2023

ECOSYSTEM MONITORING REPORT

CHILMARK POND

GREAT POND FOUNDATION

Prepared on behalf of

CHILMARK POND FOUNDATION

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Executive Summary 2023

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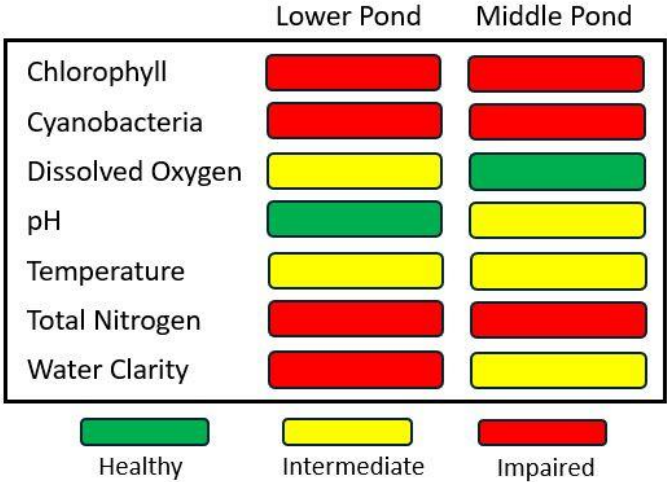
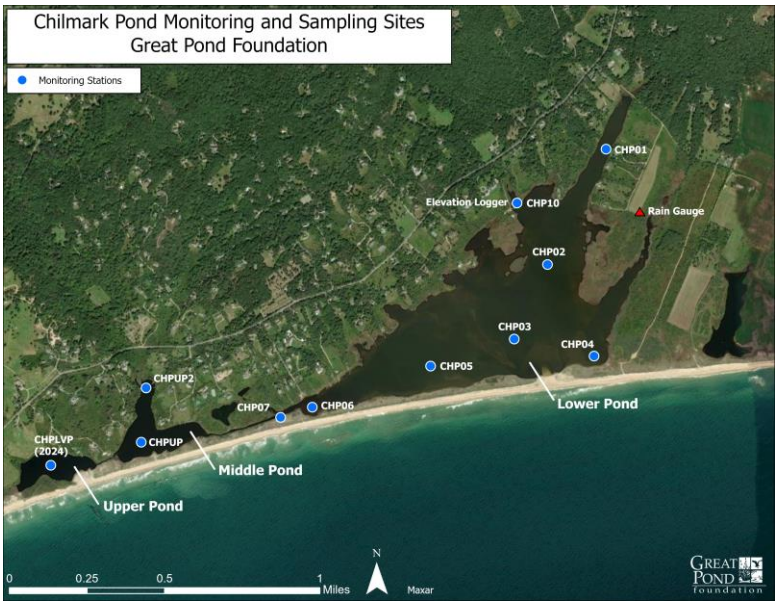
Study Area

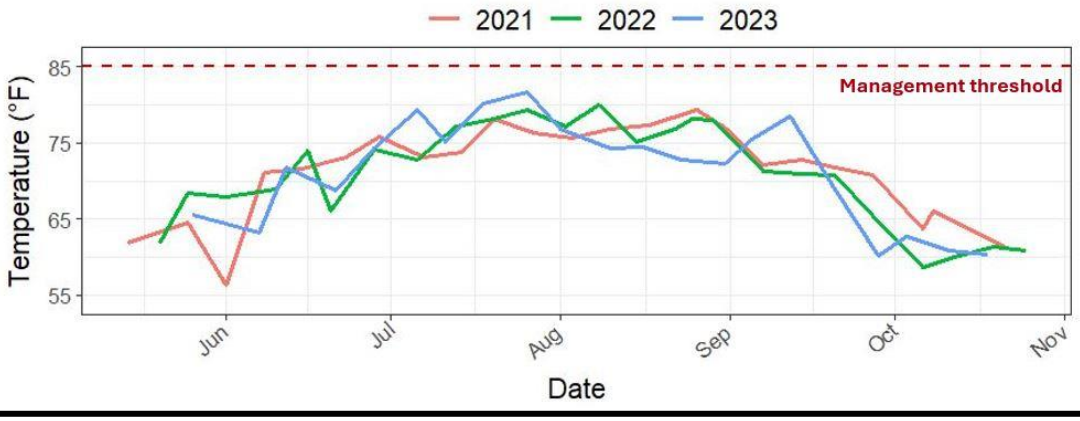
Chilmark Pond (CHP) is a coastal estuary approximately 210 acres in size located on Martha's Vineyard's southern shoreline. CHP is a complex system comprised of three interconnected basins known as the "Lower", "Middle", and "Upper" Ponds. These 3 basins encompass a roughly 3400-acre watershed. The barrier beach separating the Lower Pond from the ocean is manually breached 2-4 times per year as a nutrient management tool.

Summary of Metrics, 2023



*Refer to the *Appendix* for info on how rankings were assigned.





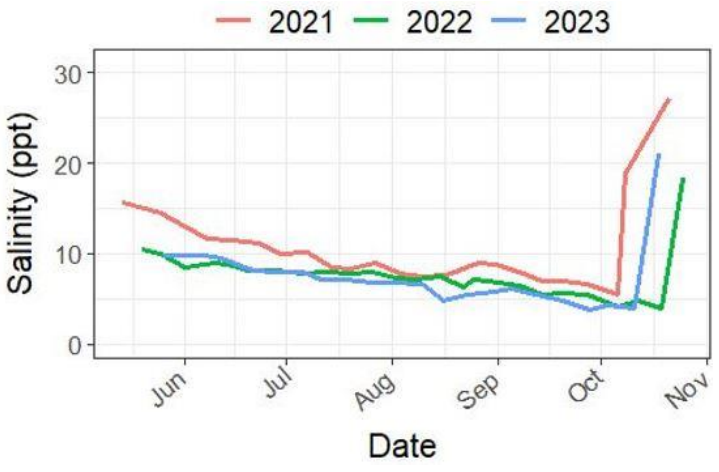
TEMPERATURE

Pond-wide mean water temperature in 2023 (blue) is compared to 2021 (red) and 2022 (green).

Mean temperature stayed similar across all years and consistently remained below the target threshold.

SALINITY

Pond-wide mean salinity in 2023 (blue) is compared to 2021 (red) and 2022 (green).

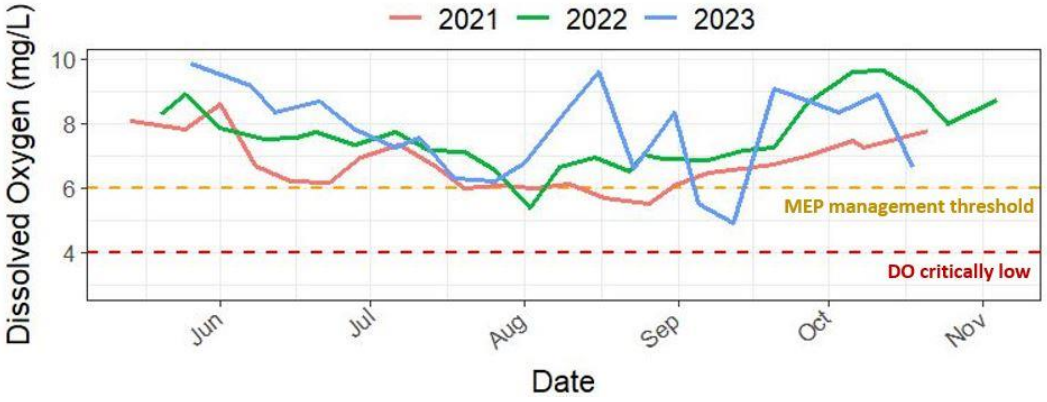


Cut Dates 2023

Date of Opening	Date of Closure	Cut Duration
Jan 5th	Jan 12th	7 days
Jan 30th	Feb 2nd	3 days
Mar 21st	Apr 1st	11 days
Oct 15th	Nov 4th	20 days
Dec 18th*	Dec 23rd	5 days

*Cut on December 18th occurred naturally rather than through a man-made breach.

DISSOLVED OXYGEN



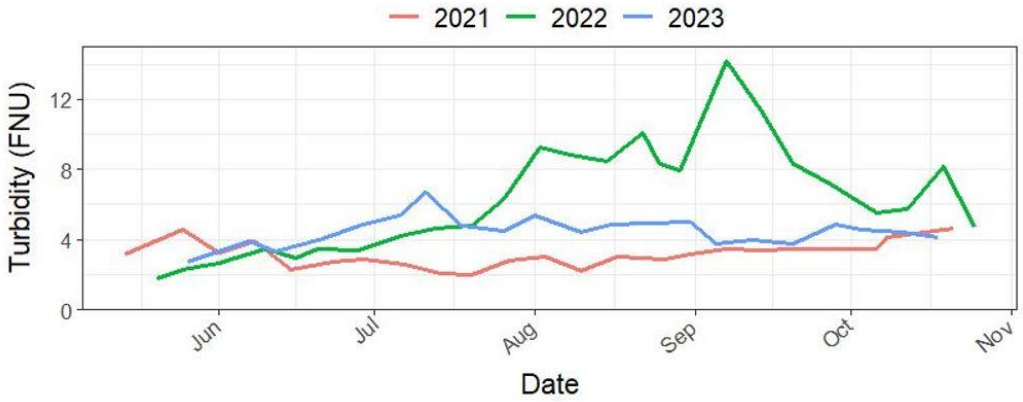
Pond-wide mean bottom-depth dissolved oxygen (DO) in 2023 (blue) is compared to 2021 (red) and 2022 (green).

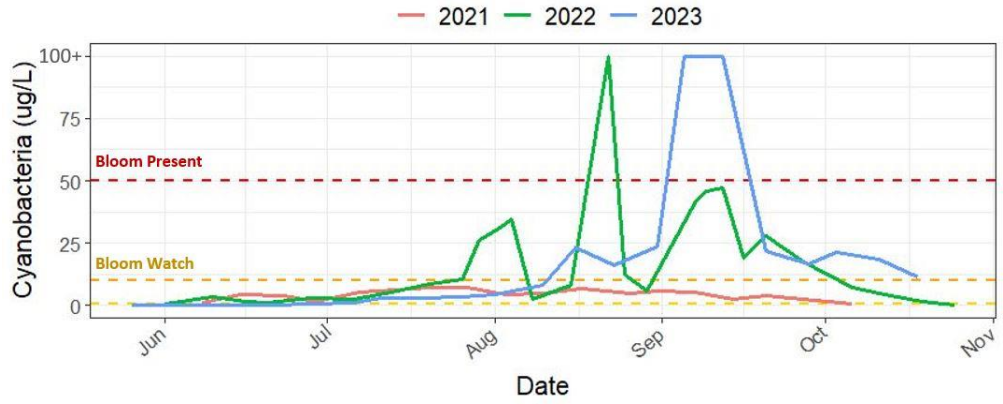
DO in 2023 was higher than all other years in August, but lower in September.

TURBIDITY

Pond-wide mean turbidity in 2023 (blue) compared to 2021 (red) and 2022 (green).

Turbidity in 2023 was lower than in 2022, but was still elevated relative to 2021.





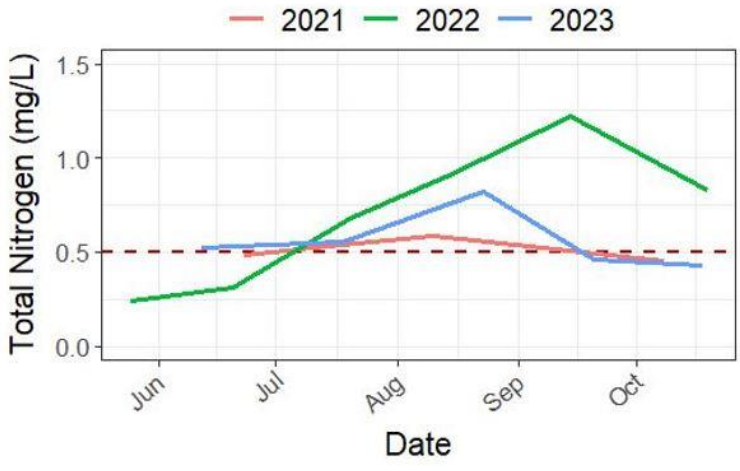
CYANOBACTERIA

Pond-wide mean cyanobacteria concentration in 2023 (blue) is compared to 2021 (red) and 2022 (green).

Cyanobacteria blooms primarily concentrated in the Middle Pond occurred in both 2022 and 2023.

TOTAL NITROGEN

Mean total nitrogen concentrations in 2023 across all monitoring stations (blue) were lower than those in 2022 (green) during the late summer.



Pond Summary

CHP exhibited reduced water quality and signs of impairment in 2023, continuing trends seen in both 2021 and 2022. Water temperatures periodically rose above a daily mean of 80 °F during the mid-summer, with heating events generally inducing dissolved oxygen declines at the pond bottom. Total nitrogen concentrations periodically exceeded management standards. This likely contributed to the development of a widespread cyanobacteria bloom in the Middle Pond and western portion of the Lower Pond, and an elevation in overall turbidity/reduction of water clarity. Observed pH levels in the Middle Pond frequently fell outside of the target range, tilting towards more basic conditions.

Introduction

Chilmark Pond (CHP) is an important ecological, historical, cultural, and economic resource for the Town of Chilmark, MA. The Massachusetts Department of Environmental Protection (MassDEP) has designated all Martha's Vineyard waters, including CHP, as "Class SA" waters, pursuant of the MA Department of Environmental Protection, MA Surface Water Quality Standards, 314 CMR 4 (MassDEP, 2021). These waters are defined as follows:

"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 shell fishing, these waters shall be suitable for shellfish harvesting without depuration (Approved and Conditionally Approved Shellfish Areas). These waters shall have excellent aesthetic value."

To cultivate the resilience of this fragile ecosystem, Chilmark Pond Foundation (CPF) has been working in collaboration with the Great Pond Foundation (GPF) since 2021 to collect environmental data and monitor ecosystem health for aid in long term planning and management. Data collection focuses primarily on water quality data collection, cyanobacteria monitoring, and studies on nitrogen sources within the watershed. GPF's Ecosystem Monitoring Program follows the methodology and standards established by the Massachusetts Estuaries Project's (MEP) 2015 report on CHP (Howes et al., 2015), as well as the surface water quality standards established by MassDEP for Class SA waters (MassDEP, 2021). The following management targets have been set for CHP in accordance with these two works:

- Chlorophyll – Shall not exceed 10 ug/L. (MEP)
- Dissolved Oxygen (DO) – Shall not be less than 6.0 mg/L, unless observed natural background conditions are lower. (Class SA)
- pH – Shall be in the range of 6.5 through 8.5 standard units and not more than 0.2 standard units outside of the natural background range. (Class SA)
- Temperature – Shall not exceed 85˚F nor a maximum daily mean of 80˚F. (Class SA)
- Total Nitrogen – Shall not exceed a mean concentration of 0.5 mg/L across the five stations (CHP01, CHP02, CHP03, CHP04, & CHP05) comprising the sentinel stations. (MEP)
- Water Clarity – Secchi depth shall not be less than 3 meters (9.8 feet), nor should it fail to reach the bottom when total depth is shallower than 3 meters. (MEP)

Study Area

Chilmark Pond is a coastal estuary approximately 210 acres in size situated along the southern coastline of Martha's Vineyard. It is a complex system comprised of three basins, colloquially referred to as the "Lower", "Middle, and "Upper" Ponds, based on downgradient flow of water from Upper (West) to the Lower (East) regions. The Upper region is comprised of the Upper or Lucy Vincent Pond and Middle Ponds, while the Lower region contains the Lower Pond. As such, the contributing watershed area of CHP is delineated into the Upper and Lower Chilmark Pond Watersheds (**Figure 1**). Together, these two watersheds encompass approximately 3400 acres contained entirely within the Town of Chilmark, MA.

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 a period of tidal exchange with the ocean. Seawater is

typically nutrient deficient compared to inland estuaries, and tidal exchange creates a “flushing” effect throughout the life of an opening and can be a nutrient management tool. Pond cuts are temporary, and close due to natural forces. The timing of an opening is determined by the commissioners of the Chilmark Pond Association, who consider factors such as pond elevation, water quality, weather, and the migration or breeding patterns of important fish and shellfish species. After closure of the cut, CHP gradually refills due to groundwater input and surface water flow via tributary creeks (i.e., Fulling Mill Brook and Mill Brook), as well as through direct precipitation onto the pond’s surface.

