East Hampton Town Trustees 2024 Water Quality Study, Final Report

by

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Executive Summary

This study was undertaken from May through October of 2024 for the East Hampton Town Trustees to assess water quality, harmful algal blooms, pathogenic bacteria, and sediments in the marine and freshwater bodies of Napeague Harbor, Acabonac Harbor, Hog Creek, Three Mile Harbor, Northwest Creek, Swan Pond, Pond Lane, Fresh Pond, Hook Pond, Georgica Pond, Wainscott Pond, and Fort Pond. The study also included continuous monitoring and/or surface mapping of Three Mile Harbor and Georgica Pond because of harmful algal blooms and/or low dissolved oxygen conditions at these sites in the past. During 2024, most East Hampton Town Trustees waters were often of a high quality. Fecal coliform bacteria levels across marine and freshwater sites varied throughout the spring and summer, although excursions beyond NYSDEC shellfishing recommendations were observed at multiple sites in Napeague Harbor, Acabonac Harbor, Hog Creek, Three Mile Harbor, Northwest Harbor, and Georgica Pond. In addition, levels of *Enterococcus* exceeded levels recommended for swimming by NYSDOH in both systems on occasion in 2024. Microbial source tracking of fecal bacteria found elevated levels of bird fecal bacteria closer inland in Hog Creek but lower levels further away. Fecal bacteria within Hog Creek were primarily derived from dogs and small mammals. Bird fecal bacteria had a high abundance at Hog creek as well. Human fecal bacteria were found at both Hog Creek sites. Chlorophyll-*a* levels were usually within a healthy range for most sites although 6 of 15 sites displayed levels above guideline values on at least one occasion during late summer or the beginning of fall. *Alexandrium* bloom level was exceeded only in Three Mile Harbor. *Dinophysis* bloom levels were exceeded in Three Mile Harbor and Hog Creek. Nevertheless, no sites in Napeague Harbor, Three Mile Harbor, Northwest Creek, Acabonac Harbor, or Hog Creek experienced *Margalefidinium* bloom levels exceeding the harmful threshold in the summer and fall. Measurements of total nitrogen across all marine sites demonstrated that all 15 marine locations sampled exceeded the Peconic Estuary Program's recommended value of 0.4 mg N/L.

East Hampton Town's freshwater bodies monitored in 2024 displayed a mix of good and poor water quality. Pond Lane, Wainscott Pond, Georgica Pond, and Fort Pond experienced blue-green algae blooms at levels that exceeded the NYSDEC threshold. Wainscott Pond was the most impacted system, with every sample exceeding bloom level and mean intensity being nearly an

order of magnitude greater than the NYSDEC threshold with the toxin microcystin chronically present but at levels below the EPA guideline for recreation. An intensive temporal assessment of Georgica Pond before and after the opening of the cut revealed a dramatic increase in salinity. Collectively, this study revealed regions of East Hampton with excellent water quality, as well as regions requiring further study, monitoring, and remediation.

1. Background

Coastal marine ecosystems are amongst the most ecologically and economically productive areas on the planet, providing an estimated US$20 trillion in annual resources or about 43% of the global ecosystem goods and services (Costanza et al., 1997). Approximately 40% of the world's population lives within 100 km of a coastline, making these regions subject to a suite of anthropogenic stressors including intense nutrient loading (Nixon, 1995; de Jonge et al., 2002; Valiela, 2006). Excessive nutrient loading into coastal ecosystems promotes algal productivity and the subsequent microbial consumption of this organic matter reduces oxygen levels and can promote hypoxia (Cloern, 2001; Heisler et al., 2008). The rapid acceleration of nutrient loading to coastal zones in recent decades has contributed to a significant expansion of algal blooms, some of which can be harmful to ecosystems or the humans who live around those ecosystems.

Globally, the phytoplankton communities of many coastal ecosystems have become increasingly dominated by harmful algal blooms (HABs) and New York's coastal waters are a prime example of this trend. Prior to 2006, algal blooms in NY were well-known for their ability to disrupt coastal ecosystem and fisheries but were never considered a human health threat. Since 2006, blooms of the saxitoxin-producing dinoflagellate *Alexandrium catenella* have led to paralytic shellfish poisoning (PSP)-inducing closures of thousands of acres of shellfish beds in Suffolk County. In 2008, a second toxic dinoflagellate, *Dinophysis acuminata*, began forming large, annual blooms that generated the toxins okadaic acid and DTX-1, both of which are the causative agents of diarrhetic shellfish poisoning (DSP). During the past decade, moderate levels of *Alexandrium* and *Dinophysis* have recently been detected in East Hampton Town waters. The limited nature of sampling, however, has prohibited definitive conclusions regarding the extent and maximal densities of blooms from being established.

In Suffolk County, blooms of the ichthyotoxic dinoflagellate *Margalefidinium*, formerly *Cochlodinium*, have occurred every year since 2004 in the Peconic Estuary and Shinnecock Bay and bloom water from these regions has been shown to cause rapid morality in fish, shellfish, and shellfish larvae (Gobler et al., 2008; Tang & Gobler, 2009a; 2009b). *Margalefidinium polykrikoides* forms blooms around the world and the highly lethal effects of these blooms on fish, shellfish, shellfish larvae, zooplankton, and subsequent impacts on fisheries have been well established (Kudela & Gobler, 2012). Studies to date suggest short-lived, labile toxins, and reactive oxygen species (ROS) play a central role in the toxicity of *M. polykrikoides* to fish and shellfish (adult, juvenile, and larvae) (Tang & Gobler, 2009a; 2009b). In 2012, these blooms spread into East Hampton Town marine waters. Large populations of bay scallops, that were otherwise abundant prior to the blooms, died following these bloom events (Deborah Barnes, NYSDEC, pers. comm.). However, the precise distribution of *Margalefidinium polykrikoides* blooms in East Hampton Town waters is unknown.

Toxic cyanobacteria blooms represent a serious threat to aquatic ecosystems. Globally, the frequency and intensity of toxic cyanobacteria blooms have increased greatly during the past decade, and have become commonplace in freshwater, upper reaches of many US estuaries. Toxin concentrations during many of these blooms often surpass the World Health Organization (WHO) safe drinking water of 1 µg/L and recreational water limit of 20 µg/L (Chorus & Bartram, 1999). There are multitudes of examples of sicknesses and deaths associated with chronic, or even sporadic, consumption of water contaminated with cyanotoxins (O'Neil et al., 2012). Cyanotoxin exposure has been linked to mild and potentially fatal medical conditions in humans including gastrointestinal cancers (i.e., liver, colorectal; Chorus & Bartram, 1999) and more recently, neurological disorders such as Alzheimer’s disease (Cox et al., 2005).

Since 2003, the Gobler lab of Stony Brook University has assessed levels of toxic cyanobacteria and microcystin in more than 40 freshwater systems across Suffolk County. Most lakes sampled contain potentially toxic cyanobacteria (typically *Microcystis* spp. or *Anabaena* spp.) and contain detectable levels of the hepatotoxin made by cyanobacteria, microcystin. *Microcystis* is a cyanobacteria that synthesizes a gastrointestinal toxin known as microcystin that is known to inhibit protein phosphorylation. In early September 2012, the NYS Department of Health reported that an autopsy of a dog that died suddenly on the shoreline Georgica Pond revealed *Microcystis*-like cells in its stomach. Although no bloom was obvious in Georgica Pond when it was investigated in late September of 2012, blooms are typically ephemeral, and the most toxic events are typically associated with nearshore, wind accumulated scums, rather than lake water. Historically, the temporal and spatial dynamics of toxic cyanobacteria in Georgica Pond, as well as densities of other harmful algae in East Hampton waters, have not been well-characterized.

A final group of microbes of concern in coastal ecosystems are pathogenic bacteria. Such pathogens can present a hazard to humans recreating in affected waters by infecting the alimentary canal, ears, eyes, nasal cavity, skin, or upper respiratory tract, which can be exposed through immersion or the splashing of water (Thompson et al., 2005). Consumption of contaminated shellfish is one of the most common exposure routes for marine pathogens. Fecal coliform bacteria and *Enterococcus* are the recommended indicator for human pathogens in marine waters, and gastrointestinal symptoms are a frequent health outcome associated with exposure (Thompson et al., 2005). The presence of high levels of fecal coliform bacteria and/or *Enterococcus* may trigger action by a municipal agency to remediate such conditions. One key obstacle to generating a successful remediation plan for high levels of indicator bacteria such as fecal coliform bacteria and/or *Enterococcus* is that the source of the potentially pathogenic bacteria is often unknown. That is, pathogenic, fecal bacteria co-present with fecal coliform bacteria and/or *Enterococcus* may be derived from any animal, including humans and remedial plans for mitigating bacteria from human wastewater will differ radically from plans focused on the mitigation of animal feces. Moreover, mitigation of feces-derived bacteria from birds that live on the waterbody would differ radically from plans to minimize dog or deer feces that might emanate from road run-off.

The objectives of this study were to assess the temporal and spatial dynamics of coliform bacteria, the PSP-causing dinoflagellate *Alexandrium*, the DSP-causing dinoflagellate *Dinophysis*, and the ichthyotoxic dinoflagellate, *Margalefidinium* in East Hampton Town marine waters. It also assesses the dynamics of toxic cyanobacteria and cyanotoxins in East Hampton's major freshwater/brackish bodies. Sampling for general water quality parameters was also included, and sampling proceeded from May through October of 2024 as part of an ongoing monitoring study.

2. Approach

2.1. Water Quality

The 2024 sampling season ran from 22-May-2024 through 17-Octobler-2024. Marine sampling was done on a bi-weekly basis, and freshwater sites were sampled weekly. Sampling included fifteen marine sites within Napeague Harbor, Acabonac Harbor, Hog Creek, Three Mile Harbor, and Northwest Creek (Fig. 1; Table 1); and ten freshwater sites within Swan Pond, Pond Lane, Fresh Pond, Hook Pond, Georgica Pond, Wainscott Pond, and Fort Pond (Fig. 1; Table 1). Sampling of Fort Pond, Montauk, was performed by the Concerned Citizens of Montauk and delivered to Southampton for processing.

Each marine water body was sampled from two or three individual sites, with at least one located near the water body's inlet to the Peconic estuary, and the others further from the inlet. Northwest Creek was the exception with only one site located near its inlet. General water quality measurements obtained for each site included salinity, temperature, and dissolved oxygen levels measured with a handheld YSI 556 probe. Onset HOBO data loggers were also deployed at the head of Three Mile Harbor to continuously record bottom temperature and dissolved oxygen levels over time. Additionally, water was collected from sites and analyzed for chlorophyll-a, fecal indicator bacteria, and total Nitrogen. Fecal coliform and *Enterococci* bacteria were quantified using Colilert-18 and Enterolert/Quanti-tray kits according to manufacturer instructions, yielding most probable number (MPN) in terms of colony forming units (CFU) per 100 mL (IDEXX).

The pigment chlorophyll-*a*, which serves as an analog for algal biomass, was measured by filtering whole water through glass fiber filters, extracting the collected pigment from the filter with acetone, and measuring the fluorescence (Parsons et al., 1984). To assess the abundance of harmful algae, five of these marine sites were sampled more comprehensively with cell counts.

Alexandrium catenella and *Dinophysis acuminata* are toxic marine dinoflagellates responsible for paralytic shellfish poisoning, and diarrhetic shellfish poisoning (DSP), respectively, and were sampled during May. For these samples, a concentrated Lugol's sample was taken for each site sieving 1 L of water through a 200 µm mesh and a 20 µm sieve backwashed into a 15 mL centrifuge tube filling the tube to 14 mL (Hattenrath-Lehmann et al., 2013). The harmful "rust tide" dinoflagellate *Margalefidinum,* formerly *Cochlodinium,* known for causing fish kills, was monitored from June through October. For *Margalefidinium* samples, whole water was collected and preserved with Lugol's iodine and cells were counted on a Sedgewick-Rafter slide under a microscope.

At the ten freshwater sites (one in Swan Pond, one in Pond Lane, one in Fresh Pond, one in Hook Pond, three in Georgica Pond, one in Wainscott Pond, and two in Fort Pond), samples were collected for the quantification of temperature, salinity, and dissolved oxygen as described above. Blue-green algae fluorescence, an analog for cyanobacterial biomass, was measured using a FluoroProbe with live samples. Samples from Fort Pond, Montauk, were delivered to the lab and measured for fluorescence only.

A telemetry monitoring buoy was deployed in southern Georgica Pond, and uploaded real-time water quality data of temperature, salinity, pH, dissolved oxygen, chlorophyll-*a*, and blue-green algae fluorescence. The sensors for chlorophyll-*a* and blue-green algae are not as sensitive as the discreet sampling methods but displayed trends that parallel those measurements.

2.2. Indicator bacteria quantification

During the present study, fecal bacteria contamination was assessed at two sites within Napeague Harbor, four sites within Acabonac, two sites within Hog Creek, five sites within Three Mile Harbors, two sites within Northwest Harbor, and one site within Georgica Pond on selected dates spanning from May to October 2024. On each date, surface water (0.25 m depth) samples were collected in sterile 2 L bottles and transported on ice to the laboratory for further processing within two hours of collection. Triplicate whole water samples were collected for DNA analysis in which samples were well-mixed to ensure even distribution of biomass prior to filtering 25 – 100 mL onto a 0.2 µm Millipore polycarbonate filter, depending on water turbidity. Samples were immediately frozen in liquid nitrogen and stored at -80°C until further processing. In parallel, sites were additionally sampled for fecal coliform bacteria and *Enterococci* bacteria from May through October, quantified using the IDEXX Enterolert & Quanti-Tray/2000 sampling kits, giving MPN per 100mL.

2.3 Historic Trends

The appropriate sampling sites were grouped together to represent each major waterbody monitored in this study including: Accabonac Harbor, Hog Creek, Northwest Creek Harbor, and Napeague Harbor, Three Mile Harbor. For the last decade of East Hampton sampling data, annual means in water quality metrics were calculated for each waterbody. Linear models were run for all the East Hampton monitoring area for each water quality metric (R Core Team, 2024).

3. Findings – Marine Systems

3.1. General Water Quality: Temperature, Salinity & Dissolved Oxygen

Overall average temperatures averaged 22.9°C and ranged 21.5 – 24.4°C across East Hampton's marine sites (Fig. 2). Maximum surface temperatures in East Hampton ranged 25.7 – 20.5°C and overall averaged 27.7°C (Fig. 2). Average maximum salinities in East Hampton ranged 26.8 – 30.3 PSU, and overall averaged 29.2 PSU (Fig. 3). Overall average salinity ranged 23.4 – 28.2 PSU and averaged 26.7 PSU across East Hampton's marine sites (Fig. 3). Overall average dissolved oxygen (DO) concentrations ranged 7.6 – 9.5 mg/L and averaged 8.4 mg/L (Fig. 4). Minimum surface DO concentrations in East Hampton ranged 3.9 – 7.4 mg/L and averaged 5.8 mg/L (Fig. 4). Overall average DO concentrations were generally above the NYSDEC minimum standard for DO (4.8 mg/L).

Surface water temperature and DO were measured continuously in Three Mile Harbor (EH11) during summer 2024. In Three Mile Harbor, temperature from the end of June until mid–August ranged 20.2 – 30.9°C and average 23.1°C (Fig. 5). During that time, DO concentrations ranged 0.0 – 8.1 mg/L and averaged 2.9 mg/L (Fig. 6). Throughout the sampling season, dissolved oxygen concentrations in Three Mile Harbor fluctuated above and below the NYSDEC minimum for DO, with DO levels in August lower than the end of June and July (Fig. 6).

Surface water temperature, salinity, and DO were measured at multiple sites at both high and low tides in Northwest Harbor (9/18/2024; low tide = 16:31; high tide = 10:44), Hog Creek (9/23/2024; low tide = 08:58; high tide = 13:40), and Napeague Harbor (9/9/2024; low tide = 08:47; high tide = 14:38). Hog Creek temperatures, salinities and dissolved oxygen ranged from 16.5-20.0˚C, 22.5-30.0 ppt, 6.5-8.55 mg/L, respectively, and all environmental parameters were higher at high tide than low tide (Fig. 88-91). Northwest harbor temperatures, salinities and dissolved oxygen ranged from 21.5-22.5 ˚C, 24.7-29.0 ppt, 4.9-7.0 mg/L, respectively, and all environmental parameters were higher at high tide than low tide except for temperature (Fig. 92-95). Napeague harbor temperatures, salinities and dissolved oxygen ranged from 19.2-22.0 ˚C, 29.7-29.9 ppt, 7.4-8.4 mg/L, respectively, and all environmental parameters were higher at high tide than low tide (Fig. 97-100).

3.2. Nitrogen and Eutrophication

In Napeague Harbor, total N concentrations ranged 0.18 – 1.0 mg N/L on all dates during 2024 between both sites EH1 and EH2 (Fig. 7). On 18-June-2024, concentrations exceeded Peconic Estuary Program threshold for EH1 with a value of 1.0 mg N/L (Fig. 8). On 14-August-2024 concentrations exceeded the threshold for EH2 with a value of 0.65 mg N/L (Fig. 8). In Acabonac Harbor, total N concentrations ranged 0.22 – 0.88 mg N/L throughout 2024 (Fig. 9). In this region, notable concentrations that exceeded the Peconic Estuary Program threshold were on 14-August-2024 at EH5 with concentration at 0.48 mg N/L (Fig. 9). At EH6a, values exceeded the threshold at all dates except for 9-September-2024 (Fig. 9). At EH7a, values exceeded the threshold from 17-July-2024 through 17-October-2024 (Fig. 9). At EH7b, values exceeded the threshold from 18-June-2024 to 9-September-2024 (Fig. 9). In Hog Creek, concentrations ranged 0.29 – 1.44 mg N/L throughout 2024. At EH8 concentrations exceeded the Peconic Estuary total N threshold once on 14-August-2024 with a concentration at 0.64 mg N/L (Fig. 10). At EH9, total

N concentrations exceeded the threshold throughout the monitoring period except on 9-September-2024 (Fig. 10). At Three Mile Harbor, concentrations ranged 0.20 – 1.1 mg N/L throughout 2024. All sites had at least one date that exceeded the Peconic Estuary Program total N threshold with EH11 and EH11a both exceeding from 17-July-2024 through 17-October-2024 (Fig. 11). In Northwest Creek, concentrations ranged 0.22 – 0.89 mg N/L (Fig. 12). At EH13, total N concentration exceeded the threshold once on 14-August-2024 at 0.89 mg N/L (Fig. 12). At EH14A, total concentration exceeded the threshold twice on 17-July-2024 and 14-August-2024 at 0.47 mg N/L and 0.57 mg N/L, respectively (Fig. 12).

The overall average concentration throughout the sites ranged from 0.31 – 0.81 mg N/L (Fig. 7). The summer average ranged from 0.34 – 0.89 mg N/L. The maximum ranged from 0.48 – 1.44 mg N/L (Fig. 7).

3.3. Algae and Harmful Algae; Alexandrium, Dinophysis, & Margalefidinium

All algae contain the pigment chlorophyll-*a* and therefore, is measured as a proxy for total phytoplankton biomass. Moderate levels of algae support productive fisheries and ecosystems, but excessive algal growth can lead to a series of negative ecological consequences, including hypoxia and acidification, and could be a sign of the development of an algal bloom.

Overall average chlorophyll-*a* concentrations ranged 3.6 – 15.6 µg/L and averaged 7.7 µg/L (Fig. 13). Maximum chlorophyll-*a* concentrations were, on average, 21.2 µg/L across all sites and ranged 6.3 – 51.5 µg/L (Fig. 13). The USEPA considers 20 µg/L of chlorophyll-*a* in marine waters as eutrophic. In this season, maximum concentrations in Napeague Harbor (EH1), Acabonac Harbor (EH6a), Hog Creek (EH9), Three Mile Harbor (EH11 and EH11a), and Northwest Creek (EH13) exceeded this level (Fig. 13). From mid-May through mid-June, chlorophyll-*a* concentrations remained below the USEPA maximum chlorophyll-*a* level (Fig. 14). Chlorophyll-*a* concentrations generally exceeded the USEPA maximum in mid-July through September. In Acabonac Harbor (EH7a), there were concentrations above the USEPA maximum on 17-July-2024 at 51.5 µg/L (Fig. 15). In Hog Creek (EH9), chlorophyll-*a* concentration exceeded the USEPA maximum on 17-July-2024 at 45.5 µg/L (Fig. 14).

Surface water chlorophyll-*a* was measured at multiple sites at both high and low tides in Northwest Harbor (9/18/2024; low tide = 16:31; high tide = 10:44), Hog Creek (9/23/2024; low tide = 08:58; high tide = 13:40), and Napeague Harbor (9/9/2024; low tide = 08:47; high tide =

14:38). Hog Creek chlorophyll-*a* ranged from 2.0-5.0 µg/L and all was higher at low tide than high tide (Fig. 91). Northwest harbor chlorophyll-*a* ranged from 3.0-5.65 µg/L and all was higher at low tide than high tide (Fig. 95). Napeague harbor chlorophyll-*a* ranged from 2.0-8.4 µg/L and all was higher at low tide than high tide (Fig. 100).

Alexandrium is a toxic dinoflagellate that synthesizes saxitoxin, which leads to the syndrome of PSP, and can cause illness or death in individuals consuming shellfish containing these toxins (Anderson, 1997). PSP has been occurring annually in New York waters since it first appeared in 2006, with Sag Harbor being the closest region to East Hampton experiencing a shellfish beds closure due to these. In 2013, densities of *Alexandrium* exceeded 1,000 cells/L, levels known to cause toxicity in shellfish (Anderson, 1997). This sampling season there was a record high of 8,050 cells/L of *Alexandrium* in Three Mile Harbor (EH11) on 22-May-2024, exceeding the bloom threshold of 1,000 cells/L (Fig. 15). There were lower density blooms of 233, 350, and 700 cells/L between late-April and early-June (Fig. 15).

Dinophysis was present in East Hampton waters during 2024, albeit very sparsely across the surveying season. In Napeague Harbor (EH1), there were 14 cells/L, 21 cells/L, and 5 cells/L on 4-June-2024, 18-June-2024, and 17-July-2024, respectively (Fig. 16). In Three Mile Harbor (EH11), *Dinophysis* had a record high density of 18,900 cells/L on 28-May-2024 (Fig. 17). There were two dates that had cell densities over 2,000 cells/L: 4-June-2024 at 2,063 cells/L and on 18-June-2024 at 2,042 cells/L (Fig. 17). EH11 had another high density bloom on 10-June-2024 at 9,392 cells/L, almost exceeding the *Dinophysis* bloom threshold (Fig. 17). At Northwest Creek (EH13), *Dinophysis* was present on 4-June-2024 and 18-June-2024 at 28 cells/L and 91 cells/L, respectively (Fig. 18). In Acabonac Harbor (EH7a), *Dinophysis* was present at low densities of 14 cells/L and 4 cells/L on 4-June-2024 and 3-July-2024, respectively (Fig. 19). At Hog Creek (EH9), the alga was present at higher concentrations throughout the monitoring period ranging from 2,500 – 1,036 cells/L (Fig. 20). *Dinophysis* concentrations never exceeded the bloom threshold for *Dinophysis* (10,000 cells/L) during 2024.

Margalefidinium, formerly *Cochlodinium*, is an ichthyotoxic dinoflagellate that has caused fish kills across the globe including some sites on eastern Long Island (Kudela & Gobler, 2012). *Margalefidinium* blooms of more than 300 cells/mL have been known to cause mortality in larval fish, which use these estuarine systems as nurseries, and in shellfish (Tang & Gobler, 2009a; 2009b). At all sites, *Margalefidinium* bloomed very sparsely and in very low densities. The highest density was 25 cells/mL on 9-September-2024 at Hog Creek (EH9) (Fig. 25). The distribution and intensity of *Margalefidinium* blooms differ from year-to-year, highlighting the importance of long-term monitoring of water quality trends. It is notable that although *Margalefidinium* does not bloom consistently in each individual location from year to year, it has spread to and reached harmful densities in several harbors. Given its ability to form cysts (Tang & Gobler, 2012), this finding suggests the potential to spread and bloom in more locations in the future.

3.4. Fecal Coliform Bacteria and Enterococcus

Fecal coliform concentrations varied among sites in Napeague Harbor, Acabonac Harbor, Hog Creek, Three Mile Harbor, Northwest Harbor, and Georgica Pond during summer and fall 2024. In Napeague Harbor, concentrations at EH1 and EH2 ranged from 1.0 – 22.0 colony forming units (CFU) per 100 mL, and averaged 9.63 and 5.7 CFU per 100 mL, respectively (Fig. 26). EH1 and EH2 had maximums of 15 and 22 CFU per 100 mL respectively (Fig. 26). In Acabonac Harbor, concentrations at EH5, EH6a, EH7a, and EH7b ranged from 1.0 – 262.8 colony forming units (CFU) per 100 mL for summer through fall (Fig. 27). Overall averages at EH5, EH6a, EH7a, and EH7b were 17.3, 75.9, 30.9, and 21.9 CFU per 100 mL, respectively, and maximum values were 43.6, 262.8, 71.8, and 71.8 CFU per 100 mL, respectively (Fig. 27). At EH6a, concentration on 4-June-2024 was the highest at 262.8 CFU per 100 mL, which exceeds the NYSDEC maximum of 14 CFU per 100 mL (Fig. 27). Sites EH5, EH7a, and EH7b had lower concentrations compared to EH6a (Fig. 27). In Hog Creek, EH8 had lower concentrations compared to EH9 and had the highest concentration of >401 CFU per 100 mL on 17-October-2024 (Fig. 28). In Three Mile Harbor, concentrations at EH11a exceeded the NYSDEC maximum throughout the whole monitoring period (Fig. 29). EH11a had concentrations ranging from 161 – >401 CFU per 100 mL (Fig. 29). All concentrations at EH10, EH10a, and EH12 were below the NYSDEC maximum. Overall averages at EH10, EH10a, EH11, EH11a, and EH12 were 2.4, 6.2, 6.3, 273.8, and 4.9 CFU per 100 mL respectively, and maximum values were 4, 10.4, 19.6, >401, and 10.2 CFU per 100 mL, respectively (Fig. 29). Fecal coliform concentrations exceeded the USFDA and NYSDEC shellfishing standards at EH11a most frequently throughout summer and fall 2024 (Fig. 29). In Northwest Harbor, EH14A had higher fecal coliform concentrations compared to EH13 (Fig. 30). EH13 had an overall average of 39.5 CFU per 100 mL and a maximum of 141.2 CFU per 100 mL

(Fig. 30). EH14A had a concentration of >401 CFU per 100 mL on 14-August-2024, an overall overage of 200.6 CFU per 100 mL, and a maximum of >401 CFU per 100 mL (Fig. 30).

Importantly, the National Shellfish Sanitation Program Guide for the Control of Molluscan Shellfish (USFDA, 2017) requires 30 data points for an official evaluation of water quality to be considered for shell fishing, which this study now cumulatively exceeds over the past several years. Moreover, it requires highly precise standards (geometric mean & estimated 90th percentile value) for the type of sampling regimen used and method of examining samples (mean probably number vs. filters). The data provided within this report is meant to provide general information on fecal coliform and to assist in guiding future sampling by NYSDEC who have ultimate authority with regards to shellfish sanitation in NY.

