GREAT POND FOUNDATION™

ANNUAL REPORT 2022

GREAT POND foundation®

Foundation

Annual Message from the Foundation

Dear Pond Community,

The year 2022 saw the consolidation of much of the progress of your Foundation in the preceding years, while at the same time having several notable events.

Perhaps most notable was the departure of our long-standing friend and colleague, Michael Shalett, from the board and as an officer of the Foundation. His sage, perceptive advice and always present humor will be greatly missed. Happily, Mike remains resident on the Vineyard and Foundation staff interact with him and his colleagues on the Edgartown Dredge Committee. Since he will be local and always up-to-date, we hope and expect he'll be available to render advice when sought and as appropriate.

The Foundation's office lease ended November 30, 2022, and staff has been housed temporarily as alternative space is sought in what has proved to be a very tight real estate market. The search continues on a regular basis, but the activities of the Foundation have continued without interruption.

The Foundation's Executive Director, Emily Reddington, remains the vital lynch-pin of the programs and activities of the Foundation, and much of the progress in recent years is directly attributable to her ideas, initiatives and efforts. Julie Pringle continues to nurture the pond science initiatives in her role as Scientific Program Director, while David Bouck, newly promoted to Watershed Science Director, has expanded the work of the Foundation by digging into the complex topic of watershed nutrient loading. Together, David and Julie address the health of land and water respectively. The Foundation's CFO, Barbara Conroy continues to tend to financial and administrative aspects of the Foundation remotely and is now joined by Operations Manager, Erin Hepfner, locally, since her addition to our team in the fall of 2021. This field season Island native and newly minted UMASS graduate, Owen Porterfield, will return to the science team as our Field Crew Leader. We are delighted about Owen's homecoming and know he will make a wonderful addition based on the hard work and dedication he displayed the previous season as our summer intern.

Rob Morrison, as Shellfish Constable, is now the lead point of contact between the Town of Edgartown and the Foundation relating to the periodic dredging and opening of the Pond. Dredging has consistently been shown to aid the flow of water out and then back in from the sea during the times that cuts in the barrier beach remain open. Over the past five years, during which time the Foundation has worked with the Town in the transition from a Foundation-led dredging effort to a Town-led dredging effort — the Town has, as a matter of law, the right and responsibility to maintain the Pond and ensure its continued health — dredging has occurred only twice during those five years, on the following schedule: January 2021 and February 2023, well below the rate occurred when the Foundation oversaw operations. Testing has confirmed, following successful cuts, healthy increases in salinity and reductions in chemicals accumulated from run-off or other intrusions into the Pond's ecosystem. During the same period, cuts were "successful" (in effect, achieving in the main their intended effect) following winters with dredging, whereas they were less inconsistently successful in the absence of annual dredging. Many factors account for the success of any given opening — the level of the Pond's water relative to sea level, weather conditions and tides — but the Foundation firmly is of the view that dredging on a regular and thorough basis contributes to the success of the openings. Every spring, cuts following winter dredging, have been successful.

Year to date in 2023, two cuts have been attempted of which one proved durable and remained open for exit and tidal flow interaction for the time generally thought necessary.

As will be detailed elsewhere in this report, the Foundation's testing programs for the Pond has continued to thrive and strengthen. As outlined before, the Foundation now works with other Vineyard pond communities and is compensated for its efforts in helping those communities increase their own awareness of ecosystem threats and ability to seek mitigating measures. These collaborative efforts have been in place now for several years, increasing the demands on the Foundation staff and the need — as directed by the Foundation – for offsite testing by trusted providers.

The Foundation's collaborations with Island Boards of Health as to the Foundation's MV CYANO™ initiative continue and provide a basis for Island Health Agents timely to warn residents and visitors as to the health of ponds Vineyard-wide.

Even with the best will and efforts, ecosystem maintenance will always be a challenge, but it is far better to see early signs of problems than to become aware after the fact. The Scientific Program Director will highlight the dearth of seagrass in the Pond which was apparent last Fall in the article entitled "Save Our Seagrass" on pages 14-15 of this report.

During 2022, the Foundation sought and received two grants from third parties to pursue the expansion of the MV CYANO program and a technology upgrade, enabling the Island's cyanobacteria monitoring program to double (2021: 4 ponds; 2022: 10 ponds) and the security and efficiency of the Foundation to increase. Contributions to the Foundation from Pond riparian residents and other interested persons totaled $614,636 in 2022, including the proceeds of several multiyear grants.

As always, new and willing friends of the Foundation are always needed and enormously appreciated. The Foundation lost one of its most stalwart friends in 2022, Nancy Kohlberg. She and her late husband, Jerome Kohlberg, Jr., for years provided the Foundation with substantial and often vital support in myriad ways, and the Foundation's thanks to her and them both is enormous — as is that of all those interested in Pond matters who perhaps indirectly and without knowing benefited from their largesse and interest in the Pond's health.

As always, the Foundation thanks you, the readers of this report, and all members of the Pond and extended community for their largesse and interest in the Pond's health. Nothing can be accomplished without the efforts of many, and the Foundation's programs and results for 2022 amply illustrate that basic fact.

Sincerely,

AC Greer
Chair of the Board of Directors

Foundation

Eelgrass Embodies Ecosystem Resilience

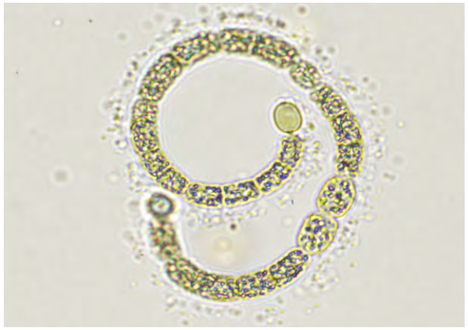
If you have spent time on the Island's ecologically rich coastal ponds you may have noticed the subtle shifts these living systems make with changing seasons and conditions. In the spring many of the Great Ponds along the south shore of Martha's Vineyard are refreshed by a cut of the barrier beach, infusing them with cool, clean, clear, salty, and oxygenated waters.

