

Citizen Scientist Monitoring HABs and Changes in Environmental Conditions

Promoting a better understanding of Harmful Algal Blooms by way of volunteer monitoring.

Steve L. Morton, Ph.D.
Research Oceanographer
Marine Biotoxins Program



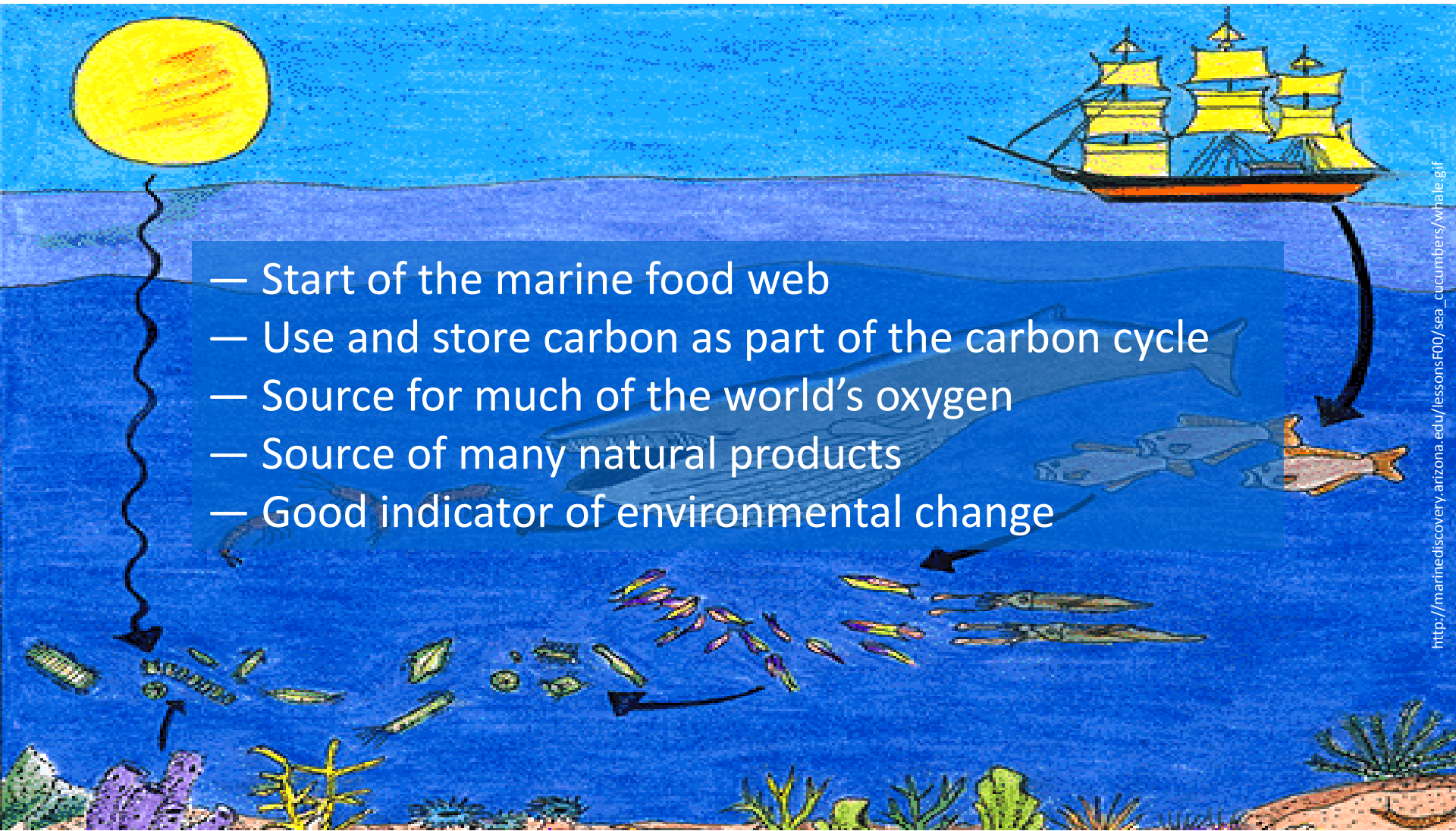
NOAA Marine Biotoxins Program

<http://www.chbr.noaa.gov/pmn/>



PHYTOPLANKTON IMPORTANCE

- Start of the marine food web
- Use and store carbon as part of the carbon cycle
- Source for much of the world's oxygen
- Source of many natural products
- Good indicator of environmental change





