Central Queens Branch of the PEI Wildlife Federation 2023 Water Quality Report on the West and Clyde River

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Introduction

The Central Queens Branch of the PEI Wildlife Federation (CQWF) has been producing an annual water quality report since 2021. The information included in this report discusses data collected by CQWF in 2023 (including historical data) along with research gathered from online sources. Some aspects that influence water quality include surface water nitrate levels, stream water temperature, stream water dissolved oxygen, fish kill events, siltation events, and estuary anoxic events.

The quality of water in our freshwater and estuary environment is directly related to habitat productivity, and can act as a limiting factor when surpassing certain thresholds. For example, the temperature can limit productivity for brook trout when temperatures exceed 20 degrees.

By gathering information on key aspects of water quality, CQWF can identify issues and implement management resolution tactics. The main objective of this report is to determine the general health of water quality flowing through both the West and Clyde Rivers. Along with this report, CQWF also has a West River Watershed Management Plan (2008) in which water quality parameters are discussed in further detail.

Methods

Data was collected for certain aspects of water quality monitoring during 2023. Surface water was sampled for nitrate concentrations by collecting a water sample at ten sites on the West River, and six on the Clyde River (Figure 2&3). Samples were analyzed at the PEI Analytical Lab. The results of these water samples are paired with flow measurements taken on the same day using a Flowmate. A formula is used to yield a quantitative measurement of the nitrate loading (kg per day) at the time of monitoring.

Stream water temperatures were recorded on the West River with HOBO data loggers at five locations plus at one location on the Clyde River. However, the Howell's Brook logger was lost due to being dislodged during the winter of 2022-2023. Temperature loggers were placed strategically throughout the drainage basin and were set at one hour logging intervals (Figure 1)

It is difficult to get an accurate measurement of how much siltation is actually occurring in a river. Data was collected using a manta turbidity logger from November 2020 to June 2021 on the main branch of the West River for the purpose of a UPEI graduate study (Figure 5). It is difficult and expensive to determine the quantity of silt moving in our systems. However, in the case of the West and Clyde Rivers, there is anecdotal evidence of excessive sediment accumltion in many sections of river.

Information regarding fish kill events was gathered from online sources https://www.princeedwardisland.ca/en/information/environment-water-and-climate-change/fish-kill-information-and-statistics.

Information regarding anoxic events in the West River estuary was gathered from online sources also https://www.princeedwardisland.ca/en/information/environment-energy-and-climate-action/anoxic-events.