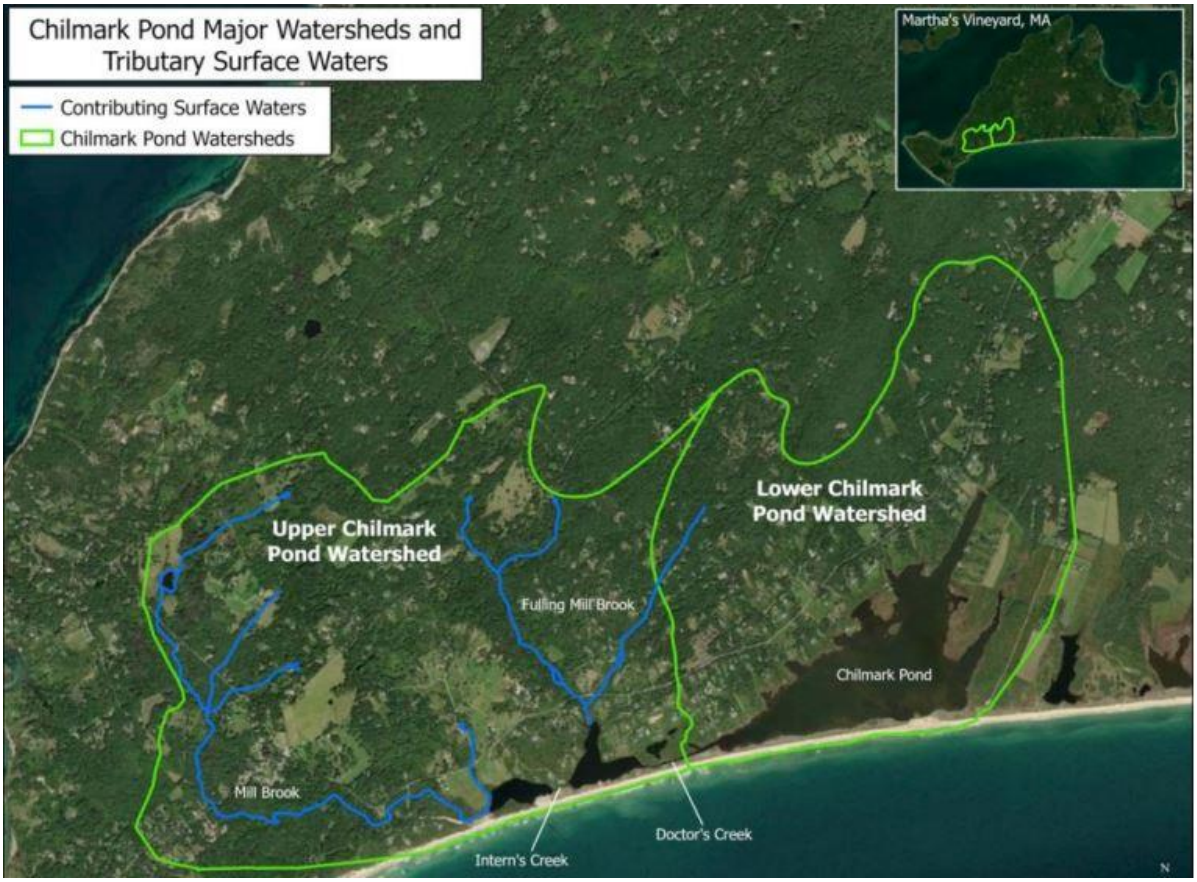


Figure 1. *Chilmark Pond’s Upper and Lower subsections are shown, as well as each subsection’s respective watershed.*

Scope of Work

In 2023, Great Pond Foundation (GPF) continued its weekly ecosystem monitoring program on CHP in collaboration with the Chilmark Pond Foundation (CPF) for the third consecutive year. GPF uses the methodology and management standards established by the Massachusetts Estuaries Project’s (MEP) 2015 report on CHP (Howes et al., 2015), as well as by MassDEP’s Surface Water Quality Standards for Class SA waters (MassDEP, 2021). A total of 21 monitoring trips were conducted on CHP between May 26th and October 18th, most of which took place in the morning hours between 7-11 AM. Data was collected at 10 stations located in the Lower Pond, Middle Pond, and adjoining Doctor’s Creek (**Figure 2**). Water quality data was obtained at each station by measuring the following metrics using a handheld YSI Pro DSS multiparameter probe: water temperature, salinity, dissolved oxygen (DO), pH, and turbidity. Additional continuous temperature, salinity, and DO readings were also collected using a

stationary logger deployed on the pond bottom at station CHP02. Water clarity was measured at each station using a Secchi Disk. Pond elevation data was collected by a continuous logger located at the Thumb Point parking area (near station CHP10). Local rainfall data is collected by a digital rain gauge and data logger installed along the eastern shoreline of the Pond.

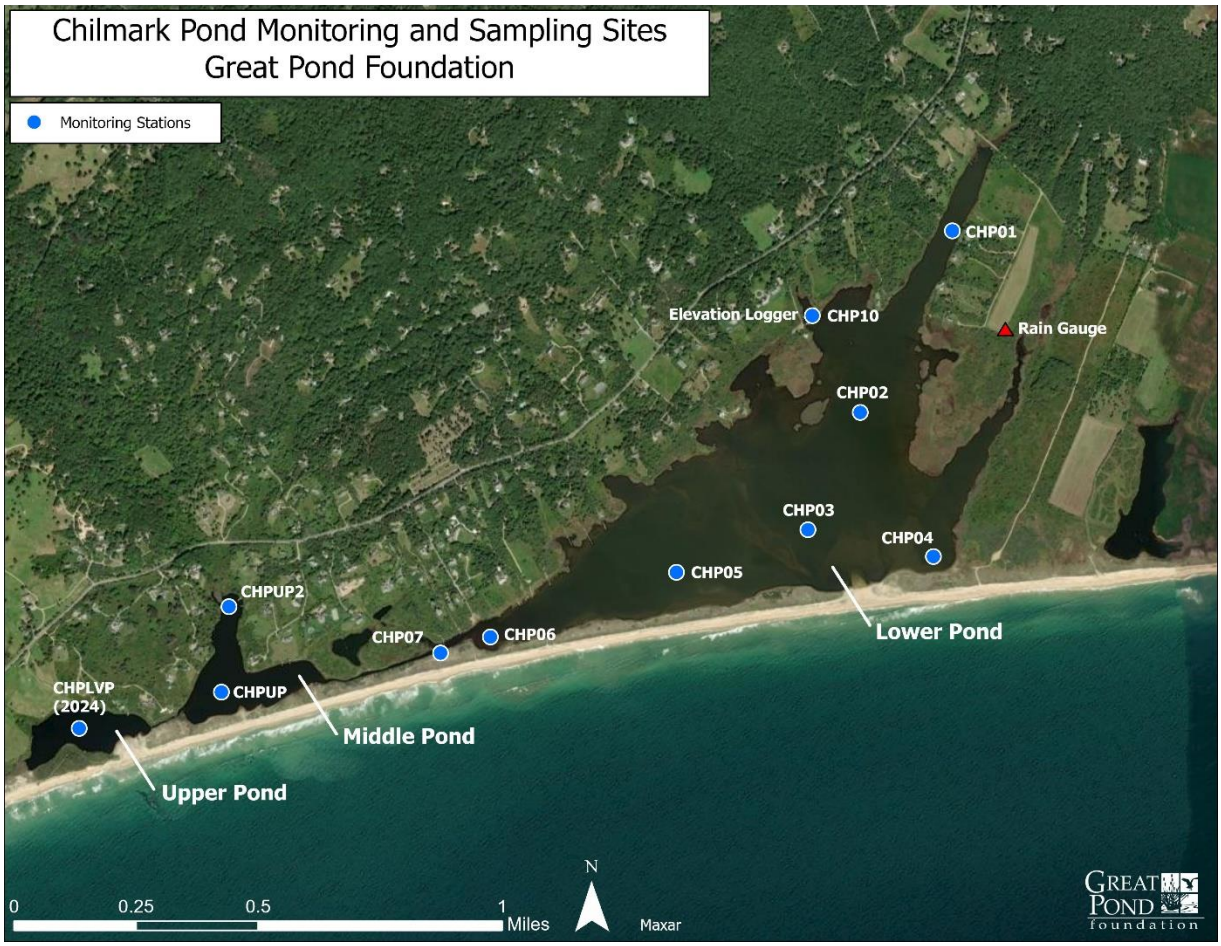


Figure 2. *The locations of the 10 monitoring stations used by GPF in 2023. Monitoring stations spanned the Lower Pond, Middle Pond, and adjoining Doctor's Creek. GPF is slated to establish a new station in the Upper Pond (CHPLVP) in 2024.*

Cyanobacteria sampling was completed during each sampling trip as part of the MV CYANO$_{TM}$ program, a collaborative initiative between GPF and the Island Boards of Health. A total of 213 cyanobacteria samples were collected from CHP and processed in 2023. Monthly nutrient sampling was conducted at 7 of the 10 monitoring stations from June through October, with a total of 35 samples being collected and processed at Marine Biological Laboratory (MBL) in Woods Hole.

Water Quality Metrics

Pond Elevation and Pond Cuts

Summary Points:

- Chilmark Pond was manually opened to the ocean 4 times in 2023 for a total of 41 days.
- A storm that occurred on December 18th caused a natural breach to the ocean.
- Average length of openings has decreased between 2021 and 2023.
- Chilmark Pond opening cycles are closely linked with rainfall patterns.

The barrier beach separating Chilmark Pond from the ocean was breached a total of five times in 2023. Four were man-made "cuts", and one was created naturally during a storm that occurred on December 18th. In total, CHP was open to the ocean for 46 days in 2023, 41 of which are attributed to deliberate cuts (**Table 1**). The longest single event occurred on 10/15/23 (20 days) and shortest on 1/30/23 (3 days), while the average length of cuts in 2023 was 10.25 days. This illustrates a decreasing trend in the average length of openings in CHP from 11.7 days in 2022 and 16.3 days in 2021. However, a comparison of total days open between 2023 (41 days) and the past two years are less consistent, with 35 days in 2022, and 49 in 2021.

Table 1. *The dates on which Chilmark Pond was opened to the ocean between 2021 and 2023. The breach on 12/18/2023 formed naturally during a storm (denoted by *) For the purpose of comparing Pond openings between years, this natural breach is not included in the year-to-year totals.*

Year	Average Length of Openings	Total Number of Days Open	Date of Opening	Date of Closure	Length of Opening
2023	NA*	NA*	12/18/2023*	12/23/2023*	5 days*
	10.25 days	46 days	10/15/2023	11/4/2023	20 days
			3/21/2023	4/1/2023	11 days
			1/30/2023	2/2/2023	3 days
			1/5/2023	1/12/2023	7 days
2022	11.67 days	35 days	10/23/2022	11/19/2022	25 days
			3/29/2022	4/1/2022	3 days
			1/22/2022	1/29/2022	7 days
2021	16.33 days	49 days	10/6/2021	10/30/2021	24 days
			4/14/2021	5/4/2021	21 days
			2/4/2021	2/7/2021	4 days

In general, water elevation in CHP fluctuates between 1 and 5 feet above the NAVD88 universal datum. Data collected by the continuous elevation logger at Thumb Point (**Figure 3**) illustrates the approximate 24-hour "drain" cycle from high water elevation to low that occurs immediately following a breach. After this cycle, the Pond becomes tidal, allowing high saline, nutrient-deficient seawater to enter and mix with the remaining nutrient rich waters of CHP. Natural filling and scouring of sand throughout the area of the inlet will eventually restrict and close the breach, depending on several environmental factors. The amount of time required for the Pond to return to high water, or "recharge time", is highly dependent on rainfall and vegetation growth patterns (**Figure 3**). In general, recharge time is reduced during the winter and spring months and increased through summer and early fall, in accordance with

the wet and dry seasons. The 2023 opening cycles adhered to these patterns, with all CHP openings occurring in either winter, spring, or mid to late fall.

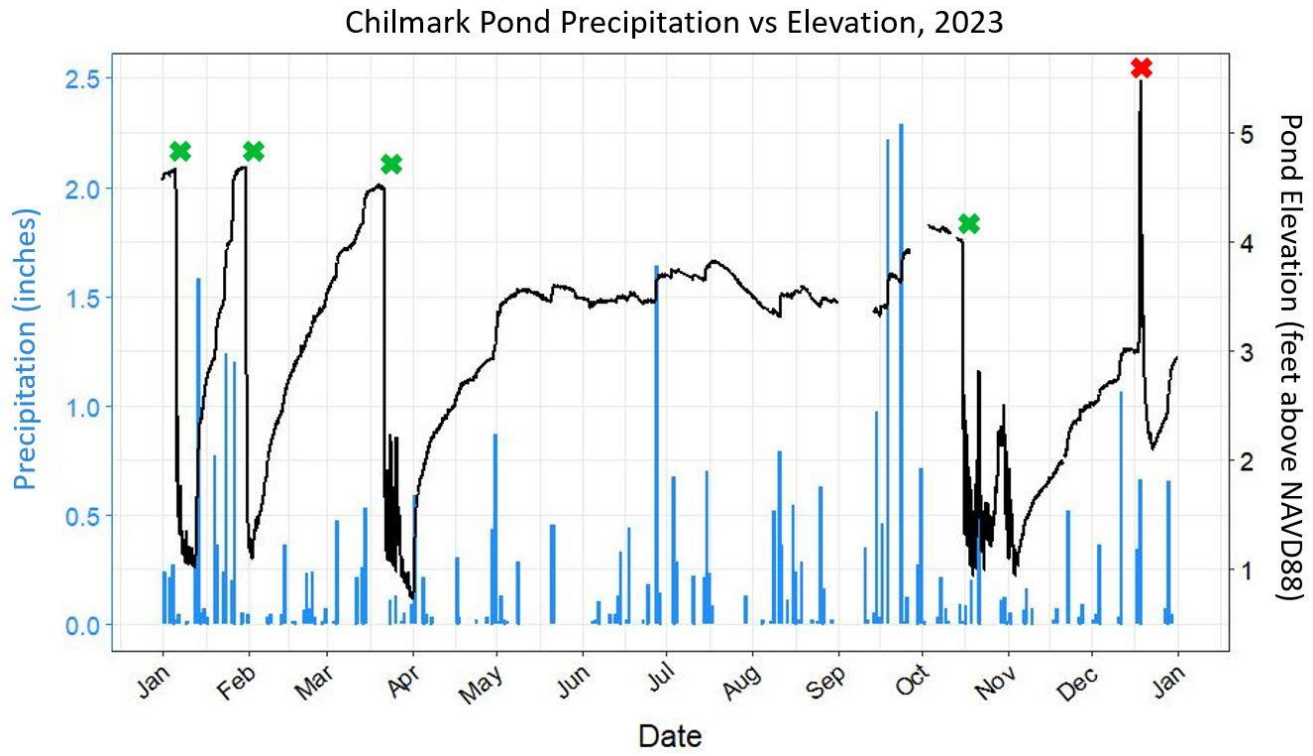


Figure 3. *Daily cumulative precipitation (in inches) on Martha's Vineyard is plotted against Chilmark Pond's water elevation in 2023. Precipitation data was obtained from the National Weather Service for the Martha's Vineyard Airport (National Weather Service, 2024). Green X's indicate when CHP was opened to the ocean via a man-made breach. The red X indicates when CHP opened to the ocean naturally during a storm on 12/18/23.*

Salinity

Summary Points:

- The upper portions of the CHP system host a more freshwater environment than the Lower Pond, which is brackish.
- Salinity in the Lower Pond is closely tied to rates of freshwater versus seawater input.
- Salinity trends throughout the summer monitoring season were consistent with the timing of manual openings of the Pond.

Lower Chilmark Pond can be classified as a brackish estuary, which is defined as maintaining a salinity concentration between 0.5 and 35 parts per thousand (ppt). As the Pond's connection to the ocean is intermittent, salinity concentrations trend downwards during a period of freshwater recharge and are highest following an opening. Incidental increases in salinity due to over wash across the barrier beach can also occur. Salinity concentrations are almost entirely influenced by rates of freshwater versus seawater input and can be an indicator of hydrodynamic factors, particularly the mixing, circulation, and flushing patterns that occur during an opening.

Surface water flows primarily through the Chilmark Pond system from the Upper Pond (aka Lucy Vincent Pond) at the westernmost extent, downgradient and eastward through the Middle Pond, and drains into the Lower Pond. Both the Upper and Middle Ponds are fed by two tributary stream networks, the Mill Brook and Fulling Mill Brook, respectively. Because these upper ponds are rarely connected to the ocean, both host predominantly freshwater ecosystems. Low levels of salinity have been observed in both the upper ponds, most noticeably in the wake of storm events and associated over wash and/or percolation through the barrier beach. It is presumed that these periods of elevated salinity are short-lived, due to steady freshwater input and downgradient flow to the Lower Pond.

Salinity concentrations during the 2023 monitoring season ranged from 1.83-30.10 ppt in the Lower Pond, and 0.06-7.88 ppt in the Middle Pond (**Figure 4**). GPF did not have a regular monitoring station in the Upper Pond during 2023 but has since established a monitoring site for the 2024 season. Salinity in the Lower Pond showed little to no stratification with increasing depth, which is an indication of a well-mixed system. The only variation observed in the Lower Pond existed in the delta zone where waters from the upper system enter the Lower Pond via Doctor's Creek (stations CHP06 & CHP07). Salinity in the Lower Pond steadily decreased throughout the summer as elevation rose intermittently until the opening on October 15th, where a rapid rise in salinity was observed.

