Photo by Anthony Fusaro

2022

ECOSYSTEM MONITORING REPORT

CHILMARK POND

GREAT POND FOUNDATION

Prepared on behalf of

CHILMARK POND FOUNDATION

ECOSYSTEM MONITORING REPORT | *Chilmark Pond 2022*

Chilmark Great Pond (CHP) is an important resource for the Town of Chilmark with ecological, historical, cultural, and economic significance. In fulfillment of its mission preserve this ecosystem for future generations, the Chilmark Pond Foundation partnered with the Great Pond Foundation to collect ecological data and assess ecosystem health in support of pond management decisions. Data collection focused on water quality and cyanobacteria monitoring.

The Massachusetts Department of Environmental Protection (MADEP) designates all Martha's Vineyard waters as *Class SA*: These waters are designated as an excellent habitat for fish, other aquatic life, and wildlife, including for their reproduction, migration, growth, and other critical functions, and for primary and secondary contact recreation. In certain waters, excellent habitat for fish, other aquatic life and wildlife may include, but is not limited to, seagrass. Where designated in the tables to 314 CMR 4.00 for shellfishing, these waters shall be suitable for shellfish harvesting without depuration (Approved and Conditionally Approved Shellfish Areas). These waters shall have excellent aesthetic value.

Study Area

To understand pond health, we study the water within the pond, water that flows over and through land on the way to the pond, and water that enters the pond through precipitation as well breaches of the barrier beach.

Chilmark Pond (CHP) is a coastal estuary approximately 210 acres in size. CHP is a complex system comprised of a main basin with two coves: Wades Cove and Gilberts Cove. CHP is connected to a secondary basin, called Middle Pond, via a narrow channel named Doctor's Creek. A third and smaller basin, Upper Chilmark Pond or Lucy Vincent Pond, flows into the Middle Pond via Intern's Creek. The CHP system hosts two primary contributing watershed, for the Upper Chilmark Pond and Lower Chilmark Pond regions. Together, these two areas encompass approximately 3400 acres located entirely within the Town of Chilmark (Figure 1). A barrier beach separates CHP from the Atlantic Ocean, which is intentionally breached or "cut" 2-4 times per year to drain the pond and allow it to be flushed with salty ocean water. Water from the

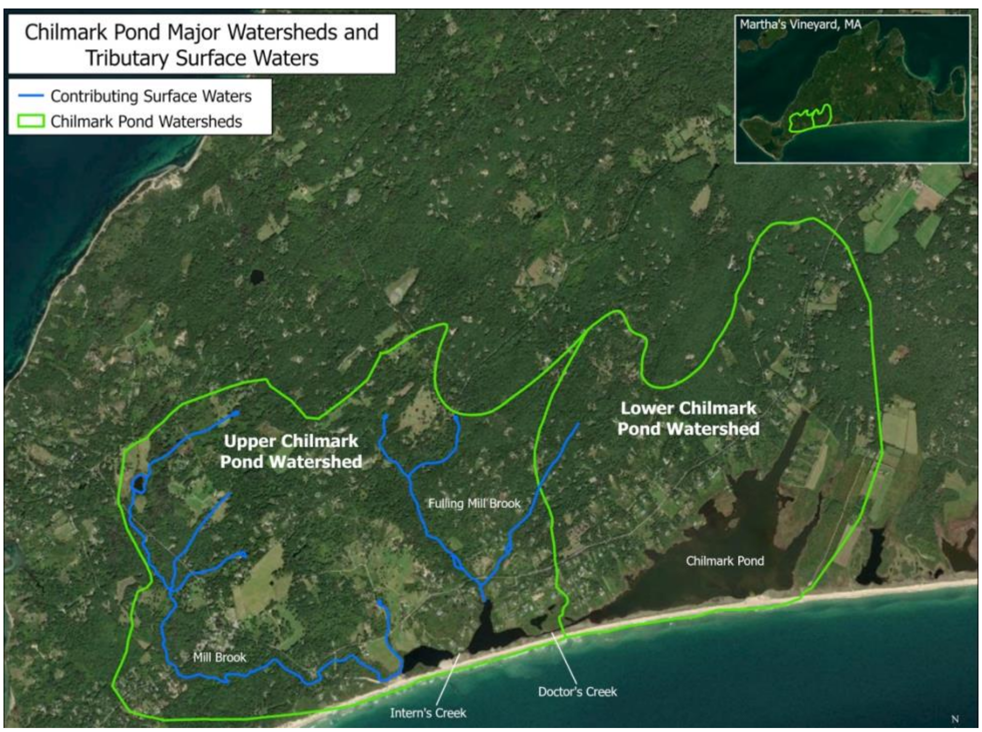

Figure 1: Chilmark Pond Watershed Map

Atlantic Ocean is also low in nutrient concentrations compared to CHP, making flushing during openings a nutrient management tool. These pond cuts are temporary and close due to natural forces. The timing of openings is determined by the commissioners of the Chilmark Pond Association, who consider factors such as pond elevation, pond water quality, weather, and the migration patterns of important species such as river herring. After closure of the cut, CHP gradually refills due to groundwater input and surface water flow via tributary creeks (i.e. Fulling Mill Brook), as well as through direct precipitation onto the pond's surface.

Land Use and Land Cover

There is an intimate connection between the health of a pond and the land that surrounds it. Intact native landscapes are capable of absorbing and transforming vast amounts of nitrogen before it reaches a pond.

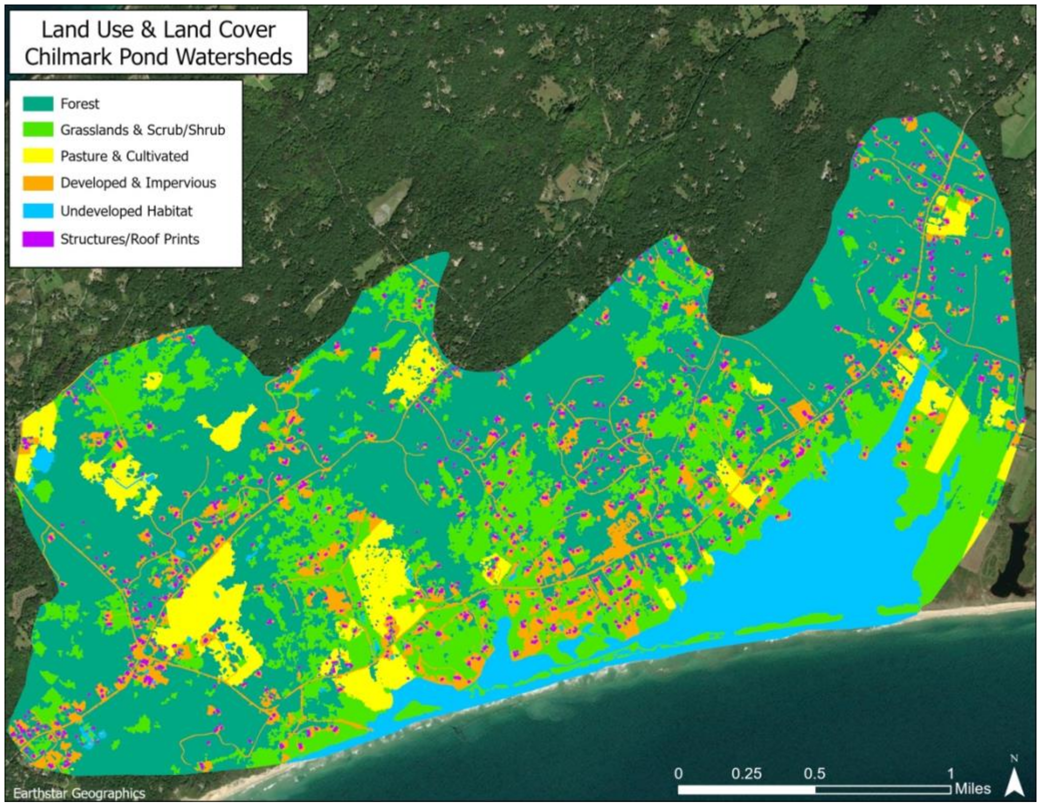

Figure 2: Land Use & Land Cover in the Chilmark Pond Watershed

2016 Land Use and Land Cover (LULC) classifications provided by the Massachusetts Bureau of Geographic Information (MassGIS) catalogue the patterns of land use within the watershed. For the purposes of this analysis, the 17 individual LULC classifications defined by MassGIS are broadly consolidated into four primary usage types: Forested, Grasslands & Shrub/Scrub, Developed & Impervious, and Pasture/Cultivated. All remaining minor classifications can be described as: Undeveloped Terrestrial or Aquatic Habitat (Figure 2).

Chilmark Pond Watersheds Land Use Land Cover by Percent Area	
Habitat Type	Percent Cover of Total Area
Forest	51%
Grasslands & Scrub/Shrub	21%
Pasture & Cultivated	7%
Developed & Impervious	11%
Other Undeveloped Habitat	10%
Broad consolidation of 2016 Land Use and Land Cover classifications provided by MassGIS. See appendix for original classification schema.	

