

**An Assessment of Fish Populations and Riparian Habitat in Tributaries of the
Upper Clark Fork River Basin**



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INTRODUCTION

Fish habitat protection and restoration are both key components to managing and maintaining quality populations of stream-dwelling salmonids. A large-scale effort to restore and protect fish habitat is currently underway in the Upper Clark Fork River Basin (UCFRB). This effort was spearheaded by litigation between the State of Montana and the Atlantic Richfield Company (ARCO) regarding damages to the natural resources of the UCFRB caused by historic mining activities in the drainage. Recent developments in this litigation has led to the third consent decree between the State of Montana and ARCO, which, combined with two previous consent decrees completed in 1999 and 2005, provides a substantial monetary settlement aimed at remediation and restoration of fisheries resources in the UCFRB.

While fish habitat restoration and protection are valuable tools for managing fish populations, these efforts need to be prioritized to ensure that they are: 1) focused in areas that will provide the most benefit to the target fisheries of Silver Bow Creek and the Upper Clark Fork River; and 2) focused on addressing factors that currently limit fish populations. This is particularly true in the UCFRB, as a substantial amount of money will be available to complete habitat restoration and protection efforts in the future. A lack of prioritization of these efforts could lead to the use of a substantial amount of monetary resources without maximizing the protection and enhancement of these target fish populations.

The State completed a watershed restoration plan¹ for the Silver Bow Creek watershed in 2005. Among other restoration needs, the plan identifies and prioritizes fishery restoration in the watershed beyond what will be accomplished through the planned remediation and restoration work on the mainstem of Silver Bow Creek. In contrast, no such planning effort has been completed for the Upper Clark Fork River fishery, primarily because litigation for this resource in the Upper Clark Fork River was not resolved until 2008.

The State of Montana considered alternatives involving restoration work on the tributaries that would best help the Clark Fork River fishery reach baseline conditions. However, there was insufficient information to conduct such a prioritization. Thus in 2007, the State, through a Memorandum of Understanding between Fish, Wildlife and Parks and the Natural Resource Damage Program, began a phased tributary restoration prioritization effort. Through discussions of this effort, three goals were established for prioritizing tributaries to the Clark Fork River. These goals were to:

- 1) Restore the Clark Fork River fishery to levels similar to other area rivers.
- 2) Maintain and enhance viable native trout populations throughout the UCFRB
- 3) Replace lost angling opportunity in the Clark Fork River by enhancing tributary fisheries.

¹ Final Silver Bow Creek Watershed Restoration Plan, Natural Resource Damage Program, December 2005 (available at <http://doj.mt.gov/lands/naturalresource/silverbowcreek.asp>).

To complete prioritization, a fishery inventory needed to be completed in tributaries to the Upper Clark Fork River. This step was critical, as the knowledge of what species are present, their relative abundance and size, and their distribution within these drainages, is all necessary information needed to begin prioritization. Fish distribution data existed for some tributaries in the Upper Clark Fork drainage, but many streams had not been previously sampled, or where data had been collected, it was dated.

In addition to fishery data, riparian and fish habitat assessment data were collected. This data was collected to document current habitat conditions at locations where fish were sampled, as well as to highlight potential habitat deficiencies at these sites. This effort, however, was not aimed at identifying all potential impacts to riparian and fish habitat in the sample drainages, and was limited in its spatial and temporal scope (see methods).

This report represents an annual progress report for the first year's (2007) effort to collect fish distribution and riparian assessment data throughout the Upper Clark Fork drainage. Fish distribution and riparian assessment data will be collected in additional drainages in 2008 to supplement the data presented in this report. Formal prioritization of tributaries in the UCFRB to determine where work on tributaries would provide the most benefit to the target fisheries of Silver Bow Creek and the Upper Clark Fork River will not be addressed until after future data collection efforts are complete.

METHODS

Stream Selection

Streams chosen for sampling during this study were selected largely by size and presumed importance (or potential importance) to mainstem Clark Fork River trout recruitment. Larger tributaries and drainage networks were prioritized because these systems generally produce larger and greater numbers of fish, which in turn, increase potential trout recruitment to the Clark Fork River.

Another important factor considered during stream selection was the known or presumed presence of bull trout *Salvelinus confluentus* and/or westslope cutthroat trout *Oncorhynchus clarki lewisi* in a stream or watershed. Bull trout are listed as a Threatened Species under the Endangered Species Act, while westslope cutthroat trout are listed as a Species of Special Concern by the State of Montana, and as a Sensitive Species by the US Forest Service. Both are important indicator species of stream health, and westslope cutthroat trout provide a unique native species angling opportunity in the UCFRB. Finally, drainages that appeared to have possible restoration potential based on available literature and discussions with other land management agencies (i.e. Forest Service) and watershed groups were also considered during the stream selection process. Some of the major drainages that were sampled in 2007 include Warm Springs Creek, Little Blackfoot River, Flint Creek and some of the upper forks of Rock Creek.

Sample Reach Selection

Sample reaches were selected by examining topographic maps and aerial photographs of each selected stream in conjunction with reviewing recent data and literature that was available for each stream. Streams were stratified by multiple factors including channel type, gradient, and noticeable changes in riparian condition in an effort to describe the range of habitat conditions and, hopefully, fishery conditions present in each selected stream. Multiple reaches were generally delineated for each stream. Sample sites were also purposefully spaced longitudinally with enough distance between sites to reflect likely changes in species composition, as it was assumed that both habitat and the location of the section within the drainage likely would affect species composition.

Because many sample reaches were located on private land, cooperation by landowners was critical to gaining access to many sampling locations. Fortunately, a majority of land owners were willing to grant access for these sampling efforts. However, permission was denied by a few landowners, some of which owned relatively large portions of target drainages. In these situations, reaches that were relatively close in location (longitudinally) and maintained similar channel types and habitat were selected.

Fish Sampling

Electrofishing was used to sample fish at all sample sites. The focus of electrofishing was primarily to assess species composition and general abundance at a broad scale. For this reason, single-pass, catch-per-unit-effort (CPUE) electrofishing was used as the standard procedure. Single-pass surveys were able to be done quickly and provided information on species composition, size (and indirectly age structure), and a rough measure of abundance. Single-pass surveys did not however, provide a precise abundance estimate of fish in a given reach, and should not be viewed as such. To get an abundance estimate with an associated standard error, it is necessary to obtain a measure of capture efficiency using multiple-pass electrofishing techniques (i.e. depletion and mark-and-recapture). Due to time constraints, it was not possible to do this at all sample sites and the time saved by not conducting these estimates at every site allowed crews to complete more single-pass surveys in a greater number of streams and sample reaches. We did however, conduct multiple-pass mark-recapture estimates at important sites on the larger mainstem tributaries (i.e. Little Blackfoot River, Warm Springs Creek, and Flint Creek). These population estimates were calculated using the partial log-likelihood algorithm provided by Montana Fish, Wildlife and Parks' FA+ fisheries analysis software. All mark-recapture population estimates were calculated for fish greater than 150 mm total length (TL, appx. 6").

For small streams (i.e. streams less than approximately 15' in width), a backpack electrofishing unit (Smith-Root LR-24) was used to sample fish in 100 m reaches. At these sites, a block net was placed at the lower end of the reach to increase capture efficiency. Electrofishing was completed in a downstream direction towards the block net. In larger streams (i.e. streams greater than approximately 15' in width), an electrofishing tote barge system (Smith-Root SR-6 w/ 2.5 GPP) was used for fish sampling. This system was more efficient at capturing fish due to its increased power output. Streams that were sampled with the tote barge system include Warm Springs Creek, Little Blackfoot River, and Flint Creek. Sampling reaches in larger streams were significantly longer than the standard 100 m reaches sampled in smaller streams. The length of these sections was variable and was based on habitat conditions and reach accessibility (i.e. put-ins and take-outs for the tote barge system). No block nets were used in sections where the tote barge electrofisher was used.

At each sample reach, all captured fish were identified to species, weighed, measured and released. Genetic samples were collected in drainages and sections suspected to contain pure westslope cutthroat trout. Genetic samples were also collected from suspected bull trout / brook trout *Salvelinus fontinalis* hybrids to confirm hybridization. All fish data were collected on standard Montana Fish, Wildlife & Parks (MFWP) electrofishing data sheets using MFWP species abbreviations. These abbreviations were also used in the tables presented in the results section of this report. Below is a key for interpreting these abbreviations.

WCT = westslope cutthroat trout
BULL = bull trout
LL = brown trout (*Salmo trutta*)
RB = rainbow trout (*Oncorhynchus mykiss*)
EB = brook trout
MWF = mountain whitefish
EBxBULL = brook trout / bull trout hybrid
ONC = *Oncorhynchus* unidentified- used at sites with rainbow trout and westslope cutthroat trout or potential hybrids between these species.
TRT = unidentified trout

It is important to note that sampling fish in short, delineated reaches represents a snapshot in time and space. It is likely that species distribution and abundance may change in a sample reach given different conditions (i.e. flow conditions, season, etc). This is always a drawback of intensively sampling short reaches. However, this method also allowed fish sampling to be completed in multiple drainages during the field season rather than only a few.

Riparian Assessments

Riparian assessments were conducted at each delineated reach where fish sampling occurred. These assessments were completed to identify possible relationships between the observed riparian condition and the existing fishery, as well as help identify areas for potential restoration or protection. Riparian assessments were completed using a modified version of the USDA Natural Resources Conservation Service (NRCS) Montana Riparian Assessment Methodology (including the supplemental attributes) (Appendix C). The methodology was modified to include a scored component that evaluated the relative condition of fish habitat in each survey reach largely based on available cover. A majority of the overall assessment survey consisted of a visual examination of stream and riparian character and condition. The only quantitative measurements collected at each site during these assessments were bankfull width and bankfull depth. All other portions of the assessment, including Rosgen channel type classification, were based on visual observations and estimates.

The NRCS Montana Riparian Assessment Methodology provides a rapid, qualitative evaluation of riparian condition by defining the stability and sustainability of current physical and ecological processes observed in a stream reach. It is not designed to give a quantitative or comprehensive analysis of these processes however. Specific habitat problems identified during these surveys may need to be further evaluated using more specific assessment techniques, which were not completed during these initial surveys. Additionally, due to time constraints, riparian assessments conducted during this sampling effort occurred only at fish sampling reaches, and not throughout the entirety of each watershed. Thus, it is doubtful that we observed all of the factors affecting riparian

health in each stream basin sampled, and subsequently, it must be assumed that not all potential habitat restoration and protection projects were observed during these sampling efforts.

Water Temperature

Stream temperature was monitored in many (but not all) of the streams sampled in 2007. Temperature monitoring consisted of the deployment of one or more thermographs (ONSET Computer Corp, Model: HOBO Water Temp Pro V2) in the target drainages. In streams where only one thermograph was deployed, the thermographs were generally placed near the mouth of the stream. In streams where multiple thermographs were deployed, the thermographs were generally distributed throughout the watershed with one being deployed near the mouth. Thermographs were set to measure temperature every half hour or hour. In some locations on private land, deployment was delayed until landowner permission was granted. At deployment sites where the stream was later found to be intermittent, thermographs were either moved to other sites in the drainage or to other drainages where temperature data was deemed useful.

Data Summary

All data collected during these sampling efforts were summarized for each sampled stream reach and were organized by stream and drainage. Each sample section is identified by a river mile (RM) that marks the top of the survey site. River miles were measured beginning at the mouth of each stream and were obtained using a geographic information system (GIS).

Fishery data was summarized by species and included the number of fish captured at each site, catch-per-unit-effort (standardized to number of fish per 100m of channel), mean and range of fish lengths, and percent of species composition. A table displaying this information was created for each sampled stream. Additionally length-frequency histograms were also produced for each sample reach when two or more fish of a given species were present in the reach. These data are provided as an appendix (Appendix A). Only trout species were considered in these data summary efforts although observations of others species were noted in some of the write-ups.

Riparian assessment data were separated into three distinct categories, which included geomorphology (NRCS Montana Riparian Assessment Methodology, questions 1-3 and 10), vegetation (NRCS Montana Riparian Assessment Methodology, questions 4-9), and fish habitat (Fish Habitat Assessment Worksheet, question 1). These categories were created to allow readers to better comprehend the results of the riparian assessment surveys and to better define habitat deficiencies at survey sites. Total scores from each

category, as well as a total overall riparian assessment score, were summarized in tables created for each sample stream.

Water temperature data (where available) was summarized by the maximum daily temperature recorded at each site, as well as the number of days maximum daily temperature rose above 15° C and 20° C. At sites where thermographs were deployed late, these summary statistics are not comparable to other sites due to the reduced number of days of operation. Charts displaying mean and max daily temperature during the period of record are provided as an appendix (Appendix B).

RESULTS

Ross Fork Rock Creek Drainage

Ross Fork Rock Creek

Ross Fork Rock Creek is a tributary to West Fork Rock Creek, which enters the drainage just above the confluence of the West and Middle Forks of Rock Creek at approximately river mile 0.2. Ross Fork Rock Creek originates on National Forest Land with the upper portions of the drainage managed as roadless. The middle portion of the drainage is also located on National Forest Land, however this portion of the drainage is roaded with historic logging present. In the lower portion of the drainage, Ross Fork Rock Creek runs through private cattle ranches. Grazing occurs on private sections as well as National Forest land through grazing allotments. Water from the Ross Fork is utilized for irrigation by cattle ranches to flood irrigate hay pastures in the lower portion of the drainage. At least six irrigation ditches draw water from the creek to flood irrigate hay pastures in the lower valley.

Six sections were electrofished on the Ross Fork during the summer of 2007 (Table 1, Figure 1). The upper site was located in the roadless area of National Forest at river mile 14.6. At this site, three bull trout (*Salvelinus confluentus*) and 19 westslope cutthroat trout (*Oncorhynchus clarki lewisi*) were captured comprising 13% and 83% of the fish community, respectively. One brook trout (*Salvelinus fontinalis*) measuring 255 mm was also captured at this site (Table 1, Appendix A). The next site downstream was located just above the end of Forest Road (FR) 5072. Eight bull trout and 23 cutthroat trout were captured at this site (Table 1, Appendix A). The remaining 9% of the sample was comprised of three brown trout and one brook trout. At river mile 8.8, native salmonids made up only 50 % of the population with one bull trout and 23 westslope cutthroat trout being sampled (Table 1, Appendix A). Fifteen brown trout (*Salmo trutta*) and nine brook trout made up the remainder of the species composition at this site (50%). At river mile 6.7, bull trout were absent from the sample while 20 cutthroat trout were captured. Other fish captured during this survey included ten brown trout and three brook trout. Electrofishing data collected by fish biologists with the Pintler Ranger District revealed that this section was sampled in the early 1990s and that no brown trout were captured at that time (U.S. Forest Service, unpublished data).

Table 1. Electrofishing data collected in six sections of Ross Fork Rock Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 14.6	BULL	3	3	144	135-161	13
	WCT	19	19	161	97-245	83
	EB	1	1	255	255	4
RM 11.5	BULL	8	8	173	133-251	20
	WCT	29	29	132	84-282	71
	LL	3	3	141	112-181	7
	EB	1	1	70	70	2
RM 8.8	BULL	1	1	160	160	2
	WCT	23	23	143	93-240	48
	LL	15	15	176	57-283	31
	EB	9	9	108	38-163	19
RM 6.7	WCT	20	20	166	49-350	61
	LL	10	10	151	58-445	30
	EB	3	3	126	63-163	9
RM 4.9	BULL	5	5	187	161-233	8
	WCT	34	34	134	45-355	54
	LL	24	24	122	58-431	38
RM 3.8	BULL	1	1	182	182	3
	WCT	21	21	187	47-365	55
	LL	14	14	152	57-454	37
	EB	2	2	196	189-202	5

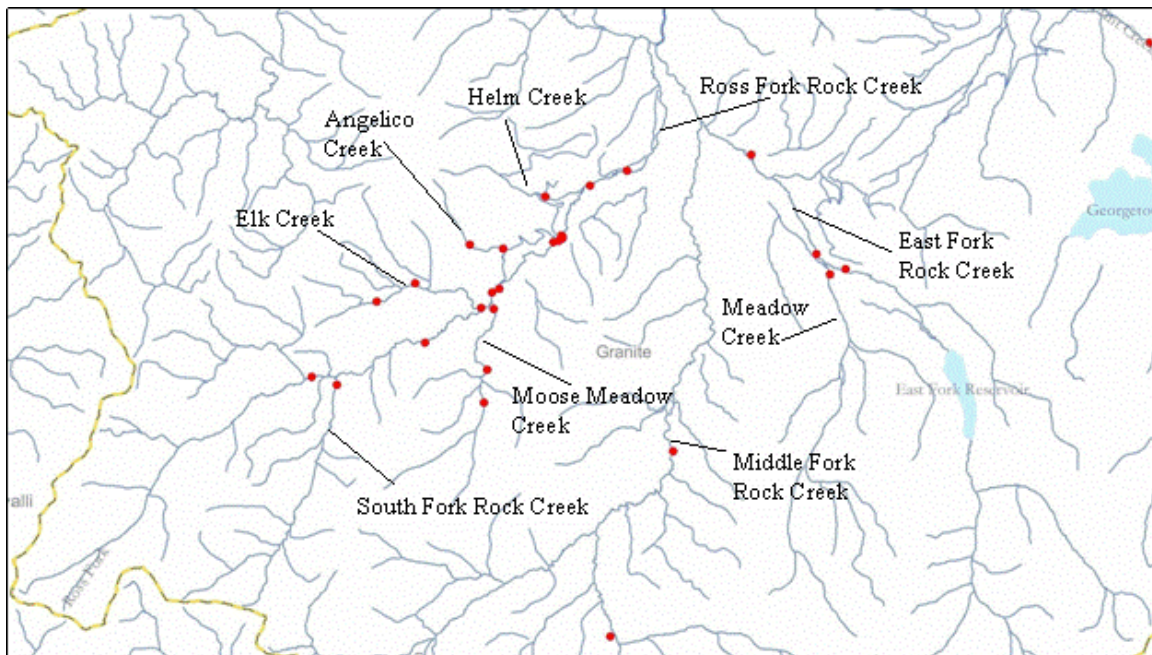


Figure 1. Map of the upper Rock Creek drainage showing electrofishing sections completed in 2007. The “aggregate” of red dots in the middle portion of the drainage represents a series of adjacent irrigation ditches that were sampled.

Two additional electrofishing sections were completed in the Ross Fork Rock Creek drainage in 2007. These sections were located on private land in the lower portion of the Ross Fork valley. At river mile 4.9, a total of five bull trout and 34 westslope cutthroat trout were sampled, comprising 8% and 54% of the trout population, respectively (Table 1, Appendix A). Brown trout were found to be relatively abundant at this site with a total of 24 fish sampled (38%). Interestingly, this site was the only site in the Ross Fork drainage where no brook trout were sampled. The lowest electrofishing section in the Ross Fork drainage was located at river mile 3.8. At this site, we captured a total of one bull trout and 21 westslope cutthroat trout which comprised 3% and 55% of the species composition for this section (Table 1, Appendix A). Additionally, brown and brook trout were also sampled at this site with a total of 14 brown trout and two brook trout captured. Brown trout comprised 37% of the trout population at this site while brook trout comprised 5% of the trout population (Table 1).

Riparian assessments were completed at nearly all of the electrofishing sections sampled in the Ross Fork Rock Creek drainage in 2007. Interestingly, the three upper-most sites sampled in 2007 all had riparian assessment scores that were nearly perfect (Table 2). The high scores in the upper two sections (river mile 14.6 and 11.5) are reflective of these sites being located in a roadless portion of the Ross Fork Rock Creek drainage where no habitat disturbance had occurred. The channel types observed at these sites were B (river mile 14.6) and C_b (river mile 11.5). The perfect score assigned to the site located at river mile 8.8 was due to minimal anthropogenic disturbance and the resiliency of the boulder-dominated B channel type.

Table 2. Riparian assessment results for five sites sampled on Ross Fork Rock Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 14.6	30/30 (100%)	10/12 (83%)	10/10 (100%)	50/52 (96%)
RM 11.5	30/30 (100%)	32/32 (100%)	10/10 (100%)	74/74 (100%)
RM 8.8	30/30 (100%)	18/18 (100%)	10/10 (100%)	58/58 (100%)
RM 6.7	25/30 (83%)	28/30 (93%)	7/10 (70%)	60/70 (86%)
RM 4.9	19/30 (65%)	12/28 (43%)	3/10 (30%)	34/68 (50%)

At river mile 6.7, the Ross Fork Rock Creek was still assigned a relatively high riparian assessment score (Table 2). The slight reduction in points was due primarily to grazing impacts at this site. Some bank instability and utilization of woody riparian vegetation species by cattle was observed at this site. However, because the stream at this site was a B channel type, with relatively large substrate, only minimal damage to the habitat was observed. This site was rated as “good” in terms of fish habitat due to the abundance of pools and LWD in the reach. The riparian assessment completed at river mile 4.9 had substantially lower scores than were observed at locations higher in the drainage. These lower scores were primarily due to fairly heavy grazing within the riparian area and also due to a transition of Ross Fork Rock Creek into a lower valley C channel type which is less resistant to riparian grazing. At this site, woody species utilization by cattle was quite prevalent and appeared to be limiting the recruitment of willows and alders. This reduction in woody riparian species had led to substantial bank erosion and channel overwidening throughout the reach. This increase in width to depth ratio (channel overwidening) caused a reduction in pool size and depth, while the reduced number of woody vegetation on the banks led to a loss of under-cut banks throughout the reach. Overall, fish habitat in this reach was characterized as “fair” based on the impacts of current grazing management and also the reduction in available water due to upstream diversions. While another electrofishing survey was completed at river mile 3.8, a riparian assessment was not completed at this site due to the observed conditions and grazing management at this site being nearly identical to those observed at river mile 4.9.

Thermographs were placed at three sites in Ross Fork Rock Creek during the summer of 2007 (Appendix B). On July 11, one was placed just above the confluence with the Middle Fork and another was placed at approximately river mile 6.7 at an old USGS gauging station. At the lower site, maximum daily temperatures exceeded 15 °C on 63 days including 24 days in which the temperature exceeded 20 °C. The maximum recorded temperature at this site was 24.4 °C on July 14. At river mile 6.7, maximum daily temperatures exceeded 15 °C on 41 occasions including four days in which the temperature exceeded 20 °C. Maximum recorded temperature at this site was 20.7 °C occurring on July 19. A third thermograph was placed approximately three miles up

from the gauging station above where FR 5072 ends on August 7, 2007. Maximum daily temperatures at this site exceeded 15 °C only nine times with a maximum recorded temperature of 15.8 °C on August 10. However, because this thermograph was not placed in the creek until after the hottest part of the summer, it is likely that these data do not accurately reflect the true maximum temperature at this site on the Ross Fork Rock Creek.

Fisheries investigations in the Ross Fork Rock Creek drainage also identified multiple irrigation diversions in the drainage. These diversions were all located on mainstem Ross Fork Rock Creek and were primarily used to flood irrigate pasture land in the lower portion of the Ross Fork valley. The upstream most diversion is located on National Forest land at approximately river 9.4. This site delivers water several miles to a downstream private ranch. This ditch appears to be highly inefficient, as it was found to be nearly dry at its intersection with Angelico Creek, several miles before reaching the water users, despite a significant amount of water being diverted into the ditch at the point of diversion. An electrofishing survey was completed on this ditch approximately 0.5 miles upstream of the crossing of FR 5060 over Ross Fork Rock Creek. In a 100 m section of this ditch, a total of 4 westslope cutthroat trout, one brown trout, and one brook trout were sampled (Table 3).

Table 3. Electrofishing data collected in the irrigation ditch located at river mile 9.4 (diversion location).

Ditch Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 9.4	WCT	4	4	98	30-211	67
	LL	1	1	138	138	17
	EB	1	1	173	173	17

Multiple diversions (5 total) are found on mainstem Ross Fork Rock Creek between river miles 6.5 and 5.5. These diversions are also used to flood irrigate pastures in the lower Ross Fork valley. Electrofishing surveys were completed in each of these ditches. These surveys were all 100 m in length and each section began within 50 meters of the main headgate (Tables 4). Westslope cutthroat trout entrainment was common in these ditches with westslope cutthroat trout being captured in each ditch sampled in this reach. Bull trout entrainment was also observed in two of the five ditches sampled. Other species sampled in these ditches include brown and brook trout (Tables 4).

Table 4. Electrofishing data collected in the irrigation ditches located between river miles 5.5 and 6.5 (diversion location). The river miles at the location of these diversions are estimated.

Ditch Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 6.5	WCT	24	24	44	37-56	73
	LL	9	9	67	52-78	27
RM 6.2	WCT	22	22	86	32-189	42
	LL	31	31	63	50-72	58
RM 6.1	BULL	1	1	43	43	50
	WCT	1	1	237	237	50
RM 6.0	WCT	16	16	54	41-146	49
	LL	17	17	64	50-150	51
RM 5.5	BULL	1	1	207	207	6
	WCT	7	7	105	41-180	41
	LL	8	8	64	55-71	47
	EB	1	1	64	64	6

The effect of these irrigation ditches on in-stream flows in the Ross Fork drainage appeared to be significant in 2007. Below the diversion structures for the ditches located between river miles 5.5 and 6.5, mainstem Ross Fork Rock Creek appeared to be fairly dewatered with summer flows in August of 2007 being approximately 50% of expected normal summer stream flows, assuming irrigation withdrawals were not occurring. This is based solely on a visual estimate with no flow measurements conducted but likely demonstrates the impacts irrigation is having on in-stream flows in the drainage. During electrofishing surveys at river mile 3.8, an additional irrigation diversion was observed on a downstream landowner's property. This ditch was not surveyed due to a lack of landowner permission, but it appeared that a majority of the remaining water in Ross Fork Rock Creek was being diverted into this ditch and the mainstem below this site appeared to have less than 10% of normal in-stream flows (again based on visual estimates), further exacerbating the low in-stream flow problem in this lower portion of the drainage.

Helm Creek

Helm Creek is a tributary to Ross Fork Rock Creek and drains into the middle portion of the Ross Fork drainage at approximately river mile 4.6. Land ownership in the Helm Creek drainage is comprised of both National Forest land and private lands with the

upper watershed being owned by the U. S. Forest Service and the lower portion being owned by a private cattle ranching operation.

Electrofishing was completed at two sites in the Helm Creek drainage in August of 2007 (Figure1). The sites were located at river mile 1.0 and 2.0 (Table 5). The electrofishing section sampled at river mile 1.0 was located on private land while the upper section was located on U. S. Forest Service land near the FR 5004 crossing. Upper Helm Creek was found to be fishless based on our sampling efforts (Table 5, Appendix A). Because habitat and water quality appeared excellent, it is likely that a barrier to fish migration was located downstream of this site. At river mile 1.0, fish were present, and the community was comprised entirely of westslope cutthroat trout (Table 5, Appendix A).

Table 5. Electrofishing data collected in two sections of Helm Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
Upper	-	0	0	-	-	-
RM 1.0	WCT	29	29	84	37-125	100

A riparian assessment was also completed for Helm Creek at both sites sampled in 2007. The upper site located at river mile 2.0 demonstrated excellent habitat with no degradation and scored a perfect 58/58 (100%), despite being fishless (Table 6). This site was classified as an A channel and lodgepole pine was the dominant woody riparian species. At the downstream site located at river mile 1.0 however, the riparian habitat was significantly degraded and this site received an overall score of 31/70 (44%) (Table 6). Cattle grazing appeared to be the sole cause of the degradation in this B channel reach. Woody species utilization by cattle was quite prevalent and appeared to be limiting the recruitment of the species. This reduction in woody riparian species had led to substantial bank erosion and channel over-widening throughout the reach and provided minimal stream shading. This increase in width to depth ratio (channel over-widening) was causing a substantial reduction in pool depth and frequency. Overall, fish habitat in this reach was characterized as “fair” based on the impacts of current grazing management, although some large woody debris and associated pools were present.

Table 6. Riparian assessment results for the two sites sampled on Helm Creek.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
Upper	30/30 (100%)	18/18 (100%)	10/10 (100%)	58/58 (100%)
RM 1.0	15/30 (50%)	13/30 (43%)	3/10 (30%)	31/70 (44%)

Angelico Creek

Angelico Creek is a tributary to Ross Fork Rock Creek and drains into the middle portion of the Ross Fork drainage at approximately river mile 6.8. Land ownership in the Angelico Creek drainage is comprised of both U. S. Forest Service administered lands and private lands with the upper watershed being owned by the U. S. Forest Service and the lower portion being owned by a private cattle ranching operation. The primary land uses in the Angelico Creek drainage are timber harvest and cattle grazing on both the private and U. S. Forest Service lands in the drainage. Cattle grazing in the upper portion of the watershed are administered through a federal grazing allotment.

Electrofishing was completed at two sites in the Angelico Creek drainage in August of 2007 (Figure 1). The sites were located at river mile 1.1 and 1.9 (Table 7). The electrofishing section sampled at river mile 1.1 was located on private land while the site at river mile 1.9 was located on U. S. Forest Service land near the Forest Road 5060 crossing. The fish community of Angelico Creek at river mile 1.9 was comprised entirely of westslope cutthroat trout (Table 7, Appendix A). At river mile 1.1, the fish community was still comprised of primarily westslope cutthroat trout (87%); however bull trout and brook trout were also sampled at this site. The average size of westslope cutthroat trout at river mile 1.1 was slightly larger than was found at river mile 1.9 with a mean total length (TL) of 117 mm, while bull trout averaged 160 mm TL and brook trout averaged 127 mm TL (Table 7, Appendix A).

Table 7. Electrofishing data collected in two sections of Angelico Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.9	WCT	25	25	106	55-150	100
RM 1.1	BULL	2	2	160	158-162	6
	WCT	27	27	117	76-187	87
	EB	2	2	127	58-195	6

A riparian assessment was also completed for Angelico Creek at each site electrofished in 2007. The survey completed at the lower site in Angelico Creek had an overall score of 49 out of a potential 70 (70%) (Table 8). The primary category that had a reduced score was vegetation with a total of 18 out of a potential 30 points (Table 8). This reach was classified as an E_b channel type. Comments from the survey indicated that very few young or older woody plants were present in this reach and that primarily facultative upland species were acting as riparian vegetation at the time of the survey. The comments also indicate that several decadent willows were observed with very few younger willows in the reach. While cattle appeared to have access to the site, only minimal evidence of cattle use in 2007 was evident and it was suspected that the state of

the riparian community may have been due to heavier grazing in past years. The supplemental questions answered as part of the riparian survey did provide some additional information about this site. In particular, while the survey did indicate that the riparian habitat was somewhat degraded at this site, water temperatures were still quite cold with water temperature measuring 9°C at the site at 11:00 a.m. Also, an additional “walk through” survey of the lower portion of the Angelico Creek drainage indicated that riparian habitat conditions changed below the river mile 1.1 site. At approximately river mile 0.7, the riparian habitat condition worsened significantly apparently due to increased cattle utilization. The impacts associated with this increase in utilization included reduced densities of woody riparian species, increased abundance of weed species in the riparian area (primarily Canada thistle (*Cirsium arvense*)), bank erosion, and suspected down-cutting. This impacted condition was observed from approximately river mile 0.7 to the mouth.

Table 8. Riparian assessment results for the two sites sampled on Angelico Creek.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.9	21/30 (70%)	18/30 (60%)	3/10 (30%)	42/70 (60%)
RM 1.1	24/30 (80%)	18/30 (60%)	7/10 (70%)	49/70 (70%)

The riparian assessment survey completed for the site located at river mile 1.9 had a total score of 42 points out of a potential score of 70 (60%) (Table 2). The categories that most affected the total score for this site were the vegetation and fish habitat categories. Comments provided during the survey indicate that while the site maintained a fair amount of adult vegetation, recruitment of younger vegetation appeared to be lower than expected, likely due to cattle grazing. Disturbance induced undesirable plants were also relatively common in the riparian area also apparently due to cattle grazing. The fish habitat category also scored relatively low for river mile 1.9. Comments for this category indicate that the reduced amount of riparian vegetation, stream over-widening in parts of the reach, and a reduced number of pools were all factors that led to this lower score. The supplemental questions answered as part of the riparian assessment survey did not provide any additional comments that were significant at this site.

Moose Meadow Creek

Moose Meadow Creek is a tributary of the Ross Fork Rock Creek, which enters the drainage at approximately river mile 8.6. It lies almost entirely on National Forest Land with the exception of the privately owned Zekes Meadows located at approximately river mile 2.0. The primary land use below the meadows is cattle grazing via a Forest Service grazing allotment, while the primary use upstream appears to be recreation.

Three sections of Moose Meadow Creek were electrofished during July and August of 2007 (Figure 1). At river mile 2.8, above Zeke’s Meadows, 16 westslope cutthroat trout and one brook trout was captured (Table 9, Appendix A). At river mile 1.9 on the downstream end of Zeke’s Meadow, the species composition changed considerably with

33 brook trout captured, compared with only 19 cutthroat trout (Table 9, Appendix A). At this site, brook trout comprised 63% of the trout sampled, while westslope cutthroat trout comprised only 37% of the trout sampled. At the lowest section sampled located at river mile 0.2, we captured two bull trout, three brown trout, 68 brook trout, and 27 westslope cutthroat trout or rainbow/cutthroat trout hybrids (*Oncorhynchus spp.*). This is the only tributary to Ross Fork Rock Creek where brown trout were sampled. A large colony of western pearlshell mussels (*Margaritifera falcata*) was also observed at the river mile 0.2 site.

Table 9. Electrofishing data collected in three sections of Moose Meadow Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.8	WCT	16	16	86	48-132	94
	EB	1	1	146	146	6
RM 1.9	WCT	19	19	121	33-261	37
	EB	33	33	124	90-195	63
RM 0.2	BULL	2	2	131	115-146	2
	LL	3	3	145	121-173	3
	EB	68	68	115	40-204	68
	Onc. Spp.	27	27	119	75-186	27

A riparian assessment was conducted at all three sites on Moose Meadow Creek. At river mile 2.8, the creek scored a 45/50 (90%) and was classified as a B channel type (Table 10). The reduced score at this site was due to a lack of good pools for fish habitat and the presence of Canada thistle in the riparian area. At river mile 1.9, the creek scored a perfect 58/58 (100%) (Table 10). In this section, the creek was classified as an E-channel. Despite the lack of large woody riparian vegetation in this reach, the banks were stabilized by sedges, and deep pools and undercut banks were abundant. This reach would likely serve as a reference reach for an E channel type. Above this middle section, as the creek transitioned from forest to meadow habitat, it was divided into a series of small braided channels. Fish habitat appeared poor in this stretch due to cattle grazing, although no survey was conducted.

Table 10. Riparian assessment results for the three sites sampled on Moose Meadow Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.8	30/30 (100%)	8/10 (80%)	7/10 (70%)	45/50 (90%)
RM 1.9	30/30 (100%)	18/18 (100%)	10/10 (100%)	58/58 (100%)
RM 0.2	22/30 (73%)	21/30 (70%)	7/10 (70%)	50/70 (71%)

At the electrofishing section located at river mile 0.2, the creek received a riparian assessment score of 50/70 (71%) (Table 10). This site was classified as an E channel and the primary land use affecting this reach was riparian grazing by cattle through an active Forest Service grazing allotment. The riparian vegetation at this site was dominated by sedges, however willows were also present. Willow browsing by cattle in this reach was evident, however abundant sedges still provided for relatively good bank stability. The channel in this reach appeared to have down-cut slightly, potentially due to past grazing, which may be limiting this channel from accessing its floodplain, except during relatively large flood events. Overall, fish habitat was still rated as “good” due to the relatively good bank stability provided by abundant sedges, the presence of good under-cut banks, and a fairly low width to depth ratio.

A thermograph was placed in the stream on July 11, 2007 (Appendix B). Maximum daily temperatures exceeded 15 °C on 15 days with a maximum recorded temperature of 16.4 °C on July 19.

Elk Creek

Elk Creek is a tributary of the Ross Fork Rock Creek and enters the drainage at approximately river mile 9.2. The lower two miles of Elk Creek are located on private land, while the upper portion of the drainage is on National Forest land. Primary land uses are grazing and historic placer mining in the lower portion of the drainage and recreation in the upper drainage.

Three sections were electrofished during July and August of 2007 (Figure 1). At river mile 2.9, only westslope cutthroat trout were sampled with a total of 28 westslope cutthroat trout being captured (Table 11, Appendix A). At river mile 1.9, Elk Creek entered into a meadow reach and brook trout were found to be part of the fish community. In this section, a total of 30 westslope cutthroat trout and five brook trout were captured (Table 11, Appendix A). In the lowest section sampled at river mile 0.1, the habitat quality decreased significantly and only six cutthroat trout and three brook trout were captured (Table 11, Appendix A).

Table 11. Electrofishing data collected in three sections of Elk Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.9	WCT	28	28	85	25-153	100
RM 1.9	WCT	30	30	100	32-174	86
	EB	5	5	143	98-198	14
RM 0.1	WCT	6	6	103	83-128	67
	EB	3	3	161	143-188	33

A riparian assessment was conducted at all three sites on Elk Creek. At river mile 2.9, the creek scored a 49/50 (98%) (Table 12). At this site, Douglas-fir (*Pseudotsuga menziesii*) made up a majority of the riparian vegetation and the creek was an armored B channel and thus, scored quite high. At river mile 1.9, the creek still scored very high with a 67/70 (96%) (Table 12). This reach may represent a reference reach for E channel types due to the minimal degradation observed at this site, although this site is located in a transition from a B to an E channel type and may not be entirely representative of an E channel. Downstream at river mile 0.1, the quality of the habitat decreased with a score of 53/70 (76%) at this site (Table 12). Throughout this section, the stream lacked good fish habitat as deep pools and LWD were rare. Fine sediment was common in this section and past down-cutting was present, although the banks had since stabilized. These deficiencies were likely the result of cattle grazing, as current riparian grazing by cattle was observed. Just downstream from the river mile 0.1, the creek was found to be channelized through several placer mine piles before entering the Ross Fork. This channelization had obvious negative impacts to the fish habitat of Elk Creek below our study reach.

Table 12. Riparian assessment results for the three sites sampled on Elk Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.9	30/30 (100%)	9/10 (90%)	10/10 (100%)	49/50 (98%)
RM 1.9	30/30 (100%)	27/30 (90%)	10/10 (100%)	67/70 (96%)
RM 0.1	26/30 (87%)	24/30 (80%)	3/10 (30%)	53/70 (76%)

A thermograph was placed at the mouth of Elk Creek on July 11, 2007 (Appendix B). Maximum daily temperatures exceeded 15 °C for the first 24 days of data collection with a maximum recorded temperature of 19.3 °C occurring on July 14.

South Fork Rock Creek

South Fork Rock Creek is a tributary to Ross Fork Rock Creek and it enters the upper portion of the drainage at approximately river mile 12.8. The South Fork Rock Creek drainage is located entirely within a roadless portion of National Forest land. The primary land use is recreation.

Electrofishing was completed at one site on the lower South Fork Rock Creek in August of 2007 (Figure 1). The site was located 0.2 miles above its confluence with Ross Fork Rock Creek. In this section, the fish community was comprised of 93% westslope cutthroat trout and 7% bull trout with a total of 27 westslope cutthroat trout and 2 bull trout sampled (Table 13, Appendix A).

Table 13. Electrofishing data collected in one section of South Fork Rock Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.2	BULL	2	2	169	161-177	7
	WCT	27	27	109	60-166	93

A riparian assessment was also completed on the South Fork Rock Creek. This portion of South Fork Rock Creek was classified as a B channel and the assessment yielded a perfect score of 46/46 (100%) (Table 14). Characteristics of the South Fork noted in the assessment were abundant LWD and good pool habitat. The quality of the fish habitat in this stream is likely due to the remoteness and undeveloped nature of this stream.

Table 14. Riparian assessment results for the site sampled on South Fork Rock Creek.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.2	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)

Middle Fork Rock Creek Drainage

Middle Fork Rock Creek

Middle Fork Rock Creek along with the West Fork combine to form Rock Creek at their confluence just above Skalkaho Bridge at approximately river mile 51.4. Middle Fork Rock Creek begins in the Anaconda-Pintler Wilderness Area and is formed by an assortment of tributaries and lakes. In the upper portion of the drainage on National Forest land, the primary land use is recreation while land ownership and use is primarily private cattle ranching in the lower portion of the drainage.

In September 2007, two sites were electrofished on Middle Fork Rock Creek (Figure 1). This drainage was not a planned focus area for 2007 and these sites were sampled due to extra field time available. Additional sampling is planned for the Middle Fork drainage for the 2008 field season. Both electrofishing sections sampled in 2007 were located on National Forest Land. The upper site was located at approximately river mile 17.4 just below the confluence of Carpp Creek. Four species of salmonids were captured at this site (Table 15, Figure 1). The majority of fish captured were westslope cutthroat trout with a total of 17 fish sampled, comprising approximately 53% of the sample. Nine bull trout were also captured comprising 28% of the sample. Non-native brook trout and brown trout comprised 19 % of the sample population with a total of four brook trout and two brown trout captured. The lower electrofishing section sampled in 2007 was located above the first Forest Service bridge at approximately river mile 11.3. The species captured at this site were the same as observed at the river mile 17.4 site, however the non-native species composition increased to 34 %. The most noticeable difference was

the reduced number of bull trout combined with the increase in brown trout. Seven bull trout were captured and comprised 17% of the species composition while ten brown trout were captured, comprising 24% of the species composition (Table 15, Appendix A). A total of 21 westslope cutthroat trout and four brook trout were also sampled at river mile 11.3. Both westslope cutthroat trout and brook trout also exhibited similar abundance as was observed at river mile 17.4 with each comprising 50% and 10% of the species composition, respectively.

Table 15. Electrofishing data collected in two sections of Middle Fork Rock Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 17.4	BULL	9	9	147	101-200	28
	WCT	17	17	184	76-343	53
	LL	2	2	360	354-366	6
	EB	4	4	162	132-179	13
RM 11.3	BULL	7	7	157	125-200	17
	WCT	21	21	179	98-274	50
	LL	10	10	140	47-309	24
	EB	4	4	175	126-265	10

A riparian assessment was conducted at each site sampled. Both sites exhibited C channel types and maintained relatively high quality fish habitat. The upper site received a nearly perfect score of 69/70 (97%) due to its abundance of woody riparian vegetation and lack of disturbance (Table 16). The lower site scored a bit lower, however, with an overall score of 61/70 (87%) (Table 16). At this site, recent cattle grazing had resulted in both browse of woody riparian vegetation and some bank instability. Fish habitat was rated as “excellent” in both sections however, due to both sections maintaining abundant pools, LWD, and channel dimensions appropriate for this channel type.

Table 16. Riparian assessment results for the two sites sampled on Middle Fork Rock Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 17.4	30/30 (100%)	29/30 (97%)	10/10 (100%)	69/70 (97%)
RM 11.3	28/30 (93%)	23/30 (77%)	10/10 (100%)	61/70 (87%)

East Fork Rock Creek Drainage

East Fork Rock Creek

East Fork Rock Creek is a tributary of Middle Fork Rock Creek, which enters the drainage at approximately river mile 2.1. The creek begins in the Anaconda-Pintler Wilderness Area and is fed by several lakes and tributaries before leaving the wilderness and entering the East Fork Reservoir at approximately river mile 8.5. The primary purpose of the reservoir is to capture and store spring high flows and deliver this water as irrigation for the Flint Creek valley. The main diversion into the Flint Creek Canal is located at approximately river mile 8.2. During summer irrigation season, a majority of the East Fork Rock Creek flow is diverted into this canal (canal capacity is 150 cfs). This water travels to approximately river mile 5.6 where it is siphoned from the west side of the valley to the east side of the valley and eventually gains the necessary elevation to enter the Trout Creek drainage. This water is then delivered to the Flint Creek valley via Trout Creek. Releases from the dam are quite high during the irrigation season (May-October), and low (<1 cfs) during the remainder of the year.

Three sections of East Fork Rock Creek were sampled during the summer of 2007 (Table 17, Figure 1). All three sections were located below the dam and siphon and were on private property. The upper section was at river mile 5.4 and was located just above the confluence of Meadow Creek. Salmonid densities were high with non-native brown and brook trout dominating the catch (Table 17, Appendix A). Only one westslope cutthroat trout, measuring 61 mm, was captured compared with 65 brown trout and 87 brook trout. Below the mouth of Meadow Creek (river mile 4.6), species composition changed slightly (Table 17, Appendix A). Native species again were rare with one 102 mm bull trout, two cutthroat trout, and one mountain whitefish (*Prosopium williamsonii*) being captured. Brown trout dominated the catch with 107 fish captured, comprising 68% of the species composition. Forty-six brook trout were also captured comprising 29% of the fish caught. In the section located at river mile 1.6, mountain whitefish were the dominant species with fifty-two fish captured (Table 17, Appendix A). Bull trout and cutthroat trout were again rare with only one of each species captured at this site. Thirty-four brown trout were also captured, comprising 33% of the fish sampled while a total of 15 brook trout were captured, comprising 15% of the fish sampled.

Table 17. Electrofishing data collected in three sections of East Fork Rock Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 5.4	WCT	1	1	61	61	1
	LL	65	65	153	56-330	44
	EB	87	87	173	64-320	56
RM 4.6	BULL	1	1	102	102	1
	WCT	2	2	291	259-324	1
	LL	107	107	174	61-337	68
	EB	46	46	145	75-274	29
	MWF	1	1	102	102	1
RM 1.6	BULL	1	1	194	194	1
	WCT	1	1	173	173	1
	LL	34	34	136	63-328	33
	EB	15	15	153	82-230	15
	MWF	52	52	125	76-222	50

Riparian assessments were also conducted at two of the sites on East Fork Rock Creek (Table 18). Each site was classified as a C channel. Total scores were identical; however the deficiencies observed at each site were different. At the upper section, riparian vegetation was poor due to cattle browsing. Cattle had severely limited the regeneration of willows and other woody vegetation, while promoting establishment of non-desirable species. Hoof shear caused by riparian grazing also contributed to bank erosion at this site. At the lower site, the vegetation score was lower than observed at river mile 4.6, as herbaceous species dominated this site with very few woody riparian species present. The poor riparian vegetation at both sites limited the fish habitat by eliminating LWD and shading for the stream. Bank erosion at both sites due to cattle utilization and the lack of woody riparian vegetation also caused channel over-widening. Controlled releases from East Fork Reservoir also appear to be reducing the spring flushing flows necessary to form scour pools. Operations at the East Fork Reservoir do not currently include spring spill and thus flushing flows in the East Fork Rock Creek drainage occur quite infrequently. East Fork Reservoir did spill in 2007, yielding a flushing flow that likely benefited fish habitat in the drainage. However, the last spill event prior to 2007 occurred in 1997 (pers. comm.. with local landowners). The infrequency of these events is not enough to maintain quality fish habitat in the drainage and likely favor non-native brown and brook trout. The riparian assessments completed at both sites indicate that these reaches of East Fork Rock Creek appear to be well below their potential.

Table 18. Riparian assessment results for the two sites sampled on East Fork Rock Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 4.6	21/30 (70%)	11/28 (39%)	3/10 (30%)	35/68 (52%)
RM 1.6	26/30 (87%)	6/28 (21%)	3/10 (30%)	35/68 (52%)

Thermographs were placed in two sections of East Fork Rock Creek on August 23, 2007 (Appendix B). The lower thermograph was placed just below the Moose Lake Bridge downstream of our lowest sampling section. At this site, maximum daily temperatures exceeded 15 °C for fourteen days with a maximum recorded temperature of 17.6 °C on September 2. Because of the late launch date of this thermograph, it is likely that the maximum temperatures that occurred at this site were higher than were recorded. The upper thermograph was placed on private land just above our middle sample site, but due to access restrictions, we were unable to download it in 2007. It will however be available in 2008.

Meadow Creek

Meadow Creek is a tributary to the East Fork Rock Creek, which enters the drainage below the East Fork Reservoir at approximately river mile 4.6. The upper end of Meadow Creek runs through National Forest land, while the lower end is split between private and state land. Primary land use is cattle grazing on the lower portions of Meadow Creek.

One section of Meadow Creek was sampled on August 23, 2007 just above its confluence with the East Fork (Figure 1). Three species of fish were captured (Table 19, Appendix A). Two bull trout were sampled, as well as 10 brown trout and 32 brook trout. Species composition was shifted heavily towards brook trout, which comprised 73% of the fish sampled. Unfortunately, no westslope cutthroat trout were sampled in this reach.

Table 19. Electrofishing data collected in one section of Meadow Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.3	BULL	2	2	275	223-327	5
	LL	10	10	141	56-251	23
	EB	32	32	146	55-269	73

A riparian assessment was also conducted at this site, which yielded a score of 44/70 (63%) (Table 20). The channel at this site was classified as an E channel. Cattle utilization at this site was found to be quite heavy and most of the reduced scores observed for Meadow Creek were related to grazing impacts. In general, the banks were unstable due to hoof-shear and the willows and other riparian vegetation had been over-

utilized, causing channel over-widening in a portion of the reach. Woody riparian species regeneration also appeared to be limited at this site and the channel also appeared to be incised in portions of the reach. Nonetheless, fish habitat was rated as good because of some deep undercut banks were present and LWD and pools were relatively abundant (Table 20).

Table 20. Riparian assessment results for the site sampled on Meadow Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.3	17/30 (57%)	20/30 (67%)	7/10 (70%)	44/70 (63%)

Flint Creek Drainage

Flint Creek

Flint Creek is a tributary to the Clark Fork River, which enters the drainage near Drummond, MT, at approximately river mile 417.6. The mainstem of Flint Creek begins below the Flint Creek Dam, which impounds Georgetown Lake, and flows approximately 43.7 miles through mostly private agricultural land to the Clark Fork River. At river mile 36.9, Trout Creek enters Flint Creek with water siphoned over from East Fork Rock Creek. During the irrigation season, instream flows in Flint Creek are generally good between the mouth of Trout Creek and approximately river mile 12.5 due to flow augmentation from the trans-basin diversion of water out of East Fork Rock Creek. At river mile 12.5, the Allendale Ditch (also known as the State Ditch) draws a significant amount of water from Flint Creek for irrigation. This water is destined primarily for center pivots and flood irrigation ditches in the lower Flint Creek valley. Many other diversions are located throughout the Flint Creek valley; however the Allendale ditch represents the largest diversion in the drainage. Flint Creek is generally drawn quite low during irrigation season from the Allendale diversion to its confluence with the Clark Fork River.

Four sections of Flint Creek were electrofished during the summer of 2007 (Figure 2). The upper site was located at river mile 41.2, just below the dam, near the Flint Creek campground. At this site, 25 brown trout and eight westslope cutthroat/rainbow trout hybrids were captured (Table 21, Appendix A). The next section downstream was located at river mile 35.5 below the confluence of Trout Creek. A mark/recapture estimate was conducted at this site, with the mark run occurring on September 17 and the recapture run occurring on September 24. A total of 510 unmarked brown trout were captured on these two passes (Table 21, Appendix A). Other fish captured included eight brook trout and six rainbow trout or hybrids (*Oncorhynchus spp.*). A population estimate was calculated at this site for brown trout greater than 150 mm (6 inches) using a partial log-likelihood estimate as calculated by FA+. This calculated estimate was 1288 (1169-1407; 95 % C.I.) brown trout per mile in this reach. Population estimates could not be calculated for other species due to their relatively low abundance.

Table 21. Electrofishing data collected in four sections of Flint Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 41.2	LL	25	25	185	80-283	76
	Onc. spp.	8	8	183	135-263	24
RM 35.5	LL	510	47	254	83-561	97
	EB	8	1	192	92-267	2
	Onc. spp.	6	1	365	290-417	1
RM 23.4	BULL	1	<1	249	249	<1
	LL	434	33	280	104-480	98
	Onc. spp.	8	1	327	270-418	2
RM 12.1	LL	43	13	264	160-404	98
	Onc. spp.	1	<1	241	241	2

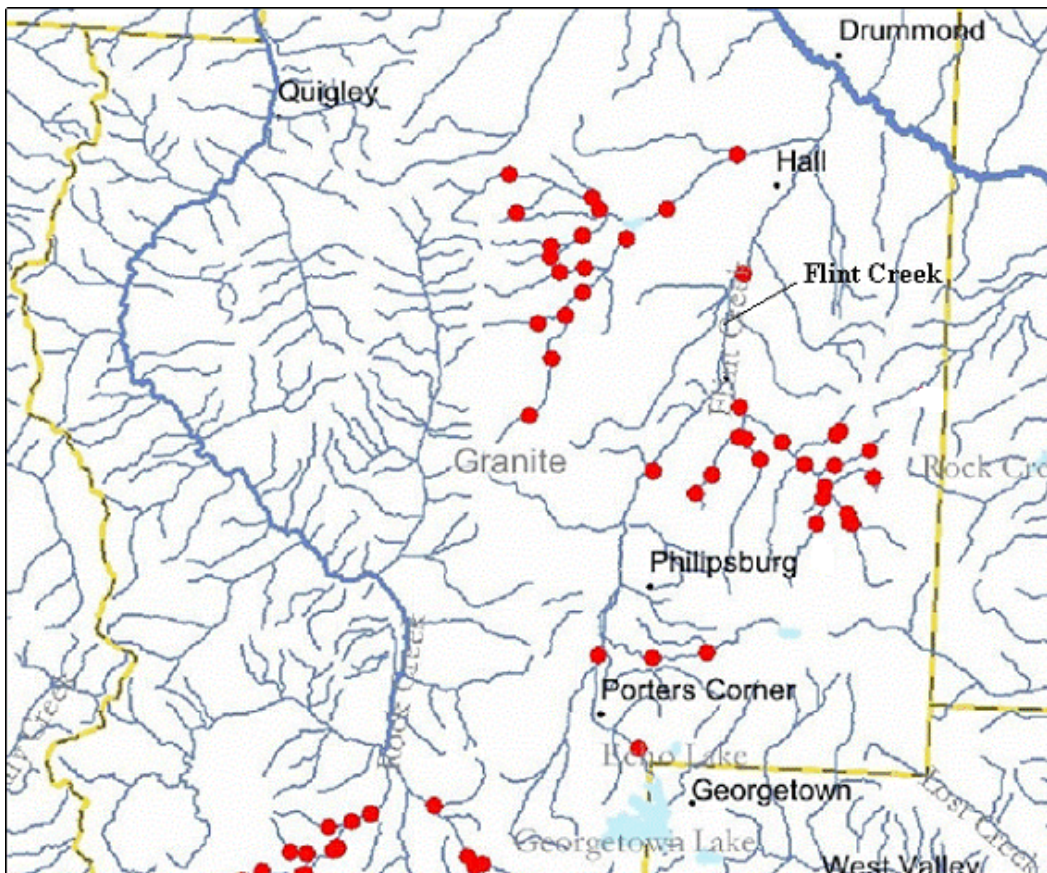


Figure 2. Map of the Flint Creek drainage showing electrofishing sections completed in 2007.

At river mile 23.4, a similar mark/recapture estimate was conducted with the mark run occurring on September 18 and the recapture run occurring on September 25. A total of 434 unmarked brown trout were captured on both runs, while one bull trout and eight rainbow or rainbow/cutthroat hybrids (*Oncorhynchus spp.*) were also captured (Table 21, Appendix A). At this site, the number of brown trout per mile was lower than river mile 35.5 section. A population estimate was calculated at this site for brown trout greater than 150 mm using a partial log-likelihood estimate as calculated by FA+. The estimated population size was 940 (846-1034; 95 % C.I.) brown trout per mile. Again, a population estimate was not completed for other species due to their relatively low abundance.

The lowest electrofishing section on Flint Creek was located at river mile 12.1, below the Allendale Diversion. A mark/recapture estimate was attempted at this site, but high post-irrigation flows and the relatively large substrate in this reach led to the sinking of the electrofishing barge on the mark run of this estimate after completing only 322 m. These high flows were believed to be partially caused by post-irrigation return flow from irrigation ditches and fields located upstream of the section. This section was also higher gradient than the upper portions of Flint Creek, which explains the relatively high velocities and large substrate encountered in the reach. In the 322 m of the section that was completed, we captured 43 brown trout and one rainbow trout or westslope cutthroat trout hybrid (*Oncorhynchus spp.*) (Table 21, Appendix A). Due to the difficulty associated with sampling this reach, a recapture run was not completed.

A riparian assessment was conducted at each of the four sites sampled on Flint Creek (Table 22). The upper three sites on mainstem Flint Creek were classified as C channels, while the lower site was a boulder dominated B_c channel type. Below the dam at river mile 41.2, Flint Creek received a riparian assessment score of 61/70 (87%) (Table 22). The controlled flows out of Georgetown Lake are believed to have prevented deep pools from scouring in this reach, which limited the diversity of the habitat. Noxious weeds such as spotted knapweed (*Centaurea biebersteinii*) were also abundant, likely due to disturbance of the high use campground located in this reach. At the site located at river mile 35.5, Flint Creek received a relatively low riparian assessment score 41/68 (60%) (Table 22). At this site, riparian grazing by cattle appeared to be the primary land use impacting the stream. Some of the direct negative impacts included heavy browse on all of the riparian vegetation by cattle and relatively little willow regeneration. Cattle hoof shear and associated bank instability were also observed. Overall, the impacts of riparian grazing were bank instability, channel over-widening, low densities of LWD, and reduced stream shading. These impacts were particularly evident for a pasture found lower in the electrofishing reach in which past stock densities appeared to have been higher than in the upstream pasture. Despite these deficiencies, the fish habitat was still rated as good in this reach because of the presence of many deep pools, undercut banks, and some LWD.

Table 22. Riparian assessment results for the four sites sampled on Flint Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 41.2	28/30 (93%)	26/30 (87%)	7/10 (70%)	61/70 (87%)
RM 35.5	23/30 (77%)	11/28 (39%)	7/10 (70%)	41/68 (60%)
RM 23.4	23/30 (77%)	19/28 (68%)	7/10 (70%)	49/68 (72%)
RM 12.1	23/30 (77%)	13/30 (43%)	3/10 (30%)	39/70 (56%)

At river mile 23.4, Flint Creek received a riparian assessment score of 49/68 (72%) (Table 22). Cattle utilization of this site was high; however more riparian vegetation remained in tact at this site than at the site located at river mile 35.5. Some shortcomings of this site were bank erosion from cattle hoof shear and the resulting increased fine sediment in the creek, as well as the abundance of noxious and disturbance-induced plants. Fish habitat was rated as good because of the presence of deep pools and undercut banks. At river mile 12.1, Flint Creek received a riparian assessment score of 39/70 (56%) (Table 22). Observations of this site earlier in the season indicated that because it was located downstream of the Allendale Ditch, the creek experienced low in-stream flows during the irrigation season and prolonged elevated temperatures at this site (Appendix B). During the October sampling period however, most irrigation ditches were shut off and there was an abundance of water. Habitat was also limited by a lack of pools, with a majority of the pools being formed by boulder pockets. Riparian vegetation was insufficient on many of the banks despite a mature overstory of cottonwoods located in the floodplain (not directly on the stream banks). This lack of woody riparian vegetation on the stream banks appeared to be due to past cattle grazing practices. Despite this lack of woody riparian vegetation, the width to depth ratio in this reach of Flint Creek appeared appropriate which is likely due to the large substrate found in this reach and resilient nature of this B_c channel type.

Three thermographs were placed in Flint Creek on July 11, 2007 (Appendix B). One was placed below Flint Creek Dam (Georgetown Lake), one below the confluence of Boulder Creek near Maxville, and one just above the confluence with the Clark Fork River. At the lowest site, water temperatures reached extremely high levels with maximum daily temperature exceeding 15 °C on 61 of the 62 days in which temperature was recorded, including 26 of these days exceeding 20 °C. The maximum recorded temperature at this site was 26.0 °C on July 14. Maximum daily temperatures below Boulder Creek exceeded 15 °C for 45 days and exceeded 20 °C for three days, with a maximum recorded temperature of 20.3 °C on July 14. Interestingly, after August 3, 2007, Flint Creek below Boulder Creek was commonly 4-5 °C cooler than it was at the site below Flint Creek Dam. At the site below Flint Creek Dam, maximum daily temperatures exceeded 15 °C on the first 63 days of recording with the maximum recorded temperature of 19.5 °C occurring on August 3.

Lower Willow Creek Drainage

Lower Willow Creek

Lower Willow Creek is a tributary to Flint Creek, which enters the drainage at approximately river mile 3.4. Mainstem Lower Willow Creek begins with the confluence of the North and South Forks of Lower Willow Creek at Lower Willow Creek Reservoir. From this point, Lower Willow Creek runs approximately 9.4 miles through private land to its confluence with Flint Creek. The Lower Willow Creek drainage is utilized heavily for agriculture, primarily through irrigated hay production and cattle grazing.

Two sites were electrofished on Lower Willow Creek during the summer of 2007 (Figure 3). The upper site was approximately 1.3 miles below Lower Willow Creek Dam at river mile 8.1 and the fish community was primarily westslope cutthroat trout. Eighty-nine westslope cutthroat trout were captured comprising 98% of the sample, compared with two brown trout (Table 23, Appendix A). Due to the abundance of small cutthroat and the lack of suitable spawning habitat in the reach, it is suspected that many of these fish traveled over the dam from the reservoir or upstream tributaries. At river mile 3.2, fish numbers declined drastically. Only two salmonids were captured at this site in addition to numerous longnose suckers (*Catostomus catostomus*) and two red-sided shiners (*Richardsonius balteatus*) (Table 23, Appendix A). The single cutthroat trout sampled had a TL of 267 mm while the one brook trout measured 275 mm TL.

Table 23. Electrofishing data collected in two sections of Lower Willow Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 8.1	WCT	89	89	118	49-311	98
	LL	2	2	355	324-387	2
RM 3.2	WCT	1	1	267	267	50
	EB	1	1	275	275	50

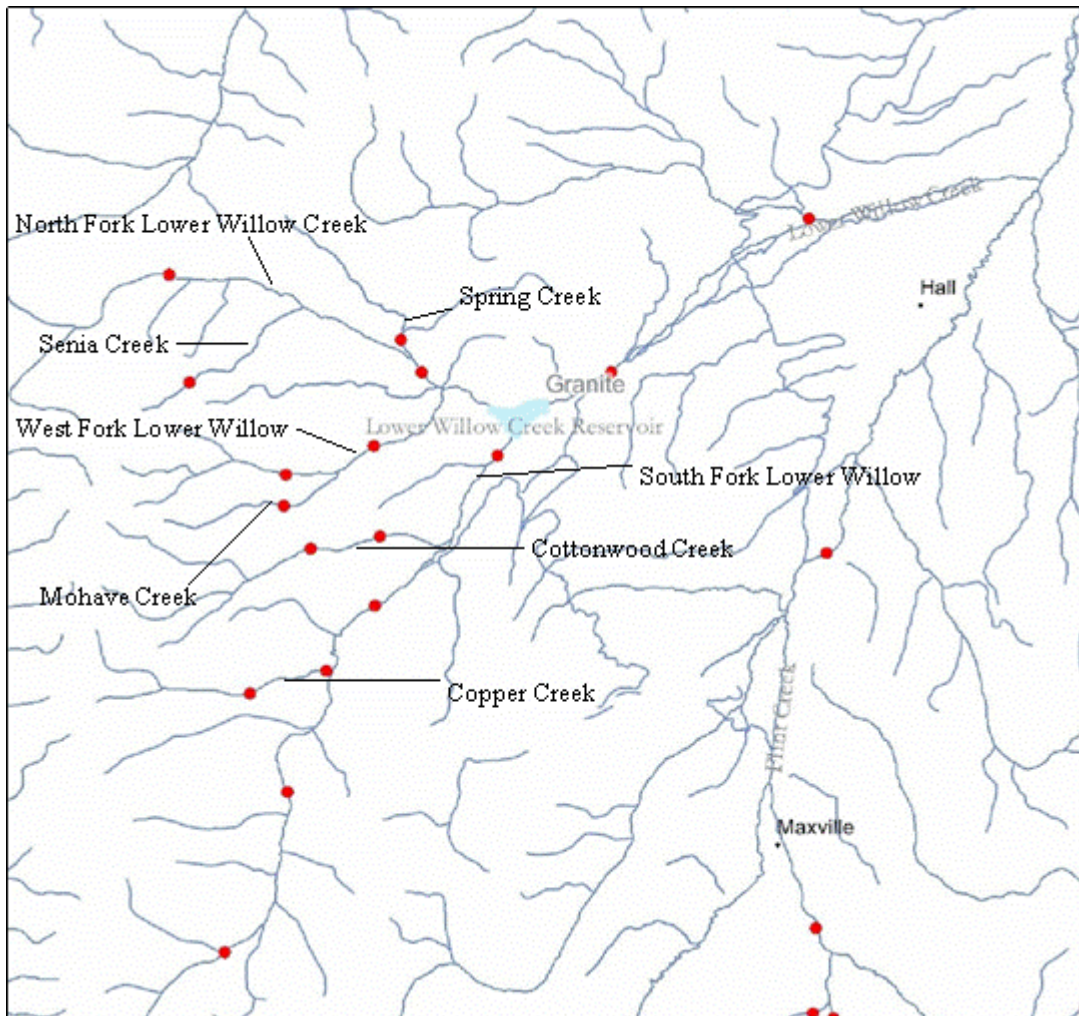


Figure 3. Map of the Lower Willow Creek drainage showing electrofishing sections completed in 2007.

A riparian assessment was conducted at each of the sites sampled on Lower Willow Creek in 2007 (Table 24). At the upper site, Lower Willow Creek was a C channel and received a riparian assessment score of 41/70 (59%). The main reason for the relatively low score of this section was extensive cattle grazing. In general, the stream banks were unstable due to hoof-shear and the willows and other riparian vegetation had been over-utilized to the point that some plants were chewed to the ground. Silt was quite prevalent in the reach and water temperatures were high with a temperature of 19.1 °C being measured at 4:10 pm on September 6 with a hand held thermometer (also see thermograph data below). Fish habitat was rated as good however, as the creek possessed quality pool and run habitat. At the downstream site, Lower Willow Creek received an even lower score of 20/68 (29%) (Table 24). This section of the creek was characterized as an F channel due to its altered state. At this site, fish habitat was poor due to high sediment loads and excess nutrients (excessive aquatic macrophytes), as well as a lack of pools. Bank erosion was high due to cattle hoof-shear and the browsing of riparian vegetation. The recruitment of willows was also minimal due to over-utilization. Down-

cutting was observed in portions of the reach and water diversions for irrigation appeared to be common, likely causing dewatering during irrigation season.

Table 24. Riparian assessment results for two sites sampled on Lower Willow Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 8.1	19/30 (63%)	15/30 (50%)	7/10 (70%)	41/70 (59%)
RM 3.6	13/30 (43%)	7/28 (25%)	0/10 (0%)	20/68 (29%)

Two thermographs were placed in Lower Willow Creek on July 11, 2007, one just below Lower Willow Dam, and one above the Highway 1 Bridge (Appendix B). The thermograph located below the dam displayed ascending temperatures until a maximum of 17.8 °C was reached on August 7. Maximum daily temperatures in this section exceeded 15 °C on 48 days in 2007. The lower thermograph recorded a maximum temperature of 23.4 °C on July 14. This section of Lower Willow Creek exceeded 15 °C for 55 days with 20 of those days exceeding 20 °C in 2007. Throughout most of the irrigation season, maximum daily temperatures on Lower Willow Creek increased 9-10°C between the two thermograph sites located at the dam and at the Highway 1 bridge. This is likely due to the extensive irrigation and riparian grazing that occurs throughout the lower portion (dam to the mouth) of the Lower Willow Creek drainage.

North Fork Lower Willow Creek

The North Fork of Lower Willow Creek is a tributary of Lower Willow Creek and enters the drainage at Lower Willow Creek Reservoir located at approximately river mile 9.4. Land ownership on the creek is divided between private and National Forest lands. The primary land use is cattle grazing on both private and National Forest lands with logging also occurring on National Forest and adjacent Stimson Lumber Company lands.

Two sections were sampled on North Fork Lower Willow Creek during August, 2007 (Figure 3). The upper section (river mile 4.8) was located on National Forest land and a total of 142 westslope cutthroat trout were captured. These fish maintained a relatively small mean TL of 85 mm (Table 25, Appendix A). There was also one 202 mm TL brook trout captured at this site. North Fork Lower Willow Creek was one of only two streams in the Lower Willow Creek drainage above the reservoir in which brook trout were captured. Downstream at river mile 1.2, westslope cutthroat trout were the only species captured, with a total of 161 fish being sampled (Table 25, Appendix A).

Table 25. Electrofishing data collected in two sections of North Fork Lower Willow Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 4.8	WCT	142	142	85	29-204	99
	EB	1	1	202	202	1
RM 1.2	WCT	161	161	84	41-233	100

A riparian assessment was conducted at both sections of North Fork Lower Willow Creek. At the upper site, the creek received a score of 41/70 (59%) (Table 26). Downstream at river mile 1.2, the creek received a slightly lower score of 37/70 (53%) (Table 26). At both sites, riparian cattle grazing was the primary reason for the observed poor habitat. At the upper site, riparian grazing caused a reduction in woody vegetation by limiting recruitment of younger individuals. This appeared to cause some bank erosion, while also reducing shading and LWD in the channel. The amount of pool habitat was limited with nearly all of the larger fish (>100 mm) being captured in one pool within a 100 m reach. Similar habitat degradation was observed at the downstream site (river mile 1.2). Riparian cattle grazing had caused a reduction in woody riparian vegetation recruitment, which caused some bank erosion in the reach and also reduced stream shading. Very few woody species were observed in the adjacent floodplain and the vegetation in the floodplain primarily consisted grass species, which provided only minimal protection. In contrast to the upper section, stream flow was found to be quite low in this reach with many of the riffles being quite shallow (nearly dry). No diversions were observed from the adjacent road and discussions with a local landowner indicated that only one historic diversion is present on North Fork Lower Willow Creek upstream of this site and it is believed to no longer be in use (Jim Dinsmore, pers. comm.). Further investigation into the low flow observed in North Fork Lower Willow Creek is likely warranted.

Table 26. Riparian assessment results for the two sites sampled on North Fork Lower Willow Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 4.8	19/30 (63%)	16/30 (53%)	7/10 (70%)	41/70 (59%)
RM 1.2	19/30 (63%)	15/30 (50%)	3/10 (30%)	37/70 (53%)

A thermograph was placed in North Fork Lower Willow Creek just above its confluence with the reservoir on August 16, 2007 (Appendix B). The maximum observed temperature was 19.4 °C on August 18 and the thermograph recorded 25 days with a maximum daily temperature exceeding 15 °C. Because the thermograph was deployed late in the season, the maximum temperature for the season was likely not observed.

Unfortunately, a lack of landowner permission prevented deploying this thermograph earlier in the season.

West Fork Lower Willow Creek

West Fork Lower Willow Creek is a tributary to North Fork Lower Willow Creek and enters the drainage at approximately river mile 1.6. Land ownership in this drainage is a mix of Forest Service, Stimson Lumber Company, and private lands. Primary land uses in this drainage are cattle grazing and timber harvest.

Two sections were electrofished on West Fork Lower Willow Creek during August 2007 (Figure 3). The upper section (river mile 3.1) was located on Forest Service land, and a total of 57 westslope cutthroat trout and four brook trout were captured (Table 27, Appendix A). At the lower site, located on Stimson Lumber Company land, 58 cutthroat trout were captured, representing 72% of the fish sampled, while 23 brook trout were captured representing 28% of the fish sampled (Table 27, Appendix A). West Fork Lower Willow Creek was the only tributary located above Lower Willow Creek Dam that contained a significant population of brook trout.

Table 27. Electrofishing data collected in two sections of West Fork Lower Willow Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 3.1	WCT	57	57	95	35-170	93
	EB	4	4	164	125-206	7
RM 1.6	WCT	58	58	82	44-235	72
	EB	23	23	106	61-165	28

A riparian assessment was conducted at both electrofishing sections on West Fork Lower Willow Creek. West Fork Lower Willow scored a 47/70 (67%) at the upper site while the downstream site received a lower score of 37/70 (53%) (Table 28). Both sections were C channels and received relatively low scores in the geomorphology category due to erosion and unstable banks caused by cattle grazing. The lower section however, scored lower in the vegetation category. This section had been recently logged and noxious and disturbance induced weeds such as spotted knapweed and Canada thistle were common. Active cattle grazing had limited the regeneration of conifers, as well as alders and willows. Fish habitat in both reaches was rated as “good” due to the presence of some quality pools and LWD, however grazing at both sites was impacting fish habitat.

Table 28. Riparian assessment results for the two sites sampled on West Fork Lower Willow Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 3.1	19/30 (63%)	21/30 (70%)	7/10 (70%)	47/70 (67%)
RM 1.6	19/30 (63%)	11/30 (37%)	7/10 (70%)	37/70 (53%)

A thermograph was placed in West Fork Lower Willow just above its confluence with North Fork Lower Willow Creek on July 12, 2007 (Appendix B). Maximum daily temperatures were high, with a maximum recorded temperature of 21.8 occurring on July 14. Maximum daily water temperatures on WFLW exceeded 15 °C on 44 days, and exceeded 20 °C on 10 days.

Mohave Creek

Mohave Creek is a tributary to the West Fork Lower Willow Creek and enters the drainage at approximately river mile 2.2. Land ownership on Mohave Creek is divided between National Forest and Stimson Lumber Company lands. Primary land use in the drainage is cattle grazing and timber harvest.

One electrofishing section was completed for Mohave Creek on August 30, 2007 (Figure 3). Westslope cutthroat trout were the sole fish species sampled, with a total of 19 fish captured (Table 29, Appendix A).

Table 29. Electrofishing data collected in one section of Mohave Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.0	WCT	19	19	84	34-153	100

The riparian assessment completed at this site rated Mohave Creek at a 21/70 (30%) (Table 30). The primary reason for the low score in this reach was the extensive grazing observed on both Stimson Lumber Company and National Forest lands. Comments from the assessment reveal that 80-90% of the banks lacked vegetation. Mohave Creek at this site is a B channel, but the stream banks were found to be unstable and the creek was over-widened due to cattle grazing. All fish greater than 50 mm were captured in the two largest pools in the entire 100 m reach, indicating that pool habitat in the reach was limited. This reach was rated “poor” in terms of fish habitat.

Table 30. Riparian assessment results for the site sampled on Mohave Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.0	12/30 (40%)	9/30 (30%)	0/10 (0%)	21/70 (30%)

Spring Creek

Spring Creek is a tributary to the North Fork Lower Willow Creek and enters the drainage at approximately river mile 2.3. This drainage lies entirely within private land and cattle grazing is the primary land use.

One section of Spring Creek was electrofished on August 16, 2007, just above its confluence with the North Fork Lower Willow Creek (Figure 3). Sixteen westslope cutthroat trout were captured with a mean TL of 82 mm (Table 31, Appendix A).

Table 31. Electrofishing data collected in one section of Spring Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.3	WCT	16	16	82	42-152	100

A riparian assessment was conducted on this section of Spring Creek, and the stream received a score of 28/70 (40%) (Table 32). Cattle grazing within the riparian area of Spring Creek had caused significant damage to the riparian vegetation on this stream. Woody riparian vegetation was nearly absent in this reach, although some young willow recruitment was observed. However, nearly all young willows were heavily browsed. Sedges were found to be quite abundant in this reach of Spring Creek but heavy utilization was also observed for this species. Overall, this reach of Spring Creek had a very high width to depth ratio for an E channel (several portions appeared to be small ponds) and thus was scored as “poor” in terms of fish habitat. In fact, after initial assessment of the stream, it was almost decided not to sample the stream as it was believed that there would be no fish present due to the small size of the stream and the poor habitat observed. The survey proved that westslope cutthroat were present, however the habitat observed in this portion of the drainage prevents this stream from supporting a sizeable population of westslope cutthroat trout.

Table 32. Riparian assessment results for the site sampled on Spring Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.3	19/30 (63%)	9/30 (30%)	0/10 (0%)	28/70 (40%)

Senia Creek

Senia Creek is a tributary to North Fork Lower Willow Creek and enters the drainage at approximately river mile 4.3. Land ownership is Forest Service in the upper portion of the drainage and a mix of Stimson Lumber and private cattle lands in the lower reaches. Land use in the drainage is primarily cattle grazing and timber harvest.

One site was electrofished on August 21, 2007 (Figure 3). This site was located on Forest Service land and five westslope cutthroat trout were captured at this site (Table 33, Appendix A).

Table 33. Electrofishing data collected in one section of Senia Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.3	WCT	5	5	115	79-142	100

A riparian assessment was conducted at this site and it scored 29/58 (50%). Senia Creek at this site was classified as a B channel type (Table 34). Riparian grazing in this reach of Senia Creek appears to be limiting the recruitment of woody vegetation and thus has led to bank instability, poor stream shading, and a lack of quality pools. Nearly all riparian vegetation was found to be heavily browsed by cattle. Thus, this reach received a relatively low riparian assessment score.

Table 34. Riparian assessment results for the site sampled on Senia Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.3	15/30 (50%)	11/18 (61%)	3/10 (30%)	29/58 (50%)

South Fork Lower Willow Creek

South Fork Lower Willow Creek is a tributary of Lower Willow Creek and enters the drainage at Lower Willow Creek Reservoir, approximately river mile 9.4. Land ownership in this drainage is divided between private land and Forest Service land. Primary land use is cattle grazing on private lands and past timber harvest and mining on Forest Service lands.

Four sections were electrofished on South Fork Lower Willow Creek during August and September of 2007 (Figure 3). In all sections, westslope cutthroat trout were the sole fish species captured. The upper site (river mile 10.7) was located on Forest Service land, and 94 cutthroat trout were captured (Table 35, Appendix A). Downstream of this site at river mile 7.8, the number of westslope cutthroat trout sampled increased slightly to 99 (Table 35, Appendix A). The river mile 3.9 section was located on private land and a total of 117 westslope cutthroat trout were captured at this site. Finally, at river mile 0.7, a total of 61 cutthroat trout were captured with these fish being somewhat larger than fish observed higher in the drainage (mean TL = 123 mm).

Table 35. Electrofishing data collected in four sections of South Fork Lower Willow Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 10.7	WCT	94	94	114	61-192	100
RM 7.8	WCT	99	99	99	31-277	100
RM 3.9	WCT	117	117	112	48-237	100
RM 0.7	WCT	61	61	123	35-229	100

Riparian assessments were completed at all four sites on South Fork Lower Willow Creek in 2007. The riparian assessment completed at the upper site (river mile 10.7) yielded a scored of 45/58 (78%) (Table 36). This site was classified as a B channel and a large part of the upper portion of this drainage appeared to have been clear-cut approximately 20-30 years ago. The recolonizing vegetation was mainly disturbance-induced species, although young lodge pole pine and alder were also present in the reach. The presence of disturbance induced species and lack of LWD recruitment detracted from the quality of the habitat, however, the stream banks and substrate in the reach were made up of boulder/cobble which made the banks quite stable and provided for good fish habitat. The next section downstream in the drainage was located below the Black Pine Mine (river mile 7.8) and the stream scored a 51/70 (73%) at this site (Table 36). At this site, the channel became lower gradient and was classified as a B_c channel. Riparian cattle grazing was observed and appeared to be the primary cause of habitat alteration in this reach. The abundance and recruitment of woody riparian vegetation was somewhat limited in this reach due to cattle browsing. This reduction in woody riparian vegetation led to reduced stream shading and also reduced bank stability. However, fish habitat in this reach was still rated as “good” because of the presence of several under-cut banks, LWD, and some quality pools.

Table 36. Riparian assessment results for the four sites sampled on South Fork Lower Willow Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 10.7	28/30 (93%)	7/18 (39%)	10/10 (100%)	45/58 (78%)
RM 7.8	24/30 (80%)	20/30 (67%)	7/10 (70%)	51/70 (73%)
RM 3.9	17/30 (57%)	11/30 (37%)	3/10 (30%)	31/70 (44%)
RM 0.7	27/30 (90%)	26/30 (87%)	7/10 (70%)	60/70 (86%)

At river mile 3.9, cattle utilization of the riparian area was found to be quite extensive. This site was estimated to be a C_b channel and scored relatively low (31/70 (44%)) due to reduced densities of woody riparian vegetation and a general lack of woody riparian vegetation recruitment. This reduction in riparian vegetation had led to subsequent bank erosion and channel over-widening (Table 36). Fish habitat in this reach was scored as “fair” due to channel over-widening, a lack of quality pool habitat, and the lack of stream shading. Despite the limitations of the riparian habitat found at this site, the densities of westslope cutthroat trout were quite high in comparison to other surveys completed within this drainage and in comparison to surveys completed in other drainages (Table 35).

The site located lowest in the South Fork drainage (river mile 0.7) was found to have a relatively high riparian assessment score (60/70 (86%)) (Table 36). This site had abundant riparian vegetation and good riparian vegetation recruitment. The width to depth ratio and bank stability were also observed to be well within the parameters of a healthy C channel. The fish habitat in the reach was found to be “good” and did not receive an “excellent” rating only based on fairly high levels of fine sediment, which is likely due to upstream land use. This site could likely be used as a reference reach for streams with similar channel types (C) in the Lower Willow Creek drainage. The high quality habitat in the reach is likely due to the enrollment of this parcel of property in the Wetland Reserve Program administered through the Natural Resource Conservation Service (Jim Dinsmore, pers. comm.).

A thermograph was placed in South Fork Lower Willow Creek just above its confluence with the reservoir on July 12, 2007 (Appendix B). Maximum daily temperatures exceeded 15 °C for 60 days and 20 °C for 23 days. The maximum recorded temperature was 25.9 °C on July 14.

One irrigation diversion was observed in the South Fork Lower Willow Creek drainage in 2007. The diversion is located at approximately river mile 3.2 on the mainstem of South Fork Lower Willow Creek and diverts a relatively large amount (appx. 30-40% of the flow based on a visual estimate) of the flow of the South Fork Lower Willow Creek. This ditch delivers water several miles to a ranch located near mainstem Flint Creek. The ditch was electrofished to assess fish entrainment approximately 2 miles below the diversion. During this survey, two westslope cutthroat (mean TL = 142.5 mm) and many juvenile longnose suckers (*Catostomus catostomus*) were observed in approximately 200 m of the ditch.

Cottonwood Creek

Cottonwood Creek is a tributary to the South Fork Lower Willow Creek and enters the drainage at approximately river mile 2.6. Land ownership on Cottonwood Creek is divided between the Forest Service, Bureau of Land Management (BLM), and Montana Department of Natural Resources (DNRC) administered lands, as well as private cattle ranching land. Land use is primarily cattle grazing and timber harvest.

Two sections of Cottonwood Creek were sampled during late August and early September of 2007 (Figure 3). Westslope cutthroat trout were the only fish species sampled at both sites. The upper site (river mile 2.3) was located on BLM land. A total of 132 cutthroat trout were captured at this site (Table 35, Appendix A). The lower site was located at river mile 1.2 on DNRC land. A total of 126 westslope cutthroat trout were captured at this site (Table 37, Appendix A).

Table 37. Electrofishing data collected in two sections of Cottonwood Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.3	WCT	132	132	88	38-207	100
RM 1.2	WCT	126	126	85	39-178	100

Riparian assessments were conducted at both electrofishing sections on Cottonwood Creek and both were classified as B channels. At the upper site, Cottonwood Creek received an assessment score of 44/70 (63%) (Table 38). Cattle were present at this site in high numbers, and their negative effects on fish habitat in this portion of Cottonwood Creek were apparent. Bank instability was evident throughout the reach due to riparian grazing. Mature alders in the riparian area were heavily browsed into an “umbrella” shape, and recruitment of younger alders was minimal. Noxious and disturbance-induced plants were common. At the site located at river mile 1.2, Cottonwood Creek received an even lower score of 31/70 (44%). Conditions were similar to river mile 2.3, except the impacts were greater due to heavier cattle grazing. Over-utilization in this reach limited the recruitment of woody vegetation also led to instability and over-widening of the channel. Fish habitat in this reach was scored as “fair” due to the lack of deep pools (channel over-widening), reduced stream shading, and lack of LWD (Table 38).

Table 38. Riparian assessment results for the two sites sampled on Cottonwood Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.3	19/30 (63%)	18/30 (60%)	7/10 (70%)	44/70 (63%)
RM 1.2	15/30 (50%)	13/30 (43%)	3/10 (30%)	31/70 (44%)

Copper Creek

Copper Creek is a tributary to the South Fork Lower Willow Creek and enters the drainage at approximately river mile 5.8. Land ownership in the Copper Creek Drainage is National Forest lands in the upper reaches, BLM land in the middle portion of the drainage, and private cattle ranching in the lower portion of the drainage. The primary land use in this drainage is cattle grazing with some historic mines found on BLM land.

Two sites were electrofished during September 2007 (Figure 3). At both sites, only westslope cutthroat trout were sampled. The upper site was located at river mile 1.4 and was on BLM land. Sampling at this site yielded 68 westslope cutthroat trout (Table 39, Appendix A). The lower site was located on private land at river mile 0.1 and a total of 17 westslope cutthroat trout were captured at this site (Table 39, Appendix A).

Table 39. Electrofishing data collected in two sections of Copper Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.4	WCT	68	68	115	59-200	100
RM 0.1	WCT	17	17	119	58-158	100

Riparian assessments were conducted at each of the sites sampled on Copper Creek. Both sites were B channels and scores were similar at each site, with the upper section receiving a 42/70 (60%) and the lower section receiving a 41/70 (59%) (Table 40). At the upper site, cattle grazing had caused a significant reduction in woody riparian vegetation, particularly young alders. This appeared to be causing bank instability and reduced stream shading in portions of the reach. However, fish habitat was rated as “good” due to a relatively good number of pools and LWD in the reach. At the lower site, mature alders lined the immediate riparian area, which provided good stream shading and bank stability. Outside of the immediate stream banks however, only upland grasses were observed with no woody vegetation present. The fish habitat at this site was rated as fair due to the shallow nature of the stream, the lack of pools, and lack of LWD and complexity.

Table 40. Riparian assessment results for the two sites sampled on Copper Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.4	19/30 (63%)	16/30 (53%)	7/10 (70%)	42/70 (60%)
RM 0.1	23/30 (77%)	15/30 (50%)	3/10 (30%)	41/70 (59%)

Boulder Creek Drainage

Boulder Creek

Boulder Creek is a tributary to Flint Creek, which enters the drainage near the town Maxville at approximately river mile 15.7. The upper portion of Boulder Creek runs primarily through National Forest land, while the lower portion of the drainage (below Princeton to Maxville) is privately owned. Historic land use in the drainage was

primarily mining and timber harvest. Remnants of old mines are visible on many tributaries and some portions of mainstem Boulder Creek. Current land use is timber harvest, small hydropower and private residences. Two irrigation ditches draw water from the lower portion of Boulder Creek, and many homes on the lower creek draw water for yard maintenance via small pumps.

Five sections of Boulder Creek were electrofished during 2007 (Figure 4). The two uppermost sections contained only native bull and westslope cutthroat trout (Table 41, Appendix A). At river mile 9.6, bull trout made up 61% of the sample population while westslope cutthroat trout made up 39% of the fish sampled. At the site located at river mile 7.7, 68% of the fish sampled were bull trout while the remainder were westslope cutthroat trout. At river mile 6.5, non-native salmonids were sampled for the first time; however bull and cutthroat trout still dominated species composition (Table 41, Appendix A). Fifty four percent of fish sampled were bull trout with a total of 31 sampled and 26% were westslope cutthroat trout with a total of 15 captured. Non-native brown trout and brook trout made up 16% and 4% of the catch respectively, with nine brown trout and four brook trout being captured. At river mile 5.1, the percentage of bull trout decreased to only 18% of the sample, while westslope cutthroat trout percentage increased to 50% of the fish captured (Table 41, Appendix A). Non-natives made up 32% of the sample with four brown trout, and five brook trout captured. At river mile 2.5, only 2% of the sample was bull trout, while westslope cutthroat made up 47% of the sample and brown trout made up 50% of the sample. No brook trout were captured at this site (Table 41, Appendix A).

Table 41. Electrofishing data collected in five sections of Boulder Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 9.6	BULL	14	14	159	114-280	61
	WCT	9	9	213	115-260	39
RM 7.7	BULL	21	21	147	83-223	68
	WCT	10	10	220	88-330	32
RM 6.5	BULL	31	31	156	47-332	54
	WCT	15	15	161	70-267	26
	LL	9	9	394	386-403	16
	EB	2	2	150	125-188	4
RM 5.1	BULL	5	5	194	163-223	18
	WCT	14	14	239	93-357	50
	LL	4	4	223	106-385	14
	EB	5	5	150	125-188	18
RM 2.5	BULL	2	2	186	171-202	3
	WCT	32	32	153	71-335	47
	LL	34	34	115	47-398	50

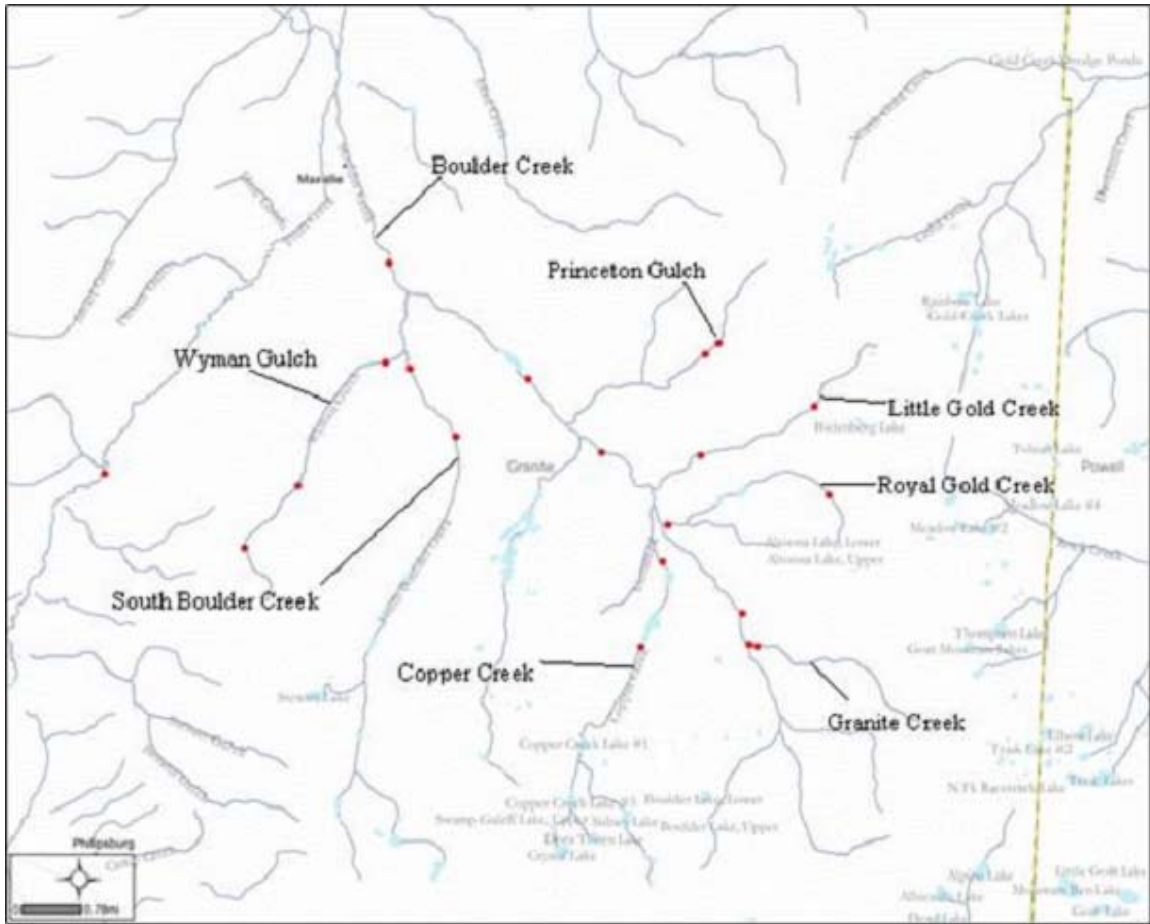


Figure 4. Map of the Boulder Creek drainage showing electrofishing sections completed in 2007.

A riparian assessment was conducted at all five sites sampled on Boulder Creek (Table 42). The upper three sites were classified as B channels while the lower two were classified as B_c channels. Riparian scores were high at all sites, with the lowest occurring at river mile 5.1. At all sites, fish habitat and geomorphology received perfect scores. The only vegetative concerns were the presence of noxious and disturbance-induced weeds such as spotted knapweed, Canada thistle, and mullein (*Verbascum thapsus*). One portion of lower Boulder Creek, approximately one half mile in length, does serve as riparian pasture for horses and no riparian fencing is currently present. This is one site on mainstem Boulder Creek that had a relatively degraded riparian area which could likely benefit from riparian fencing.

Table 42. Riparian assessment results for the five sites sampled on Boulder Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 9.6	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)
RM 7.7	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)
RM 6.5	30/30 (100%)	17/18 (94%)	10/10 (100%)	57/58 (98%)
RM 5.1	30/30 (100%)	16/18 (89%)	10/10 (100%)	56/58 (97%)
RM 2.5	30/30 (100%)	17/18 (94%)	10/10 (100%)	57/58 (98%)

Thermographs were placed at two sites on mainstem Boulder Creek on July 11, 2007 (Appendix B). One was placed upstream of Princeton where Forest Road 676 crosses Boulder Creek for the second time, while the other was placed just upstream of the Highway 1 Bridge. At the upstream site, temperatures reached a recorded high of 10.9°C on July 19. At the lower site however, temperatures exceeded 15 °C on 20 occasions in 2007 with a maximum recorded temperature of 17.2 °C on July 18. The amount of water diverted from lower Boulder Creek may have contributed to this > 5 °C average difference between the two sites during July and August 2007.

South Boulder Creek

South Boulder Creek is a tributary of Boulder Creek, which enters the lower portion of the drainage at approximately river mile 3.1. With the exception of a couple of privately held mining claims, South Boulder Creek lies entirely within National Forest land. Several roads make the lower portion of the South Boulder easily accessible, however after approximately river mile 1.7, the creek is accessible only by ATV or foot traffic. Utilization of the lower portion of the drainage appears low, with primary land use limited to past timber harvest and sporadic camping and recreation. Stewart Lake is popular recreational destination found in the headwaters of South Boulder Creek, and is accessible via County Road 8445 from Philipsburg.

Two sites were electrofished on South Boulder Creek on July 24, 2007 (Figure 4). At river mile 2.1, 38 westslope cutthroat trout and two bull trout were captured (Table 43, Appendix A). At river mile 1.0, larger numbers of fish were captured, but species composition was similar with a total of 50 westslope cutthroat trout and two bull trout captured (Table 43, Appendix A).

Table 43. Electrofishing data collected in two sections of South Boulder Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.1	BULL	2	2	177	155-198	5
	WCT	38	38	133	65-235	95
RM 1.0	BULL	2	2	147	89-205	4
	WCT	50	50	122	61-250	96

Riparian assessments were conducted at both sites on South Boulder creek. The upper section was a boulder dominated B channel and received a score of 57/58 (98%) (Table 44). The lower section was classified as a B_c channel and scored a 69/70 (99%) (Table 44). Both sections contained deep pools, abundant spawning habitat and LWD, adequate woody riparian vegetation, and stable banks. A thermograph was placed in the stream on July 10, 2007. Maximum daily temperatures exceeded 15 °C for 13 days with a maximum daily temperature of 16.1 °C occurring on July 19 (Appendix B).

Table 44. Riparian assessment results for the two sites sampled on South Boulder Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.1	30/30 (100%)	17/18 (94%)	10/10 (100%)	57/58 (98%)
RM 1.0	30/30 (100%)	29/30 (97%)	10/10 (100%)	69/70 (99%)

Wyman Gulch

Wyman Gulch is a tributary to South Boulder Creek, which enters the drainage at approximately river mile 0.8. Wyman Gulch is accessible throughout much of its length through a series of forest roads. An abandoned mine is located in the lower portion of the drainage along with several private residences. Several upland areas in the drainage were observed to have been logged in the past.

Three sites were electrofished on Wyman Gulch from July 16 through July 17, 2007 (Figure 4). At river mile 3.6, only three fish were captured and all were westslope cutthroat trout (Table 45, Appendix A). Downstream at river mile 2.4, the fish population remained entirely westslope cutthroat trout, however many more fish were sampled with a total of 68 westslope cutthroat trout captured. In the lower section, at river mile 0.3, 31 westslope cutthroat trout and two bull trout were captured (Table 45, Appendix A).

Table 45. Electrofishing data collected in two sections of Wyman Gulch in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 3.6	WCT	3	3	138	130-148	100
RM 2.4	WCT	68	68	124	52-206	100
RM 0.3	BULL	2	2	93	91-94	6
	WCT	31	31	124	49-273	94

A riparian assessment was conducted at each of the three sites on Wyman Gulch (Table 46). Both the upper and lower sections were classified as A channels and received a perfect 46/46 (100%), as these sites maintained good riparian vegetation, stable banks, and abundant LWD. The middle section was classified as a B_c channel, which flowed through a lower gradient meadow. This site received a riparian assessment score of 56/70 (80%) (Table 46). This reduced score was due mainly to past down-cutting of the channel and a lack of live willows. It appeared that beaver dams may have heavily influenced this reach (based on the presence of old beaver dams) and that upon removal or abandonment of these dams, the channel may have down-cut. It is suspected that this down-cutting lowered the water table and led to the mortality of many mature willows.

Table 46. Riparian assessment results for the two sites sampled on Wyman Gulch in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 3.6	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)
RM 2.4	28/30 (93%)	21/30 (70%)	7/10 (70%)	56/70 (80%)
RM 0.3	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)

A thermograph was placed in Wyman Gulch on July 10, 2007, and maximum daily temperatures exceeded 15 °C on eight days with a maximum recorded temperature of 15.9 °C recorded on July 13 (Appendix B).

Princeton Gulch

Princeton Gulch is a tributary of Boulder Creek and enters the drainage at approximately river mile 6.1. The lower portion of Princeton Gulch runs mainly through privately held mining claims, while much of the upper creek is on National Forest land. Primary land uses in Princeton Gulch are historic placer mining and Forest Service grazing allotments.

Placer mine piles and other evidence of extensive past mining are abundant throughout the drainage.

Electrofishing was completed at three sites on Princeton Gulch on July 19 and July 23, 2007 (Figure 4). In all three sections, no fish were captured. This lack of fish in the drainage appears to be due to the presence of a barrier falls in the lower portion of the drainage. At this site, the creek was funneled through a culvert, over a falls, and into a man-made pond. The creek subsequently went dry directly below the pond. Extensive ground disturbance in the area around the falls and the presence of the culvert, put into question whether the barrier was naturally formed or human caused. It is suspected that it was naturally formed and is likely the reason no fish were found in the drainage upstream of this site. During July, Princeton Gulch did resurface again below the dry reach, however, this lower portion of Princeton Gulch was later found to be dry in August.

Two riparian assessments were conducted in Princeton Gulch in 2007. These surveys were completed at river mile 2.6 and river mile 0.8. At river mile 0.8, the creek was classified as a B channel and received a score of 40/46 (87%) (Table 47). The main reasons for a reduction in points for this section of Princeton Gulch were bank erosion and a lack of riparian vegetation, both due to cattle grazing. The river mile 2.6 site received a much lower score of 30/70 (43%) and was classified as a G channel (Table 47). This reach was deeply entrenched within placer mine piles and was choked with fine sediment. A single step into Princeton Gulch at this site resulted in the entire creek flowing thick, brown mud. Princeton Gulch at this site also lacked pools for fish habitat.

Table 47. Riparian assessment results for the two sites sampled on Princeton Gulch in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.6	9/30 (30%)	18/30 (60%)	3/10 (30%)	30/70 (43%)
RM 0.8	27/30 (90%)	6/6 (100%)	7/10 (70%)	40/46 (87%)

Little Gold Creek

Little Gold Creek is a tributary of Boulder Creek, which enters the drainage at approximately river mile 7.8. The creek lies entirely within National Forest land, with the exception of several private mining claims. Bielenberg Lake feeds the headwaters of Little Gold Creek. Land uses in the drainage include grazing through Forest Service grazing allotments and timber harvest. Several old clear-cuts were observed near the creek. Located at approximately river mile 1.5 is a diversion structure used to divert water for a small hydro-electric plant. The diversion was not in operation when the site was visited in July 2007, but according to a local resident who frequents the area, the stream runs dry below the diversion in most years.

Electrofishing was completed at two sites in the Little Gold Creek drainage on July 18, 2007 (Figure 4). The first section sampled was located at river mile 2.5, and no fish were

captured (Table 48). A second section, located at river mile 0.8 (above the first FR 8501 crossing), was electrofished and 36 westlope cutthroat trout were captured (Table 48, Appendix A). The reach between the two sampling sections was surveyed to assess whether a barrier was present, but no definitive barrier to fish passage was found. In discussions with Steve Gerdes (U.S. Forest Service, pers. comm.), he indicated that during past electrofishing surveys conducted by Montana Fish, Wildlife and Parks in the early 1980's, no fish were captured in Little Gold Creek. Interestingly, the only fish captured in Little Gold Creek were found in a section that is believed to be dry in most years (local resident, pers. comm.). Further investigation would be necessary to fully understand fish distribution in this drainage.

Table 48. Electrofishing data collected in two sections of Little Gold Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.5	-	0	0	-	-	0
RM 0.8	WCT	36	36	134	51-199	100

A riparian assessment was completed for Little Gold Creek at each site electrofished in 2007. Both sites were A channels and scored perfect 46/46 (100%) (Table 49). Little Gold Creek had abundant woody riparian vegetation, abundant deep pools, LWD, and stable banks.

Table 49. Riparian assessment results for the two sites sampled on Little Gold Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.5	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)
RM 0.8	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)

A thermograph was placed at the mouth of Little Gold Creek on July 10, 2007 (Appendix B). Daily temperatures never exceeded 15 °C with a maximum daily temperature of 14.6°C occurring on July 19.

Copper Creek

Copper Creek is a tributary of Boulder Creek, which enters the middle portion of the Boulder Creek drainage at approximately river mile 8.0. The Copper Creek drainage lies entirely within Forest Service lands, although one private cabin is located on the creek directly below the upper electrofishing section. Several lakes feed the headwaters of Copper Creek, including Copper Lakes, Dora Thorn Lake, and Crystal Lake. A trail system provides access to these lakes, as well as to the upper reaches of the creek and primary land use is recreation.

Electrofishing was completed at two sites in the Copper Creek drainage on July 25, 2007 (Figure 4). The sites were located at river miles 0.8 and 2.8 (Table 50). The electrofishing section at river mile 2.8 was located just upstream of a large, beaver influenced meadow, while the lower section was located below the meadow in a Douglas-fir/spruce forest. The section located at river mile 0.8 had a much higher-gradient than the upstream section. The fish communities of both sites were dominated by brook trout. At river mile 2.8, 93% of the fish sampled were brook trout with a total of 127 captured (Table 50, Appendix A.) The remaining 7% were westslope cutthroat, rainbow trout, or hybrids (*Oncorhynchus spp.*). At river mile 0.8, the number of fish captured was lower but species composition was similar. Brook trout comprised 89% of the fish sampled with a total of 41 captured, while westslope cutthroat and hybrids made up the other 11% (Table 50, Appendix A). Montana Fish, Wildlife and Parks stocking records indicate that Copper Lakes, Dora Thorn Lake, and Crystal Lake were all stocked with rainbow trout in 1941 which is the likely source for the rainbow trout and rainbow/westslope cutthroat trout hybrids observed in the Copper Creek drainage.

Table 50. Electrofishing data collected in two sections of Copper Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.8	EB	127	127	139	39-215	93
	<i>Onc. spp.</i>	9	9	186	156-250	7
RM 0.8	EB	41	41	141	54-217	89
	<i>Onc. spp.</i>	5	5	133	77-190	11

A riparian assessment was completed for Copper Creek at each site electrofished in 2007. The upper site received an overall score of 69 out of a potential score of 70 (99%) (Table 51). The site was classified as a C/B_c channel type. It was located at a transitional zone between B and a C channel types. Comments from the survey indicate that vegetation was good, erosion was non-existent, and that fish habitat was excellent due to the abundance of good undercut banks, deep pools, and large woody debris (LWD). The lower section was classified as a B/A channel type and scored a perfect 46/46 (100%) (Table 51). A concern for this section however, was that the water temperature reached 16.6°C at 4:00 p.m. (handheld thermometer measurement) on the date sampled. This was likely due to upstream warming in the open, slow-moving, beaver dominated reach located just upstream of this section.

Table 51. Riparian assessment results for the two sites sampled on Copper Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.1	30/30 (100%)	29/30 (97%)	10/10 (100%)	69/70 (99%)
RM 0.8	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)

A thermograph was placed at the mouth of Copper Creek on July 13, 2007 to monitor stream temperatures. However, on September 10, 2007 the mouth of Copper Creek was found to be completely dry. Due to the abundance of fish in the upper watershed, it is suspected that this event was localized to the area near the mouth of Copper Creek. Because of this event, the temperature data was not included in this report.

Royal Gold Creek

Royal Gold Creek is a tributary of Boulder Creek, which enters the drainage at approximately river mile 8.3. Royal Gold Creek flows nearly entirely through National Forest lands except for occasional mining claims and a small parcel of private land in the lower portion of the drainage. Access to the upper watershed is difficult due to the poor conditions of the forest roads in the area. Land use in the drainage includes past logging and mining, as well as a small housing development (5-6 houses) on the private land in the lower portion of the drainage.

Electrofishing was completed at two sites on July 26, 2007 in the Royal Gold Creek drainage (Figure 4). At river mile 2.6, only westslope cutthroat trout were captured with a total of six sampled (Table 52, Appendix A). At river mile 0.1, two westslope cutthroat trout and two brook trout were captured in a 67 m section (Table 52, Appendix A).

Table 52. Electrofishing data collected in two sections of Royal Gold Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.6	WCT	6	6	139	125-163	100
RM 0.1	WCT	2	3	157	133-180	50
	EB	2	3	147	143-150	50

A riparian assessment was completed at both electrofishing sections sampled in 2007. Each section was classified as an A channel and received excellent riparian assessment scores. The site located at river mile 2.6 received a score a 57/58 (98%), while river mile 0.1 received a score of 49/50 (98%) (Table 53). Although not assessed, the private parcel directly upstream of the lower electrofishing section contained 5-6 houses. A significant amount of vegetation appeared to be removed from this area, including directly within the riparian area. A thermograph was placed in the stream on July 10, 2007, and maximum daily temperatures exceeded 15 °C for nineteen days with a maximum recorded temperature of 16.9 °C occurring on July 19 (Appendix B).

Table 53. Riparian assessment results for the two sites sampled on Royal Gold Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.6	30/30 (100%)	17/18 (94%)	10/10 (100%)	57/58 (98%)
RM 0.1	30/30 (100%)	9/10 (90%)	10/10 (100%)	49/50 (98%)

Granite Creek

Granite Creek is a tributary of Boulder Creek, which enters the upper portion of the drainage at approximately river mile 10.4. The entire Granite Creek drainage lies on National Forest land and is accessible by FR 676, which fords the lower portion of the creek, and later by FR 1590, which runs along the south side of the creek. Due to the poor condition of these roads, recreational and commercial use in the drainage is likely limited.

Electrofishing was completed at two sites on Granite Creek during the summer of 2007 (Figure 4). A section located above FR 676, at river mile 0.3, was sampled on July 23 and no fish were captured. On September 4, a 165 m section was sampled from below FR 676 to the mouth. Fifteen westslope cutthroat trout were captured in this section (Table 54). It is unknown why westslope cutthroat trout are found below the road and not directly above. The current road crossing is a ford and does not appear to serve as a barrier to fish movement and no other barriers were observed downstream.