Spring oyster harvest on Edgartown Great Pond

As spring turns to summer, the water warms, and the summer visitors arrive. Summer brings hot, sunny days, and nutrients (nitrogen and phosphorus) which fuel the rich growth of life within the ponds. The abundance of phytoplankton (micro-algae, diatoms, cyanobacteria) produces oxygen and feeds zooplankton, oysters, and small fish. Large fish then eat the smaller fish and invertebrates (shellfish and crabs) and the osprey and humans consume the large fish.

At the same time, seagrasses such as eelgrass and widgeon grass grow, produce seeds, and provide many benefits to the pond ecosystem. Seagrasses, known as Submerged Aquatic Vegetation or SAV, provide habitat for larval fish and shellfish, stabilize sediments, produce oxygen and sequester carbon. Eelgrass can only grow when the water is clean, and the ecosystem has been healthy for an extended period of time. Eelgrass is not just grass that lives in the water, it is a sign of a strong ecosystem, that when present, strengthens it further.

Living ecosystems are strengthened by their resilience. A resilient ecosystem can respond to the stress posed by changing environmental conditions because of its complex network of life, capable of cycling the basic elements of life (carbon, nitrogen, oxygen) from simple autotrophic plant-like organisms to complex carnivores.



Top left: Microscopic plant-like organisms like this Anabaenopsis (cyanobacteria), are the base of pond food webs.

Top right: Large predatory fish such as this striped bass are further up the food web and consume smaller fish and shellfish

A coastal salt pond with abundant eelgrass is the gold-standard for a healthy and resilient pond ecosystem. The theme of this annual report is "Save Our Seagrass", because in cultivating habitats where seagrass thrives, we are ensuring that our pond ecosystems are vibrant and resilient. Learn more in "Save our Seagrass" on pages 14-15.

Healthy and resilient waters strengthen our community and are fundamental to the Island's long-term sustainability. In 2022, after 24 years, Great Pond Foundation re-imagined its mission and objectives in order to support the Island community.

Emily Reddington
Executive Director

DAVID WELCH

The Island's living waters define both the spirit and the character of our community.

GPF MISSION

To cultivate the resilience of our coastal pond ecosystems through science, collaboration, and education.

OBJECTIVES

1. understand the ecological health of our coastal ponds, providing scientific resources
2. educate and engage our community about their role in pond and watershed health
3. prepare for climate challenges by cultivating ecosystem resilience
4. identify sources of impairment and support data-driven mitigation
5. advocate for scientifically informed pond management
6. foster collaboration

Foundation

Meet the Seasonal Field Crew

Seasonal staff and interns contribute nearly 2,000 hours of field and lab support to the annual monitoring programs with the bulk of the work taking place from June through September. In 2022, summer science interns Katelyn Hatem and Owen Porterfield, along with Field Crew Leader Emma Rosser worked alongside staff scientists, achieving the greatest amount of data collection to date!

SAMMI CHAVES

Katelyn Hatem is a junior at the University of Michigan studying Ecology and Evolutionary Biodiversity. She is from Massachusetts and developed a strong interest in the ocean and marine life during her summers spent on Martha's Vineyard. Katelyn is in a professional environmental fraternity, known as Epsilon Eta, where she and the other members aim to acquire careers in the environmental field. Her goal is to eventually teach science either at the high school or college level. Katelyn has tutored several students in Detroit and Chicago, and even substitute-taught American Sign Language for her alma mater, Newton South High School. She looks forward to sharing and applying what she learned at GPF with future academic and professional endeavors.

Owen Porterfield is a senior at the University of Massachusetts Amherst studying environmental science with a concentration in environmental quality. Having been born and raised on Martha's Vineyard, Owen developed a deep appreciation for the natural beauty of his island home at an early age. Upon arriving at college he quickly became interested in ensuring the health of vital environmental resources like soil and water. At UMass he works in a soil biogeochemistry lab where he tests and analyzes the heavy metal concentrations of soil samples taken from across the northeastern United States. Owen's position at GPF helped him play an active role as an advocate and scientist while maintaining the environmental health of the Vineyard. We are thrilled to announce that Owen will be returning to Great Pond Foundation as the Field Crew Leader for 2023!

Emma Rosser graduated from Hobart and William Smith Colleges in 2021, earning a B.S, in both Environmental Studies and Biology. Throughout college, Emma worked in various labs including a Water Quality lab in New York, and Marine Biology lab in Florida. Emma also spent time working as a laboratory technician for an agricultural research station. She enjoys spending time at the beach and is passionate about marine ecology and conservation. Emma is now employed at the Marine Biological Laboratory as a Research Assistant. She works on a long-term ecological research project that focuses on how the estuarine-marsh ecosystem near Plum Island changes over time in response to climate, sea level, and land use change.

Community

Beach Seine Science Days 2023

Great Pond Foundation is continuing our commitment to education by hosting Beach Seine Science Days in summer 2023. This is building off a successful collaboration with Friends of Sengekontacket Pond and Island Spirit Kayak in 2021 and 2022, where dozens of families participated in our Sengekontacket Species Roundup to learn about the fish and invertebrates found along the pond's shoreline.

MARK YOUR CALENDAR! BEACH SEINE SCIENCE DAYS 2023:

JULY 15 (rain date July 22)
10-11:30am
Little Bridge, State Beach

AUGUST 12
9:30-11:30am
at the cut, Edgartown Great Pond

Get in the water with GPF! Beach seines are one of the best ways to see the life in our ponds. Full details will be available via GPF's newsletter and www.greatpondfoundation.org.

