MACROALGAE IN FLORIDA'S ESTUARIES

Current status and future directions of macroalgae research, monitoring, and management in four Estuaries of National Significance

Macroalgae are components of healthy Florida estuaries, but excessive blooms create negative consequences for ecosystems. In recent years, multiple blooms of macroalgae in Florida estuaries have raised concerns about poor water quality and damage to seagrasses. In 2021, a group of scientists and managers convened a set of workshops to share information, identify gaps in data and knowledge, facilitate future collaborations, and guide management actions. The workshops brought together close to 200 people from government, private industry, academia, nonprofits, and the public to share information and gain knowledge about macroalgae in the boundaries of four Florida National Estuary Programs. This report synthesizes the topics, results, and outcomes of the workshops.

Credits Left: St Johns River Water Management District; Center: Rusty Chinnis; Right: Florida Sea Grant Charlotte County

Macroalgae are important, not well understood, and potentially increasing in abundance in Florida's estuaries

Seaweed - its name reveals its reputation as a nuisance. For many years, macroalgae have been understudied and often misunderstood. Yet these aquatic primary producers hold clues to a better understanding of estuarine systems. There are three phyla of algae: red, green, and brown, which can drift or grow attached to substrates. Their life histories, methods of reproducing, and other characteristics are very diverse. Due to their ability to drift and their diversity, macroalgae can be hard to sample and identify, so they are not as well studied as seagrasses. However, macroalgae are important because they are primary producers that provide food, serve as a habitat, cycle nutrients, and stabilize and accrete sediment.

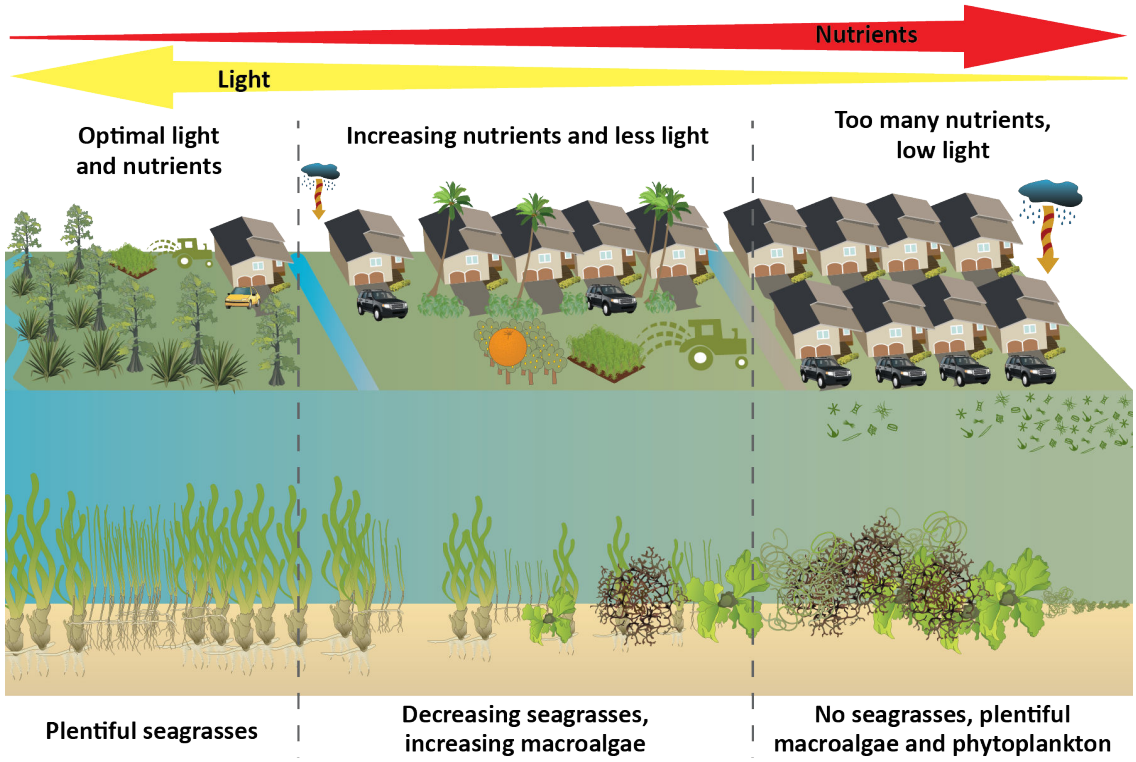
Rich in nutrients and pigments, macroalgae can be used as fertilizer, biofuels, and ingredients in beauty products. Unfortunately, macroalgal blooms can be detrimental to coastal ecosystems. Large macroalgal blooms may impact seagrasses by shading. Fisheries can suffer if decaying blooms decrease oxygen levels and kill fish. While macroalgal blooms are not considered "harmful algae blooms" because they generally do not produce toxins that are harmful to humans or wildlife (although see callout box, "*Dapis* and other *Lyngbya*--likes" on page 5), large blooms may negatively impact tourism and recreation.

The frequency and magnitude of macroalgal blooms are increasing, both globally and in Florida (see 'Lessons' section for more details). This overabundance of macroalgae can have negative impacts on coastal ecosystems, which led scientists and managers in Florida to convene a workshop on the current status and future direction of research, monitoring, and management related to macroalgae.

