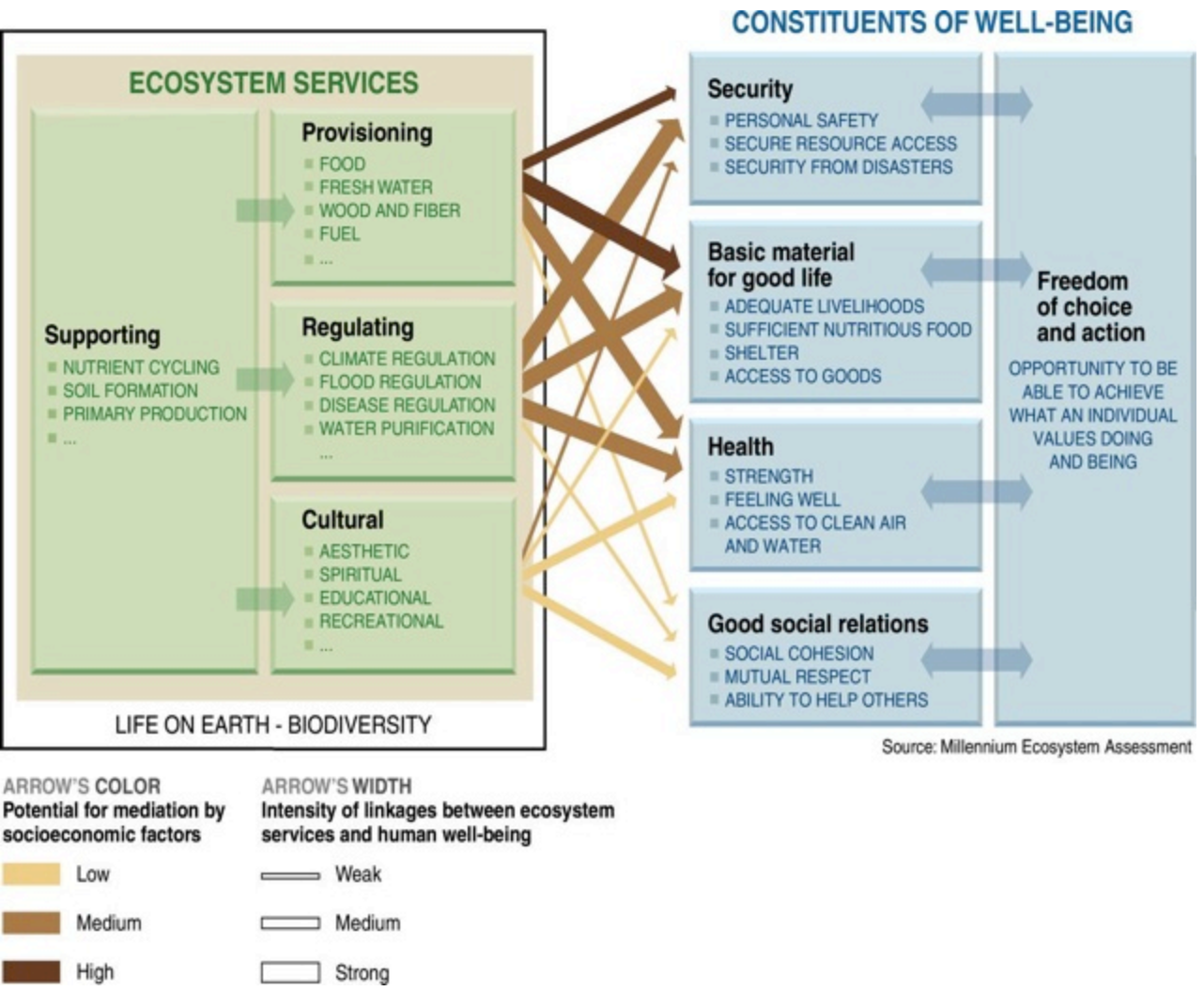
Talk outline

- **Ecosystem Services**
  - What they are
  - Global trends
  - Importance for human welfare

