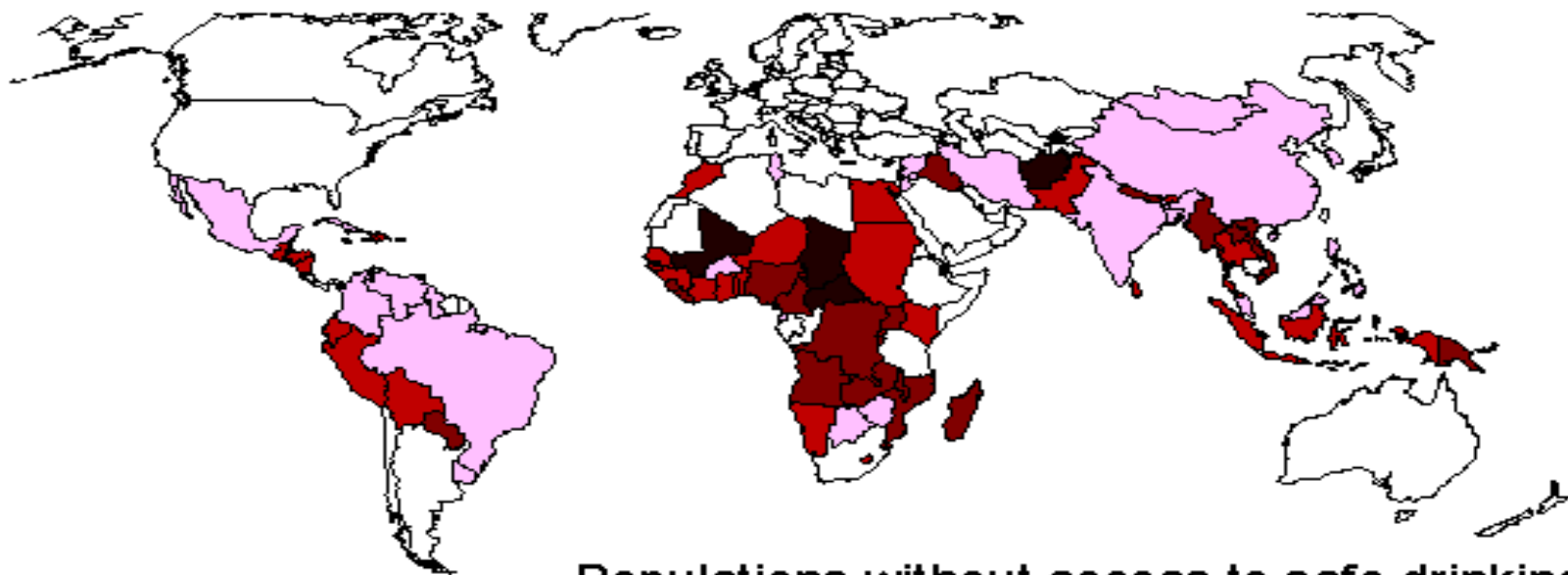
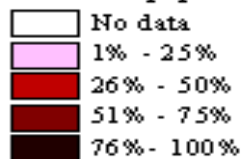


Global Water Problems

- Water and sustainable development
- International marine resources
- Water and international conflict
- Global warming



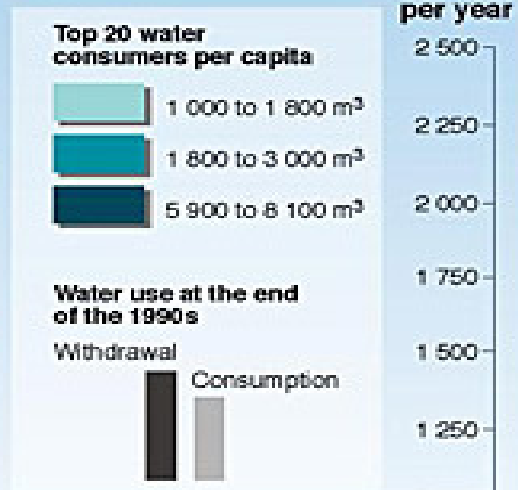
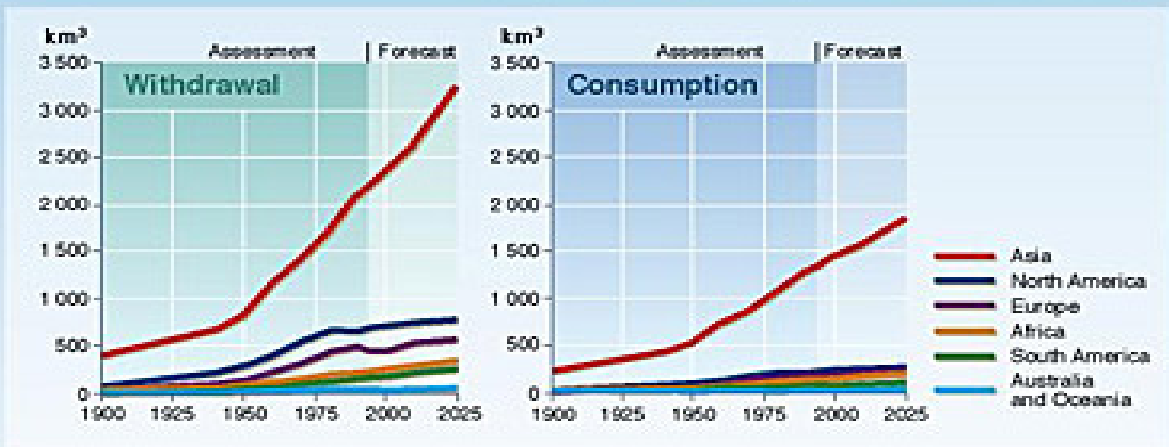
Percent of population without access



Populations without access to safe drinking water

*from The World's Water
The Biennial Report on Freshwater Resources
(Gleick 1998)*

