

## Contingency Plan Quarterly Report on Ambient Monitoring Results Third Quarter 2019

MWRA gathers data near the outfall discharge location in Massachusetts Bay. These data are used to calculate results on various thresholds in the Contingency Plan that is attached to its Deer Island Treatment Plant (DITP) NPDES discharge permit. This report shows ambient monitoring results for Contingency Plan thresholds that became available from July through September 2019. Previous Contingency Plan reports are available at <http://www.mwra.state.ma.us/harbor/html/archive.htm#cpq>.

Results in this report include 2019 flounder liver disease, sediment enrichment, spring/summer (May through August) nuisance algae abundances, summer areal chlorophyll, and summer/early fall dissolved oxygen results. There is one Contingency Plan threshold exceedance in this report —results from July *Alexandrium* samples triggered a Caution Level exceedance for this toxic algae species. These represent the continuation of a bloom that started in May, as reported last quarter.

### FISH AND SHELLFISH

#### Flounder liver disease 2019

The prevalence of liver disease centrotubular hydropic vacuolation, a disease considered a precursor to liver tumors associated with exposure to contaminants in winter flounder *Pseudopleuronectes americanus*, is a useful measure of the effects of pollution. The flounder liver disease threshold is based on measurements collected from Boston Harbor during the baseline monitoring period (1991-2000). In the harbor, flounder liver disease rates were historically quite high but dropped considerably during the 1990s.

Since Massachusetts Bay monitoring began in 1991, prevalence of early-stage liver disease near the outfall site has been much lower than the threshold. The result from 2019 was 6%, which was the second lowest ever observed, and is much lower than that observed at the site during the baseline period (Figure 1).

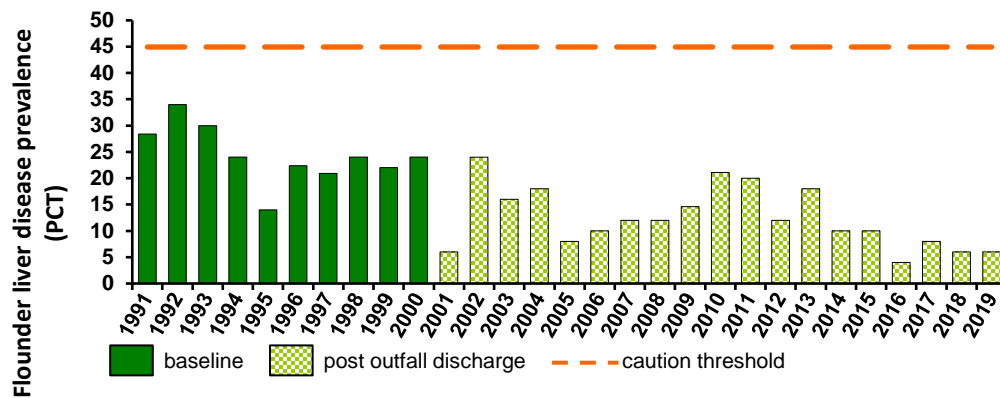


Figure 1. Flounder liver disease prevalence at outfall site (1991 - 2019)

## SEDIMENT ENRICHMENT

### Sediment redox potential discontinuity depth – 2019

The thickness of the oxygenated layer in sediment is called the redox potential discontinuity (RPD) depth. The depth of the oxygenated layer in marine sediment is a measure of ecosystem health. A diverse bottom-dwelling community includes organisms that mix water and oxygen down into the sediment. In an over-enriched environment, organic material deposited on the sediment surface can use up the available oxygen and smother the bottom-dwelling community. Such areas, including some areas of Boston Harbor, have a thin or nonexistent oxygenated layer.

In MWRA’s monitoring program, the RPD depth is estimated from sediment-profile images, cross-sections of the upper several centimeters of the sediment taken with a special mud-penetrating prism and camera. The threshold for RPD is half the mean measured in the baseline period (that is, if the thickness of the oxygenated layer fell to less than half the thickness measured pre-discharge, a caution threshold would be exceeded.) Sediment profile imaging for MWRA monitoring is conducted in August each year.

The 2019 annual sediment monitoring showed that the RPD depth near outfall site did not exceed the threshold (did not fall below the minimum RPD threshold), and was one of the deepest observed at the outfall site since monitoring program started in 1992 (Figure 2).