SAMMI CHAVES

SAMMI CHAVES

SECOND ROW: NATALIE AYMOND, MV TIMES

LEFT AND MIDDLE: NATALIE AYMOND, MV TIMES

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Science

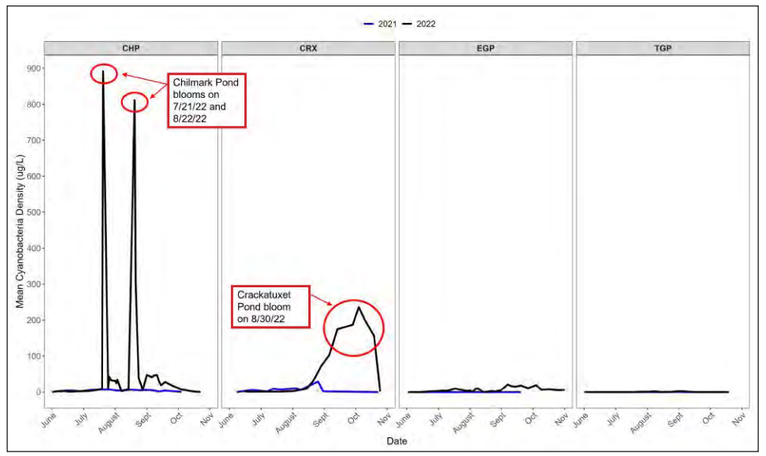
MV CYANO® Expands in 2022

By Julie Pringle, *former Scientific Program Director*

In response to the rising incidence of cyanobacteria blooms and in recognition of the need for baseline monitoring data, the Great Pond Foundation (GPF), in 2021, designed and spearheaded the launch of a cyanobacteria monitoring program on Martha's Vineyard: MV CYANO. MV CYANO is a collaborative initiative among Island Boards of Health and scientists from GPF, resulting in a comprehensive cyanobacteria monitoring program that greatly increases the local capacity to detect and respond to cyanobacteria blooms. In 2021 and 2022 this program monitored cyanobacteria presence and potential for toxic blooms in Chilmark Pond, Tisbury Great Pond, Edgartown Great Pond, Squibnocket Pond, and Crackatuxet Pond. Updates were posted on a weekly basis on respective Town, Chilmark Pond Foundation, and Great Pond Foundation websites.

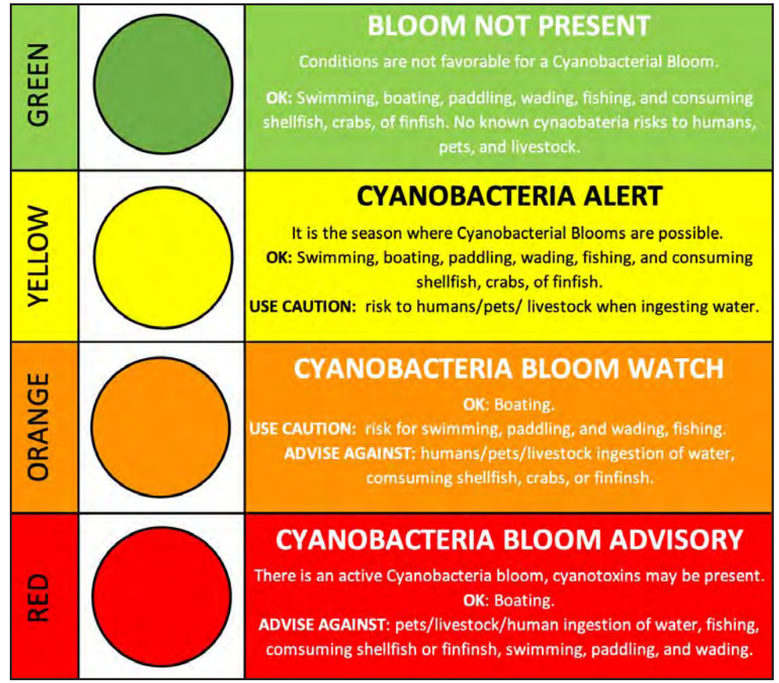
In 2022, MV CYANO doubled the number of water bodies monitored within the program from five to ten. It also began situational sample collection and processing on a needs-basis Island-wide, where concerned citizens could bring in water samples for analysis. With the extension of the program, GPF has become a resource for concerned or curious individuals. The 2022 program expansion was made possible with funds provided in part by the Edey Foundation, as well as participating Town Boards of Health and Pond Associations. This funding also allowed GPF to hire an additional seasonal staff member to increase capacity and oversee the core operations of MV CYANO. Additional monitored ecosystems included James Pond, Seth's Pond, Sengekontacket Pond, and Lake Tashmoo. This expansion of the program was timely, as the summer of 2022 was characterized by increased bloom activity and elevated cyanobacteria concentrations across the Island and throughout the region.

The western portions of Chilmark Pond observed the highest density cyanobacteria blooms compared to other ecosystems monitored in 2022 (see chart, below). These blooms periodically formed dense, vibrant green mats along shorelines of the Middle Pond area, and intermittently throughout Doctor's Creek to South Abel's Hill parking area. These dense cyanobacteria blooms can be a risk to public health due to their potential to produce toxins combined with their location at the shoreline where people and animals most frequently interact with the waterbody. Due to this risk, the Chilmark Board of Health issued several cyanobacteria advisories (red risk category, see chart on right), which restrict the recommended recreational activities in the pond. Throughout the 2022 monitoring season, cyanobacteria density in Chilmark Pond appeared to have a strong relationship with salinity at each monitoring station. Stations that exhibited the lowest salinity levels throughout the season often recorded the highest observations of cyanobacteria density. However, the same relationship was not nearly as prominent during the 2021 season. This suggests other environmental variables were at play such as ambient temperature, the timing of man-made openings to the ocean, rainfall, groundwater input, and nutrient availability.



Pond-wide average cyanobacteria density within Chilmark Pond (CHP), Crackatuxet Pond (CRX), Edgartown Great Pond (EGP), and Tisbury Great Pond (TGP) in 2021 (blue) and 2022 (black). Cyanobacteria blooms with CHP and CRX are marked with red circles.

Edgartown Great Pond (EGP) and Crackatuxet Pond also experienced increases in cyanobacteria density compared to 2021. Cyanobacteria increased dramatically in both ponds in September. While concentrations within EGP remained elevated for approximately 5 weeks, species identification and toxin analyses indicated that there was no risk to human health. However, the bloom within Crackatuxet was identified as a potentially toxic species and the Edgartown Board of Health issued a cyanobacteria advisory (red risk category) for this pond.