Global Water Withdrawal and Consumption

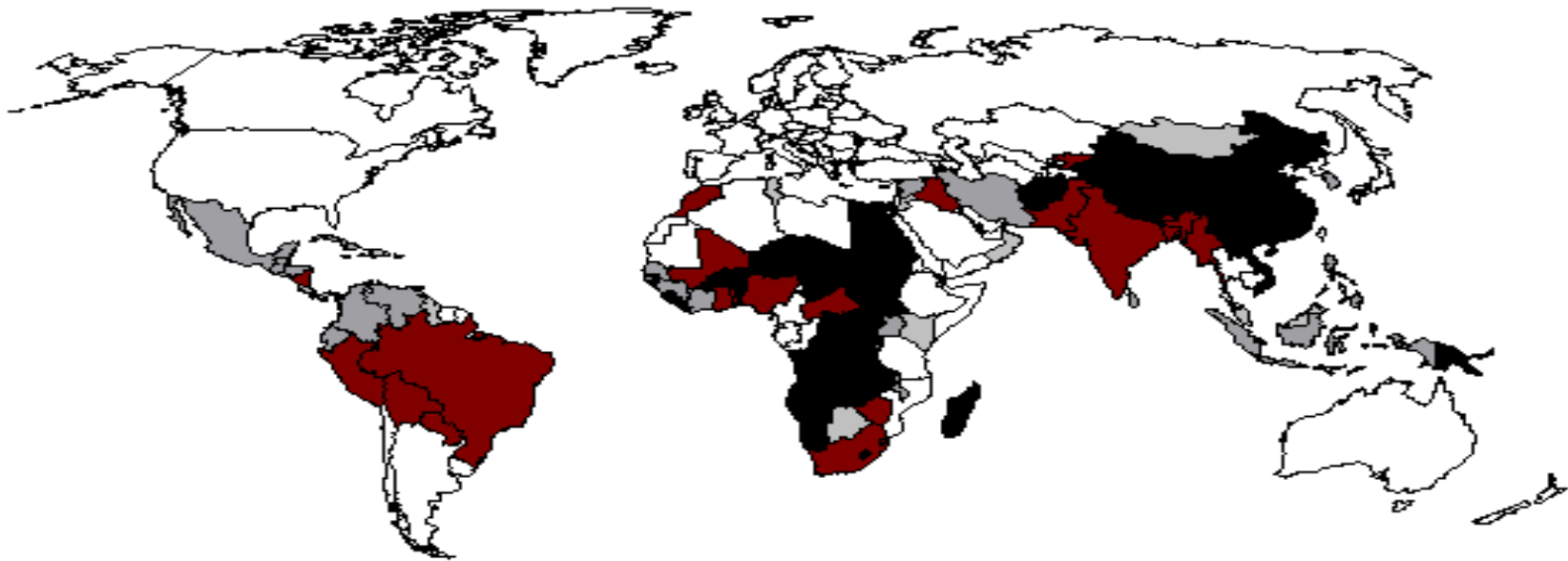


PHILIPPE REAUDEWICZ, MARCH 2002

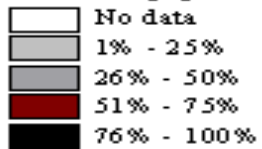
Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999; World Resources 2000-2001, People and Ecosystems: The Fraying Web of Life, World Resources Institute (WRI), Washington DC, 2000; Paul Harrison and Fred Pearce, AAAS Atlas of Population 2001, American Association for the Advancement of Science, University of California Press, Berkeley.

Sanitation Access

Populations Without Access to Sanitation Services, 1994



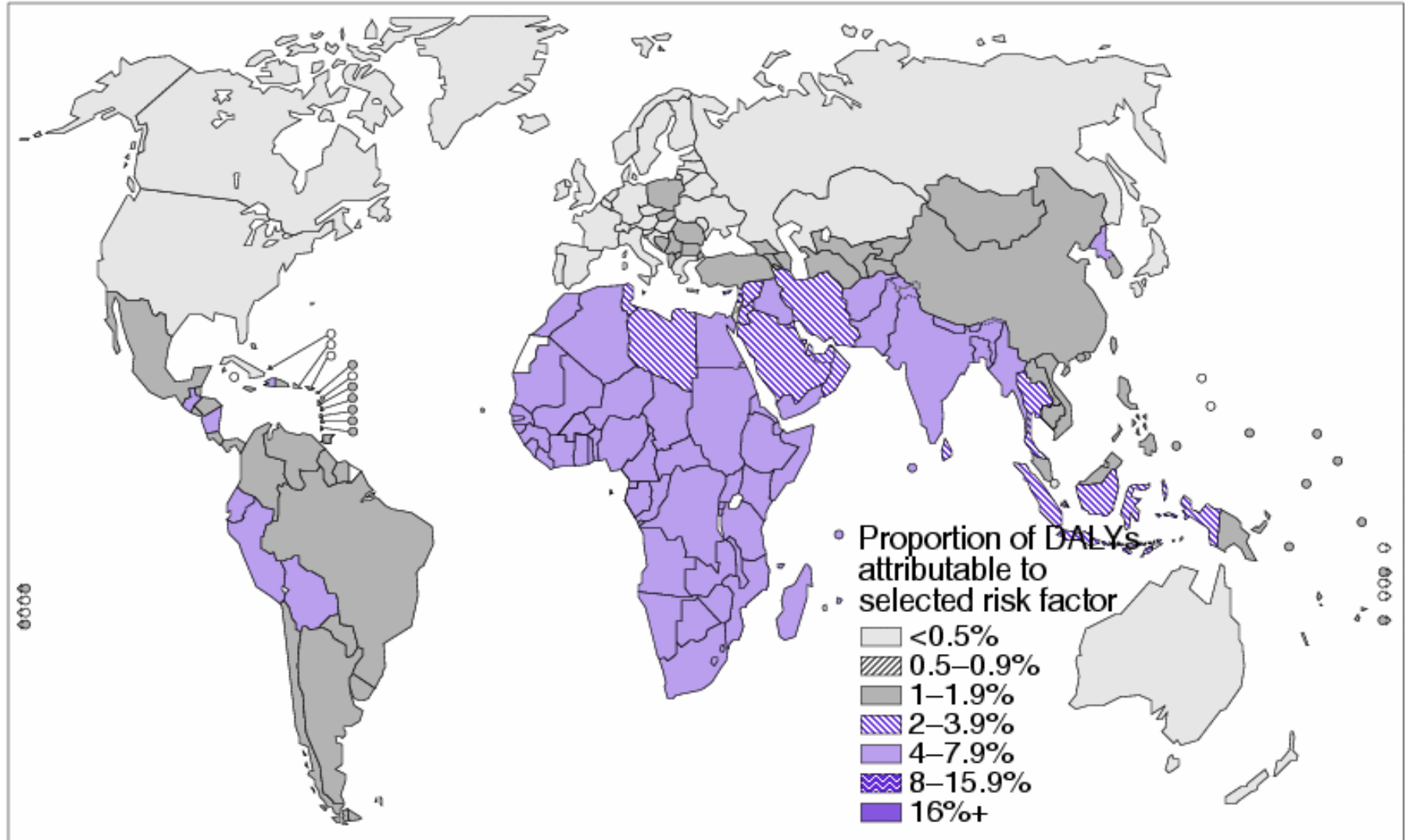
Percent of populations without access



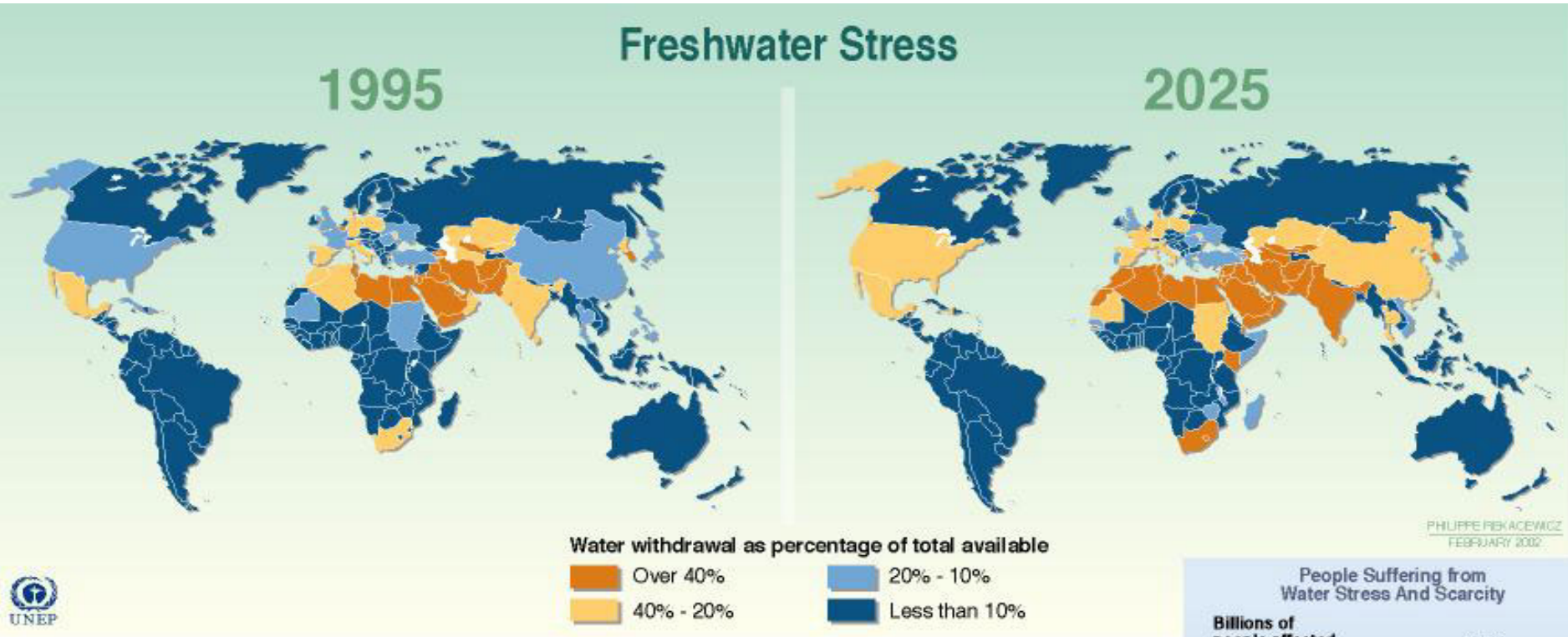
Gleick 1998

Figure 4 Burden of disease attributable to selected environmental risk
(% DALYs in each subregion)

