# Great Falls Management Area
# 2017-2020 Fisheries Monitoring Report

Fisheries Division Federal Aid Job Progress Report
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**SUMMARY**

The estimates of Rainbow Trout and Brown Trout in the Missouri River Craig section fell below the long-term average in 2019 after eight consecutive years of estimates above the average for Rainbow Trout and two consecutive years at or above average for Brown Trout. The estimate of Rainbow Trout 10 inches long and greater in the Craig section was 2,860 per mile in 2019. The estimate of 2,860 fish per mile was the lowest since 2010. The estimate of Brown Trout 10 inches long and greater in the Craig section was 390 per mile in 2019 compared to the long-term average of 568 per mile. Numbers increased in 2020, with estimates of 3,247 Rainbow Trout and 422 Brown Trout 10 inches and greater per mile. Similar to the Craig section, Rainbow Trout and Brown Trout population estimates in 2018 and 2019 were also below average in the Cascade section. Numbers increased in the Cascade section in 2020, with estimates of 1,698 Rainbow Trout and 291 Brown Trout 10 inches and greater per mile, which was slightly above and slightly below average, respectively.

A count of Mountain Whitefish was completed in 2020 for the first 2.5 miles of the Craig section to compare to 2004 and 2005 data. The average number of Mountain Whitefish counted per electrofishing run in 2004, 2005, and 2020 was 205, 183, and 107, respectively. The number of Burbot handled was above the long-term average of 74 in 2018 and 2019, and below the long-term average in 2017 and 2020. Walleye were most abundant in the Missouri River in 2010 and 2011 following high flow events and increased to a lesser extend following a high flow event in 2018. Young of the year Walleye abundance may be related to flow events that provide flushing of Walleye into the Missouri River from Holter Reservoir and flows that provide suitable spawning and rearing conditions. One juvenile Northern Pike was sampled in 2019 and one in 2020, representing the first Northern Pike sampled during these surveys. Several other Northern Pike have been observed by FWP personnel and anglers have also reported catching numerous Northern Pike from the Missouri River between Holter Dam and Ulm in 2018 through 2020. Northern Pike regulations for the Missouri River from Holter Dam downstream to Black Eagle Dam were changed from the standard regulation of 10 daily and in possession to No Limit in March 2020 to encourage harvest. This also provides consistency with Northern Pike regulations already in place in the Missouri River and reservoirs upstream of Holter Dam.

The mean annual discharge and the peak annual discharge for the Missouri River were near average in 2017, 2019, and 2020. Flows in 2018 were well above average with a mean annual discharge of 6,963 cfs and a peak discharge of 20,000 cfs. Approximately 15,000 cfs mobilizes streambed substrates in the Missouri River. Over the last 20 years (2001 through 2020) peak flows have met or exceeded 15,000 cfs only four times, compared to nine times from 1981 through 2000, and 12 times from 1961 through 1980.

Angling effort for the Missouri River Section 9 (Holter Dam to Cascade) increased to a maximum level in 2015 of 183,479 estimated angler days. The estimated number of angler days for the Missouri River Section 9 decreased in 2017 and 2019, but still exceeded levels observed prior to 2013. In 2019, it was estimated the Missouri River Section 9 received 154,628 angler days, which ranked second in the state and first in Region 4. Approximately 51% of the use was by residents and 49% by non-residents. Total angler expenditures for the Missouri River Section 9 were estimated at approximately 60.2 million dollars in 2019.

The estimate for the number of Rainbow Trout 8 inches and greater in the Eagle Creek section of the Smith River was 411 per mile in 2020, which was similar to values observed since 2016. The estimate of Brown Trout 8 inches and greater in the Eagle Creek section was 222 per mile in 2020, which was similar

to but less than values observed in 2018 and 2019, and well below that observed in 2017. Rainbow Trout and Brown Trout estimates at the Eagle Creek site in 2020 were both similar to the long-term median values. The estimates of Rainbow Trout and Brown Trout 8 inches and greater in 2020 at the County Line site were similar to one another with 348 and 326 per mile, respectively. The 2020 Rainbow Trout estimate was greater than the long-term average and 2nd highest of the five years of sampling. The 2020 Brown Trout estimate was just below the long-term average and represented the middle value of the five years of sampling.

Flows were below average in 2017, whereas 2018, 2019, and 2020 flows were all above average. In 2017, the maximum daily average flow was 632 cfs, which was the fourth lowest since 1997 and well below the long-term average of 1,459 cfs. The maximum daily average flow in 2018 was 2,350 cfs, which was the third highest flow since 1997. Time of day angling restrictions were only implemented in 2017 and were in place from July 9 through September 15. The total number of angler days and angler expenditures on the Smith River in 2019 were the highest on record with an estimated 31,954 total angler days and 13.5 million dollars in angler expenditures.

The combined trout estimates for three sites on the Sun River peaked in 2013 or 2015. Trout estimates were lower in recent years but were generally greater than estimates at these sites in late 1990s and early 2000s. The exception was at the lowest site on the Sun River, near the Town of Sun River, where the 2020 estimate of 58 combined trout per mile was the second lowest estimate of the six years with data. The highest estimate for 2020 in the Sun River was at the Highway 287 site with 153 total trout per mile, which is well below levels observed on other similar sized waters in the region (e.g., Smith River, North Fork Sun River, South Fork Sun River).

Willow Creek Reservoir was completely dewatered in summer and early fall 2019 by Greenfields Irrigation District and the Bureau of Reclamation to facilitate repair to dam outlet gates in dry conditions. Based on monitoring in fall 2019 and spring 2020 it appears relatively few Rainbow Trout were flushed into and then persisted in the Sun River. Only one tiger muskie was sampled in the Sun River. Numerous suckers, turbid water entering the Sun River, and sediment deposition was observed during sampling in fall 2019. On June 27, 2020, a large sediment plume was observed entering the Sun River from the Willow Creek Reservoir return canal. The introduction of sediment in fall 2019 and spring 2020 may have resulted in a negative impact on Rainbow Trout and Brown Trout spawning events and may be realized in future years with a reduced cohort of trout from these years.

Sun River flows are heavily influenced by irrigation throughout the basin. Montana Fish, Wildlife and Parks has instream water reservations to benefit the fishery of 100 cfs from Diversion Dam to Elk Creek and 130 cfs from Elk Creek to Vaughn with a priority date of July 1, 1985. These water reservations were based on wetted perimeter studies that evaluated the amount of water necessary to maintain fishery values. The lower inflection points were used to establish the 100 and 130 cfs thresholds, thus these values serve as absolute minimum flow targets. The upper inflection point would result in a flow of 220 cfs and is considered the recommended minimum flow, as this would keep the majority of riffle habitat and the channel wetted. Despite the average to well above average flow years over the last four years, minimum flows were often below the 130 cfs absolute minimum flow target at Simms between July 1 and September 30 and almost always below the recommended minimum flow of 220 cfs at Simms. The 2019 flow year was the exception as the flows in the Sun River were artificially inflated because water was being released from Willow Creek Reservoir throughout the summer and fall to drain the reservoir. Time of day angling restrictions were implemented in 2017, 2018, and 2020 due to high water temperatures and low flows.

Based on fish population monitoring in Belt Creek from 2011 through 2016, Westslope Cutthroat Trout were the most abundant species upstream of Neihart, and Rainbow Trout were typically most abundant from Carpenter Creek to Harley Creek, near Monarch, and in the Sluice Boxes. Average Westslope Cutthroat Trout density was lower at the Carpenter to Harley site than the Neihart site, but average total trout density was greater at the Carpenter to Harley site than the Neihart site. At the Monarch Site, Rainbow Trout estimates and as a result total trout estimates have been lower the last four years of sampling compared to the first four years of sampling from 2011 through 2014.

Pelican Point Pond #1 provides a Largemouth Bass, Yellow Perch, and crappie fishery. This pond was illegally stocked with Northern Pike, and Montana Fish, Wildlife and Parks personnel continue monitoring and suppression efforts to maintain the bass, crappie, and perch fishery.

Largent Bend Pond #3 provides a Largemouth Bass, crappie, and Yellow Perch fishery, while Pond #2 provides opportunity for Largemouth Bass with easy access. Pond #3 was stocked with tiger muskie in 2013 and 2019.

Wadsworth Pond is stocked with Rainbow Trout annually and Walleye every other year. Fifteen Walleye were sampled from Wadsworth Pond during monitoring in 2020 that were from three different stocking events, despite several years of severely low water levels.

Rainbow Reservoir is stocked annually with Rainbow Trout and Brown Trout and Walleye are also present and reproduce naturally. The fish community of Cochrane, Ryan, and Morony reservoirs is dominated by suckers, with some Walleye also present. Short retention times limit the fisheries of the five Great Falls reservoirs through flushing of juvenile fish and a limited zooplankton population.

Newlan Creek Reservoir and Sutherlin Reservoir both provide the opportunity to catch large Burbot. Approximately 40,000 and 16,000 Rainbow Trout are stocked annually in Newlan Creek Reservoir and Sutherlin Reservoir, respectively. Kokanee have been stocked in both reservoirs since 2014 and gerrard strain Rainbow Trout have been stocked in Newlan Creek reservoir since 2015. Average size of kokanee during fall 2020 sampling was 13.3 inches and 18 inches in Newlan and Sutherlin reservoirs, respectively. One hundred and ninety-four Burbot were tagged in Newlan Creek Reservoir and 70 were tagged in Sutherlin Reservoir with floy tags in fall 2020. Based on angler tag returns, future monitoring, and a creel survey that is being completed in 2021 on both reservoirs, we will be able to gain a better understanding of Burbot catch rates, harvest rates, age, growth, and densities of Burbot. The creel survey will also provide information regarding angler use, angler satisfaction, catch rates, and harvest rates for all species.

Several habitat restoration projects have been completed from 2017 through 2020 within the Great Falls Management Area, including several bank restoration and riparian fencing projects on the Missouri and Smith rivers, Little Prickly Pear Creek restoration, and Hardy Creek restoration.

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# Great Falls Management Area


Map produced by:

Montana Fish, Wildlife & Parks
Information Management Unit

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December 5, 2005 DMA

Biologist responsibility areas and dams digitized @ 1:100,000 scale by Montana Fish, Wildlife & Parks, Information Management Unit. Hydrography, County, Highway, and Cities from the Natural Resources Information System at the Montana State Library, Helena, Montana, digitized at 1:100,000 scale. Biologist responsibility areas last reviewed by Montana Fish, Wildlife & Parks Fisheries Managers in 2004.

## Introduction

The purpose of this project is to implement the Fisheries Program in the Great Falls Management Area in Northcentral Montana. Major watersheds include the Missouri River, Sun River, Smith River, and Belt Creek. In support of the Montana Fish, Wildlife and Parks (MFWP) Mission and Vision: the Fisheries Division preserves, maintains, and enhances aquatic species and their ecosystems to meet the public's demand for recreational opportunities and stewardship of aquatic wildlife (MFWP 2019a). This report summarizes activities that used MFWP Federal Aid from 2017 through 2020 (project numbers F-113-R17, F-113-R18, F-113-R19, F-113-R20, F-113-R21) and prior years through the documentation of long-term datasets in the Great Falls Management Area. This includes monitoring of the streams, rivers, lakes and reservoirs, stocking of major lakes and reservoirs, and other activities conducted by regional personnel.

## Methods

### *Monitoring - Lotic Ecosystems*

*Missouri River*

Two sections of the Missouri River downstream from Holter Dam were electrofished annually at night using aluminum jet boats to conduct population estimates. The Craig section is 5.6 miles long and located from river mile (RM) 2,199.5 (measuring from its confluence with the Mississippi River) at Wolf Creek Bridge to RM 2,193.9 at Craig Bridge. The Cascade section is 4.1 miles long and is located from the power lines near Hardy Creek at RM 2,177.6 to an irrigation pump at RM 2,173.5. Boats were equipped with headlights and fixed booms with stainless steel droppers suspended from each boom. Electricity from 240-VAC generators was converted to smooth DC using Coffelt or Smith-Root rectifying units. Brown Trout *Salmo trutta* estimates were conducted in each section in April or May each year. Two jet boats were used in the Craig section, and one boat was used in the Cascade section with two nights of marking runs and two nights of recapture runs in each section. Rainbow Trout *Oncorhynchus mykiss* estimates were conducted in late September or October each year and two boats were used in each section. Three nights of marking runs and two nights of recapture runs were completed in the Craig section, and two nights of marking and two nights of recapture runs were completed in the Cascade section. Data were uploaded into MFWP Fisheries Information System (MFIS) (aka, Godzilla) making the data publicly available through the MFWP FishMT website. Data were analyzed using FA+ statistical software (MFWP 2004). Population estimates were calculated using the partial Log-likelihood or modified Petersen's methods and are reported as number of trout per mile 10 inches long and greater.

During electrofishing estimates an attempt was made to net all Burbot *Lota lota* and Walleye *Sander vitreus* encountered. The number of Burbot and Walleye encountered is overall greater in the fall than the spring, and greater in the Craig section than the Cascade section, thus only the numbers encountered during fall in the Craig section are reported here. These data are reported as the number of fish handled, not population estimates, as to the small numbers encountered preclude the calculation of population estimates.

Since 2004, the department has tagged Walleye sampled from the Holter tailrace section (Holter Dam to Wolf Creek Bridge), which is electrofished every other year (Appendix A, Table A1). Walleye have also been tagged during other surveys since 2008, primarily during electrofishing of the Craig section (Appendix A, Table A2). Green or yellow external floy tags are used with unique numbers printed on the tags to allow for identification of individual fish.

Seining for young of the year (YOY) Walleye was first initiated in August 2009 at 12 sites in a 47-mile reach of the Missouri River between Cascade and Great Falls. The same sites have been sampled using the same

methods (4 seine hauls per site) in each year since then to evaluate general trends in the number of YOY Walleye over time.

Rainbow Trout and Brown Trout redd counts have been conducted on the Missouri River and tributaries in the past and are reported in Mullen et al. (2017). Detailed red counts were not conducted from 2017 through 2020 and thus are not reported here.

Missouri River flow and temperature data were monitored each year below Holter Dam using USGS gage 06066500. River flows were monitored to ensure FERC compliance (FERC Project #2188). Water temperature was monitored as high temperatures can be stressful to trout populations. When temperature reaches the critical threshold of 70 F, we also monitor several thermographs located throughout the river. These thermographs and USGS water temperature data are used in making management decisions that could include providing recommendations to the regional Fish, Wildlife & Parks Commissioner to institute time of day angling restrictions for certain fisheries to reduce stress from angling on the trout populations. It is the policy of MFWP that such closure requests may be made when "…daily maximum water temperature reaches or exceeds 73° F (23° C) for at least some period of time during three consecutive days…" The drought policy also recognizes that some waters (e.g., Missouri River) will not reach the established threshold levels but may require action to protect the fishery anyway. Recent flow and temperature data are further summarized in Mullen and Grisak (2015), Mullen et al. (2016b), Mullen and Vivian (2017, 2018, 2019), and Mullen (2020).

FWP has conducted a statewide mail survey to estimate angler effort on Montana waters annually from 1982 through 1985, and every other year since 1989 (McFarland 1983-2008; Selby et al. 2015, 2017, 2019, *In prep.*). For each survey, the number of angler days was estimated from Holter Dam to Cascade (Section 9). These data are reported through 2019 to document angler use on the Missouri River. Total angler expenditures for the Missouri River (Section 9) are reported from 1995 to 2019 based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures for rivers and streams (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) and the number of angler days on the Missouri River.

Creel surveys have been conducted on the Missouri River periodically to evaluate angler demographics, effort, catch and harvest rates, and angler satisfaction. Results of the most recent year-long survey in 2015-16 including comparisons to past year-long surveys in 1993-94 and 2002-03 (Horton and Liknes 2003; Horton and Clark 2004) were summarized in Mullen et al. (2017) and described in detail in Mullen and Schilz (2017) and are not repeated here.

*Smith River*

Fish populations were sampled in the Eagle Creek section of the Smith River annually from 2017 through 2020 and at the County Line section in 2018, 2019, and 2020. The 2020 sampling event represents the 42$^{nd}$ year of sampling at the Eagle Creek site, with the first sampling event in 1969, whereas sampling at the County Line site began in 2015 and has been sampled five of the last six years. Both sites were sampled using a drift boat equipped with a mobile anode, a 240-VAC generator, and a Coffelt or Smith-Root rectifying unit to convert the waveform to smooth DC. The Eagle Creek estimate was conducted in September each year and the County Line estimate was conducted in September or October. Fish data were entered, and population estimates were calculated as described for the Missouri River data, but population estimates are reported as the number of fish per mile 8 inches and greater.

Smith River flow and temperature data were monitored each year using USGS gage 06077200 below Eagle Creek. Based on data collected in 2012, USGS gage 06077200 is considered conservative regarding water

temperature, as estimated water temperatures downstream in the Smith River canyon were lower than that recorded by the USGS gage 06077200 below Eagle Creek in 2012 (Ritter and Zale 2015).

The number of angler days on the Smith River (Section 2, from Camp Baker to Hound Creek) based on the statewide mail survey estimates are reported through 2019 to document the angler use over time on the Smith River (McFarland 1983-2008; Selby et al. 2015, 2017, 2019, *In prep.*). Total angler expenditures for the Smith River (Section 2) are reported from 1995 through 2019 based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures for rivers and streams (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) and the number of angler days on the Smith River.

*Sun River*

Fish populations were sampled in the Sun River using the same techniques as in the Smith River. Three monitoring sites are periodically sampled during spring on the Sun River, located at Highway 287, near Simms, and near the Town of Sun River. From 2017 through 2019, the Highway 287 site was sampled in 2019 and 2020 and the Simms site was sampled in 2018, 2019, and 2020. High flows prevented completion of the recapture run at the Simms site in 2019 and thus a population estimate was not calculated. Sampling was completed at the Sun River site in 2020. Estimates are reported for combined Rainbow Trout and Brown Trout due to the low numbers of trout handled. Mountain Whitefish *Prosopium williamsoni* estimates are reported for each section and year when available. All available fish population monitoring results from 1997 through 2020 are reported to allow for comparisons. Fish data were entered, and population estimates were calculated as described for the Missouri River data, but population estimates are reported as the number of fish per mile 8 inches and greater.

An additional sampling event was conducted in fall 2019 at the Highway 287 site. A single pass was completed resulting in catch per effort data. This sampling was completed after the draining of Willow Creek Reservoir for dam repairs. The sampling was conducted to evaluate the impact of the complete draining of Willow Creek Reservoir on the fish population in the Sun River.

Sun River flow data were monitored each year using USGS gages 06080900, 06082200, 06085800, and 06089000 which correspond to below the Diversion Dam, below Willow Creek, at Simms, and near Vaughn, respectively. Of particular importance is the USGS gage at Simms, which provides flow information on the most dewatered reach of the Sun River. Temperature data from the USGS gage at Simms are used to provide recommendations for instituting time of day angling restrictions. In 2015, MFWP coordinated with the Simms school to deploy temperature loggers throughout the Sun River. These data were summarized in Mullen et al. (2017) and reported in detail in Vivian and Mullen (2017).

The number of angler days on the Sun River (Gibson Dam to Muddy Creek) based on the statewide mail survey estimates are reported through 2019 to document the angler use over time on the Sun River (McFarland 1983-2008; Selby et al. 2015, 2017, 2019, *In prep.*). Total angler expenditures for the Sun River are reported from 1995 through 2019 based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures for rivers and streams (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) and the number of angler days on the Sun River.

*Belt Creek*

Since 2010, MFWP has conducted extensive monitoring throughout the Belt Creek drainage, in part to document stream conditions prior to and during Barker-Hughesville and Carpenter-Snow Creek Environmental Protection Agency Superfund remediation activities. These investigations include benthic macroinvertebrate monitoring, caged fish bioassay, fish movement, fish tissue, barrier assessments and construction, temperature and discharge monitoring, and routine fish population monitoring on Belt Creek

and its tributaries (Clark et al. 2011, 2013, 2014, 2015). Techniques include using a drift boat equipped with a mobile anode as described above, barge electrofishing with two semi-mobile anodes, and backpack electrofishing. Recent fish population monitoring of the mainstem Belt Creek, which utilized regional personnel, are summarized here. The four Belt Creek sites reported here from upstream to downstream include Neihart (located upstream of Neihart), Carpenter Creek to Harley Creek, Monarch, and Sluice Boxes. All four sites were sampled in 2020. The most recent sampling prior to 2020 was in 2017 for the three upstream sites and 2016 for the Sluice Boxes site. Limited personnel and other management priorities have limited the ability to conduct monitoring annually in recent years. Population estimates were calculated using modified Petersen's methods with the MFIS analysis tools. Brook Trout *Salvelinus fontinalis*, Westslope Cutthroat Trout *Oncorhynchus clarkii lewisi*, Rainbow Trout, Brown Trout, all trout combined, and Mountain Whitefish estimates are reported as the number per kilometer 150 mm and greater.

The number of angler days on Belt Creek based on the statewide mail survey estimates are reported through 2019 to document the angler use over time for Belt Creek (McFarland 1983-2008; Selby et al. 2015, 2017, 2019, *In prep.*). Total angler expenditures for Belt Creek are reported from 1995 through 2019 based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures for rivers and streams (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) and the number of angler days.

Acid mine drainage (AMD) from past coal mining activities currently results in exceedances of Montana Water Quality Standards for iron and aluminum in Belt Creek, in the town of Belt, Montana. Montana Department of Environmental Quality (MDEQ) is proposing to construct a water treatment plant in the area of Coke Oven Flats to treat several sources of AMD water prior to it reaching Belt Creek and thereby improve water quality in Belt Creek. Fish and benthic invertebrate monitoring were conducted by the Department in Belt Creek in this area in 2015 and 2018 to evaluate the impact of the AMD. Results of these surveys are reported in Owensby and Mullen (2016), Mullen et al. (2018) and Selch and Mullen (2019).

***Monitoring - Lentic Ecosystems***

Several lakes, reservoirs, and ponds throughout the management area are routinely sampled using gill nets and traps nets. Unless otherwise stated, the gill netting procedure involves using 125-foot monofilament experimental sinking and floating gill nets with the number of sets in proportion to the size of the waterbody being sampled and the objectives of the netting. Gill net sets are generally standardized as overnight sets. Trap nets were also used in the management area with the number of sets in proportion to the size of the waterbody sampled and the objectives of the netting. It is understood that sinking gill nets, floating gill nets, and trap nets will be selective for certain species of fish but using multiple gear types maximizes probability of capture of all species in most of the waters that are netted. The recent sampling data and stocking history of major waterbodies and/or those routinely sampled are described in this report. Angler use data is reported when available. Numerous other ponds and reservoirs have also been stocked and sampled throughout the Great Falls management area and Region 4. Many of these ponds are private ponds that MFWP stocks with an agreement that landowners will allow public access. MFWP published a Region 4 Ponds, Lakes, and Reservoirs fishing guide in 2019 that describes these opportunities (MFWP 2019b). Additional information regarding stocking and sampling data (if available) of ponds, lakes, and reservoirs in Region 4 can be found on the FISH MT website.

***Other Activities***

Other activities, including research, Westslope Cutthroat Trout monitoring and conservation projects, aquatic education, and aquatic habitat restoration have been conducted throughout the Great Falls Management Area. These activities are briefly discussed in the results and discussion, and referenced for further information.

