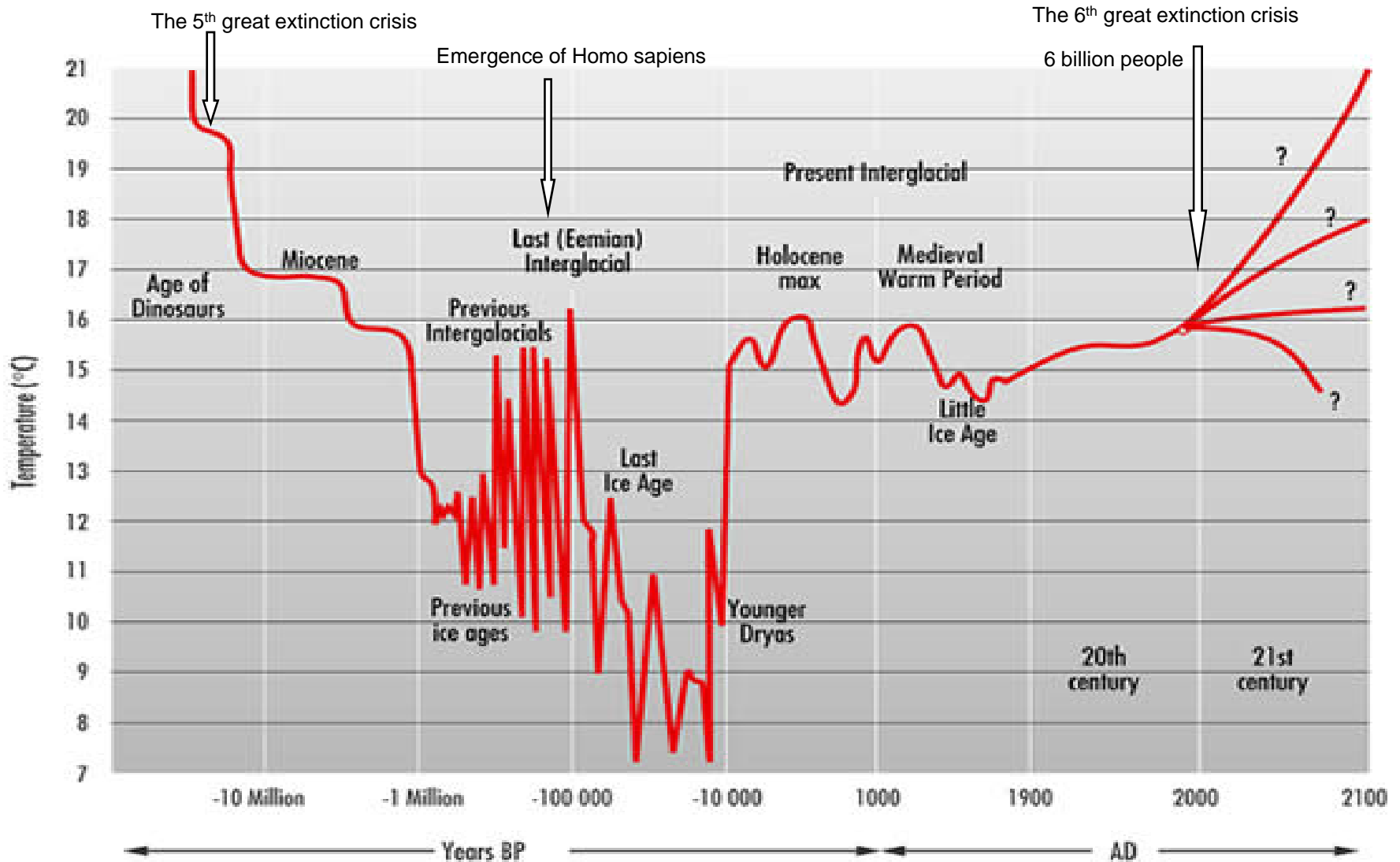




Welcome to the Anthropocene

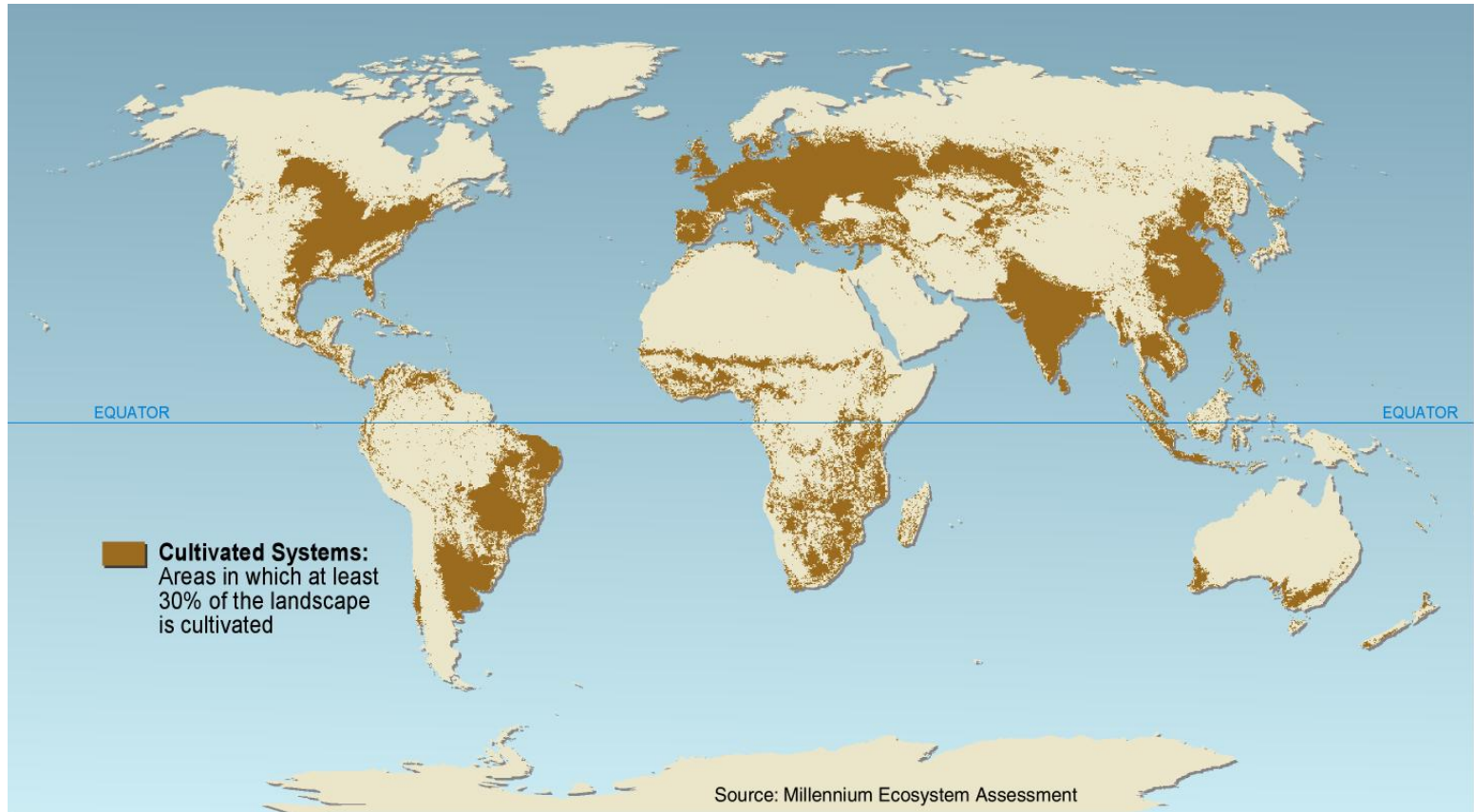
by Dr. John L. Hough
Principal Technical Advisor - Biodiversity
UNDP



Millennium Ecosystem Assessment: 2001-2005

- Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history
- This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth

More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850.