Relevant workshop presentation: Dr. Dennis Hanisak: Macroalgae 101 (PDF, video)

Nutrient pollution and changing hydrology drive macroalgal blooms

Overabundance of macroalgae in coastal systems is a symptom of eutrophication. Macroalgae can produce grow and reproduce relatively rapidly in response to nutrient pulses. However, the form of nutrients can lead to subtle differences in macroalgal responses. There are interactions among macroalgae and other primary producers like seagrasses and phytoplankton, and research suggests that nutrients often cycle between macrophytes and phytoplankton. As macroalgae increase in abundance, they may shade seagrasses, leading to decreased productivity. Macroalgal blooms can result if development, canals, and climate change increase loads of nutrients.



Left to right: Land practices transition from natural to highly urbanized areas . Increasing nutrients from development , agriculture , and air pollution lead to macroalgae and phytoplankton blooms, which decrease light availability for seagrasses .

Relevant workshop presentations: Dr. Brian Lapointe: Macroalgae Blooms in a Changing World: Some Examples in South Florida, (PDF, video) Dr. Eric Milbrandt: Drivers and Consequences of Macroalgae in Southwest Florida (PDF, video)

Significant gaps in data and knowledge hinder understanding of macroalgal ecology

During the workshop, participants ranked research questions and needs related to macroalgae in all estuaries in this order:

1. **Nutrient sources and macroalgal responses**
    - What nutrient sources drive macroalgal blooms? We need a better understanding of patterns of productivity and relationships to loads and forms of nutrients.
    - How and when do macroalgae function as sinks, sources, and fluxes of nutrients to and from the water column, other macrophytes, and phytoplankton?
2. **Water quality indicators**
    - How can macroalgae be evaluated as an indicator of water quality in addition to traditional indicators like nutrients, phytoplankton, and seagrass?
    - How should trends in macroalgal abundance be analyzed and reported?
    - How do we communicate the complex roles played by attached and drift macroalgae on a continuum from "good" to "bad" in a simple report card format?
3. **Successional patterns of macroalgal species and their relationships to other primary producers**
    - Do macroalgal blooms always cause seagrass losses or do macroalgae sometimes take advantage of areas where seagrass has already declined?

Caulerpa

Caulerpa is a genus of macroalgae with species that grow attached to substrates by rhizomes. With growth forms and habitat requirements similar to seagrass, *Caulerpa* spp. often are found intermixed with seagrass meadows throughout Florida's waters. Some recent reports, especially from estuaries in west Florida, indicate that *Caulerpa* spp. have grown into areas that were formerly established seagrass meadows. Researchers are working to understand the details of this shift - was the seagrass lost before *Caulerpa* moved in, or did *Caulerpa* directly cause loss of seagrass - as well as the potential implications for ecological services, such as wildlife foraging.

- How and why do areas with seagrass convert to *Caulerpa* spp., and do *Caulerpa* beds provide comparable ecosystem services?
- Are there controls on the type - species or morphological form (attached vs. drift) - of macroalgae that proliferate?

4. **Spatial and temporal trends in blooms**
   - Are there areas or times of year where macroalgae bloom consistently?
   - How do tidal flow and hydrology impact formation, development, and movement of macroalgal blooms?
5. **Role of climate change in driving blooms**
   - Could stresses from climate change, like warmer water, acidification, and changing patterns of precipitation, directly or indirectly benefit attached and drift macroalgae or cyanobacteria more than seagrass?

***Dapis* and other *Lyngbya*-likes**

Dapis sp. in Sarasota Bay, FL. Credit: Sarasota Bay Estuary Program

Dapis spp. and other "*Lyngbya*-like" organisms are unicellular cyanobacteria that form dense, filamentous mats on sediments, which can rise to the surface as they produce and trap bubbles of oxygen. Here, they often intermix with drift macroalgae. Therefore, surveys to understand macroalgal blooms often include and consider *Dapis*. *Dapis* spp. produce a toxin that is harmful to humans, and therefore, the species are sometimes categorized and managed as harmful algal blooms. *Dapis* was introduced into the United States, and it occurs throughout Florida's coastal waters.

Relevant workshop presentation: Dr. Valerie Paul: Exploring Florida's Benthic Cyanobacterial Blooms (PDF, video)

Consistent, long-term monitoring of macroalgae and related habitats is needed

Researchers need consistent data over the long-term to draw conclusions about macroalgae and their relationships to other primary producers.

Florida National Estuary Program macroalgae monitoring programs

The Fish and Wildlife Conservation Commission (FWC) Fisheries Independent Monitoring (FIM) program records basic volume information about drift algal bycatch. The FIM program operates in all four National Estuary Program (NEP) systems on peninsular Florida.

The Southwest Florida Water Management District (SWFWMD) conducts biannual aerial monitoring and ground-truthing of seagrass habitats in southwest Florida. This effort also documents acres of attached macroalgae. (*Relevant workshop presentation:* Dr. Chris Anastasiou and Nathaniel Morton: Seagrasses to Macroalgae: Maps of Change PDF, video)

Surveys of transects through seagrass assess drift algal cover in at least part of each Florida NEP. Some programs also measure biomass of drift macroalgae.

