An aerial photograph showing a vast expanse of ocean water. The water is a deep blue, but large, irregular patches of bright red are visible, indicating a harmful algal bloom. The red patches are scattered across the water, with some larger, more concentrated areas. In the far distance, several small, green islands are visible on the horizon under a clear sky.

Harmful algal blooms: an expanding problem in the U.S. coastal zone

Donald M. Anderson
Senior Scientist, Biology Department
Woods Hole Oceanographic Institution















DANGER

Area Closed

Shellfish (oysters, clams, mussels and other bivalve molluscs) in the area described below contain paralytic toxins and are not safe for use as food.

Secteur

Les mollusques (moules et autres bivalves) provenant de la zone décrite ci-après contiennent des toxines paralysantes et ne sont pas appropriés à la consommation.

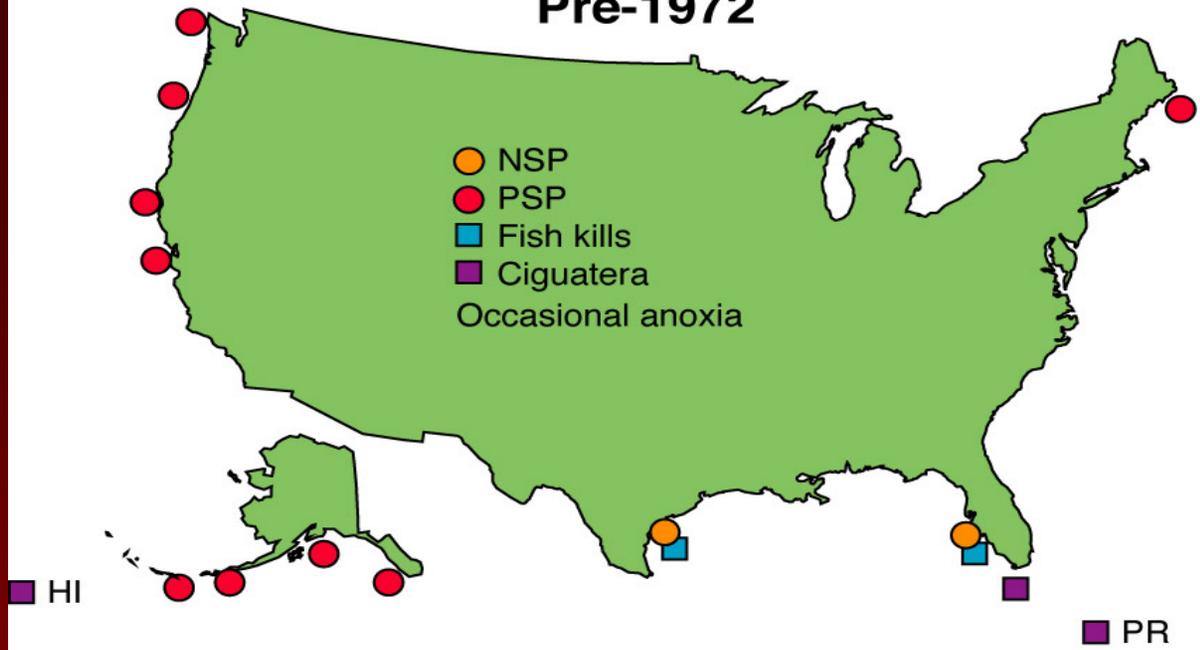




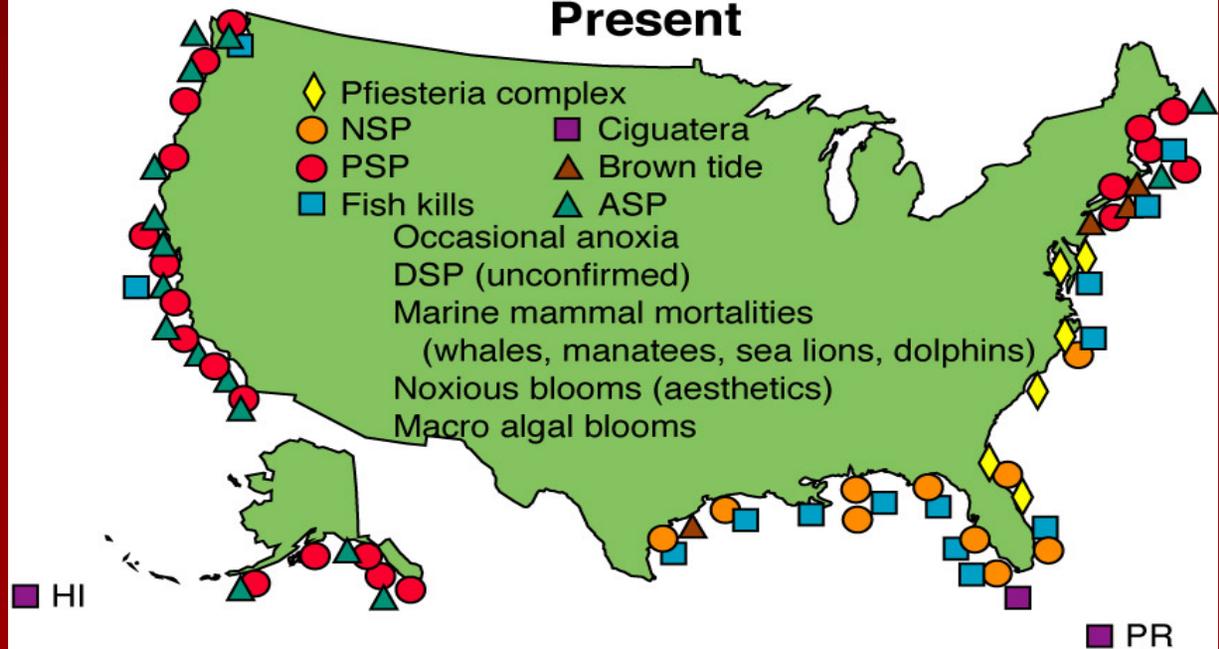
TYPES OF HAB IMPACTS

- Paralytic Shellfish Poisoning (PSP)
- Neurotoxic Shellfish Poisoning (NSP)
- Amnesic Shellfish Poisoning (ASP)
- Diarrhetic Shellfish Poisoning (DSP)
- Azaspiracid Shellfish Poisoning (AZP)
- Ciguatera Fish Poisoning (CFP)
- Brown tides
- Fish mortalities (wild and farmed)
- *Pfiesteria* (fish kills & poorly characterized human health effects)
- Other faunal mortalities (dissolved oxygen)
- Noxious blooms (aesthetics)
- Macroalgal blooms
- Freshwater toxins (drinking water, recreation)

