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

Fall 2022 Seasonal Summary

Fall 2022 Headlines

- **Above-average water temperatures delay striped bass migrations and extend residency time of juvenile summer flounder in the Bay.**
- **Strong winds from the remnants of Hurricane Ian shorten hypoxia duration.**
- **Above-average salinities support oyster recruitment and survival.**

Purpose

The 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. 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; Figure 1) and the NOAA CoastWatch Program. CBIBS buoys are located throughout the Bay and provide real-time water quality information such as water temperature and salinity (in addition to meteorological and other data). The NOAA CoastWatch Program uses satellite data to provide observations of sea surface temperature anomalies throughout the Bay. NCBO uses these seasonal summaries to develop an annual synthesis for inclusion in the Mid-Atlantic State of the Ecosystem Report. This report is developed by the Northeast Fisheries Science Center and presented to the Mid-Atlantic Fishery Management Council each year.

Water Temperature

The satellite imagery from NOAA's CoastWatch Program shows notable spatial variability in the sea surface temperature (SST) anomaly throughout the Chesapeake Bay in fall 2022 (Figure 2). In the upper Bay (north of the Choptank River), and in the lower Bay (south of the York River), water temperatures were, on average, warmer than the previous decade. In the mid-Bay (between the Choptank and York rivers), water temperatures were average to cooler-than-average, particularly in the channels. The low spatial resolution of the satellite imagery precludes any conclusions about SST anomalies in the tributaries.

Observations from the CBIBS buoys show the temporal variation in water temperatures throughout the season (Figure 3). At all four buoy locations examined, water temperatures initially fluctuated around the average throughout September, dropped below average in October, and then increased to above-average levels in November. The NOAA National Weather Service (NWS) PREcipitation Summary and Temperature Observations (PRESTO) report for October 2022 indicated that the remnants of Hurricane Ian hit the Chesapeake Bay region around October 1, driving the below-average temperatures observed at that time.

Water temperature often drives fish migrations into and out of the Chesapeake Bay as well as within the Bay. As water temperatures drop in the fall, juvenile fishes such as summer flounder (*Paralichthys dentatus*) leave the shallow nursery habitats of the Bay for coastal shelf waters, and resident striped bass

(*Morone saxatilis*) move south down the Bay to higher-salinity habitats (Itakura et al. 2021). Preliminary results from the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) survey indicated above-average catch of summer flounder, particularly smaller individuals, and below-average catch of striped bass in fall 2022. The above-average water temperatures this fall may have allowed juvenile summer flounder to remain in the Bay longer and possibly delayed the fall striped bass migration.

Dissolved Oxygen

The Maryland Department of Natural Resources' (MDNR) 2022 Chesapeake Bay Hypoxia Report indicated an above-average hypoxic volume in the Bay in September, likely due to temperature-driven water column stratification, but hypoxia was effectively absent by October. The Virginia Institute of Marine Science (VIMS) 2022 Chesapeake Bay Dead Zone Report corroborated the relatively short duration of hypoxia, citing cooler temperatures and strong winds from the remnants of Hurricane Ian as the limiting factor. Although hypoxic volume was slightly above average in September (0.77 mi^3 vs. 0.44 mi^3), the overall hypoxic conditions in the Chesapeake Bay were better than average, suggesting that fish and benthic communities likely did not experience significant hypoxic events, nor their detrimental effects, in 2022.

Salinity

Observations from the NOAA CBIBS buoys indicate that the Chesapeake Bay experienced above-average salinity throughout fall 2022 (Figure 4). The NWS PRESTO reports for September and October suggested that precipitation levels were generally below average, despite Hurricane Ian, corroborating the low salinities observed throughout the Bay. Salinity plays an important role in the survival and recruitment success of oysters in the Chesapeake Bay, with higher salinity often resulting in higher juvenile oyster abundance (Kimmel et al. 2014). Summer salinity levels are particularly important, as summer is the peak reproductive season for oysters in the Bay. Preliminary results from the 2022 Maryland Department of Natural Resources and Virginia fall oyster surveys suggest that Bay-wide oyster populations have likely benefited from strong natural recruitment in 2021 and high salinities in summer 2022.

