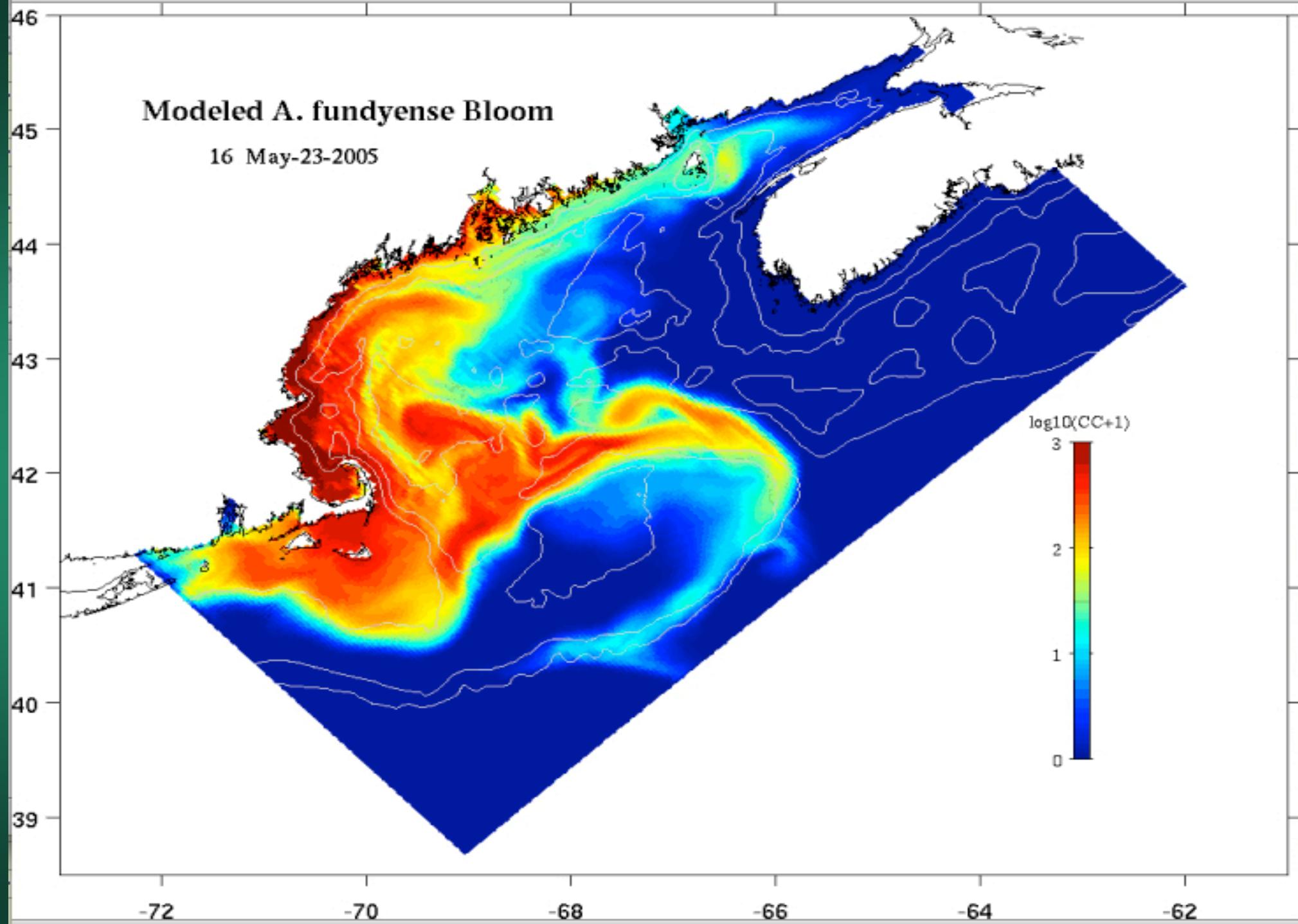


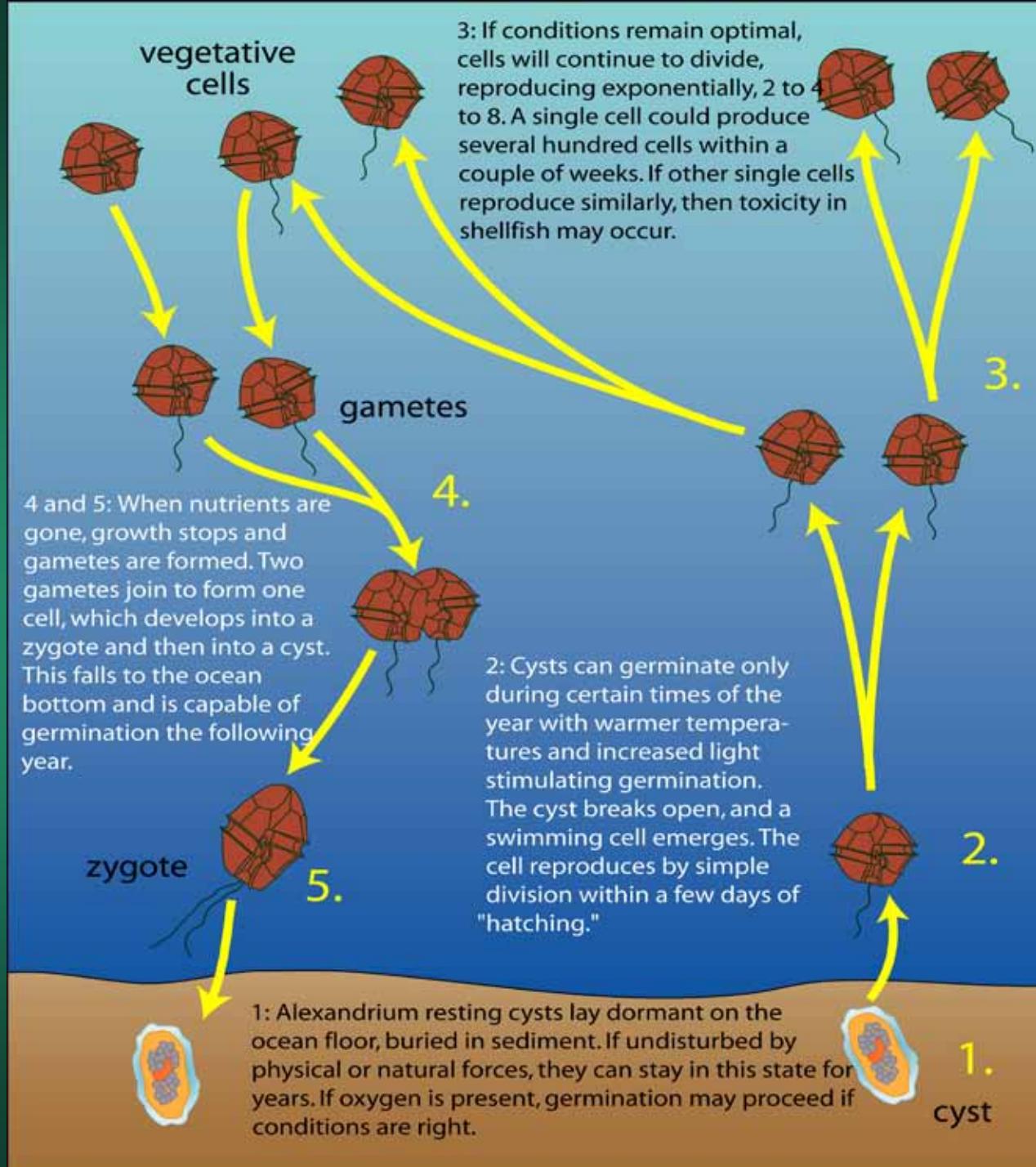
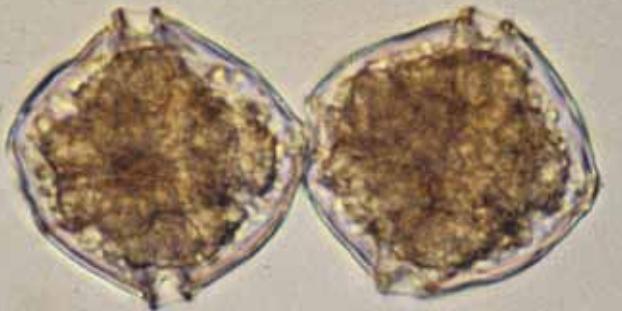
Managing toxic algal blooms in the Gulf of Maine

