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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 2017 and 2018.

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

Annual Report for 2017 and 2018

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Abstract

The Mill Creek and Corwin Springs Sections on the Yellowstone River were sampled in 2017 and 2018, and trout abundance estimates were calculated for both sections. In 2017, Rainbow Trout *Oncorhynchus mykiss*, Brown Trout *Salmo trutta*, and Yellowstone Cutthroat Trout *Oncorhynchus clarki bouvieri* estimates in both sections were all lower than the 2016 estimates. For the Corwin Springs Section in 2018, no population estimates were completed due to the inability to complete the recapture run because of high water. Brown Trout and Rainbow trout populations in the Mill Creek Bridge Section both increased in 2018, but Yellowstone Cutthroat Trout in this section continued to decrease. River conditions prohibited sampling of Shields River sections in 2017 and 2018. Results from the long-term gill netting series in Dailey Lake show that catch-per-unit-effort (CPUE) for Walleye *Stizostedion vitreum* and Yellow Perch *Perca flavescens* decreased in both 2017 and 2018. Rainbow and Yellowstone Cutthroat Trout both increased in 2017 and 2018, after neither species being present in the catch in 2016. Average lengths of Rainbow Trout and Yellow Perch increased in 2017 and decreased in 2018. Average lengths of Yellowstone Cutthroat Trout and Walleye increased both years.

Introduction

Electrofishing Procedures

Mark-recapture methodology was used to estimate trout populations in the Yellowstone River. Marking and recapture runs consisted of electrofishing the entire section or reach of river, with multiple fish-working stops to minimize stress of sampled fish. During the marking run all fish were marked with a fin clip, which can be detected during subsequent sampling events. The fish were then 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 that had the fin clip were noted as recaptured.

Yellowstone River Procedures

In spring 2017 and 2018, trout were sampled in the Mill Creek Bridge and Corwin Springs Sections of the Yellowstone River (**Error! Reference source not found.** and **Error! Reference source not found.**), both of which are long-term mo nitoring sections. Mountain Whitefish were sampled in a subsection of the Corwin Springs Section in 2017 and the Mallard's Rest Section in 2017 and 2018 (**Error! Reference source not found.** and **Error! Reference source not found.**).

Table 1 Survey sections where trout and Mountain Whitefish sampling occurred in the Yellowstone River in 2017 and 2018. Coordinates in decimal degrees are NAD83 datum.

Section Name	Survey Date	Length (ft)	Approximate Location		
Mill Creek Bridge	03/28/17	20,280	Upper Boundary	North West	45.41967 -110.64214
			Lower Boundary	North West	45.45423 -110.61621
Mill Creek Bridge	04/25/18	23,385	Upper Boundary	North West	45.41967 -110.64208
			Lower Boundary	North West	45.45764 -110.61621
Corwin Springs	4/20/17 4/26/18	21,540	Upper Boundary	North West	45.10800 -110.78955
			Lower Boundary	North West	45.15776 -110.82778
Mallard's Rest	03/27/17 04/24/18	6,600	Upper Boundary	North West	45.48545 -110.62101
			Lower Boundary	North West	45.49075 -110.59970

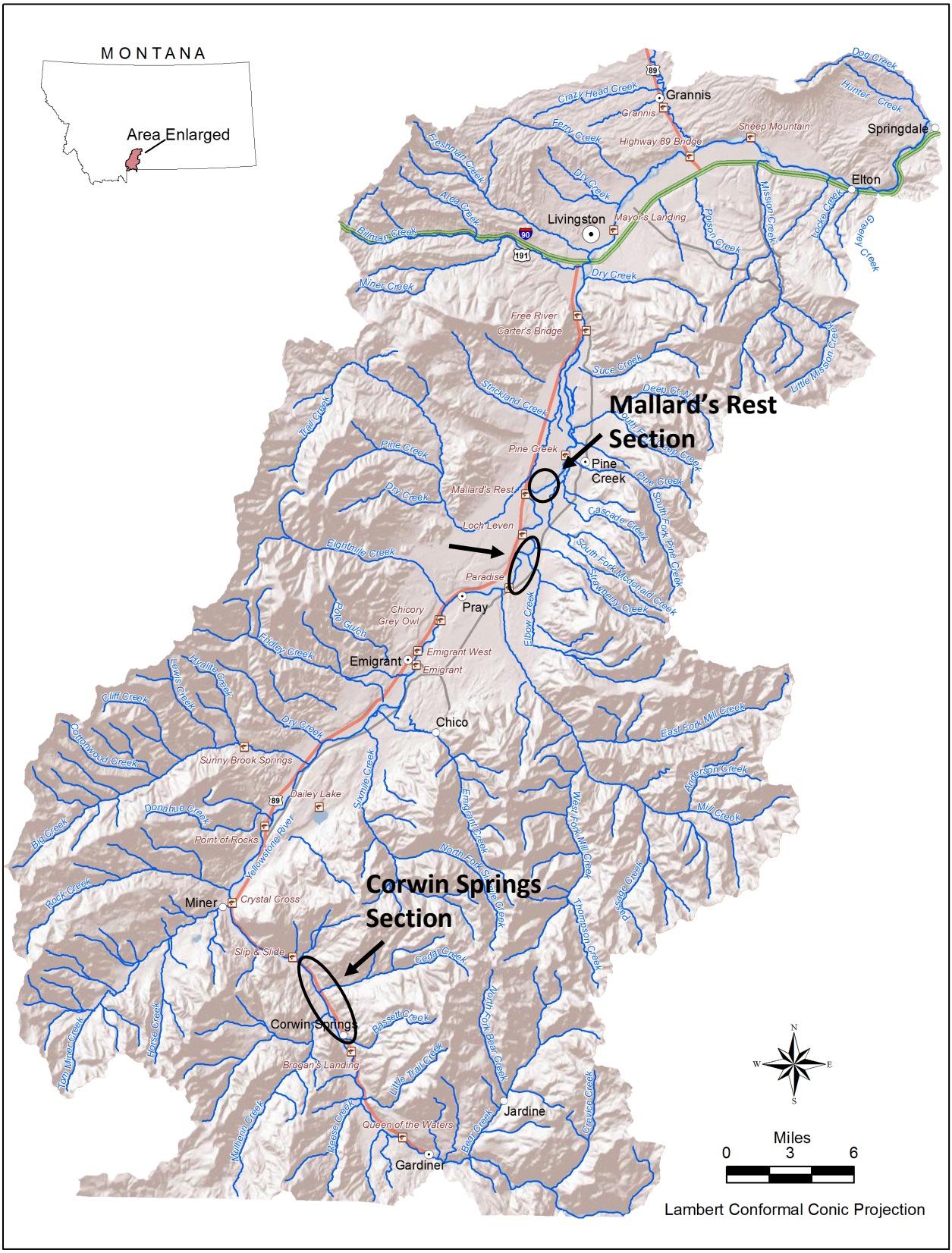

Figure 1: Map of the upper Yellowstone river displaying the 2017 and 2018 sampling locations.

Electrofishing of the Yellowstone River 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 Coffelt™ VVP-15 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 hull served as the cathode.

Mark-recapture efforts were made on the Mill Creek and Corwin Springs sections for trout and a catch-per-unit-efforts (CPUE) were made on the Mallard's Rest section and the subsection of the Corwin Springs Section for Mountain Whitefish. Fish 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 were marked with a fin clip and returned to the river. Seven days after the last marking run, the recapture effort was made.

Population abundance was estimated using the Chapman Modified Peterson method (Chapman 1951). Population estimates for Brown, Rainbow, and Yellowstone Cutthroat Trout (YCT) $\geq$ 7 inches were calculated in both sections.

Corwin Springs Section

The Corwin Springs Section is a long-term monitoring section that has been sampled since 1978 (Figure 1). In 2017, the section was sampled using the mark-recapture method to produce population estimates for trout and CPUE was used for Mountain Whitefish in a subsection of the sample reach. In 2018, due to flow conditions the mark-recapture effort could not be completed and CPUE was used for trout and Mountain Whitefish were not sampled.

The section was marked on April 20, 2017. The section was split into five subsections and sampled with one boat on each bank. Trout were sampled in all five subsections. Mountain Whitefish were only sampled in the upper most subsection to obtain and compare data to a similar effort in 1999. All trout were marked with an anal fin clip.

The recapture effort was completed on April 27, 2017 and all five subsections were completed with two boats, one on each bank.

In 2018, the marking run was completed on April 26. The section was split into five subsections and two boats, one on each bank, were used to complete the effort. All trout were given a left pelvic clip and Mountain Whitefish were not sampled. A recapture run was not completed in 2018 was due to exceedingly high stream flows.

Population estimates, by species, for the Corwin Springs Section in 2017 are presented below (Table 2). A CPUE was calculate for Mountain Whitefish.

Table 2: Population estimate results for the Corwin Springs Section of the Yellowstone River by species in 2017. 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%
2017	Rainbow Trout	261	363	193
	Brown Trout	202	297	142
	Yellowstone Cutthroat Trout	210	252	178

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), and below the 1978-2016 mean of 353 fish/mile (≥ 7in) (Figure 2). The decrease in abundance is small enough to be the result of annual fluctuation and may not be directly related 2016 PKD fish kill (Opitz and Rhoten 2017).

As noted earlier a population estimate was not completed in 2018 due to high river flows preventing completion of the recapture effort.

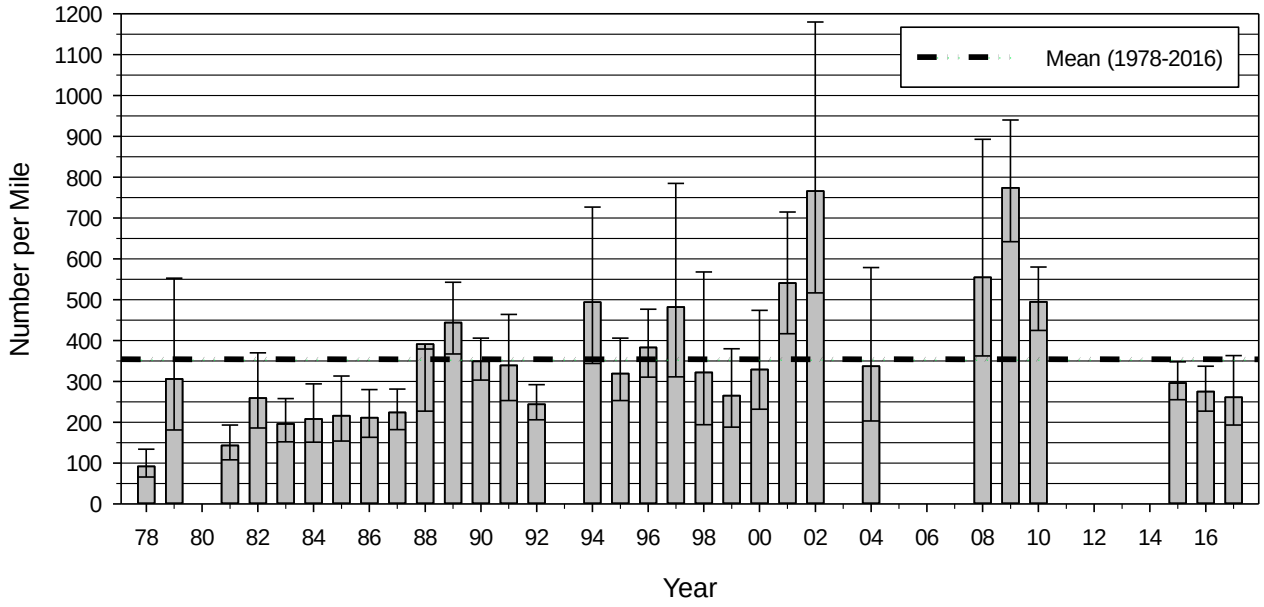

Figure 2: Corwin Springs Rainbow Trout population estimates for fish 7 inches and greater from 1978 to 2017. The error bars represent the upper and lower 95% confidence intervals.

The 2017 length-frequency distribution for Rainbow Trout in the 6.0 to 14.0-inch range decreased when compared to 2016 (Figure 3). The largest decrease in an individual length group, 6.2%, was in the 12.0 inch-group. Rainbow Trout increased from 2016 to 2017 in the 14.5 to 20.0-inch range. The largest increase in an individual length group was 3.5% in the 16.0 inch-group. As stated earlier, there does not appear to be a population-level effect due to PKD.

In 2018, length-frequency distribution for Rainbow Trout in the 8.5 to 13.5-inch range generally continued to decrease when compared with 2017 and remained below the 2014-2016 mean (Figure 3). The largest decrease, 5.3% occurred in the 13.0-inch group. Rainbow Trout in the 14.0 to 16.5-inch range continued to increase and remain above the 2014-2016 mean with the largest increase occurring in the 14.0-inch group at 4.8%. Rainbow Trout 17.0 inches and larger decreased and fell below the 2014-2016 mean in 2018 when compared to 2017 except for fish in the 20.0 and 20.5-inch groups.

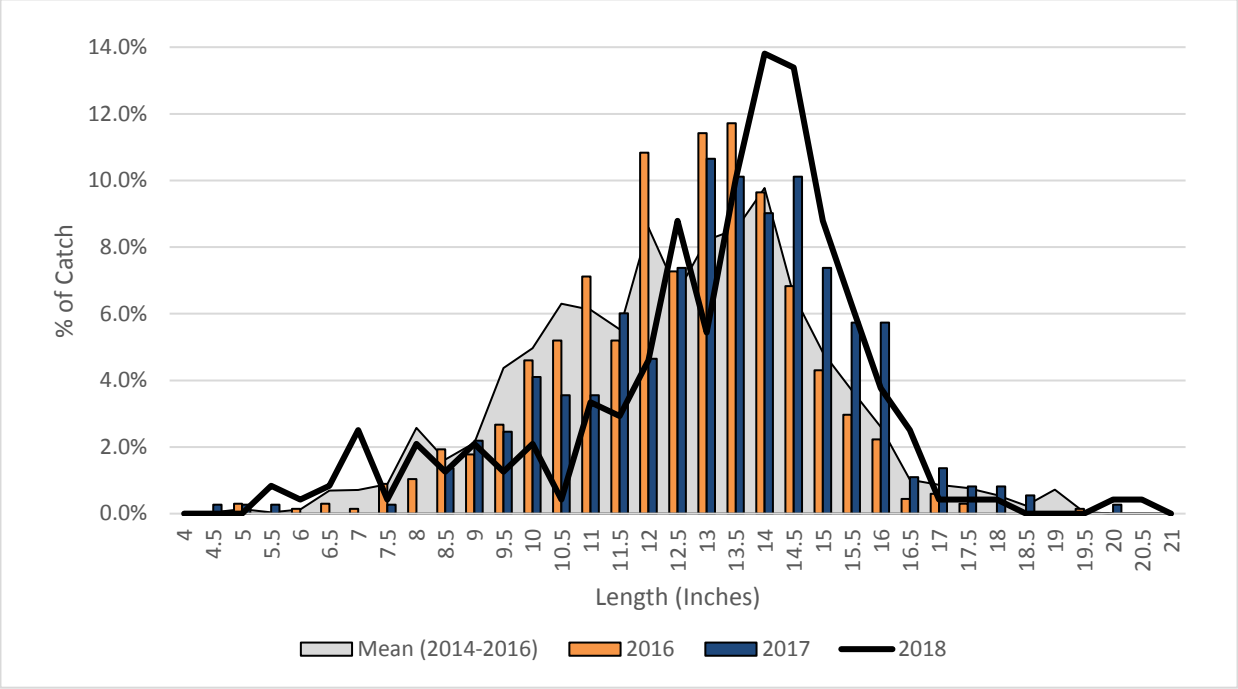

Figure 3: Length-frequency distribution for Rainbow Trout in the Corwin Springs Section by half-inch group for 2016-2018 and the mean for 2014-2016.