- **Tools for leveraging ecosystem service values for conservation and livelihoods**

- **Managing ecosystem services in the face of environmental changes,** particularly **climate change**

Findings of the Millennium Ecosystem Assessment



From the MEA, 2005

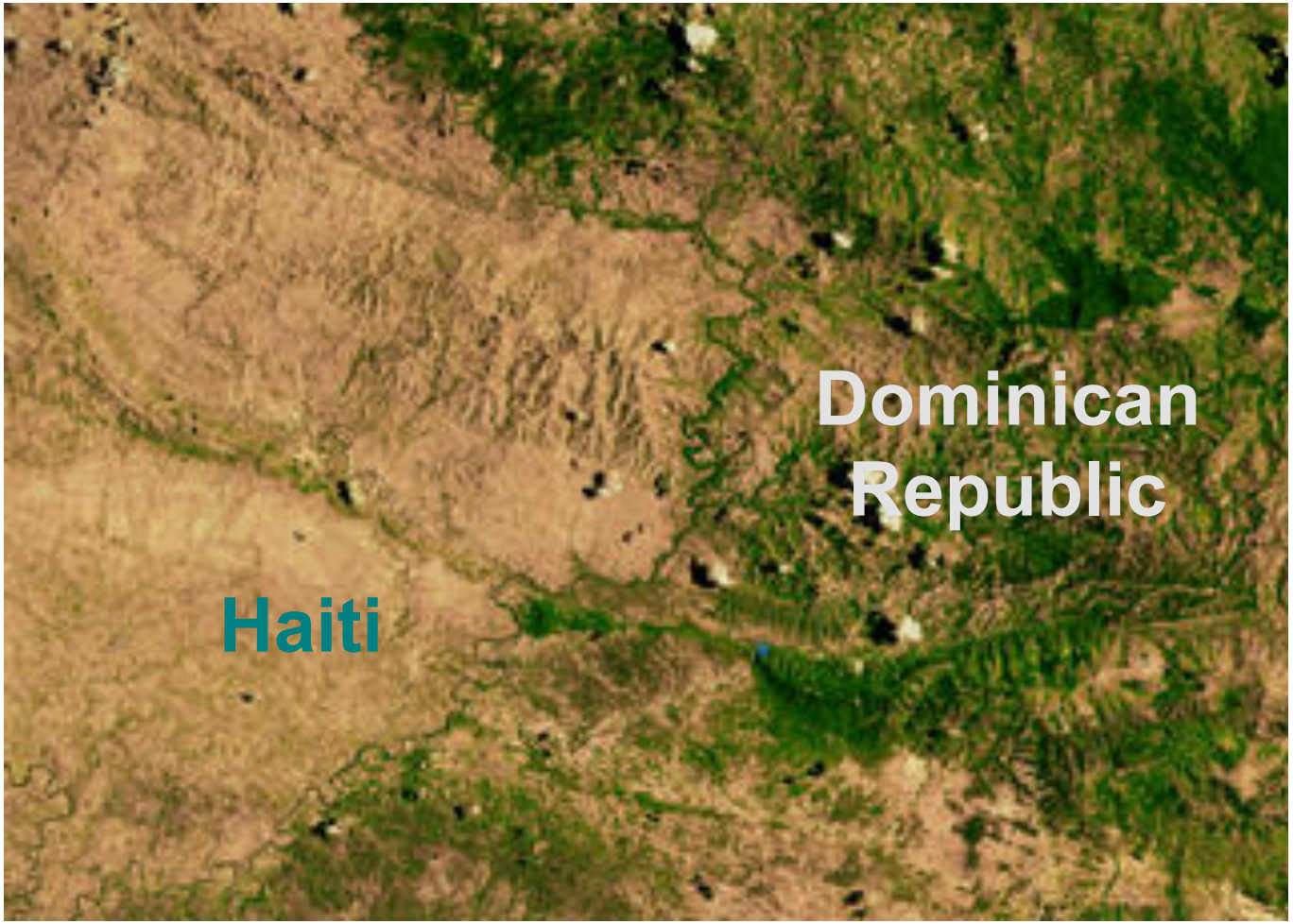
- Approximately 60% (15 out of 24) of the ecosystem services evaluated are being degraded or used unsustainably
- The use of provisioning ecosystem services has increased most rapidly
- Humans have substantially altered regulating services by modifying the ecosystems providing the services and exceeding the capabilities of ecosystems to provide the service.

