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

Summer 2021 Seasonal Summary

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 to 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) 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 spring 2021, ocean remote-sensing products from NOAA's CoastWatch Program show that overall the Chesapeake Bay experienced an average summer relative to the previous decade (Figure 1). Water temperature observations from the CBIBS buoys generally corroborate these data, showing similar temperatures at each of the four buoys analyzed relative to the long-term average for the majority of the summer period (Figure 2). However, the CBIBS data captured a period of cooler-than-average water temperatures that occurred from mid-July to mid-August that is not reflected by the satellite data. The CBIBS data also show finer-scale regional differences in water temperature anomalies, with the York Spit buoy experiencing slightly cooler-than-average water temperatures for the majority of the summer.

Summer water temperatures, particularly above-average temperatures, can significantly affect key fishery species and habitats in the Chesapeake Bay. High temperatures can create stressful conditions for fish such as striped bass, which can lead to increased natural mortality (Pörtner & Knust 2007). Catch-and-release fishing mortality can also increase during warmer periods because of the added physiological stress (Wilde et al. 2000). Similarly, seagrass (e.g., eelgrass) tends to die off when water temperatures rapidly increase to above-average levels (Moore et al. 2014), resulting in the loss of critical foraging and nursery habitats for many fish and invertebrate species. With the average summer water temperatures in 2021, fish and seagrass did not likely experience significantly increased mortality rates or degradation relative to a typical year.

Dissolved Oxygen

The Maryland Department of Natural Resources' (MDNR) June 2021 Chesapeake Bay Hypoxia Report indicated that hypoxic volume in the Bay was at or below average throughout the month of June. Hypoxic conditions at the Bay floor can create a habitat squeeze for fish and mobile benthic invertebrates when they coincide with high water temperatures (Coutant 1985). When hypoxia is prevalent, fish and invertebrates cannot escape high surface temperatures in the deeper, cooler waters due to a lack of oxygen. This can lead to higher natural mortality while inhabiting suboptimal areas of the Bay. Sessile invertebrates (e.g., clams), which are key forage in the Bay, can also experience higher natural mortality when the duration and extent of the hypoxic zone increases (Long et al. 2014). The results of the MDNR hypoxia monitoring suggest that the fish and benthic communities of the Bay did not experience significant hypoxic events, nor likely the consequential increased mortality, in summer 2021.

Dissolved oxygen is one of several key environmental factors that determine suitable habitat for juvenile spot in summer, with concentrations between 2.2 to 3.2 mg/L characterizing maximum suitable summer habitat (Fabrizio et al. 2020). The average to below-average hypoxic volume in the Chesapeake Bay in summer 2021 suggested that water column conditions were well suited for juvenile spot, an important forage fish in the Bay. Availability of suitable summer habitat is a significant factor in determining spot abundance, such that poor summer conditions could result in low abundance of spot, and, consequently, less food for important predators such as striped bass.

Salinity

Observations from the NOAA CBIBS buoys indicated higher-than-average salinity throughout summer 2021 across the Chesapeake Bay, with a decrease in salinity for a period around late July to early August (Figure 3). The high salinity in summer 2021 was likely due to decreased precipitation throughout most of the period as can be seen on the NOAA National Weather Service Advanced Hydrologic Prediction Map. The decrease in salinity, however, correlates with periods of heavy precipitation from the remnants of tropical storms in July and August.

Increased salinity often results in high juvenile oyster abundance in the Chesapeake Bay (Kimmel et al. 2014). The 2021 MDNR fall oyster survey may find above-average spatsets given the high salinity experienced this summer. 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

River discharge data collected by the U.S. Geological Survey (USGS) corroborated the CBIBS salinity observations in summer 2021. At the Harris Creek station, flow was below average throughout the timeframe, with particularly high freshwater input in August that correlates with heavy precipitation and a decrease in salinity (Figure 4; USGS 01492500 Sallie Harris Creek, MD).