Enterococcus bacteria were also quantified for sites in Napeague Harbor, Acabonac Harbor, Hog Creek, Three Mile Harbor, Northwest Harbor, and Georgica Pond as well, which was used by the NYSDOH as an environmental standard for bathing beaches. In Napeague Harbor, EH2 had higher enterococci concentrations than EH1 (Fig. 32). EH1 had one significant value on 3-July-2024 that was >401 CFU per 100 mL (Fig. 32). EH1 and EH2 had an overall average of 100.5 and 225.6 CFU per 100 mL, respectively, and both had a maximum of >401 CFU per 100 mL (Fig. 32). During July 2024, Acabonac Harbor sites had enterococci concentrations that were above NYSDOH maximum concentration. At sites EH5, EH6a, EH7a, and EH7b, all had concentrations >401 CFU per 100 mL on 3-July-2024 (Fig. 33). EH5, EH6a, EH7a, and EH7b had overall averages of 154, 180.4, 213.8, and 195.2 CFU per 100 mL, respectively (Fig. 33). At EH5, concentrations ranged from <2.0 – >401 CFU per 100 mL from June through October (Fig. 33). At EH6a, concentrations ranged 36.6 – >401 CFU per 100 mL from June through October (Fig. 33). At EH7a, concentrations ranged from 61.0 – >401 CFU per 100 mL (Fig. 33). At EH7b, concentrations ranged from 2.0 – >401 CFU per 100 mL (Fig. 33). In Hog Creek, EH9 had higher enterococci concentrations compared to EH8 (Fig. 34). Almost all dates at EH9 had concentrations exceeding the NYSDOH standard, except for 4-June-2024 that was at 12.6 CFU per 100 mL (Fig. 34). EH9 had an overall average of 197.3 and a maximum of >401 CFU per 100 mL (Fig. 34). At EH8, there was only one date that exceeded the NYSDOH standard at 219.6 CFU per 100 mL on 28-August-2024 (Fig. 34). EH8 had an overall average of 43.8 and a maximum of 219.6 CFU per 100 mL (Fig. 34). In Three Mile Harbor, enterococci concentrations varied by site. In EH10, all concentrations were below both NYSDOH standards throughout the monitoring period except for

18-June-2024 that was at 162.6 CFU per 100 mL and ranged from 6.0 – 162.6 CFU per 100 mL for June through October (Fig. 35). At the EH10a site, concentrations ranged 10.4 – 393.6 CFU per 100 mL (Fig. 35). At EH11, concentrations were all below the NYSDOH maximum except on 14-August-2024 at 124.8 CFU per 100 mL and ranged from <2.0 – 124.8 CFU per 100 mL during June through October (Fig. 35). At the EH11a site, concentrations exceeded NYSDOH standard July through October and ranged 14.4 – 275.2 CFU per 100 mL from July to October, with the higher concentration exceeding the NYSDOH shell fishing standard during the summer months (Fig. 35). Lastly, at EH12, concentrations were >401 CFU per 100 mL on 17-July-2024 and 14-August-2024, exceeding NYSDOH maximum, and ranged 15 – >401 CFU per 100 mL throughout the summer and fall of 2024 (Fig. 35). EH10, EH10a, EH11, EH11a, and EH12 had overall averages of 40.4, 137.2, 37.8, 190.6, and 171.2 CFU per 100 mL, respectively, and maximums of 162.6, 393.6, 124.8, 275.6, and >401 CFU per 100 mL, respectively (Fig. 35). In Northwest Harbor, EH13 had relatively lower concentrations compared to EH14A (Fig. 36). At EH13, two dates exceeded the NYSDOH maximum on 17-July-2024 and 14-August-2024 with concentrations at 170.5 and 128.8 CFU per 100 mL, respectively (Fig. 36). EH13 had an overall average of 78.7 and maximum of 170.5 CFU per 100 mL (Fig. 36). EH14A had an overall average of 250.3 and a maximum of >401 CFU per 100 mL (Fig. 36). In Georgica Pond (EH16B), enterococci levels were relatively high throughout mid-July to mid-September (Fig. 37). The overall average for EH16B was 195.4 CFU per 100 mL and a maximum of >401 CFU per 100 mL (Fig. 37)

3.5 Microbial Source Tracking

For 2024, microbial source tracking was utilized to assess the relative abundance of four classes of fecal bacteria in Hog Creek. The use of digital PCR permits the quantification of bacteria specifically emanating from humans, ruminants, birds, and dogs or small mammals. Within Hog Creek, birds and dogs/small mammals were the biggest source of fecal bacteria throughout all the sites in the summer (Fig. 38). Both sites had traces of human fecal bacteria during the summer (Fig. 38). Enterococcus bacteria was detected at all the sites in Hog Creek with EH9 the most abundant (Fig. 39).

Throughout the summer there was a consistent detection of dog/small animal bacteria detected, with the highest in EH9 on 17-October-2024 (Fig. 40). In comparison, EH8 had the highest bird bacteria detected on 3-July-2024 (Fig. 40). Human bacteria were detected at its highest on 14-August-2024 in EH8 and on 28-August-2024 in EH9 (Fig. 40). Bird fecal bacteria was consistently detected throughout all the sites and at almost all the dates (Fig. 40). Enterococcus bacteria was detected almost throughout the whole monitoring period at both EH8 and EH9 (Fig. 41). On 30-July-2024, enterococcus bacteria were at its highest at EH9 and did not occur on 14-August-2024 (Fig. 41).

The highest percentage class of fecal bacteria was dog/small mammal consisting of over 30% detection at almost all the sites in Hog Creek (Fig. 42). Overall, there were less human fecal bacteria detected and a more significant dog/small mammal detection than birds.

3.5 Northwest Harbor Sediment Samples

Sediment samples were taken from the outlet of Northwest Harbor on 12/16/2024. Samples were weighed and combusted to calculate the percent organic matter in the sediment. All sediment samples ranged from 0.28 – 8.05% organic matter with a mean of 2.23% and a median of 1.08% (Table. 1). The highest percent organic matter sites were located on the eastern side of the harbor (Fig. 96).

4. Findings - Freshwater Systems

4.1. General Water Quality: Temperature, Salinity & Dissolved Oxygen

The overall average temperature across East Hampton's freshwater sites was 22.7°C and ranged 17.3 – 26.9°C (Fig. 43). Maximum temperature was, on average, 28.9°C and ranged 22.3 – 34.9°C (Fig. 43). Overall average salinity for the freshwater sites was 3.8 PSU and ranged 0.07 – 15.6 PSU (Fig. 44). Maximum salinity was, on average, 7.4 PSU and ranged 0.2 – 27.1 PSU (Fig. 44).

In Pond Lane (PLEH), DO was, on average, 9.1 mg/L and was above the NYSDEC minimum for DO except for one day on 9-September-2024 at 2.4 mg/L (Fig. 45; Fig. 46). In Swan Pond (SPEH), DO averaged 8.4 mg/L and was above NYSDEC minimum for DO except for two days on 17-July-2024 and 9-September-2024 at 4.24 mg/L and 4.81 mg/L, respectively (Fig 45; Fig. 47). In Fresh Pond (EH4), DO was, on average, 7.3 mg/L and fell above the NYSDEC minimum for DO (4.8 mg/L) throughout the monitoring period (Fig. 45; Fig. 48). In Wainscott Pond (WPS), DO concentrations were, on average, 10.9 mg/L, and ranged 5.97 – 15.6 mg/L, never once falling below the NYSDEC minimum for DO (Fig. 45; Fig. 49). In Hook Pond (EH17), all DO concentrations fell above the NYSDEC minimum for DO. The average was 9.5 mg/L and ranged 6.3 – 13.3 mg/L (Fig. 45; Fig. 53). All three sites at Georgica Pond had varied DO concentrations and had frequent concentrations that exceeded the NYSDEC minimum. EH15 had an average of 5.4 mg/L and ranged 0.07 – 13.4 mg/L (Fig. 45; Fig. 50). At EH16B the average DO was 5.8 mg/L and ranged from 0.54 – 11.04 mg/L (Fig. 45; Fig. 51). At EH18 concentrations exceeded the NYSDEC minimum throughout the entire monitoring period, with an average of 8.8 mg/L and a range from 4.98 – 12.7 mg/L (Fig. 45; Fig. 52).

4.2. Nitrogen and Eutrophication

Fresh Pond (EH4) was the only freshwater site sampled for total nitrogen. Concentrations ranged 0.41 – 0.96 mg N/L during 2024, with concentrations exceeding the Peconic Estuary Program total N threshold (0.40 mg N/L) for all dates during 2024 (Fig. 54). Overall average total N concentration were 0.55 mg N/L, both of which were above the Peconic Estuary total N threshold (Fig. 54).

4.3. Algae and Harmful Algae; Cyanobacteria

Total algal biomass for freshwater systems was measured using a BBE Moldaenke Fluoroprobe. These values tend to be higher than traditional chlorophyll-*a* extraction. The overall average of chlorophyll-*a* concentration at freshwater sites in East Hampton was 86.2 µg/L and ranged 25.7 – 401.5 µg/L (Fig. 55). Maximum chlorophyll-*a* concentration was, on average, 195.7 µg/L and ranged 42.9 – 714.5 µg/L (Fig. 55). The overall average and maximum chlorophyll-*a* at all sites exceeded the USEPA maximum chlorophyll-*a* concentration for eutrophic freshwater systems (8 µg/L) (Fig. 55). In Pond Lane and Swan Pond, average concentrations were 74.5 and 81.1 µg/L, respectively, and ranged 6.9 – 187.8 µg/L and 23.7 – 189.3 µg/L, respectively (Fig. 55; Fig. 56; Fig. 57). In Fresh Pond, the average concentrations were 25.7 µg/L and ranged 17.0 – 42.9 µg/L (Fig. 58). In Hook Pond, average concentrations were 40.8 µg/L and ranged 9,6 – 95.3 µg/L (Fig. 59). In Georgica Pond, chlorophyll-*a* concentrations were, on average, 13.8 µg/L, 83.2 µg/L, and 65.8 µg/L at sites EH15, EH16B, and EH18, respectively, and ranged 1.5 – 117.8 µg/L, 2.5 – 355.95 µg/L, and 5.0 – 135.9 µg/L, respectively (Fig. 61; Fig. 62: Fig. 63). In Wainscott Pond, concentrations were, on average, 401.5 µg/L and ranged 124.0 – 714.5 µg/L, with concentrations on all dates exceeding the USEPA maximum for chlorophyll-*a* in freshwater systems (Fig. 60). In Fort Pond, concentrations were, on average, 28.0 µg/L and 32.9 µg/L for the north and south sites, respectively, and ranged 15.0 – 56.4 µg/L and 18.5 – 61.5 µg/L, respectively, with concentrations on all dates exceeding the USEPA maximum for chlorophyll-*a* in freshwater systems (Fig. 64; Fig. 65).

Toxic cyanobacteria blooms represent a serious threat to aquatic ecosystems and human health. Whereas chlorophyll-*a* is an analog for algal biomass, blue-green algal fluorescence serves as an analog specifically for cyanobacterial biomass. The recreational safety limit of 25 µg/L used by the NYSDEC was surpassed in Pond Lane, Wainscott Pond, one site in Georgica Pond (EH18) Fort Pond North, and Fort Pond South, in 2024. The overall average concentration of blue-green algae across freshwater sites in East Hampton was 48.1 µg/L and ranged 0.17 – 369.3 µg/L (Fig. 66). Maximum blue-green algae levels were, on average 99.98 µg/L and ranged 0.8 – 677.4 µg/L (Fig. 66). In Pond Lane, the average blue-green concentration was 57.5 µg/L and ranged 0.72 – 157.9 µg/L and did not start being detected until 3-July-2024 (Fig. 67). In Swan Pond, average concentration was 11.3 µg/L and ranged 0.12 – 24.6 µg/L (Fig. 68). Fresh Pond had very low concentrations of blue-green algae throughout the entire monitoring period with a high of 5.1 µg/L on 17-July-2024 (Fig. 69). In Hook Pond, blue-green algae levels were also relatively low with an average of 1.9 µg/L with the highest concentration on 22-July-2024 at 6.57 µg/L (Fig. 73). In Georgica Pond, at sites EH15, EH16B, and EH18, blue-green algae concentrations were on average 0.17 µg/L, 3.5 µg/L, and 5.0 µg/L, respectively, and ranged 0.0 – 0.56 µg/L, 0.0 – 23.35 µg/L, and 0.0 – 29.96 µg/L, respectively (Fig. 71; Fig. 72; Fig. 73). In EH15 and EH16B, blue-green algae concentrations never exceeded the NYSDEC bloom threshold. In Wainscott Pond, blue-green algae concentrations exceeded the NYSDEC bloom threshold throughout the whole monitoring period and was on average, 369.3 µg/L and ranged 80.4 –677.4 µg/L (Fig. 70). In Fort Pond, at the north and south sites, blue-green algae levels were, on average, 14.2 µg/L and 17.4 µg/L, respectively, and ranged 0.0 – 30.46 µg/L and 0.2 – 43.63 µg/L, respectively (Fig. 75; Fig. 76).

Regarding cyanotoxins in freshwater sites, concentrations of microcystin varied by site. Microcystin concentration at Pond Lane was measured throughout mid-June to mid-October with one date exceeding both recreation and drinking water thresholds on 3-July-2024 at 13.7 µg/L (Fig. 77). Swan Pond had detectable levels on 4-June-2024, 17-July-2024, and 9-September-2024, at 1.03 µg/L, 1.54 µg/L, and <0.6 µg/L respectively (Fig. 77). At Fort Pond South and Fort Pond North had very low levels with only two outstanding concentrations. At Fort Pond South microcystin concentration was 3.01 µg/L on 12-August-2024 (Fig. 78). At Fort Pond North microcystin concentration was 1.42 µg/L on 17-September-2024 (Fig. 78). At Georgica Pond (EH18), microcystin concentration was detected only on 15-July-2024 at <0.6 µg/L (Fig. 77). In Wainscott Pond, microcystin levels were the most frequently detected in 2024, but all at very low concentrations, and exceeded the drinking water threshold throughout late-May to late September (Fig. 79). At Swan Pond, Fresh Pond, Hook Pond, the three sites in Georgica Pond no cyanobacteria were identified (Table. 3). The most common cyanobacteria found at all sites was *Dolichospermum*. Wainscott Pond had a more diverse assortment of cyanobacteria identified (Table. 3).

5.0 Decadal Trends in East Hampton Marine Waterbodies

5.1 General Water Quality; Temperature, Salinity, Dissolved Oxygen and Fecal Coliform Bacteria

Across all East Hampton marine waterbodies, surface and bottom temperatures were the only water quality metric that did not change significantly over the last decade (Fig. 84-87). Surface and bottom dissolved oxygen have significantly increased with p-values of 0.01, and 0.04, respectively (Fig. 86). Specifically, Three Mile Harbor showed a significant increase in surface and bottom dissolved oxygen (p=0.0032, and 0.005). Additionally, surface and bottom salinities across East Hampton waterbodies have significantly declined over the last ten years with p-values of 0.01 and 0.002, respectively (Fig. 85). This trend is most significant in Hog Creek bottom salinity (p=0.01) and Three Mile Harbor surface and bottom salinity (p=0.007 and 0.001, respectively).

5.2 Algae and Harmful Algae; Alexandrium catenella, Dinophysis acuminata, Margalefidinium polykrikoides

Over the last decade, there has been a significant increase in annual mean chl-a values (p=0.001) (Fig. 83). More specifically chl-a has increased the most in Accabonnac Harbor with a p-value of 0.04. Across all East Hampton waterbodies, there is no significant trend in *Alexandrium catenella* or *Margalefidinium polykrikoides* blooms (Fig. 80; Fig. 82). However, in the past decade, the severity of *Dinophysis acuminata* blooms has significantly increased with a p-value of 0.01

(Fig. 81). Annual *D. acuminata* bloom densities from 2020-2024 in Hog Creek, Three Mile Harbor and Northwest Creek were denser than all other annual means measured in the last decade of monitoring data.

5.3 Fecal Coliform Bacteria

Across all waterbodies in East Hampton, there has been a significant increase in annual mean fecal coliform bacteria (p=0.01) (Fig. 87). More specifically, significant increases have been seen in Three Mile Harbor, Northwest Creek, and Hog Creek with p-values of 0.006, 0.003, and 0.008, respectively. However, the highest annual means over the last four years were seen in Accabonac Harbor and Hog Creek. In fact, Accabonnac Harbor had the highest annual mean in 2022 of more than 750 FCU 100mL^{-1}, which is more than 15 times higher than the New York state mandated annual mean for certified waterbodies (Fig. 87). Furthermore, 13% of all samples taken in the last decade were above New York state mandated single sample standards set at 14 FCU 100mL^{-1}. Interestingly, the percentage of samples above the state annual means for certified waters is not significantly increasing, suggesting that annual means are being influenced by a few extremely high measurements, rather than an increasing number of high FCU samples.

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Figures and Tables

Figure 1. Map of the various marine (top, red) and freshwater (bottom, green) sampling sites in East Hampton, NY during 2024.

Waterbody	Location	Abbr.	Coordinates
	Napeague Harbor Rd.	EH1	41.01079, -72.03769
Napeague Harbor	Lazy Pt.	EH2	41.01291, -72.05687
	Louse Pt. Ramp	EH5	41.01982, -72.13599
	Shipyard Ln.	EH6a	41.02133, -72.15191
	Trustees Trail	EH7a	41.03760, -72.14284
Acabonac Harbor	Gerald Dr.	EH7b	41.03011, -72.13845
	Kings Point Rd.	EH8	41.04956, -72.16711
Hog Creek	29 Isle of Wight Rd.	EH9	41.04090, -72.16559
	Gann Rd.	EH10	41.02701, -72.18102
	Squaw Rd.	EH10a	41.02289, -72.18149
	Head of the Harbor	EH11	41.00072, -72.18148
	Soak Hides Preserve	EH11a	40.99860, -72.18582
Three Mile Harbor	Hands Creek Rd.	EH12	41.01880, -72.20211
	NW Landing Rd.	EH13	41.00991, -72.24753
Northwest Creek	Little Northwest Creek	EH14A	41.00155,-72.27044
Swan Pond, East Hampton	Swan Pond	SPEH	41.04625, -72.17085
Pond Lane, East Hampton	Pond Lane	PLEH	41.04537, -72.17411
Fresh Pond, Amagansett	Fresh Pond	EH4	40.99510, -72.11771
Hook Pond	Hook Pond	EH17	40.94619, -72.19077
	Rt. 27	EH15	40.94999, -72.23915
		EH16B	40.94450, -72.21686
Georgica Pond	4 Eel Cove Rd.	EH18	40.93408, -72.23182
Wainscott Pond	Wainscott Pond, South	WPS	40.92729, -72.23973
	North	FPN	41.04331, -71.95556
Fort Pond	South	FPS	41.03603, -71.94773

Table 1. List of the East Hampton sampling sites in 2024, sites shaded in red and green represent marine and freshwater sites, respectively.

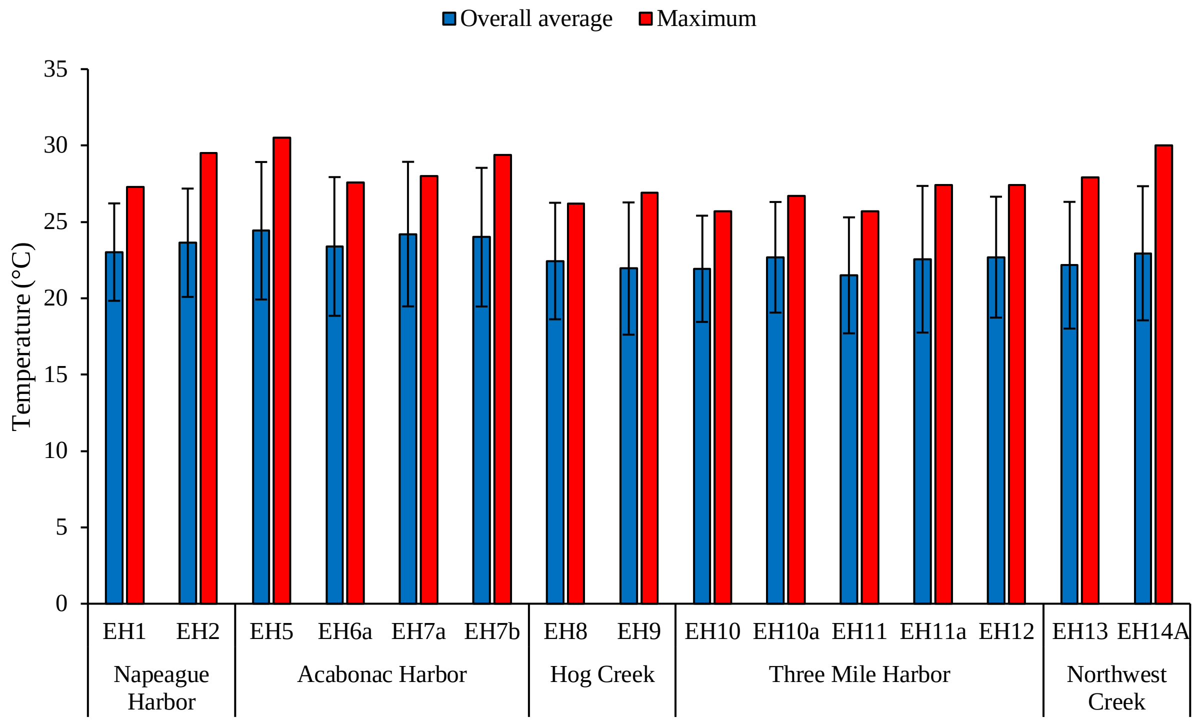

Figure 2. Overall average and maximum surface water temperatures (°C) at various marine sites in East Hampton during 2024. Error bars represent standard deviation.

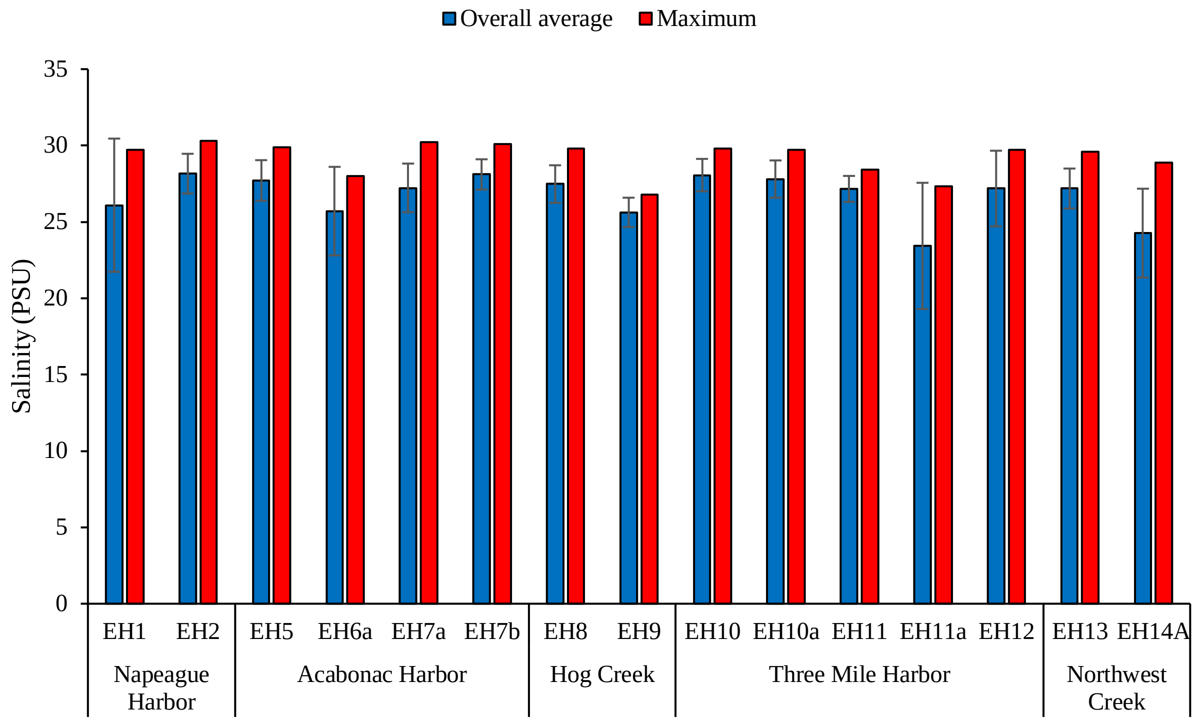

Figure 3. Overall average and maximum surface water salinities (PSU) at various marine sites in East Hampton during 2024. Error bars represent standard deviation.

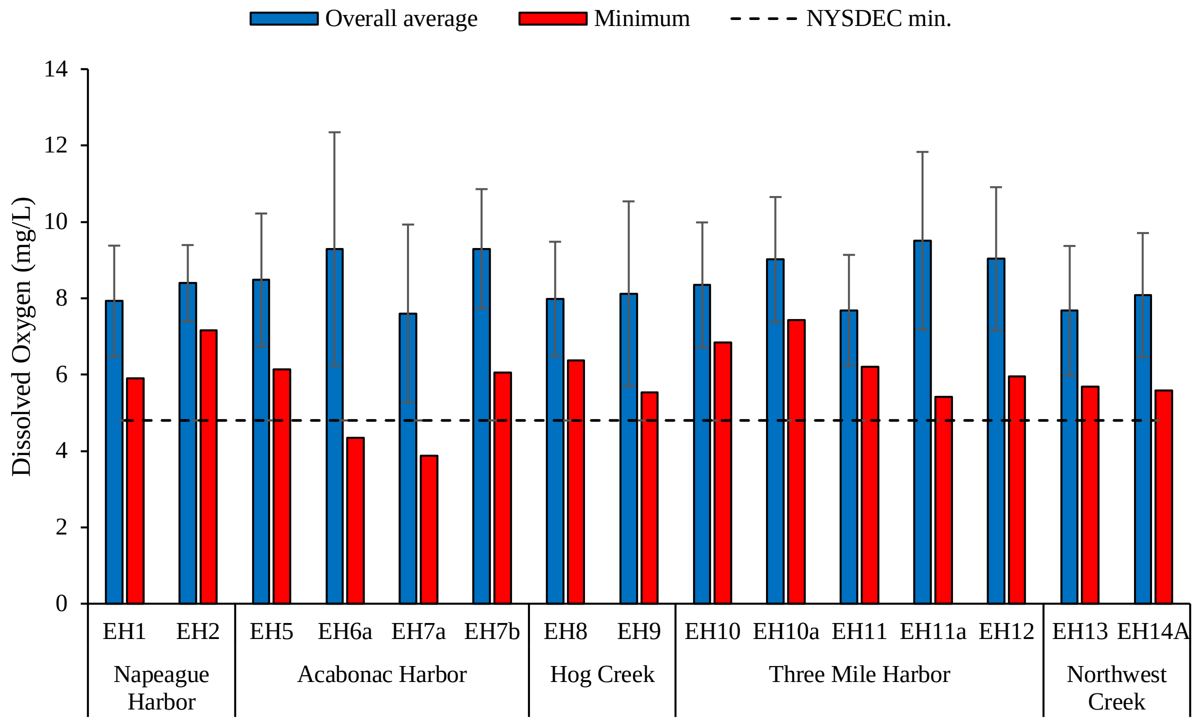

Figure 4. Overall average and minimum surface water dissolved oxygen concentrations (mg/L) at various marine sites in East Hampton during 2024. The dashed line represents the NYSDEC minimum for dissolved oxygen (4.8 mg/L). Error bars represent standard deviation.

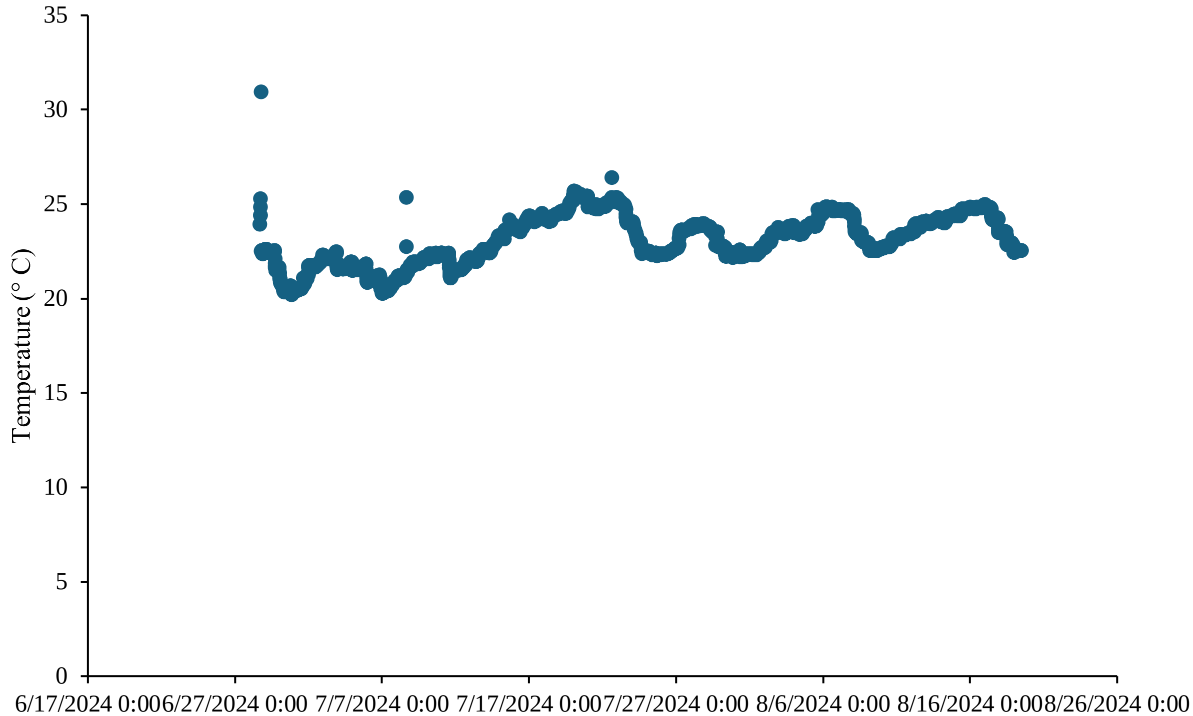

Figure 5. Continuous measurements of temperature (°C) in Three Mile Harbor (EH11) during summer 2024. Gaps in graph were when sensors were malfunctioning, and no data was recorded.

