Fisheries Investigations in the Blackfoot River Watershed, 2016-2020




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Introduction

The Blackfoot River is an important stronghold for migratory Westslope Cutthroat Trout and Bull Trout. It also supports a valuable sport fishery of nonnative Rainbow Trout and Brown Trout. Brook Trout are present in many of the tributaries with very low densities in the mainstem river, except for the upper reaches. In the Clearwater River system, many nonnative species have been introduced including Northern Pike, Smallmouth Bass, Largemouth Bass, and Pumpkinseed. Despite the significant declines in Bull Trout abundance, the Blackfoot River supports one of the most stable and robust metapopulations (Kovach et al. 2018) in the upper Clark Fork Geographic Region of the Columbia River Headwaters Recovery Unit (USFWS 2015).

The Blackfoot River flows 132 miles from its source near Roger's Pass to its confluence with the Clark Fork River near Bonner, MT. The 2,320 square mile watershed is a topographically, geologically, and geographically diverse basin with elevations ranging from 9,414 feet at Red Mountain to 3,280 feet near Bonner, Montana. The drainage contains over 1,900 miles of perennial stream length (Pierce et al. 2005), including more than 60 direct tributaries to the Blackfoot River. The Blackfoot River has a 1972-appropriated "Murphy" instream flow water right of 700 cfs during the summer at the USGS Bonner (#12340000) gage station. This value represents the minimum flow necessary for maintaining high habitat potential and food production during the trout growing season based on the wetted perimeter inflection point method (reviewed in Leathe and Nelson 1986). In 2015, this 700 cfs water right received a 1904 priority date associated with the Milltown Water Right when the Montana Legislature ratified the Confederated Salish Kootenai Water Compact with Senate Bill 262 (Pierce et al. 2019a).

Limiting factors

Historical land use and overharvest contributed to significant declines in trout abundance in the 20th century. Angler habits through the late-1980s demonstrated a high propensity to harvest fish. With native trout species already in low abundance, the potential for adverse effects from even minimal harvest was identified as a primary threat (Peters and Spoon 1989). Harvest mortality was also implicated as a significant source of mortality, particularly for large Rainbow Trout in the lower river. The creel survey indicated a strong preference to harvest fish greater than 12 inches, preventing the abundant small size class transitioning into large size classes (Peters and Spoon 1989). To alleviate controllable sources of mortality and prevent them from exacerbating other limiting factors on the severely depressed populations harvest restrictions were established in 1990 (Peters 1990) and have been in place ever since.

Agricultural practices have contributed to severe degradation throughout the drainage, particularly throughout spawning and rearing habitats in tributaries. Furthermore, irrigation has resulted in significant dewatering issues throughout the drainage, but these issues are most pronounced in discrete locations and specific tributaries. Riparian degradation has resulted in severe erosion and subsequent habitat simplification within stream channels. Channel over-widening and lack of vegetation has led to considerable warming in some tributaries and has created downstream effects in the mainstem river. Furthermore, degradation and simplification within the tributaries has facilitated shifts in species composition from native to nonnative species, as well as shifts from salmonid-bearing to only supporting non-game species (e.g., dace, suckers). Many limiting factors have been addressed throughout the drainage, with some streams undergoing complete restoration related to historical limiting factors (e.g., Chamberlain Creek, Pierce et al. 2019a). However, contemporary limiting factors in spawning and rearing habitats still exist, including low flows, passage issues, habitat degradation, elevated temperatures, and nonnative species. Furthermore, the ongoing abiotic and biotic changes associated with climate change are exacerbating anthropogenic impacts to streamflow and water temperature. The regional trends in temperature attributed to climate change are having deleterious effects on Bull Trout (Al-Chokhachy et al. 2016) and are leading to localized declines and extirpations over broad geographic scales.

Connectivity issues associated with anthropogenic disturbances were not exclusive to migration corridors within the Blackfoot River basin. Milltown Dam, downstream of the confluence with the Clark Fork River, prevented upstream passage and impacted the larger connectivity within the Clark Fork drainage. The dam was completed in 1907, completing blocking upstream passage from the Clark Fork River. Mitigation measures and research studies documented Bull Trout and Westslope Cutthroat Trout passed above the dam migrating significant distances to spawn in several tributaries in the lower and middle Blackfoot River drainage (Schmetterling 2003). Milltown Dam was breached in 2008 as part of the larger dam removal project, including channel and floodplain restoration through the previous reservoir location. The spawning year of 2008 was the first time in a century that trout could volitionally migrate from the Clark Fork River into spawning tributaries in the Blackfoot River watershed.

The history of intensive logging on commercial timberlands and public lands (e.g., USFS lands) has contributed to significant legacy and contemporary stream impacts. Early logging practices included riparian harvest and frequent manipulation of the stream channel to facilitate easier harvest and timber removal. Heavily logged tributaries had poor recruitment of large woody debris, which contributed to low habitat complexity. Furthermore, the infrastructure to support logging (i.e., roads) created passage barriers in the form of undersized culverts and contributed significant sediment loads to the channel. Riparian roads also channelized and straightened many streams, further reducing habitat complexity and natural stream function. Collectively, the issues associated with historical land uses reduced habitat capacity and ultimately production in tributaries, which contributed to reduced trout recruitment observed in Blackfoot River (Peters and Spoon 1989; Peters 1990). Nearly 20% of the watershed was privately held commercial timberlands in the 1990s (Pierce and Schmetterling 1999). Although logging practices have changed considerably in the past few decades, legacy effects still persist throughout large portions of the drainage.

In 1975, the Mike Horse tailings dam in the Upper Blackfoot Mining Complex (UBMC) failed, releasing toxic mine waste downstream where it deposited in wetlands and floodplains upstream of Lincoln. The dam failure released 100,000 tons of toxic mine tailings. Observations of tailings were evident at the Landers Fork confluence and likely continued downstream of there (Spence 1975). Fish populations were severely depressed in the upper Blackfoot, and the most heavily impacted tributaries and upper Blackfoot River sections were devoid of aquatic life. In 2009, Montana Department of Environmental Quality (DEQ), Montana Natural Resource Damage Program (NRDP), and the U.S. Forest Service (USFS) initiated cleanup efforts with the start of the water treatment plant and subsequent remediation and stream restoration. More than one million cubic yards of contaminated material have been removed and hauled to a repository since remediation efforts began.

History of restoration and management initiatives

In response to perceived declines in trout abundance and fishing quality in the Blackfoot River, the Big Blackfoot Chapter of Trout Unlimited (BBCTU) was formed to generate funding to hire a biologist to investigate the status of the fishery, and identify potential limiting factors and opportunities to address those issues (Peters and Spoon 1989). Fisheries inventories were limited prior to this time, and assessments had not been completed since 1972 (Peters and Spoon 1989). BBCTU has been integral to fundraising, gaining landowner support, and managing restoration projects. In the early years, BBCTU handled project fundraising while FWP conducted most of the project implementation (Pierce et al. 2019a). As the restoration and conservation program matured, FWP's role transitioned into technical oversight, identifying limiting factors, assessing the effectiveness of restoration projects, and providing the biological context for developing specific habitat actions. BBCTU transitioned into active implementation and hired a restoration project manager responsible for developing and managing projects from funding through implementation phases. The Blackfoot Partnership (i.e., all NGOs and government agencies working in the watershed) facilitates effective watershed-scale restoration with a robust fisheries emphasis and evaluation framework. This has enabled efficient use of public funds to implement biological meaningful projects, and the monitoring efforts demonstrate that projects are working (Pierce et al. 2013; Pierce et al. 2019a). The science-based approach has leveraged continued investment from a diverse set of funding entities.

Harvest restrictions were some of the first actions implemented to address declines in native trout abundance. Regulations to restrict harvest of Bull Trout and Westslope Cutthroat Trout were implemented in 1990 in the Blackfoot River watershed in response to detailed fisheries investigations (Peters and Spoon 1989; Peters 1990). These initial investigations established recommendations for future management and research needs and catalyzed the extensive conservation program in the drainage. After angler studies and creel surveys in the late-1990s and early-2000s, further restrictions were implemented that required artificial lures in key Bull Trout tributaries and artificial lures within the mainstem Blackfoot river within 100-yard radius of the mouths of those key Bull Trout tributaries. Tributaries with these regulations include Gold Creek, Belmont Creek (only near mouth), Monture Creek, Copper Creek, and the North Fork Blackfoot River. To facilitate further Bull Trout recovery in 2002, the Fish and Wildlife Commission adopted regulations to restrict harvest of Brook Trout in the mainstem river to prevent incidental harvest of Bull Trout due to misidentification (Schmetterling and Long 1999), which had been identified as a pervasive problem from creel surveys and angler interviews (Pierce et al. 2002). More recently in 2016, additional special regulations were enacted in the North Fork Blackfoot to limit tackle to single point barbless hooks between North Fork Falls and the Highway 200 bridge.

The Blackfoot Challenge was officially formed in 1993 and comprised of private landowners, conservation organizations, and state and federal government agencies. The group represents the diverse interests of all landowners and provides a forum for effective collaborative decision making, project implementation, and coordinated watershed management efforts across public and private lands in the watershed. The group has been effective in establishing landowner trust and participation in the conservation program. They have been involved with project implementation in the form of water conservation projects, and recently, some habitat restoration projects.

The Challenge plays a critical role in assisting FWP with administration of the "Murphy" instream flow water right. They have been instrumental in development and management of the Blackfoot Drought Response Plan. This plan is a proactive program to help water users conserve water, implement voluntary restrictions, and conduct actions that minimize the need for FWP to make call on junior water rights. Participants in the drought plan make meaningful conservation measures to be shielded from call when flows drop below 700 cfs, but remain above 600 cfs. At 600 cfs, FWP can make call on participating users. When flows drop below 500 cfs, FWP makes call on all junior users, regardless of plan participation status (Drought Committee 2016). The committee is comprised of representatives from FWP, DNRC, DEQ, Blackfoot Challenge, local guides, anglers, recreationists, and private landowners. An adjudication process for all water rights in the Blackfoot watershed was completed in 2011 and the drainage is currently closed to the development of new water right claims.

Private landowners have been essential to the success of the program (Pierce et al. 2019a). Early engagement of the landowners in the drainage paved the way for current and future actions. Working with cooperative landowners to implement demonstration projects has been an effective way of broadening the scope of work in the drainage. Furthermore, dovetailing stream restoration with land conservation and terrestrial projects has leveraged additional opportunities. Land protection through conservation easements has also retained large blocks of land in single ownership, which has facilitated effective restoration compared to areas that are subdivided with multiple landowners along streams that may preclude comprehensive restoration actions. Conservation easements not only provide assurances that management will protect existing high-quality aquatic and riparian habitats, but facilitate opportunities to conduct restoration projects on large sections of single ownership property to address major limiting factors and bring streams to their full potential. Establishing relationships between private landowners and agency personnel has garnered trust and facilitated projects on neighboring lands that may not have been possible without those key relationships. Agency personnel and practitioners seek opportunities for mutually beneficial actions that provide a benefit to the landowner while also improving the aquatic resource. Demonstrating the coexistence of working landscapes in conjunction with productive and functioning stream systems have created many opportunities for implementing additional projects in the valley.

Over 200 individual projects have been completed throughout the watershed. Projects are designed to meet the specific biological limiting factors of streams based on recommendations in Pierce et al. (2005). Opportunistic projects with willing landowners are also implemented in important areas. Projects employ a diversity of habitat actions ranging from culvert and barrier removal to complete reconstruction of miles of channel. As the restoration program progressed, projects demonstrated their effectiveness and landowners gained trust in the established methods and practitioners, which created additional opportunities. Large streams have been the focus of many large-scale restoration projects in the last 10 years (e.g., Nevada Creek Phases 1-4).

A variety of fish screens have been installed throughout the drainage including, Coanda screens, paddle-wheel McKay style fish screens, rotary drum screens, and Farmers screens. Specific designs are selected to minimize maintenance, maximize screening efficacy, and reduce the burden on the water users. Water users are engaged to take part in the operation and maintenance of fish screens. Annual maintenance is also undertaken by a land steward with the Blackfoot Challenge and funded in part by BBCTU. Without dedicated screen tenders, getting buy in from the water users is critical to having effective screening and long-term operation of the infrastructure. Screening has been prioritized in the important spawning tributaries with migratory native trout. Recently, it has been expanded into areas that have less native trout production, but have high sport fishery values (e.g., Nevada Creek mainstem). All active diversions on the North Fork Blackfoot River, Cottonwood Creek, Monture Creek, and Dunham Creek are screened. Snowbank Creek was reconnected to Copper Creek through increased flows in 2004, and diversion modification and screening occurred in 2009. Following those actions, Bull Trout production and distribution (Pierce and Podner 2013) has increased and redd counts range from one to 35 redds.

Land conservation, including fee title acquisitions held in public trust and conservation easements on private land, have been valuable tools used frequently throughout the Blackfoot Valley. Easements have facilitated positive management changes to riparian and upland areas in key areas, as well as protected the investment of stream restoration projects after degradation issues have been addressed. A total of 184,581 acres are enrolled in conservation easements. Land ownership in the drainage continues to change because of comprehensive land conservation efforts. The Blackfoot Challenge acquired 5,609 acres of former Plum Creek Timber Company land in 2008. The Blackfoot Community Conservation Area Council manages this property as the core area within a larger mixed ownership landscape through a novel public/private community forest model that maintains public recreation and sporting opportunities, while allowing for more management flexibility and timely implementation of actions compared to traditional land management agencies. The core area combined with additional adjacent public and private land includes 41,000 acres in cooperative ecosystem management that spans large portions of McCabe Creek, Dick Creek, Warren Creek, and Murphy Spring Creek drainages (BCCAC 2017).

The Nature Conservancy purchased the remaining 117,152 acres of Plum Creek Timber Company holdings in 2014. In 2019, the BLM purchased 7,268 acres in the Belmont Creek drainage and the Forest Service acquired 16,400 acres in the Gold Creek and Placid Creek drainages. In 2020, the BLM acquired another 5,600 acres in Belmont Creek. The Forest Service acquired 12,039 acres across Twin Creek, upper Belmont Creek, and Place Lake drainages. Consolidated ownership in the Gold Creek and Belmont Creek drainages will enable more comprehensive holistic management in the drainage and facilitate restoration opportunities. As of 2020, land ownership in the basin is approximately 30% private, 54% Federal, 10% state, and 6% Nature Conservancy (including Montana Checkerboard, LLC.).

The Upper Blackfoot Mining Complex cleanup has been a top priority since the dam failure occurred in 1975. Many biological (Spence 1975; Moore et al. 1991; Peters and Spoon 1989), ecological (Wilcox et al. 2014), and geomorphic (Vandeberg et al. 2011; Pierce et al. 2012) surveys were completed to inform development of the remediation and subsequent channel restoration plans. In 2009, Montana DEQ, Montana NRDP, and the USFS initiated cleanup and completed a water treatment plant. Since that time, over one million cubic yards of contaminated material have been removed and hauled to the repository. The restoration and mine waste removal have been completed downstream of the water treatment facility to the Pass Creek marsh. Prior to restoration, multiple survey sites were sampled to develop a rigorous effectiveness monitoring study using a Before-After-Control-Impact (BACI) design.

Fisheries inventories and project monitoring

Early surveys consisted of periodic monitoring of priority mainstem and tributary reaches. The first comprehensive survey of the Blackfoot River designed to investigate fisheries status and potential limiting factors was conducted in 1988 (Peters and Spoon 1989). Early fisheries inventories were collected to identify limiting factors in primary tributaries and expanded through the years. Following the first decade of targeted inventories and monitoring, practitioners and biologists developed two prioritization documents that synthesized sampling information, ranked restoration candidate streams according to biological, social, and financial considerations, and described project categories to address limiting factors (Pierce et al. 2002; Pierce et al. 2005). Furthermore, the prioritization documents are pragmatic about working in areas that provide the most meaningful conservation benefit for the particular investment. Several telemetry studies were integral to understanding life history characteristics (Swanberg 1997, Pierce et al. 2007), habitat use, potential limiting factors, and project effectiveness (Pierce et al. 2014).

Novel genetic techniques have enabled new tools for monitoring Bull Trout populations in the drainage. Genetic assignment models allow individual Bull Trout to be assigned to their natal tributary (Knotek et al. 2016). Relative contribution of various tributaries to mainstem captures can be assessed and evaluated through time to determine if projects in spawning and rearing tributaries are increasing production to the mainstem Blackfoot River. Furthermore, this tool allows a baseline by which to compare future mainstem captures. In tributaries with declining migratory or presumed resident Bull Trout populations, this tool will allow evaluation of reestablishment of migratory life histories following extensive restoration actions in those specific tributaries. This tool also contributes information on life history diversity and expands knowledge of unique movement patterns, such as adults produced in Monture Creek and North Fork Blackfoot River overwintering in Salmon Lake (Knotek et al. 2016). This also highlights the importance of considering additional outstanding issues (Clearwater River diversion passage barriers and entrainment) in the context of overall Bull Trout recovery in the Blackfoot River drainage.

Recent synthesis efforts have highlighted many of the primary long-term case studies associated with the Blackfoot restoration program. Pierce et al. (2018; 2019) describe in detail the genesis of the Blackfoot River restoration program, the key components of its success, and highlight some of the key case studies and biotic and abiotic responses associated with different restoration efforts in a variety of stream types in the watershed. Direct linkages between natural channel design and reductions in temperatures have been documented in many streams (e.g., Kleinschmidt Creek, Pierce et al. 2014). Other key findings have been the shift in species composition in the mainstem river, suggesting the targeted restoration approach in priority native species tributaries has increased production in favor of native species. Tributary monitoring has enabled inferences between increased spawning and rearing in restored tributaries to increased native species abundance in the mainstem Blackfoot River. Multiple publications have been produced demonstrating the effectiveness of restoration through natural channel design principles and provide some of the best case-studies with long-term pre-and post-treatment results (e.g., Pierce et al. 2013; Pierce et al. 2015; Pierce et al. 2019a).

With the recent culmination of 30 years of the restoration initiative, the case studies in the Blackfoot River provide valuable insight that will continue to shape restoration and conservation efforts moving forward (Pierce et al. 2019a). With the long history of projects in low and mid-elevation sections on private land and former industrial timberland, the increasing focus of native species conservation work in pristine headwater areas will complement the ongoing habitat restoration work in the valley. The proposed North Fork Blackfoot Native Fish Conservation project in the Scapegoat Wilderness above North Fork Falls (Pierce et al. 2018), provides a great opportunity to initiate a type of project that has demonstrated success in other parts of Montana, such as the South Fork Flathead River (Boyer et al. 2008) and Cherry Creek (Clancey et al. 2019). The future of the Blackfoot River conservation and restoration program will benefit from implementing similar projects to provide the best chance of long-term persistence of Westslope Cutthroat Trout and Bull Trout as climate change contracts thermally suitable habitat and constricts distributions to these important headwater areas.

Objectives

The purpose of this report is to build upon the previous 14 reports covering fisheries investigations from 1988-2015. We also include two summary reports (see *Research Project Reports*) documenting investigations in the North Fork above the falls in support of implementing the proposed native fish conservation project (Pierce et al. 2018). The overarching goal of this monitoring report is to document and disseminate fisheries investigations throughout the basin, continue long-term effectiveness monitoring, and provide critical biological baseline information and results to guide future conservation and restoration efforts in the Blackfoot River watershed. Specific objectives of sampling activities in 2016-2020 were:

1) Monitor river temperatures in priority, long-term locations to evaluate drought plan triggers.
2) Long-term monitoring of past restoration projects to assess fish population response and evaluate longevity of habitat project elements.
3) Conduct pre-restoration surveys in project areas to establish biological baselines to assess restoration response with before-after study designs.
4) Evaluate long term trends in trout abundance and species composition in the mainstem Blackfoot River.
5) Evaluate UBMC remediation efforts and fish population responses to completed restoration actions.
6) Monitor long term index sections to assess status and trends of adult Bull Trout.
7) Investigate rotenone efficacy in select streams in the upper North Fork and refine the fish distribution model to guide implementation of the North Fork Blackfoot River Native Fish Conservation project.
8) Investigate angler use, satisfaction, crowding perception, and fishery status in the Upper North Fork Blackfoot River.
9) Investigate spawning timing, run strength, and species composition in lower Blackfoot River tributaries and understand relative contribution to the Missoula Area Fishery.
10) Investigate migration patterns and habitat use of trout in Nevada Creek downstream of Nevada Reservoir.

Methods

Electrofishing

Tributary surveys were conducted with backpack, barge, or boat electrofishing units depending on bankfull width and discharge. Tributaries were sampled with single pass, multi pass, or mark recapture sampling designs depending on section length, habitat complexity, and objectives. For example, effectiveness monitoring sections were established in Poorman Creek using mark-recapture techniques because of significant project length (>1,000 feet) and the goal of providing robust before-after comparisons of fish abundance. Mark recapture techniques provide an unbiased estimate of abundance in wadeable streams, whereas multi-pass techniques can underestimate population abundance when model assumptions are violated (e.g., constant

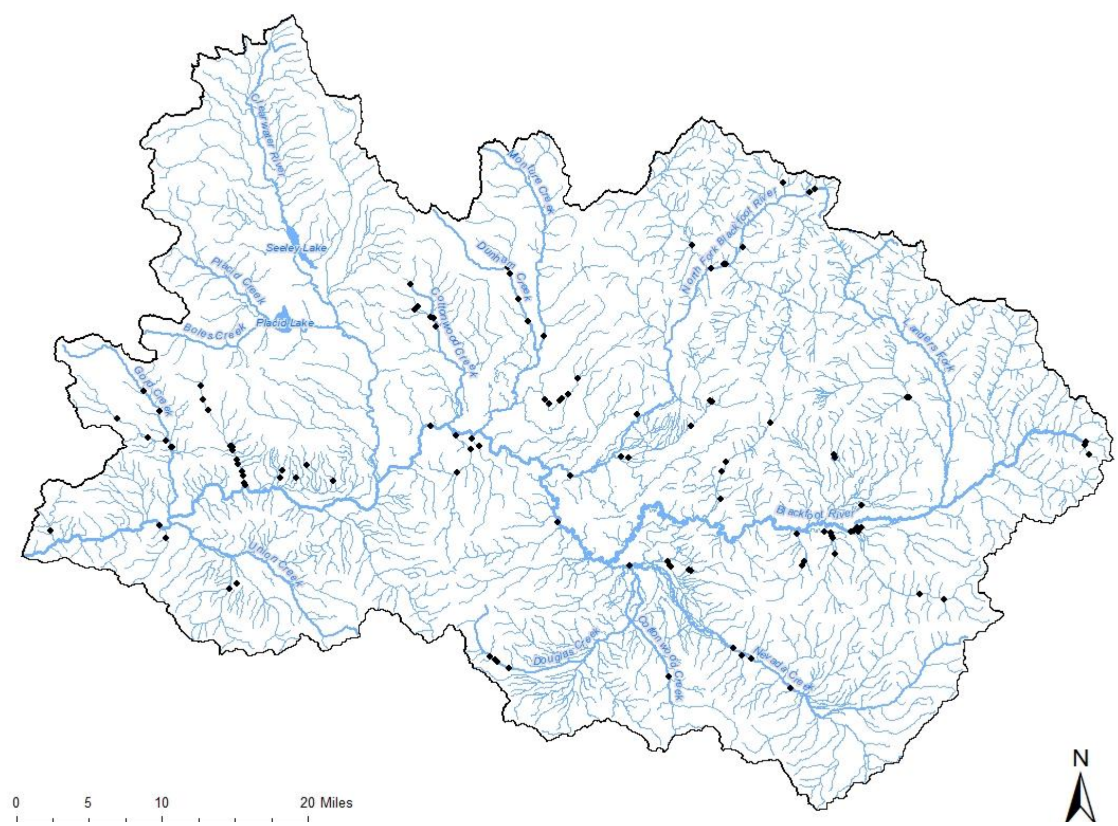

Figure 1. Map of electrofishing sites surveyed 2016-2020.

capture probability among passes, Rosenberger and Dunham 2005).

For small stream fish population surveys where species presence and distribution were the primary goals, we commonly used single-pass electrofishing as a simple measure of relative abundance. Catch per unit effort (CPUE) refers to the number of fish collected in a single electrofishing pass and is standardized per 100 feet of stream. Some figures in this report only contain CPUE even if some years contained a multi-pass depletion estimate. For those situations, depletion estimates are provided in Appendix B. We increased sampling effort in some streams and switched to multi-pass depletion for recent monitoring needs, but retained CPUE figures because historical data were limited to relative abundance estimates. Single pass electrofishing estimates can provide robust trend evaluation data when capture efficiencies are high and remain relatively constant through time and space (Hanks et al. 2018). CPUE catch statistics are located in Appendix A. Depletion estimates are located in Appendix B. Mark-recapture estimates of abundance, biomass, and condition factors for the Blackfoot River are located in Appendix C.

Blackfoot River surveys were conducted using two drift boat electrofishing units operating separately along each bank. A single marking event and recapture event were conducted in each section. Duration between mark and recapture events was seven days in 2016 and 2019. Surveys were conducted on the ascending and descending limbs of the hydrograph. In 2016, surveys were conducted between 2,320 cfs and 4,480 cfs measured at the USGS Bonner Gage. In 2019, surveys were conducted between 4,703 cfs and 6,216 cfs. A barge shocking unit was used to sample Nevada Creek Phase 3, but a drift boat shocker was used in Phase 1 and the section at mile 4.6. We also used a single drift boat to electrofish the Harry Morgan section in the North Fork Blackfoot River. Backpack electrofishing units were used in all other tributary shocking surveys. A single backpack shocker was used to cover the stream in those surveys. All age class breaks (e.g., age-0 versus age-1+) were based on length-frequency histograms. All estimates of abundance in this report were calculated with 95% confidence. Trout species composition in the Blackfoot River was calculated as a percent of the total catch for fish six inches and longer. All sampling locations are referenced by river-mile or stream-mile. Sampling personnel differentiated Westslope Cutthroat Trout from Rainbow Trout and hybrids based on phenotypic characteristics (e.g., slash and spotting patterns). Hybrid trout with predominately Westslope Cutthroat Trout characteristics were included in the Cutthroat Trout abundance estimates. However, hybrid trout with predominately Rainbow Trout characteristics and only a slash, were included in the Rainbow Trout abundance estimates.

For the Blackfoot River fish population surveys in this report, we also estimated biomass and calculated the Fulton condition factor (an index of "plumpness" where higher values indicate better condition; Murphy and Willis 1996) using Fisheries Analysis Plus software (FA +). We estimated abundance using a Chapman estimator (Seber 1982) as follows:

$$N = \frac{(m+1)\,(c+1)\,-1}{r+1}\,,$$

where N is the population estimate, m *is* the number of marked fish, c is the number of fish captured in the recapture sample, and r is the number of marked fish captured in the recapture sample. Therefore, biomass was estimated by multiplying the abundance estimate by the mean weight of fish in the population (Anderson and Neumann 1996).

For fish population estimates in small streams, we used a Zippin two-pass depletion estimator (Zippin 1956) and standard equations for calculating variance. We estimated abundance as,

$$N = \frac{(n_1)^2}{n_1 - n_2}$$

$$P = \frac{n_1 - n_2}{n_1}\,,$$

where N is the point estimate, n_1 is the number of fish collected on the first pass, n_2 is the number of fish captured on the second pass, and P is the probability of capture.

In those few cases where a three-pass estimator was necessary, we used a maximum likelihood estimator described by Carle and Strub (1978). We estimated abundance as,

$$N = [n + 1 / n - T + 1]\ [kn - X - T + 1 + (k - i) / kn - X + 2 + (k - i)]_{\mathrm{i}}\ ,$$

where N is the population estimate, i is survey pass number, k is total number of passes, C_i is number of fish caught in i^{th} sample, X is an intermediate statistic, and T is total number of fish caught in all passes.

Genetic assignment model

We collected a small tissue sample from the anal fin of all Bull Trout captured in the mainstem surveys, including juvenile and adults. The genetic assignment model was developed using baseline sampling from all known Bull Trout tributaries in the Blackfoot River and Clearwater River drainages. Because of the high propensity for Bull Trout to home to natal tributaries to spawn, Bull Trout populations typically exhibit a high degree of genetic differentiation. Therefore, genetic assignment models can trace individual Bull Trout to their natal tributary (Knotek et al. 2016). This technique is undergoing refinements with increased sample size for tributary baselines, incorporating additional tributaries into the model (e.g., Rock Creek drainage), and leveraging advancements in genetic tools to increase accuracy of assignments. The development of the Blackfoot and Clearwater genetic assignment model and validation is described in detail by Knotek et al. (2016).

Redd Counts

A single-pass survey was conducted in late-September each year in the North Fork Blackfoot River, Monture Creek, Dunham Creek, and Gold Creek. Redd count survey boundaries were expanded in Gold Creek and Dunham Creek to identify spawning activity outside the typical index survey reach (Figure 2). Belmont Creek was surveyed by the BLM in 2019 and 2020 and they conducted multiple passes in some of the reaches (Figure 2). This is considered an approximate census of the spawning population because the survey covered the entirety of suitable spawning habitat. In 2018 and 2019, all redds observed in Dunham Creek were outside the index reach. Therefore, we decided to conduct expanded surveys in Dunham

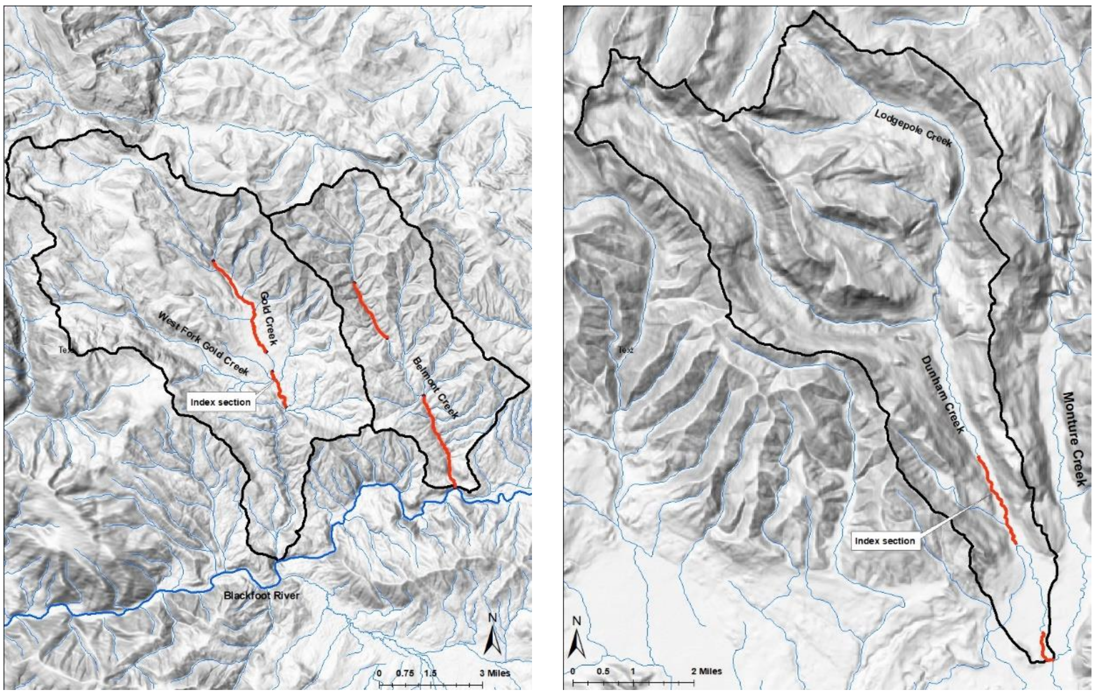

Figure 2. Spawning survey long-term index sections (labeled) and expanded surveys in Gold Creek, Belmont Creek, and Dunham Creek, 2018-2020.

Creek covering the entire section of perennial flow below Cottonwood Lakes Road to the confluence with Monture Creek.

Water temperature monitoring and streamflow

Tributary temperature loggers were maintained in priority native trout areas, locations of past restoration projects, and in specific areas to help inform potential restoration projects. Loggers were deployed in Belmont Creek and Gold (West Fork Gold) Creek to investigate longitudinal temperature profiles and compare with historical temperature data to assess long-term changes. We also deployed temperature loggers in additional locations in Dick Creek in 2018 to inform potential restoration opportunities. We reinstalled loggers in key Bull Trout spawning areas in Monture Creek and the North Fork Blackfoot River that had not been monitored in several years. We maintained the long-term temperature logger locations in the Blackfoot River. Several loggers were also discontinued in 2020 to realign priorities with locations most critical to informing future management actions or to address specific research objectives. We did not deploy any streamflow loggers but monitored USGS and DNRC gages for Drought Plan discussions and implementation of seasonal fishing restrictions.

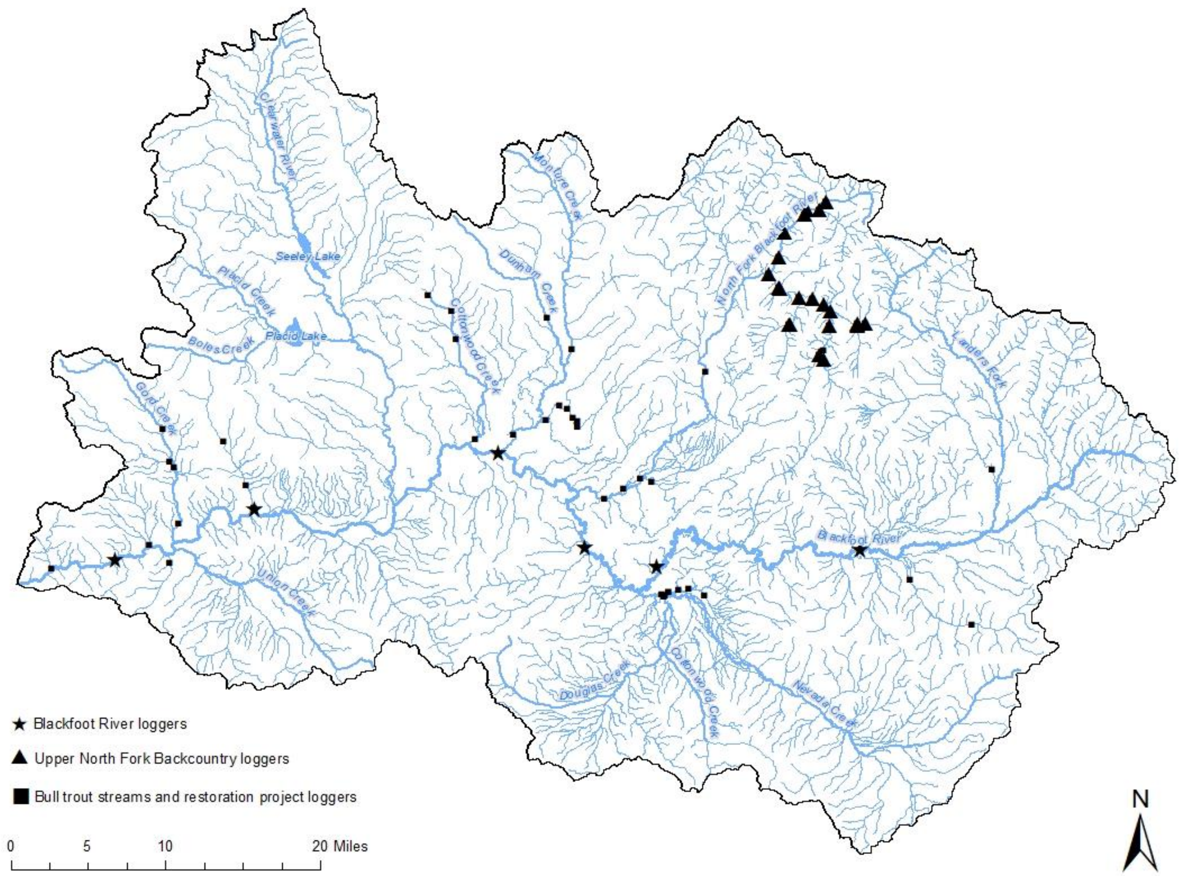

Figure 3 . Locations of mainstem Blackfoot River loggers (star), North Fork Blackfoot backcountry loggers (triangles), and Bull Trout streams and other restoration project stream loggers (squares) deployed in 2016-2020.

Results and Discussion

Water Temperature and streamflow in mainstem river

Water temperatures in the Blackfoot River exceeded the 71°F threshold in 2016, 2017, and 2020 (Figure 4, Figure 5). However, Hoot Owl restrictions were only implemented for 12 days in 2016 (July 29-August 9). Peak flows in 2018 and 2020 were above average and remained above average into August. The lowest flow year in the reporting period occurred in 2016. Peak flows were

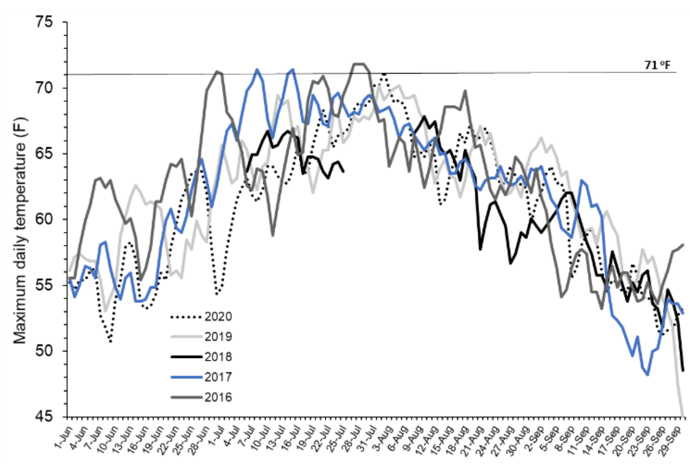

Figure 4. Summer water temperatures in the Blackfoot River near the USGS Bonner gage, 2016-2020.

significantly below average (maximum = 4,480 cfs) and dropped below 700 cfs on July 23 (Figure 6). Flows in 2019 were above average, with a slightly earlier timing of peak runoff. However, flows dropped rapidly to baseflow conditions and fell below 700 cfs on August 19. Flows in 2017 were slightly above average, and elevated flows occurred for a prolonged period before dropping below average by July.

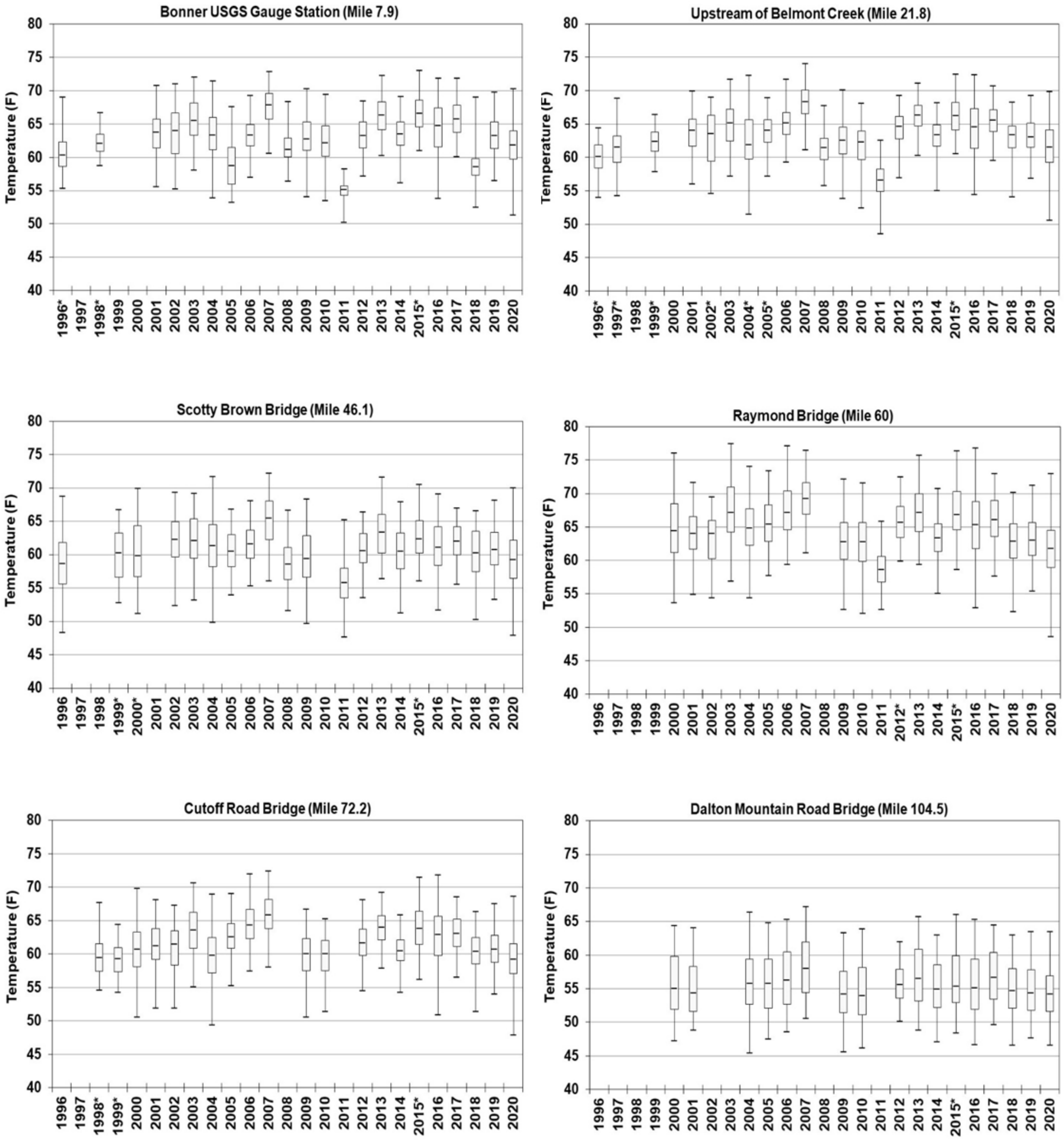

Figure 5 . July water temperatures at six long-term monitoring locations on the Blackfoot River. Box plots show minimum, maximum, median and quartile values. An asterisk denotes incomplete data for the month.

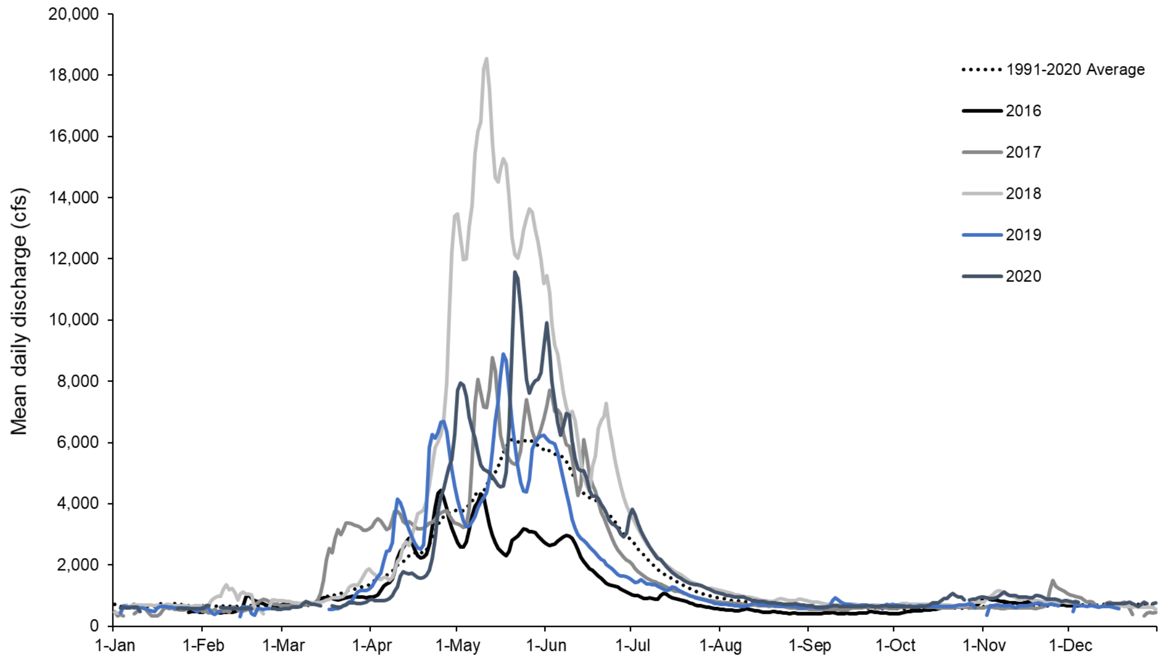

Figure 6. Mean daily discharge measured at the USGS stream gage in Bonner, MT, 2016-2020.

Blackfoot River salmonid populations

Total trout abundance and biomass has remained relatively stable since the last survey in 2014 (Figure 7). Abundance in the Johnsrud section is slightly below the previous long-term average (1989-2014) of 760 trout/mile. Point estimates in 2016 and 2019 were very similar and not significantly different from 2014. Abundance was slightly elevated in the Scotty Brown section and similar to the long-term average of 401 trout/mile. Abundance in the Wales Creek section was lower and was about half of the long-term average of 70 trout/mile.

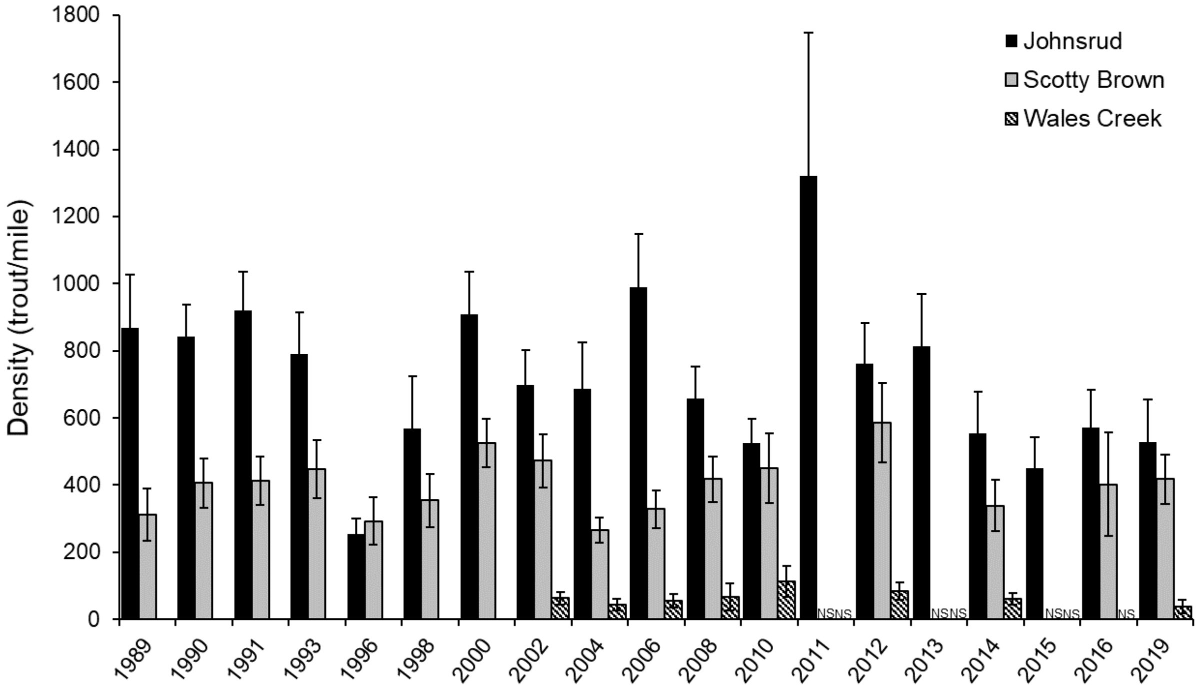

Figure 7. Abundance estimates and 95% confidence intervals (vertical bars) of trout with lengths six inches and greater, 1989-2019. Surveys in the Wales Creek section began in 2002. NS denotes years in which surveys did not occur.

Brown Trout abundance has been more variable in the Johnsrud section. A pronounced decline occurred from 2011 until 2014, but abundance has increased consistently since 2014, but differences are not statistically significant. Brown Trout abundance in the Scotty Brown section has been stable and not significantly different since 2002. Brown Trout are the most abundant species in the Wales Creek section and the 2019 estimate was about half the long-term average of 46 trout/mile. Otherwise, it has been generally stable with estimates fluctuating between 36 and 53 trout/mile prior to the 2019 survey. No significant differences existed among years, except that 2019 was significantly lower than 2002. Overall, long-term trends generally suggest stable populations of Brown Trout, although expansion of their distribution is occurring rapidly (see *tributary restoration and fisheries monitoring* section).

Westslope Cutthroat Trout abundance and biomass were slightly lower in 2016 and 2019, but not significantly different from surveys since the early 2000s (Figure 8). There has been a clear positive trend from 1989 to 2019, which is due to a combination of harvest restrictions enacted in the early 1990s and comprehensive restoration actions over the last three decades. With relatively imprecise estimates in recent years, we are unsure if abundance has started to level off or if it continues to increase in a trajectory like the 1990s through early 2000s. Nevertheless, current abundance of Westslope Cutthroat Trout is significantly greater than the early 1990s when concerns over population status restricted harvest and initiated the focus of comprehensive restoration efforts in the basin.

Rainbow Trout trends have been similar between sections and have generally been stable since 2014. Rainbow Trout abundance in 2016 and 2019 were below the long-term average of 590 trout/mile in the Johnsrud section and 189 trout/mile in the Scotty Brown section. The 2019 estimate in the Scotty Brown section was higher than in 2014 and 2016, although not significantly different.

Mountain Whitefish abundance in the Wales Creek section has remained very stable since monitoring began in 2008 and no significant differences have existed among years (Figure 9). This section was not surveyed in 2016, but there despite a slight decline in biomass from 2008, the biomass has remained relatively similar from 2012 through 2019.

Bull Trout abundance and biomass declined in recent surveys, but due to low densities, the estimates are very imprecise and we are unable to detect significant differences (Appendix C). Biomass and abundance in the Scotty Brown section have been relatively stable since the mid-2000s.

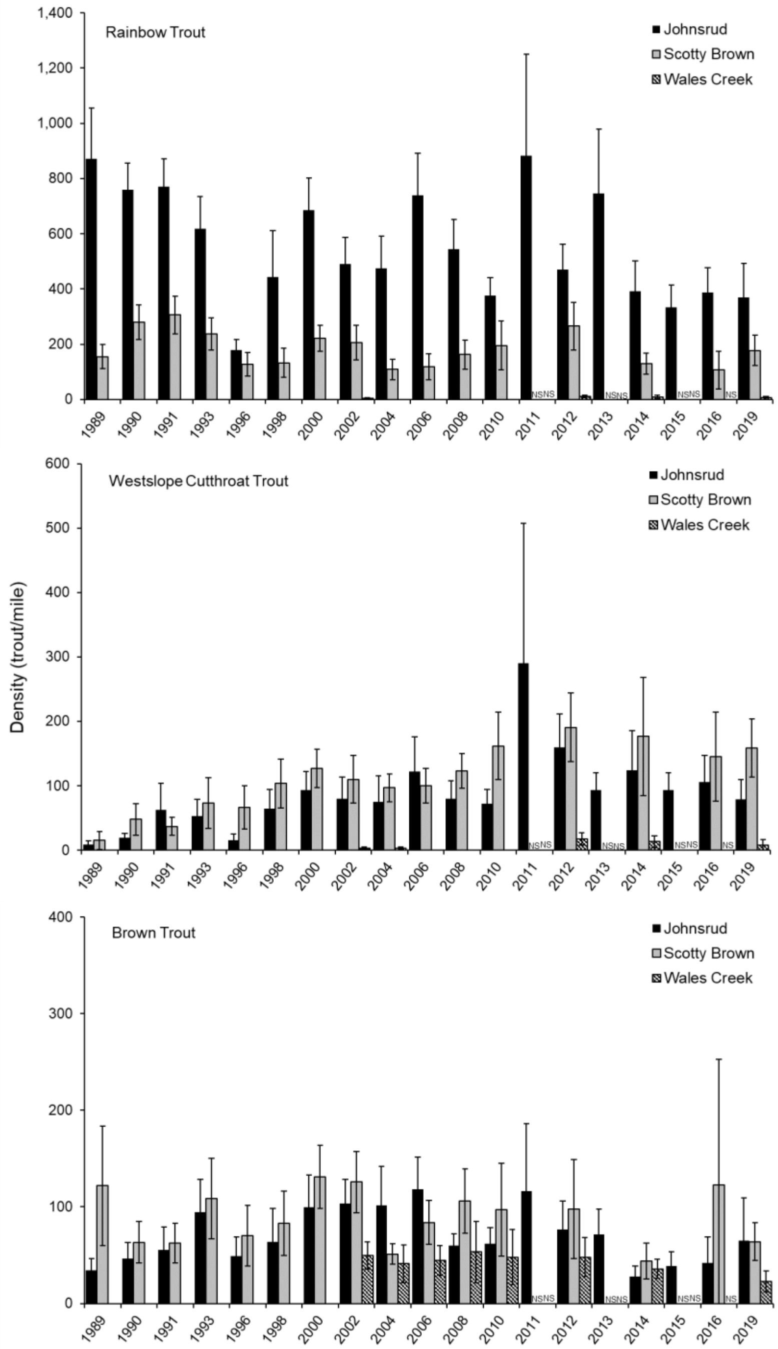

Figure 8. Species-specific abundance estimates and 95% confidence intervals (vertical bars) of trout with lengths six inches and greater, 1989-2019. Surveys in the Wales Creek section began in 2002. NS denotes years in which surveys did not occur.

There has been a pronounced and persistent long-term shift in species composition in the Blackfoot River. From 1989 through the early 2000s, a relatively rapid decrease in Rainbow Trout composition and concurrent increase in Westslope Cutthroat Trout composition was documented. Since that initial shift, the composition has remained relatively unchanged, although Westslope Cutthroat Trout represented 45% of the total catch in the Scotty Brown section in 2016, which was the highest in the monitoring period. The proportion of Westslope Cutthroat Trout in 2019 was slightly less, but still similar to years with the highest Cutthroat Trout composition. This marked shift has been attributed to the systematic restoration of priority native trout tributaries, which has increased the production of Cutthroat Trout. High prevalence of whirling disease during the 1990s and early 2000s in many spawning and rearing tributaries used by Rainbow Trout (Pierce et al. 2002), may have contributed to this species composition shift.

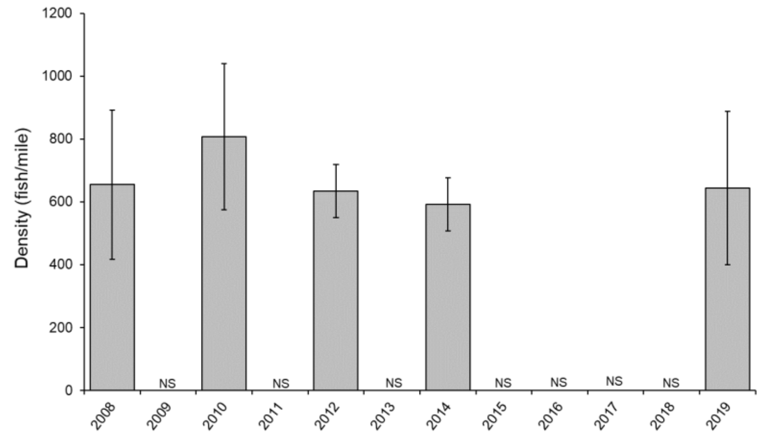

Figure 9. Estimates (95% confidence intervals) of Mountain Whitefish abundance estimates in the Wales Creek section. NS denotes years in which surveys did not occur.

Although abundances are much lower in the Wales Creek section, the species composition and trends are significantly different from the other sections. Brown Trout represent the largest proportion of the total catch and proportions range 54-89% (average = 75%). Westslope Cutthroat Trout are generally present at low abundance, but have exhibited a slight positive trend in composition since 2002 (Figure 10). Species composition in the last decade represents a marked shift from the early monitoring period of 2002-2008. Throughout the mid-2000s, the average proportion of Westslope Cutthroat Trout in the survey section was 6% whereas the average proportion of Westslope Cutthroat Trout in 2010-2019 was 17%. This may be the result of increased Cutthroat Trout recruitment associated with ongoing restoration efforts in Nevada Creek and other Cutthroat Trout-bearing streams in the middle Blackfoot River watershed over the last decade.

Bull Trout monitoring

We captured and genetically sampled 32 Bull Trout from the Johnsrud Section in 2016 (n = 18) and 2019 (n=14). All individuals were non hybridized. The majority of fish assigned to the North Fork Blackfoot River, which was similar to previous surveys (Knotek et al. 2016). Although the model performed relatively well, it was unable to confidently assign nine individuals (28%). Specifically, the model had issues differentiating among populations in the North Fork Blackfoot River, Middle/East Fork Rock Creek, and West/North Fork Rock Creek (Kovach et al. 2019). However, a power analysis suggested that assignments to the Rock Creek drainage were robust, but assignments to tributaries within the drainage were questionable (Kovach et al. 2019) The assignments of these nine individuals should be viewed with caution, but it strongly suggests that at least some are of Rock Creek origin and highlights the diversity of movement patterns in the upper Clark Fork river and the large home range associated with migratory Bull Trout.

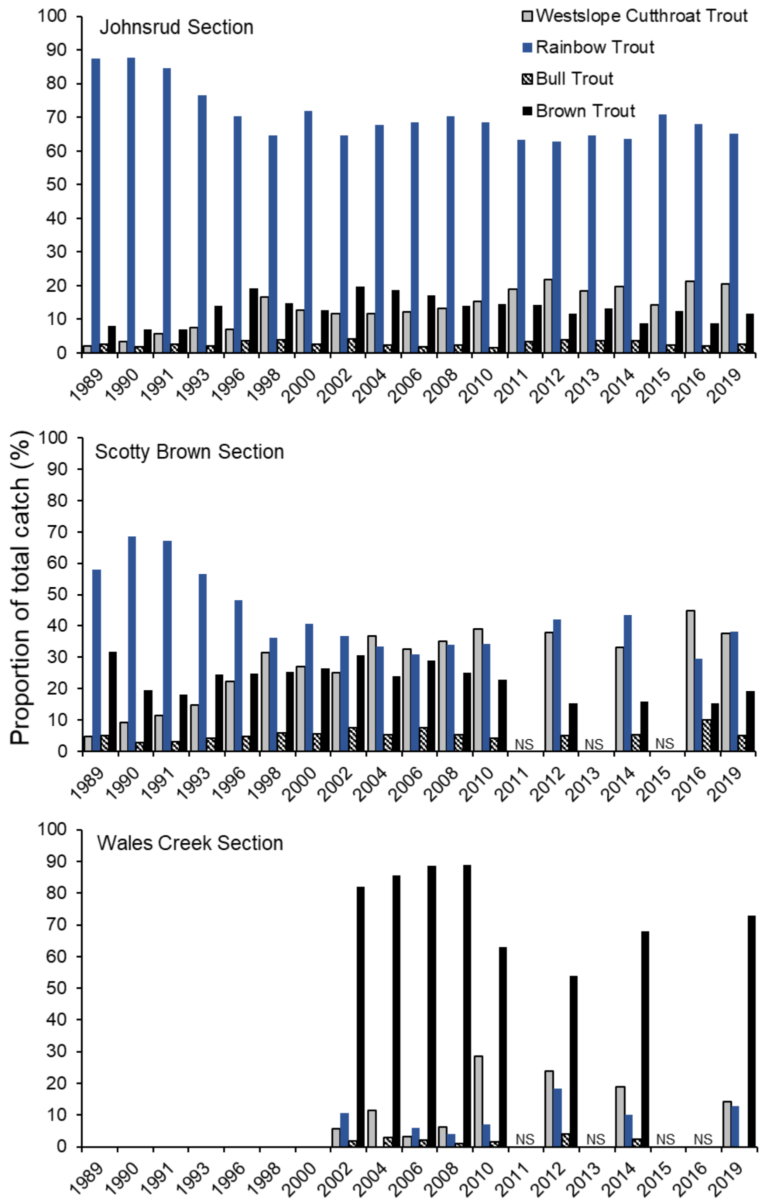

Figure 10. Species composition of trout (≥ 6 inches) in three mainstem Blackfoot River electrofishing survey sections, 1989-2019. Surveys in the Wales Creek section began in 2002. NS denotes years in which surveys did not occur.

We captured and genetically sampled 59 Bull Trout in the Scotty Brown section in 2016 (n = 30) and 2019 (n = 29). No hybridization was detected among individuals in the sample. Similar to assignments in the Johnsrud section, the model was unable to confidently assign 11 individuals (18.6%). Most fish assigned to the North Fork Blackfoot River (Figure 12). The Scotty Brown section contained a larger proportion of fish that assigned to Monture Creek compared to the Johnsrud section, which was similar to previous surveys (Knotek et al. 2016). Interestingly, no fish in either section assigned to the Copper Creek drainage. Previous surveys indicated a high proportion of fish in the Canyon Section assigning to

Copper Creek, but we did not survey that section during the reporting period. However, Knotek et al. (2016) observed a fish in the Johnsrud section that assigned to Snowbank Creek. Copper Creek redd counts have continued to decline since then, so the number of fish at large is likely much lower than in the past, reducing the chances of us encountering one of those individuals in our survey sections. Although some uncertainty exists about assignment of fish outside the Blackfoot drainage, the presence of fish from the Scotty Brown section assigning to Rock Creek highlights the large-scale migrations in the upper Clark Fork and the large area over which individuals will seek out FMO habitat. Future model refinement will be critical to interpreting these results as well as assignments from subsequent electrofishing surveys.

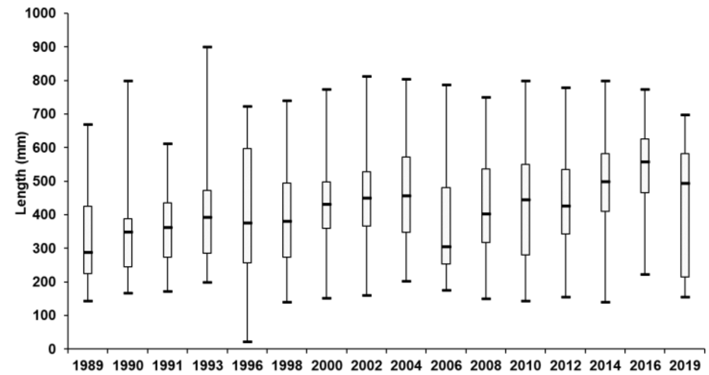

Figure 11. Lengths of Bull Trout captured in the Johnsrud and Scotty Brown Bridge monitoring sections of the Blackfoot River, 1989-2019; horizontal line illustrates the median values, boxes represent the 25th and 75th percentiles, whiskers represent the minimum and maximum values.

Electrofishing surveys have also illuminated a pronounced shift in size distribution of Bull Trout encountered in the lower and middle Blackfoot River (Figure 11). Following harvest restrictions in 1990 as well as other restoration actions to reduce and eliminate controllable sources of mortality (e.g., fish screens), larger individuals have been encountered with increased frequency. This suggests longevity of Bull Trout in the drainage has increased. As part of the Milltown Dam removal evaluation, Bull Trout were PIT tagged in the Clark Fork River and Blackfoot River from 2010 through 2015. We captured two Bull Trout in 2019 that were originally tagged in 2012. The fish were 20-22 inches when they were tagged in 2012. Bull Trout ageing studies have not been conducted in the Blackfoot River, but age and demographic studies have been conducted in Eastern Oregon (Al-Chokhachy and Budy 2008), the Flathead River drainage (Fraley and Shepard 1988), and St. Mary's River (Mogen and Kaeding 2006). In those studies, the 20–22-inch size class was estimated between 6 and 8 years old. Assuming relatively similar growth of migratory Bull Trout, we estimate that these individuals were likely 13-15 years old when we captured them 2019. Interestingly, these individuals were not the largest encountered during surveys. Collectively, this is a strong confirmation that Bull Trout in the Blackfoot River are surviving to very large sizes and old ages (Figure 11).

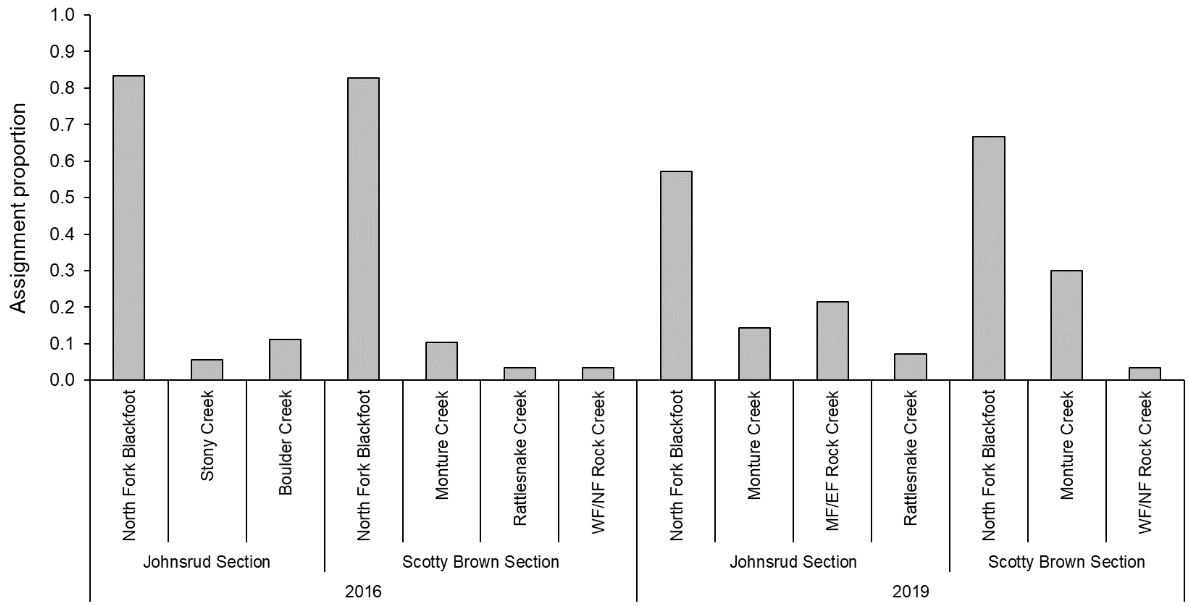

Figure 12. Assignment proportions of Bull Trout captured in the Blackfoot River electrofishing surveys, 2016-2019**.**

Redd counts have been declining in Monture Creek and the Copper Creek drainage since 2016 (Figure 13). They have been highly variable but more stable in the North Fork Blackfoot River. However, 2019 counts in the North Fork were the lowest since 2007. Monture had the lowest count since 1989 and Copper was the lowest since 2003. The disproportionately low count in Monture Creek is concerning. However, the excessive sediments from the Yellowjacket Creek disturbance may have reduced the effectiveness of our survey and prevented us from observing constructed redds. The poor summer conditions in 2016 (i.e. low flow and high temperatures) may have resulted in reduced survival in the mainstem river and poor recruitment of subadults from the tributaries (Figures 4 and 6). This may have resulted in fewer adults surviving after 2016, or fewer subadults recruiting to spawning size in 2017-2020. Furthermore,

Table 1. Redd counts from Bull Trout spawning ground surveys, 1988-2020.

Stream	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
East Fork Clearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	21	21	18	-	6	0	6	2	2	-	6	0	0
West Fork Clearwater	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	20	65	33	66	74	49	60	47	22	40	24	12	23
Marshall Creek (upper)													-	-	-	-	-	-	-	-	3	0	-	-	5	5	6	5	7	6	6	0	2
Copper Creek (lower)	-	21	23	24	25	19	23	21	21	22	27	9	20	16	15	4	12	15	33	32	34	33	21	22	19	14	16	40	16	15	12	6	5
Copper Creek (upper)	-	-	-	-	-	-	-	-	14	19	17	29	24	21	23	14	19	35	51	79	62	82	44	39	44	22	29	17	21	19	8	7	6
Snowbank Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	1	17	13	35	24	21	-	28	17	15	15	24
Belmont Creek	-	-	-	-	-	-	-	-	14	-	14	8	4	3	11	-	-	3	-	-	-	-	-	1	2	1	0	-	-	-	-	0	0
Gold Creek	-	-	-	-	-	-	-	-	-	-	16	30	9	17	6	4	-	7	-	1	2	1	1	0	1	1	2	-	7	1	0	0	0
Dunham Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	6	6	4	-	5	7	5	8	8	9	6	11	4	0	0	1	0	5
Monture Creek (index)	11	10	--	25	34	45	49	60	65	61	60	65	74	94	93	80	44	41	15	33	18	23	49	51	73	63	52	43	50	50	30	11	25
Monture Creek (upper)	-	-	-	-	-	-	-	-	14	10	7	10	6	0	8	3	9	1	0	0	14	12	3	9	3	3	2	2	0	8	2	0	2
Morrell Creek	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	10	22	16	26	4	33	54	37	27	38	24	28	36	15	11	21	5	12
North Fork Blackfoot River	12	8	-	26	39	-	-	27	59	65	76	87	123	75	70	41	42	43	61	42	95	97	86	158	131	91	96	104	118	129	102	70	66

maximum daily temperatures greater than 65°F were also observed in the lower reaches of some Bull Trout tributaries in July 2016 (Figure 14).

Interestingly, Bull Trout populations in Monture Creek and Copper Creek have followed consistent declining trends since the recent high point in 2012. Although spawning activity increased from 2019 to 2020, we are unsure if 2019 was the low point in a cycle and 2020 marks the start of another period of increasing spawner abundance, or if the population will fluctuate around a lower baseline average in the coming years. Nevertheless, 2019 represented the lowest

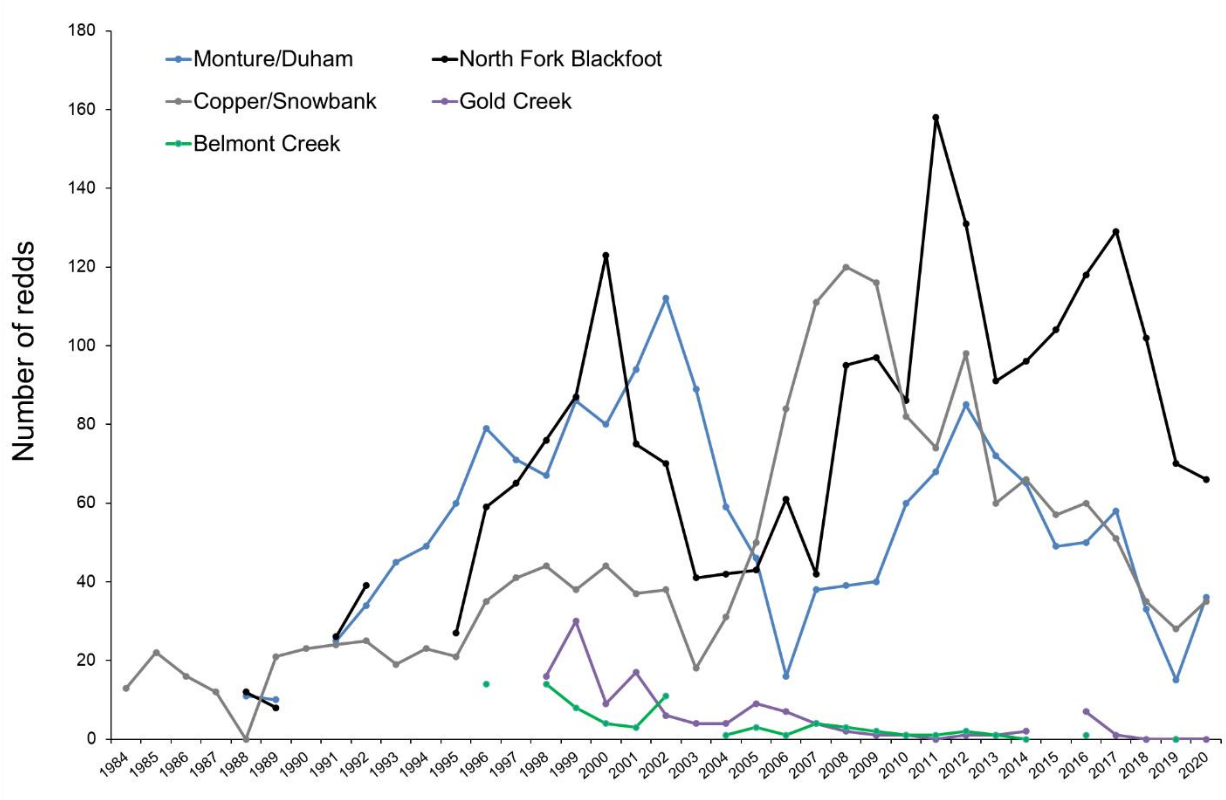

Figure 13. Redd counts from annual spawning ground surveys in priority Bull Trout tributaries, 1984-2020.

redd counts observed in the last few decades in both drainages. The Monture Creek survey followed large-scale sediment inputs from mass wasting events in Yellowjacket, Bill, Falls, and Spread Creeks attributed to high precipitation on the Rice Ridge Fire burn scar. Our ability to locate and identify redds may have diminished because of elevated water turbidity and sediment deposition over previously constructed redds. However, it is unlikely that reduced sampling efficiency contributed exclusively to the very low abundance of redds because the trend was very consistent with the long-term trend in Copper Creek. Therefore, if a few redds were missed because of poor sampling conditions, the index count still reflects the relative abundance compared to previous years.

Although redd counts in the North Fork Blackfoot exhibited a pronounced increase from 2013-2017, spawning activity has been declining since 2017 like populations in Monture Creek and Copper Creek. However, the 2020 survey in the North Fork was lower than 2019, although it only declined from 70 to 66 redds.

Bull Trout redd counts in Gold Creek and Belmont Creek suggest local extirpation of migratory spawning activity. Redds have not been observed in either drainage in several years, although surveys in Gold Creek identified 7 redds in 2016 and one redd in 2017. However, no adult Bull Trout were observed and these redds may have been constructed by Brook Trout given that subsequent electrofishing surveys failed to located Bull Trout (see *tributary restoration and fisheries monitoring* section). Furthermore, expanded redd survey sections in Gold Creek in 2019 and 2020 did not observe any evidence of Bull Trout spawning despite an abundance of high-quality spawning and adult holding habitat in the upper section. Redd count abundance among tributaries is consistent with assignment proportions of Bull Trout captured in the mainstem Blackfoot River.

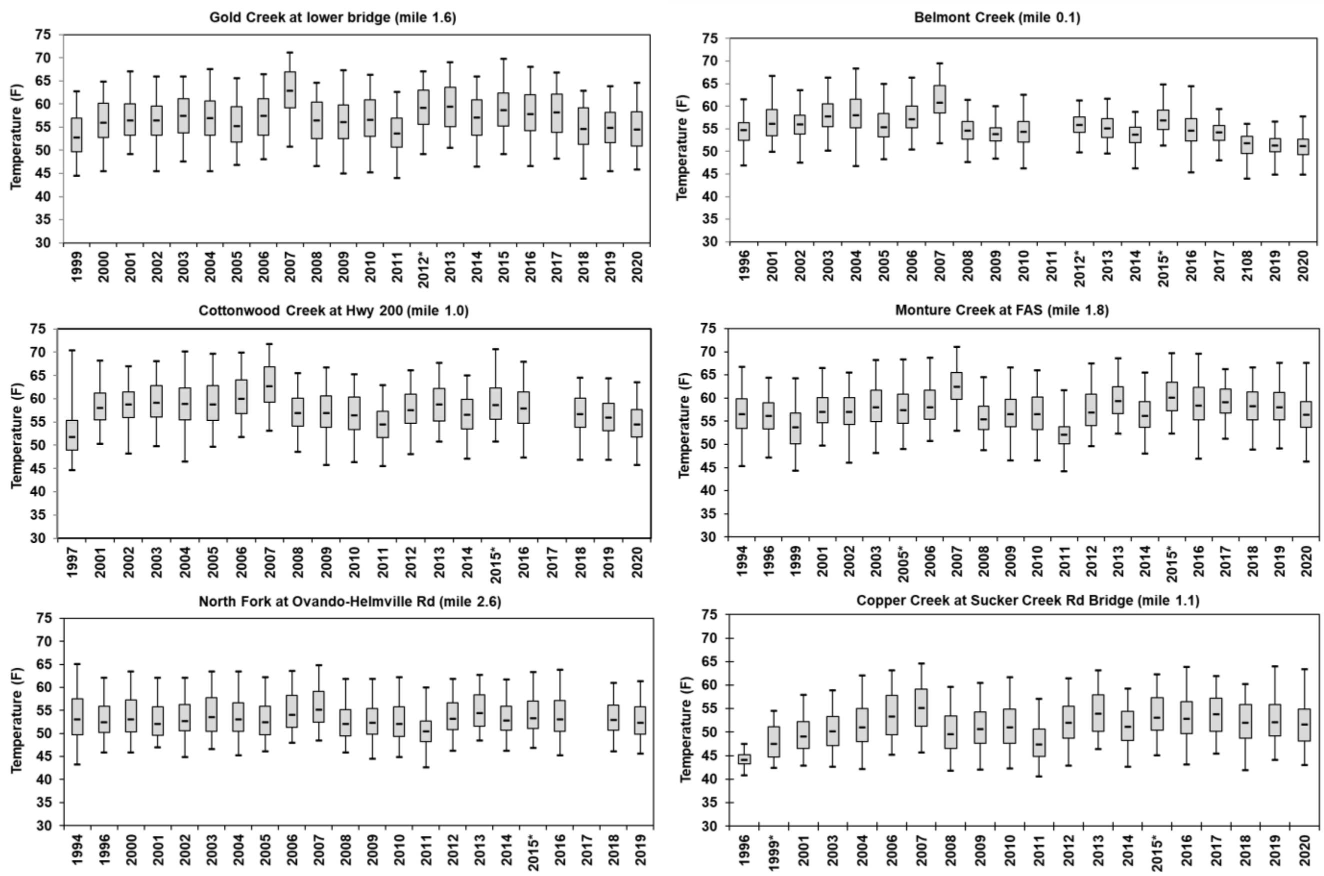

Figure 14. July water temperature summaries in six Bull Trout streams, 1994-2020; horizontal line illustrates the median values, boxes represent the 25th and 75th percentiles, whiskers represent the minimum and maximum values**.**

Tributary restoration and fisheries monitoring

Anaconda Creek

Restoration objectives: Remediate historical mining impacts in the lower section and reconnect to Beartrap Creek following UBMC remediation activities. Facilitate connectivity and migratory life history expression throughout the UBMC project area.

Project summary

Anaconda Creek is a 2nd order stream on the western slopes of the Continental Divide and flows in a westerly direction to its confluence with Beartrap Creek to form the Blackfoot River near river mile 132. A 2.96 mile^2 watershed, stream gradients average 415ft per/mile over its 2.9-mile length. Tepee Lodge Creek, a small 1st order stream enters near stream mile 0.9 and contributes approximately 0.2-0.5 cfs to Anaconda Creek's average base flow of 2-4 cfs. The drainage area is located entirely on the Helena National Forest. The stream channel contains a robust overstory of subalpine fir, Douglas fir, and Aspen above an understory of alder, red osier dogwood, grasses, and shrubs. Significant beetle kill is present in the adjacent coniferous forest, which facilitates high rates of large woody debris recruitment to the stream channel.

Located about 15 miles east of Lincoln, Montana, Anaconda Creek is located within the historical Upper Blackfoot Mining Complex (UBMC). Mining operations only affected the lower reaches of Anaconda Creek while leaving much of the mid to upper reaches unimpacted. Because of the this, Anaconda Creek maintained a robust Westslope Cutthroat Trout population while they were extirpated elsewhere in the UBMC. Prior to UBMC remediation and stream restoration work, pre-treatment surveys in treatment reaches were conducted in Beartrap Creek and the upper Blackfoot River in 2009 and 2010 (Wilcox et al. 2014). Pre-treatment surveys in reference reaches were conducted in Anaconda, Copper, and Snowbank Creeks in 2011 and 2012. The impaired lower section of Anaconda Creek was reconstructed and connected to the newly constructed Beartrap Creek channel in 2018. In 2019-2020, we conducted post-restoration surveys in all reference reach and treatment reach locations.

Fisheries monitoring

Prior to reclamation and restoration of the UBMC, we conducted depletion estimate surveys for consecutive years in 2011 and 2012 to establish baseline abundance estimates in the reference reach at mile 0.5 in Anaconda Creek. Average densities were 26.8 trout/100 ft. Although trout abundance in 2019 was significantly lower than 2011 and 2012, the densities in 2020 were very similar and not significantly different, indicating a relatively stable population (Figure 15, Appendices A & B). Brook Trout abundance has remained stable over this period

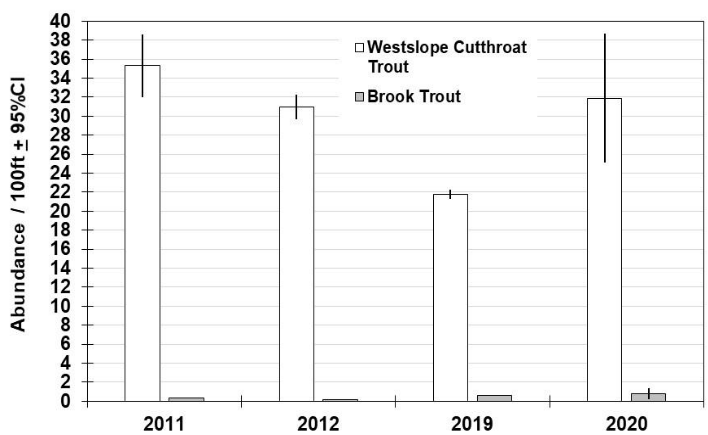

Figure 15. Abundance estimates for age -1 and older trout in Anaconda Creek at mile 0.5, 2011 – 2020.

and represents less than 3% of the total trout population. Future monitoring will include annual surveys associated with the BACI evaluation of the UBMC remediation and restoration.

Arrastra Creek

Restoration objectives: Restore upstream fish passage for fluvial native trout and contribute multi species recruitment to the upper Blackfoot River. Maintain and enhance Bull Trout abundance and distribution.

<u>Project summary</u>

Arrastra Creek is the largest tributary to the Blackfoot River between Beaver Creek (river mile 105.2) and Nevada Creek (river mile 67.8). Its headwaters originate on the slopes of Arrastra Mountain. Arrastra Creek is 12.6 miles in length and drains a forested basin with an area of 22 miles^2 before entering the Blackfoot River at river mile 88.8. Much of the middle and upper reaches are on National Forest system lands, while the lower portion is a mix of BLM and private lands. Stream gradients range from 333 ft/mile in its headwaters and decrease to 68 ft/mile the lower 5 miles of stream. Arrastra Creek is also the only stream between Poorman Creek (river mile 108) and the North Fork (river mile 54.1) that supports a Bull Trout population. A radio telemetry study identified Arrastra Creek as a primary spawning tributary for fluvial Westslope Cutthroat Trout in the middle Blackfoot River (Pierce et al. 2007). All radioed Westslope Cutthroat Trout spawned downstream from a pair of undersized culverts located at mile 3.2. In 2005, these culverts were replaced with a bridge which restored access to six miles of perennial stream upstream of the crossing. Other fisheries improvements in Arrastra Creek include riparian grazing changes on BLM land.

<u>Fisheries monitoring</u>

Arrastra Creek supports Bull Trout and Westslope Cutthroat Trout throughout the mainstem as well as Brown Trout and Brook Trout in lower reaches. In 2017, we established two new fish population survey locations at stream miles 4.5 and 5.1. We conducted single pass surveys to collect genetic samples from Westslope Cutthroat Trout and Bull Trout. Genetic results from 50 Westslope Cutthroat Trout and 16 Bull Trout samples indicated all individuals were non-hybridized. Bull Trout genetic samples were also used to develop an Arrastra Creek genetic baseline for use in the basin-wide genetic assignment model. FWP pathologists also conducted disease testing on 60 Westslope Cutthroat Trout samples in 2017 and all samples tested negative for pathogens.

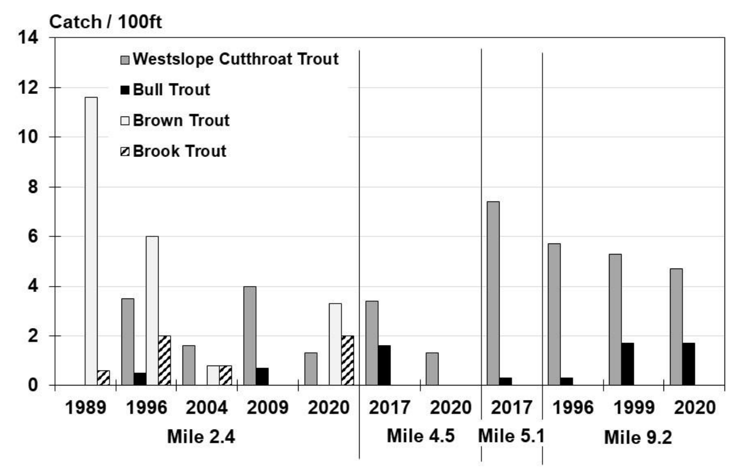

Figure 16. Catch per unit effort for age -1 and older trout at four locations in Arrastra Creek, 1989-2020.

In 2020, we resurveyed two older survey sites at stream miles 2.4 and 9.2 and resurveyed the 2017 site at mile 4.5. Results from fish population surveys indicated low relative abundance of Westslope Cutthroat Trout and Bull Trout throughout the Arrastra Creek drainage. Cutthroat Trout abundance declined from 2009 at the mile 2.4 site, whereas Brook Trout and Brown Trout densities increased from the 2004 and 2009 surveys. Many of the large beaver dams in this reach had recently blown out eliciting significant changes in habitat compared to previous surveys. Furthermore, the temperatures resulting from the upstream beaver dam complexes are creating late-summer thermal conditions that are more favorable for Brown Trout and Brook Trout. However, we have not detected upstream expansion of either species to the stream mile 4.5 site or higher (Figure 16, Appendix A). The survey site at mile 9.2 had not been sampled since 1999, and the 2020 relative abundance estimates indicate stable populations of Bull Trout and Westslope Cutthroat Trout. This section of Arrastra Creek contains high quality intact habitat and remains extremely cold, providing ideal conditions for Bull Trout and Westslope Cutthroat Trout. Future monitoring will occur periodically to assess Bull Trout status and distribution and investigate upstream expansion of nonnatives.

Ashby Creek

Restoration objectives: Protect the genetic purity of Westslope Cutthroat Trout in the upper Ashby Creek watershed using an existing wetland complex as a migration barrier. Improve Westslope Cutthroat Trout habitat by creating a natural channel that provides complexity, increases riffle-pool habitat features and available spawning substrate and increase shade and small diameter wood recruitment to the stream channel. Improve and re-establish wetland functionality.

<u>Project summary</u>

Ashby Creek is a small 2nd order tributary to Camas Creek located in the Union Creek basin. Ashby Creek is eight miles in length and drains a 24.8 mile^2 watershed. The stream originates in the Garnet Mountain range and drains a forested basin with a mix of private, DNRC and BLM properties before entering private ranchlands near stream mile 3.8. Major tributaries include the East Fork Ashby Creek entering at mile 4.5 and Arkansas Creek entering at mile 1.4. Stream gradients range from 570 ft/mile in the headwaters to 45 ft/mile in the lower reaches. In 2010, all former Plum Creek Timber Company land upstream of mile 3.8 was transferred to DNRC. Fisheries impairments include roads in riparian areas, undersized culverts, past agricultural practices on private lands that included overgrazing of the riparian zone, channelization, and dewatering.

A comprehensive restoration project plan was completed on private ranchland in 2007. The project included: 1) reconstruction of three miles of stream that had been historically ditched, 2) enhanced in-stream flows, 3) improved fish passage, 4) the installation of a fish screen at a diversion point, 5) riparian grazing changes, and 6) riparian re-vegetation including shrub plantings, soil lifts and weed management (Pierce and Podner 2008). This project also connected Ashby Creek to an 80-acre wetland in a manner that inhibits the upstream movement of fish. More recent work was completed on upstream DNRC lands in 2013 following the transfer of former Plum Creek Timber Company land to the DNRC. This DNRC work removed a 0.8-mile road segment from the riparian area, restored 0.46 miles of stream, and fenced livestock from the adjacent riparian area.

Fisheries monitoring

Ashby Creek supports a resident population of non-hybridized Westslope Cutthroat Trout and a limited population of Brook Trout. Initial post-restoration surveys were conducted at two locations in 2007 and 2008 in the completed restoration section. No fish were captured until 2009. We continued post-restoration monitoring through 2016. Downstream colonization into the project area from upstream sources occurred rapidly. The mile 2.0 site was not surveyed as frequently, but the data suggest slower recolonization and lower abundance compared to the mile 2.7 site. During surveys in 2016, we observed high levels of sediment in many pools and documented low flows of approximately 0.25 cfs. Unfortunately, 90% of shrubs planted in the treatment riparian areas failed to survive, leaving much of the stream channel without overhead canopy cover. The high sediment levels and exposed water surface contributed to high levels of algae in 2016. Fish population sampling at both survey locations showed a substantial decline because fish were only present in few high-quality pools that had large woody debris and low sediment levels. The lower estimates in 2016 indicated that fish probably migrated to other areas of the stream with more overhead cover, thermal refugia, and higher quality habitat (Figure 17; Appendices A & B). Future monitoring will occur infrequently to asses long term changes associated with the restoration actions and investigate genetic status of Westslope Cutthroat Trout to ensure that expansion of Rainbow Trout or hybrid trout does not occur through the wetland complex.

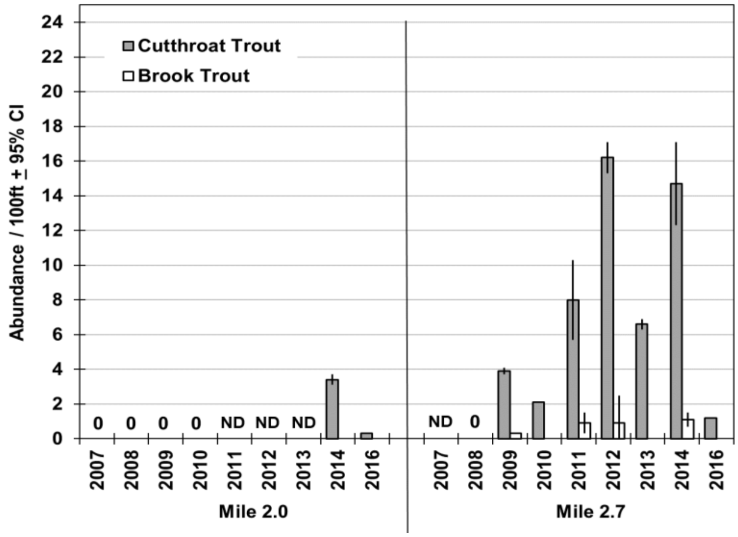

Figure 17. Abundance estimates for age-1 and older trout at two locations on Ashby Creek, 2009-2016

Bear Creek

Restoration objectives: Restore instream habitat conditions, increase fish passage, create thermal refugia, and improve recruitment of trout to the Blackfoot River.

Project summary

Bear Creek, a small 2nd order tributary to the lower Blackfoot River, flows north for six miles where it enters the Blackfoot River at river mile 12.2 with a base-flow of 3-5 cfs. Its headwaters drain the east and southeastern slopes of Olsen Mountain in the Garnet Mountain range with stream gradients ranging from 460 ft/mile in the upper reaches to 135 ft/mile in the lower mile of stream. In 2010, all former Plum Creek Timber Company land in the Bear Creek drainage was transferred to DNRC. Bear Creek is one of the colder tributaries to the lower Blackfoot River. Located on DNRC and private land, Bear Creek has a long history of adverse habitat changes, which has included undersized culverts, road drainage and siltation, irrigation, channelization of the stream, excessive riparian grazing, and streamside timber harvest. Prior to restoration activities, these fisheries impairments contributed to the loss of migration corridors and the simplification and degradation of salmonid habitat. Many of these impairments were corrected between the 1990s and 2011. Restoration activities included: 1) upgrading or removing culverts and addressing road-drainage problems, 2) improving water control structures at irrigation diversions, 3) reconstructing or enhancing habitat complexity on 4,000 feet of stream, 4) shrub plantings, and 5) the development of compatible riparian grazing systems for one mile of stream (Pierce and Podner 2013).

<ins>Fisheries monitoring</ins>

Bear Creek supports an abundance of Rainbow Trout with low numbers of Brown Trout and Brook Trout in the lower stream reaches. Westslope Cutthroat Trout are present in the upper basin and juvenile Bull Trout have been documented using the stream for rearing and seasonal refugia. In 1998, we began monitoring trout populations in a reconstructed stream reach and continued monitoring through 2018 (Figure 18; Appendices A & B). Recent surveys documented stable levels of age-1 and older trout and were only slightly below the long-term post-restoration average of 26.3 trout/100ft. In 2017, one subadult Bull Trout (length = 9 in) was captured in the monitoring section.

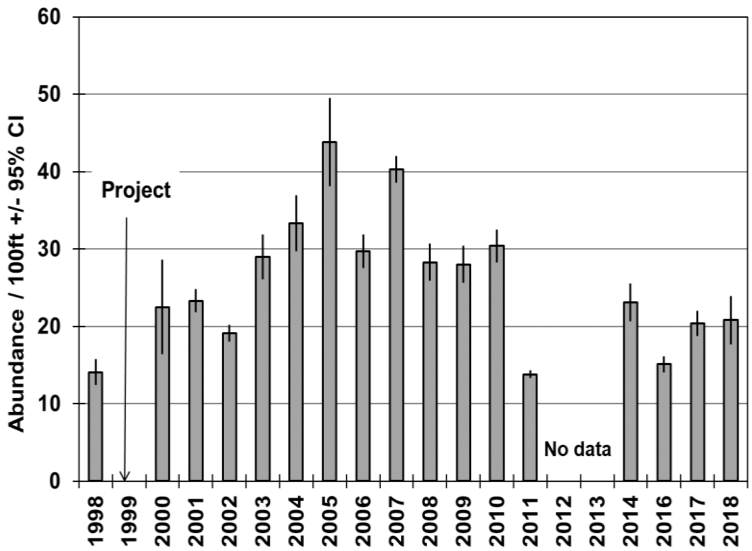

Figure 18. Estimates of total trout abundance for age-1 and older trout in Bear Creek at mile 1.1, 1998-2018.

Post -restoration visual surveys documented proper pool frequency and low levels of sediment. LWD pool structures have been maintained by stable stream banks supported by healthy riparian communities of alders, dogwoods, willows, sedges, and various grass species. The vegetation has created abundant shade and overhanging cover, contributing to complex fish habitat. Average post-restoration densities remain elevated above the pre-restoration abundance estimates. A trapping study in 2020 documented migratory trout spawning in Bear Creek and suggested spawning is occurring in and above the shocking section, which contributes trout recruitment to the project section (see *Research Project Reports* section).

Beartrap Creek

Restoration objectives: Remediate historical mining impacts. Reconstruct channel and floodplain through and downstream of the old Mike Horse tailings pond. Restore full connectivity throughout the entire stream length and facilitate migratory life history expression throughout the UBMC project area.

Project summary

Beartrap Creek is a 2nd order stream on the western edge of the Continental Divide and flows in a northwesterly direction to its confluence with Anaconda Creek to form the Blackfoot River near river mile 132. It has a 2.0 mile^2 watershed and stream gradients average 28.3 ft/mile in the lower mile of stream increasing to 96 ft/mile near the headwaters. Mike Horse Creek, a small 1st order stream enters near stream mile 0.5 and contributes approximately 0.3 cfs to Beartrap Creek's average base flow of 2-4 cfs**.** Beartrap Creek is located entirely on the Helena National Forest.

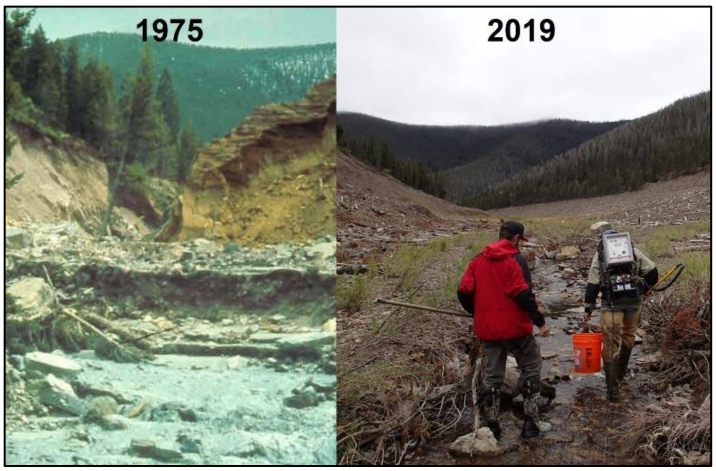

Figure 19. Beartrap Creek below the dam in 1975 (left) and Beartrap Creek after restoration in 2019 (right).

Beartrap Creek is located within the Upper Blackfoot Mining Complex (UBMC) area. Previous research identified high concentrations of toxic mining waste (e.g., heavy metals) in the floodplain, surface and ground water, and within fish and insects (Moore et al. 1991; Stratus 2007: Vandeberg et al. 2011). From 2009 through 2011, several studies investigated the existing and potential geomorphic and biotic conditions of streams in the UBMC Beartrap Creek to help develop restoration plans and to serve as a basis for long term monitoring of ecological response associated with reclamation efforts (Pierce et al. 2012; Wilcox et al. 2014). Remediation of the tailings pond and subsequent channel reconstruction of Beartrap Creek occurred in multi-year phases, with completion of Beartrap Creek restoration and floodplain reconstruction in 2018.

Fisheries monitoring

We conducted fish population surveys following completion of Beartrap Creek reclamation and channel reconstruction. The lower site (mile 0.35) was downstream of the Mike Horse Creek confluence (Figure 20; Appendices A & B). The upper site (mile 1.1) was upstream of the old tailings pond. Both sites were devoid of fish when sampled in 2009 prior to restoration. We observed rapid recolonization by Brook Trout at the lower site. Brook Trout abundance nearly doubled from 2019 to 2020 indicating rapid seeding of this vacant habitat and the early stages of probable exponential population

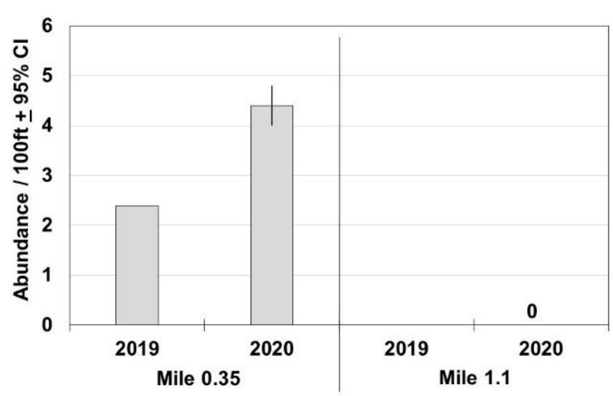

Figure 20. Abundance estimates of Age-1+ trout in Beartrap Creek, 2019-2020.

growth following recolonization. We did not capture any fish at the upper site suggesting colonization has not progressed that far upstream. Future monitoring will occur annually to continue the Before-After-Control-Impact evaluation of UBMC reclamation. The addition of another site in the location of the old tailings pond would help assess the spatial progression of recolonization. The newly constructed stream channel has high quality habitat with complex pools. The older restoration section through the reservoir footprint has high survival of willows. We did not capture any Westslope Cutthroat Trout in 2019 or 2020, but we visually observed their presence within Beartrap Creek just upstream of the Anaconda Creek confluence in 2020.

Belmont Creek

Restoration objectives: Restore pool habitat and morphological complexity. Restore thermal refugia for Blackfoot River native fish species. Reduce road sediment sources and increase quantity of habitat. Improve riparian conditions associated with legacy effects of historical land use.

Project summary

Belmont Creek, a 2nd order stream, drains a 29.2 mi^2 watershed and flows southeast for 11 miles before entering the lower Blackfoot River near mile 21.8. Average baseflow is 10-12 cfs. Ninety two percent of the Belmont Creek watershed was managed as industrial forest by Plum Creek Timber Company prior to The Nature Conservancy (TNC) purchases. Recently completed land transactions by the USFS and BLM have converted the TNC-purchased lands into public ownership, consolidating management of the Belmont Creek drainage. A small amount of TNC land still exists in the northwestern portion of the Belmont Creek drainage, with anticipated future land transactions that will place the entirety of the Belmont Creek drainage in public ownership. Two prominent waterfalls are located in the bedrock-confined middle section of Belmont Creek. The lower waterfall is approximately 3 feet high and located near stream mile 4.6 (46.99208; -113.59253). There is a series of cascades directly above the primary waterfall (Figure 21). The

Figure 21. Pictures of the upper waterfall (top) and lower waterfall (bottom) in 2019.

upper waterfall near stream mile 4.7 (46.99268; -113.59322) is approximately 6-7 feet high (Figure 21).

Restoration actions have been implemented in Belmont Creek since the early years of the Blackfoot River restoration initiative. In the early 1990s, Plum Creek Timber Company and partners removed two undersized culverts that were seasonal passage impediments. In the early 2000s, BLM implemented habitat improvement projects and grazing management in the lower section of the drainage. There were also several sediment reduction measures associated with logging roads including the installation of rolling dips and seeding and closing roads after logging. In 2015, TNC completed road inventories to identify additional sediment reduction actions and riparian improvements (Inroads Consulting 2015). TNC removed an undersized bridge in 2016 that was blocking channel function and replaced it with an appropriately sized bridge to accommodate flows and passage of LWD. TNC also removed and decommissioned an undersized crossing structure near mile 8.4.

In 2019, BLM and BBCTU decommissioned 5,295 ft of riparian road to reduce sediment input and riparian encroachment. They also removed an existing bridge and abutments at stream mile 1.7 to facilitate natural channel processes and floodplain connection. They also upgraded an undersized culvert on an unnamed, non-fish bearing tributary stream immediately upstream of the old bridge crossing. In 2020, BLM replaced the undersized 25-foot timber structure bridge on McNamara Road with a 35-foot prefabricated steel bridge structure.

Fisheries monitoring

We resurveyed Belmont Creek in 2019 at all prior established monitoring locations (miles 0.1, 0.3, 0.6, 1.2, 1.5, 2.2, 4.3, 6.3 and 7.4). We also established three new survey sites below and above a set of waterfalls at miles 4.6, 4.7, and at mile 8.4 to help determine the upstream extent of Rainbow Trout and Brown Trout distributions and to collect Cutthroat Trout genetics to assess hybridization above the waterfalls. Bull Trout were historically present at the prior established surveys locations. Despite intensive sampling throughout the Belmont drainage, 2019 surveys continue to show a substantial decline in Bull Trout abundance. Out of the lower five survey locations, we only found a single Bull Trout near the mouth. Bull Trout were present at very low densities in the two middle reach sites (miles 2.2 and 4.3) and at the upstream most (mile 8.4) site (Figure 22; Appendix A). Bull Trout redds have not been observed in recent years, which is consistent with Bull Trout declines observed in electrofishing surveys (Table 1). Surveys documented relatively low numbers of Brown Trout throughout the lower and middle reaches of the drainage, but also indicated they have expanded upstream of the upper waterfall at mile 4.7. Rainbow Trout remain below the lower set of waterfalls at mile 4.6 in moderate to high abundance. This is consistent with trapping results showing a strong run of migratory Rainbow

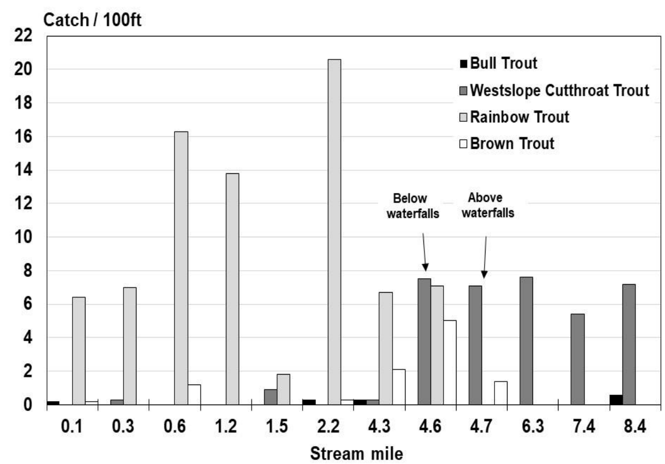

Figure 22. CPUE for trout sampled at twelve locations in Belmont Creek, 2019.

Trout spawning in Belmont Creek (see *Research Project Reports* section). Moderate numbers of Westslope Cutthroat Trout were found in the middle reach just below the lower waterfall, but their distribution is primarily above the upper waterfall at mile 4.7 (Figure 22; Appendix A). Westslope Cutthroat Trout genetic testing results from lower Belmont Creek (n=20) show relatively high introgression (32.6%) with Rainbow Trout. Conversely, Westslope Cutthroat Trout genetic results (n=10) from upstream of the upper waterfall indicate the population is 99.8% pure (Kovach et al. 2020). The significant disparity in genetic structure over a relatively short stream distance suggests that the waterfall is a periodic barrier to upstream fish movement, or that it is currently a complete barrier and nonnative fish had migrated upstream at some point in the past and caused the very low level of hybridization. Further genetic sampling is needed to evaluate hybridization status and genetic structure above the waterfall. Annual long-term water temperature monitoring continued for the period of 2016-2020 at stream mile 0.1. Additionally, we established two new long-term monitoring locations at miles 1.7 and 5.3 in 2019. All water temperature monitoring results are located in Appendix D.

Braziel Creek

Restoration objectives: Restore natural channel conditions, improve riparian area, and enhance flows to increase Westslope Cutthroat Trout abundance.

<u>Project Summary</u>

Braziel Creek, a small 2nd order tributary, enters Nevada Creek about two miles downstream of Nevada Creek Reservoir with a base flow less than 1.0 cfs. The stream is 3.7 miles in length and drains the foothills of Hoodoo Mountain. The upper 1.9 miles of stream are located on BLM property and the lower 1.8 miles flows through private ranchlands. Stream gradients range from 77 ft/mile in the lower 0.5-mile of stream to an average of 405 ft/mile in the upper 3.2 miles of stream.

Fisheries impairments in Braziel Creek include road drainage, grazing pressure, reduced flow, and habitat degradation. Prior to restoration in 2010, lower Braziel Creek was heavily altered from channelization, dewatering, and subject to heavy riparian grazing. Furthermore, undersized culverts limited fish passage, and Westslope Cutthroat Trout entrainment had been identified in one irrigation ditch at mile 0.26 (Pierce et al. 2011). To improve conditions for Westslope Cutthroat Trout, a comprehensive restoration project was initiated in 2010, which included reconstruction of 1,500 feet of channel, upgrading of an undersized county road culvert, installation of a Coanda fish screen at one diversion and a grazing management plan. The grazing plan excluded livestock to recover riparian vegetation and stabilize the new channel. The landowner entered into an agreement with Trout Unlimited in 2013 for minimum flows of 0.5 cfs. In 2013, the downstream reach of Braziel Creek (540') was also restored. The reach suffered from channelization, bank erosion, and simplified habitat.

Fisheries monitoring

Braziel Creek supports a simple fish community of Westslope Cutthroat Trout and Sculpin. Brook Trout have been captured occasionally during surveys but are present at very low densities. Genetic testing of Westslope Cutthroat Trout in 2008 found mild hybridization with Rainbow Trout (1.5%). Prior to restoration, a fish population monitoring site was established at mile 0.2 in 2010, followed by six years of post-treatment monitoring (Figure 23; Appendices A & B). Abundance of Westslope Cutthroat Trout has varied considerably from pre project implementation to six years post-treatment. With only one year of pre-restoration data, it is unclear if these fluctuations are due to natural variability or if factors contributing to the initial abundance increase in 2012 are no longer exerting positive pressure on the population. Nevertheless, the screening project was effective at maintaining passage and preventing entrainment. Furthermore, during the 2016 survey, it was noted that fish habitat and riparian vegetation was improving, but elevated sediment levels persisted. Severe channel avulsions exist in the upper part of the drainage that are likely contributing to downstream sediment issues. Future monitoring will likely occur on an infrequent basis (e.g., 5-year interval) to assess long-term population status and trends.

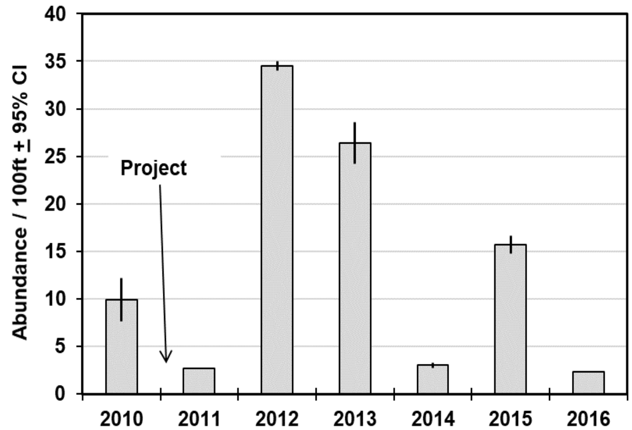

Figure 23. Abundance estimates for age-1 and older Westslope Cutthroat Trout in Braziel Creek at mile 0.2, 2010 - 2016.

Chamberlain Creek

Restoration objectives: Improve access to spawning areas; improve rearing conditions for Westslope Cutthroat Trout; improve recruitment of Westslope Cutthroat Trout to the Blackfoot River. Maintain long-term benefits of completed restoration projects.

Project summary

Chamberlain Creek, a small 2nd order tributary, drains a 22.4 mile^2 basin that contributes approximately 2-3 cfs of baseflow to the Blackfoot River at river mile 43.9. Chamberlain Creek is 11.5 miles in length and originates on the eastern slopes of Lost Horse Mountain near Chamberlain Meadows in the Garnet Mountain range. Following land exchanges, most of the upper basin is now BLM property, most of the middle basin is DNRC property, and the lower 1.3 miles of the drainage is privately owned. Furthermore, all the DNRC and private parcels in the Chamberlain Creek drainage have conservation easements.

Prior to 1990, sections of lower Chamberlain Creek were dewatered and damaged by heavy riparian grazing, road encroachment, and channelization, which led to low Westslope Cutthroat Trout abundance in the lower stream reaches (Peters 1990). Initiated in 1990, Chamberlain Creek was one of the first comprehensive restoration projects in the Blackfoot

Basin (Pierce et al. 2019a). All known fisheries impairments have been addressed through road drainage repairs, grazing management, instream habitat restoration, irrigation upgrades (consolidation of two ditches into one and the installation of a fish ladder on the diversion), and enhanced stream flows through water leasing (Pierce et al. 2019a).

Fisheries monitoring

A fish population monitoring section was established in lower Chamberlain Creek at mile 0.1 in 1989. We continued monitoring fish population status through 2019 (Figure 24). In 2019, FWP resurveyed the mile 0.1 survey location and two established survey sites at miles 1.9 and 3.8. Results show a dramatic increase in Westslope Cutthroat Trout abundance at the mile 0.1 survey location compared to pre-restoration baseline levels. Brown Trout and Rainbow Trout were present with very low abundance. Interestingly, Westslope Cutthroat Trout densities at all sites surveyed in 2019, except mile 3.8, had the highest densities in the monitoring period. This demonstrates drainage-wide increases in production attributed to the cumulative restoration efforts in Chamberlain Creek. This increase is consistent with the mainstem surveys showing a basin-wide increase in Westslope Cutthroat Trout abundance. More spawning is probably occurring in Chamberlain Creek and leading to more production of offspring, which is increasing recruitment to the mainstem river.

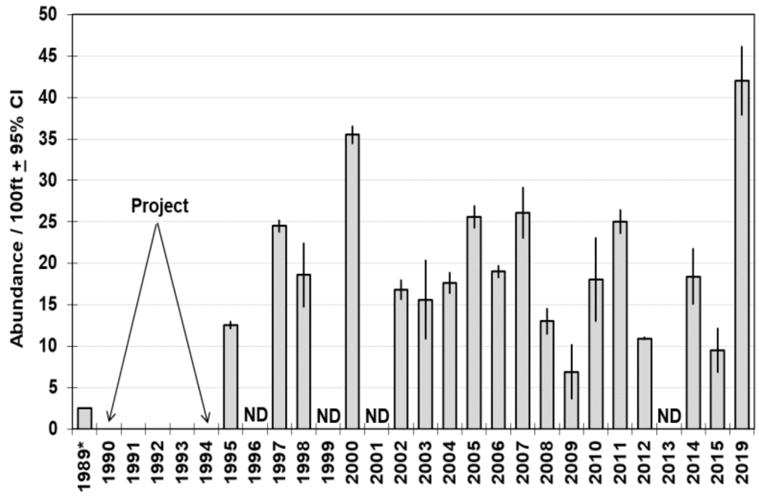

Figure 24. Abundance estimates for age-1 and older Westslope Cutthroat Trout in Chamberlain Creek at mile 0.1, 1989-2019.

The BLM restoration project near mile 1.9 appeared to maintain its intended purpose. Some of the large wood was dislodged, but the habitat remains complex and trout abundance indicates a positive response. The lower reach had low flows below the diversion, but the abundance of Westslope Cutthroat Trout demonstrates suitable habitat capacity and thermal refugia despite the lower flows from upstream irrigation withdrawals. Rainbow Trout and Brown Trout decrease in the upstream direction at miles 1.9 and 3.8. Westslope Cutthroat Trout remains the most abundant species, with Brook Trout increasing slightly in abundance at the mile 3.8 survey site (Appendices A & B). Sculpin were common in all three sampling locations. Future monitoring will likely occur on an infrequent basis (e.g., 5-year interval) to assess long-term population status and trends, and levels of hybridization in the population.

Copper Creek

Copper Creek is a large 3rd order tributary to the lower Landers Fork, flowing 17.6 miles before entering the Landers Fork near mile 4.1. It drains a 40.6 mile^2 forested watershed and has a base flow of about 20-25 cfs. The mainstem originates from two small cirque lakes (Upper and Lower Copper Lakes) within the Helena National Forest. Stream gradients range from 940ft/mile near the headwaters to 78 ft/mile near the mouth. Headwater tributaries are Red Creek (mile 11.6), Cotter Creek (mile 11.5) and the North Fork of Copper Creek (mile 8.8). Snowbank Creek enters Copper Creek at mile 6.2. The upper 13.8 miles of Copper Creek are within the Helena National Forest, whereas the lower 3.8 miles flow through a mix of DNRC, private, and Helena National Forest lands.

During August of 2003, the Snow/Talon wildfire on the Helena National Forest burned through the Copper Creek drainage. The high intensity, stand-replacement fire burned significant portions of the basin, including the Bull Trout spawning section approximately three weeks prior to the spawning season. The basin continues its post-fire recovery and succession, which has facilitated recruitment of significant amounts of large woody debris to the channel. In 2019, a collaborative project between BBCTU and the USFS eliminated a problematic section of riparian road that was encroaching the stream channel and contributing sediment to upper Copper Creek.

<u>Fisheries monitoring</u>

Copper Creek supports an entirely native fish community. The mainstem provides critical Bull Trout habitat as well as spawning and rearing habitat for genetically pure fluvial Westslope Cutthroat Trout.

The USFS has conducted annual Bull Trout redd count surveys since 1989 at an established index section. They started conducting total redd count surveys in 1996 when a telemetry study identified a second Bull Trout spawning area in upper Copper Creek. Redd counts are shown in Figure 25.

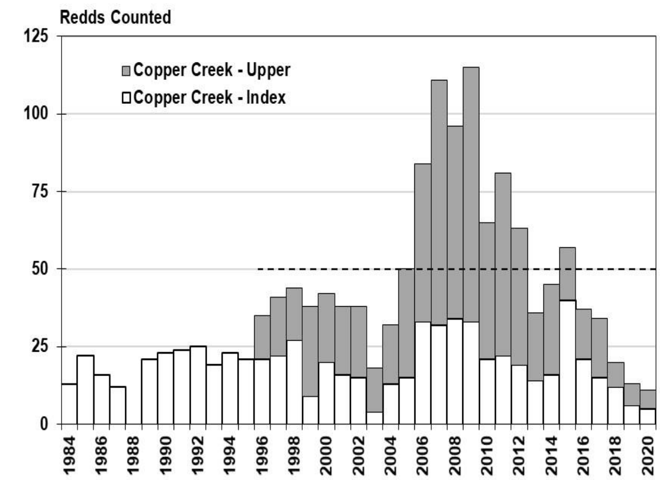

Figure 25. Bull trout redd counts for Copper Creek. White bars show redd counts in the long-term (1989-2020) index section. Grey bars show the redd counts in the upstream section monitored from 1996-2020. The dashed horizontal line shows the long-term mean of 50 redds for total Bull Trout redd counts, 1996-2020.

Similar to redd count results, 2019-2020 electrofishing surveys at mile 6.2 recorded substantial declines in age-1 and older native trout abundance. Densities in 2019 were 6.6 trout/100ft compared to 17.8 trout/100ft in 2012 (Figure 26, Appendices A & B). A significant amount of LWD was observed in the channel and the physical habitat looked adequate despite the recent declines in trout abundance.

Abundance of Age-1+ Bull Trout in 2020 was the lowest in the monitoring period, which is consistent with the decline in redds over the last five years (Figure 25). Abundance of Westslope Cutthroat Trout in 2020 was similar to the late 1990s and early 2000s prior to the 2003 Snow-Talon Fire, which was hypothesized as a primary driver for the pronounced increase in abundance due to increased productivity following the fire (Pierce and Podner 2011). If the conditions responsible for driving the post-fire increase have subsided, the Cutthroat Trout population may be approaching pre-disturbance baseline levels. The disproportionately low Bull Trout abundance may be due to conditions in FMO habitat outside of Copper Creek. Copper Creek will be monitored frequently for the next five to ten years as part of the UBMC effectiveness monitoring program. Annual water temperature monitoring during 2016-2020 recorded an average maximum daily water temperature of 62.8^{o} F for July and August at stream mile 1.1. All water temperature monitoring data can be found in Appendix D.

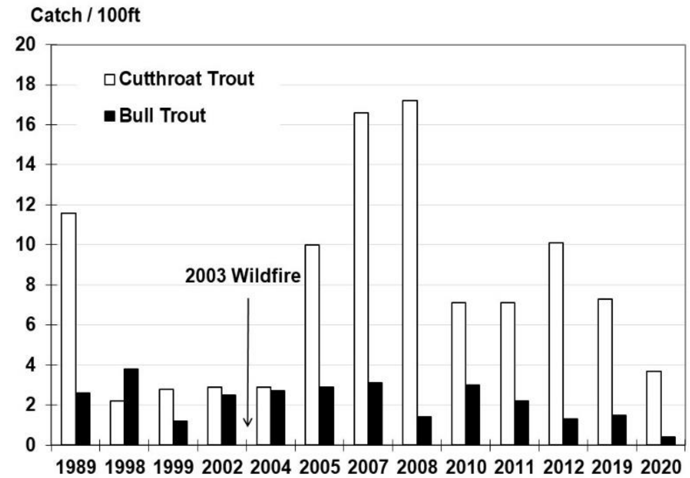

Figure 26. CPUE for age-1 and older native trout in Copper Creek at mile 6.2, 1989-2020.

Cottonwood Creek

Restoration objectives: Improve degraded habitat; eliminate fish losses to irrigation ditches; restore instream flows and migration corridors for native fish. Increase recruitment of Westslope Cutthroat Trout to the Blackfoot River.

Project summary

Cottonwood Creek, a 3rd order stream, drains a 70 mile^2 watershed and flows approximately 18 miles south from Morrell Mountain to the Blackfoot River near river mile 43. It has an average baseflow of 15-20 cfs. The largest tributary to upper mainstem of Cottonwood Creek is the North Fork of Cottonwood Creek that enters near stream mile 13.4. Shanley Creek enters near stream mile 5.6 and is the largest tributary to the lower mainstem. Cottonwood Creek originates on the Lolo National Forest before entering state owned lands (FWP, DNRC, and University of Montana) and small sections of private land near mile 12.

Cottonwood Creek has been the focus of ongoing restoration since 1996. All significant anthropogenic limiting factors have been addressed. Fisheries improvements began with a fish-friendly irrigation project at mile 12.0 that enhanced flows, improved fish passage and screened fish from an irrigation ditch. Prior to this work, a portion of Cottonwood Creek was completely dewatered from irrigation withdrawals during late summer and fall. Subsequent projects included the removal of two diversions, instream flow enhancement on lower Cottonwood Creek, and riparian fencing projects on the Blackfoot Clearwater Game Range to remediate livestock degradation of the channel. In 2007, the USFS upgraded a small culvert with a concrete bridge near mile 16. In 2014, the USFS conducted a channel reconstruction project in the intermittent section and conducted follow-up construction after the 2018 floods damaged a portion of the original project. The high snowpack in the Rice Ridge Burn area contributed to significant runoff in 2018 that caused a channel avulsion upstream of the Dryer Diversion and damaged the ditch liner. DNRC completed a bank reconstruction project in 2019 at the site of the avulsion location. The avulsion occurred at a gabion wall that was the former site of an irrigation ditch, which was decommissioned to divert water from the Dryer Ditch downstream of the fish screen. FWP reinstalled a new liner through the damaged section of ditch in 2019.

Fisheries monitoring

The headwaters of Cottonwood Creek support non-hybridized and hybridized Westslope Cutthroat Trout, Brook Trout, and very low abundance of Bull Trout. The Cottonwood Lake complex supports a small population of Rainbow Trout.

In 2020, we continued long-term monitoring of fish populations in upper Cottonwood Creek at mile 12.0, last surveyed in 2015. Aside from the initial increase in abundance due to restoration efforts that began in 1996, recent survey results indicate that Westslope Cutthroat Trout abundance has leveled off and remain relatively stable (Figure 27; Appendices A & B).

In addition to the mile 12 survey location, we resurveyed two additional sites on Cottonwood Creek at miles 12.5 and 16.0, which were originally established between 2000 and 2003. Despite intensive sampling for Bull Trout in the headwaters, recent surveys indicate very low and declining abundance of Bull Trout. Though consistently present between 1997 and 2008, more recent surveys (2009-2015) failed to detect Bull Trout presence at mile 12.0. However, the 2020 surveys revealed the presence of Bull Trout at both the mile 12 and mile12.5 survey sites

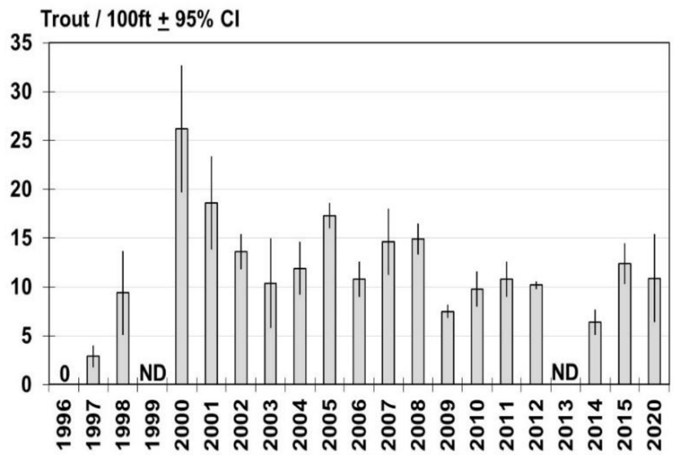

Figure 27. Abundance estimates for age -1 and older Westslope Cutthroat Trout in Cottonwood Creek at mile 12, 1996-2020.

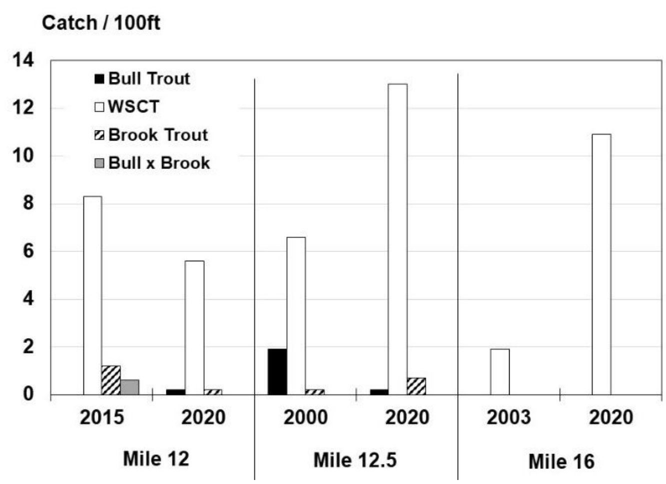

Figure 28. Catch per unit effort for age-1 and older trout at three locations in Cottonwood Creek.

(Figure 28; Appendix B). These individuals were probably produced in North Fork Cottonwood Creek and captured after migrating downstream. It is unclear if they were migrating out to the Blackfoot River or resident individuals moving downstream. To date, no Bull Trout captured in the Blackfoot River have assigned to Cottonwood Creek. Historically, suspected Bull Trout x Brook Trout hybrids were consistently found during population surveys, but none were found during the 2020 surveys.

We collected genetic samples at mile 12 and mile 16. All but two fish were identified as non-hybridized Westslope Cutthroat Trout. One fish from mile 16.0 was a non-hybridized Rainbow Trout and a single fish from mile 12 was a F1 hybrid. Since previous surveys in middle and lower Cottonwood Creek have not documented Rainbow Trout, and previous samples from Cottonwood Creek in 2000 were 100% unaltered, these fish probably indicate the recent downstream invasion of Rainbow Trout from the Cottonwood Lake complex. Although nothing is preventing Rainbow Trout from expanding upstream from the Blackfoot River, and Rainbow Trout have been captured in weir traps in lower Cottonwood Creek (Berg 1991), the lakes are the most imminent hybridization threat and warrant further investigation for potential management actions.

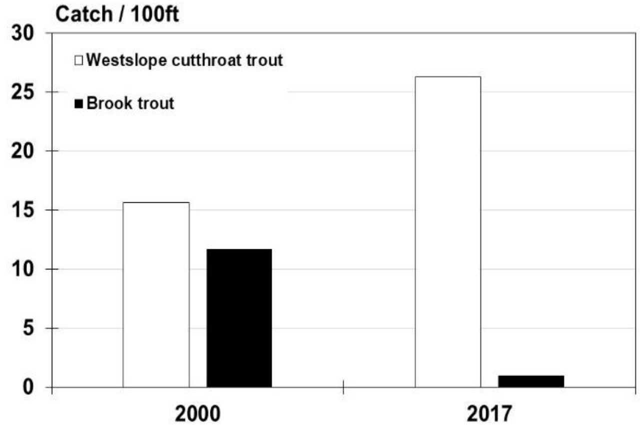

Figure 29. Catch per unit effort for age-1 and older trout on Cottonwood Creek at mile 9.3.

Twenty-two years of long-term water temperature monitoring continued in 2020 at stream mile 1.0. Moreover, FWP deployed three additional water temperature sensors within the upper Cottonwood Creek drainage at stream miles 12 and 16, and at mile 0.1 in North Fork Cottonwood Creek. All water temperature results are located in Appendix D. Most notably, the logger at Highway 200 had maximum August temperatures near 65°F, whereas the loggers at the Dryer Diversion (mile 16) and North Fork Cottonwood Creek had August maximum temperatures near 58°F, indicating thermal suitability for Bull Trout. Interestingly, the maximum temperatures at the Dryer Diversion and upper logger were within one degree which demonstrates cold water suitability over more than 4 miles of stream length. Given these temperatures are within the acceptable range for Bull Trout, there should be enough thermally suitable habitat to support resident life history forms of Bull Trout.

Cottonwood Creek (tributary to Douglas Creek)

Cottonwood Creek is a 2nd order tributary to Douglas Creek, a major tributary to Nevada Creek. Approximately 17.2 miles in length, Cottonwood Creek drains a 37.1 mi^2 basin and flows through private, state, and BLM land. The lower reach of Cottonwood Creek flows through private ranchland and has degraded habitat. Large sections of the lower drainage have poor riparian conditions and lack overhanging vegetation. Streambank erosion and lack of instream habitat contribute to low habitat capacity and the inability to support salmonids. The lower portion of the stream dewaters from irrigation withdrawals. The low flows combined with lack of overhanging vegetation cause elevated water temperatures in lower Cottonwood Creek. These warm flows combined with warm flows in Douglas Creek contribute to the warming of Nevada Creek (Appendix D).

Upper Cottonwood Creek contains a healthy riparian area. It includes a coniferous overstory with an understory of rocky mountain maple, alder, and a diverse herbaceous flora community. Instream woody debris is abundant, providing complex and suitable fish habitat. Stream substrate in this section is predominately gravel and cobble, but some boulders are present creating pocket pools for fish. The relatively intact condition of the upper watershed maintains a suitable thermal regime for native salmonids. Cattle use is present in the upper drainage, but their impacts to the stream channel and riparian area are minimal.

Fisheries monitoring

In 2017, FWP resurveyed an upper Cottonwood Creek survey location originally established in 2000 at stream mile 9.3 to collected genetic samples and conduct disease testing on Westslope Cutthroat Trout as a possible donor stock for the North Fork Blackfoot River Westslope Cutthroat Trout conservation project (Pierce et al. 2018). Electrofishing surveys documented an increase in relative abundance of age-1 and older Westslope Cutthroat Trout to 26.3 fish/100ft compared to the 2000 survey results of 15.6fish/100ft and a substantial decline from 11.7 Brook Trout/100ft to 1.0fish/100ft (Figure 29; Appendix A). These relative abundances are consistent with reference streams in the middle and upper Blackfoot drainage, suggesting that upper Cottonwood Creek supports a robust, pure isolated population. Genetic results from 18 Westslope Cutthroat Trout samples collected at stream mile 9.3 found no evidence of hybridization. Disease testing results from 60 Cutthroat Trout collected from two locations (stream miles 9.3 and 11.3) detected the presence of whirling disease infection caused by the invasive myxosporean parasite (*myxobolus cerebralis)*.

Dick Creek

Restoration objectives: Improve degraded habitat; eliminate fish entrainment in irrigation ditches; improve water quality to lower Monture Creek; increase trout recruitment to the Blackfoot River

Project summary

Dick Creek, a 3rd order tributary, drains the western slopes of Ovando Mountain and flows through the Lolo National Forest, DNRC, Blackfoot Challenge, and private ranch lands before entering Monture Creek at mile 4.1. With a total length of 13.6 miles, the upper portion of Dick Creek is a relatively steep mountain stream before entering a large alluvial fan in the middle reaches and knob-and-kettle topography in the lower basin. Dick Creek flows through a series of wetlands, which contribute to elevated water temperatures in the lower reaches.