**Results and Discussion**

***Lotic Ecosystems***

*Missouri River*

Population Monitoring

The estimates of Rainbow Trout and Brown Trout in the Missouri River Craig section fell below the long-term average in 2019 after eight consecutive years of estimates above the average for Rainbow Trout and two consecutive years at or above average for Brown Trout (Figure 1). The estimate of Rainbow Trout 10 inches long and greater in the Craig section was 2,860 per mile in 2019. The estimate of 2,860 fish per mile was the lowest since 2010 and 84% of the long-term average of 3,391 fish per mile based on annual estimates since 1982. The estimate of Brown Trout 10 inches long and greater in the Craig section was 390 per mile in 2019 compared to the long-term average of 568 per mile. Numbers increased in 2020, with estimates of 3,247 Rainbow Trout and 422 Brown Trout 10 inches and greater per mile (Figure 1). Rainbow Trout condition was the second highest on record in 2020 in the Craig section, as measured by average relative weight (110.3). Of the Rainbow Trout handled greater than 10 inches, 18 to 20-inch fish were most abundant. Rainbow Trout less than 10 inches were extremely abundant during sampling in fall 2020, with the highest percentage of fish handled between 6 and 10 inches (primarily between 6 and 8 inches) over the period of record.

Similar to the Craig section, Rainbow Trout and Brown Trout population estimates in 2018 and 2019 were also below average in the Cascade section (Figure 2). Rainbow Trout 10 inches long and greater were estimated at 1,104 per mile in 2019 compared to the long-term average of 1,588. Brown Trout 10 inches long and greater were estimated at 238 per mile in 2019 compared to the long-term average of 390. Numbers increased in the Cascade section in 2020 as well, with estimates of 1,698 Rainbow Trout and 291 Brown Trout 10 inches and greater per mile (Figure 2). The 2020 Rainbow Trout estimate for the Cascade section was slightly above average, while the Brown Trout estimate was slightly below average.

While Mountain Whitefish are also present in the Missouri River, they have typically not been handled during electrofishing surveys due to logistical constraints and the potential negative effects of stress on the fish, which is greater than for trout. However, some surveys were conducted over the first 2.5 miles of the Craig section in 2004 and 2005. While an effort was made to calculate a population estimate using Mark-Recapture techniques, the low abundance of Mountain Whitefish encountered resulted in poor estimates and the data being suitable only for general catch per unit effort (CPUE). A similar effort to evaluate CPUE of Mountain Whitefish was conducted in 2020 during the spring Brown Trout estimate. All Mountain Whitefish encountered 6 inches and greater during the first 2.5 miles were netted, counted, and measured during the first marking run. For all subsequent runs (second marking run and two recapture runs), all Mountain Whitefish were counted, but not netted, to reduce stress.

The average number of Mountain Whitefish counted per electrofishing run in 2004, 2005, and 2020 was 205, 183, and 107, respectively. While the CPUE data cannot be interpreted with the same level of confidence as population estimates, approximately half as many Mountain Whitefish were handled in 2020 as in 2004 and 2005. The size distribution of Mountain Whitefish was similar between 2004 and 2005, but resulted in a lower average length in 2020 (2004 – min=6.5, max=19.1, ave=15.7; 2005 – min=9.1, max=19.5, ave=16.6; 2020 – min=6.0, max=20.5, ave=14.0), because of an abundance of Mountain Whitefish between 9 and 12 inches in 2020 (Figure 3). A yearlong creel survey was completed from March 2015 through February 2016 on the Missouri River (Mullen and Schilz 2017). Catch rates from the 2015 creel survey were similar to those observed in 1993, but less than rates observed in 2002 and 1988 (Leathe et al. 1988; Horton and Liknes 2003; Horton and Clark 2004). While the CPUE data and creel survey data

are limited compared to the trout population estimate data, the 2020 Mountain Whitefish sampling effort will be continued in future years to collect more data for trend analysis.

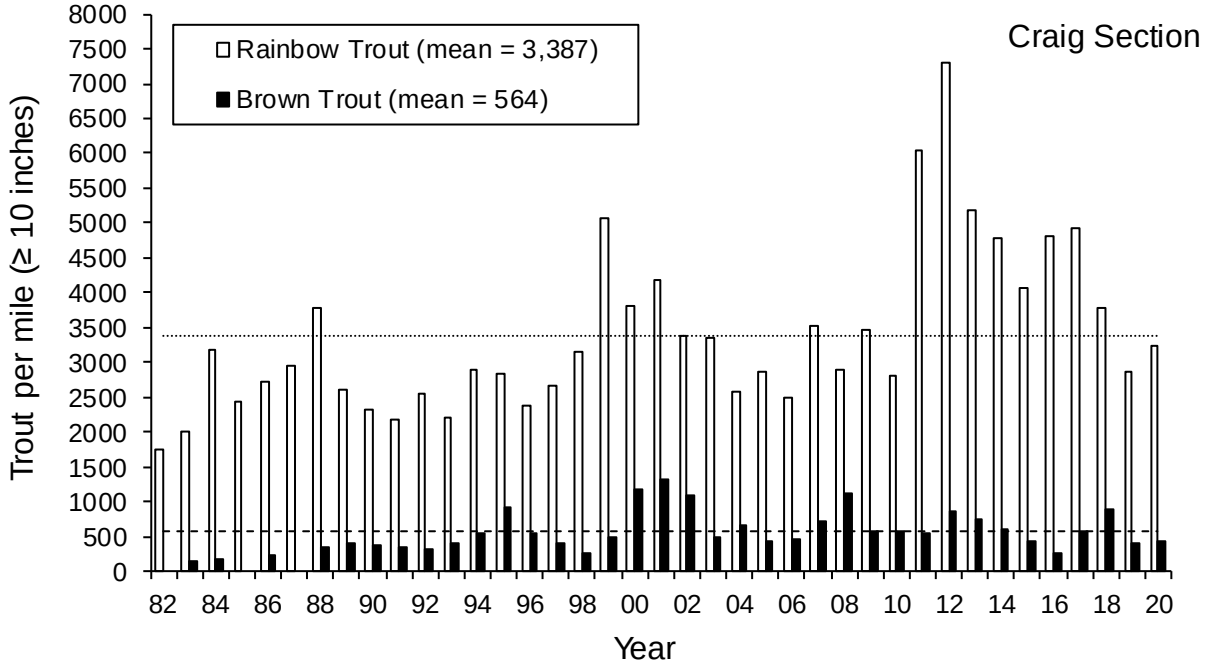


Figure 1. Rainbow Trout and Brown Trout population estimates (10 inches and greater) for the Craig section of the Missouri River from 1982 through 2020. The dotted line represents the long-term Rainbow Trout mean and the dashed line represents the long-term Brown Trout mean.

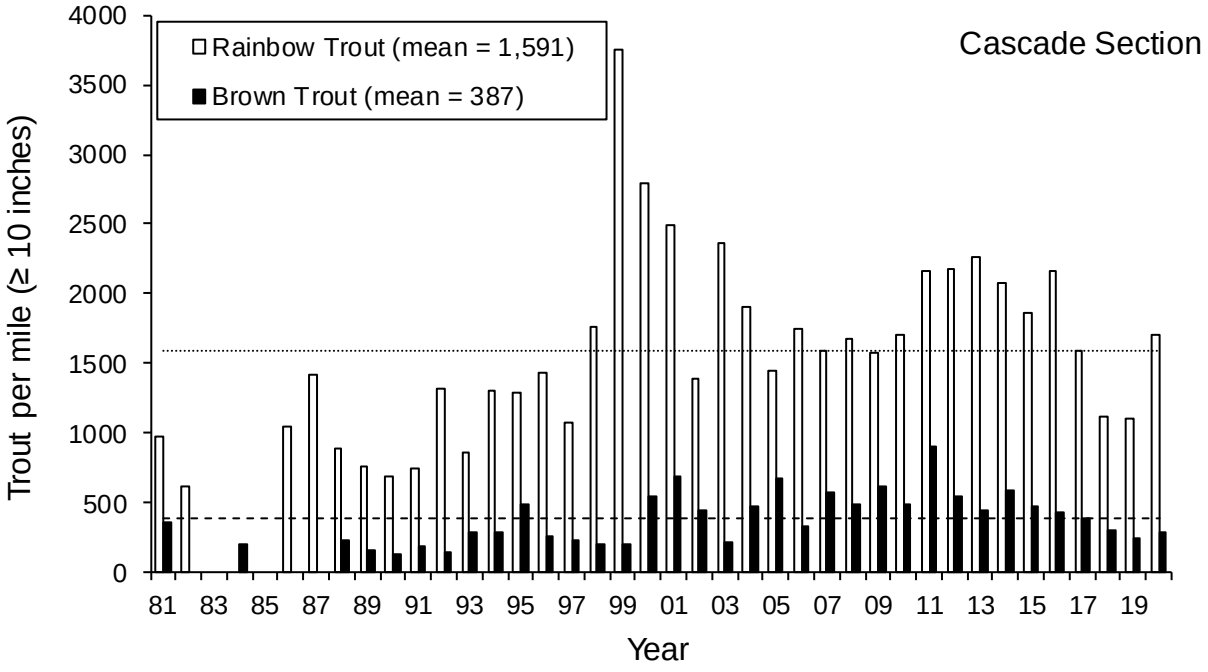


Figure 2. Rainbow Trout and Brown Trout population estimates (10 inches and greater) for the Cascade section of the Missouri River from 1981 through 2020. The dotted line represents the long-term Rainbow Trout mean and the dashed line represents the long-term Brown Trout mean.

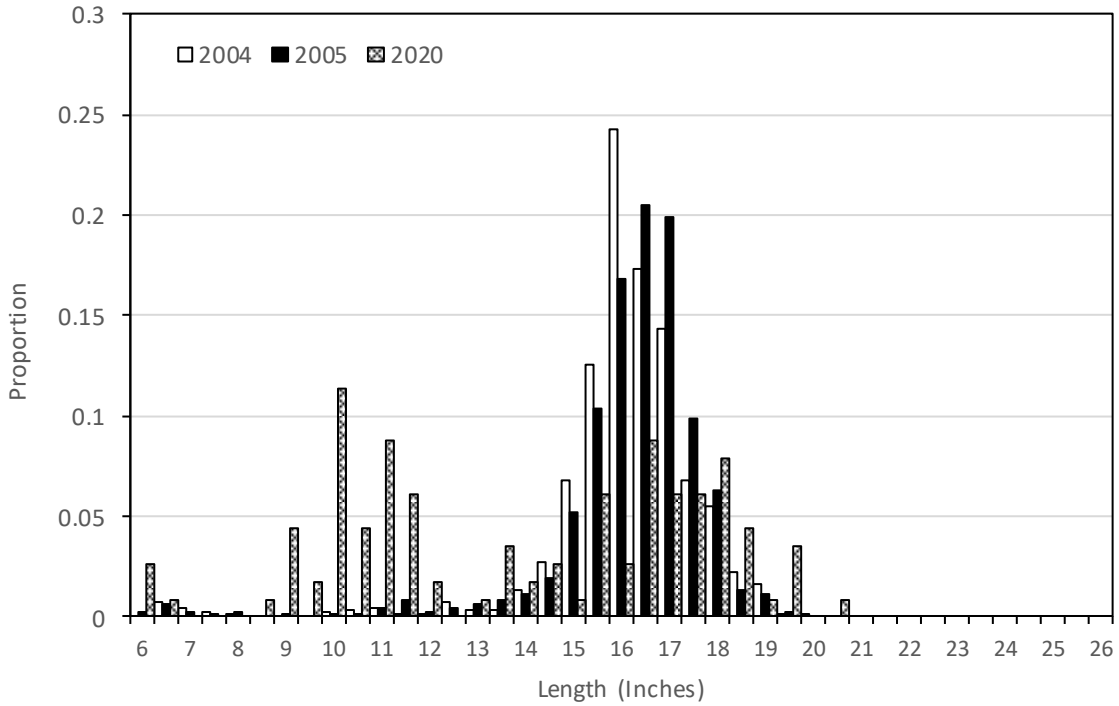


Figure 3. Length frequency histogram for Mountain Whitefish collected in 2004 (n=821, 4 runs), 2005 (n=733, 4 runs), and 2020 (n=114, 1 run) during spring electrofishing of the first 2.5 miles of the Craig section of the Missouri River. Proportion of fish for each year is shown on the y-axis as a function of length (inches) on the x-axis.

Walleye and Burbot are also handled during spring and fall electrofishing surveys. More Walleye and Burbot are handled during fall surveys than spring surveys and in the Craig section than the Cascade section, thus only fall results from the Craig section are presented here. Burbot were most abundant from 1997 through 2001 and to a lesser degree from 2010 through 2014 during fall electrofishing surveys (Figure 4). In recent years, the number of Burbot handled was near the long-term average of 74 in 2018 and 2019, and below the long-term average in 2017 and 2020. Walleye were most abundant in the Missouri River in 2010 and 2011 following high flow events (Figure 4) and corresponding with a period of relatively abundant populations in Holter Reservoir. Somewhat higher numbers of Walleye were collected in fall 2018 and 2019 following a high flow event in 2018. But densities in Holter Reservoir were lower at this time than around 2010 and 2011, which may explain the smaller increase in numbers. The numbers of Burbot and Walleye handled are substantially less than the number of trout handled. The mean number of Burbot and Walleye handled during fall electrofishing in the Craig section is 74 and 28, respectively, compared to a mean of 4,309 Rainbow Trout (during fall) and 1,580 Brown Trout (during spring) handled.

Most Walleye harvest tag returns were reported by the year after tagging with few tags reported two years after tagging or longer (Appendix A, Tables A1 and A2). In the Holter tailrace section, since 2006, an average of 14% of tagged Walleye were reported as harvested by the following year (min = 2%, max = 36%) (Appendix A, Table A1). Similarly, 18% of tagged Walleye were reported as harvested by the following year in the Missouri River below Holter (min = 6%, max = 40%), excluding the tailrace section (Appendix A, Table A2). Despite relatively few Walleye harvest tag returns beyond the year after tagging, the tagging program has allowed us to document Walleye up to 23 years old in the Missouri River, based on the age of the fish at tagging and angler reported catch.

Walleye regulations were changed by the Commission from the standard 5 daily and 10 in possession regulation in 2010 to no limit in 2011 through 2019. While the percent of anglers reporting tagged fish is unknown, based on harvest tag return rates from Walleye tagged in the Holter tailrace (Appendix A, Table A1) and those tagged primarily in the Craig section (Appendix A, Table A2), there was no apparent increase in the harvest tag return rate with the change in regulations. In fact, Walleye harvest return rates tended to be higher before 2011 than after with a combined 29% (50 of 175 tagged fish) returned as harvested within one year for fish tagged from 2004 through 2009 compared to 15% (137 of 924 tagged) returned as harvested within one year for fish tagged from 2011 through 2018 (Appendix A, Tables A1 and A2). A creel survey was completed from March 2015 through February 2016 (Mullen and Schilz 2017). Of the 75 Walleye that were documented as harvested during the survey based on angler interviews, 8 total Walleye (angler harvest of 6 to 8 Walleye) were in excess of what the prior standard regulation allowed (Mullen and Schilz 2017). Four of twenty-five (16%) anglers who harvested Walleye, harvested in excess of the old standard regulation (Mullen and Schilz 2017). The no limit regulation was removed in 2020 and replaced with 20 daily and 40 in possession from Holter Dam to Cascade and 10 daily and 20 in possession from Cascade to Great Falls.

FWP has conducted seining surveys between Cascade and Great Falls for twelve consecutive years to evaluate young of year (YOY) Walleye production. Overall, the number of YOY Walleye has been highly variable, but relatively low in most years. The most YOY Walleye were collected in the first two years of sampling in 2009 and 2010 with 213 and 235 individuals collected over the 12 sites (Figure 5). In most other years, the number of YOY Walleye has been approximately 50 or less with no individuals collected in 2016 and 2017. Young of the year Walleye abundance may be related to flow events that provide flushing of Walleye into the Missouri River from Holter Reservoir and flows that provide suitable spawning and rearing conditions. Young of the year Walleye were generally highest with moderately high peak flows in 2009 and 2010 and lowest during the low flow years of 2013, 2015, and 2016. However, YOY Walleye abundance was also relatively low during 2011, the year with the highest peak flow.

During the annual seining surveys for YOY Walleye, one juvenile Northern Pike *Esox lucius* was sampled in 2019 and one in 2020, representing the first Northern Pike sampled during these surveys. Several other Northern Pike have been observed by FWP personnel and anglers have also reported catching numerous Northern Pike from the Missouri River between Holter Dam and Ulm in 2018 through 2020. Most of the angling reports have come from the stretch of river from Cascade to Ulm, but a few reports have come from immediately downstream of Holter Dam. One Northern Pike was collected in the Craig section during spring 2020 electrofishing but was subsequently lost before measurements could be collected. This represents the first Northern Pike encountered during the annual monitoring surveys. In 2019, the MFWP Commission approved changes to the Northern Pike regulations downstream of Holter Dam that went into effect March 1, 2020. Northern Pike regulations on the Missouri River from Holter Dam downstream to Black Eagle Dam were changed from the standard regulation of 10 daily and in possession to No Limit. This regulation change is intended to encourage harvest of Northern Pike given the increased abundance throughout the system and is consistent with regulations already in place in the Missouri River and reservoirs upstream of Holter Dam.

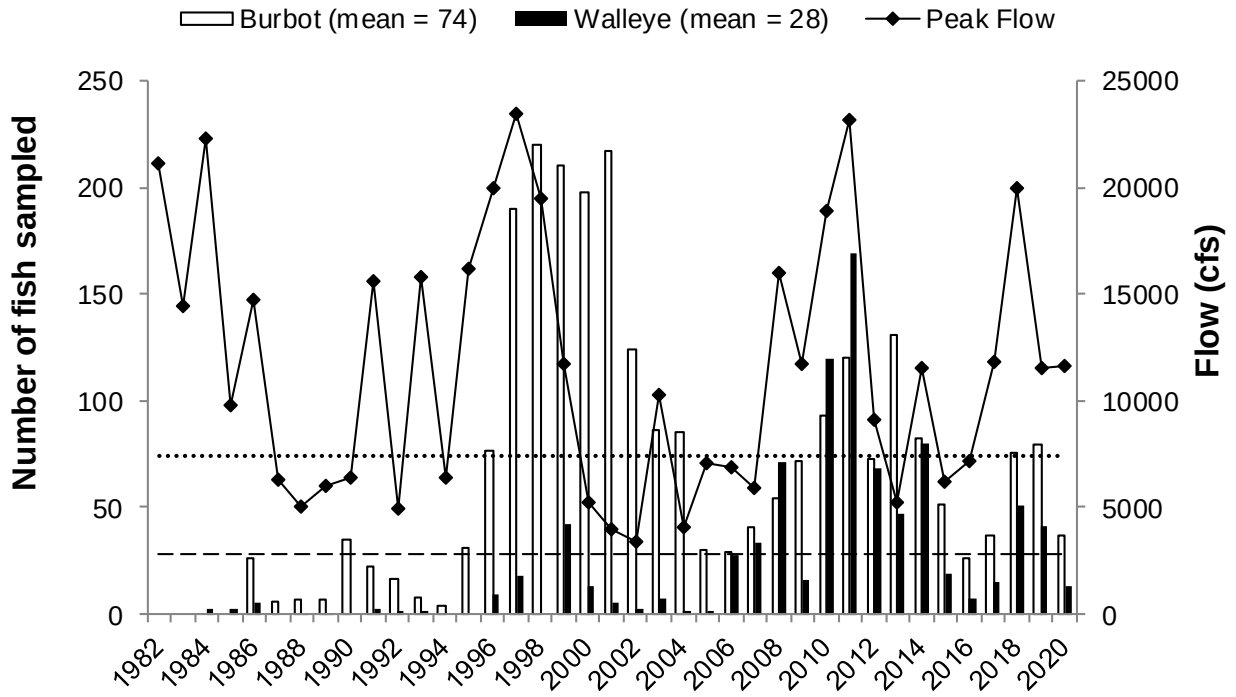


Figure 4. Number of Burbot and Walleye handled during standardized fall electrofishing surveys from 1982 through 2020 in the Craig section of the Missouri River. The peak annual flow of the Missouri River from USGS gage 06066500 (below Holter) is graphed on the right y-axis. The horizontal dotted line represents the mean number of Burbot handled and the horizontal dashed line represents the mean number of Walleye handled.

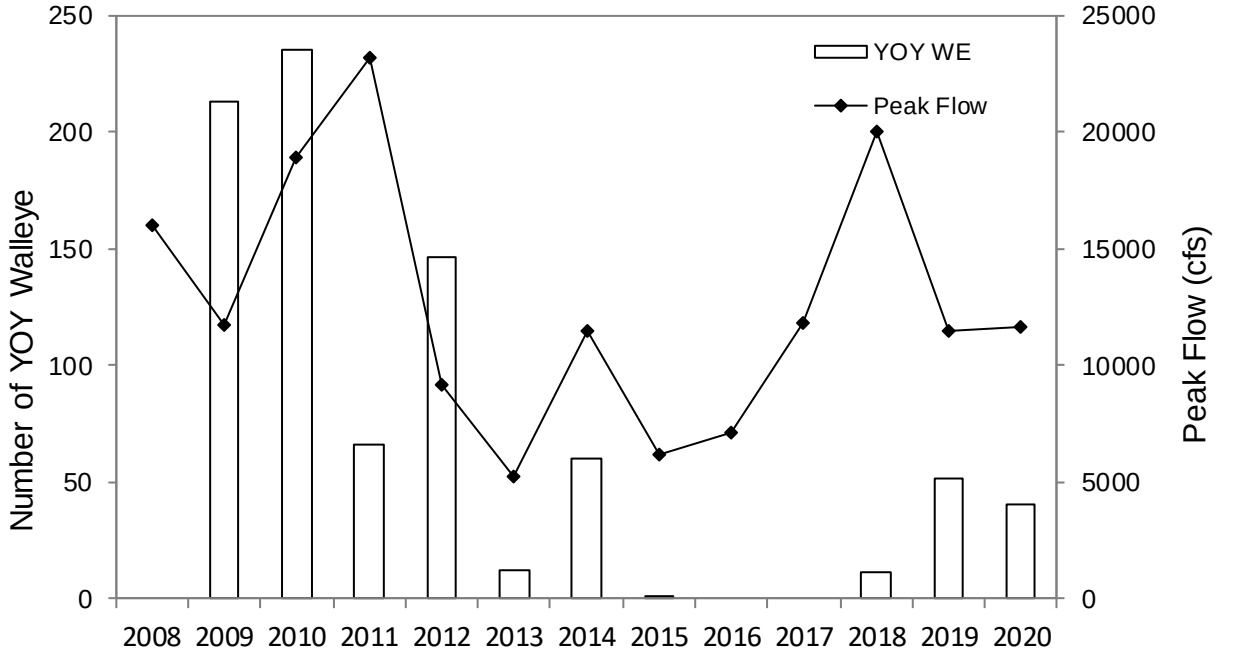


Figure 5. Total abundance of young of the year Walleye from seining sites along the Missouri River from Cascade to Great Falls from 2009 through 2020 (left y-axis) and the peak annual flow of the Missouri River from USGS gage 06066500 from 2008 through 2020 (right y-axis). Zero young of the year Walleye were collected in 2016 and 2017.