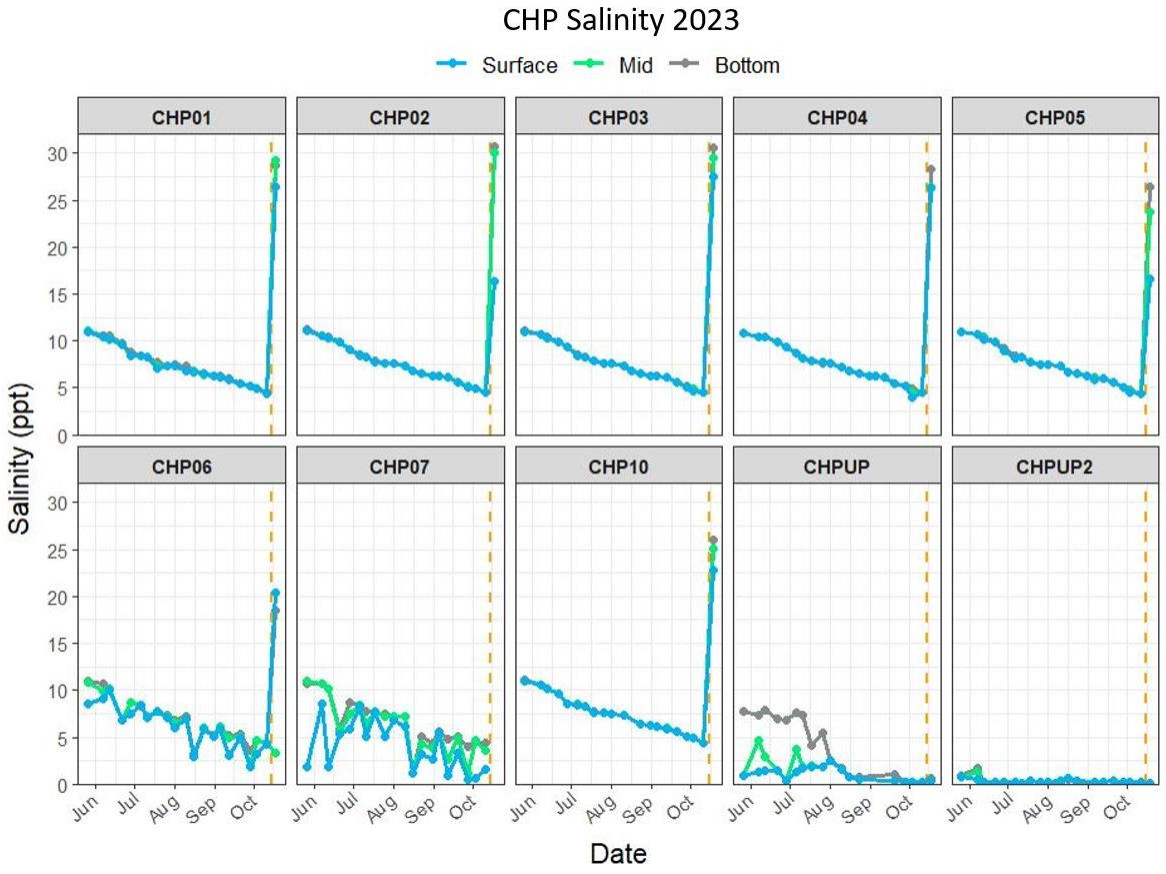


Figure 4. *Salinity in parts per thousand (ppt) for Chilmark Pond's 10 monitoring stations during the 2023 field season. Data was measured using a handheld probe for three depths (surface, mid-depth, and bottom). The dashed yellow line indicates when Chilmark Pond was opened to the ocean on 10/15/23.*

A comparison of 2021-2023 salinity concentrations yields fairly consistent trends across all three years (**Figure 5-6**). A slight downwards trend in overall salinity from 2021 to 2023 is apparent in the continuous salinity data collected by the deployed logger at station CHP02. It is unclear if this is due to the length of the cut just prior to the summer season, rainfall patterns, or reductions in overall average cut durations observed across these same years.

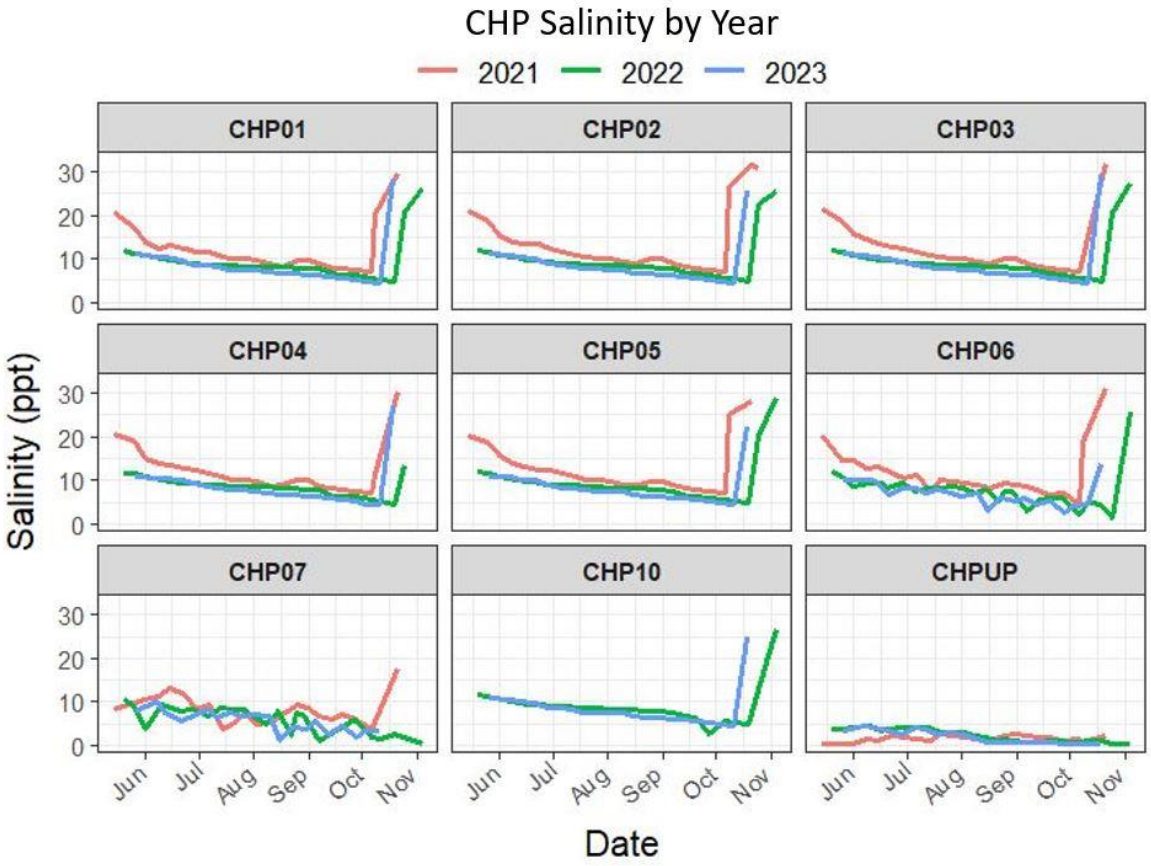


Figure 5. *Average salinity across all depths in parts per thousand (ppt) for Chilmark Pond's 9 monitoring stations for the years 2021, 2022, and 2023. Data was measured at 3 depths (surface, mid-depth, bottom) using a handheld probe. No 2021 data exists for station CHP10 since it was not established until 2022.*

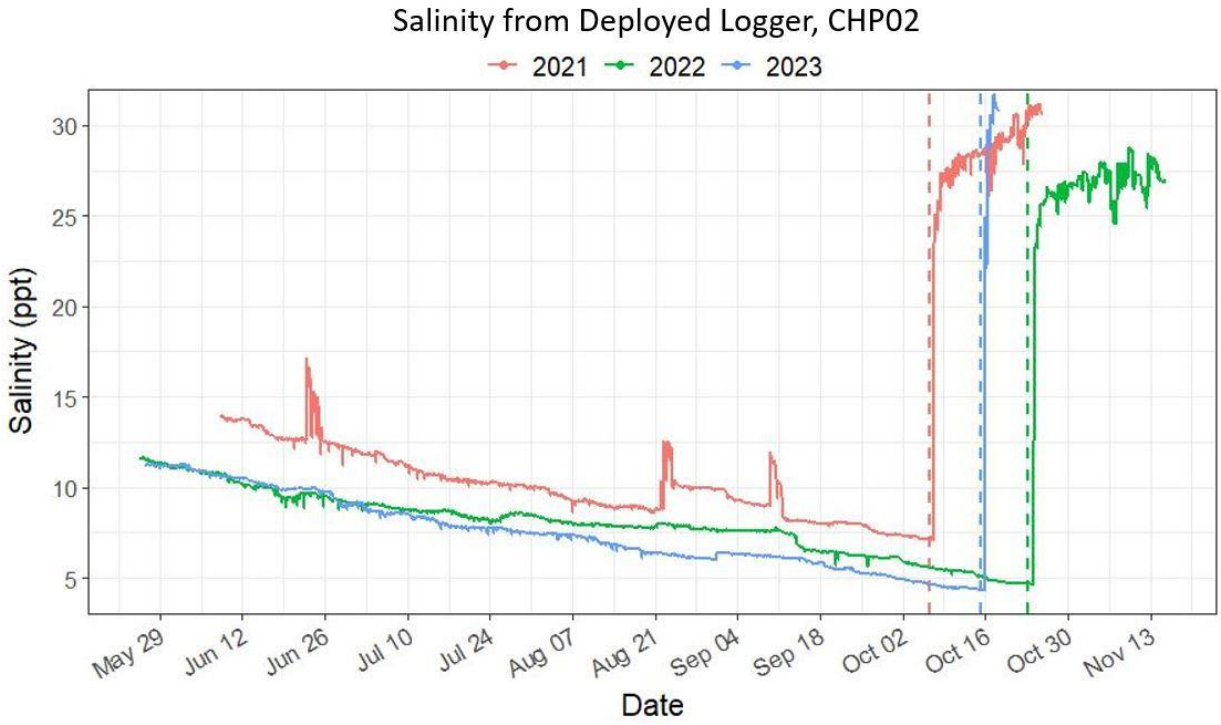


Figure 6. *Salinity in parts per thousand (ppt) for the years 2021, 2022, and 2023. Data was obtained via a conductivity/salinity data logger deployed at station CHP02. The dashed vertical lines indicate when Chilmark Pond was opened to the ocean, with their respective colors matched by year.*

Temperature

Summary Points:

- Water temperatures were highest in July and early September. Daily mean temperature exceeded 80 °F on 18 individual days.
- Temperatures in the Lower Pond were generally uniform throughout the water column, while a higher level of temperature stratification was observed in the Middle Pond.
- Water temperatures in CHP closely correspond to ambient air temperatures.

MassDEP standards for class SA waters establish that water temperature should not exceed 85 °F at any time, nor should the average temperature within a 24-hour period exceed 80 °F, as excessive water temperatures can degrade habitat quality and subject native species to heat stress. Measured water temperatures across CHP ranged from 55.8 to 85.6 °F in 2023. Continuous data obtained from a bottom-depth temperature logger deployed at station CHP02 indicates that water temperatures in the Pond are closely tied to ambient air temperatures (**Figure 7**). Accordingly, water temperatures in CHP were highest in July and early September when air temperatures were at their peak. While water temperatures only exceeded 85 °F on two days in 2023 (7/25 and 7/28), mean daily temperature exceeded 80 °F on a total of 18 days, 14 of which fell between 7/9 and 7/29 while the remaining 4 fell between 9/8 and 9/13.

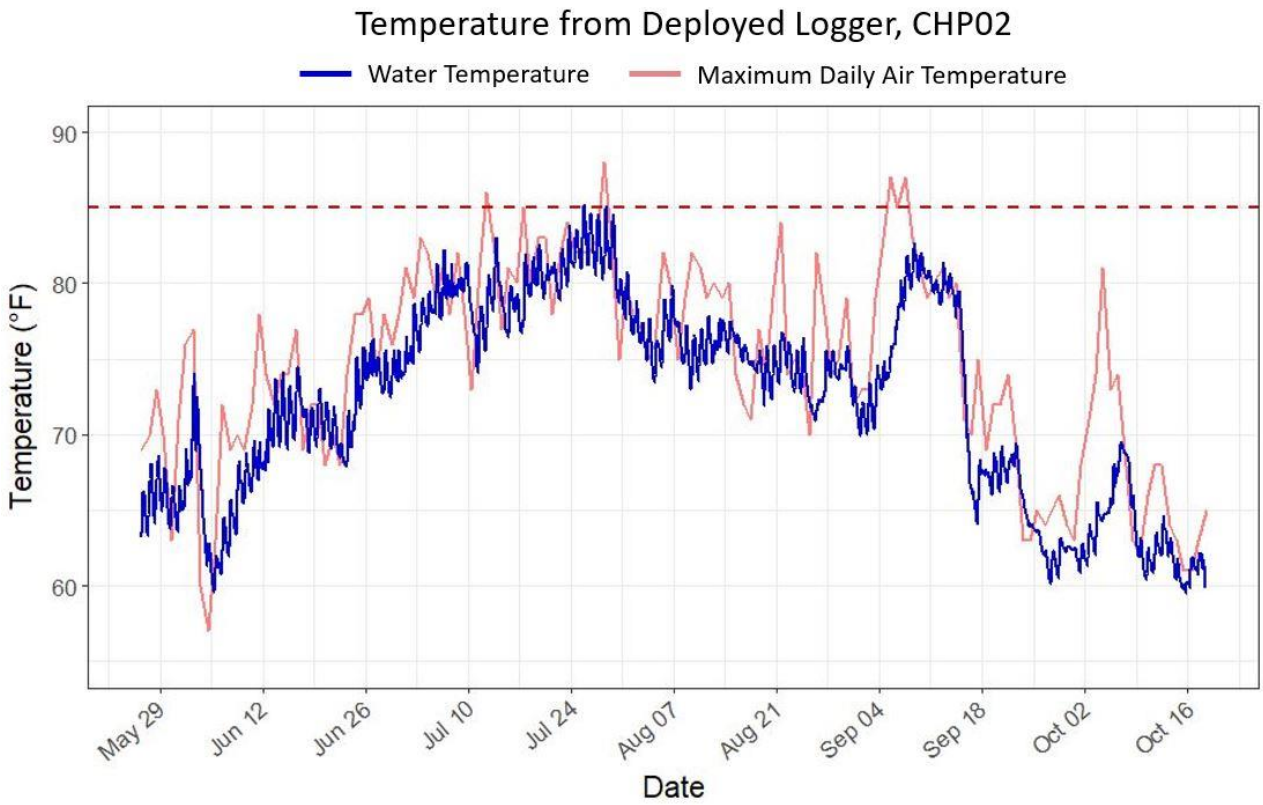


Figure 7. *Continuous water temperature in CHP (in °F) during the 2023 field season is plotted against maximum daily air temperature. Water temperature data was obtained from a data logger deployed on the pond bottom at station CHP02. Air temperature data was obtained from the National Weather Service for the Martha's Vineyard Airport (National Weather Service, 2024). The dashed red line represents the MassDEP management threshold (85 °F).*

In-situ measurements taken between 7 and 11 am show that temperature remained relatively consistent throughout the Lower Pond, with minimal variability present within the water column until the opening of the cut on October 15th (**Figure 8**). This lack of stratification is likely due to wind-driven water circulation combined with the Pond's relatively shallow depth, enabling a strong mixing effect. More variability within the water column was present in the Middle Pond (CHPUP & CHPUP2), where temperature and salinity-based density differences between the water already present in the Pond and inflowing stream and groundwater (comparatively cooler) can create separate layers within the water column. Station CHPUP2's slightly cooler water temperatures relative to all other stations can likely be attributed to cooler stream and groundwater water input from the nearby Fulling Mill Brook tributary.

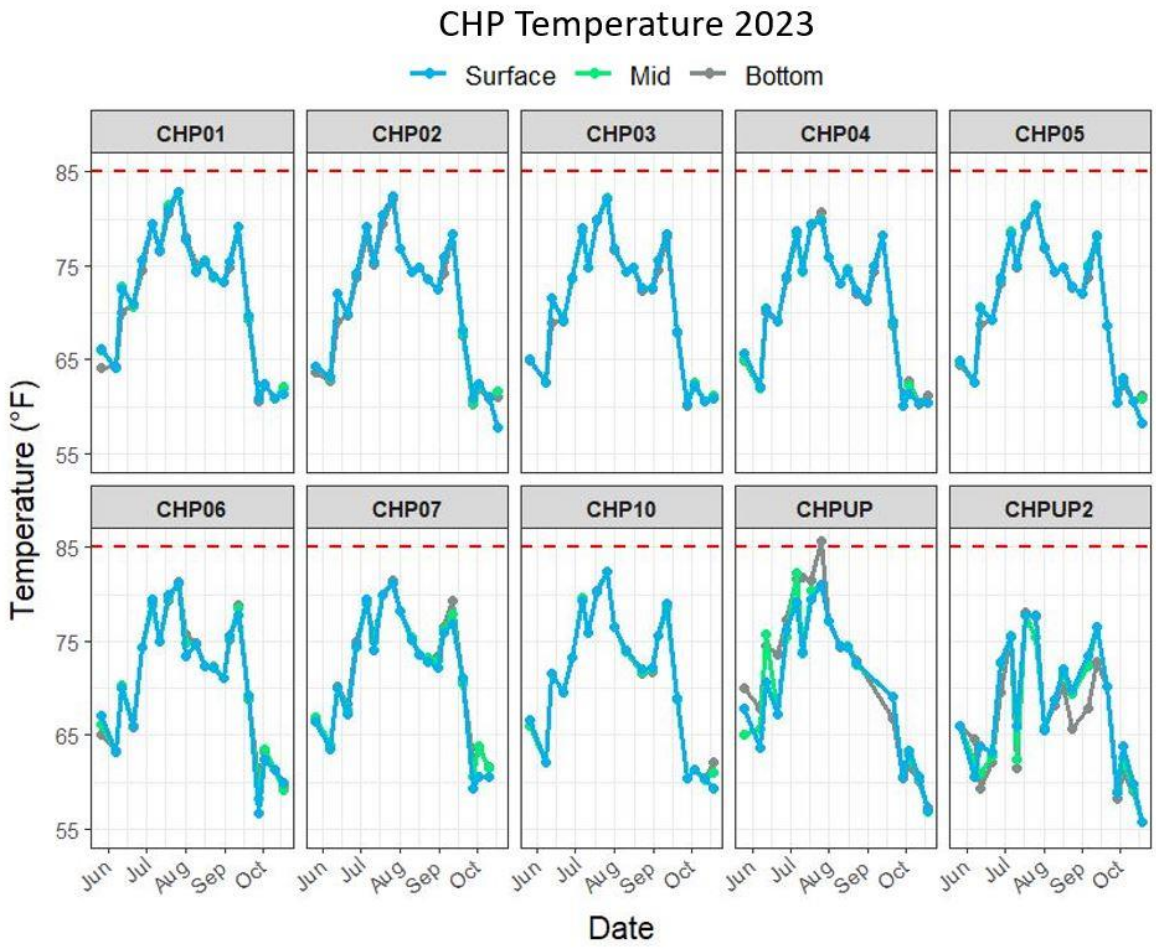


Figure 8. *Water temperature (in °F) for Chilmark Pond's 10 monitoring stations during the 2023 field season. Data was measured using a handheld probe for three depths (surface, mid-depth, and bottom). The dashed red line represents the MassDEP management threshold (85 °F).*

The water temperature trends observed in 2023 resemble those of both 2021 and 2022 (**Figure 9**). All three years experienced a rise in water temperature during late spring, peak temperature during the summer, and a decline in temperature during the fall. While August water temperatures were abnormally cool in 2023 compared to 2022 and 2021, it did experience higher temperatures during the first half of September. Mean daily water temperature ultimately exceeded 80 °F less often in 2023 (18 days) than in 2022 (36 days), but more often than in 2021 (12 days).