MARINE BIOTOXINS PROGRAM SERVICES



Phytoplankton Monitoring Network

Network that monitors distribution of harmful algae and species composition throughout the coastal US. Observations and samples by PMN monitors assist the research that is being done by the Marine Biotoxins program.



Analytical Response Team

Provides rapid and accurate identification and quantification of marine algal toxins in suspected harmful algal blooms, marine animal mortality events and human poisonings.

Identification and analytical capability provides support for management agencies that can then make timely and informed decisions impacting stakeholders involved in coastal wildlife, human health and commerce.

Phytoplankton Monitoring Network



PMN Mission ~

“To educate the public on harmful algal blooms (HABs) while expanding the knowledge of phytoplankton that exist in coastal waters.”



Program Goals

- Monitor and maintain an extended survey area along coastal waters throughout the year
- Create a comprehensive list of harmful algal species inhabiting coastal marine waters
- Promote an increased awareness and education to the public on HABs
- Identify general trends where HABs are more likely to occur
- Isolate areas prone to harmful algal blooms (HABs) for further study by researchers in effort to assist state managers in mitigating the affects of HABs
- Create a working relationship between volunteers and researchers
- Increase the public's awareness of research conducted by federal workers on HABs



HAB SAMPLING PLAN



Credit: NOAA

STEP 1:



Conduct 3-min net tow, record water temperature and salinity



Credit: NOAA

STEP 2:



Collect 1L & 30mL live whole water grab samples



STEP 3:



Analyze net tow sample for **TARGET SPECIES**



Credit: NOAA

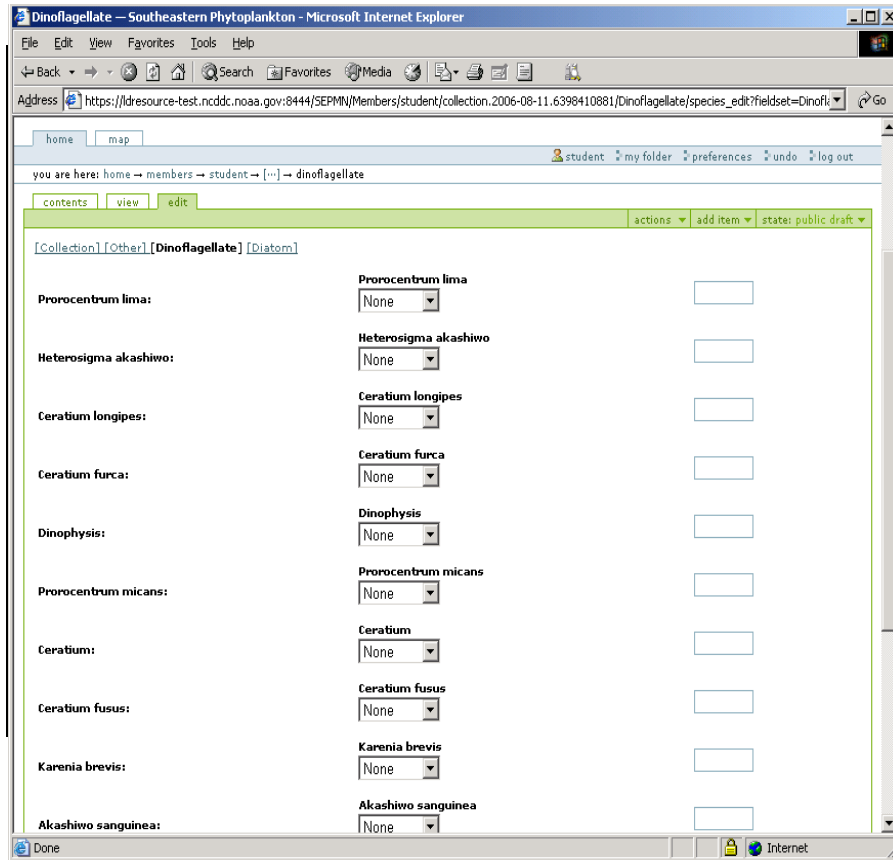
STEP 4:

If **TARGET SPECIES** are identified, prepare necessary samples for UPS shipment

▶ **SAMPLING**

▶ **SCREENING**

Volunteer Responsibilities



The screenshot shows a web browser window titled "Dinoflagellate - Southeastern Phytoplankton - Microsoft Internet Explorer". The address bar shows a URL from a NOAA test environment. The page content includes a breadcrumb trail "you are here: home -> members -> student -> [...] -> dinoflagellate" and a navigation menu with "contents", "view", and "edit" options. The main area is a data entry form for various dinoflagellate species, each with a dropdown menu set to "None" and an adjacent empty text input field. The species listed are:

Species Name	Dropdown Menu	Text Input Field
Prorocentrum lima:	None	
Heterosigma akashiwo:	None	
Ceratium longipes:	None	
Ceratium furca:	None	
Dinophysis:	None	
Prorocentrum micans:	None	
Ceratium:	None	
Ceratium fusus:	None	
Karenia brevis:	None	
Akashiwo sanguinea:	None	

- Attend a PMN Training
- Choose a convenient sampling location
- Sample weekly or bi-weekly
- Perform preliminary phytoplankton identification
- Preserve species or unknowns in high abundance
- Ship samples to PMN offices
- Submit data to PMN via secure on-line entry tool

Volunteer Equipment

Volunteers are loaned all sampling equipment



Photo credit: Elizabeth Zerai

- Refractometer
- 20 um mesh plankton net
- Thermometer
- 5 gridded slides
- Cover slips
- 250 mL bottles
- 1L bottles
- 15mL of Lugol's solution for preservation

*Region specific volunteer manual

*The PMN Manual has data sheets, phytoplankton ID sheets, and HAB information specific to your local coastal waters.



Use of Technology

WebEx communication

Digital microscopes/photography

Interactive web site and GIS mapping





“Phyto” Smart Phone App

Flash Card Game



A Phytoplankton App for the iPod Touch and iPhone

Description

Phyto helps you learn to identify phytoplankton and their proper pronunciation. It includes the most common salt water phytoplankton. The program consists of two main modes. The first mode is a listing of the different species and includes different images taken with a light microscope and the ability to hear the correct pronunciation. The second mode is a flash card game to help you improve your phytoplankton identification skills.

This application was developed by a volunteer member of the [Phytoplankton Monitoring Network](#) which is sponsored by the Center for Coastal Environmental Health and Biomolecular Research division of the U.S. National Oceanic and Atmospheric Administration (NOAA).

Demo on YouTube Apple App Store

Developed by PMN volunteer Shawn Gano, to assist with and to improve volunteer’s identification skills of marine algae in the Gulf of Mexico region.

