Synthesis of Environmental Impacts on Key Fishery Resources in the Chesapeake Bay
Spring 2024 Seasonal Summary

Spring 2024 Headlines

- **Water temperature was generally warmer around the Bay. This may extend the blue crab growing season, push striped bass spawning earlier, and provide more habitat for bay anchovy because they prefer warmer temperatures.**
- **The Bay experienced above-average precipitation and resulting below-average salinity. Low salinity for prolonged periods can kill oysters. It also lets blue catfish, which prefer lower salinity, use more areas of the Bay. The higher flow may have increased the area of spawning habitat for striped bass.**
- **Low oxygen levels occurred in mid April and worsened over the month of May. A lack of oxygen can make it hard for blue crabs, striped bass larvae, bay anchovy, and oysters to live.**

Summary of Impacts of Environmental Conditions on Species from Most Recent Four Seasons

	Summer 2023	Fall 2023	Winter 2023-24	Spring 2024
Striped Bass	WT, DO, Sal, Flow	WT, DO, Sal, Flow	WT, Sal, Flow	**WT, DO, Sal, Flow**
Blue Crabs	WT, DO, Sal, Flow	WT, DO, Sal, Flow	WT, Sal, Flow	**WT, DO, Sal, Flow**
Oysters	WT, DO, Sal, Flow	WT, DO, Sal, Flow	WT, Sal, Flow	**WT, DO, Sal, Flow**
Bay Anchovy	WT, DO, Sal, Flow	WT, DO, Sal, Flow	WT, Sal, Flow	**WT, DO, Sal, Flow**
Summer Flounder*		WT, DO, Sal, Flow	WT, Sal, Flow	**WT, DO, Sal, Flow**

WT = Water Temperature
Sal = Salinity
Flow = Streamflow
DO = Dissolved Oxygen
Green = Potentially positive impact
Red = Potentially negative impact
Black = Neutral or unknown impact

**Summer flounder was added to this table in fall 2023. It is an estuarine-dependent federally managed species.*

Purpose

The National Oceanic and Atmospheric Administration's (NOAA) Chesapeake Bay Office (NCBO) develops seasonal summaries of water-quality parameters in the Chesapeake Bay to provide fisheries managers and the public information about recent environmental conditions, how they compare with long-term averages, and how these conditions might affect key fishery resources such as striped bass (*Morone saxatilis*), blue crab (*Callinectes sapidus*), eastern oysters (*Crassostrea virginica*), and summer flounder (*Paralichthys dentatus*). The intent is to provide information linking changes in environmental conditions to effects on living resources that can inform ecosystem-based management at state and regional levels. The seasons are defined as winter (December-February), spring (March-May), summer (June-August), and fall (September-November).

The primary data sources for these seasonal summaries are the NOAA Chesapeake Bay Interpretive Buoy System (CBIBS) for real-time, surface water temperature and salinity information at four locations throughout the Chesapeake Bay (Figure 1); the NOAA CoastWatch Program for Bay-wide, satellite-based sea surface temperature (SST) anomalies; the NOAA National Weather Service PREcipitation Summary and Temperature Observations (PRESTO) reports for regional precipitation and air temperature information; the National Centers for Environmental Information for precipitation data; and the U.S. Geological Survey (USGS) National Water Information System for local streamflow information at various locations throughout the Bay. In summer, the Chesapeake Bay Environmental Forecast System (CBEFS) provides estimates of the volume and duration of seasonal hypoxia. NCBO uses these seasonal summaries to develop an annual synthesis for inclusion in the Mid-Atlantic State of the Ecosystem Report, which is developed by the Northeast Fisheries Science Center and presented to the Mid-Atlantic Fishery Management Council each year.

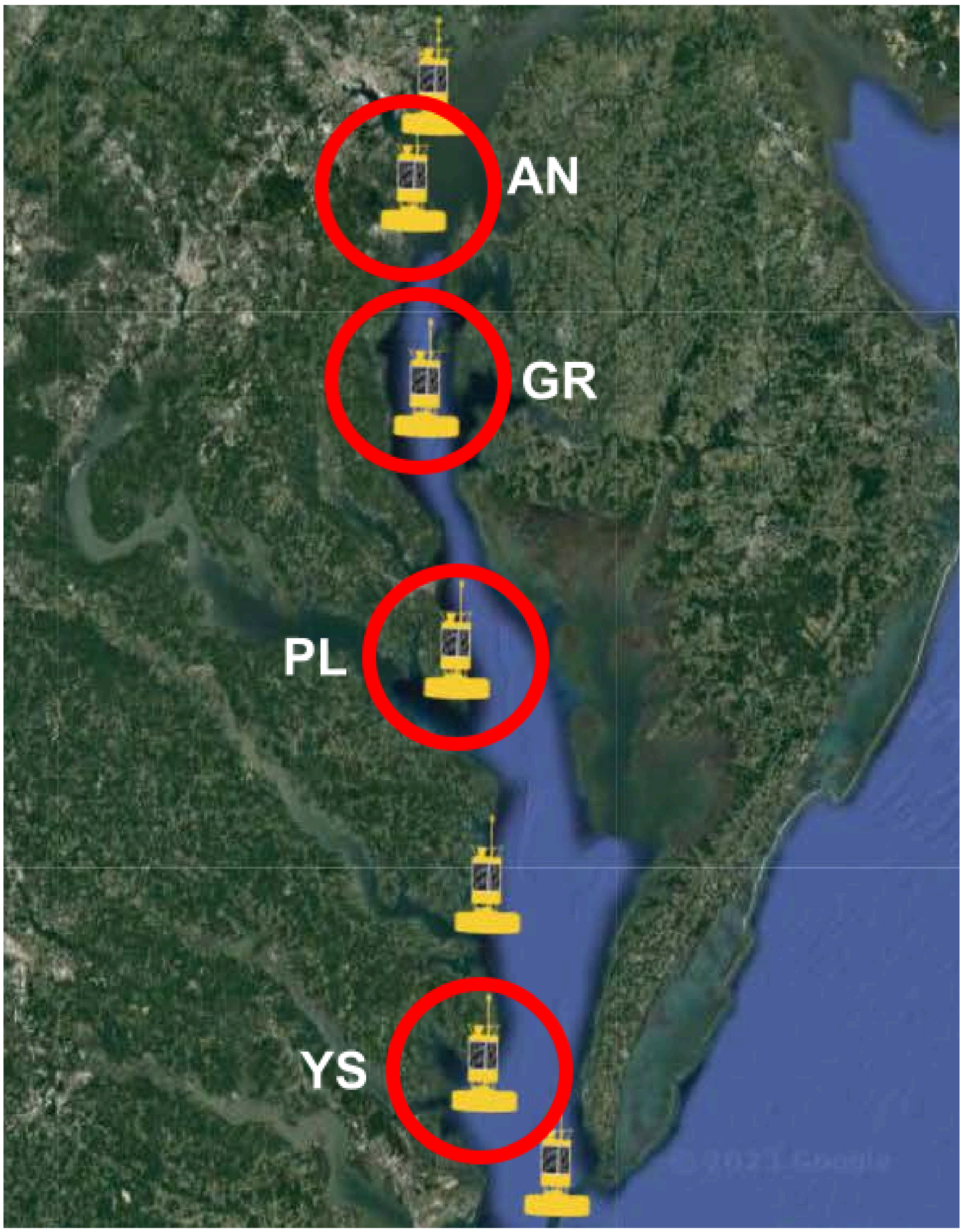

Figure 1. Map of Chesapeake Bay Interpretive Buoy System (CBIBS) observation platforms. The buoys used in these summaries are AN (Annapolis), GR (Gooses Reef), PL (Potomac), and YS (York Spit).

