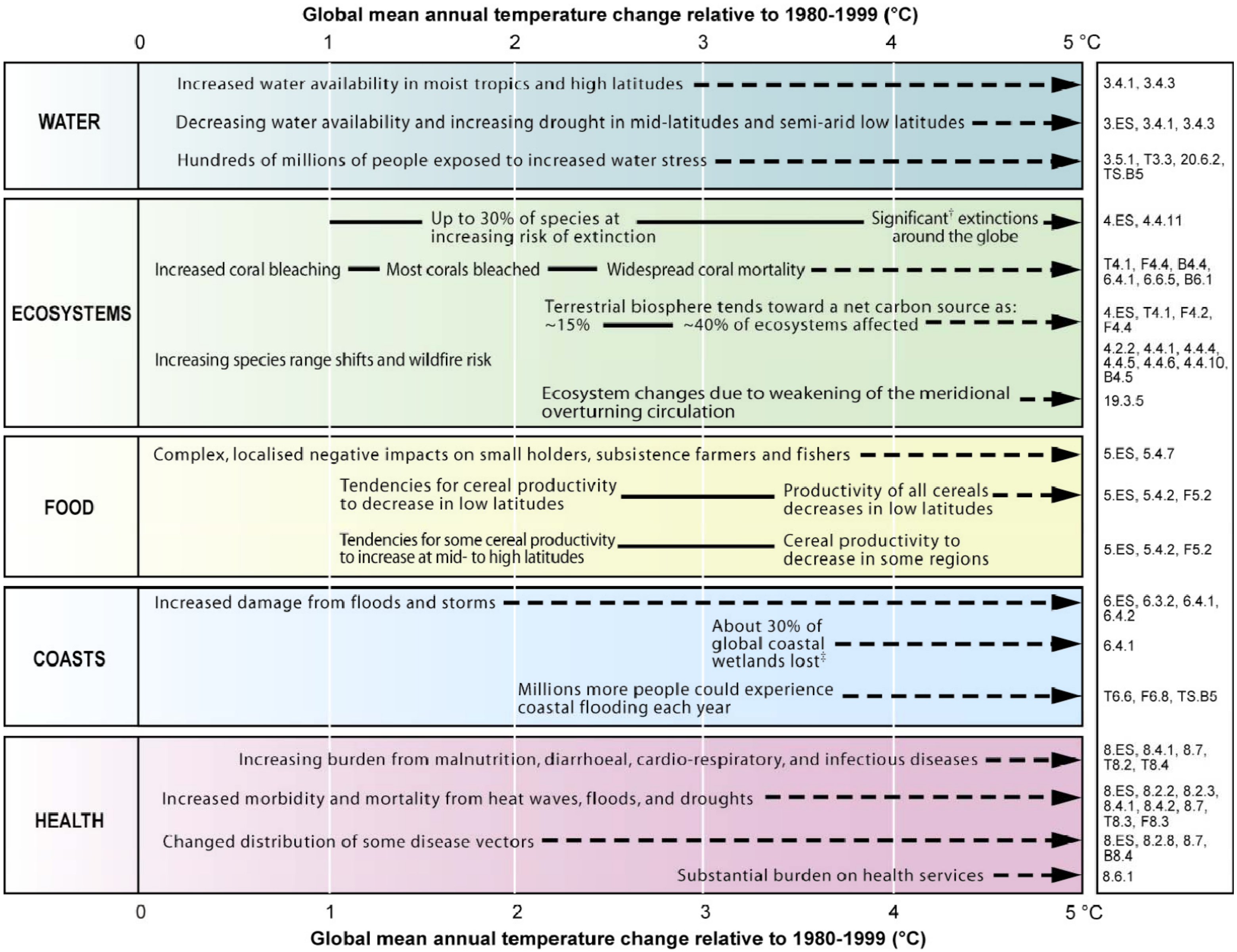


Plate 3. The rate, form, and connectivity of information flow within the BEF community and to multiple disciplines from the six most highly cited papers (=BEF-6) within the BEF database. For each generation of publications, the five most highly cited publications citing the previous generation were determined and linked, either directly (solid lines) or indirectly (dotted lines) to the BEF-6 via other highly cited publications. Line colour indicates the generation sequence (blue → red → green → orange). Publications not included in the BEF database are presented as a citation. The number of cites (from publication until December 2006) are indicated in square brackets. References listed are available in the electronic appendix. See page 39.

IPCC



† Significant is defined here as more than 40%.

‡ Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080.

