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

Summer 2022 Seasonal Summary

Summer 2022 Headlines

- **Average water temperatures and below-average hypoxic volume throughout the summer suggest favorable conditions for striped bass, blue crabs, their prey, and critical habitats such as eelgrass.**
- **Above-average salinities throughout the oyster spawning season support larval growth and recruitment.**

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, which is developed by the Northeast Fisheries Science Center and presented to the Mid-Atlantic Fishery Management Council each year.

Water Temperature

Similar to summer 2021, ocean remote-sensing products from NOAA's CoastWatch Program show that the Chesapeake Bay experienced a relatively average summer in 2022 compared with the previous decade (Figure 2). Water temperature observations from the CBIBS buoys generally corroborate these data while also showing finer-scale spatial and temporal anomalies that are not reflected in the satellite seasonal averages (Figure 3). Although the temperatures fluctuated around the long-term average at each of the four buoys throughout the summer, cooler-than-average temperatures were consistently observed from mid-June to late July, followed by a period of slightly warmer-than-average temperatures until mid-August. The magnitude of these water temperature anomalies varied by location.

Overall, the average summer water temperatures in 2022 suggest favorable conditions for key fishery resources and habitats in the Chesapeake Bay. Above-average summer temperatures can create a stressful environment for fishes such as striped bass (*Morone saxatilis*), leading to increased natural mortality (Pörtner & Knust 2007) and catch-and-release fishing mortality (Wilde et al. 2000). Similarly, eelgrass (*Zostera marina*) tends to die back when water temperatures increase rapidly to above-average levels (Moore et al. 2014), resulting in the loss of critical foraging and nursery habitats for many estuarine species. This year's average summer temperatures likely did not have significant impacts on Chesapeake Bay fishes and habitats.

Dissolved Oxygen

The Maryland Department of Natural Resources' (MDNR) June 2022 Chesapeake Bay Hypoxia Report indicated a below-average hypoxic volume in the Bay throughout the month of June. The hypoxic volume remained below average in early July, but then increased above average in late July. Hypoxic conditions are often driven by other environmental factors such as water temperature. The cooler temperatures that were observed in early summer likely hindered the typical water column stratification seen in summer that results in hypoxic bottom conditions. However, the increase in water temperature to above-average levels in late July through mid-August, as observed in the CBIBS data, would have promoted water column stratification and increased hypoxic volume for a short period of time. The 2022 Dead Zone Report developed by the Virginia Institute of Marine Science (VIMS) corroborates these insights, showing below-average hypoxic volume throughout summer 2022, except for the short period between late July and mid-August.

While hypoxic conditions can have detrimental effects on key fishery resources (e.g., striped bass, blue crabs [*Callinectes sapidus*]) and their prey (e.g., spot [*Leiostomus xanthurus*], benthic invertebrates) such as increased natural mortality (Long et al. 2014) and reduced habitat availability (Coutant 1985, Fabrizio et al. 2020), the overall below-average hypoxic volume throughout the summer suggests that the fish and benthic communities of the Bay did not experience significant hypoxic events, nor the consequential negative effects, in 2022.

Salinity

Salinity trends observed by the NOAA CBIBS buoys varied across the Chesapeake Bay throughout summer 2022 (Figure 4). In the upper Bay, at the Annapolis and Gooses Reef buoys, salinity was above average for the duration of the season. Moving south down the Bay, however, salinity trends shift from above average to average levels. The Potomac buoy at mid-Bay observed predominantly above-average salinity throughout the summer except for a period between mid-July and mid-August when salinity was depressed to average levels. At York Spit, salinity consistently fluctuated around the average. The salinity trends observed in summer 2022 reflected the freshwater inputs across the Bay, which are discussed further in the next section.

Increased salinity often results in high juvenile oyster (*Crassostrea virginica*) abundance and recruitment in the Chesapeake Bay (Kimmel et al. 2014). Given the above-average salinities observed this spring and summer, the 2022 fall oyster surveys may see above-average spatsets due to increased growth, recruitment, and survival. However, it is important to note that other local environmental conditions are also important in determining oyster recruitment success and survival. Higher salinities can also support increased oyster disease prevalence and infection intensity that can have significant negative effects on mortality (Tarnowski 2017).