Restoration actions have occurred in Dick Creek since the 1990s. Early projects focused on channel realignment, grazing management, and channel reconstruction in the meadow section below Widgeon Marsh. Furthermore, Widgeon Marsh was enhanced with a dam control structure to increase the wetland surface area for waterfowl. Other projects have occurred in the reaches above the marsh on the BCCA. In 2007, a Coanda fish screen was installed on an irrigation ditch near stream mile 6.1. In 2008, spring development projects were initiated on the BCCA in upper Dick Creek to provide off-stream livestock water to protect riparian health and improve existing riparian and streambank conditions. A large channel restoration and reconstruction project occurred in upper Dick Creek on the BCCA in 2010 that included habitat improvements on 5,000 ft of stream and improved passage by removing one culvert and upgrading another culvert crossing.

Fisheries monitoring

In 2019 and 2020, FWP conducted fish population surveys at five locations in Dick Creek to assess Westslope Cutthroat Trout distribution throughout the drainage. We re-surveyed sections at miles 4.7 and 7.8, originally established and last surveyed in 2001. The site at mile 4.7 was one of three fish population surveys conducted in lower Dick Creek that were in stream reaches influenced by wetlands and groundwater inflows (Pierce et.al 2001).

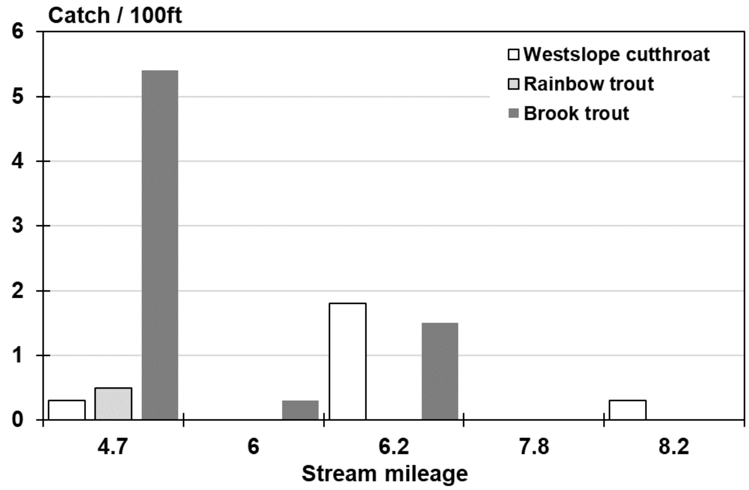

Figure 30. CPUE for trout species at five locations in Dick Creek, 2019 and 2020.

Like the original 2001 survey, Brook Trout were the most abundant species present at mile 4.7 in 2019. Additionally, the survey also documented the presence of Rainbow Trout and Westslope Cutthroat Trout (Figure 30; Appendix A). Abundant Sculpin, Redside Shiner, Longnose Sucker, and Largescale Sucker were also present. In contrast, the 2001 surveys found Rainbow Trout were only present in lower Dick Creek near stream mile 0.1 in moderate abundance as well as Brown Trout (Pierce et al 2001). Moreover, we also electrofished a few pools directly below the Widgeon Marsh dam and captured a Brown Trout in the pool below the spillway. Collectively, these results indicate upstream expansion by nonnative trout in Dick Creek.

In 2020, we established three new fish population survey sites in the middle to upper reaches of Dick Creek to further investigate Westslope Cutthroat Trout distribution and to collect genetic samples for analysis. Surveys were conducted at stream miles 6.0 and 6.2 in addition to, re-surveying the 2001 site at mile 7.8. Results from these three sites located upstream and downstream of a large, screened irrigation ditch recorded very low abundance of Westslope Cutthroat Trout and Brook Trout. No fish were found at the mile 7.8 survey location. A fourth survey was conducted in the upper part of the Dick Creek drainage near mile 8.2, documenting very low abundance of Westslope Cutthroat Trout (Figure 30; Appendix A).

A total of six genetic samples were collected during the survey at mile 6.2. Although the sample size is small, all fish were genetically unaltered Westslope Cutthroat Trout, which is consistent with genetic results from 2003. Since Rainbow Trout and hybrids were encountered below the marsh, we are uncertain if the dam is serving as a barrier, Rainbow Trout have not expanded this far upstream, or our small sample size was too small to detect hybridization in this section of Dick Creek. Additional sampling is warranted to increase sample size for genetic analyses and document any shifts in distribution of Rainbow Trout and hybrids.

Summer water temperature monitoring occurred at four locations in 2018 (miles 1.0, 4.7, 5.3 and 6.3) to assess restoration potential for native species. We recorded maximum summer temperatures of 71.1°F (mile 1.0), 66.3°F (mile 4.7),73.2°F (mile 5.3) and 56.7°F (mile 6.3) during July and August. The significant increase over the lower 6.3 miles of stream channel is primarily due to the warming effects of Dick Creek flowing through Widgeon Marsh and the lack of shading in large sections of the lower drainage. Unlike summer temperatures in lower Dick Creek, the mean daily temperatures during July and August at mile 6.3 were among the coldest for tributaries in the middle Blackfoot River drainage. Maximum temperatures were below 57°F until the naturally intermittent section went dry in mid-August. All 2018 water temperatures for the Dick Creek drainage are located in Appendix D.

Douglas Creek

Douglas Creek, a 3rd order stream, drains the largest subbasin in the Nevada Creek watershed. The mainstem is 22 miles in length and enters Nevada Creek at mile 4.4. Direct tributaries in the upstream direction are Cottonwood Creek (mile 1.2), Chimney Creek (mile 9.8), Murray Creek (mile 10.6), and Sturgeon Creek (mile 11.6). Douglas Creek originates on BLM and Nature Conservancy properties before flowing through private ranchlands in the middle and lower reaches.

Upper Douglas Creek is separated from the middle and lower reaches by four irrigation reservoirs. In 2001, a restoration project added bypass channels with step-pool fish ladders to the upper reservoirs to facilitate Westslope Cutthroat Trout passage and connectivity through the impacted reach and into upper Douglas Creek. Therefore, the lowest reservoir currently isolates the upper drainage from the significantly degraded lower drainage. This creates approximately 8 miles of connected stream and lake habitat for the isolated population of Westslope Cutthroat Trout.

<u>Fisheries monitoring</u>

In 2019, FWP established two new fish population survey locations on Nature Conservancy land in upper Douglas Creek at stream miles 16.1 and 17.3. Visual assessments documented a 5-foot diameter road culvert perched about 1 foot at the mile 16.1 survey site and an undersized 3-foot road culvert at the mile 17.3 survey location. The crossing at mile 16.1 also had a smaller, secondary culvert that probably accommodates fish passage if the height of the perched culvert prevents passage of small fish. Although upgrading both culverts would be beneficial for stream health and function, neither crossing was considered a barrier. Both survey locations have localized areas of highly degraded stream banks from intense livestock use that contributes to moderate levels of sediment near the culverts. Aside from these localized grazing impacts and historical logging roads in the valley bottom, the instream habitat and immediate riparian area are intact.

Fish population surveys in 2019 found moderate numbers of age-1 and older Westslope Cutthroat Trout at both survey locations, documenting CPUE of 11.5 trout/100ft and 6.3 trout/100ft at miles 16.1 and 17.3, respectively (Appendix A). Baseline survey data is limited for providing a context for these 2019 estimates. A nearby site at stream mile 15.3 recorded a CPUE of 6.3 age-1 trout/ 100 ft in 1994. The 2019 estimates indicate that the population is fairly robust and either stable or increasing since the early 1990s. Furthermore, compared to other reference

Westslope Cutthroat Trout populations, the relative abundance of this isolated population is consistent with populations in higher priority tributaries. Interestingly, a large section of upper Douglas Creek was dry and lacked a clearly defined channel between the upper section of the TNC parcel and the upper portion of BLM property where perennial flow was present. We electrofished a small site above the dry section to determine fish presence and documented Westslope Cutthroat Trout. Moreover, we observed many Cutthroat Trout in the large pool where the flow goes subsurface.

Genetic analyses from 20 Westslope Cutthroat Trout samples collected in 2019 were inconclusive. In 2020, we collected an additional 26 genetic samples from two more locations on upper Douglas Creek to provide a more robust evaluation of the genetic status of the isolated population. The results suggest that there might be a very small amount of Rainbow Trout admixture in the population, although it still has high conservation value and will be managed as such. Given the uncertainties, we will continue to manage Douglas Creek in the same manner as an isolated, genetically unaltered population. If future efforts to translocate or develop brood-stock with this population are desired, additional sampling and genetic tools will be used to unequivocally determine if the population is hybridized (Kovach et al. 2021). Future monitoring should focus on developing a better understanding of the dry sections, estimating the total amount of connected habitat above the irrigation reservoirs, and monitor habitat improvements associated with cattle management. Nevertheless, upper Douglas Creek is considered an important component of the broader conservation portfolio in the basin because it contains a relatively large patch of isolated, secure habitat to facilitate long-term persistence of this conservation population of Westslope Cutthroat Trout.

Dunham Creek

Restoration objectives: Eliminate the loss of native fish to irrigation canals; restore habitat conditions and migration corridors; improve recruitment of Bull Trout and Westslope Cutthroat Trout to the Blackfoot River.

<u>Project Summary</u>

Dunham Creek is 3rd order stream and the largest tributary to Monture Creek. It supports spawning and rearing for fluvial Westslope Cutthroat Trout and fluvial Bull Trout. It drains 32.8 miles^2 and flows approximately 14.4 miles before entering Monture Creek at mile 11.5. It originates in high subalpine basins near the southern slopes of Monture Mountain located on the southern boundary of the Bob Marshall Wilderness. Most of its stream length flows through heavily forested sections on the Lolo National Forest before entering private ranchland near stream mile 1.6. Dunham Creek has a base flow discharge of 15-20 cfs, which is fed primarily by Lodgepole Creek that enters Dunham Creek near stream mile 6.8 and contributes approximately 8-12cfs. Dunham Creek has two intermittent reaches in the middle and lower reaches that are fish passage barriers during base flow conditions.

The 2017 Rice Ridge wildfire burned 155,900 acres between Seeley Lake and Ovando, including a large portion of the Dunham Creek drainage. The impacts were most pronounced in the upper drainage in Lodgepole Creek. The wildfire impacts contributed to significant instability of hillsides throughout the drainage. Mass wasting events occurred in Nome and Spruce Creeks in the Lodgepole Creek drainage, transporting large amounts of sediment through the Dunham Creek drainage and Bull Trout spawning reach during high flow events. Specifically, a large precipitation event in July 2019 caused landslides and debris flows in Spruce Creek. A significant amount of sediment was mobilized downstream into Lodgepole, Dunham, and Monture creeks, and ultimately the Blackfoot River. A few days after the disturbance, we investigated conditions in Dunham Creek about six miles downstream of the debris flow. We discovered significant sediment deposition (Figure 31), but fish were still present and alive. In one pool, we captured multiple Cutthroat Trout, Brook Trout, and juvenile Bull Trout. Higher concentrations of LWD from the wildfire have created complex fish habitat, but have also led to some stream channel migration and channel braiding. The increased LWD has also increased the storage capacity of sediment behind log jams. Notably, during the 2020 fish population survey through the project area (mile 4.2) we observed many of the reconstructed pools filling in from upstream bedload movement and were generally not functioning as intended.

Figure 31. Debris flow in Spruce Creek (Left, Photo Credit: Forest Service). Sediment deposition in Dunham Creek following the disturbance upstream in Spruce Creek (Right).

Fisheries monitoring

Dunham Creek supports populations of genetically pure, fluvial Westslope Cutthroat Trout, fluvial Bull Trout, and resident Brook Trout. In 2020, FWP monitored fish populations at miles 2.3. and 4.2 that were originally established in 1996, and a site at mile 7.0 that was established in 2017. The 2020 survey represented the first documented presence of Brown Trout in Dunham Creek. Recent surveys continue to show a significant decline in Bull Trout abundance at miles 2.3 and 4.2. The low Bull Trout abundance at mile 7.0 is also consistent with this trend. Conversely, Westslope Cutthroat Trout and Brook Trout numbers remain relatively stable throughout the three survey sections. We also conducted a fish health inspection of 60 Westslope Cutthroat Trout in 2017 at miles 4.2 and 7.0. Disease testing results did not detect the presence of any pathogens. The single Brown Trout captured at the mile 2.3 site suggests the possible colonization of Dunham Creek and expansion of Brown Trout from lower Monture Creek (Figure 32; Appendices A & B). Overall, the results from electrofishing surveys suggest that no direct mortality or acute impacts occurred from the 2019 environmental disturbances. Continued monitoring will be critical to understand if populations in Dunham Creek exhibit similar post-fire responses like populations in Copper Creek in the mid-2000s.

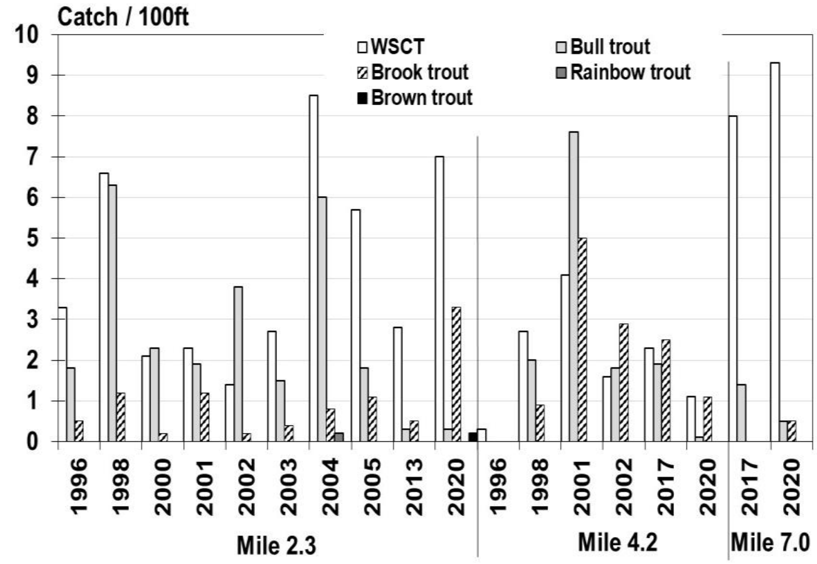

Figure 32. CPUE for age-1 and older trout at three locations on Dunham Creek, 1996-2020.

We observed 5 redds in the index section in 2020, which is the first time redds have been documented in the index section since 2015. Several subadult Bull Trout were observed in large pools throughout the index reach during the 2020 survey. Redds have been consistently observed in the perennial section below Cottonwood Lakes road the last three years (see *Bull Trout Monitoring* section above).

We deployed an additional water temperature sensor at stream mile 3.95 in 2020 to investigate the status and trends of the thermal regime within the spawning index section. Temperature monitoring recorded a maximum summer daily temperature of 59.2^{0}F in August. All 2020 water temperature results are located in Appendix D.

Game Ridge tributaries

Restoration objectives: Maintain and enhance riparian corridors; increase persistence of viable isolated fish populations; protect aquatic habitat values associated with the disconnected, relic channels in the area.

Fisheries monitoring

The area north of Nine Mile Prairie contains many ephemeral streams and a few perennial streams. None of these streams currently have surface water connection to the Blackfoot River. Much of this land is currently owned and managed by the Nature Conservancy. A previously unnamed tributary contained pure Westslope Cutthroat Trout and is currently named Game Ridge Creek. Following the survey in 2016, additional surveys were conducted in 2020 to provide a more comprehensive inventory of aquatic and fishery resources to document fish presence and provide information to TNC and other land management partners to inform management activities. Electrofishing surveys were conducted in perennial flowing sections of streams and visual surveys were conducted in drainages suspected of having water (Figure 33).

We visited all the named drainages including Jamison Gulch, Black Canyon Creek, and Woodchuck Gulch. Woodchuck Gulch did not contain water and large portions of the drainage lacked a defined channel. The small unnamed drainage to the west of Woodchuck contained a very limited amount of flow at the road crossing and was deemed inadequate to support fish. Upper Jamison Gulch was dry, but the lower portion had enough water to conduct an electrofishing survey. The streamflow was very low, and we did not capture any fish, so it is assumed that the entire drainage is fishless. The unnamed drainage to the west of Jamison Gulch had some crossings with flow and others that were dry. The flow was very minimal and did not appear adequate for supporting fish populations. The large, unnamed drainage to the east of Black Canyon Creek had enough water to conduct electrofishing surveys, but no fish were captured. Black Canyon Creek had sufficient water for electrofishing surveys in the upper and lower portions of the drainage. We assume that fish are not present in this drainage. Interestingly, the previously unnamed stream, now call Game Ridge Creek, contains a viable population of pure, Westslope Cutthroat Trout. A large section (~2,800 feet) was shocked and had an estimated trout density of 0.7 trout/100ft. Genetic samples were collected and inventoried but have not been analyzed yet. These fish are presumed genetically unaltered because the stream is completely isolated, and no Rainbow Trout have been documented in this area. Until genetic samples confirm otherwise, this population is considered a genetically pure, isolated population for management and conservation purposes.

The upper forks of Game Ridge Creek were dry (west fork) or contained limited flow (east fork). Neither fork appeared capable of supporting fish. A large, unnamed drainage a few drainages to the west of Game Ridge Creek also contained a perennial flowing section. No fish were captured in the two surveys in this creek. Based on these two surveys covering the upper and lower sections of this drainage, we assumed that fish are not present. The road crossing in the drainage to the west of this one was also dry. With the isolated status and a relatively small population size, Game Ridge Creek presents an interesting opportunity to assess inbreeding depression and continue monitoring genetic status in the future.

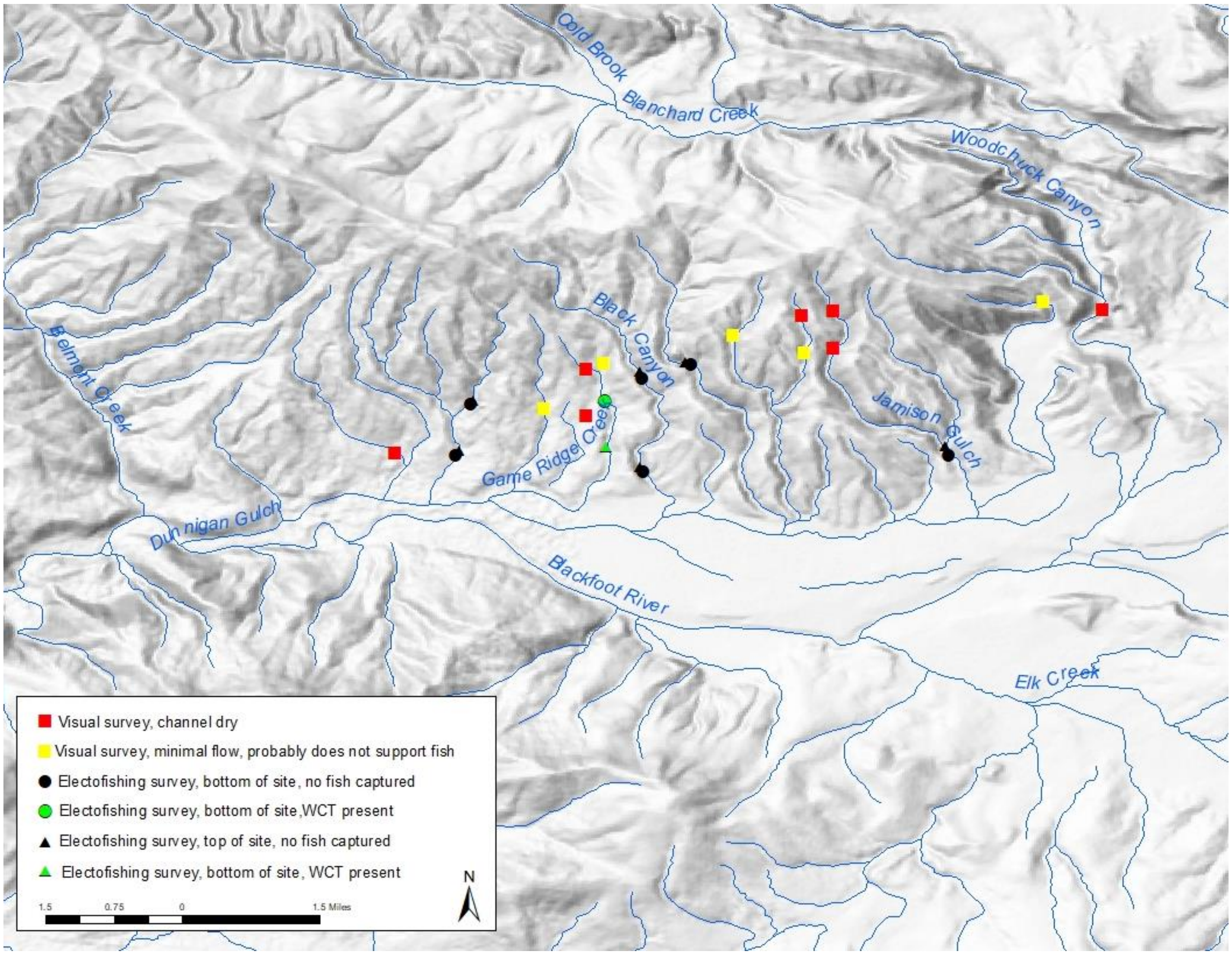

Figure 33. Map of survey locations in Game Ridge drainages, 2016-2020.

Gold Creek

Restoration objectives: Restore pool habitat and morphological complexity; restore thermal refugia for Blackfoot River native fish species. Reduce chronic and episodic road sediment sources and increase native fish habitat availability

<u>Project summary</u>

Gold Creek, a large 3rd order tributary, originates in headwater lakes in the Rattlesnake Wilderness Area. Gold Creek drains a 62.6 mi^2 watershed from the western slopes of Gold Creek Peak and Black Mountain and flows 19.9 miles to its confluence with the lower Blackfoot River at mile 13.5. Average baseflows range from 20 to 25 cfs. The West Fork of Gold Creek, the largest tributary to Gold Creek, enters near mile 6.8. Approximately 66% of the Gold Creek watershed was managed as industrial forest (Plum Creek Timber Company) prior to 2014 when those lands were purchased by TNC. Most the drainage is currently under public ownership managed by the Lolo National Forest, with some remaining TNC land considered for future public acquisition. A few parcels of private inholdings are present in the lower and middle portions of the drainage.

Prior restoration actions include removal of several culverts and mechanical ripping of decommissioned roadbeds. There were also several sediment reduction measures associated with logging roads including the installation of rolling dips and seeding and closing roads after logging was completed. Past harvest of riparian conifers combined with the removal of large wood from the channel has also reduced habitat complexity in the lower three miles of Gold Creek. In 1996, a cooperative project installed 66 habitat structures made of native material (rock and wood) constructing 61 new pools in the three-mile section (Schmetterling and Pierce 1999). Bridge upgrades have recently occurred in the upper drainage and in West Fork Gold Creek.

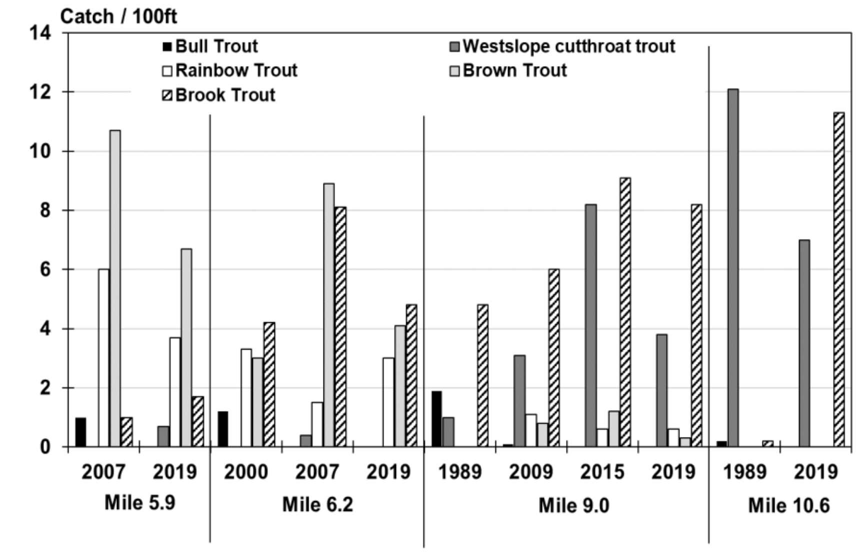

Figure 34. Catch per unit effort for age-1 and older trout at four locations on Gold Creek, 1989-2019.

Fisheries monitoring

Gold Creek is a major tributary to the lower Blackfoot River and provides important spawning and rearing habitat for migratory Westslope Cutthroat Trout, Rainbow Trout, and Brown Trout. Resident Brook Trout also inhabit the drainage. Gold Creek is considered a Bull Trout core area stream. Historically, Bull Trout were present throughout the Gold Creek drainage and exhibited migratory life histories, but distribution and abundance of Bull Trout have declined substantially over the past 15 recent years. In 2019, we resurveyed four locations in the middle and upper reaches of Gold Creek (miles 5.9, 6.2, 9.0 and 10.6) to assess Bull Trout presence and investigate current longitudinal species distribution and composition. The two sites in the middle reach (miles 5.6 and 6.2) are within the historical Bull Trout spawning index reach and were originally established in 2007 and 2000, respectively. The two upstream locations (miles 9.0 and 10.6) were established in 1989.

Bull Trout were not observed at any of the survey sites where they were present in prior surveys (Figure 34). Consistent with Bull Trout declines at all monitoring sites, redd counts conducted by Plum Creek Timber Company from 2004 through 2014 and by FWP personnel through 2020, show a similar declining trend (Table 1). Along with long-term declines in Bull

Trout, the surveys show increasing numbers of nonnative trout in the upstream direction. Westslope Cutthroat Trout are primarily found at the two upstream survey locations (miles 9.0 and 10.6) where their abundance remains low to moderate, but relatively stable. Furthermore, Brook Trout densities at mile 9.0 and 10.6 suggest that their abundance has been increasing through time. The site at mile 10.6 was not surveyed since 1989, at which point it was comprised primarily of Bull Trout and Westslope Cutthroat Trout, with minimal Brook Trout. This upper site maintains ideal Bull Trout water temperatures and would be expected to harbor at least a remnant resident population. Given that the composition has shifted so dramatically over the last 30 years, it appears that Brook Trout have replaced Bull Trout and are now the most abundant species in this upper section. Electrofishing and spawning ground surveys suggest local extirpation of Bull Trout in the Gold Creek drainage. Fisheries summary data for 2019 is in Appendix A.

Since 1998, annual water temperature monitoring has occurred in Gold Creek at mile 1.6. The mean maximum daily temperature for July and August since 2016 was 64.7^{0}F. In 2019, FWP redeployed a temperature sensor in the established Bull Trout spawning index section at mile 6.2 that was previously monitored in 1999 and 2002-2005. We also established a new location in upper Gold Creek at mile 9.0. In 2019, the monitoring site at mile 9.0 averaged 7.6^{0}F cooler than the lower Gold Creek monitoring location at mile 1.6. Maximum August temperatures in 2020 were 65.7°F, 61.9°F, and 57.4°F at mile 1.6, mile 6.2, and mile 9.0, respectively. These longitudinal temperature data demonstrate the reduction in thermal suitability for viable migratory Bull Trout populations. A summary of all water temperature monitoring is located in Appendix D.

Grantier Spring Creek

Restoration objectives: Restore natural channel features of a degraded spring creek and increase recruitment of Westslope Cutthroat Trout and Brown Trout to the upper Blackfoot River.

<u>Project summary</u>

Grantier Spring Creek is a large spring creek tributary to lower Poorman Creek, which enters the upper Blackfoot River at river mile 108. Grantier Spring Creek was the first major spring creek restoration project undertaken in the Blackfoot River Basin. Restoration work has been ongoing over the last 30 years. Additional restoration actions occurred in 2019 and 2020 that focused on increasing pool quality and restoring channel morphology between Pond 2 and Pond 3. A recent synthesis of long-term fish and habitat

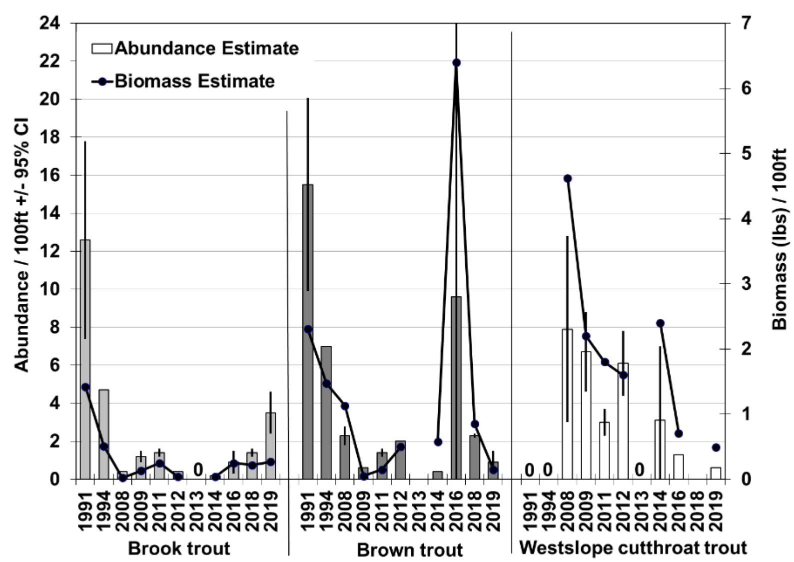

Figure 35. Abundance and biomass estimates for age -1 and older trout in Grantier Spring Creek at mile 1.0, 1991-2019.

monitoring, including future habitat restoration recommendations is described in Pierce et al. (2019b).

Fisheries monitoring

FWP established a fish population monitoring site in 1991 at mile 1.0. Brook Trout and Brown Trout were the only salmonids present in the early years of monitoring (1991 and 1994). We resurveyed the mile 1.0 site annually between 2008 and 2014 and found Westslope Cutthroat Trout were prevalent. Since 2014, surveys completed between 2016-2019 revealed a declining trend in age-1 and older Westslope Cutthroat Trout abundance (Figure 35). However, the 2019 survey revealed considerable abundance of age-0 Westslope Cutthroat Trout (Appendices A & B). Moreover, a spawning survey in 2019 documented a record number of Westslope Cutthroat Trout redds (n=33) within the upper spring creek. Another spawning survey in 2020 revealed 14 Cutthroat Trout redds. Brown Trout spawning surveys documented 110, 65, and 60 redds in 2018, 2019, and 2020, respectively. Due to the small sample size, and similarity of 2019 and 2020 redd counts, it is unclear if the 2018 spawning activity was abnormally high or if the last two years are below average. Future monitoring will focus primarily on spawning surveys for assessing population status and trends, but periodic electrofishing surveys at established monitoring sites will be used as effectiveness monitoring for ongoing restoration efforts.

Johnson Creek

Restoration objectives: Restore connectivity for migratory trout; eliminate anthropogenic impacts throughout drainage; facilitate post-fire watershed improvements; improve recruitment of multiple trout species to the Blackfoot River; provide thermal refugia opportunities in Johnson Creek.

Project summary

Johnson Creek is the furthest downstream tributary of the Blackfoot River. It drains a 7.8 mile^2 watershed fed by the southeastern slopes of Blue Point and western slopes of Wisherd Ridge. Flowing in a southernly directions it enters the Blackfoot River near river mile 3.0. The West Riverside Fire burned large portions of the Johnson Creek drainage in 2011. A 1997 fish population survey revealed fish passage issues at a series of undersized culverts in lower Johnson Creek near the confluence with the Blackfoot River. The culverts were replaced with a bridge in the winter of 1997. The Forest Service acquired commercial timberland throughout the Johnson Creek drainage and removed and upgraded culvert crossings in the headwaters of the drainage following the West Riverside Fire. The drainage area is managed almost entirely by the Lolo National Forest (> 99%), except for 36 acres of private land near the mouth.

Fisheries monitoring

Johnson Creek supports several fish species including Rainbow Trout, Brown Trout, and Westslope Cutthroat Trout. Swanberg (1997) documented Bull Trout using Johnson Creek as thermal refuge, although Bull Trout have not been encountered during any of our electrofishing surveys. A single pass fish population survey was conducted in 2019 at stream mile 0.9. Results showed higher abundance of age-1 and older Cutthroat Trout, Rainbow Trout, and Brook Trout compared to the 1997 survey (Appendix A). With only a single previous survey for comparison, it is unclear if this increase is within the range of natural variability, or previous restoration actions led to increased production in the drainage. In April 2020, FWP personnel operated a weir trap near the mouth of Johnson Creek to trap, tag, and collected genetic samples (fin clips) from spawning Rainbow Trout and Cutthroat Trout (see *Research Project Reports* section).

Water temperature monitoring in Johnson Creek last occurred on a summer seasonal basis in the mid to late 1990s and in 2005. We deployed a water temperature sensor in 2020 to assess long-term temperature changes from previous monitoring records and compare to other lower Blackfoot River tributaries in the trapping study. Water temperatures at the mouth of Johnson Creek reached a maximum of 57.4°F during August, indicating Johnson Creek is among the coldest tributary inputs to the lower Blackfoot River. Complete water temperature results are located in Appendix D.

Lincoln Spring Creek

Lincoln Spring Creek is a large, low gradient, 1st order spring creek that originates from the alluvial aquifer underlying the Lincoln Valley. The stream is 5.3 miles in length and flows entirely through private land. Lincoln Spring Creek enters the town of Lincoln at mile 3.4. Within the town of Lincoln MT, fisheries impairments relate to residential developments and include channel alterations, undersized culverts, artificial grade control (rock dams), and the removal of woody riparian vegetation. These issues contribute to a wide, shallow channel with low-quality trout habitat. At mile 2.9, the spring creek splits into two separate channels. The south channel continues to flow through residential neighborhoods and exits the town at mile 2.1. The north channel flows through willow-dominated wetlands. The two channels combined at mile 1.0 before entering Keep Cool Creek at mile 0.5.

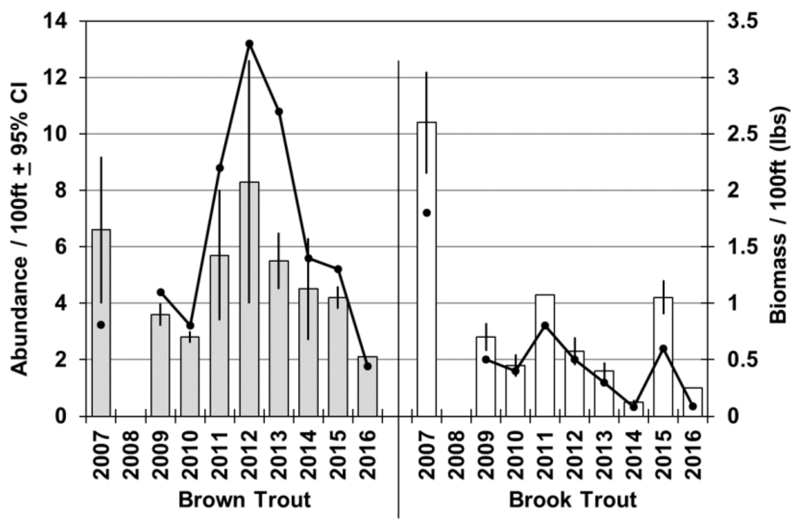

Figure 36. Estimates of abundance and biomass for age-1 and older Brown Trout and Brook Trout in Lincoln Spring Creek at mile 3.8, 2007-2016.

Lincoln Spring Creek was reconstructed in 2008 from mile 5.3 to 3.4 to achieve a more natural narrow and deep, gravel-based channel with increased stream sinuosity. This project, located upstream of the town of Lincoln, included the placement of instream wood, re-vegetation of stream banks, removal of three undersized culverts, and one irrigation diversion upgrade. In 2010, partners collaborated with Lewis and Clark County to replace an undersized culvert with a bottomless arch culvert. BBCTU implemented another large-scale restoration project downstream of Lincoln in 2018. The 4,400 ft project included installation of sod mats and root mimicry to reestablish natural channel morphology and increase habitat complexity. Overall, the project increased floodplain connection and natural spring creek channel function through the section.

Fisheries monitoring

Lincoln Spring Creek supports Brown Trout and Brook Trout with the occasional presence of Westslope Cutthroat Trout. In 2007, we established a pre-treatment fish population survey within the project area at mile 3.8 and continued to monitor fish populations through 2016 (Figure 36; Appendices A & B). The surveys show Brown Trout biomass increasing until 2012 followed by a decrease in recent years. Although there was an initial increase in abundance following the 2008 project, it's unclear if that was due to natural variability or a project response because the long-term trend suggests that the project actions have not elicited a sustained fishery response in terms of increased abundance in the sampling section. Future monitoring of the 2008 project will occur infrequently and more effort will be directed towards monitoring in the 2018 restoration project section.

Lodgepole Creek

Lodgepole Creek originates in high subalpine basins on the north slopes of Nome Point located near the southern boundary of the Bob Marshall Wilderness. A 2nd order tributary stream, it enters the middle reach of Dunham Creek at mile 6.8 and drains a 13.8 mile^2 watershed. It flows approximately 7.2 miles through coniferous forests entirely on Lolo National Forest land. The middle reaches of Lodgepole Creek are fed by two small 1st order tributaries, Spruce and Nome Creeks entering at stream miles 1.8 and 0.7, respectively. Both contribute to Lodgepole Creek's annual base flow of 8-12 cfs.

The 2017 Rice ridge wildfire burned 155,900 acres between Seeley Lake and Ovando, MT and burned a large portion of the Dunham Creek drainage. The wildfire impacts created instability and increasing avulsions and mass wasting on adjacent hillside slopes in the upper Lodgepole Creek drainage. Specifically, a large precipitation event in July 2019 caused mass wasting events and debris flows in Spruce Creek, a non-fish bearing tributary of Lodgepole Creek. However, a significant amount of sediment was mobilized downstream into Lodgepole, Dunham, and Monture creeks, and ultimately the Blackfoot River.

Fisheries monitoring

Lodgepole Creek supports populations of Westslope Cutthroat Trout, Bull Trout, and Brook Trout. A fish population survey section was originally established in 1996 at stream mile 0.1. In 2020, we resurveyed the section at mile 0.1 to investigate changes in species composition, abundance, and monitor short term and long-term impacts from the Rice Ridge Fire. We conducted a two- pass depletion survey (not displayed in Figure 37) and estimated the total abundance of age-1 and older trout as 62.2 $\pm$ 16.2 (Appendices B). We observed significant sediment deposition from the 2019 landslide disturbances. However, overall trout density, biomass,

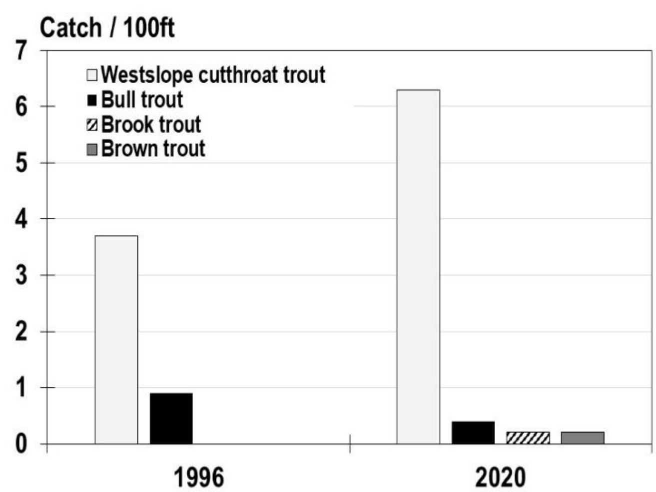

Figure 37. Catch per unit effort for age-1 and older trout at mile 0.1 on Lodgepole Creek, 1996 and 2020.

and age-structure suggest no immediate short-term impacts from those disturbances. Sampling also identified the presence of Brook Trout and one Brown Trout, documenting the upstream expansion of both nonnative species (Figure 37; Appendices A & B). The observation of a Brown Trout in the survey section represents their first documented presence in Lodgepole Creek. Given the size of the fish, it is likely a pioneering subadult rather than an indication that spawning is currently occurring in this section. This highlights the need to expand temperature monitoring in upper Dunham Creek and Lodgepole Creek to see if this expansion is consistent with the Brown Trout expansion and temperature trends documented in Al-Chokhachy et el. (2016). Furthermore, the lower abundance of Bull Trout in 2020 compared with 1996 is consistent with the juvenile abundance and redd count trends in Dunham Creek. Further investigation is needed to determine if the Bull Trout in Lodepole Creek are resident individuals, or offspring of migratory individuals that spawn in Dunham Creek or Lodgepole Creek. Ongoing monitoring will investigate long term impacts associated with the Rice Ridge Fire and provide a better understanding of Bull Trout population status and life history characteristics.

Monture Creek

Restoration objectives: Restore spawning and rearing habitat for migratory Bull Trout and Westslope Cutthroat Trout; improve recruitment of Bull Trout and Westslope Cutthroat Trout to the Blackfoot River; improve adult staging areas and thermal refugia for fluvial Bull Trout.

Project summary

Monture Creek, a 4th order tributary, drains a 152.1 mile^2 basin and flows 29.5 miles before entering the Blackfoot River at river mile 46. Average baseflow ranges from 30 to 40 cfs. The headwaters drain the southern slopes of Monahan, Foolhen, and Youngs Mountains on the edge of the Bob Marshall Wilderness Complex. Major tributaries include Dunham Creek entering at mile 11.5 and Dick Creek entering at mile 4.2. Monture Falls located at stream mile 25 marks the upper extent of Bull Trout distribution (Pierce et al. 2008). However, genetically pure Westslope Cutthroat Trout are present upstream of the falls. There is an intermittent reach between mile 13.5 and 14.5. The majority of the Monture Creek drainage is on the Lolo National Forest. The lower portion of Monture Creek drains private lands, most of which are under conservation easement.

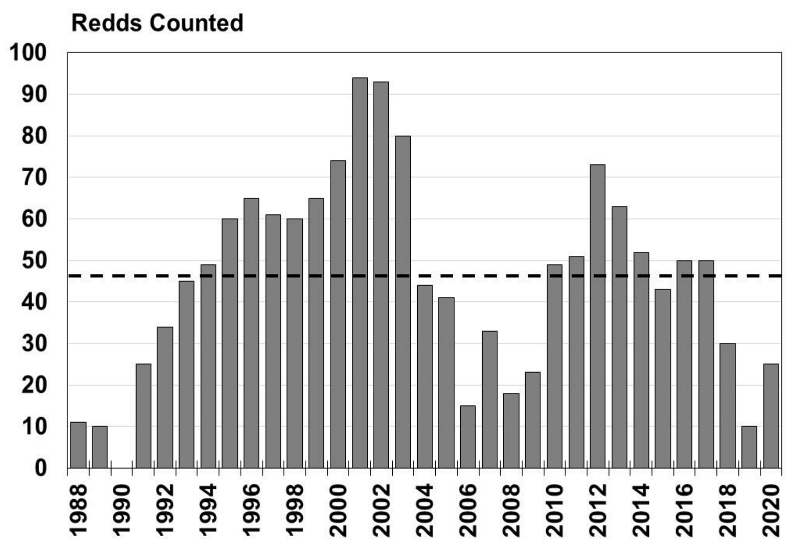

Figure 38. Bull trout redd counts for Monture Creek index section, 1988-2020. The dashed line is the long-term average.

Riparian areas in the lower reaches of Monture Creek have a long history of agricultural and forestry land uses that resulted in adverse impacts to riparian habitats (Fitzgerald 1997). All lower tributaries of Monture Creek, from Dunham Creek to the mouth, were identified as fisheries-impaired (Pierce et al. 2008). The primary instream habitat and riparian issues were corrected through decades of cooperative restoration (Pierce et al. 1997; Pierce et al. 2001). Some of the earliest restoration projects in the Blackfoot watershed were implemented in Monture Creek. In 1991, a fencing project in lower Monture Creek created a grazing exclosure to improve degraded riparian conditions. This was followed by instream work in the mid-1990s that placed LWD structures throughout 0.75 miles of stream in this section. Additional grazing management projects occurred further upstream in 1994 and 1995 that included off-channel stockwater development and grazing exclosures through the primary Bull Trout spawning section. In 2004, a major water conservation project converted wheel lines to center pivots and shifted the point of diversion from Monture Creek to a screened ditch on McCabe Creek. In 2016, a significant fencing project installed nearly 8.5 miles of riparian fencing along Monture Creek and Dunham Creek. An eroding bank at the pump station on Monture Creek was also repaired and the intake was upgraded to meet NOAA fish screening standards.

The 2017 Rice Ridge wildfire burned 155,900 acres between Seeley Lake and Ovando, including a large portion of the Monture Creek drainage. The wildfire impacts resulted in frequent avulsions and mass wasting events on adjacent hillsides in the upper Monture Creek drainage. Specifically, a large precipitation event in autumn 2019 caused landslides in Yellowjacket Creek, Bill Creek, Falls Creek, and Spread Creek. Moreover, Falls Creek had active turbidity events in May 2020. A significant amount of sediment was mobilized downstream into Monture Creek and the Blackfoot River.

Fisheries monitoring

Monture Creek is a primary spawning and rearing tributary for fluvial Bull Trout and fluvial Westslope Cutthroat Trout (Swanberg 1997, Schmetterling 2001). Reproduction and rearing of Westslope Cutthroat Trout and Bull Trout occurs primarily in the mid-to-upper basin. Lower Monture Creek supports the largest spawning run of fluvial Rainbow Trout upstream of Gold Creek (Pierce et al. 2009). Brook Trout are absent upstream of an intermittent reach at mile 14, but are found in lower Monture Creek and its tributaries downstream of the intermittent reach (Pierce et al. 2008).

Monitoring efforts conducted in the 2016-2020 period include 1) annual Bull Trout redd counts, 2) water temperature monitoring at stream miles 1.8 and 31.1, 3) electrofishing surveys within Bull Trout spawning index section at mile 12.9, and 4) collection of Bull Trout genetic samples at three locations within the Bull Trout spawning index section for further analysis. Last sampled in 2012, the survey section at stream mile 12.9 was resampled in 2020 with a two-pass depletion survey to investigate current trout abundance and species composition. Located in the upstream portion of a Bull Trout spawning index section, we documented a low abundance estimate of 5.5 trout/100ft for all age-1 and older trout (Appendix B). Prior to the 2020 survey, only single pass surveys were conducted to monitor species composition and relative abundance. Overall, the catch-per-unit-effort of trout in 2020 was very similar to 1989. Since 2000, Bull Trout numbers continue to show a declining trend (Figure 39; Appendix A). Declining juvenile

Bull Trout numbers are consistent with declining trends in redd counts in the index section (Figures 13 and 38). Interestingly, 16.1% of catchable (≥6 inch) Westslope Cutthroat Trout had evidence of hook scarring. We observed evidence of significant angling pressure in 2020 including worn paths, wader boot prints, fishing line, and other human disturbances. Although previous surveys did not indicate hook scarring or describe angling pressure, the use in 2020 was probably exceptionally high due to the proximity to camping facilities and the Covid 19-related increase in outdoor reaction observed throughout Region 2. Future monitoring will be conducted with increased frequency to develop a better understanding of natural population variability and to assess any impacts associated with the Rice Ridge Fire.

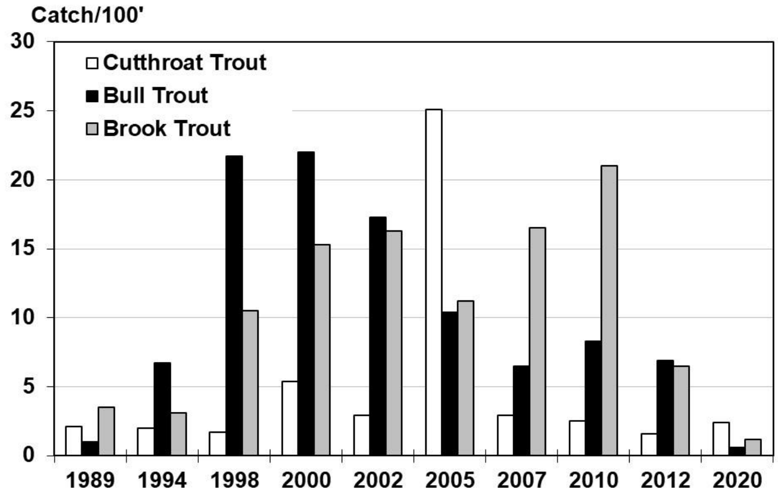

Figure 39. CPUE for trout species at mile 12.9 in Monture Creek, 1989-2020.

Long term water temperature monitoring that began in 1994 at mile 1.8 continued through 2020. In 2020, we also initiated year-round water monitoring at mile 13.1 in the Bull Trout spawning index section that was last monitored in 2008. Monitoring results for the period of July-September recorded a maximum daily water temperature of 49.6^{o}F and 68.8^{o}F at miles 13.1 and 1.8, respectively. This represents a 19.2^{o}F increase in the maximum water temperature between the Bull Trout spawning index reach and lower Monture Creek. This indicates that the primary spawning section remains highly suitable for Bull Trout despite any warming associated with climate change impacts over the past few decades. This section is strongly influenced by upwelling as it is directly downstream of the naturally intermittent section. Complete water temperature data for Monture Creek is in Appendix D.

Murphy Spring Creek

Restoration objectives: Restore spawning and rearing habitat for fluvial Westslope Cutthroat Trout; prevent fish entrainment in irrigation ditches; maintain minimum instream flows to provide rearing opportunities and seasonal refugia for North Fork Blackfoot River juvenile Bull Trout.

<u>Project summary</u>

Murphy Spring Creek, a small 1st order tributary, drains a 4.4 mile^2 basin and flows 6.7 miles before entering the North Fork Blackfoot River at mile 9.9. Average baseflow ranges from 2 to 3 cfs. The stream originates on the Lolo National Forest on the northeast side of Ovando Mountain, then enters state land at mile 2.3, before entering private land near mile 1.0.

Prior to restoration, Murphy Spring Creek frequently dewatered from irrigation withdrawals and had fish passage problems (Pierce et al. 2005). Most problematic was the chronic dewatering and entrainment of Westslope Cutthroat Trout at the Murphy Ditch at mile 1.8. Fish passage problems involved an undersized culvert at mile 0.5 and the poor condition of the diversion at mile 1.8.

Restoration of Murphy Spring Creek began in 1998 with a new diversion fitted with a Denil fish ladder. In 2004, restoration expanded with an instream flow agreement that granted habitat maintenance flows as well as a 2.2 cfs minimum instream flow to provide additional coldwater input to the lower North Fork and create high quality rearing opportunities for juvenile Bull Trout and Westslope Cutthroat Trout. In 2006, a Coanda fish screen was installed at the diversion to eliminate entrainment of Westslope Cutthroat Trout. The most recent work occurred in 2010 with an upgrade of the culvert at stream mile 0.5 and the restoration of instream habitat throughout 880 ft stream section. The instream flow lease is in the renewal process with intention for the lease to commence for another 10-year period in summer 2021.

Fisheries monitoring

Prior to restoration, we established a fish population monitoring site at mile 0.6. Following implementation of project actions, a consistent increase in native trout abundance was observed until a high point in 2011. Since then, surveys have documented that native trout abundance has leveled off and fluctuated around a post-restoration average that is higher than pre-treatment levels of abundance. Abundance of non-native trout (Brook Trout) remains relatively low, although they represented a larger proportion of the total catch in the 2018 survey (Figure 40; Appendices A & B). This might indicate an increase in Brook Trout expansion similar to other tributary drainages in the Blackfoot watershed (e.g., Gold Creek). Alders and other riparian vegetation from the restoration project have matured and contribute to high quality riparian conditions and overhanging cover. Future monitoring plans include long-term monitoring at 5–10-year intervals to continue evaluating fishery response and benefits associated with the ongoing water lease.

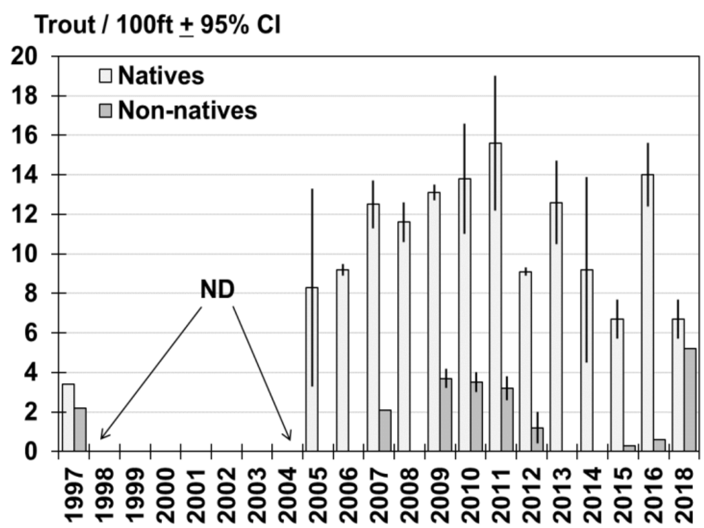

Figure 40. Estimates of abundance for age-1 and older native and nonnative trout in Murphy Spring Creek at mile 0.6, 1997-2018.

Nevada Creek

Restoration objectives: Restore a functioning stream and riparian area capable of maintaining complex habitat and providing environmental conditions favorable for trout; restore connectivity through Nevada Creek downstream of the reservoir; eliminate fish entrainment; increase recruitment of multiple fish species to the Blackfoot River.

<u>Project summary</u>

Nevada Creek, a 4th order tributary, drains a 355 mile^2 watershed and flows 53 miles from the Continental Divide north of Nevada Mountain. It enters the Blackfoot River at river mile 67.8. At mile 45.6, Nevada Creek leaves the Helena-Lewis & Clark National Forest and enters private ranchlands then flows another 11.9 miles where it enters Nevada Creek Reservoir at mile 33.7. The reservoir is managed primarily for irrigation water storage. Downstream of the reservoir, the lower 32 miles of Nevada Creek flow through private ranchland with a small amount of state and federal land in the lower reaches. Major tributaries include Nevada Spring Creek entering at mile 5.7 and Douglas Creek at mile 4.65. Downstream of the National Forest, Nevada Creek is intensively managed for irrigated hay and livestock production. Nevada Creek is a TMDL 303(d) water quality impaired stream (DEQ 2008). Downstream of the Reservoir, there are two large unscreened canals (mile 28.5 and 25.7) and several unscreened smaller ditches that divert a large proportion of total discharge in Nevada Creek.

An early restoration project in Nevada Creek in 2007 occurred upstream of the reservoir and included approximately 600 feet of channel restoration and about 15,000 feet of riparian fencing and off-stream stock water development. The first significant instream restoration project in Nevada Creek was implemented in 2010 directly downstream of the Nevada Creek Reservoir. Phase 1 included 4,400 feet of channel restoration and riparian vegetation enhancement to increase instream complexity, restore floodplain connection, and restore riparian health and streambank stability. Following this demonstration project, a project on lower Nevada Creek was completed in 2015 between the junction of Douglas Creek (mile 4.7) and Nevada Spring Creek (mile 5.7) that included channel restoration on 3,200 feet of stream. This project reestablished a vegetated bankfull bench in a reach with highly erosive and vertical streambanks. In 2017, Phase 2 was implemented at the downstream end of Phase 1 and restored 3,700 feet of channel using similar techniques employed in Phase 1. Following the success of Phases 1 and 2, similar restoration actions were implemented in the Phase 3 project section. Phase 3 was completed in 2019 and included 9,000 feet of channel restoration. In 2020, Phase 4 was implemented above the reservoir and represented the first significant project in Upper Nevada Creek. This project involved restoration of 7,100 feet of stream, including some channel realignment of short sections as well as stream bank treatments on most of the project section. In addition to active channel restoration actions, grazing management plans were developed on all four phases that maintained the agricultural viability of the properties while remaining consistent with riparian resource protection.

Fisheries monitoring

Between 2016 and 2020, fish population surveys were conducted at four locations in Nevada Creek (5.1, 29.4, 31.6, and 34.6). Pre-restoration fish population surveys were conducted upstream of Nevada Reservoir at mile 34.6 in 2016, 2017, and 2020. The 2020 survey was conducted primarily to salvage fish prior to dewatering and channel reconstruction. However, it provided the opportunity to estimate relative abundance in the project section. Although the survey encompassed the entire project section, the consistency of pre-treatment relative abundance estimates suggests that combining all sampling events into a pre-restoration average is appropriate (Figure 41). Unexpectedly, numerous Western Pearlshell Mussel were documented in the project section. Survey results documented low to moderate abundance of age-1 and older Rainbow Trout and Cutthroat Trout, as well as very low abundance of Brook Trout (Figure 41; Appendices A & B). Other species that were salvaged prior to the restoration project included 113 Western Pearlshell Mussels, Sculpin, Redside Shiner, Largescale Sucker, Longnose Dace, and Mountain Whitefish. All individuals were moved and released downstream of project area.

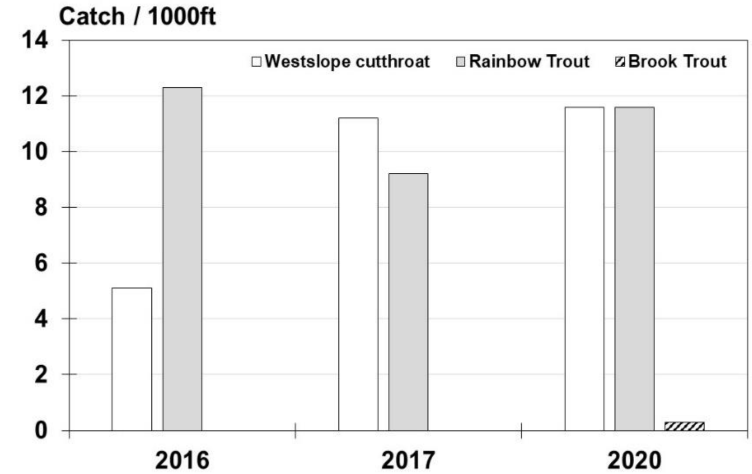

Figure 41. Catch per unit effort for age-1 and older trout in upper Nevada Creek (mile 34.6), 2016-2020.

The survey section downstream of the reservoir is located within the Phase 1 project section and was established in 2010 prior to restoration actions. Post-restoration surveys continue to document Rainbow Trout as the most abundant species with an average of 101.5 trout/1,000 ft for the 2016 and 2019 surveys (Figure 42; Appendix C). The 2019 point estimate was slightly higher than the post-restoration average of 554 trout/mile. This indicates that habitat capacity has greatly increased and provided a sustained benefit to the fishery in this section

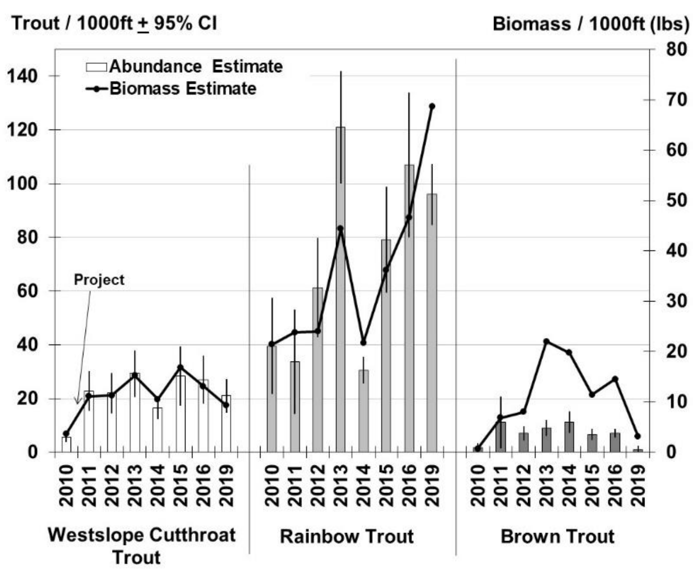

Figure 42. Estimates of abundance and biomass for age-1 and older trout in Nevada Creek at mile 31.2, 2010-2019.

of Nevada Creek. Brown Trout are least abundant in this section and were very sparse in the 2019 survey. Unlike previous years, we did not encounter any subadult Brown Trout. Nevertheless, the persistent increase in abundance and biomass of Westslope Cutthroat Trout and Rainbow Trout indicates a dramatic positive fishery response from the Phase 1 restoration actions. Biomass is also more than three times higher than the pre-restoration estimate, providing additional evidence of increased habitat capacity. The 2019 Rainbow Trout abundance and biomass estimates were the highest in the monitoring period.

Prior to implementation of the Phase 3 restoration project in 2019, we conducted an electrofishing survey (mile 29.4) to assess population status. Pre-restoration results documented Rainbow Trout and Cutthroat Trout as the most abundant species with a total trout population estimate of 137 trout/1,000ft for age-1 and older trout (Appendix C). The abundance estimate was surprisingly high, but demonstrates the overall productivity of Nevada Creek, and therefore, the potential with restoring sections and increasing habitat capacity. The Phase 3 section, although degraded, still contained localized areas of relatively high-quality pools, and intact riparian vegetation, which is where most of the fish were captured. The project design took these areas into consideration retained a lot of the high-quality habitat, while reconstructing and improving the degraded sections. Of particular note, was the large proportion of the total catch that was comprised of Westslope Cutthroat Trout (44%).

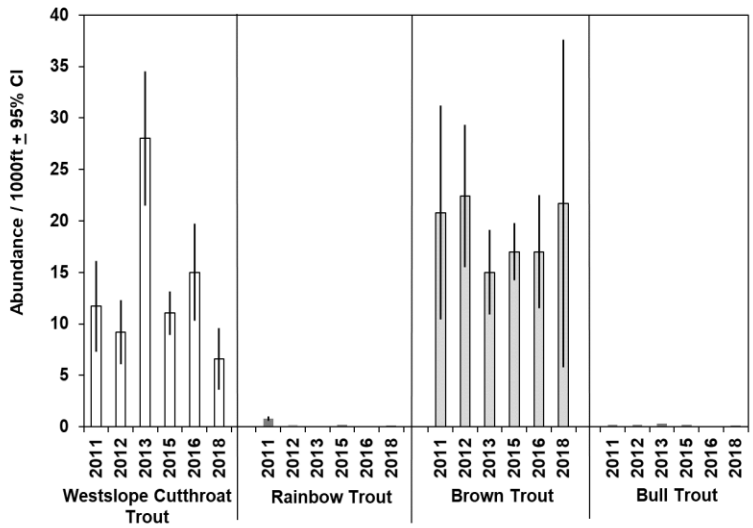

Figure 43. Catch per unit effort for age-1 and older trout in Nevada Creek immediately downstream of Nevada Spring Creek (mile 4.6-5.7), 2005-2018.

We also continued to monitor lower Nevada Creek (mile 5.1) at a site originally established in 2005 immediately downstream of the Nevada Spring Creek confluence. Trout abundance in this section has remained relatively stable over the last decade and adult Bull Trout have been captured consistently since 2011 (Figure 43). Brown Trout abundance was above average, although the estimate was very imprecise due to poor recapture rates. Westslope Cutthroat Trout abundance was below average. Nonetheless, these estimates represent significant increases in trout production compared to pre-restoration conditions when an electrofishing survey in 1990 captured a single Brown Trout in the lower four miles of Nevada Creek (FWP, unpublished data).

From 2016 through 2019, we continued water temperature monitoring at two locations established in 2003 in Nevada Creek upstream and downstream of the Nevada Spring Creek confluence. Since 2010, maximum daily water temperatures in Nevada Spring Creek (mile 0.1) during summer have been reduced by an average of 8.1°F compared to pre-restoration conditions. However, the temperature sensor (mile 4.5) located downstream of the Douglas Creek confluence demonstrates the cooling effect of Nevada Spring Creek is reduced by the warm input of Douglas Creek. We established a new monitoring location (mile 4.8) on Nevada Creek in 2016 to investigate the warming effect of Douglas Creek. On average, Nevada Spring Creek facilitates a 2.6°F decrease in Nevada Creek's daily maximum temperature in July and August. However, Douglas Creek contributes warm water that increases Nevada Creek by an average of 2.2°F, which causes Nevada Spring Creek's coldwater influence to result in an average net decrease of only 0.4°F below Douglas Creek (Figure 44). Additional temperature monitoring is needed to investigate thermal conditions between the reservoir and the logger at mile 5.8. All annual water temperature data associated with Nevada Creek, Nevada Spring Creek, and Douglas Creek are located in Appendix D.

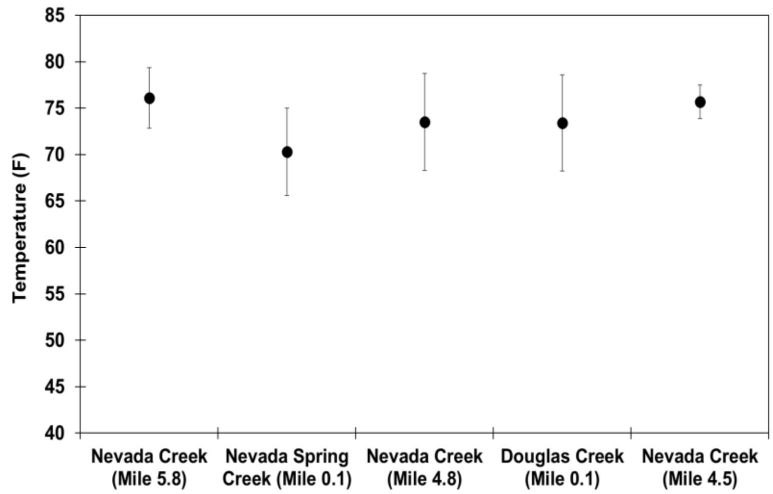

Figure 44. Mean (SD) maximum daily water temperatures during July-August at the mouth of Nevada Spring Creek, mouth of Douglas Creek, and three Nevada Creek locations, 2016-2020.

Nevada Spring Creek

Restoration objectives: Restore habitat suitability for trout; improve downstream water quality; reduce thermal stress in Nevada Creek.

<u>Project Summary</u>

Nevada Spring Creek, a spring creek tributary of lower Nevada Creek, originates from an artesian spring and flows through agricultural lands to its junction with Nevada Creek at mile 5.7. The artesian spring source produces 6-9 cfs at a constant temperature of 44-46°F (Pierce et al. 2002). Wasson Creek enters Nevada Spring Creek downstream of the spring source. Wasson Creek is a small, basin-fed tributary that contributes an

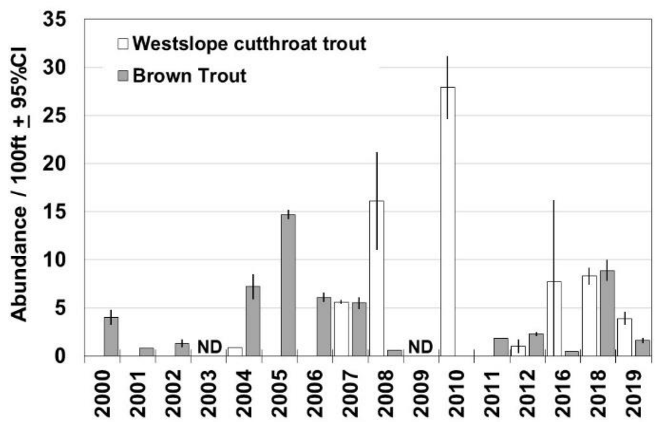

Figure 45. Abundance estimates for age-1 and older trout at mile 3.9 in Nevada Spring Creek, 2000-2019.

additional base flow of approximately 2 cfs during the non-irrigation season. Prior to restoration, summer water temperatures in Nevada Spring Creek increased from a constant groundwater temperature at the spring source to greater than 75°F in the lower spring creek due the degraded and over-widened channel condition (Pierce et al. 2002). The restoration of Nevada Spring Creek involved full channel reconstruction between 2001 and 2009, along with riparian grazing changes, instream flow enhancement, wetland restoration activities, and shrub plantings (Pierce et al. 2017). High concentrations of sediment with elevated nutrient levels from upstream sources stimulate an abundance of aquatic vegetation growth that contributes to displacement of cold water leading to flooding, which subsequently increases water temperatures (Pierce et al. 2017). In 2019, the landowners conducted a pilot-level aquatic vegetation management project that reduced the proliferation of aquatic macrophytes to accommodate stream discharge within the bankfull width.

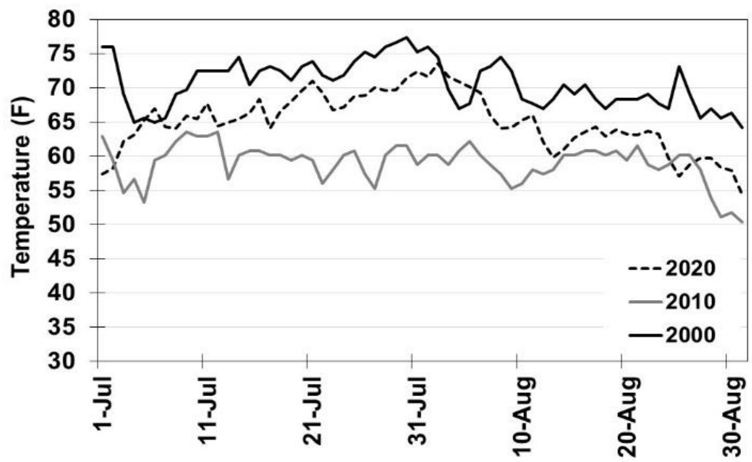

Figure 46. A pre- and post-restoration treatment comparison of maximum daily summer water temperatures in Nevada Spring Creek at mile 0.1.

<u>Fisheries monitoring</u>

Prior to channel restoration, Nevada Spring Creek supported low densities of Brown Trout in the upper reaches and non-game species (Redside Shiner, Northern Pikeminnow, and Largescale Sucker) in the lower reaches (Pierce et al. 2002). Westslope Cutthroat Trout were present in very low abundance.

We continued post-restoration fish population monitoring at mile 3.9 during 2016-2019. Westslope Cutthroat Trout densities increased following upstream restoration of Wasson Creek in 2003, which contributes to an increase in recruitment of native fish to Nevada Spring Creek (Pierce et al. 2017). Westslope Cutthroat Trout densities began declining after 2010 (Figure 45). Variability of Westslope Cutthroat Trout in Nevada Spring Creek is probably driven by population fluctuations within Wasson Creek. Although recent estimates are lower than the peak in 2010, they remain higher than pre-restoration estimates. The removal of aquatic macrophytes in 2019 resulted in a lack of fish cover, which probably elicited fish movements to other areas with suitable instream complexity. Brown Trout abundance has remained low since the 2006 survey. Their low densities are probably due to a reduction in spawning habitat and juvenile recruitment within Nevada Spring Creek. The entire stream was surveyed for spawning activity in late-November 2019. Only two redds were observed and they were both directly downstream of the Wasson Creek confluence. Future monitoring in Nevada Spring Creek will occur on an infrequent basis and be driven by project and management needs.

Additionally, a small (0.25 mile) artesian spring creek known to the local landowners as Devils Dip enters Nevada Spring Creek near stream mile 3.4. A channel reconstruction project was implemented in 2016. Prior to restoration efforts, electrofishing surveys did not confirm fish presence. Post-restoration surveys in 2016 recorded a low relative abundance for age-1 and older Westslope Cutthroat Trout of 3.0 trout/100ft. Only one Westslope Cutthroat Trout was captured in the 2018 survey. No future monitoring is planned. All fish population survey results are found in Appendices A & B.

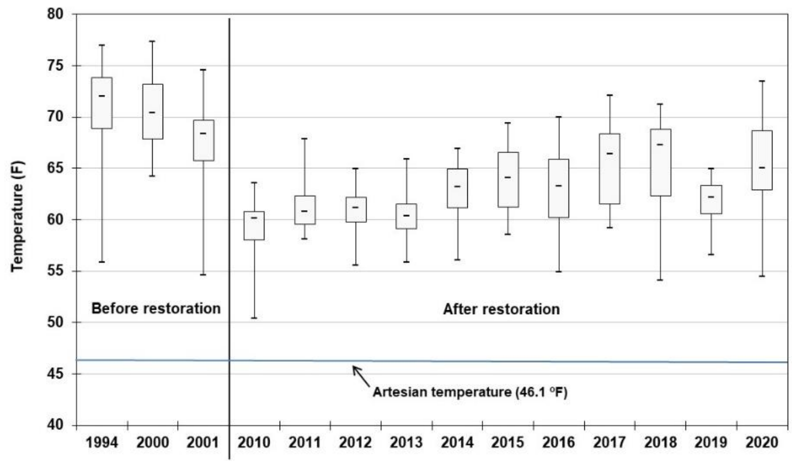

Figure 47. Box plots of water temperatures in July-August measured at the mouth of Nevada Spring Creek.

We continued monitoring water temperatures in 2016-2020 near the mouth of Nevada Spring Creek (mile 0.1). Prior to restoration, water temperature monitoring at stream mile 0.1 documented an average maximum summer (July-August) water temperature of 76.3°F. Following restoration, the average maximum summer water temperature in 2010 was 63.5°F. Monitoring over the last decade documented incremental increases in maximum summer water temperatures to 73.5°F in 2020 (Figure 47). The lack of a pronounced cooling effect in recent years may be due to excessive macrophyte growth causing flow to exceed the bankfull channel width, thus increasing surface area and contributing to rapid warming by the time discharge reaches the mouth. Furthermore, some of the adjacent wetland cells may be leaking stagnant, warm water into the channel. Interestingly, the landowners initiated a pilot-level aquatic vegetation removal in June 2019, which enabled the full discharge to remain within the stream banks throughout the

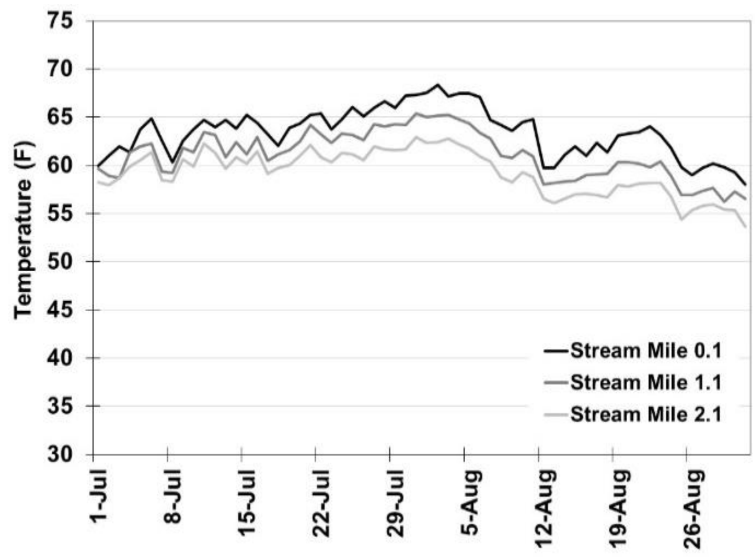

Figure 48. Average daily maximum water temperatures at three monitoring locations on Nevada Spring Creek, 2019-2020.

summer. The water temperatures near the mouth exhibited a dramatic shift from previous years and were similar to the years directly following restoration (Figure 47). This suggests that the increased water elevation and surface area is contributing to warming temperatures between the spring source and confluence with Nevada Creek. In 2020, vegetation management did not occur, and the summer temperatures returned to levels similar to 2017 and 2018.

In order to better document the water temperature gradient throughout the spring creek, we re-deployed water temperature sensors at three previously established upstream locations (mile 1.1, 2.1 and 3.5) in 2019, which were last monitored in 2012. Unfortunately, we were unable to retrieve the sensor at stream mile 3.5 which precluded a complete longitudinal temperature profile. However, monitoring during 2019-2020 documented a 4.2^{o}F increase in maximum daily summer water temperatures through the lower two miles of Nevada Spring Creek (Figure 48). Water temperature summaries for all Nevada Spring Creek monitoring locations during 2016-2020 are in Appendix D.

North Fork Blackfoot River

Restoration objectives: Eliminate entrainment of Bull Trout and Westslope Cutthroat Trout in irrigation canals; manage riparian areas to protect habitat for native fish; improve recruitment of native fish to the Blackfoot River.

<u>Project summary</u>

The North Fork Blackfoot River is a large 4th order tributary that drains a 313 mile^2 basin. It flows south from the Continental Divide near Scapegoat Mountain and enters the Blackfoot River at mile 54. The upper 23.8 miles flow through the Scapegoat Wilderness (Lolo National Forest). At stream mile 26.2, the North Fork flows over North Fork Falls, a 50 ft natural barrier. The North Fork enters private land near stream mile 16.5. Upon exiting the mountains near stream mile 13.0, the North Fork enters Kleinschmidt Flat, a large glacial outwash plain where the North Fork loses water to alluvium between miles 8.3 and 6.1 before gaining groundwater and discharge from several spring creeks. Five irrigation canals, located on the Flat between miles 15.3 and 8.8, divert up to an estimated 40-60 cfs from the North Fork.

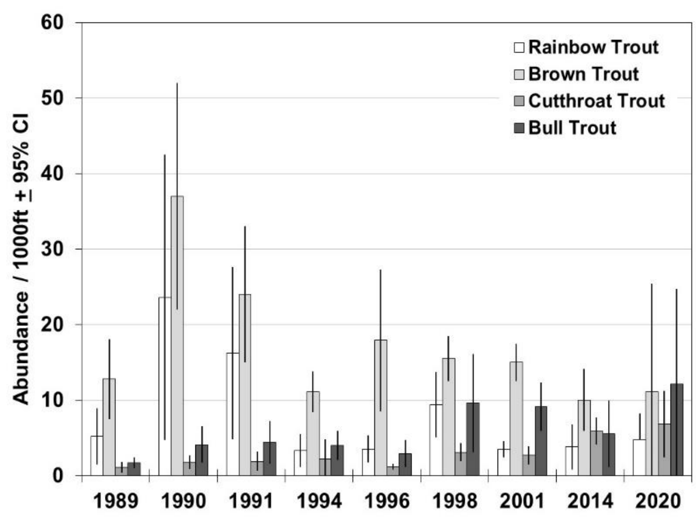

Figure 49. Estimates of trout abundance (≥6.0”) in the lower North Fork Blackfoot River, 1989-2020.

The North Fork has been the focus of comprehensive restoration projects, which include 1) the screening of all irrigation canals on the mainstem North Fork, 2) instream restoration of all spring creeks (Rock Creek, Kleinschmidt Creek, Enders Spring Creek, Jacobsen Spring Creek and Murphy Spring Creeks), 3) instream flow enhancement on the mainstem and its tributaries, 4) improved riparian grazing practices, and 5) conservation easements on a majority of the riparian areas located on private land. Restoration focus in the drainage is primarily in the maintenance phase with monitoring and upgrading previous screening infrastructure as it becomes outdated. Practitioners continue to work with landowners to identify and execute water conservation measures and land management changes. In addition to this work, a large-scale native fish conservation project is now planned in the Scapegoat Wilderness upstream of North Fork Falls (Pierce et al. 2018).

Fisheries monitoring

The North Fork Blackfoot River supports migratory Westslope Cutthroat Trout, Bull Trout, Mountain Whitefish, migratory and resident Rainbow Trout, Brown Trout and Brook Trout. The North Fork supports the largest run of migratory Bull Trout in the upper Clark Fork River Basin. A 2015 genetic assignment study not only identified North Fork stock as distinct (Knotek et al. 2016) but also identified the North Fork Bull Trout as the most prevalent stock in the lower Blackfoot River. This study also connected the North Fork stock with Salmon Lake within the Clearwater drainage for the first time.

To monitor the North Fork stock of fluvial Bull Trout, FWP relies primarily on annual spawning surveys as an index of population trends. Redd counts increased during the decade of the 1990s after protective angling regulations and the screening of all the North Fork ditches were enacted (see *Bull Trout Monitoring* section). Redd counts then showed a seven-year decline (2001-2007) during a protracted drought. Following the removal of Milltown Dam in 2008, Bull Trout spawning activity has generally increased and remained elevated above pre-2008 levels. The recent declining trend between 2017 and 2020 is likely due to the low spawning activity and resulting diminished recruitment between 2012 and 2014.

In addition to Bull Trout redd counts, we conducted a fish population survey in 2020 at a long-term monitoring site on the lower North Fork (Harry Morgan section, mile 4.0) originally established in 1989. This section has been surveyed infrequently and was most recently sampled in 2014. We conducted a single marking and single recapture run using one drift boat shocking unit. Overall trout abundance was similar to 2014 and suggests sustained increasing abundance of native trout over the last three decades (Figure 49; Appendix C). However, estimates are relatively imprecise, so caution should be used when making inferences about the strength of long-term trends. Incorporating additional marking runs to increase recapture rates and conducting surveys with increased frequency will improve our status and trend monitoring of trout populations in the North Fork Blackfoot River.

In July 2020, we reestablished a water temperature monitoring site near stream mile 16.3 that had not been surveyed since 2007. We recorded a maximum daily water temperature of 56.3°F in August. Annual long-term monitoring also continued at stream mile 2.6 for its 26th year on the lower North Fork, documenting a mean maximum daily water temperature of 62.2°F during 2016-2020. All North Fork water temperature monitoring datasets are located in Appendix D.

Pearson Creek

Restoration objectives: Improve instream habitat and riparian conditions for fluvial Westslope Cutthroat Trout; increase recruitment of Westslope Cutthroat Trout to the Blackfoot River.

Project summary

Pearson Creek is a small 1st order tributary to lower Chamberlain Creek. Approximately 9.4 miles in length, Pearson Creek begins on BLM and DNRC lands and drains the northern and western slopes of Chamberlain Mountain and Granite Mountain. It flows north and enters private agricultural land near stream mile 2.9 and joins Chamberlain Creek at mile 0.1 with an average baseflow of about 1.0 cfs.

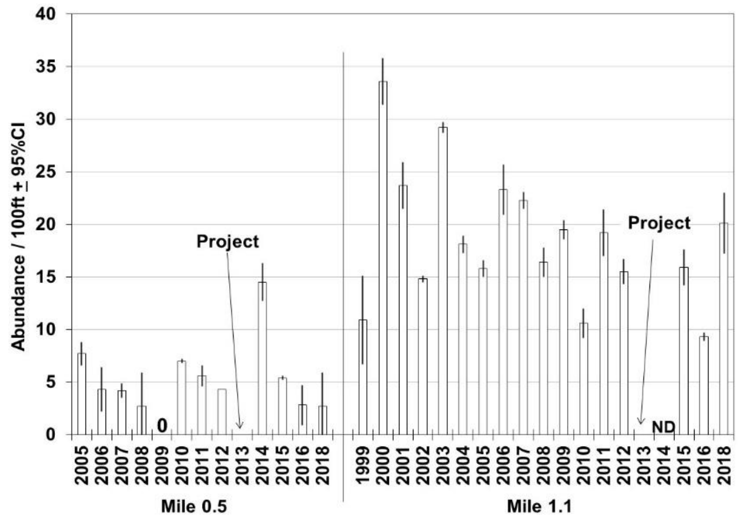

Figure 50. Estimates of abundance for age-1 and older Westslope Cutthroat Trout in Pearson Creek at miles 0.5 and 1.1.

Pearson Creek has a history of channel degradation and irrigation impacts from grazing and timber harvest practices (Pierce et al. 2005). From 1994 through 2013, the lower two miles of Pearson Creek have been the focus of restoration projects involving channel reconstruction, instream habitat improvements, revegetation, flow enhancement (water leasing), riparian grazing changes, and conservation easements (Pierce et al. 2005). In 2011, an undersized culvert at mile 0.8 was replaced with a concrete box culvert. Additionally, a restoration project was implemented immediately upstream that reconstructed 1,500 feet of channel to facilitate fish movement and improve habitat. Moreover, land exchanges in the headwaters transferred all former Plum Creek Timber Company lands to BLM and DNRC. In 2016, the BLM removed a culvert at stream mile 5.9 and a culvert at mile 6.2. They also decommissioned approximately 2,500 feet of riparian road. With the completion of this work, all major fisheries impairments have been corrected. The DNRC plans to remove a perched culvert in upper Pearson Creek that is probably a seasonal passage barrier to certain size classes of fish.

Fisheries monitoring

The upstream monitoring site (mile 1.1) was established in 1999 prior to instream restoration efforts. In 2005, we established the downstream site (mile 0.5) to assess road crossing and grazing impacts on lower Pearson Creek. Although the 2014 survey documented a pronounced increase in abundance, the long-term trend has remained relatively stable at mile 0.5 (Figure 50; Appendices A & B). Trout abundance in the upper section remains stable, with abundances just slightly higher than the long-term average since 1999. Evidence of cattle damage in the upper section was apparent in 2018. However, most LWD structures were holding up well and providing high quality pool habitat, which contributed to high trout abundance. Long-term benefits associated with historical restoration projects contribute to lasting population benefits. Therefore, future monitoring will continue at these locations, but on a less frequent sampling interval. The 2011 restoration project section above the road crossing has not been surveyed, but visual observations indicate high quality habitat is persisting, banks are stable, vegetation is maturing, and fish are present in pools. Future monitoring should incorporate that section into the sampling regimen.

Poorman Creek

Restoration objectives: Improve riparian habitat conditions and enhance instream flows; restore migration corridors; improve recruitment of native fish to the Blackfoot River.

Project summary

Poorman Creek, a large 3rd order tributary, drains a 43 $mile^2$ watershed and flows 14.1 miles to its junction with the Blackfoot River at river mile 108. Average baseflow ranges from 10 to 15 cfs. The stream originates at the Continental Divide on the Helena National Forest near Stemple Pass. Landownership in the upper 11.6 miles of Poorman Creek consists primarily of Helena National Forest land mixed with small parcels of privately-owned land adjacent to the stream channel (old, patented mining claims). The lower 2.5 miles of stream flow entirely through private ranchland.

Impairments in Poorman Creek are caused by legacy and contemporary effects of hard rock and placer mining, irrigation dewatering, fish entrainment, channel instability, excessive riparian grazing pressure, subdivision impacts, road encroachment, sedimentation, and undersized culverts. Restoration actions began in 2002 and are ongoing. Fisheries-related improvements initially focused on lower Poorman Creek and included instream flow enhancement (water lease) and ditch screening through flood-to-sprinkler irrigation conversion, stream crossing upgrades, riparian grazing changes (corridor fencing, off-stream water), and shrub plantings. Furthermore, several road crossings on the mainstem of Poorman Creek have been upgraded to improve habitat connectivity for native trout. In 2014, the USFS removed four fords, one undersized culvert, and decommissioned 2,200 feet of streamside road in the South Fork of Poorman Creek. In 2019, BBCTU and the USFS constructed 1,500 feet of new stream channel through a historically channelized placer mining area at mile 8.0. Project actions provided additional fish habitat by increasing channel sinuosity, creating more complex pools with LWD, and reconnecting the channel to a new floodplain. An undersized culvert at the upstream end of the project section was removed in 2019 and replaced with a free spanning bridge in 2020. An undersized, perched culvert at stream mile 5.0 is scheduled for replacement with a bridge in 2021. A Phase 2 restoration project is planned for implementation in lower Poorman Creek in 2021. This project will improve approximately 8,400 feet of stream using a suite of treatment actions including channel reconstruction and shaping, pool development, and installation of vegetated wood matrices and large woody debris structures. Moreover, a grazing management plan was developed for 550 acres encompassing this section of stream. The riparian area will be excluded from grazing for a minimum of 10 years to ensure recovery.

Fisheries monitoring

Poorman Creek supports genetically pure Westslope Cutthroat Trout, Brown Trout, and Brook Trout. It is the only tributary stream south of the Blackfoot River that still supports Bull Trout reproduction. The relative abundance of native trout tends to increase in the upstream direction, whereas nonnative fish are more abundant in lower Poorman Creek.

We conducted a pre-restoration fish population survey in 2019 at mile 8.0 followed by post-restoration survey in 2020.

Monitoring results from 2019 documented considerable abundance of age-1 and older Westslope Cutthroat Trout, which indicates the overall productivity of Poorman Creek. No Bull Trout were captured in the pre-restoration survey, although they have been documented upstream and downstream of the project section in the past. The post-restoration survey documented a 60% increase in abundance and a 21% increase in biomass of age-1 and older Westslope Cutthroat Trout (Figure 51). Moreover, five Bull Trout were also captured during the post-restoration survey in 2020. Surveys also documented the limited presence of brown and Brook Trout. The rapid and significant increase in abundance of Cutthroat Trout demonstrates a clear increase in habitat capacity through this section. Furthermore, the density of Cutthroat Trout also increased suggesting an increase in habitat quality, which is consistent with other recent restoration evaluations synthesized by Roni et al. (2019).

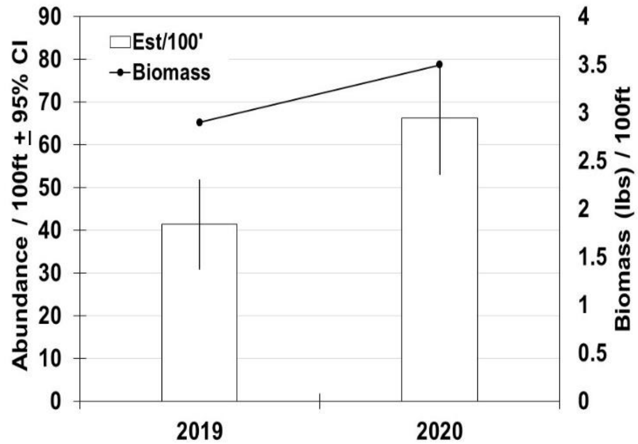

Figure 51. Abundance -Biomass estimates for age-1 and older Westslope Cutthroat Trout at mile 8.0 on Poorman Creek, 2019-2020.

We also surveyed a monitoring location established in 1989 at stream mile 9.9 that was last sampled in 2013. Historically, this survey location supported primarily Bull Trout and Westslope Cutthroat Trout in low to moderate abundance, with the limited presence of Brook Trout. However, the 2020 survey found only Westslope Cutthroat Trout with a relative abundance of 10.3 trout/100ft. The lack of Bull Trout in the survey section at mile 9.9 may indicate a redistribution since Bull Trout were captured downstream during the post-restoration survey at mile 8.0. Continued monitoring throughout Poorman Creek is needed to develop a better understanding of Bull Trout status and distribution in the drainage. Details of all fish population survey results are located in Appendices A and C.

A new survey site (stream mile 0.55) was established in 2020 within the proposed Phase 2 restoration project reach in lower Poorman Creek. The site length (3,970 ft) covers a large portion of the total project section. Previous surveys have been conducted in the project vicinity (stream miles 1.3 and 1.5), but the new section was established to provide a larger spatial scope, and therefore, more robust effectiveness monitoring. Overall, trout abundance was very low with densities of 2.2 trout/100 ft, 22.0 trout/100 ft and 0.4 trout/100 ft for age-1 and older Westslope Cutthroat Trout, Brown Trout, and Brook Trout, respectively (Appendices A & C). This is significantly lower than the pre-restoration trout density observed in the Phase 1 project section at stream mile 8.0, indicating diminished habitat capacity in the degraded lower reaches of Poorman Creek.

In June 2020, we deployed water temperature sensors at the Stemple Pass Road bridge (mile 2.2) and the completed Phase 1 restoration project section (mile 8.0). The most recent water temperature monitoring occurred at mile 0.2 in 2012 and at mile 2.2 in 2007. Water temperature monitoring at the restoration project (mile 8.0) recorded a maximum daily temperature of 53.1°F in August, indicating upper Poorman Creek provides an ideal thermal regime for Bull Trout. Poorman Creek was slightly warmer downstream at mile 2.2 with an August daily maximum temperature of 58.4°, but still within the range of suitability for Bull Trout. Continued annual water temperature monitoring will provide a better longitudinal profile of the temperature regime throughout the Poorman Creek drainage. All water temperature data for Poorman Creek in 2020 is located in Appendix D.

Rock Creek

Restoration objectives: Restore migration corridors for native fish; restore natural stream morphology to improve spawning and rearing conditions for all fish species using the system.

Project summary

Rock Creek is the largest tributary to the lower North Fork Blackfoot River, entering at stream mile 6.1. Legacy effects from historical land use caused habitat degradation over most of its 8.2-mile length (Pierce and Peters 1991; Pierce et al. 1997; Pierce et al. 2006). Rock Creek has been the focus of continued restoration since 1990. Restoration actions involved working with 13 separate landowners on grazing improvements, in-stream flow enhancement, channel reconstruction, and re-vegetation. Active restoration is complete in Rock Creek and its primary tributaries, South Fork of Rock Creek, Salmon Creek and Dry Creek (Pierce and Podner 2008). Restoration activity is in the monitoring and maintenance phase to ensure the intended purposes of previous projects are met.

Fisheries monitoring

Rock Creek supports a mixed salmonid community including Brown Trout, Rainbow Trout, Brook Trout, and Westslope Cutthroat Trout. Limited Bull Trout rearing occurs throughout the drainage. In 2017 and 2019, we surveyed fish populations at three Rock Creek restoration locations (miles 0.7, 1.6 and 6.4). Restoration actions were implemented in 1996 on the upper restoration section on DNRC land (mile 6.4) and in 1999 on the lower Rock Creek sections (miles 0.7 and 1.6). Fish population surveys at the downstream location (mile 0.7) demonstrate that Brown Trout are the most abundant trout species along with low densities of Rainbow Trout, Westslope Cutthroat Trout, and Brook Trout. Survey results from mile 1.6 continued to document low abundance of both Brown Trout and Brook Trout. The restoration section is recovering from livestock impacts that were observed during the 2012 survey.

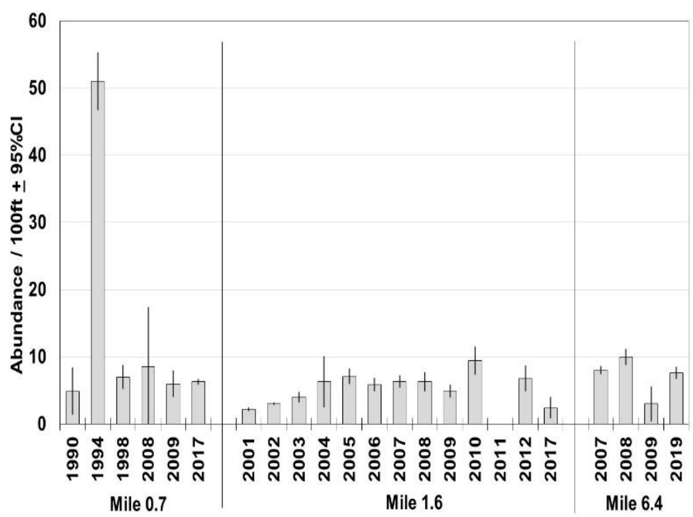

Figure 52. Abundance estimates of age-1 and older trout in Rock Creek at stream miles 0.7, 1.6 and 6.4, 1990-2019.

The recent survey at the upstream site (mile 6.4) documented low abundance of Brook Trout. It represents the first time that Westslope Cutthroat Trout have not been captured in electrofishing surveys in this section since the restoration project was completed (Appendices A & B). A visual habitat assessment observed high levels of sediment covering approximately 75-80% of the substrate throughout the restored section. Moreover, the restored channel lacks an abundance of quality riparian vegetation throughout most of the section. The plantings from the original restoration project had very low survival. Future actions should seek to improve the deficiencies of past projects to move this section towards full site potential. Westslope Cutthroat Trout are probably migrating through this section to seek better spawning and rearing habitat elsewhere in the Rock Creek drainage. Overall, trout abundance has leveled off for age-1 and older trout throughout the three survey locations (Figure 52). A potential future project at mile 6.4 will try to establish a healthy riparian corridor and improve some of the shortcomings with the original project. Future monitoring will occur after that project is completed.

Sauerkraut Creek

Restoration objectives: Restore natural stream morphology to improve spawning and rearing conditions for Westslope Cutthroat Trout.

Project summary

Sauerkraut Creek, a 2nd order stream, drains a 13.3 mile^2 watershed on the eastern slopes of Ogden Mountain. It flows for 7.6 miles and enters the upper Blackfoot River near river mile 102.1. The headwaters are located on the Helena National Forest and the lower 3.2 miles of stream are located on private land. Sauerkraut Creek loses discharge at mile 2.9 and becomes intermittent. It gains discharge at mile 2.7 and has 3-4 cfs of baseflow near the mouth. Sauerkraut Creek has a long history of placer mining that resulted in severe channel alterations, loss of floodplain function, and intermittent flows in one section of stream. Additionally, undersized culverts, overgrazing by livestock, and dewatering by irrigation have impacted fisheries. Restoration of Sauerkraut Creek began in 2008 when a conservation easement was placed on private ranchland to facilitate stream restoration and protect aquatic resources in the upper Blackfoot Valley. As part of the easement, a stream restoration project was developed on middle Sauerkraut Creek (miles 2-3) to correct past mining and grazing impacts. Restoration involved the reconstruction of approximately 5,000 feet of Sauerkraut Creek. Furthermore, the ranch implemented a grazing management plan involving riparian fencing and off-site water developments, shrub transplants, seeding, and weed control. In 2010-

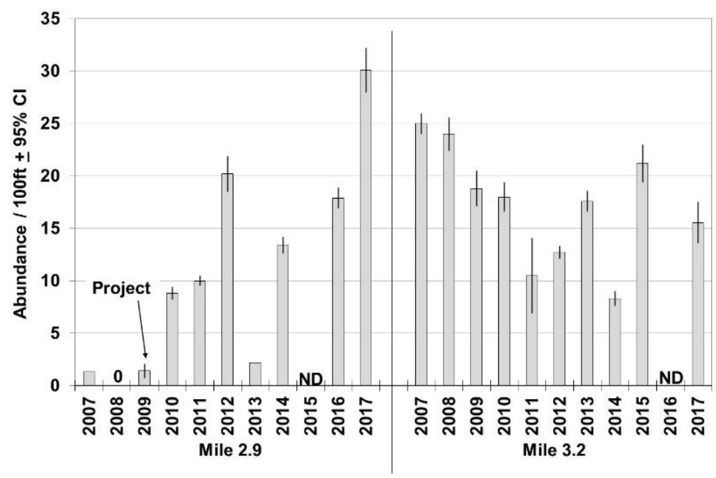

Figure 53. Abundance estimates for age-1 and older trout in Sauerkraut Creek at treatment (mile 2.9) and reference reaches (mile 3.2), 2007-2017.

2012, three undersized stream crossings (miles 0.3, 1.5 and 1.8) were upgraded to bridges to accommodate fish passage and channel function. In 2012, an instream flow agreement secured a minimum flow of 3 cfs in the lower two miles of Sauerkraut Creek. Furthermore, multiple irrigation ditches were consolidated into a single screened diversion in 2014. In 2015, an additional 770 feet of channel restoration and road decommissioning was completed on the Helena National Forest to reduce sediment delivery and improve fish habitat.

<u>Fisheries monitoring</u>

Sauerkraut Creek supports non-hybridized Westslope Cutthroat Trout and a mixed salmonid assemblage in the lower reaches (Appendices A & B). Sauerkraut Creek supports a small run of migratory Westslope Cutthroat Trout (Pierce et al. 2007). Western Pearlshell Mussel are also present in lower Sauerkraut Creek. Bull Trout have been observed using Sauerkraut Creek for juvenile rearing opportunities and seasonal refugia, but spawning has not been documented.

A repeated survey in lower Sauerkraut Creek at mile 0.2 found a mixed community of Cutthroat Trout, Brown Trout, and Brook Trout with an overall estimate of 11 trout/100ft for age-1+ trout in 2016 (Appendices A & B). To develop a pre-restoration fisheries baseline for the middle Sauerkraut Creek restoration project, we established a monitoring site at an upstream reference reach (mile 3.2) and within the treatment site (mile 2.9) in 2007 (Figure 53). In 2013, flows were very low at the mile 2.9 monitoring section and the section was completely dry due to drought and water loss to alluvium in 2015.

We continued post-restoration monitoring in the treatment reach in 2016 - 2017 (mile 2.9) and the reference reach (mile 3.2) in 2017. Since fish population monitoring surveys began in 2007, Westslope Cutthroat Trout have comprised over 90% of the total trout composition in both survey locations. Survey results in the treatment section demonstrated a long-term, increasing trend in age-1 and older trout that continued through 2017. The post-restoration (2010-2017) average abundance estimate of 14.6 trout/100ft is significantly higher than the pre-restoration estimate of 1.4 trout/100ft (Figure 53). We also observed high densities of Age-0 Westslope Cutthroat Trout suggesting that significant spawning, rearing, and recruitment is occurring in the treatment reach. Overall abundance estimates from the reference reach surveys (mile 3.2) remain at moderate to high densities with an average abundance estimate of 17.2 trout/100 ft for age-1 and older trout over the monitoring period of 2007-2017 (Appendices A & B). The long-term trend in the restoration section demonstrates prolonged elevated production with densities meeting or exceeding those in the upstream reference section. Moreover, these estimates are consistent with trout abundance in reference tributaries in the upper Blackfoot watershed.

Snowbank Creek

Restoration objectives: Restore migration corridors for native fish; enhance instream flows; eliminate entrainment of Bull Trout and Westslope Cutthroat Trout in a diversion ditch; improve recruitment of native fish to Blackfoot River.

Project summary

Snowbank Creek is a 1st order tributary to Copper Creek, entering at mile 6.2 with a base flow of approximately 4 cfs. The mainstem of Snowbank Creek is 5.1 miles in length and drains a small (7.6 mile^2) watershed on the northeast slopes of Stonewall Mountain within the Helena National Forest. In 2003, the Snow Talon wildfire burned significant portions of the Copper Creek drainage. Prior to 2003, lower Snowbank Creek was chronically dewatered downstream of a diversion at mile 0.4, which also created fish passage and entrainment problems. Following identification of these issues, baseflows were restored to a target 4 cfs in 2004. In 2009, the diversion was replaced with a rock weir structure to accommodate fish passage and a Coanda fish screen was installed in the ditch to eliminate entrainment. In 2013, an undersized culvert at mile 0.2 was replaced with a bridge to facilitate fish passage. In 2019, the bypass outlet on the Coanda screen channel was disconnected due to excessive scour below the screen. Material was excavated prior to the irrigation season in 2020. During the 2020 survey, visual inspection of the channel indicated that surface water connection existed at baseflow conditions. All known limiting factors and primary anthropogenic impacts have been addressed.

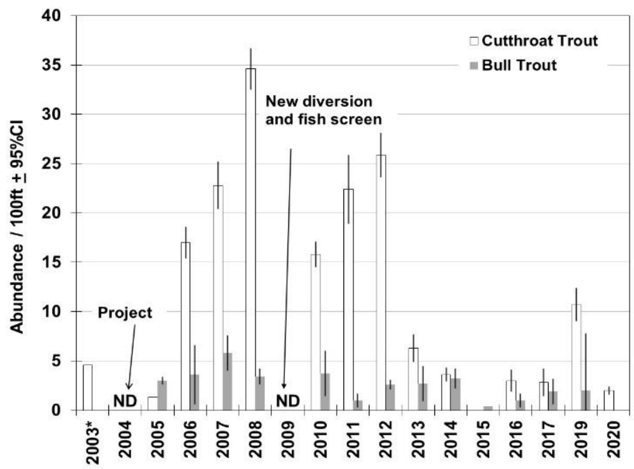

Figure 54. Population estimates for age-1 and older Westslope Cutthroat Trout and Bull Trout downstream of Snowbank Creek diversion, 2016-2020.

Fisheries monitoring

Snowbank Creek supports genetically pure Westslope Cutthroat Trout and Bull Trout. From 2016 through 2020, we continued long-term electrofishing surveys at mile 0.4 to assess project effectiveness and incorporate Snowbank Creek as a reference section for evaluating the UBMC remediation with a BACI study design. Prior to restoration, Westslope Cutthroat Trout were present in low abundance, and Bull Trout were absent from electrofishing survey sites in 2003 (Pierce et al. 2004, 2006). Following restoration, a pronounced increase in Westslope Cutthroat Trout abundance was observed, which was probably due to a combination of restoration actions and post-fire productivity increases in the drainage. Bull Trout were detected in 2005, followed by documented spawning within and upstream of the dewatered stream segment in 2008. However, more recent monitoring (2016-2020) shows low abundance of Westslope Cutthroat Trout and Bull Trout (Figure 54). The trend is similar to nearby Copper Creek, which probably indicates both streams are returning to pre-fire baseline conditions.

The trout abundance observed in 2020 may have been biased low because there was a pronounced cold snap the week before the sampling event, which may have elicited trout movement out of the section to overwinter habitat. Furthermore, we did not capture a Bull Trout until the second pass This suggests that they were concealing in the substrate and our sampling was ineffective, which has been observed in other sampling investigations (Thurow et al. 2020). Bull Trout redd counts in Snowbank Creek are located in Table 1.

Spring Creek to Cottonwood Creek

Spring Creek along with an unnamed tributary (mile 0.45) combine to form a small 2nd order tributary stream to the upper reaches of Cottonwood Creek. Spring Creek supports Westslope Cutthroat Trout and Brook Trout. Bull Trout presence was documented in the 1980s. However, Spring Creek has been diverted on a year-round basis since 1989 and its 1.0-2.0 cfs baseflow is now disjunct from Cottonwood Creek. The entire discharge is captured below the Cottonwood Lakes Road and diverted into Woodworth Meadows.

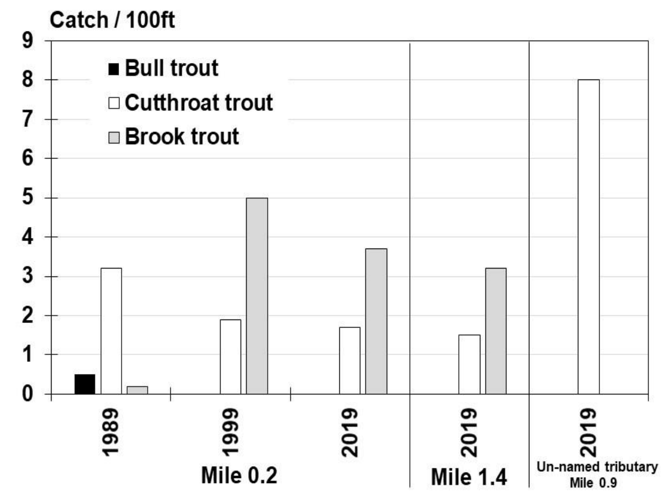

Figure 55. CPUE for age-1 and older trout at three locations on Spring Creek to Cottonwood Creek, 1989-2019.

Spring Creek historically flowed through private timber and agricultural lands. Following land acquisitions in the last decade, the entirety of the Spring Creek drainage is on public land managed by the Lolo National Forest. However, the lower portion of the channel is captured, and all discharge is diverted onto private agricultural land in Woodworth Meadows. An early project completed by the USFS upgraded an undersized culvert on Cottonwood Road to a bottomless arch culvert. In 2020, the USFS and BBCTU completed a collaborative project that decommissioned approximately 0.4 miles of riparian road and removed two undersized culverts from Spring Creek.

<u>Fisheries monitoring</u>

Last surveyed in 1999, we conducted inventories in 2020 to investigate current species composition and trout distribution. We resurveyed an established fish population survey site at mile 0.2 and established new survey sites at stream mile 1.4 on Spring Creek and on an unnamed tributary stream at mile 0.9. Since 1989, Brook Trout abundance has increased considerably, and now Brook Trout are the most abundant species at mile 0.2 and mile 1.4. Westslope Cutthroat Trout abundance has declined since 1989, which may be due to the lack of a migratory component associated with this population. The concurrent increase in Brook Trout suggests they may be outcompeting Cutthroat Trout. Bull Trout not were not captured in any of the 2020 surveys. Given that Bull Trout were not present in the 1999 surveys, and present in very low abundance in 1989, it is very likely that the precarious population status and long-term disconnection from Cottonwood Creek has led to local extirpation of Bull Trout in Spring Creek.

Results from the unnamed tributary stream survey (mile 0.9) recorded higher abundance of Cutthroat Trout than both sites in mainstem Spring Creek. No Brook Trout were found in the unnamed tributary (Figure 55; Appendix A). The perched culvert at the upstream end of the sampling section is probably a complete passage barrier (47.14139; -113.33396). A USFS survey in 2008 documented Westslope Cutthroat Trout above this location, so those fish are probably an isolated population within the broader isolated Spring Creek population.

Genetic composition of Westslope Cutthroat Trout in the isolated Spring Creek system has not been tested, but we assume the population is nonhybridized because Spring Creek has been disconnected from Cottonwood Creek since 1989 and Cottonwood Creek had a pure Westslope Cutthroat Trout population as recently as 2000. Spring Creek will be managed as nonhybridized until genetic testing confirms otherwise. Future monitoring should focus on genetic investigations to understand hybridization status and genetic bottleneck issues associated with isolation. Sampling efforts should also investigate Brook Trout status and trends throughout the Spring Creek drainage and determine if expansion is impacting Westslope Cutthroat Trout.

Stonewall Creek

Stonewall Creek, a 2nd order tributary, drains a 11.3 mile^2 watershed and enters Keep Cool Creek at mile 2.2. From the western slopes of Stonewall Mountain, Stonewall Creek flows 7.6 miles south through a mix of public (Helena National Forest and DNRC) and private lands. Park Creek, the primary tributary to upper Stonewall Creek, enters at mile 2.4 through an intermittent channel and beaver complex.

Stonewall Creek's riparian area on the National Forest has been highly altered from the past deposition of placer mine tailings near mile 5.7. Stonewall Creek flows through a beaver complex near the confluence of Park Creek. There is one large irrigation diversion at mile 4.6. There are also five small diversions, including one at mile 1.0 that directs water to Smith Lake. A reach near the forest boundary is seasonally intermittent. Downstream of the beaver complex near mile 1.0, overhanging willows and sedges above undercut banks provide suitable trout habitat, though elevated levels of fine sediment are present.

In 2015, BBCTU implemented a fish screening project on the irrigation ditch near mile 4.6. The projected included a new rock weir diversion and a paddle wheel McKay-style fish screen. In 2016, the Helena National Forest and BBCTU completed a project to increase habitat complexity and improve pool quality on 4,200 feet of stream by removing 36,000 yards of placer mine tailings from the floodplain and riparian area, reconstructing pools, and adding instream wood to the channel. They also revegetated the floodplain with site-adapted plants and seeds.

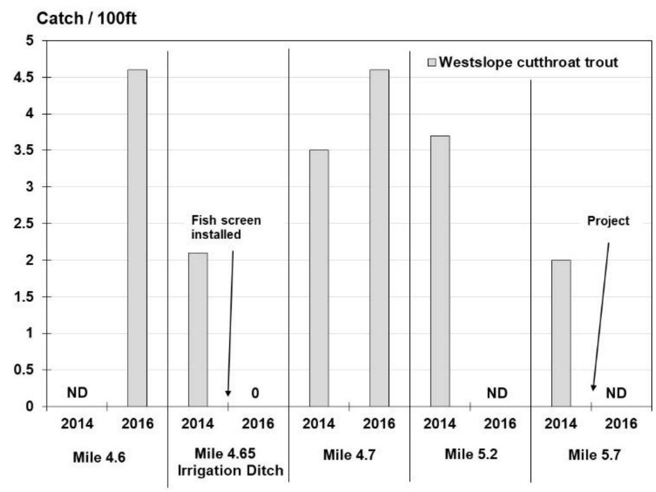

Figure 56. CPUE for age-1 and older Westslope Cutthroat Trout at five locations in Stonewall Creek, 2014-2016.

Fisheries monitoring

Stonewall Creek supports Westslope Cutthroat Trout, Brown Trout, and Brook Trout (Pierce and Podner 2016). In 2016, we conducted fish population surveys in upper Stonewall Creek upstream and downstream (miles 4.6 and 4.7) of an irrigation ditch. We also resurveyed the irrigation ditch following installation of the fish screen. A survey in the un-screened irrigation ditch at mile 4.6 documented a relative abundance of 2.1 trout/100 ft for Westslope Cutthroat Trout (Figure 56), which is similar to relative abundances within the upper mainstem channel. In 2016, an additional survey (mile 4.6) was conducted directly downstream of the fish screen project. The efficacy of the screen was confirmed by post-project surveys in the irrigation ditch that did not captured fish. The surveys also indicated an increase in abundance of age-1 and older Westslope Cutthroat Trout directly upstream of the irrigation ditch (mile 4.7) and documented similar numbers downstream (mile 4.6) (Figure 56; Appendices A & B). The 2016 analysis of 50 genetic samples collected from Westslope Cutthroat Trout during the 2014 surveys determined that the population remains genetically unaltered. FWP pathologists conducted disease testing in October 2017 for various pathogens on 60 Westslope Cutthroat Trout samples. Lab analyses did not detect any pathogens.

Wasson Creek

Restoration Objectives: Restore channel maintenance flows and maintain suitable baseflow discharge; restore migration corridors in lower Wasson Creek to provide recruitment of Westslope Cutthroat Trout to Nevada Spring Creek; restore channel conditions to support spawning and rearing conditions in lower Wasson Creek; prevent fish entrainment in irrigation ditches.

Project summary

Wasson Creek is a 2nd order, basin-fed tributary to Nevada Spring Creek with a drainage of 6.2 miles[2]. The 8.4 mile stream drains the northwestern slopes of Ogden Mountain and flows 3.7 miles through the Helena National Forest before entering private ranchland near mile 4.7. It contributes an average baseflow of 2 cfs to Nevada Spring Creek approximately 100 feet downstream of the spring source. Wasson Creek has a long history of fisheries-related impairments that include fish passage barriers (culverts and diversions), dewatering from irrigation withdrawals, fish entrainment, livestock damage to stream banks, and channelization (Pierce and Podner 2016). Numerous restoration actions have been implemented including grazing management changes, fish passage improvements, and installation of Coanda fish screens at two diversions (Pierce and Podner 2008). An instream flow lease was negotiated in 2006 that secured a minimum flow of 0.75 cfs during the irrigation season.

Fisheries monitoring

To monitor post-restoration fish response, we initiated multiple pass electrofishing surveys in 2005 at three established sites at miles 0.1 (near mouth), 2.8 (below diversions) and 3.0 (upstream of diversions). Wasson Creek is primarily a Westslope Cutthroat Trout stream with the occasional presence of Brown Trout in the lower reaches. Last surveyed in 2012, recent survey results in 2016 did not capture any fish at the mile 0.1 site. However, age-1

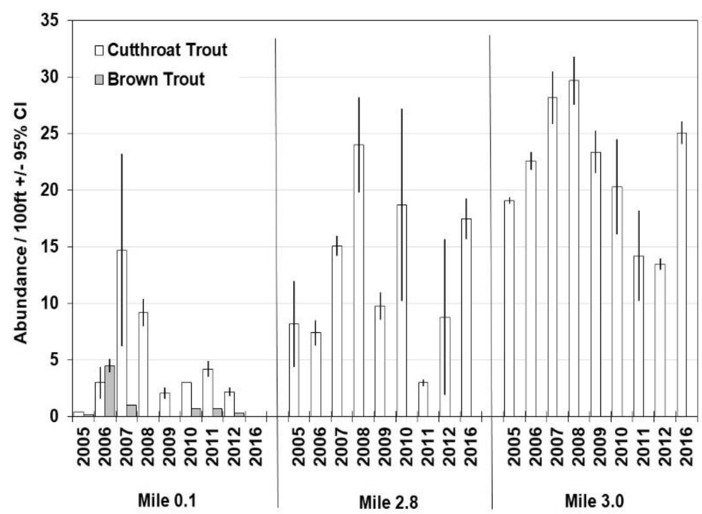

Figure 57. Abundance estimates for age-1 and older trout at three locations in Wasson Creek, 2005-2016.

and older Westslope Cutthroat Trout abundance increased considerably near the Coanda fish screen diversions at miles 2.8 and 3.0 (Figure 57; Appendices A & B). The site at mile 0.1 has little complexity and the recent accumulation of sediment may have caused fish to migrate from that section in search of better areas upstream in Wasson Creek or downstream in Nevada Spring Creek. Although pre-treatment data is unavailable for a robust inference regarding project effectiveness, the post-restoration trout densities are consistently at or above densities recorded in high quality, reference streams. Therefore, the cumulative project actions suggest an increase in habitat quality and capacity, which has improved spawning and rearing conditions for migratory and resident Westslope Cutthroat Trout. Long-term temperature monitoring near the mouth has demonstrated a probable cooling effect associated with the cumulative project benefits from increased flows, improved riparian conditions, and narrowing of the channel. All Wasson Creek water temperature monitoring data for the period of 2016-2020 is located in Appendix D.

Willow Creek (below Lincoln)

Restoration Objectives: Restore migration corridors for native fish; improve instream habitat and riparian conditions; enhance instream flows; increase recruitment of Westslope Cutthroat Trout to the upper Blackfoot River.

Project summary

Willow Creek is a 2nd order stream that originates on the northern slopes of Dalton Mountain with a drainage area of 17.1 mi^2. Willow Creek is fed primarily by the East Fork that enters near stream mile 7.5 and the West Fork that enters at mile 6.25. It flows approximately 8.9 miles to its confluence with the upper Blackfoot River near river-mile 102.5. Willow Creek, Bear Gulch (a lower tributary to Willow Creek), Sauerkraut Creek, and two miles of the Blackfoot River all fall within a contiguous area of private land located in foothills the Garnet Mountains south of Lincoln. This area adjoins the Helena National Forest and small parcels of DNRC land. In April 2008, approximately 8,000 acres were placed under a native fish HCP easement to prevent subdivision, development, and other forms of habitat loss as well as facilitate stream habitat improvements necessary to help conserve native fish. To date, Sauerkraut Creek has been the primary focus of tributary habitat restoration actions on the easement property, which were intended to serve as a demonstration projects and hopefully a catalyst for restoration work in Willow Creek. The only restoration actions implemented in Willow Creek were associated with undersized crossing structures. The USFS upgraded an undersized culvert on West Fork Willow Creek with a new culvert to accommodate 100-year flood events. In 2012, an undersized crossing structure was upgraded to a bridge near mile 4.8.

Fisheries monitoring

In 2020, we surveyed fish populations on Willow Creek at three new sites at miles 2.4, 2.9, 3.3. We also resurveyed sites at miles 3.6 and 4.8 originally established in 2007 (Figure 58). The purpose of these surveys was to assess salmonid distribution changes since 2008, as well as establish a baseline sampling section to evaluate a potential restoration project in the vicinity of the previous bridge project (mile 4.8). Fish population surveys in 2020 documented the distribution of Westslope Cutthroat Trout expanding in the downstream direction and documented low to moderate abundance at all five survey sites. Brown Trout and Brook Trout abundance remains relatively stable but low in the lower and middle reaches of Willow Creek. Conversely, the high abundance of Brook Trout in the upper reaches does not appear to be expanding downstream (Figure 58; Appendix A). Moreover, Westslope Cutthroat Trout at mile 4.8 represented 92% of the total catch, whereas Brook Trout were the most abundant species in this section in 2007 and 2009. Furthermore, the Westslope Cutthroat Trout density estimate of 14.7 age-1+ trout/ mile at 4.8 is similar to reference tributaries in the upper Blackfoot River and is similar to trout abundance in the reference site at 5.7 (Pierce and Podner 2010), suggesting Cutthroat Trout abundance has increased throughout the Willow Creek system. Although no significant restoration actions have occurred except installation of the bridge at mile 4.8, the ranch has undergone substantial land use and irrigation changes over the last decade. Most notably, the irrigation diversion near stream mile 4.0 previously captured all of Willow Creek's discharge and conveyed it into a field below Herrin Lake Road, functionally disconnecting the lower and upper reaches of Willow Creek. This irrigation practice changed in 2010. No salmonids were captured in 2007 and 2009 at mile 3.6, but we documented Westslope Cutthroat Trout presence in that site with a relative abundance of 2.1 trout/100 ft. Moreover, Cutthroat Trout were captured at mile 3.3 between Herrin Lake Road and the beaver pond complex, and at stream miles 2.4 and 2.9 below the beaver pond complex. This suggests that the change in water management successfully reconnected these sections of Willow Creek, allowing Westslope Cutthroat Trout to fully recolonize the accessible stream length.

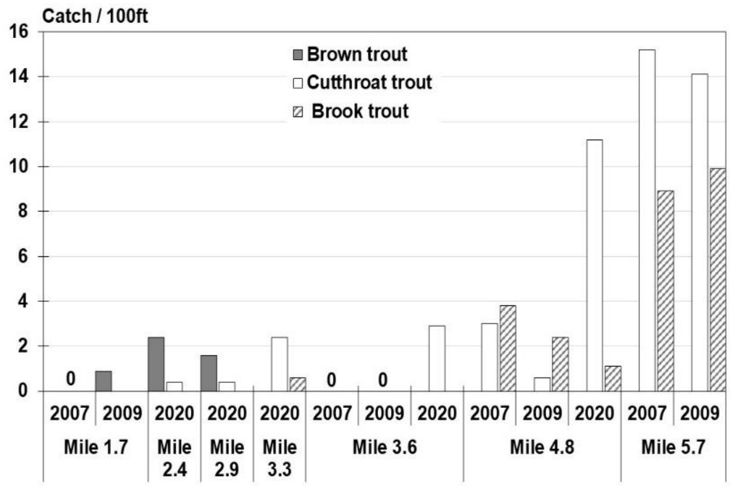

Figure 58. Relative abundance estimates of trout in Willow Creek, 2007-2020.

The high densities in the reference section likely facilitated downstream expansion of Westslope Cutthroat Trout as conditions in the middle and lower reaches became more suitable. The broad distribution of Westslope Cutthroat Trout compared to a decade ago suggests the presence of a migratory component. Also, the size structure of Westslope Cutthroat Trout in the mile 4.8 site contained a large proportion of age-1 and age-2 fish, which is consistent with migratory populations that migrate to the mainstem river after one to three years of rearing in natal streams. Future monitoring will focus on investigating Westslope Cutthroat Trout expansion, as well as targeted sampling to inform restoration projects and collect baseline information for effectiveness monitoring.

Management Recommendations

1) Continue biannual electrofishing surveys in the mainstem Blackfoot River.

2) Incorporate North Fork Blackfoot River- Harry Morgan Section (mile 4.0) sampling into routine annual or biannual electrofishing surveys. Establish additional long-term monitoring sections to understand fish population status in the context of the popular upper North Fork fishery.

3) Incorporate genetic monitoring into mainstem sampling to determine genetic composition of Westslope Cutthroat Trout and track changes through time.

4) Expand electrofishing surveys in Poorman Creek to understand Bull Trout distribution, status, and trends. Seek opportunities to conduct redd counts to assess the presence of fluvial Bull Trout spawning activity.

5) Monitor fisheries response to UBMC remediation efforts using the established BACI study design framework.

6) Develop a watershed plan for Nevada Creek to identify remaining limiting factors and future restoration strategies.

7) Continue restoration efforts in priority Westslope Cutthroat Trout tributaries to maintain increased recruitment to the mainstem Blackfoot River.

8) Continue planning efforts to implement the North Fork Blackfoot River native fish conservation project.

9) Seek opportunities to collect more than one year of pre-restoration data on restoration projects to provide more robust before-after evaluations.

10) Conduct a comprehensive investigation of Bull Trout status and distribution in the Dry Fork of the North Fork, including analysis of genetic structure.

11) Continue expanded Bull Trout redd surveys in key tributaries. Investigate the development of a sampling regimen where index sections are surveyed annually, but the entire stream is surveyed on a 5-year basis.

12) Continue assessing status and distribution of isolated Westslope Cutthroat Trout populations and seek opportunities to expand their distribution within those areas. Furthermore, investigate suitability of stream segments for introduction of Westslope Cutthroat Trout above natural barrier falls in currently fishless habitats to establish secure, conservation populations.

13) Evaluate the temperature logger network and determine which loggers have served their intended purpose, where data gaps remain, and which loggers are valuable for long-term monitoring.

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Research Project Reports

Pilot Study of The Rotenone Treatment on The North Fork Blackfoot River

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Executive Summary

Montana Fish, Wildlife and Parks personnel conducted pilot-study tests at five locations in the upper East Fork of the North Fork of the Blackfoot River (EFNF). The objectives of these tests were to conduct reach-scale bioassays in headwater streams in the proposed North Fork Blackfoot River Native Fish Restoration Project area to assess how the piscicide rotenone will perform in the different habitat and water chemistry types; to assess the effectiveness of the deactivating agent, potassium permanganate ($KMnO_4$); and to ground-truth the estimates of fish distribution in select streams. Locations of these tests were identified in the Environmental Assessment analyzing the pilot level studies, and are shown in Figure 1 of this report. At all three locations where we conducted bioassays at 1 part-per-million (ppm) formula (Blondie, Scotty and Sourdough creeks), we found this concentration to be ineffective regardless of apparent organic load of the stream, achieving mortality of sentinel fish no further than 30 minutes below the rotenone application point. Due to the ineffectiveness of 1 ppm, and based on the bioassay results at a fourth site (EF Meadow Creek (EFMC)), we believe the minimum rotenone formula concentration we would need to apply to the streams to effectively remove the existing non-native trout would likely be at least 2 ppm (0.1 ppm or 100 parts-per-billion (ppb) active ingredient (a.i.)) throughout most of the project area and would probably need to be as high as 4 ppm (0.2 ppm a.i.) in locations that have a high instream organic load. Results of individual test sites are shown in Table 1.

The fish distribution model appeared to accurately predict the fish distribution in EFMC, while under-estimating it in Scotty Creek, and perhaps over-estimating it in Sourdough Creek. The upper limit of the predicted fish distribution in Sourdough Creek was upstream of a dry reach. No wild fish were detected above the dry reach, but were detected within about 20 feet below the bottom of the dry reach. The ineffectiveness of the bioassay on Blondie Creek prevented us from determining the wild fish distribution there.

Potassium permanganate ($KMnO_4$) was applied at a rate of 3 ppm, with residual $KMnO_4$ measured at 30-minutes travel-time downstream of the application station. Estimated organic demand was 2.3 ppm KMnO4.

Introduction

From September 4 – 9, 2018, Montana Fish, Wildlife and Parks personnel conducted pilot-level tests in the proposed North Fork Blackfoot River Native Fish Restoration Project area (Figure 1). These tests involved the application of the piscicide CFT Legumine (5% rotenone) and potassium permanganate (KMnO4) in five headwater streams. The rotenone application was done in Blondie, Scotty, Sourdough and the East Fork of Meadow creeks to assess piscicide performance in the different habitat and water chemistry types using bioassays of live cutthroat trout, and concurrently to ground-truth the estimates of fish distribution in those streams. Hatchery-origin Westslope Cutthroat Trout (M012 strain) were transported into the project area on horseback and used as sentinel fish in bioassays. A limited number of transport-related mortalities occurred, so minnow cages deployed at sentinel locations had between two and five trout per cage. The single test with $KMnO_4$ was applied to the East Fork of the North Fork in order to test the organic demand of the water and stream channel materials. Locations of these tests were identified in the Environmental Assessment analyzing the pilot level studies, and are shown in Figure 1 of this report.

Results

Blondie Creek

The Blondie Creek bioassay was conducted at a concentration of 1 ppm CFT Legumine on September 6. CFT Legumine was applied to the stream from 1230 – 1700 hrs. Blondie Creek discharge was calculated to be 0.15 cfs (floating object method), requiring 60 ml of CFT to achieve 1 ppm for the test period. The only sentinel fish to succumb during the bioassay were those at the site 30 minutes downstream of the rotenone application point (Table 1). No wild fish were observed to have been affected by the rotenone during the bioassay, but the only sentinel fish affected by the rotenone were upstream of the predicted wild fish distribution.

Scotty Creek

The Scotty Creek bioassay was conducted at 1 ppm CFT Legumine on September 6. CFT Legumine was applied to the stream from 1242 – 1656 hrs. Scotty Creek discharge was calculated to be 1.3 cfs (floating object method), requiring 525 ml of CFT to achieve 1 ppm for the test period. The only sentinel fish to succumb during the bioassay were those at the site 30 minutes downstream of the rotenone application point (Table 1). The sentinel fish one hour below the rotenone application site showed signs of distress but recovered fully by the next morning. Wild fish succumbed to the rotenone within about 20 feet of the rotenone drip station, well upstream of the predicted fish distribution, and a total of 13 wild fish were found dead between the drip station and a point half-way to the 30-minute sentinel site.

Sourdough Creek

The Sourdough Creek bioassay was conducted at 1 ppm CFT Legumine on September 6. CFT Legumine was applied to the stream from 1215 - 1445 hrs, so the bioassay was not conducted for the usual 4 hours. Sourdough Creek discharge was calculated to be 2.0 cfs (floating object method), requiring 800 ml of CFT to achieve 1 ppm for the test period. The only sentinel fish in Sourdough Creek were at the mouth of the stream, 60 minutes downstream of the rotenone application point. By 1753 hrs, after 4 ½ hours exposure, most of these sentinel fish exhibited signs of distress, but recovered fully by the next morning (Table 1). At least 5 wild fish killed by the rotenone were found between the drip station and the mouth of Sourdough Creek, one about 20 feet downstream of the drip station. Several hundred feet of Sourdough Creek were dry during the bioassay, which confounded the testing of the fish distribution model. The upper limit of the predicted fish distribution in Sourdough Creek was upstream of the dry reach. The Sourdough bioassay drip station was set up immediately below this dry section to test the rotenone effects on the sentinel fish, but was later moved upstream of the dry segment above the predicted fish distribution and operated from 1515 – 1650 hrs to evaluate whether any wild fish were upstream of the dry reach. No wild fish were observed to have been affected by the rotenone upstream of the dry reach.

East Fork Meadow Creek (EFMC)

The EFMC Creek bioassay was conducted at 2.75 ppm CFT Legumine on September 8 and was applied to the stream from 1226 - 1617 hrs. EFMC discharge was calculated to be 5 cfs (floating object method), requiring 5,600 ml of CFT to achieve 2.75 ppm for the test period. This volume of CFT Legumine was split between two drip stations to prevent congealing of the CFT Legumine formulation that would likely occur in a single drip station. Sentinel fish as far as 3 ½ hours below the application point succumbed during the bioassay, while 3 of the 5 sentinels at four hours were dead the next morning (Table 1). The distribution of wild fish affected by the rotenone closely matched the predicted fish distribution.

A significant distance of the EFMC was dry downstream of the bioassay site. To ensure there was adequate stream distance to conduct the bioassay, the rotenone application site was set up well upstream of this dry reach, however, this dictated that the rotenone application point and the upper two sentinel fish locations be established upstream of a significant tributary, which coordinated well with the fish distribution test; Rainbow Trout were observed from about the mouth of the tributary down through the remainder of the section, as far as the upstream end of the dry reach. This tributary contributed approximately 1.6 of the 5 cfs. The volume of rotenone applied to the stream to achieve 2.75 ppm in 5 cfs resulted in a concentration of approximately 4 ppm at the two upstream-most sentinel fish sites where discharge was approximately 3.4 cfs.

Serial dilution bioassays were also conducted on EFMC water at the outfitter camp (Figure 1). This differs from the travel-time bioassays described above because it measures the toxicity of rotenone as affected only by the water chemistry of the EFMC and the ambient light, while the travel-time bioassays also measure toxicity affected by degradation and binding to organic materials as the rotenone moves downstream. Results in Table 2 show that concentrations of 0.5 and 0.25 ppm CFT Legumine were lethal to all fish within 4 hours of exposure, but all lower concentrations had at least one fish still alive after 8 hours of exposure.