Table 1: Percent Coverage by Habitat Type in Chilmark Pond's Watershed

The majority of land cover within the CHP watershed is "Forested", making up approximately 51% of the total land area. "Grasslands & Shrub/Scrub" habitat comprise the next largest cover type of approximately 21%. "Developed & Impervious" land area composes 11% of the landscape, while "Pasture/Cultivated" land use occupies 7%. The remaining 10% of land cover incorporates the smaller assemblages of "Undeveloped Terrestrial or Aquatic Habitat (Table 1). Of the total acreage associated with the grouping of "Pasture/Cultivated", 99% of that area is pasture and hay fields, and less than 1% cultivated agriculture. The relative impact of pastureland and hayfields largely depends on whether these areas are utilized for haying, or for grazing by cattle or other domesticated animals, due to the direct surface runoff and nutrient leaching potential from animal waste or fertilizers. Impervious surfaces comprise 4% of the total land area within the "Developed and Impervious" bin. The remaining 7% of area in this grouping is classified by MassGIS as "Developed Open Space", which primarily includes medium to low density residential development and developed landscapes, such as lawns. Similar to nutrient considerations associated with pasture, negative impacts from lawns and other developed landscapes greatly depend on the management practices employed on each property, particularly within areas adjacent to the Pond.

Soil Characteristics and Hydrology

The composition soils, rocks, and clay in the land the surrounds the pond determines the rate and path of groundwater as it moves through the watershed to the pond.

CHP and the majority of its contributing watershed areas are comprised of substrate characterized by a mixture of sand, clay deposits, and rock debris. This region of the Island is referred to as the Western Moraine, a collection of three individual terminal moraines, formed naturally over millions of years through glacial processes. As a result, hydrology and groundwater characteristics throughout this region are complicated. The path of a drop of water from upland in the watershed, to the Pond proper, is not necessarily a straight line.

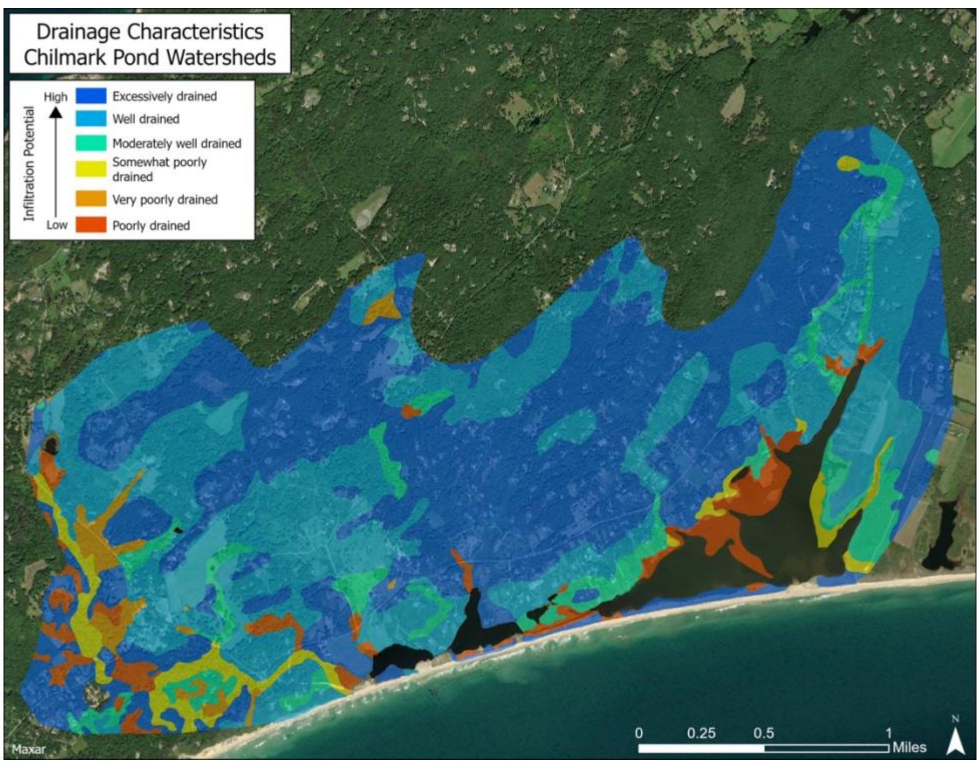

Figure 3: Drainage Characteristics of Chilmark Pond's Watersheds

Understanding the path of water into the CHP is essential to understanding the scope and magnitude of potential water quality issues. Water enters the CHP system through several possible pathways: Direct input via rainfall, surface water inflow (Mill Brook and Fulling Mill Brook), direct surface runoff, groundwater discharge, over-wash across the barrier beach, or direct seawater input during an opening. Surface water flows from the two tributary brooks, as well as groundwater discharge are the primary sources of water entering the Pond. Substrate characterized by higher drainage rates throughout the watershed (Figure 3) means that water infiltrates from rainfall on the surface into and through the ground at an elevated rate. A higher rate of groundwater flow and discharge into the Pond might lead to sudden nutrient spikes during periods of steady rainfall. This could be especially meaningful in areas of residential development and high drainage, as fast-moving groundwater will accumulate nutrient-rich wastewater from septic leach fields.

Water Quality Monitoring Methodology

The 2022 CHP monitoring period was from May 20 - November 15. Water samples were collected weekly by at 10 sites throughout Chilmark Pond (Figure 4).

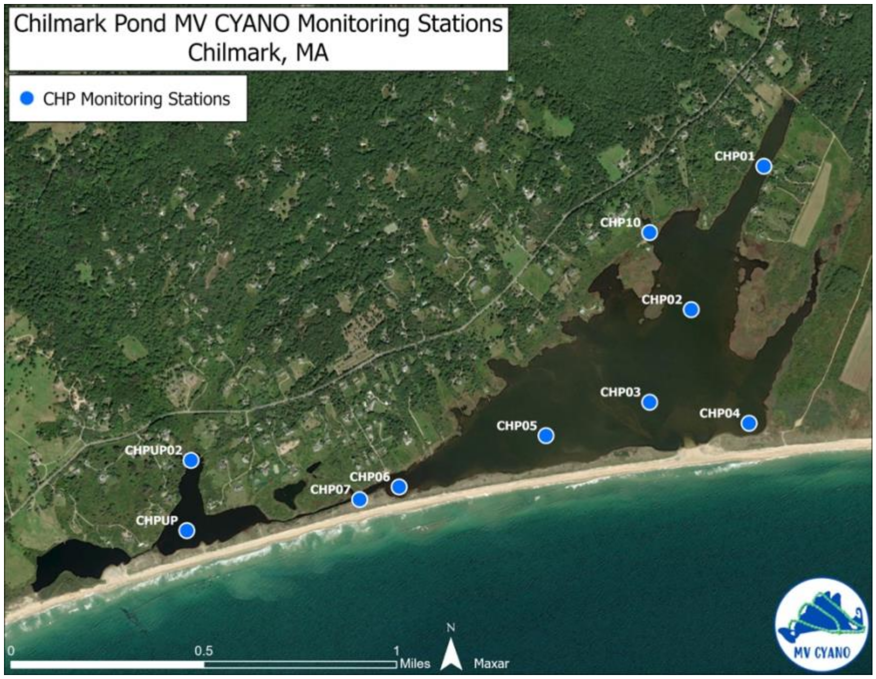

Figure 4: Water Quality & MV CYANO Monitoring Sites in Chilmark Pond, 2022

In addition to in-situ data collection during site visits, GPF deployed dissolved oxygen, temperature, and conductivity/salinity sensors which continuously monitored these parameters. These data loggers were deployed at station CHP02 and collected bottom-depth measurements every 30 minutes (48 measurements per 24 hours) until their removal. The datasets provided by these instruments are essential to understanding temporal changes and patterns in their recorded parameters and provide greater context and comparison for the accompanying data collected during field sampling.

The water quality monitoring program on CHP follows the methodology of the Massachusetts Estuaries Project (MEP) and uses the management standards established by the CHP MEP report (Howes et al., 2015). For full details on methods please see the 2021 Ecosystem Monitoring Report.

Temperature

Temperatures drive the rate of growth in plants and animals in the water, just as they do on land. As temperatures continue to increase, many seasonal cycles are altered and new extreme conditions occur.

The Massachusetts Department of Environmental Protection (MADEP) standards for class SA waters establish an 85°F maximum temperature threshold, as well as a maximum daily mean limit of 80°F. This means that Pond temperatures should not exceed 85°F at any time, and the average temperature within a standard 24-hour period should not exceed 80°F to maintain good habitat quality. Temperature dynamics within the Pond can best be understood using continuous data recorded by GPF's deployed loggers. Between the dates of July 23rd and August 26th of 2022, continuous temperatures recorded by the bottom-depth logger submerged at station CHP02 exceeded the 85°F threshold on nine days, generally occurring between the hours of 3:00 PM to 1:00 AM of the following day. Most of these events coincided with record maximum ambient air temperatures measured by the National Weather Service at the Martha's Vineyard Airport (Figure 5).