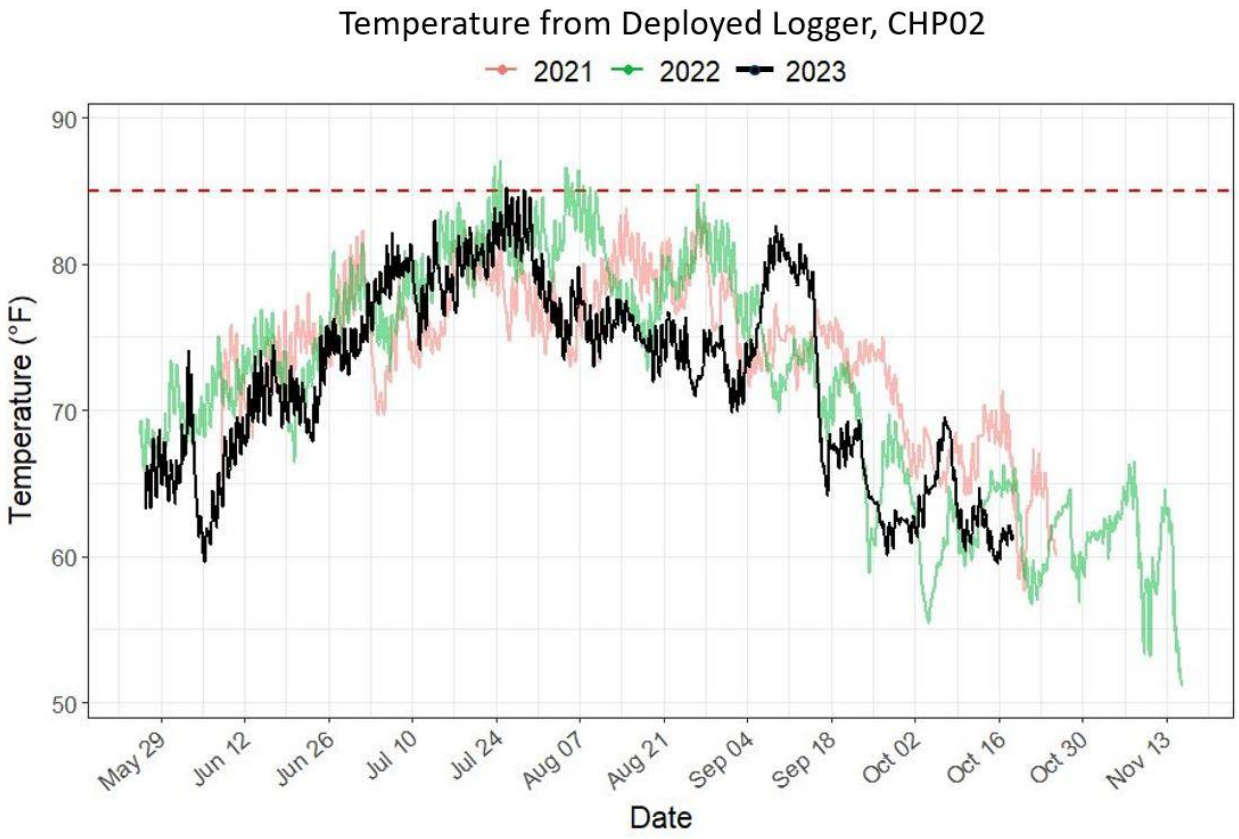


Figure 9. *Water temperature (in °F) in CHP for the years 2021, 2022, and 2023. Data was obtained from a temperature data logger deployed at station CHP02. The dashed red line represents the MassDEP management threshold (85 °F).*

Dissolved Oxygen

Summary Points:

- Bottom-depth DO levels in the Lower Pond regularly fell below the management threshold.
- The interface zone between the Middle and Lower Ponds experienced larger DO swings and more regular drops into low-oxygen stress (<4 mg/L) than other stations.
- Continuous data obtained from CHP02 shows that DO at the pond bottom in this location regularly experienced dips below 2 mg/L (hypoxia) from early July through mid-September, most often at night.
- Temperature and DO exhibit a strong inverse relationship.

Dissolved Oxygen (DO) concentrations were measured in-situ using a YSI Pro DSS handheld multiparameter meter and probe, and passively with a deployed HOBO U26 dissolved oxygen data logger. MassDEP sets a management standard of 6 milligrams per liter (mg/L) minimum concentration for Class SA waters. 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.

DO concentrations remained consistent across the Lower Pond (CHP01-CHP07, CHP10) during the 2023 field season (**Figure 10**). Stations CHP06 (western edge of Lower Pond) and CHP07 (Doctor's Creek) experienced the lowest DO levels out of all stations in this region. The Middle Pond stations (CHPUP & CHPUP2) experienced higher overall DO concentrations relative to the Lower Pond, potentially due to an abundance of submerged aquatic vegetation (SAV) throughout the Middle Pond during 2023. There was not a high degree of variability or stratification in DO concentrations at varying depth. This is likely due to the relatively shallow total depth of CHP and wind-driven mixing. However, the lowest DO concentrations observed in the Lower Pond were often recorded at the deepest depths, nearest the sediment interaction layer.

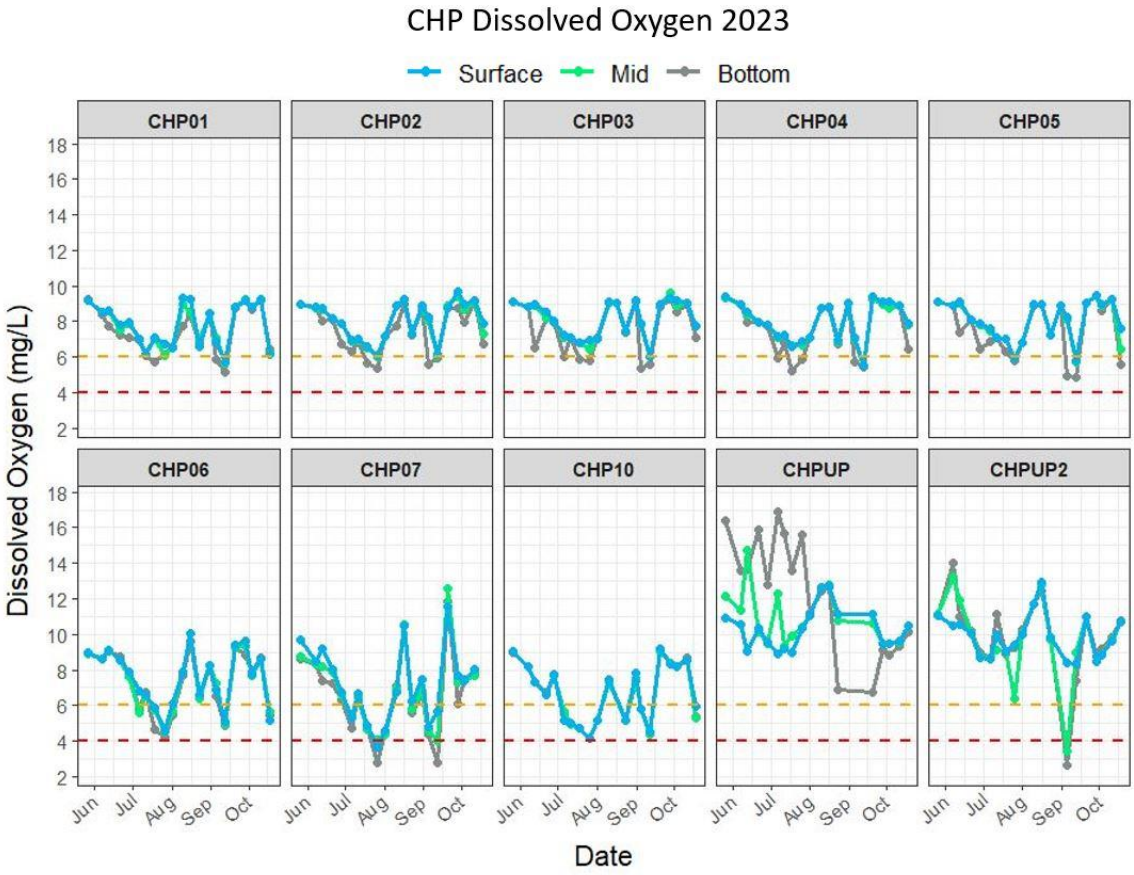


Figure 10. *Dissolved oxygen (DO) in milligrams per liter (mg/L) for Chilmark Pond's 10 monitoring stations during the 2023 field season. Data was measured using a handheld probe for three depths (surface, mid-depth, and bottom. The dashed yellow line represents the 6 mg/L management threshold, while the dashed red line represents when DO was critically low (<4 mg/L).*

Fluctuations in DO concentrations throughout CHP shared an inverse relationship with ambient air temperature, as water's capacity to hold dissolved oxygen diminishes with increasing temperature. All stations experienced DO concentrations below the management threshold (6 mg/L) in July and early September when water temperatures were at their highest (**Figure 10**). Continuous data obtained for station CHP02 show critically low DO levels (<4 mg/L) occurred regularly at the pond bottom between July and September, while periods of hypoxic conditions (<2 mg/L) occurred in July and early September in conjunction with peak temperatures (**Figure 11**). Most periods of hypoxia occurred at night when aquatic plants and photosynthetic organisms are not actively performing photosynthesis.

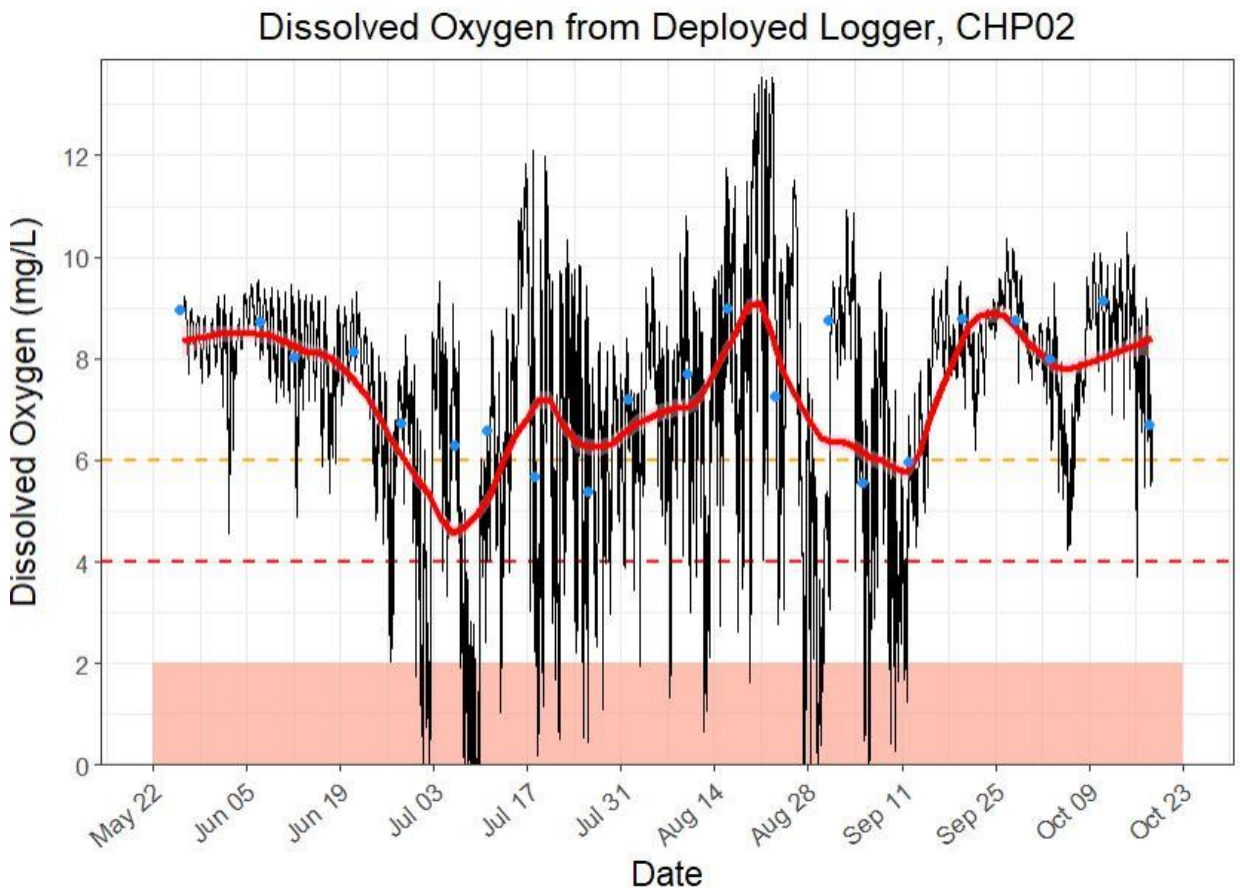


Figure 11. *Dissolved oxygen (DO) measured in milligrams per liter (mg/L) over the course of the 2023 field season. Data was obtained from a DO data logger deployed ~6 inches above the pond bottom at station CHP02. The black line represents the deployed logger's DO readings taken every 30 minutes, while the overlying red line is this data's trend line. The blue dots represent DO measurements taken by a handheld probe during intermittent site visits. The dashed yellow line represents the 6 mg/L management threshold, the dashed red line represents when DO was critically low (<4 mg/L), and the red shaded area at the bottom of the graph represents the hypoxic range of concentrations (< 2 mg/L).*

The dissolved oxygen trends observed in CHP in 2023 closely mirror those seen in both 2021 and 2022 (**Figure 12**). All three years exhibited bottom-depth DO levels in the Lower Pond drop over the course of the summer before rising again in the fall as temperatures cooled. Bottom-depth DO concentrations were consistently higher in the Middle Pond (CHPUP) relative to the Lower Pond during the 2022 and 2023 field seasons, but not during the 2021 field season. Station CHP07, located at the interface of the Lower Pond and Doctor's Creek, displayed the Pond's lowest DO levels across all three years.