Flow Monitoring

Mean daily flow for 2017, 2018, 2019, and 2020 compared to mean daily flow for the period of record are shown in Figure 6. Overall, the mean annual discharge and the peak annual discharge was near or slightly below average in 2017, 2019, and 2020 (Figures 7 and 8). Flows in 2018 were well above average with a mean annual discharge of 6,963 cfs and a peak discharge of 20,000 cfs (Figures 7 and 8). A 2008 study documented that a flow of approximately 15,000 cfs was sufficient to mobilize streambed substrates in the Missouri River (Strainer and Grisak 2009). Over the last 20 years (2001 through 2020) peak flows have met or exceeded 15,000 cfs only four times (2008, 2010, 2011, and 2018) compared to nine times from 1981 through 2000, and 12 times from 1961 through 1980 (Figure 8).

For the 2017 calendar year, the Missouri River below Holter Dam had a mean discharge of 5,010 cfs, which was 95% of the 71-year mean (Figure 7). The maximum discharge in 2017 was 11,800 cfs, which occurred on June 17th (Figures 6 and 8).

For the 2018 calendar year, the Missouri River below Holter Dam had a mean discharge of 6,963 cfs, which was 131% of the 72-year mean (Figure 7). The maximum discharge in 2018 was 20,000 cfs, which occurred on June 1st (Figures 6 and 8).

For the 2019 calendar year, the Missouri River below Holter Dam had a mean discharge of 5,652 cfs, which was 106% of the 73-year mean (Figure 7). The maximum discharge in 2019 was 11,500 cfs, which occurred on April 28th (Figures 6 and 8).

For the 2020 calendar year, the mean discharge is not yet available from the USGS. The maximum discharge in 2020 was 11,400 cfs, which occurred on July 2 (Figures and 8).

The most recent four years illustrate the variability in the magnitude and timing of the peak discharge as the peak varied from the end of April to the beginning of July. Also, of significance with regards to flow was the amount of ice accumulation in winter 2018-2019. Ice covered the Missouri River upstream past the Mountain Palace Fishing Access Site, which is further upstream than in almost any other year in recent times. After the ice broke up, it was measured up to 12 ft in thickness along the shore of an island upstream of Mountain Palace Fishing Access Site.

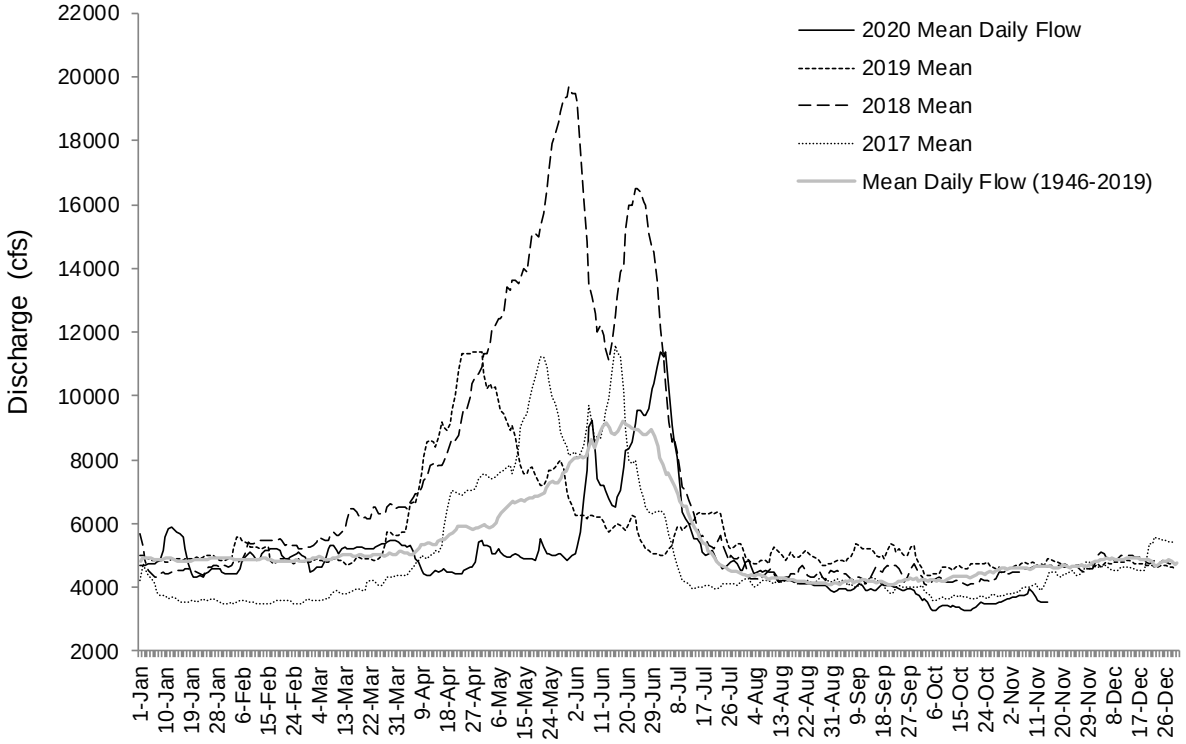


Figure 6. Mean daily flow for the Missouri River below Holter Dam at USGS gaging station 06066500 (below Holter Dam) for 2017, 2018, and 2019, 2020, and for the period of record from 1946 through 2019.

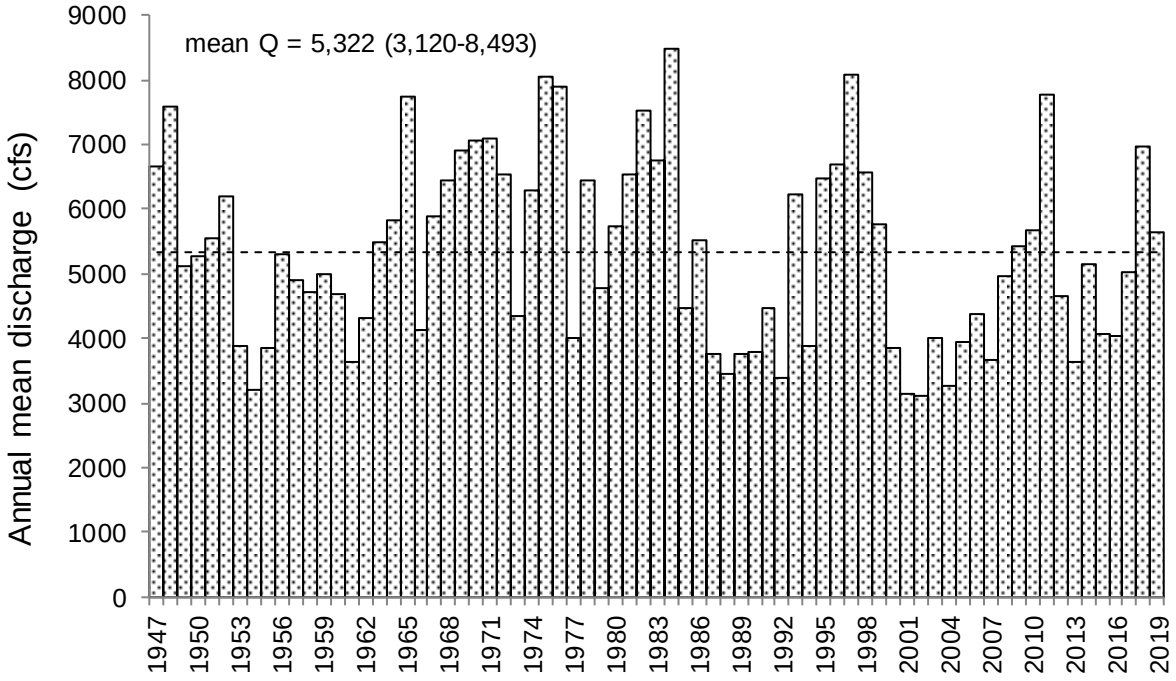


Figure 7. Mean annual flow for the Missouri River below Holter Dam at USGS gaging station 06066500 from 1947 through 2019, by calendar year. Horizontal dashed line represents the mean annual flow.

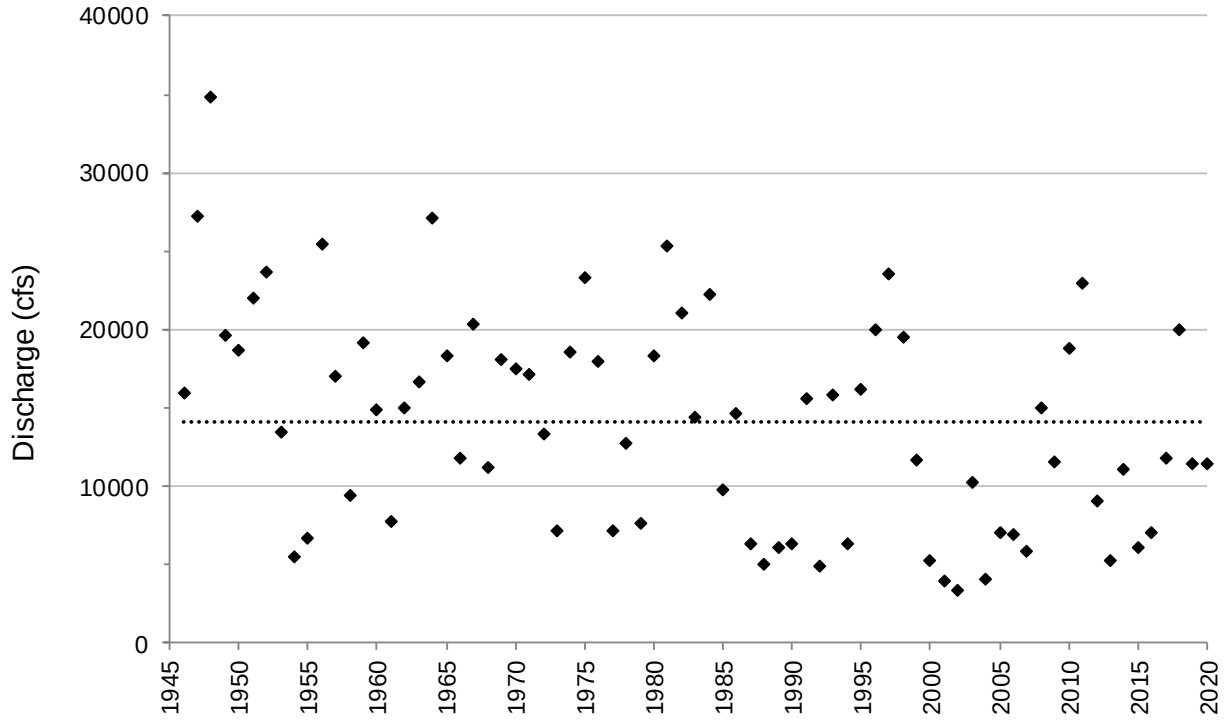


Figure 8. Peak annual flow for the Missouri River below Holter Dam at USGS gaging station 06066500 from 1947 through 2020. Horizontal dotted line represents the mean annual peak flow of 14,061 cfs.

Temperature Monitoring

Temperature data from the Missouri River below Holter Dam (USGS gage 06066500) were monitored during warm periods from 2017 through 2020. Over this period the maximum daily water temperature was 68.9°F in August 2018. This matches the maximum daily temperature that was observed from 2014 through 2016, when maximum daily temperature reached 68.9°F in August 2015 (Mullen et al. 2017). Water temperatures never exceeded the 73°F threshold from 2017 through 2020 (Figure 9) at the USGS gage below Holter Dam, which is the typical threshold used by the department where time of day angling restrictions may be implemented, and thus no recommendations for restrictions were made.

Statewide Angler Use Survey

Angling effort for the Missouri River Section 9 (Holter Dam to Cascade), as measured by a statewide mail survey, increased since 1982 to a maximum level in 2015 of 183,479 estimated angler days (Table 1). This represented the greatest amount recorded for any waterbody in the state to that point, before it was surpassed by the Madison River in 2017 (Table 1). The number of estimated angler days for the Missouri River Section 9 decreased in 2017 and 2019, but still exceeded levels observed prior to 2013 (Table 1). In 2019, it was estimated the Missouri River Section 9 received 154,628 angler days, which ranked second in the state and first in Region 4. Approximately 51% of the use was by residents and 49% by non-residents in 2019 compared to 75% resident and 25% non-resident in 1995 (Table 1). Total angler expenditures for the Missouri River Section 9 were estimated at approximately 60.2 million dollars in 2019 (Table 2).

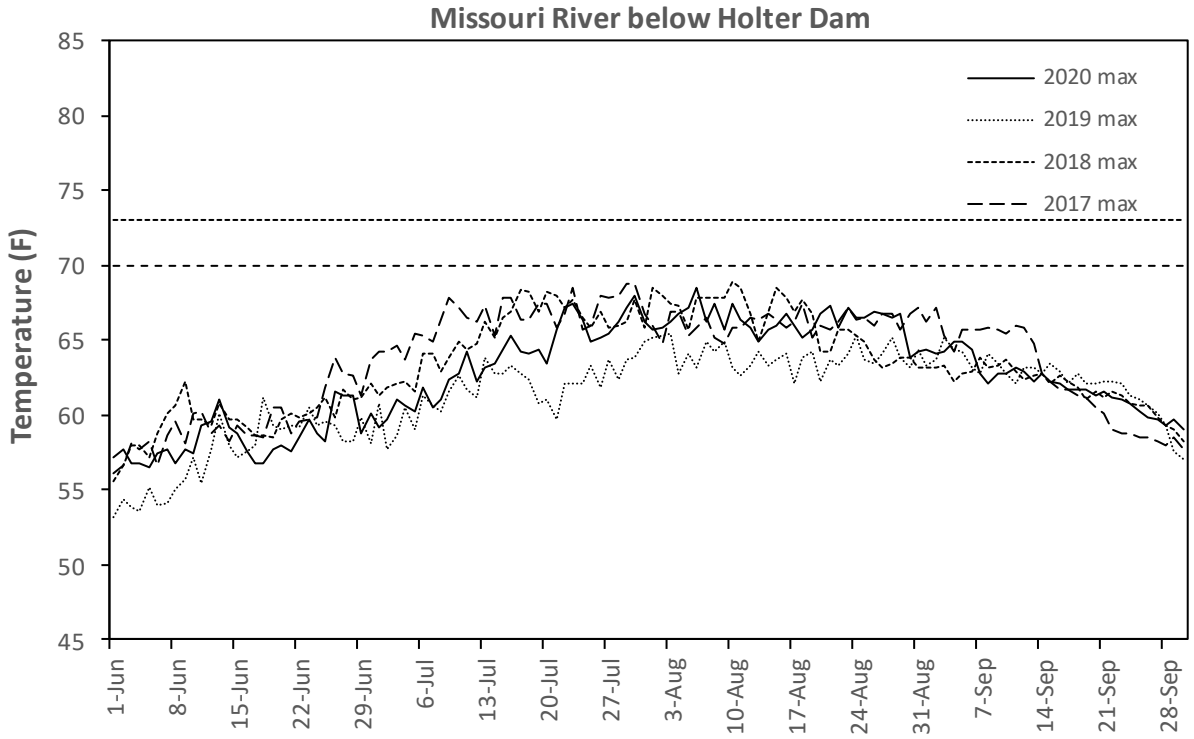


Figure 9. Maximum daily temperatures for the Missouri River below Holter Dam at USGS gaging station 06066500 for 2017, 2018, 2019, and 2020.

Table 1. Angler use statistics including estimated number of angler days for the Missouri River (Section 9) Holter tailwater fishery from 1995 through 2019 (McFarland et al. 1997-2008; Selby et al. 2015, 2017, 2019, *In prep.*).

| Year | Angler days | State rank | Reg rank | % Resident | % Non-Resident | No. 1 fishery | Angler days |
|---|---|---|---|---|---|---|---|
| 2019 | 154,628 | 2 | 1 | 51 | 49 | Madison R. (sec 2) | 172,944 |
| 2017 | 170,736 | 2 | 1 | 53 | 47 | Madison R. (sec 2) | 207,334 |
| 2015 | 183,479 | 1 | 1 | 51 | 49 | --- | --- |
| 2013 | 170,850 | 1 | 1 | 58 | 42 | --- | --- |
| 2011 | 105,986 | 2 | 1 | 55 | 44 | Big Horn Rive (sec 3) | 126,200 |
| 2009 | 106,746 | 4 | 2 | 63 | 37 | Canyon Ferry Res. | 133,220 |
| 2007 | 78,468 | 4 | 2 | 68 | 32 | Madison R. (sec 2) | 106,330 |
| 2005 | 93,229 | 2 | 1 | 64 | 36 | Madison R. (sec 2) | 116,345 |
| 2003 | 106,447 | 2 | 1 | 61 | 39 | Madison R. (sec 2) | 115,342 |
| 2001 | 123,427 | 1 | 1 | 69 | 31 | --- | --- |
| 1999 | 111,203 | 3 | 1 | 79 | 21 | Canyon Ferry Res. | 119,886 |
| 1997 | 88,576 | 4 | 1 | 75 | 25 | Fort Peck Lake | 108.562 |
| 1995 | 75,201 | 2 | 1 | 75 | 25 | Canyon Ferry Res. | 94,731 |

Table 2. Total angler expenditures and angler use days for the Missouri River (Section 9) Holter tailwater fishery from 1995 to 2019. Total angler expenditures are based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) for rivers and streams and the number of angler days on the Missouri River (McFarland et al. 1997-2008; Selby et al. 2015, 2017, 2019, *In prep.*).

| Year | Res Value ($) | Non-Res Value ($) | Total Angler Days | Res Angler Days | Non-Res Angler Days | Total ($) |
|---|---|---|---|---|---|---|
| 2019 | 90.33 | 699.95 | 154,628 | 78,824 | 75,804 | 60,179,182 |
| 2017 | 86.35 | 669.12 | 170,736 | 91,221 | 79,515 | 61,082,010 |
| 2015 | 84.12 | 651.80 | 183,479 | 93,365 | 90,114 | 66,590,169 |
| 2013 | 83.40 | 646.23 | 170,850 | 99,906 | 70,944 | 54,178,302 |
| 2011 | 46.83 | 244.44 | 105,989 | 57,825 | 48,164 | 14,481,153 |
| 2009 | 44.55 | 232.53 | 106,746 | 67,266 | 39,480 | 12,176,985 |
| 2007 | 43.04 | 224.65 | 78,468 | 53,604 | 24,864 | 7,892,814 |
| 2005 | 40.43 | 211.03 | 93,229 | 59,762 | 33,467 | 9,478,719 |
| 2003 | 38.13 | 199.04 | 106,447 | 64,854 | 41,593 | 10,751,554 |
| 2001 | 36.8 | 192.06 | 123,472 | 84,860 | 38,612 | 10,538,669 |
| 1999 | 34.57 | 180.42 | 111,203 | 87,768 | 23,435 | 7,262,282 |
| 1997 | 33.23 | 173.44 | 88,576 | 66,179 | 22,397 | 6,083,664 |
| 1995 | 32.34 | 168.78 | 75,201 | 56,613 | 18,588 | 4,968,147 |

*Smith River*

Population Monitoring

The estimate for the number of Rainbow Trout 8 inches and greater in the Eagle Creek section was 411 per mile in 2020, which was similar to values observed since 2016 (Figure 10). The estimate of Brown Trout 8 inches and greater in the Eagle Creek section was 222 per mile in 2020, which was similar to but less than values observed in 2018 and 2019, and well below that observed in 2017. Rainbow Trout and Brown Trout estimates in 2020 were both below the long-term mean values (Figure 10), but similar to the long-term median values (Rainbow Trout Median = 373; Brown Trout Median = 254).

An additional monitoring site was added at the Meagher and Cascade County line (hereafter, County Line) in 2015 and has been sampled in five of the last six years. The estimate of Rainbow Trout and Brown Trout 8 inches and greater in 2020 were similar to one another with 348 and 326 per mile, respectively. The 2020 Rainbow Trout estimate was greater than the long-term average and 2$^{nd}$ highest of the five years of sampling. The 2020 Brown Trout estimate was just below the long-term average and represented the middle value of the five years of sampling. Overall, small Rainbow Trout are typically more abundant in the Eagle Creek section, while small Brown Trout have been more abundant in the County Line section. Average relative weight values for Rainbow Trout and Brown Trout were near 105 for both sites in 2018, indicating fish in good condition. Values dropped for both species and at both sites in 2019 and 2020 to near 90, indicating relatively poor condition compared to 2018, but not outside the variability in the data observed in earlier years.

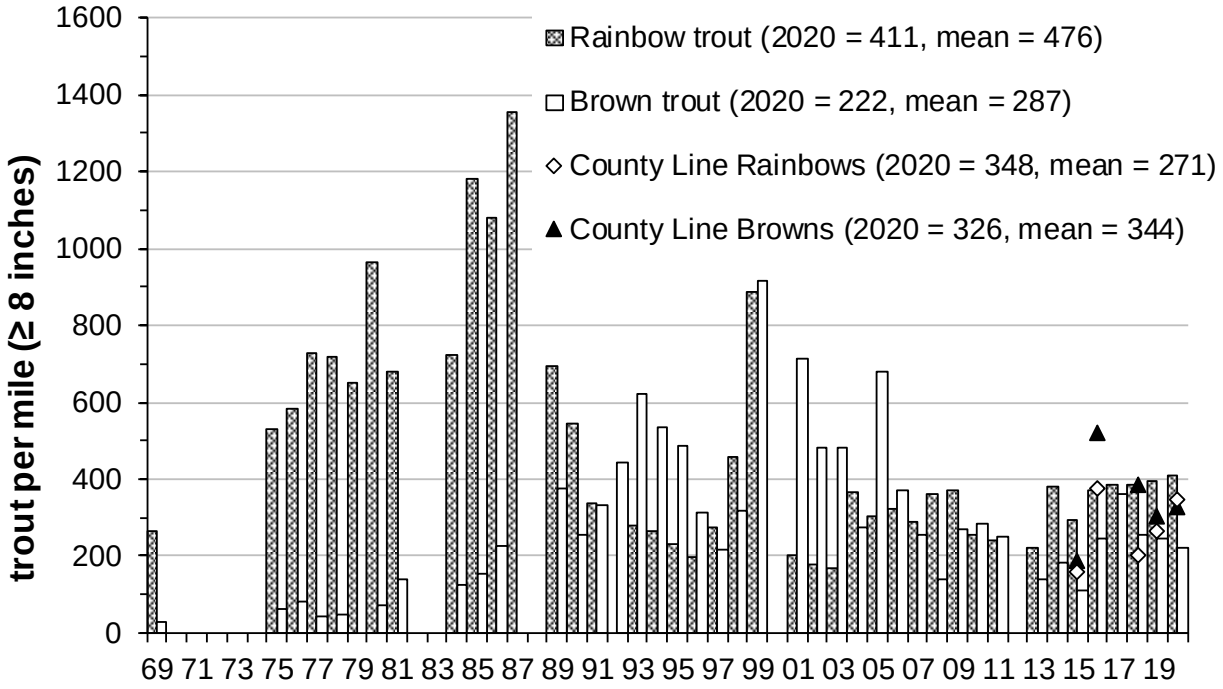


Figure 10. Rainbow Trout and Brown Trout population estimates (8 inches and greater) for the Eagle Creek (bars) and County Line (diamonds and triangles) sections of the Smith River from 1969 through 2020.