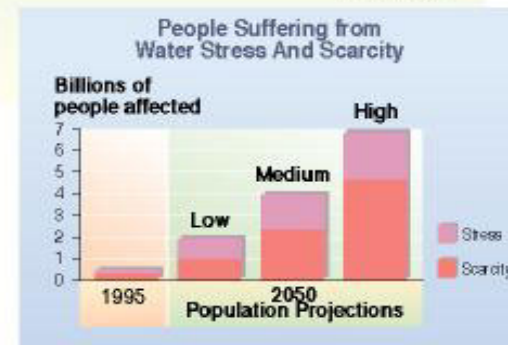
A. Unsafe water



% Supply Withdrawn



Source: World Meteorological Organisation (WMO), Geneva, 1996; Global Environment Outlook 2000 (GEO), UNEP, Earthscan, London, 1999.



World Water Council Vision

Principles for Future—Towards Solving Global Problems

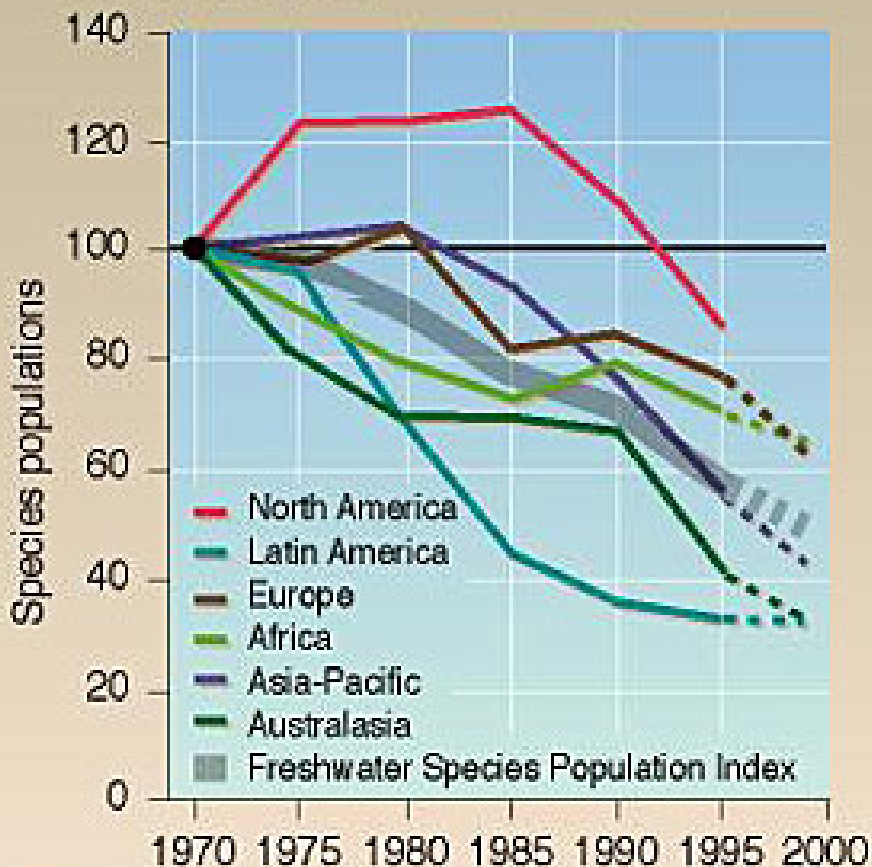
- Accurate assessment of temporal and spatial distribution of freshwater
- Integrated (Collaborative!) water management to alleviate fragmentation
- Accurate measurement of economic value of water
- Developing common vision among global stakeholders
- Ensuring representation of disadvantaged stakeholders in international forums
- Consideration of ecosystem functions

The “Soft Path” for Water Development (Peter Gleick)

- The “hard” path: Centralized infrastructure and agencies deliver potable water and treat wastewater
- The “soft” path: Complements centralized structure with investment in decentralized facilities, efficient technology, human capital
 1. Focus on how water is used, not just amounts (efficiency)
 2. Different water qualities for different uses
 3. Decentralized infrastructure supported by human capital
 4. Water agencies engage community groups
 5. Water users care about services provided by healthy ecosystems
 6. Take into account economies of joint decision-making (e.g., conjunctive use)

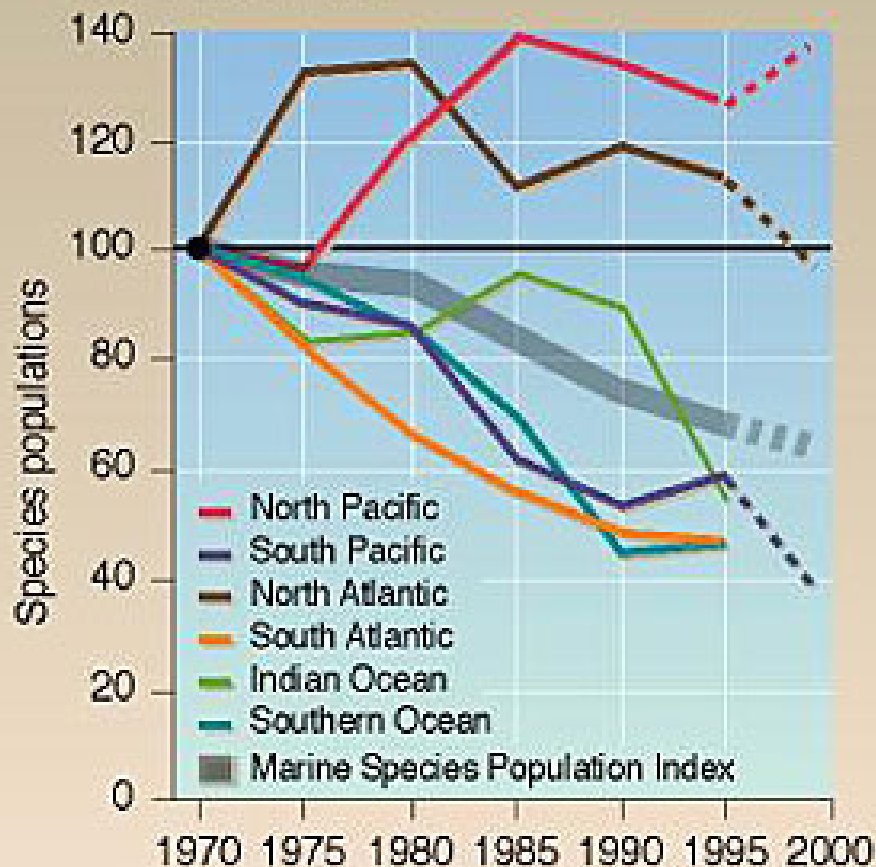
Changes in Freshwater Species Populations