Freshwater Flow

Similar to the CBIBS salinity observations, river discharge data collected by the U.S. Geological Survey (USGS) show different patterns in freshwater flow throughout the Chesapeake Bay in summer 2022 (Figure 5). The discharge data at the Susquehanna River corroborate the salinity data for the upper Bay buoys, with below-average flow throughout the season. At the St. Marys River, a tributary near the mouth of the Potomac River, flow was predominantly below average except for several peaks that

correspond to the low-salinity events observed at the Potomac between mid-July and mid-August. The Pamunkey River, which feeds into the York River, experienced more average levels of discharge with fluctuations corresponding to those seen in the salinity data from the York Spit buoy.

Presumably, the below-average to average freshwater flows into the Bay resulted in above-average to average salinities, providing a conducive environment for oyster recruitment, growth, and survival in 2022.

Figures

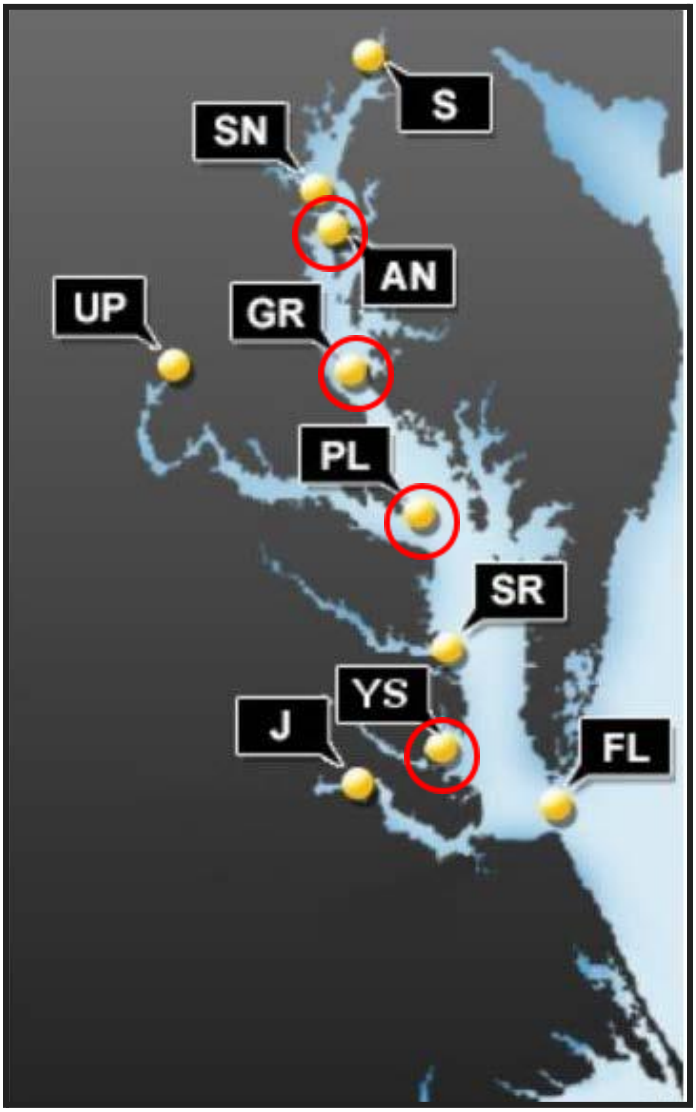


Figure 1. Map of Chesapeake Bay Interpretive Buoy System (CBIBS) observation platforms. The buoys used in these summaries are AN (Annapolis), GR (Gooses Reef), PL (Potomac), and YS (York Spit).