Flow Monitoring

Low flows and associated warm water temperatures can create stressful conditions for trout in the Smith River. Flows were below average in 2017, while 2018, 2019, and 2020 flows were all above average (Figures 11 and 12). In 2017, the maximum daily average flow was 632 cfs, which was the fourth lowest since 1997 and well below the long-term average of 1,459 cfs (Figure 12). In contrast, the maximum daily average flow in 2018 was 2,350 cfs, which was the third highest flow since 1997. In 2017 flows were frequently less than 100 cfs in July through September (Figure 11) with 71 total days less than 100 cfs, compared 13, 0, and 12 days less than 100 cfs in 2018, 2019, and 2020, respectively.

Significant filamentous green algae blooms were reported in 2016 and 2017, with substantially less green algae reported in 2018, 2019, and 2020. Fish population monitoring did not indicate any detectable impacts from the algae blooms in 2016 and 2017. In fact, trout condition as measured by relative weight, was higher in the low water and abundant algae years of 2016 and 2017 than in 2019 and 2020 when flow conditions were better and less algae present. Fish condition was also high in 2018, when flow conditions were favorable, and algae was less abundant, thus other factors are likely contributing to fish condition.

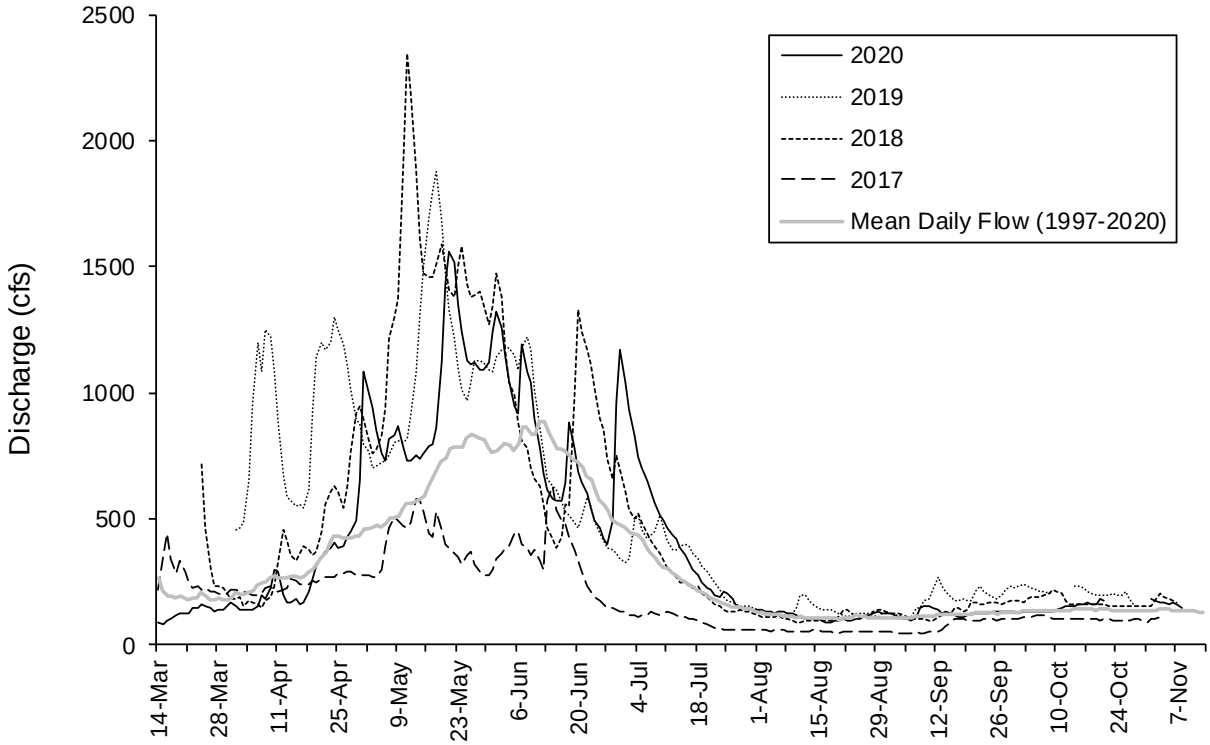


Figure 11. Mean daily flow for the Smith River near Eagle Creek at USGS gaging station 06077200 for 2017, 2018, 2019, 2020, and for the period of record from 1997 through 2020.

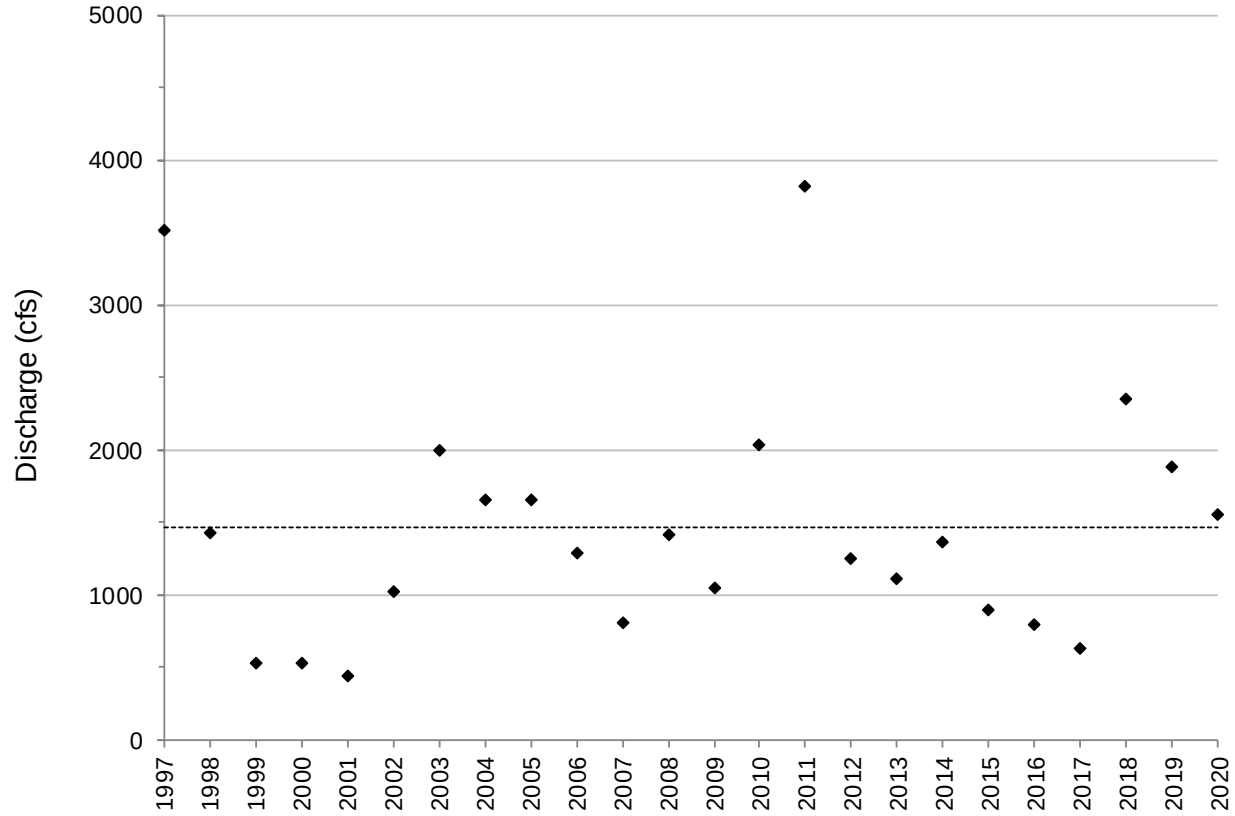


Figure 12. Maximum of daily average flow for the Smith River near Eagle Creek at USGS gaging station 06077200 from 1997 through 2020. The dashed line represents the long-term average.

Temperature Monitoring

Temperature monitoring was conducted using the USGS data for the Smith River near Eagle Creek (station 06077200). Time of day angling restrictions may be implemented when the daily maximum water temperature reaches or exceeds 73°F for three consecutive days, based on the increased stress to trout that can occur at these temperatures. Catch-and-release angling mortality in the Smith River was as high as 9% and 28% for Rainbow Trout and Mountain Whitefish, respectively, when water temperatures were 73°F or greater during a study in 2006 and 2007 (Boyd et al. 2010). The total number of days with a daily maximum water temperature greater than or equal to 73°F were 32, 11, 6, and 8 in 2017, 2018, 2019, and 2020, respectively (Figure 13). Time of day angling restrictions were implemented in 2017 from July 9 through September 15. While water temperatures exceeded 73°F for the minimum length of time in 2018, 2019, and 2020, time of day angling restrictions were never implemented due to forecasted cooler weather and associated reductions in water temperatures.

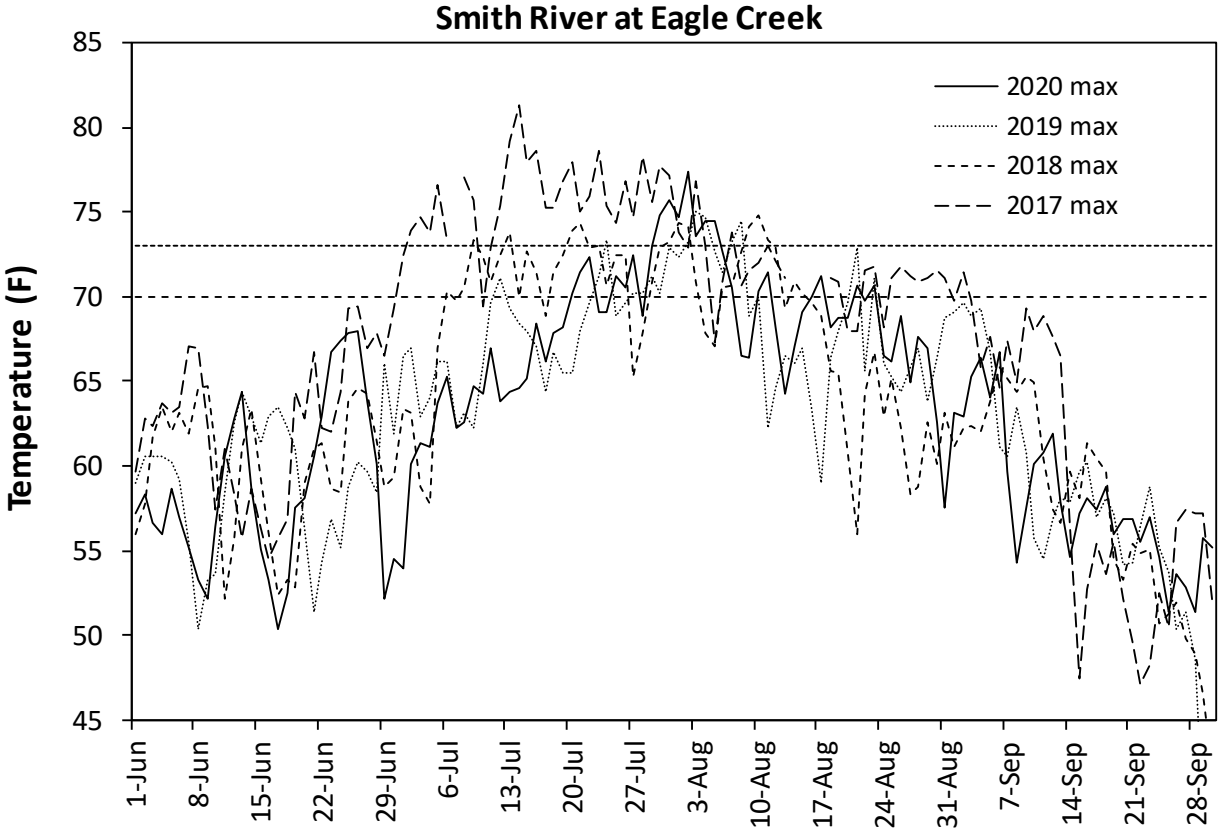


Figure 13. Maximum daily temperatures for the Smith River near Eagle Creek at USGS gaging station 06077200 for 2017, 2018, 2019, and 2020.

Statewide Angler Use Survey

The number of angler days and the total angler expenditures for the Smith River from Camp Baker to Hound Creek (which corresponds with the State Park float section) are presented for every other year from 1995 through 2019 in Table 3. Angler expenditures have generally increased over time with an associated increase in angler days. However, the number of angler days and angler expenditures in the mid-1990s exceeded those in 1999, 2001, and 2003. The total number of angler days and angler expenditures on the Smith River in 2019 were the highest recorded with 31,954 total angler days and 13.5 million dollars in angler expenditures (Table 3). The 2019 number of angler days ranked 22$^{nd}$ in the state and 5$^{th}$ in Region 4.

The estimated increase in the amount of angler days from 2017 to 2019 (12,453 angler days) exceeded the total angler days in 6 of the 9 surveys from 1995 through 2011 (Table 3). Estimated non-resident use exceeded the amount of resident use in 2019 and was more than double the previous high in 2017 (Table 3).

Table 3. Estimated total angler expenditures and angler use days for the Smith River (Section 2) from Camp Baker to Hound Creek from 1995 through 2019. Total angler expenditures are based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) for rivers and streams and the number of angler days on the Smith River (McFarland et al. 1997-2008; Selby et al. 2015, 2017, 2019, *In prep.*).

| Year | Res Value ($) | Non-Res Value ($) | Total Angler Days | Res Angler Days | Non-Res Angler Days | Total ($) |
|---|---|---|---|---|---|---|
| 2019 | 90.33 | 699.95 | 31,954 | 14,476 | 17,478 | 13,541,343 |
| 2017 | 86.35 | 669.12 | 19,501 | 10,894 | 8,606 | 6,699,144 |
| 2015 | 84.12 | 651.80 | 18,997 | 11,517 | 7,480 | 5,844,274 |
| 2013 | 83.40 | 646.23 | 14,645 | 8,674 | 5,971 | 4,582,051 |
| 2011 | 46.83 | 244.44 | 11,480 | 5,402 | 6,078 | 1,738,682 |
| 2009 | 44.55 | 232.53 | 18,100 | 11,680 | 6,420 | 2,013,187 |
| 2007 | 43.04 | 224.65 | 8,375 | 3,751 | 4,624 | 1,200,225 |
| 2005 | 40.43 | 211.03 | 14,188 | 8,371 | 5,817 | 1,566,001 |
| 2003 | 38.13 | 199.04 | 6,854 | 2,742 | 4,112 | 923,005 |
| 2001 | 36.80 | 192.06 | 9,088 | 6,362 | 2,726 | 757,677 |
| 1999 | 34.57 | 180.42 | 7,645 | 6,422 | 1,223 | 442,662 |
| 1997 | 33.23 | 173.44 | 13,391 | 8,302 | 5,089 | 1,158,512 |
| 1995 | 32.34 | 168.78 | 11,272 | 6,425 | 4,847 | 1,025,861 |

*Sun River*

Population Monitoring

The number of combined Rainbow Trout and Brown Trout (eight inches and greater) at the Hwy 287 site for years sampled from 1997 through 2020 peaked in 2013 at 442 per mile (Figure 14). The combined Rainbow Trout and Brown Trout at the Hwy 287 site was lower in subsequent sampling events in 2015, 2016, and 2019, but still remained above all estimates from 1997 through 2009 (Figure 14). The estimate of the combined Rainbow Trout and Brown Trout for 2020 was 153 per mile, which is similar to the values observed in the early 2000s. While combined trout estimates are reported here, Brown Trout were often at least 3 times greater in abundance than Rainbow Trout at the Hwy 287 site.

The Simms site was sampled in seven of the years from 1997 through 2020 (Figure 14). The combined trout estimate was less than the Hwy 287 site in each of the seven years. The highest combined trout estimate for the Simms site occurred in 2015 with 200 per mile 8 inches and greater (Figure 14). Estimates of the combined trout in 2018 and 2020 were lower than 2015, but greater than the earlier estimates in the late 1990s and early 2000s. The number of Brown Trout handled was generally 1.5 to 2.0 times greater than the number of Rainbow Trout.

The Sun River site was sampled in six of the years from 1997 through 2020, and the highest combined Rainbow Trout and Brown Trout estimate was in 2015 with 162 per mile 8 inches and greater (Figure 14). Brown Trout were estimated to be approximately 1.6 times more abundant than Rainbow Trout in 2015 at the Sun River site. The site was sampled in 2020 and it was estimated there were only 58 combined trout

per mile, which is the second lowest estimate of the six years (Figure 14). Twice as many Brown Trout were handled as Rainbow Trout in 2020.

Overall, the combined trout estimates have declined at the three Sun River sites from the highest estimates observed in 2013 and 2015. The combined trout estimate in 2020 was similar to the estimates observed in 1997 through 2009 at the Highway 287 and Sun River sites. The combined trout estimate in 2020 at the Simms site was less than in 2015, but still greater than in all other years. Population estimates are well below those observed on other similar sized rivers in central Montana (e.g., North Fork Sun River, South Fork Sun River, and Smith River). Fish populations in the Sun River continue to be reduced and monitoring of this fishery will continue in the future, with hope that improved flow management can improve the quality of the fishery.

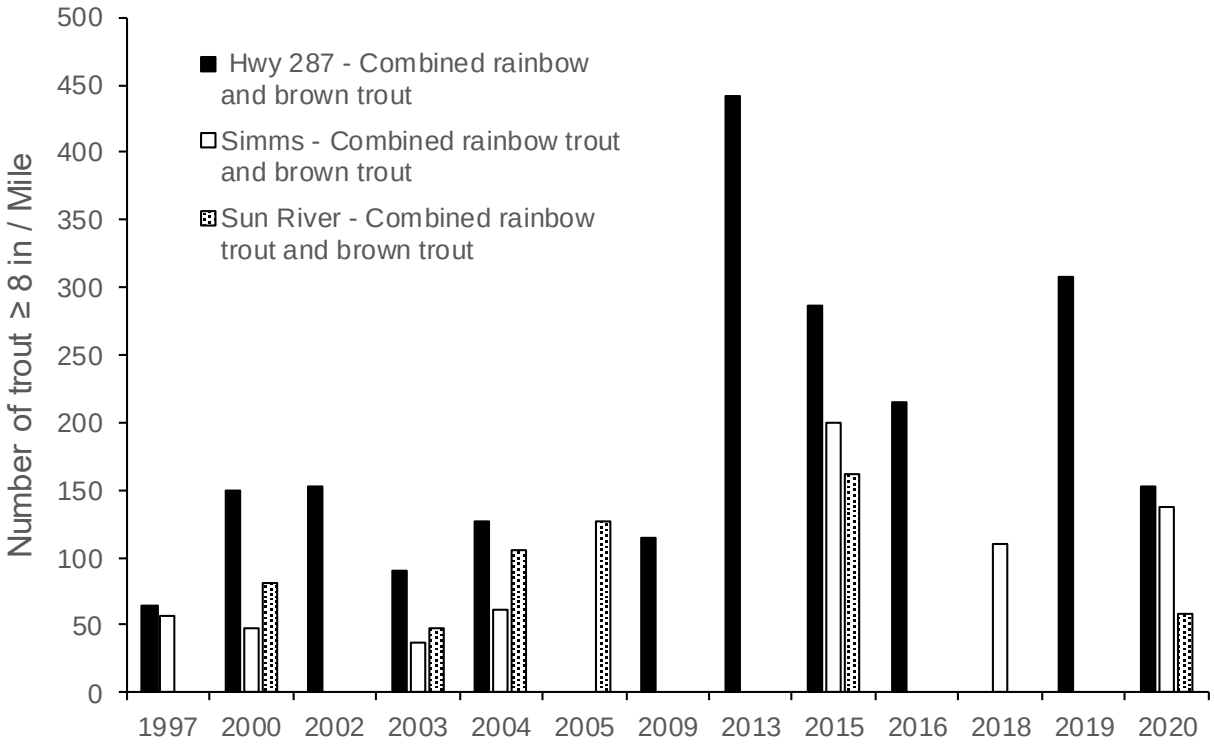


Figure 14. Combined Rainbow Trout and Brown Trout population estimates (8 inches and greater) for the Highway 287 (black), Simms (white), and the Town of Sun River (shaded) sections of the Sun River from 1997 through 2020. Missing years indicate sampling was not completed.

Mountain Whitefish abundance has been consistently low at the Hwy 287 site, ranging from none recorded or not enough sampled to calculate an estimate to 71 per mile 8 inches and greater in 2003 (Figure 15). Only 37 Mountain Whitefish were handled at the Hwy 287 site in 2020 with no marked fish collected in the recapture run, thus no estimate is available for 2020. Mountain Whitefish were slightly more abundant at the Simms site during some years, ranging from none recorded or not enough sampled to calculate an estimate to 158 per mile 8 inches and greater in 2015 (Figure 15). Mountain Whitefish estimates at the Simms site in 2018 and 2020 were 112 and 92 per mile, respectively. Mountain Whitefish have been most abundant at the Sun River site, having been present in sufficient quantities to develop an estimate during each year of sampling. Mountain Whitefish density ranged from 171 per mile 8 inches and greater in 2020 to 1,135 per mile in 2004 at the Sun River site (Figure 15). Only three sampling events have been completed since 2004, but Mountain Whitefish have declined in each year.

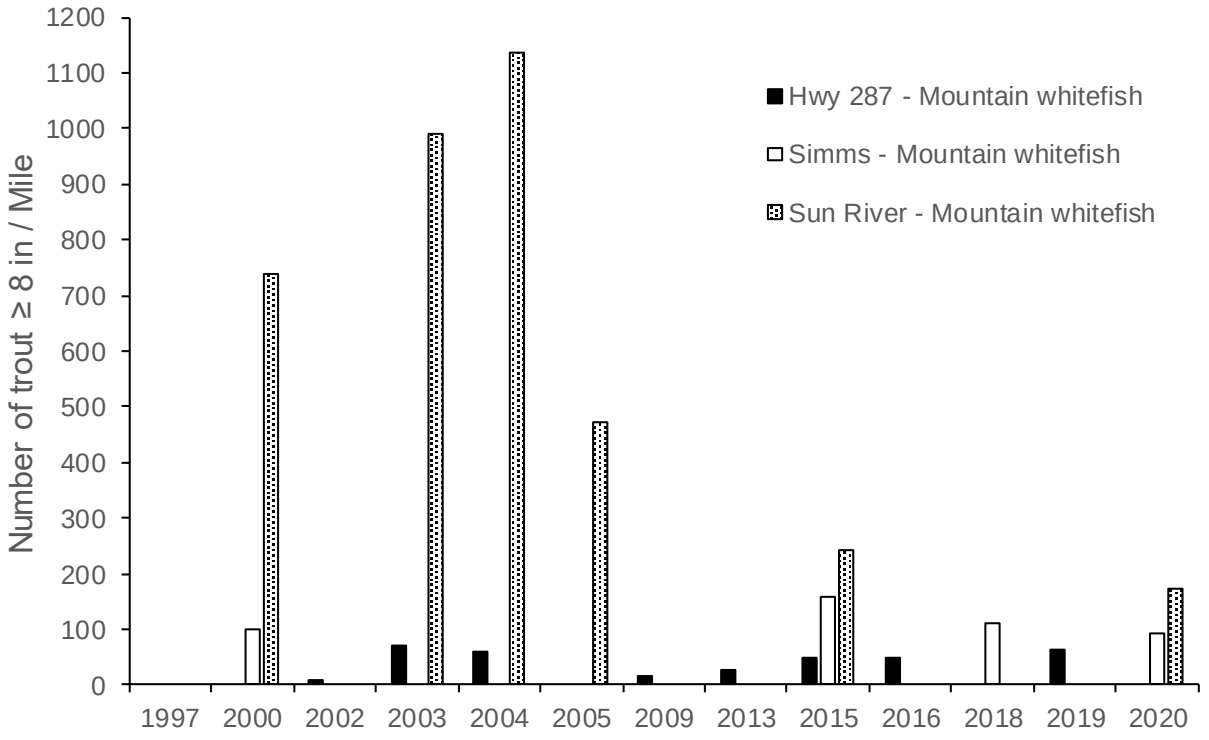


Figure 15. Mountain Whitefish population estimates (8 inches and greater) for the Highway 287 (black), Simms (white), and the Town of Sun River (shaded) sections of the Sun River from 1997 through 2020. Missing years indicate sampling was not completed, except as noted at Hwy 287 site (1997 = None recorded [NR], 2000 and 2020 = Not enough sampled [NE]) and the Simms site (1997 = NR, 2003 = NE, 2004 = NE).