Intact ecosystems can be a reservoir of ecosystem services

Ranomafana, Madagascar

- Climate regulation through carbon storage and water cycling
- Biodiversity for tourism
- Water for drinking, bathing, agriculture and hydro-electricity
- Disaster regulation services
- Disease regulation
- Pollination
- Food
- Fuel
- Fibers
- Medicine
- Spiritual values

Loss of intact ecosystems can result in loss of ecosystem services



Higher deforestation in Haiti compared to neighboring Dominican Republic is thought to be the cause of higher flash flooding and significantly higher rates of mortality in Haiti following Hurricanes such as Hurricane Jeane in 2004.

What are the drivers behind changes in ecosystem services?

Indirect drivers:

- High and increasing demand for ecosystem services, especially food, water, timber, fiber, and fuel
- Weak resource tenure and governance
- Perverse subsidies
- Market failures
- Macro-economic policy failures
- Climate Change

• Direct Drivers:

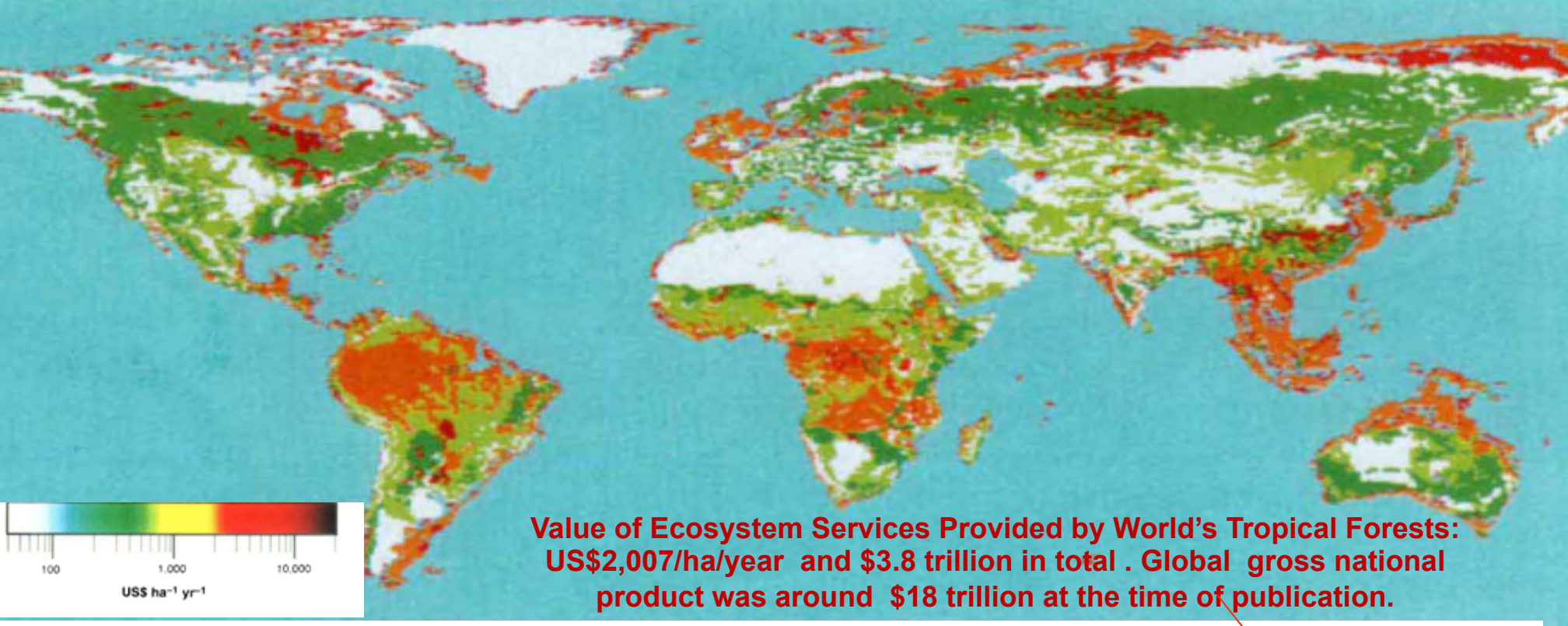
- Land cover change for roads, agriculture and extractive industries
- Overharvesting and over-extraction of natural resources
- Pollution/nutrient loading (i.e. fertilizers and pesticides)
- Invasive species
- Climate Change