IPCC AR4 model

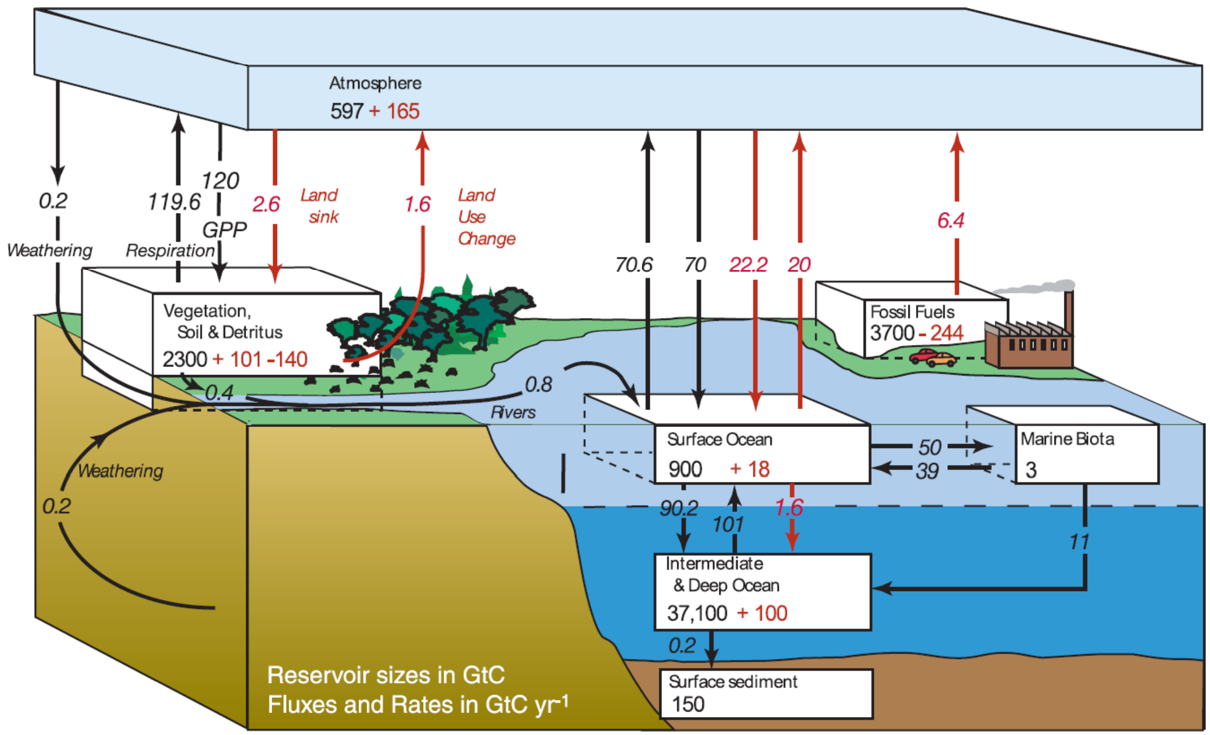
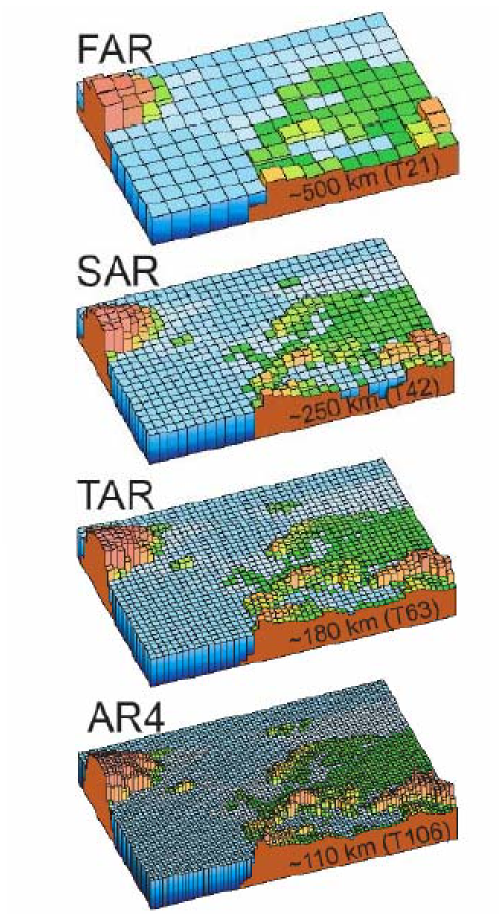


Figure 7.3. *The global carbon cycle for the 1990s, showing the main annual fluxes in GtC yr^{-1}: pre-industrial 'natural' fluxes in black and 'anthropogenic' fluxes in red (modified from Sarmiento and Gruber, 2006, with changes in pool sizes from Sabine et al., 2004a). The net terrestrial loss of –39 GtC is inferred from cumulative fossil fuel emissions minus atmospheric increase minus ocean storage. The loss of –140 GtC from the 'vegetation, soil and detritus' compartment represents the cumulative emissions from land use change (Houghton, 2003), and requires a terrestrial biosphere sink of 101 GtC (in Sabine et al., given only as ranges of –140 to –80 GtC and 61 to 141 GtC, respectively; other uncertainties given in their Table 1). Net anthropogenic exchanges with the atmosphere are from Column 5 'AR4' in Table 7.1. Gross fluxes generally have uncertainties of more than ±20% but fractional amounts have been retained to achieve overall balance when including estimates in fractions of GtC yr^{-1} for riverine transport, weathering, deep ocean burial, etc. 'GPP' is annual gross (terrestrial) primary production. Atmospheric carbon content and all cumulative fluxes since 1750 are as of end 1994.*

Climate Change 2007

IPCC

Where's the BEF?