Willow Creek Reservoir Dewatering Impact Investigation

Willow Creek Reservoir was completely dewatered in summer and early fall 2019 by Greenfields Irrigation District and the Bureau of Reclamation to facilitate repair to dam outlet gates in dry conditions (Appendix B, Photos 1 and 2). Approximately 110,000 Rainbow Trout are stocked into Willow Creek Reservoir annually and 3,685 sterile tiger muskie (Northern Pike x muskie hybrid) were stocked between 2015 and 2019 to control the sucker population and provide an additional angling opportunity. The complete dewatering of Willow Creek Reservoir prompted concern over impacts to the Sun River fishery and potential habitat degradation. A single electrofishing run was completed of the Hwy 287 site in September 2019 after the dewatering of the reservoir to evaluate potential flushing of fish from the reservoir into the Sun River. The upstream end of the Hwy 287 site begins where the Willow Creek return canal, which drains Willow Creek Reservoir, meets the Sun River.

The number of Rainbow Trout collected in fall 2019 was three to four times higher than sampling events before (spring 2019) or after (spring 2020), but it was an increase in only approximately 20 trout, and only four Rainbow Trout were identified as hatchery fish based on external characteristics (e.g., clipped adipose fin and eroded fins). Thus, it appears relatively few Rainbow Trout were flushed into and then persisted in the Sun River. First pass Brown Trout numbers were also considerably higher in fall 2019 than during the spring 2019 and spring 2020 sampling events. However, Brown Trout are absent from Willow Creek Reservoir based on the lack of stocking and their absence during reservoir sampling, providing further evidence that the higher numbers of trout sampled in fall 2019 is likely related to more favorable sampling

conditions or the different time of year and not from flushing. One tiger muskie was sampled during fall 2019 in the Sun River that was 31.5 inches and 6.28 pounds (Appendix B, Photo 6) and none were observed in spring 2020. MFWP personnel noted numerous suckers during sampling in fall 2019, particularly small suckers in the section closer to the Willow Creek Reservoir return canal. Prior to dewatering suckers were abundant in Willow Creek Reservoir, thus, it is likely these were suckers that had been flushed into the river. The presence of one tiger muskie, four hatchery Rainbow Trout, and numerous suckers indicates that some fish from Willow Creek Reservoir were flushed into the Sun River, but the number of trout and tiger muskies appeared to be minimal compared to the thousands stocked in the reservoir. Similarly, only 2 of the 41 Rainbow Trout sampled during spring 2020 were hatchery fish, and densities were similar between the spring 2019 and spring 2020 sampling events.

MFWP received reports of anglers catching trout in the Willow Creek return canal during and after the drawdown. MFWP lifted limits on Willow Creek Reservoir after it was determined that dewatering would take place. Gulls and pelicans were observed foraging for fish in the reservoir during the drawdown. While a combination of anglers, avian predators, and shore predators may account for some of the stocked Rainbow Trout and tiger muskie, it is likely numerous perished after being stranded and perhaps some overwintered in residual pools left after dewatering.

It was noted that turbid water was entering the Sun River at the time of sampling on September 4, 2019 (Appendix B, Photo 5) and the stream bottom was covered in fine sediment that was likely sediment mobilized from Willow Creek Reservoir (Appendix B, Photos 7 and 8). Turbid water was also noted at Hwy 287 on August 24, 2019 while Willow Creek Reservoir was still being drained (Appendix B, Photos 3 and 4) providing further evidence of increased sedimentation by sediment mobilization from the reservoir. The accumulation of fine sediment during or immediately prior to Brown Trout spawning, likely reduced the available spawning habitat and quality of habitat by smothering spawning gravels. On June 27, 2020 MFWP personnel observed a large sediment plume entering the Sun River from the Willow Creek Reservoir return canal that extended downstream to at least Highway 287 (Appendix B, Photos 9 through 12). Upon investigation of the Bureau of Reclamation HydroMet data there was zero discharge from Willow Creek Reservoir from after the dewatering in fall 2019 until June 27, 2020. The large plume of sediment entering the Sun River was from sediment that mobilized from Willow Creek Reservoir and settled in the return canal until the return canal resumed flowing. This mobilization of sediment into the Sun River in spring 2020 likely had negative impacts on Rainbow Trout eggs or fry that may have still been in the gravel and newly emerged Brown Trout and Rainbow Trout fry.

The introduction of sediment into the Sun River in fall 2019 and spring 2020 may have resulted in a negative impact on Rainbow Trout and Brown Trout spawning events and may be realized in future years with a reduced cohort of trout from these years. Impacts from the sediment mobilization likely extended downstream to at least Highway 287.

Flow Monitoring

Sun River flows are heavily influenced by irrigation throughout the basin. MFWP has instream water reservations to benefit the fishery of 100 cfs from Diversion Dam to Elk Creek and 130 cfs from Elk Creek to Vaughn with a priority date of July 1, 1985. These water reservations were based on wetted perimeter studies that evaluated the amount of water necessary to maintain fishery values. For the Sun River, the lower inflection points were used to establish the 100 and 130 cfs thresholds, thus these values serve as absolute minimum flow value targets. The upper inflection point would result in a flow of 220 cfs and is considered the recommended minimum flow, as this would keep the majority of riffle habitat and the channel wetted.

The mean daily flow from January 1, 2017 through December 22, 2020 for the Sun River at the USGS gages near Highway 287 and near Simms are shown in Figures 16 and 17, respectively. Peak Sun River flows, as measured at the Simms gage, were well above average in 2018 and 2019 and near average in 2017 and 2020 (Figure 18). The peak Sun River flow in 2018 was the third highest on record at the Simms gage based on 38 years of data, while the peak flow in 2019 was the fifth highest on record (Figure 18). The mean annual flow at the Sun River Simms gage in 2018 was the second highest on record, while the 2017 and 2019 mean annual flows ranked tenth and ninth out of 32 years, respectively (Figure 19). The mean annual flow for 2020 is not yet available. Despite the average to well above average flow years over the last four years, minimum flows were often below the 130 cfs absolute minimum flow target at Simms between July 1 and September 30 (Figure 20) and almost always below the recommended minimum flow of 220 cfs at Simms (Figure 21). The 2019 flow year was the exception as the flows in the Sun River were artificially inflated because water was being released from Willow Creek Reservoir throughout the summer and fall to drain the reservoir. Excluding 2019, flows were less than 130 cfs for 60, 21, and 11 of the 92 days between July 1 and September 30 for the 2017, 2018, and 2020 years, respectively (Figure 20). Flows were less than the 220 cfs recommend minimum flow for 92, 81, and 78 of the 92 days between July 1 and September 30 for the 2017, 2018, and 2020 years, respectively (Figure 21).

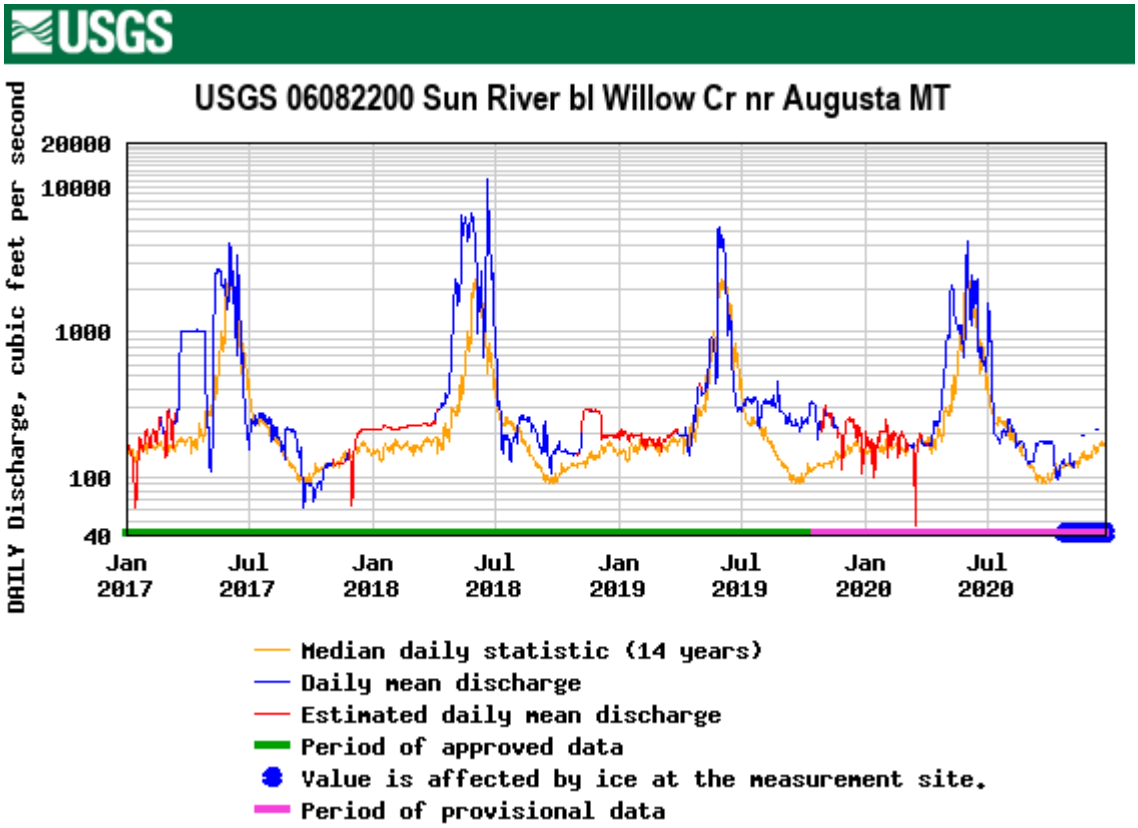


Figure 16. Mean daily flow for the Sun River below Willow Creek (blue and red lines) at USGS gaging station 06082200 from January 1, 2017 through December 22, 2020, and the median daily flow (orange line) for the 14-year period of record.

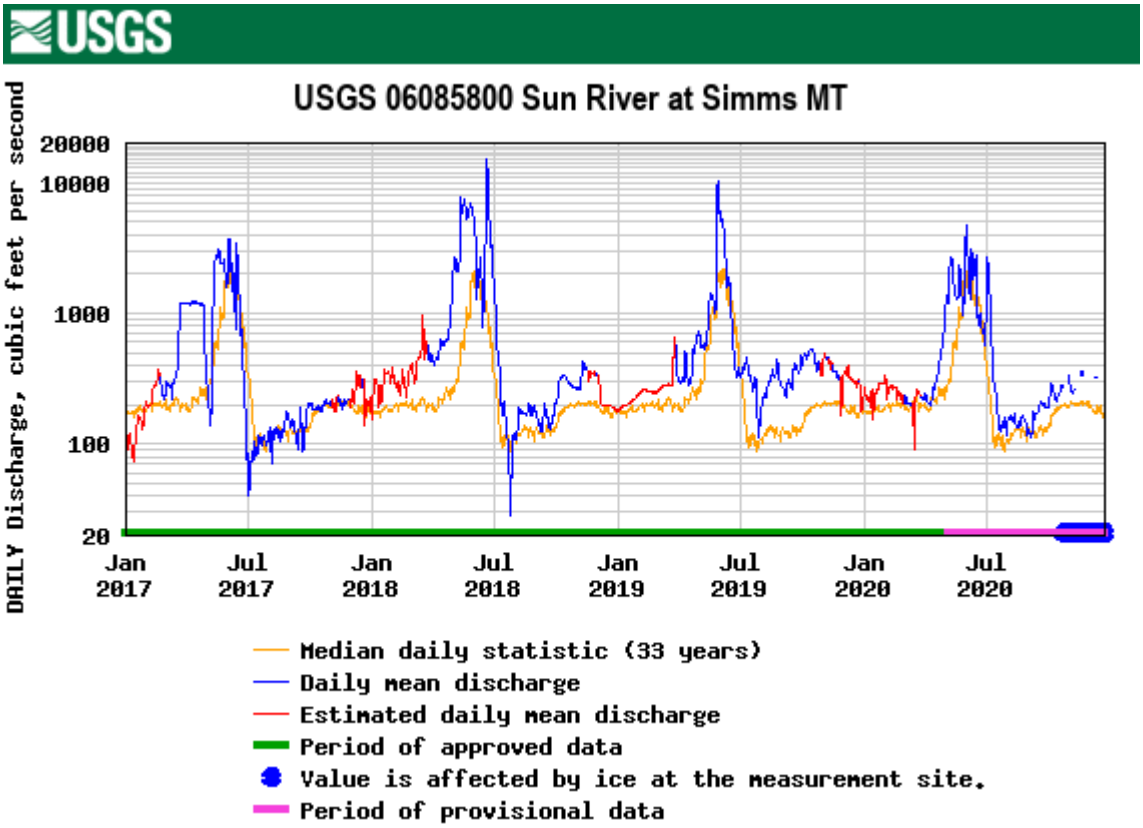


Figure 17. Mean daily flow for the Sun River at Simms (blue and red lines) at USGS gaging station 06085800 from January 1, 2017 through December 22, 2020, and the median daily flow (orange line) for the 33-year period of record.

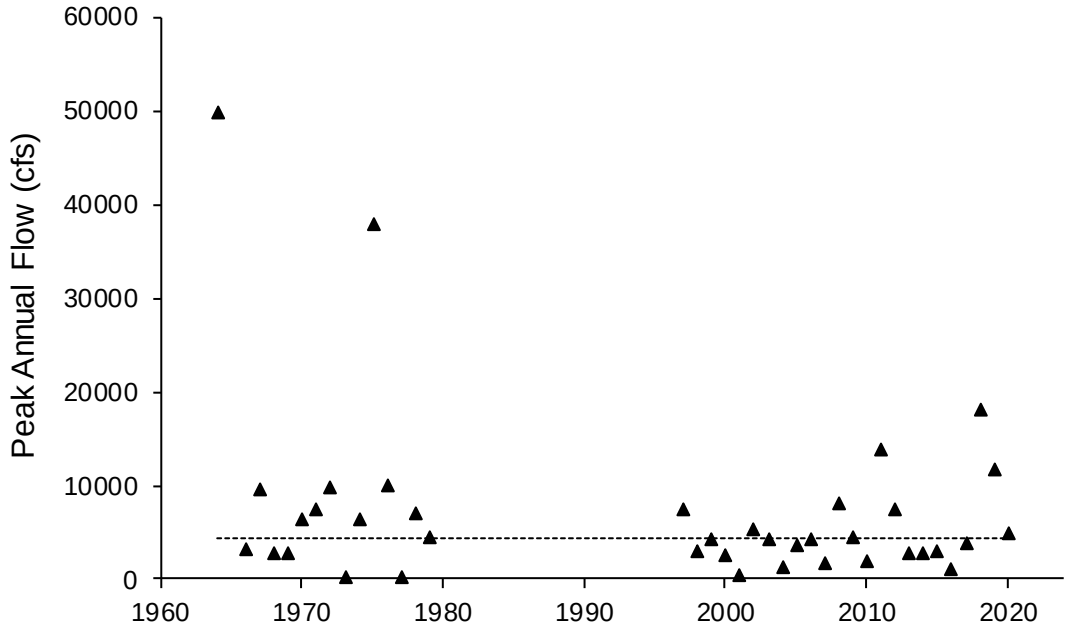


Figure 18. Peak annual flow for the Sun River at Simms (triangles) at USGS gaging station 06085800 and the median peak annual flow for the period of record (horizontal dashed line), 1964-2020.

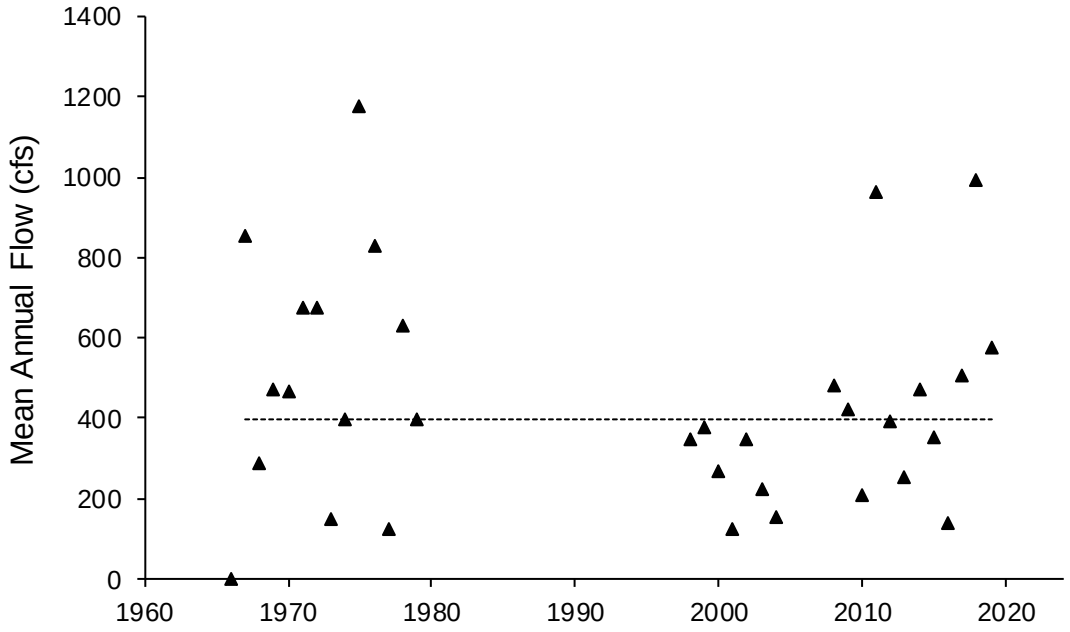


Figure 19. Mean annual flow for the Sun River at Simms (triangles) at USGS gaging station 06085800 and the median mean annual flow for the period of record (dashed line), 1967-2019.

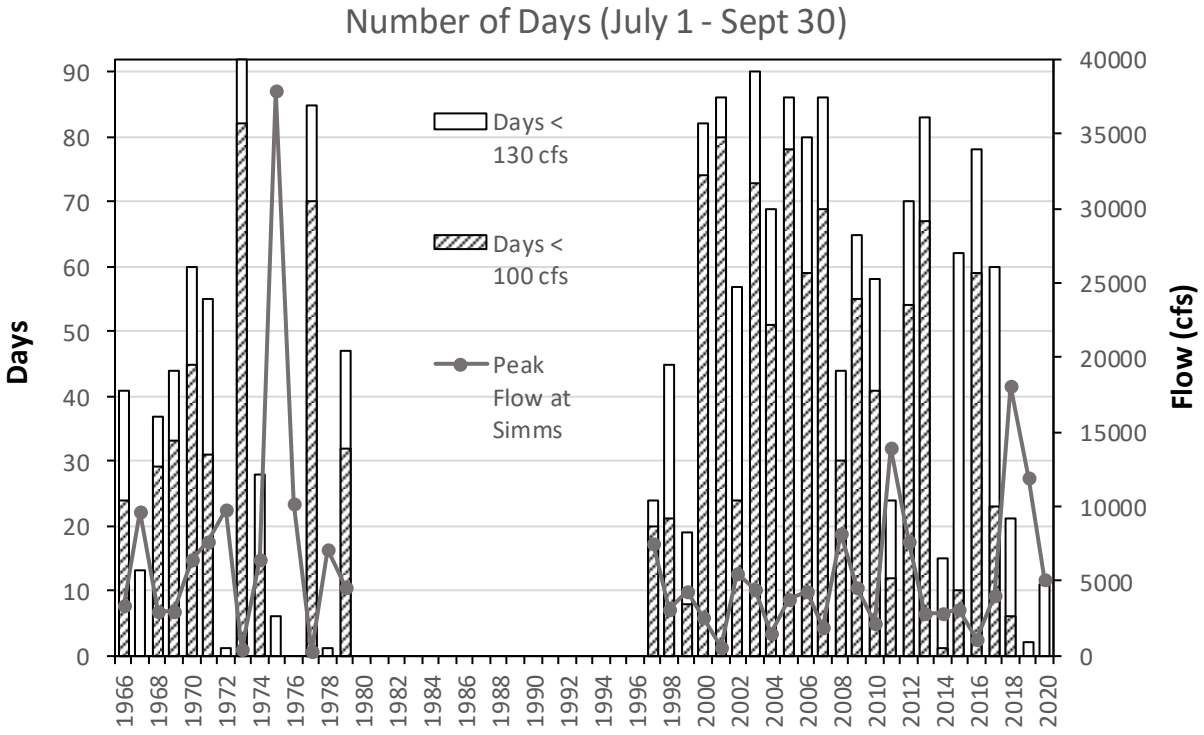


Figure 20. Number of days from July 1 through September 30 (92 days max) by year where daily average flow is less than 100 cfs and less than 130 cfs in the Sun River at Simms at USGS gaging station 06085800 for the period of record. Peak annual flow at Simms is also graphed on the right y-axis.

