Thompson River Long-Term Monitoring Update-Through 2024

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Introduction

The Thompson River is a sixth order tributary (1631 km^2; Strahler 1952) to the Clark Fork River in western Montana. Originating from multiple headwater lakes (Thompson Chain of Lakes), the Thompson River travels approximately 85 river kilometers (rkm) south/ southwest to its confluence with the Clark Fork River. The Thompson River is a north/ south oriented watershed and is generally categorized into two distinct stream segments, the upper and lower river. The upper Thompson River extends from the Thompson Chain of Lakes in the headwaters downstream to its confluence with the Little Thompson River. This stretch of river consists of a low gradient, meandering channel, which alternates between primarily an E and a C-channel types (Rosgen 1996). The lower Thompson River is defined as extending from the Little Thompson River confluence at rkm 28 downstream to its confluence with the Clark Fork River. Here, the river flows through a confined canyon and is characterized by higher gradient and larger substrate, with primarily B, and less frequently a C-channel type (Rosgen 1996).

In general, the upper Thompson River is warmer than the lower river. Several factors contribute to this thermal regime including its origin at the outflow from Lower Thompson Lake (rkm 85-88), lower stream velocities, and a lack of riparian canopy cover in some areas. The Thompson River flows for nearly 20 rkm before it begins to cool with the addition of several tributaries such as Murr Creek (rkm 68), Big Rock Creek (rkm 52), and Chippy Creek (rkm 40). Fishtrap Creek (rkm 25), the Little Thompson River (rkm 29), and West Fork Thompson River (rkm 11) are the three largest tributaries to the Thompson River by volume and drainage area, and all enter the lower river. Recent temperature monitoring has revealed that the addition of the Little Thompson River increases water temperatures in the Thompson River (Blakney et al. 2024). Temperatures become considerably cooler with the addition of Fishtrap Creek, and the lowest 11 rkm is the coolest section of the entire mainstem due to the addition of West Fork Thompson River. The Fishtrap Creek and West Fork Thompson River drainages are comprised of high-elevation headwaters, which hold snow longer and have a later and more extended runoff regime when compared to the upper drainage. In the upper drainage, spring run-off appears to start earlier and moderate more quickly. This is likely due to its more mellow topography, smaller drainage area and lower maximum drainage elevation of tributaries, and loss of a mature forest canopy associated with 100,000-acre Chippy Creek fire in 2007. This stand replacing fire intensively burned much of the highest elevations, altering hydrology and snowmelt dynamics within several large tributaries to the upper Thompson River drainage including North Fork Little Thompson River, Little Rock Creek, Bear Creek, Chippy Creek, and Big Rock Creek.

The earliest attempts at monitoring the recreational fishery on the Thompson River were creel interviews conducted on the upper river in the 1940s and extending through the 1960s (MFWP, unpublished data; Kreiner and Terrazas 2018). Electrofishing by fisheries biologists began in the 1970s at sites located near rkm 30 (Little Thompson Section) and rkm 49 (Meadow Creek Section) (MFWP, unpublished data). Currently, three established long-term electrofishing sites occur on the Thompson River (Figure 1). The Big Hole section (rkm 17.1–14) was established to document the fishery's response to a catch and release regulation on a 10.9 km section of the Thompson River. This site was first sampled in 1985, and despite the catch and release regulation being removed in 1990, has been routinely sampled since 2003. The 19-mile section (rkm 31.2–28.3) was first sampled in 1986 and in1998, with routine sampling beginning in 2003.

The 19-mile section is nearly identical to the Little Thompson section that was sampled occasionally in 1970s and 1980s (Montana Fish, Wildlife and Parks-MFWP, unpublished data). In 2013, the Big Rock Creek section (rkm 51.5–49.4) was established. Currently, we attempt to sample each of the three long-term sites on a biennial basis, to evaluate the fish community over time. This data is used to investigate abundance, species composition, species distribution, and size structure. The information gathered during routine sampling events helps inform management decisions, such as changes to fishing regulations.

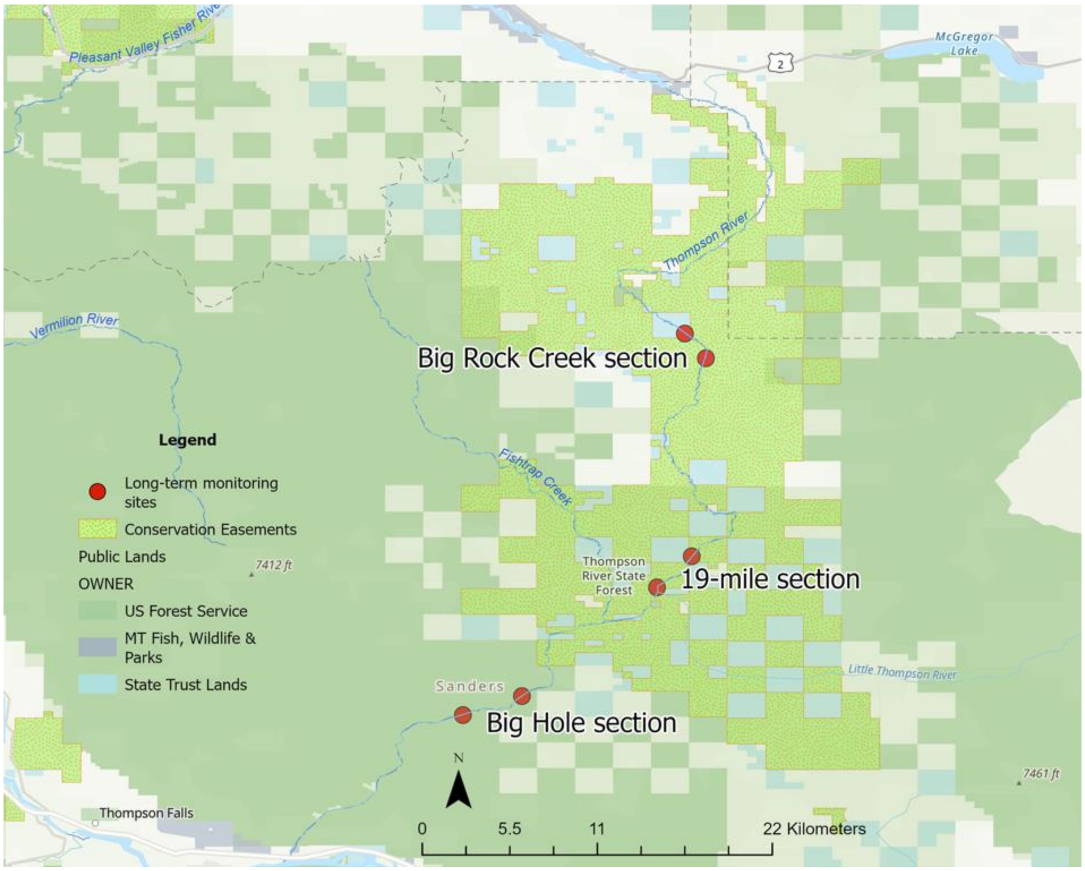

Figure 1. Long-term monitoring sections on the mainstem Thompson River.

The Thompson River has a substantial amount of public access with three major land managers in the drainage: the U.S. Forest Service (USFS)- Lolo National Forest, Green Diamond Resource Company (GD) and the State of Montana- Department of Natural Resource Conservation (DNRC). Public access is allowed by each of these entities. Green Diamond Land along the Thompson River, extending from the Murr Creek confluence (rkm 65.8) to downstream of Deerhorn Creek (rkm 20.1) occurs within Thompson-Fisher Conservation Easement (CE) which was established in 2003. A project to secure the remaining 48,000 acres GD land in the drainage, known as the Upper Thompson Connectivity Project (UTCP) is underway. A detailed description of the benefits of the UTCP to aquatic resources and public access in the Thompson River drainage is described in Blakney et al. (2022).

Montana Fish Wildlife and Parks conducts statewide angler use surveys by mailing a questionnaire to a random sample of resident and nonresident licensed anglers for each month of the year (ex., League and Caball 2023; https://fwp.mt.gov/fish/pressure-surveys). The surveys estimate total "angler days" which is defined as one angler fishing one body of water for any amount of time on a given day. The Thompson River is divided into two sections for angler pressure surveys. However, due to uncertainty of the boundary of the lower (Section 1) and upper (Section 2) river, results are combined in this report for only a total pressure estimate (Table 1).

Surveys were conducted on the Thompson River annually from 1982-1985, and then every other year from 1989 to 2019, in 2020 and 2021. Angler estimates varied from a low of 4,045 days in 1991, to 13,093 days in 2015 (Table 1). Angler estimates for residents have varied from a low of 2,750 days in 2007 to 10,476 days in 2015 (Table 1). Non-resident angling has also been highly variable with as many as 6,594 angler days in 2021, but as few as 577 days in 1985. The Thompson River has exceeded 10,000 angler days on six occasions (1997, 1999, 2009, 2015, 2020, and 2021), and has averaged 8,472 angler days per year. Residents have accounted for approximately 70% of the pressure and have averaged 5,930 days per year compared to non-resident average of 2,529 days.

Estimates of pressure have increased over the past ten years, but many recent estimates were similar to the early 1980s and late 1990s (Table 1). Based on observation and early reports (Thomas 1997), the river has likely transformed from a stream in which locals harvested large numbers of trout, to a destination fishing stream. Local anglers, as well as anglers from Missoula, Kalispell, Sandpoint, ID, and Spokane, WA, are commonly observed fishing the Thompson River. Preserving and enhancing a quality sport fishery will continue to be a priority for MFWP in the Thompson River.

Table 1. Angler pressure estimates for the Thompson River (FWP Region 1) from mail-in angler surveys including total pressure=angler days, error-standard deviation, trips= number of days respondents' fish on the water along with the state and FWP Regional rank by year.

Year	**Total Days (SD)**	**Trips**	**Resident Days (SD)**	**Trips**	**Non-Resident Days (SD)**	**Trips**	**Ranking State**	**Region**
2021	11,190 (3513)	75	4,597 (1582)	37	6,594 (2963)	38	90	15
2020	11,995 (4248)	83	8,776 (4028)	60	3,219 (1123)	23	90	14
2019	8346 (2645)	71	6,251 (2430)	54	2,095 (1042)	17	93	18
2017	6737 (1785)	45	3,725 (1245)	32	3,012 (1196)	13	98	21
2015	13,093 (3,391)	126	10,476 (3,278)	97	2,617 (869)	29	84	15
2013	8,879 (1,512	105	6,794 (1,425	82	1,832 (504)	23	113	17
2011	8,722 (1,309)	163	6,103 (1,146)	112	2,618 (634)	51	78	12
2009	11,133 (1,484)	189	6,930 (1,108)	129	4,203 (989)	60	79	17
2007	6,026 (1,288)	177	2,750 (975)	38	3,276 (842)	52	91	18
2005	7,625 (1,349)	149	3,652 (810)	82	3,973 (1,077)	67	86	17
2003	7,814 (1,221)	171	4,578 (949)	100	3,236 (767)	71	87	16
2001	6,076 (924)	156	4,172 (682)	114	1,904 (624)	42	112	26
1999	11,189 (1,881)	282	8,746 (1,709)	220	2,443 (783)	62	72	11
1997	10,081 (1,859)	257	7,893 (1,763)	194	2,188 (592)	63	79	14
1995	9,629 (2,709)	221	7,460 (2,643)	160	2,169 (596)	61	77	12
1993	6,888 (1,026)	205	5,507 (970)	163	1,381 (336)	42	86	18

1991	4,045 (814)	116	3,163 (856)	87	882 (247)	29	114	21
1989	6,569 (1,013)	142	4,849 (904)	97	1,720 (457)	45	70	11
1985	5,416 (1,574)	26	4,839 (1,542)	20	577 (317)	6	96	18
1984	6,554 (2,227)	28	5,447 (2,149)	15	1,107 (583)	13	81	13
1983	9,586 (3,687)	68	7,592 (3,619)	36	1,994 (699)	32	93	16
1982	8,790 (2,340)	63	6,174 (1,637)	51	2,616 (1,672)	12	72	14

Methods

Fish in the mainstem Thompson River were sampled using an aluminum drift boat mounted with a rectifier (Smith-Root Inc., Vancouver, WA) and 5,000-watt generator (Figure 2). The hull of the boat serves as the cathode and two fiberglass booms, each with four steel cable droppers, serves as anodes. Output was standardized at one ampere of direct current. Sampling has typically occurred on the descending limb of the hydrograph, from May to early July, depending on the site, snowpack and spring runoff conditions. Because sampling is done with a drift boat, timing is very important as each section can only be effectively sampled a few weeks each year when flows are high enough to float the boat but not too high when electrofishing would be ineffective and crew safety would be comprised.

