Synthesis of Environmental Impacts on Key Fishery Resources in the Chesapeake Bay
Winter 2021-2022 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.

Winter 2021-2022 Headlines

- The midseason transition from above-average water temperatures to average and below-average suggest that striped bass recruitment will more likely be driven by spring water temperatures and flow regimes in 2022.
- Below-average water temperatures in late winter may increase blue crab overwintering mortality in the lower Bay.
- Above-average lower Bay salinities in mid-late winter may indicate more suitable habitat available for bay anchovy.

Water Temperature

Ocean remote-sensing products from NOAA's CoastWatch Program show that the Chesapeake Bay experienced a slightly warmer-than-average winter overall relative to the previous decade (Figure 1). Observations from the CBIBS buoys provide insight into the finer-scale water temperature trends across the Bay throughout the season (Figure 2). All four buoys show above-average water temperatures from early December through mid-January, including some daily record highs at Annapolis (since 2009) and York Spit (since 2016). Temperatures then dropped to average at the northern buoys (Annapolis, Gooses Reef), and below average at the southern buoys (Potomac, York Spit).

Winter water temperatures are known to affect key fishery resources in the Chesapeake Bay such as striped bass (*Morone saxatilis*) and blue crabs (*Callinectes sapidus*). Cooler temperatures in winter and early spring (January-March) have been correlated with increased striped bass recruitment success (Martino & Houde 2010, Millette et al. 2019). Lower temperatures increase the generation time of copepod prey such that copepods are still present in the estuary when striped bass larvae are feeding in the spring (Devreker et al. 2006). Warm winter and spring temperatures may also compress the reproductive season, negatively impacting recruitment (Secor & Houde 1995, Peer & Miller 2014, Fabrizio et al. 2017). With the warm early winter temperatures falling to average by mid-January, striped bass recruitment will more likely be driven by spring water temperatures and flow regimes in 2022.

Unlike striped bass, warmer winter temperatures tend to favor blue crabs by maintaining a low (<3%) overwintering mortality (Bauer & Miller 2010a,b, Hines et al. 2010, Rome et al. 2005). The below-average water temperatures observed at the southern buoys in late winter, however, may result in higher overwintering mortalities in the lower Bay, which could result in reduced recruitment and abundance in 2022. The blue crab overwintering mortality rate and abundance estimates will be determined in the spring with the completion of the 2021-2022 Winter Dredge Survey.

Salinity

Observations from the NOAA CBIBS buoys indicated approximately average salinity throughout winter 2021-2022 across the Chesapeake Bay (Figure 3). At the Annapolis and Potomac buoys, salinity was below average throughout December before bouncing around the average for the remainder of the season. At York Spit, salinity started out average and then increased to slightly above-average levels in January. Gooses Reef experienced larger fluctuations than the other buoys, with salinity being roughly average throughout December, above average in January, and then below average in February.

Salinity often plays an important role in the survival and recruitment of oysters (*Crassostrea virginica*) in the Chesapeake Bay. Typically, increased salinity results in high juvenile oyster abundance (Kimmel et al. 2014). The approximately average salinity values in winter 2021-2022 are not likely to significantly affect the oyster population in the Bay. Spring and summer environmental conditions tend to play a bigger role in determining oyster survival and recruitment success, making salinity observations during these periods more critical.

In Virginia waters, salinity is one of several key environmental factors that determine suitable habitat for bay anchovy (*Anchoa mitchilli*) in winter, with surface salinities greater than 23.7 psu characterizing suitable winter habitat (Fabrizio et al. 2020). The above-average salinities at York Spit from January onward may indicate better habitat availability, at least in terms of salinity, for bay anchovy, one of the most ecologically important forage fishes in the Chesapeake Bay. Availability of suitable winter habitat is a significant factor in determining bay anchovy abundance, such that good winter conditions could result in higher abundance of bay anchovy, and, consequently, more food for important predators such as striped bass. Although salinity was above average in winter 2021-2022, other environmental factors (e.g., dissolved oxygen concentrations, sediment composition) are also important indicators of suitable habitat. It is unclear which drivers are the most influential for bay anchovy abundance.

