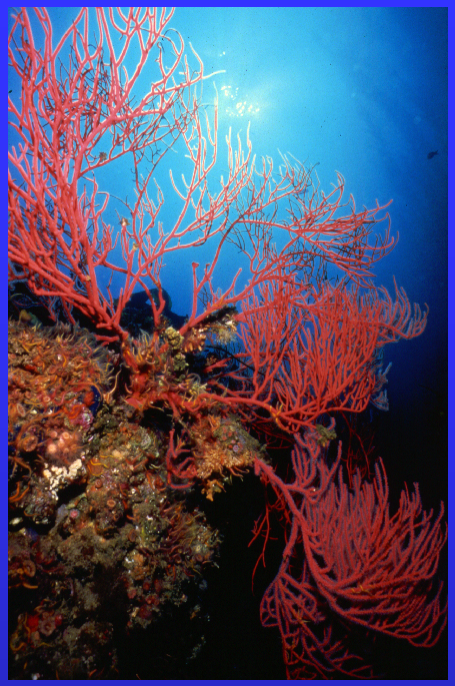
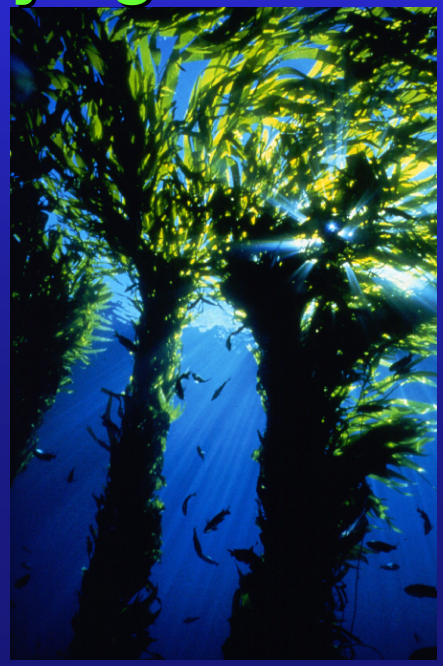


Science's *Sine Qua Non*: Making Scientific Data & Knowledge Understandable, Relevant and Useful

Jane Lubchenco

CODATA – Beijing – 23 October 2006



Sine qua non

is Latin for
“Without which, nothing”

And refers to an essential condition or element.

Science's *Sine Qua Non* :

Making Scientific Data & Knowledge not only accessible but also Understandable, Relevant and Useful to Society

Outline

1. Science and Society: A Gap
2. Bridging the Gap
3. A Case Study: the Millennium Ecosystem Assessment
4. A New Social Contract for Science

A Gap

in perceptions of relevance and usefulness of scientific data, information & knowledge

- Scientists:

  Our knowledge is relevant & important.

  Why isn't it used?

  Why isn't it better funded?

The Gap

- Policy makers:
  - Scientific information: far removed from our decisions.
  - Results: too complex and couched in uncertainties and qualifiers.
  - Conclusions: ambiguous, do not provide clear guidance & ignore the complexities of policymaking.
  - Scientists can’t agree
  - Some of our constituents don’t trust your science.

Some causes of the Gap

1. Different ideas about the role of science
2. Most scientists are not trained to translate complex science into understandable and policy-relevant information
3. Data and information: too much and not enough
4. Lack of opportunity to develop credible international scientific assessments
5. Lack of transparency in the production of knowledge and lack of opportunities for non-scientists to contribute to knowledge base.

Bridging the Gap: Some Possible Solutions

1. Clarify role of science
2. Train scientists to communicate more effectively
3. Organize data & information to make them more useful and relevant
4. Establish ongoing credible scientific assessments
5. Increase openness in the conduct of science and opportunities for citizens to participate in meaningful ways

Historic Roles of Science

1. Improve Human-Well Being
   - Health
   - Labor-saving devices
   - Communications
   - Education
   - Intellectual Curiosity
2. Assist National Defense/Security
3. Enhance National Prestige
4. Promote Economic Growth
   - Technology
   - Transportation

Another, often unappreciated role of science: To inform (not dictate)

the understanding, discussions, and decisions of individuals and institutions

and thereby improve lives and enhance human well-being

Role of science: To inform

1. Discover how systems work (natural, social and coupled social-natural systems)
2. Document changes
3. Understand consequences of changes
4. Develop and evaluate options for alternate pathways

If decisions are to be informed by science,

Decision-makers need to have access to scientific information that is understandable, relevant, usable and credible.

However, and especially for some areas like environmental science,

- The science is complex, nuanced and difficult to communicate simply.
- Uncertainties are real (but there is often more agreement about the basics than is communicated).
- Vested interests often spin, distort or cherry-pick information.

The Result:

1. Decisions are made without good science.

2. Science is seen as a weapon, not as useful knowledge.

Bridging the Gap: Some Possible Solutions

1. Clarify role of science: also to inform
2. Train scientists to communicate more effectively:

e.g. : Aldo Leopold Leadership Program (USA)

- **2-way communication**
- **“Know thy audience; know thy self; know thy stuff”**
- **Narrative; analogies; simple messages**
- **www.leopoldleadership.com**

Bridging the Gap: Some Possible Solutions

1. Clarify role of science
2. Train scientists to communicate more effectively
3. Organize data & information to make them more useful and relevant

Bridging the Gap: Some Possible Solutions

1. Clarify role of science
2. Train scientists to communicate more effectively
3. Organize data & information to make them more useful and relevant
4. **Establish ongoing credible scientific assessments**

   e.g.: Millennium Ecosystem Assessment

Bridging the Gap: Some Possible Solutions

1. Clarify role of science
2. Train scientists to communicate more effectively
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4. Establish ongoing credible scientific assessments
5. Increase openness in the conduct of science and opportunities for citizens to participate in meaningful ways

