Synthesis of Environmental Impacts on Key Fishery Resources in the Chesapeake Bay

Summer 2024 Seasonal Summary

Summer 2024 Headlines

- **Across much of the Bay, water temperatures were slightly warmer than average. From the Rappahannock River to the mouth of the Bay, water temperatures were cooler than average. However, from mid July to mid August, water temperatures exceeded suitable conditions for striped bass.**
- **Salinity was well below average at the Annapolis, Gooses Reef, and Potomac CBIBS buoys from June through August until the remnants of Hurricane Debby moved through. This was unexpected, because much of the region was experiencing drier-than-normal weather. Lower salinity can affect oyster hatchery production and natural spat sets.**
- **Dissolved bottom oxygen concentrations were below average from June to early July. This reduces the area of suitable habitat for fish and crabs and leads to die-offs of less-mobile organisms.**

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

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

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

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.

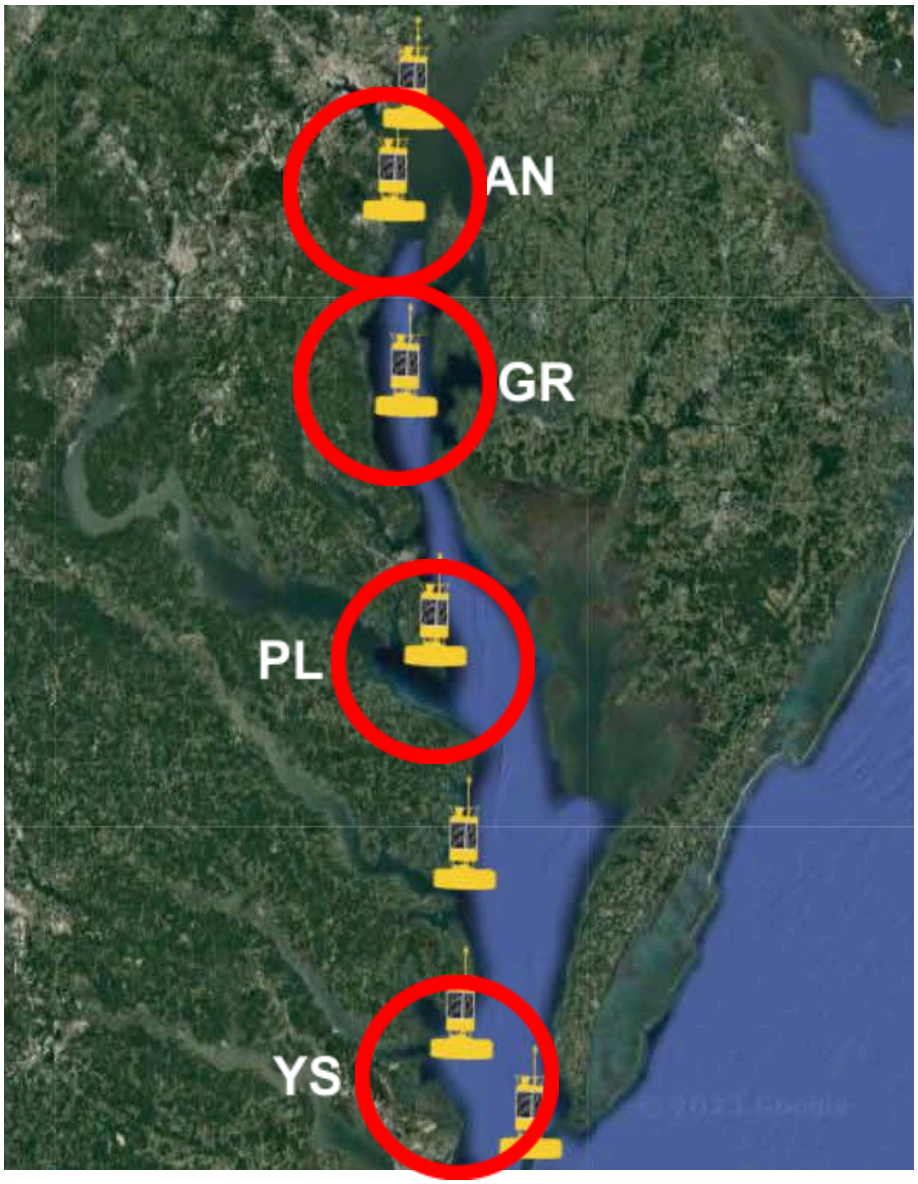

Figure 1. Map of Chesapeake Bay Interpretive Buoy System (CBIBS) observation platforms. The buoys used in these summaries are AN (Annapolis), GR (Gooses Reef), PL (Potomac), and YS (York Spit).

Water Temperature

Despite warm air temperatures during the summer, water temperature was only slightly warmer than average across much of the Bay (Figure 2). Surface water temperature, measured by satellite, was notably cooler than average south of the Rappahannock River to the mouth of the Bay. The cooler surface water temperature was apparent along the coast from the Delaware Bay to south of the Chesapeake Bay mouth. This cooler marine water likely influenced Bay temperatures at the mouth of the Bay, James River, and southern Eastern Shore of Virginia.

