MONTANA FISH, WILDLIFE & PARKS

Fisheries Division

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Montana Statewide Fisheries Management

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Project Title: Montana Statewide Fisheries Management

Job Title: Yellowstone and Shields River Drainages Fisheries Management

Abstract: Sampling results for the Yellowstone River, Shields River, and Dailey Lake for 2021, 2022, and 2023.

Fisheries Investigations in the Yellowstone and Shields River Basins, Park County, Montana

Annual Report for 2021, 2022, and 2023

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Abstract

Trout population metrics are summarized and discussed for the Mill Creek Bridge and Corwin Springs sections on the Yellowstone River. Commons species in these sections are Rainbow Trout *Oncorhynchus mykiss,* Brown Trout *Salmo trutta*, and Yellowstone Cutthroat Trout *Oncorhynchus virginalis bouvieri*. Results from the long-term gill netting series in Dailey Lake for Walleye *Stizostedion vitreum*, Yellow Perch *Perca* flavescens, Rainbow Trout and Yellowstone Cutthroat Trout are presented. A PKD related Mountain Whitefish kill in the Yellowstone and a Smallmouth Bass kill in Cottonwood Reservoir are discussed. Shields River temperature and flow data are presented and discussed in relation to fishing restrictions and closures.

Introduction

Fisheries surveys were completed on the Yellowstone River, Shields River, and Dailey Lake in 2021. In 2022 and 2023, surveys were completed on the Yellowstone River and Dailey Lake. This sampling was part of long-term monitoring that has occurred in the Yellowstone River, Shields River, and Dailey Lake. Description of these efforts are provided, and discussion of the results are presented in this document.

Electrofishing Procedures

Mark-recapture methodology was used to estimate trout populations in the Yellowstone and Shields rivers. Marking and recapture runs consisted of electrofishing the entire section of river, with multiple fish-working stops to minimize stress of captured fish. During the marking run all fish were marked with a fin clip, which can be observed during subsequent sampling events. The fish were released back into the section and allowed to redistribute for seven days prior to recapture runs. During recapture runs, fish were examined for fin clips and those with a fin clip were noted as recaptured.

Yellowstone River Procedures

In spring 2021, 2022, and 2023, trout were sampled in the Mill Creek Bridge and Corwin Springs sections of the Yellowstone River and Mountain Whitefish were sampled in the Mallard's Rest Section in 2021 and 2022 (Table 1 and Figure 1). All are long-term monitoring sections.

Table 1 Survey sections where trout and Mountain Whitefish sampling occurred in the Yellowstone River in 2021. Coordinates in decimal degrees are NAD83 datum.

Section Name	Survey Dates	Length (ft)	Approximate Location		
Mill Creek Bridge	05/04/21 05/04/22	23,385	Upper Boundary	North West	45.41967 -110.64208
	05/02/23		Lower Boundary	North West	45.45764 -110.62569
Corwin Springs	05/05/21 04/27/22	21,540	Upper Boundary	North West	45.1080 -110.78955
	04/26/23		Lower Boundary	North West	45.15776 -110.82778
Mallard's Rest	05/03/21 05/09/22	6,600	Upper Boundary	North West	45.48545 -110.62101
			Lower Boundary	North West	45.49075 -110.59970

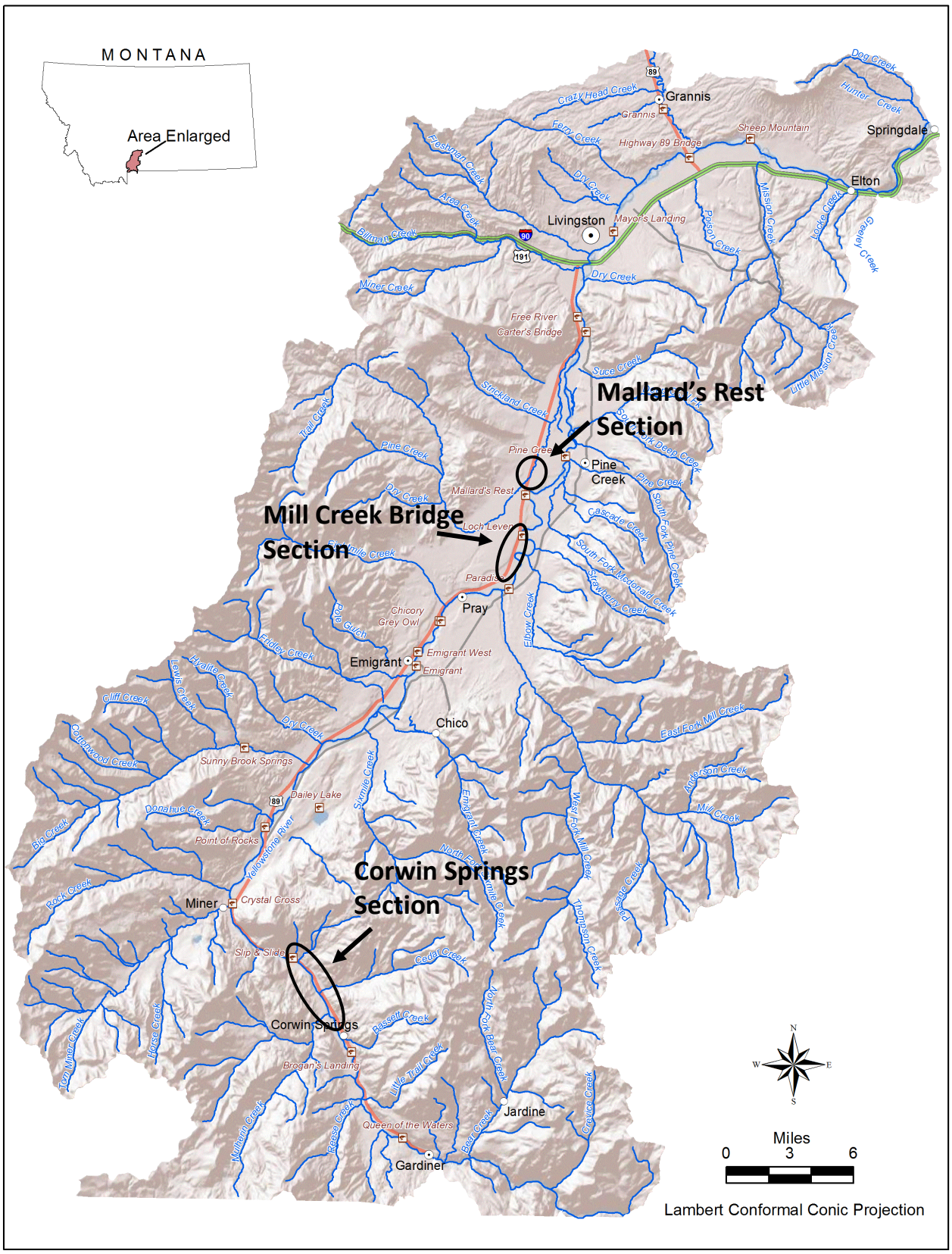

Figure 1: Yellowstone River sampling locations for 2021-2023.

Electrofishing of the Yellowstone River in 2021 was completed using one or two jet boats mounted with boom electrofishing equipment. The two boats were 20-foot Wooldridge™ outboard jet boats, one with an Evenrude™ 225 jet, equipped with a Smith Root™ VVP-15B and a Honda™ EM7500 generator and one with a Honda™ 200 jet, equipped with a Smith Root™ VVP-15B and a Honda™ ES6500 generator. The anodes on both boats were stainless steel cable droppers suspended from twin booms at the bow, and the hulls served as cathodes. In 2022 and 2023, electrofishing was completed with the use of two drift boats mounted with boom electrofishing equipment. The two boats were Boulder Boat Works™ River Taxis. One boat was equipped with a Smith Root™ VVP-15B and a Honda™ EG5000CL generator and the other was equipped with a Smith Root™ Apex and a Honda™ EG5000 generator. The anodes on both drift boats were stainless steel cable droppers suspended from twin booms at the bow, and an aluminum band around the hulls served as cathodes.

Mark-recapture efforts were made on the Mill Creek Bridge and Corwin Springs sections for trout in 2021 and 2023. In 2022, we were unable to complete mark-recapture efforts in these sections due to high flows. Trout were netted and held in live cars. After anesthetizing, the fish were identified to species, measured to the nearest 0.1 inch, and weighed to the nearest 0.01 pound. Trout ≥ 5 inches were implanted with a PIT tag that allows for individual identification of fish. The use of PIT tags will allow for calculation of growth and will hopefully aid in population abundance monitoring in the future. Fish that received a PIT tag had the adipose fin clipped to allow for study of tag retention. All trout were marked with a pelvic fin clip and returned to the river. Six to seven days after the last marking run, the recapture effort was made. Catch-per-unit-effort (CPUE) was completed on the Mallard's Rest Section for Mountain Whitefish.

Trout population abundance was estimated using the Chapman Modified Peterson method (Chapman 1951). Population estimates for Brown, Rainbow, and Yellowstone Cutthroat Trout ≥ 7 inches were calculated for the Mill Creek Bridge and Corwin Springs sections in 2021, 2022, and 2023.

Corwin Springs Section

The Corwin Springs Section is a long-term monitoring section that has been sampled since 1978 (

Figure 1). In 2021, this section was monitored using the mark-recapture method to produce population abundance estimates for trout. Prior to 2021, 2017 was the last time a mark-recapture estimate was completed in this section. High flows in 2018, 2019, and 2020 prevented completion of population estimates in this section. In 2022 and 2023, a mark-recapture effort could not be completed due to high flows following the marking run. In 2021, 2022, and 2023, PIT tagging efforts were completed in this section to evaluate a transition from mark- recapture population estimates to an open model of calculating population estimates. This transition is being driven by the limited ability to complete mark-recapture efforts because of changing spring flow regimes in the river. In both years, length-frequency data were collected for all three trout species.

In 2021, the marking and recapture efforts for this section were completed on May 5 and 13, respectively. The section was split into four subsections and sampled with two boats, one on each bank during the marking run. During the recapture effort only one boat was used. During marking efforts, two passes on each bank were made within each subsection. Only one pass on each bank within each subsection was completed during the recapture effort to complete the recapture prior to river conditions reaching a level that was not conducive to sampling.

Table 2: Population estimate results for the Corwin Springs Section of the Yellowstone River by species in 2021. N/mile represents the estimated number of Rainbow, Brown, and Yellowstone Cutthroat (≥7 inches) per mile. Upper and lower 95 % confidence intervals are also provided.

Year	Fish Species	N/Mile	Lower 95%	Upper 95%
2021	Rainbow Trout	152	120	199
	Brown Trout	253	202	325
	Yellowstone Cutthroat Trout	122	103	148

Rainbow Trout

The 2017 Rainbow Trout population estimate was 261 fish/mile (≥ 7in). This was lower than the two previous years, 296 and 275 fish/mile (≥ 7in) (Figure 2). Due to high flows, a population estimate was not completed in 2018, 2019, or 2020. In 2021, the population estimate for Rainbow Trout continued to decrease to 152 fish/mile (≥ 7in). This is well below the long-term mean and near some of the lowest abundances since 1978. Some of this decline may be the result of a reduced recapture effort, but this does not account for all the reduction in numbers. Continued sampling will provide more information about this decline.

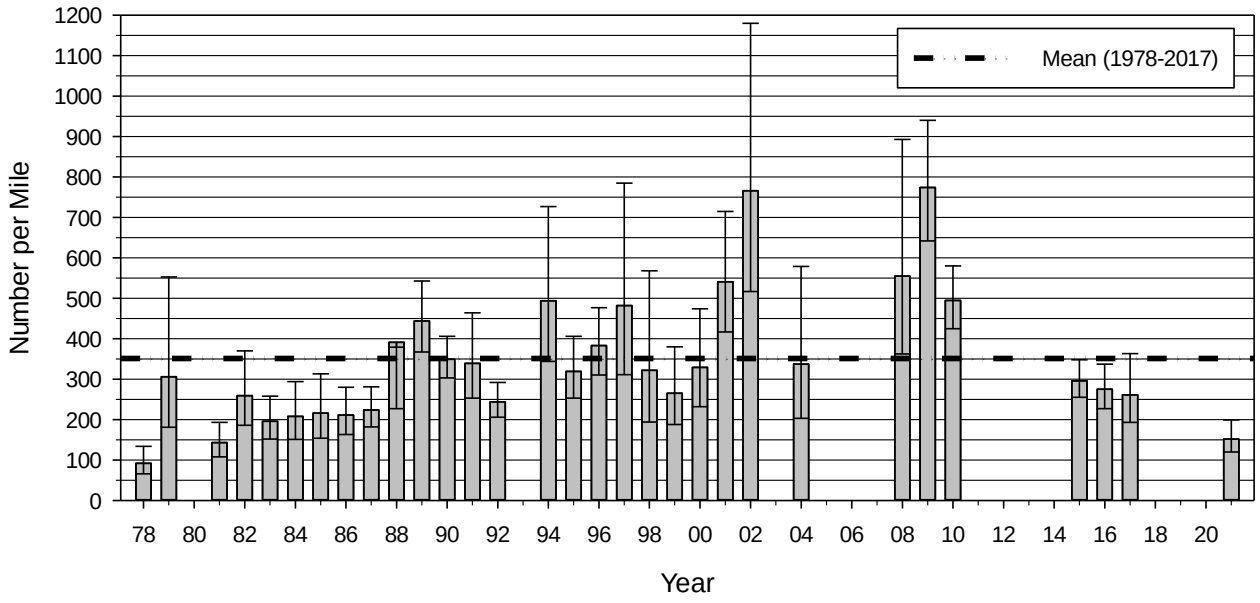

Figure 2: Corwin Springs Rainbow Trout population estimates for fish 7 inches and greater from 1978 to 2021. The error bars represent the upper and lower 95% confidence intervals.

The length-frequency distribution for Rainbow Trout indicates lower recruitment in many length groups in 2021 when compared to 2018 and the long-term mean from 1978-2018 (Figure 3). It should be noted that there is a 2-year gap in the data that may account for many of these differences. The 2021 length-frequency distribution for Rainbow Trout in the 7.5- to 12.0-inch and 17.0- to 18.5-inch range decreased when compared to 2018. Fish in the 12.5- to 15.5-inch range increased when compared to 2018 and except for 13.0-inch fish were above the long-term mean.

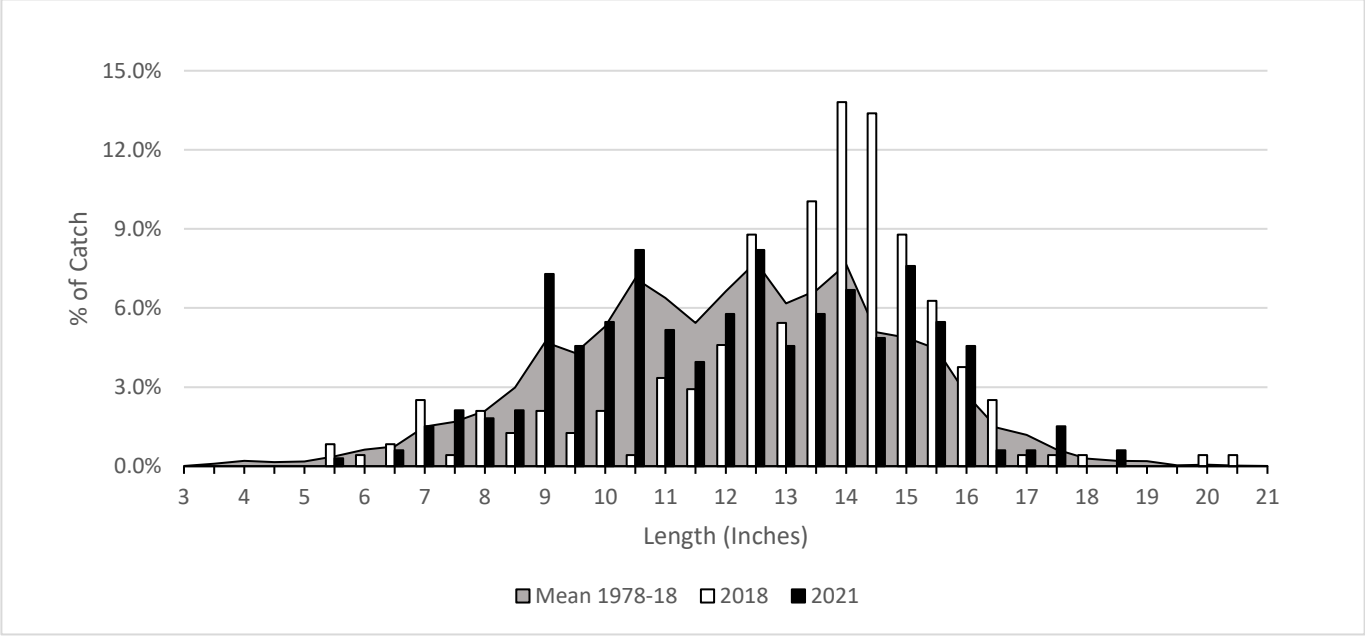

Figure 3: Length-frequency distribution as % of catch for Rainbow Trout in the Corwin Springs Section by half-inch group for 2018 and 2021 and the mean for 1978-2018.

The length-frequency distribution for Rainbow Trout in most length groups in 2022 were higher than in 2021 (Figure 4). Decreases were primarily in fish in the 9.0- to 11.5-inch range. Rainbow trout in the 13.5- to 17.5-inch range were above the long-term mean. Overall, the distribution appears to be stable. It should be noted that the sampling in 2022 was completed prior to the significant flood event that year.

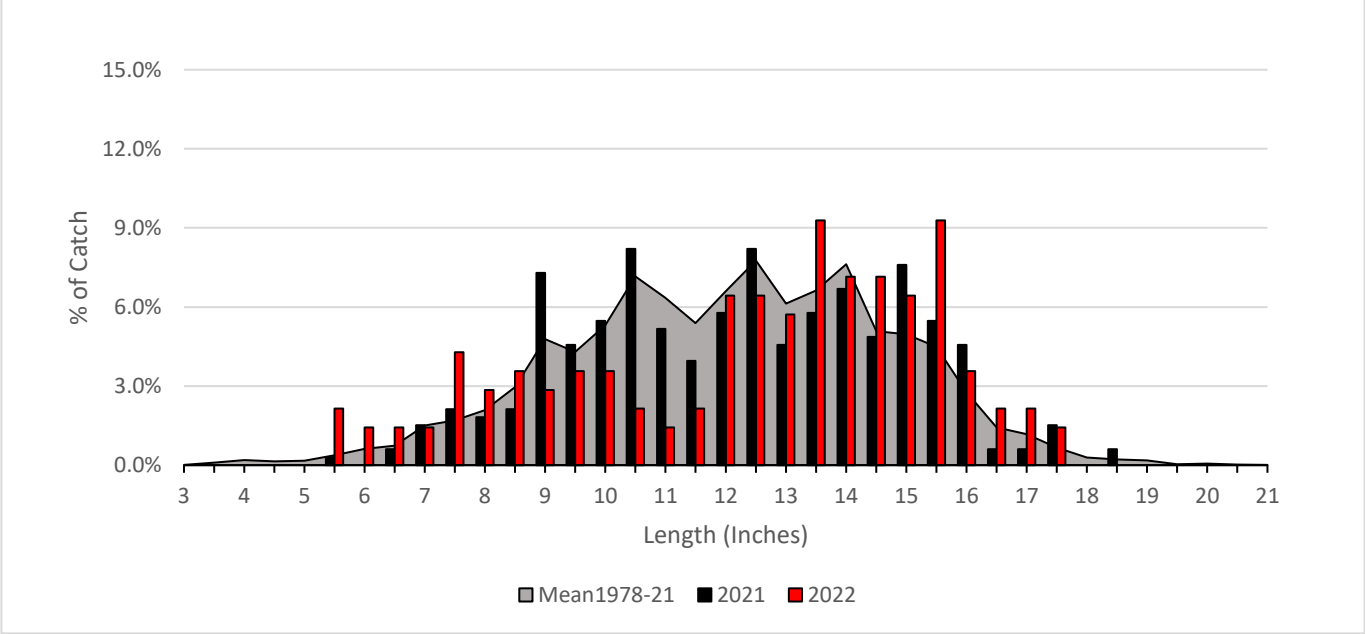

Figure 4: Length-frequency distribution as % of catch for Rainbow Trout in the Corwin Springs Section by half-inch group for 2021 and 2022 and the mean for 1978-2021.

When the 2023 length-frequency distribution is compared to 2022, recruitment of smaller fish and some of the largest fish increased, while most of the intermediate length groups saw decreases (Figure 5). Some of these changes may be the result of flood impacts in 2022 given the significance of that event. Most of the declines that occurred were in the 9.5 to 14.5-inch range. Increases in fish in the 6.5-to-9.0-inch range are encouraging in terms of potential rebounds in the length groups that had declines in 2023.

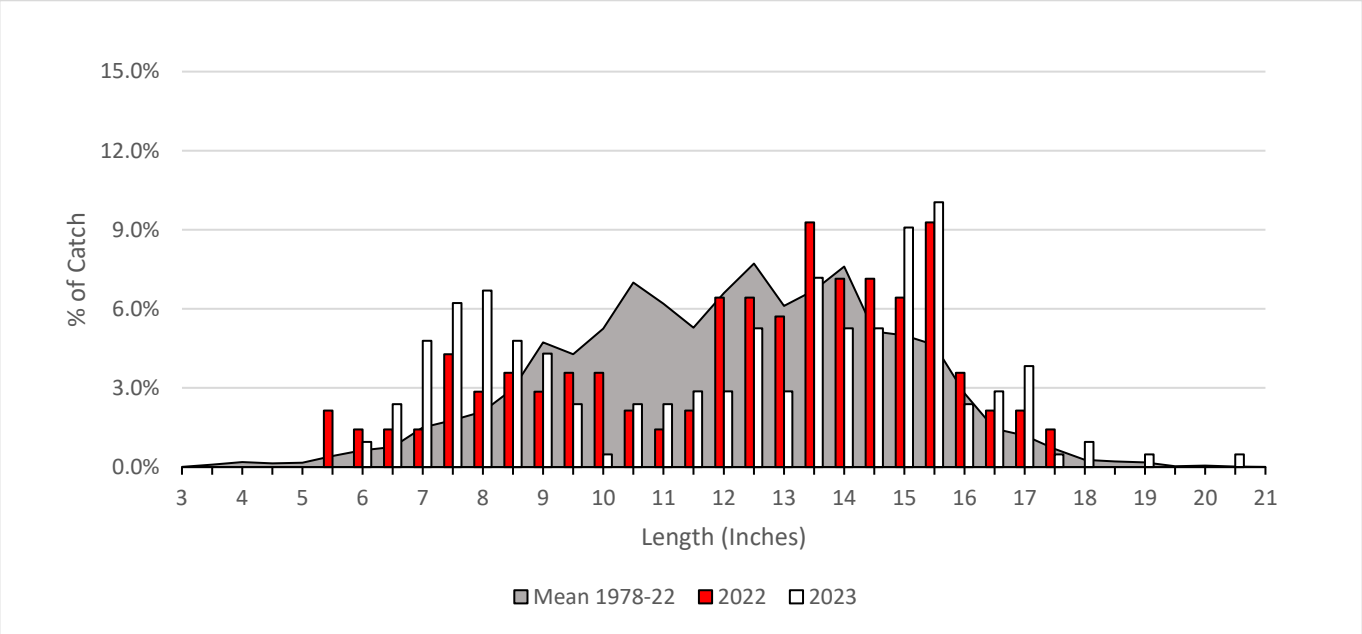

Figure 5: Length-frequency distribution for Rainbow Trout in the Corwin Springs Section by half-inch group for 2022 and 2023 and the mean for 1978-2022.

Brown Trout

The 2021 Brown Trout population estimate was higher than the two prior estimates at 252 fish/mile (≥ 7in) but remained below the long-term mean (Figure 6). The 2017 Brown Trout population estimate was 202 fish/mile (≥ 7in) and similar to 206 fish/mile (≥ 7in) in 2016. Brown Trout population estimates were not completed for the Corwin Springs Section in 2018, 2019, 2020, 2022, or 2023 because of high flows after the marking efforts.

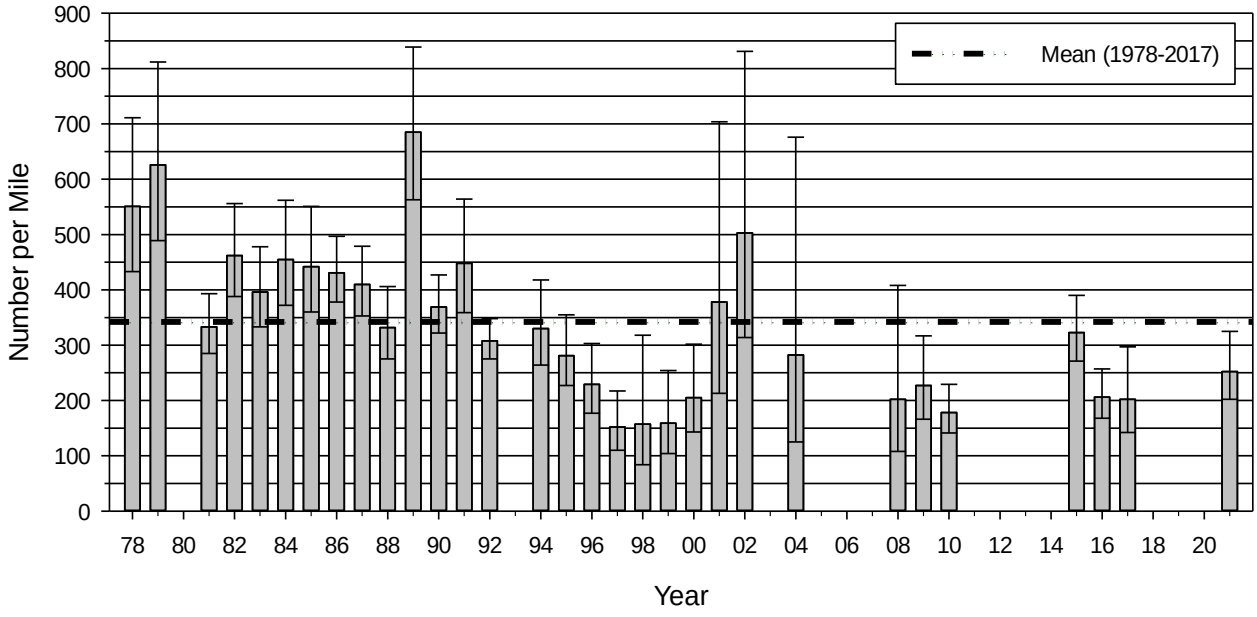

Figure 6: Corwin Springs Brown Trout population estimates for fish 7 inches and greater from 1978 to 2021. The error bars represent the upper and lower 95% confidence intervals.

The length-frequency distributions for Brown Trout in the Corwin Springs Section, in 2021, indicated that most length groups were lower than the long-term mean (Figure 7). The length-frequency distribution showed an increase in numbers of fish in the 10.5- to 12.5-inch range and the 15.5- to 24.5-inch range, except the 16.5-inch length group, when compared to 2018. It should be noted there is a 2-year gap in the data that may account for some of these differences.

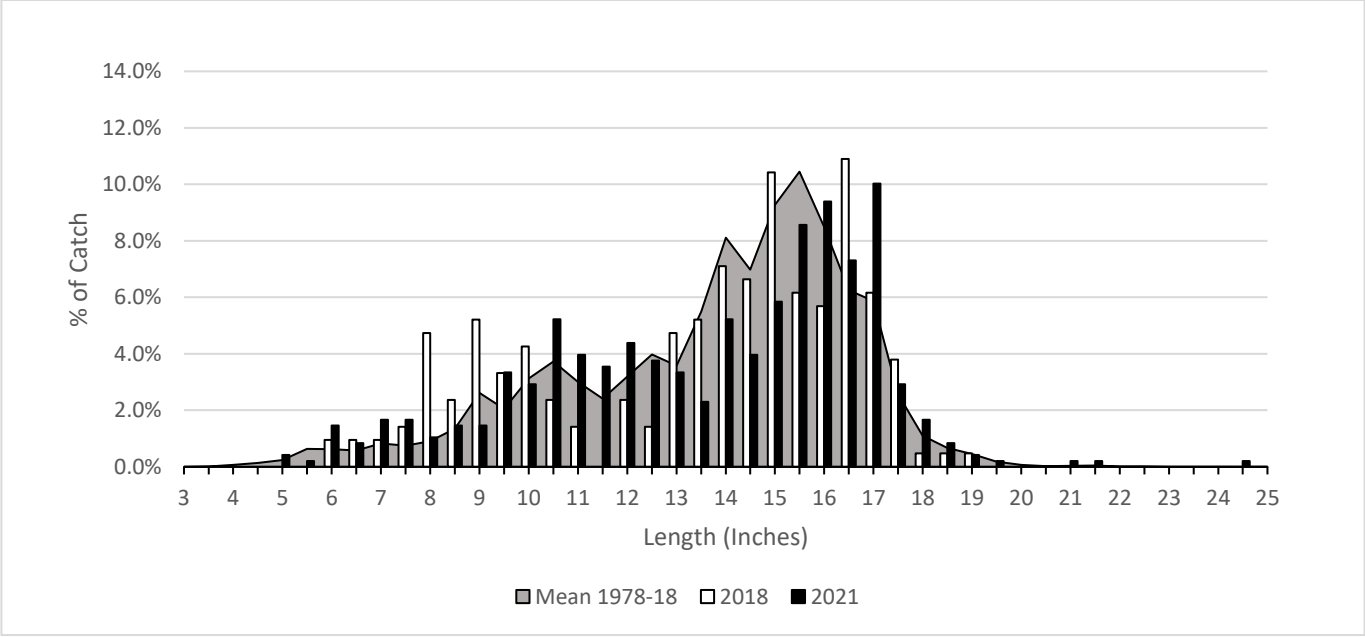

Figure 7: Length-frequency distribution for Brown Trout in the Corwin Springs Section by half-inch group for 2018 and 2021 and the mean for 1978 - 2018.

The 2022 length-frequency distribution was similar to the 2021 distribution with a few exceptions. There were decreases in the 9.5- to 12.0-inch range, the 14.0- to 15.0-inch range, and no fish were captured in the 21.0- to 24.5-inch range (Figure 8). Increases were noted in the 6.0- to 7.5-inch range, 15.5- to 16.5-inch range, and the 17.5-19.5-inch range. It should be noted that the 2022 data was collected prior to the 2022 flood event on the Yellowstone River.

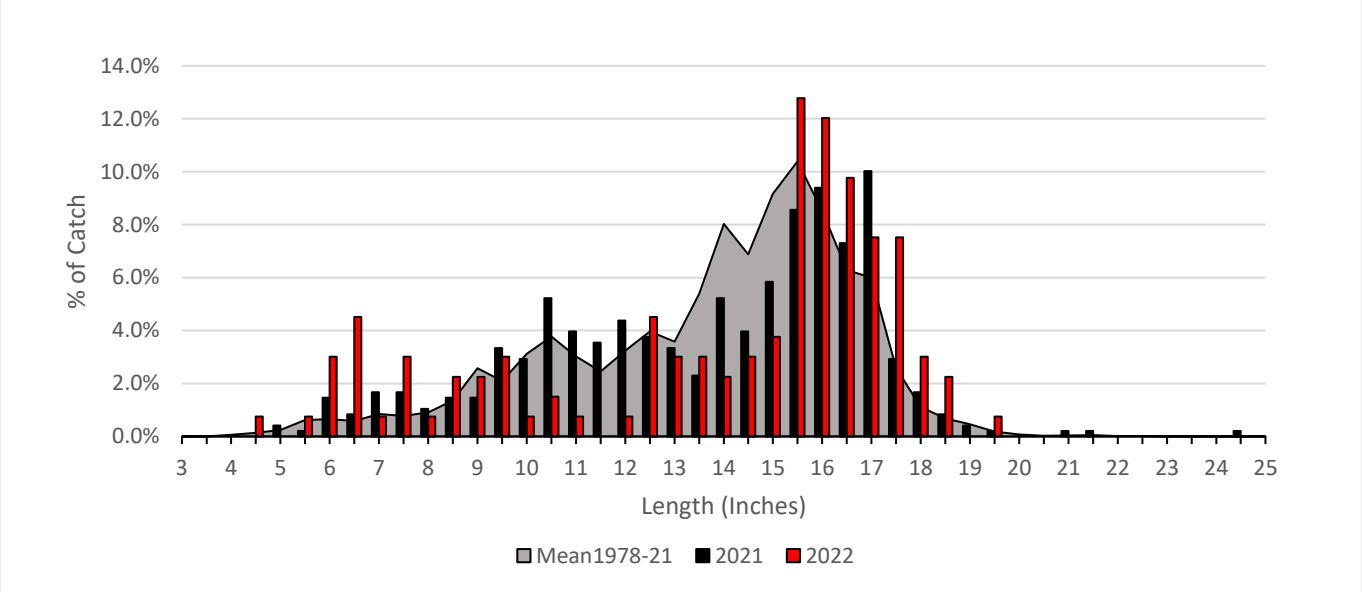

Figure 8: Length-frequency distribution for Brown Trout in the Corwin Springs Section by half-inch group for 2021 and 2022 and the mean for 1978 - 2021.