Table 54. Electrofishing data collected in two sections of Granite Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.3	-	0	0	-	-	-
RM 0.1	WCT	15	9	208	137-303	100

Due to the similar nature and proximity of the two sections, a riparian assessment was conducted only at the upper electrofishing section. Granite Creek was a high-gradient A channel and received a perfect 46/46 (100%) (Table 55). Comments from the assessment reveal that the site maintained abundant woody riparian vegetation, adequate shading, stable banks, good pools, and cold water. A thermograph was placed in the stream on July 23, 2007, and maximum daily temperatures never exceeded 9.3°C at any point after this date during the summer.

Table 55. Riparian assessment results for the site sampled on Granite Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.3	30/30 (100%)	6/6 (100%)	10/10 (100%)	46/46 (100%)

Fred Burr Creek Drainage

Fred Burr Creek

Fred Burr Creek is a tributary to Flint Creek, which enters the drainage just south of the town of Philipsburg at approximately river mile 35.1. The lower portion of Fred Burr Creek runs primarily through private land with the exception of a thin strip of BLM land at a power-line crossing. The upper portion of the drainage is mainly on National Forest land, although some private land is present. Fred Burr and Little Fred Burr Lakes are located within the drainage. Primary land use in the drainage has historically been mining. Historic photos indicate that in the early twentieth century, a large mine was in operation on Fred Burr Creek, which drastically altered the entire valley and portions of the channel and floodplain of Fred Burr Creek.

Two sections of Fred Burr Creek were electrofished on September 12, 2007 (Figure 2). The upper section was located above FR 1567 on National Forest land. Twenty-six westslope cutthroat trout and 16 brown trout were captured in this section comprising 62% and 38% of the trout population, respectively (Table 56, Appendix A). The lower site, located at river mile 3.2 on BLM land, was also sampled. A total of 23 brown trout and 13 rainbow trout were captured at this site (Table 56, Appendix A). Species composition shifted significantly from the upper site to the lower site with brown trout comprising a greater portion of the fish caught at river mile 3.2 and with rainbow trout being relatively abundant at river mile 3.2 and absent at river mile 6.3 (Table 56).

Table 56. Electrofishing data collected in two sections of Fred Burr Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 6.3	WCT	26	26	145	87-216	62
	LL	16	16	155	106-233	38
RM 3.2	LL	23	23	138	60-254	64
	RBT	13	13	163	90-231	36

A riparian assessment was conducted at each of the two electrofishing sections in Fred Burr Creek. The upper section received a 45/46 (98%) (Table 56). At this site, the stream appeared unaltered, and stream flow, riparian vegetation, and bank stability were good. This B channel was dominated by large boulders and large pools were present. At

the downstream site, Fred Burr Creek received a slightly lower score of 54/58 (90%) (Table 57). This section of stream appeared to maintain less water and the banks were less vegetated and thus pools were shallower and less shaded. However, this site was still a boulder dominated B channel that maintained excellent bank stability. The reason for the reduced amount of water observed at the lower site on Fred Burr Creek is unknown. There were no diversions or ditches observed between the two sites, so it is suspected that a portion of this reach loses surface water to groundwater. Between the upper and lower sites, the creek runs through private land and was not thoroughly assessed. However, roadside observations indicated a potentially incised channel and altered riparian vegetation due to historic mining activities and potentially residential development.

Table 57. Riparian assessment results for the two sites sampled on Fred Burr Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 6.3	30/30 (100%)	5/6 (83%)	10/10 (100%)	45/46 (98%)
RM 3.2	30/30 (100%)	15/18 (83%)	7/10 (70%)	54/58 (90%)

Gold Creek Drainage

Gold Creek

Gold Creek is a tributary to the Clark Fork River that drains for approximately 15 miles before reaching the upper portion of the Clark Fork basin at RM 291.6. Land ownership along Gold Creek is comprised largely of private lands with some U.S. Forest Service administered lands in the upper portion of the watershed. The primary land uses in the Gold Creek drainage are hay production, cattle grazing, and timber harvest. There is also evidence of extensive historic mining activity in the watershed.

Fish surveys were completed at four sites along the longitudinal gradient of Gold Creek in September of 2007. The sites were located at river mile (RM) 0.3, 4.4, 11.1, and 13.8 (Table 58; Figure 5). The sites at RM 0.3 and 4.4 were located on private land, while the sites at RM 11.1 and 13.8 were on U.S. Forest Service land. At RM 0.3 the trout community in Gold Creek was comprised primarily of brown trout with only a few westslope cutthroat trout present (Table 58). While brown trout were abundant, a majority of the fish were smaller, juvenile individuals less than 130 mm total length (Appendix A). Two mountain whitefish were also captured at this site in 2007. At RM 4.4, the fish community changed markedly from the downstream site at RM 0.3. At RM 4.4 westslope cutthroat trout were the dominant trout species present, followed closely by brown trout (Table 58). Slimy sculpin were also sampled at this site. At RM 11.1, the fish community was comprised entirely of westslope cutthroat trout, which maintained an average total length of 178 mm (Table 58, Appendix A). Like at RM 11.1, westslope cutthroat trout were the only species present at RM 13.8. However, these fish tended to be notably smaller averaging just 95 mm in total length (Table 58, Appendix A).

Table 58. Electrofishing data collected at four sections of Gold Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.3	WCT	2	2.0	221	201-241	1
	LL	202	202.0	131	61-534	99
RM 4.4	WCT	78	78.0	124	44-287	53
	LL	69	69.0	130	55-243	47
RM 11.1	WCT	59	59.0	178	62-254	100
RM 13.8	WCT	21	21.0	95	36-187	100

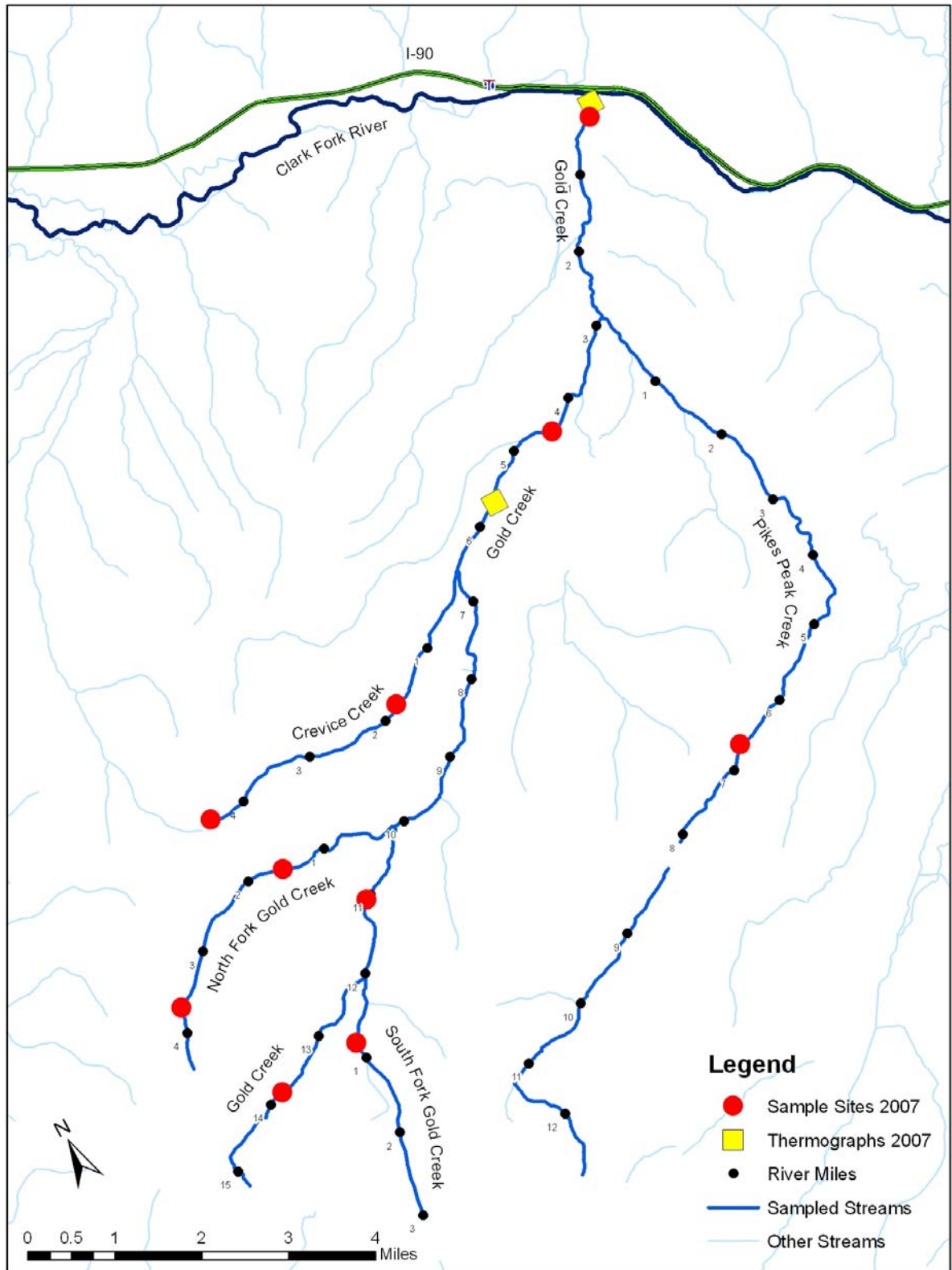


Figure 5. Map of the Gold Creek drainage showing sites of fish and temperature sampling conducted in 2007.

A riparian assessment was completed at each site electrofished on Gold Creek in 2007. At RM 0.3, Gold Creek exhibited characteristics of a Rosgen C channel type. The survey completed at this site had an overall score of 39 out of a potential score of 70 (56%) (Table 59). The categories with reduced scores were vegetation and fish habitat. The riparian area was rather simplified and consisted primarily of heavily grazed grasses, older, mature cottonwoods, and nearby irrigated hay meadows. Young cottonwood recruits, as well as mature willows and other woody species, were largely absent from the site. Additionally, a large feedlot and corral system was noted on the channel above the sample section. This area is currently a focus of the Watershed Restoration Coalition (WRC) who is working with the landowner to move the corral system off the stream, as well as install riparian fencing along one mile of channel. Irrigation impacts were also observed at this location of Gold Creek. Flow was very low and fine sediment accumulation was notable at the time of the survey. One diversion was located upstream of the sample reach approximately 0.5 miles, and at least 4 more large diversions were noted about three miles upstream that had completely dried up the channel downstream of the last takeout. The extent of this dewatering was not determined, but it is likely that it represents a significant seasonal migration barrier to fish in Gold Creek. None of the diversions were screened to prevent fish entrainment. Fish habitat in the sampled reach at RM 0.3 was most affected by low flows, a lack of deep pools, and an absence of overhanging riparian vegetation. Spawning gravels were noted to be fairly abundant however.

At RM 4.4, Gold Creek had transitioned to a channel more characteristic of a Rosgen B stream type. The overall riparian assessment score at this site was 61 out of a potential score of 65 (94%) (Table 59). The reach had a fairly healthy riparian area dominated by multiple age classes of alder, with willow, dogwood and cottonwood present as well. The factors that most affected the overall score were the frequency of noxious weeds and other undesirable plant species in the riparian area. Fish habitat in the sample reach was good (score: 7 points out of a potential of 7; Table 59), and was felt to be at its potential. The reach was high gradient and had an abundance of pocket water as well as several deep scour and dam pools. Coarse woody debris was common throughout the reach and good juvenile rearing habitat was also present. Flow did not appear to be a limiting factor at this location of the stream.

At RM 11.1 Gold Creek remained classified as a Rosgen B channel type. The overall riparian assessment score was 56 out of a potential score of 68 (82%)(Table 59). The riparian area was dominated by a conifer overstory, with spruce and Douglas fir being most common. Alder and willows were also present, but the willows appeared to be made up of older, decadent plants with little recruitment observed. It was noted that browse pressure was evident on many of the willows that were present in the reach. Fish habitat was good (score: 7 points out of a potential of 10; Table 59) in this part of Gold Creek, but a lack of deep pool habitat was thought to be somewhat of a limiting factor. Flow in this segment of the stream was noted as being relatively low.

At the most upstream site sampled in Gold Creek in 2007 (RM 13.8), the overall riparian assessment score was 61 out of a potential score of 65 (94%). The channel type at the

survey site was typical of a Rosgen B stream type. Riparian vegetation was dominated by a spruce and Douglas fir overstory, and a dense sedge and grass understory. Willows were in the area but very limited in abundance, and those present showed considerable browse. Additional notes from the assessment indicate the presence of nearby berms and old ditches likely associated with historic mining activity. Fish habitat was rated as fair (score: 3 points out of a potential of 7; Table 59), and was not felt to be at its potential. This was primarily due to low flow and a complete lack of large pools and deeper pocket water.

Table 59. Riparian assessment results for the four sites surveyed on Gold Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.3	23/30 (77%)	13/30 (43%)	3/10 (30%)	39/70 (56%)
RM 4.4	30/30 (100%)	24/28 (86%)	7/7 (100%)	61/65 (94%)
RM 11.1	28/30 (93%)	21/28 (75%)	7/10 (70%)	56/68 (82%)
RM 13.8	30/30 (100%)	28/28 (100%)	3/7 (43%)	61/65 (94%)

Water temperature was monitored at two sites in Gold Creek from July 11 through October 16, 2007 (Figure 5; Appendix B). The monitoring locations were at RM 0.1 and 5.7. At RM 0.1, maximum daily water temperatures exceeded 15°C on 65 days including eight days in which they exceeded 20°C. The maximum-recorded temperature at this site was 21.2°C on July 19. At RM 5.7, Gold Creek was considerably cooler with daily maximum temperatures exceeding 15°C only ten times during the period of record. The maximum-recorded temperature at this site was 16.1°C, which occurred on July 19.

Pikes Peak Creek

Pikes Peak Creek is a tributary to Gold Creek that drains for over 12 miles before entering lower Gold Creek at RM 2.9. Land ownership along the lower six miles of Pikes Peak Creek is comprised largely of private lands with some limited State of Montana ownership where it flows through lands administered by the Montana State Prison. The upper six miles of the stream flows exclusively through U.S. Forest Service administered lands. The primary land uses in the Pikes Peak Creek drainage are cattle grazing and timber harvest. There is also evidence of historic mining activity in the watershed.

A fish survey was completed at one site on Pikes Peak Creek in October of 2007. The site was located on U.S. Forest Service land at RM 6.7 (Table 60; Figure 5). The fish community at this site was comprised entirely of westslope cutthroat trout, which had an average total length of 113 mm (Table 60, Appendix A).

Table 60. Electrofishing data collected at one section of Pikes Peak Creek in 2007

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 6.7	WCT	52	52.0	113	74-169	100

A riparian assessment was also completed at the site electrofished on Pikes Peak Creek in 2007. The overall riparian assessment score at RM 6.7 was 45 out of a potential score of 65 (69%) (Table 61). Riparian vegetation was dominated by a conifer overstory of spruce and Douglas fir, with alder, willow and cottonwood also present. It was noted that younger age classes of willow, alder and cottonwood were largely absent, and what was present showed evidence of heavy browse pressure. And although the channel was a relatively stable Rosgen B stream type, cattle impacts to the streambanks were also noted. Fish habitat in the reach was rated only fair (score: 3 points out of a potential of 7; Table 61) due to a lack quality cover components such as deep pools and overhanging vegetation, as well as very low flow in the channel. The stream was observed to be dewatered and dry for most of its length downstream of the sample site. Larger cobbles and boulders dominated the substrate at RM 6.7, and appeared to be a possible result of historic placer mining activity in the stream channel.

Table 61. Riparian assessment results for the one site surveyed on Pikes Peak Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 6.7	23/30 (77%)	19/28 (68%)	3/7 (43%)	45/65 (69%)

Water temperature was not monitored in Pikes Peak Creek during 2007.

Crevice Creek

Crevice Creek is a tributary to Gold Creek that drains for approximately 4.5 miles before entering middle Gold Creek at RM 6.6. Land ownership along Crevice Creek is comprised mostly of lands administered by the U.S. Forest Service, with the lower mile of the channel flowing through private lands at the site of a low-density subdivision. Goldberg Reservoir is a small 8-acre impoundment at the head of the drainage. However, the primary direction of flow out of this reservoir is into the Dunkelberg Creek watershed. Only a marginal connection to Crevice Creek appears to be present, and is related to high water level elevations. The primary land uses in the Crevice Creek drainage are cattle grazing and timber harvest.

Fish surveys were completed at two sites on Crevice Creek in September of 2007. Both sites were located on U.S. Forest Service land and were at RM 1.8 and 4.4 (Table 62; Figure 5). The fish community at both sites was comprised entirely of westslope cutthroat trout of roughly equal number and size (Table 62, Appendix A). Fish were also observed to be present in Goldberg Reservoir.

Table 62. Electrofishing data collected at two sections of Crevice Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.8	WCT	70	70.0	78	35-226	100
RM 4.4	WCT	71	71.0	81	49-201	100

Riparian assessments were completed for both sites electrofished on Crevice Creek in 2007. At RM 1.8, Crevice Creek was classified as a Rosgen B channel type. The overall assessment score at this site was 58 out of a potential score of 66 (88%) (Table 63). Woody vegetation at RM 1.8 was dominated by alder and spruce, with dogwood and Douglas fir also present. However, it was noted that dogwood and an unidentified woody shrub showed notable browse pressure. Cattle hoofshear was evident along the streambanks and throughout the riparian area, and noxious weeds were also fairly abundant. Fish habitat at RM 1.8 was rated as good (score: 7 points out of a potential of 10; Table 63), but was not at its potential. This was primarily because of a lack of large woody debris in the channel, as well as the absence of deep pools. Fine sediment accumulation was notable throughout the reach.

At RM 4.4, Crevice Creek continued to display characteristics of a Rosgen B channel type. The total riparian assessment score was 59 out of a potential score of 63 (94%) (Table 63). Conifers, with spruce and lodgepole pine being most abundant, dominated the riparian overstory. Snowberry and alder plants were also present. While it did not affect the overall assessment score heavily, grazing impacts were observed throughout the reach with hoofshear along the streambanks and low stubble height on available grasses being most notable. Fish habitat at RM 4.4 had the largest influence on the overall assessment score at this site. Habitat was rated as only fair (score: 3 points out of a potential of 7; Table 63) and was not at its full potential. This was primarily due to the lack of deep pools, large woody debris, and grazed grasses on the stream bank that offered little overhead cover. Fine sediment accumulation was also notable at this site.

Table 63. Riparian assessment results for the two sites surveyed on Crevice Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.8	30/30 (100%)	21/26 (81%)	7/10 (70%)	58/66 (88%)
RM 4.4	30/30 (100%)	26/26 (100%)	3/7 (43%)	59/63 (94%)

Water temperature was not monitored in Crevice Creek in 2007.

North Fork Gold Creek

North Fork Gold Creek is a tributary to Gold Creek that drains for approximately 4 miles before entering upper Gold Creek at RM 10.1. Land ownership along North Fork Gold Creek is comprised almost exclusively of lands administered by the U.S. Forest Service. However, approximately two tenths of a mile of channel at the mouth of the stream is located within a mining claim and is under private ownership. The primary land uses in the North Fork Gold Creek drainage are cattle grazing and timber harvest.

Fish surveys were completed at two sites on North Fork Gold Creek in October of 2007. Both sites were located on U.S. Forest Service land and were at RM 1.6 and 3.7 (Table 64; Figure 5). At RM 1.6 the fish community was comprised entirely of westslope cutthroat trout, which had an average total length of 114 mm (Table 64, Appendix A). No fish were found at RM 3.7 (Table 64). The upstream distribution of fish in North Fork Gold Creek was not determined.

Table 64. Electrofishing data collected at two sections of North Fork Gold Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.6	WCT	98	98.0	114	39-183	100
RM 3.7	NO FISH	-	-	-	-	-

Riparian assessments were completed at both sites electrofished on North Fork Gold Creek in 2007. At RM 1.6, North Fork Gold Creek exhibited characteristics of both Rosgen B and C channel types, and was thus classified as a Rosgen Bc stream type. The overall riparian assessment score at RM 1.6 was 54 out of a potential score of 66 (82%) (Table 65). While the riparian health within the reach was generally good, factors affecting the overall score were site-specific grazing impacts, as well as the presence of an old road crossing that left a segment of channel wide and shallow allowing mid-channel sediment deposition. Riparian vegetation was dominated by a conifer overstory with lodgepole pine and spruce being most abundant. Alder was also present, but younger age classes were lacking. Fish habitat was rated as good (score: 7 points out of a potential of 10; Table 65), but could have been better given a greater abundance of large woody debris and deeper pools. A diversion was noted approximately one mile upstream of the survey reach.

At RM 3.7, North Fork Gold Creek was confined in a narrow valley, and the gradient of the stream was beginning to increase. For these reasons, the channel was classified as a Rosgen Ba stream type. The overall assessment score at RM 3.7 was 65 out of a potential score of 65 (100%) (Table 65). Despite the high score, no fish were captured or observed at this site as was previously noted. Riparian vegetation was dominated by a conifer overstory with lodgepole pine and spruce being most abundant.

Table 65. Riparian assessment results for the two sites surveyed on North Fork Gold Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.6	23/30 (77%)	24/26 (92%)	7/10 (70%)	54/66 (82%)
RM 3.7	30/30 (100%)	28/28 (100%)	7/7 (100%)	65/65 (100%)

Water temperature was not monitored in North Fork Gold Creek in 2007.

South Fork Gold Creek

South Fork Gold Creek is a tributary to Gold Creek that drains for approximately 3 miles before entering upper Gold Creek at RM 12.0. Land ownership along South Fork Gold Creek is a mixture lands administered by the U.S. Forest Service and a number of private mining claims. Several lakes exist within the drainage including Gold Creek Lakes, which occur at approximately RM 1.9 on South Fork Gold Creek, and Rainbow Lake, which is located off of South Fork Gold Creek. All have historically been stocked with fish (both rainbow trout and westslope cutthroat trout). However, the most recent plant was in Rainbow Lake in 2001 (westslope cutthroat trout). The primary land uses in the South Fork Gold Creek drainage are historic mining and timber harvest, and recreation.

A fish survey was completed at one site on South Fork Gold Creek in October of 2007. This site was located on U.S. Forest Service land at RM 0.8 (Table 66; Figure 5). The fish community at this site was comprised entirely of westslope cutthroat trout, which had an average total length of 131 mm (Table 66, Appendix A).

Table 66. Electrofishing data collected at one section of South Fork Gold Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.8	WCT	79	79.0	131	58-214	100

A riparian assessment was also completed at the site electrofished on South Fork Gold Creek in 2007. The overall riparian assessment score at RM 0.8 was 63 out of a potential score of 63 (100%) (Table 67). The stream at the survey site was classified as a Rosgen B channel type. Riparian vegetation was dominated by a conifer overstory, with spruce and Douglas fir being the dominant species present. Alder and snowberry were also common in the understory. Fish habitat was rated as good (score: 7 points out of a potential of 7; Table 67), and was thought to be near its potential. Large woody debris, root wads and overhanging vegetation were all abundant throughout the reach. Pools however, tended to be smaller and lacked depth. Fine sediment accumulation was notable. A culvert located upstream of the section did not appear to be a fish passage concern.

Table 67. Riparian assessment results for the one site surveyed on South Fork Gold Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.8	30/30 (100%)	26/26 (100%)	7/7 (100%)	63/63 (100%)

Water temperature was not monitored in South Fork Gold Creek in 2007.

Little Blackfoot River Drainage

Little Blackfoot River

The Little Blackfoot River is a major tributary to the Clark Fork River that drains for over 47 miles before reaching its mouth near the town of Garrison at Clark Fork RM 300.1. Land ownership along the Little Blackfoot River is comprised primarily of privately owned, agricultural lands in the lower 29 miles, and lands administered by the U.S. Forest Service with interspersed parcels of private ownership in the upper reaches. The major land uses in the Little Blackfoot River drainage include cattle grazing, hay production, timber harvest, mining, and recreation. There are a number of irrigation diversions along the mainstem Little Blackfoot River. A riparian assessment conducted in 2001 (Land and Water, 2002) indicated the presence of at least 30 diversions and eight pump sites in the lower 32 miles of the Little Blackfoot River.

Fish surveys were completed at seven sections of the Little Blackfoot River between late August and early October of 2007. The sites were located at RM 4.0, 9.6, 21.3, 26.7, 31.1, 34.9, and 40.1 (Table 68; Figure 6). The sites at RM 4.0, 9.6, 21.3, and 26.7 were located on private land, while the remaining sites were situated on lands administered by the U.S. Forest Service. Sites at RM 4.0, 9.6, and 21.3 were sample using a tote-barge electrofishing unit. The remaining sites were sampled using a backpack electrofisher. Additionally, population estimates were made at RM 9.6 and 21.3 using a mark-recapture technique.

At RM 4.0 the trout community was made up entirely of brown trout, which had an average total length of 268 mm (Table 68, Appendix A). The catch-per-unit-effort (CPUE) on brown trout at this site was 16.8 fish per 100 m of channel length (Table 11). Other fish species that were observed at this site (but not collected) were mountain whitefish, slimy sculpin, longnose dace, and both longnose and largescale suckers. Mountain whitefish and slimy sculpin were common throughout the reach, whereas longnose dace and sucker species were not as abundant. At RM 9.6 the trout community was comprised entirely of brown trout, similar to RM 4.0 (Table 68). However, while size distribution of fish from both sections was roughly the same (Appendix A), the density of brown trout at RM 9.6 was approximately double that observed at RM 4.0 (Table 68). The mark-recapture population estimate conducted for brown trout at this site showed that there were approximately 654 (+/- 62: 95% confidence interval) brown trout

greater than 150 mm in total length per kilometer at this location. In addition to brown trout, mountain whitefish and slimy sculpin were common throughout the reach, and reidside shiners and largescale suckers were also present but not abundant. At RM 21.3 the trout community was slightly more diverse than downstream sections. While brown trout still dominated the trout population, westslope cutthroat trout and brook trout were present in limited numbers (Table 68). Brown trout density at the section was similar to that found at RM 9.6 (Table 68). The mark-recapture population estimate completed at this site showed that there were approximately 664 (+/- 72: 95% confidence interval) brown trout and 10 (+/- 10: 95% confidence interval) westslope cutthroat trout greater than 150 mm total length per kilometer. No estimate was calculated for brook trout due to inadequate numbers of fish marked. Mountain whitefish, slimy sculpin and longnose suckers were also observed at RM 21.3.

At RM 26.7, the trout community was still comprised largely of brown trout, but brook trout and westslope cutthroat trout became proportionately more abundant than at downstream reaches (Table 68). Brown trout at RM 26.7 averaged 122 mm in total length, which was markedly smaller, on average, than brown trout found at lower sites (Table 68). In addition to trout, one mountain whitefish and four longnose dace were collected within the reach, and slimy sculpin were noted as being relatively abundant as well. At RM 31.1, a notable shift in trout species composition was observed. At this site, westslope cutthroat trout became the most abundant trout species present (Table 11). These fish had an average total length of 156 mm, which was notably smaller than westslope cutthroat trout found at downstream sites (Table 68, Appendix A). Brown trout were still fairly common in the reach despite the increase in westslope cutthroat trout density, and brook trout remained relatively rare (Table 68). Additionally, five juvenile mountain whitefish were captured within the section, and slimy sculpin remained common. At RM 34.9, trout species composition and density was similar to that of RM 31.1 (Table 68). Westslope cutthroat trout were most abundant, followed by brown trout, which remained fairly common, and brook trout, which remained rare (Table 68). Also at RM 34.9, six mountain whitefish were noted, and slimy sculpin were again observed to be relatively abundant. At RM 40.1, the most upstream site sampled in the Little Blackfoot River during 2007, another shift in trout species composition was observed. While westslope cutthroat trout remained the most abundant trout species present, brook trout became almost equally plentiful, and brown trout became rare. Additionally, mountain whitefish and slimy sculpin were found to be relatively common throughout the reach. Total trout density (CPUE) at RM 40.1 was the highest of all the sites sampled in the Little Blackfoot River in 2007; however, these fish also tended to be the smallest on average (Table 68).

Table 68. Electrofishing data collected at seven sections of the Little Blackfoot River in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 4.0	LL	168	16.8	268	79-489	100
RM 9.6	LL	379	31.6	256	73-488	100
RM 21.3	WCT	7	0.07	248	122-333	2
	LL	347	34.7	225	72-510	97
	EB	2	0.02	198	132-263	1
RM 26.7	WCT	3	3.0	235	120-299	7.5
	LL	28	28.0	122	47-379	70
	EB	9	9.0	105	52-171	22.5
RM 31.1	WCT	31	31.0	156	70-260	53
	LL	24	24.0	138	55-376	41
	EB	3	3.0	129	55-185	5
RM 34.9	WCT	35	35.0	143	40-258	51
	LL	29	29.0	139	43-383	43
	EB	4	4.0	186	72-286	6
RM 40.1	WCT	46	46.0	130	38-214	51
	LL	5	5.0	70	50-132	5
	EB	40	40.0	98	48-187	44

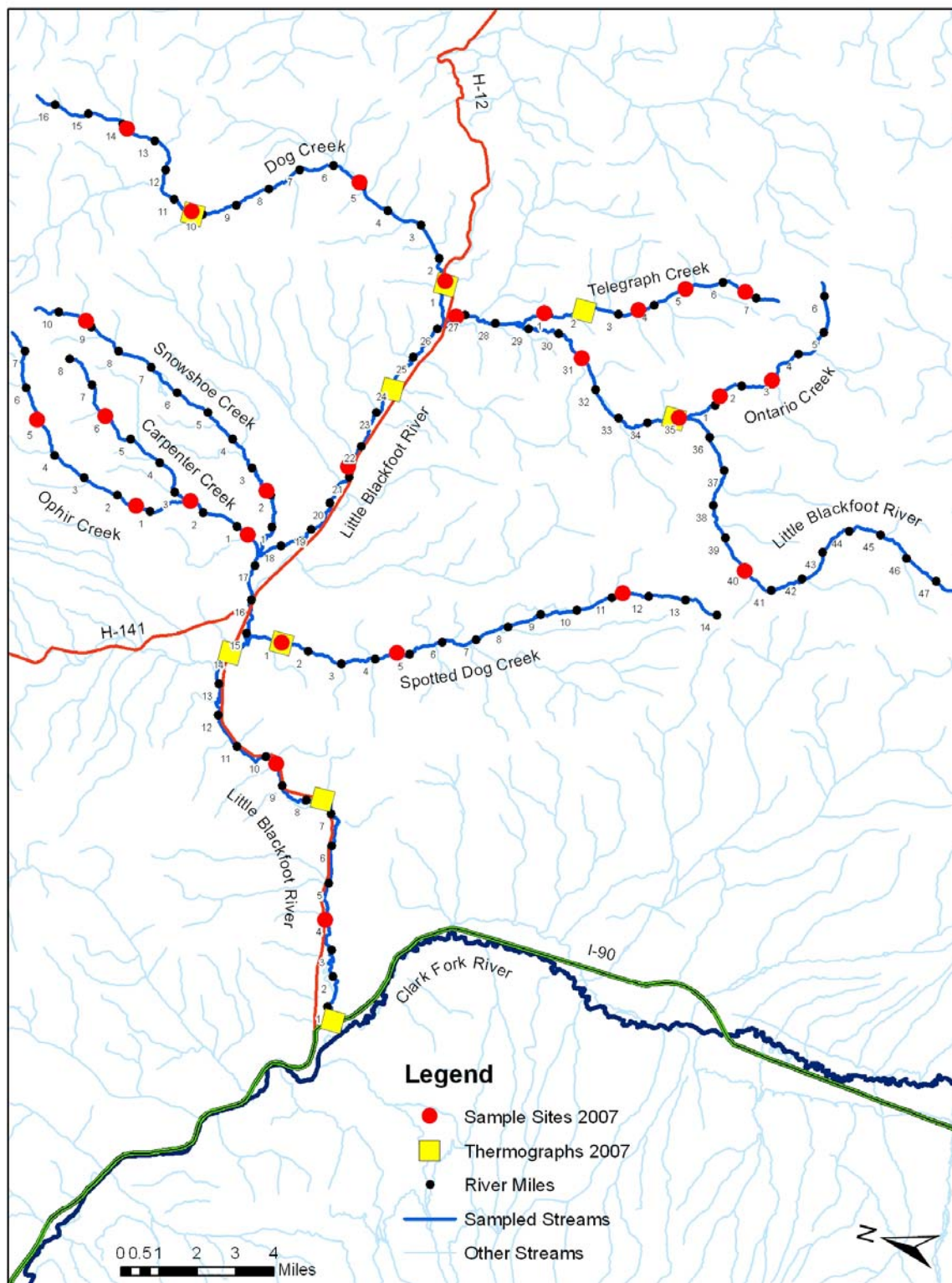


Figure 6. Map of the Little Blackfoot River drainage showing sites of fish and temperature sampling conducted in 2007.

A riparian assessment was completed at each of the seven sites electrofished on the Little Blackfoot River in 2007. At RM 4.0, the Little Blackfoot River was classified as a Rosgen C channel type. The total riparian assessment score was 49 out of a potential score of 70 (70%) (Table 69). All three habitat categories had reduced scores (Table 69). The geomorphology score was most affected by notable bank erosion evident on banks lacking vegetation with deep binding root mass. There was extensive riprap along the railroad located to the north of the channel where it came in close contact with the stream. Additionally, upstream of the survey site, significant riprap was placed on most outside meander bends, preventing the stream from migrating into an adjacent hay meadow/pasture. Riparian vegetation at RM 4.0 was dominated by a willow and cottonwood community. However, plant density was somewhat patchy and discontinuous, and much of the riparian area was interspersed with widespread disturbance induced grasses and noxious weeds. The area surrounding the survey reach is used as winter pasture, and cattle have access to the riparian area. Despite this, cattle impacts to the channel and adjacent vegetation appeared relatively light in the survey reach. Fish habitat in the Little Blackfoot River at RM 4.0 was rated as good (score: 7 points out of a possible 10; Table 69), and looked to be some of the best available habitat in the lower reaches of the stream. There were several deep meander scour pools throughout the survey reach, but habitat potential was somewhat limited by lack of large woody debris and root wads incorporated in the channel. Summer flows were noted to be very low in the sample reach and throughout the lower Little Blackfoot River. Numerous unscreened irrigation diversions were observed upstream of the survey location, and two additional diversions were noted in the lower portion of the survey reach.

At RM 9.6, the Little Blackfoot River was again classified as a Rosgen C channel type. At this location, the stream displayed greater sinuosity than reaches immediately upstream of the survey site where the channel was relatively straight and lacked a significant meander pattern for several miles. The total riparian assessment score at RM 9.6 was 59 out of a potential score of 70 (84%) (Table 69). Categories with reduced scores included geomorphology and vegetation (Table 69). The geomorphology score was primarily affected by a limited amount of observed bank erosion on several outside bends where woody vegetation was absent. Additionally, riprap and erosion was noted in several locations where the channel came in contact with Highway 12 to the south of the channel. Vegetation at this segment of the Little Blackfoot River consisted primarily of a willow and cottonwood community similar to RM 4.0, with alder, dogwood, and wild rose also fairly common throughout the reach. While denser than at RM 4.0, desirable riparian vegetation was somewhat limited by competition with disturbance-induced grasses and noxious weeds that were relatively abundant throughout the floodplain. Although fish habitat potential was to some extent limited by channel and floodplain constriction caused by Highway 12 to the south of the channel and the railroad to the north of the channel, fish habitat was largely thought to be excellent (score: 10 points out of a possible 10; Table 69) in the survey reach, and was assumed to be at its practical potential. Summer streamflows were noted to be rather low in the survey reach, although appeared better than at RM 4.0. Numerous diversions were observed both above and below the survey reach.

At RM 21.3, the Little Blackfoot River remained a Rosgen C channel type. The total riparian assessment score at the site was 49 out of a potential score of 70 (70%) (Table 69). All three categories showed some reduction in score, with vegetation being the most reduced (Table 69). The geomorphology score was primarily affected by the observation of active bank erosion on several outside bends. This was mainly limited to areas where woody, deep-rooted vegetation was lacking or absent from the banks. Additionally, riprap was noted in several areas of the reach, but was most common where the channel came in contact with the railroad grade located to the south of the channel. Past erosion was evident, and a mid-channel bar was noted in the middle portion of the reach. Desirable riparian vegetation at RM 21.3 was dominated by a willow and cottonwood community similar to downstream reaches. However, woody plant density was somewhat discontinuous along the streambanks, and cottonwood recruitment appeared limited. Disturbance induced grasses and noxious weeds were abundant throughout the riparian area. A riparian fence was noted to the north of the channel along a portion of the reach, although cattle were observed within the riparian area during the site visit in early October. Despite this, browse pressure on woody vegetation appeared only light. Fish habitat in this reach of the Little Blackfoot River was relatively good (score: 7 points out of a possible 10; Table 69), although was limited in several areas by shallow braided habitats and segments of the channel that lacked significant cover components. Several deep pools were present throughout the reach, and woody debris accumulations were also noted at several sites. One channel spanning debris jam observed in the middle portion of the reach held numerous trout. Flow was low at RM 21.3 at the time of the survey, and several irrigation diversions were noted above and below the survey reach.

Table 69. Riparian assessment results for seven sites surveyed on the Little Blackfoot River in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 4.0	23/30 (77%)	19/30 (63%)	7/10 (70%)	49/70 (70%)
RM 9.6	27/30 (90%)	22/30 (73%)	10/10 (100%)	59/70 (84%)
RM 21.3	27/30 (90%)	15/30 (50%)	7/10 (70%)	49/70 (70%)
RM 26.7	21/30 (70%)	19/29 (66%)	3/7 (43%)	43/66 (65%)
RM 31.1	23/30 (77%)	15/28 (54%)	3/7 (43%)	41/65 (63%)
RM 34.9	30/30 (100%)	22/28 (79%)	3/7 (43%)	55/65 (85%)
RM 40.1	30/30 (100%)	27/28 (96%)	10/10 (100%)	67/68 (99%)

At RM 26.7, the Little Blackfoot River still exhibited characteristics of a Rosgen C channel type. The total riparian assessment score at the site was 43 out of a potential score of 66 (65%) (Table 69). All three categories had lowered scores (Table 69). The geomorphology score was affected by significant bank erosion evident throughout the

reach, as well as a relatively high width-to-depth ratio. The channel also appeared to be slightly incised in several areas of the survey reach. Woody riparian vegetation at RM 26.7 consisted primarily of willows. However, willow density on the streambanks throughout much of the reach was limited by an abundance of noxious weeds (primarily knapweed) and disturbance-caused grasses that were prevalent throughout the survey area. Cattle were not present during the time of the survey in late August, but the area appeared to be used as winter/spring pasture. Despite this, recent browse pressure on willows appeared light. Additionally, young willow recruitment appeared to be improving in areas of the reach where the stream had access to the floodplain. Fish habitat at RM 26.7 was rated only fair (score: 3 points out of a possible 7; Table 69), and was limited by a lack of quality pools, undercut banks, rootwads, and overhead cover/shade. Much of the available habitat was shallow and lacked complexity. Flow was low at the time of the survey, and fine sediment deposition was notable in pools throughout this segment of the Little Blackfoot River. One small, unscreened diversion was observed just below the bottom of the sample section.

At RM 31.1, the Little Blackfoot River was exiting a relatively narrow canyon with limited available floodplain. The stream lacked significant sinuosity through this short segment (the constricted reach was approximately ½ mile in length), but the channel largely displayed characteristics of a Rosgen C channel type. The total riparian assessment score at RM 31.1 was 41 out of a potential score of 65 (63%) (Table 69). All three categories had reduced scores (Table 69). Erosion on several outside banks lacking deep-rooted vegetation, and a relatively high width-to-depth ratio, were the primary factors that lowered the geomorphology score. Additionally, notes taken during the survey indicated that the channel appeared slightly incised, lacking access to the floodplain in parts of the reach. Woody riparian vegetation was dominated by an overstory of Douglas fir and sparse, mature cottonwoods. Desirable understory vegetation consisted primarily of alder, dogwood, and willow. However, these species persisted at relatively low densities and were generally limited to the immediate stream banks. It is likely that relatively high banks in portions of the reach prevented channel access to the floodplain and contributed to the commonness of upland dominated species such as Douglas fir, and disturbance-induced grasses and noxious weeds. Similar to RM 26.7, fish habitat in this segment of the Little Blackfoot River was only fair (score: 3 points out of a possible 7; Table 69). Flow at RM 31.1 appeared low at the time of the survey in late August, and the reach offered little quality adult fish habitat. A lack of large woody debris, deep pools, overhanging vegetation and undercut banks all contributed to a reduced fish habitat score. Additionally, a dispersed campsite was observed near the downstream end of the reach, and recreationists had hand-constructed several rock check dams across the Little Blackfoot River creating small ponds. These structures appeared to provide a possible hindrance to fish migrating upstream.

The Little Blackfoot River at RM 34.9 was classified as a Rosgen B channel type. The stream lacked significant sinuosity, and stream gradient was higher than at downstream reaches. The total riparian assessment score at the site was 55 out of a potential score of 65 (85%) (Table 69). Categories with reduced scores included vegetation and fish habitat (Table 69). Riparian vegetation was dominated by a conifer overstory of spruce and

lodgepole pine, and an understory of alder and sparse willow. Noxious weeds were abundant throughout the area, and a few undesirable disturbance-caused plants were also present. Fish habitat at RM 34.9 was only fair (score: 3 points out a possible 7; Table 69), and consisted primarily of pocket water within a high-gradient riffle. One large pool in the middle of the survey section held a majority of the larger fish captured in the reach. Large woody debris was lacking throughout this segment of the Little Blackfoot River, although recruitment potential appeared good. Several dispersed campsites were observed in the area, and roads bounded the survey reach on each side of the stream. A large, well-traveled vehicle ford was located at RM 39.8, and this site had over-widened the channel considerably. Additionally, a rock check dam was located above the survey reach just below the confluence of Ontario Creek. This structure appeared to provide a possible hindrance to fish migrating upstream.

At RM 40.1, the Little Blackfoot River had transitioned from a Rosgen B stream type back to a meandering channel more characteristic of a Rosgen C stream type. The total riparian assessment score at RM 40.1 was 67 out of a potential score of 68 (99%) (Table 69). Woody riparian vegetation consisted primarily of a conifer overstory of lodgepole pine and spruce, and an understory of willow and alder. Sedges and grasses were also common in areas lacking dense conifer canopy cover. Wildlife (and trespass cattle from a neighboring U.S. Forest Service grazing allotment) browse pressure on area willows was notable, but only light. Fish habitat at RM 40.1 was rated as excellent (score: 10 points out a possible 10; Table 69). There were a number of quality pools created by meander scour and large woody debris, and undercut banks and rootwads were also common throughout the reach.

Water temperature was monitored at five locations along the Little Blackfoot River between July 9 and October 16, 2007 (Appendix B). The monitoring sites were located at RM 0.5, 7.5, 14.0, 23.8, and 34.8 (Figure 6). At the lowest site (RM 0.5), water temperatures were fairly high with daily maximum temperatures exceeding 15°C on 60 days, including 33 days in which the temperature exceeded 20°C. The maximum-recorded temperature at this site was 24.5°C on July 28. It should be noted that at all thermograph sites on the Little Blackfoot River lacked data from July 16 through July 24 due to equipment malfunction. Given the high temperatures surrounding these dates, it is likely that temperatures remained high during this time period, and likely exceeded 20°C in the lower portion of the river. At RM 7.5, maximum daily temperatures exceeded 15°C for 59 days including 13 days in which it exceeded 20°C. The maximum-recorded temperature was 22.4°C on both July 13 and 14. At RM 14.0, maximum daily temperatures exceeded 15°C for 48 days, and 20°C on seven of these days. Maximum-recorded temperature at this site was 20.5°C on July 28. Further upstream at RM 23.8, water temperatures were actually warmer than at RM 14.0, and were more similar to those found at RM 7.5. At this site, daily high temperatures exceeded 15°C for 50 days, and 20°C on 13 of these days. The maximum daily temperature at this site was 22.4°C recorded on July 14. At RM 34.8 temperatures were notably cooler than at downstream sites with a maximum-recorded temperature of 19.6°C on July 14, and daily highs exceeding 15°C a total of 33 times.

Spotted Dog Creek

Spotted Dog Creek is a tributary to the Little Blackfoot River that flows for approximately 14 miles before reaching its mouth at Little Blackfoot RM 14.8. The lower 10 miles of Spotted Dog Creek flows primarily through lands in private ownership. The upper four miles of stream lies within lands administered by the U.S. Forest Service. The primary land uses in the Spotted Dog Creek drainage are cattle grazing, timber harvest, and hay production (lower reaches). There is a 16-acre private reservoir located on the stream at RM 5.5. The dam and outfall limit any fish found below this point from migrating upstream.

Fish surveys were completed at three sections of Spotted Dog Creek in August of 2007. The sites were located at RM 1.2, 4.6, and 11.3 (Table 70; Figure 6). The sites at RM 1.2 and 4.6 were located below the reservoir on private land. The site at RM 11.3 was situated on U.S. Forest Service land, and was approximately 6 miles above the reservoir. We were denied access to private lands between the reservoir and the National Forest boundary. At RM 1.2 the trout community was comprised primarily of brown trout, although westslope cutthroat trout and brook trout were also present (Table 13). The average size of brown trout at this site was 223 mm (total length), with westslope cutthroat trout averaging a total length of 218 mm (Table 70, Appendix A). While brook trout were rare within the sampled section, the one individual that was captured was rather large at 301 mm in total length (Table 70). In addition to trout, slimy sculpin were common at RM 1.2, and one longnose sucker was captured within the reach as well. At RM 4.6, the trout community was comprised of roughly equal numbers of westslope cutthroat trout, brown trout, and brook trout (Table 70). Although species composition changed, total trout density within the reach was similar to that found at RM 1.2 (Table 70). However, fish at RM 4.6 tended to be smaller than fish found downstream (Table 70). Slimy sculpin remained abundant at RM 4.6, while longnose suckers remained rare with only one individual captured within the sampled reach. At RM 11.3, the trout community was comprised primarily of westslope cutthroat trout, with brook trout present, but rare (Table 70). Slimy sculpin were also observed within the reach, but no brown trout were found at the sample site. It is uncertain if brown trout occur above the reservoir.

Table 70. Electrofishing data collected at three sections of Spotted Dog Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.2	WCT	10	10.0	218	58-375	17
	LL	48	48.0	223	63-436	81
	EB	1	1.0	301	n/a	2
RM 4.6	WCT	19	19.0	190	50-272	34
	LL	17	17.0	151	66-279	30
	EB	20	20.0	153	76-254	36
RM 11.3	WCT	61	61.0	91	32-169	95
	EB	3	3.0	136	101-157	5

A riparian assessment was completed at each of the three sections electrofished on Spotted Dog Creek in 2007. At RM 1.2, the stream was classified as a Rosgen C channel type, but Rosgen E-channel tendencies were also noted. The overall riparian assessment score at this site was 49 out of a potential score of 70 (70%) (Table 71). The category with the most reduced score was vegetation (Table 71). Willows dominated the woody riparian vegetation, but consisted primarily of large, mature plants that were relatively sparse. Recruitment of young willow plants was notably absent. Hay meadows bounded the riparian area throughout this reach of Spotted Dog Creek, and disturbance-induced grasses were dense along the stream. The channel showed some evidence of historic downcutting; and current lateral cutting on outside banks was very evident throughout the surveyed reach. Fish habitat was classified as good, but would have been excellent given a greater abundance of rootwads and overhanging vegetation that would have increased cover and stream shading. The accumulation of fine sediment was notable throughout the reach, and flow appeared somewhat limited. Several unscreened irrigation diversions were present just above and below the sample section.

At RM 4.6, Spotted Dog Creek transitioned to a channel more characteristic of a Rosgen B stream type. The stream was confined within a fairly narrow canyon at this site, and riparian vegetation consisted primarily of grasses, sparse alder, and a conifer overstory dominated by Douglas fir and lodgepole pine. Cattle were observed throughout the reach and a recent timber harvest was also noted off the left bank of the stream. The overall riparian assessment score at RM 4.6 was 56 out of a potential score of 61 (92%) (Table 71). The category with the most reduced score was fish habitat (Table 71). Shallow pocket water dominated the available habitat, and large woody debris and overhead cover was largely absent from the reach. Because of this, fish habitat in this segment of Spotted Dog Creek was rated only fair (score: 3 points out of a possible 7; Table 71).

At RM 11.3, Spotted Dog Creek was classified as a Rosgen B channel type, and the overall riparian assessment score at this site was 68 out of a potential score of 68 (100%) (Table 71). The riparian area appeared in good health despite evidence of cattle presence

within the surveyed reach. Alder and a conifer overstory of spruce and lodgepole pine dominated riparian vegetation. Fish habitat was rated as excellent as large woody debris, pool habitat, and overhanging vegetation was abundant in this segment of the stream. Flow throughout this reach of Spotted Dog Creek appeared naturally low, and deposition of fine sediment was noteworthy. Downstream of the sample section located at RM 11.3, a large, unscreened diversion was noted on private land at RM 10.3. The diversion was unable to divert a significant amount of water at the time of the survey in mid-August.

Table 71. Riparian assessment results for three sites surveyed on Spotted Dog Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.2	25/30 (83%)	17/30 (57%)	7/10 (70%)	49/70 (70%)
RM 4.6	30/30 (100%)	23/24 (96%)	3/7 (43%)	56/61 (92%)
RM 11.3	30/30 (100%)	28/28 (100%)	10/10 (100%)	68/68 (100%)

Water temperature was monitored at one site in Spotted Dog Creek from July 16 to October 16, 2007 (Appendix B). The thermograph was located at RM 1.2 (Figure 2). Maximum daily temperatures at this site exceeded 15°C for 60 days including 13 days in which they exceeded 20°C. The maximum-recorded temperature was 21.9°C on July 18.

Carpenter Creek

Carpenter creek is a small tributary to the Little Blackfoot River that drains for approximately eight miles before entering the Little Blackfoot River at RM 17.3. The lower 5.5 miles of stream flows almost exclusively through private land, while the upper 2.5 miles are found mostly on lands administered by the Bureau of Land Management and the U.S. Forest Service. There are at least two privately owned mining claims in the upper reaches of Carpenter Creek that are surrounded by public ownership. The primary land uses in the drainage are cattle grazing and historic placer mining. Recreational residences associated with private mining claims in the upper reaches of the stream are also present.

Fish surveys were completed at three sections of Carpenter Creek in August of 2007. The sites were located at RM 0.6, 2.5, and 6.0 (Table 72; Figure 7). The sites at RM 0.6 and 2.5 were located on private land, while the site at RM 6.0 was situated on land managed by the Bureau of Land Management. The fish community of Carpenter Creek at RM 0.6 was comprised entirely of brown trout, which had an average total length of 100 mm (Table 72, Appendix A). While several adult fish were present within the reach, the vast majority of individuals present were young-of-the-year that were less than 90 mm in total length (Appendix A). At RM 2.5, brown trout were again the only species present in Carpenter Creek (Table 72). The density of fish at this site was relatively high with 151 individuals captured in 100 m of electrofishing (Table 72). In general, brown trout at RM

2.5 tended to be larger than those found at RM 0.6 (Table 72, Appendix A). At RM 6.0, a notable shift in the fish community was observed. At this site, westslope cutthroat trout was the only species present in Carpenter Creek. Notes taken during sampling indicated that approximately 20-30 young-of-the-year (approximately 30 mm in length) westslope cutthroat trout were observed within the reach. However, these fish were not captured due to fear of high mortality. Larger fish were relatively uncommon at RM 6.0, and those present were still relatively small averaging just over 100 mm in total length (Table 72). A probable fish barrier (a steep cascade) was observed on a private mining claim approximately 0.4 miles downstream of the sample section. Fish composition in Carpenter Creek below this site was not determined.

Table 72. Electrofishing data collected at three sections of Carpenter Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.6	LL	96	96.0	100	57-327	100
RM 2.5	LL	151	151.0	166	68-299	100
RM 6.0	WCT	10	10.0	110	29-175	100

A riparian assessment was completed at each of the three sections electrofished on Carpenter Creek in 2007. At RM 0.6 it was difficult to determine a channel type for Carpenter Creek because of low flow, and extensive historic placer mining activity that likely modified natural channel form. Large piles of placer tailings along the channel generally narrowed the historic floodplain throughout the surveyed reach, as well as for an additional mile upstream. Recognizing these factors, the reach was classified as a Rosgen C channel type with some uncertainty. The overall assessment score at RM 0.6 was 55 out of a potential score of 70 (79%) (Table 73). The primary category with a reduced score was fish habitat (Table 73). A lack of water in the channel was the main factor limiting fish habitat in this segment of stream. A diversion that diverted most of the flow from Carpenter Creek was later observed at RM 0.8, just upstream of the sample section. This diversion appeared to present at least a seasonal migration barrier for fish, and the ditch was likely entraining fish moving down Carpenter Creek. Vegetation at RM 0.6 was generally healthy and was comprised largely of diverse age classes of alder, willow and cottonwood. However, disturbance-caused undesirable upland grasses and weeds were also present throughout the riparian area. While cattle had access to the site, only minimal evidence of use was evident at the time of the survey in late August.

At RM 2.5, Carpenter Creek exhibited characteristics of a Rosgen C channel type. However, upstream and downstream of the survey reach, it was noted that the channel was more consistent with a Rosgen B stream type. The total riparian assessment score for the surveyed segment at RM 2.5 was 51 out of a potential score of 68 (75%) (Table 73). The primary category that had a reduced score was vegetation (Table 73). The riparian area within the sampled reach was rather simple and was dominated by disturbance-caused, undesirable grasses that showed relatively high grazing pressure from cattle.

Noxious weeds were also quite abundant throughout the riparian area, while woody species, including alder and willow, were rather sparse along much of the reach. Although cattle use was heavy in the riparian area at RM 2.5, the channel appeared relatively stable, and little recent bank erosion or trampling was evident. Additionally, the site appeared to support a fairly significant brown trout fishery, and fish habitat was rated at good, despite a lack of woody riparian vegetation providing shade and cover in the electrofishing section. The mouth of Ophir Creek was located just upstream of the sample section (RM 2.6), and an examination of this location showed that Ophir Creek was contributing approximately 90% of the flow to Carpenter Creek. Flow in Carpenter Creek above the Ophir Creek confluence was extremely low, but the cause for this was not determined.

At RM 6.0, Carpenter Creek was considerably smaller than at RM 2.5. The channel was characteristic of a Rosgen B stream type, although the stream was very shallow and appeared to be possibly aggrading. The total riparian assessment score at RM 6.0 was 51 out of a potential score of 65 (78%) (Table 73). The category with the most reduced score was fish habitat, which scored 0 points out of a potential 7 (Table 73). Flow was very low in this segment of Carpenter Creek, and the sparse pools present in the reach were mostly filled with sediment providing little in the way of adult fish habitat. Cattle had access to the stream at RM 6.0, and there was evidence of hoofshear and grazing pressure (primarily on grasses) throughout the riparian area. Woody vegetation along Carpenter Creek at this location was generally in good condition, and was comprised mainly of multiple age classes of alder, willow, and cottonwood. Conifers, including Douglas fir and spruce, were also present throughout the reach, and were the dominant overstory vegetation outside the riparian area. A probable fish barrier (a steep cascade) was observed at RM 5.6, and was possibly associated with historic mining activity that was very evident throughout the upper portion of the watershed. Additional notes provided during the survey indicated that the main access road along upper Carpenter Creek encroached on the channel in several locations.

Table 73. Riparian assessment results for three sites surveyed on Carpenter Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.6	28/30 (93%)	24/30 (80%)	3/10 (30%)	55/70 (79%)
RM 2.5	28/30 (93%)	16/28 (57%)	7/10 (70%)	51/68 (75%)
RM 6.0	28/30 (93%)	23/28 (82%)	0/7 (0%)	51/65 (78%)

Water temperature was not monitored in Carpenter Creek in 2007.

Ophir Creek

Ophir Creek is a tributary to Carpenter Creek that flows for approximately seven miles before entering Carpenter Creek at RM 2.6. Ophir Creek appears to provide a majority of the flow to lower Carpenter Creek despite that it is considered a tributary on all available maps. Land ownership along Ophir Creek consists mainly of privately owned lands, with public lands managed by the Bureau of Land Management and the U.S. Forest Service limited to the upper portion of the watershed. However, within the general area of public ownership, a number of privately owned mining claims exist. The primary land uses in the Ophir Creek drainage are cattle grazing, historic and current placer mining, timber harvest, and recreation.

Fish surveys were completed at two sections of Ophir Creek in August of 2007. The sites were located at RM 1.4 and 5.1 (Table 74; Figure 6). The site at RM 1.4 was located on private land, whereas the site at RM 5.1 was situated on lands managed by the U.S. Forest Service. The fish community at RM 1.4 was composed primarily of brown trout, with brook trout occurring only rarely (Table 74). While multiple year classes of brown trout were observed in the reach, the only two brook trout that were captured at RM 1.4 were adults of similar size (Table 74, Appendix A). Upstream of RM 1.4 at RM 5.1, the fish community was markedly different. At this site, brook trout and westslope cutthroat trout were the only species present. While brook trout tended to be more common making up 64% of the species composition, westslope cutthroat tended to be larger averaging 113 mm in total length (Table 74).

Table 74. Electrofishing data collected at two sections of Ophir Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.4	LL	81	81.0	149	54-302	98
	EB	2	2.0	208	200-215	2
RM 5.1	WCT	40	40.0	113	72-211	36
	EB	70	70.0	86	57-180	64

A riparian assessment was completed at each of the two sections electrofished on Ophir Creek in 2007. At RM 1.4, extensive historic placer mining activity was evident, which appeared to have modified and likely moved the natural channel. Numerous vegetated tailings piles were present throughout the floodplain, and it was difficult to classify the stream type as it had characteristics of both a Rosgen C and B channel type. The overall assessment score at RM 1.4 was 51 out of a potential score of 68 (75%) (Table 75). The vegetation and fish habitat categories showed the most notable reduction in scores (Table 75). Woody vegetation, comprised mostly of alder, willow, and wild rose, was patchy and site specific, and the numerous openings in the riparian vegetative cover were mostly dominated by grasses and disturbance induced plants. Cottonwoods were present in this area of Ophir Creek, but were relatively uncommon, and consisted of mostly mature

individuals. Cattle use in the riparian area was evident with notable grazing pressure on grasses and sedges, and moderate browse pressure on woody species. Fish habitat was rather limited at RM 1.4, scoring just 3 points out of a potential of 10 (Table 75). Field notes indicated that a reduced number of pools, patchy riparian vegetation, and notable fine sediment accumulation were all factors that led to the lower score.

At RM 5.1, Ophir Creek flowed through a deep and narrow valley. Extensive historic placer mining activity was widespread and very noticeable throughout the upper portion of the watershed. While the stream was classified as a stable Rosgen B channel type, extensive alteration of the natural channel was apparent. Large, unvegetated placer piles (consisting of large cobbles and boulders) were present throughout the narrow floodplain, and split Ophir Creek into two distinct channels at the sample site. The right bank channel carried the majority of the flow. The total riparian assessment score at RM 5.1 was 54 out of a potential score of 68 (79%). The categories that showed the most notable reduction in scores were vegetation and fish habitat (Table 75). Where placer piles did not preclude growth, willow, alder, and Douglas fir provided woody riparian vegetation. Cottonwoods were also present in this area of Ophir Creek, but were relatively uncommon, and consisted of mostly mature individuals. The sample site was located within a U.S. Forest Service grazing allotment, and cattle utilization of vegetation in and around the riparian area was apparent. Fish habitat in this reach of Ophir Creek was rather limited and scored only 3 points out of a potential of 10 (Table 75). Sparse pools, high gradient, and a general lack of large woody debris in the channel were all factors that led to the reduced score. Flow appeared adequate in Ophir Creek at RM 5.1, but surface water disappeared near RM 5.6. At RM 5.6 a recreational residence was being constructed along the stream channel, and relatively recent mining activity was noted just upstream of this site. A relatively large, unscreened irrigation diversion was also noted at RM 3.8.

Table 75. Riparian assessment results for two sites surveyed on Ophir Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.4	28/30 (93%)	20/28 (71%)	3/10 (30%)	51/68 (75%)
RM 5.1	30/30 (100%)	21/28 (75%)	3/10 (30%)	54/68 (79%)

Water temperature was not monitored in Ophir Creek in 2007.

Snowshoe Creek

Snowshoe Creek is a tributary to the Little Blackfoot River that flows for approximately 10 miles before entering the Little Blackfoot River at RM 17.4. A majority of the lands along Snowshoe Creek are in private ownership. Publicly owned lands administered by the U.S. Forest Service are limited to the headwaters portion of the watershed. However, within this area there are several privately owned mining claims along the stream that further limit the amount of perennial channel (~1.5 miles) on public land. Lois Lake, a

25-acre private reservoir, is located on Snowshoe Creek at RM 6.3. The reservoir provides irrigation storage and appears to support a trout fishery likely dominated by brown trout and westslope cutthroat trout. The dam and outlet appear to be an upstream fish migration barrier. The primary land uses in the Snowshoe Creek drainage are hay production, cattle grazing/pasturing, timber harvest, and historic mining.

Fish surveys were completed at two sections of Snowshoe Creek in August of 2007. The sites were located at RM 2.1 and 9.2 (Table 76; Figure 6). The site at RM 2.1 was located on private land, and was located below Lois Lake. The site at RM 9.2 was situated on lands managed by the U.S. Forest Service, and was upstream of Lois Lake. At RM 2.1, the trout community was made up entirely of brown trout. These fish had an average total length of 200 mm, with several fish over 300 mm (total length) present (Table 76, Appendix A). Longnose sucker also occurred at RM 2.1, but were relatively uncommon with only 9 individuals captured. At RM 9.2, both westslope cutthroat trout and brown trout were present in Snowshoe Creek. While westslope cutthroat trout comprised over half of the fish observed within the site, brown trout were almost equally common, and were slightly larger than westslope cutthroat trout on average (Table 19).

Table 76. Electrofishing data collected at two sections of Snowshoe Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 2.1	LL	54	54.0	200	75-370	100
RM 9.2	WCT	18	18.0	132	66-206	53
	LL	16	16.0	144	70-204	47

A riparian assessment was completed at each of the two sections electrofished on Snowshoe Creek in 2007. At RM 2.1, the total riparian assessment score was 53 out of a potential score of 68 (78%) (Table 77). All three assessment categories had reduced scores (Table 77). Snowshoe Creek was classified as a Rosgen G channel type at RM 2.1, and throughout its visible length the channel was incised and appeared to lack connection to the broader floodplain in many areas. While stream incisement appeared to have occurred sometime in the past (a new lower elevation floodplain and established vegetation was evident), recent lateral erosion was readily apparent on the outside bend of most meanders lacking woody vegetation. Willows dominated the woody riparian vegetation at RM 2.1, but were limited to the immediate banks of the stream and were not continuous along the channel. Hay meadows bounded the riparian area throughout this reach of Snowshoe Creek, and disturbance induced grasses were commonly distributed along the stream. Fish habitat was classified as good, but would have been excellent given a greater density of willows along the channel providing overhead cover and shade. The accumulation of fine sediment was also notable throughout the reach, and flow appeared somewhat reduced. Several unscreened irrigation diversions were noted above and below the sample section. Limited beaver activity was also present in this area of Snowshoe Creek.

Upstream of Lois Lake (RM 6.3), Snowshoe Creek flowed through a narrow canyon with notable historic mining activity. This historic effort affected channel morphology in many areas of the stream, and channel gradient was highly variable (low to high). At RM 9.2, Snowshoe Creek was classified as a relatively low gradient Rosgen E channel type. The total riparian assessment score at this site was 63 out of a potential score of 70 (Table 77). Overall, the reach appeared fairly healthy given the past mining disturbances that were evident throughout the riparian area. Vegetation on the immediate stream banks consisted primarily of a dense sedge community and a scattering of willows. Additionally, spruce and lodgepole pine were also interspersed throughout the stream bottom. The U.S. Forest Service had constructed two riparian exclosures along much of Snowshoe Creek in the vicinity of RM 9.2 to exclude cattle from the riparian area. However, these exclosures did not appear to have been maintained, and cattle were present inside both at the time of the survey in mid August. Additionally, a water gap between the two exclosures situated on a steep bank had created a significant sediment source to the stream. Fish habitat in Snowshoe Creek at RM 9.2 scored 7 points out of a potential of 10 (Table 77). Overall, the channel was fairly deep and narrow, and several quality pools were also present. However, large woody debris was somewhat lacking throughout the reach, although future recruitment potential appeared good given the number of dead trees in the area. Flow in upper Snowshoe Creek was good and appeared spring fed.

Table 77. Riparian assessment results for two sites surveyed on Snowshoe Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 2.1	23/28 (82%)	23/30 (77%)	7/10 (70%)	53/68 (78%)
RM 9.2	30/30 (100%)	26/30 (87%)	7/10 (70%)	63/70 (90%)

Water temperature was not monitored in Snowshoe Creek in 2007.

Dog Creek

Dog Creek is a tributary to the Little Blackfoot River that flows for approximately 16 miles before entering the Little Blackfoot River near the town of Elliston at RM 26.1. Lands along Dog Creek are primarily in private ownership. While there are publicly owned lands in the upper portion of the watershed that are administered by the Bureau of Land Management and the U.S. Forest Service, numerous privately owned mining claims encompass the majority of upper Dog Creek. The primary land uses in the Dog Creek drainage include cattle grazing, timber harvest, recreation, and historic mining.

Fish surveys were completed at four sections of Dog Creek in August of 2007. The sites were located at RM 1.3, 5.1, 10.4, and 13.8 (Table 78; Figure 6). The sites at RM 5.1, and 13.8 were located on private land, whereas the sites at RM 1.3 and 10.1 were respectively situated within public right-of-way and on land managed by the U.S. Forest Service. At RM 1.3, trout composition was made up of both westslope cutthroat trout and brown trout, with brown trout being most common (Table 78). Westslope cutthroat trout averaged 179 mm in total length, and brown trout had an average total length of 145

mm (Table 78). While brown trout appeared to be smaller than westslope cutthroat trout on average, this was primarily a result of an abundance of juvenile brown trout present at RM 1.3 that served to lower the overall average length of the species (Table 78, Appendix A). There were in fact several brown trout in excess of 350 mm present at RM 1.3, whereas the largest westslope cutthroat trout measured in the reach was just 277 mm in total length (Table 78, Appendix A). In addition to trout, 25 longnose dace, 19 mountain whitefish, 10 longnose sucker, and two slimy sculpin were also documented in Dog Creek at RM 1.3. At RM 5.1, the trout community was again comprised largely of brown trout, with westslope cutthroat trout also present, but relatively uncommon (Table 78). Trout density appeared rather low in this reach, but this may have been an artifact of poor electrofishing efficiency resulting from extensive deep-water habitat present throughout the reach. It was difficult to find a segment of channel in the vicinity of RM 5.1 that could be effectively sampled due to extensive beaver ponds throughout the area. In addition to trout, 31 long nose sucker, two mountain whitefish, and one slimy sculpin were also captured in the reach at RM 5.1.

At RM 10.4, brown trout again dominated the trout community in Dog Creek (Table 78). Westslope cutthroat trout were also present, but only represented approximately 30% of the trout present in the reach (Table 78). Fish of both species generally averaged less than 150 mm in total length with the largest brown trout and westslope cutthroat trout in the reach measuring 273 mm and 208 mm (total length), respectively. Eight mountain whitefish, six slimy sculpin, and four longnose suckers were also captured in the reach at RM 10.4. At RM 13.8, the fish community in Dog Creek showed a notable shift in species composition over downstream reaches (Table 78). Westslope cutthroat trout became the primary species found in the stream, with brown trout present, but relatively uncommon (Table 78). A unique finding in the reach was the presence of a very large brown trout measuring 403 mm in total length. This fish was considerably larger than all other fish sampled in the reach (Table 78, Appendix A). In addition to trout, 28 longnose suckers were also collected in Dog Creek at RM 13.8.

Table 78. Electrofishing data collected at four sections of Dog Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.3	WCT	18	18.0	179	55-277	22
	LL	63	63.0	145	68-423	78
RM 5.1	WCT	2	2.0	165	137-192	9
	LL	22	22.0	161	56-324	91
RM 10.4	WCT	17	17.0	144	45-208	29
	LL	42	42.0	132	62-273	71
RM 13.8	WCT	30	30.0	120	64-196	94
	LL	2	2.0	268	133-403	6

A riparian assessment was completed at each of the four sections electrofished on Dog Creek in 2007. At RM 1.3, Dog Creek was classified as a Rosgen C channel type. However, the floodplain at this site was restricted by an active railroad bed to the north of the channel, and a residential access road to the south. The overall assessment score at RM 1.3 was 49 out of a potential score of 70 (70%) (Table 79). The categories with reduced scores included vegetation and fish habitat (Table 79). The vegetation score was heavily influenced by the extensive distribution of disturbance-caused undesirable plants (primarily grasses) and noxious weeds throughout the riparian area. Woody vegetation in the survey reach was dominated by mature cottonwood trees in the overstory, and red-osier dogwood and willow in the understory. While there were multiple age classes of willow and dogwood at the site, young cottonwood recruits were largely absent. Fish habitat in Dog Creek at RM 1.3 was rated only fair (score: 3 out of a possible 10; Table 79). This was primarily because most pools within the reach tended to be rather shallow, and there was little large woody debris incorporated in the channel. In addition, fine sediment accumulation was notable throughout the reach.

At RM 5.1, Dog Creek was situated in a relatively wide valley bottom, and was classified as a Rosgen C channel type. However, this was somewhat difficult to determine with certainty as there was extensive beaver activity throughout a wide area, and numerous beaver dams impounded much of the active channel. The total riparian assessment score at RM 5.1 was 67 out of potential score of 70 (96%) (Table 79). Riparian vegetation consisted primarily of an extensive willow and sedge community, with only modest amounts of disturbance-caused plants and noxious weeds present. Cattle had access to the riparian area, but were highly managed and thus browse pressure appeared relatively light. Fish habitat within this segment of Dog Creek scored a 10 out of possible 10 (Table 79). Deep pools, and beaver ponds were the dominant habitat type, and overhanging vegetation and undercut banks were also abundant. Additionally, the reach had good shading and fairly abundant flow. As at RM 1.3, the railroad footprint continued to encroach on the floodplain (the railroad paralleled the stream from approximately RM 1.3 to RM 6.0).

At RM 10.4, Dog Creek was in a transitional zone as the stream moved from a riparian corridor with abundant willows and beaver activity (similar to that described at RM 5.1), to an area where woody vegetation and beaver ponds were rare or absent. The stream remained in a relatively wide valley and displayed relatively odd characteristics of a both a Rosgen E and Bc channel type in the survey reach. The total riparian assessment score at RM 10.4 was 54 out of a potential score of 70 (77%) (Table 79). All three categories had a reduced score. The geomorphology score, which was 25 out of a potential score of 30 (83%) (Table 79), was most effected by several small eroding banks on outside bends. Generally this erosion was isolated to banks that lacked deep-rooted, woody vegetation. An examination of Dog Creek upstream of the survey reach showed considerably more lateral and vertical erosion. This area was most notable between RM 11.0 and the confluence of Hope Creek (RM 11.5). Woody riparian vegetation at RM 10.4 consisted primarily of diverse age classes of willows. However, willows were relatively sparse within the survey reach, and were rare or absent farther upstream. This condition persisted from approximately RM 10.3 to approximately RM 11.9. Disturbance induced

grasses were common throughout the survey reach as well as upstream of the section. Cattle presence along Dog Creek was evident throughout the area. During the time of the survey in mid August, riparian vegetation at RM 10.4 showed relatively light grazing pressure. However, on a return visit in October, the effects of grazing on vegetation along the stream were much more notable. A small riparian exclosure (electric fence) was noted just upstream of the survey reach on private land. This exclosure was in place due to a grazing allotment agreement between the U.S. Forest Service and the landowner. Fish habitat in Dog Creek at RM 10.4 was rated as good (score: 7 points out a potential 10), but a general lack of woody vegetation in the reach contributed to a reduced score. Fish habitat for several miles upstream of the sample reach looked to be only marginal.

At RM 13.8, Dog Creek was situated in a relatively narrow, low-gradient valley. The stream was classified at a Rosgen B channel type largely because of relatively low sinuosity. However, extensive beaver activity throughout most of the observable area within the vicinity of the electrofishing section made it difficult to determine a channel type. The total riparian assessment score at RM 13.8 was 56 out of a potential score of 70 (80%) (Table 79). The sample section was selected primarily on presumed land landownership and accessibility, and was not necessarily the most representative site. The categories with reduced scores included fish habitat and vegetation (Table 79). Fish habitat within the electrofishing reach at RM 13.8 was rated only fair (score: 3 points out of a potential 10). A lack of quality pools, overhead cover, and available spawning habitat all led to a reduced score. Notes taken during the survey however, indicated that fish habitat appeared better just above and below the electrofishing reach. In these areas, woody riparian vegetation and beaver activity was more abundant. Riparian vegetation at RM 13.8 was comprised primarily of a willow and sedge community. However, bog alder and lodgepole pine were also present throughout the area. Cattle use in the riparian area was evident in this segment of Dog Creek, as hoofshear on streambanks and grazing pressure on sedges and grasses was observed. Additionally, historic logging activity in and near the riparian area was also obvious. There was a primitive bridge crossing within the sample reach that had mostly collapsed into the channel, and evidence of past placer mining activity was also present. Upstream of the sample reach between approximately RM 15.0 and RM 16.0, mining and recreational activity was common throughout the riparian area, and several recreational residences were also observed.

Table 79. Riparian assessment results for four sites surveyed on Dog Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.3	30/30 (100%)	16/30 (53%)	3/10 (30%)	49/70 (70%)
RM 5.1	30/30 (100%)	27/30 (90%)	10/10 (70%)	67/70 (96%)
RM 10.4	25/30 (83%)	22/30 (73%)	7/10 (70%)	54/70 (77%)
RM 13.8	30/30 (100%)	23/30 (77%)	3/10 (30%)	56/70 (80%)

Water temperature was monitored at two sites on Dog Creek during 2007 (Figure 6; Appendix B). At RM 1.2, temperature was monitored from July 9 through October 16,

and at RM 10.3, it was measured from July 17 through October 16. At RM 1.2, maximum daily temperatures exceeded 15°C on 58 days, and 20°C on 25 of these days. The maximum-recorded temperature was 25.0°C on July 19. At RM 10.3, maximum daily temperatures exceeded 15°C on 48 days, and 20°C on 11 of these days. The maximum-recorded temperature at this site occurred on July 19 and was 23.1°C.

Telegraph Creek

Telegraph Creek is a tributary to the Little Blackfoot River that drains for approximately seven miles before reaching the Little Blackfoot River at RM 28.6. Land ownership along Telegraph Creek is a fairly even combination of privately owned lands and lands administered by the U.S. Forest Service. The lower three miles of stream flows exclusively through private lands, while the remaining upper portion of the watershed is primarily in public ownership. However, there are a number of privately owned mining claims near the headwaters that do limit public ownership to some extent. The primary land uses in the lower portion of the Telegraph Creek drainage are cattle grazing, hay production, and rural homesites. Major land uses in the upper portion of the watershed include timber harvest and historic and current mining.

Fish surveys were completed at four sections of Telegraph Creek in July of 2007. The sites were located at RM 0.9, 3.6, 4.9, and 6.7 (Table 80; Figure 6). The site at RM 0.9 was located on private land, with the remaining sites situated on land managed by the U.S. Forest Service. The trout community in Telegraph Creek at RM 0.9 was comprised primarily of brook trout, with brown trout and westslope cutthroat trout present, but noticeably less abundant (Table 80). Overall, fish tended to be fairly small with most averaging less than 200 mm in total length (Table 80, Appendix A). In addition to trout, 40 longnose suckers and six slimy sculpin were also captured in the reach. At RM 3.6, there was a notable compositional shift in species present at the site. While brook trout were still common, westslope cutthroat trout were almost equally common, representing 47% of the trout present in the reach (Table 80). Additionally, slimy sculpin were noted as being fairly abundant throughout the sample site. Brown trout were absent from the Telegraph Creek at RM 3.6. At RM 4.9, brook trout and westslope cutthroat trout were again present, but brook trout were more common representing 74% of the trout collected in the reach. Fish of both species tended to be rather small, with each species averaging just 115 mm in total length (Table 80, Appendix A). At RM 6.7, no fish were captured or observed in Telegraph Creek. However, fish were visually observed at RM 5.9. A steep cascade observed between RM 5.9 and RM 6.7 likely is functioning as a natural fish barrier.

Table 80. Electrofishing data collected at four sections of Telegraph Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.9	WCT	3	3.0	195	167-220	3
	LL	6	6.0	112	62-130	6
	EB	97	97.0	111	55-238	91
RM 3.6	WCT	27	27.0	127	64-229	47
	EB	30	30.0	114	60-176	53
RM 4.9	WCT	18	18.0	115	62-169	26
	EB	50	50.0	115	37-195	74
RM 6.7	NO FISH	-	-	-	-	-

A riparian assessment was completed at each of the four sections electrofished on Telegraph Creek in 2007. At RM 0.9, Telegraph Creek flowed along a large hay meadow situated directly east of the stream. Along the hay meadow, the stream was isolated to a single channel thread. However, above and below the sample reach, the stream flowed through a dense, willow/alder-dominated riparian area where multiple channels existed, or no defined channel was apparent (i.e. wetland areas). The location of the electrofishing section was selected largely by accessibility and the ability to effectively electrofish the channel, and not necessarily because it was representative. While Telegraph Creek was classified as a Rosgen B channel type at RM 0.9, historic disturbance, lack of water in the stream, and abundant beaver activity made channel classification very difficult. The overall riparian assessment score at RM 0.9 was 50 out of a potential score of 69 (72%) (Table 81). All categories had reduced scores (Table 81). The geomorphology score was affected by multiple factors. Along the hay meadow, Telegraph Creek showed evidence of historic instability and appeared relatively incised, and overly wide. Additionally, several areas of past bank erosion and sloughing were also noted. Observations of relative instability were confined to approximately 0.25 miles of channel directly adjacent to the right-bank hay meadow. It is likely that this segment of channel was manipulated in the past to provide land for the hay field. Above and below this segment of channel, the stream appeared relatively undisturbed and stable. Diverse age-classes of willow and alder dominated the riparian vegetative community at RM 0.9. However, woody species were largely absent from the right bank (hay meadow) of the channel through the electrofishing reach. Additionally, the presence of disturbance-caused plants and noxious weeds was primarily associated with the adjacent hay field. Fish habitat within the electrofishing section was marginal and was rated only fair (score: 3 out a possible 10; Table 81). Flow was very low in this reach of Telegraph Creek, and the accumulation of algae and fine sediment was notable. Two irrigation diversions were noted upstream of the electrofishing section, although neither were conveying water at the time of the survey in late July.

At RM 3.6, Telegraph Creek flowed through a relatively narrow, timbered canyon and was classified as a stable Rosgen B channel type. However, the stream showed slight incisement, and substrate throughout the surveyed reach was large, consisting primarily of boulders and cobbles. All of this was evidence of historic placer mining activity. The overall riparian assessment score at RM 3.6 was 63 out of a potential score of 70 (90%) (Table 81). Riparian vegetation consisted primarily of a spruce and lodgepole pine overstory, and an alder and willow understory. Woody vegetation was somewhat sparse adjacent to an old cabin site present within the reach, as well as in areas where rocky placer piles precluded significant plant growth. While not critical for channel stability at this segment of Telegraph Creek, woody vegetation did provide important shade and overhead cover for fish. Fish habitat at RM 3.6 was rated as good (score; 7 points out of a possible 10), but was generally lacking large deep pools and woody debris in the channel. Spawning habitat was also rather limited and site specific.

At RM 4.9, Telegraph Creek remained in a narrow, timbered canyon and was again classified as a stable Rosgen B channel type. As at RM 3.6, the stream showed slight incisement, and the presence of very large substrate was evidence of historic placer mining activity. The overall riparian assessment score at RM 4.9 was 64 out of a potential score of 70 (91%) (Table 81). Woody riparian vegetation consisted primarily of a spruce and lodgepole pine overstory, and an alder understory. The canopy offered by this vegetative community provided important shade and overhead cover for fish. Fish habitat at RM 4.9 was rated as good (score; 7 points out of a possible 10), but like RM 3.6, was generally lacking large woody debris in the channel, and spawning habitat remained limited.

At RM 6.7, where no fish were observed, Telegraph Creek was again classified as a stable Rosgen B channel type. However, downstream of the sample section the channel transitioned to a high gradient Rosgen A channel for a short segment. Cascades and drops were evident, and this area likely was the location of a natural upstream fish barrier. At RM 6.7, Telegraph Creek again showed evidence of historic placer mining activity as the stream was slightly incised, and the substrate was notably large. The overall riparian assessment score at the site was 67 out of a potential score of 70 (96%) (Table 81). Riparian vegetation was dominated by a spruce and lodgepole pine overstory, and an understory of alder and young spruce. The canopy cover provided excellent shade to the channel. Fish habitat at RM 6.7 was rated as good (score; 7 points out of a possible 10) despite that fish were not present. Fish habitat limitations were similar to sites at RM 3.6 and 4.9.

Table 81. Riparian assessment results for four sites surveyed on Telegraph Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.9	23/30 (77%)	24/29 (83%)	3/10 (30%)	50/69 (72%)
RM 3.6	30/30 (100%)	26/30 (87%)	7/10 (70%)	63/70 (90%)
RM 4.9	30/30 (100%)	27/30 (90%)	7/10 (70%)	64/70 (91%)
RM 6.7	30/30 (100%)	30/30 (100%)	7/10 (70%)	67/70 (96%)

Water temperature was measured at one site on Telegraph Creek from July 9 through October 16, 2007 (Appendix B). The site was located at RM 2.0 (Figure 6). At this location, maximum daily temperatures exceeded 15°C on 44 days including 17 days in which they exceeded 20°C. The maximum-recorded temperature in Telegraph Creek occurred on July 19, and was 23.1°C.

Ontario Creek

Ontario Creek is a tributary to the Little Blackfoot River that flows for approximately six miles before reaching the Little Blackfoot River at RM 35.0. Land ownership in the Ontario Creek drainage is dominated by publicly owned lands administered by the U.S. Forest Service. However, there are several small privately owned mining claims near the mouth of the stream that support recreational residences. The primary land uses in the Ontario Creek drainage are timber harvest, recreation, and historic mining.

Fish surveys were completed at two sections of Ontario Creek in August of 2007. The sites were located on U.S. Forest Service land at RM 1.3 and 2.9 (Table 82; Figure 6). At RM 1.3, the fish community in Ontario Creek was comprised mostly of westslope cutthroat trout, with brook trout present, but only contributing to 17% of the total trout composition (Table 82). The largest cutthroat trout at RM 1.3 measured 208 mm in total length, with the largest brook trout in the reach measuring 202 mm in total length (Table 82, Appendix A). Additionally, 29 slimy sculpin were collected in Ontario Creek at RM 1.3. At RM 2.9, the trout community was similar to that found at RM 1.3. Westslope cutthroat trout and brook trout were both present in the reach, with cutthroat trout being most abundant (Table 82). However, brook trout did appear to increase in density in this reach when compared to RM 1.3, representing 36% of the total trout composition at RM 2.9. No other fish species were documented in Ontario Creek at RM 2.9.

Table 82. Electrofishing data collected at two sections of Ontario Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.3	WCT	29	29.0	121	41-208	83
	EB	6	6.0	144	49-202	17
RM 2.9	WCT	57	57.0	128	60-247	64
	EB	32	32.0	125	54-214	36

A riparian assessment was completed at each of the two sections electrofished on Ontario Creek in 2007. At RM 1.3, Ontario Creek was situated in a narrow and relatively high gradient canyon. The stream was classified as a stable Rosgen Ba channel type, and substrate consisted largely of large cobbles and boulders. The overall riparian assessment score at RM 1.3 was 65 out of a potential score of 68 (96%) (Table 83). While lodgepole pine and spruce were the primary vegetation just off the channel, woody vegetation along the relatively narrow riparian corridor was comprised primarily of sparse alder and red osier dogwood. While not critical for channel stability at this segment of Ontario Creek, woody vegetation did provide limited shade and overhead cover for fish. Fish habitat at RM 1.3 was rated as good (score; 7 points out of a possible 10). Several large scour pools were present at the survey site, but a general lack of large woody debris limited the potential of the reach. Downstream of the sample reach, several residences were noted near the stream. One site (~ RM 0.6) appeared to have a large rock check dam on the stream. We were unable to take a closer look at this location, and its function as a possible upstream fish barrier is unknown.

At RM 2.9, Ontario Creek was classified as a stable Rosgen B channel type. The overall riparian assessment score at RM 2.9 was 65 out of a potential score of 68 (96%) (Table 83). Conifers, largely consisting of spruce and lodgepole pine, were the dominant vegetation at the site. Alder and willows were also present, but were relatively limited in abundance. Throughout most of the surveyed reach, the width-depth ratio appeared good. However, immediately below the confluence of Monarch Creek, Ontario Creek was slightly over-widened for a short distance. This appeared be related to historic mining activity in the area. Fish habitat at RM 2.9 was rated as good (score; 7 points out of a possible 10). While there was a number of quality pools and complex habitat in the survey reach (including several large woody debris jams), a general lack of available water limited habitat potential. Streamflows appeared naturally low.

Table 83. Riparian assessment results for two sites surveyed on Ontario Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.3	30/30 (100%)	28/28 (100%)	7/10 (70%)	65/68 (96%)
RM 2.9	30/30 (100%)	28/28 (100%)	7/10 (70%)	65/68 (96%)

Water temperature was not monitored in Ontario Creek in 2007.

Cottonwood Creek Drainage

Cottonwood Creek

Cottonwood Creek is a tributary to the Clark Fork River that drains for over nine miles before reaching the Clark Fork River at RM 313.8 near the town of Deer Lodge. Lands along Cottonwood Creek are dominated by privately owned, agricultural lands, and rural and urban homesites. Public ownership along the stream is limited to the lower 0.3 miles of channel that flows through the Grant Kohrs Ranch administered by the National Park Service, and the upper 0.3 miles of stream that lies within U.S. Forest Service ownership. Cottonwood Creek flows through the middle of Deer Lodge, and the stream has been extensively urbanized through this reach (RM 0.3 to RM 1.4). This segment has also been the subject of a recent and ongoing FEMA (Federal Emergency Management Agency) project to address flood protection to nearby residences. The dominant land uses in the Cottonwood Creek drainage are cattle grazing/pasturing, hay production, urbanization, timber harvest, and historic mining.

Fish surveys were completed at three sections of Cottonwood Creek in August of 2007. The sites were located at RM 0.2, 3.0, and 6.9 (Table 84; Figure 3). The site at RM 0.2 was located on land managed by the Grant Kohrs Ranch (National Park Service), while the remaining sites were situated on private land. At RM 0.2 the trout community was comprised entirely of brown trout, which averaged 176 mm in total length (Table 84; Appendix A). Additionally, 22 redbreast shiner, 16 longnose sucker, and one slimy sculpin were also collected at the site. At RM 3.0, fish were relatively rare with only 8 individuals observed in the sample section (Table 84). While brook trout and brown trout were both present in the reach, brook trout were most abundant and made up 87.5% of the species composition (Table 84). No other fish species were noted in this segment of Cottonwood Creek. Discussions with the landowner immediately upstream of the sample reach however, indicated that westslope cutthroat trout were sometimes captured during angling within the vicinity of the sample site. We conducted additional spot electrofishing upstream of the survey reach but only captured juvenile brook trout that were still at relatively low densities. At RM 6.9, fish were noticeably more abundant than at downstream sampled reaches. Westslope cutthroat trout and brook trout were the only trout species observed in the reach, with brook trout comprising over half of the fish collected (Table 84). While brook trout, averaging 101 mm in total length, tended to be more abundant, westslope cutthroat trout tended to be slightly larger, averaging a total length of 136 mm (Table 84; Appendix A). Slimy sculpin were also observed to be fairly common in Cottonwood Creek at RM 6.9.

Table 84. Electrofishing data collected at three sections of Cottonwood Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.2	LL	42	42.0	176	60-425	100
RM 3.0	LL	1	1.0	185	n/a	12.5
	EB	7	7.0	132	59-185	87.5
RM 6.9	WCT	58	58.0	136	80-280	45
	EB	71	71.0	101	45-199	55

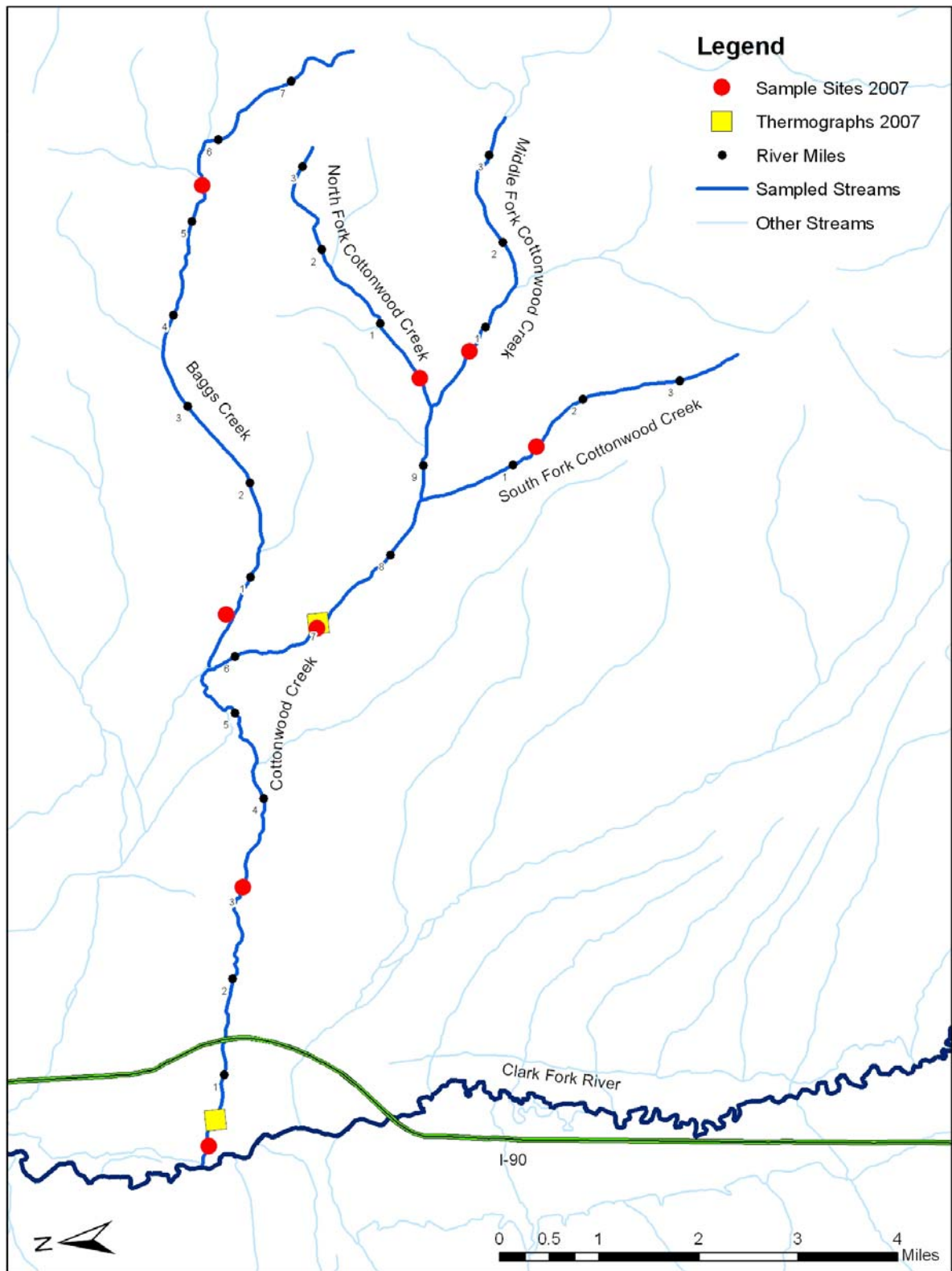


Figure 7. Map of the Cottonwood Creek drainage showing sites of fish and temperature sampling conducted in 2007.

A riparian assessment was completed at each of the three sections electrofished on Cottonwood Creek in 2007. At RM 0.2, Cottonwood Creek exhibited characteristics of a Rosgen C channel type. However, downstream of the electrofishing section, the channel was relatively entrenched and straight, and appeared to have been manipulated (historically). In this segment, the channel exhibited tendencies more indicative of a Rosgen G stream type. The total riparian assessment score at RM 0.2 was 51 out of a potential score of 70 (73%) (Table 85). All categories had reduced scores. The geomorphology score was primarily affected by observed erosion on several outside banks where woody vegetation was absent, and the appearance of historic downcutting or channel confinement near the mouth of the stream. Desirable riparian vegetation at RM 0.2 consisted primarily of cottonwoods and willows in the upper portion of the survey reach, and sedges and willows closer to the mouth. Willows tended to be somewhat sparse along the stream banks, as disturbance-induced grasses appeared to dominate much of the riparian area. Additionally, noxious weeds were also observed to be rather abundant throughout the survey reach. Fish habitat in Cottonwood Creek at the electrofishing segment was rated as good (score: 7 points out of a possible 10; Table 85), but was thought to be somewhat limited by a lack of large woody debris contributing to habitat complexity. In the straightened portion of the reach downstream of the electrofishing site, fish habitat was noted as only fair to poor. Quality cover components were largely lacking throughout this portion of the stream. Flow in Cottonwood Creek was low at the time of the survey in early August, and fine sediment accumulation was notable throughout the survey area. A large irrigation ditch at the mouth of the stream captured most of the water in Cottonwood Creek, and the diversion structure appeared to present a barrier to fish entering Cottonwood Creek from the Clark Fork River. Another probable fish barrier was noted upstream of the survey reach at RM 1.4 where the stream crossed under Interstate 90. At this site, perched culverts appeared to discourage fish from migrating upstream. Cottonwood Creek was highly urbanized between RM 0.3 and RM 1.4 where it flowed through Deer Lodge.

At RM 3.0, Cottonwood Creek was classified as a Rosgen C channel type. The total riparian assessment score at this site was 51 out of a potential score of 70 (73%) (Table 85). All categories had lowered scores, with fish habitat being most reduced (Table 85). The geomorphology score was affected by notable bank erosion on outside bends throughout the reach. This was primarily confined to locations with sparse woody vegetation. Riparian vegetation consisted primarily of a cottonwood and aspen overstory, and an understory of willow, chokecherry, and snowberry. Additionally, disturbance-induced grasses were common throughout the riparian area, and a few noxious weeds were also present. Cattle use in the survey section was evident as several trampled banks were observed, and many young cottonwoods and willows showed moderate browse pressure. Fish habitat in this segment of Cottonwood Creek was rated only fair (score: 3 points out of a possible 10; Table 85). Although there was a good number of meander pools, large woody debris, and other cover components in the reach, habitat was limited by very low streamflow. During the survey in early August, extensive accumulations of long filamentous algae were evident throughout the sample reach, and several large pools appeared almost stagnant. Additionally, fine sediment accumulation was notable. Fish

habitat would have been rated much higher given increased flows. Several unscreened diversions were noted both above and below the sample reach, and most appeared to present potential movement impediments to migrating fish.

At RM 6.9, Cottonwood Creek had transitioned to a channel more characteristic of a Rosgen B stream type. There was evidence in the upper portion of the reach that indicated the channel had made a relatively recent avulsion into a new channel. There were also several older channel scars across the floodplain, indicating this may be a relatively frequent occurrence. The total riparian assessment score at this site was 57 out of a potential score of 68 (84%) (Table 85). All categories had slightly reduced scores (Table 85). The geomorphology score was primarily affected by erosion on several outside banks where woody vegetation was lacking. The vegetative community at RM 6.9 consisted primarily of a cottonwood, Douglas fir and aspen overstory, and a relatively sparse willow and alder understory. Although not overly abundant, undesirable disturbance-caused plants and noxious weeds were present throughout the riparian area. Cattle had access to this reach of Cottonwood Creek and several crossings and areas of minor bank damage were observed. Palatable woody species showed light to moderate browse pressure. Fish habitat was rated as good (score: 7 points out of a possible 10; Table 85), but was slightly limited by a lack of large pools. The few large pools that were present held numerous trout. Flow in this segment of Cottonwood Creek appeared adequate.

Table 85. Riparian assessment results for three sites surveyed on Cottonwood Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.2	25/30 (83%)	19/30 (63%)	7/10 (70%)	51/70 (73%)
RM 3.0	27/30 (90%)	21/30 (70%)	3/10 (30%)	51/70 (73%)
RM 6.9	27/30 (90%)	23/28 (82%)	7/10 (70%)	57/68 (84%)

Water temperature was monitored at two sites on Cottonwood Creek during the summer of 2007. At RM 0.5, water temperature was monitored from July 11 through October 15, and at RM 7.0, it was measured from July 17 through October 17. At RM 0.5, maximum daily temperatures exceeded 15°C on 65 days, and 20°C on 20 of these days. The maximum-recorded temperature at this site was 24.1°C on July 20. At RM 7.0, water temperatures tended to be notably cooler than at RM 0.5. At this site, the maximum-recorded temperature was 17.8°C on July 19, and daily high temperatures exceeded 15°C a total of 25 days.

Baggs Creek

Baggs Creek is a tributary to Cottonwood Creek that flows for approximately 7.8 miles before entering Cottonwood Creek at RM 5.7. The lower 2.1 miles of the stream flows through private property while the remainder of the channel is found on land

administered by the U.S. Forest Service. The primary land uses in the Baggs Creek watershed are cattle grazing and recreation.

Fish surveys were completed at two sections of Baggs Creek in August of 2007. The sites were located at RM 0.5 and 5.4 (Table 86; Figure 3). The site at RM 0.5 was on private land, while the site at RM 5.4 was on land managed by the U.S. Forest Service. At RM 0.5, the trout community was comprised of westslope cutthroat trout and brook trout, with brook trout making up most (75%) of the species composition (Table 86). Despite their abundance, most brook trout were small, young-of-the-year individuals, that were less than 90 mm in total length (Appendix A). At RM 5.4, the fish community was comprised entirely of westslope cutthroat trout, which had a mean total length of 127 mm (Table 86; Appendix A). A “walkthrough” survey downstream of the site at RM 5.4 discovered a sizeable natural waterfall that was a definite fish barrier at RM 5.3. A spot electrofishing survey was conducted below the barrier, which found both westslope cutthroat trout and brook trout present.

Table 86. Electrofishing data collected at two sections of Baggs Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.5	WCT	19	19.0	125	95-234	25
	EB	57	57.0	76	45-261	75
RM 5.4	WCT	72	72.0	127	77-203	100

A riparian assessment was completed at each of the two sections electrofished on Baggs Creek in 2007. At RM 0.5, Baggs Creek was classified as a Rosgen B channel type. The overall assessment score was 45 out of a potential score of 70 (64%) (Table 87). All three assessment categories showed reduced scores. The geomorphology score was affected by several factors including evidence of historic downcutting, and multiple areas of notable bank erosion on outside bends where woody vegetation was lacking. Woody riparian vegetation consisted of a cottonwood and aspen overstory, and understory of relatively sparse alder, willow, wild rose, and chokecherry. A sizeable hay meadow to the north of the channel was adjacent to the stream throughout the survey reach, and noxious weeds were abundant in and around the riparian area. Downstream of the survey reach, the riparian corridor was very narrow, and was limited to the immediate stream banks. Cattle appeared to have access to this location of Baggs Creek, and moderate browse pressure was noted on young cottonwoods and other palatable woody species. Fish habitat was rated only fair (score: 3 out of a possible 10), and was limited primarily by a lack of pools. Most of the habitat in the surveyed reach was shallow pocket water, which offered relatively little cover for larger, adult fish. Flow at RM 0.5 was observed to be low at the time of the survey in early August, and one small diversion was noted just upstream of the sample site. Additionally, one other unscreened diversion was observed downstream of the survey reach near RM 0.2.

At RM 5.4, Baggs Creek was again classified as a Rosgen B channel type. The total riparian assessment score at this site was 58 out of a potential score of 68 (85%) (Table 87). Categories with slightly reduced scores included vegetation and fish habitat. The riparian vegetative canopy at RM 5.4 was comprised primarily of conifers, including lodgepole pine and spruce. Alder and aspen were also present throughout the reach, but plants were rather patchy and discontinuous. The survey area was within a U.S. Forest Service grazing allotment and cattle presence was notable throughout the area. Several localized areas of bank trampling were noted where cattle frequently crossed the channel, and young aspen trees also showed moderate browse pressure. Noxious weeds were fairly uncommon throughout the reach and were mostly isolated to disturbed areas near cattle crossings. There were a number of large pools created by large woody debris in this segment of Baggs Creek, and fish habitat was rated as good (score: 7 out of a possible 10). However, a lack of overhanging vegetation that provided cover and shade led to a slightly reduced score.

Table 87. Riparian assessment results for two sites surveyed on Baggs Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.5	21/30 (70%)	21/30 (70%)	3/10 (30%)	45/70 (64%)
RM 5.4	30/30 (100%)	21/28 (75%)	7/10 (70%)	58/68 (85%)

Water temperature was not monitored in Baggs Creek in 2007.

South Fork Cottonwood Creek

The South Fork of Cottonwood Creek is a tributary to Cottonwood Creek that drains for approximately 3 miles before entering Cottonwood Creek at RM 8.6. The lower 1.2 miles of channel flows through private land, while the remainder of the watershed is found on land managed by the U.S. Forest Service. The major land uses in the South Fork Cottonwood Creek watershed are cattle grazing, timber harvest, and recreation.

A fish survey was completed at one section of South Fork Cottonwood Creek in August of 2007. The site was located at RM 1.3 on U.S. Forest Service Land (Table 88; Figure 7). The fish community at the surveyed site was comprised entirely of westslope cutthroat trout, which had a mean total length of 101 mm (Table 35; Appendix A).

Table 88. Electrofishing data collected at one section of South Fork Cottonwood Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.3	WCT	18	18.0	101	60-175	100

A riparian assessment was completed at the one section electrofished on South Fork Cottonwood Creek in 2007. At this site (RM 1.3), the channel was classified as a Rosgen B stream type, and the total assessment score was 47 out of a potential score of 67 (70%) (Table 89). All categories showed some reduction in score. The survey site at RM 1.3 was located within a U.S. Forest Service grazing allotment, and grazing impacts were a primary factor affecting assessment categories. The geomorphology score was largely influenced by several locations of moderately trampled/eroded banks, and over-widened crossing areas. Woody riparian vegetation was comprised mostly of a lodgepole pine, spruce and aspen overstory, and a sparse alder understory. However, moderate browse pressure was thought to be somewhat limiting the vegetative community in the riparian area. Fish habitat at RM 1.3 was rated as fair (score: 3 points out of a possible 7; Table 88), and was limited by a lack of deep pools, large woody debris, and overhanging vegetation providing cover and shade. Flow in South Fork Cottonwood Creek was low at the time of the survey in early August, and an unscreened irrigation diversion was noted upstream of the electrofishing reach at RM 1.4. The diversion structure was thought to be a potential seasonal fish barrier.

Table 89. Riparian assessment results for one site surveyed on South Fork Cottonwood Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.3	21/30 (70%)	23/30 (77%)	3/7 (43%)	47/67 (70%)

Water temperature was not monitored in South Fork Cottonwood Creek in 2007.

North Fork Cottonwood Creek

The North Fork of Cottonwood Creek is a tributary to Cottonwood Creek that drains for approximately 3 miles before entering Cottonwood Creek at RM 9.6. The mainstem of the stream flows entirely through lands administered by the U.S. Forest Service. However, there are a number of private mining claims to the north of channel, several of which lie along Spring Creek, a tributary to the North Fork of Cottonwood Creek. The major land uses in the North Fork Cottonwood Creek watershed are cattle grazing, timber harvest, recreation, and historic mining.

A fish survey was completed at one section of North Fork Cottonwood Creek in August of 2007. The sample site was located at RM 0.3 on U.S. Forest Service land (Table 90; Figure 7). The fish community was comprised primarily of westslope cutthroat trout, although brook trout were also present, but rare (Table 90). The largest westslope cutthroat trout observed at RM 0.3 had a total length of 211 mm, while the largest brook trout in the section was 152 mm in total length (Table 90; Appendix A).

Table 90. Electrofishing data collected at one section of North Fork Cottonwood Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.3	WCT	33	33.0	103	66-211	94
	EB	2	2.0	100	47-152	6

A riparian assessment was completed at the one section electrofished on North Fork Cottonwood Creek in 2007. At this site (RM 0.3), the channel was classified as a Rosgen Ba stream type. The overall assessment score was 68 out of potential score of 70 (97%) (Table 91). Woody riparian vegetation was comprised of a relatively dense understory of alder, willow, and dogwood, and a conifer overstory of Douglas fir, lodgepole pine and spruce. The sample site was within a U.S. Forest Service grazing allotment and site-specific cattle impacts were noted along the surveyed reach. Several crossings with modest bank trampling were observed, and browse pressure on woody shrubs was moderate. Fish habitat in this segment of North Fork Cottonwood Creek was rated as excellent (score: 10 points out of a possible 10; Table 91), and was thought to be at its potential. Pools and large woody debris were abundant throughout the reach, and there was also a large quantity of boulders and overhanging vegetation providing cover and shade.

Table 91. Riparian assessment results for one site surveyed on North Fork Cottonwood Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.3	30/30 (100%)	28/30 (93%)	10/10 (100%)	63/70 (97%)

Water temperature was not monitored in North Fork Cottonwood Creek in 2007.

Middle Fork Cottonwood Creek

The Middle Fork of Cottonwood Creek is a tributary to Cottonwood Creek that drains for approximately 3 miles before entering Cottonwood Creek at RM 9.6. The Middle Fork is the largest of the three upper forks of Cottonwood Creek (South, North, and Middle), and the entire Middle Fork Cottonwood Creek watershed lies within lands administered by the U.S. Forest Service. The major land uses in the drainage are cattle grazing, timber harvest, and recreation.

A fish survey was completed at one section of Middle Fork Cottonwood Creek in August of 2007. The sample site was located at RM 0.7 (Table 92; Figure 7). The fish community at this segment of Middle Fork Cottonwood Creek was comprised entirely of westslope cutthroat trout, which had an average total length of 124 mm (Table 92; Appendix A).

Table 92. Electrofishing data collected at one section of Middle Fork Cottonwood Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.7	WCT	51	51.0	124	60-217	100

A riparian assessment was completed at the one section electrofished on Middle Fork Cottonwood Creek in 2007. At RM 0.7 the channel displayed characteristics of a Rosgen B stream type. The total riparian assessment score was 62 out of a potential score of 66 (94%) (Table 93). The vegetative community at RM 0.7 was dominated by an overstory of spruce, aspen, and lodgepole pine. Understory vegetation at the site consisted primarily of alder, with dogwood and wild rose also present. Density of woody shrubs along the stream banks was rather continuous. The sample site was within a U.S. Forest Service grazing allotment, but cattle impacts were light. Fish habitat was rated as good (score: 7 points out of a possible 10; Table 93) in this segment of Middle Fork Cottonwood Creek, but was slightly limited by a lack of large woody debris incorporated into the channel. However, recruitment potential appeared good.