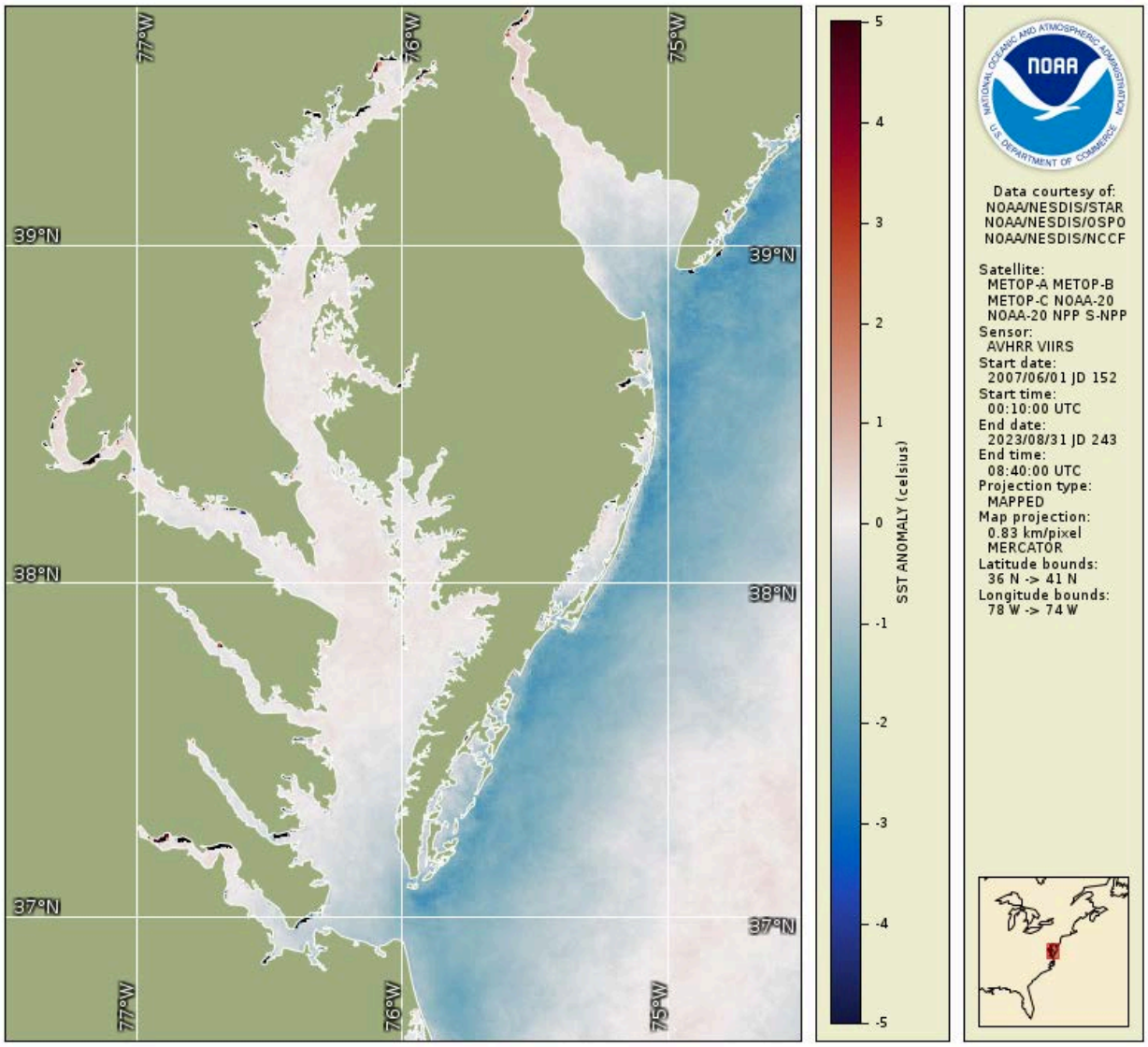

Figure 2. Sea surface temperature (SST) anomalies observed by NOAA satellites June–August 2024 relative to the average of this seasonal period 2007–2024.

Water temperature, measured by CBIBS, rose from mid June to mid July at the Annapolis, Gooses Reef, and Potomac CBIBS buoys. (Data was not available for York Spit, the southernmost buoy usually referenced in this report, as the water quality sensor that tracks temperature was not working.) This summer, water temperature was above the long-term average at the Annapolis, Gooses Reef, and Potomac CBIBS buoys from mid June to mid July (Figures 3, 4, and 5). For the remainder of summer, water temperatures fluctuated between above, near-normal, and below the long-term average. Temperatures were above 80°F from mid July to mid August, with a notable drop to below the long-term average through the remainder of August.