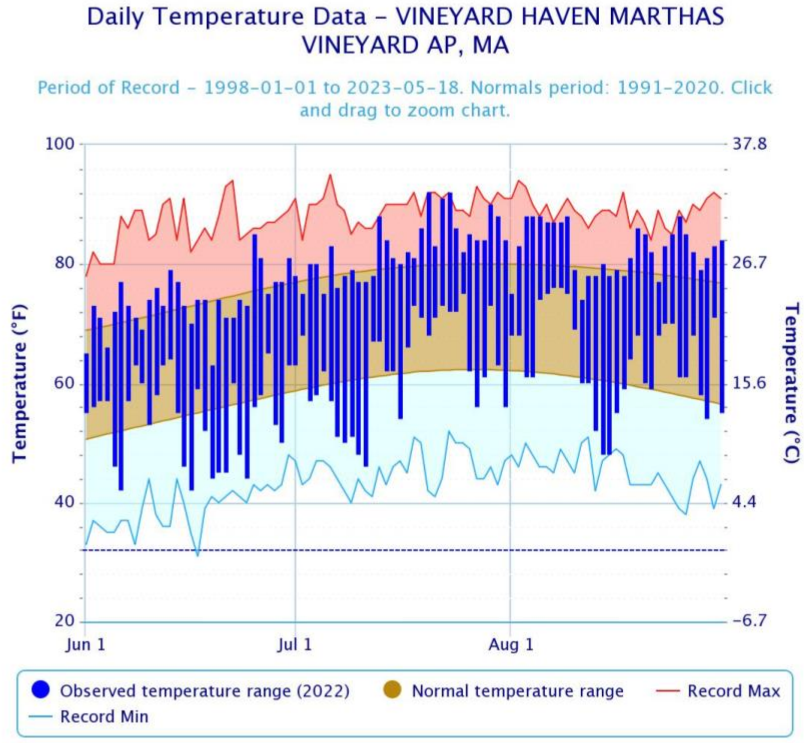

Figure 5: Martha's Vineyard Daily Temperature

The highest recorded water temperature at station CHP02 was 87°F on July 24th, which coincides with the hottest day of 2022 recorded at the airport NWS station of 92°F on July 23rd. This highlights the close relationship between Pond and ambient air temperatures. In-situ measurements throughout the water column recorded by GPF staff at all CHP stations show little to no difference in temperature between surface and bottom depths (Figure 6).

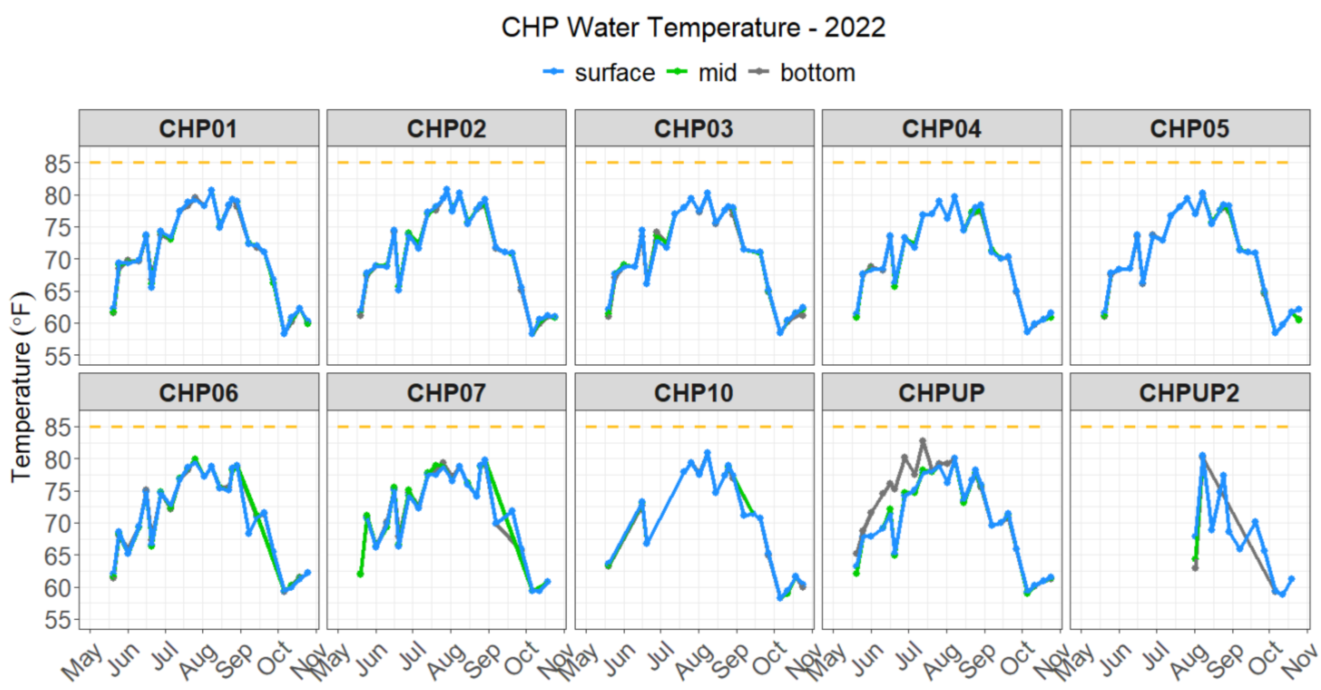

Figure 6: Chilmark Pond Water Temperature, 2022

Additionally, variation between all stations was minimal. This lack of stratification is likely a function of relatively shallow depth and wind-driven circulation of waters throughout the Pond. Maximum daily mean temperatures recorded by the same logger at station CHP02 also exceeded the 80°F MADEP threshold on 36 non-consecutive days between July 14th and September 1st, with the highest daily mean of 84.6°F occurring on August 5th (Figure 7).

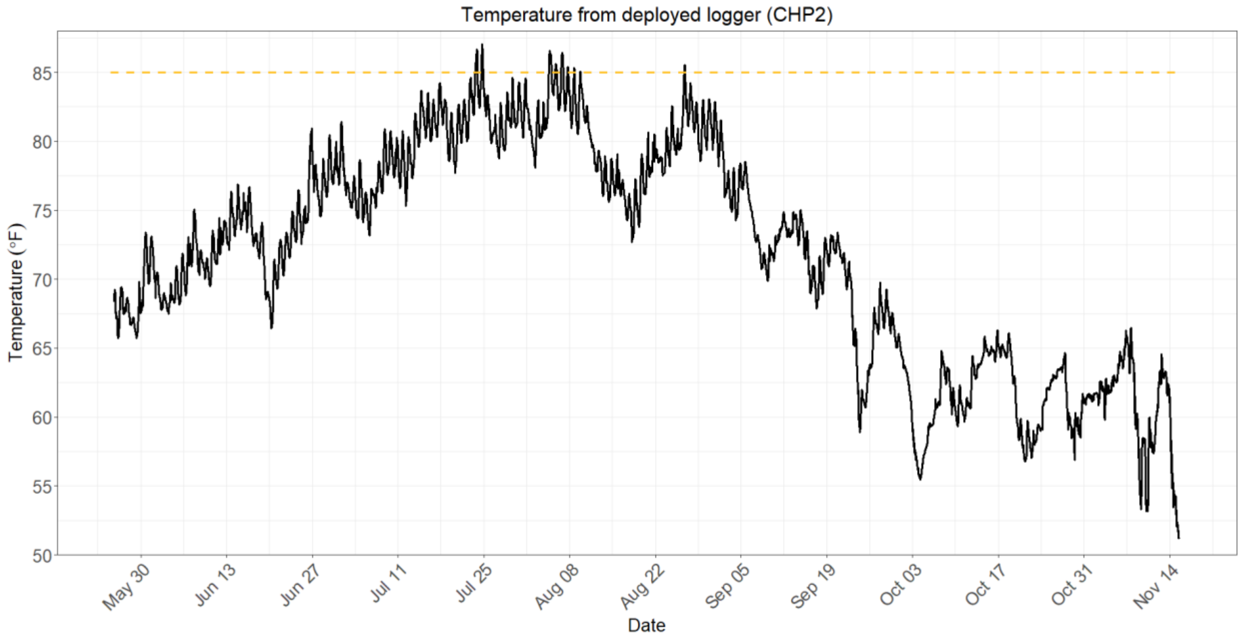

Figure 7: Daily Chilmark Pond Water Temperature in 2022 from Deployed Logger. Temperatures in excess of 85 ℉ (yellow dotted line) are considered higher than ideal for a healthy estuary.

