Rough River Lake (RRR) Water Quality Summary

Summary of 2020 Water Quality Results

Rough River Lake had one exceedance of KY's water quality criteria for temperature at the tailwater (RRR10000). Total phosphorus and total nitrogen levels at all sample locations exceeded the USEPA nutrient criteria. TSI for the three indices classified the lake as eutrophic or hypereutrophic, indicating high to very high levels of biological activity potential. Finally, our sampling showed there were three samples with cyanobacteria cell counts over 100,000 cells/mL at the time of the sampling event. The elevated nutrient levels and eutrophic/hypereutrophic TSI classification indicate there is a high potential for HAB development in the lake.
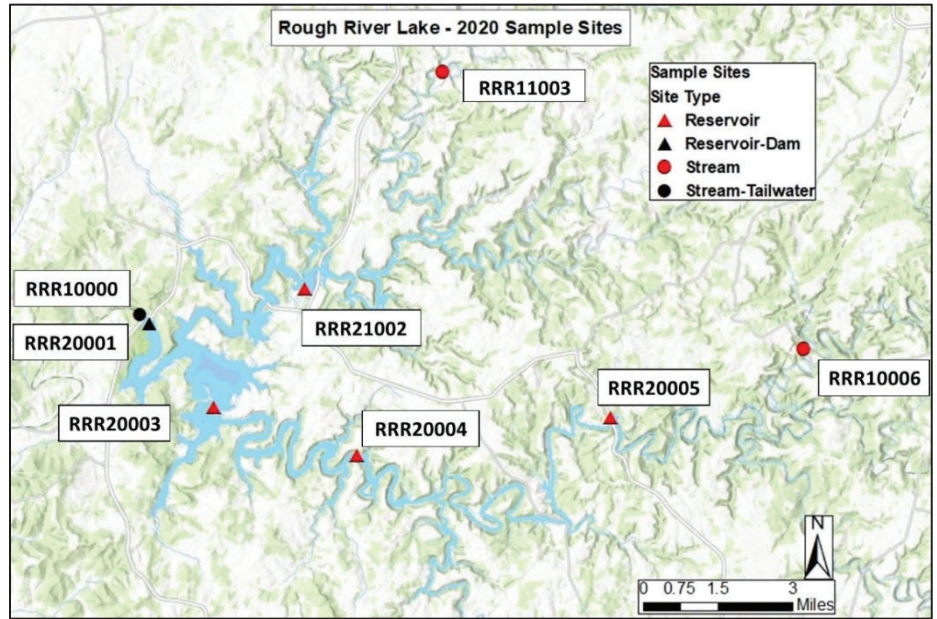

Figure 1. Water quality sampling locations for Rough River Lake in 2020.

2020 Activities

In 2020, one sampling event was conducted at Rough River Lake. Field data and chemical samples were collected at eight sample locations (Figure 1). Chlorophyll and phytoplankton were collected at five sites, and zooplankton samples were collected at the damsite (RRR20001).

Additionally, temperature and dissolved oxygen (DO) profiles were collected by the project staff at the damsite and tailwater approximately every two weeks from early May through mid-December.

Exceedances of KY State Water Quality Criteria

There was one exceedance event of KY state water quality criteria for temperature at the tailwater on January 11-12. There were no other exceedances of KY state WQ criteria.
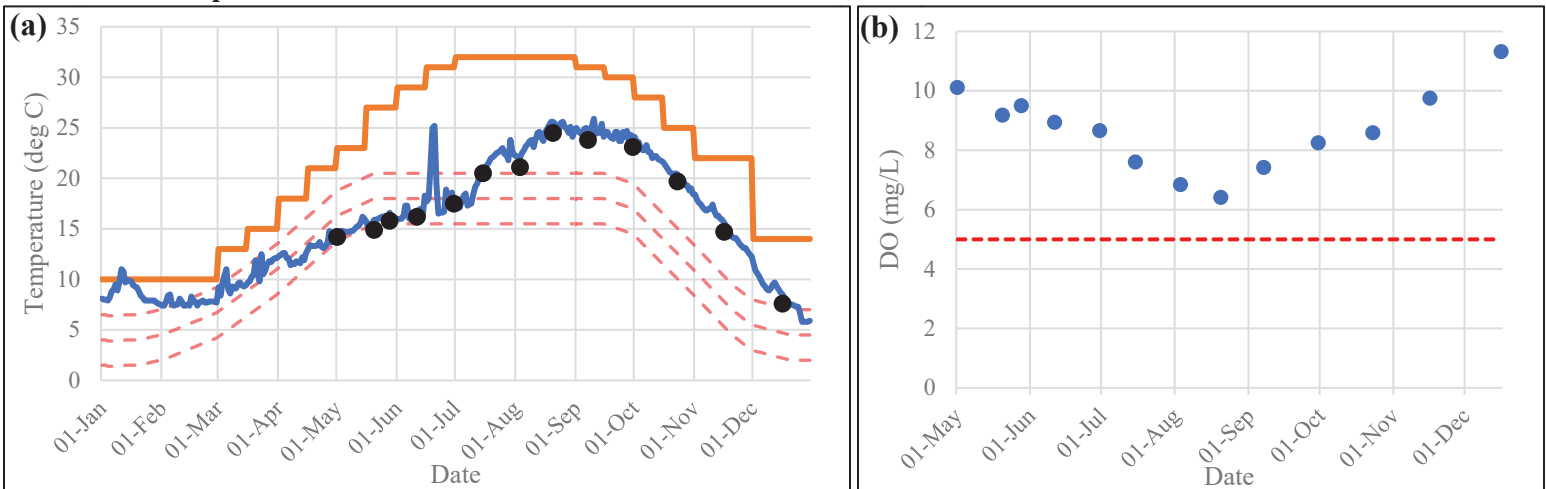
Tailwater Temperature and DO Conditions