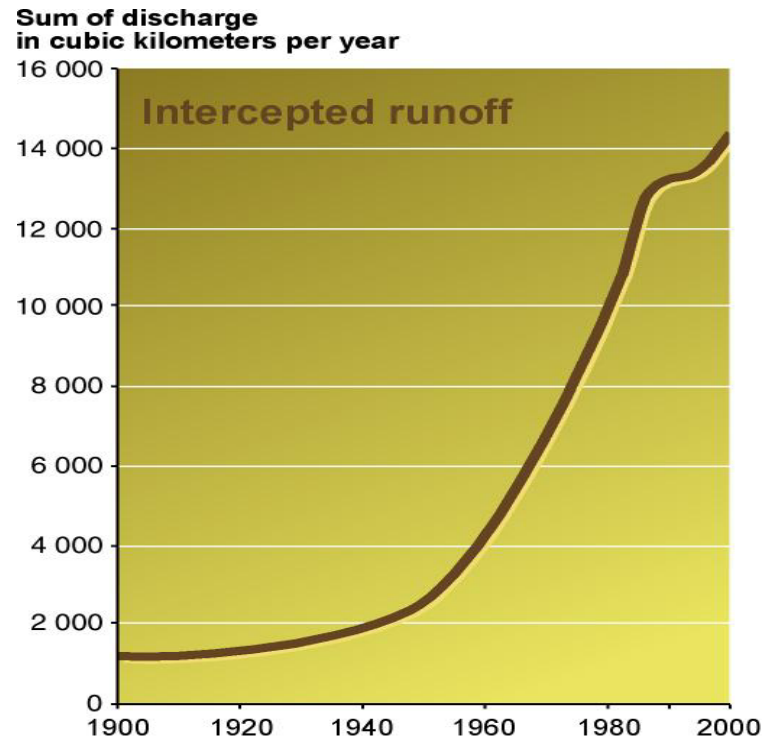


Cultivated Systems in 2000 cover 25% of Earth's terrestrial surface

(Defined as areas where at least 30% of the landscape is in croplands, shifting cultivation, confined livestock production, or freshwater aquaculture)

Unprecedented change: Ecosystems

- 20% of the world's coral reefs were lost and 20% degraded in the last several decades
- 35% of mangrove area has been lost in the last several decades
- Amount of water in reservoirs quadrupled since 1960
- Withdrawals from rivers and lakes doubled since 1960



**Intercepted Continental Runoff:
3-6 times as much water in reservoirs as
in natural rivers**

(Data from a subset of large reservoirs totaling ~65% of the global total storage)

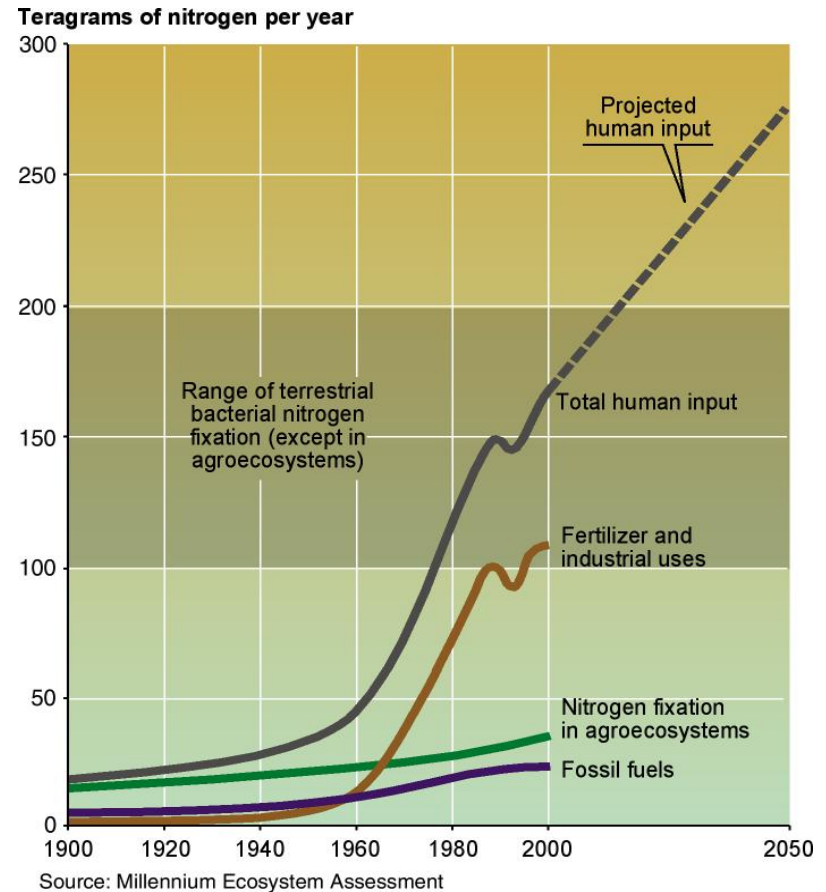
Unprecedented change: Biogeochemical Cycles

Since 1960:

- Flows of biologically available nitrogen in terrestrial ecosystems doubled
- Flows of phosphorus tripled

> 50% of all the synthetic nitrogen fertilizer ever used has been used since 1985

60% of the increase in the atmospheric concentration of CO₂ since 1750 has taken place since 1959