Figure 2. Drift boat electrofishing the lower portion of the Big Rock Creek section of the Thompson River, May 2024.

Two runs are made to mark fish, with each run focusing on a separate riverbank (on occasion additional mark runs have been completed in the past). All trout captured that were 150 mm or greater (i.e., catchable trout) were marked with an identifiable fin clip. Fish were identified to species, measured for total length and weight, and released within the sampling section. The few mortalities were weighed and measured but were excluded from population estimate. Two recapture runs were completed approximately 7-10 days after mark runs and all fish captured were visually examined for fin clips. The Chapman modification of Petersen's Mark-Recapture (MR) estimator was used to estimate population size (Equation 1) (Pine et al. 2012). Assumption to be met for a valid M-R estimates include: 1) marked fish do not lose the mark prior to recapture sampling events; 2) marked fish are not overlooked during recapture sampling events; 3) marked and unmarked fish are equally vulnerable to capture during recapture sampling events; 4) marked and unmarked fish have equal mortality between mark and recapture sampling events; 5) following release from mark sampling events, marked individuals randomly mixed with unmarked individuals ; and 6) there are no additions to the population during the period of study (Van Den Avyle and Hayward, in Kohler and Hubert, eds., 1999).

Equation 1. Chapman modification of the Petersen Mark-Recapture method (Pine et al. 2012).

$$\mathrm{N} = \frac{(\mathrm{M}+1)*(\mathrm{C}+1)}{(\mathrm{r}+1)} - 1$$

where:

N= population Estimate

M= number of fish marked on “Mark” runs

C= total number of marked and unmarked fish captured on “Recapture” runs

r= total number of marked fish captured on “Recapture” runs

and:

$$standard\ deviation\ (SD) = \sqrt{\frac{(\mathrm{M}+1)(\mathrm{C}+1)(1-\mathrm{r})(\mathrm{C}-\mathrm{r})}{(\mathrm{r}+1)^2(\mathrm{r}+2)}}$$

The 95% confidence intervals (CI) were calculated using the equation:

$$95\%\mathrm{CI} = 1.96 \times (\mathrm{SD})$$

A minimum of seven recaptures is recommended to calculate mark-recapture (MR) estimates (Ogle 2010). However, due to low capture efficiencies during certain years and for less common species, we calculated population estimates with a minimum of five recaptures. In cases where less than five marked fish were recaptured, an estimate of abundance was calculated using the long-term mean capture efficiency for a given species at a specific site (Kohler and Hubert 1999; Zale et al. 2012; Kreiner and Terrazas 2018). This simple method can be used to estimate abundance when few marked fish are recaptured (< 5 fish). Capture efficiency was defined as the proportion of fish captured on recapture runs that were initially tagged on mark runs. This proportion was divided from the total number of fish marked on the first two mark runs. For example, if long-term mean capture efficiency (r/M) is 0.25 and 100 fish were marked in that section, a population estimate (CE est.) using capture efficiency would be 400 fish. It was assumed that under normal conditions, CE and MR models should not vary greatly within the same section for a specific species. This technique was also calculated in years with adequate recaptures to verify accuracy and assumptions.

Equation 2. Capture efficiency population estimate

$$\text{CE est} = \frac{\text{M}}{\mu(\frac{r}{M})}$$

where:

CE est= capture efficiency population estimate

M= number of fish marked on "Mark" runs

r= total number of marked fish captured on "Recapture" runs

$\mu(\frac{r}{M})$= long-term mean capture efficiency

and:

$$\text{CE est Standard Deviation (CE est SD)} = \sqrt{\frac{(\sum(\text{r}/\text{M}_\text{i} - \mu)^2}{\text{N}}}$$

where:

CE est SD = capture efficiency estimate standard deviation

r/M_i = yearly capture efficiency for a species at a specific site

μ=mean yearly capture efficiency for a species at a specific site

N= sample size (i.e., # of years of data collected)

The 95% confidence intervals (CI) were calculated using the equation:

$$95\%\text{CI} = 1.96 \times (\text{CE est SD})$$

If the MR estimate was considerably higher than the CE est. it was presumed that at least one assumption of the MR estimate had been violated (e.g., fish moved out of the section between the mark and recapture run). If the MR estimate was substantially lower than the CE est., such a finding may have been associated with a relatively large difference in numbers of fish captured on mark runs versus recapture runs. There was enough agreement between MR and CE est. most years that assumptions of the abundance estimator (MR) were likely met. Population estimates at each site were calculated and divided by total section length for a standardized estimate of linear abundance per 1.6 kilometers (1 mile) for fish ≥ 150 mm.

There are limitations to electrofishing surveys on the Thompson River that are ubiquitous across long-term sampling sections. Sampling at these sites has occurred between May and July, typically on the descending limb of the hydrograph. Changes in discharge and the amount of habitat physically available for fish are often apparent between mark and recapture runs. At higher discharges water velocities are higher, and in some portions of each reach the ability to mitigate for moving faster down the river is difficult. Deepwater habitat provides effective cover for fish from electrofishing and thus efficiency of capturing all or even most trout in a deep pools in unknown, but likely moderate at best. Seasonal movements related to spawning have likely impacted the ability to estimate Rainbow Trout *Oncorhynchus mykiss* (RB) abundance. Rainbow Trout have a prolonged spawning period in the spring (redds observed in the Thompson River in March- May) and their subsequent post-spawn movements likely limited the ability to recapture the minimum number of marked fish to produce a M-R estimate in some monitoring sections some years. For the 19-mile (n=16) and Big Hole sections (n=19), 56% and 32% of the time these sections have been sampled, M-R estimates for RB could not be produced because not enough marked fish were recaptured.

Results-Discussion

Data for the Results-Discussion section of this report are organized by monitoring section. Trends in fish abundance overtime at a given monitoring site are outlined in Table 2. A description of the most recent sampling event for each section (2023 or 2024) is included. Other native fish species are present in the Thompson River and tributaries but are caught at low enough frequency or are completely absent from a sample site in a given year (including Westslope Cutthroat Trout Oncorhynchus clarkii , Bull Trout Salvelinus confluentus , Longnose Dace Rhinichthys cataractae, Largescale Sucker Catostomus macrocheilus, Longnose Sucker Catostomus catostomus, and sculpin (spp)) that estimates could not be produced. Mountain Whitefish *Prosopium williamsoni*, a native salmonid, appear to be the most abundant species across the three long-term monitoring sites in the Thompson River drainage but are not formally monitored due to logistics of capturing and holding both trout and whitefish on the drift boat at the same time. Juvenile trout that were visually observed to be significantly less than 150 mm were also not netted, thus their representation as proportion of the fish community is not documented.

The proportion of a catchable trout of a given species greater than or equal to 356 mm (14 inches) was also evaluated. A fish of this size would be considered a “good” or “nice” trout for the Thompson River. This simple waterbody-specific metric was used to replace to the formal proportional stock densities (PSD) evaluation in previous reports (i.e., Kreiner and Terrazas 2018). Inconsistencies between length categories of PSD between Rainbow Trout and Brown Trout (LL) *Salmo trutta* (no PSD for lotic Rainbow Trout) provide reasoning to use a simple metric to outline the proportion of larger fish available to anglers on a given year. Prior evaluation of relative weight (Wr) in the Thompson River (ex., Kriener and Terrazas 2018) was static and averaged in the mid-90s for each PSD length categories for LL and RB, with a Wr value of 90 considered average.

Table 2. Evaluation of the linear relationship of abundance (i.e., CE estimate) over time for most common trout species at the three long-term monitoring sections on the Thompson River with associated adjusted r^2 value, p-value and trend.

Species	**Section**	**years of data (n=)**	**adjusted r^2**	**p-value**	**trend**
LL	Big Hole	15	0.45	**0.004**	increasing
RB	Big Hole	19	0.08	0.13	stable
LL	19-Mile	15	0.02	0.60	stable
RB	19-Mile	16	0.41	**0.004**	declining
LL	Big Rock Creek	6	-0.24	0.91	stable
RB	Big Rock Creek	6	0.71	**0.02**	declining
EB	Big Rock Creek	6	0.30	0.15	stable

Big Hole section

Sampling on the Big Hole section in 2023 began on June 6th at a river discharge of 466 cubic feet per second (CFS) and was completed on June 21st with a discharge of 332 CFS at the U.S. Geological Survey (USGS) gauge at rkm 1.9. A total of 626 fish were captured over the four-day sampling period including 477 LL (76.2%), 140 RB (22.4%), five WCT (0.7%), three sculpin spp. (0.4%) and one Longnose Dace (0.1%). The catch of sculpin and dace were incidental as this sampling effort is focused on catchable sized trout and does not represent their true abundance as a portion of the fish community. Each species is likely more abundant and an important prey resource for trout in the river.

In 2023, M-R estimates were completed for both LL and RB, as an adequate number of marked fish were recaptured (Table 3). For LL in the Big Hole section, the M-R estimate was 678 fish/1.6 km compared to an CE estimate of 916 fish/1.6 km (Table 3; Figure 3). For RB in the Big Hole section, the M-R estimate was 163 fish/1.6 km compared to a CE estimate of 246 fish/1.6 km (Table 3; Figure 4). There is significant overlap between CI intervals for the M-R and CE estimates for both species and similar number of fish captured between the mark and recapture runs. This consensus indicates the assumptions of the M-R were likely met and the actual number of catchable fish in the reach is likely with the bounds of the confidence intervals for the two estimates. The combined LL and RB CE estimate for catchable fish in the Big Hole section was 1162 LL+RB/1.6 km (95 % CI, 915-1592 LL+RB/1.6 km) (Figure 5). Based on 19 individual years of data collected since 1985, the LL and RB CE estimate was the second highest combined estimate for the two species recorded at the site (Figure 5).

Since sampling began there has been a drastic change in the fish community throughout the Thompson River, including in the Big Hole section. In 1988 and 1989, FWP stocked 80,000 LL in the Thompson River. Prior to these stocking events, only a single LL had been observed in the river in 1979 (Kreiner and Terrazas 2018). Since their introduction into the system in the late 1980s, LL have become the dominant trout species in each of the three long-term monitoring sites. Trend data indicates there has been a statistically significant increase in LL abundance in the Big Hole section over time (Table 2). Since 2007, LL have comprised over 50% of the trout community nine of 11 times the site has been sampled (Figure 6). In 2023, 12% of catchable LL

(≥ 150 mm) were equal to or greater than 356 mm which is below the long-term mean of 18% at the site (Figure 7).