- In the Indian River Lagoon, monitoring includes assessments of drift macroalgal cover and biomass as well as epiphytic cover on seagrass blades. A time-limited hydroacoustic study by Nova Southeastern University provided insights on drift algal abundance in deep-water areas beyond the extent of transects.
- The Tampa Bay Interagency Seagrass Monitoring Program (TBISP) conducts annual, on-the-ground assessments along 61 transects at various fixed locations throughout the bay. Assessments conducted during the surveys include characterization of epiphytes on seagrass blades and density of all macroalgal species.
- In Sarasota Bay, Sarasota County's annual winter seagrass transect monitoring program monitors drift algal cover, epiphytic abundance on seagrass blades, and area covered by *Caulerpa* at 160 sites throughout estuaries in Sarasota County. In 2021, the Sarasota Bay Estuary Program (SBEP) adopted the volunteer Eyes on Seagrass program to further expand monitoring (see callout box, page 7).
- In the estuaries comprising the Coastal and Heartland National Estuary Partnership (CHNEP; Venice to Bonita Springs in southwest Florida), Florida Sea Grant established the Eyes on Seagrass program to collect data on cover and biomass of macroalgae. The Charlotte Harbor Aquatic Preserves document macroalgal abundance and species (if known) along their seagrass transects.

Monitoring needs

Participants provided input on the most important characteristics for a robust monitoring program:

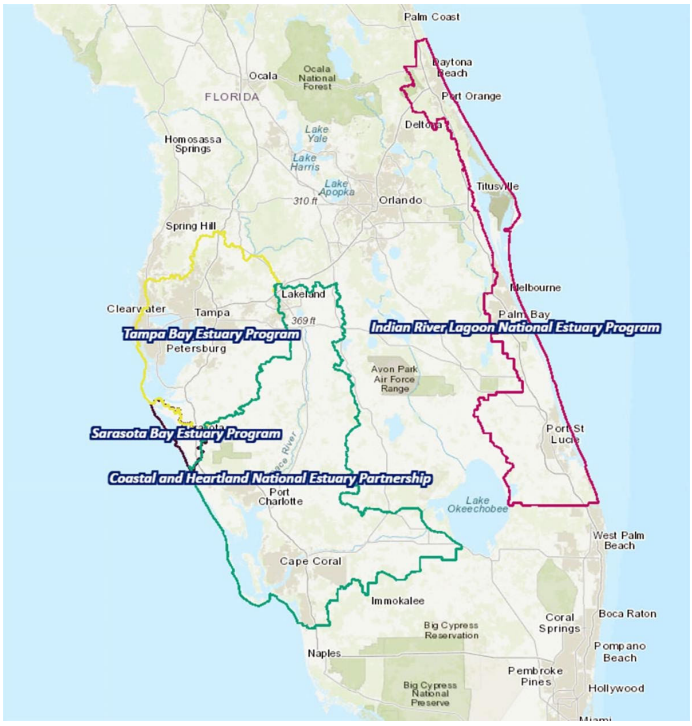
- Monitoring efforts should be coordinated among sectors to leverage resources.
- Community scientists can collect meaningful data.
- Monitoring needs to be regular and consistent through time and in space, and it should include:
    - Enough temporal intensity and duration so that seasonal changes and multi-year cycles of macroalgae are observed.
    - Enough spatial extent and density so that mechanisms causing movement and affecting distributions can be determined.
- Monitoring needs to consider how climate change is impacting macroalgae and the surrounding systems.
- Multiple types of monitoring are necessary because drift algae move and their abundance varies on long (annual) and short (daily) time scales.

Community science programs fill knowledge gaps

Community science programs have been monitoring macroalgae and seagrasses in Florida for years. The Sarasota County Seagrass Survey began engaging community members in annual monitoring of Sarasota Bay's seagrass habitats in 2014. The Eyes on Seagrass program started by Florida Sea Grant in Charlotte Harbor in 2019 has expanded into multiple estuaries on the southwest coast. Volunteer snorkelers monitor drift macroalgae and their impacts on seagrass meadows at multiple sites within each estuary. These data can be incorporated into historical datasets to fill gaps in knowledge. Furthermore, working with community scientists increases public interest in estuarine habitats and stewardship.

Relevant workshop presentation: Betty Staugler, Eyes on Seagrass: Citizen Monitoring in Charlotte Harbor (PDF, video)

Lessons from four National Estuary Programs in Florida



Florida's four peninsular National Estuary Programs. Credit: EPA

Indian River Lagoon: Nutrient cycling among primary producers plays a large role in observed ecological conditions

