

**LOWER ST. JOHNS RIVER TECHNICAL ADVISORY COMMITTEE (TAC) MEETING  
 FDEP – Northeast District, Conference Rooms A & B  
 7825 Baymeadows Way, Suite B200, Jacksonville, Florida 32256  
 September 29, 2010**

**Participants**

Khalid Al-Nahdy, FDEP	Melissa Long, FDEP
Jan Brewer, St. Johns County	Jim Maher, FDEP
Russ Brodie, FWC	Dana Morton, COJ
Robert Burks, SJRWMD	Cordelia Neff, NOAA
Derek Busby, SJRWMD	Steve Patterson, Florida Times Union
Tiffany Busby, Wildwood Consulting	Marcy Policastro, Wildwood Consulting
Dean Campbell, SJRWMD	Radha Pyati, UNF
Ivan Chou, ECT	Andy Reich, FDOH
Jodi Conway, FDEP	Geoffrey Sample, SJRWMD
Amelia Demane, Citizen	Andrew Sears, JEA
Betsy Deuerling, COJ	Justin Soloman, FWC
John Hendrickson, SJRWMD	Lucy Sonnenberg, JU
John Higman, SJRWMD	Greg Strong, FDEP
Mike Hollingsworth, USACE	Shelly Tomlinson, NOAA
Chuck Jacoby, SJRWMD	Scott Turner, DCHD
Jan Landsberg, FWC	Gary Weise, COJ
Justin Levine, COJ	April Williams, COJ
Pam Livingston Way, SJRWMD	

**Welcome and Introductions**

Jim Maher welcomed everyone to the Lower St. Johns River (LSJR) Technical Advisory Committee (TAC) meeting. Jim noted that the agenda topics are very pertinent because the river had stressors this summer that many TAC members studied including the algal bloom, fish kill, and foam. Melissa Long added that the Florida Department of Environmental Protection (FDEP) has been doing some sampling and she looks forward to the discussion on these topics during the meeting. The participants introduced themselves and the entity they represent.

**Public Health Response to Cyanobacteria Blooms in Florida**

Andy Reich stated that the Florida Department of Health (FDOH) has been coordinating with the local agencies on the algal bloom and this coordination was important for getting information out to the public. There are public health impacts of pollutants and natural contaminants like algal blooms, and certain portions of the population are more susceptible than others. Those more susceptible include people with extended exposure to the blooms, such as environmental professionals. While the algae in the water can be seen, there may be other contaminants that could cause illness. If any agency has staff who become sick after time in the field, they should contact FDOH so they can figure out the cause of the illness.

There are different types of blue-green algae and some produce toxins. It is known that when animals drink water that has algal blooms they can get sick or die; however, the public health implications of exposure, especially incidental ingestion, are unknown. There are different types of cyanotoxins including hepatotoxins (affect the liver), neurotoxins (affect nerves), and dermatotoxins (affect the skin). There are multiple potential exposure pathways including direct skin contact, ingestion of food, incidental ingestion, drinking water, and inhalation of aerosols.

FDOH is working with the National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), Center for Disease Control (CDC), and Sea Grant in

Michigan to use satellite images to track algal blooms. The goal of this work is to determine what areas could be impacted by the bloom to help with management efforts. There have been reports of rashes and respiratory problems in people who utilized Florida springs where there were algal blooms. Another concern related to algal blooms is that 10-15% of the Florida population uses surface water for drinking water and this number will increase as the Floridan aquifer is unable to meet future demands. There are uncertainties about what water treatment plants should do to treat water with algal blooms and how better to predict blooms to prevent problems with drinking water. Lee County experienced this problem several years ago when an algal bloom forced them to stop using surface water and switch to an alternative supply.

Currently, there are no regulatory standards for cyanotoxins in drinking water or recreational water, no standard methodologies for cyanotoxin quantification, no standard sampling methods, and low level chronic effects of algal toxins have not been established. The World Health Organization (WHO) has established provisional guidelines for lifetime exposure to microcystin but no guidelines have been established for acute exposure or for other cyanotoxins. However, identification of cyanobacteria and their toxins is becoming more practical.