Tisbury Great Pond (TGP) was an exception to this trend. While cyanobacteria density was slightly higher in 2022 compared to 2021, concentrations never warranted advisories from the Board of Health beyond the yellow cyanobacteria alert. While exact causes are unknown, environmental conditions have not promoted excessive cyanobacteria growth in TGP in both years.

An interesting observation was made in August '22, when both James Pond and Chilmark Pond experienced elevated cyanobacteria densities of the genus *Dolichospermum*. Subsequent toxin analysis revealed the presence of microcystin, a common but potentially dangerous cyanotoxin. Surprisingly, while the density of cyanobacteria in Chilmark Pond was several orders of magnitude higher than that of James Pond, the concentration of microcystin was almost double in the James Pond sample compared to the sample from Chilmark (microcystin remained far below thresholds which trigger beach closures). Further study is needed to help elucidate species-specific differences within individual ecosystems and inform the risk potential associated with these communities.

In 2023 GPF will conduct an in-depth analysis of environmental and ecological variables paired with ongoing monitoring and targeted sampling in order to identify the combination of factors that trigger bloom events. Specifically, genetic techniques will be used to further understand the species present within the microbial community and how those species interact with each other and with their surrounding environment. Understanding the relationships between pond environmental conditions and microbial ecology can help identify the combination of factors that trigger bloom events to ultimately help forecast and predict when harmful blooms will occur. This study is supported in part with Edey Foundation funding.

For weekly cyanobacteria updates between June and October please visit https://greatpondfoundation.org/mvcyano/

Cyanobacteria bloom in Chilmark Pond from Aug. 22, 2022.

Science

Nitrogen, Wastewater, and Title 5

By David Bouck, *Watershed Science Director*

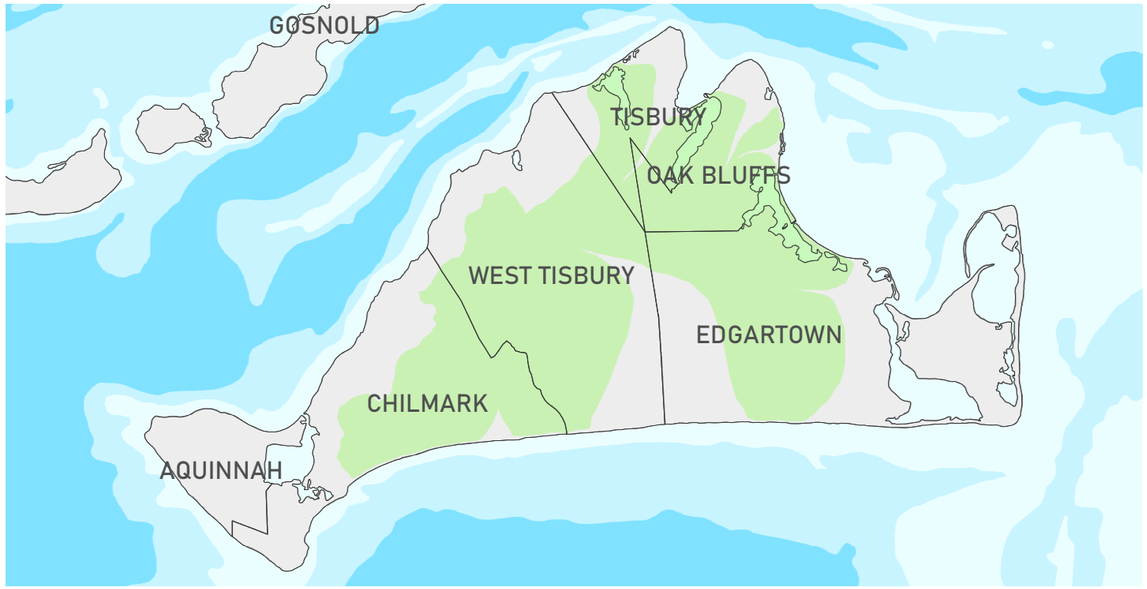
In response to concerns voiced by citizens and scientists, the Massachusetts Department of Environmental Protection recently announced two proposed amendments to the existing Title 5 regulations, which govern the form and function of on-site septic systems in the State. The goal of these new laws is to significantly reduce the input of excess nutrients entering groundwater from our wastewater, specifically, nitrogen. The first proposed amendment to Title 5 would create new zones entitled "Nitrogen Sensitive Areas", that will identify areas across the State threatened by nitrogen inputs. These new nitrogen sensitive zones will encompass all of Cape Cod and the Islands, due to the many estuaries that exist throughout these regions. Upon designating an area as nitrogen-sensitive, that population will be responsible for upgrading existing septic systems and other wastewater infrastructure to the "best available" nitrogen-reducing technology within five years. The second new amendment to Title 5 proposes the creation of a type of regulation referred to as a "Watershed Permit". These permits would allow communities to approach required nitrogen mitigation through the use of many different types of innovative and alternative technologies and techniques over a 20-year timeframe. This approach is designed to be an adaptive plan, with requirements for monitoring, analyzing and reporting results of upgrades and mitigation measures as they progress.

WHAT DOES TITLE 5 MEAN?

Many homes in Massachusetts have septic systems. Title 5 rules specify how to install, use, and maintain these systems. (Mass.gov, 4/15/2023)

Under these new regulations, individual towns would have the choice between widespread upgrades of wastewater systems across the township within 5 years of implementation, or the development of a tailored watershed management plan to be reviewed and accepted by the state with a 20-year implementation timeframe. It is clear from the State's language that obtaining the watershed permit is the preferred course of action, as it provides a community with much more time and flexibility in approaching nitrogen reductions in wastewater. The cost of upgrading septic systems is dependent on the type of upgrade, the size of the home, and any logistical issues involved in the installation. Estimates can range from a low amount of $35,000 to a high of $100,000 per home when costs of maintenance, troubleshooting, and operational energy requirements are taken into account. The cost of blanket upgrades across a town could result in steep financial investments from families and individuals who may not have the means to afford them. On the Vineyard in particular, this additional cost, coupled with the already high and increasing cost of living on the Island, might accelerate turnover within the community. This underlines the importance of developing a watershed management plan and receiving the watershed permit, which allows a more nuanced approach to these upgrades. This approach also allows town government to advocate on behalf of its citizens, as well as apply for state and federal funding for assistance.