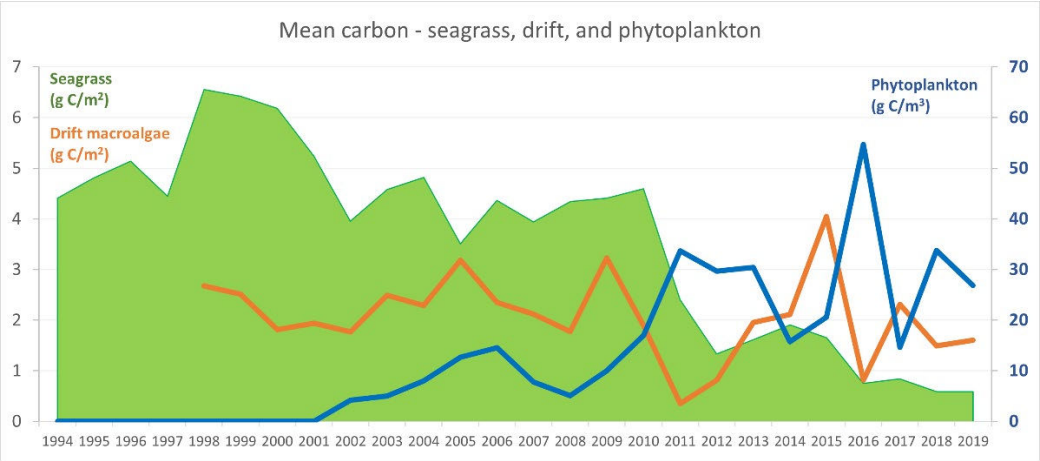
Relevant workshop presentation: Lauren Hall, Lori Morris, and Chuck Jacoby: Drift Macroalgae in the Indian River Lagoon (PDF, video)

NEP website: https://onelagoon.org/

The Indian River Lagoon (IRL) is located on the east coast of Florida. It is long and shallow, with a very long residence time in the north. Monitoring of drift algae, seagrass, and phytoplankton is robust. The lagoon has experienced a number of phytoplankton blooms leading to losses of seagrass since 2010. Drift macroalgae is often the dominant macrophyte by biomass, and it is capable of taking up and releasing large amounts of nutrients.

Analysis of multiple datasets with long periods of record has shown nutrient cycling among the lagoon's primary producers, with nutrients that are not incorporated into tissue of

macrophytes becoming available for uptake by fast-growing phytoplankton in the water column, but a series of questions still remain. Has the lagoon converted to a phytoplankton-dominated system? If so, is it possible to return to a macrophyte-dominated system? Why is this happening given that inputs of nutrients have declined over the past 25 years? How large a reduction in loads of nutrients is required to push the system back?



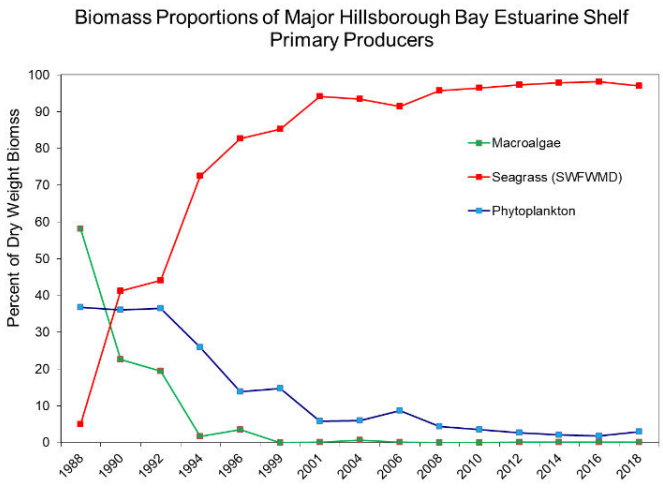
Biomass of seagrass and macroalgae (left vertical axis) and phytoplankton (right vertical axis) in the northern Indian River Lagoon, 1994-2019. Credit: St Johns River Water Management District

Tampa Bay: Controls on nutrient loading, even with a rapidly growing population, are directly related to ecosystem recovery

Relevant workshop presentation: Roger Johannsen: Trends of Macroalgae and Other Major Primary Producers in Hillsborough Bay, Tampa Bay, During a Period of Subsiding Eutrophication (PDF, video)

NEP website: https://tbep.org/

Tampa Bay, located on the west coast of Florida, has become a national success story for ecosystem recovery following a history of noxious macroalgal blooms. In the late 1970s and 1980s, the degradation of Tampa Bay became more visible to the people living along its shoreline and in the watershed. Mats of drift macroalgae were washing up on



Seagrass biomass in Hillsborough Bay increased as macroalgae and phytoplankton biomass decreased, 1988-2018. Credit: Roger Johannsen

shorelines, large blooms of phytoplankton were occurring, seagrass beds were disappearing, and populations of valued fauna were decreasing. These observations coincided with a rapid increase in human population, from less than 0.5 million in 1950 to 1.5 million in 1980. Pressure from a growing community and legislative actions led to investments in upgrades for wastewater treatment plants that reduced nutrient loading to Tampa Bay by 90%.

As the Tampa Bay area's population has continued to grow, an ad-hoc public/private partnership known as the Tampa Bay Nitrogen Management Consortium has worked to keep nutrient loadings to agreed-upon targets that protect water quality as measured by seagrass acreage. Recent setbacks, primarily in portions of the upper bay, including recurring phytoplankton blooms, loss of seagrass, and invasion of attached macroalgae, are a serious concern.