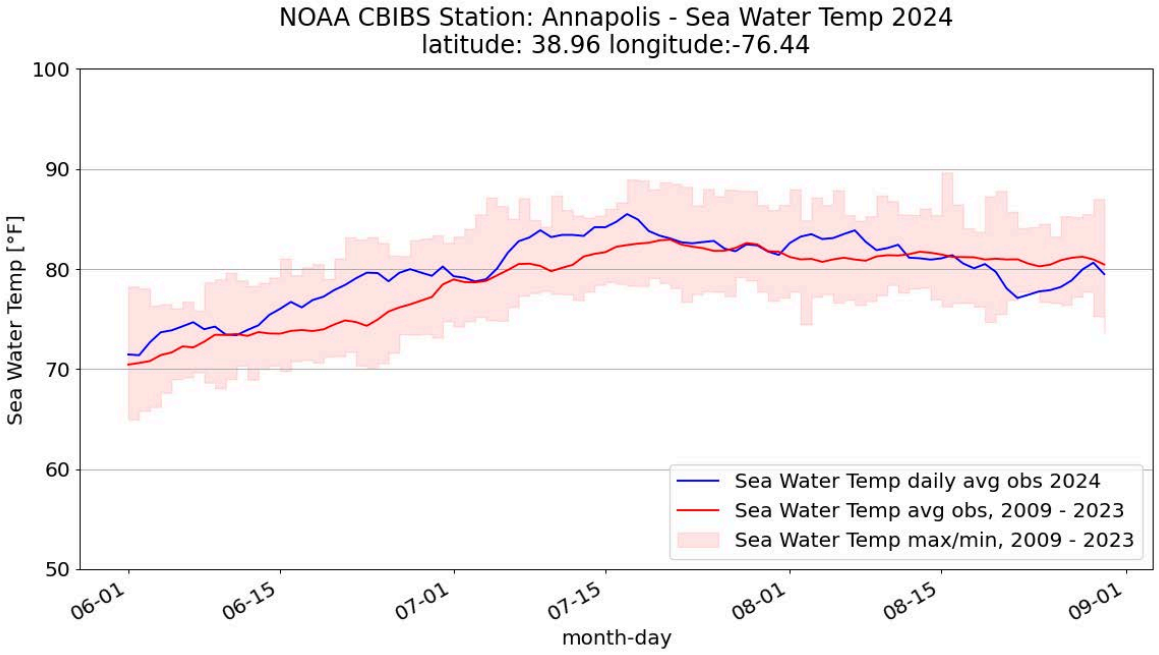

Figure 3. Surface water temperatures at the Annapolis CBIBS buoy June–August 2024 relative to the long-term average (2009–2023). The shaded area represents the full range of observations (minimum to maximum) over the time period.

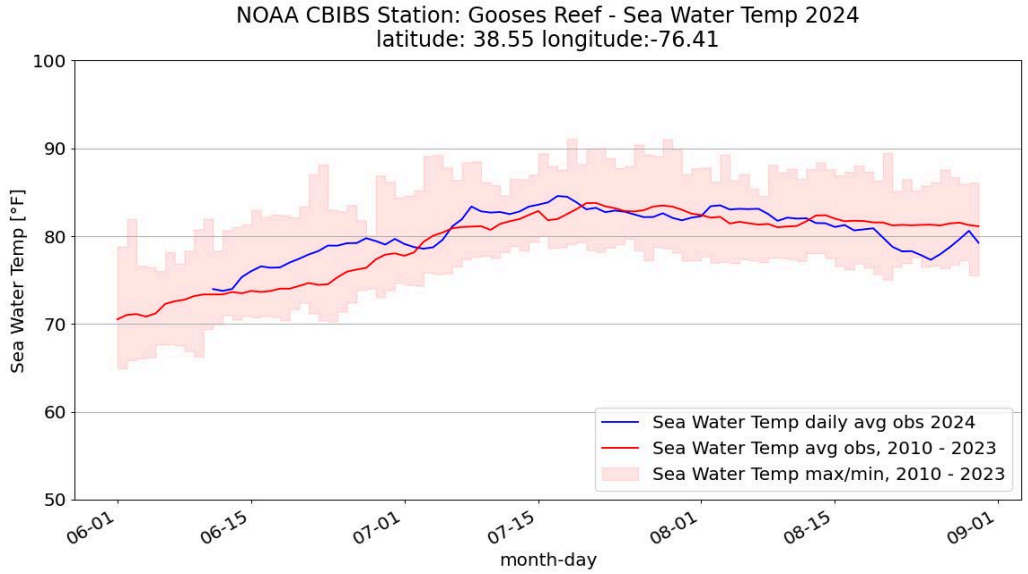

Figure 4. Surface water temperatures at the Gooses Reef CBIBS buoy June–August 2024 relative to the long-term average (2010–2023). The shaded area represents the full range of observations (minimum to maximum) over the time period.

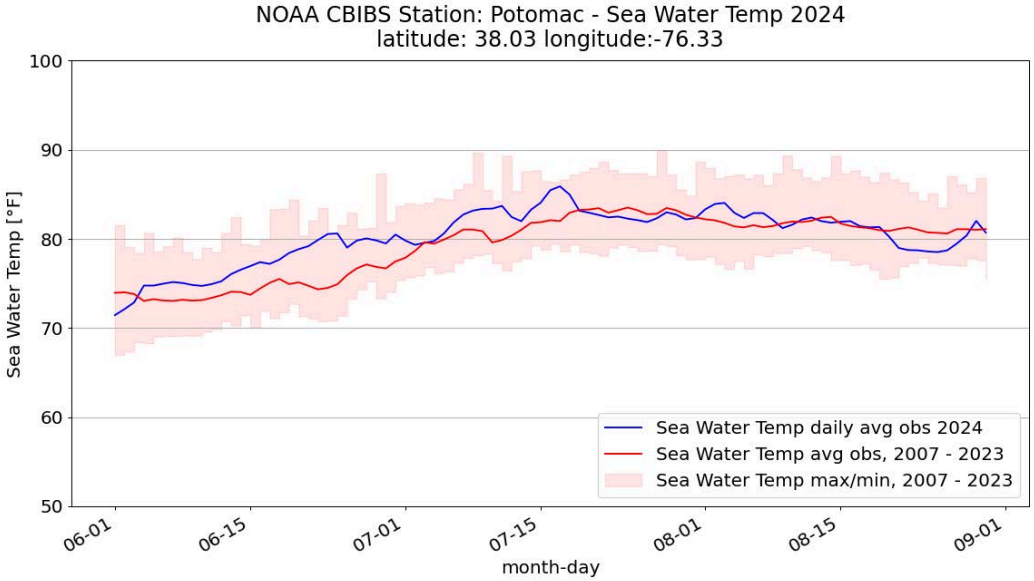

Figure 5. Surface water temperatures at the Potomac CBIBS buoy June–August 2024 relative to the long-term average (2007–2023). The shaded area represents the full range of observations (minimum to maximum) over the time period.