FDOH does have several surveillance tools to help track algal blooms. One tool is the Florida Poison Control Center, which has a toll free number where you can talk to someone 24 hours a day. This number also provides recorded information on algal blooms and impacts. Dana Morton noted that he recently received a call from a woman who had sick children from the algal bloom, and he gave her the toll free number. Dana asked if there was a way to access the information in the database to see what calls the poison center received. Andy responded that a lot of the information is protected because it is health related. There are some FDOH staff who have access to the results of calls, but there is little information related to blue-green algal blooms; more of the reported illnesses are related to red tide.

Another tool is the EpiCom System, which FDOH uses to trade information with health professionals. This system includes an aquatic toxins forum for both blue-green algae and red tide. Through this site, FDOH can send out notices about aquatic toxins to the distribution list. The message is typically a summary of the notification with a link to the site for more details. FDOH also uses the Electronic Surveillance System for Early Notification of Community-based Epidemics (ESSENCE), which was established after 9/11. This is a reportable disease database that includes information from the poison control centers and the emergency rooms of about 150 hospitals in Florida. In addition, the CDC's Harmful Algal Bloom Related Illness Surveillance System (HABISS) is used to look for early indicators of outbreaks. The goal is to rapidly detect and report HAB events, and search for patterns that suggest HAB agents. Jim asked if there are any epidemiological studies in place to learn more about acute exposure to HABs. Andy responded that epidemiological studies are expensive, so FDOH is looking for blooms to study. This program was set up in Florida but after several years of no major blooms, the funding was transferred.

FDOH and the Florida Fish and Wildlife Conservation Commission (FWC) have developed the "Resource Guide for Public Health Response to HABs in Florida," which can be found online. FDOH also has medical fact sheets and public notices that they use to provide public information on blue-green algae. FDOH is also working with the county health departments to create HAB response plans. Another tool is the Cyanobacteria Bloom Survey and Reporting Tool, which is web-based and allows involved agencies to share information on the blooms. The funding for these projects comes from CDC, Florida Department of Environmental Protection (FDEP), NOAA, and NASA.

## **Detection and Monitoring of Cyanobacterial Blooms from Satellite and Application to the St. Johns River System**

Shelly Tomlinson stated that most of the funding for this project comes from NASA. The details in the presentation are from the project in Lake Erie but there is funding in place now to start work on the SJR. They first started forecasting algal blooms on the west coast of Florida by providing information to managers in the area. When the forecasting went operational, they also added a public conditions report to provide information on respiratory issues related to the bloom. This report is emailed as a PDF to the managers in the area. The ultimate goal is to develop a framework for forecasting algal blooms nationally based on the work that was done for Lake Erie. Algal blooms are very visible so it is a good test for satellite detection.

The goals of the cyanobacteria project are to help managers with public health and safety, reduce the cost of impact by giving early warning, educate the public, reduce impacts to the public including pets, and establish a routine operations capability. This information could also be expanded to water suppliers, DOH, parks and recreation departments, and natural resources. In order to forecast algal blooms, an algorithm was developed to identify bloom areas, delineate extent, and determine the density of the bloom. For Lake Erie, they are able to forecast two to four days in the future. The model results are validated with field sampling. The satellite imagery for the Lake Erie project is one kilometer from a European satellite; however, there are higher resolution images that will be used for the project on the SJR. An algorithm is used to determine if there is a bloom. When an algal bloom is present, there is a negative curve in the wavelength data. If no bloom is present, there is a positive curve.

They are working to develop a relationship between cell counts and cyanobacterial index (CI) based on the imagery. Satellite imagery of the area is taken every other day, as long as there is no cloud cover. Typically, about two good images are taken each week. NOAA has received different requests from the management communities on how they would like to see the information from the images expressed. In addition to looking at the correlation between CI and cell counts, they are also looking at the relationship between MCI and chlorophyll.

Algal blooms in Lake Erie were first tracked by satellite in 2008. In addition, they used forecasting to determine if the blooms would impact the water treatment plant intakes. Environmental conditions, such as wind, can affect the bloom. Winds can cause mixing that makes it appear in satellite images as if the bloom as dispersed. Therefore, they also use field data and transport modeling to track the bloom.

For the SJR, 300 meter data and true color imagery will be used to determine the CI. The preliminary forecasting done using 2010 data seems to be capturing more area than the bloom actually encompassed. The Lake Erie algorithm was used and may need to be tweaked for the SJR. The colors on the SJR map show the relative abundance of the bloom but they still need to determine what the cell counts or chlorophyll level is for that abundance. Field data will be needed to develop this correlation. This project is still in its initial stages so NOAA will be coordinating with local stakeholders to obtain the data they need and to determine what information local managers would like to see. They have not started processing the 2009 data yet. Andy added that they are still establishing the process for this project. They just received the funding and this will be a five year grant. Shelly noted that they will conduct several workshops to figure out the project details.