Species List

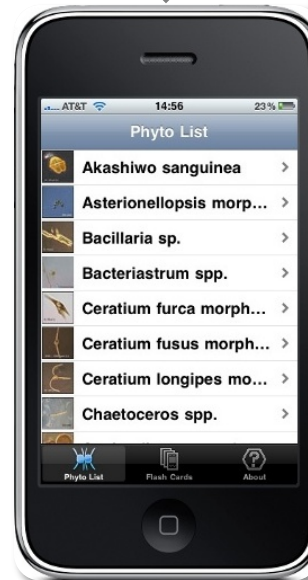
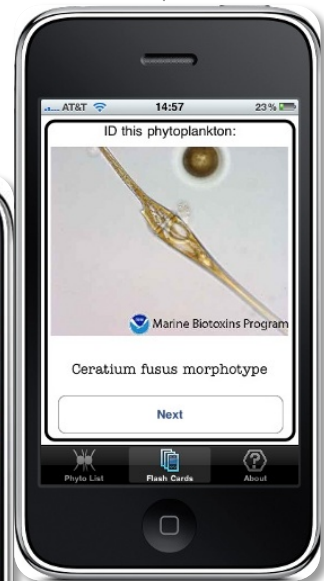
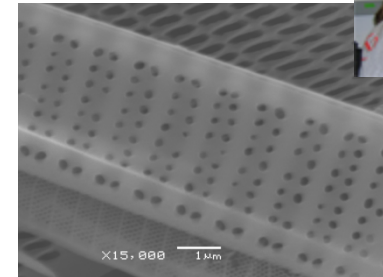