Frequent heavy rainfall over a short period of time can significantly decrease local salinity. A large flush of fresh water could result in an episode of high oyster mortality locally (Kimmel et al. 2014, La Peyre et al. 2016). The magnitude and duration of the decreased salinity event in summer 2021 was not likely enough to significantly impact oyster mortality, but may have slightly reduced growth during that period.

<u>Figures</u>

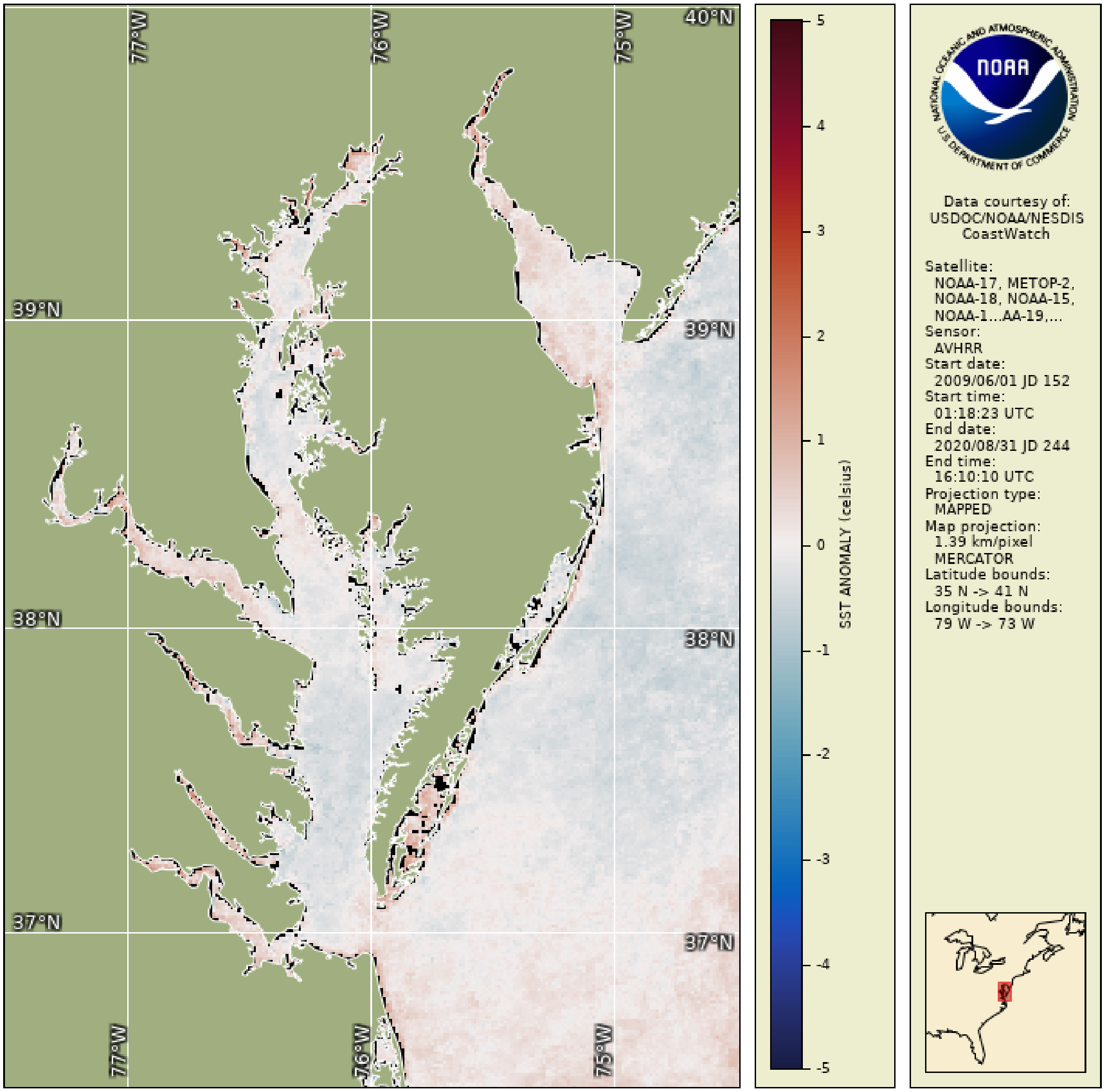

Figure 1. Sea surface temperature (SST) anomalies observed by NOAA satellites from June to August 2021 relative to the average of this seasonal period from 2009 to 2020.