The 2023 length-frequency distribution had declines in most length groups when compared to the 2022 distribution (Figure 9). Despite the significant flood in June 2022, the length frequency distribution for 2023 indicates that the initial impact on brown trout in this section was limited. There were declines across all length groups from 2022 to 2023 except for fish in the 8.0- to 11.5- and 14.0- to 15.0-inch ranges, which increased.

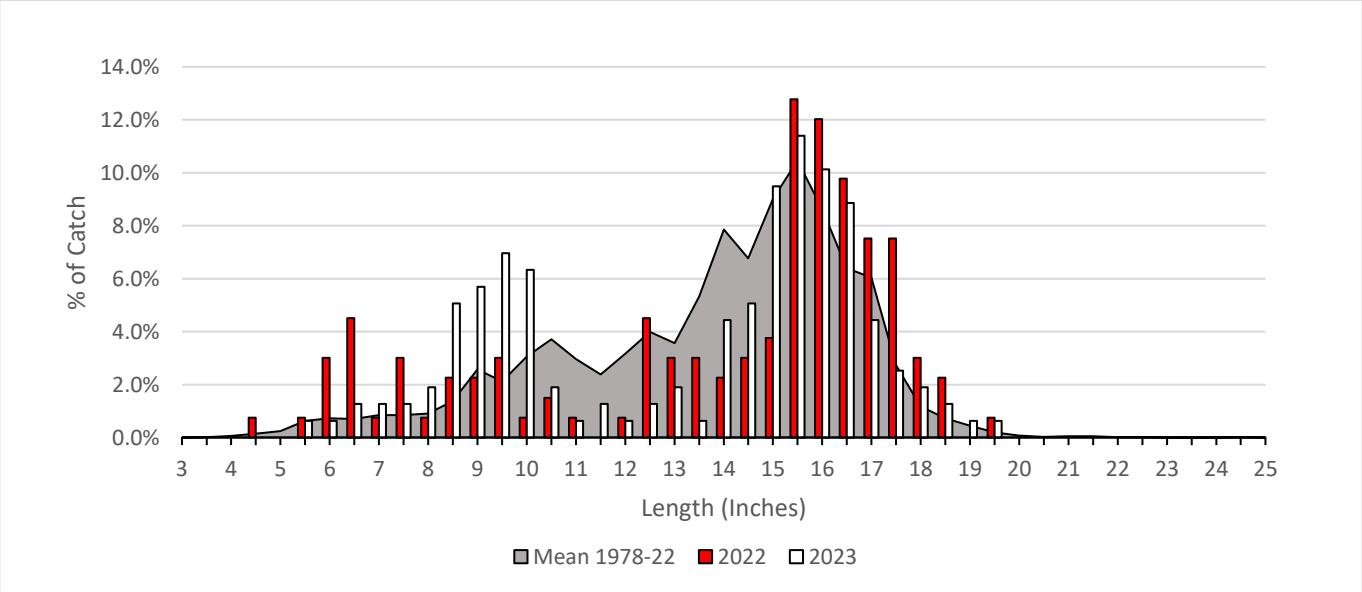

Figure 9: Length-frequency distribution for Brown Trout in the Corwin Springs Section by half-inch group for 2022 and 2023 and the mean for 1978 - 2022.

Yellowstone Cutthroat Trout

The 2021 population estimate for Yellowstone Cutthroat Trout decreased to the lowest level since 1979 at 122 fish/mile (≥ 7in) (Figure 10). The 2017 estimate was nearly twice as high at 210 fish/mile (≥ 7in). Due to high flows after the marking effort was completed a Yellowstone Cutthroat Trout population estimate was not completed for the Corwin Springs Section in 2018, 2019, 2020, 2022, or 2023. The continued decline in abundance of Yellowstone Cutthroat Trout in this section, especially to this new low, is concerning and will continue to be monitored.

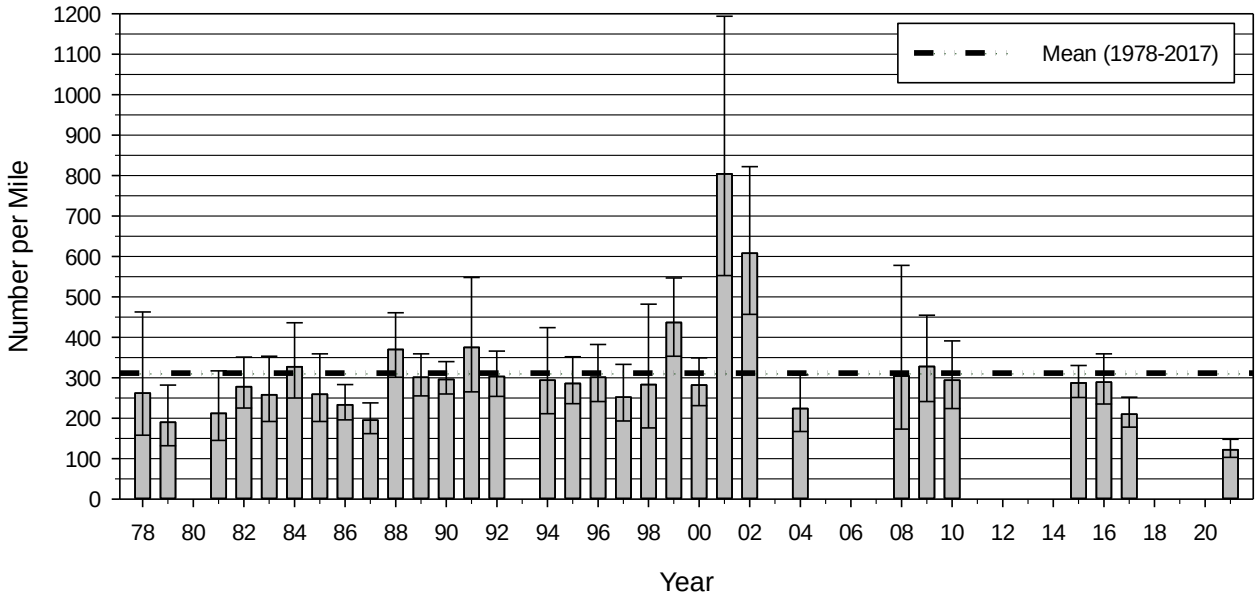

Figure 10: Corwin Springs Yellowstone Cutthroat Trout population estimates for fish 7 inches and greater from 1978 to 2021. The error bars represent the upper and lower 95% confidence intervals.

The length-frequency distribution of Yellowstone Cutthroat Trout in 2021 indicated an increase in larger fish when compared to 2018 and the long-term mean (Figure 11). This increase occurred in fish that were 14.0-inches and larger. Of note are the fish in the 17.0-, 18.0-, and 19.0-inch length groups that have not been present in the past. Almost all fish that were 13.0-inches and smaller were below the long-term mean in 2021. The largest declines in 2021 occurred in the 11.5- to 13.0- inch range.

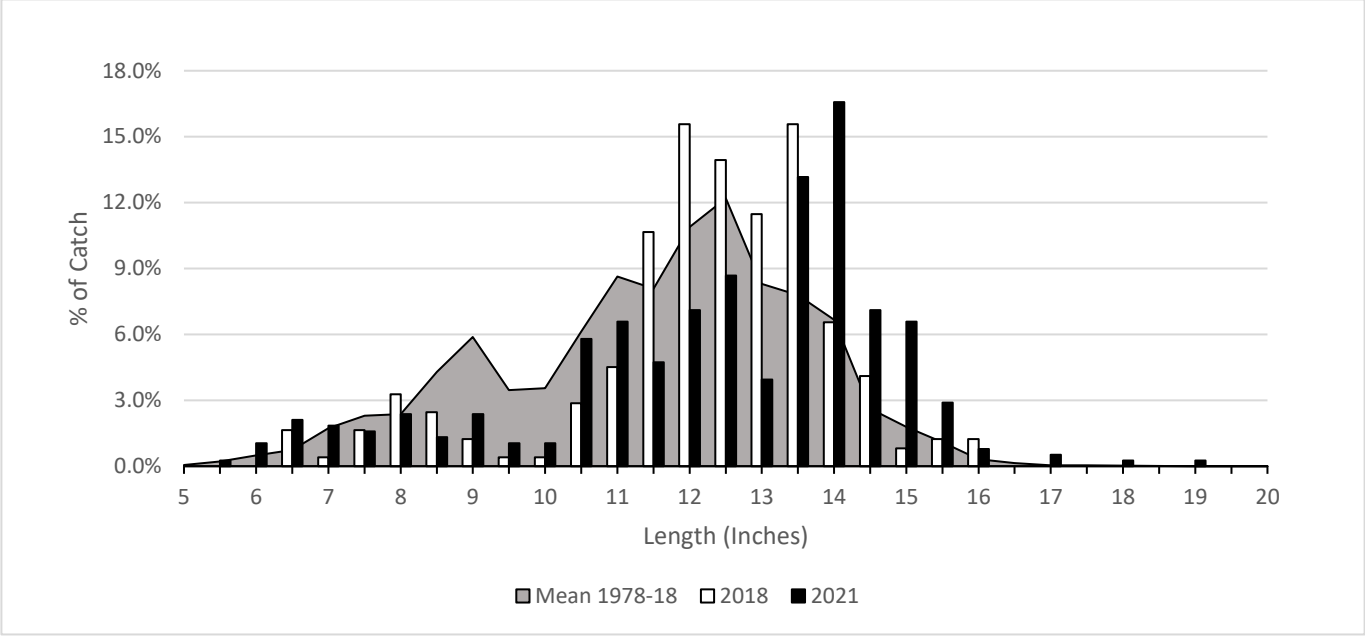

Figure 11: Length-frequency distribution for Yellowstone Cutthroat Trout in the Corwin Springs Section by half-inch group for 2018 and 2021 and the mean for 1978-2018.

The length-frequency distribution of Yellowstone Cutthroat Trout in 2021 and 2022 were very similar except for a few declines in some of the length groups larger than 10.0-inches (Figure 12). These declines occurred in fish that were 10.5- to 12.5-, 13.5- to 15.0-, and the 17.0- and 18.0-inch ranges. Fish the 8.0- to 10.0-inch range saw increases. Almost all fish that were 12.5-inches and smaller were below the long-term mean in 2022. The 2022 fish were sampled prior to the 2022 flood event.

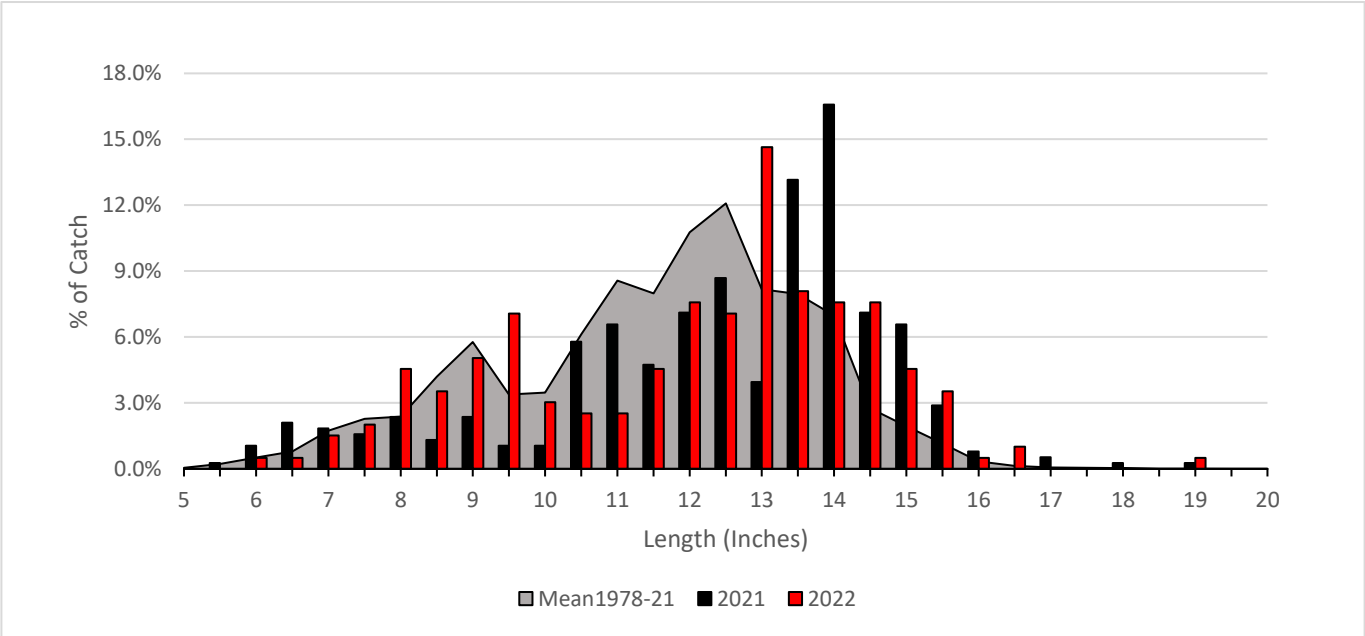

Figure 12: Length-frequency distribution for Yellowstone Cutthroat Trout in the Corwin Springs Section by half-inch group for 2021 and 2022 and the mean for 1978-2021.

The 2023 length-frequency distribution of Yellowstone Cutthroat Trout had declines in most length groups when compared to the 2022 distribution (Figure 13). Increases were noted int eh 10.0- to 12.0-inch length groups. Despite the significant flood in June 2022, the length frequency distribution for 2023 indicates that the initial impact on Yellowstone Cutthroat Trout in this section was limited. There were declines across all length groups from 2022 to 2023 except for fish in the 8.0- to 11.5- and 14.0- to 15.0-inch ranges, which had increases.

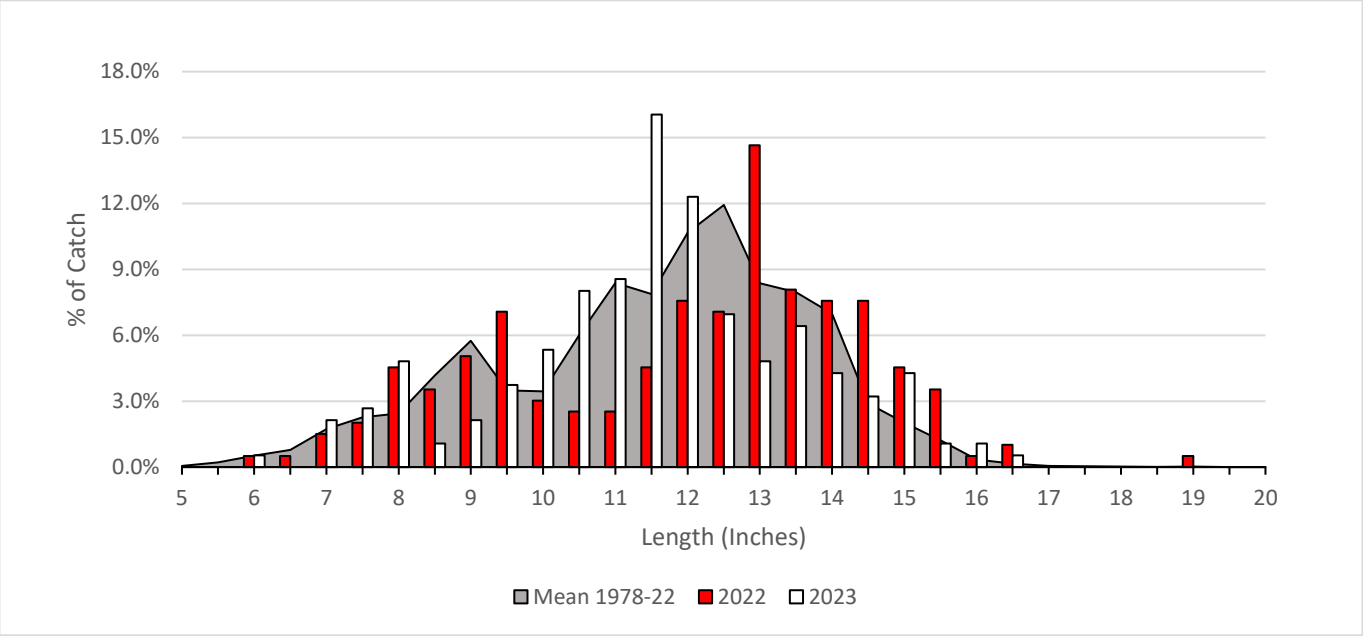

Figure 13: Length-frequency distribution for Yellowstone Cutthroat Trout in the Corwin Springs Section by half-inch group for 2021 and 2022 and the mean for 1978-2018.

Summary

Brown trout were the only species to have an increase in their abundance since 2017. Both Rainbow and Yellowstone Cutthroat Trout had continuing declines with Yellowstone Cutthroat Trout being at the lowest abundance since 1979 (Figure 14Figure 14). Proportions of Brown Trout, Rainbow Trout, and Yellowstone Cutthroat Trout in the Corwin Springs Section have continued to vary since 2015. In 2021, Brown Trout had the highest abundance, followed by Rainbow Trout and Yellowstone Cutthroat Trout. Historically, Brown Trout were highest in abundance in the 1980s and early 1990s. Starting in 1993, Rainbow Trout became the most abundant species in the section, except for 1998, 2001, 2016, and now 2021. The trend of Yellowstone Cutthroat Trout having abundance levels between Brown and Rainbow Trout had been ongoing since the early 1980s but have now fallen below the other two species.

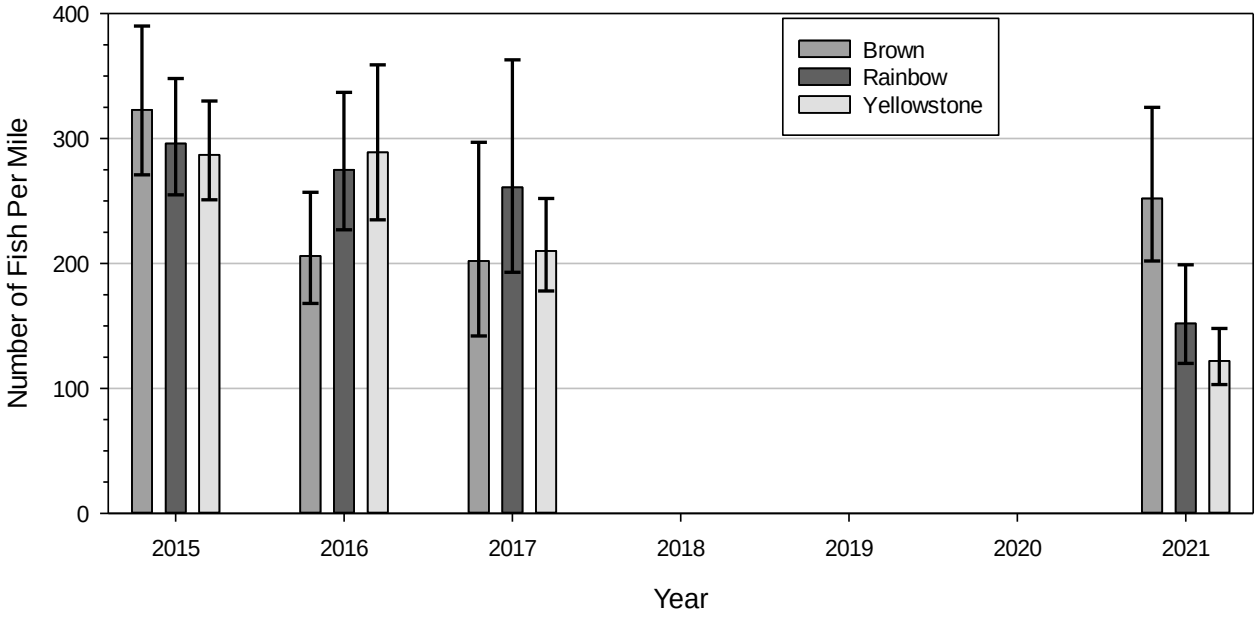

Figure 14: Abundance estimates for Brown, Rainbow, and Yellowstone Cutthroat Trout (≥ 7in) in the Corwin Springs Section of the Yellowstone River for 2015 to 2021. Error bars represent the upper and lower 95% confidence intervals. An abundance estimate was not completed in 2018 and sampling was not done in 2019 and 2020.

Similar trends in length-frequency distributions were observed when all species of trout were combined for 2021, 2022, and 2023 (Figure 15, Figure 16, and Figure 17). Yellowstone Cutthroat Trout made up most of the fish in the middle of the histogram while Brown Trout made up most of the larger length groups. Rainbow Trout made up a couple of the smaller length groups and a few of the larger ones.

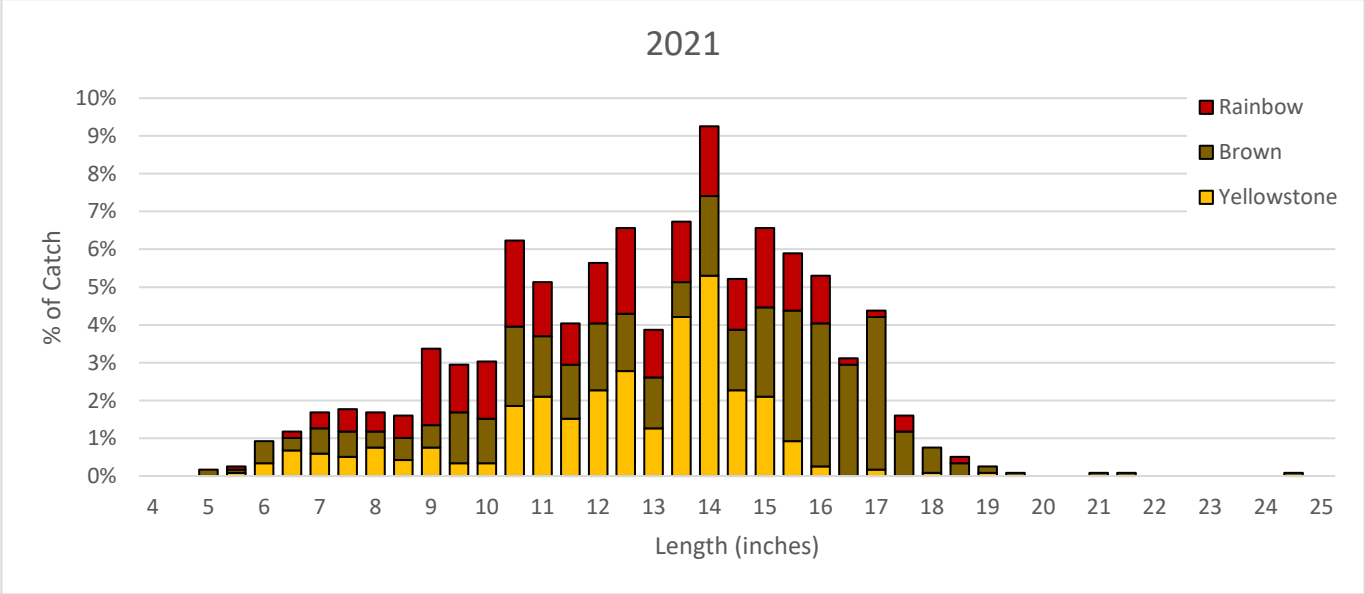

Figure 15: The combined length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Corwin Springs Section of the Yellowstone River in 2021.

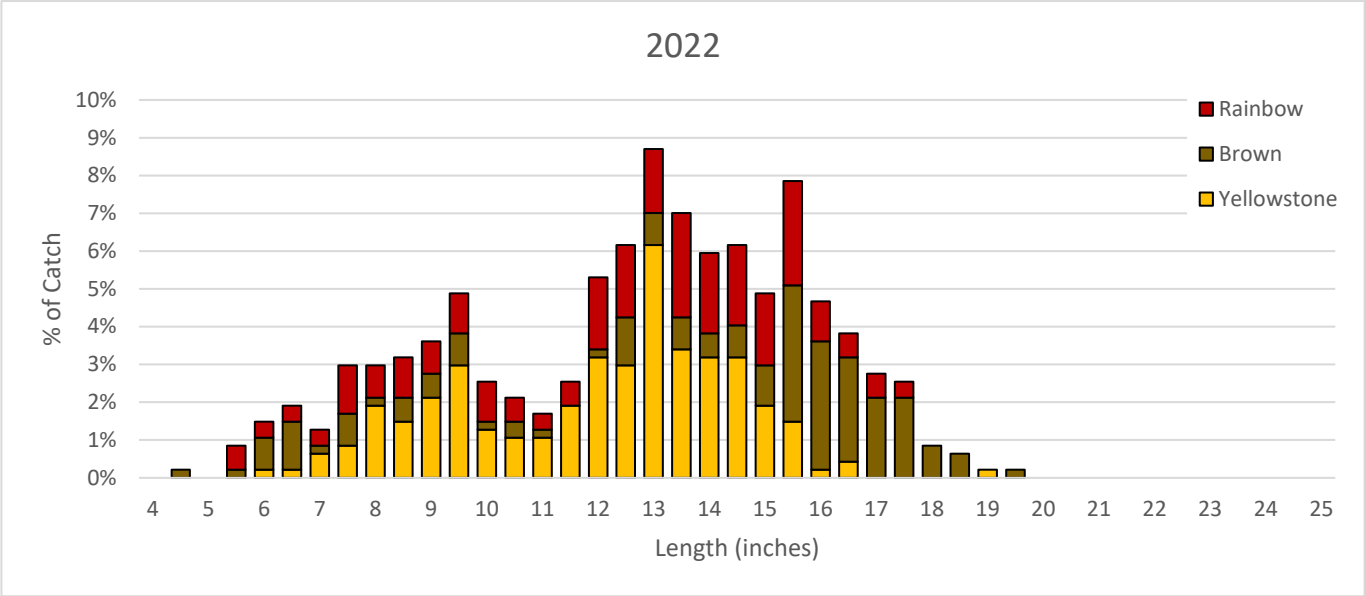

Figure 16: The combined length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Corwin Springs Section of the Yellowstone River in 2022.

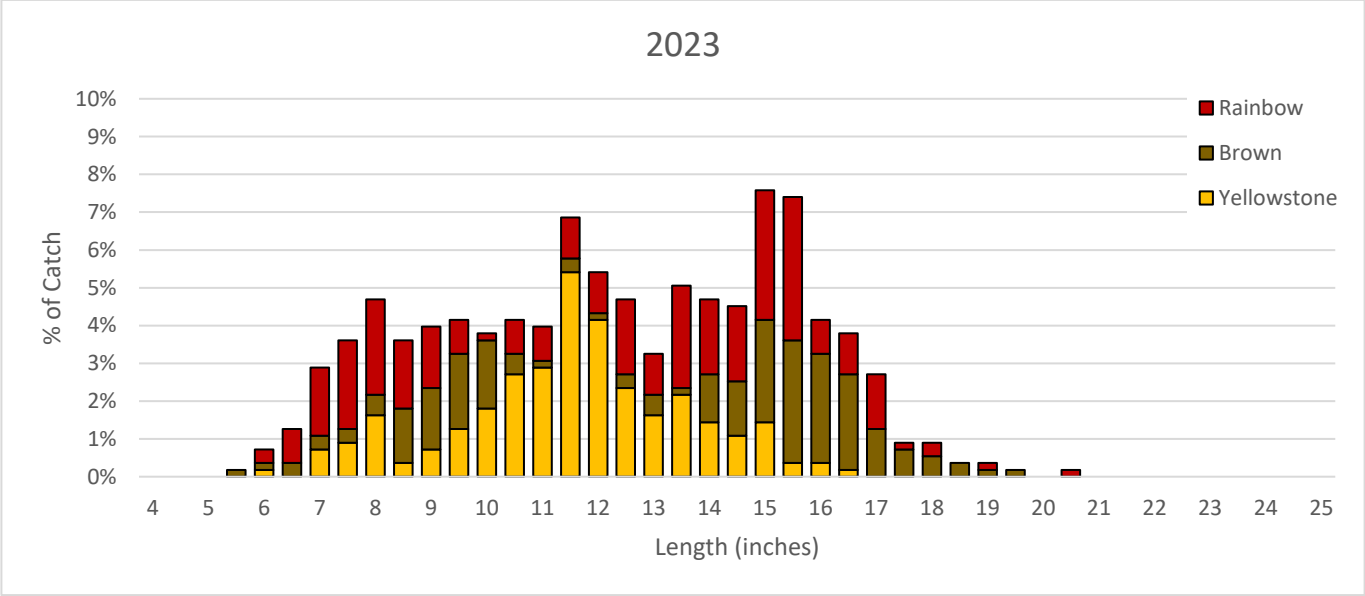

Figure 17: The combined length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Corwin Springs Section of the Yellowstone River in 2023.

In the Corwin Springs Section, population data collected in 2021 indicate that there were declines in abundance of Rainbow Trout and Yellowstone Cutthroat Trout, with an observed record low abundance of Yellowstone Cutthroat Trout. Population abundance for Brown Trout increased in 2021, ending a multi-year decline. There appears to be limited impact on trout populations in the Corwin Springs Section from the June 2022 record flooding event, based on length-frequency data.

Mill Creek Bridge Section

The Mill Creek Bridge Section is a long-term monitoring section that has been sampled since 1981 (Figure 1). In 2021 and 2023, the section was sampled using the mark-recapture method to produce population abundance estimates for trout. In 2021, 2022, and 2023, PIT tagging efforts were completed in this section to transition from mark- recapture population estimates to an open model of calculating population abundance. This transition is being driven by the inability to complete mark-recapture efforts because of changing spring flow regimes in the river. From 2021-2023, length-frequency data were collected for all three trout species.

In 2021, the Mill Creek Bridge Section was marked on May 4 and the recapture effort was completed on May 10. In 2023, the marking run was completed on May 2 and 3 and the recapture run was completed on May 9. The section was split into four subsections and sampled with two boats, one on each bank. Trout were sampled in all four subsections and were marked with an anal fin clip. The recapture run during both years was completed with two boats in the same method as the marking run.

Population estimates, by species, for the Mill Creek Bridge Section for 2021 and 2023 are presented below (Table 3).

Table 3: Population estimate results for the Mill Creek Bridge Section of the Yellowstone River by species in 2021 and 2023. N/mile represents the estimated number of Rainbow, Brown, and Yellowstone Cutthroat (≥7 inches) per mile. Upper and lower 95 % confidence intervals are also provided.

Year	Fish Species	N/mile	Lower 95%	Upper 95%
2021	Rainbow Trout	309	275	349
	Brown Trout	243	205	291
	Yellowstone Cutthroat Trout	51	38	70
2023	Rainbow Trout	228	194	273
	Brown Trout	167	140	206
	Yellowstone Cutthroat Trout	26	18	46

Rainbow Trout

The 2021 Rainbow Trout population estimate was 309 fish/mile (≥ 7in) (Figure 18). In 2023, the estimate decreased to 228 fish/mile (≥ 7in). The 2021 estimate was higher than the 2 prior years yet remained below the 2018 estimate of 358 fish/mile (≥ 7in) It was just above the and the long-term mean of 304 fish/mile (≥ 7in). The 2023 estimate was the lowest since 1999. Both current abundance estimates are higher than many of the those from the 1980s and 1990s while remaining lower than those from 2001-2016.

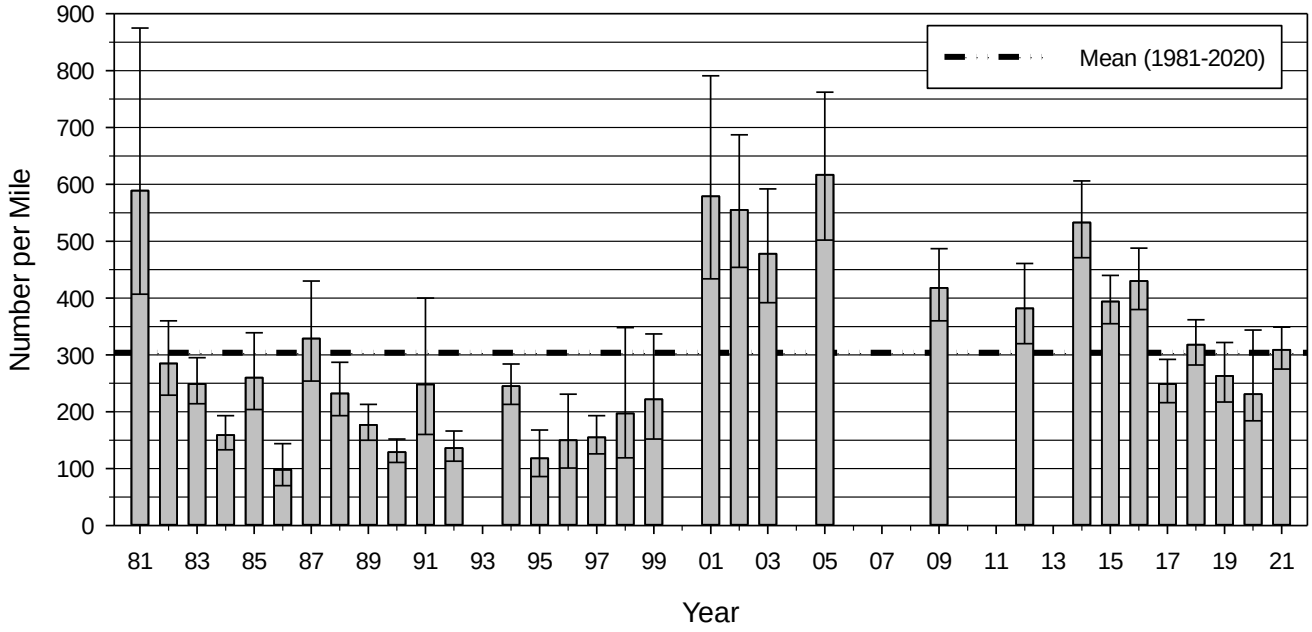

Figure 18: Mill Creek Bridge Rainbow Trout population estimates for fish 7 inches and greater from 1981 to 2023. The error bars represent the upper and lower 95% confidence intervals. Estimates were not completed in 1993, 2000, 2004, 2006-2008, 2010, 2011, 2013, and 2022.