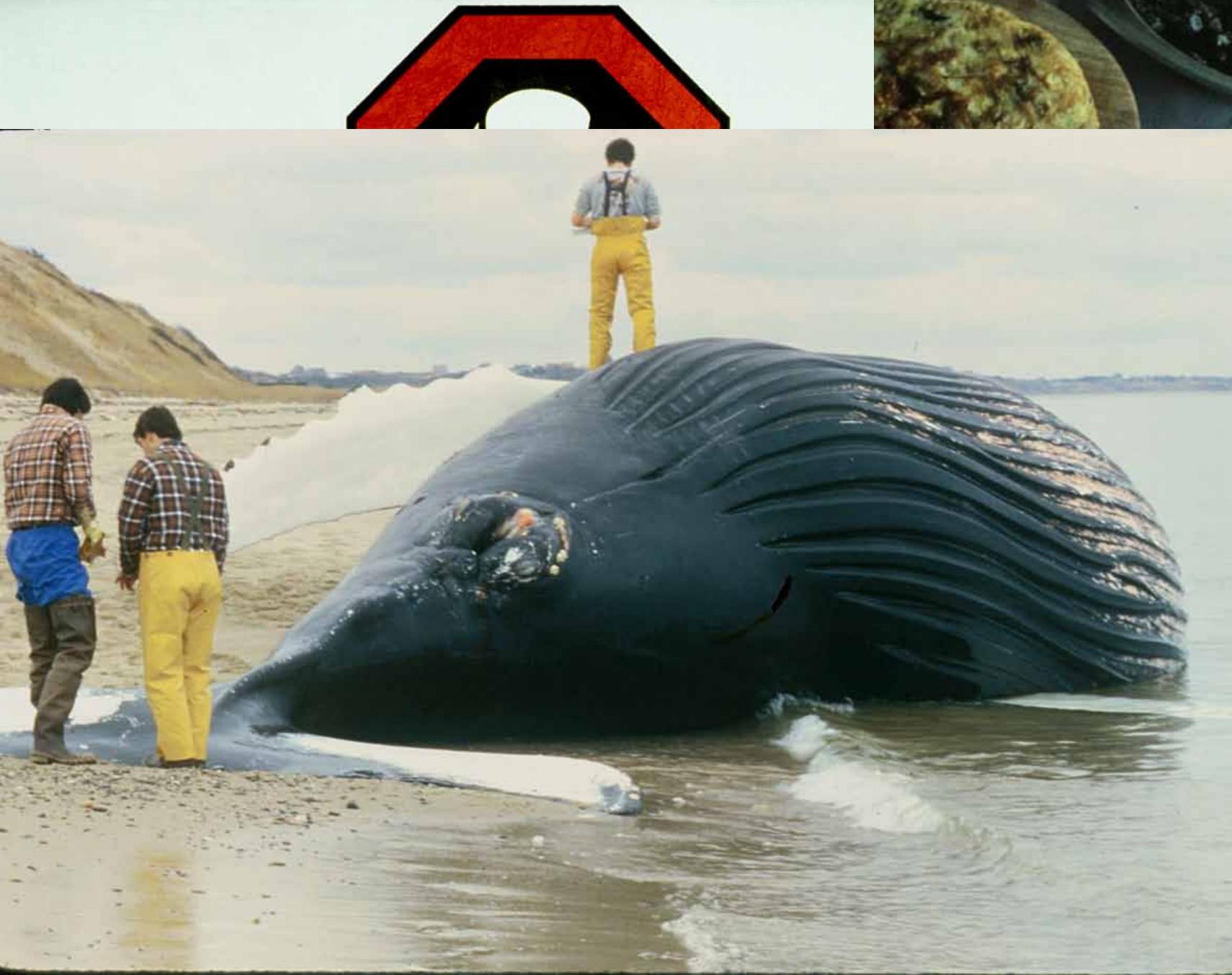


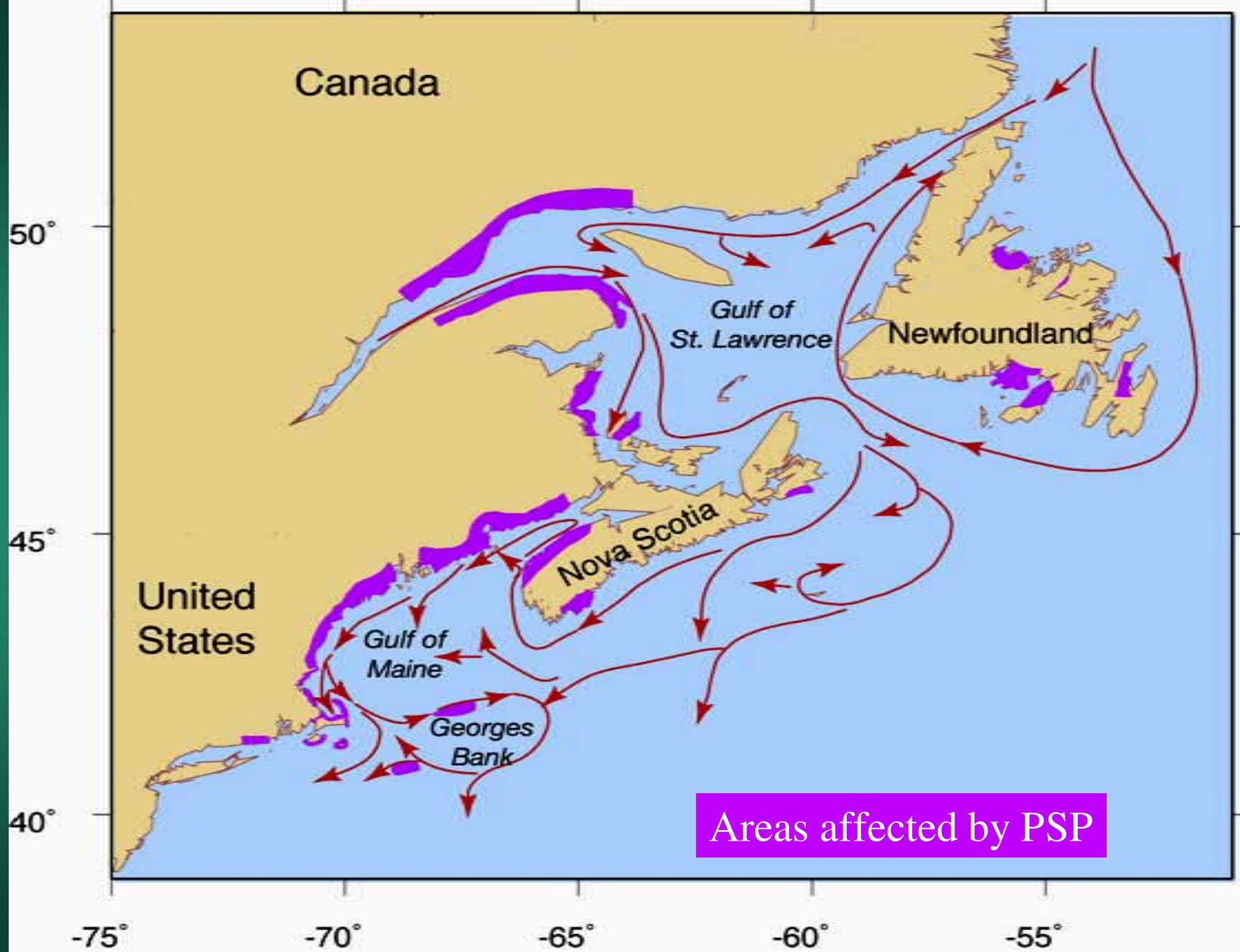
Don Anderson, Woods Hole Oceanographic Institution
Darcie Couture, Maine Department of Marine Resources











- Value of shellfish resources - \$60M/yr (ME), \$20M (MA)
- \$50M per year Georges Bank and Nantucket Shoals - surfclams, ocean quahogs
- Roe-on scallop - \$5-10M per year





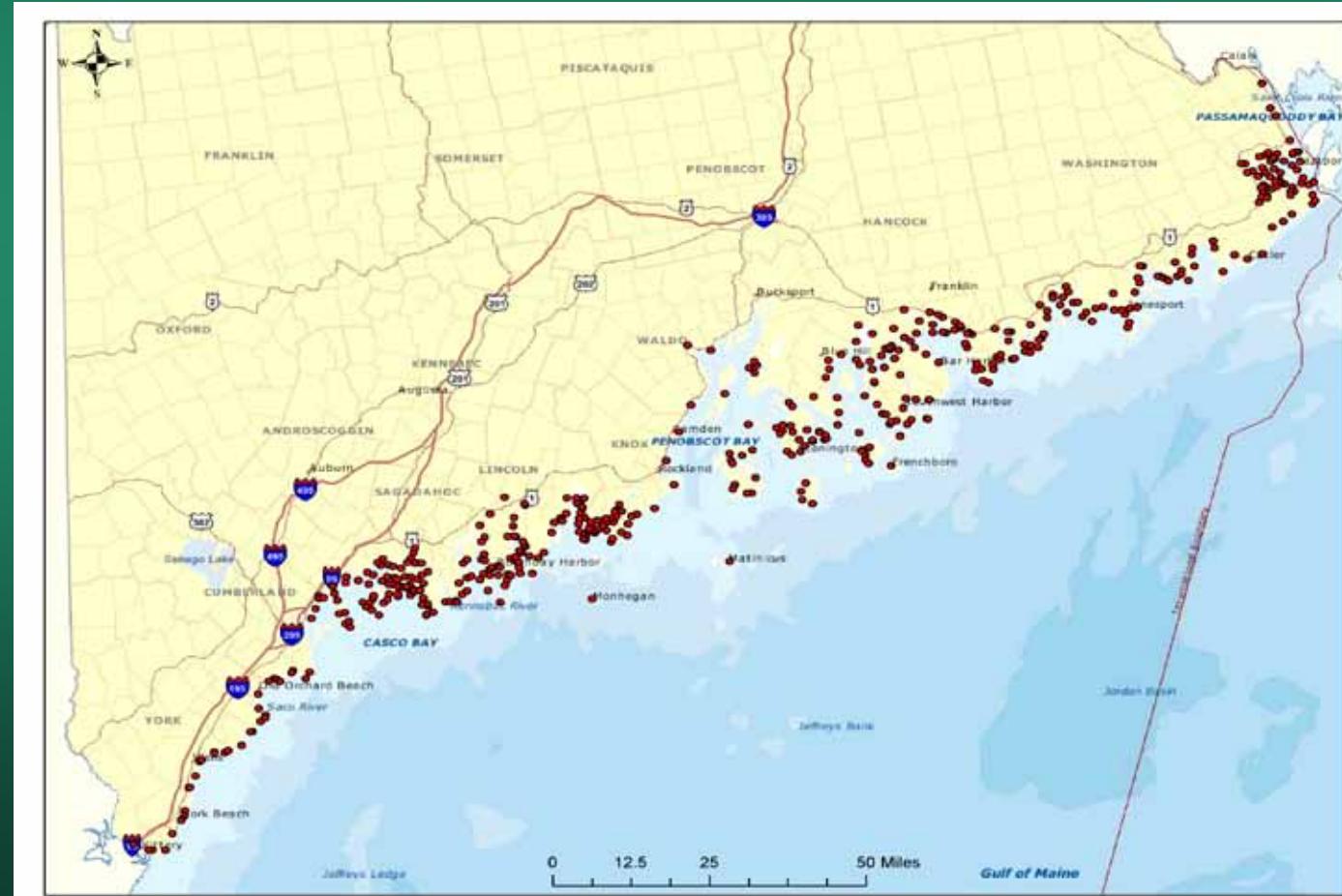
Maine Biotoxin Program

DMR staff from Labs in Boothbay Harbor and Lamoine
drive ~5000 miles each week.

160+ stations per
week (inshore &
offshore)

3000+ samples

11 species of shellfish
monitored



Challenges to safe exploitation of offshore shellfish

- Federal waters far from shore, difficult to sample on a regular basis
- Massive geographic area with unknown bloom dynamics
- Remote sensing of limited use in monitoring this problem
- Poorly understood toxin uptake and depuration characteristics for offshore shellfish