From 1985 to 2002, encompassing eight sampling efforts, RB comprised at least 80% of the trout community in the Big Hole section (Figure 6). Since then, RB presence as a proportion of the trout community sampled in the reach has consistently declined. In 2023, this proportion reached a new low, with RB comprising just over 20% of the trout community. While a statistically significant decline in RB has not been observed within the Big Hole section (using 95% confidence intervals) (Table 2), it is likely this trend will become significant if the species abundance continues on the downward trajectory that has been observed since the early 2000s. One of the issues with tracking RB abundance over time has been that six of the 19 times the site was sampled, the minimum number of recaptured fish needed for a M-R estimate was not obtained (Figure 4). This may be, in part due to the timing of sampling events (May-June) which likely coincides with post-spawn downstream movements, decreasing discharge and increase water temperatures, and thus may violate one of the assumptions of mark-recapture that no immigration or emigration occurs over the sampling period. The lack of an adequate number of recaptures may also be related the species low overall abundance within the reach in recent years. In 2023, 21% of catchable sized RB were equal to or greater than 356 mm which is slightly above the long-term mean of 19% at the site (Figure 7).

Table 3. Chapman mark-recapture and capture efficiency estimates for the Big Hole section of Thompson River is 2023.

				Mark-Recapture		**Capture Efficiency**	
Section	**Date (2023)**	**Section length**	**Spp.**	**Fish ≥ 150 mm/1.6 km**	**95% CI**	**Fish ≥ 150 mm/1.6 km**	**95% CI**
Big Hole	6/6,7,20 &21	1.89	LL	678.0	517.5 - 903.7	916.4	718.1 - 1266.1
			RB	162.7	79.3 - 298.9	246.3	197.8-326.2

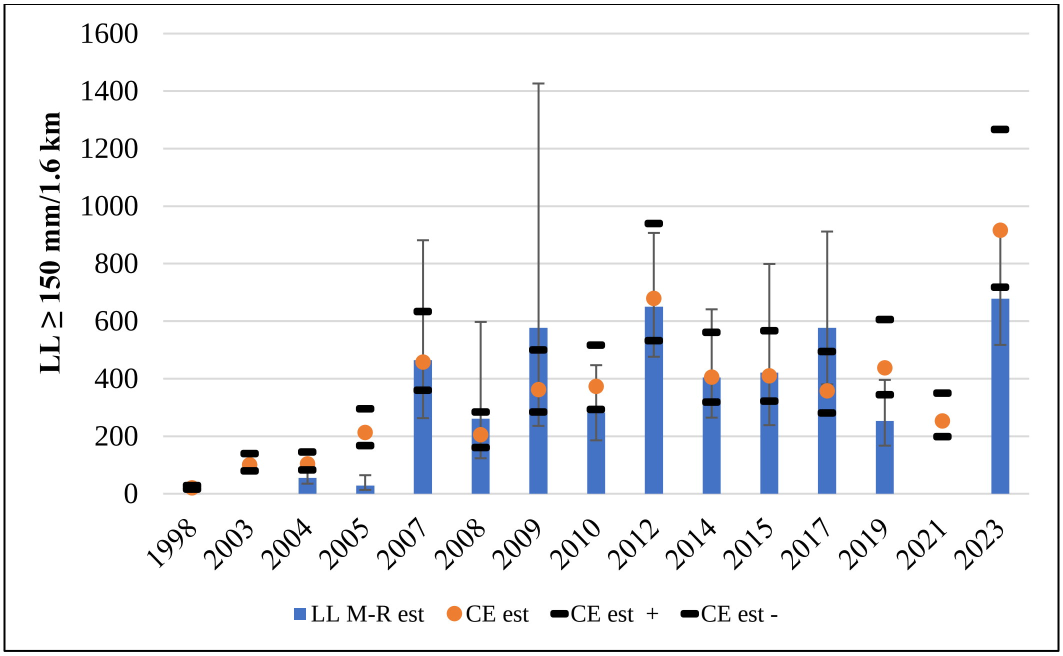

Figure 3. Chapman mark-recapture estimate (M-R est) and capture efficiency estimate (CE est, CE est +, CE est -) with 95 % confidence intervals for Brown Trout (LL) per 1.6 km (per mile) within in the Big Hole section of the Thompson River from 1998 to 2023.

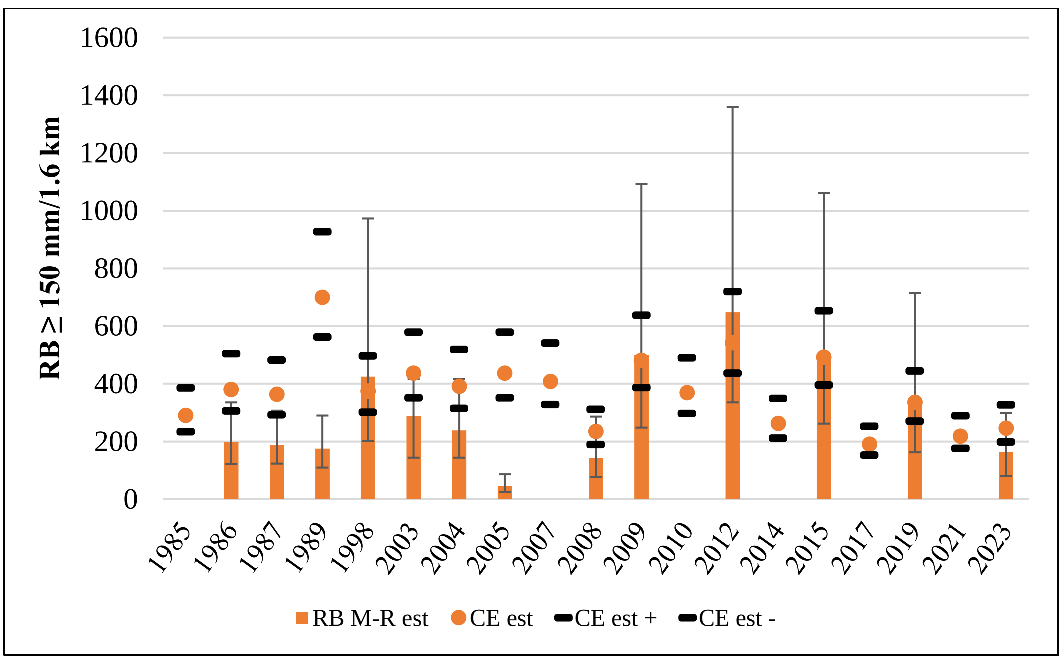

Figure 4. Chapman mark-recapture estimate (M-R est) and capture efficiency estimate (CE est, CE est +, CE est -) with 95 % confidence intervals for Rainbow Trout (RB) per 1.6 km (per mile) within in the Big Hole section of the Thompson River from 1985 to 2023.

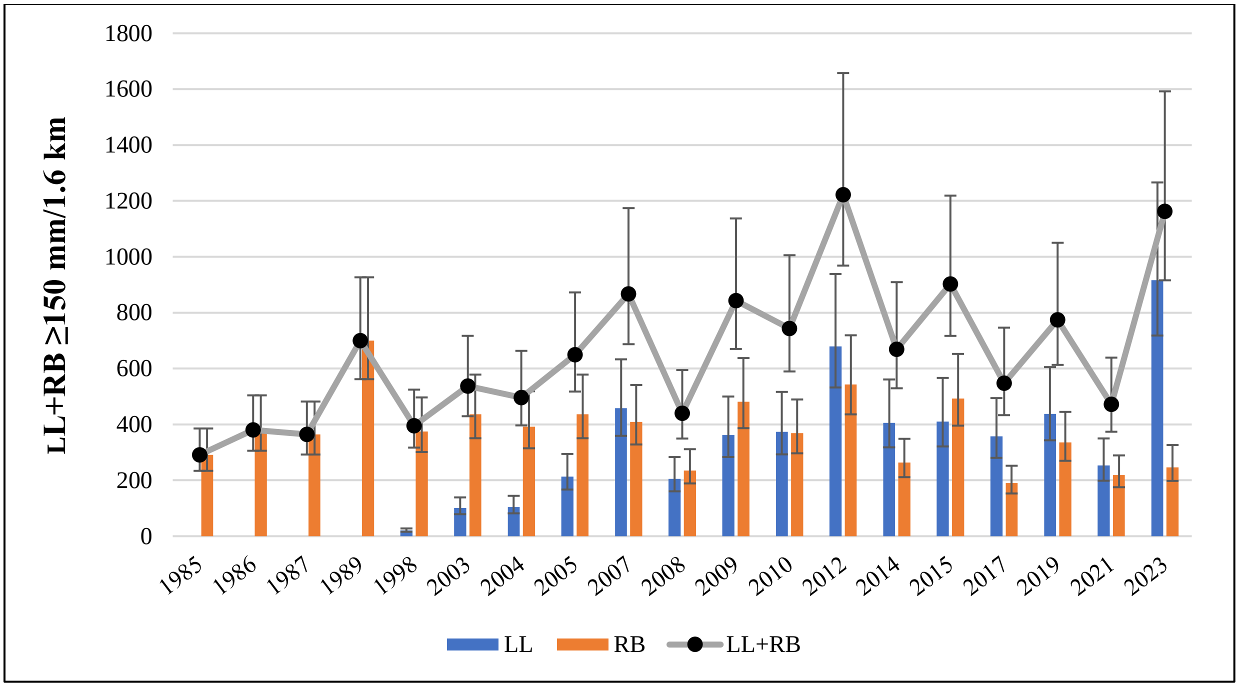

Figure 5. Capture efficiency estimates with 95% confidence intervals for Brown Trout (LL), Rainbow Trout (RB) and both species combined (LL+RB) within the Big Hole section of the Thompson River from 1985 to 2023.

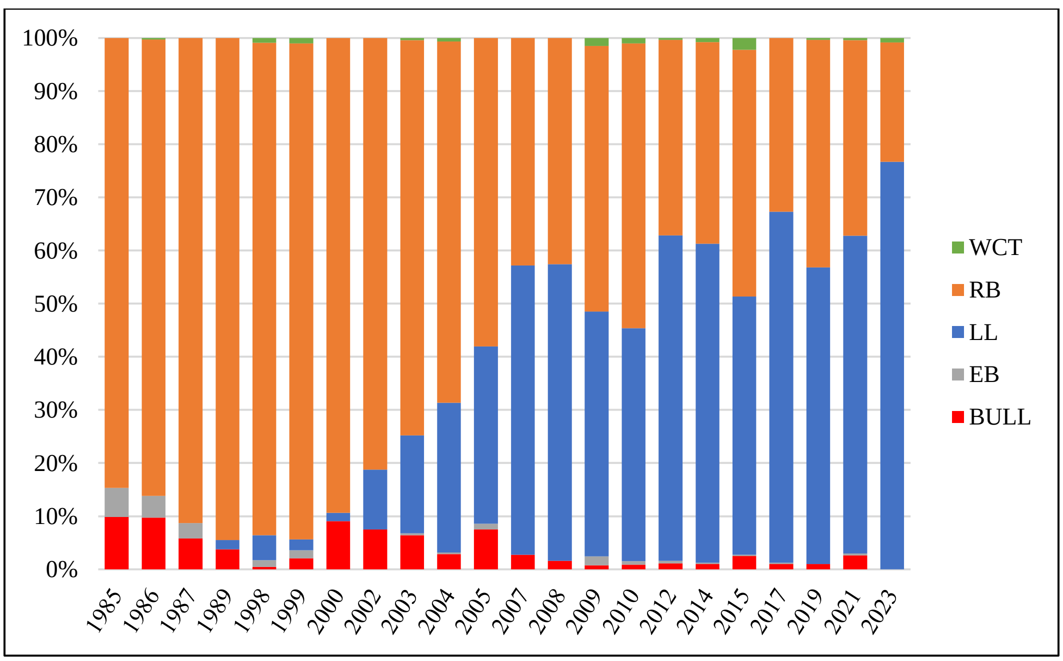

Figure 6. Cumulative frequency of trout species captured on mark and recapture runs within the Big Hole section of the Thompson River from 1985 to 2023 including Westslope Cutthroat Trout (WCT), Rainbow Trout (RB), Brown Trout (LL), Brook Trout (EB) and Bull Trout (BULL).