Freshwater Flow

River discharge data collected by the U.S. Geological Survey (USGS) showed below-average flow throughout most of winter 2021-2022, with the exception of three large peaks in mid-January and early February (Figure 4; USGS 01492500 Sallie Harris Creek, MD). The NOAA National Weather Service (NWS) PREcipitation Summary and Temperature Observations (PRESTO) reports revealed a near-record low for precipitation in December 2021 followed by average to above-average precipitation in January 2022, including a high-precipitation event on January 16 as a result of a strong nor'easter. The NWS Advanced Hydrologic Prediction Map corroborated these data and also indicated a drier-than-average February.

In addition to winter water temperature, survival of early life stages of striped bass in the Chesapeake Bay is strongly correlated with freshwater flow (Martino & Houde 2010, Millette et al. 2019, North & Houde 2003). High-flow regimes push zooplankton prey downstream, where they get trapped in the estuarine turbidity maximum with striped bass larvae. This spatiotemporal overlap allows striped bass larvae to feed on zooplankton prey during this critical life stage, increasing striped bass survival and recruitment success. If below-average flows continue into the spring, the striped bass population could experience reduced recruitment in 2022.

<u>Figures</u>

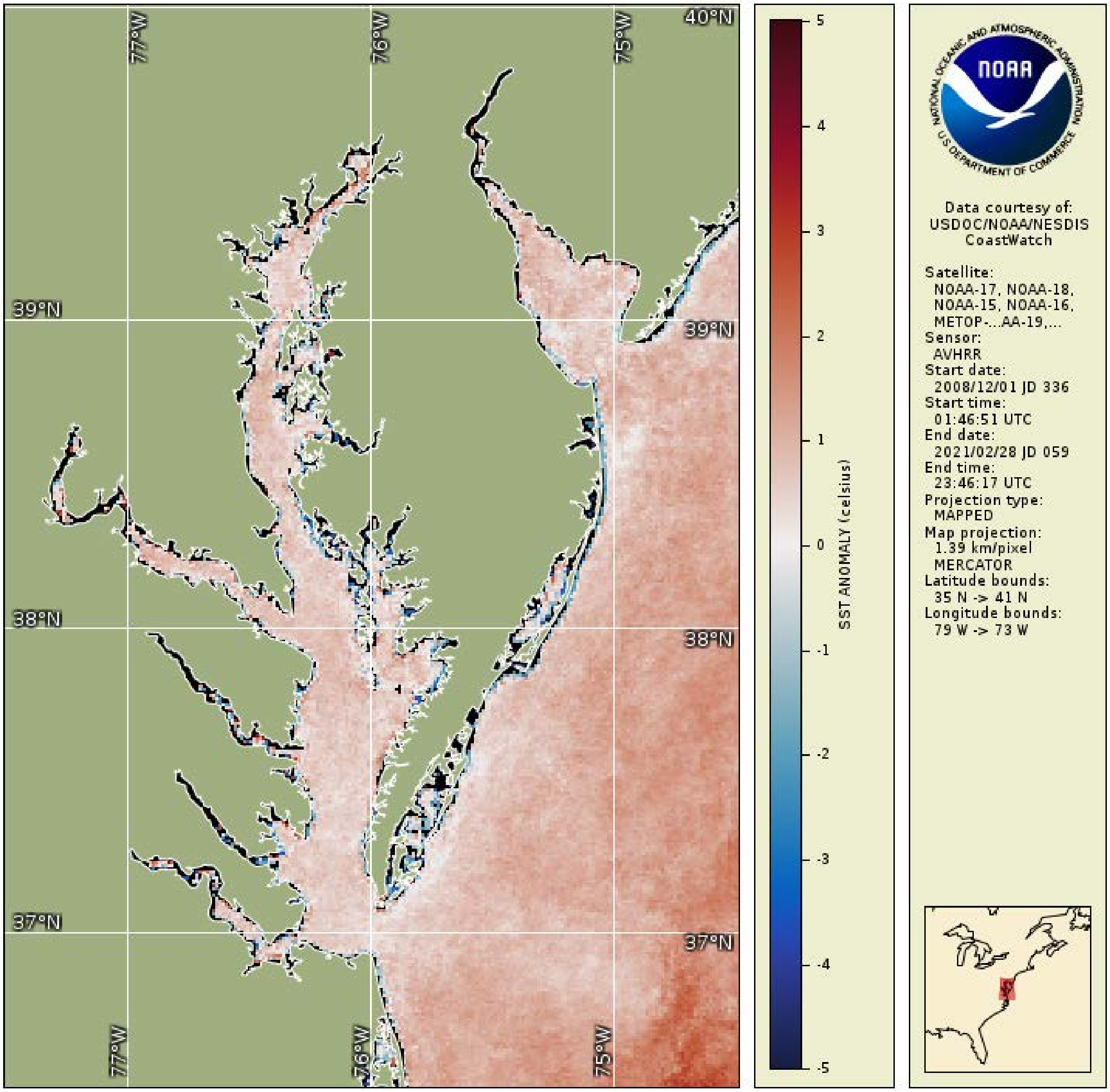

Figure 1. Sea surface temperature (SST) anomalies observed by NOAA satellites from December 2021 to February 2022 relative to the average of this seasonal period from 2008 to 2021.