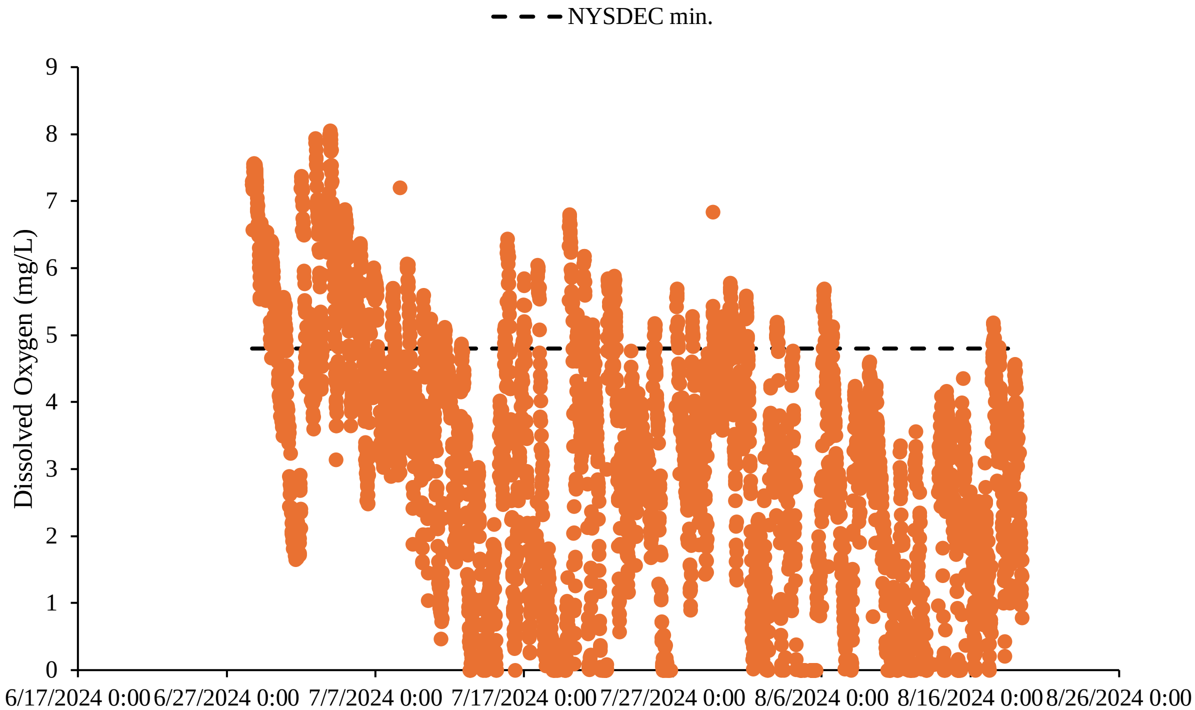

Figure 6. Discrete measurements of dissolved oxygen (mg/L) in Three Mile Harbor (EH11) during summer 2024. The dashed line represents the NYSDEC minimum for dissolved oxygen (4.8 mg/L). Gaps in graph were when sensors were malfunctioning, and no data was recorded.

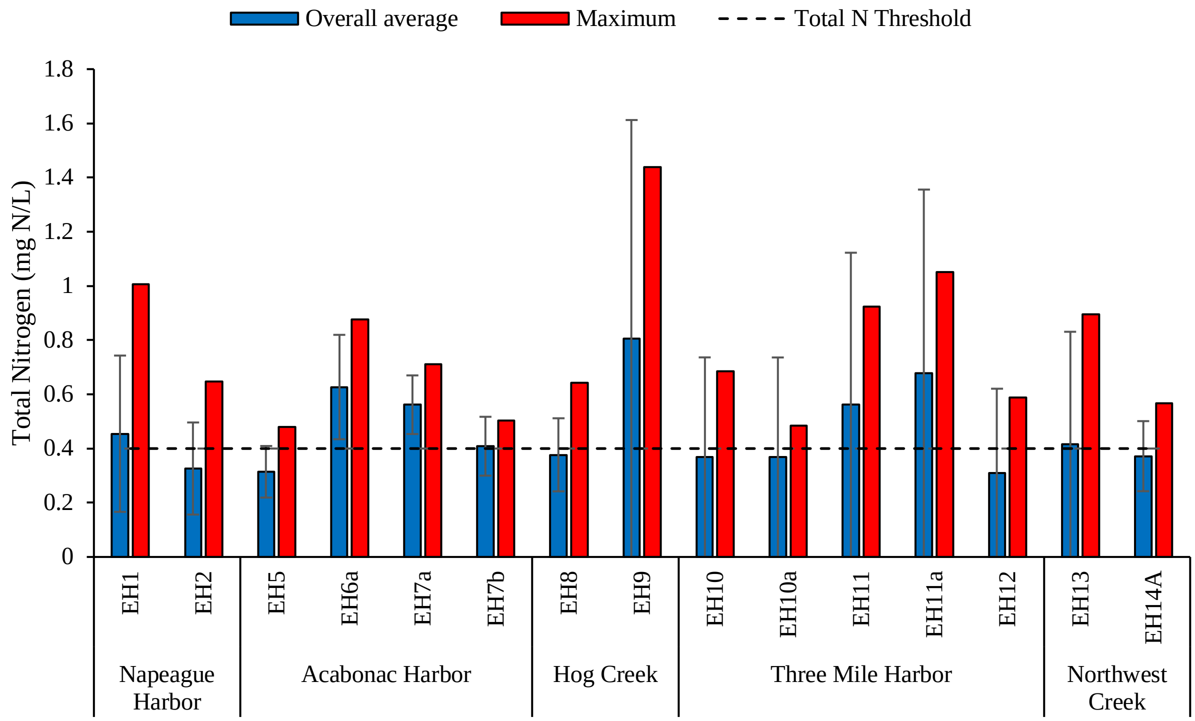

Figure 7. Overall average and maximum dissolved total nitrogen concentrations at various marine sites in East Hampton during 2024. The dashed line represents the Peconic Estuary Program threshold for total nitrogen (0.4 mg N/L). Error bars represent standard deviation.

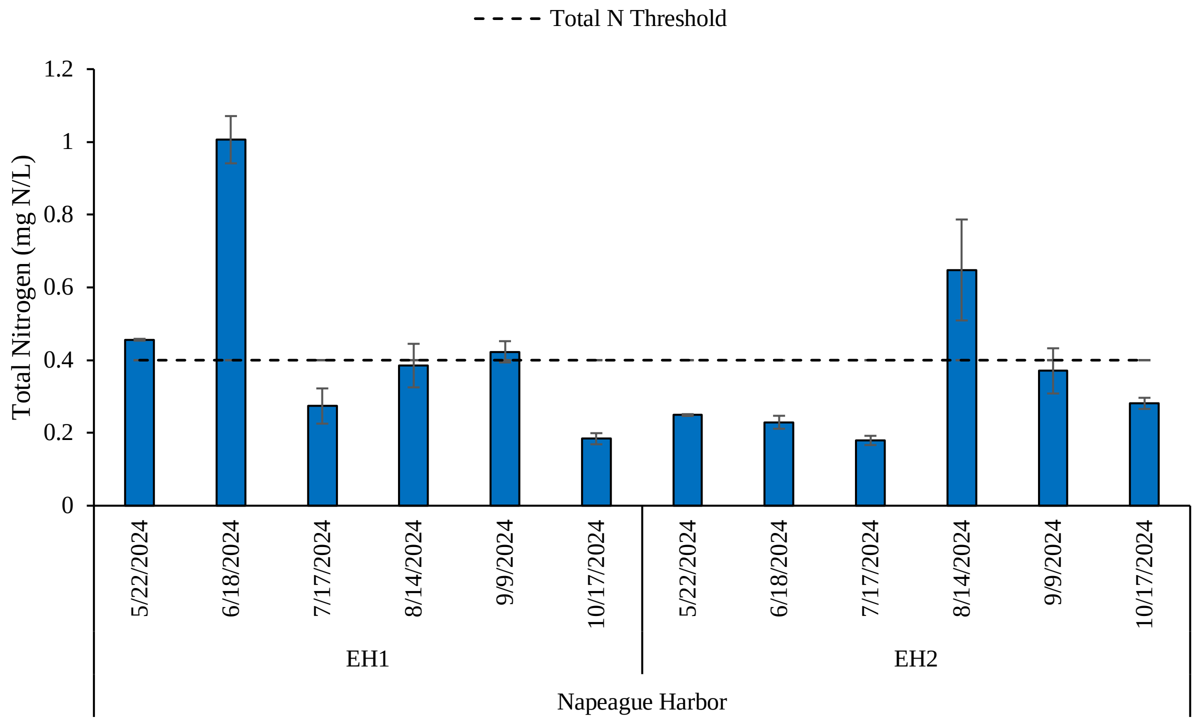

Figure 8. Total nitrogen (N) concentrations (mg N/L) at various marine sites in Napeague during 2024. Error bars represent standard deviation. The dashed horizontal lines represent the Peconic Estuary Program threshold for total N (0.4 mg N/L).

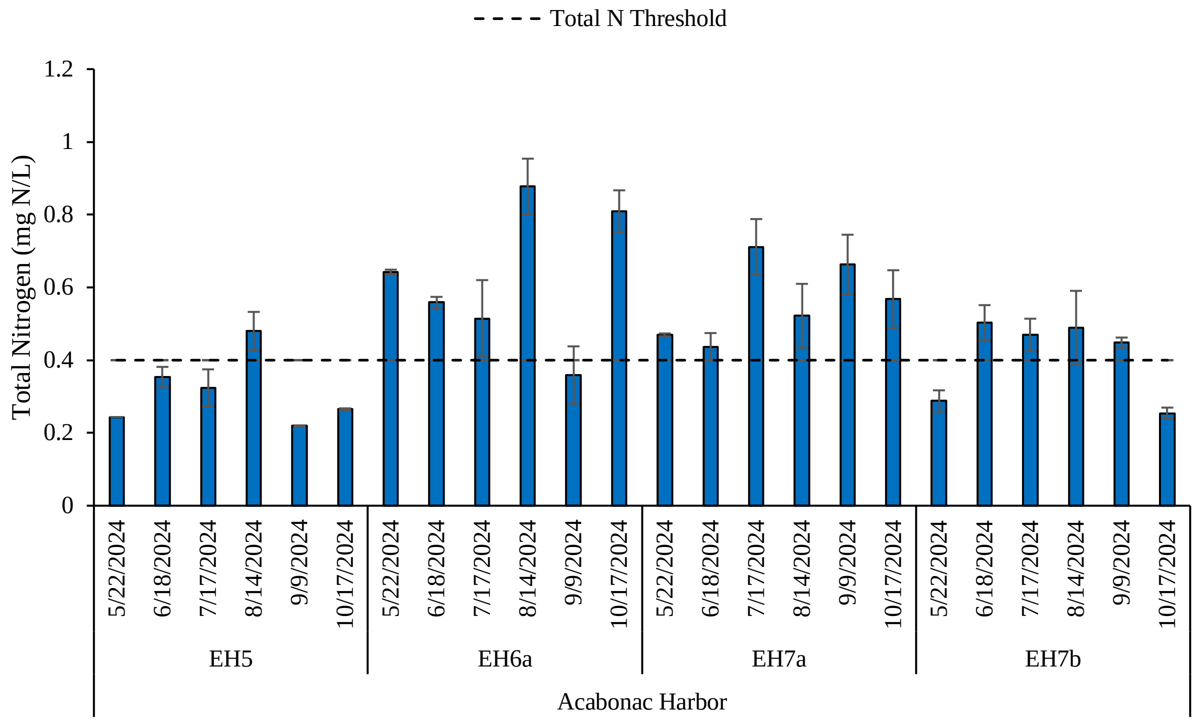

Figure 9. Total nitrogen (N) concentrations (mg N/L) at various marine sites in Acabonac Harbor during 2024. Error bars represent standard deviation. The dashed horizontal lines represent the Peconic Estuary Program threshold for total N (0.4 mg N/L).

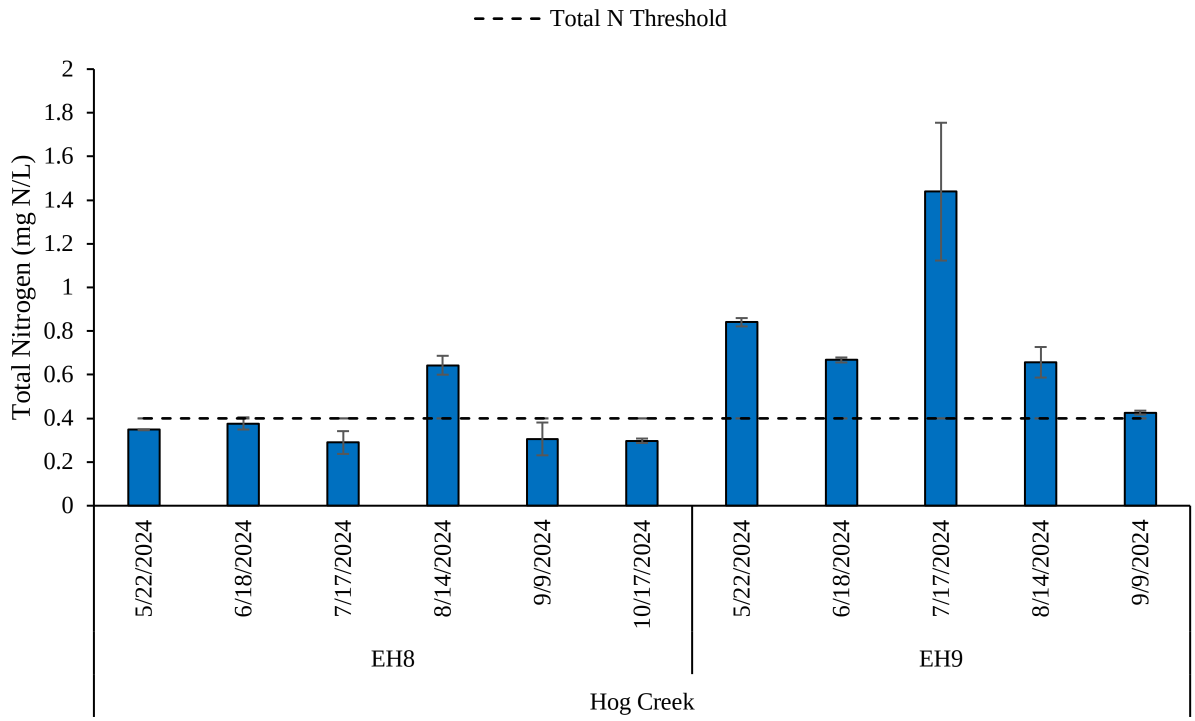

Figure 10. Total nitrogen (N) concentrations (mg N/L) at various marine sites in Hog Creek during 2024. Error bars represent standard deviation. The dashed horizontal lines represent the Peconic Estuary Program threshold for total N (0.4 mg N/L).

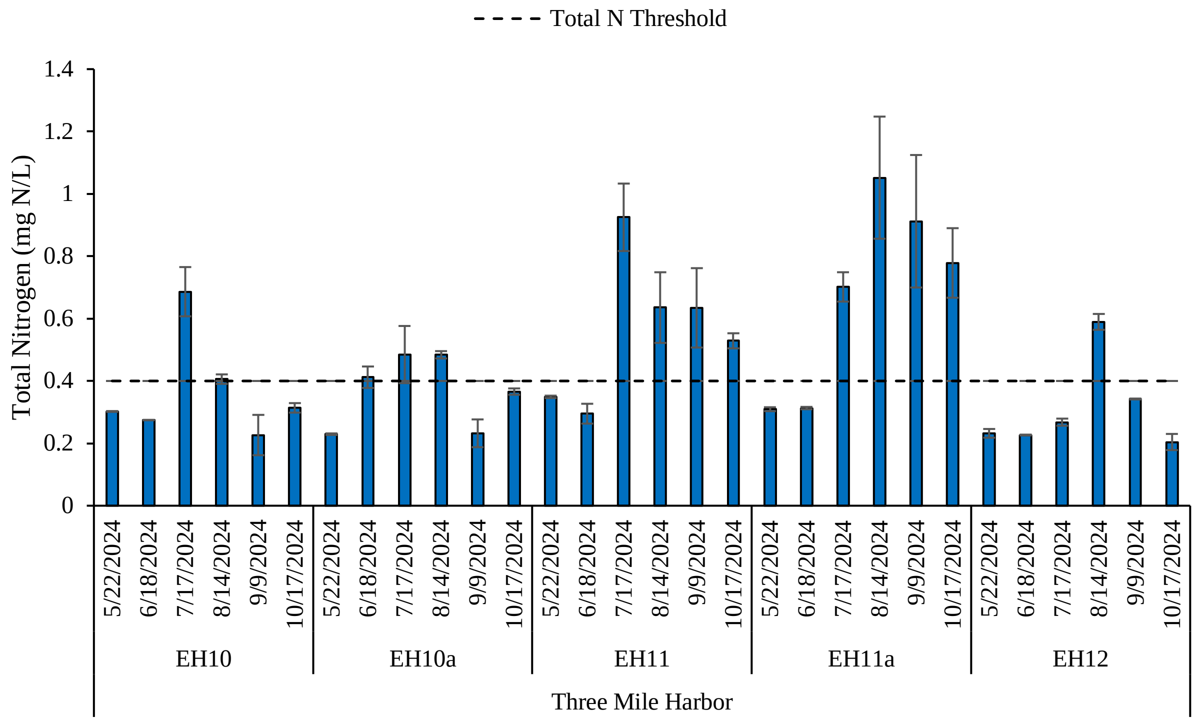

Figure 11. Total nitrogen (N) concentrations (mg N/L) at various marine sites in Three Mile Harbor during 2024. Error bars represent standard deviation. The dashed horizontal lines represent the Peconic Estuary Program threshold for total N (0.4 mg N/L).

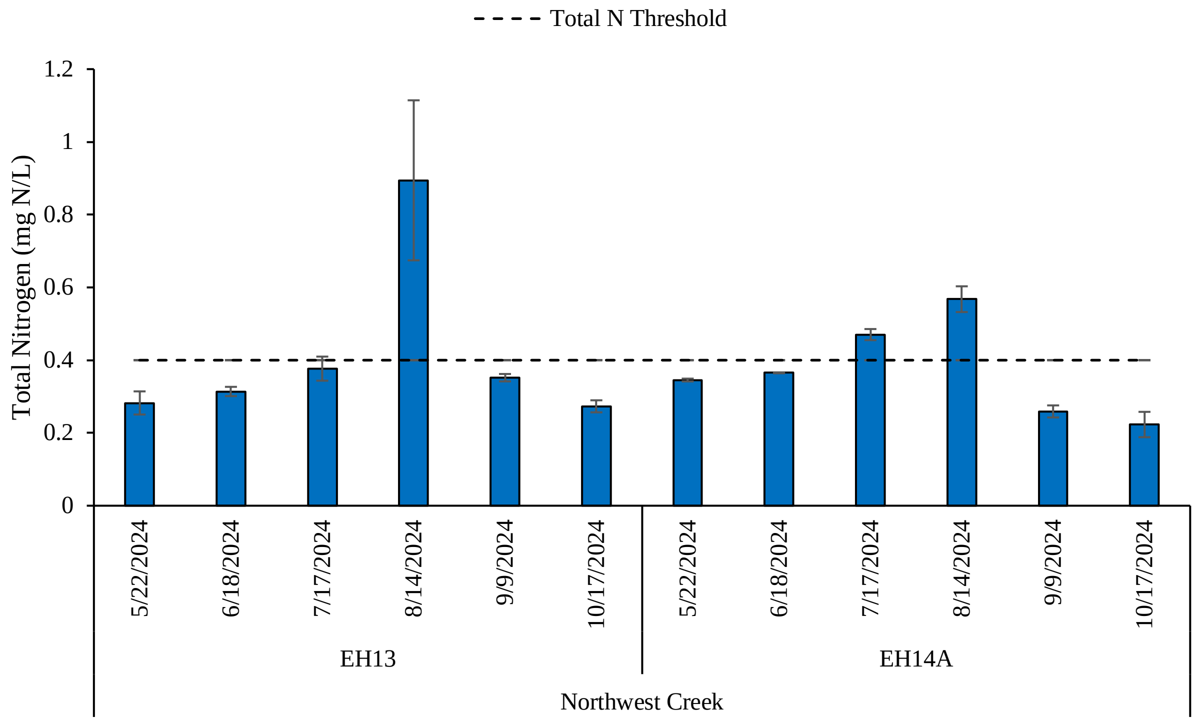

Figure 12. Total nitrogen (N) concentrations (mg N/L) at various marine sites in Northwest Creek during 2024. Error bars represent standard deviation. The dashed horizontal lines represent the Peconic Estuary Program threshold for total N (0.4 mg N/L).

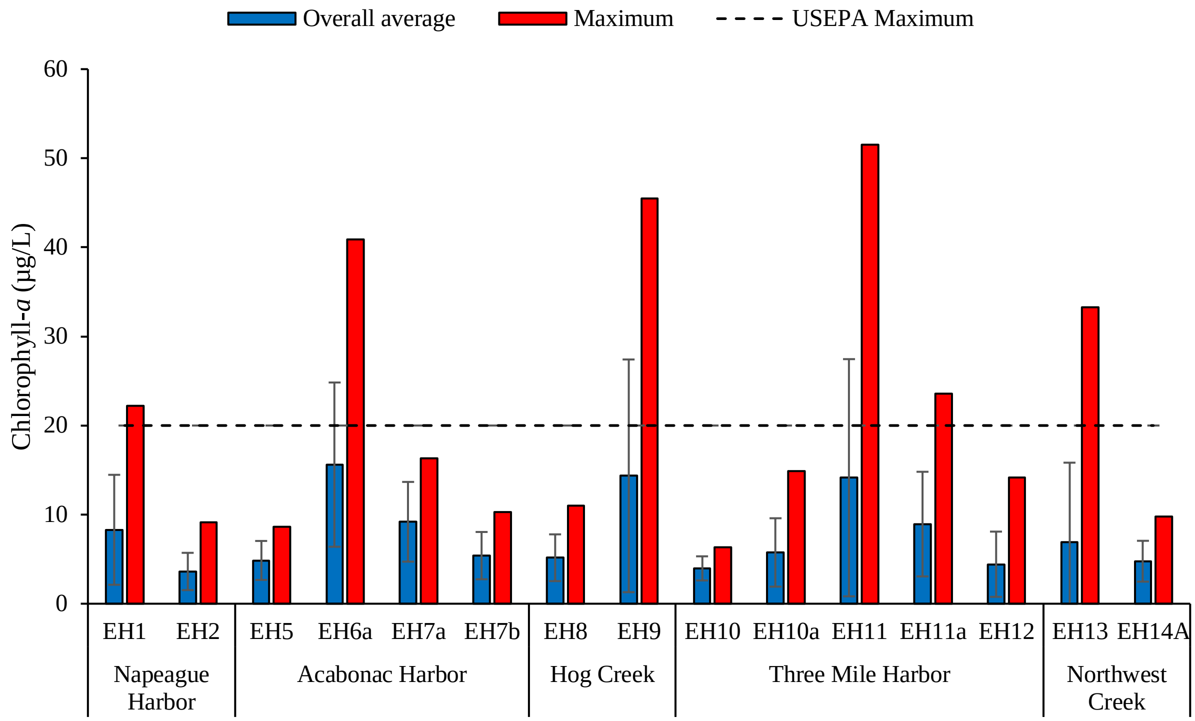

Figure 13. Overall average, summer average, and maximum chlorophyll-*a* concentration (µg/L) at various marine sites in East Hampton during 2024. The dashed line represents the NOAA maximum for chlorophyll-*a* (20 µg/L). Error bars represent standard deviation.

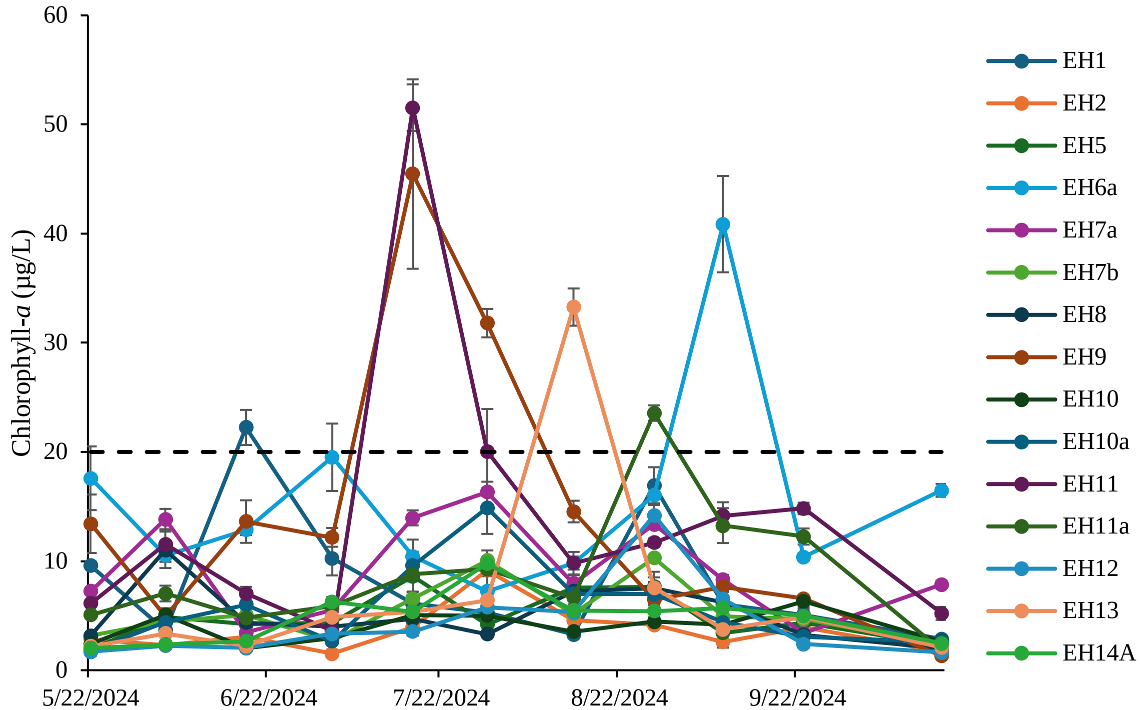

Figure 14. Chlorophyll-*a* concentrations (µg/L) at various marine sites in East Hampton during 2024. The dashed line represents the NOAA maximum for chlorophyll-*a* (20 µg/L). Error bars represent standard deviation.

Location	Site	Date	*Alexandrium cells/L*
Napeague Harbor	EH1	5/22/2024	0
Northwest Creek	EH13	5/22/2024	0
Acabonac Harbor	EH7a	5/22/2024	0
Hog Creek	EH9	5/22/2024	63

Table 2. Concentrations of *Alexandrium* (cells/L) 2024 at various sites.

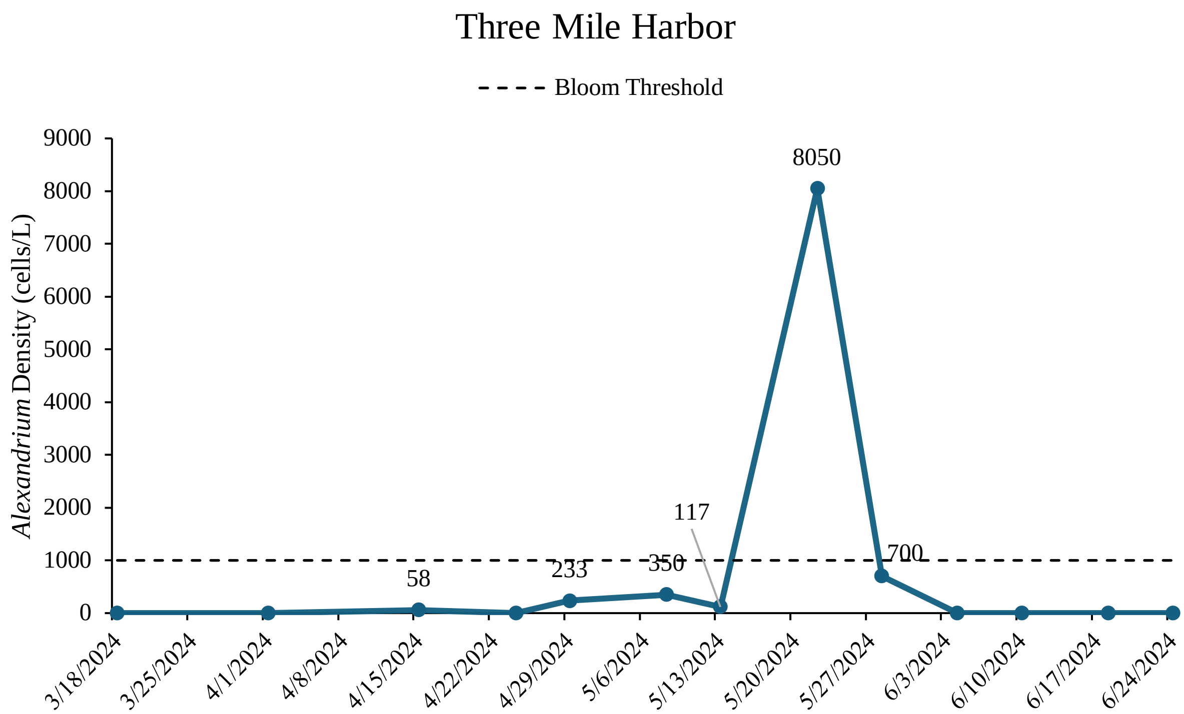

Figure 15. Concentrations of *Alexandrium* (cells/L) at one site in Three Mile Harbor Harbor during 2024. The dashed lines represent bloom thresholds for *Alexandrium* (1,000 cells/L).