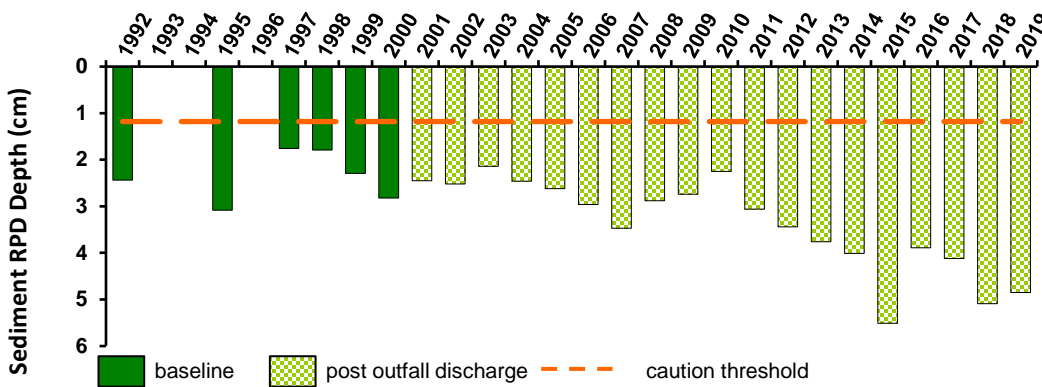


Figure 2. Sediment RPD depth in Nearfield (1992 - 2019)

## NUISANCE ALGAE

### ALEXANDRIUM - summer (May – August) 2019, including seven rapid-response surveys

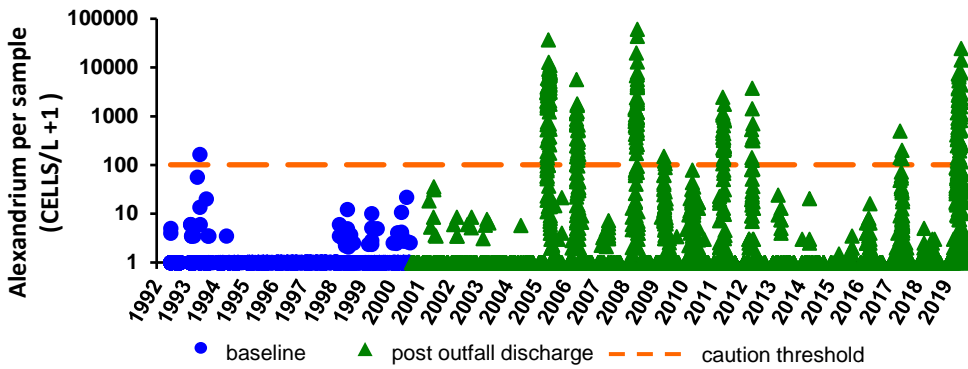
The [nuisance algae](#) *Alexandrium catenella* can cause paralytic shellfish poisoning (PSP, “red tide”) in Massachusetts Bay. MWRA measures *Alexandrium* abundance in its monitoring program, and checks observations of shellfish PSP toxicity from state fisheries agencies from Maine to Massachusetts and other regional monitoring programs to keep track of the course of Gulf of Maine *Alexandrium* blooms.

The bloom of *Alexandrium* reported last quarter continued into the period covered by this report. The report for last quarter noted that preliminary results from May *Alexandrium* samples activated a series of rapid-response *Alexandrium* surveys and triggered a caution level exceedance for this nuisance algae species. This report

includes the final results from all surveys conducted through July 31 and preliminary results from a regular survey on August 21. By the end of July the *Alexandrium* bloom had subsided bay wide. In results from the special survey on July 31 and regular survey on August 21, *Alexandrium* counts in samples collected from nearfield and offshore stations were all below 100 cells per liter, except for one sample collected from the mouth of Boston Harbor on August 21 that had counts of 108 cells per liter. The very low cell counts from the end of July and August suggest that the *Alexandrium* bloom in Massachusetts Bay had ended for this year.