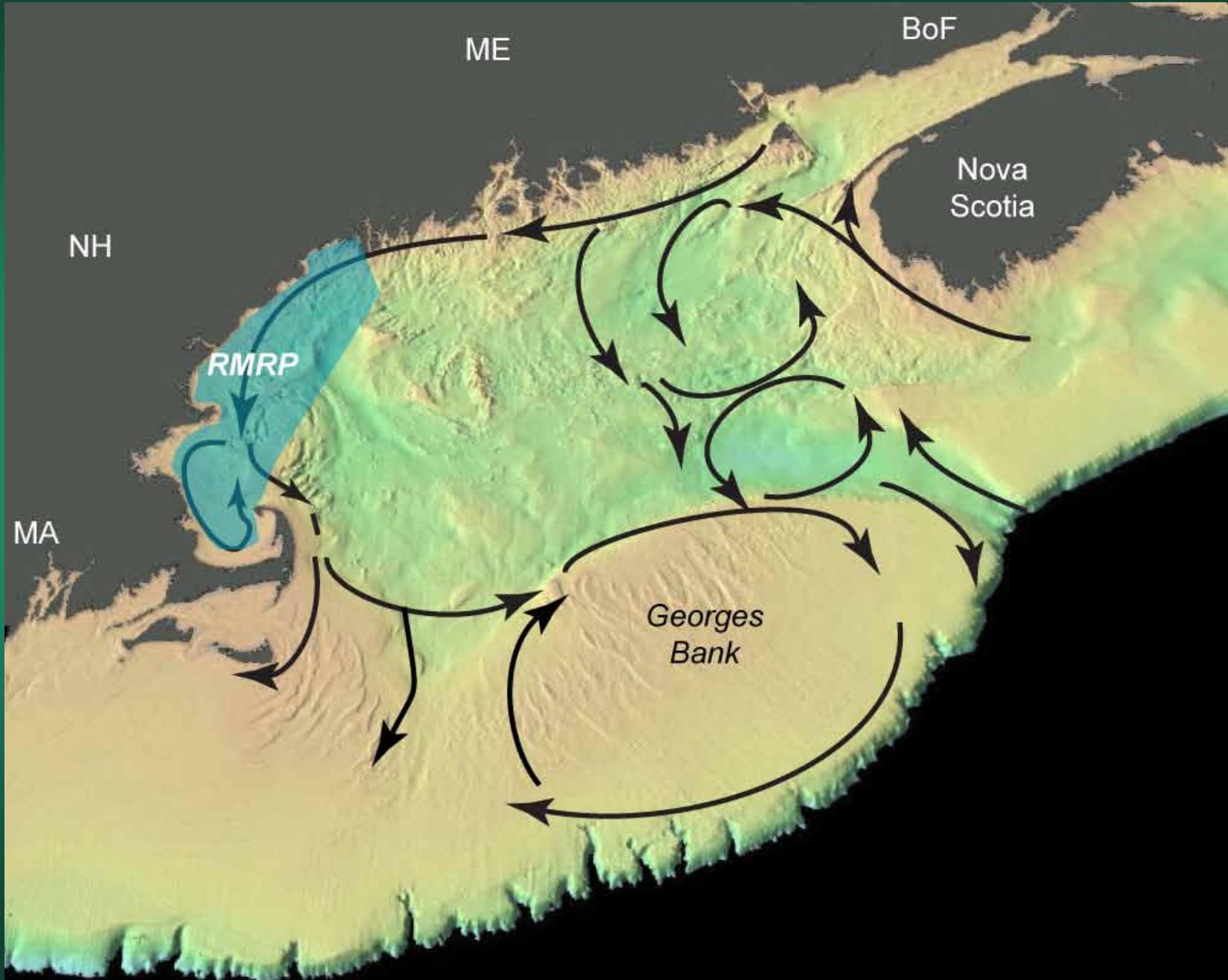
Management Issues

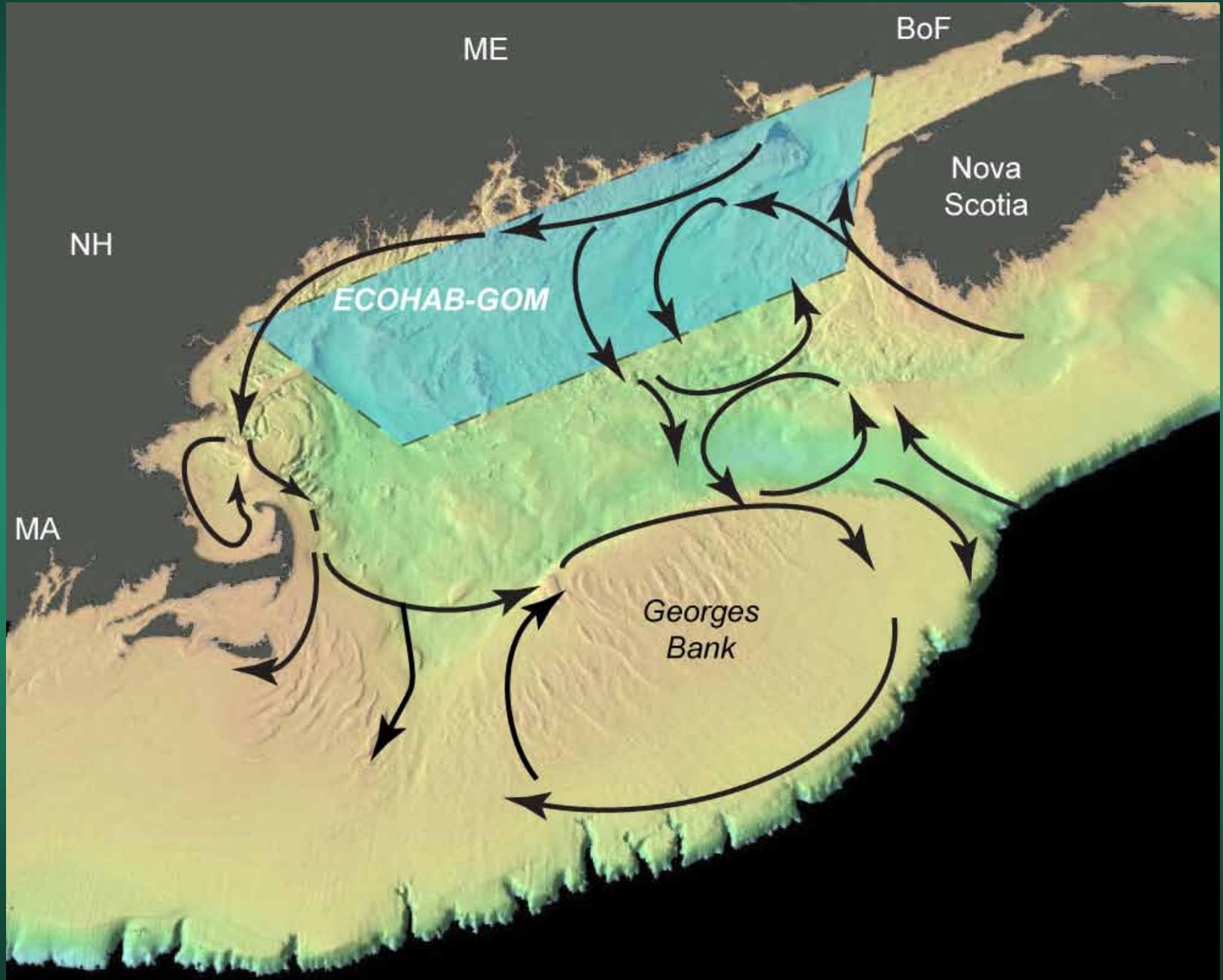
1. What determines interannual fluctuations in cell abundance and PSP toxicity?
2. What factors underlie long-term trends in PSP toxicity?
3. How can extensive offshore shellfish resources be exploited given their potential toxicity and distance from shore?
4. How do human activities, including those affecting climate, affect the *Alexandrium* populations and toxicity patterns?
5. Are there strategies that can be used to suppress or control toxic blooms within the region, thereby reducing impacts?
6. What new management tools are needed to maintain and expand a viable shellfish industry despite recurrent outbreaks?
7. What additions are needed to the growing ocean observing system to provide data for red tide or harmful algal bloom (HAB) management?

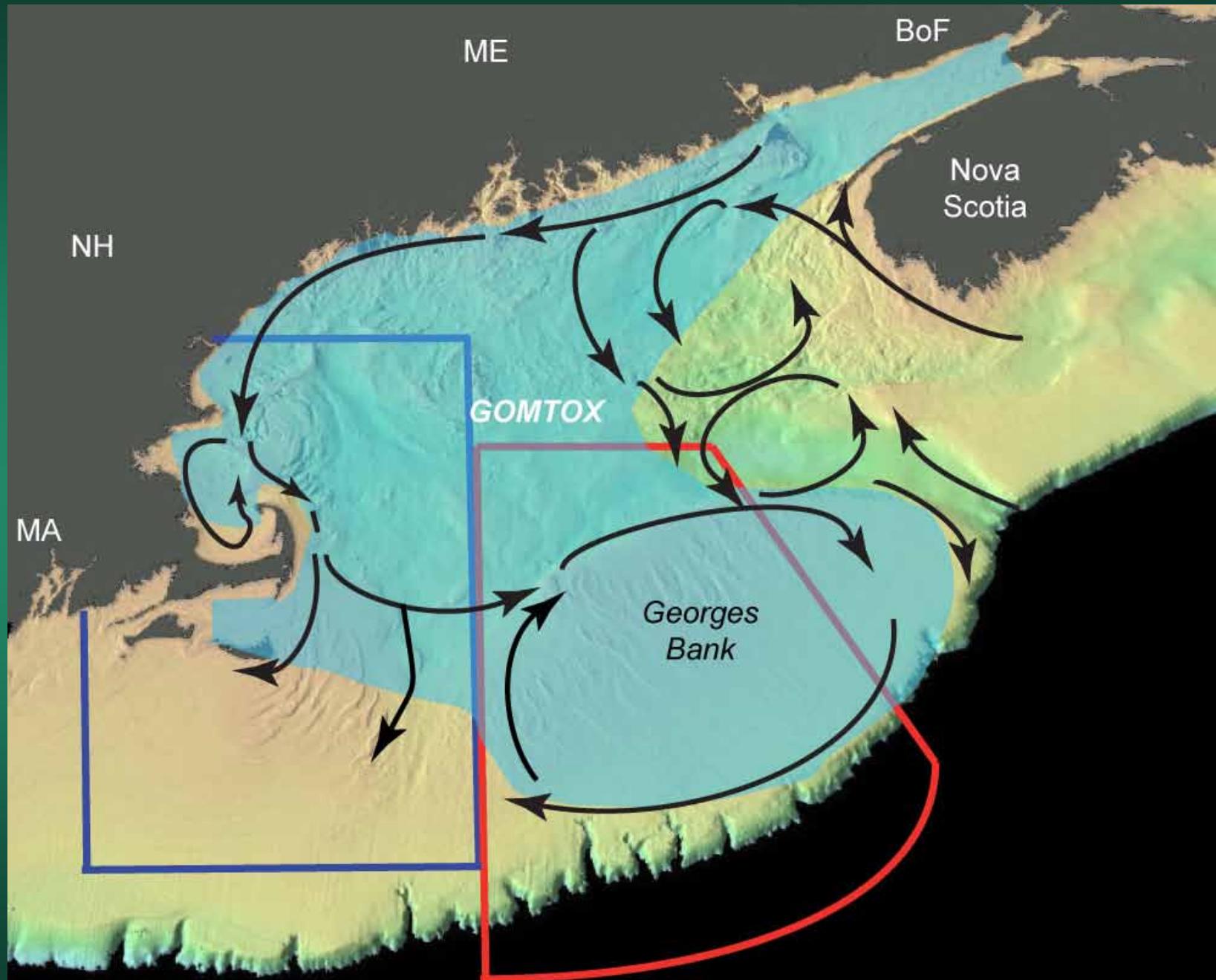
Regional research initiatives

- Regional Marine Research Program (RMRP) - western Gulf of Maine *Alexandrium* study
- ECOHAB - Gulf of Maine
- GOMTOX









GOMTOX Investigators

PIs

Don Anderson
Monica Bricelj
Jonathan Deeds
Stacey Etheridge
Sherwood Hall
Ben Haskell
Ruoying He
Bruce Keafer
Jim Manning
Jennifer Martin
Dennis McGillicuddy
Cindy Pilskaln
Neal Pettigrew
Andrew Thomas
Dave Townsend
Jefferson Turner