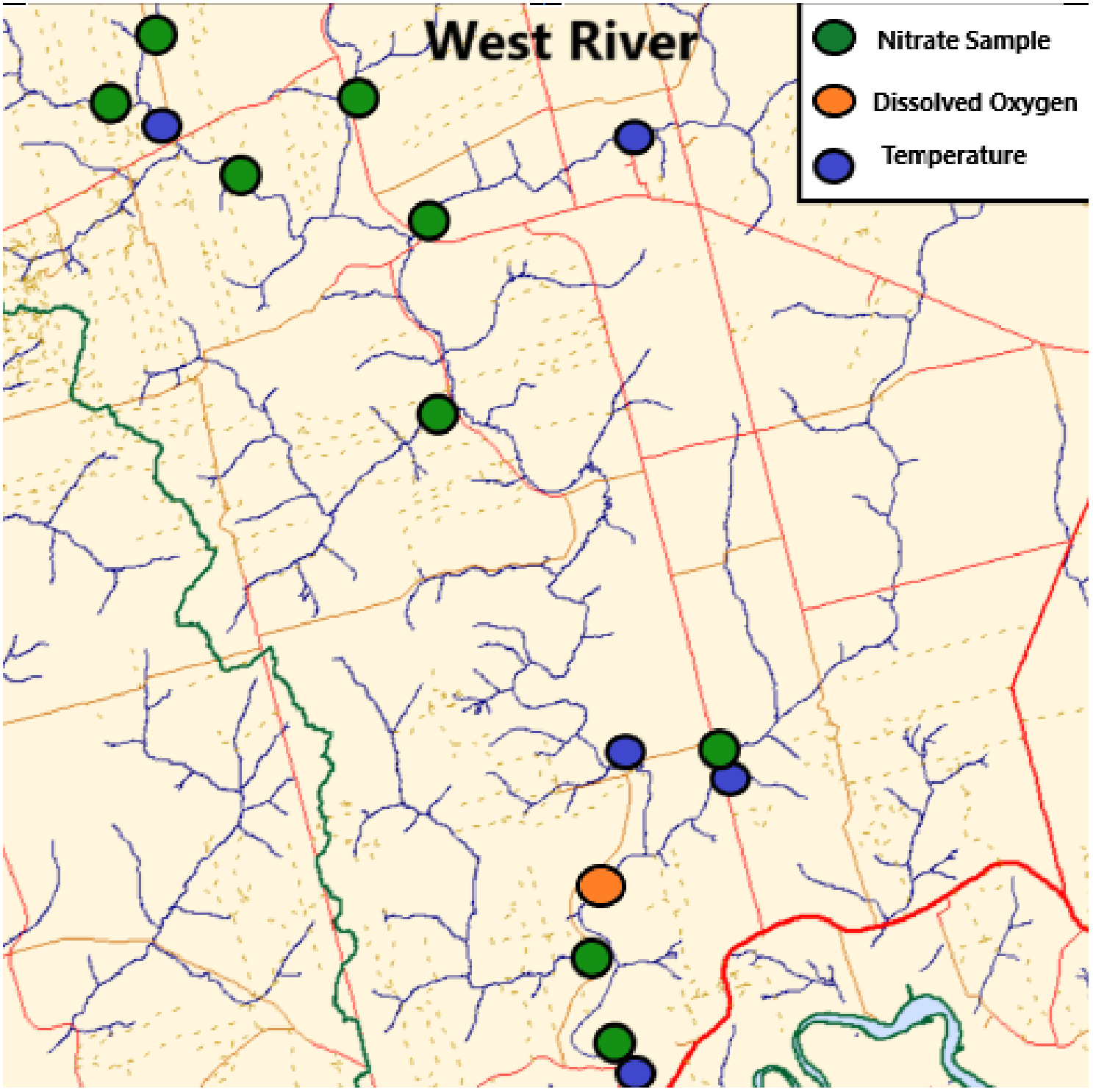

Figure 1. Various water quality monitoring locations and logger deployment locations.

Results/Discussion

Nitrate Concentration

Overall the Clyde River has higher nitrate concentrations in surface water compared to the West River. These higher concentrations of nitrates in the system can be related to land usage and more specifically the amount/type of agriculture present. The Clyde River area contains more agriculture than the West River, and also lacks adequate forest cover. The total amount of forest cover on the West River is 52% (2008 data). Sites monitored in 2023 during spring flow conditions had an average surface water nitrate of 3.7 ppm on the Clyde River (n=5) while the West River had an average of 1.4 ppm (n=9). However, when flow measurements are incorporated into the daily loading calculations the West River has a greater average loading rate of 24.6 kg/day vs the Clyde River average of 13.4 kg/day (see Figures 2&3). This is relative to the size of the river with the West River has a much greater daily discharge than the Clyde River. At the head of tide region the West River (1.7 m^3/s) has an average discharge roughly four times of Clyde River (0.42 m^3/s).

Stream Water Temperature

Water temperatures on the West and Clyde Rivers are not an issue due to the abundance of springs and the lack of open wetlands. Warm temperatures (over 20 degrees) in a river can cause stress to the salmonids forcing them to seek cold water refuge. Temperatures did not exceed 18 degrees in 2023 (Figure 4). The peak temperature reached 17.5º on a single occasion on the Clyde River and 17.3º at Crosby's on the West River. The highest record temperatures at Bolger Park was 15.9º, 17.1º on Quinn's Brook, 16.53º in Brookvale and Howell's Brook remained the coolest with a peak temperature of 15.5º. Average temperatures during the month of July ranged between 12.0º in Brookvale to 14.2º at Crosby's Mill. Both watersheds have optimal temperature regimes as temperatures do not exceed 18 degrees and remain relatively cool during the warmest periods of the year.