Figure 2. Rough River Lake tailwater temperature and DO data. (a) Tailwater temperature data collected by project staff in 2020 is represented by the black dots. The blue line represents USGS gage data (provisional) from a gage downstream from the project. The temperature guide curve is represented by the dashed red lines, and the orange line represents the KY water quality criteria for temperature. (b) Tailwater dissolved oxygen data collected in 2020 is represented by the blue dots. The KY water quality criteria for DO is represented by the dashed red line.

Tailwater data was compared to KY state water quality criteria for temperature and to the Louisville District's temperature guide curve for Rough River Lake (Figure 2a). According to the provisional USGS data, tailwater temperature exceeded the state criteria for temperature on January 11-12. During this time, the reservoir was de-stratified; therefore, nothing could be done operationally to prevent this exceedance. Also, tailwater temperatures fell outside the guide curve January through early February, mid-June, and mid-July through late December. Although the WQ Program will use these findings to inform future operational decisions to improve performance of downstream temperature management wherever possible, Rough River Lake has poor selective withdrawal capabilities which severely limits the ability to operate for temperatures downstream. Tailwater dissolved oxygen levels did not exceed state criteria at any time throughout the year (Figure 2b).

Nutrient Analyses

Nutrient data, including total nitrogen (TN) and total phosphorus (TP) data, were collected at all sample sites in 2020. The 2020 TP and TN values were compared to historical data from 2012 through 2019 (Figure 3). The TP and TN values at each site were compared to their respective USEPA recommended criteria. Nutrient levels are an area of concern because elevated nutrients can lead to high biological activity, especially with respect to HABs.

Total Phosphorus

2020 TP values were higher than historical medians and distributions in all but one of the samples. Also, 2020 TP levels at all sites were above the USEPA recommended nutrient criteria for the respective locations.