Affiliation

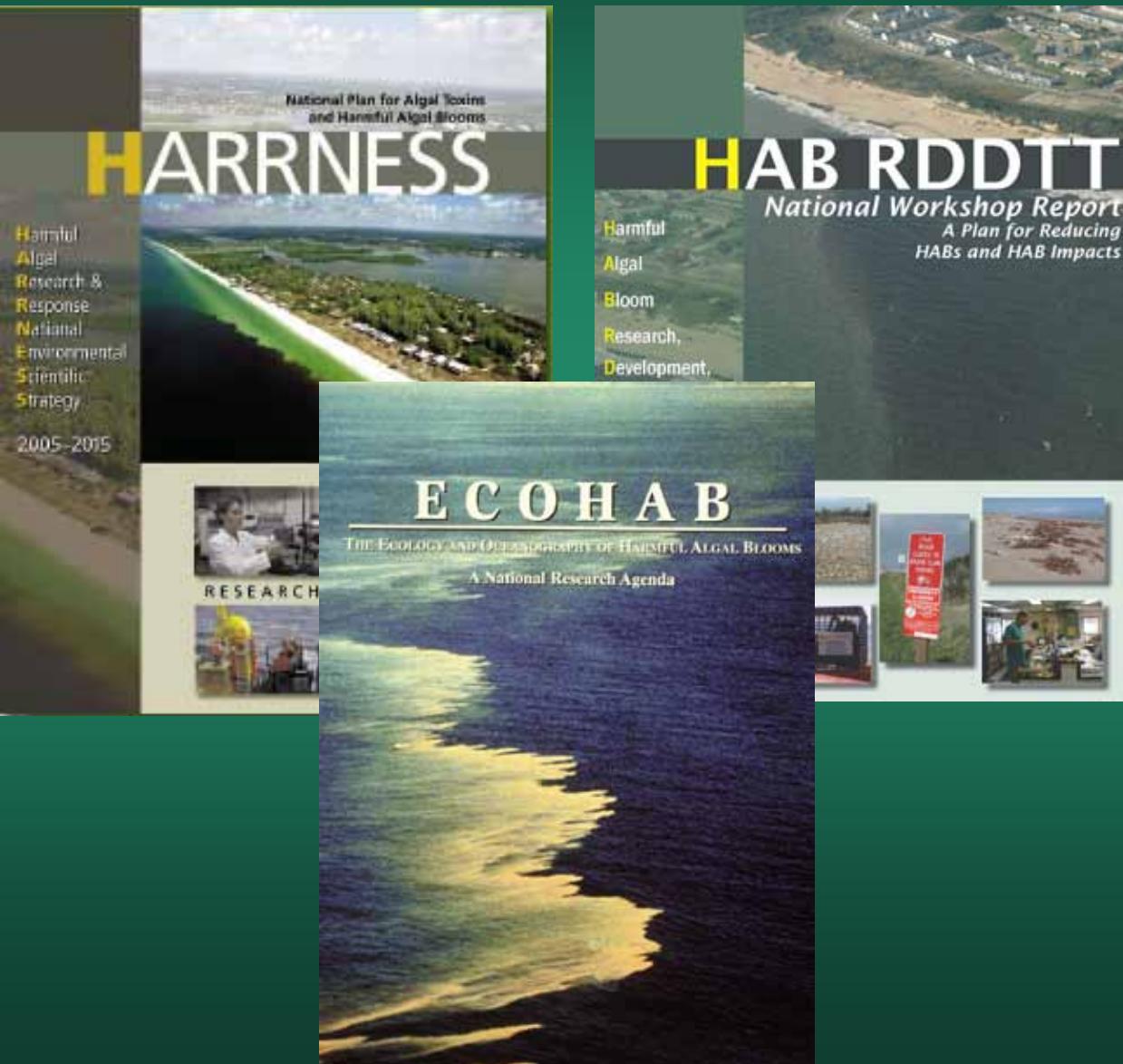
WHOI
Rutgers University
FDA
FDA
FDA
NOAA - Stellwagen Bank National Marine Sanctuary
NC State Univ
WHOI
National Marine Fisheries Service
DFO, St. Andrews Biological Sta., Canada
WHOI
Univ. of Massachusetts - Dartmouth
Univ. of Maine
Univ. of Maine
Univ. of Maine
Univ. of Massachusetts - Dartmouth

Associate Investigators

Darcie Couture
Dave Wallace
Mike Hickey
Geoffrey Day
Richard Taylor

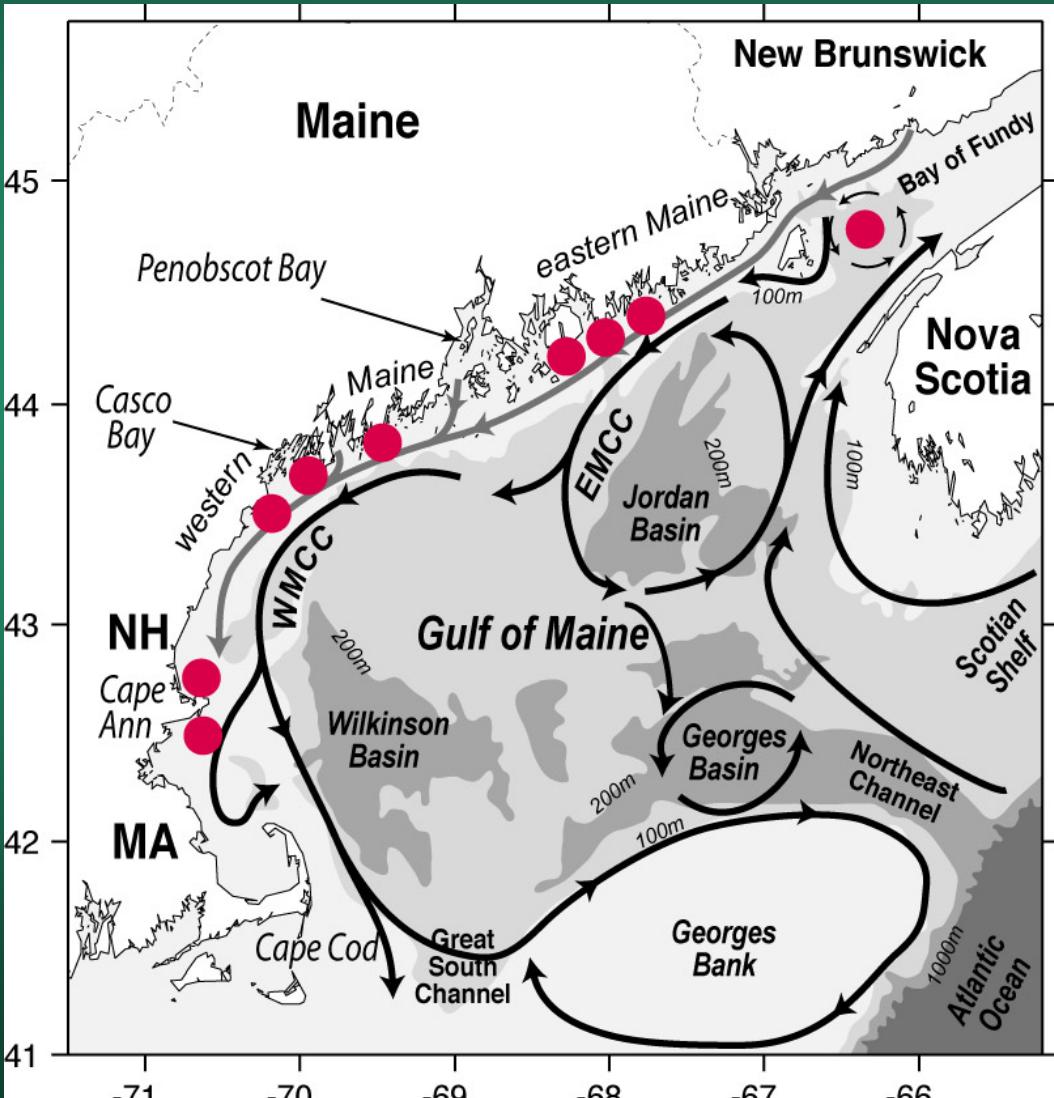
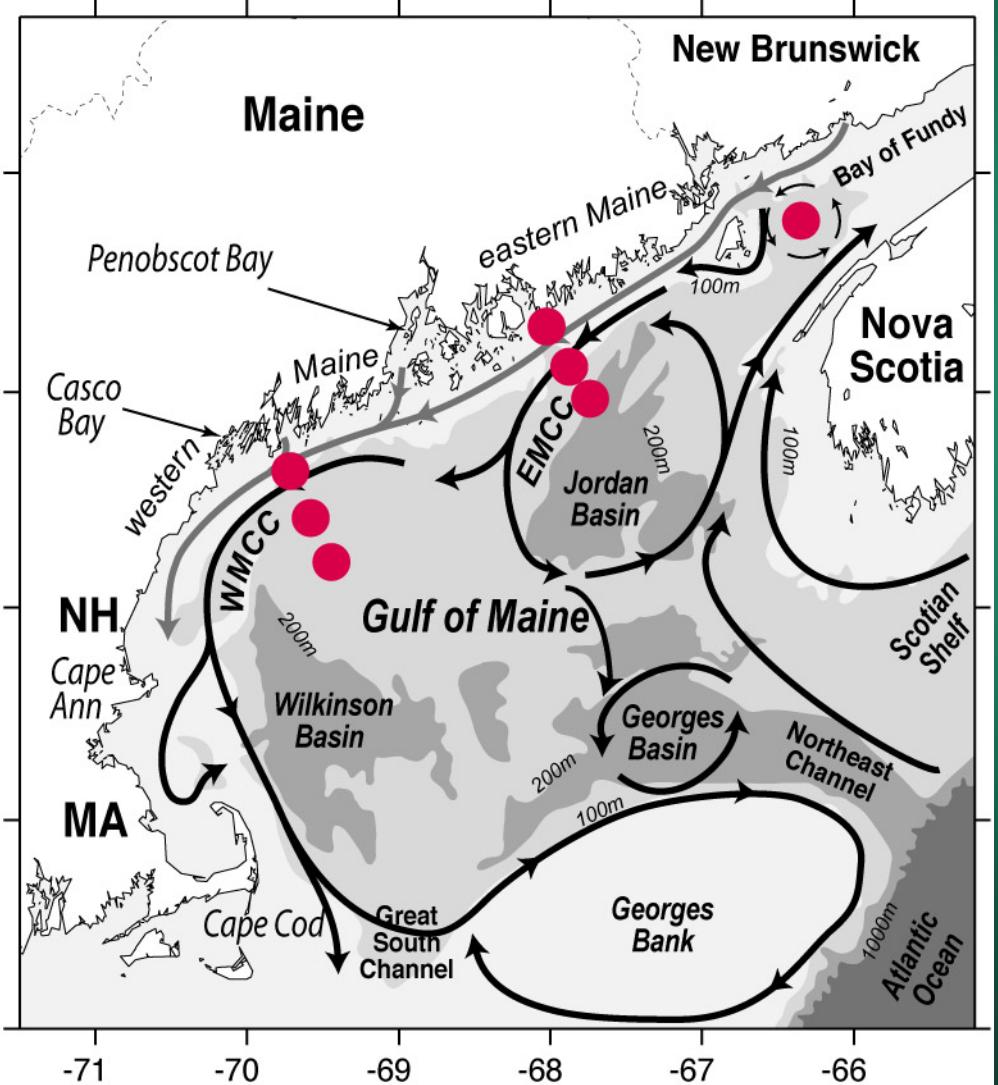
Maine Department of Marine Resources
Wallace and Associates
Massachusetts Division of Marine Fisheries
The Consulting Exchange

Prioritization of research and other activities



National level - as a community we have worked together with managers and industry to create science plans