Indices 1970-1999



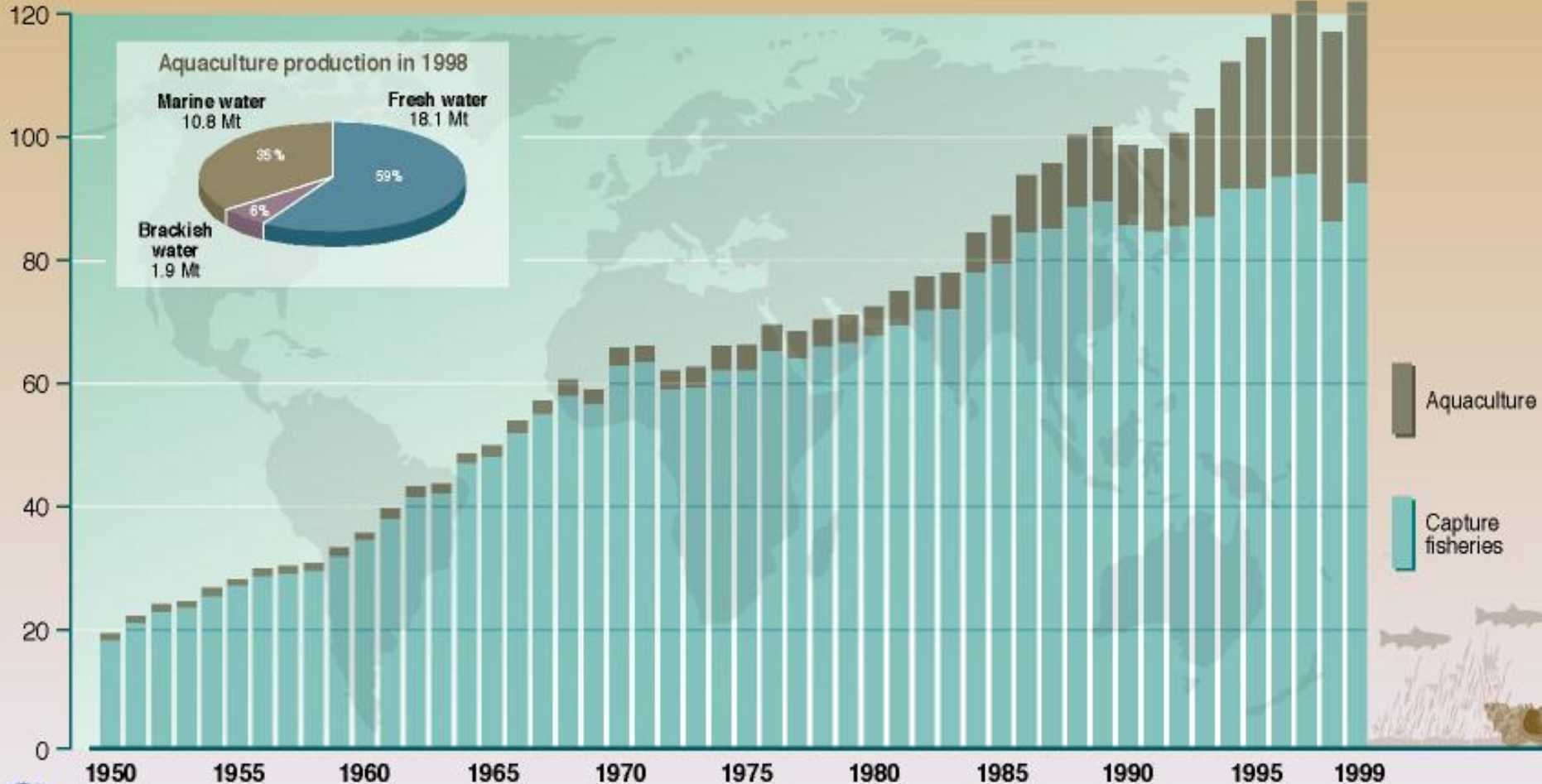
Changes in Marine Species Populations

Indices 1970-1999



Global Capture Fisheries and Aquaculture Production, 1950-1999

Million tonnes (Mt)

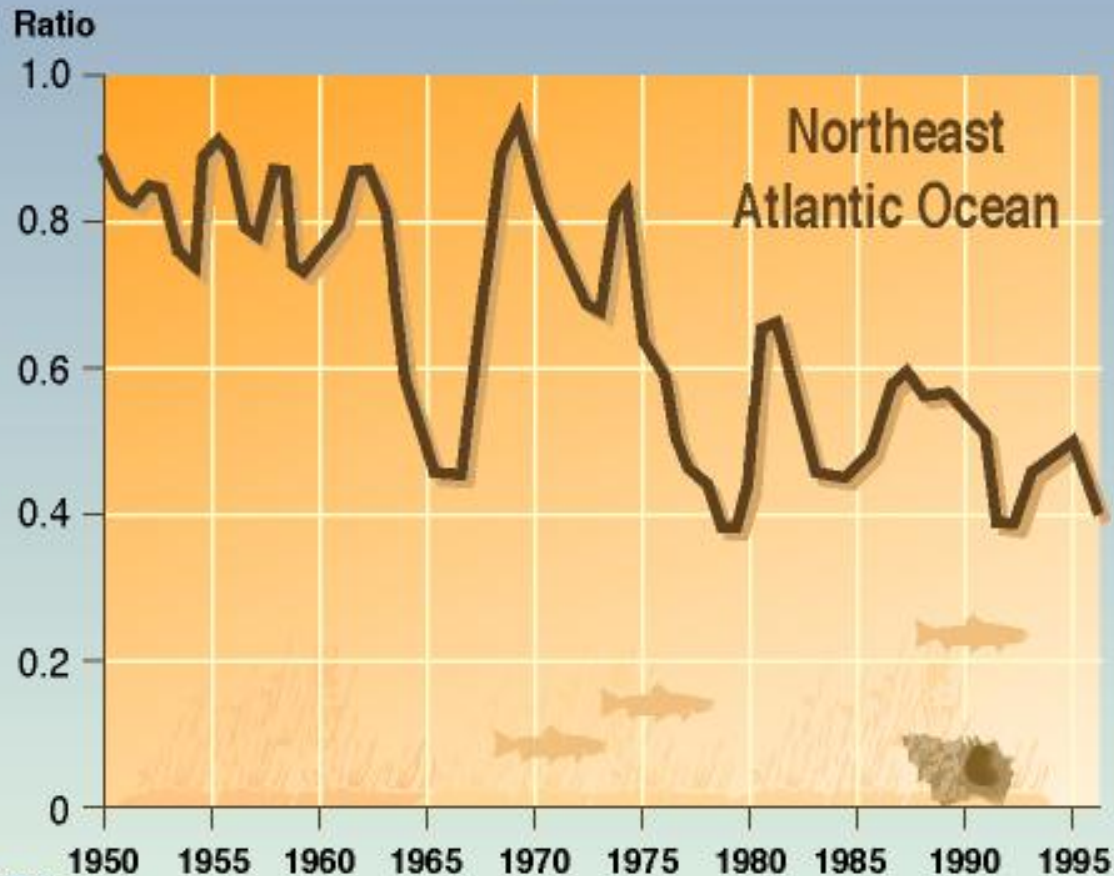


PHILIPPE REKACEWICZ
FEBRUARY 2002

Source: *The State of World Fisheries and Aquaculture 2000*, Food and Agriculture Organisation of the United Nations (FAO).