Image Gallery & Pronunciations



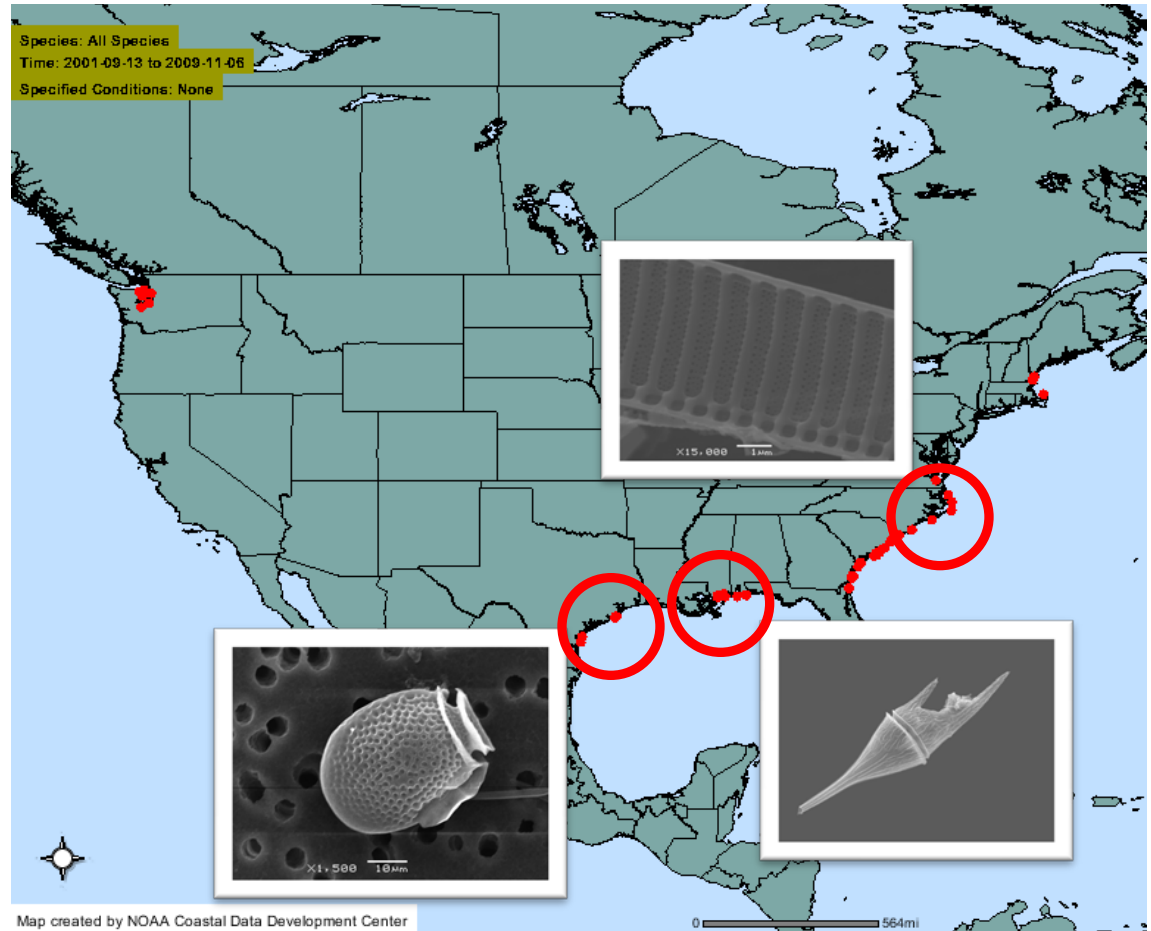
When a Bloom is reported



Bloom Events (2001-2012)

NOAA Phytoplankton Monitoring Network

Total Blooms: 200 Non-toxic: 163 Toxic: 37



Windows to Research & Response

Phytoplankton Monitoring Network

Identifies First Recorded Bloom of a Toxic Pseudo-nitzschia species in North Carolina Waters



A bloom of *Pseudo-nitzschia* was observed by students of First Flight High School and

preserved samples sent to the Marine Biotoxins Program were positively identified using scanning electron microscopy as *Pseudo-nitzschia multiseriis*, and shown by LC-mass spectrometry to produce domoic acid. The identification of *P. multiseriis* in North Carolina's waters is another example where a volunteer monitoring program is useful in developing a species list and record of distribution patterns, as well as alerting NOAA scientists to the presence of potentially harmful species.

PMN Findings Help Lead to the...

First time Identification of Domoic Acid in Marine Mammals in Southeastern U.S Waters

Domoic acid was detected exclusively in *Kogia spp.* stranding in the absence of observed HAB activity. The frequency of occurrence and concentrations of domoic acid suggests potential chronic animal exposure in a region with virtually no history of HABs.



Freshwater Phytoplankton

Monitoring Network

Promoting a better understanding of Cyano Harmful Algal Blooms by way of volunteer monitoring.

*2010 Pilot Project Sampling
Season*



Pilot Program Collaborators

Community members that have expressed concerns about lake quality and whether the presence of HABs and HAB toxins in the local waters has any adverse health impacts on people and animals (e.g. respiratory complaints and headaches).



Pilot Project Impacts:

Develop partnerships with communities impacted by HABs, public health practitioners, and scientists and engineers dedicated to addressing HAB-related public health issues.

- Enhance environmental awareness about HABs
- Increase community knowledge of the occurrence and extent of freshwater HABs





From the PMN data collected...

Enhance our understanding of the public health threats from HABs present in drinking and recreational waters and small community lakes surrounded by homes.

Pilot Program

Volunteer Requirements:

- **Collect** sample at least once every two weeks during the sampling season (May – Ice)
- **Analyze** sample, identifying target algae
- **Take** digital pictures to send into the FPMN
- **Input** data into the FPMN database
- **Notify** FPMN of any human or animal health issues
- **Ship** samples to the FPMN via FedEx when asked

Pilot Program Collaborators



Dr. Lorraine Backer

One of the original creators of the Harmful Algal Bloom-related Illness Surveillance System. Expertise in working in oceans in human health.



Dr. Steve Morton

Principal Investigator of the Phytoplankton Monitoring Network. Expertise and research involves the taxonomy and distribution of phytoplankton.



Dr. Barb Kirkpatrick

Considerable expertise in assessing the public health impacts from Florida Red Tides, including epidemiologic field studies.