Freshwater Flow

River discharge data collected by the U.S. Geological Survey (USGS) corroborate the salinity observations in the Chesapeake Bay in fall 2022 (Figure 5). At the three sites examined in the Susquehanna, St. Marys, and Pamunkey rivers, flow was predominantly below average, with several peaks corresponding to high-precipitation events identified in the PRESTO reports. The below-average freshwater flows into the Bay, and the consequent above-average salinities, provided a conducive environment for oyster recruitment, growth, and survival in 2022.

Figures

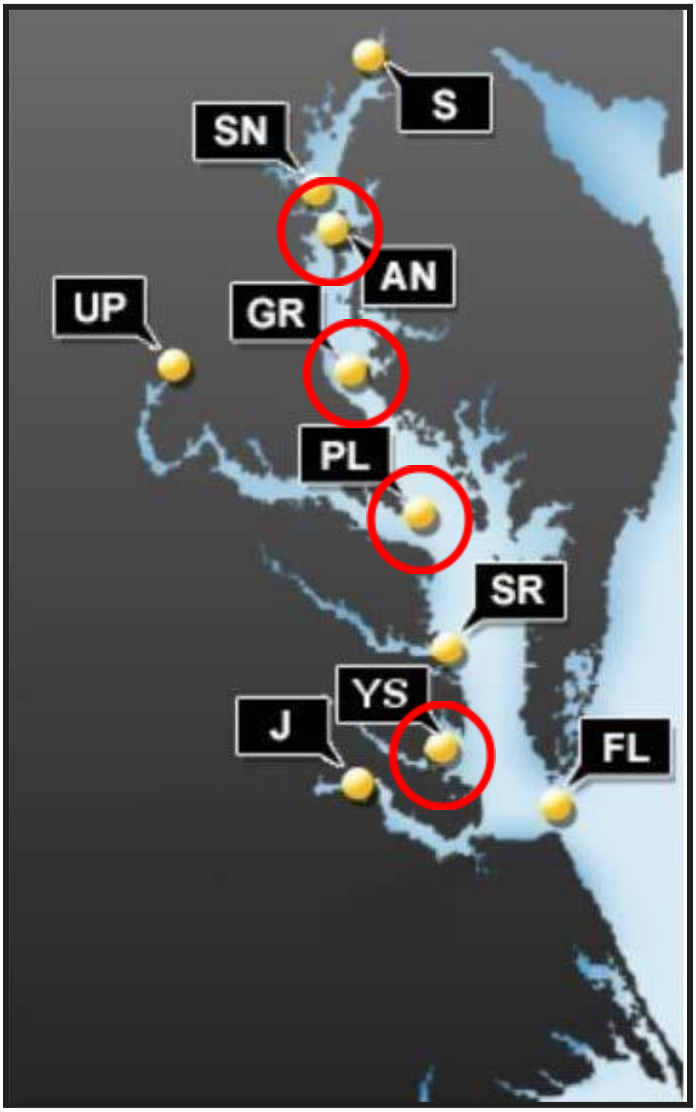


Figure 1. Map of existing and previous Chesapeake Bay Interpretive Buoy System (CBIBS) observation platforms. The buoys used in these summaries are AN (Annapolis), GR (Gooses Reef), PL (Potomac), and YS (York Spit).