Consistent with the second quarter report, there continue to be no indications that the 2019 exceedance was related to the DITP outfall discharge. The additional results continue to support the conclusion that a portion of the coastal population of *Alexandrium* along the coast of Maine, New Hampshire and Massachusetts north of Cape Ann was transported by winds and currents into Massachusetts Bay. (See also <http://www.mwra.com/harbor/pdf/20190531amx.pdf>)

In the figures below, we compare nearfield *Alexandrium* data to the threshold for each sample through August 2019. The first figure includes data since the start of the monitoring program in 1992 (Figure 3). To better display recent values, the second figure shows data for 2019 only, including seven routine surveys and seven special surveys through the August (Figure 4). Note logarithmic scale for each graph.



**Alexandrium per-sample abundance (cells/liter)**

|   |        |
|---|--------|
| Caution threshold   | 100    |
| Summer 2019   | 24342* |
| * maximum of all nearfield samples collected May-August, 2019 |        |

Figure 3. Alexandrium cell concentrations in Nearfield (1992 -2019)

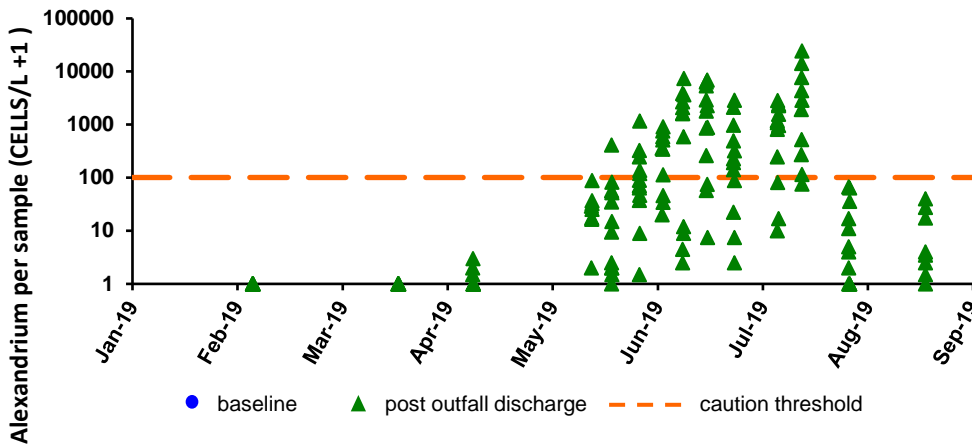


Figure 4. Alexandrium cell concentrations in Nearfield 2019

**PHAEOCYSTIS – summer (May - July) 2019**

In February 2017, EPA approved changes in the Contingency Plan to remove the threshold for the seasonal abundance of the nuisance alga *Phaeocystis pouchetii* in the nearfield water column. During bloom conditions, *Phaeocystis* can form large, gelatinous colonies, which may accumulate as foam as they disintegrate on beaches. Evaluations of prior threshold exceedances for this species have indicated that they resulted from natural fluctuations in Massachusetts Bay, do not represent degradation, were not a result of MWRA’s discharge, and have not occurred in concentrations that would pose problems for recreation. MWRA agreed to continue to report each quarter on nearfield survey mean abundances of *Phaeocystis pouchetii* compared to its historical seasonal pattern. This quarter, results from May to July 2019 became available.

The figure below shows the 2019 survey mean *Phaeocystis* results against the seasonal background for all prior years since 1992. Due to reductions in the number of surveys conducted each year, the historical seasonal pattern encompasses more time-points than shown for the current year.

Both the timing and magnitude of survey mean *Phaeocystis* abundance from May to July 2019 was within the range of the historical seasonal pattern.