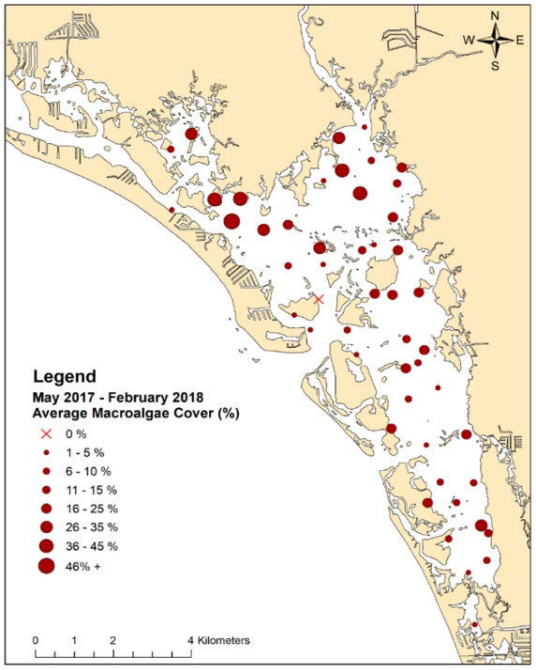
Coastal and Heartland Estuaries: Macroalgae patterns in one estuary mirror those in similar, nearby estuaries

Relevant workshop presentation: Nicole Iadevaia: Marine Macroalgae in Charlotte Harbor & CHNEP Estuaries (PDF, video)

NEP website: https://www.chnep.org/

In the eight estuaries comprising the Coastal and Heartland National Estuary Partnership, monitoring of seagrass has tracked an increase in the presence of macroalgae throughout these estuaries, especially in the last five years. FWC-FIM scientists have documented four major hotspots for blooms of green filamentous algae in the past decade. A primary goal of CHNEP is to improve water quality by reducing nutrient loads through hydrological restoration, which helps restore natural flows in these estuaries.

Additionally, CHNEP supports water quality monitoring that tracks future improvements in the waterways. However, there are still many questions surrounding the presence of macroalgae, its distribution, and its responses to



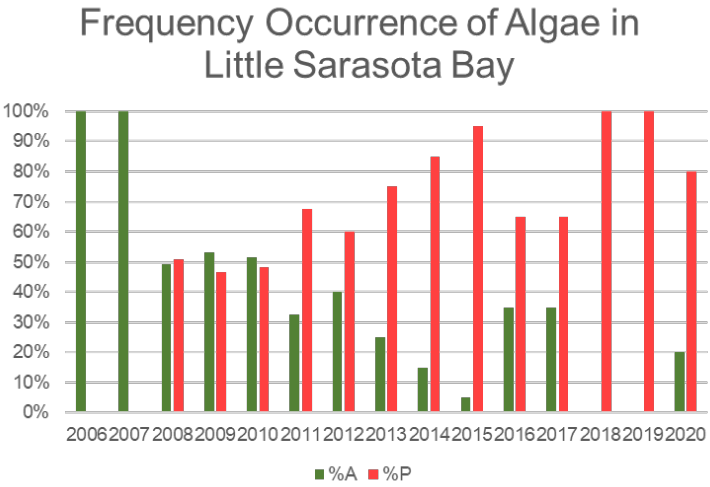
Macroalgae cover in Estero Bay, 2017-2018. Credit: Estero Bay Aquatic Preserves, South Florida Water Management District, Florida Gulf Coast University

nutrients. Layering different datasets like current and future hydrology, frequency of occurrence and biomass for macroalgae, nutrient concentrations and other factors would help determine the best way to monitor macroalgae in these estuaries.

Sarasota Bay: Regulatory criteria do not fully capture ecosystem trends

Relevant workshop presentation: Dr. David Tomasko: Macroalgae in Sarasota Bay: Status and Trends (PDF, video)

NEP website: https://sarasotabay.org



Macroalgae are consistently present throughout monitoring sites in Little Sarasota Bay. %A indicates percentage of sites where algae were absent while %P indicates percentage of sites where algae were present. Credit: Sarasota County Stormwater Environmental Utility.

Sarasota Bay is located on the west coast of Florida, south of Tampa Bay. While some small blooms of drift macroalgae have plagued areas of the bay from time to time, Sarasota Bay is generally seen as a success story for recovery of seagrass. However, beginning in approximately 2012, total nitrogen concentrations and cover of drift macroalgae increased in several embayments. After recording the most acres of seagrass in 2016, the SBEP saw a nearly 22% decline in acreage between 2016–2020. Investigation into the causes of this decline are ongoing, with special attention to two long-lasting and severe red tide blooms and persistent unpermitted discharges of non-AWT wastewater. Unfortunately, existing seagrass targets and water quality criteria were insufficient early indicators of ecosystem decline. Incorporating macroalgae as an additional indicator of water quality might help catch negative trends earlier.

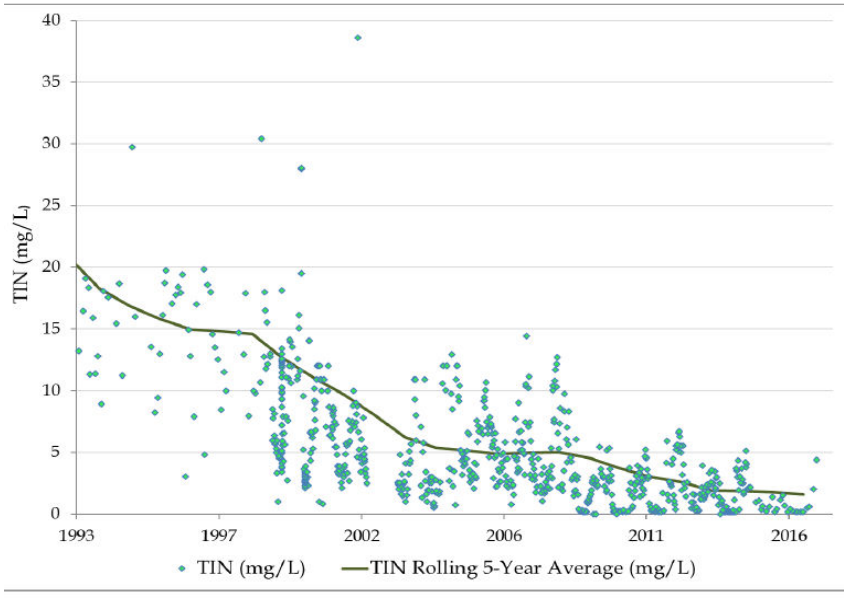
Success in other regions can help Florida address macroalgae