Changes in Catch Ratios of Predatory and Plankton Feeding Fish

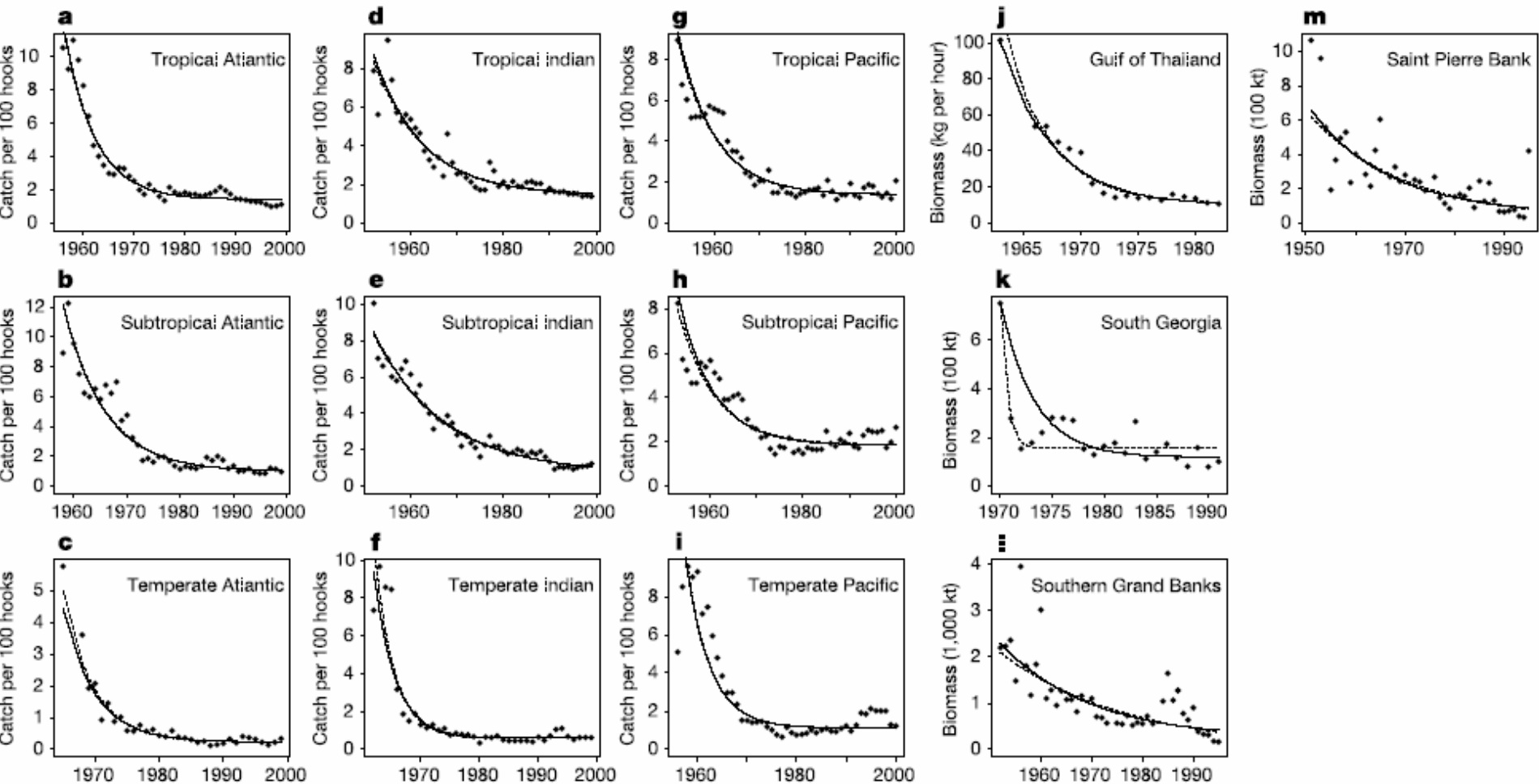
indicating structural changes in the marine ecosystem

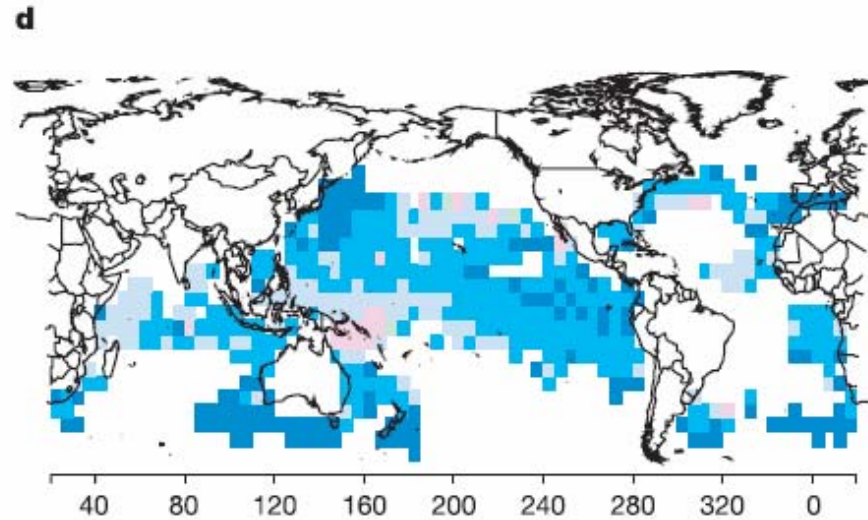
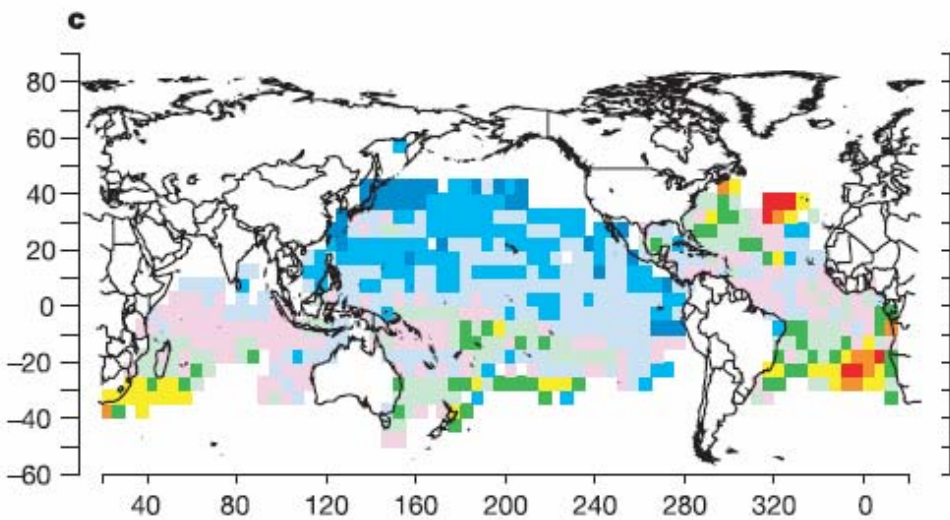
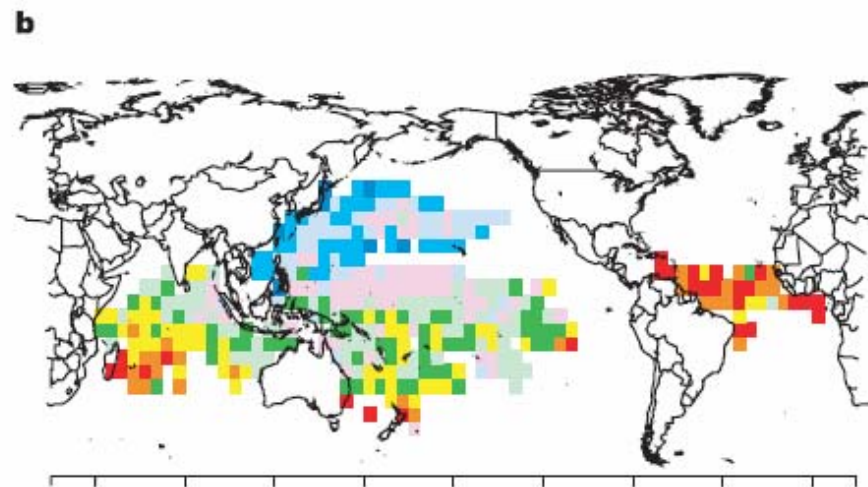
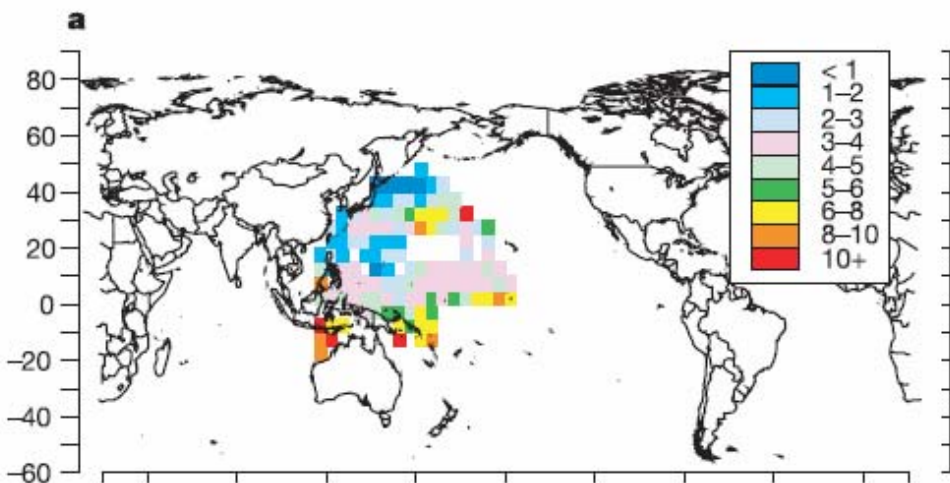