Dissolved Oxygen

During 2023 a Onset Hobo® U26-001 Dissolved Oxygen Logger was deployed on the main branch of the West River. The results are displayed in Figure 6. The logger was deployed from June 30 to December 1 at one hour intervals. Optimal dissolved oxygen levels for salmonids is >5mg/L and while fish start becoming distressed at 2-4mg/L they can begin to experience mortality once below 2mg/L. Dissolved oxygen above 9-10 mg/L is considered 100% saturation but this figure is influenced by water temperature. The average dissolved oxygen recorded was 10.8 with the max being 14.2 and lowest at 6.2. Evidently the lowest recorded dissolved oxygen levels coincide with a high water event on August 31. The exact mechanisms behind this relationship are tough to determine as this seems to be a one off event when there were 12 other high water events during the logging period and only one instance seemed to have this significant relationship. Overall however the dissolved oxygen levels on the West River are supportive of a healthy aquatic environment and is not considered a limiting factor.

Siltation Events

Siltation occurs in the events of spring snowmelt, or in cases of heavy rain throughout the year. The relationship between an increase in water levels and increased nephelometric turbidity units (NTU) is displayed in Figure 5. This illustrates the challenges climate change may pose in upcoming years as it is predicted that weather patterns will favor an increase in intense rainfall events which will increase the likelihood of siltation events.

During heavy rains, CQWF has gone to problematic clay roads to assess runoff. It is evident that there is significant runoff from these secondary roads. CQWF has strong relationships with the DTIE and a number of structures have been installed in recent years to mitigate runoff from these secondary reoads. During extreme siltation events sediment is deposited over the streambottom cobble and gravel which is essential for salmonid spawning habitat. After repeat events, the once loose gravel becomes cemented with sediment making redd construction difficult for the trout and salmon. This can starve the incubating eggs of the required oxygen to emerge successfully thus limiting habitat productivity. It is evident that farmers' fields are another major source of runoff. CQWF works with farmers to reduce the amount of sediment being introduced in our rivers and to promote more responsible farming practices.

Fish Kills Related to Pesticide Runoff

The only recorded fish kill for the West River was on June 19, 1971. The cause was a barrel of endrin that spilled into the upper reaches of Howell's Brook. The Clyde River has 3 recorded fish kill events, July 21 1999, July 19 2002, and July 25 2016. Similar to siltation due to runoff, the frequency of fish kills due to runoff is also an issue when it comes to water quality in our rivers. A fish kill can occur when a farmer sprays pesticides on a field near a river or stream before the instance of heavy rain. Farmers are supposed to avoid spraying pesticides on their fields before heavy rain, but sometimes the rain is unexpected, and other times farmers are negligent.

Anoxic Events in Estuaries

Anoxic events in an estuary are to be taken into consideration when water quality is being assessed. In 2021 there were no recorded anoxic events on the West or Clyde River. Since 2011 the only recorded anoxic event was in 2018 on the West River. Due to the lower water temperature and higher amplitude of tides (greater flushing), rivers along the south shore tend to have a lower frequency of anoxic events when compared to north shore rivers. Anoxic events are not of primary concern. They occur infrequently and it occurs in the estuary, which is shared with multiple other rivers, so it is beyond the scope of the West River management plan.

An anoxic event occurs when dissolved oxygen levels in the water are near zero. It will cause the water to turn a milky, green color, and release H_2S which gives off a sulfuric, rotten egg smell. These anoxic events are rare in the shared estuary of the West and Clyde River, but they still occur occasionally, so they must be taken into consideration.

Pathogens

The most noted pathogen affecting salmonid populations on the West River is Saprolegnia and Ulcerative Dermis Necrosis (UDN). Several necropsy reports have been submitted for brook trout and came back positive for Saprolegnia. In recent years an abnormal amount of infected salmonids have been recorded. In 2022, 2021, and 2020, Atlantic salmon were found with UDN (Ulcerative dermal necrosis) and Saprolegnia infections. Atlantic salmon, brook trout, and rainbow trout are affected by Saprolegnia during their spawning season as the stress from spawning compromises the immune system making them susceptible to infection. The largest concern with Saprolegnia and UDN is the effects and reduction of the broodstock population. Further investigations should occur to obtain reasons for the abnormal levels of recorded infections. CQWF has begun keeping a record of reported and observed infected fish since 2021. Records of observed fish alive and deceased with saprolegnia infection are displayed in Figure 6.