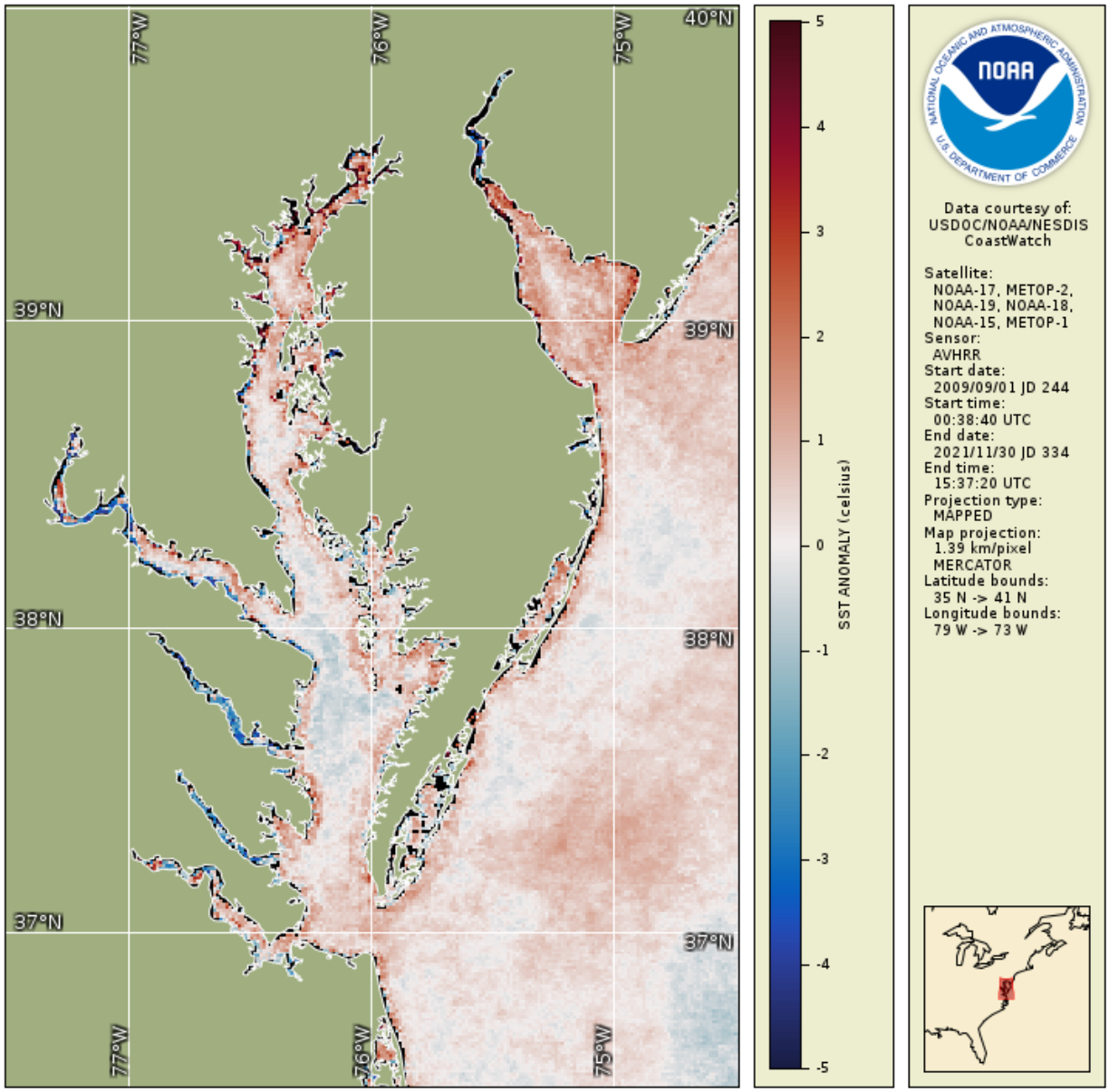


Figure 2. Sea surface temperature (SST) anomalies observed by NOAA satellites from September to November 2022 relative to the average of this seasonal period from 2009 to 2021.