Table 93. Riparian assessment results for one site surveyed on Middle Fork Cottonwood Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.7	30/30 (100%)	25/26 (96%)	7/10 (70%)	62/66 (94%)

Water temperature was not monitored in Middle Fork Cottonwood Creek in 2007.

Race Track Creek Drainage

Racetrack Creek

Racetrack Creek is a tributary to the upper Clark Fork River that drains for over 23 miles before reaching its mouth at Clark Fork RM 326.5. Land ownership along the lower 12 miles of Racetrack Creek consists primarily of privately owned, agricultural lands. The remainder of the stream flows largely through U.S. Forest Service administered lands that dominate the upper portion of the watershed. Numerous mountain lakes are present in the headwaters of Racetrack Creek and its tributaries. Several of the larger lakes have dams that provide irrigation storage for downstream agricultural users. The primary land uses in the lower portion of the drainage (i.e. downstream of RM 12) are hay/crop production, cattle grazing/pasturing, and rural homesites. Land use in the upper portion of the watershed is dominated by motorized and non-motorized recreation on public lands.

Fish surveys were completed at four sections of Racetrack Creek in August of 2007. The sample sites were located at RM 10.8, 12.7, 15.0, and 18.5 (Table 94; Figure 8). All sites were located on lands managed by the U.S. Forest Service. No sections were sampled downstream of RM 6.8 as the channel was dry for most of the summer below this location. At RM 10.8, trout composition was made up of brown trout and brook trout. However, fish were extremely rare and only eight trout were captured in the survey reach (Table 94). Brown trout, which averaged 218 mm in total length, were most abundant making up 75% of the species composition (Table 94; Appendix A). Additionally, 17 slimy sculpin and one unidentified young-of-the-year trout were also collected in the reach. At RM 12.7, a notable shift in fish abundance and species composition was observed. At this site, brown trout, brook trout, and a combination of westslope cutthroat trout, rainbow trout and their hybrids (*Oncorhynchus* species) were all present in the sample reach (Table 94). Brown trout and *Oncorhynchus* species were most abundant, representing 50% and 46% of the total species composition, respectively. *Oncorhynchus* species at RM 12.7 had a mean total length of 182 mm, and tended to be larger than brown trout, which had a mean total length of 164 mm (Table 94; Appendix A). Slimy sculpin were also present in this reach of Racetrack Creek. At RM 15.0, the fish community was comprised entirely of *Oncorhynchus* species, and included fish that had the phenotypic appearance of westslope cutthroat trout, rainbow trout, and hybrids of the two species. These fish had a mean total length of 126 mm (Table 94; Appendix A). At RM 18.5, the fish community was again comprised entirely of *Oncorhynchus* species, which had a mean total length of 128 mm (Table 94; Appendix A). Most fish in this reach had the phenotypic appearance of westslope cutthroat trout. However, a small portion of the fish did appear hybridized with rainbow trout. Fish density at RM 18.5 was relatively high with 118 individuals captured in the 100 m sample reach (Table 94).

Table 94. Electrofishing data collected at four sections of Racetrack Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 10.8	LL	6	6.0	218	103-356	75
	EB	1	1.0	65	n/a	12.5
	TRT	1	1.0	46	n/a	12.5
RM 12.7	ONC	22	22.0	182	89-331	46
	LL	24	24.0	164	55-278	50
	EB	2	2.0	156	141-170	4
RM 15.0	ONC	61	61.0	126	48-254	100
RM 18.5	ONC	118	118.0	128	52-214	100

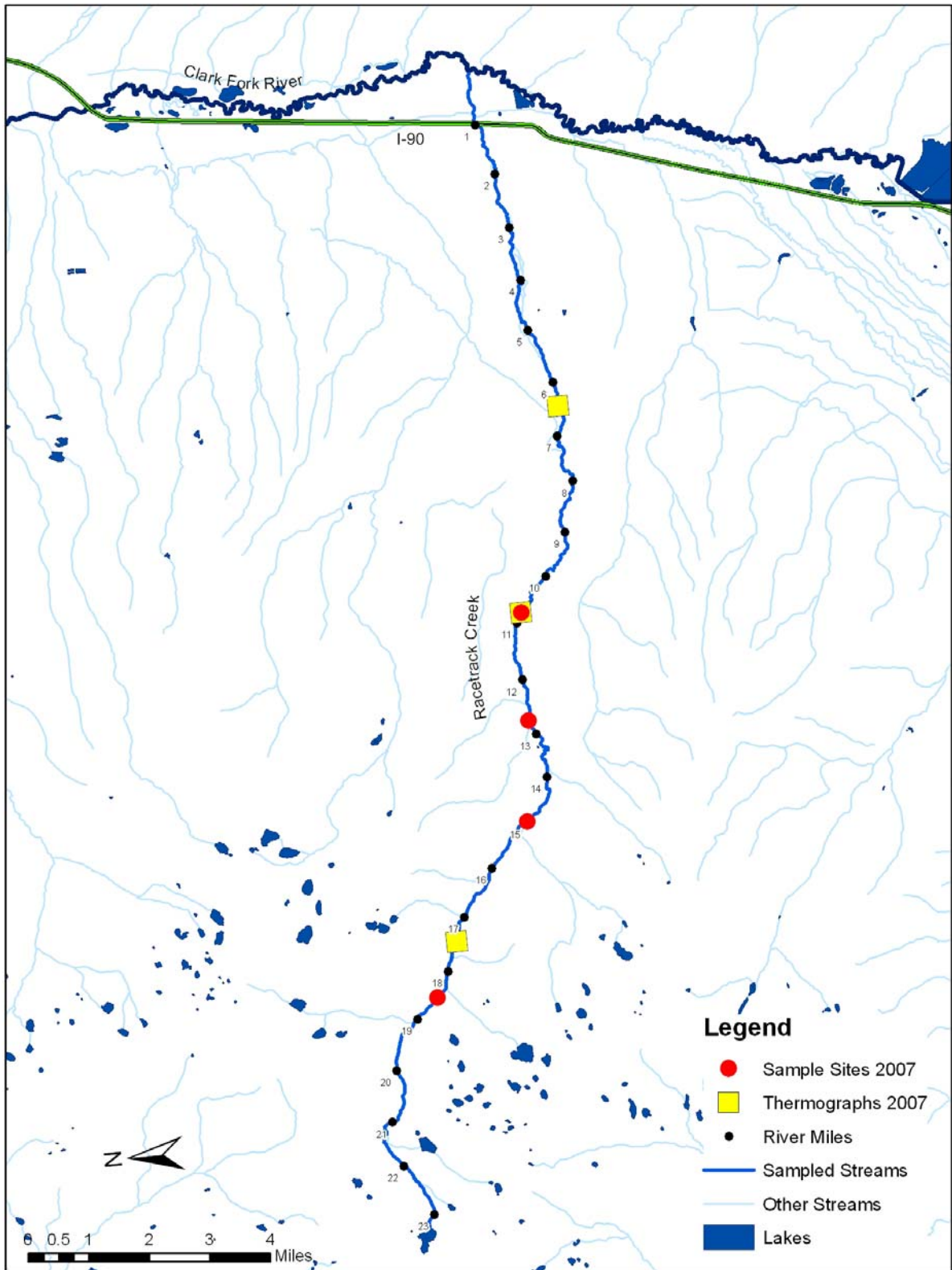


Figure 8. Map of the Racetrack Creek drainage showing sites of fish and temperature sampling conducted in 2007.

A riparian assessment was completed at each of the four sections electrofished on Racetrack Creek in 2007. At RM 10.8, the channel was classified as a Rosgen Bc stream type, but appeared to be transitioning to more of a Rosgen C channel type downstream of the survey site. The total riparian assessment score at RM 10.8 was 64 out of a potential score of 67 (96%) (Table 95). Woody riparian vegetation was dominated by willow, which was relatively continuous throughout the riparian area and along the stream banks. Leafy spurge and spotted knapweed were abundant in the uplands around the survey section, but were relatively sparse within the riparian corridor. The survey site was included in a U.S. Forest Service grazing allotment, but cattle impacts were observed to be relatively minimal. Fish habitat in this reach of Racetrack Creek was rated as good (score: 7 points out of a possible 7; Table 95), and was thought to be at its potential. Overhanging vegetation and rootwads were common throughout the sample area, and spawning habitat appeared abundant. Flow at RM 10.8 was very good at the time of the survey in early August. However, several significant unscreened diversions downstream of the sample site completely captured all flow leaving Racetrack Creek dry downstream of RM 6.8.

At RM 12.7, Racetrack Creek was situated in a narrow canyon, and the channel was characterized as a relatively high-gradient Rosgen B stream type. The total riparian assessment score at this site was 62 out of a potential score of 65 (95%) (Table 95). Riparian vegetation was comprised of a conifer overstory of Douglas fir and spruce, and an understory of alder, dogwood, and rocky mountain maple. Noxious weeds were present within the riparian area, but were primarily associated with dispersed campsites and areas with cattle disturbance. The survey reach was within a U.S. Forest Service grazing allotment, and moderate browse pressure on dogwood plants was notable. Fish habitat at RM 12.7 was rated as good (score: 7 points out of a possible 7; Table 95), and was thought to be at its potential. The survey segment was relatively steep, and riffles were the dominant habitat type. However, abundant pocket water and several large rock scour pools provided good adult fish habitat. Additionally, several pieces of large woody debris also contributed to habitat complexity in the sample reach. Flow in this segment of Racetrack Creek was high, and appeared to be augmented by upstream storage. A “walkthrough” survey upstream of the sample reach found a large cascade at RM 13.0, which appeared to be a natural fish barrier that prevented upstream fish movement.

Table 95. Riparian assessment results for four sites surveyed on Racetrack Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 10.8	30/30 (100%)	27/30 (90%)	7/7 (100%)	64/67 (96%)
RM 12.7	30/30 (100%)	25/28 (89%)	7/7 (100%)	62/65 (95%)
RM 15.0	30/30 (100%)	27/29 (93%)	7/7 (100%)	64/66 (97%)
RM 18.5	30/30 (100%)	28/28 (100%)	7/7 (100%)	65/65 (100%)

At RM 15.0, the gradient of Racetrack Creek had lessened, and the channel exhibited meandering characteristics of a Rosgen C stream type. The total riparian assessment score at this site was 64 out of a potential score of 66 (97%) (Table 95). Riparian vegetation was comprised primarily of willow and alder, with sedges and grasses also common throughout open areas. Conifers were the dominant species away the floodplain. Fish habitat within the survey reach was rated as good (score: 7 points out of a possible 7; Table 94), and was thought to be near its potential. Similar to downstream reaches, flow was very high in this segment of Racetrack Creek, and appeared to be supplemented by upstream reservoir storage.

At RM 18.5, Racetrack Creek was situated in a narrow canyon and was classified as a high-gradient Rosgen Ba stream type. The total riparian assessment score at this site was 65 out of a potential score of 65 (100%) (Table 95). Riparian vegetation was dominated by a conifer overstory of lodgepole pine, spruce, and sub-alpine fir. Fish habitat within the survey reach was rated as good (score: 7 points out of a possible 7; Table 95), and was at its potential. The channel was steep and substrate was large which created abundant pocket water and rock scour pools. Additionally, large woody debris was also common throughout the area. Flow remained good at this reach of Racetrack Creek.

Water temperature was monitored at three sites in Racetrack Creek during the summer of 2007 (Figure 95; Appendix B). On July 6, a thermograph was placed at river mile 6.4. At this site, maximum daily temperatures exceeded 15°C on 40 days, and 20°C on two of these days. The maximum-recorded temperature at this site was 20.3°C on July 12. During the late summer, this site had very little flow, and the thermograph was largely monitoring the temperature of a stagnant pool during this period. The thermograph was removed on October 17. On July 10, two additional thermographs were placed in Racetrack Creek at RM 10.8 and 17.5. At RM 10.8, maximum daily temperatures exceeded 15°C on 32 days with a maximum-recorded temperature of 18.7°C occurring on July 19. At RM 17.5, maximum daily temperatures exceeded 15°C only 11 times with a maximum-recorded temperature of 16.2°C on August 2. Both thermographs were pulled on October 17.

Warm Springs Creek Drainage

Warm Springs Creek

Warm Springs Creek is a large headwater tributary to the upper Clark Fork River that flows for approximately 32 miles before reaching the Clark Fork River near the town of Warm Springs (RM 339.4). The character of the stream varies throughout its length, as does the land ownership along its banks. While most of the lower reaches of Warm Springs Creek flow through privately owned lands, including the town of Anaconda, several state owned Wildlife Management Areas are also located along the stream. These

include the Warm Springs Wildlife Management Area near the mouth, and the Garrity Mountain Wildlife Management Area upstream of Anaconda. Warm Springs Creek transitions to lands managed by the U.S. Forest Service at approximately RM 22.9. However, several private in-holdings are also present along the stream within this area. Land uses in the Warm Springs Creek watershed are varied, and include rural and urban homesites, cattle grazing/pasturing, timber harvest, recreation, and historic mining.

Fish surveys were completed at eight sections of Warm Springs Creek in July and September of 2007. The sample sites were located at RM 1.8, 7.4, 8.4, 16.4, 18.6, 23.3, 27.4, and 29.1 (Table 96; Figure 9). The sections at RM 1.8 and 18.6 were located on state owned Wildlife Management Areas, while the sites at RM 7.4, 8.4, and 16.4 were situated on privately owned lands. All of these sample locations were surveyed using a tote-barge electrofishing unit, and a population estimate was made at RM 1.8 using a mark-recapture technique. The remaining sites sampled on Warm Springs Creek (RM 23.3, 27.4, and 29.1) in 2007 were on U.S. Forest Service land, and were sampled with a backpack electrofisher.

At RM 1.8, the trout community was comprised almost entirely of brown trout, with *Oncorhynchus* species (i.e. westslope cutthroat trout, rainbow trout, and their hybrids) occurring only rarely in the sample reach (Table 96). Brown trout were variable in size, ranging in total length from 61 mm to 542 mm, and tended to be relatively abundant as well (Table 96; Appendix A). The mark-recapture population estimate showed that there were approximately 845 (+/- 68: 95% confidence interval) brown trout greater than 150 mm in total length in the 1000 m section. There were not enough *Oncorhynchus* species handled to calculate a population estimate for this group. Mountain whitefish and slimy sculpin were also noted at RM 1.8. At RM 7.4, the fish community was similar to that found out RM 1.8. Brown trout dominated the species composition making up 99% of the fish collected in the reach (Table 96). *Oncorhynchus* species were again rare, with only two individuals captured at the survey site (Table 96). Brown trout captured at RM 7.4 had an average total length of 191 mm (Table 96; Appendix A). At RM 8.4, the fish community was again comprised primarily of brown trout, with *Oncorhynchus* species still very uncommon (Table 96). Although approximately equal numbers of brown trout were captured at RM 8.4 and 7.4, fish at the upstream site were notably smaller, averaging just 126 mm in total length (Table 96; Appendix A). The prevalence of small fish was likely related to the lack of adult fish habitat in the survey reach. At RM 16.4, brown trout continued to be the most abundant trout species present in Warm Springs Creek. However, at this site, *Oncorhynchus* species were noticeably more abundant, and comprised 10% of the species composition at the site (Table 96). Brook trout were also present in the reach, but were relatively uncommon with only 7 individuals captured in the survey section (Table 96). On average, brown trout in this segment of the stream tended to be larger than those sampled at downstream reaches, averaging 251 mm in total length (Table 96; Appendix A). Myers Dam was located at RM 16.6, just upstream of the shocking section. This structure appeared to prevent upstream fish movement.

At RM 18.6, *Oncorhynchus* species became the most abundant, representing 87% of the species composition (Table 96). Bull trout, brown trout, and brook trout were also present

in this segment of Warm Springs Creek, but were far less common comprising 6%, 5%, and 2% of the trout captured in the survey section, respectively (Table 96). Total fish density appeared noticeably lower than at downstream reaches, and was likely related to a shift in fish habitat from deep, meander pools prevalent in the lower reaches of Warm Springs Creek, to high-gradient riffle habitat, which dominated much of the upper reaches of the stream. At RM 23.3, *Oncorhynchus* species again comprised the majority of the species composition. Of those captured, all but one fish appeared to be westslope cutthroat trout. However, one rainbow trout was also captured in the reach, and thus all *Oncorhynchus* species were grouped together. Brook trout were the only other trout species captured at the site, comprising 35% of the trout composition. Slimy sculpin were also present at RM 23.3. At RM 27.4, bull trout, which averaged 219 mm in total length, were the most abundant species in the reach (Table 96; Appendix A). However, westslope cutthroat trout and brook trout were also almost equally common comprising 27% and 30% of the trout composition, respectively (Table 96). Additionally, one relatively large phenotypic bull trout – brook trout hybrid was also noted in the reach. Just upstream of the survey site, the stream naturally went subsurface and remained as such for over a mile. This area appeared to be at least a seasonal migration barrier. At RM 29.1, fish were relatively uncommon and consisted of seven westslope cutthroat trout and one bull trout (Table 96). Westslope cutthroat trout had an average total length of 164 mm, while the one bull trout had a total length of 240 mm (Table 96).

Table 96. Electrofishing data collected at eight sections of Warm Springs Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.8	ONC	2	0.2	265	166-364	< 1
	LL	552	55.2	219	61-542	> 99
RM 7.4	ONC	2	0.4	336	312-360	1
	LL	177	38.5	191	71-437	99
RM 8.4	ONC	1	0.2	415	n/a	1
	LL	194	44.1	126	63-419	99
RM 16.4	ONC	44	4.4	253	77-423	10
	LL	371	37.1	251	66-467	88
	EB	7	0.7	191	150-234	2
RM 18.6	BULL	11	1.3	187	69-323	6
	ONC	153	18.0	189	52-422	87
	LL	8	0.9	253	64-428	5
	EB	3	0.4	180	144-240	2
RM 23.3	ONC	17	17.0	139	40-308	65
	EB	9	9.0	146	66-201	35
RM 27.4	BULL	12	12.0	219	208-232	40
	EBxBULL	1	1.0	358	n/a	3
	WCT	8	8.0	157	104-265	27
	EB	9	9.0	196	93-303	30
RM 29.1	BULL	1	1.0	240	n/a	12.5
	WCT	7	7.0	164	53-210	87.5

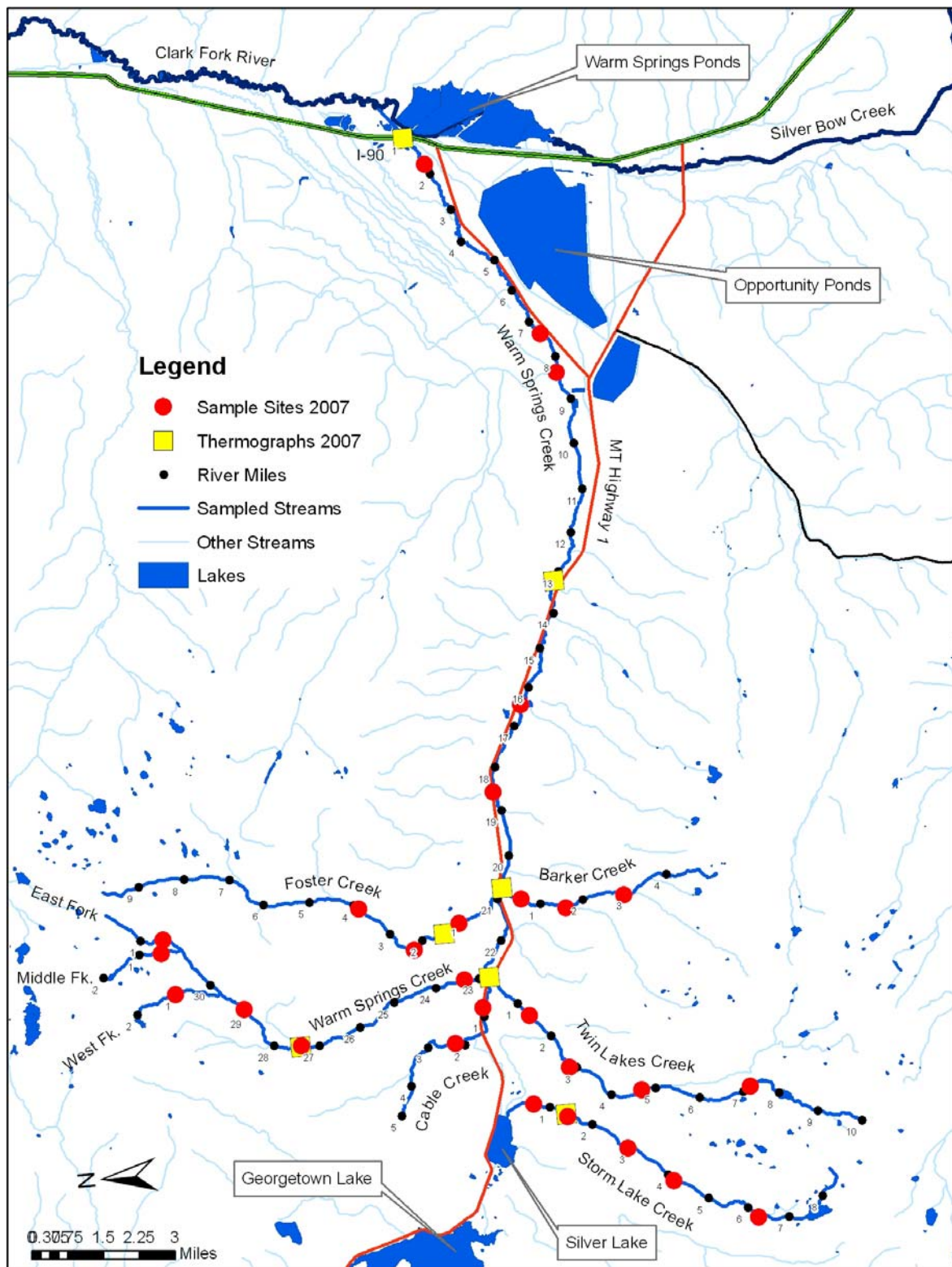


Figure 9. Map of the Warm Springs Creek drainage showing sites of fish and temperature sampling conducted in 2007.

A riparian assessment was completed for six of the eight sections electrofished on Warm Springs Creek in 2007. At RM 1.8, the stream was classified as Rosgen C channel type. The total assessment score was 66 out to a potential score of 70 (94%) (Table 97). Vegetation was the only category that showed a slightly reduced score (Table 97). The plant community at RM 1.8 was comprised mainly of a dense willow population, with alder, wild rose, dogwood, and snowberry also relatively common throughout the reach. The widespread distribution of undesirable, disturbance-induced plants and noxious weeds (mostly Canada thistle and spotted knapweed) was the primary factor that negatively affected the vegetation score. Fish habitat was rated as excellent (score: 10 points out a possible 10; Table 97), and was thought to be at its potential. There were a good number of deep meander pools as well as rootwads and overhanging vegetation throughout this segment of Warm Springs Creek. Additionally, spawning habitat was relatively abundant, and flow was good at the time of the survey in early September. Two unscreened, State controlled diversions were noted in the survey area. One was located in the lower third of the electrofishing section, and the other was situated approximately 0.4 miles upstream of the sample site.

At RM 7.4 and 8.4, no scored riparian assessment was completed for either site (Table 97). This was because the sites occurred within Section 32, a current focus of remediation and restoration planning by the State and the Federal Environmental Protection Agency. At RM 7.4, the riparian vegetative community existed in a narrow band directly adjacent to the channel, and was comprised mostly of stunted cottonwood trees and woody shrubs (mostly willow and alder). Fish habitat was fairly good in this segment of Warm Springs Creek as there were a number of deep pools present throughout the survey reach. Upstream of this section from approximately RM 7.8 to 8.1, a severely braided/anastomosed section of the stream was observed. The many small channels flowing throughout this area had created a notably wider and lush riparian area. However, many of the channels appeared relatively unstable, and recent channel migrations were obvious. At RM 8.4, the channel had been historically channelized and bermed to prevent flooding. This section of Warm Springs Creek was straight, wide and shallow, and generally lacked habitat capable of supporting larger, adult fish. The plant community at RM 8.4 was limited, and consisted primarily of what appeared to be stunted cottonwood and aspen trees growing on the berms directly adjacent to the channel. A large irrigation diversion (Gardiner Ditch) was located immediately upstream of the sample section.

At RM 16.4, Warm Springs Creek was classified as a relatively high gradient Rosgen C stream type. The total riparian assessment score at this site was 69 out of a potential score of 70 (99%) (Table 97). Riparian vegetation was comprised of a dense and diverse woody community that included willow, alder, cottonwood, aspen, dogwood, and birch. While noxious weeds (Canada thistle and spotted knapweed) were also noted in the riparian area, they tended to be sparse and their distribution was rather patchy. Fish habitat at RM 16.4 was rated as excellent (score: 10 points out a possible 10; Table 97), and was largely believed to be at its potential. There were a number of deep meander pools throughout the reach, and most of the riffle and run habitat had numerous pockets that also held fish. Additionally, flow was very good in this segment of the stream at the time of the survey in mid September. Myers Dam was located just upstream of the survey section, and is the

site where the county of Butte-Silver Bow diverts water from Warm Springs Creek for industrial uses outside the watershed.

At RM 18.6, the character of Warm Springs Creek had changed considerably from downstream reaches. At this site, the stream was inset in a narrow canyon/gully and had transitioned to a relatively high-gradient Rosgen B channel type. A high terrace existed along the left bank throughout the entire reach, and the channel lacked access to the floodplain on this side of the stream. The total riparian assessment score at RM 18.6 was 62 out of a potential score of 67 (93%) (Table 97). Riparian vegetation was comprised largely of a healthy willow community, with cottonwood, dogwood, alder, and spruce also common throughout the survey reach. Noxious weeds, including spotted knapweed and Canada thistle, were also present, but were mostly confined to upland areas and along the ditch bank of a large, unscreened diversion that was noted at the lower end of the section. The channel was stable at RM 18.6, but tended to be rather wide and shallow throughout the survey section. Fish habitat was rated only fair (score: 3 points out a possible 7; Table 97), and was limited by a complete lack of pools and large woody debris in the channel. Most of the available habitat for larger, adult fish was confined to small pockets in what was largely a high-gradient riffle throughout the entire sample section. This habitat type appeared to persist throughout much of upper Warm Springs Creek in the Highway 1 corridor.

At RM 23.3, Warm Springs Creek was upstream of most tributary inputs, and was notably smaller than at downstream reaches. The channel was classified as a Rosgen B stream type, and the total riparian assessment score was 61 out of a potential score of 65 (94%) (Table 97). The plant community was comprised primarily of an overstory of spruce and lodgepole pine, with patchy willows throughout the understory. Fish habitat at RM 23.3 was rated only fair (score: 3 points out a possible 7; Table 97), and was not thought to be at its potential. Much of the available habitat was a high-gradient riffle that offered little in the way of velocity refuge. Large woody debris was lacking, and subsequently so was pool habitat. However, flow was good in this segment of Warm Spring Creek at the time of the survey in early September.

Not far upstream from the sample site at RM 23.3, the gradient of Warm Springs Creek lessened, and extensive beaver activity was noted for the next several miles (approximately three miles). At RM 27.4, the stream had transitioned away from the beaver activity and was again a channel typical of a Rosgen B stream type. The total riparian assessment score at this site was 61 out of a potential score of 62 (98%) (Table 97). Riparian vegetation was comprised primarily of a conifer overstory of spruce and lodgepole pine. Willows were also present throughout the reach, although many were rather decadent. Noxious weeds (Canada thistle and spotted knapweed) were mostly absent from the survey site, but a few plants were noted along the main forest access road located to the west of the channel. Fish habitat at RM 27.4 was rated as good (score: 7 points out a possible 7; Table 97), and was thought to be at its potential. Much of the habitat was a high gradient riffle, but due to the presence of rather abundant large woody debris in the channel, scour pools were relatively common. Flow in this reach of Warm Springs Creek was very good, despite the channel going subsurface 0.3 miles upstream.

At RM 29.1, Warm Springs Creek was located between two forest access roads and had a limited riparian area. The channel was fairly low gradient and was classified as a Rosgen Bc stream type. The total riparian assessment score was 58 out of a potential score of 68 (85%) (Table 97). Categories with reduced scores included vegetation and fish habitat. The plant community at RM 29.1 consisted primarily of a lodgepole pine overstory, and a patchy willow understory. Much of the vegetation along the stream banks consisted of grasses and herbaceous plants. Additionally, a few noxious weeds were also noted in the area, but were mostly limited to areas near roads and stream crossings. Historic and recent timber harvest was evident near the stream, as well as throughout the wider surrounding area. Fish habitat in this reach of Warm Springs Creek was rated as good (score: 7 points out a possible 10; Table 97), but was thought to be limited by a lack of overhanging vegetation, as well as by notable fine sediment accumulation.

Table 97. Riparian assessment results for six sites surveyed on Warm Springs Creek in 2007. Note: Assessments were not completed at RM 7.4 and 8.4.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.8	30/30 (100%)	26/30 (87%)	10/10 (100%)	66/70 (94%)
RM 7.4	n/a	n/a	n/a	n/a
RM 8.4	n/a	n/a	n/a	n/a
RM 16.4	30/30 (100%)	29/30 (97%)	10/10 (100%)	69/70 (99%)
RM 18.6	30/30 (100%)	29/30 (97%)	3/7 (43%)	62/67 (93%)
RM 23.3	30/30 (100%)	28/28 (100%)	3/7 (43%)	61/65 (94%)
RM 27.4	30/30 (100%)	24/25 (96%)	7/7 (100%)	61/62 (98%)
RM 29.1	30/30 (100%)	21/28 (75%)	7/10 (70%)	58/68 (85%)

Water temperature was monitored at three sites on Warm Springs Creek from July 6 through October 17, 2007 (Appendix B). The sites were located at RM 1.0, 13.2, and 27.4 (Figure 9). At RM 1.0, maximum daily temperatures exceeded 15°C on 58 days including eight days in which they exceeded 20°C. The maximum-recorded temperature at this site was 21.2°C on July 19. At RM 13.2, maximum daily temperatures were notably cooler than at RM 1.0, and exceeded 15°C on only 11 days. The maximum-recorded temperature at this site was 16.6°C, which occurred on July 19. At RM 27.4, maximum daily temperatures remained very cold and stable, with a maximum-recorded temperature of 7.7°C occurring on July 25. The resurfacing of groundwater just upstream of the measurement site likely influenced stream temperature at this location.

West Fork Warm Springs Creek

West Fork Warm Springs Creek is a tributary to Warm Springs Creek that drains for approximately two miles before entering Warm Springs Creek at RM 29.7. All of West Fork Warm Springs Creek flows through lands administered by the U.S. Forest Service. The major land uses in the drainage are recreation and timber harvest.

A fish survey was completed at one section of West Fork Warm Springs Creek in August of 2007. The sample site was located at RM 1.0 on U.S Forest Service land (Table 98; Figure 9). Bull trout comprised 58% of the species composition in the survey reach with westslope cutthroat trout making up the remaining portion of the fish community (Table 97). Both species were relatively common and fish density in the survey reach was rather high (Table 98). Bull trout tended to be relatively small having an average total length of 98 mm (Table 98; Appendix A). However, several age classes were present ranging from young-of-the-year to what appeared to be resident adults. Westslope cutthroat trout had an average total length of 119 mm, and similar to bull trout, multiple age classes were present in this segment of West Fork Warm Springs Creek (Table 98; Appendix A).

Table 98. Electrofishing data collected at one section of West Fork Warm Springs Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.0	BULL	41	41.0	98	47-263	58
	WCT	30	30.0	119	62-205	42

A riparian assessment was completed for the one section electrofished on West Fork Warm Springs Creek in 2007. At RM 1.0, the channel had a rather steep gradient and was classified as a Rosgen Ba stream type. However, just upstream of the survey site, the stream transitioned into a low gradient meadow where the channel was more of a Rosgen E stream type. The total assessment score at RM 1.0 was 65 out of a potential score of 65, with none of the assessment categories having reduced scores (Table 99). Riparian vegetation was comprised primarily of sedges, rushes, and grasses, with a conifer overstory of spruce and lodgepole pine. Past riparian logging was evident however, as mature trees were noticeably thinned. Fish habitat in this segment of West Fork Warm Springs Creek was rated as good (score: 7 points out a possible 7; Table 99), and was thought to be at its potential. Pocket water dominated the available habitat and large woody debris was fairly widespread despite past riparian logging. Juvenile rearing habitat was also common in this portion of the stream, although spawning habitat was rather limited and site specific. Spawning habitat was markedly more abundant upstream of the survey reach in the low gradient meadow area. Flow was good at RM 1.0, and numerous springs and seeps were observed throughout the surveyed section.

Table 99. Riparian assessment results for one site surveyed on West Fork Warm Springs Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.0	30/30 (100%)	28/28 (100%)	7/7 (100%)	65/65 (100%)

Water temperature was not monitored in West Fork Warm Springs Creek in 2007.

Middle Fork Warm Springs Creek

Middle Fork Warm Springs Creek is a tributary to Warm Springs Creek that drains for approximately two miles before entering Warm Springs Creek near RM 30.9. All of Middle Fork Warm Springs Creek flows through lands administered by the U.S. Forest Service. The primary land uses in the drainage are timber harvest and recreation.

A fish survey was completed at one section of Middle Fork Warm Springs Creek in August of 2007. The sample site was located at RM 0.4 on U.S Forest Service land (Table 100; Figure 5). The fish community at this site was comprised entirely of westslope cutthroat trout, which had an average total length of 86 mm (Table 100; Appendix A). While fish density was relatively high in the survey reach, and multiple age classes were present, most fish appeared to be juveniles that ranged between 60 and 80 mm in total length (Appendix A).

Table 100. Electrofishing data collected at one section of Middle Fork Warm Springs Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.4	WCT	57	57.0	86	38-192	100

A riparian assessment was completed for the one section electrofished on Middle Fork Warm Springs Creek in 2007. At RM 0.4, the channel displayed characteristics of a Rosgen E stream type. However, just below the survey section, the stream increased gradient and transitioned to a Rosgen B channel type. The total riparian assessment score at RM 0.4 was 67 out of a potential score of 70 (96%) (Table 101). The only category with a slightly reduced score was fish habitat. Riparian vegetation at the site was comprised primarily of sedges and grasses, with a conifer overstory of spruce and lodgepole pine. Past riparian logging was evident however, as mature trees were noticeably thinned. Fish habitat in this segment of West Fork Warm Springs Creek was rated as good (score: 7 points out a possible 10; Table 101), but was thought to be limited by a lack of large woody debris in the channel. Flow was good in the survey reach at the time of the survey in late August.

Table 101. Riparian assessment results for one site surveyed on Middle Fork Warm Springs Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.4	30/30 (100%)	30/30 (100%)	7/10 (70%)	67/70 (96%)

Water temperature was not monitored in Middle Fork Warm Springs Creek in 2007.

East Fork Warm Springs Creek

East Fork Warm Springs Creek is a tributary to Warm Springs Creek that drains for approximately two miles before entering Warm Springs Creek near RM 30.9. Most of East Fork Warm Springs Creek flows through lands administered by the U.S. Forest Service. However, several privately owned mining claims are also present at the head of the stream. The primary land uses in the drainage are timber harvest and recreation.

A fish survey was completed at one section of East Fork Warm Springs Creek in August of 2007. The sample site was located at RM 0.5 on U.S Forest Service land (Table 102; Figure 9). Sampling was conducted both upstream and downstream of a cascade/barrier located within the survey reach. However, no fish were captured or observed in this area of East Fork Warm Springs Creek (Table 45).

Table 102. Electrofishing data collected at one section of East Fork Warm Springs Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.5	NO FISH	-	-	-	-	-

East Fork Warm Springs Creek displayed characteristics of a Rosgen B channel type at RM 0.5. However, a scored riparian assessment was not completed at this site in 2007. This was primarily because no fish were captured in the survey reach, and the observable riparian area, which was dominated by a spruce and lodgepole pine overstory, showed relatively little signs of active disturbance. A rather recent timber harvest was evident outside the riparian area to the west of the channel however. Water temperature was not monitored in East Fork Warm Springs Creek in 2007.

Barker Creek

Barker Creek is a tributary to Warm Springs Creek that drains in a northerly direction for approximately five miles before reaching Warm Springs Creek at RM 20.7. The lower 0.5 miles of channel flows through privately owned lands, while the remainder of the

stream is situated on lands managed by the U.S. Forest Service. The presence of public ownership in the drainage is a relatively recent event, as the U.S. Forest Service only acquired the lands between 2000 and 2001. Prior to this, most of the watershed was managed by a private timber company who extensively harvested much of the drainage. Several high mountain lakes are present in the Barker Creek watershed and include Upper and Lower Barker lakes. Both lakes support recreational fisheries for westslope cutthroat trout that are supplemented with periodic stocking. The primary land uses in the Barker Creek drainage are recreation, timber harvest, and historic mining. There are also several rural homesites along the lower portion of the stream.

Fish surveys were completed at three sections of Barker Creek in late July of 2007. The sites were located at RM 0.5, 1.6, and 2.9 (Table 103; Figure 9). All sites were situated on public land managed by the U.S. Forest Service. At RM 0.5, the trout community was comprised primarily of bull trout and westslope cutthroat trout, which respectively made up 59% and 32% of the species composition (Table 103). Brook trout, while present in the reach, were relatively uncommon, and one very large bull trout-brook trout hybrid was also noted in this segment of the stream (Table 103). Bull trout at RM 0.5 had an average total length of 173 mm, while westslope cutthroat trout had a similar mean total length of 170 mm (Table 103; Appendix A). At RM 1.6, the fish community in Barker Creek was comprised largely of bull trout, which had an average total length of 162 mm (Table 103; Appendix A). *Oncorhynchus* species, which averaged 208 mm in total length, were also present in the sample section, but were notably less common (Table 103; Appendix A). While most of the *Oncorhynchus* species appeared to be westslope cutthroat trout, one individual was identified by phenotypic characteristics as a rainbow trout or a possible westslope cutthroat trout-rainbow trout hybrid. At RM 2.9, bull trout again comprised much of the fish community in Barker Creek. This species, which averaged 206 mm in total length, made up 74% of the species composition in the survey reach (Table 103; Appendix A). Westslope cutthroat trout, which averaged 153 mm in total length, made up the remainder (Table 103; Appendix A). One notable finding at RM 2.9 was the presence of a 519 mm bull trout. This fish was very large and was thought to have been a migratory adult that moved into Barker Creek out of Warm Springs Creek to spawn.

Table 103. Electrofishing data collected at three sections of Barker Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.5	BULL	13	13.0	173	94-238	59
	EBxBULL	1	1.0	429	n/a	4.5
	WCT	7	7.0	170	75-219	32
	EB	1	1.0	267	n/a	4.5
RM 1.6	BULL	13	13.0	162	85-226	76
	ONC	4	4.0	208	113-252	24
RM 2.9	BULL	26	26.0	206	129-519	74
	WCT	9	9.0	153	93-203	26

A riparian assessment was completed for each of the three sites electrofished on Barker Creek in 2007. At RM 0.5, the stream was in a fairly narrow canyon with a steep gradient and was classified as a Rosgen Ba channel type. The total riparian assessment score was 66 out of a potential score of 70 (94%) (Table 104). The categories with slightly reduced scores included geomorphology and vegetation. While the channel appeared stable throughout much of the survey reach, site-specific erosion was noted on one steep bank present in the section. This erosion appeared to be correlated with recent logging activity in the area. Riparian vegetation was comprised mainly of a willow and alder understory, and a lodgepole pine and spruce overstory. Canopy cover was relatively high throughout the survey section despite recent timber harvest to the edge of the riparian zone on both sides of the stream. A few noxious weeds were noted in the riparian area as well as in the nearby cutover areas. Fish habitat in this section of Barker Creek was rated as excellent (score: 10 points out a possible 10; Table 104), and was thought to be at its potential. Pools and large woody debris were abundant throughout the reach, and thick riparian vegetation provided good shade and overhanging cover. Additionally, flow was very good at the time of the survey in late July.

At RM 1.6, Barker Creek was flowing through a broader canyon and gradient was less than at RM 0.5. At this site, the channel was characteristic of a Rosgen B stream type. The total riparian assessment score at RM 1.6 was 64 out of a potential score of 70 (91%) (Table 104). Categories with reduced scores included vegetation and fish habitat. Woody riparian vegetation was comprised of a patchy willow and shrub understory, and a conifer overstory primarily of lodgepole pine. Recent logging activity was very evident throughout the reach on both sides of the stream, and canopy cover was slightly limited. Additionally a few noxious weeds, mostly sulphur cinquefoil, were also present in the riparian area. Fish habitat was rated as good (score: 7 points out a possible 10; Table 104) at RM 1.6, but was thought to be limited by a general lack of pools and large woody debris in the channel. Flow was good at the time of the survey in late July.

At RM 2.9, Barker Creek had picked up gradient and was classified as a Rosgen Ba stream type. Despite the presence of old berms and placer piles in the riparian area, the

stream appeared stable. The total riparian assessment score was 61 out of a potential score of 70 (87%) (Table 104). Categories that showed slightly reduced scores were vegetation and fish habitat (Table 104). Woody riparian vegetation was comprised mostly of conifers including lodgepole pine, spruce, and sub-alpine fir. Willows were also present in the understory, but were fairly sparse and patchy in their distribution. Relatively recent logging activity was again noted near the riparian zone throughout the survey section. A few noxious weeds were also present but were mostly associated with disturbed areas. Fish habitat in this segment of Barker Creek was rated as good (score: 7 points out a possible 10; Table 104), but like at RM 1.6, was thought to be limited by a general lack of pools and large woody debris in the channel. Flow continued to be good in this reach of the stream.

Table 104. Riparian assessment results for three sites surveyed on Barker Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.5	27/30 (90%)	29/30 (97%)	10/10 (100%)	66/70 (94%)
RM 1.6	30/30 (100%)	27/30 (90%)	7/10 (70%)	64/70 (91%)
RM 2.9	30/30 (100%)	24/30 (80%)	7/10 (70%)	61/70 (87%)

Water temperature was monitored at one site in Barker Creek from July 6 through October 17, 2007 (Figure 9; Appendix B). The thermograph was placed near the mouth at RM 0.1. Water temperatures remained cool at this site reaching a maximum temperature of only 14.7 °C on July 19.

Foster Creek

Foster Creek is a tributary to Warm Springs Creek that drains in a southerly direction for over nine miles before reaching Warm Springs Creek at RM 20.9, just upstream of the mouth of Barker Creek. The lower 0.6 miles of channel flows through privately owned residences, while the remainder of the stream is situated largely on lands managed by the U.S. Forest Service. However, there are several private in-holdings present near RM 3.0, and the Forest Service operates the Anaconda Job Corps facility in the drainage as well (near RM 1.5). The primary land uses in the Foster Creek drainage are recreation, timber harvest, and rural homesites.

Fish surveys were completed at three sections of Foster Creek in August of 2007. The sites were located at RM 1.1, 2.3, and 3.9 (Table 105; Figure 9). All sites were situated on public land managed by the U.S. Forest Service. At RM 1.1, the trout community was comprised largely of westslope cutthroat trout, which had an average total length of 153 mm (Table 105; Appendix A). Brook trout were also relatively common in the reach, and one 517 mm brook trout-bull trout hybrid (phenotypic characteristics) was collected in the survey section as well (Table 105). This adult fish was likely migratory, and moved into Foster Creek out of Warm Springs Creek in an attempt to spawn. Additionally, slimy sculpin were also noted at RM 1.1. At RM 2.3, westslope cutthroat trout again comprised

the majority of the fish sampled in the reach, representing 65% of the fish captured in the sample section (Table 105). Brook trout remained relatively common, while bull trout were present, but rare (Table 105). At RM 3.9, the fish community was comprised primarily of westslope cutthroat trout, which had an average total length of 131 mm (Table 105; Appendix A). Brook trout became relatively rare in this reach of Foster Creek, with only two individuals captured in the 100 m section. No bull trout were observed at RM 3.9 during the 2007 survey.

Table 105. Electrofishing data collected at three sections of Foster Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.1	EBxBULL	1	1.0	517	n/a	1
	WCT	55	55.0	153	79-254	74
	EB	18	18.0	144	50-219	24
RM 2.3	BULL	1	1.0	171	n/a	2
	WCT	36	36.0	95	66-178	65
	EB	18	18.0	131	49-225	33
RM 3.9	WCT	59	59.0	131	55-246	97
	EB	2	2.0	188	162-213	3

A riparian assessment was completed for each of the three sites electrofished on Foster Creek in 2007. At RM 1.1, the channel was relatively low gradient and was classified as a Rosgen Bc channel type. The total riparian assessment score was 63 out of a potential score of 70 (90%) (Table 106). Categories with slightly reduced scores included vegetation and fish habitat (Table 106). Woody vegetation at RM 1.1 was comprised primarily of willow and alder, with conifers, aspen and cottonwood also distributed throughout the reach. Woody shrubs were relatively abundant along much of the stream, but there were also many small openings where grasses dominated the plant community. Noxious weeds were relatively sparse, although Canada thistle and spotted knapweed were noted to be present in the riparian area. Fish habitat in this segment of Foster Creek was rated as good (score: 7 points out of a possible 10; Table 106), but was limited by low water flow. A beaver pond complex was observed just upstream of the sample site.

At RM 2.3, Foster Creek was situated in a relatively confined canyon and gradient was noticeably higher than at RM 1.1. The stream was classified as a Rosgen Ba channel type at this location. The total riparian assessment score was 65 out of a potential score of 70 (93%) (Table 106). Woody riparian vegetation consisted of a diverse community of willow, dogwood, alder, aspen, cottonwood, and conifers. Disturbance-caused plants and noxious weeds were largely absent from the sample site. Fish habitat at RM 2.3 was rated as good (score: 7 points out of a possible 10; Table 106), but was limited by a general lack of deep pools and relatively low water flow. A large beaver pond complex was observed upstream of the sample site, and several large woody debris jams were also noted within the survey reach. Some of these sites appeared to cause some hindrance to fish

movement. Additionally, the stream went subsurface downstream of the survey reach for a significant distance, creating at least a seasonal fish barrier.

At RM 3.9, Foster Creek was in a slightly broader canyon than at RM 2.3, and was classified as a Rosgen B stream type. The total riparian assessment score was 59 out of a potential score of 70 (84%) (Table 106). Woody vegetation was rather limited throughout the riparian area and consisted primarily of a conifer overstory of lodgepole pine. Although present, woody shrubs including willow and alder were very sparse along this segment of Foster Creek. Despite this, fish habitat at RM 3.9 was rated as good (score: 7 points out a possible 10; Table 106), but was limited by a lack of quality pools and large woody debris in the channel. Flow appeared good at the time of the survey in early August.

Table 106. Riparian assessment results for three sites surveyed on Foster Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.1	30/30 (100%)	26/30 (87%)	7/10 (70%)	63/70 (90%)
RM 2.3	30/30 (100%)	28/30 (93%)	7/10 (70%)	65/70 (93%)
RM 3.9	28/30 (93%)	24/30 (80%)	7/10 (70%)	59/70 (84%)

Water temperature was monitored at one site in Foster Creek from July 6 through October 17, 2007 (Appendix B). The thermograph was placed at RM 1.5 (Figure 9). Water temperatures at this location remained relatively cool exceeding 15°C on just 11 days. The maximum-recorded temperature, which occurred on July 14, was 16.1°C.

Twin Lakes Creek

Twin Lakes Creek is a tributary to Warm Springs Creek that drains in a northerly direction for approximately 10 miles before reaching Warm Springs Creek at RM 22.8. The lower 1.2 miles of channel flows through privately owned lands, while most of the remainder of the stream is situated on lands managed by the U.S. Forest Service. The presence of extensive public ownership in the drainage is a relatively recent occurrence, as the U.S. Forest Service acquired a number of parcels between 2000 and 2001. Prior to this, a large portion of the watershed was managed by a private timber company who extensively harvested much of the area. A large, unscreened trans-basin diversion operated by the county of Butte-Silver Bow exists on Twin Lakes Creek at RM 2.2. The purpose of the diversion is to deliver water to Silver Lake. The conveyance structure is very old and in poor condition, but the site is still operable and continues to be used annually. Several high mountain lakes are present in the Twin Lakes Creek watershed and include Upper and Lower Twin lakes (on Twin Lakes Creek), and Lake of the Isle (in East Fork Twin Lakes Creek drainage). All of these lakes support recreational fishing opportunities. The primary land uses in the Twin Lakes Creek drainage are recreation and

timber harvest. There are also several rural and recreational homesites along the lower portion of the stream.

Fish surveys were completed at four sections of Twin Lakes Creek in late July of 2007. The sites were located at RM 1.4, 2.8, 4.7, and 7.2 (Table 107; Figure 9). All sites were situated on public land managed by the U.S. Forest Service. The section at RM 1.4 was located 0.8 miles downstream of the Silver Lake diversion structure. The trout community at this site was comprised of westslope cutthroat trout, bull trout, and brook trout (Table 107). Overall fish density appeared low, although high flow and steep gradient may have reduced electrofishing efficiency to some degree. Westslope cutthroat trout, which averaged 162 mm in total length, were most abundant, followed by brook trout (average total length 175 mm), and bull trout (average total length 174 mm), respectively (Table 107; Appendix A). The four bull trout captured in the section appeared to be juveniles of a similar age. Slimy sculpin were also noted in the reach. At RM 2.8 (0.6 miles upstream of the Silver Lake diversion), the trout community was comprised of roughly equal numbers of westslope cutthroat trout and brook trout, with westslope cutthroat trout being slightly more common, representing 56% of all the trout captured in the reach (Table 107). Fish of both species tended to be rather small with fish less than 110 mm dominating the catch (Table 107; Appendix A). Slimy sculpin were also observed to be common in this reach of Twin Lakes Creek. At RM 4.7, the fish community was similar to that found at RM 2.8. Westslope cutthroat trout, which averaged 146 mm in total length, comprised the majority (62%) of the trout captured at the site, with brook trout (average total length 140 mm) being the only other trout species collected in the reach (Table 107; Appendix A). Slimy sculpin were again noted as common in this segment of the stream. At RM 7.2, 0.2 miles downstream of Lower Twin Lake, the trout community was again comprised of westslope cutthroat trout and brook trout. Like at downstream reaches, westslope cutthroat trout (average total length 125 mm) tended to be more common, with brook trout (average total length 121 mm) occurring slightly less frequently (Table 107; Appendix A). Slimy sculpin continued to be very common at RM 7.2. Bull trout are known to occur in Upper and Lower Twin lakes, and annual redd counts have been conducted by the U.S. Forest Service in Twin Lakes Creek between and above the lakes since 1999. The counts have been relatively variable and have ranged from a low of 7 redds in 2000, to a high of 27 redds in 1999.

Table 107. Electrofishing data collected at four sections of Twin Lakes Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 1.4	BULL	4	4.0	174	168-178	21
	WCT	9	9.0	162	123-189	47
	EB	6	6.0	175	140-204	32
RM 2.8	WCT	20	20.0	103	58-218	56
	EB	16	16.0	105	40-218	44
RM 4.7	WCT	18	18.0	146	108-227	62
	EB	11	11.0	140	100-189	38
RM 7.2	WCT	11	11.0	125	98-137	61
	EB	7	7.0	121	74-227	39

A riparian assessment was completed for each of the four sites electrofished on Twin Lakes Creek in 2007. At RM 1.4, the channel was relatively high gradient and was classified as a Rosgen Ba stream type. The total riparian assessment score was 59 out of a potential score of 60 (98%) (Table 108). Conifers, including lodgepole pine, spruce and sub-alpine fir, comprised much of the riparian vegetation, with woody shrubs (primarily alder and willow) also present throughout the reach. While noxious weeds were also in the riparian area, they were site specific, and were associated with a vehicle pullout near to the stream. No weeds or undesirable plants were observed throughout the rest of the surveyed reach. Recent and historic timber harvest was evident near the sample site. Fish habitat at RM 1.4 was rated only fair (score: 3 points out a possible 3; Table 108), but was thought to be at its potential. This was primarily because the reach was fairly high gradient and many of the pools and pockets were relatively turbulent with fast velocity. Although this site was below the Silver Lake diversion (RM 2.2), flow was very good at the time of the survey in late July. An examination of the diversion found it in operation, but diverting relatively little water at the time. It appeared to be a complete fish barrier.

At RM 2.8, Twin Lakes Creek had noticeably less gradient than at RM 1.4, and was more characteristic of a meandering Rosgen C stream type. The total riparian assessment score at the survey location was 60 out of a potential score of 66 (91%) (Table 108). Woody vegetation along the stream banks consisted primarily of patchy willow and alder, with lodgepole pine, spruce, and sub-alpine fir being more common away from the channel. Deep-rooted vegetation was somewhat sparse along much of the bank length throughout the survey section. Additionally, a few noxious weeds were also noted in the riparian area. Fish habitat at RM 2.8 was rated as good (score: 7 points out a possible 10; Table 108), but was slightly limited by a lack of overhanging vegetation. However, there were a fair number of large pools throughout the reach, as well as a good amount of large woody debris in the channel. Additionally, spawning habitat was also abundant in this reach of Twin Lakes Creek. Flow was very good at the time of the survey in late July.

At RM 4.7, Twin Lakes Creek was classified as a Rosgen B stream type. The total riparian assessment score at this site was 64 out of a potential score of 67 (96%) (Table 108). The only category that showed a slightly reduced score was fish habitat (Table 108). Riparian vegetation was comprised primarily of conifers, including lodgepole pine, spruce, and sub-alpine fir. Woody shrubs, including alder and willow, were also present, but were mostly found as individual plants scattered throughout the reach. Fish habitat at RM 4.7 was rated as good (score: 7 points out a possible 10; Table 108), but was slightly limited by a lack of abundant large woody debris incorporated in the channel. Past logging was evident in and around the section, and many of the trees in the riparian area were rather young. There were few old or dead trees observed in the survey reach. This is a possible explanation for the reduced amount of large wood in the channel. Similar to downstream sites, there was abundant flow in this reach of Twin Lakes Creek at the time of the late July survey.

At RM 7.2, Twin Lakes Creek was notably smaller than at downstream reaches. At this site, the channel was relatively unconfined, but was high gradient and was classified as a Rosgen Ba stream type. The total riparian assessment score was 64 out of a potential score of 67 (96%) (Table 108). Fish habitat was the only category that showed a slightly reduced score (Table 108). Similar to RM 4.7, conifers (lodgepole pine, spruce, and sub-alpine fir) comprised much of the riparian overstory. Alder and willow were also present, but tended to be relatively sparse in the survey reach. Recent, widespread timber harvest was evident throughout the area. Fish habitat in this segment of Twin Lakes Creek was rated as good (score: 7 points out a possible 10; Table 108), and was near its potential. However, a lack of large woody debris incorporated in the channel limited the overall quality of fish habitat in the reach. As at RM 4.7, past timber harvest in the riparian area is likely a potential explanation for the lack of large wood in the channel. Flow in this reach of the stream was good, but was notably less than at RM 4.7. The East Fork of Twin Lakes Creek joined Twin Lakes Creek approximately two miles downstream, and appeared to contribute a significant amount of water to the mainstem.

Table 108. Riparian assessment results for four sites surveyed on Twin Lakes Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 1.4	30/30 (100%)	26/27 (96%)	3/3 (100%)	59/60 (98%)
RM 2.8	30/30 (100%)	23/26 (88%)	7/10 (70%)	60/66 (91%)
RM 4.7	30/30 (100%)	27/27 (100%)	7/10 (70%)	64/67 (96%)
RM 7.2	30/30 (100%)	27/27 (100%)	7/10 (70%)	64/67 (96%)

We attempted to monitor water temperature near the mouth (RM 0.2) of Twin Lakes Creek from July 6 through October 17, 2007 (Figure 9; Appendix B). However, the thermograph was tampered with within one week of its installation, and was left out of the water. The maximum-recorded temperature during its short period of operation was 15.3°C, which occurred on July 12. Spot temperature checks collected during

electrofishing showed that water temperatures were relatively cool at RM 1.4, 2.8, and 4.7, ranging between 11.2°C and 12.8°C (July 25-26). However, at RM 7.2, water temperature was measured at 20°C on the afternoon of July 25. This relatively high water temperature was likely related to the close proximity of the site to Lower Twin Lake. Lower Twin Lake is relatively shallow and likely has a warm surface temperature, although no data was collected to determine this in 2007.

Cable Creek

Cable Creek is a tributary to Warm Springs Creek that drains for approximately five miles before entering Warm Springs Creek near RM 22.8. Cable Creek was historically a tributary to Storm Lake Creek, but Storm Lake Creek has since been diverted to Silver Lake, and the old channel is now part of the Silver Lake aqueduct. Cable Creek joins the aqueduct at Cable Creek RM 1.5, and because the aqueduct channel is relatively naturalized at this point, and since Cable Creek was contributing most of the water at the time of the survey in late July 2007, the aqueduct was considered to be Cable Creek. Land ownership along Cable Creek is variable and consists of a mixture of public and private lands. The U.S. Forest Service manages much of the stream below RM 2.5, although private in-holdings do exist in this area. Above RM 2.5, much of the land along Cable Creek is in private ownership and several residences were noted in the vicinity. Additionally, the Cable Mountain Mine is located at the headwaters of the stream. Land uses in the Cable Creek watershed include mining, timber harvest, recreation, and private residences.

Fish surveys were completed at two sections of Cable Creek in late July of 2007. The sites were located at RM 0.8 and 2.2 (Table 109; Figure 9). All sites were situated on land managed by the U.S. Forest Service. At RM 0.8, brook trout (average total length 112 mm) were present in Cable Creek, but 70% of the fish community was comprised of *Oncorhynchus* species, which had an average total length of 149 mm (Table 109; Appendix A). An unexpected finding was that almost all of the *Oncorhynchus* species captured in the reach appeared to be pure rainbow trout (phenotypic characteristics). Only one westslope cutthroat trout was identified in the sample section. The presence and relatively high density of rainbow trout at RM 0.8 is not well understood. At RM 2.2, species composition exhibited a notable shift, with brook trout comprising the entire fish community at this site. Fish density in this segment of Cable Creek was high, and fish size was variable ranging from 48 to 275 mm in total length (Table 109; Appendix A). Past fish sampling conducted by the U.S. Forest Service upstream of this site found only high densities of brook trout. Additionally, brook trout were the only species visually observed in a pond present at the headwaters of the stream during 2007.

Table 109. Electrofishing data collected at two sections of Cable Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.8	ONC	45	45.0	149	50-263	70
	EB	19	19.0	112	64-199	30
RM 2.2	EB	94	94.0	147	48-275	100

A riparian assessment was completed for each of the two sites electrofished on Cable Creek in 2007. At RM 0.8, the survey section was located just upstream of the U.S. Forest Service picnic ground at Spring Hill. At this location, the stream was actually part of the Silver Lake aqueduct, and probably in the location of the historic Storm Lake Creek channel. Through the section, the channel appeared fairly natural, and was classified as a Rosgen B stream type. The total riparian assessment score was 58 out of a potential score of 65 (89%) (Table 110). Categories with reduced scores included vegetation and fish habitat (Table 110). Vegetation at the site was comprised largely of a conifer overstory of spruce and lodgepole pine. However, woody shrubs including willow and alder were also fairly common throughout the survey section. Downstream of the electrofishing site, in the established picnic area, much of the woody understory vegetation had been cleared, although this did not appear to have a significant effect on channel stability. A few disturbance-induced plants (mostly dandelion) were present throughout the riparian area, and noxious weeds tended to be rather abundant. The presence of these weedy species was likely related to the close proximity of the site to a main road and the picnic area. Fish habitat at RM 0.8 was only fair (score: 3 points out a possible 7; Table 110), and was limited by a lack of large pools, and minimal large woody debris in the channel. Most of the habitat in the survey section was a fast, high-gradient riffle that offered mainly small pockets of velocity refuge. Flow was very good at the time of the survey in late July, despite the fact that the Silver Lake aqueduct did not appear to be running much water at the time.

At RM 2.2, Cable Creek had transitioned into a large, low-gradient meadow that was located upstream of the confluence of the Silver Lake aqueduct. In this section, the channel was relatively deep and sinuous, and was classified as a Rosgen E stream type. There was also notable beaver activity throughout the area. The total riparian assessment score was 66 out of a potential score of 69 (96%) (Table 110). Fish habitat was the only category with a slightly reduced score (Table 110). Riparian vegetation was comprised primarily of a sedge and low growing woody shrub community. Willows and bog birch were common but because of their limited height, provided little shade to the channel. Tall willow plants capable of providing shade and cover were sparse. Fish habitat was rated as good (score: 7 points out a possible 10; Table 110), but was thought to be limited by a lack of overhead cover provided by overhanging vegetation. Additionally, extensive fine sediment accumulation throughout much of the reach greatly limited spawning habitat. Flow was very good at the time of the survey in late July, and despite the lack of shade, water temperatures were notably cool.

Table 110. Riparian assessment results for two sites surveyed on Cable Creek in 2007.

Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.8	30/30 (100%)	25/28 (89%)	3/7 (43%)	58/65 (89%)
RM 2.2	30/30 (100%)	29/29 (100%)	7/10 (70%)	66/69 (96%)

Water temperature was not monitored in Cable Creek in 2007. However, water temperature at RM 2.2, measured during fish sampling on the afternoon July 27, 2007, was a cold 9.7°C.

Storm Lake Creek

Storm Lake Creek is a tributary to Silver Lake that drains into the east end of the reservoir. Storm Lake Creek was historically a tributary to Warm Springs Creek, but the stream was completely diverted to Silver Lake to provide water for reservoir management. Storm Lake Creek has been channelized and diverted away from its historic channel at approximately RM 1.0. The dam on Storm Lake, located near RM 7.4, controls flow in Storm Lake Creek. The county of Butte-Silver Bow manages the water levels in Storm Lake and Silver Lake. Land ownership along Storm Lake Creek consists primarily of lands administered by the U.S. Forest Service. However, privately owned lands exist in the lower 0.5 miles of the stream near Silver Lake, and near the lower end of Storm Lake as well (near RM 7.4). Historically, much of the watershed was owned/managed by a private timber company who heavily harvested much of its land. However, between 2000 and 2001, the U.S. Forest Service acquired the majority of these parcels. The primary land uses in the Storm Lake Creek drainage are recreation and timber harvest.

Fish surveys were completed at five sections of Storm Lake Creek in mid-to-late July of 2007. The sites were located at RM 0.6, 1.4, 3.0, 4.2, and 6.3 (Table 111; Figure 9). All sites were situated on land managed by the U.S. Forest Service. At RM 0.6, the fish community was comprised of equal densities of westslope cutthroat trout and brook trout (Table 111). Westslope cutthroat trout had mean total length of 98 mm, whereas brook trout tended to be slightly larger on average, having a mean total length of 122 mm (Table 111; Appendix A). At RM 1.4, westslope cutthroat trout and brook trout were again present at similar densities, although westslope cutthroat trout tended to be slightly more common (Table 111). Westslope cutthroat trout had mean total length of 158mm, and brook trout had a mean total length of 149 mm (Table 111; Appendix A). In addition to these species, one 110 mm juvenile bull trout was also noted in this reach of Storm Lake Creek (Table 111). At RM 3.0, westslope cutthroat trout and brook trout were again relatively common, with westslope cutthroat trout making up 58% of the species composition, and brook trout contributing an additional 30%. The remaining portion of the fish community sampled at RM 3.0 consisted of three juvenile bull trout (9%), and one phenotypic bull trout-brook trout hybrid (3%) (Table 111). At RM 4.2, the fish community was comprised largely of westslope cutthroat trout, which averaged 159 mm

in total length (Table 111; Appendix A). Juvenile bull trout (average total length 115 mm) were also present in this segment of Storm Lake Creek, and appeared slightly more abundant than at sites sampled downstream. Brook trout (average total length 151 mm) continued to be present at RM 4.2, but were noticeably less common than at downstream reaches, making up only 14% of the fish community (Table 111). At RM 6.3, westslope cutthroat trout, averaging 139 mm in total length, again comprised the majority (68%) of the fish community (Table 111; Appendix A). Juvenile bull trout (average total length 83 mm) were also relatively common at RM 6.3, comprising 27% of the species composition (Table 111). Brook trout, which had an average total length of 172 mm, became rare in this segment of Storm Lake Creek; with only two individuals captured in the 100 m reach (Table 111; Appendix A).

Table 111. Electrofishing data collected at five sections of Storm Lake Creek in 2007.

Section Name	Species	Number of Fish Captured	Fish per 100 m (CPUE)	Mean Length (mm)	Length Range (mm)	Species Composition (%)
RM 0.6	WCT	15	15.0	98	64-186	50
	EB	15	15.0	122	93-174	50
RM 1.4	BULL	1	1.0	110	n/a	3
	WCT	17	17.0	158	124-212	55
	EB	13	13.0	162	130-221	42
RM 3.0	BULL	3	3.0	95	92-100	9
	EBxBULL	1	1.0	154	n/a	3
	WCT	19	19.0	155	110-196	58
	EB	10	10.0	149	122-173	30
RM 4.2	BULL	6	6.0	115	75-163	16
	WCT	26	26.0	159	69-239	70
	EB	5	5.0	151	138-170	14
RM 6.3	BULL	11	11.0	83	77-93	27
	WCT	28	28.0	139	63-221	68
	EB	2	2.0	172	169-175	5

A riparian assessment was completed for each of the five sites electrofished on Storm Lake Creek in 2007. At RM 0.6, the survey location was situated in the channelized portion of the stream. The stream was classified as a stable Rosgen B channel type, although it was primarily an incised ditch. The total riparian assessment score at this site was 45 out of a potential score of 68 (66%) (Table 112). All categories had reduced scores. The geomorphology score was mainly affected by the presence of large berms on each side of the channel that prevented water from accessing a floodplain. Despite this, the channel was noted to be stable with little evidence erosion observed. Riparian

vegetation was comprised primarily young and middle-aged lodgepole pine, and a mixture of willow and alder shrubs. Undesirable, disturbance-induced plants and noxious weeds were also present throughout the area, but were not very widespread. Additionally, considerable recent timber harvest was observed in the area. Fish habitat at RM 0.6 was rated as poor (score: 0 points out a possible 10; Table 112), and was limited by a lack of pools, large woody debris, and overall complexity. The ditched and straightened channel was basically a long riffle with little velocity refuge. A walk-through survey downstream of the sample section near where the stream entered Silver Lake noted the presence of a diversion structure that appeared to be at least a seasonal fish barrier to fish moving upstream out of the lake.

At RM 1.4, Storm Lake Creek had a more natural channel and was above the channelized area. At this site, the stream was classified as a Rosgen B channel type, and the total riparian assessment score was 58 out of a potential score of 66 (88%) (Table 112). Vegetation at the site was comprised mainly of a dense conifer overstory of spruce and lodgepole pine, with a few woody shrubs also present in the understory. Willow plants in the reach showed evidence of light browse pressure from wildlife. Fish habitat at RM 1.4 was rated only fair (score: 3 points out a possible 10; Table 112), and was not thought to be at its potential. This was because there were only a few large pools in the sample reach, and large woody debris was relatively sparse. The pools that were present held the majority of the fish, as most of the remaining habitat was comprised of fast, shallow riffles with little holding cover. Upstream of the sample location, the main Storm Lake access road encroached on the channel in several locations. These areas appeared to be sediment sources although silt fences had been put in place by the U.S. Forest Service to limit side cast of materials into the stream.

At RM 3.0, Storm Lake Creek remained classified as a Rosgen B stream type. The total riparian assessment score was a perfect 66 out of a potential score of 66 (100%) (Table 112). Riparian vegetation was comprised of a dense conifer community of spruce and lodgepole pine. However, extensive timber harvest was observed outside of the immediate riparian area on both sides of the stream. Despite this, there were a number of mature trees along the stream, and large woody debris was common on the forest floor and in the stream channel. Fish habitat in this reach of Storm Lake Creek was rated as excellent (score: 10 points out a possible 10; Table 112), and was thought to be at its potential. The abundance of woody debris in the channel made for diverse and complex habitat including a number of quality pools and pockets. Flow was very good in this reach of the stream during the time of the survey in late July.

At RM 4.2, Storm Lake Creek continued to be classified as a Rosgen B stream type. However, at this location the channel flowed through a relatively open meadow area that showed evidence of past timber harvest. The total riparian assessment score was 65 out of a potential score of 70 (93%) (Table 112). Riparian vegetation was comprised largely of sedges and grasses with interspersed willows, lodgepole pine, and spruce. While deep-rooted vegetation was abundant along the stream banks, trees were sparse due to past riparian harvest, and willows were relatively small and showed moderate browse pressure from wildlife. Fish habitat at RM 4.2 was rated as good (score: 7 points out a possible 10;

Table 112), but was limited by a lack of overhanging vegetation providing shade and cover to the stream. Pools were also fairly infrequent despite the presence of large woody debris in the channel. Additionally, fine sediment and sand accumulation was noted in depositional areas throughout the reach, and was likely related to historic land uses in the area including road crossings and riparian timber harvest.

At RM 6.3, Storm Lake Creek continued to be a Rosgen B stream type, although channel gradient had begun to increase in this area. The total riparian assessment score was a perfect 70 out of a potential score of 70 (100%) (Table 112). Riparian vegetation was comprised of a dense conifer community primarily of spruce and lodgepole pine. Evidence of historic timber harvest was apparent throughout the survey reach, including several abandoned road crossings. Recent timber harvest was also observed in the general area. Fish habitat at RM 6.3 was rated as excellent (score: 7 points out a possible 10; Table 112), and was at its potential. Large woody debris was abundant throughout the sample reach, and there were also numerous deep pools and pockets present. Similar to reaches surveyed downstream, flow was good in this segment of the Storm Lake Creek during the sample period in late July.

Table 112. Riparian assessment results for five sites surveyed on Storm Lake Creek in 2007.

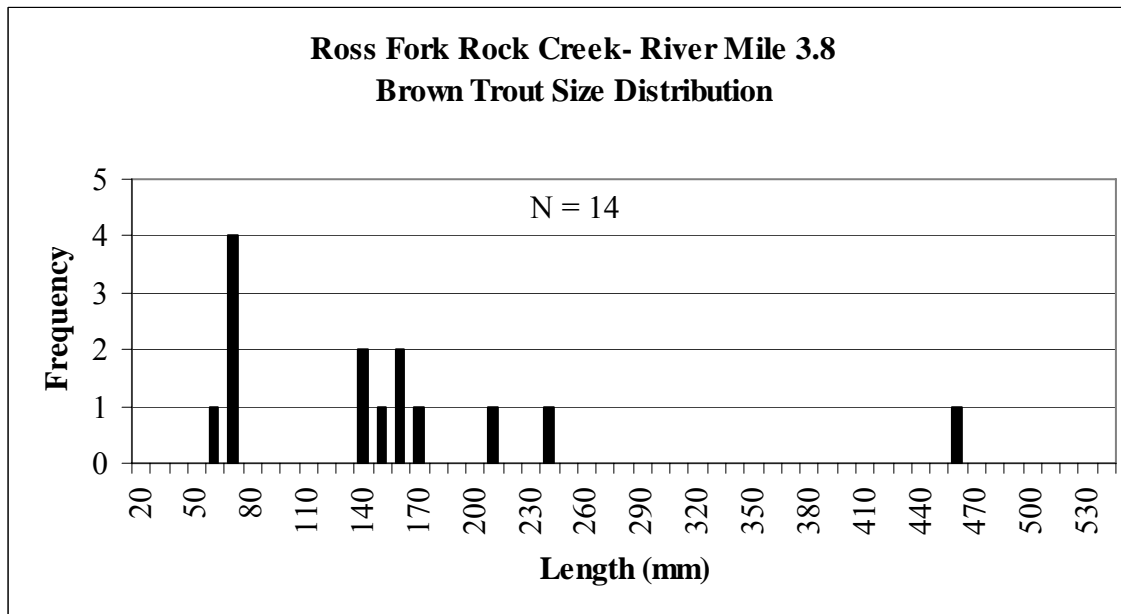
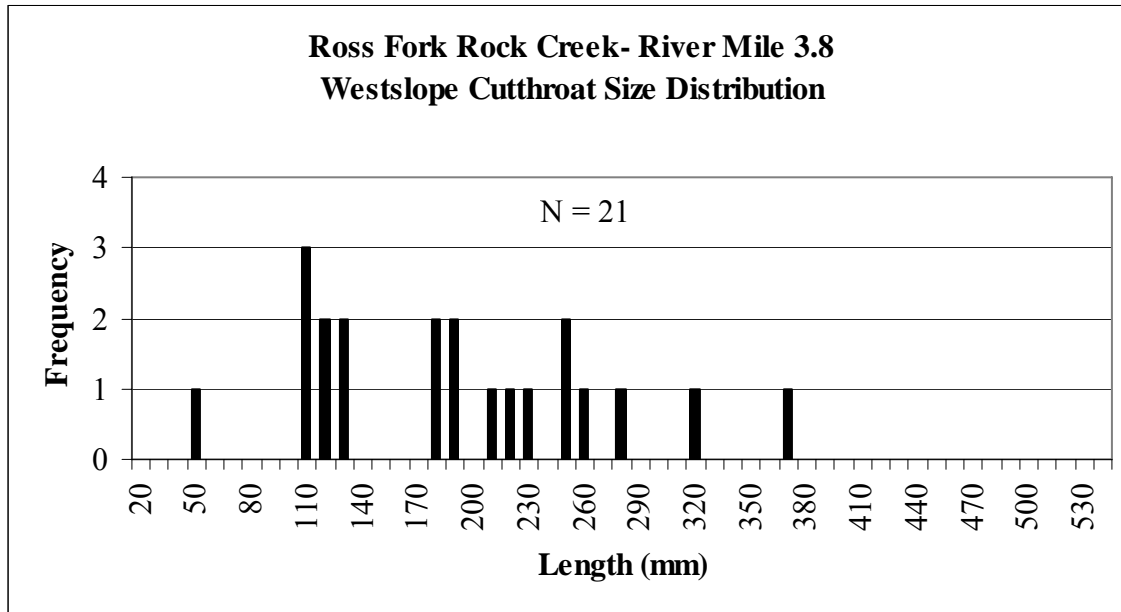
Section	Geomorphology	Vegetation	Fish Habitat	Total Score
RM 0.6	22/30 (73%)	23/28 (82%)	0/10 (0%)	45/68 (66%)
RM 1.4	30/30 (100%)	25/26 (96%)	3/10 (30%)	58/66 (88%)
RM 3.0	30/30 (100%)	26/26 (100%)	10/10 (100%)	66/66 (100%)
RM 4.2	30/30 (100%)	28/30 (93%)	7/10 (70%)	65/70 (93%)
RM 6.3	30/30 (100%)	30/30 (100%)	10/10 (100%)	70/70 (100%)

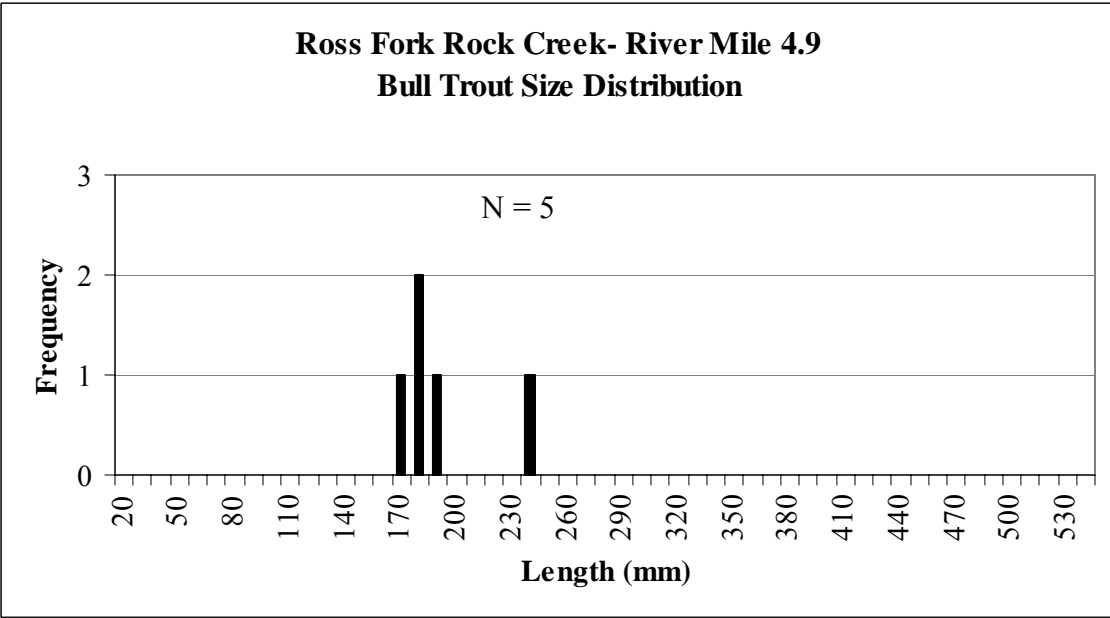
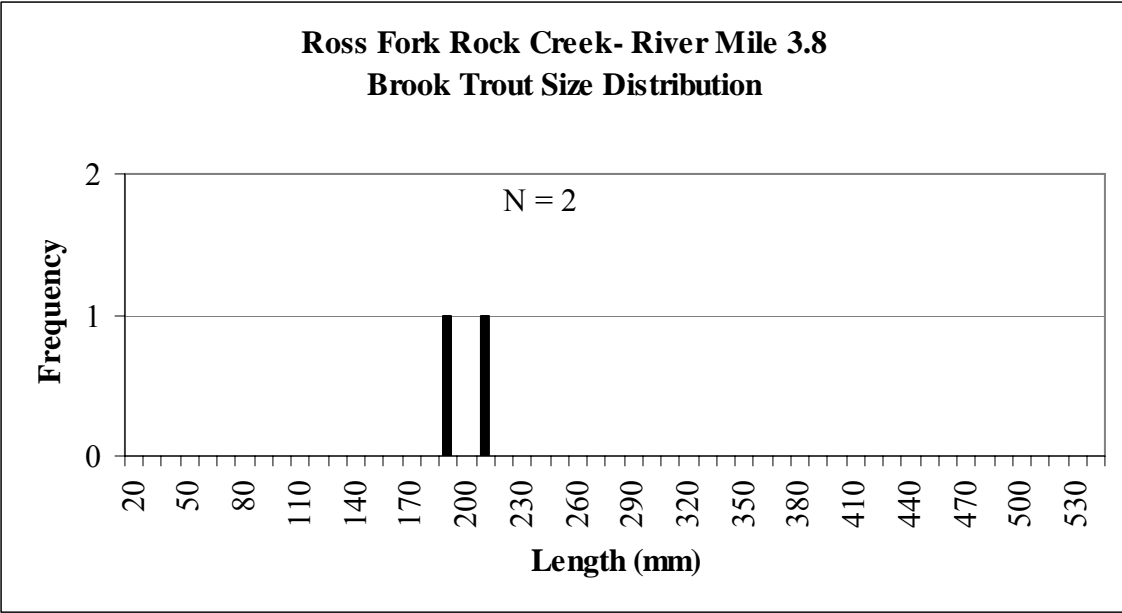
Water temperature was monitored at one site on Storm Lake Creek from July 6 through October 17, 2007 (Appendix B). The thermograph was placed at RM 1.4 (Figure 9). Maximum daily water temperatures at this location remained relatively cool exceeding 15°C on only one day. The maximum-recorded temperature was 15.1°C, which occurred on July 18.

Appendix A

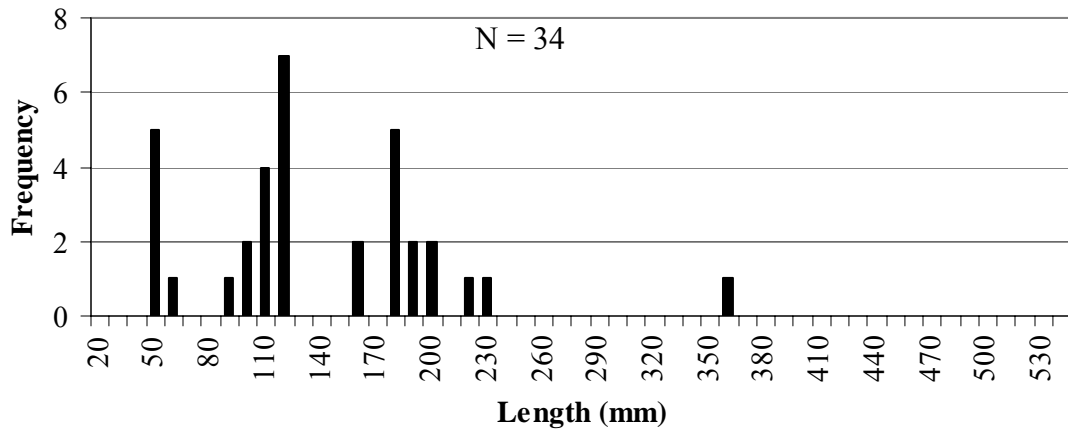
Ross Fork Rock Creek

Ross Fork Rock Creek

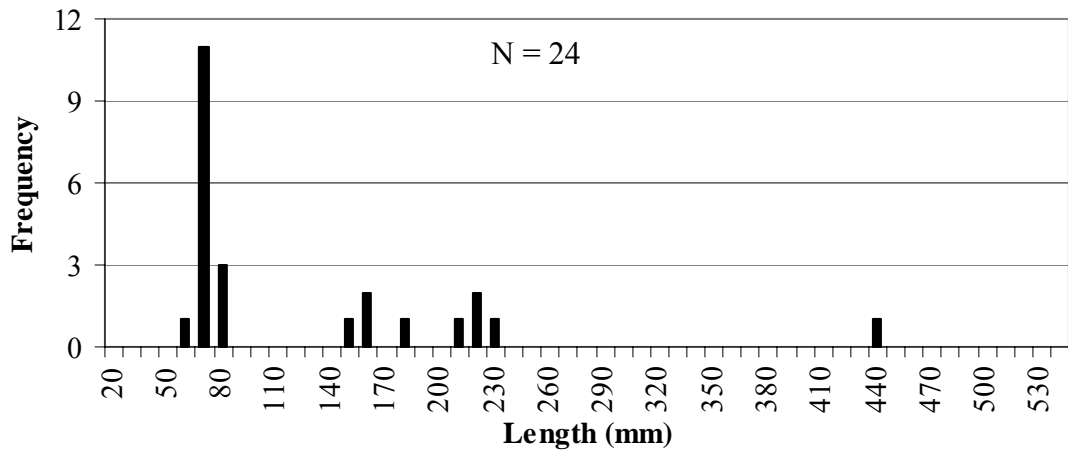




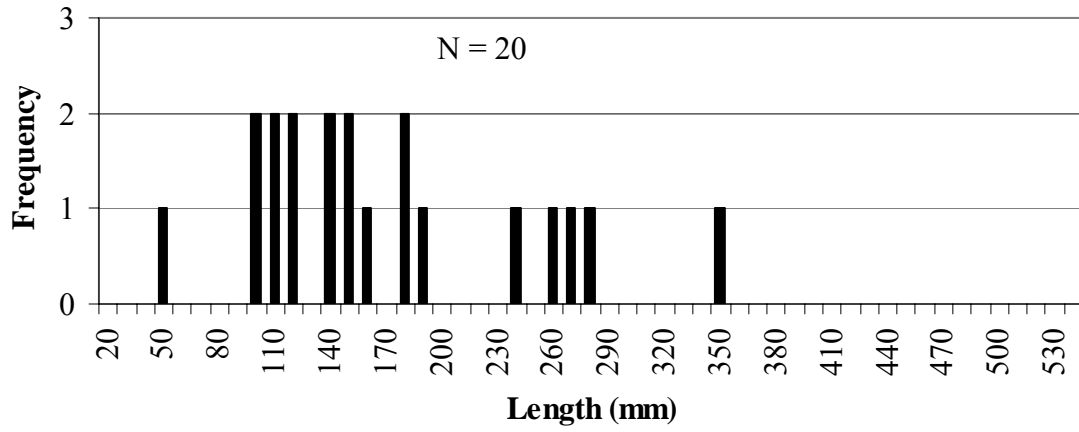
**Ross Fork Rock Creek- River Mile 4.9
Westslope Cutthroat Size Distribution**



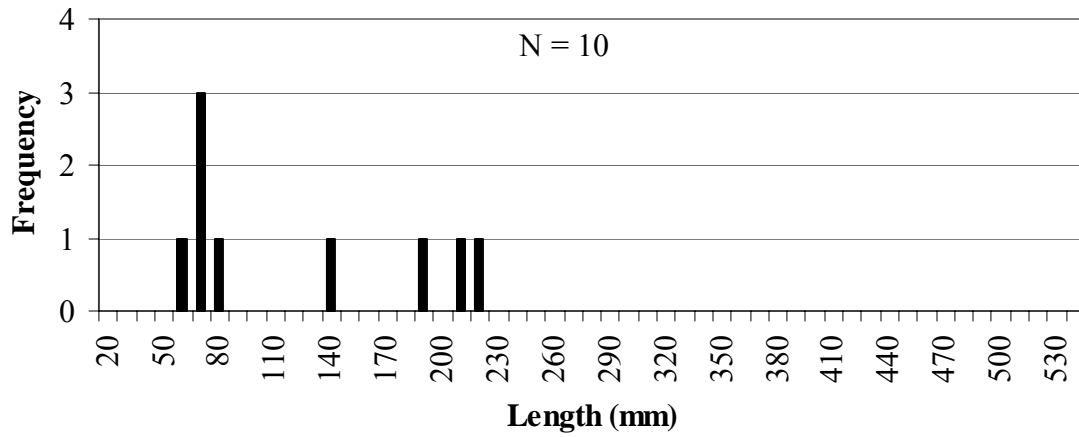
**Ross Fork Rock Creek- River Mile 4.9
Brown Trout Size Distribution**



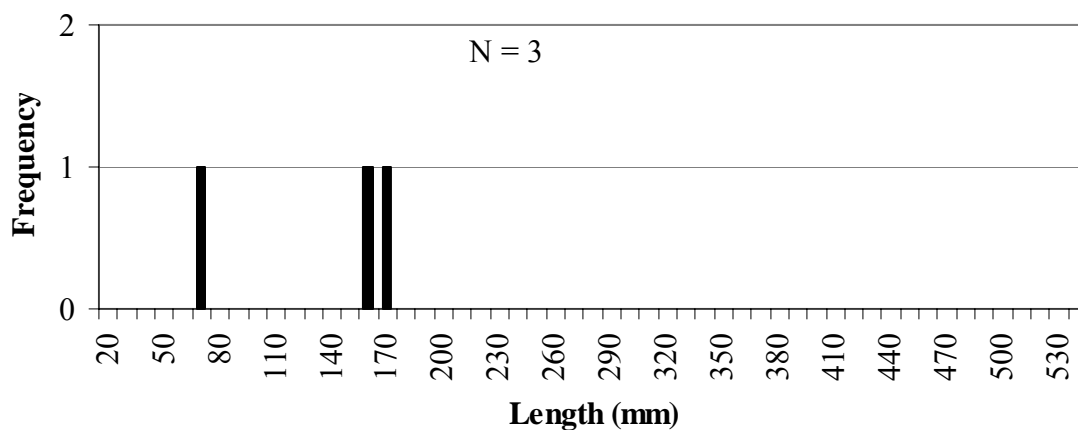
Ross Fork Rock Creek- River Mile 6.7
Westslope Cutthroat Size Distribution



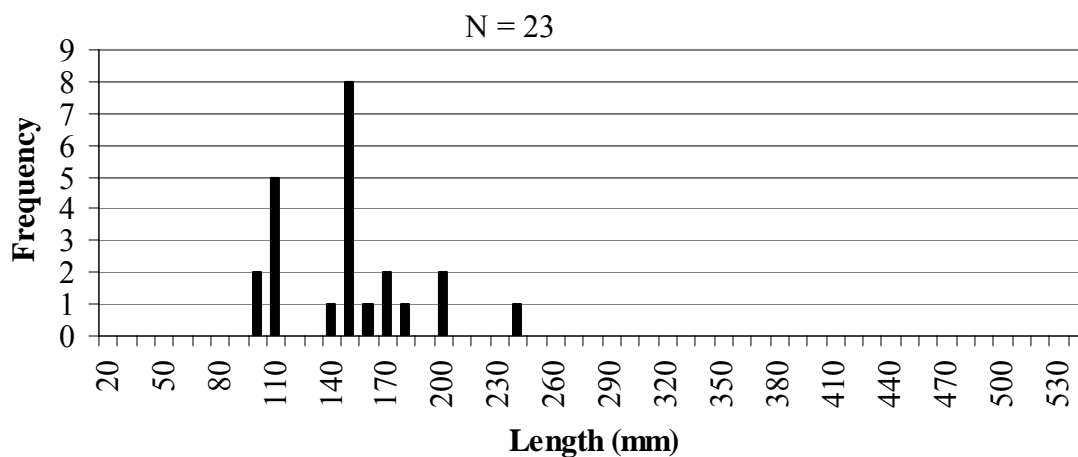
Ross Fork Rock Creek- River Mile 6.7
Brown Trout Size Distribution



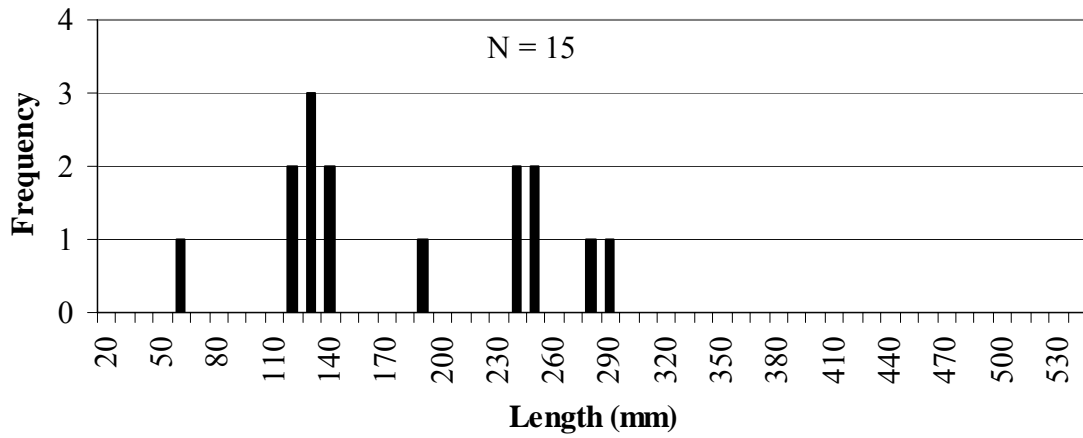
**Ross Fork Rock Creek- River Mile 6.7
Brook Trout Size Distribution**



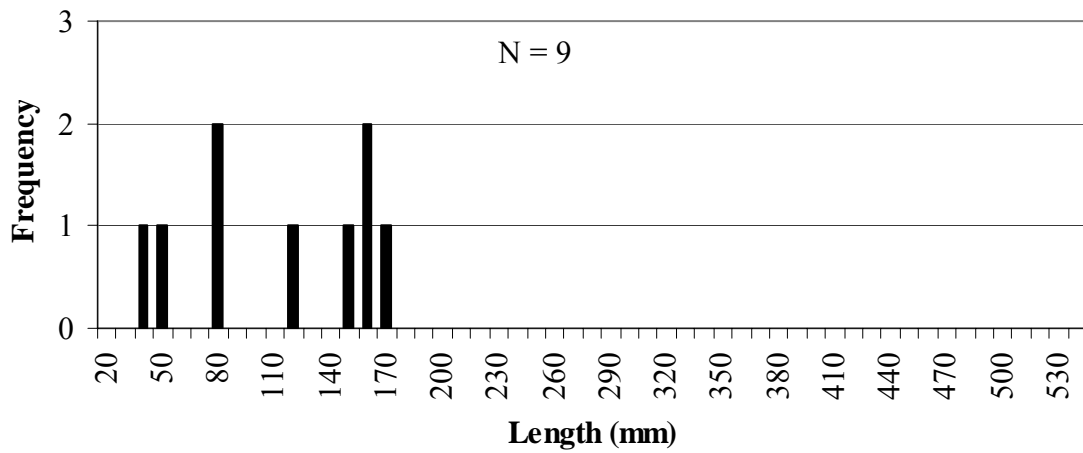
**Ross Fork Rock Creek- River Mile 8.8
Westslope Cutthroat Size Distribution**

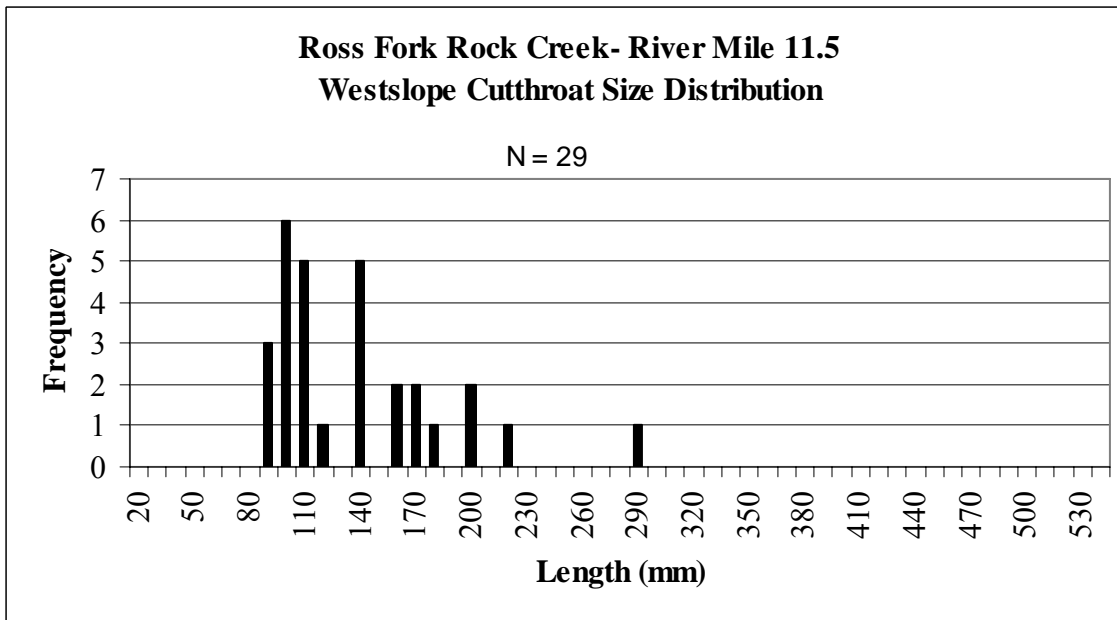
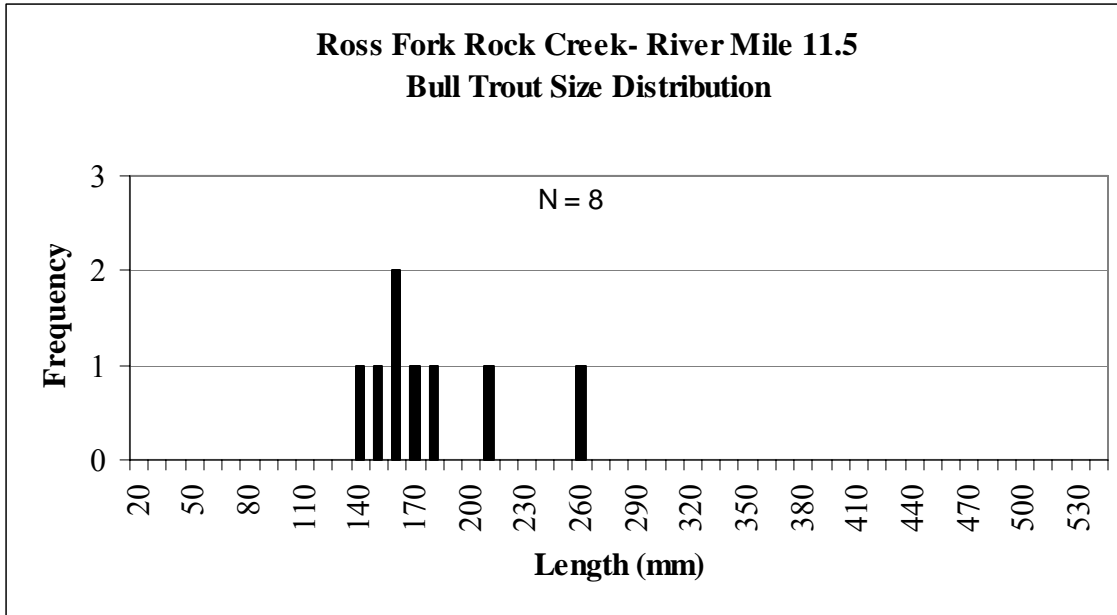


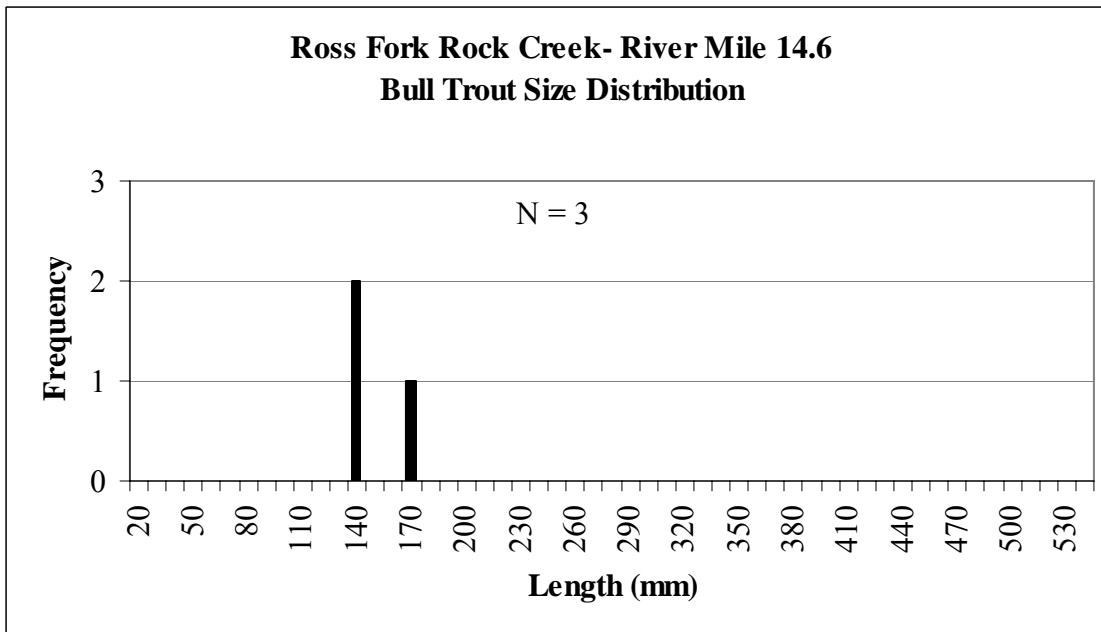
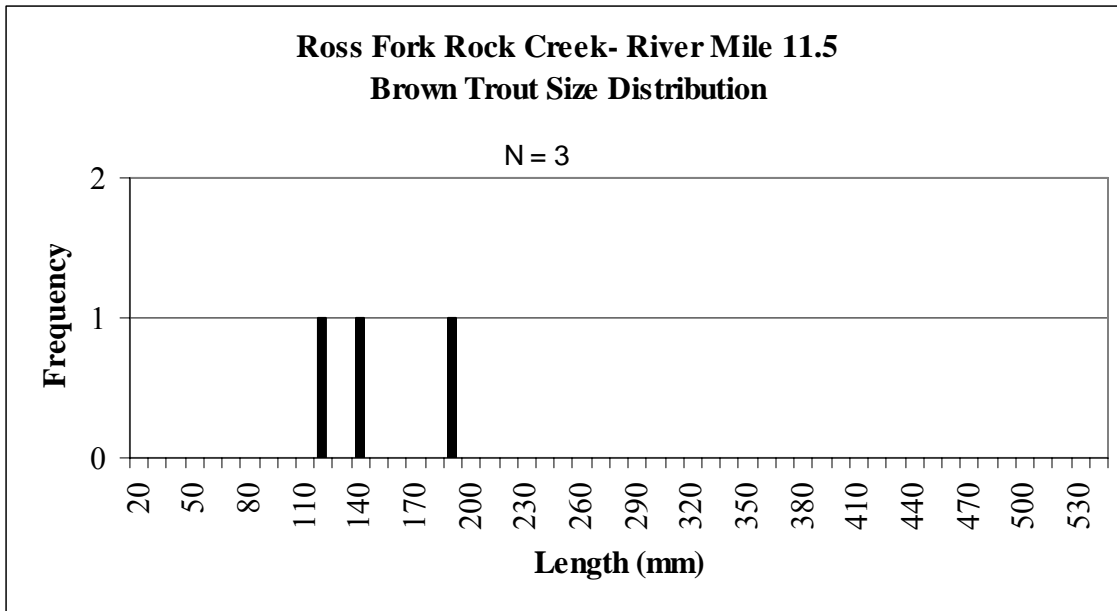
Ross Fork Rock Creek- River Mile 8.8
Brown Trout Size Distribution

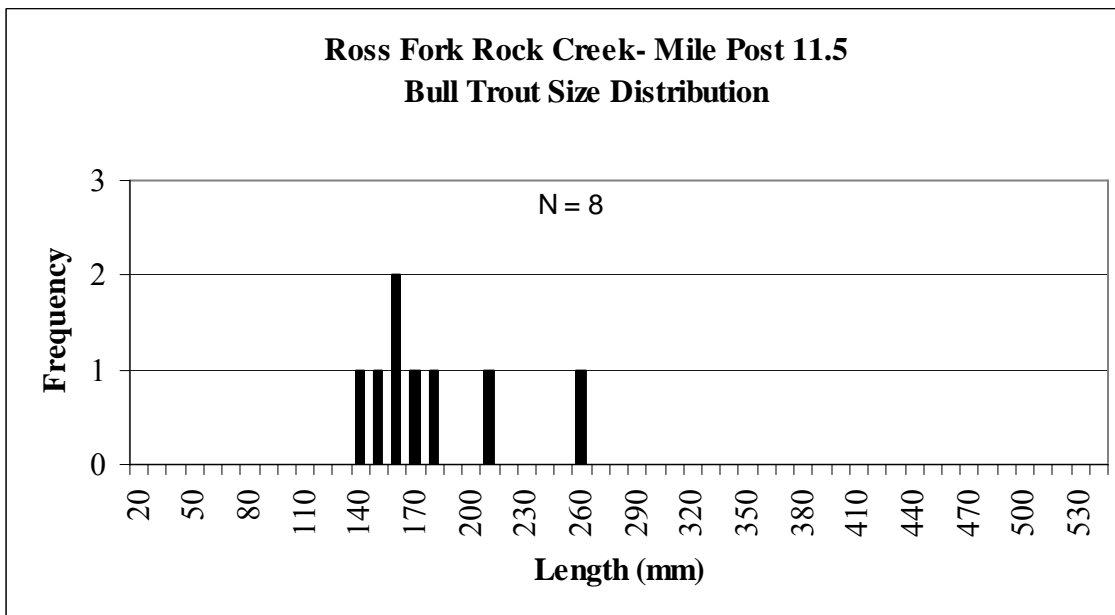
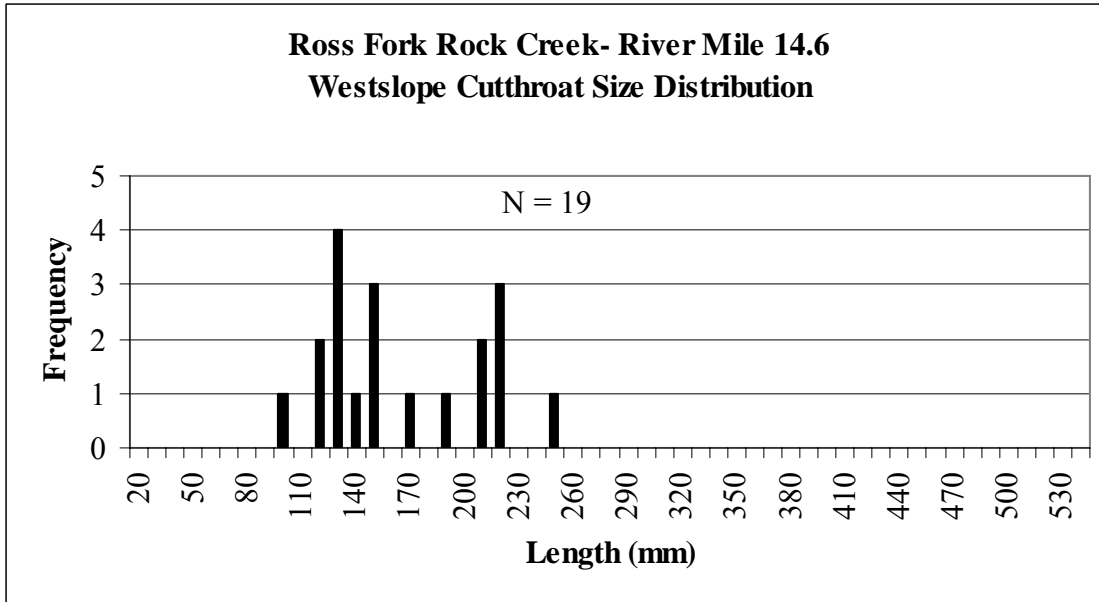


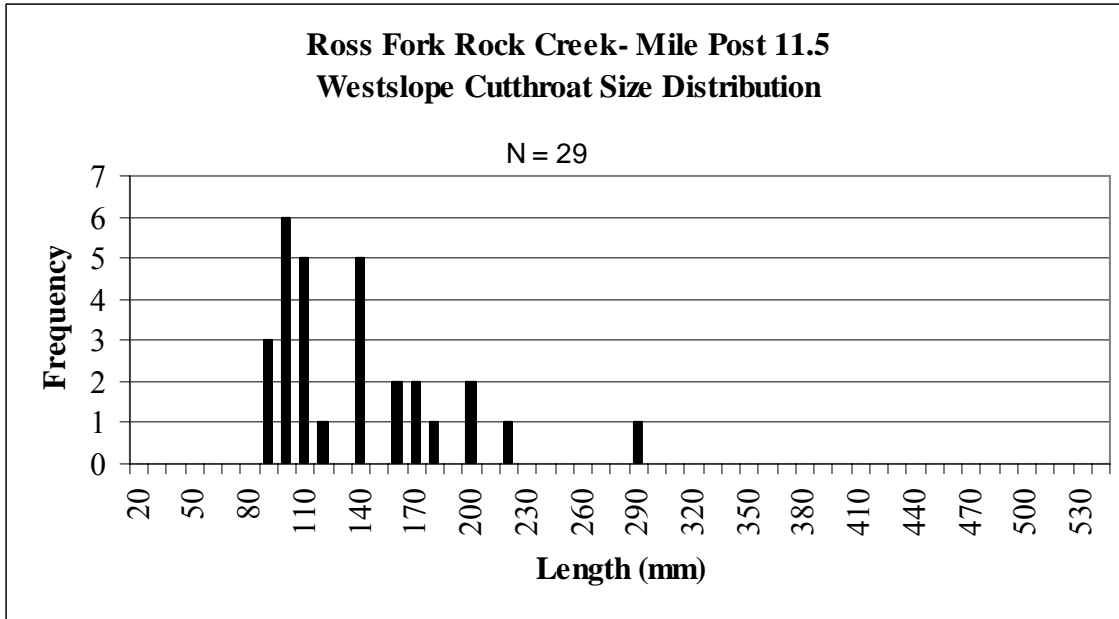
Ross Fork Rock Creek- River Mile 8.8
Brook Trout Size Distribution