Tiffany Busby noted that the blooms occur in the summer when there is a lot of cloud cover, and she asked if this is affecting the satellite images. Shelly responded that they are still processing the data but they seemed to have a lot of information for July 2010. When looking at the data, they found that the CI increased in late May, turned red in June, and some evidence of the bloom was still shown in July. There appears to be a natural, background feature of the water that will need to be accounted for when processing the data. The key efforts for this year will be to apply this process to other areas, confirm and

validate data, solve gaps in imagery from clouds, determine the relationship between CI and cell counts or chlorophyll, and prepare training materials for managers and information for the public.

John Higman asked if they are using true color or infrared images. Shelly responded that they are looking at the spectrum from orange-yellow to infrared. John asked if using infrared would help with the color issue in the river. Shelly responded that scum can sometimes shift because it can scatter. There is also a chlorophyll algorithm in the red to near infrared spectrum. Lucy Sonnenberg asked if microcystis scum occurs as the bloom dies. Shelly responded that this occurs when there is such a high concentration that it actually forms a scum. John added that the scum is mainly found in the marine reach because it is likely in the less dense water on top. The bloom has buoyancy control when it is healthy but becomes a scum when it is stressed in the last phase of the bloom or when it is stressed from higher salinity levels.

### **The 2010 St. Johns River Fish Kill: A Complex Consequence of Cyanobacteria Blooms**

Jan Landsberg stated that she presented some preliminary data at the City of Jacksonville (COJ) meeting in July, and this presentation includes more information but they are still trying to work out what caused the fish kill. The fish kill occurred between late May and early July, and FWC received more than 300 reports on their hotline. The fish kill also affected Dunns Creek and Lake George, and Doctors Lake was only minimally affected. This was not a typical fish kill caused by water quality problems. This kill was chronic, did not affect all species, and resulted in a slow die-off of fish. In late May there was a spike in salinity, which caused the cyanobacteria bloom to crash. However, water quality was relatively normal and the typical low dissolved oxygen (DO) conditions associated with a fish kill did not occur.

When studying the affected fish, FWC found that there was reddening of the fish and some had lesions. Several fish also had secondary bacterial infections that were caused by the chronic slow deaths, which made it more complicated to determine what caused the fish kill. They found congestion (blood flooding) in several tissues including heart, liver, spleen, and brain. They found evidence for lysis of red blood cells (appearing as “ghost cells”) in blood vessels in the heart and liver. FWC used a specific stain that targets iron (originating from hemoglobin) from lysed red blood cells to demonstrate recent hemolysis, particularly in the spleen. Jim noted that the expansion of the red blood cells seems to indicate that the fish need oxygen but the DO was not low. Jan responded that this is a good point. While they were dealing with a variety of symptoms the congestion was pretty consistent. This could be occurring because the red blood cells were lysing and the new red blood cells could not regenerate quickly enough, therefore the existing red blood cells compensate by flooding the gills, for example, to obtain more oxygen. They also found liver cell necrosis (cells detaching), which is a response that is typically seen from microcystin exposure.

The fish pathology, based on samples in June, indicate that a toxicosis is causing (in part) hemolysis. There are many different causes of hemolysis including bioactive compounds, bacteria, algal toxins, chemicals, contaminants, water quality, and pathogenic bacteria in fish. In order to verify if there was evidence for hemolytic activity in the water from the St. Johns River, FWC collected more environmental samples in late June. They sent water samples to a laboratory in North Carolina to examine if these samples could show evidence for hemolytic activity using a red blood cell lysis assay. The laboratory used whole water samples (i.e. not filtered), and they found that the area around Fruit Cove had the most hemolytic activity. Different microalgae have hemolytic potential, and many of the fatty acids produced by microalgae can cause fish kills, in part from hemolysis. However, cyanobacteria are not well documented to cause fish kills from fatty acids. Many Harmful Algal Bloom species produce hemolytic compounds, and field cases show that these compounds affect gills, reduce oxygen uptake, and usually result in a fish kill from asphyxiation.