Loss of ecosystem services and human welfare

- Rural livelihoods and enterprises are often directly dependent on ecosystem services (such as fisheries, forestry, and/or agriculture and tourism)
- In many rural areas, few if any substitutes or alternatives may exist or are accessible to replace ecosystem services if degraded or lost
- Many rural populations have few assets for adapting to climate change or extreme events

Making the case for conservation of ecosystem services: valuation

- Economic valuation is a method to estimate the monetary value(s) on ecosystem services
- Can support decision making by quantifying costs/benefits associated with different natural resource management plans(i.e. costs/benefits of logging versus storm regulation)
- Can provide an economic case for conservation
- Some services are more amenable to economic valuation than others (i.e. food production is very amenable, spiritual values of nature are more difficult)
- Non-monetary methods can be used to look at increases or decreases in services in response to land-use decisions and relative to each other



Value of Ecosystem Services Provided by World's Tropical Forests: US$2,007/ha/year and $3.8 trillion in total . Global gross national product was around $18 trillion at the time of publication.

Biome	Area ($ha \times 10^6$)	1 Gas regulation	2 Climate regulation	3 Disturbance regulation	4 Water regulation	5 Water supply	6 Erosion control	7 Soil formation	8 Nutrient cycling	9 Waste treatment	10 Pollination	11 Biological control	12 Habitat/ refugia	13 Food production	14 Raw materials	15 Genetic resources	16 Recreation	17 Cultural	Total value per ha ($ha^{-1} yr^{-1}$)	Total global flow value ($yr^{-1} \times 10^6$)
Forest	4,855		141	2	2	3	96	10	361	87		2		43	138	16	66	2	969	4,706
Tropical	1,900		223	5	6	8	245	10	922	87				32	315	41	112	2	2,007	3,813
Temperate/boreal	2,955		88		0			10		87		4		50	25		36	2	302	894