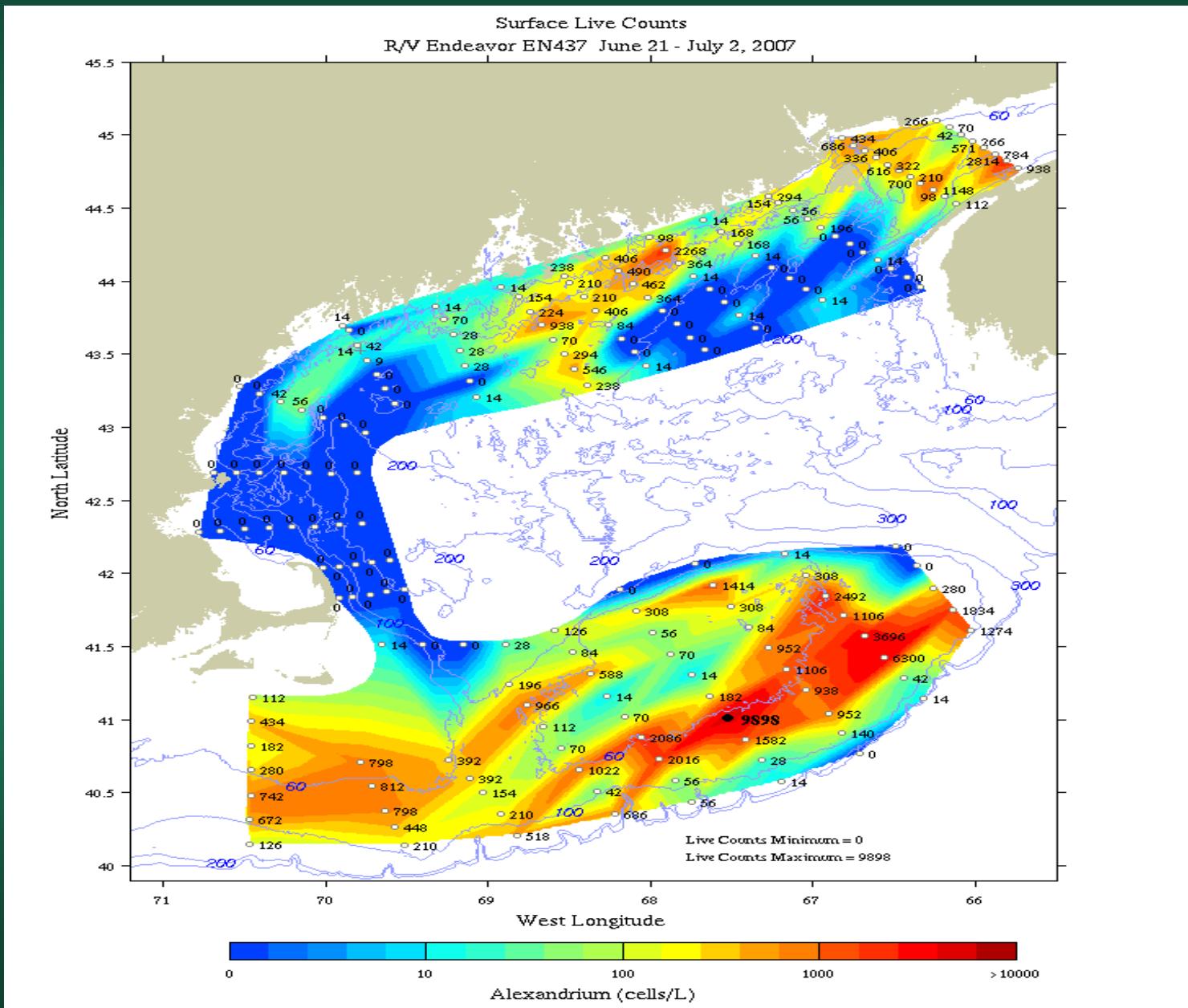
Regional level - Among the mechanisms used for prioritization of HAB research within this region, one has been workshops with managers and scientists on specific topics (e.g., several modeling workshops).



Research Oversight and Guidance

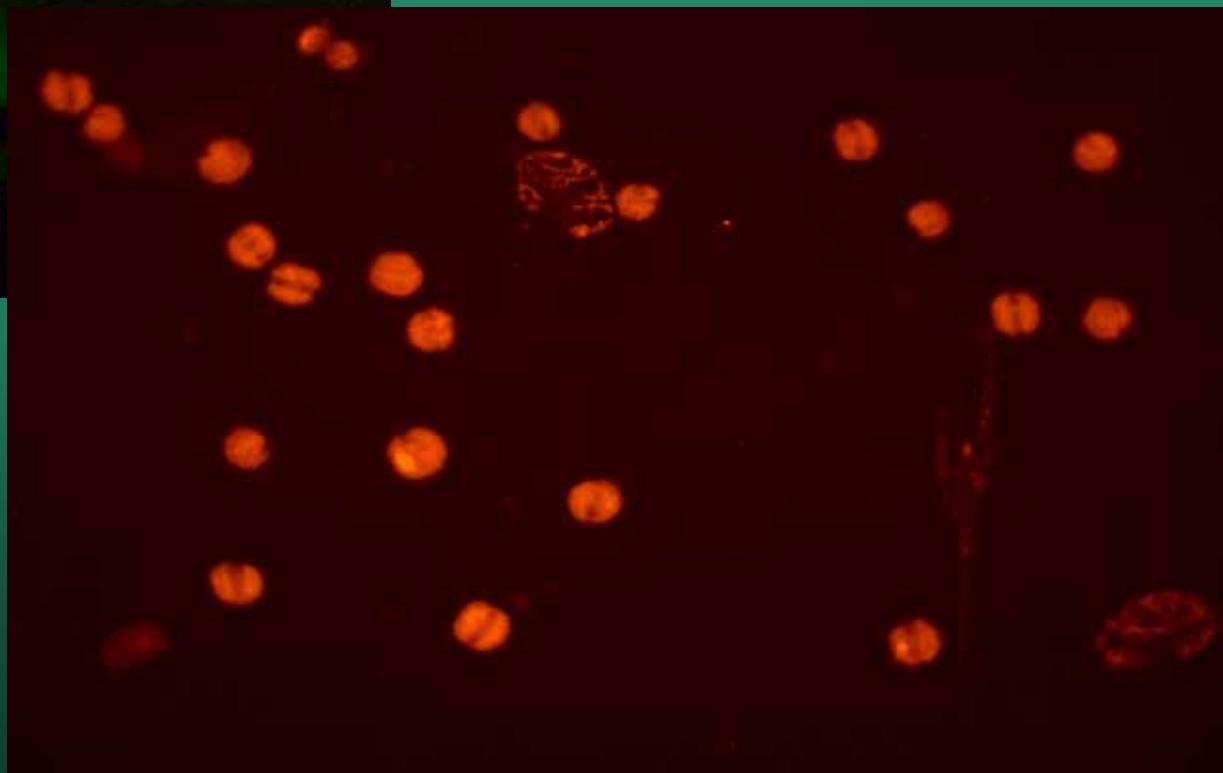
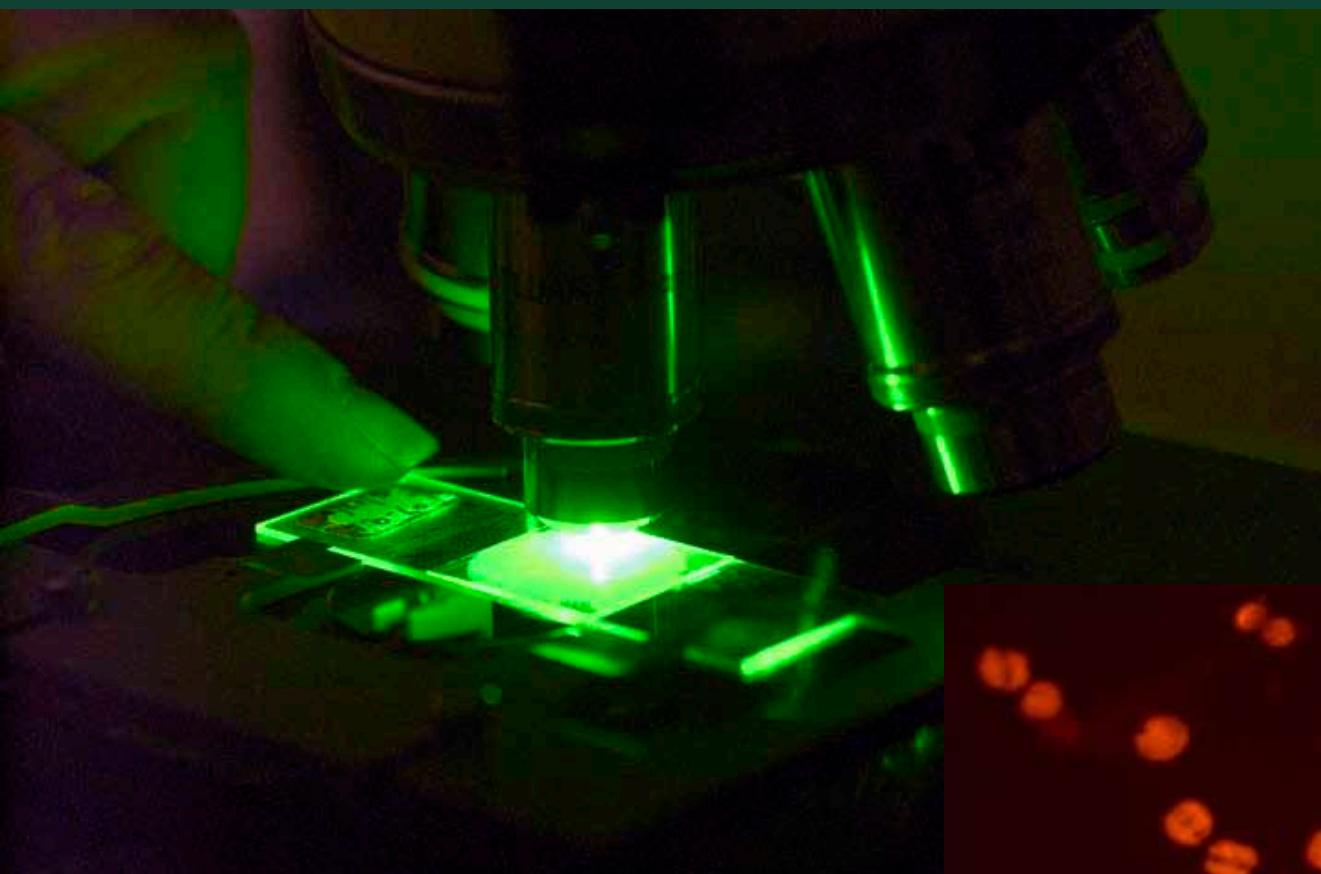
- During ECOHAB-GOM and GOMTOX planning and implementation, teams were assembled in specific focal areas, each having a leader with planning authority and oversight; a major success factor is the selection of effective leaders for these teams, as well as the personnel in them.
- By scheduling frequent PI meetings, research teams must synthesize their data in order to present them to the group. This accelerates analysis and progress, and also fosters cross-team interactions
- When the project team was being assembled, we included individuals who had competing ideas or contrary views. This leads to frequent questioning of assumptions and the challenging of paradigms. The temptation is to include only PIs who share the same perspectives.
- By including program managers and others from the funding agency (NOAA), as well as industry representatives, additional oversight and guidance is provided at the PI meetings