Based on these observations, temperature fluctuations within the Pond are closely related to ambient atmospheric temperature and solar gain. While temperature remained under the MADEP thresholds for most of the monitoring period in 2022, there is evidence of thermal stress on this ecosystem during the hottest times of the year. Current predictions of increasing average temperatures mean this stress will continue to expand each year. The summer season of 2022 was characterized by lower-than-normal accumulation of precipitation coupled with many instances of higher-than-average temperature maximums (Figures 6 & 8). These conditions contributed to a steady decline in Pond

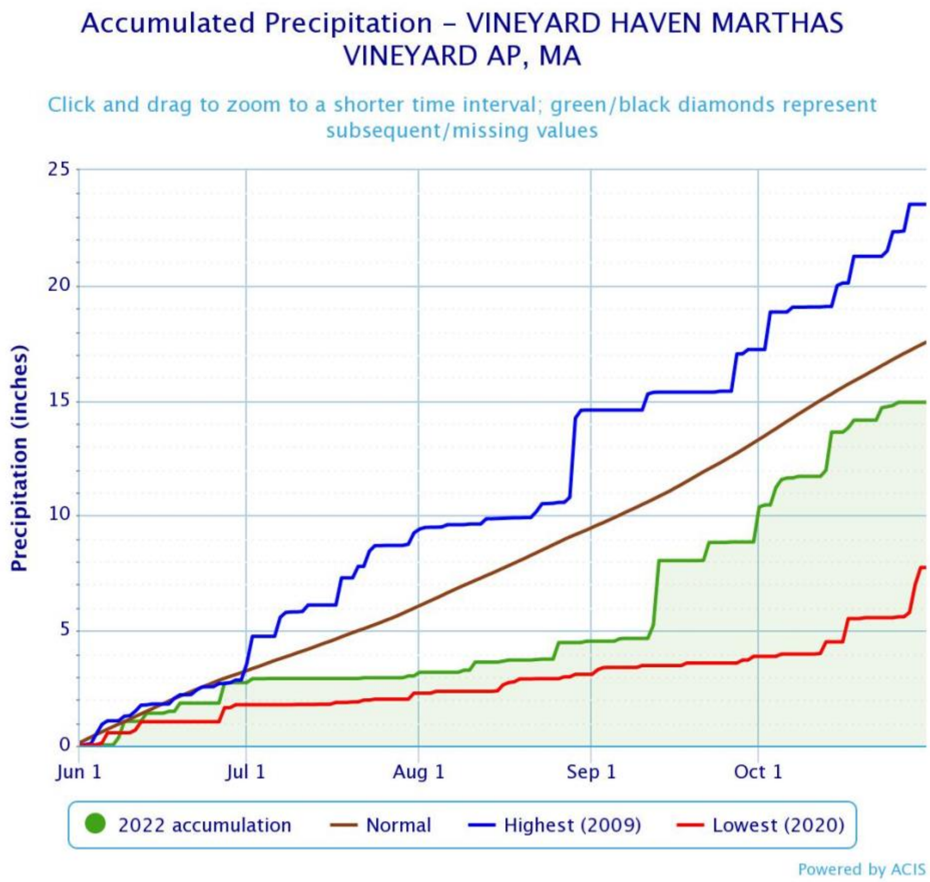

Figure 8: Annual Martha's Vineyard Precipitation, 2022

elevation throughout the summer (Figure 9) which may have made conditions for heating more efficient.

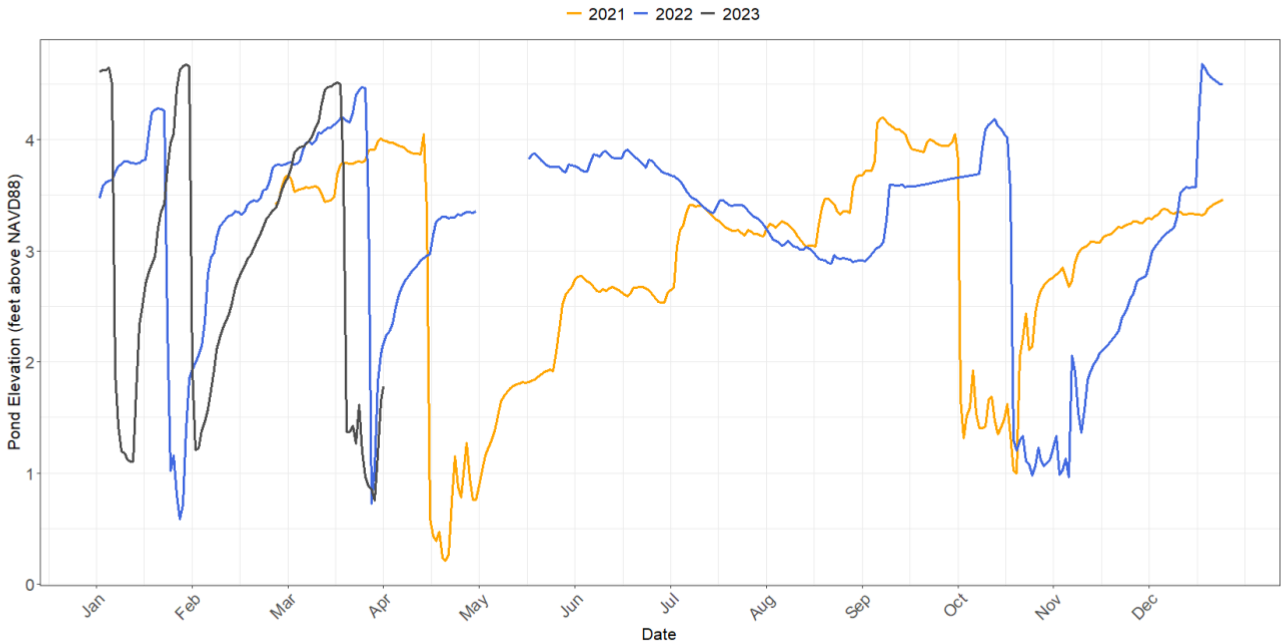

Figure 9: Annual Elevation of Chilmark Pond with respect to NAVD88

Unfortunately, mitigation of temperature stress in CHP is not likely, due to its close association with climate. One dynamic that was not documented with this data set is the influence, if any, of an opening on water temperatures in CHP. Draining of the Pond coupled with consistent tidal exchange of cooler seawater could potentially help to reduce heat stress. However, varying longevity of an opening coupled with lower water elevation within the Pond may negate any potential positive effects. A focused sampling regime designed around tracking the impacts of an opening on Pond water temperature during the hottest times of the year may help to better understand these interactions.

Salinity

The salinity of a pond determines the types of plants and animals that live within it. For ponds with fluctuating salinity, pond-life must have the ability to tolerate the range of salinities and salinity can be used to track the effectiveness of barrier beach breaching events and circulation.

MADEP does not currently assign salinity standards for class SA waters, however, concentrations can play a significant role in the assemblages of micro and macroscopic life within the Pond. CHP is classified as a brackish coastal estuary, of which the typical salinity range for these habitats is 0.5-35 ppt. Salinity concentrations within the Pond are directly influenced by fresh groundwater, rainfall, and surface runoff inputs during a period of closure, seawater influx during an opening to the ocean, and instances of over-wash from the ocean into the Pond during storm events. As such, salinity can be an excellent indicator of the dynamics of Pond mixing, circulation, and the progress of flushing during an opening, as well as the rate of groundwater infiltration during closures.

Salinity measurements collected during the 2022 sampling season exhibited an East-West spatial distribution, with consistent higher average salinity observed in the East portion of Lower CHP, and significantly lower concentrations in the West and upper portions of the Pond. CHP Stations CHP01 through CHP05 and CHP10, all displayed similar salinity concentrations and patterns, with no significant amount of stratification between depths until after the fall opening on October 23rd. Stations CHP07, CHPUP, and CHPUP2 all exhibited variable and significantly lower salinity levels throughout the sampling season, even after the fall opening (Figure 10). This suggests that water flow from the Upper Ponds into Lower CHP is unidirectional from West to East, fed by freshwater input, creating a "delta" of freshwater flow into the higher salinity waters of Lower CHP. Station CHP06 appears to be an inflection point between these two systems. Compared with the consistent salinity trends observed at stations further East, CHP06 displayed some stratification of salinity at different depths despite the relatively shallow depth at that station. This could be an indicator of mixing that occurs at the interface between fresh and saline water. Station CHP07 a short distance to the west also exhibited similar variability and stratification across depth, however, it did not experience a spike in salinity after the fall opening, as was observed at CHP06.