Pre-1972



Present



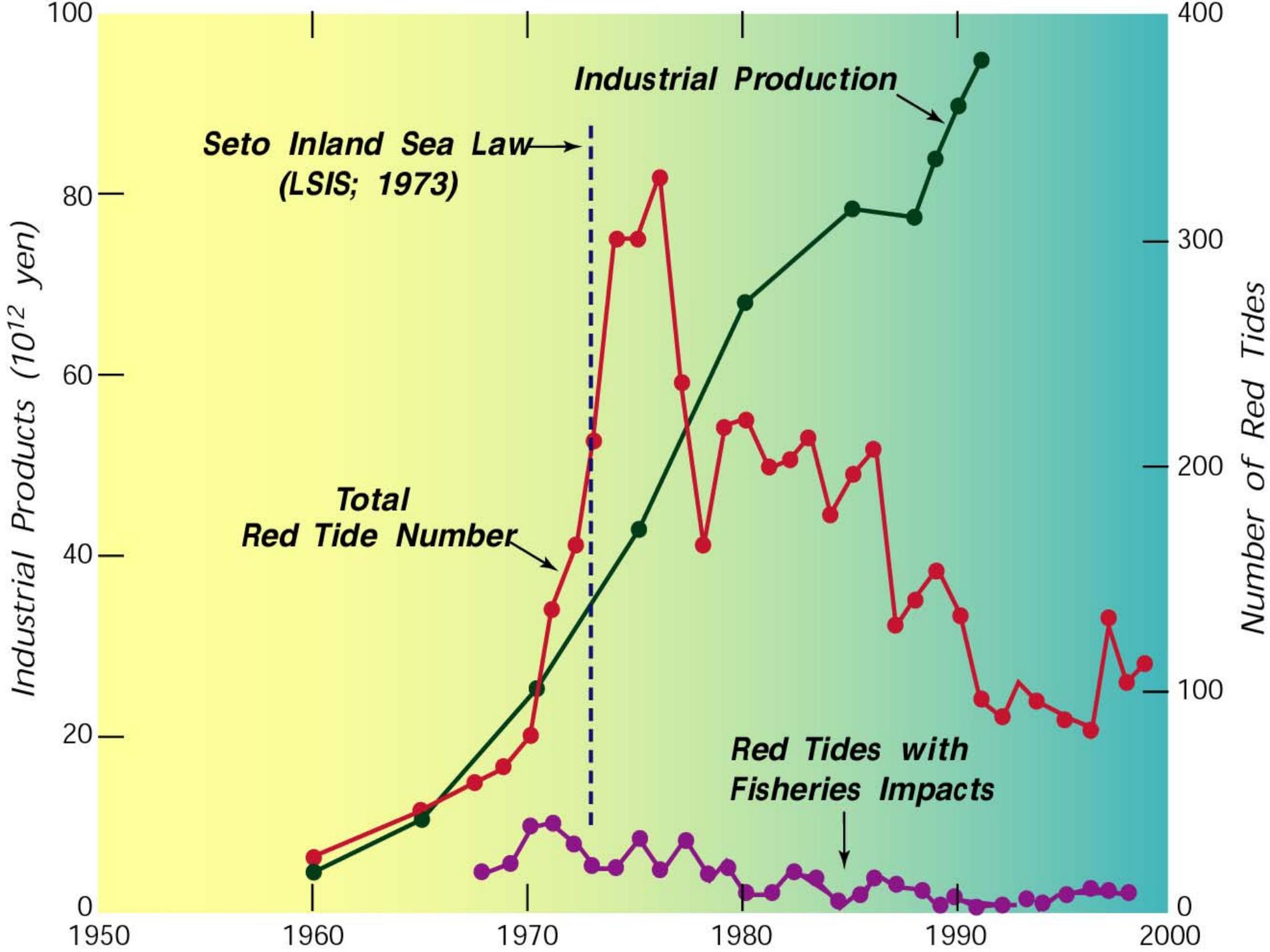
There is no doubt that the number of harmful algal blooms and the economic costs of their impacts have expanded considerably throughout the U.S. and the