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

Fall 2023 Seasonal Summary

Fall 2023 Headlines

- **Water temperature, salinity, and dissolved oxygen conditions across the Bay this fall were generally favorable for striped bass, blue crabs, and oysters.**
- **Higher than average salinity across the Bay was likely driven by low precipitation and increased the area of available habitat for species such as croaker, spot, menhaden, and red drum, while restricting habitat area for invasive blue catfish.**
- **Warmer water temperatures in the Western Shore tributaries may have been driven by lower precipitation, lower flows, and relatively calm conditions.**

Summary of Year-to-Date Impacts of Environmental Conditions on Key Species

2023	Winter	Spring	Summer	Fall
Striped Bass	WT, Sal, Flow	WT, Sal, Flow	WT, DO, Sal, Flow	WT, DO, Sal, Flow
Blue Crabs	WT, Sal, Flow	WT, Sal, Flow	WT, DO, Sal, Flow	WT, DO, Sal, Flow
Oysters	WT, Sal, Flow	WT, Sal, Flow	WT, DO, Sal, Flow	WT, DO, Sal, Flow
Bay Anchovy	WT, Sal, Flow	WT, Sal, Flow	WT, DO, Sal, Flow	WT, DO, Sal, Flow
Summer Flounder*				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 represents 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; 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.

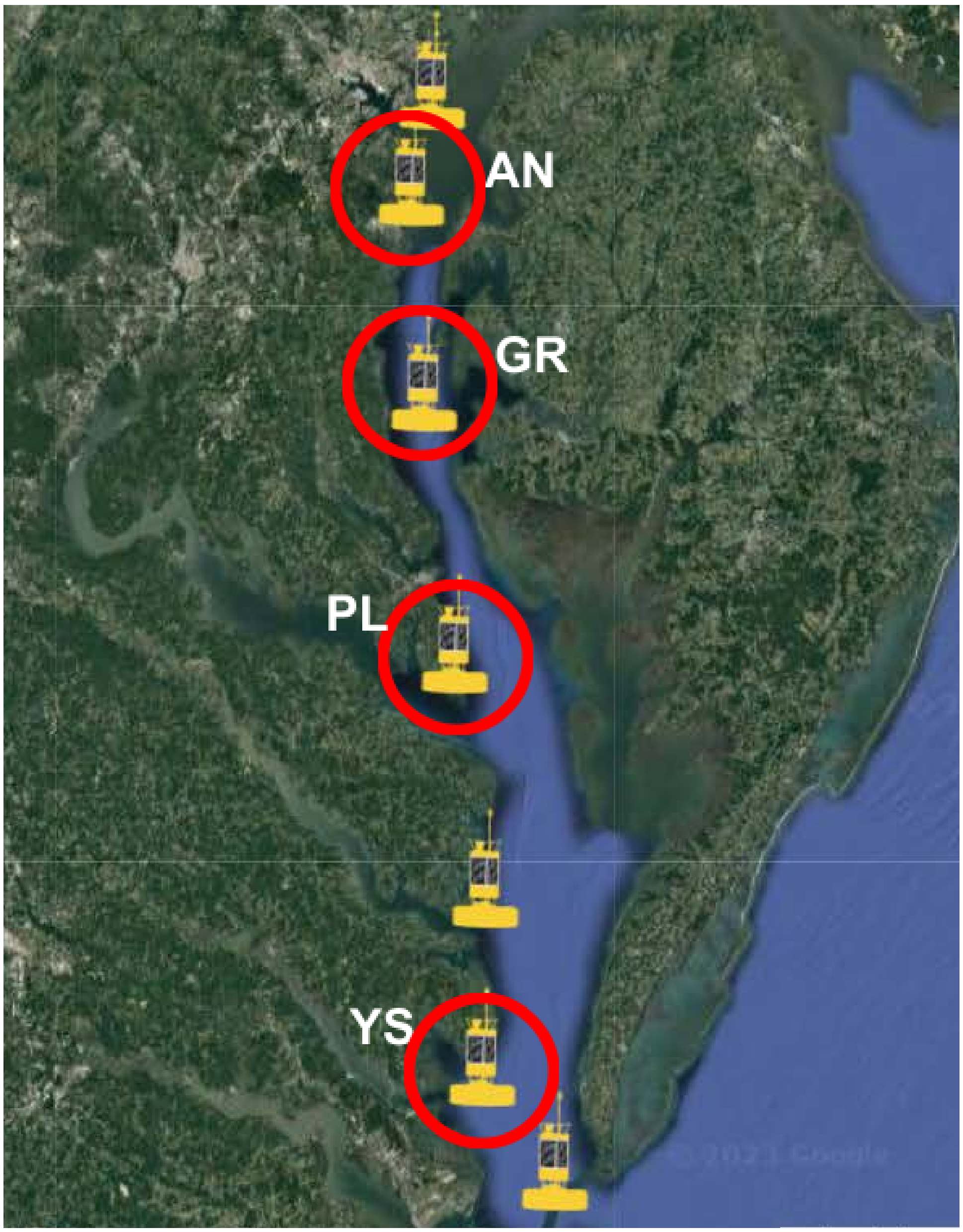

Figure 1. Map of Chesapeake Bay Interpretive Buoy System (CBIBS) observation platforms. The buoys used in these summaries are AN (Annapolis), GR (Gooses Reef), PL (Potomac), and YS (York Spit).