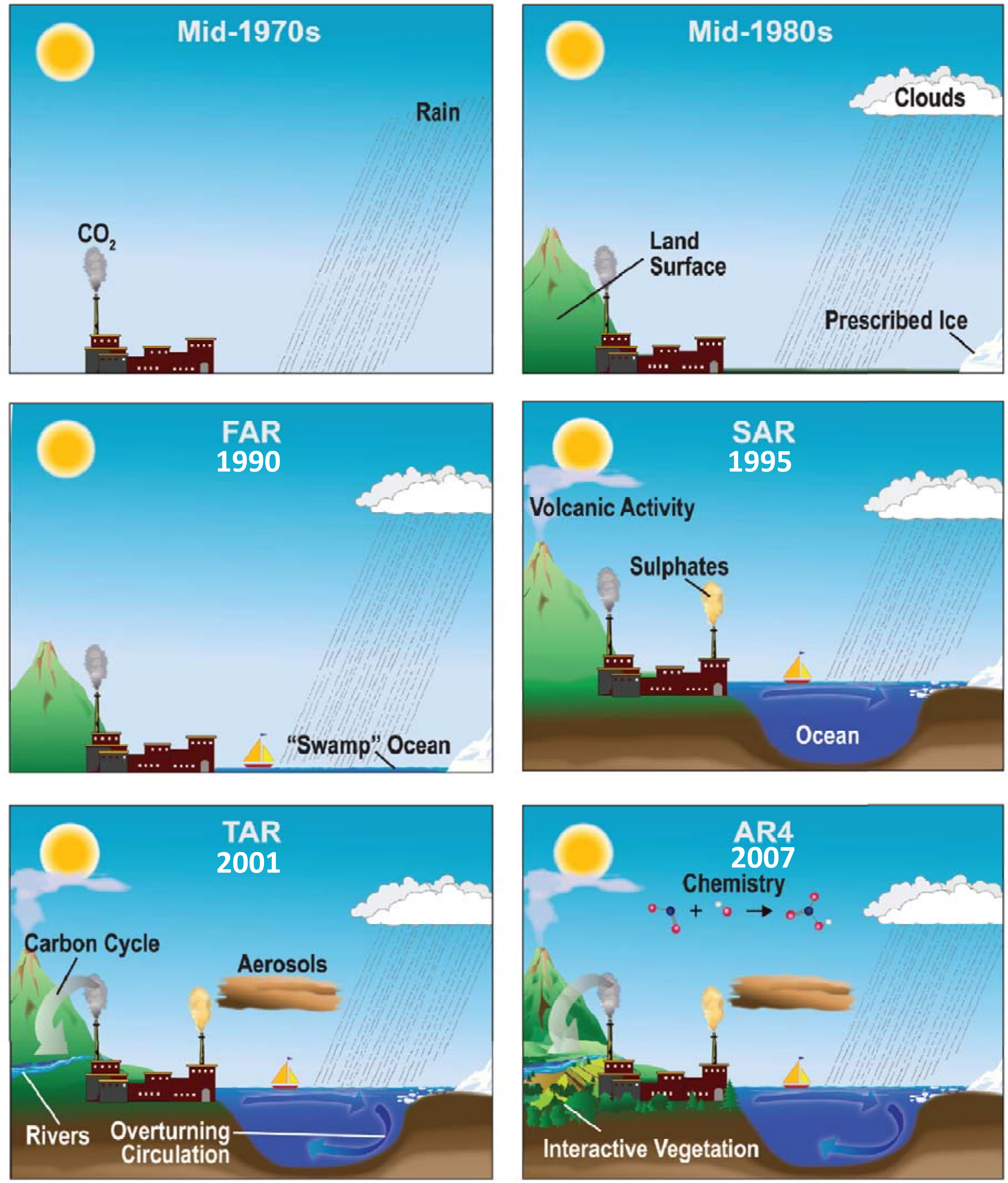


Figure 1.2. *The complexity of climate models has increased over the last few decades. The additional physics incorporated in the models are shown pictorially by the different features of the modelled world.*

"*Carta di Siracusa*" on Biodiversity

We, the G8 Environment Ministers, together with the Ministers of Australia, Brazil, China, the Czech Republic and Sweden as the current and upcoming Presidences of the European Union, Egypt, India, Indonesia, Mexico, the Republic of Korea, South Africa, and the International Organisations participating in the Siracusa meeting;

I. *acknowledging* the importance of addressing biodiversity as an essential part of the G8 dialogues and building on the "Potsdam Initiative" and the "Kobe Call for Action for Biodiversity";

II. *recognising* the importance of the 2010 target, also reiterated at the Heiligendamm and Hokkaido Toyako G8 Summits, and wishing to keep the momentum on biodiversity in the La Maddalena G8 Summit and beyond;

III. *fully aware of* the key role that biodiversity and ecosystem services play in underpinning human well-being and the achievement of the Millennium Development Goals (MDGs),

IV. *committed t*o the three objectives of the Convention on Biological Diversity (CBD);

V. *highly concerned* that biodiversity loss and the consequent reduction and damaging of ecosystem services affect food security and water availability and reduce the capacity of biodiversity to mitigate and adapt to climate change, as well as undermining global economic processes;

VI. *acknowledging* the substantial efforts made to achieve the 2010 target;

VII. *recalling* the World Summit on Sustainable Development (WSSD) Plan of Implementation, noting that efforts to significantly reduce the current rate of loss of biological diversity will require the provision of new and additional financial and technical resources to developing countries;

VIII. *recognising* the urgent need to support and strengthen the international process for the identification

XIII. *convinced* of the need to improve understanding of the benefits arising from biodiversity and ecosystem services and the costs of their loss, as well as to identify cost-effective policy options for the conservation and sustainable use of biodiversity and for ensuring the resilience of ecosystems;

decide to take the following actions:

Biodiversity and Climate

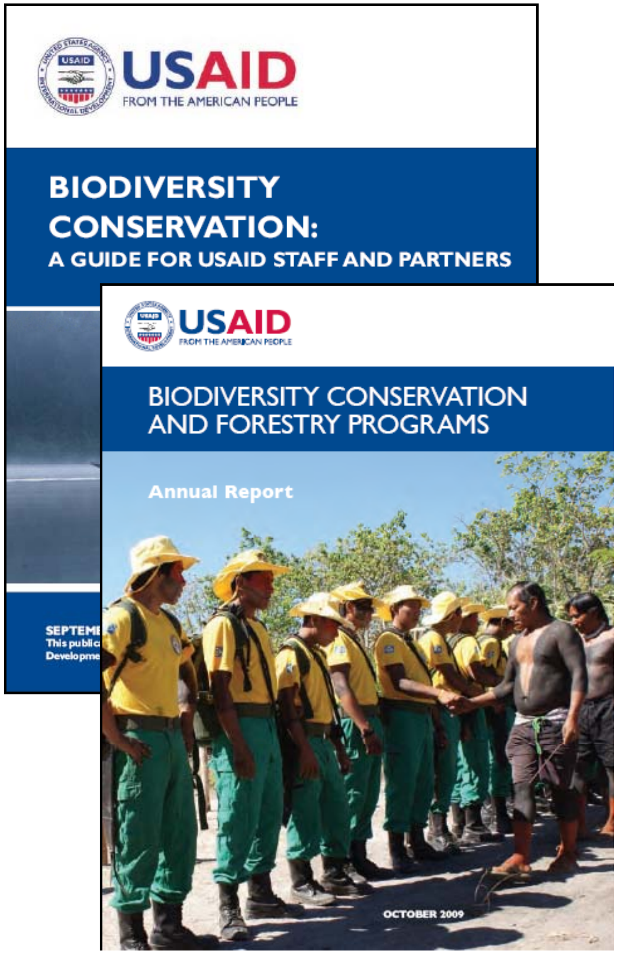
1. Developing synergistic policies that consider the contribution that biodiversity and ecosystems provide for climate change adaptation and mitigation at local, national and global levels, taking into account that biodiversity and ecosystem services are critical for regulating our climate.
2. Proactively putting in place actions for climate change adaptation of natural and managed ecosystems since spontaneous adaptation is not expected to be sufficient to reduce the impacts on biodiversity at all levels, or on vulnerable ecosystems, or for long-term human well-being.
3. Pursuing a significantly improved understanding of the role of communities and ecosystems in climate change adaptation measures with a view to building their resilience and adaptive capacity and generating additional economic benefits.
4. Implementing biodiversity conservation and sustainable use actions with a view to improving climate adaptation in priority sectoral areas such as management of water, forests, agriculture, marine and coastal areas and infrastructure development, which include the use of new and improved technologies, paying special attention to sustaining ecosystem services.
5. Combating illegal logging, according with relevant legislation, including through support for sustainable forest management, as a contribution to supporting human livelihoods, conserving and sustainably using biodiversity and increasing carbon storage and sequestration.
6. Developing land-based climate change mitigation approaches, such as Reducing Emissions from Deforestation and Forest Degradation (REDD) while promoting biodiversity conservation, sustainable forest management and enhancement of forest carbon stocks, to integrate the mitigation potential of forests and other land uses into future action to tackle climate change, taking into account the potential for such approaches to serve as a model for valuation of and payment for ecosystem services;
7. Ensuring the development and transfer of best practice, as well as soft and hard technologies, through mutually agreed terms, which will be essential to achieve a coordinated response and the cost-effective use of resources in coping with biodiversity loss and climate change.