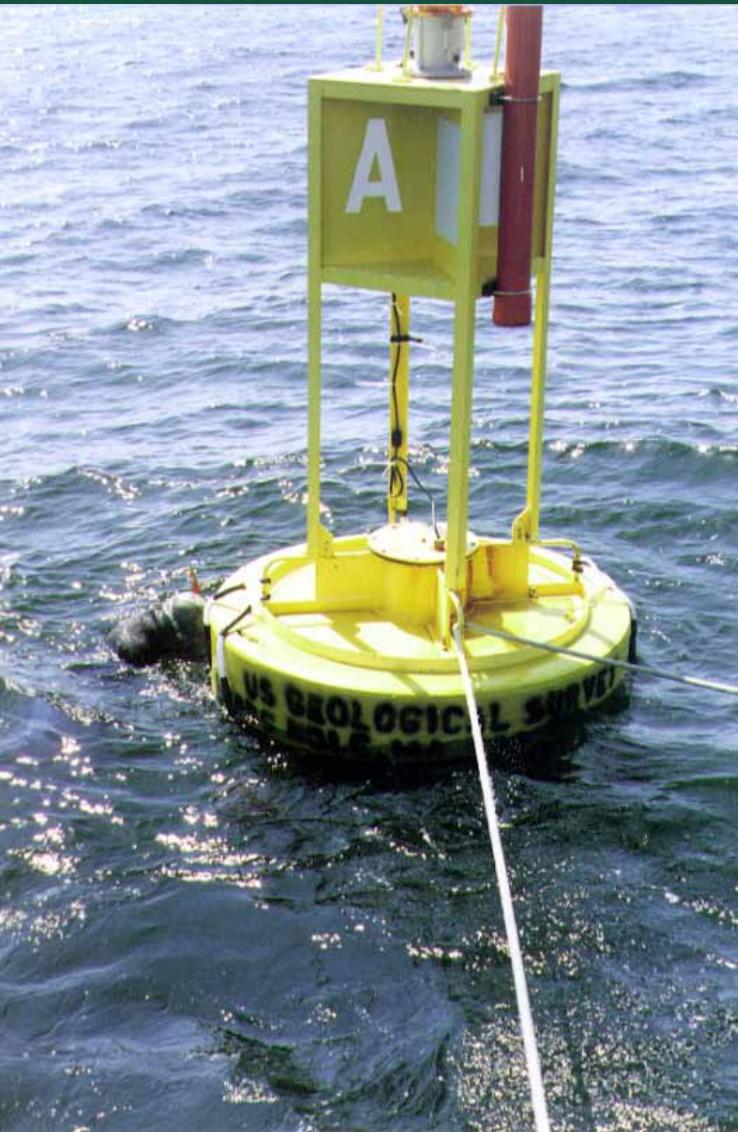
2007 GOMTOX cruise



Transition of Research to Management

- A number of tools have been incorporated into management directly from research programs
 - molecular probes for identifying cells
 - sentinel mussel bags for early detection of toxin
 - use of model output in monitoring and management program
- Communication structure - listserver, website, model runs that can be accessed.





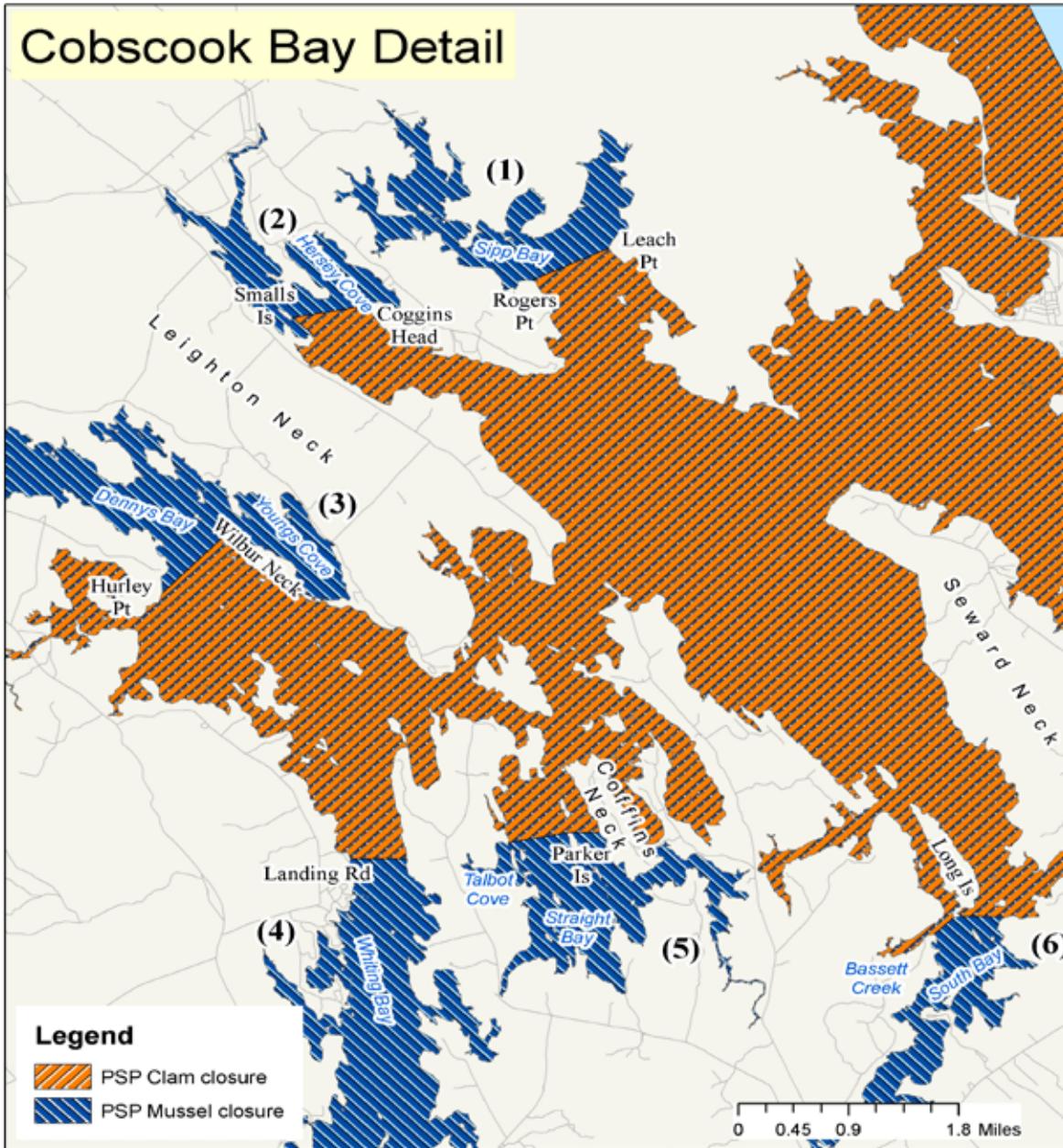


Maine Department of Marine Resources
PSP Closed Area No. 64-B
Machiasport to Canadian border



6/24/08

Cobscook Bay Detail



2005 outbreak:
Surgical closures:
even during the
height of the bloom,
there were many
coves that remained
open for the safe
harvest of *Mya
arenaria*

To: northeastpsp@whoi.edu

List-Id: Northeast Paralytic Shellfish Poisoning <northeastpsp.whoi.edu>

Dear All,

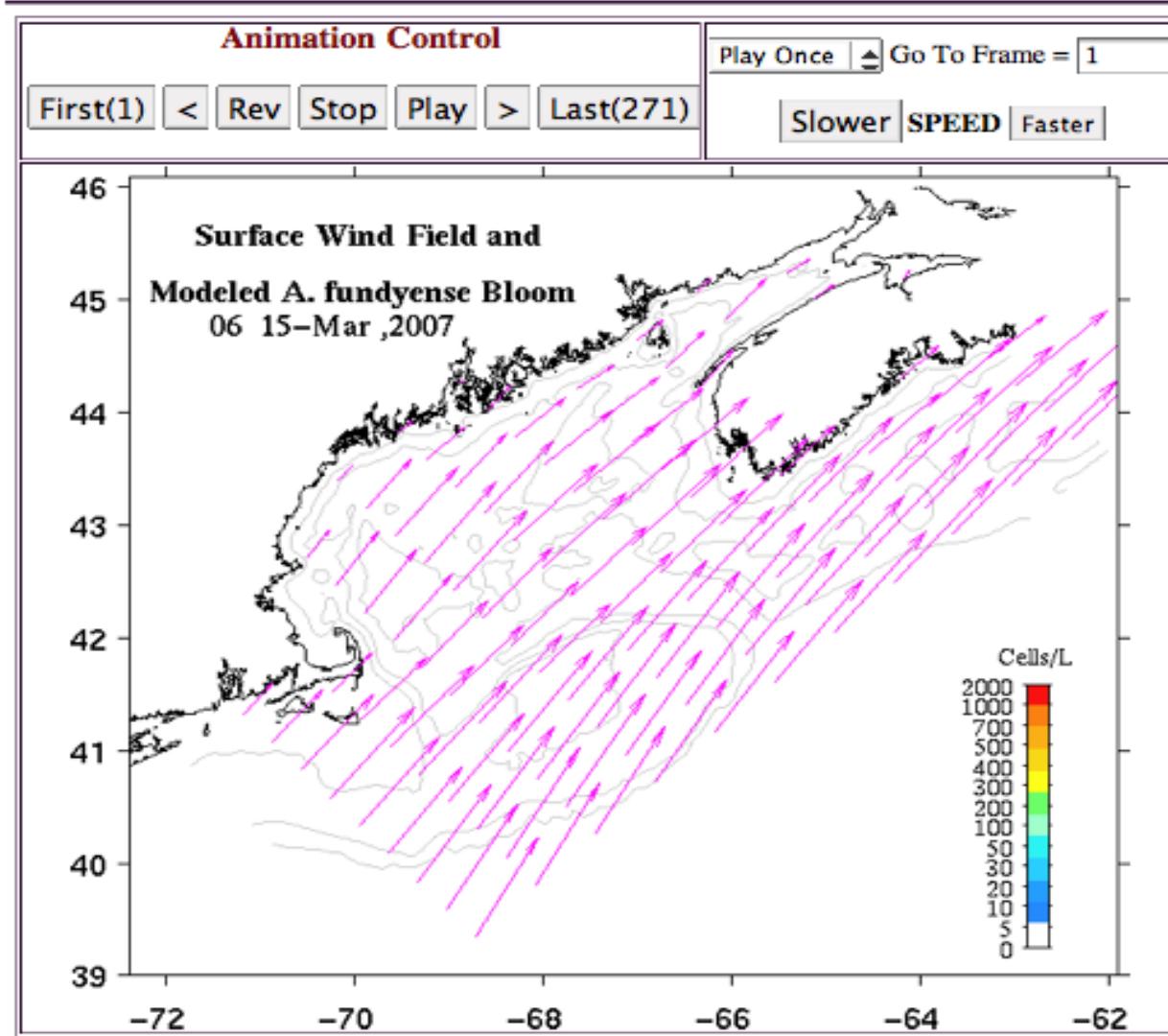
Updated model solutions (as of June 25) are now available at:

http://omgrhe.meas.ncsu.edu/Redtide/Redtide_07/

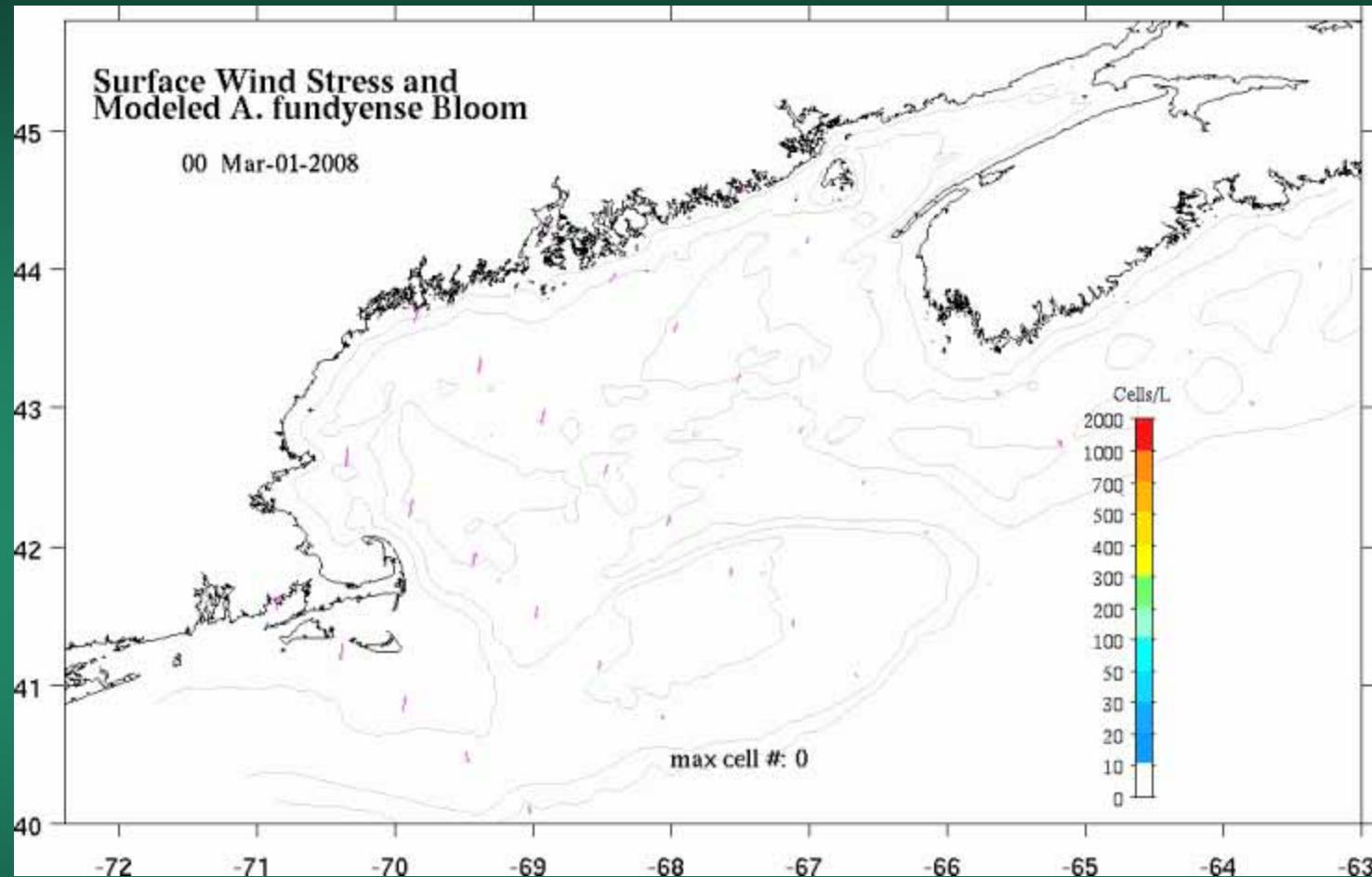
As more in-situ observations coming in, we are working diligently to validate and improve the model performance. For instance, we see the cells reach Georges Bank in the model but do not grow there as opposed to what's been observed by the first Endeavor survey. We think that it may be a result of the way nutrients are currently handled in the model, with the concentration specified from climatology. Work is now underway to upgrade the model by simulating the 3-dimensional nutrient concentration as a part of A.f. bloom prediction.

We will continue posting results from our current version of model for now, and will let you know when solutions from new version of the model become available, so stay tuned.

Gulf of Maine Redtide -2007



This animation requires JavaScript. You will need Netscape version 3.0 or higher or Internet Explorer 4.0 or higher and JavaScript enabled to view this.



<http://omglnx3.meas.ncsu.edu/yli/09forecast/>

Transition to operations

This model is now to be taken over by NOAA and used for an operational forecasting system



Gulf of Maine Harmful Algal Bloom Bulletin

20 May 2010
National Ocean Service
Last Bulletin: May 15, 2010

Conditions Report

A harmful algal bloom has been identified in Cumberland county, Maine south to Essex County, Massachusetts. An impact forecast will depend on what management agencies would do.

Analysis

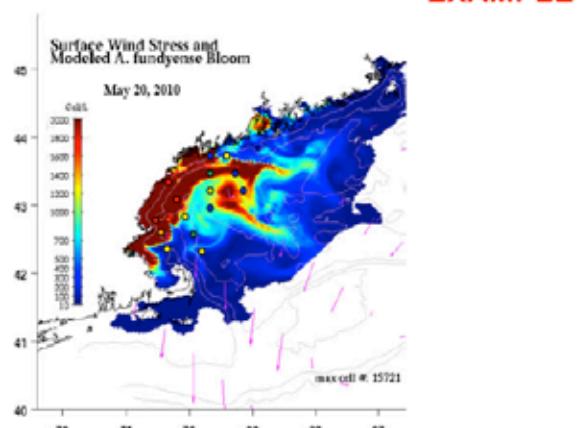
This is an example of what a bulletin might look like. Nowcast is for medium to high concentrations of *Alexandrium* along Southern Maine and New Hampshire. Counts between Saco Bay and Casco Bay ranged from 2300 to 800. Cell concentrations decreased offshore Casco Bay with a peak concentration of 350 cells per liter. Counts from SW to NE in between the Casco Bay line and the Monhegan line were low until a near-shore tongue of cells was encountered with patchy concentrations ranging from 140 to 1600 (42.3N, -71.2W). Model output indicates increases in concentrations are expected in the western Gulf of Maine by May 23rd. The Forecast: Spread is expected around Cape Cod, with agreement by the ensemble of current and previous model forecasts. Uncertainty of 20 km in alongcoast movement. The cross shore pattern, with lower cell counts nearshore is consistent with past events.

Please note the following restrictions on all imagery derived from CoastWatch

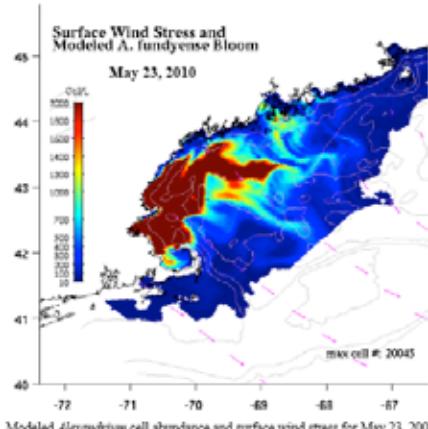
- Data are restricted to civil marine applications only, i.e. federal, state, and local government use/distribution is permitted.
- Image products may be published in newspapers. Any other publishing arrangements must receive XXXXX approval via the CoastWatch Program.

Page 1

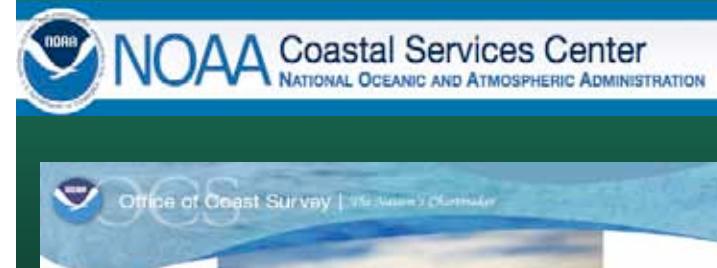
EXAMPLE



Modeled *Alexandrium* cell abundance and surface wind stress for May 20, 2008 with surface cell concentration sampling data from May 11 – 20 shown as blue (0-100 cells/L), green (101 – 300 cells/L), yellow (301 – 500 cells/L), orange (501 – 1000 cells/L) and red (> 1000 cells/L).

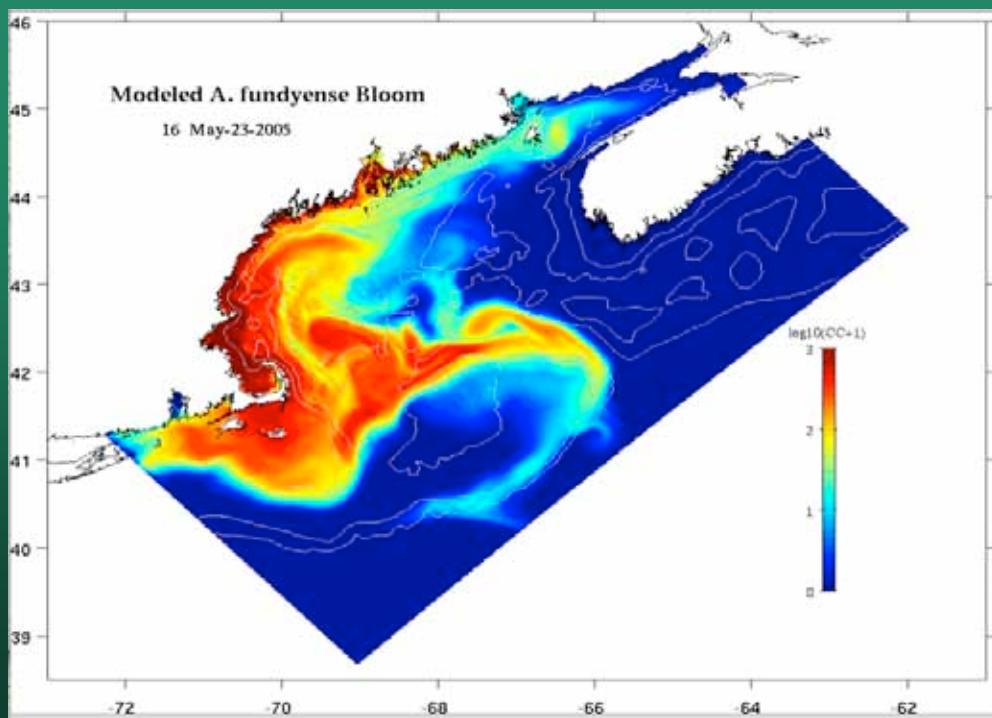


Modeled *Alexandrium* cell abundance and surface wind stress for May 23, 2008.

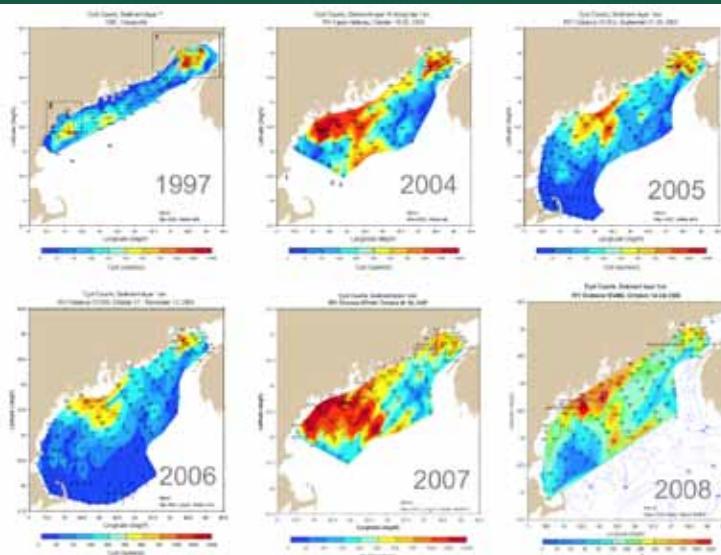


The 2005 New England *Alexandrium* bloom was very well managed with frequent communication between scientists and managers:

- No illnesses or deaths despite extensive and high levels of toxicity
 - NOAA CSCOR was quick to assist with Event Response funding
 - Scientists provided model data and observations to colleagues, managers, industry.
 - Federal agencies needed information about the offshore extent of the bloom yet no observations were available ==> numerical model results used in closure decisions
 - Interactions with the press were coordinated so there were no contradictory messages.



