

Lake Erie Protection Fund Final Reporting
Sandusky Bay Algal Bloom Early Warning Study
Lake Erie Protection Fund SG427-12



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Abstract:

Harmful Algal Blooms (HAB's) have become a serious concern for Lake Erie in the past two years. The HAB's observed during 2011 were the largest Lake Erie has seen in decades. Erie County and surrounding communities depend on a large recreational tourism industry to support our economy, especially over the warm summer months. The impacts of the HAB's have the potential to impact our health and economy. The objective of the Sandusky Bay Algal Bloom Early Warning Study was to track HAB's in the Sandusky Bay during 2012. Our department was able to track HAB's with the combination of satellite imagery, provided by National Oceanic and Atmospheric Administration (NOAA), as well as water sampling throughout 2012. The sampling performed by our agency will aid in the validation of predictive models produced by NOAA from their satellite imagery. This grant allowed our department to perform 42 microcystin toxin samples and 120 quantitative water characterizations samples in the Sandusky Bay and Lake Erie during 2012. The results of our work will aid in more accurate predictive models for future tracking of HAB's. In turn this information could be used in early detection and future prevention of HAB's.

This project was funded through the Lake Erie Protection Fund (LEPF). The LEPF is supported by the voluntary contributions of Ohioans who purchase the *Erie...Our Great Lake* license plate featuring the Marblehead lighthouse.

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Technical Report:

The Erie County Health Department began sampling 5 locations (Bay View East/Driftwood Cottages [1], Lion's Park [2], Shelby Street Boat Launch [3], Battery Park [4], and Kiwanis Park/Big Island [5]) along the south shore of the Sandusky Bay routinely from January 31, 2012 through October 24, 2012.

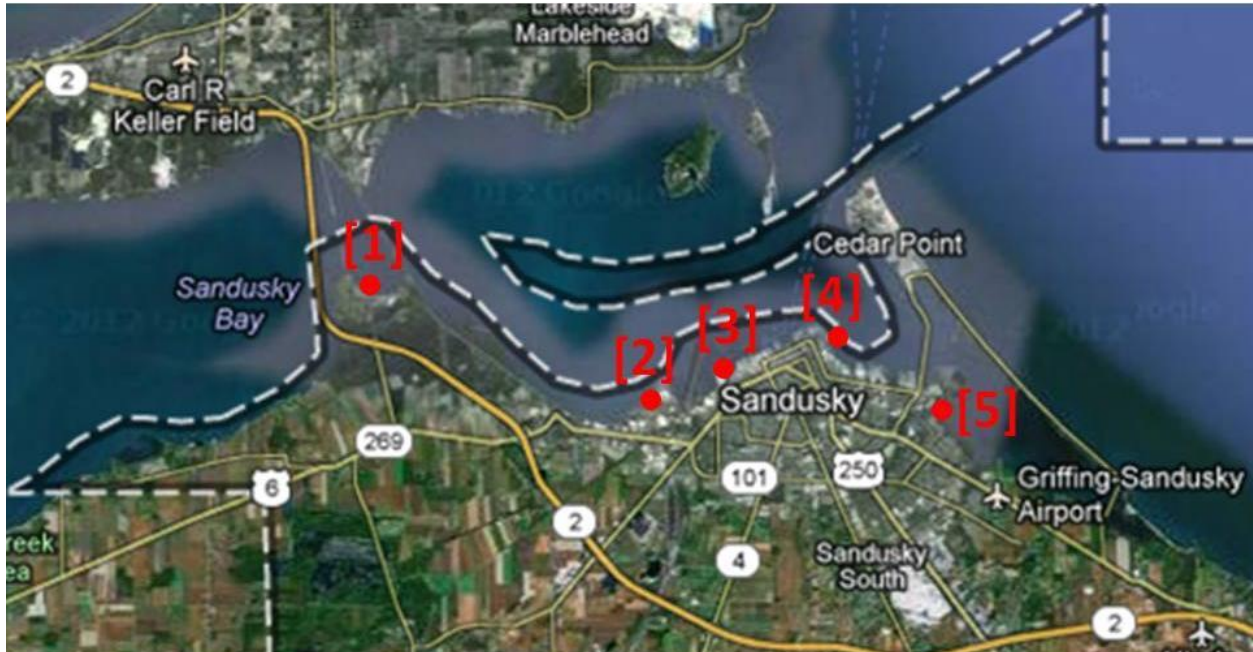


Fig. 1 Sandusky Bay satellite image from Google Maps of the 5 routinely sampled locations for Harmful Algal Blooms