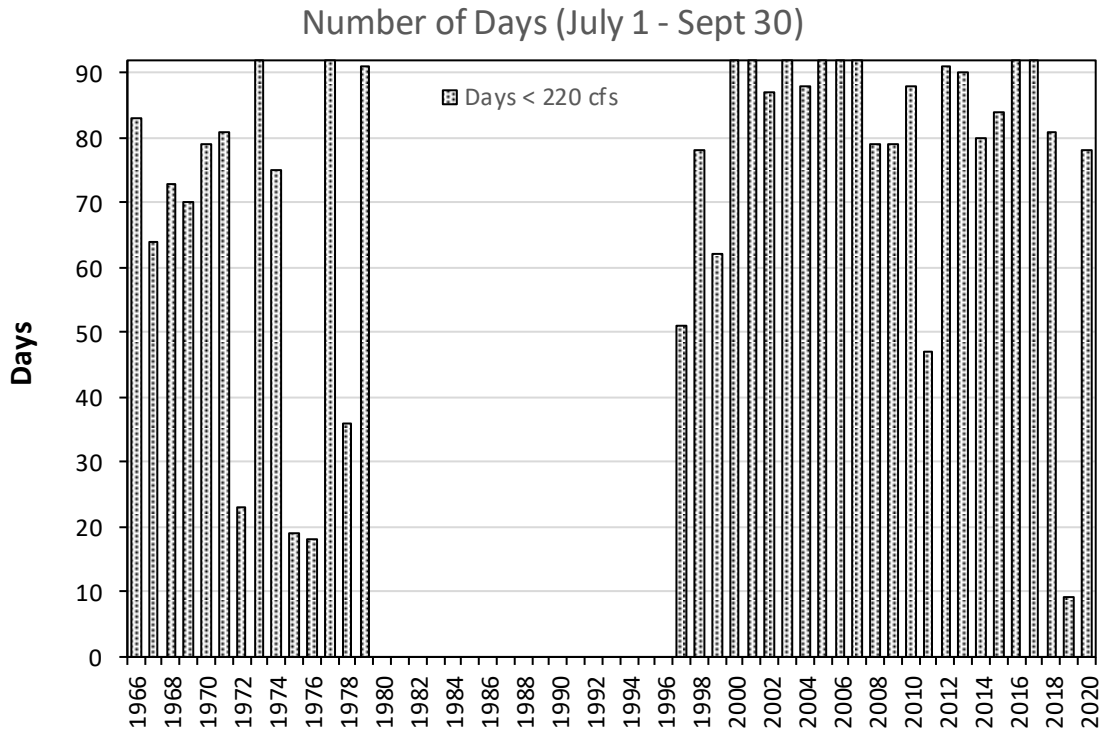


Figure 21. Number of days from July 1 through September 30 (92 days max) by year where daily average flow is less than 220 cfs in the Sun River at Simms at USGS gaging station 06085800 for the period of record.

Temperature Monitoring

Water temperature was evaluated for the Sun River using data recorded by the USGS gaging station 06085800 at Simms. Water temperatures were compared to the 73°F threshold where MFWP may request time of day closures if maximum water temperatures reach or exceed this threshold for at least some period of time during three consecutive days. Maximum water temperatures at the Sun River Simms gage frequently exceeded the 73°F threshold in 2017 through 2020 (Figures 22 and 23) but did less so in 2019 when flows frequently met the minimum flow recommendation of 220 cfs (Figures 21, 22, and 23). Time of day angling restrictions were implemented in 2017, 2018, and 2020. Maximum temperatures exceeded the 73°F threshold in 36, 30, 17, and 24 of the 92 days between July 1 and September 30 for the 2017, 2018, 2019, and 2020 years, respectively. Maximum daily temperatures were 80.8, 77.7, 77.9, 79.3 in 2017, 2018, 2019, and 2020, respectively. The number of days where water temperatures exceeded 73°F typically varied between 20 and 40 days over the last 15 years, with the exception of 2011 and 2019 when fewer days had maximum temperatures exceeding 73°F (Figure 23). Both years had fewer low flow days (Figure 21).

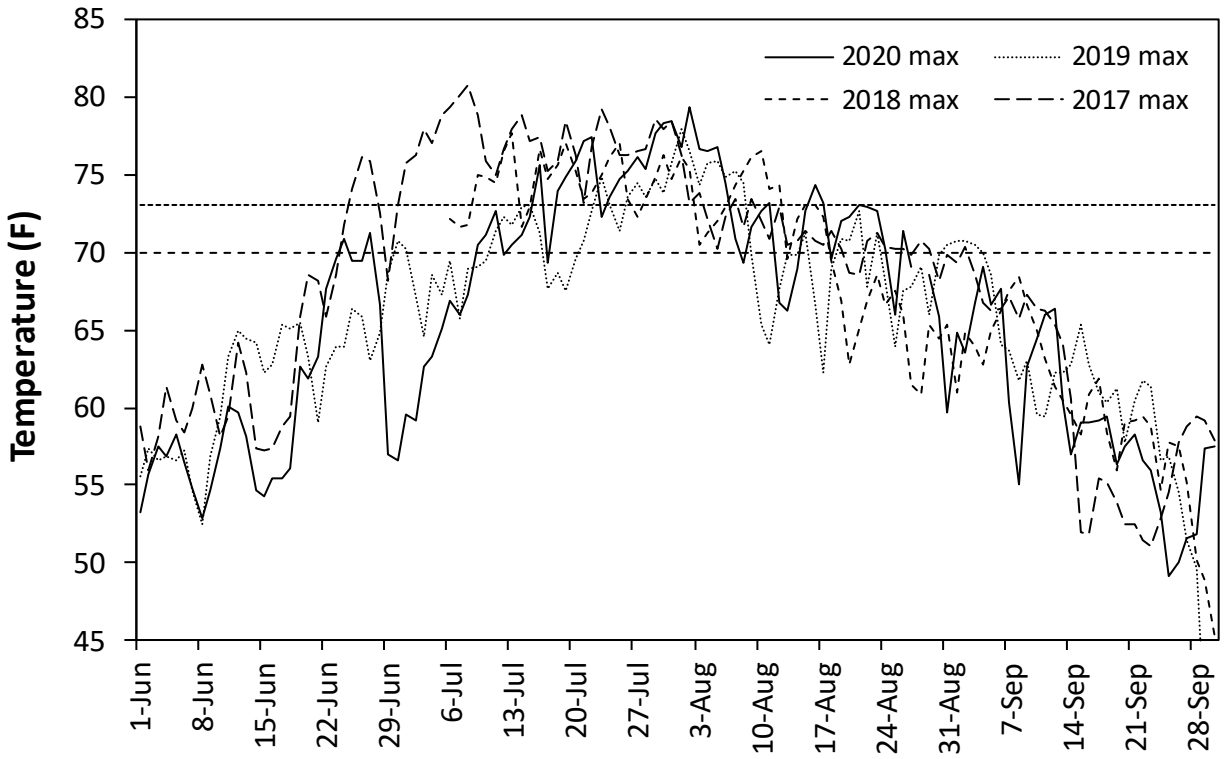


Figure 22. Maximum daily temperatures for the Sun River at Simms at USGS gaging station 06085800 for 2017, 2018, 2019, and 2020.

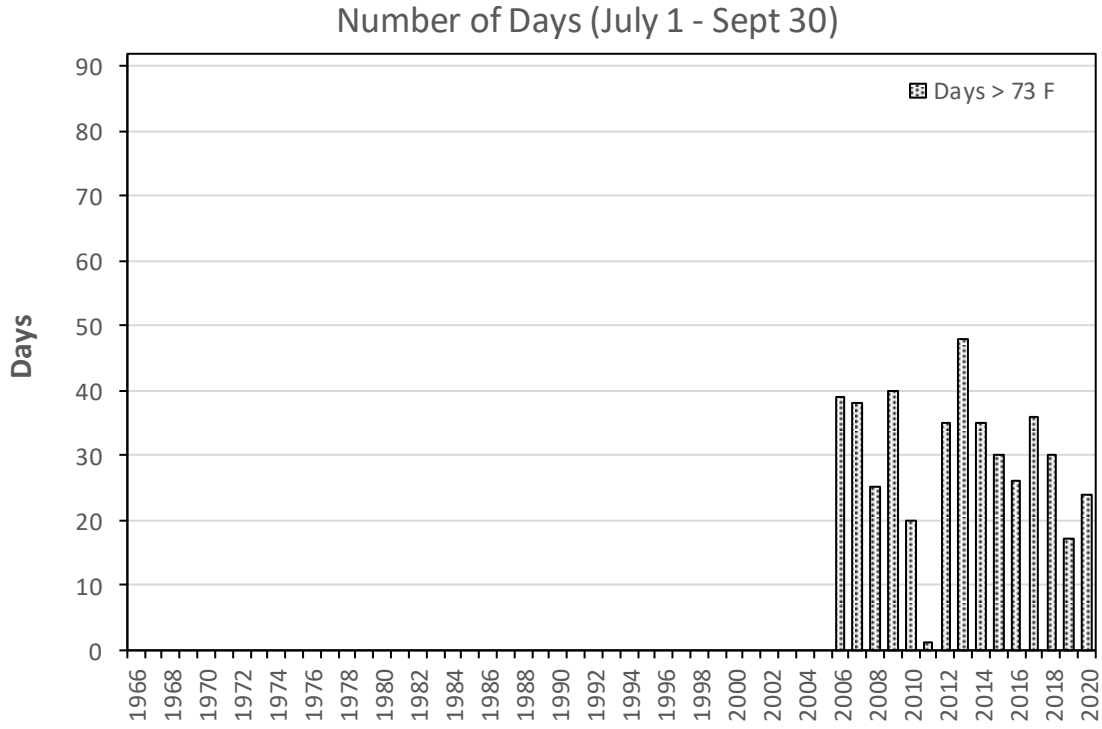


Figure 23. Number of days from July 1 through September 30 (92 days max) by year where maximum temperature is greater than 73F in the Sun River at Simms at USGS gaging station 06085800 for the period of record.

Statewide Angler Use Survey

The number of angler days and the total angler expenditures for the Sun River from Gibson Dam to Muddy Creek are presented for every other year from 1995 through 2019 in Table 4. The number of angler days peaked in 2015 (Table 4). There was an estimated 3,513 total angler days and about 900 thousand dollars in angler expenditures for the Sun River in 2019 (Table 4). The 2019 number of angler days ranked 138th in the state and 24th in Region 4. Resident angler days typically makes up about 70 to 85% of the total number of angler days in recent years (Table 4).

Table 4. Estimated total angler expenditures and angler use days for the Sun River (Section 2) from Gibson Reservoir to Muddy Creek from 1995 through 2019. Total angler expenditures are based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) for rivers and streams and the number of angler days on the Sun River (McFarland et al. 1997-2008; Selby et al. 2015, 2017, 2019, *In prep.*).

| Year | Res Value ($) | Non-Res Value ($) | Total Angler Days | Res Angler Days | Non-Res Angler Days | Total ($) |
|---|---|---|---|---|---|---|
| 2019 | 90.33 | 699.95 | 3,513 | 2,558 | 955 | 899,516 |
| 2017 | 86.35 | 669.12 | 4,534 | 3,644 | 890 | 910,176 |
| 2015 | 84.12 | 651.8 | 10,071 | 8,600 | 1,471 | 1,682,230 |
| 2013 | 83.4 | 646.23 | 9,107 | 7,842 | 1,265 | 1,471,504 |
| 2011 | 46.83 | 244.44 | 6,483 | 5,136 | 1,347 | 569,780 |
| 2009 | 44.55 | 232.53 | 7,335 | 5,964 | 1,391 | 589,145 |
| 2007 | 43.04 | 224.65 | 3,506 | 2,416 | 1,090 | 348,853 |
| 2005 | 40.43 | 211.03 | 6,328 | 5,173 | 1,155 | 452,884 |
| 2003 | 38.13 | 199.04 | 8,739 | 7,053 | 1,686 | 604,512 |
| 2001 | 36.8 | 192.06 | 6,376 | 4,509 | 1,867 | 524,507 |
| 1999 | 34.57 | 180.42 | 7,187 | 4,884 | 2,303 | 584,347 |
| 1997 | 33.23 | 173.44 | 10,350 | 7,761 | 2,589 | 706,934 |
| 1995 | 32.34 | 168.78 | 7,924 | 6,267 | 1,657 | 482,343 |

*Belt Creek*

Population Monitoring

Brook Trout and Westslope Cutthroat Trout are present at the Neihart site on Belt Creek, just upstream of the Town of Neihart. Westslope Cutthroat Trout were more abundant than Brook Trout during each sampling event from 2011 through 2020 (Figure 24). Westslope Cutthroat Trout estimates ranged from 104 per kilometer (150 mm and larger) in 2011 to 441 per kilometer in 2015. Total trout densities ranged from 150 per kilometer in 2011 to 572 per kilometer in 2015 (Figure 24).

Rainbow Trout, Westslope Cutthroat Trout, and Brook Trout were sampled from the Carpenter Creek to Harley Creek site on Belt Creek over nine years from 2000 through 2020. Rainbow Trout were the most abundant species in most years, but Westslope Cutthroat Trout were most abundant in 2010, 2017, and 2020 (Figure 25). Westslope Cutthroat Trout density ranged from 37 per kilometer (150 mm and larger) in 2014 to 247 per kilometer in 2013. All trout density ranged from 264 per kilometer in 2020 to 619 per kilometer in 2013 (Figure 25). Overall, average Westslope Cutthroat Trout density was lower at the Carpenter to Harley site (average = 123) than the Neihart site (average = 279), but average total trout density was greater at the Carpenter to Harley site (average = 401) than the Neihart site (average = 363).

At the Monarch site on Belt Creek, the fish assemblage is largely comprised of Brown Trout and Rainbow Trout. Rainbow Trout have been more abundant than Brown Trout in each year from 2011 through 2020, but estimates were similar in 2020 because of a decline in the number of Rainbow Trout (Figure 26). Rainbow Trout estimates and as a result total trout estimates have been lower the last four years of sampling compared to the first four years of sampling from 2011 through 2014 (Figure 26). The average total trout estimate from 2011 through 2014 was 309 per kilometer compared to an average total trout estimate of 182 per kilometer for 2015, 2016, 2017, and 2020.

At the Sluice Boxes site, Rainbow Trout, Brown Trout, and Mountain Whitefish were collected each year. Rainbow Trout were the most abundant trout species; however, Mountain Whitefish were the most abundant species collected in 2013 and 2020 (Figure 27). Brown Trout density was highest in 2016 at 145 per mile (150 mm and larger) but were less than 100 per mile most years. Rainbow Trout density ranged from 176 per mile in 2013 to 343 per mile in 2004 (Figure 27). Rainbow Trout and Brown Trout were combined to calculate the estimate in 2020 as not enough recaptures were sampled to calculate estimates separately. The low number of recaptures may have been related to the low flows and relatively warm water temperatures during the recapture run, as it had been delayed later into the summer than in most years because of high flows.

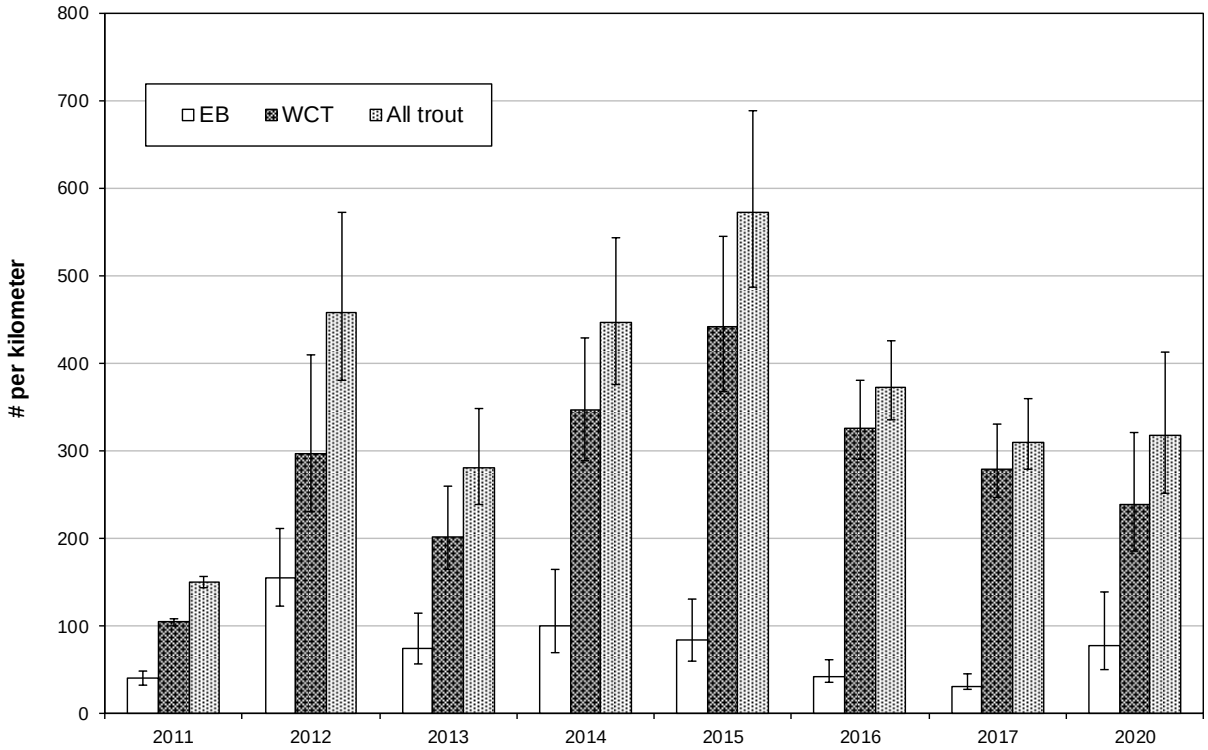


Figure 24. Brook Trout (EB), Westslope Cutthroat Trout (WCT), and all trout population estimates (150 mm and greater) for the Neihart section of Belt Creek from 2011 through 2020. Error bars represent 95% confidence intervals.

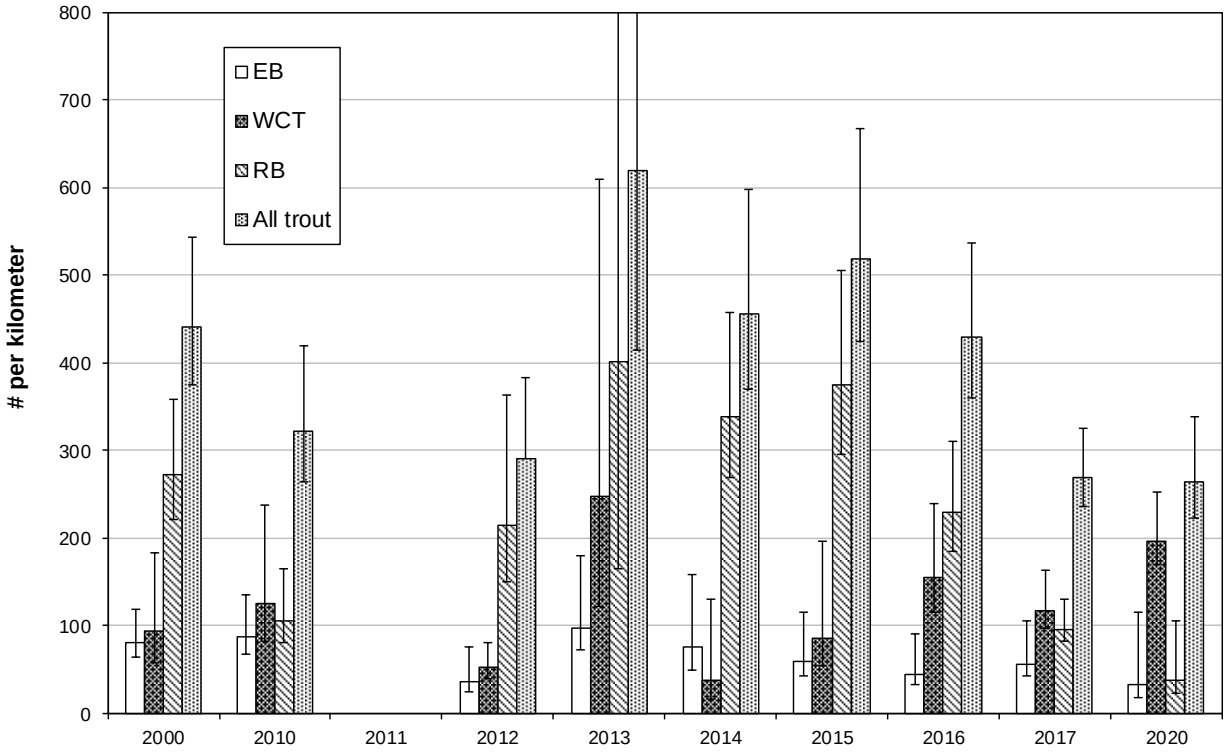


Figure 25. Brook Trout (EB), Westslope Cutthroat Trout (WCT), Rainbow Trout (RB), and all trout population estimates (150 mm and greater) for the Carpenter Creek to Harley Creek section of Belt Creek from 2000 through 2020. Error bars represent 95% confidence intervals.

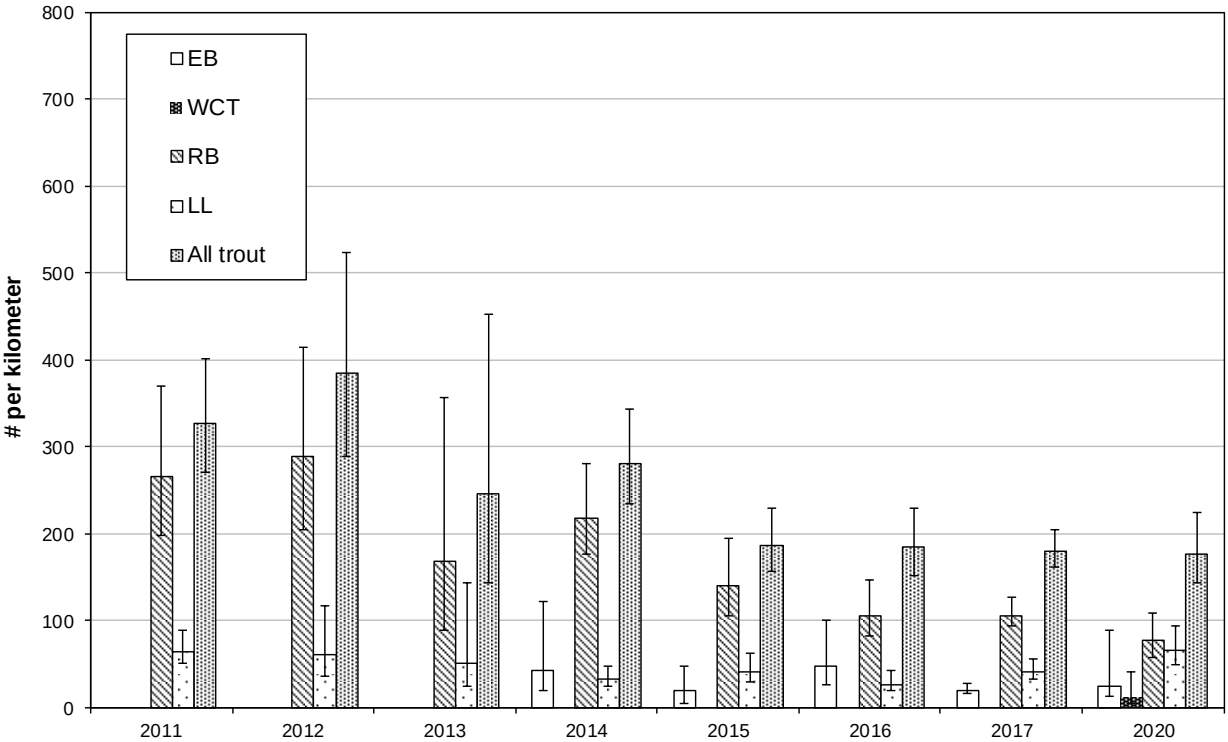


Figure 26. Brook Trout (EB), Westslope Cutthroat Trout (WCT), Rainbow Trout (RB), Brown Trout (LL), and all trout population estimates (150 mm and greater) for the Monarch section of Belt Creek from 2011 through 2020. Error bars represent 95% confidence intervals.