East Fork North Fork

The $KMnO_4$ test was conducted immediately below the confluence of the East Fork and Meadow Creek, with a calculated discharge of 10.0 cfs (floating object method) on September 7. $KMnO_4$ was applied at a rate of 3 ppm from 1347 - 1755 hrs, with residual $KMnO_4$ measured at 15, 30 and 45-minutes travel time downstream of the application station. Results are shown in Table 3. Concentrations of KMnO4 continued to rise at all locations over time, reflecting a trend toward reduction of available organic material in the stream channel.

Discussion

Application points for rotenone in stream treatments are typically spaced at least 1-2 hours apart. At all three locations (Blondie, Scotty and Sourdough creeks) where bioassays were conducted at 1 ppm CFT Legumine, regardless of apparent organic load of the stream, we found this concentration to be ineffective, achieving mortality of sentinel fish no further than 30 minutes downstream from the application point.

The serial-dilution bioassays can help interpret these data, as the response time of the fish is closely linked to actual rotenone concentration. On Blondie Creek, sentinel fish at 60 minutes showed no response after 4 hours of exposure, equivalent to no more than 0.03 ppm in the serial-dilution bioassay, meaning a loss of roughly 97% of rotenone over the 1-hour travel (0.03/1). On Scotty Creek, sentinel fish at 60 minutes travel were on their side after four hours exposure, equivalent to 0.06 ppm in the serial-dilution bioassays or a 94% loss over 1-hour travel time. On Sourdough Creek, 8 of 10 fish at the mouth (60 minutes travel time) were on their sides after 4 ½ hours, consistent with response in the serial-dilution bioassays somewhere between 0.03-0.06. Notable is that the Sourdough sentinel fish were only exposed to an application of rotenone that lasted 2 ½ hours, versus 4 hours in the other streams. Since lethality is broadly equivalent to the product of exposure concentration x exposure duration, it can safely be assumed that the response of the Sourdough sentinel fish would have been greater had they been exposed to a full 4-hour rotenone application. This suggests that the concentration at the mouth of Sourdough was probably somewhere between 0.06 and 0.125, meaning a 87.5-94% loss. On the EFMC, CFT was applied at a rate of approximately 4 ppm, or 200 ppb rotenone. Rotenone was actually measured at 60 minutes travel time, and after 4 hours exposure was found to be 71 ppb, or a loss of 64.5%. This greater level of persistence compared to the other streams is consistent with the general observation that persistence is greater as discharge increases, and the EFMC was the highest discharge of the streams studied (5 cfs).

During the serial dilution bioassay conducted with Meadow Creek water, a concentration of 0.25 ppm CFT Legumine (0.0125 ppm or 12.5 ppb rotenone) was found to be the Minimum Effective Dose (MED) necessary to achieve a complete kill of test fish within 4 hours of exposure (Table 2). Standard Operating Procedure 5 (SOP 5) in the Rotenone SOP Manual produced by the American Fisheries Society recommends treating target waters at a rate at least double the MED to achieve a complete kill. Doubling the MED would result in application of 0.5 ppm CFT Legumine to the streams. This generic prescription is meant to account for degradation of rotenone and variation in sensitivities of individual fish, but is inferior to site-specific information as gathered here, which indicates greater than 50% loss of rotenone in an hour’s travel time on all streams. Ideally, the MED should be achieved not at the point of application, but at the farthest downstream point where fish are expected to die from that application, typically immediately above the next drip station. That concentration was exceeded 2-3 fold on EFMC based on actual measurements of rotenone (Table 4), but was not even close to being achieved on the other tributaries we found to be ineffective during travel-time bioassays.

Due to these findings, we believe the minimum formulation concentration we would need to apply to the streams to effectively remove the existing non-native trout would likely be at least 2 ppm throughout most of the project area and would probably need to be as high as 4 ppm in locations that have a high instream organic load. A high organic demand was also clearly indicated from the test with potassium permanganate, with the loss of 2.3 ppm $KMnO_4$ over the first 30 minutes of travel, which included travel through a breeched beaver dam. While there is no direct relationship between $KMnO_4$ reduction and rotenone degradation, rotenone will partition to organics and higher organic levels are hence expected to result in a higher loss of rotenone between application stations. Another factor influencing these results was stream discharge, and small streams less than 1 cfs typically need higher rotenone concentrations than large ones. Therefore, the smallest or organically rich tributaries (such as Blondie) are candidates for the high application rates, while the mainstem sections with greater discharge and little or no beaver activity may take only 1-2 ppm.

The fish distribution model appeared to accurately predict the fish distribution at the EFMC, while under-estimating it at Scotty Creek and perhaps over-estimating it at Sourdough Creek. The ineffectiveness of the bioassay on Blondie Creek prevented us from determining the wild fish distribution there.

A deactivation station to neutralize rotenone, if necessary, was established near the confluence of the EFNF and the EFMC. This site was chosen because it would singularly serve to capture rotenone treated water from all test sites, and it provided significant stream water travel time to allow rotenone to naturally degrade during the bioassays. The Montana FWP Piscicide Policy states that when travel time is greater than 8 hours from the point of application to the deactivation station, then detoxification is not necessary. However, sentinel fish must be placed upstream of the deactivation station and if they show signs of stress, the deactivation station must begin operation. Unexpectedly, the EFMC had a significant length of completely dewatered stream channel downstream of the rotenone application point, so per policy detoxification of these waters was not required. Sentinel fish placed in the EFNF above the deactivation station served to monitor the movement of rotenone resulting from the treatments in Scotty and Sourdough Creeks, but they showed no signs of stress, and the deactivation station was not operated.

The $KMnO_4$ test to determine organic demand showed a loss of 2.3 ppm $KMnO_4$ (3.0 to 0.7) to the 30-minute travel time mark. This loss estimate is probably high as residual measurements at 15 and 45 minutes were still rising at the end of the test, although both appeared to be leveling off. Nonetheless, this will serve to help estimate $KMnO_4$ needed for the actual treatment.

Three of the four streams selected for testing unexpectedly contained dewatered (dry) sections, however, as described above, only one of these (Sourdough Creek) potentially influenced the tests.

Considerations for Project Design/Implementation

While fish conservation projects have previously been completed with rotenone in wilderness areas, this pilot-level study confirmed some of the logistical challenges we expect to face during the proposed North Fork Blackfoot River project. The following bullet points are project planning and implementation discussion areas generated from the pilot study work.

- Pilot study personnel spent multiple hours travelling from the Meadow Creek base camp to site locations and back to camp each day, which limited the amount of time available to conduct project work at each stream. The outfitter base camp was over two hours travel one-way, by horseback, to most locations used for bioassay testing. Should the proposed project be implemented, it will be more time-efficient to establish spike camps or use existing facilities throughout the project area, such as Forest Service cabins or secondary outfitter camps that are closer to treatment areas rather than work out of one main location.

- Due to the potential logistical challenges of treating every stream in the drainage, and the variability in fish densities among streams, it may be more practical to employ strategic genetic swamping in areas of low trout density. It will be imperative to evaluate the risks associated with not treating the entirety of wetted stream length in every tributary.
- Our desire to maintain flexibility with the pilot-study treatment schedule created confusion for the public, the outfitter, and the Forest Service. The signs we initially produced for posting at the trailhead identified the streams we expected to treat, but also left open the possibility that we may treat other unidentified streams should the need arise if our selected streams didn't work out for some reason. Due to the nature of this type of project, even at the pilot-study level, and especially in a remote area where travel is dependent on hiking or horse, it is challenging to identify a specific treatment plan for each stream prior to initiating the project, including the day of treatment, the treatment concentration, and the frequency of drip station placement. We will need to discuss what project actions we can provide pre-implementation specifics for and what items needs more flexibility.
- Closer coordination between FWP and the Forest District staff in advance of the work would have allowed the District to better handle dissemination of closure information.
- Closer coordination between FWP and the Forest District prior to conducting the work could have identified additional areas to post signs and informed personnel of each agency of the other's work plans. For instance, we encountered a Forest Service trail crew that was camped at the location of our planned detox station. This was an inconvenience to their crew logistics given that they were unable to gather water in the affected area for a period of time. Fortunately, they were able to haul water in from a near-by tributary, but not knowing about their presence at this camp put an extra burden on their staff. This encounter emphasizes the need to coordinate the proposed project activities with Forest Service work schedules in advance of project initiation to prevent similar inconveniences.
- Conduct an aerial survey in late-July or early-August prior to project implementation to identify intermittent reaches, evaluate travel feasibility in headwater sections of the tributaries, and estimate extent of beaver-influenced areas.
- Evaluate the feasibility of alternative methods for treating beaver-influenced areas. For areas with heavy beaver use, we will need to discuss the use of traditional drip stations that require dam manipulations and backpack spraying versus aerial spraying that may be quicker and require less field staff.
- Evaluate the workload and cost efficiency of conducting additional electrofishing surveys in select tributaries to refine the existing fish distribution model. The refined fish distribution model could help evaluate how to treat streams. We will consider fish distribution and fish density, as well as treatment and genetic swamping logistics, to

determine the method of treatment and how much water to treat to give us the best chance of achieving conservation goals.

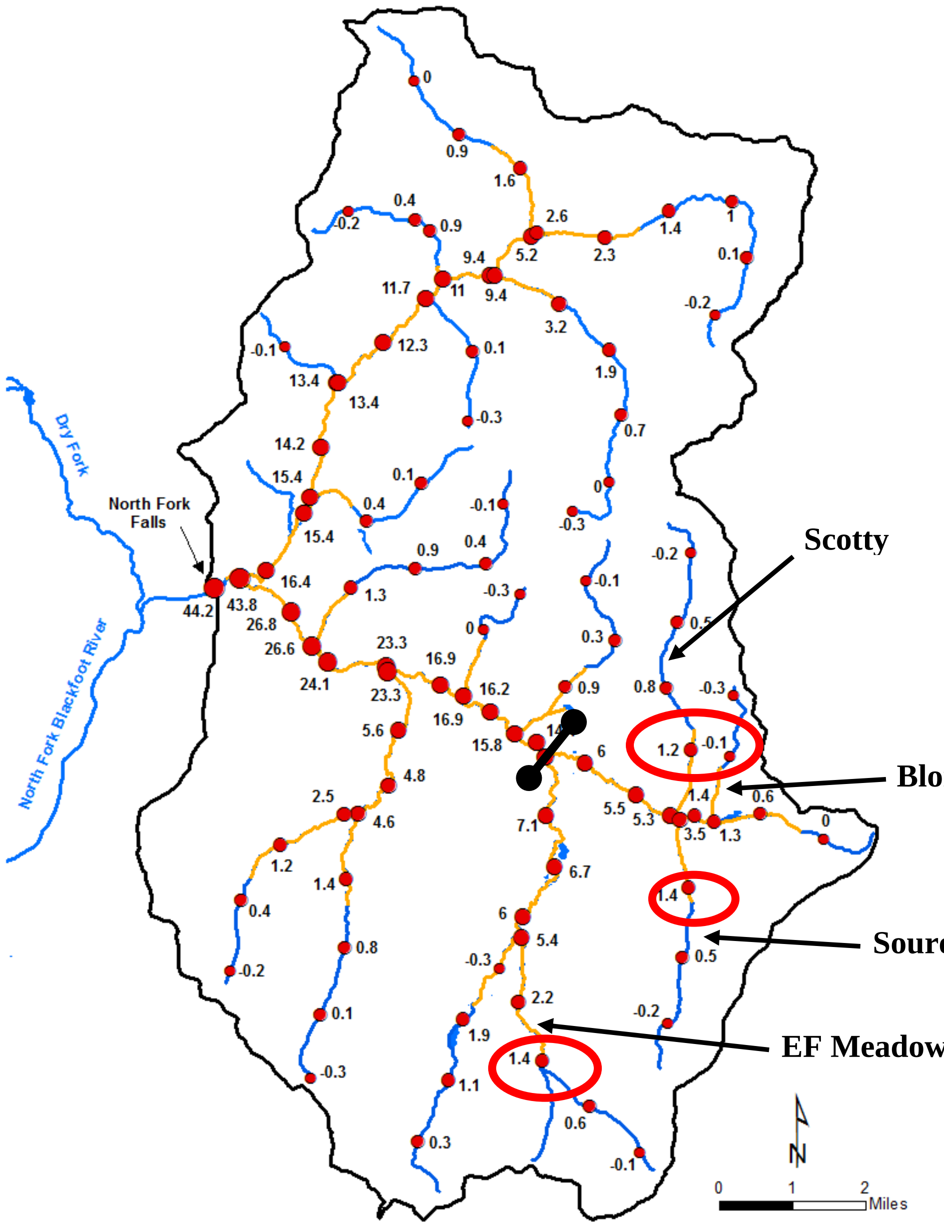

Figure 1. Perennial streams (blue), overlapping distribution of hybrid trout (orange) and estimated stream discharge (red dots with numeric values by stream mile) for the North Fork Blackfoot River drainage upstream of the North Fork Falls. Map is from the estimated budget for the North Fork Project, January 2014. Red ovals show the sites where bioassays and ground-truthing the fish distribution model were tested; the black bar shows the deactivation site.

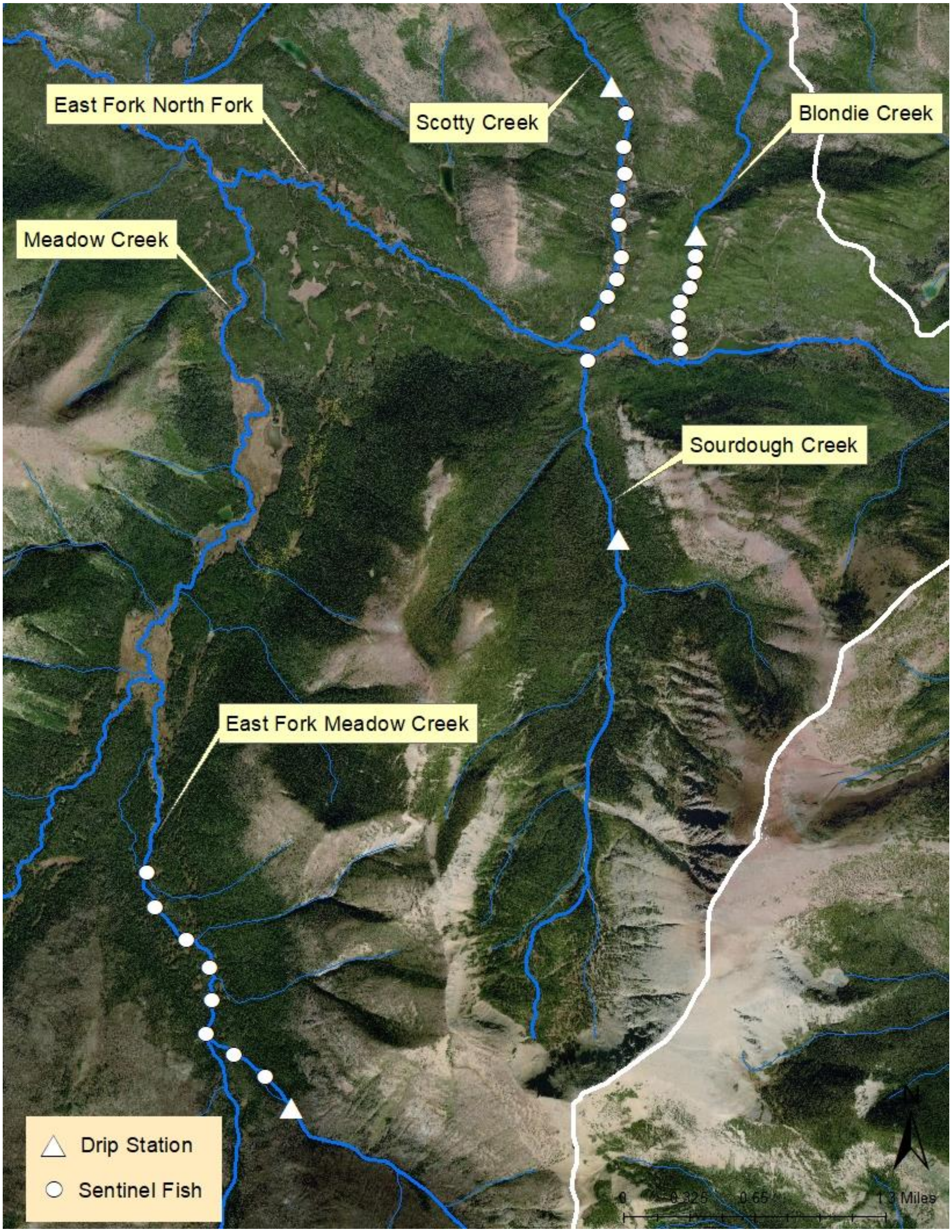

Figure 2. Locations of drip stations (triangles) and sentinel fish cages (circles) in four tributaries of the East Fork North Fork Blackfoot River that were treated with rotenone during bioassays in September 2018.

Table 1. Sentinel fish status after persistence (travel time) bioassays conducted in Blondie, Scotty, Sourdough and the EF of Meadow creeks.

		Sentinel fish status at station[a/] after rotenone bioassays							
	CFT Legumine concentration applied (ppm)	1	2	3	4	5	6	7	8
Blondie	1.0	0-0-3[b/]	3-0-0	3-0-0	3-0-0	3-0-0	3-0-0	3-0-0	3-0-0
Scotty	1.0	0-0-3	2-0-0[c/]	3-0-0	2-0-0	2-0-0	2-0-0	2-0-0	2-0-0
Sourdough	1.0	NA	10-0-0[d/]	NA	NA	NA	NA	NA	NA
EF Meadow	2.75	0-0-3	0-0-3	0-0-3	0-0-3	0-0-4	0-0-3	0-0-4	0-2-3[e/]

[a/] Station 1 = ½ hour below rotenone application point, station 2 = 1 hour, station 3 = 1 ½ hours, etc.
[b/] sentinel fish status key: # upright - # distressed - # dead
[c/] Scotty Creek sentinel fish displayed a 0-2-0 status 4 hours after initial rotenone exposure, but recovered to a 2-0-0 status by the next morning
[d/] Sourdough sentinel fish were deployed at only the stream mouth, 60 minutes downstream of the rotenone application point. Those fish displayed a 2-8-0 status 4 ½ hours after initial rotenone exposure, but recovered to a 10-0-0 status by the next morning.
[e/] Sentinel fish at EF Meadow station 8 displayed a 1-4-0 status upon deployment, likely due to transportation stress.

Table 2. Status of sentinel fish (# alive - # distressed - # dead) in varying rotenone concentrations during a serial dilution bioassay in Meadow Creek water. The bioassay was initiated at 0915 hrs.

Time	0.50	0.25	0.125	0.06	0.03	Control	Stream temperature (Cº)	Bucket temperature (Cº)
0915	3-0-0	3-0-0	3-0-0	3-0-0	3-0-0	3-0-0		
0945	0-3-0	2-1-0	3-0-0	3-0-0	3-0-0	3-0-0		
1015	0-0-3	0-0-3	2-1-0	3-0-0	3-0-0	3-0-0	11.0	10.0
1045			0-3-0	3-0-0	3-0-0	3-0-0		
1215			0-3-0	1-2-0	3-0-0	3-0-0		
1245			0-3-0	1-2-0	3-0-0	3-0-0	11.0	12.0
1315			0-2-1	0-3-0	3-0-0	3-0-0	11.0	12.0
1415			0-1-2	0-3-0	3-0-0	3-0-0		
1515			0-1-2	0-3-0	3-0-0	3-0-0		
1615			0-1-2	0-2-1	3-0-0	3-0-0		
1715			0-1-2	0-1-2	3-0-0	3-0-0	13.0	13.0

Table 3. Results of potassium permanganate (KMnO4) bio-demand test. $KMnO_4$ was applied to the stream at a calculated concentration of 3 ppm. The $KMnO_4$ station was operated from 1347 - 1755 hrs.

Minutes downstream of $KMnO_4$ station	Time	Residual $KMnO_4$ concentration (ppm)
15	1420	0.40
	1515	0.22
	1530	0.68
	1630	0.85
	1725	0.94
30	1745	0.70
45	1500	0.11
	1600	0.29
	1700	0.32
	1755	0.42

Table 4. Residual hourly rotenone concentration at East Fork Meadow Creek station 2 (EFM 2) during a travel-time bioassay. The rotenone was applied at EFM 0 at a concentration of 2.75 ppm formula (1.375 ppm a.i.) for 5 cfs streamflow measured at EFM 7. The residual rotenone concentration samples were collected at EFM 2 where stream discharge was estimated to be 3.4 cfs. The volume of rotenone formula applied to achieve 2.75 ppm in 5 cfs resulted in a concentration of 4 ppm in 3.4 cfs at EFM 2.

Hours post rotenone exposure	Residual rotenone concentration (ppb)
0	ND[a/]
1	40
2	53
3	64
4	71

[a/] No detection

Investigations in the North Fork Blackfoot River Native Fish Conservation Project Area, 2019-2020

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Introduction and Methods

Fisheries investigations in the North Fork Blackfoot River above North Fork Falls have been ongoing since 2005 (Pierce et al. 2018). Those studies have informed development of the proposed North Fork Blackfoot Native Fish Conservation Project. Primary steps towards implementing this project include identification of species presence, abundance, and distribution, as well as the testing of rotenone in waters to assess efficacy of rotenone concentrations in the project streams. Results from pilot-level bioassays (Clancey et al. 2018) highlighted inconsistencies in the predictive ability of the fish distribution model previously used for planning implementation of the North Fork Blackfoot Native Fish Conservation Project (Pierce et al. 2018). Furthermore, Clancey et al. (2018) recommended several considerations for project planning that were used to guide sampling efforts in 2019 and 2020.

Sampling events in the project area occurred in August 2019 and 2020. Prior to sampling activities in 2019, a helicopter flight was conducted on August 2 to provide aerial reconnaissance of the project area. This survey was conducted at baseflow to identify the distribution of active beaver dams, fish suitability in headwater areas of tributaries, and locate suspected fish passage barriers to investigate on the ground. We conducted environmental DNA (eDNA) sampling following standard protocols (Carim et al. 2015) in 2019 and 2020. In 2019 and 2020, eDNA samples were collected in key areas to 1) identify upstream extent of trout; 2) assess the validity of the fish distribution model; and 3) conduct ground reconnaissance in off-trail areas in tributaries to determine travel time for potential rotenone drip station applications. The eDNA samples were tested for the presence of salmonid DNA fragments (as opposed to single species) because previous investigations determined the genetic composition of populations in the tributaries (Peirce et al. 2018) and we were only interested in trout presence/absence for this investigation.

Samples were collected in the East Fork of the North Fork and North Fork Blackfoot rivers, as well as several named and unnamed tributaries (Figure 1). Initial sampling locations coincided with the predicted upstream distribution from the original fish distribution model. Additional samples were also collected upstream of those locations following a systematic sampling design to identify the upstream extent of trout occupancy. Potential barriers in Scotty Creek, Blondie Creek, and Theodore Creek were also targeted for eDNA sampling based on observations from the helicopter flight and observations from outfitters. A single eDNA sample was also collected at East (Upper) Twin lake to confirm fish absence because it was historically stocked, but a gill net survey in 2005 did not capture fish (Pierce et al. 2018).

Personnel also conducted a beaver dam breaching trial on five beaver dams in the East Fork of the North Fork Blackfoot River (Figure 2). A secondary breaching trail was conducted on a large beaver dam in Meadow Creek to test the assumption that beavers would rebuild it overnight. Two-person teams timed themselves notching and draining impounded water upstream of targeted beaver dams using hand tools (e.g., Pulaskis and mattocks). The primary objective was to assess various notching techniques, the minimum number of personnel required to notch a dam, and the duration to notch and drain the impoundment.

Results

The eDNA sampling effort yielded 22 samples in 2019 and 19 samples in 2020 (Table 1 and 2). Five samples were collected in the Scotty Creek drainage, including one sample in an unnamed tributary. The sample at the model-predicted upstream extent was positive, as well as the sample above the first suspected fish barrier (2–3-foot bedrock step falls). The second potential barrier was a bedrock waterfall approximately 8-10 feet tall and the eDNA sample was negative, suggesting that it was a complete passage barrier. Furthermore, the eDNA sample above the next waterfall, which was approximately 7 feet tall also tested negative. The unnamed tributary was sampled a short distance upstream from the confluence with Scotty Creek. This perennial channel had an average bankfull width of 1-2 feet and appeared suitable for fish, but the eDNA sample was negative.

Three samples were collected in Blondie Creek in 2019. A waterfall was identified in the 2018 bioassay. An eDNA sample was collected at the predicted fish distribution about 0.3 miles above the waterfall. That sample tested negative, as did the sample directly above the waterfall. A third sample was opportunistically collected below the falls and it tested positive.

Two samples were collected in upper Meadow Creek. The site at the predicted upstream trout extent tested positive. Another sample was collected approximately 1.5 miles upstream of the first sample location and it tested positive for salmonid DNA. The upper sampling location was approximately 0.5 miles downstream of the high gradient headwater source of Meadow Creek that was expected to preclude trout presence.

Eight samples were collected in the Mineral Creek drainage. In East Fork Mineral Creek, the location at the upstream extent of the model-predicted distribution tested positive and so did another point approximately 1.2 miles upstream from that location. An unnamed tributary like the one in Scotty Creek tested negative. The location of the model-predicted distribution in upper Mineral Creek tested positive and so did another sample approximately 0.8 miles upstream of this location. Mineral Creek had numerous unnamed tributaries flowing from the ridgeline on the west side of the drainage. The unnamed tributary # 3 was positive and had an average bankfull width of 3 feet. The other unnamed tributaries that were sampled tested negative (Figure 1).

Five samples were collected in the Lost Pony Creek drainage. The sample at the predicted upstream extent tested positive and so did the sample at a location approximately 0.25 miles upstream. An unnamed tributary with a confluence in this vicinity also tested positive for trout DNA. Following all three samples testing positive in 2019, two additional samples were collected further upstream in 2020. The 2020 samples tested negative for salmonid DNA. The furthest downstream sample was only about 0.3 miles upstream of the positive 2019 location and no passage barriers were observed between the two locations, although the entire stream channel was not investigated. A single eDNA sample was collected at East Twin Lake in 2019 and it was negative.

Extensive sampling occurred in Cooney Creek due to the abundance of high-quality habitat and the sparse distribution of previous electrofishing surveys. The two unnamed tributaries appeared very suitability for trout, but samples in both streams tested negative for salmonid DNA. All four eDNA samples collected in mainstem Cooney Creek in 2020 tested negative for salmonid DNA. There was a significant intermittent section between sampling sites 2 and 3. The perennial section above the intermittent reach also had very high-quality habitat.

All samples in Dobrota Creek tested negative for salmonid DNA even though the habitat was classified as highly suitable. A substantial unnamed tributary to the North Fork Blackfoot River upstream of Dobrota Creek was sampled upstream of the trail crossing (Figure 1). This sample tested positive for salmonid DNA. Two samples were collected in the upper North Fork Blackfoot River. The sample collected directly upstream of the Upper North Fork Falls tested negative. Another smaller waterfall is approximately 0.3 miles downstream of the upper falls, and the eDNA sample collected directly above that falls tested positive for salmonid DNA.

Table 1. Sampling locations and eDNA results in the East Fork of the North Fork drainage, 2019.

Site	Stream	Date	Latitude	Longitude	Salmonid DNA Detected	Positive Wells (#/3)
1	Scotty Creek	8/7/2019	47.17695	-112.76067	Yes	3
2	Scotty Creek	8/7/2019	47.18503	-112.76332	Yes	3
3	Scotty Creek	8/7/2019	47.18923	-112.76044	No	0
4	Scotty Creek	8/7/2019	47.19019	-112.75979	No	0
1	Unnamed tributary to Scotty Creek	8/7/2019	47.17698	-112.76054	No	0
1	Meadow Creek	8/5/2019	47.10754	-112.82136	Yes	3
2	Meadow Creek	8/5/2019	47.08888	-112.82729	Yes	3
1	Mineral Creek	8/6/2019	47.13709	-112.88016	Yes	3
2	Mineral Creek	8/6/2019	47.12952	-112.88389	Yes	3
1	Unnamed tributary to Mineral Creek #1	8/6/2019	47.13413	-112.88325	No	0
2	Unnamed tributary to Mineral Creek #2	8/6/2019	47.13731	-112.88152	No	0
3	Unnamed tributary to Mineral Creek #3	8/6/2019	47.14567	-112.8707	Yes	3
1	East Fork Mineral	8/6/2019	47.13317	-112.85183	Yes	3
2	East Fork Mineral	8/6/2019	47.11759	-112.85495	Yes	3
1	Unnamed tributary to EF Mineral Creek	8/6/2019	47.14511	-112.85133	No	0
1	Lost Pony	8/7/2019	47.17996	-112.78787	Yes	3

2	Lost Pony	8/7/2019	47.1819	-112.78496	Yes	2
1	Unnamed tributary to Lost Pony Creek	8/7/2019	47.18079	-112.78688	Yes	3
1	East Twin Lake	8/7/2019	47.16553	-112.77276	No	0
1	Blondie Creek	8/9/2019	47.15723	-112.74611	Yes	3
2	Blondie Creek	8/9/2019	47.15994	-112.74541	No	0
3	Blondie Creek	8/9/2019	47.16328	-112.74439	No	0

Table 2. Sampling locations and eDNA results in the East Fork of the North Fork and North Fork Blackfoot River drainages, 2020.

Site	Stream Name	Date	Latitude	Longitude	Any Salmonid DNA Detected	Positive Wells (#/3)
1	Theodore Creek	8/20/2020	47.25232	-112.83337	No	0
1	Unnamed tributary to Cooney Creek (West)	8/19/2020	47.24744	-112.79006	No	0
1	Unnamed tributary to Cooney Creek (East)	8/19/2020	47.24209	-112.76415	No	0
2	Unnamed tributary to Cooney Creek (East)	8/19/2020	47.2436	-112.77672	No	0
1	Cooney Creek	8/19/2020	47.22063	-112.78191	No	0
2	Cooney Creek	8/19/2020	47.23199	-112.77769	No	0
3	Cooney Creek	8/19/2020	47.24121	-112.77787	No	0
4	Cooney Creek	8/19/2020	47.24896	-112.78883	No	0
1	North Fork Blackfoot River	8/20/2020	47.27413	-112.76421	No	0
2	North Fork Blackfoot River	8/20/2020	47.27134	-112.77061	Yes	3
1	South Creek	8/18/2020	47.20868	-112.84933	No	0
1	Unnamed tributary to North Fork upstream of Dobrota Creek	8/20/2020	47.27007	-112.77482	Yes	3
1	East Fork of the North Fork Blackfoot River	8/17/2020	47.14796	-112.70889	No	0
2	East Fork of the North Fork Blackfoot River	8/17/2020	47.1511	-112.72058	No	0
1	Lost Pony Creek	8/18/2020	47.18932	-112.77781	No	0
2	Lost Pony Creek	8/18/2020	47.18379	-112.77928	No	0
1	Dobrota Creek	8/20/2020	47.29358	-112.84067	No	0
2	Dobrota Creek	8/20/2020	47.28792	-112.83208	No	0
3	Dobrota Creek	8/20/2020	47.27932	-112.80908	No	0

Following the 2018 bioassay (Clancey et al. 2018) and 2019 eDNA results, the predicted fish distribution was expanded from the original distribution model (Table 3) to account for fish presence above predicted distribution limits. Collectively, the 2019 eDNA sampling that identified barriers in some streams and the 2020 eDNA sampling in other large tributary drainages, provides a more accurate prediction of trout distribution. The recent data has informed an updated predicted fish distribution of approximately 56 miles that will require treatment with rotenone.

Table 3. Summary of changes to the predicted stream length occupied by trout following eDNA sampling.

Stream	Original model estimated stream length with trout (miles)	2019 estimated stream length with trout (miles)	2020 estimated stream length with trout (miles)
Sourdough Creek	1.2	0.9	0.9
East Fork of the North Fork River	10.5	11.4	10.5
East Fork Meadow Creek	1.9	2.6	2.6
Meadow Creek	4.6	7.2	7.2
Mineral Creek	4.6	5.7	5.7
Unnamed tributary to Mineral #1	--	0.5	0.5
Unnamed tributary to Mineral #2	--	0.5	0.5
East Fork Mineral Creek	1.4	3.8	3.8
Blondie Creek	0.8	0.6	0.6
Scotty Creek	1.3	2.8	2.8
Lost Pony Creek	1.4	3.5	1.8
Spaulding Creek	0.9	0.9	0.9
Camp Creek	1.1	3.4	3.4
South Creek	0.7	2.2	1.1
Theodore Creek	--	1.6	0.2
Broadus Creek	0.2	0.1	0.1
Cooney Creek	0.9	4.4	2.2
Cooney Creek unnamed tributary (west)	--	1.2	0.0
Cooney Creek unnamed tributary (east)	--	0.9	0.0
Dobrota Creek	1.5	2.8	0.9
North Fork Blackfoot River	9.3	9.9	9.9
Effluent channel from Twin Lake	0.3	0.3	0.3
Unnamed tributary to North Fork upstream of Dobrota Creek	--	0.0	0.5
Total length	**42.5**	**67.0**	**56.2**

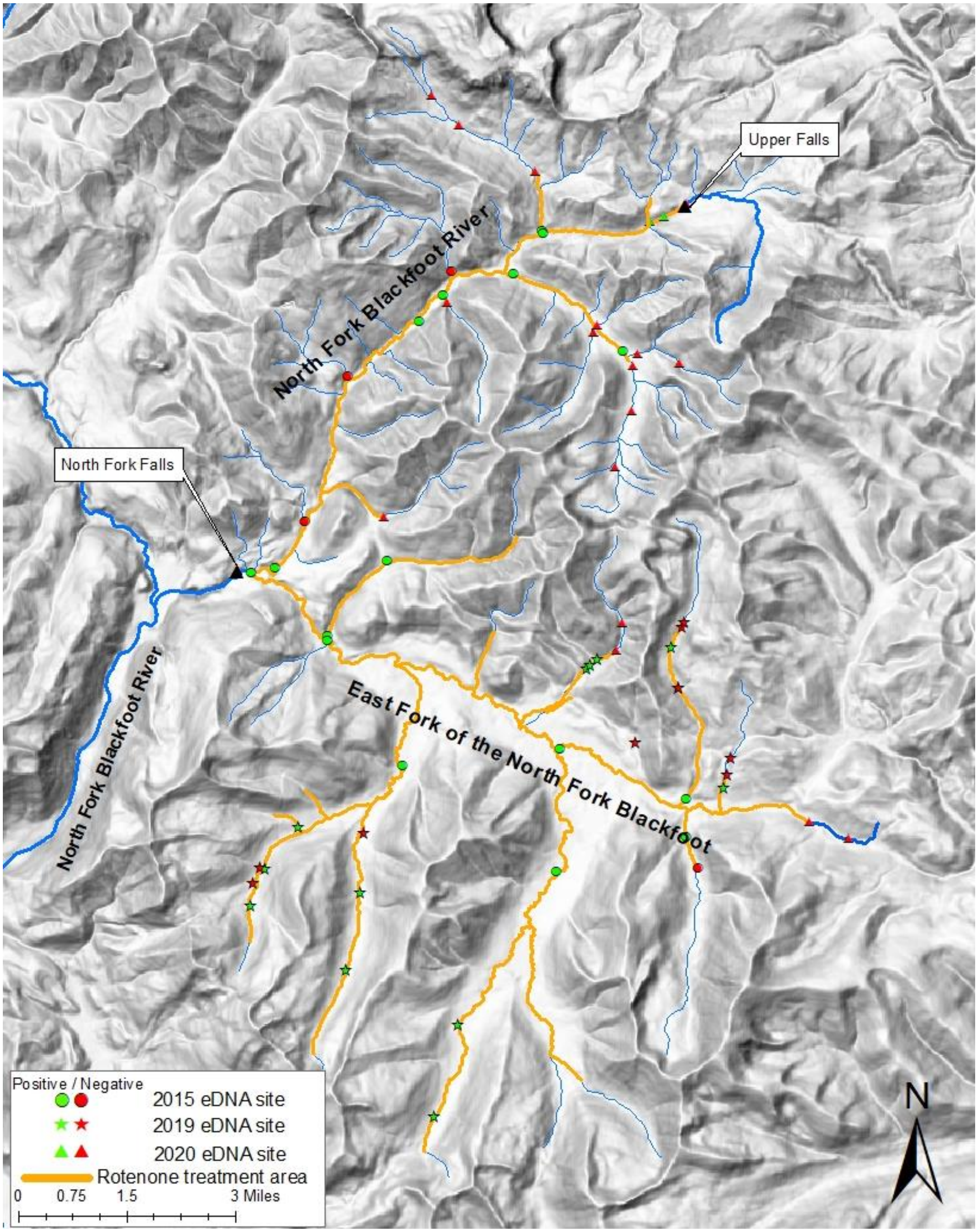

Figure 1. Environmental DNA sampling locations in 2015 (circles), 2019 (stars), and 2020 (triangles) with results testing negative (red) and positive (green) for salmonid DNA. Map of predicted extent of rotenone treatment (orange line) after adjusting the predicted fish distribution model following eDNA results.

Approximately 20-60 minutes were required for 2-person teams to breach each beaver dam (Figure 2). Time was dependent on the diameter of anchor logs in the dam, as well as the height of the dam. The impoundments behind the dams drained in under 60 minutes. Pulaskis and mattocks were the most efficient tools, whereas hand winches and grappling hooks were ineffective at breaching dams.

Figure 2. Time lapse of dam notching investigation during notching (left), draining (middle), and following draining to pre-impounded levels (right).

Discussion

The eDNA results confirmed the presence of fish passage barriers, which identified the upper extent of trout distribution in Scotty Creek, Blondie Creek, and Theodore Creek. However, the upper sampling sites in many of the other primary tributaries were positive, which indicated trout are present further upstream than the original distribution model predicted. These results, combined with the bioassay results from 2018 (Clancey et al. 2018), suggest using caution when relying strictly on the predicted fish distribution model. Given the challenges of traveling to all the tributary drainages, the distribution model can probably be applied in the smaller tributaries with low trout densities, where failing to treat all occupied habitat poses a lower threat to project success. However, in the large tributaries (e.g., Mineral Creek and Meadow Creek), in the absence of locating the upper extent with additional eDNA sampling, the rotenone treatment should commence at the source of perennial flow or where stream gradient precludes fish occupancy.

The presence of positive eDNA results in unnamed tributaries in Mineral Creek and Lost Pony Creek suggest that some of the larger unnamed tributaries warrant further investigation with eDNA, or at least targeted rotenone application with drip stations or spraying during the piscicide application. If unnamed tributaries are encountered during treatment that have not been sampled for eDNA, it will be prudent to assume fish are present and apply rotenone to those locations.

The beaver dam investigation demonstrated the efficacy of notching dams to lower the surface water elevation to pre-impounded levels and suggested that this effort is feasible during the rotenone application. The reconnaissance flight identified three active beaver dams in Meadow Creek and six active dams in Mineral Creek. The East Fork of the North Fork between Parker Lake and the Meadow Creek confluence appeared to have the most challenges. It was hard to identify beaver dams from the air given the large amount of woody debris. The impounded areas are caused by a combination of debris jams, active beaver dams, and abandoned beaver dams. Some of the backwater channels and wide areas in upper Meadow Creek may be caused by extremely low valley gradient rather than beaver impacts. These sections may need to be treated by backpack sprayers on kayaks or other techniques to facilitate rotenone mixing. The beaver dam that was notched in Meadow Creek below the outfitter camp was not reconstructed by a beaver overnight. However, active beaver dams in the project area should be notched within 48 hours of scheduled rotenone application to prevent beavers from having enough time to rebuild dams.

The eDNA sampling excursions also enabled staff to venture into headwater areas of tributaries where sampling has not occurred. In East Fork Mineral Creek, we located an old outfitter trail that will facilitate access to the upper areas, which will be necessary since the eDNA results demonstrated the need to treat near the stream source. In Scotty Creek, it took approximately two hours of bushwhacking to reach the first barrier falls. In Lost Pony Creek, it required about two hours of bushwhacking from the trail leading to West Twin Lake to reach the negative eDNA location. This provides valuable information for developing daily treatment itineraries and anticipating the length of time to travel between camping locations and designated drips stations.

Although we did not locate the upstream extent of fish presence with eDNA in every perennial waterbody in the project area, we sampled locations in all the known areas of high fish abundance. Therefore, the current amended fish distribution of 56 miles provides sufficient data to implement an effective rotenone treatment without further baseline data collection and investigation. The lack of positive eDNA, particularly in large portions of the upper part of the North Fork Blackfoot River drainage, demonstrates currently vacant, but high-quality habitat that should provide excellent habitat for native trout following introduction. These negative eDNA locations provide valuable baseline information to test the hypothesis that pure Westslope Cutthroat Trout will be more broadly distributed than the current hybrid trout population in the project area. Overall, the 2019 and 2020 backcountry investigations provided critical knowledge of fisheries status in the project area and provided valuable information to help guide effective implementation of the North Fork Blackfoot River Native Fish Conservation Project.

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Seasonal movement patterns and habitat use of trout in Nevada Creek downstream of Nevada Reservoir

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Montana Fish, Wildlife & Parks

Introduction

Understanding life history characteristics, including seasonal movement patterns and spawning behavior, is critical to effective fisheries management and conservation. Individual home ranges and movement timing can provide critical information about potential conflicts between important migration corridors and anthropogenic impacts (i.e., irrigation infrastructure). This information is valuable for understanding limiting factors and developing effective restoration strategies to address biological issues. Nevada Creek was historically a productive native trout fishery, supporting robust populations of migratory Westslope Cutthroat Trout and Bull Trout. It currently supports a mixed salmonid community including Brown Trout, Brook Trout, Rainbow Trout, Westslope Cutthroat Trout, and Bull Trout. Although Bull Trout have been detected at low densities in lower Nevada Creek (Pierce et al. 2016), contemporary spawning and reproduction in the drainage has not been documented.

The Nevada Creek valley is a primary agricultural area in the Blackfoot watershed with most of the land managed for traditional uses of hay production and cattle grazing. Nevada Creek was impounded in 1938 to form Nevada Creek Reservoir to deliver irrigation water downstream to expanding agriculture in the valley. The Douglas Canal is a primary delivery system located 3.8 miles downstream of the reservoir. The North Helmville Canal is located about 6 miles below the reservoir and delivers contracted water for a shorter period in the irrigation season and serves fewer producers. The reservoir covers 368 surface acres and stores 11,152 acre-feet of water. Lower Nevada Creek flows approximately 33 miles from the dam to the confluence with the Blackfoot River (Pierce et al. 2005).

Lower Nevada Creek was ranked as a low priority restoration candidate tributary because of low native species values and low sport fish values to the Blackfoot River (Pierce et al. 2005). Although it ranked low in these categories, it ranked high for its potential to increase flow and improve downstream water quality to the Blackfoot River. Primary limiting factors include sedimentation, irrigation impacts (entrainment and reduced flow), nutrient inputs, elevated water temperatures, passage issues, and lack of instream habitat complexity (Pierce et al. 2005). The first major restoration project (Phase 1) in Nevada Creek occurred in 2010 directly below the reservoir and involved the reconstruction of 0.8 miles of channel (Pierce et al. 2019). Restoration actions reduced width-to-depth ratios, raised incised channel elevations, created lateral scour pools with complex habitat, and reestablished riparian vegetation along the new floodplain and streambanks (Pierce et al. 2019).

Phase 1 served as a major demonstration project and, ultimately, a catalyst for additional projects nearby. Another large-scale project was implemented in 2014 below the confluence of Nevada

Spring Creek that primarily involved bank treatments and revegetation of the riparian corridor. A second project below the reservoir was implemented in 2017 (Phase 2) and involved another 0.7 miles of channel reconstruction utilizing similar restoration techniques as Phase 1. Phase 3 was implemented in 2019 and followed a similar approach as the first two phases and restored approximately 1.7 miles of stream. As monitoring demonstrated the success of these projects, support for restoration work in the valley has increased, leading to potential future restoration opportunities in this tributary.

Given the extensive footprint of these projects, the documented increases in trout abundance following Phase 1 restoration (Pierce and Podner 2016, Pierce et al. 2019), and the limited movement information in this section of Nevada Creek, the current study was developed to address key knowledge gaps. A previous telemetry project was conducted in the lower six miles of Nevada Creek near the confluence of Nevada Spring Creek (Pierce et al. 2014). That study investigated movement of trout tagged in mainstem Nevada Creek and followed their spawning migrations into Nevada Spring Creek and Wasson Creek. It provided valuable information about movement and spawning migrations of Westslope Cutthroat Trout overwintering in lower Nevada Creek. However, the lack of migration upstream of Nevada Spring Creek creates a paucity of knowledge about trout migrations in the 28 miles between Nevada Spring Creek and the dam.

With the rapid increase in trout abundance associated with increased habitat capacity from restoration projects (Pierce and Podner 2016), a better understanding of movement patterns in the affected reach is necessary to guide future restoration efforts below the reservoir. Furthermore, the Douglas Canal has high levels of fish entrainment (FWP, unpublished data) and is located directly downstream of this section. Given the frequency of trout movement between lower Nevada Creek and the Blackfoot River, it is valuable to understand if trout in this section exhibit similar movement patterns. The objectives of this study were to 1) investigate how trout use Nevada Creek downstream of the reservoir; 2) assess if trout from the stream reach near Douglas Canal migrate to the Blackfoot River; and 3) investigate spawning migrations and seasonal habitat selection of trout inhabiting the completed restoration project sections.

Methods

We used radio tags programmed for 12 hours on/12 hours off (model MST-930 miniature sensor tag; Lotek Wireless, Newmarket, Ontario, Canada) to monitor movements of Rainbow Trout, Westslope Cutthroat Trout, and Brown Trout. The tags had a warrantied life of 385 days and an estimated detection range of 200-800 meters. The tags were 9.5 mm x 26 mm and weighed 4.0 grams. We selected fish such that tag weight did not exceed 2% of body weight (Winter 1996).

We tagged seven Westslope Cutthroat Trout with lengths ranging from 329 to 370 mm and weights ranging from 365 to 615 g (Table 1). All tagged Westslope Cutthroat Trout had greater than 95% Westslope Cutthroat Trout genetic contribution, and two of them were non-hybridized (Table 1). We tagged six Rainbow Trout with lengths ranging from 362 mm to 465 mm and weights ranging from 490 g to 1040 g. We tagged two Brown Trout with lengths of 397 mm and 519 mm and weights of 685 g and 1535 g. Tags were implanted surgically while fish were sedated with MS-222. We followed standard methods previously used in telemetry studies in the Blackfoot River watershed (Pierce et al. 2014). All fish were held in live wells for a minimum of 30 minutes following surgery to assess potential surgery related injuries. We did not observe any mortality related to fish handling or surgical procedures. Ten trout were tagged in the Phase 1 restoration project section during mark recapture electrofishing surveys associated with long-term project effectiveness monitoring. Tags were divided between the marking and recapture events. The remaining five tags were implanted in trout that were removed from the Douglas Canal during an annual fish salvage event following canal closure at the end of September.

Table 1. Summary of sizes, species, and locations of radio tagged trout in this study. Species abbreviations are as follows: BT = Brown Trout, WCT = Westslope Cutthroat Trout, RB = Rainbow Trout.

Tag	Species	Length (in)	Weight (lbs.)	Date	Capture location	Latitude	Longitude	Tagging location
101	BT	20.4	3.4	9/18/19	Nevada Creek	46.806	-112.825	Phase 1 project
102	WCT[a]	13.5	1.0	9/18/19	Nevada Creek	46.806	-112.825	Phase 1 project
103	WCT[b]	13.1	0.8	9/18/19	Nevada Creek	46.806	-112.825	Phase 1 project
104	BT	15.6	1.5	9/16/19	Nevada Creek	46.806	-112.825	Phase 1 project
105	RB	17.4	1.7	9/16/19	Nevada Creek	46.806	-112.825	Phase 1 project
106	RB	16.4	1.8	9/16/19	Nevada Creek	46.806	-112.825	Phase 1 project
107	RB	17.6	1.8	9/18/19	Nevada Creek	46.806	-112.825	Phase 1 project
108	WCT[b]	14.6	1.4	9/26/19	Douglas canal	46.816	-112.852	Diversion
109	RB	16.7	1.8	9/26/19	Douglas canal	46.816	-112.852	Diversion
110	RB	18.3	2.3	9/16/19	Nevada Creek	46.806	-112.825	Phase 1 project
111	WCT[a]	13.9	1.1	9/26/19	Douglas canal	46.816	-112.852	Diversion
112	WCT[a]	14.6	1.2	9/16/19	Nevada Creek	46.806	-112.825	Phase 1 project
113	WCT[a]	13.0	0.8	9/26/19	Douglas canal	46.816	-112.852	Diversion
114	RB	14.3	1.1	9/26/19	Douglas canal	46.816	-112.852	Diversion
115	WCT	13.1	1.0	9/16/19	Nevada Creek	46.806	-112.825	Phase 1 project

[a] Genetic results indicate 98.7% WCT genetic contribution

[b] Genetic results indicate 100% WCT genetic contribution

Tracking

Tagged fish were tracked once a week from September through December. Tracking occurred once a month from January through March because we assumed most fish had migrated to overwinter locations and remained relatively sedentary through winter. Tracking occurred weekly from April through early-July, and then once or twice a month until the end of September when the last tracking event occurred on September 10, 2020. Tracking usually consisted of locating fish from the vehicle with a roof-mounted antenna or standing alongside the vehicle with a handheld Yagi antenna. Our typical tracking routine entailed driving Highway 141 to the top of the dam, turning around and driving on Cottonwood Meadows Road to Nevada Creek Ranch Road, and then driving across the Nevada Creek Connection Road to Highway 141. After completing that loop, we turned around and drove the backroad (Airport Road) into Helmville along the Douglas Canal. We expanded our tracking area during the spawning season by driving up Braziel Creek Road to the headwaters each week. On July 2, 2020, we conducted a single floating event from the mouth of Nevada Spring Creek to Cedar Meadows FAS on the Blackfoot River to determine if any unlocated fish had migrated downstream. After high flows subsided, we made attempts in June and July to pinpoint fish that appeared sedentary to determine their mortality status. Two fish were confirmed dead and one of the tags was recovered.

Movement Analysis

The study design partitioned Nevada Creek into sections (Appendix) to make it easier to track fish and communicate movements throughout the drainage because the primary purpose was to investigate large-scale movements. Locations were generally identified from the road and estimated by assuming the fish was located perpendicular to the spot on the road with the highest power output reading at the lowest gain setting. Therefore, the movement analysis is conducted on a relatively coarse scale. Defining geographical references such as mailboxes, houses, and unique features were noted, and that location was transcribed on aerial imagery from the 2015 National Agriculture Imagery Program (NAIP). Distances from original tagging location were based on these approximate locations and then measured along the stream length on aerial imagery. Updated imagery was not available following Phase 3 construction, so measurements were calculated based on pre-treatment conditions. Given the coarse resolution of fish detections, the pre-treatment conditions are sufficient to address the objectives of this study. Home range was calculated as the distance between the maximum upstream and downstream locations of individual fish throughout the study period.

Overwinter locations were identified based on multiple relocations in the same vicinity between the end of December and early spring. One fish (Tag 115) appeared to have two distinct overwinter locations. The first location was inhabited from the end of November – January, followed by a downstream migration to a second location that was inhabited from February – April. The latter detection location was used for this analysis. Presumed spawning locations were inferred by integrating observed movements with general species-specific timeframes from other studies in Nevada Creek and the Blackfoot River drainage (Pierce et. al 2007; Pierce et al. 2009; Pierce et al. 2014). Summer locations were based on lack of movements after spawning migrations and included in the analysis if the fish was detected at least once after July 1st.

Results

Several fish elicited pronounced migrations in the spring as runoff increased (Figure 1). No fish were documented migrating into the few accessible tributaries in this vicinity of Nevada Creek. Although we did not observe fish on redds, we assume spawning probably occurred in the mainstem of Nevada Creek based on migration patterns, timing, and lack of movement into possible spawning tributaries. Fish consistently exhibited little or no movement during the winter season. The largest proportion of fish exhibiting detectable movements occurred in the fall. Similarly, most fish were actively migrating in the spring. The largest movements by trout were documented in the spring, with three fish moving at least 3 miles from their previous location

(Table 2). The largest proportion of fish that moved at least one mile from their previous location

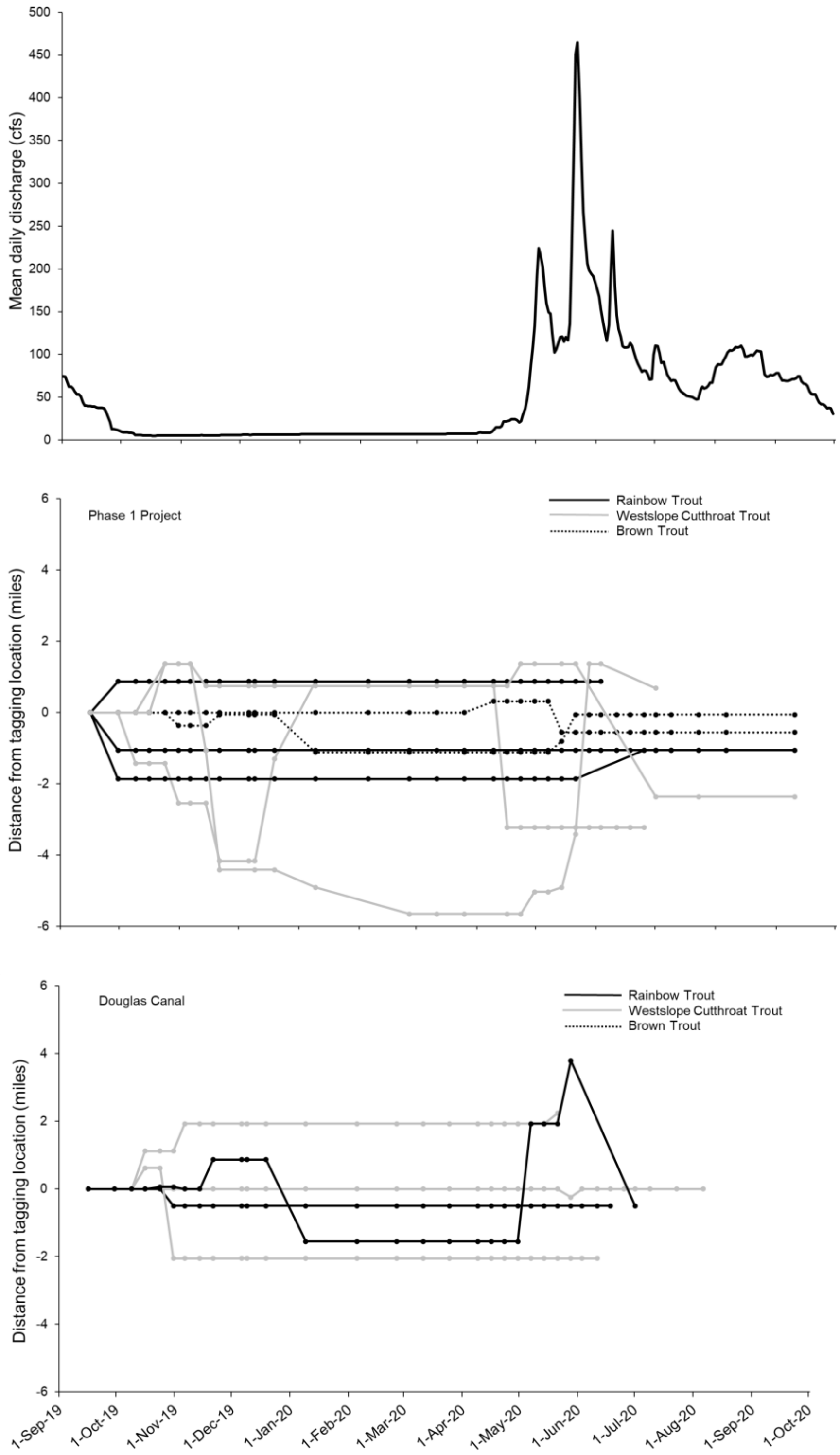

Figure 1. Mean daily discharge below Nevada Reservoir (top), migration distance from tagging location of fish tagged in the Phase 1 project section (middle), and migration distance from tagging location of fish tagged after salvage from Douglas Canal (bottom). Distance is calculated as distance downstream (negative) and upstream (positive) from tagging location (zero). Lines represent individual fish that were detected, and dots represent detection dates.

occurred in the fall (Table 2).

Table 2. Average (maximum) distance between relocation events by season. Fall is date of tagging through December, winter is January through March, spring is April through June, and summer is July through the end of the study period.

Tag	Species	Fall movements (miles)	Winter movements (miles)	Spring movements (miles)	Summer movements (miles)
101	BT	0.06 (0.37)	0.26 (1.06)	0.09 (0.75)	0.00 (0.00)
102[a]	WCT	0.59 (2.86)	0.43 (2.17)	0.34 (4.10)	--
103[b]	WCT	0.07 (0.87)	--	--	--
104	BT	0.00 (0.00)	0.06 (0.31)	0.07 (0.87)	0.00 (0.00)
105	RBT	0.14 (1.86)	0.00 (0.00)	0.12 (0.81)	0.00 (0.00)
106[c]	RBT	0.07 (0.87)	0.00 (0.00)	0.00 (0.00)	--
107	RBT	0.06 (0.62)	0.00 (0.00)	0.14 (0.68)	0.22 (0.43)
108	WCT	0.00 (0.00)	0.00 (0.00)	0.04 (0.25)	0.00 (0.00)
109[d]	RBT	0.04 (0.50)	0.00 (0.00)	0.00 (0.00)	--
110	RBT	0.09 (1.06)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
111[e]	WCT	0.27 (2.67)	0.00(0.00)	0.00 (0.00)	--
112	WCT	0.18 (1.37)	0.00(0.00)	0.10 (0.62)	1.24(3.73)
113[f]	WCT	0.16 (1.12)	0.00(0.00)	0.04 (0.31)	--
114	RBT	0.08 (0.87)	0.48 (2.42)	0.67 (3.48)	0.50(0.50)
115	WCT	0.71 (3.36)	0.31 (0.75)	0.88 (4.78)	0.68 (0.68)

[a] Fish not located after June 25, 2020

[b] Fish not located after December 19, 2019

[C] Presumed dead, transmitter located on bank June 11, 2020

[d] Fish not located after June 18, 2020

[e] Fish not located after June 11, 2020

[f] Fish confirmed dead on May 29, 2020

Overall, six trout moved downstream past the Douglas Canal diversion at least once during the study period. Two of the fish tagged in the Phase 1 project section migrated downstream of the diversion and four of the fish salvaged from the canal migrated downstream over the diversion into Section 4. Four of five fish tagged from the Douglas Canal overwintered in the section below the Douglas Canal headgate. Conversely, only 1 of 10 fish tagged in the Phase 1 project area overwintered in the section below the canal. Overwinter locations (Figure 2) were distributed over a broader section of river than summer locations (Figure 3). The frequency of fish selecting locations below the Douglas Canal was higher in winter than summer.

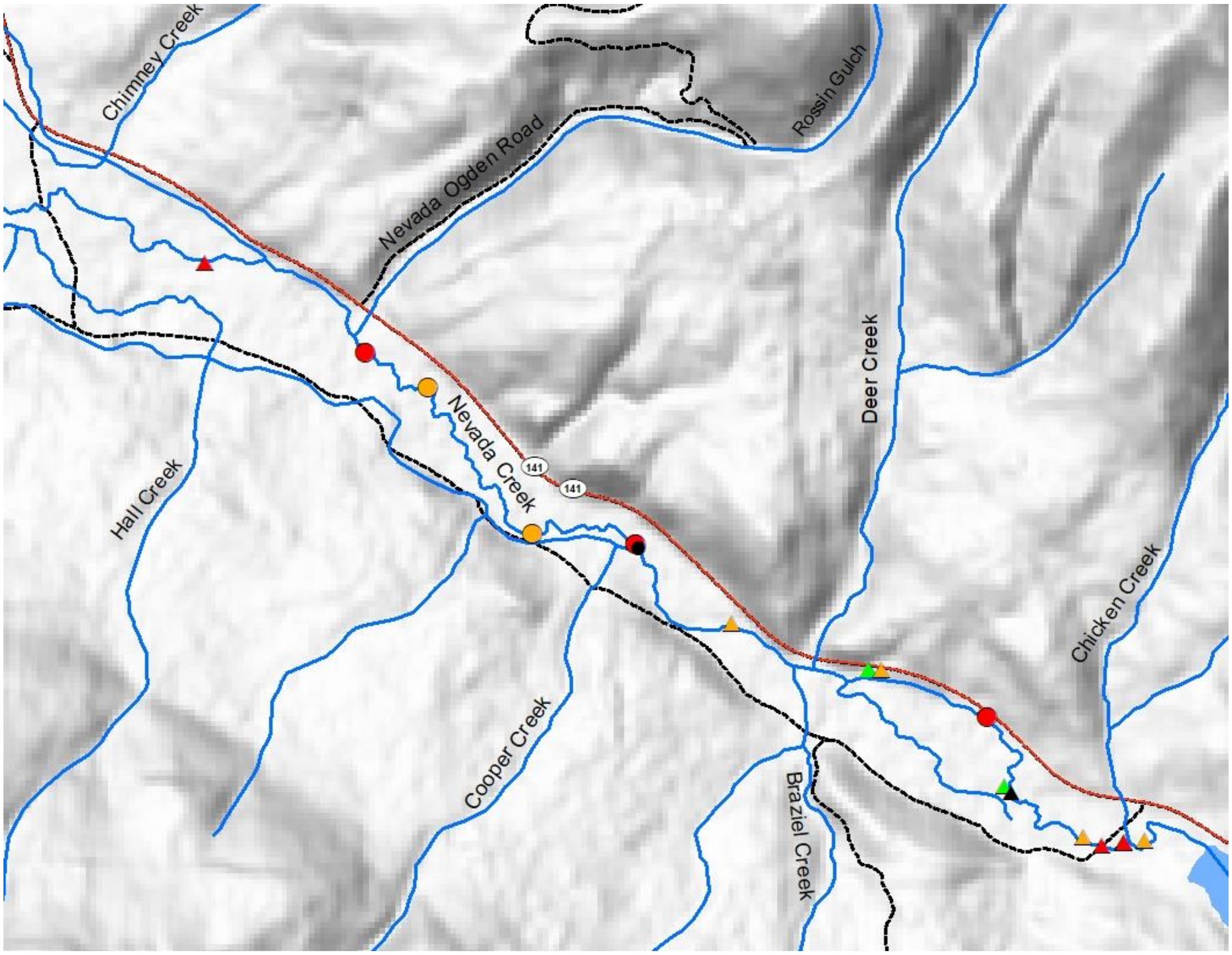

Figure 2. Overwinter locations of Brown Trout (green), Rainbow Trout (orange), and Westslope Cutthroat Trout (red) tagged in the Phase 1 project area (triangles) and tagged after salvage from the Douglas Canal (circles). The black triangle and black circle denote approximate tagging locations.

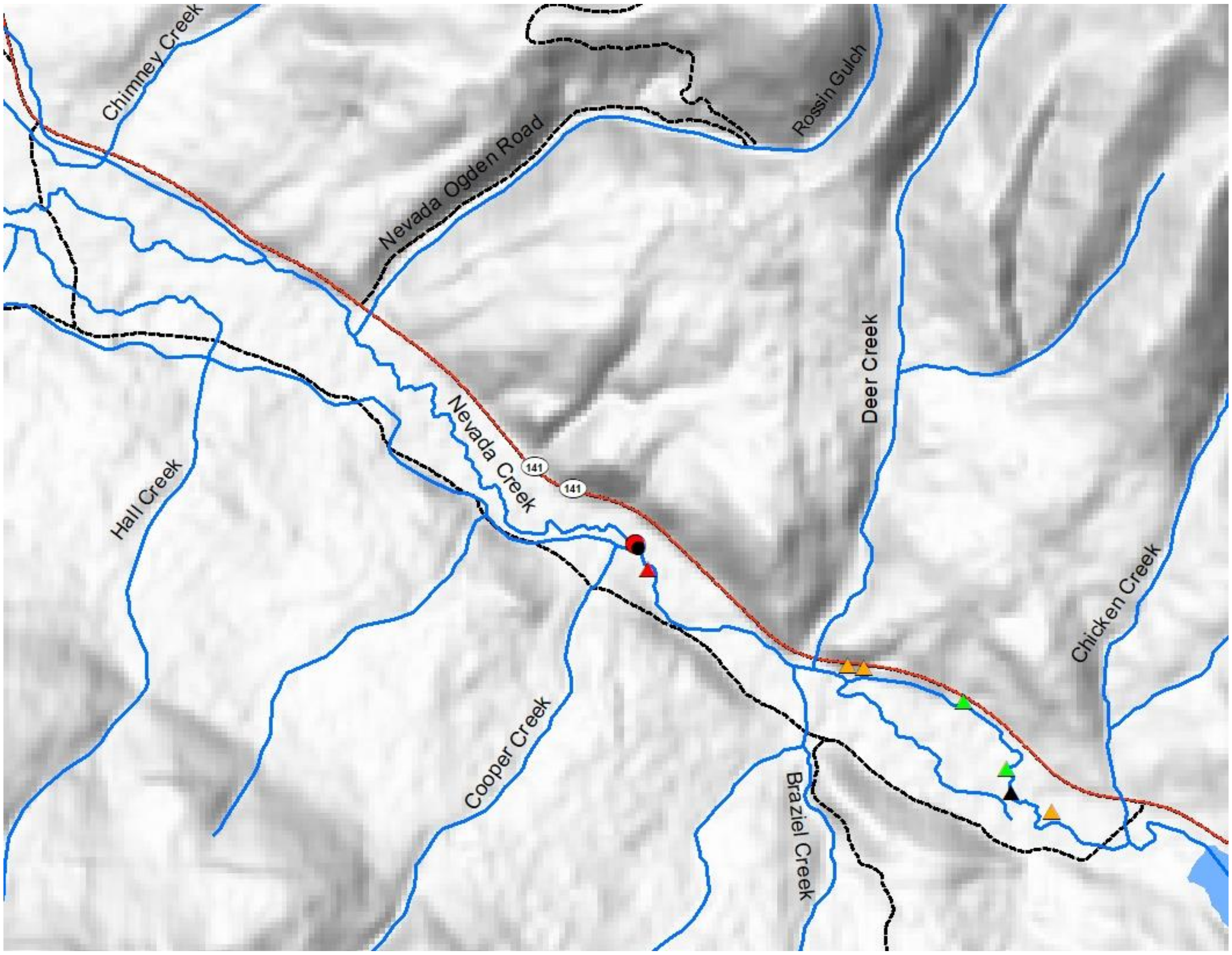

Figure 3. Summer locations of Brown Trout (green), Rainbow Trout (orange), and Westslope Cutthroat Trout (red) tagged in the Phase 1 project area (triangles) and tagged after salvage from the Douglas Canal (circles). The black triangle and black circle denote approximate tagging locations.

Home ranges varied considerably among individuals (Table 3). The average home range of trout in the study was 2.5 miles (SD = 2.5 miles). Although small sample size precludes robust comparison of home ranges among species, Brown Trout had the smallest home range during the study period. Westslope Cutthroat Trout had an average home range of 3.1 miles (SD = 2.4 miles), Rainbow Trout had an average home range of 1.8 miles (SD=1.8 miles), and Brown Trout had an average home range of 1.0 mile (SD = 0.2 miles).

Table 3. Individual home ranges of radio tagged Brown Trout (BT), Westslope Cutthroat Trout (WCT), and Rainbow Trout (RBT) in Nevada Creek estimated from the furthest upstream and downstream locations detected for each fish over the study period.

Tag	Species	Tagging Location	Maximum distance downstream from tagging location (miles)	Maximum distance upstream from tagging location (miles)	Home range (miles)
101	BT	Phase 1	1.1	0.0	1.1
102	WCT	Phase 1	4.2	0.9	5.0
103	WCT	Phase 1	0.0	0.9	0.9
104	BT	Phase 1	0.6	0.3	0.9
105	RBT	Phase 1	1.9	0.0	1.9
106	RBT	Phase 1	0.0	0.9	0.9
107	RBT	Phase 1	0.0	1.3	1.3
108	WCT	Douglas Canal	0.2	0.0	0.2
109	RBT	Douglas Canal	0.5	0.0	0.5
110	RBT	Phase 1	1.1	0.0	1.1
111	WCT	Douglas Canal	2.1	0.6	2.7
112	WCT	Phase 1	2.4	1.4	3.7
113	WCT	Douglas Canal	0.0	2.2	2.2
114	RBT	Douglas Canal	1.6	3.8	5.3
115	WCT	Phase 1	5.7	1.4	7.1

Discussion

Seasonal movement patterns in Nevada Creek below the reservoir were similar to those reported in the Blackfoot River (Schmetterling 2001; Pierce et al. 2006; Pierce et al. 2014) and other rivers in western North America (Schoby and Keeley 2011; Dobos et al. 2016). In general, fish exhibited greater mobility in the spring and fall, and were sedentary in the summer and winter, which has been previously documented for Westslope Cutthroat Trout (Schmetterling 2001, Schoby and Keeley 2011). Most fish in the study displayed limited movements in the winter indicating that if they were moving, it was on a microhabitat scale that was not detectable with our monitoring methods. The few trout displaying relatively large movements in the winter, migrated near the beginning or end of the season, but remained relatively sedentary throughout a large portion of the winter. Similarly, fish that displayed large summer movements, migrated in late June through early July and remained in local habitats for the duration of the study. Larger movements in late-June may be post-spawn migrations or responses to discharge changes associated with irrigation delivery to the Douglas Canal.

Several fish migrated upstream and overwintered near the dam outlet conduit. The reservoir may be influencing this section through outflows or upwelling, which probably creates a stable winter thermal regime with lower chances of subsurface ice formation (Brown and Mackay 1995a, Lindstrom and Hubert 2004a). Trout have been observed selecting overwinter locations with localized areas of warm water compared to broader ambient temperatures elsewhere in the river system (Brown and Mackay 1995a). Although temperature data is not available for the current study, previous years of data indicate the reservoir outlet provides a cooling effect in the summer, which suggests it may moderate temperatures in winter compared to reaches further downstream as the tailwater effect diminishes (FWP, unpublished data). We lost track of one fish during the winter and could not confirm its fate. It is possible that it migrated out of the detection area because it was last detected on December 19, but not detected during the following event on January 9. Two-stage winter migrations are well documented, where fish undergo secondary large-scale migrations after initial overwinter locations become unsuitable due to ice conditions (Brown and Mackay 1995a, Jakober et al. 1998). However, if this fish migrated in response to significant changes in conditions, we would have expected other fish in the vicinity to display similar movements. It is also plausible that this fish was predated upon because the presence of open water below the dam spillway could have facilitated predation by avian or mammalian predators, which is common in winter (Jakober 1995, Lindstrom and Hubert 2004b).

Two Westslope Cutthroat Trout moved downstream from winter locations during the spawning migration period suggesting they may have spawned downstream, as has been documented for Cutthroat Trout even when suitable spawning exists upstream (Brown and Mackay 1995b). Cutthroat Trout have been documented spawning in mainstem rivers and side channels of mainstem rivers (Brown and Mackay 1995b; Homel et al. 2015). Although Nevada Creek is a larger stream, it is still a tributary to the Blackfoot River, so it is not entirely surprising that we did not observe trout migrating into smaller tributaries during the expected spawning period. Monture Creek and the North Fork Blackfoot River are similar in magnitude to Nevada Creek, and both have significant trout spawning activity in their mainstem sections.

Trout migrating upstream towards the dam outlet may have been attracted to the dam conduit outflow or reservoir spillway. Some of the tagged fish may have been trying to migrate to natal streams if they were produced in tributaries draining into the reservoir or Nevada Creek above the reservoir. Additional evidence of mainstem spawning in this section was confirmed by observation of a Brown Trout redd in the Phase 3 project section in 2019. The redd was constructed downstream of the two radio tagged Brown Trout in this study, so it could have been constructed by one of them. Nevertheless, the presence of Brown Trout redds and the lack of movement out of this section by mature trout, indicate that spawning does occur in this mainstem section. Furthermore, the lack of Rainbow Trout and Cutthroat Trout movement into Chicken Creek, Braziel Creek, or Deer Creek, the only accessible tributaries in this section of Nevada Creek, suggest that they spawned in the mainstem. Although it is possible that a fish could have migrated into a tributary, spawned, and then out-migrated prior to a subsequent tracking event, it is unlikely that our tracking schedule would have failed to detect this movement pattern. Previous migration studies in the Blackfoot River watershed identified that Rainbow Trout and Westslope Cutthroat Trout spent an average of 17 days and 27 days, respectively, in spawning tributaries before migrating back to the mainstem river (Pierce et al. 2009; Schmetterling 2001).

We did not observe entrainment of tagged fish. However, some fish were in the vicinity of the canal headgate at the time of their last detection, so we were unable to confirm their fate. We observed a common pattern of fish migrating upstream towards the dam during the spawning season suggesting that many of the larger fish that become entrained in the canal are conducting post-spawn migrations. Two of the fish that overwintered below the Douglas Canal and made significant upstream migrations in the spring also moved downstream in early summer. One fish (Tag 102) moved downstream below the Douglas Canal in April prior to irrigation season. Another fish (Tag 115) moved downstream into Section 2 and was upstream of the canal at the time of its last detection on July 2. We also observed downstream movement of fish that overwintered above the canal, such as Tag 112 that overwintered in Section 2, but made a large-scale movement into Section 3 during the summer. Although the last detection of that fish was above the canal in Section 3, it highlights the type of downstream movement that is likely causing entrainment. A fish salvaged from the canal (Tag 114) overwintered below the diversion and made an upstream migration to Section 1 in the spring, followed by a downstream migration below the Douglas Canal in June where it was last detected. Unfortunately, we could not locate this fish after June 25, but its movement patterns suggest this was a probable cause of its entrainment in 2019. The Douglas Canal started delivering water on May 10 and discharge remained relatively high through June. The probability of entrainment was likely low during the period when fish were detected migrating past the diversion because of the low proportion of total Nevada Creek discharge diverted into the canal (Walters et al. 2013).

We anticipated that individuals entrained in the Douglas Canal would exhibit larger movements and migrate to the Blackfoot River at higher rates because they had become entrained in the ditch while migrating downstream. However, there were no significant differences between the two groups of tagged fish, and the fish that exhibited the largest home range was tagged in the Phase 1 project section. Although we might assume a higher probability of capturing a migratory individual from the canal, our small sample size may have precluded the capture of a long-range migratory fish if that life history is rare in this section. Furthermore, we failed to confirm the fate of several fish, so some individuals may have migrated to the Blackfoot River without detection.

The annual apparent survival rate was 47%, assuming all of the fish not located after early-July were mortalities. Only two fish in the study were confirmed moralities. Therefore, our estimate of survival is very conservative and represents a minimum survival rate. For example, if we assume that two of the fish with unknown fates had moved out of detection range and were alive, the survival rate increases to 60%. Nevertheless, the apparent survival rate is consistent with inland wild trout natural mortality rates of 50% in the western U.S. (Carlson and Rahel 2007). Only one fish was not located after winter. Tag 103 was not detected any time after December 19. If we assume this individual perished during the winter then the estimated winter survival rate is 93%, which is similar to reported winter survival rates of adult trout (Carlson and Rahel 2010). During winter, fish were probably inhabiting pools with small woody debris (Meyer and Gregory 2000), which is present in the form of mature willow riparian areas and submerged branches below the Douglas Canal and in the form of toe wood matrices (root mimicry structures) and young willow plantings in the Phases 1-3 project sections. Similar to other studies investigating spring-spawning trout species, the estimated morality rate for fish in this study was highest in Spring (Carlson and Rahel 2010).

The relatively small home ranges of tagged trout suggest that there is high-quality, diverse habitat in this section of Nevada Creek that provides for the full suite of seasonal resource requirements of adult trout. Trout generally complete migrations to secure adequate feeding, survival, and reproductive habitats that are patchily distributed in river systems (Northcote 1997). Overall, the frequency of detection intervals with little or no movements, and the relatively small home range for most fish, indicate a sufficient diversity of habitat exists in the section below the reservoir for fish to compete their life cycle. We observed few long-range migrations over the course of the study, which was contrary to observations in the previous Nevada Creek telemetry study closer to the confluence with the Blackfoot River (Pierce et al. 2014). Interestingly, we documented more fish overwintering in the section below the Douglas Canal than occupying summer locations in this same section. This may indicate potential limiting factors in late-summer due to low flows.

One of the primary objectives of this study was to assess movements between this section of Nevada Creek and the Blackfoot River, but we did not observe any tagged fish migrating outside of the 7-mile section downstream of the reservoir. This underscores several limitations with our study design. We experienced a high rate of tagged fish with unknown fates (27%), which precluded our ability to determine if any fish migrated outside of our detection area. Additionally, our sampling timeframe may have biased the movement patterns we observed. Because we captured and tagged fish in September, migratory trout from the Blackfoot River may have already migrated downstream to lower Nevada Creek or the Blackfoot River. The previous study in lower Nevada Creek tagged fish in late-winter and early-spring, and those fish had either overwintered in Nevada Creek or had already initiated their upstream spawning migrations from the Blackfoot River (Pierce et al. 2014). If they had migrated from the Blackfoot River, it is likely that they would have migrated back out to lower Nevada Creek or the Blackfoot River before September (Pierce et al. 2014). Therefore, the fish available for capture at the time of our tagging study could have been biased towards individuals with a resident life history strategy. Finally, our focus on large-scale movements contributed to the study design with a maximum tracking frequency of once a week, which could have resulted in fish moving out of detection range between events. Despite these limitations, the study still provides valuable information about movement patterns, general habitat use, and overall life history characteristics of trout inhabiting the section of Nevada Creek directly downstream of Nevada Reservoir.

<u>Management Recommendations</u>

1) Continue electrofishing the Douglas Canal at the end of irrigation season.
2) Establish long-term monitoring sections between the Douglas Canal diversion and Highway 271 to collect baseline data regarding trout distribution and abundance.
3) Explore future research opportunities to determine if trout migrate between the Blackfoot River and this section of Nevada Creek
4) Seek opportunities to implement restoration projects downstream of Phase 3.
5) Develop a better understanding of thermal conditions in lower Nevada Creek with an emphasis on the low-flow section below the Douglas Canal diversion.

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Appendix

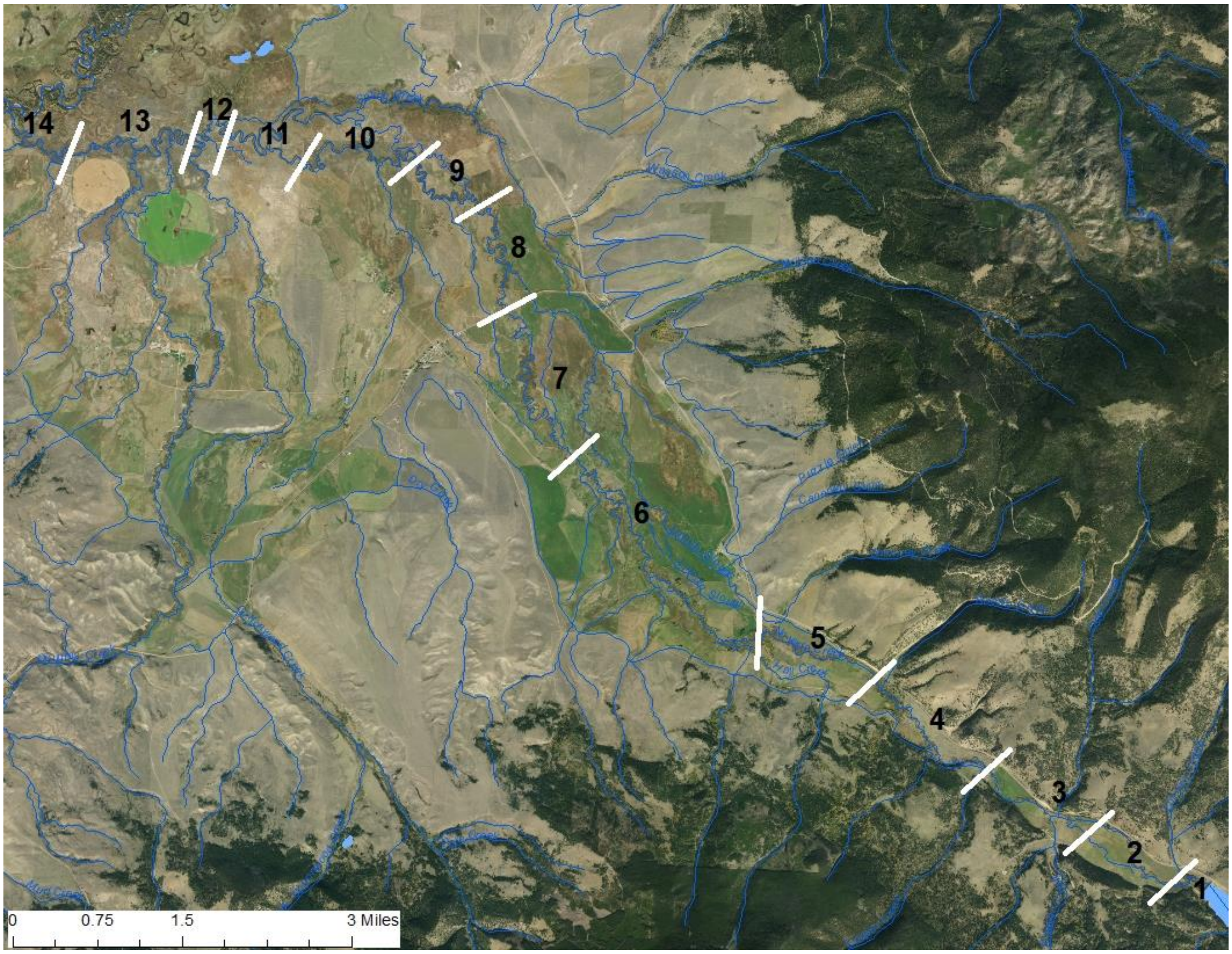

Figure A1. Map of the tracking sections in Nevada Creek below Nevada Reservoir.

Angler Surveys in the Upper North Fork Blackfoot River Fishery

Patrick Uthe and Craig Podner

Montana Fish, Wildlife & Parks

Introduction

The North Fork Blackfoot River (hereafter, “North Fork”) has significant biological, cultural, and recreational value. It is the largest tributary to the Blackfoot River and ranks among the highest priorities for restoration and conservation in the watershed (Pierce et al. 2005). The North Fork is one of the most important spawning and rearing streams for migratory Bull Trout and Westslope Cutthroat Trout in the Blackfoot River watershed. Private landowners, watershed groups, and government agencies have worked incessantly for decades to address limiting factors throughout the lower sections of the river. Today, all major diversions on the North Fork have fish screens, resulting in full connectivity for migrating trout. Furthermore, many water conservation projects involving private landowners have improved flow conditions in areas that experienced chronically low streamflow.

Anglers have long sought quality Westslope Cutthroat Trout angling opportunities in the North Fork. The lower section of the river is very popular for float fishing, as many anglers frequently launch at Harry Morgan FAS to fish the lower North Fork before floating to the mainstem Blackfoot River and fishing downstream to Scotty Brown FAS or Russell Gates FAS. For anglers that prefer hiking to secluded spots and wade angling, the upper North Fork is an ideal spot. Like other Western Montana rivers, and the Blackfoot River in general, the North Fork has experienced significant increases in fishing pressure over the last few decades. In particular, there has been a pronounced increase in angling pressure since 2009. Angler use on the North Fork fluctuated between 600 and 3,000 angler days per year in the 1990s and early 2000s and increased to 4,000 - 6,600 angler days after 2009.

The North Fork does not have specific river sections like the mainstem Blackfoot River for angler pressure estimates, but the river can generally be divided into three primary fishing locations. The lower fishery encompasses the lower eight miles from the mouth to the Ryan Bridge crossing, although the portion from Harry Morgan FAS to the mouth receives the most use (Figure 1). The section from Ryan Bridge upstream to the Forest Service boundary receives the least pressure because of lack of public access and lower fish abundance because of low flows in this section of river. The popular Westslope Cutthroat Trout fishing section is the primary focus of the upper fishery and extends from the downstream Forest Service boundary upstream to North Fork Falls.

Recently, there have been more frequent anecdotal reports that fishing quality has declined, as well as the perception that Westslope Cutthroat Trout abundance has declined. However, long-term monitoring surveys in the lower North Fork indicate relatively stable to increasing abundance of trout since 1989. Electrofishing surveys in 2020 (see Uthe et al. 2021) show that the long-term trend of increasing native trout abundance has continued since the previous survey

(Pierce and Podner 2016). Except for fisheries inventories upstream of North Fork Falls (Pierce et al. 2018), minimal sampling effort has been dedicated to the upper North Fork fishery. The closest long-term survey section is a small side channel below the USFS Road #5550 bridge downstream of the trailhead at stream mile 17.2 (Piece and Podner 2013). The nearest mainstem survey section is located downstream in the hydrologic losing reach at stream mile 12 (Pierce and Podner 2006) where relatively low densities of trout have been observed while electrofishing the stream margins on both sides of the river. Collectively, these two sections do not provide valuable insight regarding the trout abundance experienced by anglers in the popular fishing section, nor a comprehensive understanding of the recreational fishery status. As such, the concerns recently expressed by anglers have been challenging to address with the limited data in this section of river.

Creel surveys have provided valuable information regarding angler habitats and catch rates in Blackfoot River drainage over the last few decades. Creel surveys were conducted in the Blackfoot River in 1994 (Peters and Workman 1996), 1999 (Schmetterling and Bohnemann 2000), and 2004 (Pierce and Podner 2006). The previous surveys collected some information on the North Fork, but the data is very sparse and not specific to the fishery in the upper river section. We installed a survey kiosk at the North Fork trailhead parking lot to rely on angler self-reporting to gain a better understanding of the fishery in this popular river section. The specific objectives of this study were to 1) assess fishing quality; 2) estimate catch rates; 3) document angler use; and 4) understand angler satisfaction in this section of river.

Methods

The survey kiosk was installed at the North Fork trailhead on June 4, 2020 and remained operational for the duration of the open fishing season (through November 30). A sign (Appendix) was installed on the kiosk survey box, as well as the information board near the entrance of the Forest Service campground. This signing configuration was designed to maximize the extent of notification given that all anglers accessing this portion of the river may not park in the designated parking lot where the single survey kiosk was located. The location was selected to maximize the attention of anglers targeting the primary upper river section from the trailhead upstream to the falls. The Forest Service road bridge crossing (Figure 1) is another popular angling access point, but the information gathered from this kiosk location was assumed to be representative of the entire upper North Fork fishery.

The survey requested 10 pieces of information from anglers (Appendix). Completion rates of surveys were generally high, but a few anglers omitted critical items. If an angler expressed time spent fishing as day(s), we assumed that an angler day equated to 12 hours. This was selected as opposed to another duration (e.g., 8 hours) because several completed surveys during the peak of the summer reported cumulative time spent fishing in a single day as 12 hours. A single survey omitted the date, but we estimated a date (August 10) based on the position of the survey in the stack in the collection box. Finally, two otherwise completed surveys reported total fish caught, but omitted cumulative fishing time. The mean weekly fishing time per angler trip was used as a proxy for those two surveys for summary and analysis.

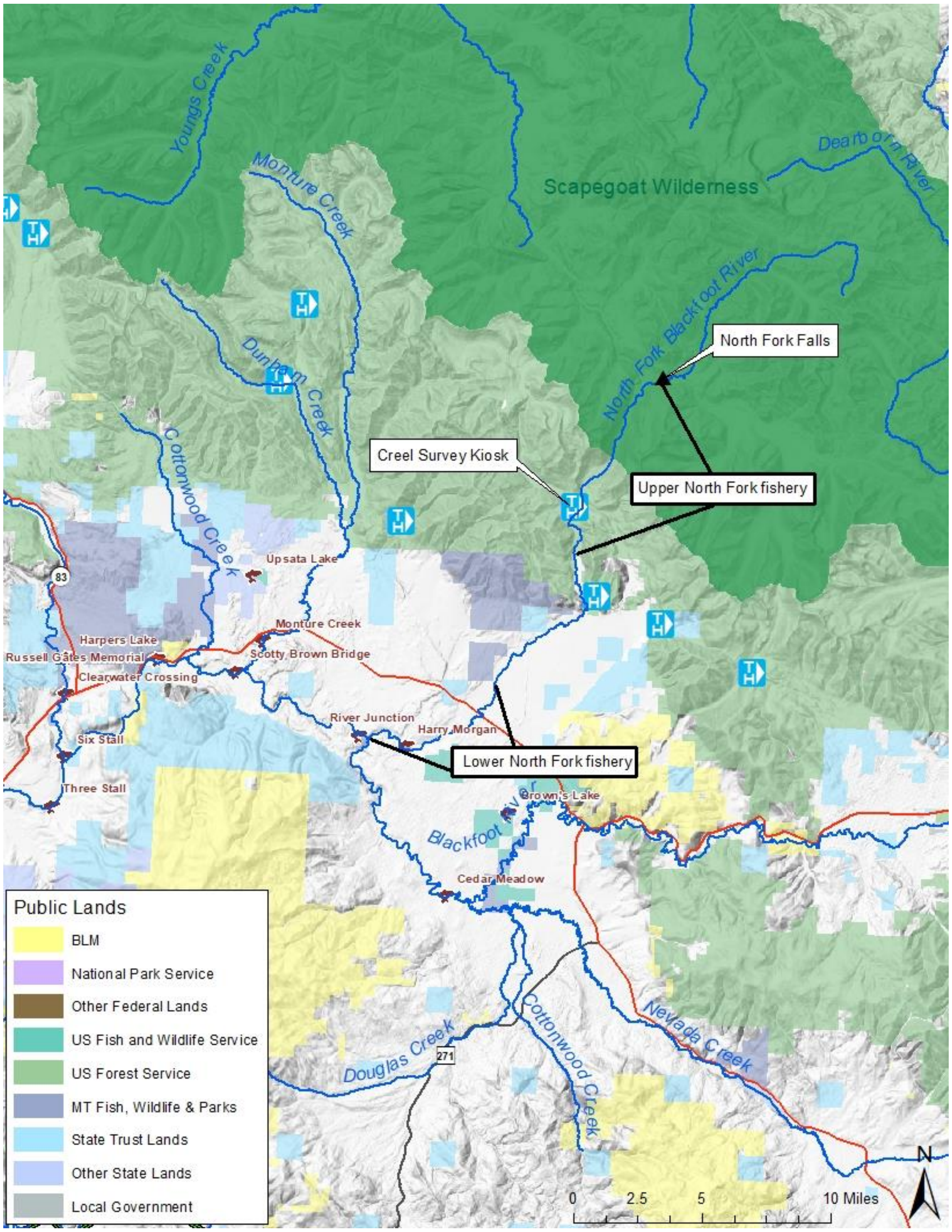

Figure 1. North Fork Blackfoot River primary fishing sections, access points, and location of the survey kiosk.

Results

Anglers submitted 98 surveys from June 6 through October 10. Residents represented 73% of the total responses. Of the anglers that responded to Question 3 (Appendix), 69% reported fishing the river in the past. Angler pressure, as indexed by surveys submitted, peaked during the first two weeks of August, and then oscillated around the level of use documented in early- summer. Interviewed anglers accumulated a total of 632.5 hours of angling and caught a total of 610 trout for a total catch rate of 0.96 trout/hour. Of the total catch, anglers reported catching 60 Rainbow Trout. Given the inconsistency of the reported frequency of angler-caught Rainbow Trout with the proportion of hybrids and Rainbow Trout in electrofishing surveys near this section, and the high frequency of anglers misidentifying species (Pierce and Podner 2006), all fish were considered Westslope Cutthroat Trout for analyses.

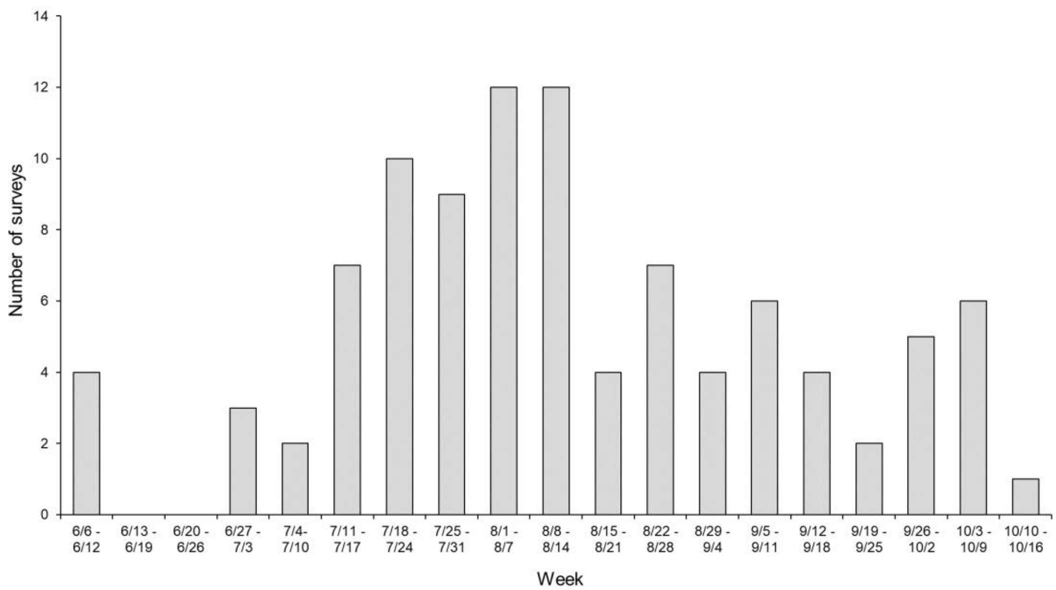

Figure 2. Number of creel surveys submitted by anglers each week.

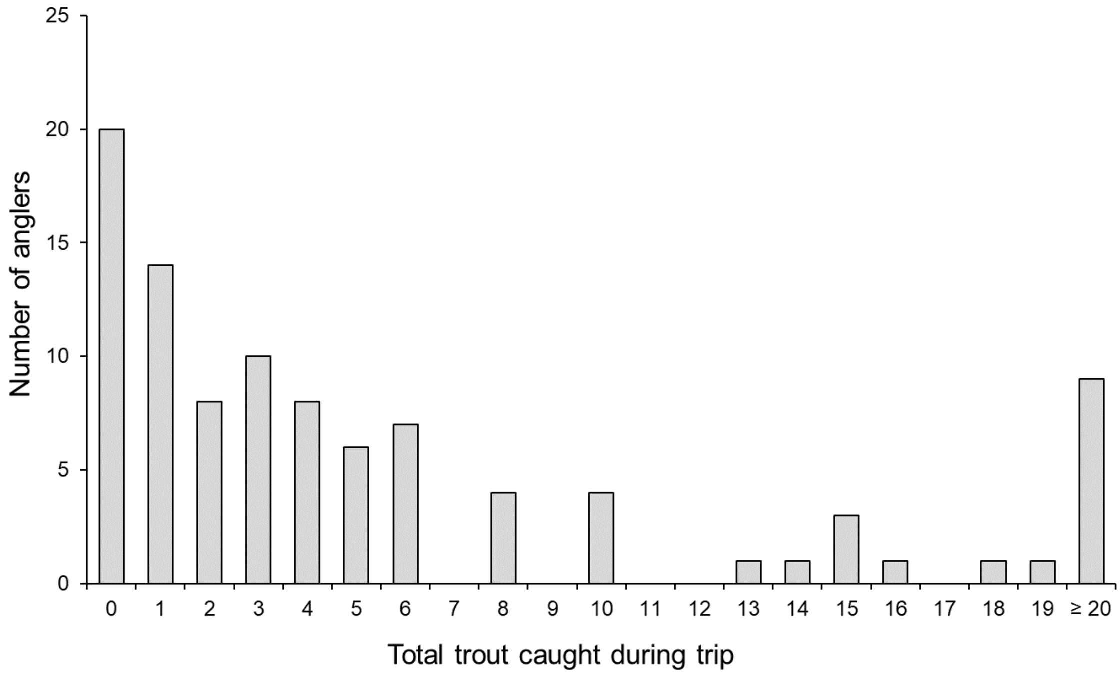

Figure 3. Frequency of total catch per trip reported by anglers over the entire study period.

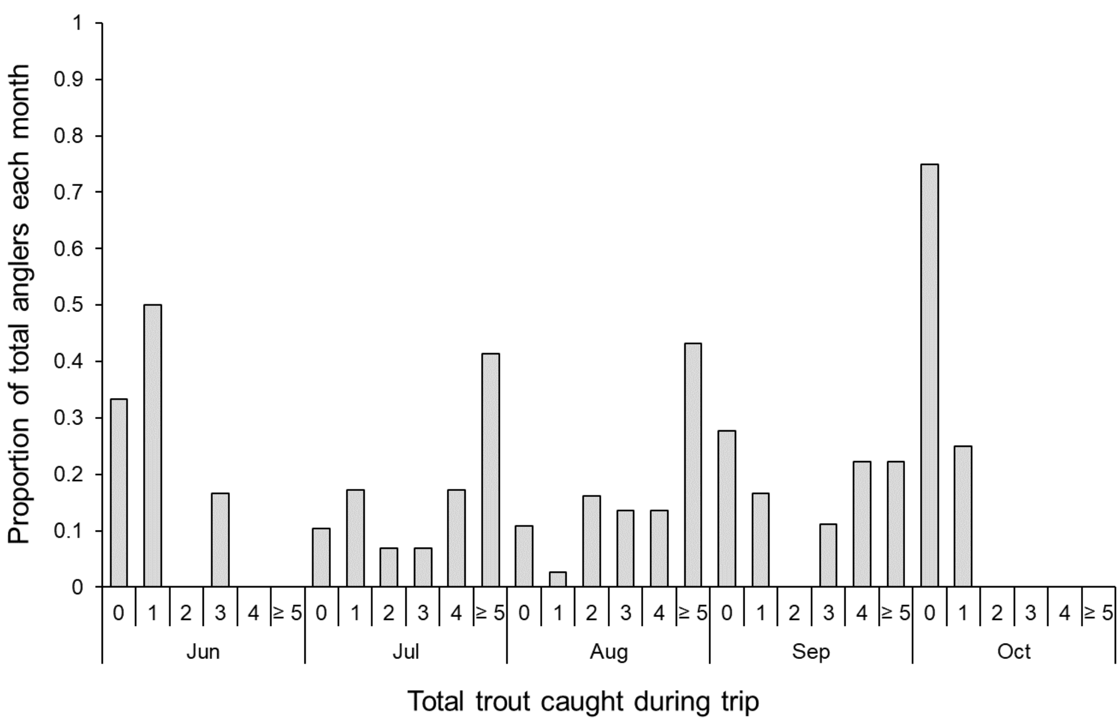

Figure 4. Cumulative catch per trip reported by anglers each month.

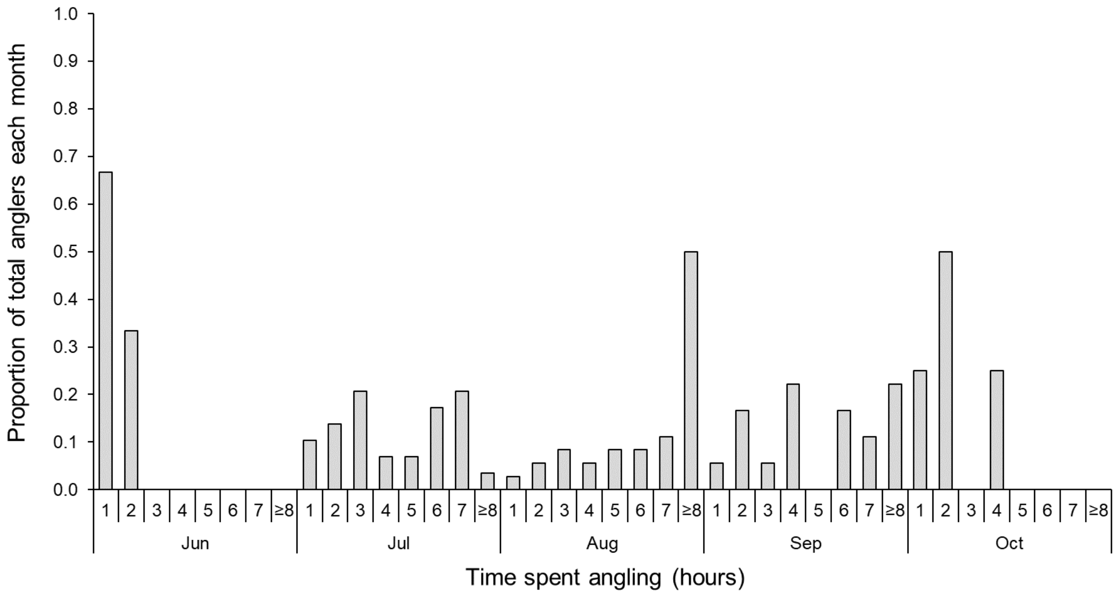

Figure 5. Cumulative time spent fishing per trip by anglers each month.

Overall, 80% of anglers reported catching at least one trout (Figure 3). More than half of surveyed anglers reported catching at least three trout (58%) and 9% reported catching 20 or more trout during their fishing trip. Total fish caught per trip varied seasonally. In July, 90% of anglers caught at least one trout, and in August, 89% of anglers caught at least one trout before dropping to 72% in September (Figure 4). During July and August, over 40% of anglers caught at least five trout during their trip (Figure 4).

Cumulative time spent angling varied seasonally (Figure 5). In early summer, anglers participated in short duration fishing trips. As summer progressed, more anglers had multiple-hour trips on full-day and multi-day excursions. In August, there was a significant increase in the proportion of anglers engaging in full day and multi day fishing trips. Following a decline in the length of fishing trips through September, the month of October had a similar pattern as June, with the majority of anglers fishing for two hours or less (Figure 5).

Catch rates started off slow until runoff subsided and fishing conditions improved in July (Figure 6). July had the highest catch rates, with anglers fishing in the middle of the month averaging nearly 2 fish per hour. Following this peak, average catch rates decreased until the middle of August when catch rates dropped below 1 fish per hour. Fishing pressure as indexed by surveys submitted (Figure 2), demonstrated an inverse relationship with catch rates (Figure 6). They increased again in late August and early September to about 1.5 fish per hour before consistently declining into early October when catch rates dropped precipitously. Even though average catch rates decreased during this timeframe, some anglers reported catching over 20 trout at the end of

September. Hook scarring rate was 21.8% over the course of the study. The highest scarring rates occurred in September and October, which followed the summer timeframe when angler catch rates were high (Table1).

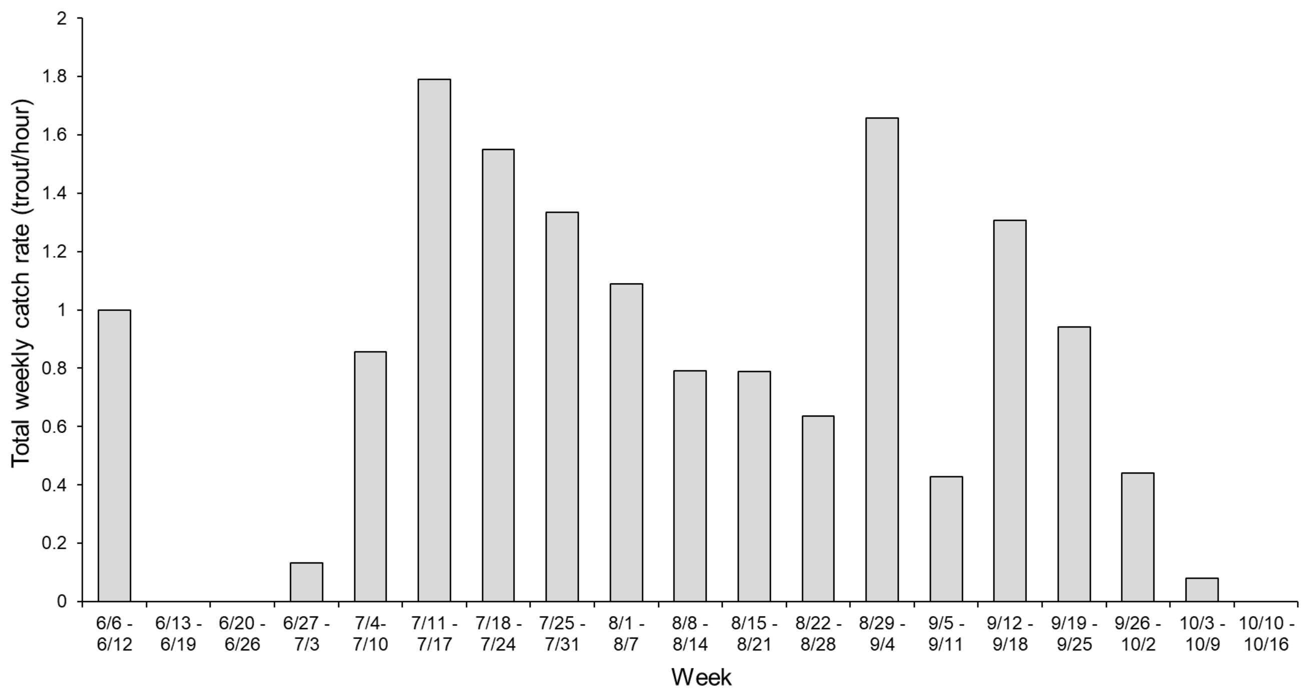

Figure 6. Total weekly catch rates during the study period.

Table 1. Total fish caught by month and incidence of hook scarring reported by anglers.

Month	Total fish caught	Fish with hook scars	Scarring rate (%)
June	6	0	0.0
July	196	46	23.5
August	308	47	15.3
September	98	38	38.8
October	2	2	100.0
Total	610	133	21.8

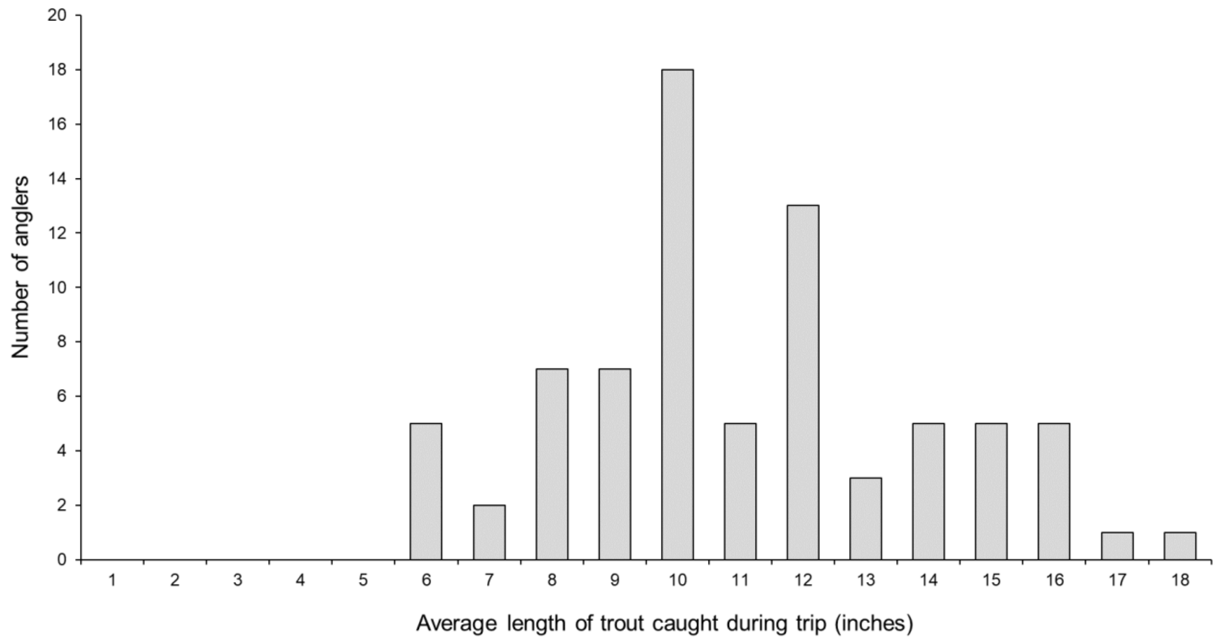

Figure 7. Average length of fish per angler trip.

Angler responses about perceptions of recreational use were generally consistent with the trends in number of surveys submitted over the study period. Few surveys were submitted in June, and all of the anglers rated the amount of use as light or very light. As the number of surveys submitted each week increased rapidly throughout July, more anglers rated the amount of use as slightly crowded (21%) or very crowded (7%). August experienced the highest level of use and angler perceptions during that month had the highest frequency of anglers that rated use as slightly crowded (40%) or very crowded (11%). As use declined in September, the number of anglers reporting use as slightly crowded (12%) and very crowded (6%) also declined. Similar to June, all anglers fishing in October rated use as either light or very light.

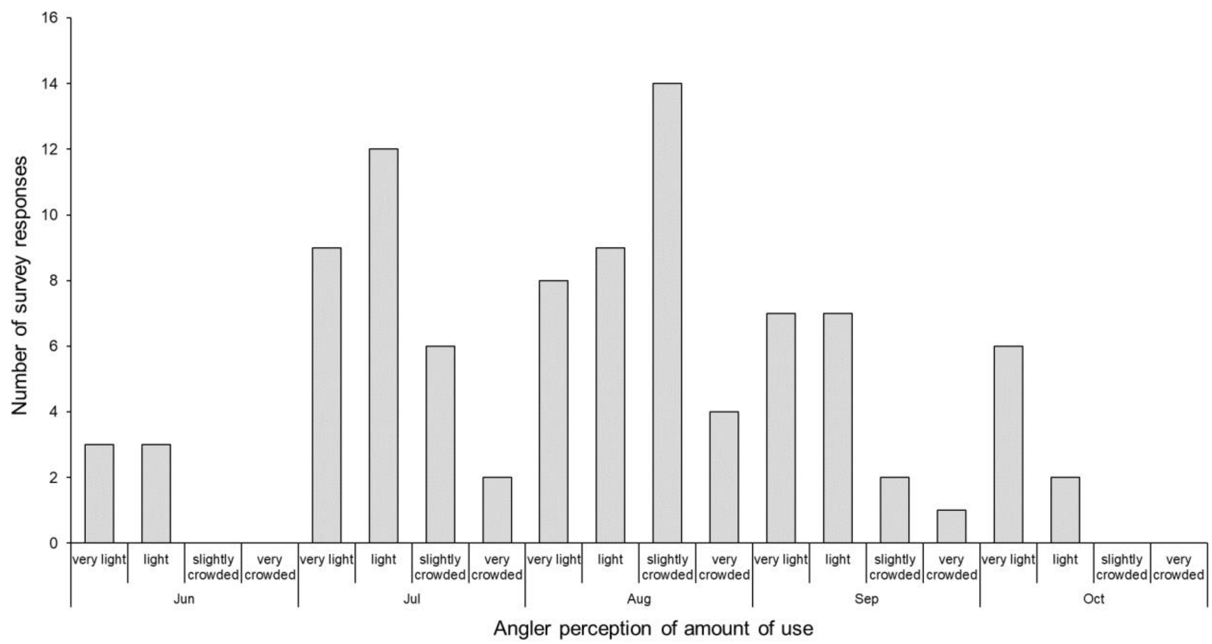

Figure 8. Perception of crowding by month.

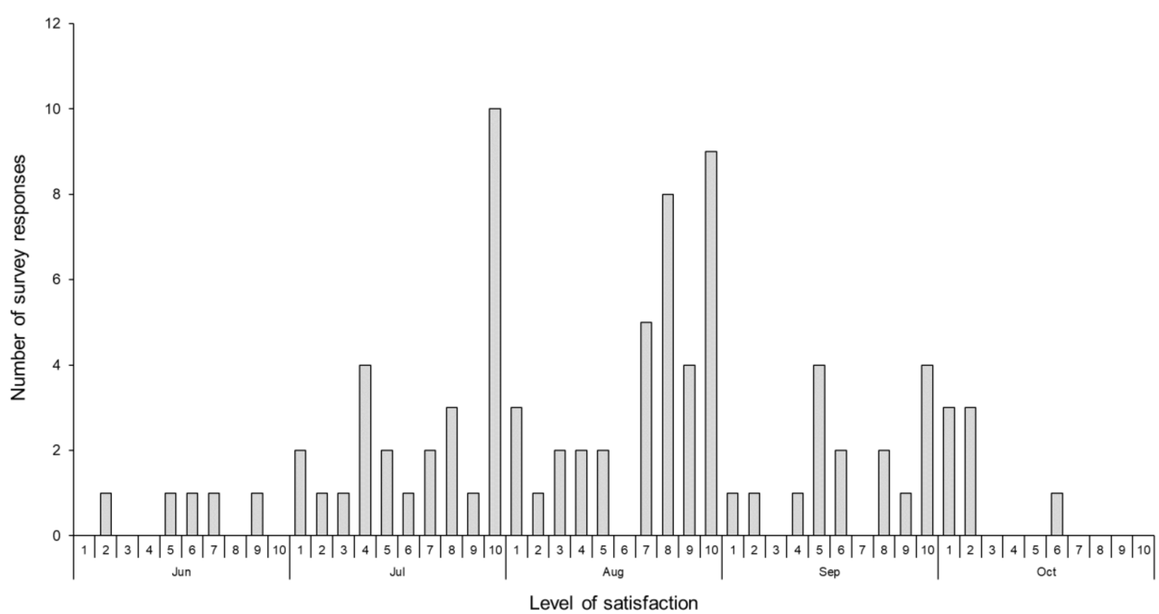

Figure 9. Frequency of levels of satisfaction reported by anglers.

Average monthly satisfaction ratings generally followed the same trend as catch rates. In June, the average satisfaction was 5.8 (SD =2.6) and increased to 6.9 (SD=3.1) in July before peaking at 7.1 (SD=2.9) in August. Satisfaction decreased in September to 6.5 (SD = 2.9) and reached the lowest point in October with an average satisfaction of 2.1 (SD = 1.8). July had the highest frequency of anglers ranking their level of satisfaction as a ten.

Discussion

Like many areas throughout Western Montana in 2020, angling pressure was exacerbated by the Covid-19 trend of increased outdoor recreation by residents and tourists alike. This remote section of the North Fork was no exception. For many survey respondents, it was their first time fishing the North Fork. The regulations restrict angling methods to artificial lures only with the additional stipulation of single point barbless hooks. Interestingly, two survey respondents provided comments suggesting implementation of a barbless hook regulation. This indicates that some anglers are not checking the regulations prior to fishing and do not read the numerous, highly visible regulation signs posted at obvious parking and foot access areas near this section of river. Furthermore, one of the respondent's comments in early-August noted the use of treble hooks, bait, and illegal harvest of Westslope Cutthroat Trout, indicating ignorance or blatant disregard for regulations. Maintaining or increasing the frequency and level of enforcement presence during the peak fishing season in this section of river may help alleviate and prevent these illegal activities.

Catch rates were inversely related to the number of surveys submitted by anglers. Although this study was not a census and not designed to estimate total angler use, it provides an index of angler use. As the number of survey responses increased from early July to mid-August, catch rates consistently declined. Moreover, the proportion of responses ranking crowding perception as slightly or very crowded increased from July to August, corroborating the evidence that angling pressure was correlated with the number of survey responses. August had consistently lower catch rates coinciding with the timeframe of highest use. This suggests that lower catch rates were related to increased fishing pressure as previously caught fish may exhibit learned hook avoidance (Askey et al. 2006). After survey responses dropped sharply in late-August, catch rates increased again and then remained highly variable before declining sharply towards the end of the fishing season. Anglers that fished this section in the past and reported a decrease in angling quality in 2020 may have that perception due to the dramatic increase in angling pressure over the last decade.

Catch rates are generally influenced by seasonal factors (Van Poorten and Post 2005), variability in vulnerability among individuals (Cox and Walters 2002), and behavioral responses associated with previous history of being caught (Cox 2000; Lovén Wallerius et al. 2019). The variable and declining catch rates in late-summer and early-fall are probably a combination of residual effects of high summer fishing pressure influencing persistent declining fishing success, as well as seasonal effects. Beyond total fishing pressure, the spatial variation in fishing pressure can also influence catch rates (Koeck et al. 2020). Furthermore, learned hook avoidance associated with high angling pressure can decrease relatively quickly after pressure subsides (Koeck et al. 2020), which may explain the pronounced increase in catch rates in early September. Catch rates can decline during the fishing season because of the decreasing likelihood of subsequent catches after a particular fish has been caught and released, and the assumption that only a proportion of the total population is available or susceptible to potential angling capture (Cox 2000).

Interestingly, the few surveys in 2004 at the USFS Bridge and trailhead, estimated average catch rates from late-June through the first week of August as 0.2 trout/hour (FWP, unpublished data). This is significantly lower than the catch rate we documented during this same timeframe (1.3 trout/hour). There were fewer surveys overall (13 interviewed anglers that accumulated time spent fishing), but the results still provide a valuable context for comparing our estimated catch rates. Only 40% of interviewed anglers reported catching at least one fish in 2004. The data was collected in a different manner and only resulted in angler interviews on 11 days during the summer, so the average catch rates should be interpreted with caution. Nonetheless, this strongly suggests that catch rates in 2020 were considerably higher than 2004.

Catch rates can be biased by fishing pressure and they do not always correspond directly to population size, particularly when comparing within-season catch rates as our study did. However, they can provide an index to population size in the absence of other survey methods (Isaak et al. 1992). Furthermore, temporal trends in annual catch rates have been positively correlated with annual increases in fish abundance (Pitman et al. 2019). Collectively, the increased catch rate compared to 2004 along with increasing trends in Westslope Cutthroat Trout abundance from electrofishing surveys in the lower North Fork and Blackfoot River (Pierce et al. 2016), provide evidence that the population in the upper North Fork is stable or increasing. This suggests that angler perceptions of declining Cutthroat Trout abundance are associated with individual experiences of low catch rates due to fishing during periods of high angling pressure, rather than population declines reducing the number of trout available for capture.

Peak catch rates in mid-July were similar to other popular, high-quality Westslope Cutthroat Trout fisheries in Western Montana (Rich 2016). The overall catch rate that we documented (0.96 trout/hour) is considerably higher than what has been previously documented in the Blackfoot River drainage. Overall catch rates in the Blackfoot River declined from 0.79 fish/hour in 1999 (Schmetterling and Bohnemann 2000) to 0.56 fish/hour in 2004 (Pierce and Podner 2006). Pierce and Podner (2006) posited that the decline may have been due to different survey methods or the result of population declines from prolonged drought in the watershed during the period of investigation. Although our estimated catch rate is not entirely comparable to this basin-wide estimate, it provides a valuable context for comparison. Regardless, 2020 catch rates in the upper North Fork fishery indicate an abundance of high-quality fishing opportunities.

Angler satisfaction was very high throughout most of the fishing season. Not surprisingly, July had the highest frequency of anglers rating their satisfaction as a ten and it was also the month with the highest catch rates. Conversely, October had the highest proportion of anglers that did not catch any fish and it was also the month with the lowest average satisfaction rating. These results are consistent with other studies showing a positive relationship between catch rates and angler satisfaction (McCormick and Porter 2014; Pitman et al. 2019). Although August had the highest frequency of anglers rating use as crowded, it also had the highest average satisfaction rating, suggesting that catch rates and overall fishing experiences remained high enough to compensate for any potential dissatisfaction associated with high levels of use. Pittman et al. (2019) found an interaction between catch rate and crowding such that higher catch rates were necessary to maintain a certain degree of satisfaction in the presence of increased crowding.

The incidence of hook scarring reported by anglers was similar to other popular catch and release trout fisheries (Meka 2004; Rich 2016). The North Fork has special regulations that require the use of single point, barbless hooks in this section of river. There is a paucity of data linking hook scarring to elevated mortality. Hook scarring is probably a social issue due to the perceived negative experience of the angler catching the fish, rather than a biological issue given that many studies have failed to demonstrate differences in catch and release mortality between barbed and barbless hooks (Schill and Scarpella 1997). Nevertheless, the high degree of hook scarring underscores the high use and high catch rates in this section of river. Furthermore, the increased incidence of hook scarring throughout the season as catch rates were increasing, suggests that hook scarring is not causing elevated mortality because those fish are surviving for multiple hooking and capture events.

We did not differentiate between species when calculating catch rates and other catch summaries even though some anglers reported catching Rainbow Trout. Previous research demonstrated anglers' weak abilities to accurately identify native Westslope Cutthroat Trout and Bull Trout in the Blackfoot drainage (Pierce and Podner 2006). Overall, 20 anglers reported catching Rainbow Trout and 7 of those anglers reported only catching Rainbow Trout. The seemingly high incidence of Rainbow Trout catch is contrary to general patterns of Rainbow Trout abundance and distribution in tributaries, where they are most prevalent in the lower mainstem Blackfoot River and lower tributary sections (Pierce et al. 2005). Furthermore, Rainbow Trout in the North Fork primarily spawn in tributaries in the lower six miles of the drainage (Pierce et al. 2018). While these angler reports indicate additional species composition investigations are warranted, the primary purpose of this study was to document catch rates and angler satisfaction, so our calculation methods are appropriate for addressing these objectives. The lack of recent population surveys and genetic analyses cannot exclude the possibility that the distribution and abundance of Rainbow Trout may be increasing from Rainbow Trout migrating upstream from the lower North Fork and Rainbow Trout and hybrid trout migrating downstream over North Fork Falls (Pierce et al. 2018). These angler reports underscore the importance of increasing monitoring efforts in the upper North Fork fishery.

Overall, this first comprehensive upper North Fork creel survey provides valuable insight into current angler habits, use, satisfaction, and catch rates. Although there is not a strong baseline dataset for comparison, the 2020 survey suggests the fishery is healthy and providing quality angling experiences to satisfied anglers. The survey also illuminated several important areas of further investigation and demonstrated the need for increased monitoring and sampling efforts in this popular section of river.

Management Recommendations

1. Establish long-term monitoring sections in the upper North Fork to monitor Westslope Cutthroat Trout population status and investigate changes in species composition.
2. Conduct genetic evaluations in the upper North Fork to describe genetic structure and status.
3. Conduct periodic creel surveys to investigate changes in angler use, catch rates, and satisfaction.

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Appendix

1. **Date** ____________________

2. **Are you a resident of Montana?** Yes / No (circle one)

   If a non-resident, what state did you travel from? ________________

3. **How many times do you typically fish at this location annually?** __________________

4. **What was the cumulative time spent angling on this trip?** __________________

5. **What was your total catch on this trip?**

Species	**# caught**	**Average length**	**# of fish with hook scars**
Westslope Cutthroat Trout			
Rainbow Trout			

6. **Were any Bull Trout caught incidentally?** Yes / No (circle one)

7. **What gear did you use?** Flies Lures (circle one)

8. **How satisfied are you with your catch?** (circle one)

   Dissatisfied 1 2 3 4 5 6 7 8 9 10 **Satisfied**

9. **How would you rate the amount of use by recreationists and anglers at this location today?** (circle one)

   very light light slightly crowded very crowded

10. **Do you have any comments for fisheries managers?**

Figure A1. Copy of self-reporting survey sheet that anglers submitted at survey kiosk at the North Fork Blackfoot River trailhead.

Attention Anglers!

FWP needs your help to gather information about the upper North Fork Blackfoot River fishery. Please take a minute to fill out the survey after your fishing trip.

Fisheries managers will use this information to better understand angler use, angler satisfaction, and fishery status in this section of the North Fork Blackfoot River.

Thanks for your time. For questions and comments, please contact:

Montana Fish, Wildlife & Parks
3201 Spurgin Road
Missoula, Montana 59804
406-542-5532

MONTANA FISH, WILDLIFE & PARKS

Figure A2. Sign posted at survey kiosk to notify anglers of creel survey study.

Fluvial Trout Spawning Populations, Movement, and Habitat Use In the Lower Blackfoot and Middle Clark Fork River Systems

R. Frey, C. Podner, L. Knotek, & P. Uthe - Montana Fish, Wildlife and Parks
R. Roberts & W. Pfeiffer - Trout Unlimited

Overview

In spring 2020, Montana Fish, Wildlife, & Parks (MFWP) conducted a fluvial trout evaluation and movement study on the lower Blackfoot River and middle Clark Fork River in cooperation with Montana Trout Unlimited (TU). The project focused on spawner population characteristics and migrations of wild, adult trout (*Oncorhynchus* spp. including Westslope Cutthroat Trout, Rainbow Trout and their hybrids) captured within or adjacent to spawning tributaries, implanted with external (Floy) tags, and recaptured after the spawning period. Recapture and movement information relied primarily on subsequent reporting by anglers.

Goals of the project included:

(A) Describe the migration timing, size distribution, and species composition of adult, wild trout entering or congregating at seven known spawning tributaries.

(B) Evaluate the spatial distribution and extent of movement for marked trout in local main stem river reaches after spawning.

(C) Evaluate the relative influence of tributary spawning populations on adjacent river reaches and sport fisheries.

(D) Engage local guides, anglers and communities in applied fisheries research and conservation.

Figure 1. Fluvial Westslope Cutthroat Trout captured and Floy-tagged (blue projection on top of fish) near the mouth of Deer Creek.

Methods

Project objectives focused on capturing, tagging, and tracking movements of adult trout that entered or congregated near the mouths of seven known spawning tributaries in spring 2020 (Figure 2). Capture and marking locations included four Blackfoot River tributaries (Belmont Creek, Bear Creek, East Twin Creek, Johnson Creek) and three Clark Fork River tributaries (Deer Creek, Marshall Creek, Rattlesnake Creek).

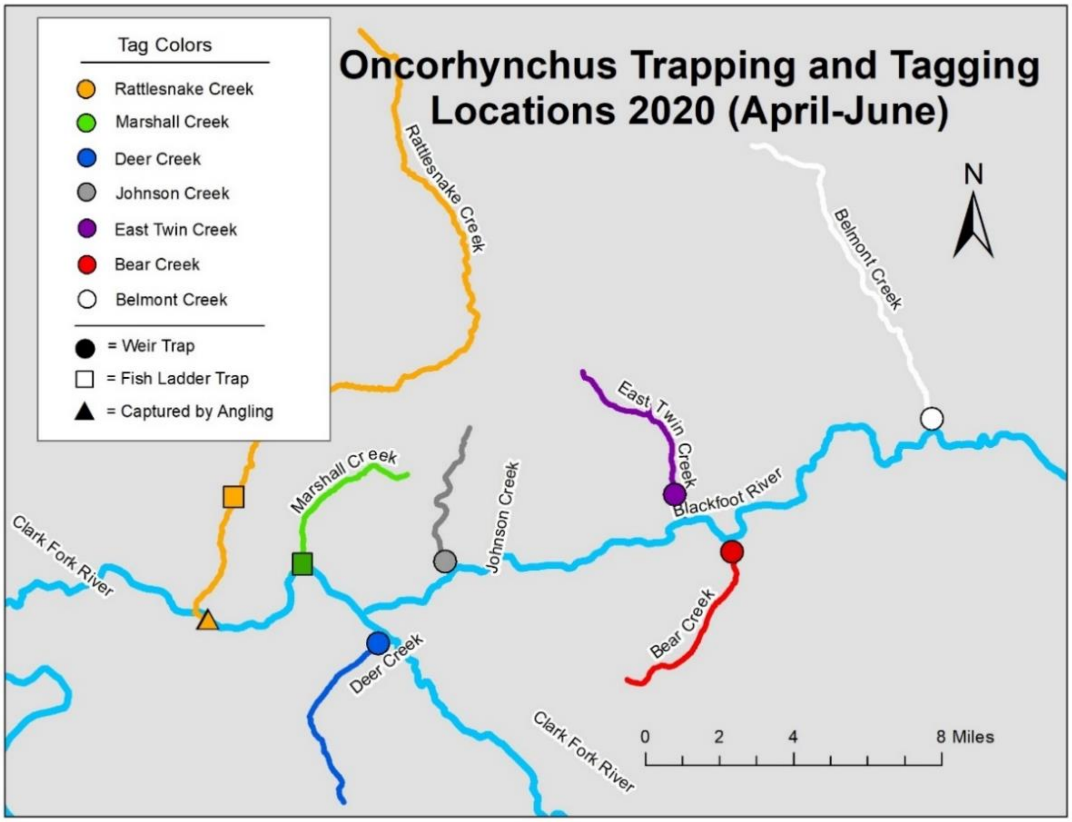

Figure 2. Capture locations for adult *Oncorhynchus* spp. Floy-tagged in Clark Fork and Blackfoot River tributaries, including corresponding capture methods and tag colors for each tributary population.

Fish Capture

We captured adult fluvial trout when they congregated at tributary mouths or as they ascended the lower portions of spawning streams. Capture methods and specific location were based on site constraints (e.g., stream size), logistics, and opportunity for capture. Standard weir traps were installed near the mouths of most tributaries, but capture methods were modified in other streams to maximize capture efficiency (Table 1). Where possible, continuous discharge and temperature measurements were recorded in tributary streams where fish traps were operated.

We installed standard box weir traps with metal-framed leads to capture fish entering Deer, Bear, Belmont, East Twin, and Johnson creeks (Figure 3). Lead fences employed removable, vertical posts with

~ 2 inch spacing that allowed small debris to pass, but prevented upstream movement of adult trout. Trap boxes employed a circular cone that allowed entry, while discouraging captured trout from exiting. Weirs and other fish traps were generally operated seven days a week and checked daily once installed. However, two visits per day were often required during high flow periods to mitigate debris collection and to ensure traps and leads were operating properly. If the trap became dislodged and inoperable due to high flows, it was reinstalled as soon as conditions allowed safe and effective operation.

Figure 3. Weir trap installed in Belmont Creek to capture adult migratory *Oncorhynchus* spp.

At Marshall Creek and Rattlesnake Creek, existing fish ladders provided excellent capture opportunities. The Marshall Creek fish ladder was retrofitted with a barrier screen on the upstream side of the second ladder step-pool (within the ladder) to inhibit further upstream fish movement (Figure 4). The downstream end of this pool was fitted with a second screen and cone to allow upstream movement of migrating fish, but prevent them from exiting the pool (downstream). Although this ladder 'trap' was very effective at peak flows, many fish were also captured with hand-held landing nets near the ladder entrance at lower flow levels. These fish were congregated in small pools fed by ladder attractant flow (Marshall Creek water) adjacent to the ladder entrance.