Final Comments

Overall the West River has relatively healthy water quality. Water temperatures did not exceed 17.3 degrees in 2023. The water temperature regime for salmonids on the West River is not a limiting factor or issue as it remains constantly within a suitable range. The West River has a moderately forested landscape which is reflective of the nitrate levels present in surface water samples. Spring flow in 2023 measured surface water nitrate levels ranging 0.7- 2.2 ppm, which is considered low to moderate. It has been 50 years since the last fish kill on the West River but siltation events are still very common during spring melts and rainfall events. The largest water quality issues on the West River is the abnormally high rates of Saprolegnia and excessive siltation.

The Clyde River has moderate water quality. Similar to the West River the temperature regime is ideal for salmonids as it did not exceed 17.5 degrees in 2023. The total area with forest cover in the Clyde River is low (~25%), which is reflective of the surface water nitrate levels. The range of surface water nitrate levels is moderate to high for PEI standards (2.6 - 4.9 ppm). A good portion of the land is farmland, although this is not ideal, it is primarily pasture rather than row crops. Pasture lands contribute little soil erosion when compared to row crops as there is no exposed soil during the spring freshet. There have been three fish kills since 1999, the most recent in 2016 and with present agriculture practices the risks of another fish kill occurring is high. The biggest factors contributing to poor water quality on the Clyde River are poor land usage practices which lead to excessive siltation and high nitrate levels in surface water. Anoxic events are infrequent in the Clyde Rivers estuary.

Future Recommendations

Since siltation is one of the known limiting factors on both the West and Clyde Rivers a future recommendation would be to increase monitoring efforts to expand current knowledge around this issue. By increasing monitoring efforts on this water quality aspect CQWF will be able to identify problematic areas and begin the resolution process.

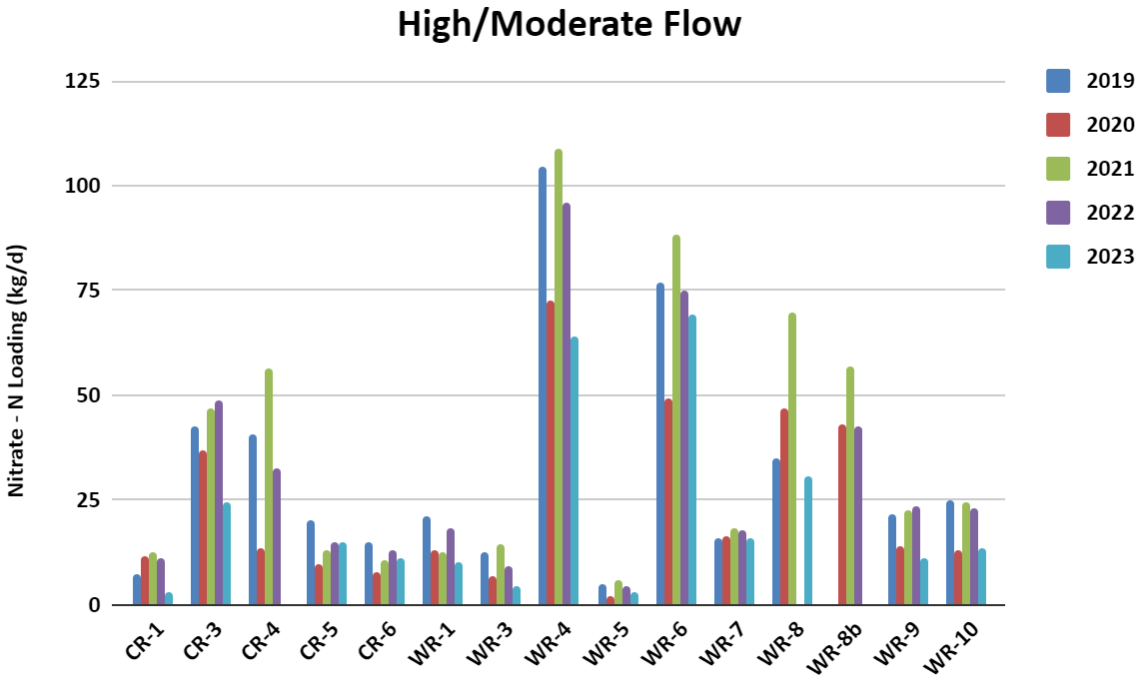

Figure 2. Daily nitrate loading was calculated for the West River (WR) and the Clyde River (CR) during high/moderate flows in 2023.