The SJR fish kill is different because cyanobacteria usually do not cause this type of chronic fish kill or pathology. Microcystin can be hemolytic, as documented in the lab but not in the field. Microcystin was

shown to be present at low concentrations in fish tissues, and may have contributed to the pathology (severe damage was seen in the kidneys, heart, liver, and other tissues). Cyanobacteria bioactive compounds (fatty acids) can cause gill pathology. The question is whether the cyanobacteria toxins or fatty acids caused the hemolysis in the fish. FWC analyzed samples and found that microcystin (and cylindrospermopsin and saxitoxin) was present in the whole water samples (i.e. including algae), but it appeared that something else might be causing the hemolysis. Therefore, they also ran water samples for potentially hemolytic bacteria. They found two types of hemolytic bacteria in the water but one type, *Bacillus cf. cereus/thuringiensis* (subject to molecular confirmation), was found at all 8 stations (from Tallyrand to Shands Bridge). *Bacillus* is known to cause human health issues but not much is known about how it affects aquatic animal health. Presumptive *Bacillus* was found in a few fish but they are not sure if it is the same type as what is in the water. *Bacillus* and other bacteria play a role in lysing and contributing to the decomposition of *Microcystis* and other cyanobacteria. FWC took additional river samples in August, after the fish kill, and found that the same presumptive *Bacillus* species was present in the water at the same 8 locations, but at a much lower concentration than what was found during the fish kill.

They also ran some foam and underlying water samples collected by Robert Burks (SJRWMD) to see if bacteria could be significant. Other research has shown that *Bacillus* is known for biosurfactant production and can cause foam. The foam could have occurred as the bacteria broke down the cyanobacterial bloom. They took the foam samples, plated it, and grew bacteria. They found that the bacterial biomass increases from south to north, and the foam has a greater bacterial biomass than the corresponding water sample. The next steps will be to identify the *Bacillus* species in the water, fish, and foam; identify the source of the hemolytic compounds; test known hemolytic agents for pathogenicity in fish; identify algal toxin producers; identify health risks; and map toxin fate and persistence.

#### **Characteristics of Foam in the Lower St. Johns River**

Lucy stated that she did some laboratory work with the foam, using samples provided by Dana Morton and Robert Burks, to try and determine the characteristics of the foam. She started by looking at the chemistry of cyanuric acid, which a pool chemist found a positive hit on when he sampled the foam. There are other naturally-occurring chemicals with similar structures, which may have caused the positive hit for cyanuric acid assay. Lucy determined total and volatile solids in the foam and by drying the foam and then combusting it. She also ground the dried solids material, and used acid hydrolysis to determine some of the foam components. In addition, she performed a spectrophotometric protein analysis, the Bradford assay.

When studying the foam collected at Blue Cypress Park by Lucy, she learned that she needed to exclude all river water and debris, which is hard to do because filtering the sample could remove parts of the foam. When the foam is compressed, it becomes about 3% of the original size. Approximately 2% of the foam is solids of which about 74% is volatile. Lucy stated that she also learned that it is better to look at the whole foam instead of separately analyzing the filtrate and solids. The foam consists of a lot of organic carbon and nitrogen, with a high molar ratio of carbon to nitrogen of 2.0.

Based on the consistency of the foam, it appears to be made up of proteins; therefore, a common assay for proteins was utilized. Lucy stated that she found that the foam has a much higher concentration of protein than the river water. The protein content is only part of the organic nitrogen found in the foam so the protein does not explain the entire content of the foam. Lucy also found fatty acids in the foam, most of which are C16, C18, and C20. Lucy also analyzed the foam for amino acids, but results were inconclusive.

### **Discussion of Other Studies on the Algal Bloom and Fish Kill**

Greg Strong stated that the thought has been that the foam is a natural byproduct of the breakdown of algae, and he asked if this is still the thought. Lucy responded that there is nothing in her results to show otherwise. John Hendrickson asked if the foam was caused by the breakdown of the algal bloom if it would still be high in nitrogen. Lucy responded that she cannot differentiate between the bacteria and phytoplankton with the type of data she has now, but it may be helpful to do a labile nitrogen study to see where it came from. Jim noted that the presence of bacteria with the die-off of the bloom could possibly provide the surfactant content found in the foam. Lucy responded that it could be a combination of things. There have also been discussions about the fact that the foam does not smell, and when it is dried or acid hydrolysis is used, the foam smells sweet.