Water Temperature

Sea surface temperature anomalies from satellite data (Figure 2) show warmer-than-average waters in the Western Shore tributaries, but cooler-than-average waters on the the Eastern Shore. Warmer conditions likely developed due to low precipitation, which leads to lower freshwater flow into the Bay. Relatively calm conditions may have contributed as well by reducing mixing. Warmer conditions on the Western Shore may have delayed migration of some species to marine waters.

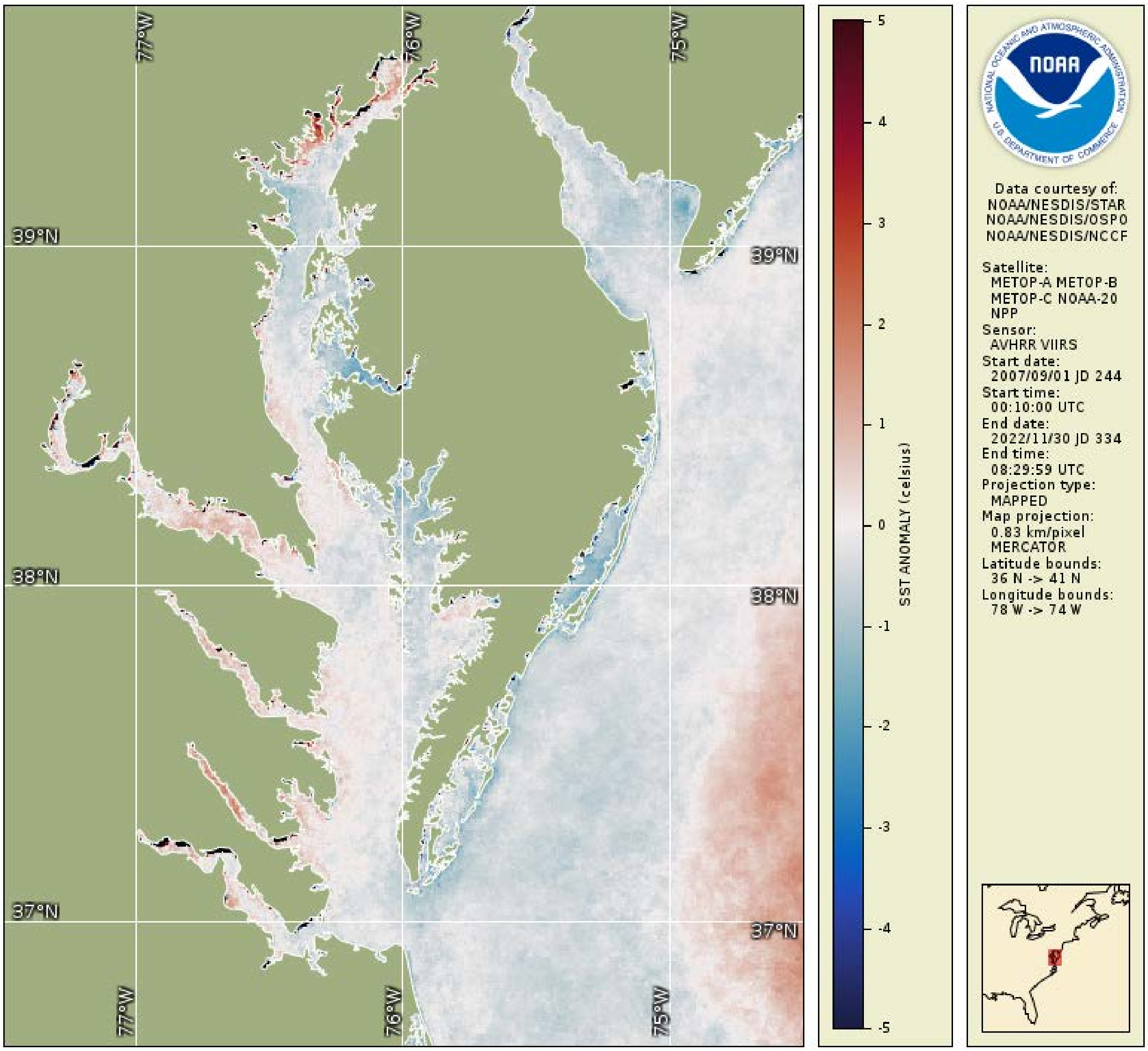

Figure 2. Sea surface temperature (SST) anomalies observed by NOAA satellites September–November 2023 relative to the average of this seasonal period 2007–2022.

Water temperatures at Annapolis buoy dropped from over 80°F to 50°F between September and the end of November, fluctuating above and below the long-term average over this time period. This is representative of the normal fall pattern.