PHILIPPE REKAOEWICZ
FEBRUARY 2002

Source: John F. Caddy and Luca Garibaldi, *Apparent Changes in the Trophic Composition of Marine Harvests: the Perspective from the FAO Capture Database*, *Ocean and Coastal Management* 43(8-9), 2000.

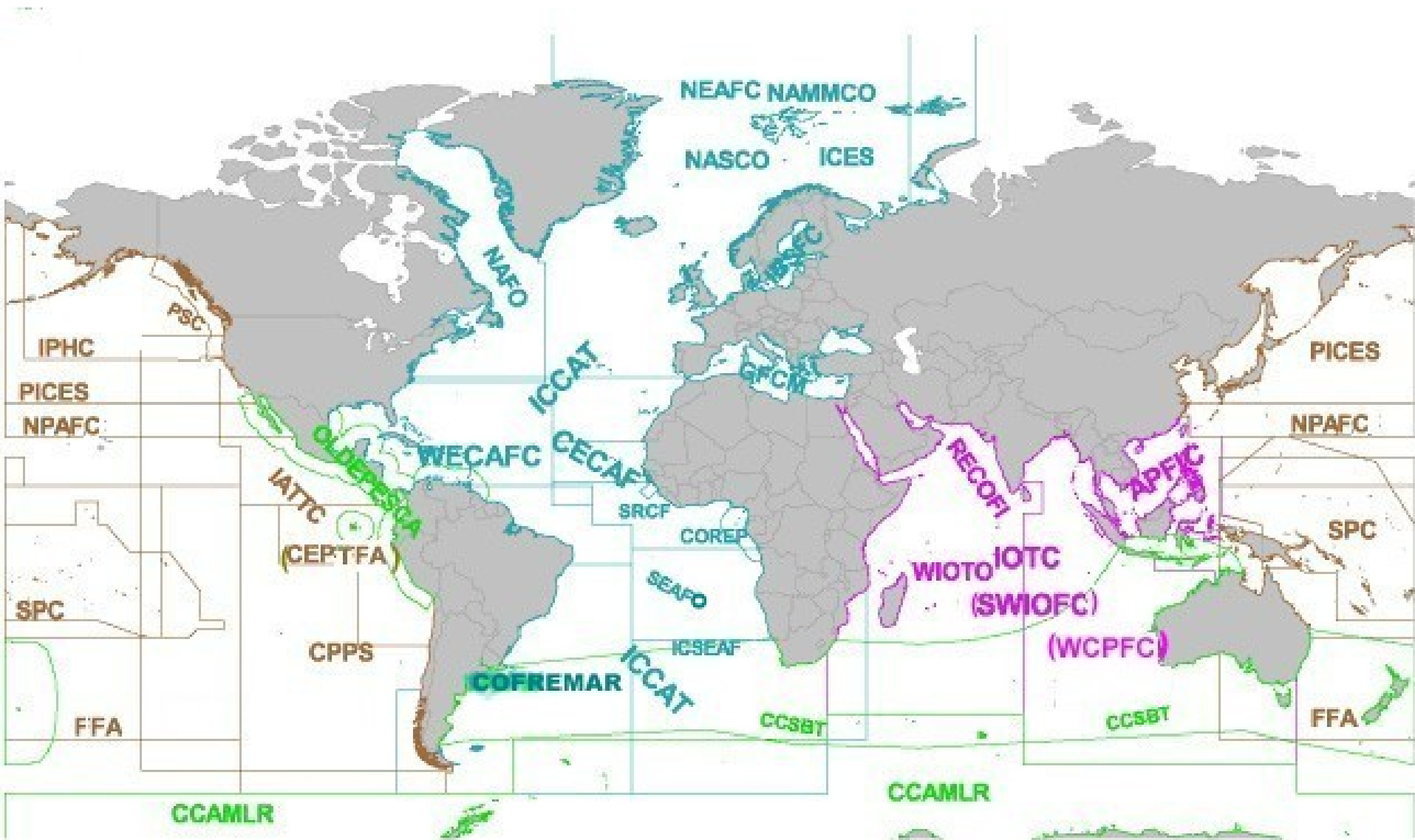
Global Ocean has lost 90% of Predatory Fish Biomass