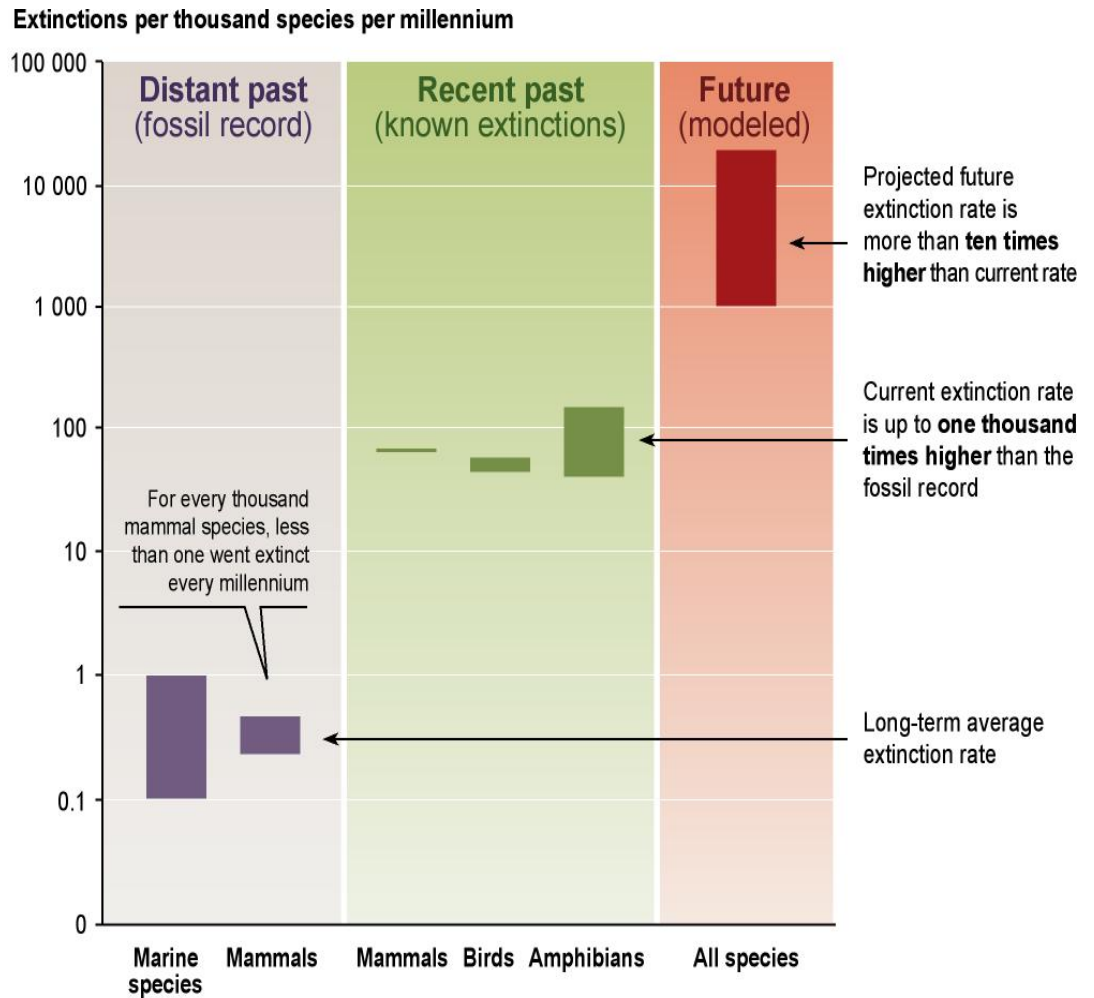


Human-produced Reactive Nitrogen

Humans produce as much biologically available N as all natural pathways and this may grow a further 65% by 2050

Significant and largely irreversible changes to species diversity

- **Humans have increased the species extinction rate by as much as 1,000 times over background rates typical over the planet's history (*medium certainty*)**
- **10–30% of mammal, bird, and amphibian species are currently threatened with extinction (*medium to high certainty*)**



Source: Millennium Ecosystem Assessment

Degradation and unsustainable use of ecosystem services

- In 2005 approximately 60% (15 out of 24) of the ecosystem services evaluated in the Millenium Ecosystem Assessment were being degraded or used unsustainably
- The degradation of ecosystem services often causes significant harm to human well-being and represents a loss of a natural asset or wealth of a country

Status of Provisioning Services

Service		Status
Food	crops	↑
	livestock	↑
	capture fisheries	↓
	aquaculture	↑
	wild foods	↓
Fiber	timber	+/-
	cotton, silk	+/-
	wood fuel	↓
Genetic resources		↓
Biochemicals, medicines		↓
Fresh water		↓

Status of Regulating and Cultural Services

	Status
Regulating Services	
Air quality regulation	↓
Climate regulation – global	↑
Climate regulation – regional and local	↓
Water regulation	+/-
Erosion regulation	↓
Water purification and waste treatment	↓
Disease regulation	+/-
Pest regulation	↓
Pollination	↓
Natural hazard regulation	↓
Cultural Services	
Spiritual and religious values	↓
Aesthetic values	↓
Recreation and ecotourism	+/-