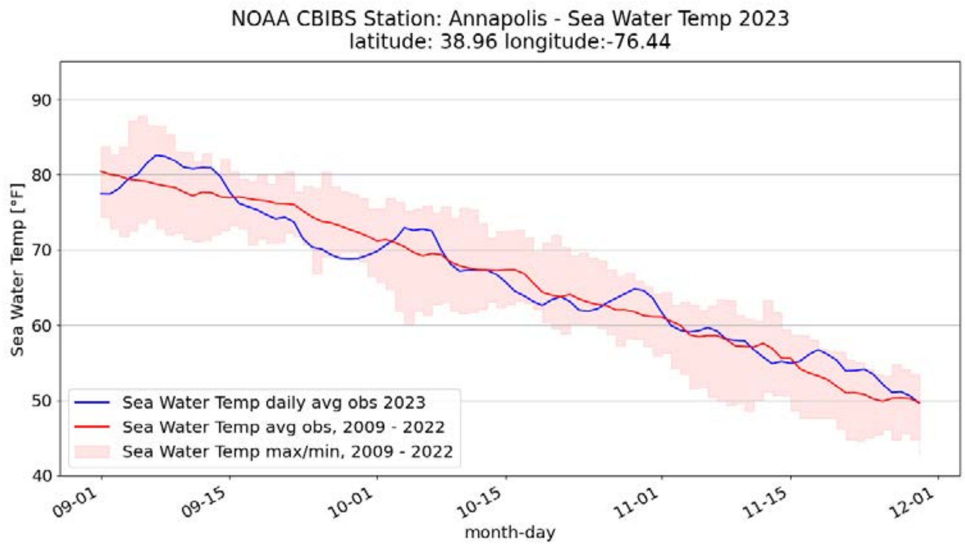

Figure 3. Surface water temperatures at the Annapolis buoy September–November 2023 relative to the long-term average (2009–2022). The shaded area represents the full range of observations (minimum to maximum) over the time period.

A similar pattern was observed at the Gooses Reef, Potomac, and York Spit buoys (Figures 4, 5, and 6). There was a cooling period at all stations from mid-September to the beginning of October when temperatures then increased again for a few days following the remnants of Tropical Storm Ophelia.

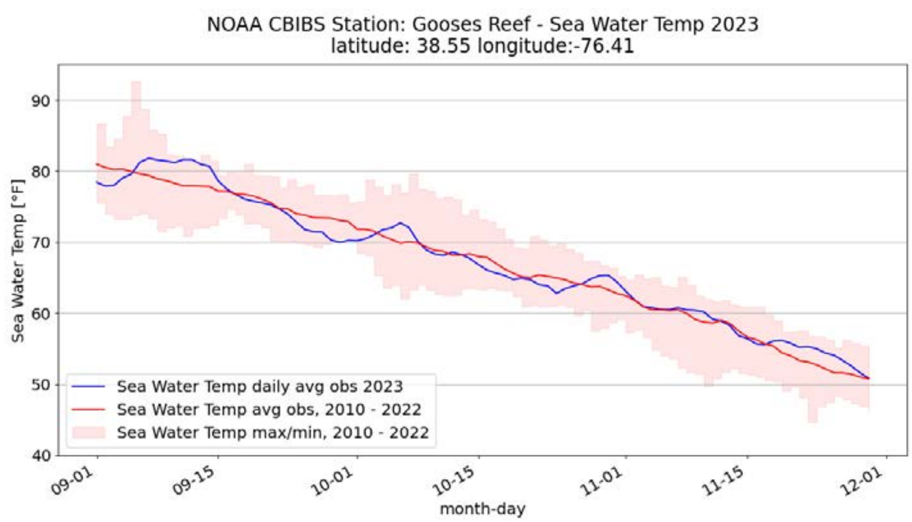

Figure 4. Surface water temperatures at the Gooses Reef buoy September–November 2023 relative to the long-term average (2010–2022). The shaded area represents the full range of observations (minimum to maximum) over the time period.

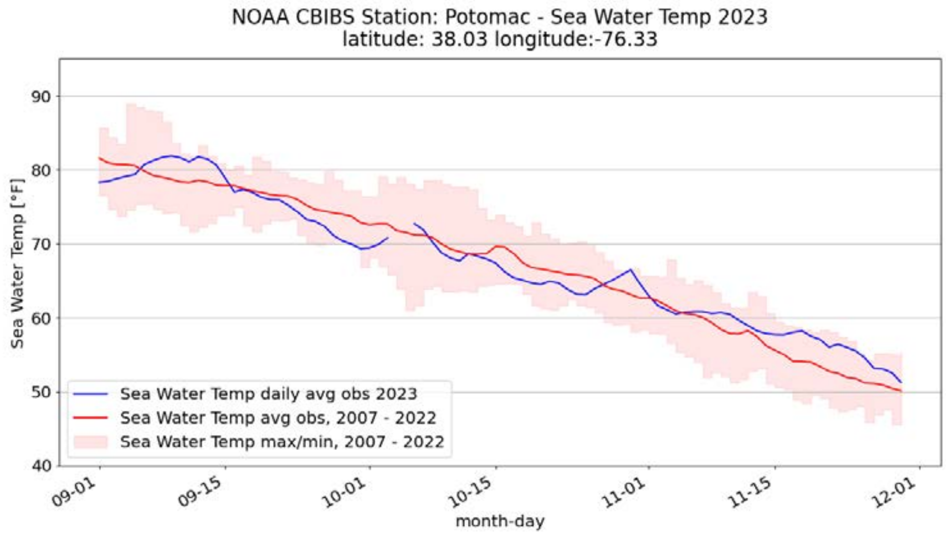

Figure 5. Surface water temperatures at the Potomac buoy September–November 2023 relative to the long-term average (2007–2022). The shaded area represents the full range of observations (minimum to maximum) over the time period.