Length-frequency distribution of Rainbow Trout in the Mill Creek Bridge Section in 2021 was almost completely opposite of the 2020 distribution (Figure 19). There was an obvious decline of the percentage of fish in the 12.0- to 17.0-inch. The increase in the percentages of fish in the 7.0- to 11.0- inch length groups indicate strong recruitment and survival of these younger fish.

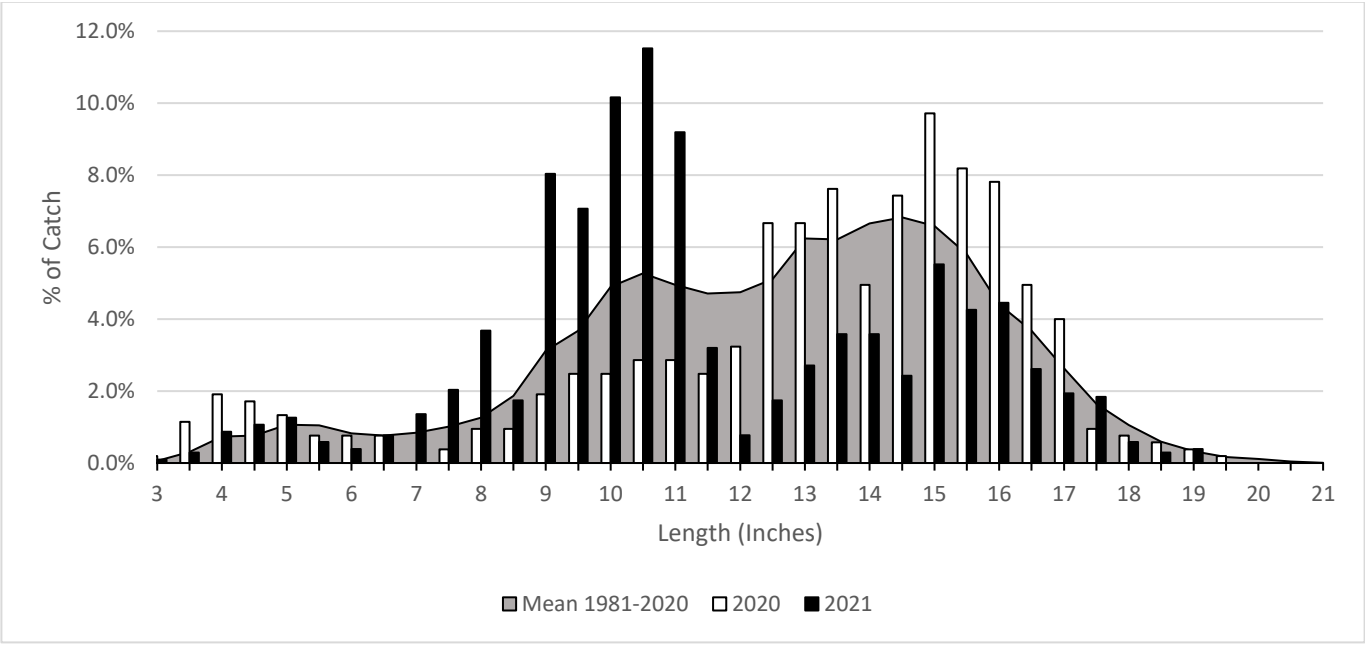

Figure 19: Length frequency distribution for Rainbow Trout in the Mill Creek Bridge Section for 2020 and 2021 by half-inch group.

The 2022 length-frequency distribution continued to show declines in the 13.5- to 17.0-inch groups and increases in the 5.0- to 10.0-inch length groups when compared to 2021 (Figure 20). This trend continued to indicate good recruitment and survival of younger fish while larger, older fish continued to have reduced recruitment and survival. Most of the larger fish were well below the long-term averages as well. It should be noted that the 2022 sampling took place prior to the large flood event in June of that year.

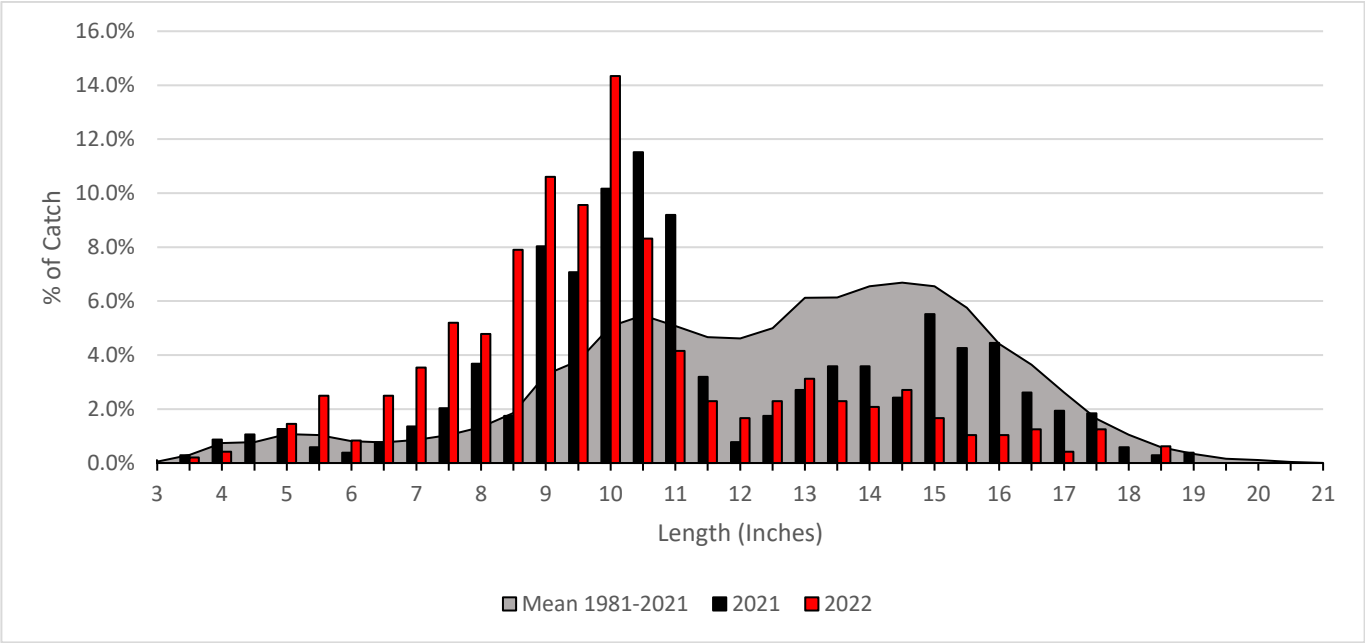

Figure 20: Length frequency distribution for Rainbow Trout in the Mill Creek Bridge Section for 2020 and 2021 by half-inch group.

In 2023, length-frequency distribution increased in the 11.5-inches and larger length groups with fish in the 11.5- to 14.0-inch groups exceeding the long-term average (Figure 21). Fish in the 5.0- to 11.0-inch groups decreased when compared to 2022. Fish in the 5.0- to 9.5-inch range did remain above the long-term average even with the decreases. It should be noted that the 2022 sampling took place prior to the larger flood event in June of that year.

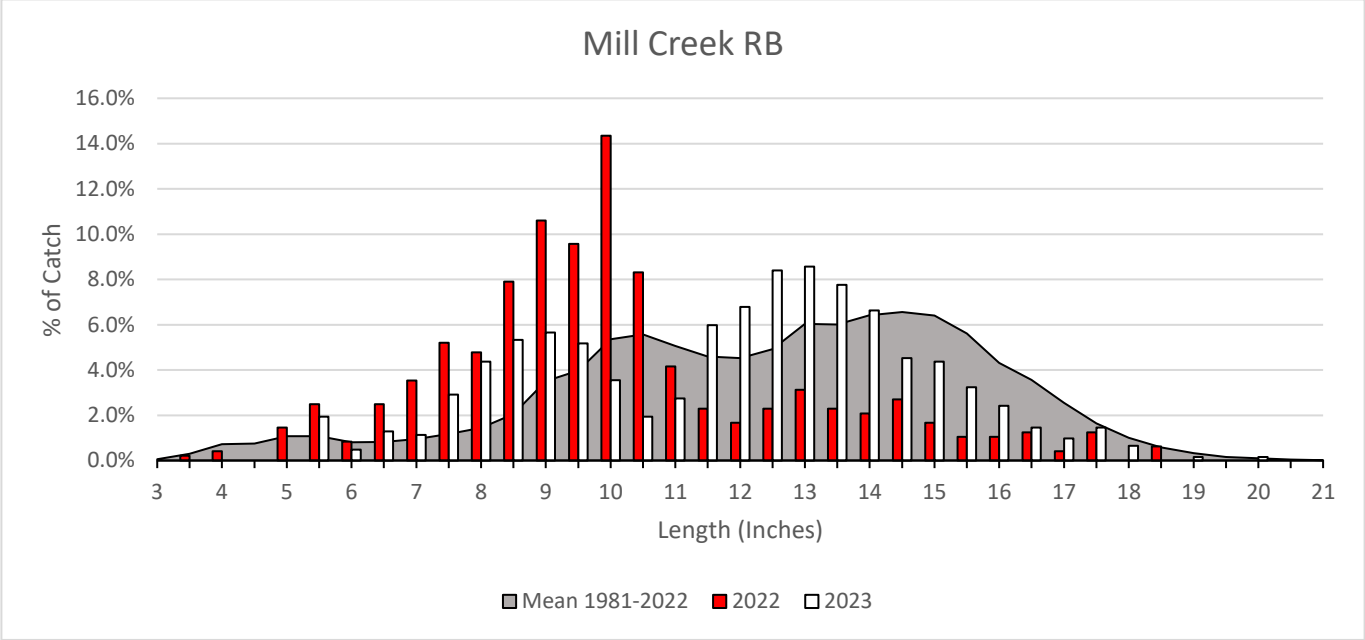

Figure 21: Length frequency distribution for Rainbow Trout in the Mill Creek Bridge Section for 2020 and 2021 by half-inch group.

Brown Trout

The Mill Creek Bridge Section Brown Trout population estimate for 2021 declined to 243 fish/mile (≥ 7in) from 263 fish/mile (≥ 7in) in 2020 (Figure 22). In 2023, the estimate continued to decline to 167 fish/mile (≥ 7in). Recent estimates continue to remain below the long-term mean of 352 fish/mile (≥ 7in) and lower than estimates from the 1980s and early 1990s. A population estimate was not completed in 2022.

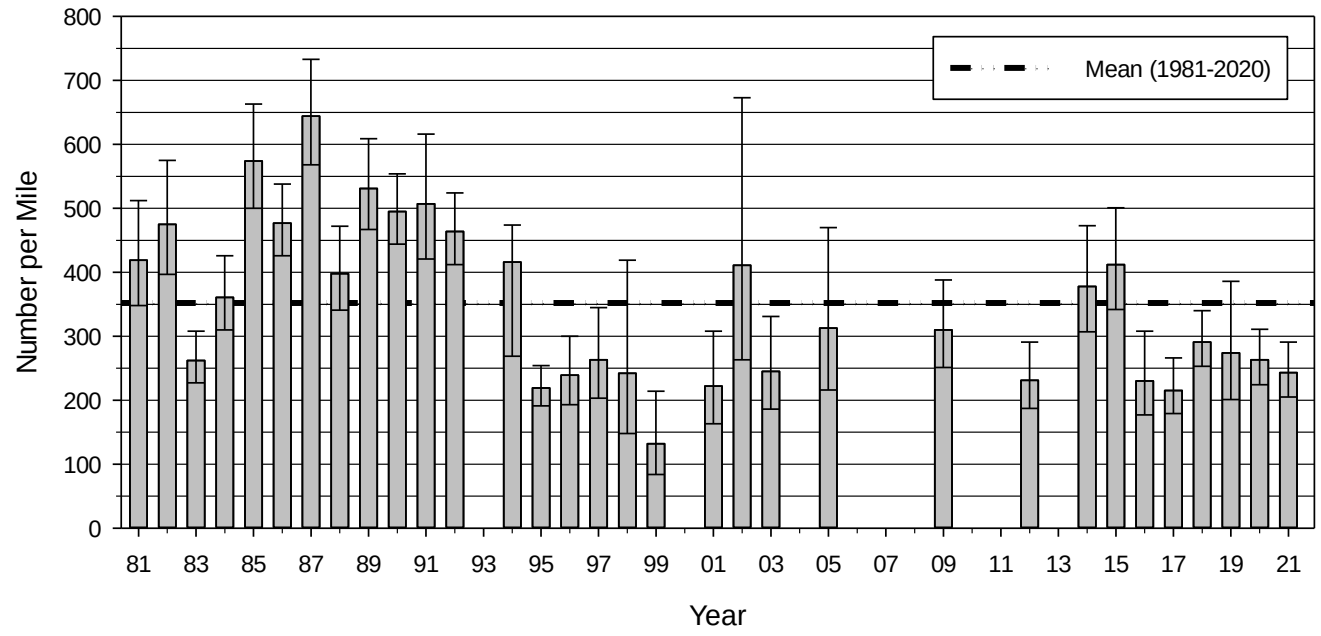

Figure 22: Mill Creek Bridge Brown Trout population estimates for fish 7 inches and greater from 1981 to 2023. The error bars represent the upper and lower 95% confidence intervals. Estimates were not completed in 1993, 2000, 2004, 2006-2008, 2010, 2011, 2013, and 2022.

In the Mill Creek Bridge Section in 2021, the length-frequency distribution showed a decline in the percentages of larger Brown Trout and an increase in smaller fish when compared to 2020 (Figure 23). The declines were in the 13.5- to 18.0-inch range and the increases were in the 4.5- to 13.0-inch range. Brown Trout in the 11.0- to 12.5- and 16.0- to 21.0-inch range with a couple of exceptions were above the long-term mean.

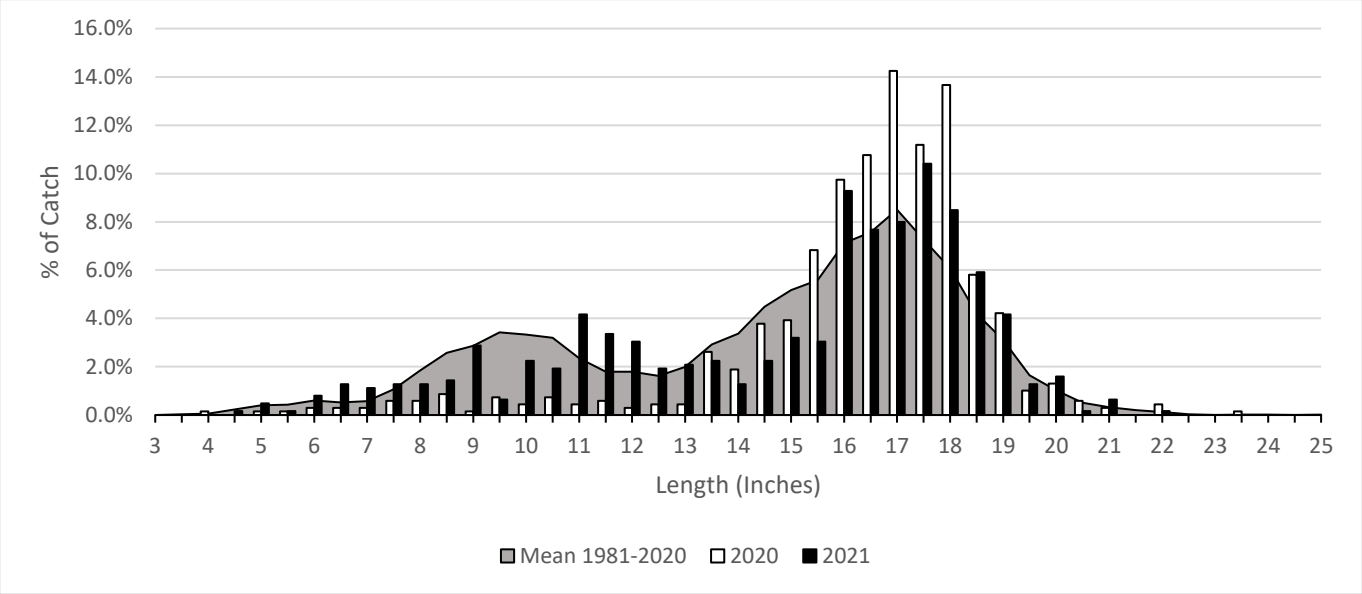

Figure 23: Length-frequency distribution for Brown Trout in the Mill Creek Bridge Section for 2020 and 2021 by half-inch group.

The length-frequency distribution for Brown Trout in 2022 continued to decline for fish in the 13.5- to 18.0-inch range (Figure 24). Fish in the 4.5- to 7.5-, 9.5- to 11.0-, and 18.5- to 20.5-inch ranges increased, with many being above the long-term mean. It should be noted that the 2022 sampling effort occurred prior to the large flood event that year.

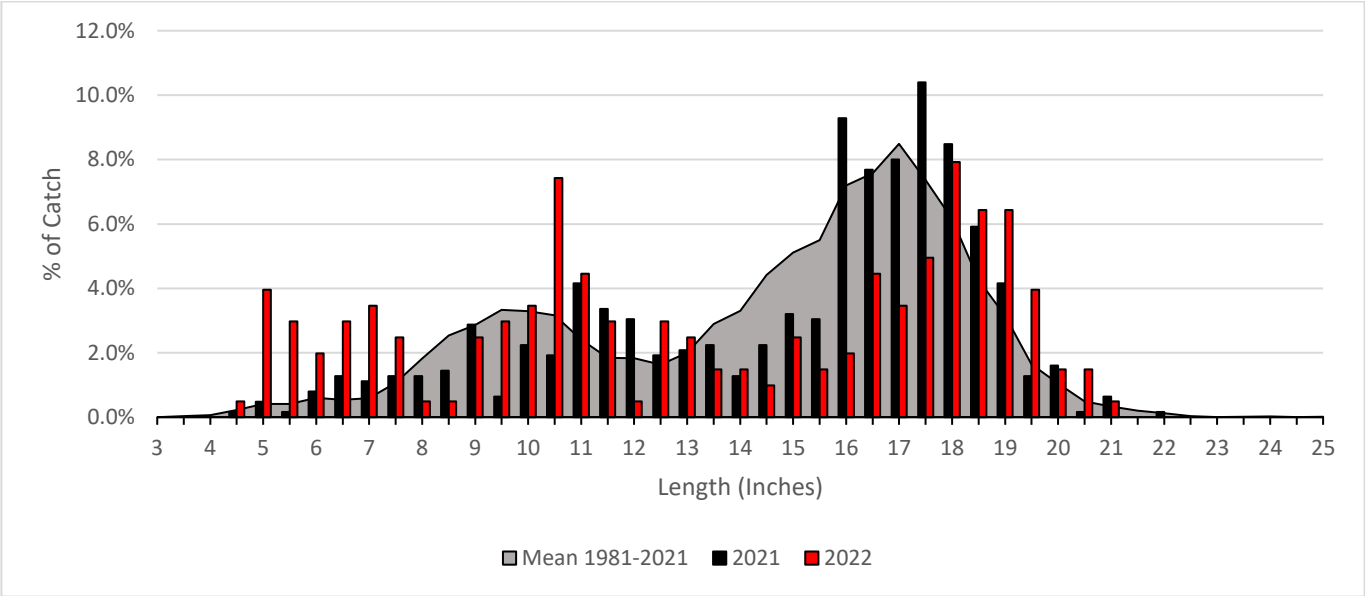

Figure 24: Length-frequency distribution for Brown Trout in the Mill Creek Bridge Section for 2021 and 2022 by half-inch group.

In the Mill Creek Bridge Section for 2023, the length-frequency distribution showed a decrease in almost all length groups except for Brown Trout in the 13.5- to 17.5-inch range, which had large increases (Figure 25). Most length groups in the 14.0-inch and under range were below the long-term mean. Brown Trout in the 21.5- to 25.0-inch range were captured in 2023. Again, it should be noted that the 2022 sampling was completed prior to the large flood event that year.

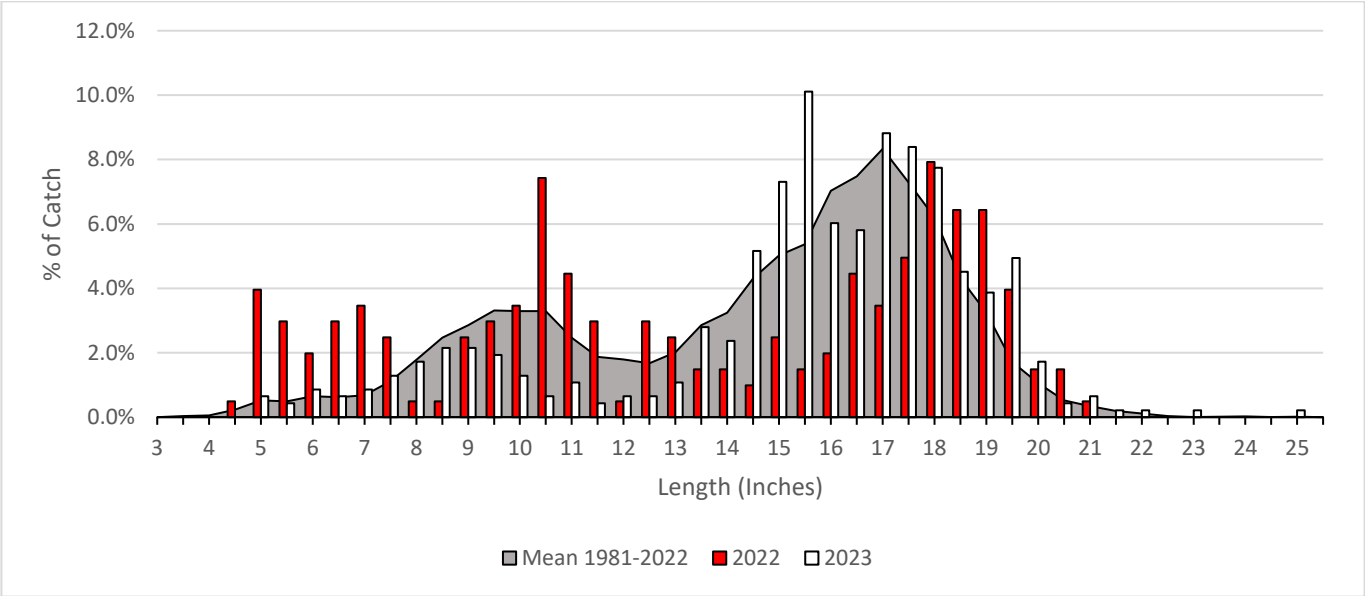

Figure 25: Length-frequency distribution for Brown Trout in the Mill Creek Bridge Section for 2022 and 2023 by half-inch group.

Yellowstone Cutthroat Trout

The abundance estimate for Yellowstone Cutthroat Trout in the Mill Creek Bridge Section in 2021 decreased to 51 fish/mile (≥ 7in) from the 74 fish/mile (≥ 7in) in 2020 (Figure 26). In 2023, the abundance estimate continued to decease to a record low of 26 fish/mile (≥ 7in). The prior record low was 28 fish/mile (≥ 7in) in 2009. The abundance estimates for both 2021 and 2023 were well below the 131 fish/mile (≥ 7in) long-term mean. This continued decline and new record low are concerning. The 2022 flood event may have influenced the record low population estimate in 2023. Continued monitoring should provide further insight.

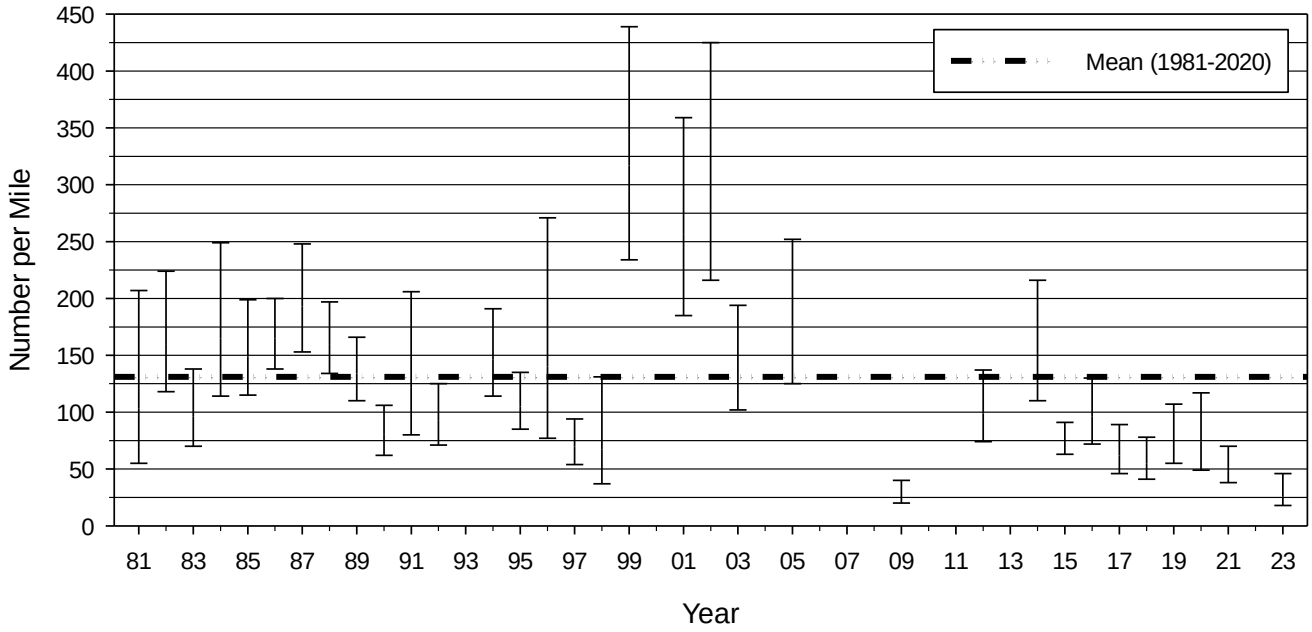

Figure 26: Mill Creek Bridge Yellowstone Cutthroat Trout population estimates for fish 7 inches and greater from 1981 to 2023. The error bars represent the upper and lower 95% confidence intervals. Estimates were not completed in 1993, 2000, 2004, 2006-2008, 2010, 2011, and 2013.

The length-frequency distribution of Yellowstone Cutthroat Trout in the Mill Creek Bridge Section in 2021 showed a variety of increases and decreases across all length groups when compared to 2020 (Figure 27). The most noticeable changes were increases in fish smaller than 8.0 inches and greater than 16.0 inches and decreases in fish in the 11.5- to 12.5- inch groups.

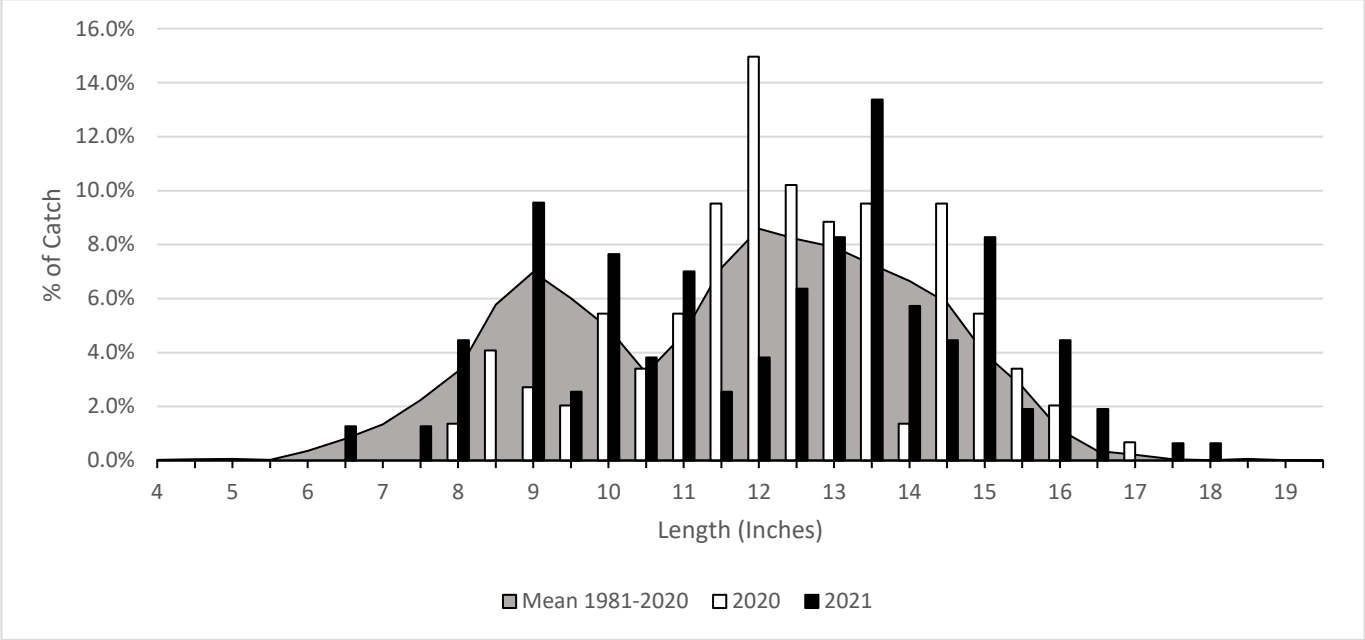

Figure 27: Length-frequency distribution for Yellowstone Cutthroat Trout in the Mill Creek Bridge Section in 2020 and 2021 by half-inch group.

In 2022, the length-frequency distribution of Yellowstone Cutthroat Trout indicated a shift to smaller length groups with most length groups larger than 9.5 inches having declines when compared to 2021(Figure 28). Most length groups larger than 9.5 inches were also below the long-term average, except for fish in the 17.0- and 18.0-inch groups. The large increase in smaller fish suggests good recruitment and survival. The low percentages of larger fish are concerning. It should be noted that the 2022 sampling took place prior to the large flood event that year.

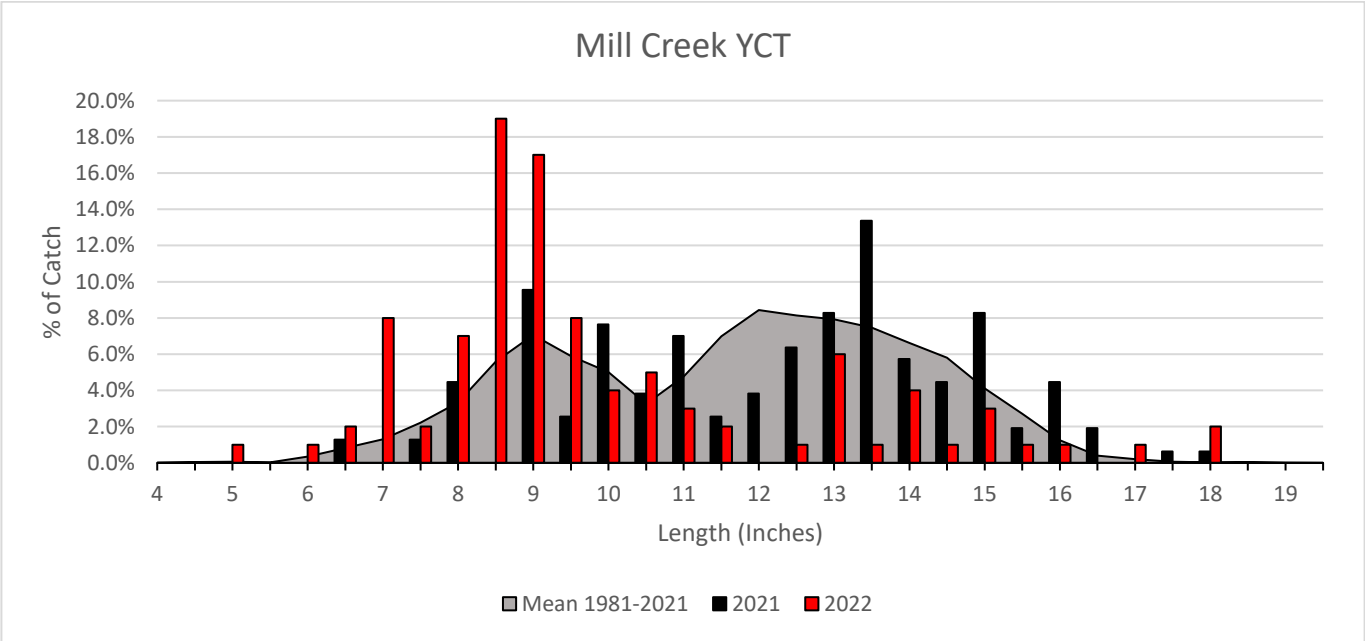

Figure 28: Length-frequency distribution for Yellowstone Cutthroat Trout in the Mill Creek Bridge Section in 2021 and 2022 by half-inch group.