world during the last 30 years.

We have:

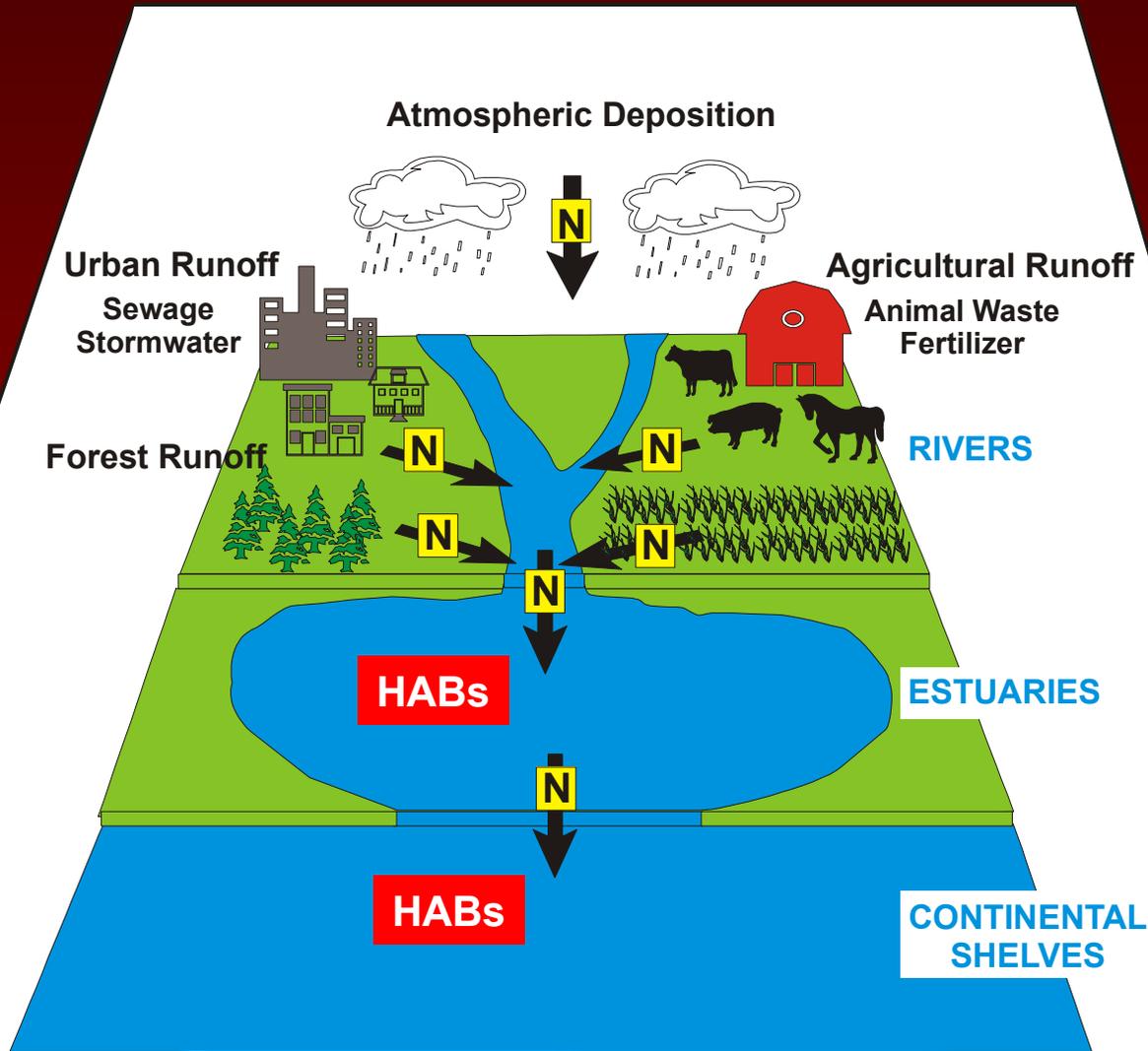
- - more algal toxins
- more toxic algal species
- more fisheries resources affected
- more areas affected
- higher economic costs