Note: Surface water temperatures at the York Spit CBIBS buoy June–August 2024 are not available because the water-quality sensor at that location was not working during that time period.

Salinity

Salinity remained well below average at the Annapolis, Gooses Reef, and Potomac CBIBS buoys from June through August. (Data was not available for York Spit, the southernmost buoy usually referenced in this report, as the water quality sensor that tracks salinity was not working.) This was unexpected, because much of the region was experiencing drier-than-normal weather and resulting drought conditions in some areas from June through most of July, according to PRESTO. Lower precipitation generally leads to higher sailities, because flows of fresh water coming into the Bay are diminished. Salinity dropped at all buoy locations in early to mid August following the remnants of Hurricane Debby. Annapolis and Gooses Reef buoys showed salinity 5 PSU or more below average in mid August.

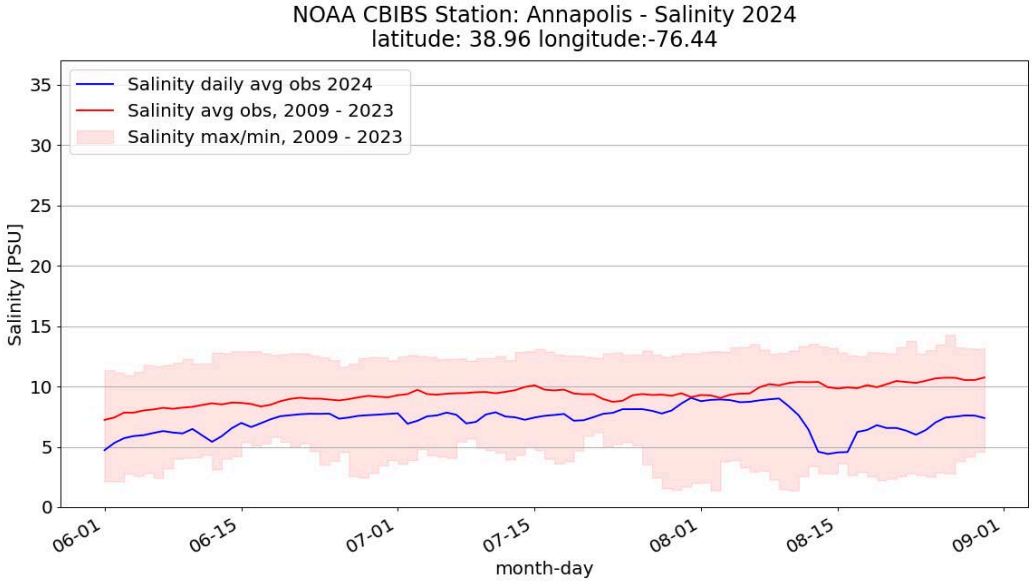

Figure 6. Salinity observations at the Annapolis CBIBS buoy June–August 2024 (blue line) relative to the average at each buoy over this seasonal period 2009–2023 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

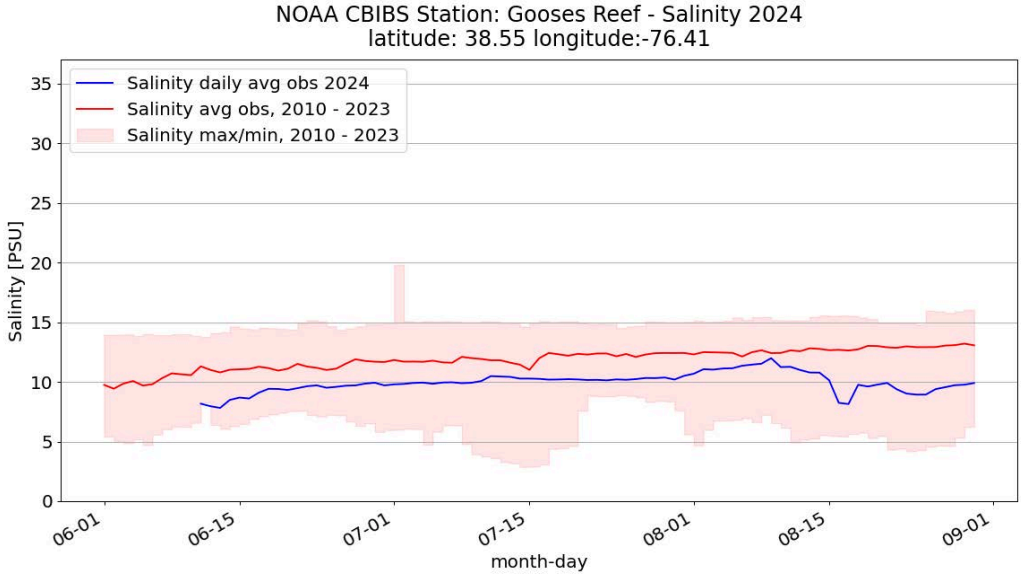

Figure 7. Salinity observations at the Gooses Reef CBIBS buoy June–August 2024 (blue line) relative to the average at each buoy over this seasonal period 2010–2023 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