Conclusions

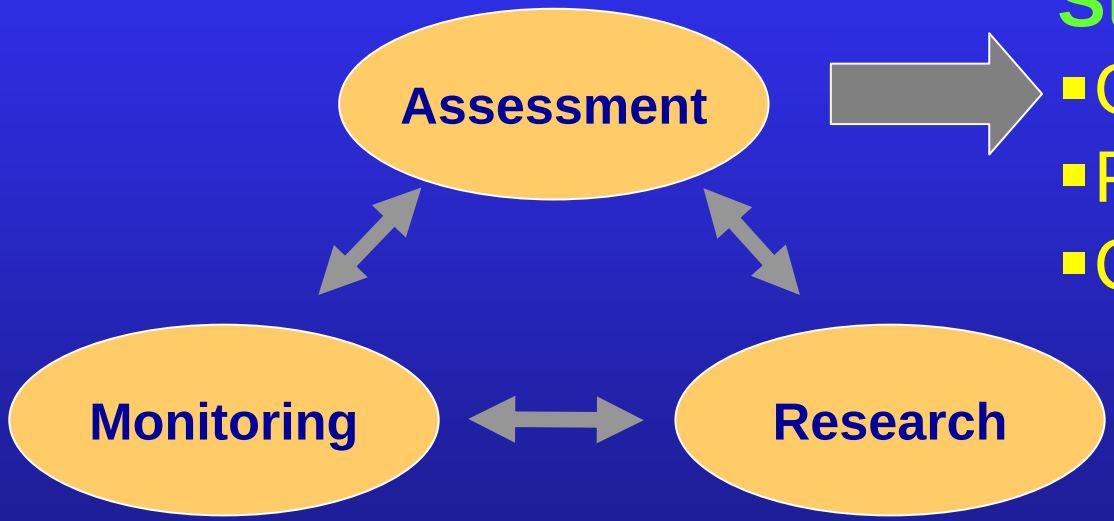
The Gap can be Bridged, but doing so requires effort by scientists and by society.

Scientists can and should actively work to build these bridges, but they must be done in partnership with governments and civil society

Outline

1. The Gap
2. Bridging the Gap
3. A Case Study:
   the Millennium Ecosystem Assessment (the ‘MA’)

Scientific Assessment



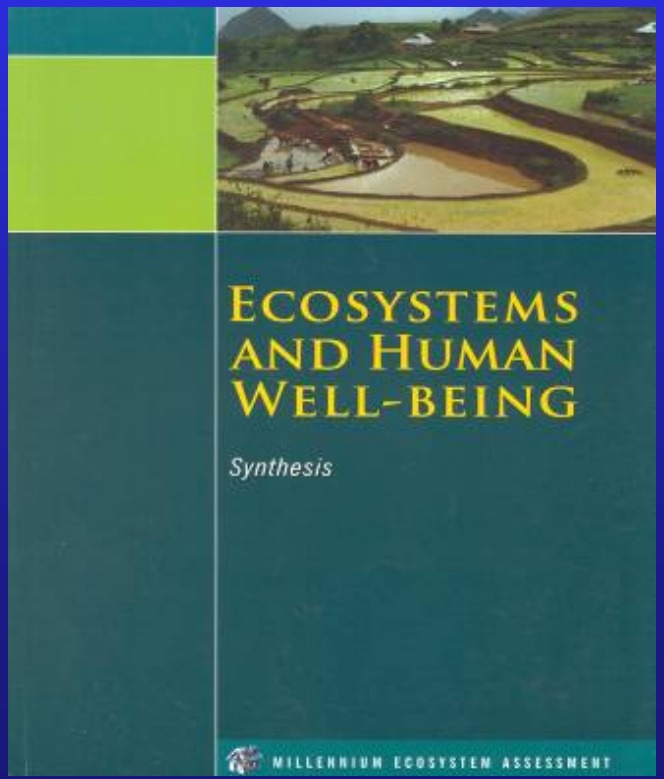
Stakeholders:

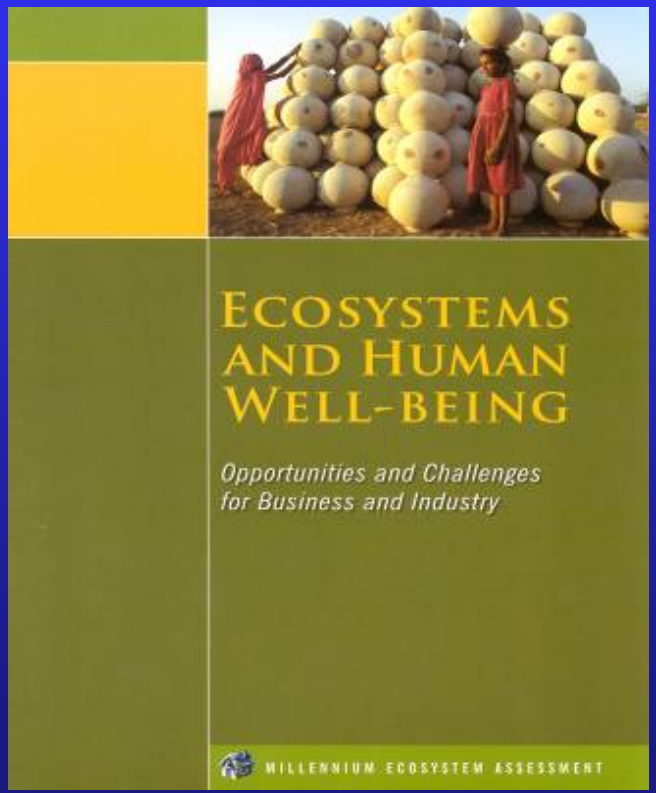
- Governments
- Private Sector
- Civil Society

The Millennium Ecosystem Assessment

- international scientific assessment
- ecosystems and services around the world
- www.MAweb.org
- 2005, 2006

- status & trends in ecosystems around the world





The Millennium Ecosystem Assessment (MA)

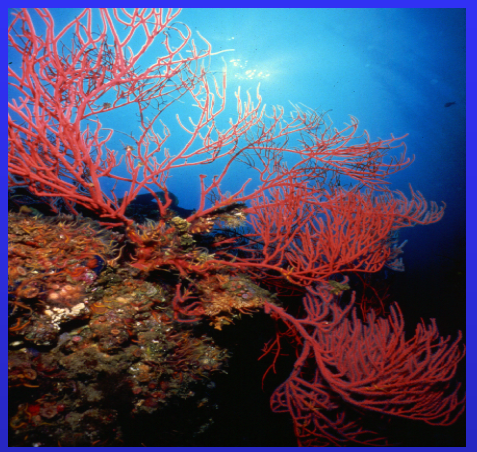
A global scientific assessment of:

- the consequences of environmental changes to human well-being
- status of global ecosystem services
- options for change

Released 2005, 2006
www.MAweb.org

"Ecosystem Services"

= Benefits provided by ecosystems



Converting an ecosystem means losing some services and gaining others – e.g., A mangrove ecosystem:

Provides nursery and adult habitat ,
Seafood, fuelwood, & timber;
traps sediment; detoxifies pollutants;
protects coastline from erosion & disaster

Converting a mangrove to provide housing, shrimp ponds or agricultural areas, means Losing some services and gaining others

Gain: housing,

Shrimp,

Loose: nursery and adult habitat ,
Seafood, fuelwood, & timber;
traps sediment; detoxifies pollutants;
protects coastline from erosion & disaster

Or crops

Many ecosystem services are quite valuable, but are not priced.