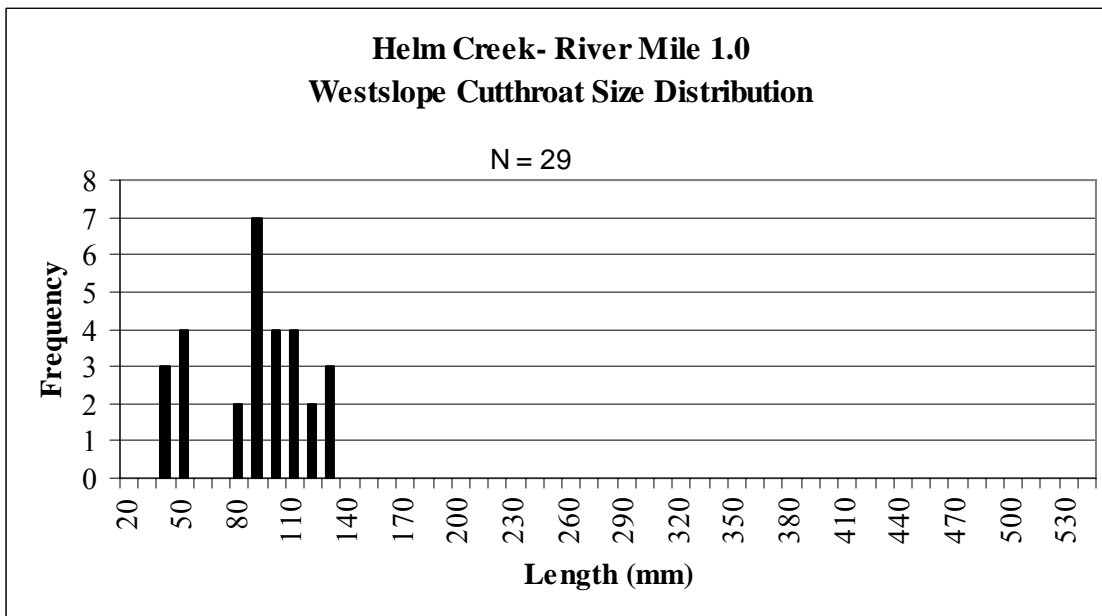




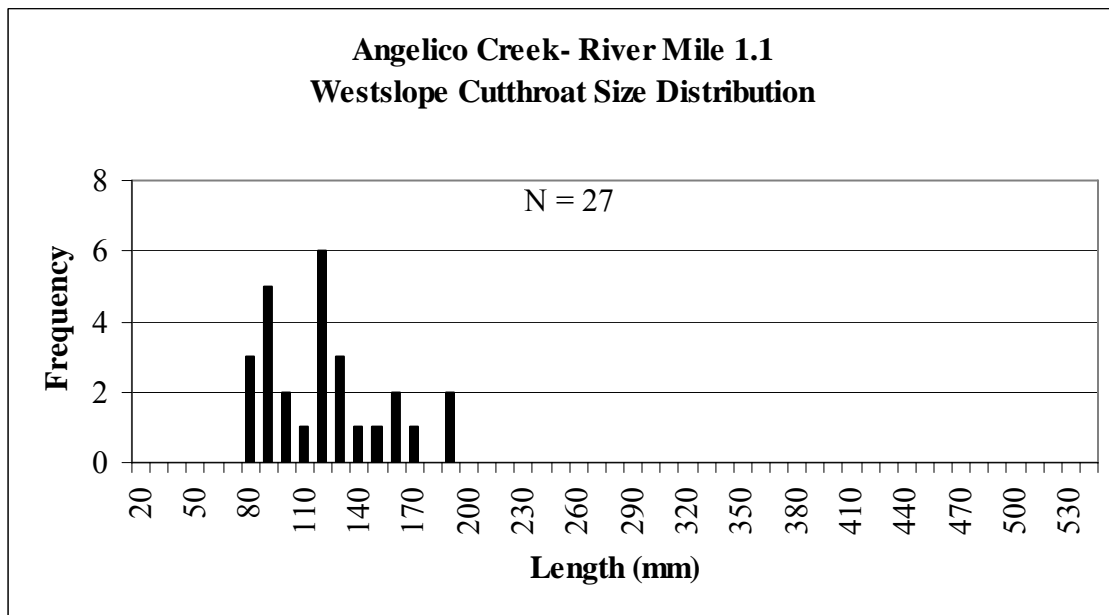
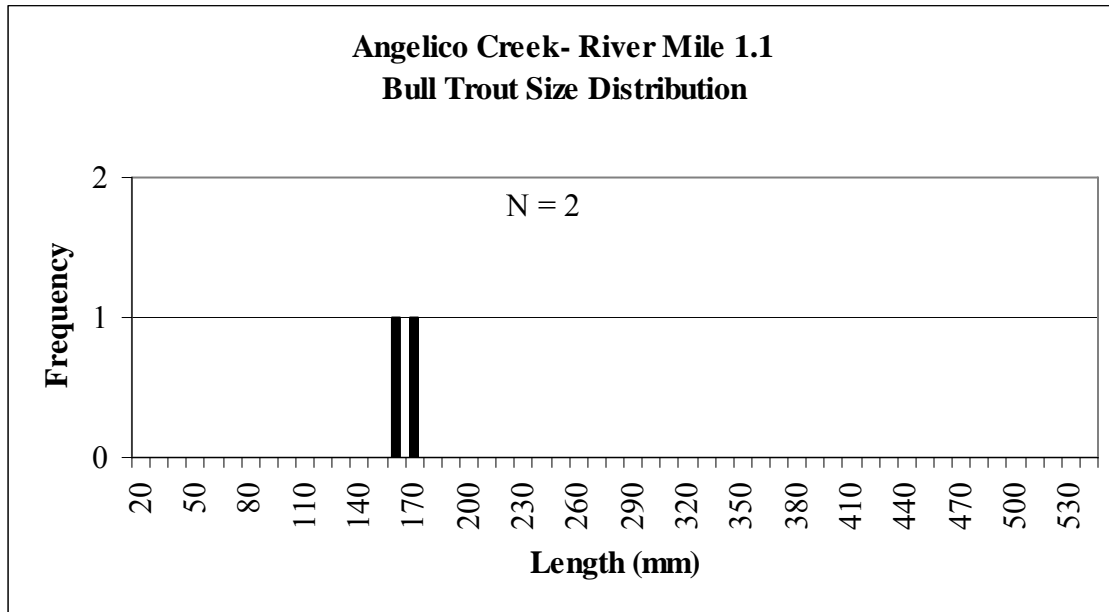


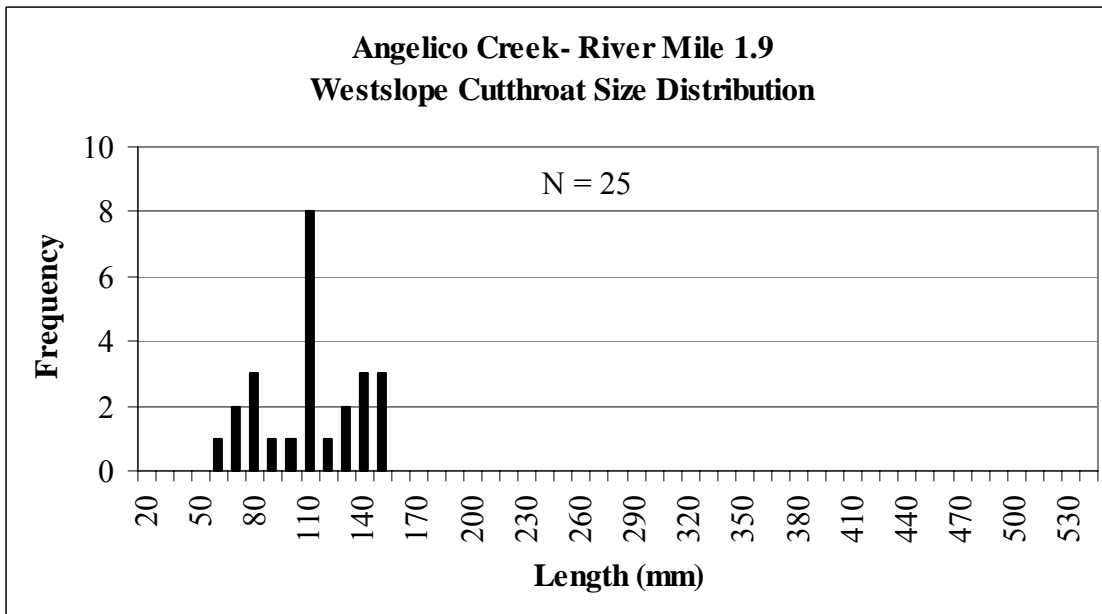
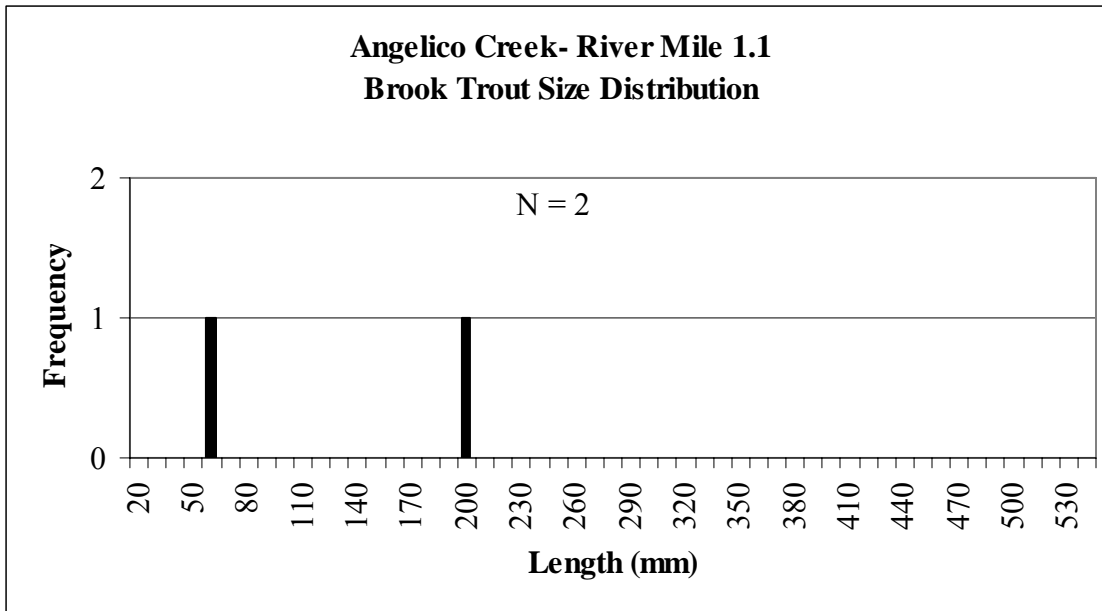


Helm Creek

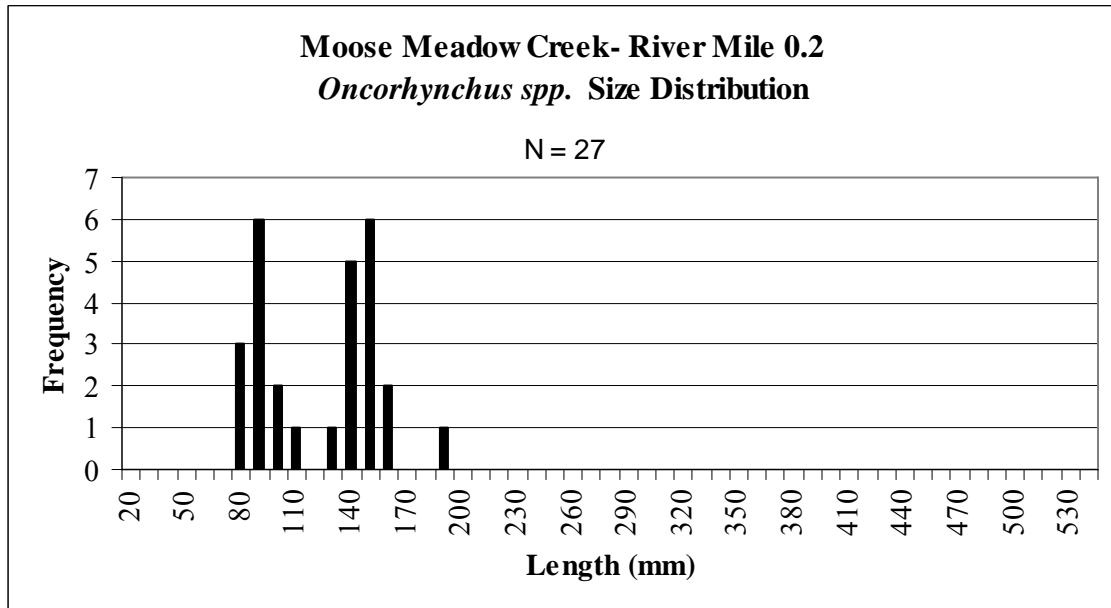
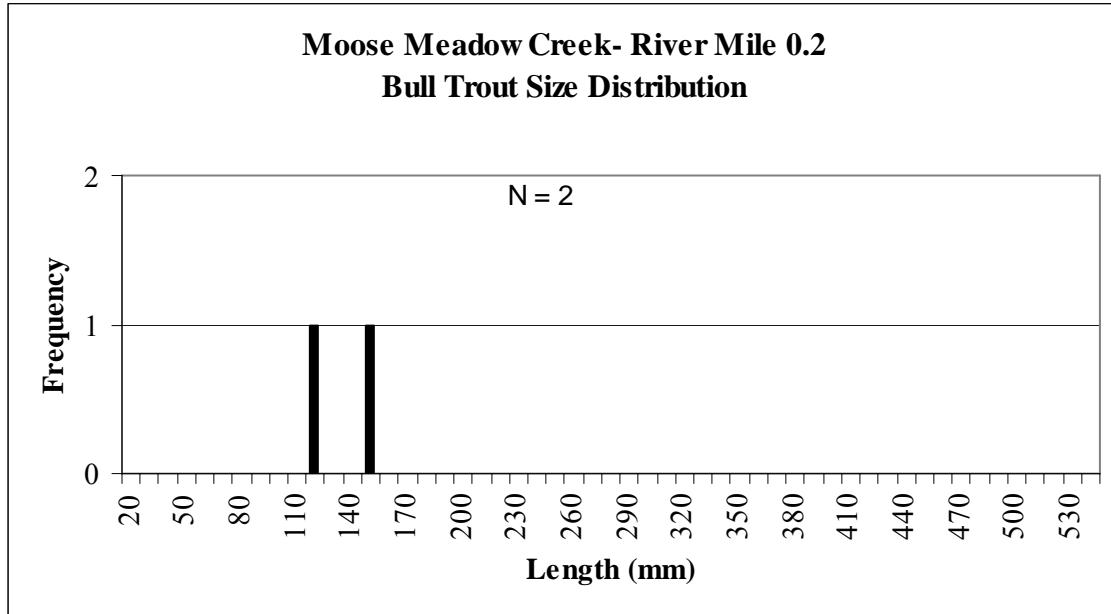


Angelico Creek

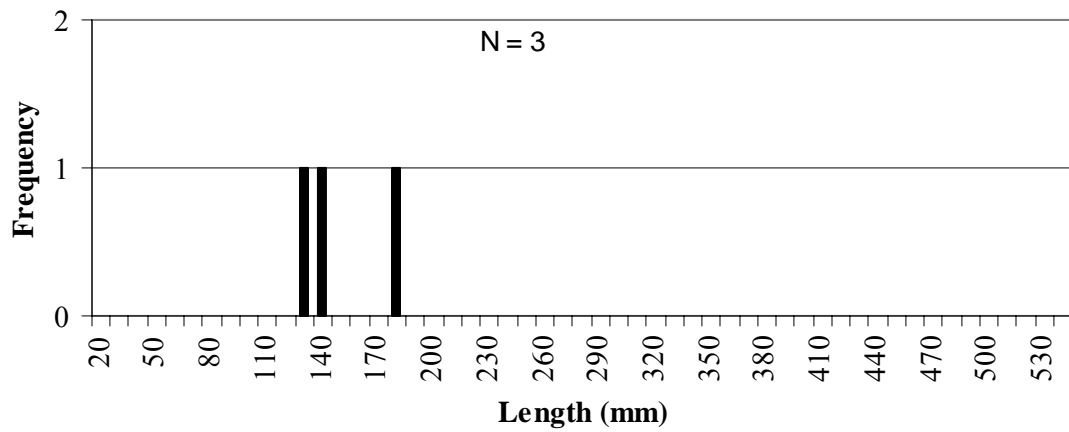




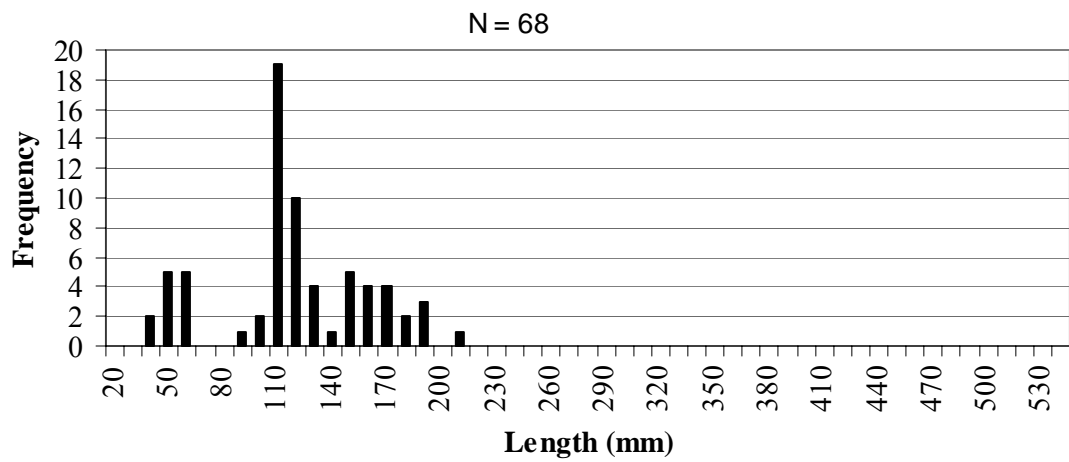
Moose Meadow Creek



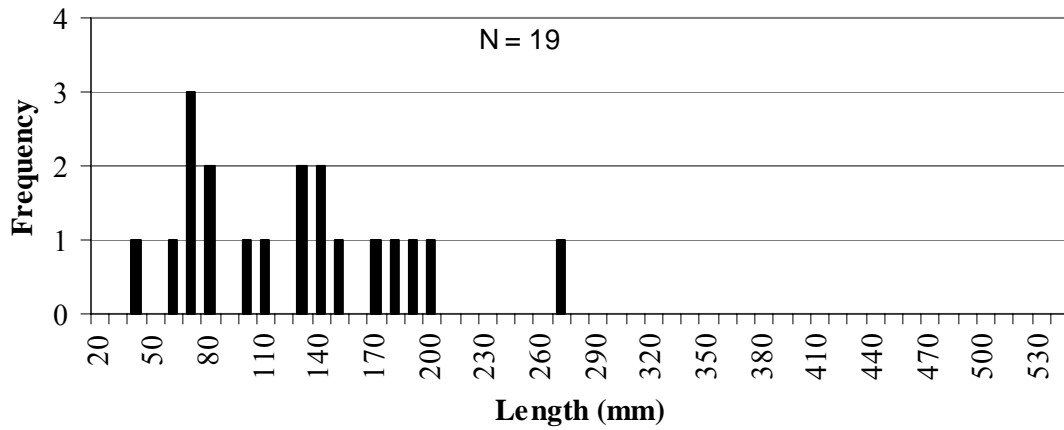
Moose Meadow Creek- River Mile 0.2
Brown Trout Size Distribution



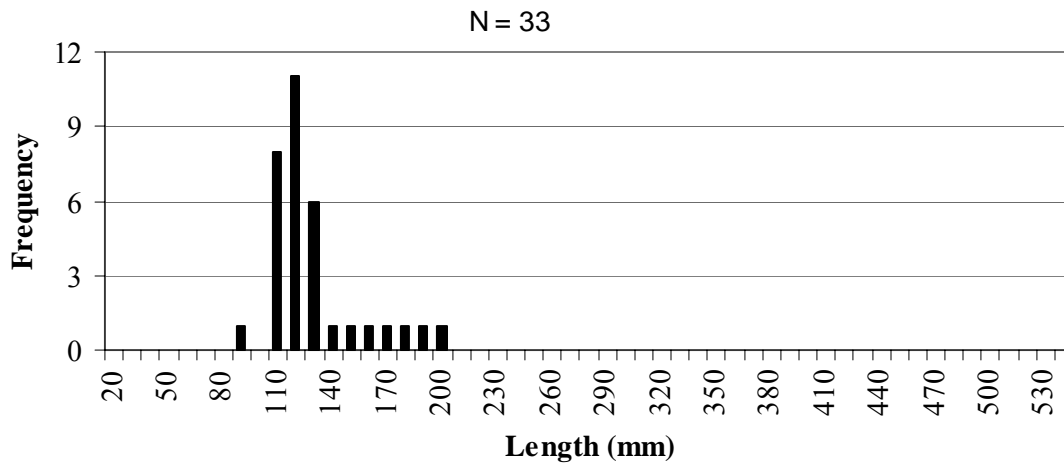
Moose Meadow Creek- River Mile 0.2
Brook Trout Size Distribution

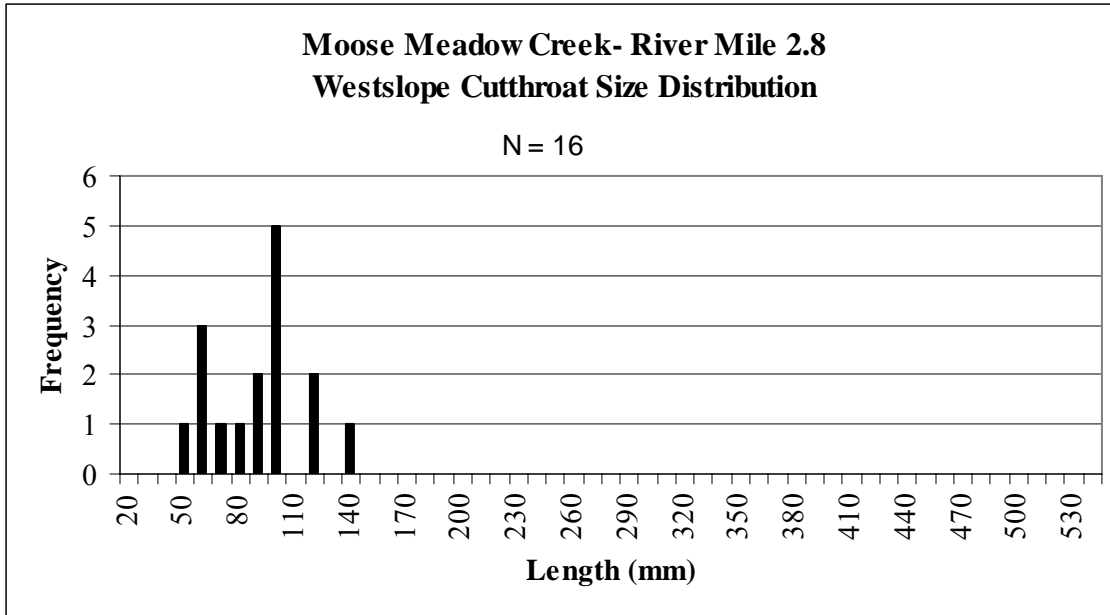


**Moose Meadow Creek- River Mile 1.9
Westslope Cutthroat Size Distribution**

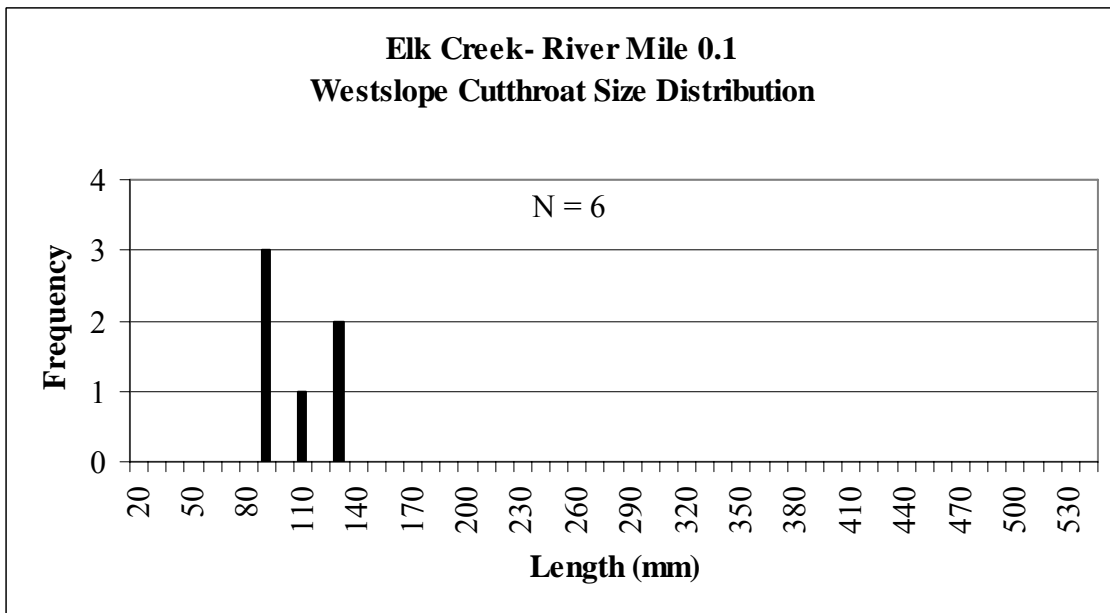


**Moose Meadow Creek- River Mile 1.9
Brook Trout Size Distribution**

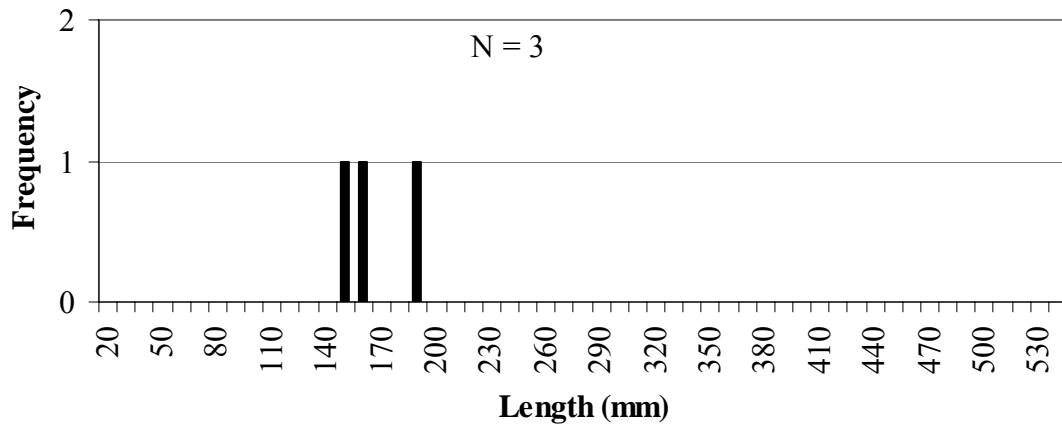




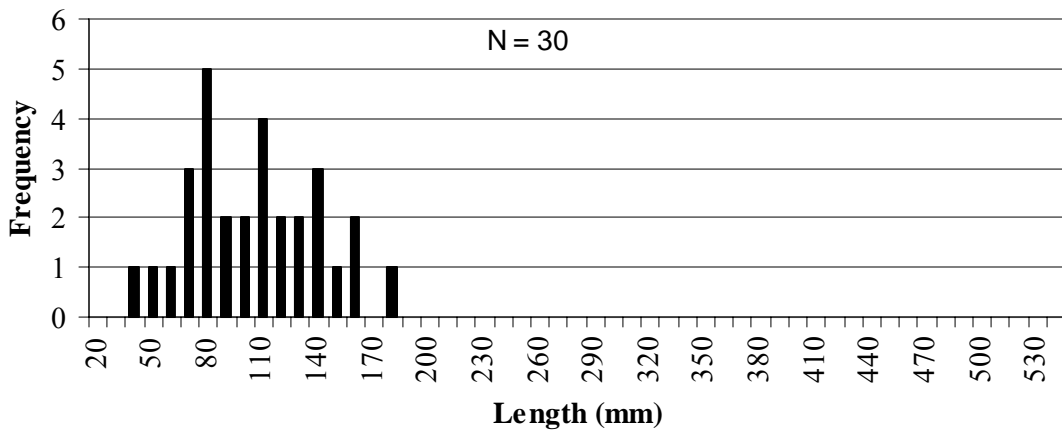
Elk Creek

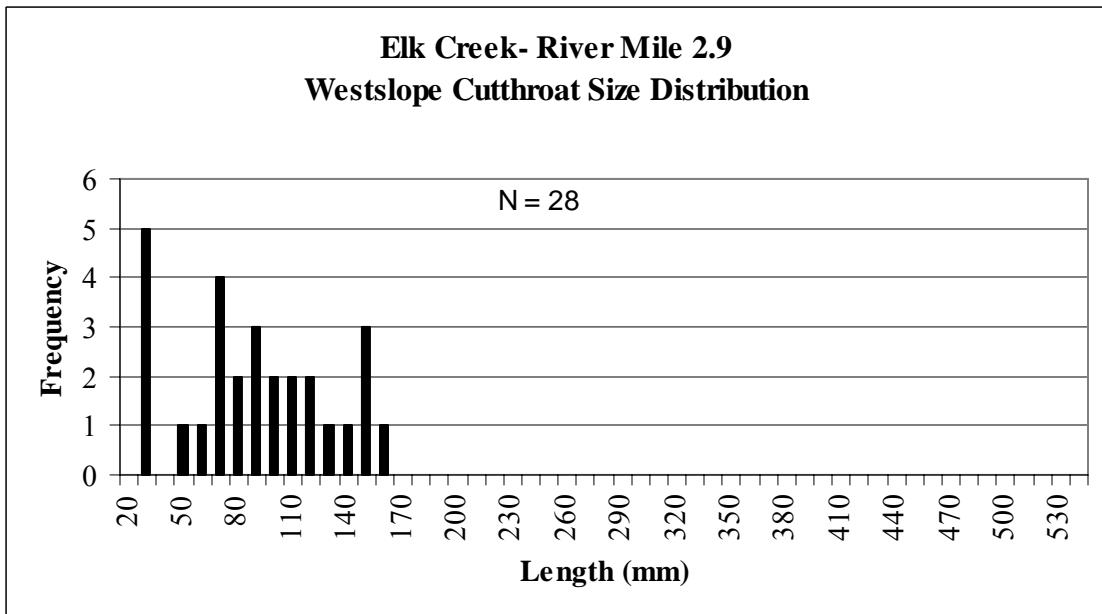
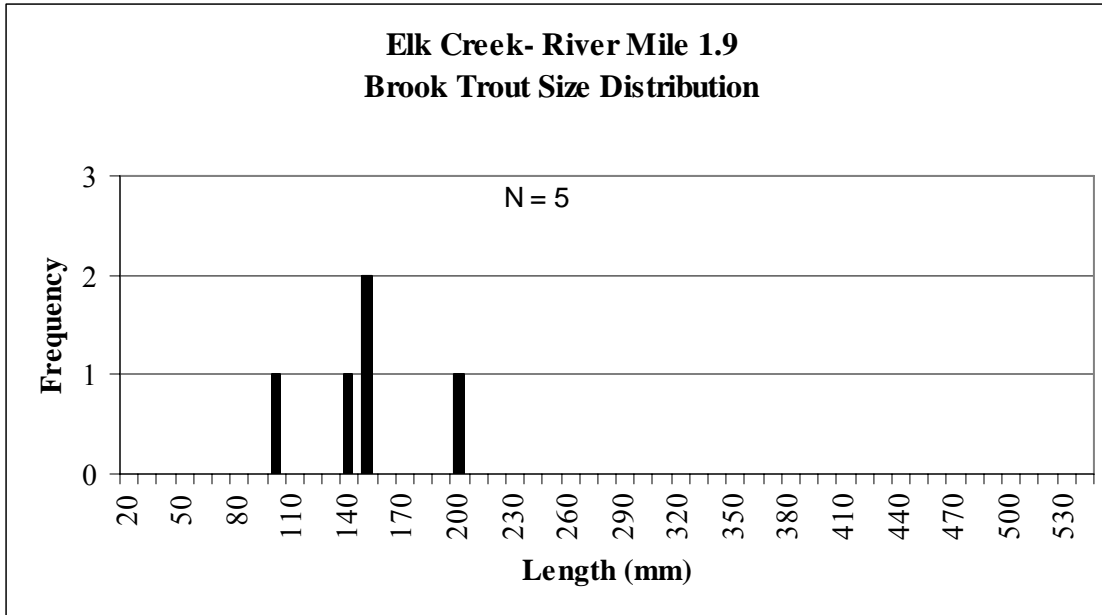


**Elk Creek- River Mile 0.1
Brook Trout Size Distribution**

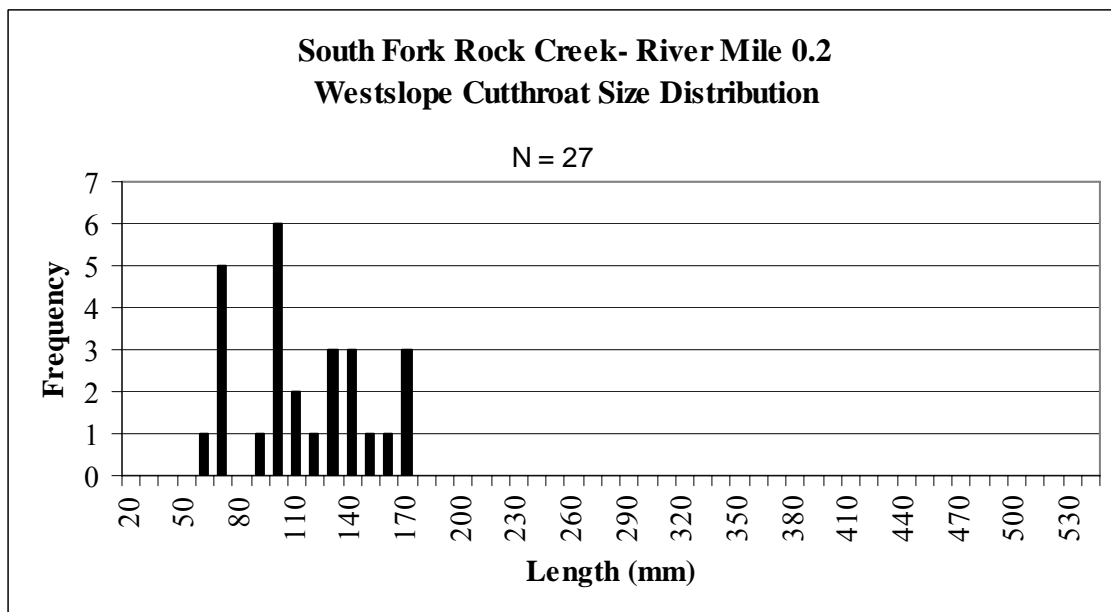
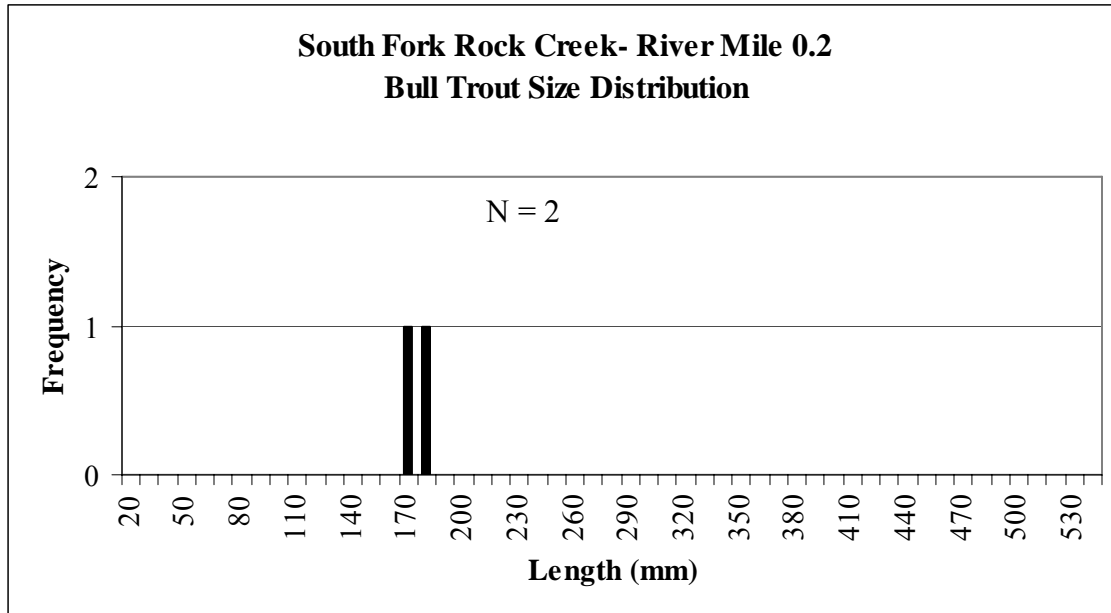


**Elk Creek- River Mile 1.9
Westslope Cutthroat Size Distribution**



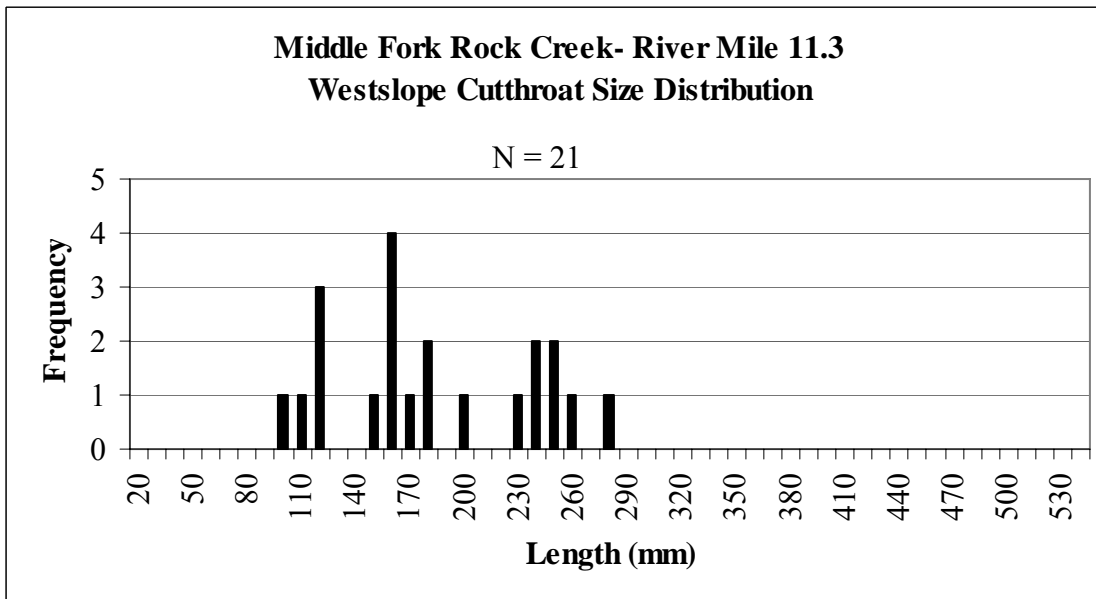
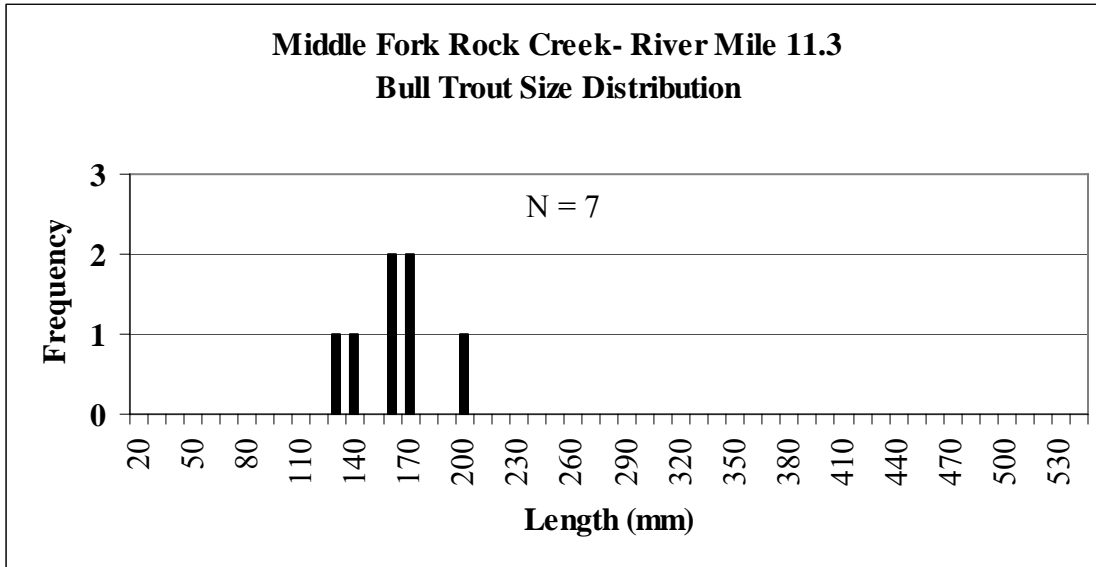


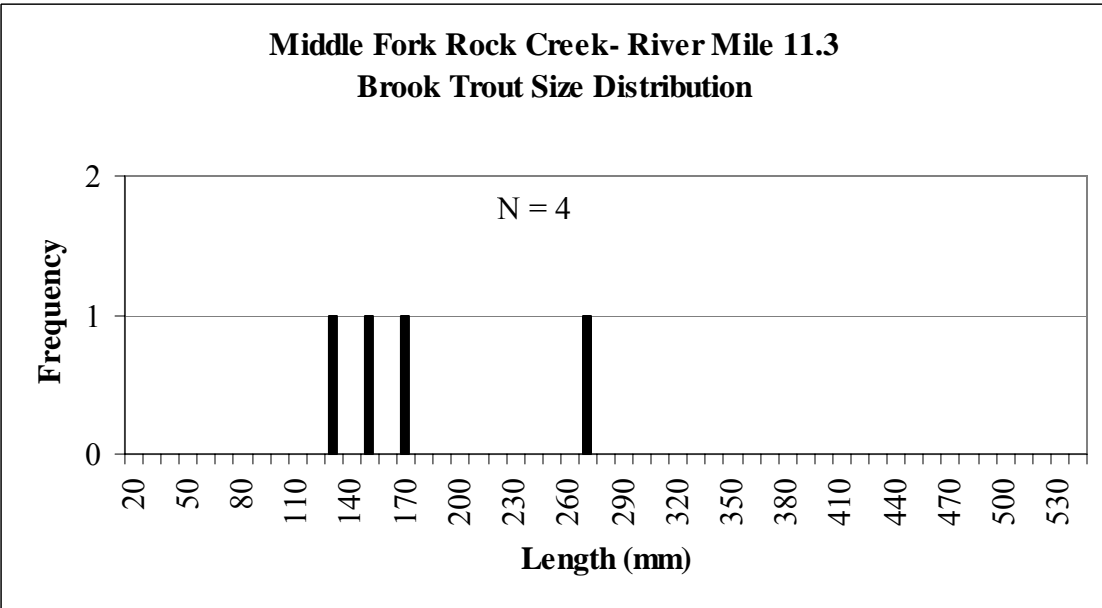
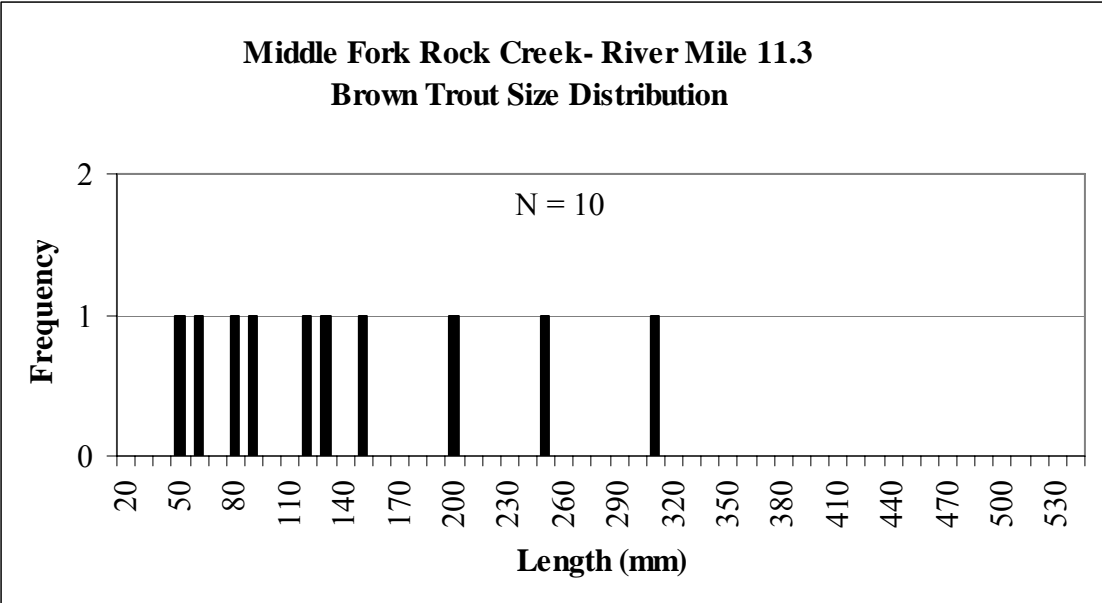
South Fork Rock Creek

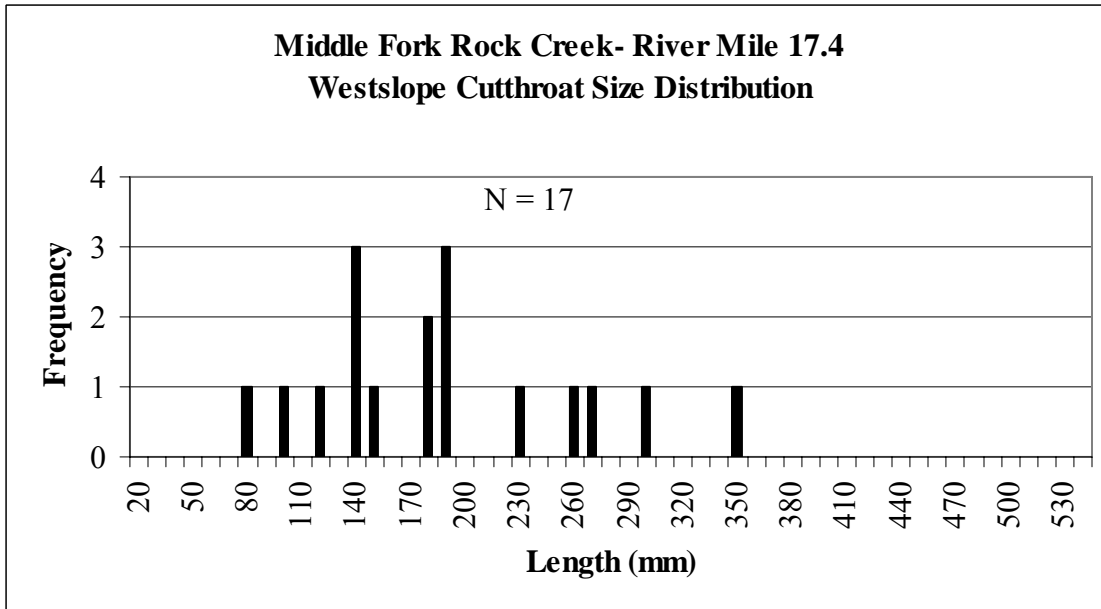
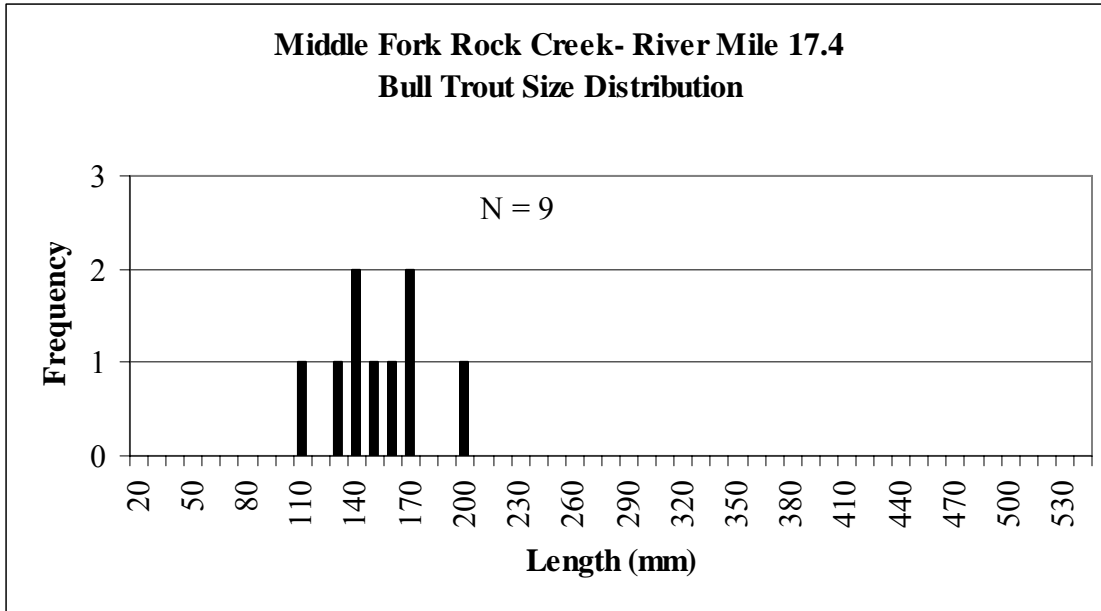


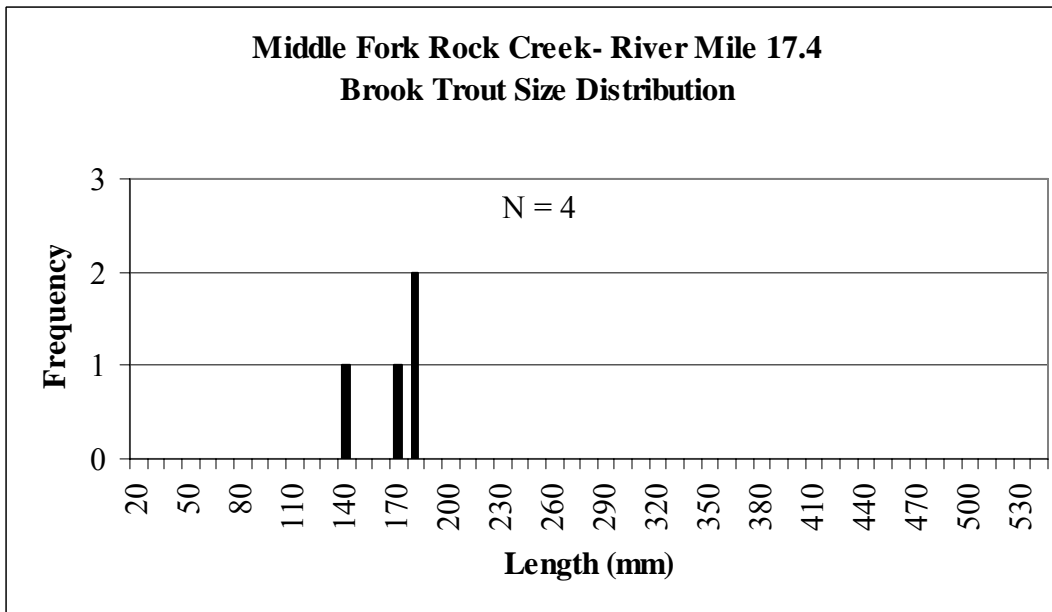
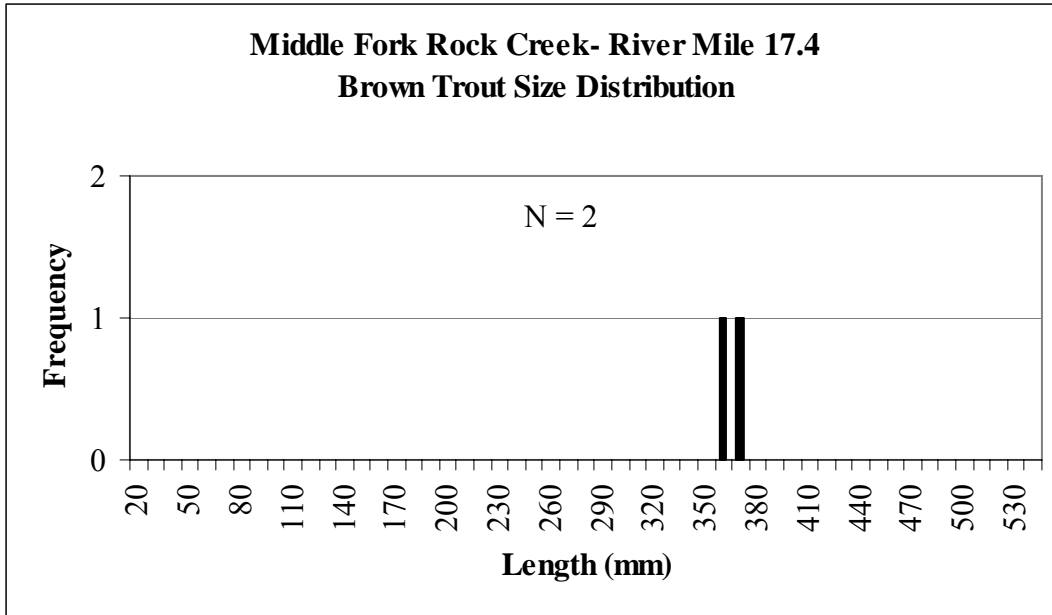
Middle Fork Rock Creek

Middle Fork Rock Creek



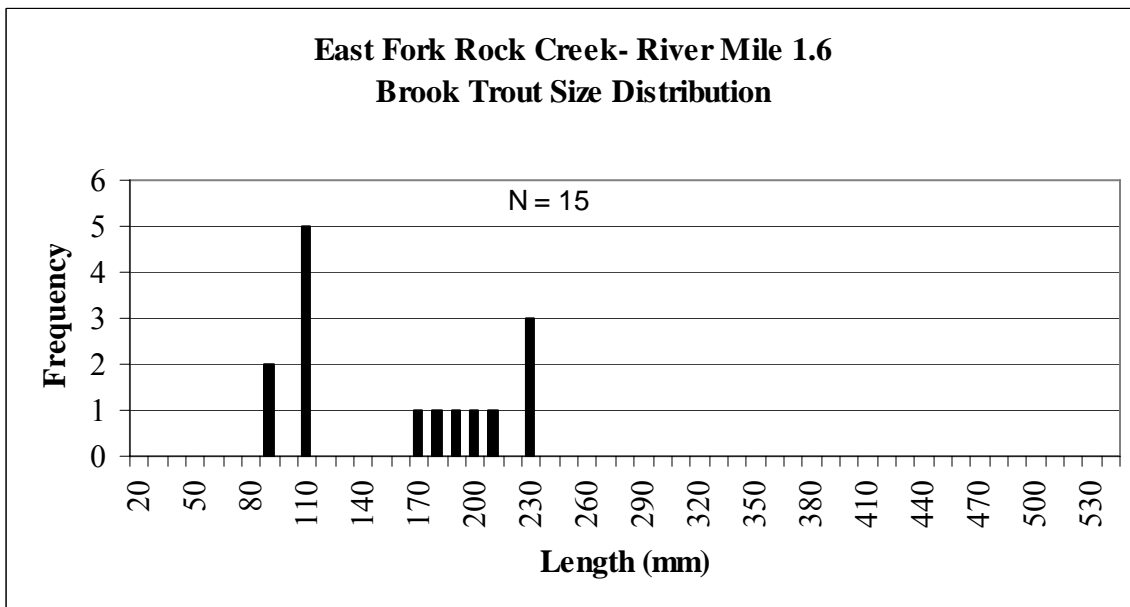
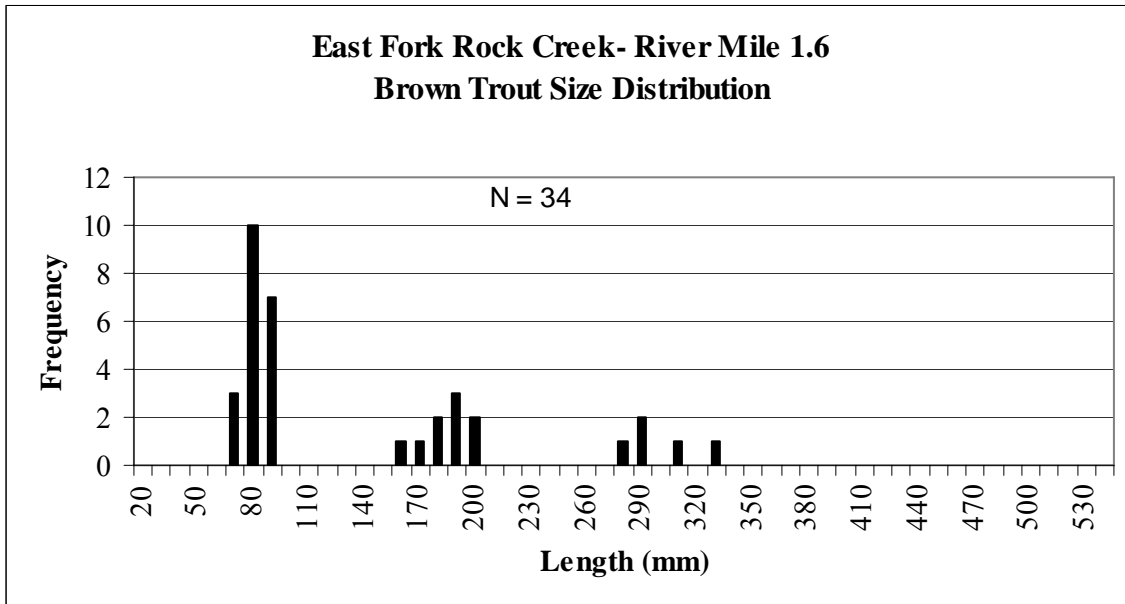


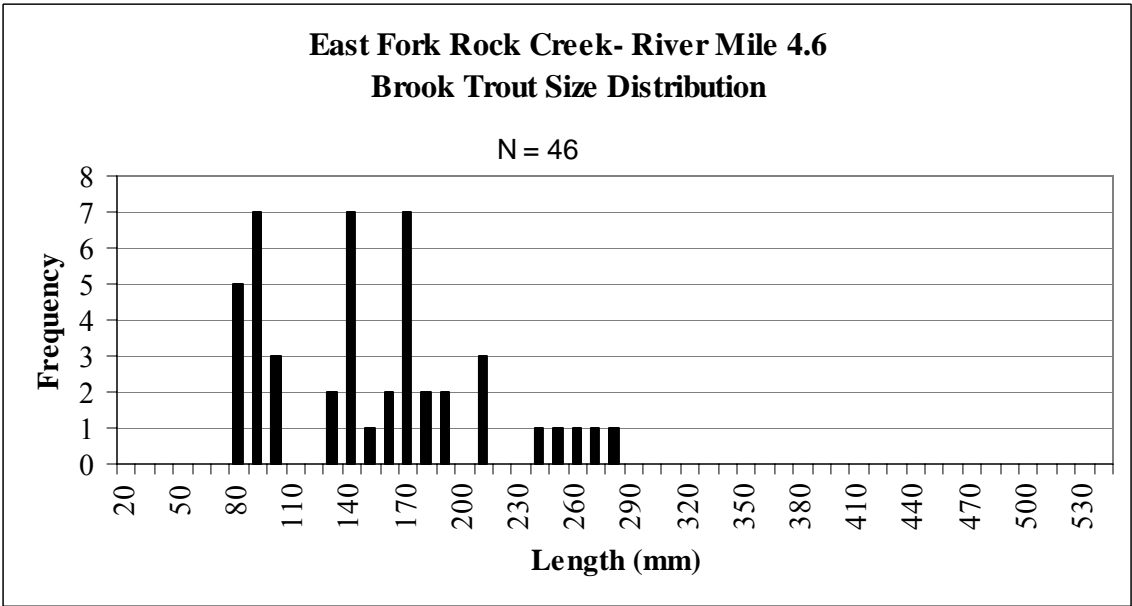
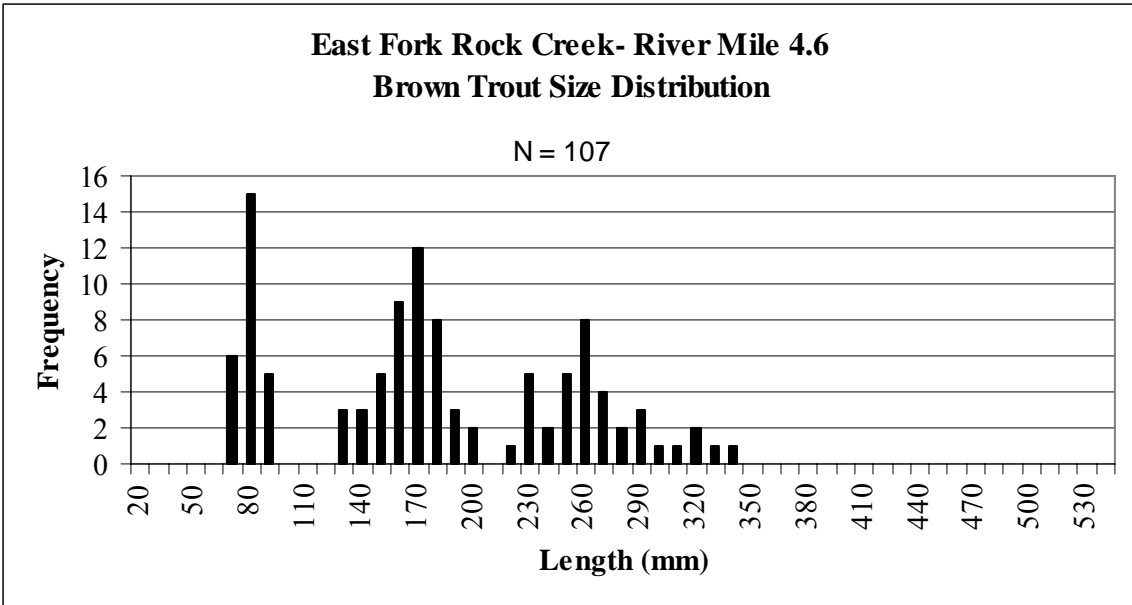




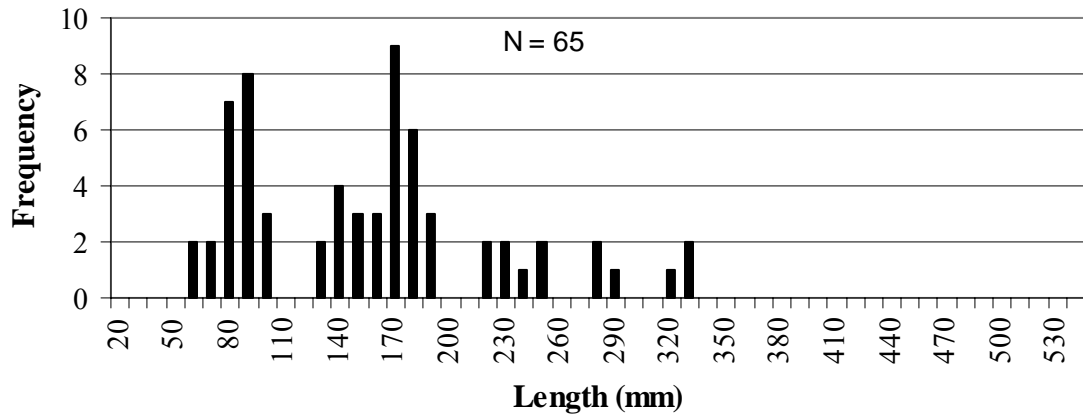
East Fork Rock Creek

East Fork Rock Creek

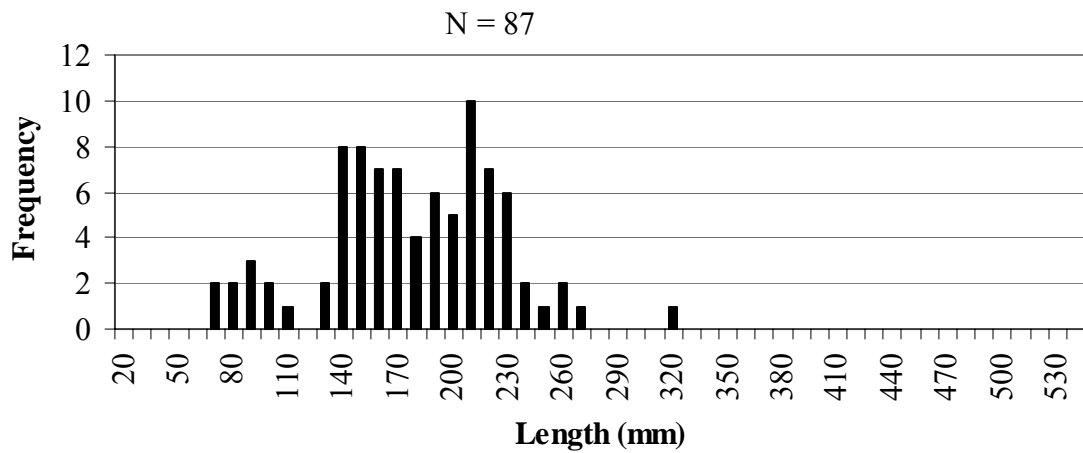




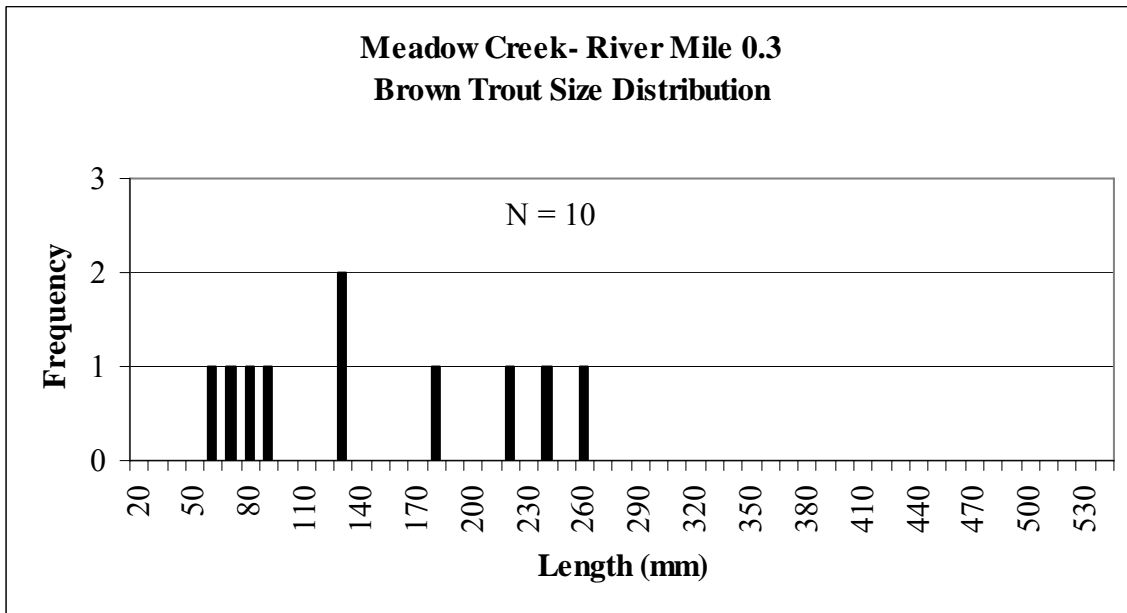
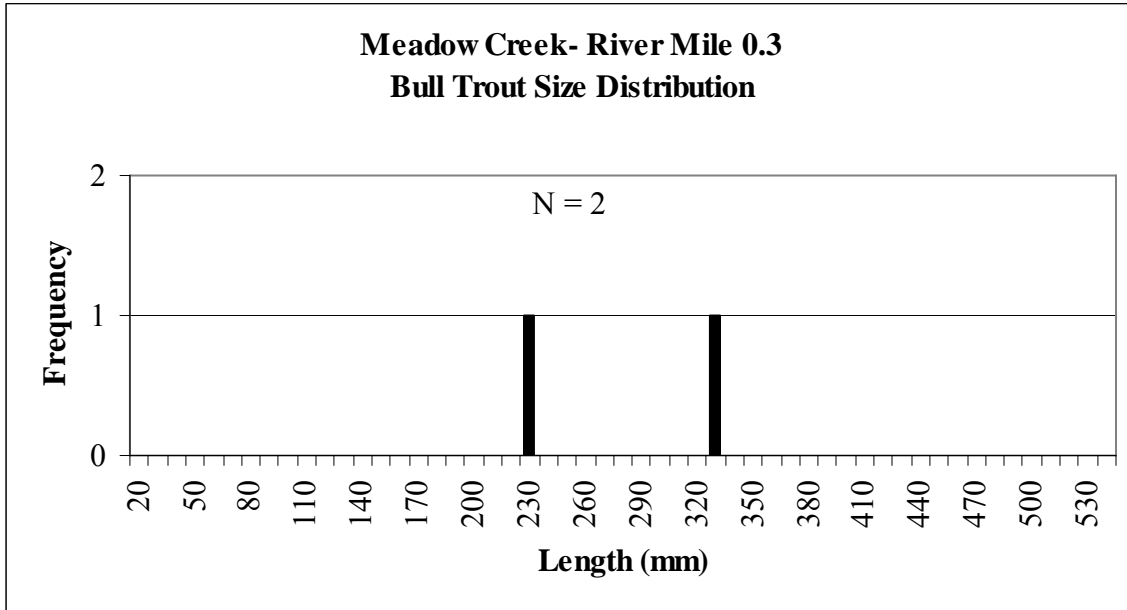
East Fork Rock Creek- River Mile 5.4
Brown Trout Size Distribution

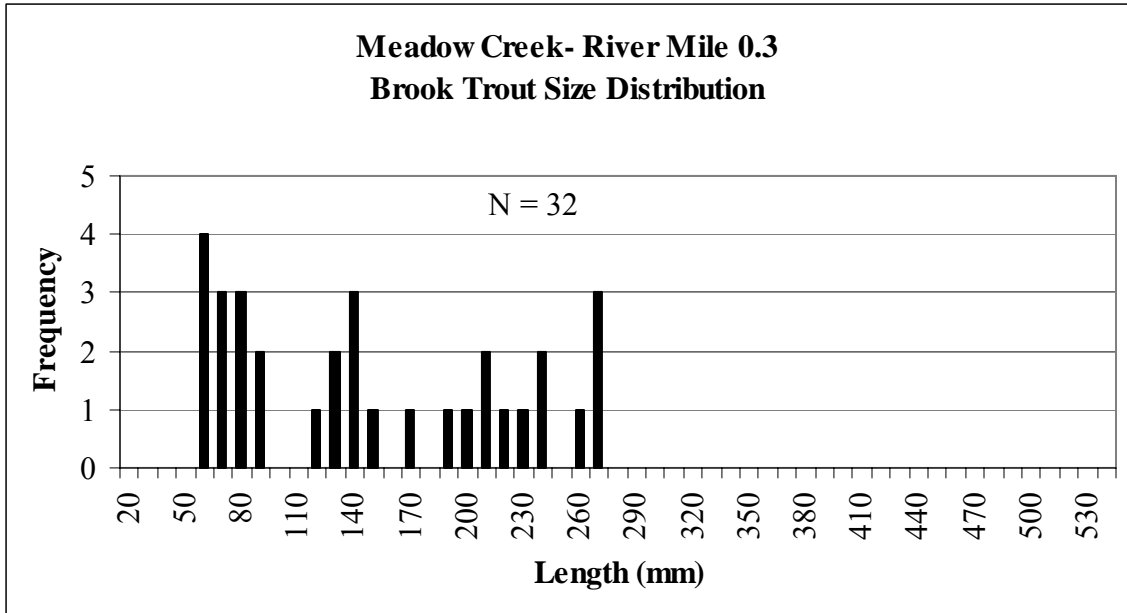


East Fork Rock Creek- River Mile 5.4
Brook Trout Size Distribution



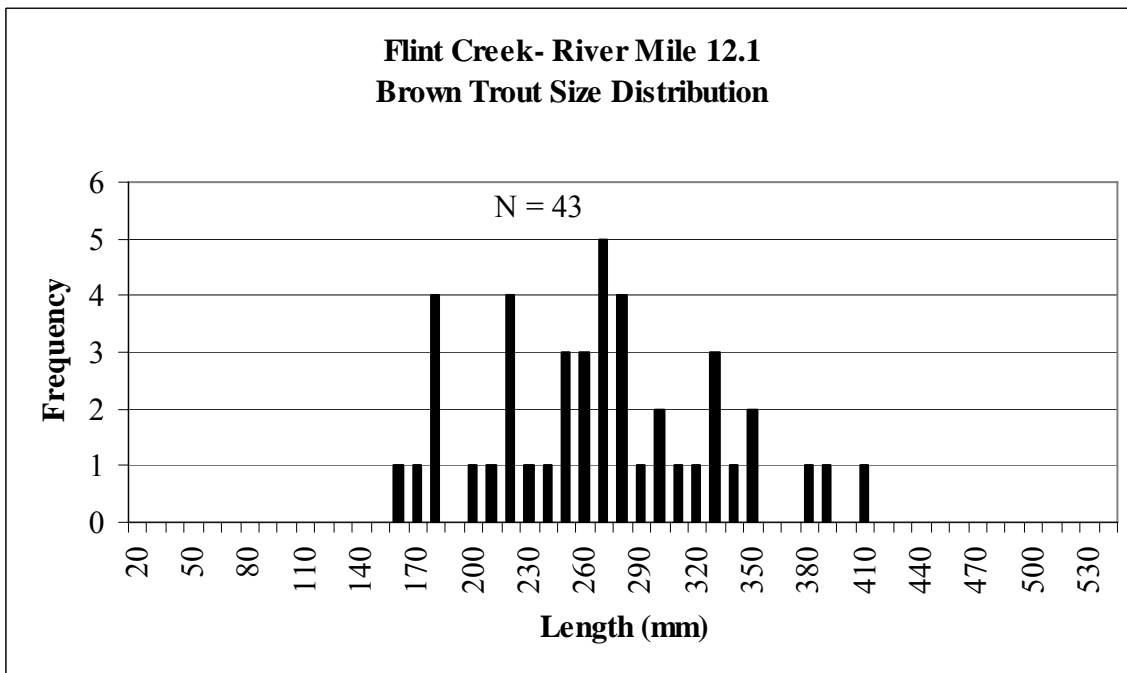
Meadow Creek



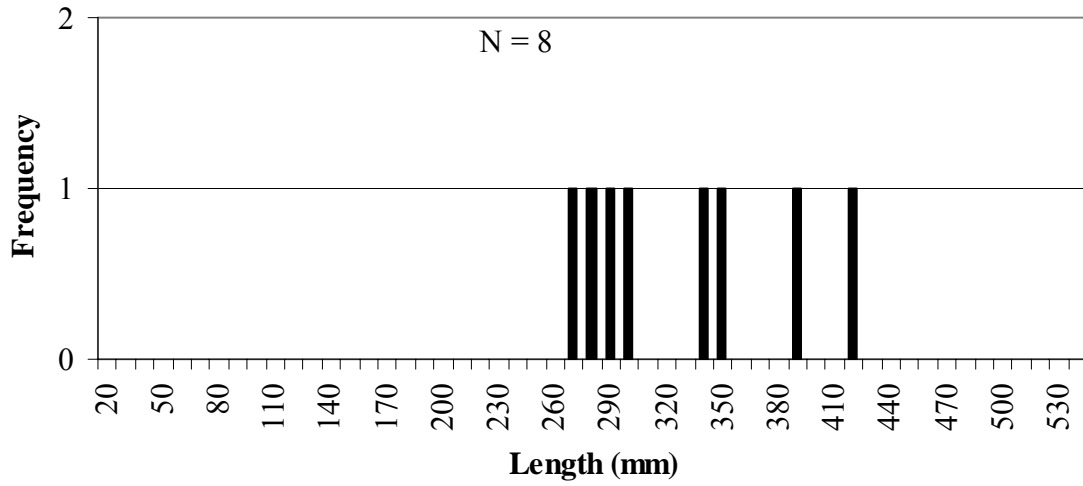


Flint Creek

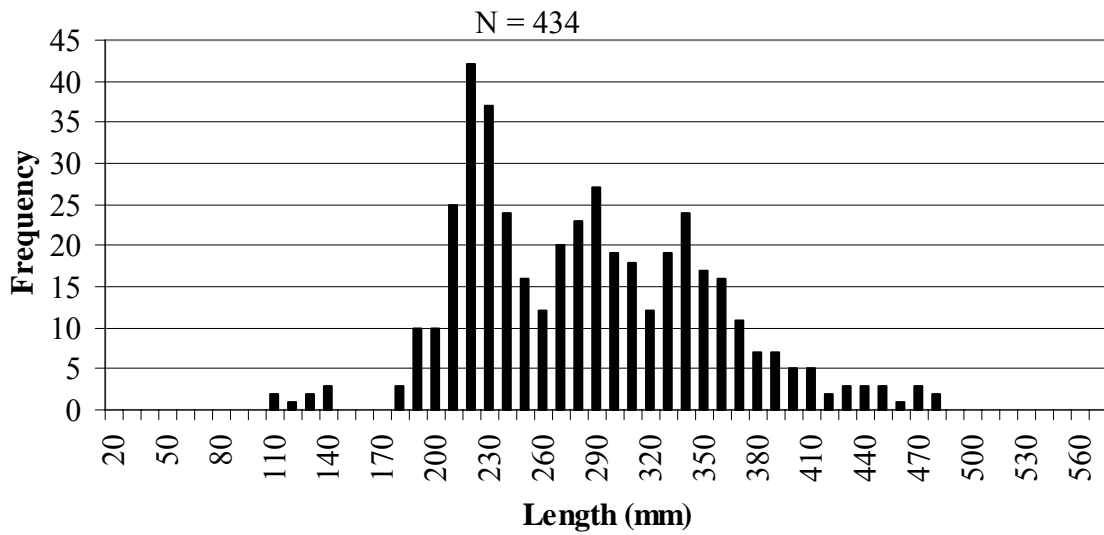
Flint Creek



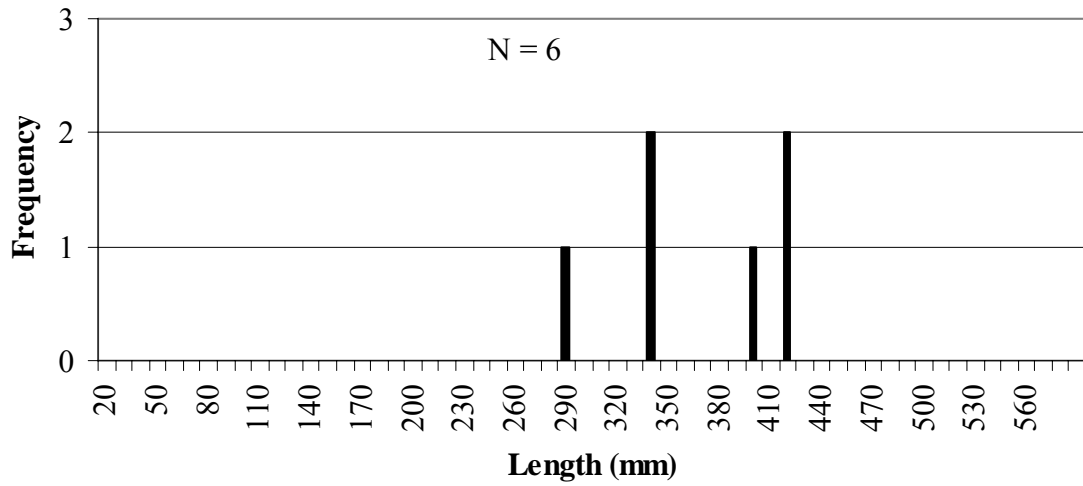
Flint Creek- River Mile 23.4
***Oncorhynchus* spp. Size Distribution**



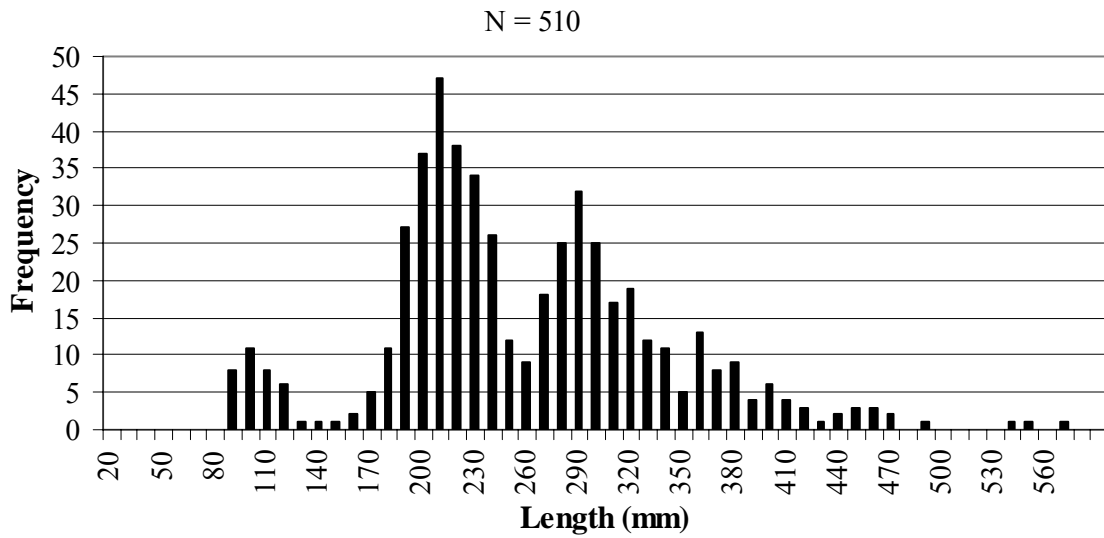
Flint Creek- River Mile 23.4
Brown Trout Size Distribution

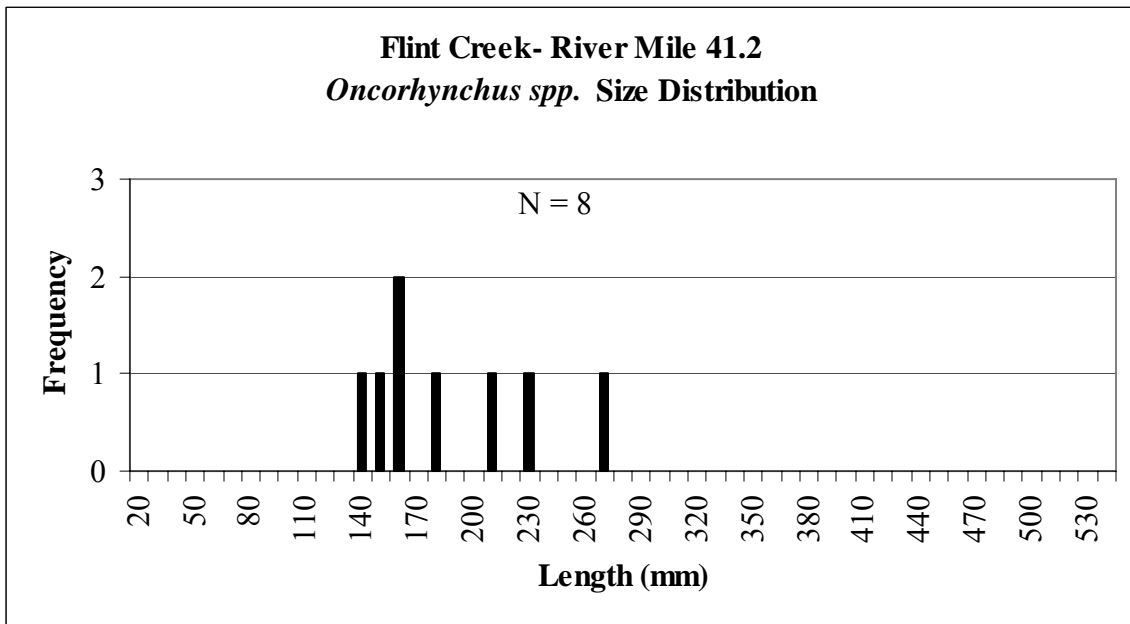
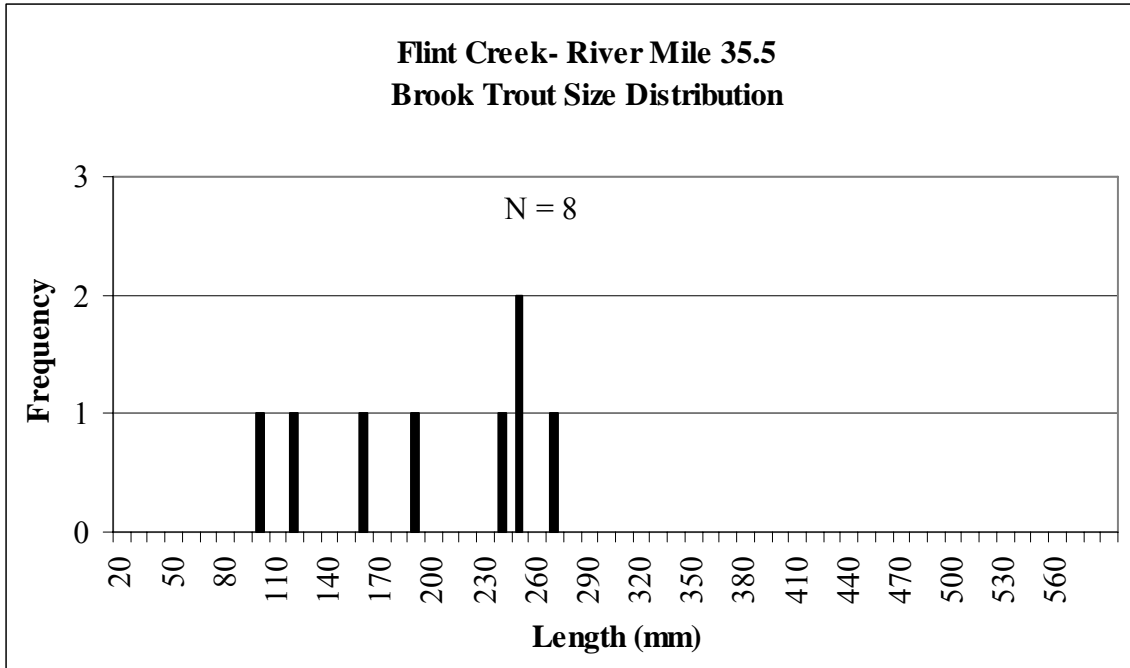


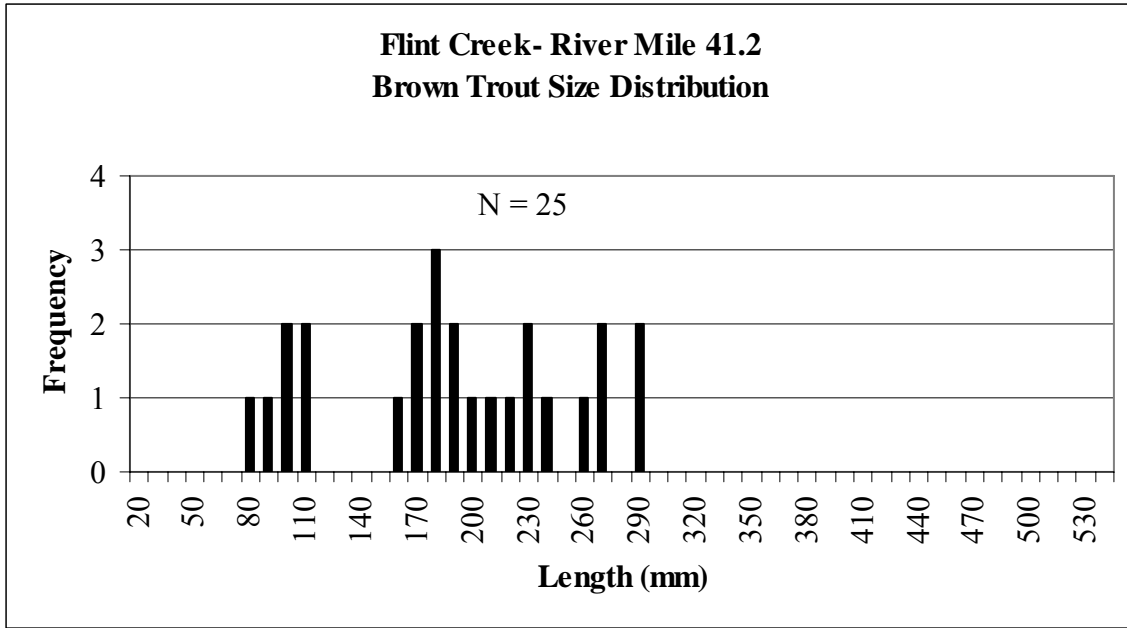
Flint Creek- River Mile 35.5
***Oncorhynchus* spp. Size Distribution**



Flint Creek- River Mile 35.5
Brown Trout Size Distribution

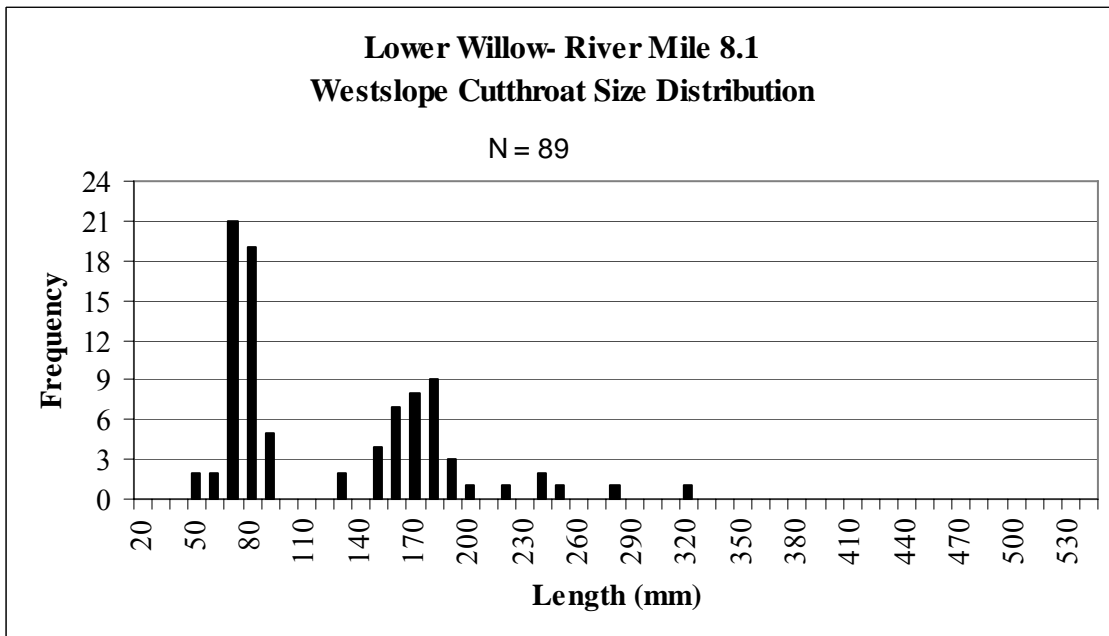


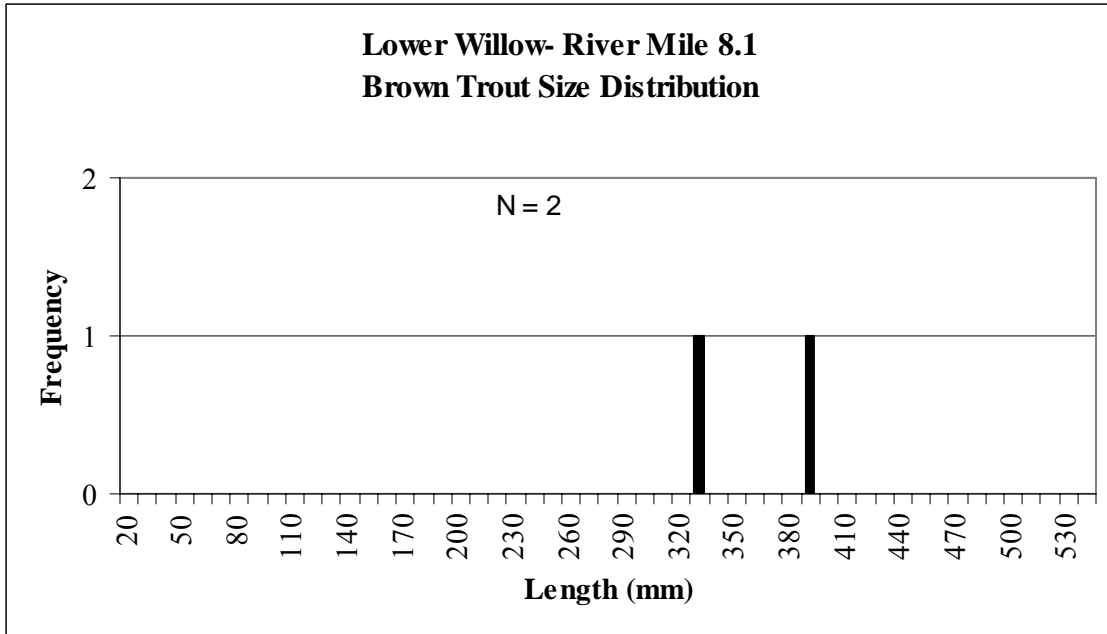




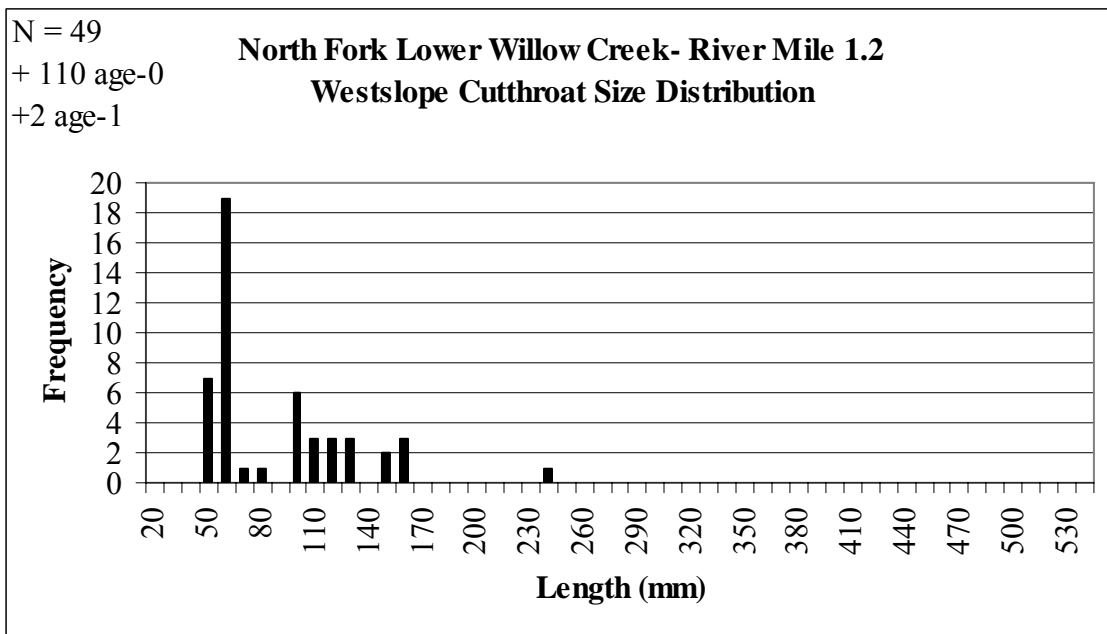
Lower Willow Creek

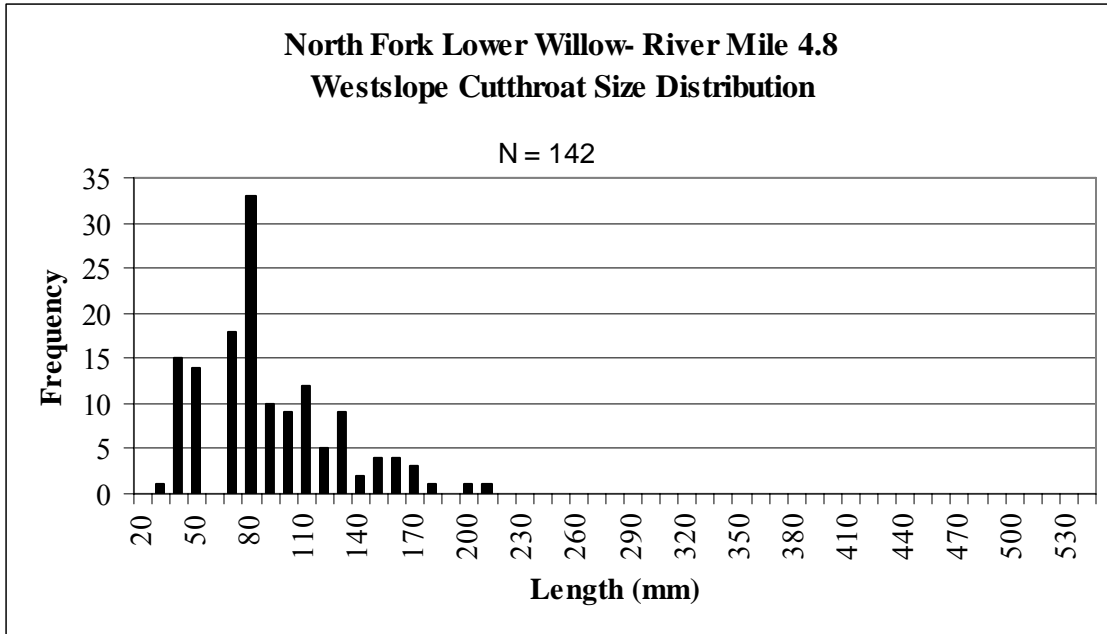
Lower Willow Creek



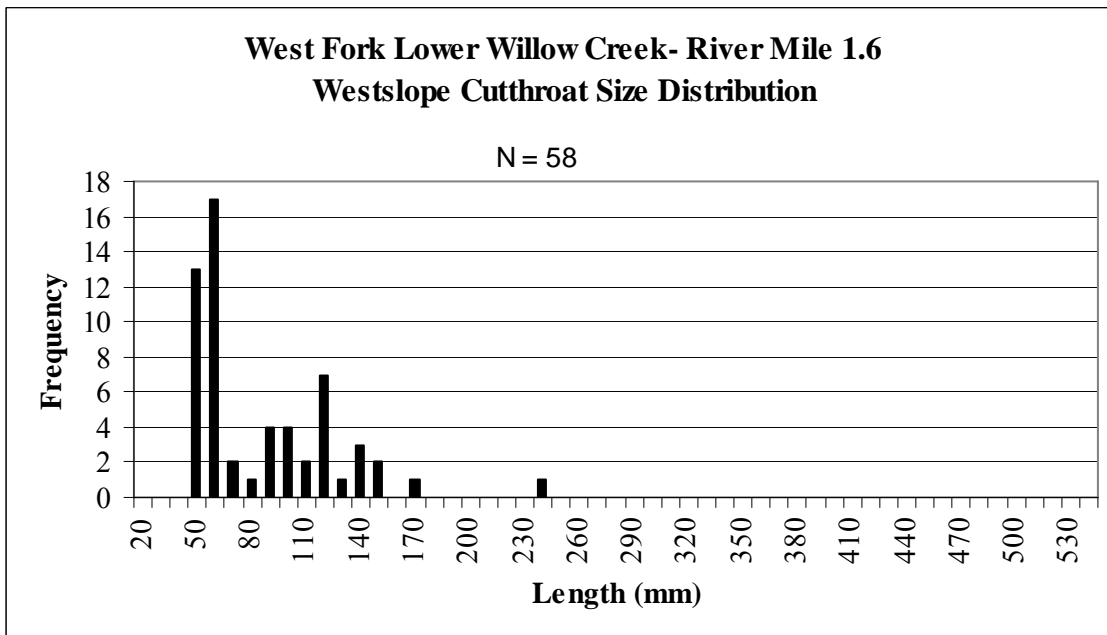


North Fork Lower Creek

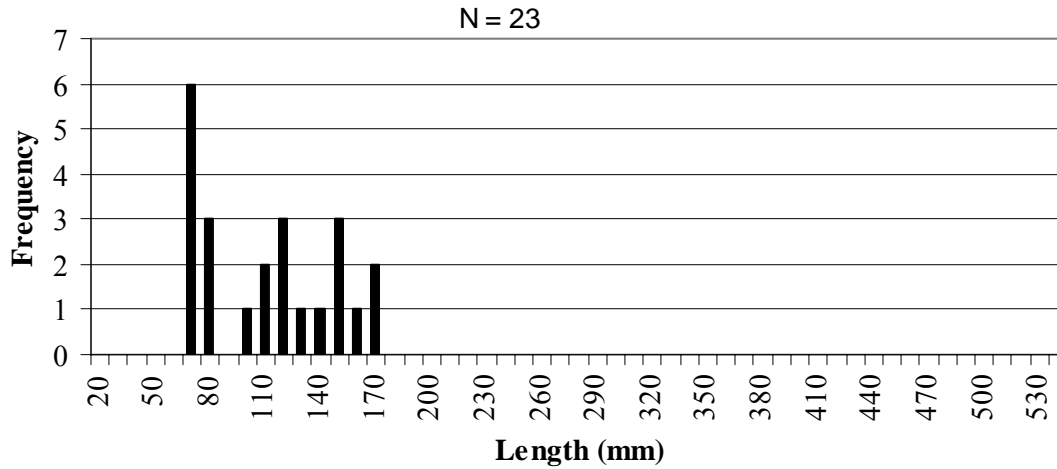




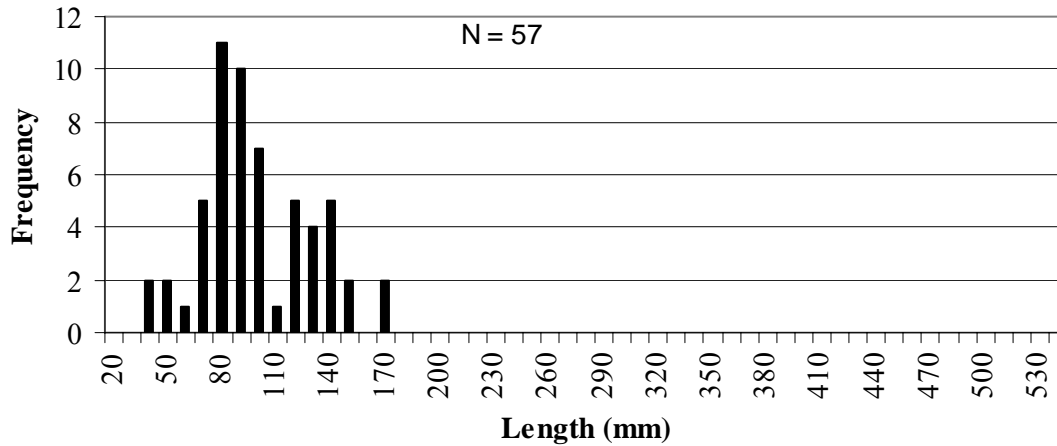
West Fork Lower Willow Creek

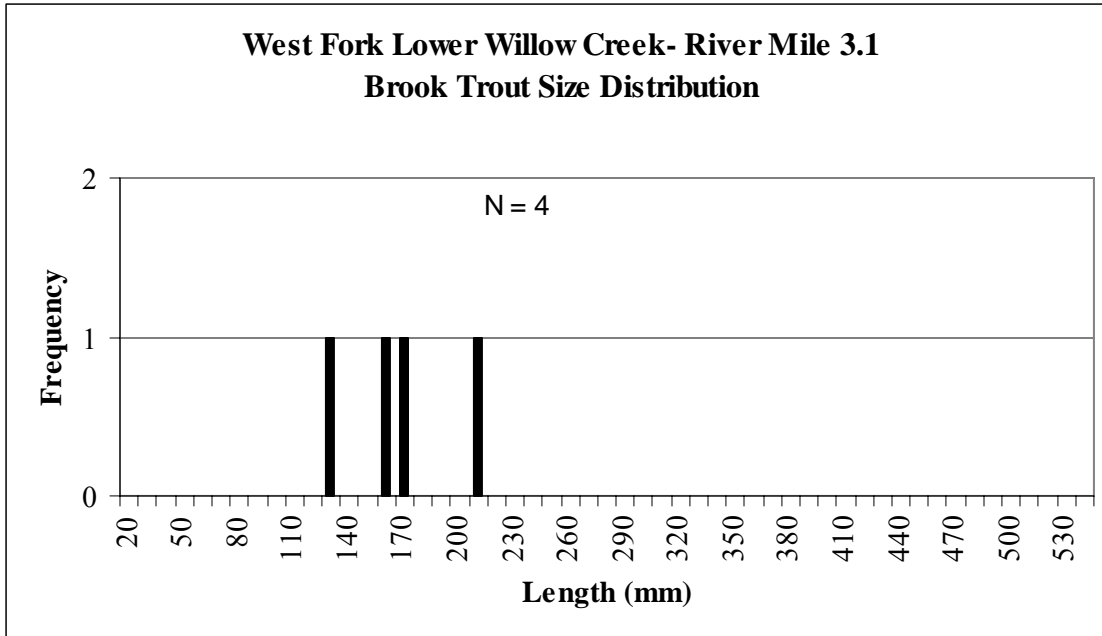


West Fork Lower Willow Creek- River Mile 1.6
Brook Trout Size Distribution

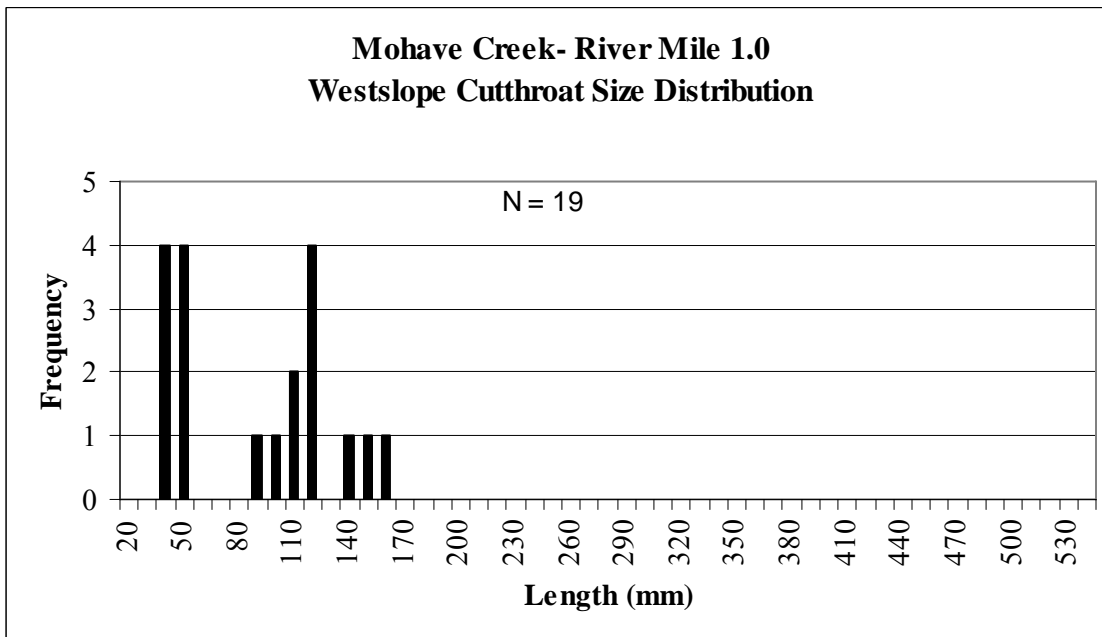


West Fork Lower Willow Creek- River Mile 3.1
Westslope Cutthroat Size Distribution