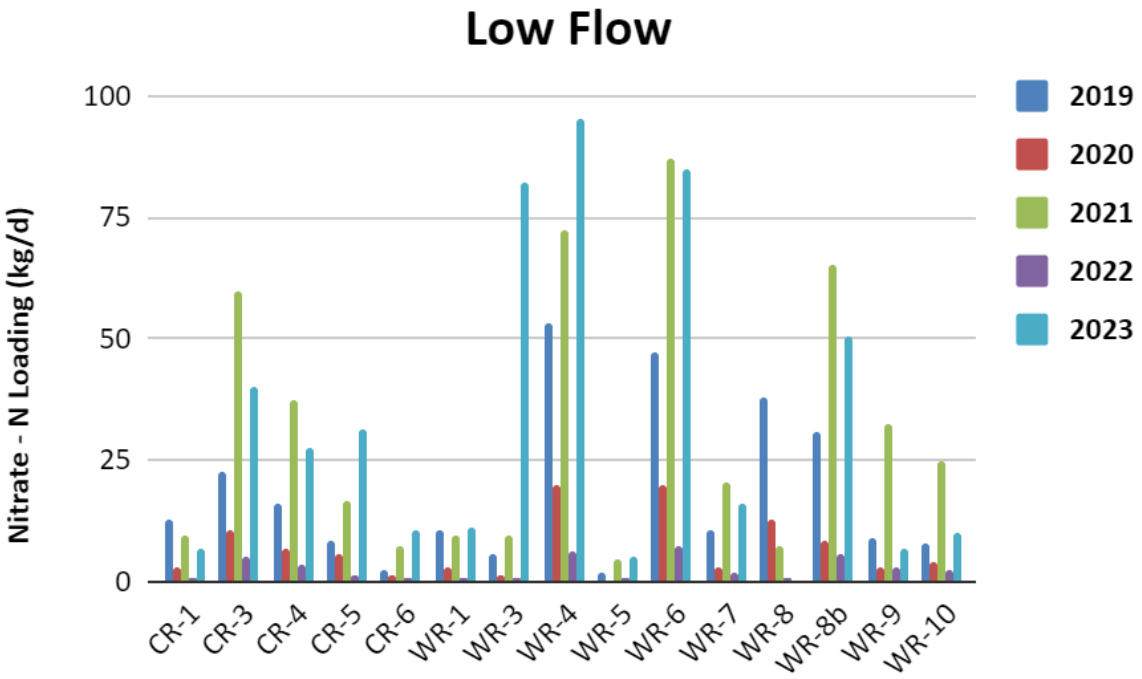

Figure 3. Daily nitrate loading was calculated for the West River (WR) and the Clyde River (CR) during base flows in 2023.

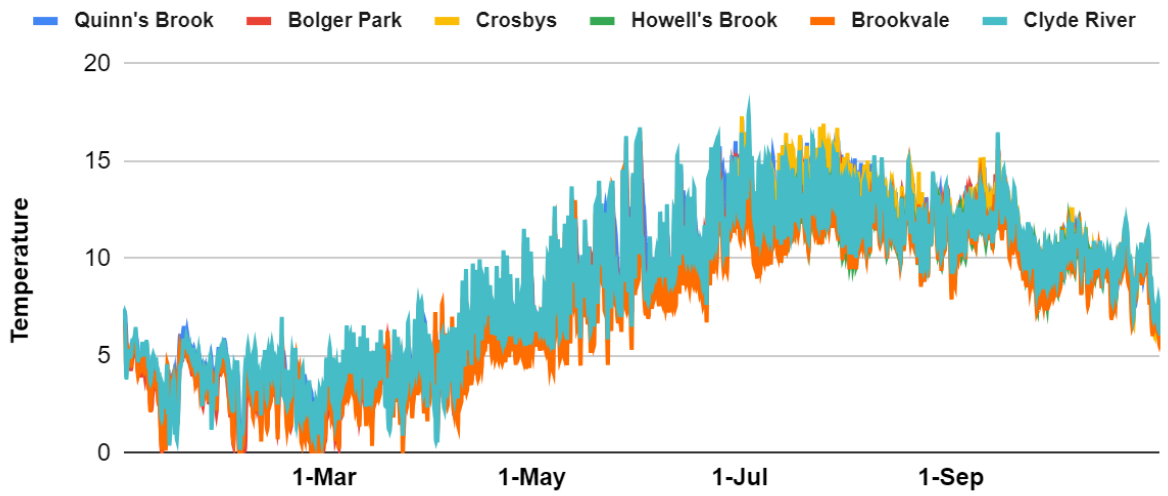

Figure 4. Stream water temperature from October 2021 to October 2022 on the West River.