Example: The Catskill Watershed provides drinking water to the city of New York

water purification
is one
ecosystem service
provided by this forest

Options:

1) Restore the watershed so it could resume providing this service of water purification = $1 billion

Options:

1) Restore the watershed so it could resume providing this service of water purification = $1 billion

OR

2) Build a water purification plant (i.e., build a human-made substitute) = $8-10 billion

“You don’t know what you’ve got ‘til it’s gone.”

(Joni Mitchell)

4 Types of Ecosystem Services

Provisioning

- food
- fresh water
- fuel wood
- genetic resources

Regulating

- climate regulation
- disease regulation
- flood regulation
- water purification

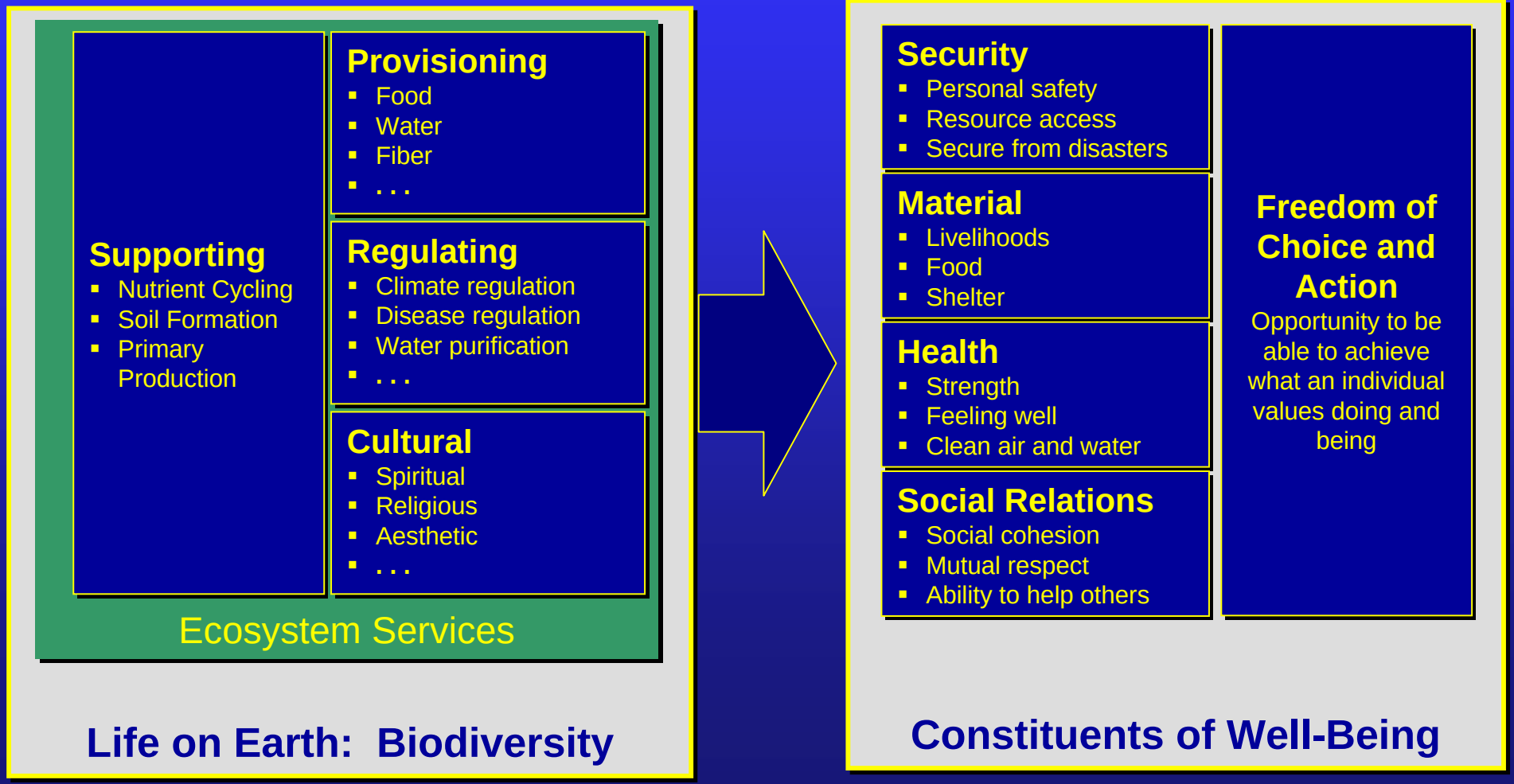
Cultural

- spiritual
- recreational
- aesthetic
- educational

Supporting

- Soil formation
- Nutrient cycling
- Primary production

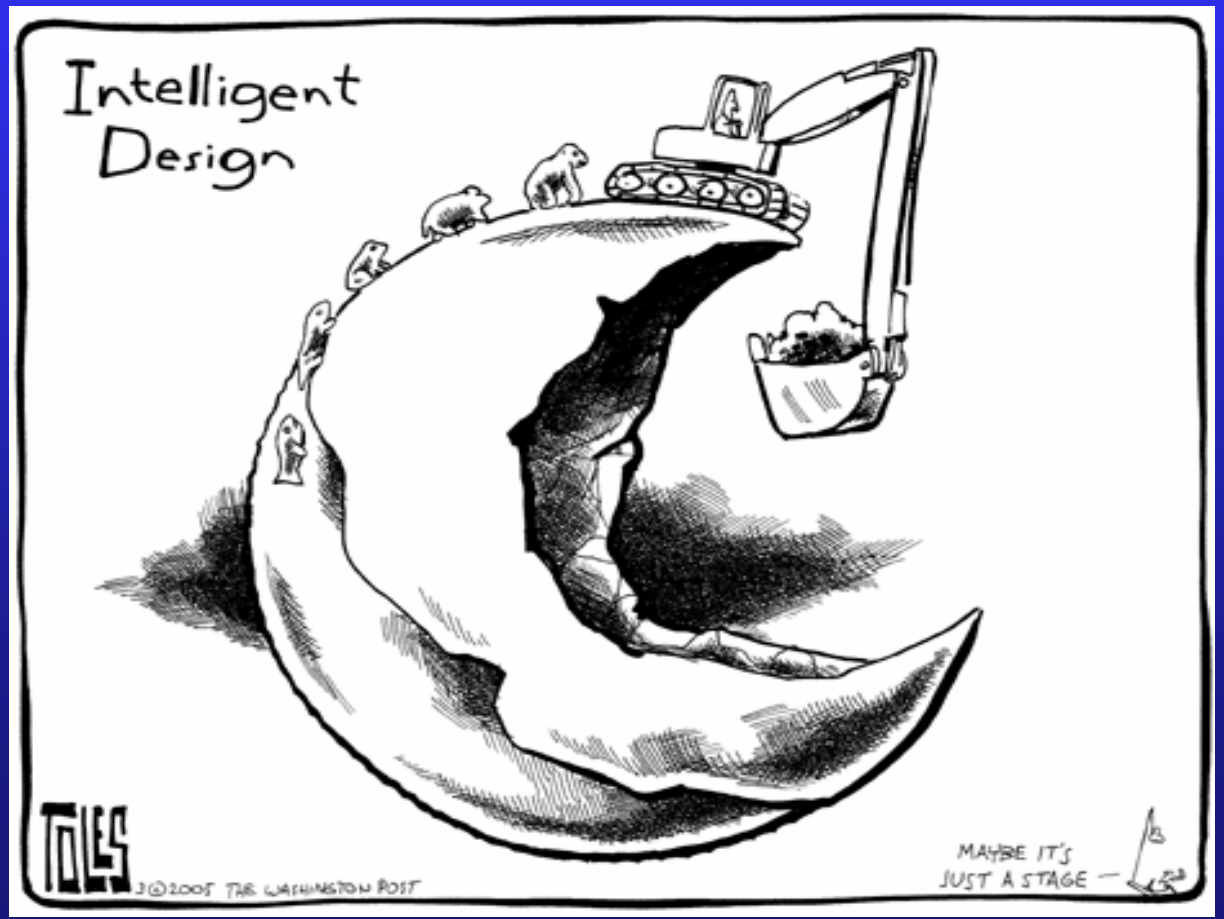
A unique feature of the MA: Consequences for People



