# GREAT POND FOUNDATION





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#### **Dear Friends of Edgartown Great Pond,**

I am absolutely delighted to report that this past year has been exceptional for the Great Pond Foundation. The goals we set for dredge operations as well as science and education have been far surpassed, and we could not be more pleased.

Strong donor support over the years paid off handsomely by allowing much needed repairs and maintenance to our dredge last fall. As a result, "Nessie", in the capable hands of Steve Ewing and his crew, was able to operate flawlessly through the winter months leading to a remarkable **six-week** pond opening. As some of you may know, Edgartown voted this spring to replace its town-owned dredge. After twenty years of operation, the old dredge had come to the end of its useful life. We are confident that with continuing maintenance in a diligent manner, GPF's "Nessie" will enjoy a long and productive life. With your continued support, we can expect many more years of successful dredge operations, while providing for the eventual replacement when the time comes.

Since last summer, Emily Reddington, our recently hired Director of Science & Education, has worked tirelessly to build a robust program. The Martha's Vineyard Shellfish Group's ten-year old Oyster Restoration Project was expanded to include 26 new oyster cages and a strategic experiment was initiated to test all corners of the Pond for oyster viability with the help of Foundation staff and interns. Emily and her two interns also began collaborating with BiodiversityWorks on their program that monitors shorebirds including Piping Plovers, Least Terns and American Oystercatchers. Lastly, with purchase by the Foundation of state-of- the-art water quality testing equipment, Emily has designed and implemented a comprehensive water quality monitoring program that will provide much needed data to measure and document the effectiveness of management and restoration efforts over time. This past year we have also worked hard to bring new life to the way we share our knowledge with friends, supporters, and the public at large. Our website has been redesigned to showcase the Foundation's work on the Pond in an informative and, hopefully, exciting format. As a complement to the site, e-newsletters are periodically sent to keep our supporters up-to-date on the latest Pond news.

As I look to the future, I feel assured that the Foundation will continue its evolution as a valuable asset, not just to the Edgartown Great Pond, but to the Island community at large. While mindful of our primary mission of Stewardship for Edgartown Great Pond, the Foundation recognizes the importance of cooperative efforts among local towns and other conservation organizations.

Please enjoy this annual report, contact us with your thoughts and ideas, and continue your generous support.

Many thanks to you all.

Thomas C. Wallace, President Great Pond Foundation



# Dredge Report

## Steve Ewing, Dredge Manager

The winter of 2016-2017 was a fairly mild one. February was exceptionally warm and quiet; however, cold winter weather in March made up for that. All in all, we had a good season with "Nessie" the Foundation owned dredge pumping its permitted share of sand out of The Edgartown Great Pond into the Atlantic.

Over the past few years we have made major repairs to the dredge and rebuilt most systems to keep the dredge in good working order. Our efforts clearly paid off as we were able to increase our productivity and move considerably more sand this year than was possible in previous years.

After a couple of openings of the barrier beach in November, dredging began in earnest in December. We followed a plan implemented some years ago by our dredge crew that called for dredging two channels to create a pie shaped wedge from the Pond pointing to the beach. When the cut to the ocean is made this way, all the water rushing out takes the "slice of pie" with it making it a bit of cost effective dredging by Mother Nature. We cut the Pond in mid-March. As soon as the beach was opened, the swift moving current devoured that piece of pie saving gallons of diesel fuel and man hours in the process. All this, combined with fairly decent weather, afforded an opening lasting six weeks. This flushing gave the Pond a complete exchange with the sea. Hopefully the seasonal visitor will appreciate the clarity of the Pond water this year as much as the oysters and clams enjoy the salt it brings in.

In early May, the dredge was hauled and power-washed by the crew. The dredge now sits on its trailer where it will undergo routine maintenance and any necessary repairs before next winter's season. The hydraulic arm needs to be taken apart and new bushings installed. The pipe and fuel tank have also been hauled and stored for the season.

With each year, the dredge crew hones its knowledge and skills in order to achieve a successful, effective dredging program. Most recently, we have identified several items that will help our operations. We are currently in the process of replacing our worn-our whaler with a new steel skiff that will be able to cut through ice and allow us to reach the dredge in the winter.