Carta di Siracusa

- Developing synergistic policies that consider the contribution that biodiversity and ecosystems provide for climate change adaptation and mitigation…
- Pursuing a significantly improved understanding of the role of communities and ecosystems in climate change adaptation…
- Implementing biodiversity conservation and sustainable use actions with a view to improving climate adaptation …

USAID Guide for Biodiversity Conservation & Annual Report

- Identify threats
- Prioritize
- Develop participatory programs
- Develop sustainable programs
- Focus on saving species/habitats

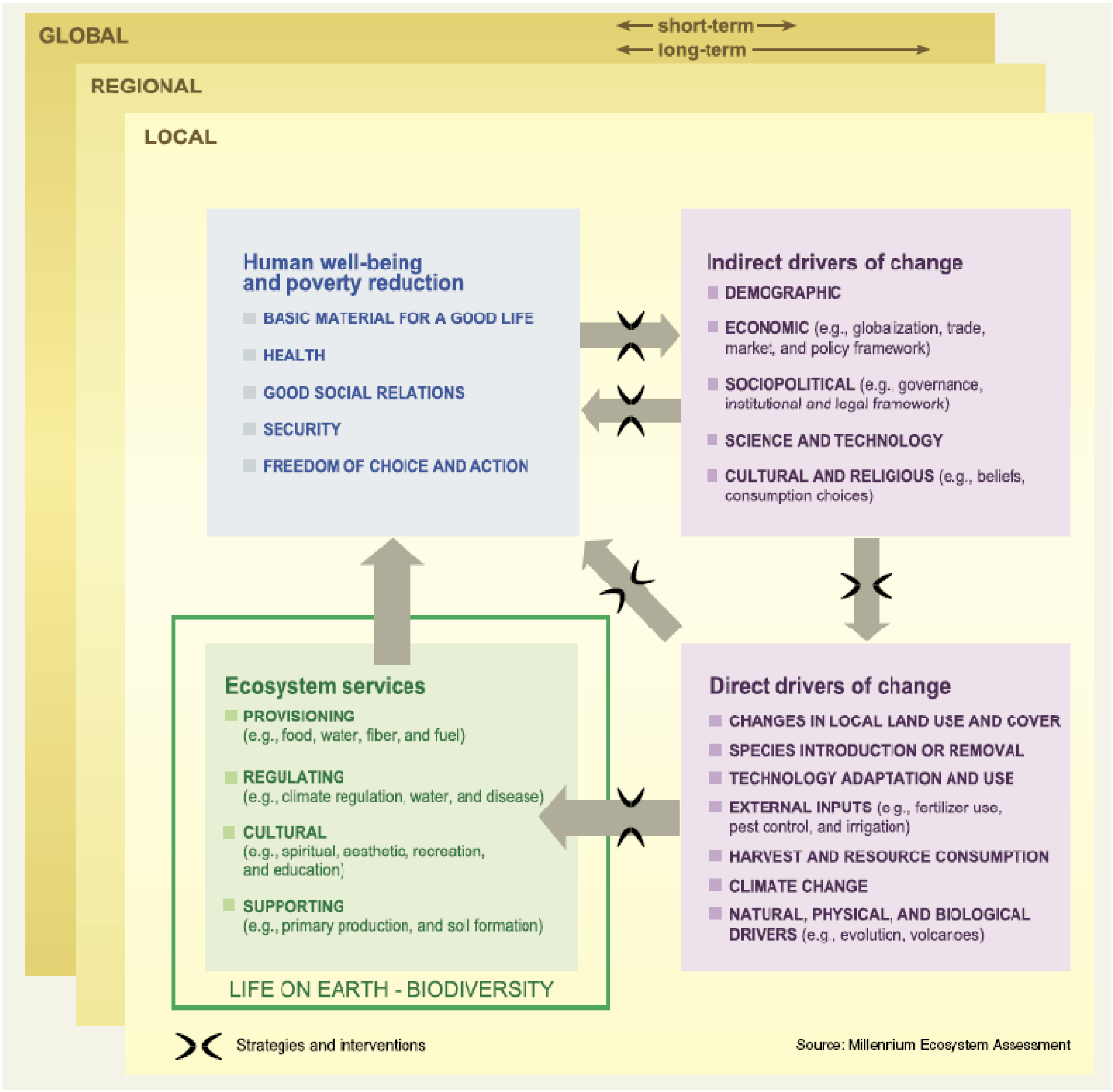


Convention of Biological Diversity (CBD)

1992 Earth Summit in Rio de Janeiro

- World leaders agreed on a comprehensive strategy for "sustainable development" -- meeting our needs while ensuring that we leave a healthy and viable world for future generations.
- CBD: A pact among the vast majority of the world's governments establishing commitments for maintaining the world's ecological underpinnings as we go about the business of economic development.