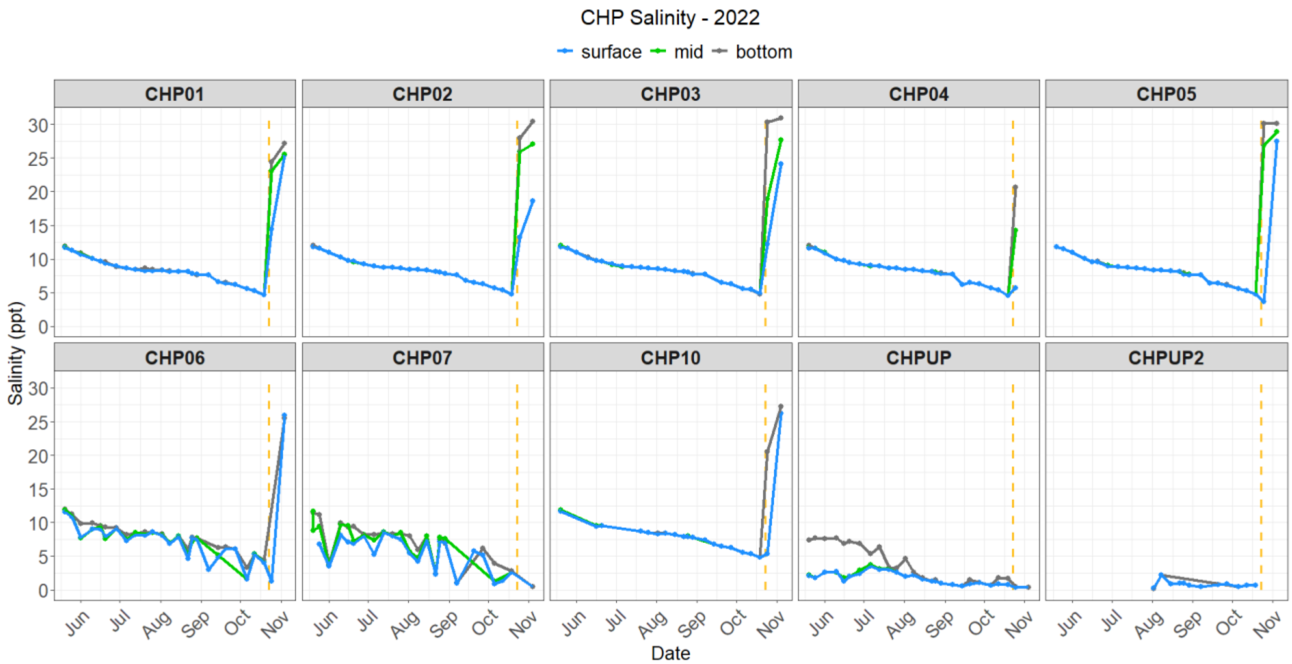

Figure 10: Chilmark Pond Salinity, 2022

Cataloging trends in salinity in the Pond can provide valuable insight into water circulation and mixing patterns within CHP. Salinity trends collected in 2022 show a striking spatial difference between the Upper and Lower portions of CHP, which likely impacts the composition of both micro and macroscopic species assemblages between these two regions. A focused sampling regime designed around tracking changes in salinity throughout the Pond during an opening, as well as the deployment of a continuous conductivity logger near the interface zone at stations CHP06 and CHP07 may help to better understand the circulation patterns and salinity trends observed.

Dissolved Oxygen

Dissolved oxygen is critical for almost all pond life. Low levels of dissolved oxygen are a sign of poor pond health.

Dissolved oxygen (DO) concentrations in milligrams per liter (mg/L) were measured by GPF staff in-situ at all monitoring stations across CHP from late May to mid-November in 2022. Continuous measurements of bottom-depth DO were also collected from a submerged sensor at station CHP02. DO concentrations fluctuate throughout a 24-hour period as a product of photosynthesis during sunlight hours and consumed during respiration by aquatic organisms. DO is a good indicator of overall ecosystem health and consistently low levels can be a sign of eutrophic conditions. MADEP has established a 6 mg/L threshold concentration for Class SA waters to maintain good ecosystem health. Low-oxygen stress on aquatic organisms may begin to occur at concentrations of 4 mg/L, while concentrations of 2 mg/L or lower are considered critical (hypoxic) and may lead to mortality events. Stratification of DO commonly exists with higher average concentrations observed near the surface and lower average concentrations observed near the bottom of the water column. This is due to the air-water interface and greater light availability for photosynthetic microalgae at the surface, contrasted by less light availability and the breakdown of organic matter in sediments near the bottom. Excess nutrients and organic material will accelerate the consumption of oxygen by bacteria. In general, the lowest levels of dissolved oxygen are observed in the early hours of the morning before sunrise, after bacteria and other respiring organisms have consumed DO throughout non-daylight hours. Oxygen concentrations are also inversely related to water temperature, as cold water can hold more DO than warmer water. The lowest concentrations of oxygen are typically observed during the hottest times of the year.

DO concentrations throughout CHP during the 2022 season were consistent at stations within the lower region of the Pond, with greater variability measured at the Upper Pond stations (CHPUP & CHPUP2). Overall, in-situ measurements collected during the 6AM-11AM timeframe by GPF staff remained above the 6 mg/L threshold throughout the season (Figure 11) This trend was fairly consistent across surface, mid, and bottom depths, with some variability occurring at stations CHP01 (Wades Cove), CHP07 (Doctor's Creek), and both CHPUP and CHPUP2 stations. Frequency of measurements below the 6 mg/L threshold were low, with only one instance of levels dropping below the 2 mg/L level at station CHPUP in early August. Lows of observed DO concentrations coincided with peak ambient temperature increases in late July, early August (Figure 6).

Continuous bottom-measurements collected by the deployed sensor at station CHP02 exhibit a much greater range in concentrations over the course of a 24-hour period when compared to the field measurements collected during morning hours (Figure 12). Beginning in mid-June, DO concentrations at this location began to frequently fall below 4 mg/L and occasionally below 2 mg/L before stabilizing again in late October. Most low readings (less than 6 mg/L) occurred within the 12AM – 9AM

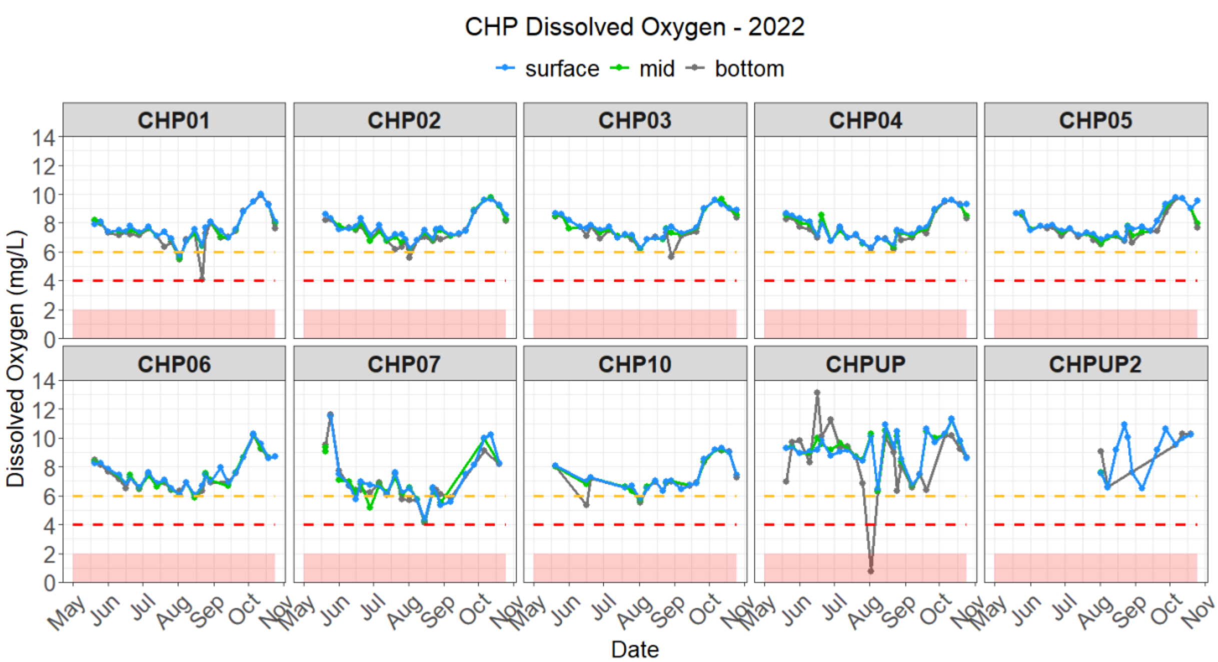

Figure 11: Dissolved Oxygen Levels throughout Chilmark Pond, 2022

timeframe. Collectively, these results show that the majority of the water column retained sufficient oxygen concentrations to support life, however, low readings recorded at station CHP02 suggest near-bottom concentrations are consistently depleted at night. Due to the consistency of measurements between the logger and the hand-held probe, as well as consistency between stations throughout the Pond, it is likely that the bottom conditions observed by the logger at station CHP02 are indicative of trends in other areas of the Pond.