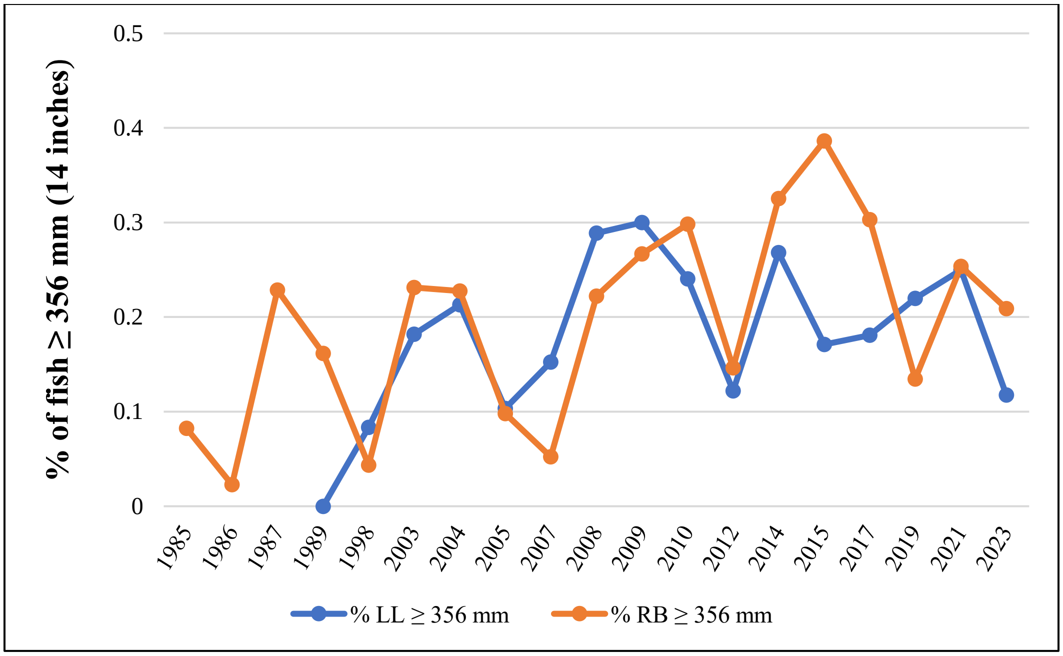

Figure 7. Proportion of catchable (≥ 150mm) Brown Trout (LL) and Rainbow Trout (RB) greater than or equal to 356 mm (≥ 14 inches) in the Big Hole section of the Thompson River from 1985 to 2023.

<u>19-Mile section</u>

Sampling on the 19-mile section in 2023 began on May 22nd at river discharge of 1040 CFS and was completed on May 30th with a discharge of 654 CFS at the USGS gauge at rkm 1.9. A total of 454 fish were captured over the four-day sampling period including 419 LL (92.3%), 31 RB (6.8%), three Longnose Dace (0.7%) and one Brook Trout (EB) (0.2%). The catch of dace was incidental as this sampling effort is focused on catchable sized trout and does not represent their true abundance as a portion of the fish community. The species is likely more abundant and an important prey resource for trout in the river .

In 2023, M-R estimates were produced for LL but not RB, as an adequate number of marked RB were not recaptured (Table 4; Figure 8; Figure 9). For LL in the 19-mile section, the M-R estimate was 701 fish/1.6 km compared to an CE estimate of 334 fish/1.6 km (Table 4; Figure 8). For RB in the 19-mile section, the CE estimate of 41 fish/1.6 km (Table 4; Figure 9). There was no overlap between CI intervals for the M-R and CE estimates for LL, however similar number of fish were captured on the mark and recapture runs. This lack of consensus between the estimators indicates the assumptions of the M-R were likely violated. The most plausible explanation is that fish left the reach between mark and recapture sampling events. River discharged dropped 386 CFS near the mouth over the sampling period. The decline in discharge was noticeable between the mark and recapture period, likely reducing the carrying capacity of this reach for catchable fish, especially given lack of complexity and deep water refugia within portions of the section. The combined LL and RB CE estimate for catchable fish in the 19-mile section was 376 LL+RB/1.6 km (95 % CI, 326-446 LL+RB/1.6 km) (Figure 10). Based on 16 years of data collected since 1986, the LL and RB CE estimate was considerably lower than the combined mean of 570 LL+RB/ 1.6 km for the two species recorded at the site. Although, the

2023 combined CE estimate was higher than the combined estimate recorded for the two species for the previous two sampling events in 2019 and 2021.

Similar to the Big Hole section, the trout community in the 19-mile section has changed drastically with the introduction of LL to the Thompson River in the late 1980s. Rainbow Trout have shown a significant decline overtime (Table 2). A M-R estimate for RB has not been produced the last three times the 19-miles section has be sampled due to low numbers of fish (Figure 9). Over the 16 sampling events on the 19-mile section, RB M-R estimates have not been able to be produced nine times due to inadequate number of recaptured fish. Brown Trout abundance in the 19-mile section has been stable over time (Table 2). In fact, LL became the dominant trout species in this section based on CE estimates in 2003, the third time the site was sampled (Figure 10). Since 2003, LL have comprised over 50% of the trout community each of the 14 times the site has been sampled and as of 2023 the species comprised 92% of the trout community in this portion of the Thompson River (Figure 11). In 2023, 6% catchable LL (≥ 150 mm) were equal to or greater than 356 mm which is below the long-term mean of 12% at the site (Figure 12). For the first two M-R events on the 19-mile section in 1986 and 1998, RB comprised 68% and 83% of the trout community, but have continued to decline since 2003, and in 2023 represented only 8% of the trout community (Figure 11). While there is not a clear understanding of the drastic decline in RB abundance over time in the Thompson River drainage within and upstream of this site, it is likely related to multiple factors that may include competition with and habitat conditions that favor LL, predation on juvenile RB by LL, and whirling disease *Myxobolus cerebralis*-which was first detected in the Clark Fork River drainage in the mid-1990s (Montana Whirling Disease Task Force).

Stream temperature monitoring in the Thompson River drainage occurs at six locations (Blakney et al. 2024). The location that had the highest daily maximum water temperatures in July and August in both 2022 and 2023, occurred below the mouth of the Little Thompson River, less than 1.6 km below the downstream portion of the 19-mile section. Three other mainstem thermographs were placed upstream of the 19-mile section and generally have mean daily water temperatures in July and August in the 15-18°C range, with daily maximum temperatures in the 17-22°C range (See Temperature Monitoring section). Temperature data and habitat conditions (ex., warmer, slower, more sediment, smaller substrate) above the confluence of the Little Thompson River (i.e., upper Thompson River drainage) likely favor LL over RB, which can tolerate warmer water temperatures and areas with more marginal or degraded habitat. Competition for food and habitat likely favor LL in the upper drainage. Brown Trout are also known to become piscivorous as they grow larger and may have suppressed juvenile RB through direct predation.

Whirling disease was first documented in the Clark Fork River near Missoula in 1995 (Montana Whirling Disease Task Force). Portions of the upper Thompson River (above the Little Thompson confluence), especially the low gradient, slow, sinuous E channel type (Rosgen 1996) provide ideal habitat (slow, silty, decaying organic matter) for the parasite's host, the tubifex worm *Tubifex tubifex* (Zendt and Bergersen 2000; Anlauf and Moffitt 2010).Whirling disease was first documented in the Thompson River drainage in 2019 (Big Hole section) and has been subsequently detected in the lower reaches of three tributary streams: Fishtrap Creek (2020, 2023,2024), West Fork Thompson River (2020) and Deerhorn Creek (2023) (J. Blakney, MFWP unpublished data). The earliest fish pathogen sampling in the Thompson River drainage was conducted in 2014 (mainstem and two tributaries); no infected fish were identified. Therefore, given the limited fish pathogen sampling in the drainage, the higher gradient areas in the lower drainage where the disease has been found, the large size of the drainage, the diversity of mainstem and tributary habitats and channel types, the known connection with the upstream portions of the Clark Fork drainage where the parasite was identified in the 1990s; it is likely whirling disease has been present in the drainage much earlier than 2020 and may have helped facilitate the decline of RB in the upper drainage where the species was once abundant.

Table 4. Chapman mark-recapture and capture efficiency estimates for the 19-mile section of Thompson River is 2023.

Section	Date (2023)	Section length	Spp.	Mark-Recapture Fish ≥ 150 mm/1.6 km	Mark-Recapture 95% CI	Capture Efficiency Fish ≥ 150 mm/1.6 km	Capture Efficiency 95% CI
19 Mile	5/22,23,30 & 31	2.08	LL	701.1	429.3 - 1215.4	334.2	292.1-390.4
			RB	-	-	41.5	33.3-55.2
			EB	-	-	3.8	-

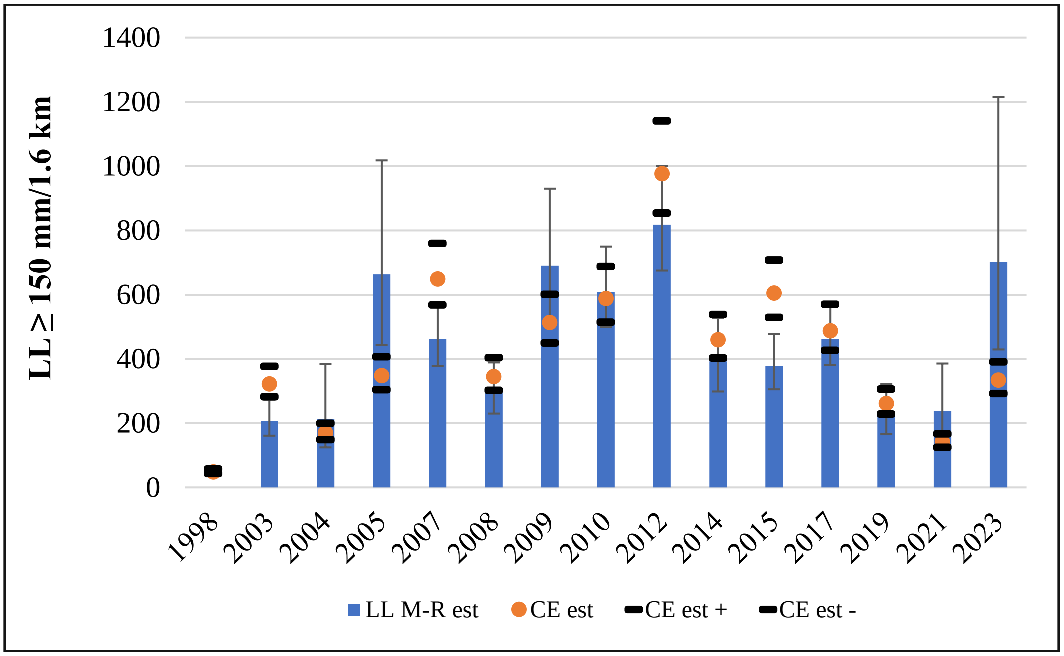

Figure 8. Chapman mark-recapture estimate (M-R est) and capture efficiency estimate (CE est, CE est +, CE est -) with 95 % confidence intervals for Brown Trout (LL) per 1.6 km (per mile) within in the 19-mile section of the Thompson River from 1998 to 2023.