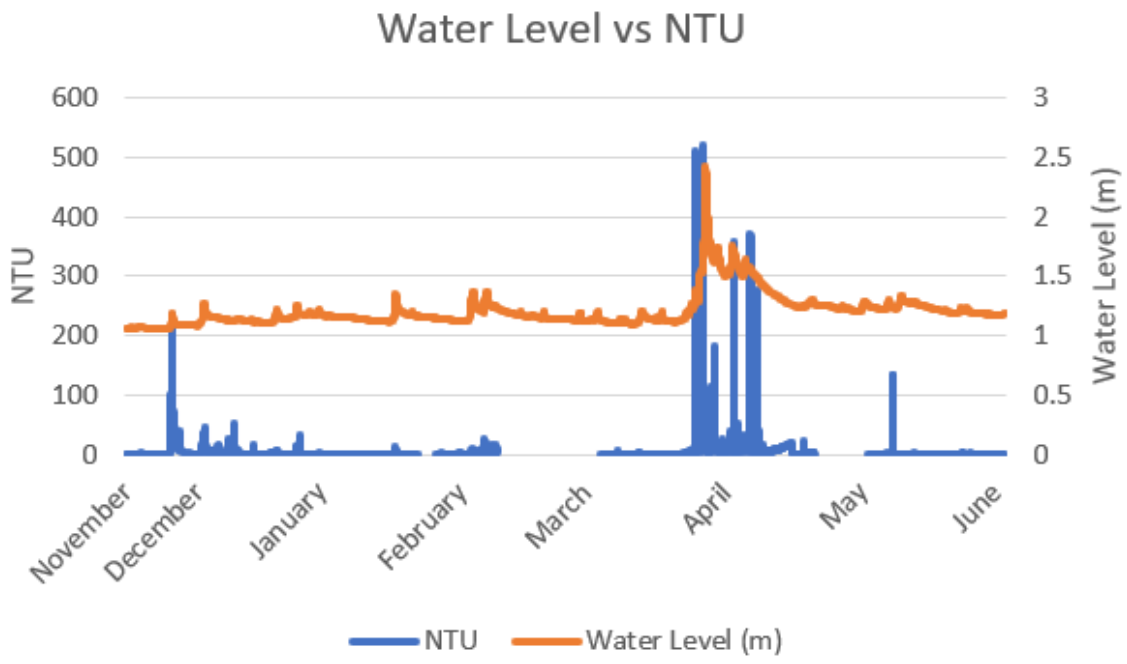

Figure 5. Nephelometric Turbidity Unit (NTU) or suspended particles from November to June 2021 in relation to water level (m) on the West River.