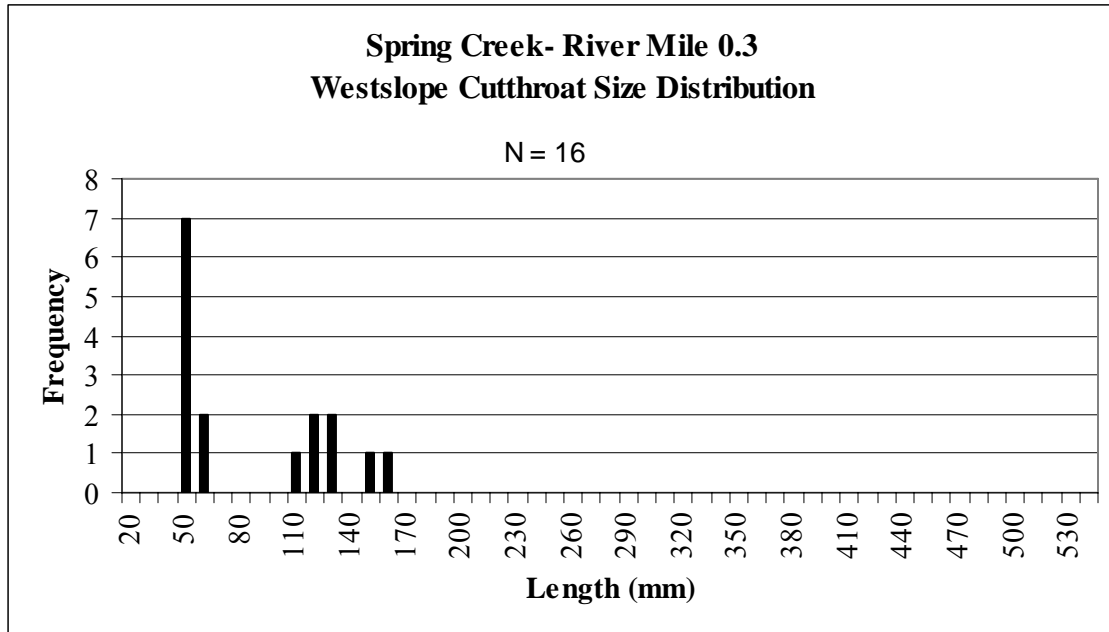




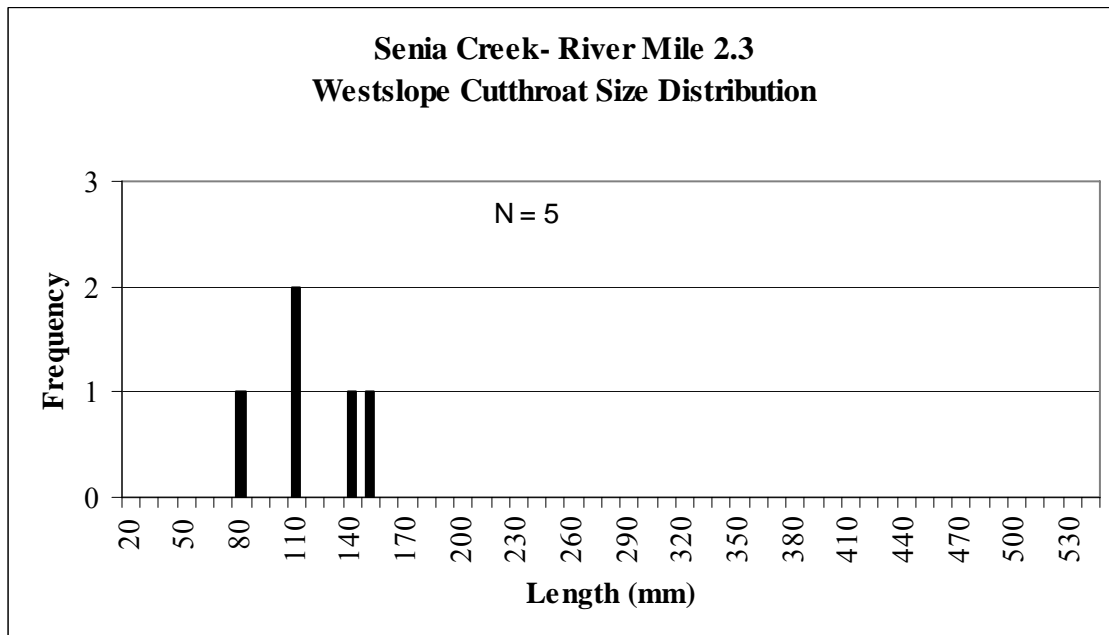
Mohave Creek



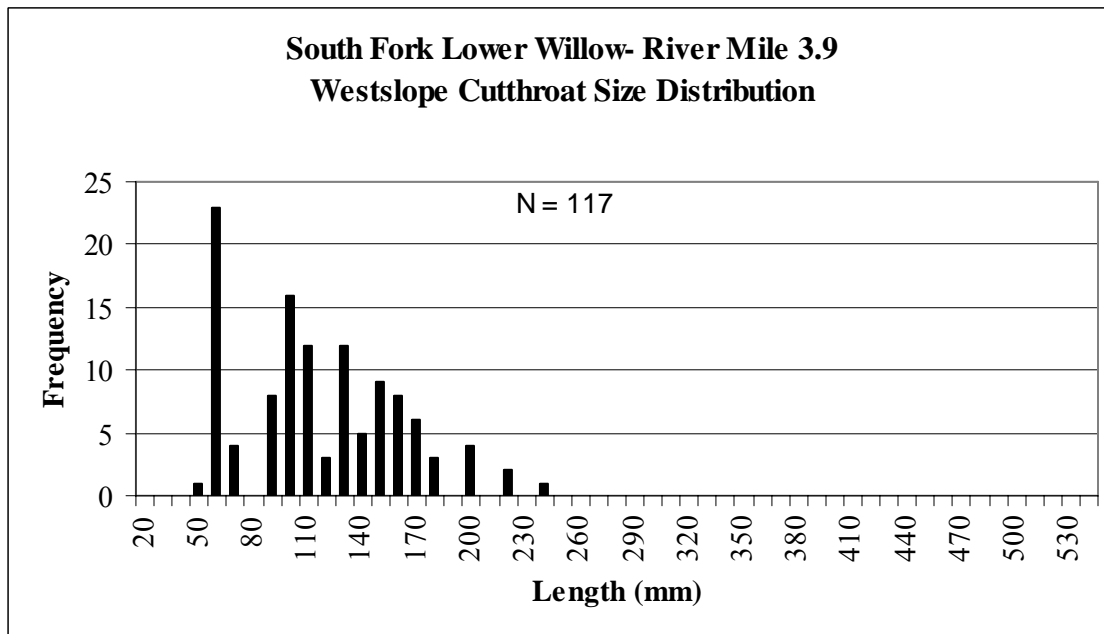
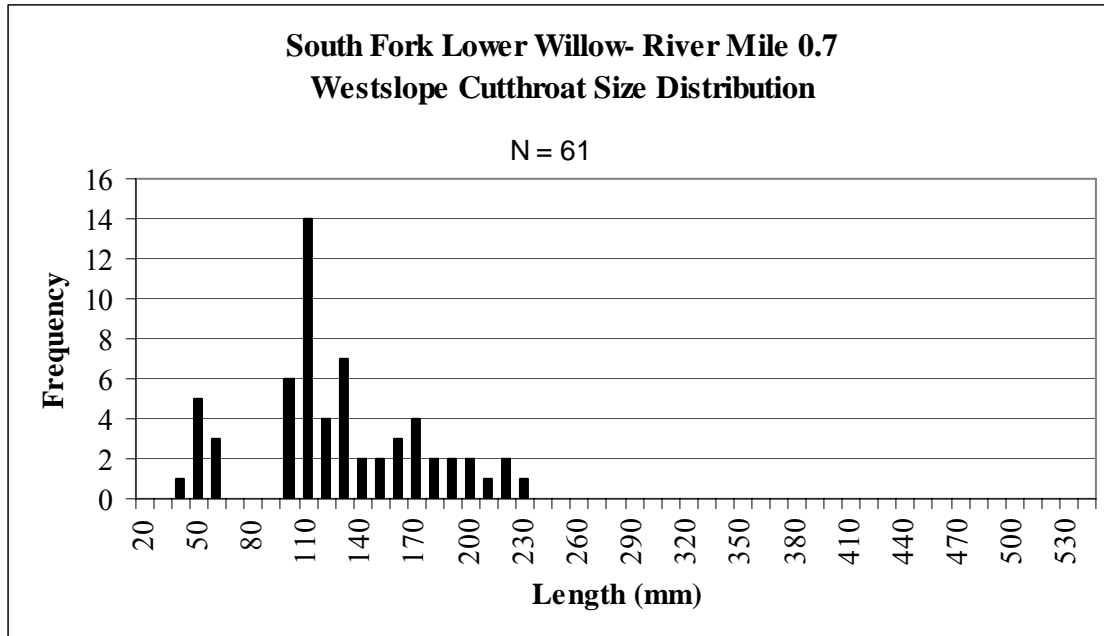
Spring Creek



Senia Creek

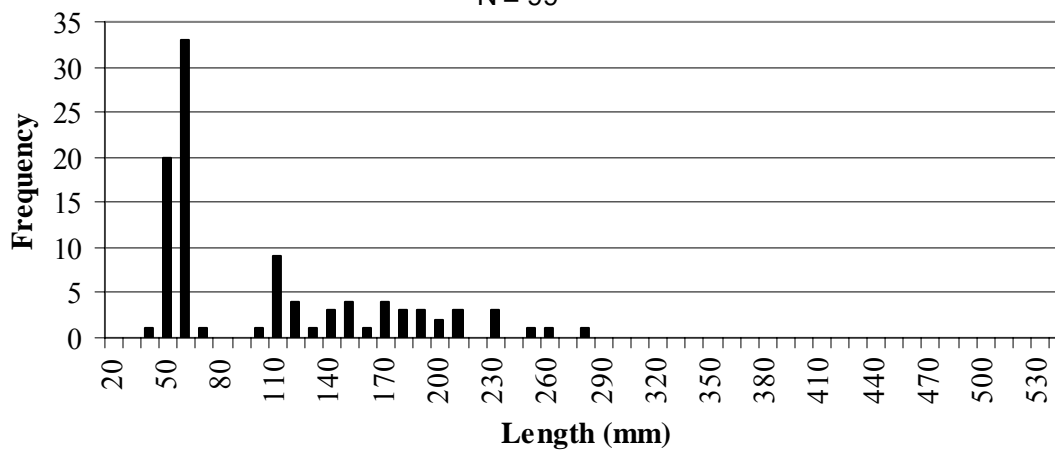


South Fork Lower Willow Creek



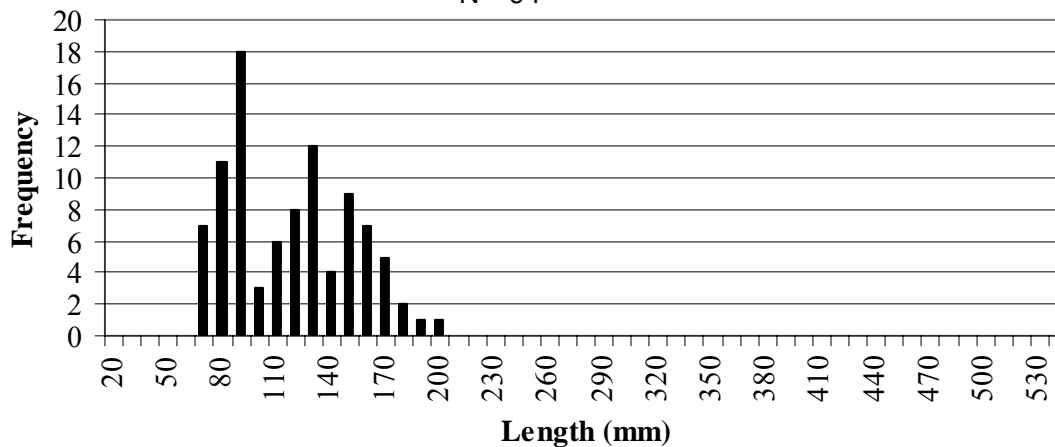
**South Fork Lower Willow- River Mile 7.8
Westslope Cutthroat Size Distribution**

N = 99

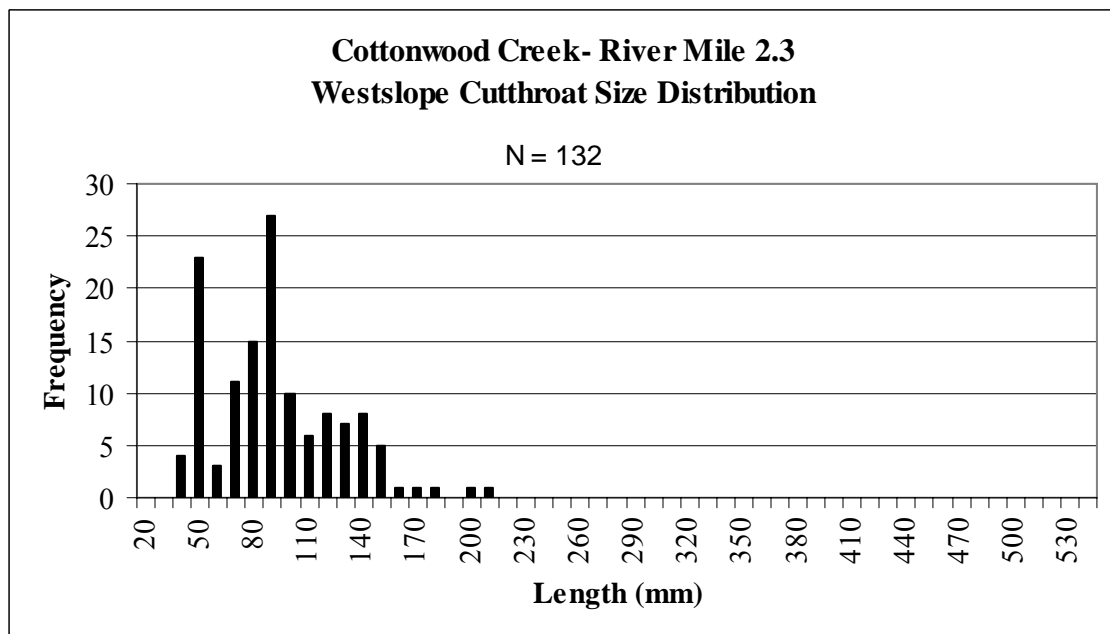
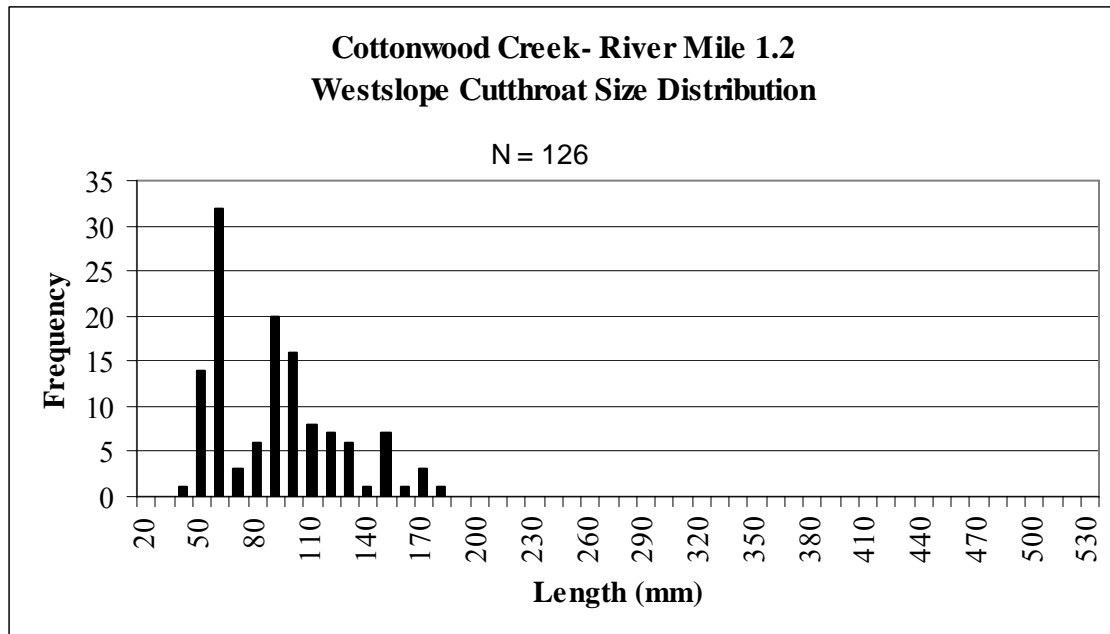


**South Fork Lower Willow- River Mile 10.7
Westslope Cutthroat Size Distribution**

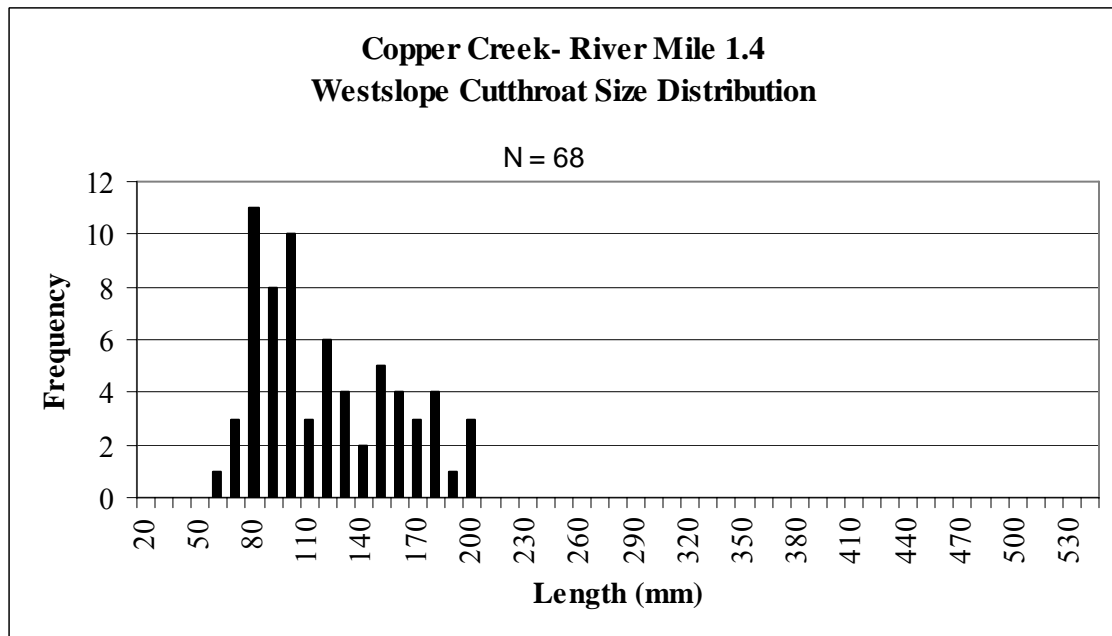
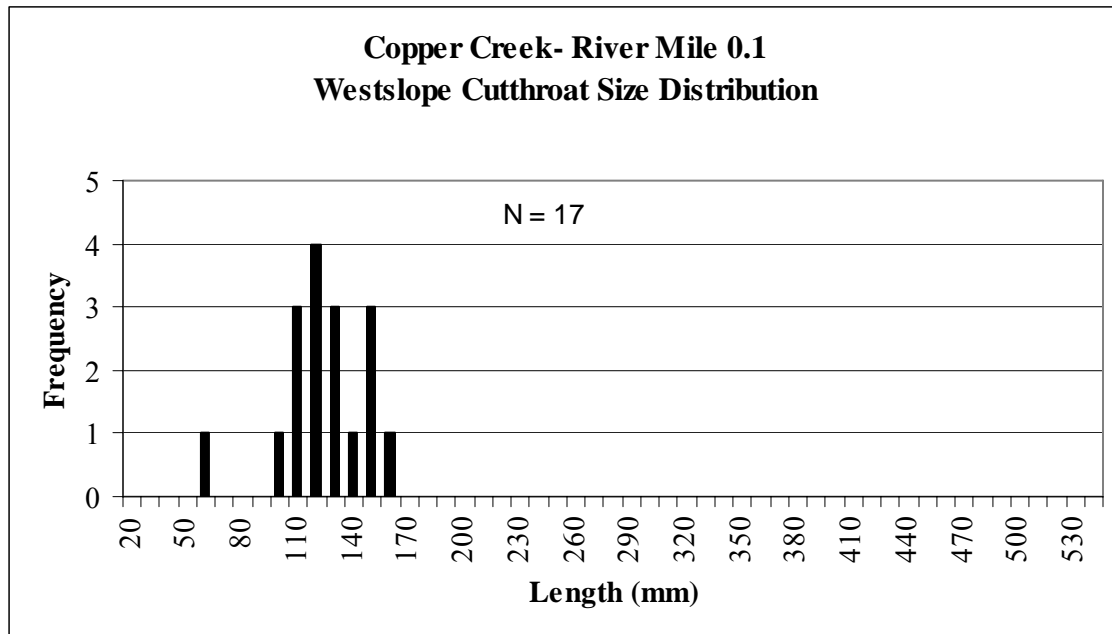
N = 94



Cottonwood Creek

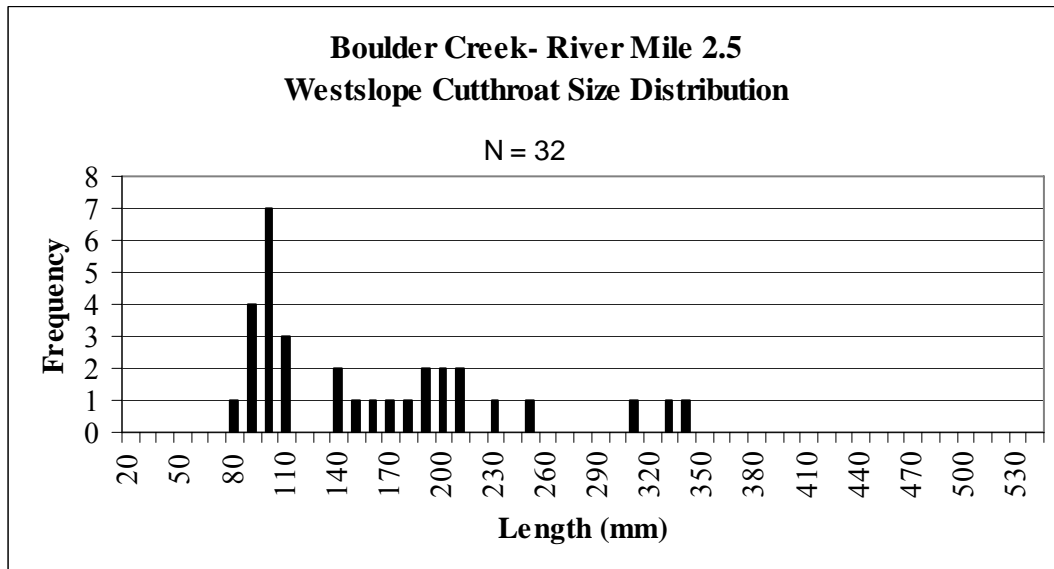
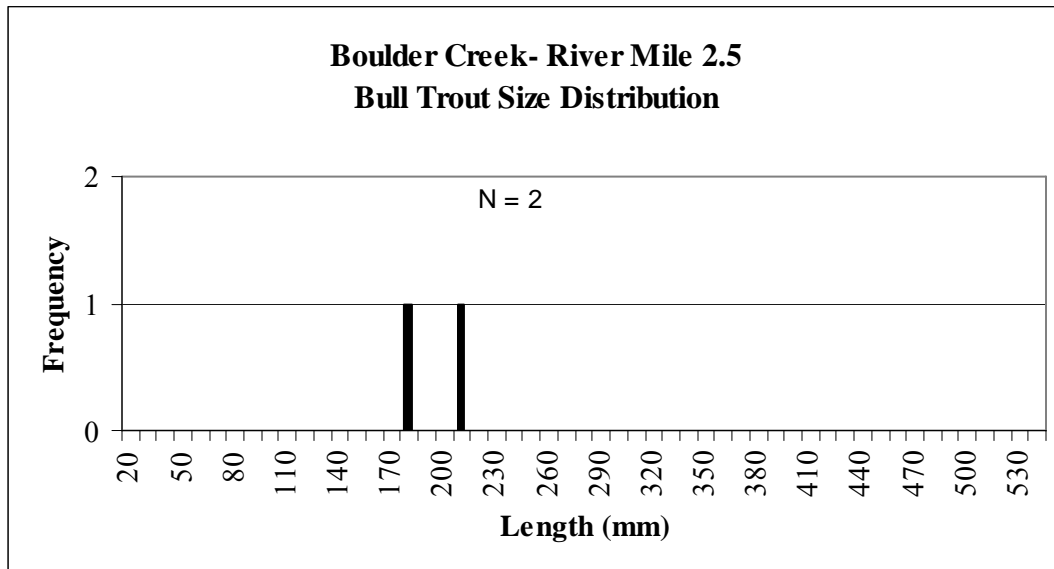


Copper Creek

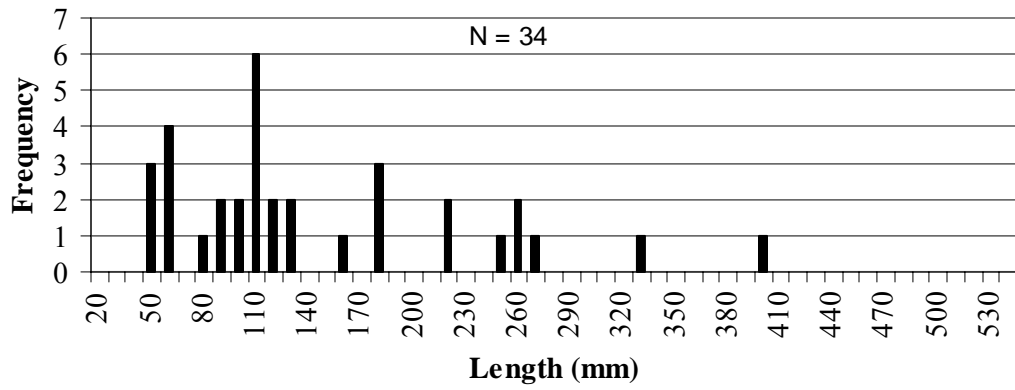


Boulder Creek

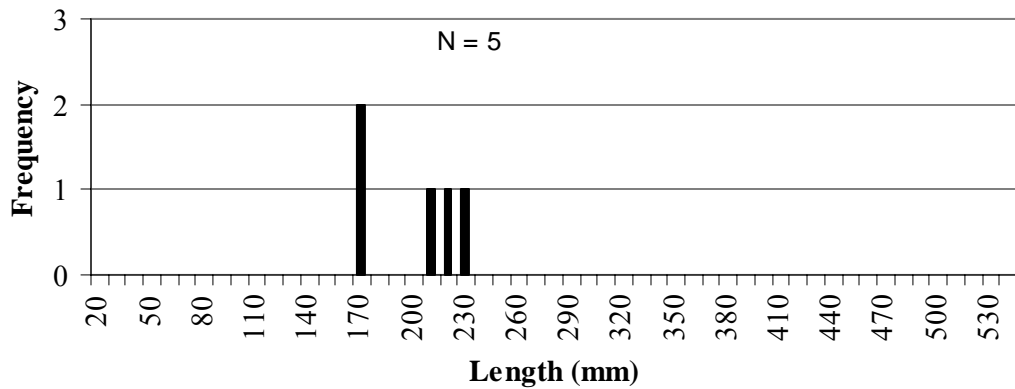
Boulder Creek



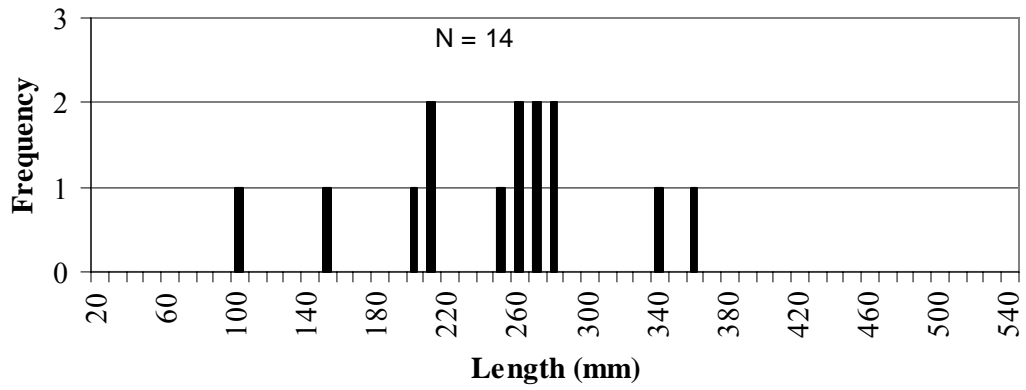
**Boulder Creek- River Mile 2.5
Brown Trout Size Distribution**



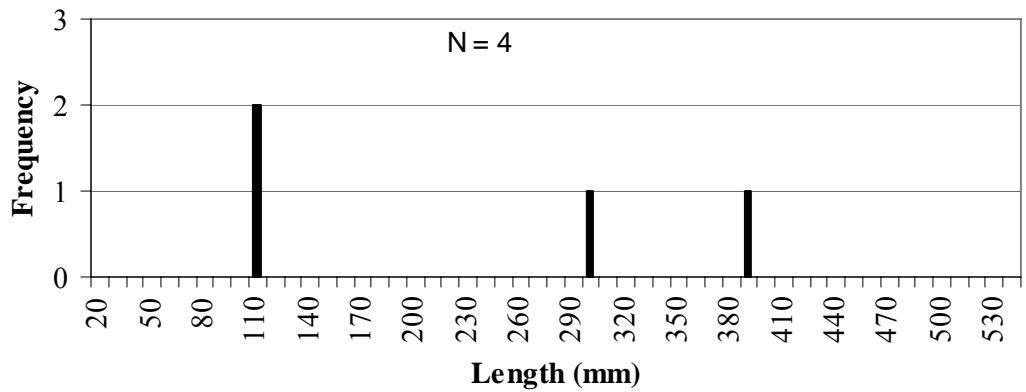
**Boulder Creek- River Mile 5.1
Bull Trout Size Distribution**

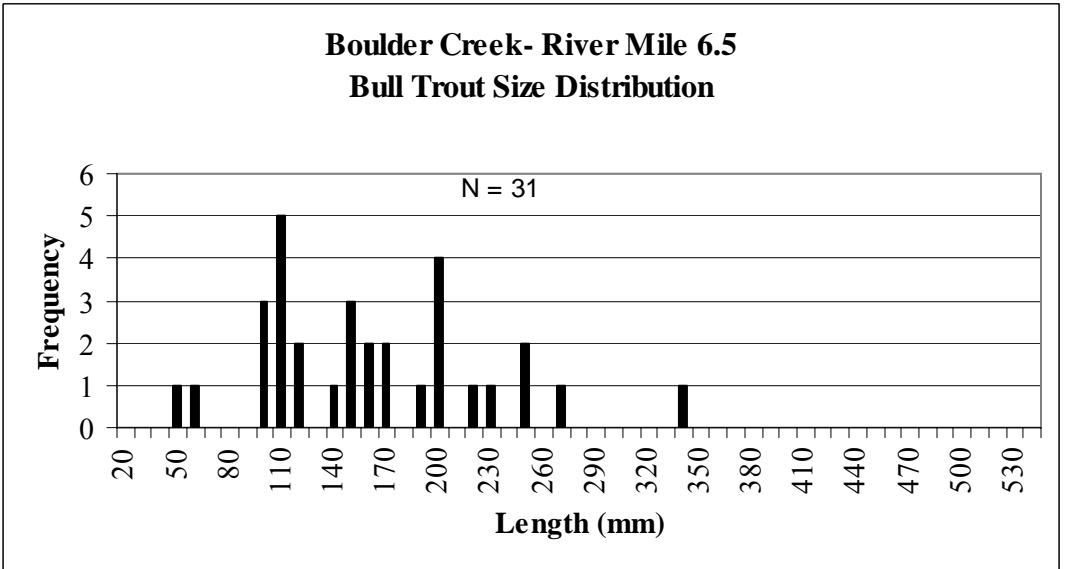
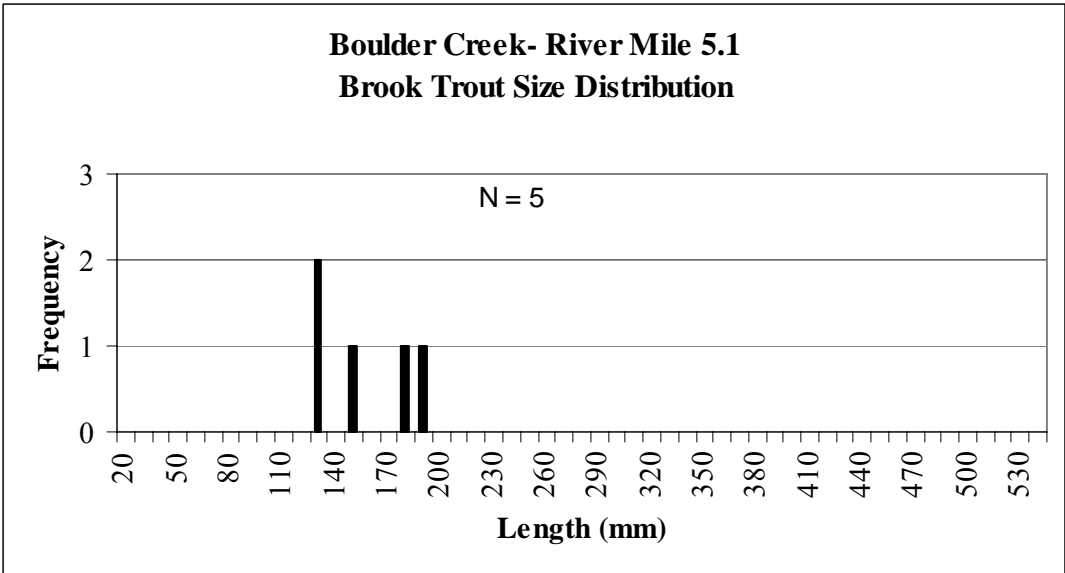


**Boulder Creek- River Mile 5.1
Westslope Cutthroat Size Distribution**

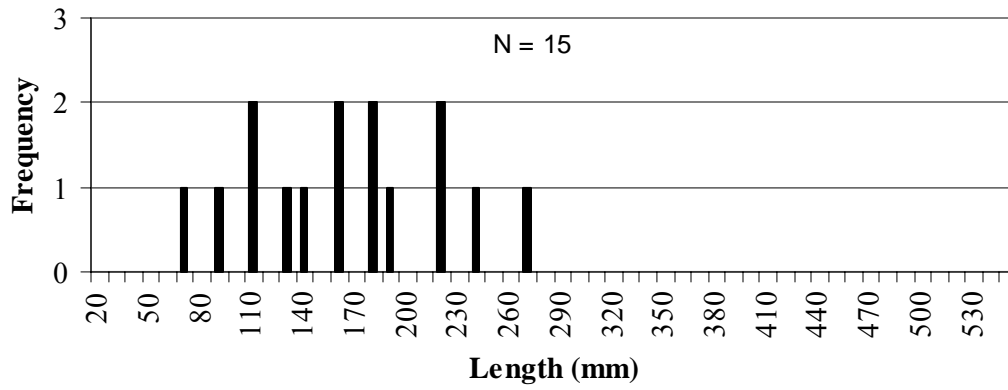


**Boulder Creek- River Mile 5.1
Brown Trout Size Distribution**

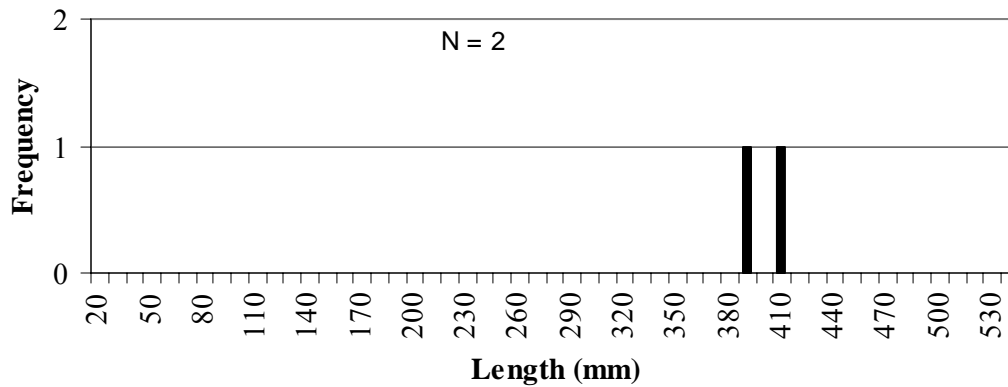




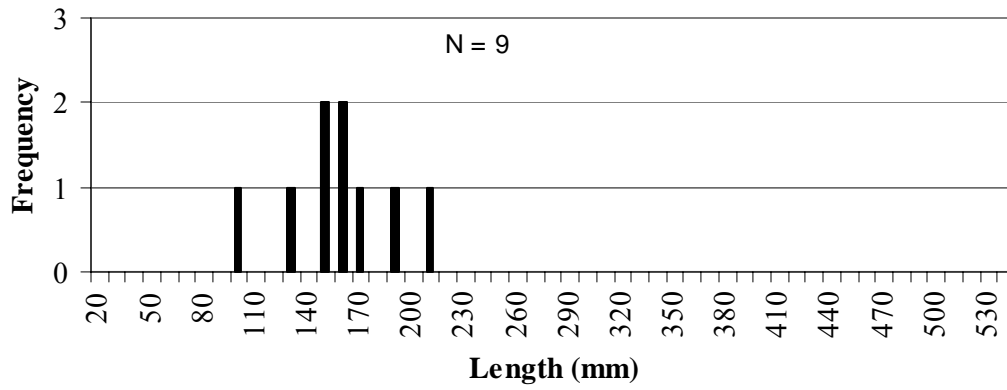
**Boulder Creek- River Mile 6.5
Westslope Cutthroat Trout Size Distribution**



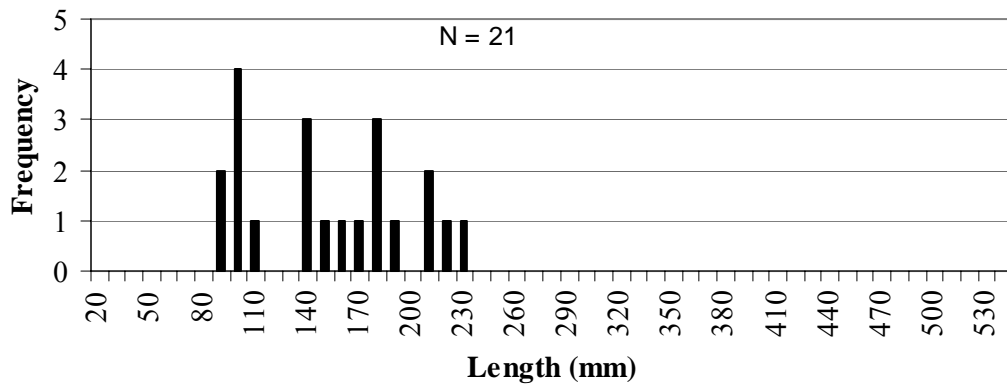
**Boulder Creek- River Mile 6.5
Brown Trout Size Distribution**



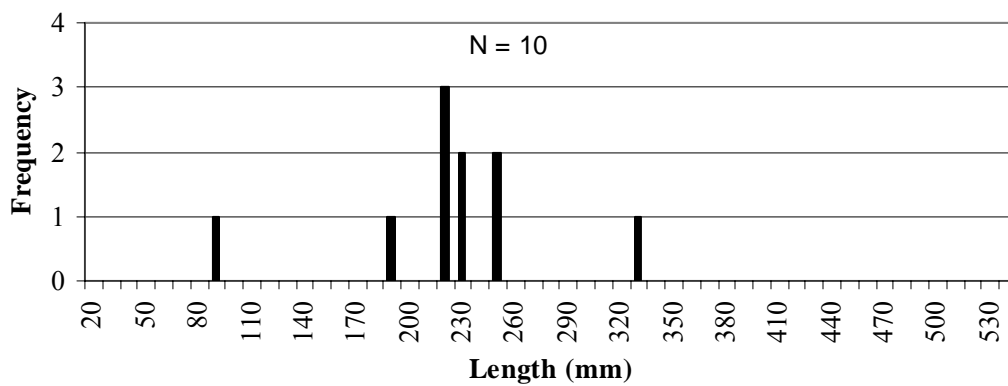
**Boulder Creek- River Mile 6.5
Brook Trout Size Distribution**



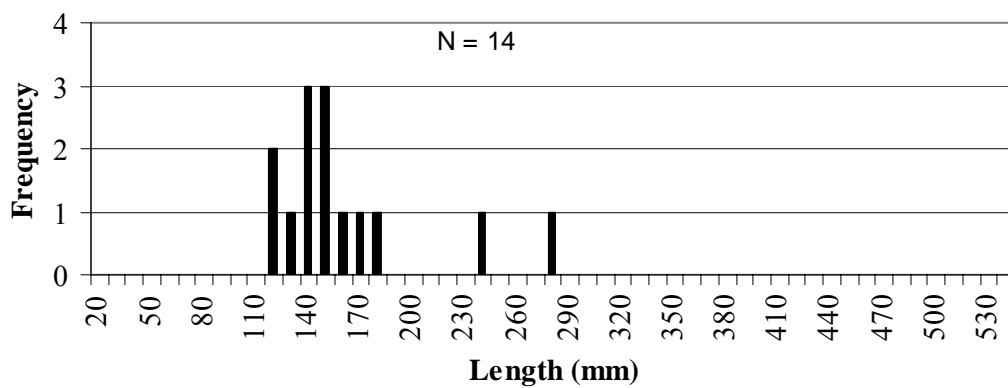
**Boulder Creek- River Mile 7.7
Bull Trout Size Distribution**

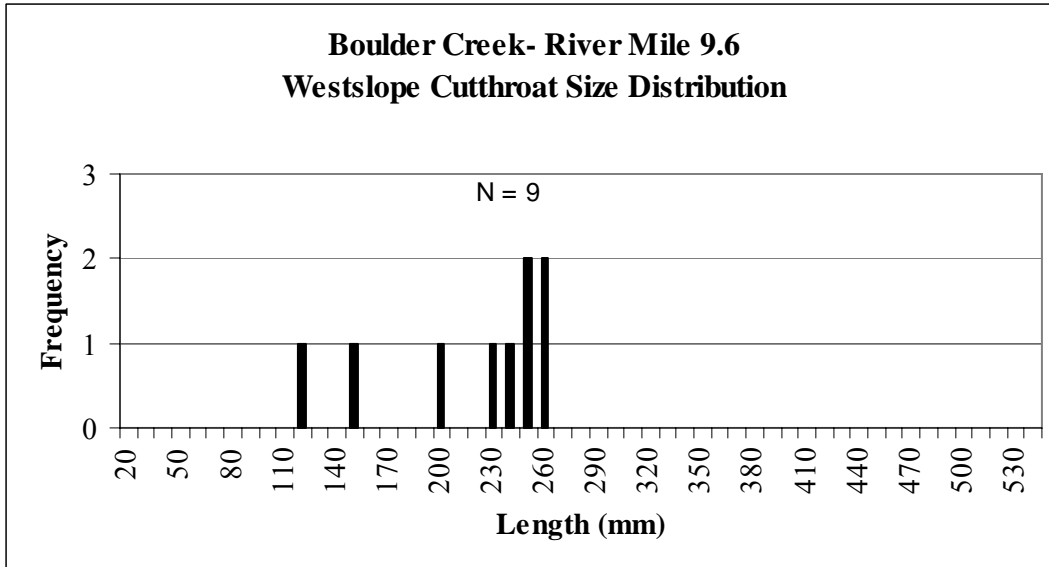


**Boulder Creek- River Mile 7.7
Westslope Cutthroat Size Distribution**

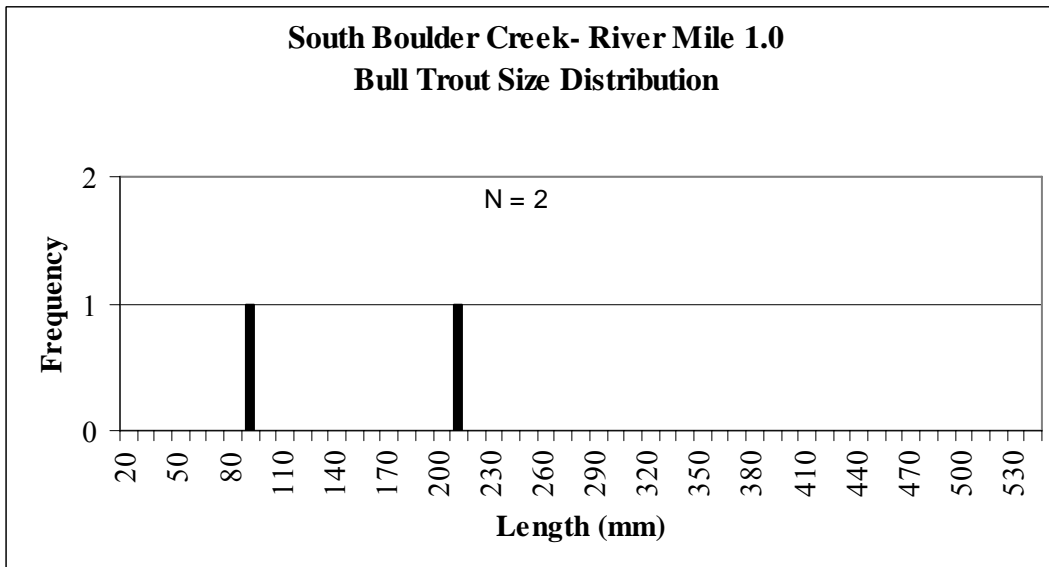


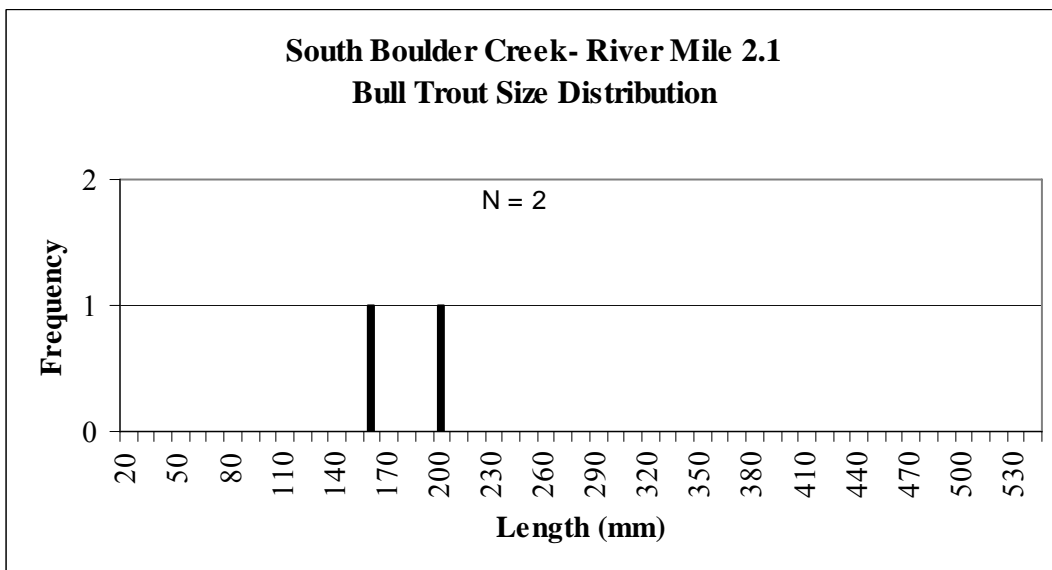
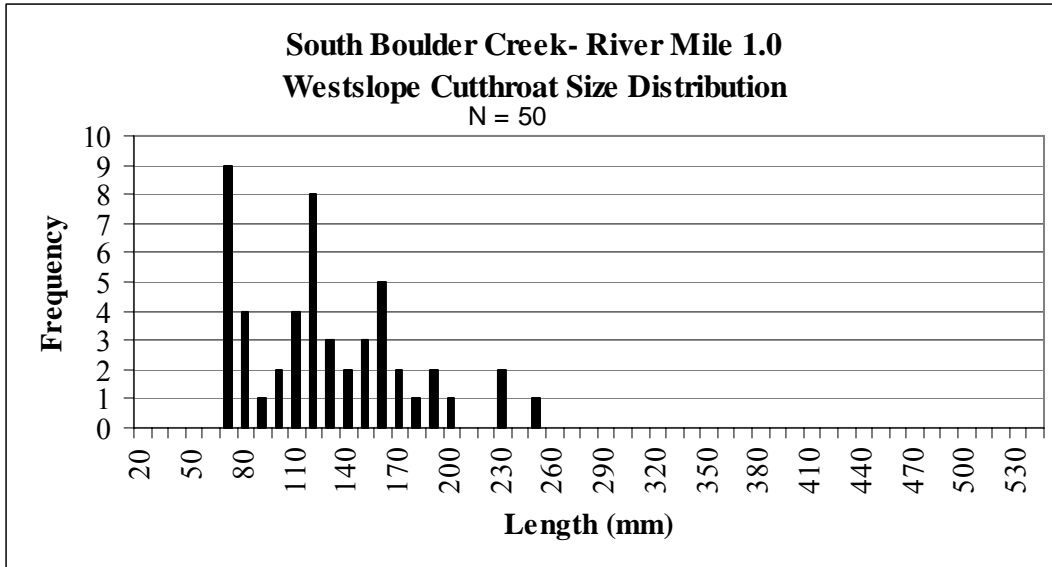
**Boulder Creek- River Mile 9.6
Bull Trout Size Distribution**

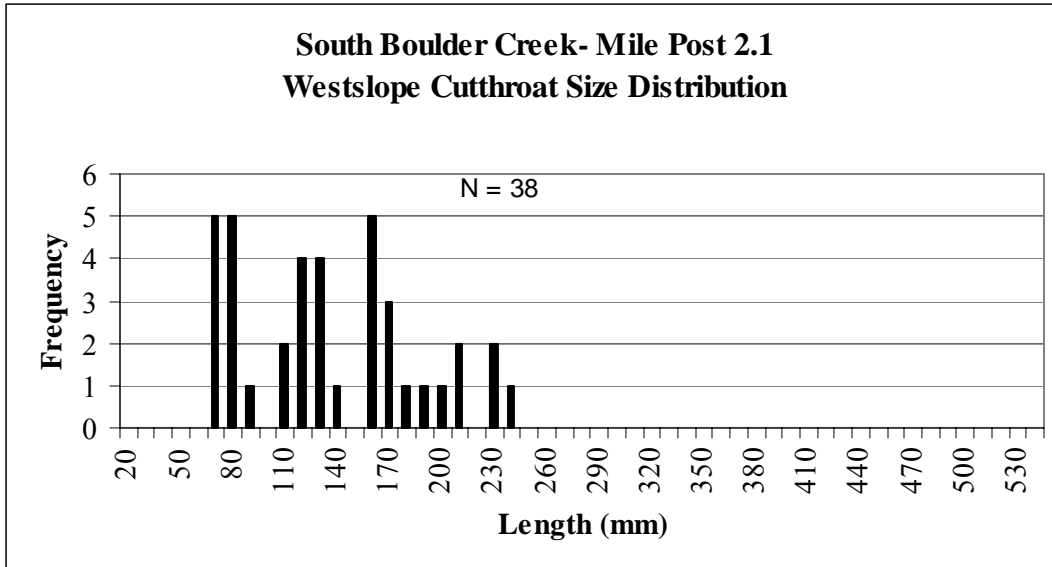




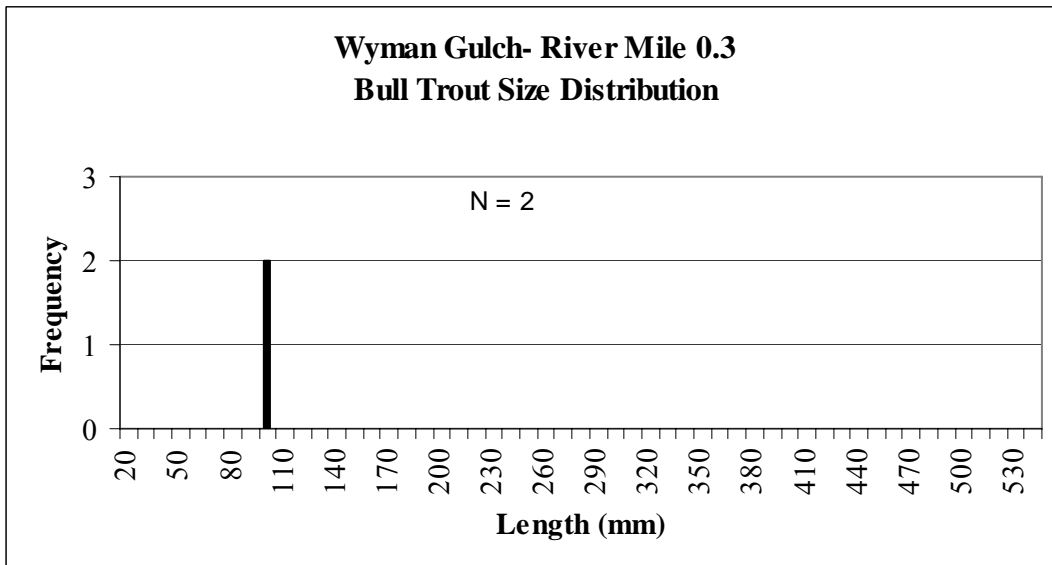
South Boulder Creek



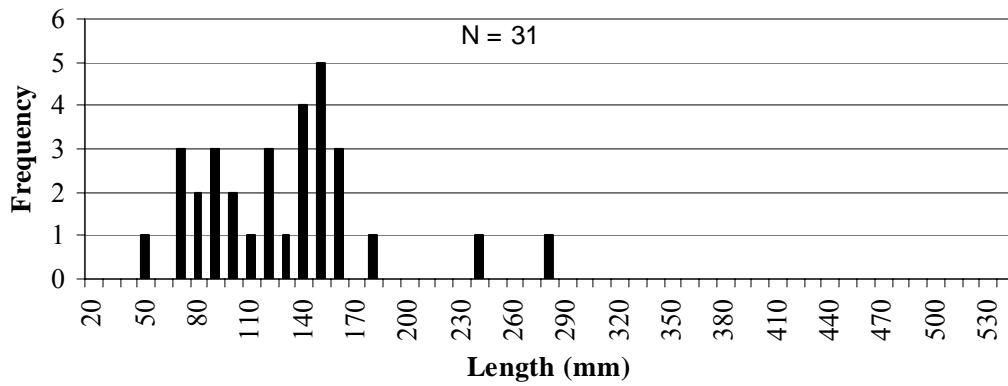




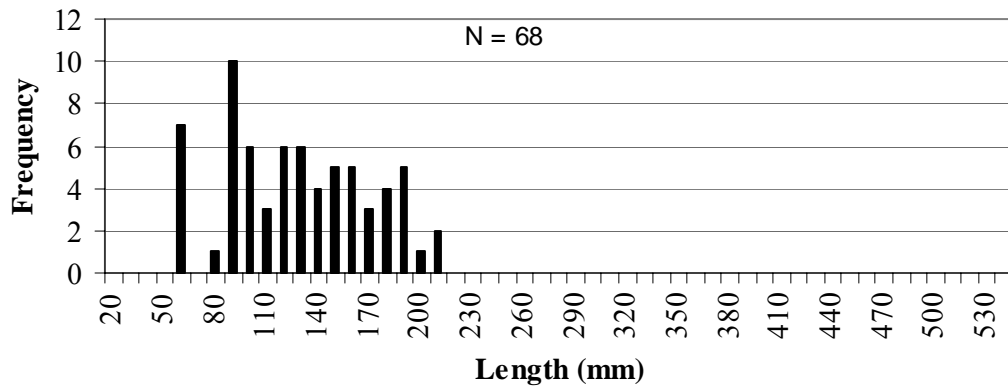
Wyman Gulch

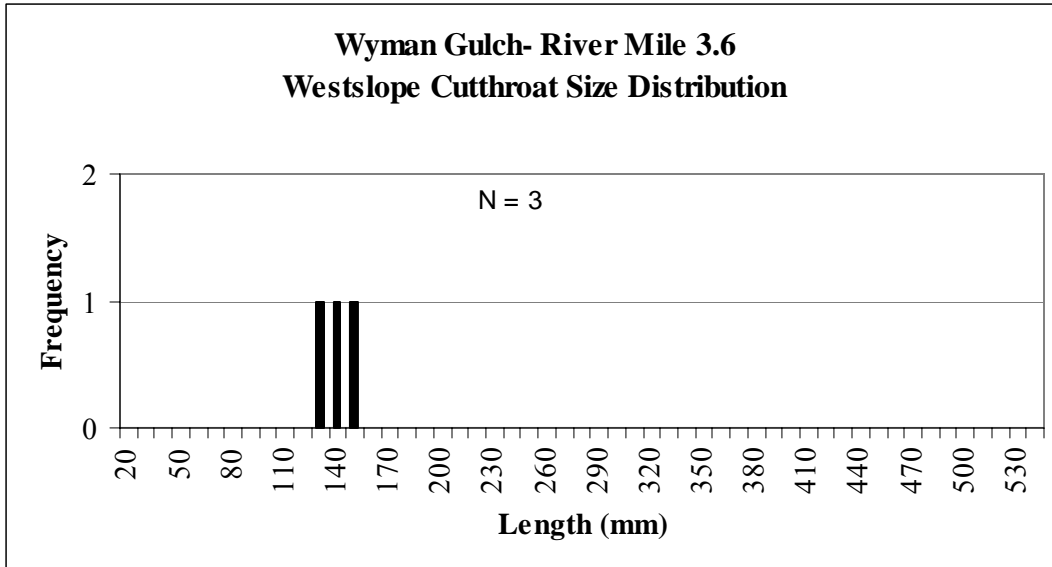


**Wyman Gulch- River Mile 0.3
Westslope Cutthroat Size Distribution**

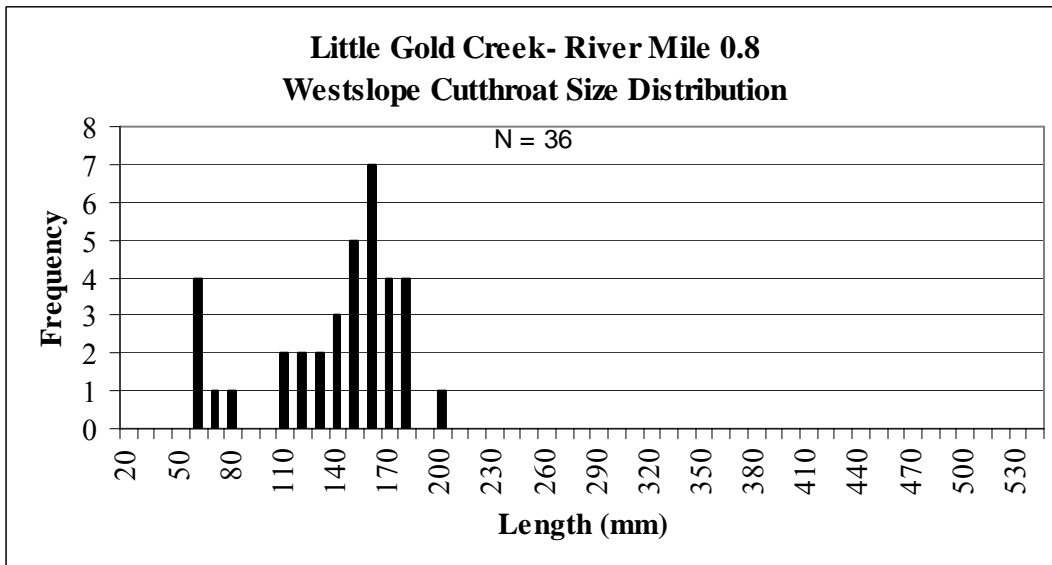


**Wyman Gulch- River Mile 2.4
Westslope Cutthroat Size Distribution**

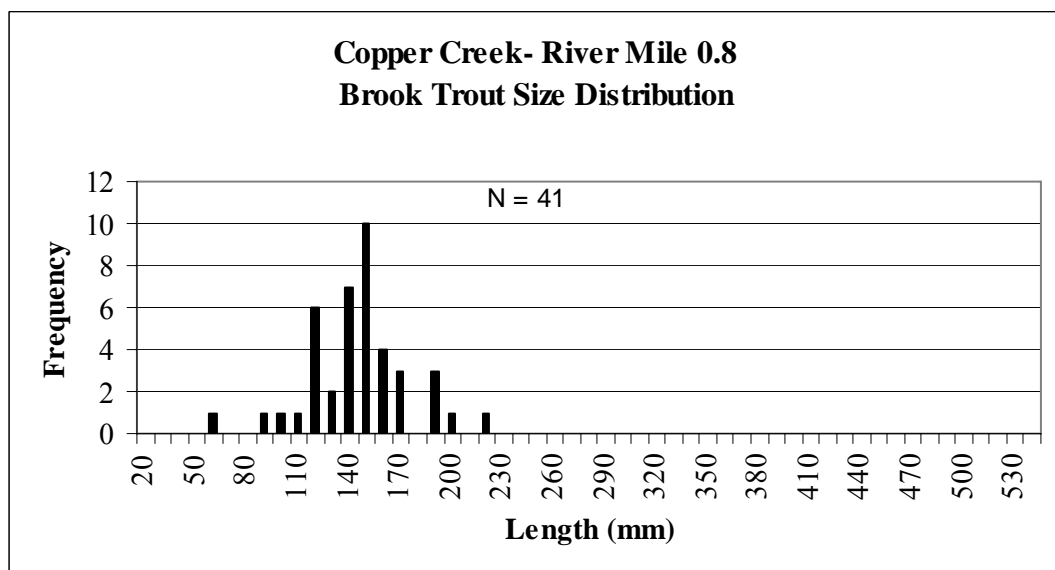
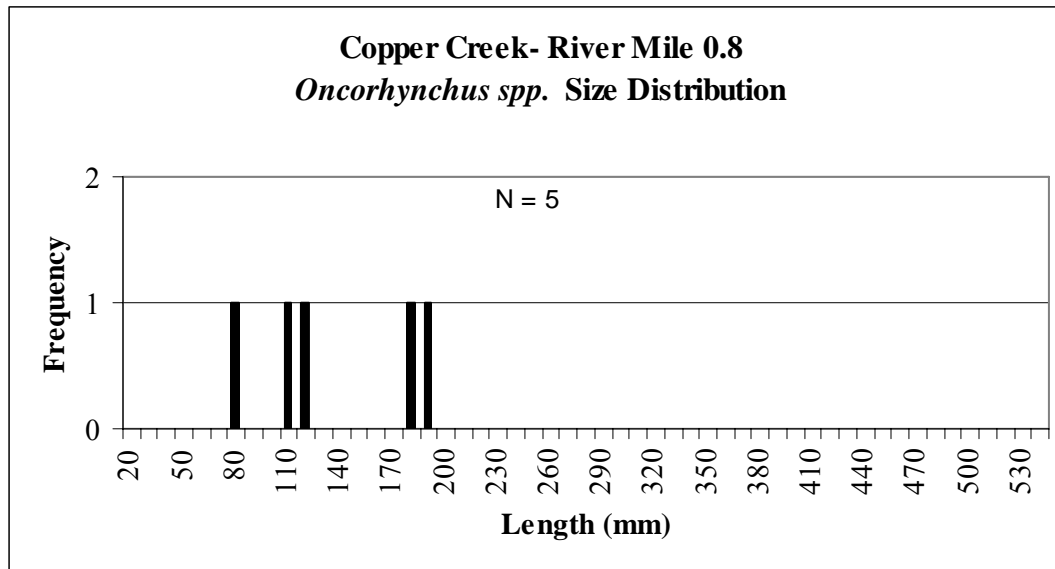




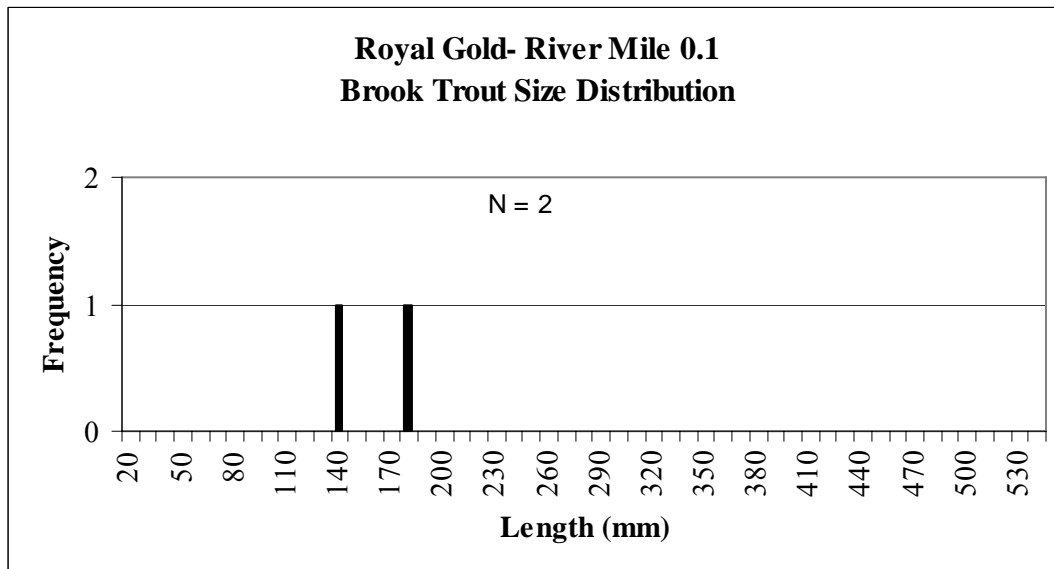
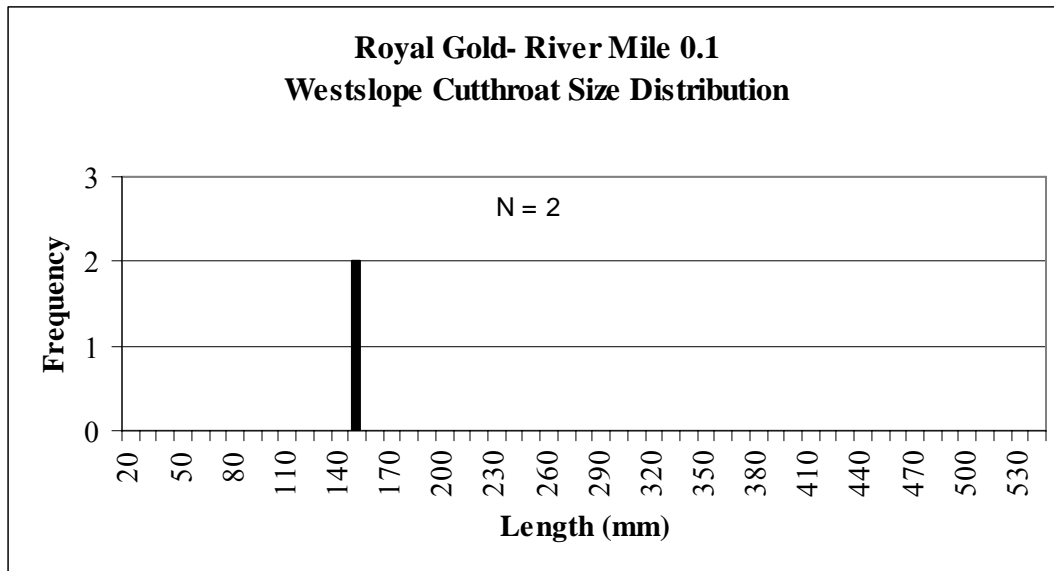
Little Gold Creek

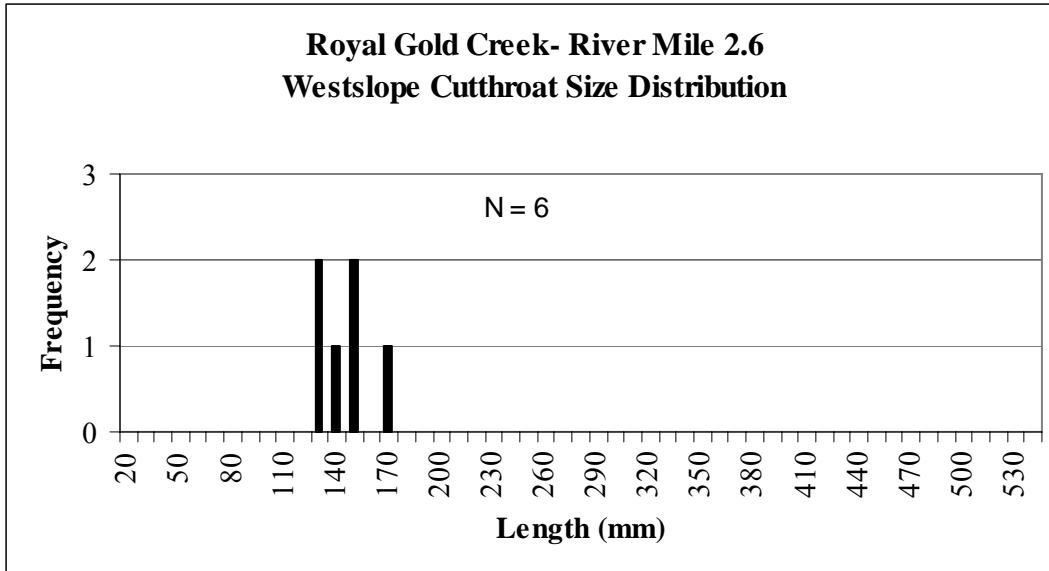


Copper Creek

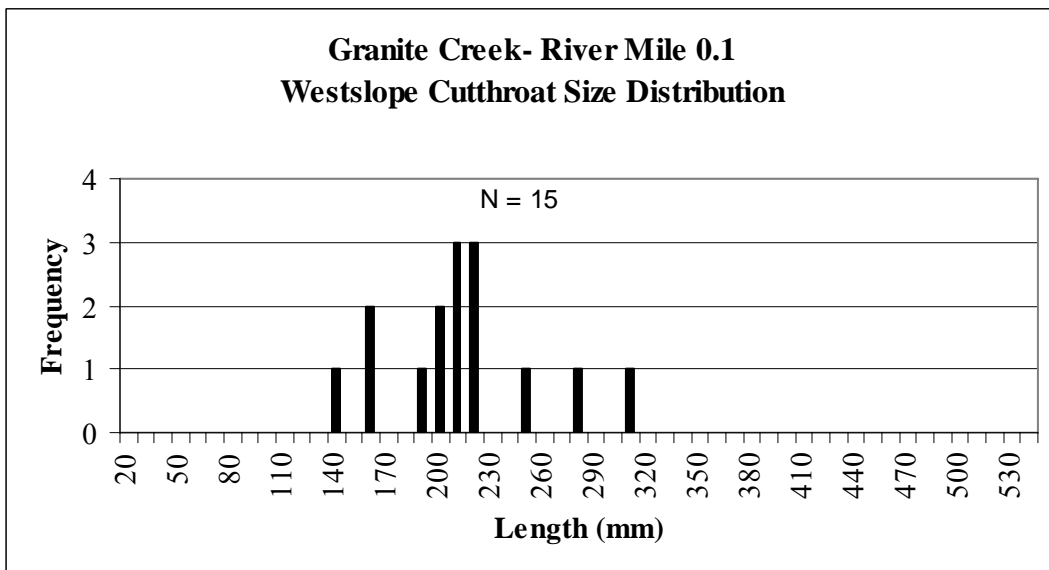


Royal Gold Creek



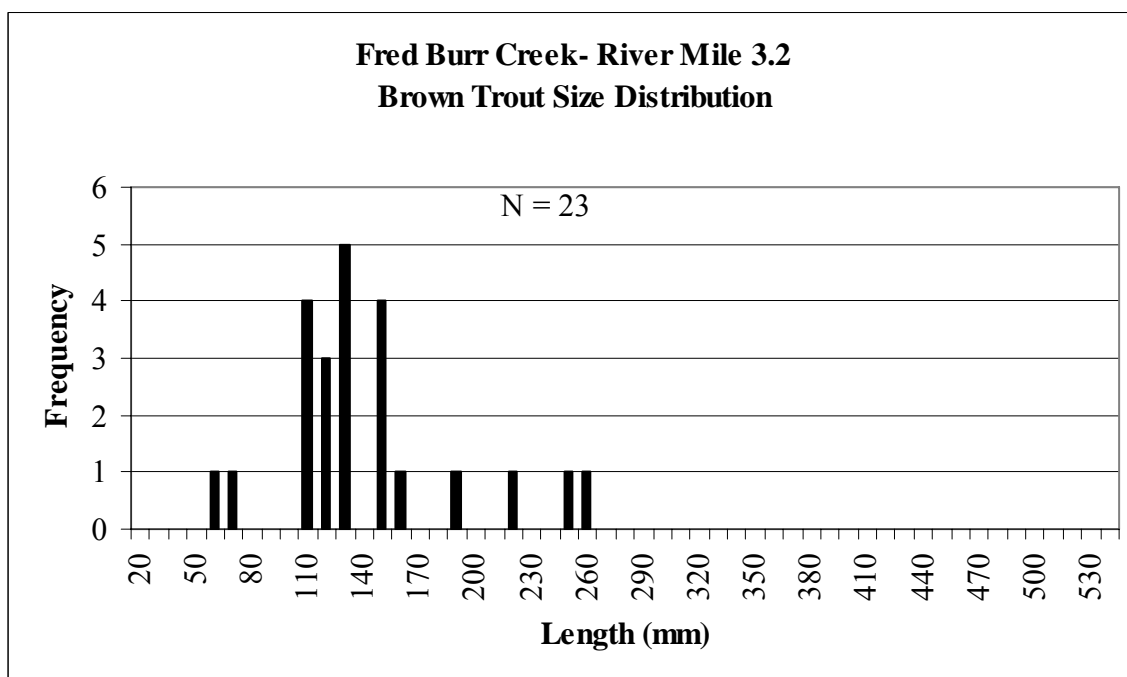
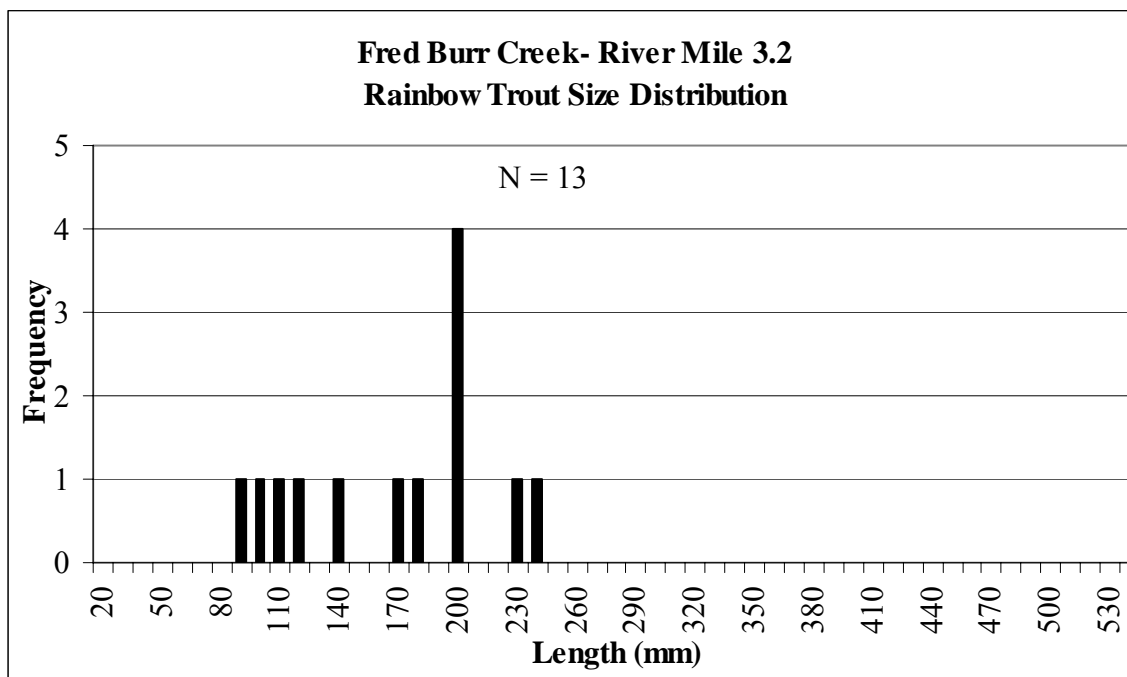


Granite Creek

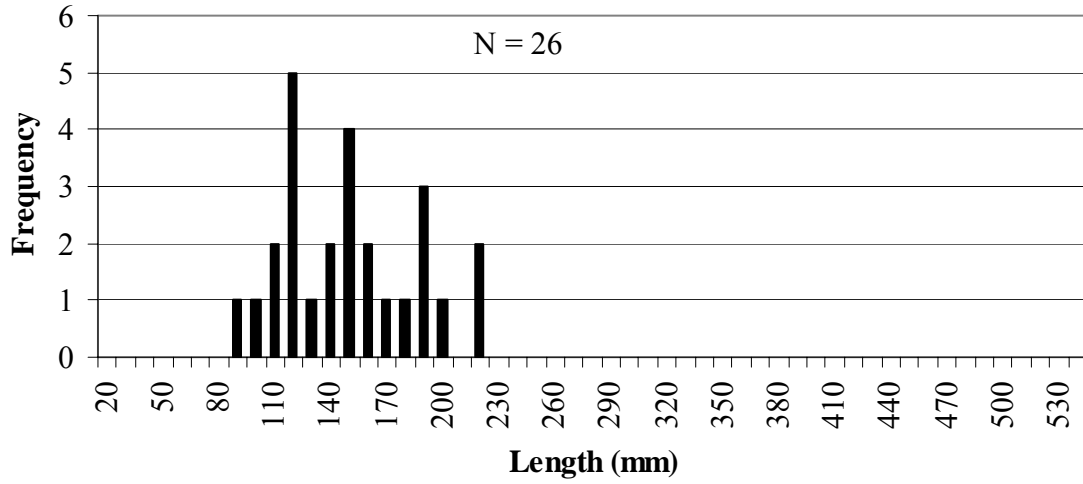


Fred Burr Creek

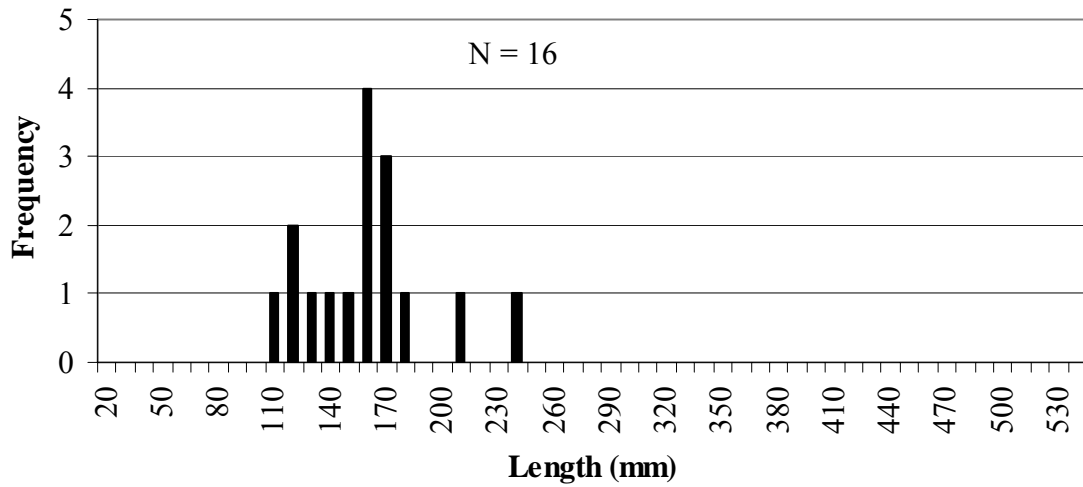
Fred Burr Creek



**Fred Burr Creek- River Mile 6.3
Westslope Cutthroat Size Distribution**

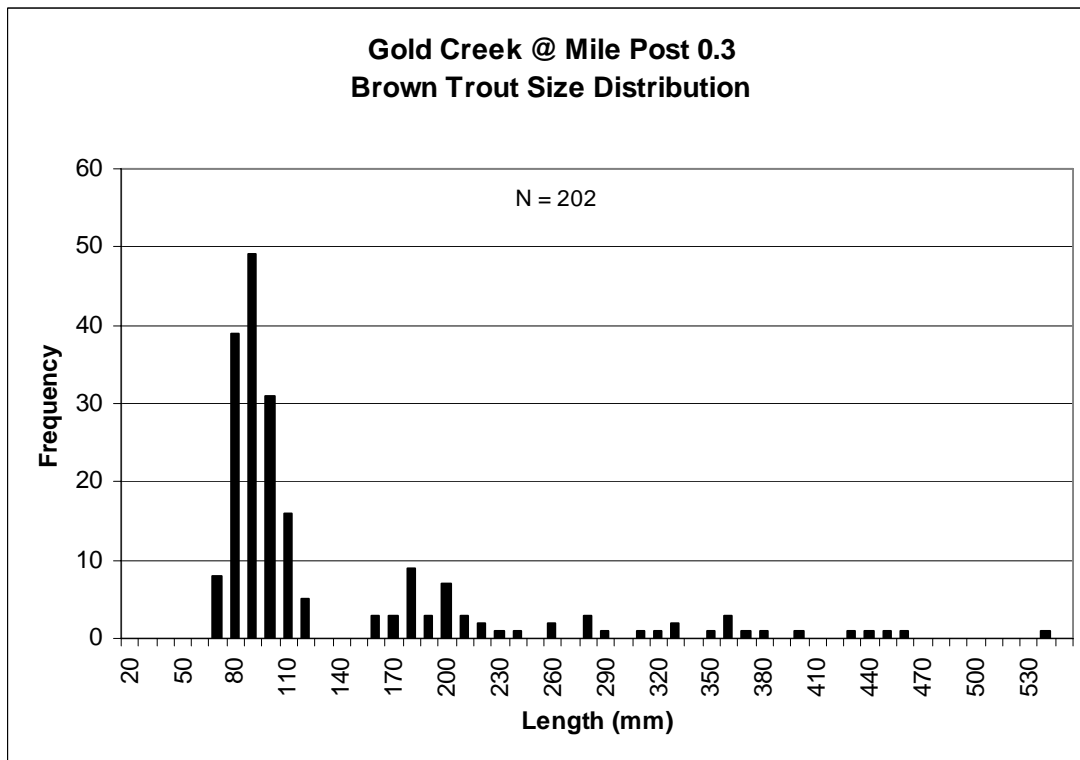
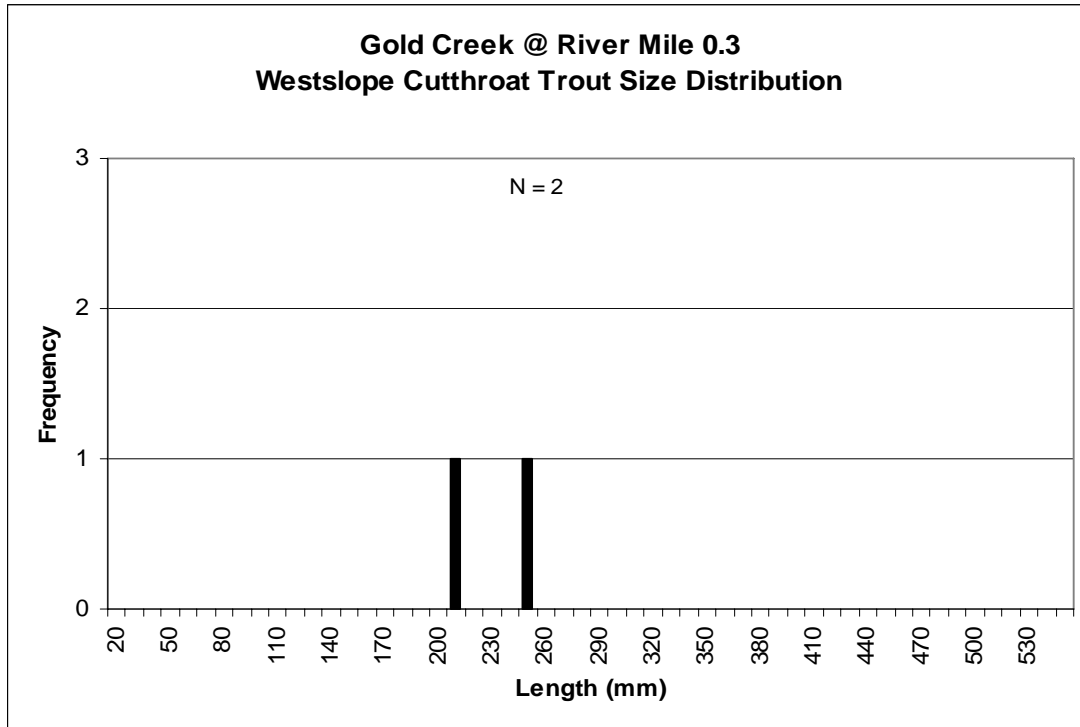


**Fred Burr Creek- River Mile 6.3
Brown Trout Size Distribution**

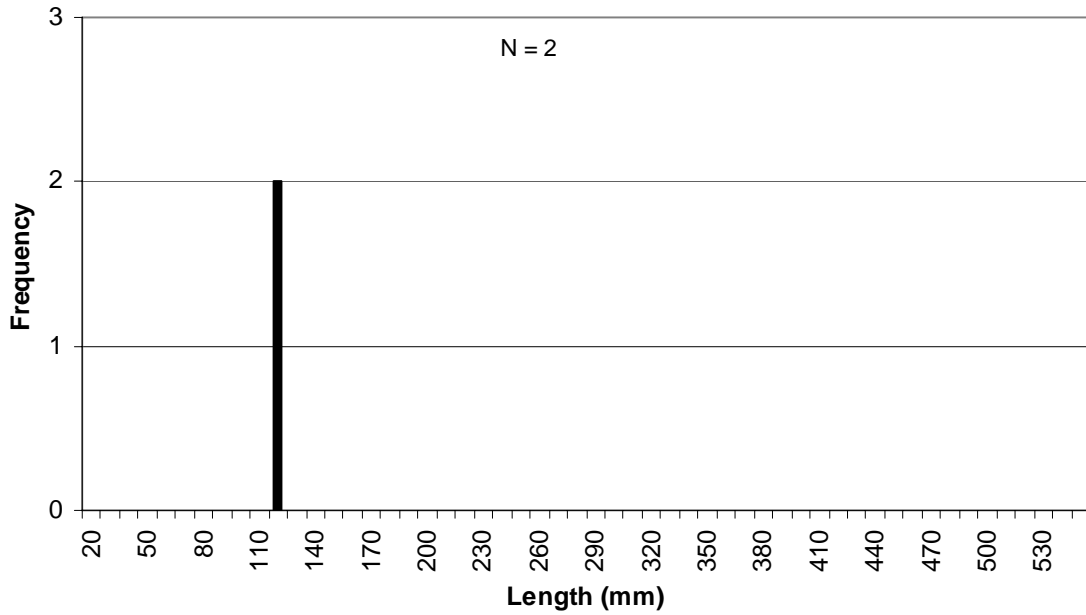


Gold Creek

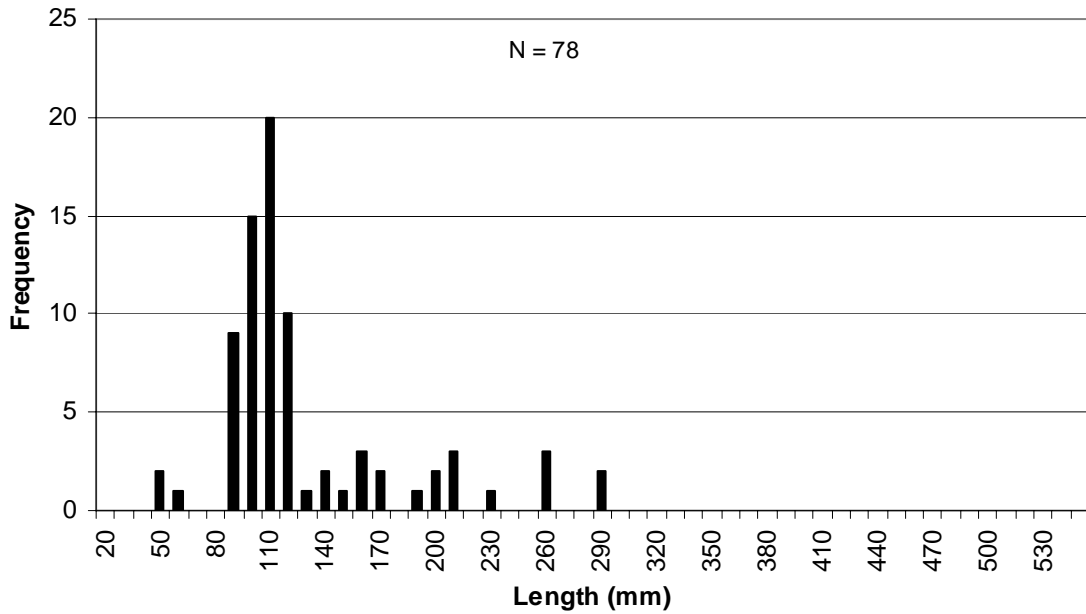
Gold Creek



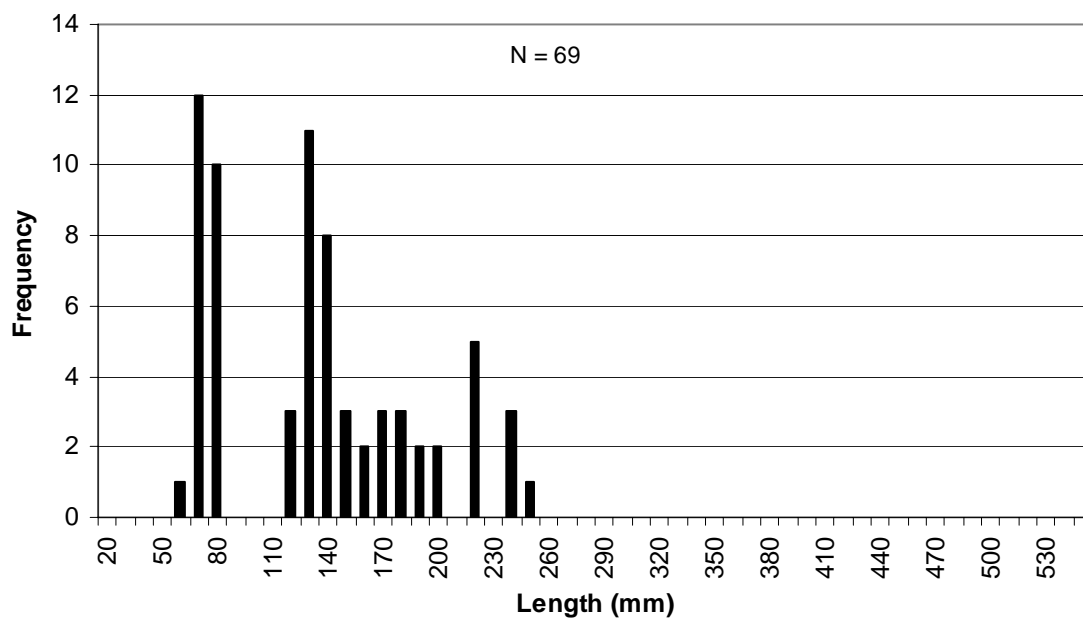
**Gold Creek @ River Mile 0.3
Mountain Whitefish Size Distribution**



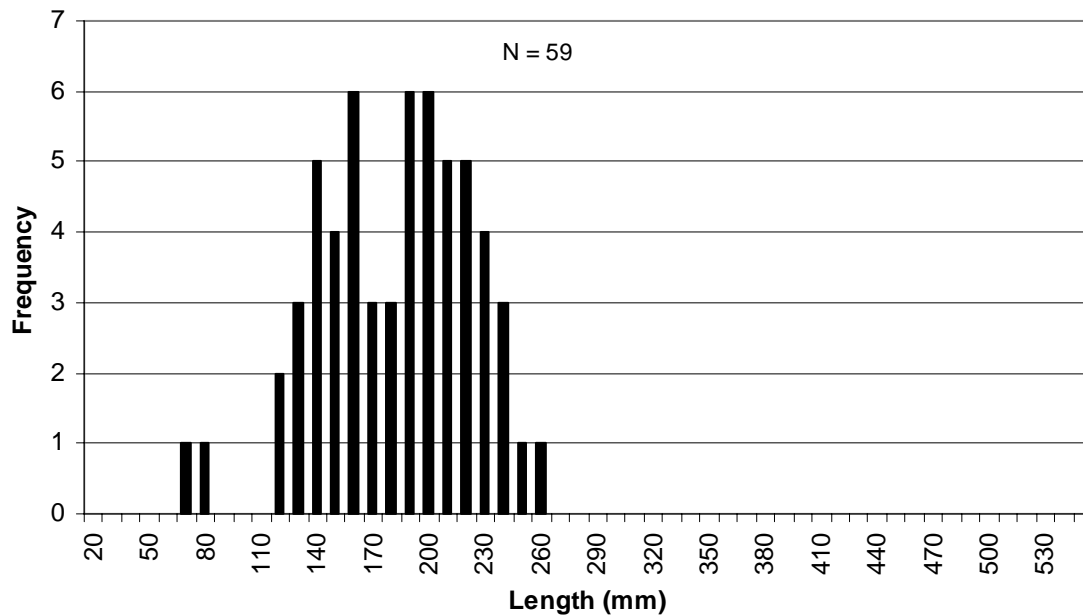
**Gold Creek @ River Mile 4.4
Westslope Cutthroat Trout Size Distribution**

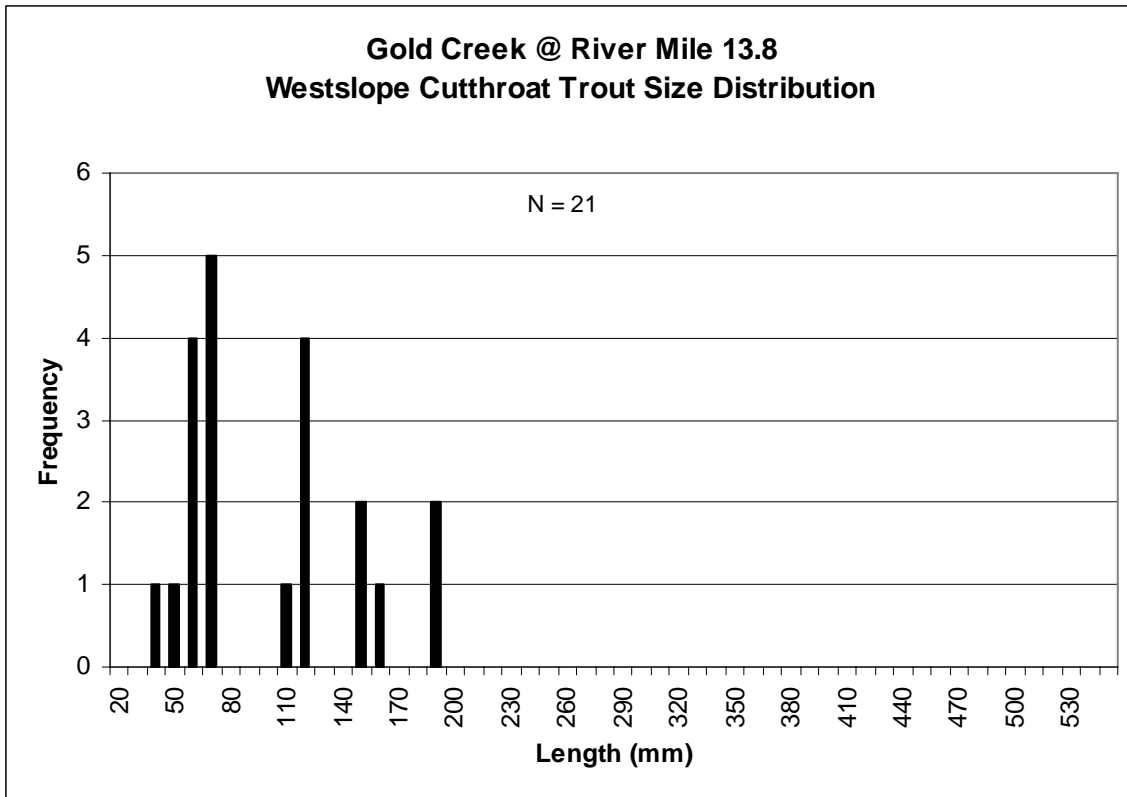


Gold Creek @ River Mile 4.4 Brown Trout Size Distribution

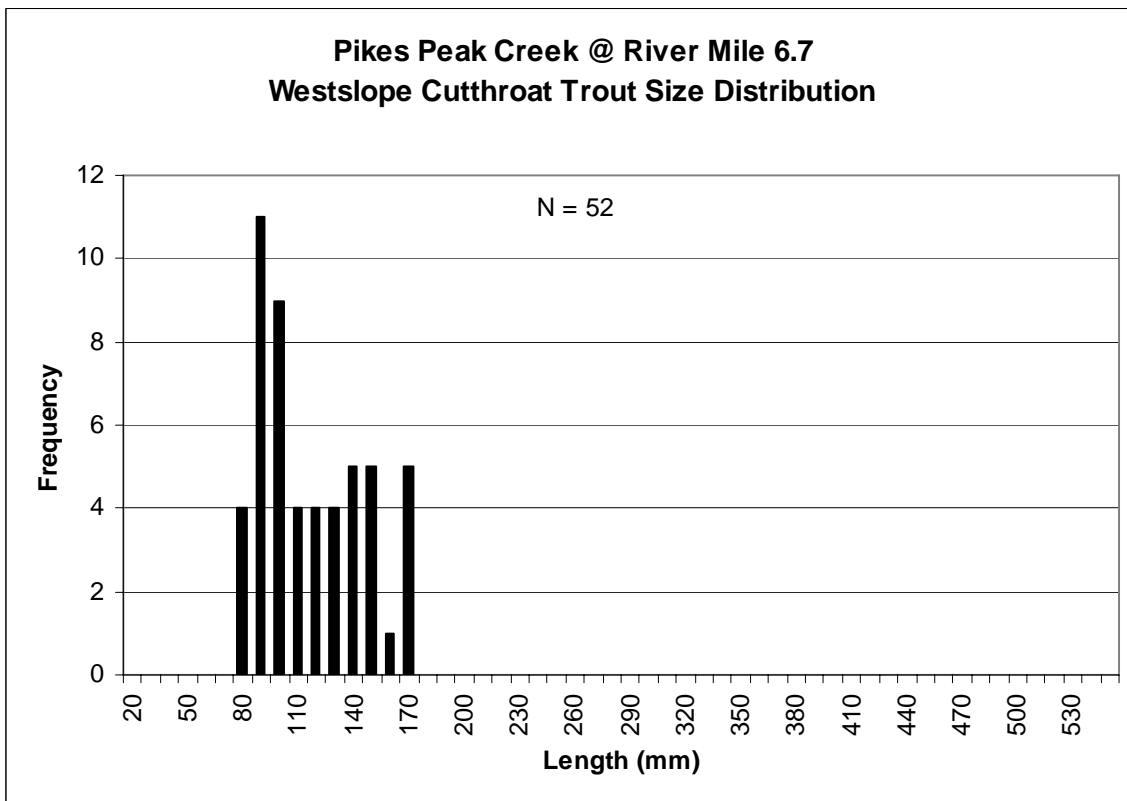


Gold Creek @ River Mile 11.1 Westslope Cutthroat Trout Size Distribution

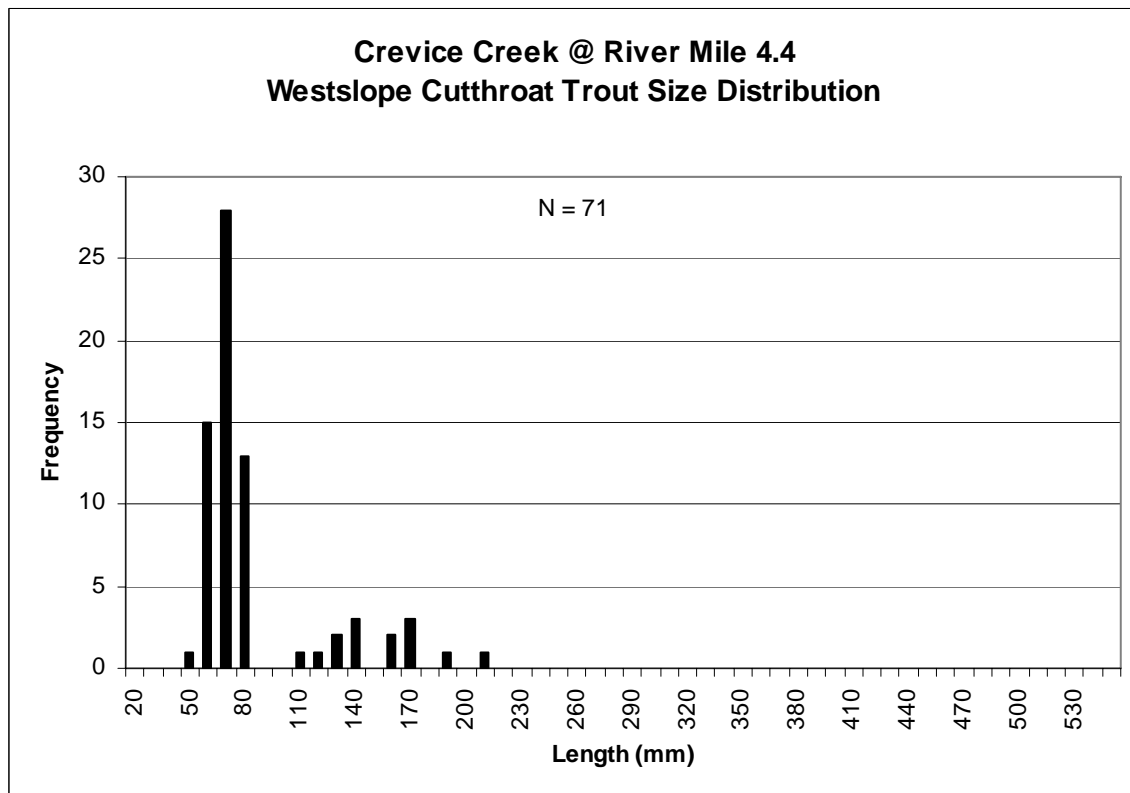
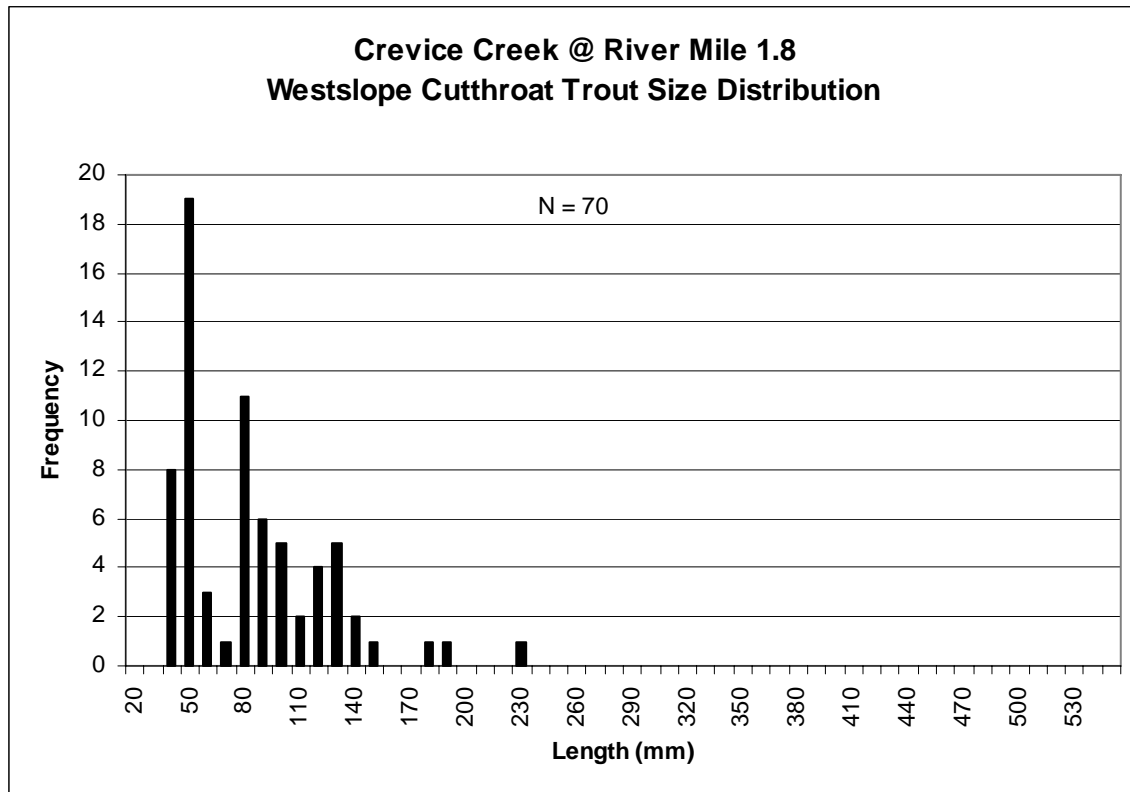