The length-frequency distribution of Yellowstone Cutthroat Trout in the Mill Creek Bridge Section in 2023 indicates an almost complete switch from being dominated by smaller fish in 2022 to most fish being 13.5 inches and larger (Figure 29). Of concern, is the complete absence of fish in many smaller length groups with only four length groups smaller than 13.5 inches containing fish. These drastic changes may be due in part to the large flood event that occurred in 2022 after sampling had been completed. Continued sampling is planned to monitor this concerning change.

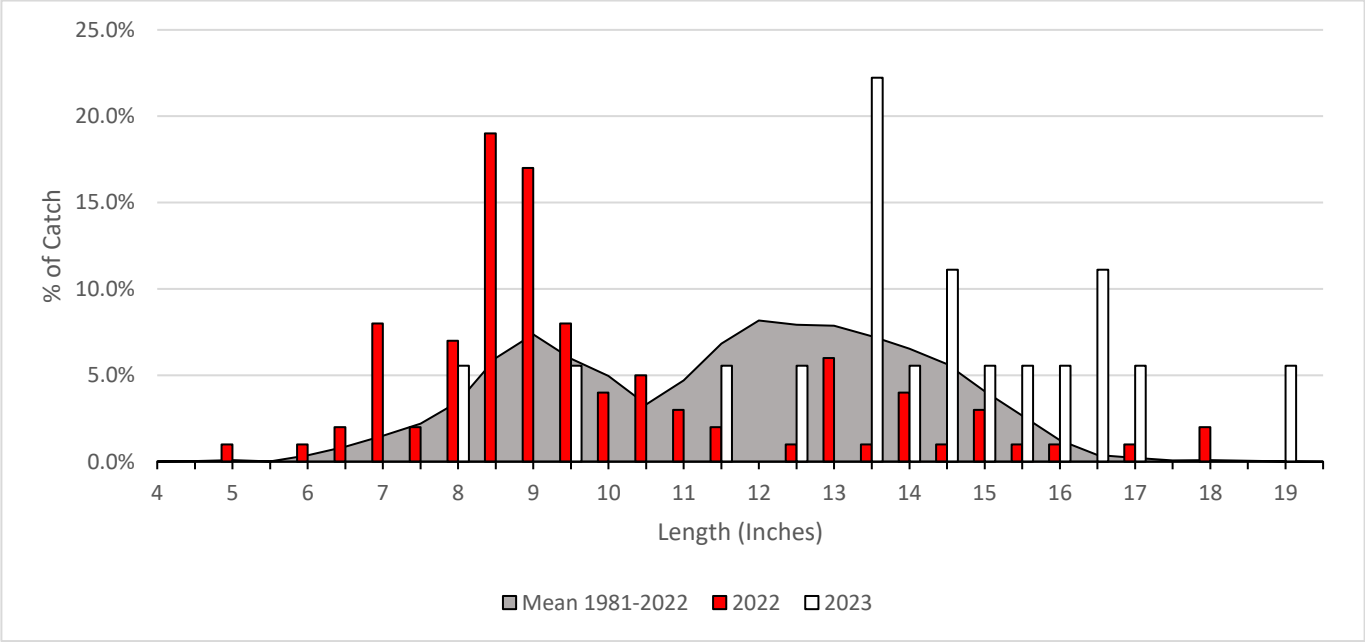

Figure 29: Length-frequency distribution for Yellowstone Cutthroat Trout in the Mill Creek Bridge Section in 2022 and 2023 by half-inch group.

Mill Creek Bridge Section Overall Trout Population

Both Brown Trout and Yellowstone Cutthroat Trout are continuing to experience declining trends with Yellowstone Cutthroat Trout reaching a record low abundance (Figure 30). Rainbow Trout population abundances continue to fluctuate. The trend of abundance estimates for Brown and Rainbow Trout being significantly higher than Yellowstone Cutthroat Trout in the Mill Creek Section continued in 2021 and 2023. In 2023, Rainbow Trout had the highest abundance of the three species and Brown Trout were the second highest. Brown Trout historically were the most abundant species in the 1980s and 1990s. Starting in 2000, Rainbow Trout began to be the most abundant species in the section except for 2015, 2019, and 2020. The trend of Yellowstone Cutthroat Trout having the lowest abundance has been ongoing since the early 1980s and is likely the result of multiple factors including dewatering of spawning tributaries, limited fry production and recruitment, and competition with Rainbow and Brown Trout. Historically angler harvest may have contributed to the lower abundance of Yellowstone Cutthroat Trout as well.

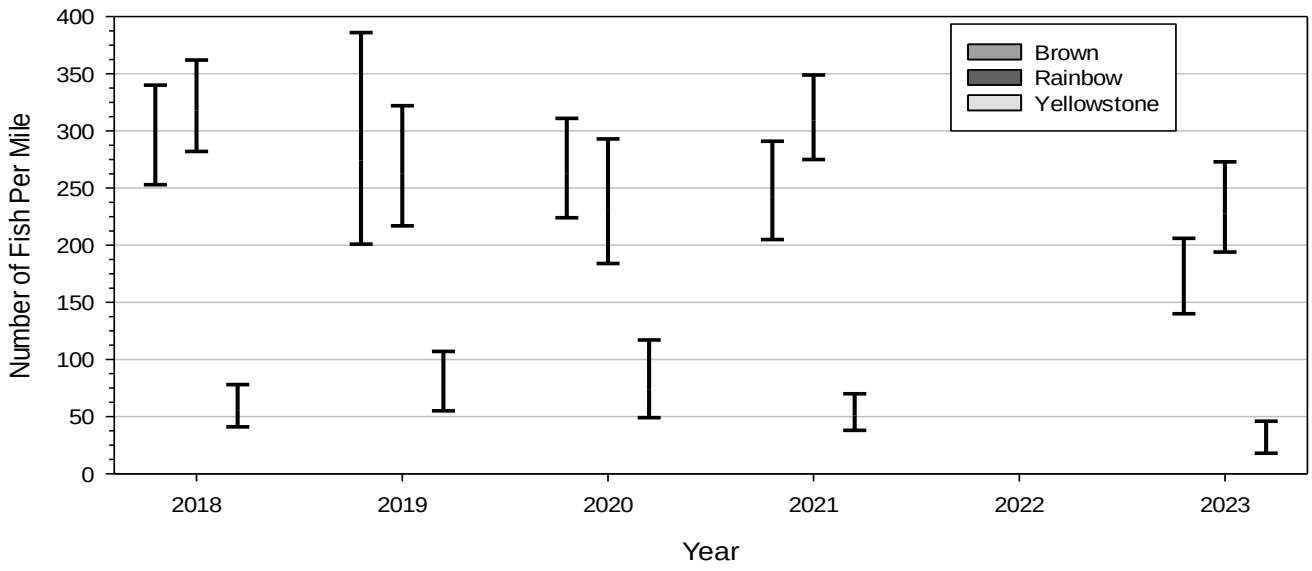

Figure 30: Abundance estimates for Brown, Rainbow, and Yellowstone Cutthroat Trout (≥ 7in) in the Mill Creek Bridge Section of the Yellowstone River for 2018 to 2023. Error bars represent the upper and lower 95% confidence intervals.

The 2021 length-frequency distribution for the combined trout species in the Mill Creek Bridge Section had two distinct peaks. One around fish in the 10.5-inch length group and the other around fish in the 16.0-inch length groups (Figure 31). Rainbow Trout made up most of the fish in the 3.5 to 15.5-inch length range. Brown Trout made up most of the fish in the 16.0- to 19.0-inch length range and were the only species in the 19.5 to 22.0-inch range.

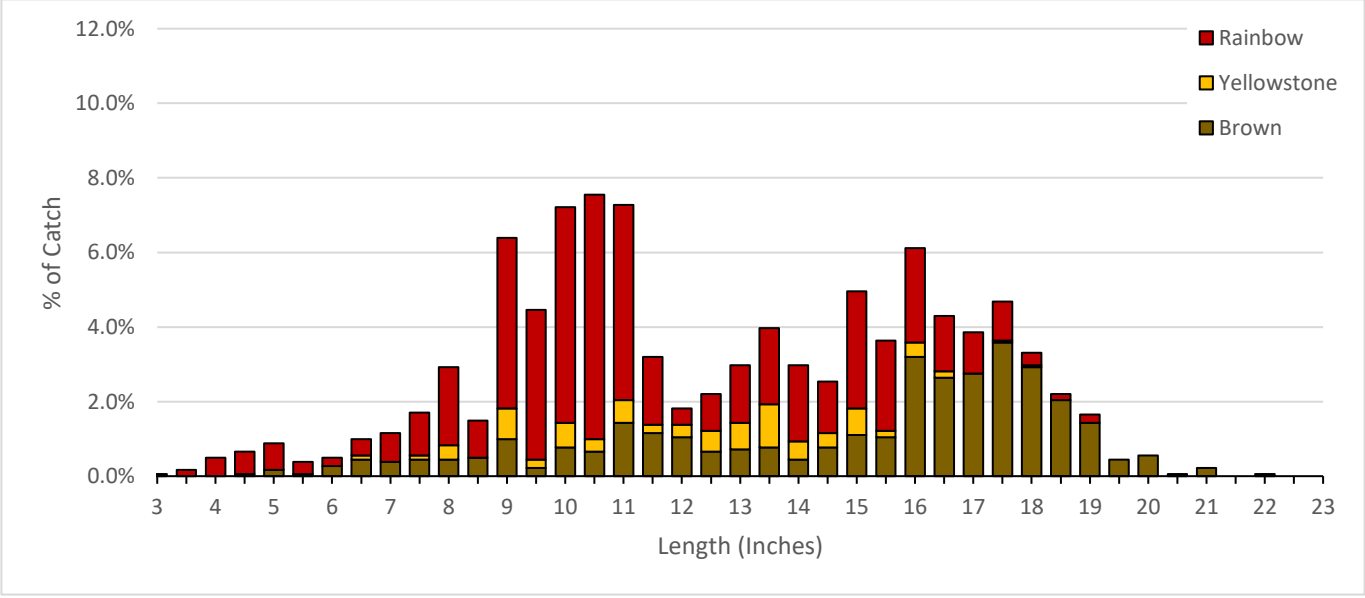

Figure 31: The length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Mill Creek Bridge Section of the Yellowstone River in 2021.

For 2022, the length-frequency distribution for the combined trout species only had one distinct peak. The peak was centered around fish in the 10.0-inch length group (Figure 32). Rainbow Trout made up most of the fish in the 3.5 to 16.0-inch length range. Brown Trout made up most of the fish in the 16.5- to 18.5-inch length range and were the only species in the 19.0- to 21.0-inch range.

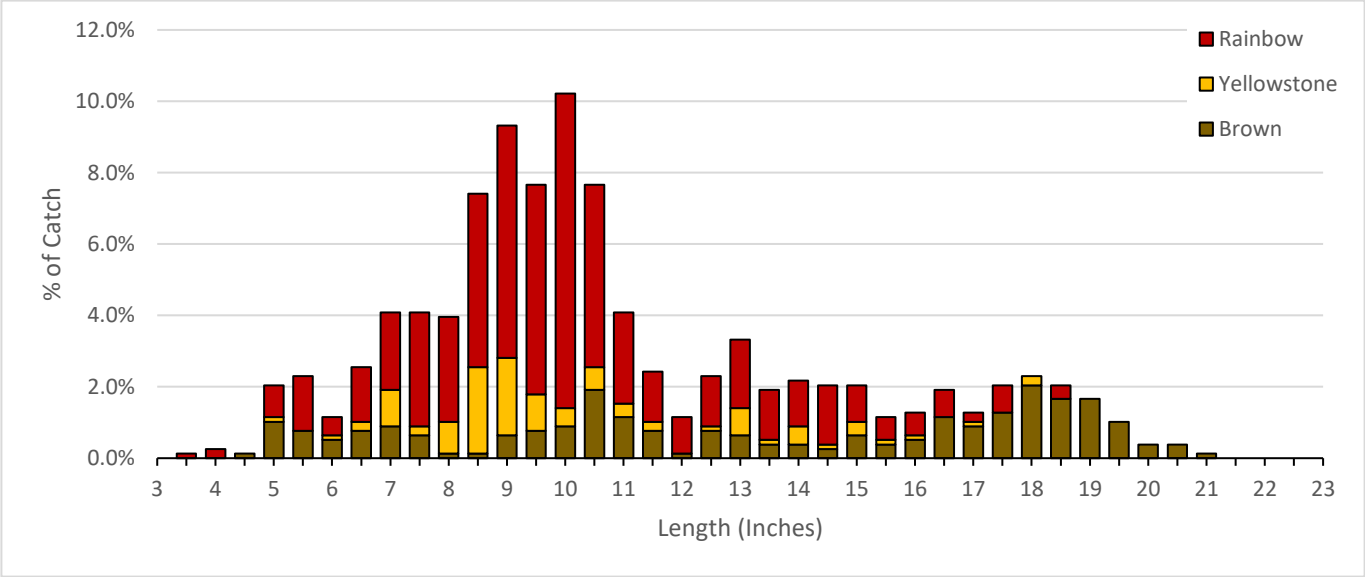

Figure 32: The length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Mill Creek Bridge Section of the Yellowstone River in 2022.

In 2023, the length-frequency distribution for the combined trout species in the Mill Creek Bridge Section had multiple peaks (Figure 33). Despite the increases, most length groups remained lower than the percentages in 2021. Rainbow Trout made up most of the fish in the 5.5- to 14.5-inch length range. Brown Trout made up most of the fish in the 15.0 to 18.0-inch length range and were the only species in the 5.0- inch and 19.0- to 25.0-inch range.

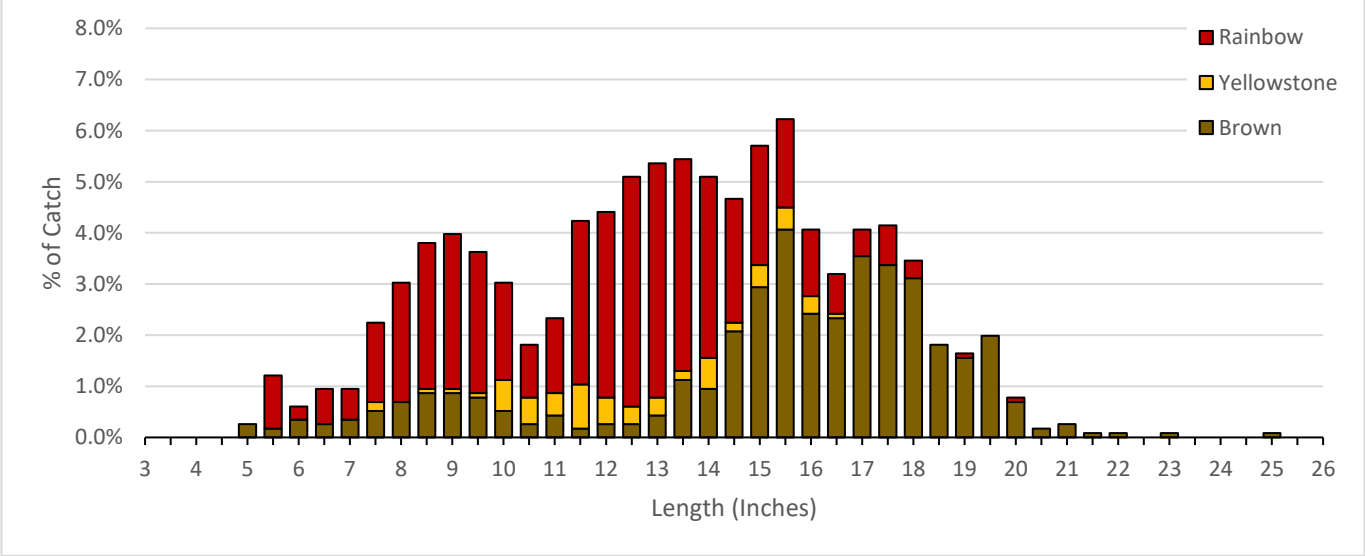

Figure 33: The length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Mill Creek Bridge Section of the Yellowstone River in 2023.

PIT Tagging

Since the early 1980s monitoring the abundance of trout has been completed using the same methods, and on the same dates in the spring. However, because of the change in the timing and duration of spring snow melt run off, it has become increasingly difficult in the last 20 years to consistently get accurate estimates. In some years estimates were unable to be completed. Work with the Montana State University is being done to evaluate a new technique that uses individually tagged fish to provide accurate estimates of abundance.

Traditionally the mark-recapture method was used to generate an abundance estimate. This method of monitoring can take about two weeks for each section. On the upper Yellowstone enough flow is needed to safely operate our jet boat and effectively capture fish, but too much flow reduces capture efficiency and can be unsafe for crews.

Historically spring low-land runoff started earlier and lasted longer. This allowed enough time with ideal sampling conditions to complete mark-recapture monitoring. Currently spring low-land runoff starts around 2 weeks later, flows are increasing faster, and peak flows are occurring sooner. These changes have reduced the window of time to complete monitoring. With shorter time frames to complete this work it is becoming increasingly difficult to conduct this form of monitoring. These new flow regimes are expected to continue, and it was decided to explore other ways to estimate fish abundance.

Beginning in 2021, trout in the Corwin Springs and Mill Creek Bridge Sections were tagged with 8mm, individually identifiable permanent electronic tags (PIT tag) which can be identified with a scanner. The tags were placed in the dorsal sinus using preloaded needles and injectors or a manually loaded syringe method. Length and weight data were collected for each fish and the adipose fin was clipped so tag retention could be studied. In 2021, genetic fin clips were also collected from all Yellowstone Cutthroat Trout. The use of these tags allows tracking of the individual history of each fish and the use of different statistical methods that are not tied to discrete dates to estimate the abundance of trout.

In 2021, 1,969 trout were tagged. In 2022, 1,063 trout were tagged, and 192 previously tagged trout were recaptured (

Table 4). In 2023, 1,372 trout were tagged, and 470 previously tagged trout were recaptured. In total, 4,404 trout have been tagged from 2021 to 2023 and 663 trout were recaptured. Rainbow Trout comprised 46% of tagged fish, followed by Brown Trout (33%), Yellowstone Cutthroat Trout (17%), and Hybrid Trout (<1%). One Brook Trout was tagged in 2021 from the Corwin Springs Section.

Table 4: Number of PIT tags implanted in trout in the Corwin Springs and Mill Creek Bridge Sections by date and species for 2021-2023.

Section		Species					
2021		**LL**	**RB**	**YCT**	**Hyb**	**EB**	**Total**
Corwin Springs	5/5/2021	301	207	38	209	0	**755**
Mill Creek Bridge	5/4/2021	336	458	25	71	0	**890**
	5/10/2021	106	185	4	28	0	**323**
	Total	**743**	**850**	**67**	**308**	**0**	**1,968**
2022		**LL**	**RB**	**YCT**	**Hyb**	**EB**	**Total**
Corwin Springs	4/27/2022	51	65	6	84	0	**206**
	4/28/2022	57	59	8	84	0	**208**
Mill Creek Bridge	5/4/2022	95	225	9	44	0	**373**
	5/5/2022	51	180	6	39	0	**276**
	Total	**254**	**529**	**29**	**251**	**0**	**1,063**
2023		**LL**	**RB**	**YCT**	**Hyb**	**EB**	**Total**
Corwin Springs	4/26/2023	81	119	16	115	1	**332**
	4/27/2023	50	62	10	40	0	**162**
Mill Creek Bridge	5/2/2023	154	170	4	26	0	**354**
	5/3/2023	106	139	10	21	0	**276**
	5/9/2023	78	159	3	9	0	**249**
	Total	**469**	**649**	**43**	**211**	**1**	**1373**
	Grand Total	**1,466**	**2,028**	**139**	**770**	**1**	**4,404**

Mallard's Rest Section

MWF mark-recapture population estimates in the Yellowstone River are difficult and often produce unreliable estimates. To look at population trends for MWF, CPUE efforts were started in 2017 in the Mallard's Rest Section (

Figure 1). The recent CPUEs were then compared to the CPUE of the marking effort in mark-recapture efforts prior to 2017 in the section. The 2021 and 2022 CPUEs continue to remain much lower than the 1980s and 1990s long-term mean of 897 fish/mile, indicating notable change in abundance of MWF (Figure 34). The 18-year time span between sampling makes it difficult to determine if MWF have been declining over time or more recently because of the 2016 PKD fish kill, other biotic or environmental factors, or a combination of factors. The CPUEs for 2021 and 2022 continued to decline from the recent high of 452 fish/mile in 2019 and remain below the recent average of 436 fish/mile.

Sampling of MWF in the Mallard's Rest Section was not competed in 2023. The fishing access site that is used to gain access to this portion of the river was closed due to road damage caused by the 2022 flood event.

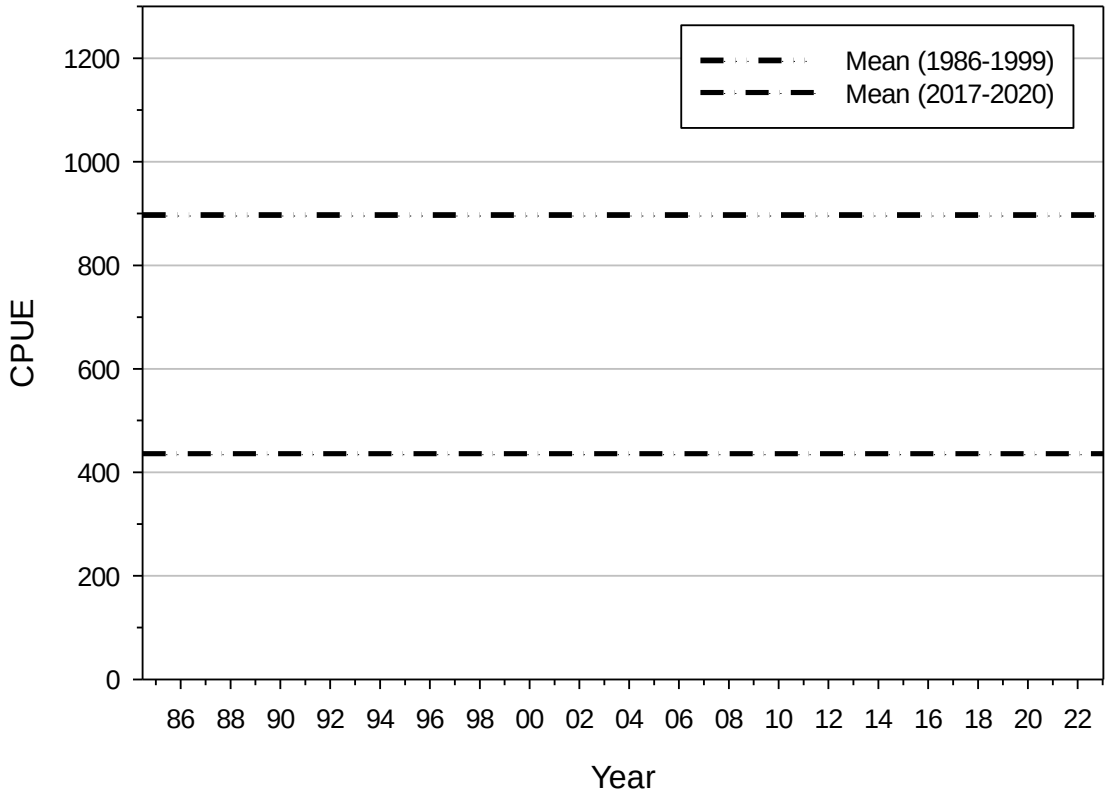

Figure 34: Mountain Whitefish CPUE in the Mallard's Rest Section from 1986 to 2022. The CPUE value is Mountain Whitefish (≥ 7in) per mile. Sampling efforts were not completed during the years with no bars.

The Mallard's Rest Section length-frequency distribution of MWF in 2021 was similar to 2020 except for fish in the 8.0- to 9.5- and 12.0- to 12.5-inch ranges which saw obvious declines (Figure 35). All the MWF in the 13.0- to 18.0-inch range were at or above the long-term mean.

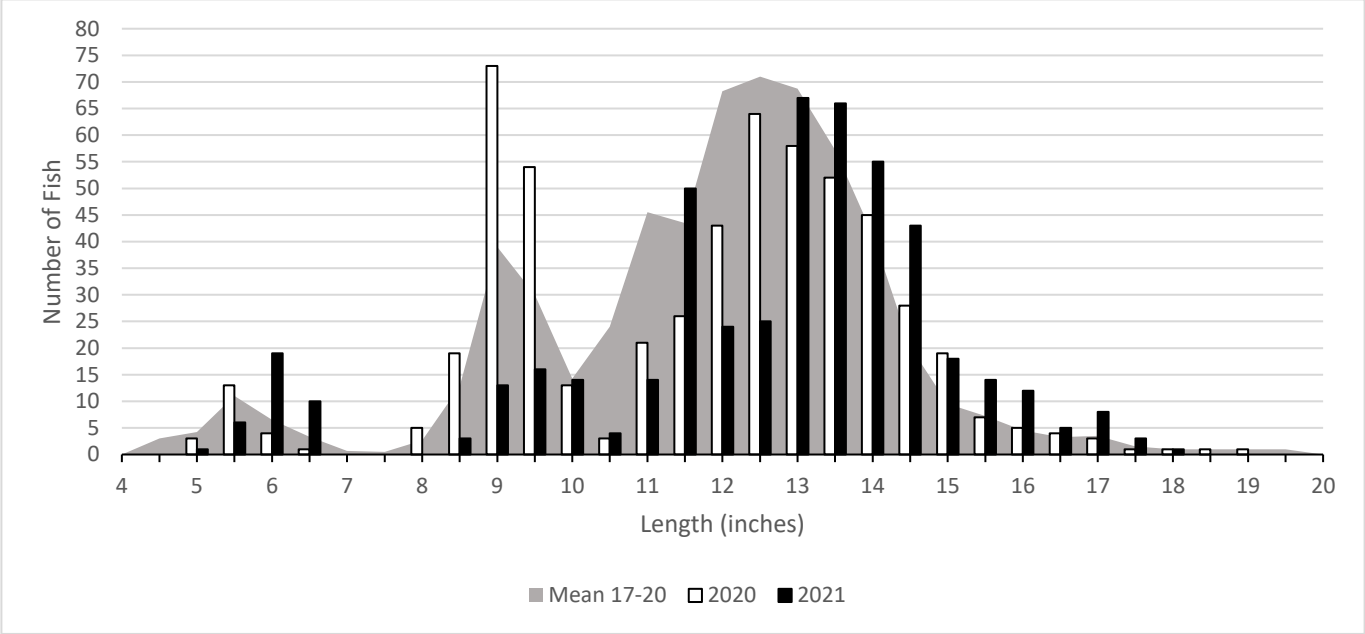

Figure 35: Length-frequency distribution for MWF in the Mallard's Rest Section for 2020 and 2021 by half-inch group.

In 2022, the length-frequency distribution of MWF generally saw decreases in all length groups aside from fish in the 8.0- to 9.5- inch range, 10.5-inch group and the 18.0-inch group when compared to 2021(Figure 36). These declines suggest a broadscale impact of some type, that may include a PKD outbreak that occurred in September of 2021. This is discussed in the next section of this document. It should be noted that the sampling in 2022 occurred prior to the June flood event that year.

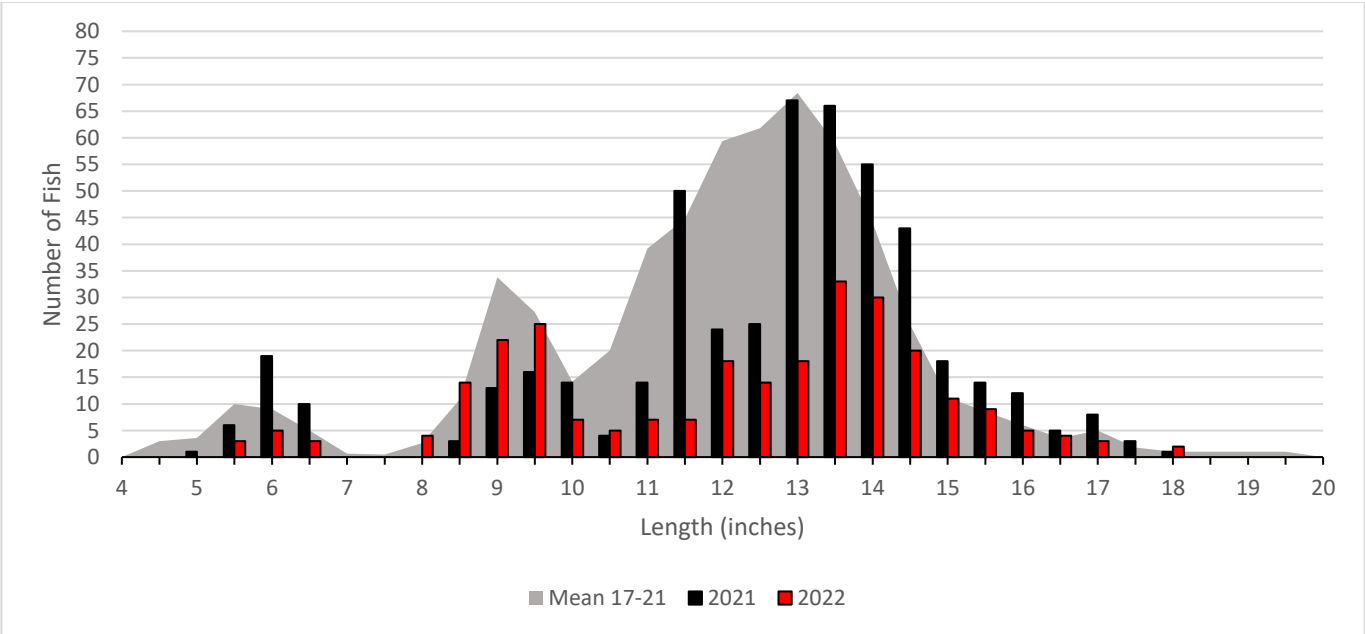

Figure 36: Length-frequency distribution for MWF in the Mallard's Rest Section for 2021 and 2022 by half-inch group.

Mountain Whitefish Kill

Background

A Mountain Whitefish (MWF) kill in 2021 was centered around the Grey Owl to Mallard's Rest reach of the Yellowstone River and numbers of dead whitefish were moderate compared to prior years. Dead and dying MWF were noted between September 4 and 17, 2021, which was later in the year than prior incidents. Water temperatures at the time of the fish kill were in the 50- 60°F range and flows were near record lows for this time of year (Figure 37 and Figure 38). These were the lowest water temperatures and flows that have been observed during any of the MWF kills on the Yellowstone River.

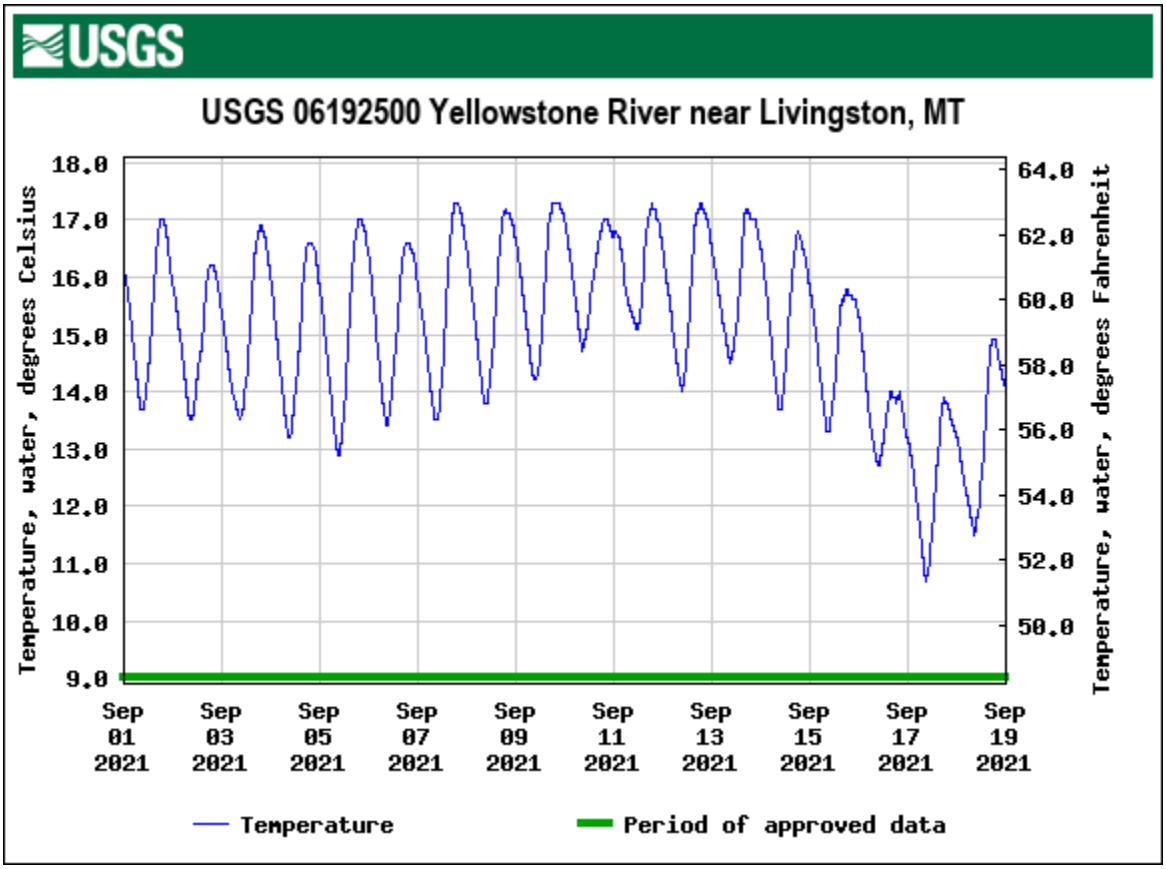

Figure 37: Yellowstone River water temperature data from USGS for September 1-19, 2021.