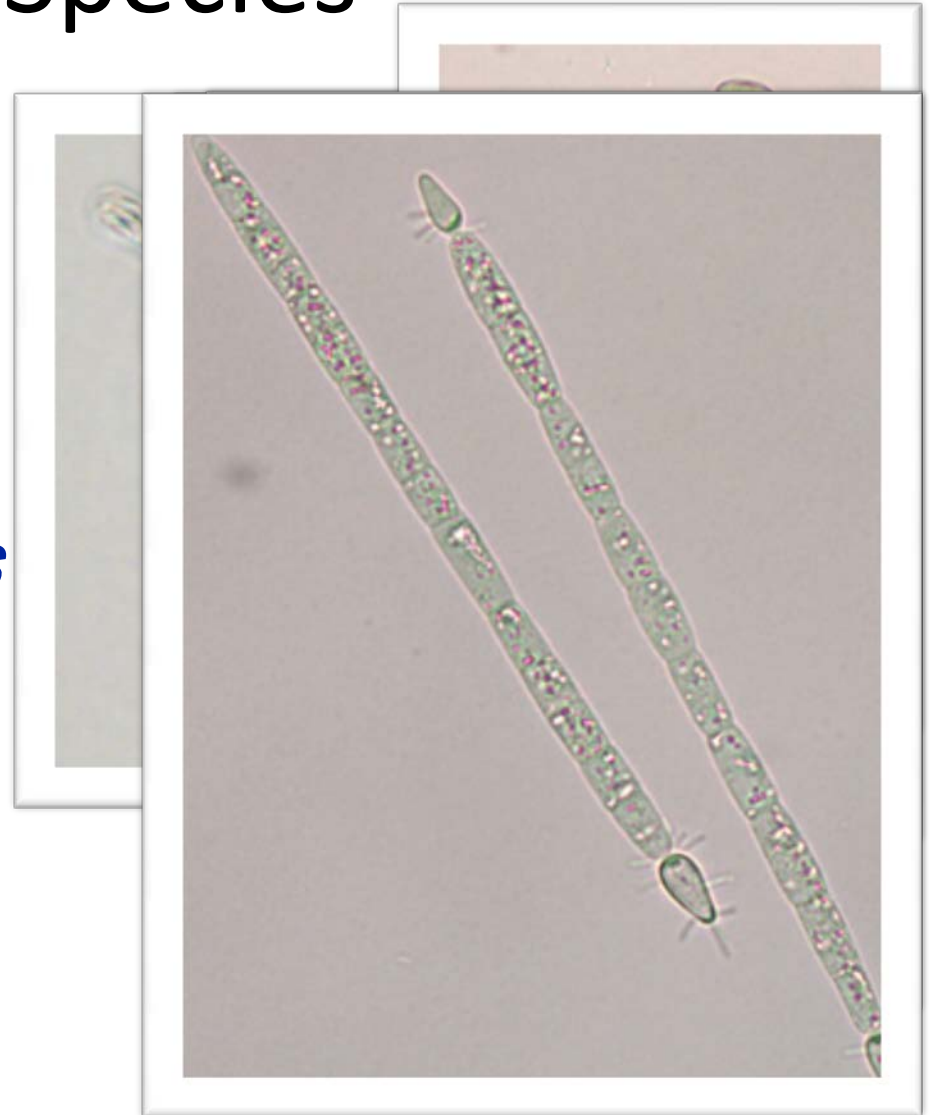
David Austin

Civil and environmental engineer. Expertise is in water resource management and ecological engineering.



Target Species

- *Microcystis*
- *Anabaena*
- *Aphanizomenon*
- *Cylindrospermopsis*
- *Oscillatoria*
- *Euglena*



Environmental Conditions

Condition	No	Yes		
		Mild	Moderate	Severe
Strong smell				
Discolored water				
Mats of algae				
Other (explain)				



Human Health Symptoms

Symptom	No	Yes		
		Mild	Moderate	Severe
Cough				
Wheezing				
Throat irritation				
Shortness of breath				
Nasal congestion				
Eye irritation or redness				
Headache				
Diarrhea				
Rash				
Itchy skin				
Other (explain)				