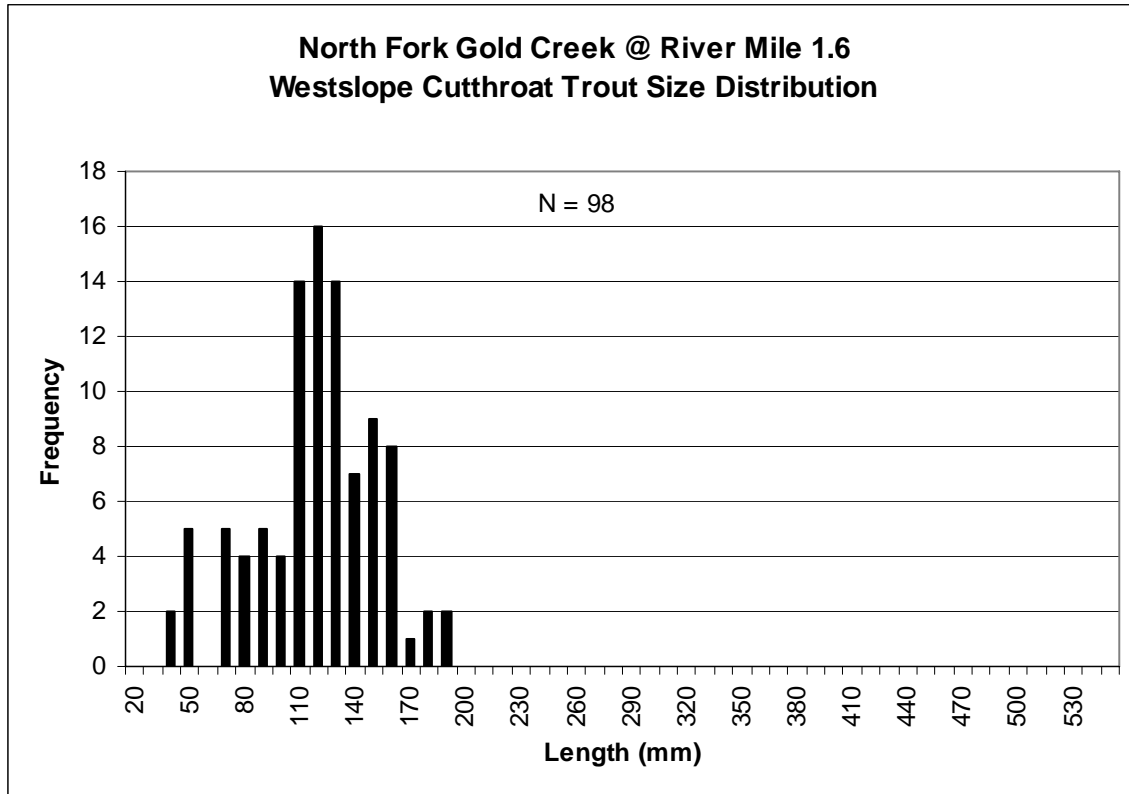
Pikes Peak Creek



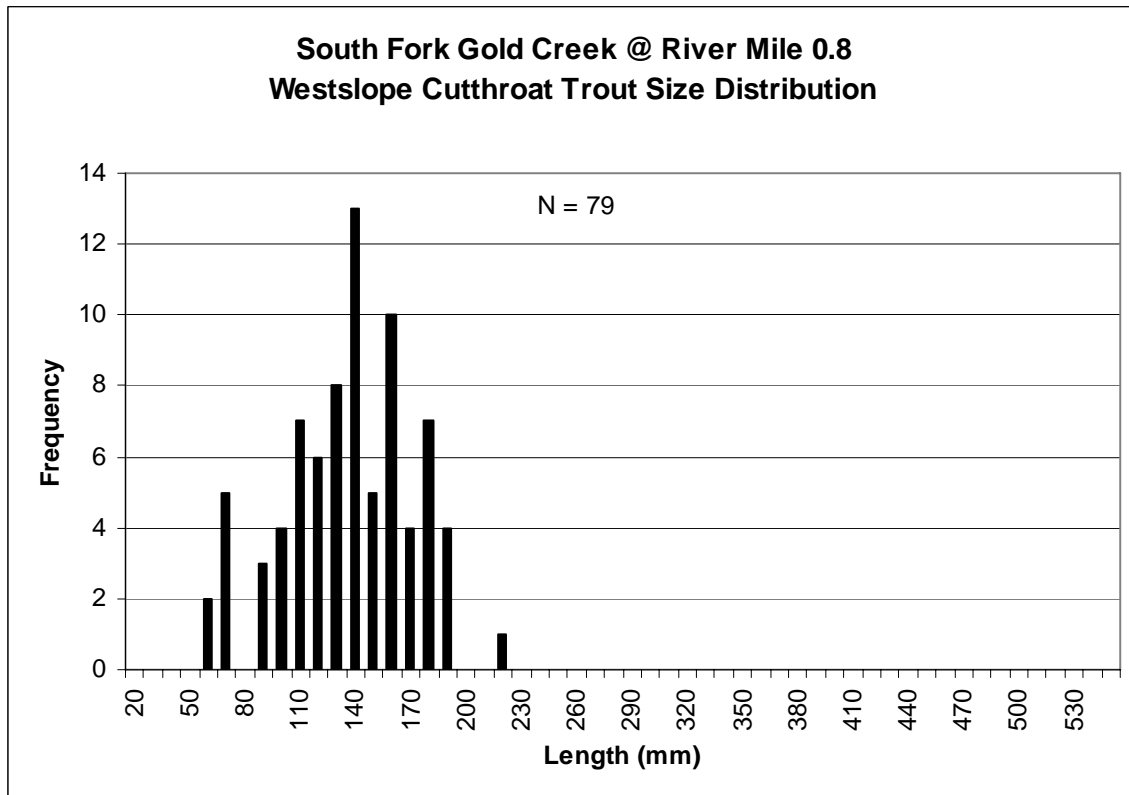
Crevice Creek



North Fork Gold Creek

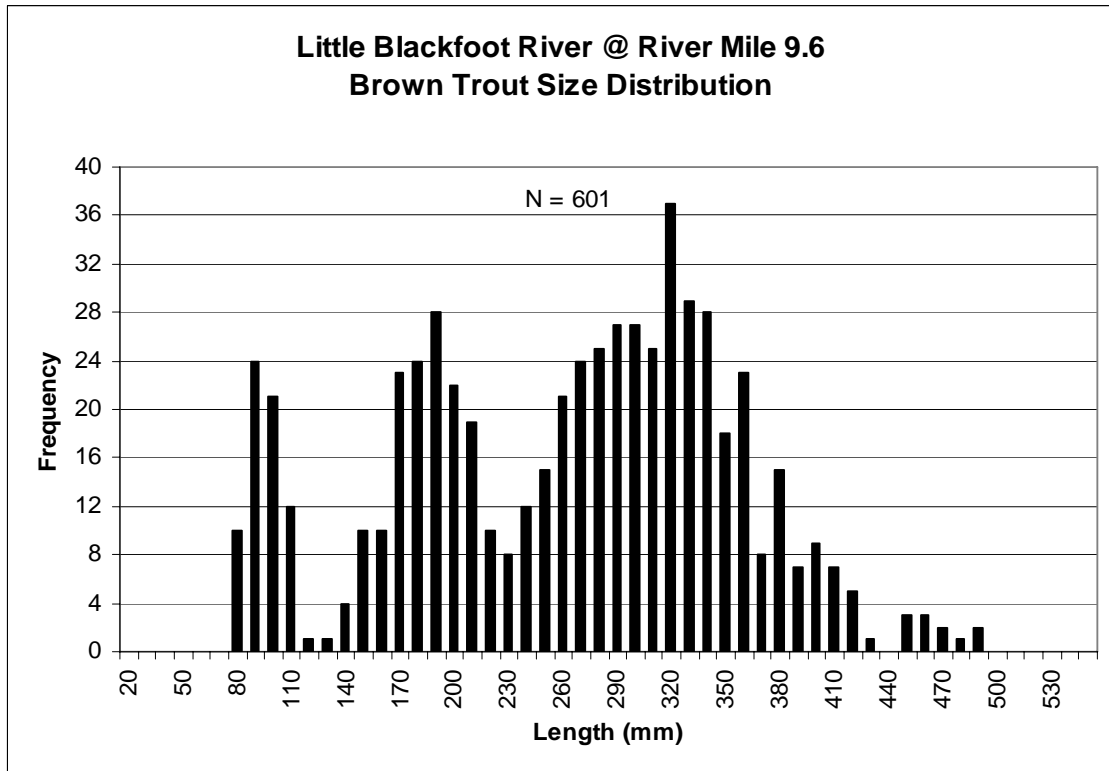
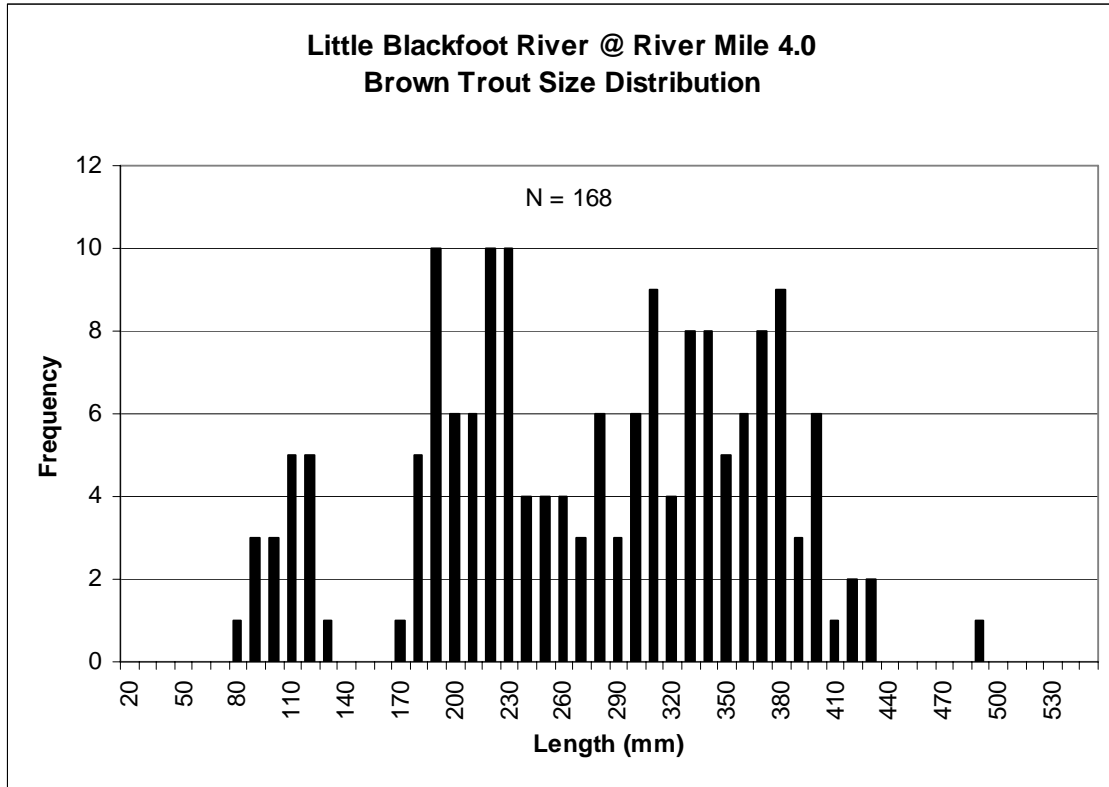


South Fork Gold Creek

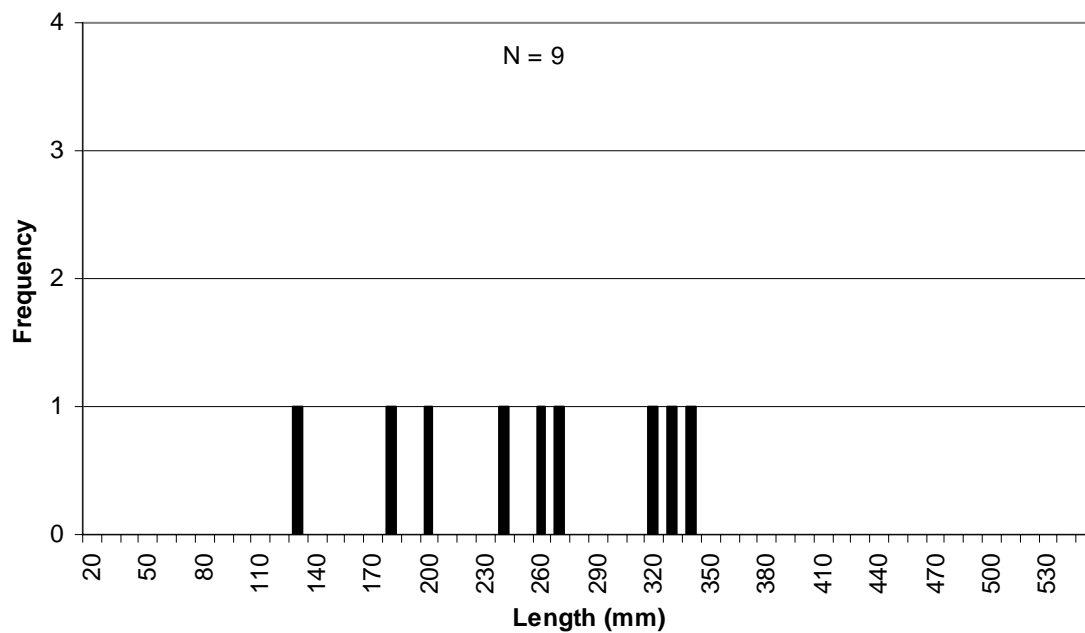


Little Blackfoot River

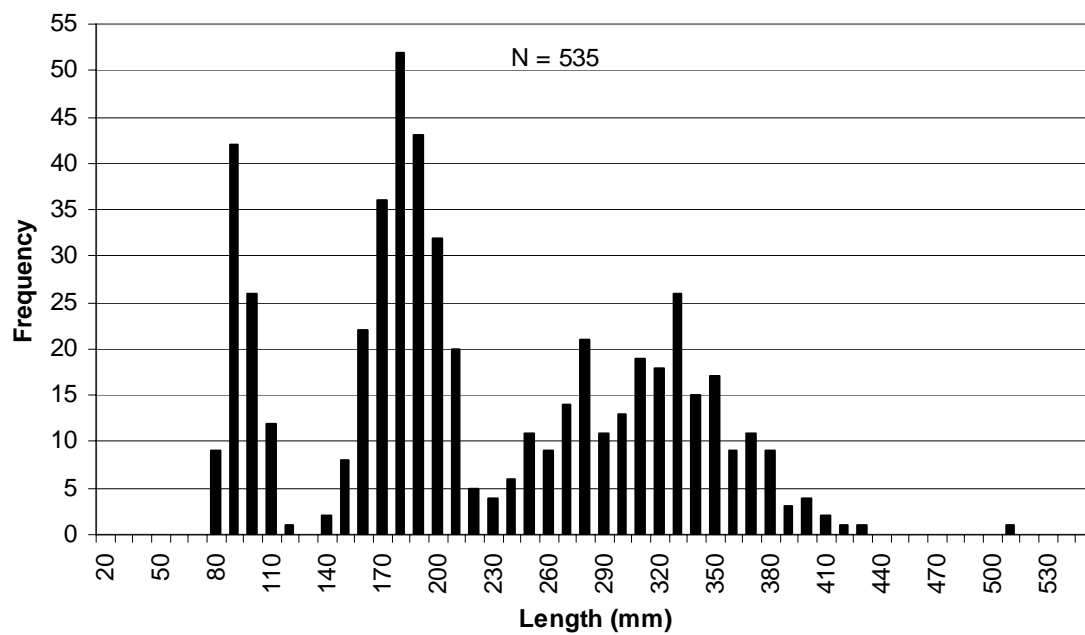
Little Blackfoot River

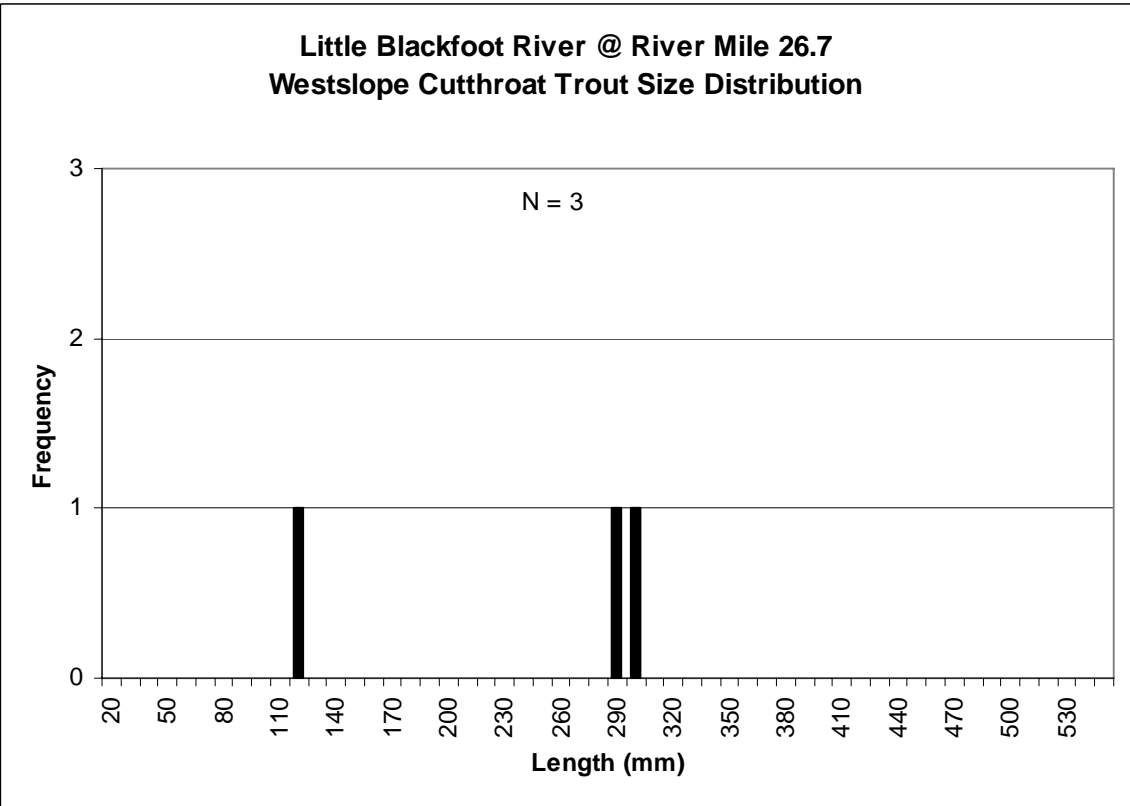
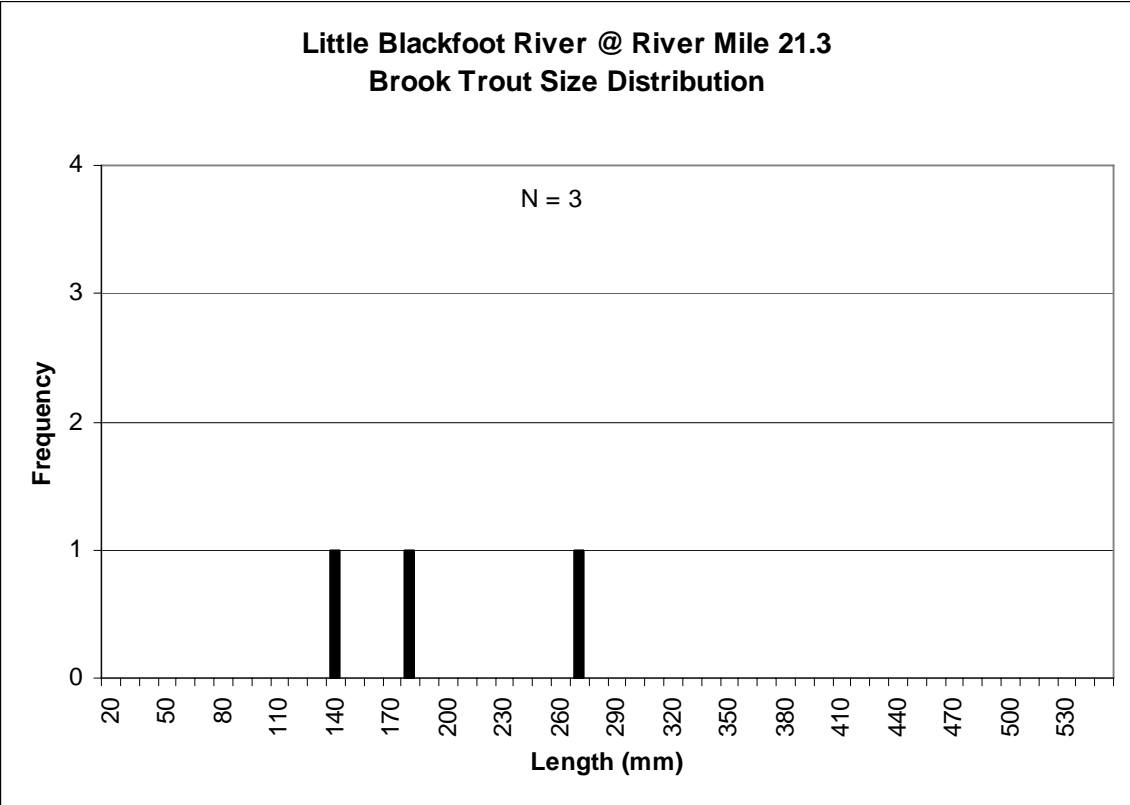


**Little Blackfoot River @ River Mile 21.3
Westslope Cutthroat Trout Size Distribution**

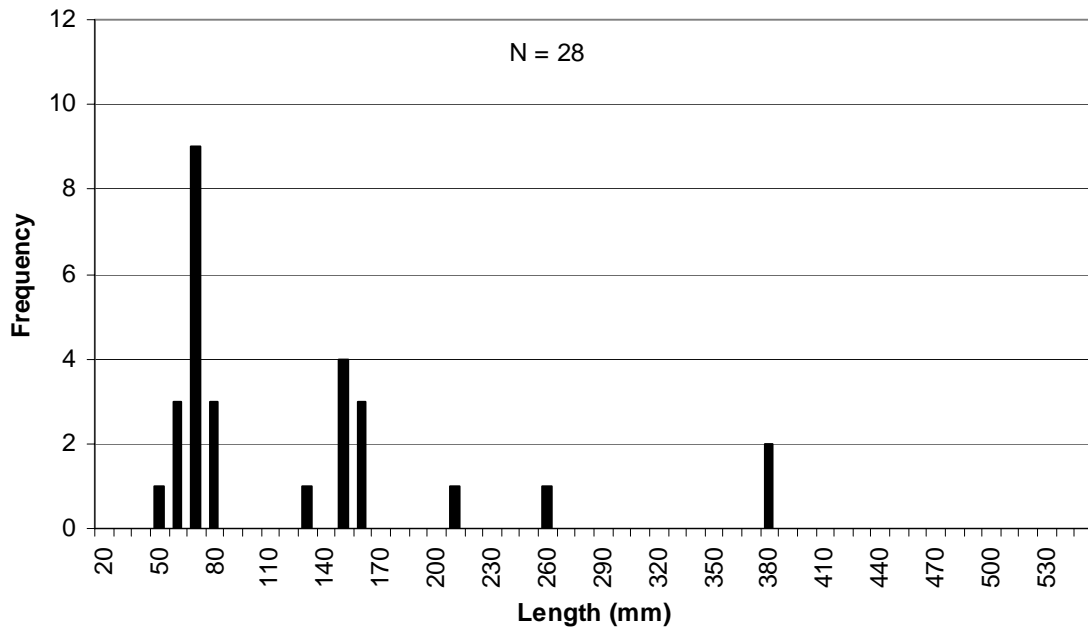


**Little Blackfoot River @ River Mile 21.3
Brown Trout Size Distribution**

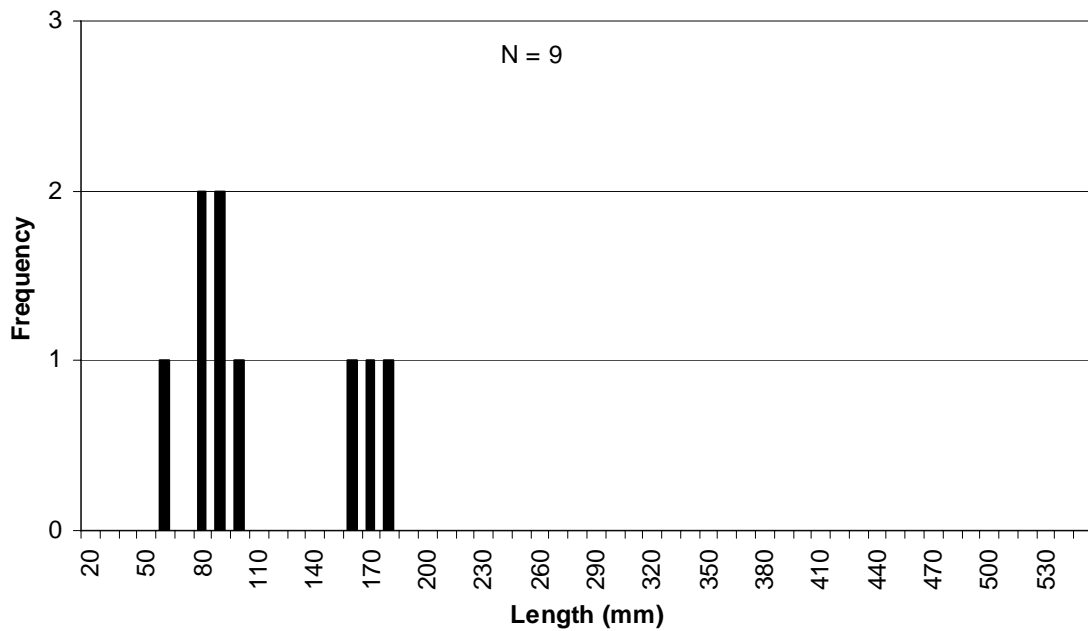




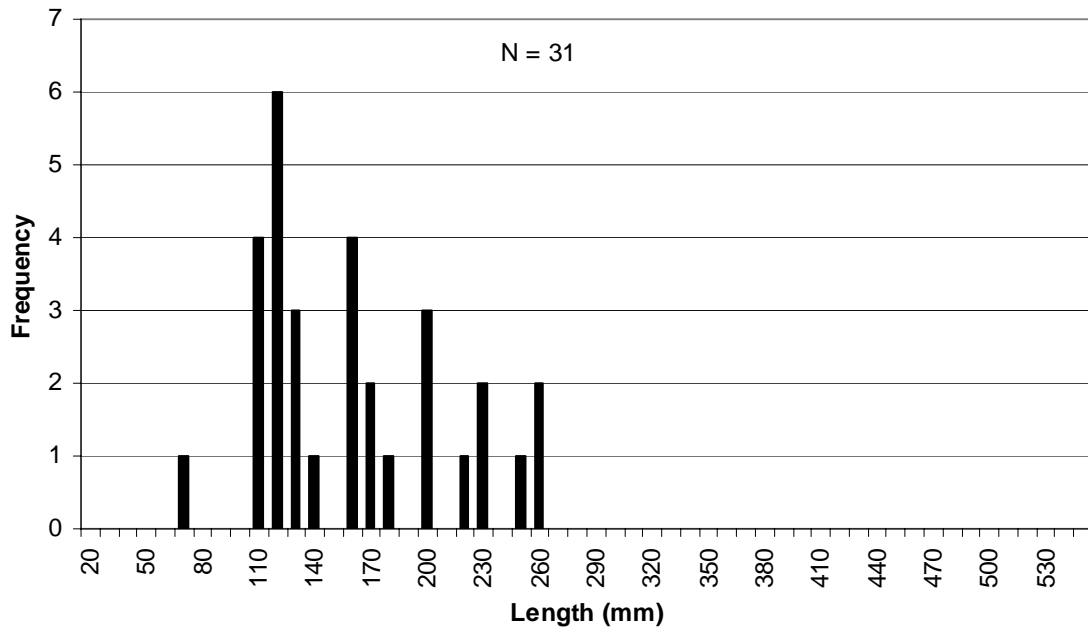
Little Blackfoot River @ River Mile 26.7
Brown Trout Size Distribution



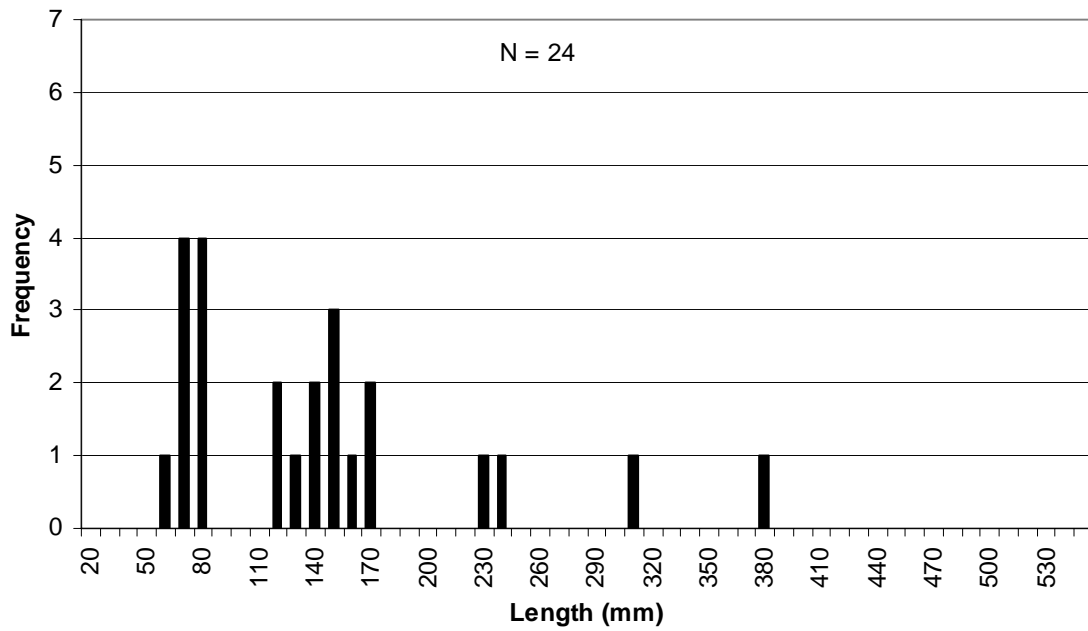
Little Blackfoot River @ River Mile 26.7
Brook Trout Size Distribution



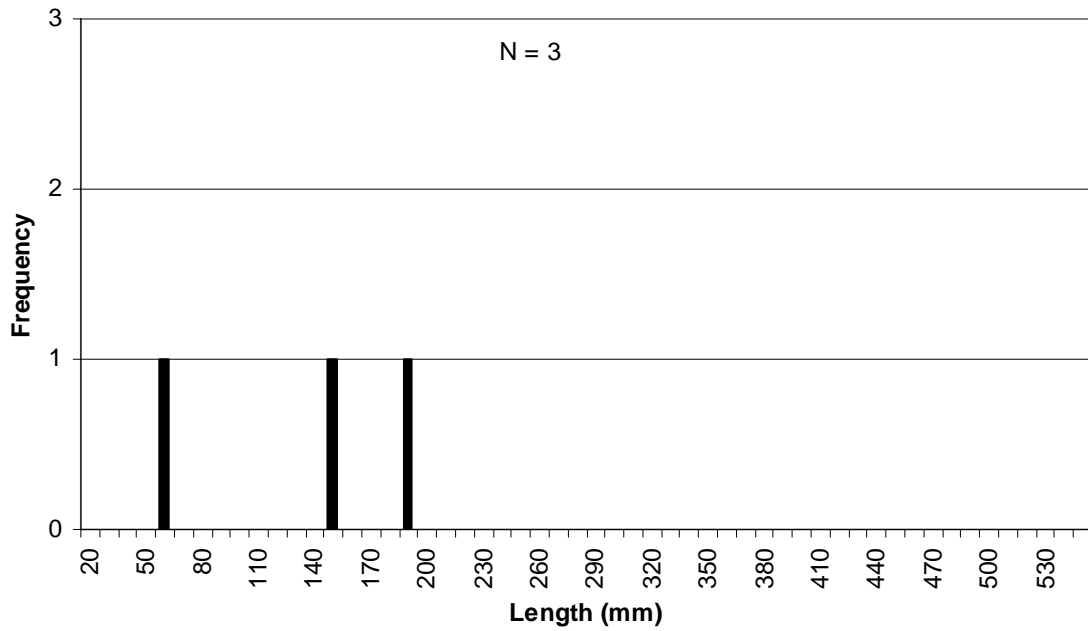
**Little Blackfoot River @ River Mile 31.1
Westslope Cutthroat Trout Size Distribution**



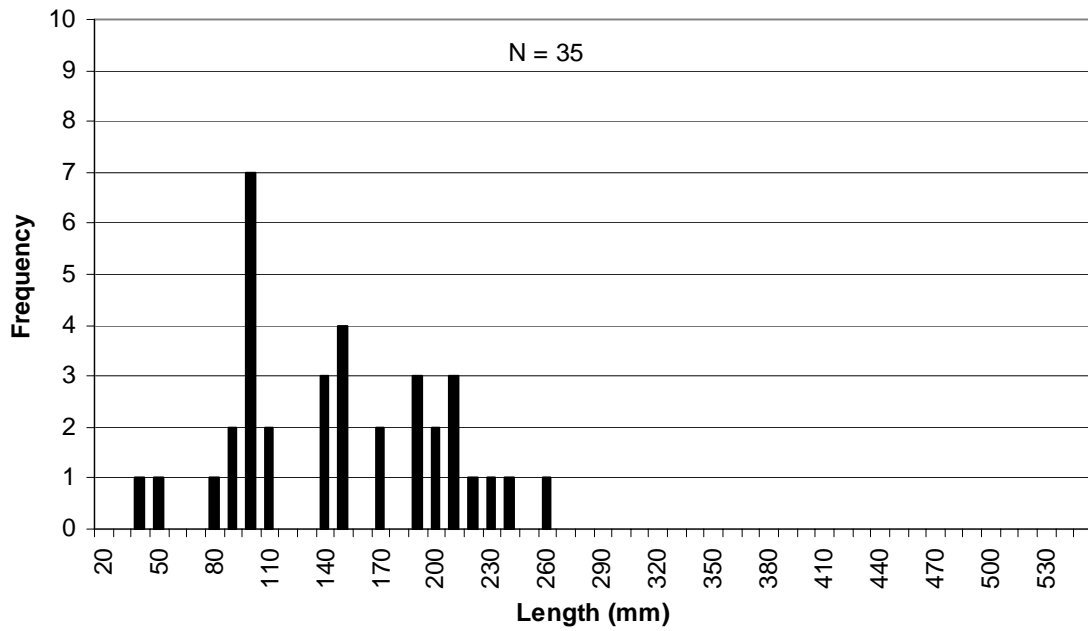
**Little Blackfoot River @ River Mile 31.1
Brown Trout Size Distribution**



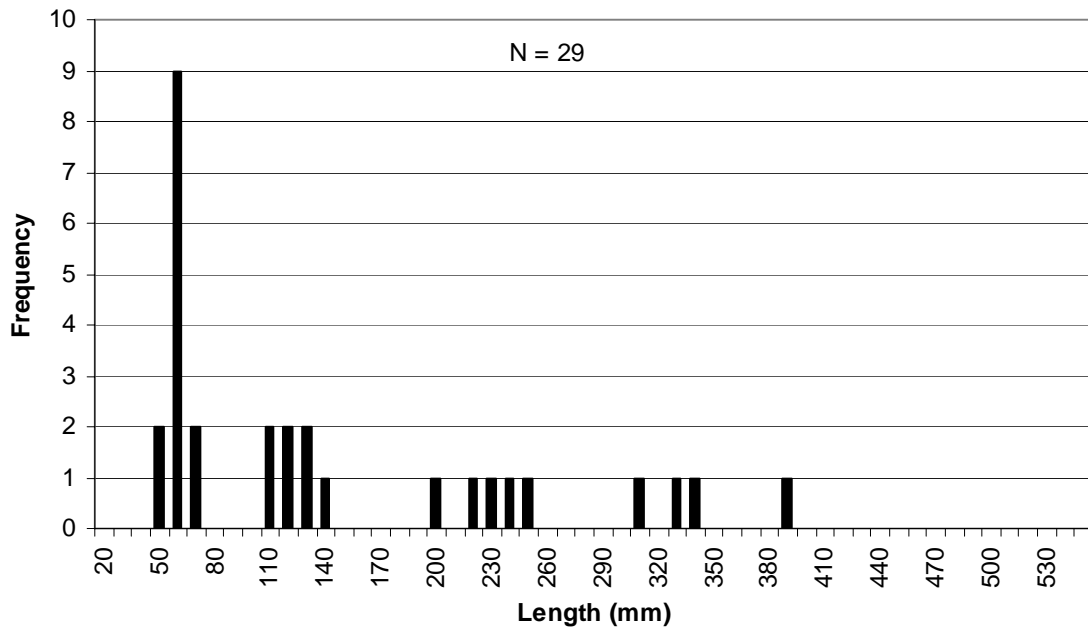
**Little Blackfoot River @ River Mile 31.1
Brook Trout Size Distribution**



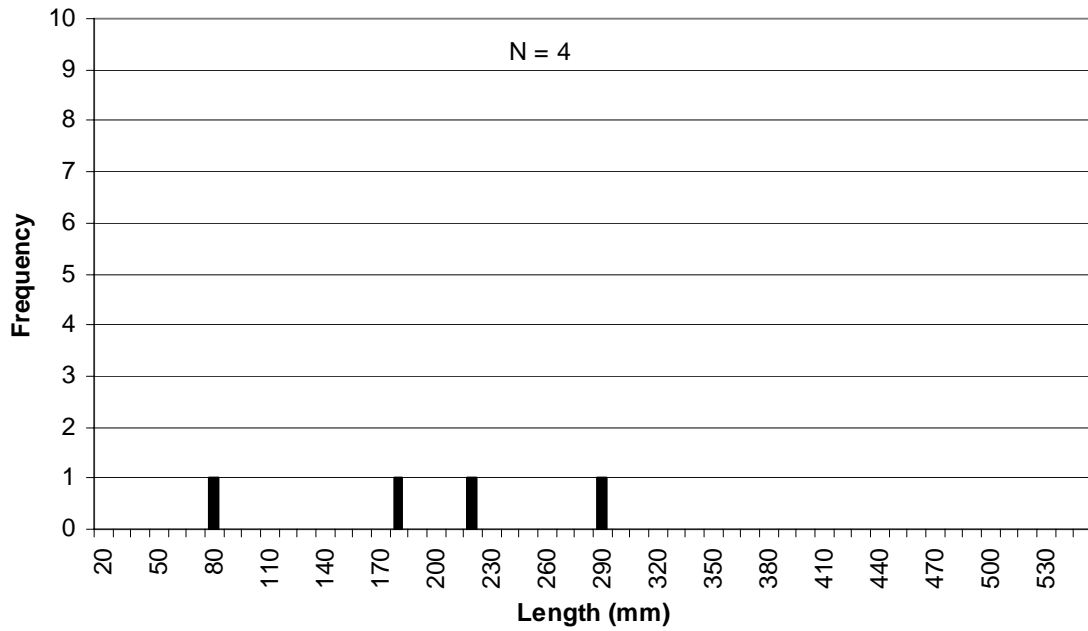
**Little Blackfoot River @ River Mile 34.9
Westslope Cutthroat Trout Size Distribution**



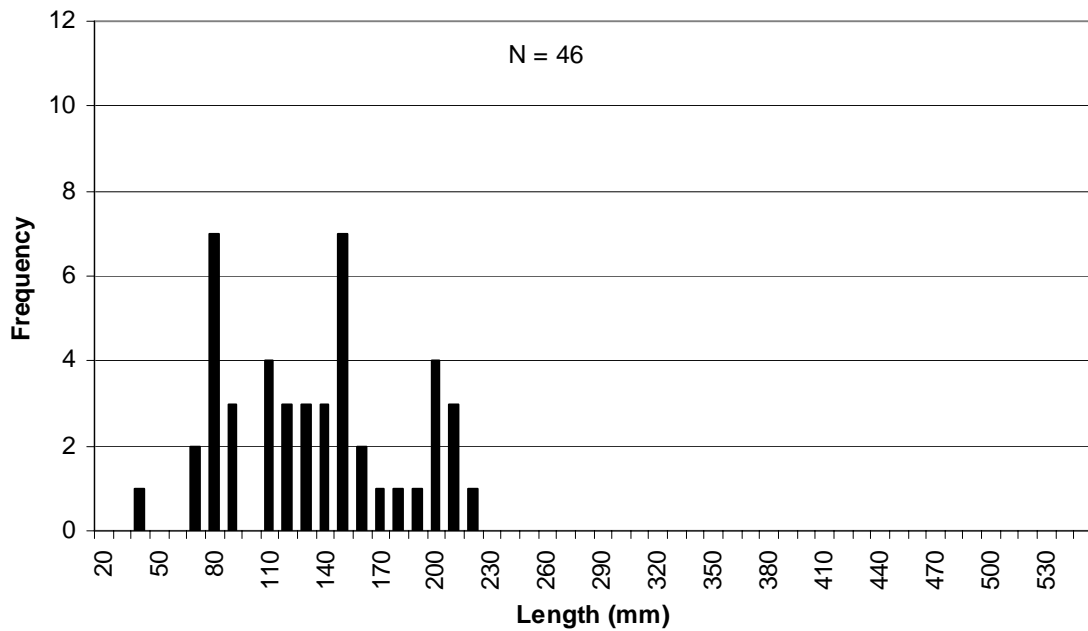
**Little Blackfoot River @ River Mile 34.9
Brown Trout Size Distribution**



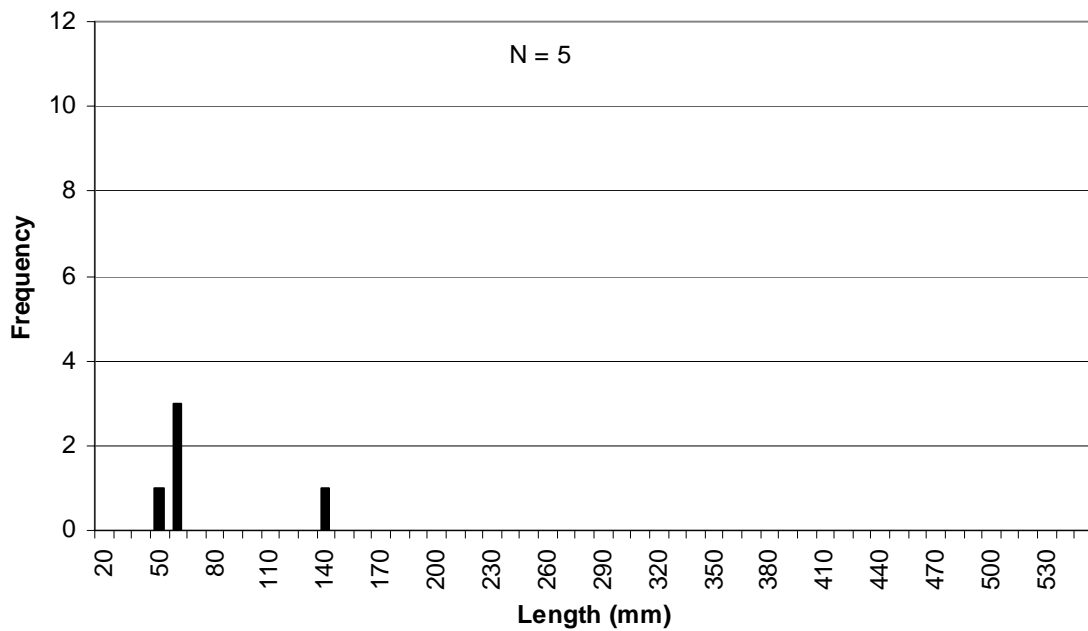
**Little Blackfoot River @ River Mile 34.9
Brook Trout Size Distribution**

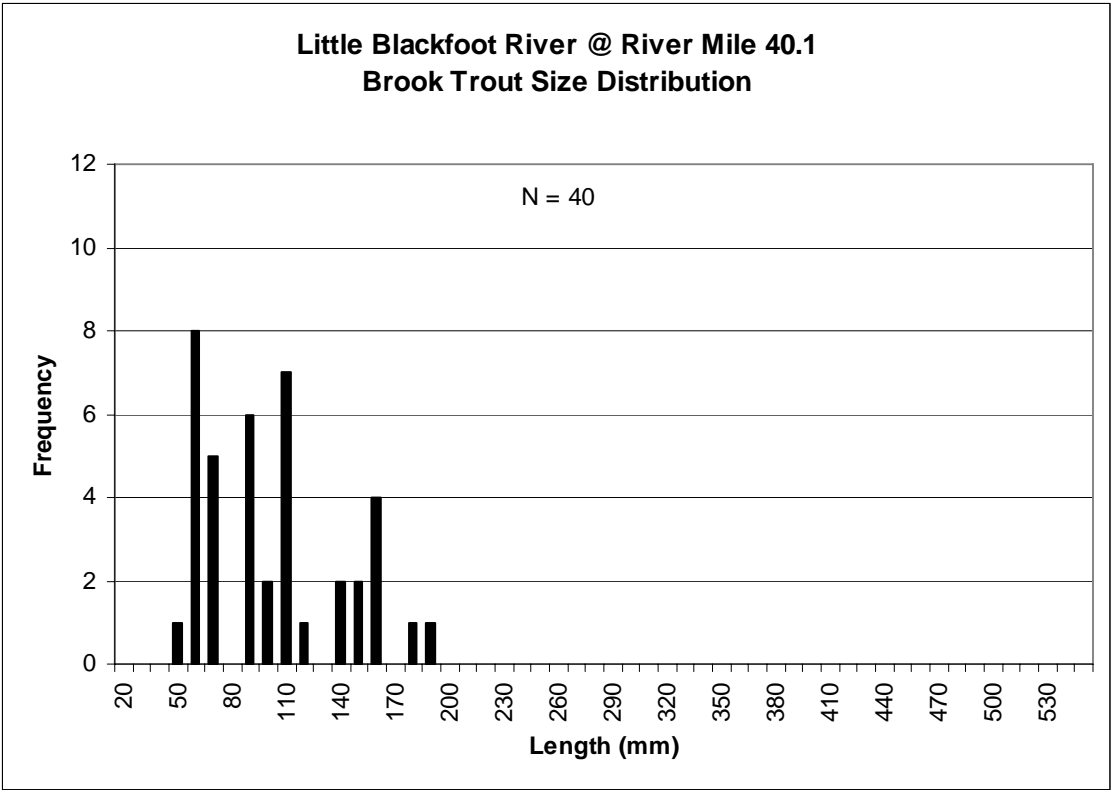


**Little Blackfoot River @ River Mile 40.1
Westslope Cutthroat Trout Size Distribution**

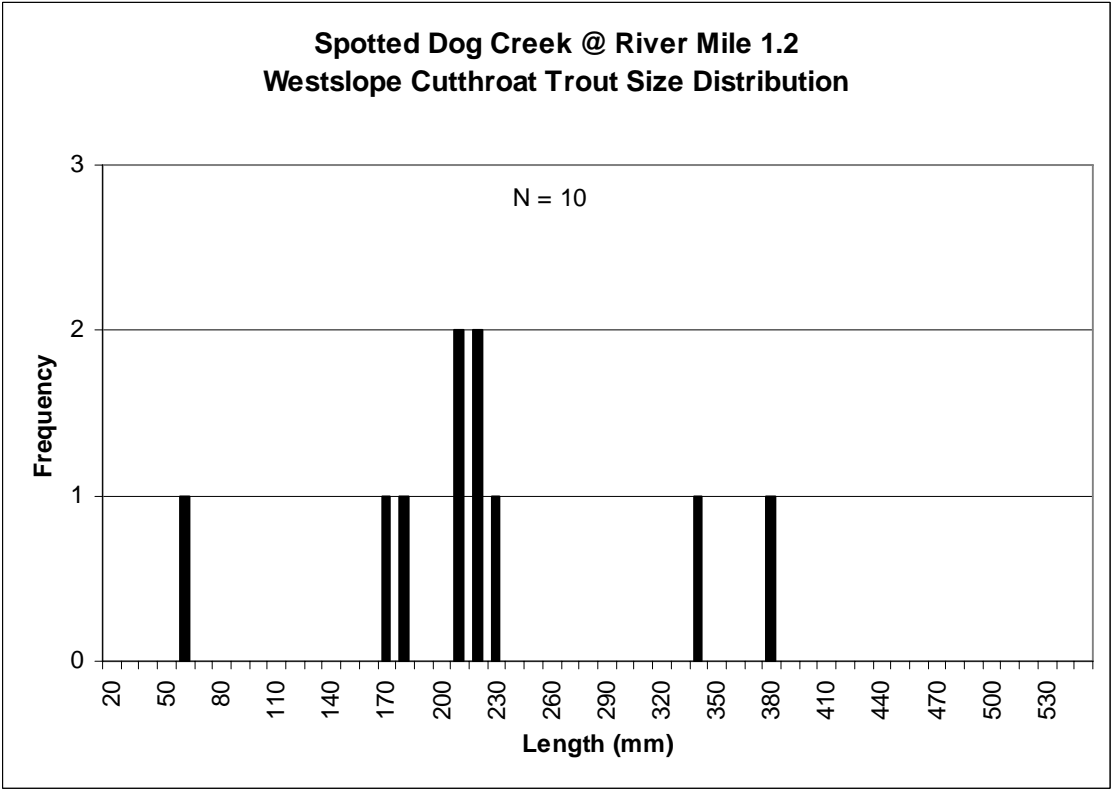


**Little Blackfoot River @ River Mile 40.1
Brown Trout Size Distribution**

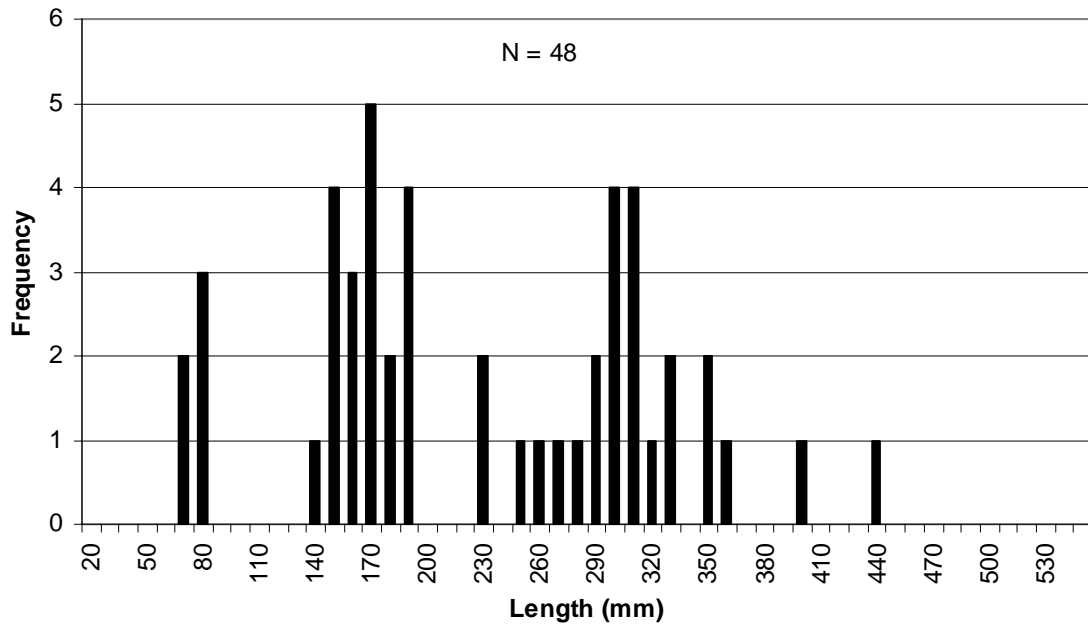




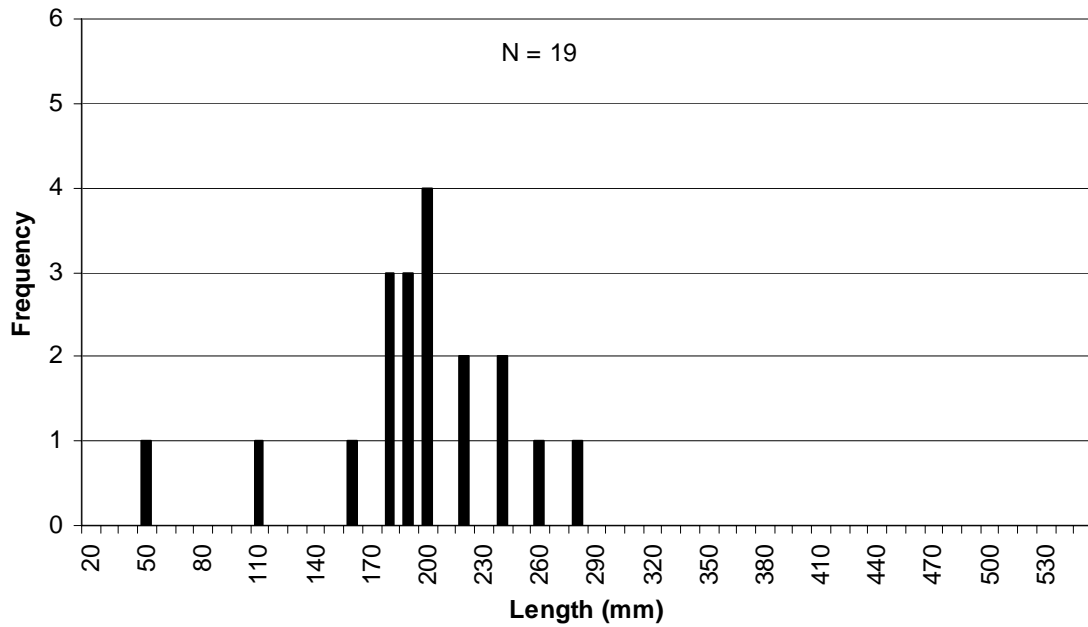
Spotted Dog Creek



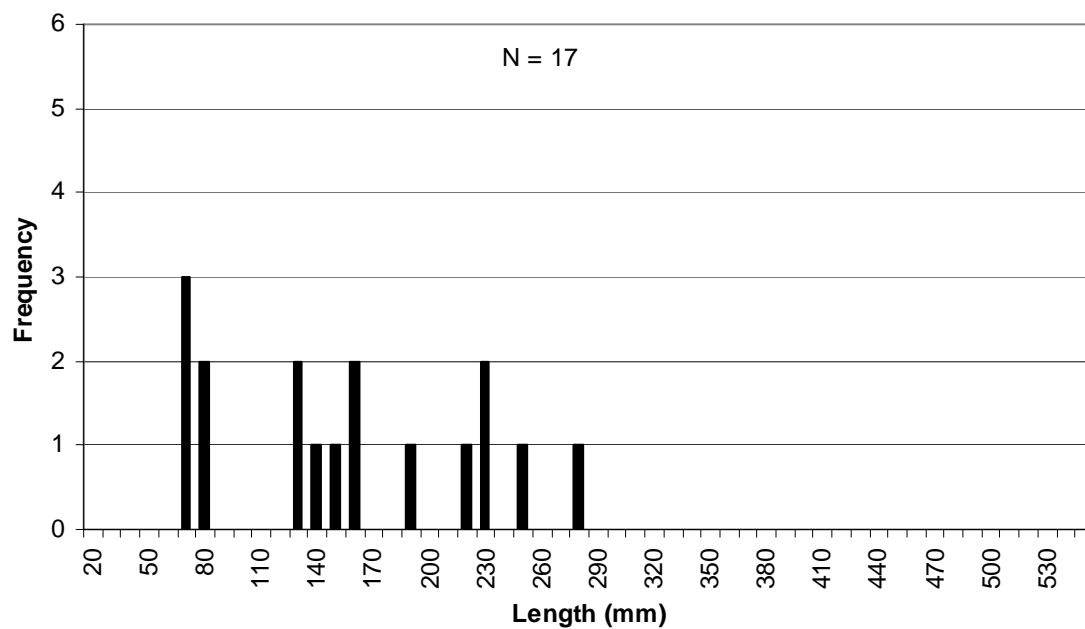
**Spotted Dog Creek @ River Mile 1.2
Brown Trout Size Distribution**



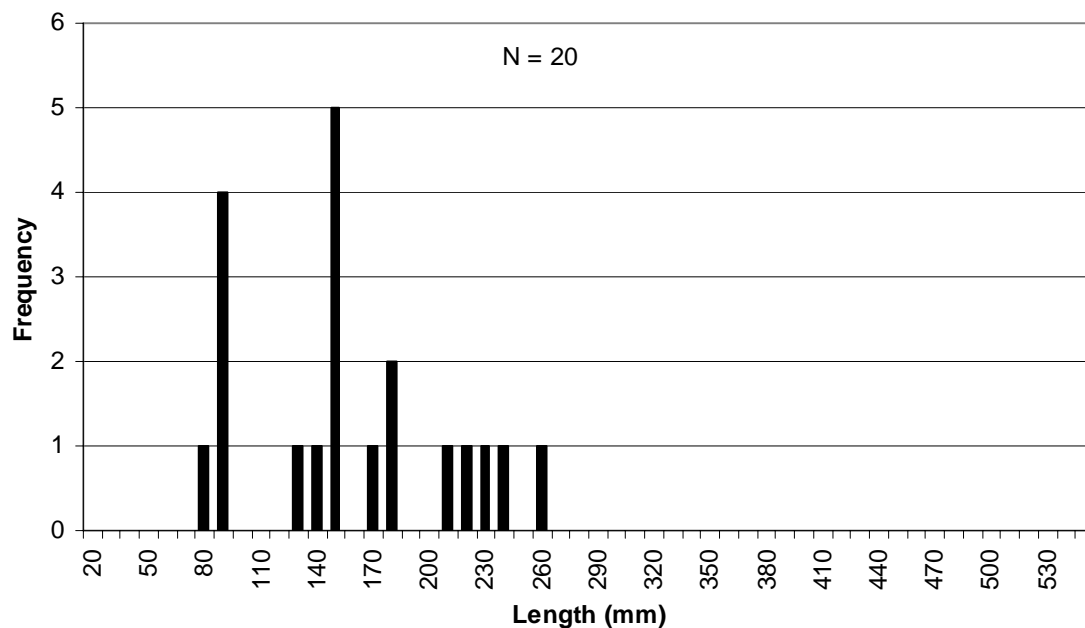
**Spotted Dog Creek @ River Mile 4.6
Westslope Cutthroat Trout Size Distribution**



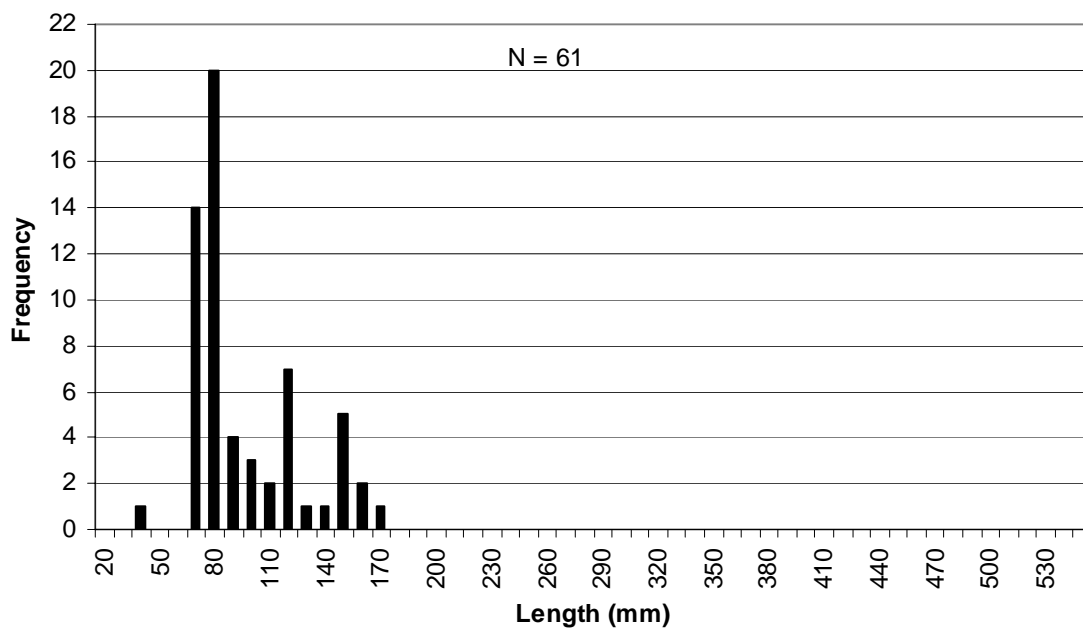
Spotted Dog Creek @ River Mile 4.6
Brown Trout Size Distribution



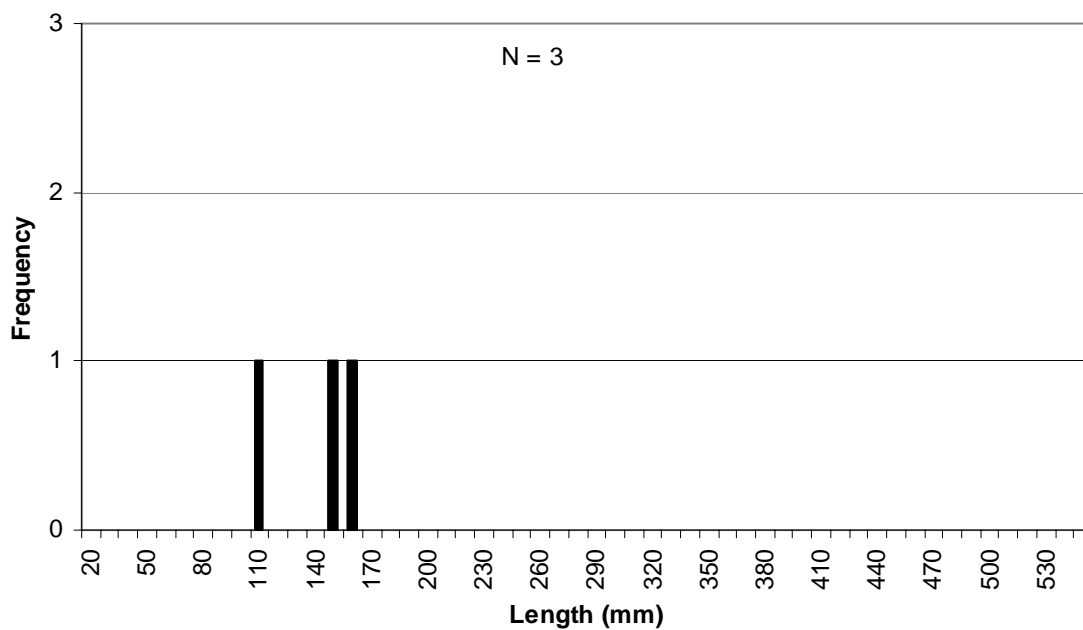
Spotted Dog Creek @ River Mile 4.6
Brook Trout Size Distribution



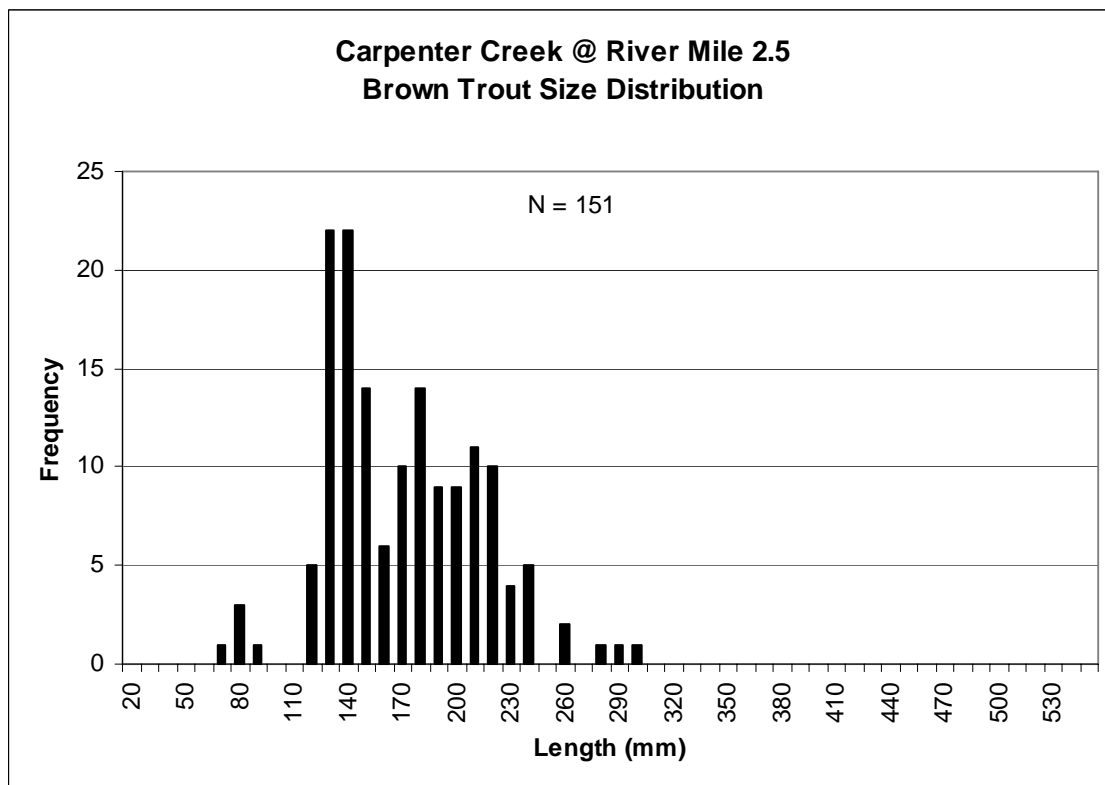
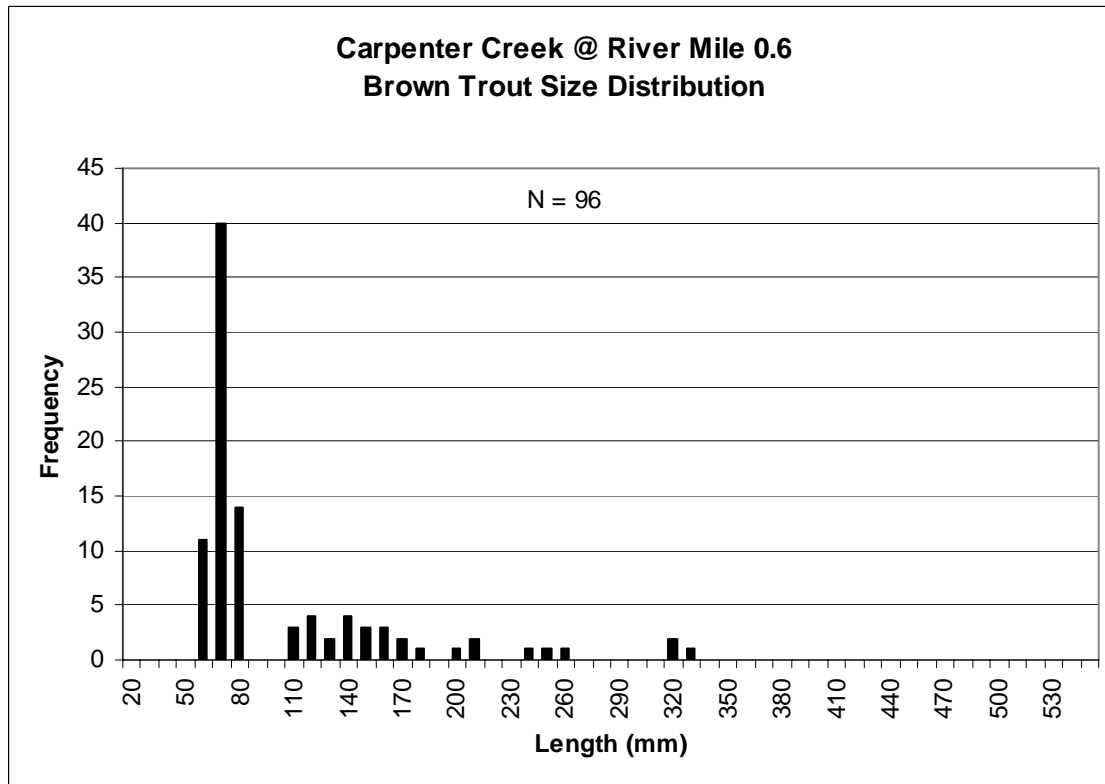
**Spotted Dog Creek @ River Mile 11.3
Westslope Cutthroat Trout Size Distribution**

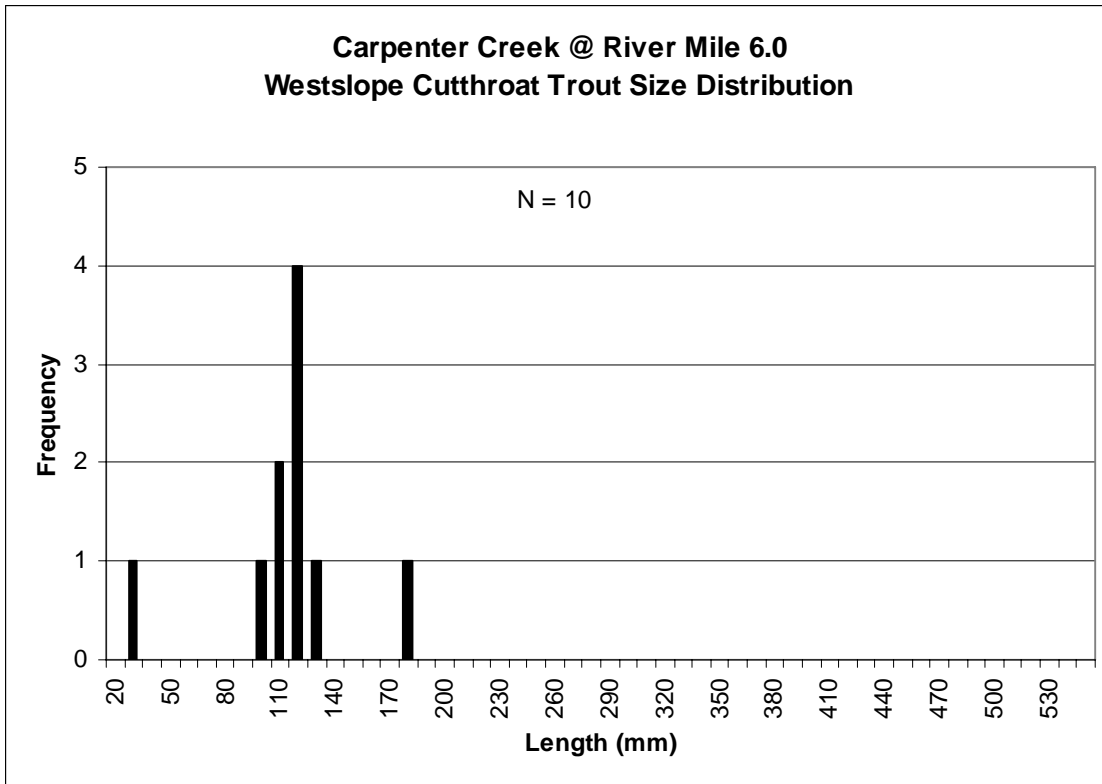


**Spotted Dog Creek @ River Mile 11.3
Brook Trout Size Distribution**

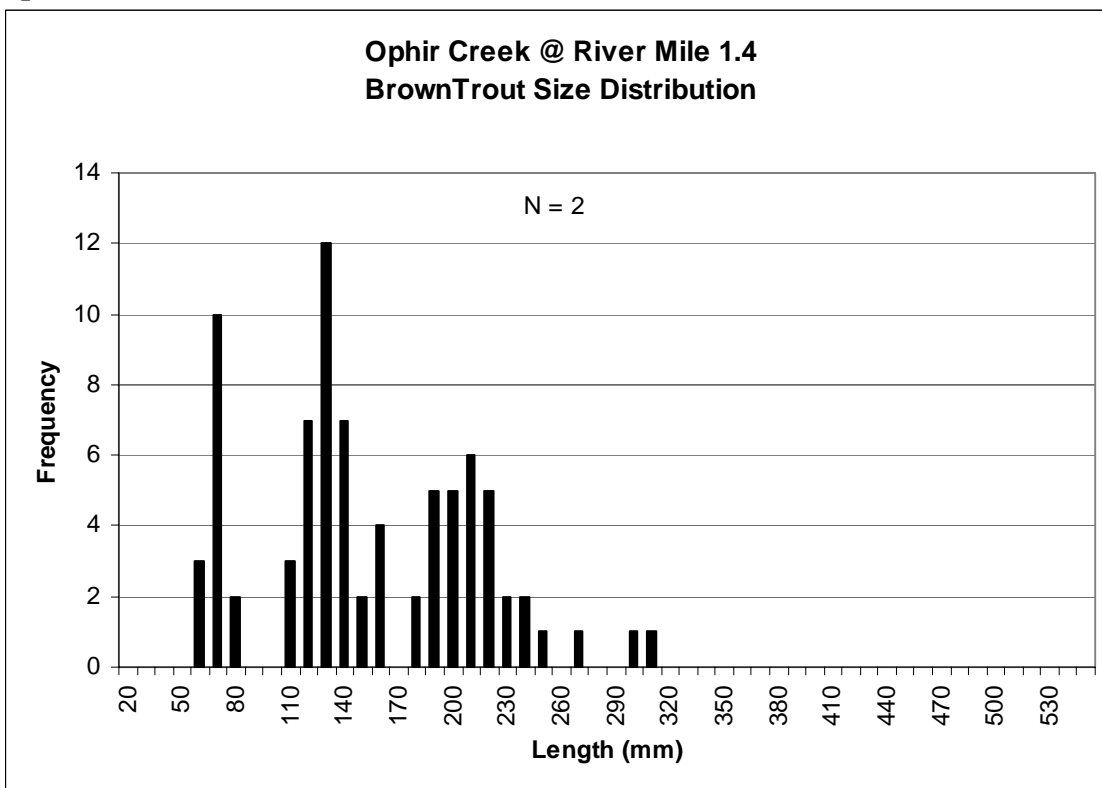


Carpenter Creek

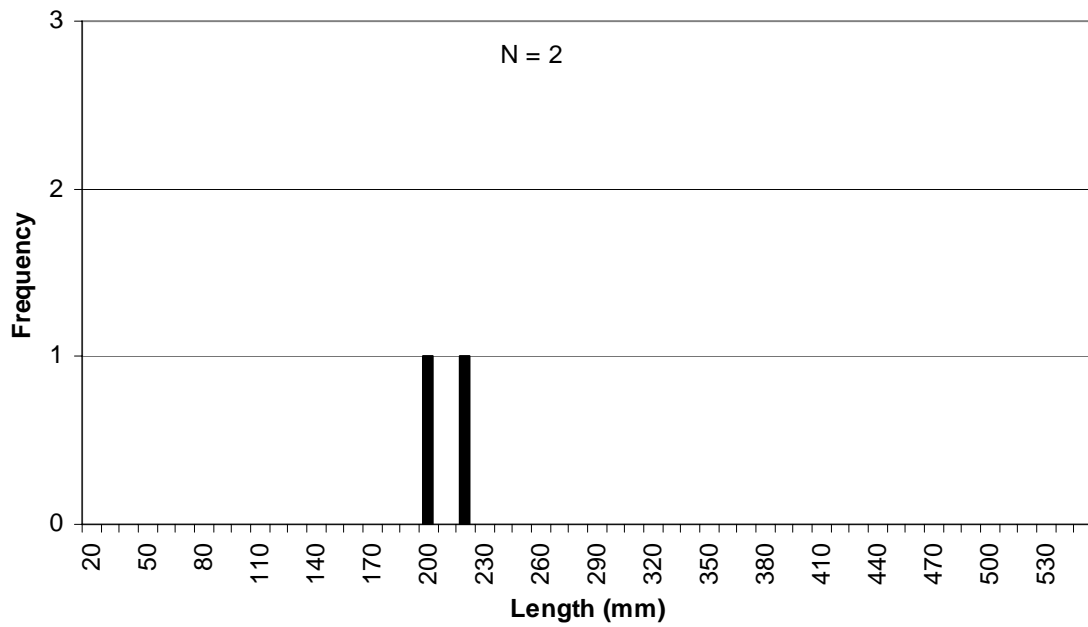




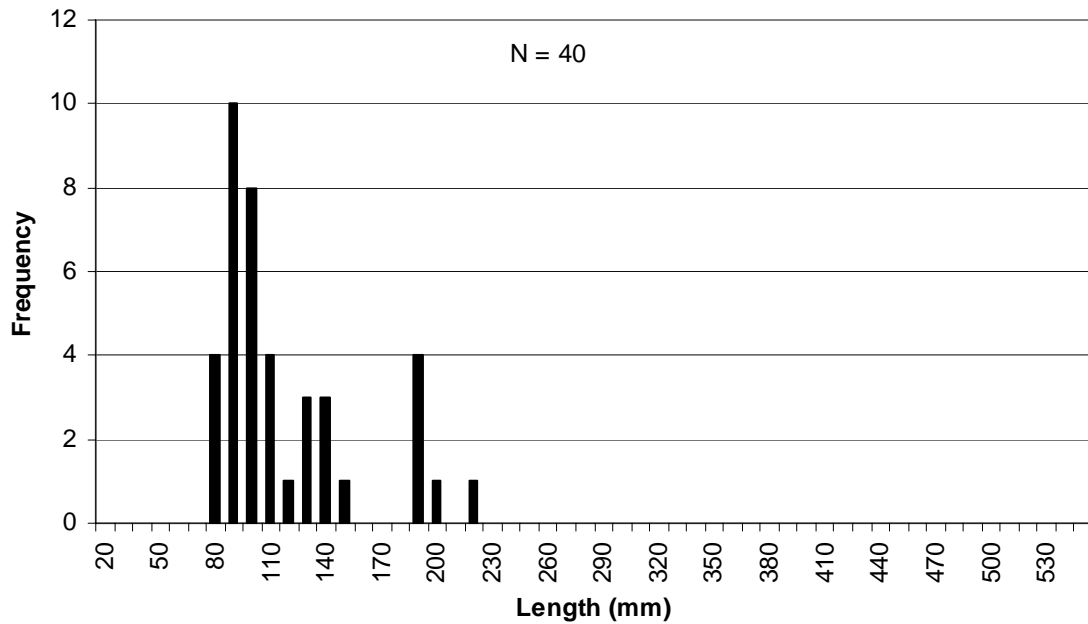
Ophir Creek

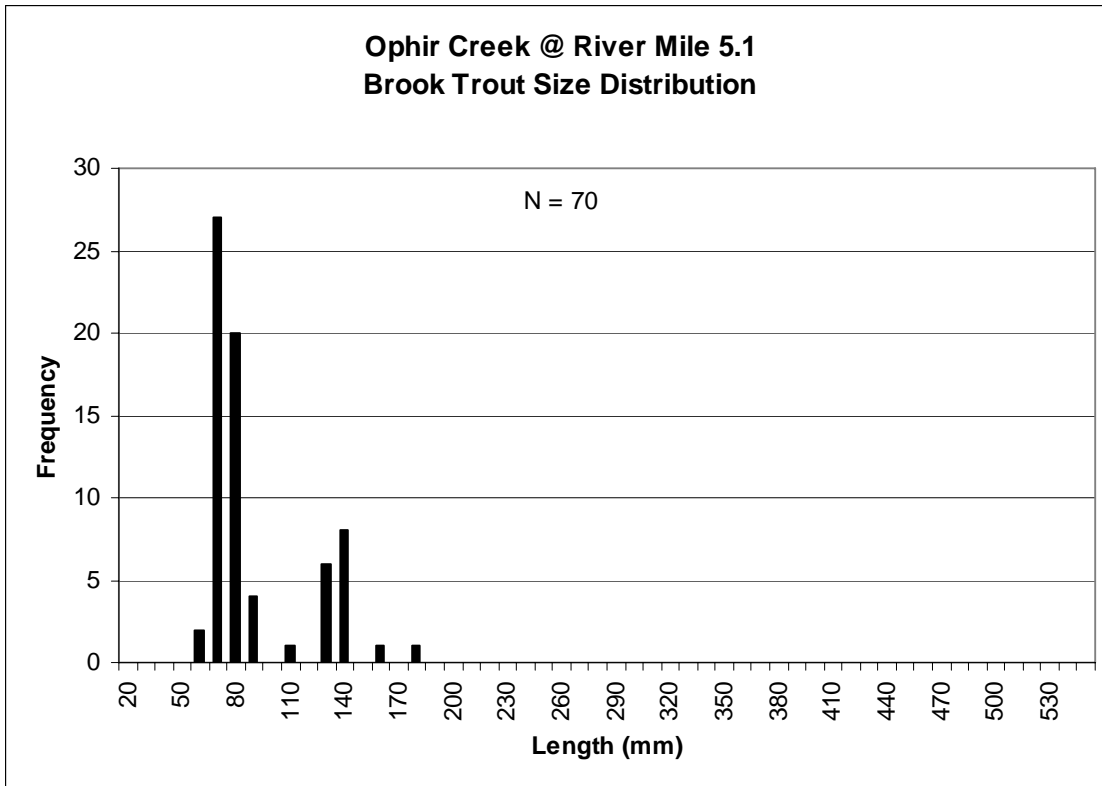


**Ophir Creek @ River Mile 1.4
Brook Trout Size Distribution**

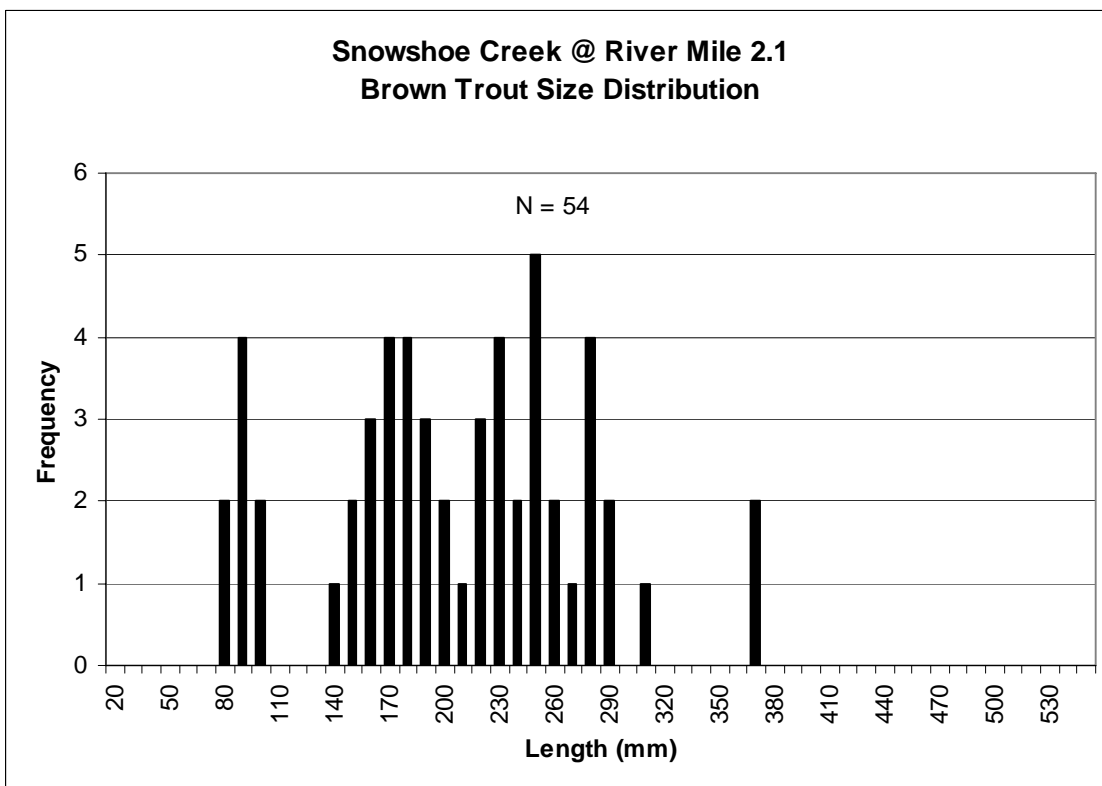


**Ophir Creek @ River Mile 5.1
Westslope Cutthroat Trout Size Distribution**

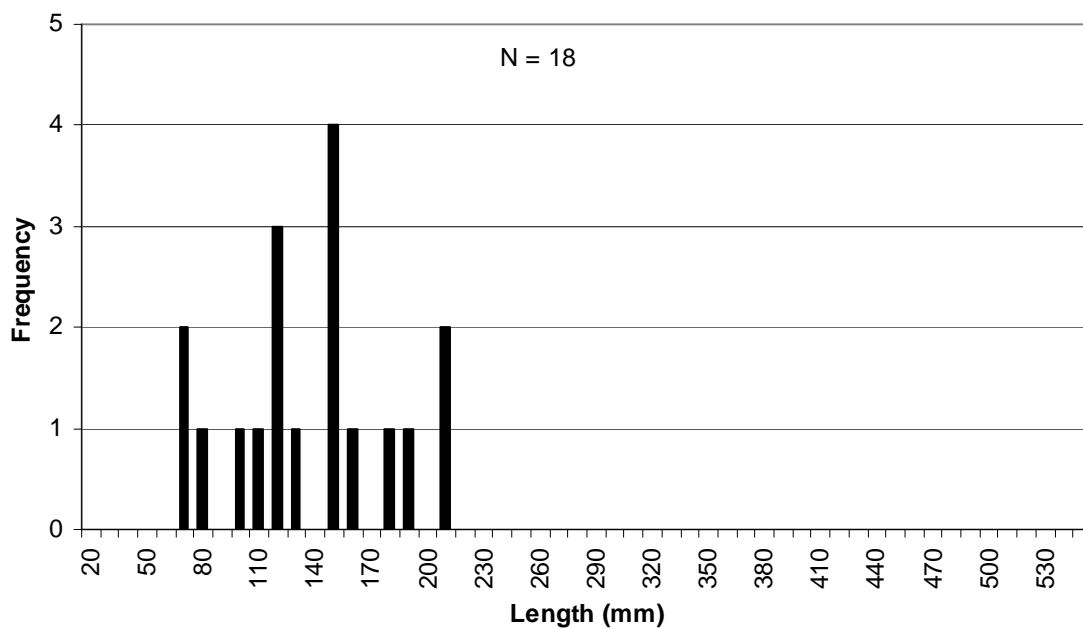




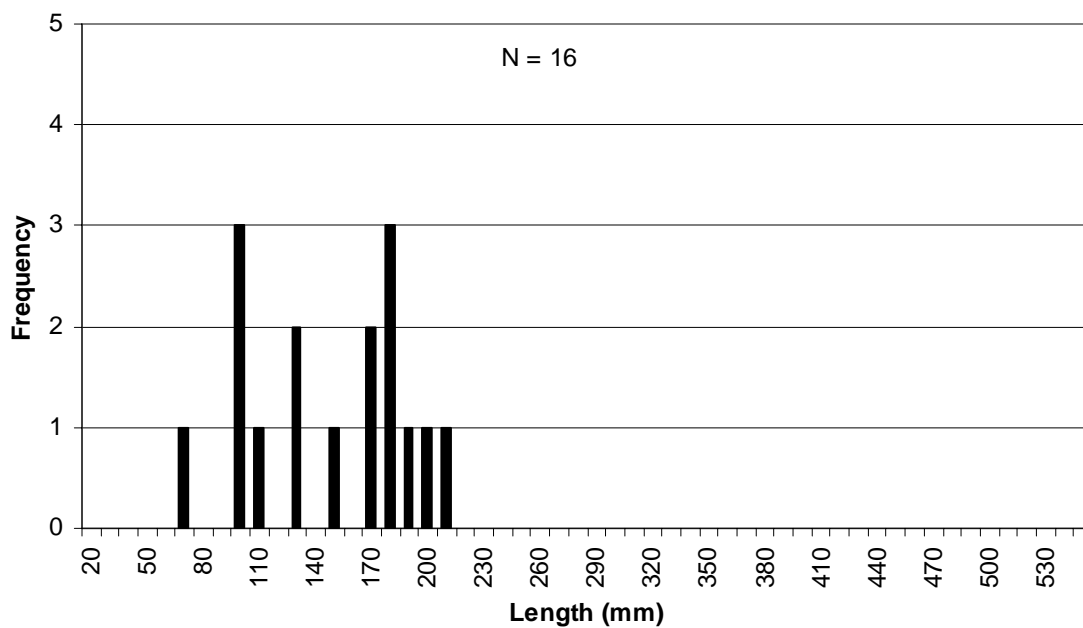
Snowshoe Creek



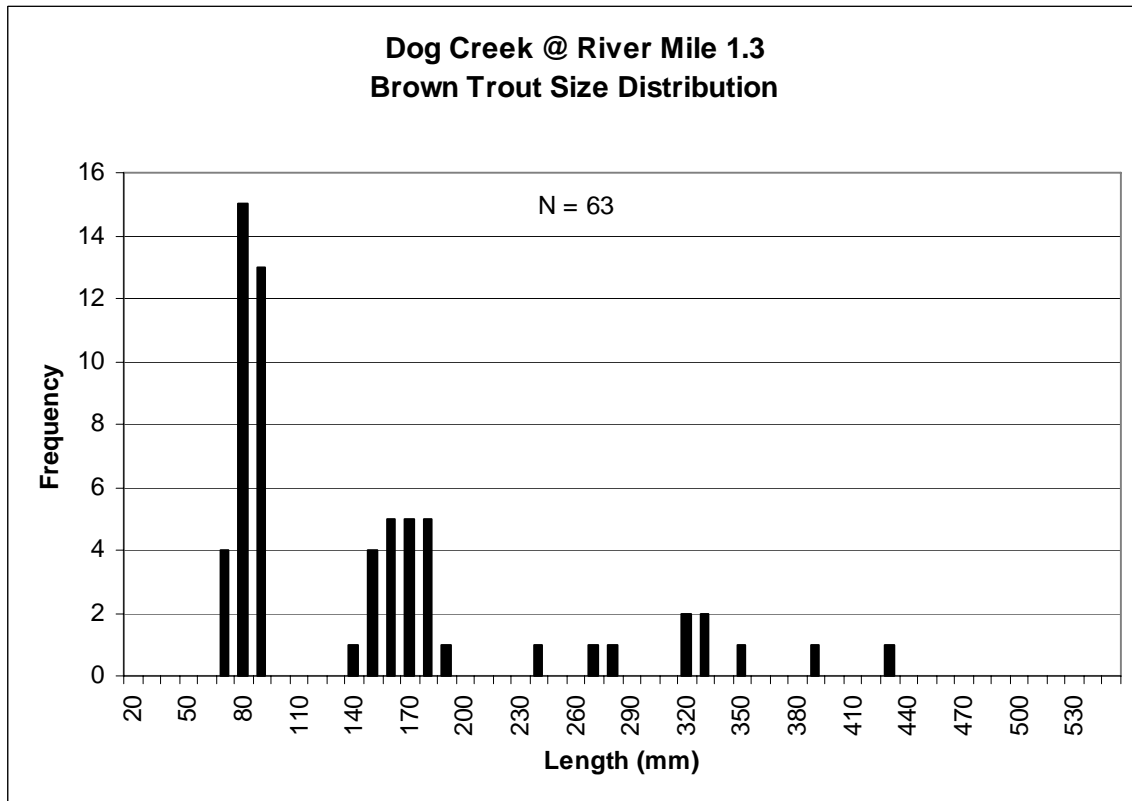
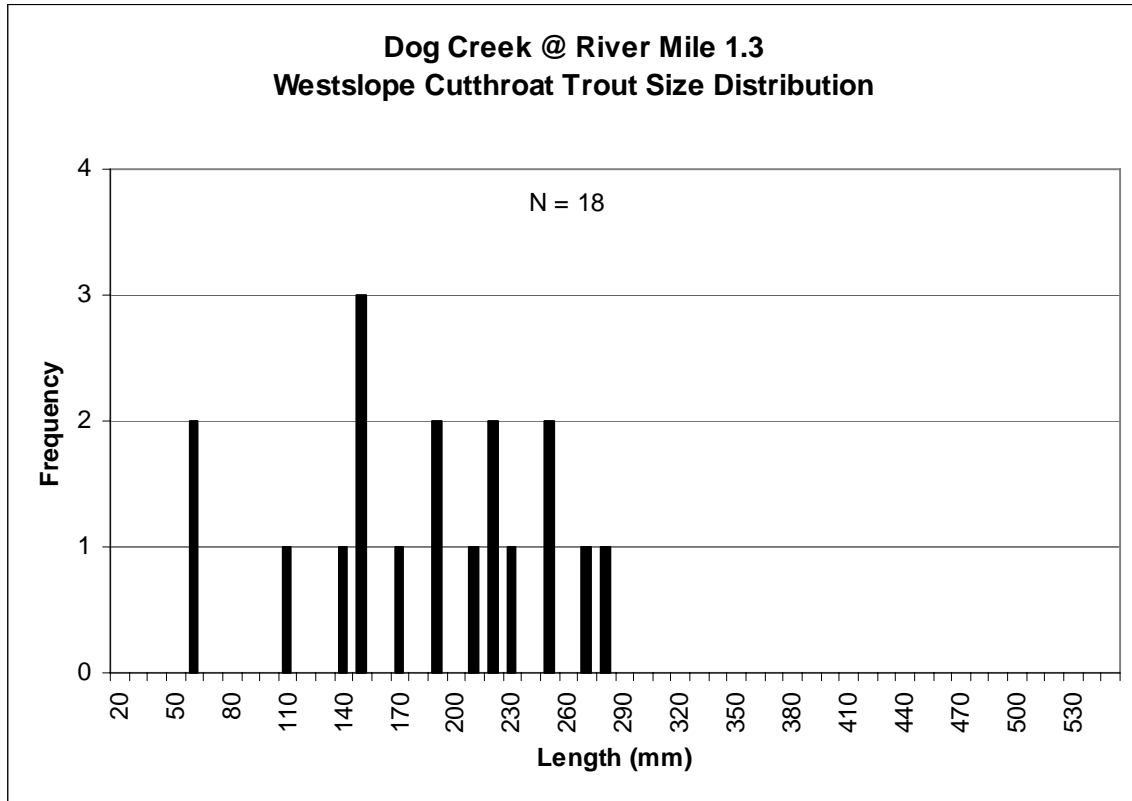
**Snowshoe Creek @ River Mile 9.2
Westslope Cutthroat Trout Size Distribution**



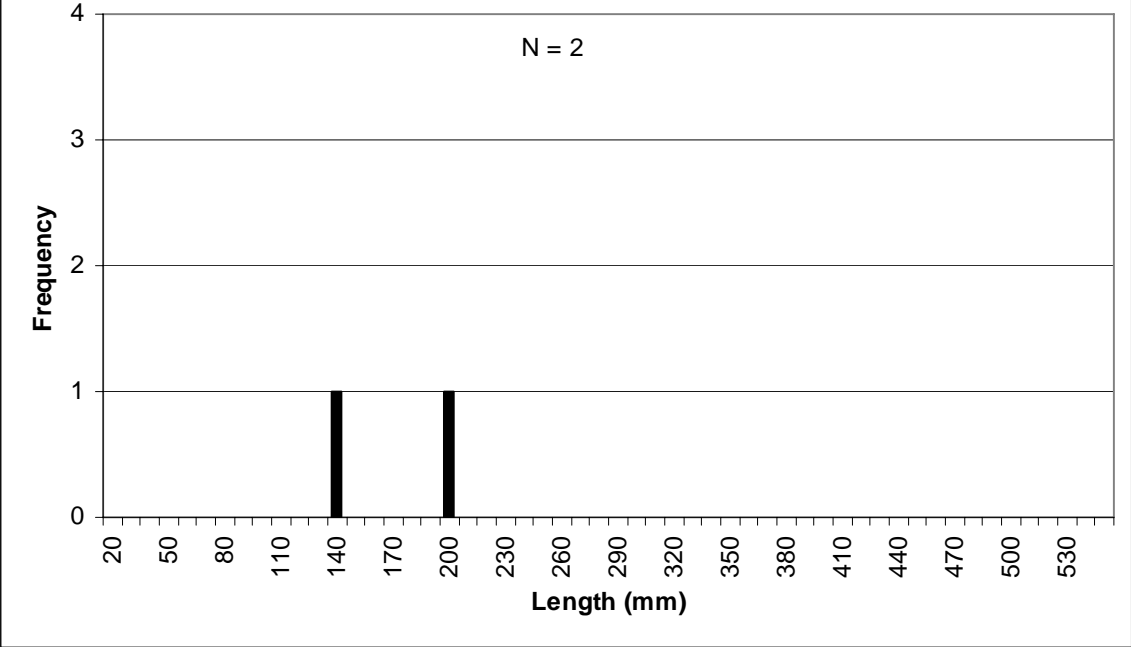
**Snowshoe Creek @ River Mile 9.2
Brown Trout Size Distribution**



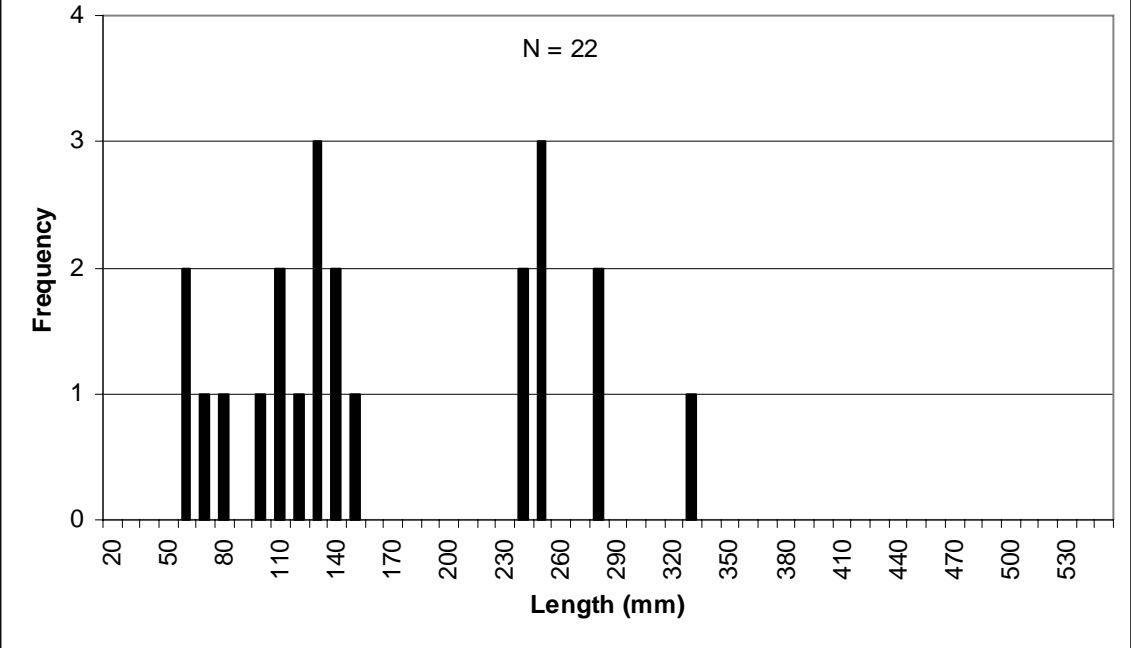
Dog Creek



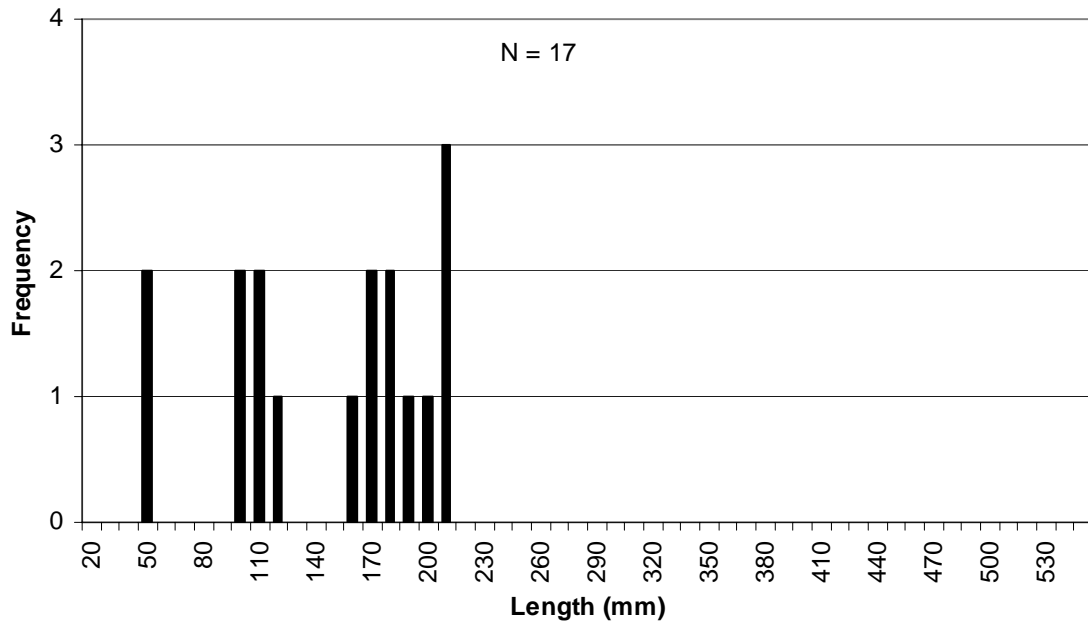
Dog Creek @ River Mile 5.1
Westslope Cutthroat Trout Size Distribution



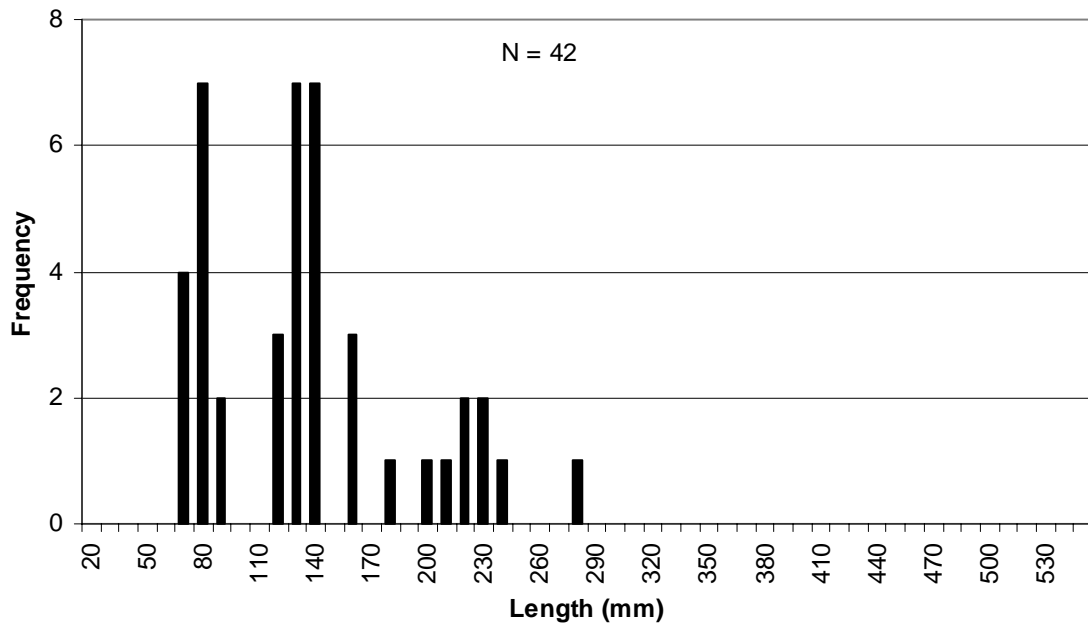
Dog Creek @ River Mile 5.1
Brown Trout Size Distribution



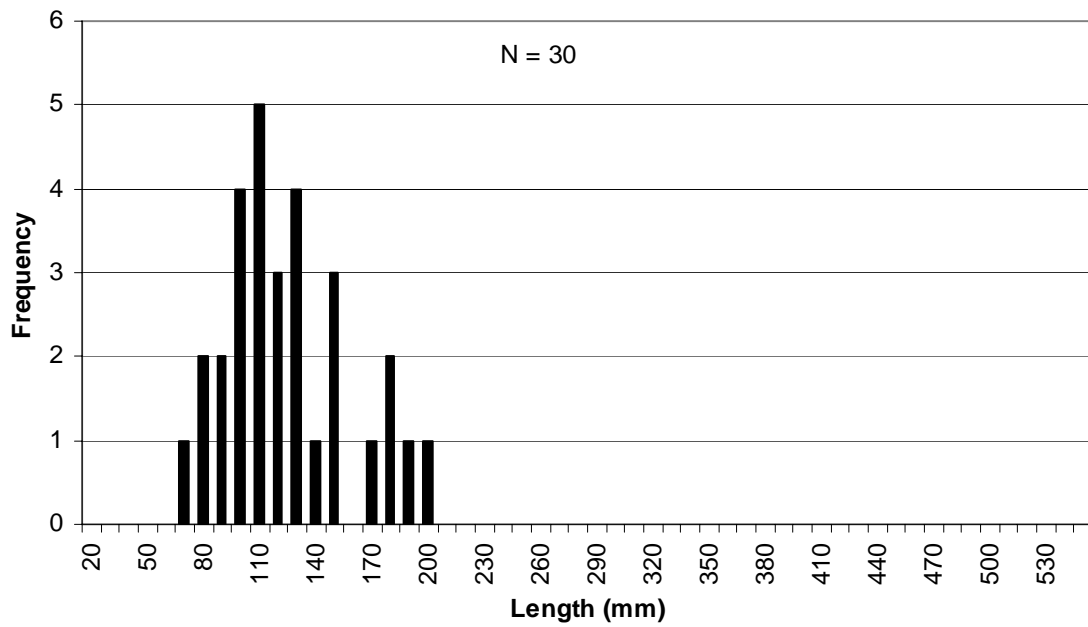
**Dog Creek @ River Mile 10.4
Westslope Cutthroat Trout Size Distribution**



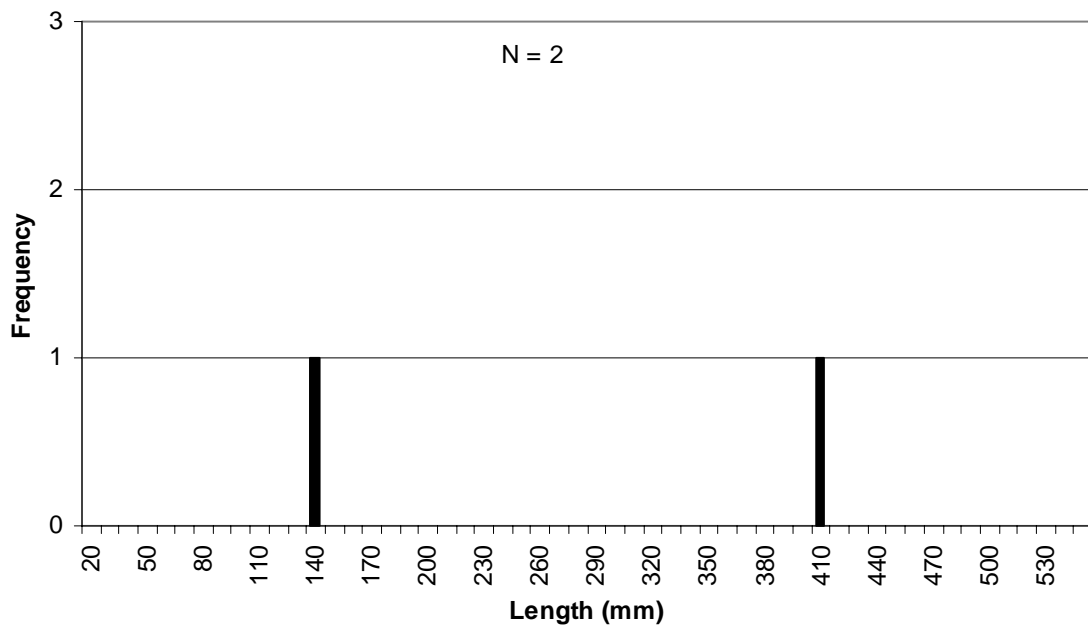
**Dog Creek @ River Mile 10.4
Brown Trout Size Distribution**