Water Temperature

Satellite data shows surface water temperature was higher than the long-term average throughout the mainstem and tributaries of the Chesapeake Bay (Figure 2). This was verified by data from the NOAA Chesapeake Bay Interpretive Buoy System. In general, temperatures were warmer than average at the buoys, except for a period near or below average in late March through mid-April. (There is no daily data after early March for the York Spit buoy location due to a sensor failure.)

By May 1, water temperatures were above 60°F at the Annapolis, Gooses Reef, and Potomac buoys. Striped bass typically begin spawning in the spring when water temperatures reach 60°F, with most spawning occurring between 61°F and 69°F. The spawning season usually lasts from April to mid-June. However, a 2024 study found no statistically significant change in the temperature threshold that triggers the start of spawning season in the Chesapeake Bay (Guilano, 2023). This is likely because water temperatures haven't shifted enough to cause a consistently earlier spawn. The study did find a significant change was detected in the timing of the end of the spawning season, suggesting that the striped bass spawning period in the Bay has shortened since 1985 when the survey started (Guiliano, 2023).

Blue crabs emerge from overwintering burrows at 50°F. This threshold was met at all buoy locations by mid-March and may extend their growing season. Oyster spawning can be triggered at about 60°F; this was met at the Annapolis, Gooses Reef, and Potomac buoys by May 1.

Warmer spring waters may increase habitat suitability for bay anchovy because they prefer warmer water. The extent of suitable bay anchovy habitat may increase as waters continue to warm with climate change (Fabrizio et al., 2020, 2021).

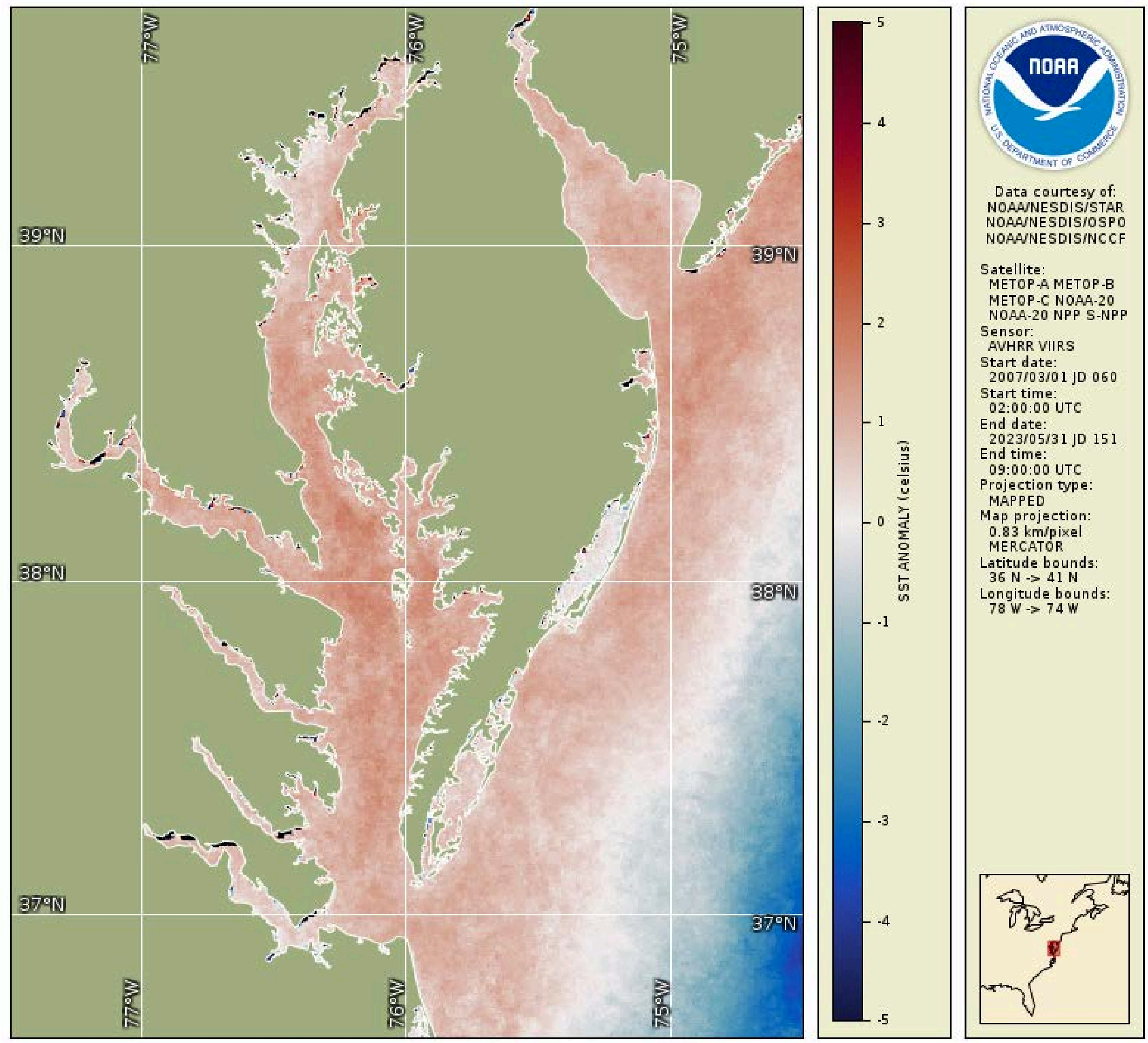

Figure 2. Sea surface temperature (SST) anomalies observed by NOAA satellites March–May 2024 relative to the average of this seasonal period 2007–2024.