Our goal is to help improve the water quality of the Pond by dredging in the safest and cleanest manner possible. With sufficient funding and thoughtful planning we should be able to use "Nessie" for some years and eventually replace her when that time comes.



# Finance Report - December 2016

### Bob Rukeyser, Treasurer

With a growing base of contributors, the financial condition of the Great Pond Foundation is solid. During 2016, these resources were deployed to support a notably successful dredging season along with substantially enhanced Science and Education program while also maintaining strong reserves for the maintenance and ultimate replacement of our dredge, "Nessie". Together, these activities carry out our mission of preserving the health of Edgartown Great Pond on a sound, long-term basis.

During 2016, we changed our fiscal year from a June 30 to a December 31 year-end. This change will support greater focus on our science and education programs, which are most intense in the summer months, without distracting from our primary dredging activity, which peaks in the winter.

For the calendar year (January-December) 2016, total income of \$259,152 was up 3% from a year earlier and up 53% from just four years ago. Donations from generous neighbors around the Pond were supplemented by contributions from other individuals as well as by a grant and investment income. Among neighborhoods, Boldwater was once again the leader, with Swan Neck continuing to provide major support. Herring Creek is becoming a consistent substantial contributor, Kanomika benefits from 100% participation, and Turkeyland is much improved.

[With the fiscal year change, our auditor reviewed our June 30 financial statements as well as our "short year" July-December statements. For this report, financial data is presented on a calendar year basis consistent with the presentation we will use going forward. Please note that the transition created short-term distortions in income and expense comparisons and that this presentation has not been reviewed by the auditor but is believed to be correct.]

Total expenses for 2016 were \$316,915, 95% higher than a year earlier. This substantial increase principally reflects much greater dredging activity (up 136% to \$111,341), a substantially enhanced Science and Education program (up 120% to \$80,110), and timing.

Nessie has now been in service for eight years. Over the past two, we made major maintenance investments, completely overhauling the main pump system and the main hydraulic system. Under the direction of Steve Ewing, these efforts paid off handsomely this past winter as the dredge performed flawlessly through the long season. The result was longer, more successful openings to the sea, including a six-week opening this past spring. Without effective periodic exchanges of Pond and sea water, the health of the Pond would deteriorate rapidly.

Emily Reddington, our Science and Education Director, has dramatically expanded these programs. Under Emily's leadership, we are now systematically monitoring water quality around the Pond through much of the year, expanding the Oyster Restoration Project and working together with BiodiversityWorks on shorebird restoration — all aided by a substantially enhanced intern program.

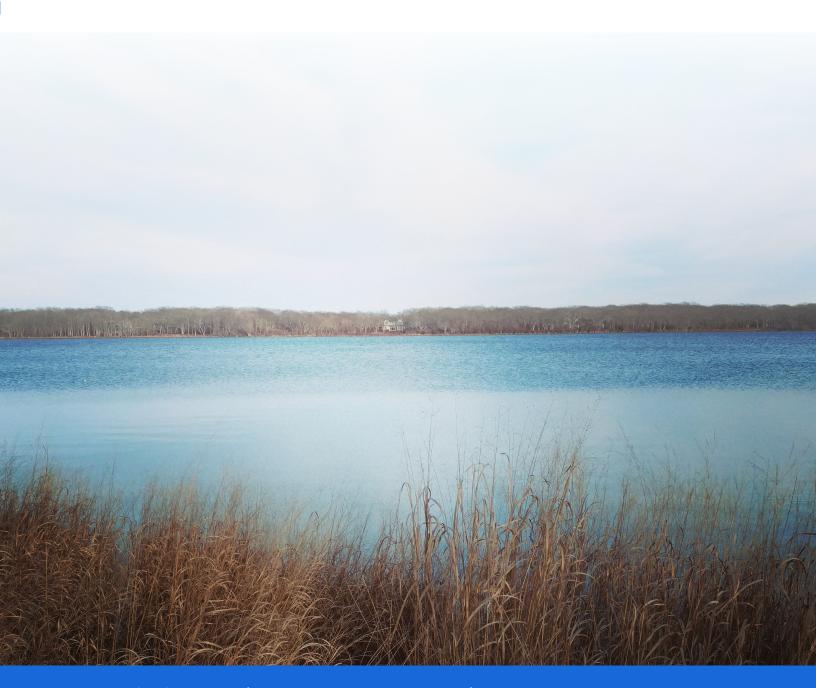
Our website has been totally redesigned (please check it out at www.greatpondfoundation.org) and periodic e-newsletters keep friends and supporters informed on a timely basis.