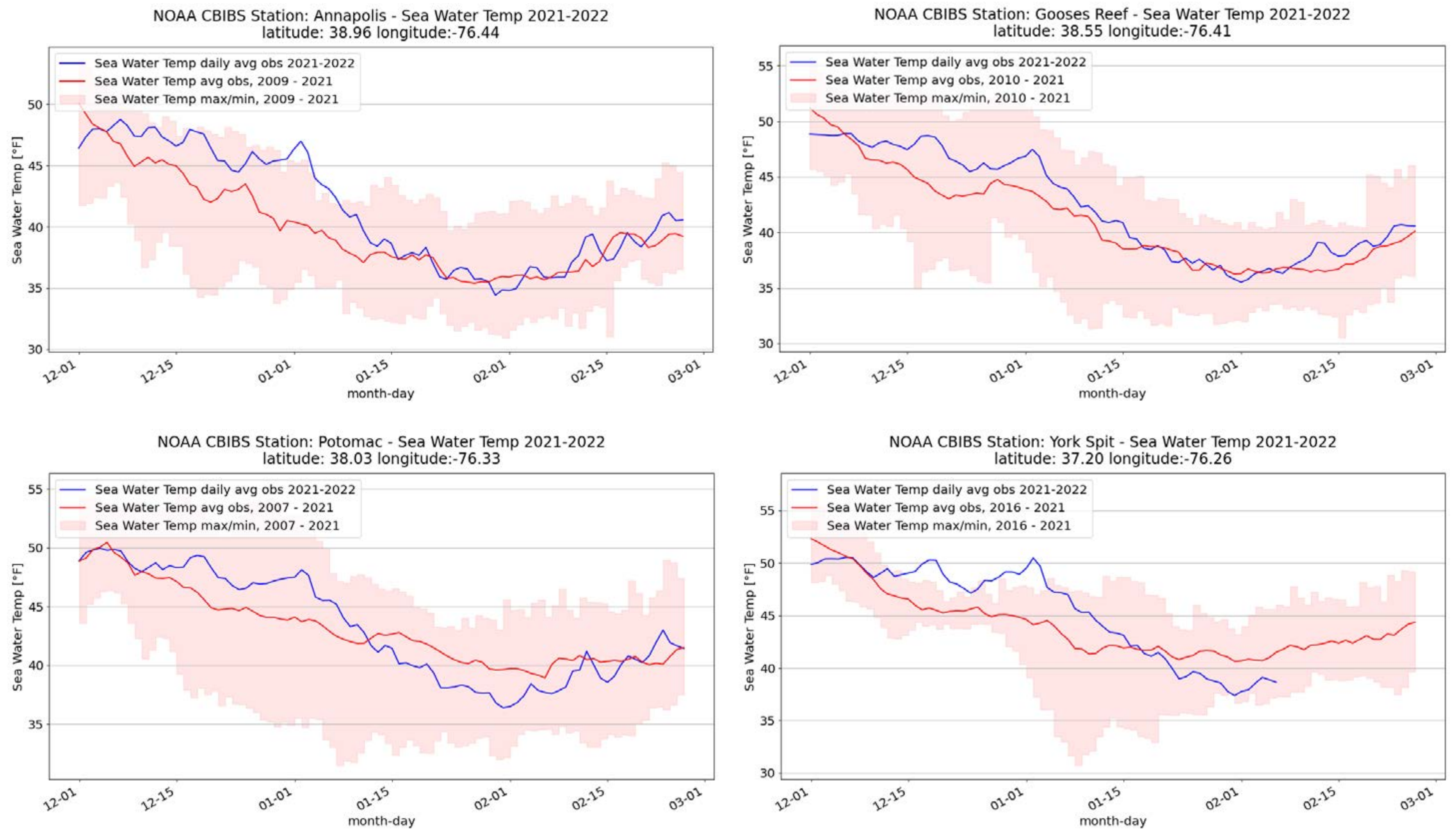

Figure 2. Water temperature observations at four NOAA CBIBS buoys (Annapolis, Gooses Reef, Potomac, York Spit) from December 2021 to February 2022 (blue line) relative to the average at each buoy over this seasonal period from 2007 to 2021 (red line). The shaded area represents the full range of observations (minimum to maximum) over the time period.