Millennium Assessment



Adaptation vs. Mitigation

IPCC (2001)
Third Report
Summary for
Policy Makers

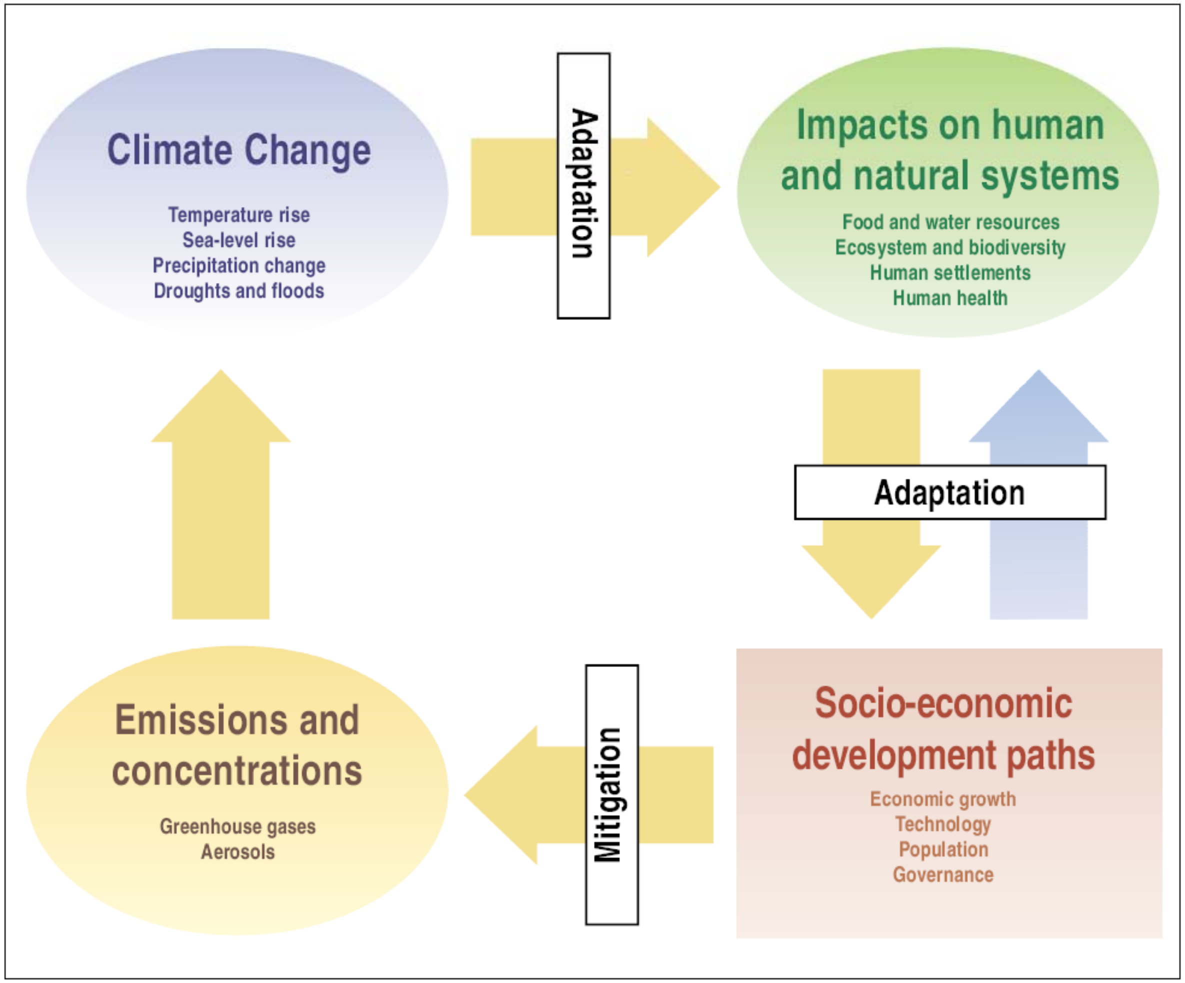
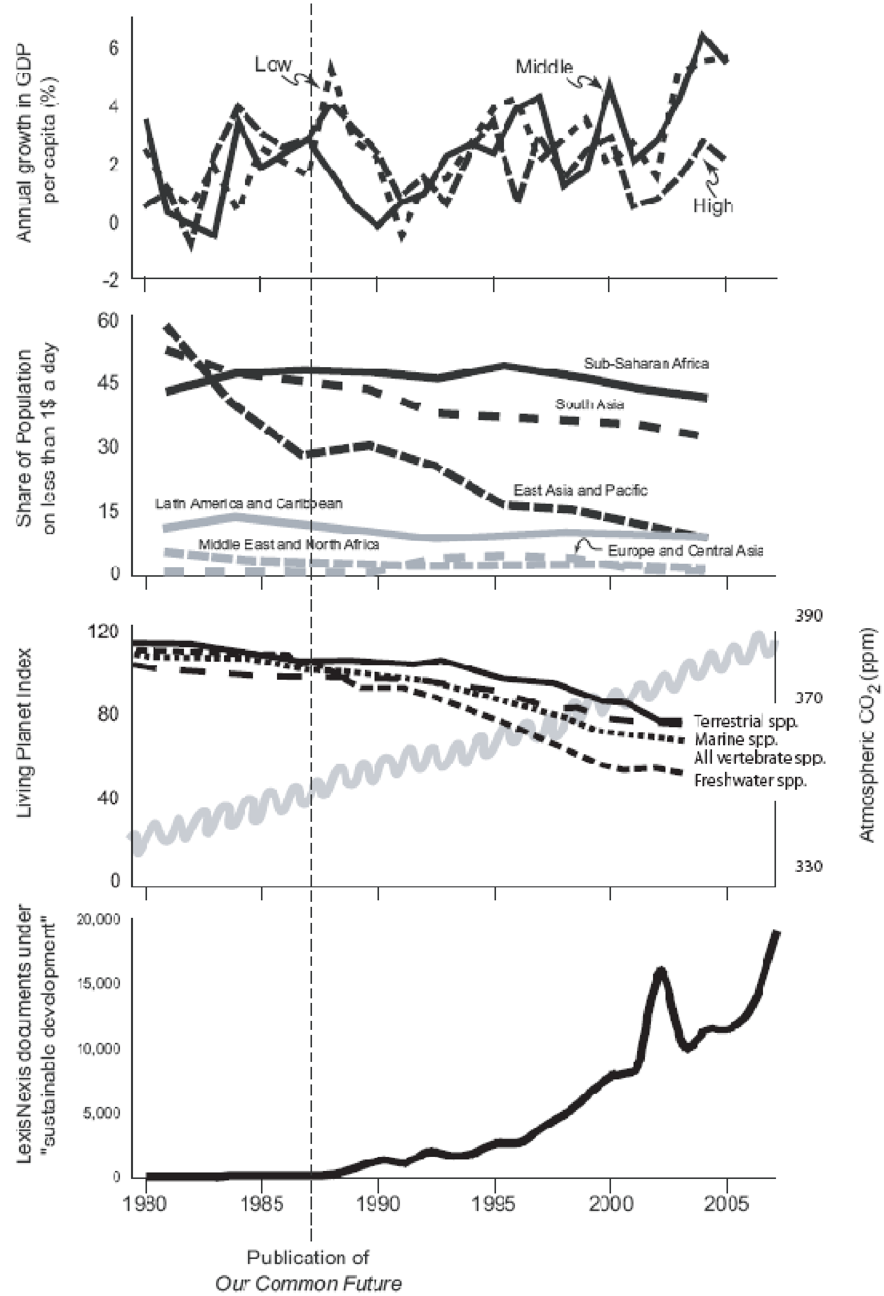