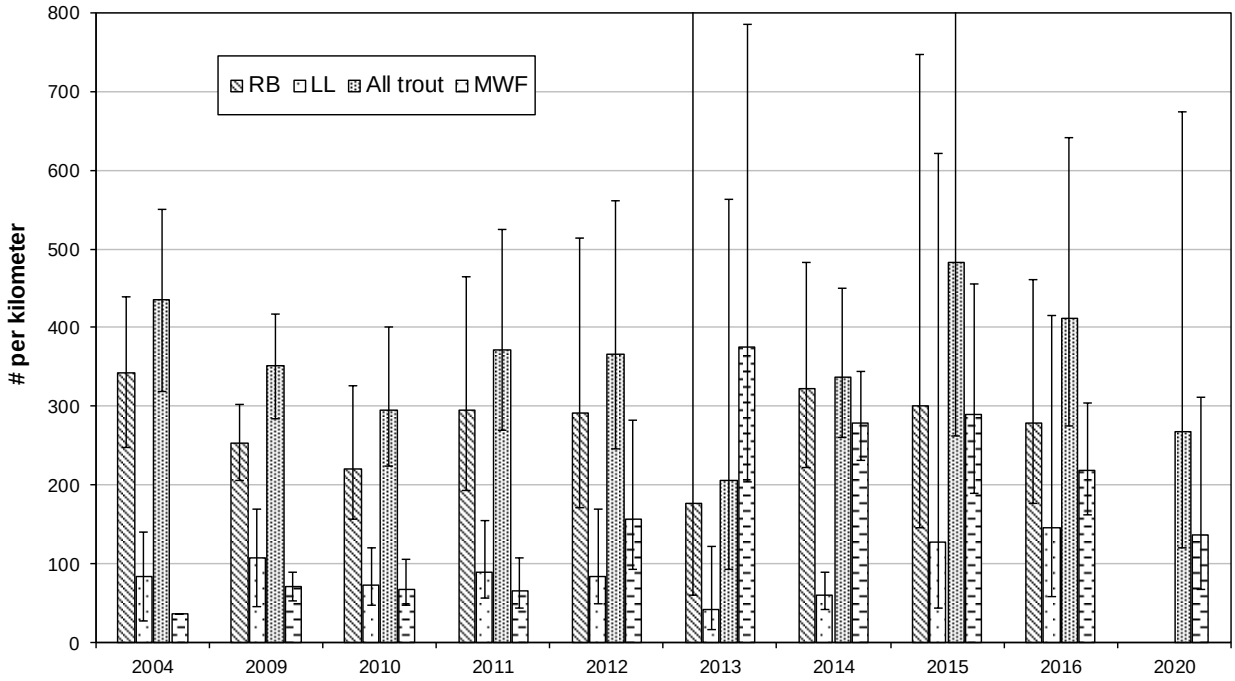


Figure 27. Rainbow Trout (RB), Brown Trout (LL), all trout, and Mountain Whitefish (MWF) population estimates (150 mm and greater) for the Sluice Boxes section of Belt Creek from 2004 through 2020. Error bars represent 95% confidence intervals.

Statewide Angler Use Survey

The number of angler days and the total angler expenditures for Belt Creek are presented for every other year from 1995 through 2019 in Table 5. The estimated number of angler days was generally higher in the late 1990s than in recent years in Belt Creek (Table 5). The number of angler days was highest in 1997 followed by 2013 (Table 5). The estimated total number of angler days and angler expenditures on Belt Creek in 2019 was 8,408 total angler days and about 2.3 million dollars in angler expenditures, respectively (Table 5). The 2019 number of angler days ranked 81$^{st}$ in the state and 13$^{th}$ in Region 4. The number of non-resident angler days in 2019 was the highest over the period of record and accounted for about 30% of the use (Table 5).

Table 5. Estimated total angler expenditures and angler use days for Belt Creek from 1995 through 2019. Total angler expenditures are based on the resident (Res) and non-resident (Non-Res) estimated daily angler expenditures (Lewis and King 2014; Lewis 2017; Lewis 2018; Lewis 2020) for rivers and streams and the number of angler days on Belt Creek (McFarland et al. 1997-2008; Selby et al. 2015, 2017, 2019, *In prep.*).

| Year | Res Value ($) | Non-Res Value ($) | Total Angler Days | Res Angler Days | Non-Res Angler Days | Total ($) |
|---|---|---|---|---|---|---|
| 2019 | 90.33 | 699.95 | 8,408 | 5,852 | 2,557 | 2,318,383 |
| 2017 | 86.35 | 669.12 | 3,959 | 2,526 | 1,433 | 1,176,969 |
| 2015 | 84.12 | 651.8 | 6,592 | 5,694 | 898 | 1,064,296 |
| 2013 | 83.4 | 646.23 | 11,105 | 9,168 | 1,937 | 2,016,359 |
| 2011 | 46.83 | 244.44 | 8,993 | 7,667 | 1,326 | 683,173 |
| 2009 | 44.55 | 232.53 | 10,330 | 9,429 | 901 | 629,571 |
| 2007 | 43.04 | 224.65 | 7,620 | 7,035 | 585 | 434,207 |
| 2005 | 40.43 | 211.03 | 4,718 | 3,916 | 802 | 327,570 |
| 2003 | 38.13 | 199.04 | 3,678 | 3,297 | 381 | 201,549 |
| 2001 | 36.8 | 192.06 | 3,437 | 2,914 | 523 | 207,683 |
| 1999 | 34.57 | 180.42 | 10,389 | 9,112 | 1,277 | 545,398 |
| 1997 | 33.23 | 173.44 | 13,424 | 12,175 | 1,249 | 621,202 |
| 1995 | 32.34 | 168.78 | 10,978 | 10,382 | 596 | 436,347 |

***Lentic Ecosystems***

*Pelican Point Pond*

Pelican Point Pond #1 (the larger of the two ponds on south side of the access road) is managed as a Largemouth Bass *Micropterus salmoides*, Black Crappie *Pomoxis nigromaculatus*, and Yellow Perch *Perca flavescens* fishery, with occasional stocking of trout (Table 6). Northern Pike first appeared in Pelican Point Pond #1 in 2012 when two pike were caught in trap nets. In 2013, 62 pike measuring 11.9-15.6 inches long were sampled in traps. Based on the size of these pike, we suspect they originated from an illegal introduction that occurred in 2010 or 2011. In 2013 the Fish, Wildlife & Parks Commission approved a no limit harvest regulation for Northern Pike in Pelican Point Pond #1 that began in March 2014 to encourage anglers to remove these fish to maintain the bass, perch, and crappie fishery. Biologists began active removal efforts in October 2013 removing 28 pike during trapping. Removal efforts continued in 2014, 2015, and 2016 removing 179, 42, and 5 pike, respectively. Sampling has been conducted in each year since 2016 and no pike have been observed. Monitoring efforts will continue in 2021 to continue to evaluate the apparent success of the pike removals.

In response to the illegal Northern Pike introduction, Largemouth Bass were stocked in 2013, 2014, 2015, and 2018 (Table 6). Prior to the illegal introduction the bass fishery was sustained by natural reproduction, but competition for forage by Northern Pike and the predation of bass by pike necessitated the stocking of bass to maintain angling quality. In addition, adult Black Crappie were transferred from Largent Bend Pond #3 to Pelican Point Pond #1 in 2014 to supplement the population (Table 6), which was also likely impacted by the illegal pike introduction. Wild fish transfers are conducted and approved by the Department only in waters that have had rigorous fish health inspections, including disease testing and aquatic invasive species surveys. Rainbow Trout were also stocked into Pelican Point Pond #1 in 2019 and 2020 to provide additional angling opportunity (Table 6).

Results of the spring 2020 sampling effort are shown in Table 6. A total of 43 Black Crappie were collected with an average length of 246 mm (9.7 inches) and maximum length of 282 mm (11.1 inches) (Table 7). Twelve Largemouth Bass and 76 Yellow Perch were also collected (Table 7). While only 12 Largemouth Bass were collected, this number is not indicative of the density of Largemouth Bass, as they are consistently not as vulnerable to being collected by the nets as other species. Anglers have reported good success catching Largemouth Bass from Pelican Point Pond #1, including reports of two tagged individuals that were caught in 2020 that were 16.5 inches (weight = 3 pounds) and 19.5 inches. Largemouth Bass were last tagged in Pelican Point Pond #1 in 2013. Based on the size of the fish at tagging, these fish were likely 10 years old in 2020.

Table 6. Recent stocking records for Pelican Point Pond #1, 2011 through 2020.

| Year | Largemouth Bass | Black Crappie | Brook Trout | Rainbow Trout |
|---|---|---|---|---|
| **Pelican Point Pond #1** | | | | |
| 2020 | -- | -- | -- | 2,290 |
| 2019 | -- | -- | -- | 500 |
| 2018 | 1,500 | -- | -- | -- |
| 2017 | -- | -- | -- | -- |
| 2016 | -- | -- | -- | -- |
| 2015 | 2,000 | -- | -- | -- |
| 2014 | 2,000 | 350 | -- | 773 |
| 2013 | 750 | -- | 1,500 | |
| 2012 | -- | -- | 1,500 | 200 |
| 2011 | -- | -- | 2,000 | -- |

Table 7. Catch statistics for fish sampled from Pelican Point Pond #1 in 2020. Sampling consisted of one floating gill net and 4 sinking gill nets set overnight on 3/26/2020 and 3/27/2020 (2 net nights). A trap net was also set overnight on 3/26/2020 and checked on 3/27/2020 (1 net night).

| | | Length (mm)* | | | | Weight (grams)* | | Condition | | Relative Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Min | Max | Avg | SD | Avg | SD | Avg | SD | Avg | SD |
| Black Crappie | 43 | 175 | 282 | 245.5 | 25.3 | 243.6 | 75.4 | 58.0 | 5.5 | 100.3 | 13.2 |
| Largemouth Bass | 12 | 226 | 287 | 254.5 | 19.6 | 215.9 | 51.9 | 48.4 | 4.2 | 96.6 | 8.6 |
| Pumpkinseed | 27 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| White Sucker | 1 | 427 | 427 | 427.0 | -- | 1,107 | -- | 51.4 | -- | 116.3 | -- |
| Yellow Perch | 76 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

* 100 mm = 3.9 inches, 100 grams = 0.2 pounds

*Largent Bend Pond*

Pond #3 (south side of the river) provides a fishery for Black Crappie, Yellow Perch, and Largemouth Bass. Largemouth Bass were first stocked into Pond #3 in 2016 as fingerlings (~3 inches) (Table 8). In 2013, a small number of tiger muskie were stocked in pond #3. Tiger muskie, are a sterile hybrid of Northern Pike and muskie, and were stocked as a tool to reduce the number of suckers in the pond. The stocking has also provided an additional opportunity for anglers to catch a large and aggressive predatory fish. Pond #3 was inundated by flooding of the Sun River in 2018. Additional tiger muskie (~5 inches) were stocked in 2019. Limited sampling was completed in 2020 and several Largemouth Bass were collected, indicating at least

some individuals persisted from the 2016 stocking event and following the 2018 flood event. No tiger muskie were collected, but it is possible they are present and avoided capture during sampling.

Pond #2 (north side of river) provides a Largemouth Bass fishery with easy access that has become a popular fishery for families. Bluegill *Lepomis macrochirus* were added to the pond in 2018 when 58 were stocked. The Bluegill have become established and anglers reported success catching them in 2020. Brook Trout and Rainbow Trout have also been stocked occasionally in the past.

Table 8. Recent stocking records for Largent Bend Ponds #2 and #3 from 2011 through 2020.

| Year/ Pond | Largemouth Bass | Tiger muskie | Black Crappie | Bluegill | Brook Trout | Rainbow Trout |
|---|---|---|---|---|---|---|
| **Largent Bend Pond #2** | | | | | | |
| 2020 | 500 | -- | -- | -- | -- | -- |
| 2019 | 2,682 | -- | -- | -- | -- | -- |
| 2018 | 500 | -- | -- | 58 | -- | -- |
| 2017 | 500 | -- | -- | -- | -- | -- |
| 2015 | 500 | -- | -- | -- | -- | -- |
| 2014 | 500 | -- | -- | -- | 1,034 | -- |
| 2013 | -- | -- | -- | -- | 1,000 | -- |
| 2012 | -- | -- | -- | -- | 1,100 | 200 |
| 2011 | 500 | -- | -- | -- | 1,000 | -- |
| | -- | -- | -- | -- | -- | -- |
| **Largent Bend Pond #3** | | | | | | |
| 2019 | -- | 150 | -- | -- | -- | -- |
| 2016 | 600 | -- | -- | -- | -- | -- |
| 2013 | -- | 53 | -- | -- | -- | -- |
| 2011 | -- | -- | 83 | -- | -- | -- |

*Wadsworth Pond*

Wadsworth Pond has relatively poor water quality as a result of evaporation and the lack of ground water input. The City of Great Falls and West Great Falls Flood Control and Drainage District have the ability to add water to Wadsworth Pond from the Sun River during periods of high river flow. Water was not added from 2016 through 2019, resulting in very low pond water levels. The pond was filled in spring 2020 and while evaporation occurred throughout the summer, the current water level at the end of 2020 is near full and well above the water level at the end of 2019. The higher water levels should result in more favorable conditions for fish survival compared to recent years.

Wadsworth Pond is typically stocked with one to two thousand Rainbow Trout annually and 5,000 Walleye biennially (Table 9). Surplus Rainbow Trout were stocked in 2020 for a total of 7,500 Rainbow Trout (Table 9). The surplus trout were stocked given the improved water levels.

Six nets were set overnight on June 6, 2020 to evaluate the status of the fishery after a prolonged period of low water levels. While 1,000 Rainbow Trout had been stocked in 2020 prior to sampling, no Rainbow Trout were sampled. Fifteen Walleye (Table 10) from three size groups were sampled; 180-213 mm (n=6), 318-394 mm (n=7), and 635-686 mm (n=2) (Figure 28), which likely correspond to the 2019, 2017, and 2015 stocking events, respectively. Five Yellow Perch, Pumpkinseed Sunfish *Lepomis gibbosus*, and White Suckers *Catostomus commersonii* were also sampled (Table 10).

The presence of Walleye and several Yellow Perch was encouraging given the extreme low water levels in Wadsworth Pond prior to the filling in spring 2020. Planned updates to the pond infrastructure may allow more regular pulses of water to Wadsworth Pond, which should improve water quality and the fishery. A Yellow Perch transfer has been approved and is planned for early spring 2021, prior to spawning, to supplement the amount of perch in Wadsworth Pond. Completion of the transfer prior to spawning will allow the Yellow Perch to take advantage of the high water-level in the pond and the abundant submerged vegetation for spawning.

Table 9. Recent stocking records for Wadsworth Pond from 2014 through 2020.

| Year/ Pond | Walleye | Rainbow Trout |
|---|---|---|
| 2020 | -- | 7,500 |
| 2019 | 5,000 | 1,000 |
| 2018 | -- | 1,000 |
| 2017 | 5,000 | 2,000 |
| 2016 | -- | 1,001 |
| 2015 | 5,486 | 2,000 |
| 2014 | -- | 7,045 |

Table 10. Catch statistics for fish sampled from Wadsworth Pond in 2020. Sampling consisted of one floating gill net, two sinking gill nets, and three trap nets set overnight on 6/16/2020.

| | | Length (mm)* | | | | Weight (grams)* | | Condition | | Relative Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Min | Max | Avg | SD | Avg | SD | Avg | SD | Avg | SD |
| Carp | 1 | 282 | 282 | 282.0 | -- | 431 | -- | 69.4 | -- | 131.5 | -- |
| Pumpkinseed | 31 | 79 | 130 | 100.6 | 10.2 | -- | -- | -- | -- | -- | -- |
| White Sucker | 32 | 353 | 450 | 409.1 | 23.1 | 874.7 | 143.0 | 45.9 | 4.0 | 103.7 | 8.9 |
| Walleye | 15 | 180 | 686 | 337.6 | 155.2 | 513.6 | 873.0 | 35.8 | 5.3 | 101.7 | 18.3 |
| Yellow Perch | 5 | 124 | 241 | 209.6 | 48.5 | 182.8 | 23.2 | 53.5 | 4.6 | 103.0 | 9.1 |

* 100 mm = 3.9 inches, 100 grams = 0.2 pounds

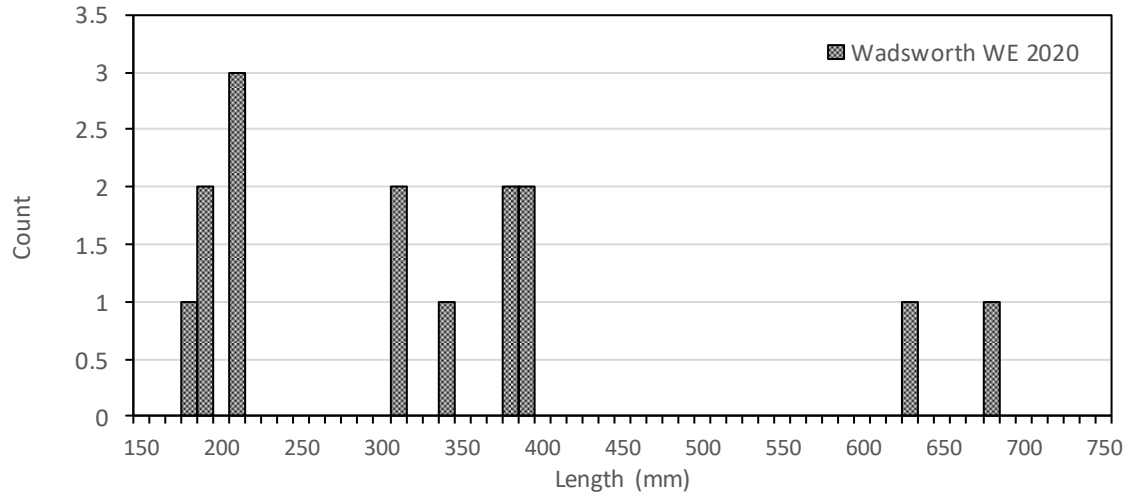


Figure 28. Length frequency histogram of Walleye (WE) handled during surveys in 2020 at Wadsworth Pond. The number of fish is shown on the y-axis as a function of length (millimeters) on the x-axis.

*Great Falls Reservoirs*

Fish population monitoring results from 1990 through 2009 for Black Eagle, Rainbow, Cochrane, Ryan, and Morony reservoirs were summarized by Leathe (2011). Black Eagle reservoir was only surveyed in 1990 due to the clogging of gill nets by drifting algae. Rainbow reservoir was only sampled in 2008 and 2009 and had a greater proportion of suckers and Black Bullheads than observed in Cochrane, Ryan, and Morony reservoir (Leathe 2011). The fish community was similar in Cochrane, Ryan, and Morony and were dominated by suckers, Walleye, and Yellow Perch (Leathe 2011). Short retention times limit these fisheries through flushing of juvenile fish and a limited zooplankton population (Leathe 2011). Rainbow Trout density during the study and since then is typically low based on gill net surveys, despite stocking substantial numbers in Rainbow Reservoir in some years (Table 6). Angling pressure is low on these reservoirs, except for Rainbow Reservoir, which receives some angling pressure for trout and Walleye. Some Rainbow Trout and Brown Trout naturally reproduce in the river section upstream of Rainbow Reservoir and downstream of Black Eagle Dam. Brown Trout were last stocked in Rainbow Reservoir in 2001, yet anglers still report catching Brown Trout in recent years. Stocking of Rainbow Trout was reduced in 2018 along with many other reservoirs in the state because of budget cuts. Numbers were increased in 2019 and 2020, with plans to further increase the annual number of Rainbow Trout stocked to 12,000 beginning in 2021.

Table 11. Recent stocking records for Rainbow Reservoir from 2007 through 2020.

| | Rainbow Trout (RB) strains | | | | | |
|---|---|---|---|---|---|---|
| Year | Erwin | Gerrard | Arlee x Erwin | Eagle | Arlee | **Total RB** |
| 2020 | -- | -- | 4,000 | -- | 4,000 | **8,000** |
| 2019 | -- | -- | 4,964 | -- | 5,721 | **10,685** |
| 2018 | -- | -- | 1,294 | 2,095 | -- | **3,389** |
| 2017 | -- | 2,000 | 18,535 | -- | -- | **20,535** |
| 2016 | -- | 2,002 | 28,000 | -- | -- | **30,002** |
| 2015 | -- | 2,136 | 7,142 | -- | -- | **9,278** |
| 2014 | -- | -- | 20,001 | 1,000 | -- | **21,001** |
| 2013 | -- | -- | 20,039 | -- | -- | **20,039** |
| 2012 | -- | -- | 18,743 | -- | -- | **18,743** |
| 2011 | -- | -- | 18,692 | -- | | **19,692** |
| 2010 | -- | -- | 2,000 | -- | | **2,000** |
| 2009 | 19,901 | -- | -- | -- | | **19,901** |
| 2008 | 17,428 | -- | -- | -- | | **17,428** |
| 2007 | 21,000 | -- | -- | -- | | **21,000** |

*White Sulphur Springs Reservoirs – Newlan Creek Reservoir and Sutherlin Reservoir*

Newlan Creek Reservoir and Sutherlin Reservoir (also known as Lake Sutherlin and Smith River Reservoir) are the two largest reservoirs in the Great Falls Management Area and are located near White Sulphur Springs. Newlan Creek Reservoir has a capacity of approximately 15,600 acre-ft (Caldwell and Eddy-Miller 2013) and a maximum depth 100 ft, while Sutherlin Reservoir has a capacity of approximately 14,200 acre-ft (Caldwell and Eddy-Miller 2013) and a maximum depth of 60 ft. Both reservoirs typically provide quality angling for stocked Rainbow Trout, as well as the potential to catch large Burbot. In most years, more than 45,000 trout are stocked in Newlan Creek Reservoir (Table 12) and more than 15,000 trout are stocked in Sutherlin Reservoir (Table 13).

Gerrard strain Rainbow Trout have been stocked since 2015 in Newlan Creek Reservoir to increase the diversity of angling opportunities (Table 12). The gerrard strain of Rainbow Trout is known for its ability to reach large sizes in some situations. The intent was that the gerrard Rainbow Trout would utilize the abundant white suckers and longnose suckers *Catostomus catostomus* in the reservoir, reducing the sucker biomass, while providing the potential for a trophy Rainbow Trout fishery. With the exception of the first year of stocking, all gerrard strain Rainbow Trout have had their adipose fin clipped to aid in identification. To this point, only limited numbers of gerrard Rainbow Trout have been sampled, and no large individuals. The number of gerrard strain Rainbow Trout stocked into Newlan Creek Reservoir was reduced in 2016, with a corresponding increase in eagle creek and arlee strain Rainbow Trout.