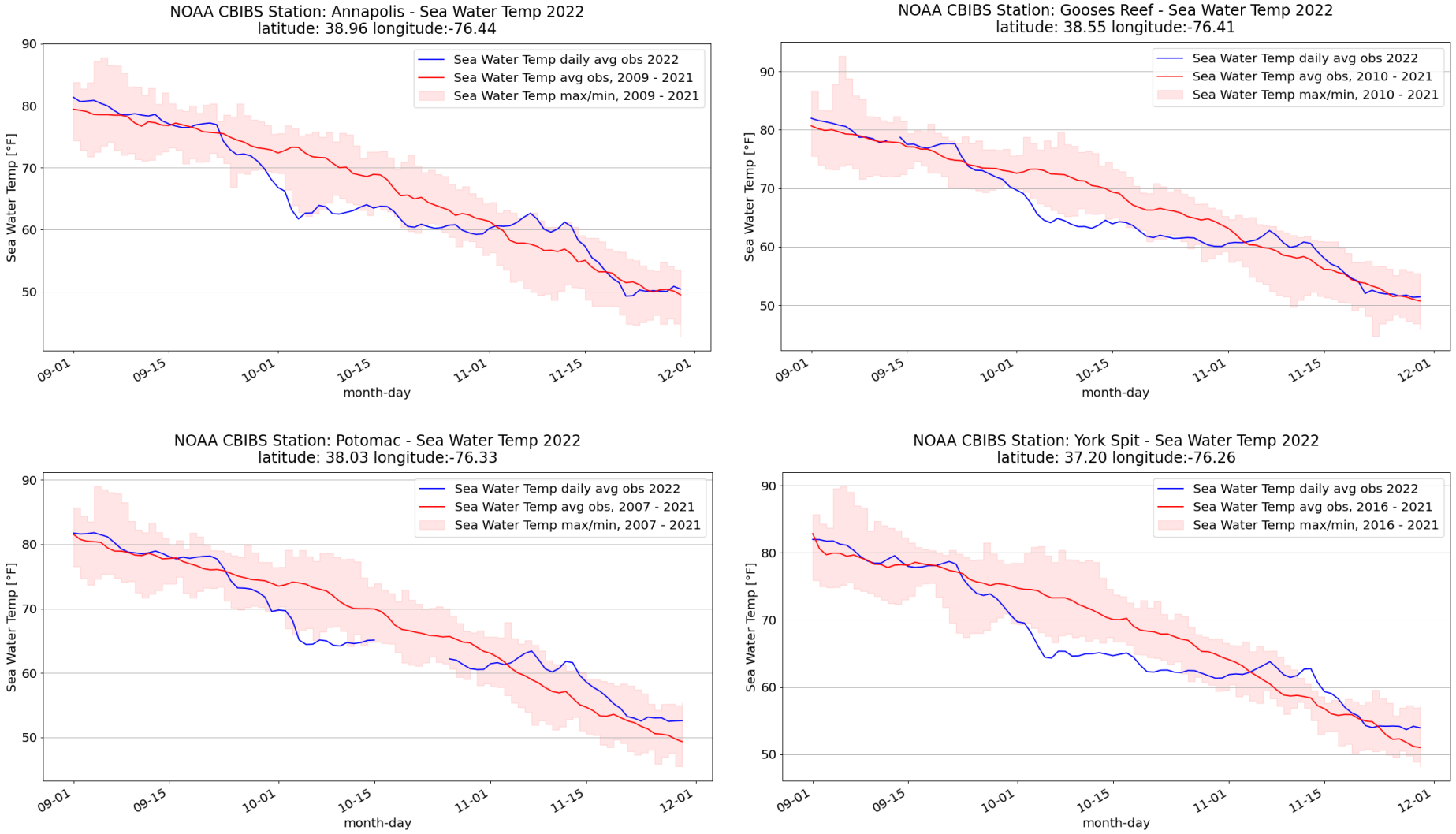


Figure 3. Water temperature observations at four NOAA CBIBS buoys (Annapolis, Gooses Reef, Potomac, York Spit) from September to November 2022 (blue line) relative to the average at each buoy over this seasonal period from 2007 to 2021 (red line). The shaded area represents the range of observations (minimum to maximum) over the time period.