Brown Trout

Like Rainbow Trout, the 2017 Brown Trout population estimate was lower than the two prior years and remained below the long-term mean. The 2017 Brown Trout population estimate was 202 fish/mile (≥ 7in) down from 323 and 206 fish/mile (≥ 7in) in 2015 and 2016, respectively (

Figure 4). There does not appear to be a population-level effect on Brown Trout in the Corwin Springs Section due to the 2016 PKD fish kill (Opitz and Rhoten 2017).

Due to high flows after the marking run was completed a Brown Trout population estimate was not completed for the Corwin Springs Section in 2018.

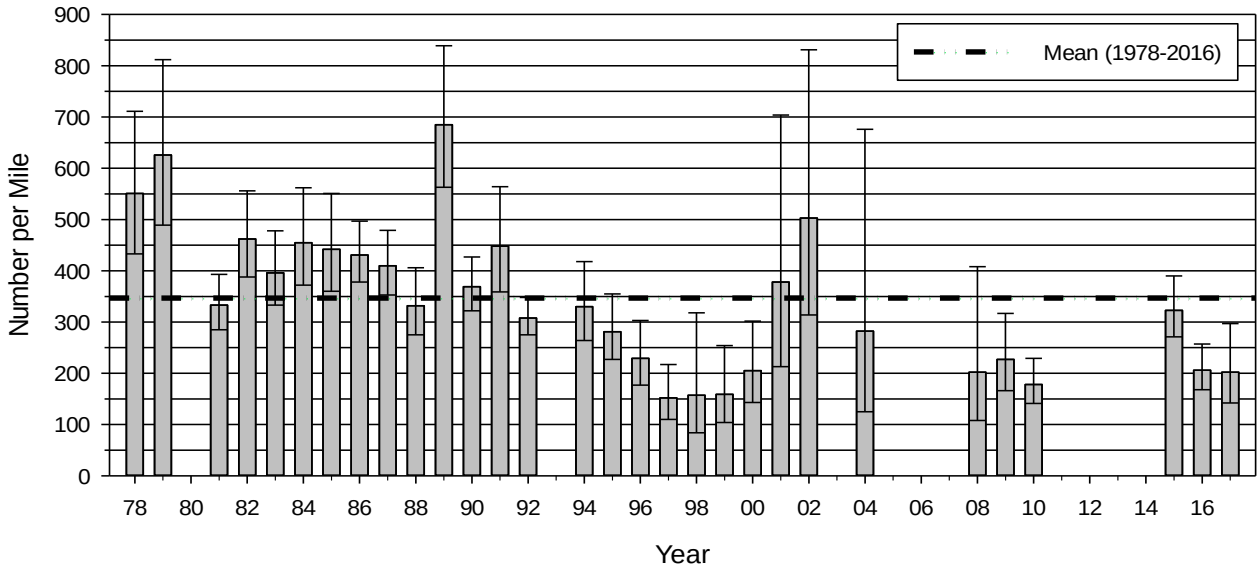

Figure 4: Corwin Springs Brown Trout population estimates for fish 7 inches and greater from 1978 to 2017. The error bars represent the upper and lower 95% confidence intervals.

The length-frequency distribution for Brown Trout in the Corwin Springs Section, in 2017, indicated some changes compared to 2016 and the 2014-2016 mean. There was an increase from 2016 to 2017 in the 7.5 to 12.0-inch range and fish in the 10.0 to 12.0-inch range were also higher than the 2014-2016 mean (Figure 5). The largest increase in an individual length group, 4.7%, was in the 10.0 inch-group. There was a decrease in the distribution of fish in the 12.5 to 16.5-inch range from 2016 to 2017. The largest decrease in an individual length group was 4.9% in the 15.5-inch group.

The 2018 length-frequency distribution for Brown Trout increased in the 6.0 to 9.5-inch range when compared to 2017 and was also above the 2014-2016 mean, indicating a strong year class of fish (Figure 5). There were decreases when compared to 2017 in the 10.0 to 12.5-inch range and no fish in the 11.5-inch group were captured. The length-frequency distribution for Brown Trout in the 13.0-inch and larger range was similar to the 2014-2016 mean with the exception of fish in the 15.5 and 16.0-inch range.

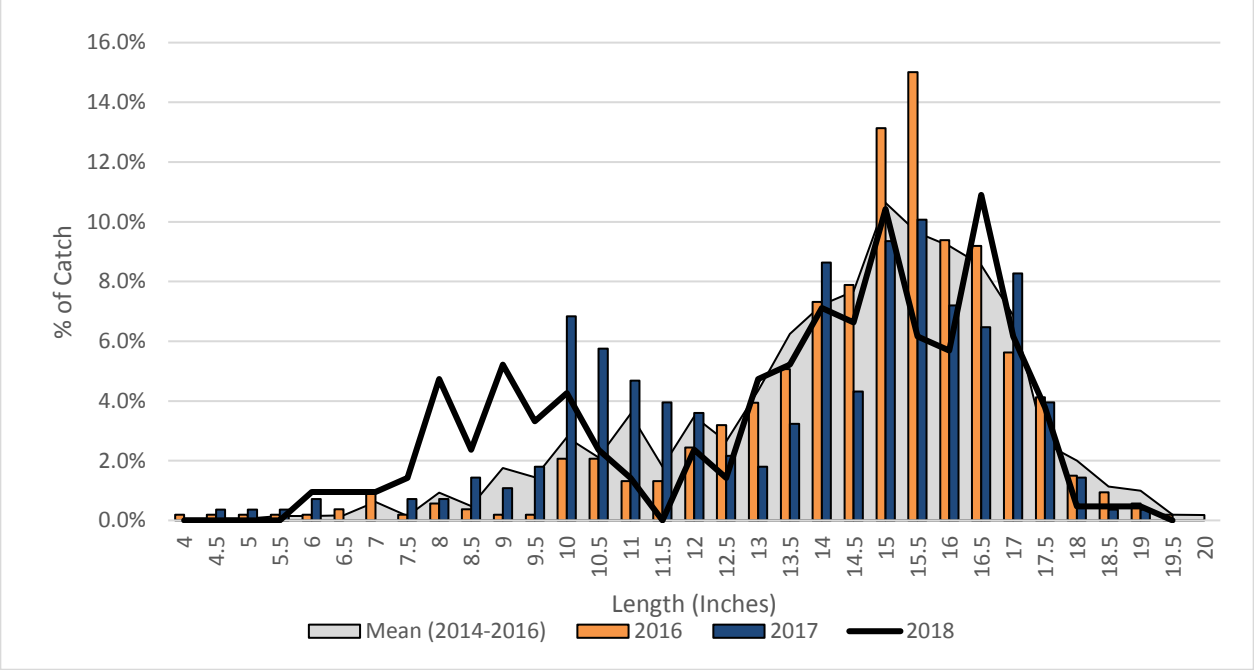

Figure 5: Length-frequency distribution for Brown Trout in the Corwin Springs Section by half-inch group for 2016-2018 and the mean for 2014-2016.

Yellowstone Cutthroat Trout

The 2017 population estimate for YCT decreased from the prior two years like the Rainbow and Brown Trout estimates for this section. The 2017 estimate was 210 fish/mile (≥ 7in) compared to 287 and 289 fish/mile (≥ 7in) in 2015 and 2016, respectively (Figure 6). This is the lowest abundance estimate for YCT in this section since 1979 and was also below the long-term mean of 314 fish/mile (≥ 7in). The decline in abundance may have been the result of annual variability and a limited impact from the PKD fish kill in 2016 or some other factor.

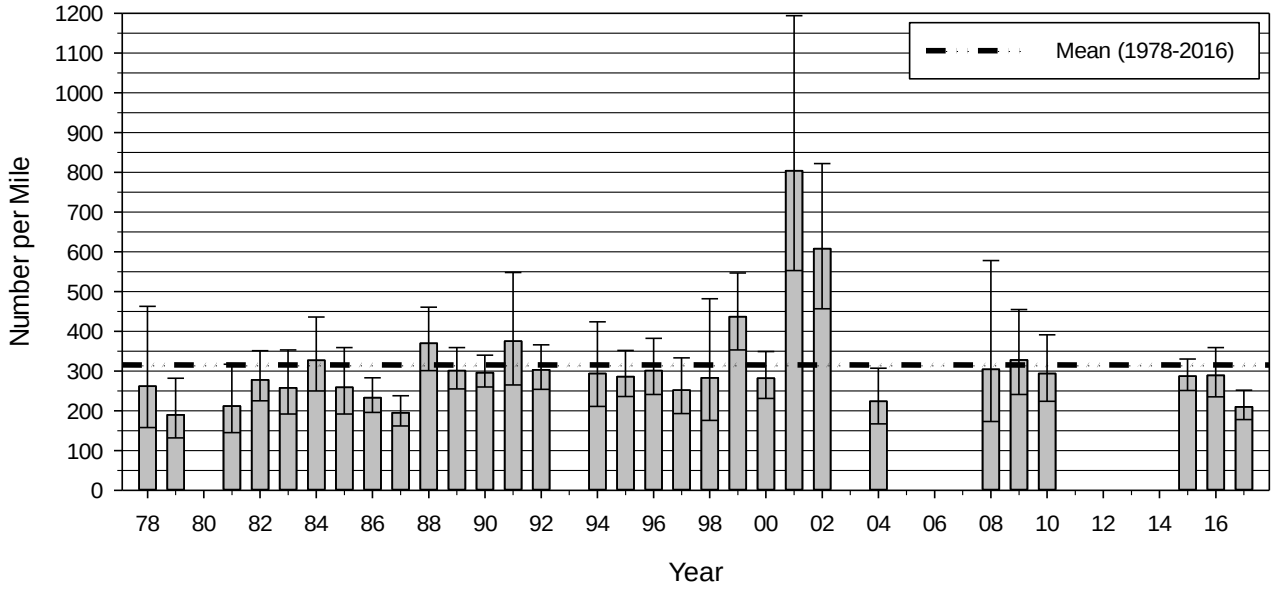

Figure 6: Corwin Springs YCT population estimates for fish 7 inches and greater from 1978 to 2017. The error bars represent the upper and lower 95% confidence intervals.

The length-frequency distribution of YCT across length groups in 2017 varied little from 2016 and was similar to the 2014-2016 mean (Figure 7). The 2018 length-frequency distribution was similar to both 2016 and 2017 with the exception of an increase in the 6.5 to 8.5- inch range suggesting a strong year class and a decrease in the 9.0 to 10.0-inch range limited recruitment of fish in that length range.

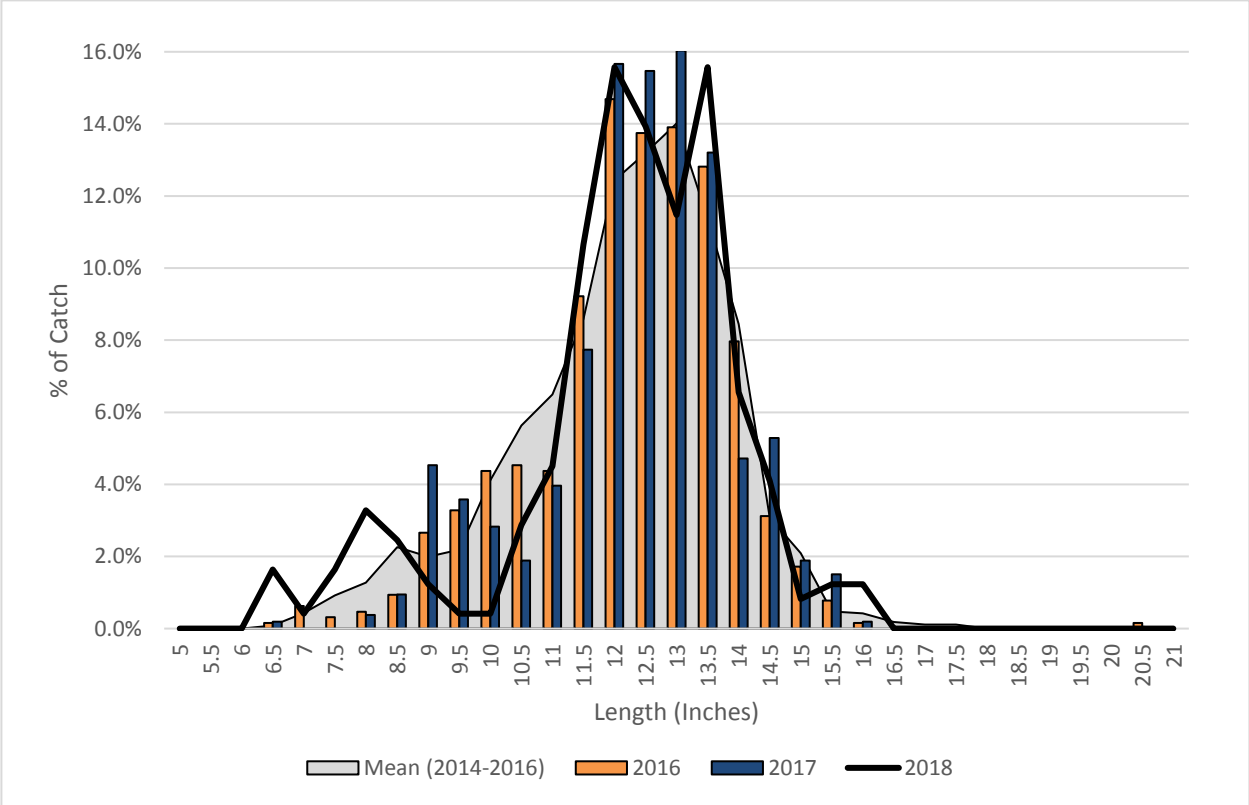

Figure 7: Length-frequency distribution for Yellowstone Cutthroat Trout in the Corwin Springs Section by half-inch group for 2016-2018 and the mean for 2014-2016.Mountain Whitefish

Mountain Whitefish

The 2017 Mountain Whitefish CPUE of 1,130 fish/mile (≥ 7in) for Corwin Springs was higher than the CPUE from 1999 of 1,070 fish/mile (≥ 7in) (Figure 8). The 18-year time span between CPUE efforts and the lack of more data points makes it difficult to determine if significant changes have occurred. The increase is likely natural variability in the population and provides indication that PKD had little to no impact when combined with the sparse numbers of dead fish detected in this portion of the river in 2016.

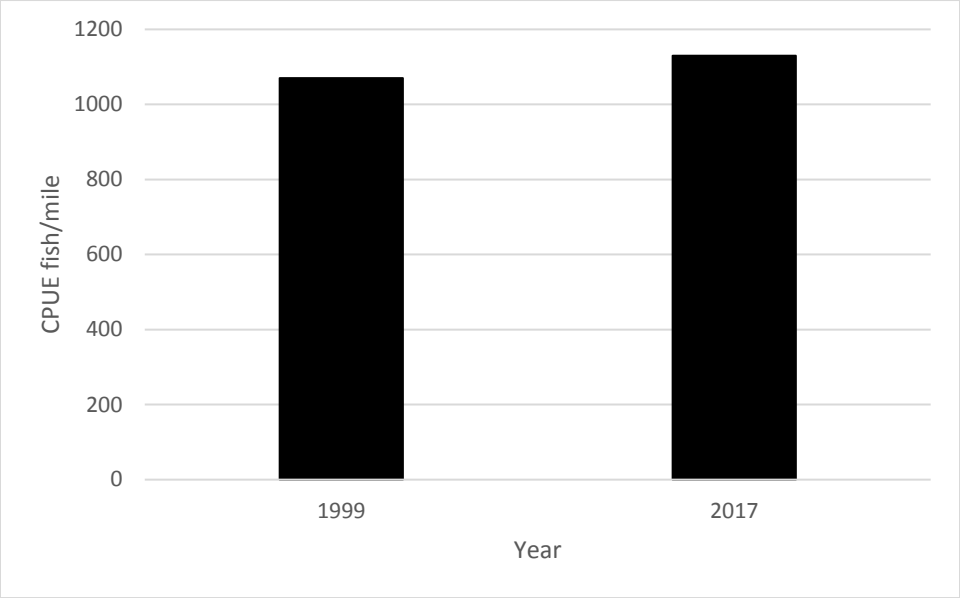

Figure 8: Corwin Springs Mountain Whitefish CPUE for fish 7 inches and greater from 1999 and 2017.