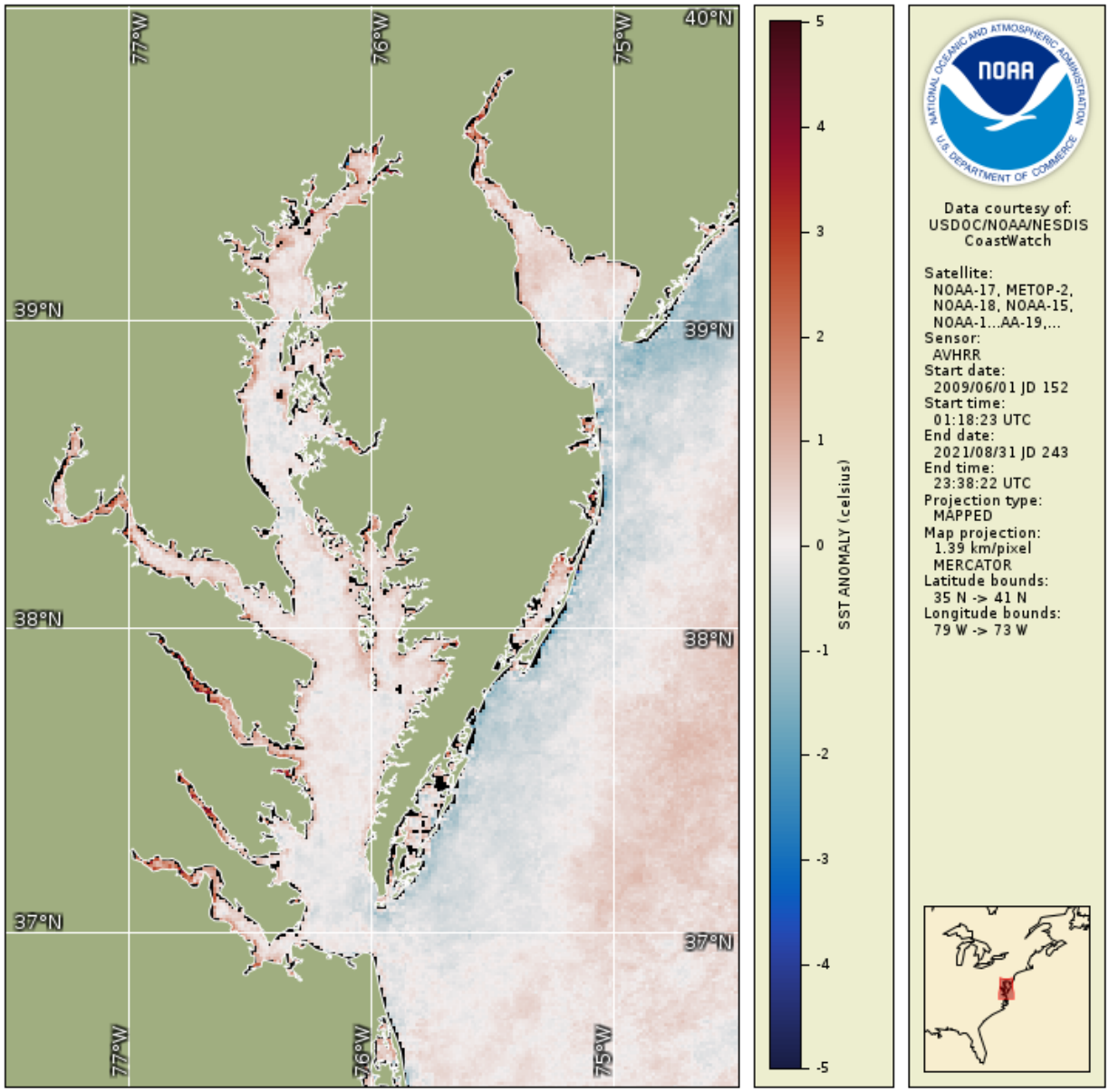


Figure 2. Sea surface temperature (SST) anomalies observed by NOAA satellites from June to August 2022 relative to the average of this seasonal period from 2009 to 2021.