Depending on the town, watershed plans can be very different. If municipal wastewater treatment already exists, one traditional approach is to invest and expand coverage of sewer hookups and wastewater processing. Treatment plants can increase their capacity and add additional levels of treatment to help attenuate nitrogen. These upgrades coupled with the replacement of septic systems in the most sensitive areas where municipal linkage is not feasible, could be enough to meet the nitrogen reduction targets approved for that town. Watershed plans can also incorporate other methodologies with a proven track record for nitrogen mitigation, such as expanding aquaculture of filter-feeding shellfish, restoring habitats that process and store nitrogen, installation of permeable reactive barriers, reducing stormwater runoff, or changing land-use practices in areas adjacent to impaired waters. With each proposed method for mitigation, a framework for monitoring and assessment of their relative success will need to be implemented. Watershed plans must also address how the town plans to fund the proposed upgrades. Several towns on Martha's Vineyard host municipal wastewater treatment infrastructure with the potential for traditional upgrades. However,



Map of MV: MassDEP Natural Resource Area Nitrogen Sensitive Area (NSA) map identifies watersheds on Martha's Vineyard that may be designated as NSAs after the promulgation of proposed Title 5 amendments. (Retrieved from MassDEP website, 4/10/23)

the vast majority of homes (up-island in particular) are using on-site septic systems. Many of the less densely developed areas of the Island are not feasible locations for large, centralized wastewater treatment development. This means that individual upgrades of traditional septic tanks will likely be the principal method available to these communities.

Considering the significant costs that may be required per household, the increased difficulty of bringing materials to the Island, along with the logistics of siting, permitting, and installing new systems, the Vineyard faces an uphill battle. It is important to increase our local capacity to manage these potential upgrades sooner rather than later. One possible strategy is to refine the existing nitrogen loading models within each town. We are fortunate on this Island to host a highly educated community that cherishes and invests in the ecological health of the Island. Our community already retains much of the expertise required to investigate precisely where primary nitrogen sources emanate in a scientifically defensible manner acceptable by State standards. Refined models can help to inform eventual watershed management plans and may identify more efficient and cost-effective strategies for reducing nitrogen inputs.

It is time for our society to address its nitrogen impacts and to protect or restore our wetlands and estuaries where possible. Investments of this scale that promote resiliency of fragile and essential ecosystems will help to buttress against the unforeseen impacts of a changing climate. It should not have to be stated that this is also an investment in the sustainability of our Island population. We stand at a crucial moment and must be thoughtful about implementing these changes in the most efficient and effective manner possible. It can be expected that as more climate issues arise, there will be less funding and resources available from public sources to assist in management. It is essential that we get this right. A problem this far-reaching and intertwined can only be solved through honest coordination and collaboration at all levels of public and private engagement. But just because something is difficult, does not mean that it is impossible. Luckily for the Vineyard, the ties that bind our Island population are strong, and the motivation to do what is right is one of the reasons why we live here.

To learn about MassDEP Innovative Alternative (I/A) to Title 5 systems, visit https://www.mass.gov/guides/innovative-technology-and-title-5-systems.

Science

Save Our Seagrass

By Julie Pringle, *former Scientific Program Director*

Eelgrass *(Zostera marina)* is a native seagrass that grows on the sandy bottoms of local salt ponds and coastal waters. This natural resource provides immense ecological and commercial value by improving the health of waters both locally and globally. Eelgrass serves as habitat for larval fish, produces oxygen, sequesters carbon, improves water quality, stabilizes shorelines, and is an indicator of the overall health of an estuary. Eelgrass requires clear and clean water, which makes it an indicator of water quality and overall ecosystem health.

Coastal seagrasses and wetlands remove carbon from the atmosphere and help to combat climate change. This carbon removal and storage within coastal marine ecosystems is called blue carbon. In Edgartown Great Pond (EGP) and other local ponds and bays, the native eelgrass meadows store carbon in the sediments of the pond floor. These coastal ecosystems can remove large amounts of carbon from the atmosphere and can store it for hundreds to thousands of years. Because of this, protecting and restoring this species not only protects a vital habitat, but also helps reduce the impacts of climate change.

Unfortunately, this fragile species is struggling both locally and globally. Eelgrass is threatened due to water quality degradation caused by excess nutrients from septic systems, fertilizer from lawns and agriculture, and other anthropogenic sources. Additionally, the decline of this species is exacerbated by climate change, as increasing temperatures intensify eutrophication and more frequently exceed the temperature limits of the species. Worldwide, seagrass meadows are in decline, down 30% from their historical extent, with the rate of loss increasing at 7% per year[1]. A recent study in nearby Waquoit Bay on Cape Cod found that eelgrass extent has decreased by at least 97% compared to 1951 aerial image estimates[2].

There are three primary variables that affect seagrass growth and survival: temperature, light, and nutrients. Light is required for photosynthesis to occur, inorganic nutrients (C, N, P) are needed to form fundamental cellular molecules such as DNA and proteins, and temperature impacts seagrass metabolism. While inorganic nutrients are needed to form the building blocks of life, problems arise when there are too many nutrients in the water. Excess nutrients increase phytoplankton (microscopic plants) and algal growth, which makes the pond water murky and causes a reduction in light availability to seagrass and other submerged plants. If light levels are too low and the rate of photosynthesis is less than the overall metabolic rate, mortality may occur.

Additionally, rising temperatures due to climate change are adding to the multitude of stressors currently facing seagrass. Eelgrass has a thermal limit of 25°C (77°F), above this threshold the rate of photosynthesis can't keep up with other metabolic processes, creating an energy deficit. Unfortunately, temperatures in coastal ponds are increasingly exceeding this limit. This means that eelgrass will struggle to survive, especially if other factors limit its ability to photosynthesize, such as light availability. Reducing nutrients and in turn reducing the biomass of phytoplankton is difficult to do in the short term, and long-term solutions require a nitrogen mitigation strategy, such as the installation of Innovative/Alternative septic systems (see page 12 for more information).