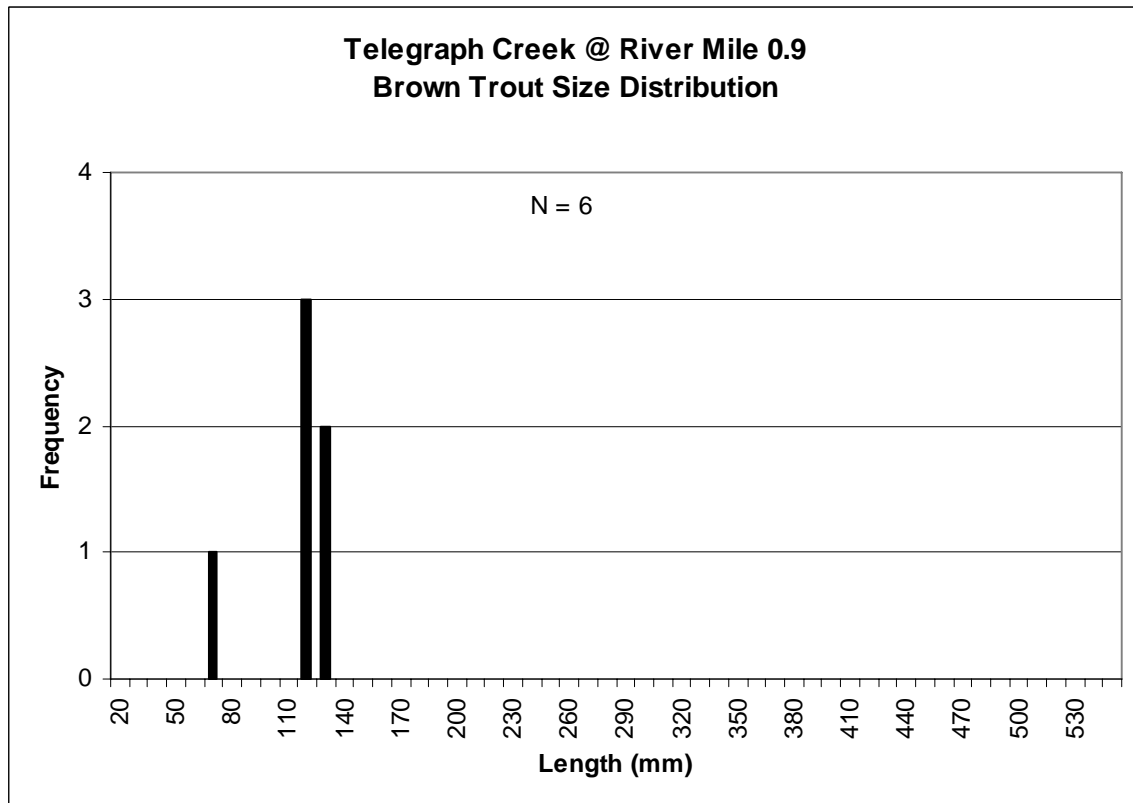
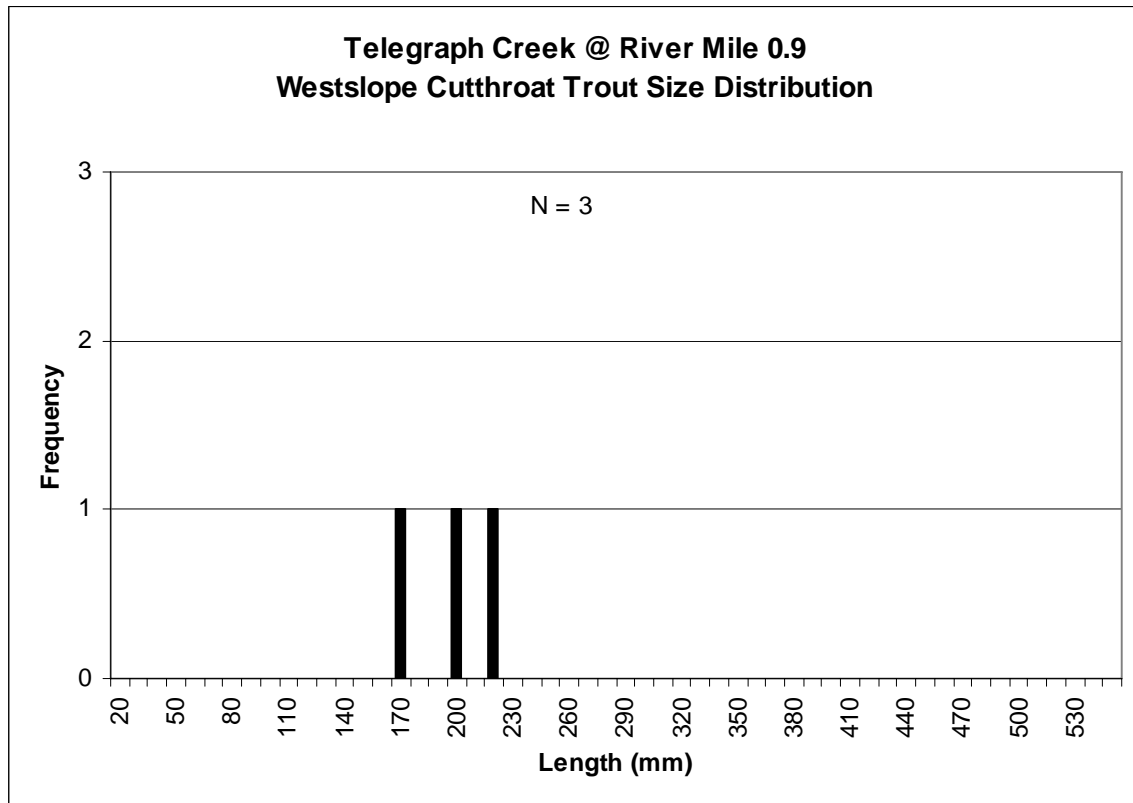
**Dog Creek @ River Mile 13.8
Westslope Cutthroat Trout Size Distribution**



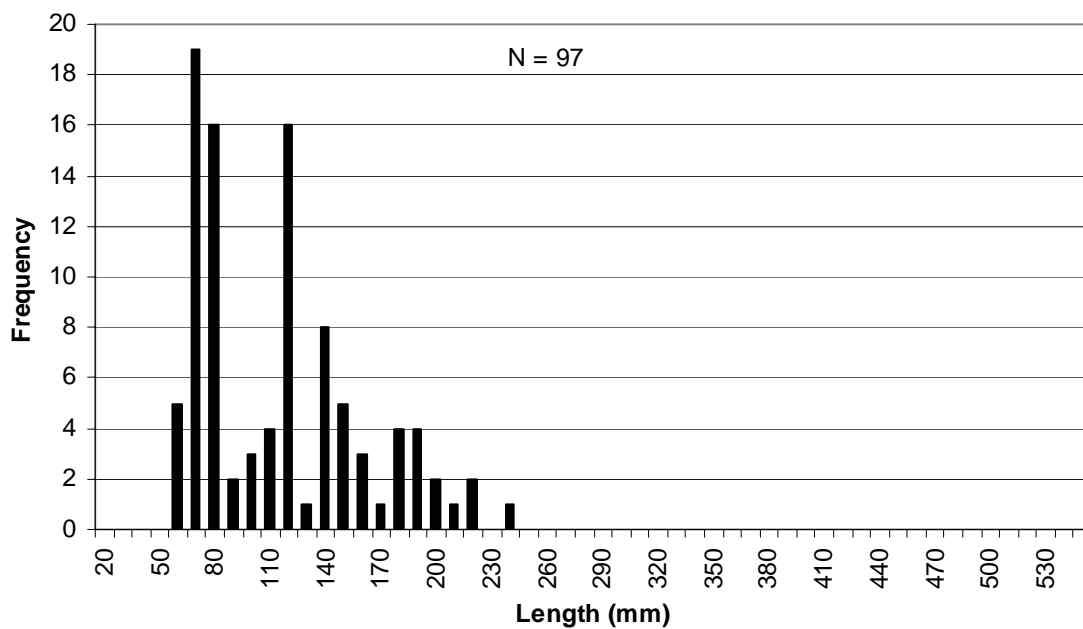
**Dog Creek @ River Mile 13.8
Brown Trout Size Distribution**



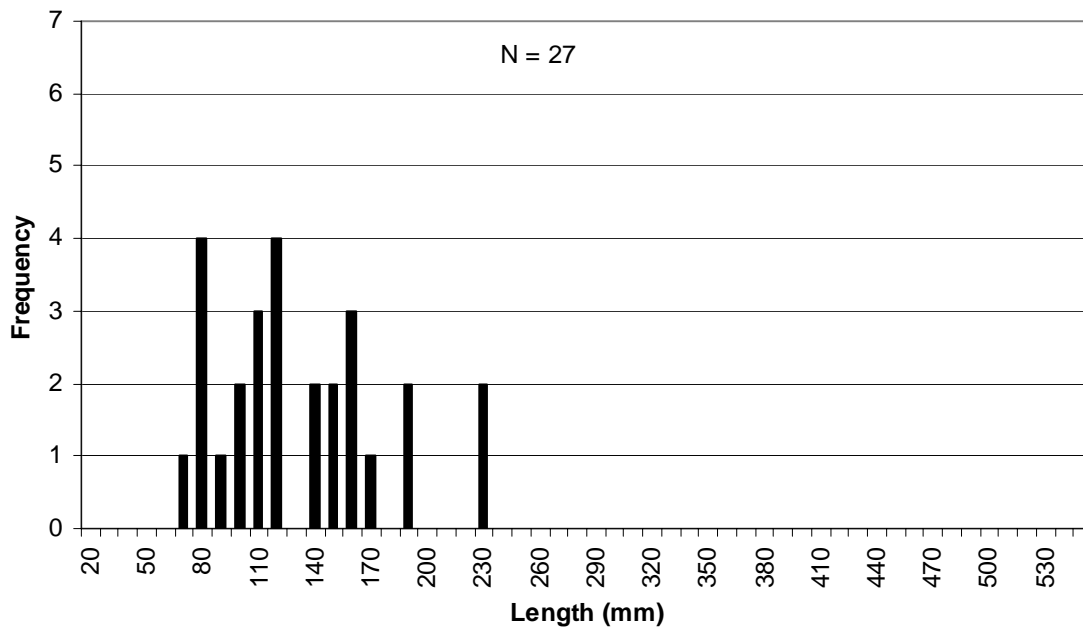
Telegraph Creek



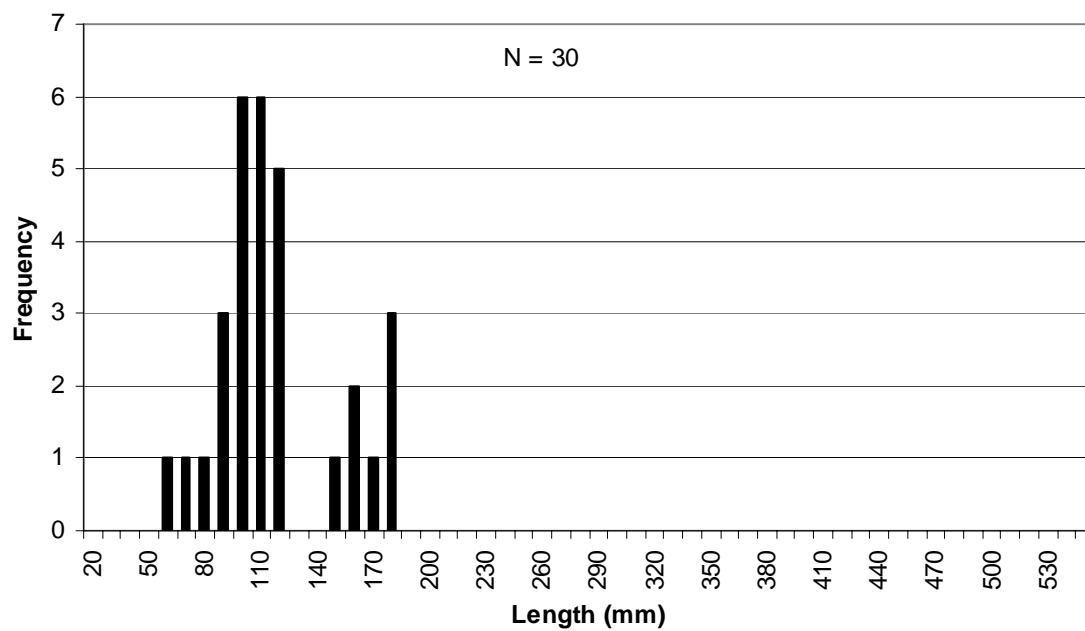
**Telegraph Creek @ River Mile 0.9
Brook Trout Size Distribution**



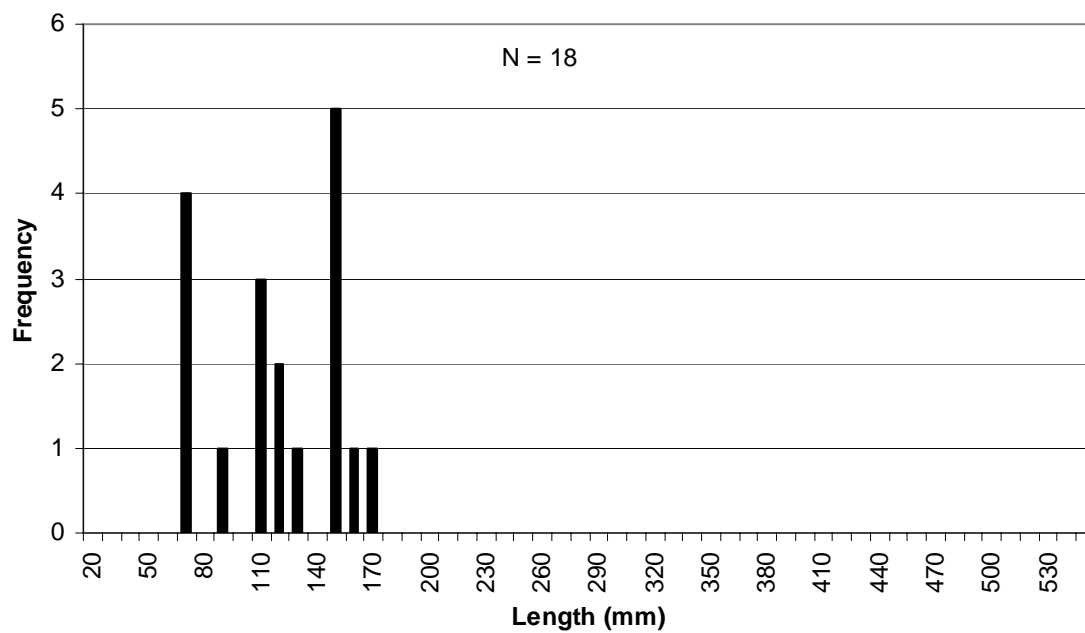
**Telegraph Creek @ River Mile 3.6
Westslope Cutthroat Trout Size Distribution**

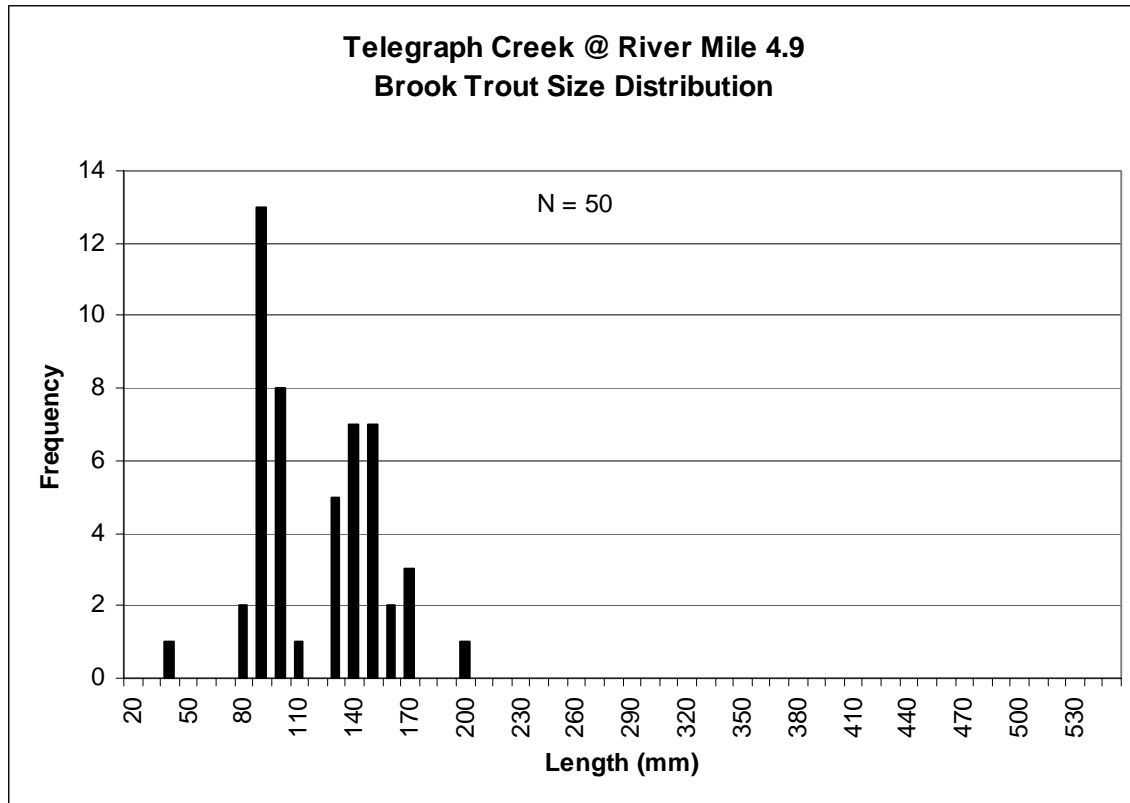


**Telegraph Creek @ River Mile 3.6
Brook Trout Size Distribution**

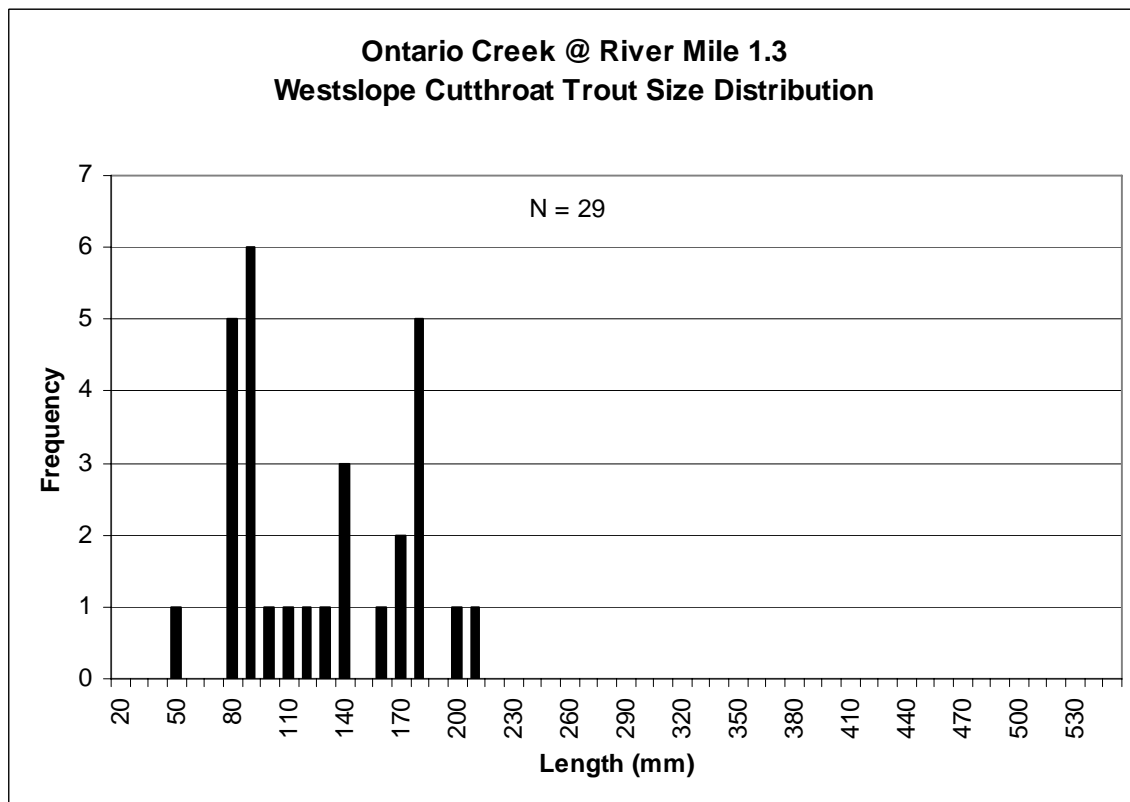


**Telegraph Creek @ River Mile 4.9
Westslope Cutthroat Trout Size Distribution**

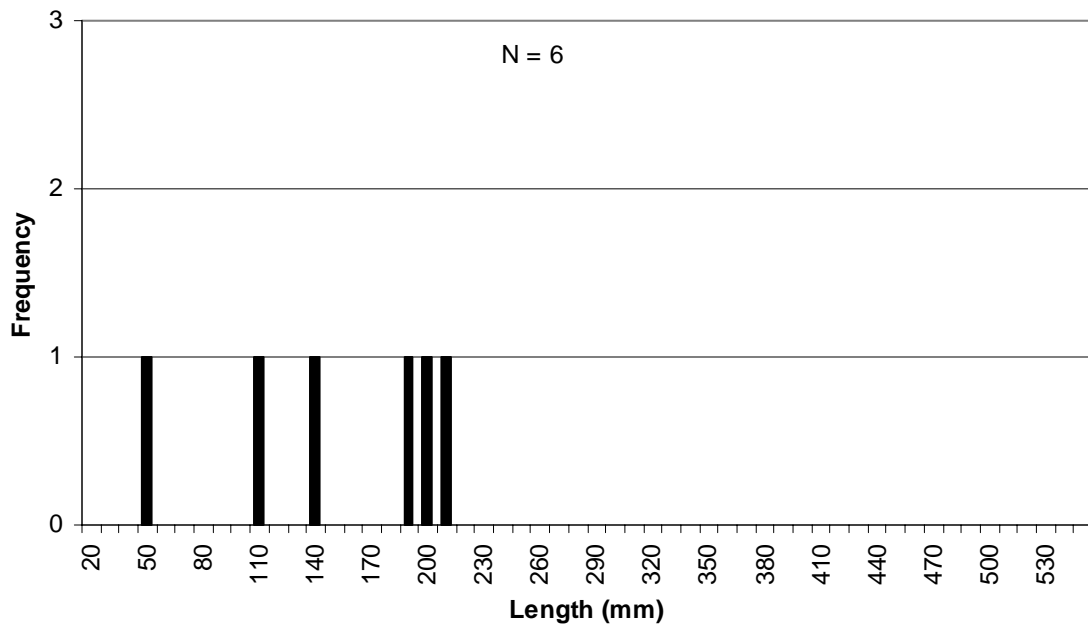




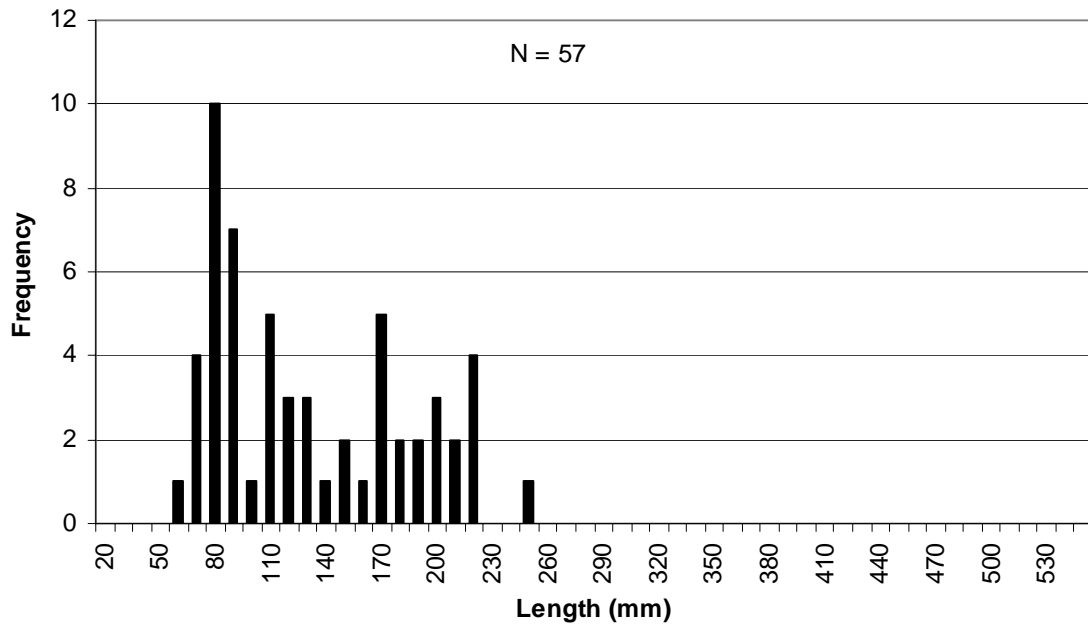
Ontario Creek

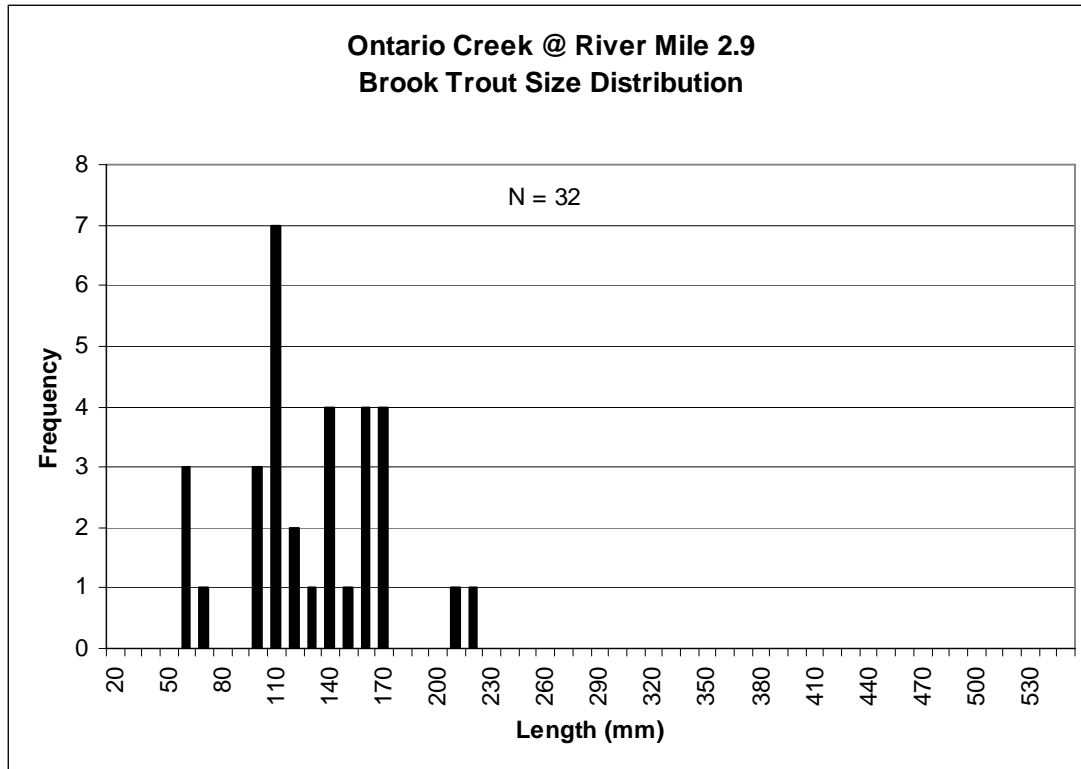


**Ontario Creek @ River Mile 1.3
Brook Trout Size Distribution**



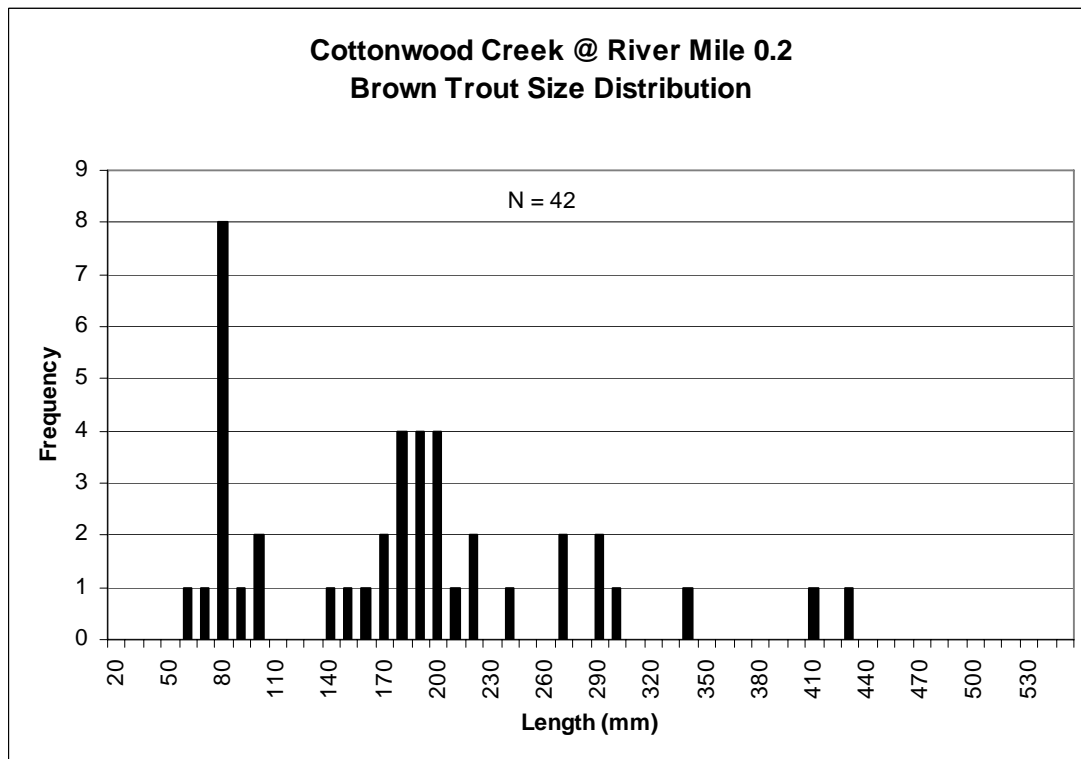
**Ontario Creek @ River Mile 2.9
Westslope Cutthroat Trout Size Distribution**



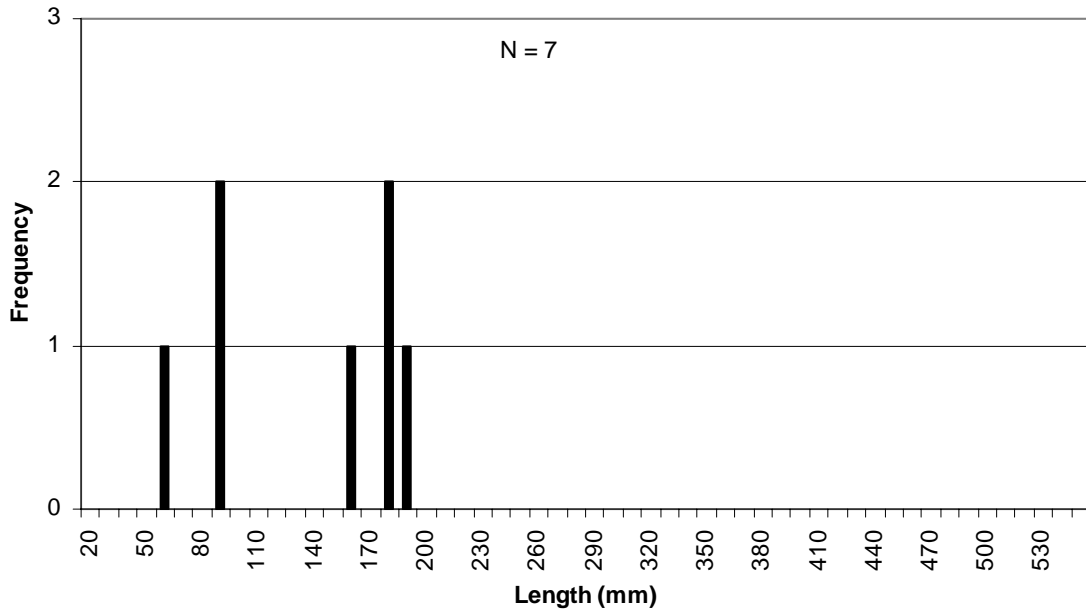


Cottonwood Creek

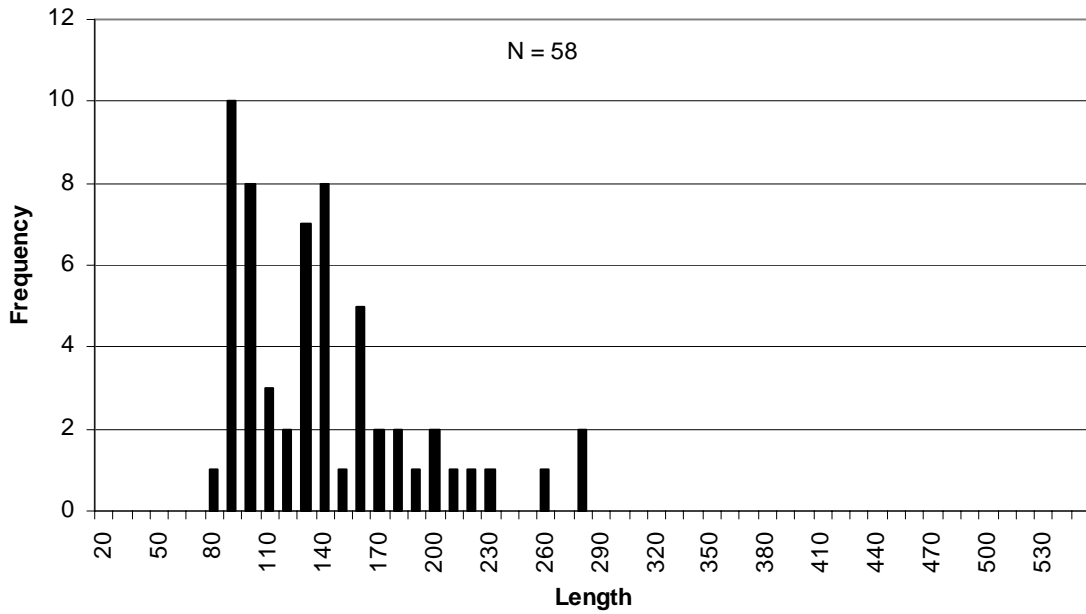
Cottonwood Creek

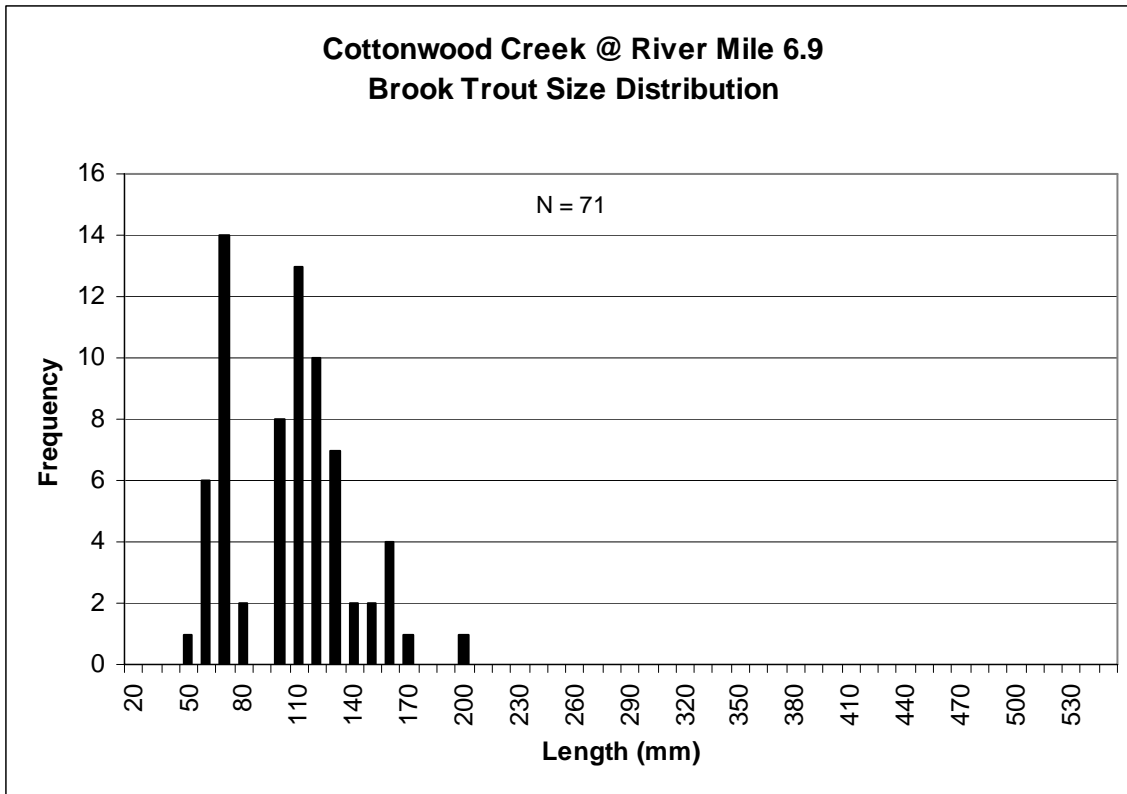


**Cottonwood Creek @ River Mile 3.0
Brook Trout Size Distribution**

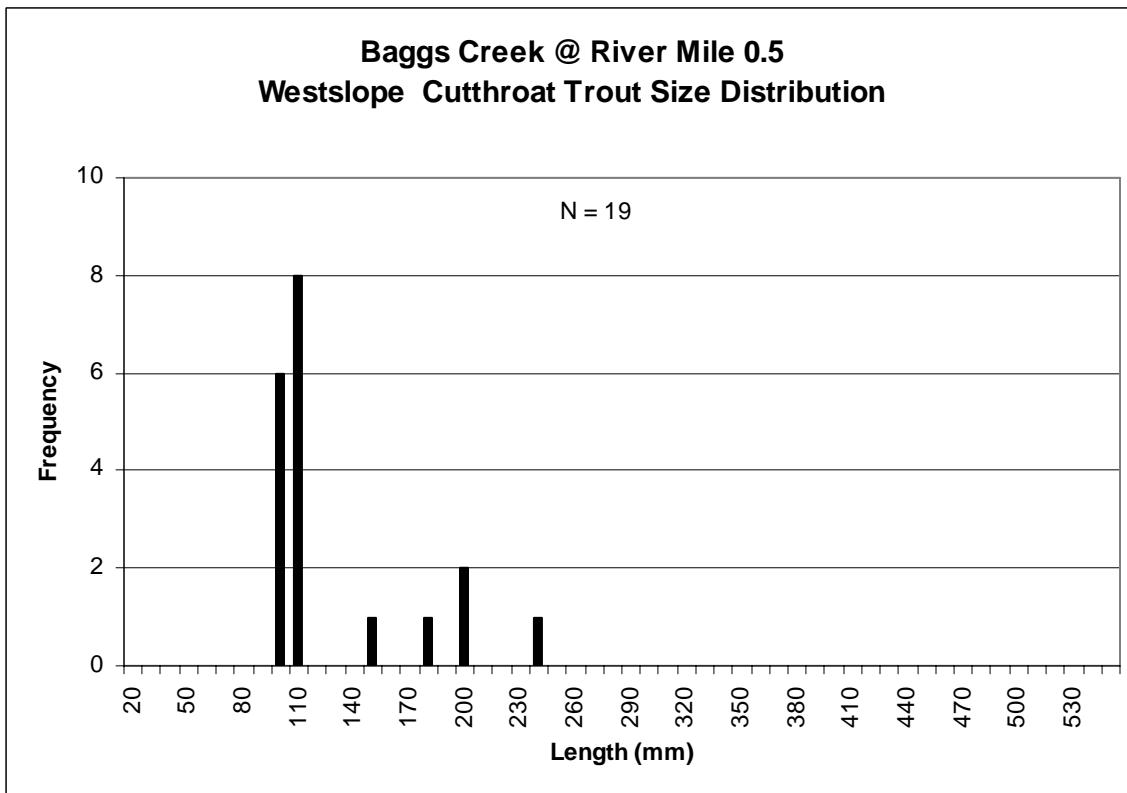


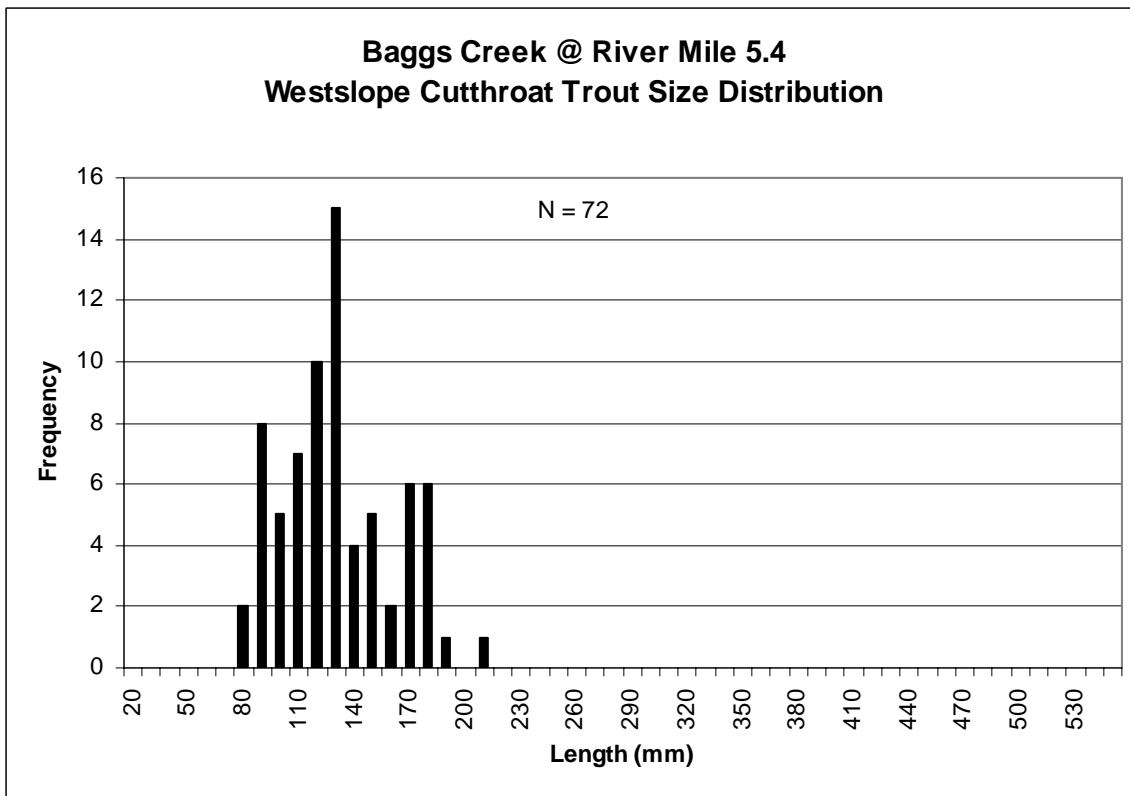
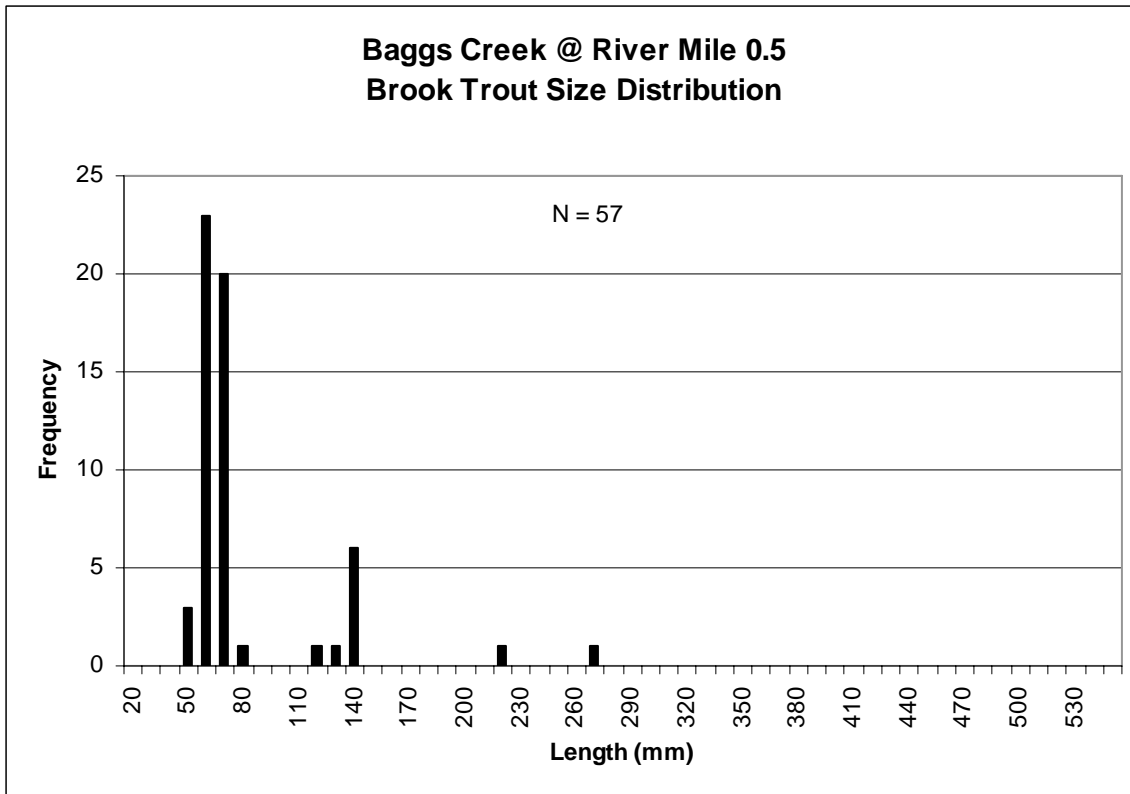
**Cottonwood Creek @ River Mile 6.9
Westslope Cutthroat Trout Size Distribution**



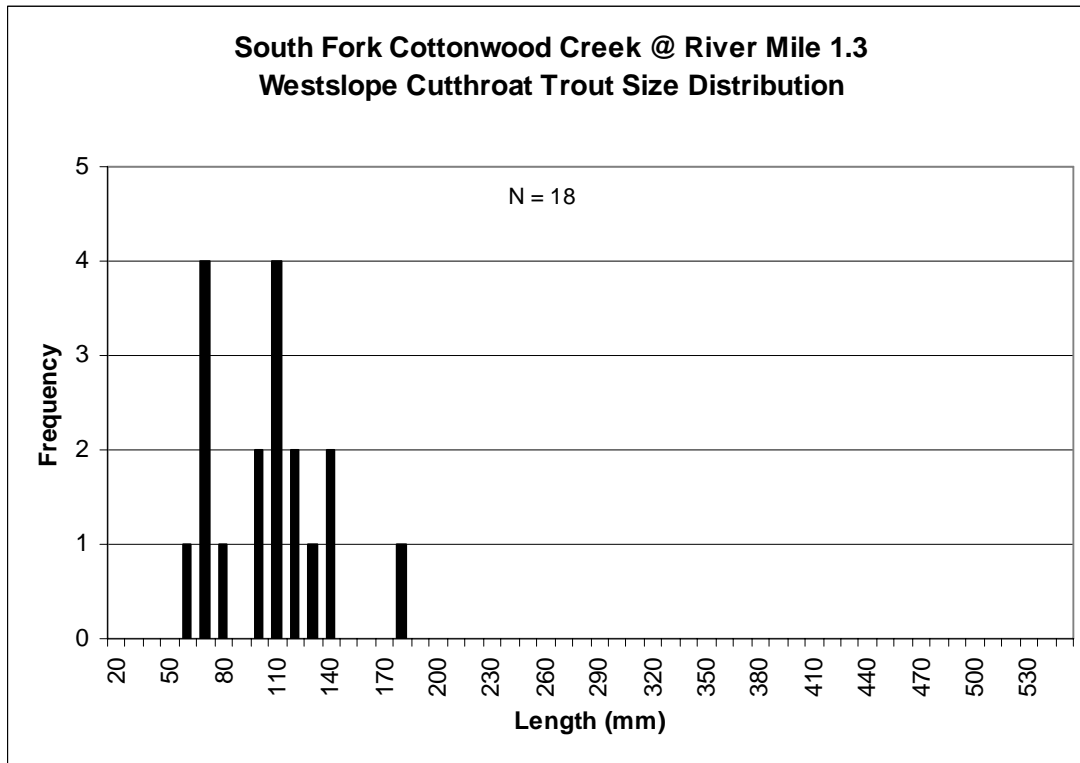


Baggs Creek

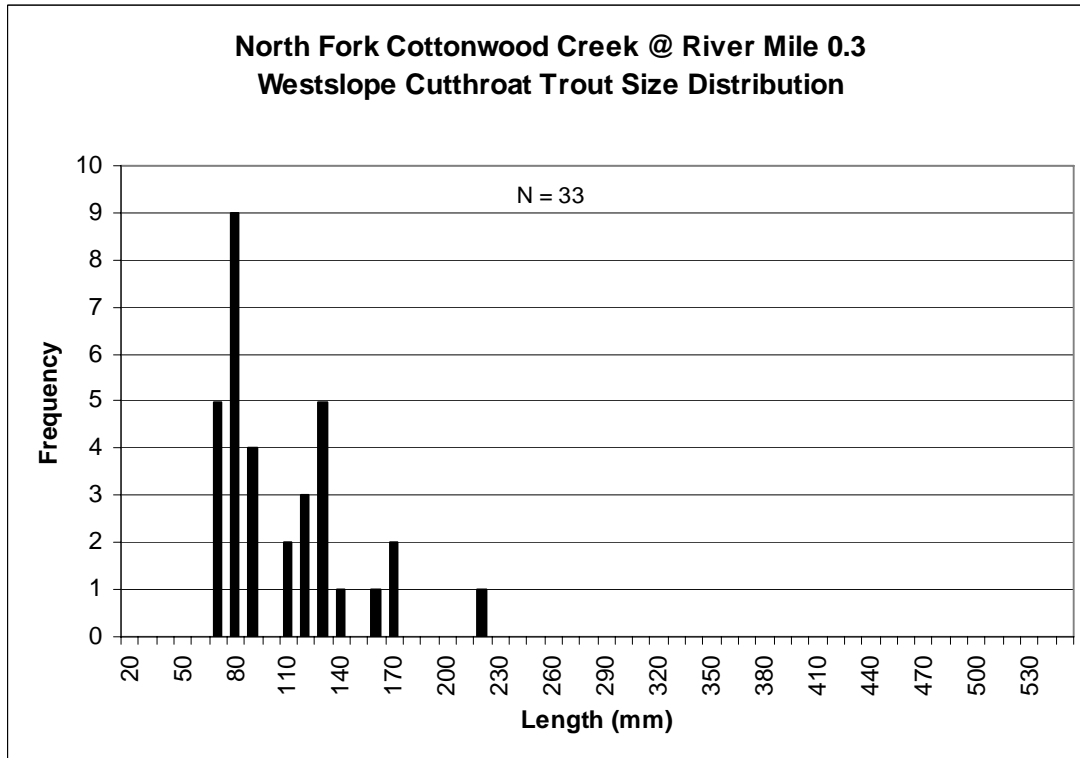


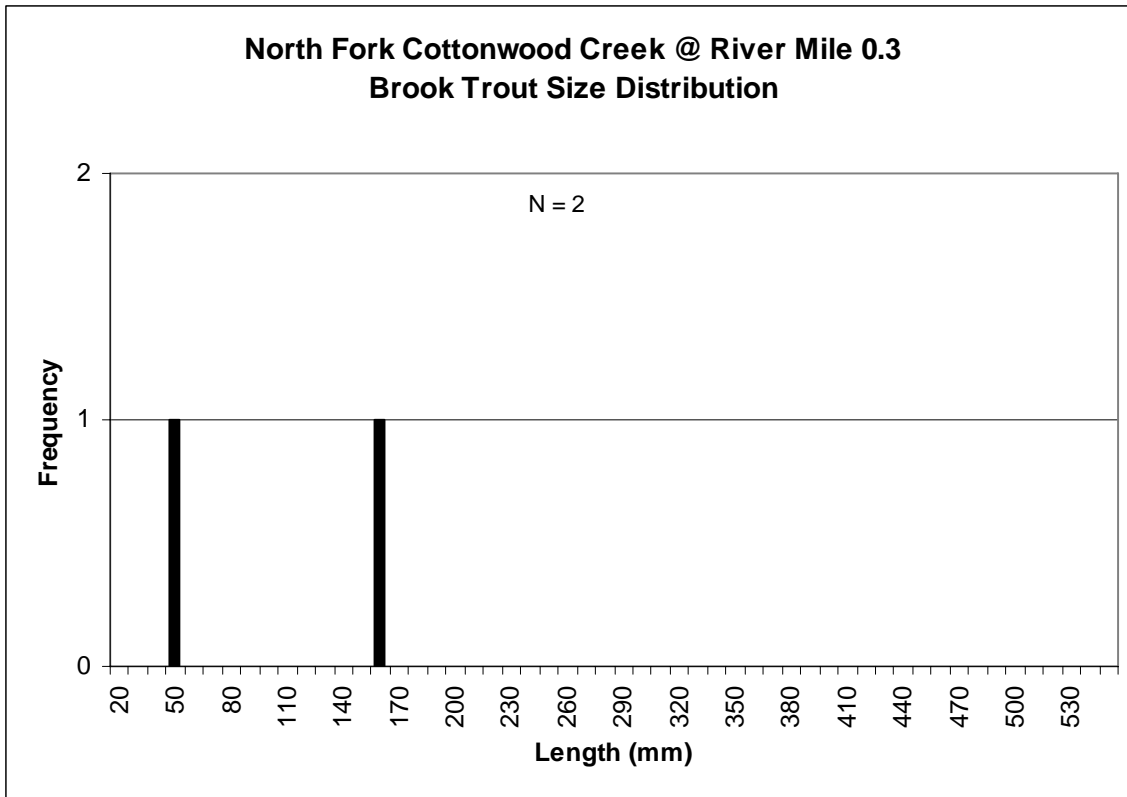


South Fork Cottonwood Creek

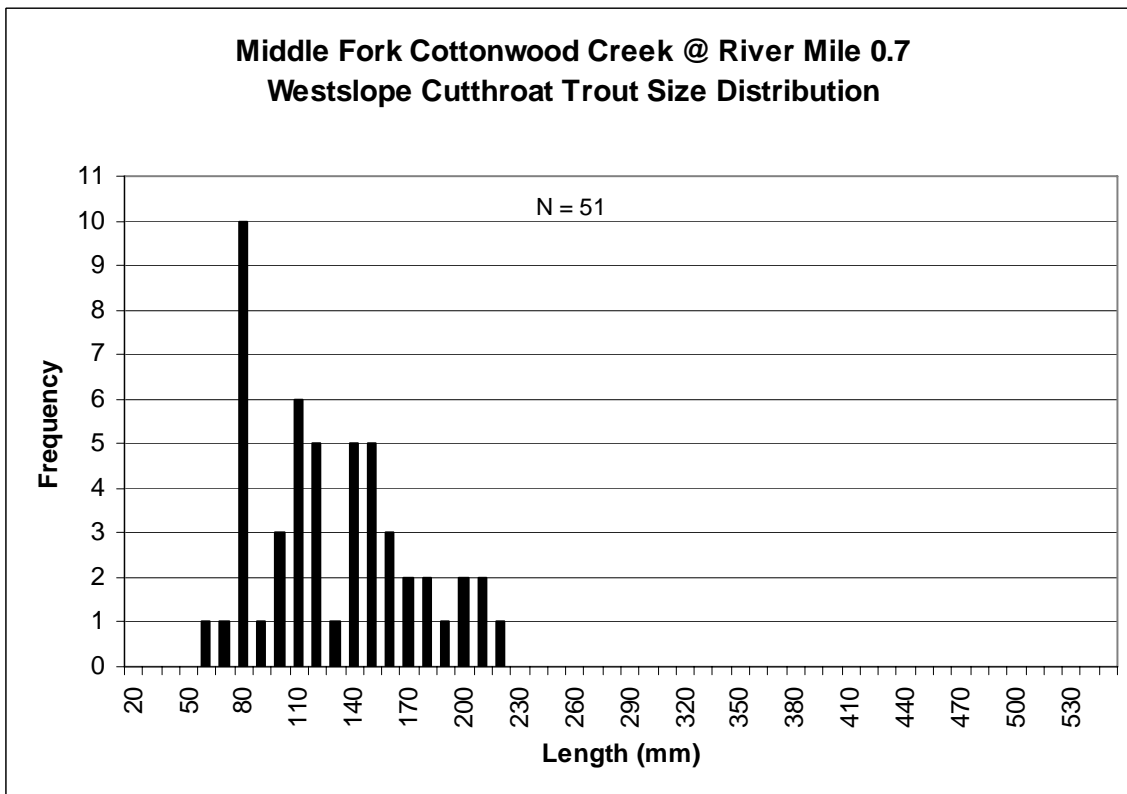


North Fork Cottonwood Creek



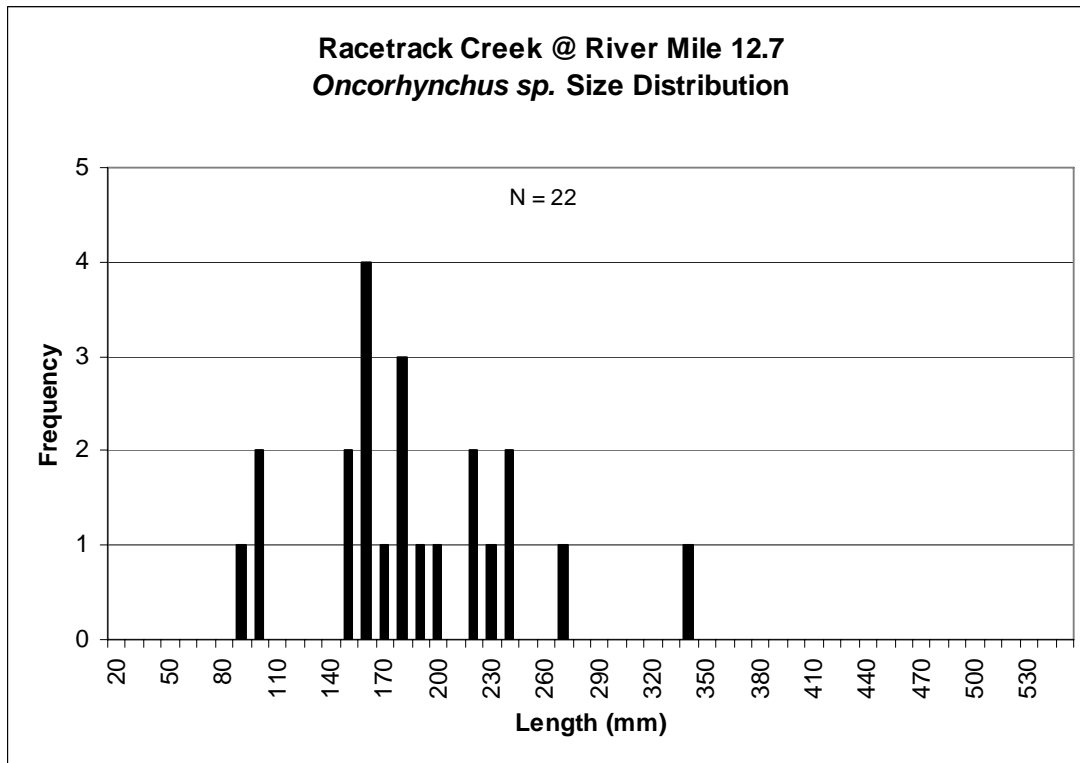
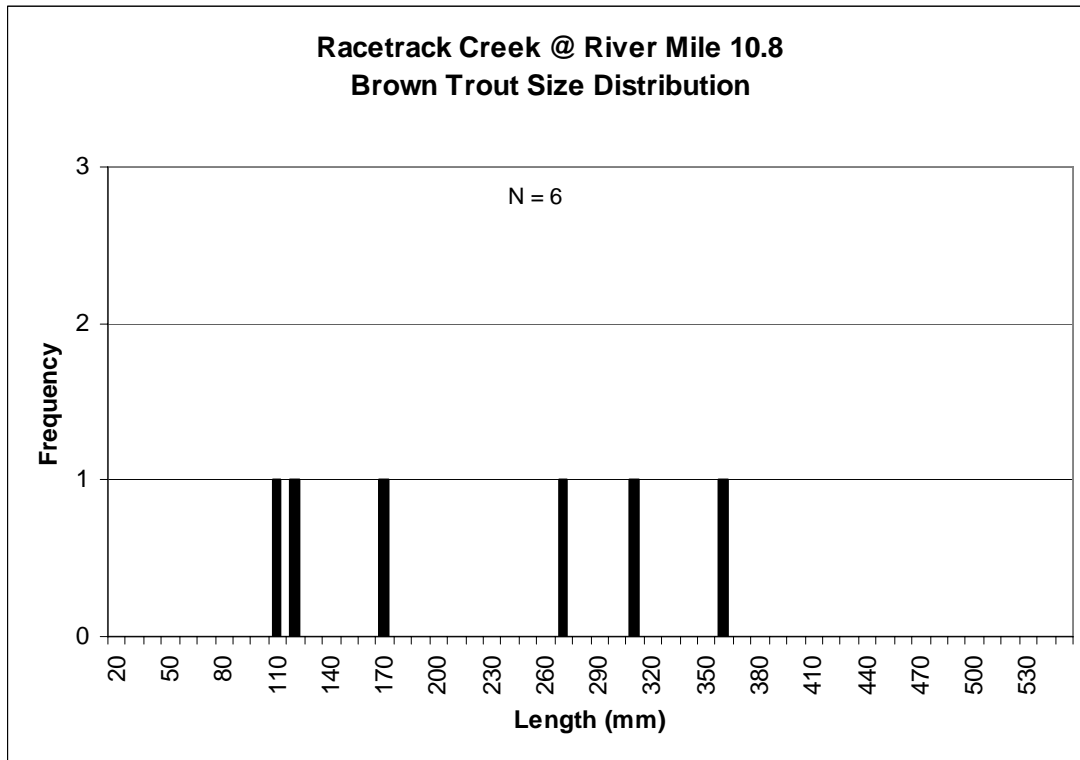


Middle Fork Cottonwood Creek

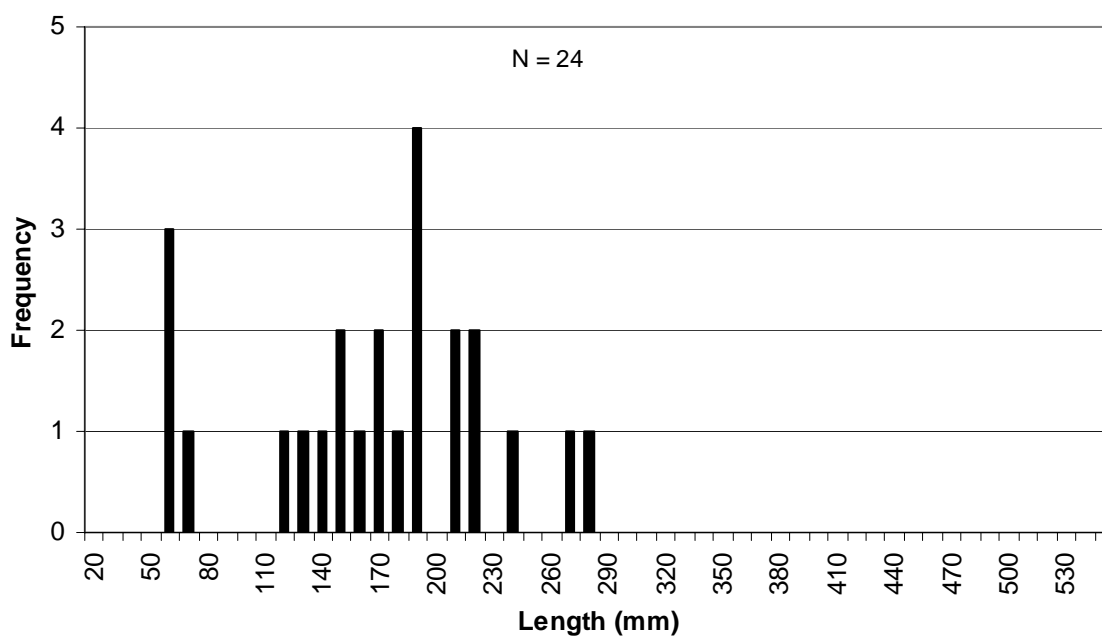


Racetrack Creek

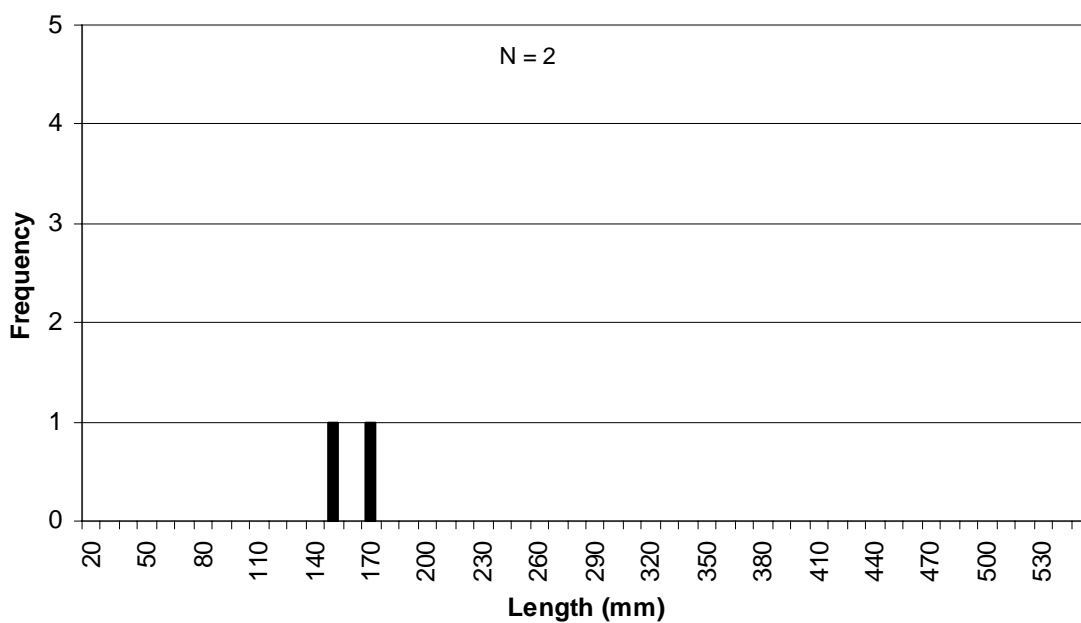
Racetrack Creek



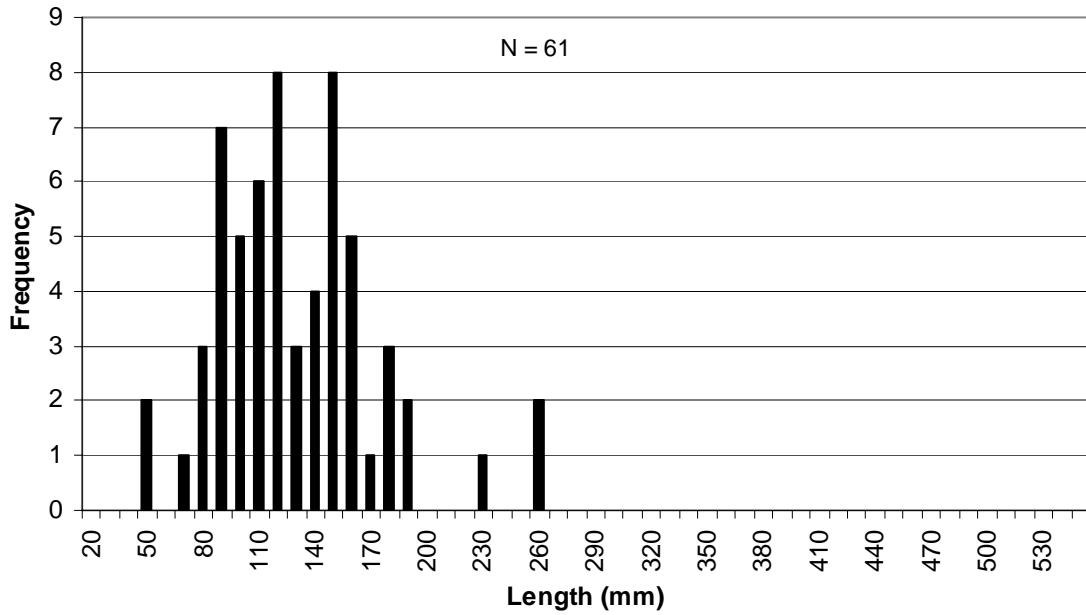
Racetrack Creek @ River Mile 12.7 Brown Trout Size Distribution



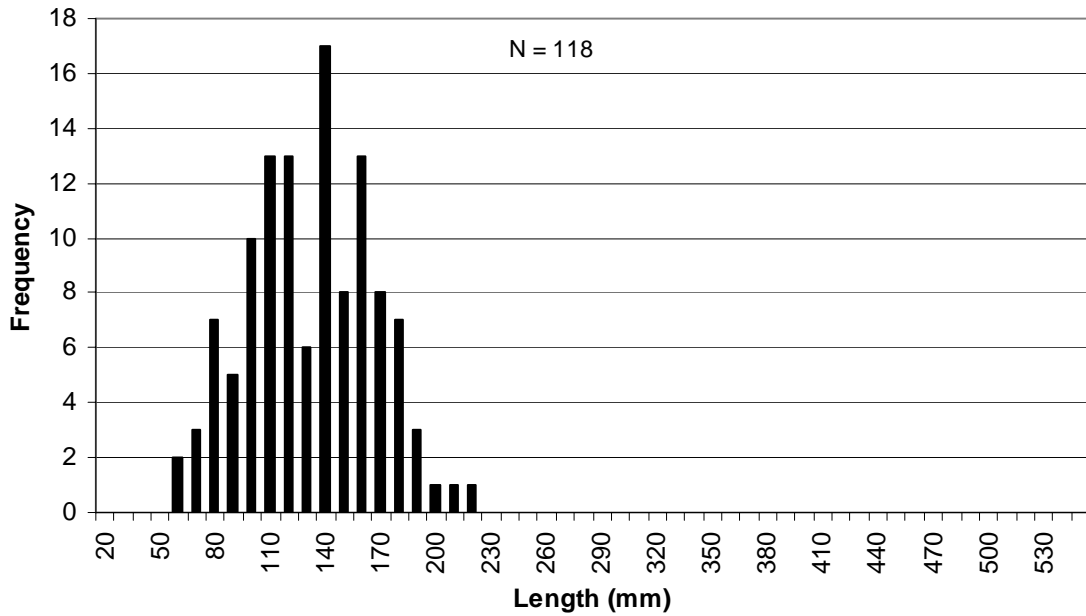
Racetrack Creek @ River Mile 12.7 Brook Trout Size Distribution



Racetrack Creek @ River Mile 15.0
***Oncorhynchus* sp. Size Distribution**

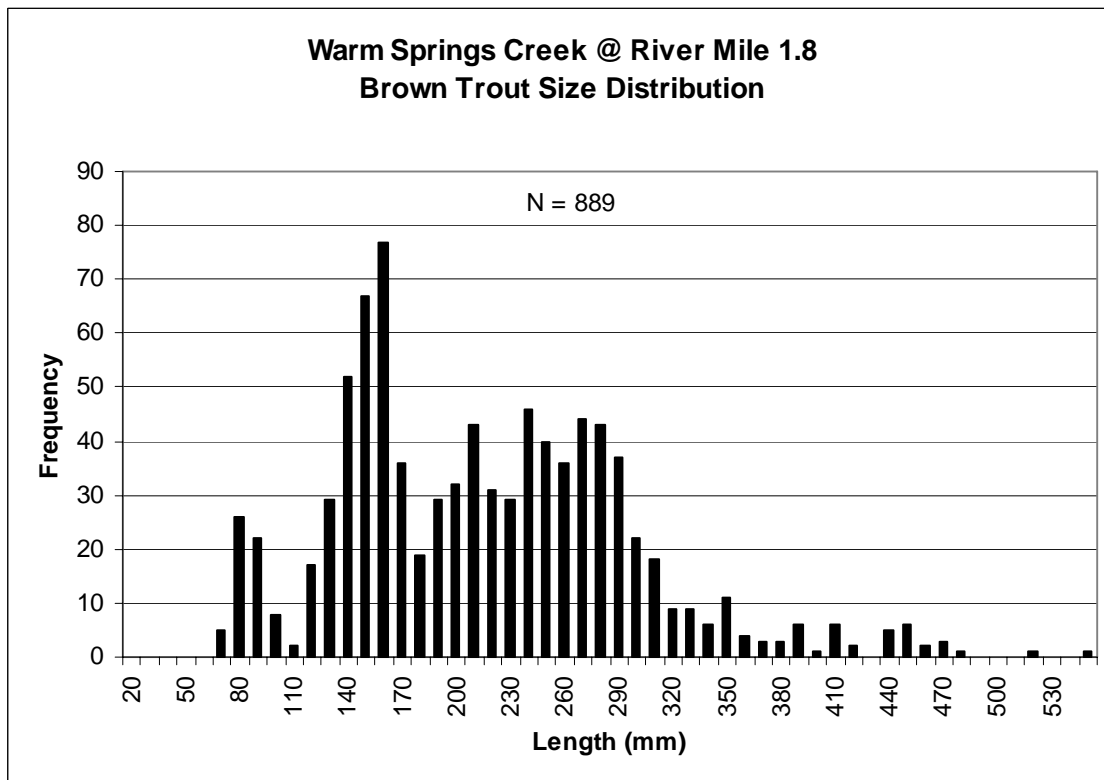
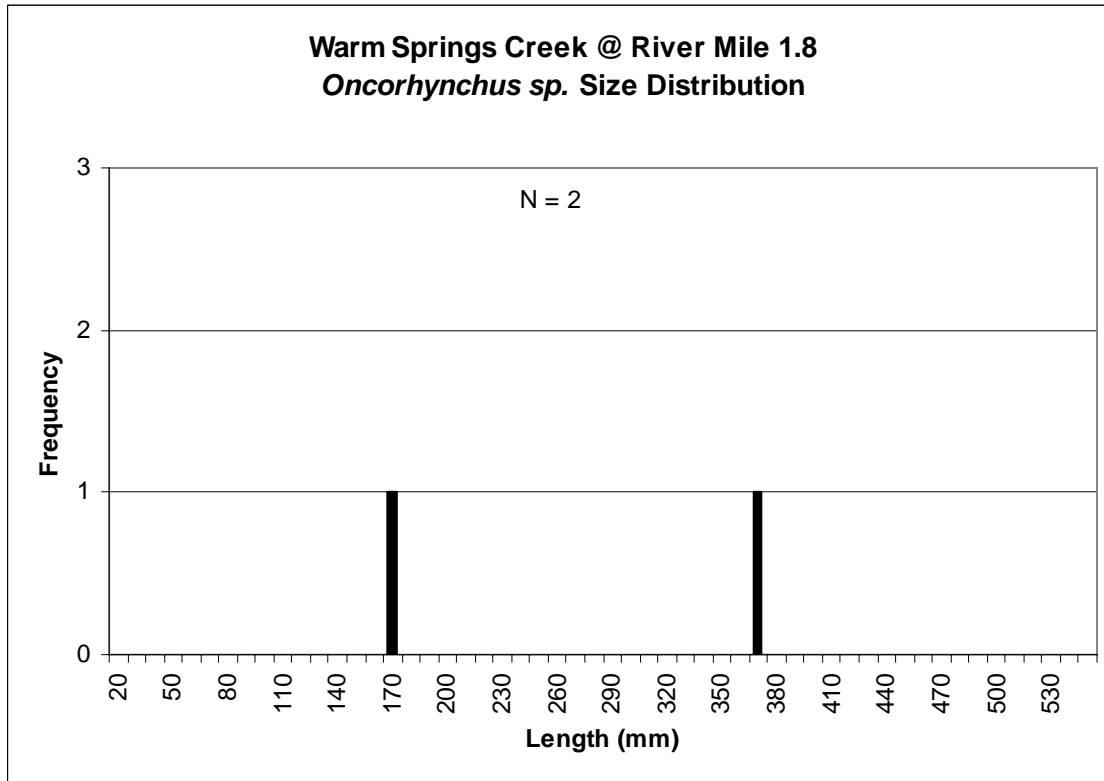


Racetrack Creek @ River Mile 18.5
***Oncorhynchus* sp. Size Distribution**

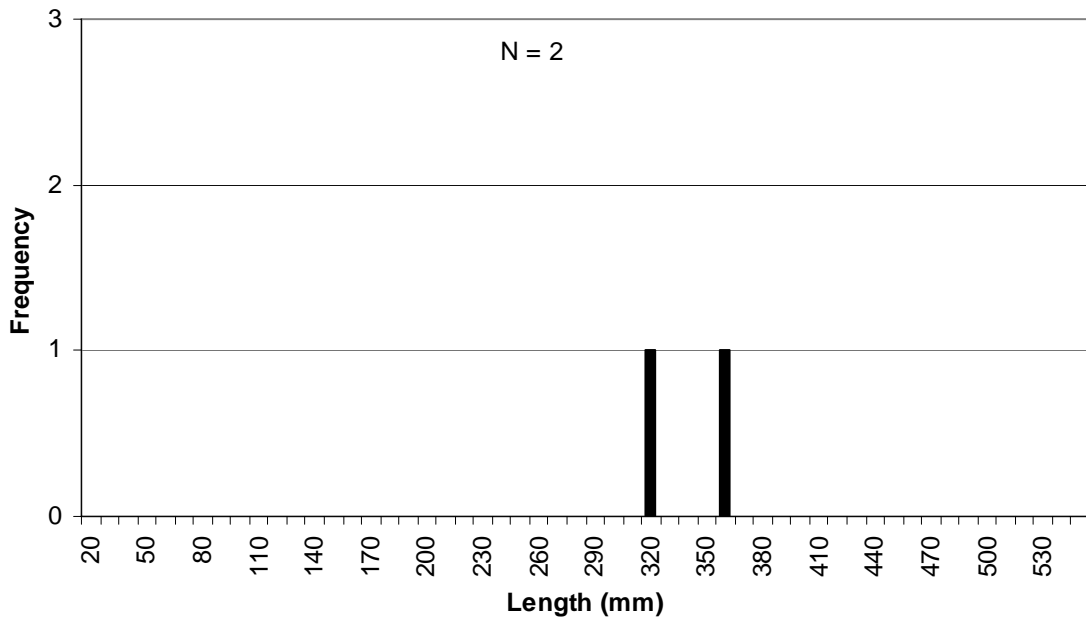


Warm Springs Creek

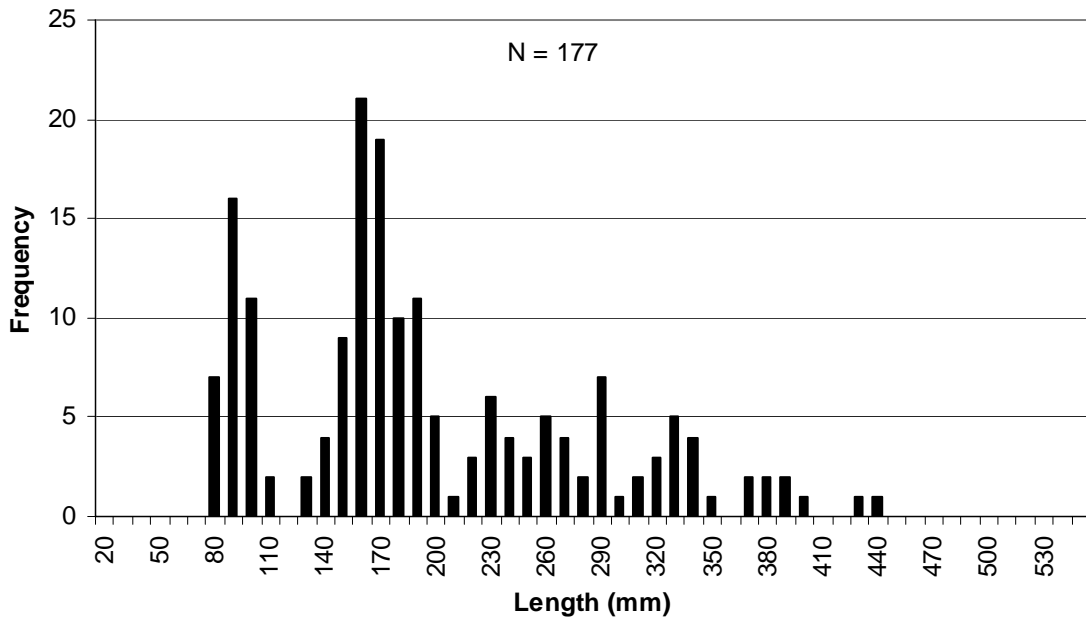
Warm Springs Creek



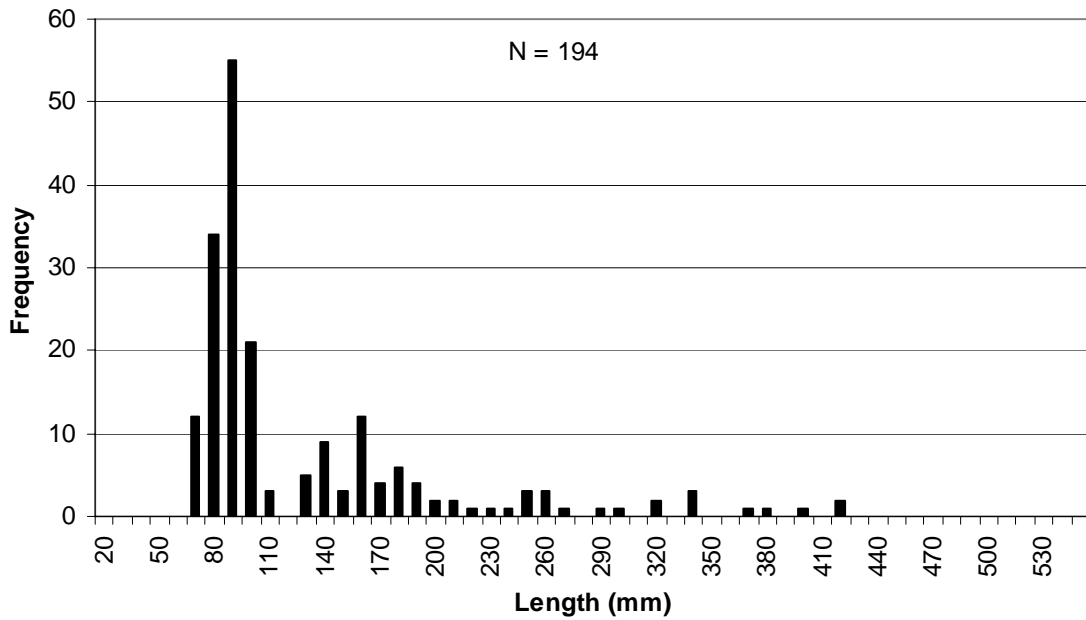
Warm Springs Creek @ River Mile 7.4
***Oncorhynchus* sp. Size Distribution**



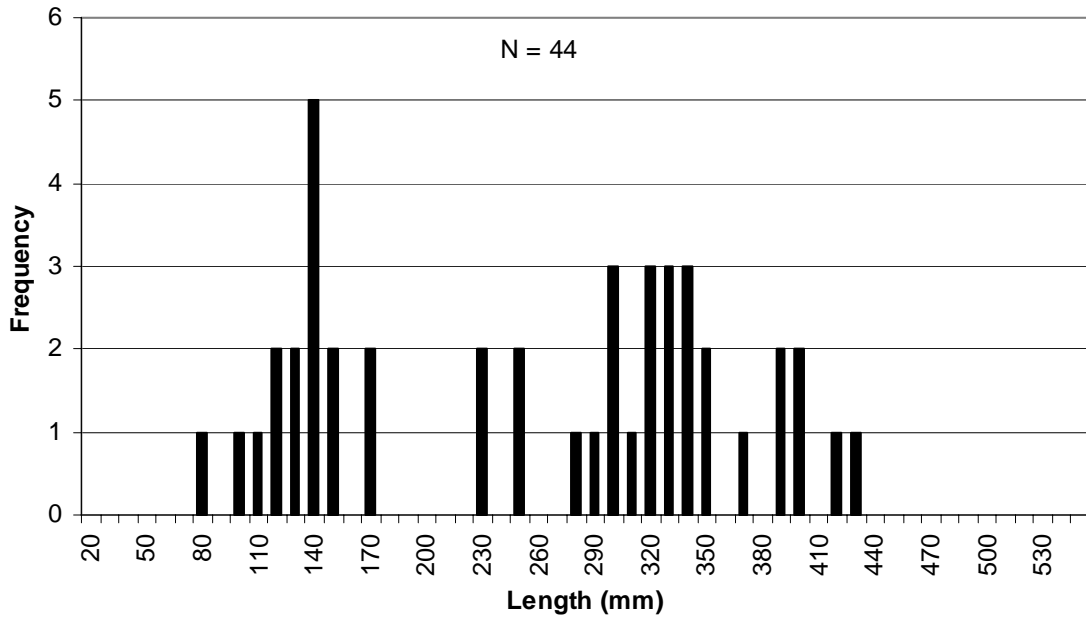
Warm Springs Creek @ River Mile 7.4
Brown Trout Size Distribution



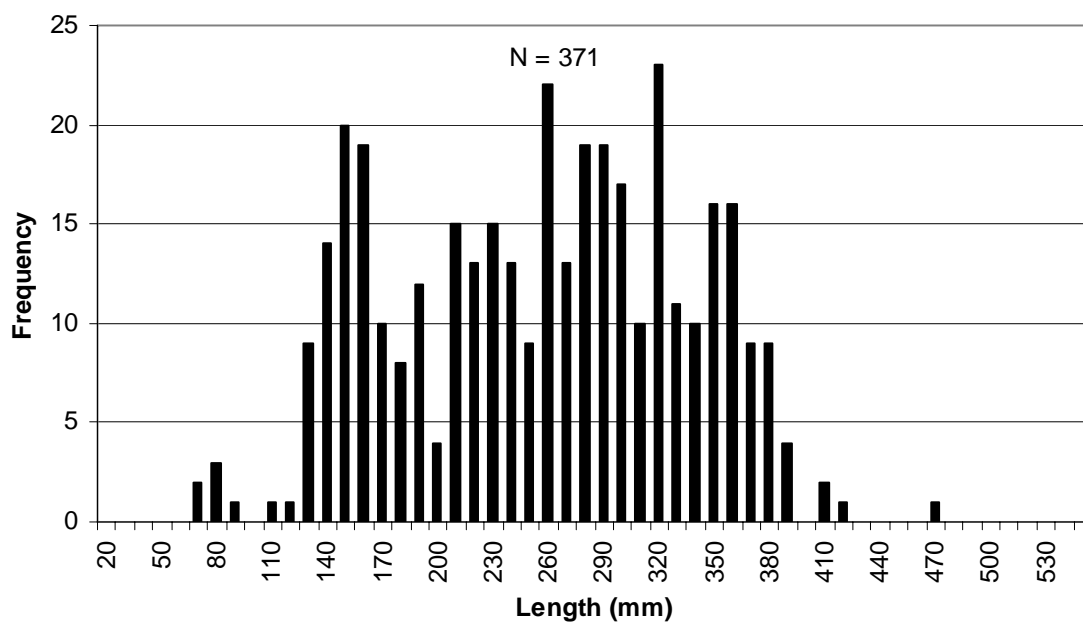
**Warm Springs Creek @ River Mile 8.4
Brown Trout Size Distribution**



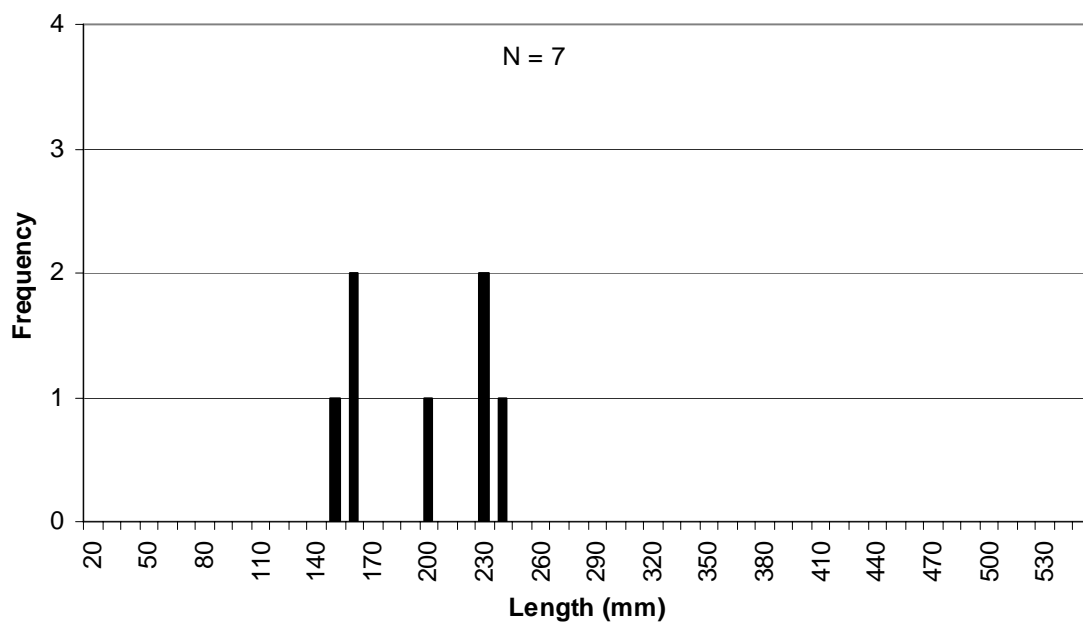
**Warm Springs Creek @ River Mile 16.4
Oncorhynchus sp. Size Distribution**



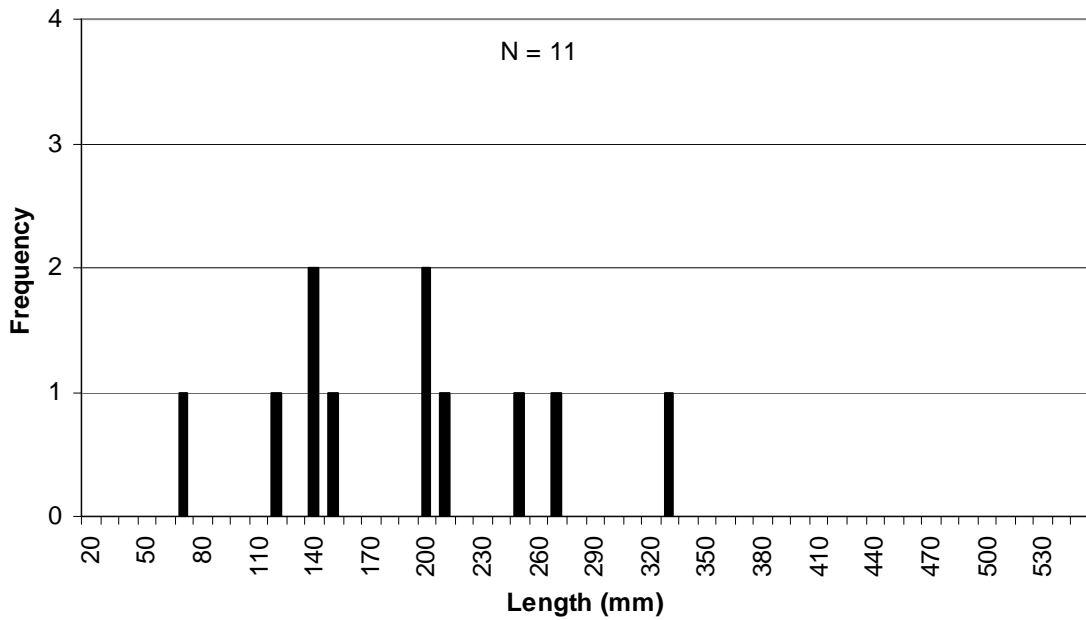
**Warm Springs Creek @ River Mile 16.4
Brown Trout Size Distribution**



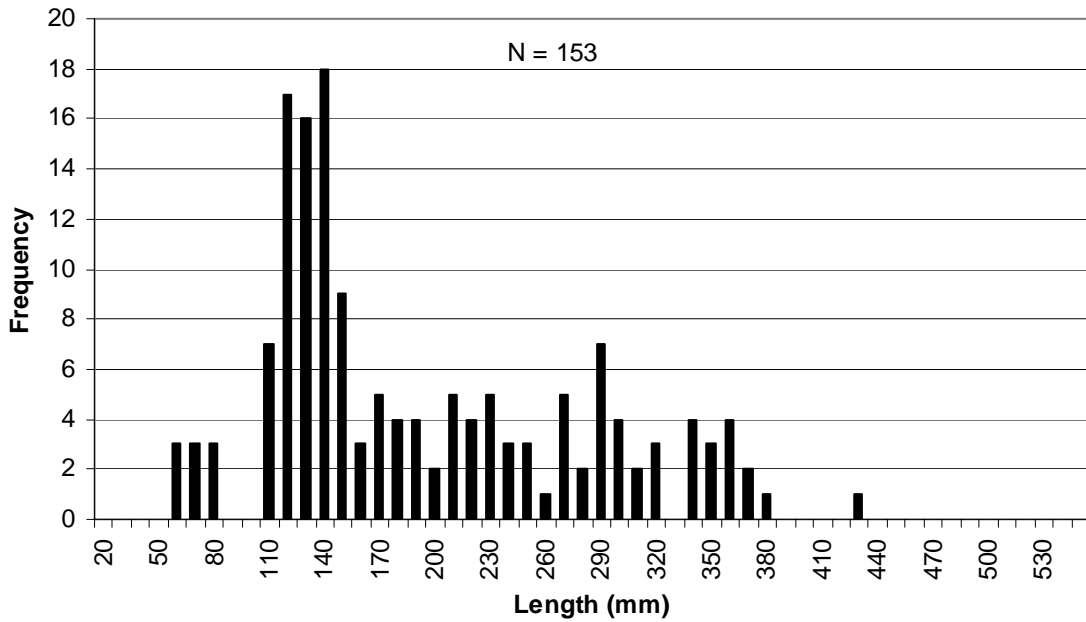
**Warm Springs Creek @ River Mile 16.4
Brook Trout Size Distribution**



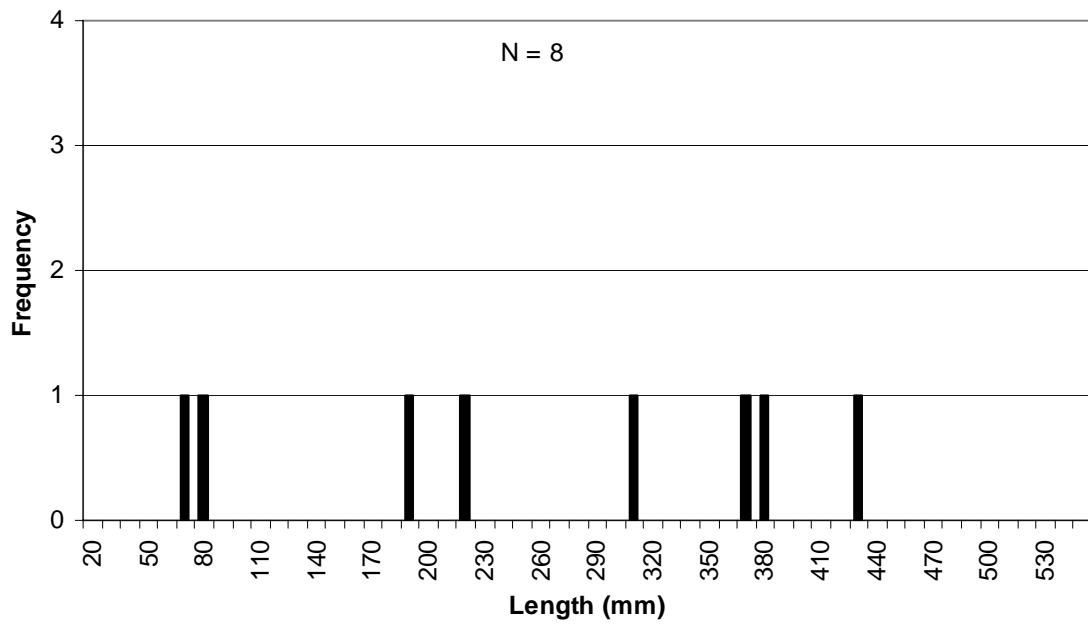
Warm Springs Creek @ River Mile 18.6
Bull Trout Size Distribution



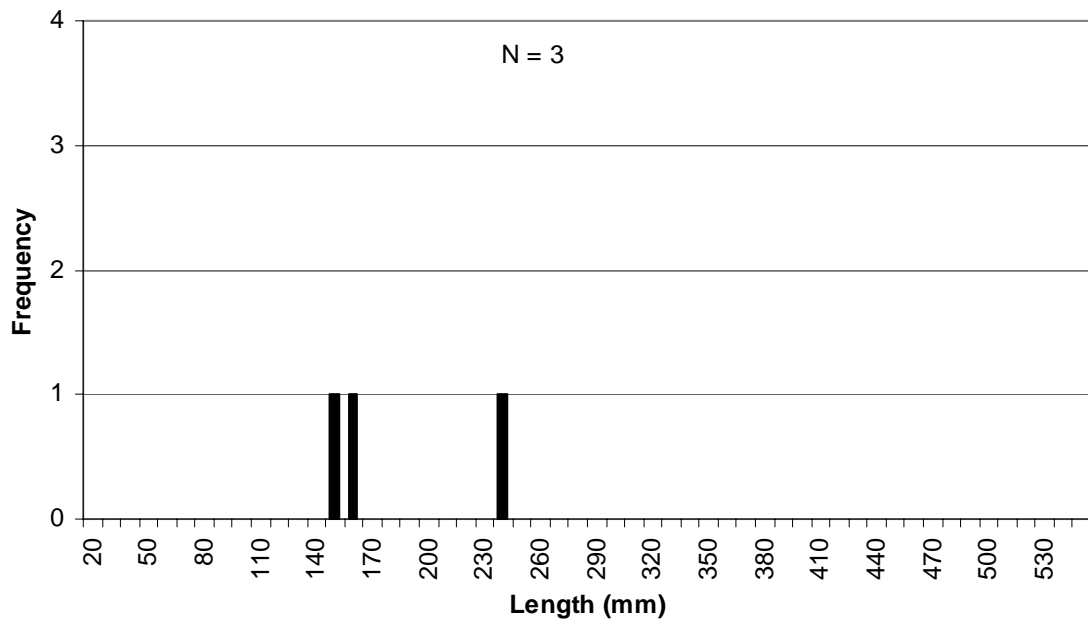
Warm Springs Creek @ River Mile 18.6
***Oncorhynchus spp.* Size Distribution**



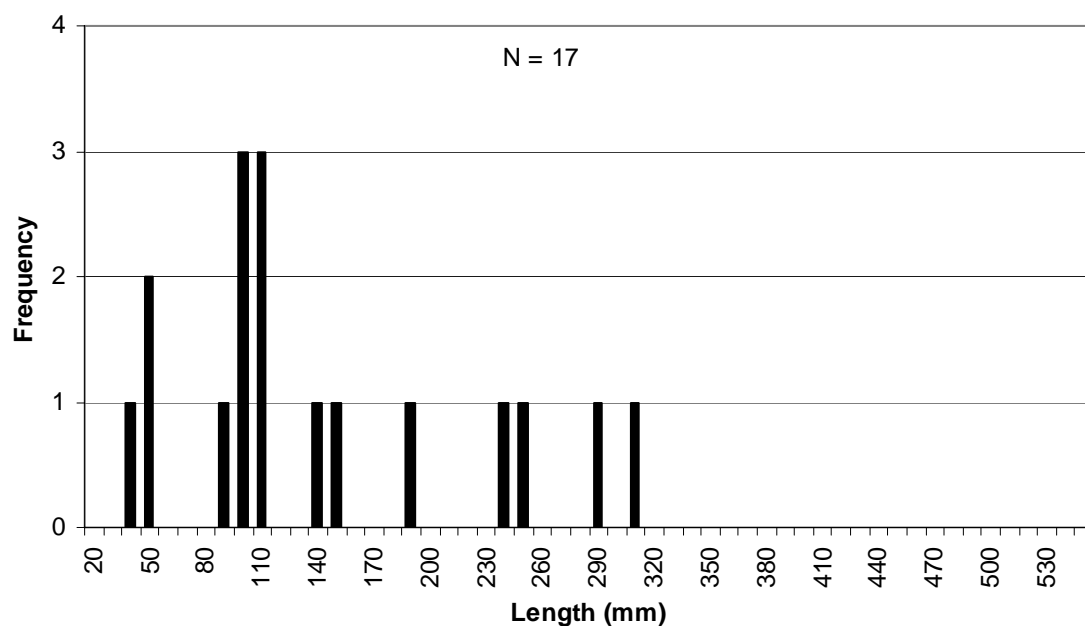
**Warm Springs Creek @ River Mile 18.6
Brown Trout Size Distribution**



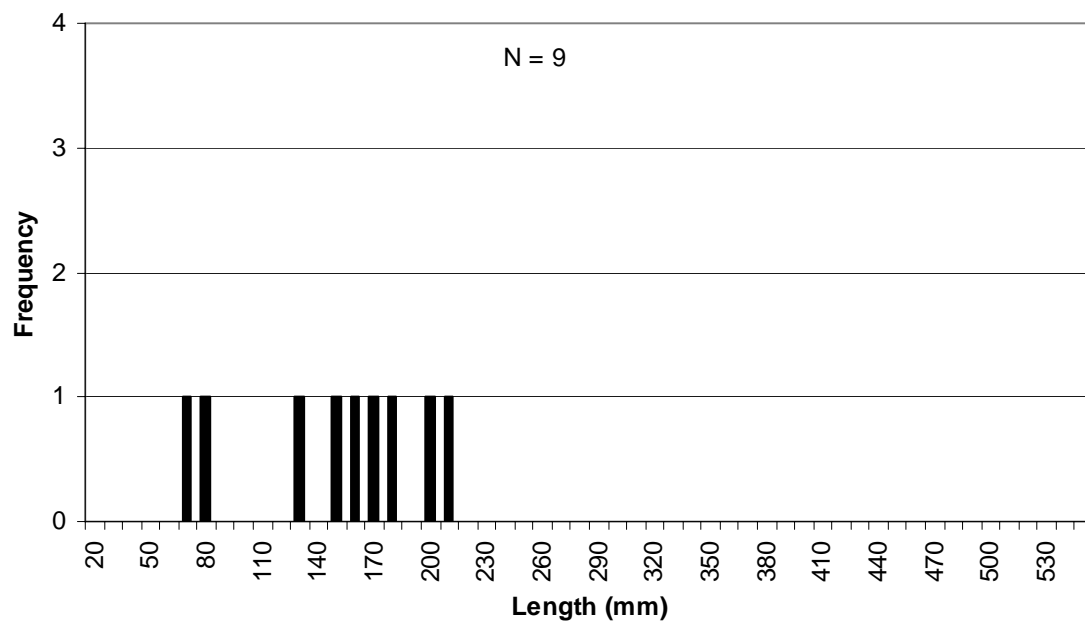
**Warm Springs Creek @ River Mile 18.6
Brook Trout Size Distribution**



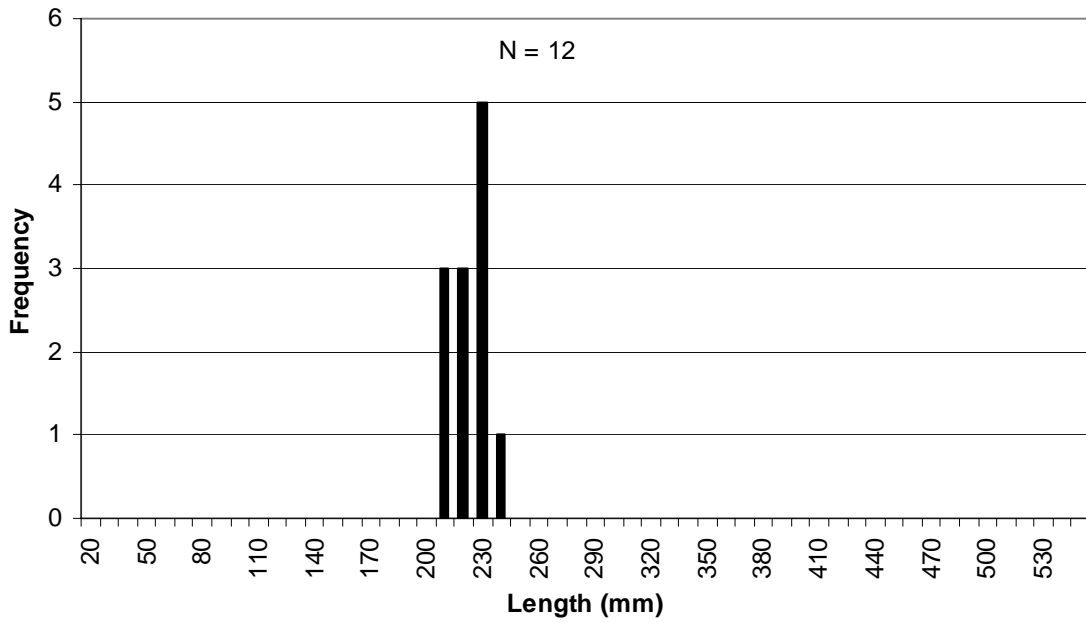
Warm Springs Creek @ River Mile 23.3
***Oncorhynchus* spp. Size Distribution**