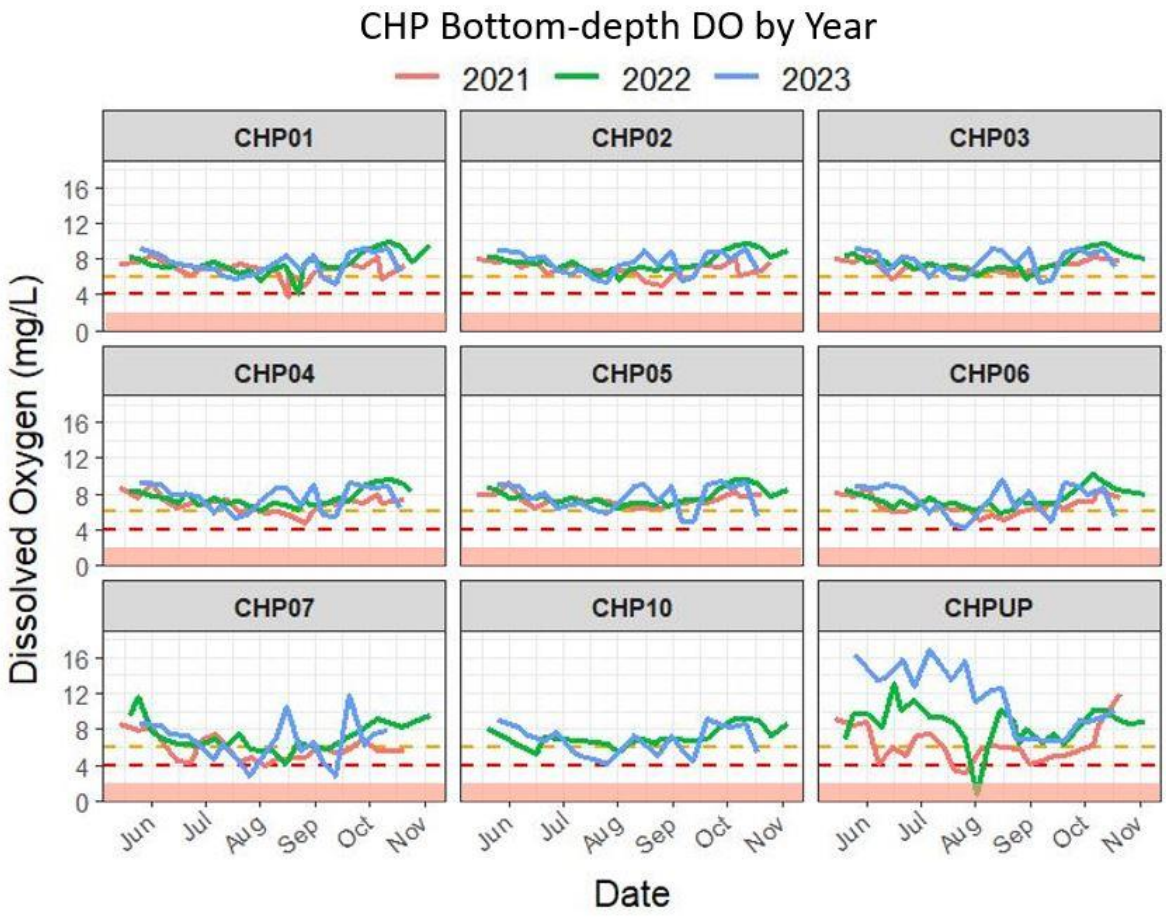


Figure 12. *Bottom-depth dissolved oxygen (DO) levels in milligrams per liter (mg/L) for Chilmark Pond's 9 monitoring stations during the years 2021, 2022, and 2023. Data was measured using a handheld probe. The dashed yellow line represents the 6 mg/L management threshold, the dashed red line indicates when DO levels dropped critically low (<4 mg/L), and the red shaded area represents the hypoxic range of concentrations (<2 mg/L). No 2021 data is available for CHP10 since this station was not established until 2022.*

pH

Summary Points:

- The Lower Pond maintained pH within the target range throughout the 2023 field season.
- The Middle Pond experienced larger pH swings and more variability throughout the water column, often seeing pH levels rise above the target range.
- pH in the Middle Pond has increasingly spent more time above the target range since 2021.

pH, or Potential of Hydrogen, is a measure of acidity in solution. Neutral pH is 7, while any pH above 7 is basic and any pH below 7 is acidic. It's important that ponds maintain a near neutral pH, as overly basic or acidic conditions can have a detrimental effect on ecosystem health. MassDEP has established a pH management range of 6.5 to 8.5 for Class SA waters. pH trends were generally consistent throughout the Lower Pond in 2023, with all stations remaining within the target range for the entirety of the field season (**Figure 13**). Relative to the Lower Pond, the Middle Pond (CHPUP & CHPUP2) and Doctor's

Creek (CHP07) exhibited more variable pH trends and spent more time above the target range. This was especially true of station CHPUP, which saw pH levels remain above 8.5 for most of the season.

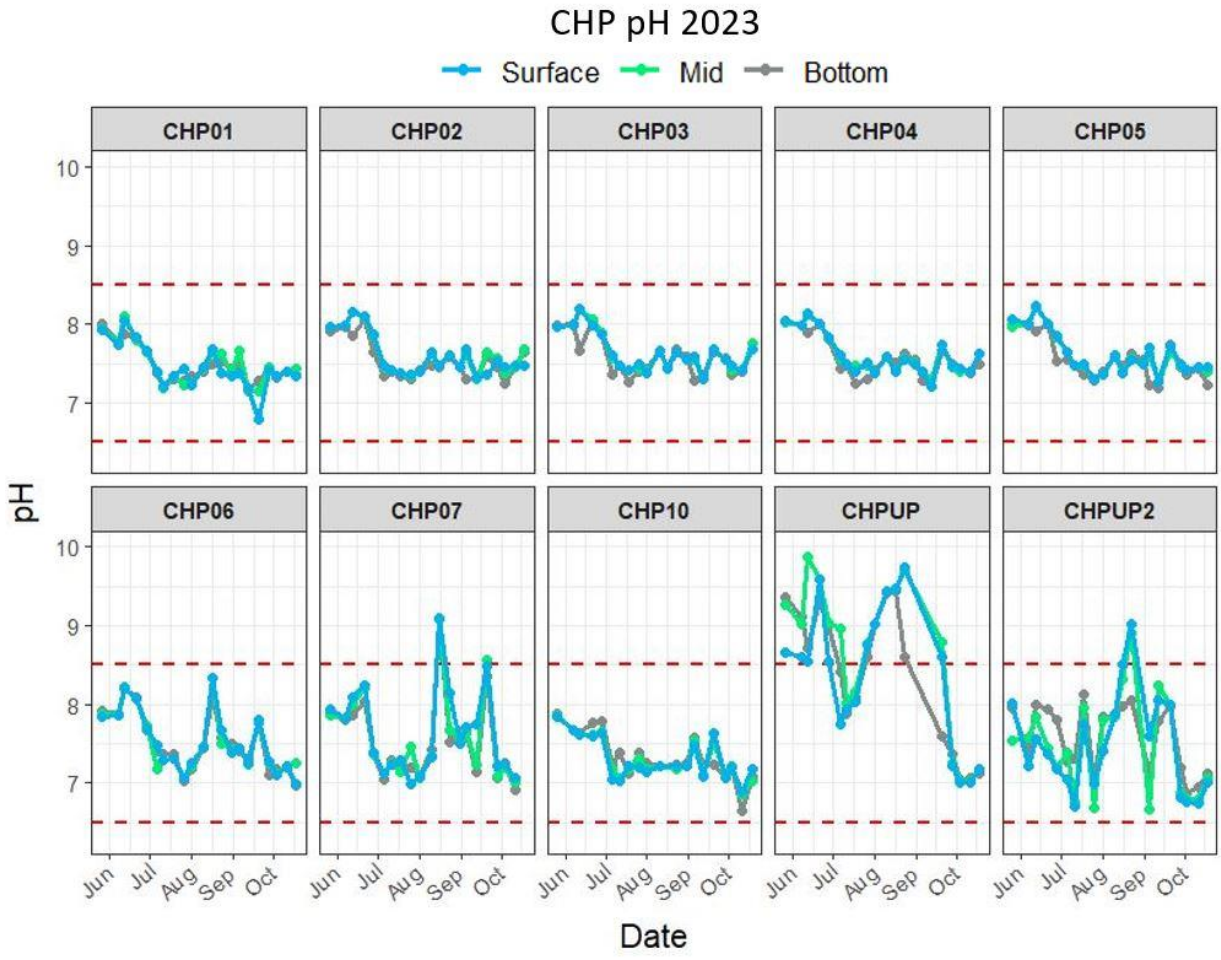


Figure 13. *pH for Chilmark Pond's 10 monitoring stations during the 2023 season. Data was measured using a handheld probe for three depths (surface, mid-depth, and bottom). The dashed red lines indicate the boundaries of the management target range for pH (6.5-8.5).*

The Middle Pond's higher/more basic pH relative to the Lower Pond may be due to its abundance of aquatic vegetation, as photosynthesis can act to raise pH by removing carbon dioxide from the water. The removal of carbon dioxide and subsequent rise in pH in the Middle Pond may have been accelerated in 2023 by the development of a cyanobacteria bloom in August and September, given that cyanobacteria are photosynthetic organisms. The occurrence of this late summer bloom can be seen to coincide with a spike in pH above the management threshold.

During each of GPF's three sampling years on CHP (2021-2023), all stations located in the Lower Pond maintained a near-neutral pH falling within the target range (6.5-8.5) for the duration of the field season (**Figure 14**). Despite the Middle Pond (CHPUP) maintaining healthy pH levels in 2021, it saw a higher degree of pH variability and a greater amount of time spent above the target range in 2022 and 2023. Additionally, 2023 represents the first year that CHP07 (Doctor's Creek) has exhibited pH readings above the 8.5-unit threshold. This trend of rising pH in the Middle Pond and Doctor's Creek over the last two years may be due to a heightened incidence of algal and cyanobacterial growth in this section of

the Pond. Regardless, none of the three comparison years ever saw pH fall below the target range into overly acidic conditions at any monitoring station.

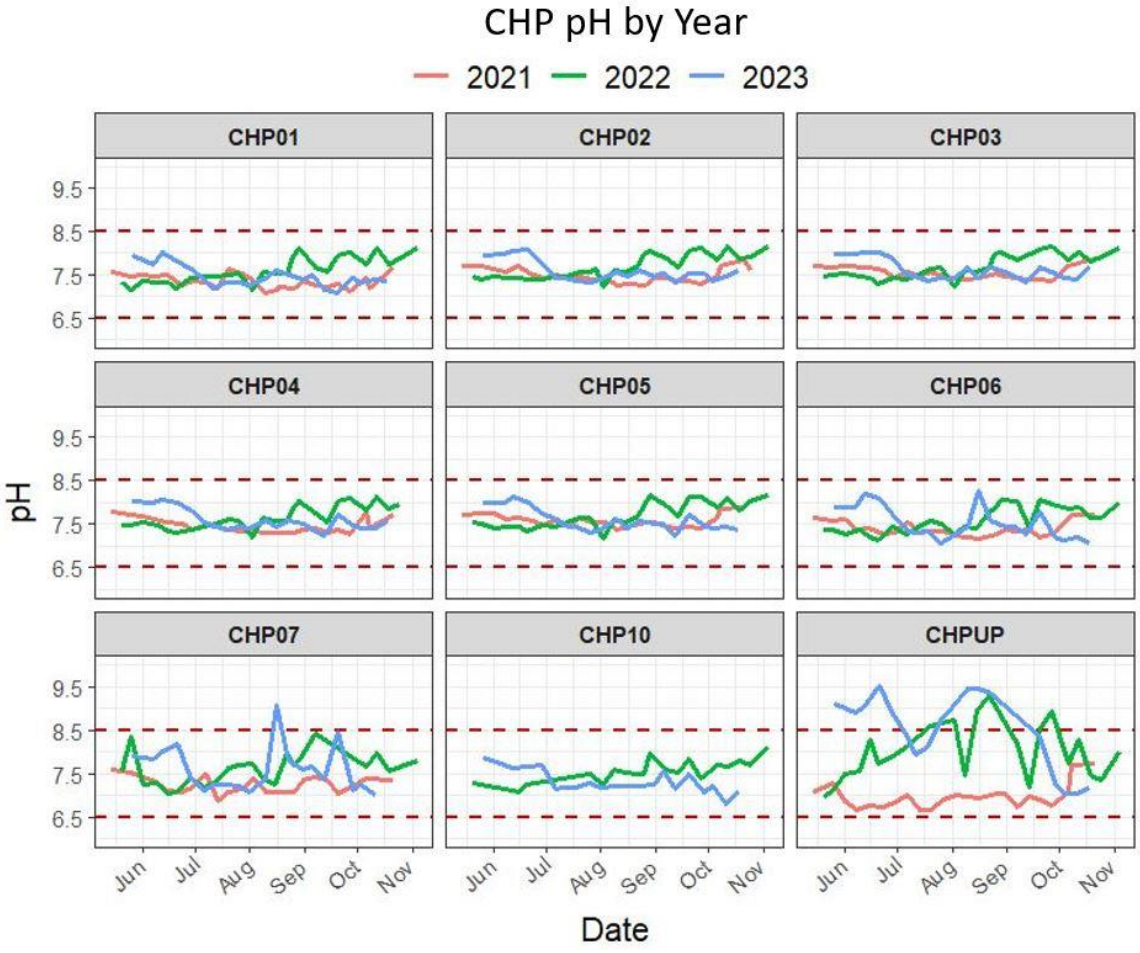


Figure 14. *pH for Chilmark Pond's 10 monitoring stations for the years 2021, 2022, and 2023. The dashed red lines indicate the boundaries of the management target range for pH (6.5-8.5).*

Water Clarity

Summary Points:

- Average visibility through the water column was 2.7 feet, typically falling between 2 and 4 feet.
- Visibility at Chilmark Pond's deeper stations rarely reached the bottom.
- Turbidity was highest in the Lower Pond in June and July, and highest in the Middle Pond in August and September.

Turbidity is commonly used to assess water quality due to the ease with which it can be measured and interpreted. When turbidity is high, the water within a pond will appear murky and prevent light from fully penetrating through the water column. Several factors can cause turbid water conditions, including sediment suspension, organic matter buildup, and algal growth. GPF measured turbidity within CHP in 2023 using a Secchi Disk, a standardized black and white disk that is lowered through the water column

with a measuring tape. The depth at which the disk disappears represents the point at which turbidity restricts light from penetrating any deeper into the water column. CHP's MEP report set a management target for Secchi depth to be either 9.8 feet or to the pond bottom (Howes et al., 2015). Given that all of CHP's monitoring stations are shallower than 9.8 feet, the Pond's acceptable Secchi depth is defined as visibility to the bottom.

Turbidity within CHP was high in 2023, as evidenced by an average Secchi depth of just 2.7 feet. Visibility among the Lower Pond's deepest stations consistently fell several feet short of reaching the pond bottom up until the opening on October 18th (**Figure 15**). While visibility regularly reached the bottom at stations CHP06, CHP07, CHP10, and CHPUP2, this is an artifact of these stations being particularly shallow (<4 feet deep). Station CHPUP in the Middle Pond experienced comparatively lower turbidity than the Lower Pond stations from June through July, but saw a substantial rise in turbidity in August and September during the development of a cyanobacteria bloom. This is the direct opposite trend seen in the Lower Pond, which reached its peak in July before seeing turbidity begin to decline in August. Each basin's respective peak in turbidity coincides with its peak in total chlorophyll concentrations, suggesting that algal growth was a strong driver of overall turbidity increases during 2023.

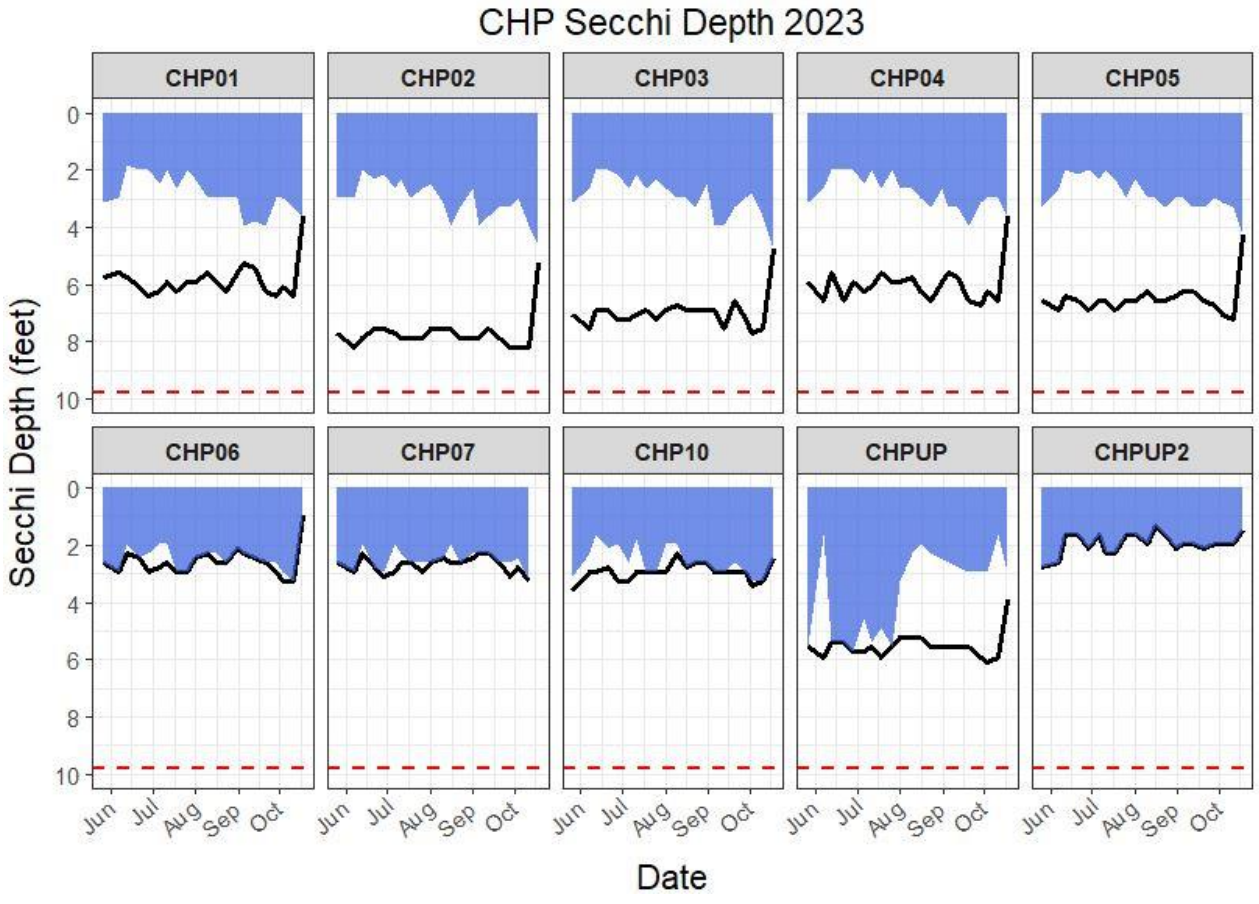


Figure 15. *Secchi depth and total depth in feet for Chilmark Pond's 10 monitoring stations during the 2023 season. Secchi depth is the depth at which a standardized disk disappears, thereby representing visibility into the water column. Total depth at each station is represented by a black line, while secchi depth is represented by the overlying blue shaded area. Any point where secchi depth is equal to bottom depth indicates that visibility was to the bottom. The management target is for secchi depth to either equal total depth or reach 9.8 feet, which is represented by the dashed red line on the graph.*

Turbidity was also measured in 2023 using a YSI multiparameter probe and can be more easily compared across years. These measurements were recorded in Formazin Nephelometric Units (FNU), a unit that measures turbidity based on the degree to which incoming light is scattered by particles present in the water column. CHP's water clarity in 2023 was improved from 2022, but was still worse than that of 2021 (**Figure 16**). All three years experienced a similar level of turbidity through July; however, 2022 saw turbidity spike across the Pond in August in conjunction with a rise in chlorophyll concentrations, particularly at stations CHP07 and CHPUP where a concentrated cyanobacteria bloom had developed. It's likely that turbidity also spiked at CHPUP in August of 2023 during the development of another cyanobacteria bloom, but data is missing from this period. Out of the three years, cyanobacteria and chlorophyll concentrations were lowest in 2021, likely explaining the Pond's reduced turbidity during this year.