Macroalgae have been studied throughout the United States and the world. Applying lessons learned in other regions could improve management of macroalgae in Florida's coastal waters. Presenters highlighted success stories from three very different systems.

Newport Bay, California - setting nitrogen targets combined with restoration projects decreased nitrogen concentrations and macroalgal blooms

Relevant workshop presentation: Dr. David Tomasko: A macroalgae-based TMDL for Newport Bay, California - did it work? (PDF, video)

Macroalgal blooms driven by chronic and episodic loads of nutrients from agricultural runoff, urbanization, and baseflow became a problem in the Newport Bay watershed during the 1980s. At first, managers attempted a "band-aid" approach of manually removing blooms. A Total Maximum Daily Load (TMDL) based on a mechanistic model of macroalgal growth required loads to be reduced by 50%. Implementing projects like low impact development, constructed wetlands, and stream restoration decreased nutrient loads. As a result, macroalgal blooms decreased and have stayed low in recent years.



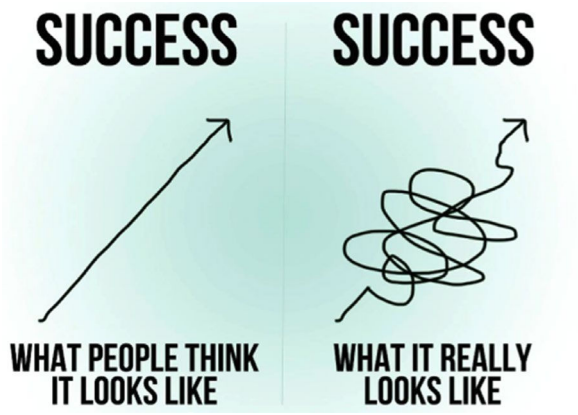
Total Inorganic Nitrogen (TIN) in Newport Bay, California.

Long Island Sound - macroalgae indicator helps determine health of embayments

Relevant workshop presentation: Dr. Jamie Vaudrey: Assessing the extent and understanding the controls on seaweed blooms in Long Island Sound, the Urban Sea (PDF, video)

After both monitoring and modeling studies were completed, it was determined that 1) macroalgal blooms were widespread in shallow embayments but not deeper embayments and 2) the reasons for macroalgal blooms varied among these small embayments. By working with volunteer monitors and designing a macroalgal monitoring protocol that volunteers can implement, individual embayments gain data to support place-based solutions. Data from monitoring have been incorporated into a report card for Long Island Sound and a statewide water quality improvement plan. Monitoring methods are available online.

Crystal River/Kings Bay - solving macroalgal problems requires adaptive management



Relevant workshop presentation: Dr. Chris Anastasiou: Stories of Estuarine Macroalgae Monitoring and Management: Crystal River/Kings Bay, Florida (PDF, video)

The health of the Crystal River declined rapidly from the 1970s to the 2000s due to intense development over that period. The system has moved from submerged vegetation to filamentous algae and is now phytoplankton dominated. Recognizing that no single action would solve the problem led to an adaptive management framework and collaborative partnerships among agencies. Work within this collaborative framework identified multiple projects that restore and protect Crystal River. Monitoring throughout restoration will help adapt future projects by identifying what works best. One key aspect of this success story is defining a new future rather than attempting to reverse course.

Outcomes

By the end of the final day of the workshops, a clear consensus on several outcomes was apparent. The main objectives of the workshop (build a shared understanding, identify gaps in data and knowledge, and start coordinating across systems) were met. Participants showed strong support for new and continued monitoring of macroalgae, highlighting the need to understand drivers and trends related to its abundance.

- The workshop enhanced understanding of gaps in data and needs for research/monitoring.
- The breakout sessions connected practitioners, researchers, and managers within and across estuarine systems.
- Presenters raised awareness of the importance of macroalgae in nutrient cycling and other ecosystem processes.
- There was consensus among presenters that macroalgae must be included in the resource management framework of all Florida estuaries.

Piney Point: a timely test of workshop outcomes

An emergency discharge of wastewater from a former phosphate processing plant, Piney Point, affected the Tampa Bay watershed from late March to early April 2021, and it offered a timely test of the goals identified during the macroalgae workshop. The Tampa Bay Estuary Program mobilized coordinated environmental monitoring to understand conditions immediately prior to, during, and after the onset of the discharges to Lower Tampa Bay. Monitoring of impacts on nearshore, shallow water habitats that included macroalgae was implemented quickly. Scientists adopted methods from the *Eyes on Seagrass* program developed in the Charlotte Harbor area (see "Community science programs fill knowledge gaps" on page 8). The outcomes of monitoring Piney Point will help inform future, collaborative monitoring of macroalgae and contribute valuable information related to questions about the relationship between nutrients and macroalgal blooms. For more information, see Piney Point monitoring update reports from the Tampa Bay Estuary Program.