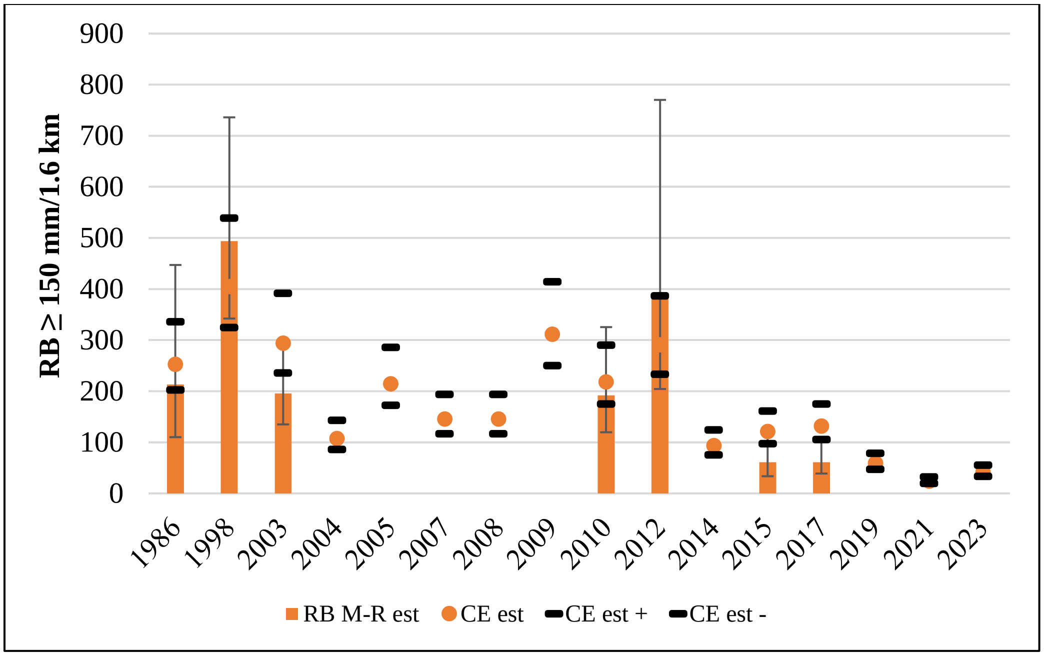

Figure 9. Chapman mark-recapture estimate (M-R est) and capture efficiency estimate (CE est, CE est +, CE est -) with 95 % confidence intervals for Rainbow Trout (RB) per 1.6 km (per mile) within in the 19-mile section of the Thompson River from 1986 to 2023.

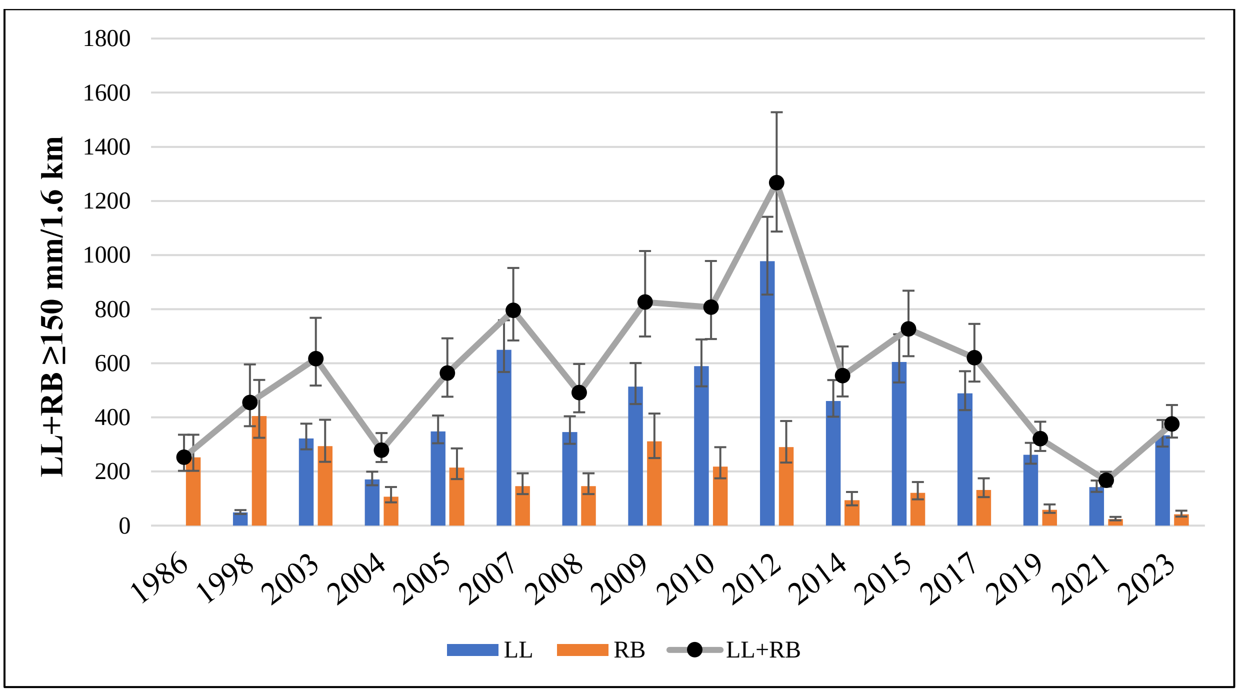

Figure 10. Capture efficiency estimates with 95% confidence intervals for Brown Trout (LL), Rainbow Trout (RB) and both species combined (LL+RB) within the 19-Mile section of the Thompson River from 1986 to 2023.

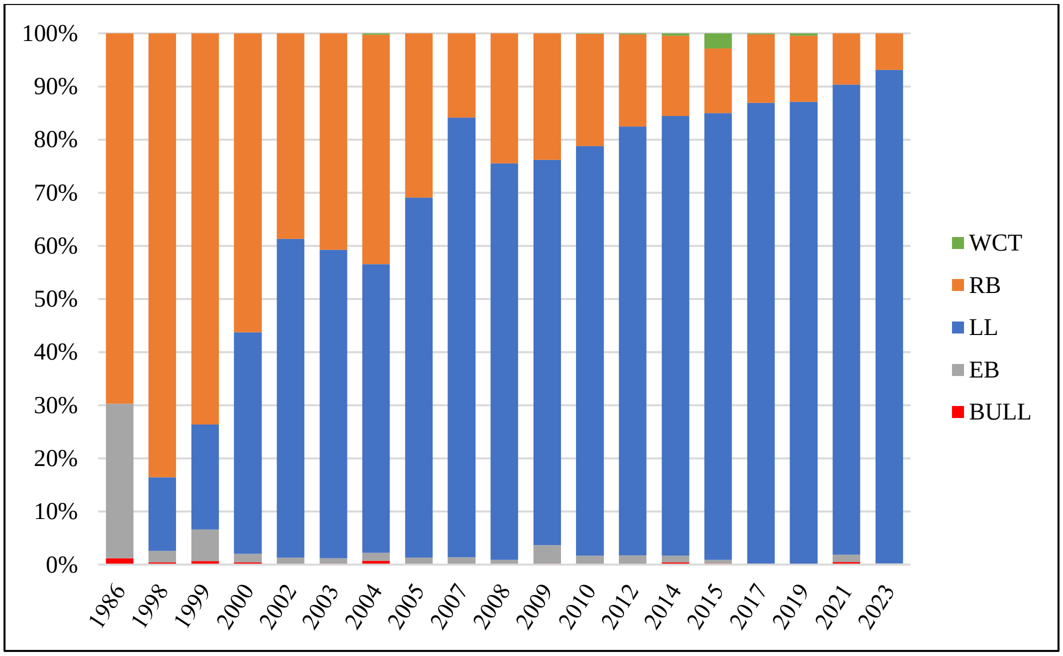

Figure 11. Cumulative frequency of trout species captured on mark and recapture runs within the 19-mile section of the Thompson River from 1985 to 2023 including Westslope Cutthroat Trout (WCT), Rainbow Trout (RB), Brown Trout (LL), Brook Trout (EB) and Bull Trout (BULL).

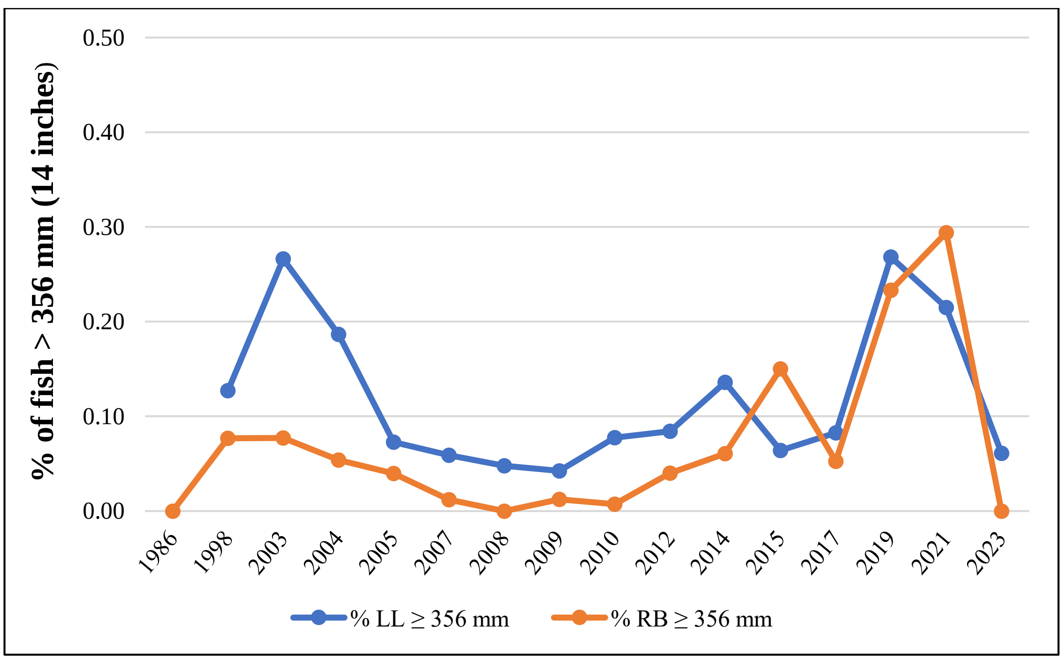

Figure 12. Proportion of catchable (≥ 150mm) Brown Trout (LL) and Rainbow Trout (RB) greater than or equal to 356 mm (≥ 14 inches) in the 19-mile section of the Thompson River from 1985 to 2023.