The distribution of MWF across length groups in 2017 varied from 1999. An increase of 40.2% was observed in the 8.0 to 12.0-inch range with the largest individual length group increase in the 11.5 inch-group, 15.4% (Figure 9). Decreases of 10.0% in the 4.5 to 6.5- inch range and 29.7% in the 12.5 to 14.0-inch range were observed in 2017. The largest individual length group decrease was 20.2% in the 12.5-inch group. As mentioned earlier, it is difficult to determine how significant these changes are based on limited data and an 18-year sampling gap.

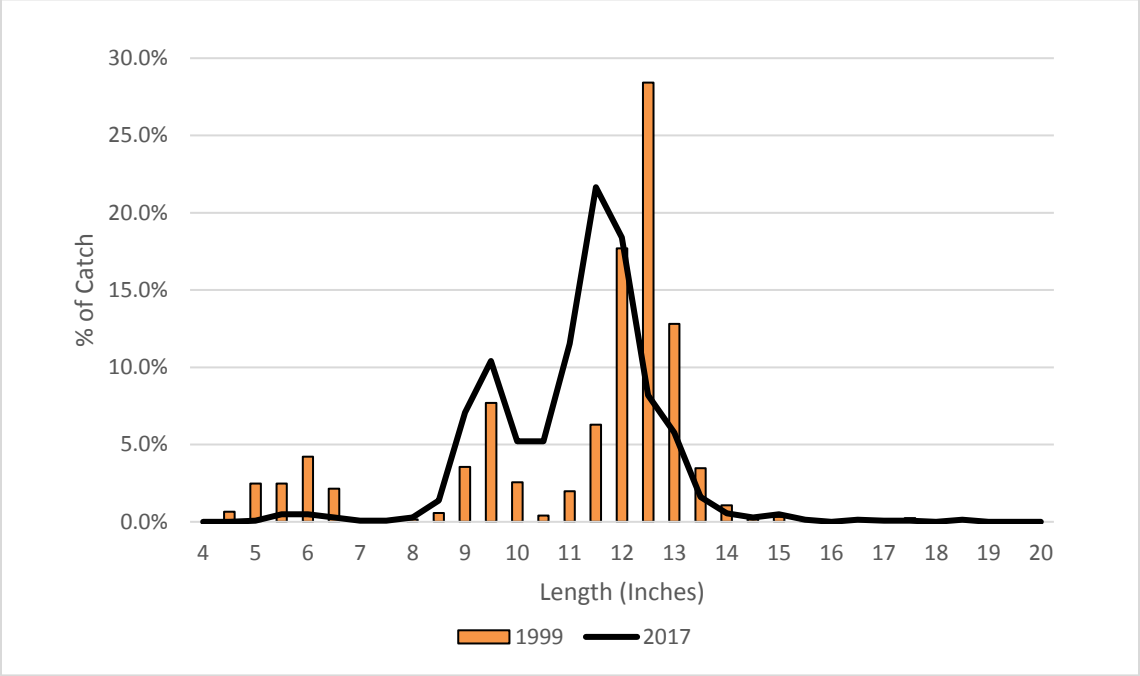

Figure 9: Length-frequency distribution for Mountain Whitefish in the Corwin Springs Section by half-inch group for 1999 and 2017.

Summary

Proportions of Brown Trout, Rainbow Trout, and YCT in the Corwin Springs Section varied in 2016 and 2017 (Figure 10). Due to river conditions in 2018, no population estimates were completed. YCT had the highest abundance of the three species in 2016 and Rainbow Trout had the highest in 2017. 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, and 2016. The trend of YCT having abundance levels between Brown and Rainbow Trout has been ongoing since the early 1980s.

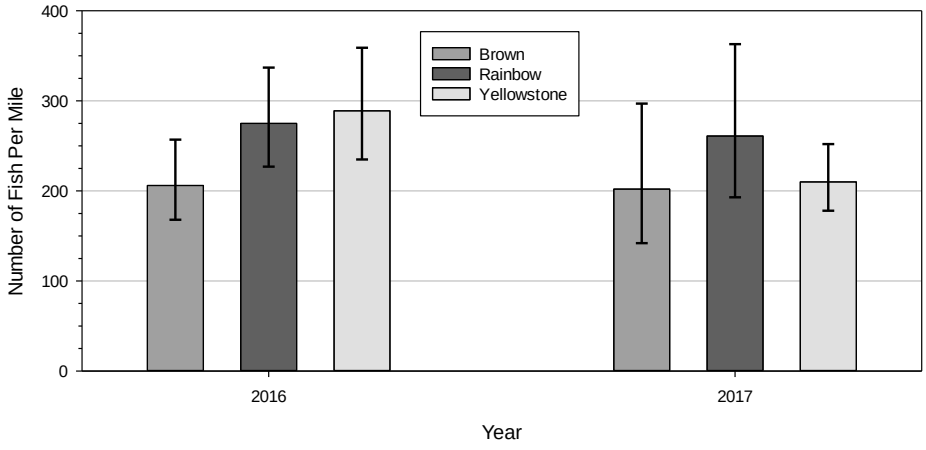

Figure 10: Abundance estimates for Brown, Rainbow, and Yellowstone Cutthroat Trout (≥ 7in) in the Corwin Springs Section of the Yellowstone River for 2016 and 2017. Error bars represent the upper and lower 95% confidence intervals.

When length-frequencies for all trout species in the Corwin Springs Section were plotted for 2016, YCT made up most of the fish in the 9.0 and 9.5-inch groups and the 11.5 to 13.5-inch length ranges (Figure 11). Brown Trout made up the

largest part of the fish in the 4.0 and 4.5, 5.5 to 7.0, and 14.5 to 19.5-inch ranges. Rainbow Trout made up the majority of the fish in the 5.0, 7.5 to 8.5, 10.0 to 11.0, and 14.0-inch length ranges.

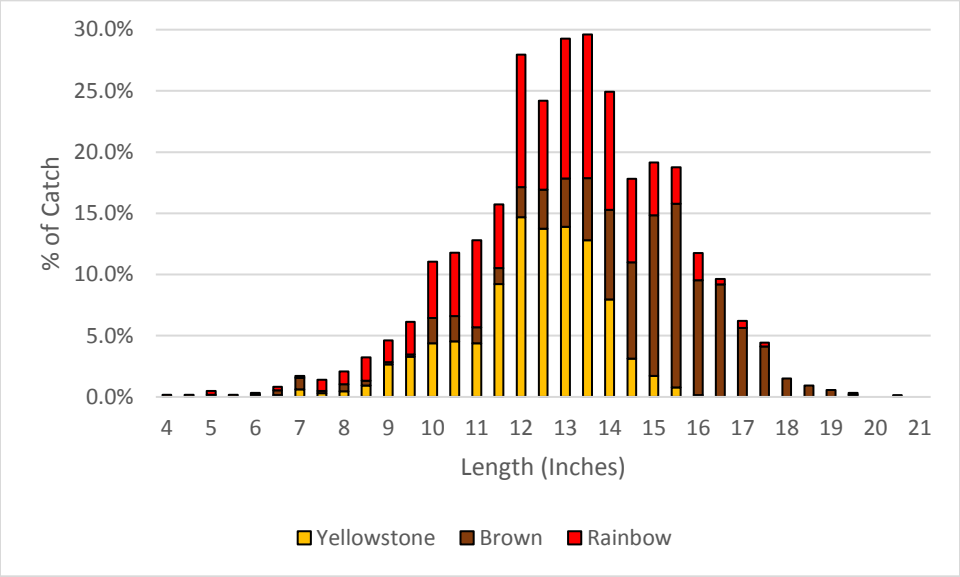

Figure 11: Length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Corwin Springs Section of the Yellowstone River in 2016.

The combination of length-frequencies for all trout in the Corwin Springs Section in 2017 indicate that YCT made of the majority of the fish in the 6.5 and 11.5 to 13.5-inch length ranges (Figure 12). Brown Trout made up most of the fish in the 4.5 to 6.0, 7.5 to 8.0, 10.0 to 11.0, 15.0 to 18.0, and 19.0-inch length ranges. Rainbow trout made up the largest part of the fish in the 8.5 to 9.5, 14.0 and 14.5, and 18.0-inch ranges.

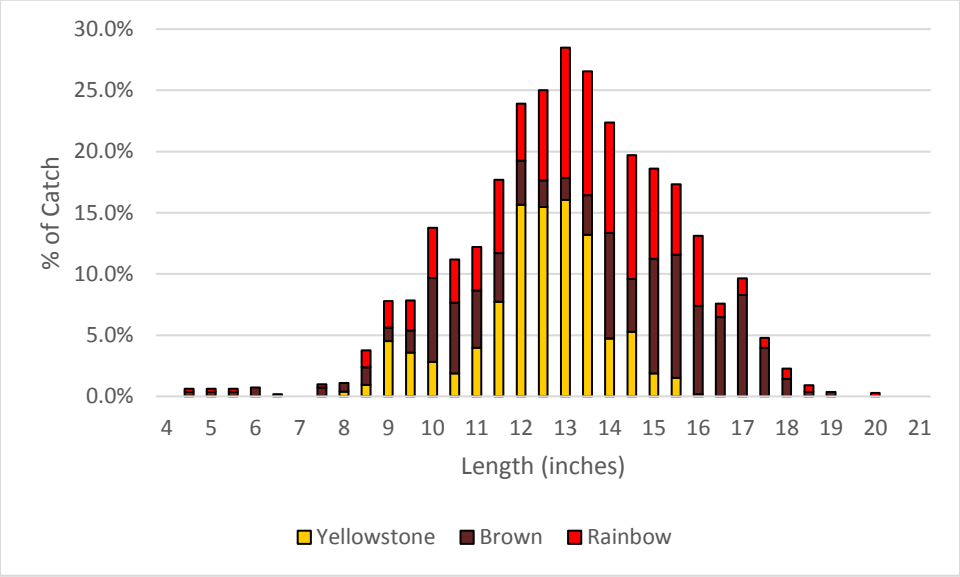

Figure 12: Length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Corwin Springs Section of the Yellowstone River in 2017.

Similar trends in length-frequency distributions were observed when all species of trout were combined in 2018 (Figure 13). YCT 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.

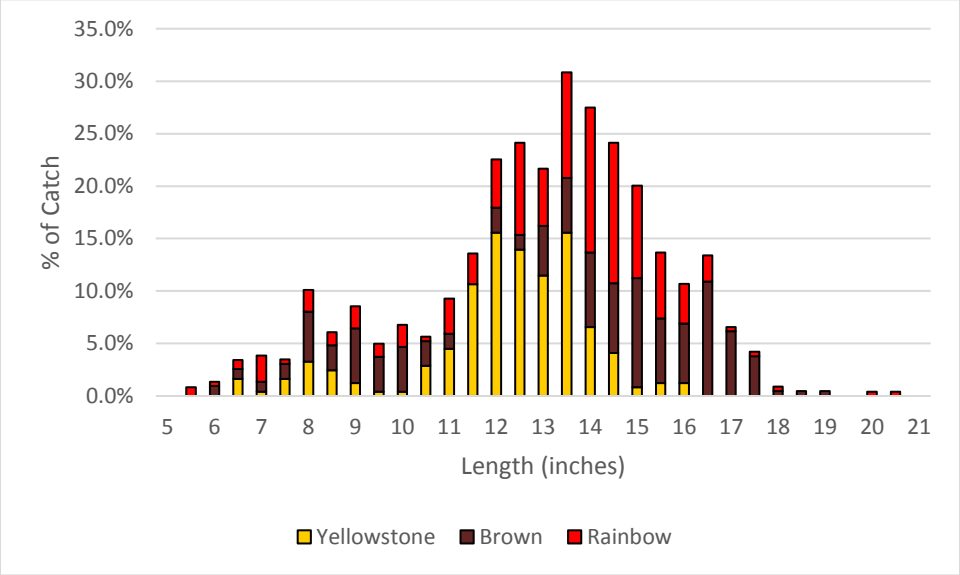

Figure 13: Length-frequency distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Corwin Springs Section of the Yellowstone River in 2018.

In the Corwin Springs Section, data collected in 2017 indicate that there were declines in abundance of trout that appear to be within the normal range of variability. The CPUE for MWF increased slightly from 1999 to 2017. There appears to be little to no impact on trout and MWF populations in the Corwin Springs Section because of PKD in 2016. Trout and MWF length-frequency distributions indicate changes in distributions in both 2017 and 2018, but not of any significance to cause concern. Overall trout and MWF populations in the Corwin Springs Section are doing well.

Mill Creek Bridge Section

The Mill Creek Bridge Section is a long-term monitoring section that has been sampled since 1981 (Figure 1). In 2017 and 2018, the section was sampled using the mark-recapture method to produce population estimates for trout

The section was marked on March 28, 2017. 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 effort was completed on April 3, 2017 and all four subsections were completed with two boats like the marking run.

In 2018, the marking run was completed on April 25. The section was split into four subsections and one boats was used to complete the marking effort. All trout were given a left pelvic clip. The recapture run was completed on May 3, 2018. Two boats, one on each bank, were used to complete the recapture of all four subsections.

Population estimates, by species, for the Mill Creek Bridge Section for 2017 and 2018 are presented below (Table 2).

Table 3: Population estimate results for the Mill Creek Bridge Section of the Yellowstone River by species in 2017 and 2018. 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%
2017	Rainbow Trout	249	216	292
	Brown Trout	215	179	265
	Yellowstone Cutthroat Trout	62	46	89
2018	Rainbow Trout	318	282	362
	Brown Trout	292	253	340
	Yellowstone Cutthroat Trout	55	41	78

Rainbow Trout

The 2017 Rainbow Trout population estimate was 249 fish/mile (≥ 7in) (Figure 14). This was the lowest estimate since 2001 and was below the long-term mean of 310 fish/mile (≥ 7in). The decrease in abundance is large enough when compared to previous estimates that PKD may have had a population-level effect on Rainbow trout in the Mill Creek Bridge Section in 2016. It should be noted that factors other than PKD may have contributed to the decline in abundance (e.g., drought conditions, spring runoff, etc.).

The 2018 population estimate for Rainbow Trout in the Mill Creek Bridge Section increased to 358 fish/mile (≥ 7in) and was above the long-term mean of 310 fish/mile (≥ 7in).