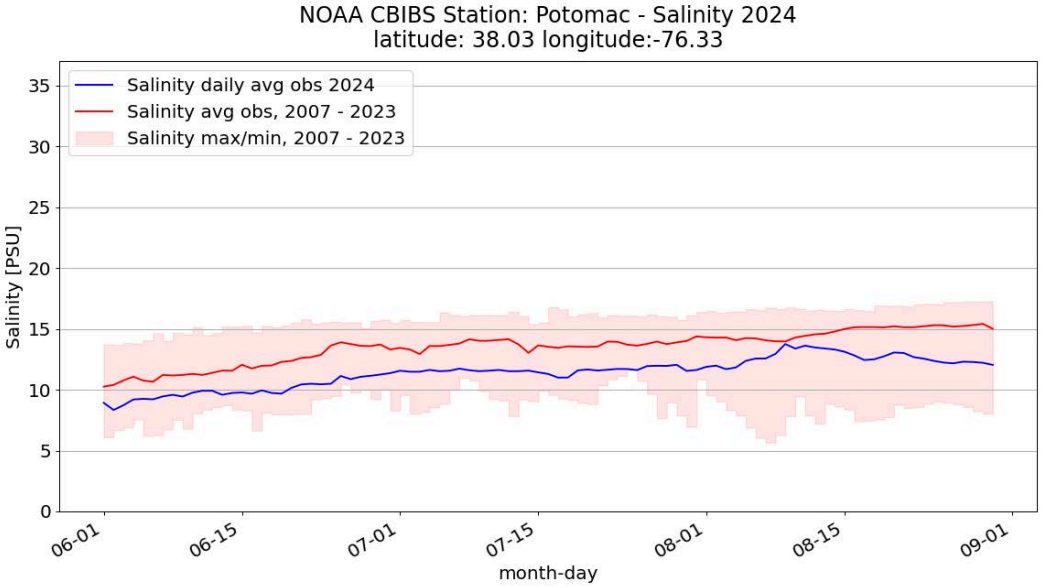

Figure 8. Salinity observations at the Potomac CBIBS buoy June–August 2024 (blue line) relative to the average at each buoy over this seasonal period 2007–2023 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

Note: Salinity at the York Spit CBIBS buoy June–August 2024 is not available because the water-quality sensor at that location was not working during that time period.

Precipitation and Freshwater Flow

According to precipitation data from NOAA's National Centers for Environmental Information, rainfall amounts for tidewater Virginia and southern Maryland were the sixth and third lowest, respectively, since 2007 (Figures 9 and 10). Lower precipitation usually results in low flow to the Bay. This correlation was observed at USGS streamflow stations. Stream flow was generally below historic flows, with a few notable spikes above historic flows at Choptank, Zekiah Swamp, and Pamunkey on July 1 (Figure 11). Jabez Branch shows a spike above historic flows in early August, corresponding with the passing of remnants of Hurricane Debby. A smaller spike was also observed in early August at Pamunkey; however, it did not exceed historic flow. Zekiah Swamp and Pumnkey show increasing flow at the end of August.

Figure 9. Precipitation data from 2007–2024 for June–August for Tidewater Virginia. Data from NOAA Centers for Environmental Information.

Figure 10. Precipitation data from 2007–2024 for June–August for southern Maryland. Data from NOAA Centers for Environmental Information.

