Mote / University of South Florida
Fixed-Price Subagreement
MERHAB 2002: Eastern GOMx Sentinel Program

Progress Report
For the Period 08/01/05 to 02/28/06

To
Florida Institute of Oceanography, University of South Florida
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For
Florida Fish and Wildlife Conservation Commission
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I. INTRODUCTION

Blooms of the red-tide dinoflagellate, _Karenia brevis_, occur annually in Florida coastal waters of the eastern Gulf of Mexico (GOMx) and present serious impacts to marine resources, public health, and community economics. To minimize these impacts, early forecasting of and subsequent mitigation for bloom events are the goals of federal, state, academic, and private partnerships. The difficulty in forecasting occurrence and impacts of _K. brevis_ blooms can be traced to the absence of appropriate monitoring technologies. Clearly, the successful, operational utility of any monitoring program (and any resulting mitigation strategies) will be dependent upon synoptic-scale, real-time sampling, regional-based data assimilation and modeling and adaptive, event-response confirmation.

_MERHAB 2002: Eastern GOMx Sentinel Program_ is a multi-investigator and multi-disciplinary program to develop and assess the utility of a networked system of autonomous sampling platforms incorporating physical/chemical- and bio-sensor packages. As such, it will facilitate model and forecast initializations and state-wide, adaptive field sampling. Monitoring platforms for sensor deployment will utilize both existing and newly established buoys (The West Florida Coastal Ocean Monitoring and Prediction System) and Bottom-Stationed Ocean Profilers (autonomous, water-column profiling vehicles carrying modular sensor payloads). The bio-sensors, including an optical phytoplankton detector and a sample processor containing a molecular-probe array, are existing first generation instruments that previously have provided positive, consistent results in both laboratory and field trials and show great promise for remote, autonomous discrimination of _Karenia brevis_. Generated data will be used to initialize a coupled bio-physical model for forecasting the development and movement of _K. brevis_ red tides. In addition, the data can be used for (near) real-time ‘ground-truthing’ of a NOAA/NOS forecast tool based on satellite ocean-color imagery and other forecast tools.

This FIO subagreement represents Mote Marine Laboratory’s obligations for the MERHAB 2002: Eastern GOMx Sentinel Program. The project period began on June 6, 2005 and continues through February 25, 2006. This project focuses on four major tasks:

1) **Maintain operation of the deployed bio-optical sensors.**
2) **Conduct Field-based Comparisons of the bio-optical sensor and autonomous Sandwich Hybridization Assay (SHA) system, evaluate and develop a coupled sensor with the SHA system.**
3) **Monitor Sarasota Transect.**
4) **Develop future integrated sensor technologies.**

II. PROGRESS DURING REPORTING PERIOD

A. **Maintain the operation of the deployed bio-optical sensors.**

Two Optical Phytoplankton Discriminators (OPDs) were fabricated and deployed during the first year, one on a BSOP and one on COMPS buoy C10. During the second year two additional OPDs were fabricated and tested. One was designated as the maintenance spare and one assigned to COMPS buoy C15. During this reporting period an OPD was
installed on the C15 buoy and all four OPDs were maintained in rotation. Also, a real-time reporting system was developed for OPDs within telemetry range of a shore-based receiving station. The OPD on C10 is currently not able to transmit to shore, but the unit on the C15 buoy is within range and reports *Karenia brevis* Similarity Index, Colored Dissolved Organic Material (CDOM) parameters and instrument status every 2 hours. These data are automatically stored in a database and reported in tabular and graphic form on the Sarasota Operations of the Coastal Ocean Observation Laboratories (SO COOL) webpage (http://coolgate.mote.org/socooll) maintained at Mote Marine Laboratory.

B. **Conduct Field-based Comparisons of the bio-optical sensor and Sandwich Hybridization Assay (SHA) system, evaluate and develop a coupled sensor with the SHA system.**

Two 4-day cruises were conducted on the R/V Suncoaster to run the OPD and the SHA system on the same natural water samples. Those cruises took place on September 27-30, 2005 and November 7-11, 2005 in the eastern Gulf of Mexico. Both cruises were conducted during periods when *Karenia brevis* concentrations were high. During the November cruise the distribution of *K. brevis* was observed to be in filaments paralleling the coastline. These filaments were evident in MODIS remote chlorophyll fluorescence imagery, in the underway chlorophyll fluorometer data and OPD results (Figure 1).

C. **Monitor Sarasota transect (conducted via other funding).**

During this reporting period two three-day cruises of the R/V Clark were conducted October 18-20 and January 10-12, and one two-day survey was conducted February 15-16, 2006. These survey cruises included the Sarasota transect with simultaneous OPD deployments on the C10 and C15 buoys. All processed data were provided to FWRI.

D. **Develop future integrated sensor technologies.**

During this reporting period plans were put in place to deploy the OPD and the SHA system simultaneously near the C10 buoy. The SHA system will be deployed by Monterey Bay Aquarium Research Institute in September 2006 if deployment funds can be found. Mote Marine Laboratory will support the deployment with boats, personnel and laboratory workspace. Daily boat trips will be conducted, weather permitting, to acquire validation samples.

Work was conducted on the redesign of the water flow scheme through the OPD to improve the spatial resolution of the OPD integrated into the BSOP. An enhancement is being tested in the laboratory to improve the sensitivity of the OPD by disrupting the phytoplankton cells prior to absorbance measurements. In addition, design work continued on a drifter version of the OPD.

III. **WORK PLANNED FOR NEXT REPORTING PERIOD.**

A. **Maintain four bio-optical sensors.**
The three OPDs for buoy deployment will be maintained and exchanged as required to provide near-continuous operation on the C10 and C15 buoys. The OPD integrated in the BSOP will be maintained as needed for deployments of opportunity.

**B. Conduct Field-based Comparisons of the bio-optical sensor and autonomous Sandwich Hybridization Assay (SHA) system, evaluate and develop a coupled sensor with the SHA system.**

Mote will support the simultaneous deployment of OPDs on buoys and the SHA system on its own buoy in September 2006. Daily boat trips to the site will recover water samples for validation of the observations of the instruments.

**C. Monitor Sarasota Transect.**

Cruises of the R/V Clark are scheduled every six-weeks during the next reporting period, supported by the State of Florida, and include the Sarasota transect. All data will be provided to the FWRI.
Figure Gary 1. Similarity indexes for Karenia sp. from the BreveBuster collected while underway during the November 2005 MERHAB cruise onboard the R/V Suncoaster. Background images, produced by USF/IMaRS, are MODIS Fluorescence Line Height. Upper left panel is from November 7, 2005, the upper right panel from November 8, 2005, the lower left panel from November 9, 2005 and the lower right from November 10, 2005. Similarity index below 0.6 indicates less than 10% of the chlorophyll biomass is Karenia sp. Values above 0.7 indicate that more than 40% of the biomass is Karenia sp.