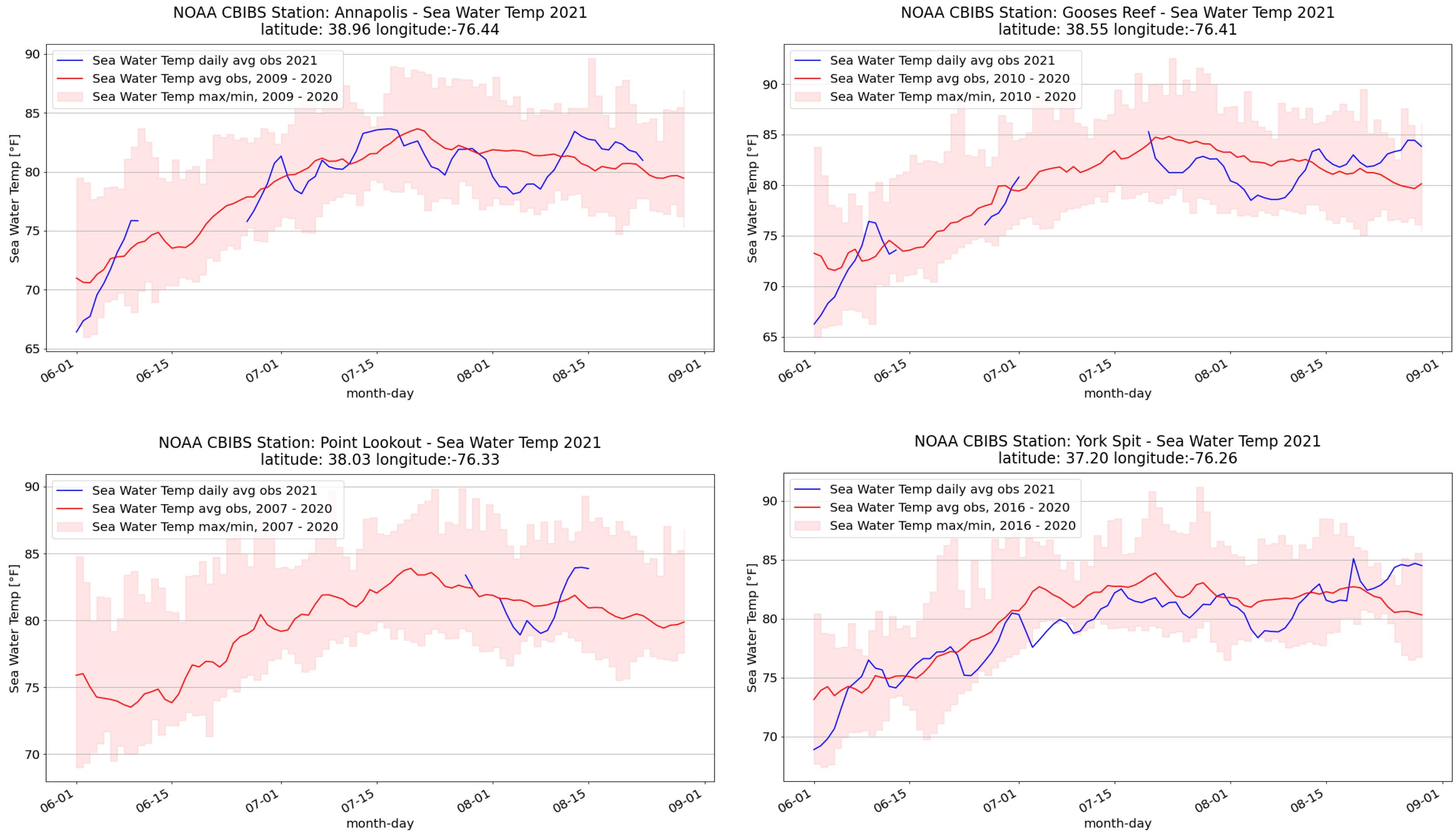

Figure 2. Water temperature observations at four NOAA CBIBS buoys (Annapolis, Gooses Reef, Point Lookout, York Spit) from June to August 2021 (blue line) relative to the average at each buoy over this seasonal period from 2007 to 2020 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