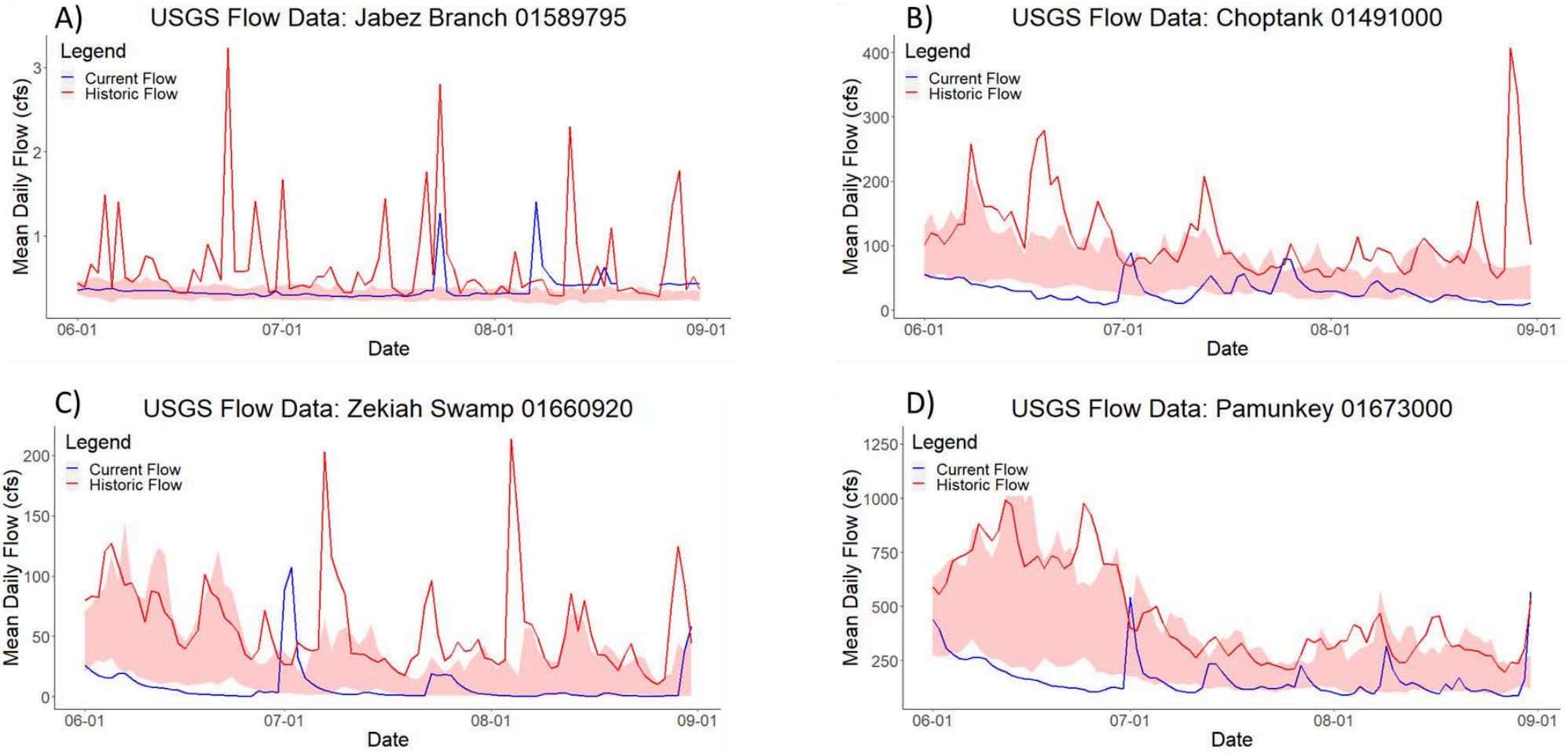

Figure 11. Daily mean streamflow observations (discharge, cubic feet/second) from the upper to lower Chesapeake Bay at U.S. Geological Survey monitoring sites at the (A) Jabez Branch, (B) Choptank River, (C) Zekiah Swamp (D), and Pamunkey River throughout summer 2024 relative to the daily averages over this seasonal period from 2000–2023. The red shading indicates the interquartile range (25%-75%), where 50% of the historical values fall.

Dissolved Oxygen

The Virginia Institute of Marine Science tracks data including dissolved oxygen at the surface and the bottom on a regular basis. To complete the picture of how dissolved oxygen levels change over time, they also run models that describe what dissolved oxygen levels would be throughout time. So at these locations, both directly measured data and modeled information are available.

Water-quality monitoring data show that dissolved oxygen at the surface at a mid-Bay location (station CB4.3C) ranged from average to above the monthly average for July and August 2024, measuring between about 7-9 mg/L for that time period (Figure 12). Dissolved oxygen levels in this range typically means organisms continue normal activity and behavior. Modeled data for this location does show surface dissolved oxygen dropping to below 6 mg/L at times during this same period.

At this same mid-Bay location, dissolved oxygen levels were below average from June to early July for both observed and modeled data (Figure 12). Bottom dissolved oxygen levels at this station improved to above average in August, but remained below 4 mg/L. Fish and crabs begin to move out of and avoid areas when dissolved oxygen concentrations reach 4 mg/L.

Data from a station at the mouth of the Potomac River (CBLE2.3) show surface dissolved oxygen was below the monthly average at the end of June; it improved to above average for July to August (Figure 13). Modeled data show drops well below 6 mg/L at several points during this same period.

This Potomac River station shows a similar, although more variable, pattern as the mid-Bay station for bottom dissolved oxygen (Figure 13). While conditions improved from July into August, bottom dissolved oxygen levels—both observed and modeled—were below 2 mg/L for much of this time period. Fish will not be present in areas with these low dissolved concentration levels. Crabs will move out of these areas and organisms such as worms (prey for fish and crabs) can be negatively affected.