Forty two microcystin toxin samples and 120 quantitative water characterizations samples were taken during the grant period. Not all of the samples taken in 2012 were from the same 5 locations in the Sandusky Bay. Out of the 120 quantitative samples 107 of these samples were taken in the Sandusky Bay. The remaining 13 samples were taken in Erie County east of the Cedar Point peninsula. All of the samples collected were done so using guidelines from the State of Ohio Harmful Algal Bloom Response Strategy For Recreational Waters. An independent laboratory, BSA Environmental Services Inc., analyzed all of the collected samples, and determined quantities and species of bacteria within our water samples.

The activities and timeline of our project were drastically changed at the beginning of our grant period. The mild and unusually warm weather allowed our department to begin sampling as early as January 31, 2012. We were able to sample so early into the year our grant funds began to deplete much more rapidly than was originally anticipated. Our department soon reduced the frequency of sampling from weekly to bi-weekly until the warmer spring months in order to reserve grant funds for testing later into the year.

Our activities and timelines were also altered from our original project when all contact was lost with the European Space Agency's Envisat satellite which housed the Medium-Spectral Resolution Imaging Spectrometer (MERIS) in April of 2012. One of the original grant objectives was to use the sampling data collected to provide validation patterns observed using the MERIS imagery. Local partnerships were formed prior to April of 2012 to allow for open water sampling once per month on the Sandusky Bay. This sampling would have provided NOAA with information which could be used to validate patterns for MERIS. The Erie County Health Department, while working with NOAA, moved quickly to amend procedures to develop a new project because of the loss of the Envisat satellite. Instead of using our data for validation patterns, our department received specialized equipment from NOAA to continue our work in aiding in the development of more accurate harmful algal bloom tracking in Lake Erie. The equipment our department received was a handheld radiometer, which was used to detect specific light wavelengths to identify specific species of bacteria that make up harmful algal blooms. This radiometer was capable of collecting most of the same information that MERIS collected. Ultimately, instead of calibrating MERIS our department used the radiometer readings to aid in the development of an algorithm for NOAA which will be used in the MERIS replacement on the 2014 European Sentinel-3 satellite.



Fig. 2. Handheld radiometer field work at Lions Park June 13, 2012

The results of our study demonstrated that in the winter and early spring of 2012 the Sandusky Bay was dominated by a diatom bloom. A shift from a diatom bloom to a cyanobacteria bloom/harmful algal bloom was seen by the end of May 2012. The first documented visual algal bloom was observed at Lion's Park on May 31, 2012. Cyanobacteria algal blooms dominated the characterization samples for the remainder of the sampling season. NOAA predicted that the summer/fall of 2012 would be a mild year for harmful algal blooms; however our data still indicated that high levels of cyanobacteria were present in our samples. The State of Ohio Harmful Algal Bloom Response Strategy for Recreation Waters produced by the Environmental Protection Agency, Ohio Department of Health and the Ohio Department of Natural Resources states that a bloom can be identified when a visual discoloration of the water is observed or the bloom has a cyanobacteria count of 4,000 cells per milliliter of water. Prior to June 14, 2012 the algae that dominated our characterization samples were species of non-toxin producing diatoms. After June 14, 2012 at least one species of cyanobacteria, usually planktothrix sp., was found with counts far exceeding 4,000 cells per milliliter of water in all of our characterization samples. The three most dominant species of cyanobacteria found in the 2012 algal characterization samples were planktothrix sp., aphanocapsa sp., and pseudanabaena sp. The

algal characterization data indicated that all samples taken after June 14, 2012 at our sample sites were experiencing a HAB because of one or more species of cyanobacteria exceeding 4,000 cells per milliliter of water. Even though cyanobacteria levels counts were greater than 4,000 cells per milliliter of water, very few HAB's were reported. It is believed that very few HAB's were reported because of the lack of visual discoloration of the water when compared to previous years. In fact, our department only had two reports of visual algal blooms during 2012, as seen in the figures 3 and 4 below.