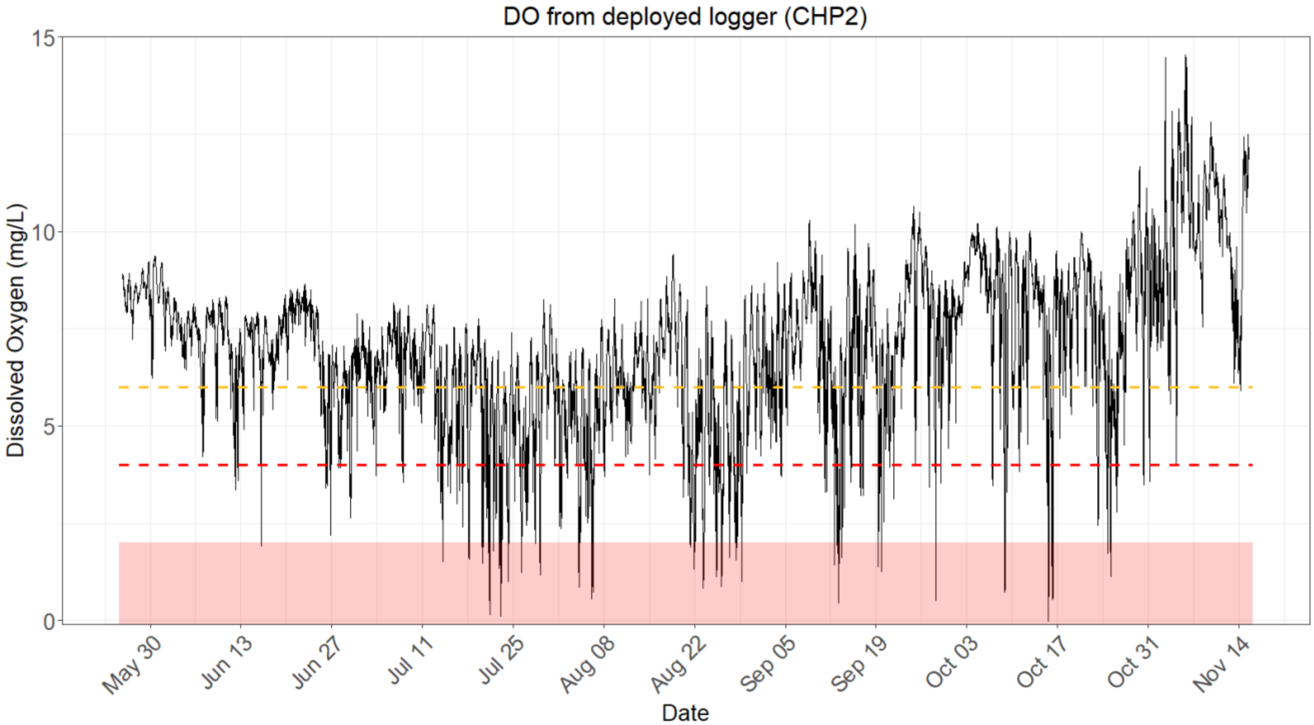

Figure 12: Dissolved Oxygen Measurements from deployed logger in Chilmark Pond, 2022

Data collected across the 24-hour timescale at station CHP02 indicates an impaired ecosystem experiencing intermittent periods of oxygen stress. Hypoxic events of less than 2 mg/L near the bottom can lead to mortality in benthic organisms, and a decline in habitat quality. Large swings from healthy to hypoxic within a 24-hour period are an indication of excess nutrient availability, creating an imbalance in the ratio of DO production versus consumption. While it is likely that these conditions exist in other areas of the Pond, deployment of continuous DO sensors at additional stations would help to confirm whether this is a uniform trend, or exhibits a spatial trend related to depth or other factors. Sampling of benthic communities at station CHP02 throughout the summer may also help to ascertain the severity of these low oxygen events on the benthic community. Solutions to improve the DO balance ultimately require the mitigation of excess nutrients entering the Pond. Increasing the frequency and longevity of openings may also help to regulate DO fluctuations through flushing and dilution of nutrient-rich waters with low-nutrient seawater. Designing a focused sampling regime around a summer opening would help to better understand how opening may or may not improve DO characteristics.

Water Clarity

Turbidity is often used as a benchmark for water quality analyses as it is simple to measure and interpret. Murky water is generally indicative of impaired water quality. One method of measuring turbidity is with a Secchi disk. A Secchi disk is a standardized black and white disk attached to a measuring tape that is lowered through the water column. The depth at which it disappears from view corresponds to the depth at which turbidity is too high for light to penetrate to deeper depths. Thus, light cannot easily reach benthic plants and animals when turbidity is elevated. MADEP does not define a specific target for Class SA waters however, the 2015 MEP management goal for Secchi depth is 3 meters (9.8 feet) or to the bottom of the body of water (Howes et al., 2015). All of the CHP sampling stations are less than 3 meters deep. This means acceptable Secchi depth for CHP is defined as visibility to the bottom.

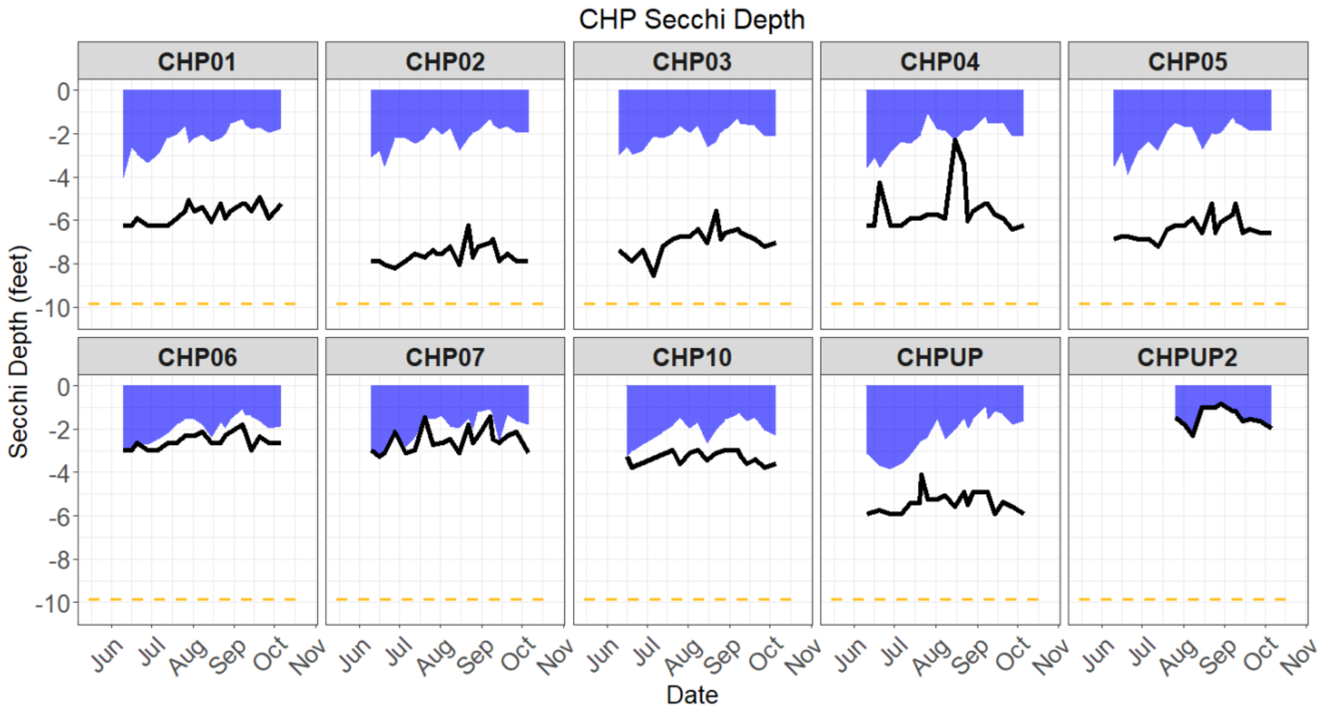

Figure 13: Water Clarity Measurements using a Secchi Disk in Chilmark Pond, 2022

Turbidity was high throughout the 2022 sampling season. Water clarity in CHP varied depending on the location within the Pond. Visibility was typically at least 1 foot, as measured by Secchi disk (Figure 13). Most stations were frequently too murky for the Secchi disk to be seen on the pond bottom, with the exception of stations CHP6 and CHP7 and CHPUP2. These stations are exceptionally shallow, and the bottom of the Pond was consistently visible. All other sampling stations experienced reduced water clarity, with Secchi depths measuring a third of the total depth. Stations CHP02 and CHP03 had the greatest depth profiles and exhibited the most reduced water clarity. Elevated turbidity can likely be attributed to higher average temperatures during the summer that fuel algal growth coupled with increased nutrient inputs.

Nutrients

The Total Nitrogen (TN) was greater in 2022 than 2021 and far exceeded the management target for 4/6 months that were sampled in 2022. This excess nitrogen likely was a driver of the cyanobacterial blooms.

While two monitoring seasons (2021 and 2022) is not sufficient to determine trends we can see a notable increase in nitrogen in 2022 (Figure 14). CHP suffered from phytoplankton blooms and elevated nitrogen concentrations in 2022. Two substantial cyanobacteria blooms occurred, mostly within the Middle Pond and Doctor’s Creek. Additionally, no summer cut occurred in 2022.