Jan noted that the foam was showing up in June at a smaller scale, and if it is partly triggered by the bloom decomposition then the question is whether the foam composition is changing over time. Dana noted that someone from DOH did a literature search on foam and put together a good list of sources. Lucy stated that she also did a search but did not find a lot of detail on the structure of the fatty acids. Ed Lowe (SJRWMD) had sent a paper implicating urea but that does not appear to be in this foam. Jim asked if there is still a lot of foam. Dana responded that they are still seeing a few inches of foam in certain areas.

Tiffany asked if there is a need for coordination to prepare for next year or if this is already being accomplished through existing groups. Melissa noted that background information is needed to determine what concentrations of these compounds are normal in the river. Jan stated that they are finishing their analyses, and then they hope to generate reports and coordinate with other agencies to try and anticipate what will occur. This could be difficult because each year seems to be different for the river. Gary Weise asked if any attempt has been made to match or quantify the bloom and foam up and down the river. John Hendrickson responded that this is the direction the sampling needs to go. Using the usual ambient sampling misses a lot of information. Blooms are also very patchy so a spatial component is needed. Lucy asked if there is SJR Alliance funding to help with the sampling since the Alliance has a research committee looking to fund small scale research projects. Tiffany responded that the Alliance is working to generate the funding sources to do this. In addition, Senator Thrasher and others are working towards an initiative to obtain funding for river, and a monitoring component might be a component of this.

### **Technical Updates and Announcements**

#### **St. Johns River Alliance/2010 River Summit**

Tiffany thanked everyone who participated in the SJR Summit on September 15 and 16. Many TAC members were involved in the planning or were speakers. In addition, the SJR license plate passed in last legislative session and will be available soon. There is the option to buy gift certificates for the license plate. The funding from the plate will go to the SJR Alliance and they hope it will provide an annual source of funding for river projects. At the Summit, the Alliance also released a calendar created by Georgia-Pacific and 100% of the proceeds will go to the Alliance. The calendar is available on the Alliance's website.

#### **Fisheries Data Collection**

Russ Brodie stated that they have officially moved into the new building at Jacksonville University. They are finishing last year's report for the St. Johns River Water Management District (SJRWMD) on the expansion monitoring. They are also meeting soon to review the minimum flow study that FWC led to determine potential impacts from proposed water withdrawals. FWC is also working on an update to the species list for the SJR. They recently put together a species list for the U.S. Army Corps of Engineers (USACE) for the Big Fishweir Creek project.

### **U.S. Army Corps of Engineers**

Mike Hollingsworth stated that USACE is close to having a final draft feasibility study for the Big Fishweir Creek project. They hope to have the report to the division office within the next few weeks for approval. Once they have approval, the report will be released for public and agency review. Input from the TAC may be needed for parts of the report. USACE completed a cost-benefit analysis for various alternatives and they did find an alternative with good benefits for the appropriate cost. They are going to field verify the alternative to ensure it is viable. COJ is the local sponsor for the project, which includes marsh creation, channel creation, and sediment manipulation to keep sediments on site. The Hogan Creek project is also in the feasibility stage but is farther behind due to several constraints. USACE is planning on additional sampling of this site to check for contaminants. Both projects will not be under construction for another two to three years.

The contract for the Mayport deepening project was awarded and the contractor is looking to start dredging in the winter. They will start with a clamshell dredge and then move to the main channel in early 2011 using a hopper dredge. This will be a significant deepening at the mouth of the river that will stop at the entrance of Mayport. The dredging should take about a year to complete depending on the weather and scheduling. There is no dredging going on now in Jacksonville Harbor. The deepening was completed in July, and USACE is about to do a new maintenance dredging application. USACE has also completed an extensive engineering study for the Blount Island slipway deepening. They found that there will be issues with the piers in the area so the piers need to be redesigned before any dredging can be completed. This project is on hold for about one year.

### **Other Member Updates**

Lucy noted that the University of North Florida commissioned Heather McCarthy to write an environmental resource guide to Northeast Florida, which is now available at the UNF bookstore.

Jim noted that FDEP is working on a living shoreline program. They do not have funding but they can provide technical expertise, sources, species, and configurations. If anyone has a project that could benefit from having natural vegetation, at a potential cost savings, they should contact Jim for more information.

### **Next Meeting**

The next meeting will be held in December and will be hosted by SJRWMD.

### **Adjourn**

The meeting was adjourned at 2:05 PM.