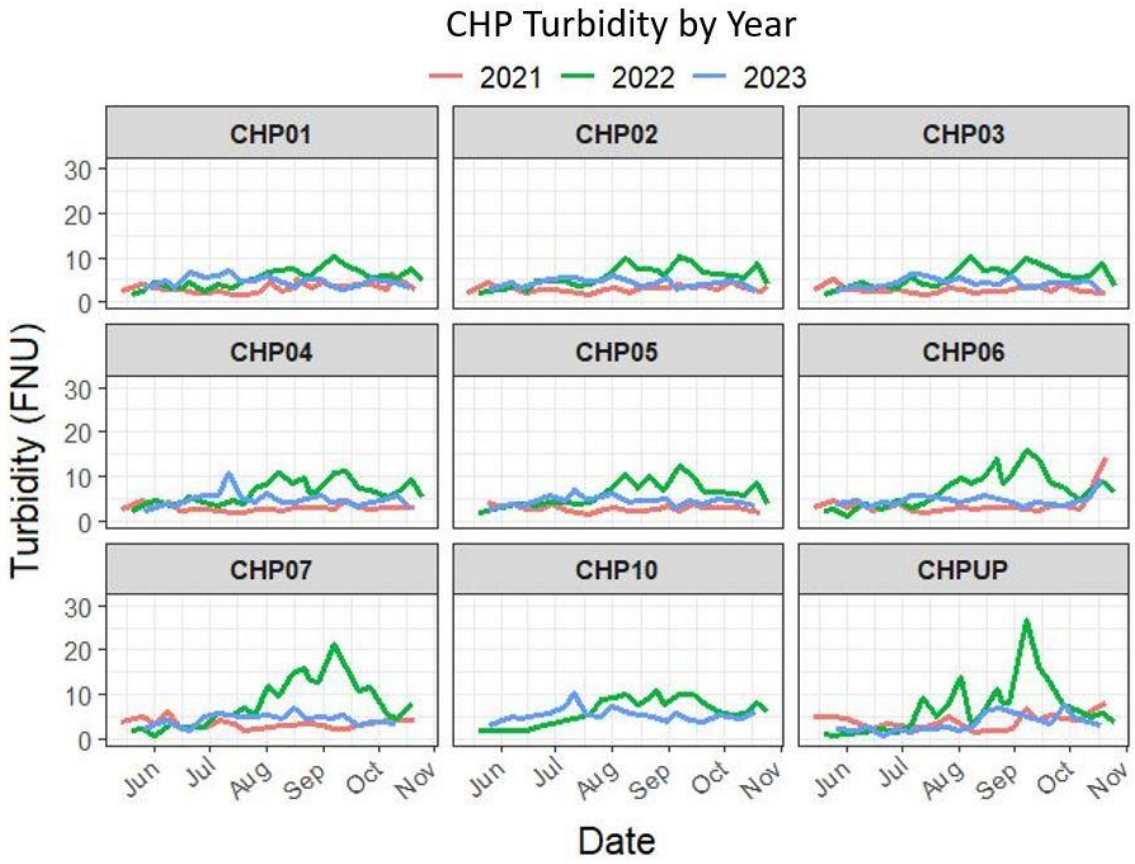


Figure 16. *Average turbidity throughout the entire water column in Formazin Nephelometric Units (FNU) is shown for Chilmark Pond's 9 monitoring stations for the years 2021, 2022, and 2023.*

Nutrients

Summary Points:

- The sentinel station exceeded the 0.5 mg/L management threshold for total nitrogen from June through August.
- Measured total nitrogen concentrations peaked across all monitoring stations on 8/23/23. The highest single day concentration was observed in the Middle Pond (CHPUP).
- Phosphate concentrations were generally higher in the Middle Pond relative to the Lower Pond.

Excessive nutrient inputs into aquatic ecosystems, specifically that of nitrogen and phosphorus, can lead to the development of eutrophic conditions, in which nutrient-fueled algal and phytoplankton growth acts to deplete oxygen reserves and reduce overall ecosystem health. In coastal and brackish water bodies like CHP, nitrogen is most often the primary driver of eutrophication. During the 2023 field season, GPF conducted monthly nutrient sampling at 7 of its normal 10 monitoring stations (CHP01, CHP02, CHP04, CHP05, CHP06, CHP10, and CHPUP) to gain a better understanding of nutrient loading into the CHP system. The Massachusetts Estuaries Project's (MEP) 2015 report on CHP established a total nitrogen (TN) threshold of 0.5 mg/L for the "sentinel station," which encompasses the average TN concentration of stations CHP01-CHP05 (Howes et al., 2015). GPF has excluded station CHP03 from its nutrient sampling program due to its proximity and overall similarity to station CHP05. Therefore, all sentinel station calculations included in this report pertain to the average of stations CHP01, CHP02, CHP04, and CHP05.

TN concentrations were similar across the Lower Pond in 2023, with most stations exceeding the 0.5 mg/L threshold from June through August before seeing concentrations fall back below this threshold in September and October (**Figure 17**). The sentinel station ultimately exceeded the 0.5 mg/L management threshold on three of the five nutrient sampling days conducted in 2023. All monitoring stations exhibited their highest measured TN concentrations on 8/23/23. Contrary to the Lower Pond, station CHPUP in the Middle Pond maintained TN below the management threshold through July before seeing a sharp rise to 1.17 mg/L on 8/23/23, representing the highest TN concentration measured for the entire Pond in 2023. The TN concentrations measured in 2023 were consistently lower than those of 2022 across the Pond, particularly in the late summer and early fall, but slightly higher than those of 2021. This can be seen by the sentinel station exceeding the management threshold less often in 2023 (3 days) than in 2022 (4 days), but more often than in 2021 (2 days).

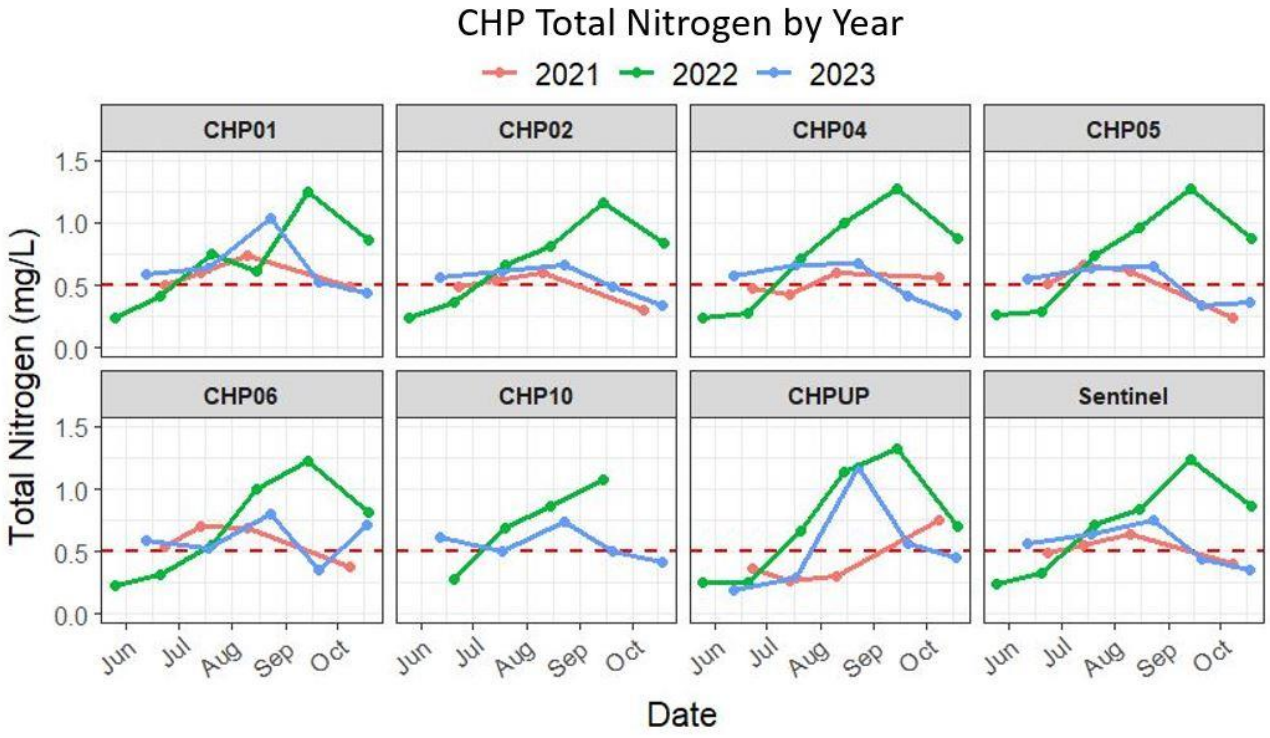


Figure 17. *Total nitrogen in milligrams per liter (mg/L) is shown for CHP's seven nutrient stations and the sentinel station (average of CHP01, CHP02, CHP04, and CHP05) for the years 2021, 2022, and 2023. The dashed red line represents the MEP management threshold (0.5 mg/L).*

Historical TN data for the CHP sentinel station was provided to GPF by the Martha's Vineyard Commission (MVC). Nutrient samples were collected by the MVC and processed by their partner lab at the University of Massachusetts Dartmouth, School for Marine Science and Technology, during the years of 1999, 2004, 2007, 2010, 2015, 2016, 2017, 2018, 2019, and 2020. This data is plotted along with GPF's TN data from 2021-2023 in **Figure 18**. Since 1999, TN concentrations for the sentinel station have consistently exceeded the management threshold, this being the case during 10 of the 13 years for which data is available. The highest measured TN concentration for the sentinel station came in 1999 (1.52 mg/L); measured concentrations have not reached this high of a level since. Following a spike in TN in 2020, concentrations have remained comparatively lower since 2021 despite still exceeding the management threshold.

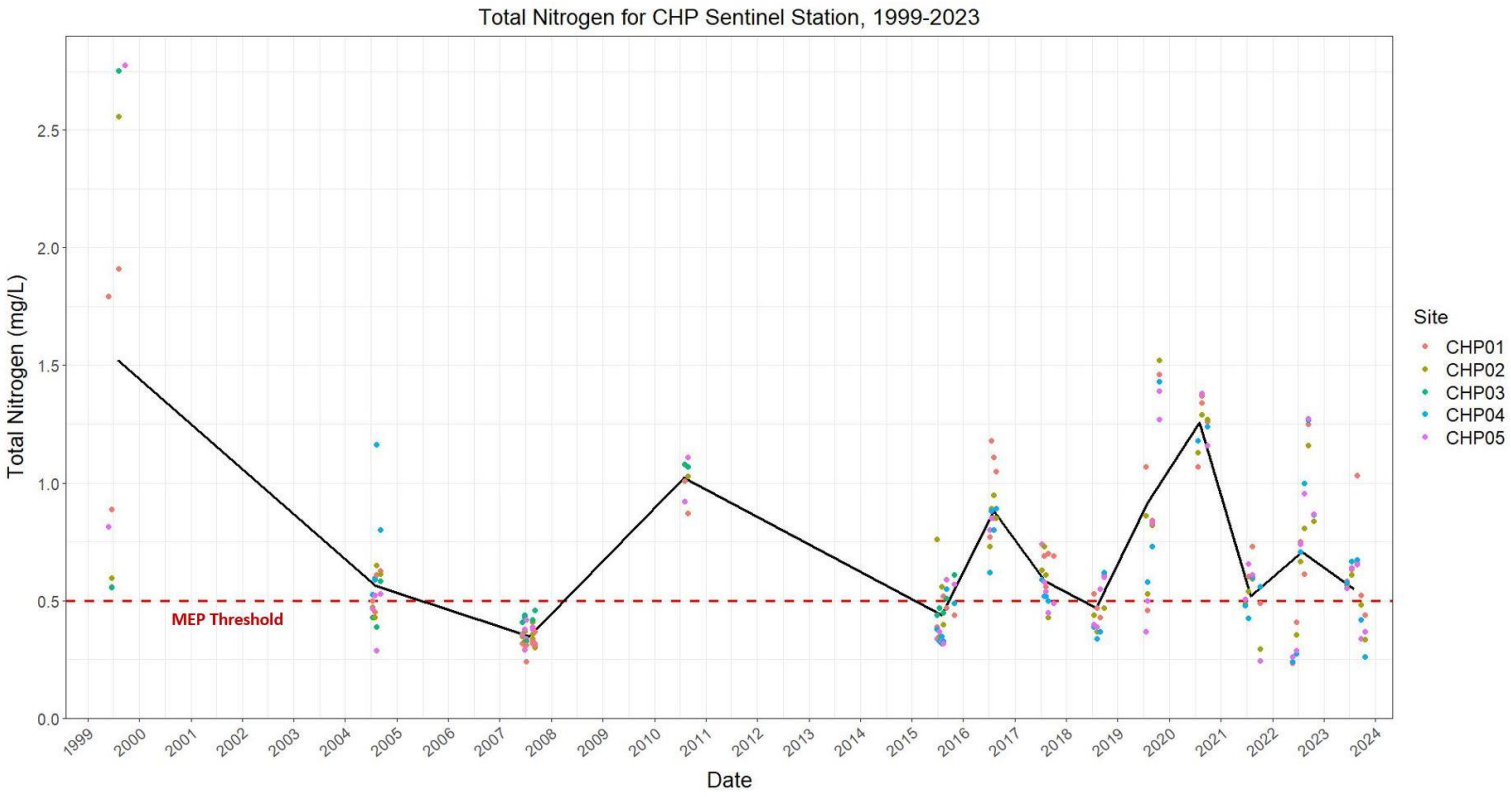


Figure 18. *Total nitrogen in milligrams per liter (mg/L) for the CHP sentinel station (average of stations CHP01-CHP05, represented by black line) for years ranging from 1999 to 2023. Data between 1999 and 2020 was collected and obtained from the Martha's Vineyard Commission. Data from 2021 to 2023 was obtained from Marine Biological Laboratory on behalf of GPF. The sentinel station average from 2021 to 2023 pertains only to stations CHP01, CHP02, CHP04, and CHP05. The dashed red line represents the MEP management threshold (0.5 mg/L).*

Phosphate concentrations within the Lower Pond generally remained at 0.02 mg/L or less throughout the 2023 field season (**Figure 19**). Several of the Lower Pond stations exhibited their highest measured phosphate concentration on the year's final nutrient sampling day on 10/18/23. Station CHPUP in the Middle Pond exhibited comparatively higher phosphate concentrations in August and September relative to all other stations in 2023. Pond-wide phosphate concentrations remained similar between 2021 and 2023 apart from a universal spike experienced across most monitoring stations in September of 2022, with this spike being especially pronounced at station CHPUP.

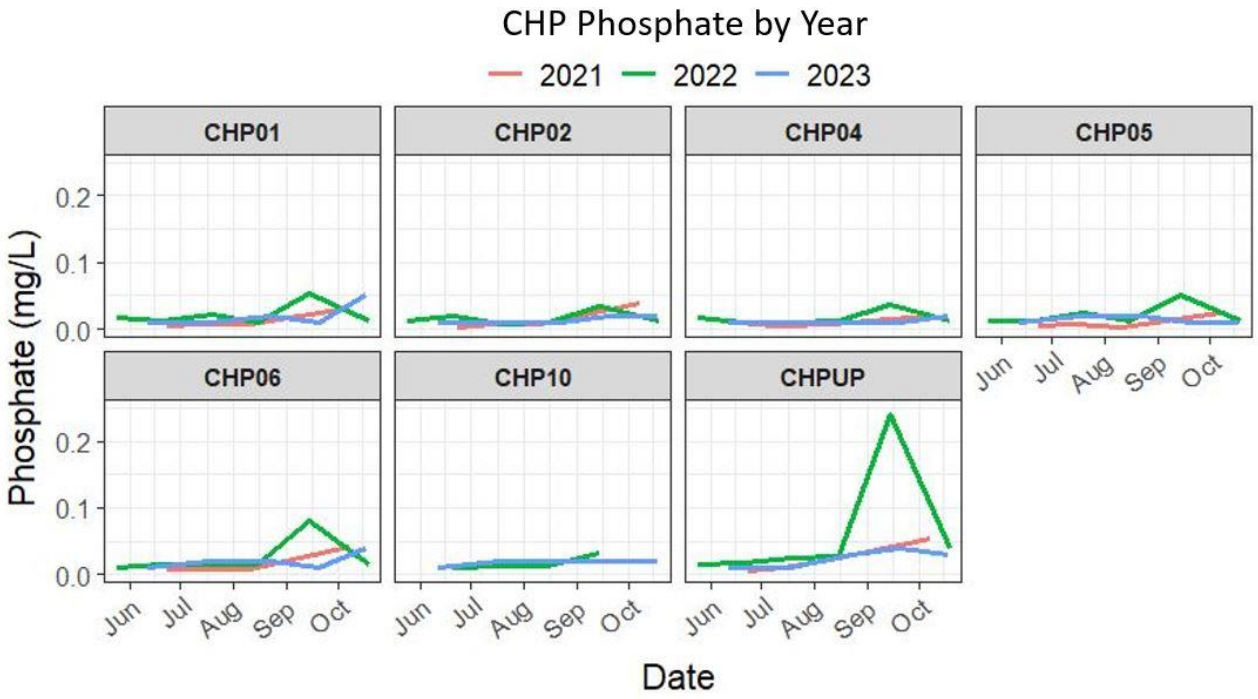


Figure 19. *Phosphate in milligrams per liter (mg/L) is shown for CHP's seven nutrient stations for the years 2021, 2022, and 2023.*

Chlorophyll

Summary Points:

- Chlorophyll concentrations in the Lower Pond peaked in June, while concentrations in the Middle Pond and Doctor's Creek peaked in September.
- Chlorophyll concentrations were highest in the upper portions of the CHP system, but consistently exceeded the management threshold across all monitoring stations.