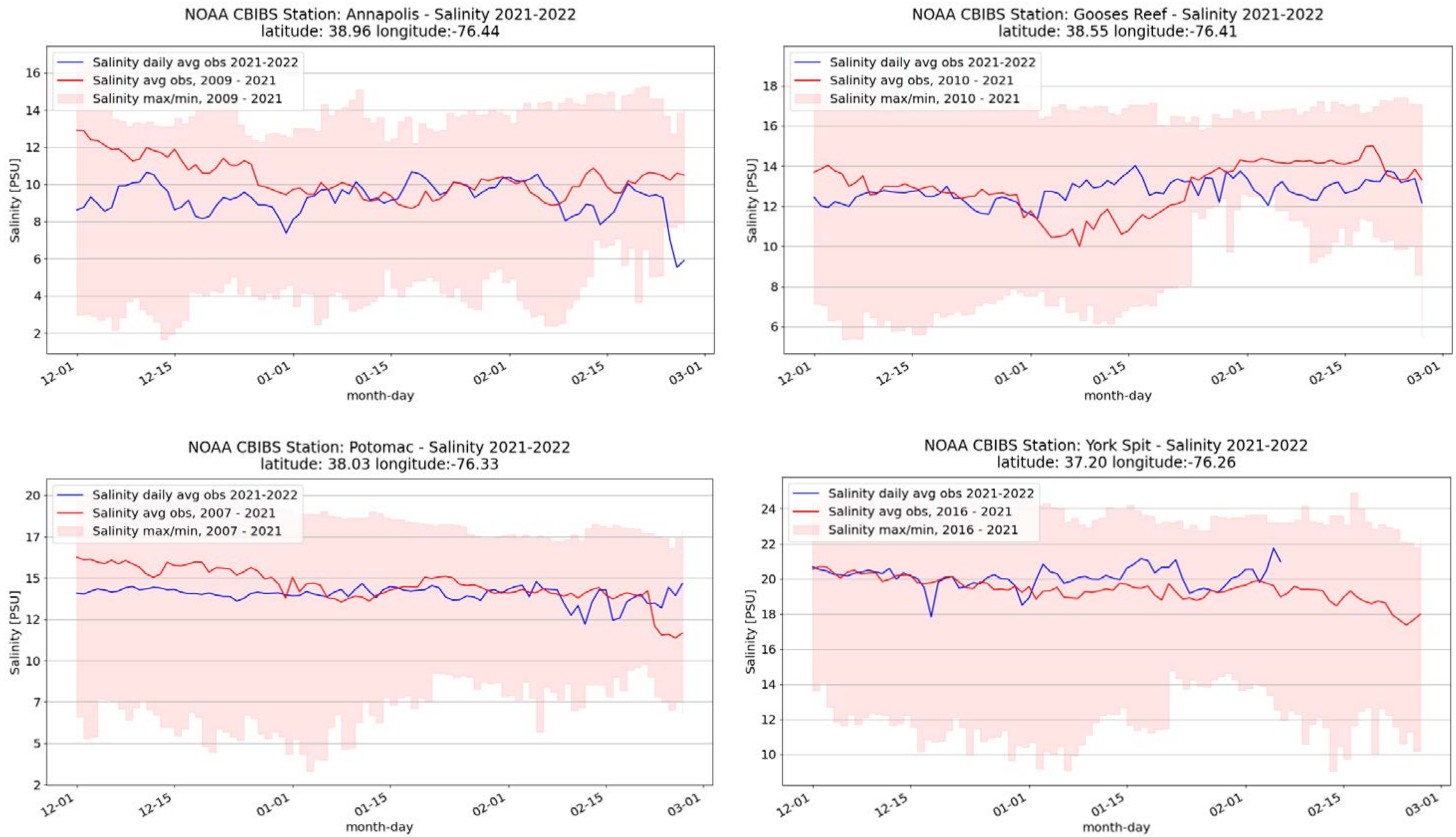

Figure 3. Salinity observations at four NOAA CBIBS buoys (Annapolis, Gooses Reef, Potomac, York Spit) from December 2021 to February 2022 (blue line) relative to the average at each buoy over this seasonal period from 2007 to 2021 (red line). The shaded area represents the full range of observations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