We also modified a previously constructed fish ladder to capture adult trout on Rattlesnake Creek. This ladder was associated with a bypass channel at the Missoula Water Company Dam (~ 4 miles above stream mouth) and included a series of step pools and an underground pipe for operation. Similar to Marshall Creek, a screen placed within the ladder prevented migrating fish from moving further upstream and enabled collection of fish within the structure. To capture fish, we simply blocked the downstream exit, manually turned off the flow, and collected fish trapped within the ladder pools.

Angling was also employed at the mouth of Rattlesnake Creek over a two week period in April to take advantage of an accessible adult trout staging area (Figure 4). Fishing events incorporating local anglers were effective for capturing and tagging large numbers of pre-spawn trout at this location and offered a great opportunity for constituent participation in the study.

Figure 4. Alternative trout capture methods included retrofitting an existing fish ladder at Marshall Creek (left) and angling at the mouth of Rattlesnake Creek (right).

Fish Processing & Tagging

Adult trout captured at each tributary were placed in holding tanks and anesthetized prior to handling. For each individual, we noted species, total length, sex, and reproductive status. We also collected an anal fin clip from fish captured in Blackfoot River tributaries for subsequent genetic analysis. Individually numbered, plastic 'T-bar' Floy tags were implanted in the musculature just posterior to the dorsal fin in each fish (see Figure 1). Tags also displayed reporting information (including phone number) and were color-coded by tributary (Table 1). Tagged fish were placed in mesh holding tanks (in the stream) until fully recovered, then released upstream of the trap to allow continuation of spawning migrations.

Table 1. Trout capture and tagging information in Clark Fork and Blackfoot River tributaries in 2020.

Tributary	Capture Method	Capture Location	Dates**	Floy Tag Color	Tag Numbers (Range)
Clark Fork River					
Deer Creek	Weir Trap	Mouth	04/16-05/28	Blue	0501-0570
Marshall Creek	Fish Ladder*	Mouth	04/16-05/28	Green	0601-0790
Rattlesnake Creek	Angling	Mouth	04/07-04/22	Orange	0001-0135
	Fish Ladder*	Mile 4	04/20-06/05	Orange	0137-0177

Blackfoot River					
Bear Creek	Weir Trap	Mile 0.5	04/08-05/02	Red	0201-0230
Belmont Creek	Weir Trap	Mile 0.6	04/08-05/22	White	0701-0870
East Twin Creek	Weir Trap	Mile 0.1	04/07-05/01	Purple	0301-0360
Johnson Creek	Weir Trap	Mouth	04/08-05/21	Grey	0401-0570

*Existing fish ladder modified/retro-fitted to act as fish trap.

**Date range trap/ladder operated or when angling events were held in 2020.

Recapture of Tagged Trout

Tagged trout were recaptured, with pertinent information reported by anglers throughout the summer and fall. Requested information included: tag number and color, capture location, date, angler name and contact information. Anglers reported recaptures by either calling MFWP directly or by entering requested data on the interactive project webpage managed by TU (www.montanatu.org/trouttag). All submissions to the webpage were automatically forwarded to MFWP via email for entry into the project database. We attempted to contact all anglers that reported catching a tagged fish to verify pertinent capture information and to provide them any additional data associated with the fish or the overall study.

In addition to angler reports, several tagged individuals were recaptured during MFWP population (electrofishing) surveys on the Clark Fork River near Milltown. These fish were noted below in Table 2 and included with recapture information.

Advertising and Public Notification

Trout recapture and movement information for the project largely relied on voluntary angler reports. Therefore, public notification of the project was a critical component. Advertising project objectives, rationale, and the need for angler participation was conveyed repeatedly using numerous methods throughout the spring and summer in 2020. Notifications included the TU and MFWP websites and social media platforms, local news outlets, public presentations and communications with local sporting groups, posters at local fly shops and businesses (Appendix IV), and personal contacts with anglers.

Results

A total of 775 adult trout were captured and tagged in spring 2020 (April – June) within or at the mouth of the seven Blackfoot River and Clark Fork River tributary streams (Table 2). The majority of these fish (>90%) were visually identified as hybrids of Westslope Cutthroat Trout x Rainbow Trout (WCTxRBT) or fish with predominantly Rainbow Trout (RBT) features. The remaining individuals were classified as Westslope Cutthroat Trout (WCT) based on physical characteristics. However, we collected fin clips and genetically tested a subset of individuals from Blackfoot River tributaries and many fish visually classified as WCT exhibited low levels of hybridization with RBT (Appendix III).

The genetic composition of adult *Oncorhynchus* spp. individuals varied significantly among Blackfoot River tributaries and physical characteristics were not a good indication of actual genetic makeup. We captured 32 fish with phenotypic WCT characteristics (i.e., orange slash) in Johnson Creek. These individuals ranged from non-introgressed (non-hybridized) WCT to trout that only had only 1% WCT genetic contribution, even though all fish had an orange jaw slash (Appendix III). Two individuals were non-hybridized WCT (100% WCT genetic contribution), indicating that Johnson Creek still supports a limited population of genetically unaltered, migratory WCT. Three of the suspected hybrid trout were predominantly RBT with less than 10% WCT genetic contribution. Of the remaining samples, 22 of 29 had 50% or greater WCT contribution and several of these individuals were considered first-generation (F1) offspring of RBT and WCT parents. In Belmont Creek, suspected individuals of WCT origin (based on phenotypic characteristics) ranged from 3% to 51% WCT genetic contribution and four of twelve were first generation hybrids. Only two suspected WCT were sampled in East Twin Creek and genetic testing results were highly variable, as the actual WCT genetic contributions were 1% and 51% for these individuals. Similarly, six suspected WCT from Bear Creek were all hybridized with 47% to 53% WCT contribution.

Table 2. Tagging and recapture information for adult fluvial trout captured in Clark Fork and Blackfoot River tributaries in 2020.

Tributary	WCT** Tagged	Other *Oncorhynchus* Tagged	Total Fish Tagged	Total Tagged Fish Recaptured*	% Tagged Fish Recaptured
Clark Fork River					
Deer Creek	26	34	60	0	0 %
Marshall Creek	11	167	178	14	7.9 %
Rattlesnake Creek	16	154	170	15	8.8 %
Blackfoot River					
Bear Creek	0	25	25	0	0 %
Belmont Creek	0	150	150	14	9.3 %
East Twin Creek	0	41	41	2	4.9 %
Johnson Creek	3	148	151	5	3.3 %
TOTAL	**56**	**719**	**775**	**50**	**6.5 %**

* 9 Floy tagged trout were recaptured by MFWP in the Clark Fork River electrofishing section near Milltown and included with angler reported recaptures.

** Fish classified as WCT in Clark Fork River tributaries were not confirmed through genetic testing.

Adult trout captured in traps and by angling ranged from 9.8 – 20.1 inches (250-530 mm) and averaged 15.9 inches (403 mm). A few smaller, sub-adult individuals were also captured, but were not tagged (see Figure 5). The size distributions for tagged trout were relatively consistent among tributary populations (Appendix I). However, *Oncorhynchus* spp. classified as WCT in Rattlesnake, Deer, and Marshall Creeks were generally smaller than the overall spawner populations captured at these tributaries (Appendix I).

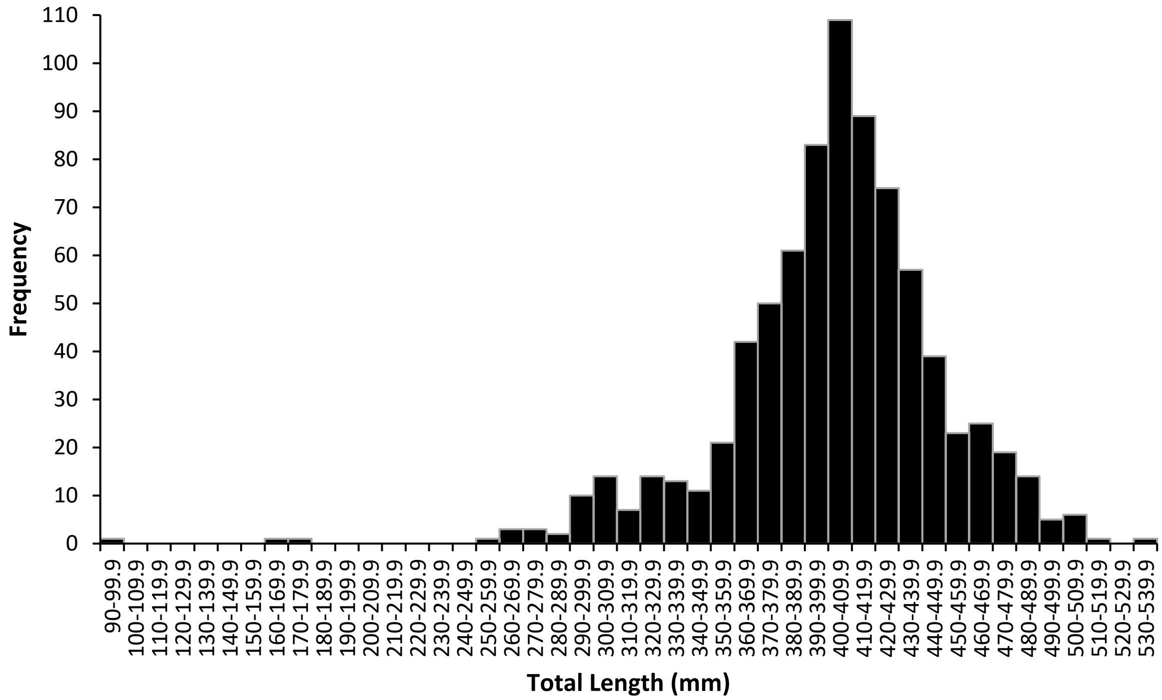

Figure 5. Combined length-frequency distribution for all *Oncorhynchus* spp. captured at Clark Fork River and Blackfoot River tributaries in spring 2020.

Fish movement to tributaries and the timing of migrations were inconsistent throughout the spring, with catch rate closely tied to water temperature and flow levels (Appendix II). Fish movement generally increased at higher temperatures and corresponding increases in discharge (see Figure 6). However, in many instances, trapping fish and maintaining trap integrity became more difficult at higher flows. This was particularly true at weir traps installed in Blackfoot River tributaries that experienced significant flow increases following precipitation and snowmelt events.

Trout species composition in traps also varied among tributaries and over the course of the spawning season. Fish classified as WCT generally became more prevalent in latter portions of the trapping period, consistent with prior tributary sampling at Rattlesnake Creek and Marshall Creek over the past 15 years (MFWP, unpublished data). This trend was particularly evident in Rattlesnake Creek (Figure 6) and Deer Creek (Appendix II) in 2020.

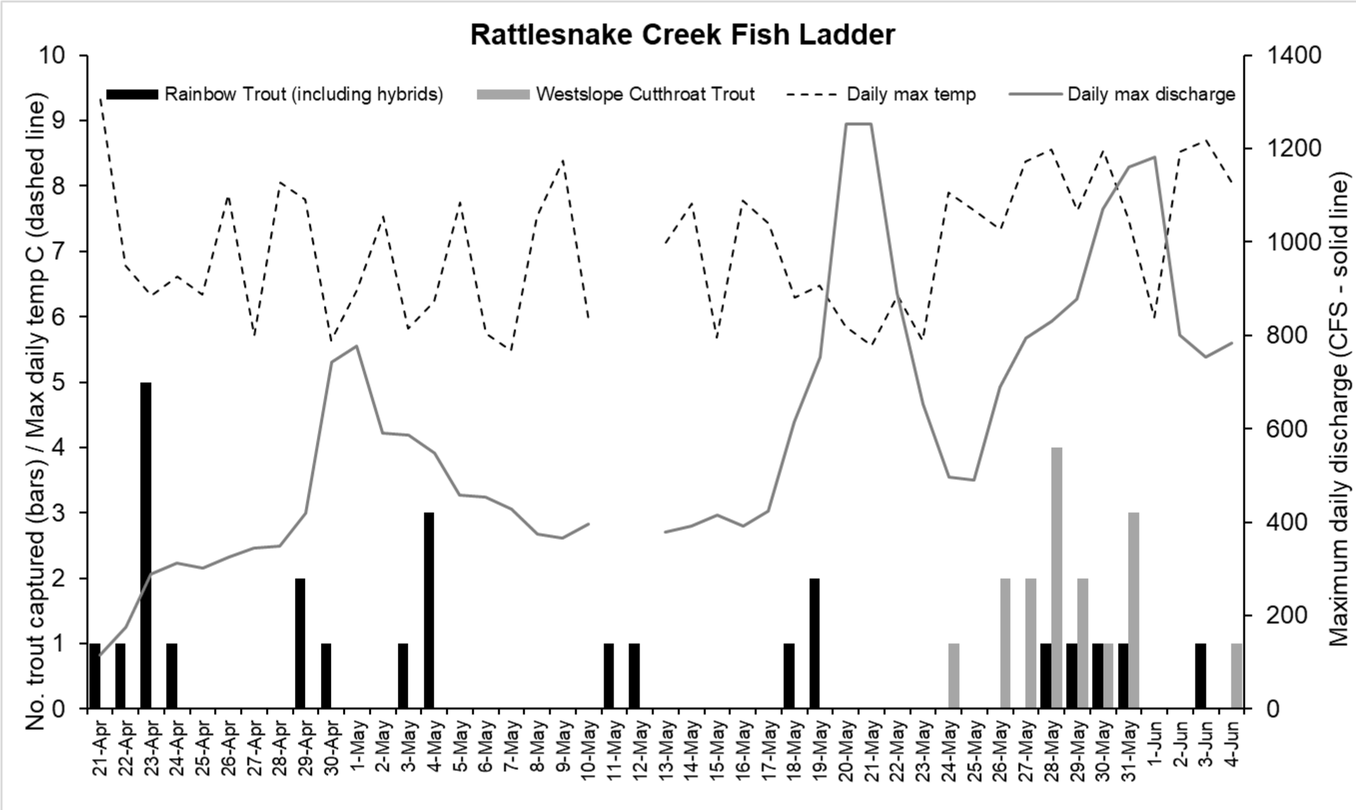

Figure 6. Trout capture over time at the Rattlesnake Creek ladder trap in relation to temperature and flow conditions in 2020.

Recapture of Tagged Trout

A total of 50 trout recaptures (excluding fish recaptured in the same tributary by MFWP during tagging) were documented during the first year of the study. Reports from anglers began shortly after we initiated the tagging effort and continued throughout the summer and fall. Most recaptured trout were tagged in Rattlesnake Creek, Marshall Creek and Belmont Creek (Table 2).

The geographic range of recapture locations extended from the Clark Fork River near Frenchtown, MT to the confluence of the Clearwater River and Blackfoot River near Greenough, MT (Figure 7). However, most trout were recaptured within 10 miles (typically downstream) of their tributary tagging locations.

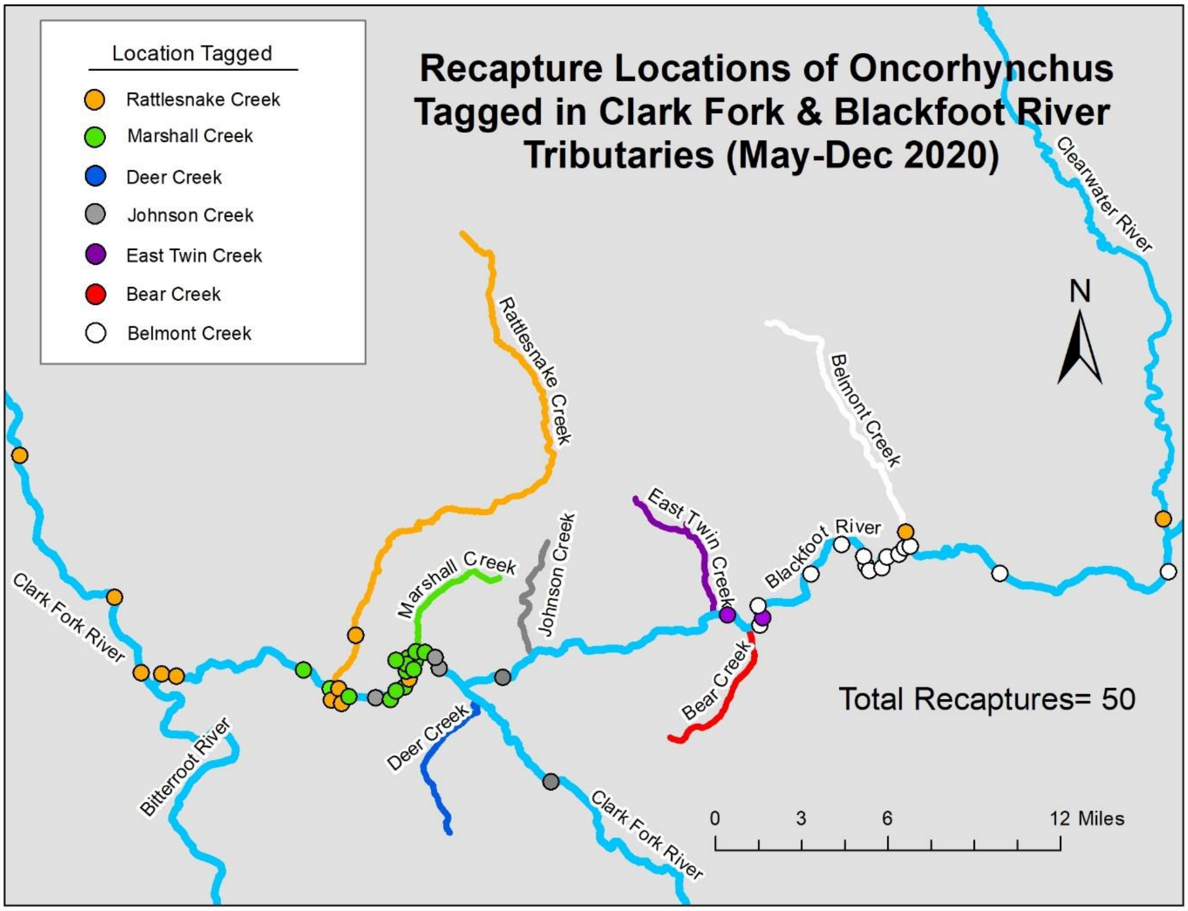

Figure 7. Recapture locations for adult fluvial trout captured and tagged at lower Blackfoot River and middle Clark Fork River tributaries in 2020.

Rattlesnake Creek

Trout tagged at Rattlesnake Creek had the highest recapture rate (8.8%) and the widest geographic distribution of movements. Although several reported recaptures occurred near the mouth of Rattlesnake Creek, many other individual fish moved relatively long distances upstream and downstream in the river system (Figure 7). The longest documented movement downstream was ~ 20 river miles for a RBT hybrid caught at the Rattlesnake fish ladder and recaptured near Frenchtown, Montana. A female RBT tagged at the mouth of Rattlesnake Creek in early April completed the longest documented upstream movement. This fish was recaptured by an angler seven months later (in November) ~ 40 river miles upstream in the lower Clearwater River.

Marshall Creek

Recapture rates for trout tagged at the mouth of Marshall Creek were higher than the collective average for all tributaries (Table 2). However, several of these fish (5 of 14) were recaptured during MFWP's electrofishing surveys in the river reach surrounding the stream mouth. Both electrofishing surveys and subsequent recaptures by anglers indicated limited movement in the river system as nearly all Marshall Creek spawners were recaptured in the five mile Clark Fork River reach immediately downstream of the creek mouth (East Missoula-Missoula area).

Belmont Creek

Anglers recaptured 13 tagged RBT and *Oncorhynchus* spp. hybrids from Belmont Creek in the Blackfoot River over the course of the summer and early fall (June-Sept). Most recaptures were reported in the 9 mile river reach between the mouth of Belmont Creek and Johnsrud Park Fishing Access Site (FAS) which coincides with the Blackfoot River Recreation Corridor. However, two trout were recaptured in upstream reaches of the Blackfoot River approximately 4 and 11 river miles above the tributary mouth. The longest documented movement was 11 miles upstream of the tagging location, where the fish was caught in the Blackfoot River just below the Clearwater River confluence.

Johnson Creek

Only 5 of 152 trout marked in Johnson Creek were subsequently recaptured. Three of these fish were recaptured by anglers and the other two were collected during MFWP's electrofishing surveys on the main stem Clark Fork River just downstream of the Blackfoot River confluence. Angler recaptures included one in the lower Blackfoot River, one in East Missoula in the Clark Fork River, and one in the upper Clark Fork River just downstream of Turah. This was the only fish in the study that ascended the Clark Fork River upstream of the Blackfoot River confluence.

East Twin Creek, Deer Creek, and Bear Creek

Recapture rates were insignificant for trout tagged in East Twin Creek, Deer Creek and Bear Creek. East Twin Creek was the only population where recaptures were observed (2 total) and these individuals were both caught by anglers on the Blackfoot River within two river miles of the tagging location. No fish tagged in Bear Creek or Deer Creek were recaptured in 2020.

Discussion and Management Implications

The purpose of this study was to investigate life history characteristics of wild *Oncorhynchus* spp. spawning populations, with a focus on post-spawn movements and habitat use within portions of the Clark Fork River and Blackfoot River systems. Trapping adults at spawning tributaries allowed us to characterize the timing, size structure, species composition (genetics), and relative abundance of each spawner population. Once captured and Floy-tagged, adult trout continued their migrations and dispersed in the interconnected river system. Recapture reports throughout late spring, summer, and fall provided documentation of these movements and the geographic distribution of trout emigrating from the various tributary locations. From a fishery management perspective, we gained a better understanding of the relative importance of individual tributary populations for local river fisheries, the comparative size and composition of spawning runs, and the geographic range or reach that each population predominantly influences.

Tributary Trapping and Trout Population Attributes

Weir traps and other capture methods were effective tools for catching adult trout. However, success at different locations and variable flow conditions required versatility and creativity. Weir traps were the most viable and effective method for most tributary locations. Installation sites were carefully selected at pool tail-outs or in deeper runs where velocities were moderate and consistent. Traps required frequent maintenance to alleviate debris accumulation and washouts around the trap box and leads, particularly as stream discharge increased. Many of these challenges were avoided at locations where permanent infrastructure was already in place and could accommodate 'retro-fits' for trapping. Examples included the Marshall Creek and Rattlesnake Creek fish ladders. These locations not only facilitated fish attraction and capture, but also allowed us to control (adjust and shut off) water supply to concentrate fish and enable collection with hand nets. In other instances, we simply recognized and exploited accessible concentrations of staging adults. The mouths of Rattlesnake Creek and Marshall Creek provided these opportunities, which allowed efficient capture and tagging through angling and hand-netting.

Variation in the number of adult trout we captured at different spawning tributaries was an indication of the variability in run strength among populations. These differences were not simply driven by stream size, location, or physical habitat conditions. Rather, these factors, along with underlying productivity and physical connectivity to the river collectively influence the strength of tributary spawning populations and their relative importance to the river fishery. Marshall Creek provides a good illustration of unexpected significance for wild trout spawning and recruitment. Despite being small, channelized, over-steepened, and fragmented by fish passage barriers, we captured and tagged more adult trout at this tributary than any other in the study.

However, spawning population abundance comparisons among streams should be viewed cautiously given differences in trapping efficiency and variability in trap locations within tributaries (i.e., distances upstream from mouth). For instance, we captured similar numbers of trout in Johnson Creek and Belmont Creek, despite different trapping situations. The Johnson creek trap was directly upstream of the stream mouth with no suitable spawning habitat below it, whereas the Belmont Creek trap was located 0.6 miles upstream from the mouth with some downstream spawning habitat. Therefore, trapping data likely underestimated trout run size for Belmont Creek. The Bear Creek trap presented a similar scenario, located approximately 0.5 miles upstream of the mouth with suitable habitat downstream of the trapping location. Trapping efficiency and duration were also much higher at Johnson Creek and Belmont Creek relative to East Twin Creek and Bear Creek, contributing to the disparity in trout capture rates among streams.

We captured significantly more adult trout in Belmont Creek and Johnson Creek than a previous trapping study in 1990 (Berg 1992). Numerous habitat restoration projects have occurred in both drainages since the prior study, including fish passage improvements, land management changes, and instream habitat enhancements (Pierce et al. 2005). These actions may have contributed to the increases in spawning adults captured, but conclusions are speculative given differences in sampling methods. The trapping period in the previous study was earlier (March-April) than in 2020 and likely missed a large portion of the run that we captured during May.

Similar to our findings, Belmont Creek had the largest trout spawning run among the lower Blackfoot tributaries investigated in 1990. Surprisingly, Berg (1992) only captured 14 migratory trout in Johnson Creek during 49 days of trap operation. This suggests lower trapping efficiency, incorrect timing of trap operation, lower abundance of migratory adult trout, or some combination of these factors. Nevertheless, the current study highlights the present status and importance of Johnson Creek and other lower Blackfoot River tributaries for migratory *Oncorhynchus*.

The size distribution of trout captured at Blackfoot River and Clark Fork River tributaries was generally consistent among streams and similar to long term data associated with river main stem electrofishing (Appendix I; MFWP, unpublished file data). However, fish visually identified as WCT or hybrids with high WCT contribution were noticeably smaller in some cases (e.g., Deer Creek, Appendix I-E). It is not clear whether size variation in populations like Deer Creek is due to actual differences in growth among species or simply due to differences in age structure and year class strength.

Peak migration timing was also similar among the tributary populations we studied (see Appendices I & II), but some notable exceptions were documented. For instance, we observed large congregations of mature adults at the mouth and in lower reaches of Rattlesnake Creek in April, several weeks earlier than peak movements at other nearby tributaries. We suspect this variability is due to a combination of factors including species (genetic) composition, tributary habitat conditions, and local environmental cues. One of these cues is certainly water temperature (see Figure 6 above), as pulses of migrating fish consistently coincided with increases in daily maximum water temperatures in all tributaries. Some of the fish captured near the mouths of Rattlesnake Creek and other tributaries may also have been staging or overwintering in this portion of Clark Fork River and were intercepted on their migration to spawning tributaries further upstream.

Differences in species composition among tributaries related primarily to the persistence of WCT or hybrids with high WCT contribution in some streams. All tributary populations in this study exhibit introgression, but the degree of hybridization varies spatially among tributary populations and has changed temporally for some streams (MFWP and UM Conservation Genetics Laboratory, unpublished data). The certainty of our conclusions is limited for this study as we did not genetically verify species identity of individuals outside of Blackfoot River tributaries. However, recent genetic testing in Deer Creek and Marshall Creek identified a high WCT genetic contribution and non-introgressed individuals in both streams. Trout visually identified as WCT tend to migrate later than those with obvious RBT characteristics (e.g., see Rattlesnake Cr results, Figure 6 and Deer Cr example cited above). These observations are consistent with trends observed previously in Rattlesnake Creek (MFWP, unpublished data) where migration timing varied among telemetered adult *Oncorhynchus* spp. with various levels of introgression. Furthermore, many of the weir traps became inoperable during peak flow periods and failure to capture trout with high WCT genetic contribution may have been due to sampling logistics, rather than low tributary population abundance.

Genetic results from Blackfoot River tributary spawning populations provide updated information regarding migratory adults and compliment previous genetic surveys of juveniles collected via electrofishing. Genetic results from prior longitudinal tributary sampling suggest a pattern of RBT and highly hybridized (RBTxWCT) individuals in lower tributary reaches and trout with higher WCT genetic contribution near the headwaters of each stream (MFWP and UM Conservation Genetics Laboratory, unpublished data). The current study helps to elucidate patterns in hybridization within tributaries as we are uncertain if remaining WCT individuals sampled with electrofishing are strictly stream-resident or possibly offspring of migratory individuals. Although results confirmed that hybridization is prevalent and may be expanding, our data indicate that genetically unaltered WCT sub-populations persist in certain streams (e.g., Johnson Creek) and that some of these individuals are migratory.

The lack of WCT and hybrids (WCTxRBT) with obvious WCT characteristics captured in Bear Creek and Belmont Creek traps was not surprising given the previous documentation of strong RBT production and prior longitudinal genetic samples collected via electrofishing (MFWP and UM Conservation Genetics Laboratory, unpublished data). However, the presence of several first-generation (F1) hybrid WCTxRBT in our samples indicate that pure WCT still reside in upper Belmont Creek (Appendix III).

Trout Recapture and Movement

We documented the recapture of 50 Floy-tagged adults in the Blackfoot River and Clark Fork River systems between 4/24/2020 and 11/11/2020. Recaptures included several fish sampled during our river population estimate (electrofishing) near Milltown in early summer, but the vast majority (41) were reported by anglers. Our overall (unadjusted) recapture rate of 6.5% was consistent with a parallel trout tagging study in the lower Clark Fork River basin associated with Thompson Falls Dam mitigation, which reported a 4.8% overall recapture rate by anglers in 2017-2020 (Blakney & Terrazas, *In Prep)*. Similarly, Meyer et al. (2012) reported a 9.5% unadjusted recapture rate of non-reward tags for wild trout fisheries in Idaho.

In each of these studies, recapture rates certainly underestimate the actual proportion recaptured as data do not account for post-tagging (post-spawn) mortality, tag loss, or unreported recaptures. For instance, Meyer et al. (2012) estimated that only 54% of anglers reported recaptured trout with visible non-reward tags.

Recaptured trout in our study were primarily tagged in Rattlesnake Creek, Marshall Creek, and Belmont Creek (collectively 86% of reports). This was not entirely surprising, given the majority of our sample were tagged at these locations (64% of total). However, trout recaptures were absent or much lower for the other four tributary populations. Fewer recaptures were expected for trout originating in Deer Creek, Bear Creek and E. Twin Creek, given the low total number of adults captured and marked. In other words, each of the other tributary populations in this study had more trout captured and marked (150-178 each) than the collective total for East Twin, Deer and Bear Creeks (125 total). With relatively few fish marked, and an assumed low angler reporting rate, it is very likely that some fish from each tributary were recaptured and not reported. Johnson Creek was an outlier in this respect, as many trout were marked, but reported recaptures remained low.

One factor contributing to low recapture rates may be reduced fishing pressure in river reaches where most adults reside after spawning. Examples include the Milltown State Park area near the mouth of Deer Creek and the Clark Fork River below Milltown. However, this explanation is not applicable for many areas, including the lower Blackfoot River. This river reach supports relatively high levels of angling pressure (est. 27,604 angler-days in 2019) between the Clearwater River confluence and the mouth (MFWP 2020). Interestingly, the proportion of reported tags from Johnson Creek (2.0%) was noticeably lower than Belmont Creek (7.3%), although roughly the same number of fish were tagged at both streams. Most of the Belmont Creek tag reports came from the Blackfoot River Recreation Corridor area, which has high fishing pressure throughout the summer. The lack of Johnson Creek tag reports may be partially attributed to post-spawn adults residing in downstream areas with lower fishing pressure.

We did not assess post-spawn mortality or tag loss rates, which both surely contributed to low unadjusted recapture rates. Since we did not operate traps in late spring or assess outmigration from tributaries, we were unable to effectively monitor the post-spawning period. A previous study of migratory RBT in the Blackfoot River basin found that adults spent an average of 17 days (range, 3–63 days) in spawning tributaries before migrating back to the mainstem river (Pierce et al. 2009). Spawning activities for migratory wild trout can incur high seasonal mortality rates from predation and energy exertion. For instance, WCT post-spawn mortality in Blackfoot River and Clark Fork River tributaries has ranged from 11% to 31% (Schmetterling 2001; Schmetterling 2003). Post-spawn mortality for other cutthroat trout subspecies has been documented as high as 43% (Carlson and Rahel 2010). Large, migratory RBT also have high seasonal mortality rates associated with spawning (Thorley and Andrusak 2017). Normal attrition during summer and fall presumably further reduced our pool of tagged fish by the end of the year. Therefore, the total number of fish actually available to anglers was likely significantly lower than the 775 originally tagged and our actual recapture rate was much higher than 6.5%.

Recapture rates were also depressed because we only marked a small percentage of the adults in pertinent Blackfoot and Clark Fork River reaches. For instance, long-term monitoring in the lower Blackfoot River indicates abundance of trout greater than 6 inches conservatively averages about 700 trout/mile. Expansion of this density to the lower 32 miles of the Blackfoot River (downstream of the Clearwater River confluence), which encompasses the range of tagged trout movement in this study, produces an estimated 22,400 catchable trout. In other words, we likely Floy- tagged less than 2% of the catchable trout in the lower Blackfoot River.

The geographic distribution of recaptured trout was also much more limited than expected (Figure 7). Most recapture reports came from river reaches near source tributary mouths or just downstream, suggesting limited river movement in the months following spawning. This is particularly surprising since past studies have frequently documented long-range upstream migrations to spawning tributaries (e.g., Schmetterling 2001; Schmetterling 2003; Swanberg 1997). We expected that fish making post-spawn migrations to their summer and winter habitats would have made a similar range of movements and been caught by anglers further from spawning tributaries. Exceptions primarily involved a few trout tagged at Rattlesnake Creek, which either migrated downstream in the Clark Fork River (up to 20 miles) or up the Blackfoot River (40 miles). Other noteworthy movements included a trout from Johnson Creek that migrated upstream in the Clark Fork River and two individuals that spawned in Belmont Creek and later moved up the Blackfoot River corridor.

Our results are generally consistent with other tagging projects and movement studies in Western Montana, although notable long-range movements for *Oncorhynchus* spp. have been more common in other investigations. The longest documented migrations in the upper Clark Fork Basin in recent years involved RBT Floy tagged at Thompson Falls Dam (Blakney & Terrazas, *In Prep*) that subsequently moved more than 150 miles upstream to the mouths of Rattlesnake Creek (2019) and Johnson Creek (2020). Other significant movements were observed when trout captured below Milltown Dam were radio-tagged and tracked to tributaries in the lower and middle Blackfoot River Drainage (Schmetterling 2001; Schmetterling 2003). Regional Bull Trout radio-telemetry projects (Swanberg 1997; Schmetterling 2003; Knotek et al. 2004, Benson et al. 2009) and genetic assignment assays (Knotek et al. 2016) over the past two decades have also demonstrated long range movements for this species in the upper Clark Fork Basin.

The current study also builds upon a previous investigation that documented RBT movements between the Clark Fork River and Blackfoot River tributaries (Pierce et al. 2009). Interestingly, a RBT we tagged near the mouth of Rattlesnake Creek that was re-captured by an angler in the Clearwater River suggests that trout may be migrating between the Clark Fork River and Clearwater River tributaries to spawn, forage or overwinter. Rainbow Trout spawning in Gold Creek and Monture Creek have also made post-spawn migrations to summer and winter locations in the Clark Fork River (Pierce et al. 2009), but the aforementioned RBT is one the first documented long range movements into the Clearwater River drainage.

Collectively, Floy tagging, radio telemetry, genetic assignment and other trout movement investigations in the upper Clark Fork Basin have demonstrated that long range migrations persist for wild trout populations, but most adults occupy river reaches adjacent to natal spawning tributaries. These observations suggest and support the need for broad scale restoration programs that address limiting factors in tributaries throughout the basin, with a focus on specific streams with high base productivity and recruitment potential. Our results also highlight the relevance of lower Blackfoot River and Milltown area tributaries, particularly for trout production and recruitment to the Missoula area fishery.

Partnerships and Public Involvement

Tagging and voluntary angler reporting aspects of this study garnered strong public support as MFWP and Montana TU made concerted efforts to raise public awareness and involvement. Cooperation and participation by local sporting groups and anglers collectively increased cost-effectiveness, biological efficacy, and social acceptance. Angler interest, attitudes, and participation were encouraging as we advertised the project through local businesses and media outlets, and made personal contacts with anglers in the field. The involvement of TU staff and local West Slope Chapter members only bolstered these efforts and enhanced credibility with anglers. In similar future projects, we may be able to enhance angler reporting rates by offering and advertising financial rewards for recapture information.

Acknowledgments

Thanks to all the volunteers and staff that participated in this project, including anglers that helped tag fish at the mouth of Rattlesnake Creek, TU staff that assisted with trapping, and all of the anglers that captured and reported tagged fish. Special thanks to volunteer ‘Super Tech’ Glenn Grandjean for his efforts on this and other fisheries projects in the Missoula area.

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APPENDIX I. **Length-frequency distributions for adult trout captured at Blackfoot River and Clark Fork River tributaries in spring 2020.**

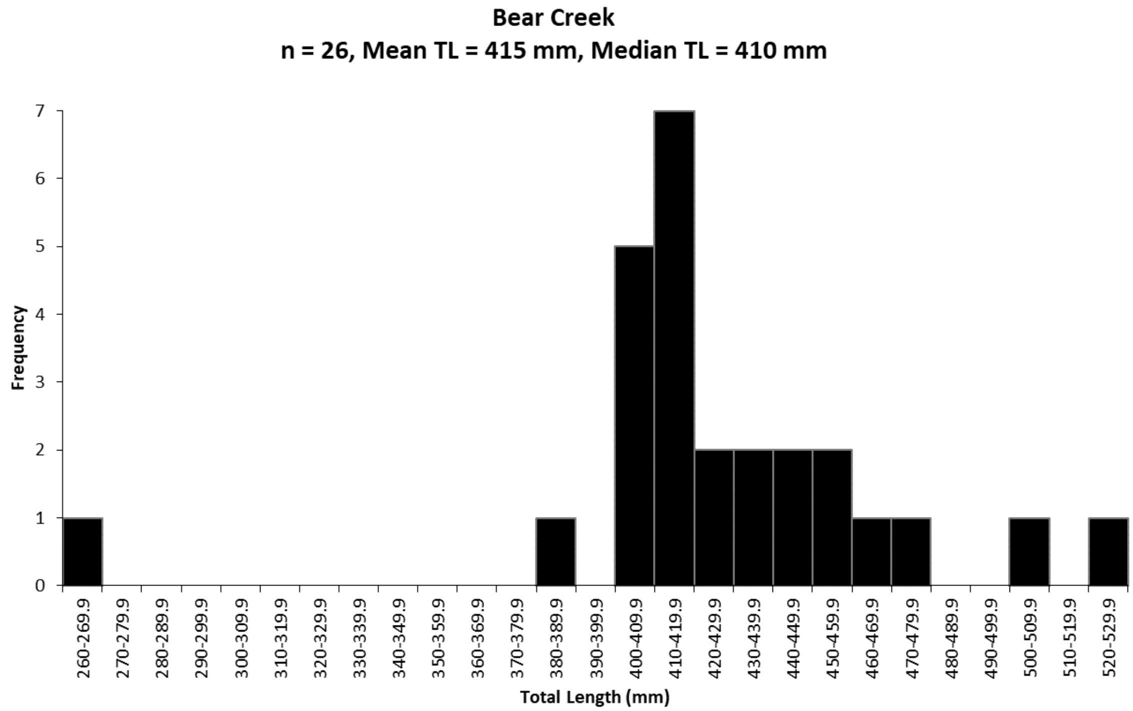


Figure A. Length-frequency distribution for adult *Oncorhynchus* spp. captured and Floy tagged near the mouth of Bear Creek in spring 2020.

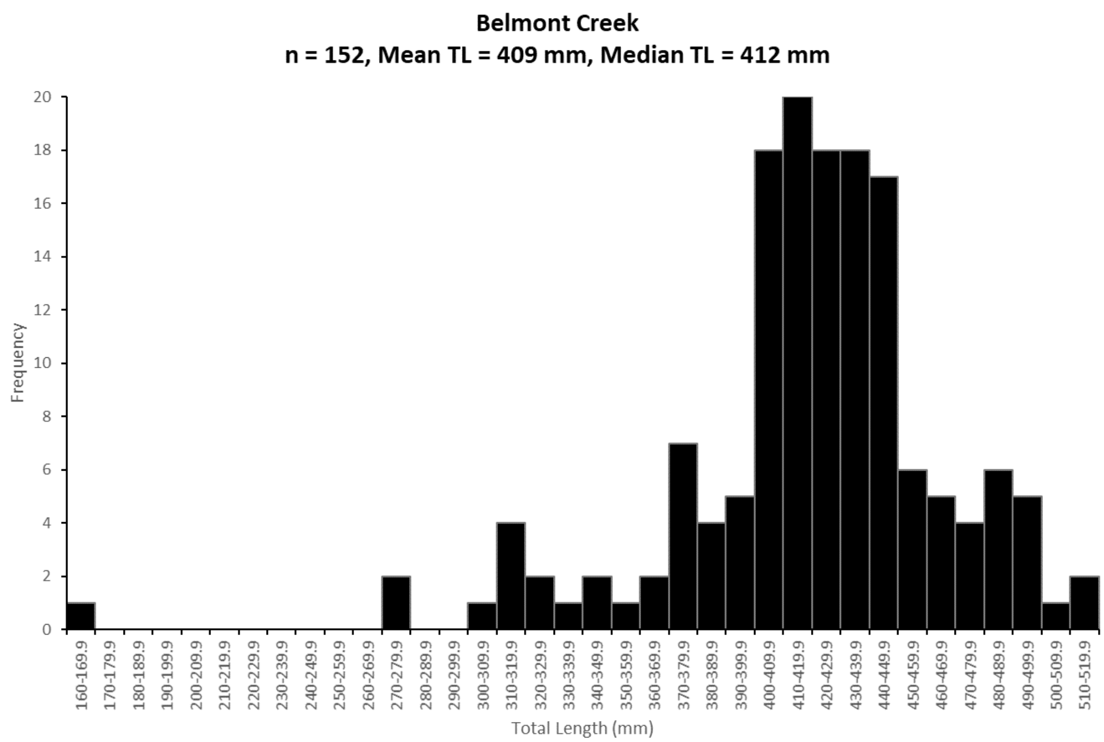


Figure B. Length-frequency distribution for adult *Oncorhynchus* spp. captured and Floy tagged near the mouth of Belmont Creek in spring 2020.

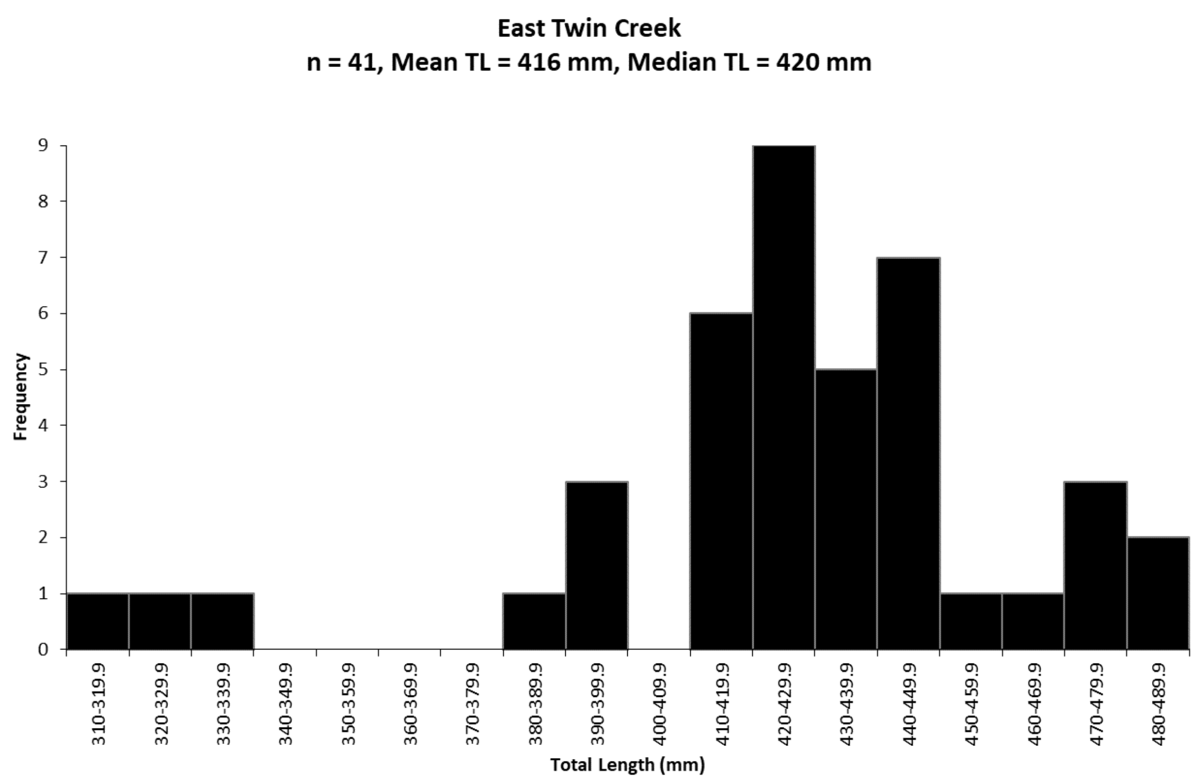


Figure C. Length-frequency distribution for adult *Oncorhynchus* spp. captured and Floy tagged near the mouth of East Twin Creek in spring 2020.

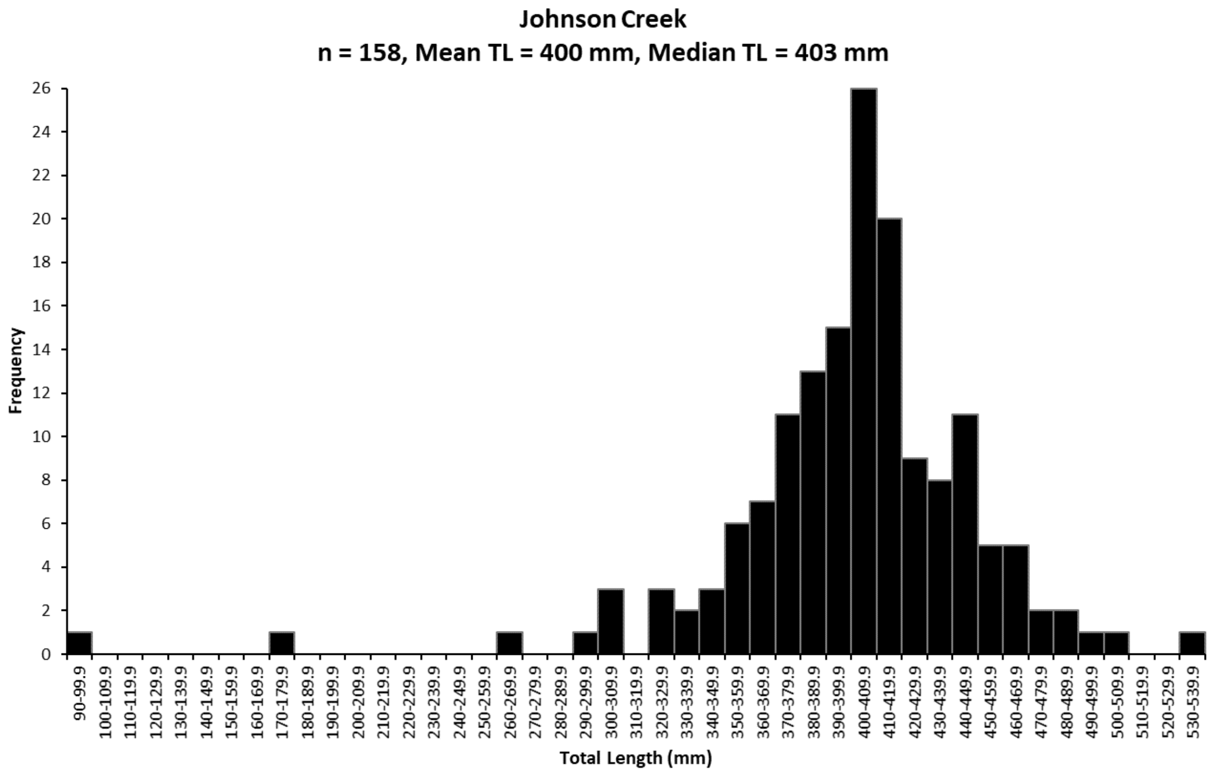


Figure D. Length-frequency distribution for adult *Oncorhynchus* spp. captured and Floy tagged near the mouth of Johnson Creek in spring 2020.

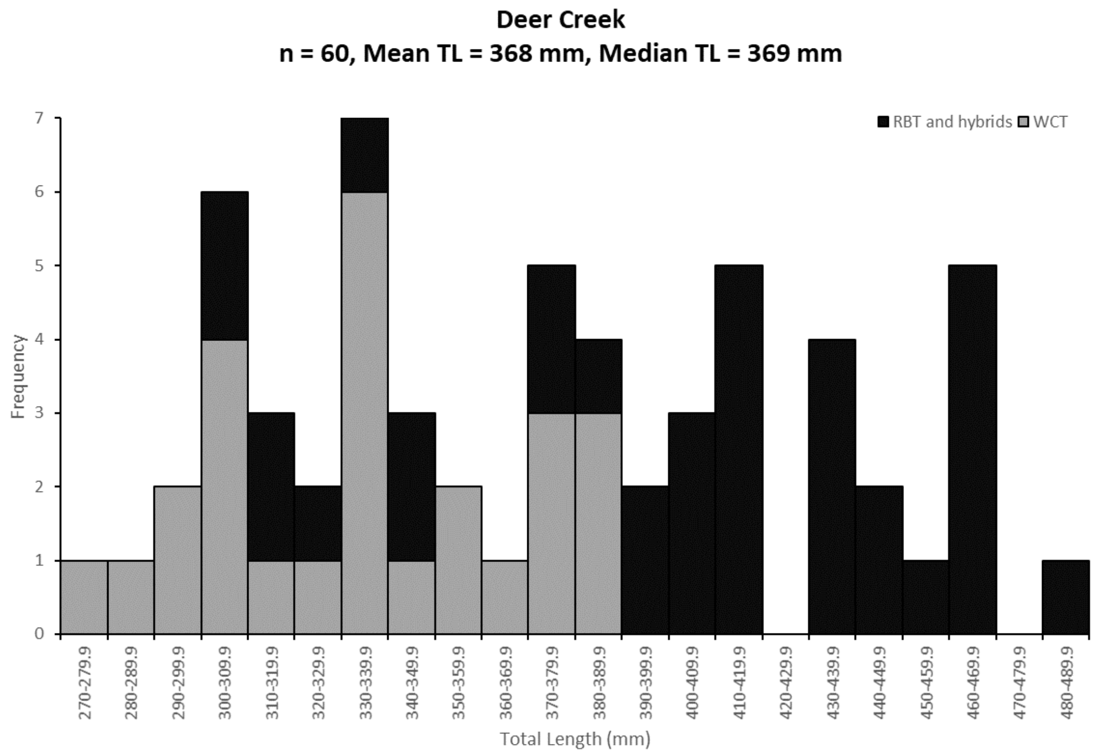


Figure E. Length-frequency distribution for adult Westslope Cutthroat Trout and other adult *Oncorhynchus* spp. captured and Floy tagged near the mouth of Deer Creek in spring 2020.

Marshall Creek
n=194, Mean TL = 396 mm, Median TL = 396 mm

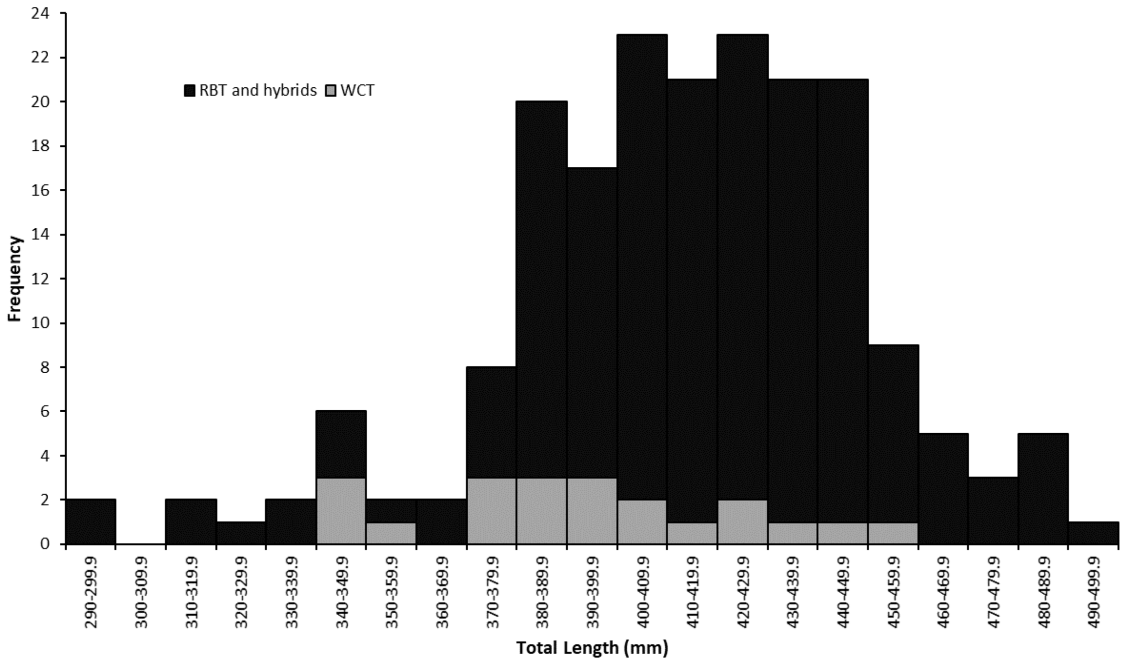


Figure F. Length-frequency distribution for adult Westslope Cutthroat Trout and other adult *Oncorhynchus* spp. captured and Floy tagged at the mouth of Marshall Creek in spring 2020.

Rattlesnake Creek Mouth
n = 128, Mean TL = 420 mm, Median TL = 419 mm

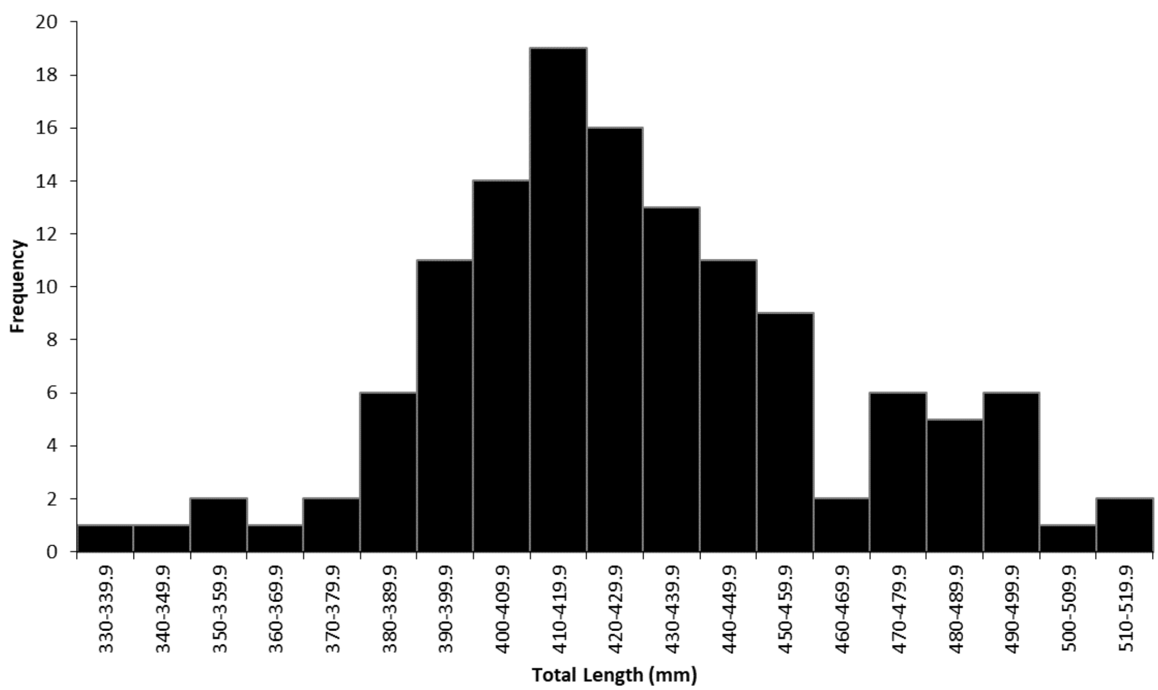


Figure G. Length-frequency distribution for adult *Oncorhynchus* spp. captured and Floy tagged at the mouth of Rattlesnake Creek in spring 2020.

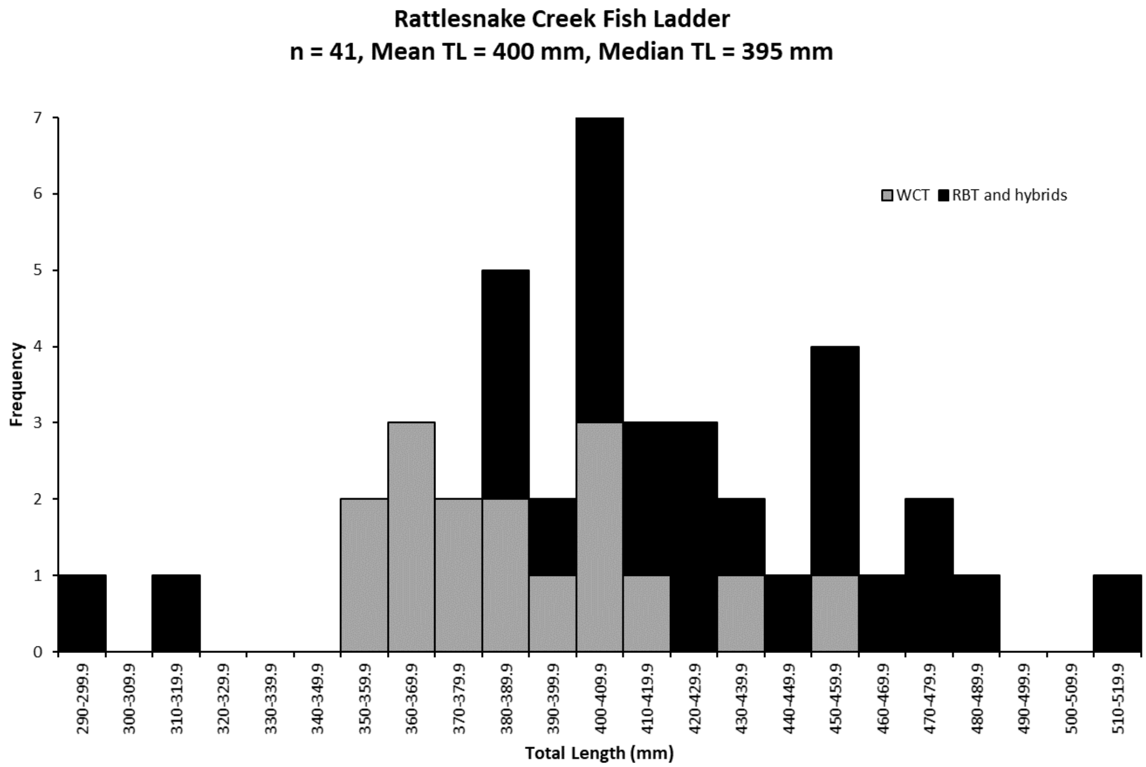


Figure H. Length-frequency distribution for adult Westslope Cutthroat Trout and other adult *Oncorhynchus* spp. captured and Floy tagged at the Rattlesnake Creek fish ladder (mile 4) in spring 2020.

APPENDIX II. Magnitude and timing of trout captured at Blackfoot and Clark Fork River tributaries in 2020.

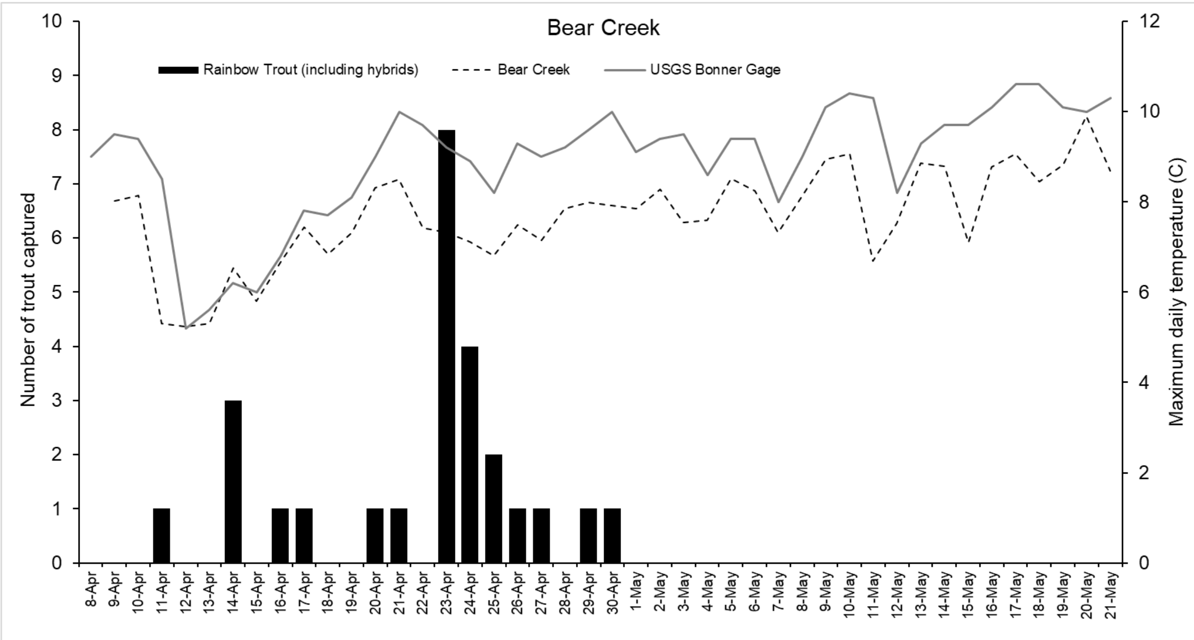


Figure A. Number and timing of adult *Oncorhynchus* spp. captured at Bear Creek in relation to tributary and Blackfoot River (USGS gauge) temperature regimes in spring 2020. Note: the trapping period ended on May 2 in Bear Creek.

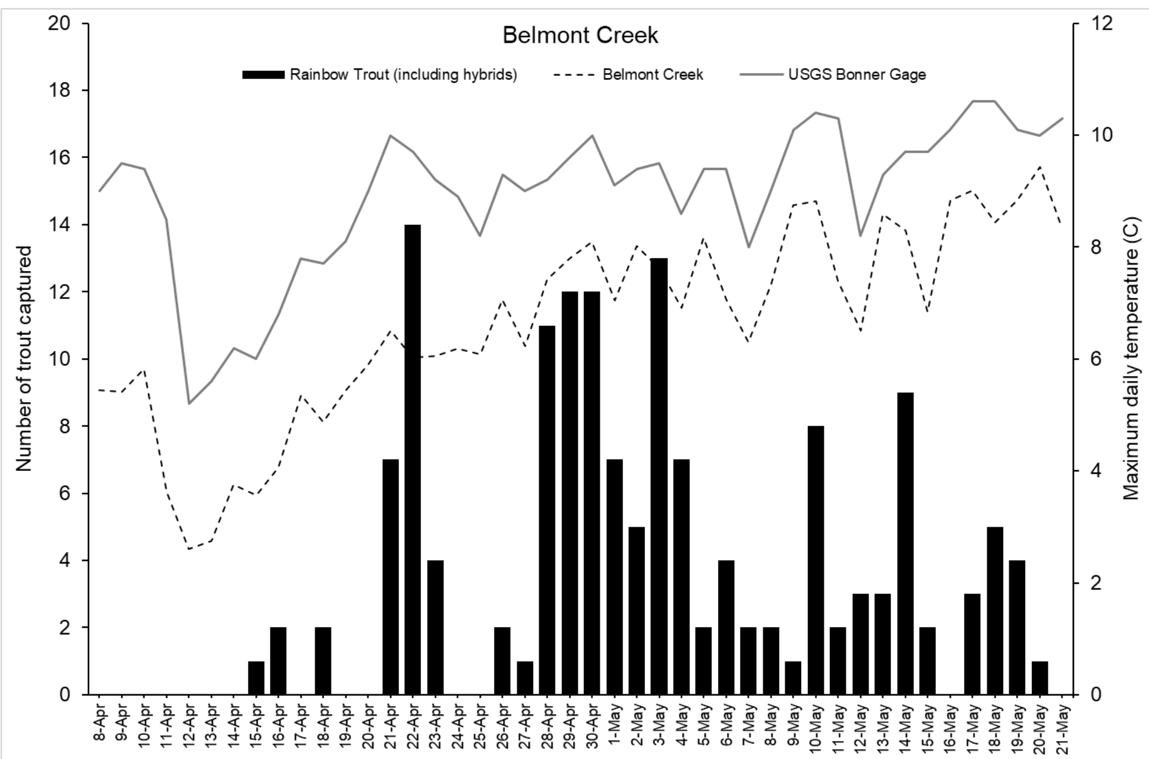


Figure B. Number and timing of adult *Oncorhynchus* spp. captured at Belmont Creek in relation to tributary and Blackfoot River (USGS gauge) temperature regimes in spring 2020. Note: the trapping period ended on May 22 in Belmont Creek.

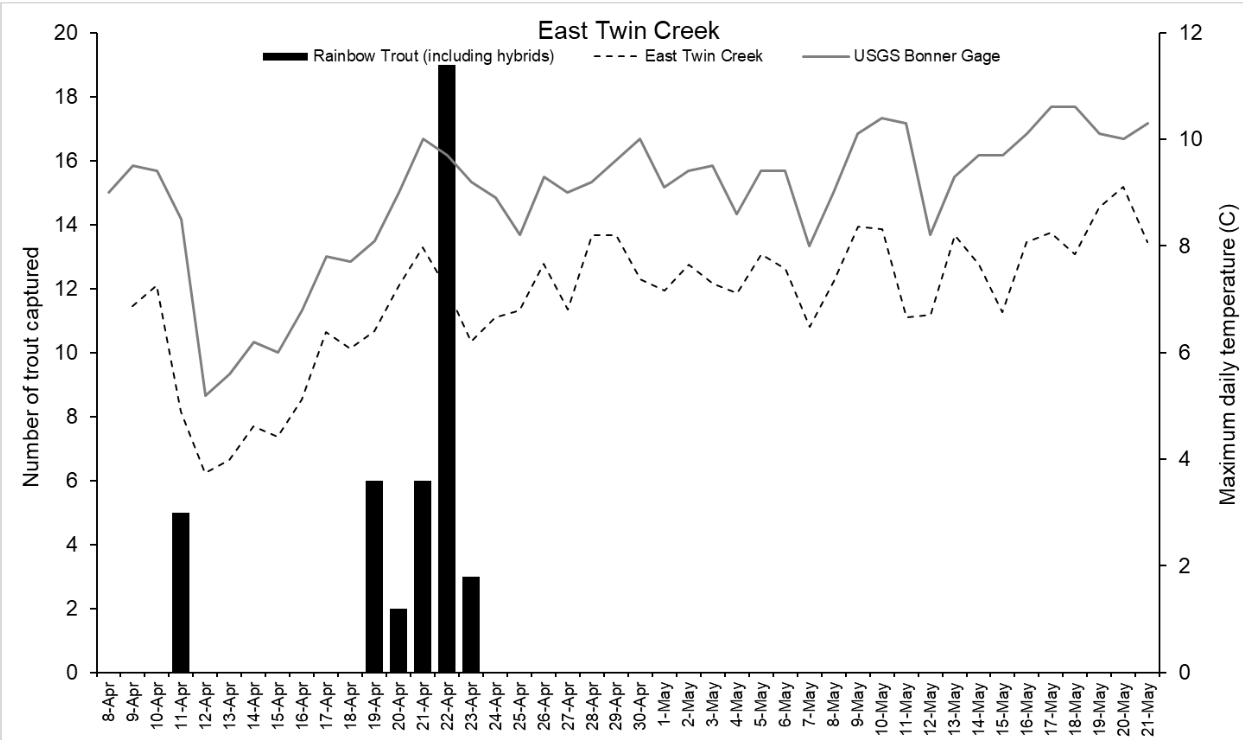


Figure C. Number and timing of adult *Oncorhynchus* spp. captured at East Twin Creek in relation to tributary and Blackfoot River (USGS gauge) temperature regimes in spring 2020. Note: the trapping period ended on May 1 in Twin Creek.

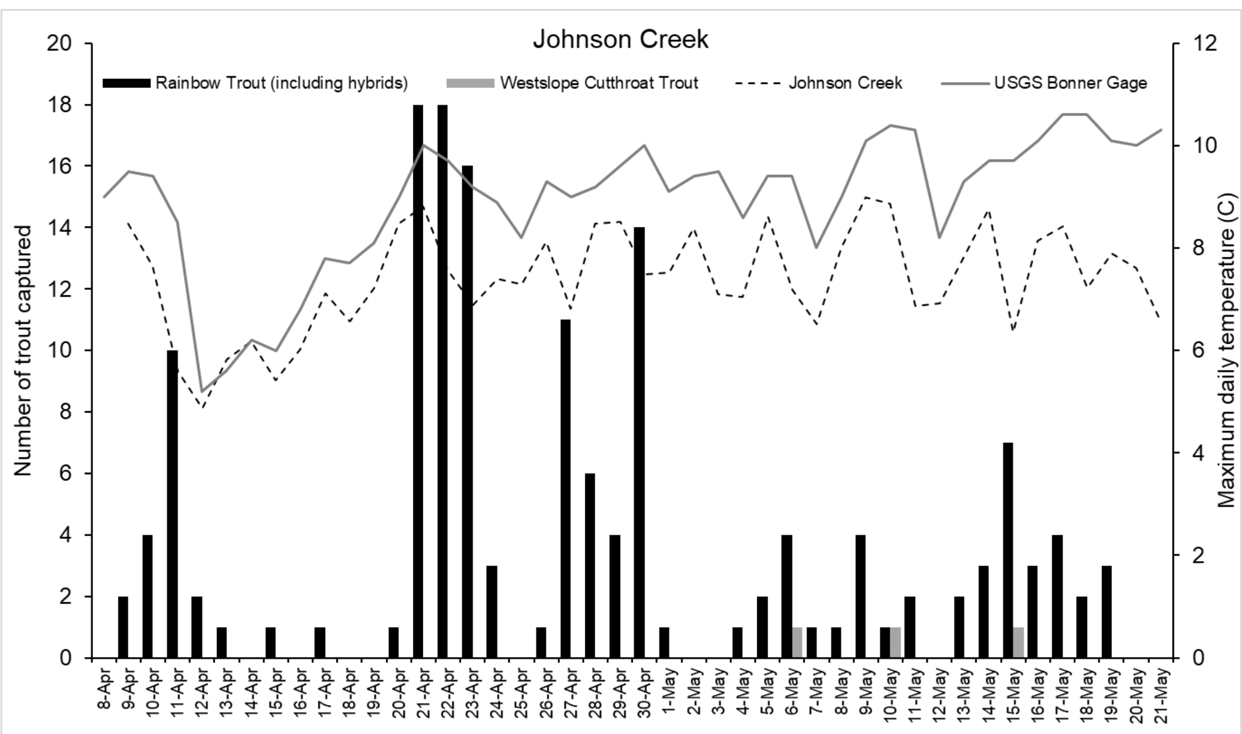


Figure D. Number and timing of adult *Oncorhynchus* spp. captured at Johnson Creek in relation to tributary and Blackfoot River (USGS gauge) temperature regimes in spring 2020. Note: the trapping period ended on May 21 in Johnson Creek.

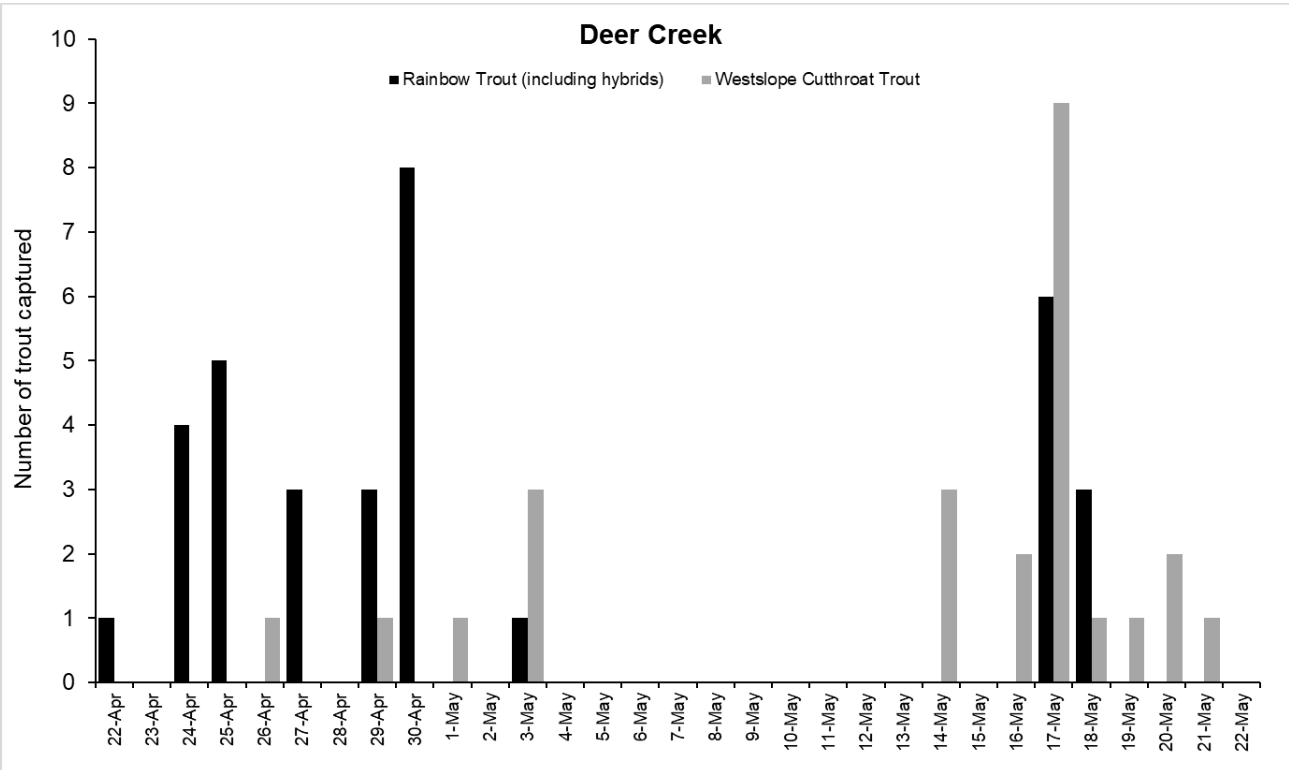


Figure E. Number and timing of adult *Oncorhynchus* spp. captured at Deer Creek trap in spring 2020.

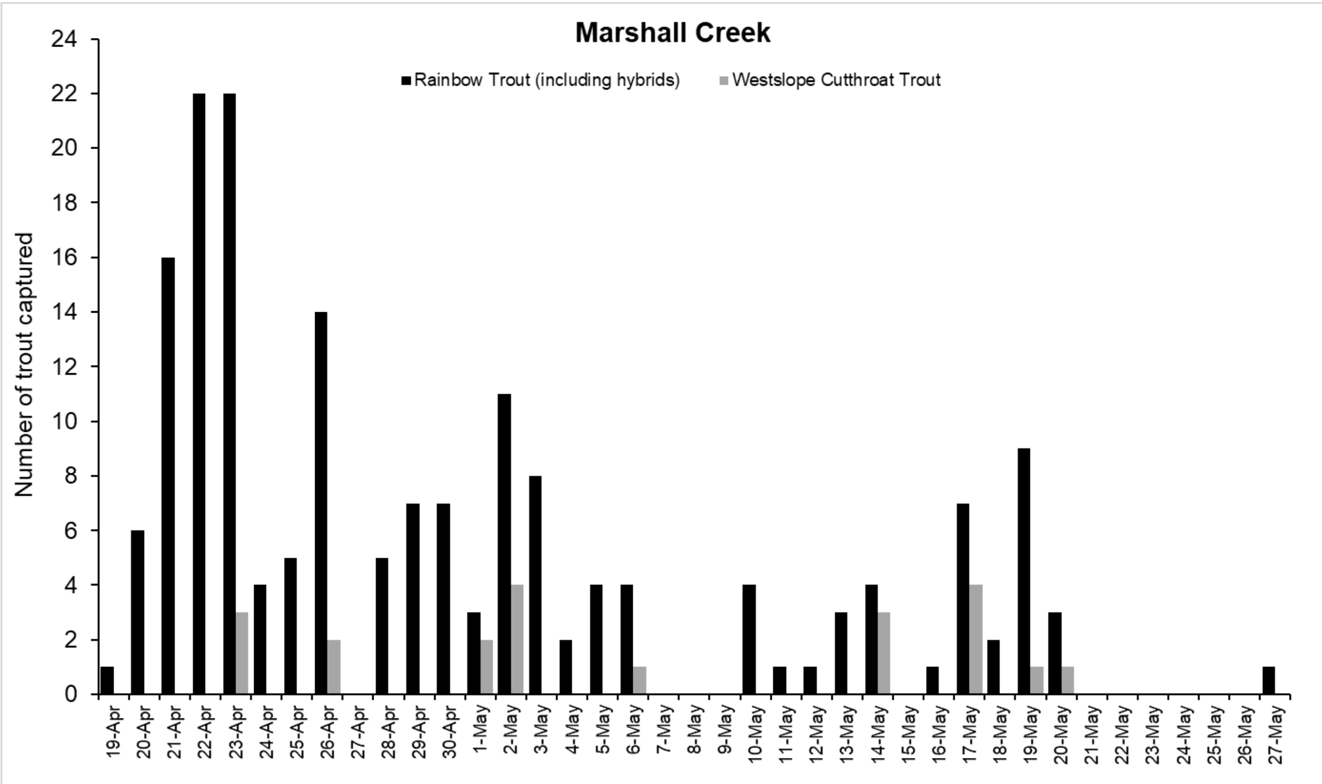


Figure F. Number and timing of adult *Oncorhynchus* spp. captured at Marshall Creek trap in spring 2020.

APPENDIX III. Results of genetic testing for adult *Oncorhynchus* spp. captured in Blackfoot River tributaries.

Stream	Capture Date	Length (mm)	Tag Code	% WCT genetic contribution	F1 Hybrid
Bear Creek	4/23/2020	410	0215	47.44	
Bear Creek	4/23/2020	423	0216	48.72	
Bear Creek	4/23/2020	435	0220	48.72	
Bear Creek	4/23/2020	392	0221	51.28	
Bear Creek	4/24/2020	462	0224	47.44	
Bear Creek	4/24/2020	409	0226	52.56	
Belmont Creek	4/26/2020	453	0735	51.28	
Belmont Creek	4/29/2020	442	0748	50.00	X
Belmont Creek	4/30/2020	486	0762	51.00	
Belmont Creek	4/30/2020	436	0764	50.00	X
Belmont Creek	4/30/2020	455	0767	49.00	
Belmont Creek	4/30/2020	431	0770	2.56	
Belmont Creek	5/4/2020	436	0805	50.00	X
Belmont Creek	5/6/2020	420	0810	30.77	
Belmont Creek	5/10/2020	395	0820	50.00	X

Belmont Creek	5/10/2020	421	0822	2.56	
Belmont Creek	5/13/2020	476	0831	2.56	
Belmont Creek	5/19/2020	472	0854	48.72	
East Twin Creek	4/22/2020	442	0329	51.28	
East Twin Creek	4/23/2020	405	0346	1.32	
Johnson Creek	4/21/2020	430	0432	50.00	X
Johnson Creek	4/22/2020	352	0452	50.00	
Johnson Creek	4/22/2020	482	0456	50.00	
Johnson Creek	4/22/2020	429	0461	50.00	X
Johnson Creek	4/22/2020	371	0462	50.00	
Johnson Creek	4/22/2020	396	0464	51.28	
Johnson Creek	4/23/2020	441	0470	64.10	
Johnson Creek	4/23/2020	399	0471	38.46	
Johnson Creek	4/23/2020	393	0472	32.05	
Johnson Creek	4/23/2020	425	0481	50.00	X
Johnson Creek	4/23/2020	405	0482	51.28	
Johnson Creek	4/24/2020	501	0484	50.00	X
Johnson Creek	4/27/2020	455	0489	1.28	
Johnson Creek	4/27/2020	403	0492	50.00	X
Johnson Creek	4/27/2020	476	0495	50.00	X
Johnson Creek	4/29/2020	412	1004	50.00	X
Johnson Creek	4/30/2020	381	1012	50.00	X
Johnson Creek	4/30/2020	433	1014	50.00	
Johnson Creek	4/30/2020	369	1016	50.00	X
Johnson Creek	4/30/2020	445	1017	50.00	X
Johnson Creek	5/6/2020	417	1027	1.28	
Johnson Creek	5/6/2020	402	1029	100.00	
Johnson Creek	5/10/2020	380	1039	100.00	
Johnson Creek	5/13/2020	386	1044	50.00	X
Johnson Creek	5/15/2020	415	1056	97.44	
Johnson Creek	5/16/2020	414	1060	48.72	
Johnson Creek	5/17/2020	400	1063	1.28	
Johnson Creek	5/17/2020	388	1064	44.87	
Johnson Creek	5/18/2020	322	--[a]	80.77	

[a] Mortality

APPENDIX IV. Project poster used as part of public information and notification for project.

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2020.

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
Anaconda Creek	0.5	15N,6W,22C	10-Sep-19	530	CT	117	106	3	1.4 - 8.1	4.2	0.6	19.4
					EB	3	3	0	6.3 - 7.7	7.1	0.0	0.6
			14-Sep-20	530	CT	133	91	0	2.4 - 8.6	4.2	0.0	17.2
					EB	13	10	7	1.9 - 7.5	3.6	1.3	0.6
Arrastra Creek	2.4	14N,10W,17D	30-Jul-20	300	CT	4	4	0	3.8 - 7.8	5.7	0.0	1.3
					LL	10	10	0	4.8 - 7.5	6.0	0.0	3.3
					EB	6	6	0	5.0 - 10.3	6.4	0.0	2.0
	4.5	14N,10W,9B	25-Jul-17	858	CT	36	36	7	3.0 - 10.4	6.3	0.8	3.4
					DV	14	14	0	4.2 - 11.1	6.5	0.0	1.6
			30-Jul-20	400	CT	5	5	0	6.3 - 11.3	8.1	0.0	1.3
	5.1	14N,14W,4B	27-Jul-17	390	CT	35	32	3	2.5 - 9.7	6.1	0.8	7.4
					DV	2	2	1	3.7 - 7.4	5.6	0.3	0.3
	9.2	15N,10W,24C	30-Jul-20	300	DV	5	5	0	6.6 - 8.5	7.6	0.0	1.7
					CT	14	14	0	6.4 - 9.9	7.9	0.0	4.7
Ashby Creek	2	13N,16W,26A	23-Aug-16	300	CT	1	1	0	5.4	4.3	0.0	0.3
					Spotted frog	observed						
	2.7	13N,16W,26D	23-Aug-16	489	CT	9	8	2	1.9 - 8.4	5.3	0.4	1.2
					EB	2	2	2	2.6 - 2.8	2.7	0.4	0.0
					Spotted frog	present						
Bear Creek	1.1	13N,16W,18B; 13N,16W,7C	16-Aug-16	393	RB	43	36	3	1.9 - 10	4.8	0.8	8.4
					LL	18	16	0	4.1 - 11.2	6.9	0.0	4.1
					EB	2	2	0	5.1 - 6.8	6.0	0.0	0.5
					Sculpins	abundant						
			14-Aug-17	393	CT	1	1	0	6.3	6.3	0.0	0.3
					DV	1	1	0	9.1	9.1	0.0	0.3
					RB	83	68	21	1.5 - 9.1	4.0	5.3	12.0
					LL	22	16	4	2.4 - 7.6	4.7	1.0	3.1
					EB	16	13	12	2.4 - 5.0	3.0	3.1	0.3
					Sculpins	abundant						
			30-Jul-18	393	RB	93	71	35	1.8 - 9.4	3.3	8.9	9.2
					LL	21	19	2	3.7 - 11	6.0	0.5	4.3
					EB	3	3	1	3.9 - 6.7	5.5	0.3	0.5
					Sculpins	abundant						
Beartrap Cr	0.35	15N,6W,27B	10-Sep-19	656	EB	43	41	25	3.0 - 10.7	4.8	3.8	2.4
			14-Sep-20	656	EB	28	24	0	5.4 - 11.0	7.0	0.0	3.7
	1.1	15N,6W,27D	10-Sep-19	328	No fish							
			14-Sep-20	328	No fish							

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2020 (cont'd).

Stream		River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
Belmont Creek		0.1	14N,16W,24C	19-Aug-19	471	RB	34	34	4	1.5 - 7.8	4.3	0.8	6.4
						DV	1	1	0	8.4	8.4	0.0	0.2
						LL	1	1	0	7.9	7.9	0.0	0.2
						EB	1	1	1	2.6	2.6	0.2	0.0
						Sculpins	common						
		0.3	14N,16W,24C	20-Aug-19	342	RB	31	31	7	1.5 - 8.7	4.4	2.0	7.0
						WCT	1	1	0	5.3	5.3	0.0	0.3
						LL	2	2	2	2.6 - 3.1	2.8	0.6	0.0
						Sculpins	common						
		0.6	14N,16W,24B	20-Aug-19	410	RB	71	71	4	1.7 - 7.5	4.2	1.0	16.3
						LL	6	6	1	2.0 - 9.2	7.5	0.2	1.2
						Sculpins	common						
		1.2	14N,16W,14D	20-Aug-19	312	RB	49	49	6	1.1 - 7.5	3.7	1.9	13.8
						LL	3	3	3	2.1 - 2.2	2.2	1.0	0.0
						Sculpins	common						
Data collected by BLM		1.5	14N,16W,14A	20-Aug-19	450	RB	8	8	0	3.3 - 9.2	5.2	0.0	1.8
						CT	5	5	1	2.6 - 4.7	4.0	0.2	0.9
						Sculpins	present						
		2.2	14N,16W,11C	21-Aug-19	350	DV	1	1	0	10	10.0	0.0	0.3
						RB	79	79	7	1.5 - 7.9	4.5	2.0	20.6
						LL	1	1	0	9.7	9.7	0.0	0.3
						Sculpins	common						
Data collected by BLM		4.3	14N,16W,11B	21-Aug-19	330	DV	1	1	0	8.7	8.7	0.0	0.3
						CT	1	1	0	4.3	4.3	0.0	0.3
						RB	22	22	0	3.6 - 8.1	5.9	0.0	6.7
						LL	7	7	0	8.1 - 9.3	8.6	0.0	2.1
						Sculpins	common						
	below 1st falls	4.6	14N,16W,11B	22-Aug-19	240	CT	18	18	0	3.5 - 8.9	6.5	0.0	7.5
						RB	17	17	0	3.2 - 6.5	5.3	0.0	7.1
						LL	12	12	0	6.0 - 11.5	8.5	0.0	5.0
	pool below 2nd falls	4.7	14N,16W,11B	22-Aug-19	NA	CT	3	3	0	5.9 - 6.9	6.5		
						LL	4	4	0	7.9 - 9.3	8.7		
	above 2nd falls			22-Aug-19	140	CT	10	10	0	3.0 - 6.9	4.9	0.0	7.1
						LL	2	2	0	5.3 - 8.9	7.1	0.0	1.4
		6.3	15N,16W,28B	21-Aug-19	315	CT	25	25	1	2.8 - 8.2	5.8	0.3	7.6
Data collected by BLM		7.4	15N,16W,20A	20-Aug-19	372	CT	20	20	0	3.9 - 8.3	6.8	0.0	5.4
		8.4	15N,16W,20A	21-Aug-19	360	DV	2	2	0	7.5 - 7.9	7.7	0.0	0.6
						CT	26	26	0	3.6 - 8.8	6.5	0.0	7.2
Black Canyon Creek		0.65	14N,15W,15C	13-Jul-20	300	No fish found							
		1.8	14N,15W,15B	13-Jul-20	450	No fish found	1 spotted frog	observed					
Blackfoot River		131	15N,6W,21C	16-Sep-20	600	CT	26	13	0	3.7 - 8.9	6.1	0.0	2.2
						EB	261	160	53	2.5 - 9.1	5.1	8.8	17.8
		131.8	15N,6W,21D	15-Sep-20	656	EB	73	61	18	3.0 - 9.9	6.6	2.7	6.6
						LNS	6	4	0	5.9 - 7.7	6.6	0.0	0.6
		132	15N,6W,21D	11-Sep-19	682	CT	1	1	0	5.4	5.4	0.0	0.1
						EB	12	9	0	6.1 - 11	8.4	0.0	1.3
				15-Sep-20	682	CT	12	10	0	5.6 - 9.6	8.4	0.0	1.5
						EB	258	170	153	2.8 - 11.7	3.7	22.4	2.5
Braziel Creek		0.2	12N,10W,10D	25-Aug-16	300	CT	16	15	8	1.6 - 6.7	3.4	2.7	2.3
						EB	1	1	1	3.8	3.8	0.3	0.0
						Sculpins	abundant						

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2020 (cont'd).

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
Chamberlain Creek	0.1	15N,13W,32A	29-Aug-19	358	CT	167	123	20	1.5 - 9.7	3.7	5.6	28.8
					LL	12	9	3	3.0 - 9.2	6.3	0.8	1.7
					RB	3	2	1	3.4 - 3.6	3.5	0.3	0.3
					EB	2	1	1	2.6 - 3.0	2.8	0.3	0.0
					Sculpins	abundant	RSS & LNS	common	Spotted frog	observed		
	1.9	14N,13W,4A	27-Aug-19	300	CT	184	153	24	1.4 - 7.1	3.3	8.0	43.0
					LL	1	1	0	6.5	6.5	0.0	0.3
					EB	1	1	1	3.9	3.9	0.3	0.0
					Sculpins	common						
	3.8	14N,13W,8D,17A	29-Aug-19	360	CT	201	154	5	1.5 - 7.9	4.3	1.4	41.4
					EB	35	29	0	3.8 - 8.5	6.2	0.0	8.1
					Sculpins	common						
Copper Creek	6.2	15N,8W,9A	3-Sep-19	535	DV	14	10	2	2.2 - 14.1	5.3	0.4	1.5
					CT	55	44	5	1.6 - 13.6	5.1	0.9	7.3
					Sculpins	abundant						
			8-Sep-20	515	DV	2	2	0	4.2 - 6.0	5.1	0.0	0.4
					CT	28	20	1	2.0 - 8.4	5.0	0.2	3.7
					Sculpins	abundant						
Cottonwood Creek trib to Blackfoot River	12.0	16N,14W,24D	28-Jul-20	515	CT	43	29	0	2.6 - 12.5	5.7	0.0	5.6
					DV	1	1	0	6.8	6.8	0.0	0.2
					EB	1	1	0	4.6	4.6	0.0	0.2
					Sculpins	common						
	12.5	16N,14W,24A	27-Jul-20	440	CT	57	57	0	2.4 - 10.9	6.7	0.0	13.0
					DV	1	1	0	6.7	6.7	0.0	0.2
					EB	3	3	0	5.6 - 9.5	7.9	0.0	0.7
					Sculpins	common						
	16	16N,14W,10A,11A	27-Jul-20	475	CT	52	52	0	2.1 - 8.7	4.5	0.0	10.9
Spring Creek to Cottonwood Creek	0.2	16N,14W,24B	13-Jun-19	300	CT	5	5	0	4.2 - 5.5	5.0	0.0	1.7
					EB	16	16	5	2.4 - 6.6	4.2	1.7	3.7
	1	16N,14W,14C	13-Jun-19	340	CT	5	5	0	2.6 - 5.7	4.4	0.0	1.5
					EB	20	20	9	2.3 - 6.2	3.8	2.6	3.2
Un-named tributary to Spring Creek	0.2	16N,14W,24B	13-Jun-19	300	CT	26	26	2	1.7 - 5.4	3.7	0.7	8.0
Cottonwood Creek trib to Douglas Creek	9.3	12N,11W,23A	19-Jul-17	300	CT	79	79	0	2.6 - 9.6	5.2	0.0	26.3
					EB	3	3	0	3.6 - 5.1	4.2	0.0	1.0
					Sculpins	present						
Dick Creek	4.8	15N,12W,17D	16-Oct-19	368	CT	1	1	0	6.8	6.8	0.0	0.3
					RB	2	2	1	2.4 - 6.0	4.2	0.3	0.3
					EB	20	20	16	2.4 - 7.5	3.6	4.3	1.1
					Sculpins	common	RSS & LNS	present				
	6	15N,12W,16D	6-Jul-20	320	EB	1	1	0	4.5	4.5	0.0	0.3
	6.2	15N,12W,16D	9-Jul-20	330	CT	6	6	0	5.4 - 7.3	6.2	0.0	1.8
					EB	5	5	2	3.0 - 4.8	4.1	0.6	0.9
	7.8	15N,12W,15B	6-Jul-20	225	No fish sampled	1 observed						
	8.2	15N12W,10A	6-Jul-20	385	CT	1	1	0	5	5.0	0.0	0.3
Spring Creek to Widgeon Marsh (Dick Creek drainage)	0.1	15N,12W,17D	16-Oct-19	70	EB	4	4	3	2.8 - 4.0	3.2	4.3	1.4
Dobrota Creek	1	18N,10W,25D	20-Jul-16	328	No fish	found	3 tadpoles	observed				
Douglas Creek	16.1	12N,13W,24A	26-Aug-19	321	CT	40	40	3	1.2 - 6.4	4.1	0.9	11.5
	17	12N,13W,14D	7-Jul-20	200	CT	18	18	1	1.9 - 6.0	3.7	0.5	8.5
	17.3	12N13W,14D	26-Aug-19	300	CT	20	20	1	1.02 - 7.5	4.3	0.3	6.3
	17.7	12N,13W,14B	7-Jul-20	320	CT	12	12	0	3.8 - 8.0	5.4	0.0	3.8
Dry Fork of North Fork Blackfoot River	3	17N,11W,24A	20-Jul-16	1000	DV	1	1	0	4.7	4.7	0.0	0.1
					CT	21	21	0	3.3 - 6.2	4.3	0.0	2.1

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2020 (cont'd).

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
Dunham Creek	2.3	16N,12W,19B	3-Aug-20	600	DV	5	2	0	5.8 - 8.0	6.5	0.0	0.3
					CT	50	42	0	3.8 - 13.2	6.8	0.0	7.0
					LL	1	1	0	4.7	4.7	0.0	0.2
					EB	46	36	16	2.0 - 12.4	4.9	2.7	3.3
	4.2	16N,13W,12D	4-Aug-20	790	DV	3	1	0	5.8 - 6.3	5.9	0.0	0.1
					CT	16	9	0	3.5 - 9.3	5.7	0.0	1.1
					EB	20	9	0	5.0 - 8.1	5.6	0.0	1.1
					Sculpins	present						
	7	16N,13W,2A	20-Jul-17	348	CT	28	28	0	2.8 - 10.8	5.0	0.0	8.0
					DV	5	5	0	7.2 - 8.7	7.7	0.0	1.4
			3-Aug-20	400	CT	51	37	0	3.0 - 10.2	6.0	0.0	9.3
					DV	2	2	0	6.0 - 6.2	6.1	0.0	0.5
					EB	3	2	0	5.4 - 8.3	7.2	0.0	0.5
					Sculpins	present						
East Fork of NFBLKFT (Sculpin survey)	0.1	17N,10W,28C	18-Jul-16	187	No Sculpins	0	0	0				
Game Ridge un-named tributary stream	0.9	14N,15W,16AD	31-Oct-16	2865	CT	19	19	0	3.3 - 5.6	4.8	0.0	0.7
Game Ridge un-named tributary stream	0.56	14N,15W,17D	13-Jul-20	350	No fish found							
	1.2	14N,15W,17A	13-Jul-20	250	No fish found							
Game Ridge un-named tributary stream	2.3	14N,15W,10C	13-Jul-20	300	No fish found							
Gold Creek	5.9	14N,16W,7B	17-Jul-19	300	CT	2	2	0	6.0 - 8.1	7.0	0.0	0.7
					RB*	12	12	1	2.8 - 13.2	6.2	0.3	3.7
					LL	22	22	2	3.8 - 15.4	7.4	0.7	6.7
					EB	5	5	0	5.1 - 5.9	5.5	0.0	1.7
					Sculpins	present						
	6.2	14N,16&17W,7B	16-Jul-19	270	RB	9	9	1	2.6 -14.8	5.8	0.4	3.0
					LL	11	11	0	4.3 - 14.3	8.0	0.0	4.1
					EB	13	13	0	4.8 - 9.1	6.2	0.0	4.8
	9	15N,17W,25C	16-Jul-19	342	CT	13	13	0	3.1 - 8.6	5.7	0.0	3.8
					RB	2	2	0	5.2 - 8.2	6.7	0.0	0.6
					LL	1	1	0	6.5	6.5	0.0	0.3
					EB	29	29	1	2.1 - 7.9	5.0	0.3	8.2
					No Sculpins	observed						
	10.6	15N,17W,22D	16-Jul-19	230	CT	16	16	0	5.4 - 9.3	7.3	0.0	7.0
					EB	26	26	0	4.5 - 9.7	7.1	0.0	11.3
					Tadpole	observed						
Gold Creek, West Fork	0.1	14N,17W,1D	11-Jul-19	361	CT	1	1	0	8.5	8.5	0.0	0.3
					RB	10	10	0	3.1 - 6.9	4.6	0.0	2.8
					LL	10	10	0	4.1 - 7.9	6.6	0.0	2.8
					EB	10	10	1	2.2 - 8.8	6.1	0.3	2.5
	1.5	14N,17W,2C	17-Jul-19	290	CT	14	14	0	3.5 - 8.1	5.2	0.0	4.8
					RB	3	3	0	3.6 - 4.3	4.1	0.0	1.0
					EB	18	18	9	1.7 - 9.5	4.9	3.1	3.1
	4.6	15N,17W,33C	11-Jul-19	350	CT	44	44	0	2.8 - 7.5	4.8	0.0	12.6
					RB	11	11	0	2.9 - 5.6	3.8	0.0	3.1
					EB	1	1	0	5.4	4.5	0.0	0.3
					ONC	2	2	2	1.7 - 2.6	2.2	0.6	0.0
					Tadpoles	present						

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2019 (cont'd).

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
Grantier Spring Creek	0.1	14N,9W,25C	20-Aug-18	510	CT	9	9	0	9.7 - 13.5	12.0	0.0	1.8
					LL	33	33	16	2.4 - 20.6	6.7	3.1	3.3
					MWF	5	5	0	11 - 15.5	13.1	0.0	1.0
					Sculpins	abundant						
	0.3	14N,9W,25B	20-Aug-18	450	CT	4	4	0	9.9 - 14.1	11.8	0.0	0.9
					LL	27	27	9	2.8 - 20.5	9.0	2.0	4.0
					Sculpins	abundant	MWF YOY	observed				
	0.6	14N,9W,25AB	9-Sep-19	420	CT	16	16	11	1.7 - 15.9	4.4	2.6	1.2
					LL	61	61	51	2.8 - 17.4	4.4	12.1	2.4
					EB	9	9	7	2.8 - 4.8	3.9	1.7	0.5
					Sculpins	common						
	1.0	14N,9W,25A	24-Aug-16	521	CT	8	8	1	1.8 - 14.3	9.5	0.2	1.3
					LL	31	22	12	2.4 - 20.2	6.2	2.3	1.9
					EB	8	4	1	2.4 - 9.1	5.9	0.2	0.6
					Sculpins	abundant	MWF	present				
			20-Aug-18	521	CT	24	18	13	1.6 - 15.4	6.4	2.5	1.0
					LL	57	53	42	2.4 - 19.5	4.5	8.1	2.1
					EB	36	31	25	2.6 - 12.2	4.1	4.8	1.2
					Sculpins	abundant	MWF	present				
			9-Sep-19	521	CT	93	68	65	1.6 - 15.4	2.3	12.5	0.6
					LL	34	26	23	2.8 - 7.8	3.8	4.4	0.6
					EB	75	54	42	2.4 - 8.9	3.9	8.1	2.3
					Sculpins	abundant	MWF	present				
Jamison Gulch	0.7	14N,15W,13C	14-Jul-20	600	No fish found							
Johnson Gulch	0.9	13N,18W,11C	24-Jun-19	330	CT	17	17	0	2.0 - 6.9	4.7	0.0	5.2
					RB	13	11	2	1.2 - 6.8	3.9	0.6	2.7
					EB	10	10	0	3.4 - 6.6	4.3	0.0	3.0
					Tadpoles	observed						
Lincoln Spring Creek	3.8	14N,9W,13D	15-Aug-16	385	LL	9	5	0	3.5 - 11.6	6.6	0.0	1.3
					EB	5	3	1	3.4 - 6.5	5.3	0.3	0.5
					Sculpins	common						
Lodgepole Creek	0.1	17N,13W,36B	4-Aug-20	560	CT	52	37	2	3.2-8.6	5.9	0.4	6.3
					DV	2	2	0	5.0-6.2	5.6	0.0	0.4
					EB	1	0	0	5.4	5.4	0.0	0.0
					Sculpins	common	tadpoles	common				
McPhee Spring Creek	0.1	15N,10W,17B	2-Aug-16	396	EB	3	3	3	1.7 - 1.9	1.8	0.8	0.0
	0.3	15N,10W,17B	2-Aug-16	240	EB	2	2	1	3.9 - 4.3	4.1	0.4	0.4
					Spotted frog	observed						
	0.4	15N,10W,17B	2-Aug-16	300	No fish found	Spotted frog	observed					
Murphy's Spring Creek	0.6	15N,11W,21B	31-Aug-16	348	DV	1	1	0	7.7	7.7	0.0	0.3
					CT	50	41	5	1.7 - 6.9	3.9	1.4	10.3
					EB	4	4	2	2.0 - 4.8	3.3	0.6	0.6
					Sculpins	common						
			20-Sep-18	348	DV	2	1	0	5.1 - 5.5	5.3	0.0	0.3
					CT	29	25	7	1.4 - 5.2	3.3	2.0	5.2
					EB	10	6	0	3.4 - 5.8	4.4	0.0	1.7
					Sculpins	common						
Monture Creek	12.9	16N,12W,29B	6-Aug-20	1400	DV	15	9	3	2.8-10.3	6.0	0.2	0.4
					CT	40	33	1	1.5-17.5	7.5	0.1	2.3
					EB	18	17	3	2.1-10.9	5.2	0.2	1.0
					Sculpins	abundant						

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2019 (cont'd).

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
Nevada Creek	5.1	13N,11W,9C,8D	12-Sep-16	6500	CT	60	41	0	7.2 - 14.7	9.7	0.0	0.6
					DV	1	1	0	24.2	24.2	0.0	0.0
					LL	66	52	0	4.3 - 21	10.7	0.0	0.8
					All trout	127	94	0	4.3 - 24.2	10.3	0.0	1.4
					MWF & LSS	common						
			12-Sep-18	6500	CT	27	21	0	6.5 - 14.4	10.8	0.0	0.3
					DV	1	1	0	18.6	18.6	0.0	0.0
					RB	1	0	0	6.7	6.7	0.0	0.0
					LL	43	26	0	6.7 - 18.3	10.2	0.0	0.4
					All trout	72	48	0	6.5 - 18.6	10.5	0.0	0.7
					MWF & LSS	common						
	29.4	12N,10W,10AB	3-Jul-19	9050	CT	226	98	0	3.2 - 16.2	7.8	0.0	1.1
					RB	277	105	0	3.1 - 19	9.0	0.0	1.2
					LL	3	1	0	16.3 - 23.6	19.5	0.0	0.0
					EB	6	2	0	4.5 - 11.8	6.7	0.0	0.0
					All trout	512	206	0	3.1 - 23.6	8.5	0.0	2.3
					Sculpins	common						
	31.6	12N,10W,11C	13-Sep-16	3440	CT	56	36	0	4.2 - 16.5	9.9	0.0	1.0
					RB	185	91	2	3.3 - 20	8.8	0.1	2.6
					LL	20	16	0	6.2 - 22.8	14.6	0.0	0.5
					EB	4	3	0	7.1 - 12	8.6	0.0	0.1
					All trout	265	146	2	3.3 - 23.4	9.6	0.1	4.2
					RSS, Sculpins,	MWF ,LSS	& LNS	observed				
			16-Sep-19	3695	CT	52	35	0	5.4 - 14.6	10.0	0.0	0.9
					RB	255	160	0	5.8 - 18.3	11.4	0.0	4.3
					LL	3	2	0	15.6 - 20.4	17.5	0.0	0.1
					EB	3	3	0	7.2 - 12.8	9.7	0.0	0.1
					All trout	313	200	0	5.4 - 20.4	11.2	0.0	5.4
					RSS, Sculpins,	MWF ,LSS	& LNS	observed				
	34.6	12N,9W,19D	11-Aug-16	978	CT	5	5	0	7.0 - 11.2	8.2	0.0	0.5
					RB	16	14	2	2.4 - 9.9	6.2	0.2	1.2
					LSS	4	4	0	15.4 - 19	16.7	0.0	0.4
					All trout	21	19	2	2.4 - 11.2	6.6	0.2	1.7
					Sculpins, RSS	LSS,LND	common	Spotted frog	observed			
			16-Aug-17	978	CT	13	11	0	4.5 - 12.5	8.2	0.0	1.1
					RB	13	9	0	3.2 - 16.8	6.6	0.0	0.9
					All trout	26	20	0	3.2 - 16.8	10.0	0.0	2.0
					Sculpins, RSS	LSS,LND,MWF	common	Spotted frog	observed			
			13-Aug-20	7390	CT	87	87	1	3.4 - 13.7	7.6	0.0	1.2
					RB	86	86	0	3.4 - 20.7	7.0	0.0	1.2
					EB	2	2	0	3.5 - 7.6	5.6	0.0	0.0
					All trout	175	175	1	3.1 - 20.7	7.0	0.0	2.4
			Sculpins,	RSS,LSS	LND,MWF	common	Spotted frog	observed	Western	Pearlshell	Mussels	common
Nevada Spring Creek	3.9	13N,11W,11D	22-Sep-16	438	CT	22	14	1	2.9 - 7.7	4.7	0.2	3.0
					LL	2	2	0	7.4 - 10.8	9.1	0.0	0.5
			26-Sep-17	438	CT	32	32	0	3.7 - 8.1	5.3	0.0	7.3
					LL	43	43	35	2.9 - 7.4	3.7	8.0	1.8
					NPM	1	1	0	4.3	4.3	0.0	0.2
			18-Sep-18	438	CT	35	29	0	4.2 - 9.5	5.6	0.0	6.6
					LL	42	35	5	3.0 - 9.1	6.6	1.1	6.8
			3-Oct-19	438	CT	16	13	0	4.3 - 7.0	5.6	0.0	3.0
					LL	9	7	1	3.4 - 11.7	5.9	0.2	1.4
					RSS present	LNS present						
Devils Dip tributary to Nevada Spring Creek	0.1	13N,11W,11A	25-Aug-16	225	CT	9	6	0	3.6 - 5.6	4.6	0.0	2.7
			24-Sep-18	225	CT	1	0	0	4.8	4.8	0.0	0.0

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2020 (cont'd).

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
North Fork Blackfoot River												
downstream of North Fork falls (Sculpin survey)	25.2	17N,10W,29C	18-Jul-16	150	Sculpins	8	8	0	2.3 - 3.2	2.7	0.0	5.3
upstream of NorthFork falls (Sculpin survey)	26.4	17N,10W,28C	18-Jul-16	1500	No Sculpins	0	0	0				
downstream of un-named upper falls	36.4	18N,9W,32D	19-Jul-16	360	No fish	7 adult tailed frogs	31 tadpoles					
upstream of un-named upper falls	36.9	18N,9W,33B	19-Jul-16	328	No fish	8 adult tailed frogs	20 tadpoles					
Pearson Creek	0.5	15N,13W,33D	14-Sep-16	300	CT	7	5	0	3.8 - 6.0	4.8	0.0	1.7
					Sculpins	present						
			17-Sep-18	300	CT	6	4	0	4.5 - 8.5	6.0	0.0	1.3
	1.1	14N,13W,3B	14-Sep-16	370	CT	34	31	0	3.1 - 7.0	4.7	0.0	8.4
					EB	3	3	1	3.4 - 7.6	5.6	0.3	0.5
			17-Sep-18	370	CT	68	51	0	2.6 - 7.9	4.0	0.0	13.8
					EB	1	1	0	6.7	6.7	0.0	0.3
Poorman Creek	0.55	14N,9W,25C	5-Aug-20	3970	CT	56	33	1	1.3 - 12.0	5.5	0.0	0.8
					LL	421	221	37	1.9 - 14.3	5.0	0.9	4.6
					EB	9	6	0	4.7 - 9.7	6.9	0.0	0.2
					Sculpins	present						
	8	13N,8W,14C,23B	1-Jul-19	993	CT	230	108	0	2.2 - 10.8	5.2	0.0	10.9
					LL	1	0	0	7.5	7.5	0.0	0.0
					EB	1	1	0	7.6	7.6	0.0	0.1
			15-Jul-20	1492	CT	429	220	7	2.2 - 10	5.0	0.5	14.3
			21-Jul-20		DV	5	2	0	5.6 - 6.3	6.0	0.0	0.1
					LL	2	2	0	9.1	9.1	0.0	0.1
	9.9	13N,8W,24A	28-Jul-20	340	CT	35	35	0	3.7 - 11.1	6.3	0.0	10.3
Rock Creek	0.7	14N,11W,5B	22-Aug-17	500	CT	4	4	0	5.2 - 6.3	5.7	0.0	0.8
					RB	5	5	5	1.6 - 2.2	1.8	1.0	0.0
					LL	124	103	85	2.4 - 11.5	3.7	17.0	3.6
					EB	10	8	3	3.2 - 11.7	5.8	0.6	1.0
					Sculpins	common						
	1.6	14N,11W,5A	22-Aug-17	510	LL	10	4	3	2.4 - 8.5	4.4	0.6	0.2
					EB	15	11	5	2.8 - 9.9	5.2	1.0	1.2
					Sculpins	common						
	6.4	15N,11W,24D	27-Aug-19	525	EB	112	83	52	2.1 - 7.8	3.7	9.9	5.9
					Sculpins	abundant	LNS	present				
Sauerkraut Creek	0.2	14N,9W,29C	17-Aug-16	300	CT	32	28	10	1.8 - 6.7	3.6	3.3	6.0
					LL	7	5	2	3.0 - 6.6	4.5	0.7	1.0
					EB	24	19	13	2.0 - 9.7	3.6	4.3	2.0
					Sculpins	common						
	2.9	13N,9W,5D	17-Aug-16	297	CT	67	61	23	1.5 - 5.8	3.0	7.7	12.8
					EB	18	16	9	2.2 - 6.9	3.6	3.0	2.4
			1-Aug-17	405	CT	111	89	5	1.3 - 8.3	3.8	1.2	20.7
					EB	11	11	2	3.3 - 7.9	5.0	0.5	2.2
					Sculpins	present						
	3.2	13N,9W,8A	26-Jul-17	303	CT	42	33	1	2.4 - 7.2	4.0	0.3	10.6
					EB	3	3	0	4.3 - 5.7	4.8	0.0	1.0
					Sculpins	common						

Appendix A: Catch and size statistics for tributaries to the Blackfoot River, 2016-2020 (cont'd).

Stream	River Mile	Location (T, R, S)	Date Sampled	Section Length (ft)	Species	Total Number Captured	Number Captured 1st Pass	YOY Captured 1st Pass	Range of Lengths (in)	Mean Length (in)	YOY CPUE	CPUE Age 1+
Snowbank Creek	0.4	15N,8W,9A	7-Aug-16	450	DV	17	13	10	1.8 - 15.9	3.7	2.2	0.7
					CT	12	9	0	3.0 - 6.8	4.3	0.0	2.0
					Sculpins	common	Tadpoles	observed				
			1-Aug-17	450	DV	10	8	3	1.9 - 5.3	3.8	0.7	1.1
					CT	11	8	0	3.4 - 6.9	4.9	0.0	1.8
					Sculpins	common						
			3-Sep-19	450	DV	8	6	3	2.2 - 6.0	3.6	0.7	0.7
					CT	51	39	5	1.5 - 10.2	4.5	1.1	7.6
					Sculpins	common						
			8-Sep-20	450	DV	4	0	3	2.1 - 5.6	3.1	0.0	0.0
					CT	10	4	0	1.9 - 11.7	6.2	0.0	0.9
					Sculpins	common						
South Creek	0.4	17N,10W,22B	20-Jul-16	300	ONC	10	10	3	2.6 - 6.9	4.4	1.0	2.3
Spring Creek tributary to Cottonwood Creek	0.2	16N,14W,24B	13-Jun-19	300	CT	5	5	0	4.2-5.5	5.0	0.0	1.7
					EB	16	16	5	2.4-6.6	4.2	1.7	3.7
	1.4	16N,14W,14C	13-Jun-19	340	CT	5	5	0	2.6-5.7	4.4	0.0	1.5
					EB	20	20	9	2.3-6.2	3.8	2.6	3.2
Un-named trib to Spring Creek	0.2	16N,14W,24B	13-Jun-19	300	CT	26	26	2	1.7-5.4	3.7	0.7	8.0
Stonewall Creek	4.6	15N,9W,34D	3-Aug-16	388	CT	35	30	12	2.2 - 5.0	3.4	3.1	4.6
irrigation ditch			3-Aug-16	300	No fish	found						
	4.7	15N,9W,34A	3-Aug-16	282	CT	18	15	2	2.5 - 6.9	4.1	0.7	4.6
Wasson Creek	0.1	13N,11W,11D	25-Aug-16	327	No fish	found						
	2.8	13N,10W,7C	25-Aug-16	320	CT	66	52	9	1.9 - 7.7	3.8	2.8	13.4
	3	13N,10W,7C	25-Aug-16	300	CT	125	107	42	1.8 - 6.9	3.1	14.0	21.7
Willow Creek	2.4	14N,9W,27C	2-Sep-20	550	CT	2	2	0	8.7 - 9.7	9.2	0.0	0.4
					LL	13	13	0	5.6 - 14.8	8.6	0.0	2.4
					Sculpins	common						
	2.9	14N,9W,27D	2-Sep-20	498	CT	2	2	0	6.6 - 8.0	7.3	0.0	0.4
					LL	8	8	0	6.4 - 9.3	7.4	0.0	1.6
					Sculpins							
	3.3	14N,9W,27D	2-Sep-20	330	CT	8	8	0	4.7 - 7.8	6.1	0.0	2.4
					EB	2	2	0	5.7 - 6.7	6.2	0.0	0.6
					Sculpins	Common						
	3.6	14N,9W,34A	2-Sep-20	240	CT	7	7	0	4.8 - 8.5	6.3	0.0	2.1
					Sculpions	common						
	4.8	13N,9W,3A	10-Sep-20	660	CT	94	74	3	1.7 - 10.2	5.2	0.5	10.8
					EB	8	7	1	2.2 - 9.8	4.9	0.2	0.9
					Sculpins	common						

***** Sample may include rainbow trout / cutthroat trout hybrids

****** Sample may include bull trout / brook trout hybrids

******* Sample maybe Yellowstone cutthroat- genetics pending

CT = Cutthroat trout

DV = Bull trout

LL = Brown trout

RB = Rainbow trout

EB = Eastern brook trout

MWF = Monutain whitefish

LNS = Longnose sucker

LSS = Largescale sucker

LND = Longnose dace

RSS = Redside shiner

ONC = Oncorhynchus spp.

Appendix B : Two-pass depletion estimates for Blackfoot River and tributaries, 2016-2020.

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class	1st Pass	2nd Pass	3rd Pass	Prob. of Capture	Total Estimate ± CI	Estim/100' ± CI
Anaconda Creek	0.5	15N,6W,22C	10-Sep-19	530	CT	YOY	3	0		1.00	3.0 ± 0.0	0.6 ± 0.0
						Age 1+	103	11		0.89	115.3 ± 2.8	21.8 ± 0.5
					EB	Age 1+	3	0		1.00	3.0 ± 0.0	0.6 ± 0.0
					All trout	YOY	3	0		1.00	3.0 ± 0.0	0.6 ± 0.0
						Age 1+	106	11		0.90	118.3 ± 2.7	22.3 ± 0.5
			14-Sep-20	530	CT	Age 1+	91	42		0.54	169 ± 36	31.9 ± 6.8
					EB	YOY	7	2		0.71	9.8 ± 3.3	1.8 ± 0.6
						Age 1+	3	1		0.67	4.5 ± 2.9	0.8 ± 0.6
					All trout	YOY	7	2		0.71	9.8 ± 3.3	1.8± 0.6
						Age 1+	94	43		0.54	173.3 ± 35.7	32.7 ± 6.7
Ashby Creek	2	13N,16W,26A	23-Aug-16	300	CT	Age 1+	1	0		1.00	1.0 + 0.0	0.3 + 0.0
	2.7	13N,16W,26D	23-Aug-16	489	CT	YOY	2	1		0.50	4.0 ± 6.8	0.8 ± 1.4
						Age 1+	6	0		1.00	6.0 ± 0.0	1.2 ± 0.0
					EB	YOY	2	0		1.00	2.0 ± 0.0	0.4 ± 0.0
					All trout	YOY	4	1		0.75	5.3 ± 1.9	1.1 ± 0.4
						Age 1+	6	0		1.00	6.0 ± 0.0	1.2 ± 0.0
Bear Creek	1.1	13N,16W,18B,7C	16-Aug-16	393	RB	YOY	3	0		1.00	3.0 ± 0.0	0.8 ± 0.0
						Age 1+	33	7		0.79	41.9 ± 4.2	10.7 ± 1.1
					LL	Age 1+	16	2		0.88	18.3 ± 1.4	4.7 ± 0.3
					EB	Age 1+	2	0		1.00	2.0 ± 0.0	0.5 ± 0.0
					All trout	YOY	3	0		1.00	3.0 ± 0.0	0.8 ± 0.0
						Age 1+	51	9		0.82	62 ± 4.0	15.8 ± 1.0
			14-Aug-17	393	CT	Age 1+	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
					DV	Age 1+	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
					RB	YOY	21	4		0.81	26 ± 3.0	6.6 ± 0.7
						Age 1+	47	11		0.77	61.4 ± 6.0	15.6 ± 1.5
					LL	YOY	4	3		0.25	16 ± 62.2	4.1 ± 15.8
						Age 1+	12	3		0.75	16 ± 3.4	4.1 ± 0.9
					EB	YOY	12	3		0.75	16 ± 3.4	4.1 ± 0.9
						Age 1+	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
					All trout	YOY	37	10		0.73	50.7 ± 6.8	13 ± 1.7
						Age 1+	62	14		0.77	80.1 ± 6.4	20.4 ± 1.6
			30-Jul-18	393	RB	YOY	35	6		0.83	42.2 ± 3.1	10.7 ± 0.8
						Age 1+	36	16		0.56	64.8 ± 20.4	16.5 ± 5.2
					LL	YOY	2	0		1.00	2.0 ± 0.0	0.5 ± 0.0
						Age 1+	17	2		0.88	19.3 ± 1.3	4.9 ± 0.3
					EB	YOY	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
						Age 1+	2	0		1.00	2.0 ± 0.0	0.5 ± 0.0
					All trout	YOY	38	6		0.84	45.1 ± 2.9	11.5 ± 0.7
						Age 1+	55	18		0.67	81.8 ± 12.1	20.8 ± 3.1
Beartrap Creek	0.35	15N,6W,27B	10-Sep-19	656	EB	YOY	25	2		0.92	27.2 ± 1.0	4.1 ± 0.1
						Age 1+	16	0		1.00	16 ± 0.0	2.4 ± 0.0
			14-Sep-20	656	EB	Age 1+	24	4		0.83	28.8 ± 2.5	4.4 ± 0.4

Appendix B : Two-pass depletion estimates for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class	1st Pass	2nd Pass	3rd Pass	Prob. of Capture	Total Estimate ± CI	Estim/100' ± CI
Blackfoot River	131	15N,6W,21C	16-Sep-20	600	CT	Age 1+	13	8	5	0.49	28.9 ± 5.3	4.8 ± 2.2
					EB	YOY	53	25	14	0.50	105 ± 14.7	17.5 ± 6.0
						Age 1+	107	39	23	0.50	197 ± 31.6	32.8 ± 12.9
					All trout	YOY	53	25	14	0.50	105 ± 14.7	17.5 ± 6.0
						Age 1+	120	47	28	0.50	225.6 ± 28	37.6 ± 11.4
	131.8	15N,6W,21D	15-Sep-20	656	EB	YOY	18	6		0.67	27 ± 7.2	4.1 ± 1.1
						Age 1+	43	6		0.86	50 ± 2.6	7.6 ± 0.4
					LNS	Age 1+	6	4		0.33	18 ± 37	2.7 ± 5.7
	132	15N,6W,21D	11-Sep-19	682	CT	Age 1+	1	0		1.00	1.0 ± 0.0	0.1 ± 0.0
					EB	Age 1+	9	0		1.00	9.0 ± 0.0	4.2 ± 0.0
					All trout	Age 1+	10	0		1.00	10 ± 0.0	1.5 ± 0.0
			15-Sep-20	682	CT	Age 1+	10	2		0.80	12.5 ± 2.1	1.8 ± 0.3
					EB	YOY	153	84		0.45	339.3 ± 81.5	49.7 ± 11.9
						Age 1+	17	4		0.76	22.2 ± 3.6	3.3 ± 0.5
					All trout	YOY	153	84		0.45	339.3 ± 81.5	49.7 ± 11.9
						Age 1+	27	6		0.78	34.7 ± 4.1	5.1 ± 0.6
Braziel Creek	0.2	12N,10W,10D	25-Aug-16	300	CT	YOY	8	1		0.88	9.1 ± 1.0	3.0 ± 0.3
						Age 1+	7	0		1.00	7.0 ± 0.0	2.3 ± 0.0
					EB	YOY	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
Chamberlain Creek	0.1	15N,13W,32A	29-Aug-19	358	CT	YOY	20	12		0.40	50 ± 42	14 ± 12
						Age 1+	103	32		0.69	149.4 ± 15	42 ± 4.2
					LL	YOY	3	0		1.00	3.0 ± 0.0	0.8 ± 0.0
						Age 1+	6	3		0.50	12 ± 11.8	3.4± 3.3
					RB	YOY	1	1		0.00	No estimate	
						Age 1+	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
					EB	YOY	1	1		0.00	No estimate	
					All trout	YOY	25	14		0.44	56.8 ± 35.4	16 ± 10
						Age 1+	110	36		0.67	163.5 ± 17	45.7 ± 4.8
	1.9	14N,13W,4D	27-Aug-19	300	CT	YOY	24	5		0.79	30.3 ± 3.5	10.1 ± 1.2
						Age 1+	129	26		0.80	161.6 ± 7.7	54 ± 2.6
					LL	Age 1+	1	0		1.00	1.0± 0.0	0.3 ± 0.0
					EB	YOY	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
	3.8	14N,13W,17A,8D	29-Aug-19	360	CT	YOY	5	1		0.80	6.3 ± 1.5	1.7 ± 0.4
						Age 1+	149	46		0.69	216 ± 18	60 ± 5.0
					EB	Age 1+	29	6		0.79	36.6 ± 3.8	10.2 ± 1.1
					All trout	YOY	5	1		0.80	6.3 ± 1.5	1.7 ± 0.4
						Age 1+	178	52		0.71	251.5 ± 17.3	70 ± 5.0
Copper Creek	6.2	15N,8W,9A	03-Sep-19	535	DV	YOY	2	0		1.00	2.0 ± 0.0	0.4 ± 0.0
						Age 1+	8	4		0.50	16 ± 14	3.0 ± 2.5
					CT	YOY	5	1		0.80	6.3 ± 1.5	1.2 ± 0.3
						Age 1+	39	10		0.74	52.5 ± 6.4	9.8 ± 1.2
					All trout	YOY	7	1		0.86	8.2 ± 1.1	1.5 ± 0.2
						Age 1+	47	14		0.70	67 ± 9.2	12.5 ± 1.7
			8-Sep-20	515	DV	Age 1+	2	0		1.00	2.0 ± 0.0	0.4± 0.0
					CT	YOY	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
						Age 1+	19	8		0.58	32.8 ± 12.8	6.4 ± 2.5
					All trout	YOY	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
						Age 1+	21	8		0.62	33.9 ± 10.5	6.6 ± 2.0
Cottonwood Creek	12.0	16N,14W,24D	28-Jul-20	515	CT	Age 1+	29	14		0.52	56.1 + 23.2	10.9 + 4.5
					DV	Age 1+	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
					EB	Age 1+	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
					All trout	Age 1+	31	14		0.55	56.5 ± 19.7	11.0 ± 3.8

Appendix B : Two-pass depletion estimates for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class	1st Pass	2nd Pass	3rd Pass	Prob. of Capture	Total Estimate ± CI	Estim/100' ± CI
Dunham Creek	2.3	16N, 12W, 19B	3-Aug-20	600	CT	Age 1+	42	8		0.81	51.9 ± 4.0	8.6 ± 0.7
					DV	Age 1+	2	3		-0.50	No estimate	
					LL	Age 1+	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
					EB	YOY	16	1		0.94	17.1 ± 0.6	2.8 ± 0.1
						Age 1+	20	9		0.55	36.4 ± 15.7	6.1 ± 2.6
					All trout	YOY	16	1		0.94	17.1 ± 0.6	2.8 ± 0.1
						Age 1+	65	20		0.69	94 ± 11.6	15.6 ± 1.9
	4.2	16N, 13W, 12D	4-Aug-20	790	DV	Age 1+	1	1	1	0.50	3.0 ± 0.0	0.4 ± 0.0
					CT	Age 1+	9	6	1	0.67	16 ± 0.0	2.0 ± 0.0
					EB	Age 1+	9	6	5	0.44	23.29 ± 6.0	3.0 ± 2.2
					All trout	Age 1+	19	13	7	0.47	44.62 ± 8.2	5.7 ± 2.9
	7.0	16N,13W,2A	3-Aug-20	400	DV	Age 1+	2	0		1.00	2.0 ± 0.0	0.5 ± 0.0
					CT	Age 1+	37	14		0.62	59.5 ± 13.7	15 ± 3.4
					EB	Age 1+	2	1		0.50	4.0 ± 6.8	1.0 ± 1.7
					All trout	Age 1+	41	15		0.63	64.7 ± 13.3	16.2 ± 3.3
Grantier Spring Creek	1.0	14N,9W,25A	24-Aug-16	521	CT	YOY	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
						Age 1+	7	0		1.00	7.0 ± 0.0	1.3 ± 0.0
					LL	YOY	12	1		0.92	13.1 ± 0.7	2.5 ± 0.1
						Age 1+	10	8		0.20	50 ± 166	9.6 ± 32
					EB	YOY	1	3		-2.00	No estimate	
						Age 1+	3	1		0.67	4.5 ± 2.9	0.9 ± 0.6
					All trout	YOY	14	4		0.71	19.6 ± 4.7	3.8 ± 0.9
						Age 1+	20	9		0.55	36.4 ± 15.7	7.0 ± 3.0
			20-Aug-18	521	CT	YOY	13	1		0.92	14.1 ± 0.7	2.7 ± 0.1
						Age 1+	5	5		0.00	No estimate	
					LL	YOY	42	3		0.93	45.2 ± 1.1	8.7 ± 0.2
						Age 1+	11	1		0.91	12.1 ± 0.7	2.3 ± 0.1
					EB	YOY	25	4		0.84	29.8 ± 2.4	5.7 ± 0.5
						Age 1+	6	1		0.83	7.2 ± 1.2	1.4 ± 0.2
					All trout	YOY	80	8		0.90	88.9 ± 2.3	17.1 ± 0.4
						Age 1+	22	7		0.68	32.3 ± 7.2	6.2 ± 1.4
			9-Sep-19	521	CT	YOY	65	25		0.62	105.6 ± 19	20.3 ± 3.6
						Age 1+	3	0		1.00	3.0 ± 0.0	0.6 ± 0.0
					LL	YOY	23	7		0.70	33.1 ± 6.8	6.3 ± 1.3
						Age 1+	3	1		0.67	4.5 ± 2.9	0.9 ± 0.6
					EB	YOY	43	17		0.60	71.1 ± 16.4	13.6 ± 3.2
						Age 1+	12	4		0.67	18 ± 5.9	3.5 ± 1.1
					All trout	YOY	131	49		0.63	209.3 ± 25.1	40.2 ± 4.8
						Age 1+	18	5		0.72	24.9 ± 5.0	4.8 ± 1.0
Lincoln Spring Creek	3.8	14N,9W,13D	15-Aug-16	385	LL	Age 1+	5	2	1	0.70	8.0 ± 0.0	2.1 ± 0.0
					EB	YOY	1	0	0	1.00	1.0 ± 0.0	0.3 + 0.0
						Age 1+	2	1	1	0.57	4.0 ± 0.0	1.0 ± 0.0
					All trout	YOY	1	0	0	1.00	1.0 ± 0.0	0.3 + 0.0
						Age 1+	7	3	2	0.63	12 ± 0.0	3.1 ± 0.0
Lodgepole Creek	0.1	17N,13W,36B	4-Aug-20	560	CT	YOY	2	3		-0.50	No estimate	
						Age 1+	35	12		0.66	53.3 ± 10.7	9.5 ± 1.9
					DV	Age 1+	1	1		0.00	No estimate	
					LL	Age 1+	0	1		0.00	No estimate	
					EB	Age 1+	1	1		0.00	No estimate	
					All trout	Age 1+	37	15		0.59	62.2 ± 16.2	11.1 ± 2.9

Appendix B : Two-pass depletion estimates for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class	1st Pass	2nd Pass	3rd Pass	Prob. of Capture	Total Estimate ± CI	Estim/100' ± CI
Monture Creek	12.9	16N,12W,29B	6-Aug-20	1400	CT	YOY	1	0		1.00	1.0 ± 0.0	0.1 ± 0.0
						Age 1+	33	7		0.79	41.9 ± 4.2	3.0 ± 0.3
					DV	YOY	3	2		0.33	No estimate	
						Age 1+	9	6		0.33	No estimate	
					EB	YOY	3	1		0.67	4.5 ± 2.9	0.3 ± 0.2
						Age 1+	17	1		0.94	18.1 ± 0.6	1.3 ± 0.0
					All trout	YOY	7	3		0.57	12.3 ± 8.1	0.9 ± 0.6
						Age 1+	59	14		0.76	77.4 ± 6.8	5.5 ± 0.5
Murphy's Spring Creek	0.6	15N,11W,21B	31-Aug-16	348	DV	Age 1+	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
					CT	YOY	5	0		1.00	5.0 ± 0.0	1.4 ± 0.0
						Age 1+	36	9		0.75	48 ± 5.8	13.8 ± 1.7
					EB	YOY	2	0		1.00	2.0 ± 0.0	0.6 ± 0.0
						Age 1+	2	0		1.00	2.0 ± 0.0	0.6 ± 0.0
					All trout	YOY	7	0		1.00	7.0 ± 0.0	2.0 ± 0.0
						Age 1+	38	9		0.77	48.8 ± 5.5	14.3 ± 1.6
			20-Sep-18	348	DV	Age 1+	1	1		0.00	No estimate	
					CT	YOY	7	0		1.00	7.0 ± 0.0	2.0 ± 0.0
						Age 1+	18	4		0.78	23.1 ± 3.4	6.7 ± 1.0
					EB	Age 1+	6	4		0.33	18 ± 37.4	5.2 ± 10.7
					All trout	YOY	7	0		1.00	7.0 ± 0.0	2.0 ± 0.0
						Age 1+	25	9		0.64	39.1 ± 10	11.2 ± 2.9
Nevada Creek	34.6	12N,9W,19D	11-Aug-16	978	CT	Age 1+	5	0		1.00	5.0 ± 0.0	0.5 ± 0.0
					RB	YOY	2	0		1.00	2.0 ± 0.0	0.2 ± 0.0
						Age 1+	12	2		0.83	14.4 ± 1.8	1.5 ± 0.2
					All trout	YOY	2	0		1.00	2.0 ± 0.0	0.2 ± 0.0
						Age 1+	17	2		0.88	19.3 ± 1.3	2.0 ± 0.1
			16-Aug-17	978	CT	Age 1+	11	2		0.82	13.4 ± 1.9	1.4 ± 0.2
					RB	Age 1+	9	4		0.56	16.2 ± 10.2	1.7 ± 1.0
					All trout	Age 1+	20	7		0.65	31 ± 8.4	3.1 ± 0.9
Nevada Spring Creek	3.9	13N,11W,11D	22-Sep-16	438	CT	YOY	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
						Age 1+	13	8		0.38	33.8 ± 37.4	7.7 ± 8.5
					LL	Age 1+	2	0		1.00	2.0 ± 0.0	0.5 ± 0.0
					All trout	Age 1+	15	8		0.47	32.1 ± 23	7.3 ± 5.3
			18-Sep-18	438	CT	Age 1+	29	6		0.79	36.6 ± 3.8	8.3 ± 0.9
					LL	YOY	5	0		1.00	5.0 ± 0.0	1.1 ± 0.0
						Age 1+	30	7		0.77	39.1 ± 4.7	8.9 ± 1.1
					All trout	YOY	5	0		1.00	5.0 ± 0.0	1.1 ± 0.0
						Age 1+	59	13		0.78	75.7 ± 6.0	17.3 ± 1.4
			3-Oct-19	438	CT	Age 1+	13	3		0.77	16.9 ± 3.1	3.9 ± 0.7
					LL	Age 1+	6	1		0.83	7.2 ± 1.2	1.6 ± 0.3
					All trout	Age 1+	19	4		0.79	24.1 ± 3.2	5.5 ± 0.7
Devil's Dip trib to Nevada Spring Creek	0.1	13N,11W,11A	25-Aug-16	225	CT	Age 1+	6	3		0.50	12 ± 11.8	5.3 ± 5.2
			24-Sep-18	225	CT	Age 1+	0	1			No estimate	

Appendix B : Two-pass depletion estimates for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class	1st Pass	2nd Pass	3rd Pass	Prob. of Capture	Total Estimate ± CI	Estim/100' ± CI
Pearson Creek	0.5	15N,13W,33D	14-Sep-16	300	CT	Age 1+	5	2		0.60	8.3 ± 5.8	2.8 ± 1.9
			17-Sep-18	300	CT	Age 1+	4	2		0.50	8.0 ± 9.6	2.7 ± 3.2
	1.1	14N,13W,3B	14-Sep-16	370	CT	Age 1+	31	3		0.90	34.3 ± 1.4	9.3 ± 0.4
					EB	YOY	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
						Age 1+	2	0		1.00	2.0 ± 0.0	0.5 ± 0.0
					All trout	YOY	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
						Age 1+	33	3		0.91	36.3 ± 1.3	9.8 ± 0.3
			17-Sep-18	370	CT	Age 1+	51	16		0.69	74.3 ± 10.7	20.1 ± 2.9
					EB	Age 1+	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
					All trout	Age 1+	52	16		0.69	75.1 ± 10.4	20.3 ± 2.8
Rock Creek	0.7	14N,11W,5B	22-Aug-17	500	CT	Age 1+	4	0		1.00	4.0 ± 0.0	0.8 ± 0.0
					RB	YOY	5	0		1.00	5.0 ± 0.0	1.0 ± 0.0
					LL	YOY	85	18		0.79	108 ± 6.8	22 ± 1.4
						Age 1+	18	3		0.83	22 ± 2.2	4.3 ± 0.4
					EB	YOY	3	1		0.67	4.5 ± 2.9	0.9 ± 0.6
						Age 1+	5	1		0.80	6.3 ± 1.5	1.3 ± 0.3
					All trout	YOY	93	19		0.80	117 ± 6.7	23.4 ± 1.3
						Age 1+	27	4		0.85	32 ± 2.2	6.3 ± 0.4
	1.6	14N,11W,5A	22-Aug-17	510	LL	YOY	3	4		-0.33	No estimate	
						Age 1+	1	2		-1.00	No estimate	
					EB	YOY	5	3		0.40	12.5 ± 20.8	2.5 ± 4.1
						Age 1+	6	1		0.83	7.2 ± 1.2	1.4 ± 0.2
					All trout	YOY	8	7		0.13	64 ± 425	12.5 ± 83.4
						Age 1+	7	3		0.57	12.3 ± 8.1	2.4 ± 1.6
	6.4	15N,11W,24D	27-Aug-19	525	EB	YOY	52	22		0.58	90.1 ± 21.4	17.2 ± 4.1
						Age 1+	31	7		0.77	40 ± 4.6	7.6 ± 0.9
Sauerkraut Creek	0.2	14N,9W,29C	17-Aug-16	300	CT	YOY	10	0		1.00	10 ± 0.0	3.3 ± 0.0
						Age 1+	18	4		0.78	23.1 ± 3.4	7.7 ± 1.1
					LL	YOY	2	2		0.00	No estimate	
						Age 1+	3	0		1.00	3.0 ± 0.0	1.0 ± 0.0
					EB	YOY	13	4		0.69	18.8 ± 5.2	6.3 ± 1.7
						Age 1+	6	1		0.83	7.2 ± 1.2	2.4 ± 0.4
					All trout	YOY	25	6		0.76	32.9 ± 4.5	11 ± 1.5
						Age 1+	27	5		0.81	33.1 ± 3.1	11 ± 1.0
	2.9	13N,9W,5D	17-Aug-16	297	CT	YOY	23	0		1.00	23 ± 0.0	7.7 ± 0.0
						Age 1+	38	6		0.84	45.1 ± 2.9	15.2 ± 1.0
					EB	YOY	9	1		0.89	10.1 ± 0.9	3.4 ± 0.3
						Age 1+	7	1		0.86	8.2 ± 1.1	2.7 ± 0.4
					All trout	YOY	32	1		0.97	33 ± 0.4	11.1 ± 0.1
						Age 1+	45	7		0.84	53.3 ± 3.1	18 ± 1.0
			1-Aug-17	405	CT	YOY	5	0		1.00	5.0 ± 0.0	1.2 ± 0.0
						Age 1+	84	22		0.74	114 ± 9.7	28.1 ± 2.4
					EB	YOY	2	0		1.00	2.0 ± 0.0	0.5 ± 0.0
						Age 1+	9	0		1.00	9.0 ± 0.0	2.2 ± 0.0
					All trout	YOY	7	0		1.00	7.0 ± 0.0	1.7 ± 0.0
						Age 1+	93	22		0.76	122 ± 8.5	30.1 ± 2.1
	3.2	13N,9W,8A	26-Jul-17	303	CT	YOY	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
						Age 1+	32	9		0.72	44.5 ± 6.8	14.7 ± 2.3
					EB	Age 1+	3	0		1.00	3.0 ± 0.0	1.0 ± 0.0
					All trout	YOY	1	0		1.00	1.0 ± 0.0	0.3 ± 0.0
						Age 1+	35	9		0.74	47.1 ± 6.1	15.5 ± 2.0

Appendix B : Two-pass depletion estimates for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile	Location (T,R,S)	Date Sampled	Section Length (ft)	Species	Size Class	1st Pass	2nd Pass	3rd Pass	Prob. of Capture	Total Estimate ± CI	Estim/100' ± CI
Snowbank Creek	0.4	15N,8W,9A	7-Aug-16	450	DV	YOY	10	3		0.70	14.3 ± 4.3	3.2 ± 1.0
						Age 1+	3	1		0.67	4.5 ± 2.9	1.0 ± 0.7
					CT	Age1+	9	3		0.67	13.5 ± 5.1	3.0 ± 1.1
					All trout	YOY	10	3		0.70	14.3 ± 4.3	3.2 ± 1.0
						Age 1+	12	4		0.67	18 ± 5.9	4.0 ± 1.3
			1-Aug-17	450	DV	YOY	3	0		1.00	3.0 ± 0.0	0.7 ± 0.0
						Age 1+	5	2		0.60	8.3 ± 5.8	1.9 ± 1.3
					CT	Age1+	8	3		0.63	12.8 ± 6.2	2.8 ± 1.4
					All trout	YOY	3	0		1.00	3.0 ± 0.0	0.7 ± 0.0
						Age 1+	13	5		0.62	21.1 ± 8.4	4.7 ± 1.9
			3-Sep-19	450	DV	YOY	3	0		1.00	3.0 ± 0.0	0.7 ± 0.0
						Age 1+	3	2		0.33	9.0 ± 26.3	2.0 ± 5.8
					CT	YOY	5	2		0.60	8.3 ± 5.8	1.9 ± 1.3
						Age 1+	34	10		0.71	48.2 ± 7.7	10.7 ± 1.7
					All trout	YOY	8	2		0.75	10.7 ± 2.8	2.4 ± 0.6
						Age 1+	37	12		0.68	54.8 ± 9.7	12.2 ± 2.2
			8-Sep-20	450	DV	YOY	0	2	1	0.00	No estimate	
						Age 1+	0	0	1	0.00	No estimate	
						YOY	0	1	0	0.00	No estimate	
					CT	Age 1+	4	3	2	0.55	9.2 ± 0.8	2.0 ± 0.4
					All trout	Age 1+	4	3	3	0.45	11 ± 2.7	2.5 ± 1.3
Stonewall Creek	4.6	15N,9W,34D	3-Aug-16	388	CT	YOY	12	3		0.75	16 ± 3.4	4.1 ± 0.9
						Age 1+	18	2		0.89	20.3 ± 1.2	5.2 ± 0.3
	4.7	15N,9W,34A	3-Aug-16	282	CT	YOY	2	1		0.50	4.0 ± 6.8	1.4 ± 2.4
						Age 1+	13	2		0.85	15.4 ± 1.6	5.4 ± 0.6
Wasson Creek	0.1	13N,11W,11D	25-Aug-16	327		No fish	found					
	2.8	13N,10W,7C	25-Aug-16	320	CT	YOY	9	4		0.56	16.2 ± 10.2	5.1 ± 3.2
						Age 1+	43	10		0.77	56 ± 5.6	17.5 ± 1.8
	3.0	13N,10W,7C	25-Aug-16	300	CT	YOY	42	9		0.79	53.5 ± 4.9	17.8 ± 1.6
						Age 1+	65	9		0.86	75.5 ± 3.1	25.1 ± 1.0
Willow Creek	4.8	13N,9W,3A	10-Sep-20	660	CT	YOY	3	1		0.67	4.5 ± 2.9	0.7 ± 0.4
						Age 1+	71	19		0.73	96.9 ± 9.3	14.7 ± 1.4
					EB	YOY	1	0		1.00	1.0 ± 0.0	0.2 ± 0.0
						Age 1+	6	1		0.83	7.2 ± 1.2	1.1 ± 0.2
					All trout	YOY	4	1		0.75	5.3 ± 1.9	0.8 ± 0.3
						Age 1+	77	20		0.74	104 ± 9.1	15.8 ± 1.4

* Sample may include rainbow trout / cutthroat trout hybrids
** Sample may include bull trout / brook trout hybrids
*** Sample maybe Yellowstone cutthroat- genetics pending
CT = Cutthroat trout
DV = Bull trout
LL = Brown trout
RB = Rainbow trout
EB = Eastern brook trout
MWF = Monutain whitefish
LNS = Longnose sucker
LSS = Largescale sucker
LND = Longnose dace
RSS = Redside shiner
ONC = Oncorhynchus spp.