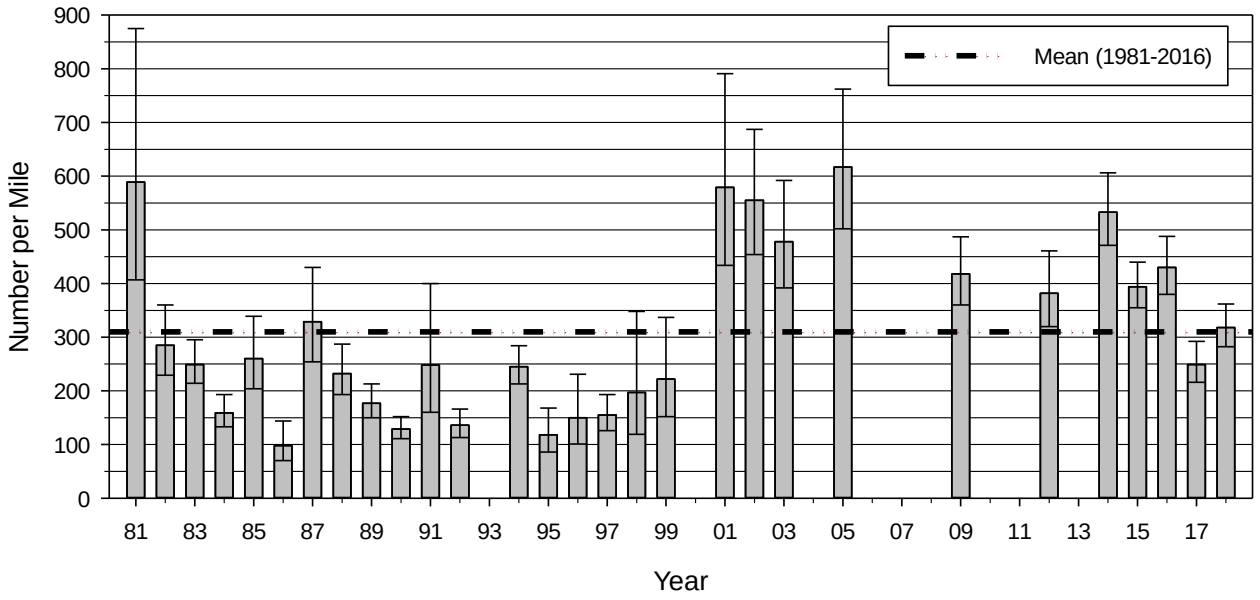

Figure 14: Mill Creek Bridge Rainbow Trout population estimates for fish 7 inches and greater from 1981 to 2017. The error bars represent the upper and lower 95% confidence intervals.

Length-frequency distribution of Rainbow Trout in the Mill Creek Bridge Section in 2017 increased 9.9% in the 7.5 to 10.0-inch range when compared to 2016 (Figure 15). The largest increase in an individual length group was 2.7% in both the 8.5 and 9.0-inch groups. The length-frequency distribution for the 10.5 to 16.0-inch range was 13.5 % lower than 2016. The largest individual length group decrease, 2.9%, occurred in the 13.5-inch group. These results further

indicate there was a population-level effect in larger Rainbow Trout as the result of PKD, other biotic or environmental factors, or a combination of factors.

The 2018 length-frequency distribution decreased 15.4% in the 8.5 to 10.5-inch range and increased 16.5 % in the 11.0 to 17.0-inch range when compared to 2017. These changes are likely the result of recruitment of fish to larger size groups, specifically in the 12.0 to 13.5-inch range.

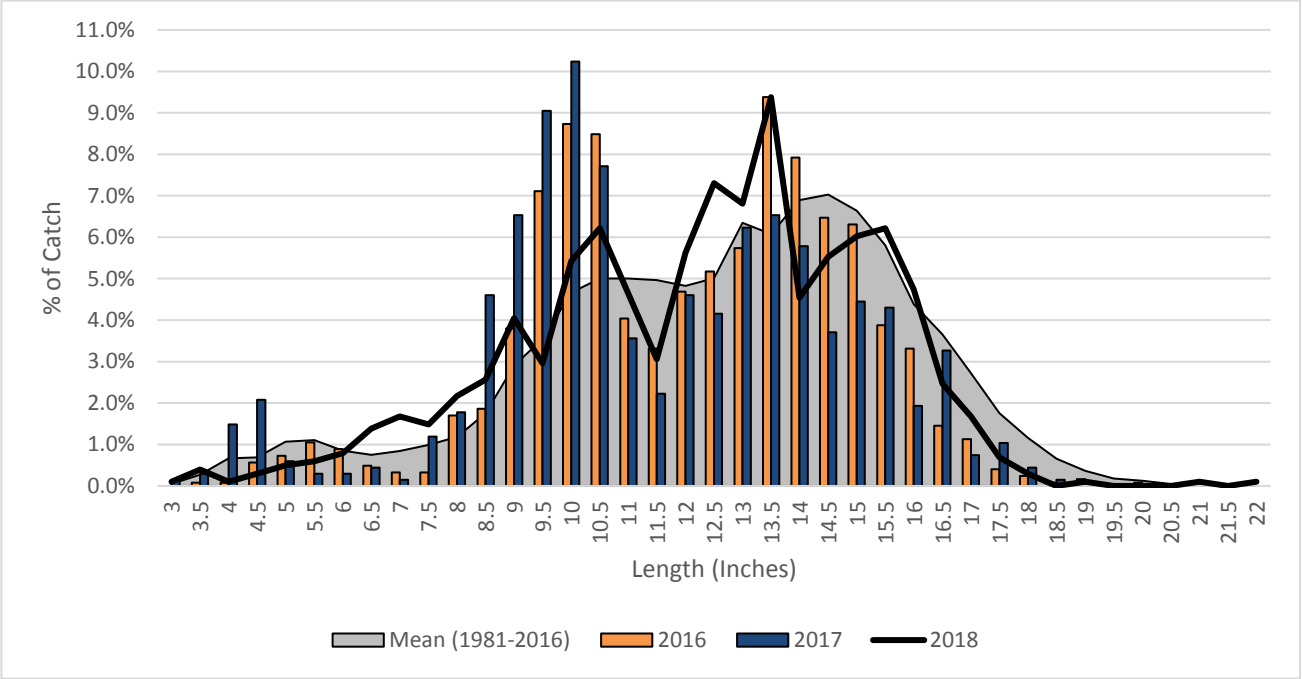

Figure 15: Percent of catch for Rainbow Trout in the Mill Creek Section by half-inch group.

Brown Trout

The Mill Creek Bridge Section Brown Trout population estimate for 2017 was 215 fish/mile (≥ 7in) (Figure 16). This was down from 230 and 412 fish/mile (≥ 7in) in 2016 and 2015, respectively.

In 2018, the population estimate for Brown Trout increase to 329 fish/mile (≥ 7in), the highest level since 2013. Like most years since 1995 the 2018 population estimate remained below the long-term mean of 366 fish/mile (≥ 7in).

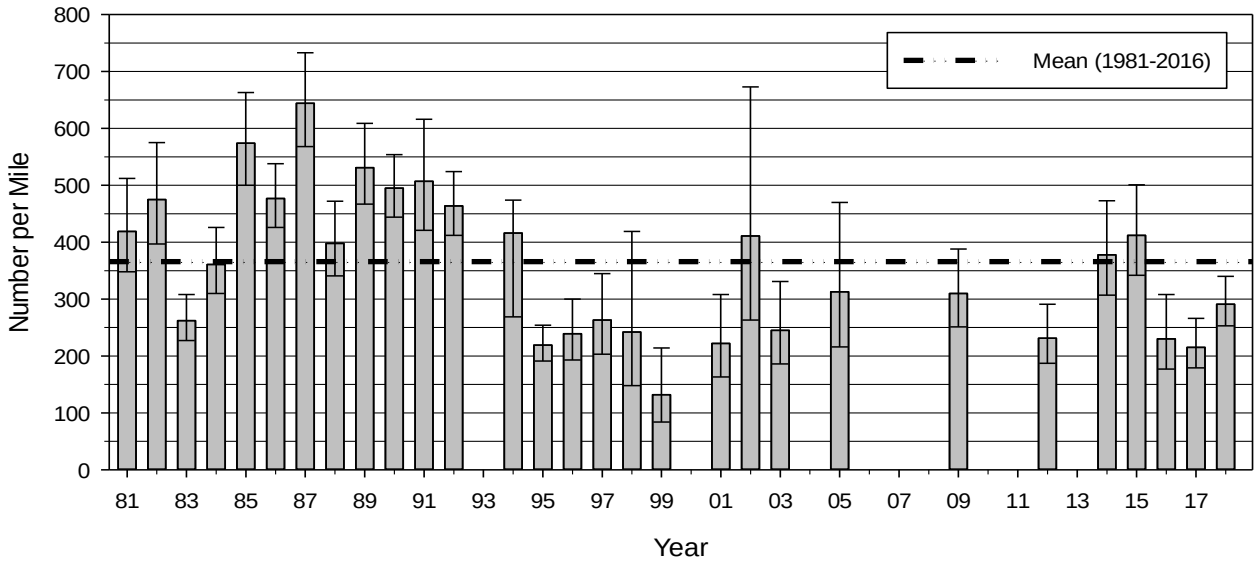

Figure 16: Mill Creek Bridge Brown Trout population estimates for fish 7 inches and greater from 1981 to 2017. The error bars represent the upper and lower 95% confidence intervals.

In 2017, there was an obvious change in the distribution of Brown Trout from the Mill Creek Bridge Section across length groups when compare to 2016. There was an increase in the 7.5 to 13.0-inch range of 59.6% from 2016 to 2017 (Figure 17). The largest increase in an individual length group, 11.1%, was in the 10.5-inch group. There was a decrease of 58.4% from 2016 to 2017 of fish in the 13.5 to 21.5-inch range. The largest individual length group decrease, 8.3%, occurred in the 16.5-inch group.

The decrease in larger fish could have been the result of multiple factors including PKD, fall spawning, and/or ice jamming on the Yellowstone River in winter of 2016/2017.

The length-frequency distribution for Brown Trout in 2018 was much closer to the long-term mean for fish in the 9.0 to 12.0-inch range than 2017. There was an increase of 39.5% in Brown Trout that were in the 13.5 to 19.5-inch range from 2017 to 2018 indicating good recruitment and recovery from the large decline in 2017.

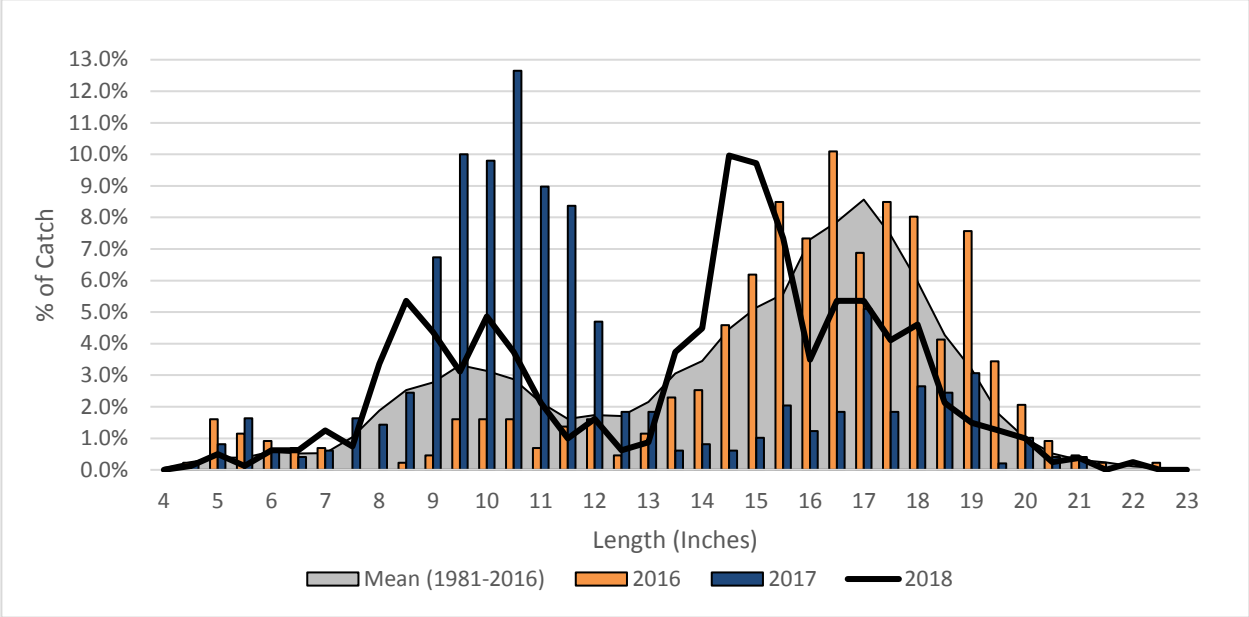

Figure 17: Percent of catch for Brown Trout in the Mill Creek Section by half-inch group.

Yellowstone Cutthroat Trout

The population estimate for YCT in the Mill Creek Bridge Section in 2017 was lower than the previous three years and the long-term average for this section. In 2017, the population estimate was 62 fish/mile (≥ 7in) compared to 152, 75, and 96 fish/mile (≥ 7in) in 2014, 2015, and 2016, respectively (Figure 18).

There may have been a population-level effect on YCT in the Mill Creek Bridge Section as the result of PKD, other biotic or environmental factors, or a combination of factors.

In 2018, the declining trend for YCT population abundance continued. The estimate was 49 fish/mile (≥ 7in) and well below the long-term mean of 140 fish/mile (≥ 7in). This continued decline appears to be caused by something other than PKD given the recovery noted in both Rainbow and Brown Trout.

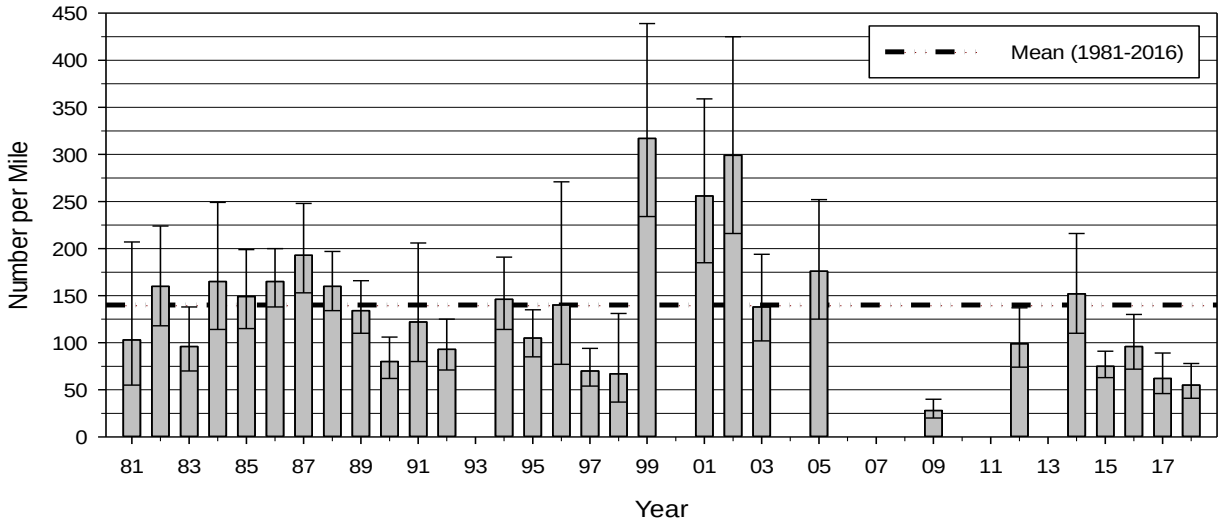

Figure 18: Mill Creek Bridge YCT population estimates for fish 7 inches and greater from 1981 to 2017. The error bars represent the upper and lower 95% confidence intervals.

The length-frequency distribution of YCT in the Mill Creek Bridge Section in 2017 was comparable to 2016 with a few exceptions. There was a 4.5%, 5.5% and 4.6% decrease in the 8.5, 12.0, and 12.5-inch lengths, respectively (Figure 19). There was a 14.6% decrease in the 13.0 to 15.5-inch range. The largest decrease in an individual length group, 5.7%, occurred in the 14.0-inch length group.

In 2018, the length frequency distribution of YCT decreased in the 8.5 to 9.5-inch group and the 13.5 to 14.5-inch group and the 16.0-inch group of 14.9%, 1.8%, and 2.7%, respectively, when compared to 2017. The length frequency distribution was also below the long-term average in the 6.5 to 9.5-inch range. There was a 12.9% increase in the 11.5 to 13.0-inch range indicating good recruitment from the prior year.