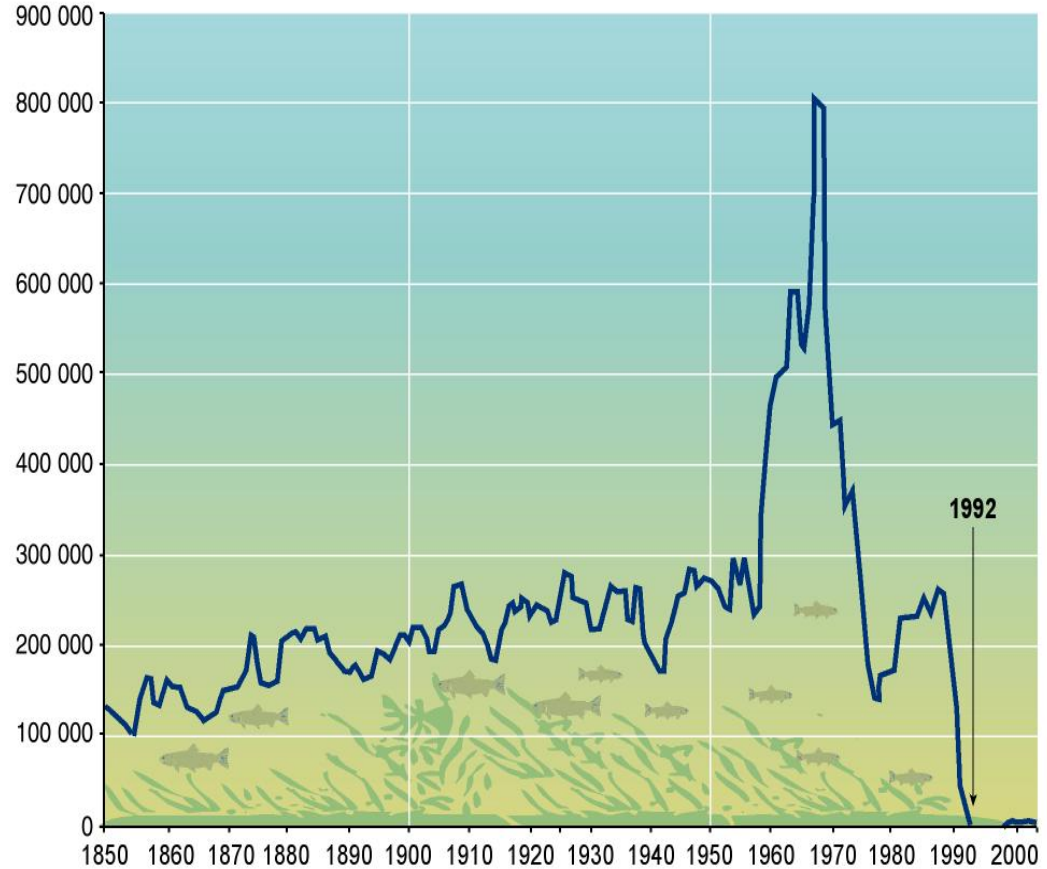
Increased likelihood of nonlinear changes

- There is *established but incomplete* evidence that changes being made in ecosystems are increasing the likelihood of nonlinear changes in ecosystems (including accelerating, abrupt, and potentially irreversible changes), with important consequences for human well-being

Fisheries collapse

- The Atlantic cod stocks off the east coast of Newfoundland collapsed in 1992, forcing the closure of the fishery
- Depleted stocks may not recover even if harvesting is significantly reduced or eliminated entirely

Fish landings in tons



Source: Millennium Ecosystem Assessment

Observed recent impacts of climate changes on ecosystems:

- **Changes in species distributions**
- **Changes in population sizes**
- **Changes in the timing of reproduction or migration events**
- **Differences in the ability of species to adapt or migrate**
- **Changes in synchronization of reproduction or migration**
- **Increase in the frequency of pest and disease outbreaks**
- **Many coral reefs have undergone major, although often partially reversible, bleaching episodes when local sea surface temperatures have increased**

Implications

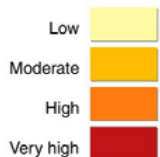
- **Changes in competitive relationships**
- **Up to 30% of today's species will go extinct**
- **“Connectivity” and “assisted migration” will make little difference**
- **New assemblages of species – ie. new ecosystems. Ecosystem Function?**