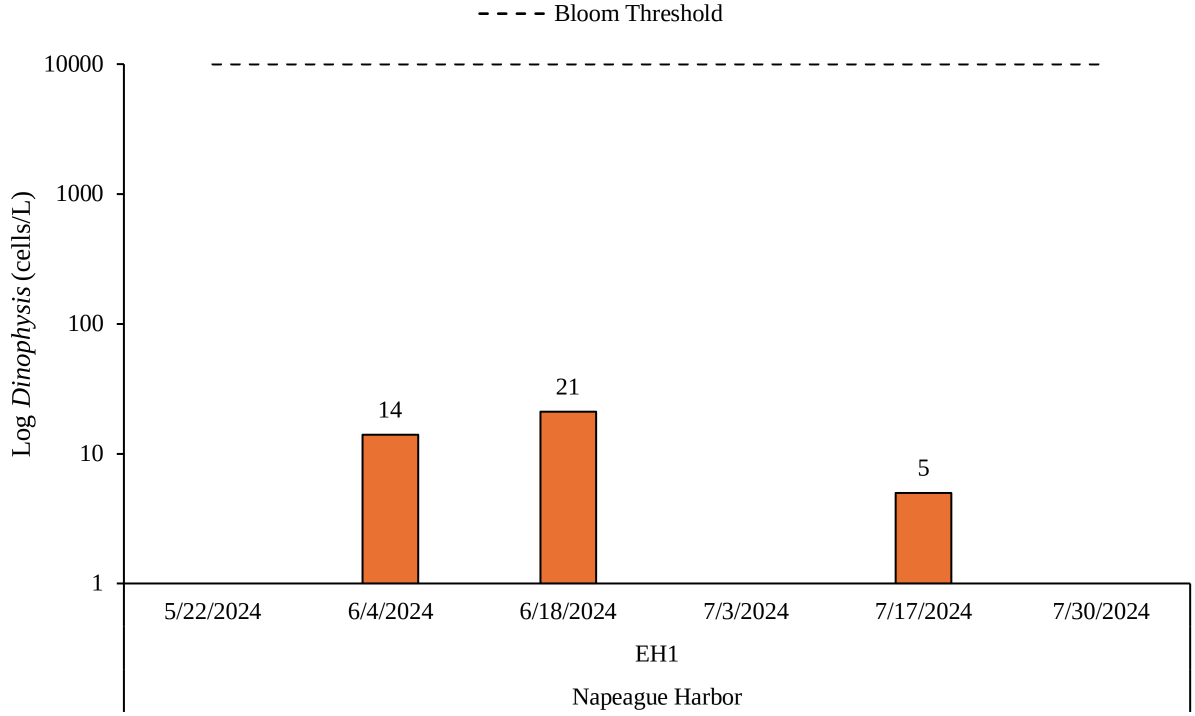

Figure 16. Concentrations of *Dinophysis* (cells/L) at one site in Napeague Harbor during 2024. The dashed lines represent bloom thresholds for *Dinophysis* (10,000 cells/L).

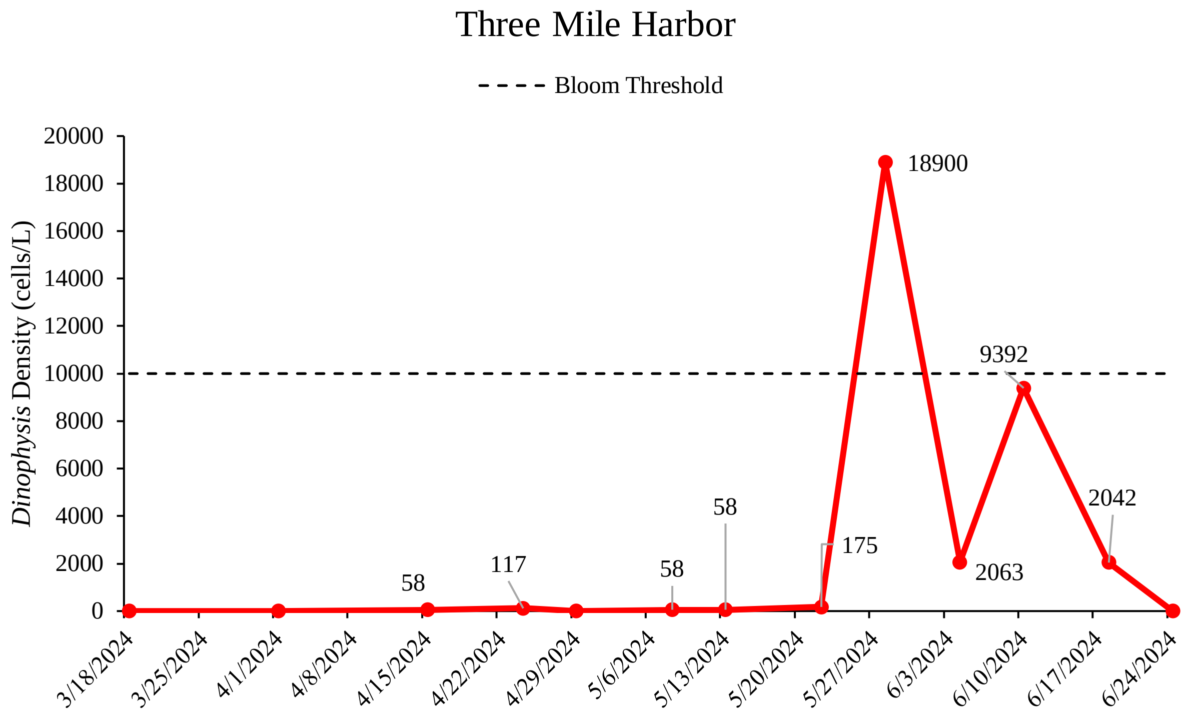

Figure 17. Concentrations of *Dinophysis* (cells/L) at one site in Three Mile Harbor (EH11) during 2024. The dashed lines represent bloom thresholds for *Dinophysis* (10,000 cells/L).

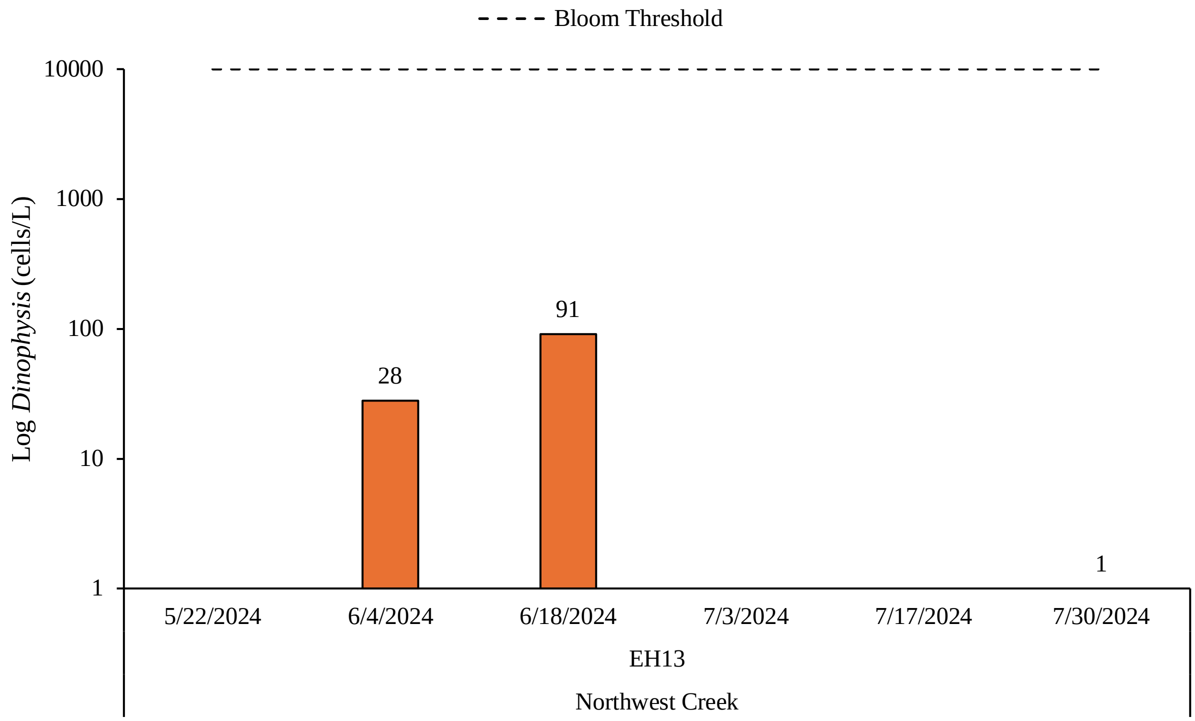

Figure 18. Concentrations of *Dinophysis* (cells/L) at one site in Northwest Creek during 2024. The dashed lines represent bloom thresholds for *Dinophysis* (10,000 cells/L).

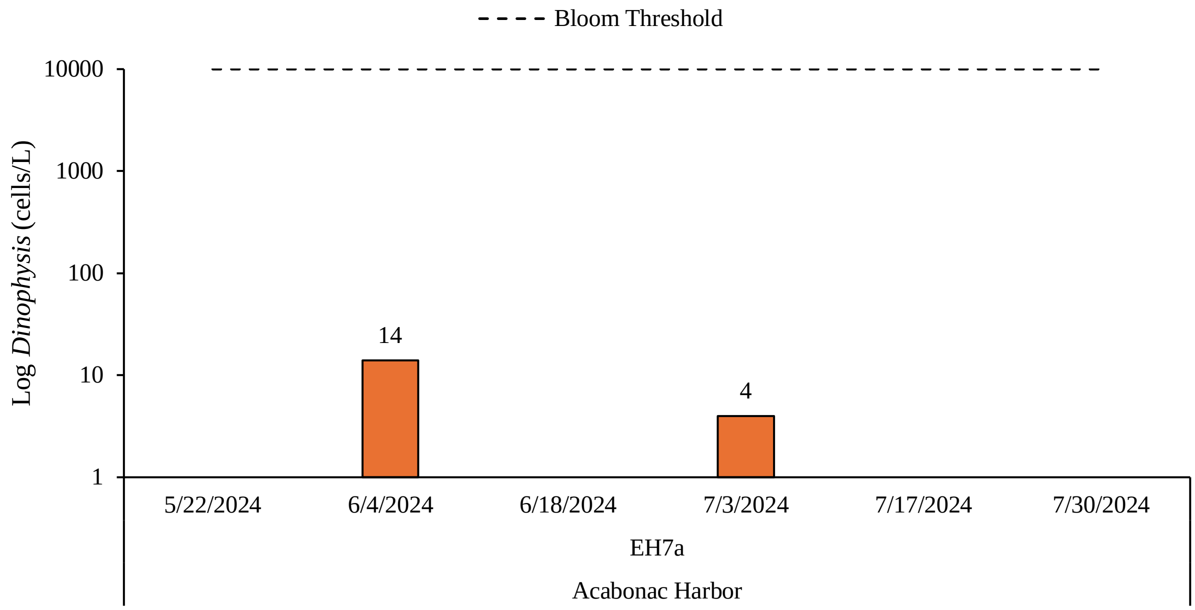

Figure 19. Concentrations of *Dinophysis* (cells/L) at one site in Acabonac Harbor during 2024. The dashed lines represent bloom thresholds for *Dinophysis* (10,000 cells/L).

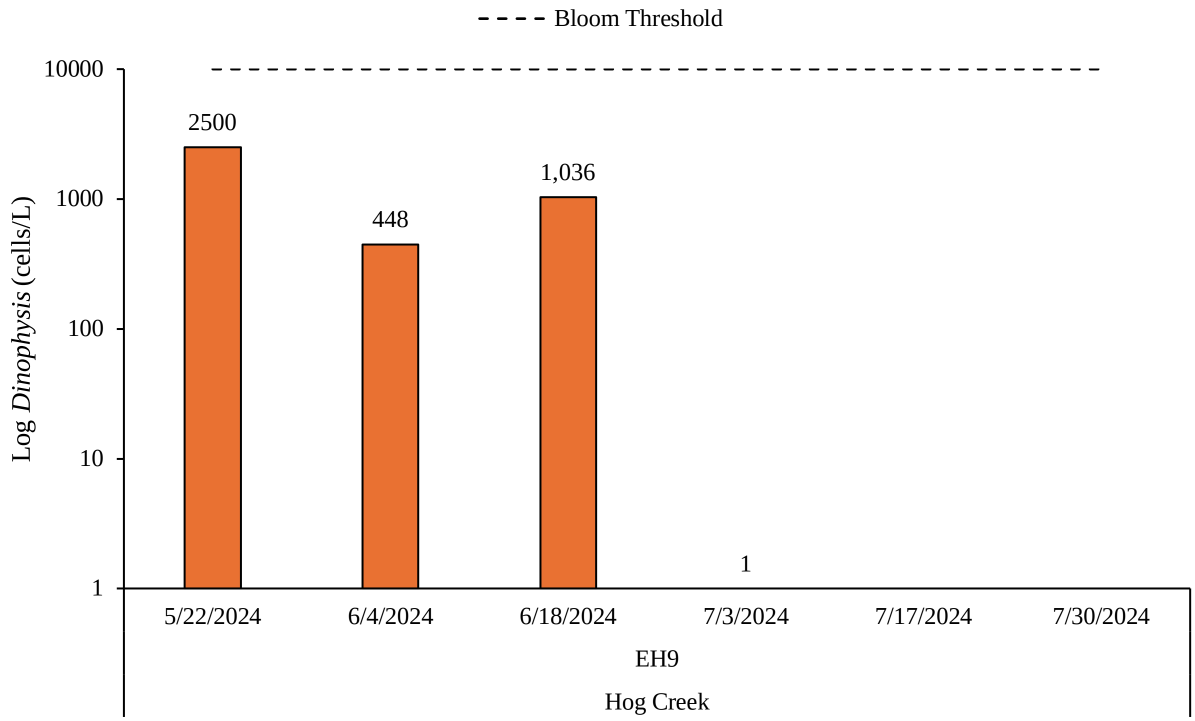

Figure 20. Concentrations of *Dinophysis* (cells/L) at one site in Hog Creek during 2024. The dashed lines represent bloom thresholds for *Dinophysis* (10,000 cells/L).

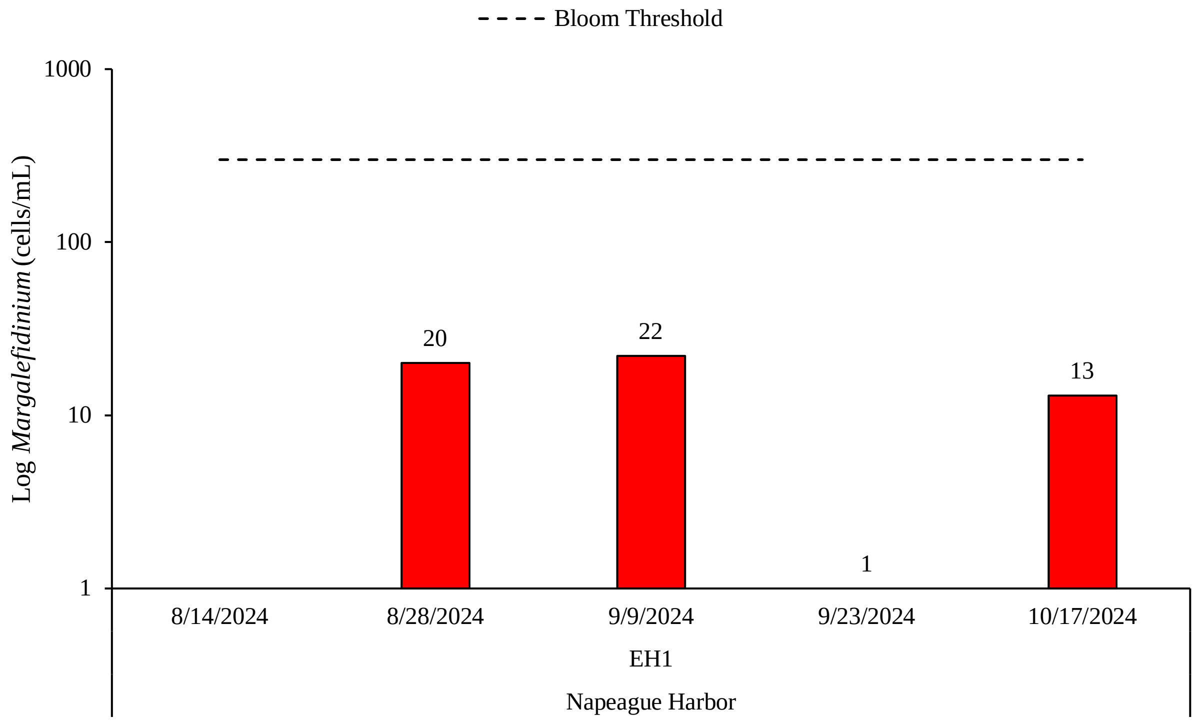

Figure 21. Concentrations of *Margalefidinium* (cells/mL) at one site in Napeague Harbor during 2024. The dashed lines represent bloom thresholds for *Margalefidinium* (300 cells/mL).

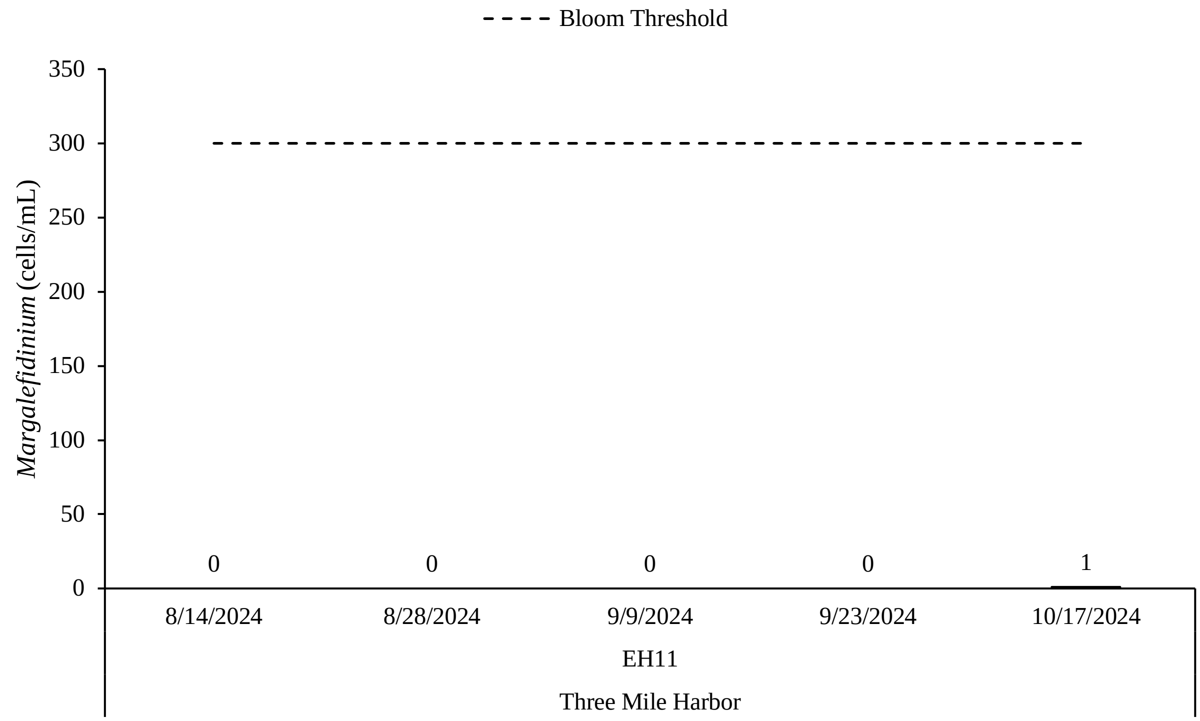

Figure 22. Concentrations of *Margalefidinium* (cells/mL) at one site in Three Mile Harbor during 2024 The dashed lines represent bloom thresholds for *Margalefidinium* (300 cells/mL).

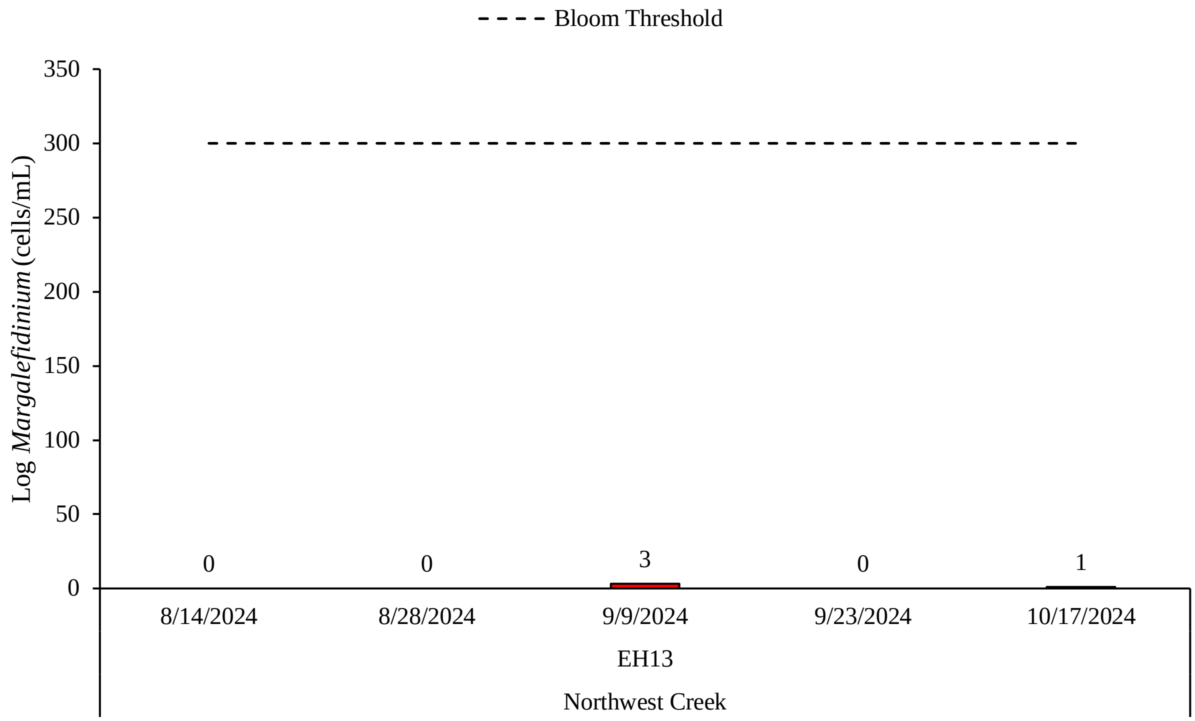

Figure 23. Concentrations of *Margalefidinium* (cells/mL) at one site in Northwest Creek during 2024. The dashed lines represent bloom thresholds for *Cochlodinium* (300 cells/mL).

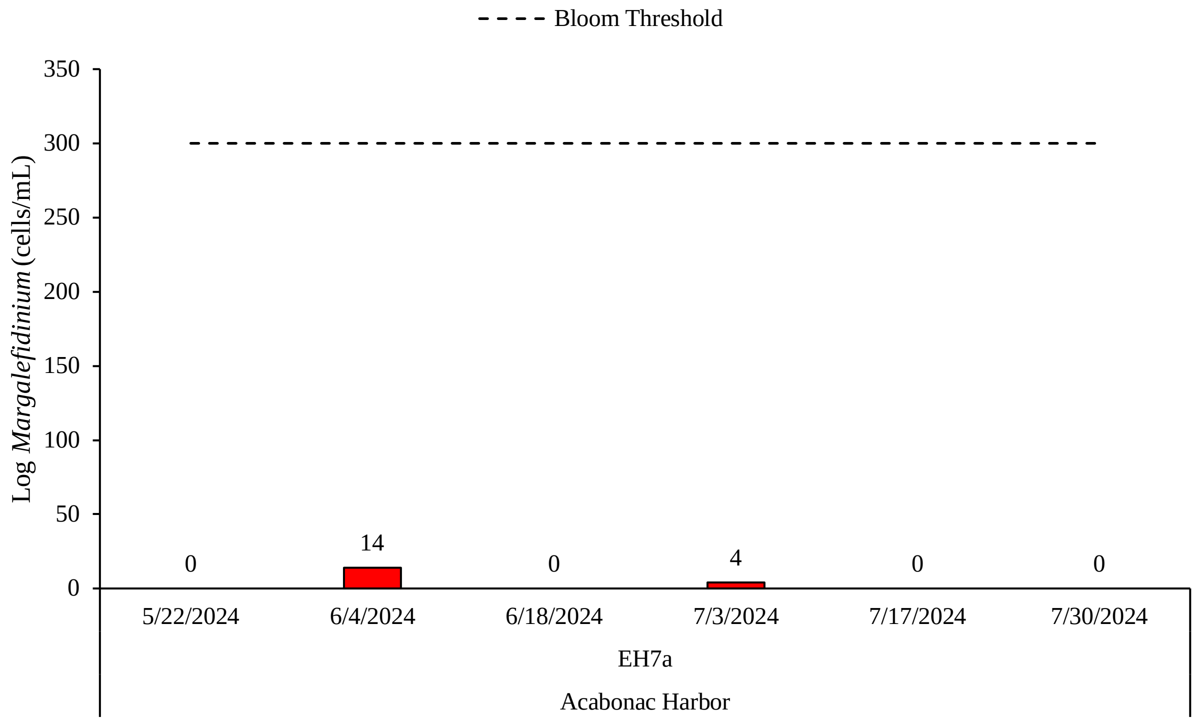

Figure 24. Concentrations of *Margalefidinium* (cells/mL) at one site in Northwest Creek during 2024. The dashed lines represent bloom thresholds for *Margalefidinium* (300 cells/mL).

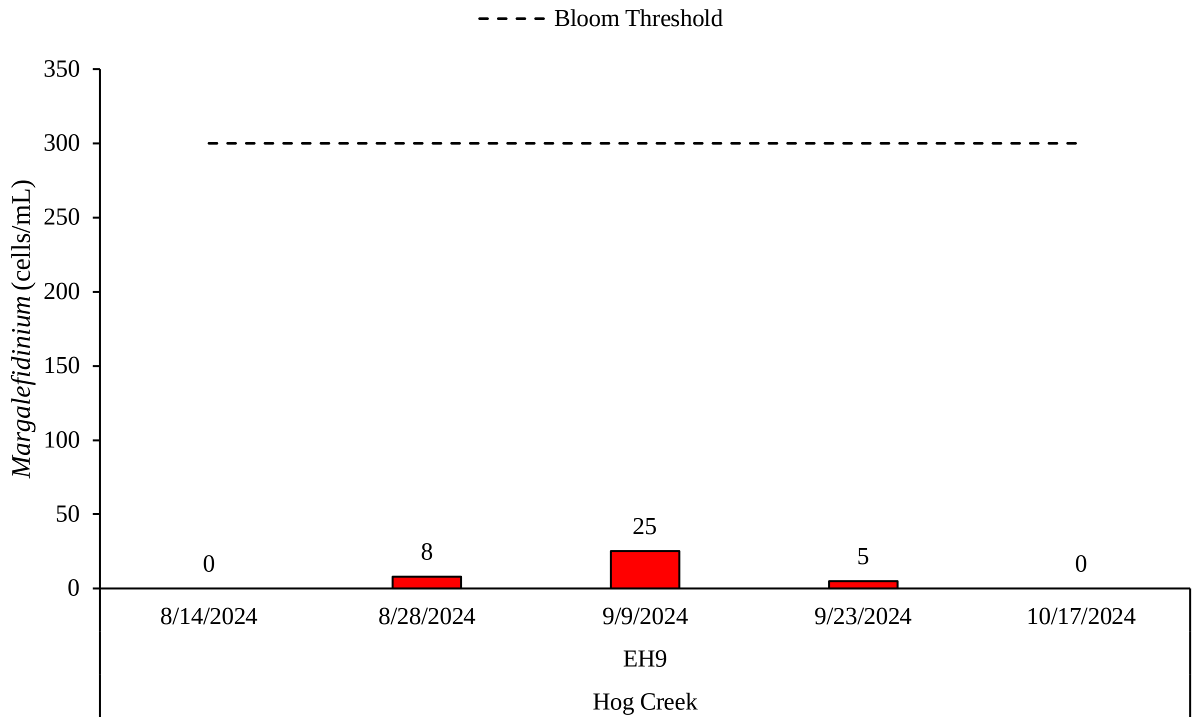

Figure 25. Concentrations of *Margalefidinium* (cells/mL) at one site in Hog Creek during 2024. The dashed lines represent bloom thresholds for *Margalefidinium* (300 cells/mL).