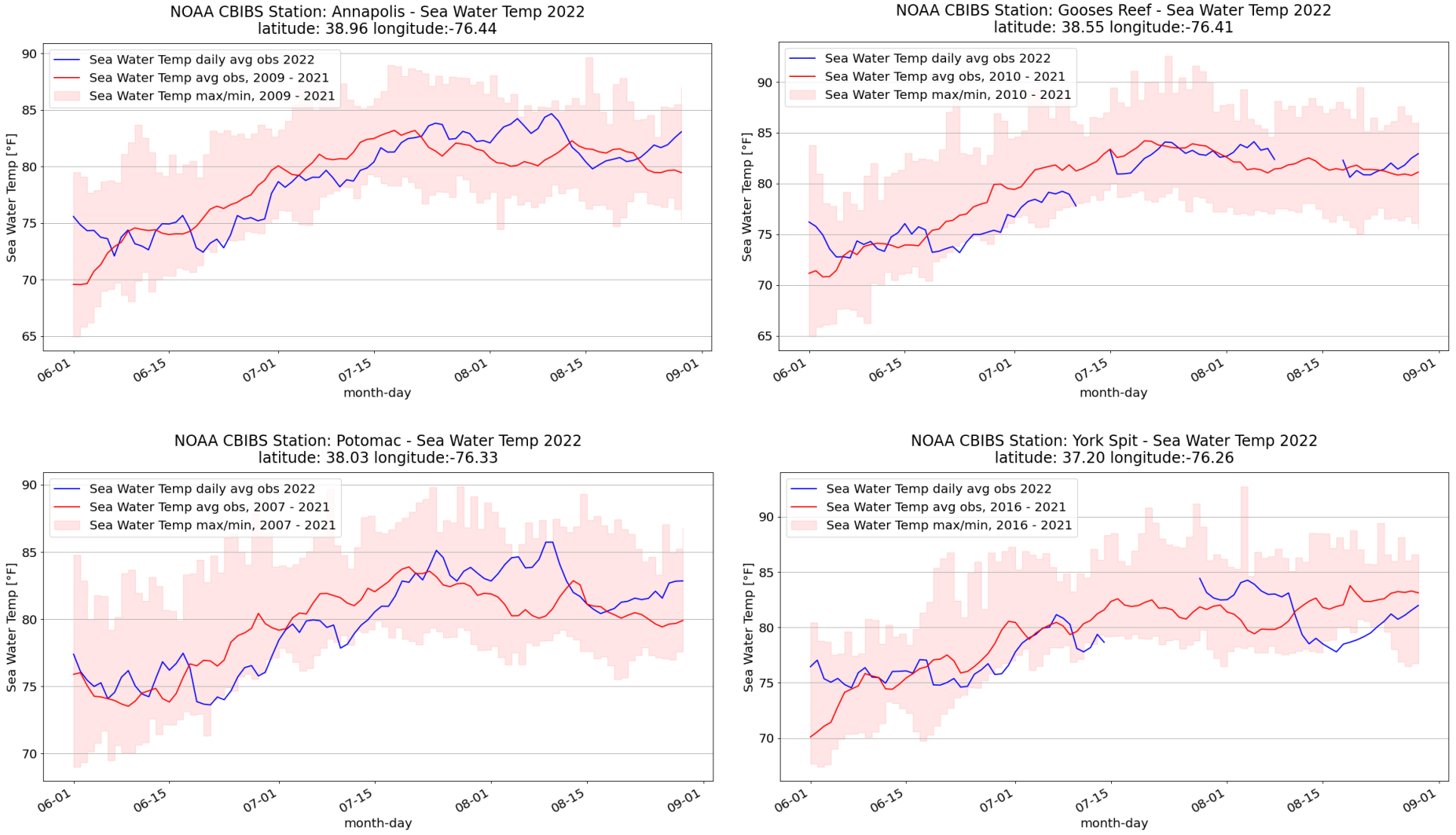
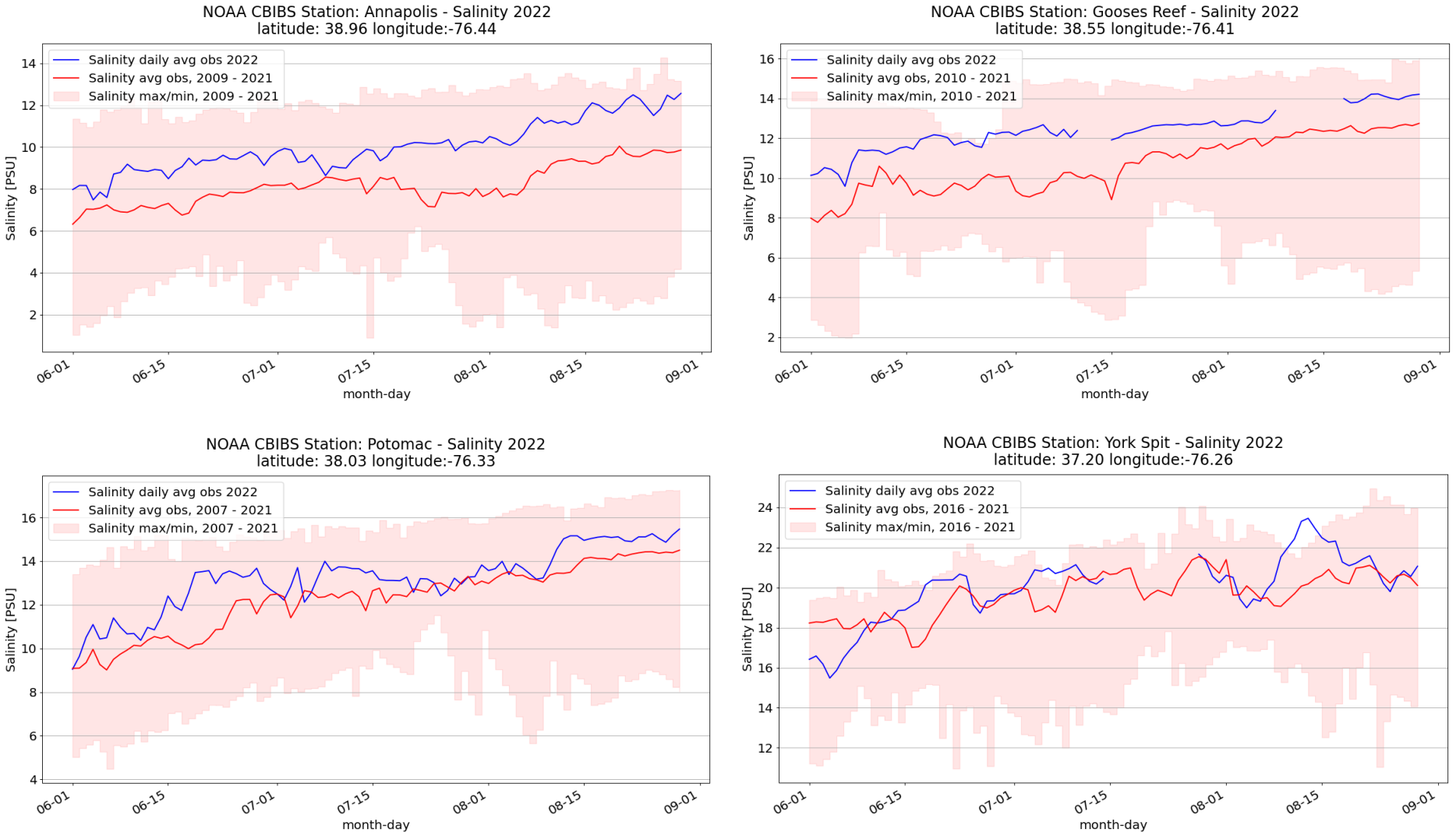