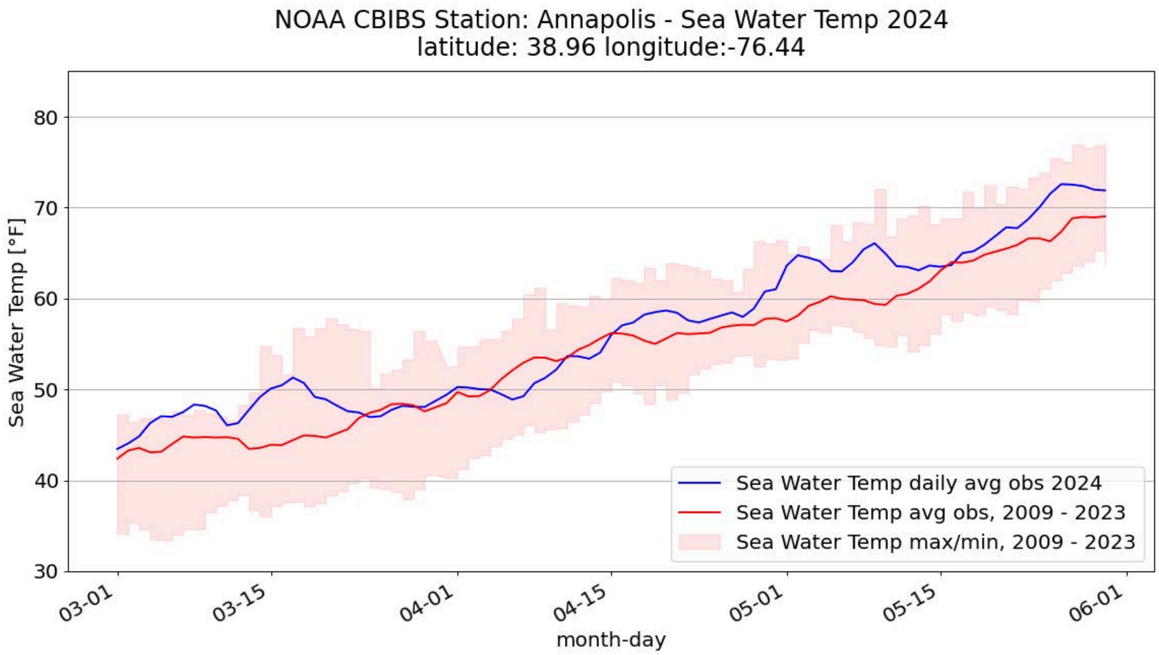

Figure 3. Surface water temperatures at the Annapolis buoy March–May 2024 relative to the long-term average (2009–2023). The shaded area represents the full range of observations (minimum to maximum) over the time period.

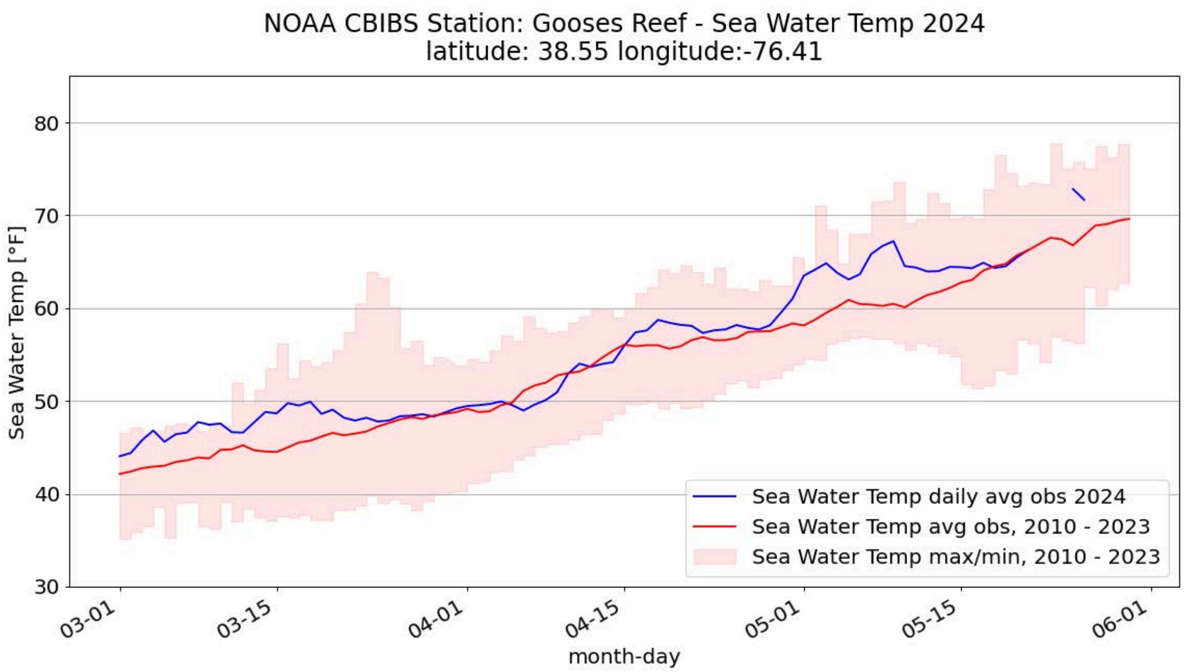

Figure 4. Surface water temperatures at the Gooses Reef buoy March–May 2024 relative to the long-term average (2010–2023). The shaded area represents the full range of observations (minimum to maximum) over the time period.

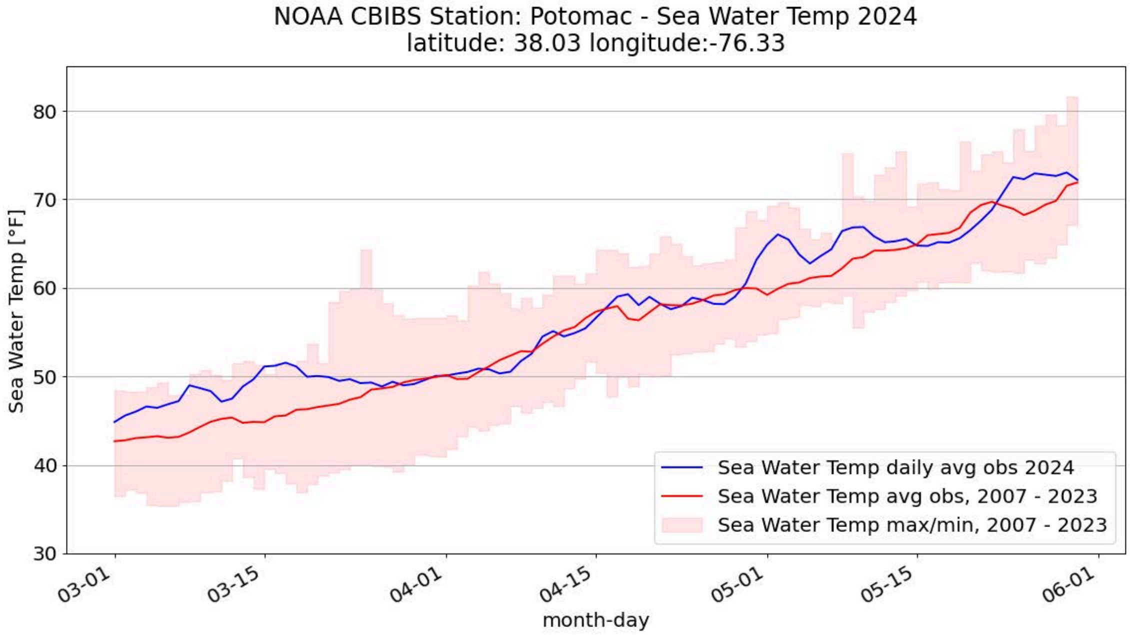

Figure 5. Surface water temperatures at the Potomac buoy March–May 2024 relative to the long-term average (2007–2023). The shaded area represents the full range of observations (minimum to maximum) over the time period.

