The National Phytoplankton Monitoring Network:

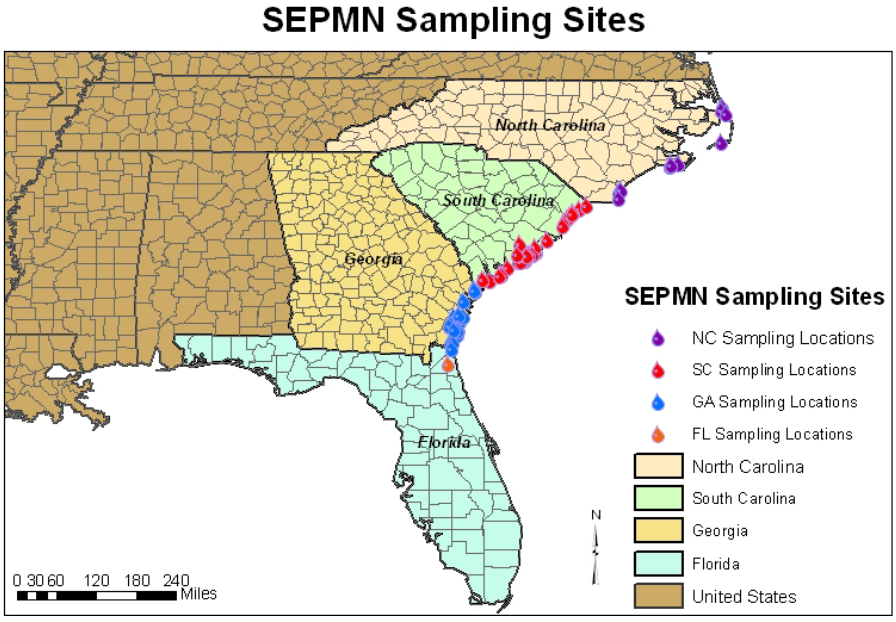
A white paper to employ the SEPMN concept nationally

March 2006

Since its inception in 2001 the Southeast Phytoplankton Monitoring Network has received requests to broaden its coverage of coastal regions within the U.S. The network originally implemented in South Carolina has carefully expanded its coverage to include Georgia, North Carolina, and northern Florida and in FY06 will include regions in Maryland. However, additional requests from other U.S. coastal regions as far as Alaska, the Hawaiian Humpback Sanctuary and St Thomas, US Virgin Islands. A National strategy is essential to efficiently incorporate these and regions still requiring monitoring and others which are operating independently. This moment is opportune, because of the need of a National Phytoplankton Monitoring Network to support of initiatives for HAB forecasting and observing systems within NOAA.

THE SOUTHEAST PHYTOPLANKTON MONITORING NETWORK (SEPMN)

In 2001, the South Carolina Phytoplankton Monitoring Network (SCPMN) was established by NOAA's Marine Biotoxins Program, located at the Center for Coastal Environmental Health and Biomolecular Research (CCEHBR) and the Hollings Marine Lab (HML) in Charleston, SC, as an outreach program to unite volunteers and scientists in monitoring the marine phytoplankton community and harmful algal blooms. SCPMN recruited 10 volunteer groups to sample marine and coastal waters for phytoplankton in order to learn what types of phytoplankton exist. The program was so successful that it expanded throughout the coastal regions of the state. In October 2003, a collaboration with SC Sea Grant's Center for Ocean Sciences Education Excellence – SouthEast (COSEE-SE) led to a partnership with educators in North Carolina, South Carolina, and Georgia to form the Southeast Phytoplankton Monitoring Network (SEPMN). To date, there are 62 volunteer groups monitoring 76 sites along the southeast Atlantic coast from the northern Outer Banks in North Carolina to Jacksonville, Florida.



Volunteers are instructed on algae identification and sample on a weekly or biweekly basis, reporting their data to researchers at the Marine Biotoxins Program. Each volunteer group is supplied with a plankton net, thermometer, salt refractometer, and an Olympus MIC-D digital microscope. Groups are instructed on the identification of 26 species. However, if a species is observed in high abundance which is not on this list, species are preserved and sent to the Marine Biotoxins Program for positive identification. Results from volunteer groups enable researchers to identify problem areas to isolate for further study.