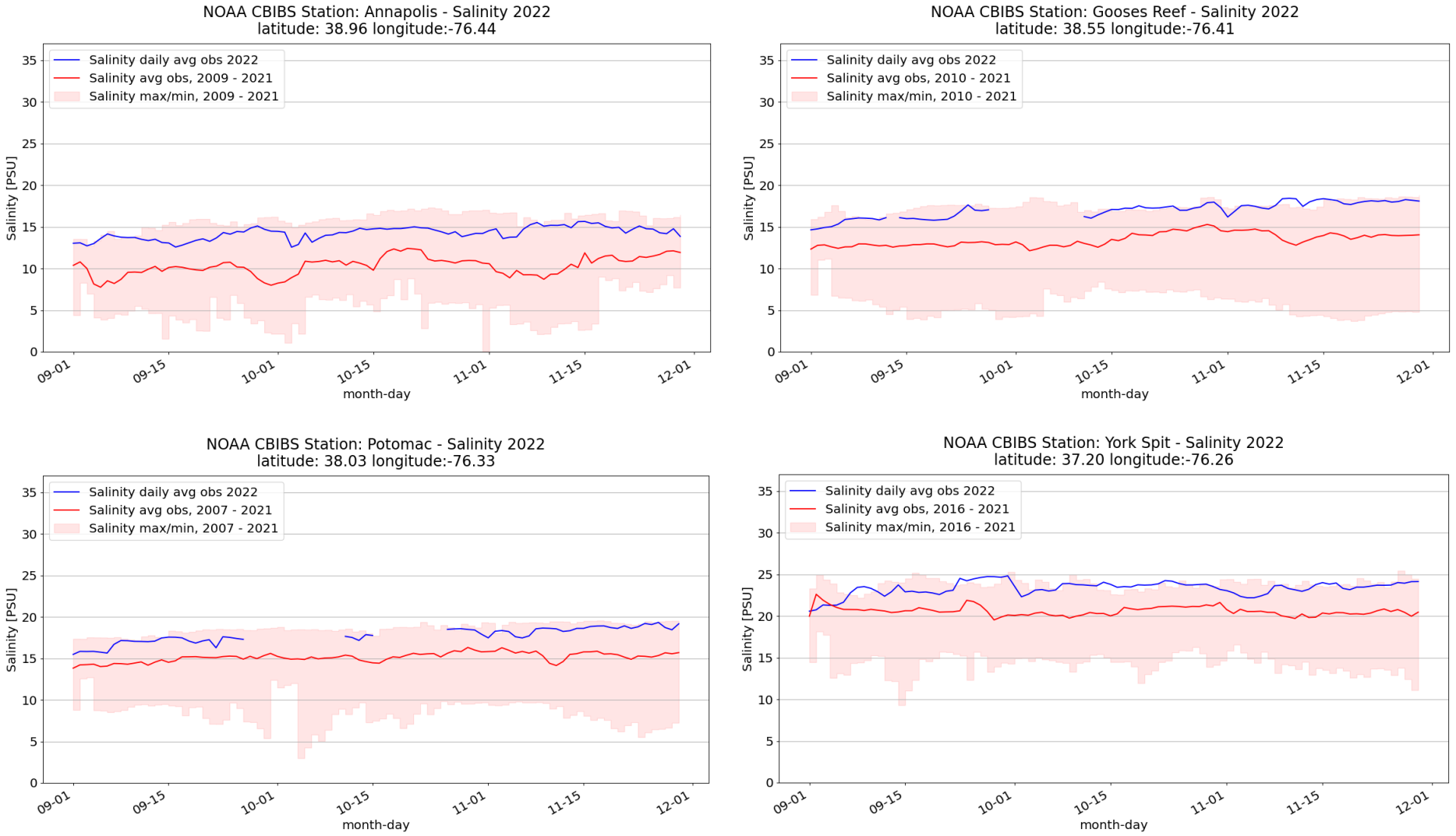
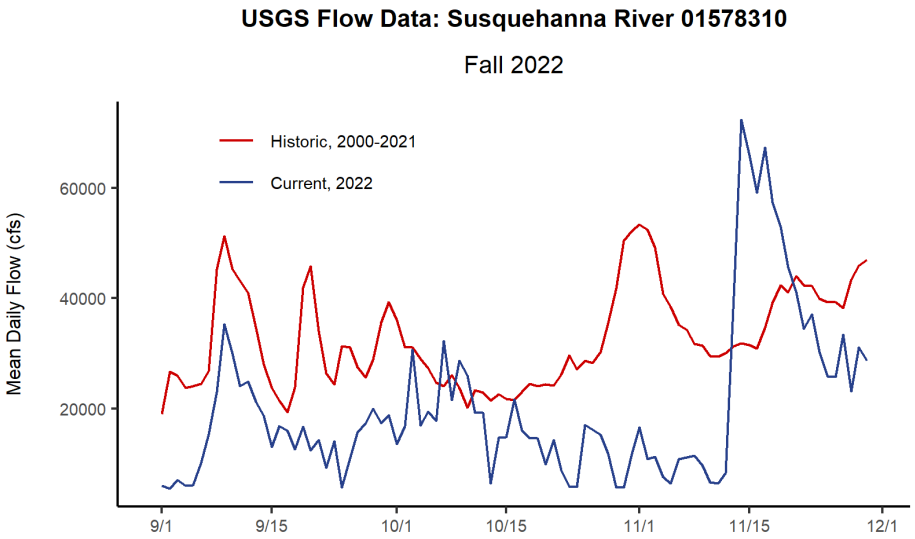
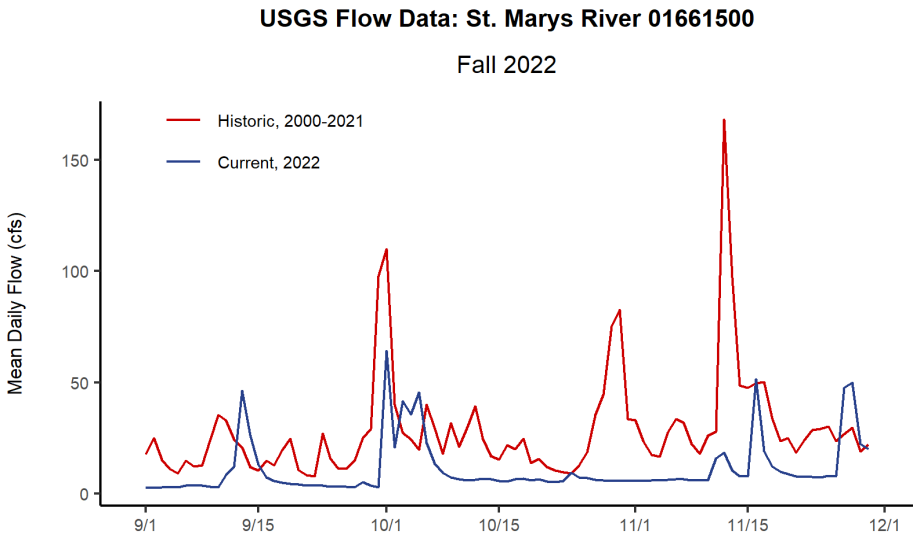