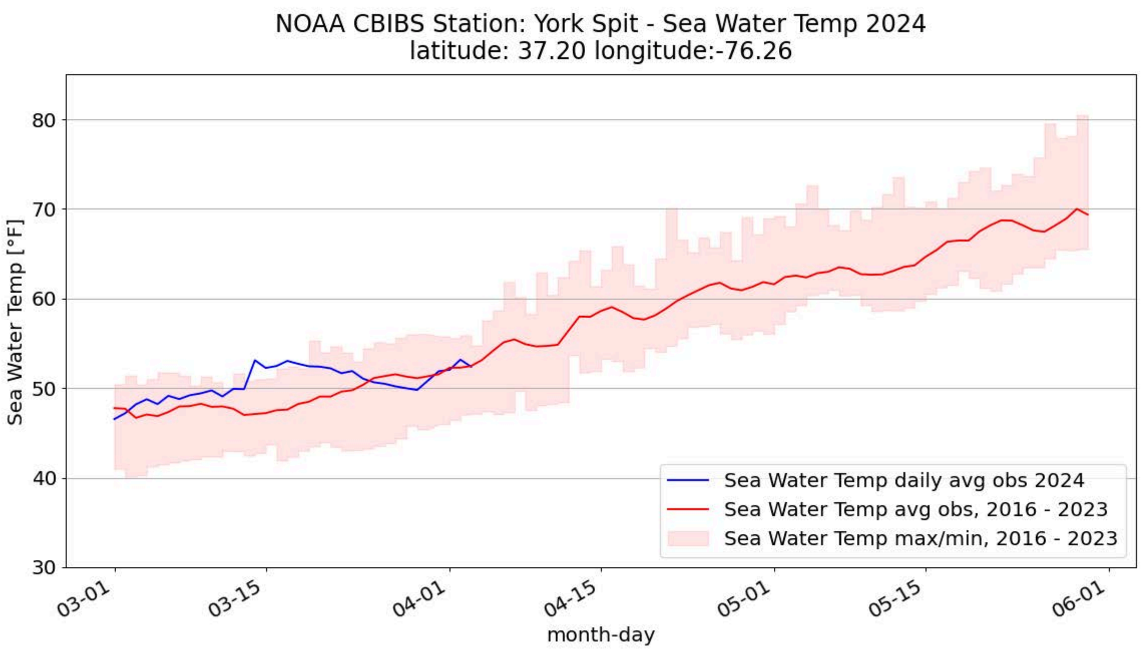

Figure 6. Surface water temperatures at the York Spit buoy March–May 2024 relative to the long-term average (2016–2023). The shaded area represents the full range of observations (minimum to maximum) over the time period. The sensor that tracks water temperature at this location failed in early April, so no 2024 data is available after that time.

Salinity

Observed salinity at the Annapolis, Gooses Reef, and Potomac CBIBS buoys was below average from early March to May 31. At times, salinity was several practical salinity units (PSU) lower than the long-term average at all buoy locations (Figures 7, 8, and 9). The lower salinity is likely related to the above-average precipitation (Figures 10 and 11).

Salinity below 14 PSU is tolerable for blue catfish. This means blue catfish were likely able to move into large portions of the Bay which could increase predation on prey species such as blue crabs in these areas. Salinity below 14 PSU was observed at all locations except York Spit.

Salinity can have a significant effect on oysters in the Chesapeake Bay because it affects their growth, reproduction, and survival. Oysters grow best in brackish to moderately salty water with a salinity of 10–28 PSU. Oysters produce more young oysters (spat) at higher salinity levels. Salinity below 5 PSU for prolonged periods can cause mortality in oysters. Salinity hovered below 5 PSU at the Annapolis buoy from mid-April to mid-May. Salinity was below 10 PSU for a month or longer at the Gooses Reef and Potomac CBIBS buoys. If similar low-salinity conditions were experienced at nearby oyster reefs, they could have had negative effects on oyster growth and survival.

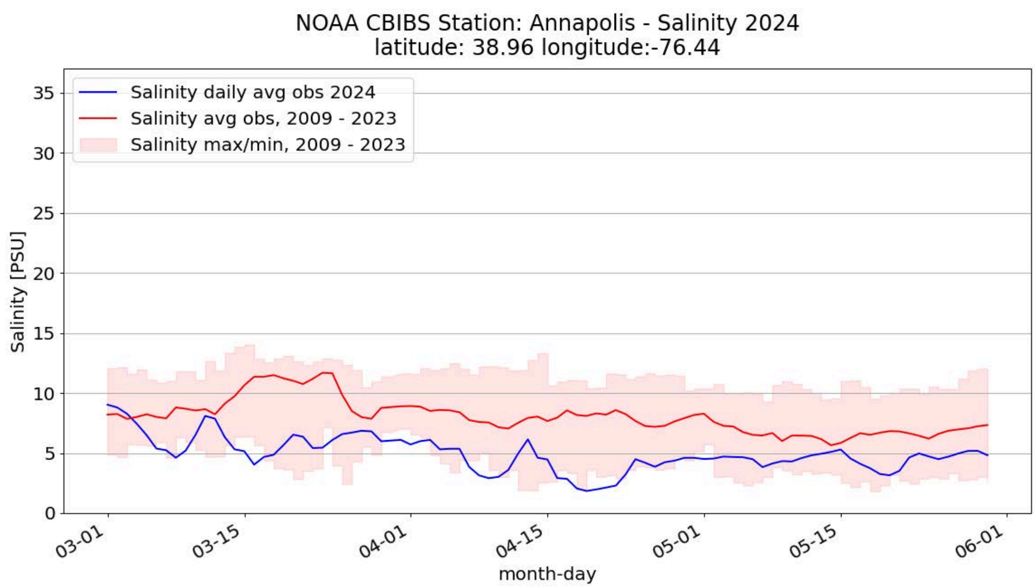

Figure 7. Salinity observations at the Annapolis CBIBS buoy March–May 2024 (blue line) relative to the average at each buoy over this seasonal period 2009–2023 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