Direct drivers growing in intensity

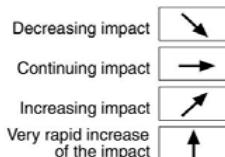
		Habitat change	Climate change	Invasive species	Over-exploitation	Pollution (nitrogen, phosphorus)
Forest	Boreal	↗	↑	↗	→	↑
	Temperate	↘	↑	↑	→	↑
	Tropical	↑	↑	↑	↗	↑
Dryland	Temperate grassland	↗	↑	→	→	↑
	Mediterranean	↗	↑	↑	→	↑
	Tropical grassland and savanna	↗	↑	↑	↘	↑
	Desert	→	↑	→	→	↑
Inland water		↑	↑	↑	→	↑
Coastal		↗	↑	↗	↗	↑
Marine		↑	↑	→	↗	↑
Island		→	↑	↘	→	↑
Mountain		→	↑	→	→	↑
Polar		↗	↑	→	↗	↑

Most direct drivers of degradation in ecosystem services remain constant or are growing in intensity in most ecosystems

Driver's impact on biodiversity over the last century



Driver's current trends



Source: Millennium Ecosystem Assessment

Changes in direct drivers: Climate Change

Potential future impacts

- By the end of the century, climate change and its impacts may be the dominant direct driver of biodiversity loss and changes in ecosystem services globally
- Harm to biodiversity will grow worldwide with increasing rates of change in climate and increasing absolute amounts of change
- Some ecosystem services in some regions may initially be enhanced by projected changes in climate. As climate change becomes more severe the harmful impacts outweigh the benefits in most regions of the world

Net harmful impact on ecosystem services

- The balance of scientific evidence suggests that there will be a significant net harmful impact on ecosystem services worldwide if global mean surface temperature increases more than 2° C above preindustrial levels (*medium certainty*). This would require CO₂ stabilization at less than 450 ppm.

Projected Impacts of Climate Change

Global temperature change (relative to pre-industrial)

0°C 1°C 2°C 3°C 4°C 5°C

Food

Falling crop yields in many areas, particularly developing regions

Possible rising yields in some high latitude regions

Falling yields in many developed regions

Water

Small mountain glaciers disappear – water supplies threatened in several areas

Significant decreases in water availability in many areas, including Mediterranean and Southern Africa

Sea level rise threatens major cities

Ecosystems

Extensive Damage to Coral Reefs

Rising number of species face extinction

Extreme Weather Events

Rising intensity of storms, forest fires, droughts, flooding and heat waves

Risk of Abrupt and Major Irreversible Changes

Increasing risk of dangerous feedbacks and abrupt, large-scale shifts in the climate system