Figure SPM-1: Climate change – an integrated framework. Schematic and simplified representation of an integrated assessment framework for considering anthropogenic climate change. The yellow arrows show the cycle of cause and effect among the four quadrants shown in the figure, while the blue arrow indicates the societal response to climate change impacts. See the caption for Figure 1-1 for an expanded description of this framework.

Q1 Figure 1-1

Sustainable Development:
In its Third Decade




举手之劳· 共创文明
Civilization is from
every tiny thing

Integration and Implementation

- Is it possible?
- TransLinks
  - Nature, wealth, power
  - Institutional diversity
- Current and future Activities
  - USAID perspective

Reality is Complicated

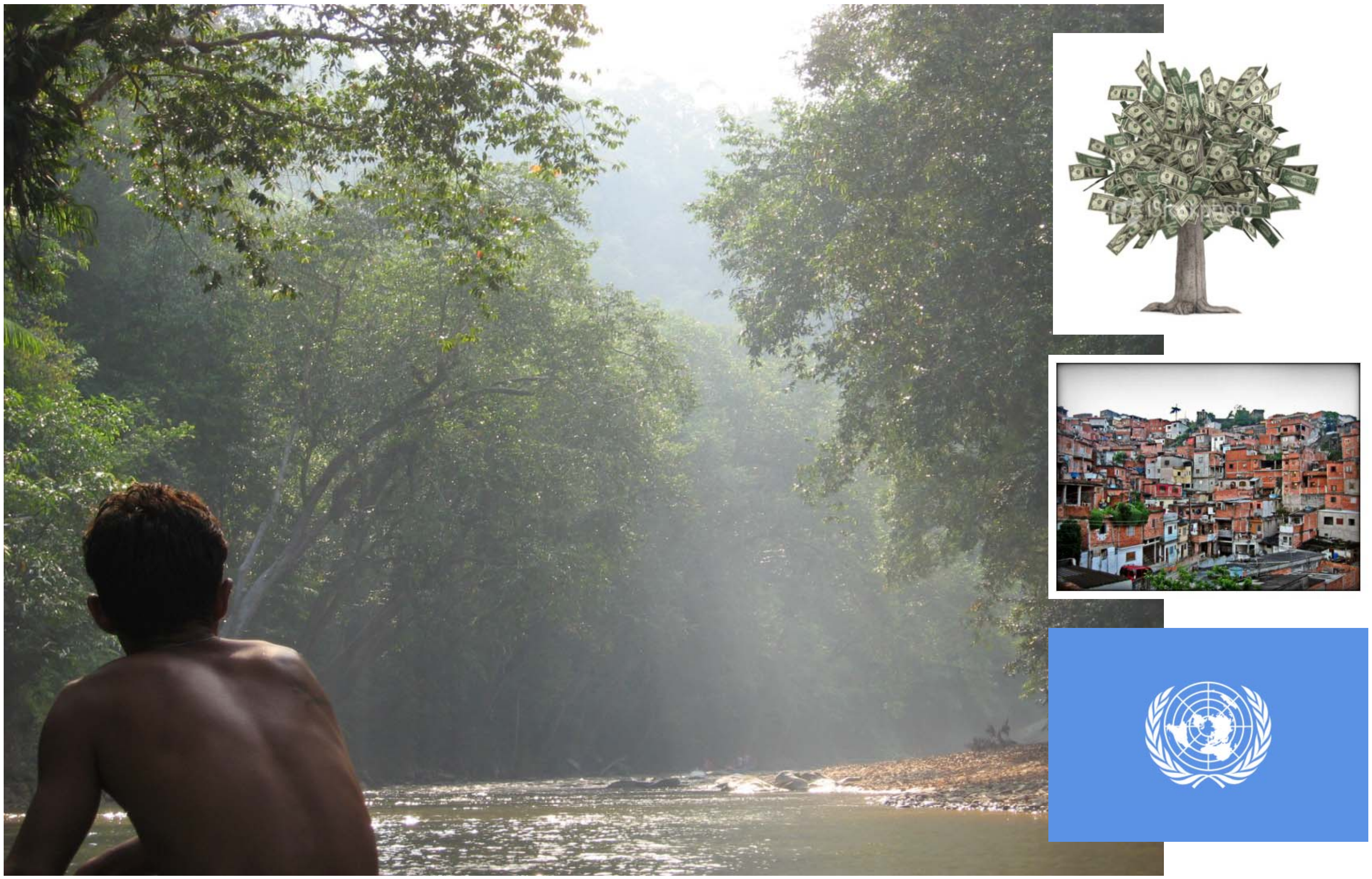


Image credits: Paige Olmsted, schoolloans.org, un.org, infed.org

TransLinks - Partners

- Wildlife Conservation Society
  - REDD guidance
- Land Tenure Center
  - Reality on the ground
    - Parks not pristine
    - Already overdrawing from ecosystems
  - Appropriate starting points for planning