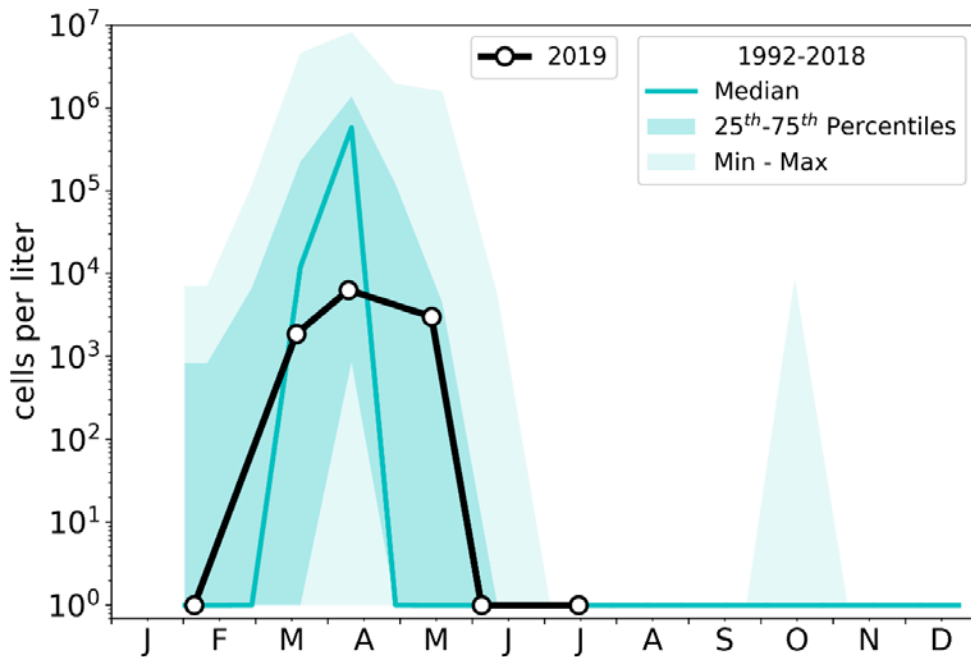
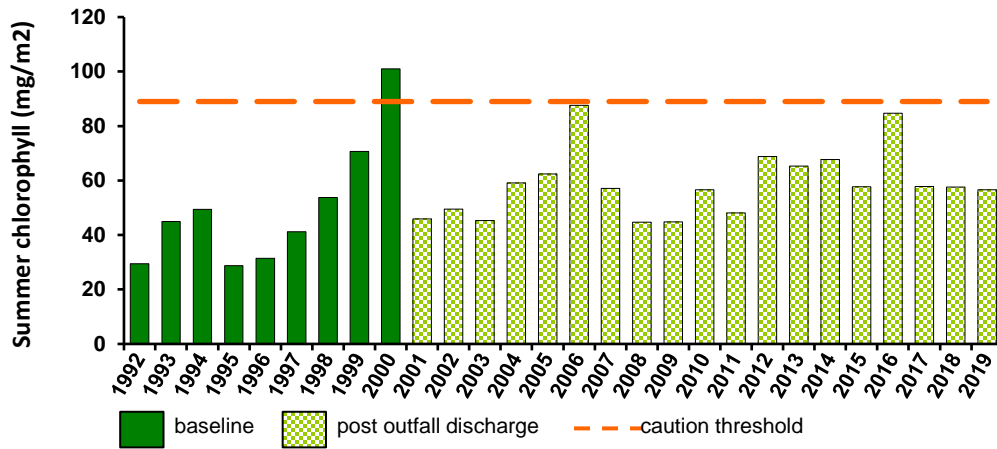


Figure 5. Mean *Phaeocystis* abundance per survey in Nearfield

**CHLOROPHYLL - summer (May – August) 2019**

There were no [chlorophyll threshold](#) exceedances for summer 2019. The nearfield mean areal chlorophyll in summer 2019 was 56.6 mg/m<sup>2</sup>, well below the Caution Level threshold for summer of 89 mg/m<sup>2</sup> and well within the range of other years in the baseline (pre-discharge) and discharge years.

The figure below compares chlorophyll data for summer 2019, which included four routine surveys, and the results since the start of the monitoring program in 1992.



**Figure 6. Summer mean areal chlorophyll concentrations in Nearfield (1992-2019)**

**DISSOLVED OXYGEN (DO) – June - September 2019**

The DO thresholds are tested on results collected in the bottom water from nearfield and Stellwagen Basin stations during June through October each year. During this period, warmer temperatures cause lower solubility and water column stratification, which can reduce dissolved oxygen concentration and saturation in bottom water.

The graphs below show the annual fluctuation of bottom DO and percent saturation from nearfield and Stellwagen Basin, which are typically lowest in early autumn. To better compare the threshold results across years, a subset of data collected during 1992-2010 are used, corresponding to the current design of the Massachusetts Bay monitoring program that began in 2011.