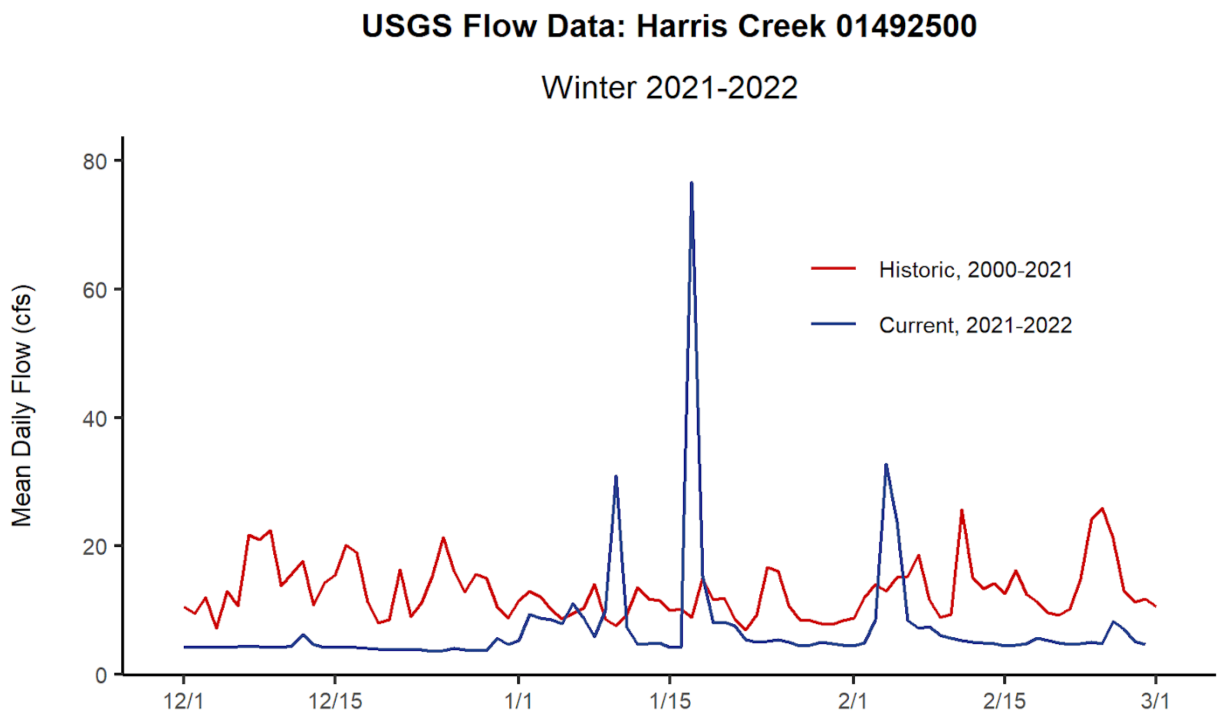

Figure 4. Mean daily streamflow (discharge, cubic feet/second) at the USGS monitoring site in Harris Creek, Maryland, throughout winter 2021-2022 relative to the daily averages over this seasonal period from 2000 to 2021.

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