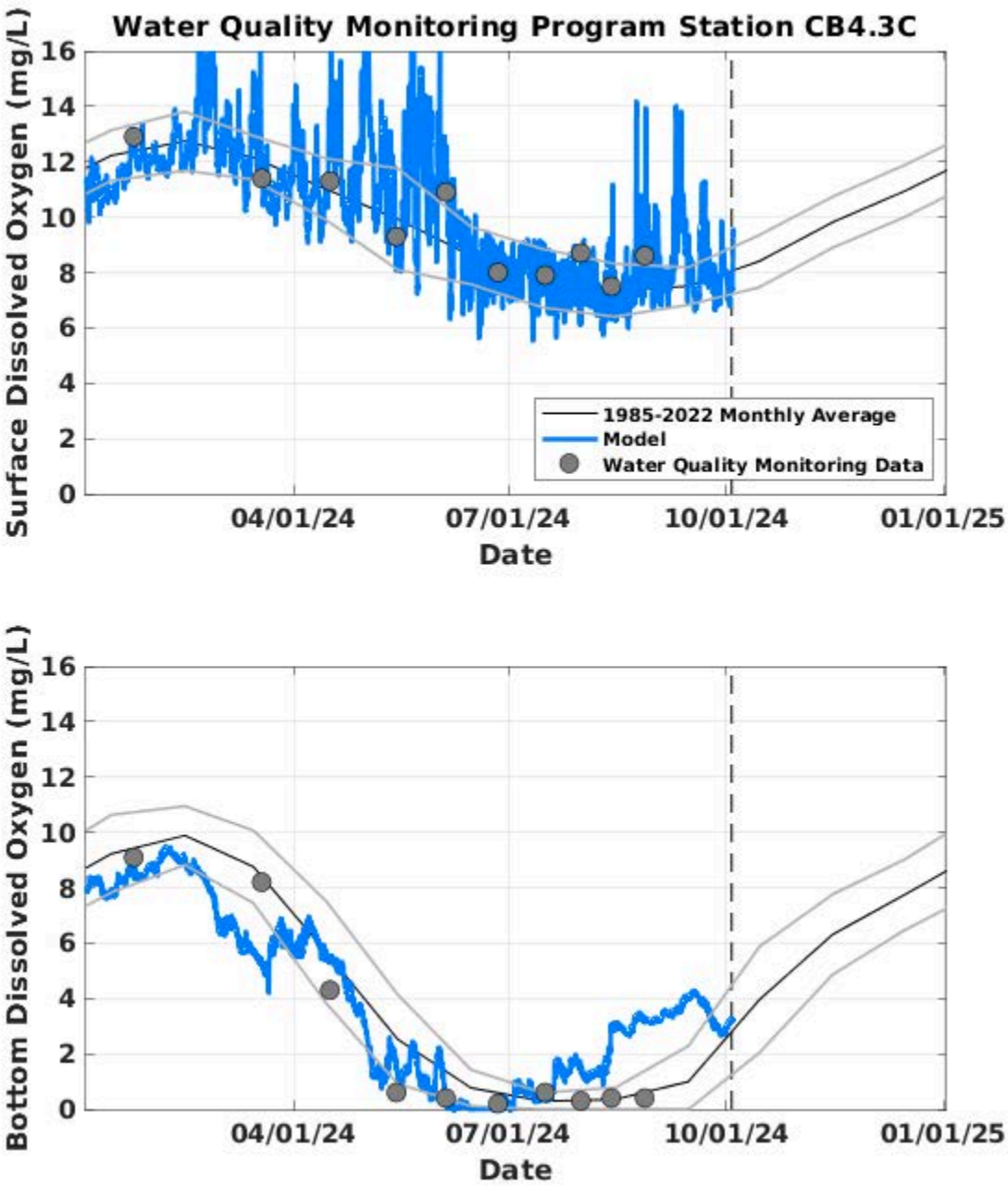

Figure 12. Observed and modeled dissolved oxygen at VIMS CB 4.3 station located in the mid Bay. Data from VIMS-CBEFS, Bever (2021).

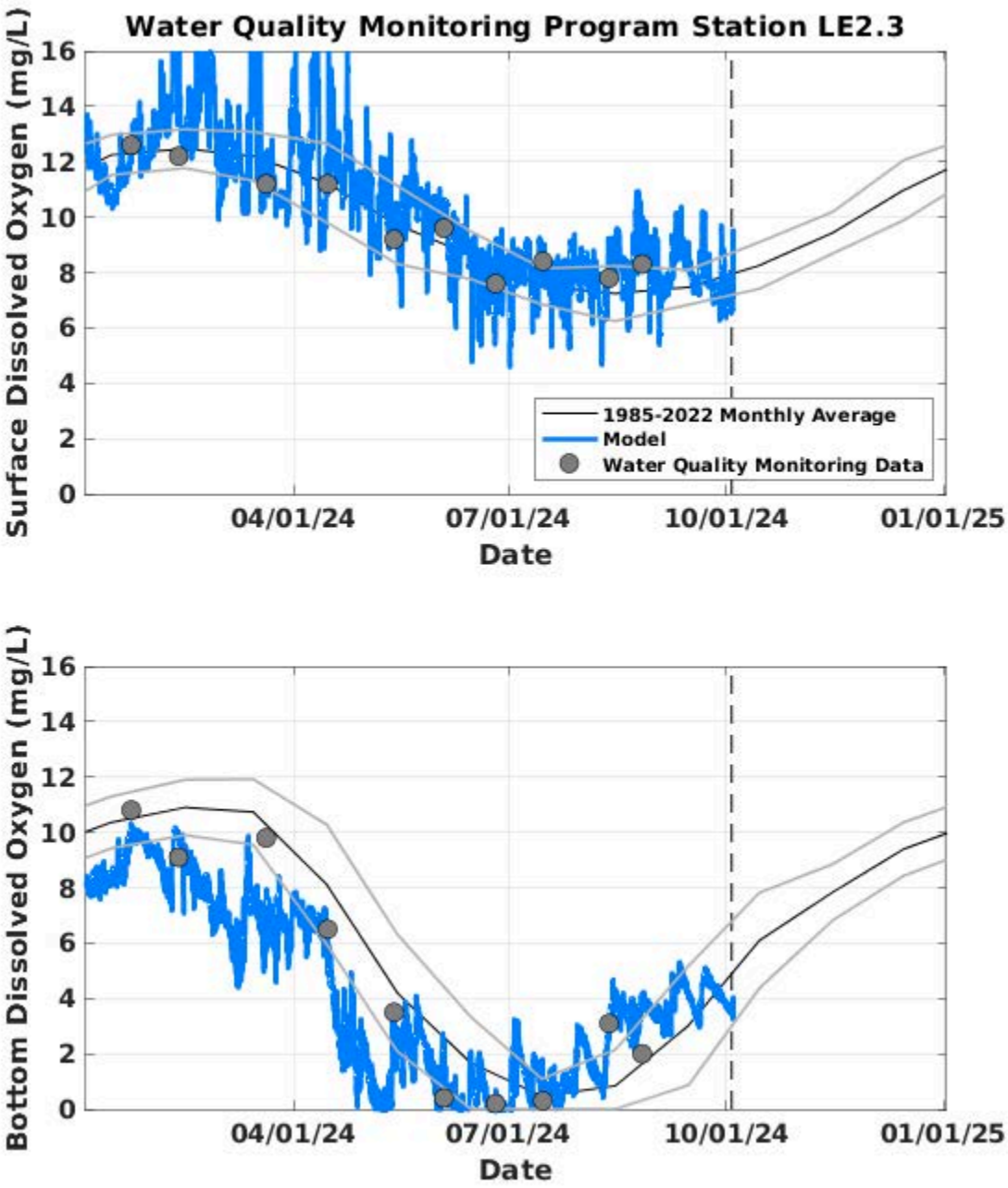

Figure 13. Observed and modeled dissolved oxygen at VIMS-CBEFS LE 2.3 station located at the mouth of the Potomac. Data from VIMS-CBEFS, Bever (2021).