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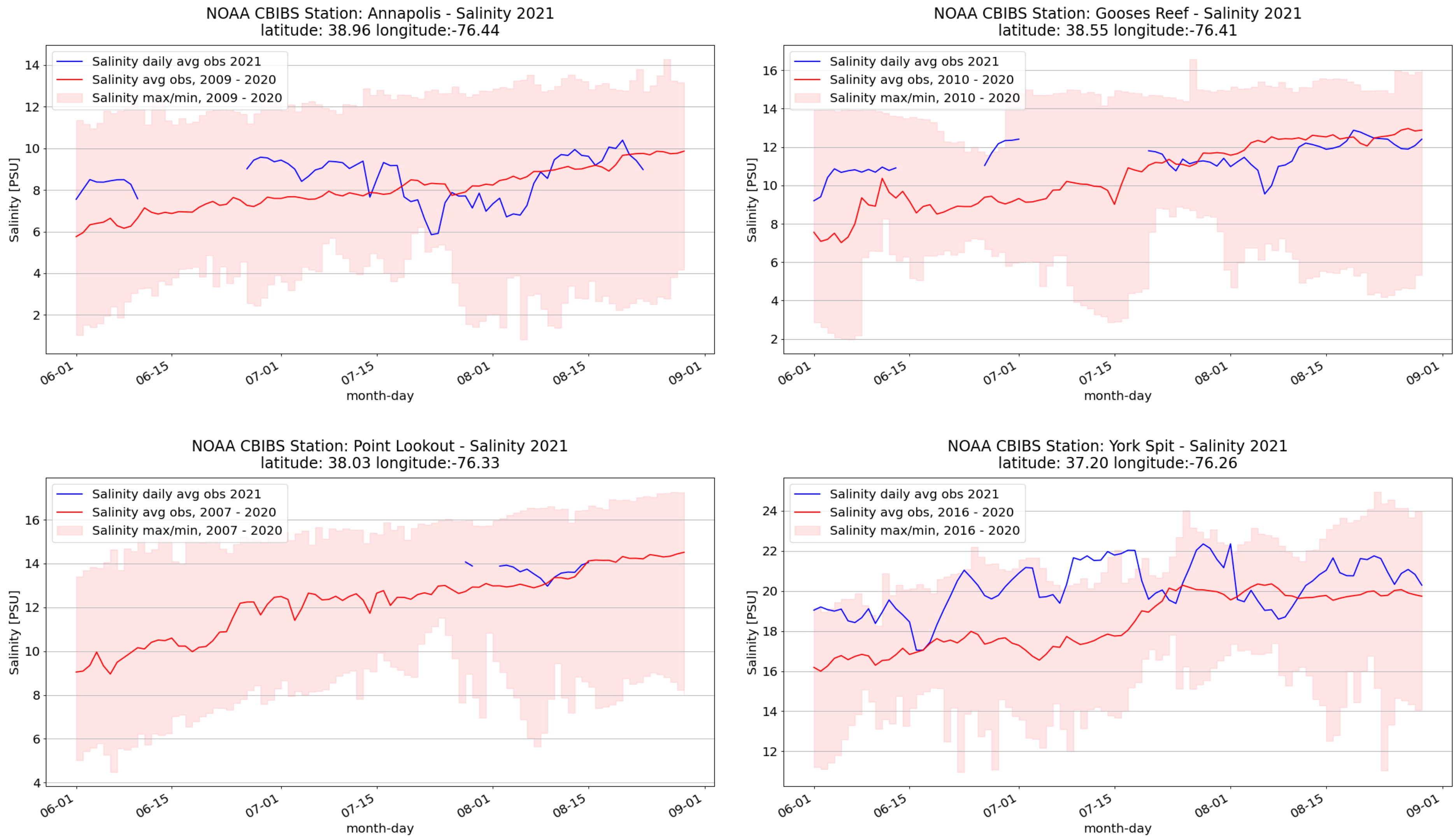