Table 12. Recent stocking records for Newlan Creek Reservoir from 2007 through 2020.

| | Rainbow Trout (Rb) strains | | | | Westslope | | | |
|---|---|---|---|---|---|---|---|---|
| Year | Gerrard | Eagle | Arlee x Erwin | Arlee | Cutthroat (WCT) | **Total Rb and WCT** | Brown Trout | Kokanee |
| 2020 | 15,026 | -- | -- | 30,205 | 10,000 | **55,231** | -- | 9,986 |
| 2019 | 15,901 | 30,000 | -- | -- | -- | **45,901** | -- | 10,000 |
| 2018 | 16,002 | -- | -- | 30,088 | -- | **46,090** | -- | 10,000 |
| 2017 | 24,730 | 13,348 | -- | -- | -- | **38,078** | -- | 10,000 |
| 2016 | 25,173 | 20,000 | -- | -- | -- | **45,173** | 1,353 | 10,019 |
| 2015 | 25,039 | 20,052 | 1,000 | -- | -- | **46,091** | -- | 20,048 |
| 2014 | -- | 20,000 | -- | -- | 10,000 | **30,000** | -- | 5,089 |
| 2013 | -- | -- | 1,170 | 30,360 | 10,000 | **41,530** | -- | -- |
| 2012 | -- | -- | -- | -- | 5,400 | **5,400** | 4,588 | -- |
| 2011 | -- | 43,164 | -- | -- | -- | **43,164** | 9,196 | -- |
| 2010 | -- | -- | -- | 34,503 | 9,000 | **43,503** | -- | -- |
| 2009 | -- | 30,000 | -- | -- | 10,000 | **40,000** | -- | -- |
| 2008 | -- | 30,000 | -- | -- | 12,500 | **42,500** | -- | -- |
| 2007 | -- | 30,050 | -- | -- | 10,000 | **40,050** | 9,509 | -- |

Table 13. Recent stocking records for Sutherlin Reservoir from 2007 through 2020.

| | Rainbow Trout (Rb) strains | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | Erwin | Eagle | Arlee x Erwin | Arlee | Undesignated | **Total Rb** | Kokanee |
| 2020 | -- | 12,273 | 4,435 | -- | -- | **16,708** | 2,504 |
| 2019 | -- | -- | -- | 17,046 | -- | **17,046** | 2,500 |
| 2018 | -- | 12,000 | 4,000 | -- | -- | **16,000** | 2,500 |
| 2017 | -- | -- | 4,000 | 12,028 | -- | **16,028** | 2,528 |
| 2016 | -- | -- | 4,000 | 12,000 | -- | **16,000** | 2,513 |
| 2015 | -- | -- | 4,000 | 12,143 | -- | **16,143** | 2,506 |
| 2014 | -- | -- | 3,984 | 12,000 | -- | **15,984** | 2,008 |
| 2013 | -- | -- | 5,170 | 12,260 | -- | **17,430** | -- |
| 2012 | -- | 9,996 | 4,000 | 2,017 | -- | **16,013** | -- |
| 2011 | -- | -- | 4,000 | 12,076 | -- | **16,076** | -- |
| 2010 | -- | -- | 4,000 | 17,066 | -- | **21,066** | -- |
| 2009 | 4,000 | -- | -- | 12,000 | -- | **16,000** | -- |
| 2008 | 4,000 | -- | -- | 12,222 | -- | **16,222** | -- |
| 2007 | -- | -- | -- | 11,999 | 4,000 | **15,999** | -- |

Kokanee salmon have been stocked since 2014 in both reservoirs with approximately 10,000 annually in Newlan Creek Reservoir and 2,500 annually in Sutherlin Reservoir (Tables 12 and 13). Netting surveys were completed in fall 2020 to target Burbot and corresponded with near the time of kokanee spawning. Average size of kokanee in Newlan Reservoir was 339 mm (13.3 inches) compared to 458 mm (18 inches) in Sutherlin Reservoir (Tables 14 and 15, Figure 29). Given the kokanee fishery is sustained by stocking and natural reproduction is minimal, a fall snagging season was established on Newlan Creek Reservoir in 2018 to provide additional opportunity. A fall snagging season has also been approved on state lands on Sutherlin Reservoir that will begin in fall 2021.

The fall sampling effort utilized trap nets to target Burbot for a tagging study to gain a better understanding of the Burbot fishery. A total of 228 Burbot were collected from Newlan Creek Reservoir (Table 14) and 90 Burbot were collected from Sutherlin Reservoir (Table 15). Burbot ranged from 328 to 991 mm in Newlan Creek Reservoir and from 348 to 932 mm in Sutherlin Reservoir with a larger average size in Sutherlin Reservoir (Tables 14 and 15, Figure 29). While more than twice as many fish were caught in Newlan Reservoir than Sutherlin Reservoir this is not indicative of densities in the reservoirs as the timing of the sampling was different and number of Burbot handled was likely related to the kokanee spawn timing. Of the Burbot sampled, 194 were tagged in Newlan Creek Reservoir and 70 were tagged in Sutherlin Reservoir with floy tags. Based on angler tag returns, future monitoring, and a creel survey that is being completed in 2021 on both reservoirs, we will be able to gain a better understanding of Burbot catch rates, harvest rates, age, growth, and densities of Burbot. The creel survey will also provide information regarding angler use, angler satisfaction, catch rates, and harvest rates for all species.

The number of angler days has been estimated every other year for Newlan Creek Reservoir and Sutherlin Reservoir (Table 16). The number of angler days at Newlan Creek Reservoir in 2019 was 7,755 compared to 1,959 angler days in Sutherlin Reservoir. These estimates rank 14$^{th}$ and 30$^{th}$ in Region 4 and 87$^{th}$ and 191$^{st}$ in the state for Newlan Creek Reservoir and Sutherlin Reservoir, respectively. The number of angler days has consistently been estimated to be at least 2 to 3 times higher in Newlan Creek Reservoir than Sutherlin Reservoir since 2003 (Table 16).

Table 14. Catch statistics for fish sampled from Newlan Reservoir in 2020, from 12 total trap net nights over three sampling events from 9/21/2020 through 10/14/2020.

| | | Length (mm)* | | | | Weight (grams)* | | Condition | | Relative Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Min | Max | Avg | SD | Avg | SD | Avg | SD | Avg | SD |
| Burbot | 228 | 328 | 991 | 569.6 | 131.5 | 1,288 | 1,024 | 22.4 | 3.86 | 87.26 | 15.5 |
| Kokanee | 203 | 295 | 394 | 338.9 | 19.43 | 360.0 | 53.5 | 33.3 | 3.2 | 87.8 | 8.5 |
| Longnose Sucker | 41 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Rainbow Trout | 14 | 203 | 516 | 302.1 | 114.7 | 367.8 | 407.4 | 32.6 | 5.1 | 83.1 | 12.7 |
| White Sucker | 13 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

* 100 mm = 3.9 inches, 100 grams = 0.2 pounds

Table 15. Catch statistics for fish sampled from Sutherlin Reservoir in 2020, from 18 total trap net nights over three sampling events from 9/30/2020 through 11/2/2020.

| | | Length (mm)* | | | | Weight (grams)* | | Condition | | Relative Weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | n | Min | Max | Avg | SD | Avg | SD | Avg | SD | Avg | SD |
| Brook Trout | 5 | 193 | 259 | 214.4 | 25.8 | 96.0 | 43.4 | 33.58 | 2.6 | 89.8 | 6.8 |
| Burbot | 90 | 348 | 932 | 621.6 | 162.7 | 1,828 | 1,428 | 21.9 | 3.8 | 86.1 | 16.0 |
| Kokanee | 30 | 345 | 541 | 458.1 | 39 | 943.5 | 257.9 | 35.3 | 7.4 | 92.0 | 19.3 |
| Longnose Sucker | 35 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| Mountain Whitefish | 3 | 391 | 478 | 440.3 | 44.7 | 822.7 | 233.6 | 34.2 | 2.8 | 92.6 | 7.6 |
| Rainbow Trout | 20 | 208 | 432 | 345.3 | 71.7 | 429.7 | 185.7 | 36.1 | 7.3 | 91.6 | 19.1 |
| White Sucker | 286 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

* 100 mm = 3.9 inches, 100 grams = 0.2 pounds

Table 16. Estimated angler use days for Newlan Creek Reservoir and Sutherlin Reservoir from 1995 through 2019 (McFarland et al. 1997-2008; Selby et al. 2015, 2017, 2019, *In prep.*).

| | Newlan Creek Reservoir | | | Sutherlin Reservoir | | |
|---|---|---|---|---|---|---|
| Year | Total Angler Days | Res Angler Days | Non-Res Angler Days | Total Angler Days | Res Angler Days | Non-Res Angler Days |
| 2019 | 7,755 | 7,551 | 204 | 1,959 | 1,595 | 364 |
| 2017 | 5,696 | 4,981 | 715 | 633 | 633 | 0 |
| 2015 | 4,203 | 3,514 | 689 | 2,043 | 1,818 | 225 |
| 2013 | 6,595 | 5,621 | 974 | 2,324 | 2,324 | 0 |
| 2011 | 4,430 | 4,077 | 353 | 1,409 | 1,253 | 156 |
| 2009 | 9,321 | 8,550 | 771 | 1,529 | 1,480 | 49 |
| 2007 | 7,757 | 7,672 | 85 | 2,626 | 2,529 | 97 |
| 2005 | 7,472 | 6,831 | 641 | 2,901 | 2,818 | 83 |
| 2003 | 7,827 | 7,371 | 456 | 3,205 | 2,907 | 298 |
| 2001 | 5,236 | 5,137 | 99 | 4,516 | 4,119 | 397 |
| 1999 | 3,255 | 3,114 | 141 | 2,556 | 2,442 | 114 |
| 1997 | 3,848 | 3,781 | 67 | 5,888 | 5,544 | 344 |
| 1995 | 3,288 | 3,195 | 93 | 1,470 | 1,350 | 120 |

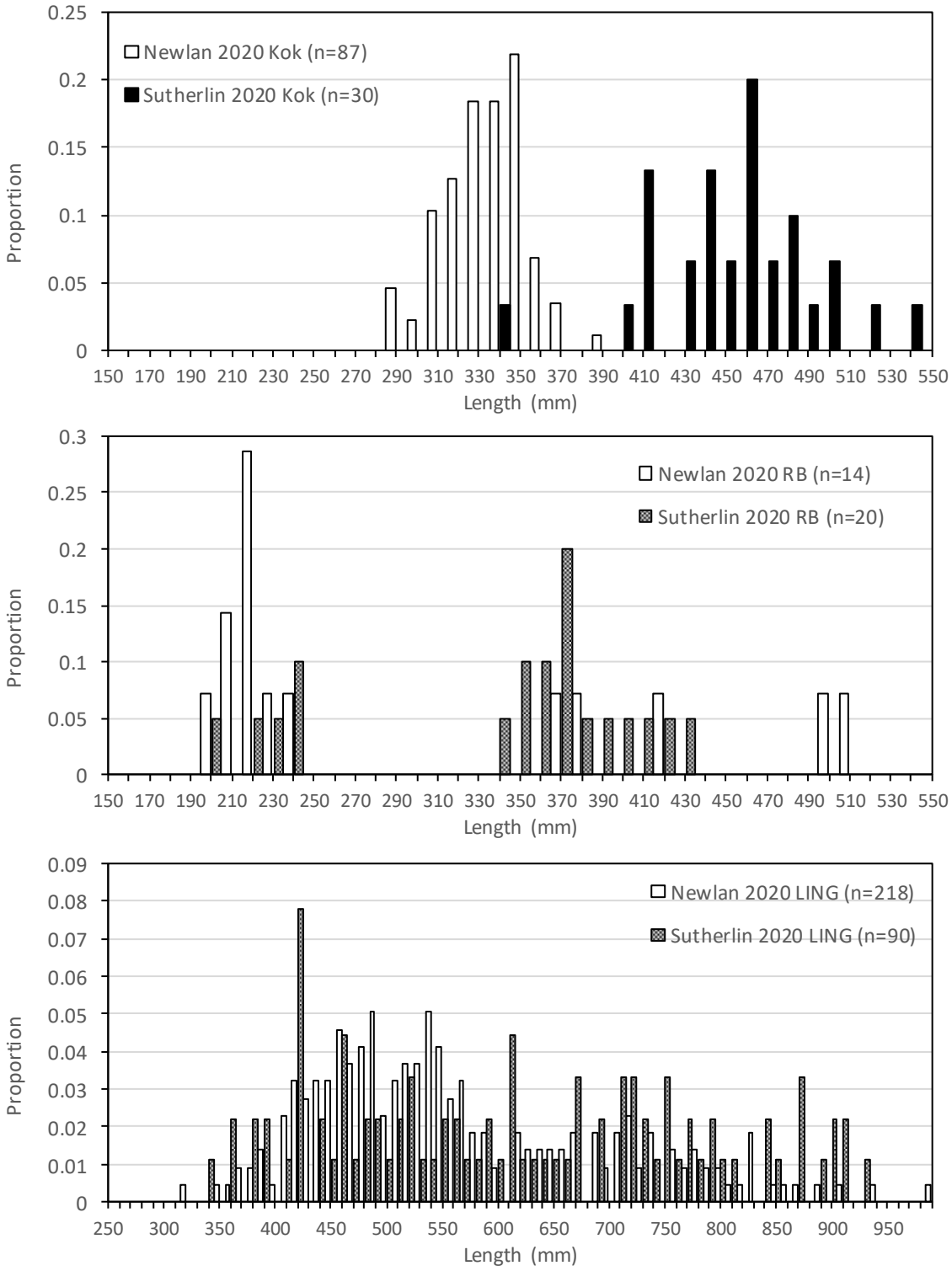


Figure 29. Length frequency histogram for kokanee (Kok, Top), Rainbow Trout (RB, Middle), and Burbot (LING, Bottom) handled during fall surveys in 2020 in Newlan Creek Reservoir (12 Trap Net Nights) and Sutherlin Reservoir (18 Trap Net Nights). Proportion of fish for each reservoir is shown on the y-axis as a function of length (millimeters) on the x-axis.

**Other Activities**

*Research*

Northwestern Energy through the Missouri River Technical Advisory Committee awarded MFWP funding to investigate trout and Mountain Whitefish life history characteristics. This study was initiated in 2014 continued through 2018. The specific objectives of this study were to;

1. Compare outmigration timing with past studies,
2. Evaluate homing/straying with natal stream,
3. Document level of straying over multiple years,
4. Identify summer and winter locations of tagged fish in the Missouri River,
5. Use known age fish to evaluate historic ageing results and growth patterns over the past 31 years.
6. Identify connectivity with Sun River and Smith River trout populations.

To meet these objectives, Passive Integrated Transponder (PIT) technology was used to monitor fish movement in the Missouri, Smith, and Sun river systems. Half duplex PIT tags were used with primarily 23 and 35 mm long tags to increase read range and tag detection efficiency. Most fish were tagged by making a small incision in the abdomen and placing the tag into the abdominal cavity. Fish movements were monitored using a network of remote PIT tag monitoring stations and tracking with mobile antennae. Five remote PIT tag monitoring stations were installed in the Missouri River drainage, three in the Sun River drainage, and fifteen in the Smith River drainage. The five monitoring stations in the Missouri River drainage were installed spring 2014 and the three stations in the Sun River drainage were installed spring 2015. Many of the stations in the Smith River drainage were installed during summer 2014, with the remaining stations installed in 2015 and 2016 by a graduate student at Montana State University working on the Smith River portion of the study. Preliminary results of this study have been reported in Mullen et al. (2016a) and Mullen et al. (2017). The Smith River portion of the study was reported in detail in a master's thesis (Lance 2019). The Missouri River portion of the study will be reported in a detailed manuscript that is in preparation.

*Westslope Cutthroat Trout Summary*

Various Westslope Cutthroat Trout conservation projects and monitoring has been conducted from 2017 through 2020 and utilized regional personnel. Westslope Cutthroat Trout monitoring results and conservation efforts are described in detail in the annual Northcentral Montana Westslope Cutthroat Trout Restoration Project Cost Share reports (Webster 2017, 2018, and 2019; Poole 2020).

*Aquatic Education*

Regional staff gave annual presentations to the Pat Barnes Chapter of Trout Unlimited, Missouri River Flyfishers, Smith River Outfitters, Upper Missouri Advisory Council, Missouri River Technical Advisory Committee, and other organizations. A presentation was also given to the Billings Chapter of Trout Unlimited during one of their field trips to the Missouri River. Regional staff have also been active with the Sun River watershed group and provided annual updates on the status of the fishery to the group.

Regional staff participated in annual kids fishing events at various reservoirs during winter and Wadsworth Pond during summer. Regional staff also assisted in preparing the exhibit and answered questions by the public at the annual State Fair in Great Falls. Regional staff conducted demonstrations of fish tagging, electrofishing, and fish population monitoring on Belt Creek and Newlan Creek for two high school science classes.

Aquatic education and outreach opportunities were limited in 2020 due to the Covid-19 pandemic and social distancing requirements.

*Aquatic Habitat Restoration*

From 2017 through 2020, various habitat restoration projects have been completed in the Great Falls Management Area that have been initiated by or involved collaboration with MFWP personnel. These projects are summarized in detail in other reports and include:

- Missouri River bank restoration upstream of boat ramp near the Dearborn River (Mullen 2018a, 2019a)
- Missouri River riparian fencing downstream of Sheep Creek (Mullen 2019b)
- Missouri River riparian fencing upstream of Little Prickly Pear Creek (Mullen 2018b)
- Little Prickly Pear Creek restoration upstream of canyon (Mullen 2019c)
- Hardy Creek restoration to reconnect Hardy Creek to the Missouri River (Mullen *In prep.*)
- Smith River bank restoration downstream of Camp Baker (Mullen 2019d)

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**Appendix A – Missouri River Walleye Tagging Harvest Tables**

Table A1. Number and percent of Walleye harvested (columns) and number tagged (rows) by year in the Missouri River Holter tailrace section (Holter Dam to Wolf Creek Bridge).

| Tagging Year | | Harvest Year | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2004-2005 | | 2006-2007 | | 2008-2009 | | 2010-2011 | | 2012-2013 | | 2014-2015 | | 2016-2017 | | 2018-2019 | | 2020-2021 | | Totals | |
| Year | # Tagged | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % |
| **2004** | **4** | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% |
| **2006** | **11** | | | 4 | 36% | 0 | 0% | 1 | 9% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 5 | 45% |
| **2008** | **42** | | | | | 9 | 21% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 1 | 2% | 0 | 0% | 10 | 24% |
| **2010** | **57** | | | | | | | 5 | 9% | 6 | 11% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 11 | 19% |
| **2012** | **52** | | | | | | | | | 9 | 17% | 1 | 2% | 0 | 0% | 0 | 0% | 0 | 0% | 10 | 19% |
| **2014** | **43** | | | | | | | | | | | 3 | 7% | 0 | 0% | 0 | 0% | 0 | 0% | 3 | 7% |
| **2016** | **35** | | | | | | | | | | | | | 2 | 6% | 2 | 6% | 0 | 0% | 4 | 11% |
| **2018** | **48** | | | | | | | | | | | | | | | 1 | 2% | 0 | 0% | 1 | 2% |
| **2020** | **17** | | | | | | | | | | | | | | | | | 0 | 0% | 0 | 0% |
| **Total** | **309** | | | **4** | | **9** | | **6** | | **15** | | **4** | | **2** | | **4** | | **0** | | **44** | **14%** |

Table A2. Number and percent of Walleye harvested (columns) and number tagged (rows) by year in the Missouri River below Holter Dam. Most Walleye were tagged during monitoring in the Craig section. Table excludes tags from the Holter Tailrace (Holter Dam to Wolf Creek Bridge) section.

| **Tagging Year** | | **Harvest Year** | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **2008** | | **2009** | | **2010** | | **2011** | | **2012** | | **2013** | | **2014** | | **2015** | | **2016** | | **2017** | | **2018** | | **2019** | | **2020** | | **Totals** | |
| **Year** | **# Tagged** | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % | *N* | % |
| **2008** | **61** | 20 | 32% | 5 | 8% | 0 | 0% | 2 | 3% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 27 | 43% |
| **2009** | **57** | | | 12 | 21% | 0 | 0% | 0 | 0% | 1 | 1% | 1 | 1% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 14 | 23% |
| **2010** | **107** | | | | | 7 | 6% | 2 | 2% | 2 | 2% | 2 | 2% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 13 | 12% |
| **2011** | **185** | | | | | | | 10 | 12% | 18 | 10% | 8 | 4% | 1 | 1% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 37 | 27% |
| **2012** | **140** | | | | | | | | | 21 | 15% | 2 | 1% | 5 | 4% | 0 | 0% | 1 | 1% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 29 | 21% |
| **2013** | **93** | | | | | | | | | | | 16 | 17% | 2 | 2% | 1 | 1% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 19 | 20% |
| **2014** | **142** | | | | | | | | | | | | | 14 | 10% | 9 | 6% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 23 | 16% |
| **2015** | **44** | | | | | | | | | | | | | | | 11 | 25% | 1 | 2% | 0 | 0% | 1 | 2% | 0 | 0% | 0 | 0% | 13 | 29% |
| **2016** | **21** | | | | | | | | | | | | | | | | | 3 | 14% | 0 | 0% | 0 | 0% | 0 | 0% | 0 | 0% | 3 | 14% |
| **2017** | **30** | | | | | | | | | | | | | | | | | | | 0 | 0% | 2 | 6% | 0 | 0% | 0 | 0% | 2 | 6% |
| **2018** | **91** | | | | | | | | | | | | | | | | | | | | | 6 | 7% | 7 | 8% | 1 | 1% | 14 | 16% |
| **2019** | **94** | | | | | | | | | | | | | | | | | | | | | | | 8 | 9% | 3 | 3% | 11 | 12% |
| **2020** | **54** | | | | | | | | | | | | | | | | | | | | | | | | | 4 | 7% | 4 | 7% |
| **Total** | **1119** | **20** | | **17** | | **7** | | **14** | | **42** | | **29** | | **22** | | **21** | | **5** | | **0** | | **9** | | **15** | | **8** | | **209** | **19%** |

**Appendix B – Willow Creek Reservoir Dewatering and Sun River Impact Investigation Photo Log**

Photo 1. Willow Creek Reservoir (WCR) dewatered at boat ramp facing north. August 25, 2019.


Photo 2. Willow Creek Reservoir dewatered at boat ramp facing west. August 25, 2019.

Photo 3. Turbid water in the Sun River at Hwy 287 from WCR dewatering. August 24, 2019.

Photo 4. Turbid water in the Sun River at Hwy 287 from WCR dewatering. August 24, 2019.

Photo 5. Turbid water entering the Sun River from WCR return canal on left side of photo. Sept. 4, 2019.

Photo 6. Tiger muskie flushed from WCR, sampled electrofishing in the Sun River downstream of WCR return canal. Sept. 4, 2019.

Photo 7. Sediment accumulation in the Sun River between WCR return canal and Hwy 287. Sept. 4, 2019.

Photo 8. Sediment accumulation in the Sun River between WCR return canal and Hwy 287. Sept. 4, 2019.

Photo 9. Turbid water entering Sun River from WCR return canal. June 27, 2020.

Photo 10. Turbid water entering Sun River from WCR return canal. June 27, 2020.

Photo 11. Turbid water in WCR return near confluence with the Sun River. June 27, 2020.

Photo 12. Turbid water in WCR return canal near confluence with the Sun River. June 27, 2020.