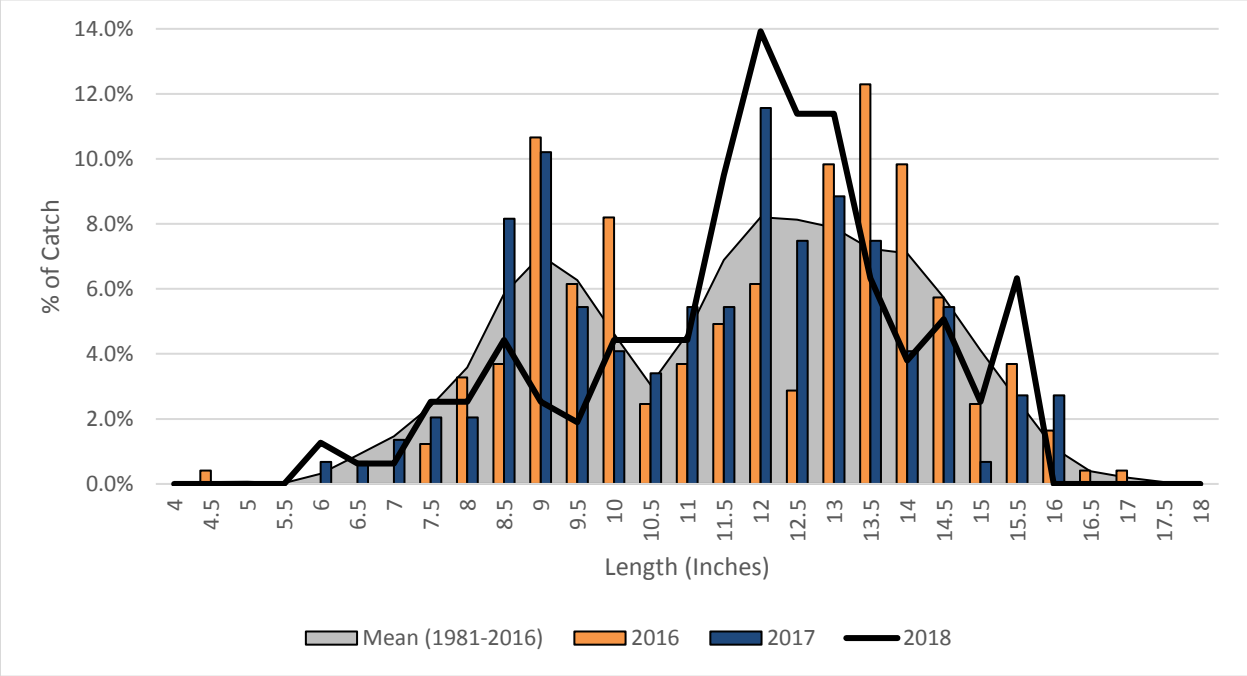

Figure 19: Percent of catch for YCT in the Mill Creek Section by half-inch group.

Yellowstone River Summary

There are obvious differences among the abundance estimates for Brown, Rainbow, and YCT in the Mill Creek Section for 2016-2018. The Rainbow and Brown Trout estimates are higher than the YCT (Figure 20). Rainbow Trout had the highest abundance of the three species and Brown Trout had the second highest abundance in all three years. Brown Trout were highest in abundance in the 1980s and 1990s. In 2000, Rainbow Trout began to be the most abundant in the section, except for 2015. The trend of YCT having the lowest abundance has been ongoing since the early 1980s and is likely the result of habitat change, dewatering of spawning tributaries, and limited fry production and recruitment.

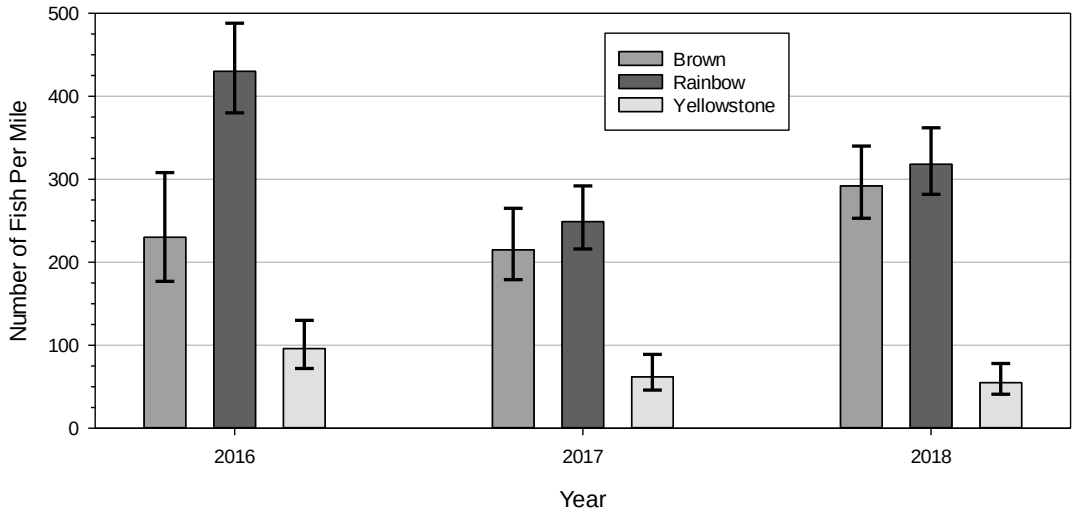

Figure 20: Abundance estimates for Brown, Rainbow, and Yellowstone Cutthroat Trout (≥ 7in) in the Mill Creek Section of the Yellowstone River for 2014 - 2016. Error bars represent the upper and lower 95% confidence intervals.

The 2016 length-frequency distributions for the combined trout species in the Mill Creek section had two distinct peaks that were the result of increases in Rainbow Trout in those length groups form 2015 (Figure 21). Rainbow Trout made up the majority of the fish in the 3.5 to 4.5, 9.5 to 11.0, and 14.5 to 15.0-inch length ranges. YCT made up most of the fish in the 7.5 to 9.0 and 11.5 to 14.0-inch ranges. Brown Trout were the most frequent fish in the 5.0 to 7.0 and 15.5 to 22.5-inch length ranges.

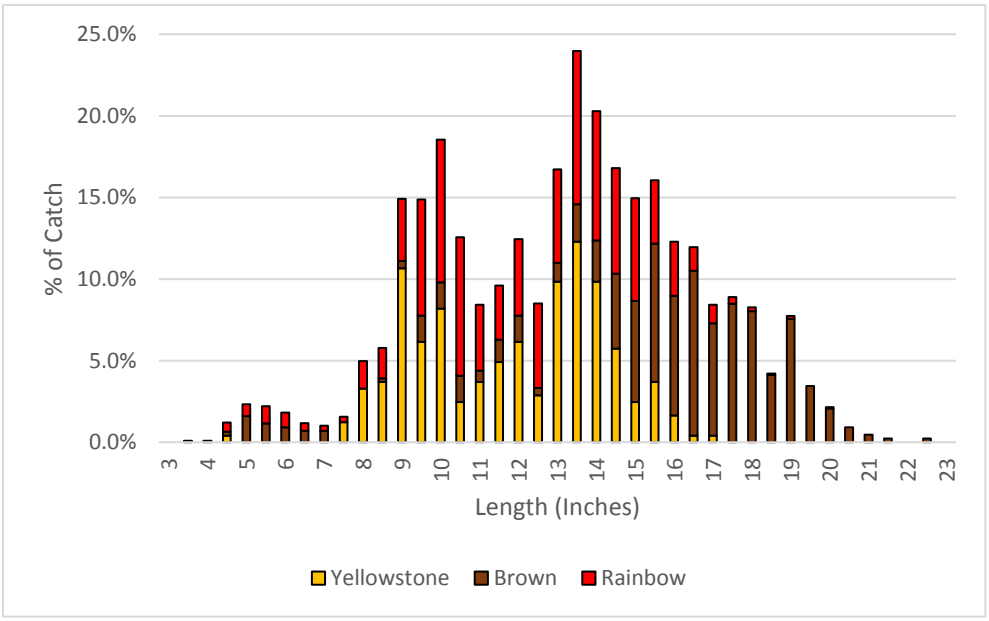

Figure 21: % of catch distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Mill Creek Section of the Yellowstone River in 2016.

The 2017 length-frequency distributions for the combined trout species in the Mill Creek Section had some changes when compared to 2016, primarily with Brown Trout and a biomass shift to fish in the 8.5 to 12.0-inch range. Rainbow

Trout continued to make up most of the fish in the 3.0 to 4.5 and 14.0 to 16.0-inch ranges, but not the 9.0 to 11.0-inch range (Figure 22). Brown Trout made the largest portion of the trout in the 5.0 to 5.5, 9.5 to 11.5, and the 17.0 to 21.0-inch length ranges. YCT made up most of the fish in the 6.0 to 9.0 and 12.0 to 13.5-inch ranges in 2017. The changes in distribution reflect the impacts of the 2016 PKD event.

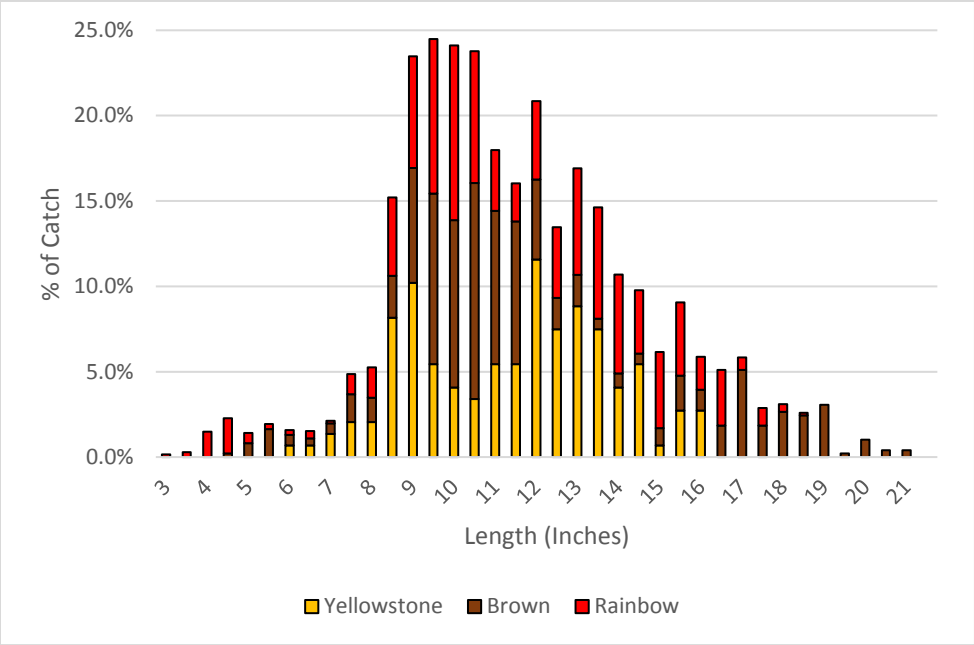

Figure 22: % of catch distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout sampled in the Mill Creek Section of the Yellowstone River in 2017.

In 2018, the length-frequency distributions for the combined trout species in the Mill Creek Section continued to change and more fish were concentrated in the 12.0 to 15.0-inch range as Brown Trout increased (Figure 23). Rainbow Trout made up the majority of fish in the 3.0 to 7.5 and 10.0 to 11.5-inch ranges. The increase in Brown Trout made them the largest portion of the fish in the 8.0 to 9.5 and 14.0 to 22.0-inch ranges. YCT made up most of the fish in only the 11.5 to 13.0-inch range in 2018. The in distribution is expected to change and populations continue to recover from the 2016 event.

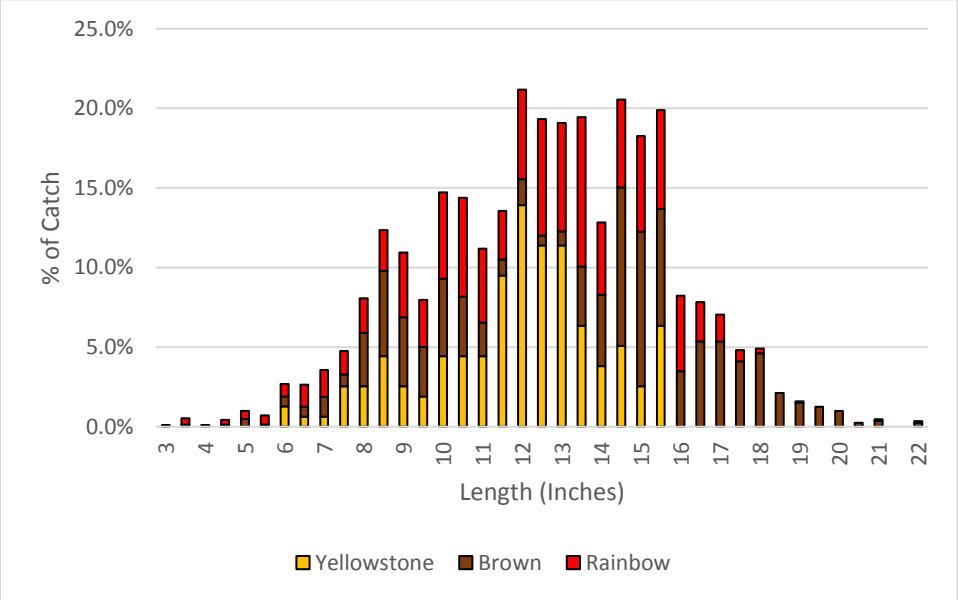

Figure 23: % of catch distribution for Rainbow, Brown, and Yellowstone Cutthroat Trout samples in the Mill Creek Bridge Section of the Yellowstone River in 2018.

Mallard's Rest Section

MWF mark-recapture population estimates in the Yellowstone are difficult and often produce unreliable estimates. To look at population trends for MWF a CPUE was completed in the Mallard's Rest Section in 2017 and 2018 (**Error! R eference source not found.**). This was compared to the CPUE of the marking effort in previous mark-recapture efforts in the section. The 2017 and 2018 CPUEs were much lower than previous years and the long-term mean of 897 fish/mile, indicating notable change in abundance of MWF (Figure 24). 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. Continued monitoring will provide insight into the changes.

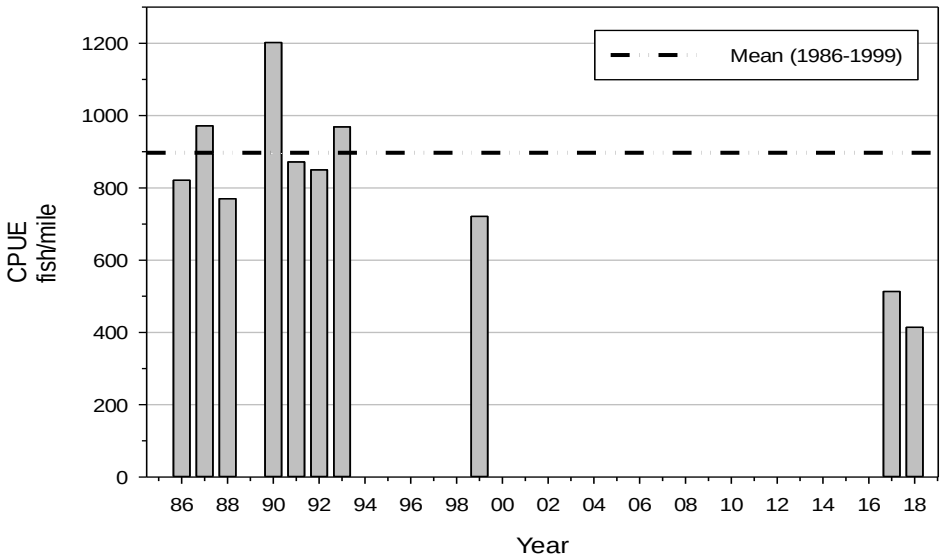

Figure 24: Mountain Whitefish CPUE in the Mallard's Rest Section from 1986 to 2017. The CPUE value is Mountain Whitefish (≥ 7in) per mile.