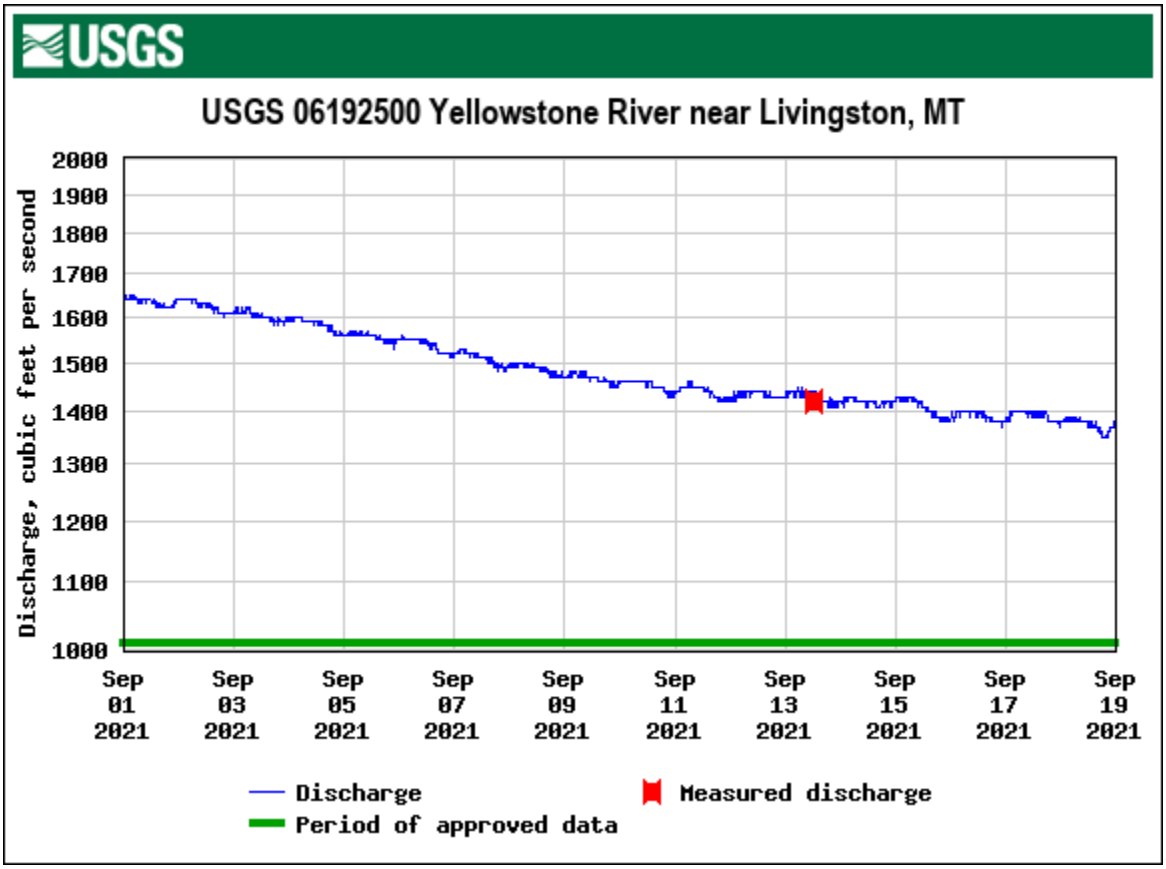

Figure 38: Yellowstone River stream flow data from USGS for September 1-19, 2021.

Beginning on September 4, 2021, a report of five dead whitefish was received from an angler. On September 6, 2021, a second report of nine dead whitefish was received. On September 8, 2021, a survey was completed from Grey Owl Fishing Access Site (FAS) to Mallard's Rest FAS. During the survey, a total of 57 dead whitefish were observed. In addition to the dead fish, two moribund whitefish were noted. The moribund fish were collected for histological examination, one recently dead fish was collected for histological examination, and four recently dead fish were collected for genetic testing to look for Proliferative Kidney Disease (PKD). Genetic results indicated that T. bryosalmonae was present at a high level in the kidney tissue of all 4 fish.

Surveys on the reach of the Yellowstone River from Carbella FAS to Point of Rock FAS and Emigrant FAS to Grey Owl FAS took place on September 16, 2021. In the reach from Carbella to Point of Rocks only one dead whitefish was observed. Three dead whitefish were observed in the reach from Emigrant to Grey Owl.

On September 17,2021, the reach from Pine Creek FAS to Carter's Bridge FAS was surveyed and eight dead whitefish were observed.

No MWF kills were observed or reported in 2022 or 2023.

Dailey Lake

Fish Stocking

Dailey Lake is stocked with Rainbow Trout, Yellowstone Cutthroat Trout, and Walleye to maintain a recreational fishery and control the naturally reproducing Yellow Perch population in the lake. Changes to the stocking plan were introduced in 2012, replacing historical efforts dating back to the 1950s for Rainbow Trout and the late 1980s for Walleye. Rainbow Trout were reduced from 20,000 to 10,000 fish annually and Walleye were reduced from 10,000 fish annually to 5,000 fish every other year. Rainbow Trout and Yellowstone Cutthroat Trout stocking size was increased to approximately 8 inches to limit Walleye predation. The intent of these changes was to increase survival for Rainbow Trout, Yellowstone Cutthroat Trout and Walleye by reducing competition within and among fish species in the lake. These changes are being monitored to evaluate the fishery response and success.

Ten years post stocking change, gill net catch data indicate positive shifts in size structure for Rainbow Trout, Walleye, and Yellow Perch. Yellowstone Cutthroat Trout were initially stocked into Dailey Lake in 2011 and there is not enough data to analyze their response in this manner.

Rainbow Trout 14.0- to 17.0-inches and 20.0- to 24.5-inches made up a higher percentage of the catch in the last 10 years compared to the previous 20-year historical averages (Figure 39). The decrease in the number of Rainbow Trout from 17.0- to 19.5-inches is addressed in more detail in the Rainbow Trout length-frequency section below.

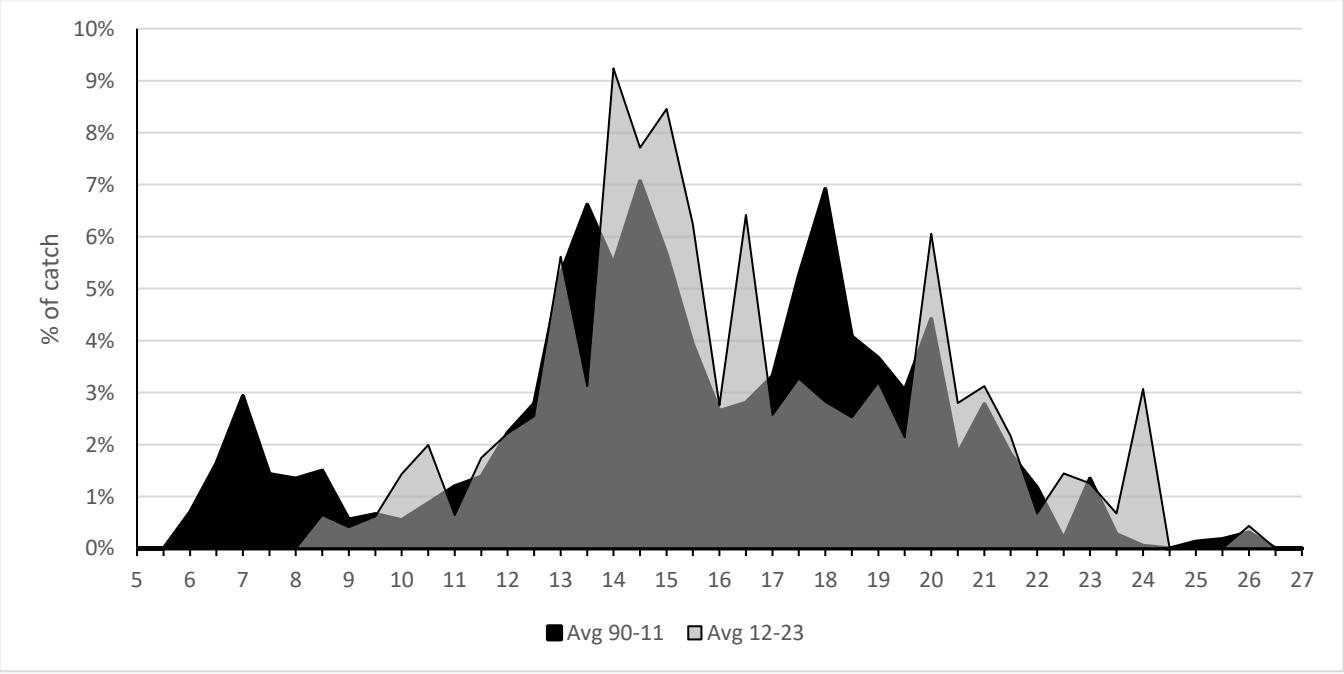

Figure 39: Comparison of average Rainbow Trout length-frequency data for Dailey Lake from 1990-2011 in black and 2012-2023 in grey.

The biggest change in Walleye length-frequency distribution occurred in the 7.0- to 13.0-inch fish (Figure 40). From 1990 to 2011, these fish made up roughly 57% of the total Walleye catch each year. Since 2012, this number has dropped to roughly 31% of the total Walleye catch each year. This is in stark contrast to the 18.0- to 24.0-inch fish, which have comprised 26% of the Walleye catch each year since 2012, compared to only 10% from 1990-2011.

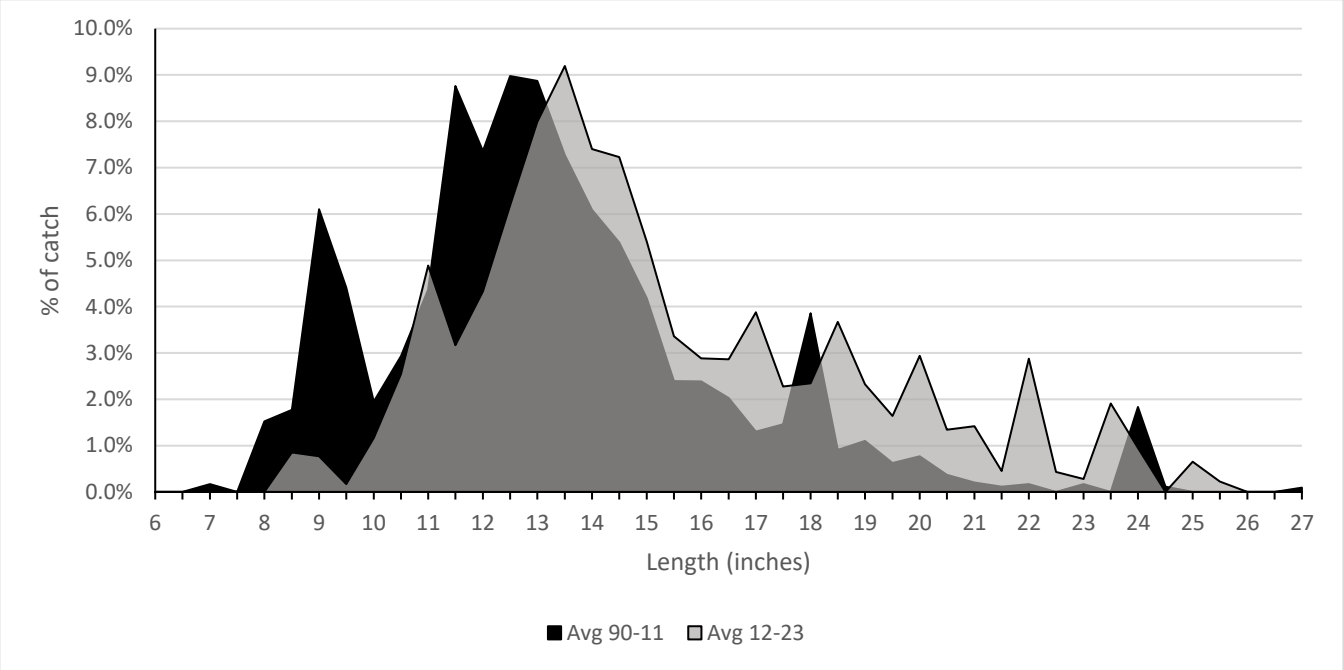

Figure 40: Comparison of average Walleye length-frequency data for Dailey Lake from 1990-2011 in black and 2012-2023 in grey.

The naturally reproducing population of Yellow Perch have also benefited from the stocking plan change. There is an obvious shift is size structure since 2012, with more fish in the larger 9.0- to 12.0-inch size range (Figure 41). From 1990-2011, these fish accounted for roughly 36% of the total yearly catch, but that number has increased to over 66% since 2012.

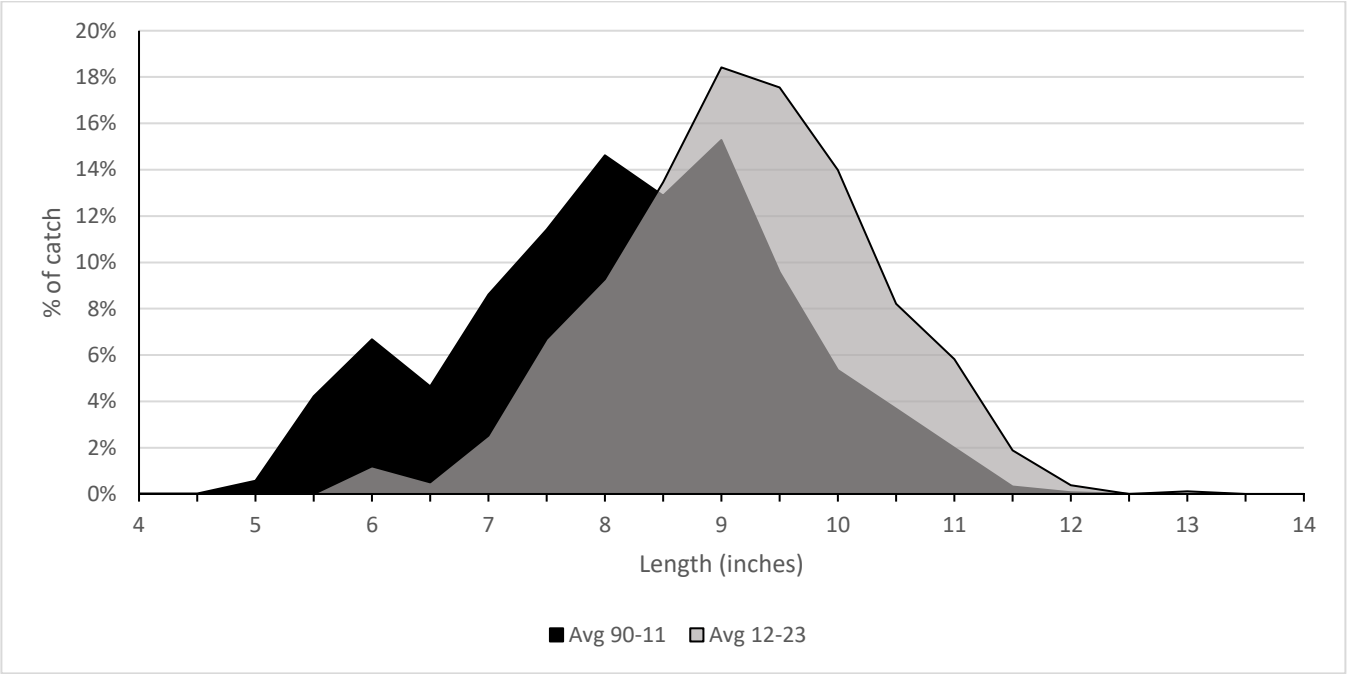

Figure 41: Comparison of average Yellow Perch length-frequency data for Dailey Lake from 1990-2011 in black and 2012-2023 in grey.

Walleye

In 2021 and 2023, Dailey Lake was stocked with Walleye as part of the 2012 stocking plan change described above. Stocking rates for Walleye from 2015 through 2023 are presented in the table below (Table 5). The reduced number of stocked Walleye in 2017 was the result of poor survival at the hatchery prior to stocking.

Table 5: Walleye stocking data for Dailey Lake from 2015-2023.

Year	Date	Strain	Length (in)	Number
2015	Sep. 02	Fort Peck	5.0	5,000
2017	Aug. 08	Fort Peck	8.2	1,800
2019	Aug. 16	Fort Peck	3.1	5,085
2021	Aug. 4	Fort Peck	6.2	5,419
2023	Aug. 25	Fort Peck	4.0	3,445
	Sep. 1	Fort Peck	4.0	1,198
			Total	**4,643**

Rainbow and Yellowstone Cutthroat Trout

In total, 12,230 Rainbow Trout and 6,247 Yellowstone Cutthroat Trout were stocked in 2021 (Table 6). In 2022, 8,296 Rainbow Trout and 3,760 Yellowstone Cutthroat Trout were stocked, and 11,040 Rainbow Trout and 11,917 Yellowstone Cutthroat Trout were stocked in 2023.

Table 6: Trout stocking data for Dailey Lake from 2016-2020.

Year	Date	Strain	Length (in)	Number
2020	Mar. 30	Yellowstone	6.6	1,680
	Apr. 06	Yellowstone	6.6	1,695
	May 26	Yellowstone	7.4	1,625
	Sep. 03	Arlee	11.3	875
	Sep. 03	Arlee	11.7	229
	Sep. 03	Arlee	6.7	3,897
			Total	**10,001**
2021	Mar. 15	Yellowstone	6.6	1.484
	May 27	Yellowstone	7.9	1.250
	Jun. 1	Yellowstone	7.9	1,250
	Jun. 7	Yellowstone	7.9	1,250
	Jun. 8	Yellowstone	7.9	1,250
	Jul. 21	Arlee	8.6	2,070
	Aug. 24	Arlee	5.7	5,304
	Aug. 25	Eagle Lake	5.9	4,856
			Total	**18,477**
2022	May 17	Yellowstone	7.1	1,260
	May 31	Yellowstone	7.2	1,250
	May 31	Yellowstone	7.2	1,250
	Jun. 27	Arlee	6.4	3,296
	Sept. 14	Eagle Lake	5.9	5,000
			Total	**12,056**
2023	Apr. 26	Yellowstone	6.5	2,089
	May 22	Arlee x Erwin	8	2,179
	May 23	Arlee x Erwin	8	2,179
	May 24	Arlee x Erwin	8	2,179
	May 26	Arlee x Erwin	8	2,179
	Jun. 1	Arlee x Erwin	7.4	2,324
	Jun. 6	Yellowstone	6.7	1,508
	Jun. 20	Yellowstone	6.7	1,483
	Sept. 27	Yellowstone	3.81	6,837
			Total	**22,957**

Gill Nets

Two floating and two sinking experimental (125-feet long and 6.0-feet deep with 1.0, 1.5, 2.0, 2.5 and 3.0 inch-bar-measure mesh), multifilament gill nets were used to sample Dailey Lake during the evenings of May 11, 2021, June 2, 2022, and May 16, 2023. A gill net was set overnight in each of the four corners of the lake (Figure 42). The gill nets were pulled the next morning and lengths were recorded for all fish to the nearest 0.1 inch and weights to the nearest 0.01 pound.

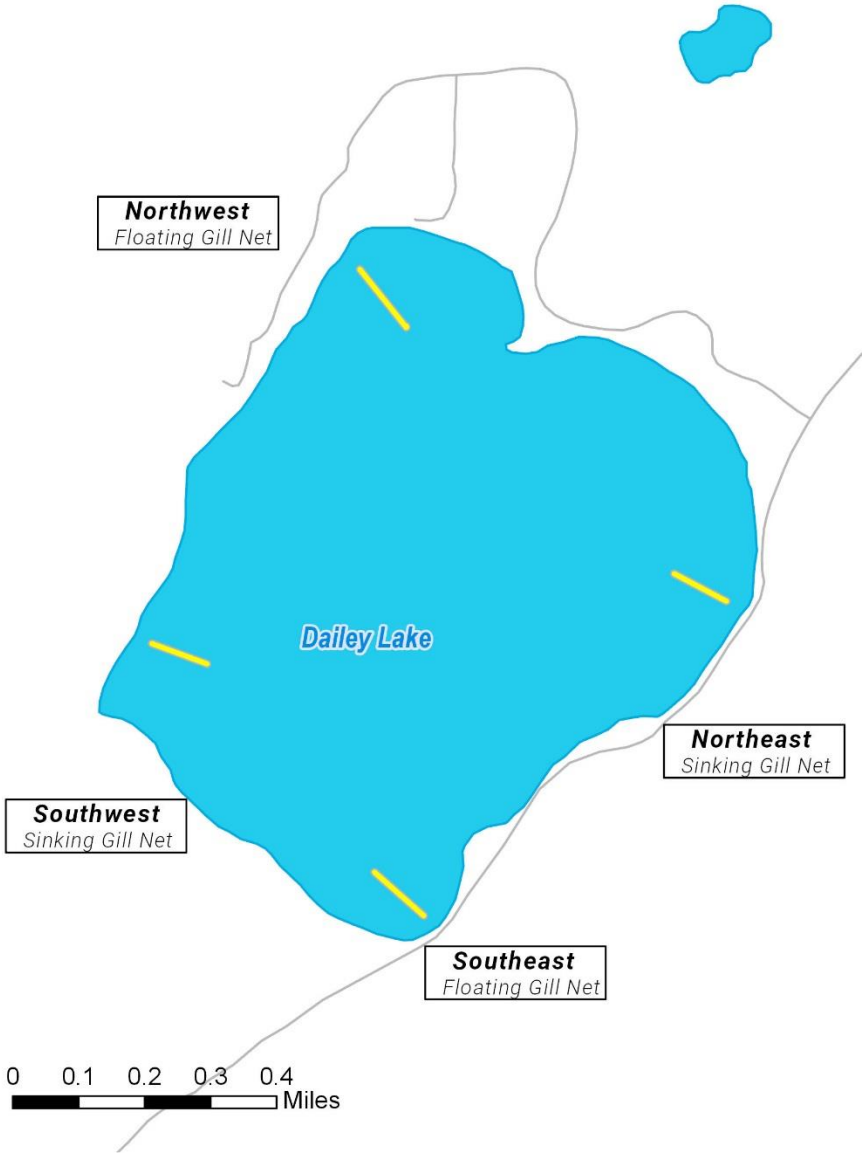

Figure 42: Map of Dailey Lake showing locations of gill nets in 2019 and 2020.

Catch-Per-Unit-Effort

The combined sportfish, Rainbow Trout, Yellowstone Cutthroat Trout, Walleye, and Yellow Perch, catch-per-unit-effort (CPUE) for all nets was 0.7 fish/hour in 2021, increasing from 0.4fish/ hour in 2020 (Figure 43). The combined CPUE for all nets increased again to 0.9 fish/ hour in 2022 before decreasing to 0.6 fish/ hour in 2023. The combined CPUE for floating nets was 0.4 fish/ hour in 2021, increasing from 0.3 in 2020. The combined CPUE for floating nets was 0.4 fish/ hour in 2022 before declining to 0.3 fish/ hour in 2023. The combined CPUE for sinking nets was 1.0 fish/ hour in 2021, doubling from 2020, 0.5 fish/ hour. The combined CPUE for sinking sets increased again to 1.4 fish/ hour in 2022 before declining to 0.9 fish/ hour in 2023.

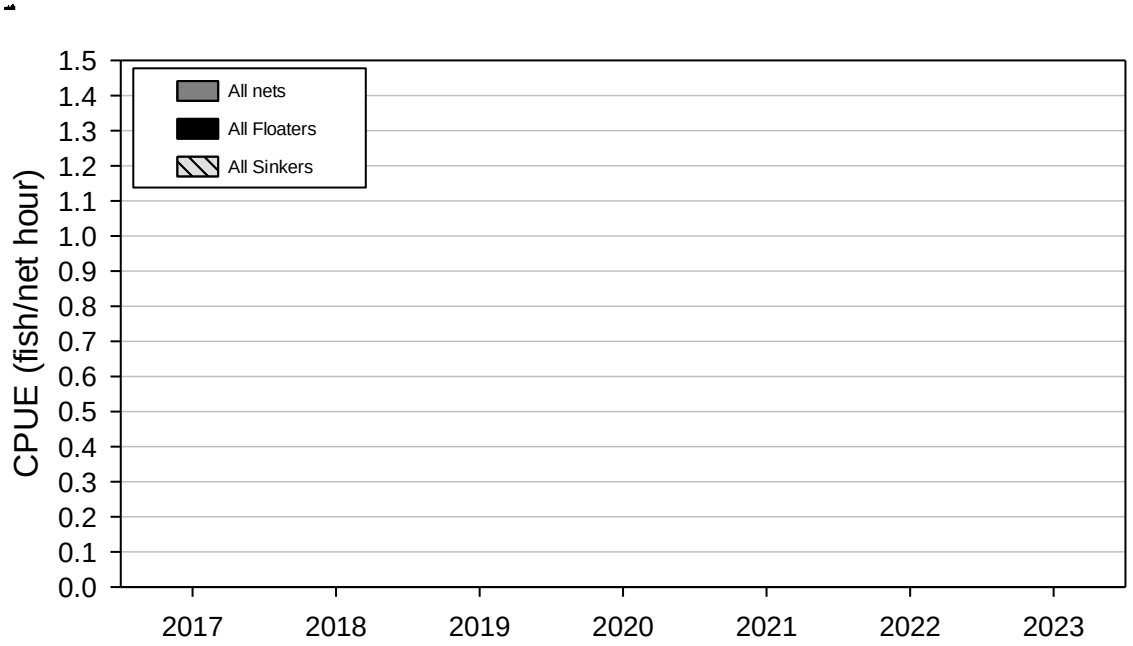

Figure 43: The combined catch-per-unit-effort for Rainbow Trout, Yellowstone Cutthroat Trout, Walleye and Yellow Perch in Dailey Lake by net type for 2017-2023.

Rainbow Trout

The Rainbow Trout CPUE for all nets was 0.7 fish/ hour in 2021, increasing from 0.3 fish/ hour in 2020 (Figure 44). The CPUE for all nets declined to 0.2 fish/ hour in 2022 before increasing again to 0.3 fish/ hour in 2023.

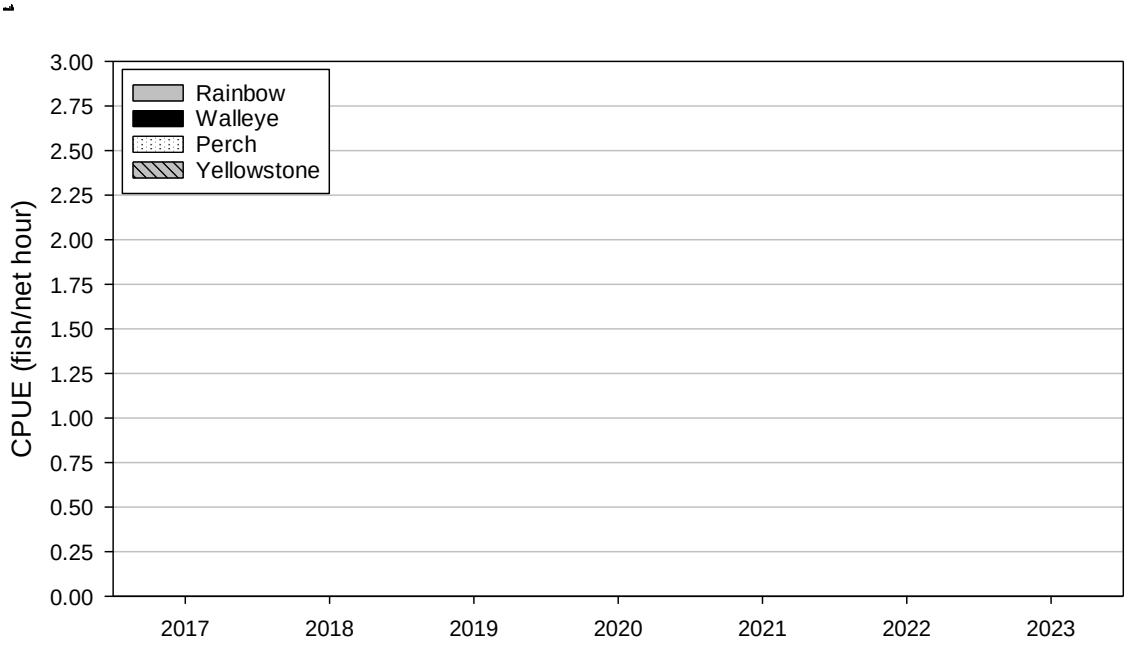

Figure 44: Catch-per-unit-effort for Rainbow Trout, Walleye, Yellow Perch, and Yellowstone Cutthroat Trout in all gill nets for 2017-2023.

The Rainbow Trout CPUE for floating nets increased to 0.8 fish/ hour in 2021 from 0.4 fish/ hour in 2020, dropped to 0.2 fish/ hour in 2022, and increased to 0.4 fish/ hour in 2023 (Figure 45).

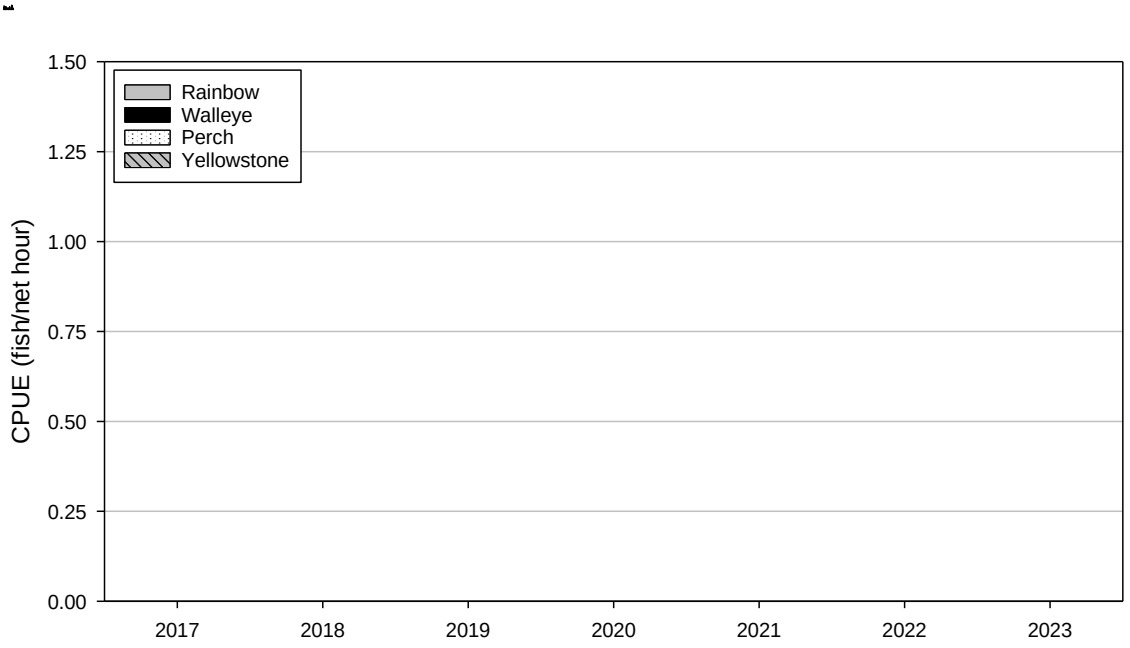

Figure 45: Catch-per-unit-effort for Rainbow Trout, Walleye, Yellow Perch, and Yellowstone Cutthroat Trout in floating gill nets for 2017-2023.

The Rainbow Trout CPUE for sinking nets increased to 0.6 fish/ hour in 2021 from 0.1 fish/ hour in 2020, decreased to 0.1 fish/ hour in 2022, and increased slightly to 0.2 fish/ hour in 2023(Figure 46).