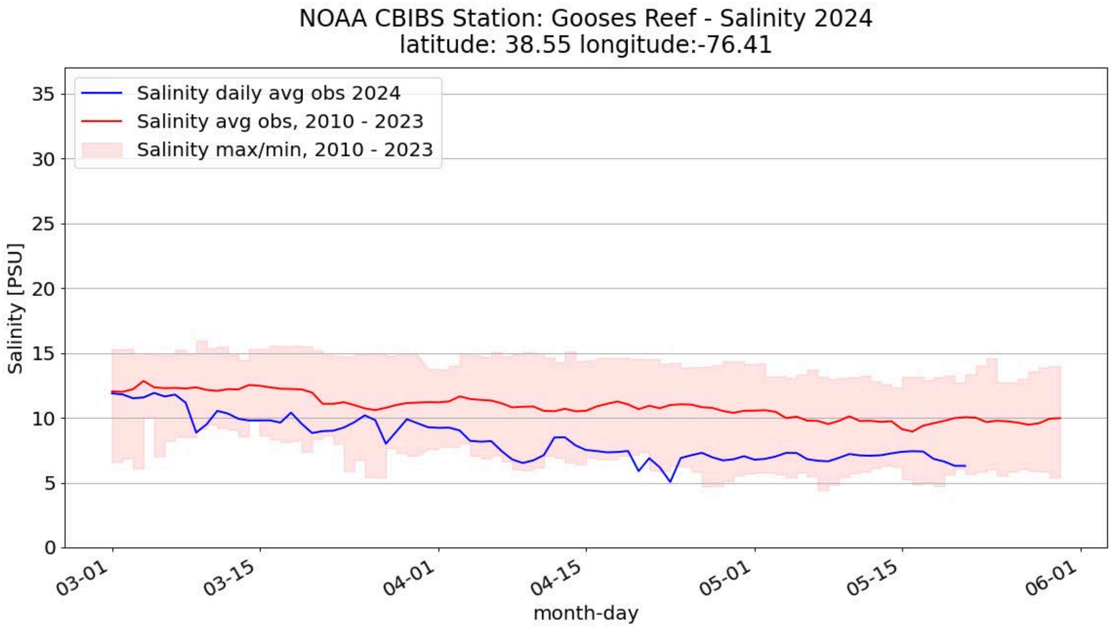

Figure 8. Salinity observations at the Gooses Reef CBIBS buoy March–May 2024 (blue line) relative to the average at each buoy over this seasonal period 2010–2023 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

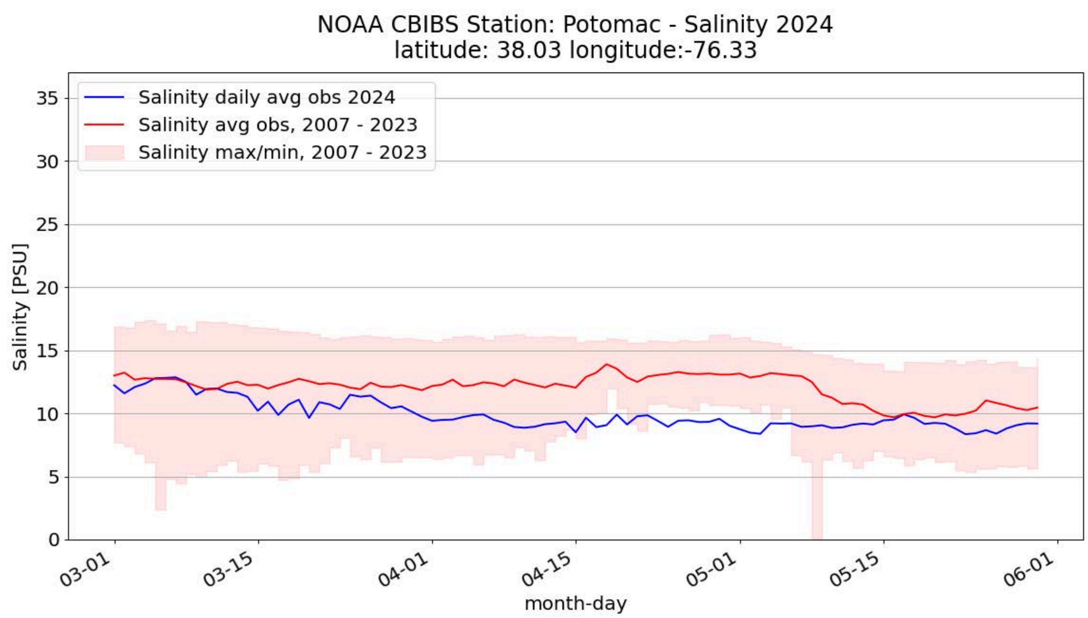

Figure 9. Salinity observations at the Potomac CBIBS buoy March–May 2024 (blue line) relative to the average at each buoy over this seasonal period 2007–2023 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

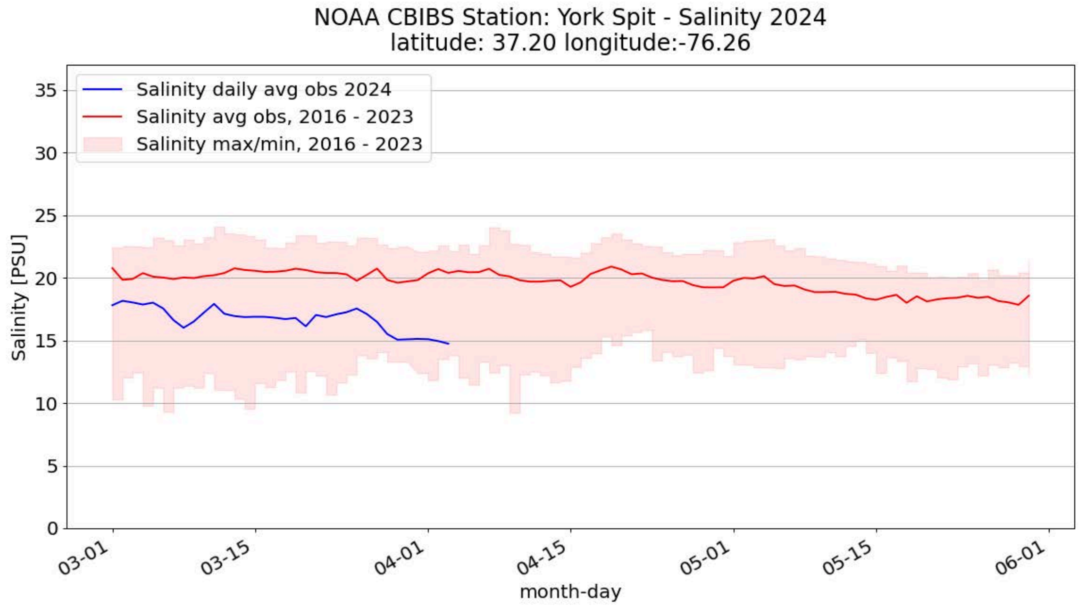

Figure 10. Salinity observations at the York Spit CBIBS buoy March–May 2024 (blue line) relative to the average at each buoy over this seasonal period 2016–2023 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period. The sensor that tracks salinity at this location failed in early April, so no 2024 data is available after that time.