Impacts of Climate Change

Health Impact

Food & Agriculture

Impacts on Forestry

Water Resources

Impact on Coastal Zones

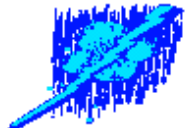
Biodiversity



•Temperature

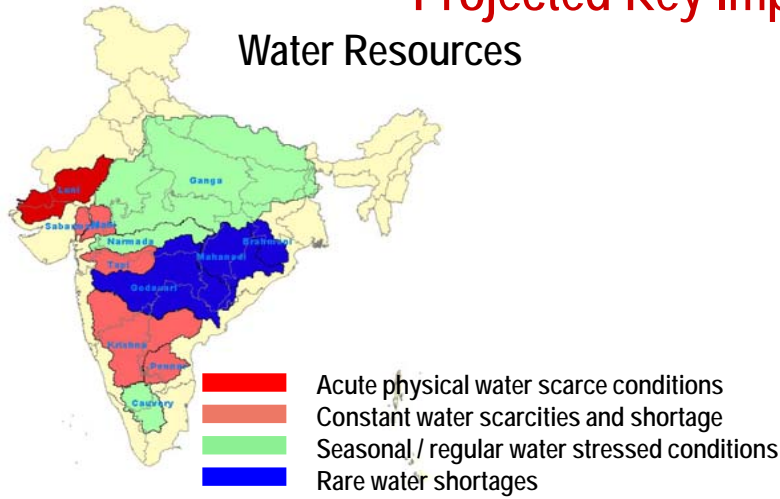
•Rainfall

•Rise of Sea Level

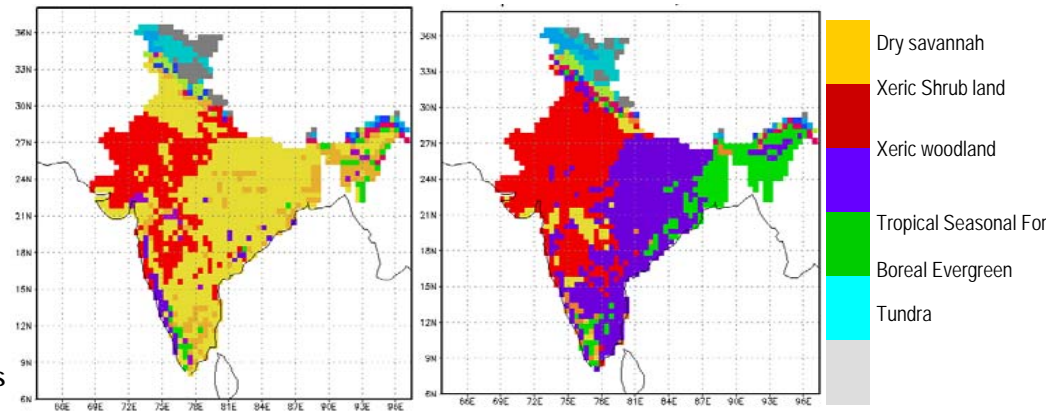


Projected Key Impacts

Water Resources



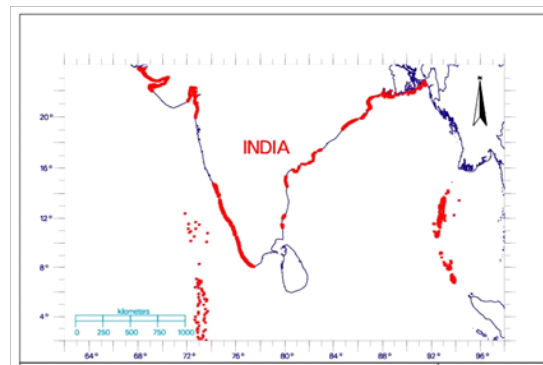
Forestry



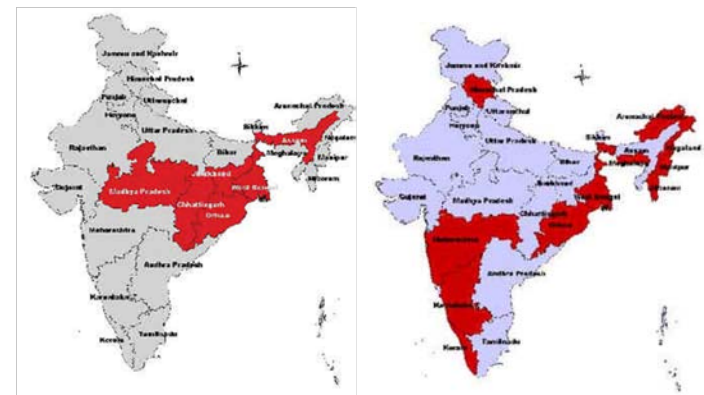
Agriculture



Coastal Zones



Human Health



Endemic regions of malaria

Regions likely to be affected by malaria in 2050s

Level of poverty remains high and inequities are growing

Economics and Human Development

- 1.1 billion people surviving on less than \$1 per day of income. 70% in rural areas where they are highly dependent on ecosystem services
- Inequality has increased over the past decade. During the 1990s, 21 countries experienced declines in their rankings in the Human Development Index

Access to Ecosystem Services

- An estimated 852 million people were undernourished in 2000–02, up 37 million from the period 1997–99
- Per capita food production has declined in sub-Saharan Africa
- Some 1.1 billion people still lack access to improved water supply, and more than 2.6 billion lack access to improved sanitation
- Water scarcity affects roughly 1–2 billion people worldwide

Ecosystem services and poverty reduction

Degradation of ecosystem services harms poor people

- Half the urban population in Africa, Asia, Latin America, and the Caribbean suffers from one or more diseases associated with inadequate water and sanitation
- The declining state of capture fisheries is reducing an inexpensive source of protein in developing countries. Per capita fish consumption in developing countries, excluding China, declined between 1985 and 1997
- Desertification affects the livelihoods of millions of people, including a large portion of the poor in drylands

Ecosystem services and poverty reduction

- Many changes in ecosystem management have involved the privatization of what were formerly common pool resources often harming individuals who depended on those resources
- Some of the people affected by changes in ecosystem services are highly vulnerable
- Significant differences between the roles and rights of men and women in developing countries lead to increased vulnerability of women to changes in ecosystem services
- The reliance of the rural poor on ecosystem services is rarely measured and thus typically overlooked in national statistics and poverty assessments