The majority of SEPMN volunteer groups include teachers and students in grades 5 through 12, however, universities, aquariums, parks and recreational facilities, and environmental and citizen groups participate as well. Students and volunteers receive training in sampling methods, plankton taxonomy and ecology, microscopy, and phytoplankton identification, and then participate in sampling on a weekly or biweekly basis, reporting their data to researchers at the Marine Biotoxins Program. During 2005, approximately 3000 participants were actively involved in SEPMN programs and monitoring activities. Since its inception in 2001, SEPMN volunteers have submitted over 3200 data sets. In this process they have identified 40 harmful algal blooms and generated valuable data on species composition and distribution in southeastern coastal waters.

SEPMN MISSON STATEMENT

"To educate the public, particularly students, on harmful algal blooms (HABs) while expanding the knowledge of phytoplankton that exists in the Southeast Atlantic coastal waters."

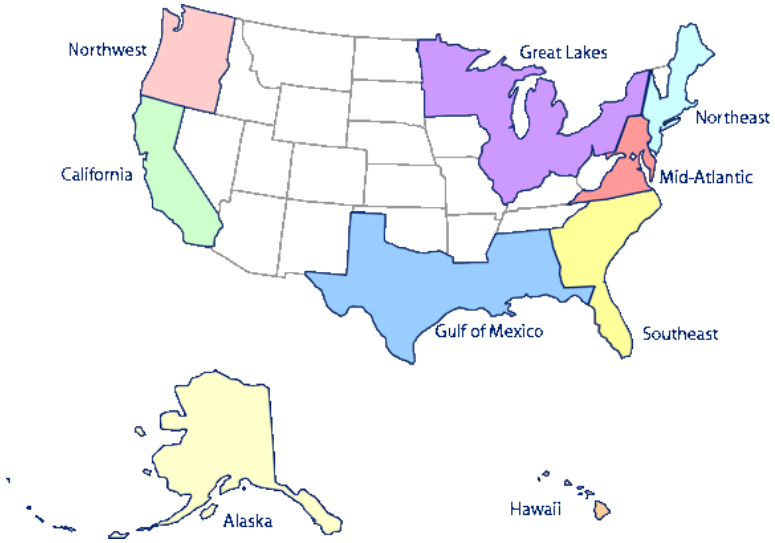
SEPMN GOALS INCLUDE:

- To create a comprehensive list of marine phytoplankton and potentially harmful algal species;
- To monitor and maintain an extended survey area year-round
- To isolate areas prone to harmful algal blooms (HABs) for further study by researchers;
- To identify general trends, such as time and area, where HABs are more likely to occur;
- To increase public awareness of phytoplankton and HABs through education and outreach;
- To increase public awareness of research conducted by federal, state, and private researchers;
- To support communication and interaction between researchers and the public via SEPMN volunteers.

A NATIONAL PHYTOPLANKTON MONITORING NETWORK (NPMN)

Using the successful monitoring protocols and outreach applications of SEPMN in North Carolina, South Carolina, Georgia and Florida, NOAA would like to expand the concepts of SEPMN into additional states and regions of the United States. To achieve this goal, two different approaches are proposed: (1) the incorporation of additional states into SEPMN and (2) the "franchising" of methods used by SEPMN. Regardless of approach, proposed United States regions would include Northeast, Mid-Atlantic, Southeast, Gulf of Mexico, California, Pacific Northwest, Alaska, and Hawaii with the possibility of future inclusion of monitoring freshwater HABs in the Great Lakes through the NOAAs FY08 PPBES for HAB forecasting.

Potential Regional Phytoplankton Monitoring Networks



Implementation

NOAA will coordinate a workshop and meeting for the coordinators of existing monitoring networks to encourage collaboration for developing national monitoring protocols and outreach activities. State stakeholders such as state Department of Natural Resources, phytoplankton researchers and educational specialists would be invited to participate in order to ensure that the goals of the monitoring network remain intact. The newly-created National Phytoplankton Monitoring Network will have a board of advisors to ensure the science and education goals for the network are up-to-date with current research and in line with state and national science education standards.