#### **LOOKING AHEAD**

For 2017, the Board has set a fundraising goal of \$252,100. That is slightly (1%) higher than our 2016 revenue excluding interest income (which we do not budget). As noted, dredging expense was unusually high in 2016, supporting exceptional dredging activity. We anticipate this budget will support more typical dredging along with our expanded science and education programs.

We entered 2017 with significant strengths. Our principal physical asset, Nessie, is in excellent condition and is performing extremely well. Financially, we are building strong reserves to cushion the impact of future maintenance and ultimate replacement of Nessie. We have an excellent team in place, led by Barbara Conroy, CFO and Chief Administrative Officer, Steve Ewing, Manager of Dredge Operations, and Emily Reddington, Director of Science & Education.

Most important, we have generous contributors who make this important work possible. We are very appreciative of your support.



# Science & Education Report

### Emily Reddington, Director of Science & Education

So many wonderful things have been happening on and around Edgartown Great Pond over the course of the last year. We were out on the water sampling from the launch of our Bristol Skiff in July until the weather got too rough to sample in late November. That means we have over 30 days of sampling and thousands of measurements of water quality. Our success is due in large part to the bright young minds who have contributed so much to our efforts in water quality monitoring, oyster restoration, and shorebird monitoring. A hearty thanks to both Natalie Scanlan and Sam Hartman for a productive 2016!



Sam Hartman & Natalie Scanlan, August 2016

#### 2016 Highlights

- Bristol Skiff launch in July
- New equipment: CTD Probe
- & Photometer
- >30 days of water sampling
- Water sampling before
- & after pond openings

- New partnership to monitor shorebirds with **BiodiversityWorks**
- Co-sponsored STEM class to build pond sensors
- Intern exchange with the

#### Marine Biological Laboratory

Developed a protocol to genetically identify tunicates

#### 2017 Field Team

It brings me great pleasure to welcome Sam Hartman back as our 2017 Summer Science Intern! Sam just completed his junior year at the Newman School in Boston's Back Bay. Sam will expand his contribution to our team this year by taking some of our CTD probe data back with him to school and analyzing it for his Senior Project.

Dani Cleary, a native islander and young scientist, joined our team in September of 2016 as our Field Technician. During the chilly mornings of the fall Dani collected some invaluable water quality data that documented the changes within the Pond before and after the fall cuts. Congratulations are in order for Dani, as she was awarded a 3-year Vineyard Vision Fellowship this spring.

The first year of Dani's fellowship will be a project to sample 4 Vineyard bodies of water and create a baseline data set for the health of each. In addition to Edgartown Great Pond,

Chilmark Pond, Senegkotacket Pond, and Cape Pogue Bay will also be included in the study. During the following 2 years, Dani will pursue a Master's Degree and will continue to work with Great Pond Foundation in the summer.



### Offseason 2016

While Sam and Natalie returned to Boston and New Jersey respectively, and Dani went to New Zealand to explore, Great Pond Foundation spent the winter digesting the data we collected and developing a protocol to genetically identify tunicates. A tunicate is a marine animal more commonly known as a sea squirt. You may have encountered a tunicate on the underside of your sailboat or growing on the side of the oyster cages floating in the Pond, as Anne Mazar and Melissa Vail did last summer.