Big Rock Creek section

Sampling on the Big Rock Creek section in 2024 began on May 6 at river discharge of 449 CFS and was completed on May 14 with a discharge of 952 CFS at the USGS gauge at rkm 1.9, which is located nearly 50km downstream of this monitoring section. Because of low snowpack, this period is the earliest this section has been sampled. The upper Thompson River Drainage, especially above Big Rock Creek (which enters the Thompson within the middle of this sampling section) is generally comprised of tributaries with smaller drainage areas and lower maximum elevations when compared to the two downstream monitoring reaches. Therefore, there is a very short timeframe when the Big Rock Creek section can be effectively floated and sampled with a drift boat. Though discharge was nearly double nearly the mouth on the mark runs compared to the recapture runs, discharge within the sample section was visually similar if not only slightly higher during recapture runs. The upper half of the Big Rock Creek section (above the Big Rock Creek confluence) occurs in a slow, sinuous E-channel type with one or more large beaver dams present that have great influence on stream habitat within the section. The abundance of slow and deep habitat within this section provides ideal overwinter habitat for fish that reside within C-channel types that occur upstream and downstream of this section. Changes in stream discharge and temperature could initiate movements out of this section in the spring, potentially even between mark and recapture sampling events.

A total of 537 fish were captured over the four-day sampling period including 493 LL (91.8%), 13 EB (2.4%), 23 sculpin spp. (4.3%), four longnose sucker (0.7%), two largescale sucker (0.4%) and two RB (0.4%). The catch of sculpin was incidental as this sampling effort is focused on catchable sized trout and thus does not represent their true abundance as a portion of the fish community. Sculpin are likely much more abundant and an important prey resource for trout in the river. Sculpin lack a swim bladder, and as a result are unable float. Therefore, drift boat electrofishing is an ineffective means of sampling the species, especially in deeper water which comprises a significant portion of the site, specifically above the Big Rock Creek confluence where the stream is slow and sinuous.

In 2024, M-R estimates were only completed for LL but not RB or EB, as both species were caught in low abundance and because an adequate number of marked fish were not recaptured (Table 5; Figure 13; Figure 14; Figure 15). For LL in the Big Rock Creek section, the M-R estimate was 711 fish/1.6 km compared to an CE estimate of 901 fish/1.6 km (Table 5; Figure 13). There is significant overlap between CI intervals for the M-R and CE estimates and similar numbers of fish were captured on the mark and recapture runs. This consensus indicates the assumptions of the M-R were likely met and the actual number of catchable LL in the reach is likely within the bounds of the confidence intervals of the two estimates.

The combined LL, RB and EB CE estimate for catchable fish in the Big Rock Creek section was 932 LL+RB+EB/1.6 km (95 % CI, 775-1172 LL+RB+EB/1.6 km) (Figure 15). The combined three species CE estimate for the site in 2024, based on six sampling years of since 2013, was higher than the mean combined CE estimate of 715 LL+RB+EB/ 1.6 recorded at the site from 2013-2024. Since the site was first sampled in 2013, LL have comprised 83%-97% of the trout community (Figure 16). In 2024, 17% of catchable LL (≥ 150 mm) were equal to or greater than 356 mm which is below the long-term mean of 19% at the site (Figure 17). The small sample size (n=6) and the outlying data from 2020 (34% ≥ 356 mm) skew the mean, and therefore the proportion of fish ≥ 356 mm appears stable based on the available data. Brown Trout and EB appear stable at the site, while RB have declined significantly over the sample period (Table 2).

Table 5. Chapman mark-recapture and capture efficiency estimates for the Big Rock Creek section of Thompson River is 2024.

				Mark-Recapture		**Capture Efficiency**	
Section	**Date (2024)**	**Section length**	**Spp.**	**Fish ≥ 150 mm/1.6 km**	**95% CI**	**Fish ≥ 150 mm/1.6 km**	**95% CI**
Big Rock Creek	5/6, 7,13 &14	1.3	LL	710.6	572.3 - 903.8	901.3	764.6 - 1097.3
			RB			15.8	5.0-18.0
			EB	-	-	14.7	9.9 - 47.1

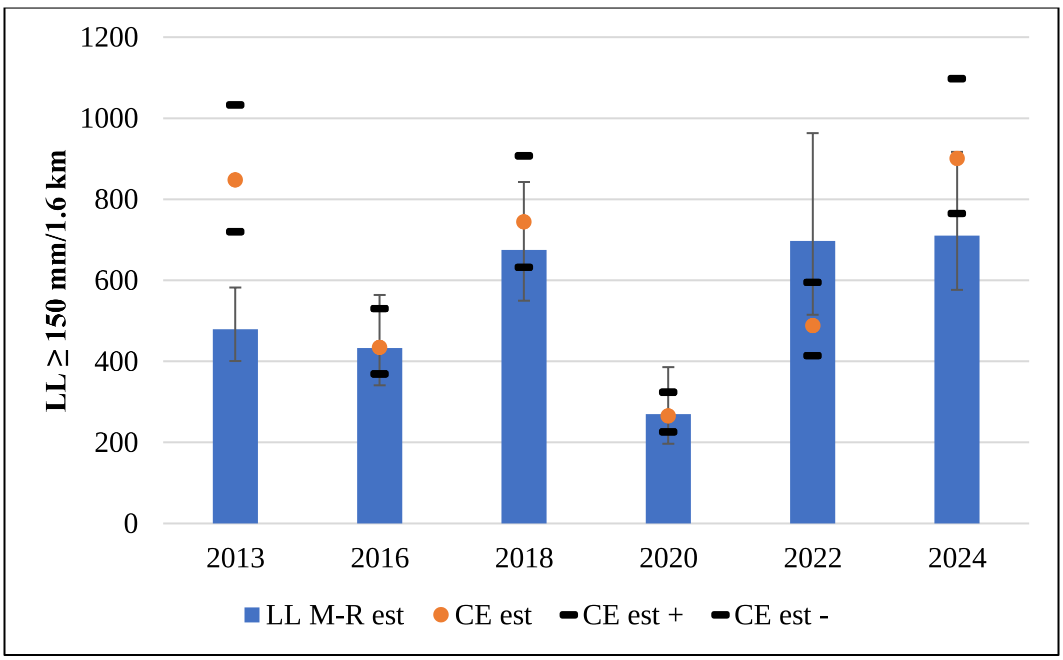

Figure 13. Chapman mark-recapture estimate (M-R est) and capture efficiency estimate (CE est, CE est +, CE est -) with 95 % confidence intervals for Brown Trout (LL) per 1.6 km (per mile) within in the Big Rock Creek section of the Thompson River from 2013 to 2024.

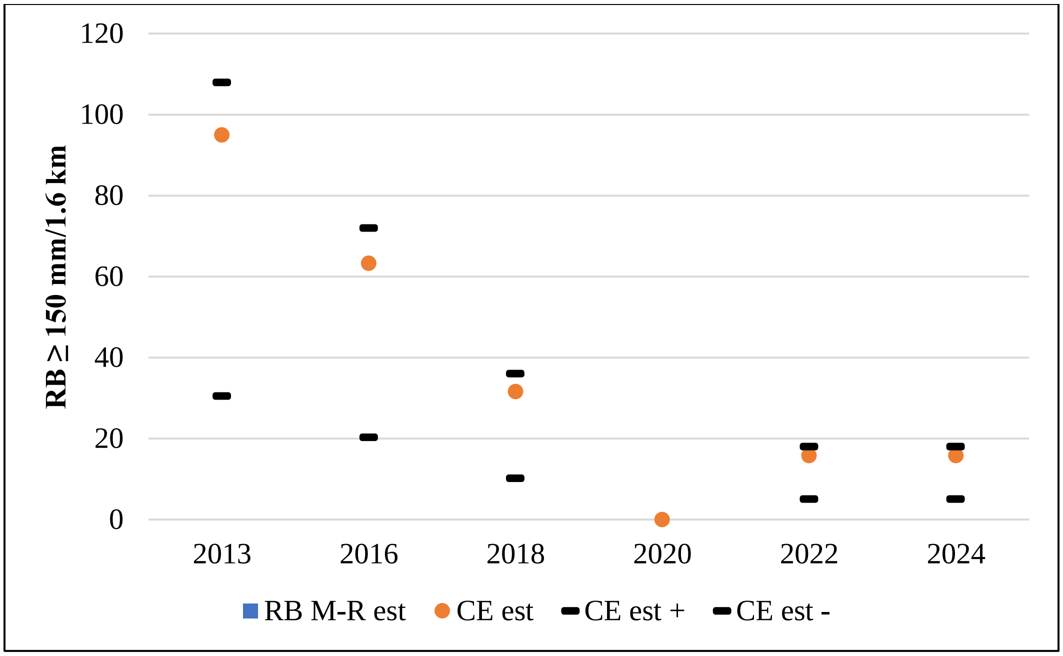

Figure 14. Capture efficiency estimate (CE est, CE est +, CE est -) with 95 % confidence intervals for Rainbow Trout (RB) per 1.6 km (per mile) within in the Big Rock Creek section of the Thompson River from 2013 to 2024.

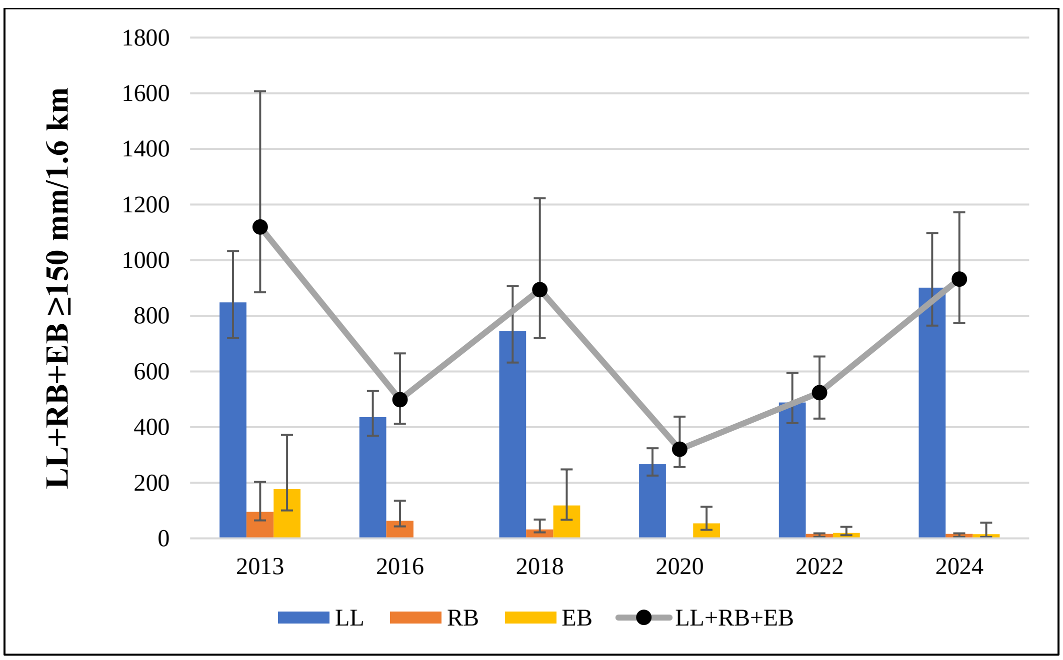

Figure 15. Capture efficiency estimates with 95% confidence intervals for Brown Trout (LL), Rainbow Trout (RB), Brook Trout (EB) and the three species combined (LL+RB+EB) within the Big Rock Creek section of Thompson River from 2013 to 2024.