Fortunately, a short-term nutrient reduction strategy exists within EGP and other south shore ponds: pond openings. When a coastal pond is cut to the ocean, nutrient-rich pond water drains into the ocean and incoming tides replace it with ocean water. Ocean water has a lower nutrient content, so an ideal opening will fully flush the pond with ocean water and reduce the nutrient concentration within the pond.

Pond cuts have an additional benefit: raising the salinity. In addition to temperature limits, eelgrass also has salinity thresholds. *Z. marina* prefers salinity above 20 parts per thousand (ppt) but can tolerate salinity down to 15 ppt. Below this, the plant begins to be stressed and survival is threatened. Since eelgrass is a keystone species in coastal ecosystems, it is ideal for salinity to be 20 ppt or above during the spring and summer growing season. Salinity 20 ppt or above is favorable for key shellfish populations as well. Previous studies such as the MEP Report[3] and the Gaines Report[4], as well as GPF data indicate that this can be accomplished via a spring and/or summer opening with 11-14 days of tidal exchange with the ocean. This is the ideal cut duration which ensures an increase in salinity throughout the Pond.

Throughout the years of 2009 through the spring of 2019, the inlet area of EGP was dredged nearly annually through a combination of GPF and Town of Edgartown's efforts. During this period, the Pond experienced a rebound of eelgrass habitat within the lower basin and extending into the coves. EGP also observed decreases in total nitrogen concentrations to near the goals set by the MEP. This is likely due to improvements in wastewater management coupled with a higher frequency of openings with at least 11-14 days tidal exchange. Dredging of the inlet improves flow throughout this shoaled area, maximizing tidal flow and increasing the probability of large salinity increases throughout the Pond. While dredging does not guarantee a successful cut, GPF advocates for dredging on an annual basis to increase the likelihood of openings that flush the pond and increase the salinity pond-wide. There are many unpredictable and uncontrollable variables that contribute to the longevity of an opening, however annual dredging is one variable that we can control to increase the odds of an optimal exchange.

In the summer of 2022, a massive decrease in eelgrass was observed in EGP. Eelgrass was previously abundant south of Swan Neck and was expanding in Lyle's Bay and even into the northern coves (see map). Beginning in July of 2022, phytoplankton growth exploded. Fluorometer readings from the MV CYANO program indicated that this was a green algae bloom that affected the whole pond. As a result, the water became a murky, green color. Further, this bloom persisted for the entire monitoring season. While green algae are nontoxic to humans, the density of the bloom created a barrier to light transmission into the water column. With light greatly reduced, eelgrass was not able to sustain itself. Additionally, water temperature in 2022 frequently exceeded the 77°F thermal limit. In EGP, average daily temperature was above 77°F for 59 days in 2022, as measured by a temperature data logger deployed south of Swan Neck. Stress has a cumulative impact on eelgrass health. In 2022 EGP eelgrass meadows combatted low light, low salinity, and high temperatures all of which resulted in the massive decline of the species.

In 2023, GPF will monitor EGP to determine if eelgrass returns. *Z. marina* seeds are produced each summer and germinate the following spring. This creates a seed bank that buffers against years of environmental stress. This species has suffered large losses in the past, most notably in the 1930s when a wasting disease decimated eelgrass along the US east coast. According to Phil Colarusso, an eelgrass expert at the Environmental Protection Agency, eelgrass in EGP can recover after the reduction that occurred in 2022. This spring and summer, GPF will be conducting surveys to hopefully document this recovery. While we cannot control the temperature of the water, in the short term we can focus on maximizing the efficiency of cuts (which increase salinity and decrease nutrients) and in the long term, reducing nitrogen entering the watershed.

FOOTNOTES:

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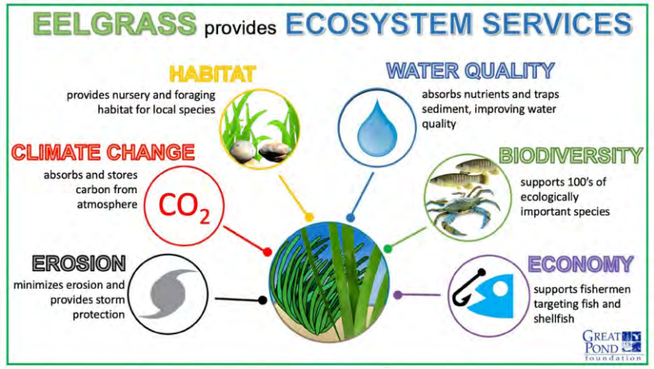
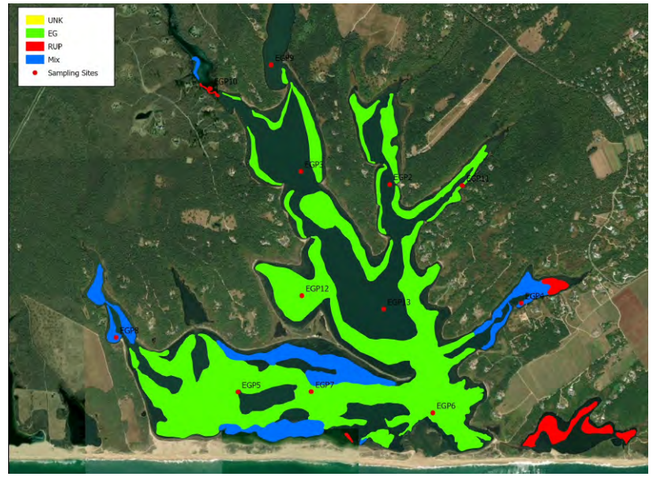
2. Long, Matthew H., and Jordan W. Mora. "Deoxygenation, Acidification and Warming in Waquoit Bay, USA, and a Shift to Pelagic Dominance." Estuaries and Coasts (2023): 1-18.

3. Howes Brian L., John S. Ramsey, Roland I. Samimy, David R. Schlezinger, and Ed M. Eichner. "Linked Watershed-Embayment Model to Determine the Critical Nitrogen Loading Threshold for the Edgartown Great Pond System, Edgartown, Massachusetts." SMAST/MassDEP Massachusetts Estuaries Project, Massachusetts Department of Environmental Protection. Boston, MA. (2007).