Native solitary tunicate, *Molgula manhattensis* (Photo courtesy of Anne Mazar)

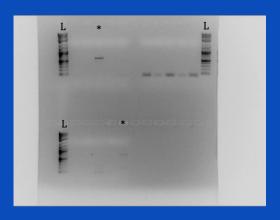
Colonial tunicate, unknown species (Photo courtesy of Melissa Vail)

Tunicates can be solitary (composed of discrete individuals) or colonial (composed of a mass of individuals sharing one outer covering or tunic). Solitary and colonial tunicates, both native and non-native, can be found in Vineyard waters. In 2016 study of Stonewall Pond 7 species of tunicates were documented, only 2 of which were native (Colarusso et al., 2016). One species of particular concern is the invasive non-native colonial tunicate *Didemnum vexillum*. This invasive species is known to change the ecology of an area by reducing the potential settling sites of for larvae and otherwise changing the ecological balance of species (Lengyel et al, 2009). Thanks to visual identification by Woods Hole Oceanongraphic Institution (WHOI) Scientist Mary Carman, we know the solitary tunicates that Anne Mazar collected from Edgartown Great Pond were native species *Molgula manhattensis*. It was not possible to identify from photographs the colonial tunicates that Melissa Vail documented, but Mary suggested that they might be *Didemnum vexillum*. When species are morphologically cryptic, it is useful to be able to identify them genetically.

This winter we turned to Marine Biological Laboratory (MBL) Scientist Kristin Gribble for help developing a protocol to take the samples that we collect from Edgartown Great Pond, extract the DNA, and generate phylogenetic trees. We collected a tunicate sample from the Pond in the fall of 2016 and froze it for later lab work at the MBL. Once at the MBL we extracted the DNA → amplified genes of interest with polymerase chain reaction (PCR) → Sanger sequenced the product → combined the sequence data with other know tunicates, and built a phylogenetic tree.

During the winter of 2017 we plan to genetically identify the solitary and colonial species of tunicates that we collect this summer in Edgartown Great Pond. Stay tuned, there is much more to learn about tunicates in our Pond. We are grateful to our colleagues in Woods Hole for sharing their time, expertise, and lab space.

### The following is an excerpt from Kristin Gribble's Tunicate Identification Report:

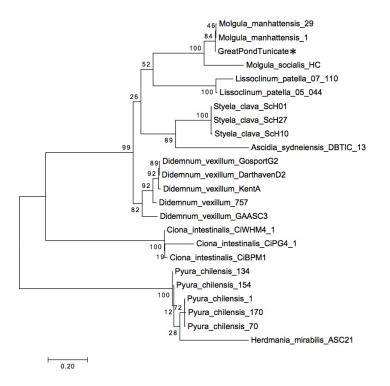


**Figure 1.** Agarose gel showing bands for successful PCR reactions for primer sets 1 and 3. L indicates lanes with ladder marking DNA fragment size; \*designates lanes with bands showing PCR products of expected size.

This project identified the sampled tunicate from Great Pond as *Molgula manhattensis*, a native, solitary tunicate known to occur in the region. The sampled tunicate was not *Didemnum vexillum*, an invasive, colonial tunicate of concern for its rapid and extensive biofouling of shellfish habitat and marine infrastructure.

BLAST homology showed that the Great Pond tunicate sequence was 99% identical to *Molgula manhattensis*. This species identification was confirmed by phylogenetic analysis, in which there was strong statistical support for grouping the Great Pond tunicate in a clade with other strains of *M. manhattensis* (Figure 2).

**Figure 2.** Phylogenetic tree showing DNA sequence similarity among nine species of tunicates. Branch labels show toolstrap support for each clade. The Great Pond tunicate clusters with *Molgula manhattensis*.



Colarusso, P., Nelson, E., Ayvazian, S., Carman, M., Chintala, M., Grabbert, S., & Grunden, D. (2016). Quantifying the ecological impact of invasive tunicates to shallow coastal water systems. *Management of Biological Invasions*, 7(1), 33-42. doi:10.3391/mbi.2016.71.05

Lengyel, N., Collie J. S. & Valentine P. C. (2009). The invasive colonial ascidian Didemnum vexillum on Georges Bank - Ecological effects and genetic identification. *Aquatic Invasions*, 4(1), 143-152. doi:10.3391/ai.2009.4.1.15



# Scientist Spotlight

### Kristin Gribble, MBL Assistant Scientist

Kristin Gribble is a molecular biologist and ecologist, and works as an Assistant Scientist at the Marine Biological Laboratory in Woods Hole, MA. Kristin is broadly interested in how environmental conditions and genetics interact to determine an organism's evolutionary fitness. Currently, Kristin uses rotifers, microscopic aquatic invertebrate animals, as a model to investigate the biology of aging, and to understand how maternal environment influences offspring health and lifespan.