Wisconsin: 9 Lakes with 34 Volunteers

Minnesota: 2 Lakes with 3 Volunteers

Lotus Lake

Chetek Lake

Petenwell Lake

Castle Rock Lake

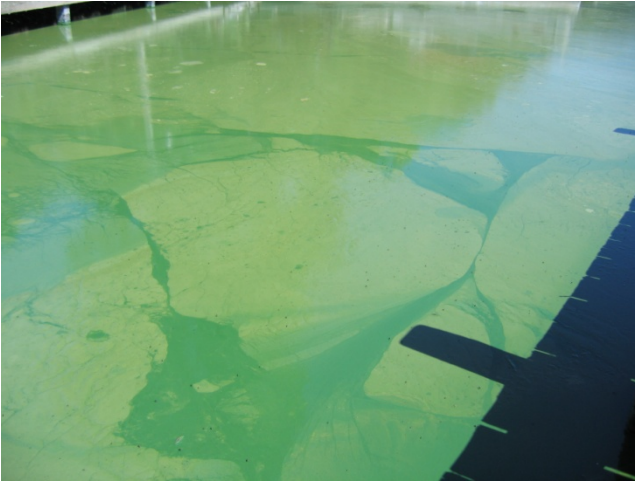
Wisconsin

Milwaukee

Michigan

Over 300 data points during Summer 2010

5 Microcystis blooms and 3 Oscillatoria blooms



Forecasting of HABs



Gulf of Mexico Harmful Algal Bloom Bulletin
 29 November 2005
 NOAA Ocean Service
 NOAA Satellites and Information Service
 Last bulletin: November 7, 2005

Conditions Report

HAB location, expected impacts (low - high), reports of dead fish, respiratory irritation...

Analysis

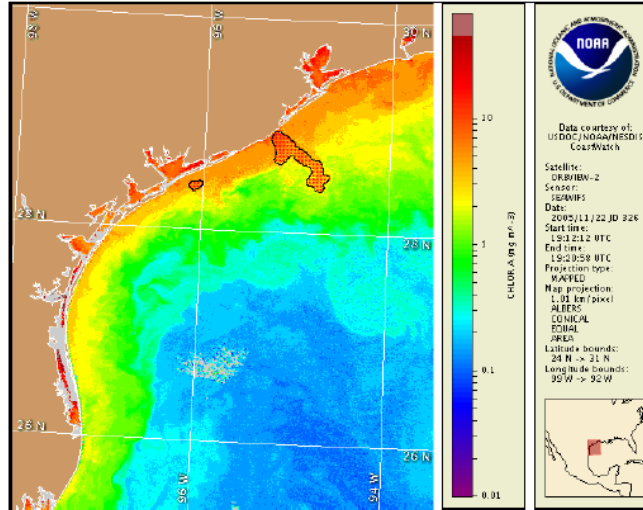
- Description of imagery, high chlorophyll (non-species specific) regions, and areas that have undergone a rapid increase in chlorophyll concentration.

- Projected transport of blooms.

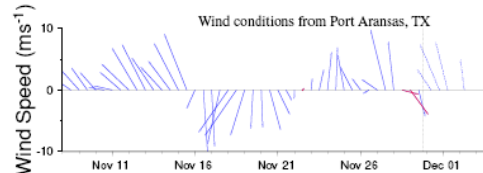
- Anomaly polygons showing high chlorophyll regions with verified *K. brevis*.

- estimates of *K. brevis* bloom location and extent.

- expected impacts and transport of *K. brevis* blooms.



Satellite chlorophyll image with possible HAB areas as shown by red polygon(s).