Precipitation and Freshwater Flow

Virginia had the highest precipitation since 2007 for March through May at 14.5 inches (Figure 11). Maryland precipitation was greater than last year and was the eighth highest in the time series for March through April at just under 12 inches. Higher precipitation generally leads to higher flow, which improves spawning conditions for striped bass.

All stations experienced peaks in flow in April before resuming more normal flow patterns in May (Figure 13). Higher flow is generally good for striped bass spawning because it increases the area of available habitat. With higher flow, the creeks have a greater volume of water in which fish can spawn.

Salinity alterations due to increased precipitation as projected under climate change scenarios may limit suitable habitat for some forage species in the future (Fabrizio et al 2021).

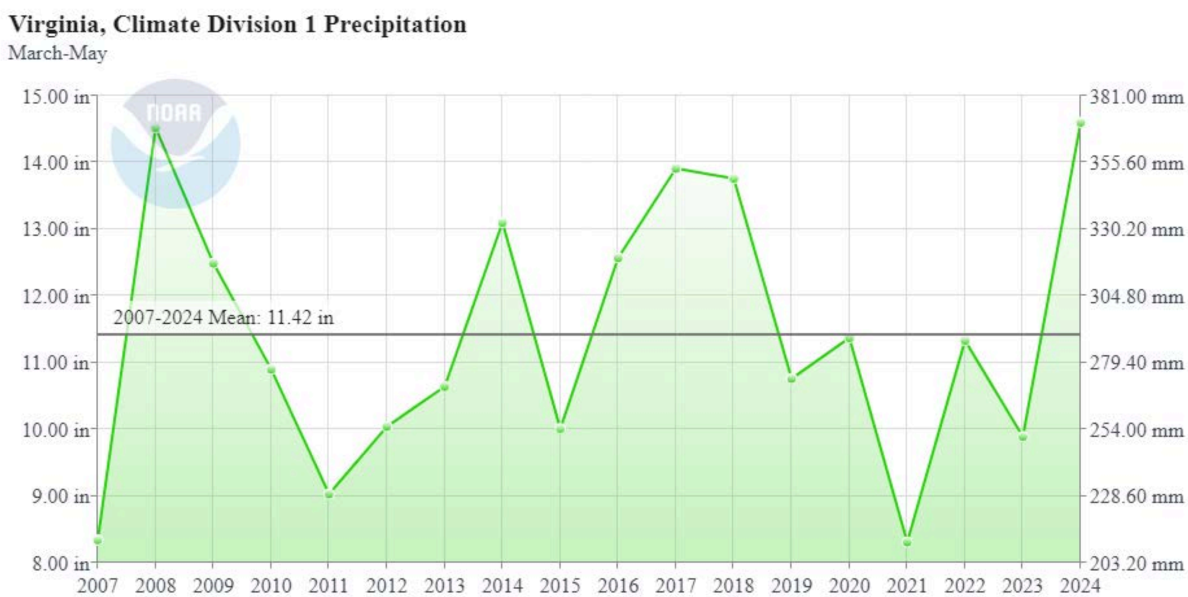

Figure 11. Precipitation data from 2007–2024 for March–May for Tidewater Virginia. Data from NOAA Centers for Environmental Information.

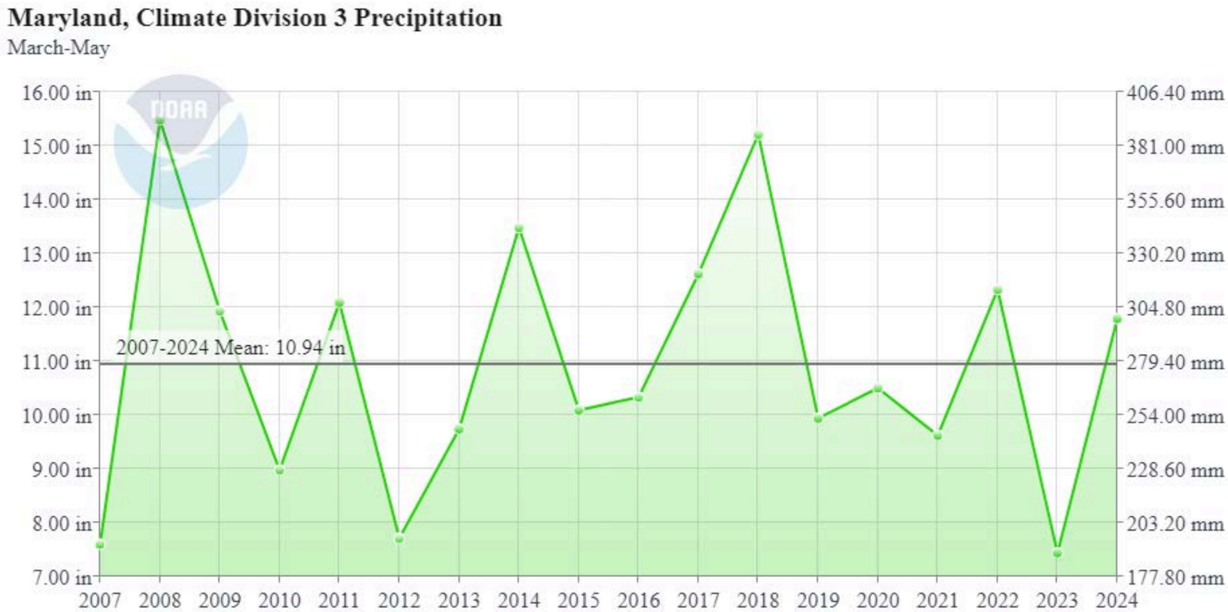

Figure 12. Precipitation data from 2007–2024 for March–May for southern Maryland. Data from NOAA Centers for Environmental Information.