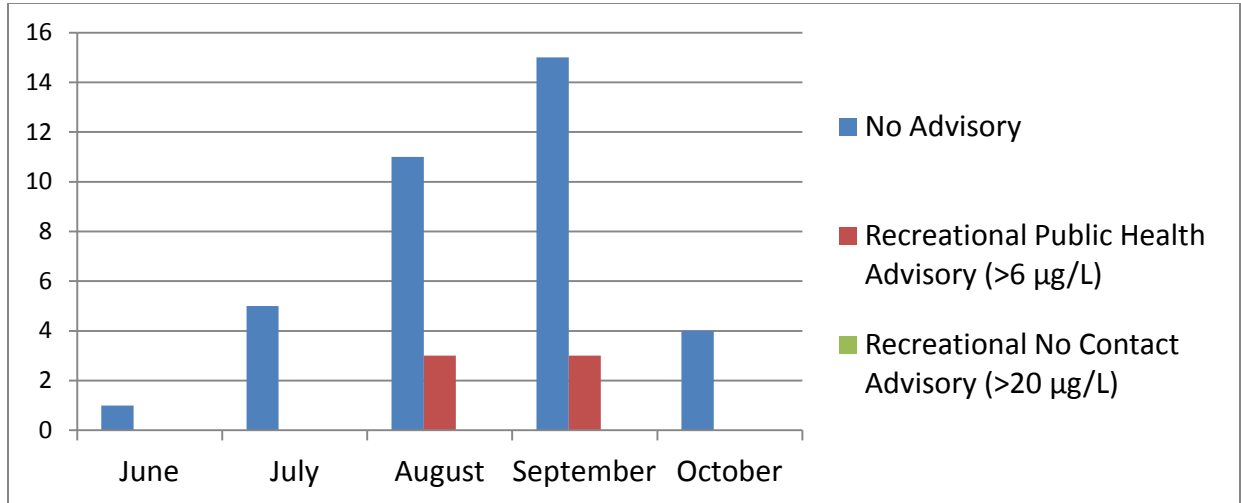
Fig. 3. Lions Park May 30, 2012 Harmful Algal Bloom (*Anabaena circinalis* was the dominate cyanobacteria)



Fig. 4. Bay View August 1, 2012 Harmful Algal Bloom (species of cyanobacteria was not identified, however microcystin levels were 3.05 µg/L)

Along with tracking the harmful algal blooms our department would take microcystin toxin samples to determine if the level of toxins exceeded the state guidelines for recreational thresholds. The State of Ohio Harmful Algal Bloom Response Strategy For Recreational Water

states that a Recreational Public Health Advisory should be posted when the threshold for microcystin exceeds 6 µg/L. The state strategy response also suggests the posting of a Recreational No Contact Advisory if the microcystin toxin exceeds 20 µg/L. An illustration of sample toxin advisories for the 2012 grant sampling period can be seen in Graph 1 below.



Graph 1 Microcystin Toxin Sample Advisories for 2012

Graph Summary: sampling results revealed 0 Recreational No Contact Advisories and 6 Recreational Public Health Advisories out of the 42 toxin samples collected.

The data from our testing and radiometry work is still being interpreted by NOAA. However, a brief description of NOAA’s interpretation of our work can be seen below as stated by Dr. Richard Stumpf:

“The March222012CI_Sandusky (figure 1) is our standard MERIS CI index (MERIS is the medium resolution imaging spectro-radiometer), which indicates bloom biomass. In summer it is an excellent measure of total cyano (e.g. CI = cyano index). In the spring it probably does not, but we don't have much data to support this.

In contrast March22012CImulti_Sandusky is a CI with an exclusion to remove areas that are probably not cyanobacteria.