NOAA funding will be used to supply sampling equipment, digital microscopes, training, web-based infrastructure, and identification of unknown phytoplankton species. NOAA will provide funding for existing monitoring groups to assist them in aligning their monitoring efforts with the goals of SEPMN. Regional and state coordinators

would receive annual training at the NOAA Laboratory in Charleston, SC. A National Coordinator would be responsible for organize and conduct one-on-one instruction of regional coordinators, develop and maintain web-based infrastructure, as well as data management and analyses, newsletter creation, and outreach activities.

The incorporation of additional regions within the National Phytoplankton Monitoring Network will utilize existing infrastructure such as the NOAA's Marine Sanctuaries program (http://www.sanctuaries.nos.noaa.gov/), COSEE Network (http://www.cosee.net), NOAA's National Estuarine Research Reserve System (http://nerrs.noaa.gov/) NOAA's SeaGrant Offices, and other NOAA facilities and programs such as the Oxford Cooperative Laboratory. The NOAA Charleston laboratory would be responsible for hiring regional and state coordinators. The franchising of methods used by SEPMN would allow incorporation of existing monitoring efforts such as Native American tribes in Alaska and the Pacific Northwest and existing state phytoplankton networks. This method will create a centralized location for the training of regional coordinators, sharing of methods and protocols, along with web-based GIS and database infrastructure at the NOAA facilities in Charleston, SC. The existing volunteer phytoplankton monitoring networks of Maine, Connecticut, Delaware, Oregon, and California would be a base group in each region. Regardless of the method of expansion, a NOAA contract employee would coordinate each region in a centralized office. These

regional coordinators would be responsible all aspects of the monitoring network within each region.

Rationale for a National Phytoplankton Monitoring Network

Similar state-scale volunteer phytoplankton monitoring networks exist within Maine, Connecticut, New Hampshire, Delaware, Florida, and California. These state programs were initiated in response to specific human disorders caused by blooms of HAB organisms. For example, the California Phytoplankton Network examines coastal waters for blooms of the diatom, *Pseudo-nitzchia* while the Florida Network examines for blooms of the dinoflagellate *Karenia brevis*. Both these programs instruct personnel on the collection of samples which are sent to state researchers for identification. In the New England states of Maine, Connecticut, and New Hampshire, samples are collected and identified by volunteers and data is collected by state personnel. These monitoring efforts include both school and civic groups which focuses on known HAB species such as *Alexandrium* and *Dinophysis*. The Delaware program is made of civic groups monitoring a number of different species with no involvement with schools. The strengths of each program have been incorporated into the SEPMN framework at the inception of the program in 2001. These existing state phytoplankton programs are limited in scope, participation, and funding.

A National Network would provide opportunities for students to participate in a real science research while offering researchers opportunities to not only study the "sentinel" HAB species in their area but to also learn more about the interactions these sentinel species have with other cosmopolitan algal species. Expanding SEPMN to the National Phytoplankton Monitoring Network will unite these programs under one umbrella through collaborating with these existing monitoring programs.

Benefits of a National Phytoplankton Monitoring Network

The benefits of a National Phytoplankton Monitoring Network would include:

1) The identification of algal blooms over a large monitoring area. The utilization of volunteer monitoring groups is a cost effective means of the development of a national surveillance of HABs along the coast of the United States. The observations of blooms will alert state managers and HAB researcher to these events.
2) Providing a one-stop depository of HAB data from the volunteers. This will enable for researchers to look at HAB events nationally in one snap shot via web-based GIS.
3) Samples of blooms reported by volunteers could be collected, preserved and/or cultured for testing of genetic variability, toxin production, etc. These samples would be available to researchers that participate in the national monitoring network.
4) Increasing public awareness and interest in HAB events will potentially increase public support for funding HAB research.

5) Creating partnerships between regional phytoplankton monitoring networks and programs such as the Integrated Ocean Observing System.
6) The standardization of methods and outreach materials supplied by regional phytoplankton monitoring networks.
7) The National Phytoplankton Monitoring Network would give national recognition to NOAA though innovative outreach and scientific results through presentation, articles and group interactions.
8) Providing volunteer benefits such as teacher professional development, promotion of science careers, improving quality of science education and public ocean literacy.