Chlorophyll is commonly used as a measure of algal growth, with higher concentrations indicating greater phytoplanktonic and algal activity within the water column. Phytoplankton and algae, like all primary producers, respond rapidly to changes in light availability, temperature, and nutrient availability within the water column. As any number of these factors increase, so does the potential for primary producers to grow at an accelerated rate, resulting in an algal "bloom". In general, higher densities of phytoplankton/algae support the growth of bacteria and other grazing organisms. As such, chlorophyll is often used as an indication of overall ecosystem balance and health.

GPF monitored total chlorophyll concentrations in CHP on a weekly basis as part of the MV CYANO$_{TM}$ program. Estimates of total chlorophyll were derived via analysis of surface samples collected in the field and measured the same day using a bbe Moldaenke FluoroProbe, a spectral fluorometer that can estimate phytoplankton abundance through fluorescence of pigments unique to individual algal groups. The Massachusetts Estuaries Project's (MEP) 2015 report on CHP established a chlorophyll management target of <10 micrograms per liter (ug/L) for the Pond (Howes et al., 2015).

CHP's Upper and Lower Systems experienced opposite chlorophyll trends in 2023 (**Figure 20**). While the Lower Pond reached peak chlorophyll concentrations in June before seeing concentrations level off

for the rest of the summer, the Upper System (Middle Pond and Doctor's Creek) didn't see a rise in chlorophyll concentrations until August, ultimately reaching a peak in early September. Out of all the Lower Pond stations, only CHP04 saw a spike in chlorophyll in early September when the Upper System was at its peak. Station CHP06, located at the interface between the two systems, appears to have captured both system's respective rises in chlorophyll, albeit to a reduced degree. Peak chlorophyll concentrations were ultimately higher in the Upper System relative to the Lower System in accordance with the development of a late summer cyanobacteria bloom (see "Phytoplankton and Cyanobacteria"). Regardless, total chlorophyll concentrations across all stations generally exceeded the management threshold (10 ug/L) throughout the field season.

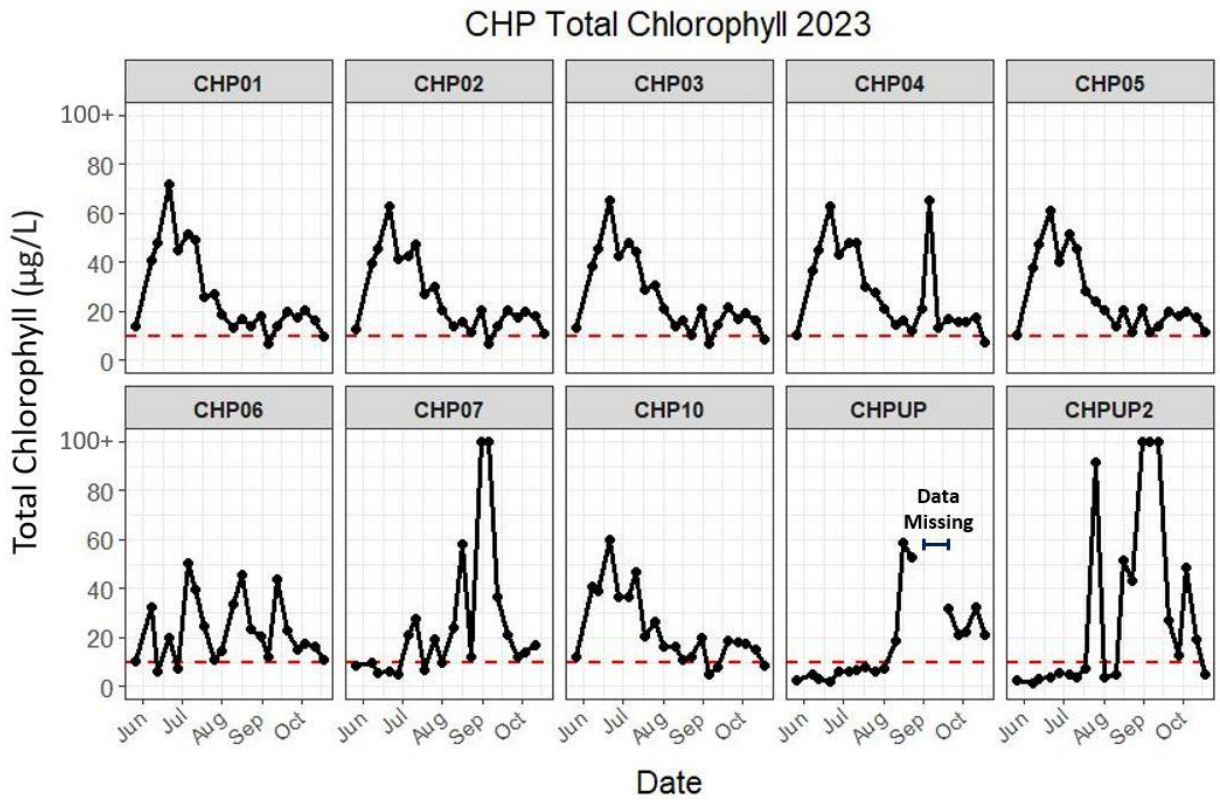


Figure 20. *Total chlorophyll in micrograms per liter (µg/L) at Chilmark Pond's 10 monitoring stations during the 2023 season. Samples were taken at the surface and measurements were obtained via a fluorometer. The dashed red line represents the MEP management threshold (10 ug/L).*

Phytoplankton and Cyanobacteria

Summary Points:

- Cyanobacteria concentrations among the Lower Pond stations generally remained in the MV CYANO$_{TM}$'s "alert" category.
- The Middle Pond and Doctor's Creek experienced a cyanobacteria bloom spanning late August through mid-September.
- Toxin analysis revealed the presence of Microcystins in the Middle Pond at levels below the EPA's recreational water standards on 8/14/23.

In addition to estimating total chlorophyll concentrations, GPF's weekly fluorometry analysis of samples collected from CHP also provide estimated concentrations of individual phytoplankton classes present within the water column. The following four phytoplankton classes were routinely monitored on CHP during 2023 as part of the MY CYANO program: cyanobacteria, green algae, cryptophyta, and diatoms. CHP's two systems housed different phytoplankton community structures in 2023 (**Figure 21**), potentially due to the differing salinity regimes present in either system. The Lower Pond was mostly dominated by green algae, especially in the early summer when green algae concentrations consistently exceeded 60 ug/L across the basin. Alternatively, following a short-lived rise in diatoms concentrated near station CHPUP2 in July, the Middle Pond had transitioned to a cyanobacteria-dominated system by the start of August.

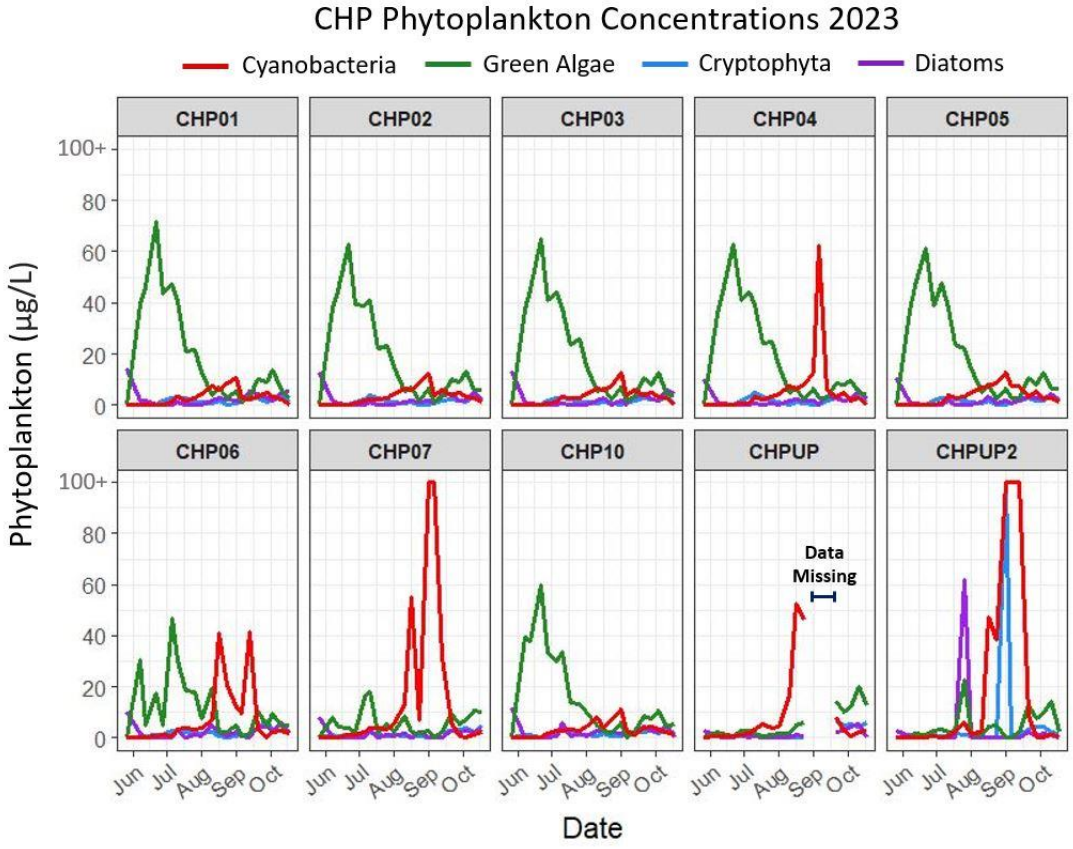


Figure 21. *Phytoplankton concentrations in micrograms per liter (ug/L) for Chilmark Pond's 10 monitoring stations are shown for 2023. Samples were taken at the surface and measurements were obtained via a fluorometer. Hazardous cyanobacteria conditions at station CHPUP prevented data from being collected in late August and early September.*

Out of the various types of phytoplankton that exist within the island's coastal ponds, cyanobacteria are of particular concern as certain species can produce toxins harmful to humans and animals. Cyanobacteria concentrations in the Middle Pond (CHPUP & CHPUP2) and Doctor's Creek (CHP07) reached "bloom advisory" status, as defined by the MV CYANO$_{TM}$ program, beginning in mid-August (**Figure 22,** refer to **Figure 24** for MV CYANO$_{TM}$ key). This bloom remained present through mid-September before dying back as temperatures began to cool. At the interface between the Lower Pond and Doctor's Creek (CHP06), cyanobacteria concentrations were elevated but not high enough to qualify as a bloom. Excluding station CHP04, which experienced bloom-level concentrations on September 5th, cyanobacteria concentrations in the Lower Pond generally remained within the MV CYANO$_{TM}$ program's "cyanobacteria alert" category.

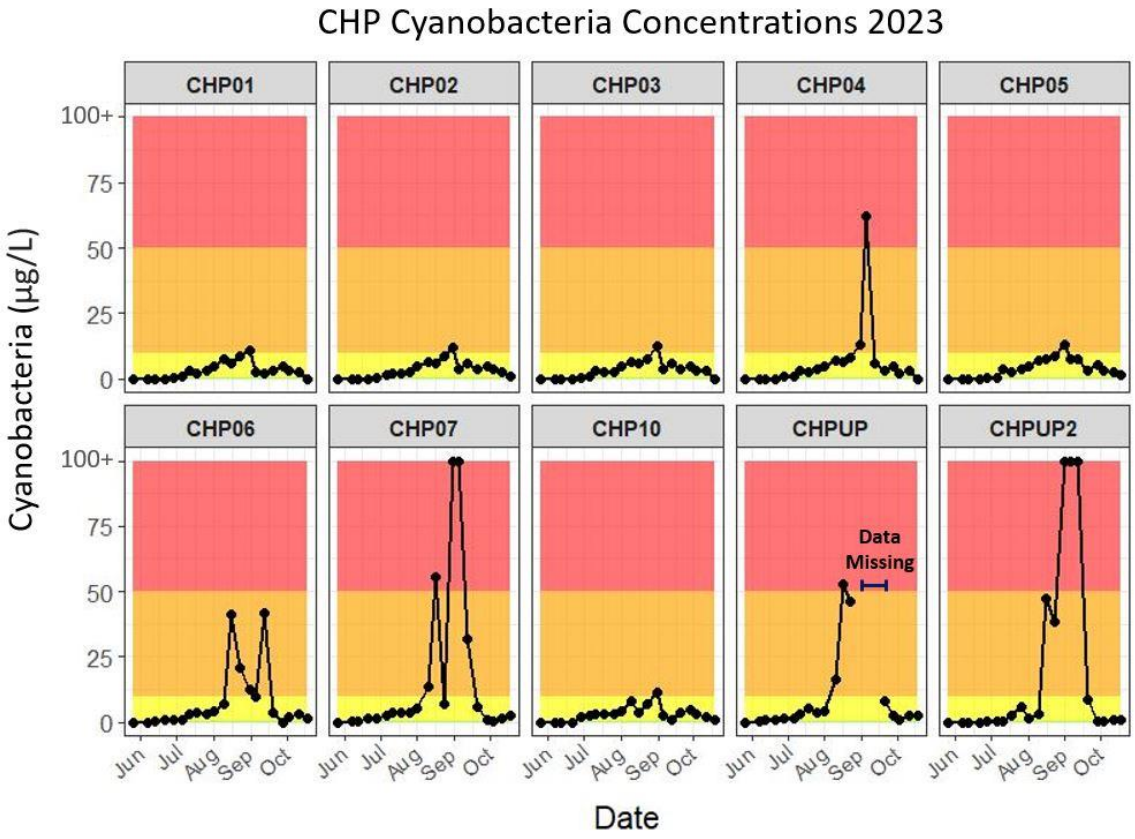


Figure 22. *Cyanobacteria concentrations in micrograms per liter (µg/L) at Chilmark Pond's 10 monitoring stations during the 2023 season. Samples were taken at the surface and measurements were obtained via a fluorometer. Background colors pertain to the color-coded risk matrix used by the MV CYANO$_{TM}$ monitoring program (see* ***Figure 24****). Hazardous cyanobacteria conditions at station CHPUP prevented data from being collected in late August and early September.*

Cyanobacteria concentrations in the Lower Pond's main basin (CHP01-CHP05, CHP10) remained similar between 2021 and 2023, with concentrations generally remaining in the MV CYANO$_{TM}$ program's yellow "cyanobacteria alert" category across all three years (**Figure 23**). Apart from a one-day spike seen at station CHP04 in 2023, only 2022 saw cyanobacteria concentrations in the Lower Pond enter "bloom watch" status thanks to a universal rise in September. Cyanobacteria concentrations in the Middle Pond (CHPUP & CHPUP2) and Doctor's Creek (CHP07) reached "bloom advisory" status in both 2022 and 2023, representing a substantial increase in cyanobacteria in this region of the Pond relative to 2021. Bloom concentrations in the Middle System were ultimately higher in 2022 than in

2023, in turn leading to higher cyanobacteria concentrations at the interface zone (CHP06) in 2022 as well.