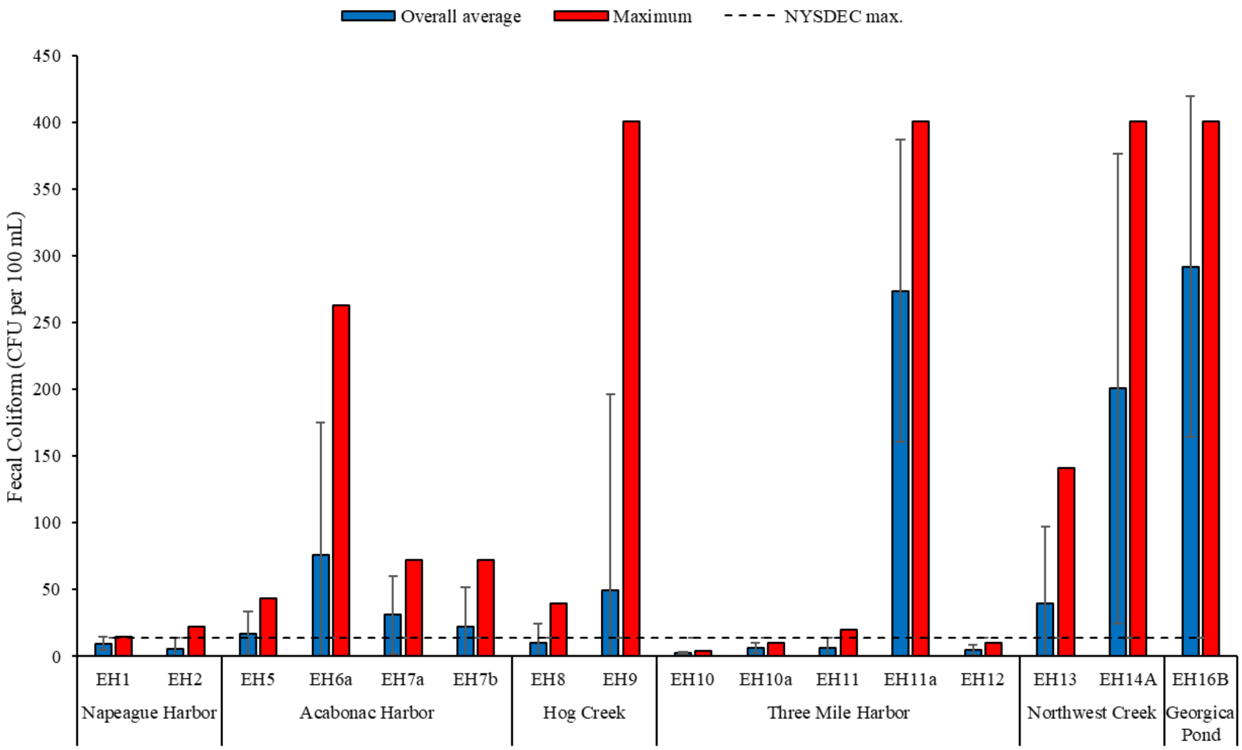

Figure 13. Overall average and maximum enterococci levels (CFU per 100 mL) at various marine sites in East Hampton during 2024. The dashed lines are the NYSDEC maximum fecal coliform levels for shellfishing (14 CFU per 100 mL).

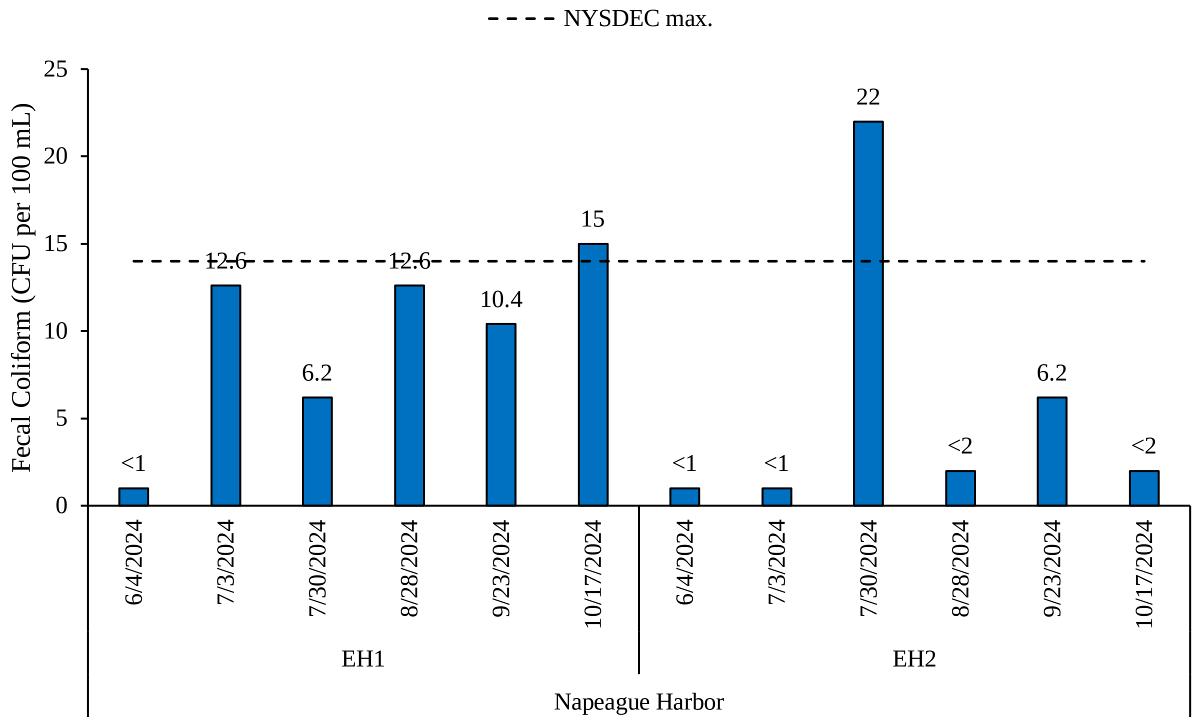

Figure 26. Fecal coliform levels (CFU per 100 mL) at various sites in Napeague Harbor during 2024. The dashed lines are the NYSDEC maximum fecal coliform levels for shellfishing (14 CFU per 100 mL).

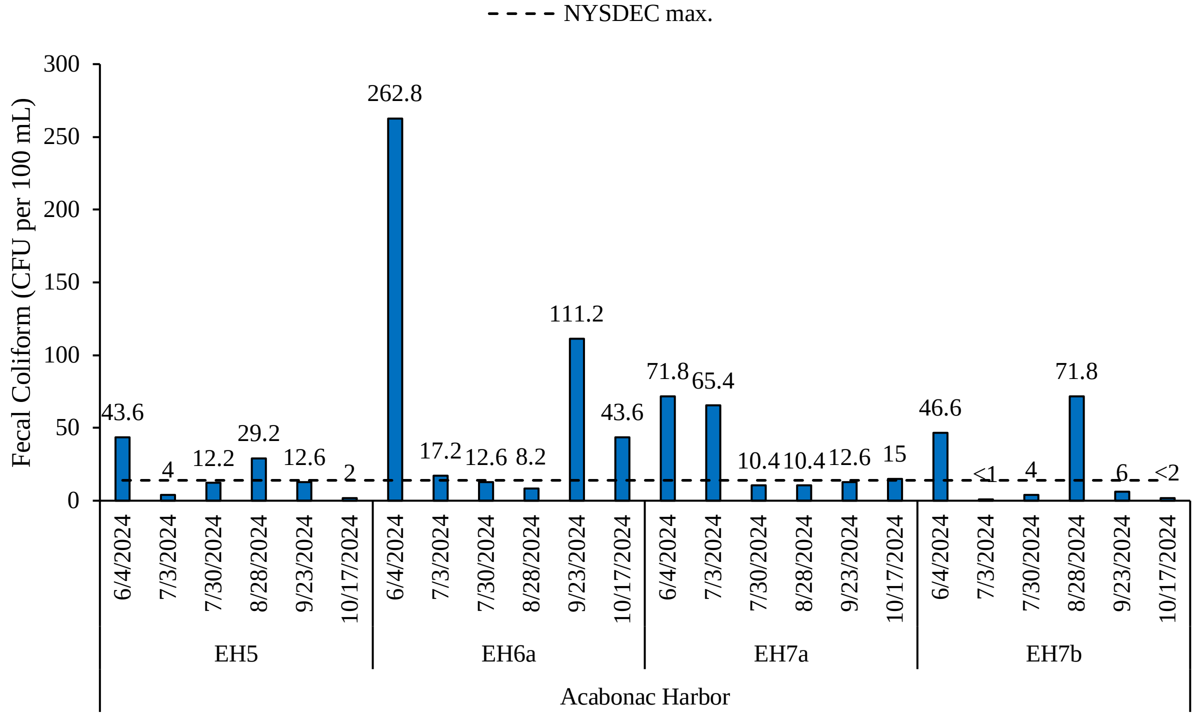

Figure 27. Fecal coliform levels (CFU per 100 mL) at various sites in Acabonac Harbor during 2024. The dashed lines are the NYSDEC maximum fecal coliform levels for shellfishing (14 CFU per 100 mL).

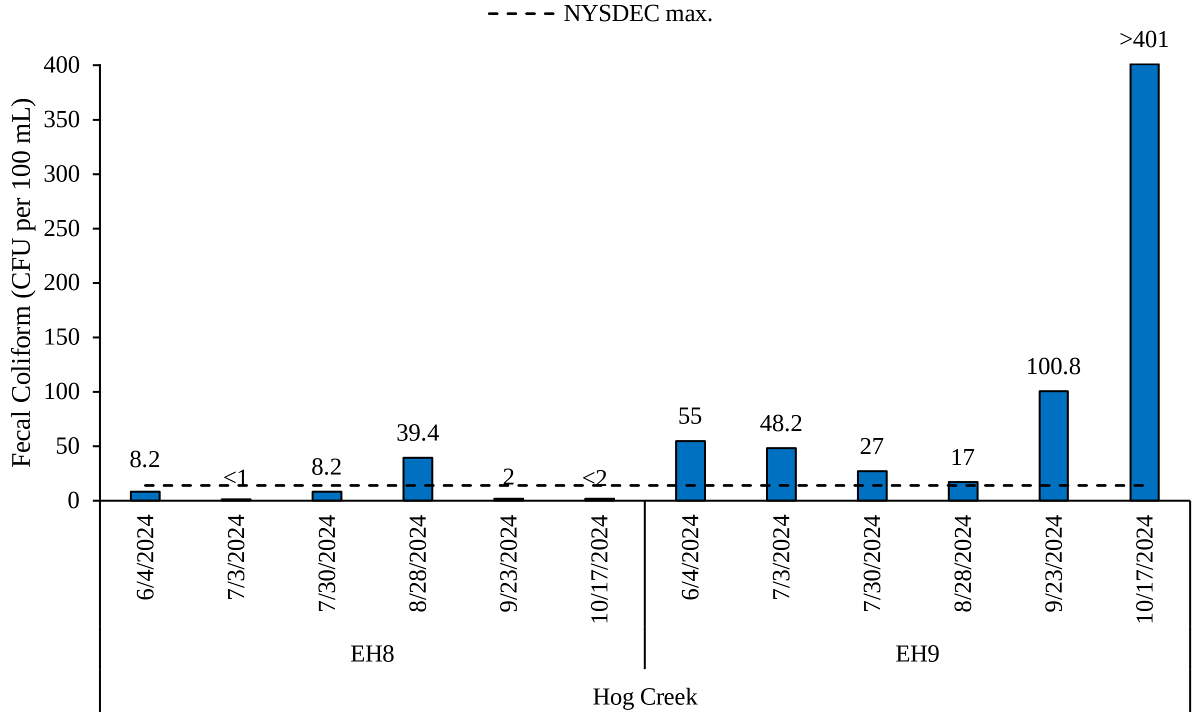

Figure 28. Fecal coliform levels (CFU per 100 mL) at various sites in Hog Creek during 2024. The dashed lines are the NYSDEC maximum fecal coliform levels for shellfishing (14 CFU per 100 mL).

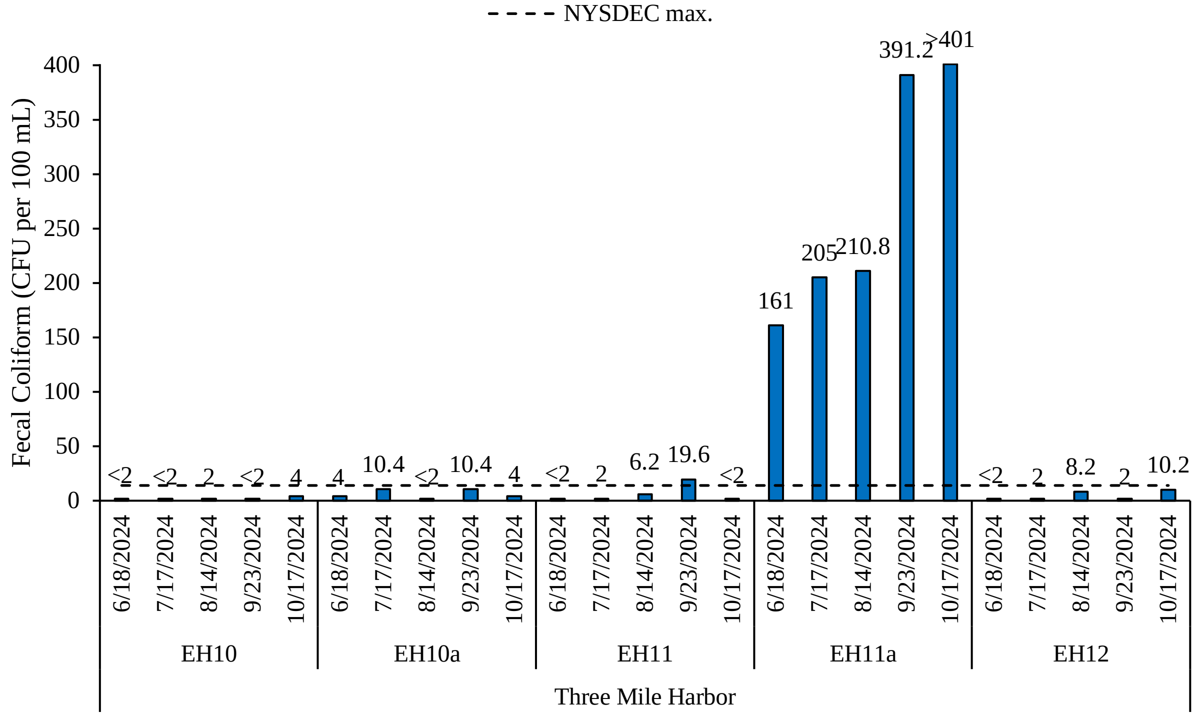

Figure 29. Fecal coliform levels (CFU per 100 mL) at various sites in Three Mile Harbor during 2024. The dashed lines are the NYSDEC maximum fecal coliform levels for shellfishing (14 CFU per 100 mL).

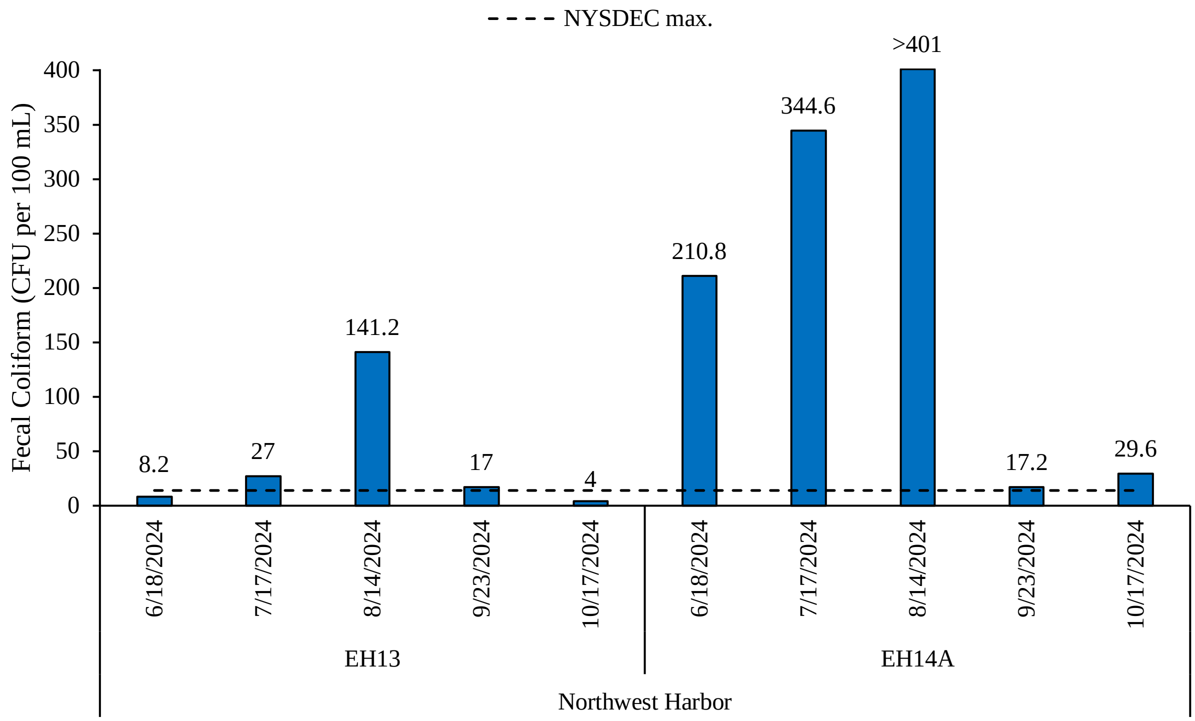

Figure 30. Fecal coliform levels (CFU per 100 mL) at various sites in Northwest Harbor during 2024. The dashed lines are the NYSDEC maximum fecal coliform levels for shellfishing (14 CFU per 100 mL).

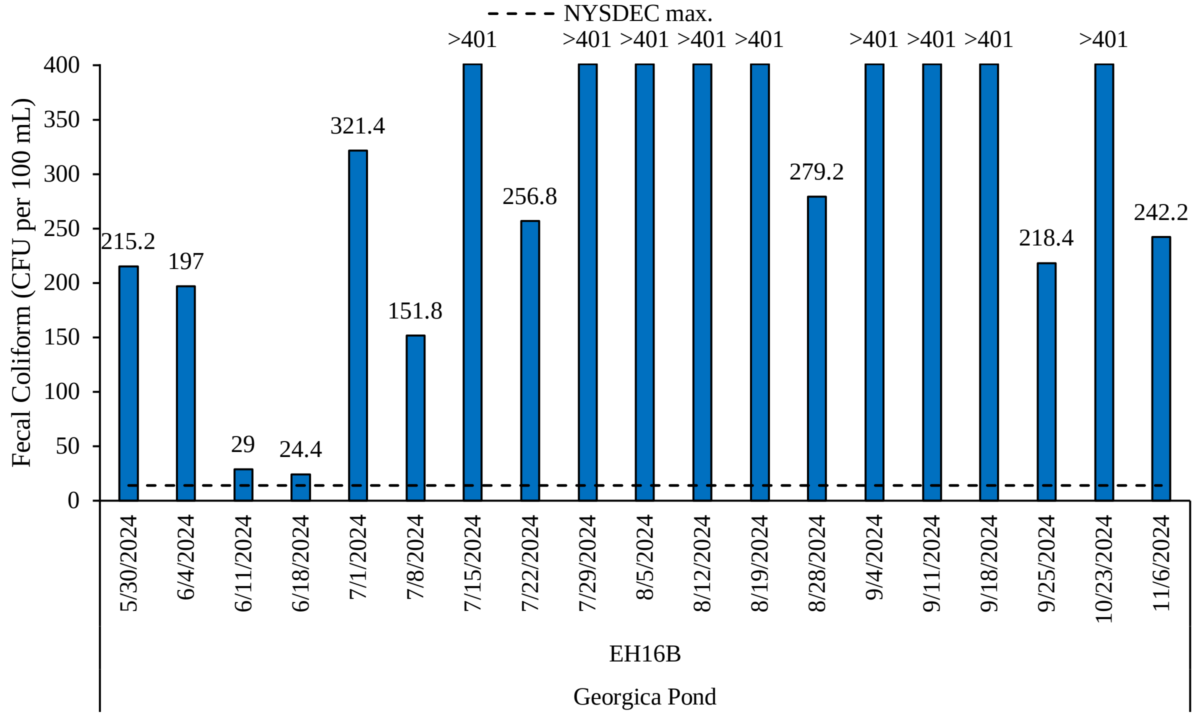

Figure 31. Fecal coliform levels (CFU per 100 mL) at one site in Georgica Pond during 2024. The dashed lines are the NYSDEC maximum fecal coliform levels for shellfishing (14 CFU per 100 mL).

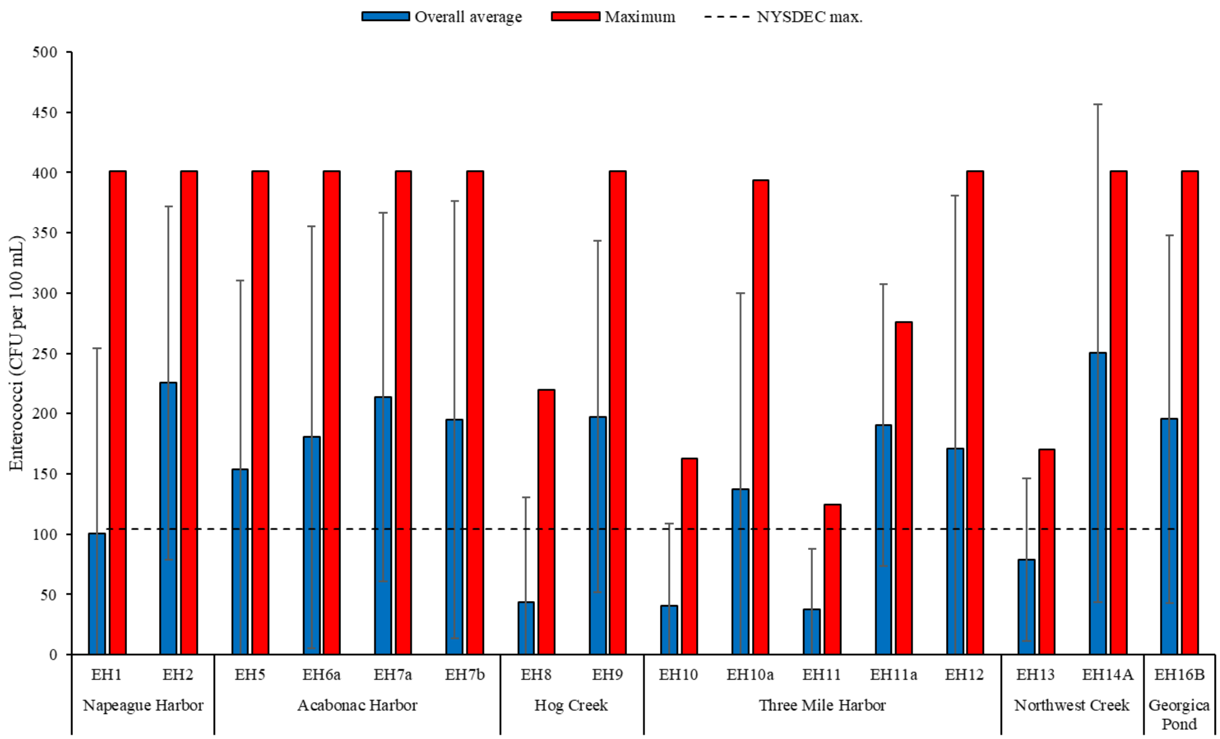

Figure 13. Overall average and maximum enterococci levels (CFU per 100 mL) at various marine sites in East Hampton during 2024. The dashed lines are the NYSDOH maximum enterococci levels for recreational use (104 CFU per 100 mL).

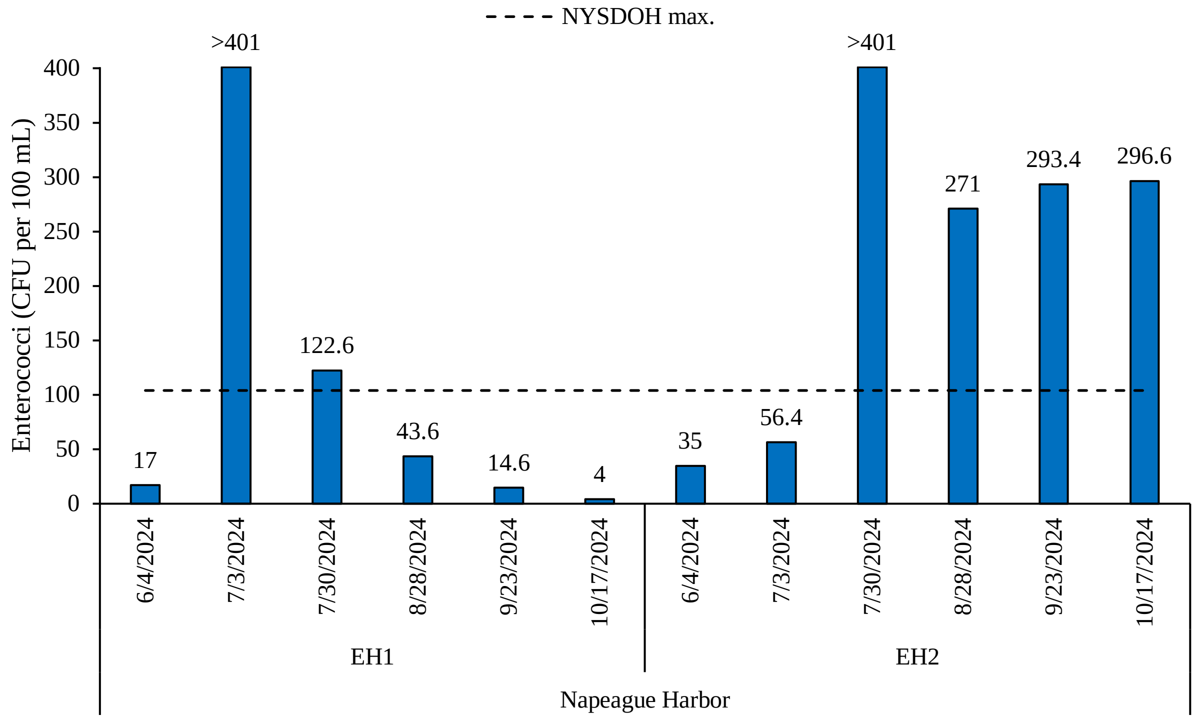

Figure 32. Enterococci levels (CFU per 100 mL) at various sites in Napeague Harbor during 2024. The dashed lines are the NYSDOH maximum enterococci levels for recreational use (104 CFU per 100 mL).

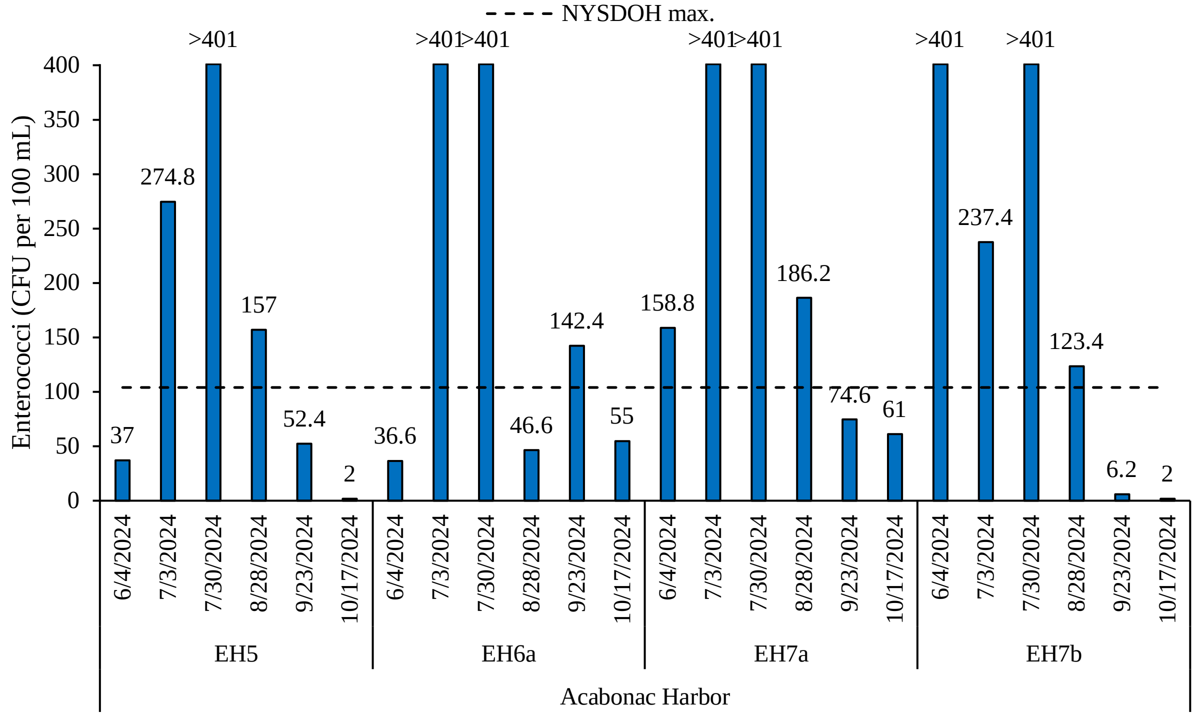

Figure 33. Enterococci levels (CFU per 100 mL) at various sites in Acabonac Harbor during 2024. The dashed lines are the NYSDOH maximum enterococci levels for recreational use (104 CFU per 100 mL).