Next steps

The following list enumerates the short-term and long-term next steps for the entire community of practitioners (monitors and managers) in Florida based on feedback from the participants and the Steering Committee.

Short-term:

- Develop macroalgal indicators for use in ecological assessments
- Expand and improve existing monitoring programs to include macroalgae
- Prioritize research questions about drivers of macroalgal abundance and connect them to future management actions
- Reduce loads of nutrients that drive macroalgal blooms
- Engage and collaborate with local, state, and federal partners on goals for monitoring, assessment, and management
- Develop and employ tools to communicate key information about macroalgae
- Make methods for monitoring and best practices easily accessible to others who want to develop programs

Long-term:

- Compare data on macroalgal indicators across systems
- Develop new monitoring programs in areas lacking information on macroalgae
- Fund research that answers critical questions about macroalgae
- Develop recommendations for managing macroalgal blooms
- Develop recommendations for policy that permanently reduces sources of nutrients
- Participate in future workshops that provide updates on the state of the science and management related to macroalgae

Photo credit: Sarasota County Stormwater Environmental Utility

Perspectives on the way forward

The Florida Macroalgae Workshop identified many gaps in our collective understanding of macroalgae. However, it also highlighted success stories where nuisance blooms of macroalgae were brought under control through deliberate management actions. The case studies of Tampa Bay and Newport Bay, California demonstrate that a combination of public demand, policy tools, management actions, and consistent efforts to "hold the line" on reduced nutrient loads can bring about measurable reductions in macroalgae cover and biomass.

Roger Johannsen, independent scientist

Roger Johansson began studies of Tampa Bay in the 1970s when conditions likely were at their worst. Poor controls of discharges from wastewater treatment plants and industries provided a continuous and over abundant supply of nutrients to the bay's algal communities. Decades of persistent fertilization resulted in frequent and dense blooms of phytoplankton and macroalgae, and a large loss of seagrass. Strict regulation of these sources soon resulted in substantially reduced phytoplanktonic and macroalgal biomass. Soon, growth of seagrass was noted in upper portions of the bay where it had been sparse or lacking for several decades; growth that until recently continued at a near steady pace. Losses of seagrass during the past several years indicate that it is now our time to be vigilant and ensure the continued progress of Tampa Bay.

Dr. David Tomasko, Executive Director, Sarasota Bay Estuary Program

Dave Tomasko was the first scientist hired for the Sarasota Bay Estuary Program in 1989. He has held a variety of roles with different organizations since then, but the connecting thread has always been a dedication to improving water quality. He believes that the health of Sarasota Bay has slipped over the past few years, due to a combination of factors, including population growth, aging infrastructure, and changes in rainfall patterns, all leading to increased nutrient loads to the bays. This oversupply of nutrients has increased the amount of algae in the water, which has reduced water clarity. Increases in the amount of macroalgae along the bay bottom have combined with the reduced water clarity to bring about a significant decline in coverage of seagrass. Restoring water quality in the bay will require a decisive and sustained focus on nutrient management in the watershed.

Actions taken since the workshops

- Sarasota Bay Estuary Program adopted the Eyes on Seagrass program in Sarasota Bay and completed the first season of sampling in July 2021.
- Sarasota Bay Estuary Program developed a water quality report card for that includes macroalgae as an indicator, and the report card has been presented to various groups of stakeholders.
- The Piney Point event resulted in media coverage, public interest, and coordinated monitoring related to nutrient pollution and algal blooms in spring 2021 (https://shiny.tbep.org/piney-point/). Monitoring will continue through late fall 2021.
- The Tampa Bay Interagency Seagrass Monitoring Program (TBISP) will emphasize monitoring of macroalgae as part of its annual assessments.
- Coastal and Heartland National Estuary Partnership has been working closely with Florida Sea Grant to train volunteers. Sea Grant staff helped to collect data on macroalgae in the spring and summer as part of the Eyes on Seagrass project.
- Coastal and Heartland National Estuary Partnership presented information on the current state of Charlotte Harbor, including macroalgae, water quality, and seagrass to several different groups since the April workshops.
- Coastal and Heartland National Estuary Partnership is working with Florida Department of Environmental Protection's Aquatic Preserves and the CHNEP Water Atlas to post data on algae, which will likely be live in 2022.

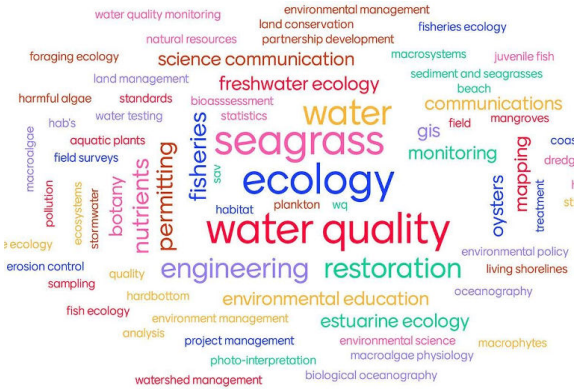
Acknowledgements

Thanks to all the participants at the virtual workshop:
119 government or agency representatives,
26 consultants,
25 members of the public,
22 nongovernmental organizations,
13 university faculty or staff,
12 graduate students, and
2 undergraduates.