Main Findings

1. Humans have radically altered ecosystems in last 50 years
2. Changes have brought gains but at growing costs that threaten achievement of development goals
3. Degradation of ecosystems could grow worse but can be reversed
4. Workable solutions will require significant changes in policy


Across all Ecosystems, 60% of Ecosystem Services are degraded



The Ecosystem Services Balance Sheet

	Enhanced	Degraded	Mixed
Provisioning Services	Crops Livestock Aquaculture	Capture fisheries Wild foods Wood fuel Genetic resources Biochemicals	Timber Fiber
Regulating Services	Carbon sequestration	Fresh Water Air quality regulation Regional & local climate regulation Erosion regulation Water purification Pest regulation Pollination Natural Hazard regulation	Water regulation Disease regulation
Cultural Services		Spiritual & Religious Aesthetic values	Recreation & Ecotourism

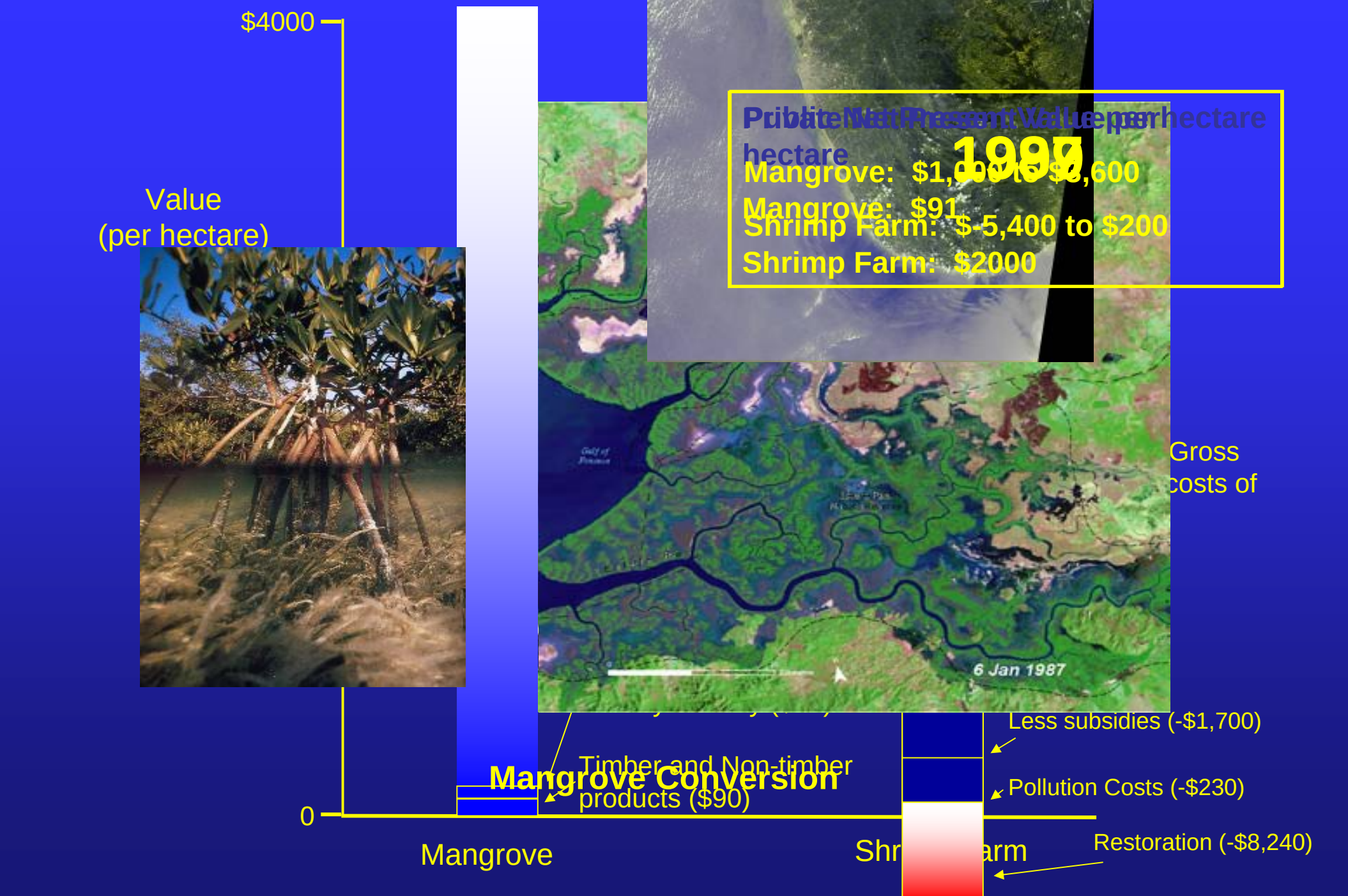
Trade-offs among ecosystem services

Mangrove Services:

- nursery and adult fishery habitat
- fuelwood & timber
- carbon sequestration
- traps sediment
- detoxifies pollutants
- protection from erosion & disaster

Mangrove ecosystem

crops


$4000
0
Value
(per hectare)
Private Net Present Value per hectare
1997
Mangrove: $1,000 to $36,600
Mangrove: $91
Shrimp Farm: $-5,400 to $200
Shrimp Farm: $2000
6 Jan 1987
Gross
costs of
Less subsidies (-$1,700)
Timber and Non-timber
products ($90)
Mangrove Conversion
Pollution Costs (-$230)
Restoration (-$8,240)
Mangrove
Shr arm

The main messages of the MA

1. We are having increasingly larger impacts on ecosystems and their services
2. Many segments of society have benefited from the mining of ecosystem services but the sustainability of these services is at risk
3. Scenarios of the future show do not show substantial abatement of degradation
4. We have options to build more favorable trajectories, but these will take substantial new actions

The MA Bottom Line

- We are spending Earth's natural capital, putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted.
- The future is in our hands. We can reverse the degradation of many ecosystem services over the next 50 years, but many changes in policy and practice will be required.

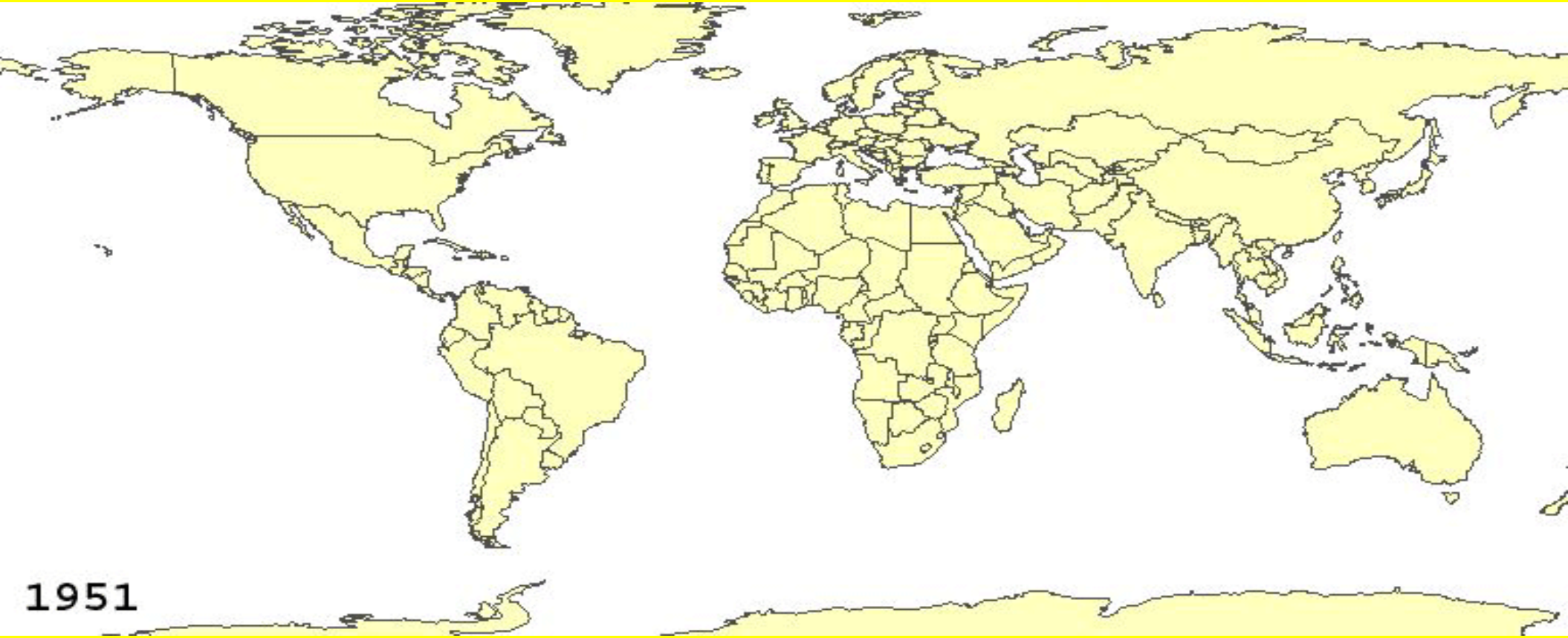
Example: global ocean trends

1. Depletion of ocean ecosystems
2. Loss of resilience (increased likelihood of abrupt changes)

“The times they are a changin’…

Today we fish

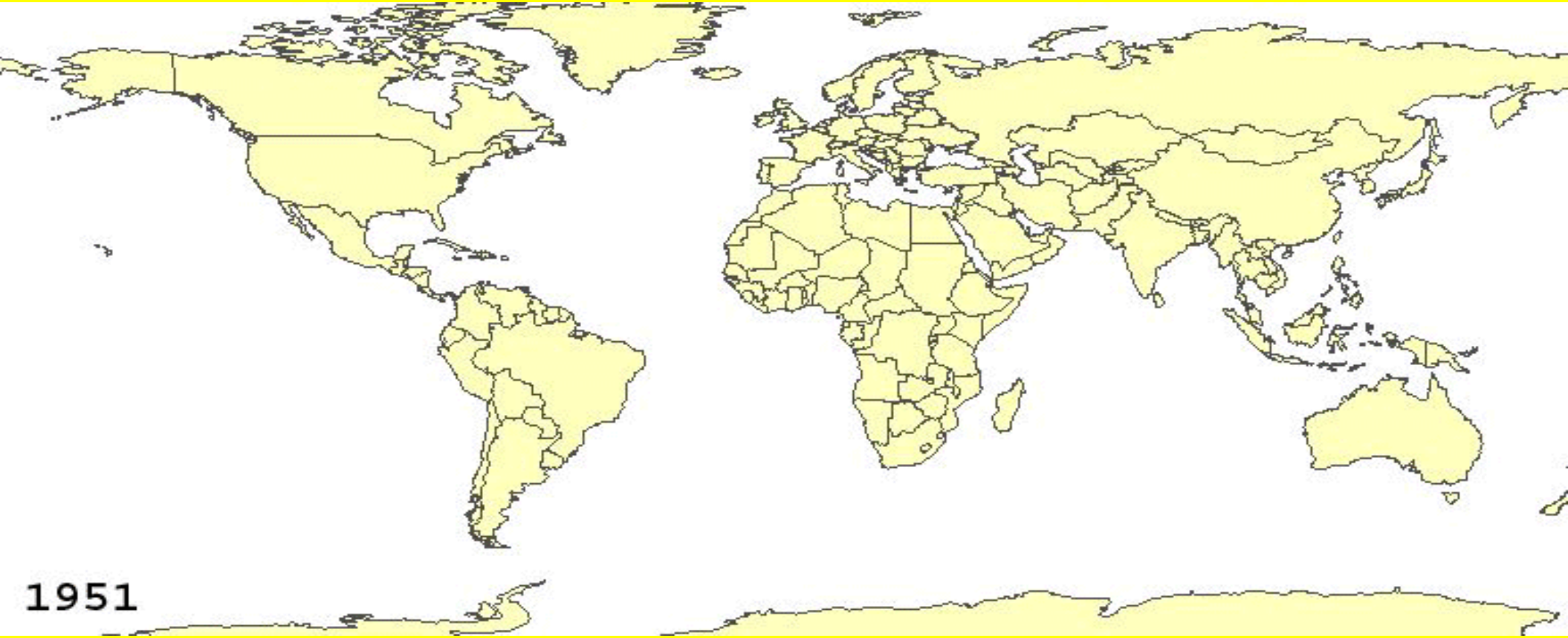
- farther and farther from shore,
- deeper and deeper,
- more efficiently,
- more safely,
- and in formerly inaccessible places