The Mallard's Rest Section length-frequency distribution of MWF in 2017 differed from 1999 in several length groups (Figure 25). In 2017, there were decreases of 9.0% and 22.9% in the 8.0 to 9.5-inch range and the 13.0 to 15.0-inch range, respectively. The largest decrease in an individual length group was 8.2% in the 14.0-inch length group. There was an increase of 1.3% in the 5.0 to 7.0-inch range and 28.7% in the 10.0 to 12.5-inch range. MWF in the 10.0 to 12.5-inch range were below the long-term mean. The 2018 length-frequency distribution for MWF was close to the long-term mean and increased in the 10.0 to 11.5-inch range when compared to 2017. The increase from 2017 to 2018 in the 10.0 to 11.5-inch group was 10.7% and there was a decrease of 6.7% in the 12.0 to 12.5-inch range.

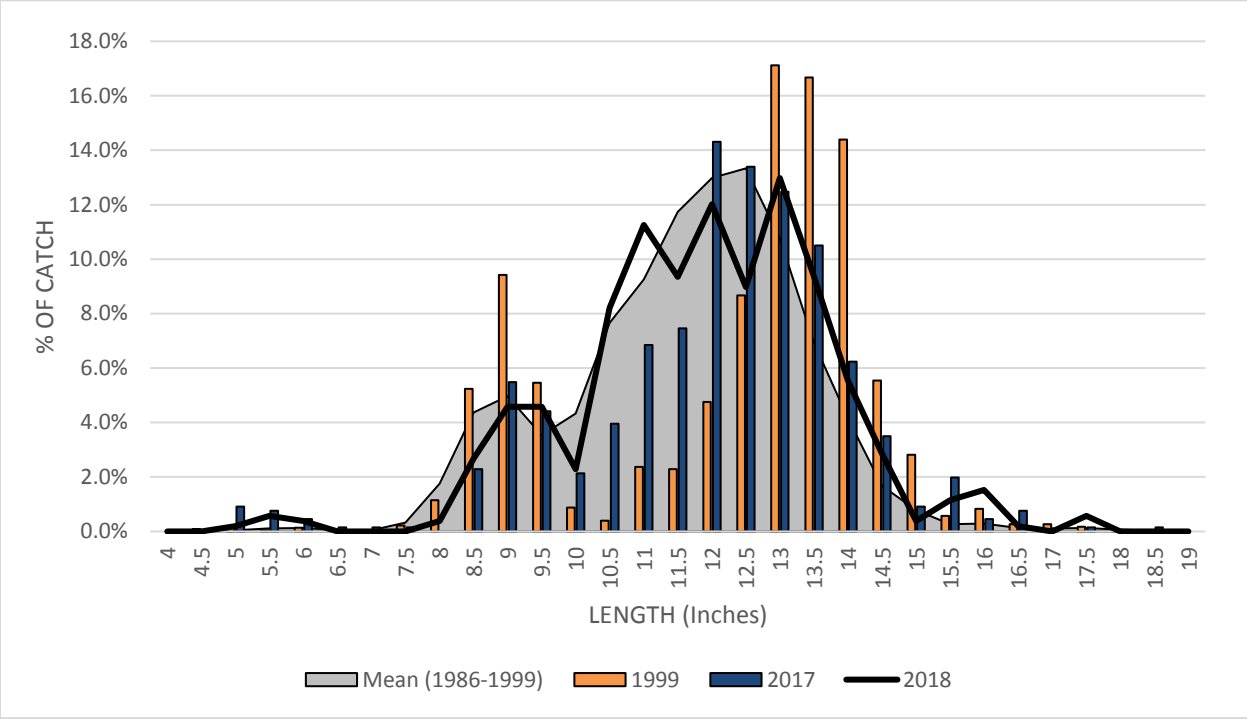

Figure 25: Percent of catch for MWF in the Mallard's Rest Section by half-inch group.

Dailey Lake

Fish Stocking

Dailey Lake is stocked with Rainbow Trout, YCT, and Walleye to maintain a recreational fishery and control the naturally reproducing Yellow Perch population in the lake. Trout are stocked on an annual basis and Walleye are on a 2-year rotation. In 2017, the lake was stocked with Rainbow Trout, YCT, and Walleye and in 2018 it was stocked with Rainbow Trout and YCT.

Walleye

In 2017, Dailey Lake was stocked with Walleye as part of a stocking plan change that was initiated in 2012. Walleye stocking was changed from annually to every other year in the lake and the number of Walleye stocked was reduced from 10,000 to 5,000. The intent of the change is to increase the survival of Walleye by reducing competition within and among the fish species in the lake. This change is being monitored to determine success and will be changed as necessary.

Stocking rates for Walleye from 2010 through 2017 are presented in the table below (

Table 4). The reduced number of stocked Walleye in 2017 was the result of poor survival at the hatchery prior to stocking. As indicated above, Walleye were not stocked in 2018 as part of the new stocking plan.

Table 4: Walleye stocking data for Dailey Lake from 2010-2017.

Year	Date	Strain	Length (in)	Number
2010	July 01	Fort Peck	1.4	5,000
	Sept. 14	Fort Peck	3.8	5,500
			Total	10,500
2011	June 29	Fort Peck	1.6	5,112
	Sept. 13	Fort Peck	5.0	5,000
			Total	10,112
2013	Sept. 30	Fort Peck	4.5	5,000
2015	Sept. 02	Fort Peck	5.0	5,000
2017	Aug. 08	Fort Peck	8.2	1,800

Rainbow and Yellowstone Cutthroat Trout

The number of Rainbow Trout that were stocked in the lake was reduced from 20,000 to 10,000 as part of an annual stocking plan change implemented in 2012. The intent is to increase the survival of Rainbow Trout by reducing the competition within the species. This change will be monitored and modified if needed.

A total of 10,532 Arlee Rainbow Trout young-of-the-year (YOY) from Giant Springs Trout Hatchery were stocked in 2017 (

Table 5). A total of 5,500 Eagle Lake strain YOY Rainbow Trout from Bluewater Springs Trout Hatchery were also stocked in 2017. 9,207 YCT were stocked in Dailey Lake in 2017. The increase in trout stocked in the lake was the result of surplus fish that were available from the hatcheries. In 2018, a total of 5,000 Arlee Rainbow Trout from the Giant Springs Hatchery and 6,380 Eagle Lake Rainbow Trout were stocked in Dailey Lake. The Eagle Lake Rainbow Trout were given an adipose clip prior to stocking both years to allow for future identification and determination of survival in the lake.

Table 5: Trout stocking data for Dailey Lake from 2014-2018.

Year	Date	Strain	Length (in)	Number
2014	Apr. 21	Arlee	4.4	5,152
	Apr. 22	Yellowstone	7.3	5,000
	May 29	Eagle Lake	3.4	5,500
			Total	15,652
2015	Apr. 13	Arlee	3.7	4,984
	Apr. 22	Yellowstone	6.45	5,000
	Jun. 09	Eagle Lake	3.0	5,500
			Total	15,484
2016	Apr. 27	Arlee	3.5	5,500
	Apr. 20	Yellowstone	6.1	5,192
	Jun. 08	Eagle Lake	3.1	6,309
			Total	17,001
2017	Apr. 03	Yellowstone	7.8	1,728
	Apr. 24	Yellowstone	8.4	1,186
	Apr. 25	Arlee	4.6	5,032
	Apr. 26	Yellowstone	8.4	1,043
	May 1	Yellowstone	8.3	1,050
	Jun. 22	Arlee	8.4	5,500
	Oct. 10	Eagle Lake	7.3	5,398
	Nov. 16	Yellowstone	4.0	4,200
			Total	25,137
2018	Apr. 24	Yellowstone	7.6	1620
	Apr. 28	Yellowstone	7.6	744
	May 16	Arlee	4.5	5,000
	Aug. 21	Eagle Lake	4.8	6,380
			Total	13,744

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 in 2017 and 2018. The long-term series of gill nets were set the evening of May 22, 2017 and May 14, 2018. This set consists of four gill nets located in the four corners of the lake (Figure 26).

The nets were pulled on the morning of May 23, 2017 and May 15, 2018. Lengths were recorded for all fish to the nearest 0.1 inch and weights to the nearest 0.01 pound. All live fish were released back into the lake.

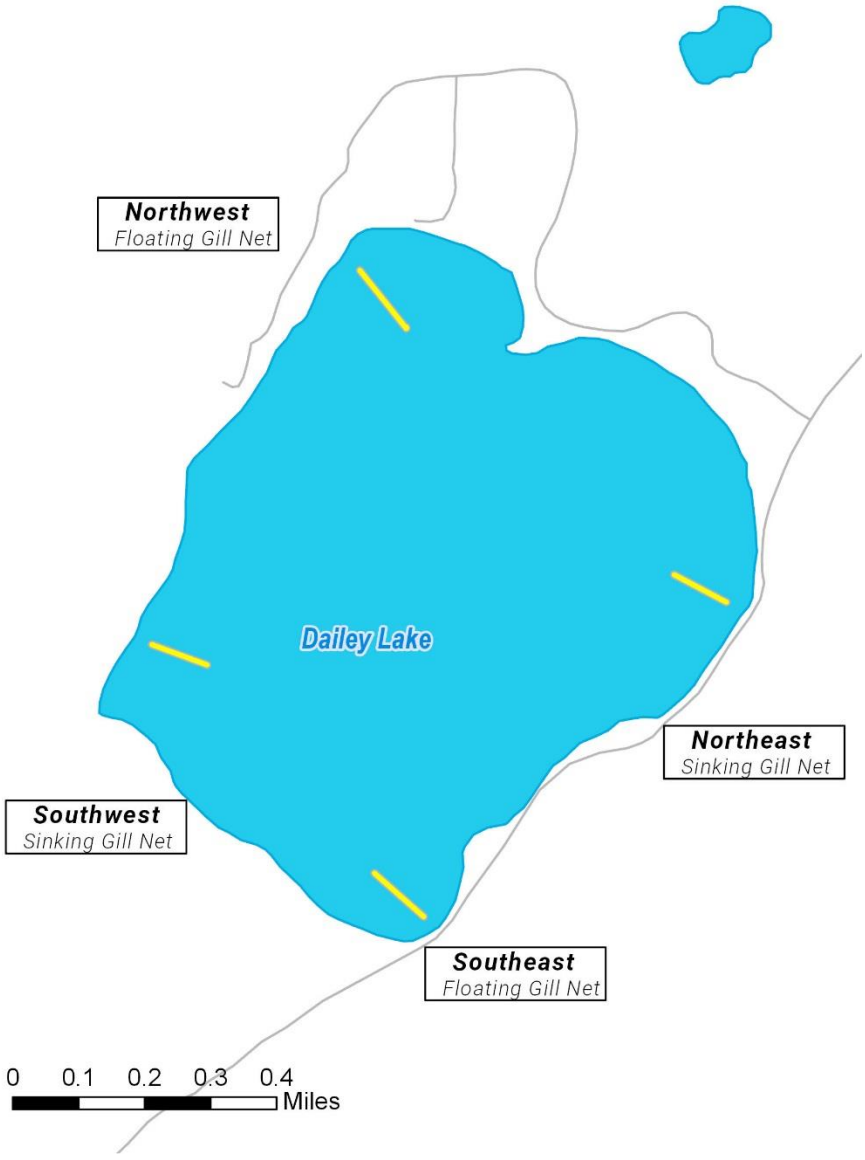

Figure 26: Map of Dailey Lake showing locations of gill nets in 2017 and 2018.

Catch-Per-Unit-Effort

Rainbow Trout

In 2017, CPUE for Rainbow Trout in all nets increased to 0.44 fish/net hour, from 0.00 fish/net hour in 2016 (Figure 27). In 2018 the CPUE continued to increase to 0.69 fish/net hour. The CPUE for Rainbow Trout in floating nets also increased from 0.00 fish/net hour in 2016 to 0.06 fish/net hour in 2017 and then to 0.53 in 2018 (Figure 28). CPUE in sinking nets increased from 0.00 fish/net hour in 2016 to 0.29 fish/net hour in 2017 (Figure 29). It then increased close to the levels see in 2005 and 2006 at 0.86 fish/net hour in 2018. This increase in Rainbow CPUE is likely the result of increased stocking in 2017 and improved survival of the 2016 and 2017 plants.

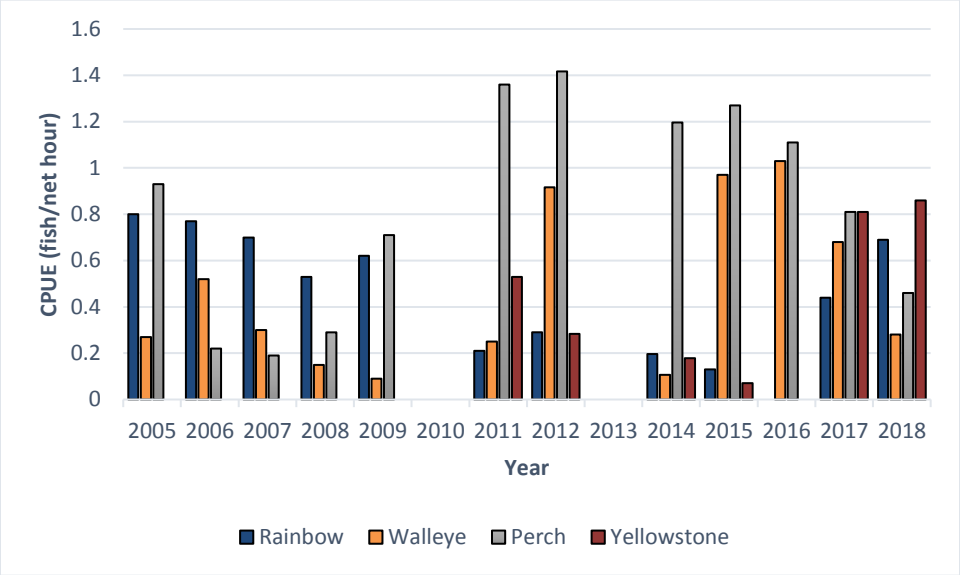

Figure 27: Catch-per-unit-effort for Rainbow Trout, Walleye, Yellow Perch, and Yellowstone Cutthroat Trout in all gill nets for 2005-2018. No gill net sampling was completed in 2010 and 2013.

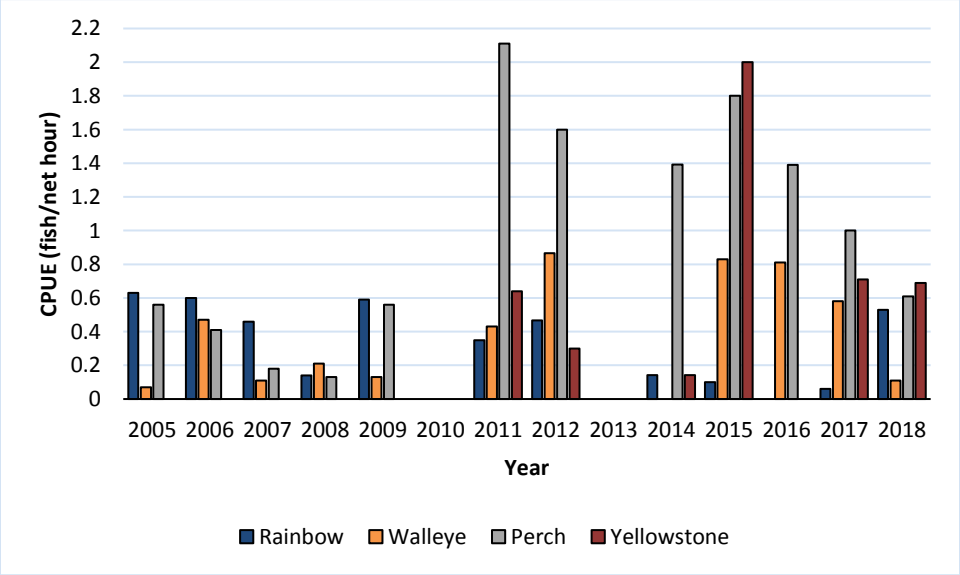

Figure 28: Catch-per-unit-effort for Rainbow Trout, Walleye, Yellow Perch, and Yellowstone Cutthroat Trout in floating gill nets for 2005-2018. No gill net sampling was completed in 2010 and 2013.