Figure 3. Water temperature observations at four NOAA CBIBS buoys (Annapolis, Gooses Reef, Potomac, York Spit) from June to August 2022 (blue line) relative to the average at each buoy over this seasonal period from 2007 to 2021 (red line). The shaded area represents the full range of observations (minimum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



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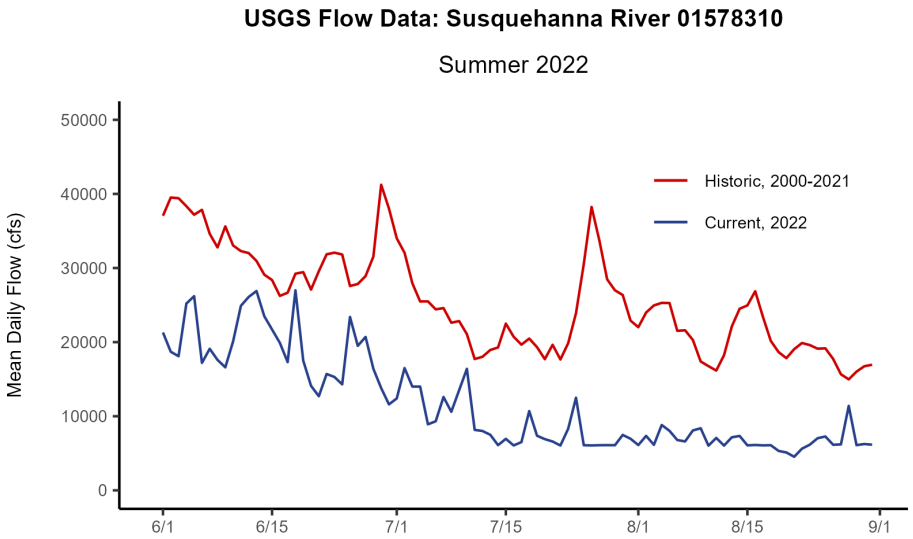