ALIGNMENT OF NPMN TO NOAA GOALS AND INITIATIVES

Alignment with the National HAB Plan

The NOAA supported national plan directing HAB research, *HARRNESS, Harmful Algal Research and Response: A National Environmental Science Strategy 2005-2015* recognized the critical need for outreach programs to maintain and disseminate information about HABs and to produce educational programs to produce a greater community awareness of HABs and a resurgence of stewardship of coastal ecosystems. As shown by SEPMN volunteers, students and nonscientists can play an important role in monitoring coastal waters. Thus, the National Phytoplankton Monitoring Network offers an ideal pedagogic vehicle to explore the interrelationships between humans and the coastal environment, at the same time providing students with meaningful opportunities for hands-on engagement in science. The SEPMN has achieved proven success in outreach and education by directly engaging students, educators, and the private groups in field sampling and laboratory work.

Alignment with NOAA HAB Ecological Forecasting

NOAA has conducted nearly a decade of research and monitoring to improve HAB forecasting capabilities and to transfer successful prototype forecasting products from a research to an operational mode within or outside of NOAA. As part of the FY08-12 PPBES process, NOAA has identified several transition products for forecasts that will become operational. A National Phytoplankton Monitoring Network is one forecasting product identified for application testing.

Alignment with Observing Systems

The U.S. Commission on Ocean Policy and the National Ocean Research Leadership Council identified the Integrated Ocean Observing System (IOOS) as a high priority for the United States. IOOS is the United States' contribution to the Global Ocean Observing System (GOOS), and a contribution to the Global Earth Observation System of Systems (GEOSS). GOOS is currently being designed and implemented to meet the requirements of a number of international agreements and conventions. NOAA has been chosen as the lead federal agency and the Co-Chair of the educational and training sub-committee of IOOS.

IOOS contain seven societal goals (Weather and Climate, Marine Operations, Natural Hazards, National Security, Public Health, Healthy Ecosystems and Sustained Resources) with 20 core variables. Phytoplankton species composition is a key core variable in 6 of 7 societal goals of IOOS. Collection of salinity and temperature is included in every societal goal; each volunteer group which makes up SEPMN collects both water temperature and salinity. SEPMN has shown to be a cost effective means of collection phytoplankton species composition and environmental parameters such as salinity and temperature. Data collected by volunteer groups can also be utilized to "ground-truth" satellite imagery at the heart of IOOS.

Alignment with NOAA's Educational Mission

The National Phytoplankton Monitoring Network has direct alignments with the four main strategies detailed in the NOAA Education Plan, identified below:

Strategy 1 – Integrate NOAA sciences into high-quality educational material: *This strategy statement describes precisely the overall intent of the proposed work. SEPMN has already created multi-subject/multi-grade level standards-based science curriculum focused on HABs and phytoplankton. The national expansion will allow for additional creation and implementation of high-quality educational materials to be disseminated nationally among formal and informal educators.*

Strategy 2 - Improve access to NOAA educational resources: *This project will not only develop new educational resources for NOAA, but will make them widely available online. This project will also be promoted at various local and national educational conferences.*

Strategy 4 – Promote participation in NOAA-related sciences and careers, particularly by members of underrepresented groups: *The SEPMN has a proven track record of engaging students in doing science; this project will build upon the Network's successes by engaging a much larger audience through collaborations with other educational and scientific groups and organizations as well as the World Wide Web.*

A student identifying marine phytoplankton in class

Conclusion

The SEPMN concept of linking scientist and volunteer groups has a proven track record of success of raising the awareness of HAB issues and research to a broad range of continuant groups. Teachers who participate in the program have noticed a raise in test scores and general enthusiasm in science education by their students. A number of known toxic HAB species have been observed by volunteer groups which were originally not known to exist in the Southeastern coast of the United States. The creation of a National Phytoplankton Network would provide opportunities for students to participate in a real science research while offering researchers opportunities to not only study the "sentinel" HAB species in their region but to also learn more about the interactions these sentinel species have with other cosmopolitan algal species. The goals of the National Phytoplankton Monitoring Network are inline with the Ocean Literacy Initiative (www.oceanliteracy.org). Since ocean science is not required in the classroom at any level, programs like SEPMN links individual state science standards of biology into ocean sciences. Expanding SEPMN to the National Phytoplankton Monitoring Network will unite differing regional phytoplankton monitoring networks under one umbrella to share facilities, methods, and results.