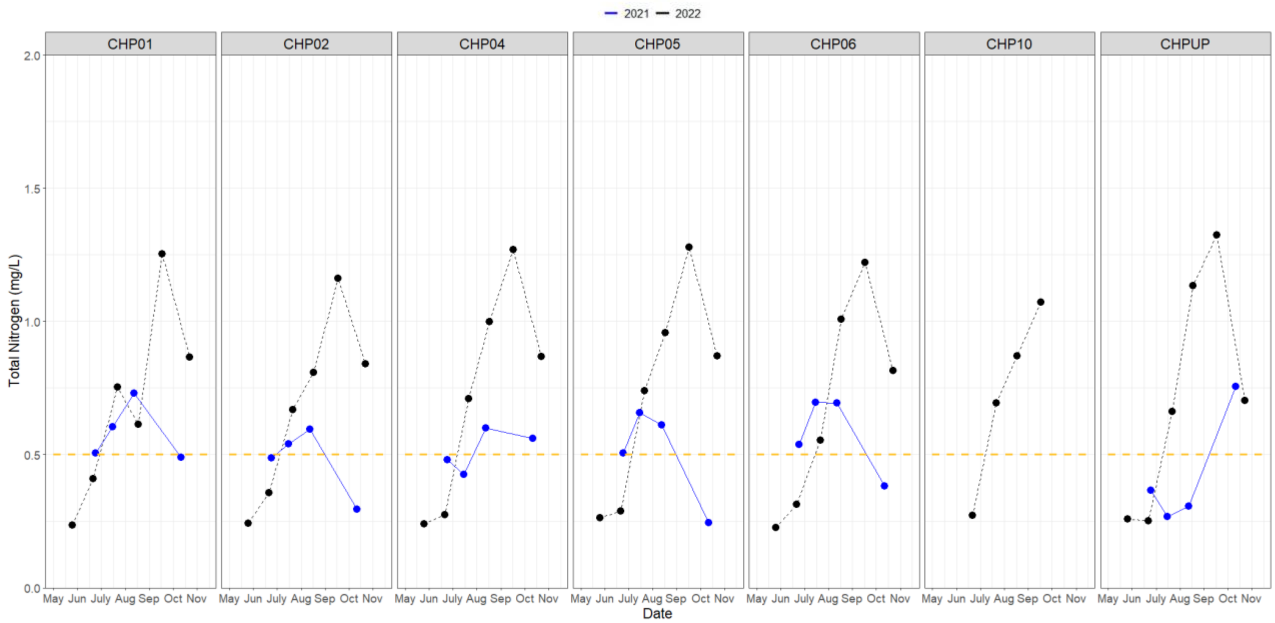

Figure 14: Total Nitrogen in Chilmark Pond was higher in 2022 than in 2021. The yellow line indicates the management target and any measurements >0.5 mg/L are in excess of the limits of a healthy ecosystem and indicate nutrient pollution.

One factor that influences algal growth in coastal ecosystems is nutrient concentrations. High levels of chlorophyll can indicate that nutrients such as nitrate and phosphate were in excess. Elevated nutrient levels can help catalyze the formation of a phytoplankton bloom. However, these nutrients are usually consumed by microalgae as they grow. Chlorophyll-a in CHP was consistently elevated throughout the summer. This indicates that nutrients were consistently elevated in CHP in 2022 to sustain this amount of growth.

In November 2022, Chilmark Pond Foundation in collaboration with the Marine Biological Laboratory in Woods hole and our scientific partners at Great Pond Foundation began studying the groundwater nitrogen inputs in CHP's watershed. This work will continue in 2023 in order to identify "nitrogen hot-spots" where mitigation technologies can be deployed to counteract this nitrogen pollution before it enters the Pond.

Elevated Chlorophyll-a

Chlorophyll-a is a pigment found in phytoplankton (microscopic plant-like organism) and it can be used as an indicator of pond health. High levels of chlorophyll-a can be indicative of impairment or even an algal bloom.

A defining characteristic of the 2022 monitoring season was a widespread phytoplankton and cyanobacteria bloom that persisted from mid-July to early October. Phytoplankton are microscopic plants that form the base of the food web and are the primary source of oxygen in coastal ponds. Phytoplankton are always present, however under optimal environmental conditions they can grow rapidly in what scientists call a bloom. These blooms are easy to observe, as the surface of the water becomes murky and green in color. Phytoplankton blooms are typically short in duration, as there is often an environmental factor that begins to restrict growth. However, the blooms in CHP in 2022 were unique because it persisted for 2 months and were present throughout the entire pond.

The concentration of phytoplankton, often referred to as biomass, can be measured in multiple ways. Most commonly, the amount of chlorophyll-a in the water is used to estimate phytoplankton biomass. Chlorophyll is a pigment used by plants during photosynthesis. Chlorophyll pigments were measured in CHP via two methodologies: 1) **laboratory** extraction and analysis via spectrophotometry at the Marine Biological Laboratory (MBL) in Woods Hole, and 2) **fluorometry** analysis at the GPF lab (specifically with a bbe Moldaenke Fluoroprobe). The spectrophotometry (laboratory) method is more accurate than measuring chlorophyll via the Fluoroprobe (fluorometry), but both methods tended to show the same patterns; if levels were high with the fluoroprobe, they were also high in laboratory measurements.

The MEP uses a management target of 10 micrograms per liter (µg/L) of chlorophyll-a (measured via laboratory analysis) for coastal ponds (Howes et al., 2015). Measurements in excess of 10 µg/L are an indicator of impairment. MBL laboratory analyses showed that chlorophyll-a was above this threshold at every station in September of 2022. Stations CHP06 (near South Abel's Hill) and CHPUP (Middle Pond) consistently measured the highest chlorophyll-a, and were at or above the 10 µg/L threshold July-September. The highest chlorophyll-a measured via laboratory analysis was 111.9 µg/L at CHPUP (Middle Pond) on 9/14/22. Elevated chlorophyll concentrations were observed at the majority of sampling locations in September due to the widespread phytoplankton bloom (Figure 15).

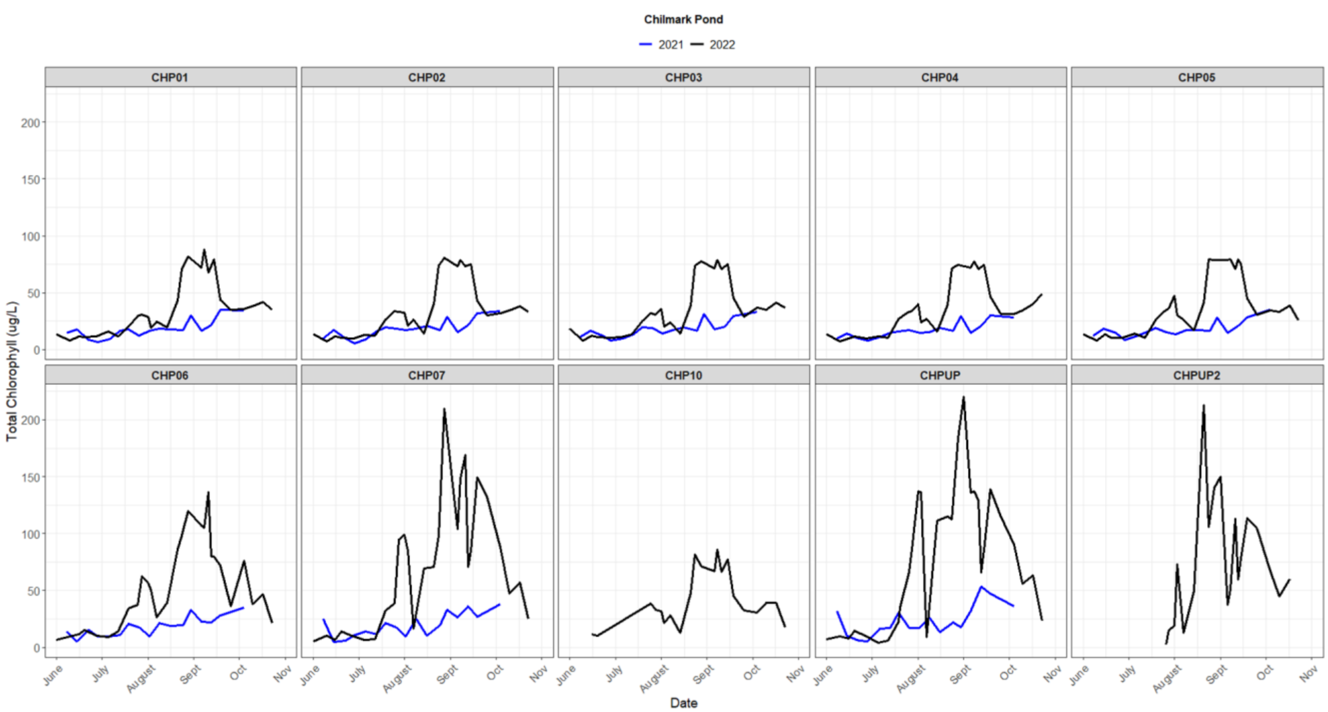

Figure 15: Laboratory measurements of chlorophyll-a were much higher in 2022 than in 2022, far exceeding the 10 mg/L target.

Fluoroprobe measurements confirm this trend (Figure 16) with total algal concentrations (fluoroprobe determined chlorophyll-a) reaching notably high levels in 2022. The spatial and temporal resolution of the Fluoroprobe measurements which are collected weekly throughout CHP allow for evaluation of distribution patterns throughout the Pond. The most apparent pattern was the difference between the Middle Pond (stations CHPUP & CHPUP2) and the Lower Pond (main basin of CHP). The Middle Pond is a freshwater pond with salinities below 10 parts per thousand (ppt), and often 0-5 ppt (Figure

10). This freshwater then flows through Doctor's Creek and into the Lower Pond. The Lower Pond, which is occasionally opened to the ocean, has higher salinity (~5-30 ppt) (Figure 10). This salinity gradient creates two separate habitats which impact the species composition and distribution within the Pond. The divide occurs around South Abel's Hill, where Doctor's Creek flows in the Lower Pond. For this reason, phytoplankton analyses will be divided into West CHP (stations CHPUP, CHPUP2, CHP07, CHP06) and East CHP (stations CHP01-05 & CHP10).