Possible mechanisms for the expansion of the HAB problem

- Species dispersal or introduction via natural currents, storms; cyst deposition
- More scientists, improved chemical analysis, better communication
- Increased aquaculture (more resources, more monitoring)
- Dispersal by human activities (ballast water, shellfish seeding)
- Pollution (nutrient enrichment)



Non-point sources of nitrogen and phosphorus enter coastal ecosystems

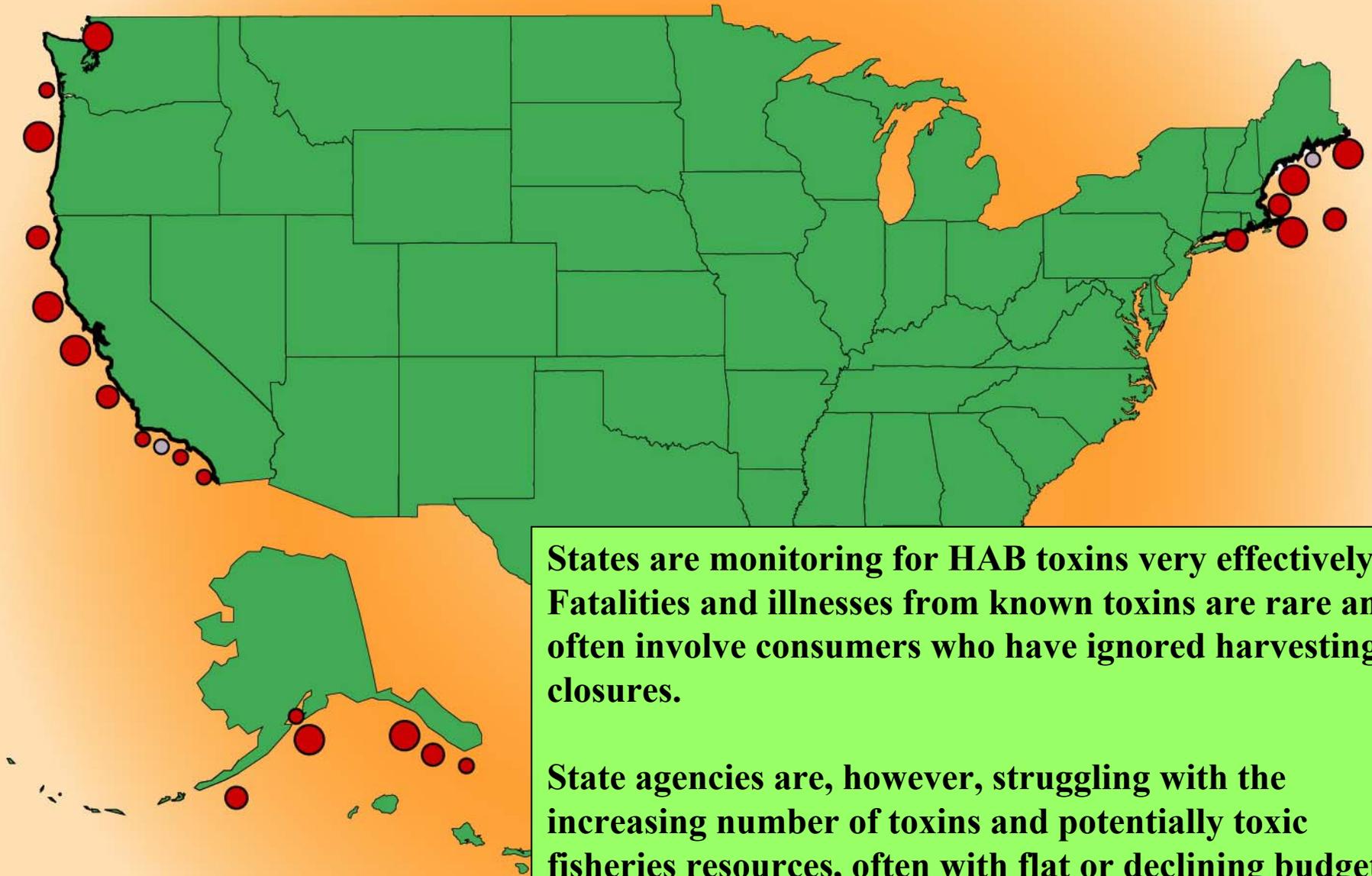


- The global increase in HABs is thus a reflection of two factors:
 - An actual expansion of the problem due to pollution and other causes
 - An increased awareness of its “natural” size or scale
- The fact that part of the HAB expansion is a result of increased awareness should not negate our concern. HABs are a large and serious coastal problem.
- The fact that some HAB phenomena are expanding due to human activities adds urgency to our concerns.

The status of HAB management and research in the U.S.

- Are we managing HABs effectively?
- How effective are our HAB research programs?
- What additional resources, policies, or tools do we need to improve HAB management capabilities?

PSP events in the United States of America



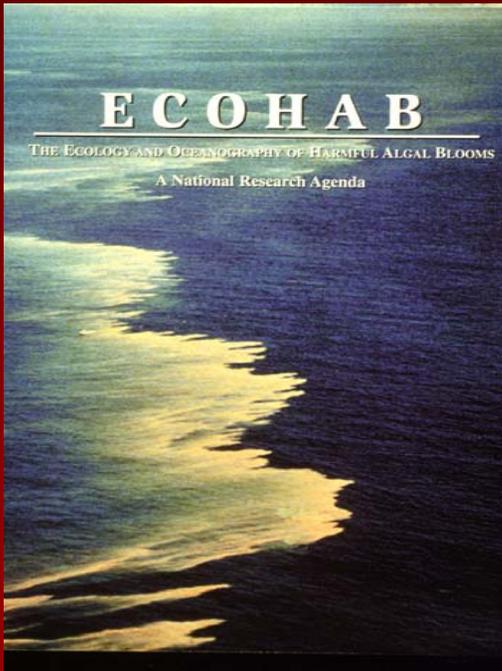
States are monitoring for HAB toxins very effectively. Fatalities and illnesses from known toxins are rare and often involve consumers who have ignored harvesting closures.

State agencies are, however, struggling with the increasing number of toxins and potentially toxic fisheries resources, often with flat or declining budgets.