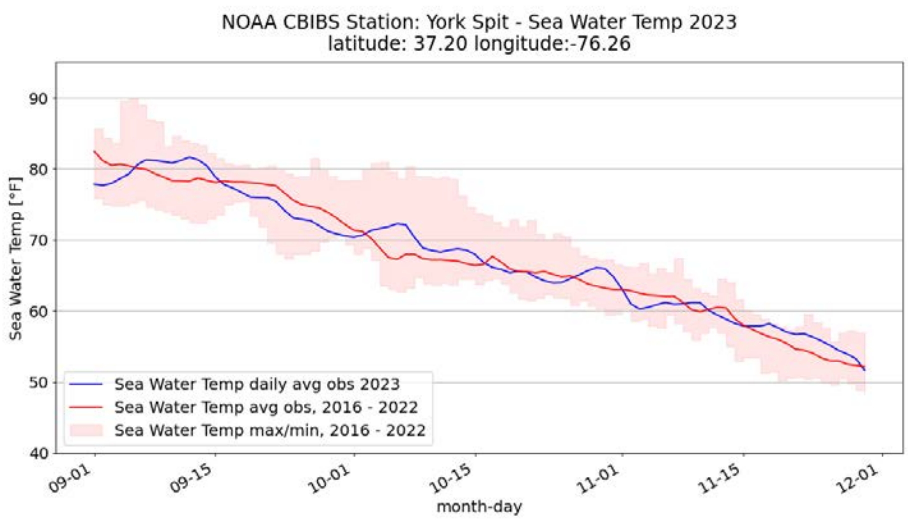

Figure 6. Surface water temperatures at the York Spit buoy September–November 2023 relative to the long-term average (2016–2022). The shaded area represents the full range of observations (minimum to maximum) over the time period.

Dissolved Oxygen

Overall hypoxic conditions were favorable for fish, crabs, and oysters in the fall as daily hypoxic volume remained low. Hypoxic conditions ended relatively early in the year. By mid-September, cooling temperatures and strong winds associated with the remnants of Tropical Storm Ophelia resulted in very low daily hypoxic volume as indicated in Figure 7 and further detailed in this report by the Virginia Institute of Marine Science. Low hypoxia conditions mean that more area of suitable habitat was available for striped bass and blue crabs; this can improve their rates of survival.

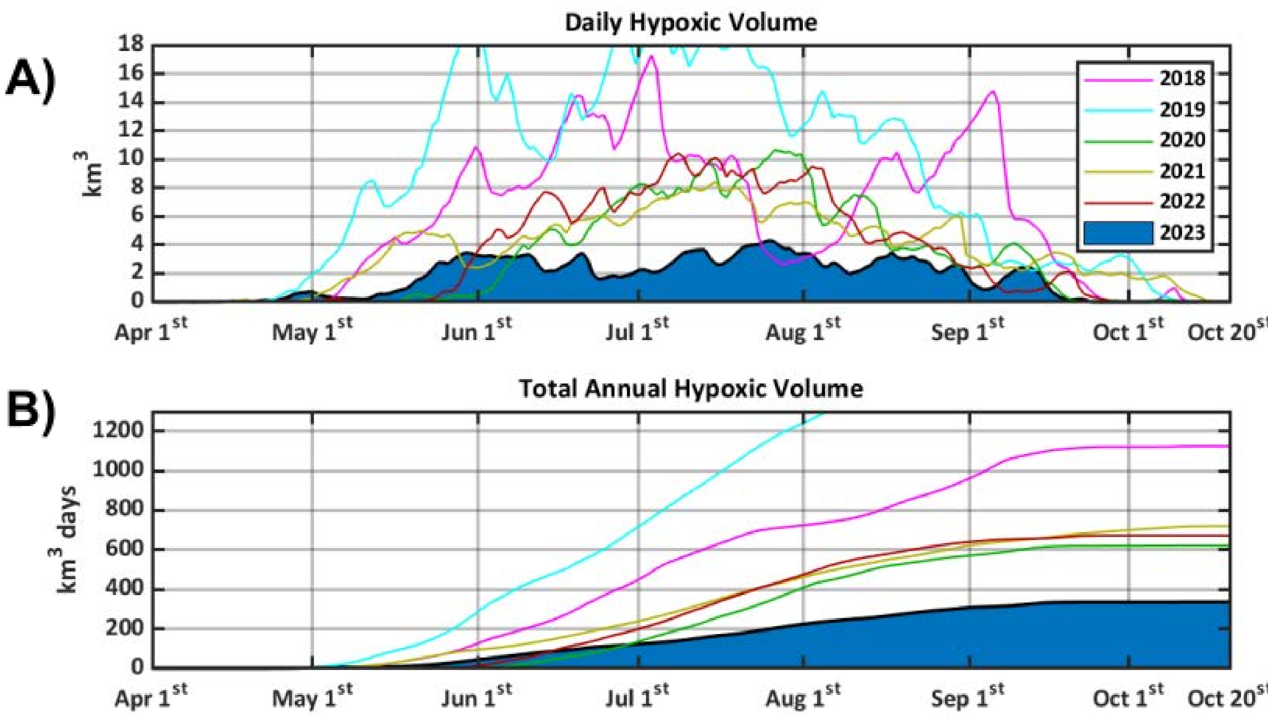

Figure 7. Estimates of (A) daily hypoxic volume and (B) total annual hypoxic volume from the Chesapeake Bay Environmental Forecast System for 2018–2023. Hypoxia is defined as dissolved oxygen concentrations below 2 mg/L.