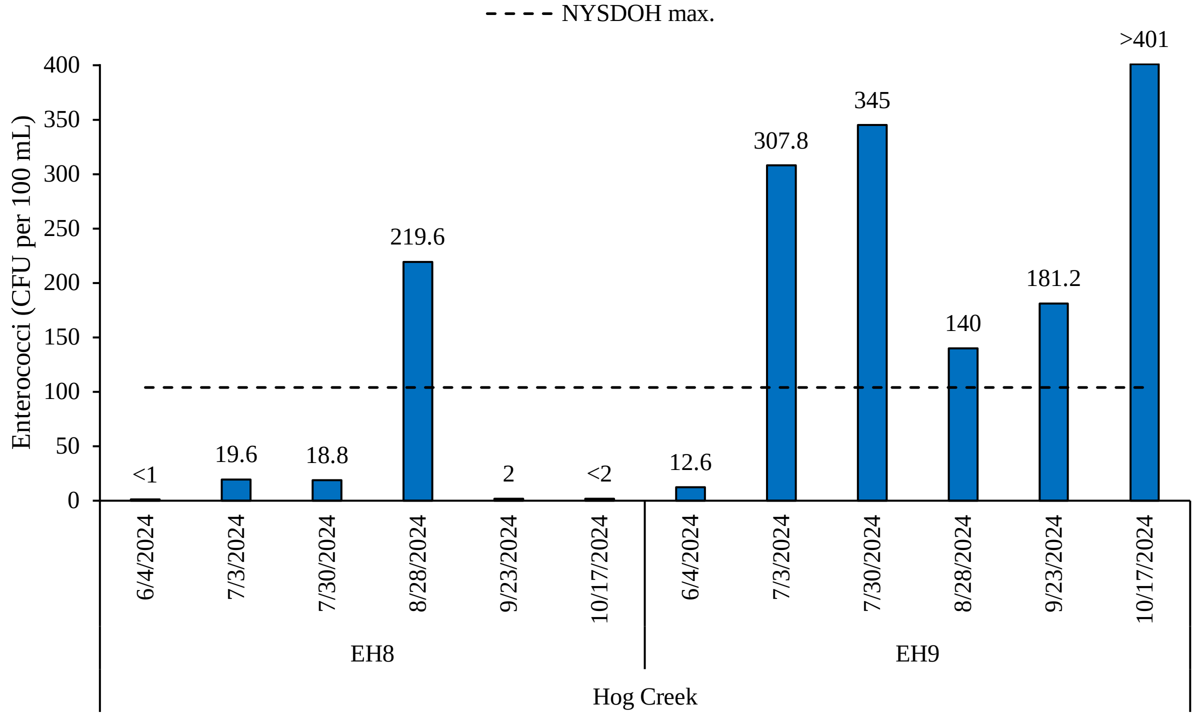

Figure 34. Enterococci levels (CFU per 100 mL) at various sites in Hog Creek during 2024. The dashed lines are the NYSDOH maximum enterococci levels for recreational use (104 CFU per 100 mL).

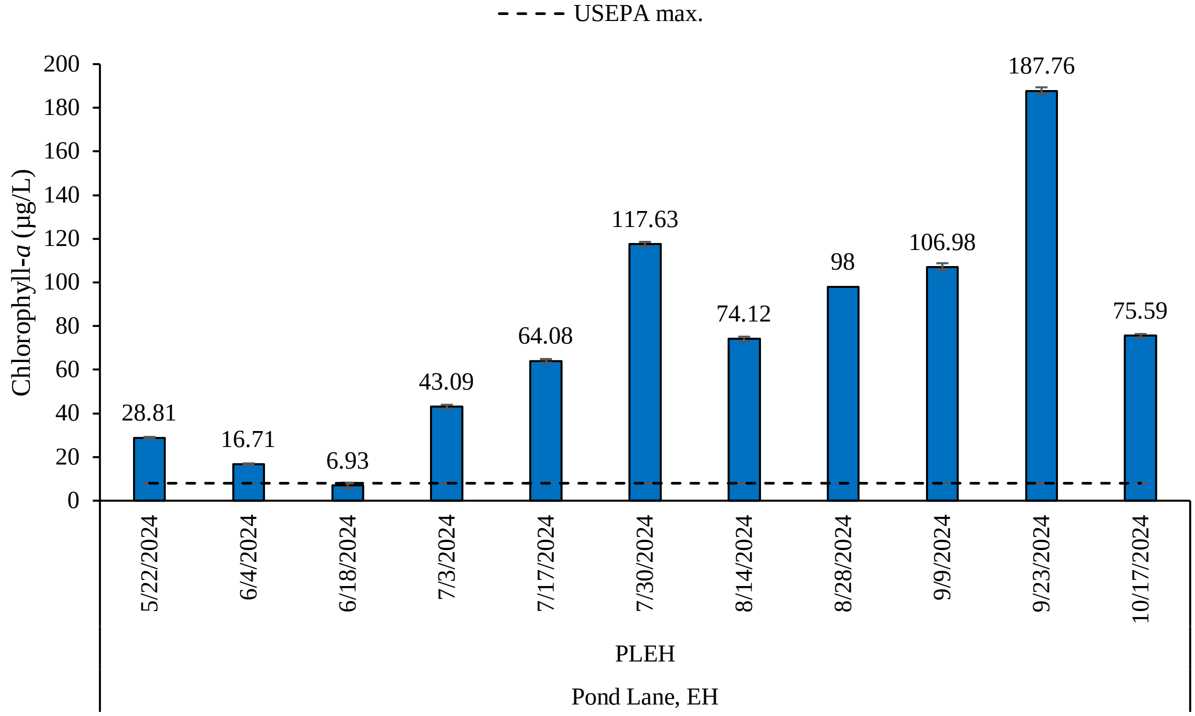

Figure 56. Chlorophyll-*a* concentrations (µg/L) in Pond Lane (PLEH) during 2024. The dashed line represents the USEPA maximum for chlorophyll-*a* in freshwater systems (8 µg/L). Error bars represent standard deviation.

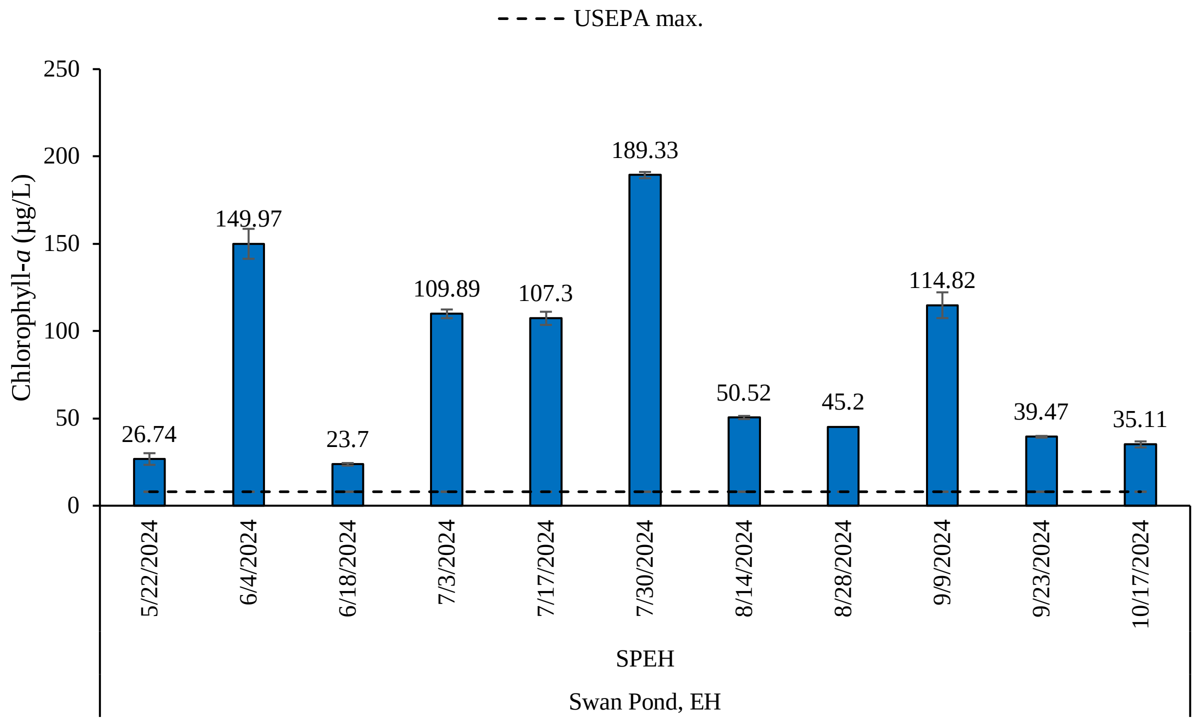

Figure 57. Chlorophyll-*a* concentrations (µg/L) in Swan Pond (SPEH) during 2024. The dashed line represents the USEPA maximum for chlorophyll-*a* in freshwater systems (8 µg/L). Error bars represent standard deviation.

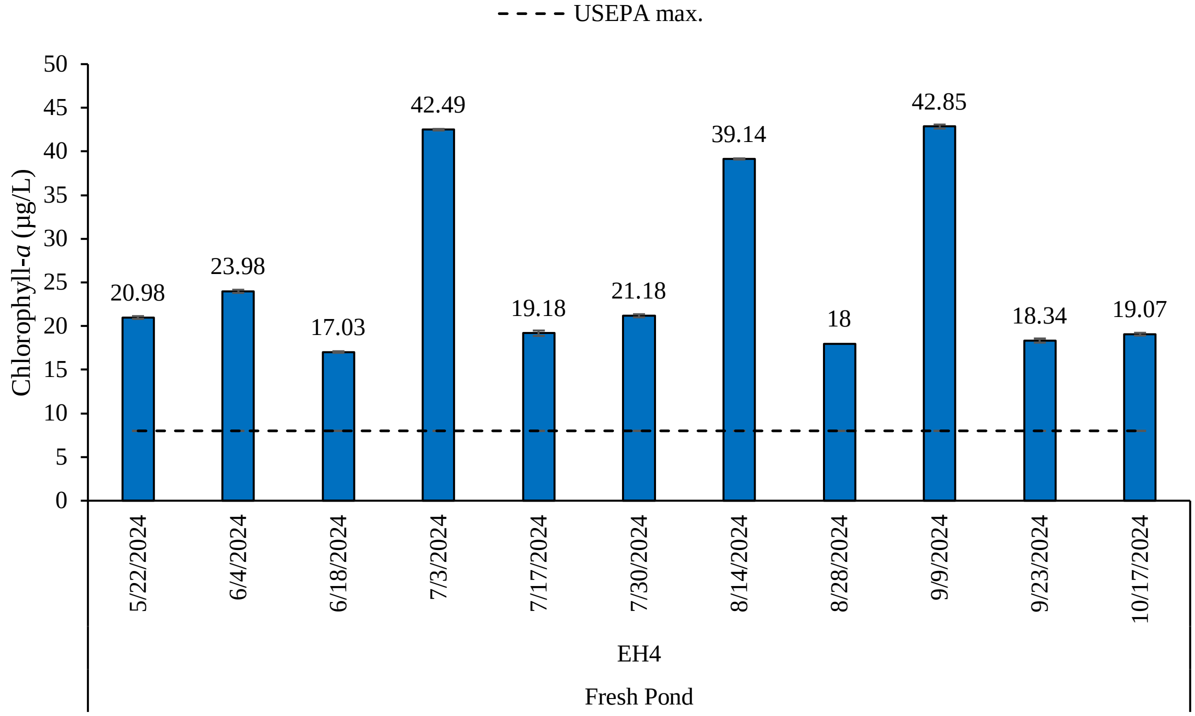

Figure 58. Chlorophyll-*a* concentrations (µg/L) in Fresh Pond (EH4) during 2024. The dashed line represents the USEPA maximum for chlorophyll-*a* in freshwater systems (8 µg/L). Error bars represent standard deviation.

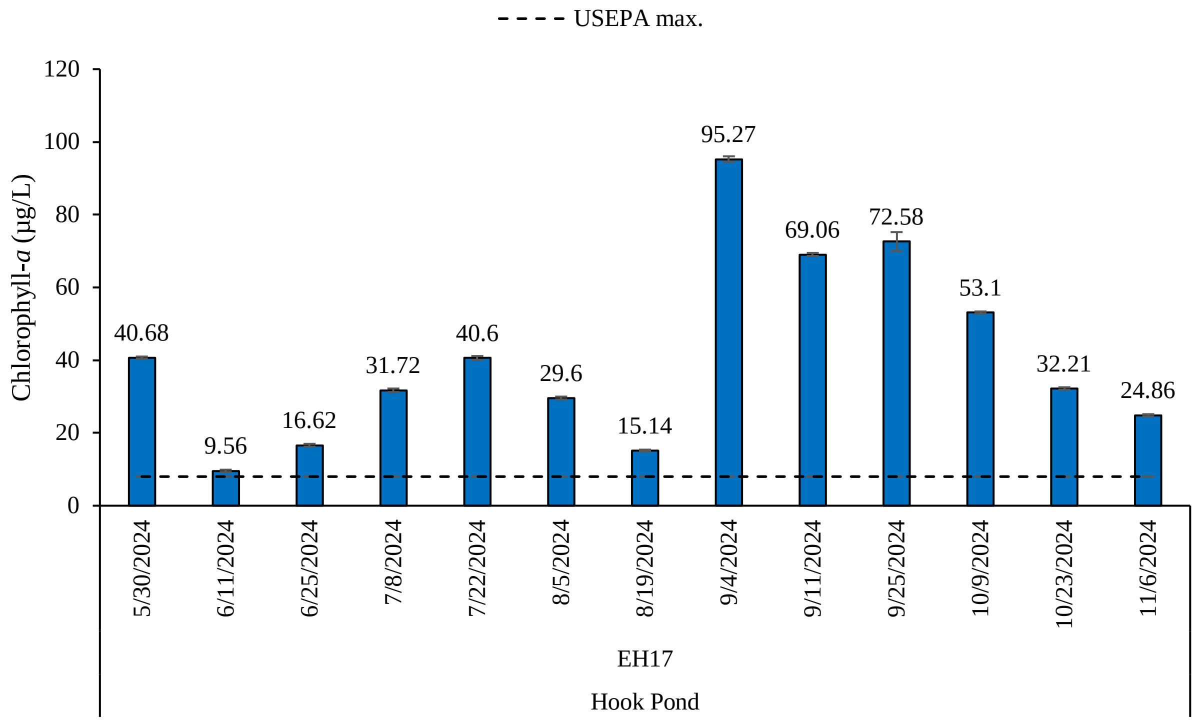

Figure 59. Chlorophyll-*a* concentrations (µg/L) in Hook Pond (EH17) during 2024. The dashed line represents the USEPA maximum for chlorophyll-*a* in freshwater systems (8 µg/L). Error bars represent standard deviation.

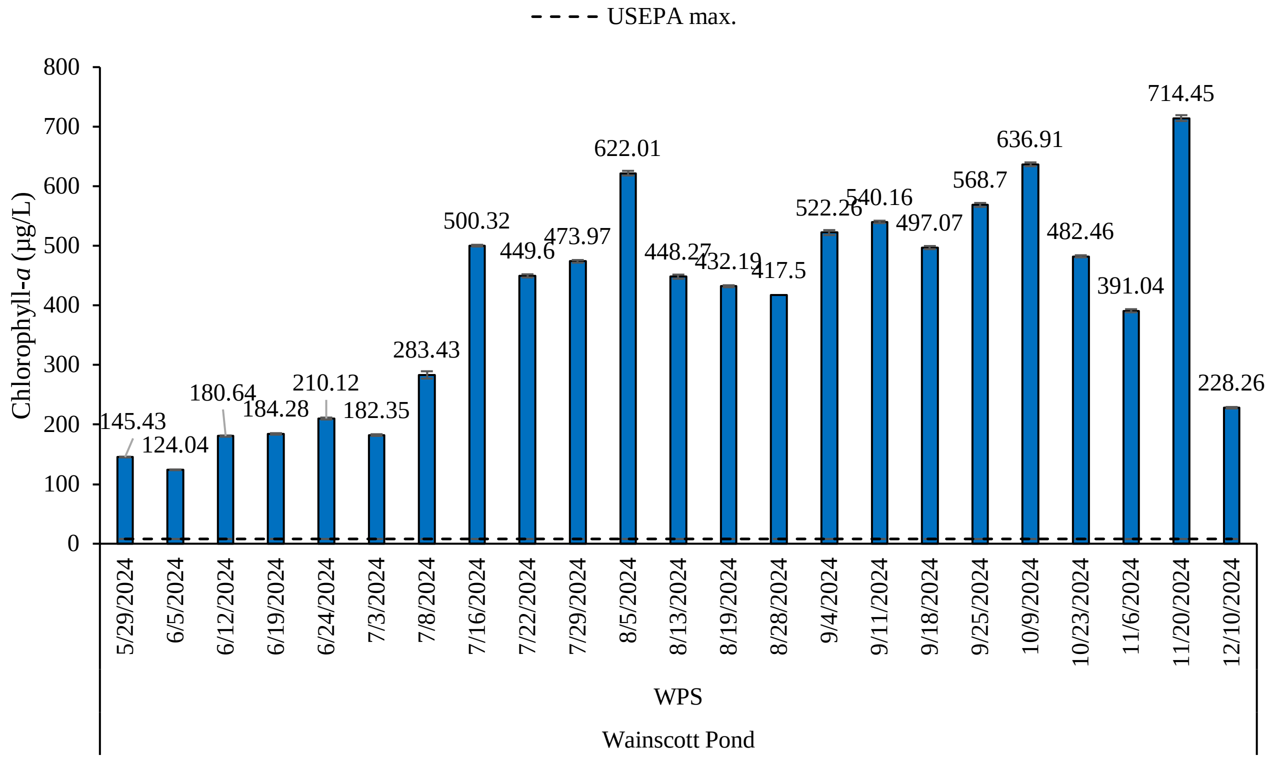

Figure 60. Chlorophyll-*a* concentrations (µg/L) in Wainscott Pond during 2024. The dashed line represents the USEPA maximum for chlorophyll-*a* in freshwater systems (8 µg/L). Error bars represent standard deviation.

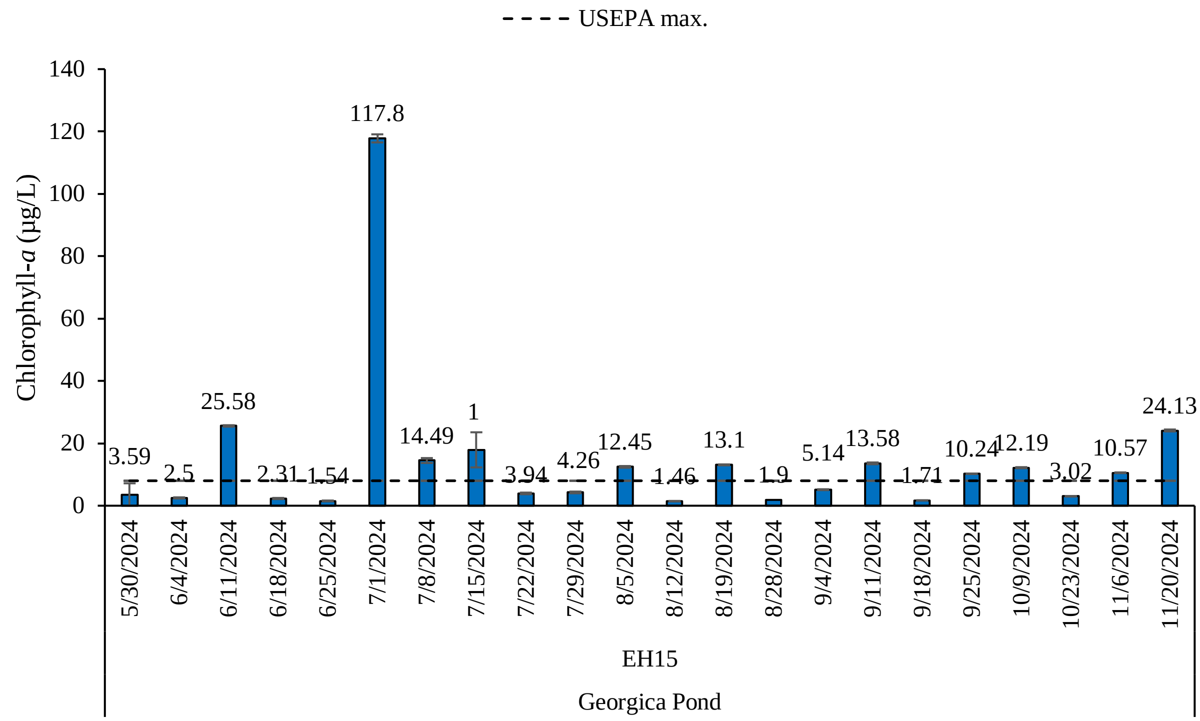

Figure 61. Chlorophyll-*a* concentrations (µg/L) in a site in Georgica Pond (EH15) during 2024. The dashed line represents the USEPA maximum for chlorophyll-*a* in freshwater systems (8 µg/L). Error bars represent standard deviation.

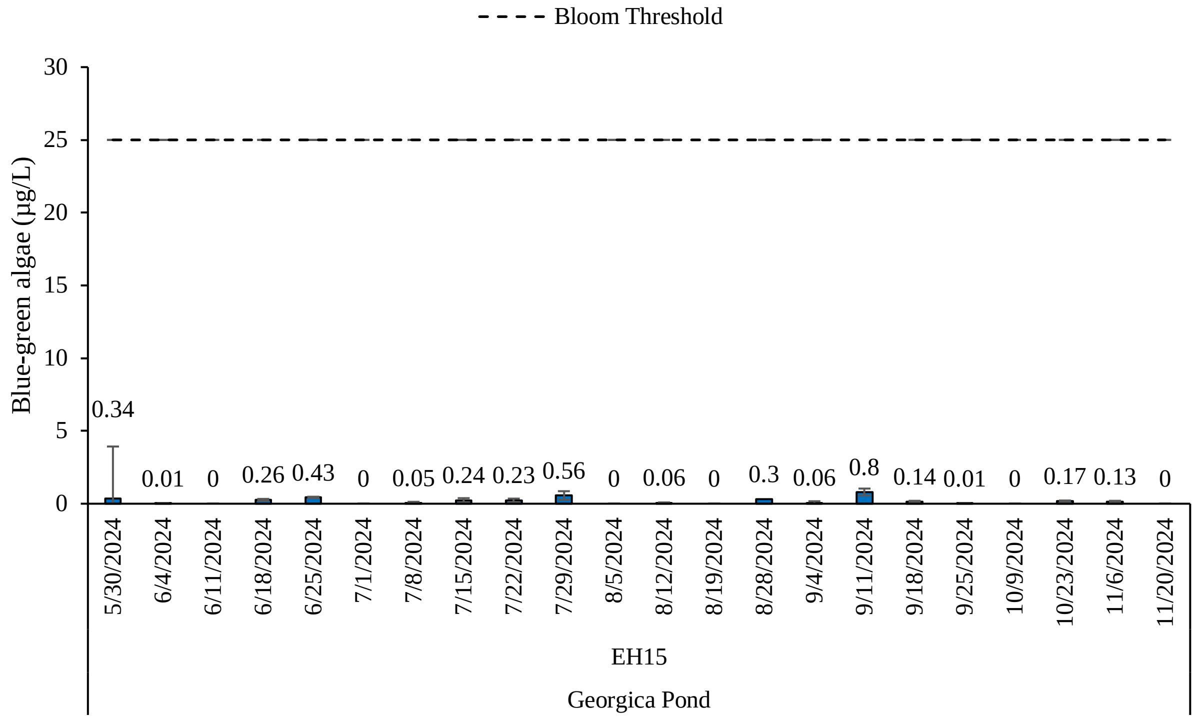

Figure 71. Blue-green algae concentrations (µg/L) in a site in Georgica Pond (EH15) during 2024. The dashed line represents the NYSDEC bloom threshold for blue-green algae (25 µg/L). Error bars represent standard deviation.

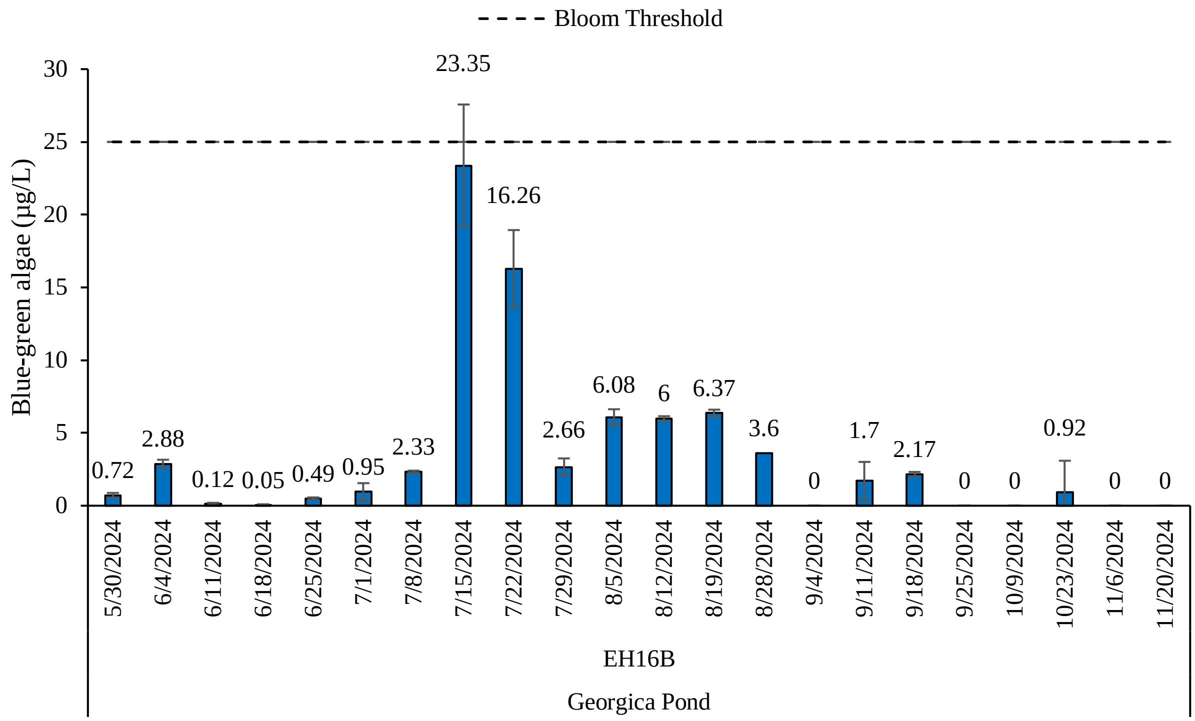

Figure 72. Blue-green algae concentrations (µg/L) in a site in Georgica Pond (EH16B) during 2024. The dashed line represents the NYSDEC bloom threshold for blue-green algae (25 µg/L). Error bars represent standard deviation.

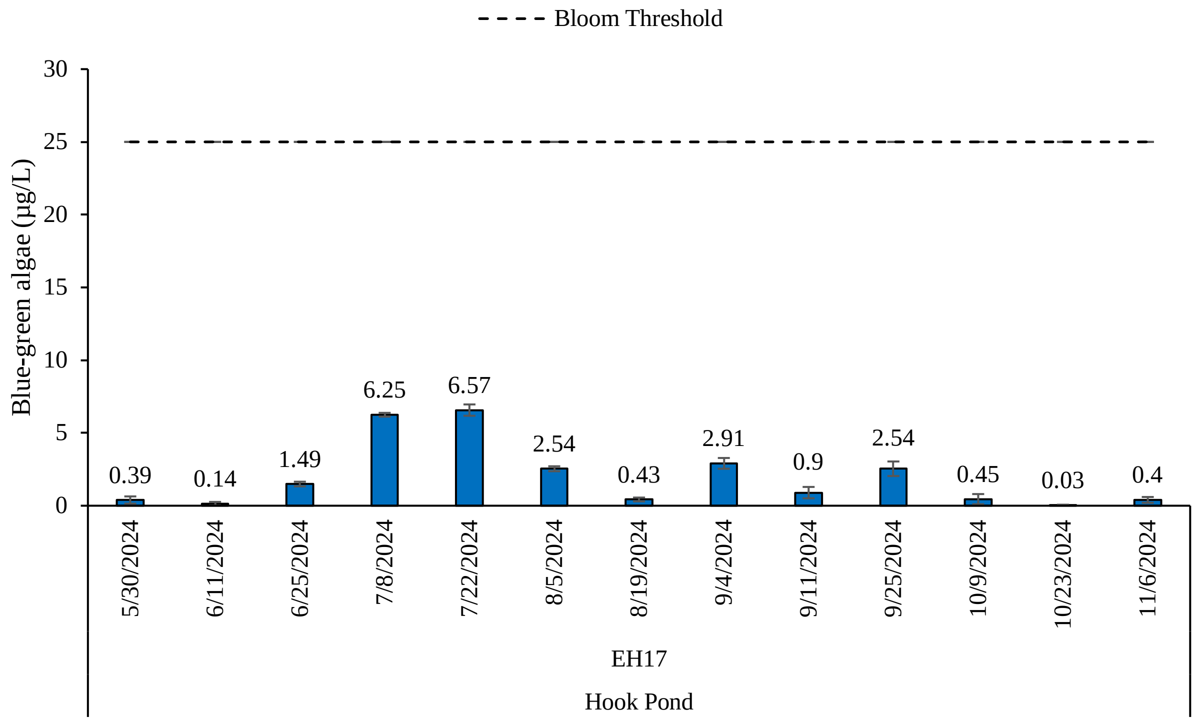

Figure 73. Blue-green algae concentrations (µg/L) in Hook Pond (EH17) during 2024. The dashed line represents the NYSDEC bloom threshold for blue-green algae (25 µg/L). Error bars represent standard deviation.