Figure 4. Salinity observations at four NOAA CBIBS buoys (Annapolis, Gooses Reef, Potomac, York Spit) from September to November 2022 (blue line) relative to the average at each buoy over this seasonal period from 2007 to 2021 (red line). The shaded area represents the range of observations (minimum to maximum) over the time period.





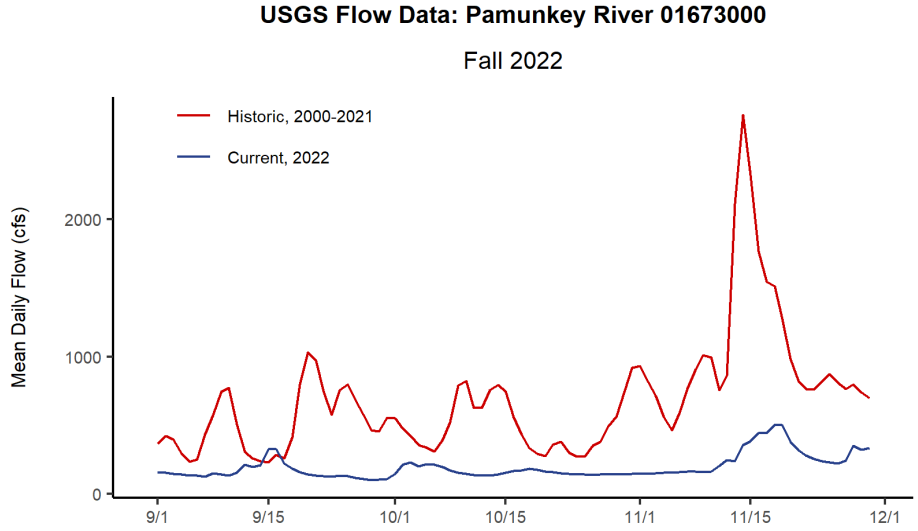


Figure 5. Mean daily streamflow (discharge, cubic feet/second) at USGS monitoring sites at the Susquehanna, St. Marys, and Pamunkey rivers throughout fall 2022 relative to the daily averages over this seasonal period from 2000 to 2021.

Literature Cited

Itakura H, O'Brien MHP, Secor DH (2021) Tracking oxy-thermal habitat compressions encountered by Chesapeake Bay striped bass through biotelemetry. ICES Journal of Marine Science. doi:10.1093/icesjms/fsab009

Kimmel DG, Tarnowski M, Newell RIE (2014) The relationship between interannual climate variability and juvenile eastern oyster abundance at a regional scale in Chesapeake Bay. North American Journal of Fisheries Management 34: 1-15