Kristin has a B.A. in Biology from Lawrence University in Appleton, WI, and a Ph.D. in Biological Oceanography from the MIT-Woods Hole Oceanographic Institution Joint Program. As a graduate student, Kristin studied the ecology and evolution of harmful algal blooms in the Gulf of Maine and off the coast of Ireland. Prior to graduate school, Kristin worked at the Center for Coastal Studies and the Waquoit Bay National Estuarine Research Reserve as a coordinator and research assistant for citizen water quality monitoring groups on Cape Cod; she has both a personal and scientific interest in the health and ecology our local coastal waters. Kristin lives in Falmouth with her husband and 9-year old son.



# Scientist Spotlight

Mary Carman, WHOI Research Specialist

Mary R. Carman is a Research Specialist in the Biology Department at Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. Her work has centered around invasive invertebrate species in marine coastal habitats, and in particular has looked at the impacts of fouling tunicates (sea squirts) on shellfish aquaculture, eelgrass, and community structure. She has been able to show that non-native species can dominate the habitats that they associate with, outcompeting native species. By mapping the occurrence of invasive tunicates in eelgrass meadows, Carman and her colleagues were able to document this infestation in Northwest Atlantic latitudinal studies from New Jersey to Newfoundland. She recognized the pending impacts tunicates would cause and created the International Invasive Sea Squirt Conference series. She also studies the toxic jellyfish *Gonionemus vertens*, a new invader and member of the eelgrass communities in New England. Carman has worked extensively on Martha's Vineyard for the past decade.

### Field Season 2017

#### Eelgrass, Tunicates, & Clinging Jellyfish

Eelgrass, *Zostera marina*, is a native seagrass that serves as habitat for larval fish and shellfish (Thayer et al., 1984), a producer of dissolved oxygen through photosynthesis, and an indicator of the overall health of an estuary (Pe'eri et al., 2016). Over the past 40 years there has been a massive decline in the distribution and abundance of eelgrass driven by the deceasing water quality in eutrophic and turbid coastal waters (Murphy & Johnson, 2011).

In our ever-expanding effort to examine the health of Edgartown Great Pond, we are going to begin documenting the density and distribution of eelgrass throughout the Pond. Although the historical records of eelgrass in Edgartown Great Pond are incomplete, many islanders wax poetic about the vast beds of eelgrass that once lined the Pond. Anecdotally, many of these same people are remarking upon the expansion of eelgrass in recent years. In to order quantitatively assess the eelgrass distribution in the Pond, we will start an annual aerial eelgrass survey in 2017. We will combine this data with quadrant and transect surveys of eelgrass density.

This summer we will be participating in a latitudinal study of tunicates in eelgrass habitats led by WHOI's Mary Carman. In 2013 Mary Carman and her colleagues sampled the distribution and diversity of tunicates in eelgrass beds from New Jersey to Newfoundland. In their study, they identified 8 species of tunicates attached to eelgrass, most of which were invasive (Carman et al, 2016). In 2017 this study will be replicated and expanded upon by increasing the number of sampling sites, including Edgartown Great Pond, and by assessing the tunicates on anthropogenic surfaces such as oyster cages. Mary Carman will join us during our tunicate sampling this summer and help us identify non-cryptic tunicate species. Individuals of each species of tunicate will be preserved for genetic analysis at the MBL this winter in Kristin Gribble's laboratory.

Both Mary Carman and Kristin Gribble will be bringing their expertise to Edgartown Great Pond when they visit this summer. While Mary is here, she will also help us look for the invasive clinging jellyfish *Gonionemus vertens*, which packs a powerful sting. No individuals of this unwelcome jellyfish have yet been identified in Edgartown Great Pond. Kristin has monitored estuaries on the Cape and studied harmful algal blooms. We are looking forward to Kristin's insights about monitoring and protecting Edgartown Great Pond.