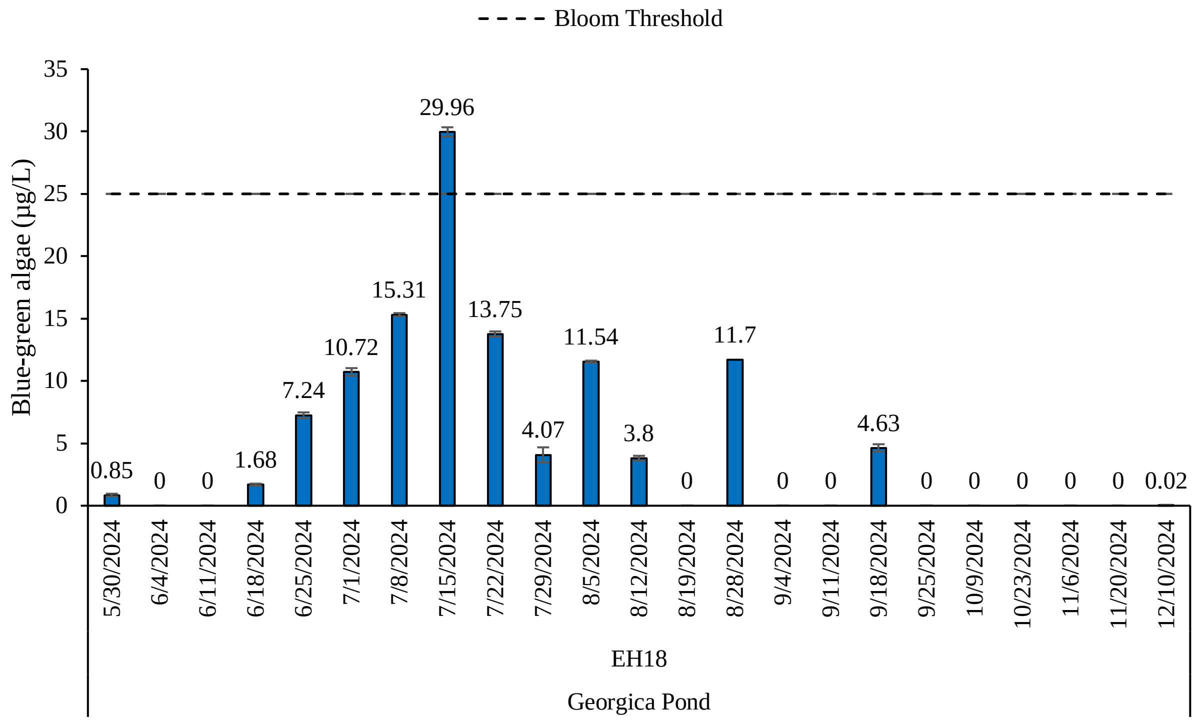

Figure 74. Blue-green algae concentrations (µg/L) in a site in Georgica Pond (EH18) during 2024. The dashed line represents the NYSDEC bloom threshold for blue-green algae (25 µg/L). Error bars represent standard deviation.

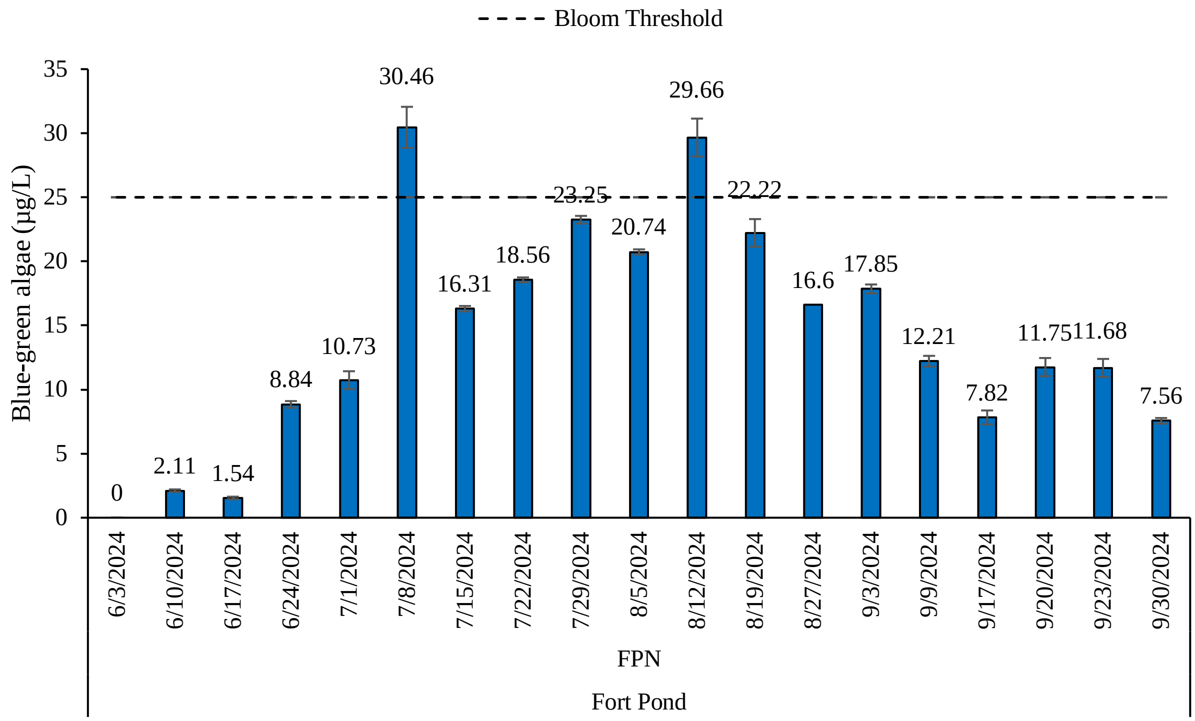

Figure 75. Blue-green algae concentrations (µg/L) in Fort Pond (North) during 2024. The dashed line represents the NYSDEC bloom threshold for blue-green algae (25 µg/L). Error bars represent standard deviation.

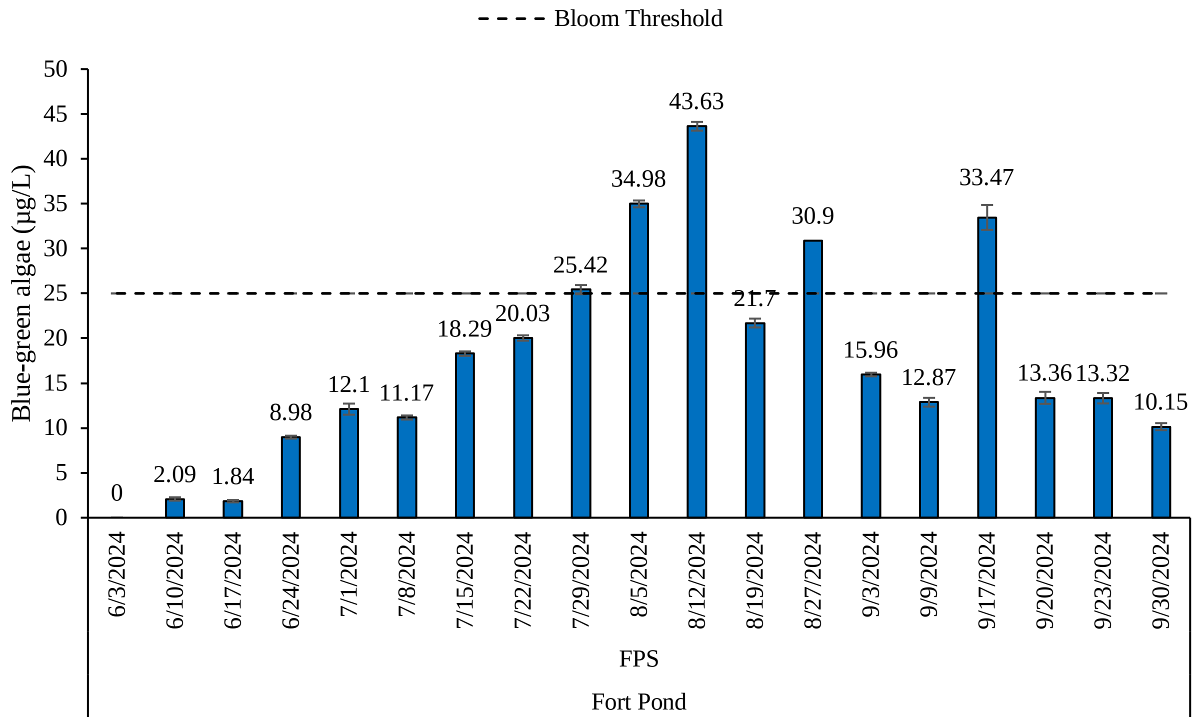

Figure 76. Blue-green algae concentrations (µg/L) in Fort Pond (South) during 2024. The dashed line represents the NYSDEC bloom threshold for blue-green algae (25 µg/L). Error bars represent standard deviation.

Location	Site	Cyanobacteria identified
Swan Pond, East Hampton	SPEH	Not detected
Pond Lane, East Hampton	PLEH	*Microcystis, Aphanizomenon, Aphanocapsa, Dolichospermum*
Fresh Pond, Amagansett	EH4	Not detected
Hook Pond	EH17	Not detected
Georgica Pond	EH15	Not detected
	EH16B	Not detected
	EH18	Not detected
Wainscott Pond	WPS	*Dolichospermum,Aphanizomenon, Microcystis, Planktothrix, Aphanocapsa*
Fort Pond	FPN	*Dolichospermum, Aphanizomenon, Microcystis*
	FPS	*Dolichospermum, Aphanizomenon, Planktothrix*

Table 3. List of cyanobacteria identified at each of the freshwater East Hampton sites in 2024.

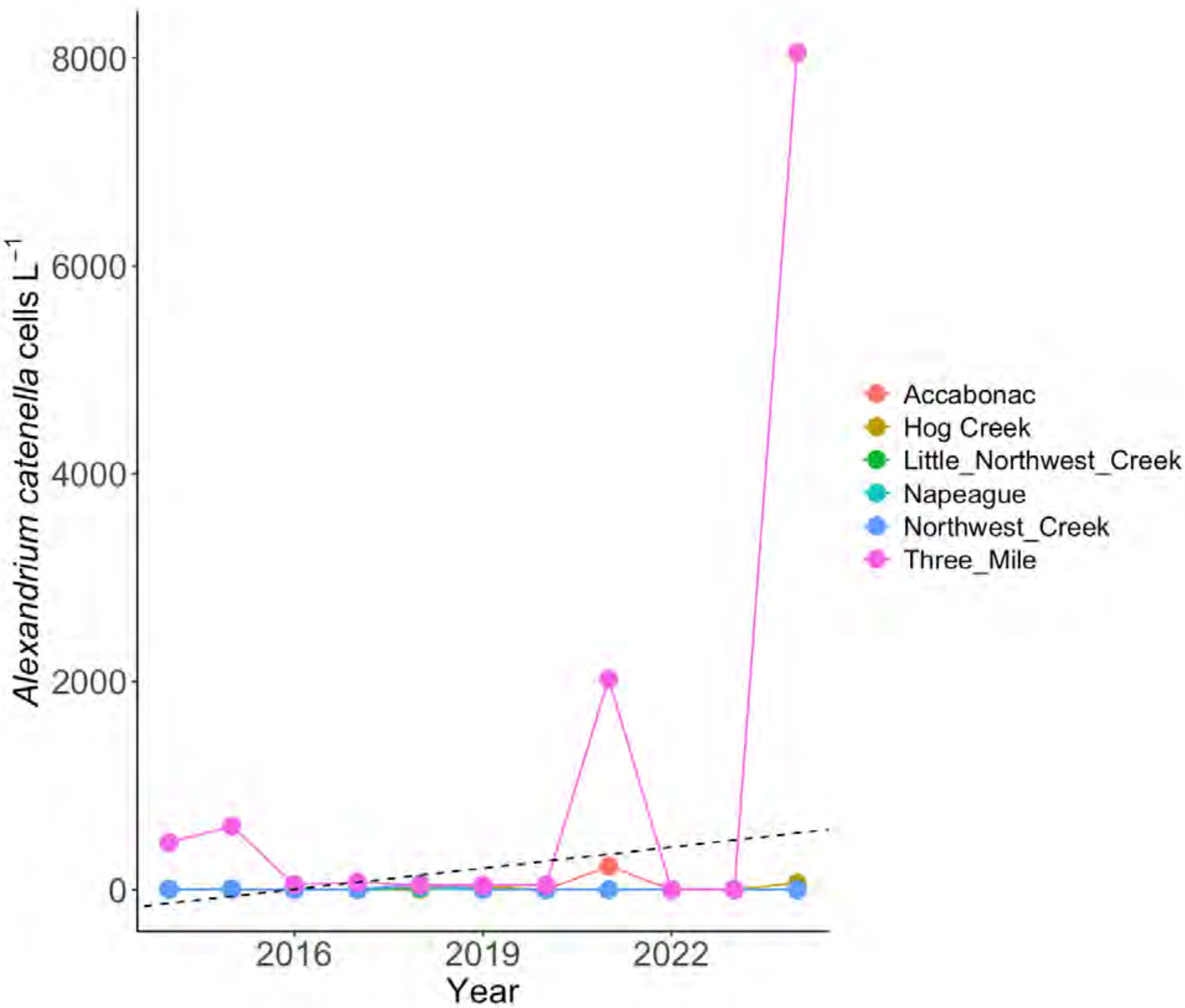

Figure 80. Yearly averages of *Alexandrium catenella* cell counts from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. There is no significant trend.

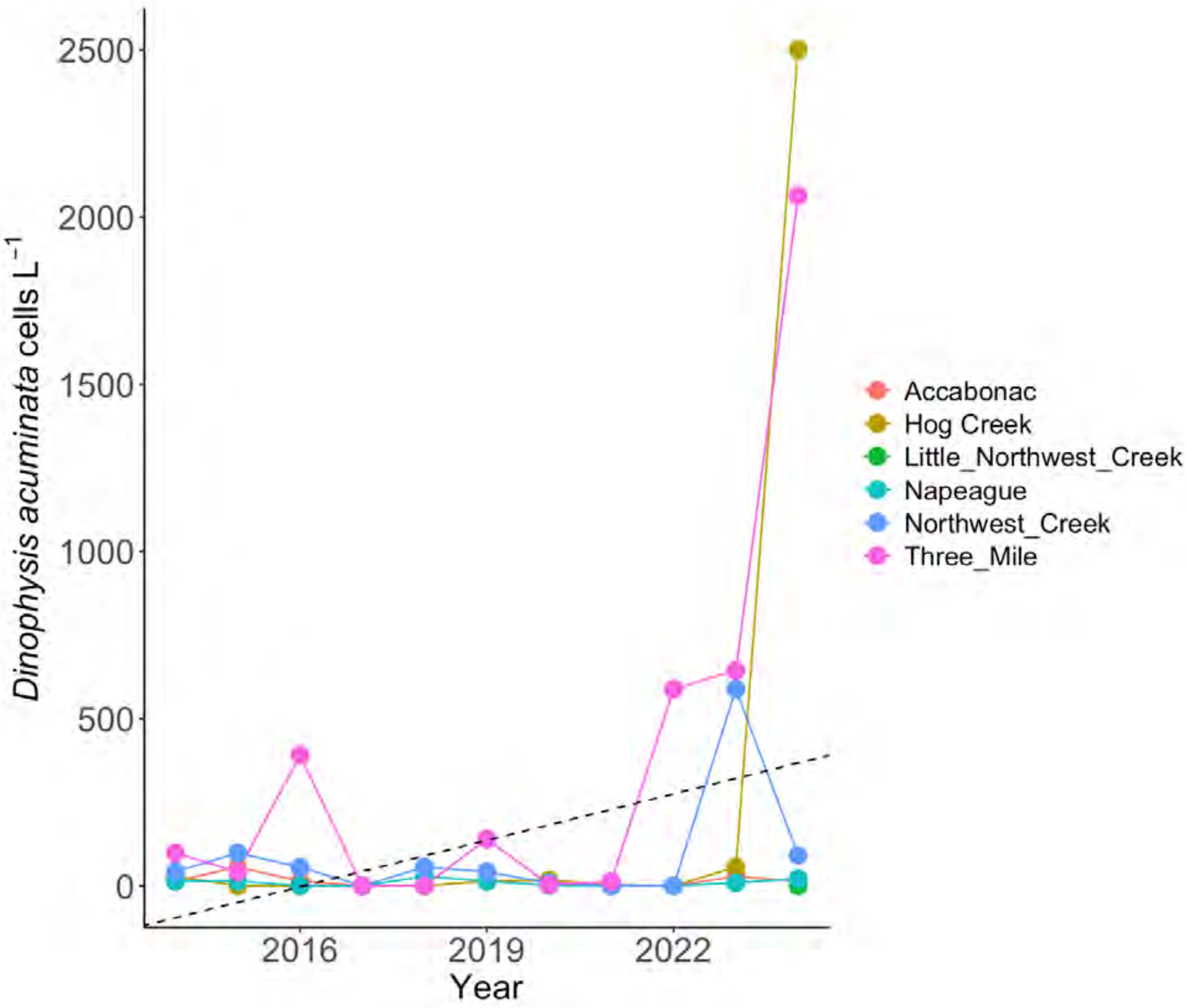

Figure 81. Annual maximum densities of *Dinophysis acuminata* cell counts from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. *D. acuminata* cell counts have increased in the last 10 years p-value=0.011.

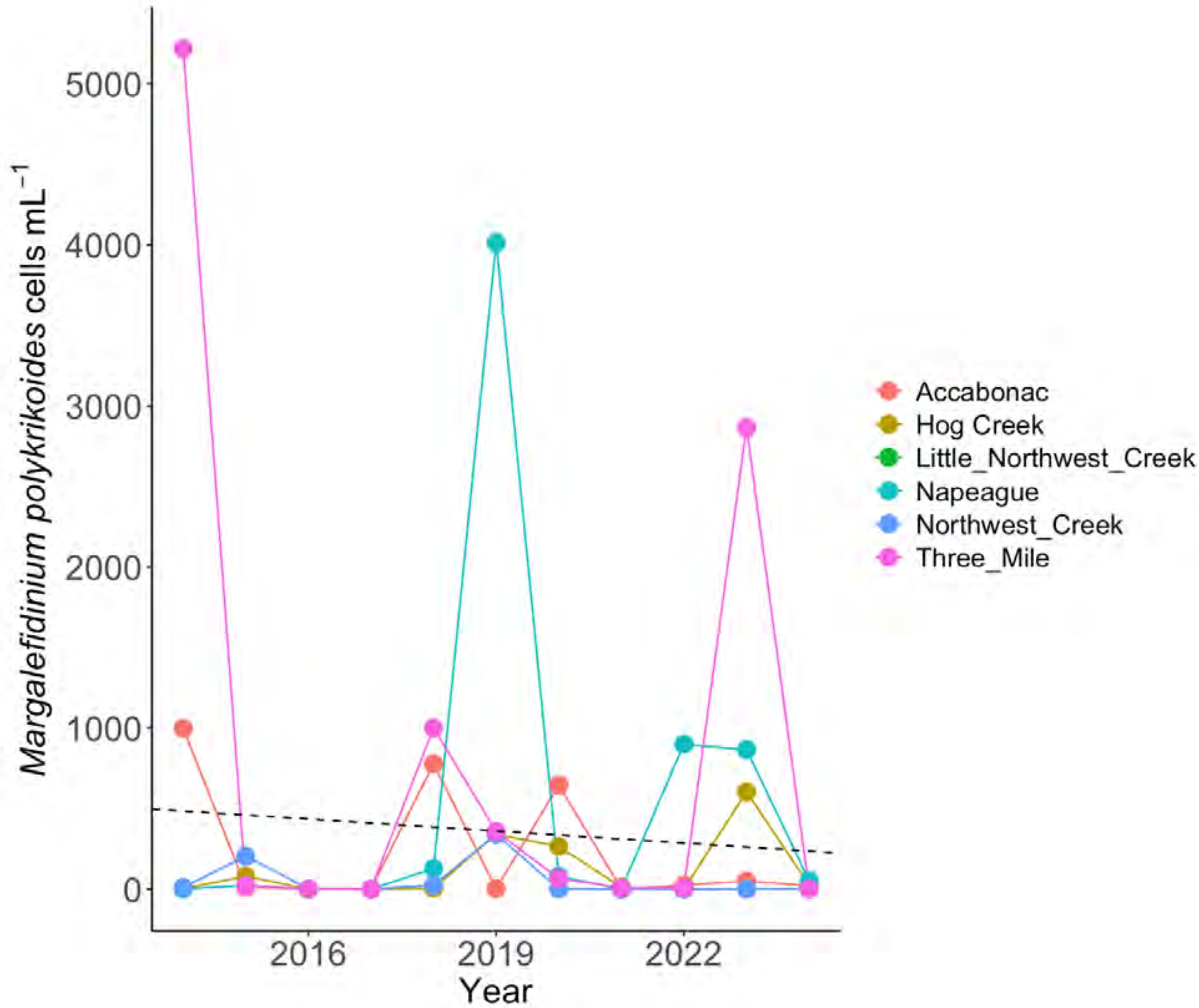

Figure 82. Annual maximum densities of *Margalefidinium polykrikoides* cell counts from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. There is no significant trend.

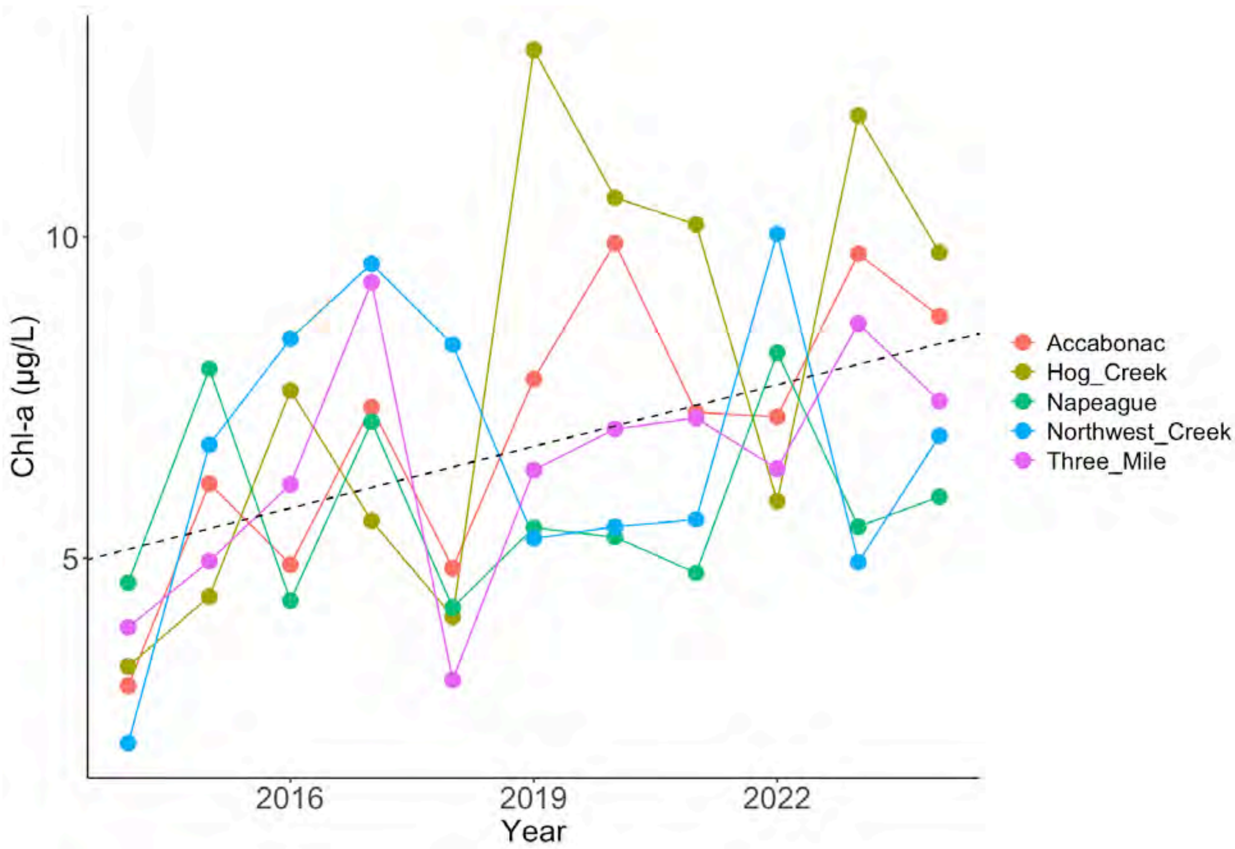

Figure 83. Yearly averages of chlorophyll-a (mg/L) from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. Chlorophyll-a values have increased in the last 10 years p-value=0.001.

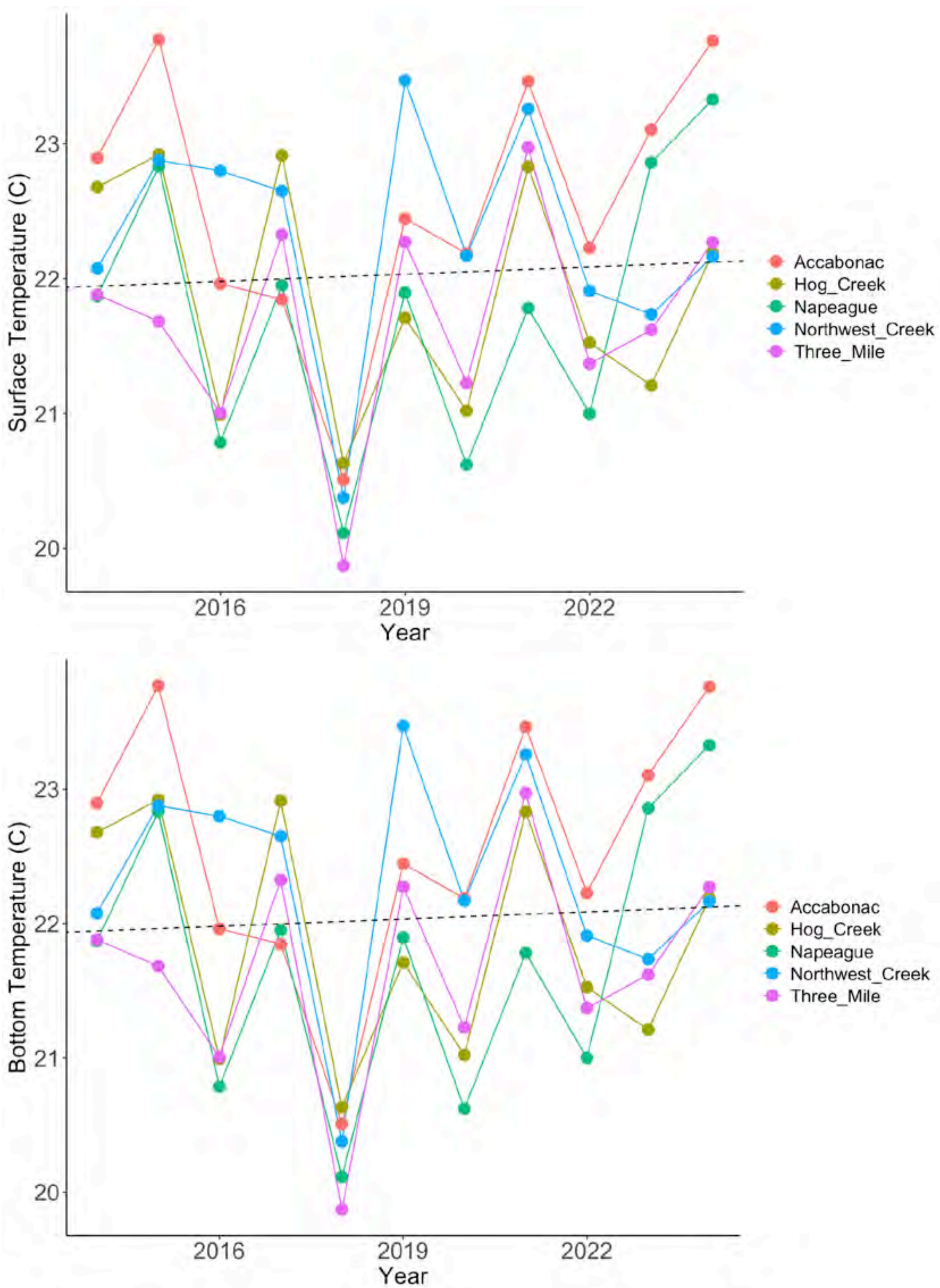

Figure 84. Yearly averages of surface (A) and bottom (B) temperature measurements from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. There is no significant trend.