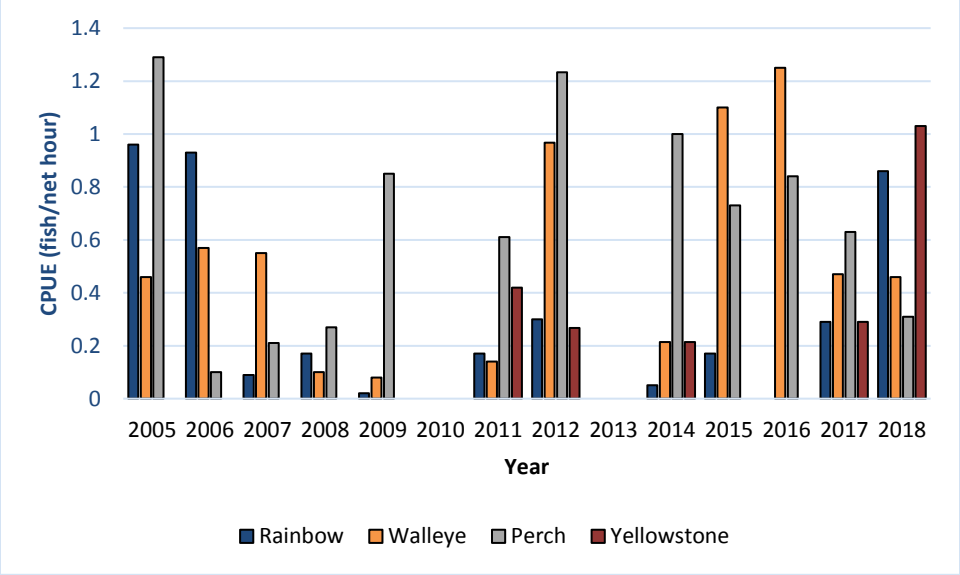

Figure 29: Catch-per-unit-effort for Rainbow Trout, Walleye, Yellow Perch, and Yellowstone Cutthroat Trout in sinking gill nets for 2005-2017. No gill net sampling was completed in 2010 and 2013.

Yellow Perch

In 2016, the CPUE for Yellow Perch in all nets was 1.11 fish/net hour and decreased to 0.81 fish/net hour in 2017 (Figure 27). In 2018, the CPUE for all nets continued to decrease and reached 0.46 fish/net hour. In 2016, CPUE for Yellow Perch in the floating nets was 1.39 fish/net hour, it decreased to 1.00 fish/net hour in 2017 and to 0.61 fish/net hour in 2018 (Figure 28). The CPUE for sinking gill nets was 0.84 fish/net hour in 2016, it decreased to 0.63 fish/net hour in 2017 and increased to 0.31 fish/net hour in 2018 (Figure 29). Some the decline in CPUE for Yellow Perch may be the result of larger Walleye present in the lake.

Walleye

CPUE for Walleye in all nets decreased from 1.03 fish/net hour in 2016 to 0.68 fish/net hour in 2017 and then to 0.46 fish/net hour in 2018 (Figure 27). In 2016, no Walleye were captured in floating nets (Figure 28). Then in 2017 and 2018, the CPUE in the floating nets was 0.58 and 0.11 fish/net hour, respectively. A decreasing trend was noted in the CPUE of Walleye in sinking gill nets. The CPUE was 1.25 fish/net hour in 2016 and decreased to 0.47 and 0.46 fish/net hour in 2017 and 2018, respectively (Figure 29). Some of the decline in Walleye CPUE may be related to the reduced number and frequency of Walleye stocking.

Yellowstone Cutthroat Trout

The CPUE for YCT in all nets has been on a declining trend since 2011 when they first recruited to the nets and hit a low of 0.00 in 2016 (Figure 27). In 2017, the CPUE for all nets increased to 0.81 fish/net hour. It then increased to 0.86 fish/net hour in 2018. In 2016, CPUE for floating nets was 0.00 fish/net hour and increased to 0.71 fish/net hour in 2017 (Figure 28). It then dropped to 0.69 fish/net hour in 2018. The CPUE for the sinking nets in 2016 was 0.00 fish/net hour and increased to 0.29 fish/net hour in 2017 (Figure 29). In 2018, the CPUE for the sinking nets increased to 1.03 fish/net hour. The increase in CPUE in both 2017 and 2018 are likely the result of increased numbers of stocked YCT in 2017 and improved survival of the 2016 and 2017 plants.

Length

Rainbow trout

As noted above, no Rainbow Trout were captured in the gill nets in 2016 (Figure 30). In 2017, the maximum was 15.7 inches, the mean was 15.1 inches, and the minimum was 14.4 inches. Only three Rainbow trout were captured in 2017. The maximum length for Rainbow Trout decreased to 15.5 inches in 2018. The mean and minimum lengths also decreased to 12.4 and 8.6 inches, respectively. The decreases in the mean and minimum are likely the result of no fish being captured in 2016 and 49 fish being captured in 2018 versus 3 in 2017.

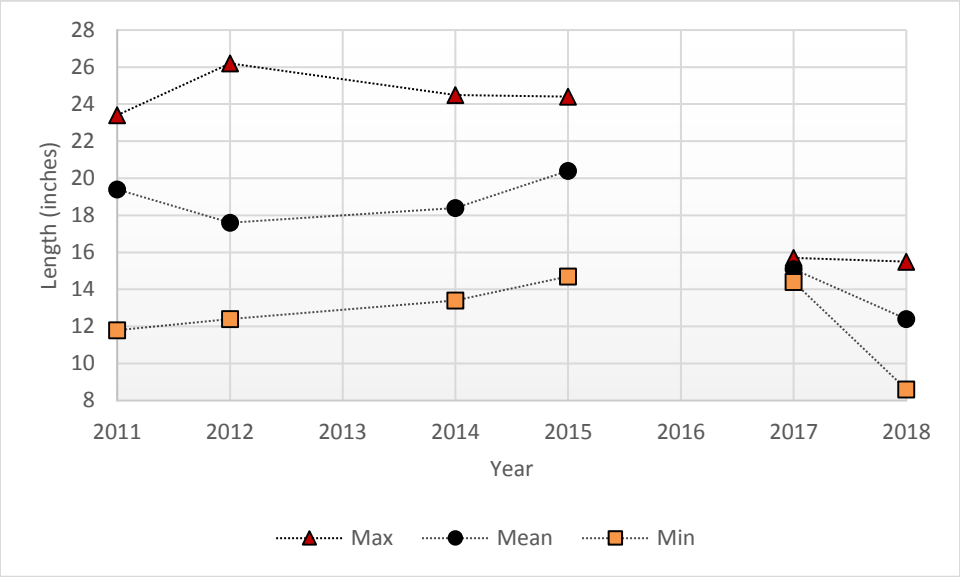

Figure 30: Maximum, mean, and minimum lengths of Rainbow Trout captured in gill nets in Dailey Lake in 2011-2018. Nets were not set in 2013.

Yellow Perch

In 2016, the maximum, mean, and minimum lengths of Yellow Perch were 11.2, 9.2, and 7.2 inches, respectively (Figure 31). In 2017, the maximum, mean, and minimum lengths all increased slightly to 11.9, 9.6 and 7.7 inches, respectively. The maximum length decreased to 10.6 inches in 2018, the lowest since 2011. The mean length decreased to 9.2 inches and the minimum decreased to 7.5 inches in 2018. The decline in maximum length could be the result of increased predation from larger Walleye in the lake.

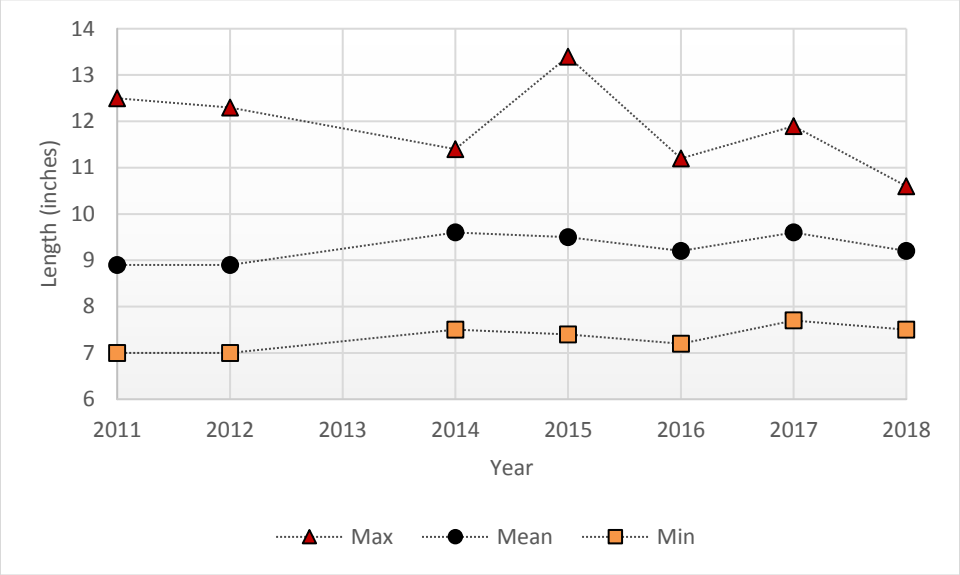

Figure 31: Maximum, mean, and minimum lengths of Yellow Perch captured in gill nets in Dailey Lake in 2011-2018. Nets were not set in 2013.

Walleye

The maximum length of Walleye in 2016 was 23.5 inches (Figure 32). The mean was 14.3 inches and the minimum were 9.2 inches. In 2017, the maximum length declined to 22.4 inches. The mean and minimum lengths increased to 15.0 and 12.0 inches, respectively. In 2018, the maximum length of Walleye increased to 25.0 inches, the highest since 2011. The mean and the minimum lengths continued to increase to 17.0 and 13.0 inches, respectively. The increases in sizes of Walleye may be the result of the stocking change that was implemented in 2012 to increase survival and reduce competition among Walleye.

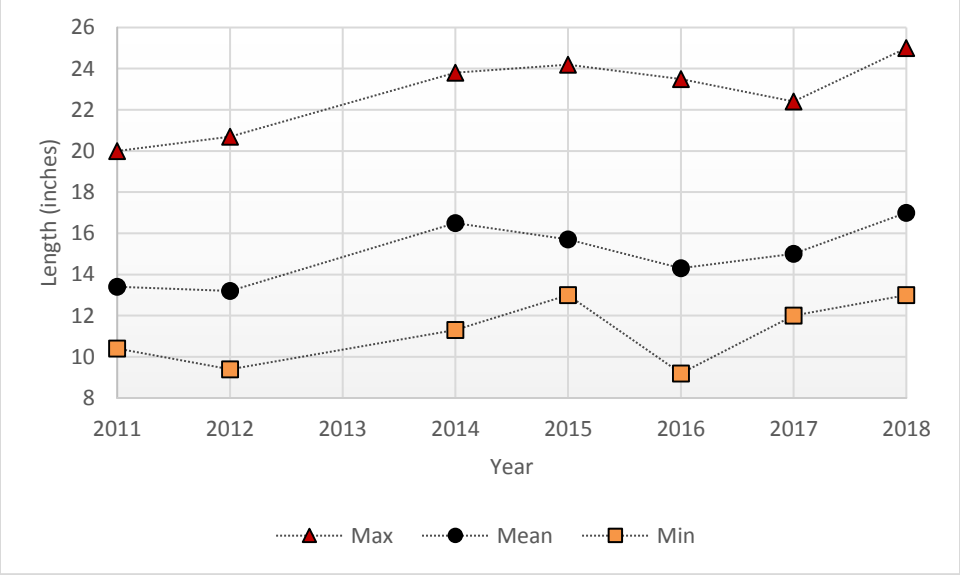

Figure 32: Maximum, mean, and minimum lengths of Walleye captured in gill nets in Dailey Lake in 2011-2018. Nets were not set in 2013.

Yellowstone Cutthroat Trout

Like Rainbow Trout, no YCT were captured in the gill nets in 2016 (Figure 33). In 2017, YCT were captured and the maximum length was 11.7 inches and the mean was 10.1 inches. The minimum length for YCT captured in 2017 was 8.0 inches. The maximum and mean length both increased in 2018 to 15.7 and 13.1 inches, respectively. The minimum length in 2018 declined to 7.9 inches in 2018. YCT have been stocked in Dailey Lake since 2008 and have only been sampled in gill nets in 2011- 2015,2017, and 2018.

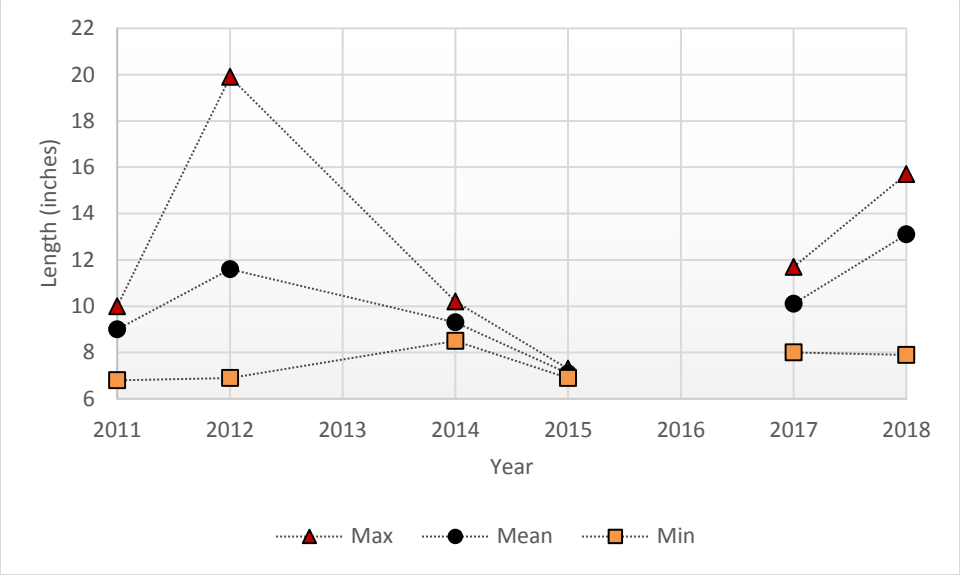

Figure 33: Maximum, mean, and minimum lengths of Yellowstone Cutthroat Trout captured in gill nets in Dailey Lake in 2011-2018. Nets were not set in 2013.

Length-Frequency

Rainbow Trout

In 2016, no Rainbow Trout were captured in the nets and no length-frequency distribution was produced as a result. In 2017, only three Rainbow Trout were captured in the gill nets and they ranged from 14.4 to 15.7 inches (Figure 34). In 2018, the length-frequency distribution was heavily weighted with fish in the 8.0 to 15.5-inch range. Rainbow Trout in the 8.0 to 11.0-inch range and the 12.5 to 14.5-inch range were above the 2011-2016 mean indicating good survival and recruitment. Monitoring will continue to see if these fish continue to recruit to the missing larger length groups.