- Thayer, G. W., Kensworth, W. J. and Fonseca, M. S. 1984. The ecology of eelgrass meadows of the Atlantic Coast: a community profile. U.S. Fish and Wildlife Service FWS/OBS-84\02
- Peeri, S., Morrison, J. R., Short, F., Mathieson, A., & Lippmann, T. (2016). Eelgrass and Macroalgal Mapping to Develop

  Nutrient Criteria in New Hampshires Estuaries using Hyperspectral Imagery. *Journal of Coastal Research*, 76, 209-218. doi:10.2112/si76-018
- Murphy, R., L. Orzetti and W. Johnson. 2011. Plant fact sheet for eelgrass (Zostera marina). USDA, Natural Resources Conservation Service, Norman A. Berg National Plant Materials Center. Beltsville, MD 20705
- Carman, M., Colarusso, P., Nelson, E., Grunden, D., Wong, M., Mckenzie, C., Matheson, K., Davidson, J., Fox, S., Neckles, H. A., Bayley, H., Schott, S., Dijkstra, J. A., & Stewart-Clark, S. (2016). Distribution and diversity of tunicates utilizing eelgrass as substrate in the western North Atlantic between 39° and 47° north latitude (New Jersey to Newfoundland). *Management of Biological Invasions*, 7(1), 51-57. doi:10.3391/mbi.2016.71.07

# Water Quality in EGP

Since the launch of our boat last July we have been collecting water quality data from 10 sites around Edgartown Great Pond 2x per week, weather permitting. Great Pond Foundation measures Dissolved Oxygen, Turbidity, pH, ORP/Redox, Conductivity, Specific Conductance, Salinity, Total Dissolved Solids, Resistivity, Seawater Density, Depth, Temperature, and Nutrients (Ammonium, Nitrate/Nitrite, Phosphate, Silicate). At this point we have a lot of data and are beginning to see patterns emerge.

What makes our data set unique is its level of resolution. The resolution is due to the number of sites we study, the number of days we sample throughout the seasons (Spring, Summer, Fall), and shear amount of data we collect at each water station. Edgartown Great Pond is a dynamic system that has fresh water influences, tidal overwash, manmade cuts to the Atlantic, manual dredging in the offseason, and nutrient inputs from around the Pond. To answer our

Eggstown Great Pord

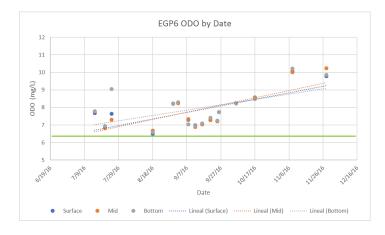
Water Resource Assessment Stations

\*\*\*The State of the State

Water Sampling stations of EGP

questions about the health of the Pond, given that there are so many variables, year to year, and season to season, we need to collect an immense amount of data in order to differentiate the seasonal patterns and trends in Pond health from the static of the natural and anthropogenic perturbations. Every year that we collect data, our data set becomes more informative. We are building a dataset that will inform the management of the Pond for decades to come.

Dissolved oxygen (DO) is a key indicator of the overall health of the Pond. Animals and plants need it in order to complete basic metabolic processes. The Massachusetts Estuary Program sent a benchmark of 6 mg/L of DO for healthy estuaries. Below you will see our measurements of DO from July through November at station 6 (EGP6). Station 6 is the station located closest to the cut in the barrier beach. We measure DO, at the surface of the water (blue), the middle of the water column (orange), and just above the bottom (gray). Throughout our sampling station 6 remained above the 6 mg/L threshold (green line). We have similar data sets for every station in the Pond, as well as for all of the other parameters we measure.



There are many things that affect the levels of DO in the Pond. Biotic as well as abiotic factors have an influence on DO throughout the year. Dani has done a wonderful job of explaining the importance and of dynamics of DO in Edgartown Great Pond. The following is the first installment in a series that Dani will be writing that explains the significance of the water quality measurements we record. This series will be incorporated into our website and will be part of her final report for the Vineyard Vision Fellowship.