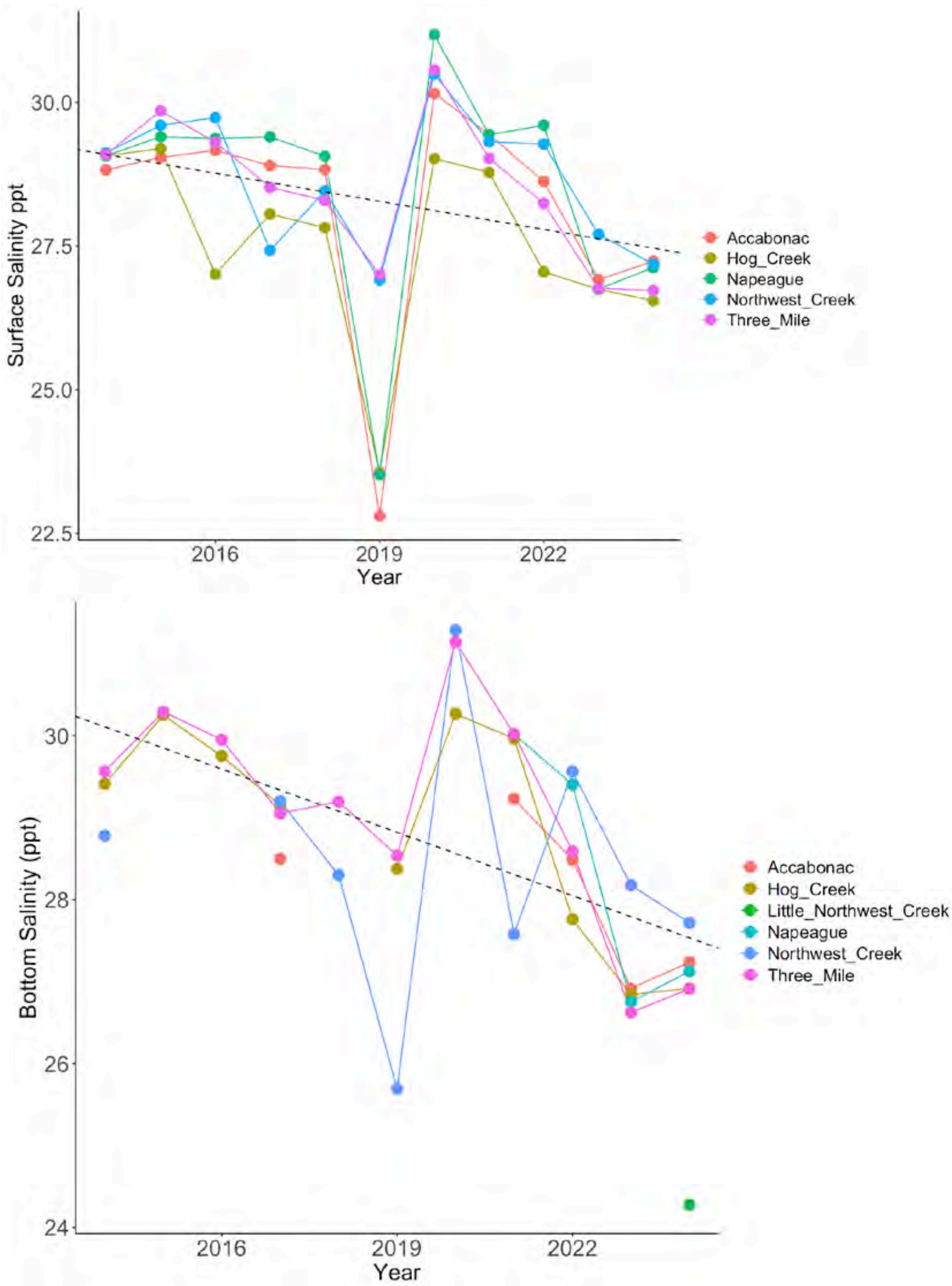

Figure 85. Yearly averages of surface (A) and bottom (B) salinity measurements from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. Salinity levels have decreased in both surface and bottom waters in the last 10 years, p-values are 0.01 and 0.0002, respectively.

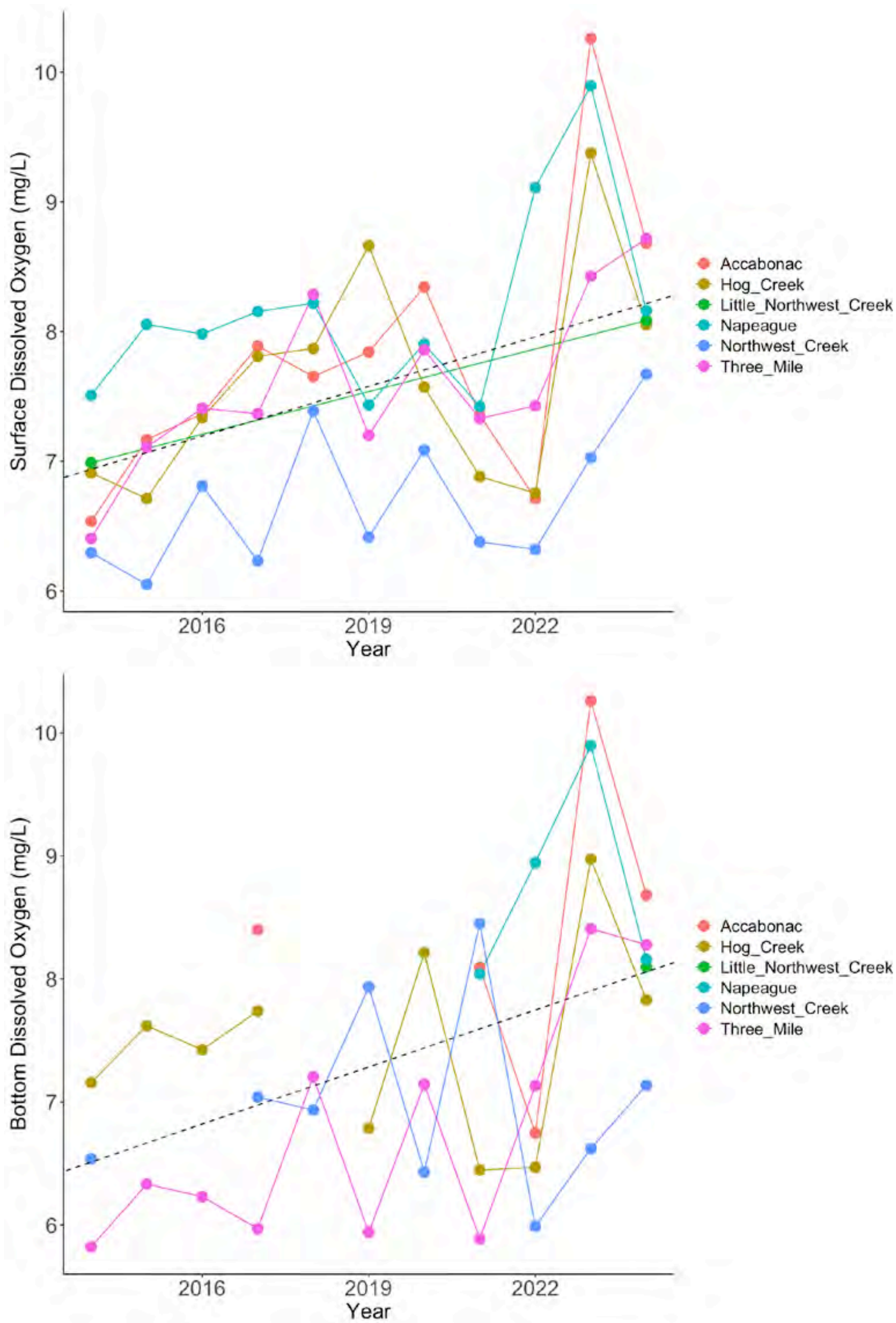

Figure 86. Yearly averages of surface (A) and bottom (B) dissolved oxygen measurements from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. Dissolved oxygen levels have increased in both surface and bottom waters in the last 10 years, p-values are 0.01 and 0.04, respectively.

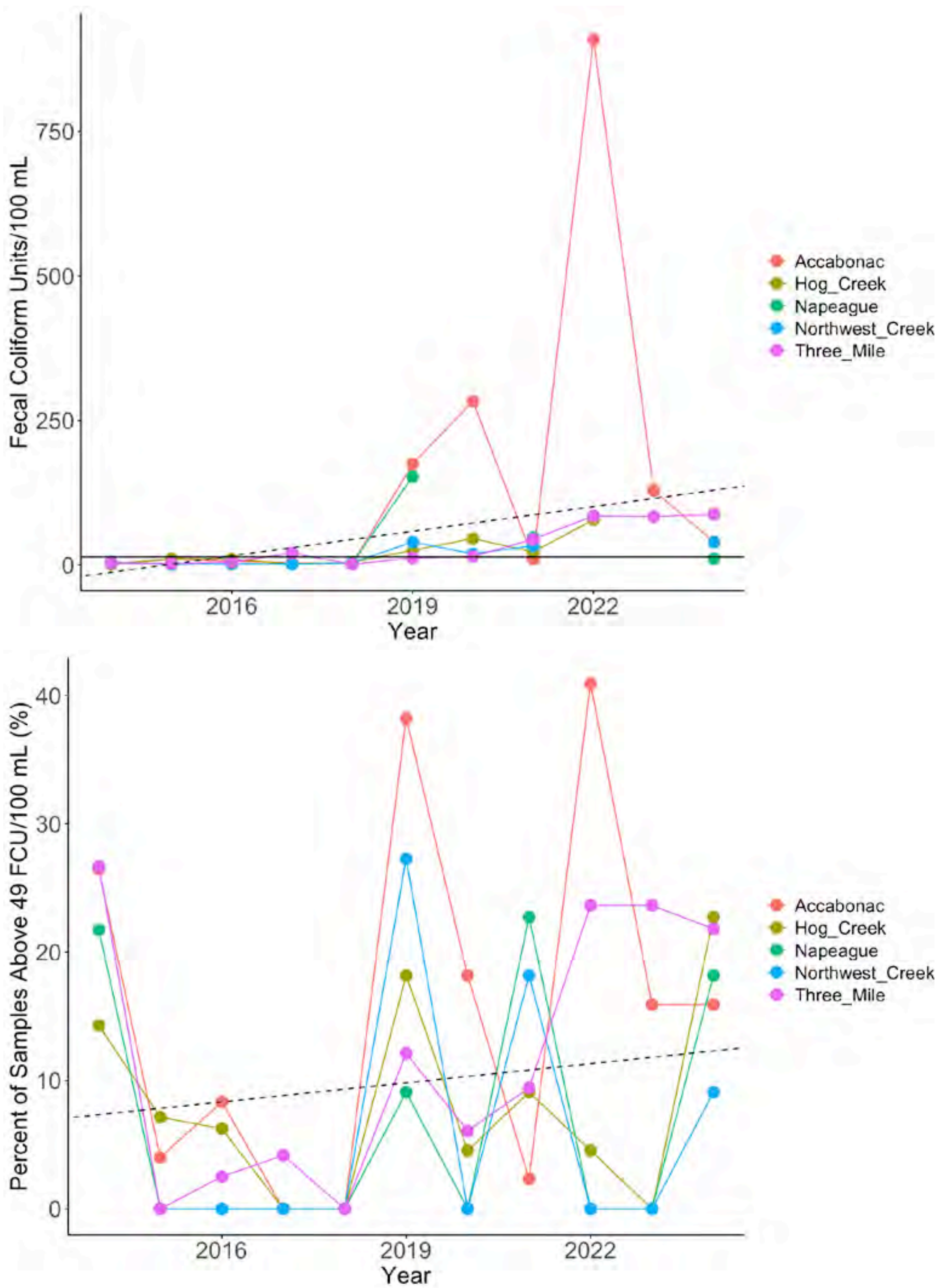

Figure 87. Yearly averages of fecal coliform bacteria (FCU per 100mL) (A) and percent of samples over the New York State annual mean (49 FCU) (B) from East Hampton sampling locations from 2014-2024. Black dashed line represents a linear regression of all annual means. Fecal coliform annual means have increased in both surface and bottom waters in the last 10 years, p-values= 0.01. There is no trend in percent of samples over the New York State annual mean (49 FCU).

Table 3. Sediment samples from Northwest Harbor retrieved 12/16/2024 and measured for percent organic matter.

Site	Mud depth	Sediment description	Percent Organic Matter (%)
1a	0	Two grabs, 1 sandy mud 1 muddy sand	1.015268782
1b	0	Sand and small rocks	0.290654079
1c	0	Muddy sand	0.641244468
1d	Too deep	Muddy sand	1.144329367
2a	Too deep	Sand, mostly rocks (in channel)	0.276259808
2b	0	Sand, some rocks	0.318226269
2c	0	Sand	0.48164715
2d	>20 cm (too deep)	Sandy mud	3.458606334
3a	Too deep	Mud	2.31988828
3b	0	Muddy sand	0.687750917
3c	0	Sand	0.386382144
3d	0	Sand	0.592327725
4a	Too deep	Mud	2.225361039
4b	too deep	Mud	5.668358035
4c	0	Sand, very little mud	0.410467197
4d	30 cm	Sandy mud	2.571734813
5a	too deep	Mud	4.820475838
5b	too deep	Mud	8.052131412
5c	too deep	Mud	6.547842597
5d	15 cm	Sandy Mud	2.793081141

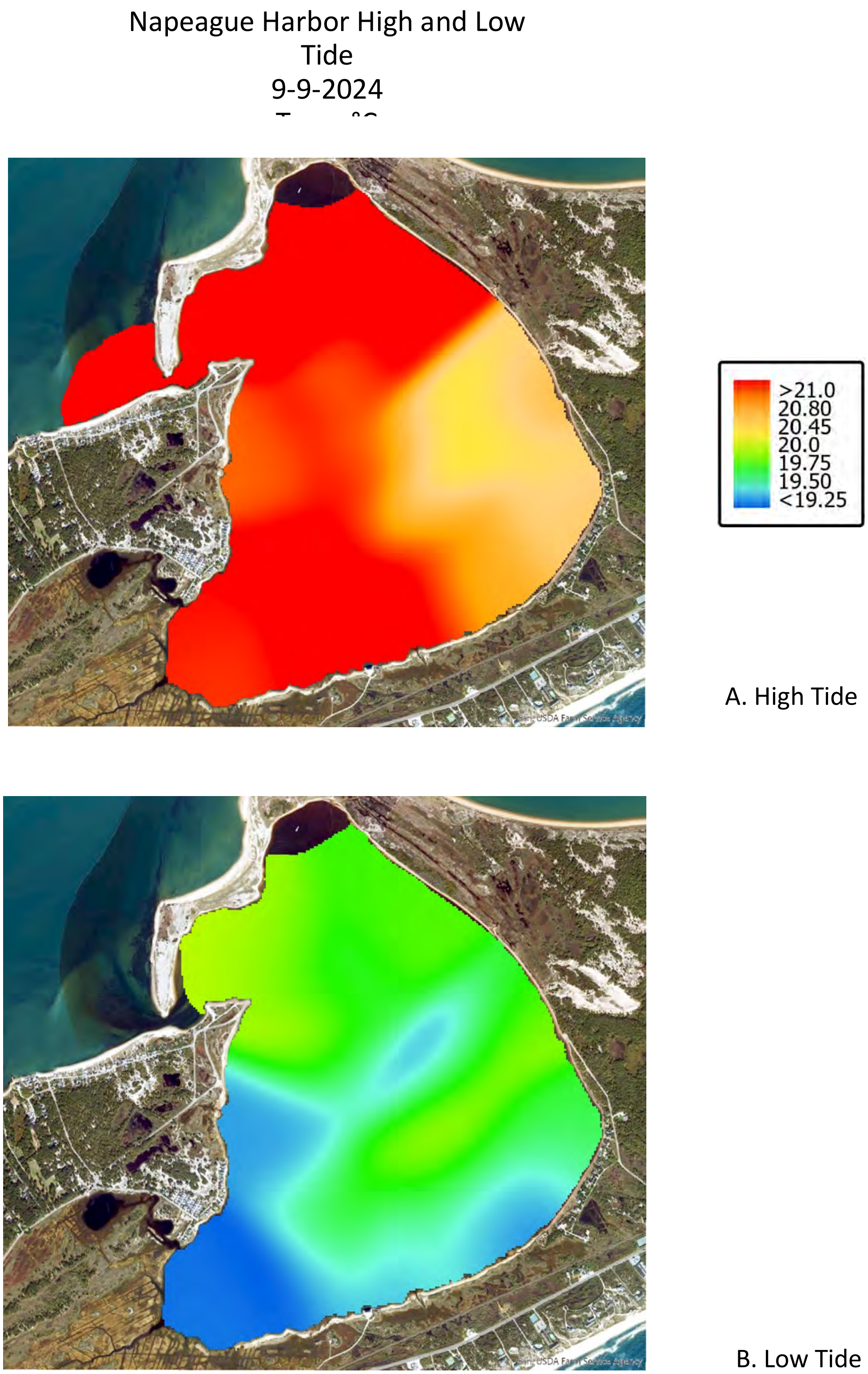

Figure 97. Interpolation of temperatures (˚C) in Napeague Harbor harbor on 9/9/2024. (A) High tide and (B) low tide maps utilize a normalized scale. Temperatures were higher at high tide than at low tide.

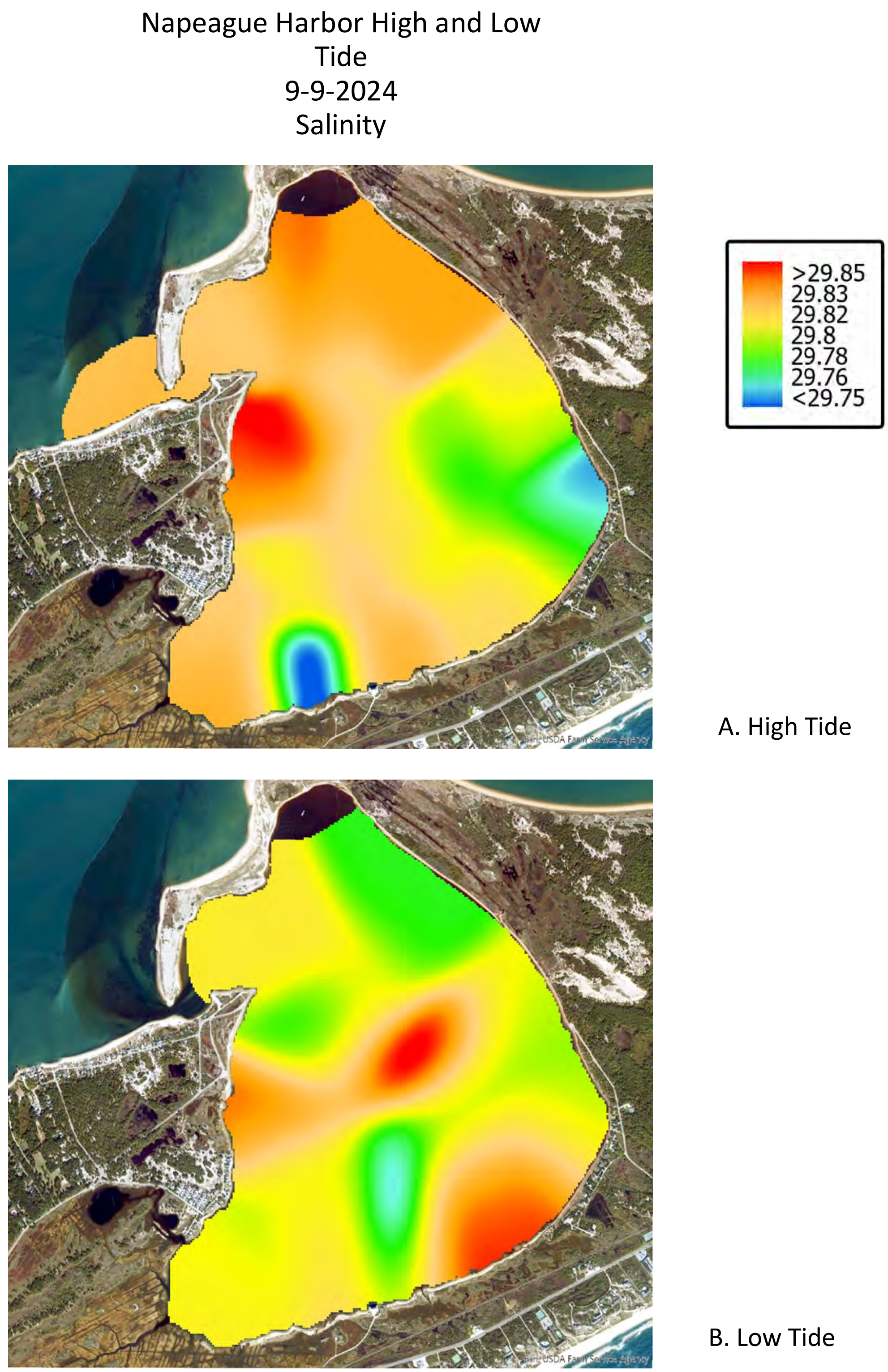

Figure 98. Interpolation of salinities in Napeague Harbor harbor on 9/9/2024. (A) High tide and (B) low tide maps utilize a normalized scale. Temperatures were higher at high tide than at low tide.

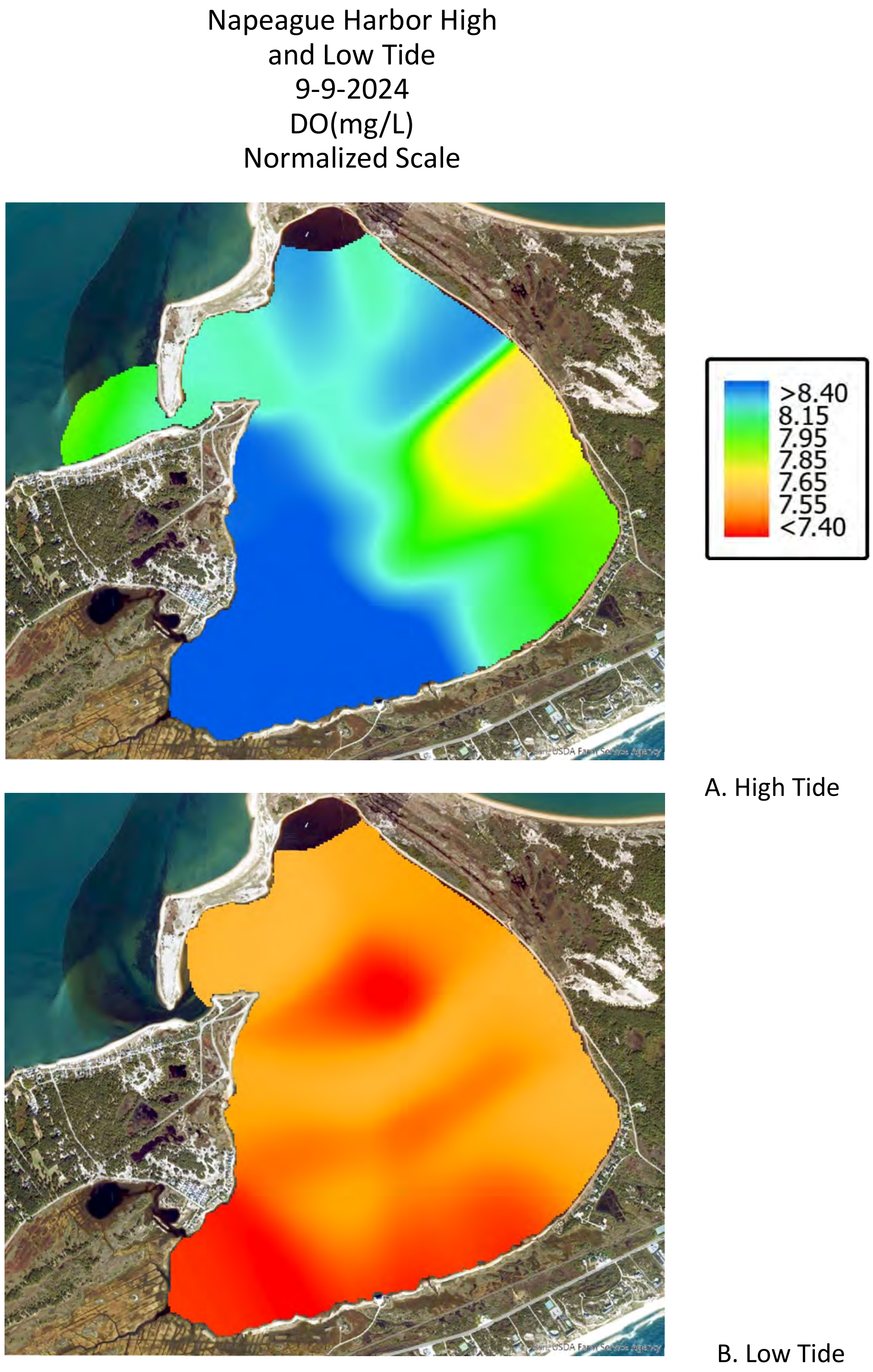

Figure 99. Interpolation of dissolved oxygen (mg/L) in Napeague Harbor harbor on 9/9/2024. (A) High tide and (B) low tide maps utilize a normalized scale. Dissolved oxygen values were higher at high tide than at low tide.

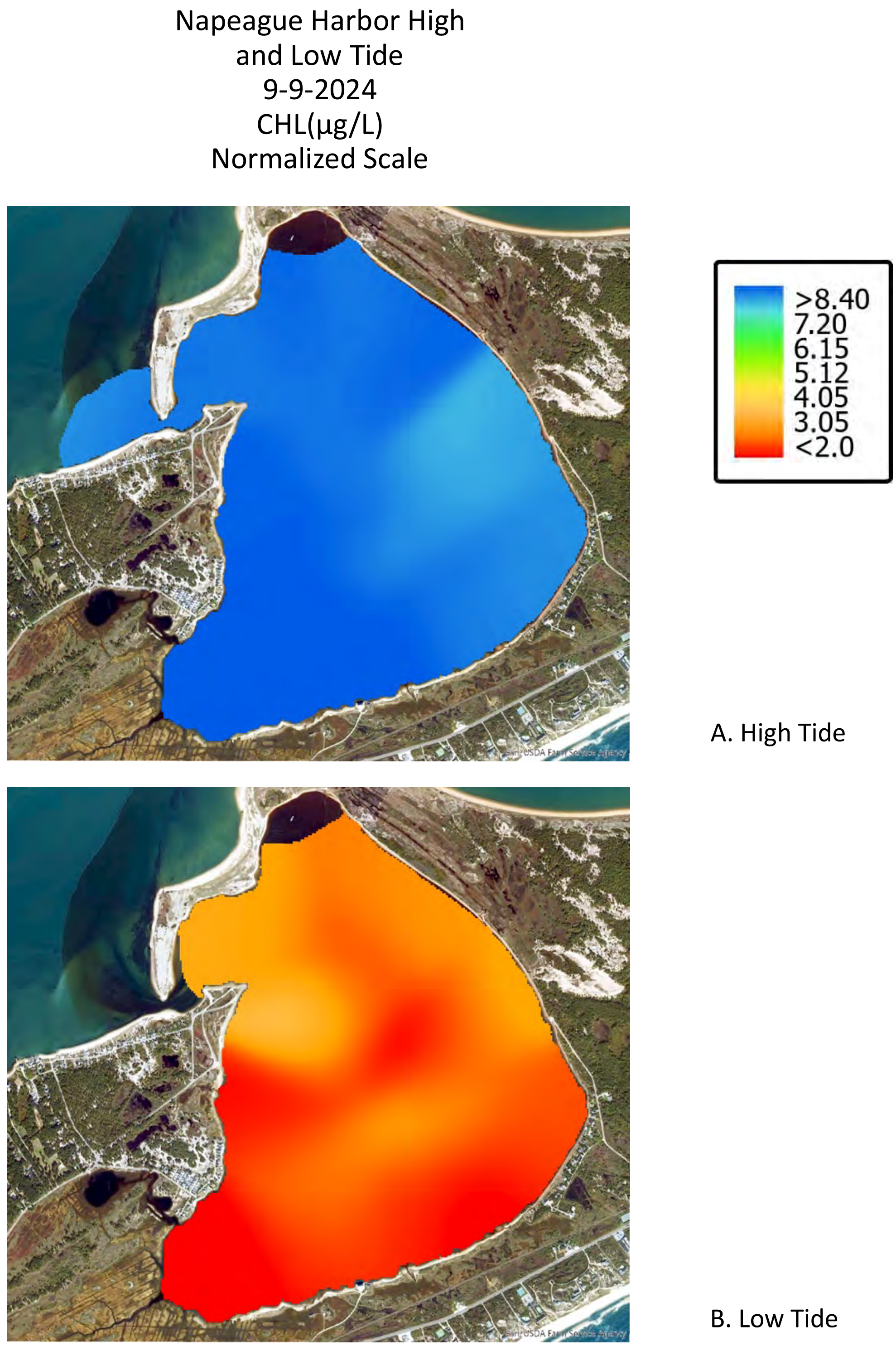

Figure 100. Interpolation of chlorophyll (µg/L) in Napeague Harbor harbor on 9/9/2024. (A) High tide and (B) low tide maps utilize a normalized scale. Chlorophyll - a was higher at high tide than at low tide.