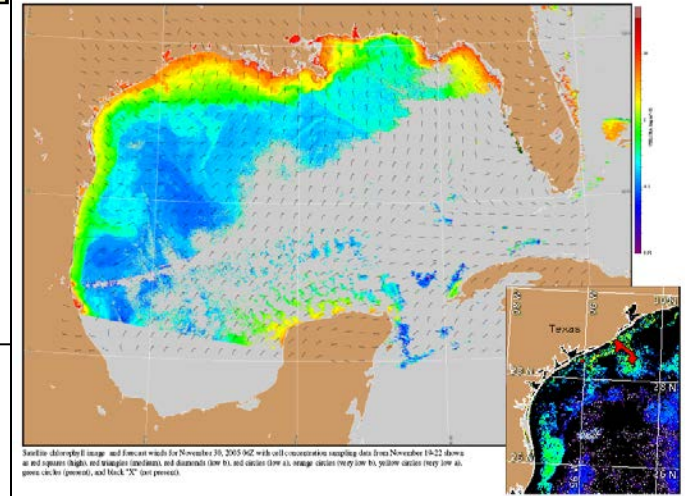


Wind speed and direction are averaged over 12 hours from buoy measurements. Length of line indicates speed; angle indicates direction. Red indicates that the wind direction favors upwelling near the coast. Values to the left of the dotted vertical line are measured values; values to the right are forecasts.

Northerly winds today (10 kts, 5 m/s) today becoming southeasterly tomorrow.

Please note the following restrictions on all SeaWiFS imagery derived from CoastWatch:

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



Satellite chlorophyll image and forecast winds for November 30, 2005 (02 UTC) with cell concentration sampling data from November 19-22 shown as red squares (high), red triangles (low/med), and diamonds (low hi), and circles (low hi), orange circles (very low hi), yellow circles (very low hi), green circles (low/med), and black "X" (not present).

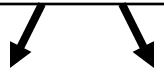
Verified HAB areas shown in red. Other bloom areas shown in yellow (see p. 1 analysis for interpretation).



Observations
(satellite imagery,
Buoys, field samples)

**Analysis of data
and models**

Model output
(physical, ecological,
health impacts)



Conditions Report

Monday, April 26, 2003

Harmful algae has been identified in Northern Brazoria and Southern Galveston Counties. Very low impacts are possible in Northern Brazoria and Southern Galveston Counties today through Thursday. No impacts are expected in any other Texas Counties through Friday.

Conditions Report (public)

Gulf of Mexico Harmful Algal Bloom Bulletin
29 November 2005
NOAA Ocean Service
NOAA Station and Information Service
Last bulletin: November 7, 2005

Conditions Report
HAB location, expected impacts (low - high), reports of dead fish, respiratory irritation...

Analysis
- Description of imagery, high chlorophyll (non-species specific) regions, and areas that have undergone a rapid increase in chlorophyll concentration.
- Projected transport of blooms.
- Anomaly polygons showing high chlorophyll regions with verified *K. brevis*.
- estimates of *K. brevis* bloom location and extent.
- expected impacts and transport of *K. brevis* blooms.

Please see the following restrictions on all SeaWiFS imagery derived from CoastWatch:
1. Data are restricted to civil marine applications only - i.e., federal, state, and local government investigations is permitted.
2. Image products may be published in newspapers. Any other publishing arrangements must receive OMB/NOAA approval via the CoastWatch Program.

Satellite chlorophyll image with possible HAB areas shown by red polygons.

Wind conditions from Port Aransas, TX

Wind speed and direction are averaged over 12 hours from buoy measurements. Length of line indicates speed, angle indicates direction. Red indicates that the wind direction is on an opposing near the coast. Values to the left of the dashed vertical line are measured values; values to the right are forecasts.

Northerly winds today (10 kts, 5 mph) today becoming southeasterly tomorrow.

HAB Bulletin (managers)

What is next

- Western Basin of Lake Erie
- Support the HAB forecast



Conclusion

- Volunteer Phytoplankton Monitoring Networks are a proven key asset in the detection of harmful algal blooms.
- Data generated by volunteers is very useful in many aspects of HAB research and management decisions.

Funding



NOS/NCCOS CCEHBR Marine Biotoxins Base funding
NOS/NCCOS CCMA HAB forecast funds
NESDIS/NOCD/NCDDC Database/IMS backing



HABISS funding for HAB Surveillance in SC

Novel Sources of Surveillance Data for Climate Change



Pleurosigma



Bacillariastrum



Ceratium furca



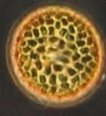
Ceratium fuscum



Protoperidinium



Coccinodiscus



Chaetoceros



Thalassionema