Appendix C: Mark and recapture estimates of abundance and biomass for Blackfoot River and tributaries, 2016-2020.

Stream	River Mile Mid-point	Date Sampled	Section Length (ft)	Species	Size Class (inches)	M	C	R	(R/C)	Total Estimate ± 95%CI	Total Biomass (lb/section)	Estimate/1000' ± 95%CI	Biomass (lb/1000')	Condition Factor/1000'
Blackfoot River,	13.5	9-May-16	17680	RB	5 - 9.9	207	155	34	0.22	926 ± 243	163.00	52.4 ± 13.8	9.20	40.55
Johnsrud Section		16-May-16			10 -11.9	48	17	5	0.29	146 ± 83.3	72.40	8.3 ± 4.7	4.10	38.40
					≥ 5	342	202	44	0.22	1546 ± 368	620.00	87.5 ± 21	35.00	39.40
					≥ 6	321	176	43	0.24	1294 ± 305	561.20	73.2 ± 17.2	31.70	38.70
					≥12	87	30	5	0.17	454 ± 292	457.00	25.7 ± 16.5	25.80	36.50
				LL	≥ 6	41	16	4	0.25	142 ± 90.1	165.10	8.0 ± 5.1	9.30	34.70
					6 - 11.9	10	5	0	0.00	65 ± 80	14.90	3.7 ± 4.5	0.80	35.30
					≥12	31	11	4	0.36	76 ± 43	116.30	4.3 ± 2.4	6.60	34.40
				CT	≥ 6	100	52	14	0.27	356 ± 137	191.20	20.1 ± 7.7	10.80	40.55
					6 - 11.9	72	39	13	0.33	208 ± 77	76.30	12 ± 4.3	4.30	40.80
					≥12	28	13	1	0.08	202 ± 205	192.60	11.4 ± 11.6	10.90	39.96
				DV	≥ 6	10	9	1	0.11	54 ± 25.7	216.60	3.1 ± 2.9	12.30	34.40
				All trout	≥ 5	501	287	64	0.22	2223 ± 441	1257.00	125.8 ± 25	71.10	39.10
					≥ 6	472	253	62	0.25	1906 ± 377	1164.00	108 ± 21.3	65.80	38.70
		21-May-19	17680	RB	5 - 9.9	129	122	16	0.13	939.4 ± 376.1	146.70	53 ± 21.3	8.30	36.00
		28-May-19			10 -11.9	24	15	2	0.13	132.3 ± 110.5	61.00	7.5 ± 6.3	3.40	35.30
					≥ 5	198	182	27	0.15	1300 ± 403	534.00	73.5 ± 22.8	30.20	35.40
					≥ 6	190	173	26	0.15	1230 ± 388.3	545.00	69.6 ± 22	29.70	35.40
					≥12	45	45	9	0.20	211 ± 97.9	237.20	11.9 ± 5.5	13.40	33.50
				LL	≥ 6	32	32	4	0.13	217 ± 148	202.00	12.3 ± 8.4	11.40	35.30
					6 - 11.9	18	11	1	0.09	113 ± 111.4	26.80	6.4 ± 6.3	1.50	35.00
					≥12	14	21	3	0.14	82 ± 56	125.20	4.6 ± 3.2	7.10	35.60
				CT	≥ 6	65	55	13	0.24	263 ± 103	166.00	14.9 ± 5.8	9.40	39.60
					6 - 11.9	41	36	9	0.25	154.4 ± 68.5	48.10	8.7 ± 3.9	2.70	36.20
					≥12	24	19	4	0.21	99 ± 62	117.20	5.6 ± 3.5	6.60	45.30
				DV	≥ 6	12	3	1	0.33	25 ± 19	112.20	1.4 ± 1.1	6.30	34.20
				All trout	≥ 5	307	272	45	0.17	1827 ± 440	1132.00	103.3 ± 24.8	64.00	36.20
					≥ 6	299	263	44	0.17	1759 ± 428	1120.70	100 ± 24.2	63.40	36.20
Blackfoot River,	43.9	11-May-16	20064	RB	4 - 10.9	22	7	1	0.14	91 ± 86.2	18.30	4.5 ± 4.3	0.90	35.70
Scotty Brown Bridge Section		18-May-16			≥ 4	73	33	5	0.15	418 ± 270	461.50	20.9 ± 13.5	23.00	36.30
					≥ 6	73	32	5	0.16	406 ± 261	452.20	20.2 ± 13	22.50	36.10
					11 - 13.9	10	4	0	0.00	54 ± 65	43.30	2.7 ± 3.2	2.20	38.96
					≥ 14	41	22	4	0.18	192 ± 128.4	308.00	9.6 ± 6.4	15.40	36.00
				LL	≥ 6	38	23	1	0.04	467 ± 494	683.10	23.3 ± 24.6	34.00	37.40
					6 - 11.9	13	6	1	0.17	48 ± 43.4	11.70	2.4 ± 2.2	0.60	36.70
					≥ 12	25	17	0	0.00	467 ± 618	927.00	23.3 ± 30.8	46.20	37.70
				CT	≥ 6	111	53	10	0.19	549 ± 264	522.50	27.4 ± 13.1	26.00	38.80
					6 - 11.9	30	23	1	0.04	371 ± 390	143.50	18.5 ± 19.4	7.20	38.50
					≥ 12	81	30	9	0.30	253 ± 116	314.00	12.6 ± 5.8	15.60	39.00
				DV	≥ 6	25	8	2	0.25	77 ± 59	297.10	3.8 ± 2.9	14.80	35.50
				All trout	≥ 6	247	116	18	0.16	1526 ± 589	2059.00	76.1 ± 29.3	102.60	37.50

Appendix C: Mark and recapture estimates of abundance and biomass for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile Mid-point	Date Sampled	Section Length (ft)	Species	Size Class (inches)	M	C	R	(R/C)	Total Estimate ± 95%CI	Total Biomass (lb/section)	Estimate/1000' ± 95%CI	Biomass (lb/1000')	Condition Factor/1000'
Blackfoot River,	43.9	22-May-19	20064	RB	4 - 10.9	99	74	16	0.22	440 ± 163.3	76.60	22 ± 8.1	3.80	36.80
Scotty Brown Bridge Section		29-May-19			≥ 4	141	128	25	0.20	703 ± 214.6	420.50	35.1 ± 10.7	21.00	36.40
					≥ 6	136	122	24	0.20	673 ± 209	418.10	33.5 ± 10.4	20.80	36.60
					11 - 13.9	14	18	3	0.17	70.3 ± 48	51.00	3.5 ± 2.4	2.50	37.60
					≥ 14	28	36	6	0.17	152.3 ± 83.3	256.00	7.6 ± 4.2	12.80	34.80
				LL	≥ 6	73	65	19	0.29	243.2 ± 74.5	186.00	12.1 ± 3.7	9.30	33.60
					6 - 11.9	47	41	11	0.27	167 ± 67	36.50	8.3 ± 3.3	1.80	33.40
					≥ 12	26	24	8	0.33	74 ± 30.4	131.00	3.7 ± 1.5	6.50	34.00
				CT	≥ 6	141	118	27	0.23	602 ± 172.1	398.40	30 ± 8.6	19.90	36.00
					6 - 11.9	85	63	15	0.24	343 ± 128	94.00	17.1 ± 6.4	4.70	35.40
					≥ 12	56	55	12	0.22	245 ± 99	289	12.2 ± 4.9	14.40	36.60
				DV	≥ 6	17	17	4	0.24	63.8 ± 37.5	194.00	3.2 ± 1.9	9.70	33.10
				All trout	≥ 6	367	322	74	0.23	1583 ± 279	1238.30	79 ± 13.9	61.70	35.60
Blackfoot River,	63	23-May-19	31635	RB	≥ 6	9	2	0	0.00	29 ± 32.2	22.00	1.0 ± 1.0	0.70	49.9
Wales Creek Section		30-May-19			6 - 11.9	6	1	0	0.00	13 ± 13	8.50	0.41 ± 0.40	0.30	59.4
					≥ 12	3	1	0	0.00	7.0 ± 6.8	6.60	0.22 ± 0.21	0.20	33.1
				LL	≥ 6	47	22	7	0.32	137 ± 66.5	190.60	4.3 ± 2.1	6.00	34.9
					6 - 11.9	10	4	2	0.50	17.3 ± 9.7	6.00	0.55 ± 0.31	0.20	36.9
					≥ 12	37	18	5	0.28	119.3 ± 67.7	196.00	3.8 ± 2.2	6.20	34.4
				CT	≥ 6	8	4	0	0.00	44 ± 52.6	22.70	1.4 ± 1.7	0.70	37.2
					6 - 11.9	7	3	0	0.00	31 ± 36	13.30	1.0 ± 1.1	0.40	37.9
					≥ 12	1	1	0	0.00	3.0 ± 2.8	2.90	0.09 ± 0.09	0.10	33.5
				All trout	≥ 6	64	28	7	0.25	234.6 ± 123	278.20	7.4 ± 3.9	8.80	37.2
					6 - 11.9	23	8	2	0.25	71 ± 54	31.80	2.2 ± 1.7	1.00	42.7
					≥ 12	41	20	5	0.25	146 ± 85	229.00	4.6 ± 2.7	7.20	34.3
Blackfoot River,	63.6	23-May-19	23760	MWF	≥ 6	340	177	20	0.11	2889.3 ± 1099	1589.00	122 ± 46.3	50.20	33.5
Wales Creek Section		30-May-19			6 - 11.9	191	69	8	0.12	1492.3 ± 844	596.00	63 ± 36	18.80	34.4
					≥ 12	149	108	12	0.11	1257 ± 591	886.00	53 ± 25	28.00	32.6
"MWF estimates"					≥ 8	330	176	20	0.11	2789 ± 1059	1561.10	117.4 ± 45	49.30	33.5
					8 - 11.9	181	68	8	0.12	1394.3 ± 786.3	575.00	59 ± 33.1	18.20	34.4

Appendix C: Mark and recapture estimates of abundance and biomass for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile Mid-point	Date Sampled	Section Length (ft)	Species	Size Class (inches)	M	C	R	(R/C)	Total Estimate ± 95%CI	Total Biomass (lb/section)	Estimate/1000' ± 95%CI	Biomass (lb/1000')	Condition Factor/1000'
Nevada Creek	5.1	12-Sep-16	6500	CT	≥4.0	41	32	13	0.41	98 ± 31	36.8	15.1 ± 4.8	5.7	38
		19-Sep-16		DV	≥4.0	1	0	0		1.0 ± 0.0	4.8	0.2 ± 0.0	0.7	33.5
				LL	≥4.0	52	26	12	0.46	109.1 ± 36.1	76.2	16.8 ± 5.6	11.7	40.1
				All trout	≥4.0	94	58	25	0.43	214.6 ± 52	124.0	33 ± 8.0	19.1	39.1
		12-Sep-18	6500	CT	≥4.0	21	11	5	0.45	43 ± 19.7	22.2	6.6 ± 3.0	3.4	37.1
		24-Sep-18		DV	≥4.0	1	0	0		1.0 ± 0.0	2.0	0.15 ± 0.0	0.3	30.5
				LL	≥4.0	26	20	3	0.15	140.8 ± 103.2	71.6	21.7 ± 15.9	11.0	37.9
				RB	≥4.0	0	1	0	0.00	1.0 ± 0.0	0.1	0.15 ± 0.0	0.0	36.6
				All trout	≥4.0	48	32	8	0.25	178.7 ± 85.8	93.9	27.5 ± 13.2	14.4	37.5
Nevada Creek	29.4	3-Jul-19	9050	CT	≥4.0	99	154	29	0.19	516 ± 137	139.4	57 ± 15	15.4	43.1
		10-Jul-19		RB	≥4.0	106	193	29	0.15	691 ± 190	330.0	76.4 ± 21	36.5	42.5
				LL	≥4.0	1	2	0	0.00	5.0 ± 4.8	15.7	0.6 ± 0.5	1.7	40.9
				EB	≥4.0	2	5	1	0.20	8.0 ± 4.8	1.5	0.9 ± 0.5	0.2	46.2
				All trout	>4.0	208	354	59	0.17	1236 ± 239	491.0	137 ± 26.4	54.3	42.8
Nevada Creek	31.6	13-Sep-16	3440	CT	≥4.0	36	32	12	0.38	93 ± 31	45.1	27 ± 9	13.1	43
		20-Sep-16		RB	≥4.0	89	122	29	0.24	368 ± 92	160.2	107 ± 27	46.6	42.8
				LL	≥4.0	16	14	9	0.64	24.5 ± 5.6	49.8	7.1 ± 1.6	14.5	42.9
				EB	≥4.0	3	2	1	0.50	5.0 ± 2.8	1.8	1.5 ± 0.8	0.5	42
				All trout	≥4.0	144	170	51	0.30	476 ± 85.8	272.4	138.3 ± 25	79.2	42.9
		16-Sep-19	3695	CT	≥4.0	35	30	13	0.43	79 ± 23	34.3	21 ± 6.3	9.3	39.6
		18-Sep-19		RB	≥4.0	160	172	77	0.45	356 ± 42	254.0	96 ± 11.3	69.0	39.6
				LL	≥4.0	2	1	0	0.00	5.0 ± 4.8	11.3	1.4 ± 1.3	3.1	40.6
				EB	≥4.0	3	0	0		3.0 ± 0.0	1.2	0.8 ± 0.0	0.3	35.9
				All trout	≥4.0	200	203	90	0.44	450 ± 51	305.0	122 ± 13.7	82.5	39.6
North Fork Blackfoot River	4.0	27-Aug-20	19700	CT	≥ 8.0	27	21	4	0.19	122 ± 78.5	133.6	6.5 ± 4.2	6.8	33.9
		31-Aug-20			≥ 12.0	25	15	4	0.27	82.2 ± 49.6	103	4.4 ± 2.6	5.2	33.6
					≥ 6.0	27	22	4	0.18	128 ± 83	137	6.8 ± 4.4	6.9	33.9
				DV	6.0 - 11.9	8	13	0	0.00	125 ± 158.7	31.1	6.6 ± 8.4	1.6	30.5
					≥ 12.0	3	5	0	0.00	23 ± 26.3	25	1.2 ± 1.4	1.3	31.4
					≥ 6.0	11	18	0	0.00	227 ± 294.5	109	12.1 ± 15.6	5.5	30.7
				LL	6.0 - 11.9	8	10	0	0.00	98 ± 123.3	31.4	5.2 ± 6.6	1.6	33.7
					≥ 12.0	1	10	0	0.00	21 ± 21	30.6	1.1 ± 1.1	1.6	35.7
					≥ 6.0	9	20	0	0.00	209 ± 269.5	157.1	11.1 ± 14.3	8.0	34.4
				RB	6.0 - 11.9	7	11	1	0.09	47 ± 43	10.8	2.5 ± 2.3	0.5	34.3
					≥ 12.0	8	11	2	0.18	35 ± 25	56.8	2.0 ± 1.3	2.9	33.7
					≥ 6.0	15	22	3	0.14	91 ± 63.5	84.3	4.8 ± 3.4	4.3	34
				All trout	≥ 6.0	62	86	7	0.08	684 ± 398.5	566	36.3 ± 21.2	28.7	33.6

Appendix C: Mark and recapture estimates of abundance and biomass for Blackfoot River and tributaries, 2016-2020 (cont'd).

Stream	River Mile Mid-point	Date Sampled	Section Length (ft)	Species	Size Class (inches)	M	C	R	(R/C)	Total Estimate ± 95%CI	Total Biomass (lb/section)	Estimate/100' ± 95%CI	Biomass (lb/100')	Condition Factor/100'
Poorman Creek	0.55	5-Aug-20	3970	CT	≥3.0	32	36	13	0.36	86.2 ± 26.4	7.3	2.2 ± 0.7	0.2	31.6
		11-Aug-20		LL	≥3.0	184	168	35	0.21	867.5 ± 223	92.4	22 ± 5.6	2.3	34.5
				EB	≥ 4.0	6	4	1	0.25	16.5 ± 13	2.1	0.42 ± 0.33	0.1	36
				All trout	Age 1+	222	208	49	0.24	931 ± 197	96.7	23.4 ± 5.0	2.4	34.1
Poorman Creek	8	1-Jul-19	993	CT	≥3.0	108	145	31	0.21	496 ± 126	34.4	50 ± 13	3.5	38.5
		8-Jul-19												
		15-Jul-20	1492	CT	≥3.0	213	253	54	0.21	987.3 ± 197	51.6	66.2 ± 13.2	3.5	34.4
		21-Jul-20		DV	≥ 4.0	2	3	0	0.00	No estimate				
				LL	≥ 4.0	2	0	0	0.00	No estimate				
				All trout	Age 1+	217	256	54	0.21	1018 ± 205	54.3	68.2 ± 13.7	3.7	34.4

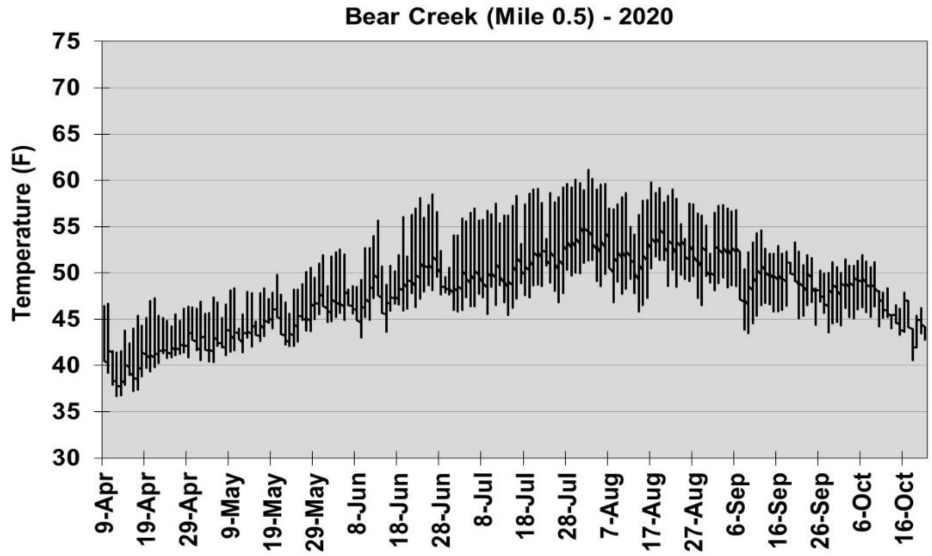
CT = Cutthroat trout **LL = Brown trout (Loch Leven)** **EB = Eastern brook trout**
DV = Bull trout (Dolly Varden) **RB = Rainbow trout** **MWF = Mountain whitefish**

Appendix D: Temperature sensor locations in the Blackfoot drainage, 2016-2020

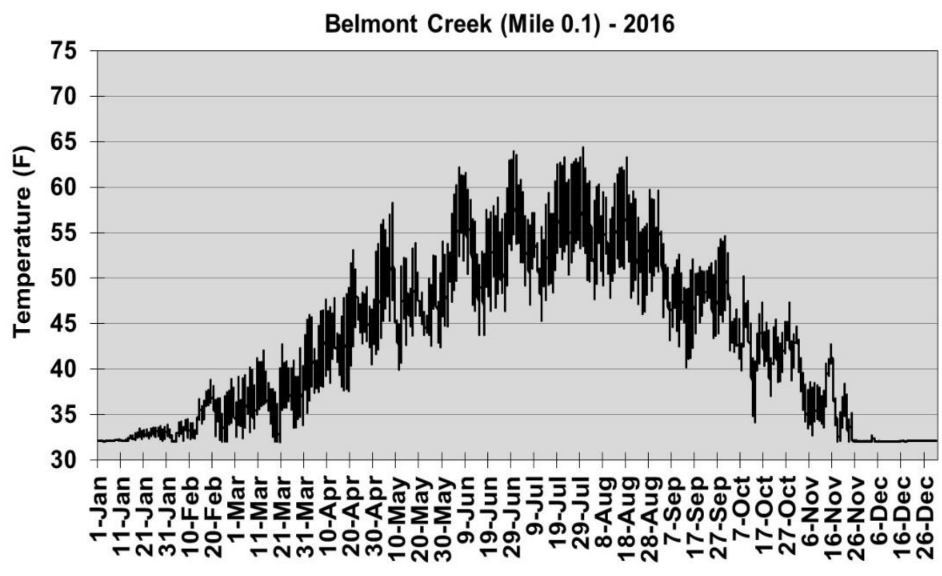
Stream Name	Stream mile	Legal Description	Latitude	Longitude	Duration
Bear Creek	0.5	13N,16W,7B	46.90017	-113.68097	4/21/20 - 10/21/20
Belmont Creek at mouth	0.1	14N,16W,24C	46.95494	-113.57029	1/1/16 - 10/21/20
Belmont Creek	1.7	14N,16W,14A	46.97553	-113.5821	6/25/19 - 10/21/20
Belmont Creek	5.3	15N,16W,33A	47.01596	-113.61716	6/25/19 - 10/21/20
Blackfoot River at USGS Gauge Station	7.9	13N,17W,9B	46.90334	-113.75584	1/1/16 - 10/21/20
Blackfoot River upstream of Belmont Creek	21.8	14N,16W,24C	46.95399	-113.56914	1/1/16 - 10/21/20
Blackfoot River at Scotty Brown Bridge	46.1	15N,13W,33A	47.01804	-113.2394	1/1/16 - 11/4/20
Blackfoot River at Raymond Bridge	60	14N,12W,28D	46.93426	-113.11462	1/1/16 - 11/4/20
Blackfoot River at Cuttoff Rd Bridge	72.2	14N,11W,32D	46.91931	-113.01502	1/1/16 - 11/4/20
Blackfoot River at Dalton Mtn Rd Bridge	104.5	14N,9W,28B	46.94336	-112.73949	1/1/16 - 11/4/20
Blondie Creek at mouth	0.1	16N,9W,9C	47.15423	-112.74626	1/1/16 - 8/9/19
Broadus Creek at mouth	0.1	17N,10W,2A	47.25778	-112.83207	1/1/16 - 8/19/20
Camp Creek at mouth	0.1	17N,10W,34C	47.1835	-112.86493	1/1/16 - 8/29/17
Cooney Creek near mouth	0.2	17N,10W,1A	47.25836	-112.81499	1/1/16 - 8/19/20
Copper Creek at Sucker Creek Rd Bridge	1.1	15N,8W,25C	47.02248	-112.56364	1/1/16 - 11/4/20
Cottonwood Creek at Hwy 200	1	15N,13W,29B	47.03015	-113.27287	1/1/16 - 11/4/20
Cottonwood Creek at Dryer Ranch Diversion	12	16N,14W,24D	47.1227	-113.3052	6/30/20 - 11/5/20
Cottonwood Creek at upper bridge	16	16N,14W,10A	47.1619	-113.34621	7/27/20 - 11/5/20
North Fork Cottonwood Creek	0.1	16N,14W,13A	47.14874	-113.31385	6/30/20 - 11/5/20
Dick Creek	1	15N,12W,18C	47.05057	-113.17628	7/16/18 - 10/11/18
Dick Creek upstream of McCabe Creek	4.7	15N,12W,17B	47.06225	-113.14889	7/16/18 - 10/11/18
Dick Creek downstream of Widgeon Marsh	5.3	15N,12W,17D	47.05442	-113.14005	7/16/18 - 10/11/18
Dick Creek at Monture Creek Rd	6.3	15N,12W,21A	47.046	-113.13313	7/16/18 - 9/26/18
Spring Creek to Widgeon Marsh	0.1	15N,12W,16C	47.05107	-113.13425	7/23/18 - 10/11/18
Dobrota Creek at mouth	0.1	18N,9W,31C	47.26688	-112.80663	1/1/16 - 8/20/20
Douglas Creek at mouth	0.1	13N,11W,9C	46.89103	-113.00499	6/15/16 - 11/4/20
Dunham Creek	3.95	16N,13W,12D	47.14669	-113.18238	7/27/20 - 11/5/20
East Fork Meadow Creek	0.9	16N,10W,25A	47.11964	-112.80044	9/7/16 - 9/8/18
East Fork Meadow Creek	1.1	16N,10W,25A	47.11736	-112.79995	9/8/18 - 8/5/19
East Fork of the North Fork Blackfoot River	1.7	17N,10W,34C	47.18415	-11286679	1/1/16 - 8/18/20
East Fork of the North Fork Blackfoot River	7	16N,9W,7A	47.16439	-112.7942	1/1/16 - 8/7/19
East Fork of the North Fork Blackfoot River	9.4	16N,9W,8D	47.15252	-112.75653	1/1/16 - 8/9/19
East Twin Creek near mouth	0.2	13N,17W,2A	46.91531	-113.71029	4/21/20 - 10/21/20
Enders Spring Creek at mouth	0.1	14N,11W,6B	47.00055	-113.04377	1/1/16 - 11/5/20
Gold Creek at lower bridge	1.6	14N,16W,30C	46.9375	-113.6712	1/1/16 - 11/4/20
Gold Creek upstream of Gold Creek Rd Bridge	5.7	14N,17W,12A	46.98916	-113.68201	6/19/19 - 10/21/20
Gold Creek at upper bridge	9	15N,17W,25C	47.02436	-113.70054	6/1/19 - 10/21/20
West Fork Gold Creek at West Fork Rd Bridge	0.2	14N,17W,1D	46.99426	-113.68942	6/19/19 - 10/21/20
Jacobsen Spring Creek at mouth	0.1	14N,12W,1C	46.99034	-113.06611	1/1/16 - 11/5/20
Johnson Gulch at mouth	0.1	13N,18W,14B	46.88837	-113.84104	4/9/20 - 10/21/20
Kleinschmidt Creek	0.4	14N,11W,6A	46.99783	-113.02841	1/1/16 - 11/5/20

Appendix D: Temperature sensor locations in the Blackfoot drainage, 2016-2020 (cont'd).

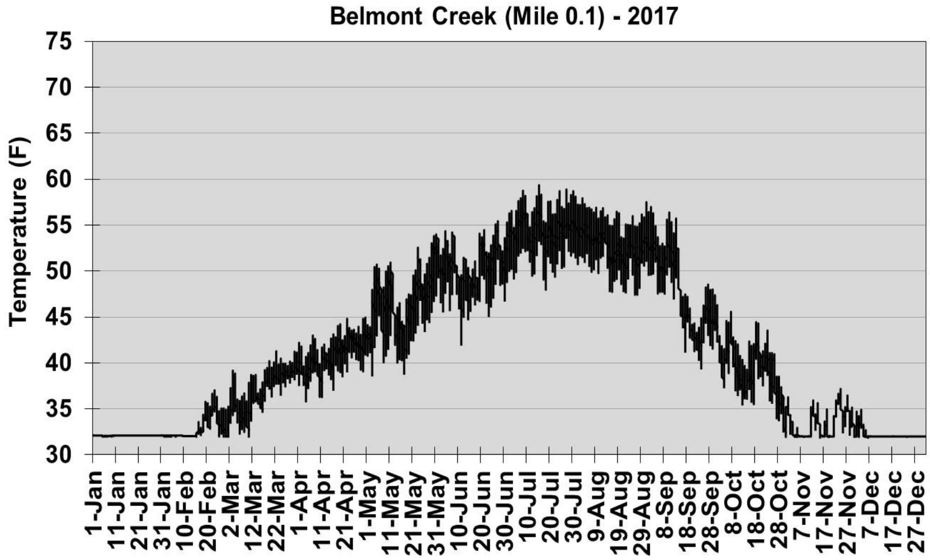
Stream Name	Stream mile	Legal Description	Latitude	Longitude	Duration
McCabe Creek at mouth	0.1	15N,12W,7D	47.06502	-113.15982	7/17/18 - 10/11/18
Meadow Creek	1.4	16N,9W,7A	47.15121	-112.79451	1/1/16 - 8/7/19
Meadow Creek upstream of East Fork confluence	5.3	16N,10W,25B	47.12273	-112.80659	1/1/16 - 8/5/19
Mineral Creek near mouth	0.3	17N,10W,35C	47.17638	-112.83852	1/1/16 - 8/18/20
Mineral Creek upstream of East Fork conflunece	3.5	16N,10W,10C	47.15066	-112.84978	1/1/16 - 8/29/17
Monture Creek at FAS	1.8	15N,13W,22D	47.0375	-113.21991	1/1/16 - 11/4/20
Monture Creek at USFS Bridge	12.9	16N,12W,29C	47.11841	-113.14655	6/30/20 - 11/5/20
Nevada Creek downstream of Douglas Creek	4.5	13N,11W,8D	46.89346	-113.00755	1/1/16 - 11/4/20
Nevada Creek upstream of Douglas Creek	4.8	13N,11W,9C	46.8923	-113.00452	6/15/16 - 11/4/20
Nevada Creek upstream of Nevada Spring Creek	5.8	13N,11W,9C	46.89505	-112.99953	1/1/16 - 1/4/20
Nevada Spring Creek at mouth	0.1	13N,11W,9C	46.8956	-112.99938	1/1/16 - 11/4/20
Nevada Spring Creek at lower bridge	1.1	13N,11W,10B	46.89838	-112.98492	4/29/19 - 11/4/20
Nevada Spring Creek near lower fenceline	2.1	13N,11W,10A	46.89858	-112.96996	4/29/19 - 11/4/20
North Fork Blackfoot River at Ovando-Helmville Rd	2.6	14N,12W,10D	46.97976	-113.09237	1/1/16 - 11/4/20
North Fork Blackfoot River at USFS Bridge	16.3	16N,11W,35B	47.10289	-112.96086	7/27/20 - 11/5/20
North Fork Blackfoot River upstream of East Fork	27	17N,10W,28D	47.19709	-112.88103	1/1/16 - 8/21/20
North Fork Blackfoot River upstream of Dobrota Creek	34.7	18N,9W,31C	47.2669	-112.80636	1/1/16 - 8/20/20
Poorman Creek at Stemple Pass Rd Bridge	2.2	14N,9W,36D	46.91631	-112.66924	6/11/20 - 11/4/20
Poorman Creek	8	13N,8W,23B	46.8773	-112.58295	6/11/20 - 11/4/20
Sarbo Creek at mouth	0.1	17N,10W,10C	47.23612	-112.86185	1/1/16 - 8/30/17
Scotty Creek near mouth	0.2	16N,9W,8D	47.15463	-112.75708	1/1/16 - 8/9/19
Sourdough Creek at mouth	0.1	16N,9W,8D	47.15256	-112.75677	1/1/16 - 8/9/19
South Creek at mouth	0.1	17N,10W,22B	47.21288	-112.86847	1/1/16 - 9/9/16
Spaulding Creek at mouth	0.1	16N,10W,2A	47.17592	-112.8201	1/1/16 - 6/15/17
Theodore Creek at mouth	0.1	17N,10W,2D	47.25367	-112.83528	1/1/16 - 8/19/20
Wasson Creek at mouth	0.1	13N,11W,11D	46.89362	-112.94879	1/1/16 - 11/4/20



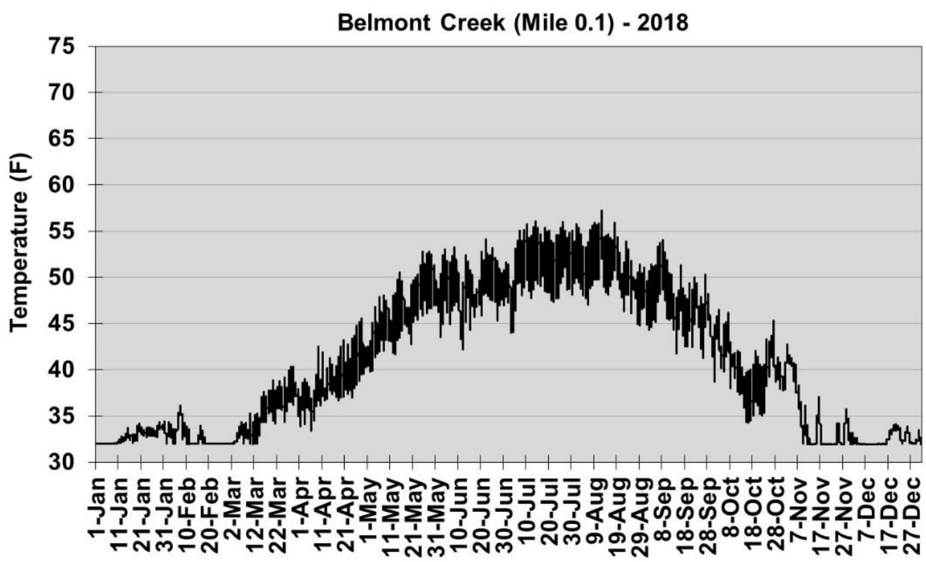
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April	47.3	36.7	41.6	2.4	5.5
May	51.9	40.4	44.7	2.2	5.0
June	58.5	43.1	49.0	2.9	8.6
July	60.1	45.4	51.7	3.6	12.6
August	61.2	45.8	52.9	3.3	10.8
September	57.3	43.5	49.5	2.9	8.6
October	51.9	40.6	46.4	2.4	5.9
November					
December					



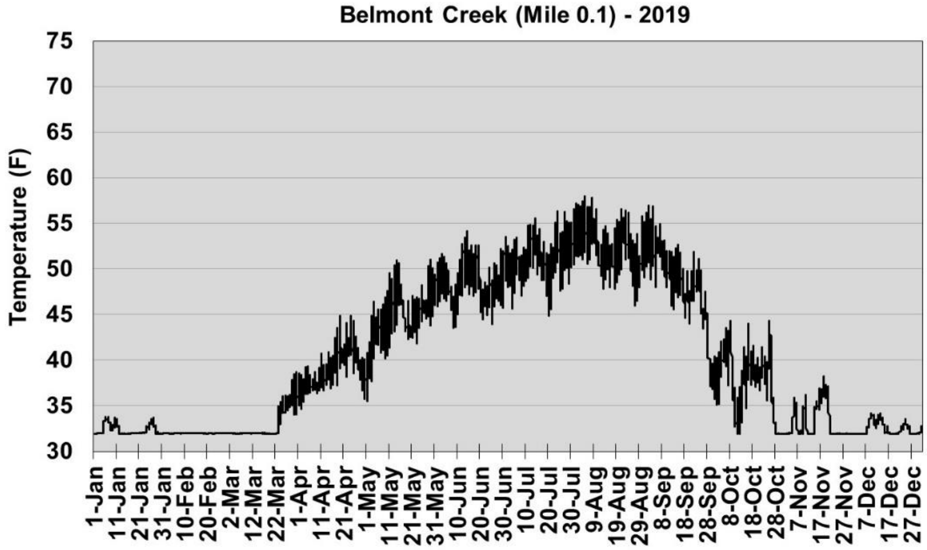
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.9	32.0	32.6	0.5	0.2
February	38.9	32.0	34.3	1.7	3.0
March	43.7	32.0	36.5	2.3	5.4
April	53.1	35.2	43.2	3.3	10.6
May	58.3	39.9	47.7	3.3	10.9
June	64.0	43.7	53.1	4.1	16.7
July	64.4	45.4	54.9	3.8	14.6
August	63.3	46.0	53.9	3.4	11.8
September	59.6	40.2	48.2	3.1	9.6
October	52.7	34.1	42.7	2.9	8.2
November	43.3	32.0	35.4	2.9	8.6
December	32.7	32.0	32.1	0.1	0.0



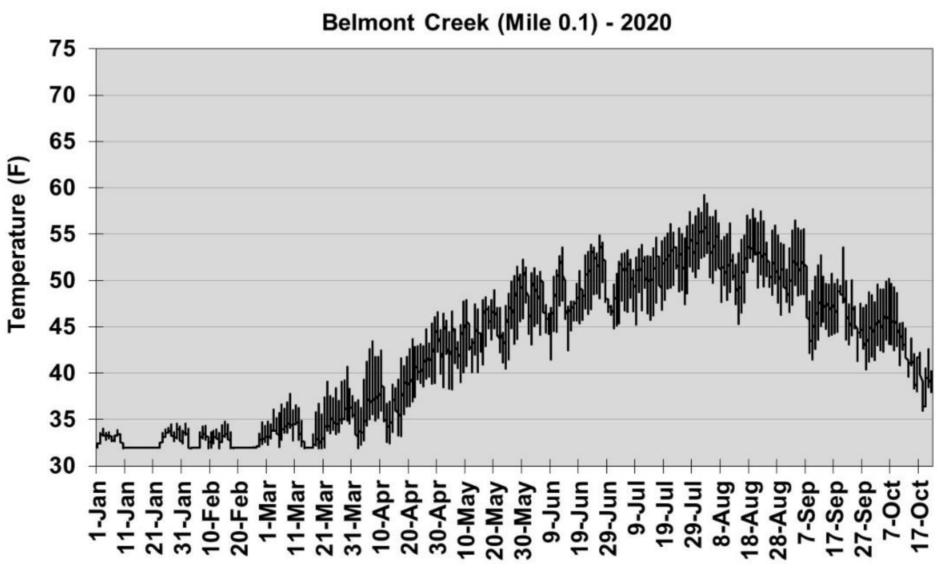
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.1	32.0	32.1	0.0	0.0
February	37.0	32.0	32.9	1.2	1.5
March	41.3	32.0	36.9	2.2	4.7
April	44.9	35.9	40.7	1.9	3.5
May	54.0	38.7	46.0	3.4	11.7
June	55.4	42.1	49.9	2.5	6.1
July	59.4	48.0	54.1	2.2	5.0
August	57.9	47.4	52.8	2.3	5.2
September	57.0	39.5	47.7	4.2	18.0
October	46.3	31.9	39.1	2.9	8.2
November	37.2	31.9	33.3	1.4	2.1
December	34.9	31.9	32.1	0.5	0.2



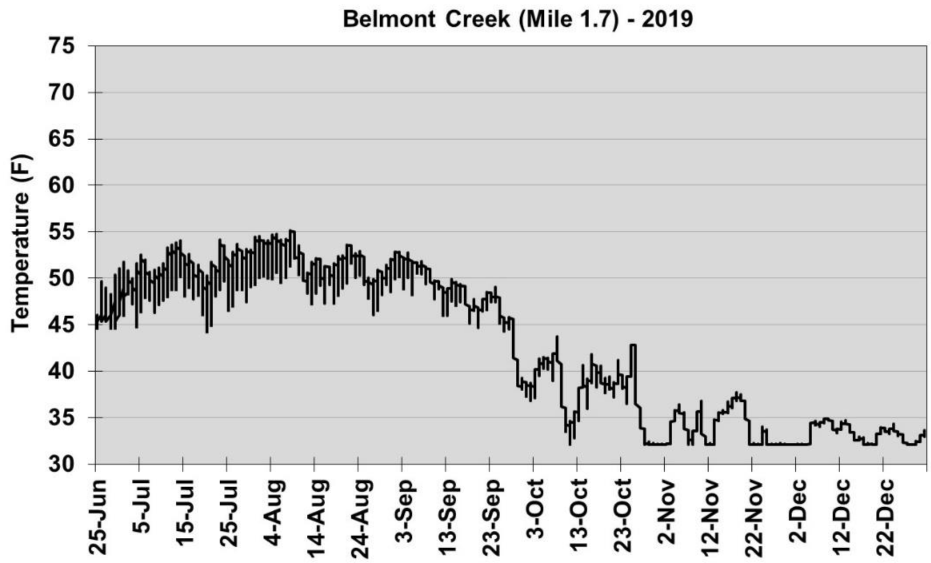
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.4	32.0	32.8	0.7	0.4
February	36.1	32.0	32.6	0.9	0.9
March	40.3	32.0	34.9	2.1	4.5
April	45.5	33.4	38.7	2.3	5.5
May	52.8	39.8	46.2	3.0	8.7
June	54.1	42.2	48.8	2.3	5.1
July	56.1	44.0	51.5	2.4	5.8
August	57.2	44.8	50.9	2.4	5.8
September	54.0	41.3	46.9	2.6	6.6
October	46.5	34.3	40.0	2.7	7.3
November	42.8	31.9	34.5	3.2	10.4
December	34.1	31.9	32.4	0.7	0.4



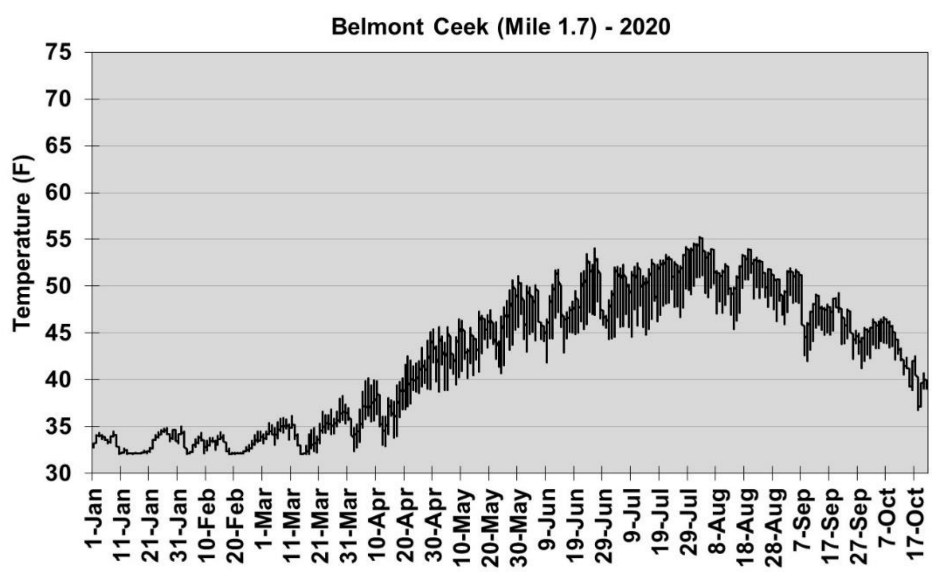
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.8	31.9	32.3	0.5	0.3
February	32.0	31.9	32.0	0.0	0.0
March	38.7	31.9	32.9	1.5	2.4
April	44.9	34.7	39.0	2.1	4.5
May	51.0	35.5	44.9	2.9	8.2
June	54.2	43.5	48.6	2.2	4.8
July	56.6	44.9	51.3	2.1	4.6
August	58.0	46.1	52.3	2.3	5.5
September	57.0	36.8	48.5	4.0	16.0
October	44.4	31.9	37.5	3.3	11.0
November	38.3	31.9	33.1	1.7	3.0
December	34.2	31.9	32.5	0.7	0.4



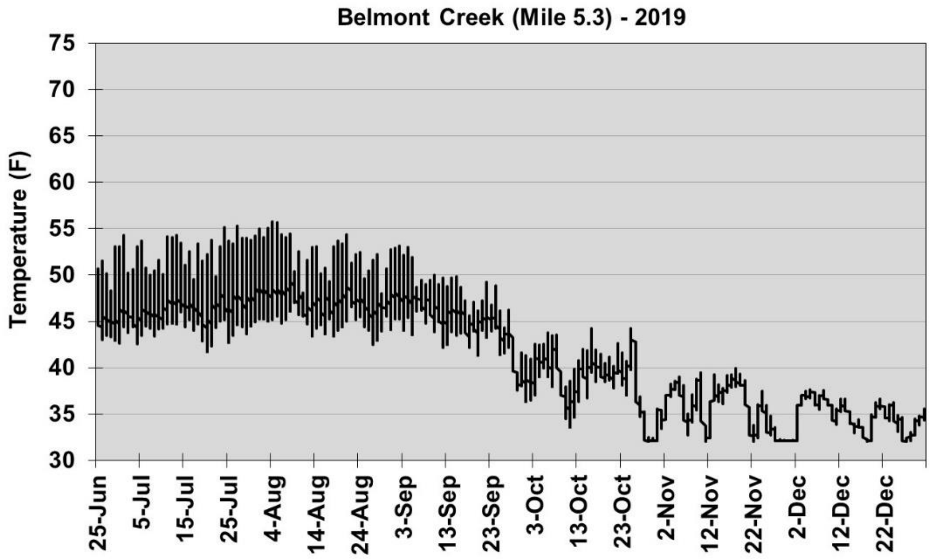
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.6	31.9	32.7	0.7	0.6
February	34.8	31.9	32.6	0.8	0.6
March	40.7	31.9	34.4	1.8	3.2
April	46.6	31.9	38.3	3.3	11.1
May	52.3	38.3	44.7	2.9	8.4
June	54.9	41.5	48.2	2.7	7.1
July	57.8	44.8	51.0	2.6	6.7
August	59.2	45.4	52.3	2.7	7.1
September	56.5	40.4	47.4	3.3	10.8
October	50.2	35.9	42.9	3.3	11.1
November					
December					



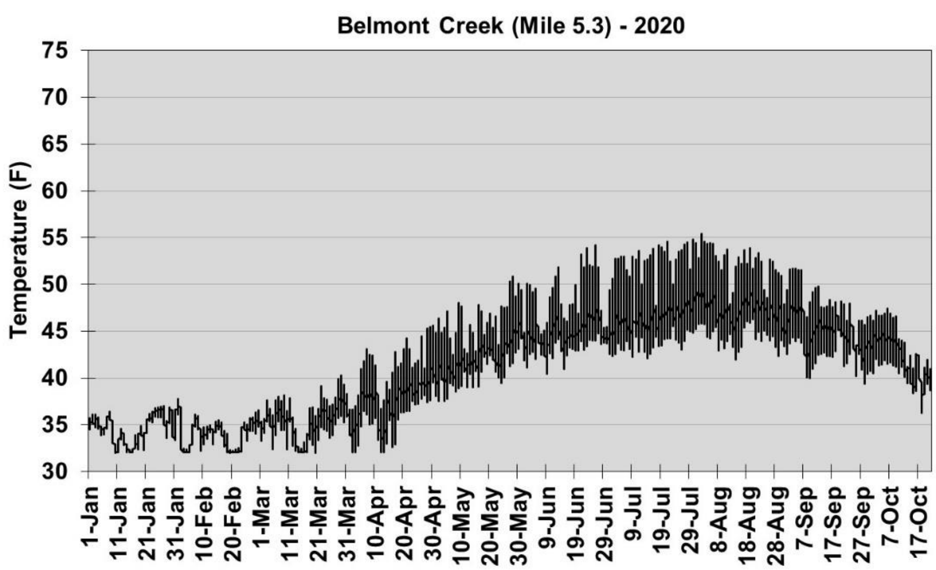
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	51.1	44.7	47.4	1.8	3.3
July	54.5	44.3	50.3	2.0	3.9
August	55.1	46.1	51.2	1.8	3.3
September	52.9	38.0	47.9	3.3	10.6
October	43.8	32.1	37.8	3.0	9.1
November	37.8	32.1	33.8	1.8	3.4
December	34.9	32.1	33.2	0.9	0.9



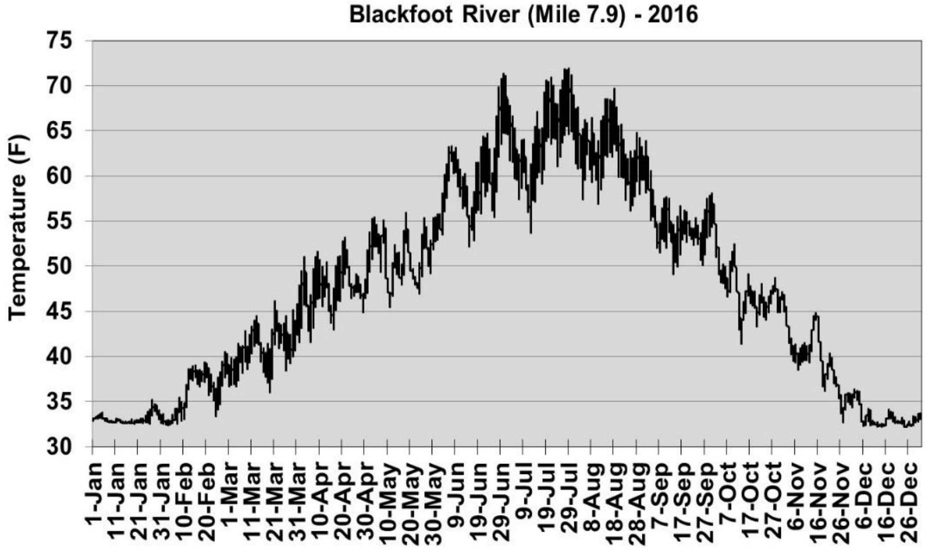
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.9	32.1	33.3	0.9	0.8
February	35.1	32.1	33.1	0.7	0.6
March	38.3	32.1	34.5	1.3	1.8
April	45.4	32.3	38.0	2.8	8.0
May	51.1	38.7	44.1	2.6	6.6
June	54.0	41.9	47.4	2.4	5.7
July	54.6	44.4	49.8	2.3	5.3
August	55.3	45.4	50.8	1.9	3.7
September	51.9	41.2	46.7	2.4	5.7
October	46.7	36.8	42.8	2.7	7.2
November					
December					



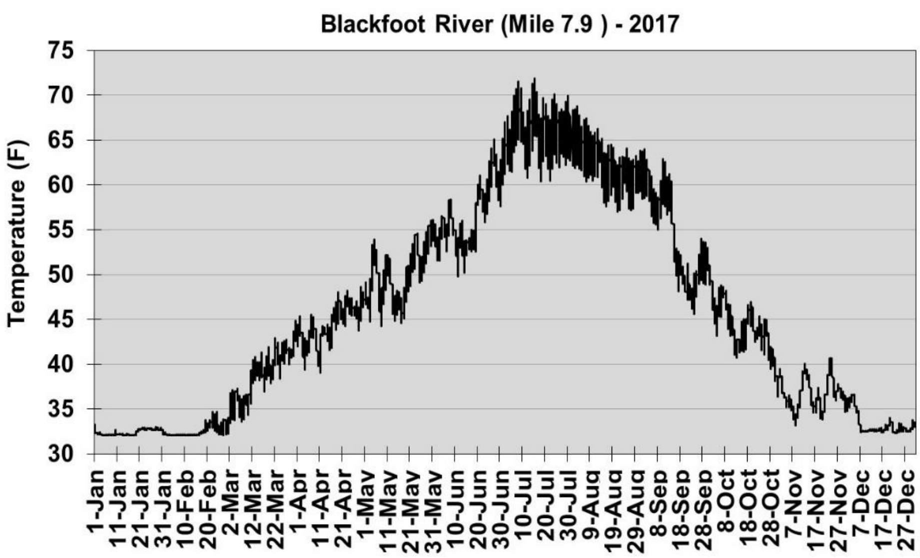
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	53.1	42.6	46.3	2.7	7.2
July	55.3	41.8	47.5	3.0	8.8
August	55.7	42.5	48.0	2.8	7.6
September	53.1	37.6	45.5	2.9	8.6
October	44.2	32.0	38.6	3.0	8.8
November	39.9	32.0	35.7	2.4	5.6
December	37.6	32.0	34.8	1.6	2.6



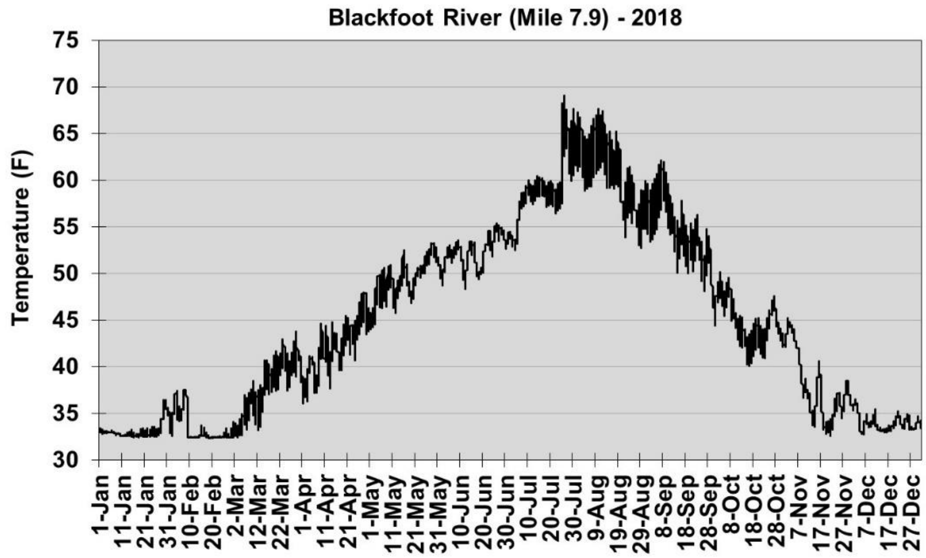
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.0	32.0	34.5	1.5	2.1
February	37.8	32.0	34.0	1.4	1.9
March	40.3	32.0	35.3	1.8	3.4
April	45.6	32.1	37.9	3.0	8.8
May	50.9	37.5	42.8	2.7	7.3
June	54.2	40.5	45.4	2.5	6.5
July	54.8	42.1	47.2	3.1	9.8
August	55.4	42.0	47.7	2.8	8.0
September	51.7	39.5	45.0	2.5	6.1
October	47.4	36.4	42.2	2.5	6.2
November					
December					



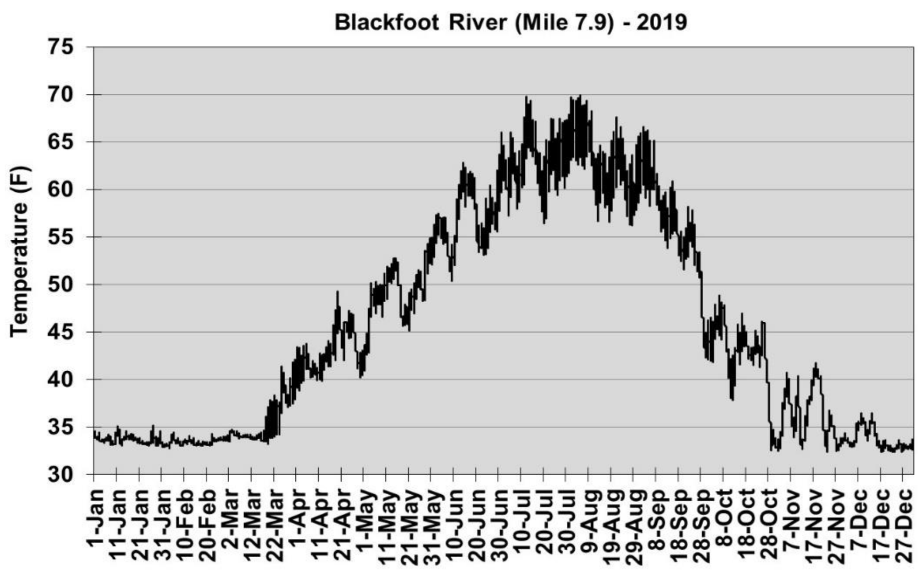
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.2	32.5	33.1	0.5	0.2
February	40.5	32.4	36.0	2.3	5.3
March	46.1	36.0	40.9	2.1	4.6
April	53.2	41.6	47.4	2.2	4.9
May	55.9	45.4	51.0	2.4	5.7
June	71.3	52.2	59.6	3.8	14.4
July	71.9	53.8	64.5	3.9	15.3
August	69.7	56.1	62.7	2.7	7.2
September	63.9	49.1	54.7	2.4	5.8
October	56.8	41.4	47.5	2.6	7.0
November	46.8	32.7	39.5	3.1	9.8
December	36.4	32.2	33.2	1.0	1.1



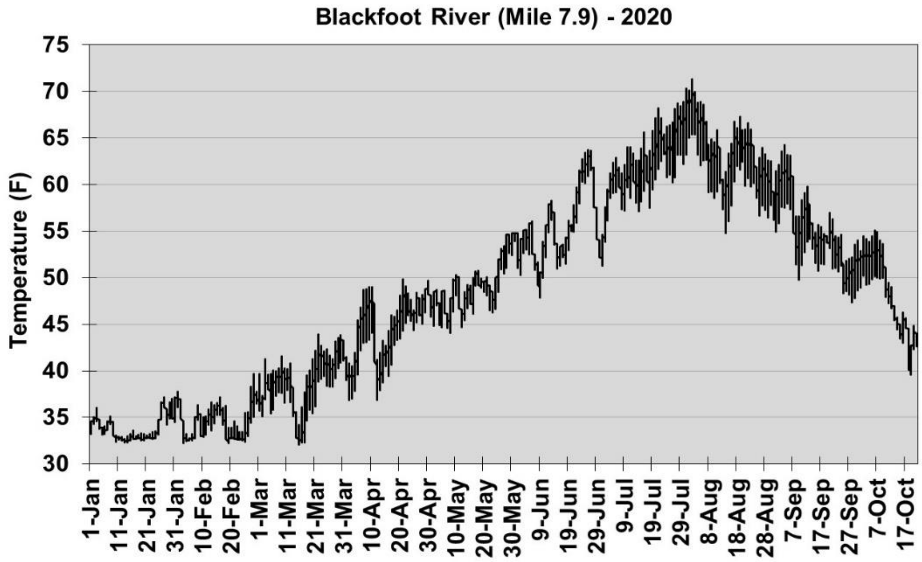
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.3	32.1	32.4	0.3	0.1
February	34.7	32.1	32.5	0.6	0.4
March	44.8	32.2	38.6	2.8	7.6
April	48.6	39.1	44.2	2.0	4.1
May	56.1	44.2	49.8	2.9	8.5
June	65.1	49.8	56.2	3.3	10.9
July	71.9	60.0	65.8	2.6	6.8
August	68.7	57.0	62.6	2.5	6.3
September	63.9	45.6	54.5	5.0	24.9
October	51.0	36.4	44.1	2.7	7.4
November	40.7	33.1	36.6	1.7	2.8
December	36.7	32.3	33.2	1.1	1.3



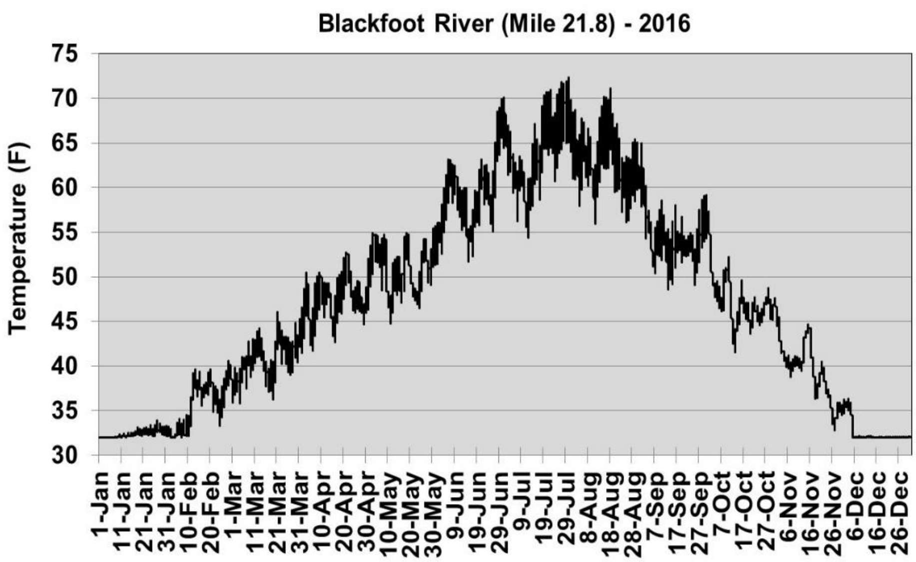
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.5	32.4	33.1	0.9	0.8
February	37.5	32.3	33.3	1.4	2.1
March	43.8	32.4	37.7	2.9	8.4
April	48.0	36.1	41.9	2.7	7.5
May	53.3	44.0	49.1	2.1	4.6
June	55.4	48.4	52.1	1.7	2.8
July	69.1	52.5	58.9	3.5	12.6
August	67.6	52.7	60.9	3.5	12.0
September	62.1	46.3	54.8	3.4	11.6
October	50.1	40.1	44.8	2.2	4.7
November	45.2	32.5	37.8	3.5	12.2
December	36.5	32.8	33.9	0.8	0.6



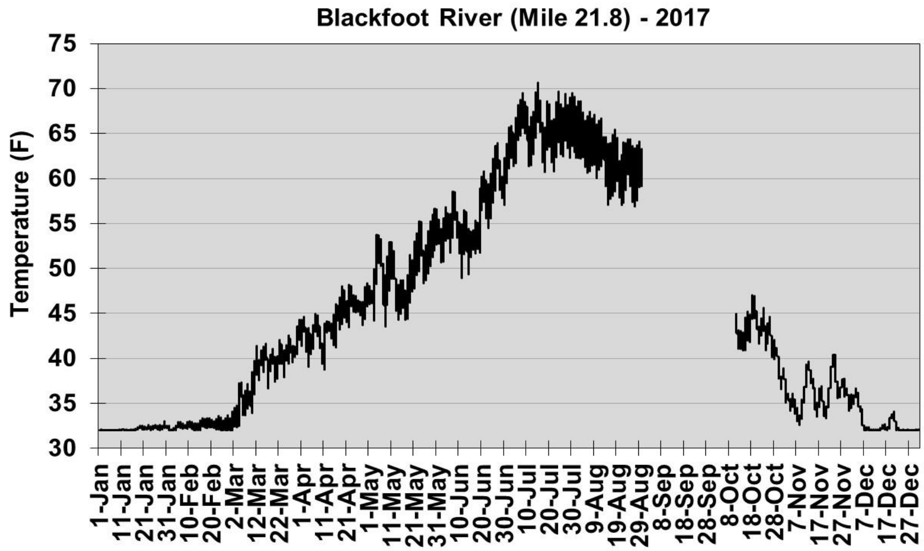
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.2	33.0	33.7	0.4	0.2
February	34.5	32.7	33.4	0.3	0.1
March	42.1	33.3	35.6	2.2	4.9
April	49.3	38.8	42.8	2.2	4.6
May	55.0	41.0	49.0	2.7	7.5
June	63.6	50.4	56.9	2.8	7.9
July	69.8	56.5	63.3	2.7	7.5
August	69.9	56.2	63.0	3.2	10.3
September	66.6	42.3	56.5	5.1	25.6
October	48.9	32.5	42.6	3.7	13.9
November	41.7	32.4	36.2	2.6	6.8
December	36.5	32.4	33.7	1.1	1.1



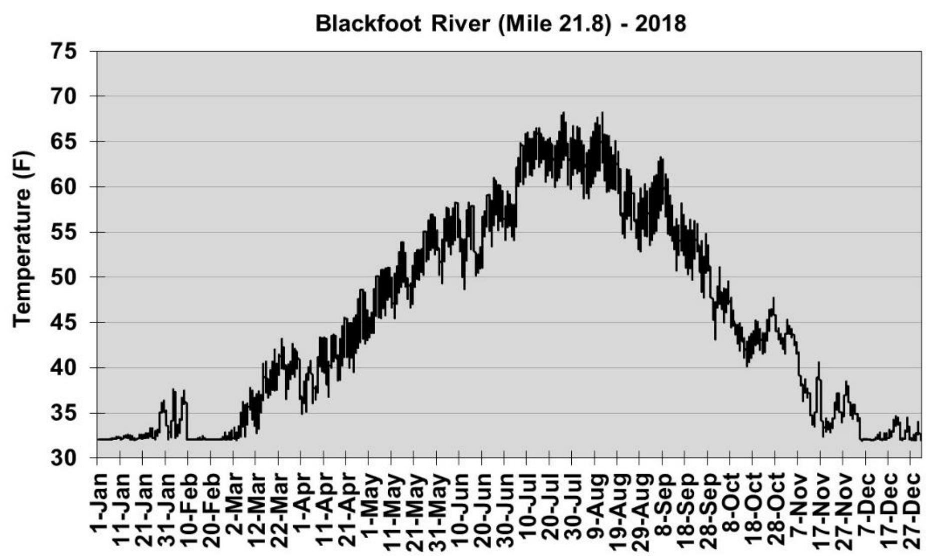
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.2	32.3	33.8	1.2	1.5
February	39.7	32.2	34.4	1.6	2.6
March	43.9	32.1	38.6	2.7	7.4
April	49.9	36.8	44.1	3.3	11.0
May	54.8	44.1	48.8	2.6	6.7
June	63.7	47.8	55.2	3.8	14.1
July	70.3	51.3	61.9	3.5	12.4
August	71.3	54.9	62.9	3.3	11.1
September	64.3	47.4	54.7	3.7	13.6
October	55.1	39.5	48.2	4.1	16.8
November					
December					



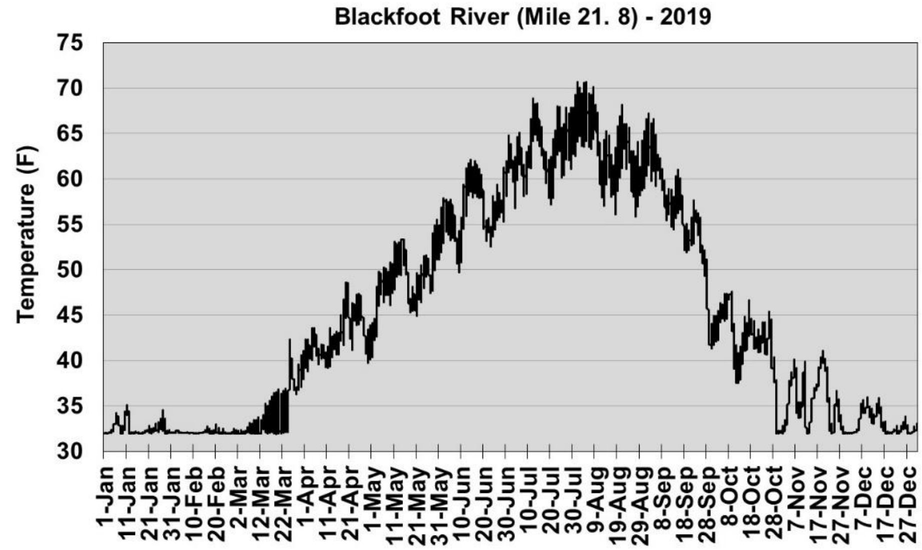
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.9	32.0	32.4	0.4	0.1
February	40.6	32.0	35.6	2.5	6.4
March	46.0	35.8	40.7	2.1	4.4
April	52.8	41.6	47.3	2.2	4.9
May	55.6	44.8	50.7	2.5	6.2
June	69.9	51.4	59.2	3.8	14.2
July	72.3	54.4	64.3	4.0	15.6
August	71.1	55.9	62.9	3.0	9.0
September	65.0	48.6	54.3	2.7	7.3
October	57.3	41.5	47.2	2.6	6.7
November	46.6	32.8	39.4	3.1	9.5
December	36.4	32.0	32.5	1.2	1.4



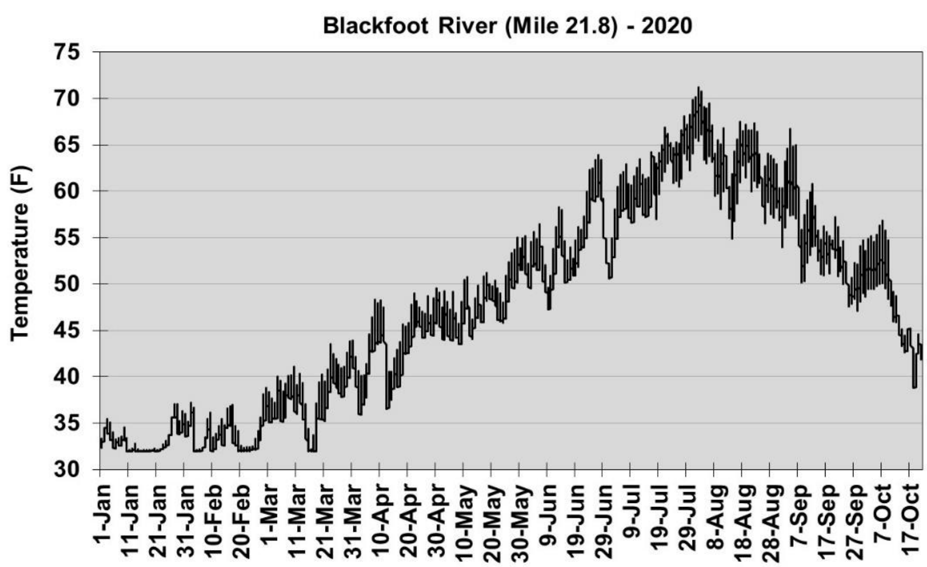
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.0	32.0	32.2	0.2	0.0
February	33.7	32.0	32.4	0.3	0.1
March	44.3	32.0	38.3	2.9	8.7
April	48.3	38.8	44.1	2.1	4.4
May	56.7	43.5	49.6	3.0	9.1
June	63.9	48.9	55.8	3.4	11.3
July	70.7	59.5	65.5	2.2	4.7
August	68.6	56.9	62.5	2.5	6.2
September					
October	47.0	36.6	42.5	2.1	4.3
November	40.4	32.6	36.1	1.8	3.2
December	36.7	32.0	32.8	1.3	1.6



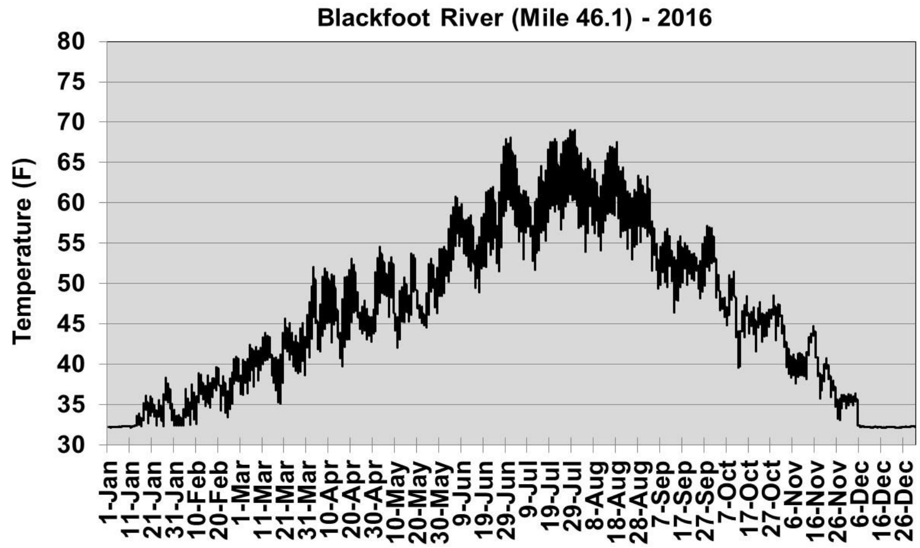
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.4	32.0	32.6	1.0	0.9
February	37.6	32.0	32.8	1.4	1.8
March	43.2	32.0	37.1	3.0	9.0
April	48.6	34.9	41.3	3.0	9.1
May	56.9	43.4	50.0	3.1	9.6
June	61.0	48.7	54.9	2.7	7.2
July	68.2	54.1	62.6	3.0	8.8
August	68.2	52.9	60.7	3.5	12.0
September	63.3	45.3	54.6	3.6	12.9
October	51.1	40.2	44.6	2.1	4.4
November	45.4	32.3	37.5	3.5	12.3
December	35.9	31.9	32.8	1.0	1.0



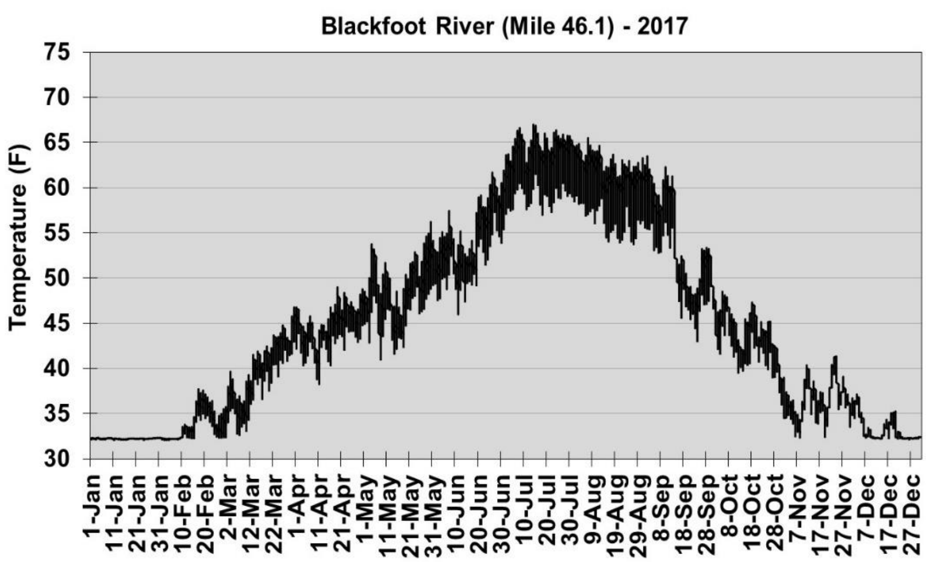
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.1	31.9	32.5	0.7	0.5
February	33.0	31.9	32.1	0.1	0.0
March	42.3	31.9	34.1	2.7	7.2
April	48.6	38.9	42.6	2.2	4.7
May	55.5	40.4	48.8	2.8	8.1
June	62.1	49.7	56.7	2.8	8.1
July	69.3	56.8	63.3	2.6	6.7
August	70.7	55.9	63.2	3.3	11.1
September	67.2	41.4	56.3	5.4	29.2
October	47.6	32.0	42.0	3.6	13.3
November	41.1	32.0	35.5	2.7	7.5
December	36.0	31.9	33.0	1.2	1.4



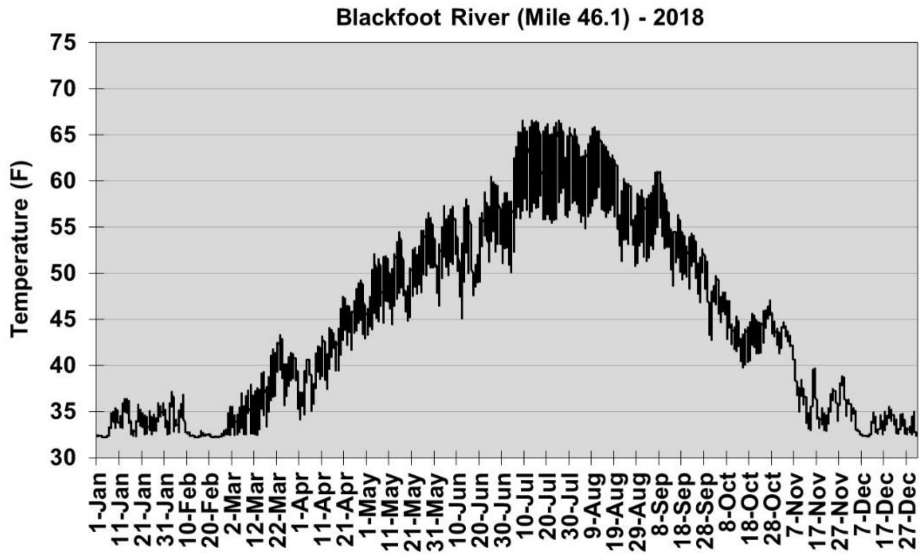
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.0	32.0	33.2	1.3	1.7
February	38.8	31.9	33.8	1.6	2.7
March	43.9	31.9	38.0	2.8	7.8
April	49.6	35.9	43.7	3.3	10.8
May	55.0	43.5	48.5	2.6	6.6
June	63.9	47.2	54.8	3.8	14.5
July	69.8	50.6	61.4	3.7	13.8
August	71.2	54.9	62.9	3.3	11.0
September	66.7	47.1	54.5	4.0	16.0
October	56.9	38.8	47.6	4.4	19.3
November					
December					



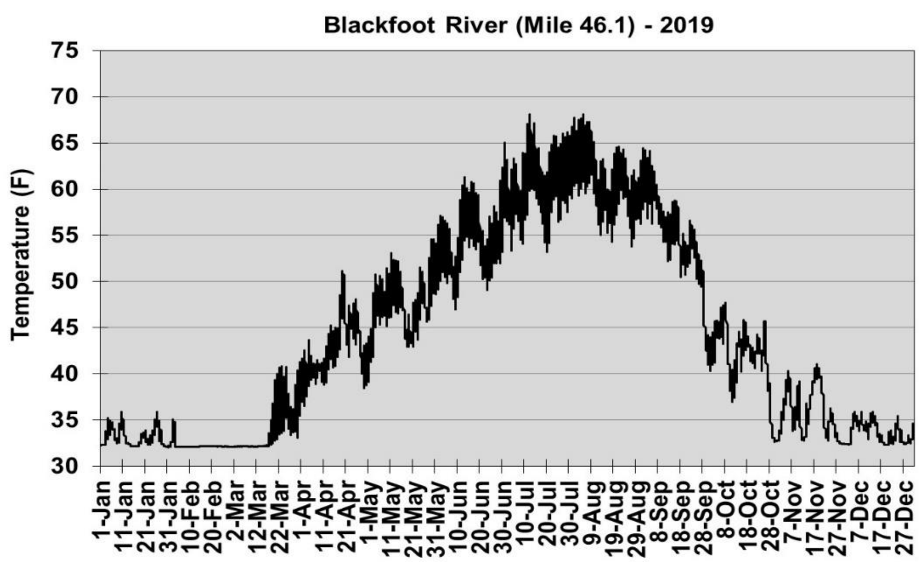
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.3	32.1	33.5	1.4	2.1
February	41.0	32.4	36.1	2.1	4.5
March	46.2	35.2	40.8	2.2	4.7
April	53.0	39.7	46.4	2.8	7.7
May	54.6	42.1	48.6	2.7	7.3
June	67.9	48.9	56.4	3.9	15.2
July	69.0	51.7	61.2	3.9	15.0
August	67.5	52.9	60.4	3.0	9.2
September	63.3	46.4	53.1	2.6	7.0
October	55.8	39.6	46.5	2.6	7.0
November	46.0	33.1	39.3	2.9	8.3
December	36.4	32.1	32.7	1.2	1.4



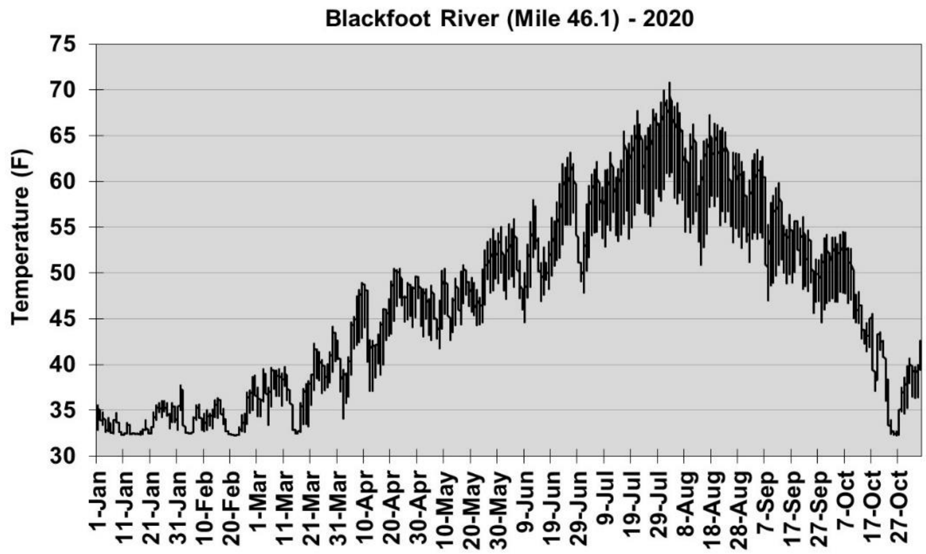
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.1	32.2	0.0	0.0
February	37.7	32.1	33.6	1.5	2.4
March	46.8	32.4	39.1	3.3	10.9
April	49.0	38.3	44.2	2.0	4.1
May	56.2	41.0	48.1	3.1	9.4
June	61.7	46.0	53.5	3.3	11.1
July	67.0	55.5	62.1	2.5	6.5
August	65.5	53.7	60.1	2.7	7.3
September	63.5	43.1	53.1	5.0	25.4
October	49.0	36.1	43.3	2.6	6.6
November	41.3	32.3	36.3	1.9	3.8
December	37.1	32.2	33.2	1.3	1.7



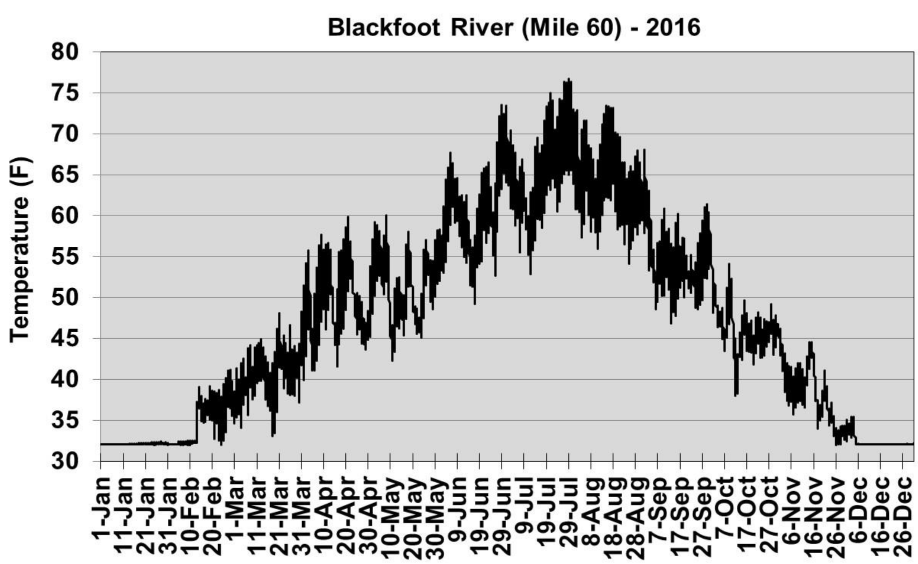
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.4	32.2	33.8	1.1	1.3
February	37.2	32.2	33.0	1.2	1.3
March	43.3	32.4	36.7	2.9	8.2
April	49.2	34.2	41.7	3.6	12.8
May	56.6	43.4	49.4	2.9	8.4
June	60.4	45.2	53.0	3.1	9.8
July	66.6	50.2	60.3	3.8	14.3
August	65.9	50.8	58.8	3.6	12.6
September	61.0	43.3	53.3	3.6	12.6
October	49.7	39.8	44.4	2.0	4.1
November	44.7	32.9	37.4	3.3	10.6
December	36.3	32.3	33.6	1.0	1.0



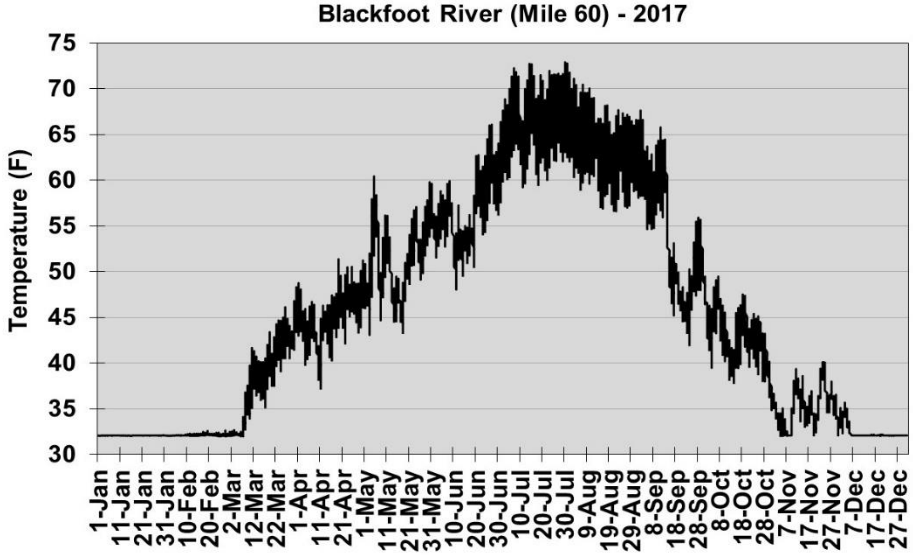
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.9	32.0	33.1	1.0	0.9
February	35.1	32.1	32.2	0.4	0.1
March	41.3	32.1	33.9	2.4	5.9
April	51.1	36.5	42.6	2.9	8.2
May	54.6	39.1	47.5	3.0	8.9
June	62.4	47.0	54.3	3.2	10.1
July	68.1	53.3	60.8	3.2	10.3
August	68.1	53.9	61.0	3.2	10.0
September	64.4	41.0	55.0	4.9	24.1
October	47.7	32.6	41.7	3.6	13.1
November	41.0	32.4	35.7	2.5	6.4
December	35.9	32.3	33.6	1.1	1.2



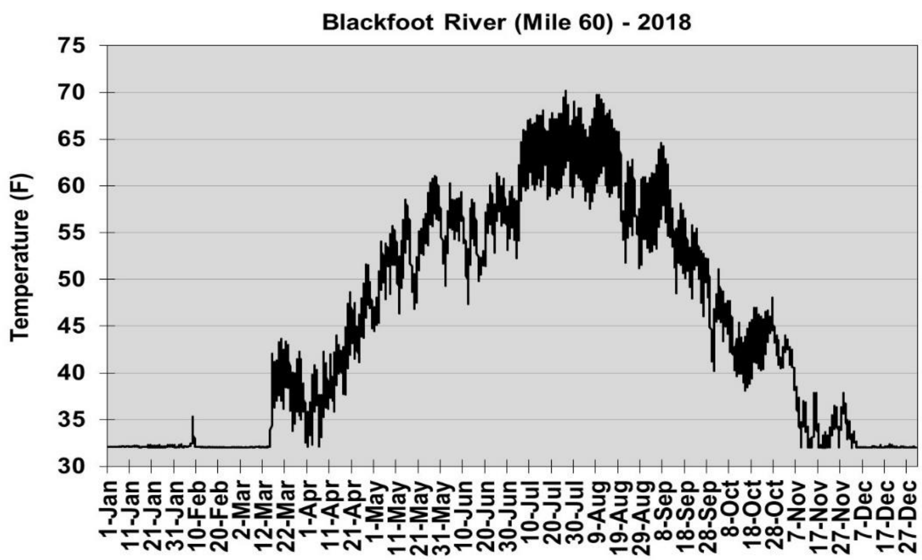
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.0	32.3	33.5	1.1	1.2
February	38.8	32.2	34.1	1.6	2.5
March	44.2	32.4	37.5	2.7	7.2
April	50.5	34.1	44.0	3.8	14.2
May	55.0	41.8	47.5	2.8	8.0
June	63.1	44.7	52.7	3.9	15.6
July	69.9	47.8	59.3	4.2	17.8
August	70.8	50.9	60.5	4.0	16.0
September	63.5	44.6	53.2	3.9	15.5
October	54.5	32.2	42.9	6.5	41.8
November	42.6	36.4	38.8	1.3	1.8
December					



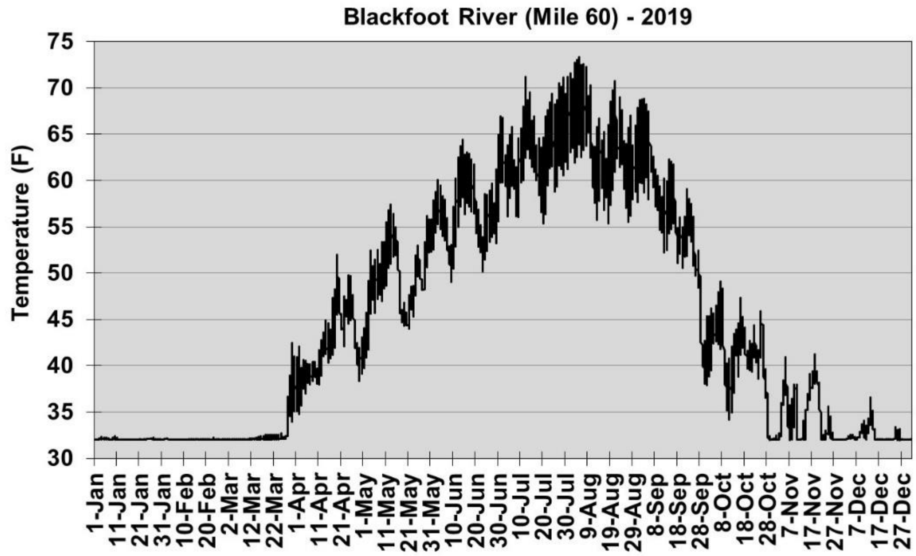
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.4	32.0	32.1	0.1	0.0
February	41.2	32.0	34.7	2.6	6.9
March	48.3	33.0	40.4	2.8	8.1
April	59.8	39.9	49.2	4.1	16.9
May	60.0	42.3	51.2	3.8	14.8
June	73.6	49.2	60.0	4.7	22.5
July	76.7	52.9	65.4	5.0	25.3
August	73.5	54.1	64.1	4.1	16.6
September	68.1	46.8	54.5	3.6	13.2
October	57.7	37.9	46.3	3.2	10.1
November	46.2	32.0	38.1	3.5	11.9
December	35.4	32.0	32.3	0.7	0.5



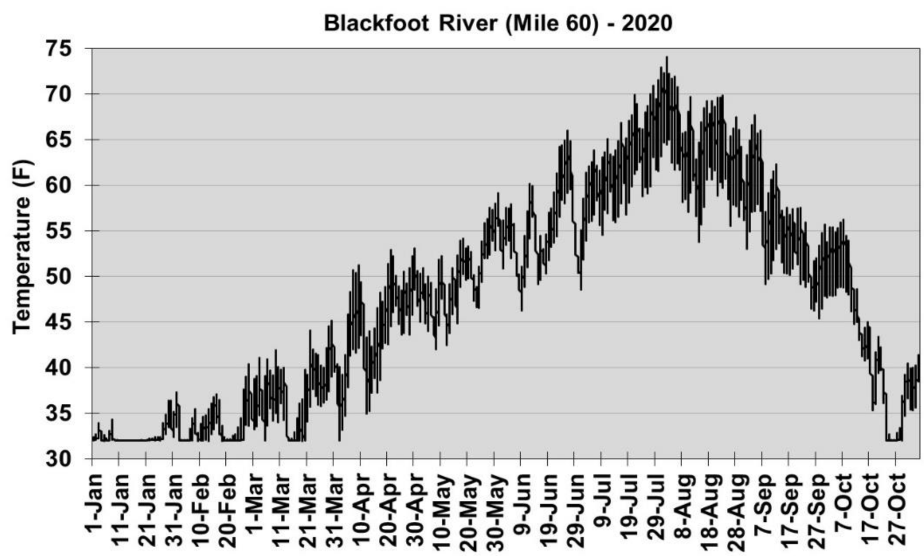
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.1	32.0	32.1	0.0	0.0
February	32.6	32.0	32.1	0.1	0.0
March	48.3	32.0	38.4	4.3	18.6
April	51.4	37.3	45.1	2.6	7.0
May	60.4	43.1	51.2	3.9	14.9
June	66.1	48.0	56.4	3.6	13.2
July	72.9	57.6	66.2	3.4	11.6
August	71.8	56.6	63.6	3.3	11.1
September	67.6	42.0	54.1	6.5	41.9
October	49.5	34.9	42.6	3.0	8.9
November	40.1	32.0	35.1	2.1	4.2
December	35.7	32.0	32.4	0.7	0.5



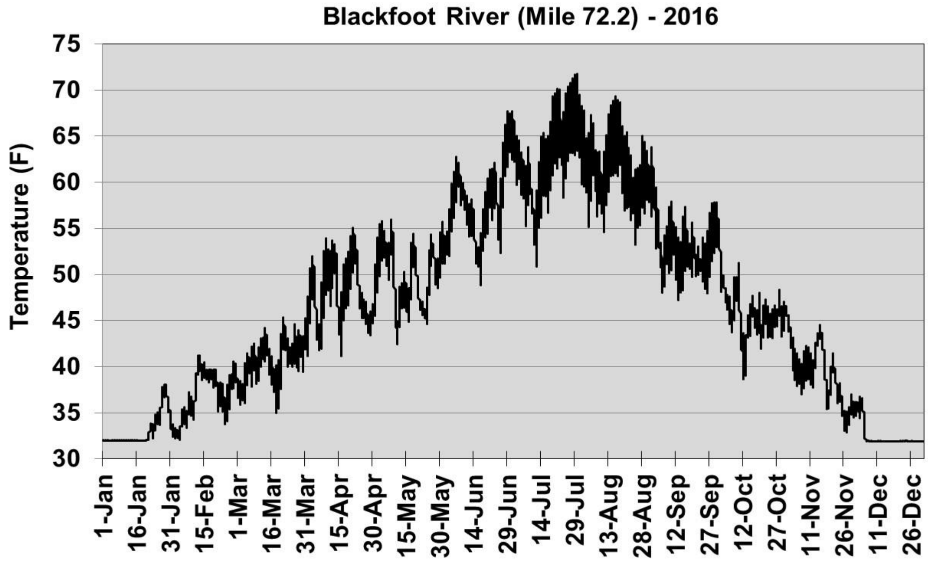
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.0	32.1	0.1	0.0
February	35.3	32.0	32.1	0.3	0.1
March	43.7	32.0	35.4	3.7	13.5
April	51.6	32.1	41.2	4.7	21.7
May	61.1	44.4	53.0	3.9	15.0
June	61.4	47.3	55.3	2.8	8.1
July	70.2	52.3	62.6	3.6	13.2
August	69.8	51.2	61.1	4.2	17.9
September	64.6	41.2	54.1	4.6	20.8
October	51.1	38.1	43.6	2.5	6.1
November	44.0	32.0	35.8	3.5	12.0
December	34.8	32.0	32.2	0.4	0.2



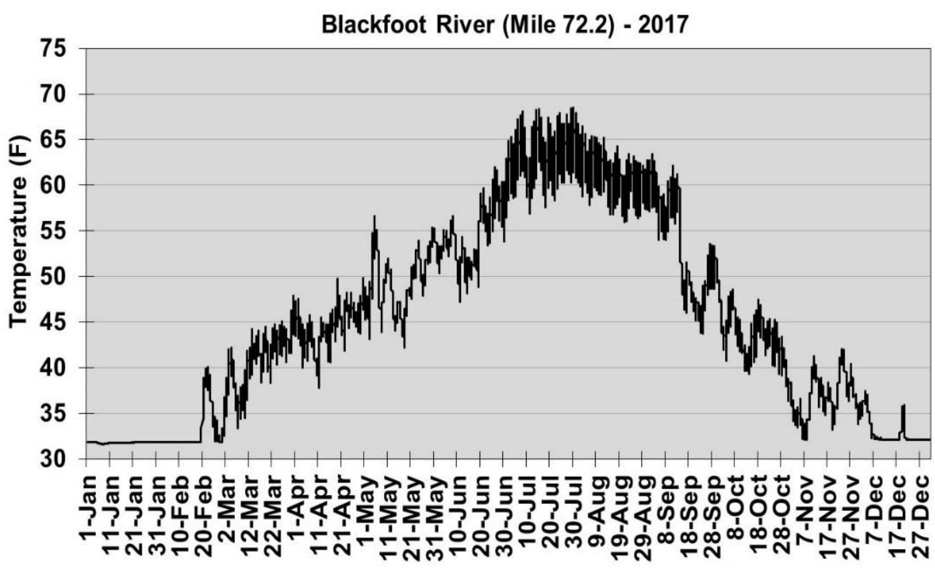
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.4	32.0	32.1	0.1	0.0
February	32.3	32.0	32.1	0.0	0.0
March	42.5	32.0	32.7	1.8	3.4
April	52.0	34.8	42.2	3.5	12.4
May	57.4	39.7	49.4	3.7	13.8
June	65.0	49.1	56.6	3.3	10.8
July	71.2	55.3	63.2	3.4	11.9
August	73.3	55.3	63.9	4.0	16.2
September	68.9	38.0	56.0	6.3	39.6
October	49.1	32.0	40.6	4.0	16.0
November	41.3	32.0	34.5	2.6	6.9
December	36.6	31.9	32.4	0.7	0.5



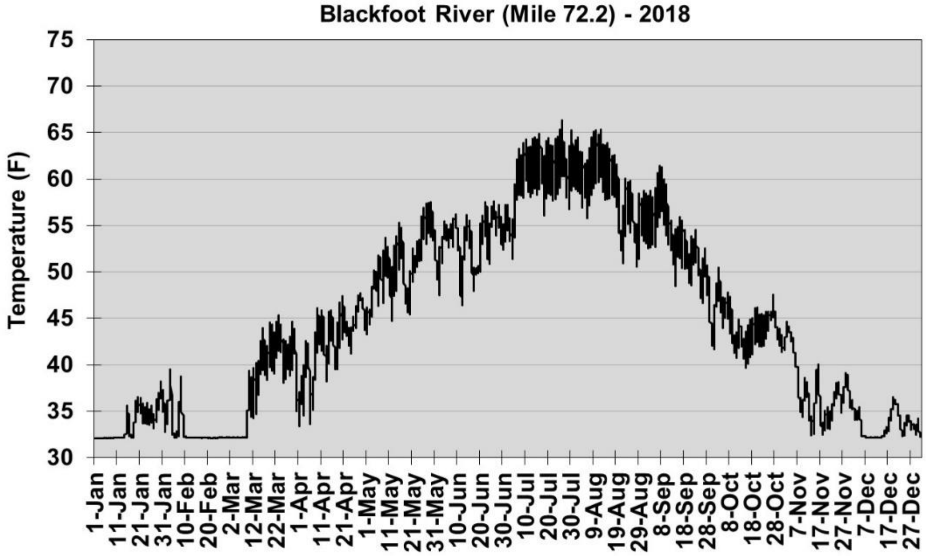
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.4	32.0	32.5	0.9	0.8
February	40.4	32.0	33.5	1.8	3.1
March	45.2	32.0	36.8	3.2	10.0
April	53.1	32.0	44.1	4.7	22.2
May	59.1	42.1	49.7	3.6	13.0
June	66.0	46.3	55.2	4.1	16.6
July	73.0	48.5	61.7	4.4	18.9
August	74.1	53.9	63.6	4.0	16.1
September	67.7	45.4	54.6	4.7	22.1
October	56.3	32.0	42.6	7.4	54.9
November	41.4	35.3	38.0	1.5	2.2
December					



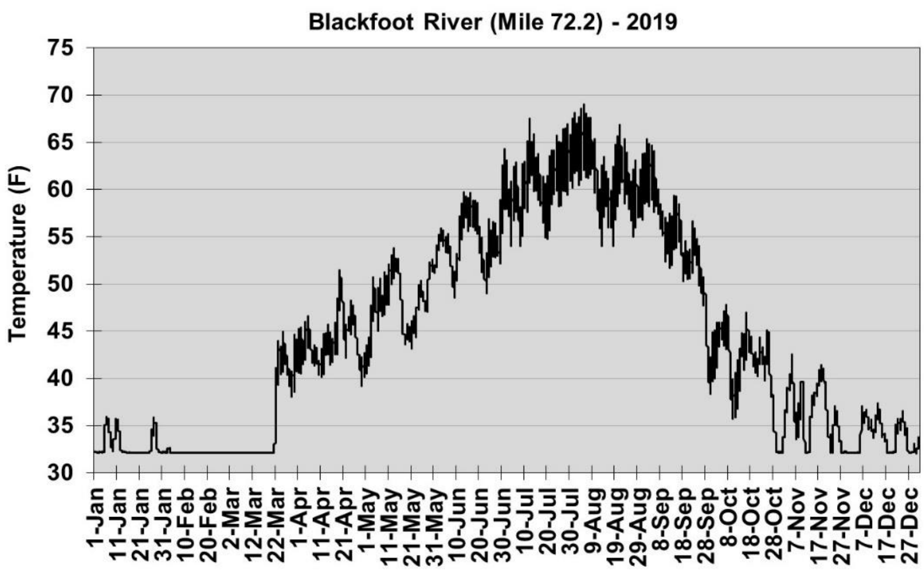
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.1	32.0	33.0	1.7	2.8
February	41.2	32.1	36.9	2.5	6.3
March	45.3	35.0	40.5	2.1	4.5
April	55.1	41.2	47.9	3.2	10.5
May	55.9	42.4	49.7	3.2	9.9
June	67.7	48.9	57.4	3.8	14.6
July	71.8	50.8	62.7	4.2	17.8
August	69.3	53.3	61.5	3.3	10.9
September	63.8	47.2	53.1	2.9	8.5
October	55.9	38.7	46.0	2.6	7.0
November	45.6	32.8	39.1	3.0	8.7
December	36.8	31.9	32.4	1.3	1.6



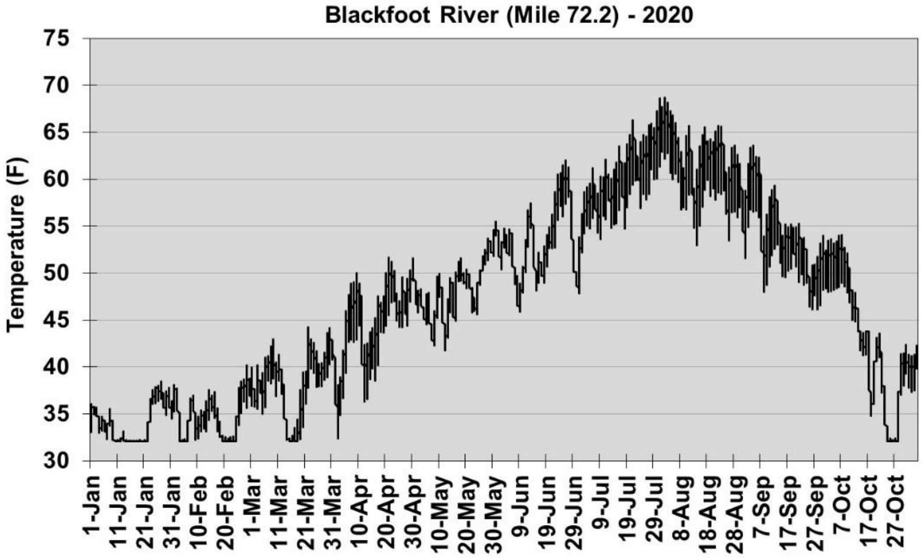
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	31.9	31.6	31.8	0.1	0.0
February	40.1	31.8	33.0	2.2	5.1
March	47.9	32.5	40.5	3.1	9.5
April	49.8	37.8	44.4	2.2	4.9
May	56.6	42.2	49.3	3.2	10.4
June	62.0	47.2	54.2	3.1	9.8
July	68.5	56.5	63.1	2.7	7.4
August	66.8	55.9	61.0	2.3	5.2
September	63.4	43.7	53.1	5.4	28.9
October	49.5	36.3	43.2	2.5	6.5
November	42.1	32.1	36.7	2.3	5.4
December	37.5	32.1	32.9	1.4	2.0



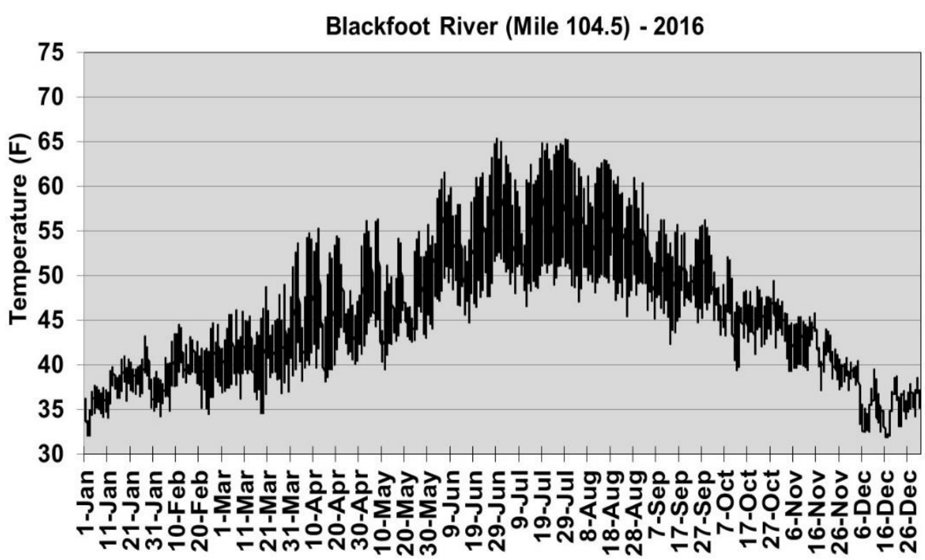
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.2	32.1	33.5	1.6	2.7
February	39.5	32.1	32.8	1.5	2.2
March	45.3	32.1	38.0	4.3	18.2
April	47.7	33.4	42.2	3.4	11.5
May	57.5	43.3	50.5	3.3	10.9
June	57.6	46.4	53.1	2.5	6.0
July	66.3	51.4	60.1	3.0	9.1
August	65.3	50.6	58.9	3.4	11.8
September	61.4	42.0	53.1	3.9	15.0
October	50.4	39.6	44.2	2.0	3.9
November	44.7	32.4	37.3	3.1	9.8
December	36.5	32.1	33.4	1.2	1.5



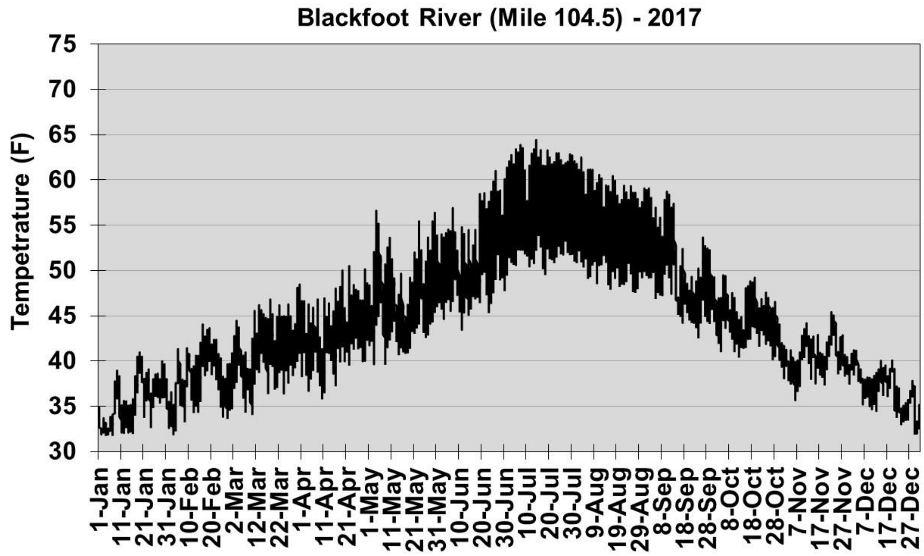
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.0	32.1	32.9	1.1	1.3
February	32.6	32.1	32.1	0.1	0.0
March	44.9	32.1	35.0	4.4	19.2
April	51.5	39.2	43.9	2.4	5.6
May	53.8	40.5	48.0	3.0	9.2
June	62.6	48.5	54.6	2.6	6.8
July	67.5	54.0	60.8	2.9	8.3
August	69.0	54.0	61.4	3.3	10.6
September	65.3	38.4	54.4	5.5	30.2
October	47.8	32.1	41.3	3.8	14.7
November	42.6	32.1	35.9	3.0	9.0
December	37.4	32.0	33.8	1.6	2.6



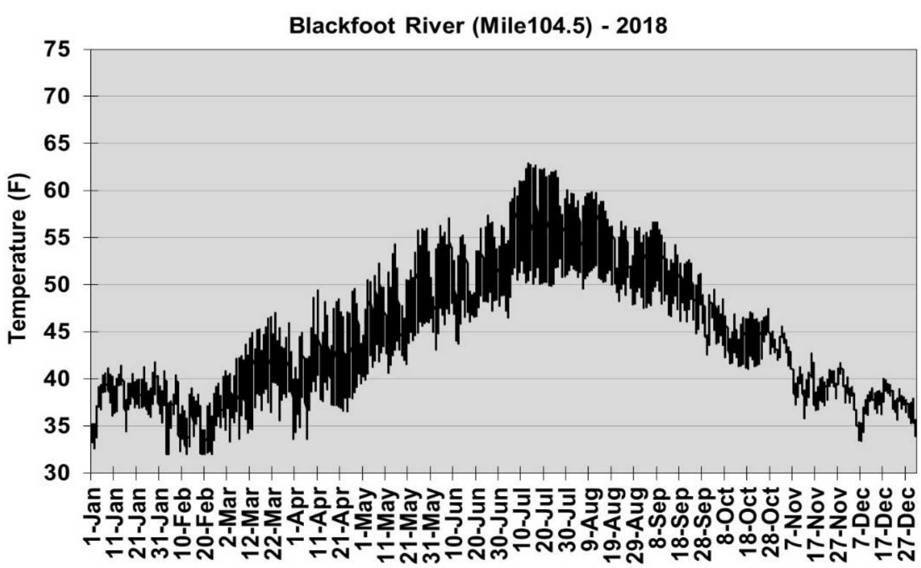
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.4	32.0	34.0	1.9	3.7
February	40.2	32.0	34.5	2.1	4.3
March	44.2	32.1	38.0	3.2	10.4
April	51.6	32.4	44.3	4.2	17.7
May	55.5	41.8	48.3	2.9	8.6
June	62.0	45.9	53.2	3.6	12.9
July	68.6	47.8	59.3	3.6	12.7
August	68.7	53.0	60.9	3.2	10.2
September	63.6	46.2	53.4	3.9	15.2
October	54.0	32.0	42.8	6.7	45.5
November	42.3	37.3	39.7	1.2	1.4
December					



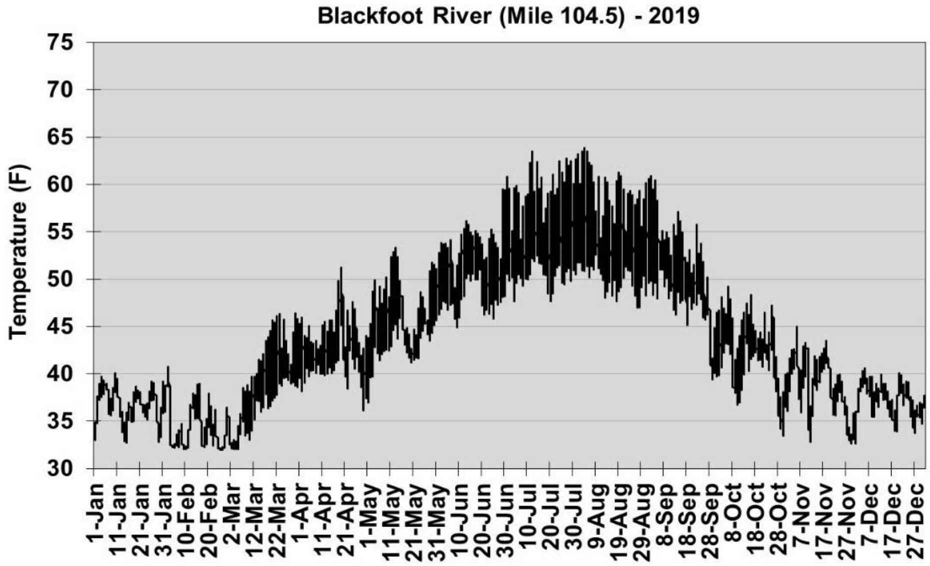
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	43.2	32.1	37.2	2.0	4.2
February	44.6	34.3	39.2	2.2	4.8
March	48.9	34.6	41.1	2.7	7.4
April	55.3	38.2	45.2	4.0	15.7
May	56.3	39.5	47.2	3.7	13.8
June	65.4	44.0	53.3	4.4	19.4
July	65.3	46.6	55.7	4.5	20.2
August	62.9	45.4	54.2	4.0	16.3
September	60.3	42.3	49.9	3.0	9.1
October	52.2	39.4	45.8	2.3	5.1
November	47.1	37.1	41.6	2.2	4.6
December	40.4	31.9	35.7	2.1	4.4



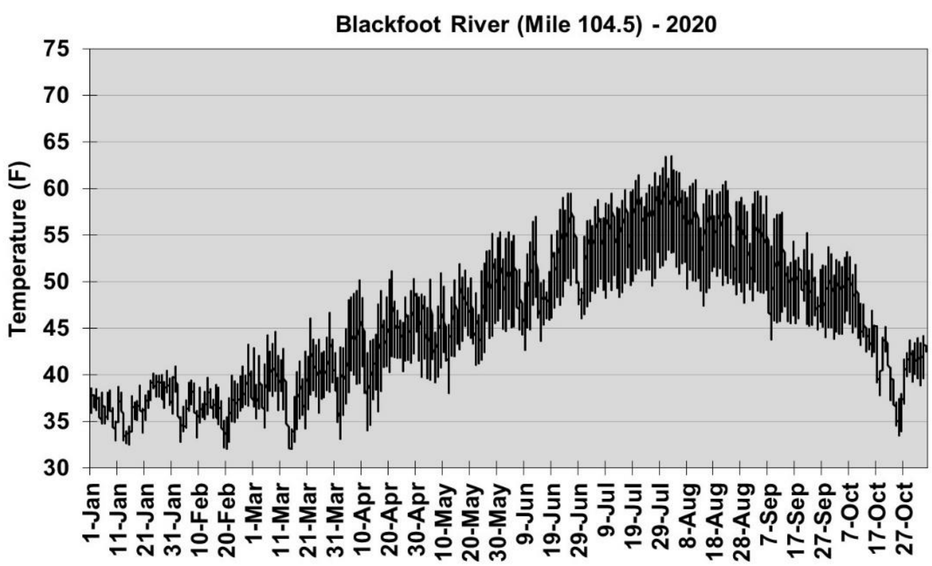
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	41.0	31.9	35.5	2.4	5.7
February	44.0	31.9	37.7	2.7	7.5
March	48.5	34.1	40.7	2.9	8.2
April	50.5	35.9	42.9	2.9	8.5
May	56.6	39.6	46.8	3.7	13.8
June	61.0	43.4	51.1	3.7	13.5
July	64.4	49.6	56.8	3.8	14.6
August	62.5	47.7	54.4	3.5	12.1
September	59.1	42.7	49.7	3.8	14.8
October	49.5	39.4	44.2	2.1	4.5
November	45.4	35.7	40.3	1.8	3.2
December	41.2	32.0	36.7	2.2	4.8



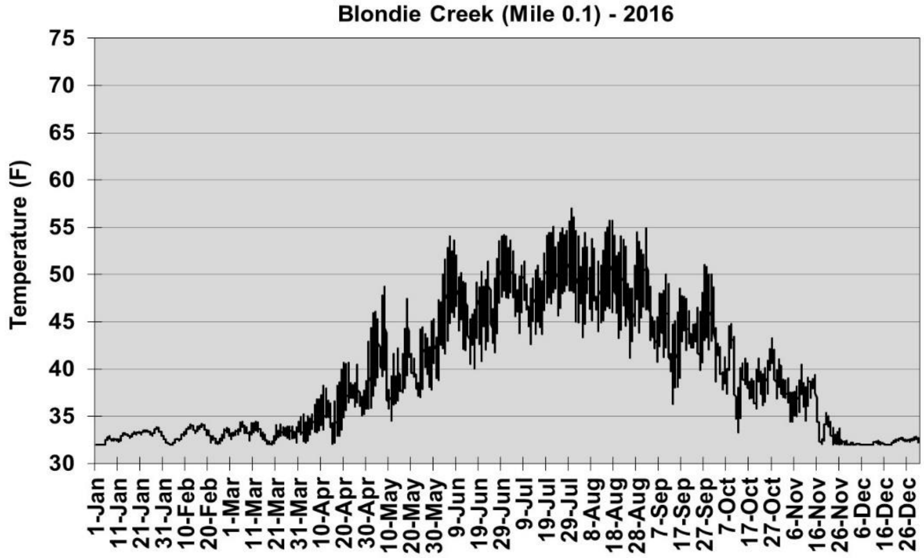
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	41.8	32.7	38.1	1.7	3.1
February	40.9	32.0	35.8	2.3	5.3
March	47.0	33.4	39.8	2.9	8.3
April	49.6	33.6	41.3	3.4	11.2
May	55.9	39.9	46.9	3.6	12.7
June	57.4	43.2	50.1	3.1	9.3
July	62.9	46.5	55.0	3.6	13.3
August	59.8	48.0	53.6	2.9	8.4
September	56.6	42.6	50.0	2.9	8.4
October	49.5	41.0	44.5	1.8	3.1
November	45.5	35.8	40.1	2.1	4.3
December	40.2	33.4	37.4	1.4	2.0



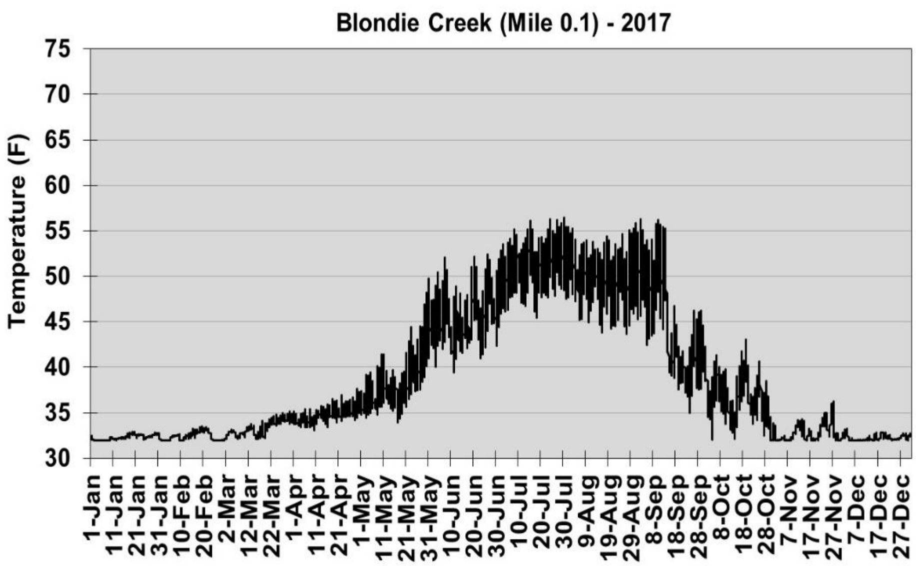
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	40.1	32.7	36.7	1.7	2.9
February	40.7	32.0	34.2	2.1	4.6
March	46.4	32.0	38.4	3.7	13.8
April	51.2	36.2	42.5	2.4	5.8
May	53.3	37.0	45.5	3.0	9.1
June	59.4	44.9	50.9	2.8	7.8
July	63.5	47.6	54.8	3.6	13.2
August	63.9	47.0	54.3	3.7	13.8
September	60.9	39.4	50.2	4.0	16.0
October	49.2	33.5	42.1	3.1	9.7
November	45.0	32.6	38.7	2.8	7.9
December	40.6	32.6	37.3	1.6	2.5