Image credit: National Geographic

TransLinks – Partners

- Forest Trends
  - Species Banking
  - BBOP
  - State of Biodiversity market reports
- Enterprise Works
  - Wildlife friendly

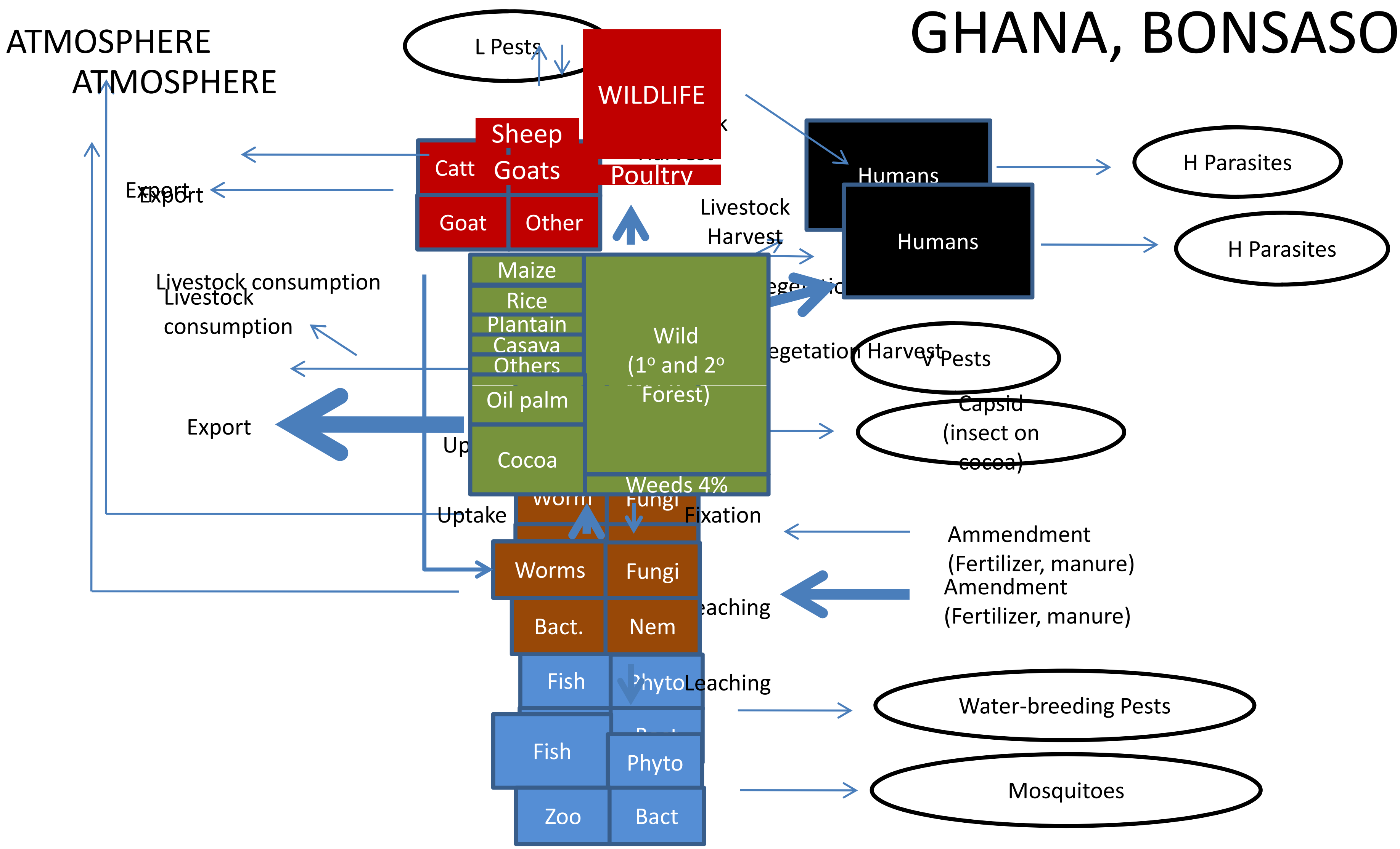
Image credit: flickr.com

TransLinks – The Earth Institute

- Guides for practitioners
  - Ecosystem Services Primer
- Academic papers
  - Ecosystem Services in Sub Saharan Africa
- Tools for farmers
  - Nitrogen "mapping"

Image credit: flickr.com

Nitrogen Mapping



MDG 7: Environmental Sustainability

- 7a: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources
- 7b: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss
- 7c: Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation
- 7d: Achieve significant improvement in lives of at least 100 million slum dwellers, by 2020

The Earth Institute

- Millennium Villages Project
  - Health, education infrastructure, agriculture
  - Half way point, limitationswith cross cutting sectors including environment