From Costanza et al. 1997

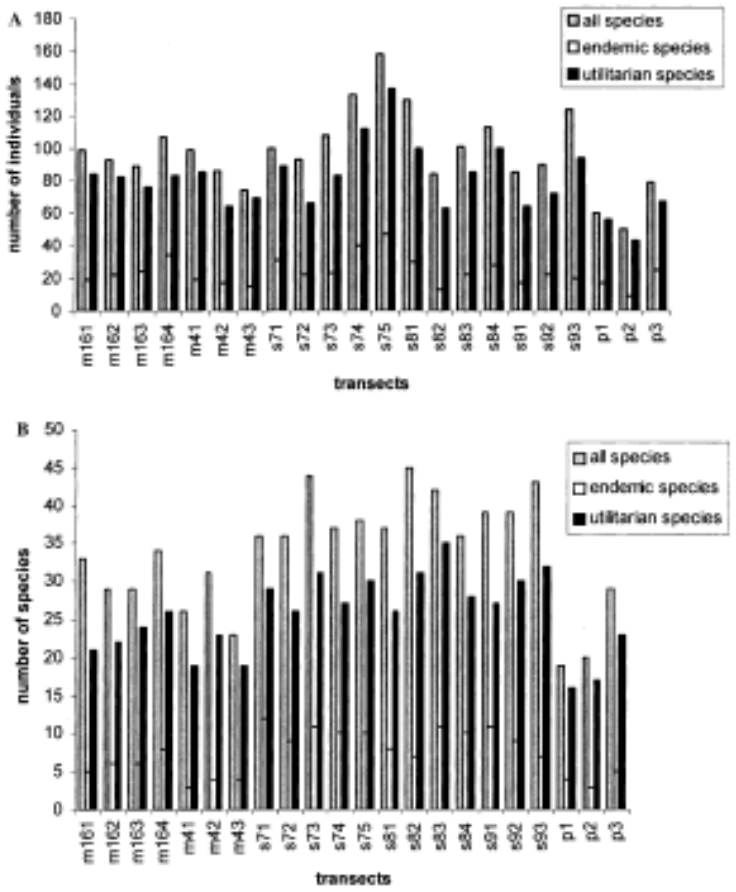
Local Scale Example: Economic Values of the Sarawak Mangroves Forest Reserve, Malaysia

Table 7. Summary of costs which could be expected if the area were to be converted to an alternative form of land use

Use/function	Impact of conversion	Potential Loss	
		Non-monetary	Monetary
Forestry production	Total loss of poles, charcoal, nipa	Housing materials, fishing poles, firewood, nipa	US$123 217
Fisheries production	Total loss of fish, prawns, crabs etc.	Up to 3000 jobs; major decline in seafood supplies for local villages and Kuching	US$21.1 million
Tourism support	Siltation of: (a) all beaches, including Damai, Santubong, Santin, Satang, possibly Bako; (b) coral reefs	Scenic and recreational values; genetic resources of coral reefs	US$ 3.7 million
Wildlife conservation	Total loss of all wildlife species, including endangered and protected ones	Genetic resources; aesthetic values; tourist potential	Immeasurable
Physical protection; barrier to coast erosion; silt entrapment; land stabilization; flood protection; pollutant filtration	Erosion and salt intrusion inland; loss of sandy beaches and coral; storm and tidal flooding in villages and Kuching		Bunding, flood damage repair; incalculable

Bennett and Reynolds, 1993

Non-Monetary Values of Ecosystem Services



High number of total forest tree individuals and species recorded in surveys are used for rural livelihoods in south-eastern Madagascar. Certain forest stands are conserved for spiritual values in this region, but not captured in forestry inventories. From Ingram et al. 2005

Incentives for Conservation: Payments for Ecosystem Services

Distinguishing factors:

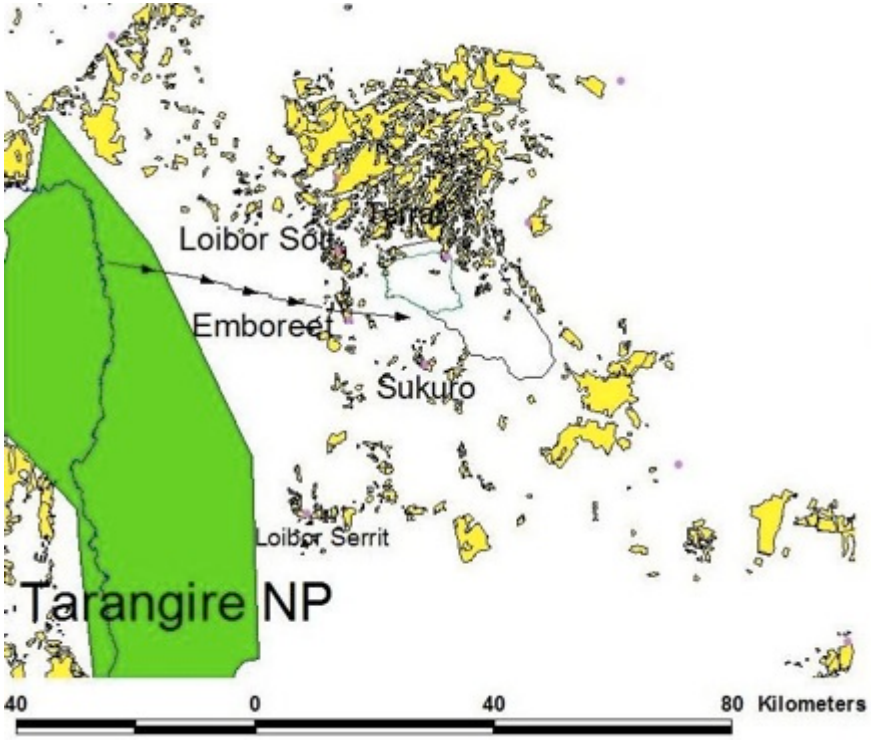
- the mechanism must involve a (voluntary) transaction where a well-defined ecosystem service (or a land use likely to secure that service);
- is being 'bought' by a (minimum of one) service buyer
- from a (minimum of one) service provider and
- if and only if the service provider secures service provision (conditionality)

(Adapted from Wunder, 2005)

Types of Payments for Ecosystem Service Programs

- Payments for climate regulation through carbon storage or sequestration
- Payments for watershed services (water quality and/or quantity)
- Payments for biodiversity (tourism, green products)

Payments for Supporting Services and Biodiversity in Tanzania



Clearly Defined Ecosystem Service(s): Primary production that supports wildlife
Buyer: Tour Operators
Sellers: Local community
Conditionality: Payments are conditional upon maintaining grasslands

From Nelson, 2008

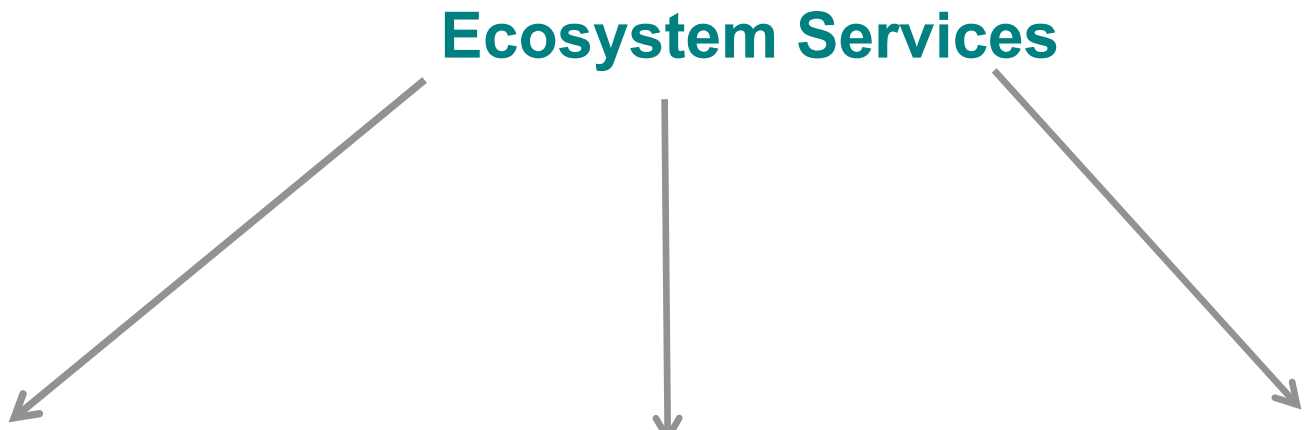
Payments for Ecosystem Services in Tanzania

- 5 year contract between village and tour operators
- $4500/year in conditional payments
- $3500/year for village game scouts
- Important source of discretionary funds for village

But, what if ecosystem services (grasslands or wildlife) important for program change?