Salinity

Salinity was about average through mid-September at the Annapolis buoy increasing to above average from October through November (Figure 8). In early November, salinity was more than 5 ppt higher than the long-term average, which can affect habitat and species distribution. A similar pattern was observed at the Gooses Reef and Potomac buoys (Figure 9 and 10). Higher salinities can support improved oyster spawning success and spat set, but also increase disease prevalence. Salinities over 14 ppt are not tolerable by invasive blue catfish. This may have limited their ability to occupy larger parts of tributaries and the Bay.

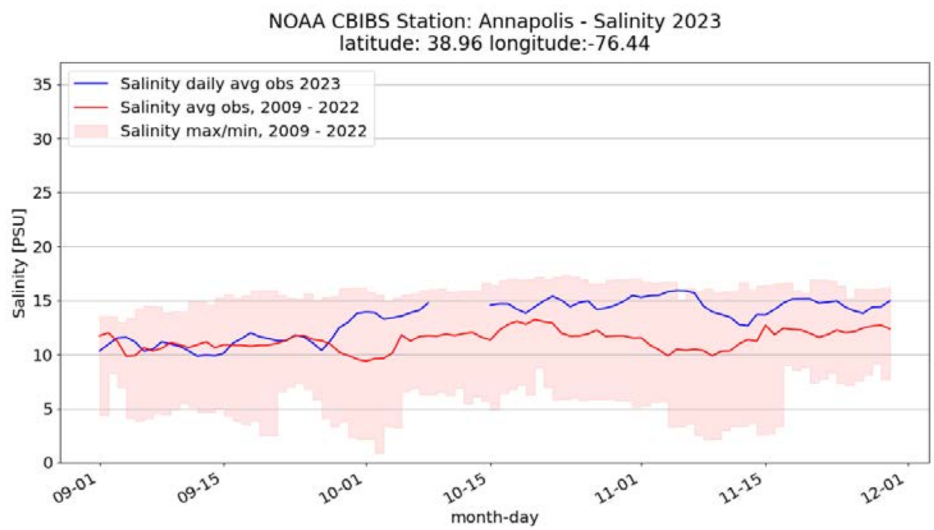

Figure 8. Salinity observations at the Annapolis CBIBS buoy September–November 2023 (blue line) relative to the average at each buoy over this seasonal period 2009–2022 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

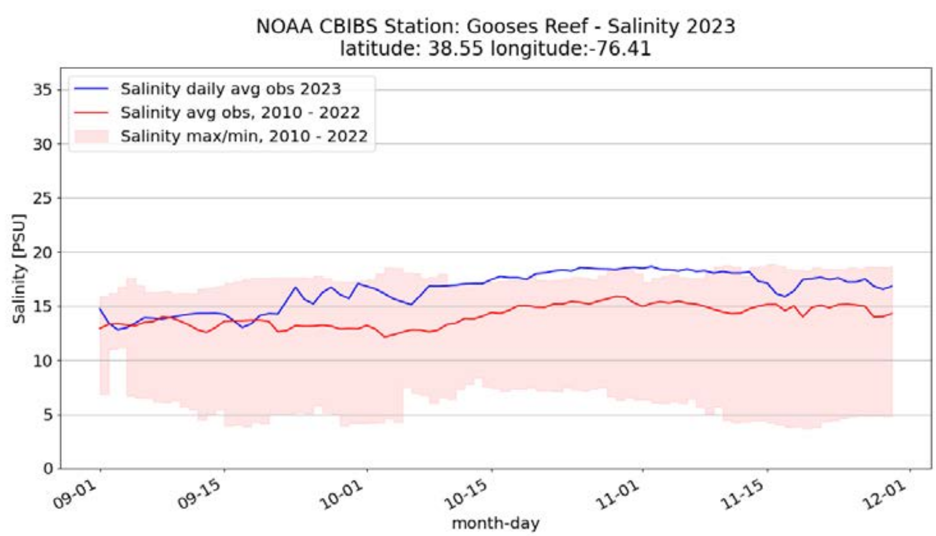

Figure 9. Salinity observations at the Gooses Reef CBIBS buoy September–November 2023 (blue line) relative to the average at each buoy over this seasonal period 2010–2022 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