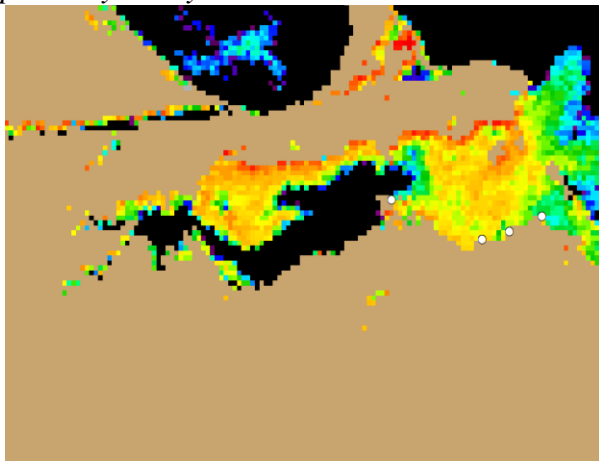


Figure 1 March222012CI_Sandusky

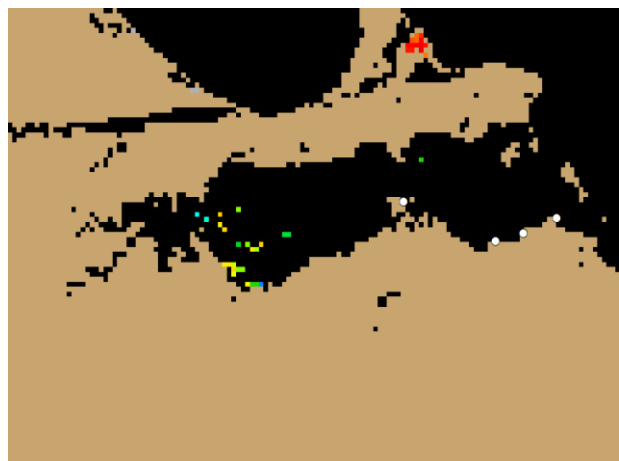


Figure 2 March22012CImulti_Sandusky

The CI shows a bloom in Sandusky bay, the CImulti (figure 2) does not. This indicates that the bloom is not cyano, and may be diatom or green algae. The field data confirms that the water was dominated by diatoms. The concentrations measured with the CI are quite high, similar to those for summer cyanobacteria blooms in Sandusky Bay, so this separation is quite important.

The data set from your study allows us to tune the exclusion algorithm to better improve the separation. We expect to apply these algorithms to the Ocean Land Colour Imager (OLCI) that is a MERIS replacement due for launch in 2014 on the European Sentinel-3 satellite.”

The Sandusky Bay Harmful Algal Bloom Early Warning Study was successful by providing data which will advance the science of tracking HAB's. The research and sampling done during the summer of 2012 will aid in better technology and a better understanding of the Harmful Algal Blooms effecting Lake Erie.

Outreach Efforts

The Erie County Health Department had several opportunities during 2012 and 2013 to inform the public of our efforts. Some of our outreach took place at meetings with local city, village, township, and county officials. The Erie County Health Department was also given the opportunity to give a harmful algal bloom presentation at the Fall Northwest Ohio Environmental Health Association (OEHA) Annual Meeting on October 18, 2012. The OEHA members and participants at this conference are made up of environmental health professionals from all over Northwest Ohio. On November 2, 2012 our department gave two short harmful algal bloom presentations to about 20 people at the Viewpoint Senior Center and the Harbor View Senior Apartments in Sandusky City. Both buildings overlook the Sandusky Bay, which was our study area for the harmful algal bloom early warning study. During all of the presentations given by the Erie County Health Department recognition was given to the Lake Erie Protection Fund and the Lake Erie Commission for the grant money they provided to make this project possible.

Reference:

http://www.epa.state.oh.us/portals/35/Harmful_Algal_Bloom/Inland%20Lakes%20HARMFUL_ALGAL_BLOOM%20Monitoring%20Strategy%20FINAL.pdf , State of Ohio Harmful Algal Bloom Response Strategy For Recreational Waters