During June - September 2019, results from four regular water column surveys show that bottom-water oxygen percent saturation and concentration in both the nearfield and Stellwagen Basin are within the range of previous years. The oxygen percent saturation in Stellwagen Basin decreased below the caution threshold of 80% during the July survey, but was well above the background level. All other measurements remained above both caution levels and background levels. Thus, there were no threshold exceedances during this period (Figure 7 & Figure 8).

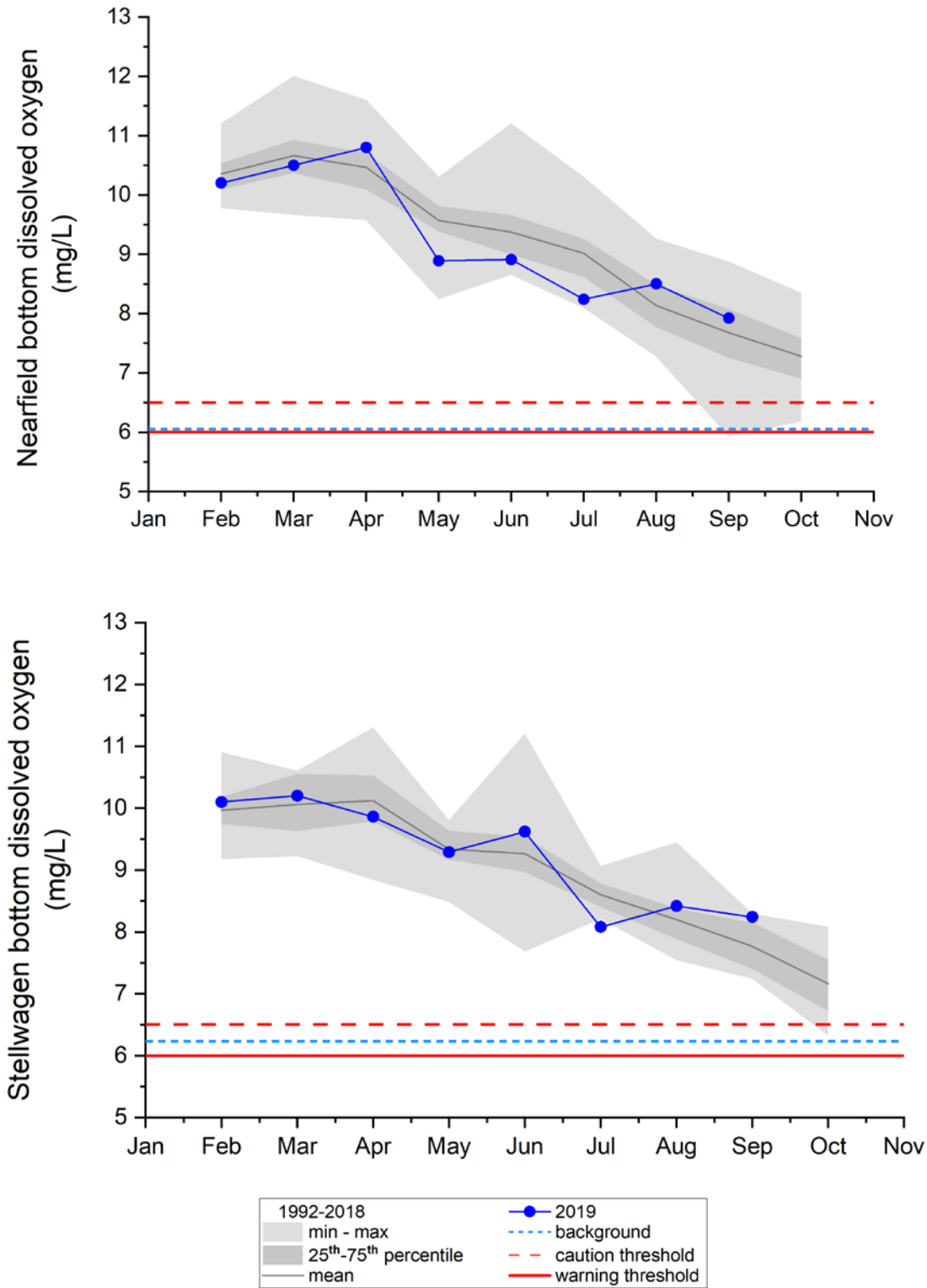


Figure 7. Bottom dissolved oxygen in Nearfield and Stellwagen Basin

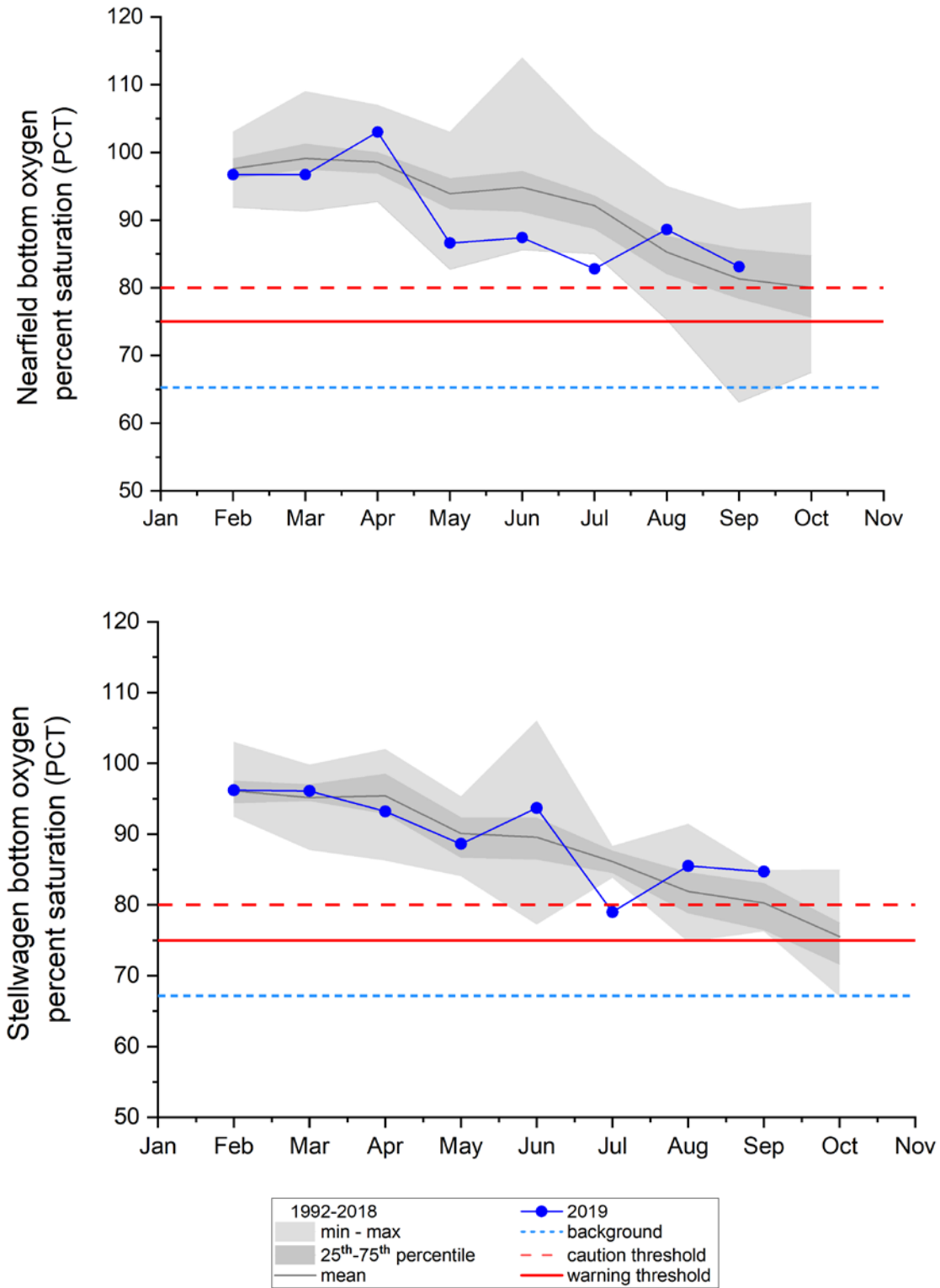


Figure 8. Bottom oxygen percent saturation in Nearfield and Stellwagen Basin