4. Gaines, Arthur G. "Coastal Resources Planning and Management: Edgartown Great Pond, Edgartown, Massachusetts. Final Report prepared for the Board of Selectmen, Town of Edgartown, Massachusetts." Marine Policy Center, Woods Hole Oceanographic Institution, Woods Hole, MA. (1993).



This infographic was produced with funding from the Edey Foundation.



This map represents Great Pond Foundation's best understanding of the distribution of seagrass beds in Edgartown Great Pond. It incorporates MassDEP's 2020 Aerial survey and field work conducted by GPF. Vegetation included eelgrass (EG- Zostera marina) *in green,* Ruppia maritima *(RUP) in red, and a mix of both types of seagrass in blue.*

Below: Blades of eelgrass (Zostera marina) *with developing seeds. Eelgrass is a flowering plant, much like the plants in your garden! Eelgrass creates essential habitat for species such as oysters.*

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Science

Scientific Collaborations

Great Pond Foundation not only conducts its own coastal pond research, but also collaborates with local, regional and national scientific organizations to produce and share data that are used to protect the unique ecology of our coastal ponds and watersheds.

Here we highlight our partnering organizations and their scientists who share thoughts on collaborating with GPF!

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (US EPA)
Dr. Phil Colarusso, Marine Biologist

How do you, or your organization benefit from collaborating with GPF?
Working on an island poses logistical challenges for researchers from the mainland. Logistical support from GPF greatly assists in our ability to carry out our work. Equally important is their knowledge of the local environment. When considering and designing sampling plans, that local knowledge is priceless.

What will the result of your collaboration with GPF be?
A better understanding of the health of the eelgrass meadows within the coastal ponds. Eelgrass, our local seagrass species, serves as important fish and shellfish habitat and acts as a buffer to climate change by sequestering carbon.

Why is this scientific contribution important?
The coastal ponds are really interesting ecosystems that due to their reduced flushing and shallow nature may provide a preview of what climate change may bring the broader North Atlantic.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

WOODS HOLE OCEANOGRAPHIC INSTITUTION (WHOI)
Dr. Paige Hovenga, Postdoctoral Investigator

How do you, or your organization benefit from collaborating with GPF?
The GPF has shared first-hand knowledge of historical breaches with our team, provided observational datasets, and connected us with local community members involved with coastal management decisions. This collaboration has been essential for guiding our investigations and improving our overall understanding of the processes that affect machine-made breaches of coastal ponds along Martha's Vineyard.

What will the result of your collaboration with GPF be?
As a result of our collaboration with GPF, we will develop tools and best practice recommendations for coastal managers and communities to design optimal breaching strategies and understand how they will recover based on a better understanding of wave- and current-driven sediment transport and morphological evolution.

Why is this scientific contribution important?
This scientific collaboration is important for optimizing management decisions related to the breaching of coastal ponds to reach nutrient and flooding mitigation goals more effectively. Obtaining local knowledge of past breaches and how the system responded helps guide our research.

MARINE BIOLOGICAL LABORATORY (MBL)
Dr. Javier Lloret, Research Scientist

How do you, or your organization benefit from collaborating with GPF?
GPF's help in funding and support of our work has been invaluable to us. Working side by side with the GPF team has been a great experience. Their expertise proved to be instrumental in allowing us to move our science forward. We are excited to continue this collaboration and hope that it helps us achieve our goal of understanding the complex interactions of nitrogen in coastal ponds.

What will the result of your collaboration with GPF be?
Our collaborative efforts in monitoring nitrogen in the Vineyard's ponds and tracing its sources and impacts using stable isotopes will allow us to identify, locate and quantify sources of nitrogen inputs entering local ponds, and determine the relative ecological status of those ponds. This information is highly relevant for managers, and could help in the design of focused strategies and actions aimed at remediating the nitrogen pollution problem that many of our waterways are experiencing.

Why is this scientific contribution important?
This collaboration not only provides help with the logistics and other details that make our job possible. Collaborating with local groups like GPF is key for our efforts, since they possess the much-needed local knowledge about the sites where we do our science. More importantly, their role in facilitating connections with neighbors, local managers, towns, and other stakeholders is key to our outreach.

MARINE BIOLOGICAL LABORATORY • WOODS HOLE •

WIDENER UNIVERSITY
Dr. Caroline Fortunato, Assistant Professor

How do you, or your organization benefit from collaborating with GPF?
The collaborative project my lab has with GPF focuses on determining how microbial communities change across environmental gradients in the Great Ponds, with specific attention given to the better understanding cyanobacteria bloom dynamics. Using DNA sequencing, we aim to determine who is there, where they are, and why these microbial populations grow within the Great Ponds

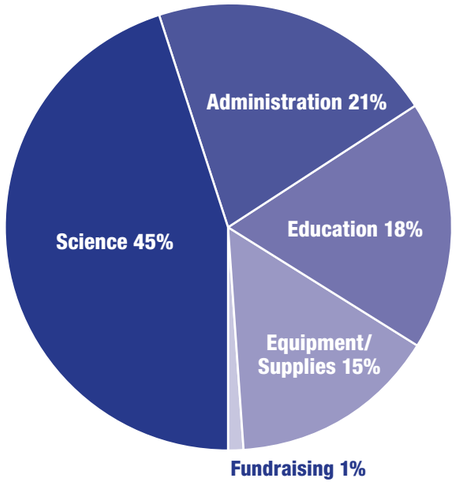
What will the result of your collaboration with GPF be?
As Widener is primarily an undergraduate institution, the data collected through this collaboration will be analyzed by undergraduates in my lab and used in peer-reviewed publications. The ultimate goal is to determine the occurrence of microbial populations across the ponds, with specific attention given towards where and, more importantly, why cyanobacterial blooms occur.

Why is this scientific contribution important?
Through collaboration, scientists gain more holistic answers to the questions they are asking. With this collaboration, my lab gains access to all types of data (CTD, nutrients, toxin data) we can combine with our sequence data to better understand the microbes of the Great Ponds and the role they play in ecosystem functions.