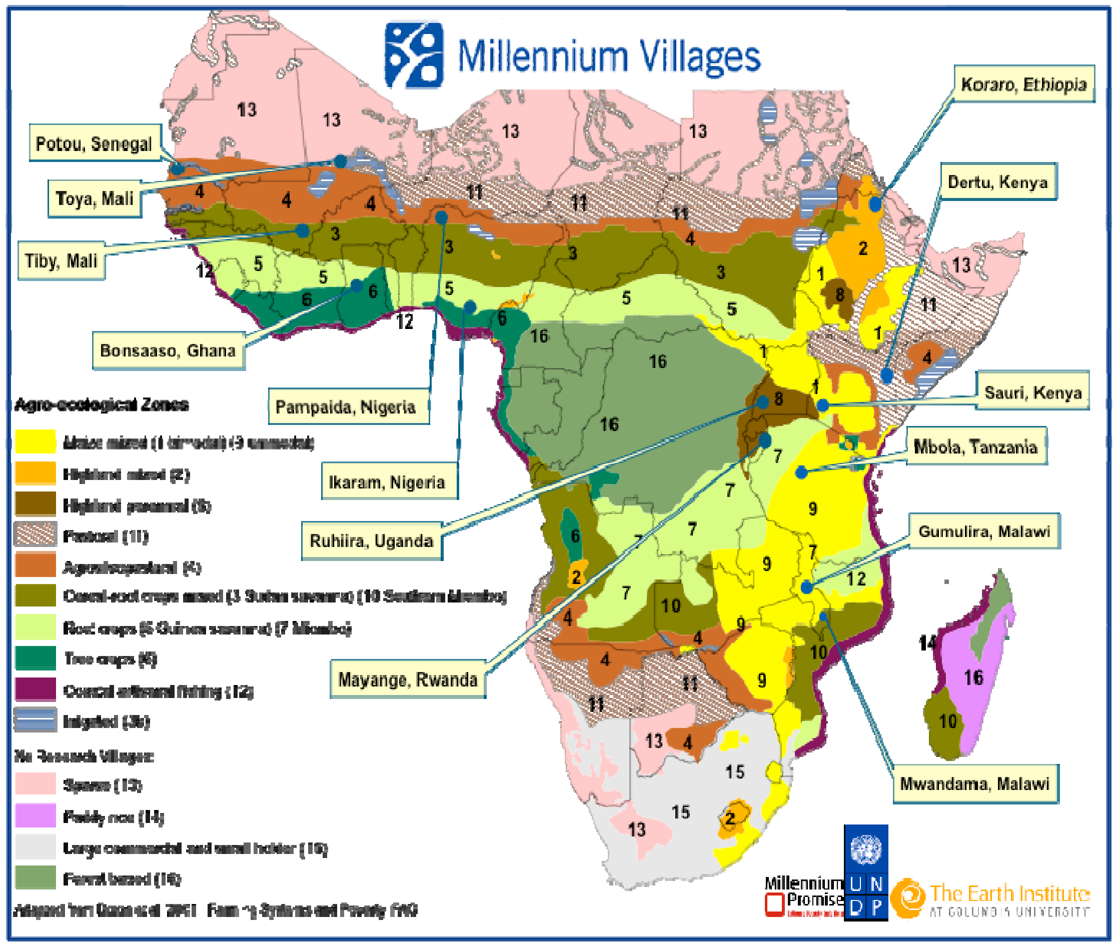
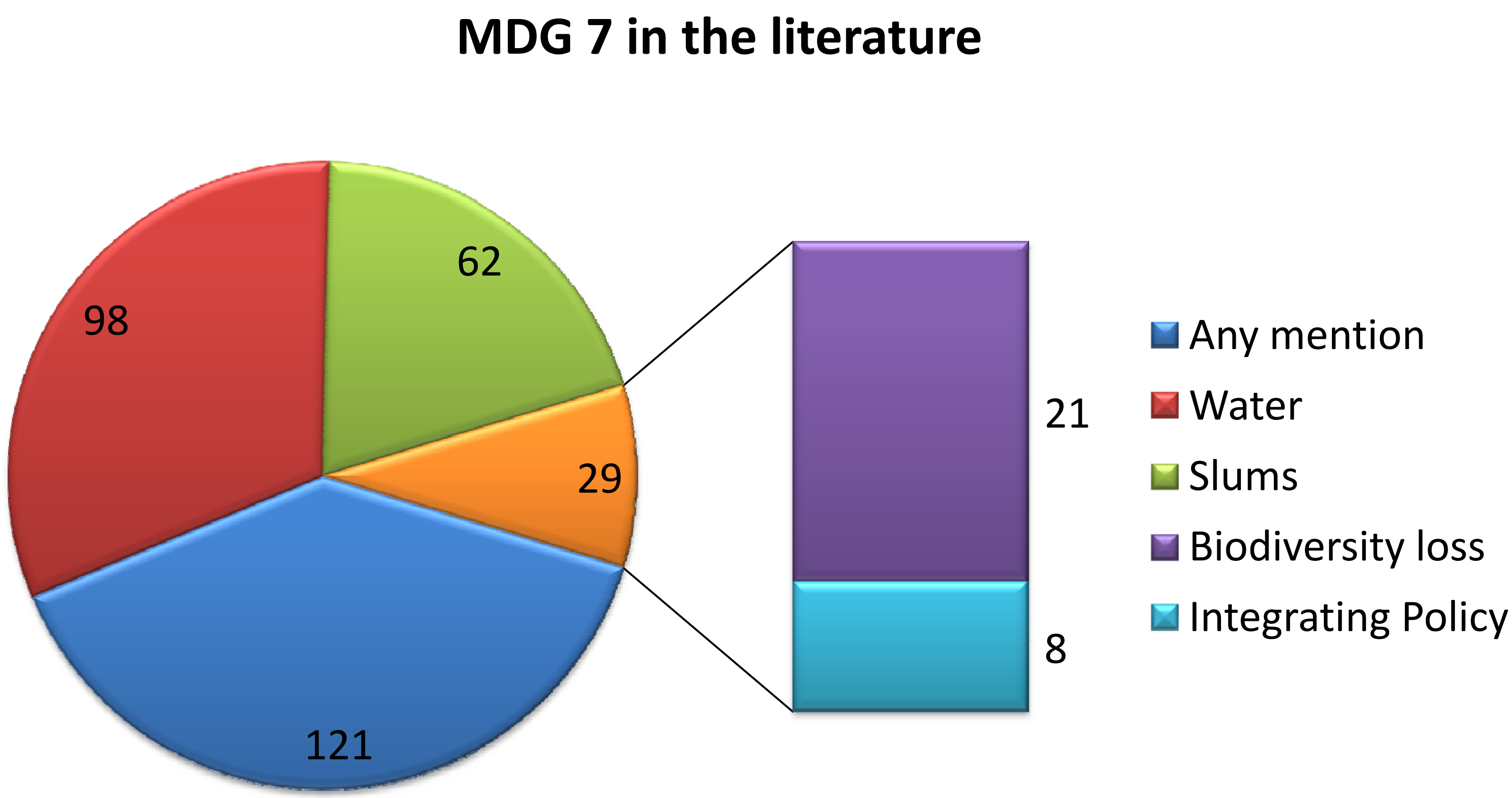


Image credit: Millennium Villages

MDG 7: Environmental Sustainability



Possible Areas for Discussion

- Can or should biodiversity and climate change be addressed in concert by Aid agencies/the development community?
- When considering environment within larger development agenda, how can environmental objectives be better integrated?
- What kind of tools/materials could best support USAID to achieve any of the above?

Thank You!