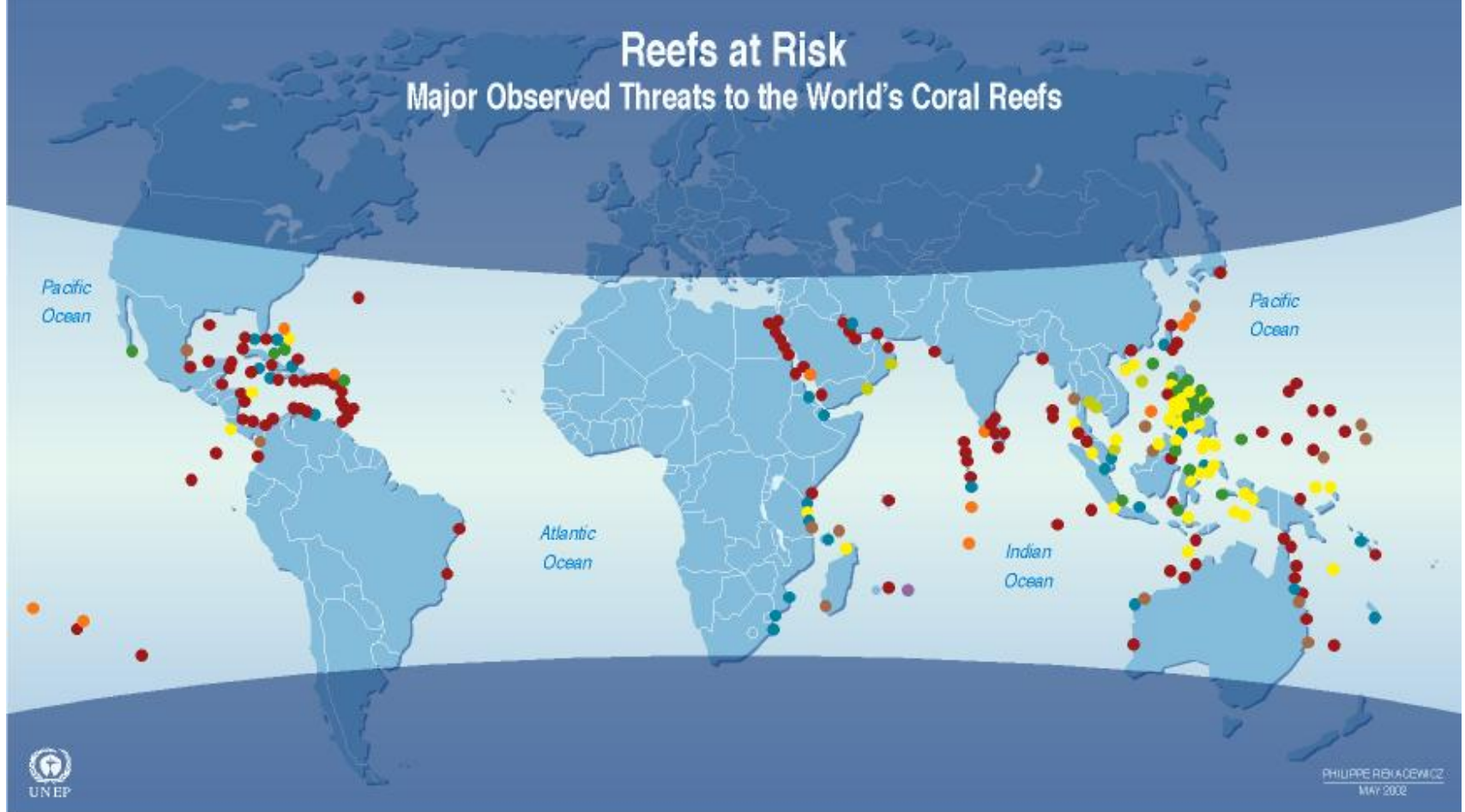
Longitude

International Fishing Agreements



Reefs at Risk

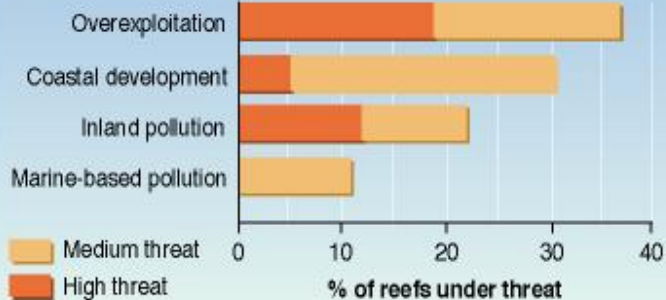
Major Observed Threats to the World's Coral Reefs



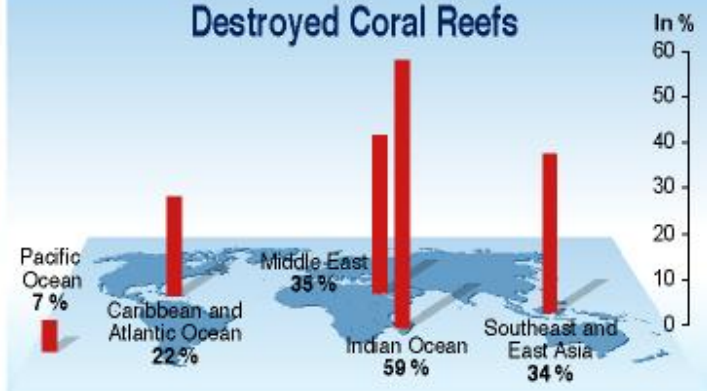
Categories

- Tourism
- Poison fishing
- Overexploitation
- Sedimentation
- Coral harvesting
- Dynamite fishing
- Pollution

Major Threats to Reefs



Destroyed Coral Reefs



Source: Bryant et al., *Reefs at Risk; a Map-Based Indicator of Threats to the World's Coral Reefs*, World Resources Institute (WRI), Washington DC, 1998.

Arguments for Water War

Water as Source of Conflict

- Water is vital resource for national economy and biology
- Water scarcity and unequal distribution leads to political pressures to secure water
- Water ignores national boundaries and organizational concepts
- Missing link between water quality and quantity decisions
- Lack of specificity in water rights allocations
- Poorly developed, contradictory, and unenforceable sets of international laws
- International law generally focuses on nation-states; not lower political units or ethnic groups

Water Wars in the Future?

- Increasing populations
- Increasing water scarcity and uses
- Global environmental change
- Will water generate more armed conflict?

Water Wars are Frequent (Gleick)

Water and National Security

- Water and water-supply systems have been the cause and instruments of war
- Threats to security include resource problems that reduce quality of life and increase tensions within a country

Factors that Increase Likelihood of Water War

- Scarcity (ratio of water demand to available supply—index highest in Middle East)
- Number of sharing nations (% of water supply outside borders)
- Power differentials between states
- Reliance on hydroelectric power (creates economic dependence)
- Availability of alternative water supplies
- Lack of water for developing countries (destabilization)

Water Wars are Infrequent (Wolf)

Little Conflict

- Armed conflict over water very rare (7/412 conflicts between 1918-94)
- Appears most evident in Arab-Israeli conflicts
- But author claims causal influence of water not clear even in those
- Most incidents of water-related violence appear at subnational level (e.g., between states and cities, between different types of water users)
- Realize that database does not include navigation issues; navigation issues have had more conflict

Prevalent Cooperation

- In contrast, since 805 AD, 3600 treaties have been signed regarding water (1984 FAO data)
- 150 in 20th century alone; majority deal with water supply and hydropower
- Authors argue that most treaties are in infancy: 46% have no monitoring, 80% have no enforcement; 63% do not clearly define water rights

Why Few Water Wars?

Strategic Interests

- Strategic situation favoring a water war is rare
- Author argues water war requires a “downstream hegemon”; no democracies in conflict
- The small percentage of watersheds featuring this strategic situation have ongoing negotiations/treaties
- Even when water is a major issue, the cost of war may be too high; resources better spent on acquiring new sources of water rather than fighting

Shared Interests

- Treaties generally show sensitivity to shared interests (CPR!) and reflect details of watershed
- E.g., upstream hydropower and downstream flood control

Institutional Resiliency

- Treaties that are established are very resilient
- Many water supply treaties and negotiation forums survive even through conflicts over other issues



Lessons from the Rhine: What Makes International Cooperation Work?

Voluntary Cooperation Among Riparian States

- Free navigation on Rhine River, supported by 1815 Commission on Rhine River
- Post-WWII Negotiation of water rights to Rhine between France/Germany

Pay Attention to Multiple River-Uses and Coastal Resources

- Salmon fishery on Rhine is gone
- Too much attention paid to water supply and hydropower issues

Mutual Trust and International Institutions

- 1950: Riparian states create International Commission for Protection of the Rhine Against Pollution
- 1963: Convention on the Rhine
- Mutual distrust lead to water quality crisis in early 70s, and resulting negotiations were costly