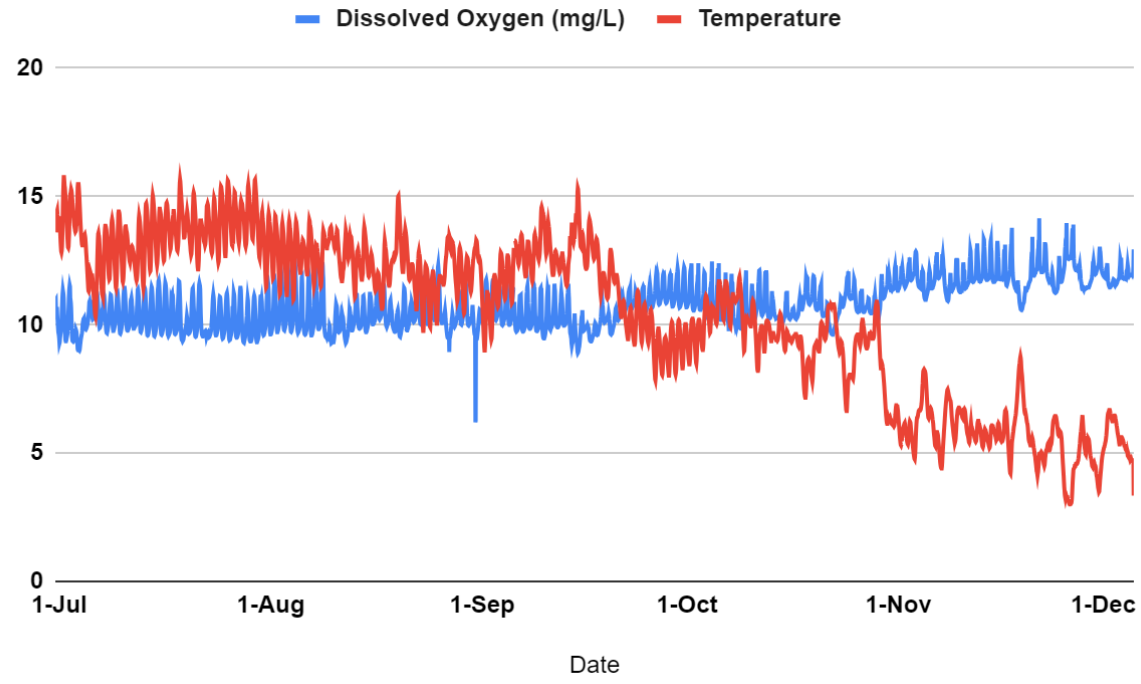

Figure 6. Dissolved oxygen levels presented in mg/L and stream temperature (celisus) on the main West River from June to December in 2023.

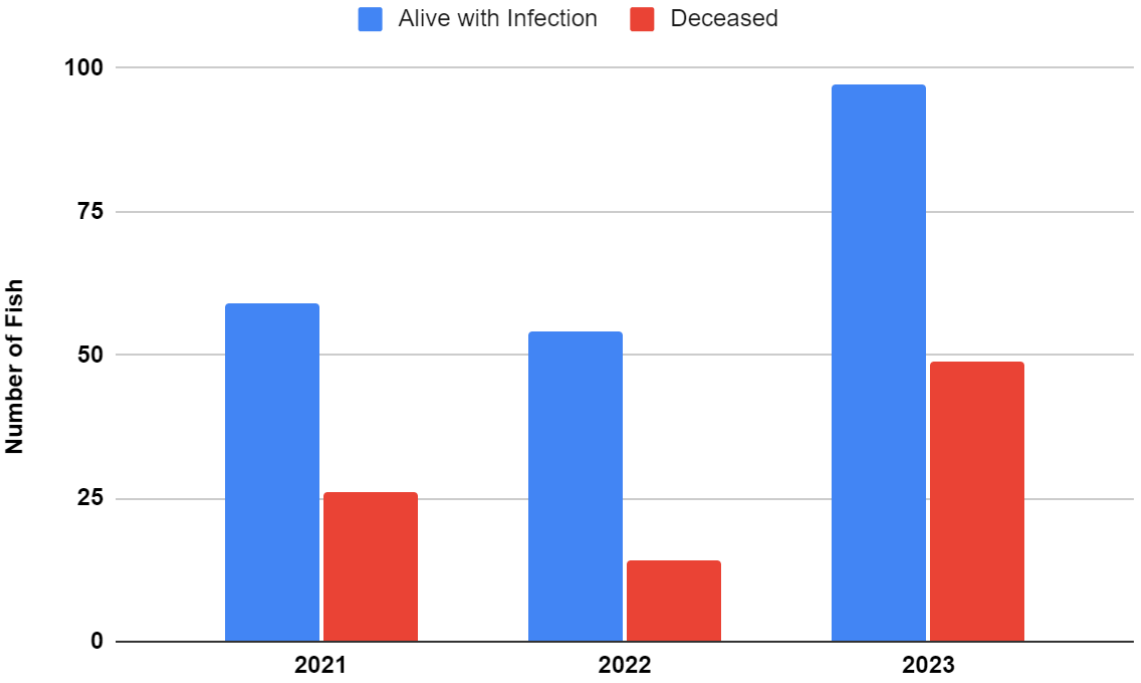

Figure 7. Recorded saprolegnia infections in wild salmonids since 2021 indicating the number of alive and deceased fish seen with signs of saprolegnia infection.