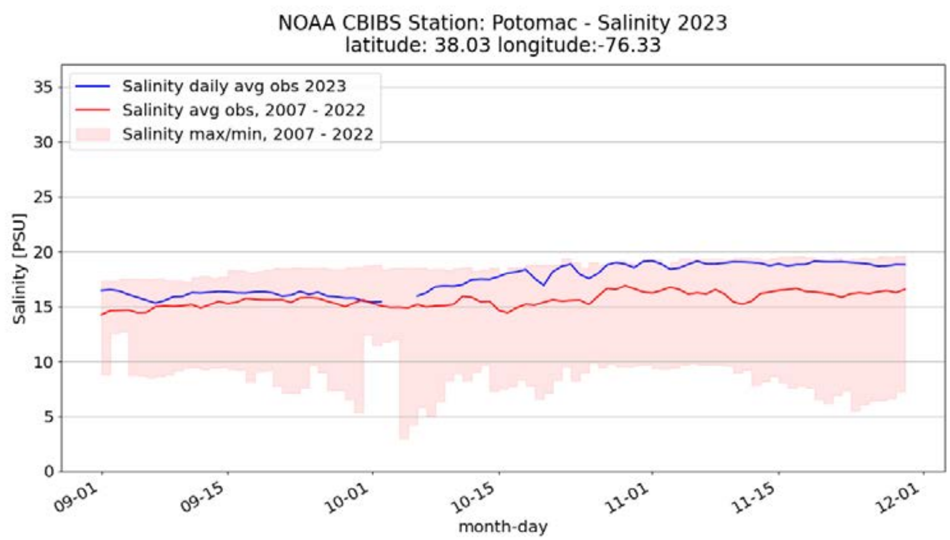

Figure 10. Salinity observations at the Potomac CBIBS buoy September–November 2023 (blue line) relative to the average at each buoy over this seasonal period 2007–2022 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

Salinity at York Spit was close to average from September to mid October, when a slight increase occurred into November, but overall, salinity remained very close to the long-term average.

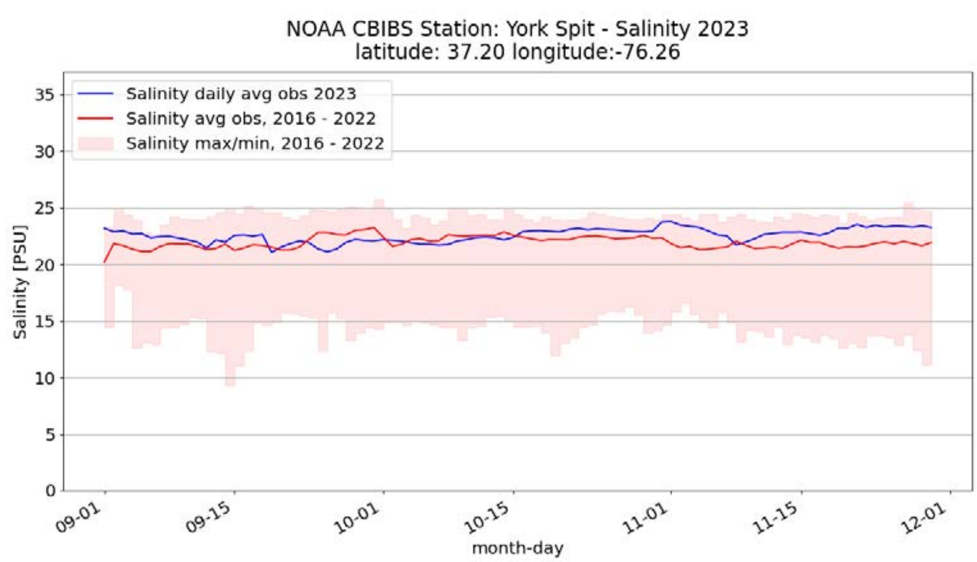

Figure 11. Salinity observations at the York Spit CBIBS buoy September–November 2023 (blue line) relative to the average at each buoy over this seasonal period 2016–2022 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

Precipitation and Freshwater Flow

Rainfall from September through November was 2.96 inches in Virginia and 2.39 inches in Maryland below the 2007-2023 average (Figures 12 and 13). Lower rainfall amounts lead to lower freshwater flow (Figure 13) and result in higher salinity, as observed by the buoys. Lower rainfall and flow can also reduce the amount of nutrients entering the Bay. Low flow can reduce the amount of habitat available for some species such as blue catfish, because they cannot tolerate the resulting higher salinity, and increase habitat for marine species, which will move into higher-salinity areas when available.

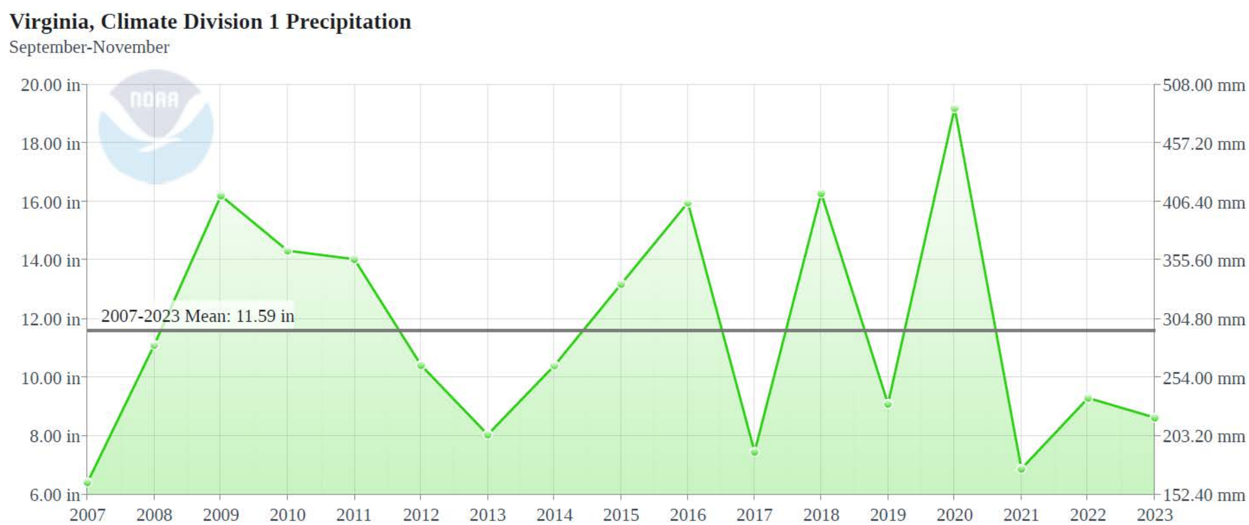

Figure 12. Precipitation data from 2007–2023 for September–November for Tidewater Virginia. Data from NOAA Centers for Environmental Information.