Figure 3. Salinity observations at four NOAA CBIBS buoys (Annapolis, Gooses Reef, Point Lookout, York Spit) from June to August 2021 (blue line) relative to the average at each buoy over this seasonal period from 2007 to 2020 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

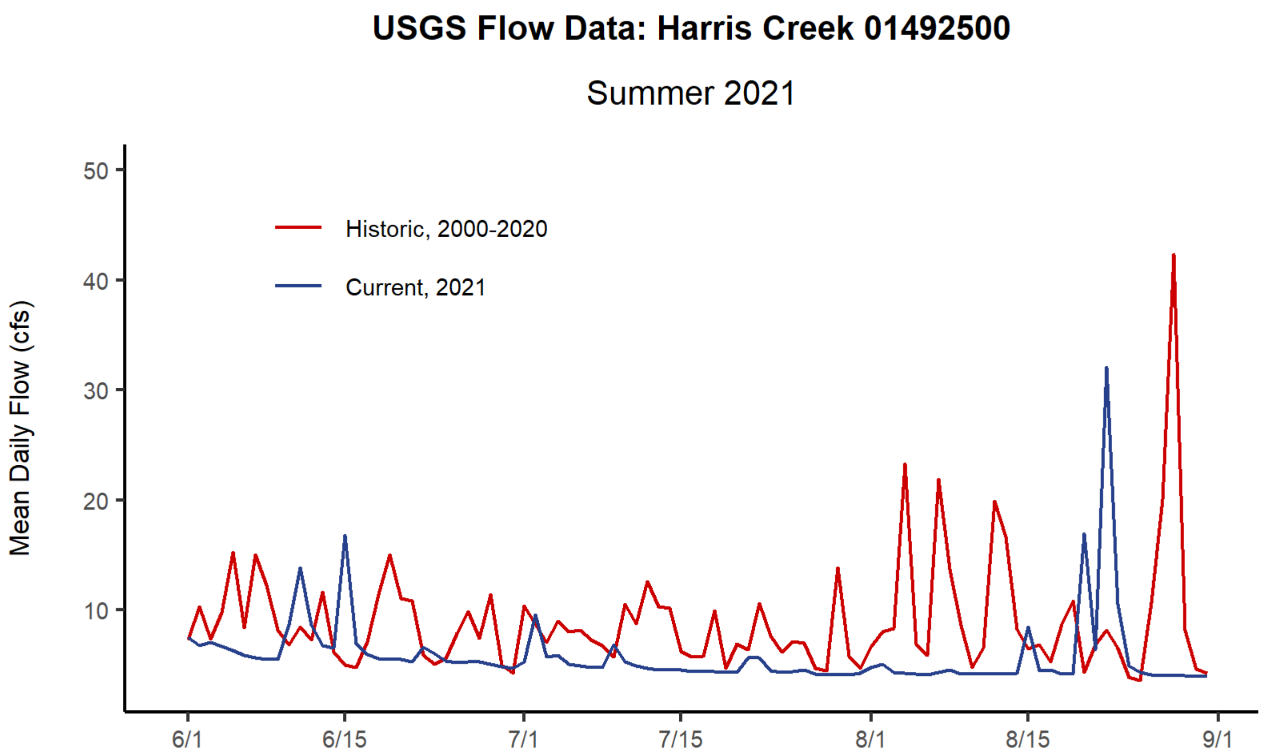

Figure 4. Mean daily streamflow (discharge, cubic feet/second) at the USGS monitoring site in Harris Creek, Maryland, throughout summer 2021 relative to the daily averages over this seasonal period from 2000 to 2020.

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