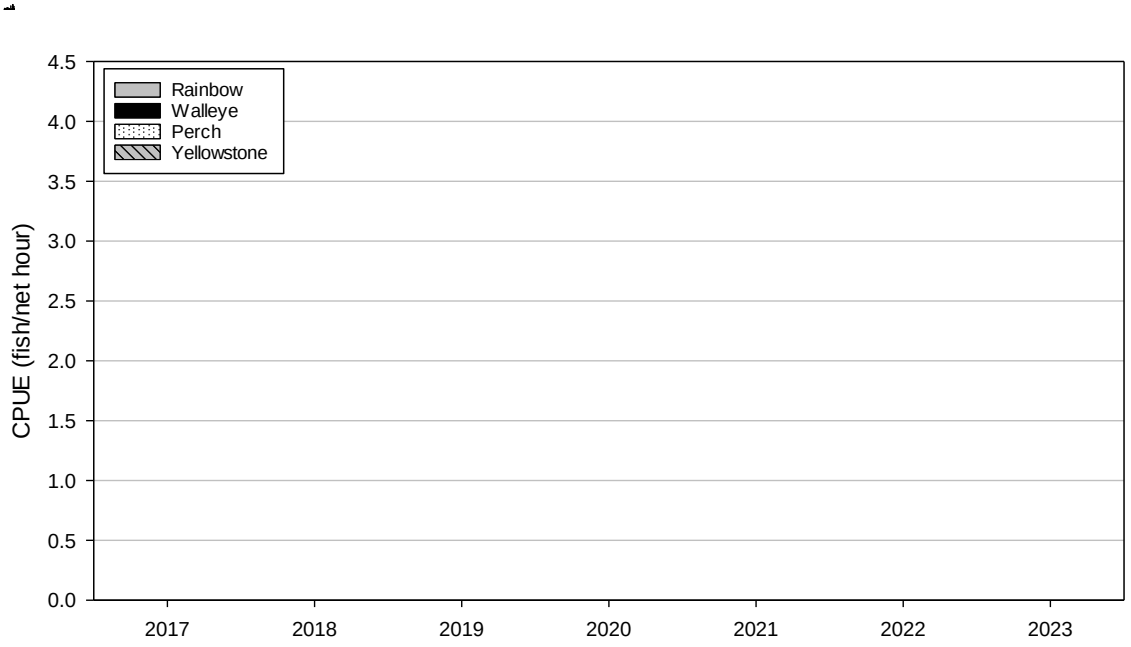

Figure 46: Catch-per-unit-effort for Rainbow Trout, Walleye, Yellow Perch, and Yellowstone Cutthroat Trout in sinking gill nets for 2017-2023

Yellow Perch

The Yellow Perch CPUE for all nets was 1.67 fish/net hour in 2021, increasing from 0.55 fish/net hour in 2020 (Figure 44). The CPUE for all nets dropped to 0.78 fish/net hour in 2022 before increasing again to 1.33 fish/net hour in 2023. The Yellow Perch CPUE for floating nets increased to 0.52 fish/net hour in 2021 from 0.45 fish/net hour in 2020, dropped to 0.03 fish/net hour in 2022, and increased to 0.20 fish/net hour in 2023 (Figure 45). The Yellow Perch CPUE for sinking nets increased to 2.81 fish/net hour in 2021 from 0.65 fish/net hour in 2020, decreased to 0.86 fish/net hour in 2022, and increased 2.47 fish/net hour in 2023 (Figure 46).

Walleye

The Walleye CPUE for all nets was 0.42 fish/net hour in 2021, decreasing from 0.49 fish/net hour in 2020 (Figure 44). The CPUE in all nets increased slightly to 0.43 fish/net hour in 2022 before dropping to 0.30 fish/net hour in 2023. The Walleye CPUE for floating nets decreased to 0.08 fish/net hour in 2021 from 0.12 fish/net hour in 2020, increased to 0.13 fish/net hour in 2022, and increased again to 0.30 fish/net hour in 2023 (Figure 45). The Walleye CPUE for sinking nets has decreased each year since 2020 from 0.85 fish/net hour to 0.75 fish/net hour in 2021, 0.73 fish/net hour in 2022, and 0.35 fish/net hour in 2023 (Figure 46).

Yellowstone Cutthroat Trout

The Yellowstone Cutthroat Trout CPUE for all nets was 0.04 fish/net hour (N=3) in 2021, decreasing from 0.27 fish/net hour in 2020 (Figure 44). The CPUE for all nets increased substantially to 2.61 fish/net hour in 2022 before decreasing to 0.45 fish/net hour in 2023. The Yellowstone Cutthroat Trout CPUE for floating nets decreased to 0.05 fish/net hour in 2021 from 0.12 fish/net hour in 2020, increased to 1.16 fish/net hour in 2022, and decreased to 0.34 fish/net hour in 2023 (Figure 45). The Yellowstone Cutthroat Trout CPUE for sinking nets decreased to 0.03 fish/net hour in 2021 from 0.41 fish/net hour in 2020, increased substantially to 4.06 fish/net (n=151) hour in 2022, and decreased to 0.55 fish/net hour in 2023 (Figure 46).

Length

Rainbow trout

In 2023, the maximum, mean, and minimum lengths of Rainbow Trout were 20.3, 16.3, and 11.5 inches, respectively (Figure 47). The maximum length decreased from 24.0 inches in 2021, and 2022, 22.7 inches, maximum lengths. However, the minimum and mean lengths increased over the three-year period. The minimum lengths in 2021 and 2022 were 8.5 and 10.8 inches, respectively, while the mean lengths in 2021 and 2022 were 15.4 and 14.9 inches, respectively.

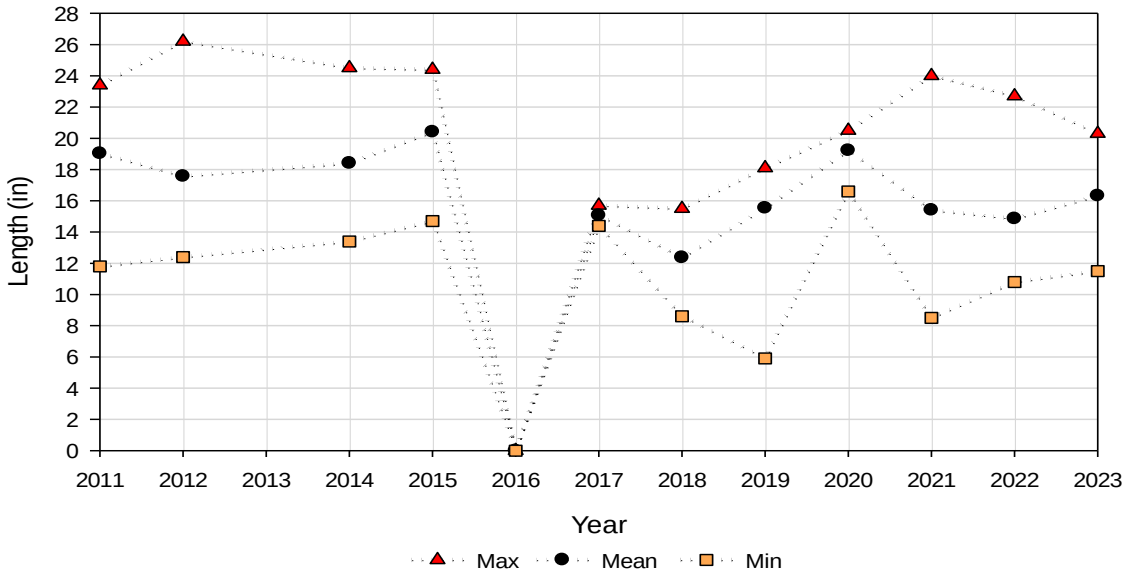

Figure 47: Maximum, mean, and minimum lengths of Rainbow Trout captured in gill nets in Dailey Lake in 2011-2023. Nets were not set in 2013 and no Rainbow Trout were captured in 2016.

Yellow Perch

In 2021, the maximum, mean, and minimum lengths of Yellow Perch were 12.1, 9.2, and 6.1 inches, respectively (Figure 48). In 2022, the maximum, mean, and minimum lengths all increased to 12.2, 9.8, and 7.2 inches, respectively. In 2023, the maximum and mean lengths decreased to 11.5 and 9.1 inches, respectively and both were lower than the 2021 values. The minimum length decreased to 6.2 inches, just above the previous low of 6.1 inches in 2021.

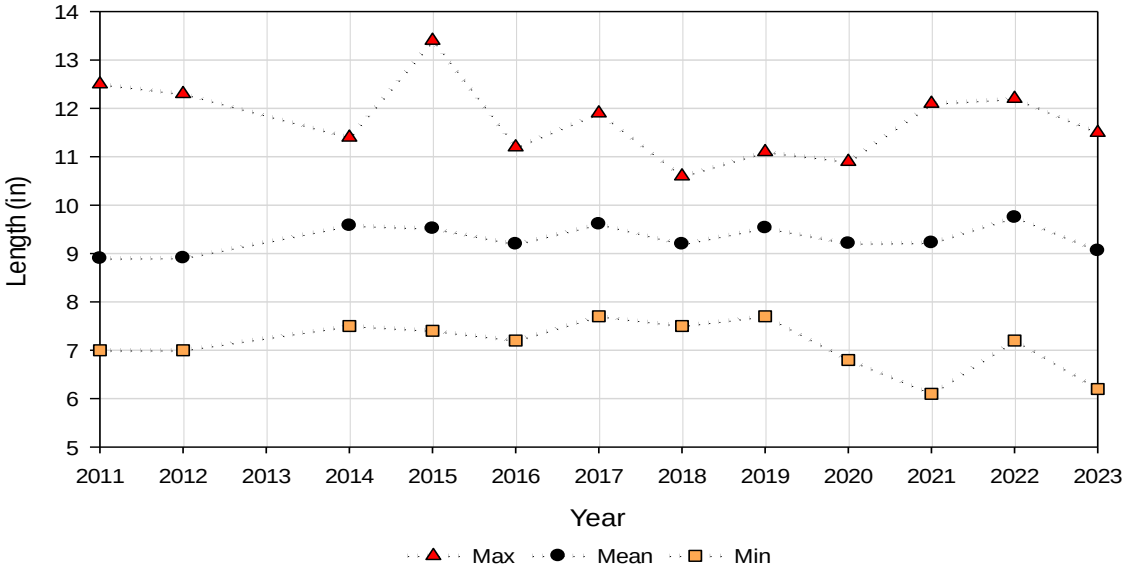

Figure 48: Maximum, mean, and minimum lengths of Yellow Perch captured in gill nets in Dailey Lake in 2011-2023. Nets were not set in 2013.

Walleye

From 1990-2011, the average maximum, mean, and minimum lengths for Walleye were 20.5, 13.2, and 9.3 inches, respectfully. From 2012-2023, the average maximum, mean, and minimum lengths have increased to 23.7, 15.5, and 11.1 inches, respectively. These changes are attributed to the changes in Walley stocking rates and frequency beginning in 2012.

In 2021 the maximum, mean, and minimum lengths for Walleye were 24.0, 16.5, and 13.3 inches, respectively (Figure 49). The maximum was lower than 2020, while both the mean and minimum both increased when compared to 2020. In 2022, the maximum and minimum lengths both decreased to 22.4 and 8.8 inches, respectively. The mean length continued to increase to 17.4 inches. In 2023, the maximum and minimum lengths increased to 25.1 and 10.4 inches, respectfully, while the mean length decreased to 15.9 inches. The 2023 maximum, mean, and minimum lengths are all above the 2011 values, prior to the stocking rate and frequency change in 2012.

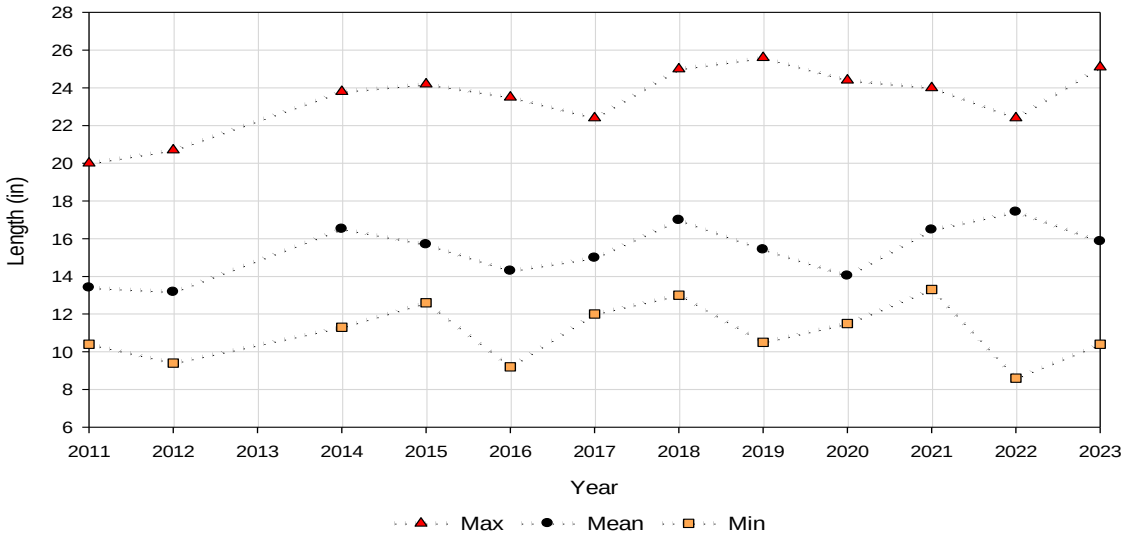

Figure 49: Maximum, mean, and minimum lengths of Walleye captured in gill nets in Dailey Lake in 2011-2023. Nets were not set in 2013.

Yellowstone Cutthroat Trout

After four years of increasing maximum lengths from2017-2020, the largest Yellowstone Cutthroat Trout caught in 2021 was only 8.5 inches (Figure 50). This appears to be an outlier and was likely a result of poor recruitment to the nets, as only three Yellowstone Cutthroat Trout were captured that year. In 2022, the maximum, mean, and minimum lengths were 15.2, 10.2, and 7.1 inches, respectfully. In 2023, the maximum, mean, and minimum lengths all increased when compared to 2022 and were 16.2, 11.04, and 7.2 inches, respectfully. In both 2022 and 2023, the maximum and mean lengths met or exceeded the long-term average for 2011-2021 of 13.1 inches and 10.0 inches, respectively.

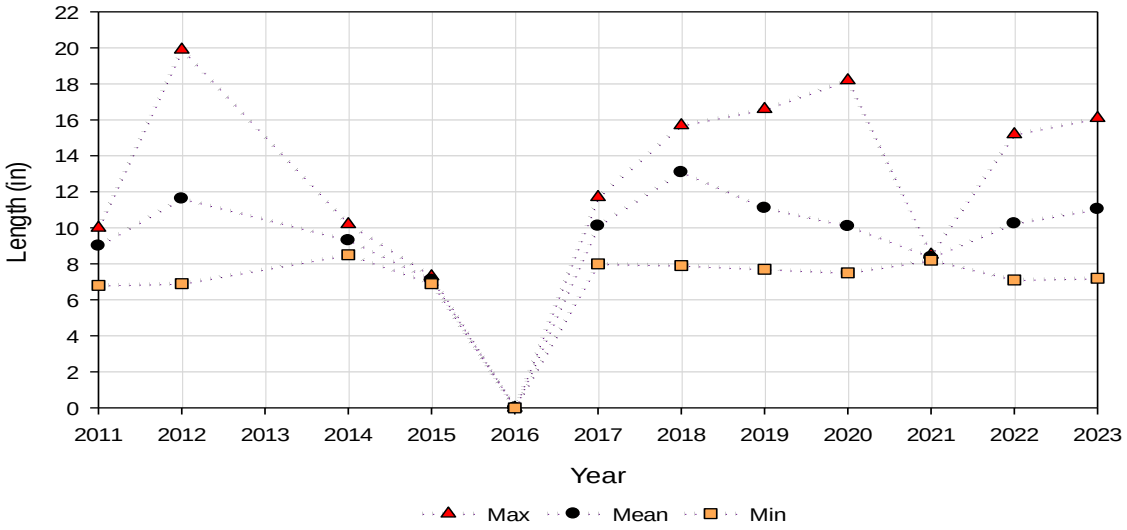

Figure 50: Maximum, mean, and minimum lengths of Yellowstone Cutthroat Trout captured in gill nets in Dailey Lake in 2011-2023. Nets were not set in 2013 and no Yellowstone Cutthroat Trout were captured in 2016.

Length-Frequency

Rainbow Trout

In 2021, the length-frequency distribution of Rainbow Trout shows two distinct concentrations of fish. One in the 11.0- to 15.5-inch range and one in the 20.0- to 23.5-inch range (Figure 51). The presence of fish less than 16.0 inches in total length was encouraging as fish in those size classes were absent in 2020.

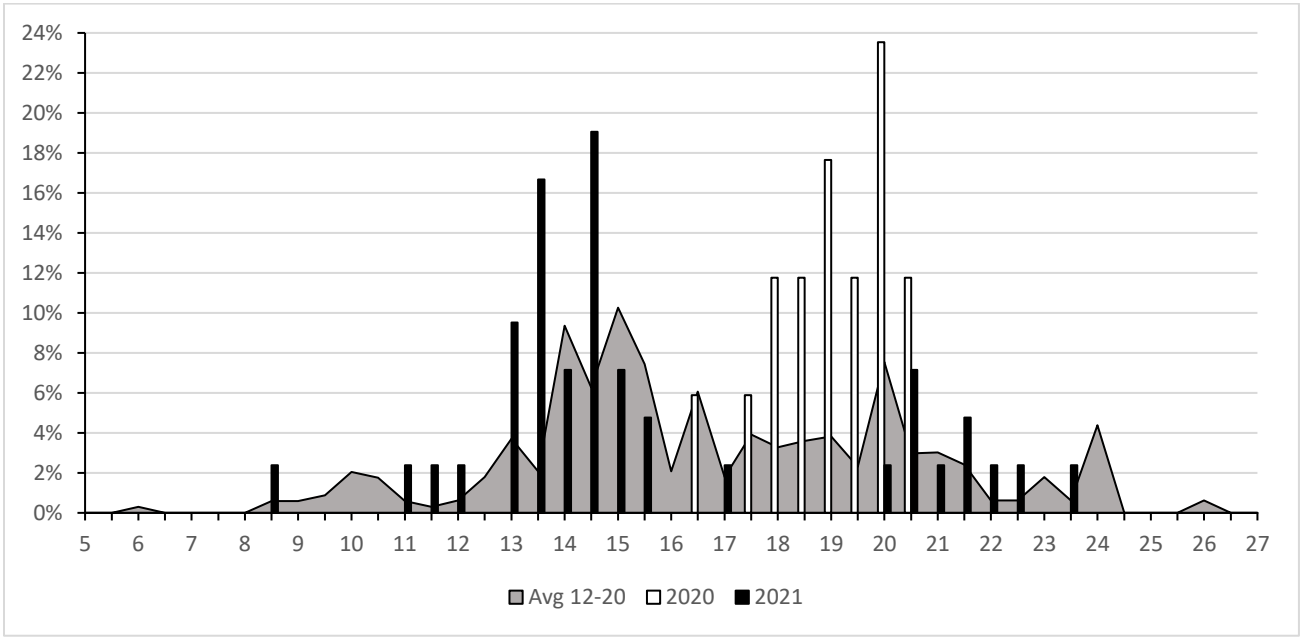

Figure 51: Rainbow Trout length-frequency data from Daily Lake for 2020 and 2021.

In 2022, the length-frequency distribution shifted slightly to smaller fish, centered around the 12.0- to 14.0-inch length groups (Figure 52).

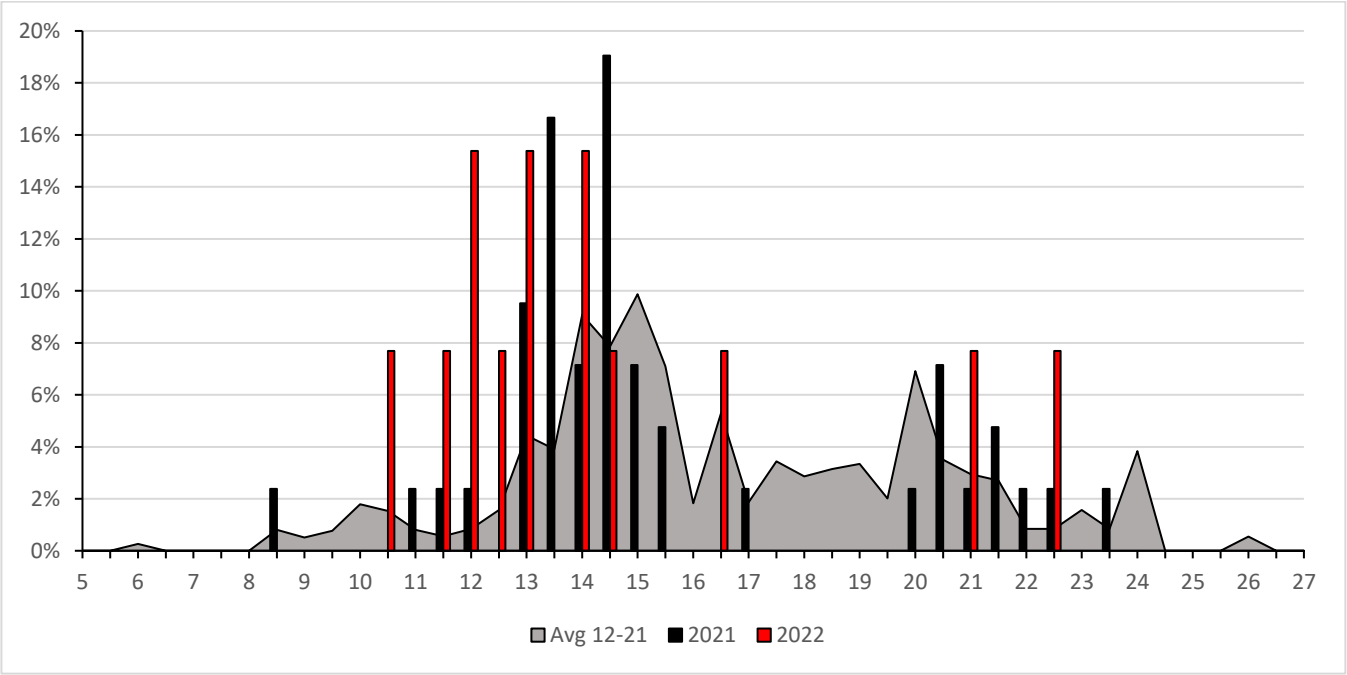

Figure 52: Rainbow Trout length-frequency data from Daily Lake for 2021 and 2022.

In 2023, the length-frequency data showed a return of 17.0- to 20.0-inch fish. Rainbow Trout in these length groups were primarily absent in the previous two years and have been captured in lower percentages since 2012 (Figure 53).

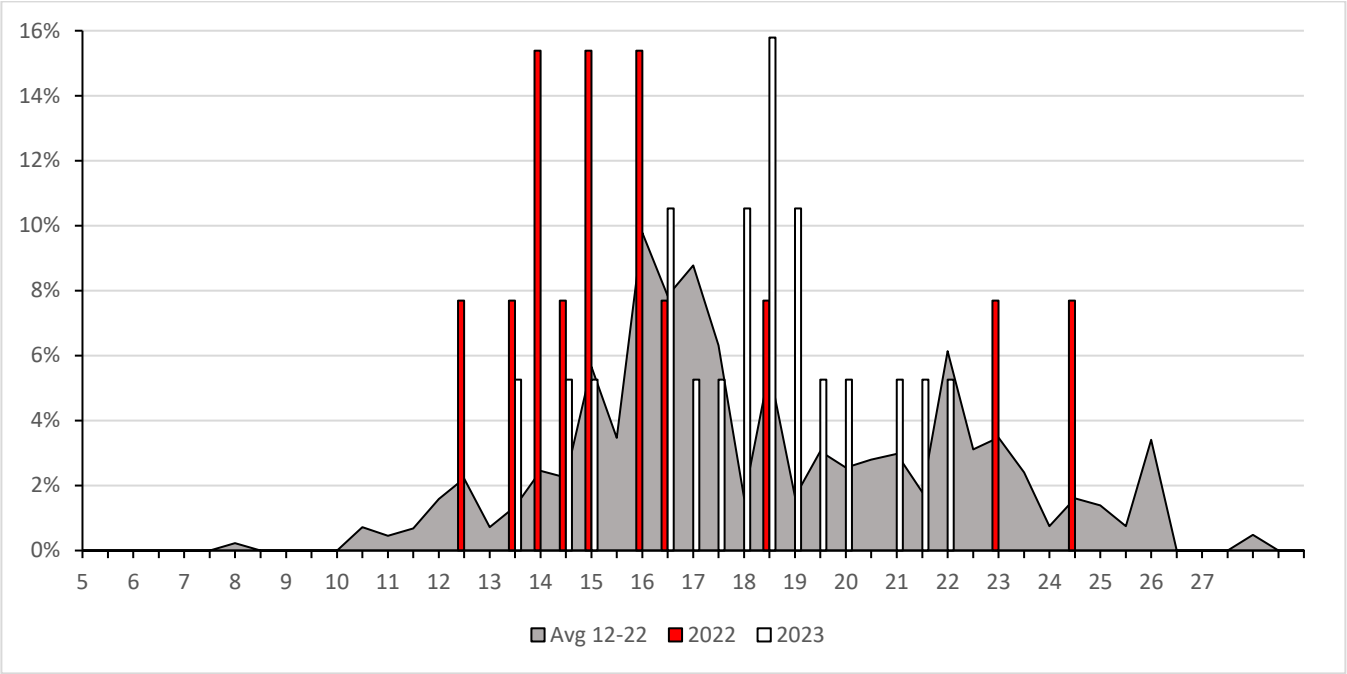

Figure 53: Rainbow Trout length-frequency data from Daily Lake for 2022 and 2023.

Rainbow Trout catch data from 2012-2023 was plotted in a heat map (Figure 54). While overall Rainbow Trout size distribution has shifted toward larger fish there is a clear lack of fish in the 17.0- to 19.5-inch size range when comparing the 2012-2023 mean to the 1990-2011 mean for this size range (Figure 39). Since 2012, there were four years, 2016, 2017, 2018, and 2022, that fish in this size range were not captured. In 2012, 2015, 2019 and 2021, capture of 17.0- to 19.5-inch fish was less than the 1990-2011 yearly average of 24%.

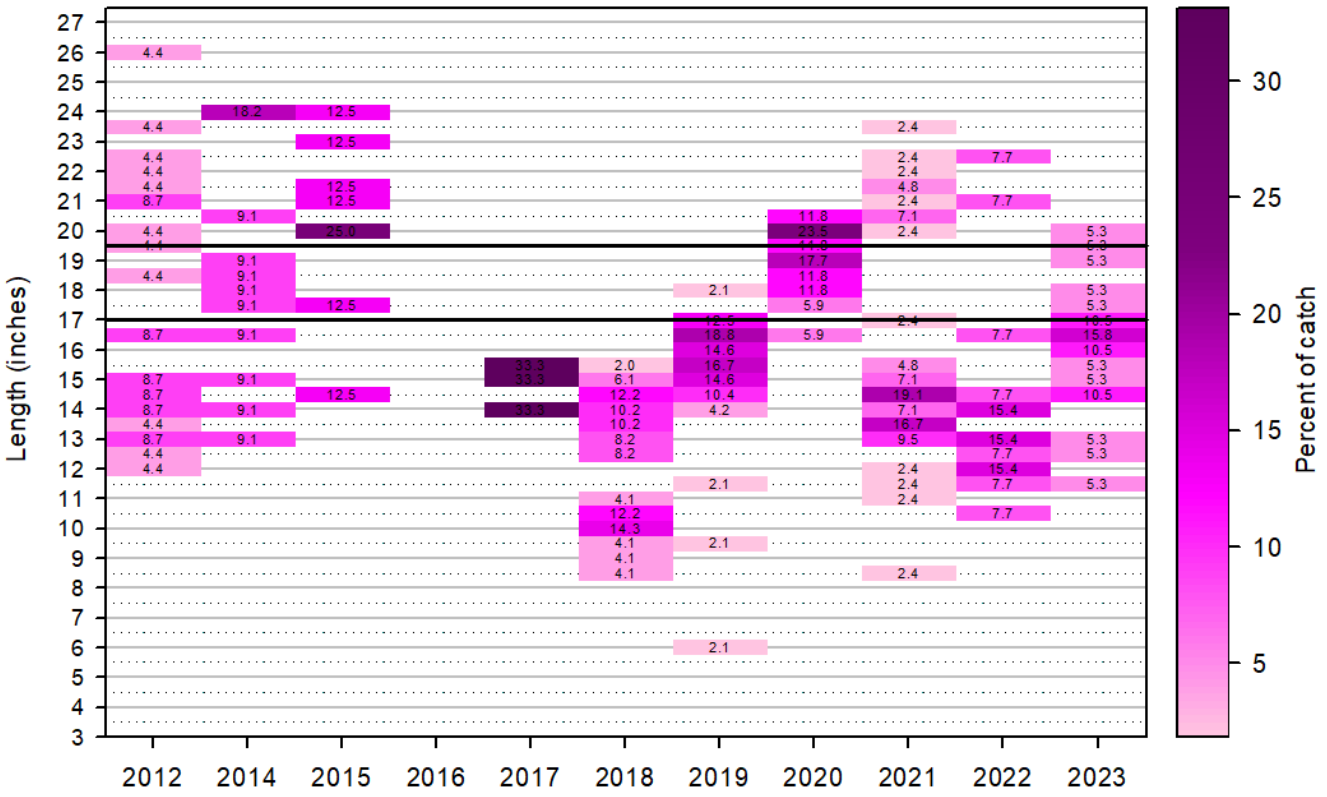

Figure 54: Length-frequency heat map for Dailey Lake Rainbow Trout from 2012-2023. The x-axis is half-inch length groups. Colors represent the percent of catch for each year; darker colors indicate a higher percent of the catch. The solid black, horizontal lines frame the 17 to 19.5-inch length groups.

The missing 17.0-19.5-inch Rainbow Trout catch in 2017 and 2018, and the limited catch in 2019 is likely related to the absence of Rainbow Trout in 2016. There appears to have been some level of population crash that took several years to recover from. Distinct age class progressions were noted from year to year. In 2012, the 12.0- to 15.0-inch fish appear to recruit into the 16.0- to 20.0-inch size range in 2014, and then to 20.0 inches and larger in 2015. This same pattern is seen in 2018-2021, with a clear progression of length starting with the 12.0 to 16.0-inch range of fish in 2018. However, the 8.0 to 11.0-inch fish in 2018 are not captured in subsequent years, and aside from two individuals caught in 2019, this size class disappears from the data altogether. It is unclear why recruitment of smaller fish was absent in 2019 and 2020.

Yellow Perch

In 2021, the length-frequency distribution for Yellow Perch ranged from 6.0 to 11.5 inches (Figure 55). There was an increase in the percentage of 9.0- to 10.0-inch fish and decreases in fish 10 inches and larger compared to 2020.

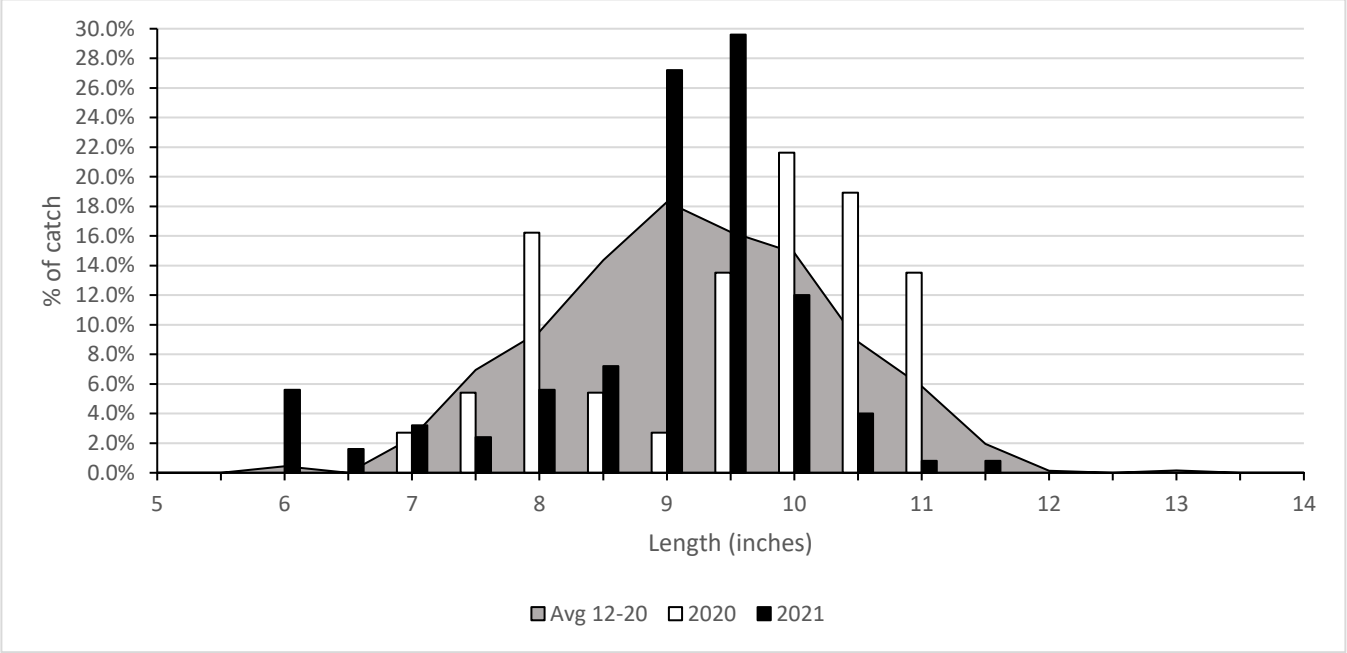

Figure 55: Yellow Perch length-frequency data from Daily Lake for 2020 and 2021.