Potential Effects of Anomalous Conditions on Living Resources

Striped Bass

Water temperatures above 82.4° F exceed suitable habitat thresholds for striped bass. Water temperatures were above this threshold from about mid-July to mid-August at all buoy locations included in this report. Bottom dissolved oxygen remained below the suitable habitat threshold for striped bass from June through August. Conditions that are less than suitable can affect the distribution, growth, and survival of striped bass.

Red Drum

A number of anglers reported good catches of red drum during the summer. During this summer's routine sampling at Poplar Island, NOAA Chesapeake Bay Office scientists recorded the highest number of red drum since monitoring began in 1995 (Figure 14). This may indicate habitat conditions in the lower and upper Bay are conducive to red drum. This may be related to rising water temperatures linked to climate change. Conservation measures for red drum implemented by management agencies have contributed to improved recreational fishing for this species in the Bay in recent years. However, there are few new studies focused on understanding these changes.

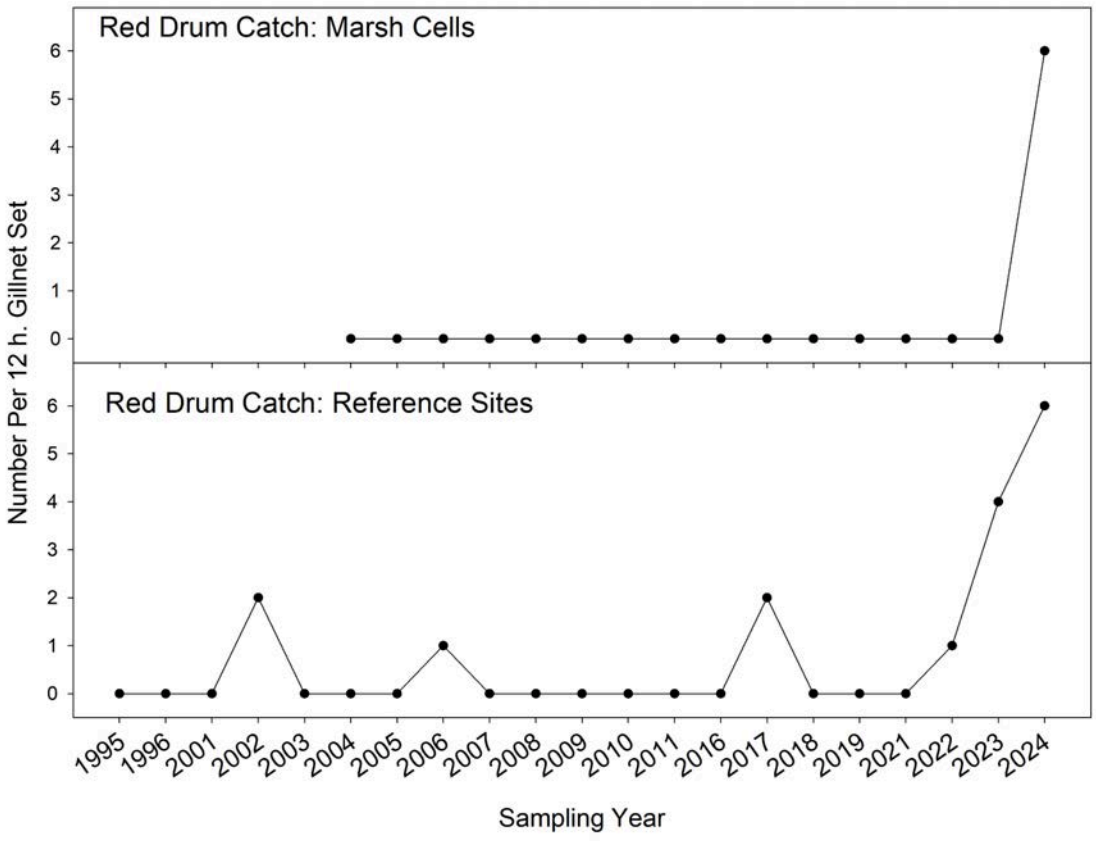

Figure 14. Total red drum collected by NCBO during routine sampling with gill nets within Poplar Island restoration cells and at nearby reference sites.

Oysters
Oysters may have been affected by low dissolved oxygen and by lower salinity. The University of Maryland Center for Environmental Science's Horn Point Laboratory Oyster Hatchery on the Choptank River had salinity-related issues with spawning all season, and it was still salting water to induce spawning into the summer. Lower salinity may lead to a lower spat set this year in the upper Bay; however, it could result in lower disease intensities as well.

Blue Crab
Female blue crab migrations to the lower Bay and mouth can be affected by low dissolved oxygen conditions. Low dissolved oxygen can also make blue crabs more susceptible to harvest as they move out of sanctuary boundaries to avoid adverse conditions.

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

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.