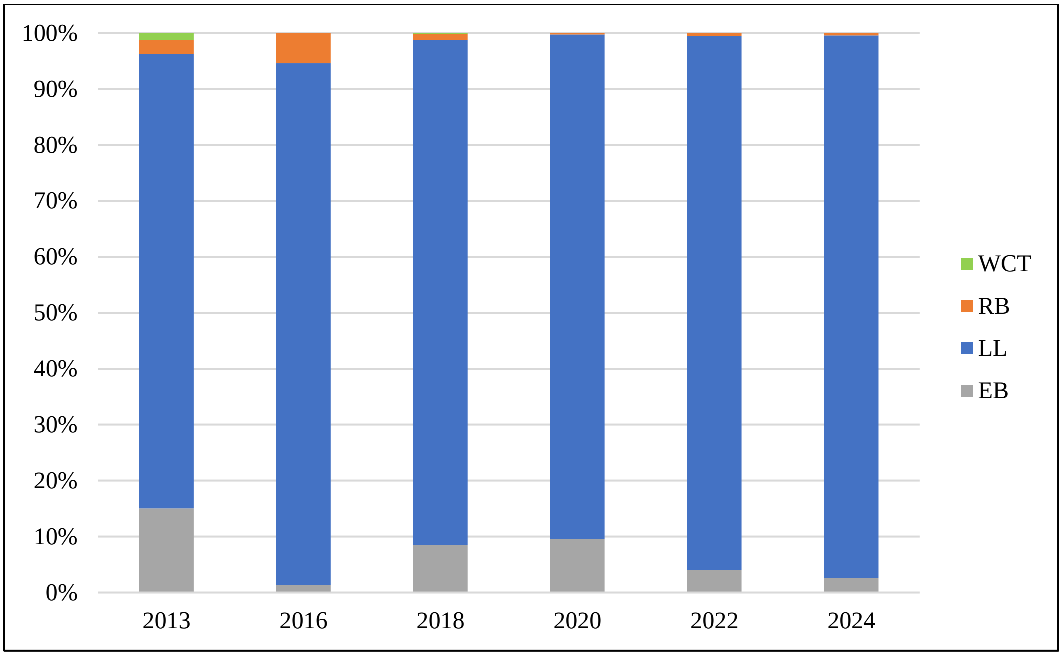

Figure 16. Cumulative frequency of trout species captured on mark and recapture runs within the Big Rock Creek section of the Thompson River from 2013 to 2024 including Westslope Cutthroat Trout (WCT),Rainbow Trout (RB), Brown Trout (LL) and Brook Trout (EB).

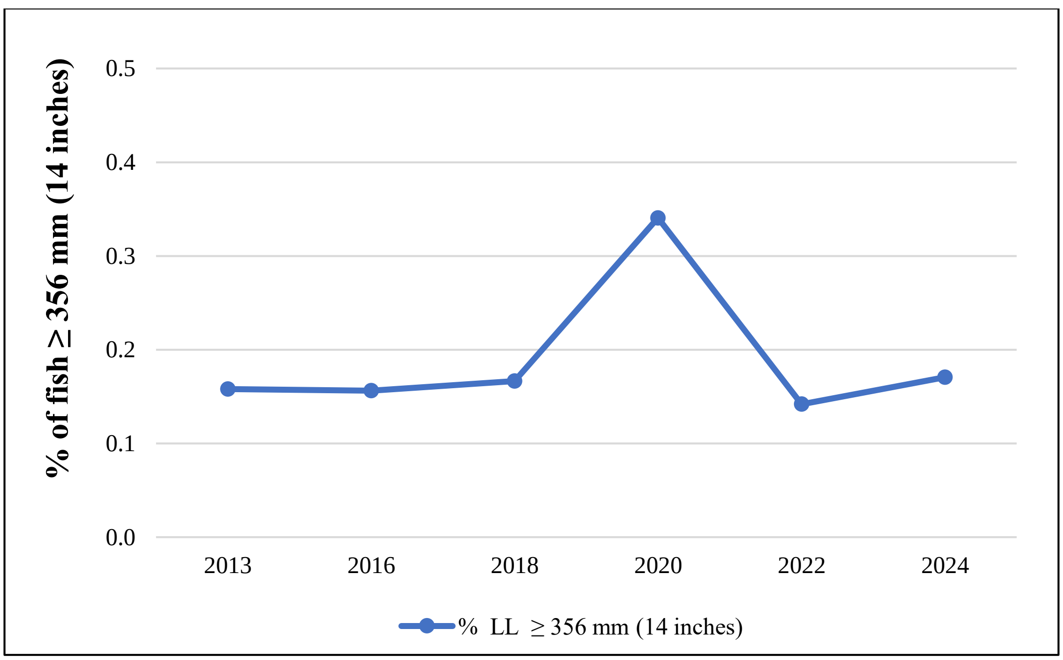

Figure 17. Proportion of catchable (≥ 150mm) Brown Trout (LL) greater than or equal to 356 mm (≥ 14 inches) in the Big Rock Creek section of the Thompson River from 2013 to 2024.

Temperature monitoring

Each year nearly 40 thermographs are deployed across the Thompson River drainage to monitor stream temperature in reaches important to native fish conservation and the mainstem recreational fishery. Temperature data are collected from July 1 through September 30 at each site. This time frame captures the most sensitive period for native and recreational trout fisheries. Currently, six locations on the mainstem Thompson River are monitored, with the site above the West Fork Thompson River confluence monitored for hoot owl restrictions. Hoot owl restrictions for recreational trout fisheries in Montana are applied when stream temperatures exceed 23℃ for three consecutive days (MFWP 2023). These restrictions generally include a fishing closure from 2 pm to midnight and can also encompass closures of critical fish habitat such as whole rivers, stream mouths or other areas of thermal refuge. Such closures can also be applied where insufficient stream flow is documented. The section above the West Fork confluence has not exceeded 20℃ in recent years and is among the coolest sections of the river during the summer. For more information about temperature data collected throughout the Thompson River drainage, see Blakney et al. (2024).

Currently, six thermographs are deployed in the mainstem Thompson River at the following locations: ACM Bridge (river kilometer- rkm 1.5), above the West Fork Thompson River (abv. WFTR, rkm 11.7), below Little Thompson River (blw. LTR, rkm 26), below Chippy Creek (blw. Chippy, rkm 38.2), below Big Rock Creek (blw. Big Rock, rkm 50.4), and below Murr Creek (blw. Murr, rkm 65.3). Mainstem temperature data collected in 2022 and 2023 are displayed and compared using mean daily temperature (Figure 18; Figure 19) and maximum daily temperature (Figure 20; Figure 21). River temperature patterns in the drainage are unique as they do not follow the pattern observed in many western Montana rivers and larger tributary streams of cooler temperatures in in the headwater with a gradual warming trend moving downstream. Mean daily temperatures in 2022 and 2023 show similar patterns with the warmest sites being Below Murr, Below Little Thompson and Below Chippy. Mean daily temperatures at these sites in July 2022 and 2023 ranged from 16.1-18.0°C and in August ranged from 15.8-16.7°C (Figure 18; Figure 19). Maximum daily temperatures at the warmer sites in July 2022 and 2023 ranged from 19.4-22.8°C and in August ranged from 18.8-22.1°C (Figure 20; Figure 21). Mean daily temperatures at the coolest three sites showed separation from the warmest sites (Figure 18; Figure 19) with these sites being Below Big Rock, Above West Fork and at the AMC bridge. Mean daily temperatures at the coolest sites in July 2022 and 2023 ranged from 13.7-15.5°C and in August ranged from 14.0-14.8°C (Figure 18; Figure 19). Maximum daily temperatures at the cooler sites in July 2022 and 2023 ranged from 18.2-20.7°C and in August ranged from 17.6-19.6°C (Figure 20; Figure 21).

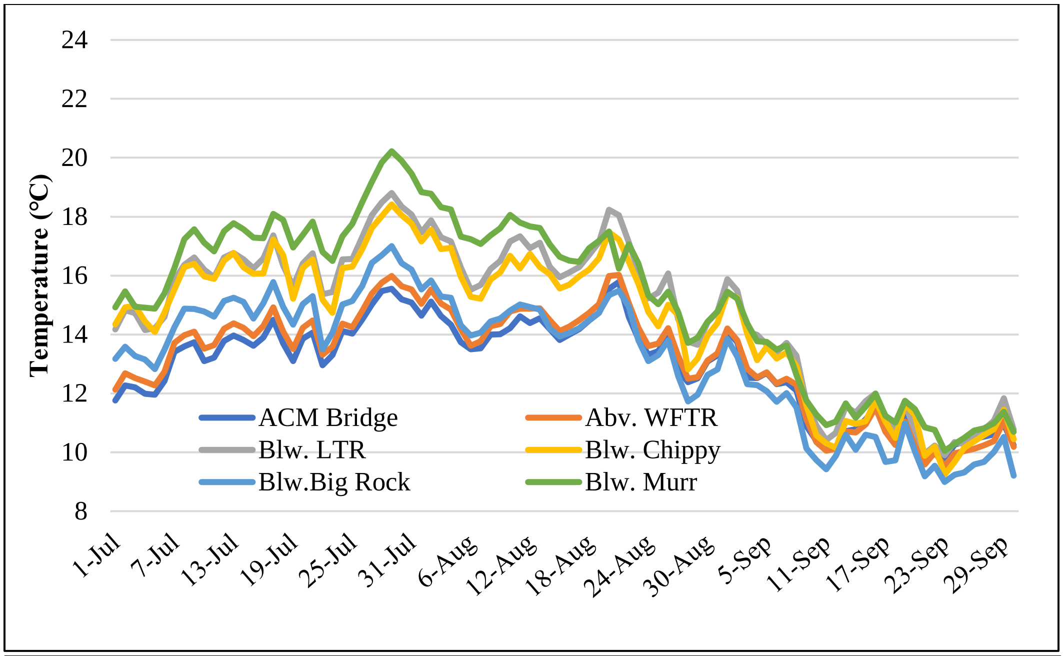

Figure 18. Mean daily temperatures in 2022 throughout the mainstem Thompson River at the ACM Bridge (rkm 1.5), above the West Fork Thompson River (Abv. WFTR, rkm 11.7), below the Little Thompson River (blw. LTR, rkm 26), below Chippy Creek (blw. Chippy, rkm 38.2), below Big Rock Creek (blw. Big Rock, rkm 50.4), and below Murr Creek (blw. Murr, rkm 65.3).