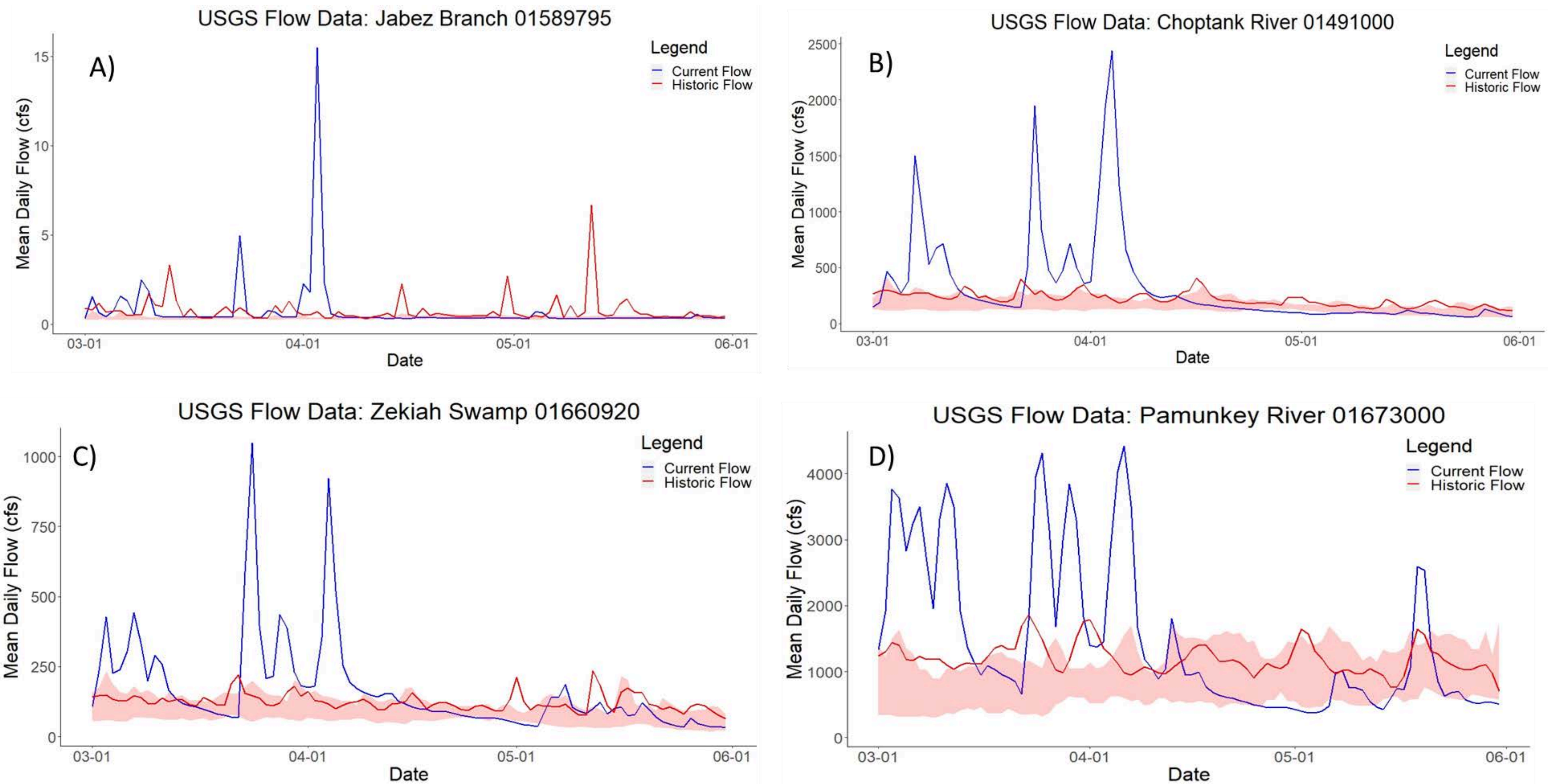

Figure 13. Daily mean streamflow observations (discharge, cubic feet/second) from the upper to lower Chesapeake Bay at USGS monitoring sites at the (A) Jabez Branch, (B) Choptank River, (C) Zekiah Swamp (D), and Pamunkey River throughout Spring 2024 relative to the daily averages over this seasonal period from 2000–2023. The red shading indicates the interquartile range (25%-75%), where 50% of the historical values fall.

Hypoxia

Hypoxic conditions began earlier than usual this year (late April), as recorded and modeled at stations CB4.3C and LE2.3 in the mid Bay (Figure 14) and at the mouth of the Potomac (Figure 15). This was driven mostly by high precipitation and flow, as well as higher temperature and lower winds.

Blue crabs require dissolved oxygen levels of 3mg/L. Larval stages of striped bass may need as much as 6 mg/L of dissolved oxygen. Portions of the Potomac and Choptank rivers that are used for spawning were below 6mg/L by April 22, and part of the mainstem that includes the blue crab sanctuary was below 3mg/L (Figure 16). These conditions worsened throughout May; this may affect habitat suitability and survival.

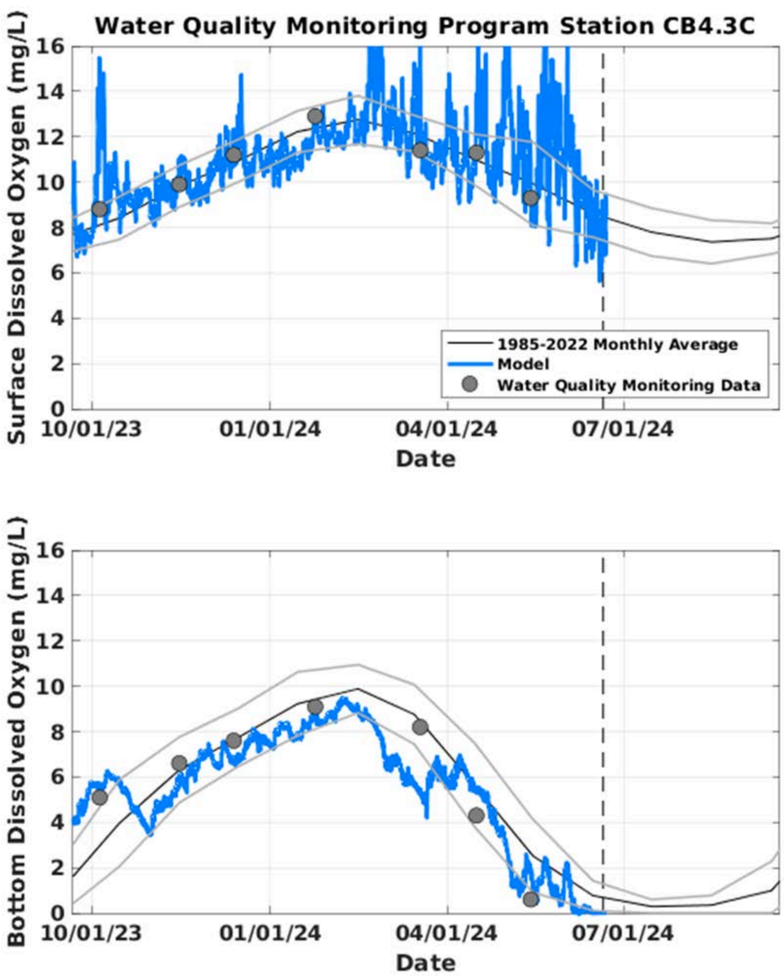

Figure 14. Observed and modeled dissolved oxygen at VIMS CB 4.3 station located in the mid Bay. Data from VIMS-CBEFS, Bever (2021).