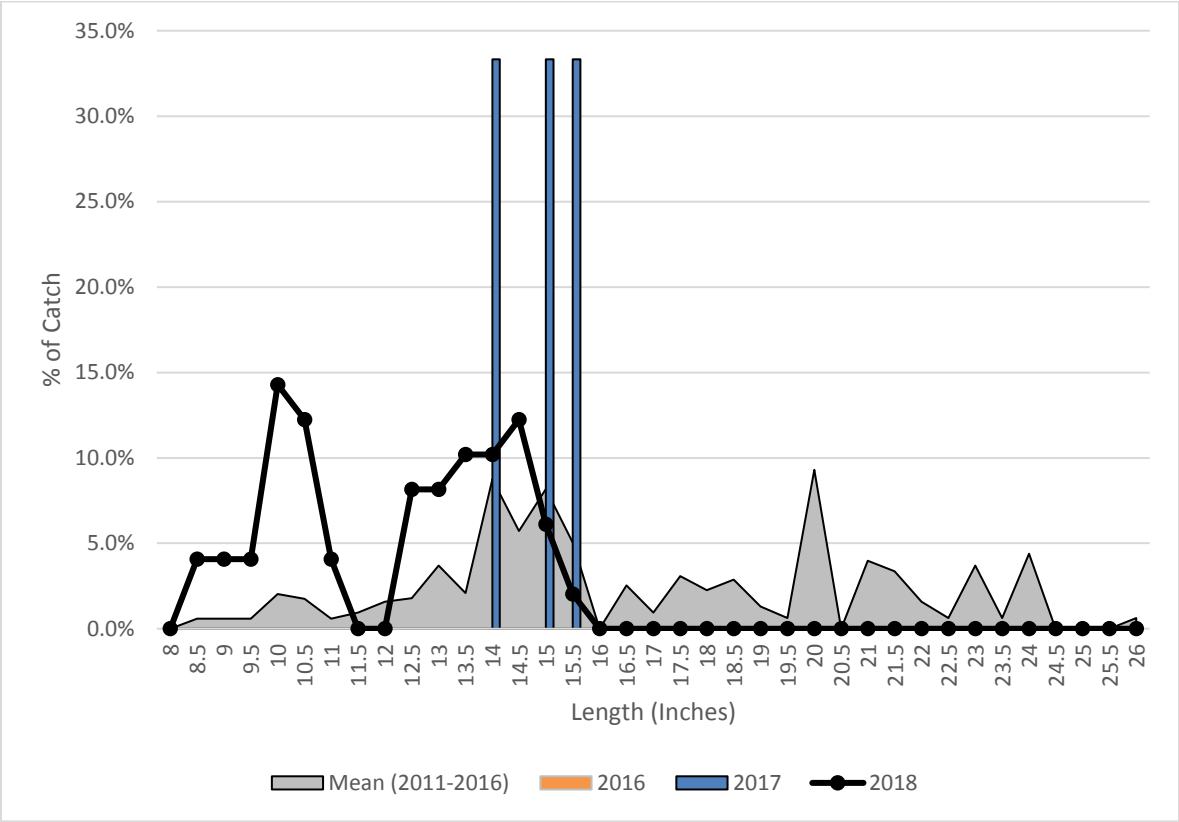

Figure 34: Length-frequency distribution for Dailey Lake Rainbow Trout for 2016-2018 and the mean (2011-2016).

Yellow Perch

The length-frequency distribution for Yellow Perch in 2016 and 2017 were similar except for a large decrease in the 7.0 and 7.5-inch length groups and a substantial increase in the 11.5-inch group in 2017 (Figure 35). The Yellow Perch length-frequency distribution for 2018 had a decrease in the 7.5 and 8.0-inch range as well as the 10.5 to 11.5-inch range. The decrease in the smaller fish could be the result of increased predation by larger Walleye in the lake or sampling error. From 2017 to 2018 there as an increase in the 8.5 to 10.0-inch range. With the largest increase, 20.3%, being in the 8.5-inch group.

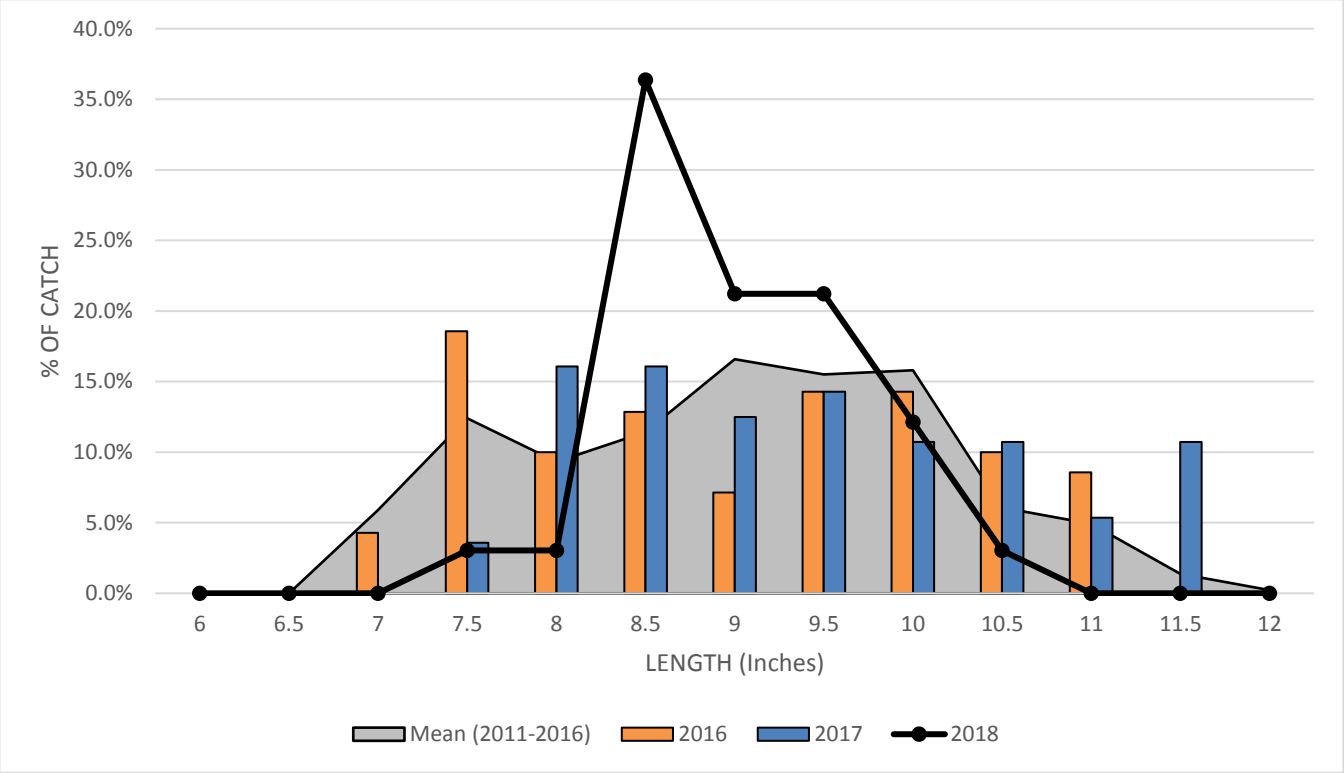

Figure 35: Length-frequency distribution for Dailey Lake Yellow Perch for 2016-2018 and the mean (2011-2016).

Walleye

The length-frequency distribution of Walleye in 2017 indicated an increase in in the 12.0 to 13.5-inch range and the 16.5 to 18.0-inch range when compared to 2016 (Figure). There were no Walleye captured in the 8.5 to 11.5-inch range. The 2018 length-frequency distribution of a Walleye indicates a continued lack of fish in the 8.5 to 11.5-inch range and expanded to include the 12.0 and 12.5-inch groups indicating poor recruitment and survival of the 2015 and 2017 stocking. The 2017 stocking was at a reduced number of fish because of survival issues at the hatchery. There were several increases in fish in the larger length groups in 2018 indicating strong recruitment and survival as well as a population weighted more heavily toward larger fish than in the past.

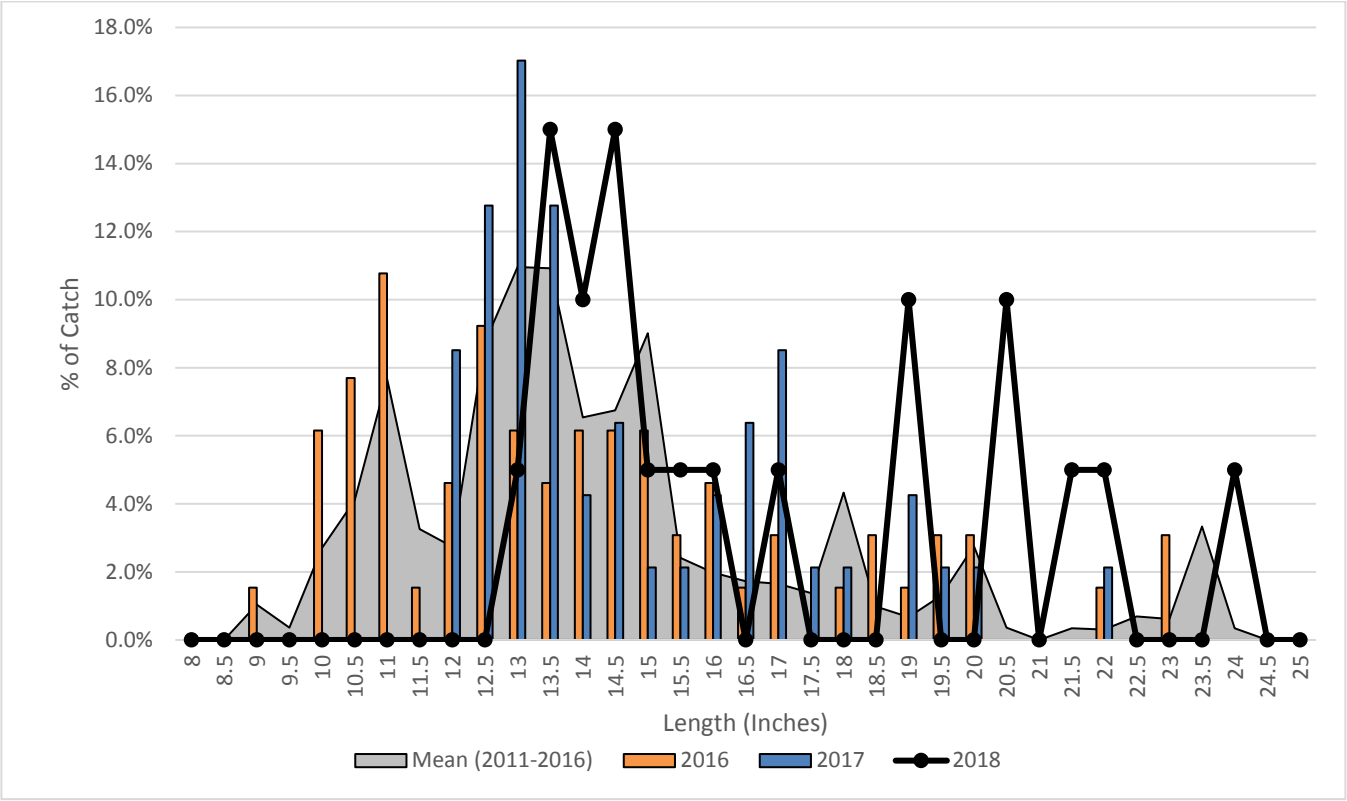

Figure 36: Length-frequency distribution of Dailey Lake Walleye for 2016-2018 and the mean (2011-2016).

Yellowstone Cutthroat Trout

Like Rainbow Trout no YCT were captured in the gill nets in Dailey Lake in 2016 and no length-frequency distribution was done as a result. In 2017, YCT were captured in the 8.0 to 11.5-inch range and fish in the 9.5 to 11.5-inch range were above the mean (2011-2016) (Figure). This indicates some survival of fish from prior stocking. In 2018, it appears that the fish captured in 2017 recruited to the 12.5 to 15.5-inch range, again indicating good survival and recruitment. Fish were also captured in the 7.5 to 10.0-inch range indication survival of prior stocking. Continued monitoring will take place to see if the YCT population recovers and if stocking changes are needed.

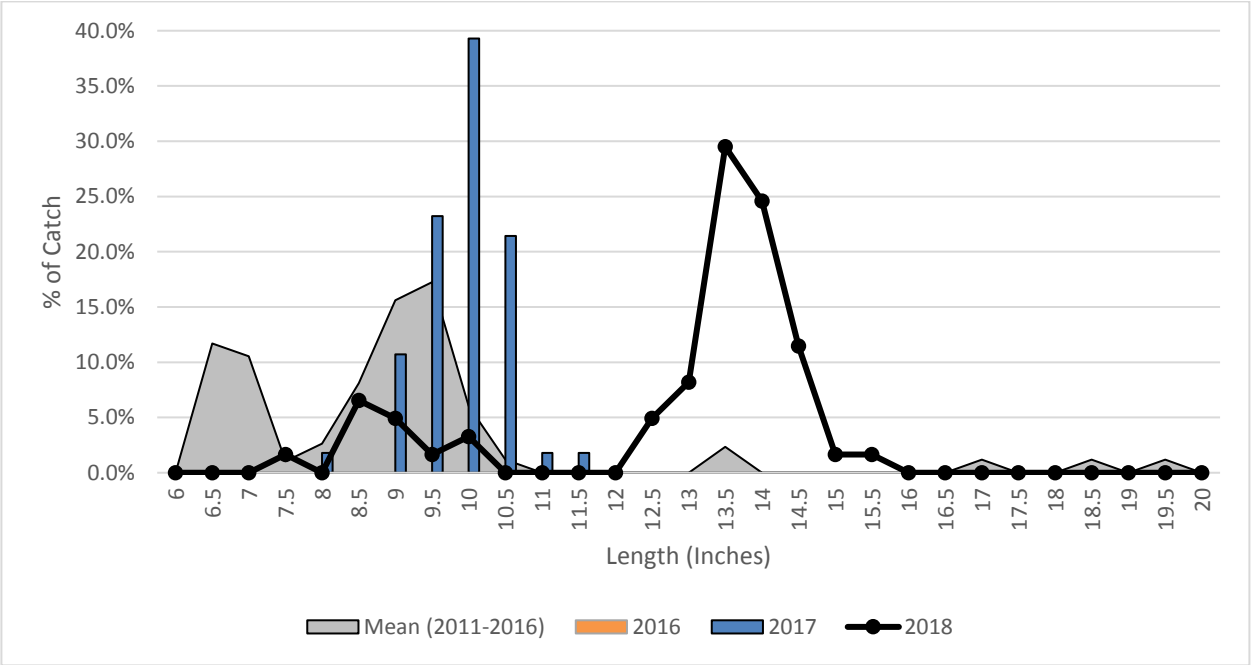

Figure 37: Length-frequency distribution of Dailey Lake Yellowstone Cutthroat Trout for 2016-2018 and the mean (2011-2016).

Dailey Lake Summary

The biggest changes for species in Dailey Lake the absence of Rainbow Trout and YCT in the nets in 2016 and the subsequent recovery in 2017 and 2018 as the result of the increase in the number of fish stocked in 2017 and improved survival of the 2016 and 2017 plants. Further monitoring will provide the information needed to adjust the stocking levels for these two species. Walleye CPUE has decreased, but the overall size of captured walleye has increased. This was part of the goal with the change in stocking of Walleye in the lake.

Summary

Population monitoring on the Yellowstone River indicates that trout populations have increased and are recovering from the declines noted after the 2016 PKD outbreak. If the trend continues with fish recruiting back to the larger size classes that were lost, within two to three years the populations should be similar to those prior to 2017 in both numbers and size distributions. More data will be needed to get a strong indication of where MWF populations are in terms of recovery given the limited data prior to 2016. The 2018 water year has been good and should help to improve the recovery of the trout and MWF populations.

In Dailey Lake, there is still no clear explanation for the disappearance of Rainbow and Yellowstone Cutthroat Trout in the sample nets. With stocking of increased numbers of trout in 2017 and improved survival of the 2016 and 2017 plants both species are improving in numbers and are similar to years prior to 2016. With continued survival and recruitment fish in larger size classes should return to the population. The changes made for the number fish and frequency of Walleye stocking appears to be increasing the size of Walleye in the lake.

Acknowledgements

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