Forecasts / Advisories



News Release : Researchers Report Potential for 'Moderately Large' Red Tide Outbreak in the Gulf of Maine Region for 2009

Toxic bloom expected to be smaller than last year, but still significant

FOR IMMEDIATE RELEASE

(508) 289-3340

media@whoi.edu

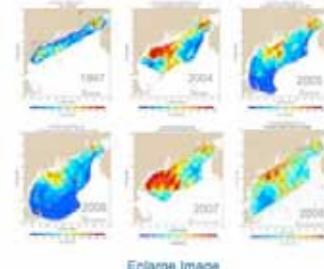
April 22, 2009
Media Relations Office
93 Water Street MS #16
Woods Hole Oceanographic Institution

April 22, 2009
Source: [Media Relations](#)

The potential for an outbreak of the phenomenon commonly called "red tide" is expected to be "moderately large" this spring and summer, according to researchers with the Woods Hole Oceanographic Institution (WHOI) and North Carolina State University (NCSU).

This advisory is based in part on a regional seafloor survey of quantities of *Alexandrium fundyense* — the algae notorious for producing a toxin that accumulates in clams, mussels, and other shellfish and can cause paralytic shellfish poisoning (PSP) in humans who consume them. The survey maps are used with computer models that simulate different scenarios of weather and oceanographic conditions to indicate where and in what abundance the toxic cells might be expected in 2009.

The researchers found concentrations of *Alexandrium* cysts — the dormant seed-like stage of the algae's life cycle — in the Gulf of Maine to be



[CYST CONCENTRATIONS – Maps of the Gulf of Maine](#)

News Release : In Computer Models and Seafloor Observations, Researchers See Potential for Significant 2008 "Red Tide" Season

Conditions are ripe for another large bloom in New England waters; weather and ocean conditions will determine outcome

FOR IMMEDIATE RELEASE

(508) 289-3340

media@whoi.edu

April 24, 2008
Media Relations Office
93 Water Street MS #16
Woods Hole Oceanographic Institution

Source: [Media Relations](#)

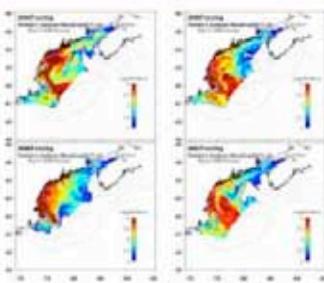
The end of April usually brings the first signs of harmful algae in New England waters, and this year, a research team led by the Woods Hole Oceanographic Institution (WHOI) is preparing for a potentially big bloom.

A combination of abundant beds of algal seeds and excess winter precipitation have set the stage for a harmful algal bloom similar to the historic "red tide" of 2005, according to WHOI biologist Don Anderson, principal investigator of the [Gulf of Maine Toxicity \(GOMTOX\) study](#). The 2005 bloom shut down shellfish beds from the Bay of Fundy to Martha's Vineyard for several months and caused an estimated \$60 million in losses to the Massachusetts shellfish industry alone.

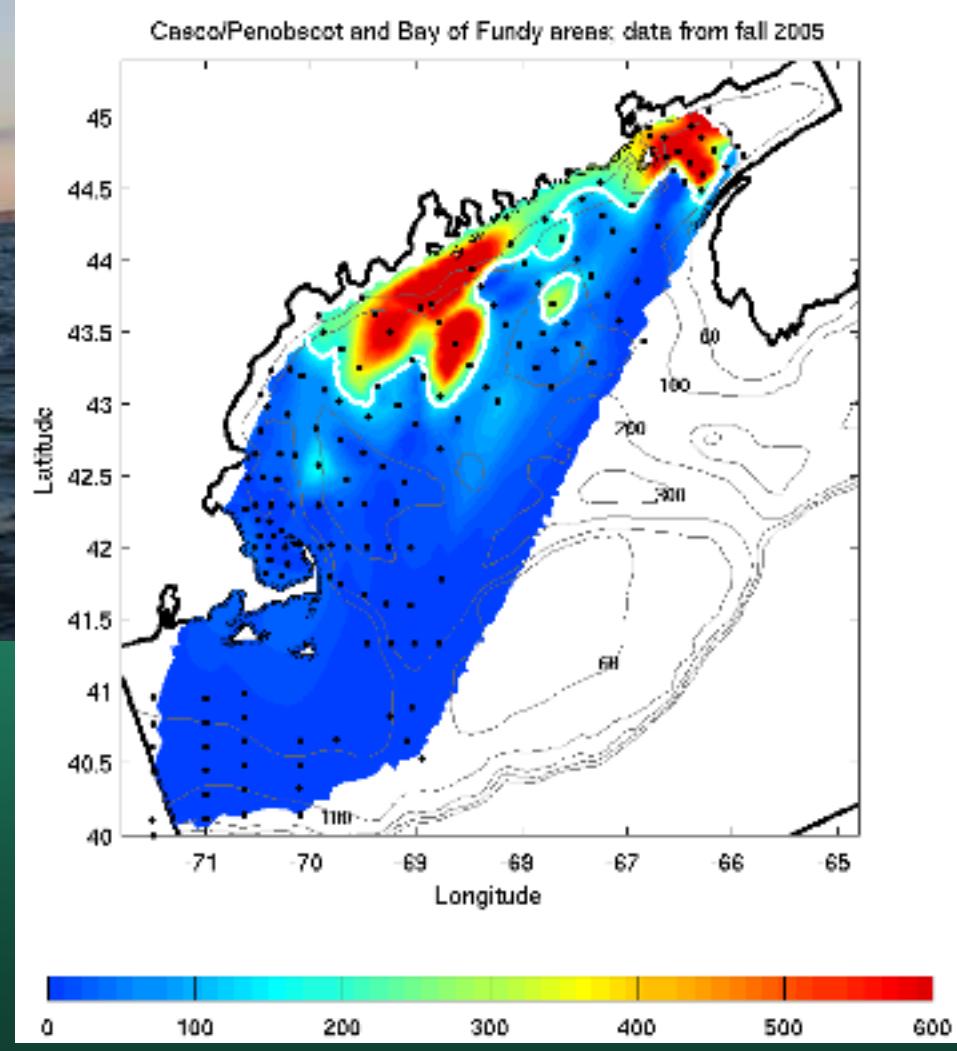
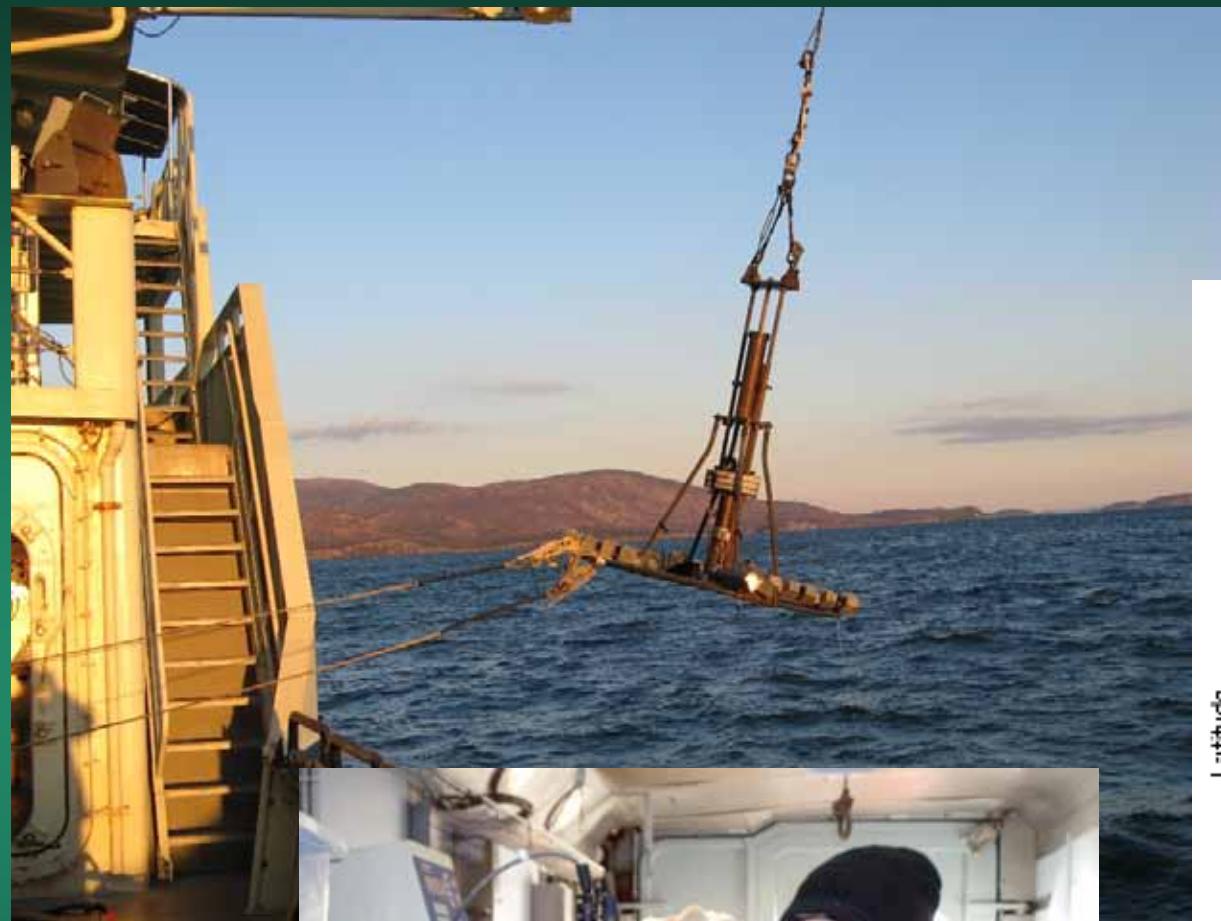
Weather patterns and ocean conditions over the next few months will determine whether this year's algal growth approaches the troubles of 2005.

Oceanographers Dennis McGillicuddy (WHOI) and Ruoying He (North Carolina State University) are several years along in the development of a computer model to predict the intensity and location of blooms of the toxic algae *Alexandrium fundyense* in the Gulf of Maine.

Scientists are reluctant to make a "forecast" of precisely where and when the bloom will make landfall because bloom transport depends on



[Enlarge Image](#)
Maps show the results of four different runs of a computer simulation of the cell concentrations of *Alexandrium fundyense* under four different



Successes

- Very strong and productive relationship between scientists and state and federal managers, industry (stakeholders)
- Excellent communications network established as well
- Communication and cooperation between regional managers and funding program managers in Washington
- Management of the HAB problem in GoM now utilizes multiple tools that were derived from research programs
- Scientists and managers together have formulated future research topics that build on past successes
- Despite a very dangerous widespread and recurrent problem, shellfish fisheries in the GoM region remain healthy and viable.

Lessons learned

- Development of national and regional science plans helps to establish priorities and facilitates funding success.
- Involvement of resource managers and industry representatives as PIs and inclusion of NOAA program managers and program representatives provides important management input throughout planning, implementation and transition.
- Frequent PI meetings with clearly identified research theme leaders and teams provides good direction and oversight.
- Periodic workshops with managers and other stakeholders can be highly instructive and can guide research towards more practical outcomes.
- Communication between state and regional resource managers and NOAA program managers can greatly facilitate funding.
- The media can be your friend by highlighting research and management successes, giving visibility to the program and to NOAA.

Lessons learned (cont'd.)

- **Involve NOAA programs and other entities early in the project to facilitate transition**
- **A strong partnership between the resource management community, NOAA program managers, research scientists, and industry is a win-win-win-win situation.**

Acknowledgements

**NOAA/Center for Sponsored Coastal Ocean Research/Coastal
Ocean Program**

ECOHAB Grant #NA06NOS4780245

Event Response Funds

and

NOAA / NMFS Federal Disaster Relief Funds