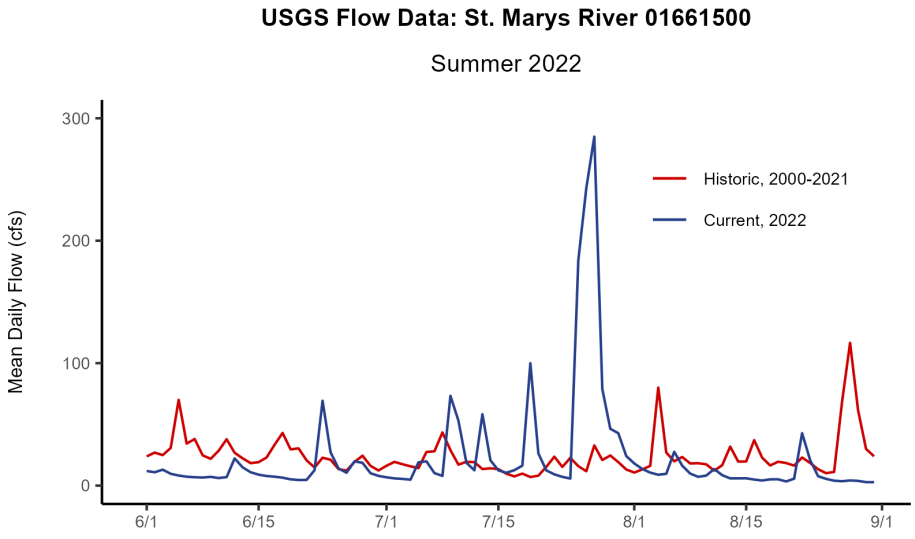

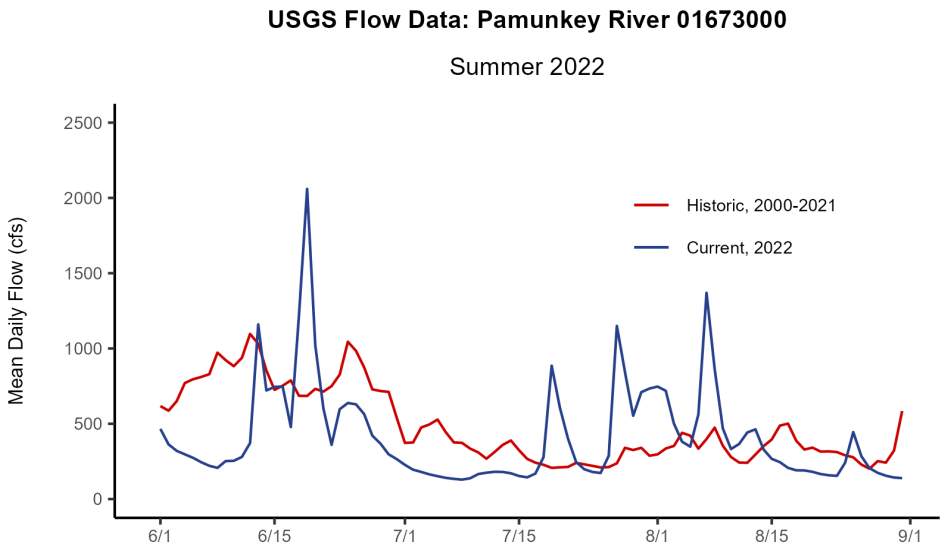

Figure 5. Mean daily streamflow (discharge, cubic feet/second) at USGS monitoring sites at the Susquehanna, St. Marys, and Pamunkey rivers throughout summer 2022 relative to the daily averages over this seasonal period from 2000 to 2021.

Literature Cited

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