1

**ERADICATE
EXTREME POVERTY
AND HUNGER**



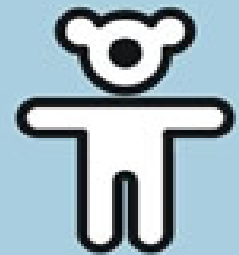
2

**ACHIEVE UNIVERSAL
PRIMARY EDUCATION**



3

**PROMOTE GENDER
EQUALITY AND
EMPOWER WOMEN**



4

**REDUCE
CHILD MORTALITY**

The Millennium Development Goals



5

**IMPROVE MATERNAL
HEALTH**



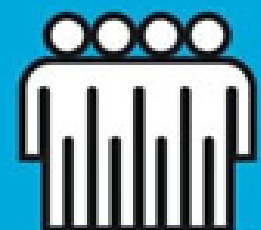
6

**COMBAT HIV/AIDS,
MALARIA AND OTHER
DISEASES**



7

**ENSURE
ENVIRONMENTAL
SUSTAINABILITY**

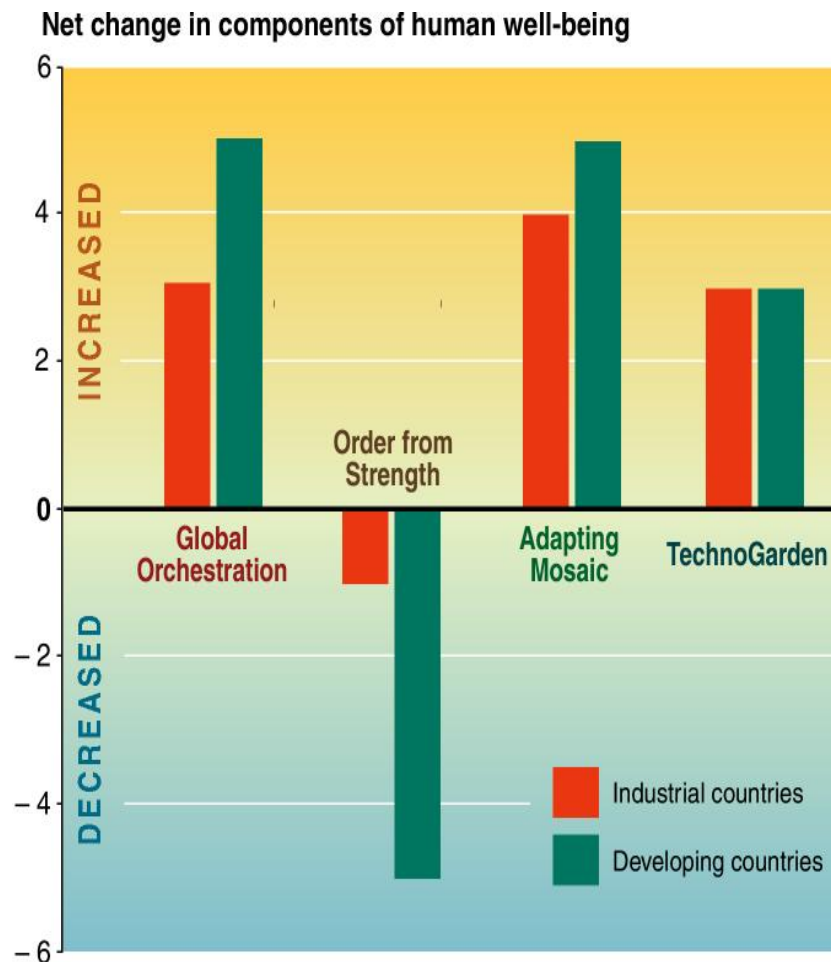


8

**GLOBAL
PARTNERSHIP FOR
DEVELOPMENT**

Changes in human well-being under MA scenarios

- In three of the four MA scenarios, between three and five of the components of well-being (material needs, health, security, social relations, freedom) improve between 2000 and 2050
- In one scenario (*Order from Strength*) conditions are projected to decline, particularly in developing countries



Source: Millennium Ecosystem Assessment

Scenario Storylines



- **Global Orchestration** Globally connected society that focuses on global trade and economic liberalization and takes a reactive approach to ecosystem problems but that also takes strong steps to reduce poverty and inequality and to invest in public goods such as infrastructure and education.



- **Order from Strength** Regionalized and fragmented world, concerned with security and protection, emphasizing primarily regional markets, paying little attention to public goods, and taking a reactive approach to ecosystem problems.

Scenario Storylines



- **Adapting Mosaic** Regional watershed-scale ecosystems are the focus of political and economic activity. Local institutions are strengthened and local ecosystem management strategies are common; societies develop a strongly proactive approach to the management of ecosystems.



- **TechnoGarden** Globally connected world relying strongly on environmentally sound technology, using highly managed, often engineered, ecosystems to deliver ecosystem services, and taking a proactive approach to the management of ecosystems in an effort to avoid problems.

3 themes

- **Disaster Prevention, Relief and Recovery;**
- **Food resources, Diet and Nutrition; and**
- **Emerging Infectious Diseases.**

Things to Consider:

- **Not species, not ecosystem services, but ecosystem function**
- **Who pays and who benefits?**
- **Not just the short term issues, but the longer term pathways towards sustainable development – policy and management (governance)**



Welcome to the Anthropocene !