In 2022, the length-frequency distribution had an increase in the percentages of fish in the 10.0- to 12.0- inch length groups (Figure 56). Fish in these length groups also exceeded the 2012-2021 mean. Yellow Perch in the 7.0- to 9.5-inch length groups dropped below the long-term mean.

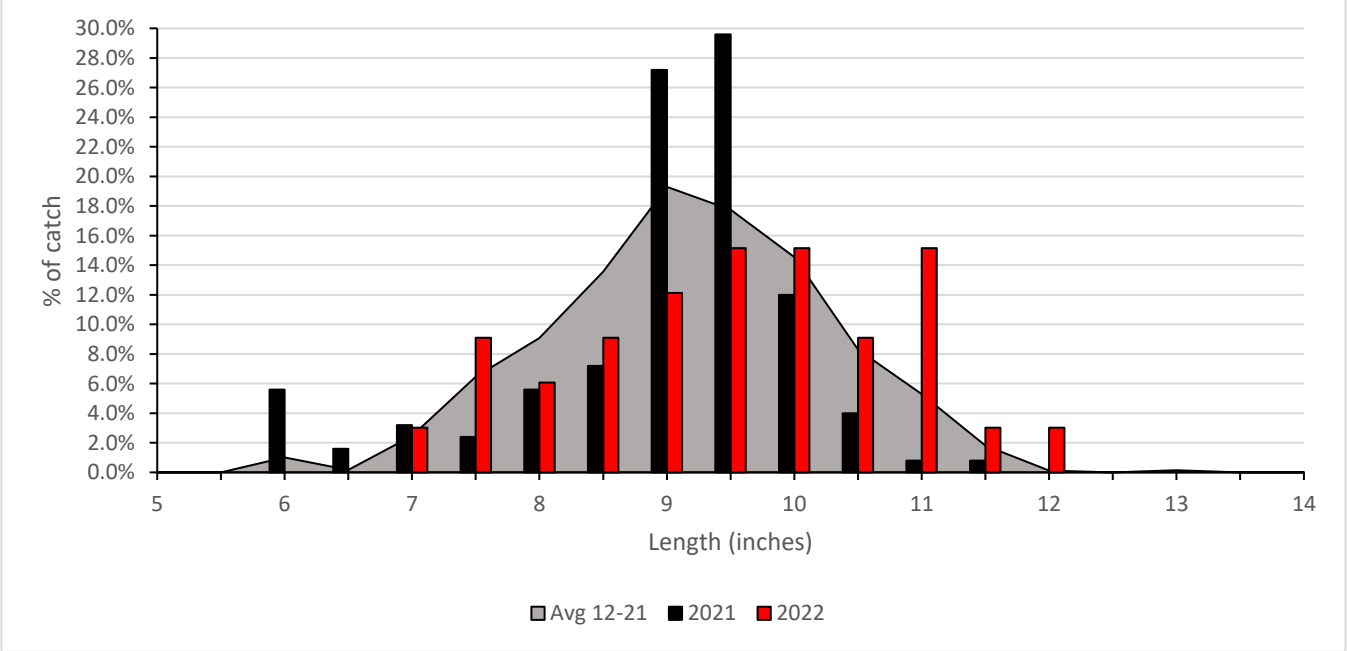

Figure 56: Yellow Perch length-frequency data from Daily Lake for 2021 and 2022.

In 2023, the length-frequency distribution nearly matched the historical mean from 2012-2022, with increases in almost all length groups in the 6.0- to 9.5-inch length range (Figure 57). Decreases were noted in the 10.0- to 12.0-inch length groups. Overall, length-frequency distribution trends have remained stable for Yellow Perch.

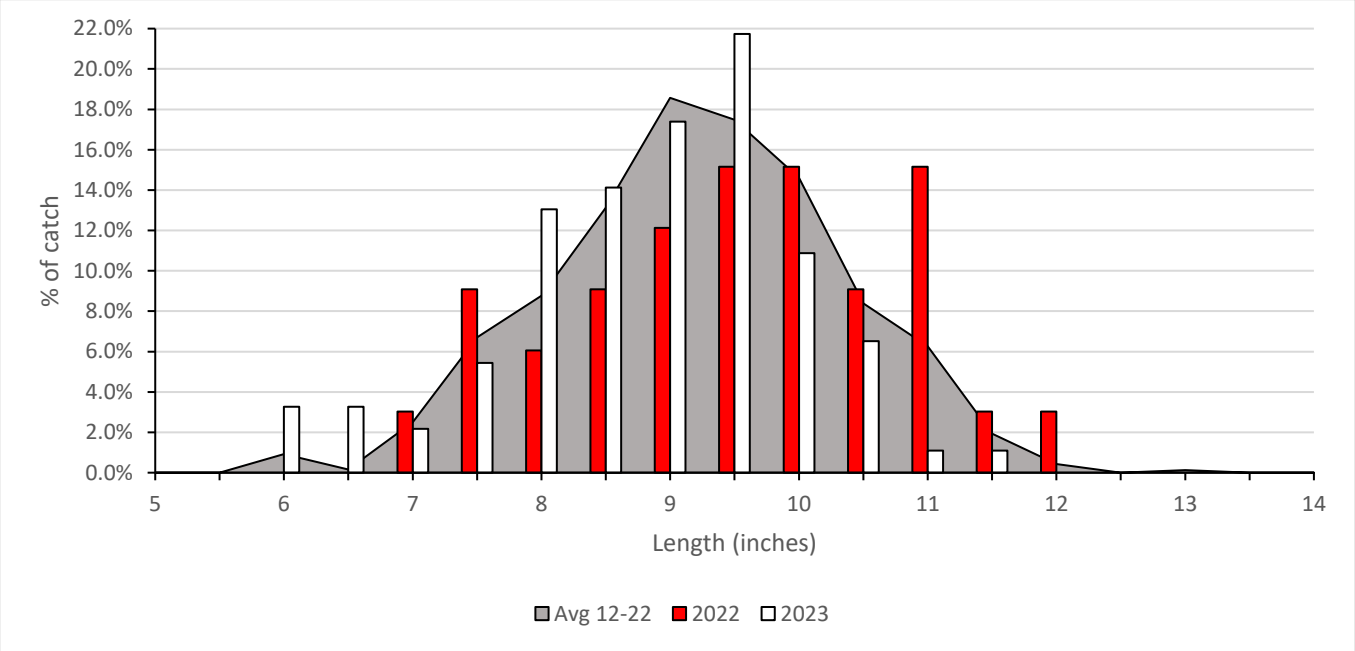

Figure 57: Yellow Perch length-frequency data from Daily Lake for 2022 and 2023.

Walleye

In 2021, the length-frequency distribution of Walleye showed an overall increase in the percentage of fish 14.0 inches and larger when compared to 2020, with two distinct peaks at the 14.5- and 16.5- inch length groups (Figure 58). Walleye smaller than 13.0 inches were absent from the sample in 2021.

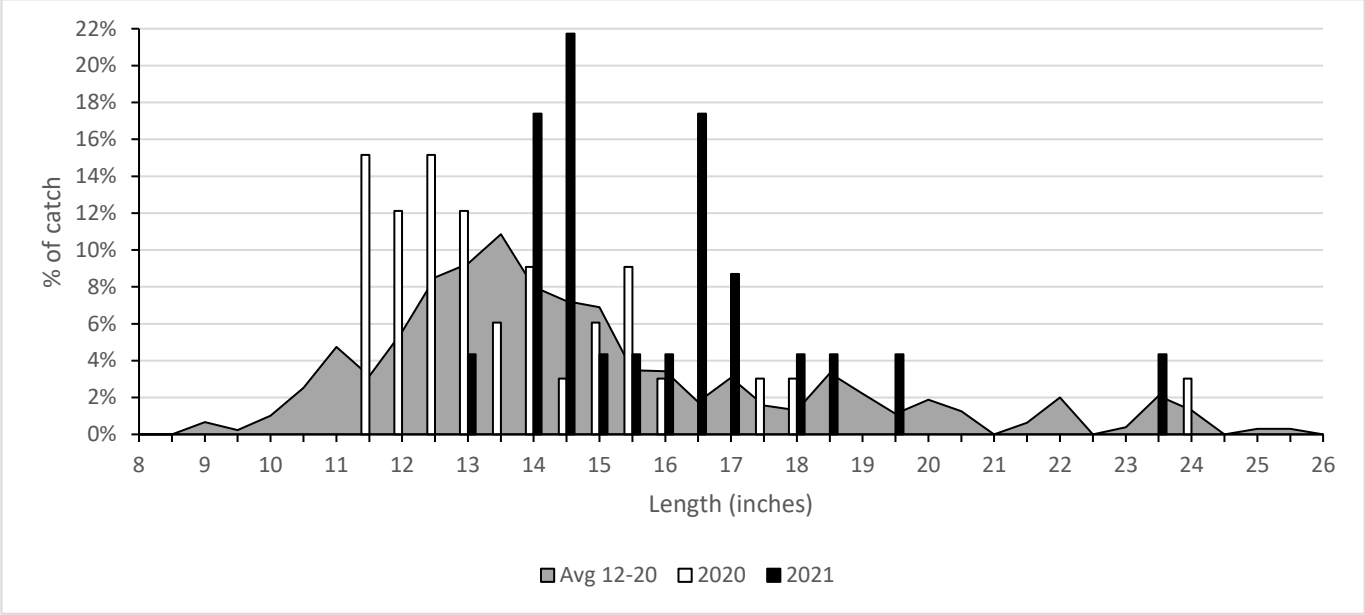

Figure 58: Walleye length-frequency distribution from Dailey Lake for 2020 and 2021.

In 2022, the length-frequency distribution indicates continued recruitment of fish to larger length groups, with the highest percentages of fish moving from the 14.0- to 17-inch range in 2021, to the 17.0- to 22-inch range (Figure 59). Several fish under 13 inches were captured in 2022 indicating recruitment of smaller fish.

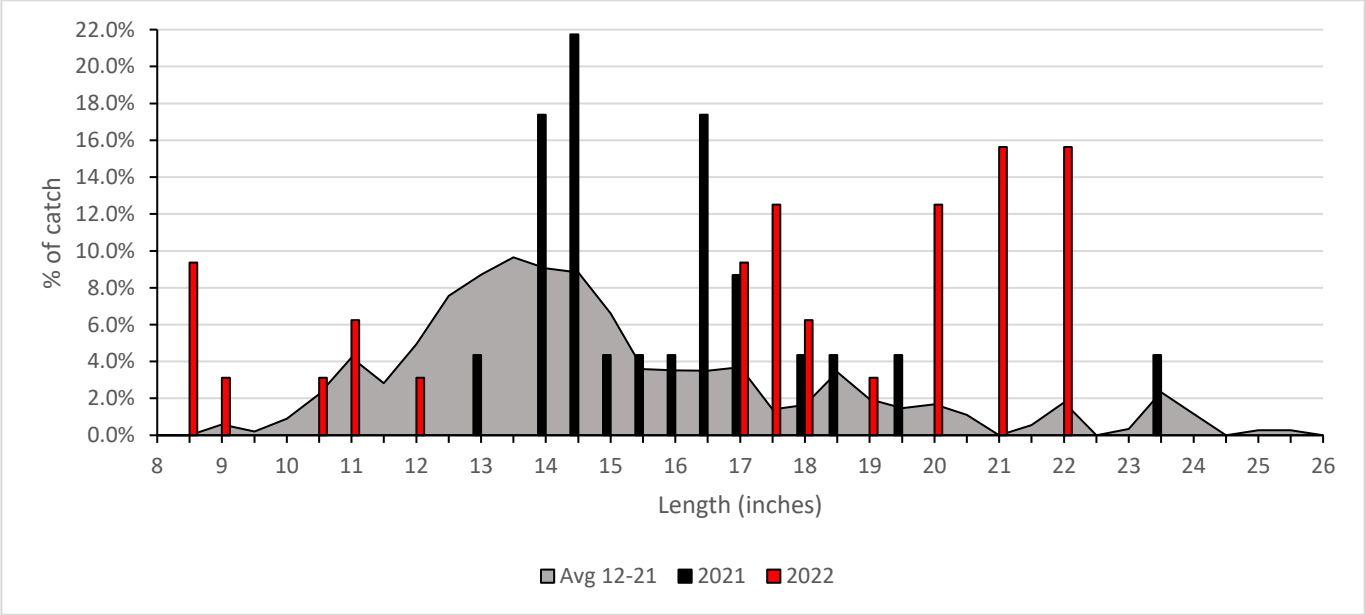

Figure 59: Walleye length-frequency distribution from Dailey Lake for 2021 and 2022.

In 2023, fish less than 10.0 inches were again absent from the sample (Figure 60). Percentages of fish in the 17.0-inch groups were lower when compared to 2022 except for fish in the 23.5- and 25.0-inch length groups.

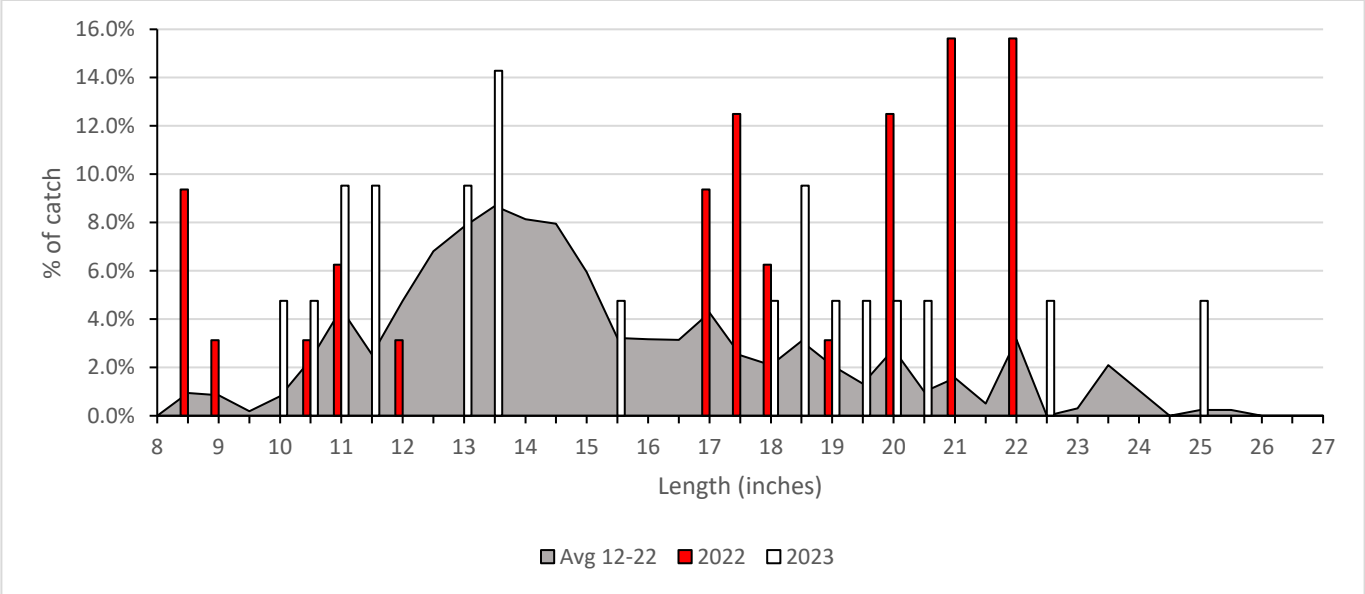

Figure 60: Walleye length-frequency distribution from Dailey Lake for 2022 and 2023.

Yellowstone Cutthroat Trout

In 2021, only three Yellowstone Cutthroat Trout were captured in the nets and only in the 8.0- and 8.5-inch groups (Figure 61). This appears to be an issue related to capture efficiency based on the capture of fish in 2022.

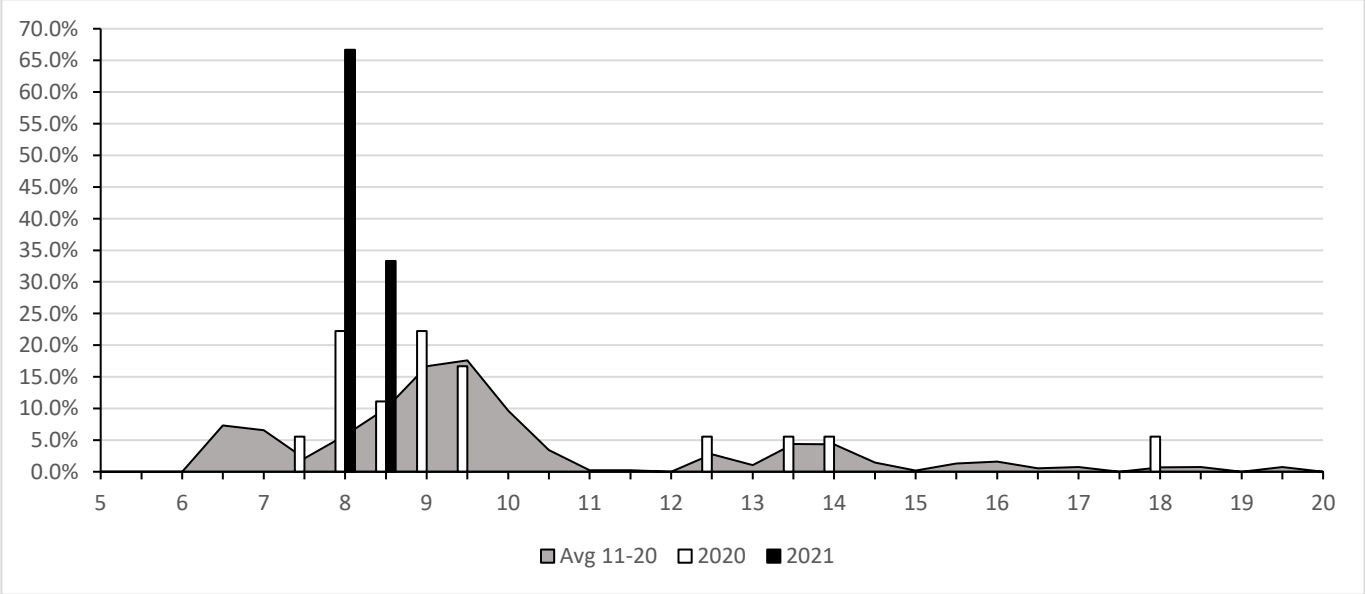

Figure 61: Yellowstone Cutthroat Trout Length-frequency data from Dailey Lake for 2020 and 2021.

In 2022, fish were captured in most of the length groups between 7.0 and 15.0 inches (Figure 62). The length-frequency distribution was similar to the long-term mean with a bimodal distribution concentrated between the 7.0- to 10.0-inch groups and 12.0- to 15.0-inch groups.

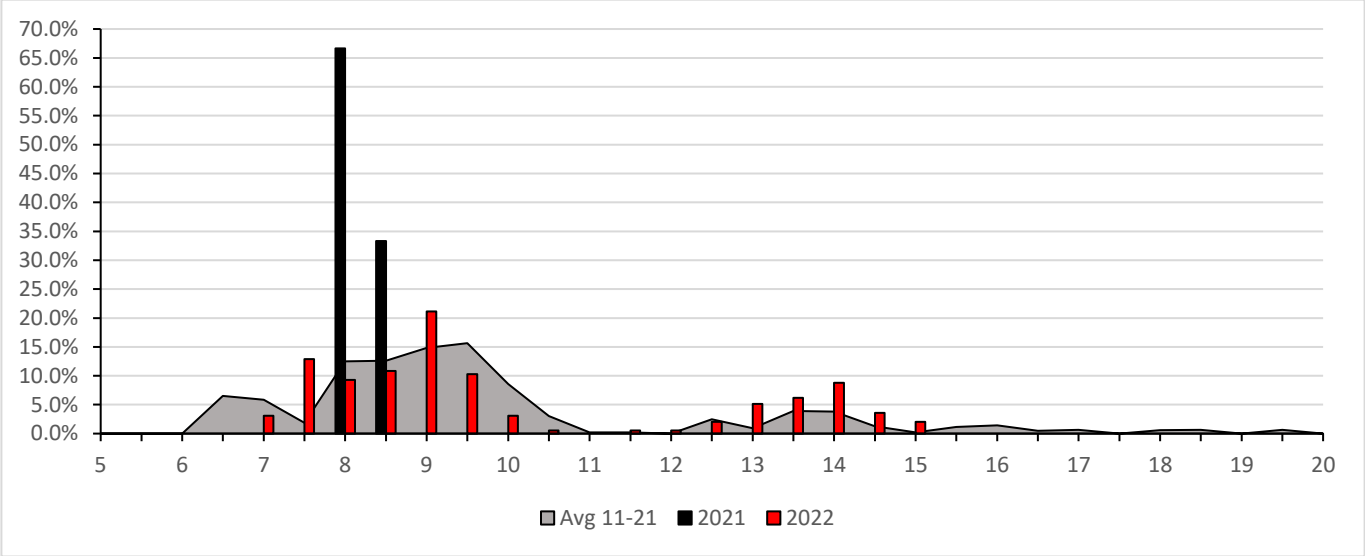

Figure 62: Yellowstone Cutthroat Trout Length-frequency data from Dailey Lake for 2021 and 2022.

In 2023, the length-frequency distribution was again bimodal in distribution, but no Yellowstone Cutthroat Trout were captured in the 9.0- to 12.5-inch length groups (Figure 63). There was an increase in the percent of fish 13 inches and larger with fish in the 15.5- to 16.0-inch range returning to the distribution.

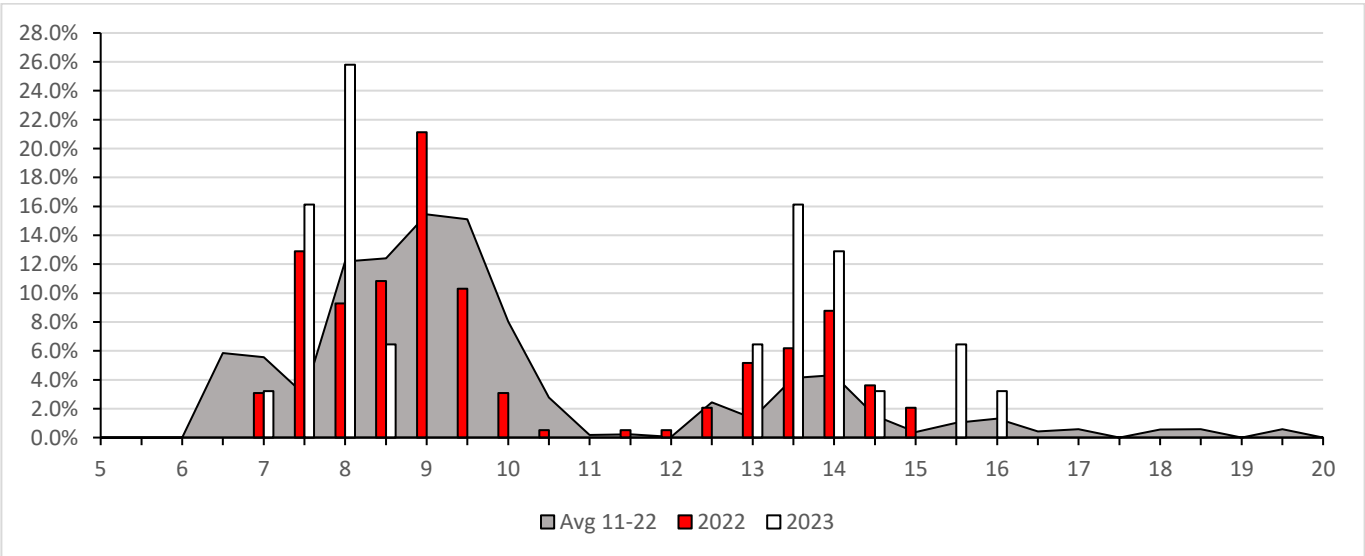

Figure 63: Yellowstone Cutthroat Trout Length-frequency data from Dailey Lake for 2022 and 2023.

Surface Water Elevations

Records of Dailey Lake surface water elevations have been monitored since 2008. In 2021, five measurements were recorded (Table 7). The 2022 elevation data are not available. Seventeen measurements were recorded in 2023 as part of an increased effort to better characterize surface water elevations throughout the year.

Table 7: Dailey Lake surface elevation measurements by date and associated comments.

Date	Elevation	Distance to Pin	Comments
5/11/2021	94.97	17.1	
6/2/2021	94.97	17.1	
6/24/2021	94.69	20.1	Water is flowing, equal split
7/1/2021	94.49	22.4	Water is flowing, equal split
8/3/2021	94.14	26	Water is flowing, equal split
5/18/2023	93.63	31.7	Water not flowing yet
5/22/2023	Not measured		Water flowing; turned on 5/19/2023; all water flowing to Lens Lake; weir boards moved to direct flow to Dailey Lake
5/30/2023	93.13	38.4	Water not flowing; water turned off 5/25/23
6/6/2023	93.19	37.8	Water not flowing yet
6/12/2023	93.19	37.7	Water flowing and diverted to Dailey Lake; some spillover to Lens Lake ditch
6/16/2023	93.2	37.6	Water not flowing
6/21/2023	93.16	38.1	Water not flowing
6/26/2023	93.16	38	Water not flowing
7/6/2023	93.28	36.6	Water was flowing and diverted to Dailey Lake. Water had not yet reached the lake; ditch may need obstructions cleared
7/10/2023	93.28	36.6	Water was flowing, diverted to and reaching Dailey Lake
7/17/2023	93.22	37.4	Water flowing but not reaching lake; diversion boards still in place
8/16/2023	93.03	39.6	Water flowing, slow trickle not reaching diversion structure
8/28/2023	92.96	40.6	Water not flowing
9/27/2023	92.79	42.6	Water flowing, slow trickle not reaching diversion structure
10/2/2023	92.78	42.7	Water flowing, slow trickle not reaching diversion structure; boards moved to direct all flow to Lens Lake
11/2/2023	92.81	42	High winds, very choppy water
11/16/2023	92.96	40.6	Calm, no wind; water not flowing
12/14/2016	92.85	41.5	Calm, no wind; water not flowing; some ice build-up at the ramp; able to break ice and measure to water

Water inputs for Dailey Lake come from subsurface springs and water diverted from Sixmile Creek through a ditch system (Figure 64). A diversion structure exists along Sixmile Ditch and allows staff to divert water between Dailey Lake and a privately owned lake downstream of Dailey Lake. Under the current water use agreement, when the surface elevation of Dailey Lake reaches 94.13 feet, water diversion is split 50-50% between Dailey Lake and the private Lake.

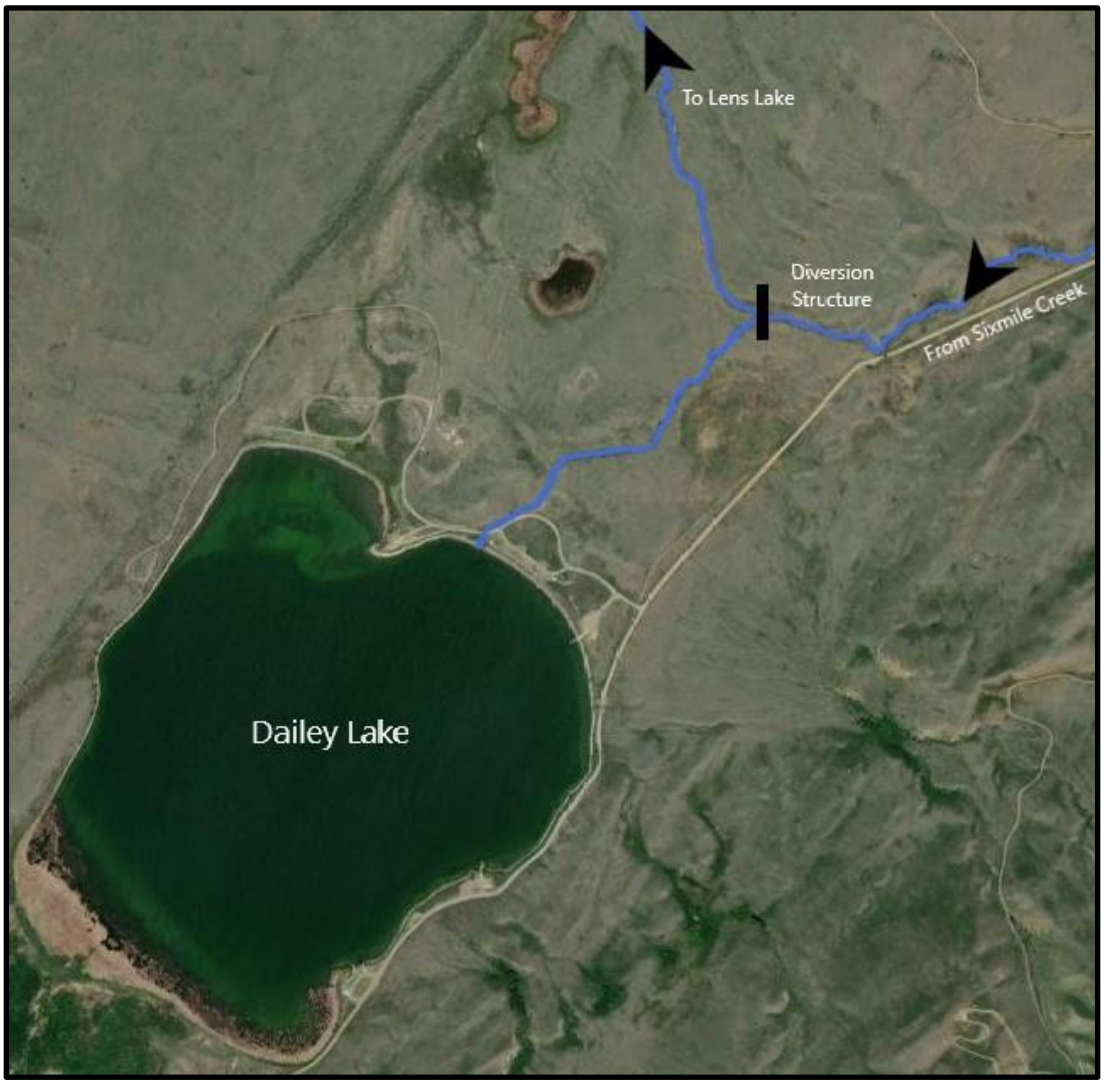

Figure 64: Aerial view of Dailey Lake with ditch system for Sixmile Creek highlighted in blue.

In 2021, Dailey Lake surface water elevation was measured on five separate occasions (Figure 65). The highest recorded elevation was 94.97 feet on May 11, and June 2, 2021. Water was flowing in Sixmile Ditch on three of the five measurement days but did not reach Dailey Lake on any of those days. All five surface water measurements were above 94.13 feet. As required under the current water use agreement, water was diverted at a 50-50 split between Dailey Lake and the private lake beginning June 24, 2021.