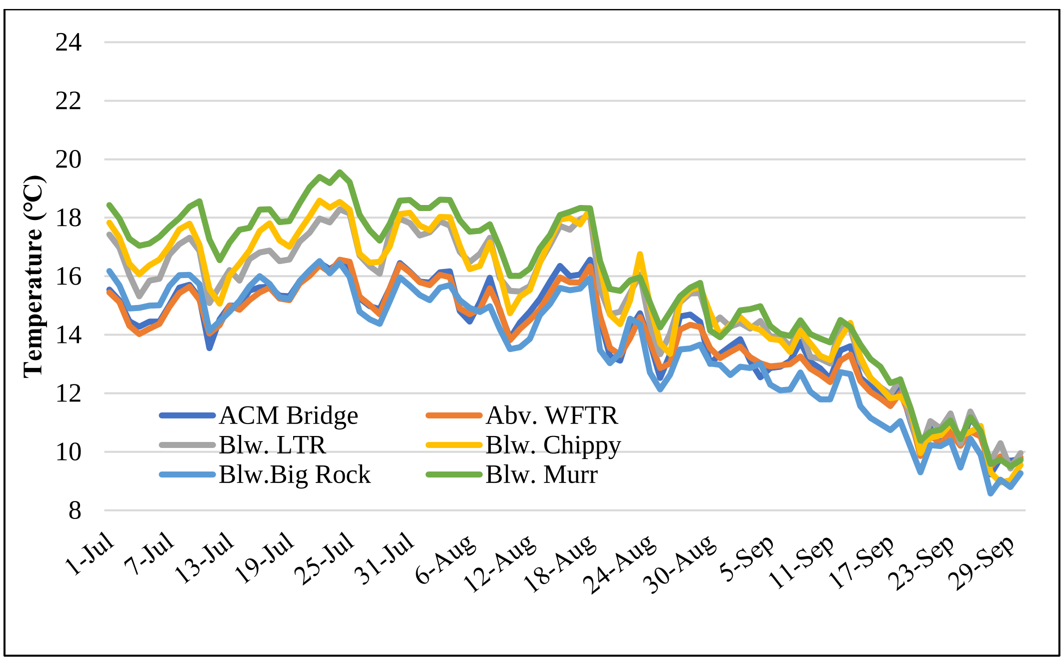

Figure 19. Mean daily temperatures in 2023 throughout the mainstem Thompson River at the ACM Bridge (rkm 1.5), above the West Fork Thompson River (Abv. WFTR, rkm 11.7), below the Little Thompson River (blw. LTR, rkm 26), below Chippy Creek (blw. Chippy, rkm 38.2), below Big Rock Creek (blw. Big Rock, rkm 50.4), and below Murr Creek (blw. Murr, rkm 65.3).

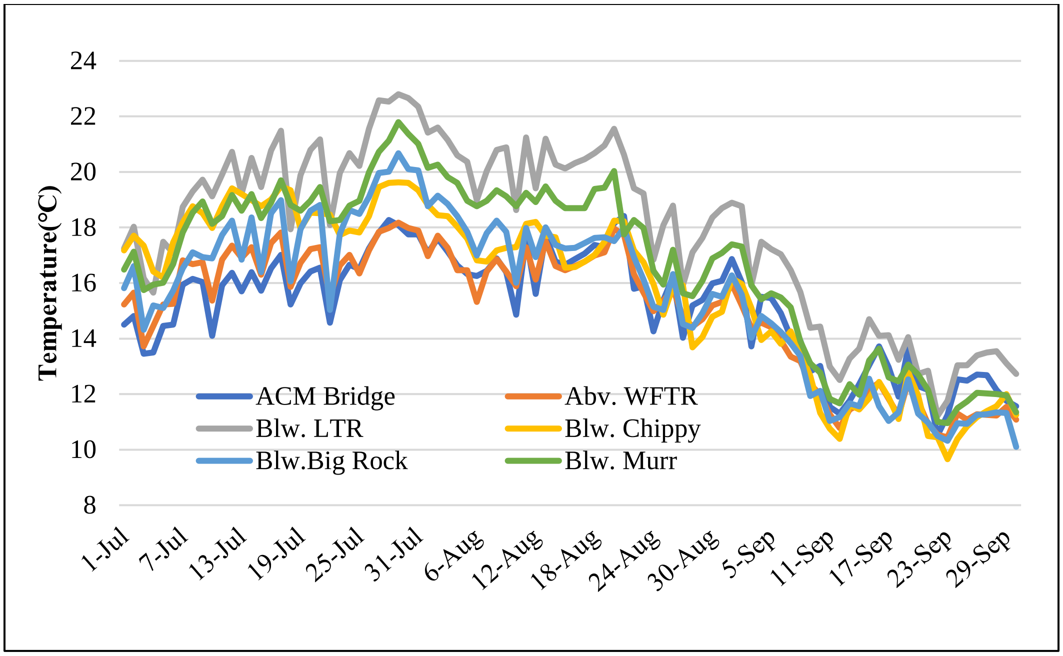

Figure 20. Maximum daily temperatures in 2022 throughout the mainstem Thompson River at the ACM Bridge (rkm 1.5), above the West Fork Thompson River (Abv. WFTR, rkm 11.7), below the Little Thompson River (blw. LTR, rkm 26), below Chippy Creek (blw. Chippy, rkm 38.2), below Big Rock Creek (blw. Big Rock, rkm 50.4), and below Murr Creek (blw. Murr, rkm 65.3).

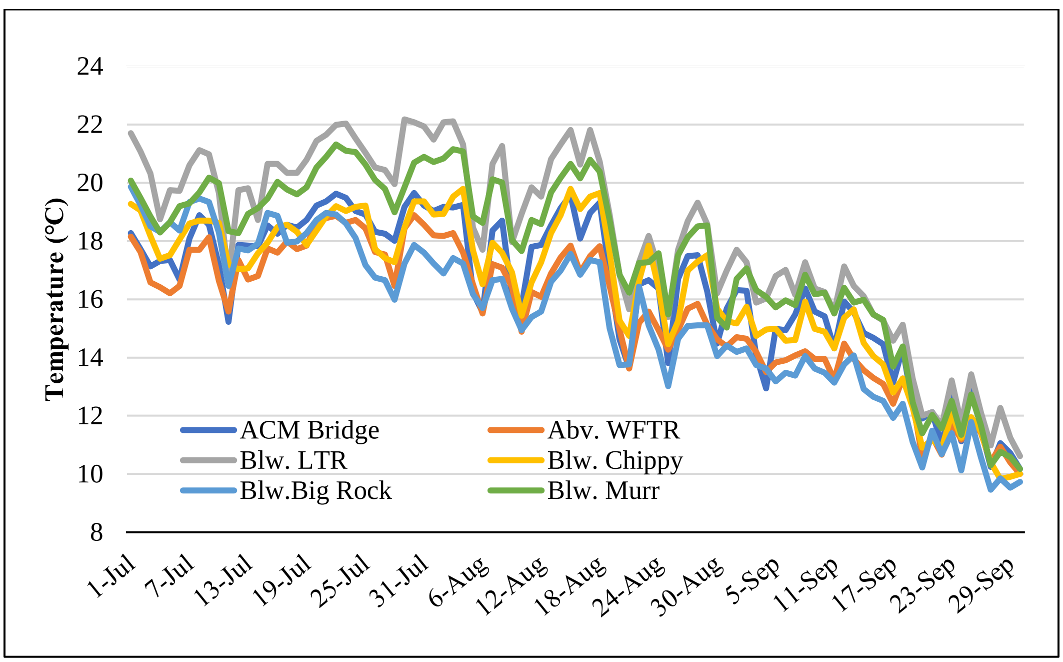

Figure 21. Maximum daily temperatures in 2023 throughout the mainstem Thompson River at the ACM Bridge (rkm 1.5), above the West Fork Thompson River (Abv. WFTR, rkm 11.7), below the Little Thompson River (blw. LTR, rkm 26), below Chippy Creek (blw. Chippy, rkm 38.2), below Big Rock Creek (blw. Big Rock, rkm 50.4), and below Murr Creek (blw. Murr, rkm 65.3).

Native trout monitoring and conservation in tributary streams

Each summer a substantial amount of local FWP effort is focused on native trout monitoring and conservation efforts in Thompson River tributary streams. These efforts including temperature monitoring, population estimates using backpack electrofishing, genetic sample collection to inform hybridization status, Bull Trout redd counts and translocation of non-hybridized Westslope Cutthroat Trout into suitable fishless habitat above natural barriers. This work is described in various reports including the 2023-2024 Lower Clark Fork annual Federal Aid Report (Blakney and Maddigan 2024), 2022-2023 Thompson River drainage temperature monitoring report (Blakney et al. 2024) as well other reports including Blakney et al. (2022), Kreiner and Terrazas (2020), and Kreiner and Terrazas (2018). Data from this work can be viewed at: https://myfwp.mt.gov/fishMT/reports/surveyreport.

Works Cited

Anlauf, K., and C. Moffitt. 2010. Modelling of landscape variables at multiple extents to predict fine sediments and suitable habitat for Tubifex tubifex in a stream system. Freshwater Biology, 55:4, pp.794-805.

Blakney, J., Maddigan, A., and H. Carlsmith. 2022. Thompson River drainage fisheries monitoring report: 2021. Montana Department of Fish, Wildlife, and Parks. Thompson Falls, MT.

Blakney, J., Maddigan, A., and H. Carlsmith. 2024. Thompson River drainage temperature monitoring report 2022-2023. Montana Department of Fish, Wildlife, and Parks. Thompson Falls, MT.

Blakney, J., and A. Maddigan. 2024. Montana Statewide Fisheries Management-Job Progress Report, Lower Clark Fork River Drainage Fisheries Management, Federal Aid Project Number: F-113, July 1, 2023 through June 30, 2024. Montana Department of Fish, Wildlife, and Parks. Thompson Falls, MT.

Kohler, C., and W. Hubert, editors. 1999. Inland fisheries management in North America, 2nd Edition. American Fisheries Society, Bethesda, MD.

Kreiner, R. and M. Terrazas. 2018. Lower Clark Fork River tributary sampling. Montana Department of Fish, Wildlife, and Parks. Thompson Falls, MT

Kreiner, R. and M. Terrazas. 2020. Lower Clark Fork River tributary sampling. Montana Department of Fish, Wildlife, and Parks. Thompson Falls, MT.

League, C. and B.Caball. 2023. Montana Statewide Angling Pressure-2021, Summary Report. Montana Department of Fish, Wildlife, and Parks. Helena, MT

MFWP. 2023. Statewide Fisheries Management Plan, 2023-2026. Montana Department of Fish, Wildlife and Parks. Helena, MT. Statewide Fisheries Management Plan 2023-2026 | Montana FWP.

Montana Whirling Disease Task Force. 1995. Interim report and short-term recommendations. Prepared by Policy Resources, Inc., Helena, MT.

Ogle, D. 2010. Mark-Recapture Abundance Estimates (Closed) Vignette. R vignette series.

Pine, W., Hightower, J., Coggins L., Lauretta, M., and K. Pollock. 2012. Design and analysis of tagging studies. Pages 521-572 in Zale, A., Parrish, D., and T. Sutton, editors. Fisheries techniques, 3rd edition. American Fisheries Society, Bethesda, MD.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

Strahler, A. N. 1952. Hypsometric (area-altitude) analysis of erosional topography. Geological Society of America Bulletin 63, pp.1117-1142.

Thomas, G. 1997. Flyfisher's Guide to Montana. Wilderness Gateway Press. Gallatin Gateway, MT.

Van Den Avyle, M., and R. Hayward. 1999. Dynamics of exploited fish populations. Pages 127-163, in Kohler, C., and W. Hubert. 1999. Inland fisheries management in North America, 2nd Edition. American Fisheries Society, Bethesda, MD.

Zale, A., Nielsen, L., D. and Johnson, editors. 2012. Fisheries techniques, 3rd Edition. . American Fisheries Society, Bethesda, MD.

Zendt, J., and E. Bergersen. 2000. Distribution and abundance of the aquatic oligochaete host Tubifex tubifex for the salmonid whirling disease parasite Myxobolus cerebralis in the upper Colorado River basin. North American Journal of Fisheries Management, 20:2, pp.502-512.