Research framework: Elements of the US HAB national program

National Plan for Marine Biotoxins and Harmful Algae

Ecology and oceanography

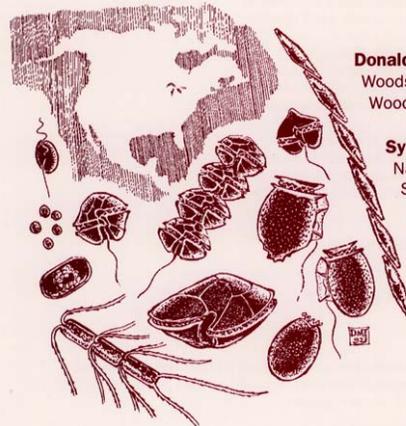


**ECOHAB (Funded:
Partners: NOAA, NSF,
EPA, ONR, NASA)**



WHOI-93-02

Marine Biotoxins and Harmful Algae: A National Plan



Donald M. Anderson
Woods Hole Oceanographic Institution
Woods Hole MA 02543

Sylvia B. Galloway
National Marine Fisheries Service
Southeast Fisheries Science Center
Charleston, SC 29422

Jeanne D. Joseph
National Marine Fisheries Service
Southeast Fisheries Science Center
Charleston, SC 29422

January 1993

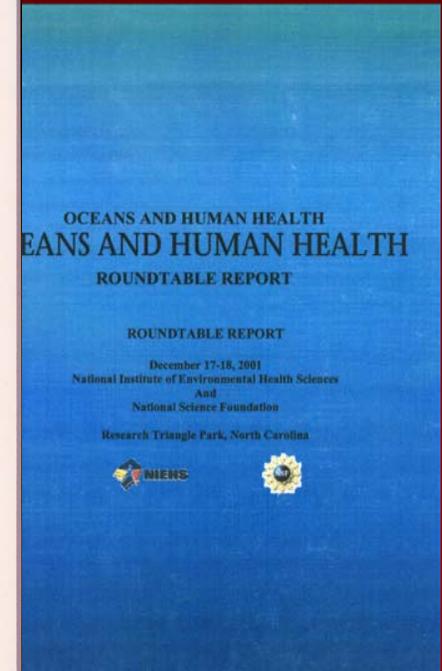
Woods Hole Oceanographic Institution

Technical Report

Funding was provided by the National Marine Fisheries Service Saltonstall-Kennedy Grant No. NA27FD0092-01, National Marine Fisheries Service's Charleston Laboratory and by the NOAA Coastal Oceans Program.

Approved for public release; distribution unlimited.

Epidemiology,
public health



Research plan written, but no
program funded yet - Potential
partners NIEHS, NSF

Summary and recommendations (1)

- **HABs are a serious and growing problem in the US, affecting every coastal state. HABs impact public health, fisheries, aquaculture, tourism, and coastal aesthetics. HAB problems will not go away and will likely increase in severity.**
- **A coordinated National HAB Program has been formulated and partially implemented. The significant success of this program stems in part from:**
 - **Sustained funding (6 years thus far for ECOHAB)**
 - **Interagency partnerships**
 - **Regional oceanography (e.g., Gulf of Maine, Gulf of Mexico, Chesapeake Bay, Puget Sound)**

Recommendations:

- **Sustain and enhance support for the national HAB program**
 - **Implement programs on Prevention, Control and Mitigation, and on Oceans and Human Health**
 - **Encourage interagency partnerships (e.g., NIEHS & NSF for Oceans and Human Health)**

Summary and recommendations (2)

- **State agencies are doing an excellent job protecting public health and fisheries, but those monitoring programs are facing growing challenges**
 - **Needs for the future:**
 - **New technologies for HAB monitoring and forecasting**
 - **Incorporation of these tools into regional Ocean Observing Systems**

Recommendations:

- **Support methods and instrument development for land- and mooring-based cell and toxin detection, and for bloom forecasting (e.g., through a program on HAB Prevention, Control and Mitigation or through instrument development support for the Ocean Observing System).**
- **Incorporate HAB monitoring into an integrated U.S. Ocean Observing System;**

Summary and recommendations (3)

- **HABs are just one of many problems in the coastal zone that are affected by nutrient inputs and over-enrichment from land. They represent a highly visible indicator of the health of our coastal ocean.**
- **More subtle impacts to fisheries and ecosystems are likely occurring that are far more difficult to discern.**

Recommendations:

- **Support long-term water quality and HAB monitoring programs in coastal waters**
- **Implement agriculture and land-use policies that reduce point and non-point source pollution loadings to coastal waters.**