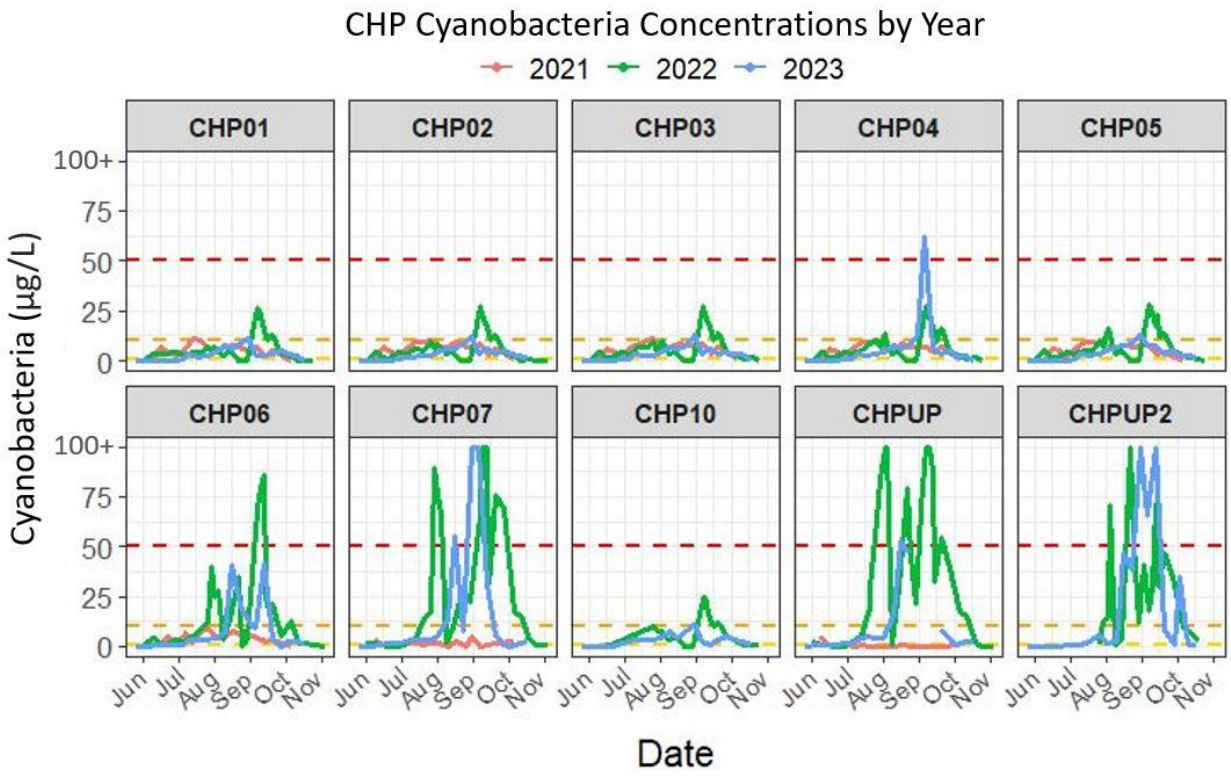


Figure 23. *Cyanobacteria concentrations in micrograms per liter (µg/L) at Chilmark Pond's 10 monitoring stations for the years 2021, 2022, and 2023. Samples were taken at the surface and measurements were obtained via a fluorometer. Dashed lines pertain to the color-coded risk matrix used by the MV CYANO™ monitoring program (see* ***Figure 24****). No 2021 data is available for stations CHP10 and CHPUP2 since these stations were not established until 2022.*

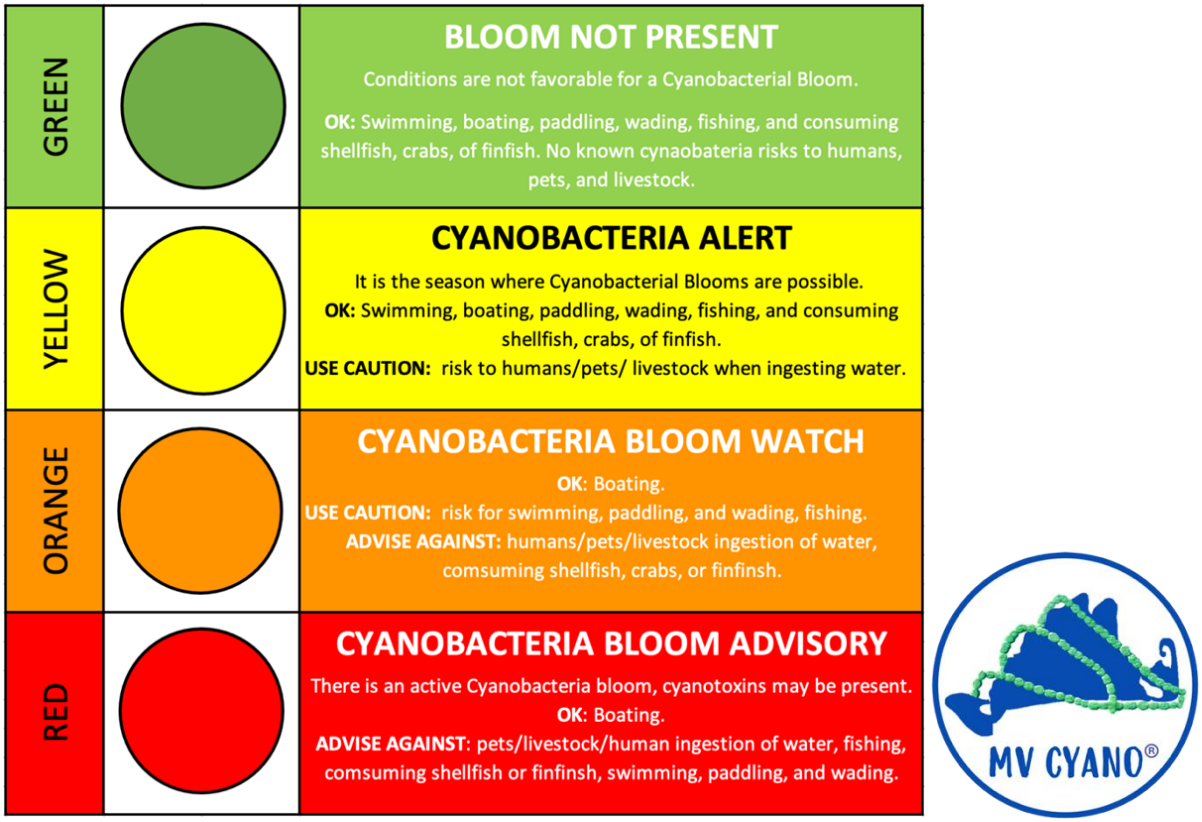


Figure 24. *The color-coded messaging & logo used by the MV CYANO™ monitoring program.*

Discussion

Chilmark Pond (CHP) exhibited reduced water quality and signs of ecosystem impairment during the 2023 field season, continuing similar trend observed in the Pond in 2021 and 2022. Chlorophyll concentrations generally exceeded the MEP management threshold (10 ug/L) across all monitoring stations, indicating an excessive level of micro and macroscopic plant growth within the water column. This led to a significant reduction in water clarity across CHP, as evidenced by both the upper and lower systems' respective peaks in chlorophyll coinciding with their periods of lowest water clarity. As this plant matter died off and subsequently decomposed, dissolved oxygen (DO) at the pond bottom was likely depleted by this process. This was particularly true in the Lower Pond, where DO concentrations regularly dropped into the hypoxic range (<2 mg/L) during the hottest periods of the summer when water's capacity to hold oxygen was most diminished. Alternatively, the Middle Pond generally maintained sufficient bottom-depth DO throughout the season, potentially due to its abundance of submerged aquatic vegetation (SAV) and the inflow of cooler freshwater helping to mitigate oxygen depletion.

For the second consecutive year, CHP's upper system experienced a concentrated cyanobacteria bloom during the late summer, present from the Middle Pond eastward into Doctor's Creek and out into the far western end of the Lower Pond. Apart from a brief spike into bloom-level concentrations in the Lower Pond's southeastern corner (CHP04) on 9/5/23, cyanobacteria concentrations generally remained low throughout the Lower Pond in 2023, with green algae instead comprising the lower system's dominant phytoplankton class. The different phytoplankton assemblages present in either system likely owes in

part to their differing salinity regimes, with the upper system housing a more freshwater environment relative to the more brackish lower system. Most research suggests that high salt concentrations can act to stress cyanobacteria and limit their growth, which may explain the prevalence of cyanobacteria in the comparatively fresher water of the upper system.

While the Lower Pond consistently maintained pH within the MassDEP target zone for class SA water (6.5-8.5) throughout the field season, the upper system periodically saw pH rise above 8.5 into excessively basic conditions. This could owe to the Middle Pond's abundance of SAV, as photosynthesis can act to raise pH by removing carbon dioxide from the water column. Given that cyanobacteria are photosynthetic organisms, the removal of carbon dioxide and subsequent rise in pH may also have been attenuated by the upper system's late summer bloom.

Total nitrogen (TN) concentrations exceeded the MEP management threshold (0.5 mg/L) from June through August across most monitoring stations, before falling below the threshold in September when a substantial portion of this nitrogen had presumably been consumed by phytoplankton and aquatic plants. These elevated nutrient concentrations suggest that excessive nutrient loading (i.e. eutrophication) into CHP likely fueled much of the abundant phytoplankton growth, heightened turbidity, and diminished DO levels observed in the Pond in 2023. Excess nutrients are primarily added to aquatic ecosystems as a result of human development, often through septic systems, agriculture, and fertilizers.

GPF monitoring in 2024 will continue its data collection in CHP and expand its regular water quality monitoring program to include a sampling site at the Upper Pond (Lucy Vincent Pond). It will also expand its collection of continuous data to include both Middle and Upper Ponds. Additional investigative sampling of groundwater nutrients within the Upper and Middle Pond regions will be completed, as well as exploratory sampling within the tributary streams entering the Upper and Middle Ponds, with partners at the Marine Biological Laboratory.

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Appendix

Summary of Metrics Explanation

Introduction to the Summary of Metrics Index

The "Summary of Metrics" health index was first developed by the Great Pond Foundation (GPF) in early 2024 as a means of visually summarizing the water quality data collected through its ecosystem monitoring program in simple terms. GPF regularly collected data on the following five coastal ponds during the 2023 summer season: Chilmark Pond, Crackatuxet Pond, Edgartown Great Pond, Tisbury Great Pond, and Watcha Pond. As such, the Summary of Metrics grading system was first applied to the 2023 water quality data collected for each of these ponds. It should be noted that separate analyses were performed for Chilmark Lower Pond (stations CHP01-CHP07, CHP10) and Chilmark Middle Pond (stations CHPUP & CHPUP2).

Assigning Grades to Metrics

The index works by assigning one of the following three grades to each water quality metric measured for a specific pond ecosystem: "Healthy," "Intermediate," or "Impaired". This is done by comparing data collected by GPF to management thresholds set by two primary bodies of work. These include the Massachusetts Department of Environmental Protection's (MassDEP) MA Surface Water Quality Standards, 314 CMR 4 for "Class SA" waters (MassDEP, 2021), to which all Martha's Vineyard ponds belong, as well as the Massachusetts Estuaries Project's (MEP) reports on Chilmark Pond, Edgartown Great Pond, and Tisbury Great Pond (Howes et al., 2008; Howes et al., 2013; Howes et al., 2015), all of which establish the same management thresholds. The management thresholds used by GPF are summarized below in **Table A1**.

Table A1. The management thresholds used by GPF to assess the health of water quality metrics.

Water Quality Metric	Management Threshold	Establishing Work
Chlorophyll	< 10 ug/L	MEP Reports
Dissolved Oxygen	> 6 mg/L	MassDEP Class SA Waters
pH	6.5-8.5	MassDEP Class SA Waters
Total Nitrogen	< 0.5 mg/L	MEP Reports
Water Clarity	$\geq$ 3 meters (or to bottom)	MEP Reports
Water Temperature	< 80 °F	MassDEP Class SA Waters

Following a thorough review of the water quality data collected across all five ponds in 2023, GPF established a set of criteria for assigning grades to individual water quality metrics (see **Table A2**). Grades are assigned to metrics based on the percentage of total measurements falling within a given metric's management target range. For example, in order for a pond to receive a "Healthy" grade in relation to chlorophyll, at least 90% of all chlorophyll measurements taken by GPF during the summer season would have to fall within the management target range (i.e. be less than 10 ug/L in concentration). Alternatively, if 65% or less of chlorophyll measurements fell within the target range, chlorophyll would receive an "Impaired" grade, while any percentage between 65% and 90% would warrant an "Intermediate" grade.

Table A2. GPF's criteria for assigning grades to individual water quality metrics. Percent values refer to the percentage of total measurements falling within the management target range.

Water Quality Metric	Healthy	Intermediate	Impaired
Chlorophyll	≥ 90%	65.01-89.99%	≤ 65%
Dissolved Oxygen (Bottom-depth)	≥ 90%	70.01-89.99%	≤ 70%
pH	≥ 90%	65.01-89.99%	≤ 65%
Water Temperature	≥ 90%	65.01-89.99%	≤ 65%
Total Nitrogen	≥ 90%	65.01-89.99%	≤ 65%
Water Clarity	≥ 75%	65.01-74.99%	≤ 65%

Cyanobacteria Grading

GPF has also included cyanobacteria in its Summary of Metrics health index; however, a different method of assigning grades is used for cyanobacteria concentrations relative to all other water quality metrics. The cyanobacteria criteria used in the index was modeled after the cyanobacteria risk assessment standards used by the MV CYANO$_{TM}$ program, a collaborative initiative between GPF and the Island Boards of Health that monitors cyanobacteria in various ponds across Martha's Vineyard (Great Pond Foundation, 2024).

In order for a pond to receive a "Healthy" grade for cyanobacteria, concentrations must remain within the program's "bloom not present" category for the duration of the summer. Alternatively, if any sampling station on a given pond enters the program's "cyanobacteria alert" and/or "bloom watch" categories during the summer, an "Intermediate" grade is automatically assigned to the pond. Similarly, if any sampling station enters the program's "bloom advisory" category during the summer, an "Impaired" grade is automatically assigned to the pond.

Final Product – Summary Figure

Once grades have been assigned to each water quality metric measured for a given pond, these grades are incorporated into a Summary of Metrics figure to visually convey a pond's general ecosystem health during a particular summer season. "Healthy" grades are designated in green, "Intermediate" grades are designated in yellow, and "Impaired" grades are designated in red. GPF's Summary of Metrics figure for Chilmark Pond during the 2023 summer season is shown below in **Figure A1** as an example.

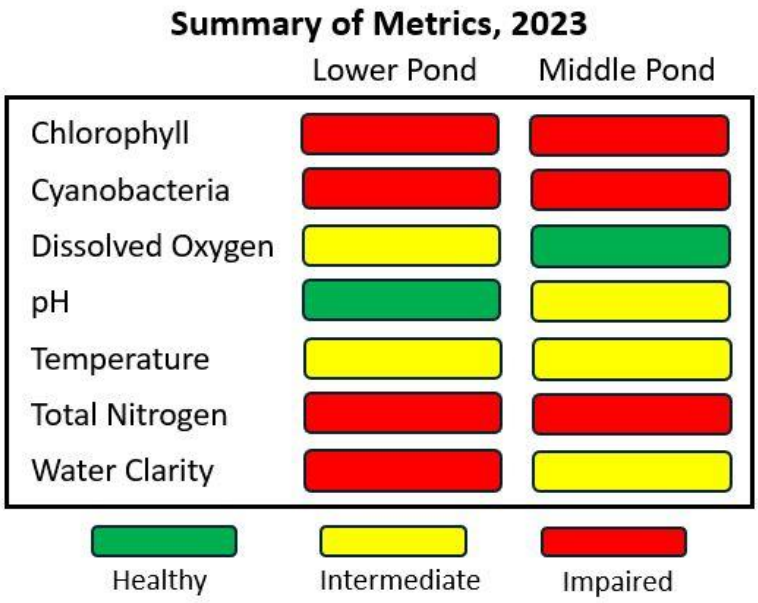

Figure A1. *Chilmark Pond's Summary of Metrics figure for the 2023 summer season. Separate grades were assigned to the Lower and Middle Ponds, respectively.*

Data Used in Index

GPF opted to use continuous readings obtained from its stationary logger at station CHP02 for all temperature and dissolved oxygen analyses of the Lower Pond. This was done under the assumption that continuous readings logged every 30 minutes throughout the course of the day are more representative than handheld probe readings logged once every week. Alternatively, all temperature and dissolved oxygen analyses of the Middle Pond were performed using data logged on a weekly basis using a YSI multiparameter probe, as GPF did not operate a continuous logger in the Middle Pond in 2023. All pH and water clarity analyses performed for both ponds were done using data collected on a weekly basis using a YSI multiparameter probe and Secchi disk, respectively. All chlorophyll and cyanobacteria analyses were performed using data obtained on a biweekly basis using a bbe Moldaenke FluoroProbe. Finally, all total nitrogen analyses were performed using data obtained from nutrient samples collected on 9/20/23 and subsequently processed at Marine Biological Laboratory in Woods Hole, MA.

Selective Grading

In rare instances, GPF may deem that the grade assigned to an individual water quality metric through the Summary of Metrics index isn't truly representative of the metric's health during the previous summer season. Under these circumstances, GPF may selectively choose to assign a different grade using additional data and observations to more accurately grade the metric.

Selective grading was only applied once during GPF's Summary of Metrics analysis of its 2023 CHP field data. This involved the changing of Chilmark Middle Pond's water temperature grade from "Healthy" to "Intermediate". One of the Middle Pond's two sampling stations (CHPUP2) is located in the Pond's northwest corner at the mouth of Fulling Mill Brook, where water temperatures are consistently cooler than the main body of the Pond due to a steady inflow of cool stream water. The

inclusion of data from this sampling station into the Summary of Metrics analysis therefore resulted in a "Healthy" grade being assigned to water temperature, even though temperatures were much warmer at the sampling station located in the center of the Middle Pond. This prompted GPF to assign a new grade of "Intermediate" in accordance with the temperature data collected in the center of the Pond, as this was assumed to be more representative of the Middle Pond as a whole.

Chilmark Pond Site Visits in 2023

Table A3.

Dates of Chilmark Pond Site Visits: 2023					
May	**June**	**July**	**August**	**September**	**October**
5/26	6/7	7/6	8/1	9/5	10/3
	6/12*	7/11	8/10	9/12	10/11
	6/21	7/18*	8/16	9/20*	10/18*
	6/28	7/26	8/23*	9/28	
			8/31		

*Nutrient samples collected