2016 measurements of DO at EGP6

## **Dissolved Oxygen**

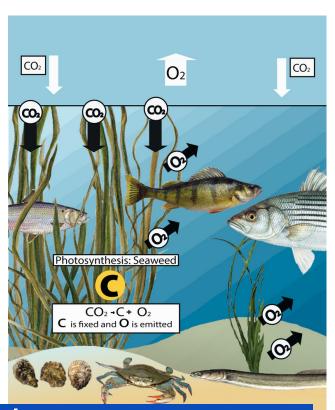
#### By Dani Cleary

Dissolved Oxygen (DO), the microscopic bubbles of oxygen ( $O_2$ ) found in water, is essential for almost all organisms to thrive in marine environments. DO is one of many parameters Great Pond Foundation measures while collecting water samples to determine overall pond health. We measure DO because marine life depends on it for basic metabolic activities just as humans and terrestrial animals depend on  $O_2$  in the atmosphere. If DO begins to decline hypoxia, detrimentally low oxygen, can occur. Hypoxia in an environmental system such as Edgartown Great Pond occurs when the environment is deprived of oxygen to a point where organisms can no longer survive. Many scientists agree that 6 mg/L of DO is the minimum a healthy estuary needs to support animal life.

#### DO entering and exiting water systems:

- 1. Wind and wave activity  $\uparrow$  atmospheric input of  $O_3$  into the water.
- 2. Photosynthesis from plants and algae † DO into the water system.
- 3. Plankton, zooplankton, and fish  $\downarrow$  the DO by consumption.
- 4. Plants and animals die and fall to the bottom of the pond. Decomposers break down the dead matter and  $\downarrow$  DO in the process.

There should be an even balance between the metabolic processes of producers (plant life that adds  $O_2$  to water through photosynthesis), consumers (animals that breathe  $O_2$ ) and decomposers (microbes that break down dead matter and consume  $O_2$ ) to maintain a healthy level of DO in marine systems. If the balance is thrown off, levels of DO in the pond will most often decrease. Low



DO is produced by plants and consumed by animales (Illustration by John Holladay)

levels of DO can reduce the health of and even lead to the death of fish and other animals. Once DO starts to reach critically low levels, a chain reaction occurs. Lower levels of oxygen will kill larvae which will in turn decrease the overall animal population in the pond. With extremely low DO levels, animals will die after maturing. These dead animals will fall to the bottom of the pond and settle. Because there is more food for decomposers their population increases, and they consume high levels of DO, decreasing the already low levels. A similar thing can occur with algal blooms. Algae often blooms in eutrophic or nutrient-rich waters. At first the growing population of algae will produce O<sub>2</sub> through photosynthesis and increase the level of DO in the water. When the algae begin to die the microbial population of decomposers begins its rapid growth, consuming O<sub>2</sub> and rapidly decreasing DO, often leading to local hypoxia.

Many different factors can affect DO other than the physical and biological process described above.

- O<sub>2</sub> is less soluble in cold water. Cold water =  $\uparrow$  DO. Warmer water =  $\downarrow$  DO.
- $\uparrow$  salinity =  $\downarrow$  DO,  $\downarrow$  salinity =  $\uparrow$  DO.
- † turbidity (suspended particles in the water column) =  $\downarrow$  DO,  $\downarrow$  turbidity = † DO.

#### What are seasonal patterns of DO?

- Spring- cool water, high plant production = higher levels of DO
- Summer- warm water, high plant production, high animal and decomposer population = low levels of DO
- Fall- cool water, plants starting to die, decomposer activity increases = mid-levels of DO
- Winter- cold water, low photosynthesis rates because most plants already dead = higher levels of DO

#### How does Edgartown Great Pond look seasonally?

- Spring- All stations are above 6 mg/L and range between 8 mg/L-9 mg/L
- Summer- many stations drop slightly below 6 mg/L for at least one day's worth of sampling
- Fall- DO stays around 7 mg/L for most stations
- Winter- each station stays above the minimum of 6 mg/L and most stations range between 8 mg/L 12 mg/L



# The Great Pond Foundation

would like to acknowledge the following generous individuals and foundations who supported us in 2016:

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Toni Chute & John O'Keefe

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