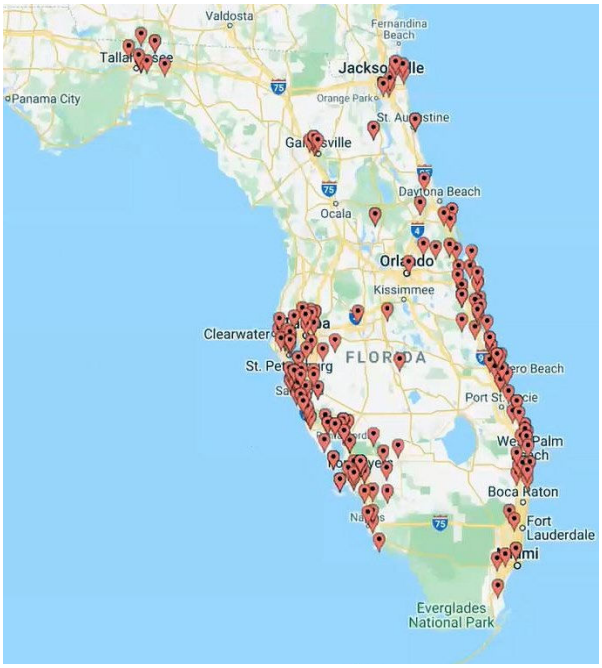
A Steering Committee organized the sessions and edited this report:

Dr. Chris Anastasiou, Southwest Florida Water Management District
Dr. Dennis Hanisak, Harbor Branch, Florida Atlantic University
Jennifer Hecker, Coastal and Heartland National Estuary Partnership
Nicole Iadevaia, Coastal and Heartland National Estuary Partnership
Dr. Charles Jacoby, St. Johns River Water Management District
Dr. Jay Leverone, Sarasota Bay Estuary Program
Dr. Gary Raulerson, Tampa Bay Estuary Program
Ed Sherwood, Tampa Bay Estuary Program
Betty Staugler, Florida Sea Grant
Dr. David Tomasko, Sarasota Bay Estuary Program
Armando Ubeda, Florida Sea Grant
Darcy Young, Sarasota Bay Estuary Program

Workshop facilitation and reporting by Caroline Donovan (consultant)



Participants represented many stakeholder groups with a wide range of expertise.



Map of Florida participant locations. Participants from outside of Florida not shown.

Workshop Agenda and Links to Materials

Monday, March 29, 2021

Time	Speaker	Topic	Presentation Links
Invited Presentations: Marine Macroalgae in Florida's National Estuary Programs			
9:20	Dr. Dennis Hanisak, Harbor Branch Oceanographic Institute, Florida Atlantic University	Macroalgae 101	PDF, video
9:40	Lauren Hall, St. Johns River Water Management District	Indian River Lagoon	PDF, video
10:00	Roger Johansson, independent consultant	Tampa Bay	PDF, video
10:40	Nicole Iadevaia, Coastal & Heartland National Estuary Partnership	Charlotte Harbor	PDF, video
11:00	Dr. David Tomasko, Sarasota Bay Estuary Program	Sarasota Bay	PDF, video

Wednesday, March 31, 2021

Time	Speaker	Topic	Presentation Links
Invited Presentations: Marine Macroalgae and Cyanobacteria - Drivers, Consequences, and Data Gaps			
9:10	Dr. Brian Lapointe, Harbor Branch Oceanographic Institute, Florida Atlantic University	Macroalgae Blooms in a Changing World: Some Examples in South Florida	PDF, video
9:30	Dr. Valerie Paul, Smithsonian Marine Station at Fort Pierce	Exploring Florida's Benthic Cyanobacterial Blooms	PDF, video
9:50	Dr. Eric Milbrandt, Sanibel-Captiva Conservation Foundation	Drivers and Consequences of Macroalgae in Southwest Florida	PDF, video
10:25	Betty Staugler, Florida Sea Grant Charlotte County	Eyes on Seagrass: Citizen Monitoring in Charlotte Harbor	PDF, video
10:45	Dr. Chris Anastasiou and Nathaniel Morton, Southwest Florida Water Management District	Seagrass to Macroalgae: Maps of Change	PDF, video
	Breakout rooms for each geographic area (Indian River Lagoon, Tampa Bay, Sarasota Bay, and Charlotte Harbor) engaged participants in discussions about what we know and what we need to know about macroalgae blooms in Florida estuaries.		Breakout Materials

Friday, April 2, 2021

Time	Speaker	Topic	Presentation Links
9:05	Report-out from Day 2 geographic area discussion groups		video
Invited Presentations: Stories of Estuarine Macroalgae Management and Monitoring			
9:30	Dr. Jamie Vaudrey, University of Connecticut	Assessing the extent and understanding the controls on seaweed blooms in Long Island Sound, the Urban Sea	PDF, video
9:55	Dr. David Tomasko, Sarasota Bay Estuary Program	A macroalgae-based TMDL for Newport Bay, California - did it work?	PDF, video
10:35	Dr. Chris Anastasiou, Southwest Florida Water Management District	Crystal River/Kings Bay, Florida	PDF, video