Total Nitrogen

2020 TN values were above historical medians in 16 out of 18 samples and were above historical distributions in over half of the samples. All 2020 TN values exceeded the USEPA recommended nutrient criteria.
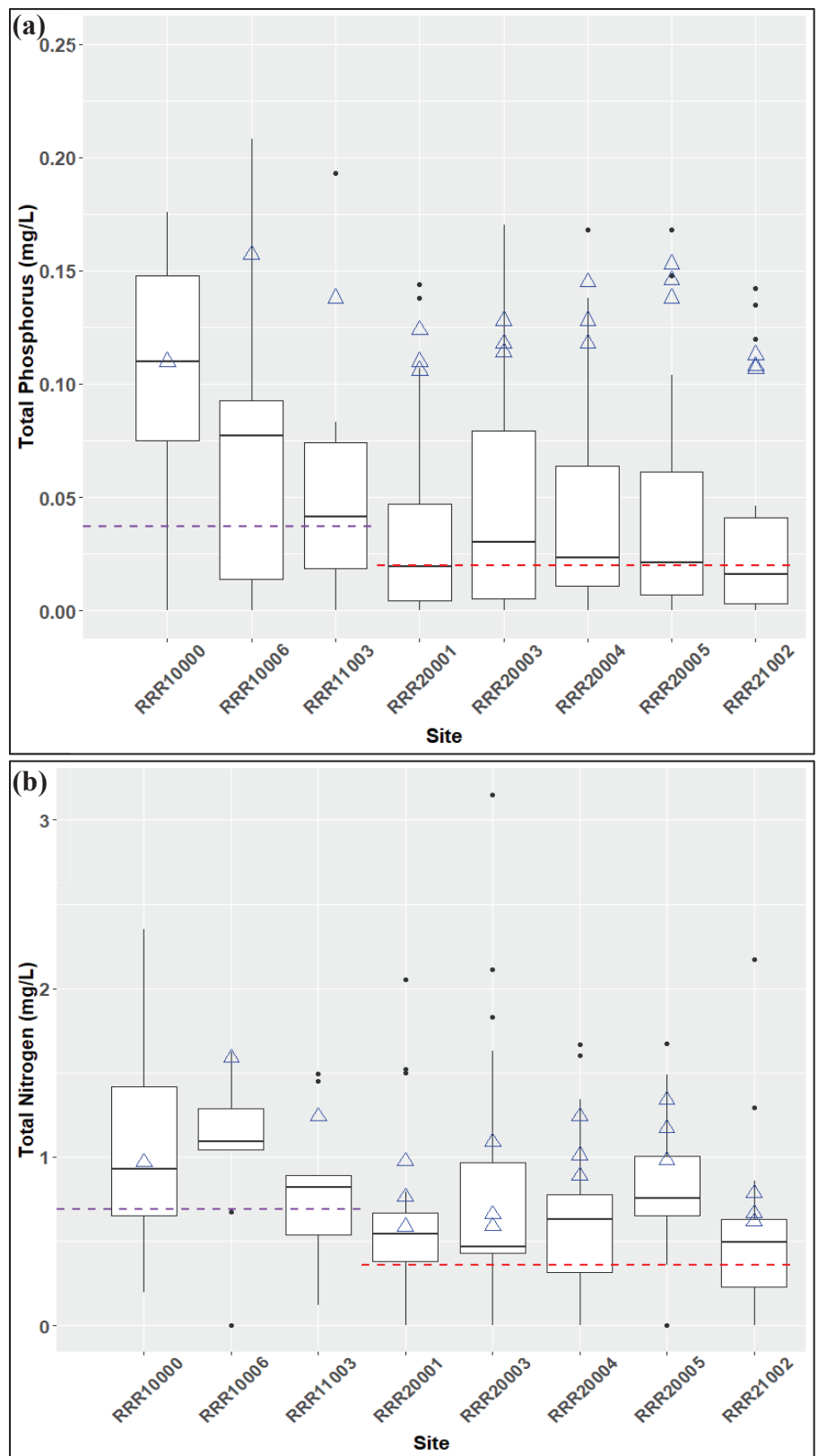

Figure 3. Comparison of Rough River Lake 2020 nutrients data to historical samples and nutrient criteria. Boxplots represent data collected in 2012-2019 and blue triangles represent 2020 data. Purple and red dotted lines represent USEPA recommended nutrient criteria for streams and reservoirs, respectively. (a) Comparison of total phosphorus data. Five outliers (values range from 0.272 to 0.322 mg/L) were excluded to make graph easier to interpret. (b) Comparison of total nitrogen data.

Cyanobacteria Data, HABs, and Trophic State Index

Cyanobacteria Data

20 phytoplankton samples were collected from various depths at 5 sites. Total cyanobacteria cell counts exceeded 100,000 cells/mL (guideline value for moderate health risk from the World Health Organization's Guidelines for Safe Recreational Water Environments [2003]) in three samples from one site on Rough River Lake. These results indicate Rough River Lake had cell count levels potentially indicative of a HAB at one site at the time of sampling.

Harmful Algal Bloom (HAB) Response

The KY Division of Water (KDOW) is the lead agency for HAB response in Kentucky. KDOW did not issue any advisories for HABs at Rough River Lake in 2020.

TSI

The trophic state indices for Secchi depth [TSI(SD)], chlorophyll-*a* [TSI(CHL)], and total phosphorus [TSI(TP)] were calculated for five reservoir sites at Rough River Lake (Table 1). The mean categories of all three indices ranged from eutrophic to hypereutrophic, indicating high to very high levels of biological activity potential.

Table 1. Summary of calculated trophic state indices at Rough River Lake.

	Mean Score (range)	**Mean Category (Range)**
TSI(SD)	58 (52-63)	**Eutrophic** (Moderately Eutrophic-Eutrophic)
TSI(CHL)	64 (58-75)	**Eutrophic** (Eutrophic-Hypereutrophic)
TSI(TP)	73 (72-75)	**Hypereutrophic**