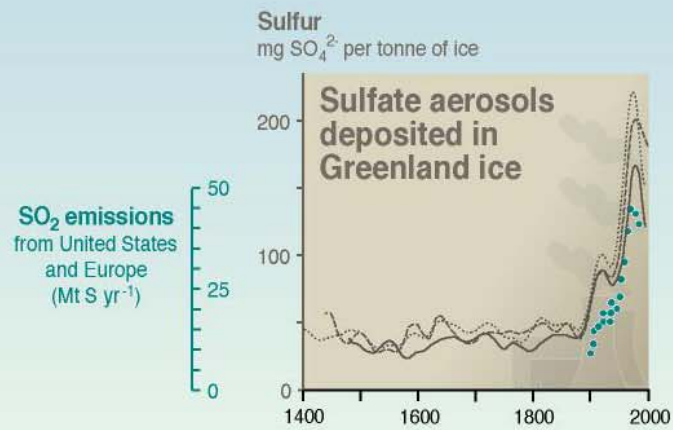
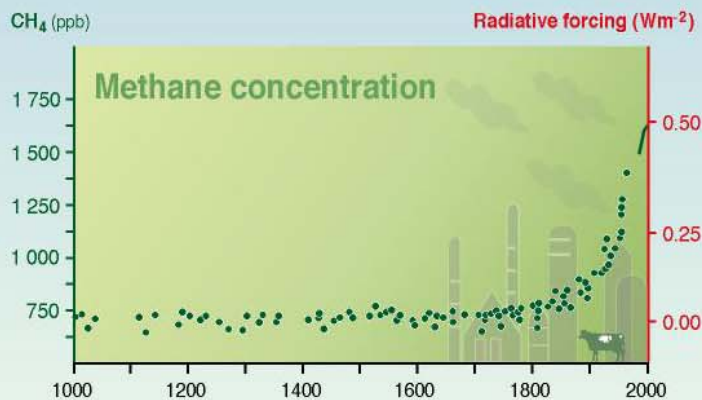
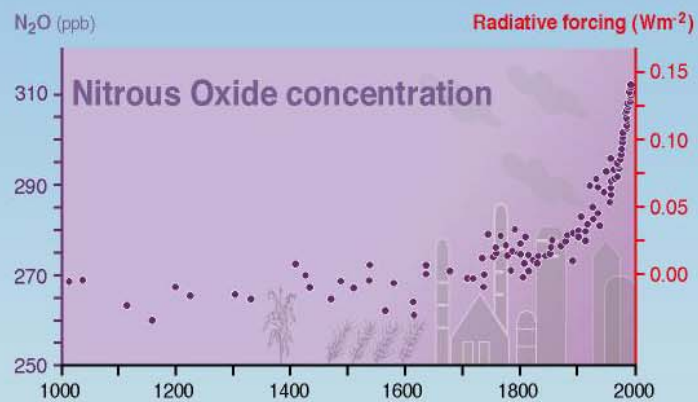
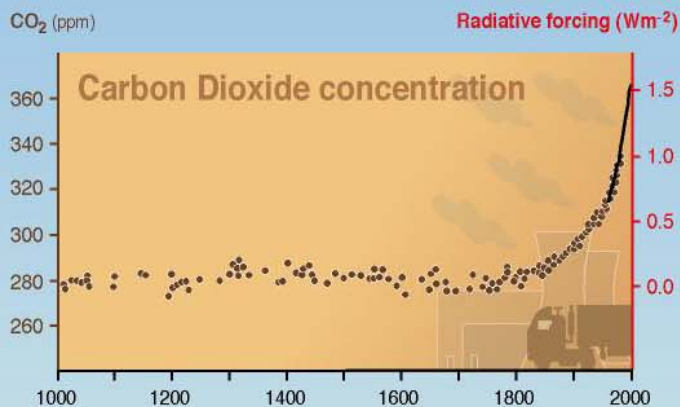
Disasters Catalyze Cooperation

- Fire (1986) in Swiss chemical factory leads creation of “Rhine Action Programme”; included broad ecological goals (salmon restoration)

Common Monitoring Framework: Regularize Data Collection Protocols

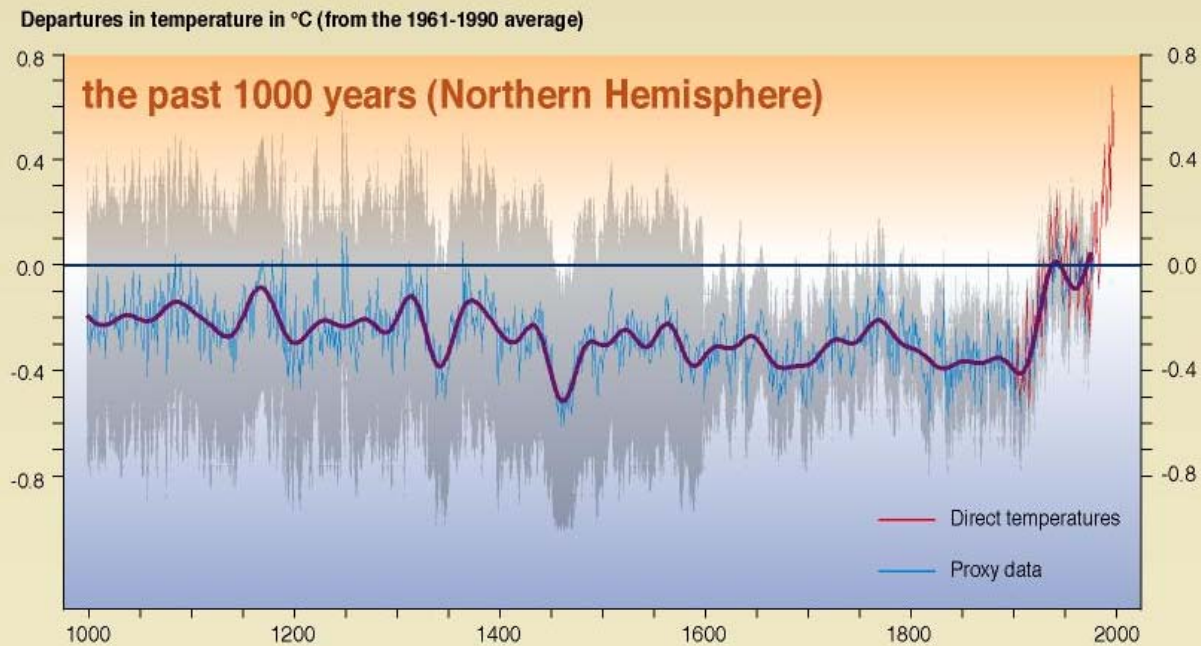
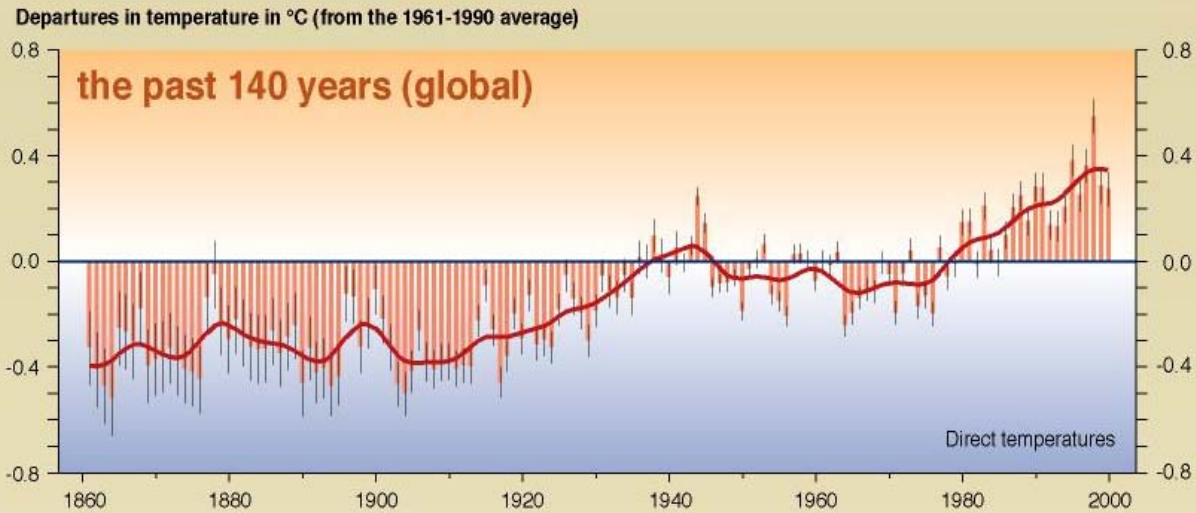
- RAP seems to have had some successes in meeting pollutant reduction targets, especially from point sources
- Non-point sources still a problem

Indicators of the human influence on the atmosphere during the Industrial era



SYR - FIG
WG1 FIGU

Variations of the Earth's surface temperature for...



SYR - FIGURE 2-3



Water and Global Warming

- Increased water scarcity
- Rising sea levels
- Oceanic changes affect biodiversity
- More intense weather events
- Increased uncertainty about water resources versus rigid water management institutions