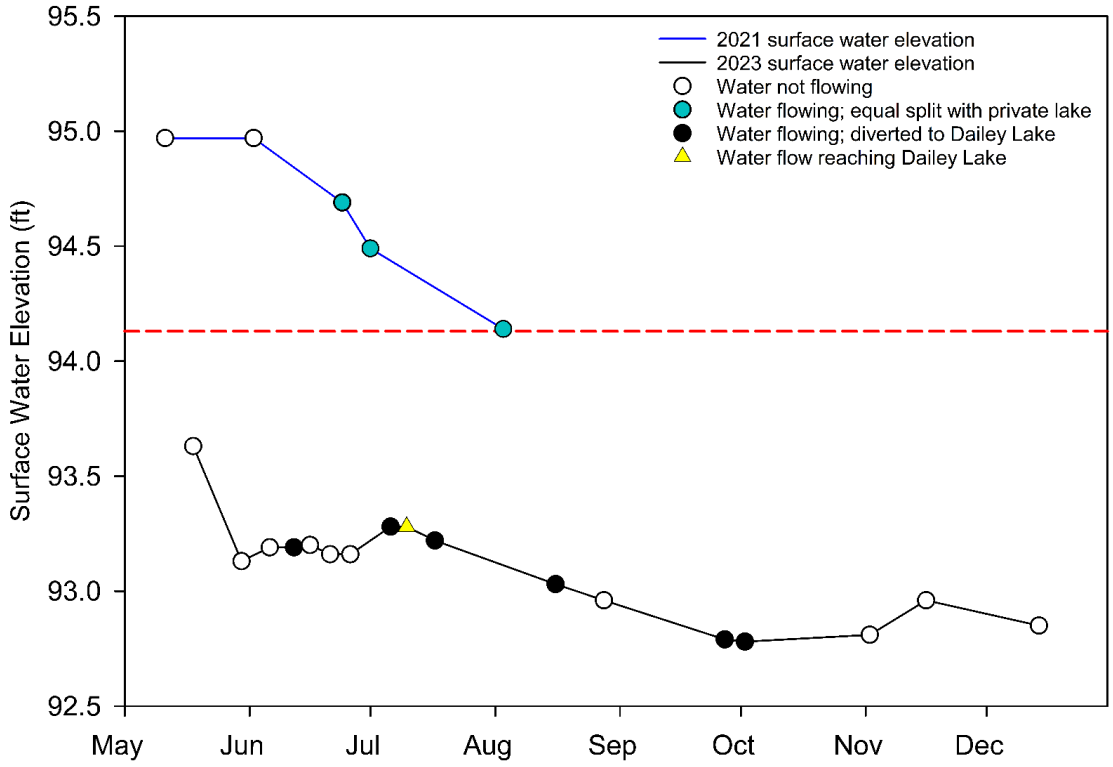

Figure 65: Dailey Lake surface elevations for 2021 and 2023. The red dashed line represents the elevation, 94.13 ft, when ditch water is split between Dailey Lake and the private lake.

In 2023, Dailey Lake surface water elevation was measured on 17 separate days (Figure 65). The highest recorded elevation was 93.63 feet on May 18, 2023, and the lowest recorded elevation was 92.78 on October 2, 2023. Water was flowing in Sixmile Ditch on 10 of the 17 measurement days, but water was only observed reaching Dailey Lake on July 10, 2023.

Dailey Lake Summary

Length-frequency data show a positive shift in size structures of Rainbow Trout, Walleye, and Yellow Perch in Dailey Lake since the implementation of the 2012 stocking plan change.

When compared to the 1990-2011 historical means, catches of 17.0- to 19.5-inch Rainbow Trout have decreased since 2012. These length groups have comprised less than 15% of the total catch in 8 of the last 11 sampling events while the historical average was 26%. In 2023, the percent of Rainbow Trout in the 17.0 to 19.5 inches in total length exceeded the historical average and were 32% of total catch.

Walleye, 15 inches and longer have comprised, on average, 44% of the total yearly Walleye catch since 2012. In 2021-2023, quality length fish comprised 57%, 75%, and 48% of the total yearly Walleye catch, respectively. From 2012 to 2023, the average maximum length for Walleye has been 23.7 inches, an increase of 3 inches over the 1990-2011 average maximum length. The longest Walleye sampled in 2023 was 25.1 inches, the fourth longest since 1990.

Since 2012, 66% of Yellow Perch have been over 9 inches in total length. In 2022, 73% of Yellow Perch were over 9 inches in total length. In 2023, the size structure shifted to slightly smaller fish with 59% of the catch measuring over 9

in total length. The Yellow Perch population in Dailey Lake is stable and has benefited from the changes to the Walleye stocking strategy.

Year-to-year catch rates of Yellowstone Cutthroat Trout have been highly variable since 2011. In 2021, 2022, and 2023, total Yellowstone Cutthroat Trout catch was 3, 194, and 31, respectively. Despite this variability, maximum and mean lengths show increasing trend since the recent low in 2021.

Cottonwood Reservoir

Smallmouth Bass

In July 2020, illegally introduced Smallmouth Bass were confirmed in the reservoir through angling, electrofishing, and gill netting. Varying sizes of Smallmouth Bass indicated that reproduction had likely occurred in the reservoir, which was confirmed by otolith microchemistry.

In August 2021, while potential options to remove Smallmouth Bass from the reservoir were being examined a fish kill occurred. The fish kill appeared to be complete, and no surface flow was coming into the reservoir at that time. Extremely low water elevations in the reservoir combined with warm water temperatures appeared to cause the fish kill. Fish may have moved upstream out of the reservoir prior to disconnection of the inflowing stream but appeared unlikely. Several dead Smallmouth bass were identified among the dead fish. No angler reports of Smallmouth Bass catch have been reported since the fish kill and follow up monitoring will be completed.

Shields River Flow and Temperature Monitoring

Flow Monitoring

Figure 66USGS gage 06192980 provides data for the upper river and is located near the confluence with Smith Creek (Figure 66). This station provides historical data back to August of 2018. Station 06195600 provides data for the lower river and is located approximately 1.5 miles upstream of the confluence with the Yellowstone River. This station provides historical data back to October of 1991. Discharge and temperature data from these stations are used to inform emergency fishing restrictions on the Shields River, which occur when maximum daily water temperatures meet or exceed 73 F for three consecutive days or flows fall to or below the 5th percentile of daily mean values.

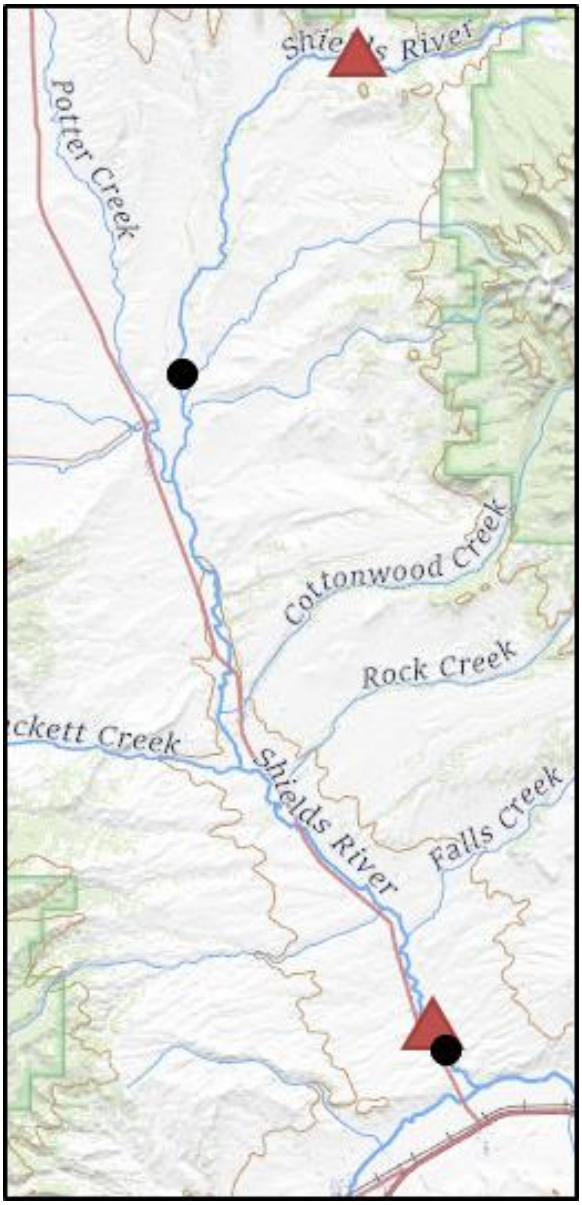

Figure 66: Locations of Shields River USGS stream gauge stations are noted with red triangles and Shields River sampling locations are noted with black dots.

In 2021, measured flows were below historical averages (Figure 67). In the upper river, flows peaked at 286 cfs on June 6th. In the lower river, flows peaked on June 5th at 965 cfs, well below the average peak of 1,100 cfs. Summer flows on the lower river were very low. From July 1st to September 30th, mean daily flows in the lower river were 34% lower than historical means.

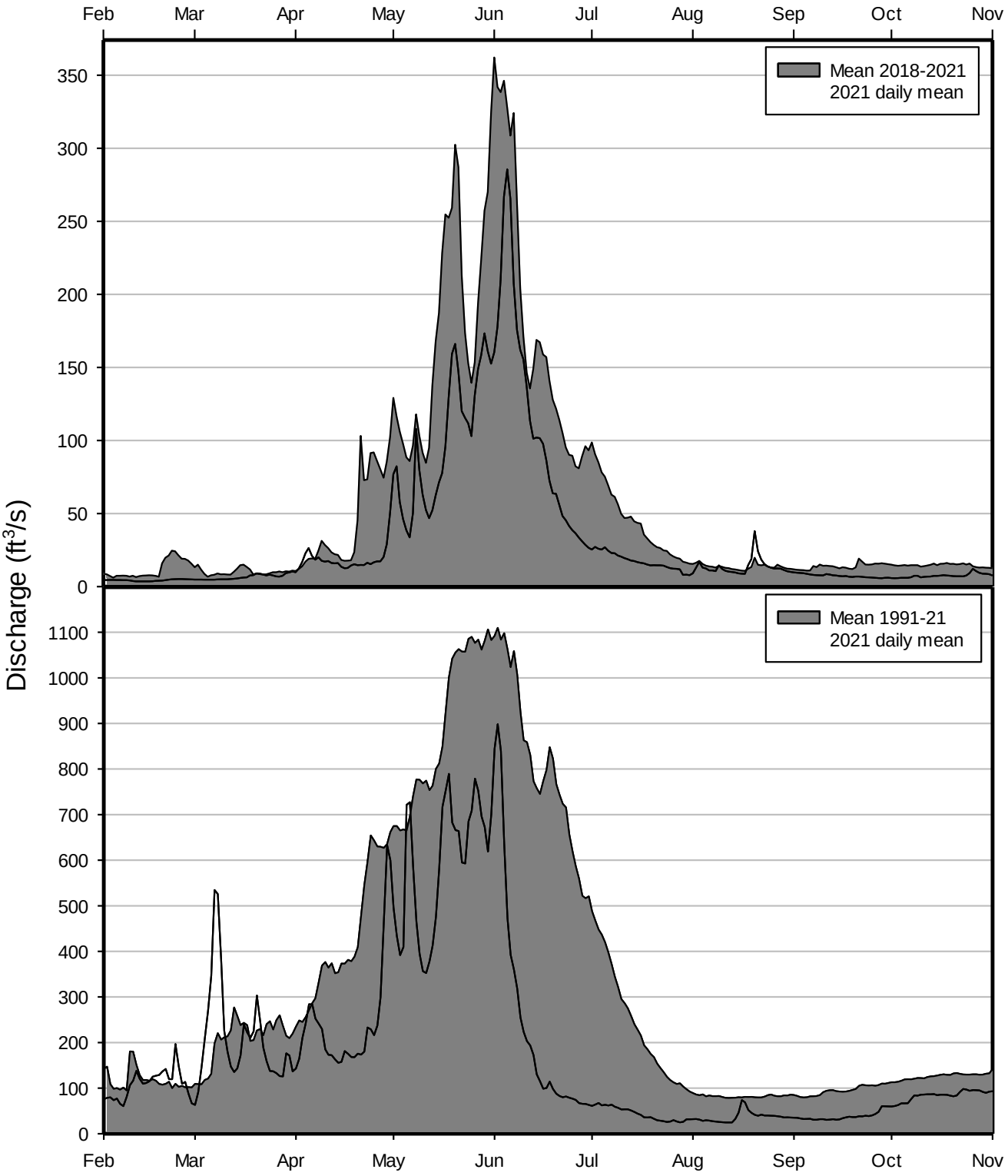

Figure 67: Summary of mean daily flow data for the upper (top figure) and lower (bottom figure) Shields River for 2021. Data collected by USGS stream gauges.

In 2022, flows in the upper river were higher for most of the year than in 2021, while more closely aligning with historical means (Figure 68). Flows peaked at 514 cfs on June 6th and stayed high for most of June. Summer flows were in line with historical means, while October flows were well above. In the lower river, flows were below historical averages for most of the year. Peak flow reached 1,240 cfs on June 6th and did not drop as quickly as 2021. Mean daily flows during June and July were 320% higher in 2022 than in 2021. Despite this increase from 2021, summer flows in 2022 were still below the historical mean.

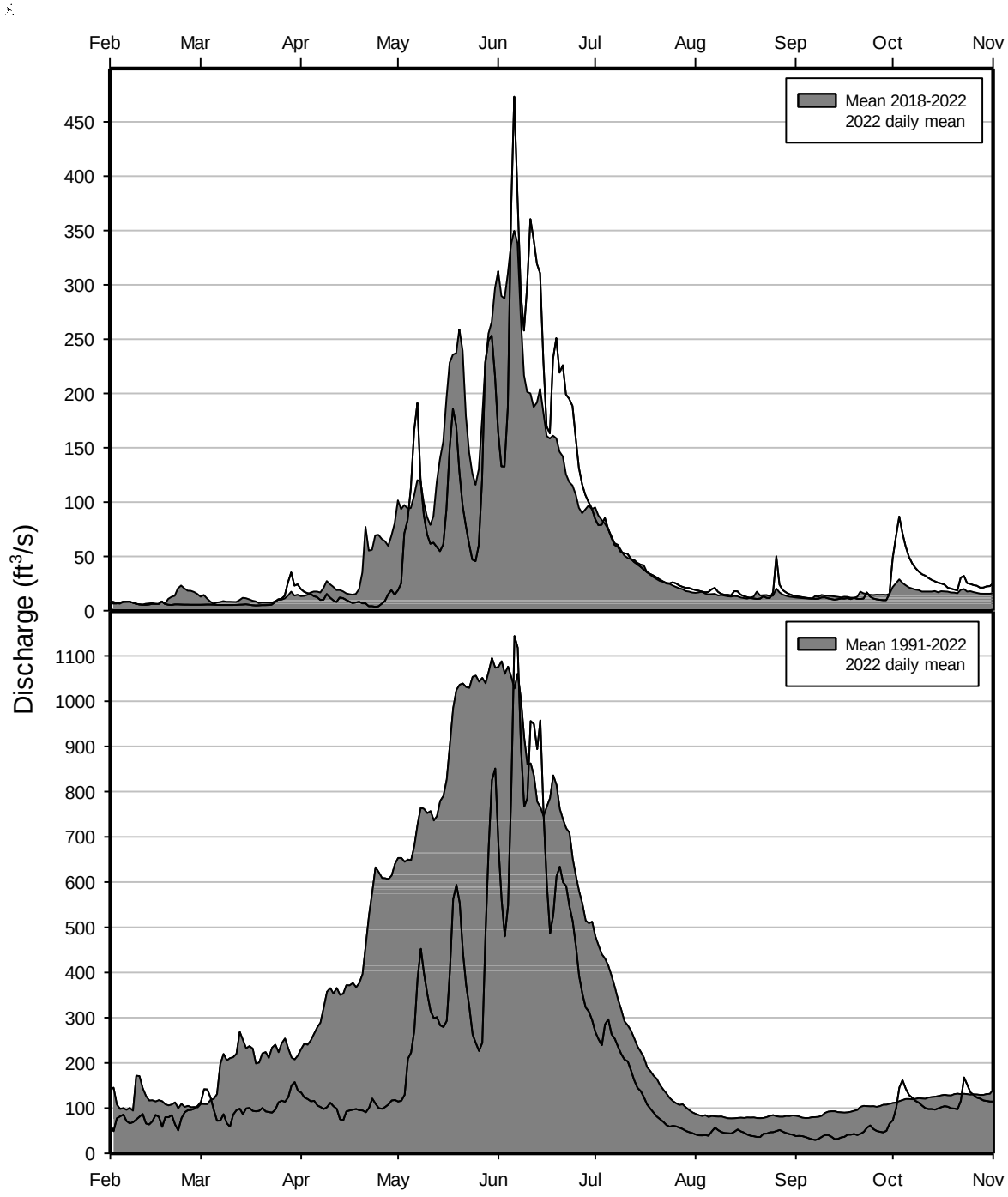

Figure 68: Summary of mean daily flow data for the upper (top figure) and lower (bottom figure) Shields River for 2022. Data collected by USGS stream gauges.

In 2023, flows were mostly above average in both the upper and lower Shields River (Figure 69). In the upper river, daily flows exceeded historical averages on 138 of 183 days between April 1st and August 31st. There were three distinct spikes in flows: May 5, 1,130 cfs, May 14, 733 cfs, and June 3, 1,710 cfs. In the lower river, flows were below average from January through March. On April 7, flow was measured at 134 cfs. Over the next five days flows rapidly rose and on April 12, peaked at 4,980 cfs. Flows remained elevated through the rest of the spring and summer, with additional spikes in flow occurring on May 5, 2,090 cfs, May 17, 1,900 cfs and June 4, 2,230 cfs. From April 1 through October 31, daily flows on the lower river exceeded historical averages on 185 of 214 days.

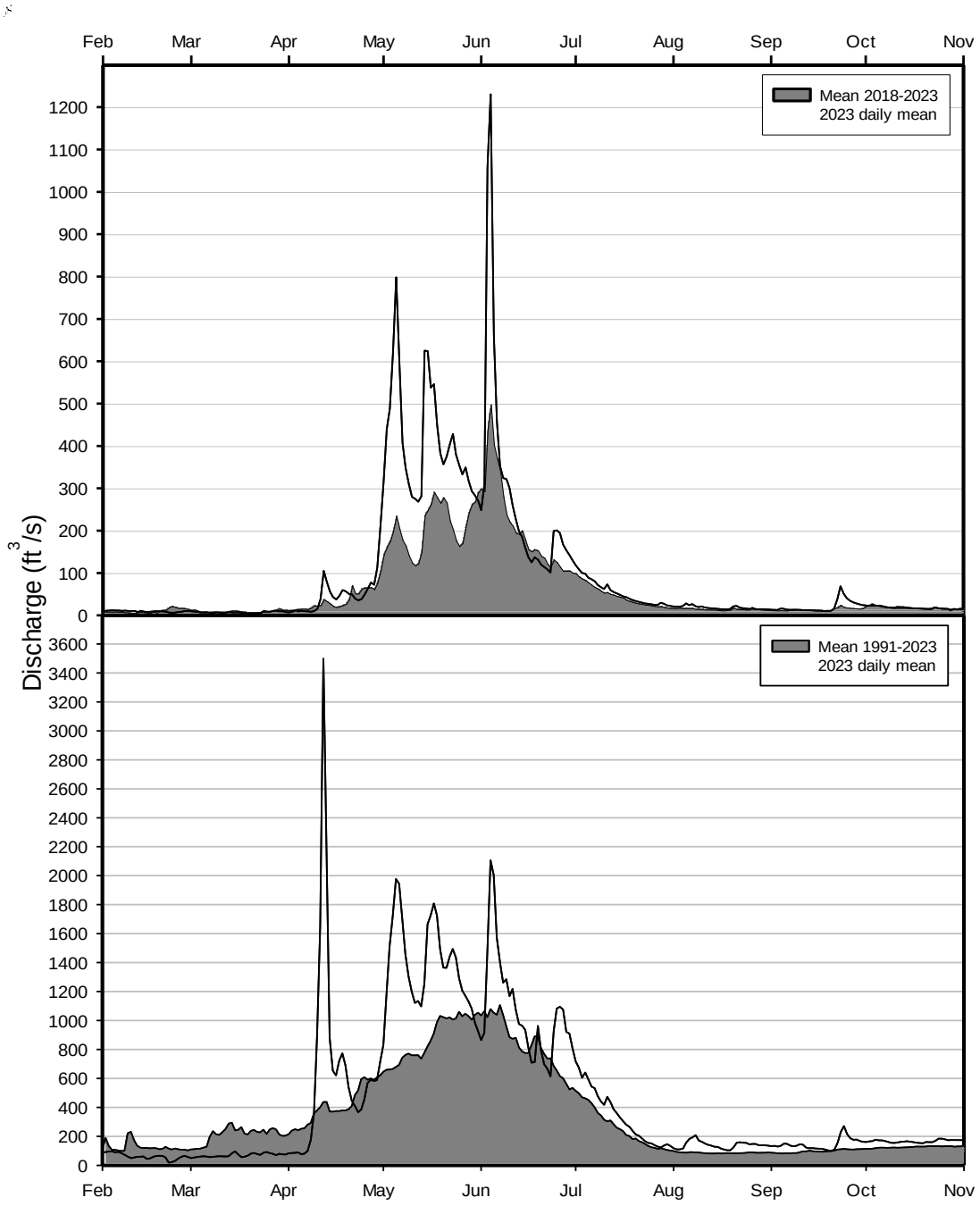

Figure 69: Summary of mean daily flow data for the upper (top figure) and lower (bottom figure) Shields River for 2023. Data collected by USGS stream gauges.

Water Temperature Monitoring

In 2021 and 2023, HOBO Pendant MX Water Temperature Data Loggers were deployed in mainstem of the Shields River to monitor summer water temperatures (Figure 70). The loggers provide critical water temperature data used to inform fishing restrictions and closures on the river. The threshold for hoot owl restrictions is three consecutive days with peak water temperatures above 73°F.

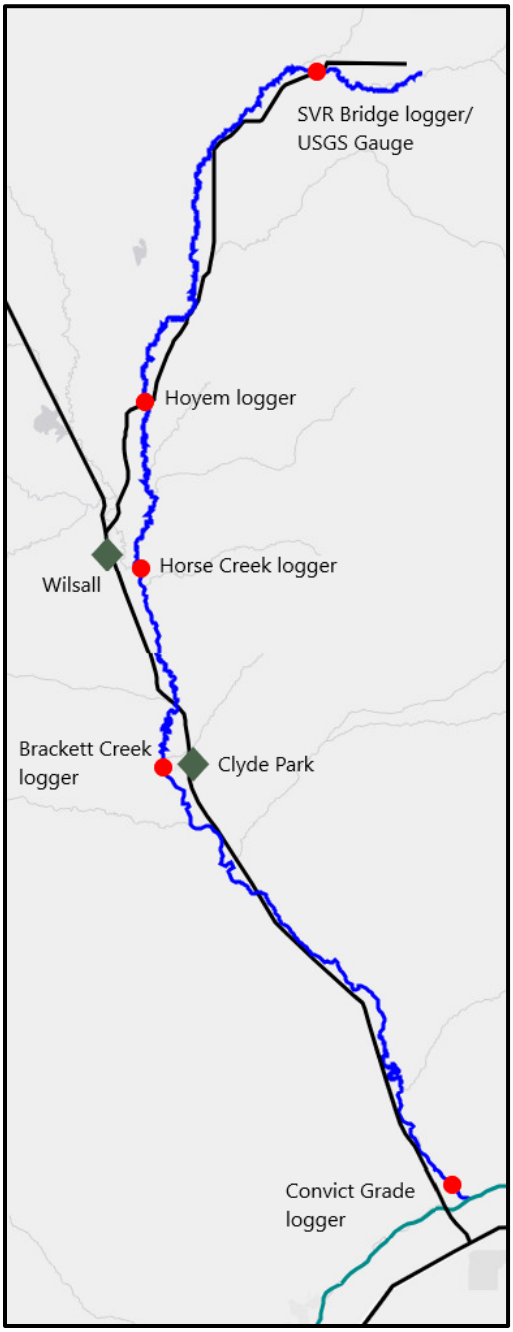

Figure 70: Locations of the Shields River temperature loggers for 2021-2023 represented by red dots.

In 2021, five loggers were deployed between July 2 and August 9, though timing varied by logger. Loggers were deployed at Brackett Creek, Hoyem, and SVR Bridge for 39 days from July 2 to August 9. A logger was deployed at Horse Creek for 35 days from July 6 to August 9 and one at Convict Grade for 18 days from July 2 to July 19.

In 2023, loggers were used at the same locations as 2021 except for the SVR Bridge. All were deployed on July 14 and pulled on September 27, 76 days. The USGS gauge station, 06192980, in the upper Shields River began collecting water temperature in spring 2022. Data from this station was used in 2023 instead of deploying a data logger at SVR Bridge.

In 2021, three of the five loggers recorded daily maximum water temperatures over 73°F (Figure 71). The Convict Grade logger recorded maximum temperatures over 73°F on 9 of the 18 days it was deployed. Brackett Creek exceeded 73°F on 18 of 39 days and Horse Creek exceeded it on 19 of 35 days. The Convict Grade logger recorded consecutive days above 73°F on July 2 through 4 and July 17 through 19. The Brackett Creek logger recorded consecutive days above 73°F four times; on July 2 through 4, July 16 through 21, July 24 through 26, and July 30 through August 1. The Horse Creek logger recorded consecutive days above 73°F for 10 days on July 17 through 26 and five days on July 28 through August 1.

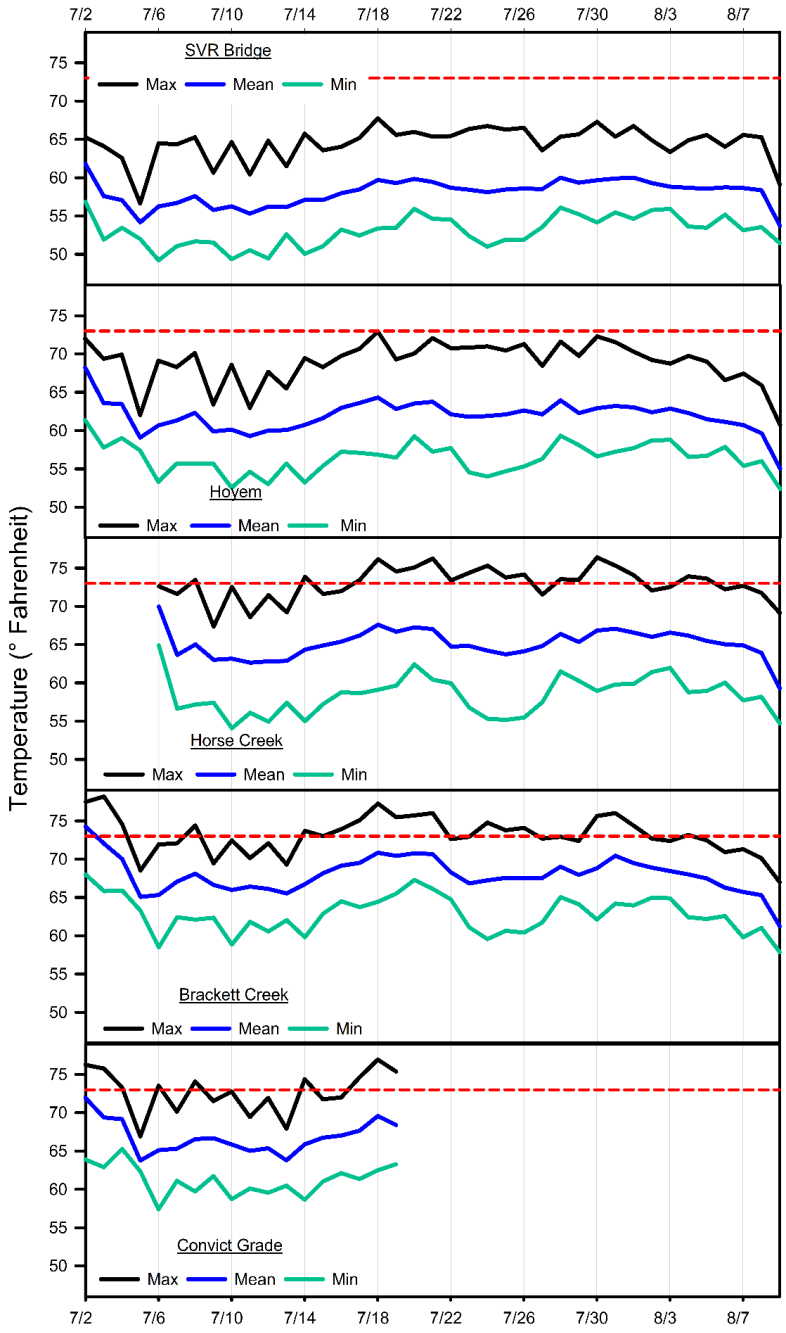

Figure 71: Daily maximum, mean, and minimum water temperatures for the five temperature logger sites on the Shields River for 2021. The red dashed lines represent 73°F.

In 2023, water temperatures in the Shields River peaked near the end of July across all five sites (Figure 72). Several consecutive days of rain and lower daytime air temperatures helped cool the river in early August. The Convict Grade logger reached 73°F on July 22, 73.00°F, and again on July 26, 73.39°F. No other site recorded water temperatures at or over 73°F. The highest recorded temperatures at the other four sites were 72.8°F at Brackett Creek logger on July 30, 72.61°F at Horse Creek logger on July 23, 70.91°F at Hoyem logger July 23, and 65.66°F at USGS Station on July 29. No hoot owl restrictions were enacted on the Shields River as result of water temperatures during 2023.

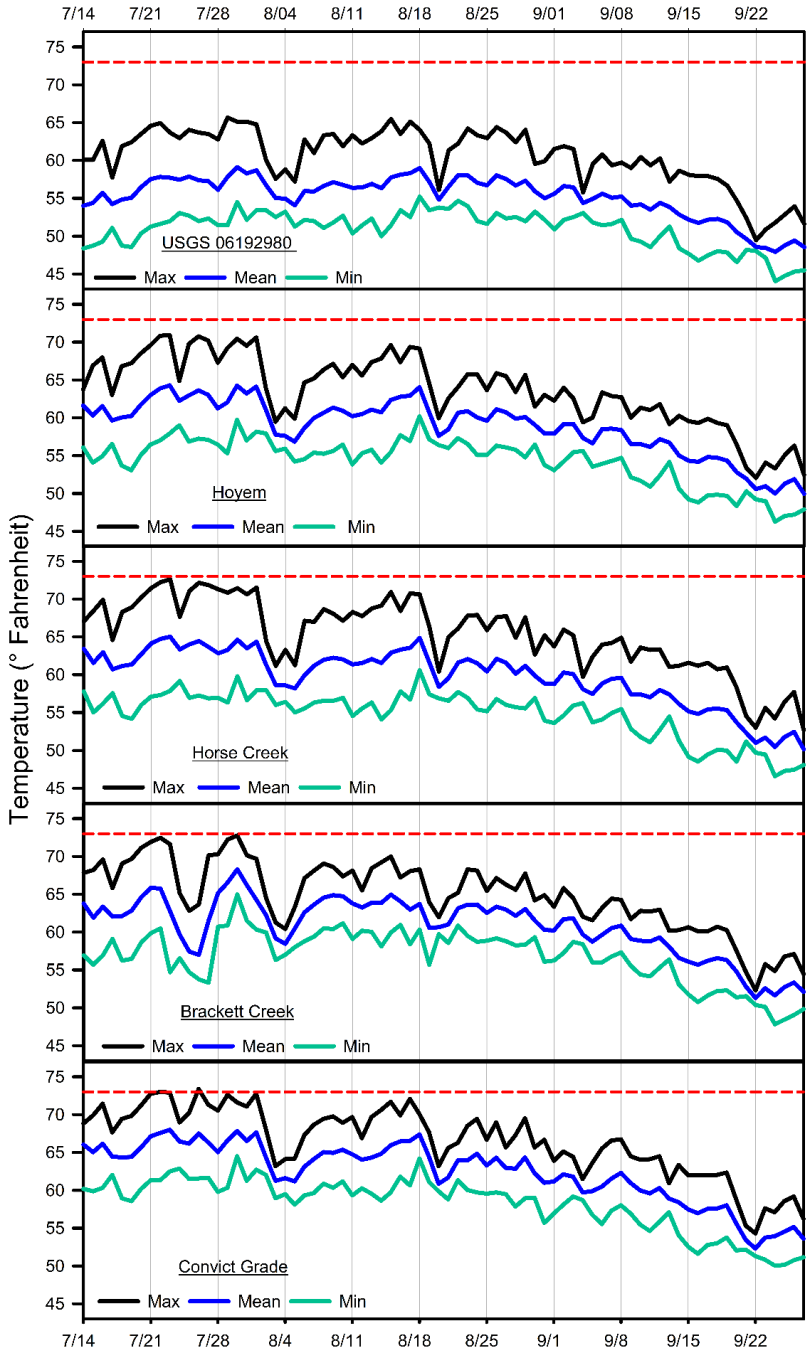

Figure 72: Daily maximum, mean, and minimum water temperatures for the four temperature logger sites on the Shields River. The red dashed lines represent 73°F. Only the Convict Grade logger recorded high temperatures over 73°F.

Fishing Restrictions and Closures

Emergency fishing closures and hoot-owl fishing restrictions were enacted on the Shields River in 2021 and 2022. On June 28, 2021, flows fell below the 5th percentile of the daily mean, while water temperatures were at 70°F and increasing. On June 29, 2021, an emergency fishing closure was enacted on the portion of the Shields River from the confluence with the Yellowstone River to Rock Creek. On July 1, 2021, hoot-owl restrictions were enacted on the

Shields River from Rock Creek to the US Forest Service Crandall Creek Bridge in the upper Shields. The closure and fishing restrictions were in effect until July 21, 2021, at which time a new emergency fishing closure was enacted on the Shields River from the confluence with the Yellowstone River to the Crandall Creek bridge. The new closure was in place for 40 days before ending on August 30, 2021, when river conditions improved.

On August 2, 2022, a hoot-owl restriction was enacted based on water temperatures for the portion of the Shields River from the confluence with the Yellowstone River to the Shields River Road Bridge, where the Hoyem logger is located, between Jordan Bench and Pinkerton roads (Figure 70). The restrictions remained in place for 45 days before expiring on September 15, 2022.

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