Year of Peak Fish Harvest

Pre-peak
Harvest peak
Post-peak

Source: Millennium Ecosystem Assessment and Sea Around Us project



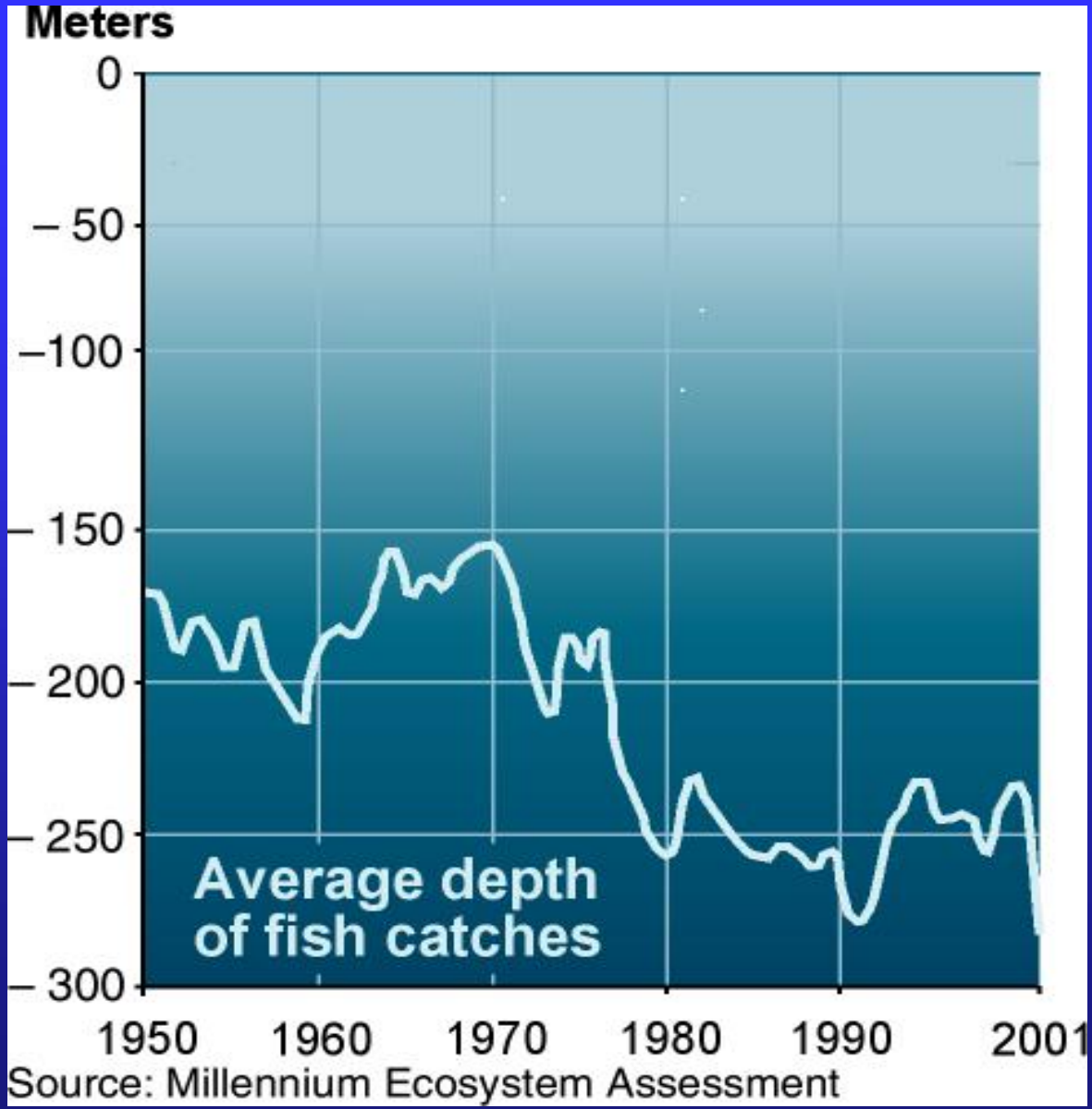
Year of Peak Fish Harvest

- Pre-peak
- Harvest peak
- Post-peak

Source: Millennium Ecosystem Assessment and Sea Around Us project

Fishing Deeper and Deeper:

Global Average Depth of Fish Catches



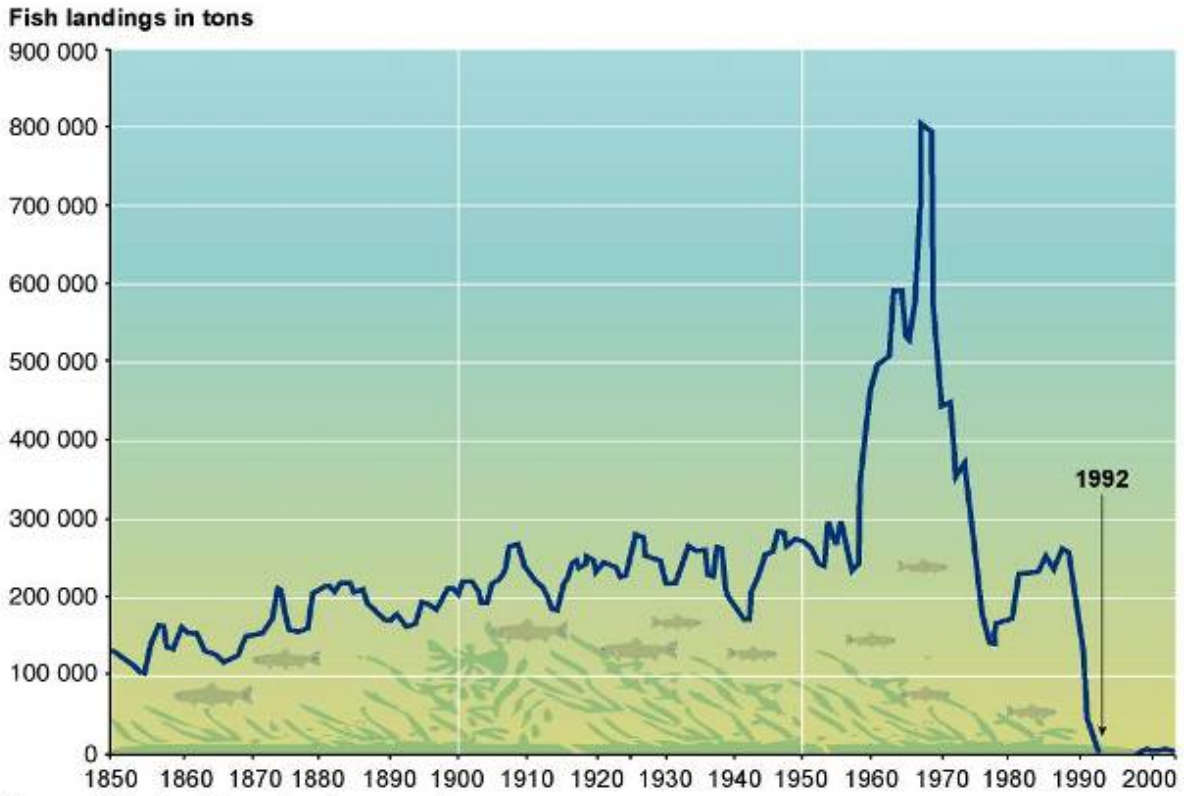
www.MAweb.org

The Oceans are Being Depleted

- Global fisheries peaked in 1980s and are now declining*
- 25% of global fisheries are significantly depleted*
- 90% of all big fish are gone**

*** UN FAO 2005**
**** Myers and Worm 2003 *Nature***
-www. MAweb.org

There is an increased likelihood of abrupt changes



Newfoundland Cod landings

www.MAweb.org

The Result:
Empty Oceans
Empty Nets

Biological Causes of Declines

1. Rate of Fishing > rate of replenishment
2. Selective catch of big old fat female fish (BOFFF) undermines replenishment
3. Unintended ecosystem impacts of fishing: habitat destruction & by-catch
4. Cumulative and interactive effects of fishing, pollution, coastal development, upstream activities, climate change

What's Down the Road?

More of the same unless underlying problems are addressed

(overfishing + coastal development + chemical and nutrient pollution + climate change)

A vision for the future:

1. Healthy seafood
2. Clean beaches
3. Stable fisheries
4. Abundant wildlife
5. Vibrant coastal communities

For now and future generations

Key recommendations to achieve vision

1. Protect and restore ecosystems
2. Improve fishery management & implement ecosystem-based management
3. Establish networks of marine reserves
4. Couple management of land and sea
5. Educate citizens
6. Invest in research and monitoring