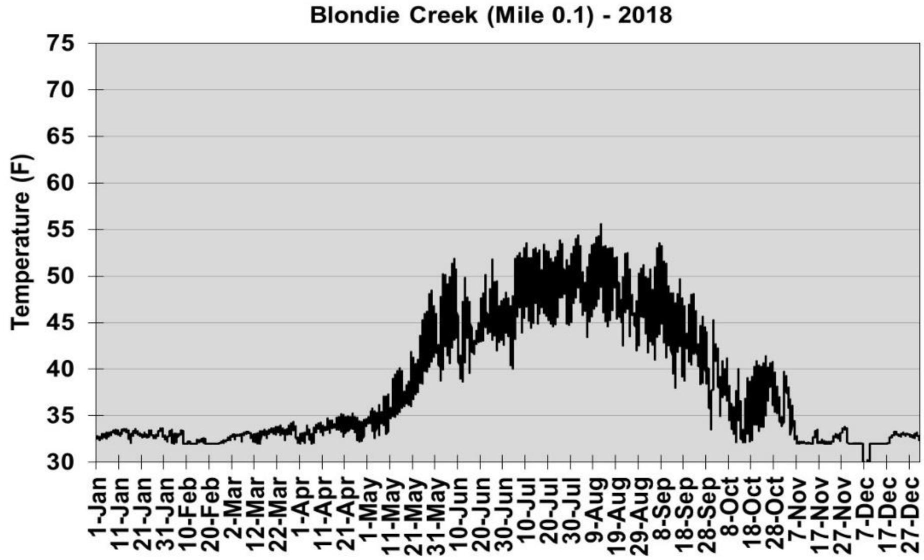
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	40.5	32.5	36.8	1.8	3.2
February	43.3	32.1	36.8	1.9	3.8
March	46.7	32.1	38.8	2.9	8.7
April	51.1	33.2	42.8	3.8	14.2
May	55.3	38.0	45.9	3.5	12.3
June	59.5	42.7	50.0	3.6	12.6
July	63.4	46.5	54.4	3.5	12.3
August	63.5	47.4	54.5	3.4	11.7
September	59.7	43.8	50.1	3.4	11.8
October	53.2	33.5	43.4	4.5	20.0
November	44.2	38.9	41.7	1.5	2.3
December					



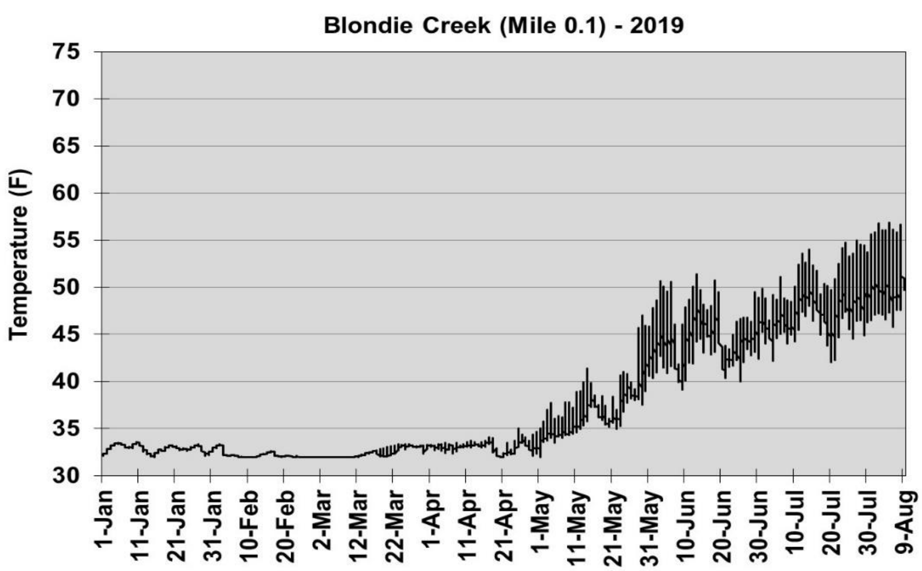
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.3	32.0	33.2	0.6	0.3
February	34.7	32.0	33.2	0.8	0.7
March	37.8	32.0	33.6	1.1	1.3
April	43.8	32.4	35.8	2.3	5.1
May	51.3	35.3	40.9	3.3	10.7
June	56.5	41.4	48.3	3.4	11.5
July	57.0	45.1	50.5	2.6	6.5
August	59.2	41.0	50.0	3.2	10.2
September	54.9	36.3	44.3	2.8	7.9
October	48.7	33.3	39.6	2.4	5.8
November	40.4	32.0	35.2	2.4	6.0
December	32.8	32.0	32.2	0.3	0.1



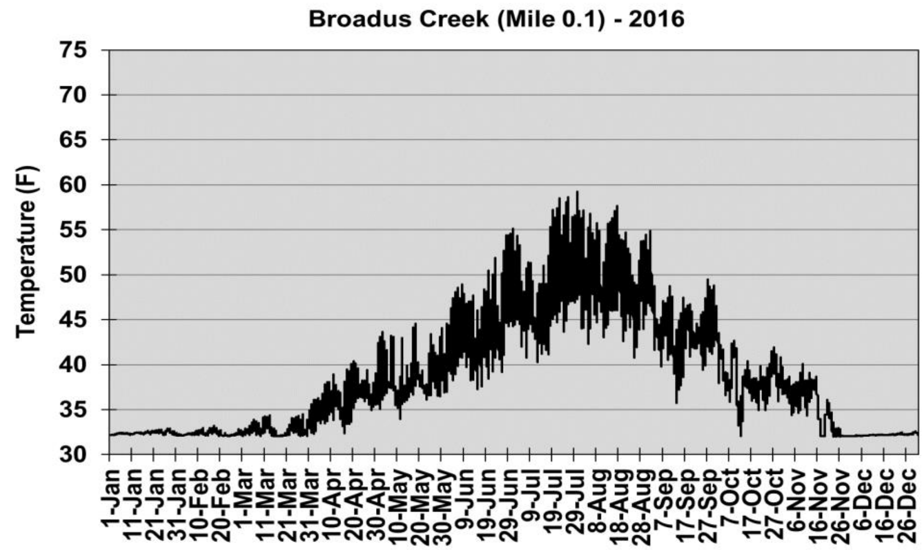
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.9	32.0	32.3	0.3	0.1
February	33.5	32.0	32.4	0.5	0.2
March	35.1	32.0	33.3	0.8	0.6
April	37.6	33.1	34.7	0.7	0.6
May	49.7	33.9	38.2	2.9	8.4
June	52.4	39.4	45.4	2.8	7.6
July	56.5	44.4	50.9	2.6	6.5
August	55.8	43.7	49.6	2.6	6.9
September	56.3	35.1	44.5	5.2	27.3
October	43.1	31.9	36.4	2.3	5.3
November	36.2	31.9	32.8	0.9	0.8
December	33.2	32.0	32.2	0.3	0.1



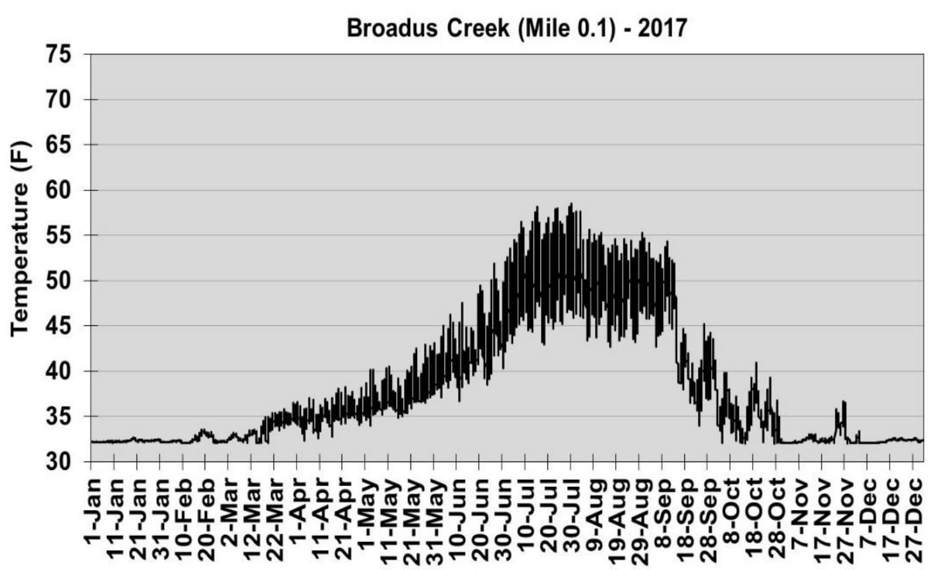
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.6	32.0	33.1	0.3	0.1
February	33.5	32.0	32.3	0.4	0.2
March	34.4	32.0	33.1	0.4	0.1
April	35.2	32.0	33.6	0.7	0.4
May	48.5	32.6	37.8	3.4	11.6
June	51.9	38.7	44.4	2.8	7.7
July	53.9	40.1	48.3	2.9	8.4
August	55.6	42.0	48.4	2.7	7.4
September	53.5	33.6	43.8	3.5	12.4
October	45.3	32.1	36.8	2.6	6.9
November	39.7	32.0	33.1	1.7	2.8
December	33.3	28.9	32.2	0.9	0.7



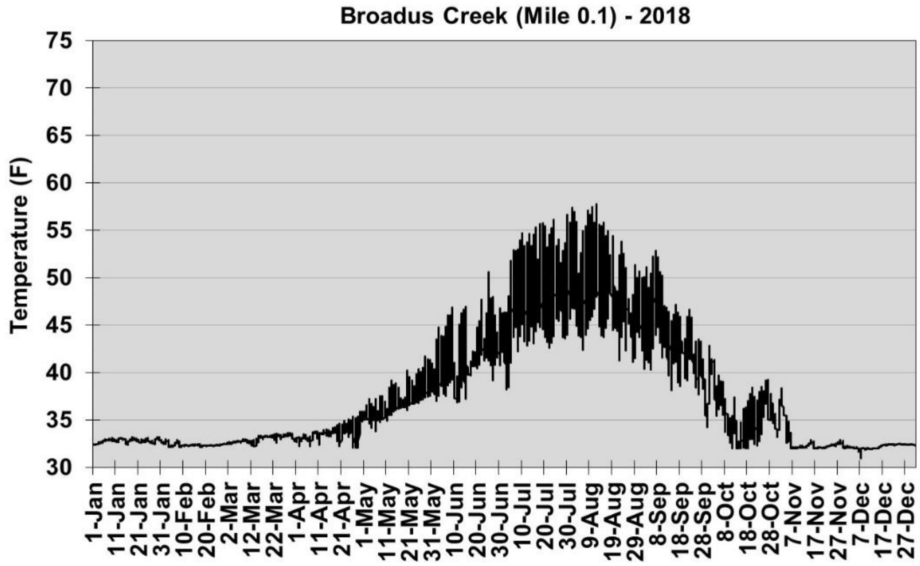
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.5	32.0	32.9	0.4	0.2
February	33.4	31.9	32.2	0.3	0.1
March	33.3	31.9	32.5	0.5	0.2
April	35.1	32.0	33.1	0.5	0.3
May	47.0	32.0	37.2	2.7	7.4
June	51.4	39.1	44.7	2.7	7.0
July	55.6	42.0	48.0	2.6	6.9
August	56.9	45.8	50.7	2.8	8.0
September					
October					
November					
December					



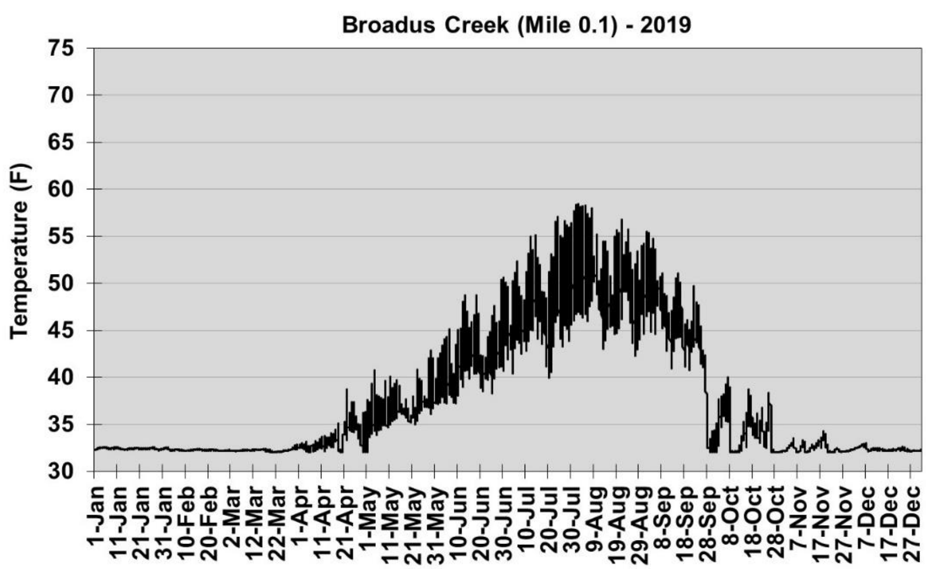
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.9	32.1	32.4	0.1	0.0
February	33.2	32.0	32.3	0.2	0.1
March	35.0	32.0	32.7	0.6	0.4
April	40.4	32.3	35.7	1.6	2.6
May	44.6	34.0	38.3	2.0	3.9
June	54.6	37.0	43.5	3.6	12.6
July	59.3	40.3	48.2	4.0	15.7
August	57.7	40.8	48.9	3.5	11.9
September	54.9	35.7	43.8	2.9	8.4
October	46.6	32.0	38.5	2.4	5.9
November	40.1	32.0	34.9	2.3	5.3
December	32.6	32.0	32.2	0.1	0.0



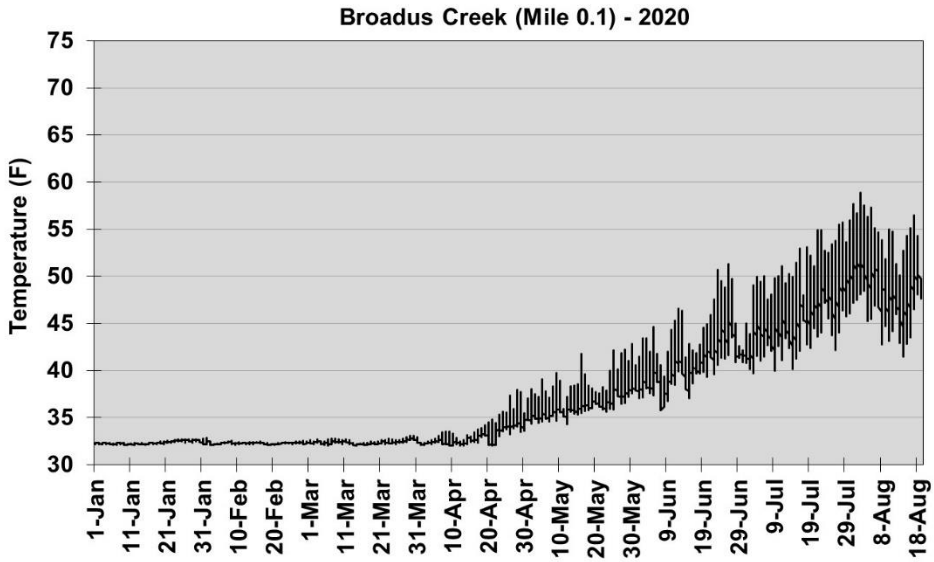
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.7	32.1	32.3	0.1	0.0
February	33.6	32.0	32.4	0.4	0.1
March	36.5	32.1	33.5	1.0	1.0
April	38.2	32.3	35.1	1.0	1.0
May	43.1	34.0	37.3	1.7	2.8
June	51.9	36.7	42.1	3.0	8.8
July	58.5	42.2	49.7	3.7	13.4
August	57.6	42.8	49.3	3.1	9.8
September	54.3	34.0	43.9	5.3	27.8
October	41.2	32.0	35.0	2.2	4.8
November	36.7	32.0	32.7	1.0	1.0
December	33.3	32.0	32.3	0.2	0.0



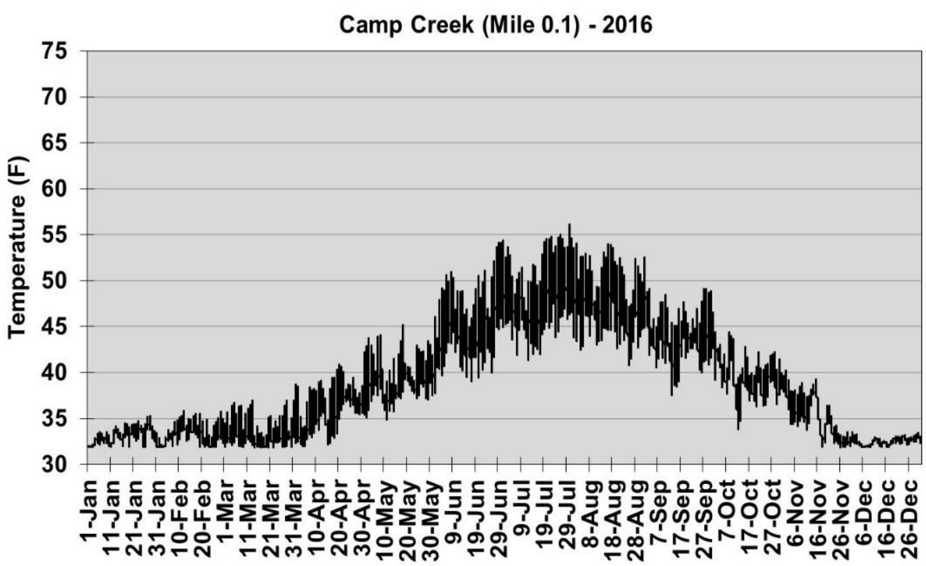
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.2	32.4	32.8	0.2	0.0
February	33.0	32.1	32.4	0.2	0.0
March	33.7	32.2	33.0	0.3	0.1
April	35.9	32.1	33.7	0.7	0.5
May	41.7	33.9	36.8	1.4	2.1
June	50.6	36.9	41.5	2.6	6.8
July	56.6	38.3	47.7	3.7	13.8
August	57.8	41.1	48.3	3.5	12.0
September	52.8	34.2	43.3	3.5	12.6
October	42.8	32.0	35.7	2.4	6.0
November	38.4	32.0	32.8	1.3	1.8
December	32.5	30.9	32.2	0.2	0.0



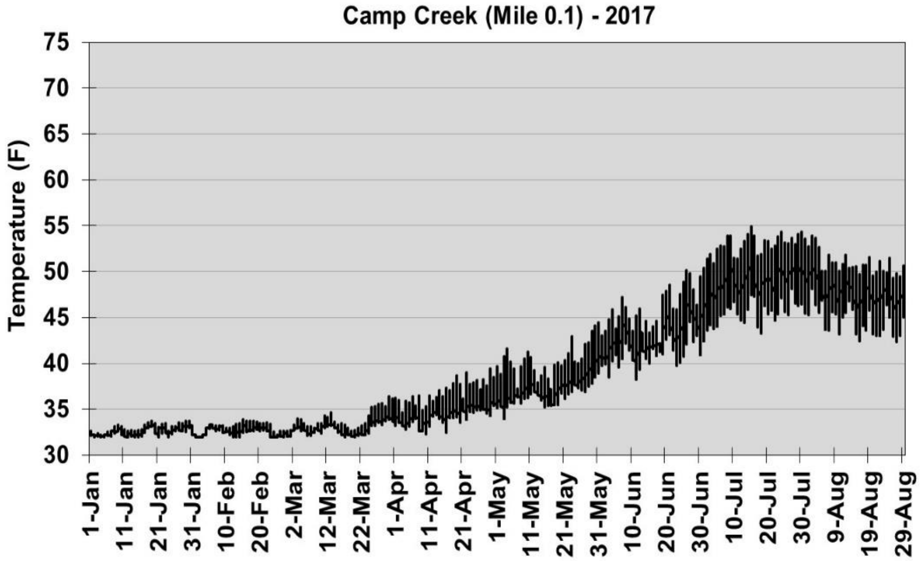
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.6	32.2	32.4	0.1	0.0
February	32.5	32.1	32.3	0.1	0.0
March	32.8	32.0	32.2	0.1	0.0
April	38.7	32.0	33.4	1.1	1.3
May	42.8	32.0	36.6	1.6	2.6
June	50.6	37.1	41.8	2.8	7.7
July	57.7	40.0	47.5	3.4	11.7
August	58.4	42.3	49.6	3.2	10.1
September	55.5	32.0	44.9	4.9	23.8
October	40.0	32.0	34.1	2.0	4.0
November	34.3	32.0	32.5	0.5	0.2
December	33.0	32.1	32.3	0.2	0.0



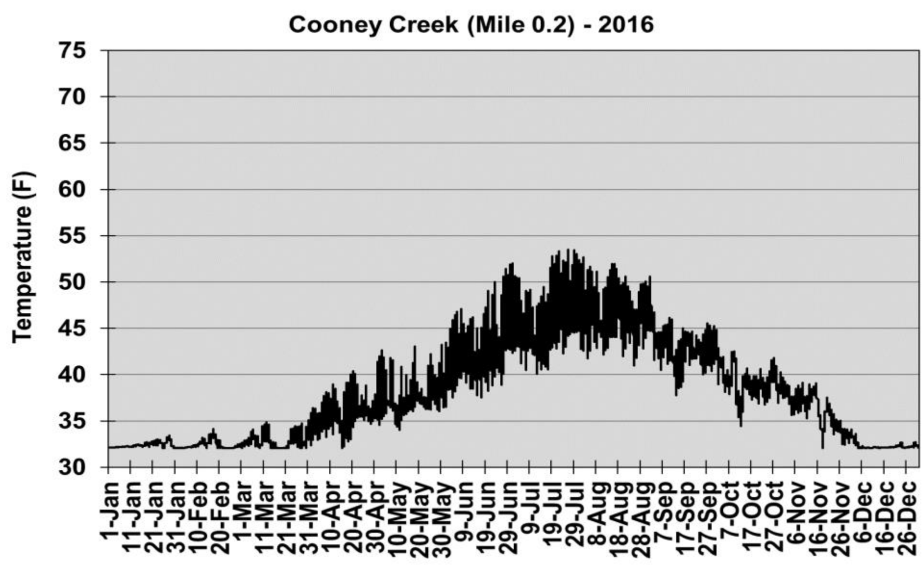
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.7	32.1	32.3	0.2	0.0
February	32.8	32.1	32.3	0.1	0.0
March	33.1	32.0	32.4	0.2	0.0
April	37.9	32.0	33.2	1.1	1.2
May	42.8	34.3	36.8	1.6	2.6
June	51.3	35.8	41.4	2.9	8.4
July	57.7	39.7	46.6	3.6	13.0
August	58.9	41.5	49.3	3.5	12.2
September					
October					
November					
December					



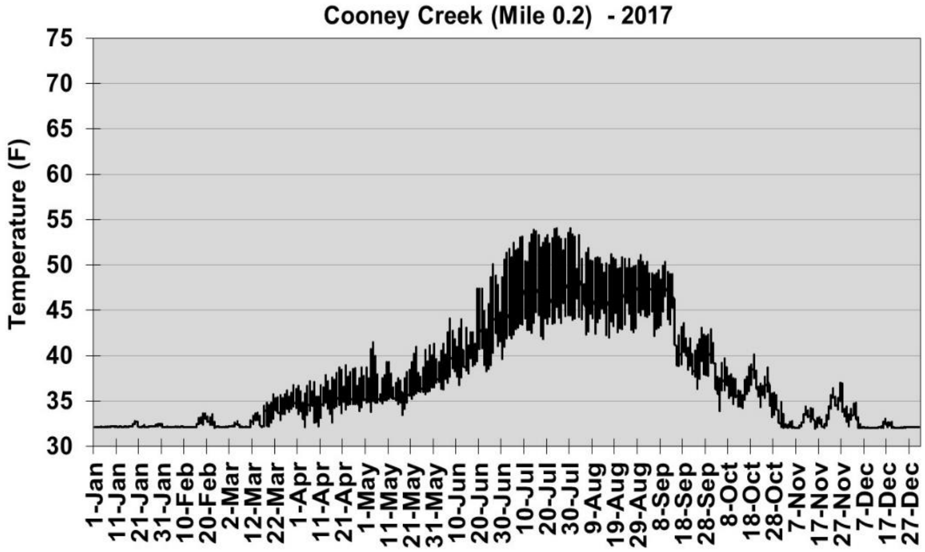
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.3	31.9	33.1	0.8	0.6
February	35.8	31.9	33.1	0.9	0.9
March	37.0	31.9	33.2	1.1	1.2
April	40.9	32.0	35.7	2.1	4.3
May	45.2	34.9	39.1	1.9	3.7
June	54.1	37.8	44.8	3.1	9.9
July	56.1	41.3	48.0	3.1	9.7
August	54.1	40.9	47.3	2.8	7.7
September	52.6	37.6	43.9	2.4	5.6
October	46.6	33.8	39.7	2.1	4.4
November	40.3	31.9	35.1	2.1	4.5
December	33.5	31.9	32.5	0.4	0.1



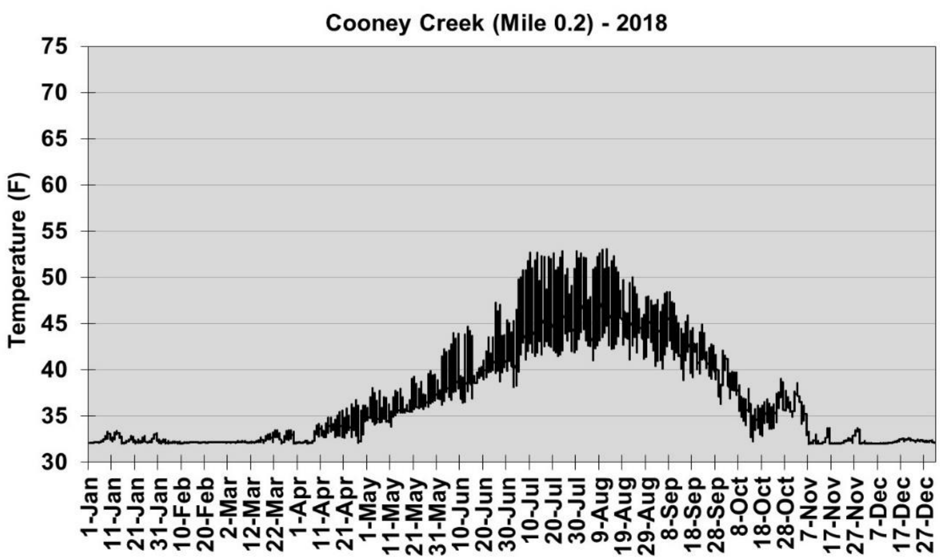
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.7	31.9	32.6	0.5	0.2
February	33.9	31.9	32.7	0.5	0.2
March	36.4	31.9	33.1	0.8	0.6
April	39.4	32.3	35.0	1.3	1.6
May	44.4	34.1	37.9	1.9	3.6
June	50.2	38.2	43.0	2.3	5.3
July	54.9	42.5	48.8	2.8	7.7
August	54.0	42.4	47.5	2.4	5.9
September					
October					
November					
December					



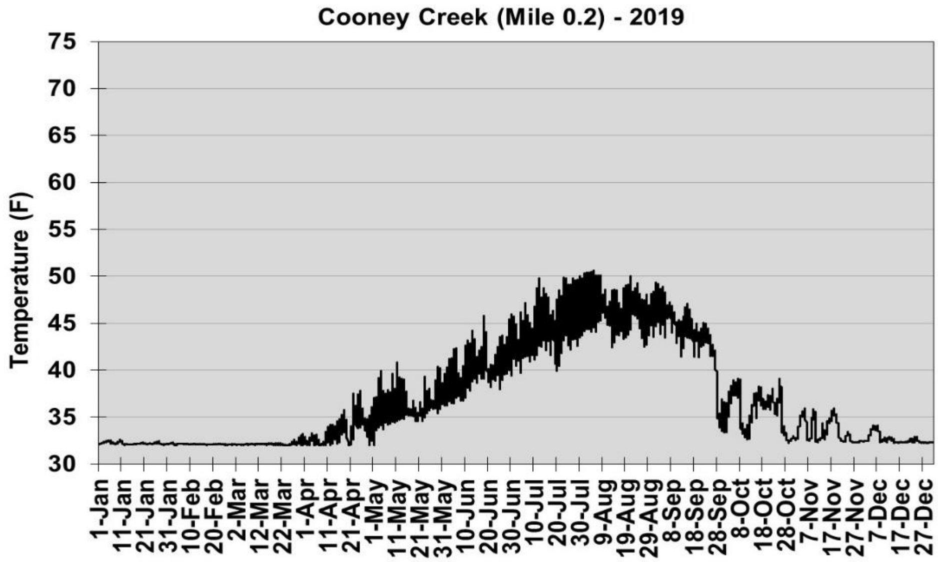
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.4	32.1	32.4	0.3	0.1
February	34.1	32.0	32.4	0.4	0.2
March	35.1	32.0	32.8	0.7	0.5
April	40.4	32.1	35.4	1.5	2.4
May	43.3	34.0	37.6	1.7	3.0
June	51.9	36.5	42.2	3.0	8.9
July	53.5	40.1	46.0	3.1	9.7
August	52.7	41.0	46.5	2.5	6.2
September	50.6	37.8	43.0	1.9	3.7
October	44.9	34.5	39.3	1.7	2.9
November	39.3	32.0	36.0	1.8	3.3
December	34.1	32.1	32.3	0.3	0.1



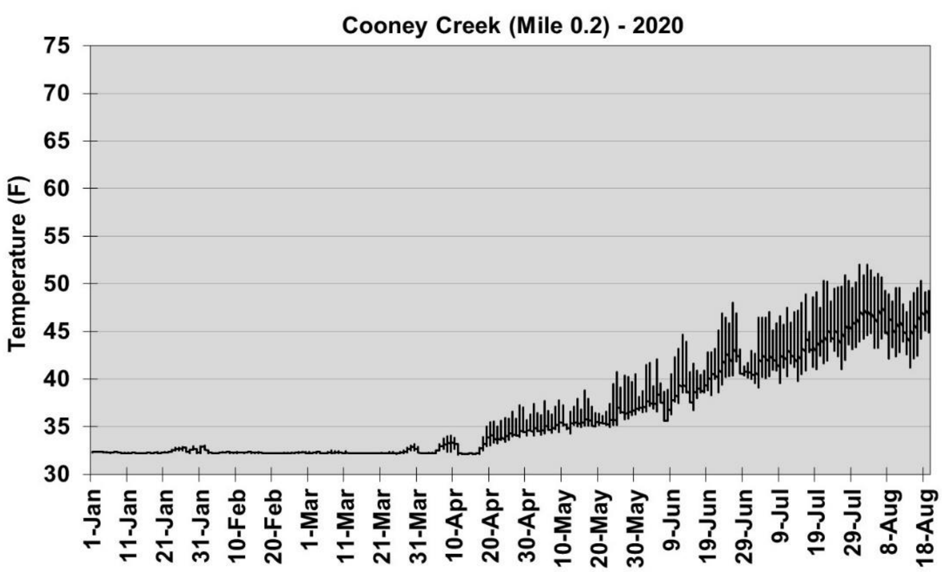
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.8	32.1	32.2	0.1	0.0
February	33.7	32.0	32.4	0.4	0.2
March	36.7	32.1	33.3	1.2	1.3
April	39.0	32.1	35.2	1.3	1.7
May	41.5	33.5	36.5	1.5	2.2
June	50.1	36.4	40.8	2.8	7.6
July	54.1	41.0	47.3	3.3	10.8
August	53.3	42.0	47.0	2.4	5.9
September	50.4	36.3	43.1	3.7	13.4
October	41.4	32.1	36.4	1.7	2.8
November	37.0	32.0	33.3	1.2	1.5
December	34.9	32.0	32.3	0.6	0.3



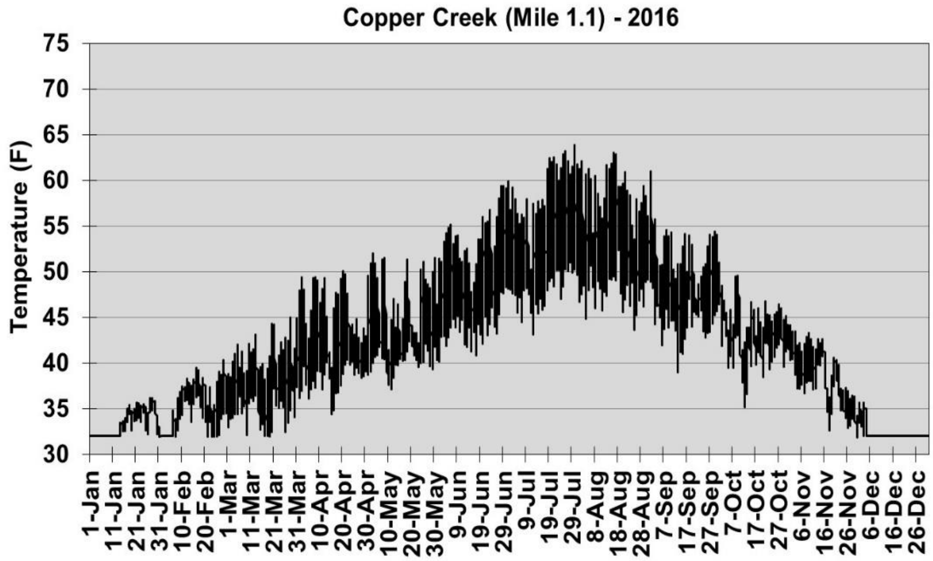
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.4	32.0	32.4	0.3	0.1
February	32.5	32.0	32.1	0.1	0.0
March	33.5	32.0	32.4	0.4	0.1
April	36.7	32.0	33.4	1.0	1.1
May	39.9	33.8	36.1	1.1	1.3
June	47.3	36.2	40.0	2.1	4.5
July	52.9	38.2	45.2	3.2	10.0
August	53.1	41.0	45.9	2.6	6.8
September	48.5	36.3	42.6	2.4	5.8
October	42.1	32.2	36.4	2.0	4.0
November	38.6	32.0	33.2	1.7	2.8
December	32.6	32.0	32.2	0.2	0.0



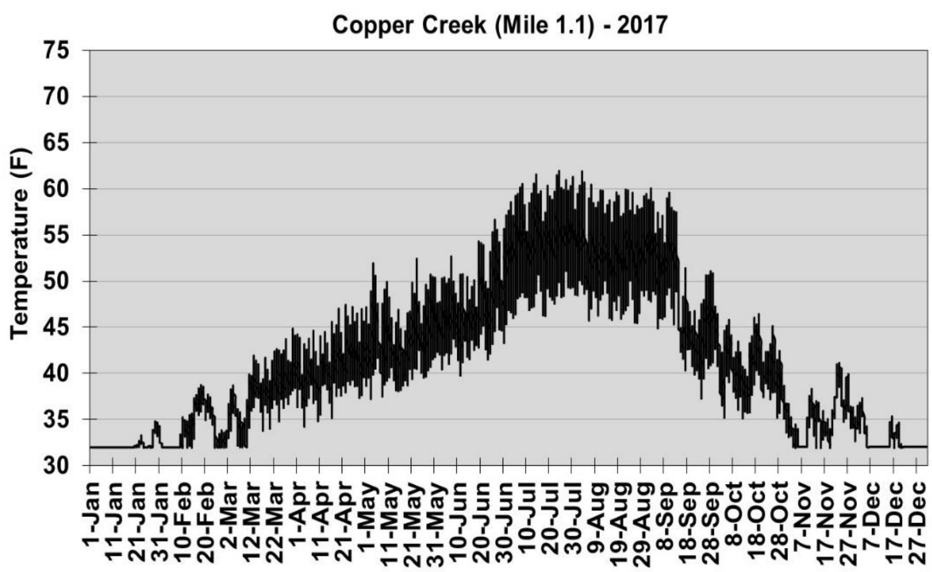
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.6	32.0	32.2	0.1	0.0
February	32.3	32.0	32.1	0.0	0.0
March	33.2	32.0	32.2	0.2	0.0
April	37.8	32.0	33.3	1.2	1.5
May	40.9	32.0	36.0	1.4	2.0
June	45.9	36.2	40.0	2.0	4.0
July	50.0	39.7	44.4	2.4	5.7
August	50.6	42.5	46.4	1.8	3.1
September	49.3	33.5	43.6	3.2	10.4
October	39.1	32.2	35.6	1.9	3.7
November	36.0	32.3	33.5	1.2	1.4
December	34.1	32.2	32.6	0.5	0.2



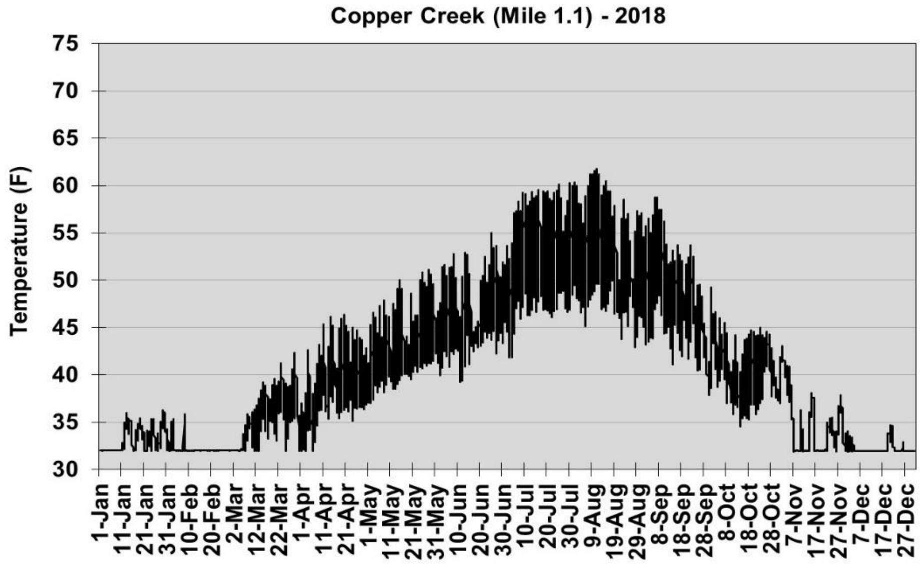
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.9	32.2	32.4	0.2	0.0
February	33.0	32.2	32.3	0.1	0.0
March	33.1	32.1	32.3	0.2	0.0
April	37.2	32.0	33.3	1.2	1.4
May	40.7	34.1	36.0	1.3	1.6
June	48.0	35.6	40.0	2.4	5.6
July	52.0	39.1	44.1	2.7	7.4
August	52.0	41.3	46.2	2.3	5.5
September					
October					
November					
December					



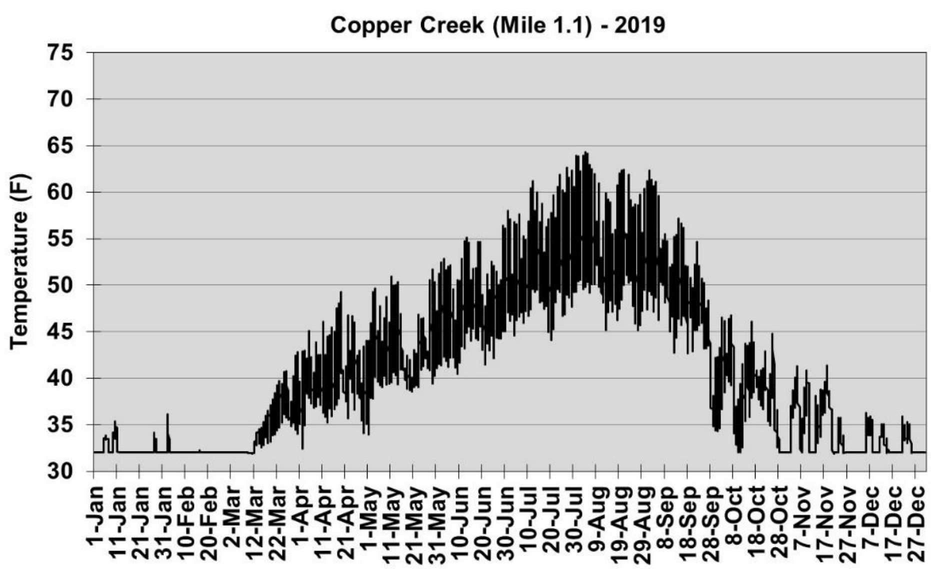
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.2	31.9	33.2	1.3	1.7
February	40.3	31.9	34.8	2.3	5.1
March	45.0	32.0	37.4	2.8	8.0
April	50.0	34.4	41.8	3.3	11.2
May	52.0	37.2	43.7	3.3	11.2
June	59.4	40.2	48.8	4.2	17.7
July	63.9	43.2	53.3	4.6	20.8
August	63.0	43.6	53.0	4.3	18.8
September	61.0	39.0	48.1	3.5	12.1
October	51.0	35.2	43.1	2.6	6.7
November	44.1	31.9	38.3	2.8	7.9
December	35.7	32.0	32.2	0.7	0.5



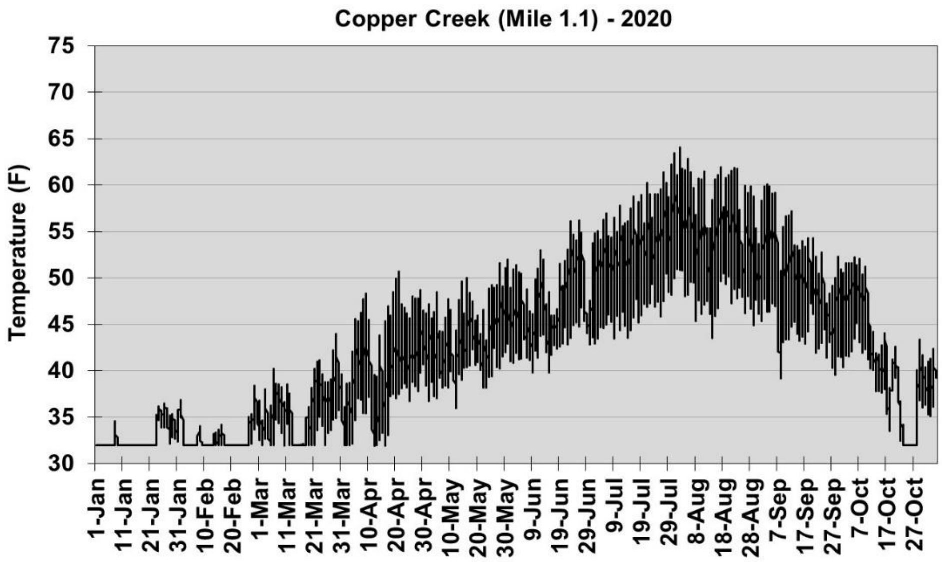
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.8	31.9	32.2	0.6	0.3
February	38.7	31.9	33.8	2.1	4.3
March	44.9	32.0	37.3	2.8	8.0
April	47.4	34.2	40.7	2.7	7.2
May	52.4	37.3	43.5	3.3	11.0
June	56.6	39.8	46.7	3.6	12.7
July	61.9	45.4	53.8	4.1	16.5
August	61.9	45.4	52.9	4.0	15.7
September	60.0	37.3	47.8	5.2	26.6
October	46.4	33.6	39.9	2.7	7.2
November	41.1	32.0	34.8	2.3	5.4
December	37.3	32.0	32.7	1.2	1.5



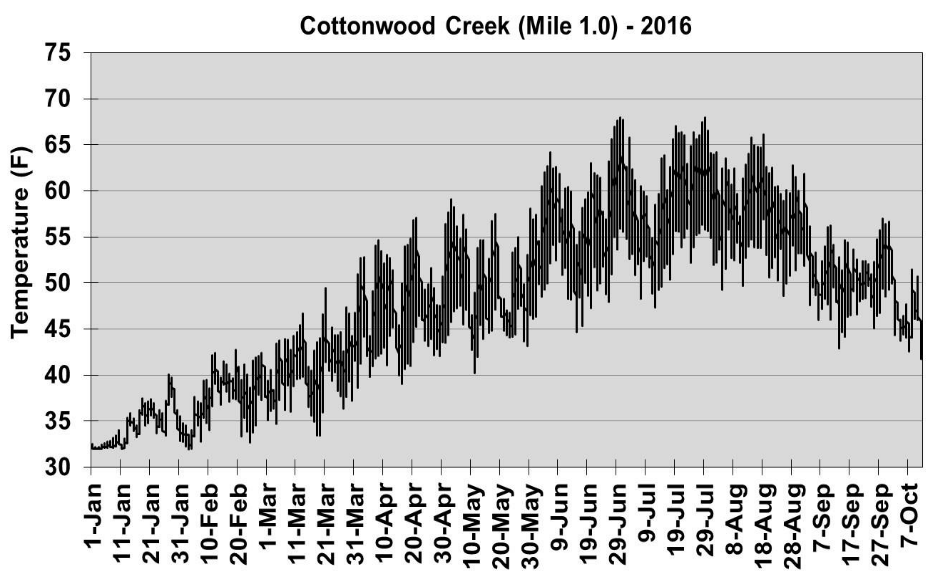
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.3	31.9	33.1	1.2	1.5
February	35.8	32.0	32.2	0.7	0.5
March	42.3	31.9	35.2	2.5	6.2
April	46.3	31.9	38.5	3.3	10.8
May	51.1	37.1	43.0	3.1	9.9
June	55.0	39.3	46.1	3.3	11.0
July	60.3	41.9	52.2	4.3	18.4
August	61.8	43.0	52.1	4.3	18.9
September	58.8	37.9	47.7	4.3	18.9
October	49.2	34.6	40.6	2.8	7.7
November	43.0	31.9	34.6	3.1	9.4
December	34.7	31.9	32.2	0.5	0.3



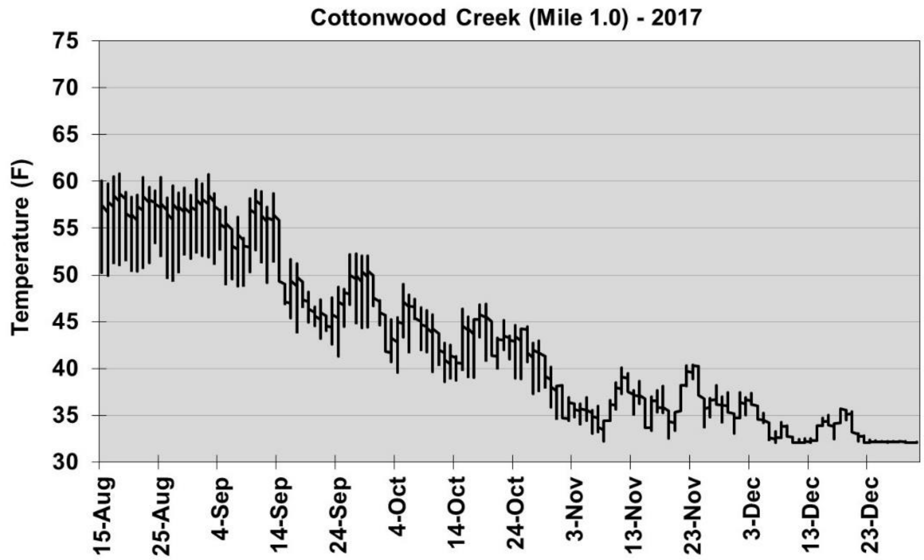
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.3	32.0	32.2	0.6	0.4
February	36.2	32.0	32.1	0.5	0.2
March	42.8	31.9	34.6	2.7	7.3
April	49.2	32.5	39.9	2.9	8.6
May	51.7	34.0	42.9	3.2	10.4
June	56.4	40.5	47.5	3.5	12.2
July	63.9	44.1	52.7	4.3	18.3
August	64.3	45.2	53.8	4.5	20.1
September	62.3	34.4	48.8	5.3	28.3
October	46.8	32.0	38.1	3.9	15.3
November	41.4	31.9	34.7	2.8	7.9
December	36.3	31.9	32.7	1.2	1.5



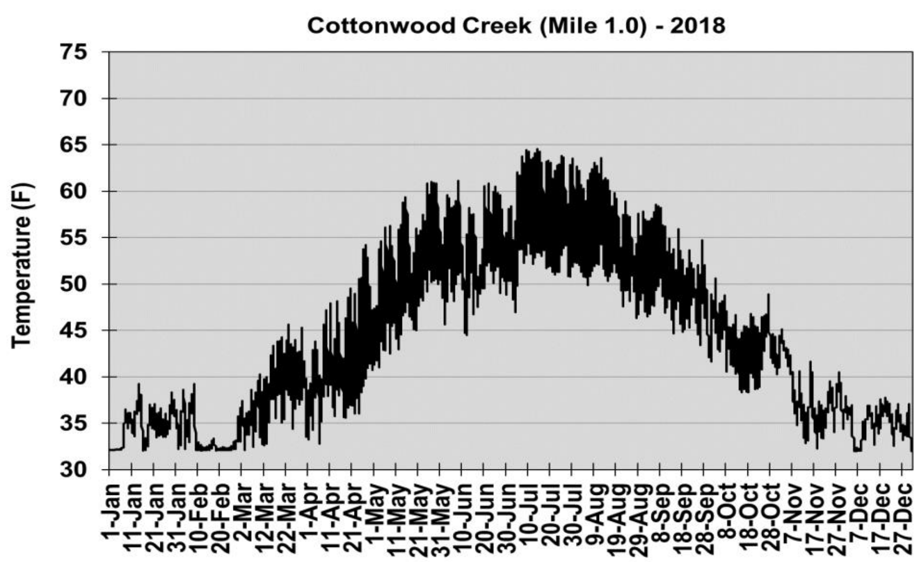
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.5	32.0	32.7	1.2	1.5
February	38.4	31.9	32.6	1.3	1.6
March	44.0	31.9	35.2	2.8	7.7
April	50.7	31.9	39.7	4.6	21.4
May	52.0	36.0	43.1	3.3	11.0
June	56.2	39.9	46.3	3.5	12.3
July	63.4	43.0	51.7	4.4	19.6
August	64.0	43.5	53.3	4.5	20.6
September	60.1	39.3	48.4	4.5	20.3
October	52.2	32.0	40.3	5.6	31.8
November	42.3	35.1	38.4	2.1	4.3
December					



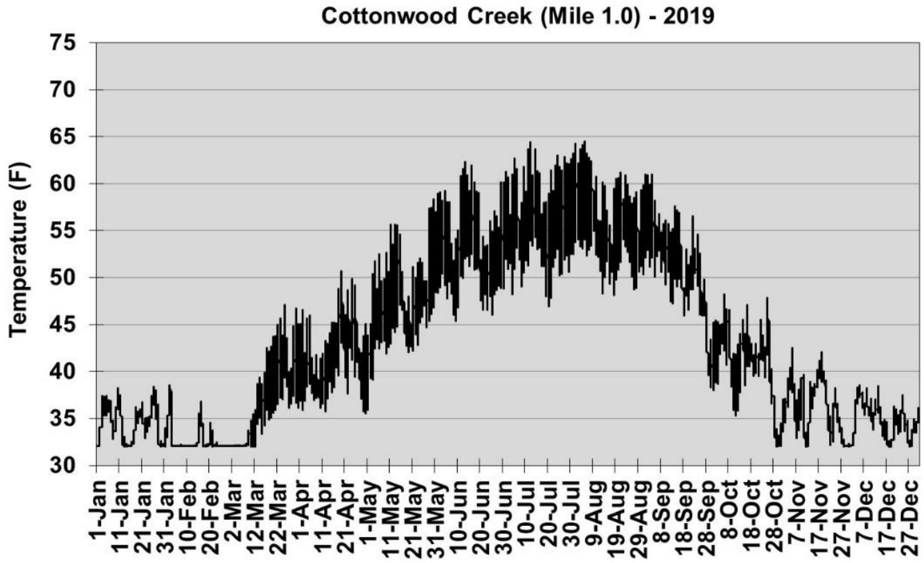
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	40.1	32.0	34.3	2.0	3.9
February	42.8	32.0	37.3	2.7	7.2
March	49.5	33.4	40.5	3.0	8.9
April	57.1	38.6	46.8	3.8	14.6
May	59.1	40.3	49.2	3.9	15.1
June	68.0	44.7	55.4	4.7	22.4
July	68.0	47.3	58.1	4.6	20.9
August	66.1	48.6	57.2	3.7	13.7
September	61.8	42.9	50.8	3.0	9.1
October	53.6	41.7	46.6	2.5	6.4
November					
December					



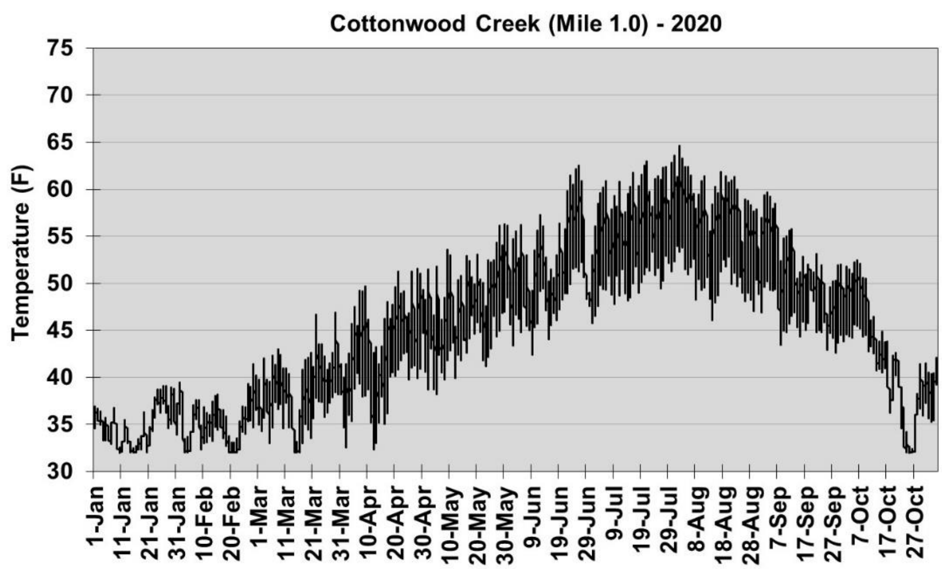
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July					
August	60.8	49.5	55.5	2.9	8.6
September	60.8	41.3	50.3	4.4	19.6
October	49.0	34.8	42.4	2.7	7.4
November	40.4	32.2	36.1	1.8	3.2
December	37.4	32.1	33.4	1.4	2.1



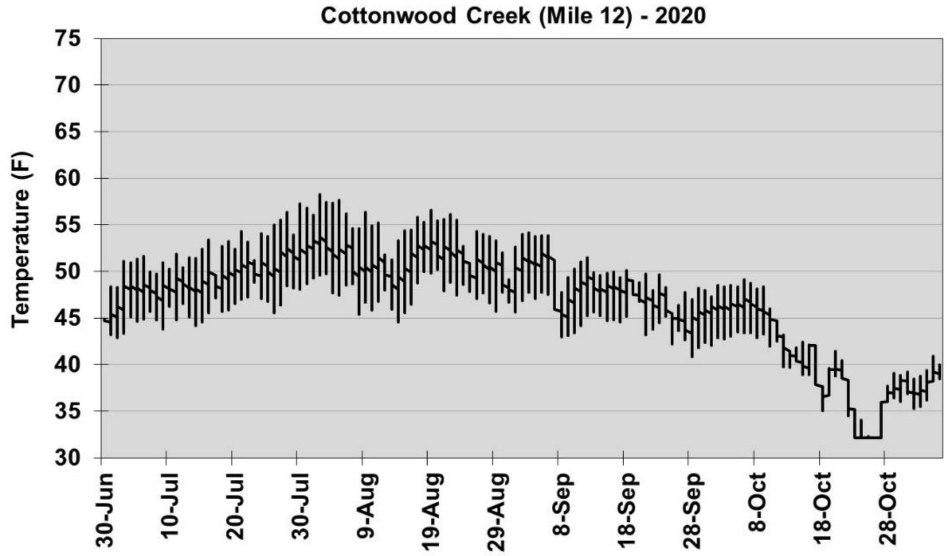
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.3	32.0	34.6	1.7	3.0
February	39.2	32.0	33.3	1.8	3.1
March	45.7	32.1	38.0	3.0	9.0
April	54.2	32.8	41.4	4.3	18.5
May	61.0	41.0	50.8	4.6	21.1
June	61.1	44.5	53.1	3.5	12.6
July	64.5	46.9	56.9	3.9	15.5
August	63.6	46.3	54.8	3.8	14.3
September	58.5	42.1	50.3	3.4	11.4
October	50.6	38.3	43.7	2.5	6.1
November	45.1	32.3	37.9	3.0	9.0
December	37.9	32.0	34.9	1.6	2.5



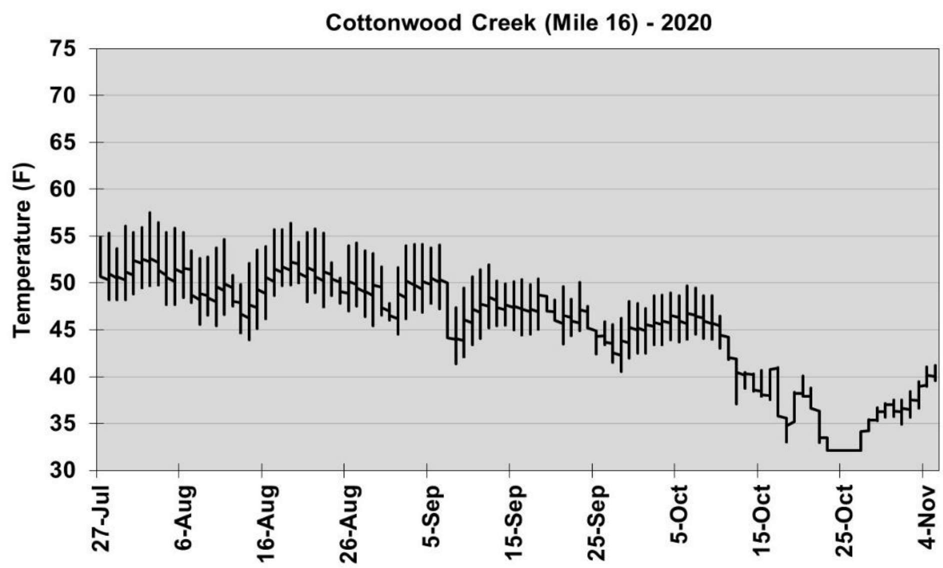
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.4	32.0	34.5	1.9	3.5
February	38.6	32.0	32.6	1.3	1.7
March	47.1	32.0	36.7	4.1	16.7
April	50.7	35.6	41.4	3.2	10.1
May	58.4	36.0	47.5	4.0	16.1
June	62.3	45.4	53.1	3.8	14.2
July	64.4	46.9	56.1	3.7	13.9
August	64.5	48.1	55.7	3.5	12.4
September	61.0	38.3	51.3	4.5	20.0
October	48.2	32.0	40.8	3.7	14.0
November	42.5	32.0	36.2	2.7	7.6
December	38.5	32.0	34.8	1.7	3.0



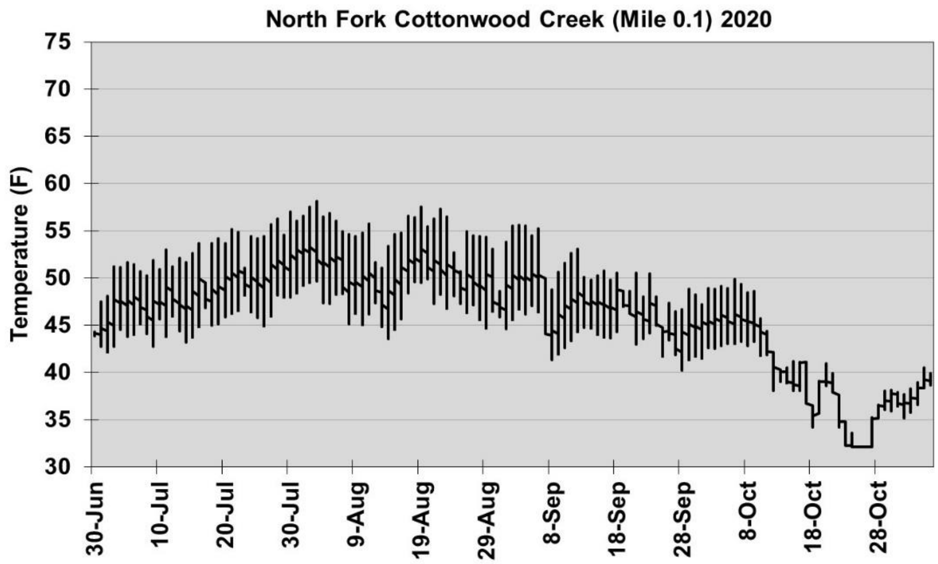
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.1	32.0	34.7	1.9	3.7
February	41.4	32.0	35.0	2.0	4.2
March	46.9	32.0	38.2	3.0	9.2
April	51.5	32.3	42.5	4.3	18.2
May	56.3	38.3	46.9	3.8	14.4
June	62.5	42.5	51.0	4.0	16.2
July	63.6	45.8	54.7	3.8	14.4
August	64.6	46.1	54.9	3.8	14.2
September	59.7	42.6	49.7	3.6	13.2
October	52.5	32.0	41.7	5.6	31.0
November	42.1	35.3	38.5	1.6	2.7
December					



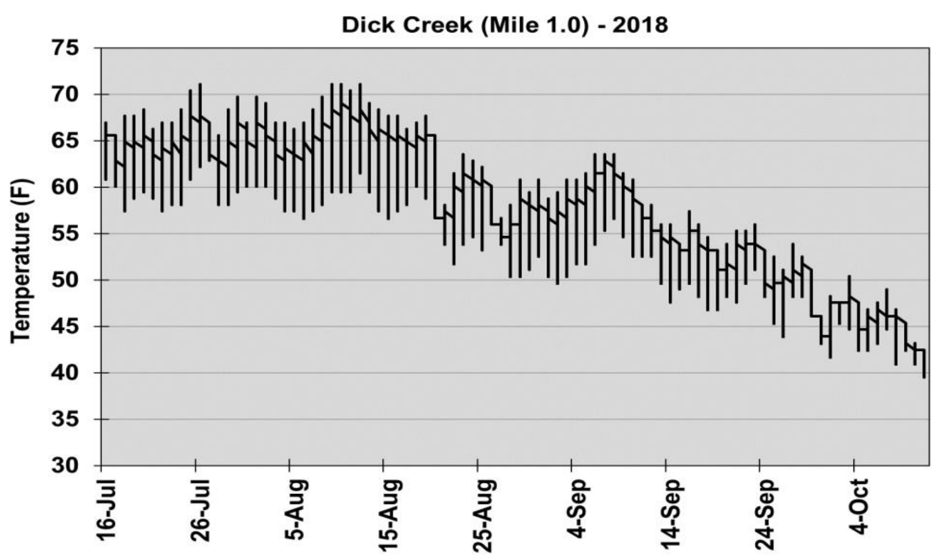
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	44.9	44.7	44.8	0.1	0.0
July	57.2	42.9	48.7	2.8	7.8
August	58.2	44.6	50.7	2.7	7.6
September	54.1	40.8	47.2	2.7	7.1
October	49.1	32.1	40.2	4.7	21.9
November	40.9	35.2	37.8	1.4	2.1
December					



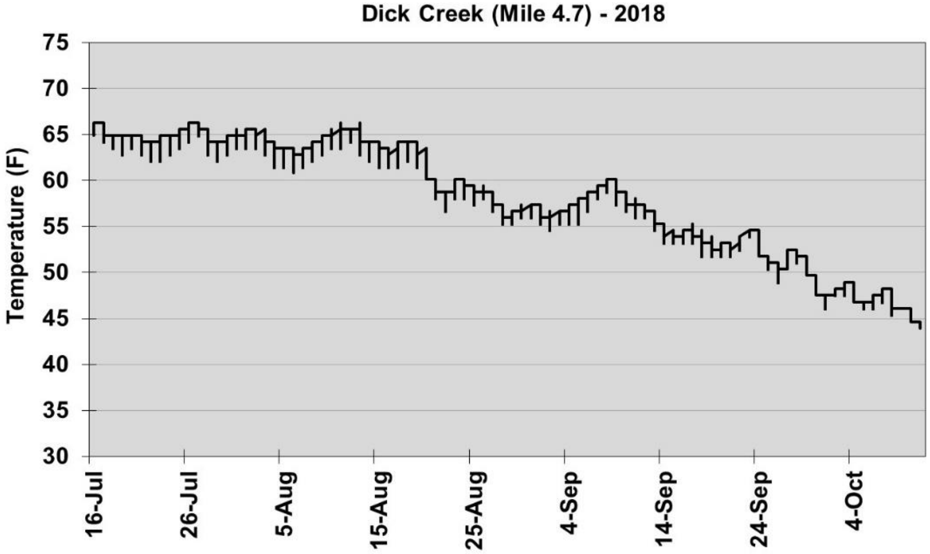
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	56.1	48.2	51.2	2.4	5.6
August	57.5	43.9	50.0	2.7	7.2
September	54.2	40.5	46.7	2.7	7.4
October	49.7	32.1	39.5	5.1	26.4
November	41.2	34.9	38.0	1.8	3.2
December					



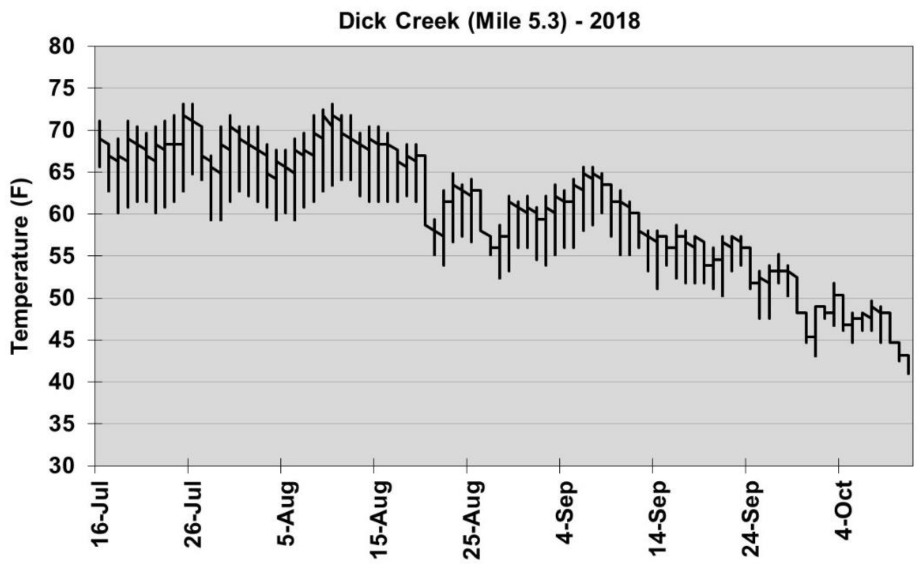
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	44.3	43.9	44.1	0.1	0.0
July	57.0	42.2	48.4	3.2	10.1
August	58.2	43.5	50.3	3.0	9.2
September	55.6	40.2	46.7	2.9	8.5
October	49.9	32.1	39.7	4.7	22.0
November	40.5	35.2	37.8	1.4	1.9
December					



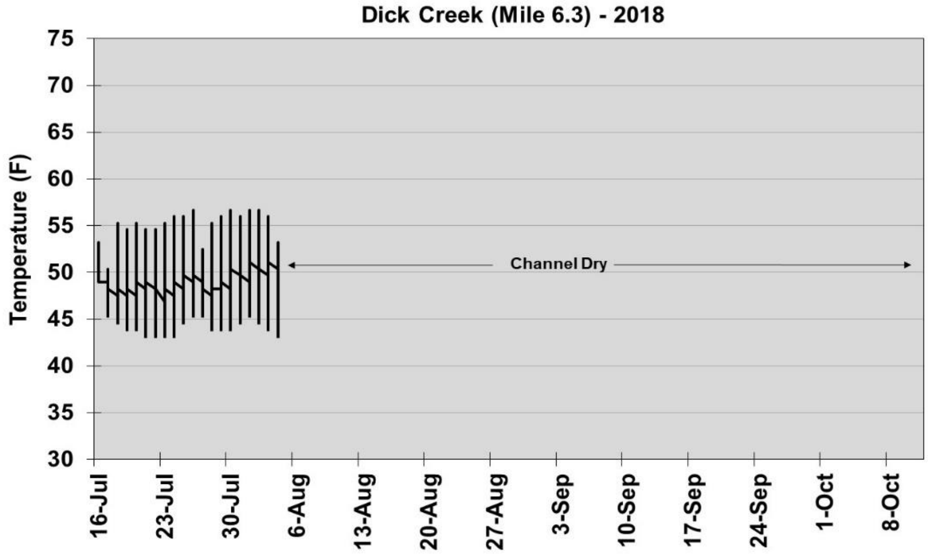
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	71.1	57.4	63.4	3.2	10.2
August	71.1	50.4	60.9	4.8	23.0
September	63.5	43.2	53.2	4.5	20.0
October	50.4	39.5	44.8	2.3	5.1
November					
December					



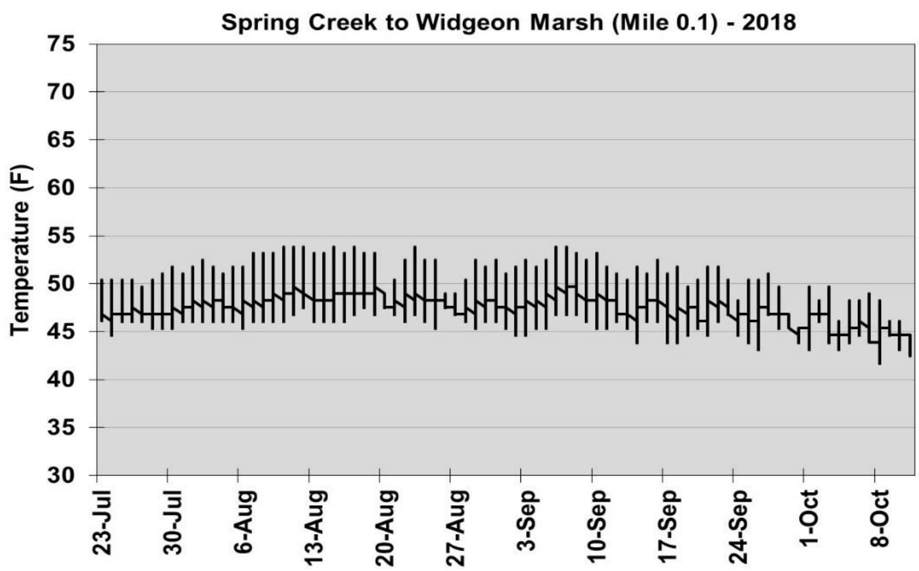
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	66.3	62.2	64.3	1.0	1.0
August	66.3	55.3	61.4	3.0	9.0
September	60.1	47.5	54.4	2.9	8.2
October	49.0	43.9	46.8	1.2	1.3
November					
December					



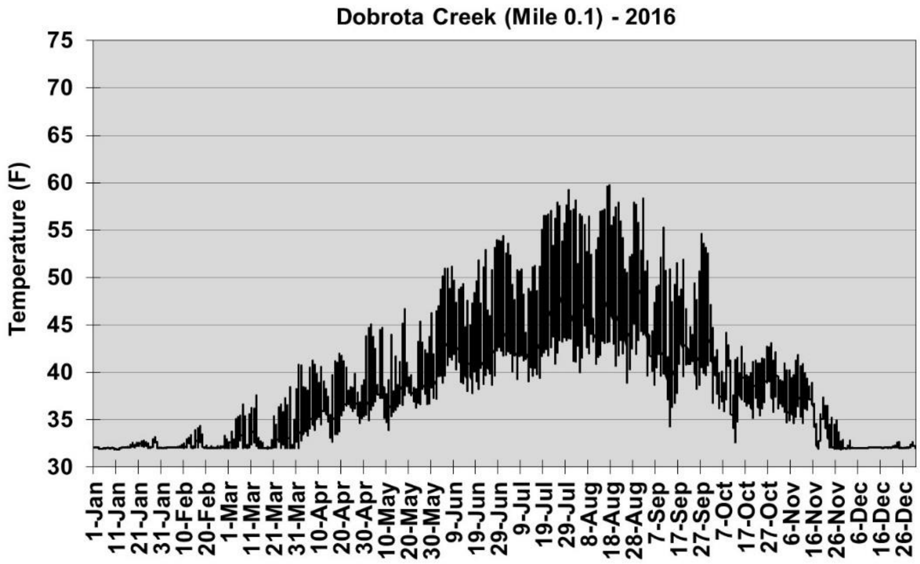
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	73.2	59.4	66.2	3.3	11.1
August	73.2	52.5	63.1	4.6	21.5
September	65.6	44.7	55.9	4.4	19.0
October	51.8	41.0	46.6	2.2	4.6
November					
December					



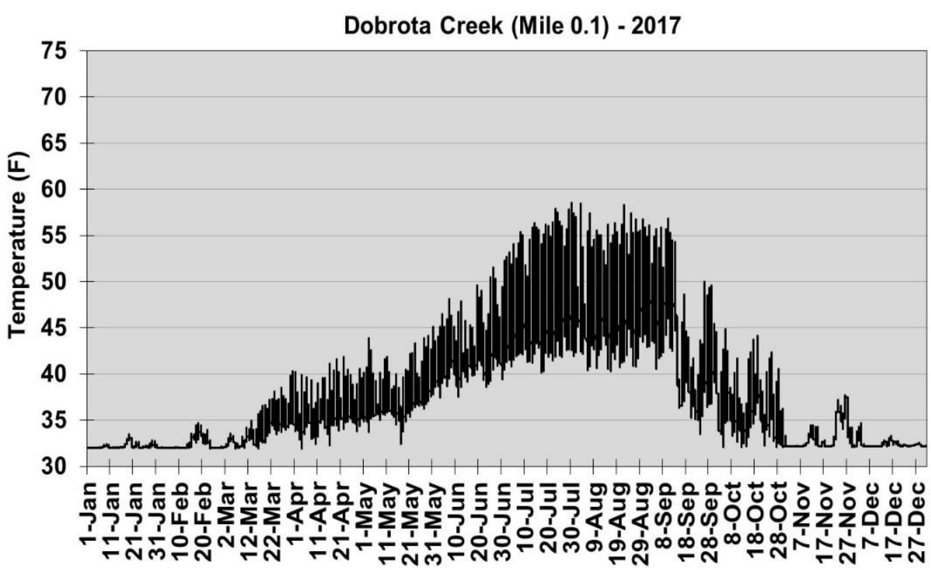
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	56.7	43.2	48.7	3.6	13.0
August	56.7	43.2	49.4	4.0	15.7
September					
October					
November					
December					



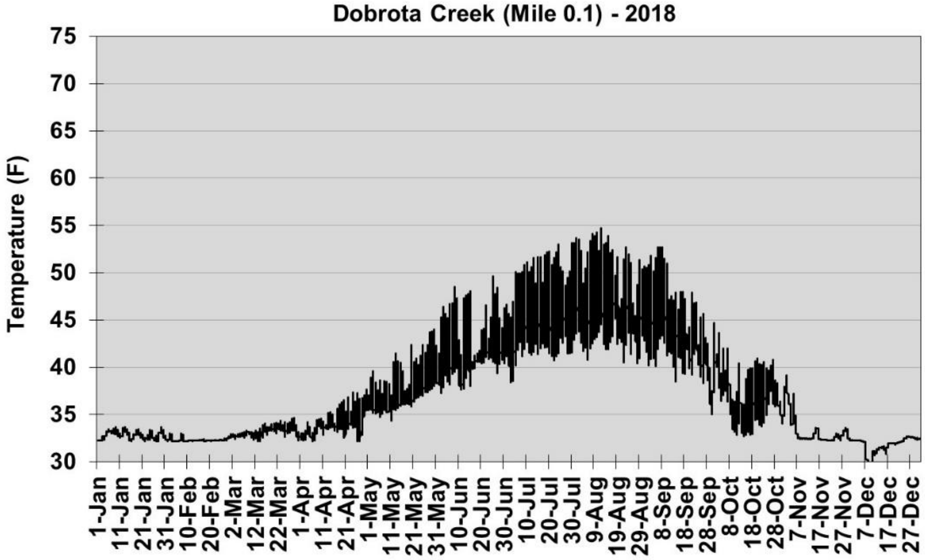
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	51.8	44.7	47.6	1.7	2.8
August	53.9	45.4	48.7	2.2	4.6
September	53.9	43.2	47.7	2.2	5.0
October	49.7	41.7	45.4	1.6	2.6
November					
December					



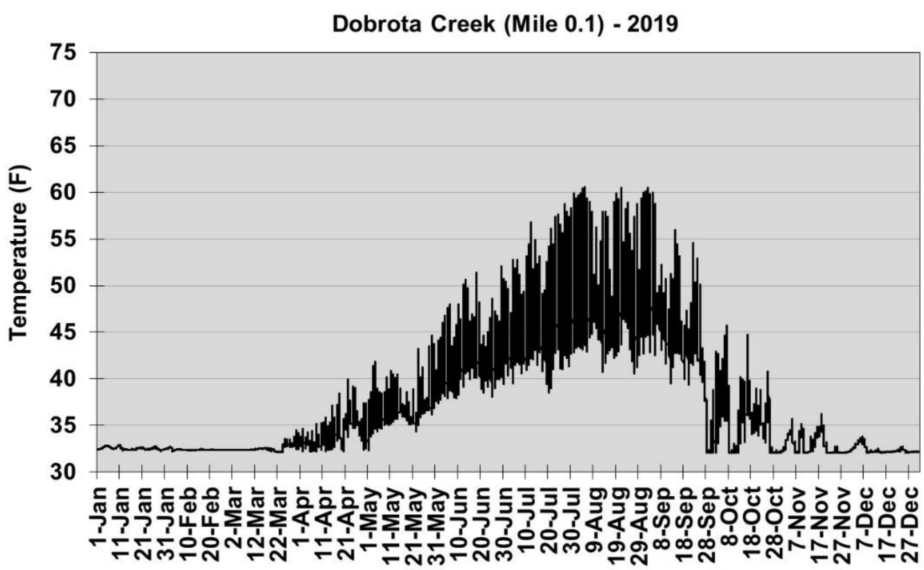
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.2	31.8	32.2	0.2	0.1
February	34.3	32.0	32.3	0.4	0.2
March	38.5	31.9	33.0	1.3	1.7
April	42.0	32.0	36.3	2.0	3.9
May	46.7	33.9	38.7	2.3	5.4
June	54.0	37.2	43.5	3.6	12.9
July	59.2	39.0	46.2	4.4	19.5
August	59.7	38.9	47.5	4.5	20.3
September	58.4	34.3	43.4	3.8	14.3
October	47.1	32.6	38.8	2.3	5.1
Novenber	41.9	31.9	35.4	2.5	6.0
December	32.8	32.0	32.1	0.1	0.0



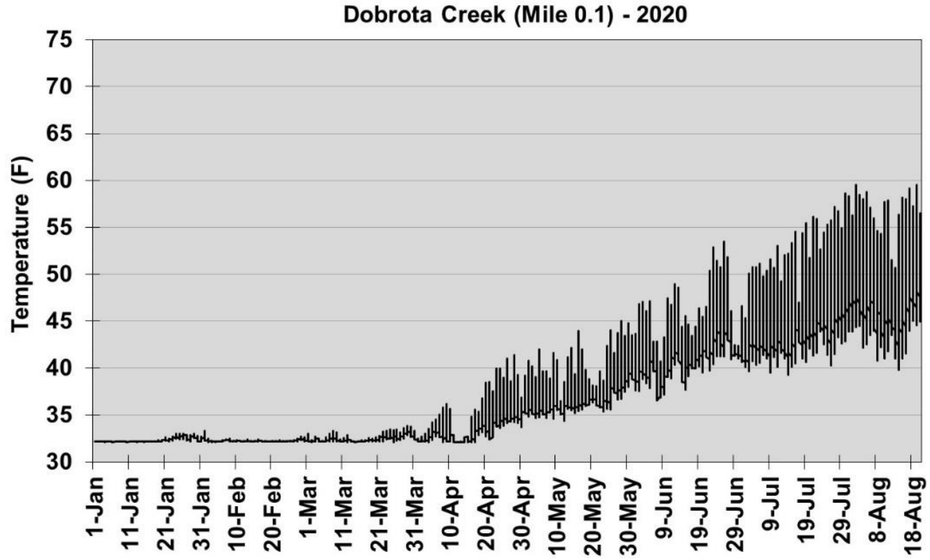
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.5	32.0	32.2	0.3	0.1
February	34.7	31.9	32.4	0.6	0.3
March	40.3	31.9	33.9	1.5	2.2
April	41.8	31.9	35.7	1.8	3.1
May	45.1	32.5	37.5	2.2	4.6
June	51.6	37.5	42.1	2.7	7.2
July	58.5	40.3	46.8	4.5	20.4
August	58.5	40.3	47.2	4.3	18.4
September	56.8	33.6	43.3	5.4	28.9
October	44.9	32.1	35.9	2.7	7.4
November	37.7	32.1	33.1	1.4	2.0
December	34.7	32.1	32.4	0.4	0.2



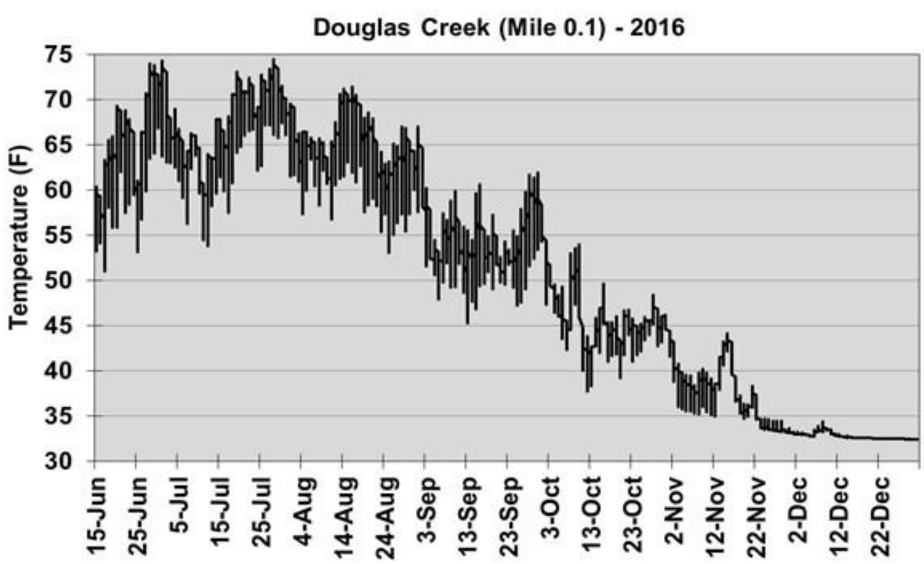
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.7	32.2	32.8	0.4	0.2
February	33.0	32.2	32.3	0.2	0.0
March	34.7	32.2	33.2	0.5	0.2
April	37.6	32.2	34.0	1.1	1.2
May	44.0	34.4	37.4	1.8	3.4
June	49.6	37.3	41.5	2.3	5.5
July	53.1	38.5	45.0	3.2	10.5
August	54.7	40.4	46.2	3.3	10.8
September	52.7	35.0	43.3	3.4	11.7
October	44.7	32.7	36.9	2.4	5.8
November	39.1	32.3	33.3	1.5	2.3
December	32.7	27.9	31.8	1.0	1.0



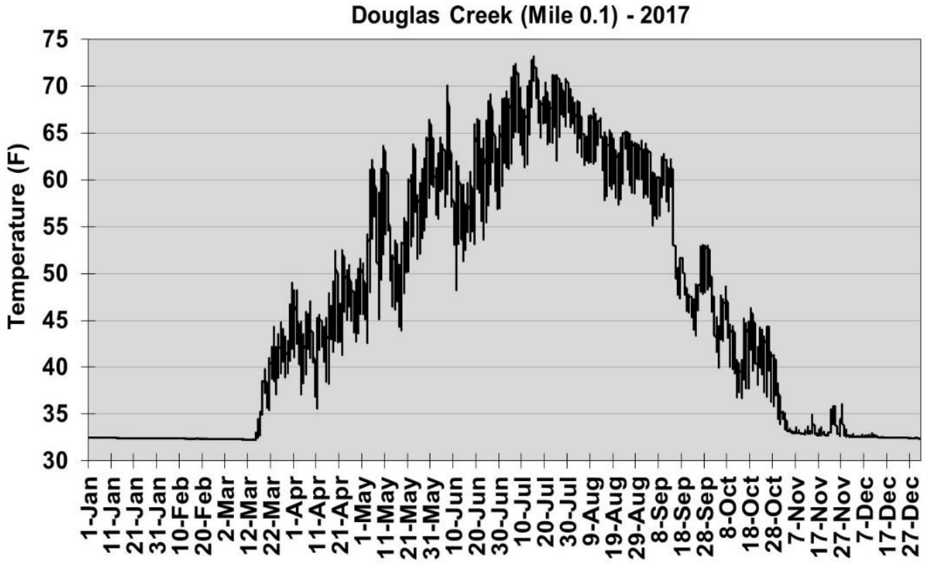
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.9	32.2	32.5	0.1	0.0
February	32.7	32.2	32.4	0.1	0.0
March	34.5	32.1	32.5	0.4	0.1
April	40.0	32.2	34.1	1.5	2.2
May	44.6	32.3	36.9	1.9	3.5
June	52.1	37.4	42.0	2.9	8.4
July	59.9	38.5	45.7	4.3	18.3
August	60.6	40.5	48.1	4.5	20.4
September	60.5	32.1	44.2	5.4	28.8
October	45.7	32.0	35.0	2.7	7.4
November	36.3	32.1	32.9	1.0	1.0
December	33.8	32.1	32.4	0.4	0.2



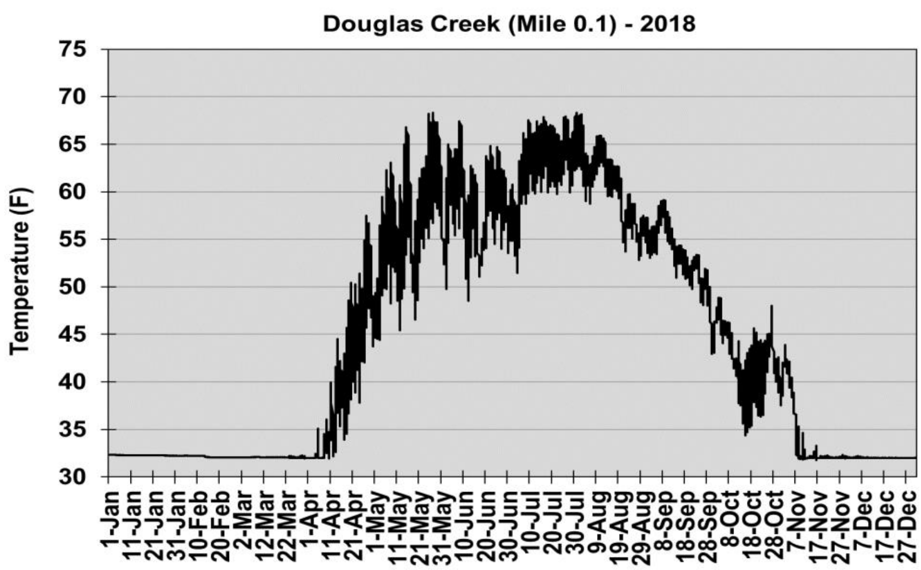
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.0	32.1	32.3	0.2	0.1
February	33.3	32.1	32.3	0.2	0.0
March	33.8	32.1	32.5	0.4	0.1
April	41.4	32.1	33.8	1.8	3.2
May	45.0	34.4	37.4	2.1	4.5
June	53.5	36.6	42.0	3.0	8.7
July	58.6	39.3	45.1	4.2	17.3
August	59.5	39.8	47.6	4.6	21.5
September					
October					
November					
December					



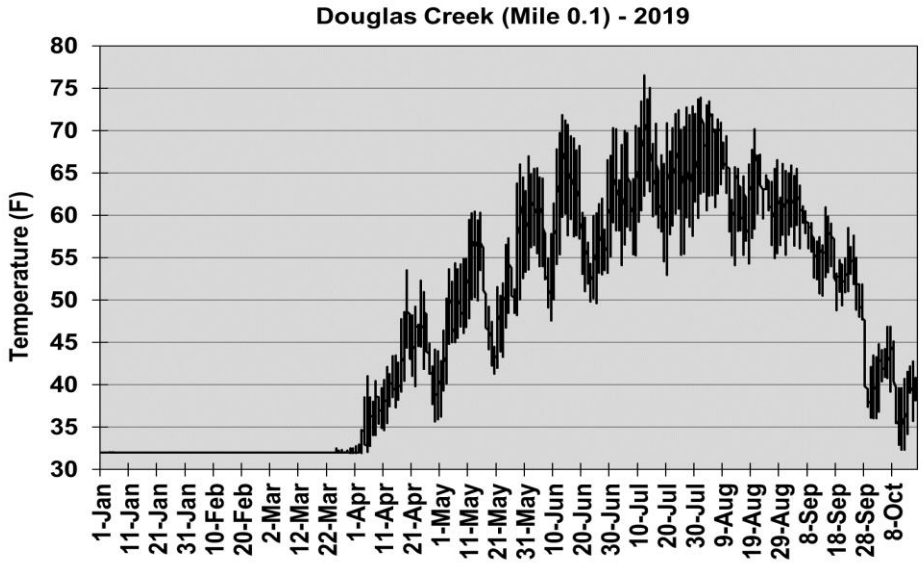
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	74.0	51.1	62.7	5.2	26.8
July	74.5	53.9	65.5	4.2	17.9
August	71.5	53.2	63.1	3.5	12.2
September	67.0	45.4	53.8	3.7	14.0
October	58.4	37.8	45.7	3.6	12.7
November	44.4	33.1	37.1	3.0	8.9
December	34.4	32.4	32.8	0.4	0.1



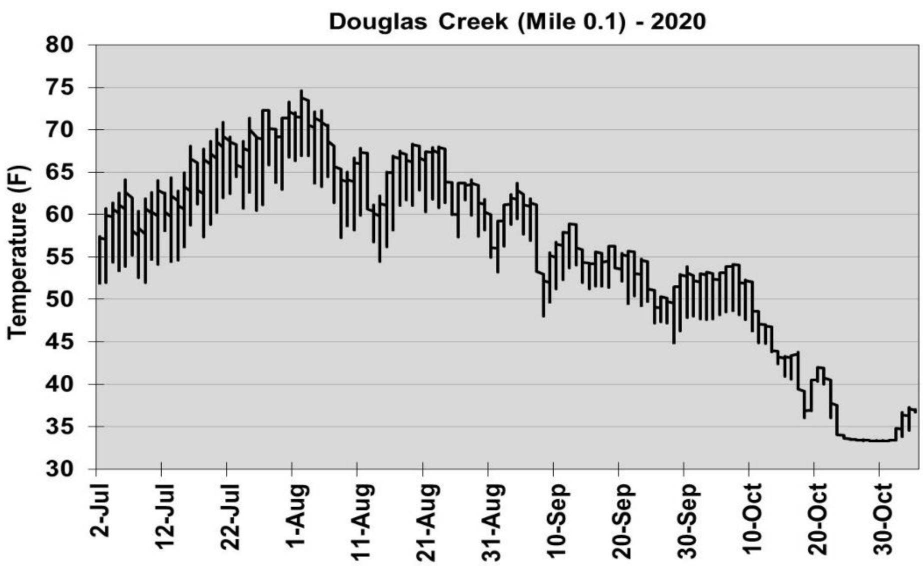
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.4	32.4	32.4	0.0	0.0
February	32.4	32.3	32.4	0.0	0.0
March	49.0	32.2	36.1	4.5	19.9
April	52.6	35.6	44.4	3.4	11.5
May	66.4	42.6	54.2	5.4	28.6
June	70.1	48.3	59.6	4.0	16.4
July	73.2	59.3	67.2	2.7	7.2
August	68.8	57.4	63.2	2.4	5.8
September	63.9	43.4	53.8	5.9	34.4
October	49.6	33.9	41.6	3.3	10.7
November	36.0	32.6	33.3	0.8	0.6
December	32.9	32.3	32.5	0.1	0.0



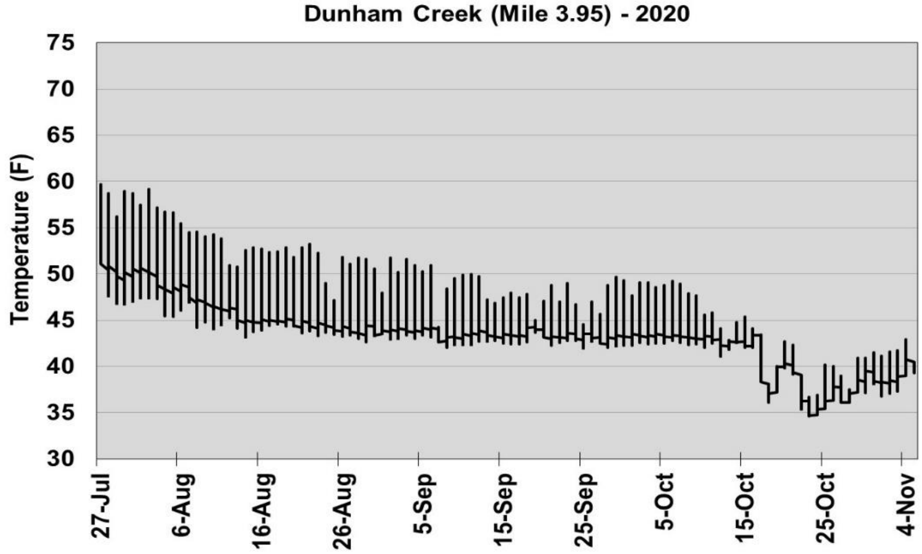
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.2	32.3	0.0	0.0
February	32.3	32.0	32.1	0.1	0.0
March	32.3	31.9	32.0	0.0	0.0
April	57.5	31.9	39.5	7.0	49.5
May	68.3	44.4	56.1	5.6	30.8
June	67.4	48.5	58.0	3.8	14.5
July	68.3	51.5	62.6	3.4	11.8
August	68.1	52.8	60.3	3.6	13.0
September	59.1	42.9	53.1	3.2	10.5
October	48.9	34.4	42.2	3.2	10.0
November	43.9	31.8	33.9	3.4	11.4
December	32.2	32.0	32.0	0.0	0.0



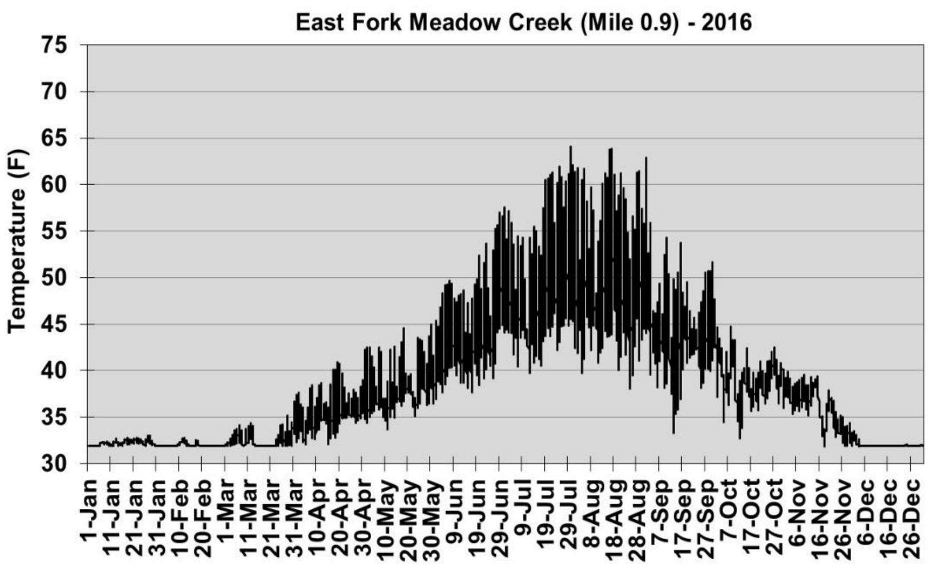
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.0	32.0	32.0	0.0	0.0
February	32.0	32.0	32.0	0.0	0.0
March	32.5	31.9	32.0	0.1	0.0
April	53.6	31.9	40.2	5.0	25.0
May	66.0	36.2	50.4	5.6	31.6
June	71.9	47.6	58.9	5.3	27.8
July	76.6	52.9	64.1	4.8	23.2
August	73.9	54.1	63.3	4.4	19.3
September	65.9	36.1	54.4	6.1	37.3
October	46.9	32.3	39.7	3.5	12.0
November					
December					



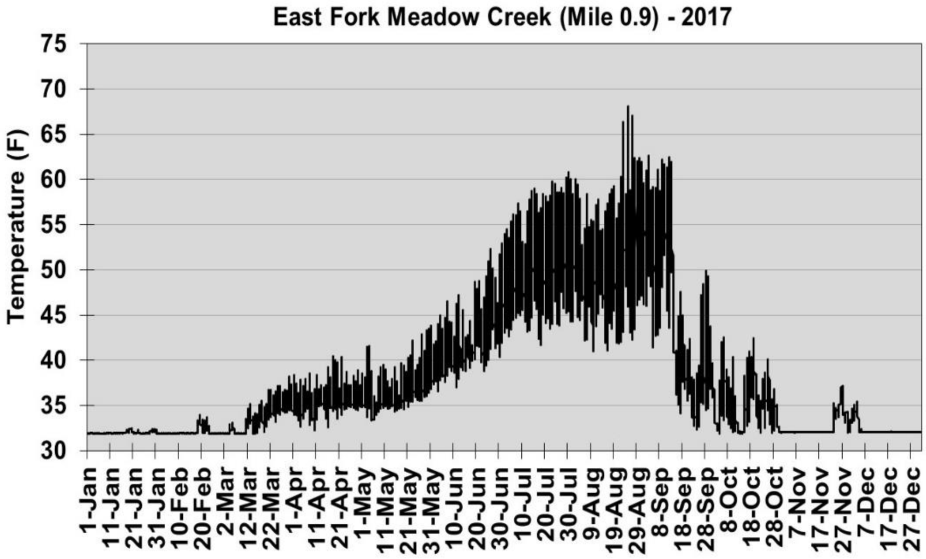
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	73.3	52.0	62.3	5.0	24.6
August	74.6	54.5	63.5	4.1	16.5
September	63.7	45.0	53.8	3.9	15.3
October	54.1	33.3	42.2	7.0	48.6
November	37.3	33.4	35.1	1.3	1.7
December					



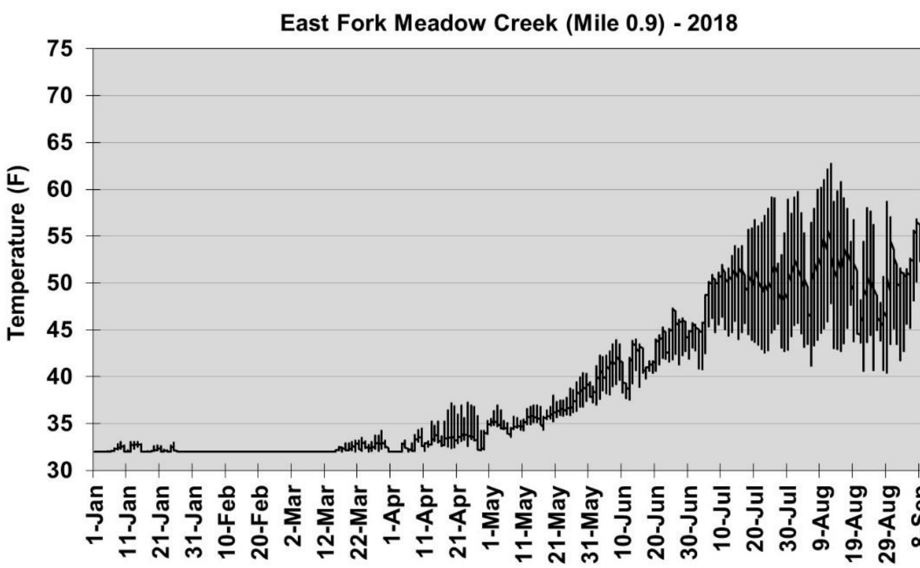
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	59.7	46.8	52.1	3.8	14.8
August	59.2	42.6	47.5	3.5	12.0
September	51.7	42.0	44.6	2.1	4.3
October	49.2	34.6	41.0	3.3	11.0
November	42.9	36.8	39.3	1.5	2.4
December					



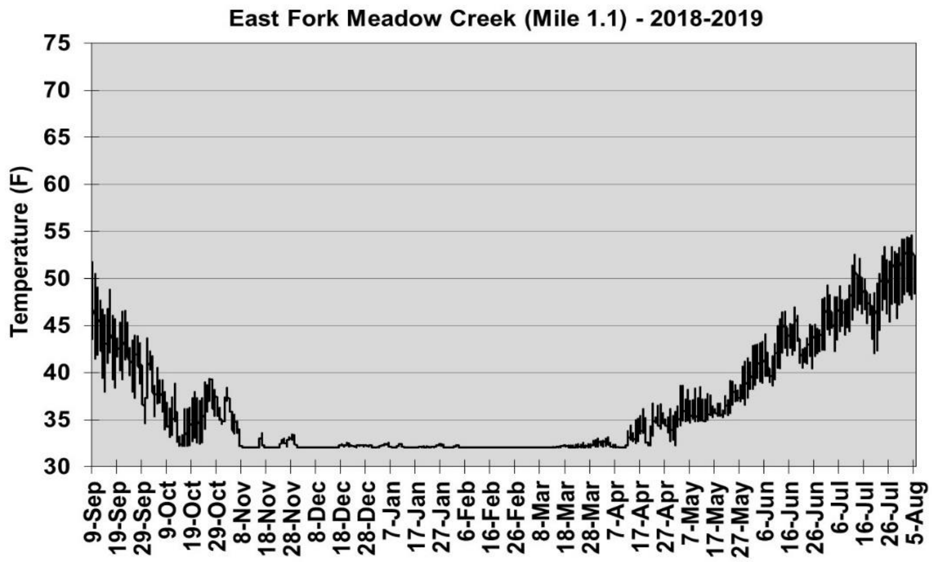
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.0	31.9	32.2	0.3	0.1
February	32.8	31.9	32.0	0.2	0.0
March	36.7	31.9	32.5	0.7	0.6
April	40.9	32.1	35.2	1.6	2.6
May	45.0	33.7	38.0	2.2	4.7
June	57.0	36.9	43.7	4.0	15.7
July	64.1	39.8	48.7	5.0	24.6
August	63.9	38.1	48.9	5.4	29.5
September	62.9	33.3	43.7	4.0	16.0
October	47.6	32.7	39.1	2.3	5.4
November	39.9	31.9	35.9	2.1	4.4
December	33.5	31.9	32.0	0.2	0.1



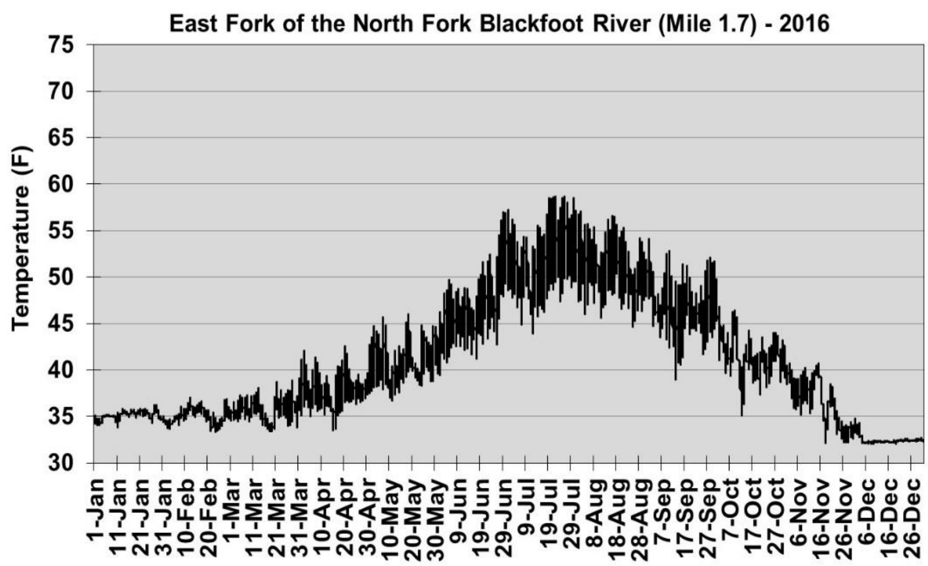
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.5	31.9	32.0	0.1	0.0
February	34.0	31.9	32.1	0.4	0.2
March	38.2	31.9	33.5	1.4	2.0
April	40.5	32.3	35.4	1.4	1.8
May	43.9	33.3	36.6	1.9	3.8
June	52.3	36.6	41.9	3.1	9.8
July	60.9	41.8	49.5	4.4	19.2
August	68.1	41.0	50.1	5.2	26.8
September	62.6	32.4	44.8	8.3	68.5
October	42.5	31.8	34.8	2.5	6.4
November	37.2	32.0	32.6	1.1	1.3
December	35.4	32.0	32.3	0.6	0.4



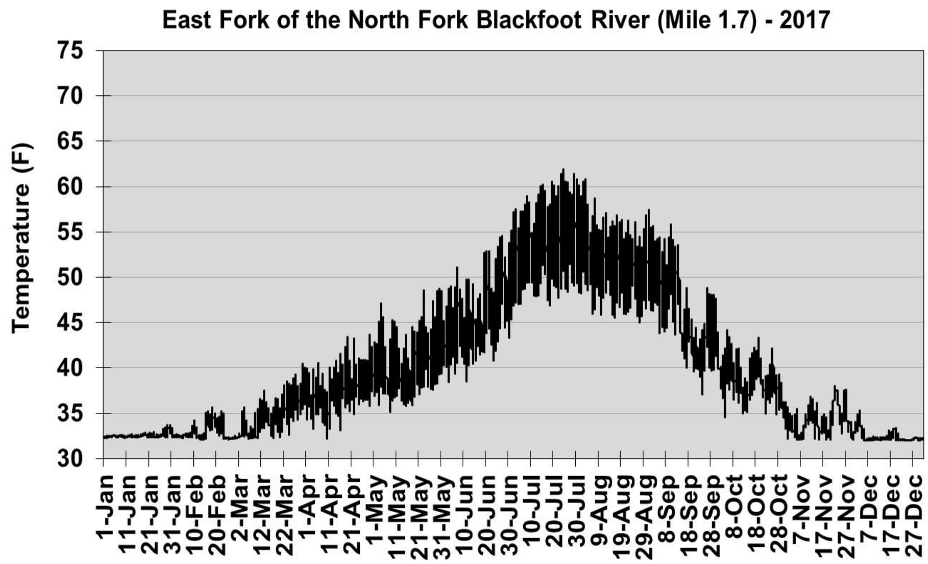
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.1	32.0	32.2	0.3	0.1
February	32.0	32.0	32.0	0.0	0.0
March	34.3	32.0	32.3	0.4	0.2
April	37.2	32.0	33.4	1.1	1.3
May	40.4	33.6	36.0	1.4	1.9
June	47.3	37.0	41.4	2.2	5.0
July	59.1	40.8	48.0	3.8	14.2
August	62.7	40.5	49.0	4.9	23.7
September	56.8	41.8	49.4	3.7	13.3
October					
November					
December					



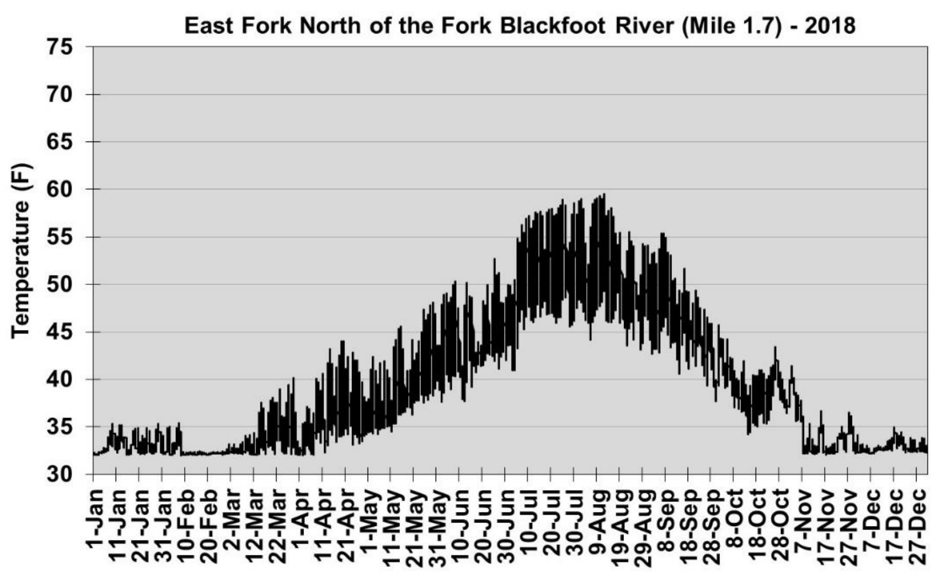
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
September	51.7	34.6	42.4	3.0	9.2
October	43.6	32.2	36.0	2.5	6.1
November	38.4	32.0	33.0	1.5	2.2
December	32.5	32.0	32.1	0.1	0.0
January	32.5	32.1	32.2	0.1	0.0
February	32.3	32.1	32.1	0.0	0.0
March	33.0	32.1	32.2	0.1	0.0
April	36.7	32.0	33.4	1.2	1.4
May	41.5	32.3	36.5	1.5	2.3
June	48.0	38.2	42.5	2.0	4.1
July	54.1	42.1	47.7	2.5	6.1
August	54.6	47.8	51.1	2.0	4.2



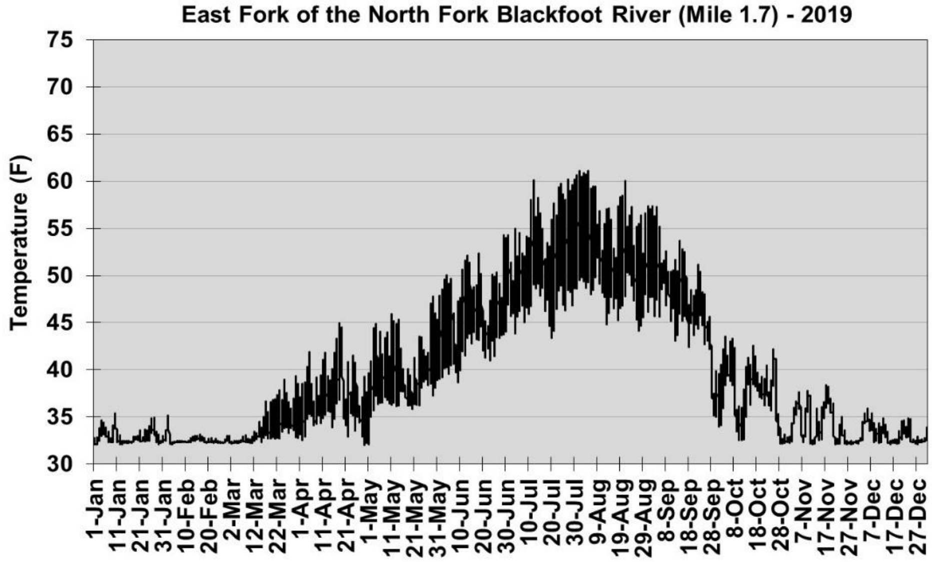
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.2	33.8	35.1	0.4	0.2
February	37.0	33.3	35.0	0.7	0.6
March	39.1	33.4	35.6	1.1	1.2
April	42.6	33.5	37.7	1.6	2.6
May	46.0	36.7	40.7	2.0	3.9
June	57.0	39.5	46.6	3.4	11.4
July	58.7	43.9	51.7	3.3	10.6
August	57.0	44.6	50.7	2.6	6.5
September	54.1	39.0	46.7	2.6	6.6
October	49.8	35.1	41.7	2.2	5.0
November	40.7	32.1	36.5	2.4	5.8
December	34.8	32.1	32.4	0.4	0.2



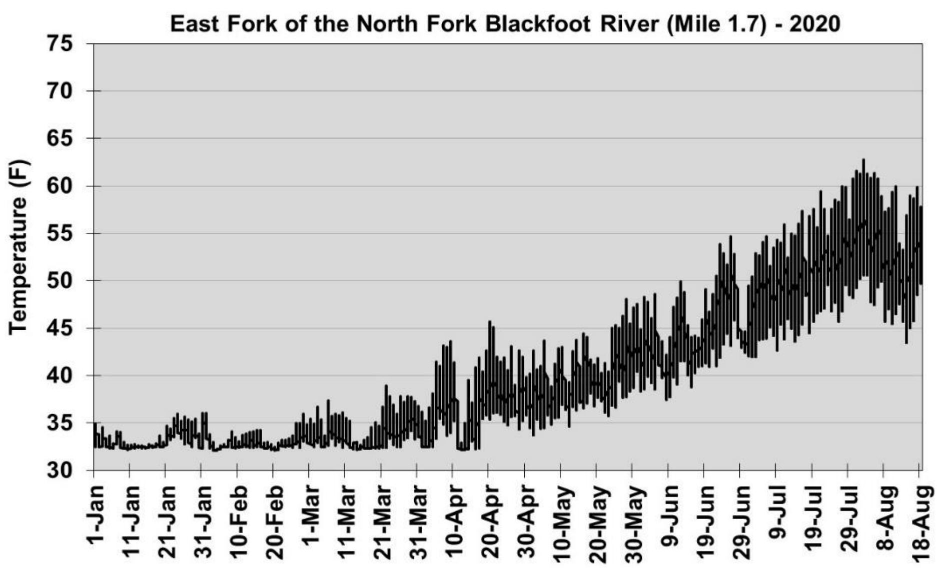
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.7	32.3	32.6	0.2	0.1
February	35.6	32.1	32.9	0.8	0.6
March	40.5	32.2	34.6	1.9	3.6
April	43.7	32.3	37.6	2.2	4.7
May	48.8	35.2	40.6	3.0	9.1
June	54.6	38.6	45.5	3.6	12.8
July	61.9	45.4	53.5	3.7	13.4
August	60.8	45.0	51.6	3.2	10.1
September	55.8	37.1	46.1	4.4	19.1
October	44.2	33.3	38.6	2.2	4.7
November	38.0	32.1	34.0	1.4	2.1
December	35.3	32.0	32.4	0.6	0.4



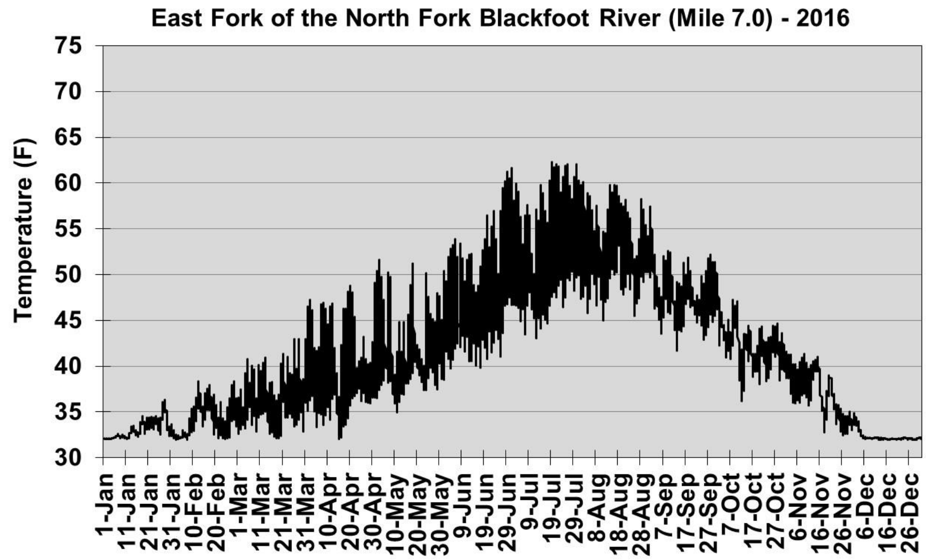
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.3	32.0	33.0	0.8	0.7
February	35.4	32.0	32.5	0.7	0.5
March	40.2	32.0	33.6	1.6	2.5
April	44.0	32.1	36.0	2.6	6.8
May	48.1	34.3	39.3	3.2	10.2
June	52.7	37.6	44.0	3.2	10.1
July	58.9	41.0	51.0	4.0	15.8
August	59.5	43.2	50.7	3.7	13.8
September	55.3	37.7	46.0	3.5	12.3
October	45.7	34.2	39.2	2.2	4.7
November	41.4	32.1	34.4	2.3	5.2
December	35.0	32.2	32.9	0.5	0.3



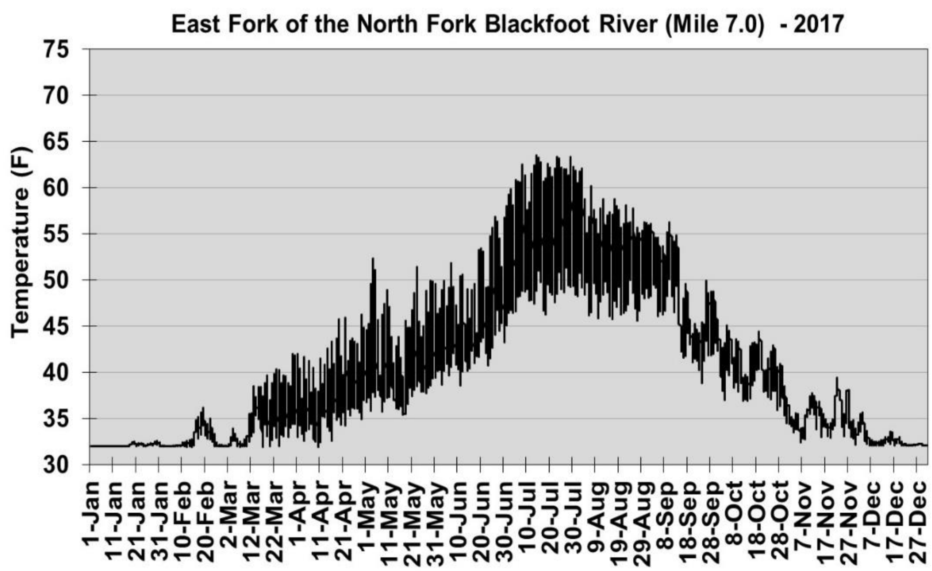
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.4	32.1	32.9	0.7	0.5
February	35.2	32.1	32.5	0.4	0.2
March	39.4	32.2	33.7	1.5	2.2
April	45.0	32.0	36.7	2.4	5.6
May	47.8	32.1	39.7	2.7	7.6
June	54.3	38.7	45.4	3.3	10.7
July	60.6	43.4	51.3	3.8	14.4
August	61.1	44.2	52.1	3.6	13.0
September	57.3	35.0	47.1	4.4	19.1
October	43.5	32.2	37.3	3.0	8.8
November	38.4	32.1	34.0	1.8	3.4
December	35.9	32.1	33.2	0.9	0.8



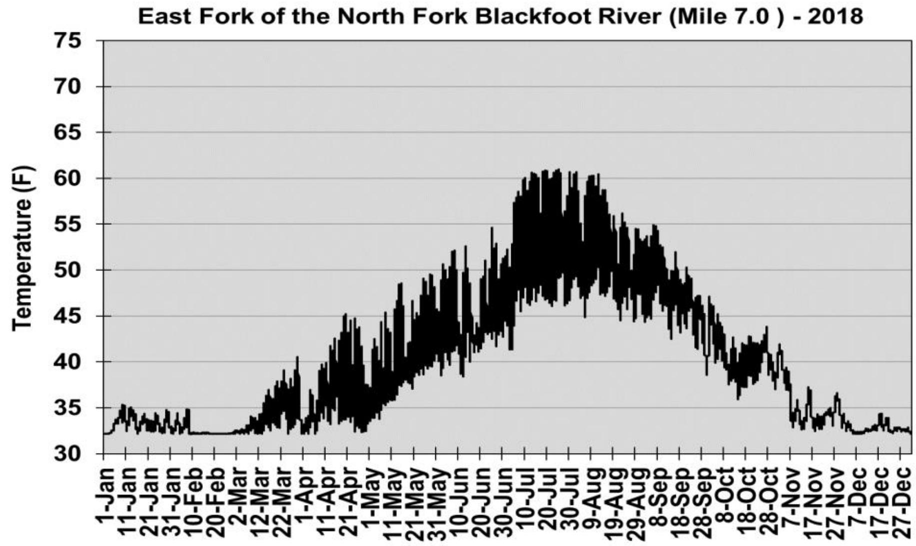
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.0	32.1	33.2	0.9	0.8
February	36.0	32.1	32.9	0.7	0.5
March	38.9	32.2	33.9	1.4	2.1
April	45.7	32.2	36.6	3.0	9.2
May	48.0	33.8	39.4	2.9	8.6
June	54.7	37.4	44.0	3.5	12.1
July	61.5	42.0	50.3	4.2	17.5
August	62.8	43.5	52.7	4.2	17.3
September					
October					
November					
December					



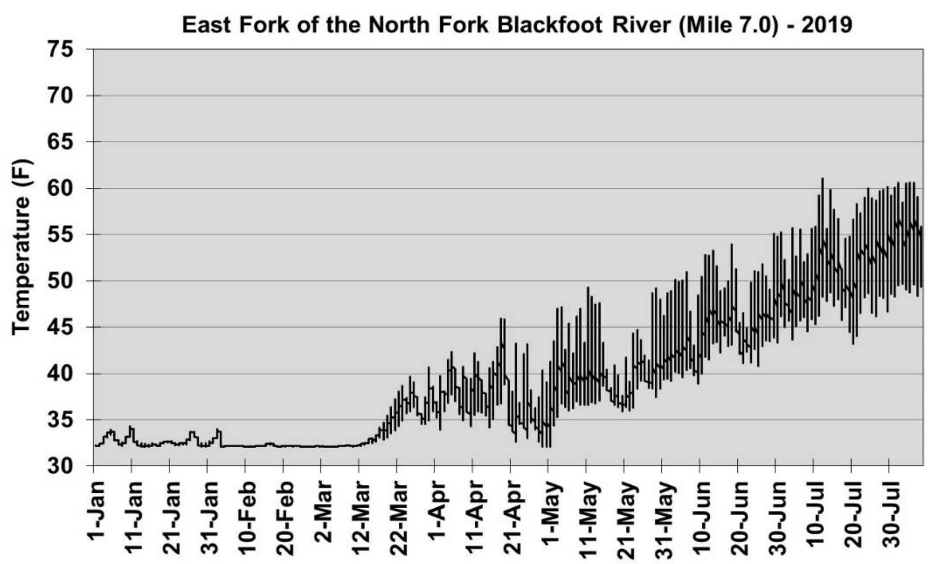
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.4	32.0	33.1	0.9	0.9
February	38.3	32.0	34.1	1.7	2.7
March	43.0	32.1	36.1	2.3	5.1
April	48.8	32.0	39.1	3.6	12.6
May	51.6	35.0	41.4	3.4	11.9
June	61.3	38.6	47.2	4.8	22.7
July	62.3	43.0	52.7	4.8	22.7
August	60.1	45.0	52.7	3.3	11.2
September	57.5	41.7	48.1	2.5	6.3
October	50.1	36.3	42.4	2.3	5.5
November	41.6	32.5	37.0	2.4	5.9
December	34.9	32.0	32.3	0.5	0.3



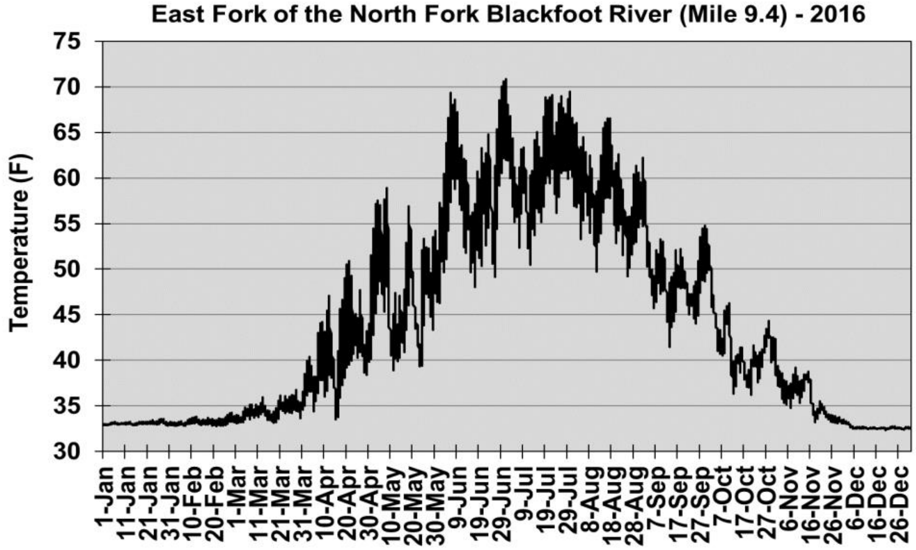
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.6	32.0	32.1	0.1	0.0
February	36.2	31.9	32.7	1.0	0.9
March	42.1	31.9	34.7	2.4	5.6
April	46.3	31.9	37.5	3.0	9.1
May	52.4	35.4	41.3	3.6	13.0
June	56.9	38.6	45.4	4.0	16.1
July	63.5	45.1	54.5	4.7	22.1
August	62.1	45.7	52.8	3.5	12.5
September	56.3	38.9	47.7	4.4	19.4
October	45.7	34.5	40.2	2.3	5.1
November	39.5	32.2	35.0	1.5	2.2
December	35.7	32.1	32.6	0.7	0.5



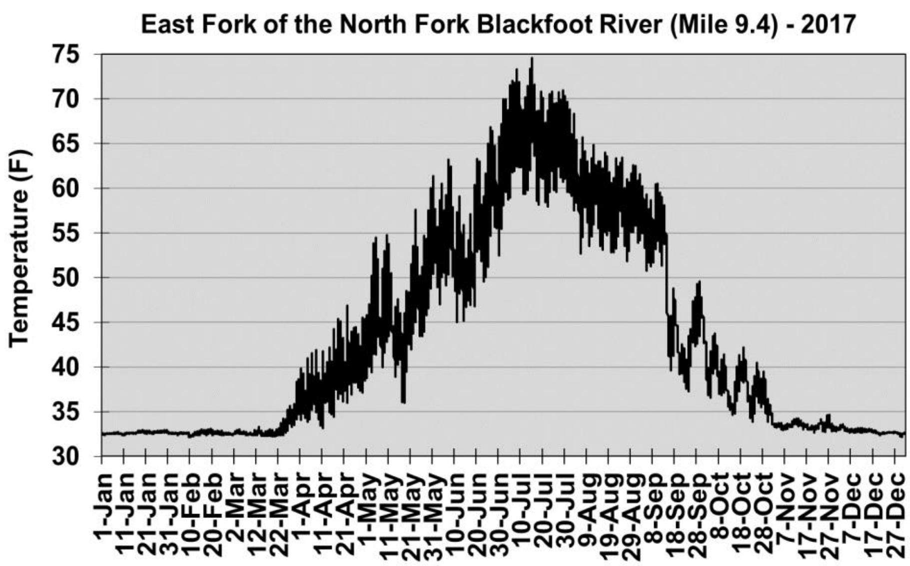
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.3	32.1	33.3	0.8	0.6
February	34.8	32.1	32.4	0.6	0.3
March	40.5	32.1	34.2	1.8	3.4
April	45.2	32.1	36.2	3.1	9.9
May	49.5	33.6	40.1	3.7	13.4
June	54.6	38.4	44.5	3.4	11.3
July	61.0	41.3	52.0	4.7	22.3
August	60.7	44.4	51.7	3.8	14.8
September	54.9	38.6	47.5	3.4	11.6
October	47.1	35.9	40.7	2.1	4.3
November	41.9	32.4	35.3	2.3	5.2
December	34.4	32.1	32.7	0.5	0.2



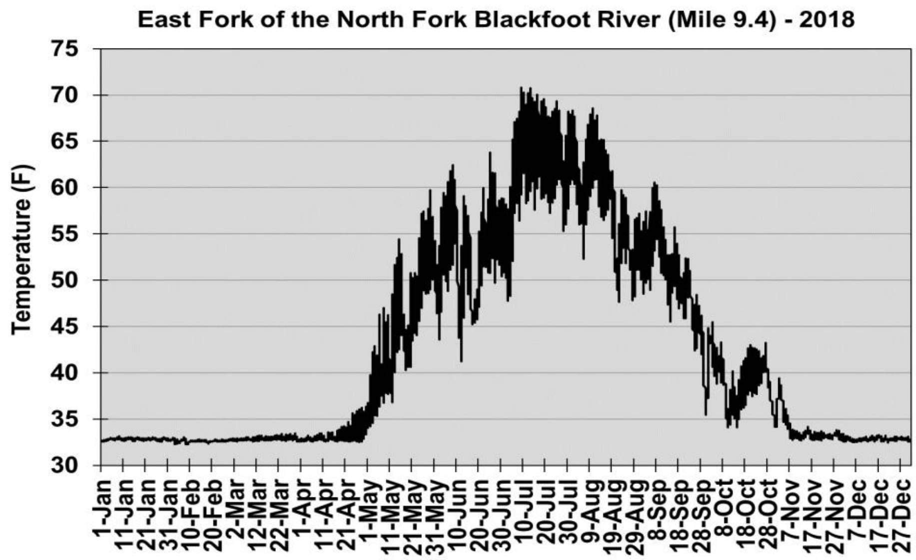
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.3	32.1	32.6	0.5	0.2
February	34.0	32.1	32.2	0.3	0.1
March	40.6	32.1	34.1	2.2	4.8
April	45.9	32.1	37.5	2.7	7.3
May	49.3	32.1	40.1	3.3	10.7
June	55.1	38.9	45.4	3.5	12.4
July	61.0	43.3	51.3	4.1	17.0
August	60.6	48.4	54.4	3.7	13.7
September					
October					
November					
December					