Nelson, 2008

Ecosystem Services and Climate Change

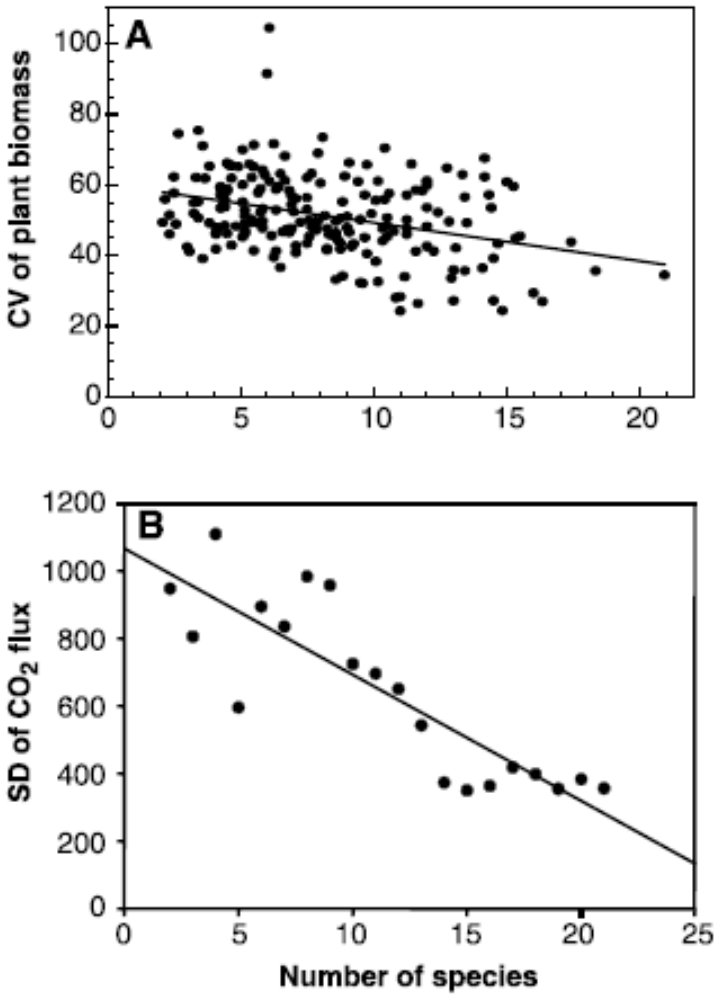


Climate regulation (one of the services that has been degraded)

Affected by climate change

A range of ecosystem services will be important for human based adaptation in rural communities

Biodiversity can provide stability to ecosystem services insurance



From Loreau et al. 2001

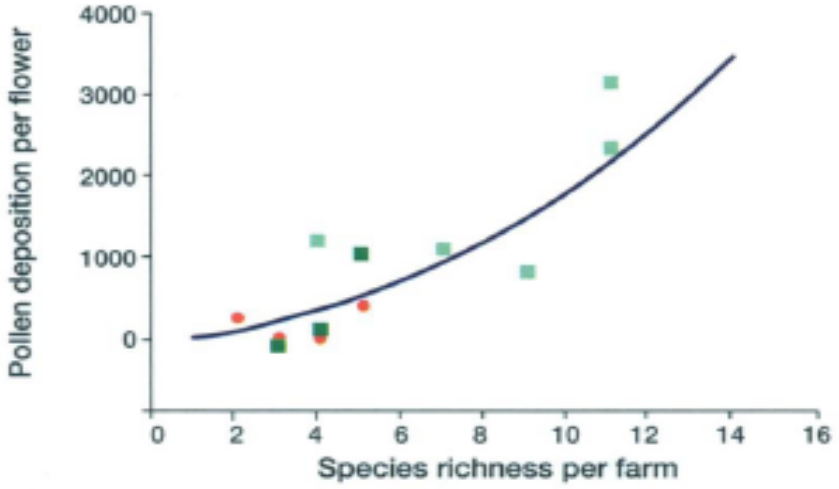
Precautionary Measures for Managing Ecosystem Services in the face of change:

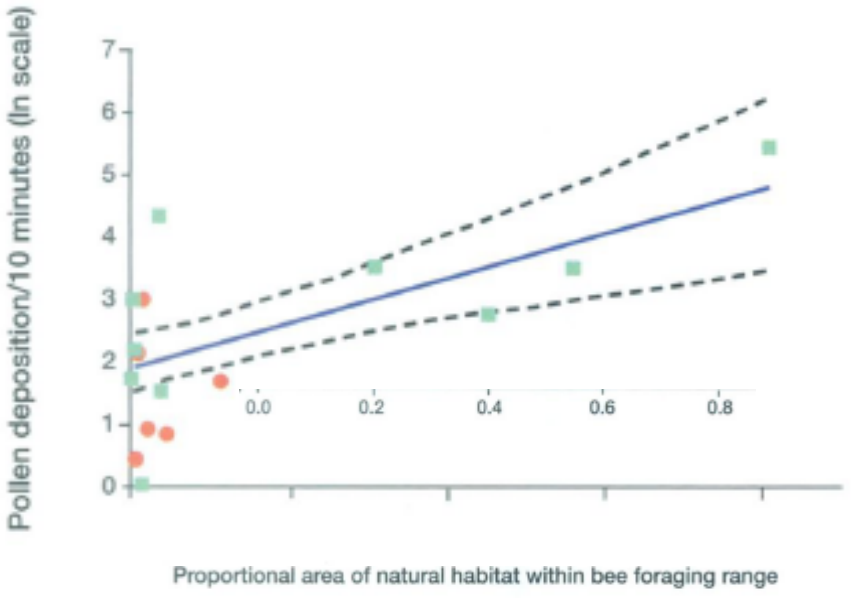
• Higher species richness can decrease variation in some ecosystem services

•How much diversity to protect to stabilize a service will depend on the range of environmental conditions expected: the greater expected variation, the greater the diversity within groups providing different functions will be needed

•Conservation of regulating services can help conserve a higher number of ecosystem services (Bennett et al. 2009, Raudsepp-Hearne et al. 2010).

Relationship between biodiversity and ecosystem services





From Kremen, 2005

What do we need to know to reduce uncertainty about how ecosystem services will respond to change?

- **Understand how ecosystem services are provided by ecosystems:**
  - Identify Service Providers (SP): species, populations, and habitats that provide ecosystem services
  - Identify important functional traits and attributes of SPs that make them effective (Luck et al. 2003, Kremen 2005, Luck et al. 2009)
- **Monitor functional diversity and functional redundancy**
- **Identify the synergies and tradeoffs in ecosystem services as a result of management practices or environmental change**

Summary Points

- Ecosystem services represent the range of benefits that people get from nature
- Intact, functional land/sea-scapes can be reservoirs of many ecosystem services
- Monetary and non-monetary valuation and PES are tools for leveraging ecosystem services values for incentivizing land-use planning, conservation and livelihoods.
- Conserving dynamic services in the face of climate change and other pressures will require more knowledge on how ecosystem services are provided, used and how they will respond to change
- In the absence of complete knowledge, a focus on protecting regulating services may result in protection of more ecosystem services overall and may enhance resilience of a system

Questions for Albertine Rift

- What are the key ecosystem services of local, regional and global importance in the Albertine Rift?
- Which services might be affected directly by climate change?
- Would an increase, loss or change in species composition as a result of climate change influence ecosystem services?
- How would losses in ecosystem services influence local livelihoods? Regional or national economies?
- What information is needed to manage key services in the face of climate change?
- What tools (valuation, PES, and/or protected areas, etc.) are needed to conserve ecosystem services for current and future generations?