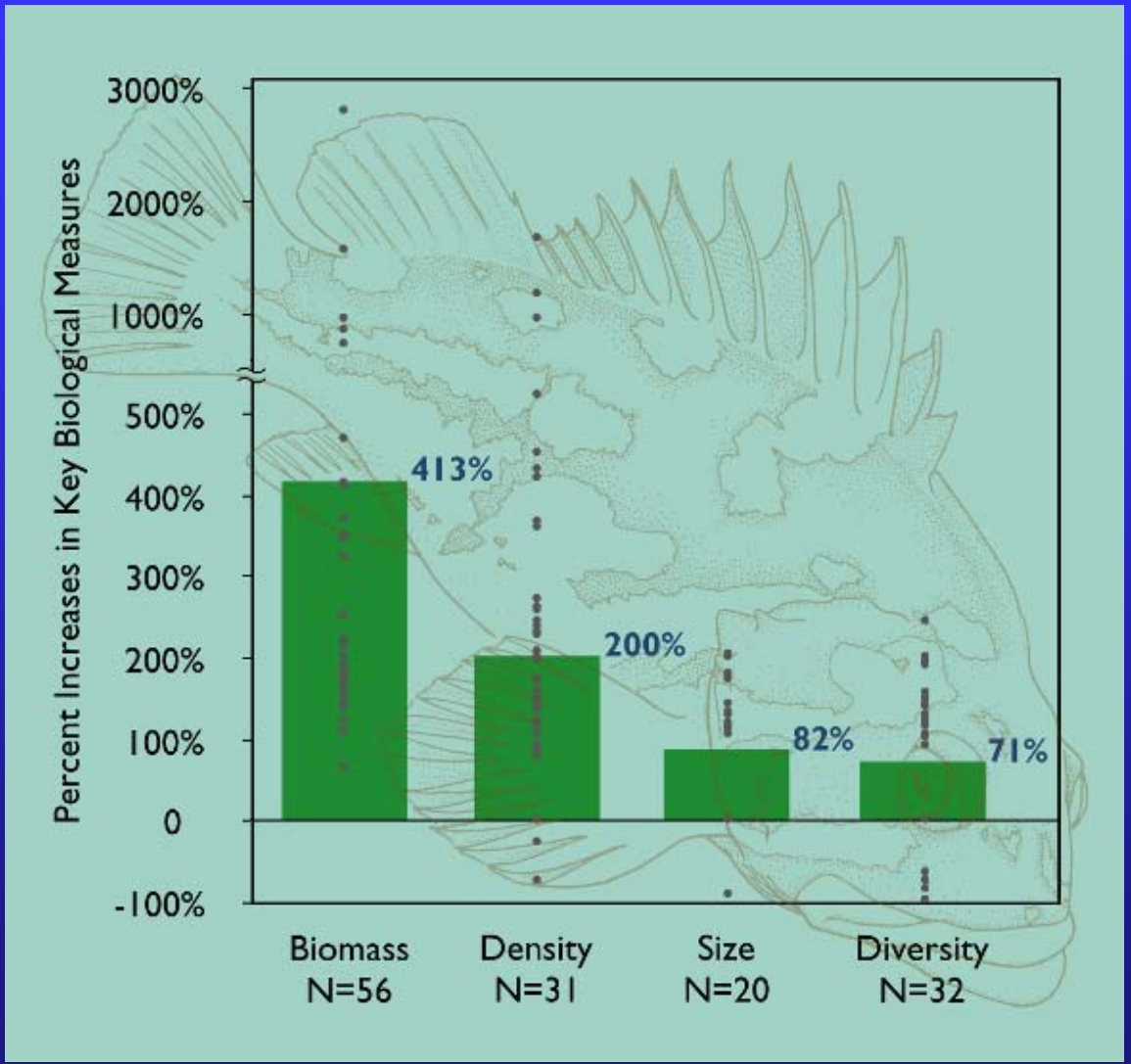
Historical Note

Until very recently, the ocean was replete with *de facto* marine reserves – areas where it was:

too far away,
too deep, or
too rocky to fish.

Now, < 1% is in reserves

Changes inside Marine Reserves:

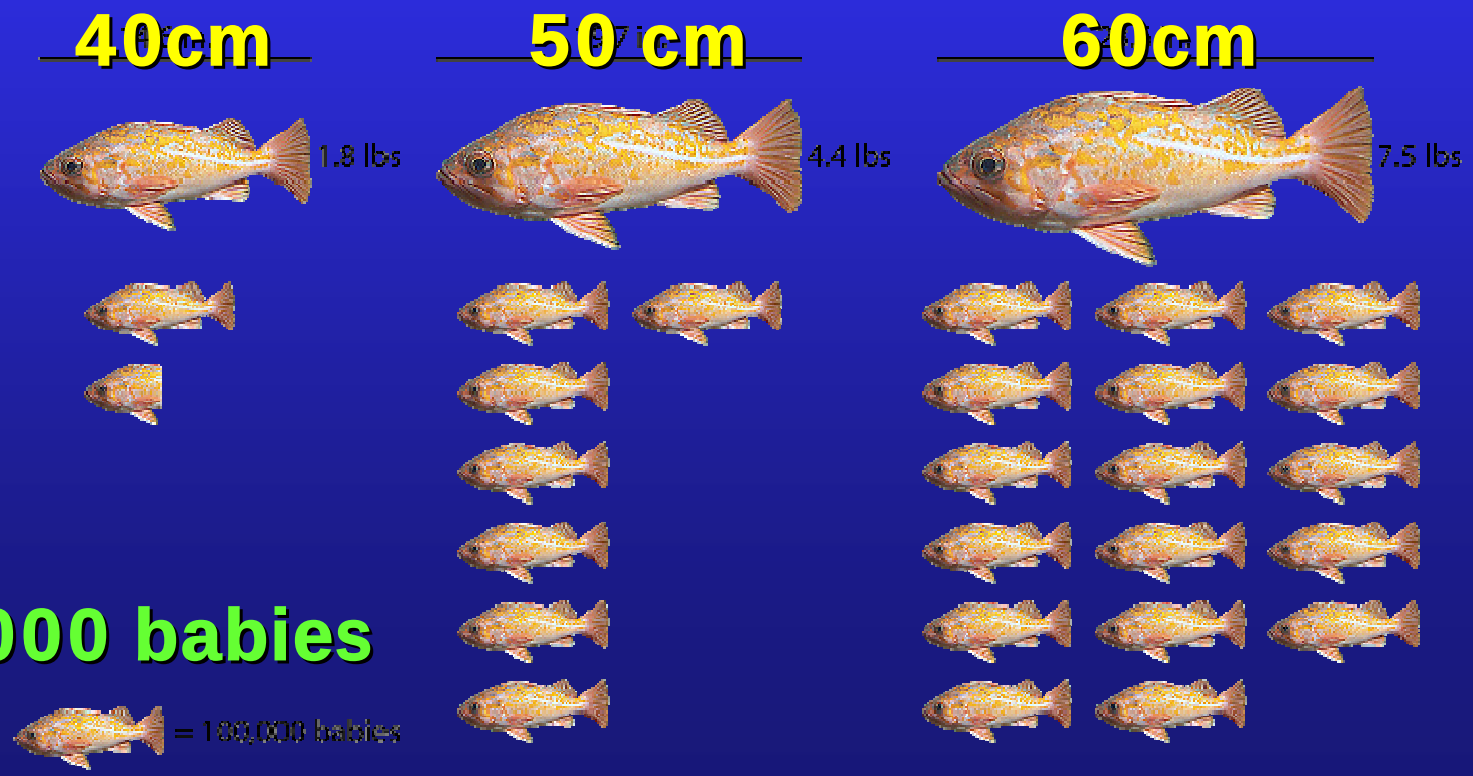


Species are more abundant, larger and more diverse inside reserves.

- From Halpern '03 and Palumbi '03

Size matters:

A 40 cm vermilion rockfish produces 150,000 young, whereas a 60cm one produces 1.7 million young



Marine Reserve Conclusions:

Potential to Benefit both Conservation & Fishery Management

1) Protect Habitats, Species and Ecosystem Functioning
2) Provide Spill over of juveniles & adults
3) Provide Export of larvae
4) Protect big old fat female fish (BOFFF)
5) Provide insurance against mismanagement or environmental changes
6) Serve as scientific reference areas

Recap: Role of science - To inform examples from oceans

1. Document changes: **depleted oceans**
2. Understand consequences:

   poverty; poor human health; economic and social disruption; political conflict

3. Develop and evaluate options:

   e.g., marine reserves = "no take" areas

Recap: Outline

1. Science and Society: A Gap
2. Bridging the Gap
3. A Case Study: the Millennium Ecosystem Assessment : Oceans
4. A New Social Contract for Science?

Recap: Bridging the Gap
Some Possible Solutions

1. Clarify role of science
2. Train scientists to communicate more effectively
3. Organize data & information to make them more useful and relevant
4. Establish ongoing credible scientific assessments
5. Increase openness in the conduct of science and opportunities for citizens to participate in meaningful ways

Society needs credible, understandable and relevant scientific data, information and knowledge.

Are we delivering?
Are we fulfilling our social contract?

- www.MAweb.org
- www.leopoldleadership.org
- www.PISCOweb.org