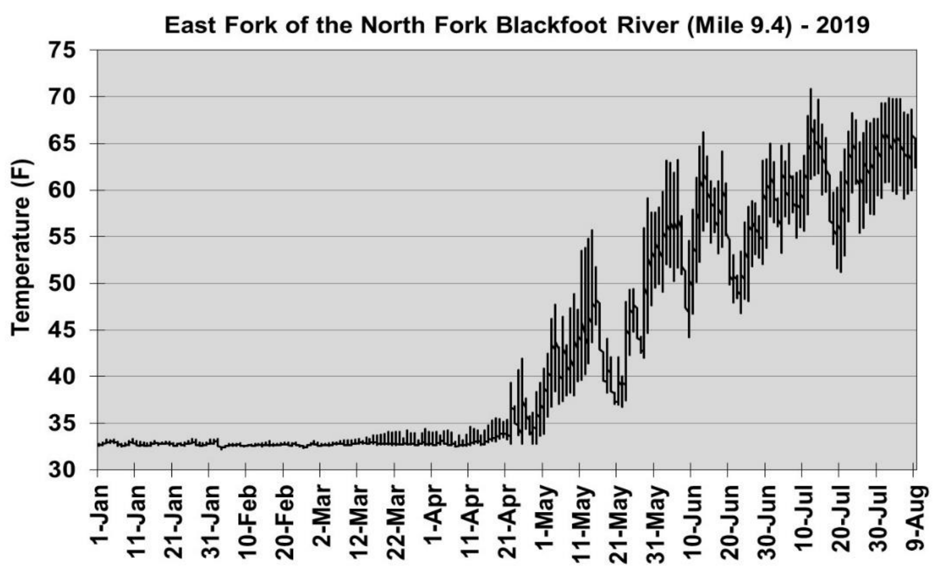
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.6	32.8	33.1	0.1	0.0
February	34.3	32.7	33.2	0.3	0.1
March	36.8	33.1	34.4	0.8	0.6
April	50.9	33.5	40.5	3.6	12.7
May	58.9	38.9	47.3	4.6	21.4
June	70.6	46.3	58.3	5.2	27.2
July	70.8	50.5	61.4	4.2	17.6
August	66.6	49.2	58.0	3.7	13.6
September	62.2	41.5	49.3	3.4	11.7
October	52.5	36.2	41.5	3.2	9.9
November	39.4	33.1	35.7	1.8	3.4
December	33.5	32.3	32.6	0.2	0.0



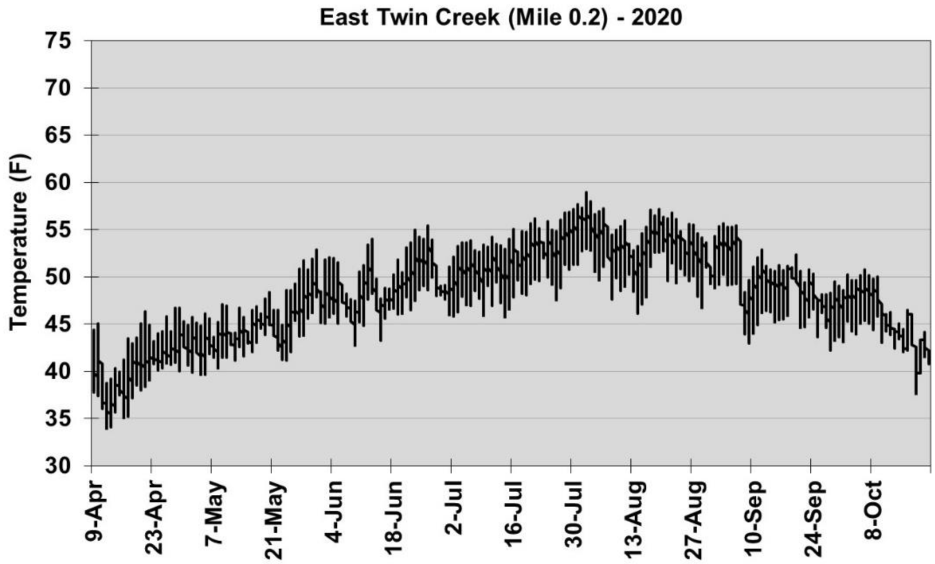
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.9	32.4	32.6	0.1	0.0
February	33.1	32.1	32.6	0.1	0.0
March	38.7	32.2	33.1	1.1	1.3
April	46.8	33.1	38.7	2.9	8.4
May	61.3	36.0	46.5	4.8	23.1
June	66.9	45.0	54.6	4.8	22.9
July	74.6	55.5	65.5	3.8	14.8
August	68.8	51.9	59.4	3.3	11.1
September	61.6	37.3	49.0	7.0	49.0
October	45.5	33.9	38.2	2.4	5.8
November	34.8	32.6	33.4	0.4	0.1
December	33.6	32.2	32.8	0.2	0.1



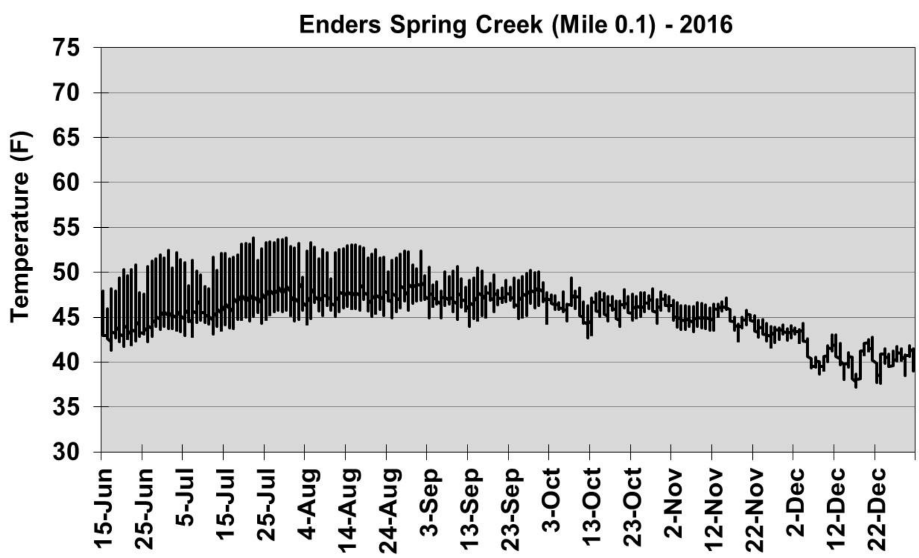
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.1	32.6	32.8	0.1	0.0
February	33.0	32.2	32.6	0.1	0.0
March	33.4	32.5	32.8	0.2	0.0
April	36.3	32.5	33.2	0.8	0.6
May	59.7	34.0	44.6	6.1	37.8
June	63.8	41.2	52.5	4.6	21.5
July	70.8	47.8	62.2	5.0	24.9
August	68.6	47.6	58.4	5.1	25.7
September	60.6	35.4	50.1	4.9	23.9
October	45.5	34.1	39.1	2.6	6.8
November	39.4	32.7	33.8	1.4	2.1
December	33.4	32.4	32.8	0.2	0.0



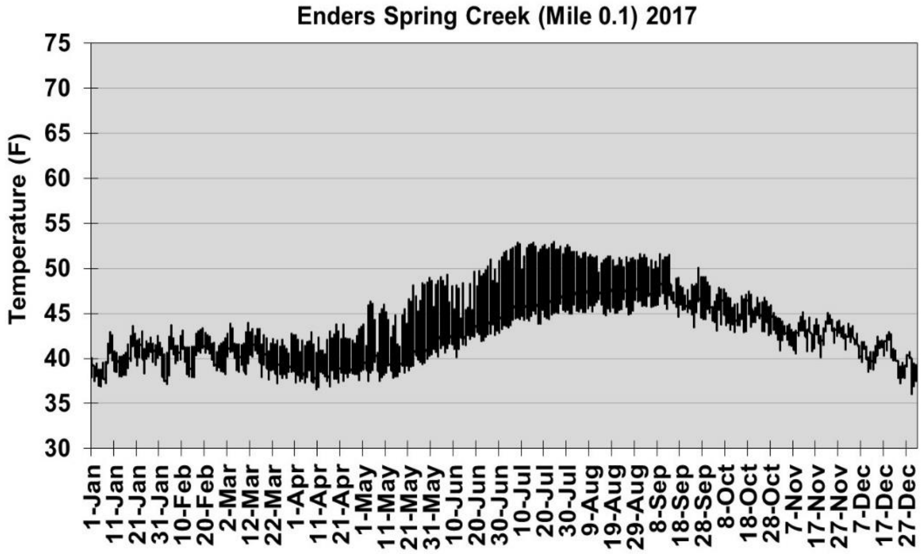
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.3	32.5	32.8	0.2	0.0
February	33.3	32.2	32.7	0.2	0.0
March	34.4	32.5	33.0	0.3	0.1
April	42.0	32.5	34.1	1.7	2.9
May	59.1	33.9	44.0	5.2	27.3
June	66.2	44.2	55.2	4.5	20.0
July	70.9	51.2	61.1	3.9	15.6
August	69.9	59.1	64.7	3.1	9.3
September					
October					
November					
December					



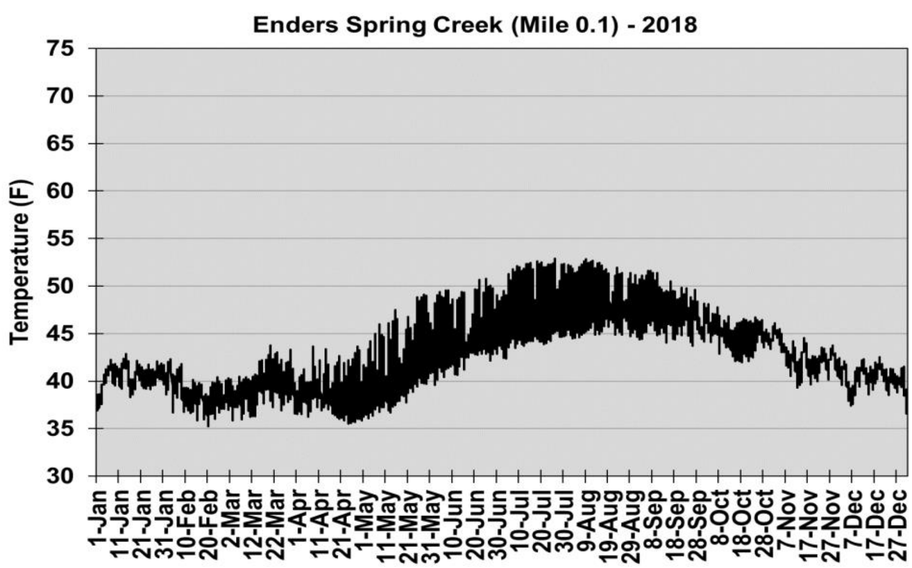
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April	46.8	34.0	40.5	2.9	8.3
May	52.9	39.6	44.6	2.6	6.6
June	55.5	42.8	48.7	2.4	5.9
July	57.7	45.9	51.5	2.7	7.1
August	59.0	46.1	52.9	2.5	6.2
September	55.7	42.2	48.9	2.9	8.4
October	50.8	37.7	45.2	2.7	7.5
November					
December					



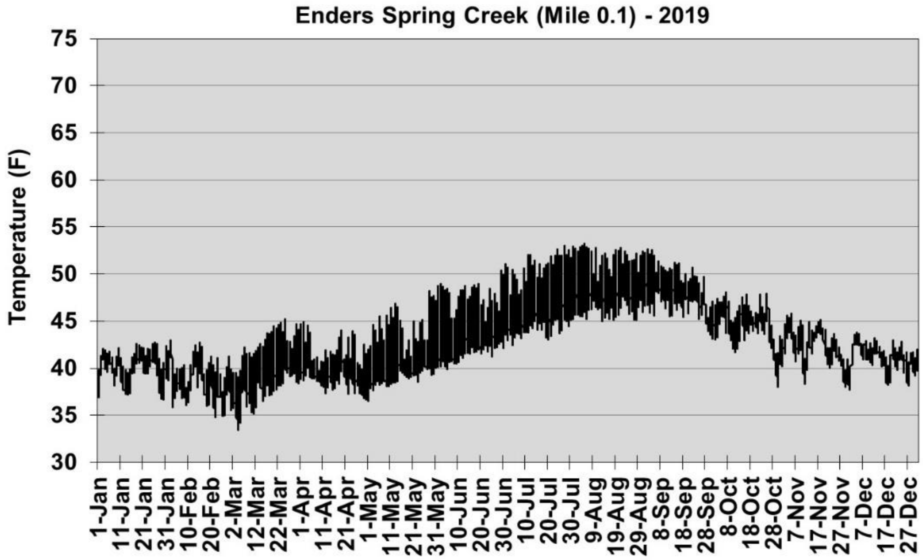
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	52.0	41.4	45.4	2.7	7.3
July	53.9	42.9	47.7	3.0	8.7
August	53.3	44.4	48.4	2.3	5.3
September	52.3	43.9	47.5	1.5	2.1
October	49.3	42.7	46.3	1.1	1.1
November	47.3	41.8	44.6	1.2	1.4
December	44.3	37.2	40.8	1.5	2.2



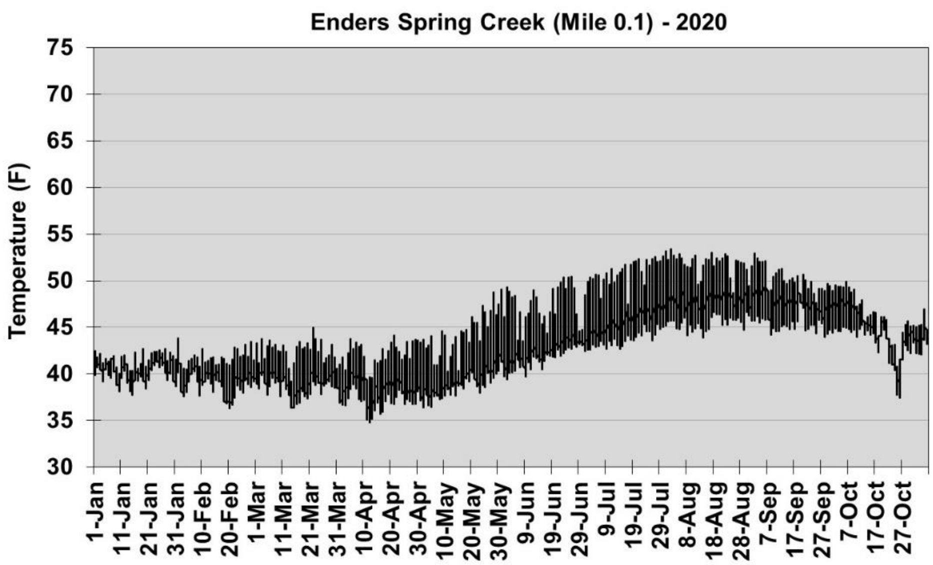
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	43.6	36.9	40.1	1.5	2.1
February	43.7	37.2	40.5	1.3	1.7
March	44.0	37.3	40.3	1.4	1.8
April	43.8	36.6	39.5	1.6	2.5
May	48.9	37.5	41.4	2.6	6.7
June	51.0	40.2	44.4	2.5	6.4
July	53.0	43.3	47.7	2.8	7.7
August	51.9	44.8	47.9	2.0	3.9
September	51.6	43.5	47.3	1.7	2.8
October	48.0	42.1	44.9	1.2	1.4
November	45.2	40.1	42.9	1.0	0.9
December	43.9	36.1	40.5	1.6	2.5



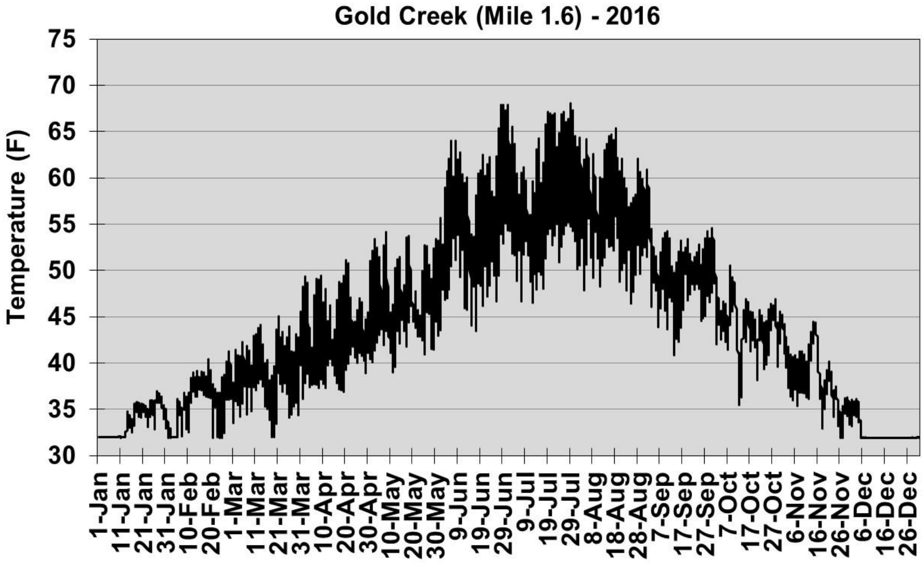
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	42.9	36.9	40.4	1.1	1.3
February	42.3	35.2	38.6	1.4	2.1
March	43.8	35.9	38.9	1.4	2.0
April	43.7	35.5	38.5	1.7	3.0
May	49.1	36.1	40.7	2.9	8.7
June	50.8	39.6	44.3	2.5	6.4
July	52.9	42.4	47.1	2.7	7.4
August	52.8	44.5	48.0	2.3	5.1
September	51.6	43.7	47.2	1.8	3.2
October	48.1	42.0	44.9	1.3	1.6
November	46.1	39.3	42.6	1.5	2.1
December	42.5	36.6	40.3	1.1	1.3



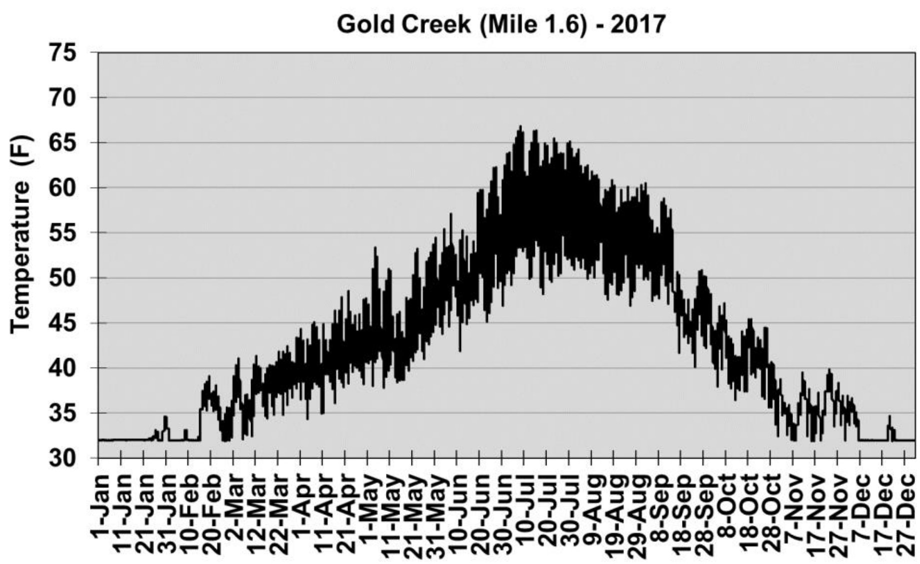
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	42.8	36.7	40.2	1.4	1.9
February	42.9	34.8	38.7	1.7	2.9
March	45.2	33.4	39.3	2.4	5.5
April	44.9	36.7	39.8	1.6	2.6
May	48.2	36.6	41.0	2.2	4.9
June	50.4	39.9	43.9	2.4	5.7
July	53.0	42.5	47.0	2.7	7.2
August	53.2	45.0	48.6	2.2	4.9
September	52.6	43.5	48.1	1.8	3.3
October	48.0	38.0	44.5	1.9	3.6
November	45.9	38.0	42.4	1.7	2.9
December	43.8	37.7	41.2	1.2	1.3



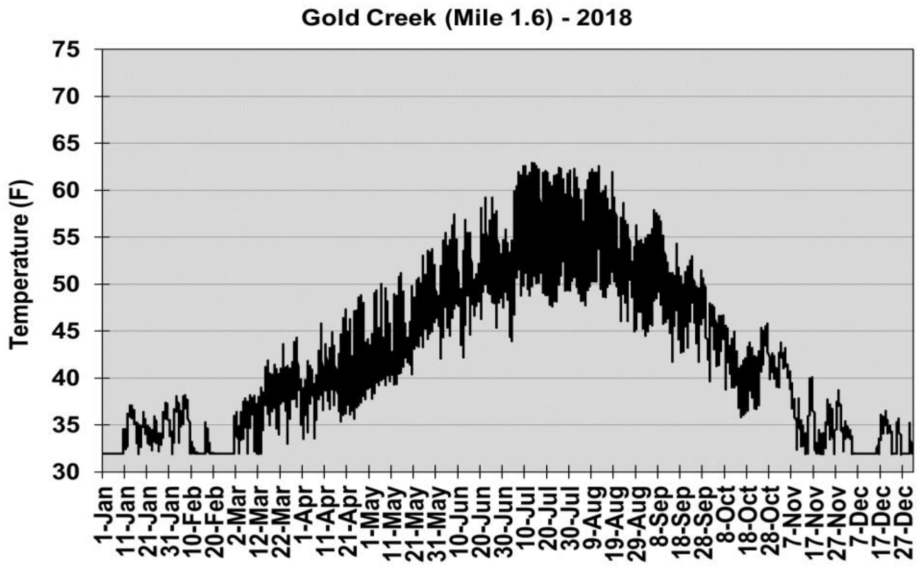
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	42.7	37.8	40.6	1.0	0.9
February	43.8	36.3	39.8	1.3	1.7
March	45.0	36.4	39.9	1.6	2.5
April	44.1	34.8	39.2	2.0	4.0
May	49.1	36.5	40.7	2.5	6.5
June	50.4	39.4	43.8	2.4	5.8
July	53.2	42.5	46.7	2.8	7.8
August	53.4	43.9	48.3	2.4	5.7
September	52.9	43.9	47.6	2.0	3.8
October	49.9	37.5	44.8	2.4	5.8
November	46.9	42.2	43.9	1.2	1.4
December					



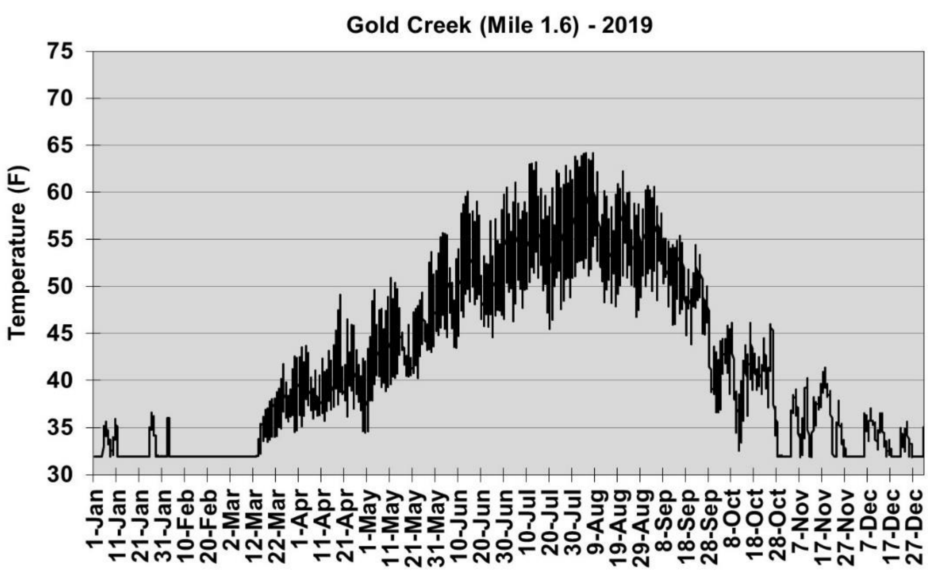
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.9	31.9	33.6	1.5	2.3
February	41.3	31.9	35.8	2.4	5.7
March	45.5	32.0	38.7	2.8	7.7
April	51.1	36.1	42.7	3.3	10.8
May	54.1	39.0	46.4	3.4	11.2
June	67.9	43.5	54.8	5.3	28.5
July	68.1	46.6	58.0	5.0	25.4
August	65.4	46.5	56.6	4.1	16.7
September	60.9	40.9	50.1	3.1	9.5
October	53.2	35.5	44.2	2.7	7.4
November	44.5	31.9	38.1	3.0	8.8
December	36.2	31.9	32.3	1.1	1.1



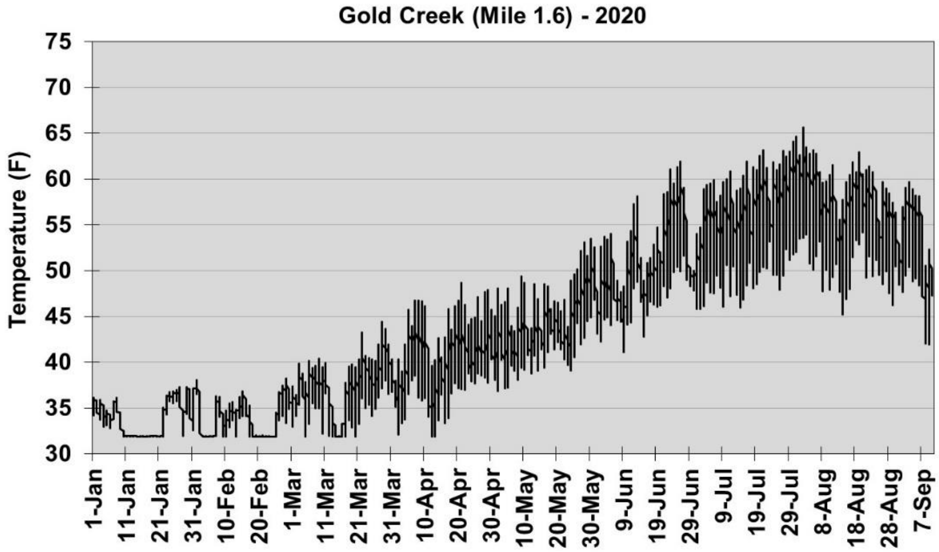
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.6	31.9	32.1	0.4	0.2
February	39.1	31.9	33.6	2.1	4.2
March	43.4	32.1	37.6	2.3	5.4
April	48.5	34.3	41.1	2.8	7.8
May	54.4	37.8	44.7	3.8	14.1
June	62.3	41.9	51.2	4.2	17.6
July	66.8	48.2	58.0	4.7	22.1
August	64.2	46.9	55.7	3.9	14.9
September	60.5	40.1	49.6	4.6	21.5
October	48.2	32.4	41.0	2.9	8.2
November	39.8	31.9	35.3	2.0	4.0
December	36.9	31.9	32.6	1.2	1.5



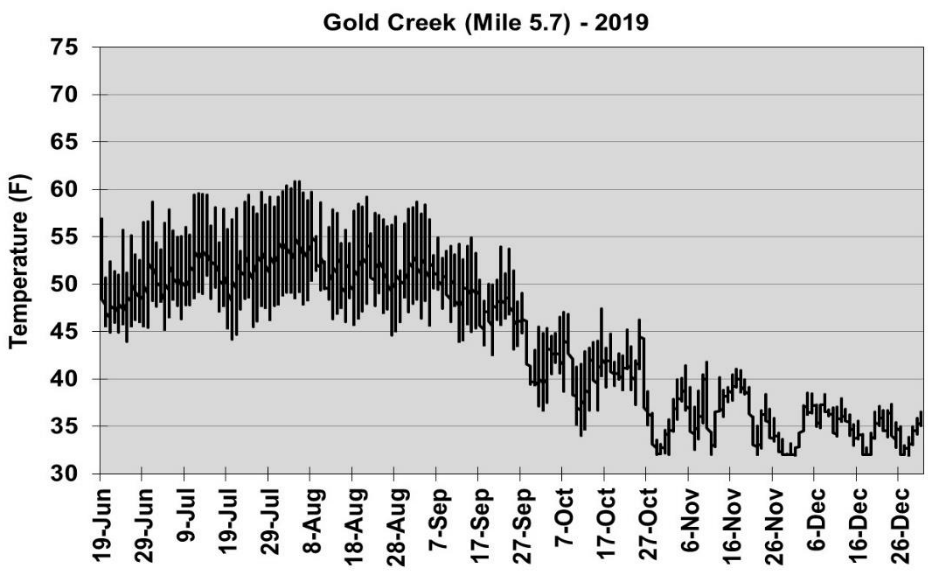
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.4	31.9	33.8	1.7	2.8
February	38.2	31.9	33.2	1.9	3.7
March	44.3	31.9	37.2	2.8	7.8
April	48.9	33.5	39.9	3.1	9.4
May	53.8	37.8	44.9	3.6	13.2
June	59.3	42.1	50.5	3.5	12.5
July	62.9	43.9	55.0	4.5	20.5
August	62.6	45.0	53.8	4.1	16.9
September	57.9	41.7	49.1	3.5	12.4
October	48.0	35.8	42.1	2.6	6.9
November	43.8	31.9	36.3	3.3	10.9
December	36.5	31.8	33.0	1.4	1.9



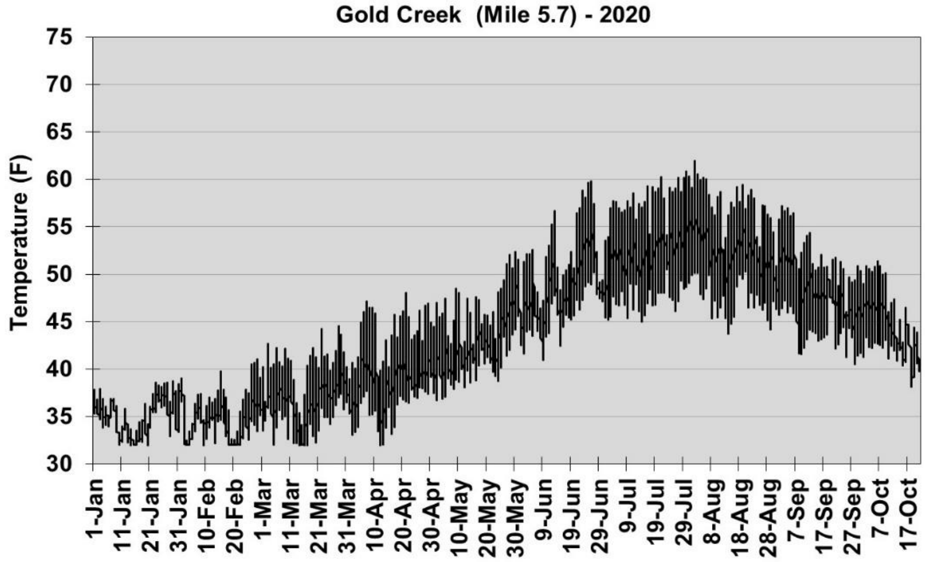
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.6	31.9	32.7	1.2	1.5
February	36.0	31.9	32.0	0.5	0.3
March	42.6	31.9	34.6	2.9	8.2
April	49.1	34.5	39.7	2.5	6.5
May	53.7	34.6	44.2	3.3	10.8
June	60.1	43.5	51.1	3.8	14.6
July	63.8	45.5	55.0	4.1	16.6
August	64.2	46.8	55.6	3.9	15.0
September	60.6	38.5	50.6	4.6	21.1
October	46.2	31.9	39.6	3.8	14.7
November	41.4	31.8	35.1	2.9	8.4
December	37.1	31.8	33.3	1.5	2.4



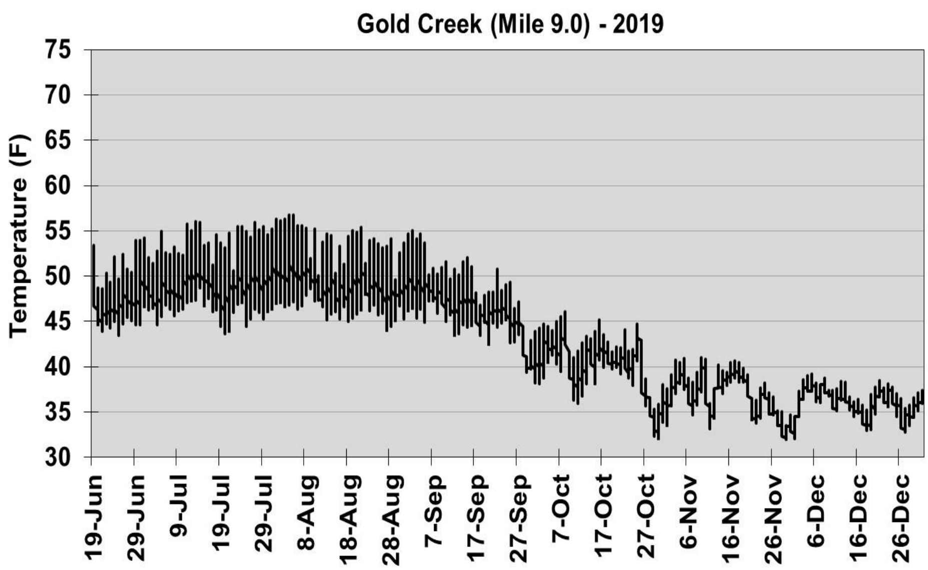
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.3	31.9	33.8	1.8	3.2
February	38.2	31.8	33.7	1.8	3.4
March	44.4	31.8	36.7	2.9	8.6
April	48.7	31.8	39.9	3.8	14.2
May	53.5	36.9	43.8	3.5	12.5
June	61.9	41.2	50.1	4.2	18.0
July	64.6	45.9	54.6	4.5	20.5
August	65.7	45.3	55.2	4.2	17.4
September	59.7	41.9	52.0	4.5	19.8
October					
November					
December					



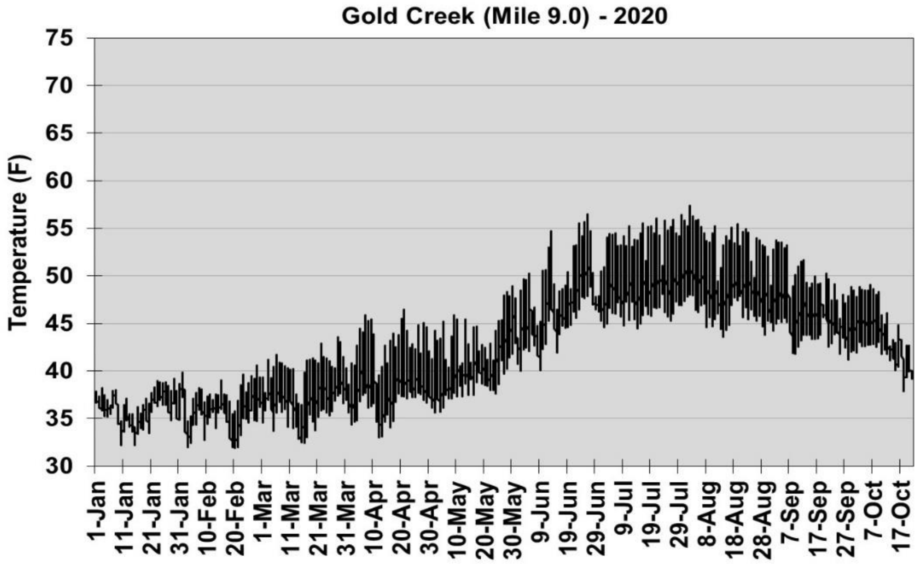
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	56.9	43.9	49.3	3.1	9.6
July	59.7	44.1	52.2	3.6	12.7
August	60.9	44.6	52.4	3.5	12.3
September	58.7	39.4	48.7	3.9	15.1
October	47.4	32.0	40.0	3.6	12.9
November	41.8	32.0	36.2	2.6	6.9
December	38.6	32.0	35.0	1.7	2.8



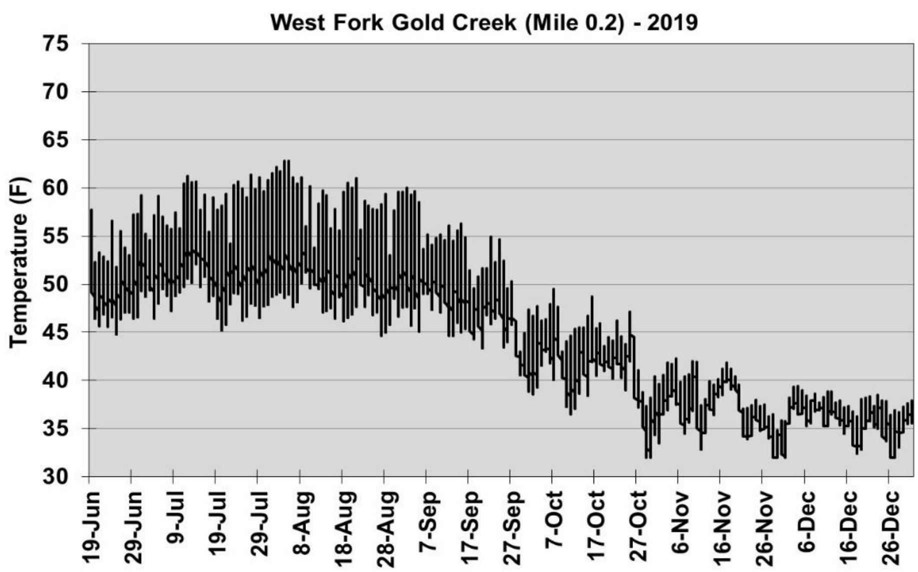
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.7	32.0	35.0	1.8	3.2
February	41.0	32.0	34.7	2.0	4.0
March	44.5	32.0	37.0	2.8	7.9
April	48.0	32.0	39.2	3.4	11.8
May	52.4	36.7	42.9	3.3	11.0
June	59.8	41.0	48.7	3.8	14.1
July	60.8	45.1	52.3	3.9	14.9
August	61.9	43.8	52.1	3.8	14.7
September	57.2	40.5	47.8	3.5	12.2
October	51.4	38.1	44.2	3.0	8.9
November					
December					



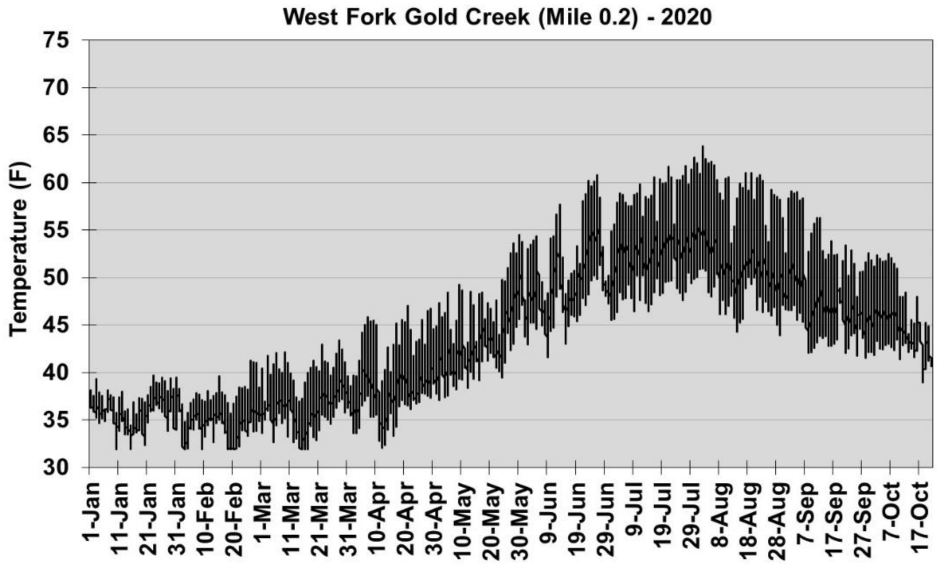
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	54.0	43.4	47.4	2.5	6.5
July	56.0	43.6	49.5	2.9	8.6
August	56.8	44.1	49.6	2.9	8.6
September	55.0	39.4	46.7	3.0	9.2
October	46.0	32.1	40.1	2.9	8.4
November	41.0	32.0	37.0	2.2	4.7
December	39.2	32.0	36.2	1.4	2.0



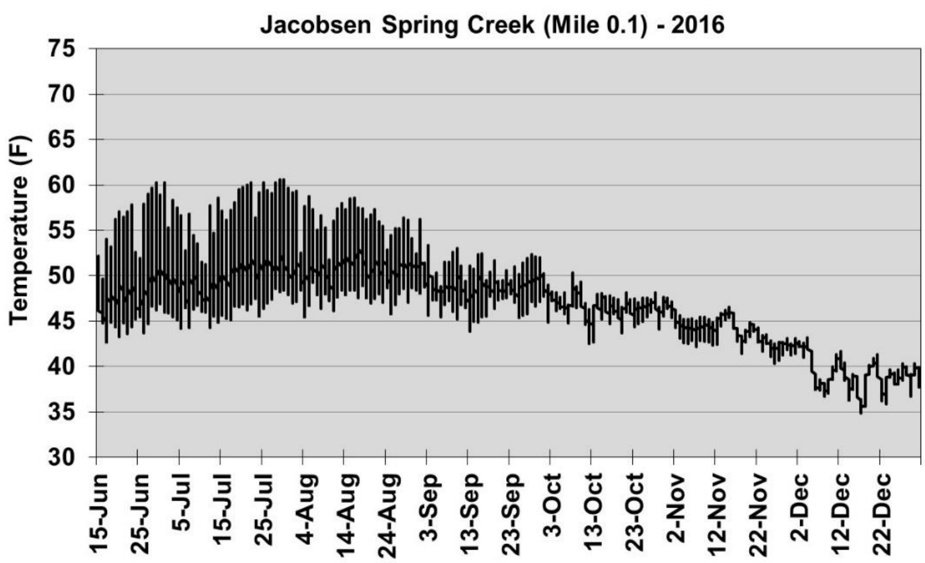
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.2	32.2	36.2	1.4	2.1
February	40.6	31.9	35.9	1.8	3.1
March	43.6	32.4	37.5	2.3	5.1
April	46.5	33.0	38.9	2.8	7.6
May	48.9	35.7	40.7	2.7	7.5
June	56.5	40.1	46.8	3.3	10.8
July	56.4	44.4	49.5	3.0	8.8
August	57.4	43.6	49.3	3.0	9.2
September	53.8	41.2	46.3	2.6	6.9
October	49.1	37.9	43.4	2.5	6.1
November					
December					



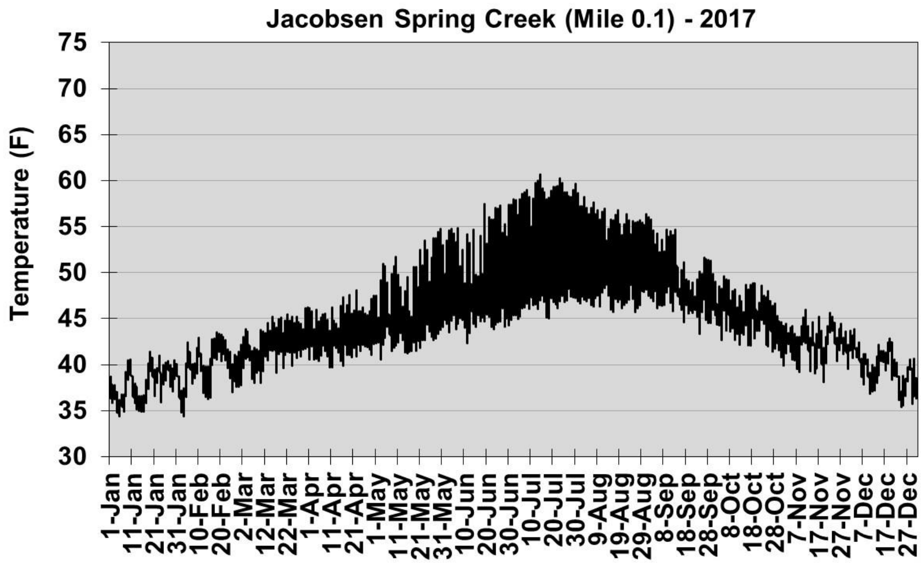
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	57.7	44.9	50.1	3.1	9.3
July	61.4	45.3	53.0	3.7	13.5
August	62.8	44.6	52.6	4.0	16.2
September	60.0	40.6	49.1	3.8	14.6
October	49.5	32.0	41.6	3.3	11.2
November	42.3	31.9	37.4	2.3	5.3
December	39.4	31.9	36.2	1.5	2.1



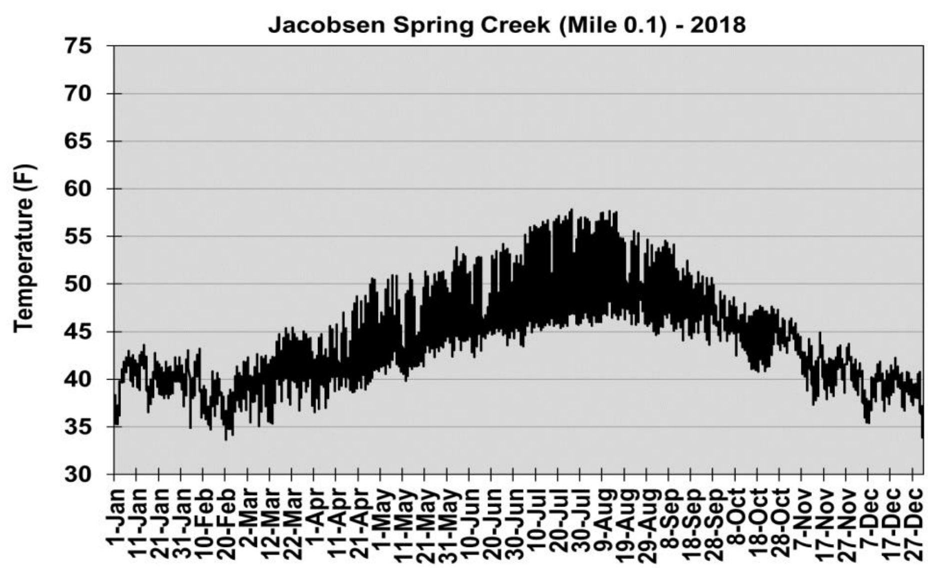
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.7	31.9	36.0	1.5	2.3
February	41.2	31.9	35.2	1.9	3.5
March	43.4	31.9	36.9	2.5	6.1
April	47.0	32.0	38.9	3.2	10.3
May	54.5	37.1	43.7	3.7	13.4
June	60.8	41.6	49.7	3.8	14.8
July	62.7	45.6	53.4	3.9	15.1
August	63.8	44.0	52.6	4.4	19.4
September	59.1	41.6	48.1	3.9	15.4
October	52.5	39.0	44.9	3.0	8.9
November					
December					



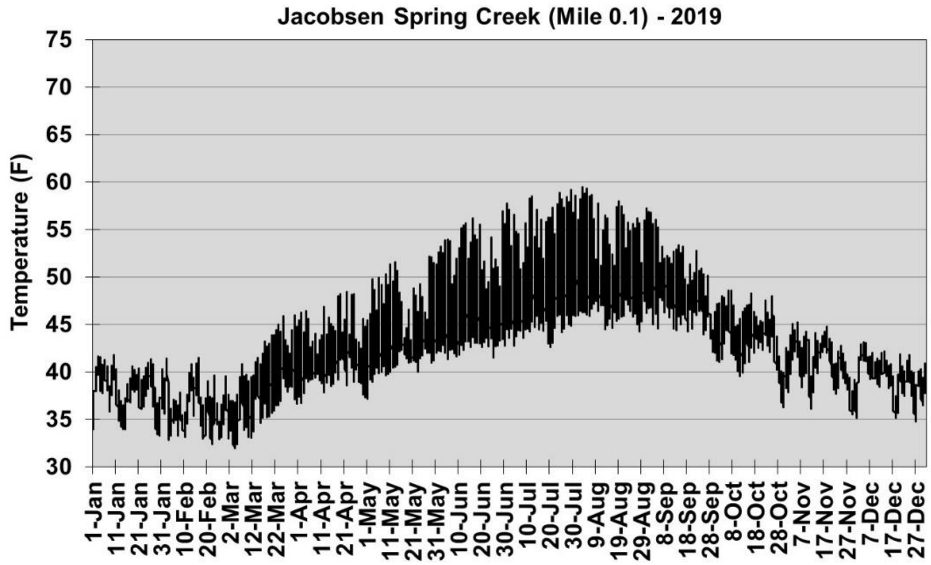
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	60.2	42.8	49.4	4.2	17.3
July	60.6	44.3	50.9	4.1	16.9
August	59.4	45.6	51.3	3.1	9.5
September	56.3	43.9	48.7	1.9	3.6
October	50.3	42.5	46.6	1.3	1.7
November	47.1	40.3	43.7	1.4	2.0
December	43.2	34.9	39.2	1.8	3.2



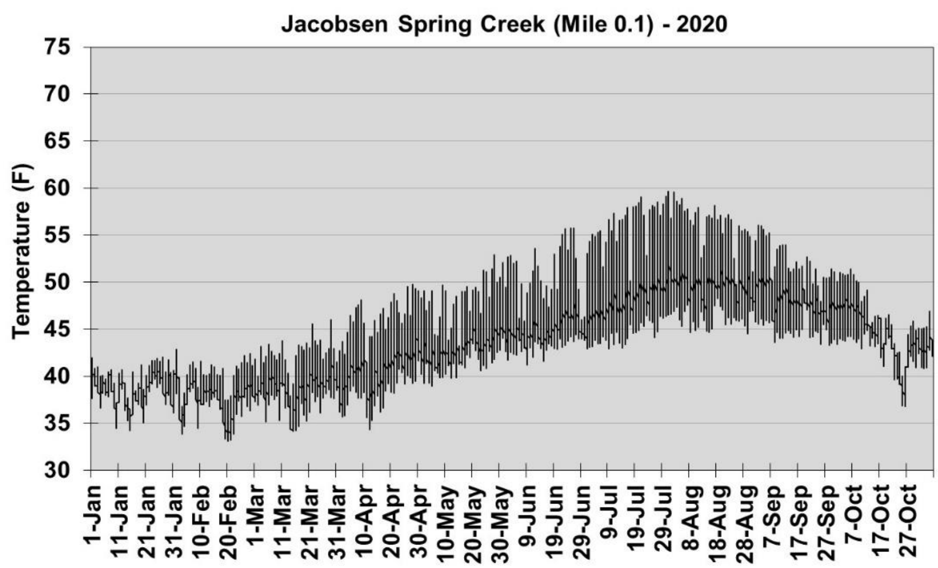
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	41.4	34.4	37.8	1.7	3.0
February	43.5	34.4	39.7	2.0	3.8
March	46.2	37.8	42.0	1.7	2.9
April	48.0	39.7	43.2	1.7	3.0
May	54.7	40.6	45.8	3.1	9.3
June	57.5	42.3	48.4	3.4	11.7
July	60.7	44.9	51.6	4.2	17.4
August	58.2	45.7	51.0	3.1	9.3
September	56.0	43.4	48.7	2.5	6.2
October	49.6	40.8	45.2	1.8	3.4
November	45.9	38.1	42.3	1.4	2.0
December	43.8	35.4	39.7	1.9	3.4



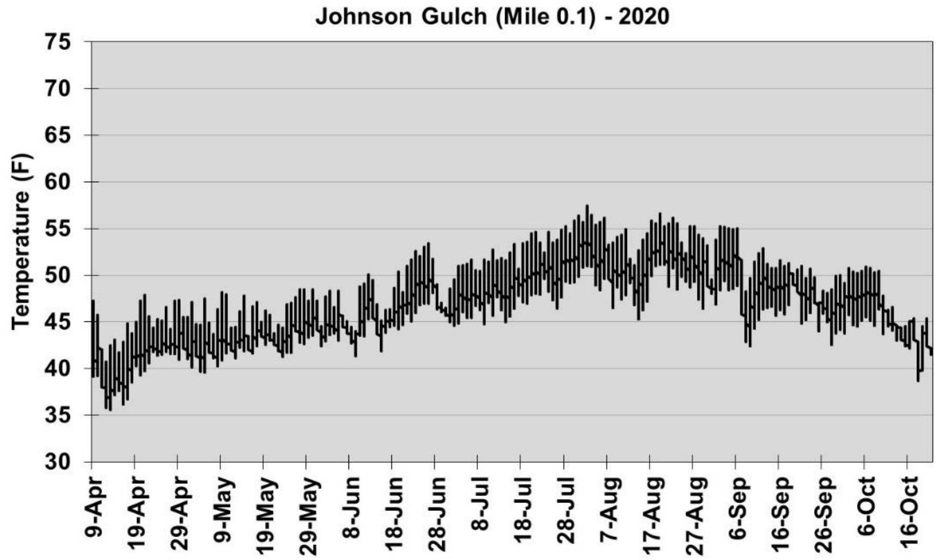
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	43.6	35.3	40.1	1.6	2.6
February	43.2	33.6	38.3	2.0	4.1
March	45.4	35.1	40.2	2.2	4.8
April	50.6	36.5	42.1	2.8	7.8
May	51.3	39.8	45.0	2.8	7.7
June	54.2	42.3	47.1	2.8	7.8
July	57.9	43.4	49.8	3.5	12.4
August	57.7	45.6	50.0	3.1	9.3
September	54.6	43.6	48.1	2.3	5.5
October	49.2	40.8	44.9	1.8	3.1
November	46.4	37.3	41.8	1.9	3.8
December	42.2	33.9	39.1	1.5	2.3



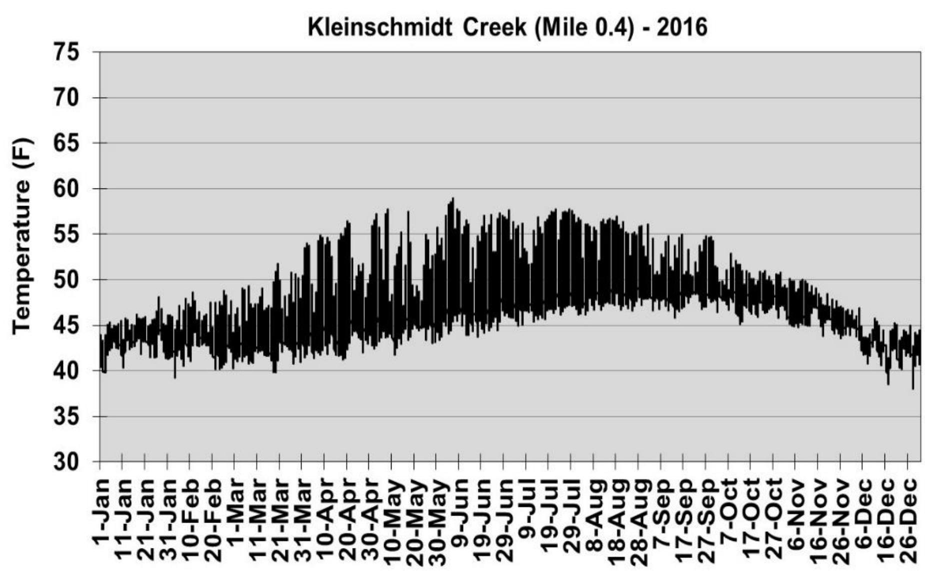
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	41.8	33.3	38.1	2.0	3.9
February	41.5	32.4	36.2	2.0	3.9
March	46.0	32.0	38.2	3.0	8.9
April	48.5	36.7	41.5	2.4	5.6
May	52.2	37.2	43.9	2.9	8.7
June	57.0	41.4	46.7	3.6	12.8
July	59.2	42.7	49.1	4.0	15.8
August	59.5	44.3	49.9	3.4	11.8
September	56.9	42.0	48.1	2.7	7.5
October	48.6	36.3	43.4	2.4	5.9
November	45.3	35.5	40.9	2.1	4.4
December	43.2	34.8	39.6	1.6	2.7



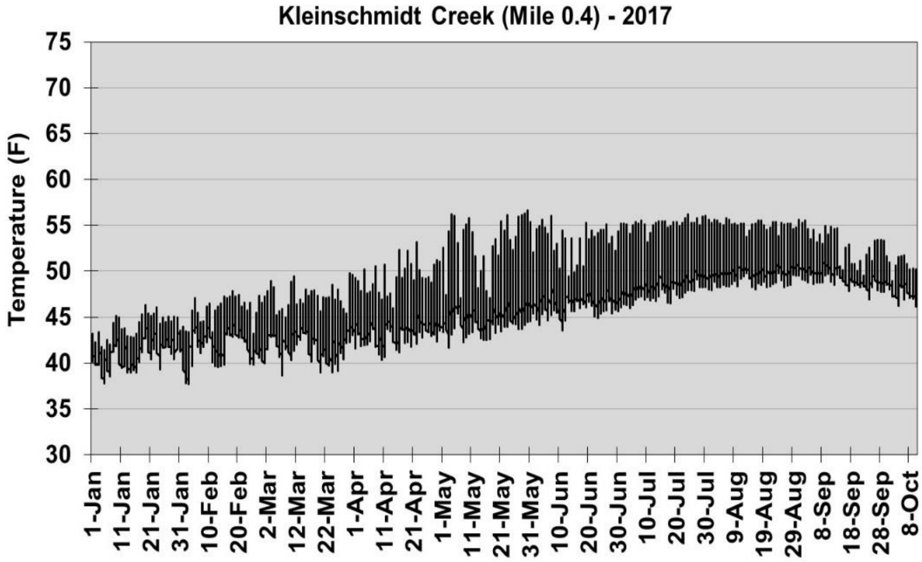
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	42.1	34.3	38.7	1.5	2.4
February	42.8	33.1	38.0	1.9	3.8
March	46.0	34.2	39.2	2.2	5.0
April	49.7	34.4	41.5	3.2	10.5
May	52.9	39.0	44.0	2.9	8.2
June	55.8	41.2	46.2	3.1	9.6
July	59.7	42.9	49.2	4.1	16.9
August	59.5	44.6	50.2	3.5	12.2
September	56.1	43.3	48.0	2.8	7.6
October	51.4	36.8	44.4	2.9	8.3
November	46.9	40.9	43.2	1.5	2.3
December					



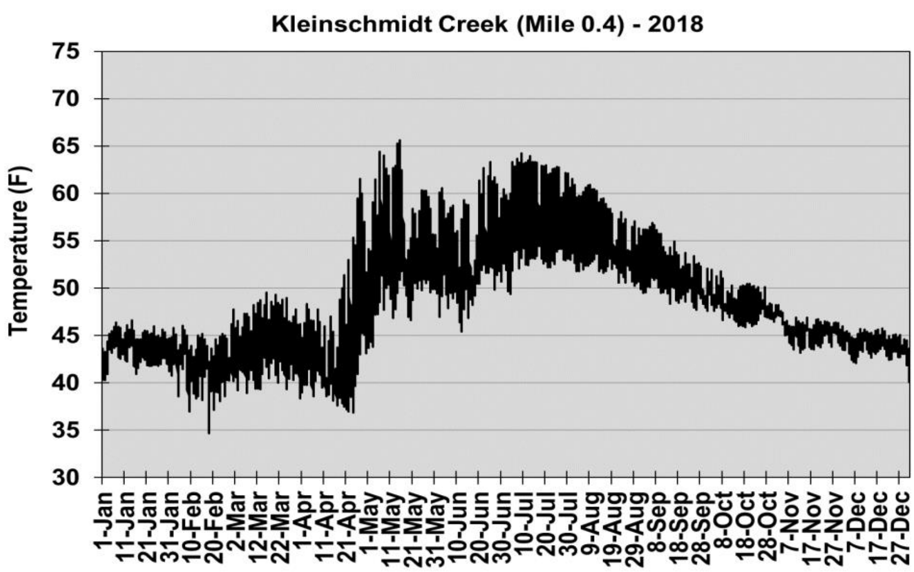
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April	47.9	35.5	41.6	2.6	7.0
May	48.5	39.6	43.6	1.8	3.4
June	53.4	41.4	46.3	2.4	5.6
July	56.4	44.6	49.5	2.5	6.5
August	57.4	45.4	51.4	2.4	5.5
September	55.2	42.5	48.5	2.6	6.6
October	50.9	38.7	45.4	2.7	7.1
November					
December					



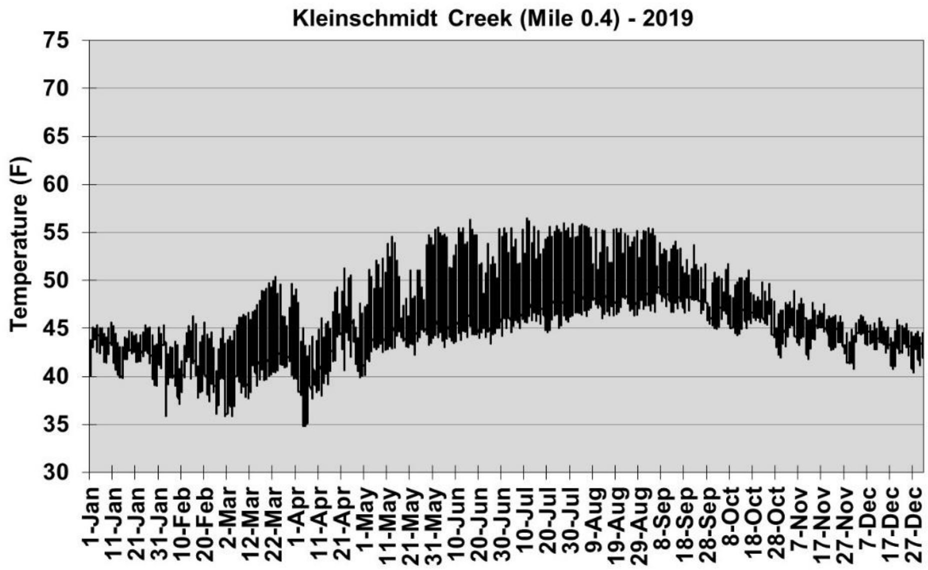
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	48.0	39.9	43.4	1.3	1.8
February	48.8	39.4	43.5	1.8	3.3
March	51.8	39.9	44.0	2.4	5.7
April	56.4	41.3	46.3	3.7	13.5
May	57.8	41.9	47.4	3.6	12.8
June	58.9	43.8	49.4	3.9	15.1
July	57.8	45.0	50.0	3.5	12.0
August	56.9	46.2	50.4	2.9	8.3
September	56.0	45.9	49.4	2.0	4.0
October	52.9	45.1	48.2	1.3	1.7
November	50.0	43.5	46.3	1.4	1.9
December	46.9	38.1	43.0	1.5	2.1



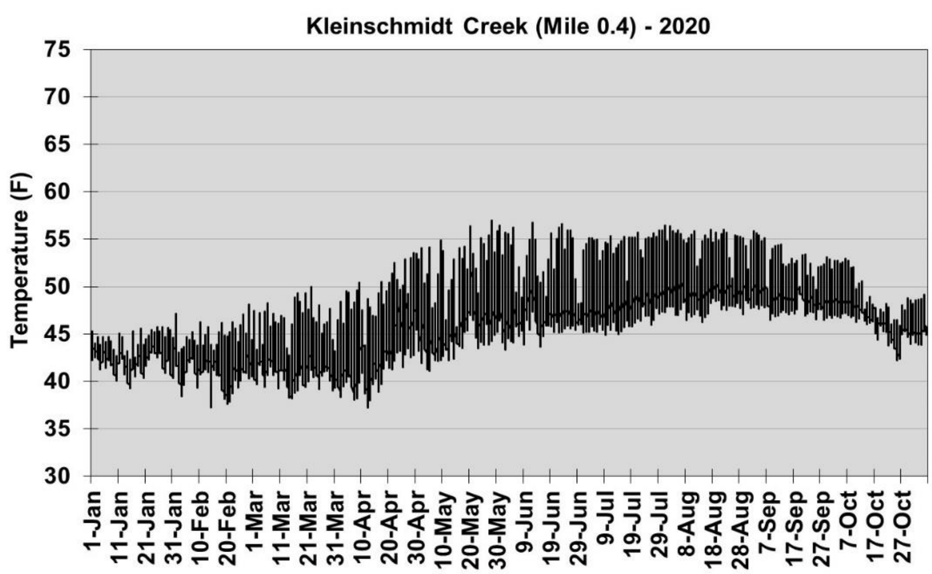
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	46.3	37.8	41.9	1.7	3.0
February	47.8	37.7	42.9	2.1	4.4
March	49.8	38.7	43.5	2.3	5.3
April	53.2	40.4	45.0	2.6	6.7
May	56.6	41.6	47.4	3.7	13.7
June	56.0	43.6	48.7	3.0	8.8
July	56.2	46.0	50.5	2.8	8.0
August	55.8	48.0	51.2	2.2	4.8
September	55.6	47.0	50.3	1.8	3.2
October	51.9	45.3	48.0	1.4	1.9
November	48.4	43.6	45.6	1.0	0.9
December	46.6	40.0	43.7	1.3	1.6



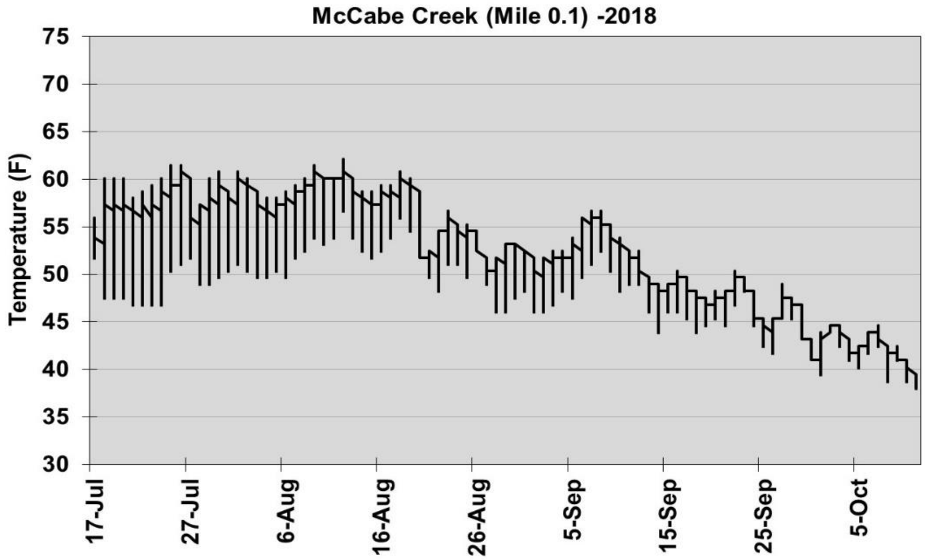
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	46.6	40.3	43.5	1.2	1.5
February	46.2	34.7	41.8	2.0	4.0
March	49.5	38.3	43.2	2.4	6.0
April	61.5	36.8	43.8	4.9	24.0
May	65.6	43.7	53.6	4.4	19.0
June	63.3	45.4	53.3	3.7	13.7
July	64.2	49.4	57.0	3.4	11.4
August	61.5	50.2	54.7	2.6	6.6
September	56.9	47.7	51.2	2.0	4.0
October	52.1	45.9	48.1	1.2	1.5
November	48.2	43.2	45.4	1.1	1.2
December	46.0	40.1	43.9	0.9	0.8



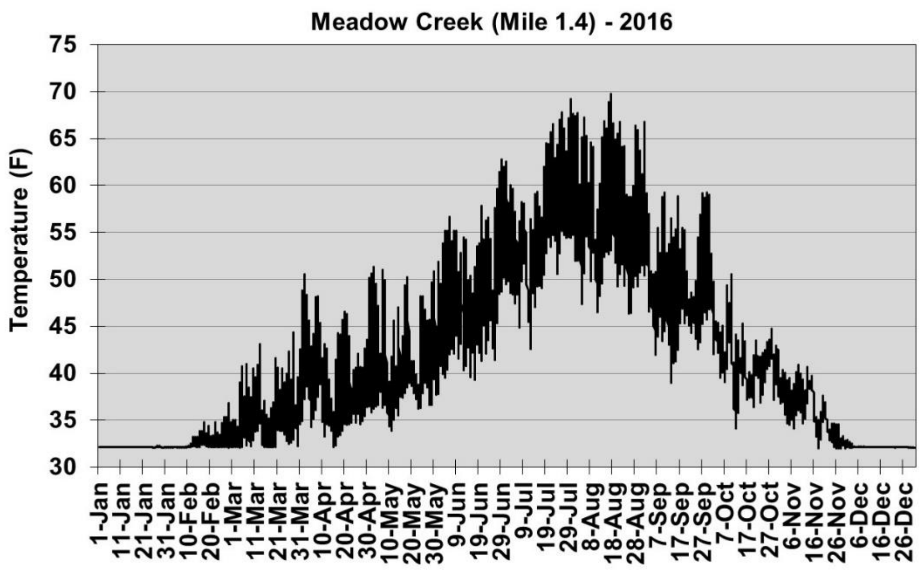
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	45.6	39.0	42.8	1.4	1.9
February	46.3	35.9	41.1	2.0	3.9
March	50.4	35.9	42.4	3.1	9.3
April	51.3	34.8	42.8	3.1	9.6
May	54.7	40.2	46.2	3.0	8.8
June	56.3	43.1	48.0	3.4	11.7
July	56.5	44.6	49.2	3.2	10.1
August	55.8	46.1	49.7	2.6	7.0
September	55.4	45.3	49.2	2.0	4.2
October	51.7	42.0	46.6	1.7	3.0
November	48.9	41.4	44.7	1.4	2.0
December	46.3	40.4	43.7	1.1	1.3



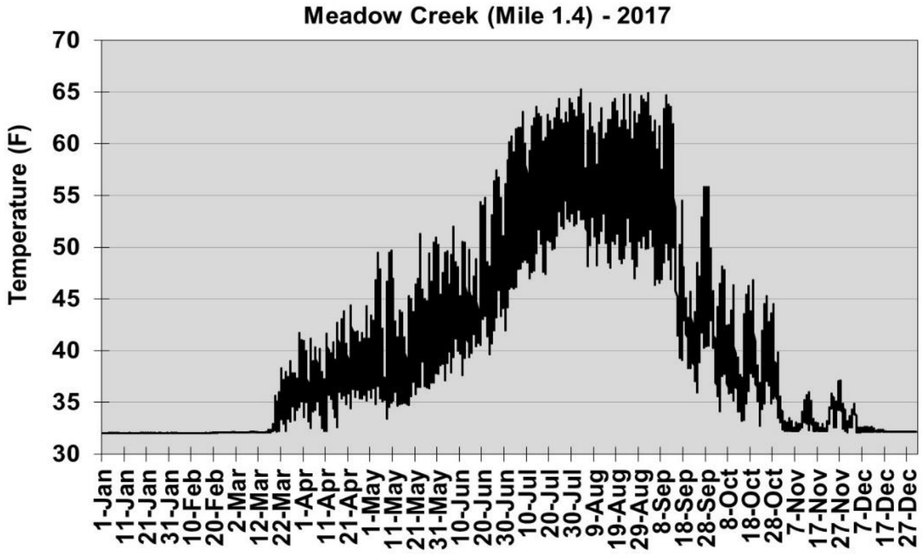
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	45.8	39.3	42.8	1.2	1.5
February	48.1	37.3	42.0	1.9	3.4
March	50.0	38.2	42.5	2.5	6.2
April	53.5	37.2	44.3	3.7	13.4
May	56.9	41.1	47.3	3.6	12.7
June	56.8	43.4	48.5	3.1	9.6
July	56.5	44.9	49.6	3.1	9.4
August	56.3	46.2	50.5	2.6	6.6
September	55.8	46.5	49.6	2.1	4.3
October	52.9	42.2	47.0	2.1	4.3
November	49.1	43.9	45.9	1.5	2.2
December					



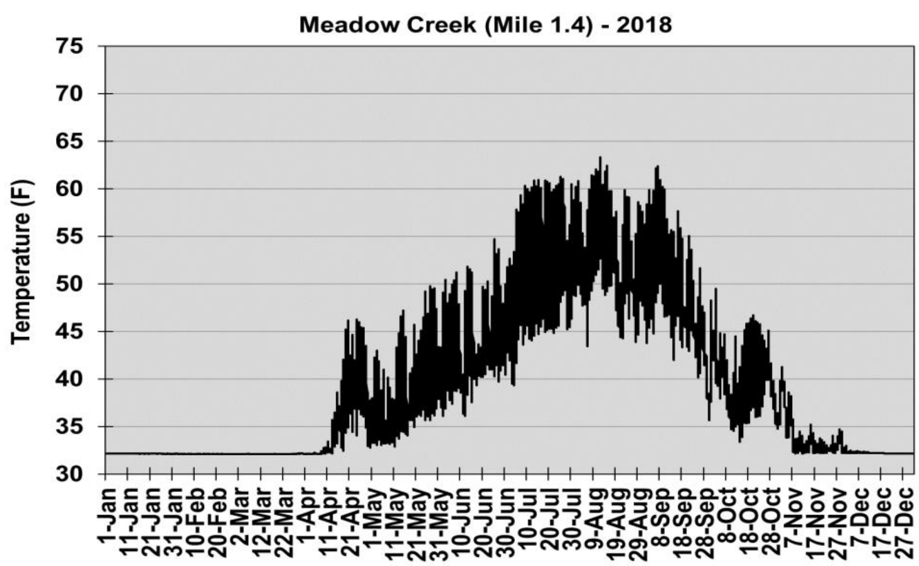
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	61.5	46.8	54.1	4.0	16.4
August	62.2	46.1	54.5	3.6	12.7
September	56.7	41.0	48.4	3.4	11.3
October	44.7	38.0	42.0	1.7	3.0
November					
December					



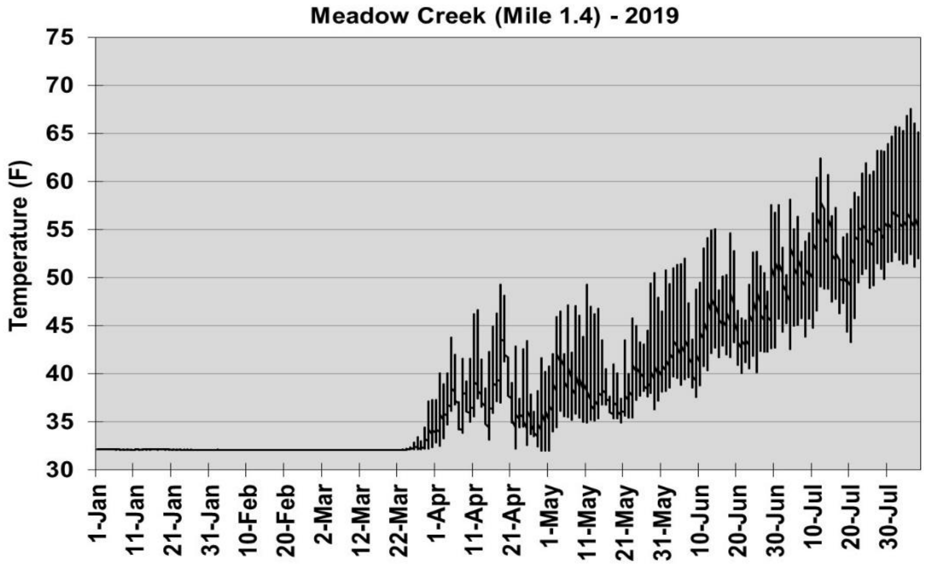
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.0	32.1	0.0	0.0
February	36.8	32.0	32.6	0.8	0.6
March	44.4	32.0	35.0	2.6	6.5
April	50.6	32.1	38.8	3.6	12.8
May	51.3	33.8	41.0	3.9	15.5
June	62.8	37.8	48.4	5.2	27.5
July	69.2	42.6	55.5	5.0	25.4
August	69.8	46.4	56.0	5.1	25.7
September	66.8	39.0	49.0	4.5	20.5
October	52.7	34.2	41.5	3.1	9.3
November	40.9	32.0	35.8	2.5	6.1
December	32.9	32.0	32.1	0.1	0.0



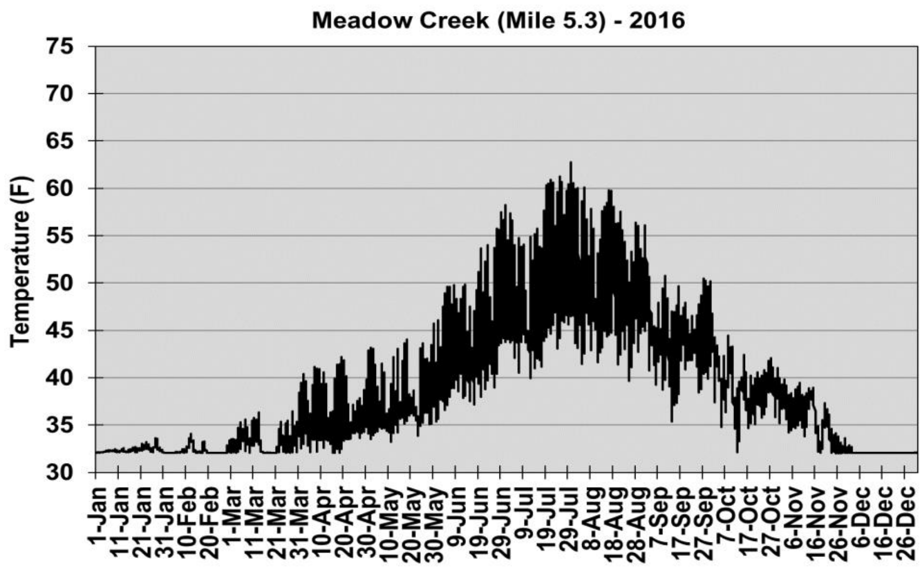
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.1	32.0	32.0	0.0	0.0
February	32.1	32.0	32.1	0.0	0.0
March	41.7	32.1	33.5	2.1	4.5
April	44.4	32.2	37.7	2.5	6.4
May	51.3	33.4	40.3	4.1	16.6
June	57.5	37.1	45.1	4.4	19.2
July	64.4	44.2	55.5	4.5	19.9
August	65.3	47.1	55.4	4.3	18.1
September	64.9	36.0	48.7	7.1	50.3
October	48.2	32.7	38.5	3.4	11.7
November	37.1	32.1	33.2	1.1	1.3
December	34.9	32.1	32.3	0.5	0.2



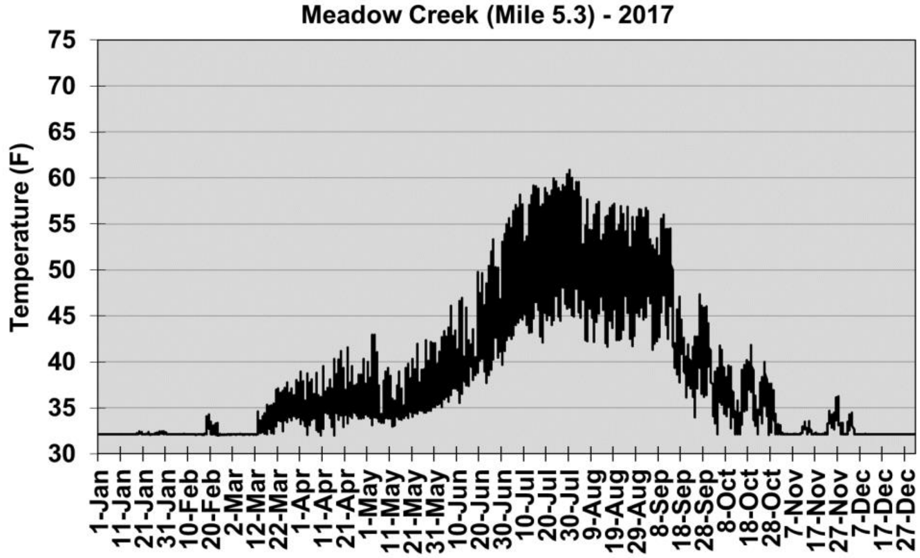
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.1	32.1	32.1	0.0	0.0
February	32.1	32.1	32.1	0.0	0.0
March	32.2	32.1	32.1	0.0	0.0
April	46.3	32.1	35.4	3.8	14.4
May	49.8	32.9	38.2	4.0	15.8
June	54.7	36.1	43.2	4.0	15.9
July	61.3	39.3	51.6	5.3	27.8
August	63.3	43.4	52.7	4.3	18.6
September	62.4	35.6	48.4	5.2	27.5
October	49.5	33.4	39.6	3.2	10.4
November	41.3	32.1	33.8	2.0	4.1
December	33.0	32.1	32.2	0.1	0.0



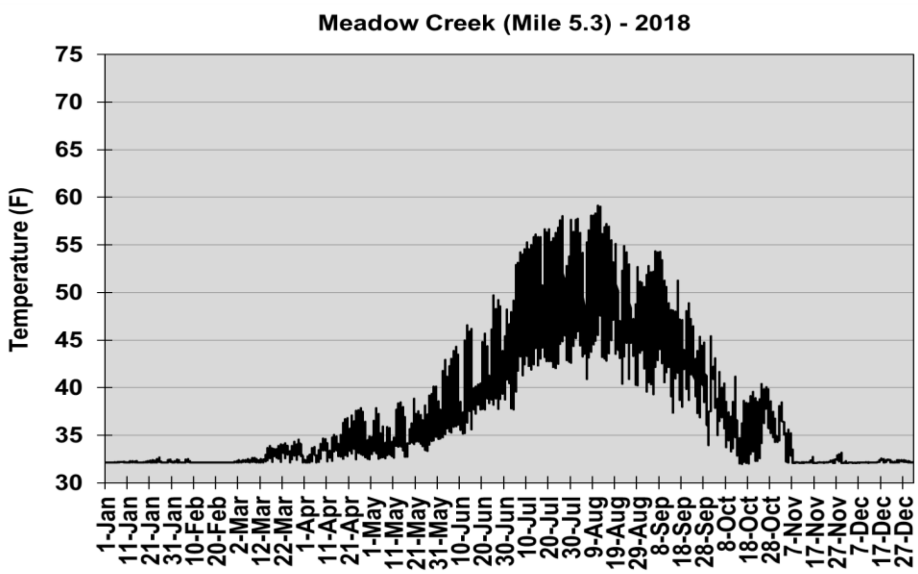
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.1	32.1	32.1	0.0	0.0
February	32.1	32.1	32.1	0.0	0.0
March	37.3	32.1	32.3	0.7	0.5
April	49.3	32.0	37.6	3.4	11.2
May	50.5	32.0	39.6	3.6	12.9
June	57.6	37.7	45.5	4.2	17.8
July	64.7	42.6	52.8	4.6	21.4
August	67.5	51.1	57.9	4.8	22.9
September					
October					
November					
December					



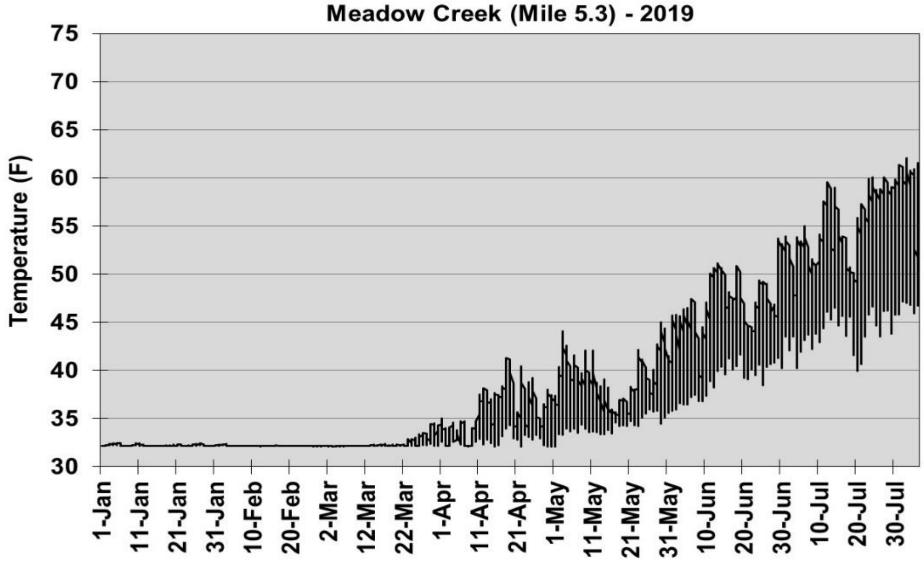
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.6	32.1	32.4	0.3	0.1
February	34.1	32.1	32.3	0.4	0.2
March	38.4	32.1	33.2	1.2	1.4
April	42.2	32.0	35.3	2.1	4.6
May	45.7	33.2	37.1	2.4	6.0
June	57.5	35.6	43.5	4.5	20.7
July	62.7	40.0	49.4	5.1	25.6
August	60.1	39.6	49.4	4.6	20.9
September	56.1	35.3	44.1	3.3	10.9
October	46.8	32.1	39.0	2.5	6.2
November	39.8	32.0	35.2	2.2	4.9
December	32.9	32.0	32.1	0.1	0.0



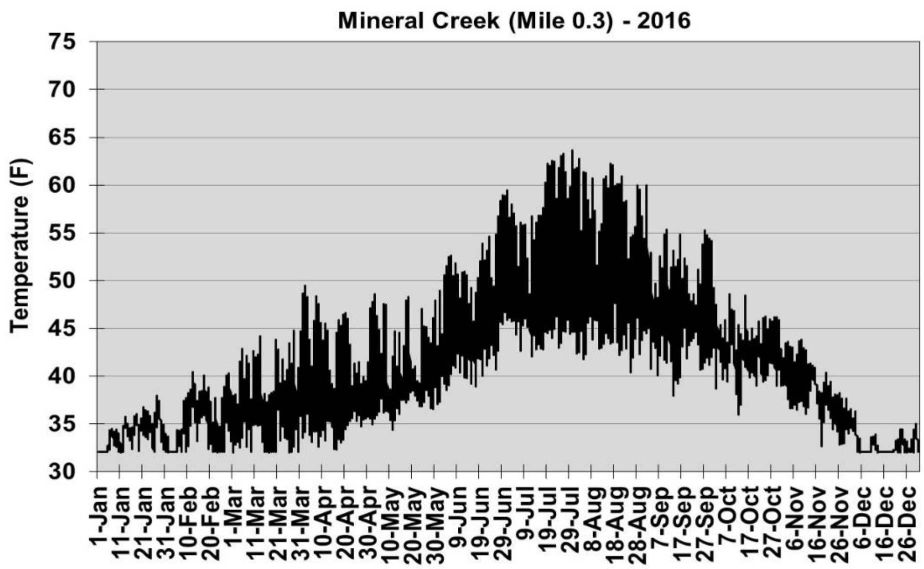
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.4	32.0	32.1	0.1	0.0
February	34.3	32.0	32.2	0.4	0.1
March	38.0	32.0	33.4	1.4	2.1
April	41.6	32.0	35.3	1.8	3.3
May	43.0	33.0	35.8	2.1	4.3
June	53.3	35.1	41.0	3.9	14.9
July	60.9	41.2	50.2	4.8	22.9
August	59.6	41.6	49.7	4.2	17.8
September	56.7	34.0	44.4	5.4	29.0
October	41.8	32.0	35.8	2.4	6.0
November	36.3	32.1	32.6	0.8	0.7
December	34.5	32.1	32.2	0.4	0.1



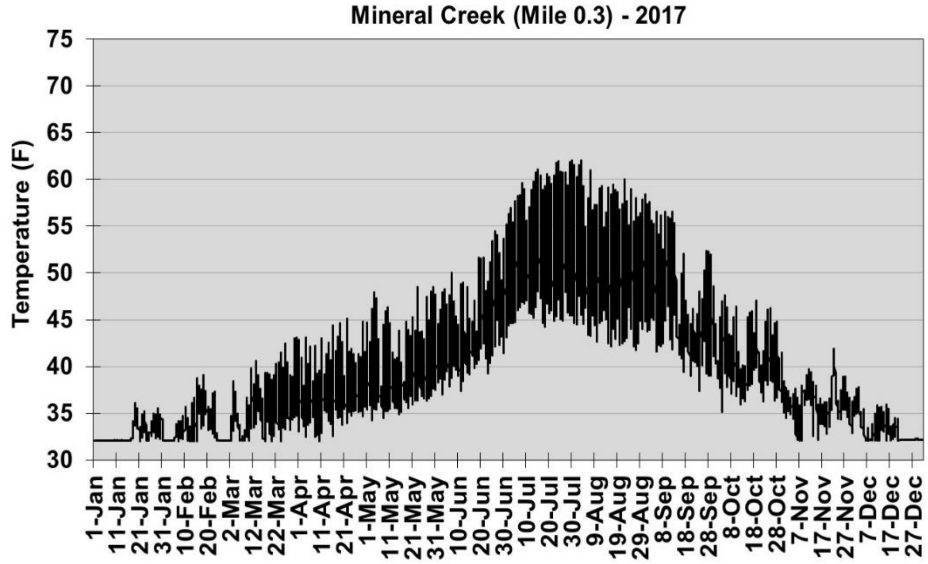
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.7	32.1	32.2	0.1	0.0
February	32.5	32.1	32.2	0.1	0.0
March	34.6	32.1	32.8	0.6	0.4
April	37.8	32.1	33.7	1.2	1.5
May	40.2	32.5	34.7	1.5	2.1
June	49.7	34.7	39.4	3.1	9.8
July	58.1	37.7	47.6	4.6	21.6
August	59.1	40.3	48.4	4.3	18.9
September	54.3	34.0	43.9	4.0	16.3
October	45.4	32.0	36.6	2.6	6.7
November	38.5	32.1	32.8	1.4	2.0
December	32.6	32.1	32.2	0.1	0.0



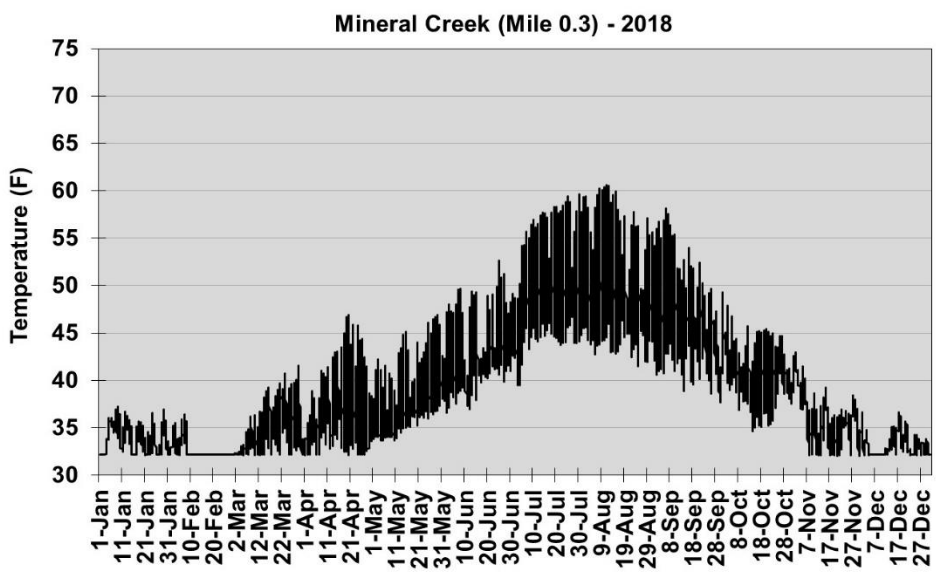
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.5	32.1	32.2	0.1	0.0
February	32.4	32.1	32.2	0.0	0.0
March	34.5	32.1	32.3	0.4	0.1
April	41.3	32.1	34.0	1.7	3.0
May	45.0	32.1	36.3	2.4	5.6
June	53.7	35.8	42.4	3.6	13.1
July	61.0	40.0	49.1	4.4	19.6
August	62.1	45.9	53.4	4.6	21.4
September					
October					
November					
December					



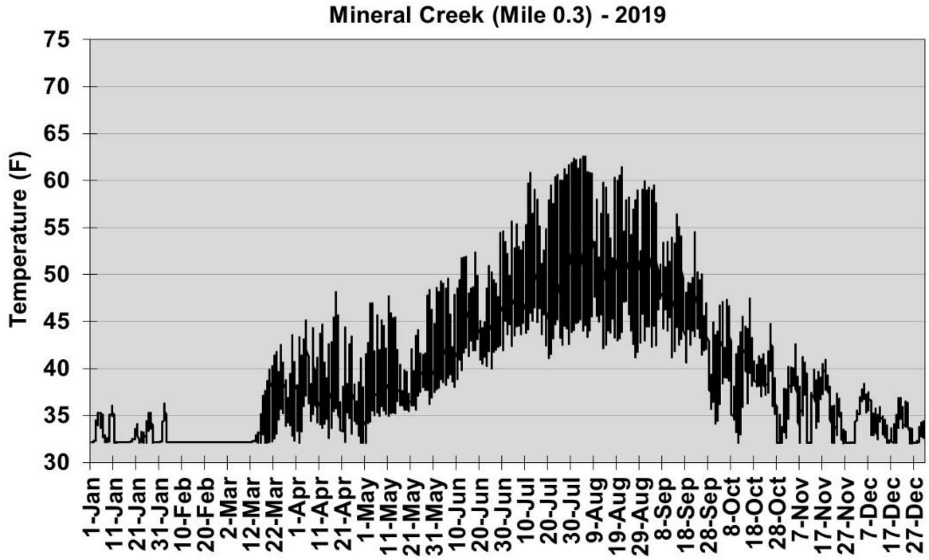
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.0	32.0	33.9	1.4	2.0
February	40.5	32.0	34.8	2.4	5.6
March	44.8	32.0	36.6	3.1	9.9
April	49.5	32.4	38.2	3.7	14.0
May	48.6	34.5	40.0	3.1	9.5
June	58.9	37.4	45.9	4.4	19.7
July	63.6	42.1	50.6	5.3	28.3
August	62.8	40.4	50.4	5.5	29.7
September	60.0	37.9	46.6	3.9	15.2
October	49.2	36.0	42.6	2.3	5.4
November	43.8	32.7	37.8	2.3	5.5
December	36.6	32.0	32.8	1.0	1.0



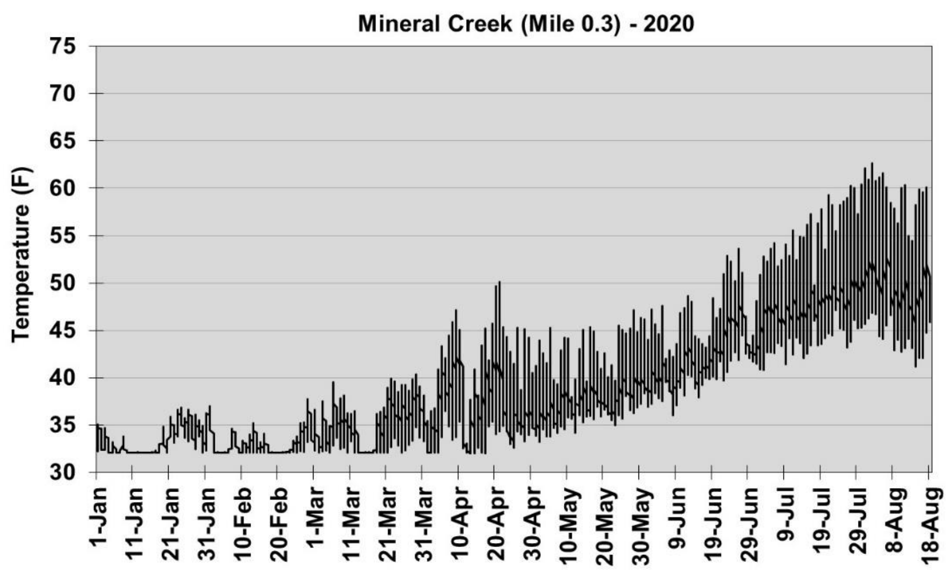
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.1	32.1	32.7	1.0	0.9
February	39.1	32.0	33.4	1.7	2.8
March	43.1	32.0	35.0	2.4	5.9
April	45.1	32.1	37.1	2.8	7.7
May	48.5	34.3	39.4	3.3	11.0
June	54.5	37.0	43.8	3.8	14.6
July	62.0	43.2	51.7	4.9	23.6
August	62.1	41.8	50.4	5.1	25.9
September	57.6	37.4	46.3	4.7	22.3
October	47.6	35.1	40.3	2.7	7.4
November	41.9	32.1	35.9	1.9	3.6
December	37.8	32.1	33.2	1.4	2.0



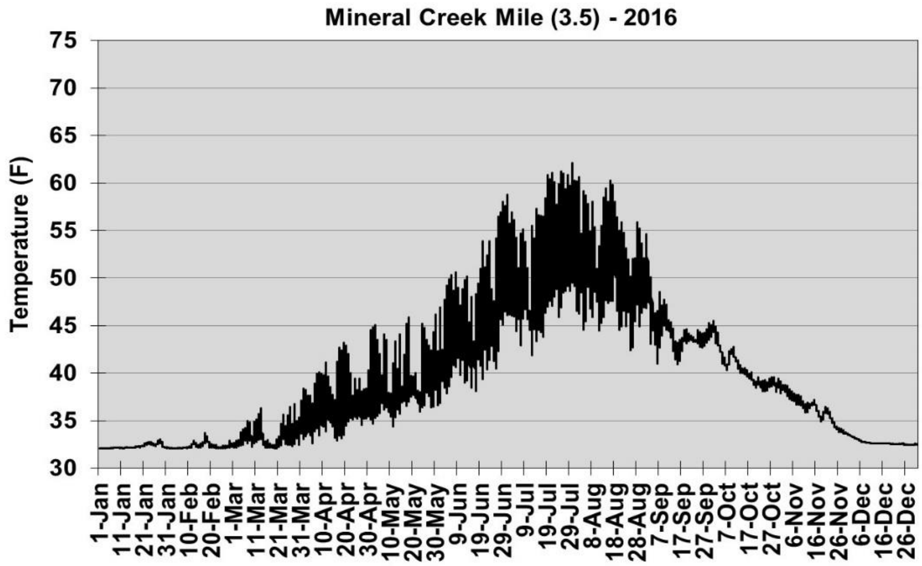
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.2	32.1	33.9	1.4	2.1
February	36.4	32.1	32.6	0.9	0.9
March	41.6	32.1	34.5	2.3	5.4
April	46.9	32.1	36.4	3.5	12.5
May	46.9	33.6	37.9	3.1	9.6
June	52.6	36.7	42.7	3.4	11.3
July	59.6	39.5	49.5	4.6	20.9
August	60.6	41.6	49.5	4.9	23.9
September	58.1	37.7	45.9	4.5	20.2
October	49.3	34.7	40.6	2.8	7.7
November	43.0	32.0	35.9	2.7	7.6
December	36.6	32.1	33.0	1.1	1.1



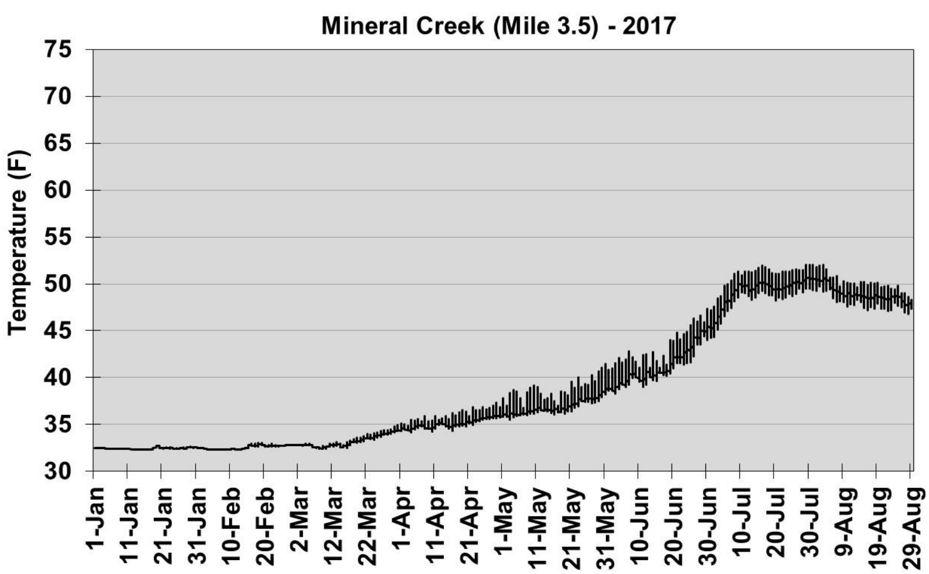
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.0	32.1	32.9	1.0	1.1
February	36.3	32.1	32.3	0.6	0.4
March	43.5	32.1	34.4	2.9	8.2
April	48.2	32.1	37.4	3.3	10.8
May	48.4	32.1	39.0	3.2	10.0
June	54.6	37.8	44.3	3.5	12.3
July	62.4	41.2	49.7	5.0	25.0
August	62.6	41.3	50.7	5.3	27.9
September	59.5	35.7	46.8	4.7	22.2
October	47.5	32.0	38.9	3.5	12.3
November	42.6	32.0	35.9	2.9	8.2
December	38.4	32.0	34.2	1.7	2.8



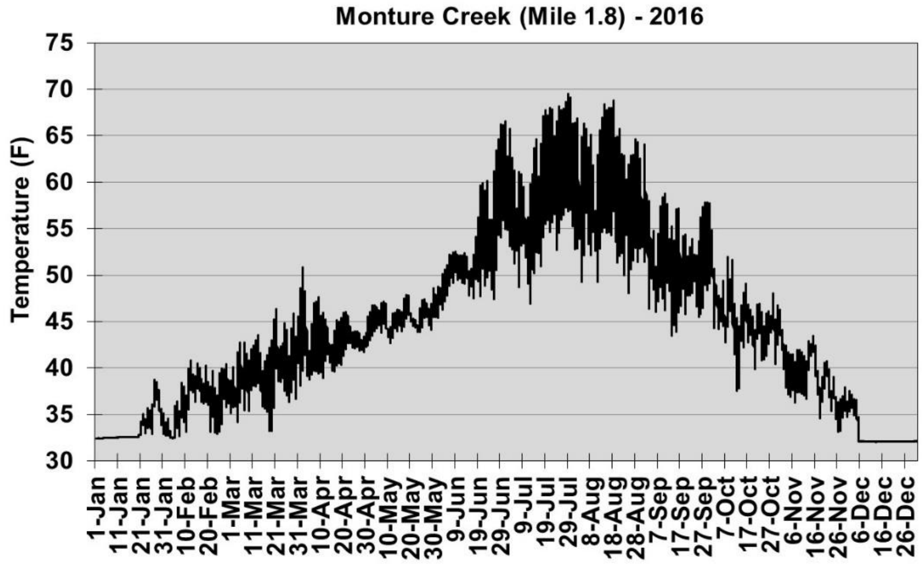
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.8	32.1	33.3	1.4	1.8
February	37.8	32.1	32.9	1.1	1.3
March	40.3	32.1	34.5	2.3	5.1
April	50.1	32.0	37.3	4.1	17.0
May	47.2	33.3	38.6	3.1	9.5
June	53.6	36.0	42.7	3.4	11.8
July	62.1	40.9	48.9	4.6	21.6
August	62.7	41.2	50.7	5.6	31.0
September					
October					
November					
December					



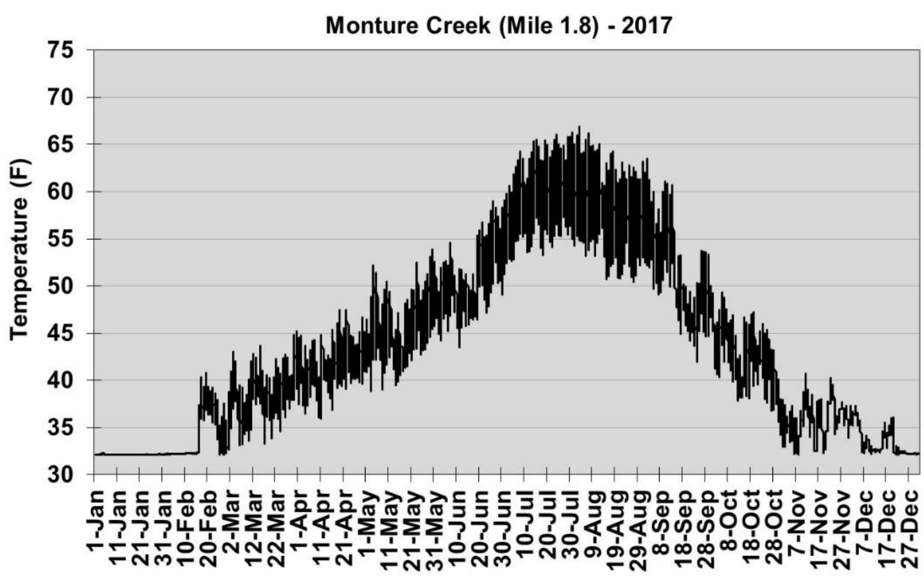
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.0	32.1	32.3	0.2	0.0
February	33.7	32.1	32.3	0.3	0.1
March	37.1	32.1	33.3	1.0	1.1
April	43.2	32.6	36.1	2.0	4.1
May	46.2	34.4	38.6	2.4	5.8
June	58.0	36.9	44.7	4.3	18.6
July	62.1	41.9	51.1	4.5	20.2
August	60.6	42.5	50.7	3.7	13.8
September	54.6	41.0	44.5	2.1	4.5
October	45.5	37.9	40.4	1.8	3.1
November	38.8	33.5	36.1	1.5	2.1
December	33.5	32.5	32.7	0.2	0.1



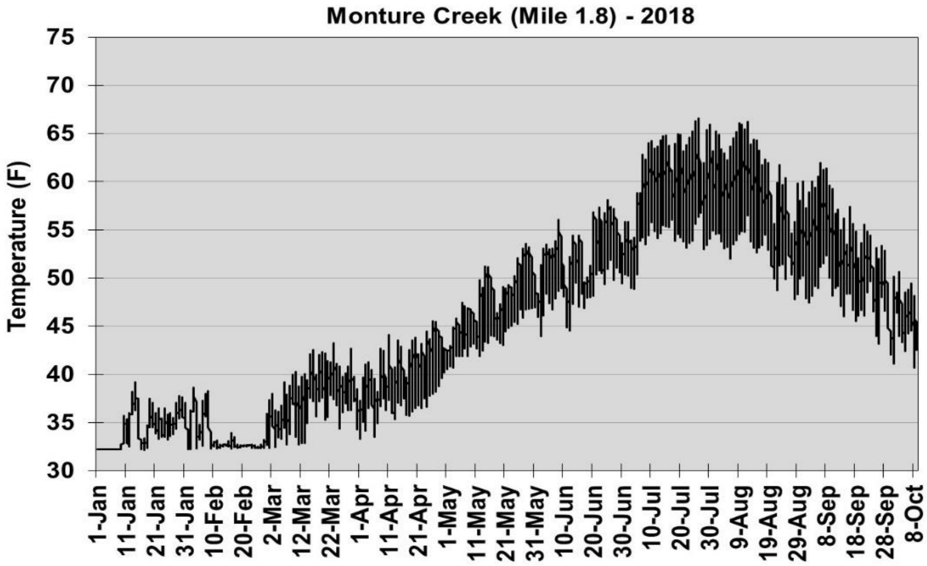
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.7	32.3	32.4	0.1	0.0
February	33.0	32.3	32.6	0.2	0.0
March	35.0	32.4	33.2	0.6	0.4
April	37.4	34.1	35.3	0.6	0.4
May	41.5	35.5	37.4	1.1	1.3
June	47.4	38.3	41.6	2.0	4.1
July	52.0	44.2	49.3	1.6	2.7
August	52.0	46.8	49.0	1.1	1.1
September					
October					
November					
December					



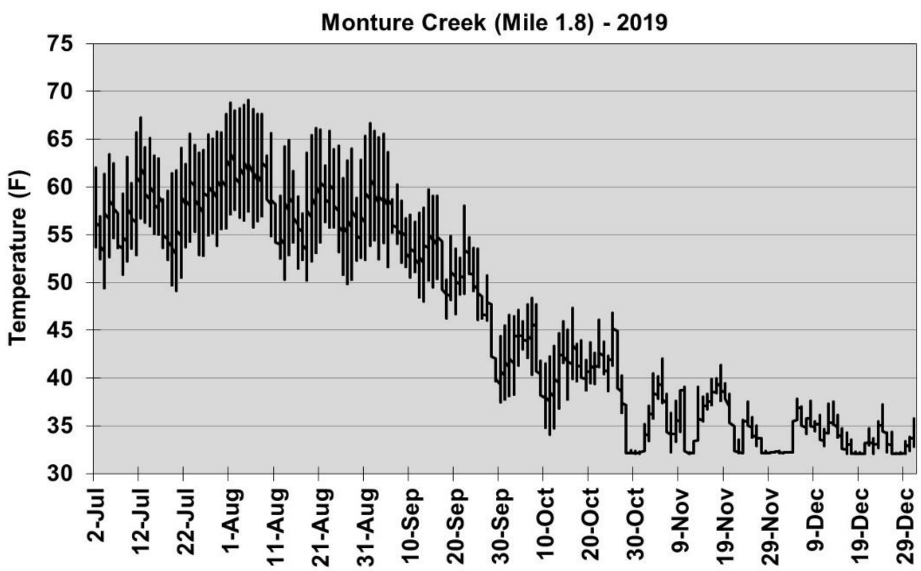
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.7	32.4	33.4	1.5	2.2
February	40.9	32.4	36.2	2.3	5.2
March	46.4	33.3	39.4	2.5	6.3
April	50.9	38.1	42.9	2.1	4.2
May	48.6	42.4	45.3	1.1	1.3
June	66.3	45.4	52.2	4.3	18.1
July	69.6	46.9	58.8	4.9	23.8
August	68.8	48.1	58.5	4.5	20.0
September	64.1	43.5	51.5	3.5	12.3
October	54.9	37.6	45.1	2.7	7.3
November	44.1	33.1	38.7	2.4	5.8
December	37.6	32.0	32.6	1.3	1.8



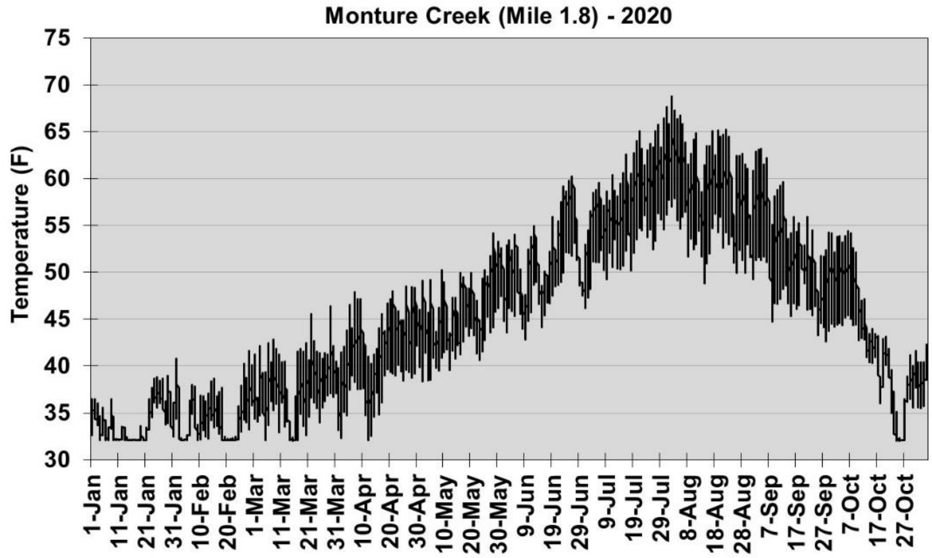
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.1	32.1	0.0	0.0
February	40.8	32.1	34.0	2.4	5.9
March	45.2	32.6	38.3	2.5	6.2
April	47.5	36.0	41.6	2.3	5.3
May	53.9	38.9	45.4	3.1	9.9
June	59.0	43.5	50.4	3.3	11.2
July	66.3	51.2	59.3	3.3	11.1
August	66.9	50.4	58.1	3.8	14.1
September	63.5	42.0	51.4	4.7	21.7
October	49.3	34.3	42.2	3.1	9.4
November	40.7	32.2	35.7	1.8	3.3
December	37.3	32.1	33.5	1.4	2.0



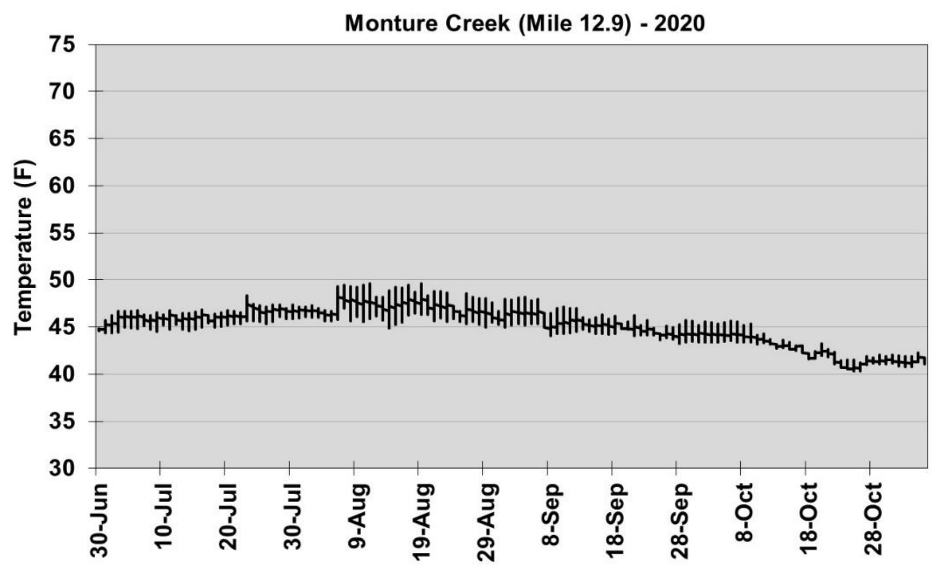
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.2	32.1	34.2	1.7	3.0
February	38.7	32.2	33.4	1.5	2.3
March	43.3	32.3	37.4	2.4	5.8
April	45.5	33.4	39.1	2.6	6.6
May	53.6	40.5	46.0	2.9	8.6
June	58.1	43.9	50.9	2.9	8.7
July	66.6	48.9	58.2	3.9	15.5
August	66.2	47.8	57.0	4.2	17.7
September	61.9	42.1	51.6	4.1	16.7
October	50.6	40.7	45.8	2.3	5.2
November					
December					



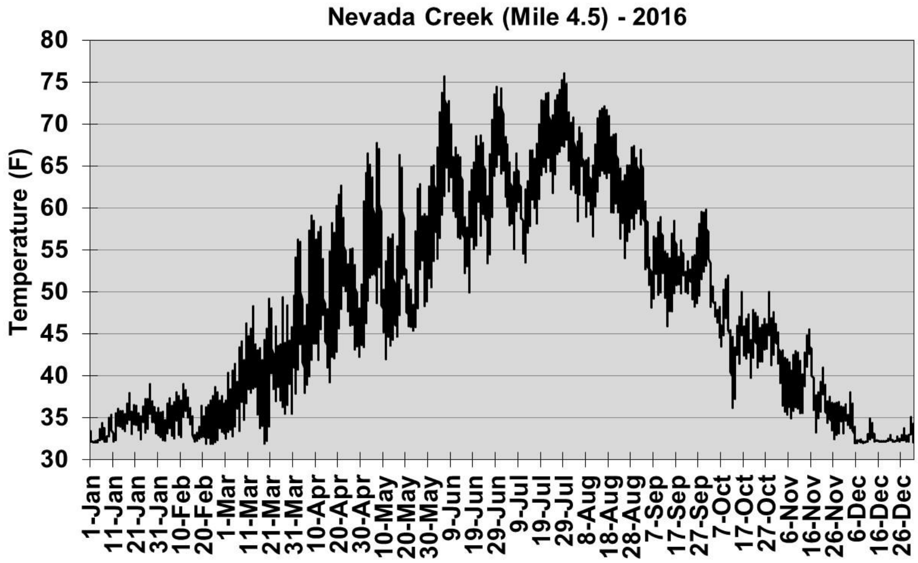
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	67.6	49.1	58.2	3.9	15.5
August	69.1	49.9	59.0	4.4	19.3
September	66.7	37.5	52.6	5.5	30.6
October	48.4	32.1	40.7	4.0	16.1
November	42.1	32.1	35.5	2.7	7.2
December	37.8	32.1	33.8	1.6	2.5



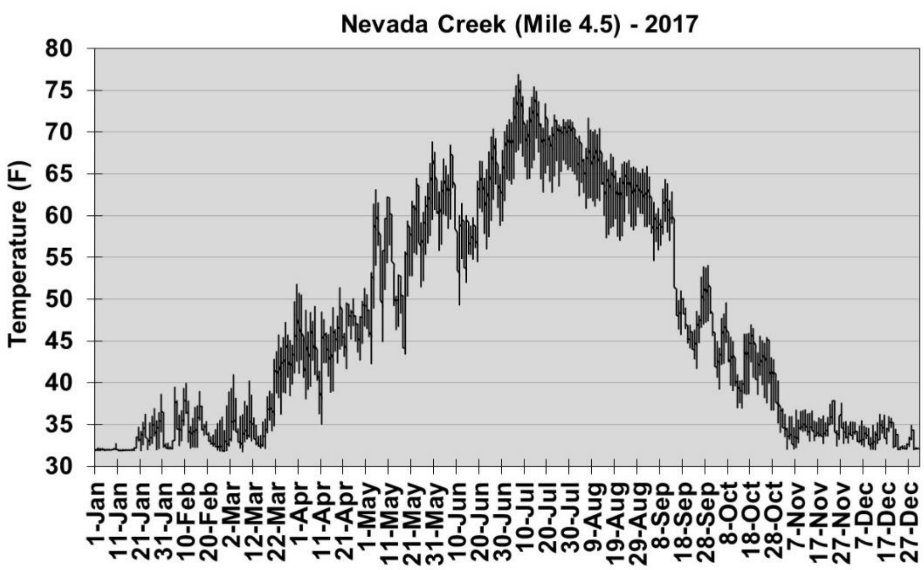
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.0	32.1	33.9	1.9	3.6
February	41.6	32.1	34.4	2.2	5.0
March	46.4	32.0	37.4	3.0	8.9
April	48.5	32.1	41.0	3.7	13.3
May	54.2	38.4	45.0	3.3	10.8
June	60.2	42.8	50.3	3.8	14.4
July	67.6	46.3	56.6	4.1	17.2
August	68.8	48.9	58.3	4.1	16.7
September	63.2	42.7	51.5	4.4	19.7
October	54.4	32.0	42.0	5.9	34.9
November	42.3	35.5	38.2	1.6	2.6
December					



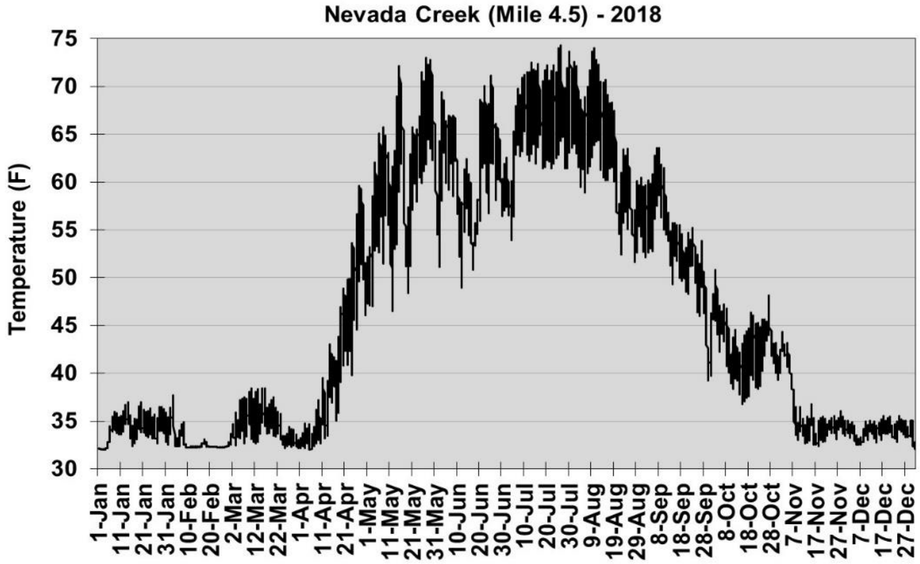
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	44.9	44.6	44.7	0.1	0.0
July	48.3	44.4	45.9	0.7	0.5
August	49.6	44.9	46.9	1.1	1.1
September	48.2	43.4	45.2	1.0	1.0
October	45.7	40.3	42.7	1.3	1.7
November	42.2	40.8	41.4	0.4	0.1
December					



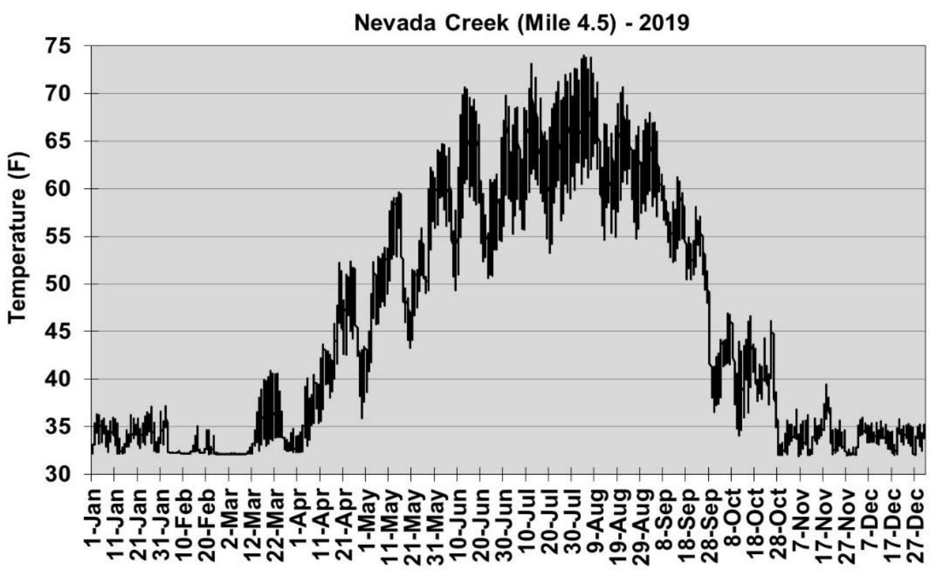
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.0	32.0	34.1	1.5	2.1
February	39.0	31.8	34.4	1.6	2.5
March	49.6	32.0	39.7	3.8	14.6
April	62.6	37.8	48.9	5.2	27.1
May	67.8	42.0	53.4	5.8	33.2
June	75.7	50.0	62.7	5.3	28.3
July	76.1	53.5	65.5	5.0	24.9
August	72.1	54.0	64.1	3.6	13.2
September	66.9	45.9	53.7	3.5	12.3
October	57.2	36.1	45.5	3.4	11.4
November	45.5	32.5	38.1	3.0	9.0
December	38.0	32.0	32.8	1.0	1.1



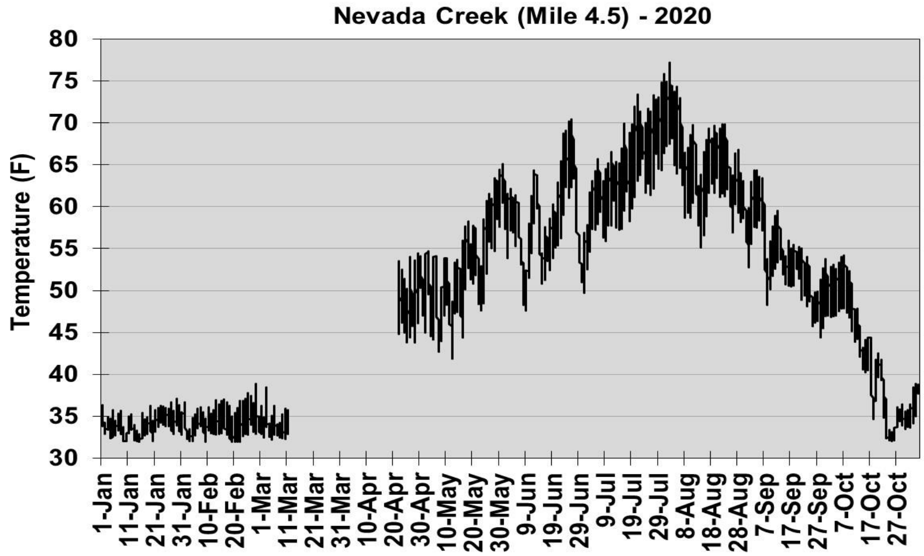
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.6	31.9	32.8	1.3	1.7
February	39.9	31.8	34.1	1.9	3.5
March	51.8	31.7	37.4	4.4	19.3
April	51.4	35.1	44.9	3.1	9.8
May	68.8	42.3	55.2	5.8	33.5
June	70.4	49.4	60.8	4.1	17.0
July	76.9	61.8	69.0	2.9	8.7
August	71.7	57.1	64.1	3.0	9.0
September	65.9	41.8	53.4	6.5	42.5
October	49.6	34.1	41.9	3.1	9.4
November	37.8	32.1	34.6	1.2	1.3
December	36.2	32.0	33.4	1.1	1.2



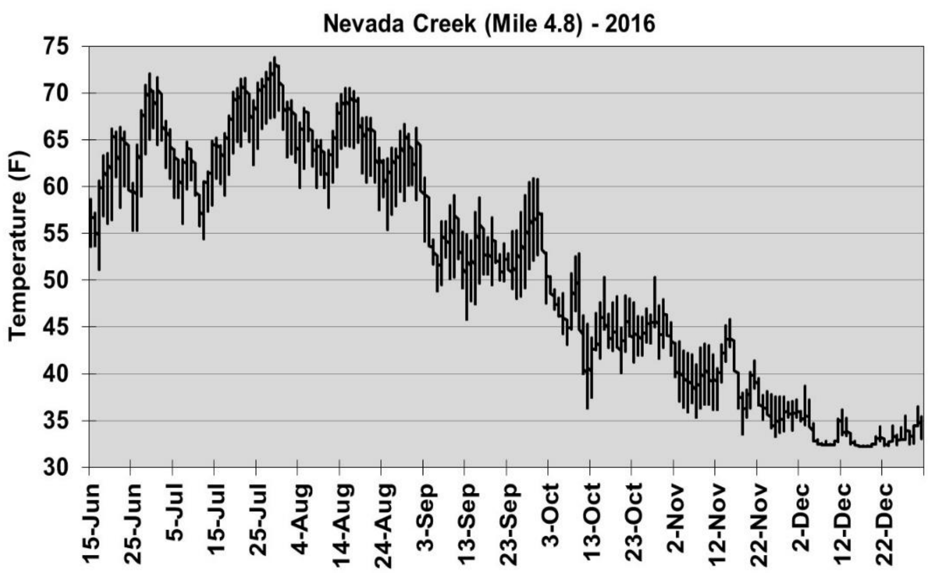
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.0	32.0	34.1	1.2	1.5
February	37.7	32.2	32.8	1.0	0.9
March	38.5	32.2	34.3	1.5	2.3
April	59.6	32.0	40.7	7.5	55.9
May	73.0	46.5	59.7	6.3	39.4
June	71.1	48.9	60.4	4.8	23.2
July	74.3	54.0	65.7	4.2	17.9
August	74.0	51.7	62.8	5.3	28.0
September	63.6	39.3	53.4	4.7	22.4
October	50.8	36.7	42.8	2.7	7.2
November	44.4	32.4	35.7	3.0	9.3
December	35.5	32.1	33.9	0.7	0.6



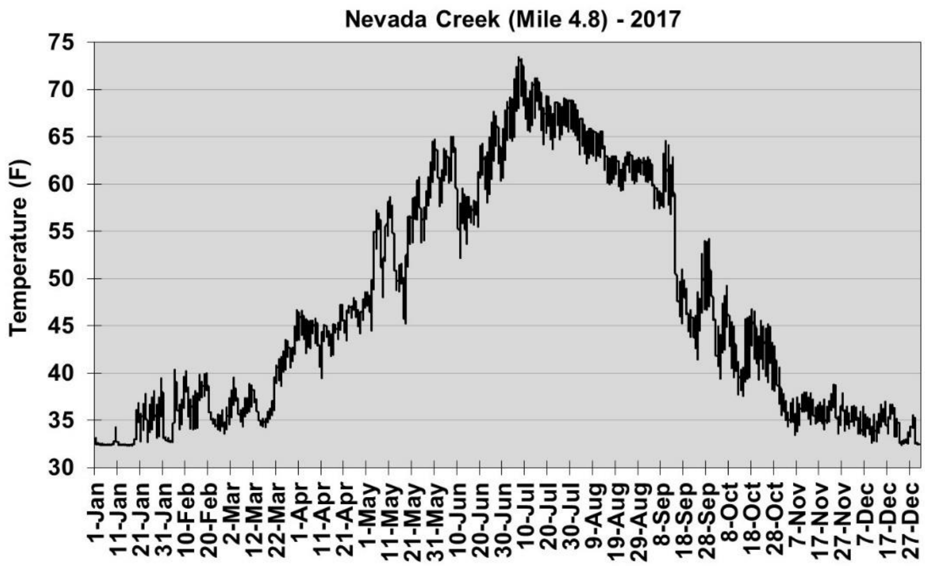
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.1	32.1	34.0	1.1	1.2
February	37.2	32.1	32.7	0.9	0.9
March	40.9	32.1	33.9	2.2	5.0
April	52.3	32.3	41.2	5.2	26.8
May	62.2	38.7	51.3	5.0	25.4
June	70.7	49.3	59.6	4.8	22.6
July	73.1	53.3	63.6	4.1	17.0
August	74.0	54.7	63.8	4.3	18.7
September	68.0	36.6	55.2	6.3	39.8
October	46.9	34.1	40.9	3.0	9.3
November					
December					



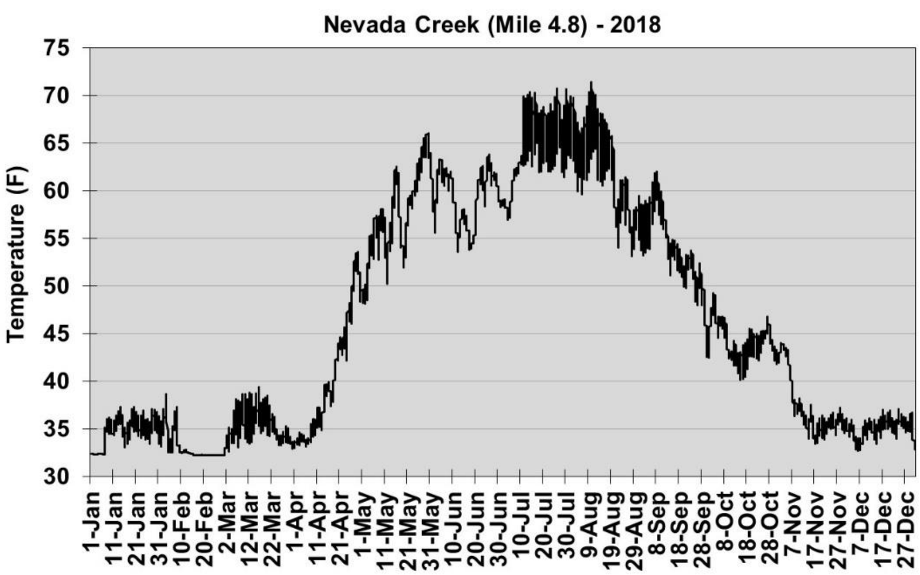
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.1	31.9	33.9	1.1	1.1
February	38.9	31.9	34.1	1.3	1.8
March	38.4	32.2	33.8	1.2	1.4
April	54.4	43.8	48.9	2.9	8.4
May	65.1	41.9	52.4	5.2	27.1
June	70.5	47.6	58.1	4.9	24.3
July	75.9	49.7	63.6	5.1	26.2
August	77.2	55.1	64.6	4.4	19.6
September	64.4	44.5	53.5	4.3	18.8
October	54.2	32.0	42.0	6.8	45.7
November	38.9	33.6	36.3	1.6	2.5
December					