Figure 13. Precipitation data from 2007–2023 for September–November for southern Maryland. Data from NOAA Centers for Environmental Information.

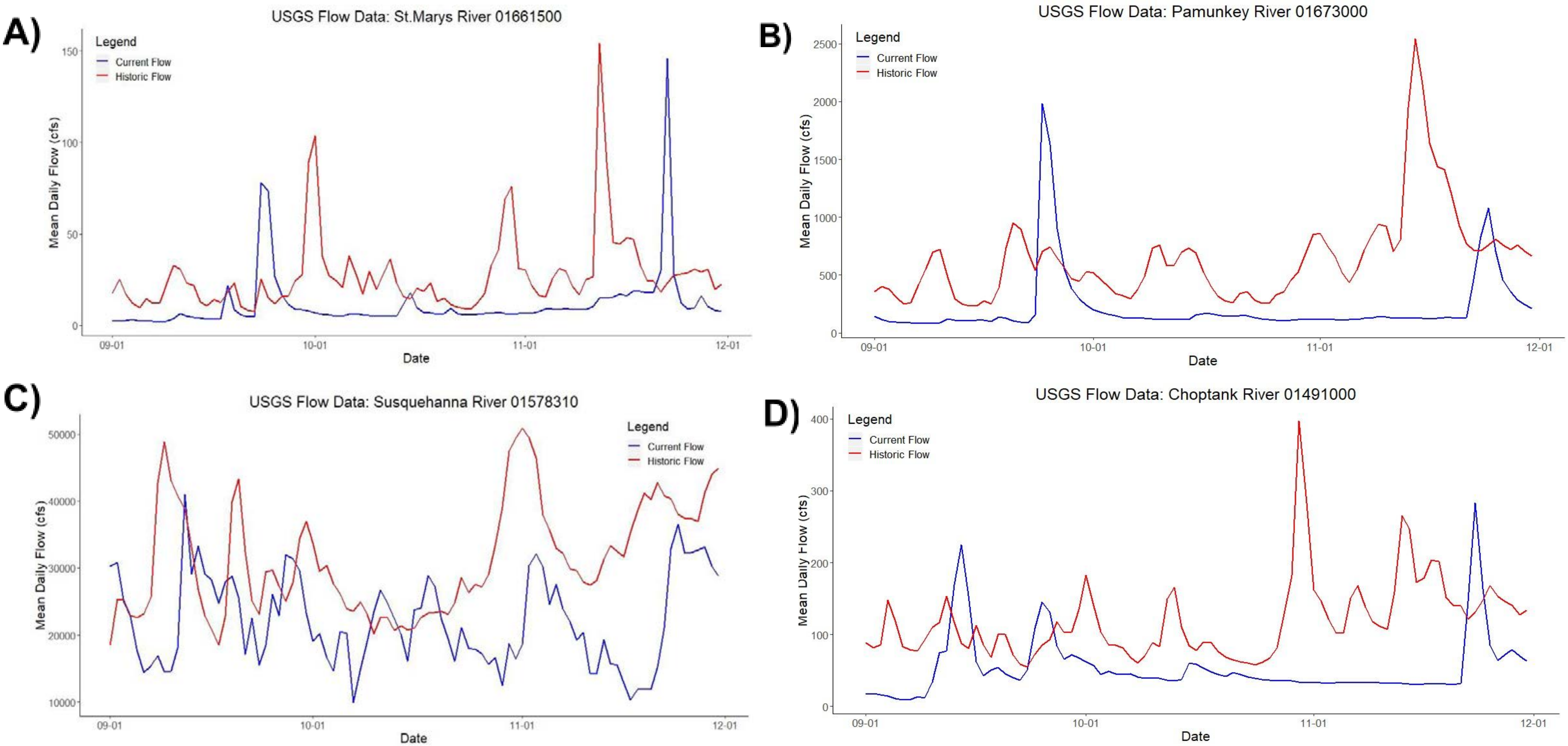

Figure 14. Daily mean streamflow observations (discharge, cubic feet/second) at USGS monitoring sites at the (A) St. Mary's, (B) Pamunkey, (C) Susquehanna (D), and Choptank rivers throughout fall 2023 relative to the daily averages over this seasonal period 2001–2022.

Fish Movement

Acoustic telemetry is used to track fish movements, habitat use, and support fishery management. NCBO and partners oversee three arrays of telemetry receivers in the Chesapeake Bay (Figure 15). The Chesapeake Bay North Array and South Array are overseen by NCBO in partnership with the Maryland Department of Natural Resources and Virginia Marine Resources Commission, respectively. The Mid Bay Array is managed by the University of Maryland Chesapeake Biological Laboratory. Data is provided to the Mid-Atlantic Acoustic Telemetry System/Atlantic Cooperative Network (MATOS; ACT), which matches detections of tagged individuals with fish taggers and receiver owners across all databases.