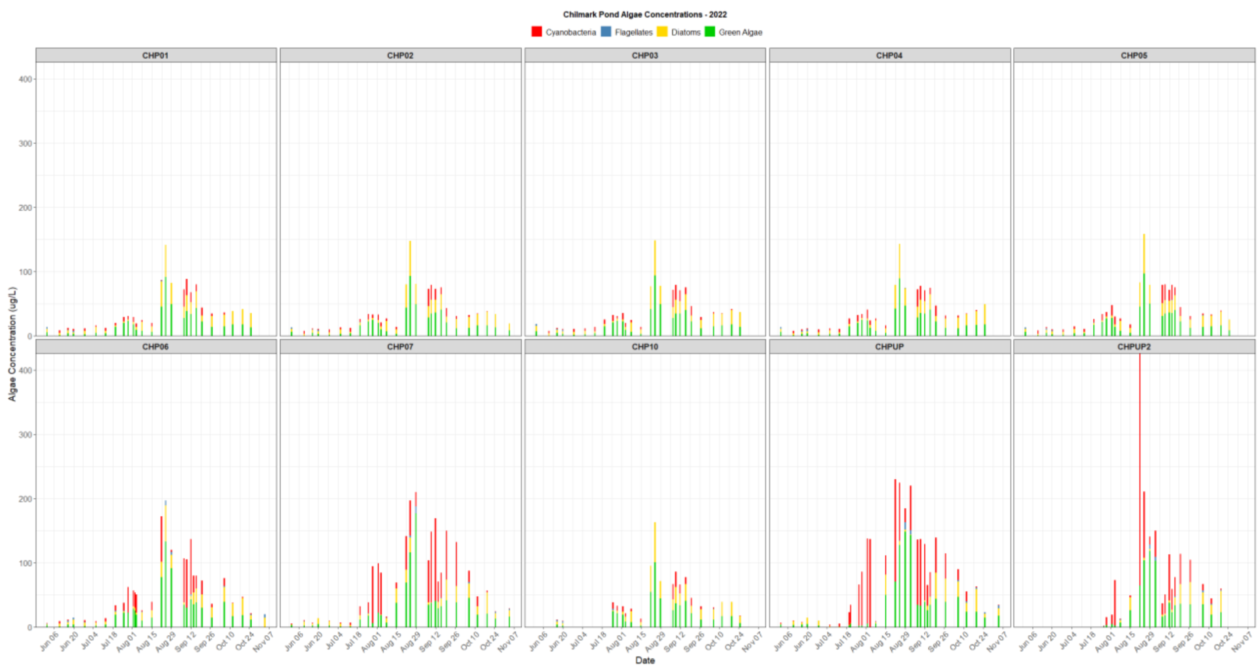

Figure 16: Algae Concentration or chlorophyll-a measured with the fluoroprobe in 2022 Chilmark Pond samples

The differences between West and East CHP are apparent when observing trends in phytoplankton species composition. Species composition refers to the mixture of different types of phytoplankton present in the water at one time. The Fluoroprobe that measures chlorophyll-a in samples is capable of differentiating different types of phytoplankton and calculating their abundance. While this is not as accurate as identifying taxa and counting cell density under a microscope, it allows the idenfication of major groups of phytoplankton and their relative abundance. The different types of phytoplankton measured by the Fluoroprobe are diatoms, green algae, microflagellates, and cyanobacteria. While all of these groups help form the base of the aquatic food web, only cyanobacteria are known to produce toxins harmful to humans and animals.

While phytoplankton abundance and composition were similar between West and East CHP in June, a shift occurred in July that lasted for the remainder of the summer. West CHP consistently had higher chlorophyll-a measurements, where mean chlorophyll-a was frequently twice that of East CHP. This was driven by cyanobacteria blooms that occurred in West CHP throughout the summer. These blooms were first observed in July, when West CHP shifted from an ecosystem dominated by diatoms to one dominated by cyanobacteria. August and September continued to experience elevated cyanobacteria biomass in West CHP, however green algae were also abundant. This is in contrast to East CHP, where phytoplankton biomass was dominated by green algae followed by diatoms throughout the summer.

Cyanobacteria were less abundant in East CHP and did not form any visual indicators of a bloom such as scums or mats on the surface of the water.

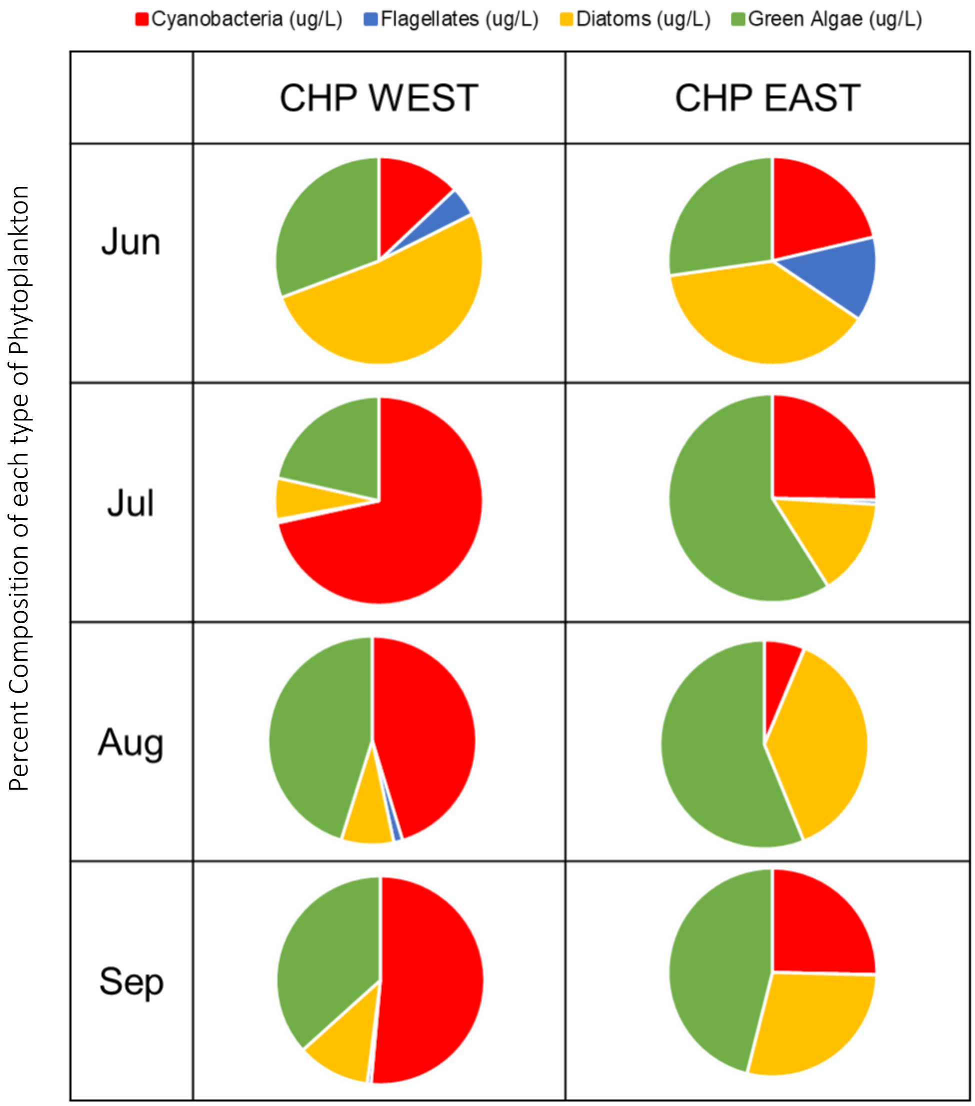

Figure 17: Percent Compositon of each type of Phytoplankton in Chilmark Pond, 2022

Differentiating the types of phytoplankton present in CHP allows us to distinguish between harmless, non-toxic organisms and potentially toxic cyanobacteria. Additionally, in this field of emerging scientific study, microbial ecologists suspect that the ecology, or community composition, may influence the timing and concentration of cyanotoxin production.

With each year of study, we learn more about pond dynamics with the goal of providing vital information to Island Health Agents who issue public safety recommendations. We are working together as an Island community to support and restore the health of our cherished coastal ponds, but also to feel safe enjoying their beautiful and beloved waters.

Works Cited

MEP Report:

Howes B.L., E.M. Eichner, R.I. Samimy, D.R. Schlezinger, J. S. Ramsey, S. Kelley, (2015). Linked Watershed-Embayment Management Model to Determine the Critical Nitrogen Loading Threshold for the Chilmark Pond Embayment System, Chilmark, Massachusetts. SMAST/MassDEP Massachusetts Estuaries Project, Massachusetts Department of Environmental Protection. Boston, MA.

https://www.mass.gov/doc/chilmark-pond-embayment-system-chilmark-ma-2015/download