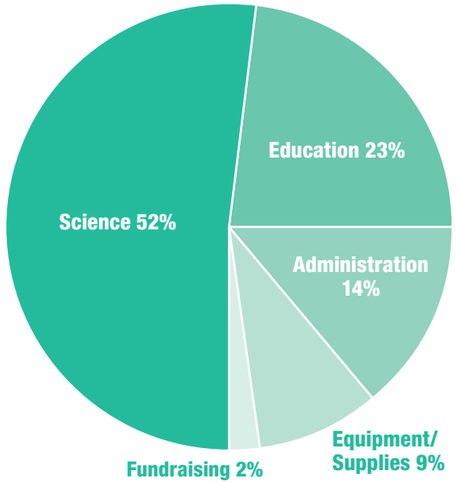
Financial

2022 Highlights

2022 TOTAL EXPENSES $636,228

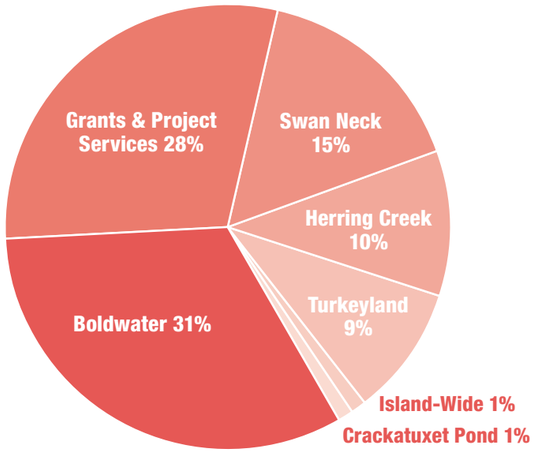


2021 TOTAL EXPENSES $433,409

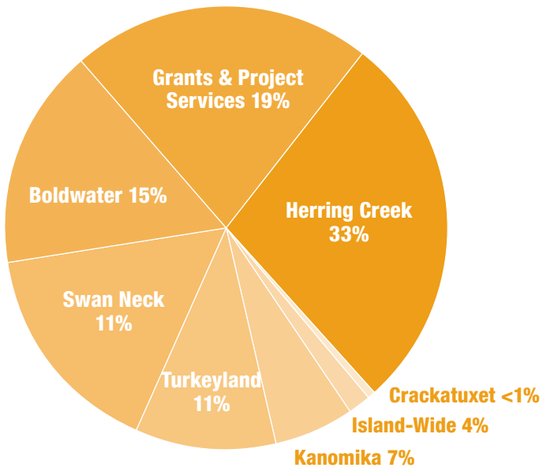


Total revenue decreased marginally to $614,636 despite an overall increase of donor income from most neighborhoods. This can be attributed to a large non-recurring donation received in 2021. Grants and program increase saw an increase with additional income from various towns and local groups for water quality monitoring on some island ponds.

2022 TOTAL REVENUE $614,636



2021 TOTAL REVENUE $627,688



Total expenses rose 47% to $636,228 primarily due to increased science and administrative staffing levels and additional overall programs. Core science activities now account for 45% of total expenses. Education decreased from 23% to 18% of the overall expense budget. Administrative expenses rose from 14% to 21%, again due to increased staffing levels.

(All figures are preliminary and subject to audit.)

2022 Donor Recognition List

Leadership Circle
$10,000 +
Anonymous (2)
Cindy & A.J. Janower
Pam Kohlberg & Curt Greer
Herring Creek Farm Landowners Association
Kohlberg Foundation
Anne & Brian Mazar
The John & Inge Stafford Foundation
Mary & Timothy Walsh
Anne Woodhull
Chilmark Pond Foundation
Edey Foundation

Blue Carbon Society
$5000 to $9999
Jennifer & Mike Corbo
Catherine Samuels & Jeremy Henderson
Joanne & Martin Homlish
Deborah & Joe Loughrey
Kimberly & Brian McCaslin
Christine Campbell & William Massa
Karen & Alan Muney
Yael & Zeev Pearl
Lady Jill & Sir Paul Ruddock
Leah & Bob Rukeyser
Bette & Richard Saltzman
Melissa Vail & Norman Selby
Gail & John Wasson
The George & Doris Daniels Wildlife Trust

DAVID WELCH

Ecosystem Sustainers
$2500 to $4999
Martha's Vineyard Community Foundation
Betsy & Andy Forrester
Sarah & Fergus Henderson
Debbie & Glenn Larsen
Linda & Michael Purvis
Lisa Berkower & Mitch Rubin
Beth & Eric Schlager
Susan & James Snider
Marie & Craig Vought

Clean Water Coalition
$1000 to $2499
Dalia & David Blass
Gail & Randy Gibbs
Caroline & Bob Maruska
Yvonne Kwauk & William Reinfeld
Kate & Patrick O'Keefe
Toni Chute & John O'Keefe
Pam & Bill Craven
Barbara & Roger Fieldman
Hesperia Fund
Becky & Tony Hull
Linda & Gerald Jones
Doris Luening
Gabriella Morizio & Robert McLaughlin
Amy Salzman & Randy Milch
Amy & Howard Seife
Dr. Richard Shumway & Joan Shumway
Bruce Tomason
The Vessenes Family
Heidi & Alex Wason

Blue Crab Crew
Up to $1000
Anonymous
AmazonSmile
Ollie Becker
Stefanie & Doug Cronin
Kitty & John Culbert
Angela & Robert Egerton, Jr.
David Faber
Cabray Haines
Sara Hoffman & Jeremy Houser
Charlotte & John Klein
John Coskie
Steve Levin
Megan Lindberg
Elizabeth & Michael MacKenty
Martha's Vineyard Bank Charitable Foundation
Frank McCulloch
Patricia McGrath
John Siffert
Ms. Deb Watts & Dr. John Ward in honor of Russell Bridges & Dudley Cannada
Marjorie Wolfe

AERIAL VIEW OF EDGARTOWN GREAT POND COURTESY OF OLLIE BECKER

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