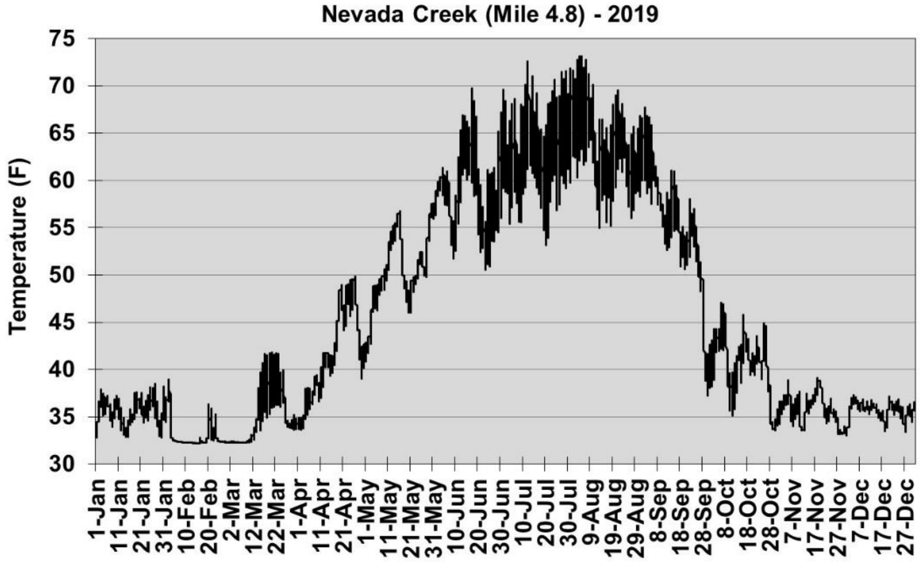
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	72.1	51.1	61.7	4.6	21.0
July	73.8	54.4	64.8	4.4	19.2
August	70.5	55.4	63.9	3.0	9.0
September	66.3	45.9	53.9	3.6	12.8
October	57.1	36.4	45.7	3.3	10.9
November	45.8	33.4	38.7	2.8	8.1
December	38.7	32.2	33.4	1.3	1.6



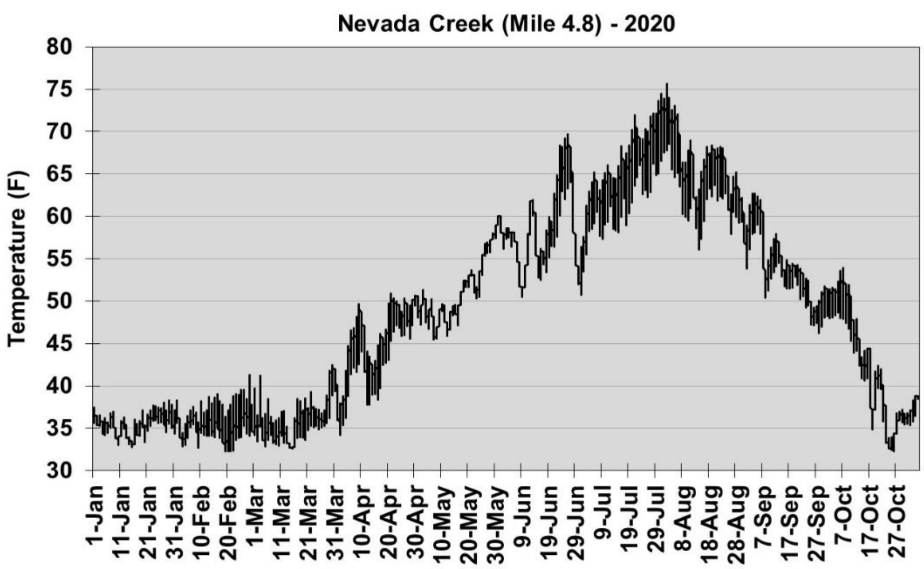
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	39.5	32.3	33.7	1.7	2.8
February	40.3	32.7	35.9	2.0	4.1
March	46.7	34.3	38.0	2.9	8.6
April	48.6	39.5	44.8	1.7	2.7
May	64.7	44.5	54.2	4.6	21.6
June	67.7	52.2	60.5	3.2	10.5
July	73.5	62.6	67.8	2.0	3.9
August	68.4	59.3	62.9	1.9	3.6
September	64.5	41.5	53.3	6.5	42.8
October	49.2	35.5	42.3	2.7	7.3
November	38.8	33.4	35.8	1.0	1.0
December	37.0	32.4	34.3	1.2	1.4



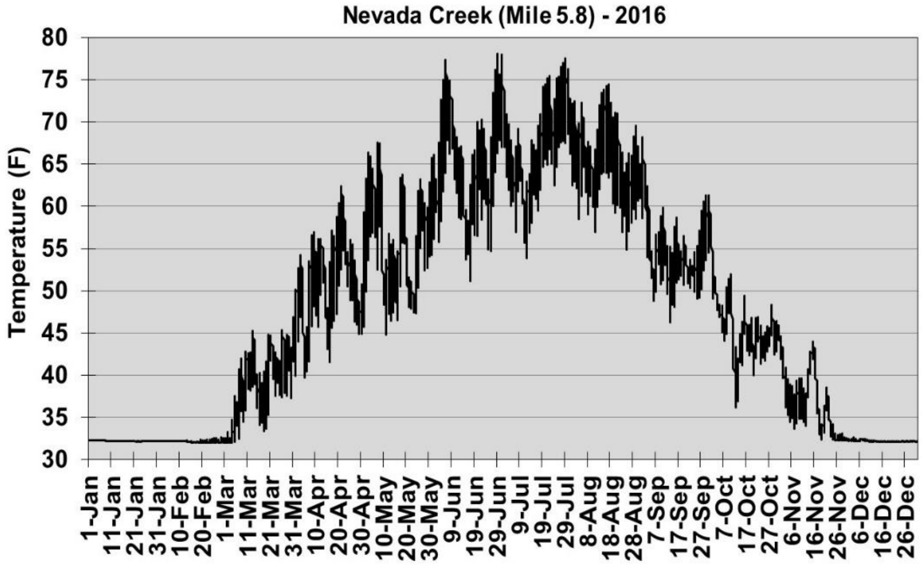
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	37.3	32.3	34.6	1.4	2.0
February	38.7	32.2	33.1	1.4	1.9
March	39.4	32.2	35.1	1.6	2.5
April	53.6	33.0	40.0	6.1	37.6
May	66.1	48.2	57.2	4.5	20.7
June	63.8	53.6	59.2	2.8	7.8
July	70.8	57.0	64.0	3.6	12.8
August	71.4	53.1	62.2	4.4	19.4
September	62.1	42.5	53.7	3.9	15.4
October	49.3	40.2	44.2	1.8	3.1
November	44.1	33.5	37.2	3.0	8.7
December	37.1	32.7	35.1	1.0	0.9



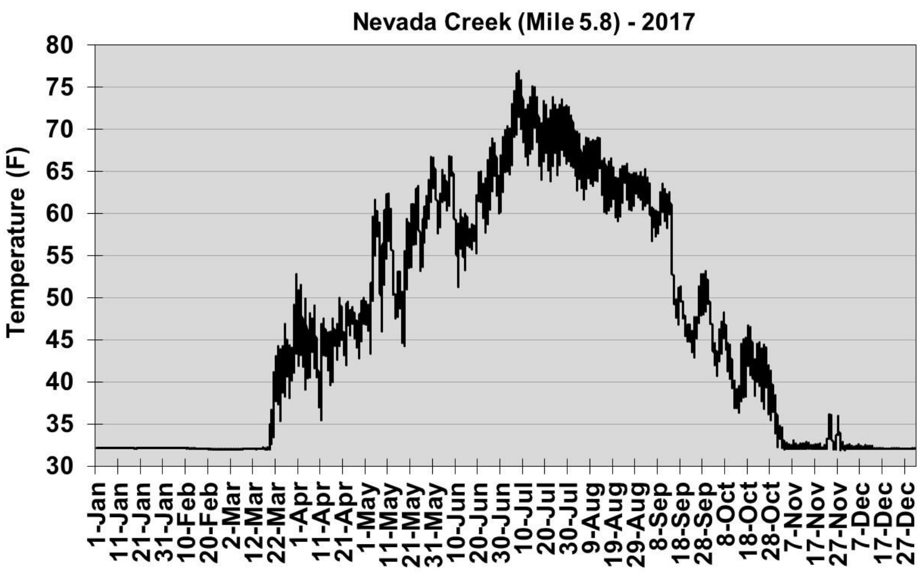
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.5	32.8	38.5	1.3	1.8
February	38.9	32.2	38.9	1.3	1.8
March	41.8	32.2	41.8	2.8	8.0
April	49.9	33.6	49.9	4.5	19.9
May	57.6	40.8	57.6	3.9	14.9
June	69.7	50.6	69.7	4.0	15.6
July	72.7	53.1	72.7	4.0	16.1
August	73.2	55.0	73.2	3.9	15.5
September	67.8	37.2	67.8	6.2	38.0
October	47.1	33.5	40.4	3.1	9.5
November	39.1	33.1	35.7	1.5	2.2
December	37.3	33.0	35.7	0.9	0.8



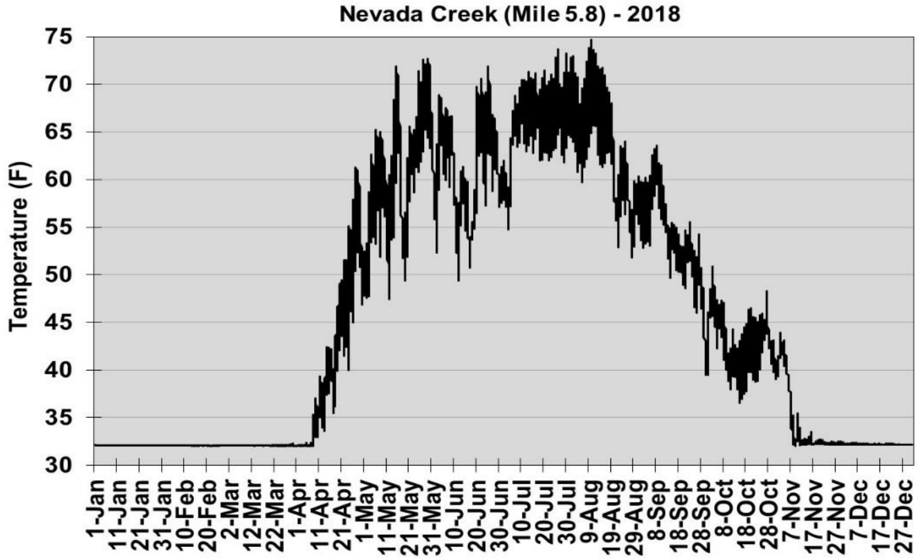
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	38.3	32.8	35.4	1.2	1.3
February	41.3	32.2	35.5	1.6	2.7
March	42.5	32.6	35.8	2.2	4.7
April	50.9	34.2	44.2	4.2	17.5
May	60.0	45.5	51.0	3.7	13.5
June	69.7	50.4	58.1	4.4	19.6
July	74.5	50.7	63.7	4.6	21.0
August	75.6	56.1	64.5	4.0	15.9
September	62.7	46.2	53.6	3.9	15.3
October	54.0	32.3	42.3	6.3	39.5
November	38.8	35.4	37.2	1.1	1.1
December					



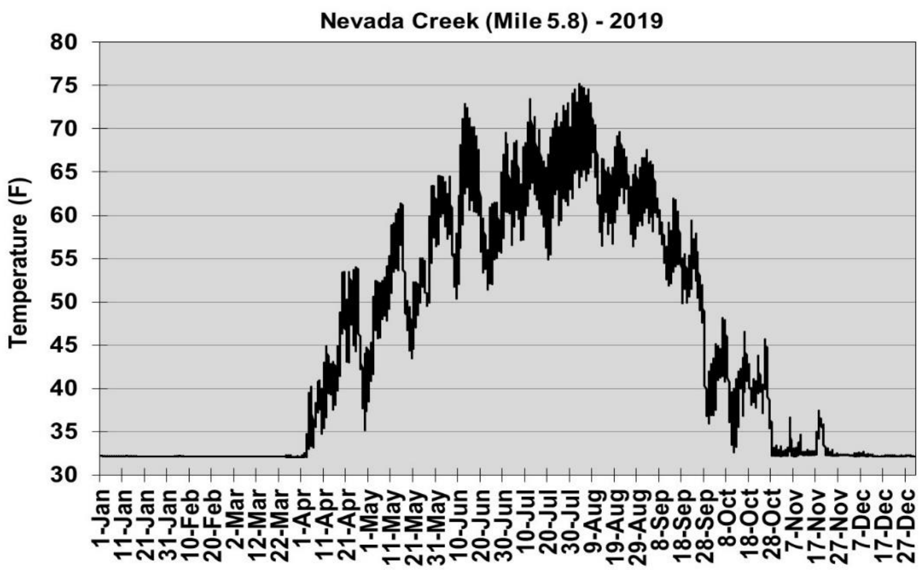
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.1	32.2	0.0	0.0
February	32.6	32.0	32.2	0.1	0.0
March	46.9	32.0	38.5	3.7	13.8
April	62.4	39.7	50.3	4.7	22.0
May	67.5	44.8	55.2	5.3	28.0
June	78.1	51.1	64.5	5.6	31.5
July	78.0	53.9	66.9	5.1	26.2
August	74.5	54.9	64.9	4.0	16.3
September	68.2	46.2	54.3	3.7	13.5
October	59.0	36.2	45.6	3.7	13.5
November	44.6	32.2	36.4	3.4	11.5
December	32.6	32.1	32.2	0.1	0.0



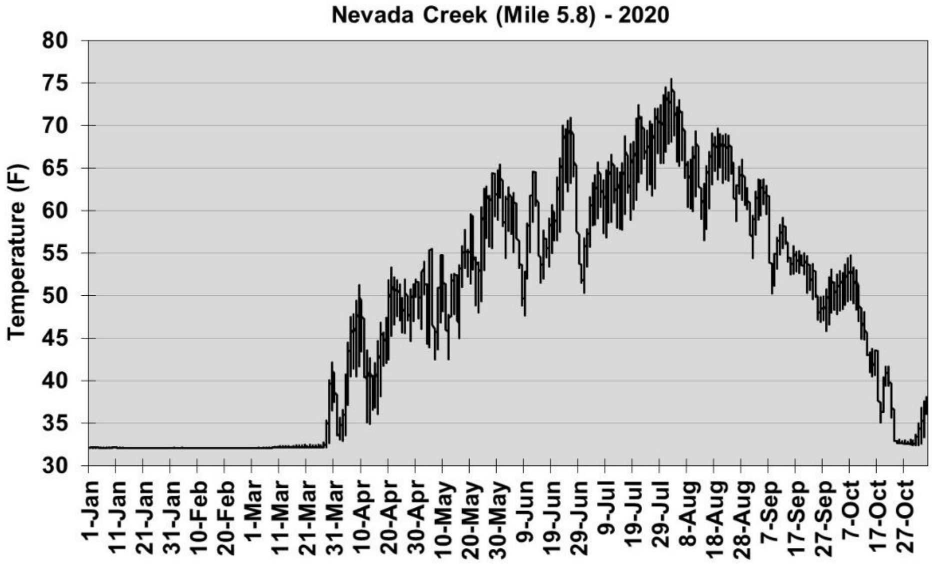
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.2	32.1	32.1	0.0	0.0
February	32.1	32.0	32.1	0.1	0.0
March	52.9	32.0	35.6	5.1	26.2
April	51.5	35.5	45.1	2.9	8.3
May	66.8	43.4	55.2	5.5	30.4
June	68.9	51.2	61.0	3.7	13.4
July	77.0	62.5	69.8	2.9	8.1
August	70.8	59.1	64.5	2.3	5.4
September	65.3	42.9	54.1	6.6	43.8
October	49.5	32.2	41.6	3.4	11.7
November	36.2	31.9	32.6	0.9	0.7
December	32.6	32.0	32.1	0.1	0.0



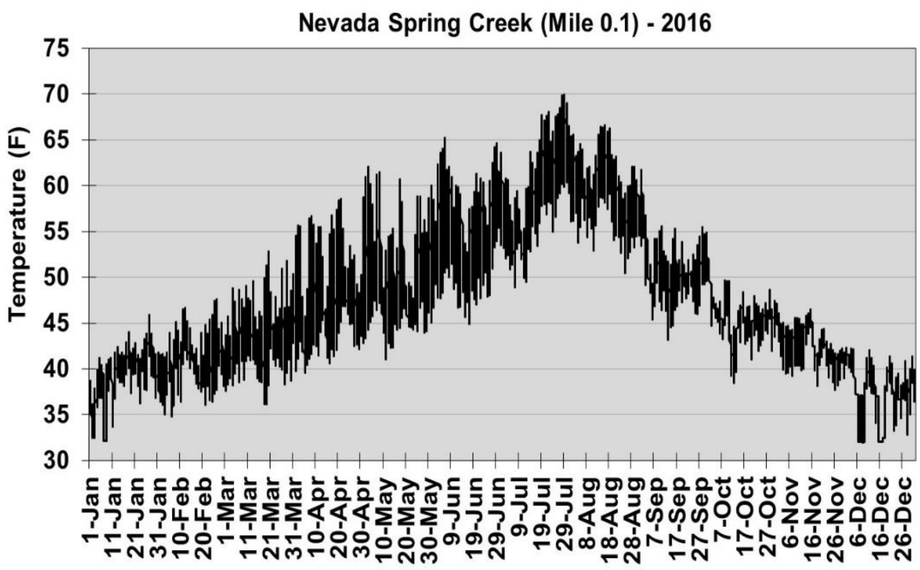
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.1	32.1	32.1	0.0	0.0
February	32.1	32.0	32.1	0.0	0.0
March	32.3	32.0	32.1	0.0	0.0
April	61.3	32.0	40.7	8.0	64.1
May	72.7	47.5	59.9	6.2	37.9
June	71.9	49.3	60.7	4.9	24.2
July	73.6	54.8	65.6	3.8	14.6
August	74.7	51.8	63.4	5.4	28.7
September	63.6	39.5	53.8	4.8	22.7
October	50.9	36.6	42.6	2.8	7.9
November	43.9	32.0	34.3	3.5	12.5
December	32.4	32.1	32.2	0.0	0.0



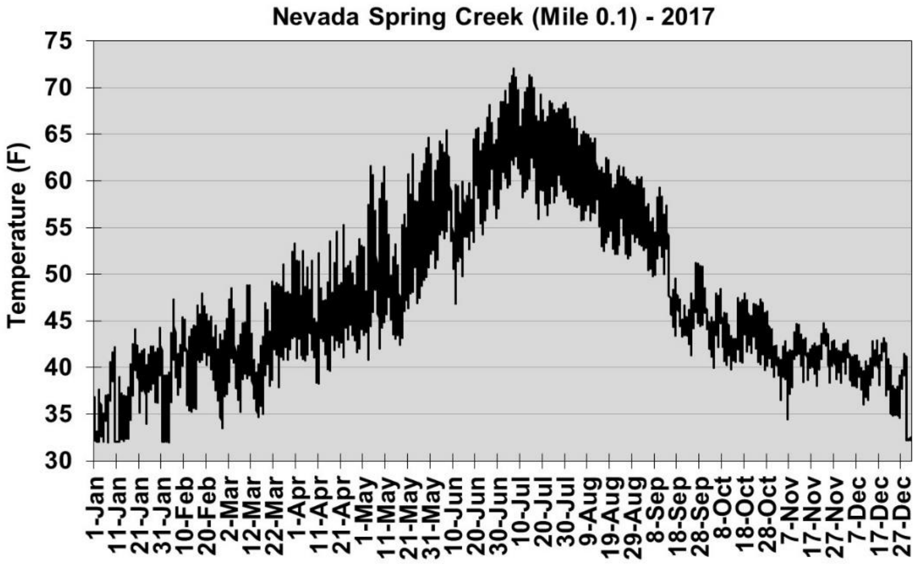
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.2	32.1	32.2	0.0	0.0
February	32.2	32.1	32.1	0.0	0.0
March	32.3	32.0	32.1	0.0	0.0
April	54.0	32.0	41.3	5.7	32.6
May	63.3	38.5	51.7	5.1	26.3
June	72.9	50.4	60.5	4.9	24.3
July	74.1	54.9	64.6	3.9	15.5
August	75.2	56.5	64.7	4.3	18.8
September	67.5	35.9	55.3	6.6	43.2
October	48.1	32.2	39.6	3.8	14.3
November	37.5	32.1	32.9	1.1	1.2
December	32.7	32.1	32.2	0.1	0.0



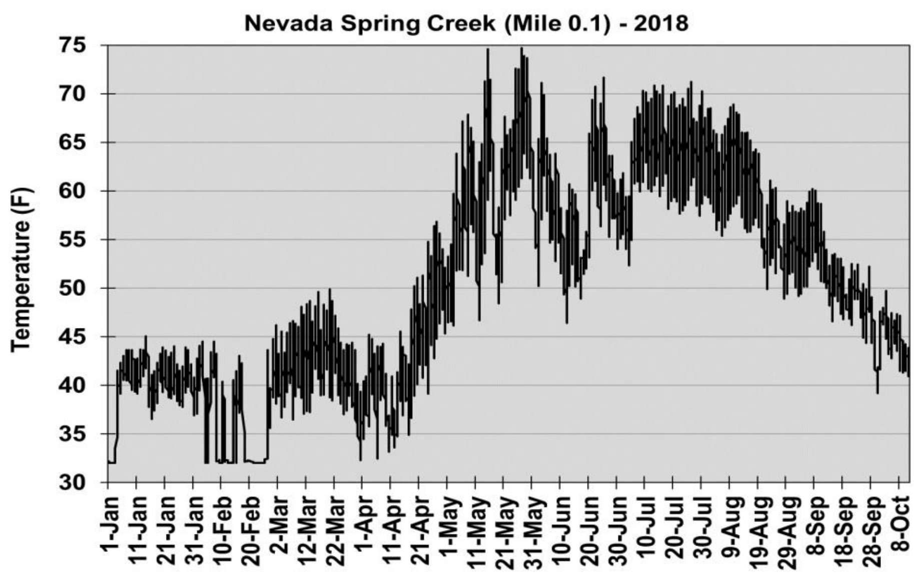
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.2	32.0	32.1	0.0	0.0
February	32.1	32.0	32.1	0.0	0.0
March	42.2	32.0	32.8	2.0	3.8
April	53.3	32.9	43.8	5.4	29.3
May	65.4	42.5	52.7	5.5	30.2
June	70.9	47.6	58.7	5.0	25.3
July	74.5	50.4	63.7	4.7	22.1
August	75.6	56.6	65.1	3.8	14.5
September	63.7	45.8	54.3	4.3	18.6
October	54.8	32.4	41.9	7.3	53.6
November	38.1	32.4	34.8	1.6	2.6
December					



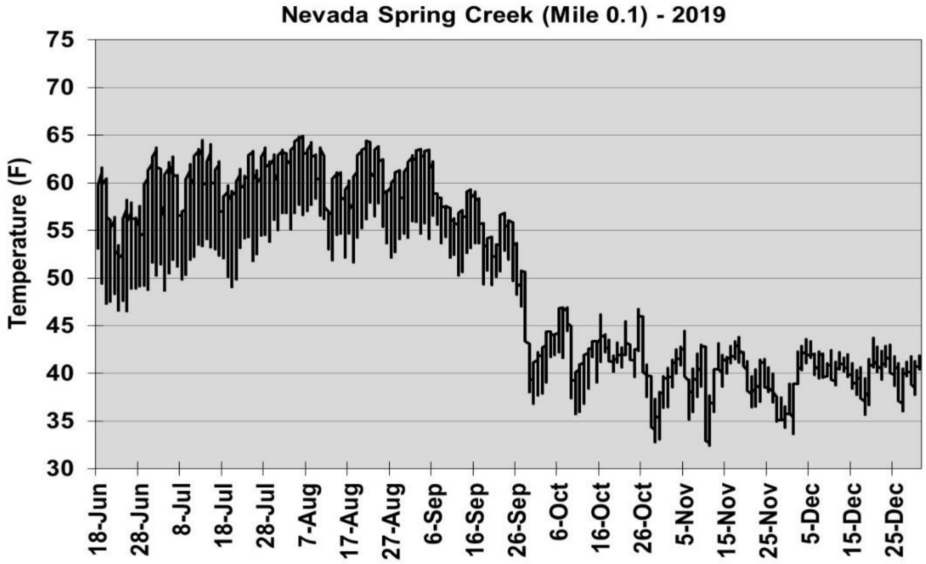
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	45.9	32.1	39.2	2.6	6.7
February	47.6	34.9	40.5	2.6	7.0
March	52.8	36.1	43.1	3.3	10.6
April	58.5	39.6	47.4	4.4	19.1
May	62.1	41.1	49.8	4.7	21.9
June	65.3	44.9	54.7	4.6	21.0
July	69.9	48.9	59.1	4.8	23.4
August	66.6	50.5	59.2	3.3	11.1
September	61.7	43.1	50.6	3.0	8.7
October	52.0	38.5	45.4	2.2	4.8
November	46.5	37.8	42.3	2.0	3.8
December	42.3	32.0	37.3	2.8	8.0



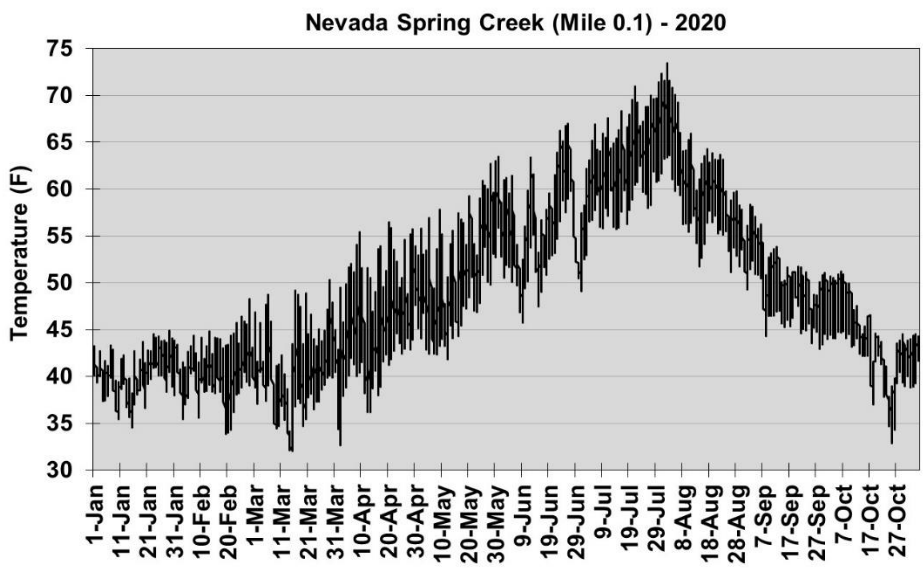
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	44.3	32.0	37.0	3.3	11.1
February	47.9	32.0	40.3	3.4	11.5
March	53.3	34.7	42.2	3.7	13.9
April	55.3	38.3	45.5	3.4	11.5
May	64.7	40.9	51.4	5.3	28.2
June	68.2	46.9	58.3	4.1	17.2
July	72.1	55.9	64.0	3.5	12.3
August	66.9	51.7	58.6	3.3	11.0
September	60.4	41.3	49.9	4.7	21.7
October	48.5	39.0	43.6	2.0	4.2
November	44.7	34.4	41.0	1.8	3.1
December	43.2	32.2	38.8	2.7	7.5



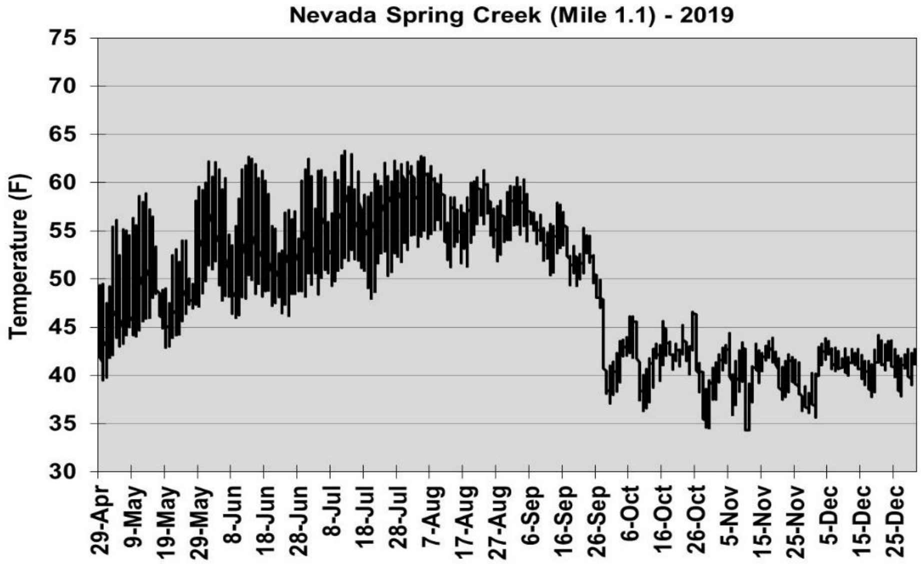
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	45.0	32.0	39.9	3.0	80.2
February	44.8	32.0	35.9	4.3	65.3
March	49.9	32.3	41.5	3.4	80.3
April	56.9	32.4	42.4	5.6	75.1
May	74.7	46.1	60.0	6.6	80.2
June	71.7	46.4	58.3	5.2	75.1
July	71.2	52.3	63.1	4.1	80.2
August	68.9	48.9	58.9	4.7	80.0
September	60.2	39.2	50.7	4.0	75.1
October	49.7	40.9	44.6	2.1	9.5
November					
December					



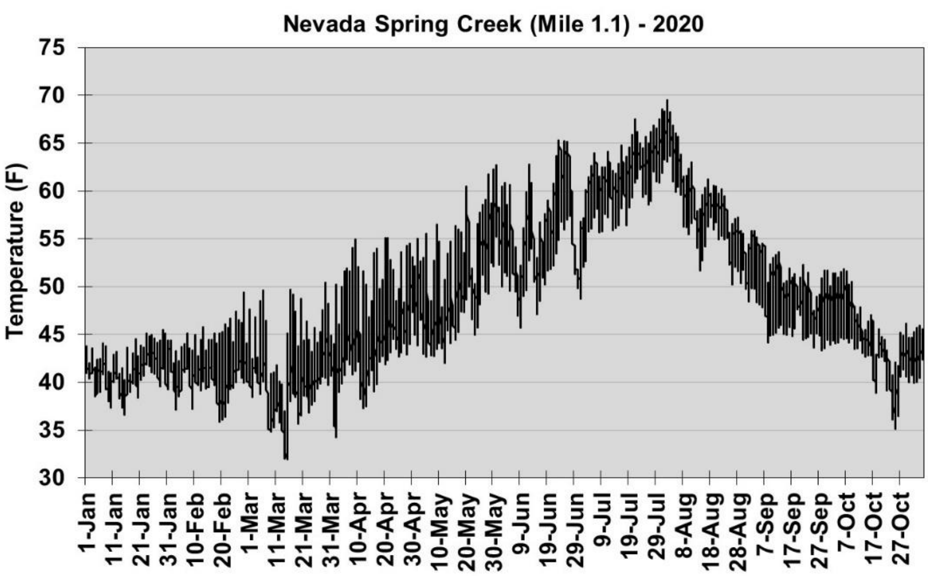
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	61.6	46.6	52.8	3.6	12.9
July	64.5	48.8	57.0	3.5	12.6
August	64.9	51.7	58.2	2.9	8.5
September	63.6	36.8	53.4	5.2	27.1
October	46.9	32.8	41.0	2.8	7.8
November	44.4	32.4	39.4	2.5	6.4
December	43.8	33.7	40.4	1.7	2.8



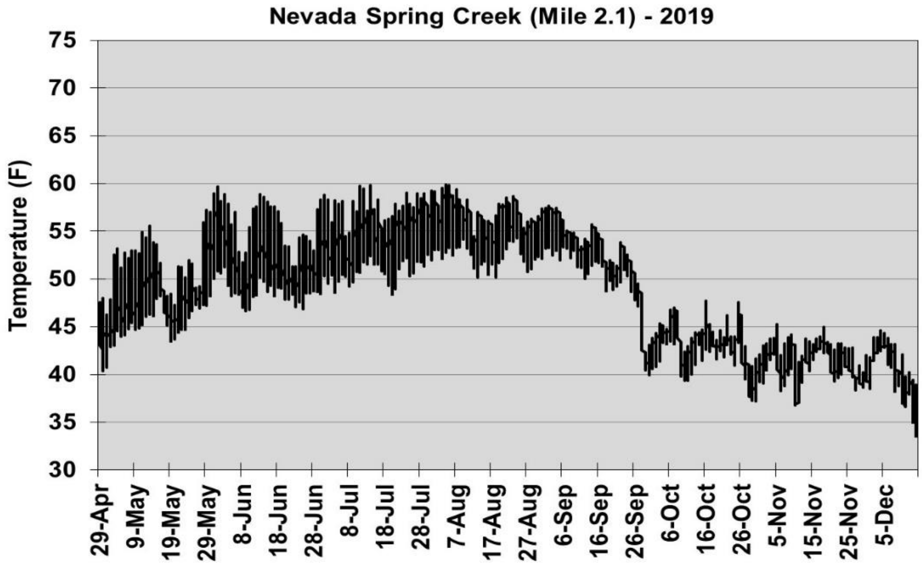
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	44.9	34.6	40.3	2.1	4.2
February	48.3	33.8	40.6	2.5	6.3
March	50.3	32.0	40.3	3.8	14.7
April	56.5	32.6	45.4	4.9	23.7
May	63.4	41.9	50.9	5.0	25.5
June	67.0	45.8	55.8	4.6	20.9
July	72.3	49.1	62.0	4.3	18.6
August	73.5	51.1	59.8	4.7	22.5
September	58.4	42.9	49.6	3.2	10.0
October	51.2	32.9	43.5	4.0	16.3
November	44.5	38.8	41.8	1.8	3.4
December					



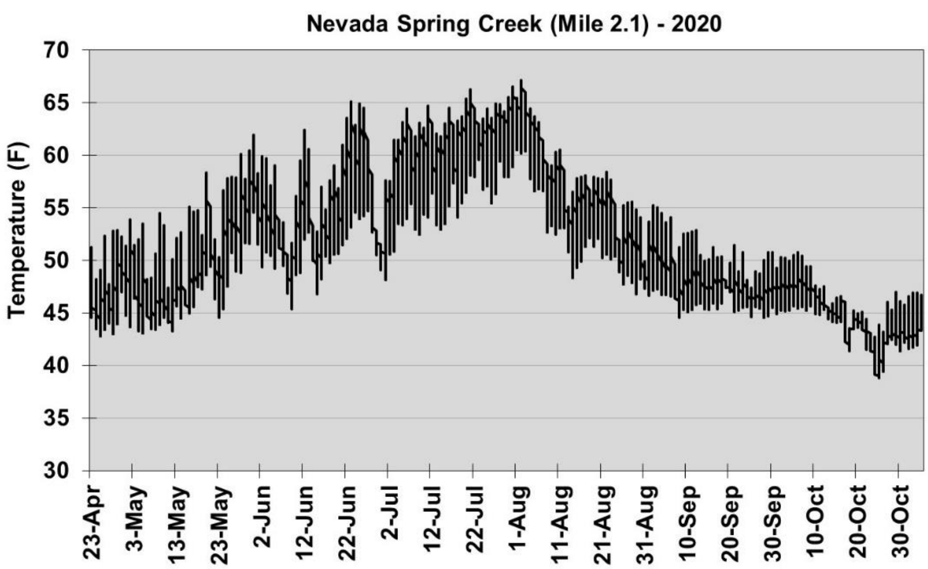
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April	49.5	39.5	44.5	3.5	12.5
May	60.0	39.8	48.9	4.1	17.2
June	62.7	46.0	52.9	4.2	17.3
July	63.3	48.0	55.6	3.6	12.9
August	62.7	51.2	56.8	2.4	6.0
September	60.5	37.1	52.6	4.9	23.6
October	46.6	34.6	41.4	2.5	6.2
November	44.4	34.3	40.2	2.2	4.7
December	44.2	35.6	41.3	1.4	1.9



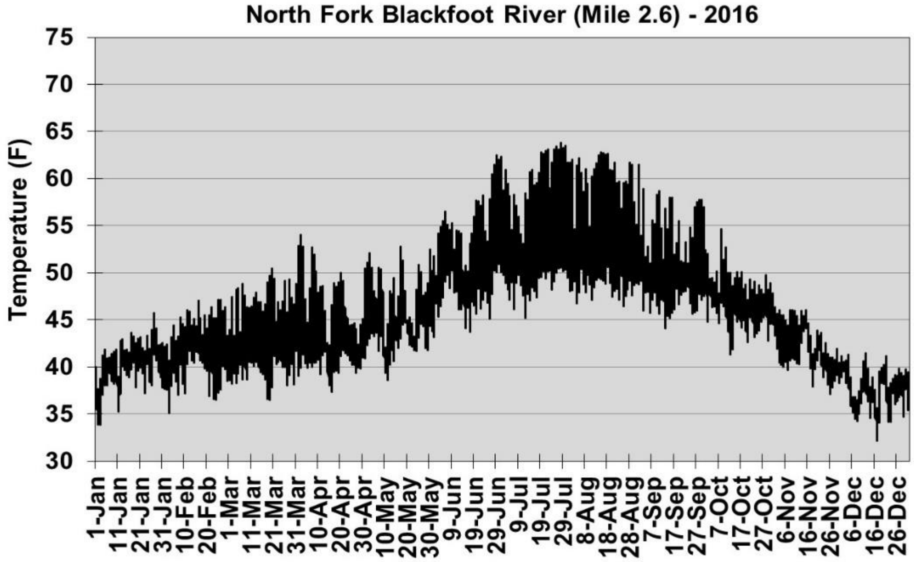
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	45.4	36.6	41.3	1.7	3.0
February	49.4	35.8	41.5	2.2	5.0
March	50.4	31.9	40.7	3.6	13.2
April	55.1	34.3	45.3	4.4	19.0
May	62.7	42.1	50.1	4.7	21.6
June	65.3	45.7	54.9	4.3	18.6
July	68.6	48.8	60.8	3.4	11.9
August	69.5	49.8	58.2	4.2	17.8
September	55.9	43.3	48.8	2.9	8.6
October	51.8	35.1	44.0	3.4	11.6
November	45.9	39.9	42.6	1.8	3.4
December					



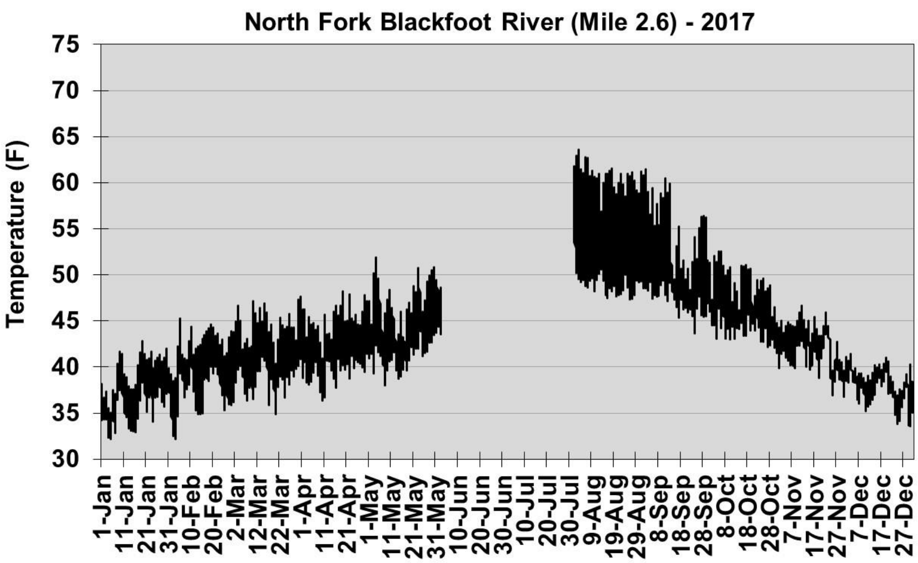
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April	48.0	40.4	44.4	2.6	6.7
May	59.0	40.7	48.4	3.3	10.7
June	59.7	46.6	51.7	3.1	9.5
July	59.8	48.4	53.9	2.7	7.2
August	59.9	50.2	54.7	2.1	4.4
September	57.7	39.9	51.5	3.7	14.0
October	47.7	37.2	42.6	2.1	4.2
November	45.3	36.7	41.4	1.7	2.8
December	44.6	33.6	40.5	2.5	6.2



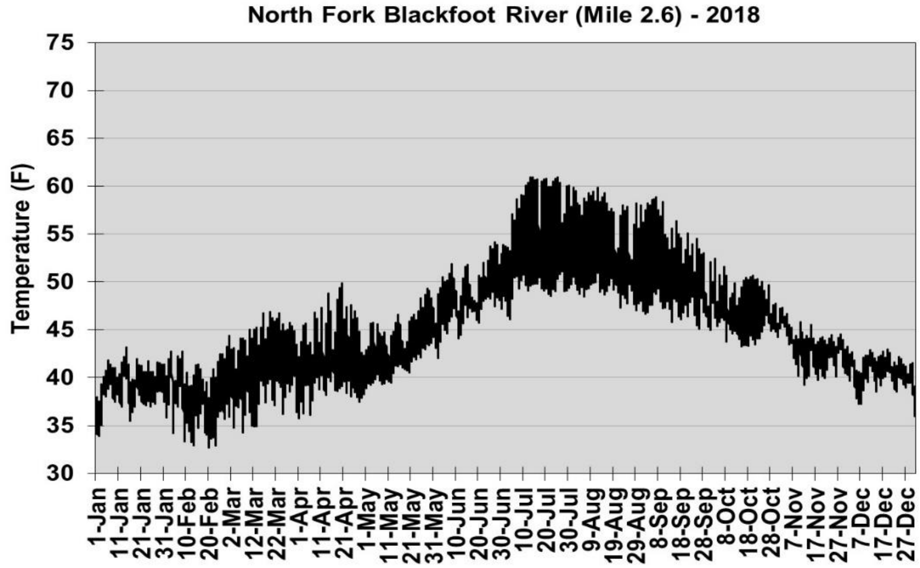
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April	52.9	42.9	47.2	2.8	7.7
May	62.0	43.2	49.7	4.2	17.7
June	65.1	45.4	54.0	4.1	16.6
July	66.6	48.1	59.2	3.7	13.5
August	67.2	46.8	55.2	4.7	21.7
September	55.3	44.5	48.0	2.3	5.2
October	50.8	38.8	44.8	2.5	6.0
November	46.9	41.6	43.7	1.6	2.7
December					



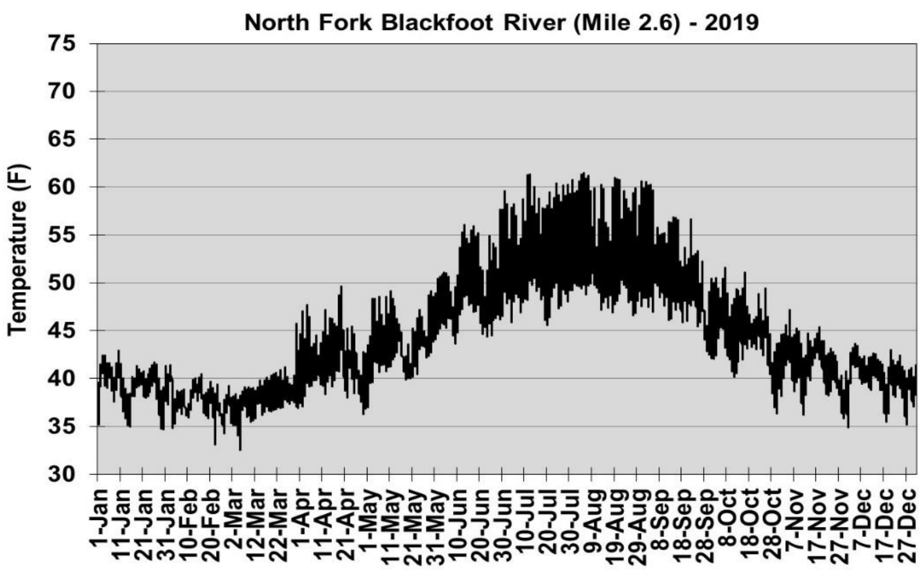
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	45.7	33.9	40.0	2.0	4.1
February	47.2	35.2	41.1	2.3	5.4
March	50.4	36.5	42.3	2.8	7.8
April	54.0	37.4	43.4	3.1	9.5
May	52.8	38.7	45.2	2.8	7.8
June	62.4	43.2	51.0	3.7	13.6
July	63.8	45.3	53.9	4.3	18.7
August	62.8	46.5	53.4	4.2	17.7
September	61.5	44.1	50.2	3.2	10.0
October	54.6	41.4	46.7	2.0	4.2
November	46.3	37.1	41.8	2.1	4.4
December	41.5	32.2	37.5	1.8	3.1



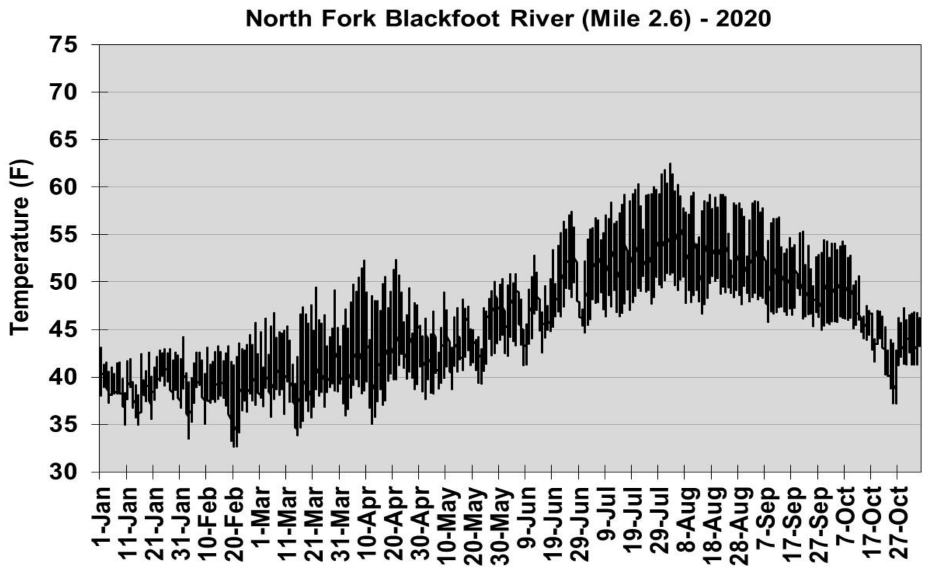
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	42.8	32.2	37.1	2.4	5.6
February	45.3	32.1	39.1	2.6	6.6
March	47.6	34.9	41.0	2.4	5.9
April	48.2	36.3	41.9	2.2	4.9
May	51.9	38.1	44.1	2.8	7.9
June	48.6	43.6	46.1	1.4	2.1
July					
August	63.6	47.4	53.6	4.0	16.1
September	61.5	43.7	50.3	3.5	12.5
October	52.6	41.5	46.0	2.2	4.9
November	46.6	36.8	41.9	1.9	3.7
December	41.4	33.6	37.9	1.6	2.6



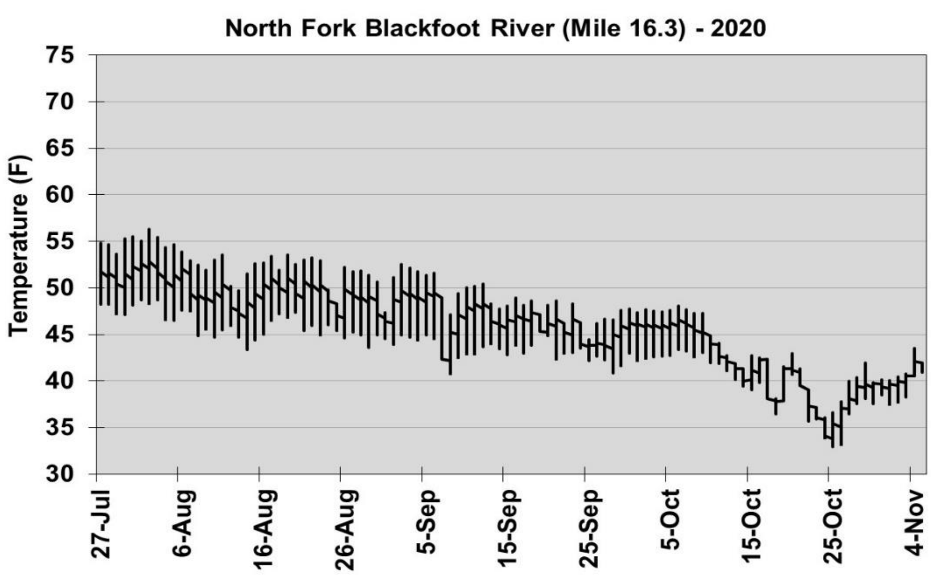
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	43.2	33.9	38.9	1.6	2.6
February	43.3	32.7	37.7	2.4	5.8
March	46.8	34.3	40.4	2.8	7.8
April	49.9	35.8	41.6	2.8	7.7
May	49.3	38.9	43.2	2.3	5.5
June	54.2	42.0	48.3	2.2	5.0
July	60.9	46.1	53.5	3.5	12.3
August	59.8	47.1	52.8	3.1	9.9
September	58.8	45.1	50.3	3.1	9.4
October	52.4	43.3	46.7	1.9	3.4
November	47.3	39.2	43.0	1.8	3.1
December	43.3	36.0	40.5	1.3	1.7



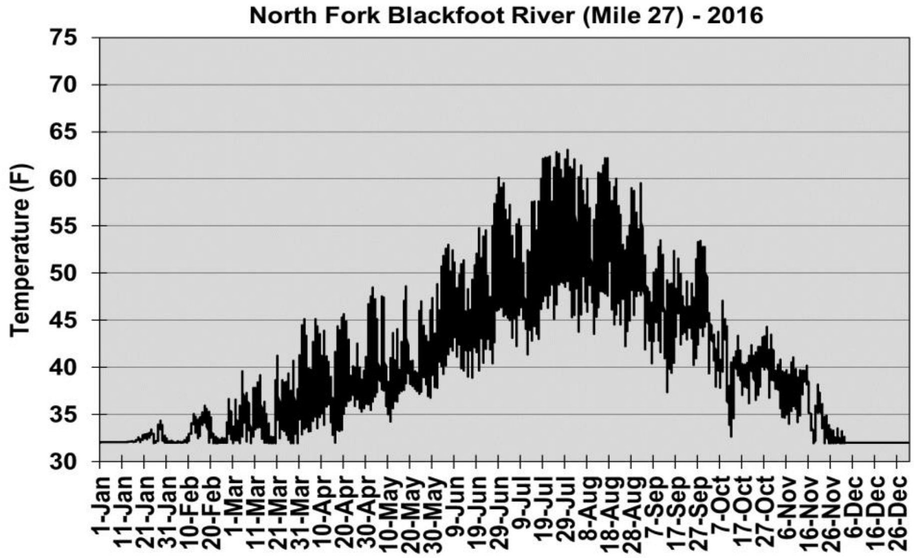
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	42.9	34.7	39.3	1.7	2.9
February	41.4	33.2	37.7	1.3	1.8
March	45.7	32.6	37.8	1.5	2.2
April	49.6	36.4	41.6	2.4	5.8
May	49.2	37.0	43.8	2.4	5.6
June	57.7	43.6	49.1	2.9	8.3
July	61.3	45.6	52.8	3.6	13.2
August	61.5	46.7	52.9	3.7	13.5
September	60.5	42.6	50.2	3.4	11.9
October	51.6	36.4	44.4	2.8	7.9
November	47.2	35.9	41.3	2.1	4.5
December	43.6	34.9	40.1	1.6	2.6



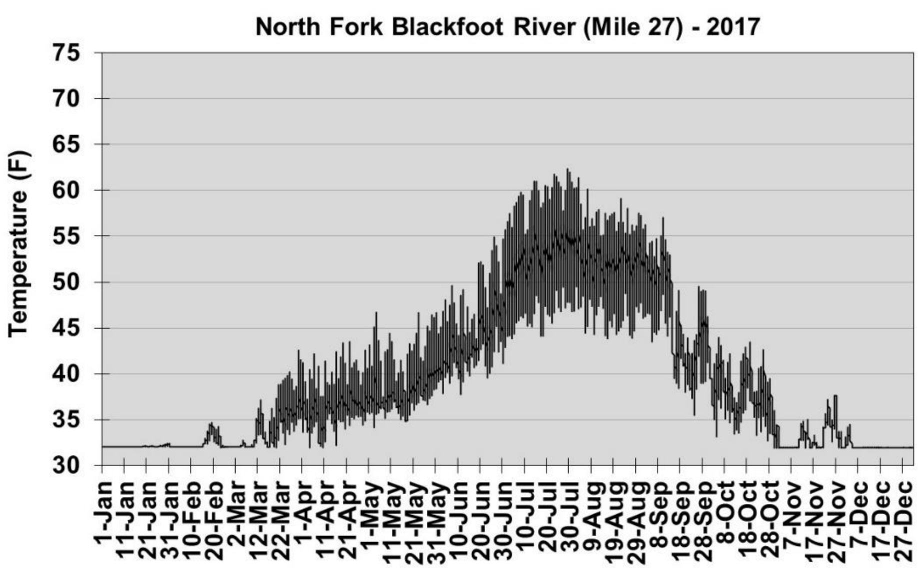
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	43.1	35.0	39.4	1.7	2.7
February	45.7	32.6	39.0	2.4	5.7
March	49.5	33.8	40.5	3.0	8.9
April	52.4	35.2	42.8	3.7	13.6
May	50.3	37.7	43.4	2.7	7.2
June	57.4	41.2	47.8	3.3	10.7
July	61.8	44.8	52.4	3.6	13.2
August	62.5	46.7	53.0	3.3	10.9
September	58.5	45.0	50.2	3.0	8.9
October	54.3	37.2	45.5	3.5	12.1
November	46.8	41.3	43.6	1.7	2.9
December					



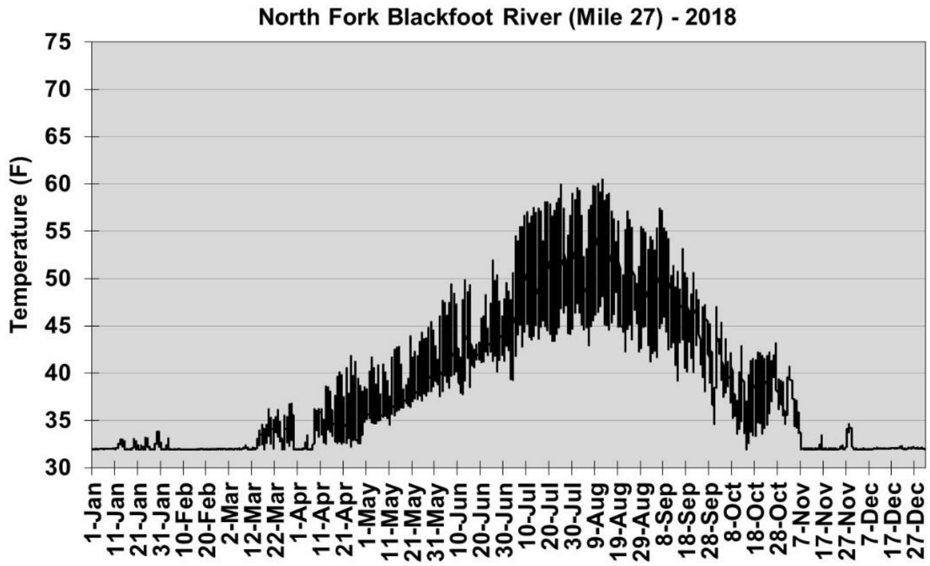
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June					
July	67.4	47.2	51.4	3.3	10.9
August	56.3	43.4	48.9	2.7	7.2
September	52.6	40.9	45.8	2.4	5.7
October	48.1	32.9	41.0	3.6	13.1
November	43.5	37.6	40.0	1.5	2.3
December					



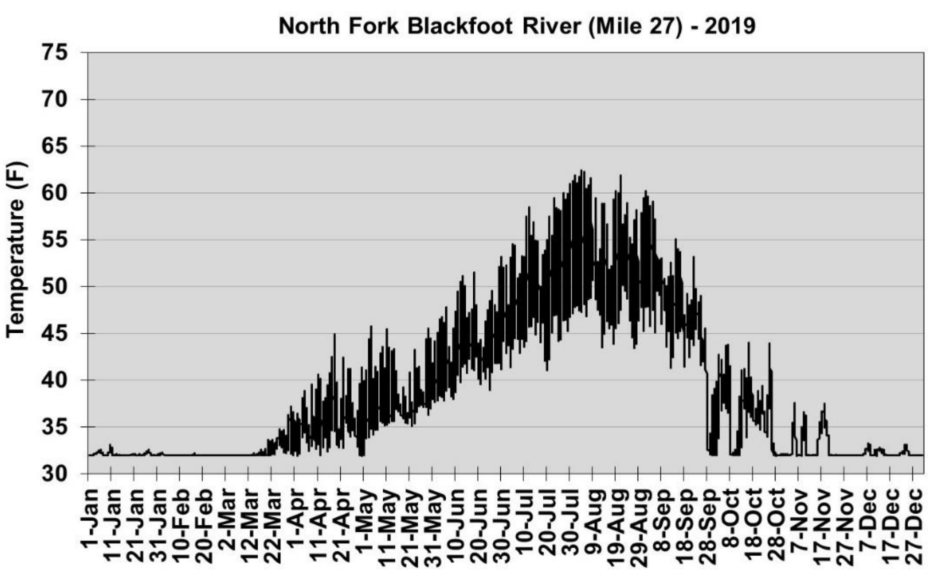
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.4	32.0	32.4	0.5	0.2
February	36.7	31.9	33.0	1.1	1.3
March	41.3	31.9	34.7	2.2	4.6
April	45.7	32.0	37.6	2.9	8.7
May	48.6	34.3	40.1	3.0	8.9
June	60.1	37.8	46.2	4.5	19.9
July	63.1	41.4	51.4	5.1	25.6
August	62.2	42.3	51.9	4.5	19.9
September	59.6	37.4	46.5	3.5	12.0
October	49.6	32.6	40.6	2.7	7.3
November	41.1	31.9	35.7	2.7	7.0
December	33.2	32.0	32.1	0.1	0.0



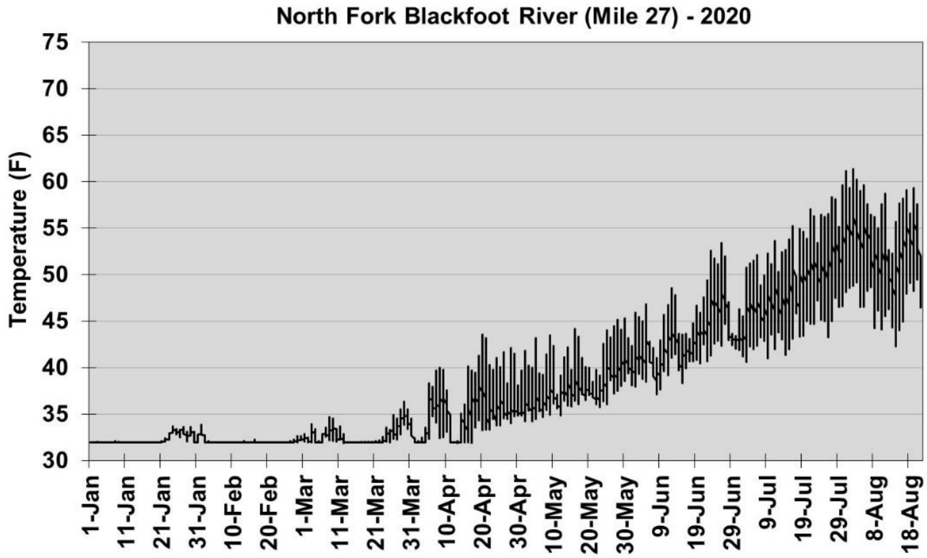
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.4	32.0	32.1	0.1	0.0
February	34.7	32.0	32.4	0.6	0.4
March	42.6	32.0	34.1	2.3	5.2
April	43.5	31.9	36.8	2.4	5.8
May	46.7	34.2	39.0	2.8	7.6
June	54.9	37.8	44.1	3.6	12.9
July	62.4	42.9	52.3	4.8	22.8
August	61.4	43.9	51.5	3.9	15.4
September	57.0	35.5	45.7	5.0	24.6
October	43.9	31.9	37.5	2.7	7.1
November	37.6	31.9	32.9	1.4	1.8
December	34.5	31.9	32.0	0.4	0.1



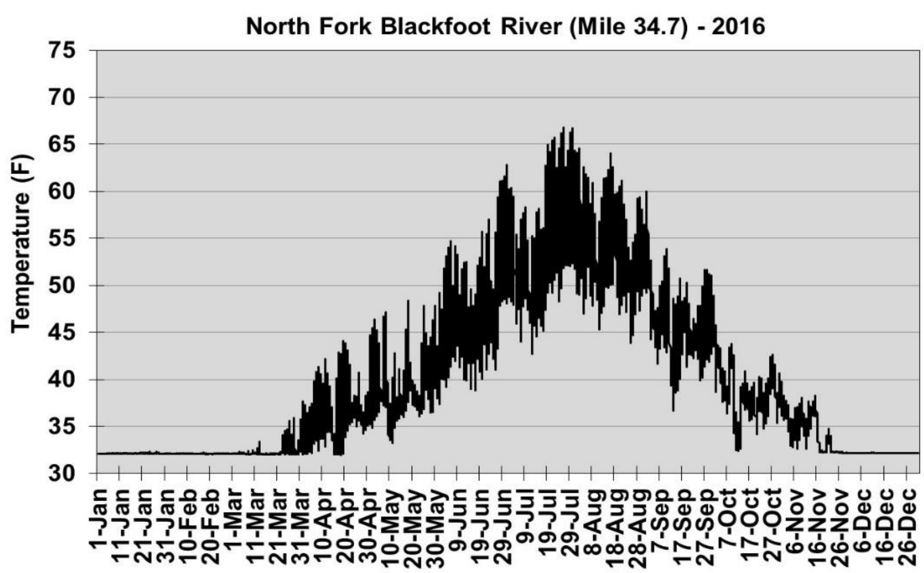
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.8	31.9	32.2	0.4	0.2
February	33.1	31.9	32.0	0.1	0.0
March	36.8	31.9	32.9	1.2	1.4
April	41.8	31.9	34.5	2.2	5.0
May	45.4	34.5	38.3	2.4	5.7
June	51.9	37.5	42.9	2.9	8.2
July	60.0	39.3	49.4	4.6	21.5
August	60.5	42.3	50.2	4.3	18.2
September	57.4	34.6	45.7	4.4	19.1
October	47.0	31.9	38.3	2.8	7.9
November	40.7	31.9	33.2	2.2	4.8
December	32.3	31.9	32.0	0.1	0.0



Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.1	31.9	32.1	0.2	0.0
February	32.2	31.9	32.0	0.1	0.0
March	37.2	31.9	32.5	1.0	1.0
April	44.9	31.9	35.6	2.4	5.6
May	45.7	31.9	38.0	2.5	6.5
June	53.2	37.7	43.4	3.2	10.3
July	61.3	41.1	49.7	4.5	20.0
August	62.4	43.5	52.0	4.3	18.9
September	60.2	31.9	46.8	5.6	31.5
October	44.0	31.9	36.0	3.3	10.6
November	37.6	31.9	32.8	1.5	2.2
December	33.2	31.9	32.1	0.3	0.1

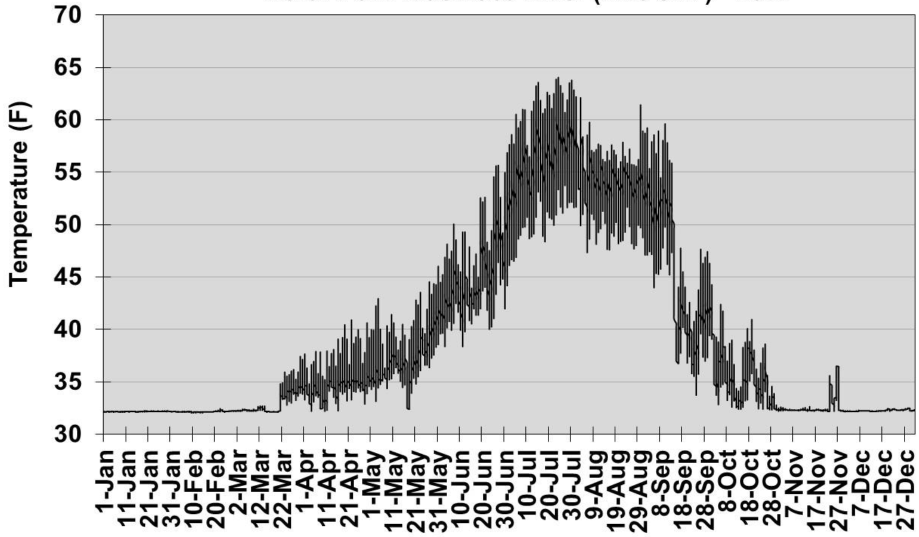


Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.7	31.9	32.2	0.5	0.2
February	33.9	31.9	32.0	0.3	0.1
March	36.4	31.9	32.7	0.9	0.9
April	43.5	31.9	35.1	2.8	7.6
May	45.3	34.3	38.3	2.5	6.0
June	53.4	37.1	43.0	3.2	10.0
July	61.1	40.6	48.3	4.3	18.8
August	61.4	42.2	51.7	4.2	17.6
September					
October					
November					
December					



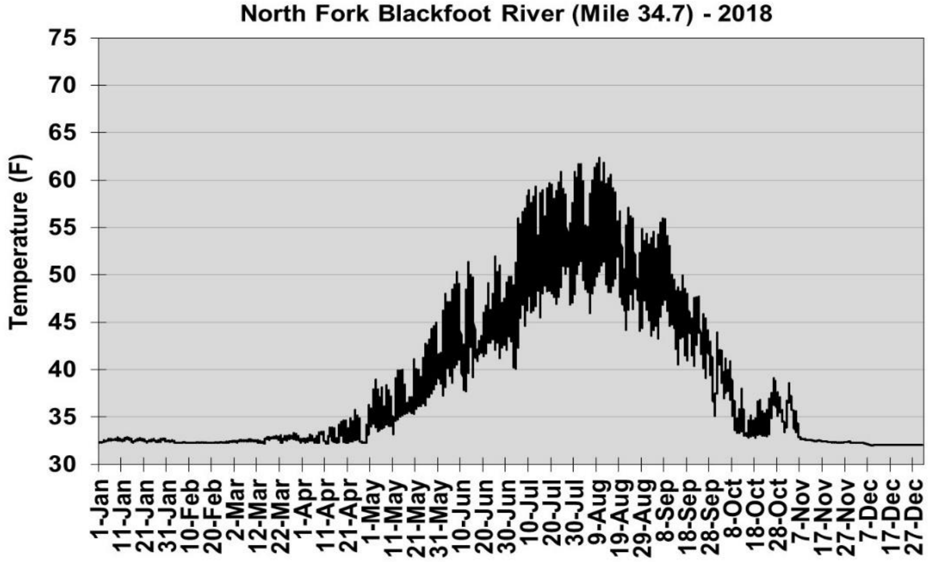
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.1	32.1	0.0	0.0
February	32.2	32.0	32.1	0.0	0.0
March	35.9	32.0	32.3	0.7	0.4
April	44.1	32.0	35.7	2.6	6.6
May	48.4	33.2	39.2	3.0	9.2
June	61.6	37.4	47.0	5.1	25.6
July	66.8	42.7	54.1	5.4	28.9
August	64.6	43.9	53.6	4.4	18.9
September	60.0	36.7	45.8	3.7	13.5
October	48.9	32.4	38.7	2.9	8.3
November	38.3	32.2	34.1	1.9	3.5
December	32.2	32.1	32.2	0.0	0.0

North Fork Blackfoot River (Mile 34.7) - 2017

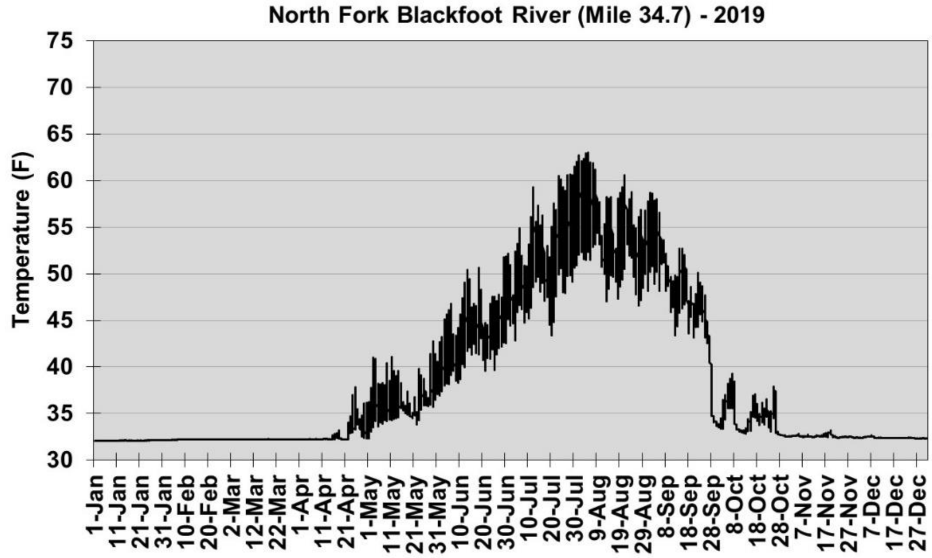


Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.2	32.1	32.2	0.0	0.0
February	32.4	32.1	32.2	0.0	0.0
March	37.4	32.1	33.0	1.1	1.3
April	40.9	32.2	35.2	1.7	3.0
May	46.0	32.4	37.7	2.6	6.9
June	55.6	38.4	44.8	3.6	13.2
July	64.0	44.2	55.3	4.4	19.1
August	62.2	47.4	53.4	3.0	9.1
September	59.6	33.8	45.4	6.5	42.1
October	44.3	32.2	35.2	2.4	6.0
November	36.5	32.2	32.6	0.8	0.6
December	32.5	32.2	32.3	0.1	0.0

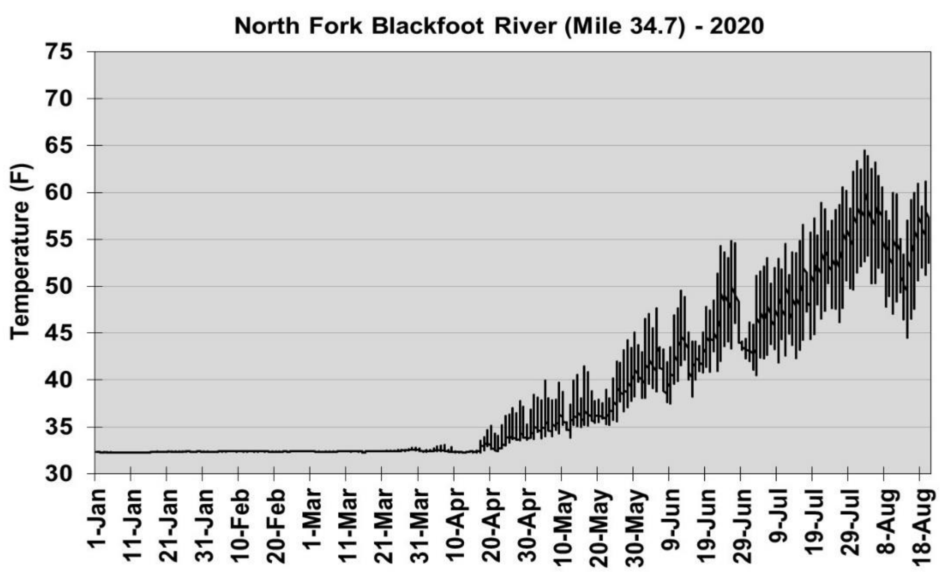
North Fork Blackfoot River (Mile 34.7) - 2018



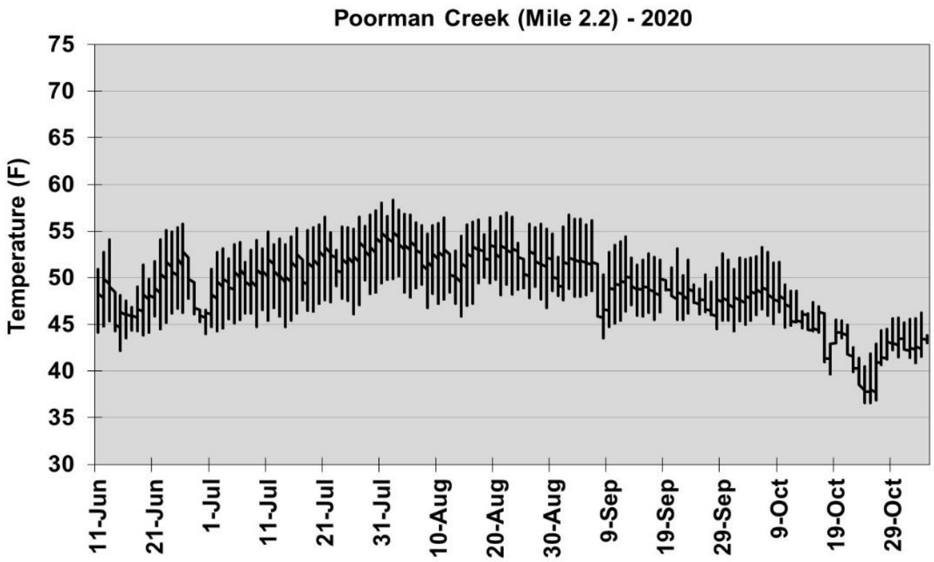
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.8	32.3	32.5	0.1	0.0
February	32.6	32.2	32.3	0.1	0.0
March	33.3	32.2	32.6	0.2	0.1
April	36.3	32.2	33.0	0.7	0.5
May	44.9	33.1	37.0	2.4	6.0
June	51.9	37.3	43.6	3.1	9.4
July	60.9	40.1	51.7	4.6	21.1
August	62.4	44.1	52.5	4.2	17.5
September	56.0	35.1	45.7	4.2	17.7
October	43.9	32.8	35.9	2.6	6.6
November	38.6	32.3	33.0	1.3	1.7
December	32.3	32.0	32.1	0.1	0.0



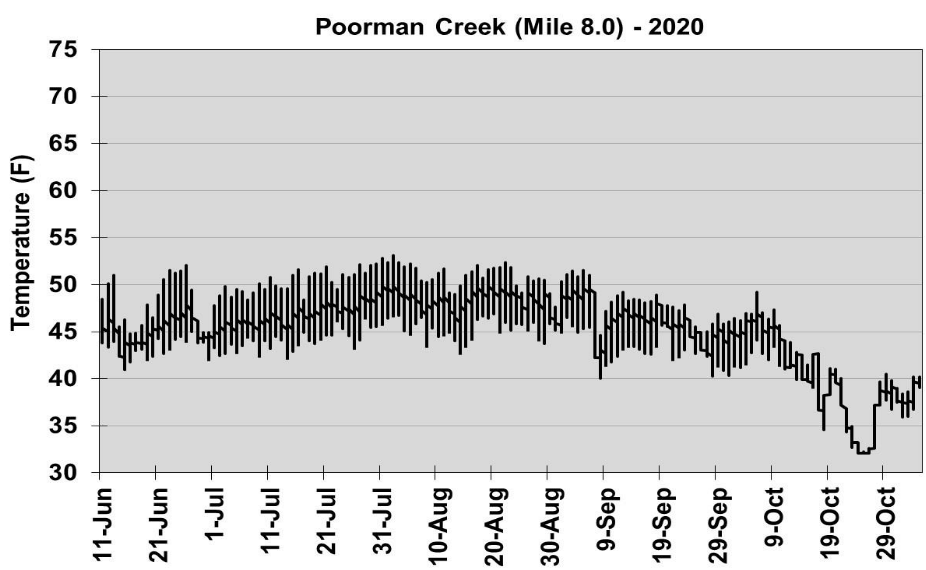
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.1	32.1	32.1	0.0	0.0
February	32.2	32.1	32.2	0.0	0.0
March	32.3	32.2	32.2	0.0	0.0
April	37.8	32.2	32.8	1.0	1.0
May	42.8	32.4	36.2	1.9	3.6
June	51.9	36.9	43.3	3.0	9.3
July	62.1	42.8	51.4	4.2	17.5
August	63.0	46.6	54.1	3.6	12.8
September	58.7	33.6	47.2	5.5	30.0
October	39.3	32.5	34.4	1.6	2.5
November	33.2	32.4	32.6	0.1	0.0
December	32.6	32.3	32.4	0.1	0.0



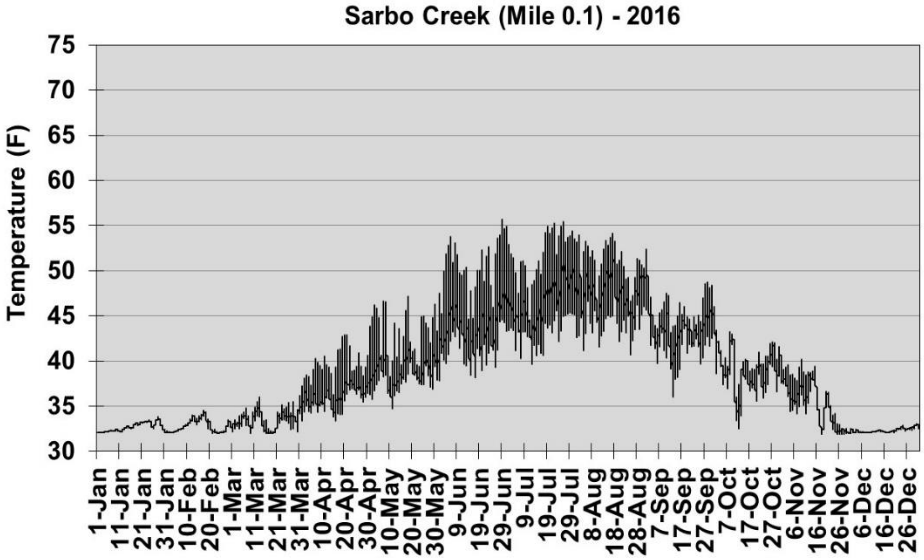
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.4	32.2	32.3	0.0	0.0
February	32.4	32.3	32.4	0.0	0.0
March	32.8	32.3	32.4	0.1	0.0
April	37.8	32.3	33.1	1.1	1.2
May	45.1	33.7	37.1	2.4	5.6
June	54.9	37.5	43.8	3.6	13.0
July	63.3	40.6	49.8	4.9	23.8
August	64.5	44.5	54.5	4.3	18.6
September					
October					
November					
December					



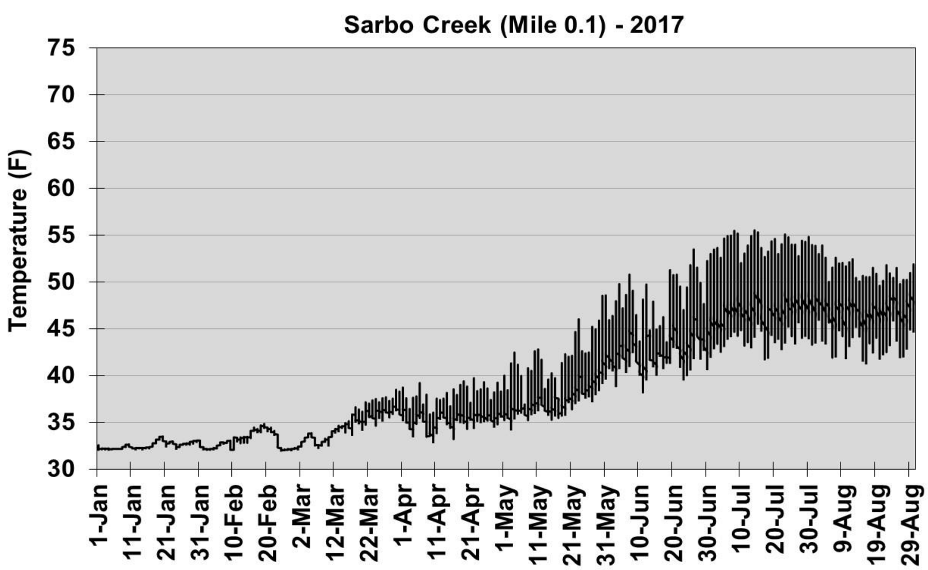
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	55.8	42.2	47.8	3.0	8.7
July	58.0	44.4	50.3	3.0	9.2
August	58.4	46.0	51.7	2.6	6.6
September	56.7	43.5	49.0	2.5	6.4
October	53.3	36.6	44.6	3.5	12.1
November	46.3	41.0	43.0	1.4	2.0
December					



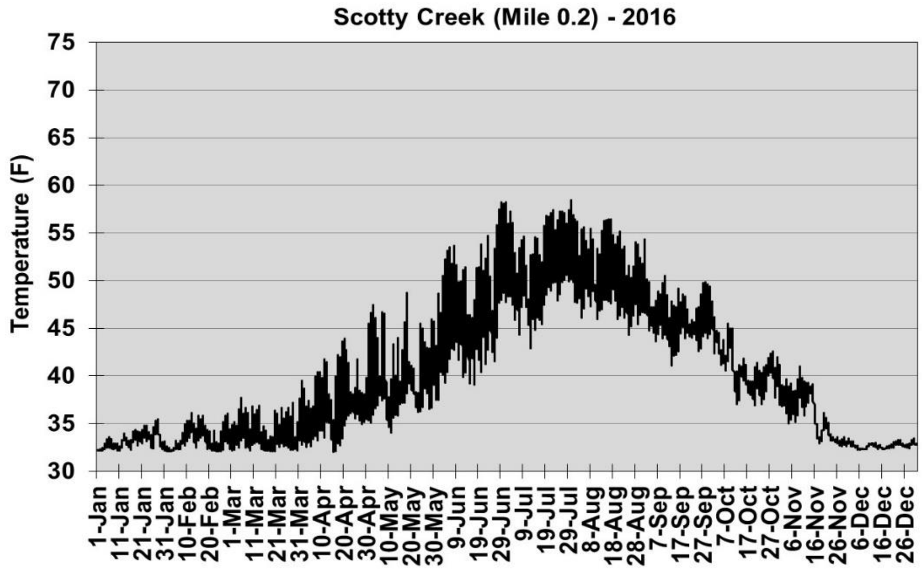
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January					
February					
March					
April					
May					
June	52.0	41.0	45.3	2.3	5.3
July	52.8	42.2	46.8	2.4	5.8
August	53.1	42.8	47.9	2.2	4.8
September	51.5	40.0	45.6	2.4	5.8
October	49.2	32.1	40.0	4.3	18.3
November	40.2	35.9	37.9	1.3	1.6
December					



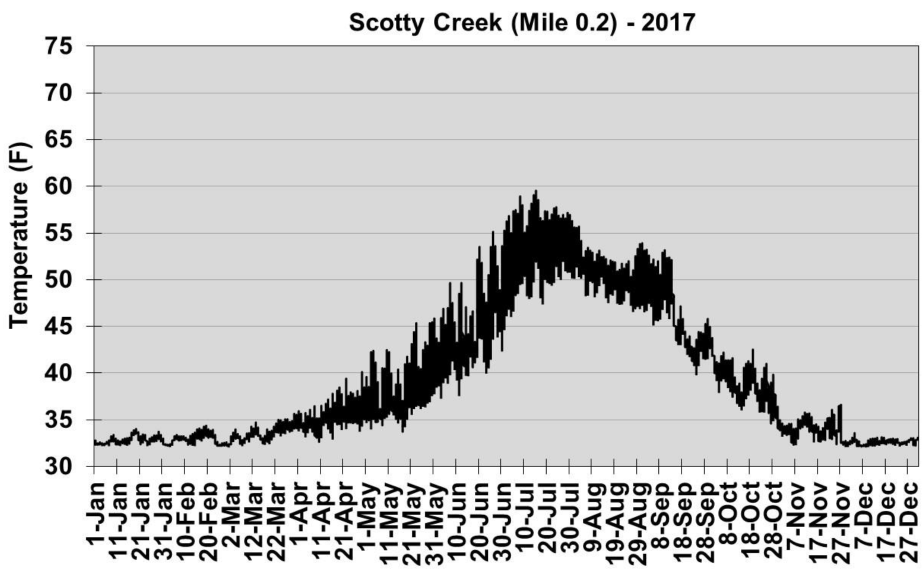
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.8	32.1	32.7	0.5	0.2
February	34.5	32.0	32.8	0.7	0.5
March	36.2	32.0	33.4	0.9	0.8
April	42.9	33.4	37.0	1.9	3.5
May	47.2	34.8	40.0	2.5	6.2
June	55.7	37.8	45.1	3.8	14.5
July	55.4	39.7	47.3	3.7	13.6
August	54.1	40.7	47.5	2.9	8.6
September	52.4	36.1	43.6	2.4	5.7
October	46.0	32.5	39.1	2.3	5.2
November	40.2	31.9	35.2	2.4	5.6
December	33.0	32.0	32.3	0.3	0.1



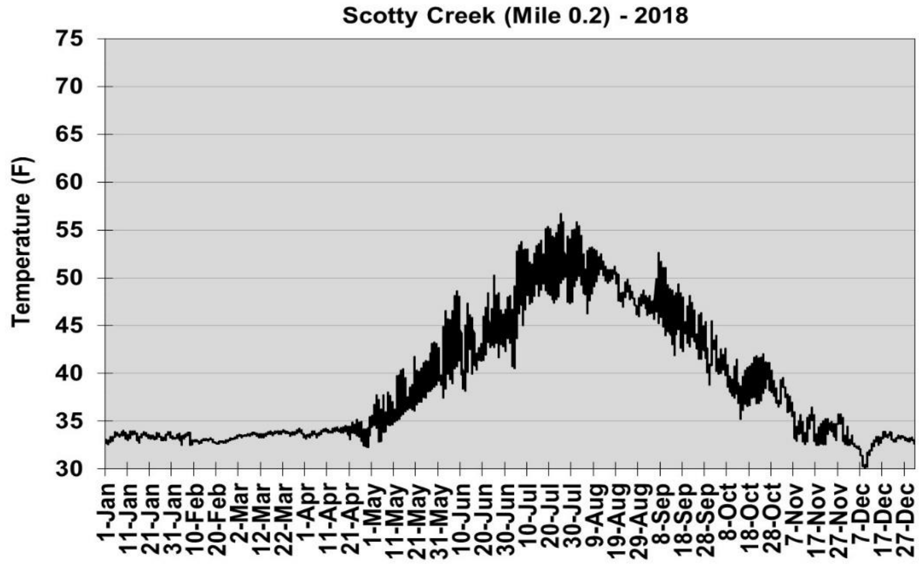
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.5	32.1	32.5	0.4	0.1
February	34.8	32.0	33.0	0.8	0.7
March	38.5	32.1	34.7	1.6	2.4
April	39.7	32.9	36.0	1.3	1.6
May	48.5	34.3	38.7	2.7	7.1
June	53.4	38.2	44.1	3.0	8.8
July	55.5	41.7	48.3	3.7	13.4
August	53.9	41.3	47.2	2.9	8.3
September					
October					
November					
December					



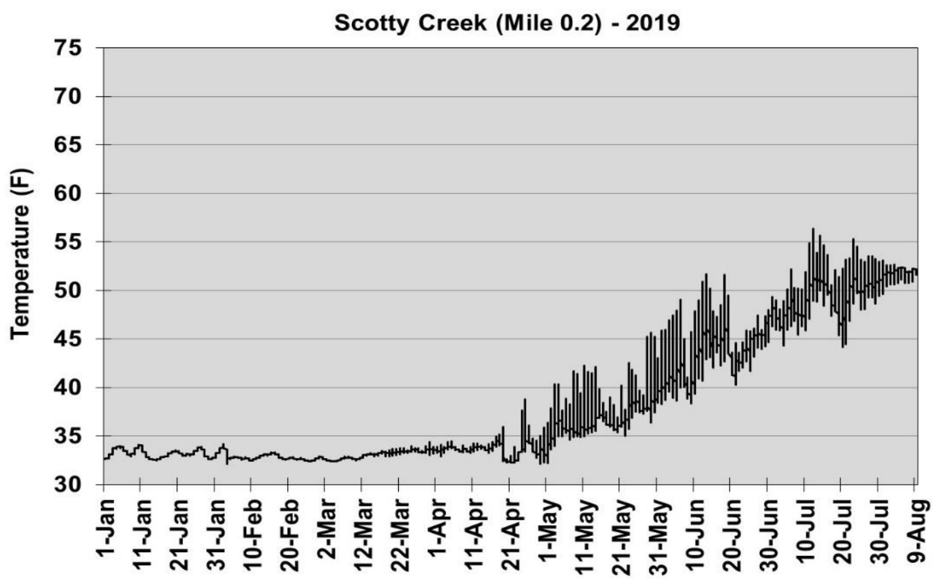
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.4	32.1	33.1	0.7	0.5
February	36.1	32.1	33.2	1.0	0.9
March	37.7	32.1	33.6	1.2	1.4
April	43.9	32.0	36.1	2.4	5.6
May	48.7	34.0	39.4	2.8	7.9
June	58.2	37.5	46.3	4.3	18.2
July	58.5	43.0	50.9	3.1	9.8
August	56.5	44.3	49.9	2.6	6.6
September	54.3	41.1	45.8	1.9	3.7
October	47.8	36.9	40.8	2.3	5.1
November	41.0	32.6	35.7	2.2	4.9
December	33.4	32.2	32.7	0.3	0.1



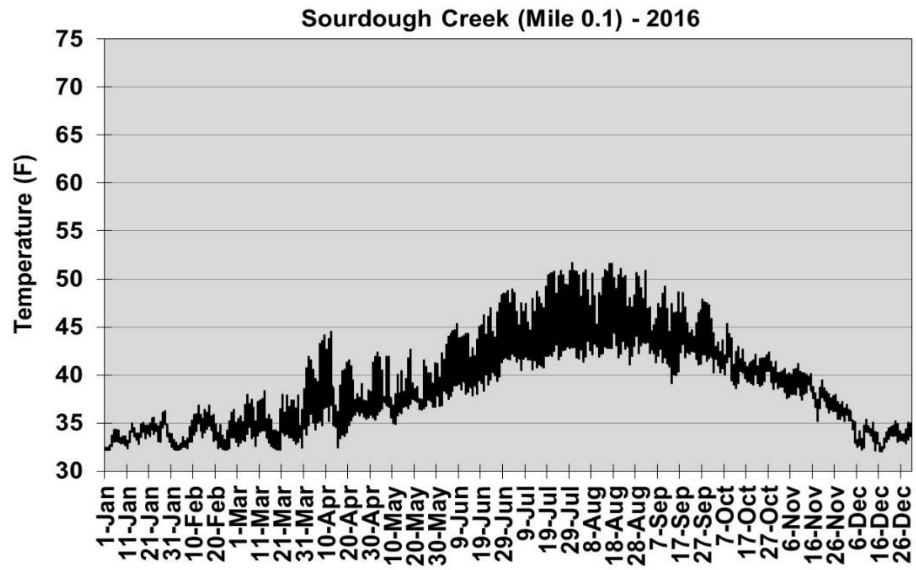
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.0	32.3	32.8	0.4	0.2
February	34.4	32.2	32.9	0.5	0.3
March	35.6	32.2	33.5	0.7	0.5
April	40.1	32.6	35.1	1.2	1.5
May	45.9	33.7	37.8	2.4	6.0
June	55.1	37.4	44.0	3.8	14.1
July	59.5	44.8	52.8	2.9	8.5
August	55.7	46.7	50.4	1.8	3.1
September	53.2	39.9	45.8	3.3	10.8
October	43.8	33.9	38.5	2.0	4.1
November	36.6	32.2	33.9	0.9	0.9
December	33.6	32.1	32.6	0.3	0.1



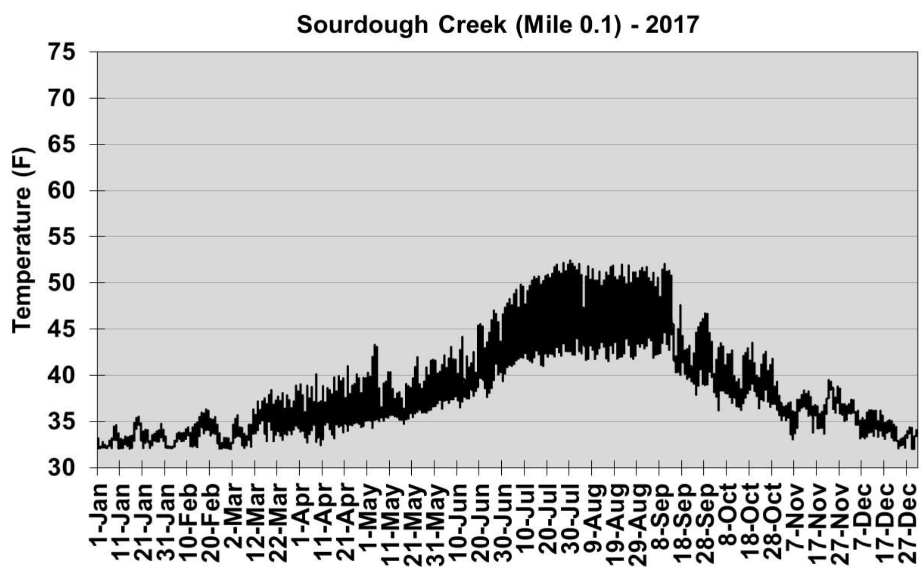
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.0	32.6	33.4	0.3	0.1
February	33.8	32.5	33.1	0.3	0.1
March	34.2	33.2	33.7	0.2	0.0
April	35.4	32.3	33.8	0.5	0.2
May	43.2	32.9	37.3	2.2	4.8
June	50.2	37.4	42.9	2.6	6.6
July	56.7	40.6	49.9	3.0	9.2
August	55.8	46.0	49.7	1.8	3.4
September	52.6	38.8	45.3	2.4	5.6
October	45.4	35.2	39.3	1.8	3.3
November	39.5	32.5	34.8	1.7	2.7
December	34.4	29.7	32.7	0.9	0.8



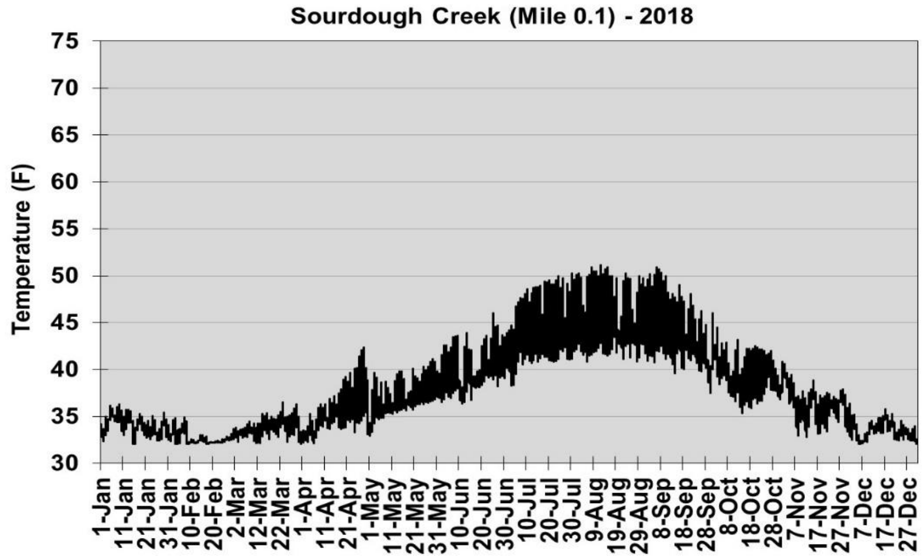
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.1	32.5	33.2	0.4	0.2
February	34.2	32.1	32.8	0.3	0.1
March	34.4	32.4	33.1	0.4	0.2
April	38.8	32.2	33.7	0.9	0.7
May	45.7	32.3	37.5	2.3	5.1
June	51.7	38.3	43.9	2.8	8.0
July	56.3	44.2	49.5	2.4	5.7
August	52.7	50.4	51.6	0.5	0.3
September					
October					
November					
December					



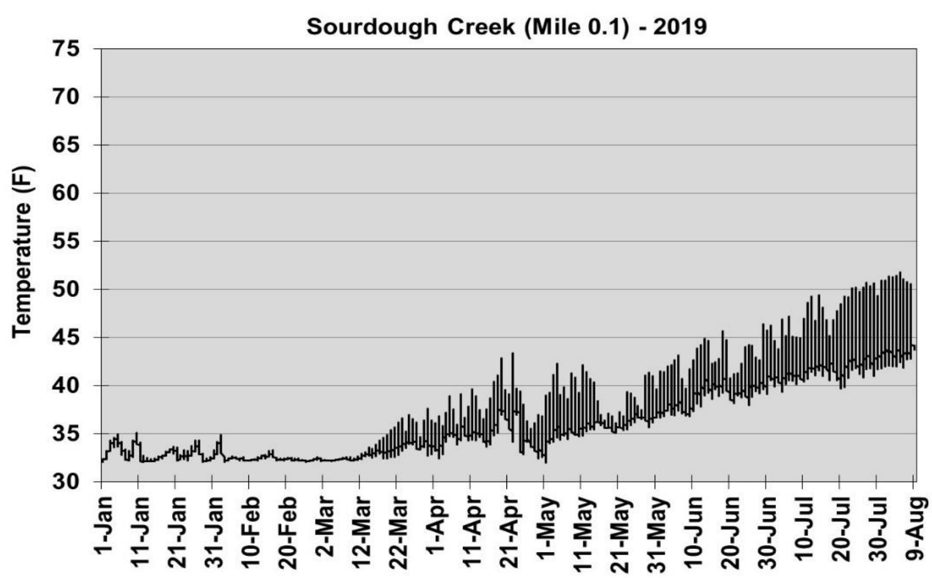
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.3	32.2	33.8	0.9	0.7
February	36.8	32.2	33.8	1.2	1.4
March	38.6	32.2	34.6	1.4	1.9
April	44.5	32.5	37.0	2.2	4.8
May	42.7	34.9	37.8	1.5	2.2
June	48.5	36.8	41.2	2.3	5.3
July	51.7	40.6	44.4	2.5	6.3
August	51.6	41.1	45.3	2.4	5.9
September	50.8	39.2	43.6	1.9	3.5
October	45.9	38.6	40.9	1.3	1.7
November	41.1	35.2	38.0	1.3	1.7
December	36.9	32.0	33.9	1.0	1.0



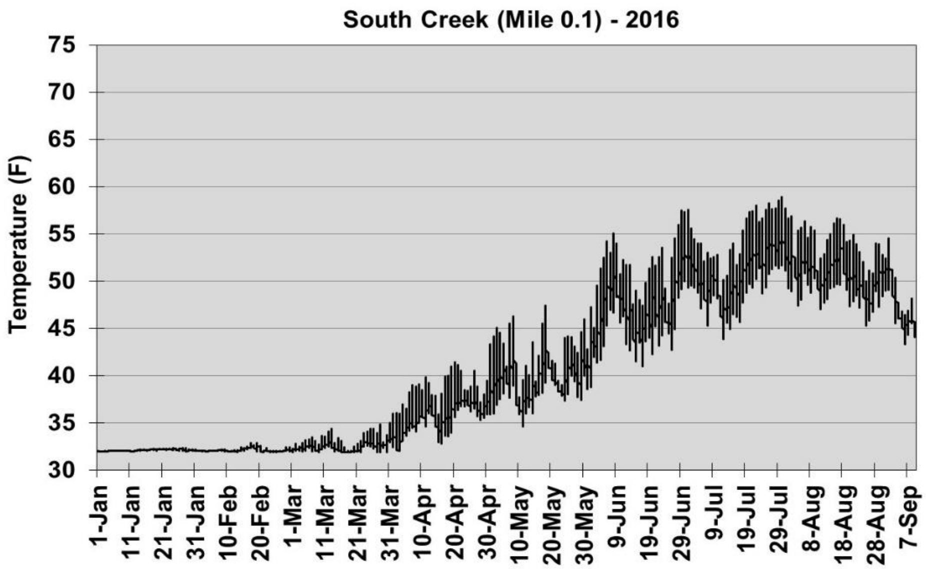
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.5	32.1	33.1	0.8	0.7
February	36.3	32.1	33.4	1.0	1.0
March	38.9	32.1	34.6	1.4	1.8
April	41.0	32.4	35.6	1.6	2.6
May	43.3	34.4	37.0	1.6	2.6
June	47.0	36.5	40.0	2.3	5.1
July	52.4	40.3	45.0	2.9	8.2
August	52.1	41.6	45.8	2.7	7.5
September	52.1	37.9	43.6	3.1	9.9
October	43.6	35.7	38.9	1.6	2.6
November	39.5	33.1	36.3	1.2	1.5
December	37.4	32.0	34.3	1.2	1.5



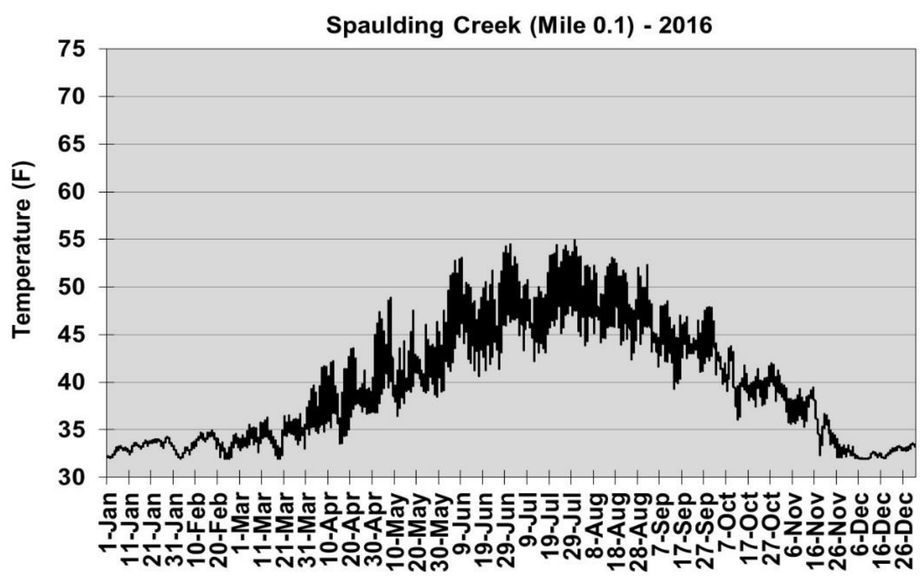
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.3	32.1	34.1	0.9	0.9
February	34.9	32.0	32.7	0.6	0.4
March	36.5	32.1	33.7	0.8	0.7
April	42.4	32.1	35.2	1.9	3.6
May	41.1	32.9	36.7	1.5	2.2
June	46.0	36.4	39.5	1.9	3.5
July	50.2	38.3	43.5	2.6	6.6
August	51.1	40.9	44.6	2.5	6.2
September	50.9	37.6	43.2	2.6	6.5
October	46.0	35.3	39.1	1.8	3.4
November	40.9	32.8	36.2	1.6	2.7
December	36.4	32.0	33.5	0.9	0.8



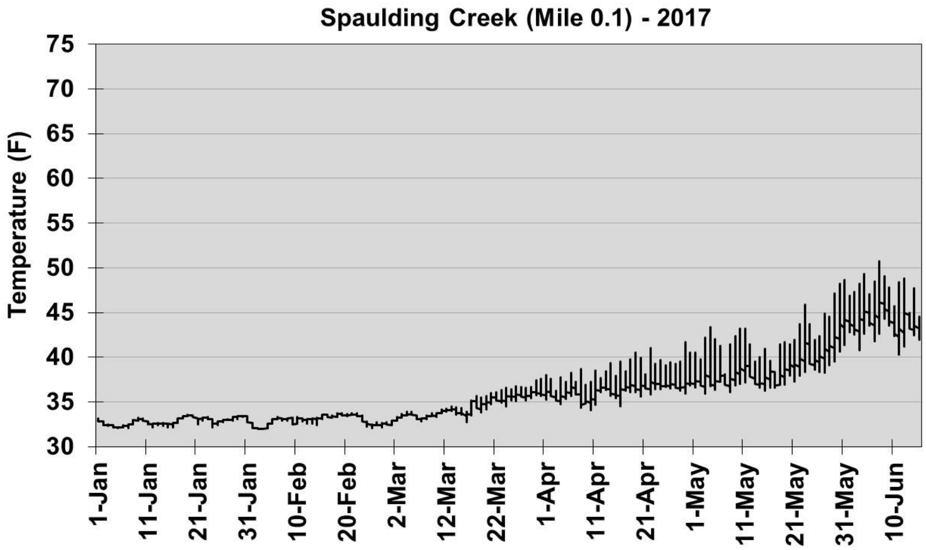
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.1	32.1	33.0	0.7	0.5
February	34.9	32.1	32.5	0.5	0.2
March	37.6	32.1	33.3	1.1	1.2
April	43.4	32.4	35.8	1.9	3.6
May	42.3	32.0	36.7	1.7	2.7
June	46.3	36.7	40.1	1.9	3.7
July	50.9	39.4	43.3	2.6	6.5
August	51.8	41.8	45.3	2.9	8.2
September					
October					
November					
December					



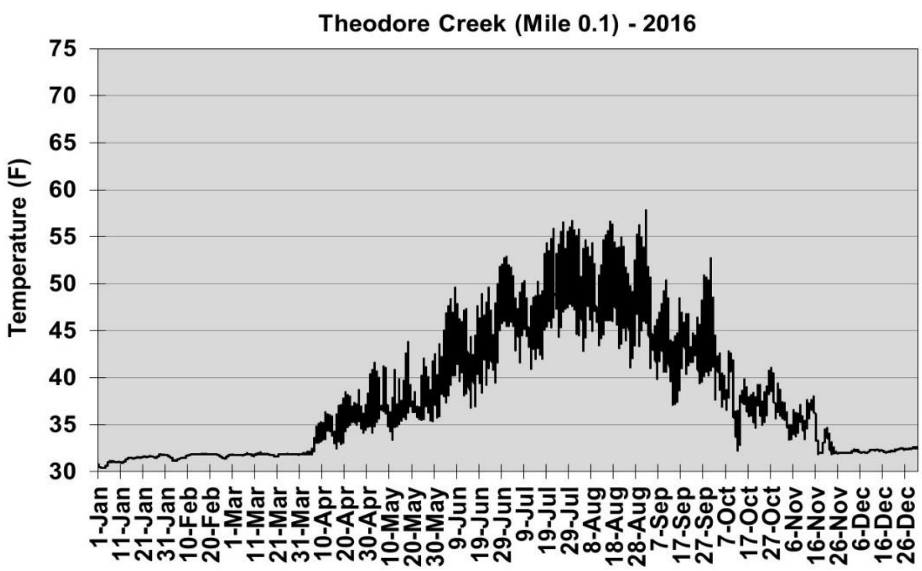
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.3	32.0	32.1	0.1	0.0
February	32.9	31.9	32.1	0.2	0.0
March	35.0	31.9	32.6	0.6	0.3
April	41.5	32.1	36.2	1.9	3.6
May	47.4	34.6	40.0	2.3	5.4
June	57.5	38.8	47.3	3.4	11.7
July	58.9	43.9	51.1	3.0	9.0
August	56.9	45.3	50.8	2.2	4.8
September	54.6	43.4	47.2	2.4	5.7
October					
November					
December					



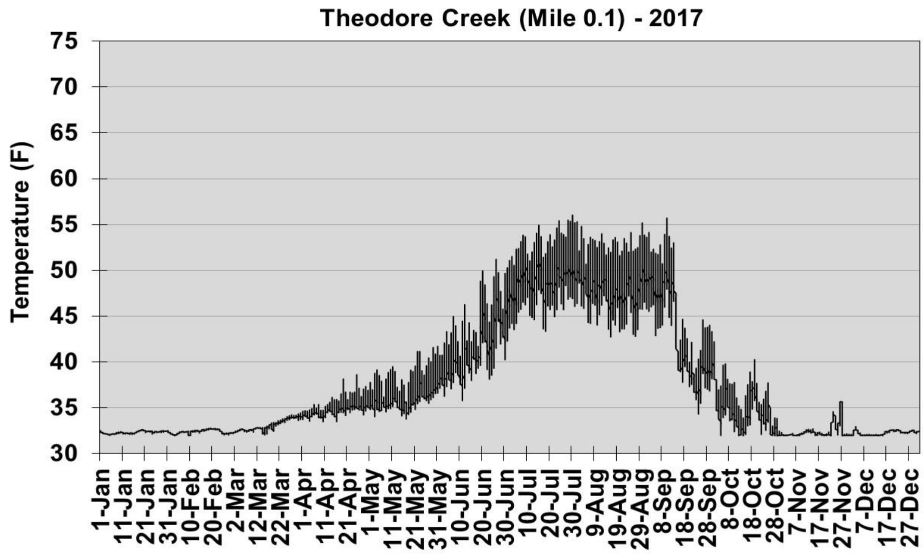
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	34.3	32.0	33.3	0.6	0.3
February	35.0	31.9	33.3	0.8	0.7
March	37.4	31.9	34.4	1.0	1.1
April	43.6	33.6	37.6	2.0	3.9
May	48.9	36.5	41.2	2.3	5.2
June	54.3	39.2	46.4	3.0	9.0
July	55.0	42.2	48.3	2.5	6.5
August	53.2	42.5	47.7	2.1	4.6
September	52.3	39.3	44.2	1.8	3.4
October	46.4	36.1	40.3	1.8	3.1
November	39.8	32.1	35.9	2.1	4.5
December	33.6	32.0	32.6	0.5	0.2



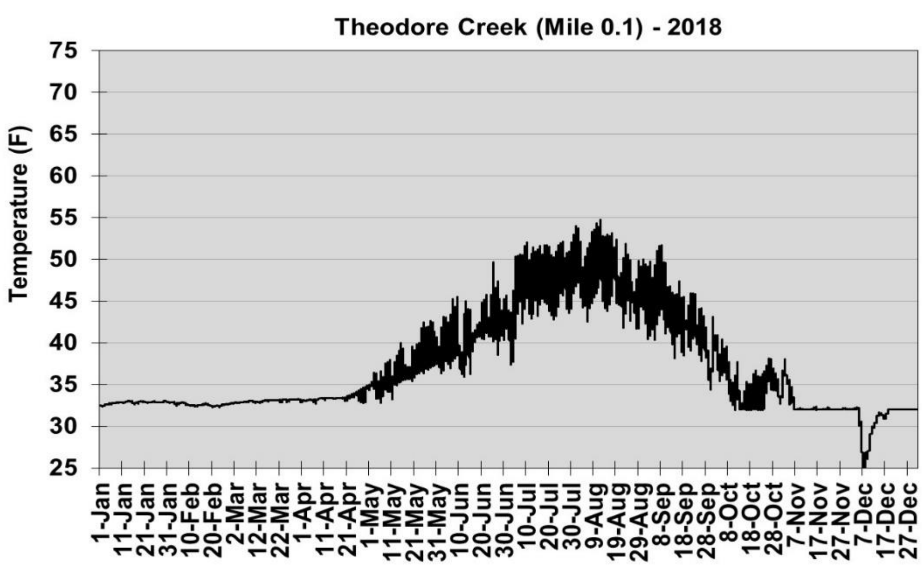
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.6	32.0	32.8	0.4	0.2
February	33.8	32.0	32.9	0.5	0.3
March	37.6	32.4	34.5	1.1	1.3
April	41.7	34.1	36.8	1.2	1.5
May	48.7	35.9	39.5	2.5	6.1
June	50.8	40.3	44.6	2.1	4.5
July					
August					
September					
October					
November					
December					



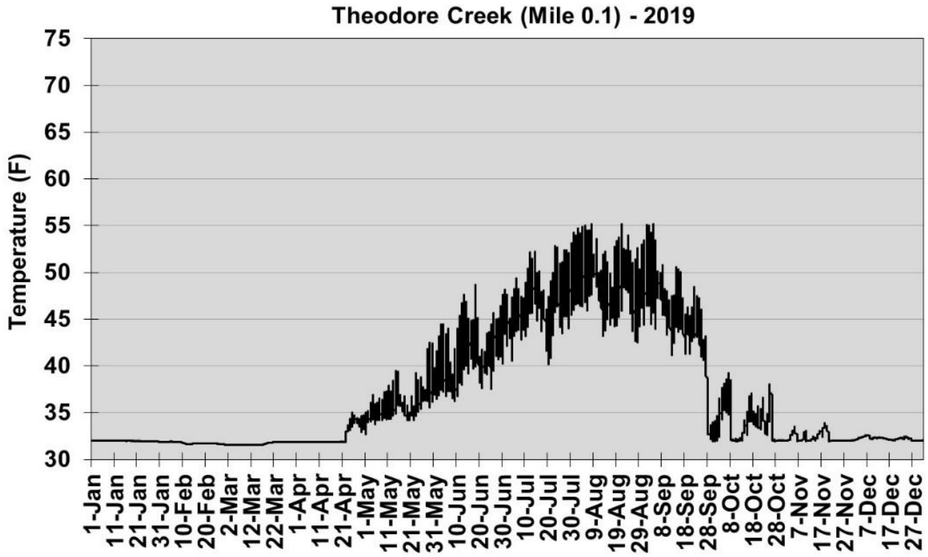
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	31.9	30.4	31.3	0.4	0.2
February	31.9	31.1	31.7	0.2	0.1
March	32.1	31.6	31.8	0.1	0.0
April	38.7	31.9	34.5	1.7	2.8
May	43.8	33.4	37.3	1.9	3.5
June	52.7	35.9	43.3	3.5	12.3
July	56.7	41.0	48.0	3.2	10.4
August	56.6	41.1	48.5	3.2	10.2
September	57.9	37.1	43.6	3.1	9.5
October	48.5	32.2	38.2	2.4	5.8
November	38.0	31.9	34.1	1.8	3.3
December	32.6	32.0	32.3	0.2	0.0



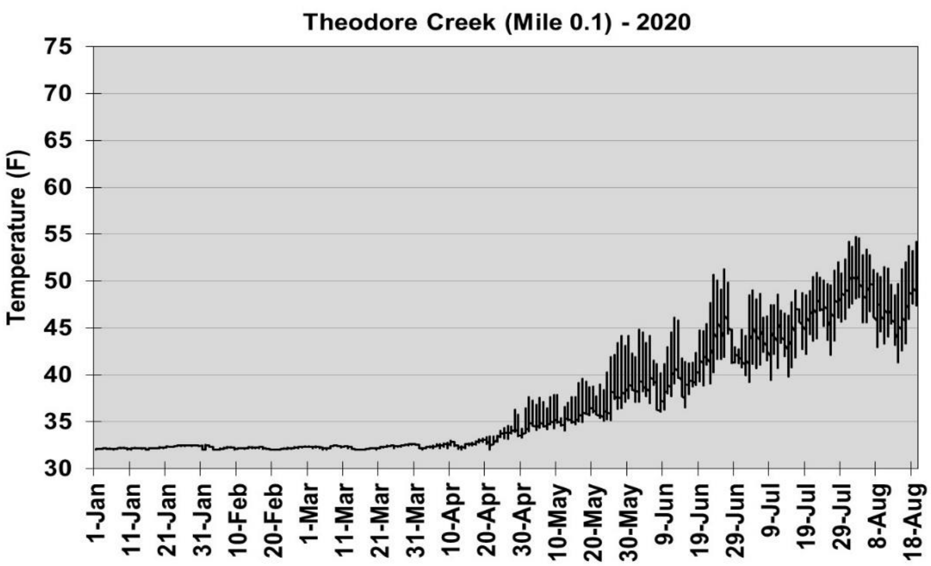
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.6	32.0	32.3	0.1	0.0
February	32.8	32.0	32.4	0.2	0.0
March	34.4	32.1	33.1	0.6	0.4
April	38.6	33.5	34.9	0.7	0.5
May	41.7	33.8	36.6	1.6	2.6
June	51.2	35.8	41.7	3.2	10.2
July	56.0	42.3	49.2	2.8	7.8
August	55.3	42.8	48.5	2.8	7.7
September	55.7	34.4	43.6	5.1	26.0
October	42.2	31.9	34.6	2.1	4.4
November	35.6	31.9	32.4	0.7	0.4
December	32.9	32.0	32.3	0.2	0.0



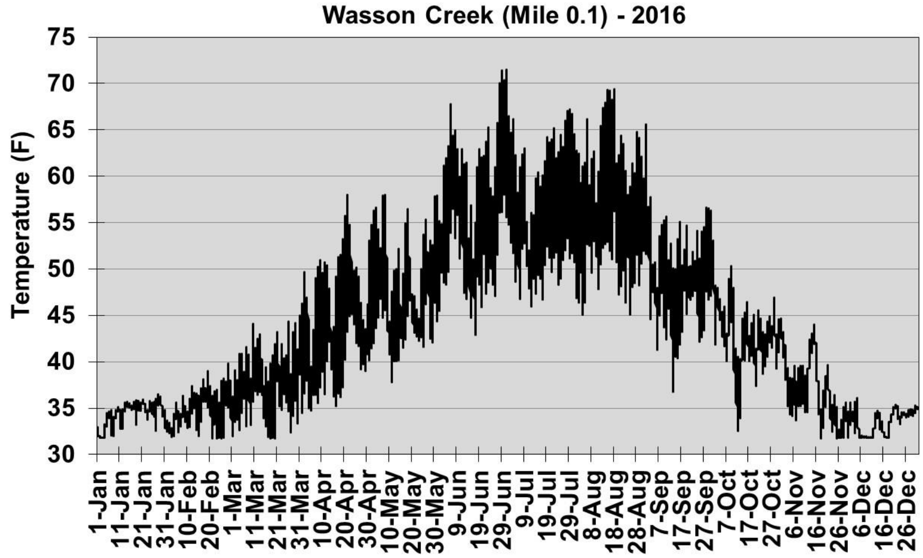
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	33.0	32.3	32.8	0.2	0.0
February	32.9	32.3	32.6	0.2	0.0
March	33.3	32.7	33.0	0.2	0.0
April	34.9	32.7	33.5	0.4	0.2
May	42.6	32.8	36.7	2.0	3.9
June	49.7	35.9	40.9	2.5	6.3
July	52.9	37.4	46.8	3.1	9.8
August	54.7	41.7	47.5	2.8	7.8
September	51.7	34.4	42.8	3.2	10.3
October	43.1	31.9	35.0	2.5	6.1
November	38.0	31.9	32.6	1.3	1.7
December	32.3	24.9	30.9	1.9	3.7



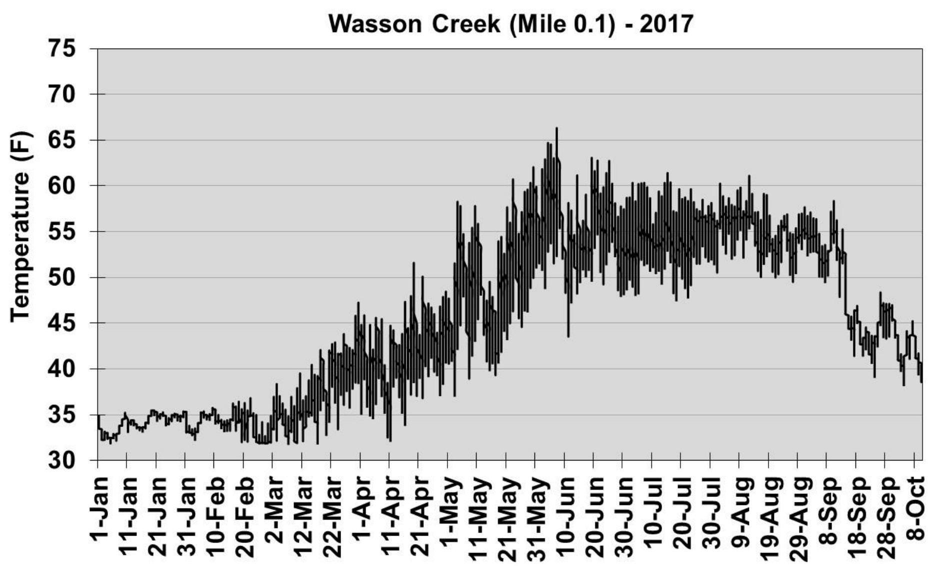
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.0	31.9	32.0	0.0	0.0
February	31.9	31.6	31.7	0.1	0.0
March	31.9	31.5	31.7	0.1	0.0
April	35.0	31.9	32.4	0.9	0.8
May	42.5	32.7	35.9	1.6	2.6
June	48.7	36.2	41.2	2.7	7.3
July	54.3	40.2	46.7	2.6	6.7
August	55.2	42.6	48.6	2.7	7.1
September	55.2	31.9	44.6	4.6	21.4
October	39.2	31.9	33.8	1.8	3.1
November	33.9	31.9	32.3	0.5	0.2
December	32.6	32.0	32.2	0.2	0.0



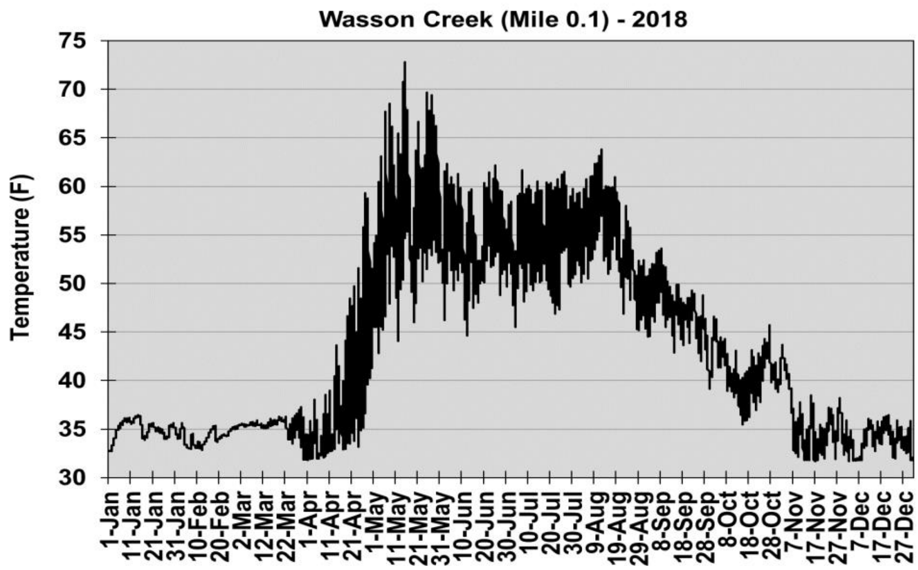
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	32.5	32.0	32.2	0.1	0.0
February	32.5	32.0	32.2	0.1	0.0
March	32.6	32.0	32.3	0.2	0.0
April	36.3	32.0	32.9	0.7	0.5
May	44.2	33.8	36.7	2.1	4.4
June	51.3	36.1	41.4	3.0	9.2
July	54.2	39.3	45.6	2.9	8.5
August	54.7	41.4	48.2	2.9	8.2
September					
October					
November					
December					



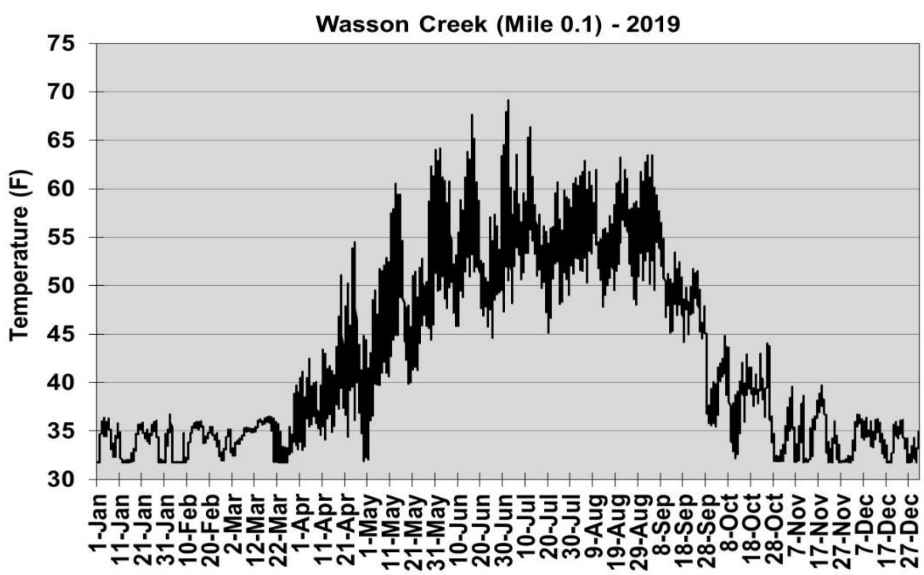
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.5	31.8	34.5	1.2	1.5
February	39.8	31.7	34.7	1.7	3.0
March	45.0	31.7	37.3	2.8	8.0
April	58.0	34.5	43.8	4.7	22.5
May	58.0	37.8	47.4	4.3	18.3
June	71.4	42.9	55.2	5.5	30.4
July	71.5	45.9	55.6	4.9	24.3
August	69.4	45.0	55.6	5.1	25.9
September	65.6	36.8	48.7	4.0	16.4
October	53.1	32.5	42.9	3.2	10.2
November	44.0	31.7	36.6	3.1	9.5
December	36.1	31.8	33.5	1.2	1.4



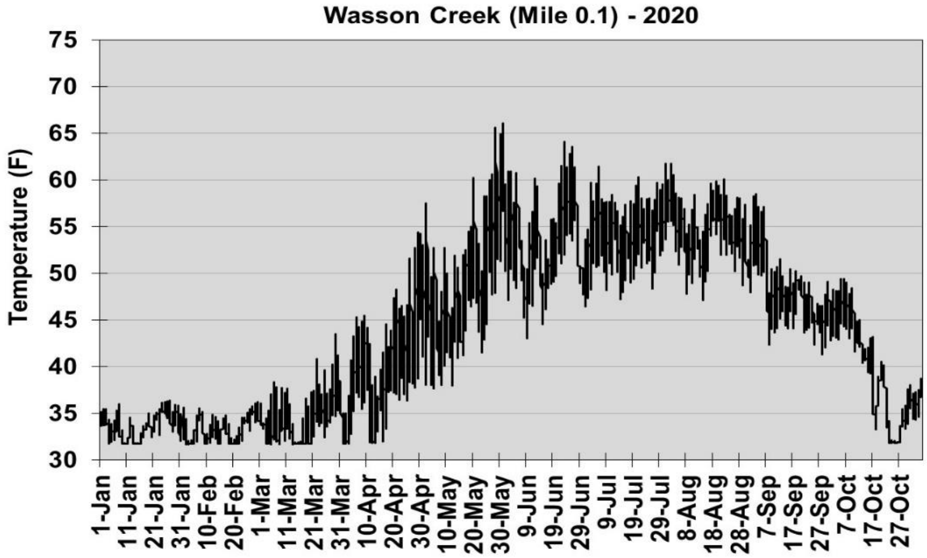
Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	35.4	31.8	34.0	0.9	0.8
February	36.8	31.8	34.1	1.2	1.4
March	47.2	31.8	37.2	3.2	10.1
April	51.6	32.2	41.2	3.6	12.7
May	62.1	37.1	49.3	5.5	30.2
June	66.3	43.5	55.1	4.1	16.7
July	61.4	47.6	54.4	3.0	9.1
August	61.1	49.5	55.0	2.2	4.7
September	58.4	39.2	48.4	4.8	23.0
October	45.3	34.9	40.5	2.1	4.3
November	37.7	33.1	35.3	1.2	1.5
December	36.0	32.6	33.8	1.0	1.0



Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.5	32.7	35.0	0.9	0.8
February	35.6	32.8	34.2	0.7	0.6
March	37.3	31.8	35.3	0.8	0.6
April	59.3	31.8	38.2	6.1	37.0
May	72.8	42.8	56.4	6.1	37.4
June	62.4	44.6	54.1	3.8	14.2
July	61.7	45.5	54.3	3.4	11.7
August	63.8	45.2	54.4	3.9	15.2
September	53.6	39.1	47.2	2.7	7.1
October	46.6	35.5	41.0	2.3	5.3
November	43.7	31.7	35.8	3.0	9.3
December	36.5	31.7	33.9	1.3	1.7



Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.4	31.8	33.8	1.5	2.3
February	36.7	31.8	33.9	1.5	2.1
March	39.7	31.7	34.6	1.5	2.3
April	54.5	31.9	39.5	4.0	16.4
May	64.0	32.1	47.6	5.7	32.1
June	67.6	44.6	53.4	4.4	19.7
July	69.2	45.2	54.5	3.6	12.9
August	63.3	47.8	55.1	3.1	9.3
September	63.5	35.6	49.5	5.4	29.2
October	44.8	31.9	38.2	3.3	11.2
November	39.7	31.8	34.3	2.3	5.4
December	36.7	31.7	34.1	1.4	2.0



Month	Max Temp	Min Temp	Avg Temp	StDev	Variance
January	36.4	31.7	33.7	1.3	1.7
February	36.2	31.7	33.3	1.3	1.6
March	43.5	31.7	34.4	2.3	5.3
April	54.4	31.7	39.7	5.2	26.8
May	66.1	37.7	48.7	6.2	38.7
June	64.1	43.0	53.2	4.3	18.3
July	61.8	46.4	53.9	2.9	8.5
August	61.8	47.2	54.5	2.7	7.4
September	58.5	41.4	48.0	3.5	11.9
October	49.4	31.8	39.9	5.3	28.0
November	38.7	34.4	36.2	1.0	1.1
December					