From January through November 2023, a total of 763 individual fish representing 15 different species were observed by these three arrays (Figure 16). These fish were from 23 separate studies and were tagged as far away as Alabama, the Florida Keys, and Maine (Figure 17). The most frequently observed species were striped bass, sturgeon, and cownose ray. We will compare acoustic telemetry data with observations of water-quality parameters in future seasonal summaries to explore how some species might be reacting to environmental conditions.

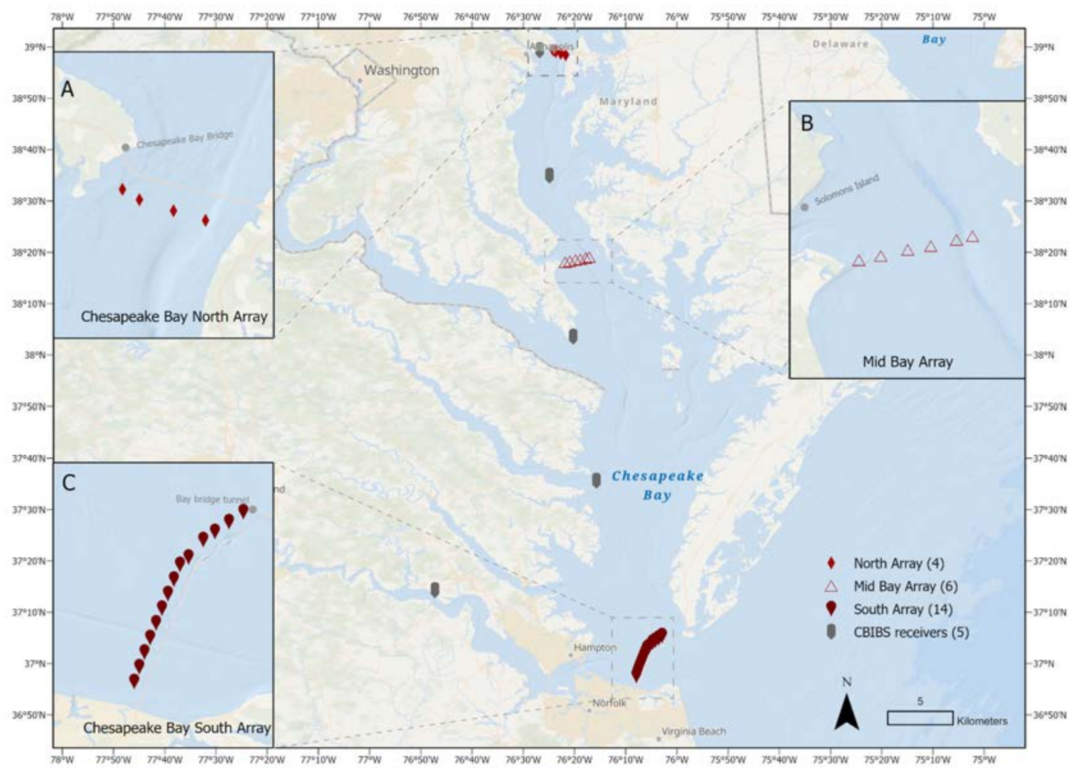

Figure 15. Passive acoustic receivers located in the Chesapeake Bay Arrays in 2023. A total of 29 acoustic receivers were active within the Chesapeake Bay in the North, Mid Bay, and South Arrays.

Arrays	Detections	Num of fish observed
Chesapeake Bay North	5867	100
Chesapeake Bay Mid Bay	4426	37
Chesapeake Bay South	11192	487
CBIBS	11473	139
Total	32958	763

Figure 16. A summary of the fish detections observed at each of the mainstem Chesapeake Bay acoustic telemetry arrays the CBIBS buoys.

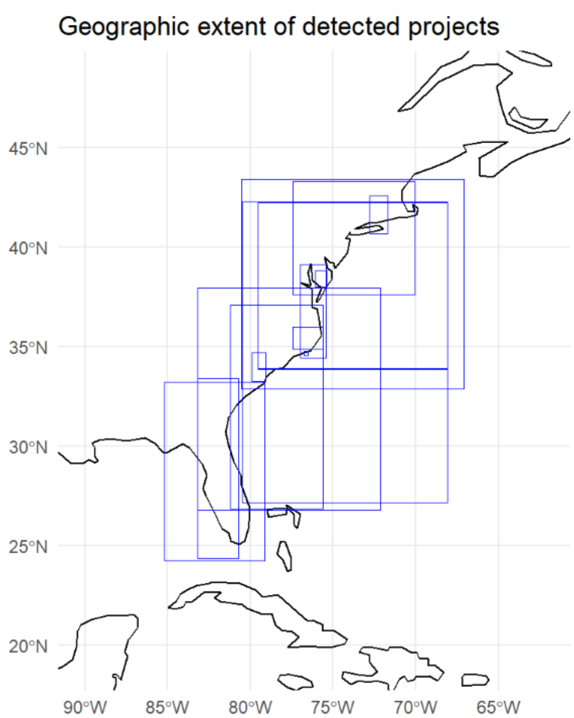

Figure 17. Geographic extent of the tagged fish locations. Blue squares represent the area where fish projects originate geographically.

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