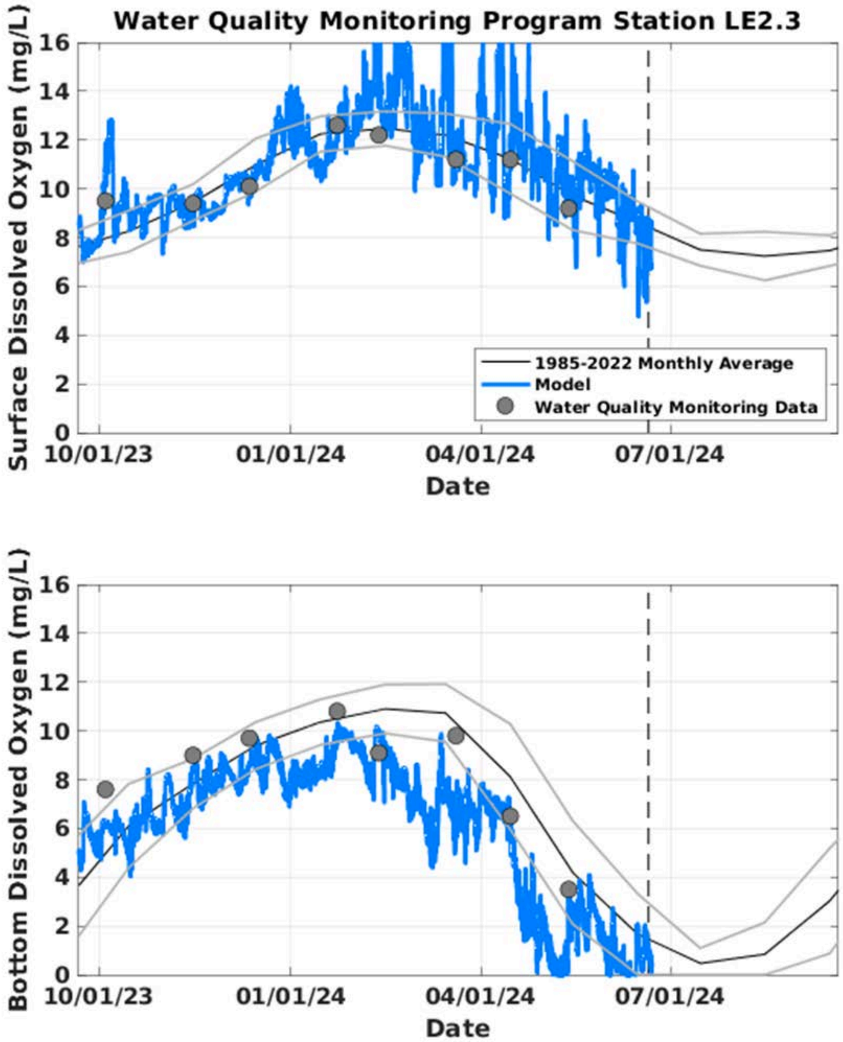

Figure 15. Observed and modeled dissolved oxygen at VIMS-CBEFS LE 2.3 station located at the mouth of the Potomac. Data from VIMS-CBEFS, Bever (2021).

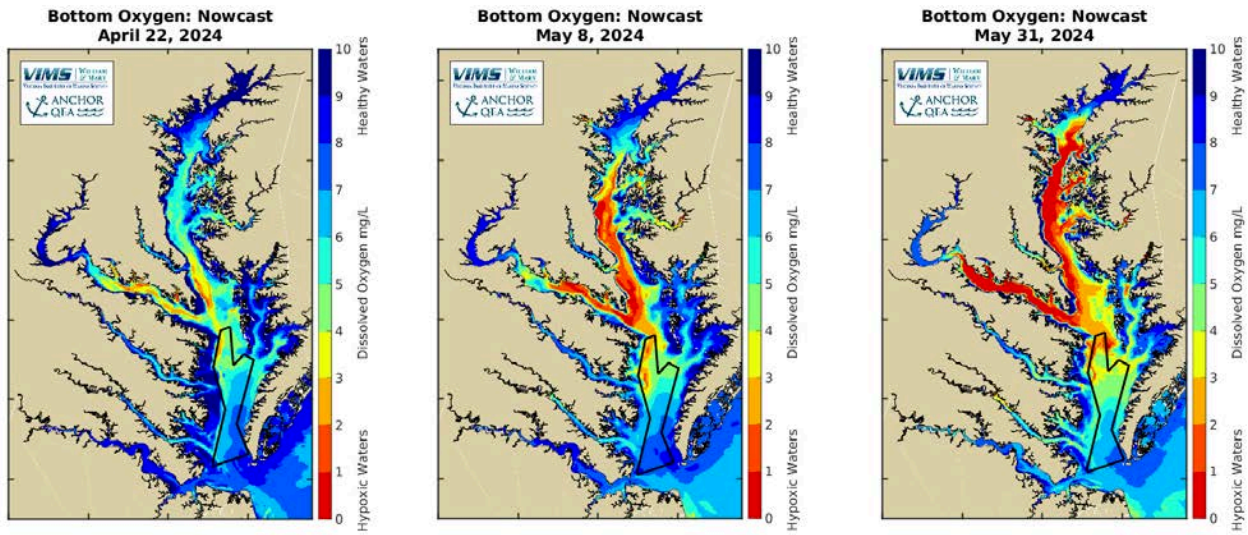

Figure 16. Bottom oxygen concentration measurements from VIMS at three dates in spring 2024 (April 22, May 8, and May 31). Note: black polygons represent an estimation of the blue crab sanctuary boundary for illustration purposes. Data from VIMS-CBEFS, Bever (2021)

References

Bever, A.J., M.A.M. Friedrichs, P. St-Laurent (2021) Real-time environmental forecasts of the Chesapeake Bay: Model setup, improvements, and online visualization. Environmental Modelling and Software, 105036, https://doi.org/10.1016/j.envsoft.2021.105036

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Guiliano A (2023) Climate effects on the timing of Maryland Striped Bass spawning runs. Marine and Coastal Fisheries Dynamics, Management and Ecosystem Science 15.

VIMS-CBEFS (Virginia Institute of Marine Science – Chesapeake Bay Environmental Forecast System). 2024. Chesapeake Bay Environmental Forecast System. Available at: https://www.vims.edu/cbefs.