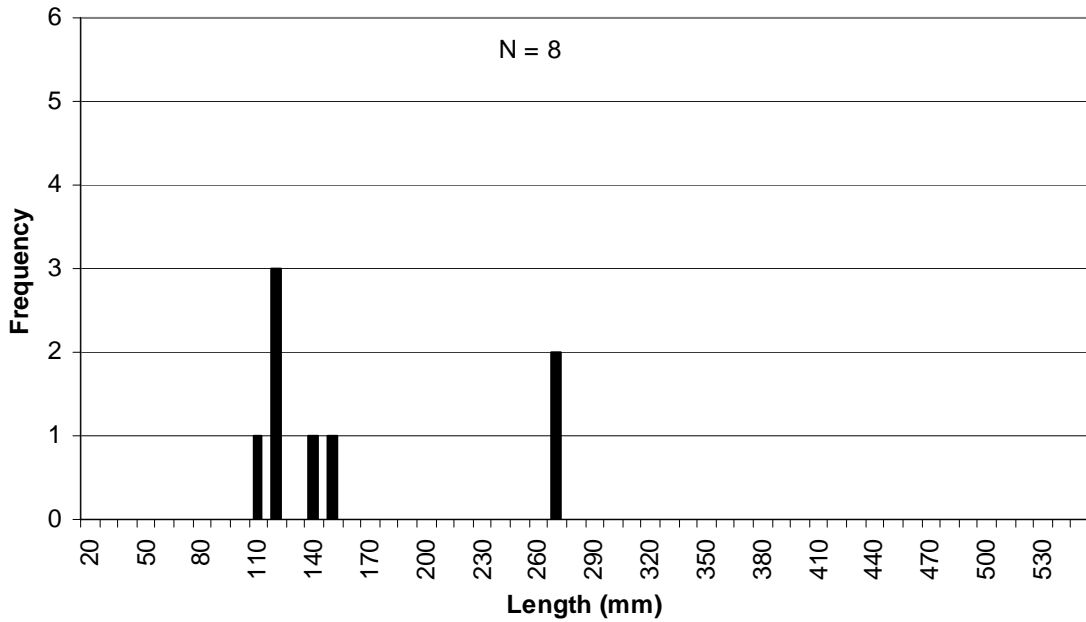
Warm Springs Creek @ River Mile 23.3
Brook Trout Size Distribution



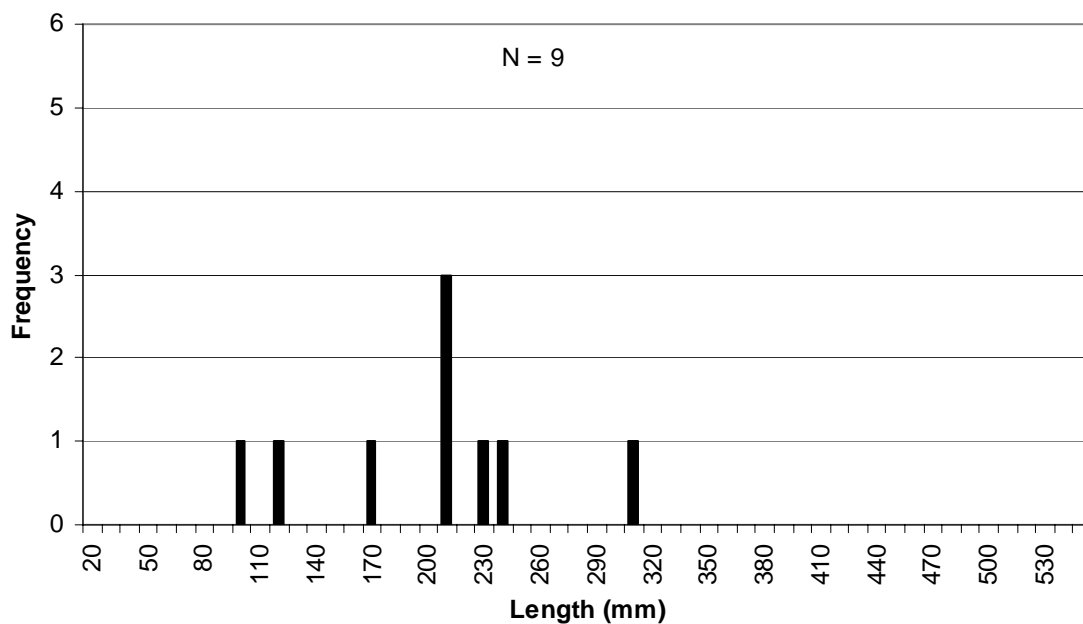
**Warm Springs Creek @ River Mile 27.4
Bull Trout Size Distribution**



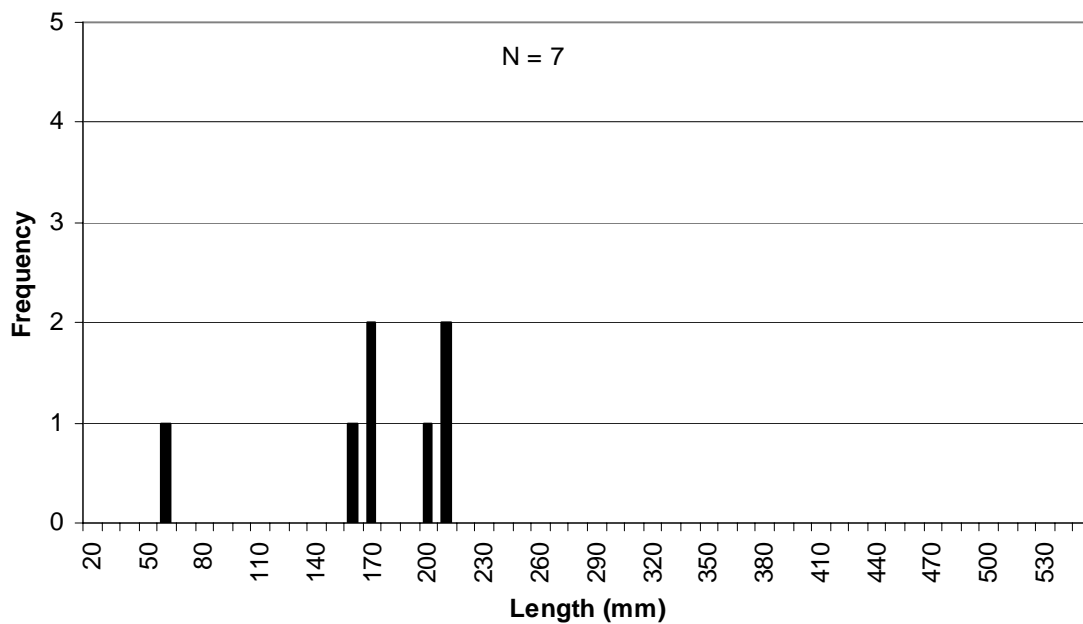
**Warm Springs Creek @ River Mile 27.4
Westslope Cutthroat Trout Size Distribution**



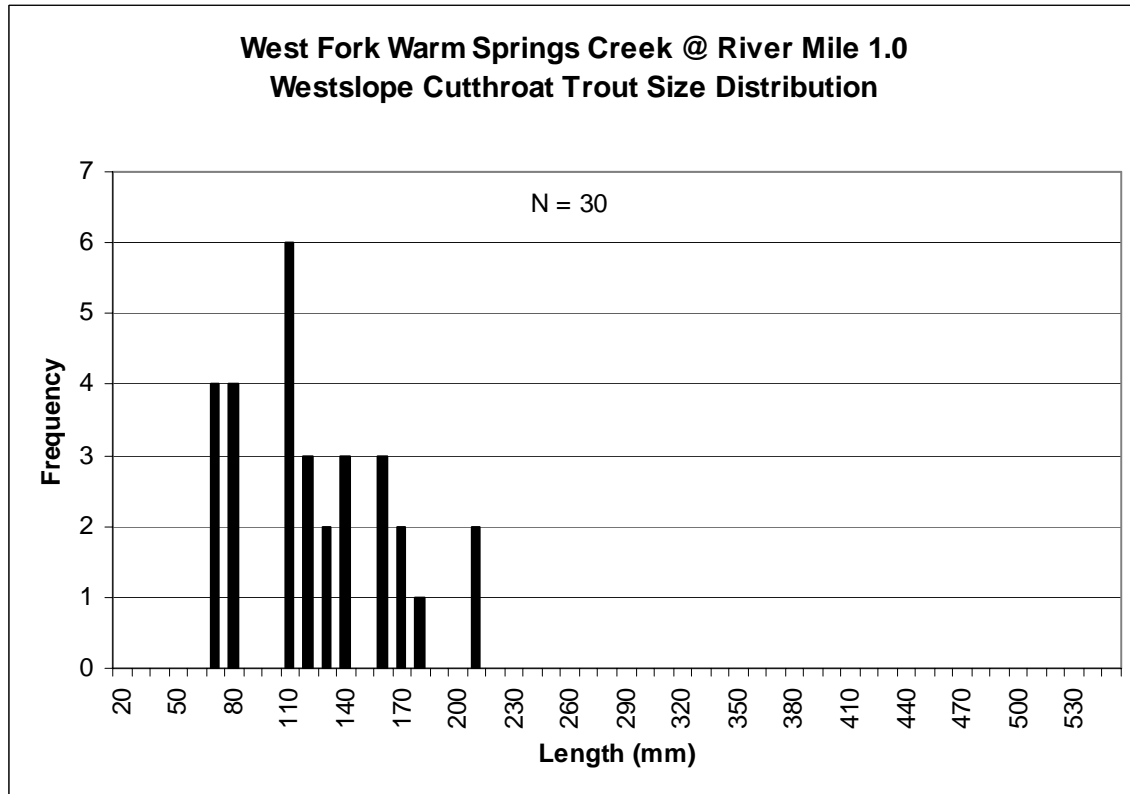
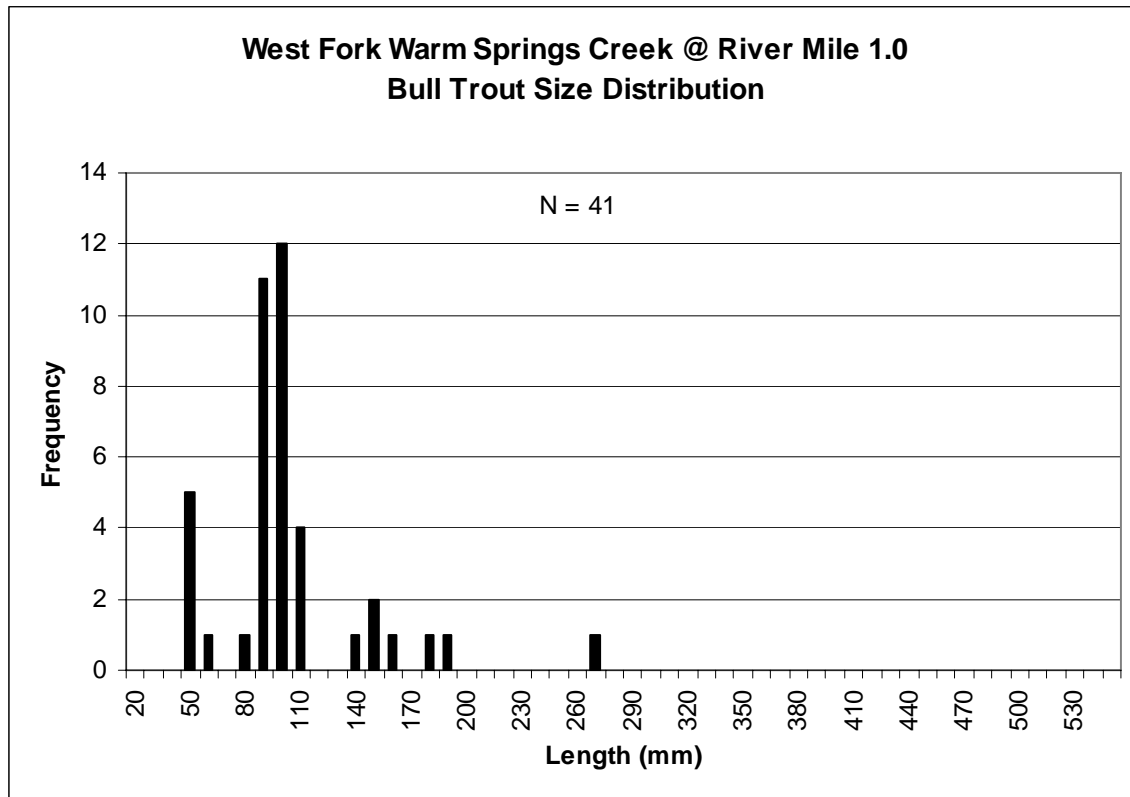
**Warm Springs Creek @ River Mile 27.4
Brook Trout Size Distribution**



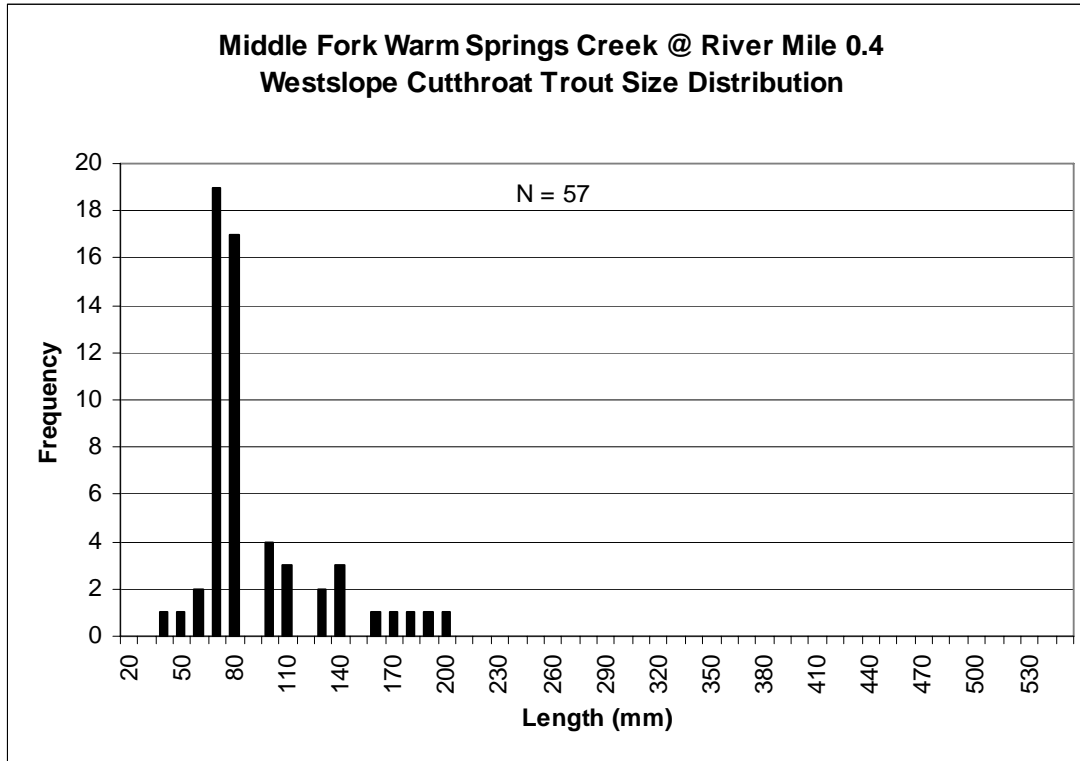
**Warm Springs Creek @ River Mile 29.1
Westslope Cutthroat Trout Size Distribution**



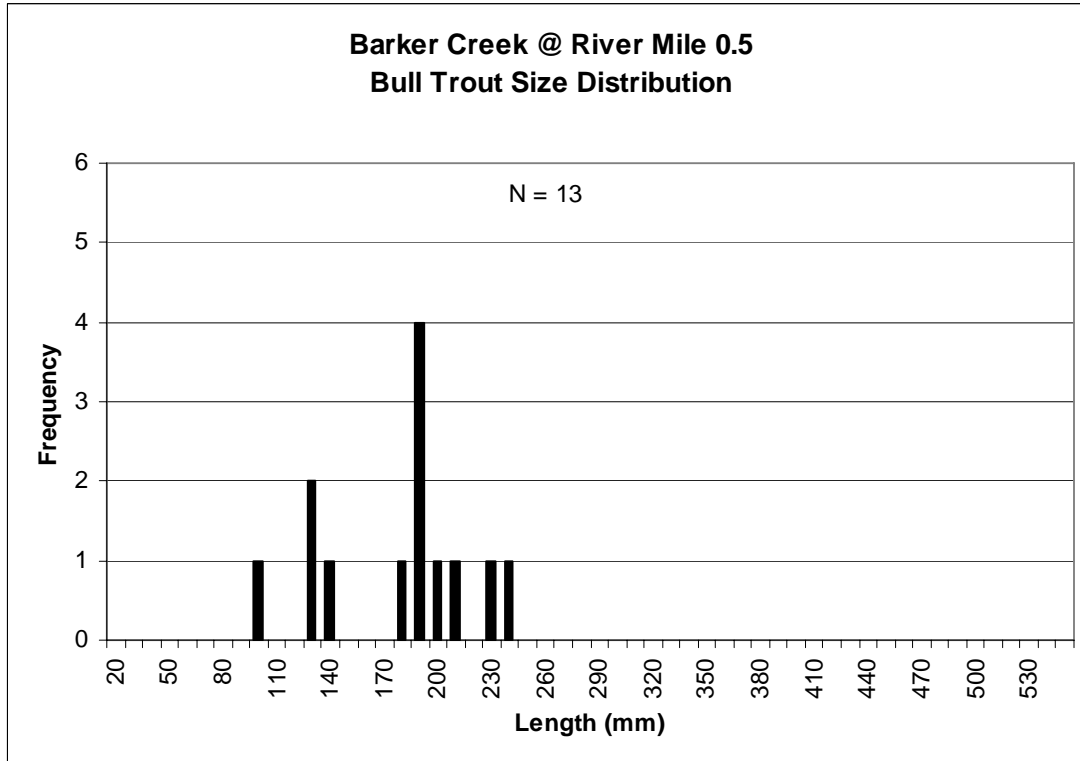
West Fork Warm Springs Creek



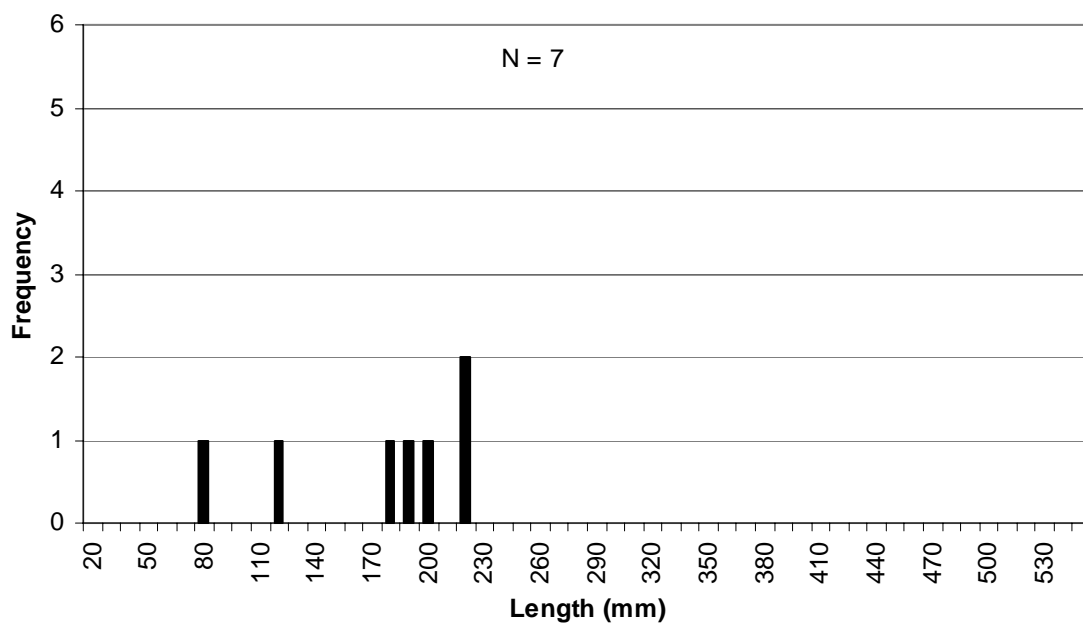
Middle Fork Warm Springs Creek



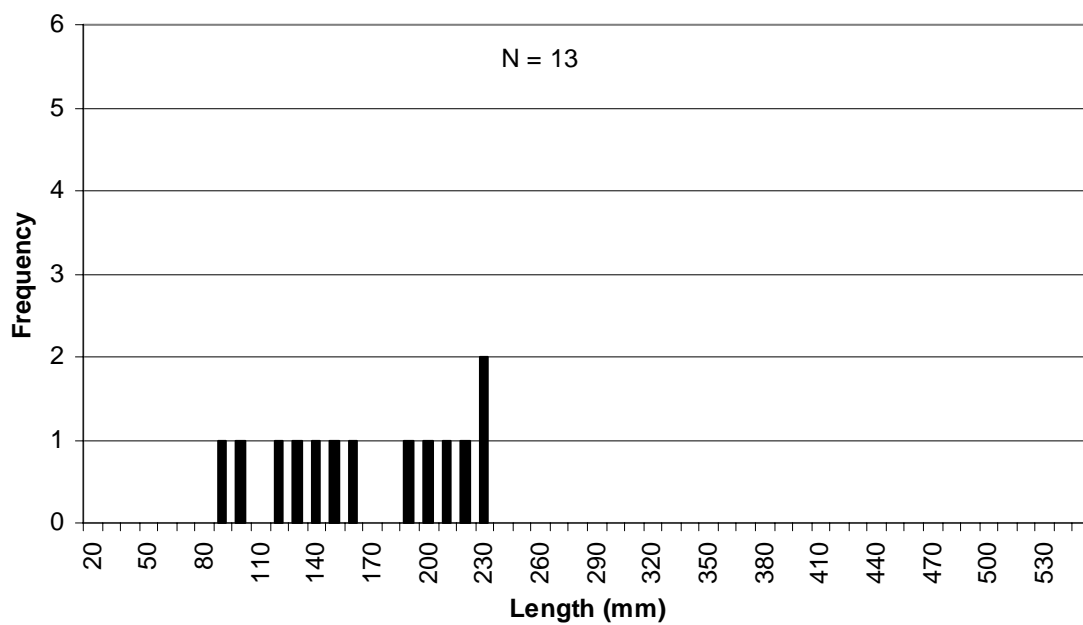
Barker Creek



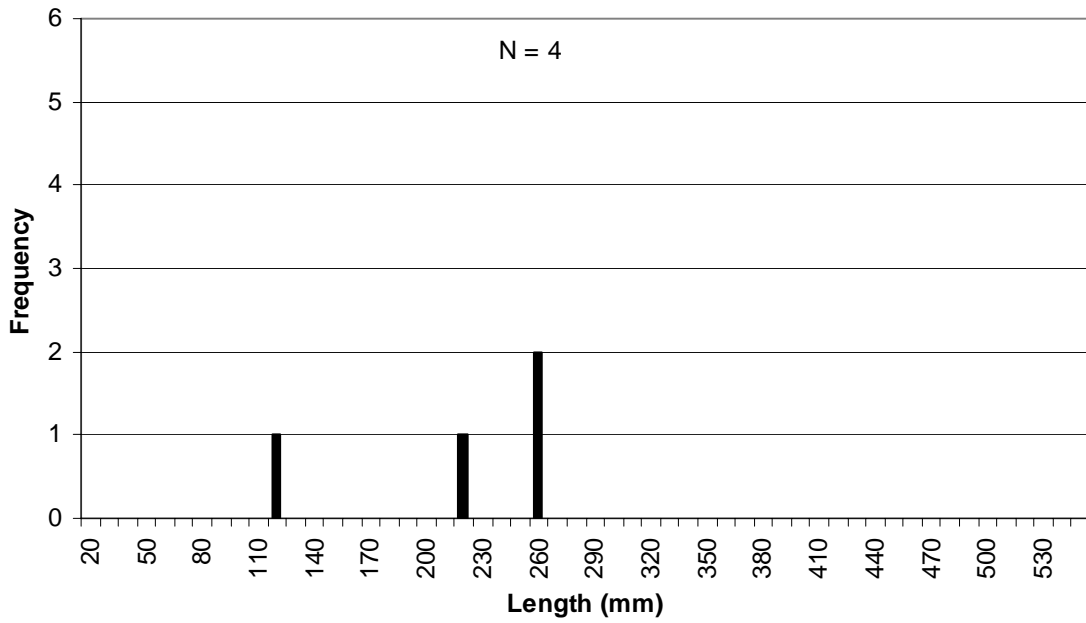
**Barker Creek @ River Mile 0.5
Westslope Cutthroat Trout Size Distribution**



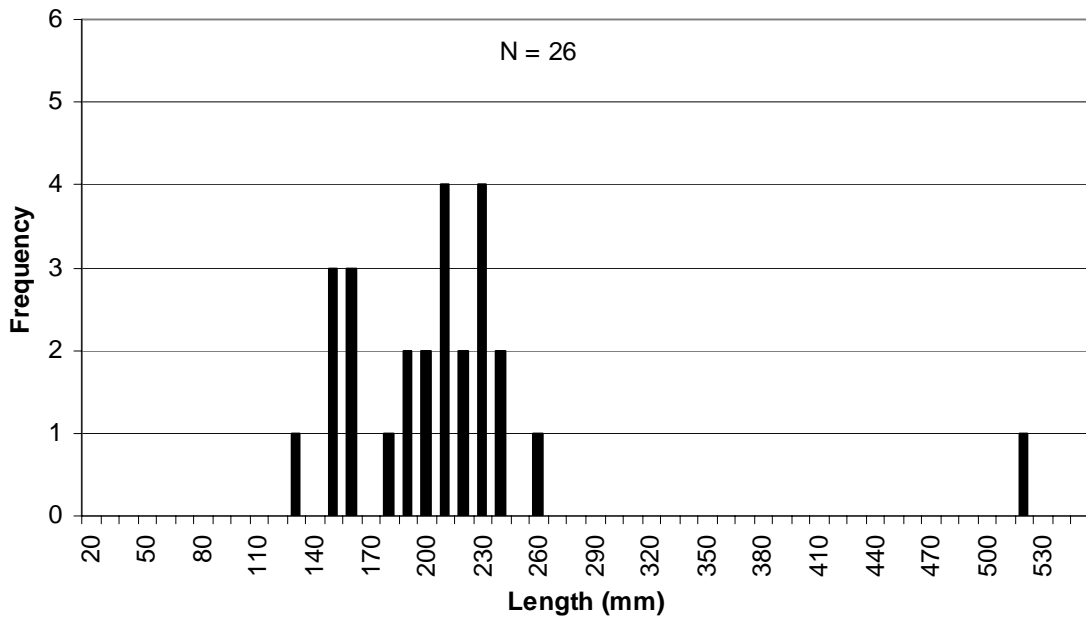
**Barker Creek @ River Mile 1.6
Bull Trout Size Distribution**

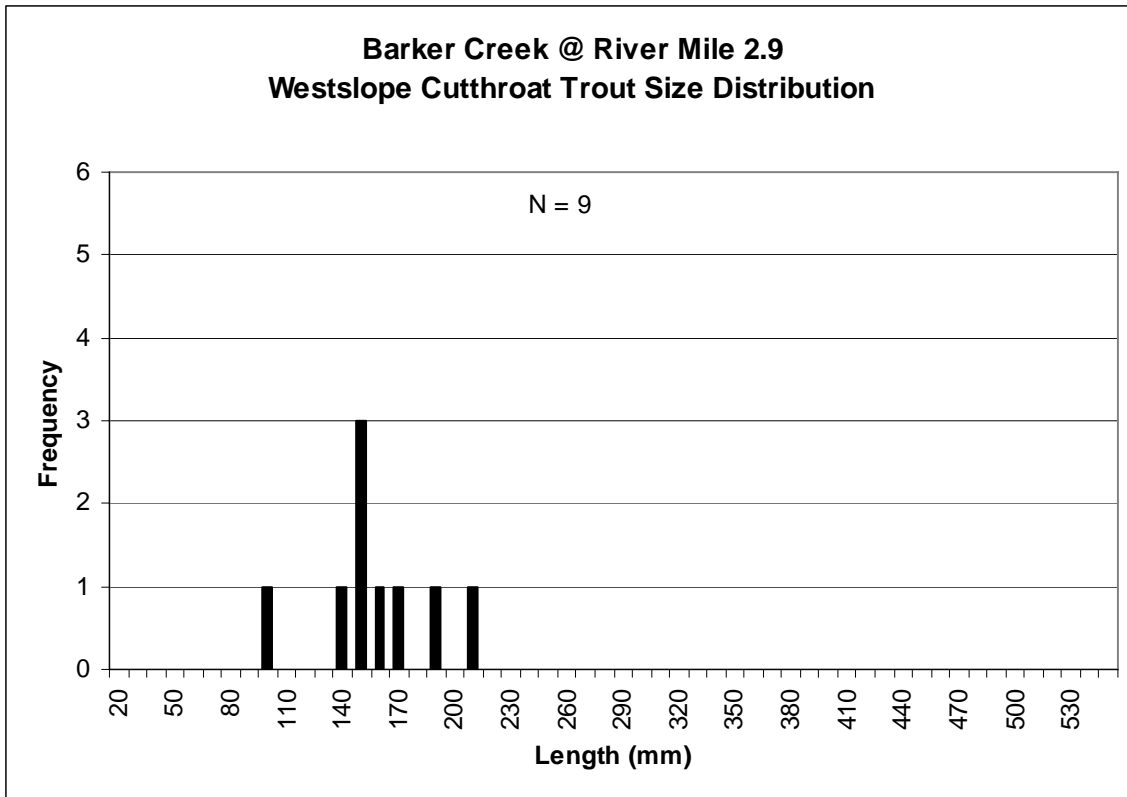


**Barker Creek @ River Mile 1.6
Oncorhynchus spp. Size Distribution**

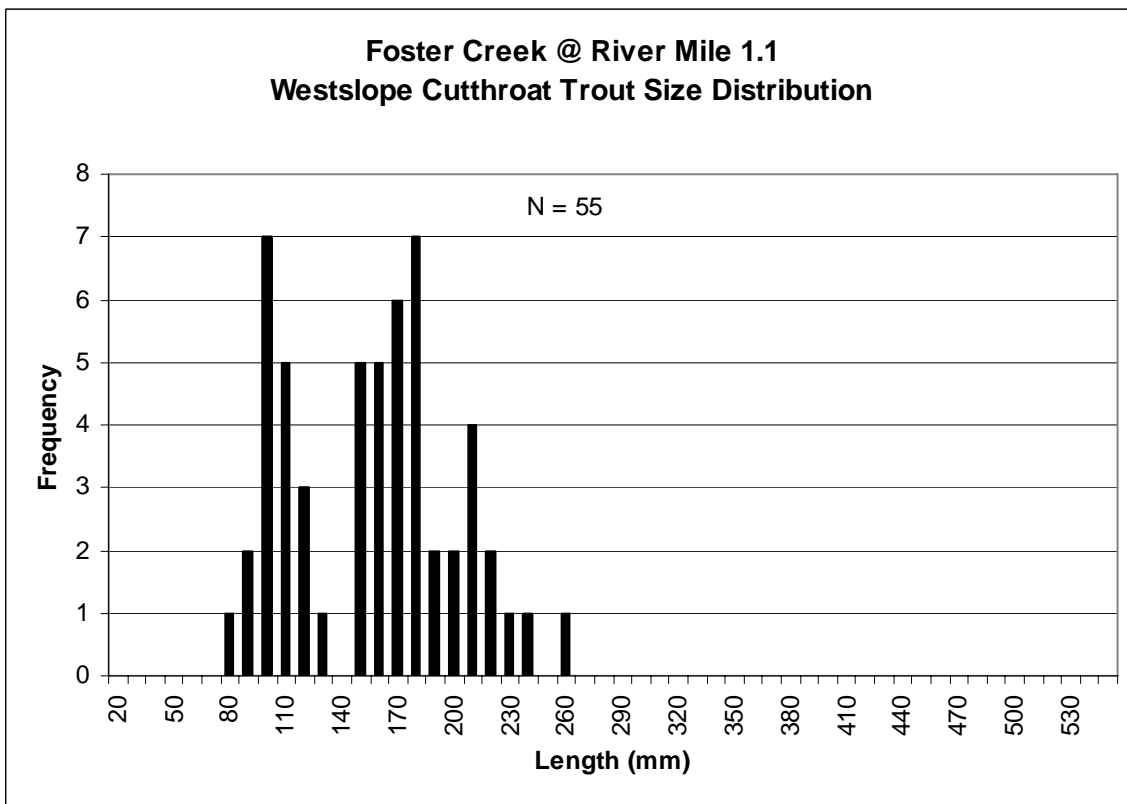


**Barker Creek @ River Mile 2.9
Bull Trout Size Distribution**

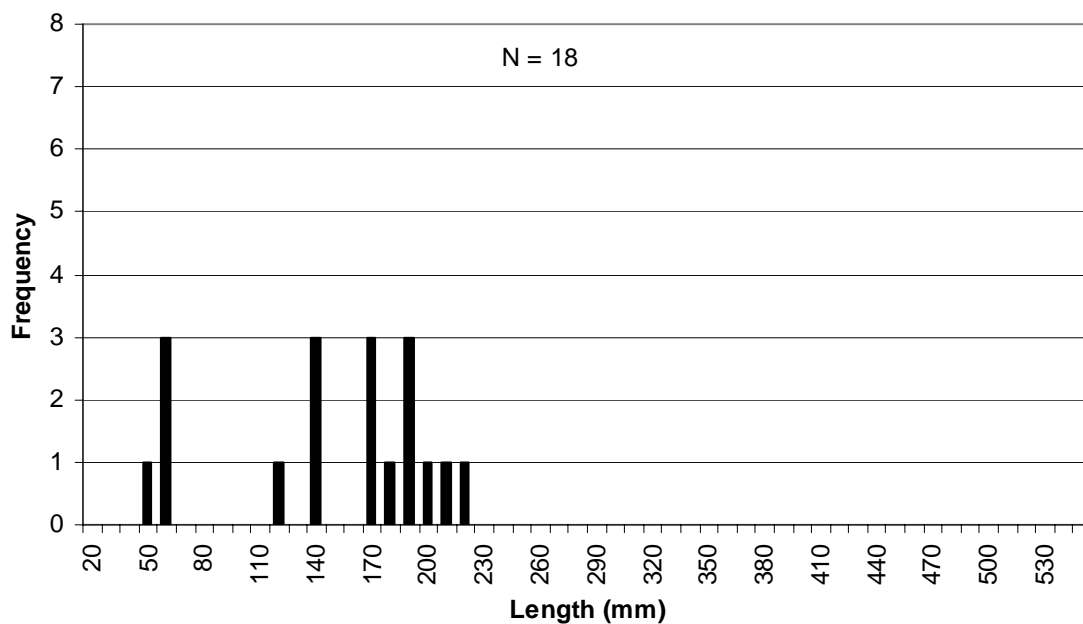




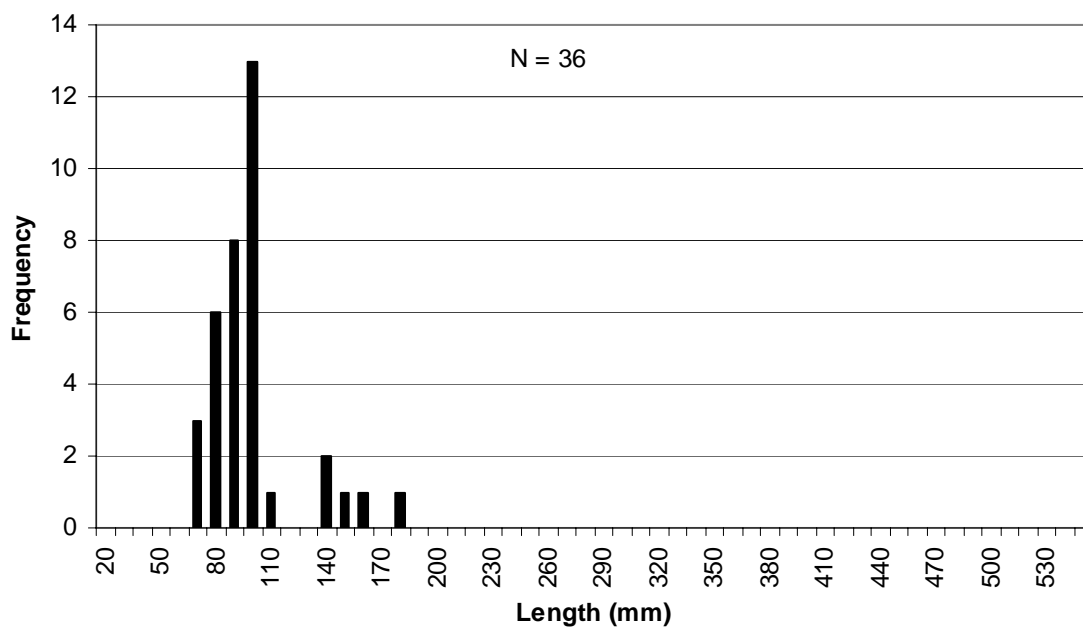
Foster Creek



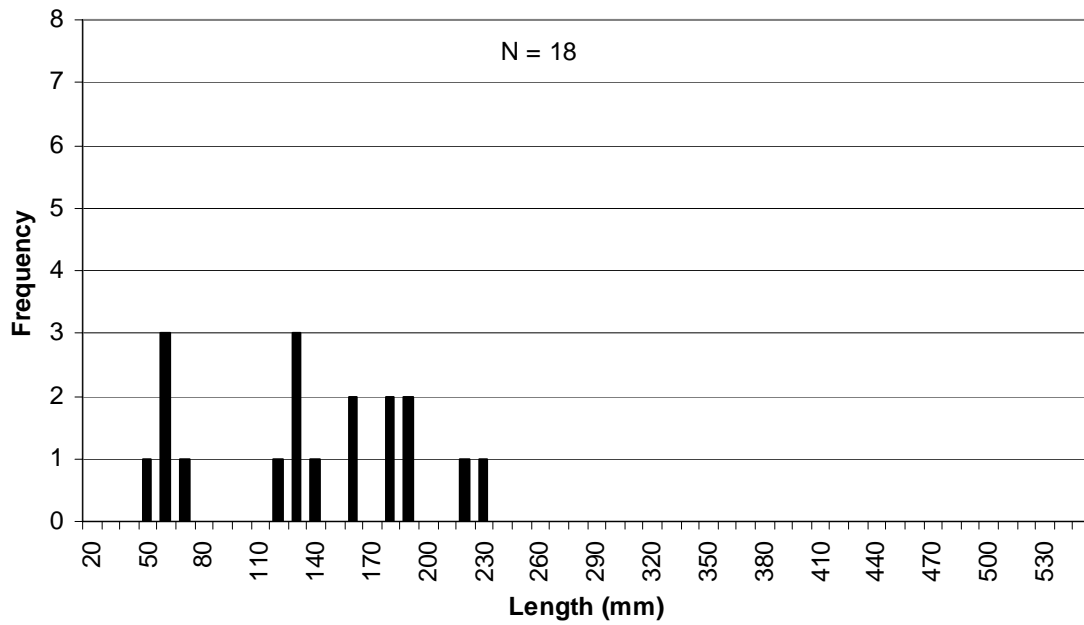
Foster Creek @ River Mile 1.1 Brook Trout Size Distribution



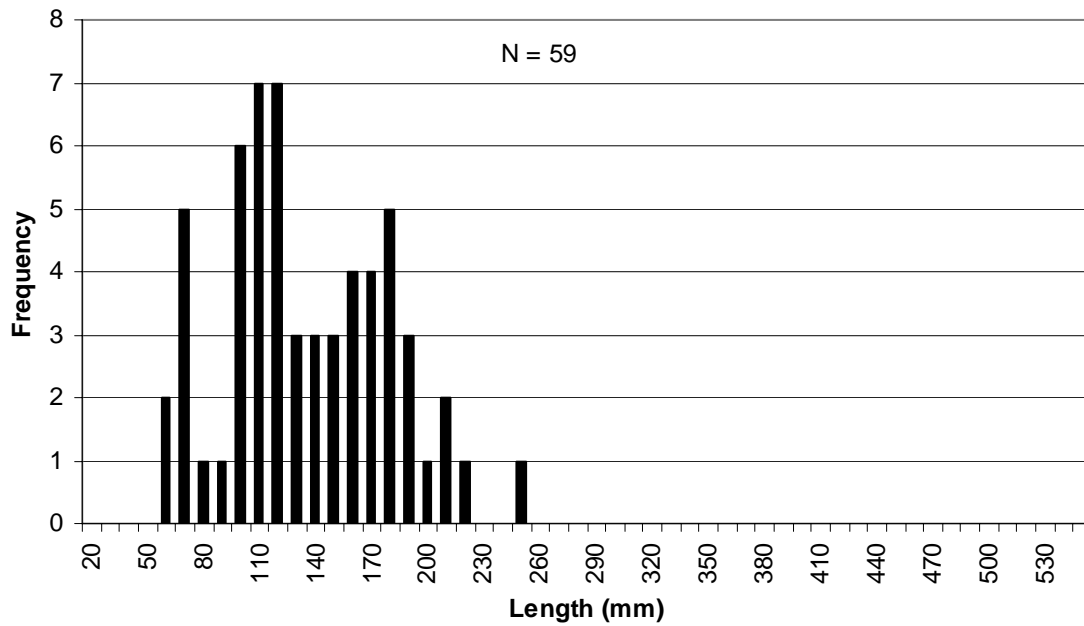
Foster Creek @ River Mile 2.3 Westslope Cutthroat Trout Size Distribution

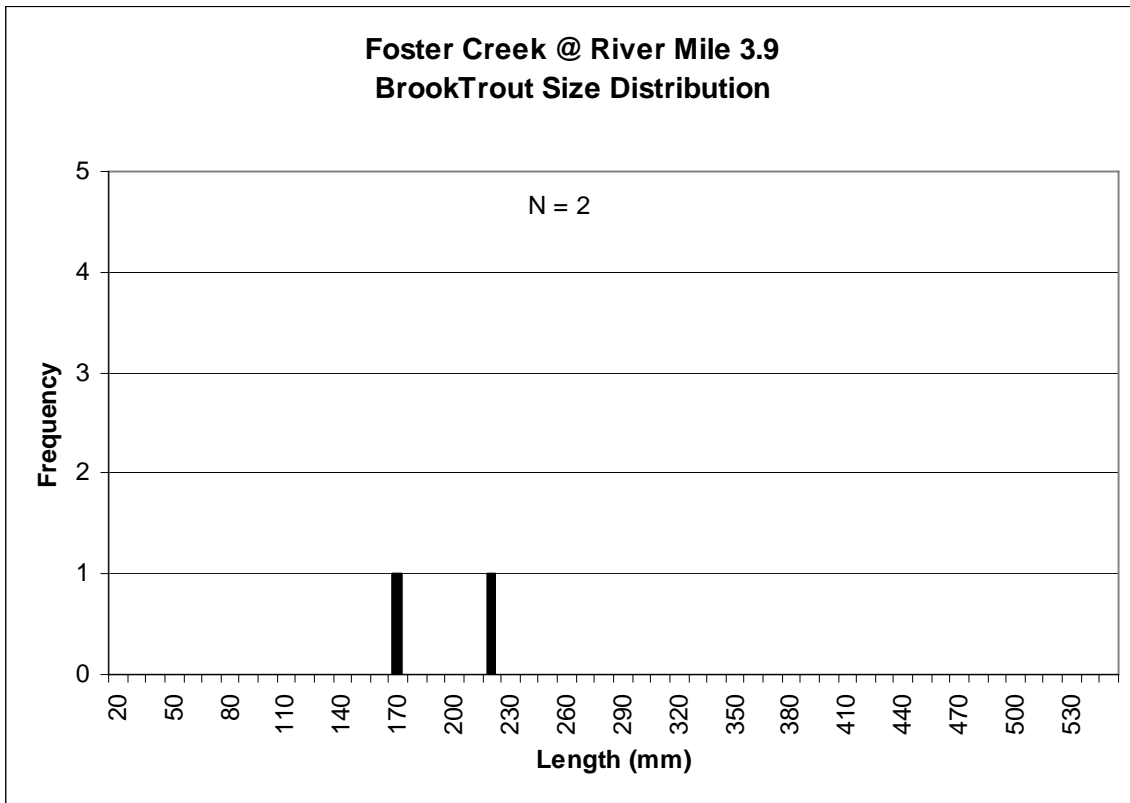


**Foster Creek @ River Mile 2.3
Brook Trout Size Distribution**

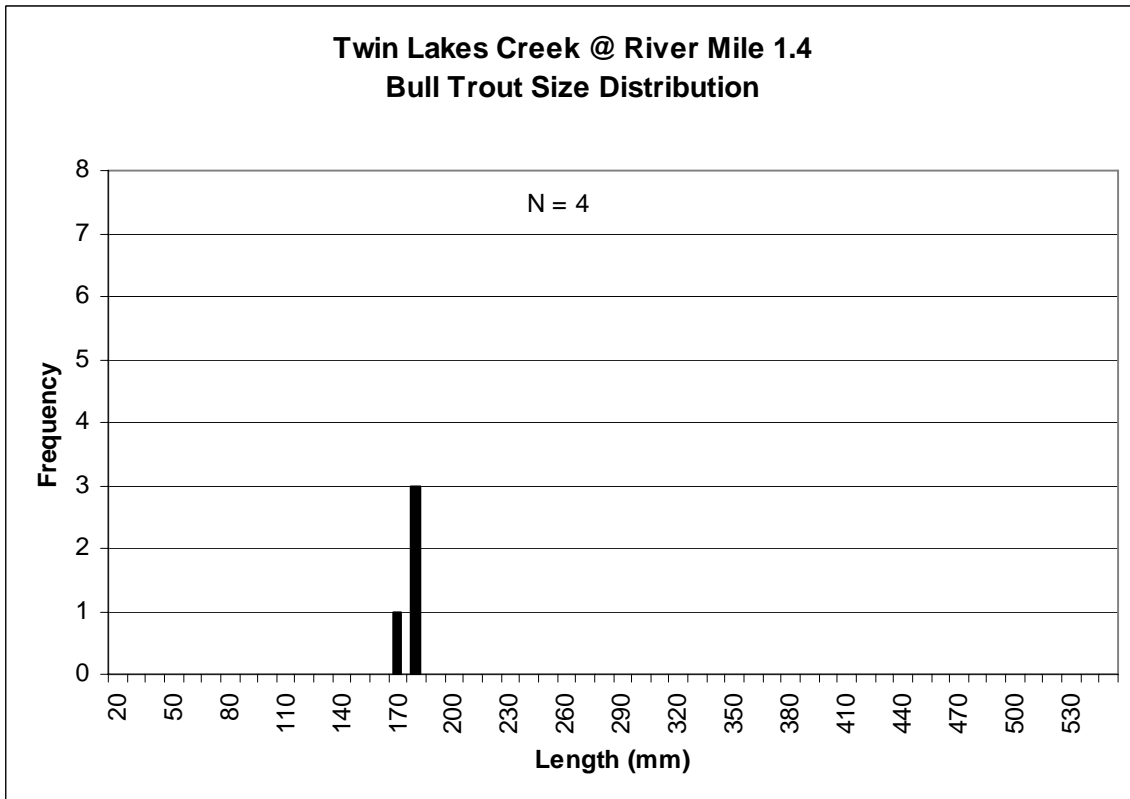


**Foster Creek @ River Mile 3.9
Westslope Cutthroat Trout Size Distribution**

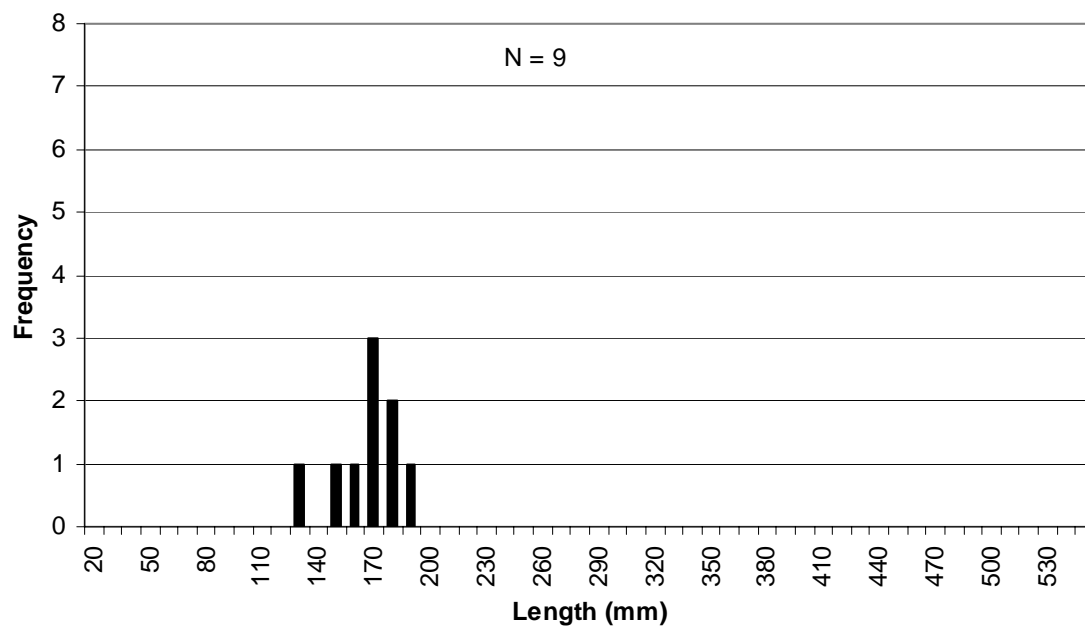




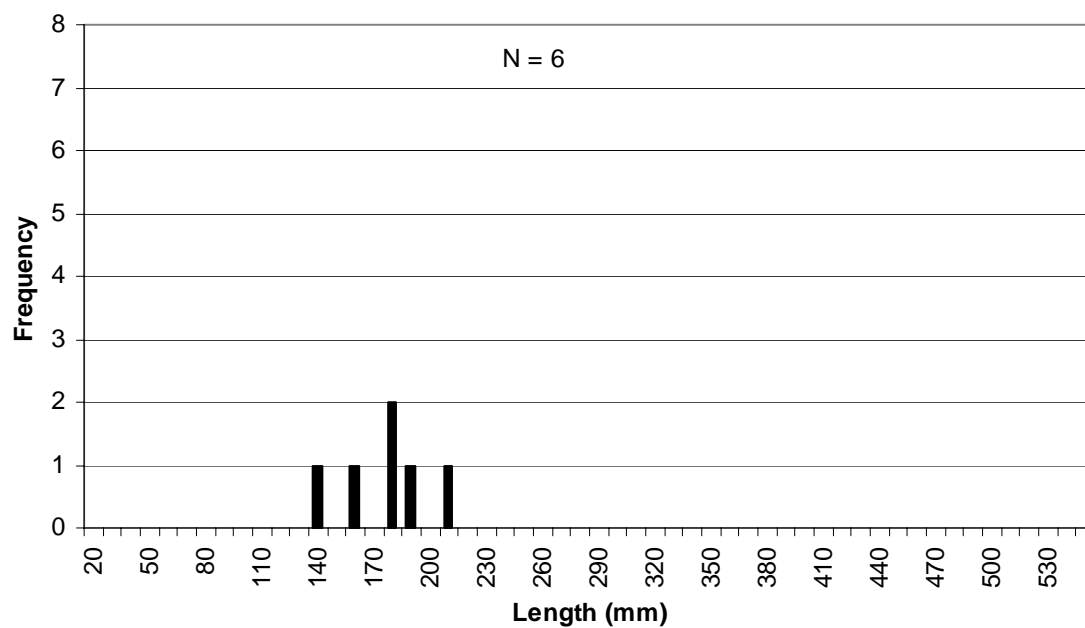
Twin Lakes Creek



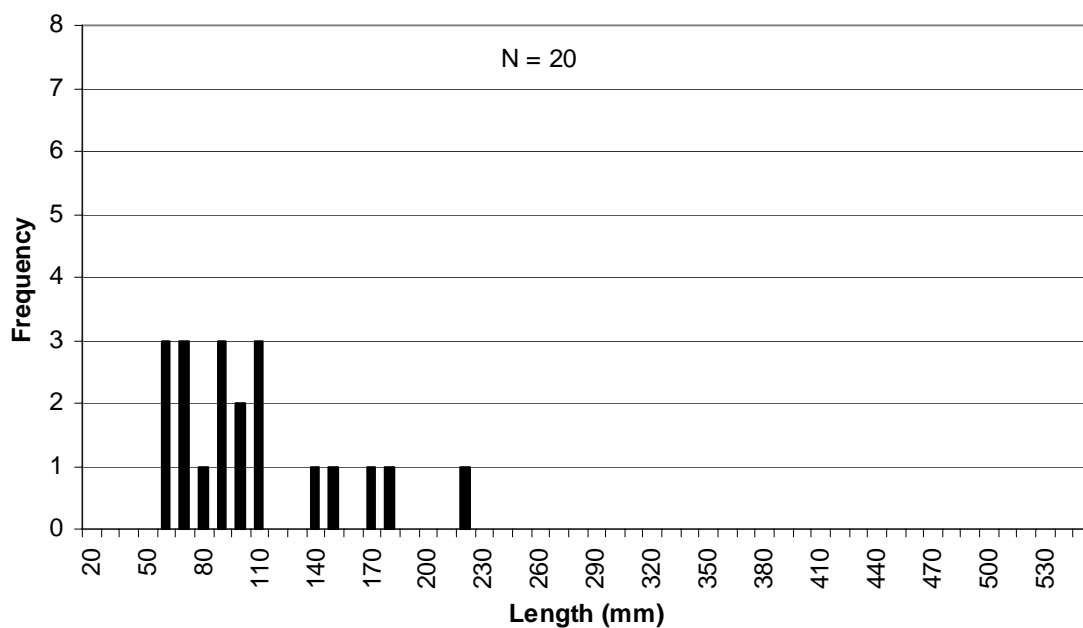
**Twin Lakes Creek @ River Mile 1.4
Westslope Cutthroat Trout Size Distribution**



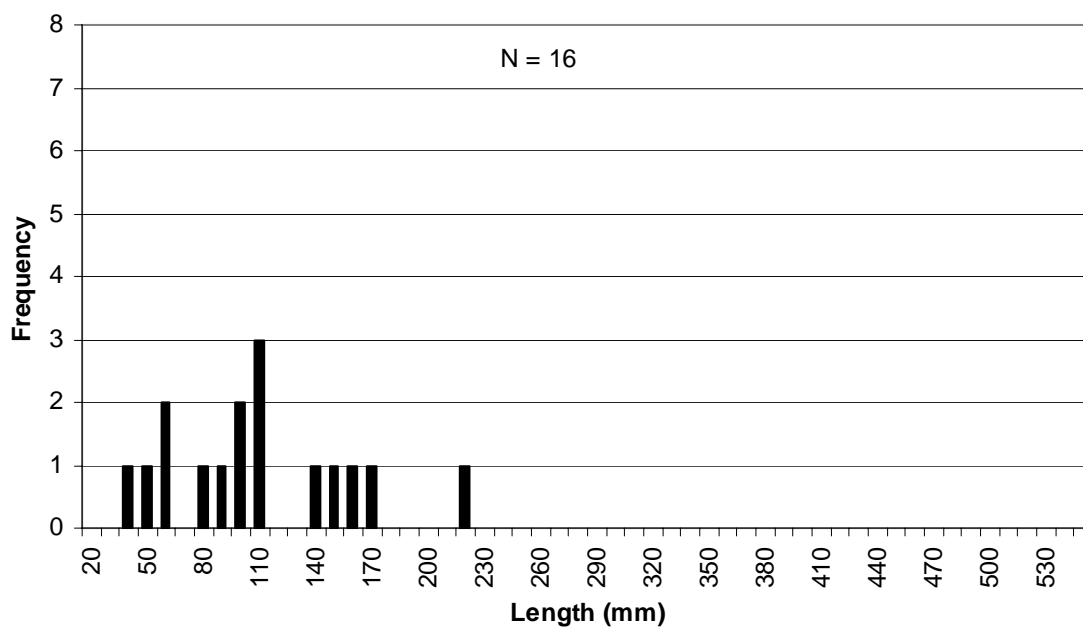
**Twin Lakes Creek @ River Mile 1.4
Brook Trout Size Distribution**



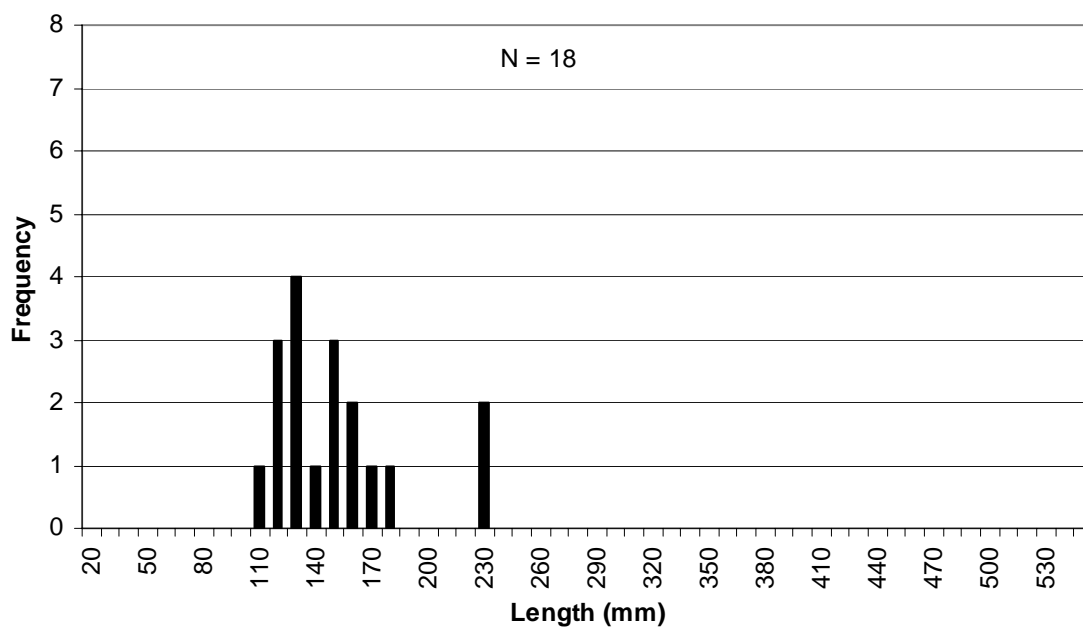
**Twin Lakes Creek @ River Mile 2.8
Westslope Cutthroat Trout Size Distribution**



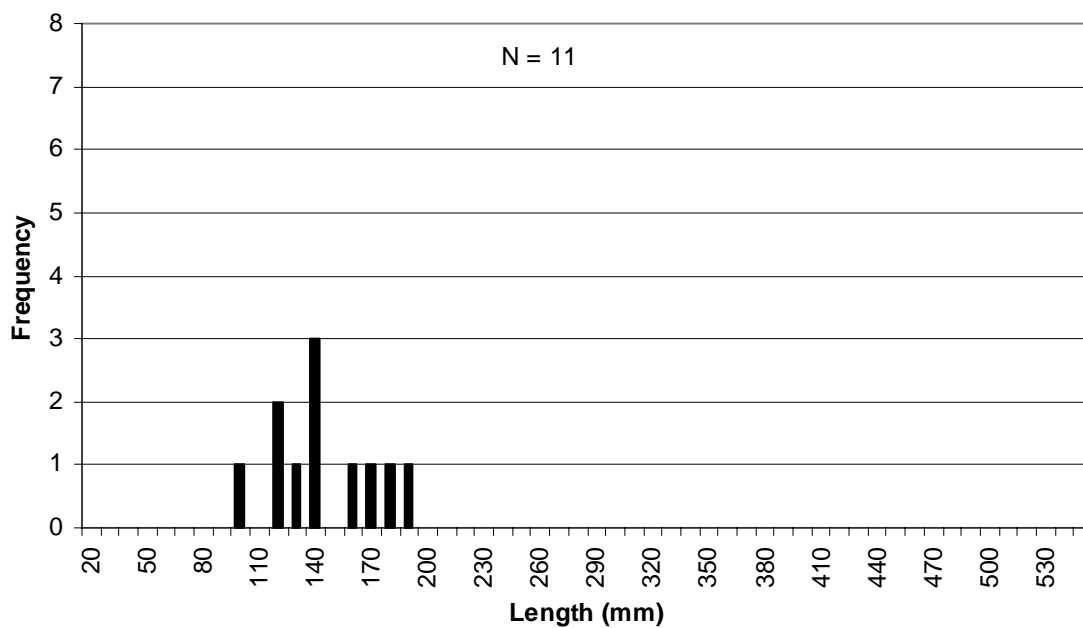
**Twin Lakes Creek @ River Mile 2.8
Brook Trout Size Distribution**



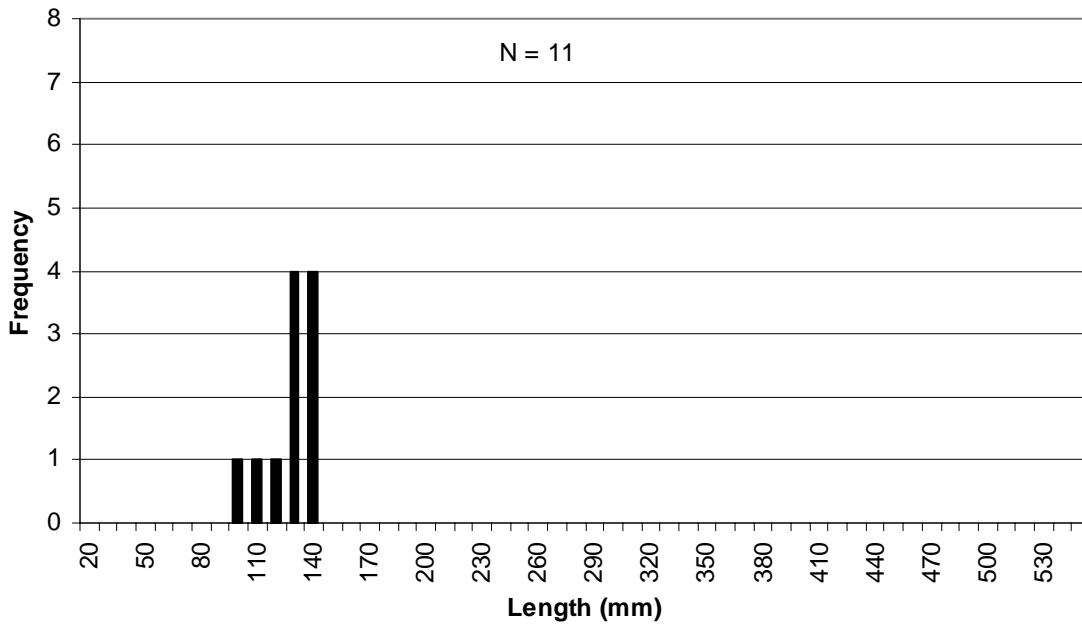
**Twin Lakes Creek @ River Mile 4.7
Westslope Cutthroat Trout Size Distribution**



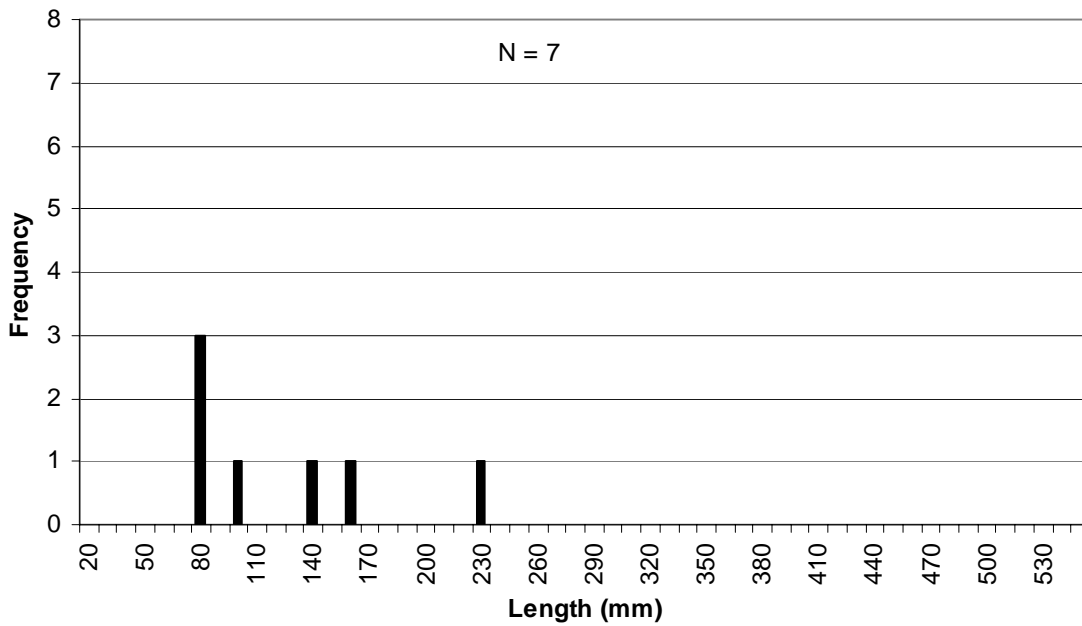
**Twin Lakes Creek @ River Mile 4.7
Brook Trout Size Distribution**



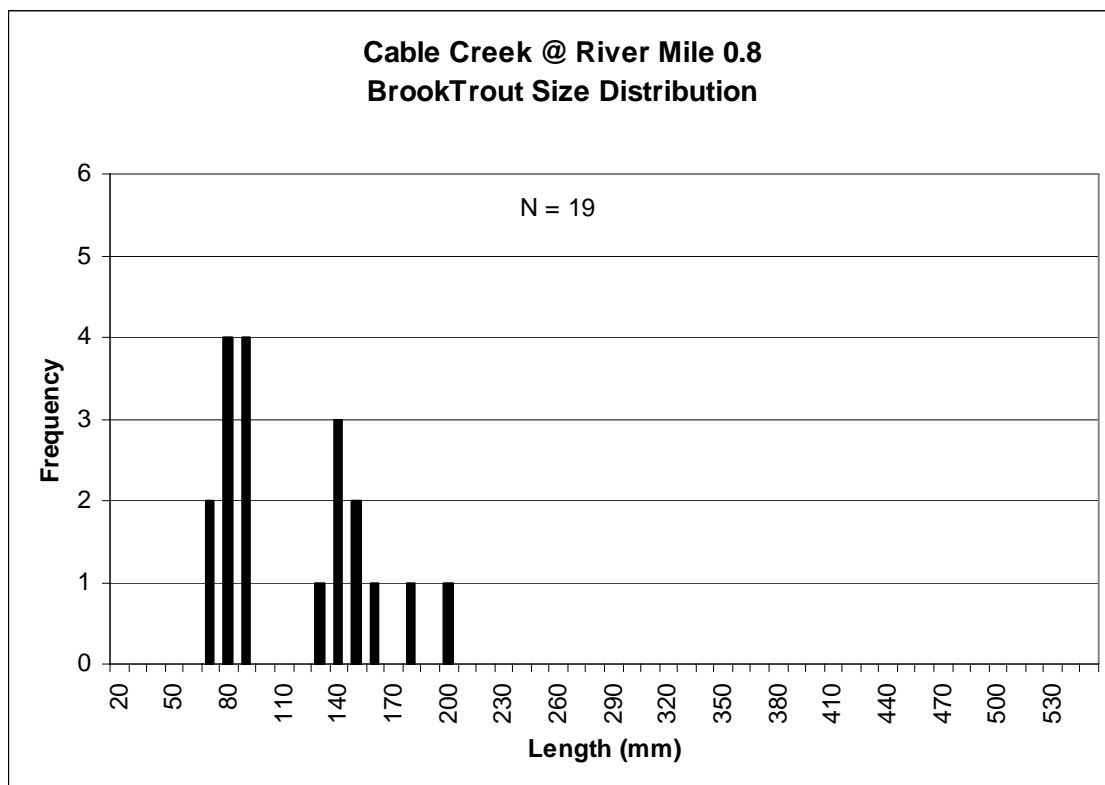
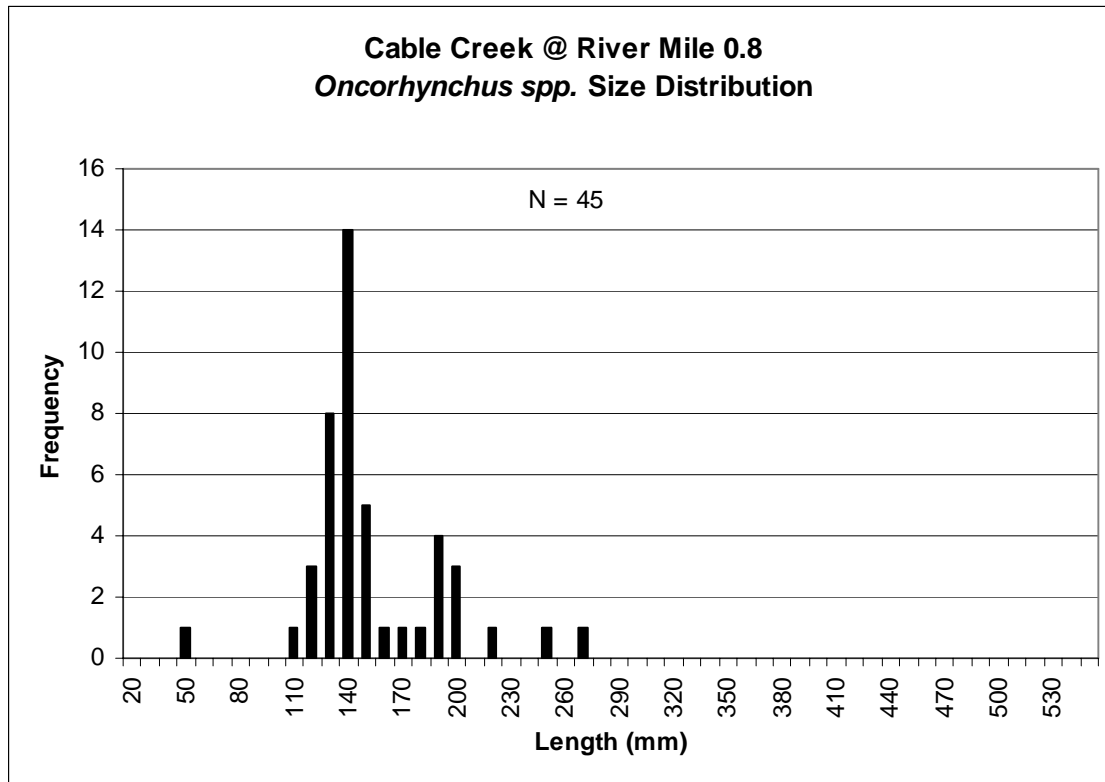
**Twin Lakes Creek @ River Mile 7.2
Westslope Cutthroat Trout Size Distribution**

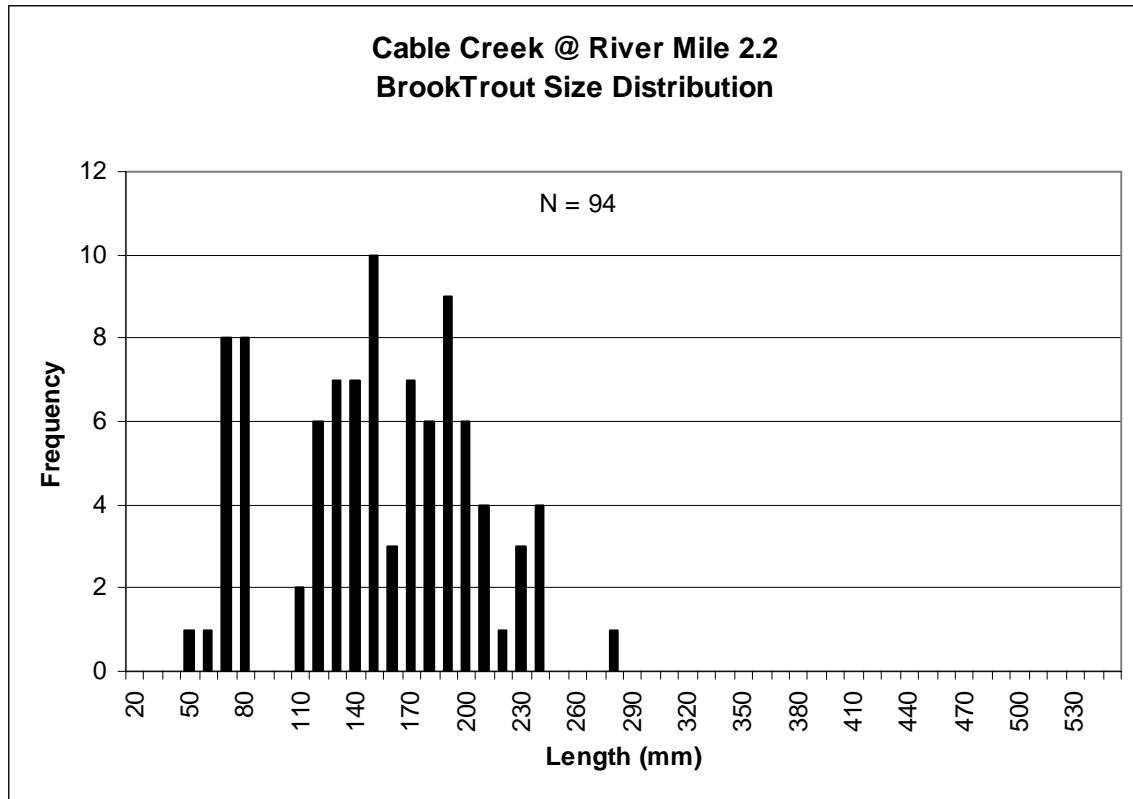


**Twin Lakes Creek @ River Mile 7.2
Brook Trout Size Distribution**

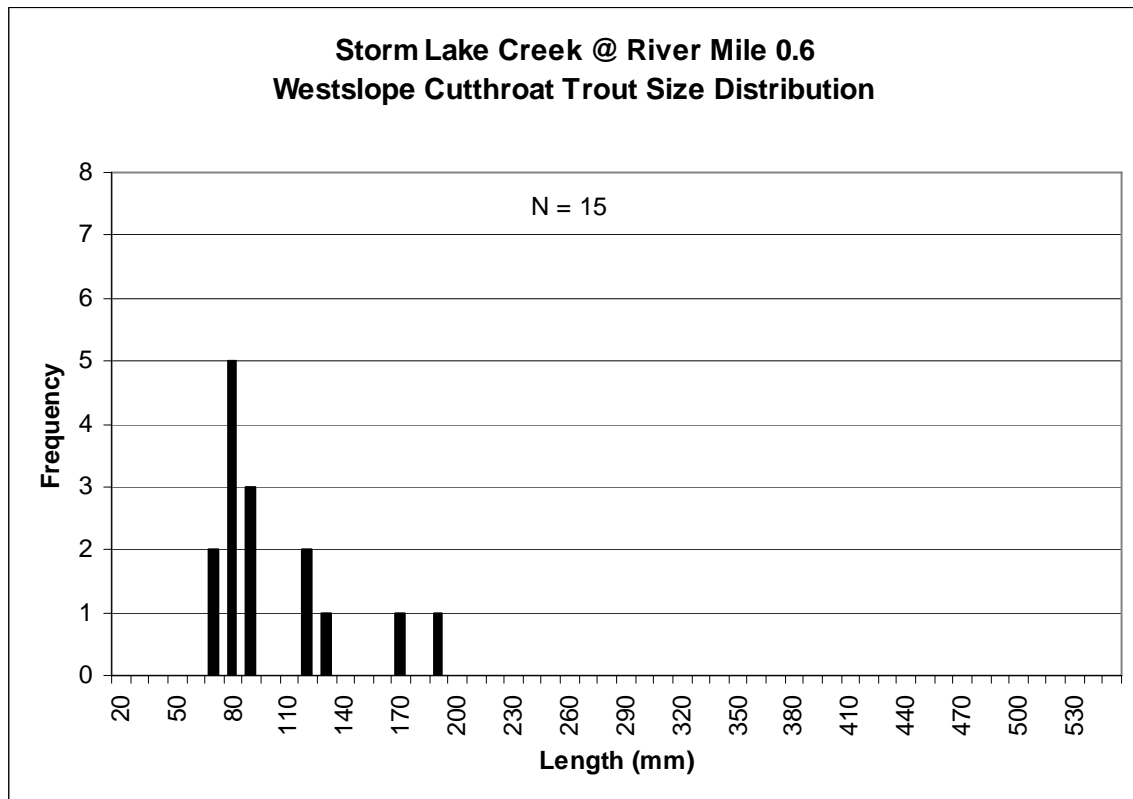


Cable Creek

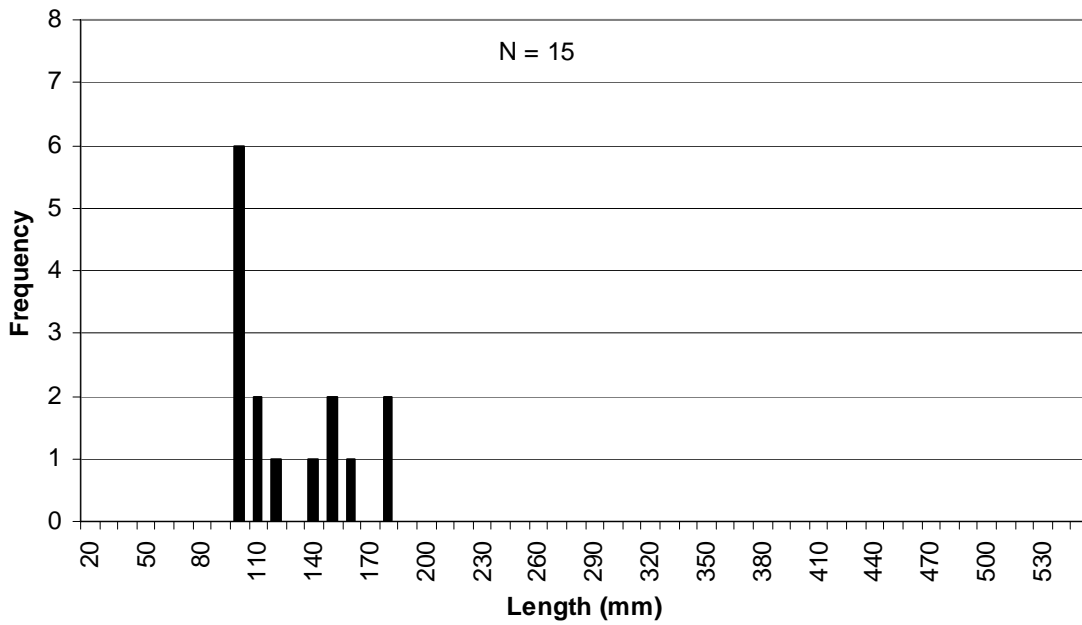




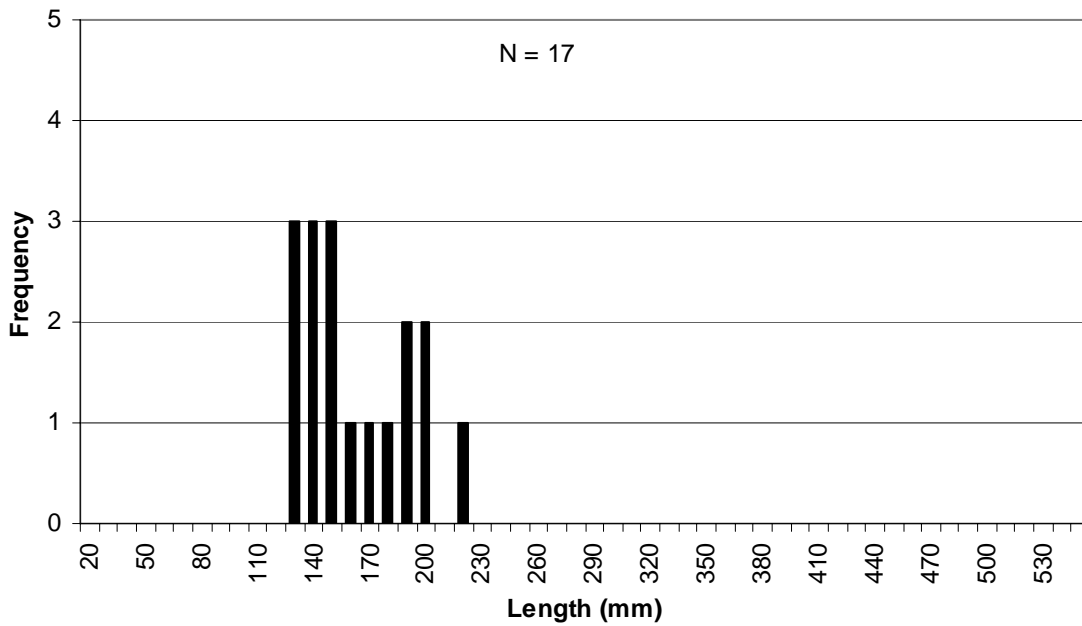
Storm Lake Creek

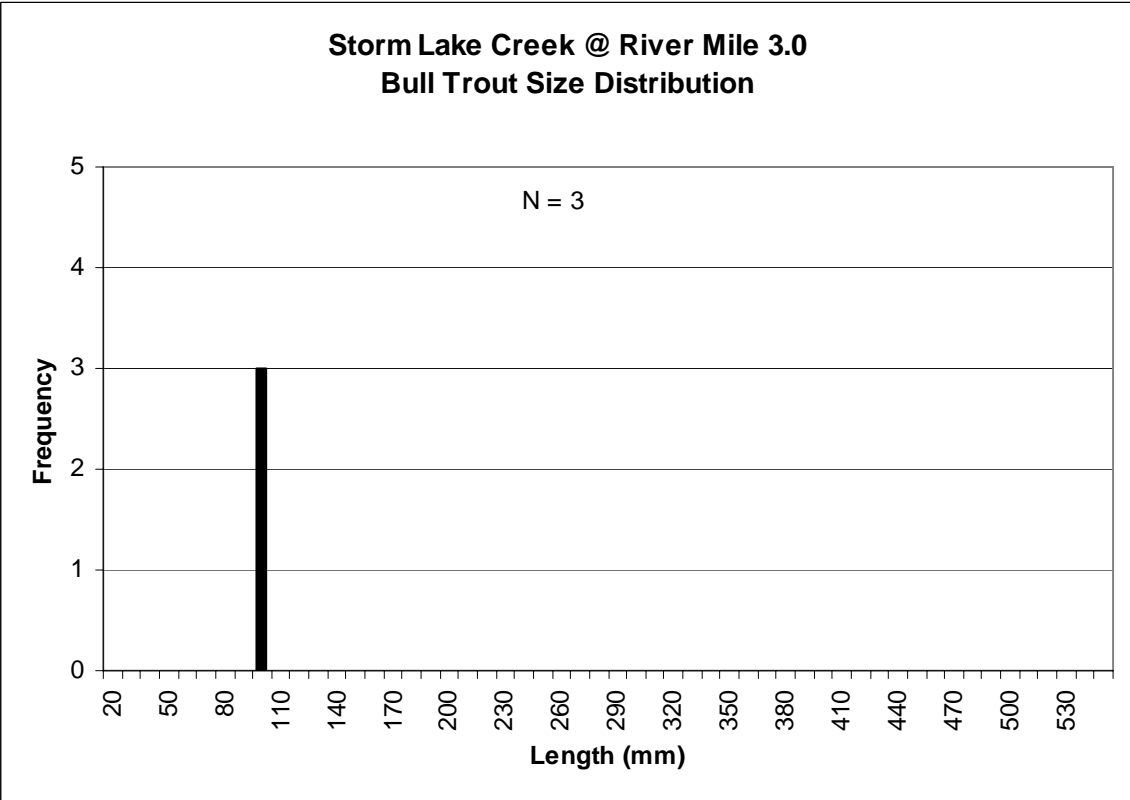
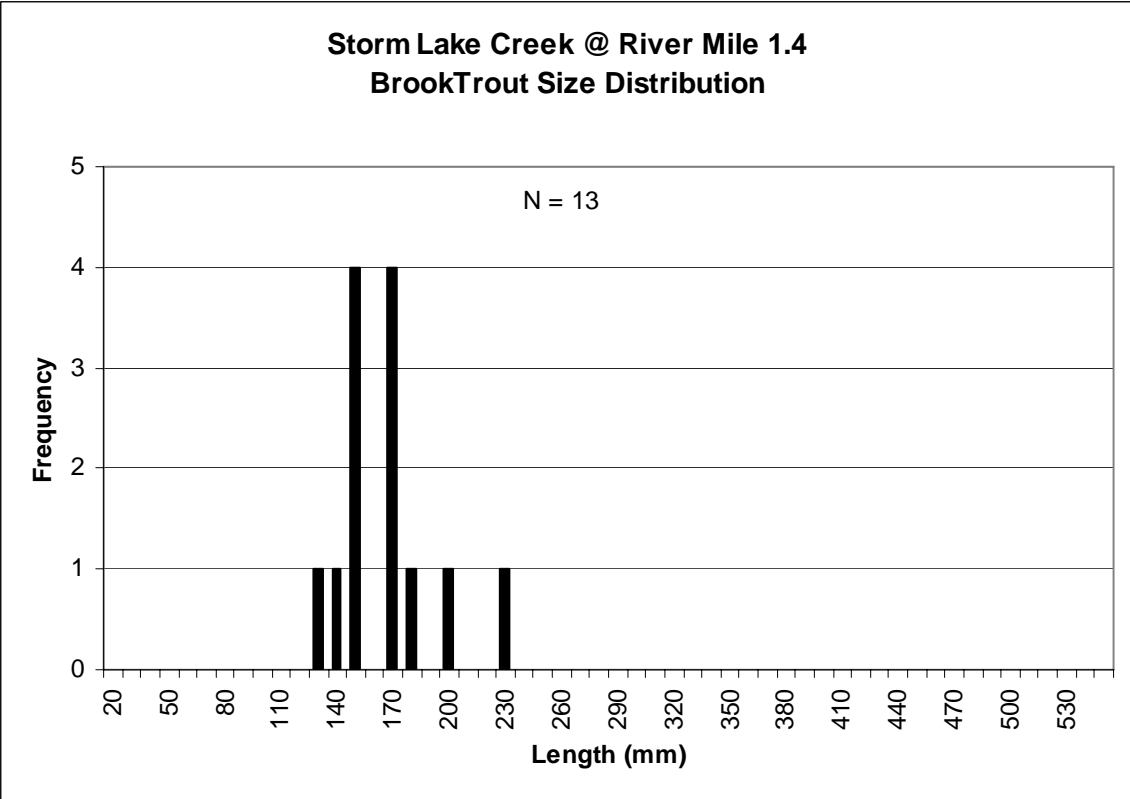


**Storm Lake Creek @ River Mile 0.6
Brook Trout Size Distribution**

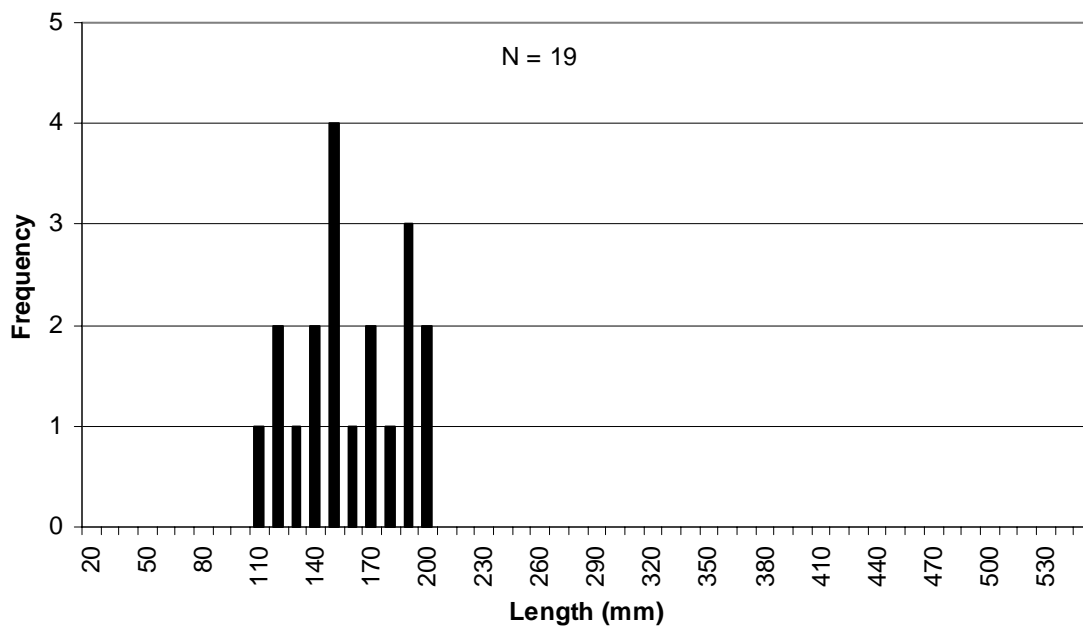


**Storm Lake Creek @ River Mile 1.4
Westslope Cutthroat Trout Size Distribution**

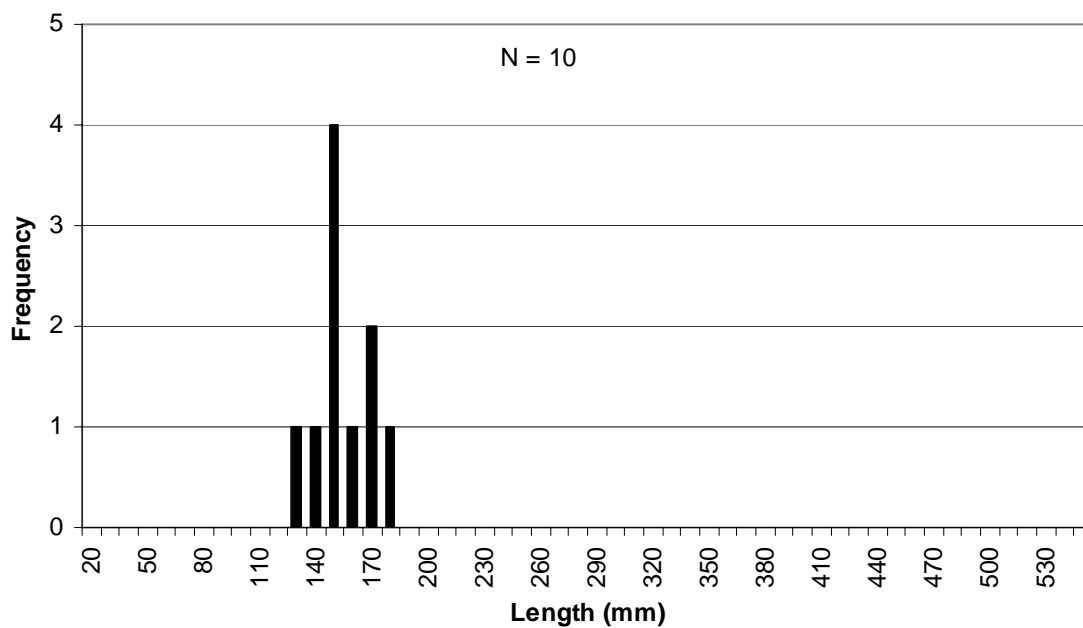




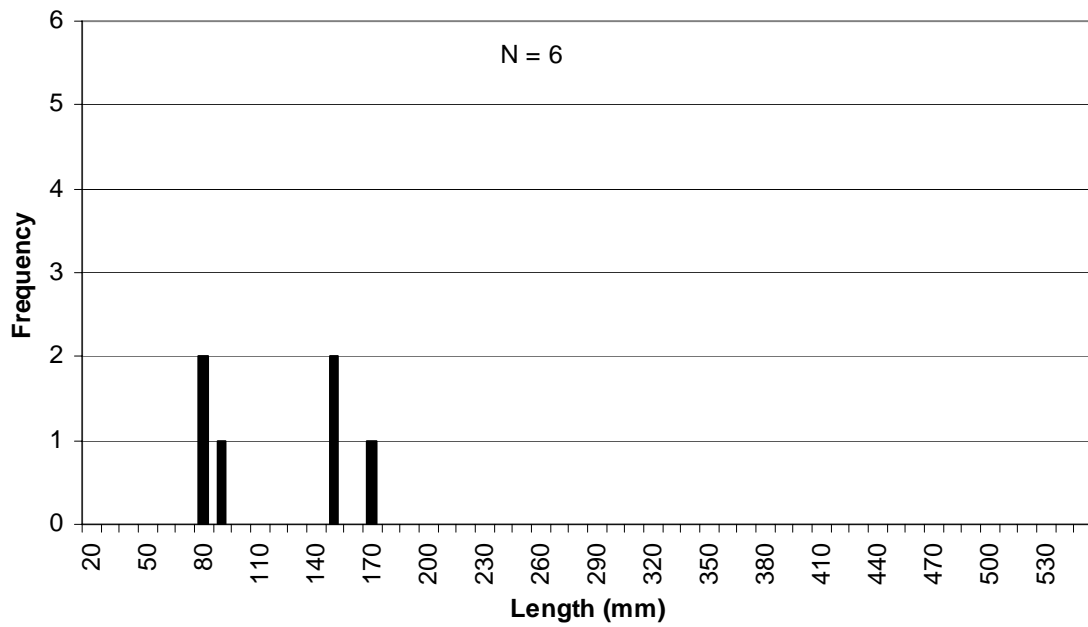
**Storm Lake Creek @ River Mile 3.0
Westslope Cutthroat Trout Size Distribution**



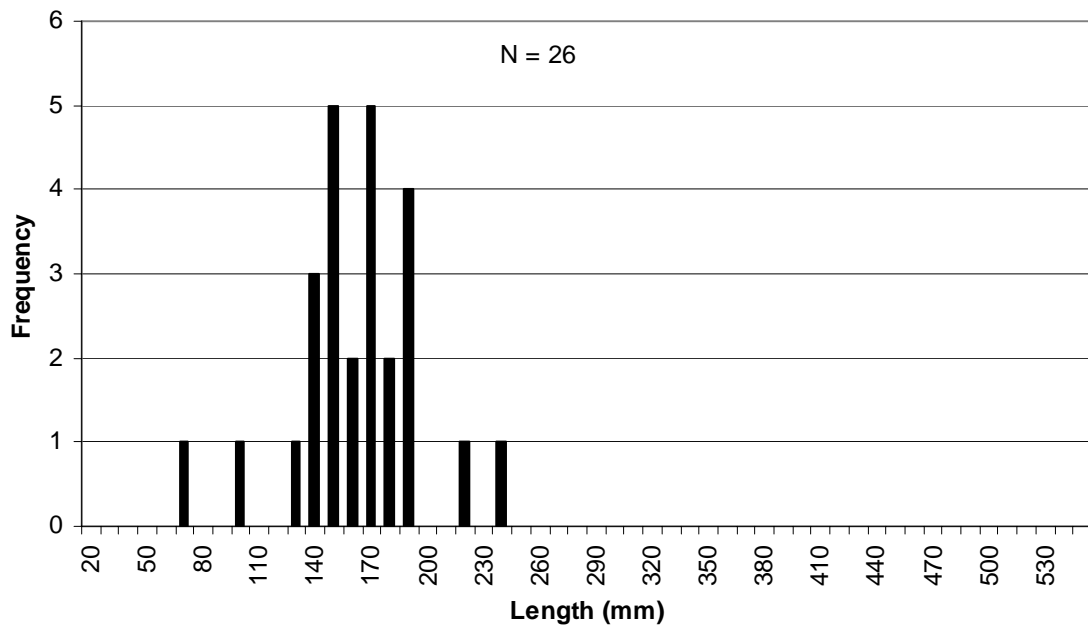
**Storm Lake Creek @ River Mile 3.0
Brook Trout Size Distribution**



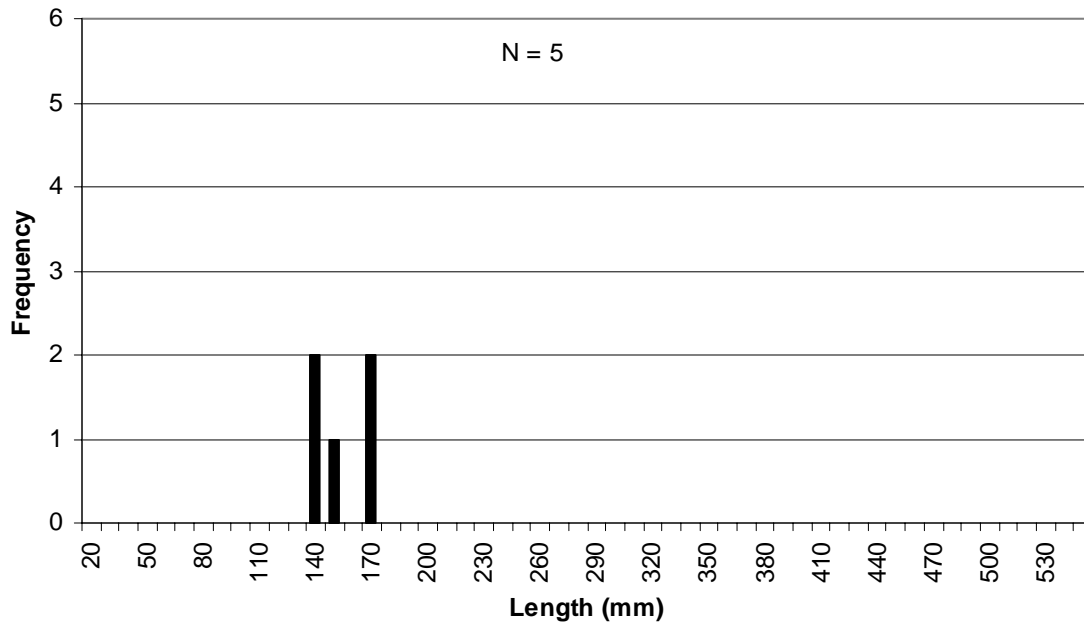
**Storm Lake Creek @ River Mile 4.2
Bull Trout Size Distribution**



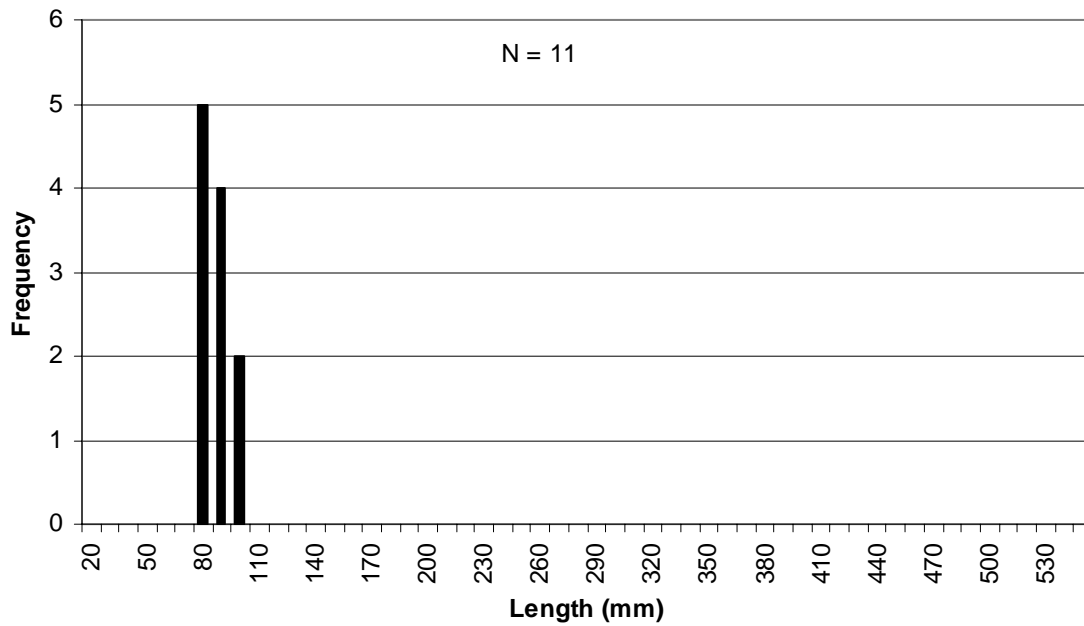
**Storm Lake Creek @ River Mile 4.2
Westslope Cutthroat Trout Size Distribution**



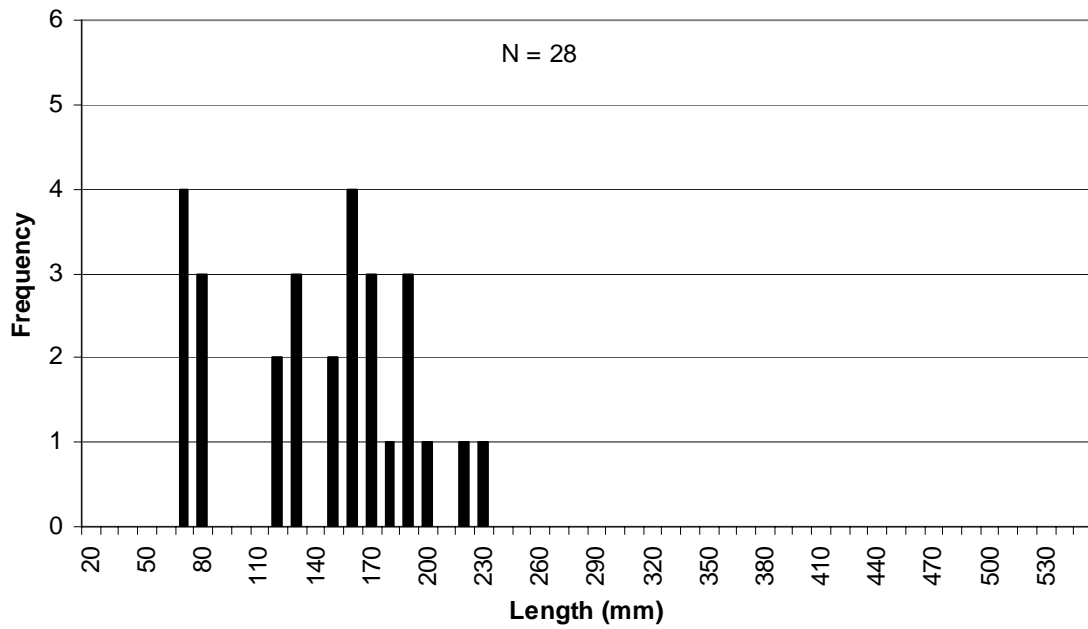
**Storm Lake Creek @ River Mile 4.2
Brook Trout Size Distribution**



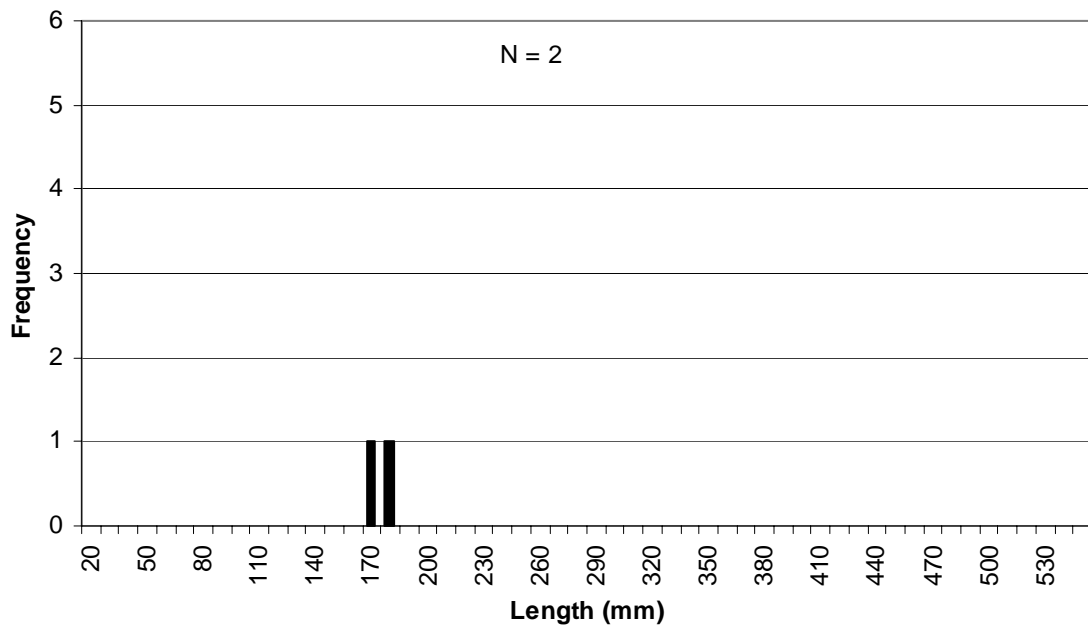
**Storm Lake Creek @ River Mile 6.3
Bull Trout Size Distribution**



**Storm Lake Creek @ River Mile 6.3
Westslope Cutthroat Trout Size Distribution**



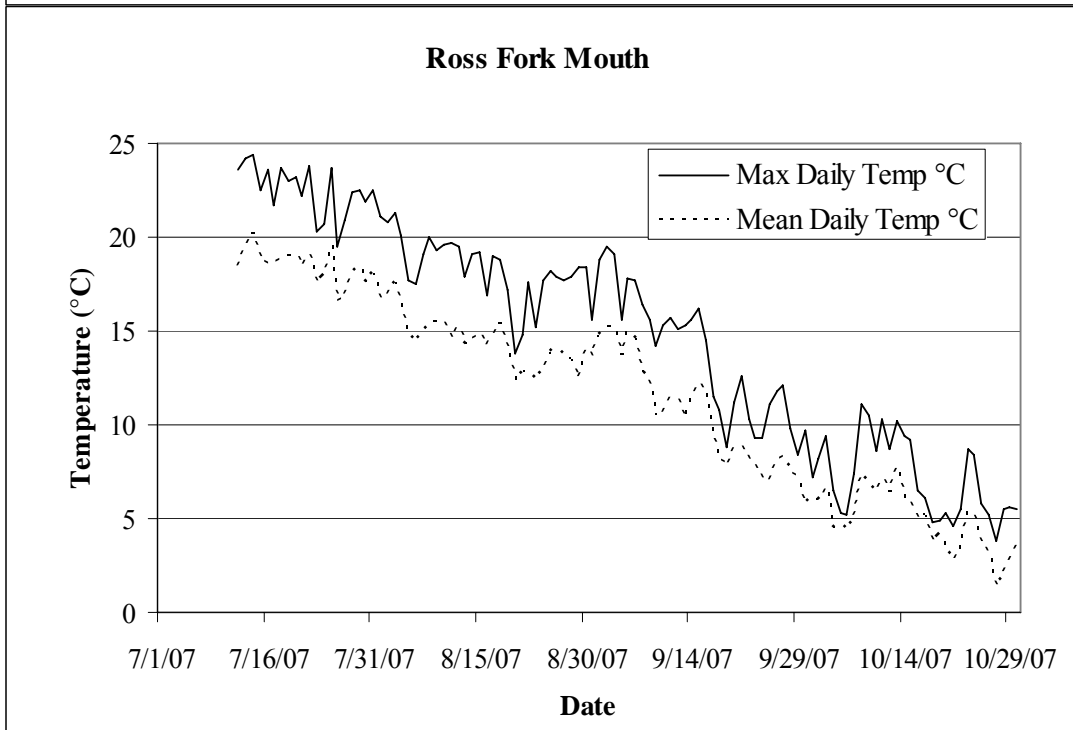
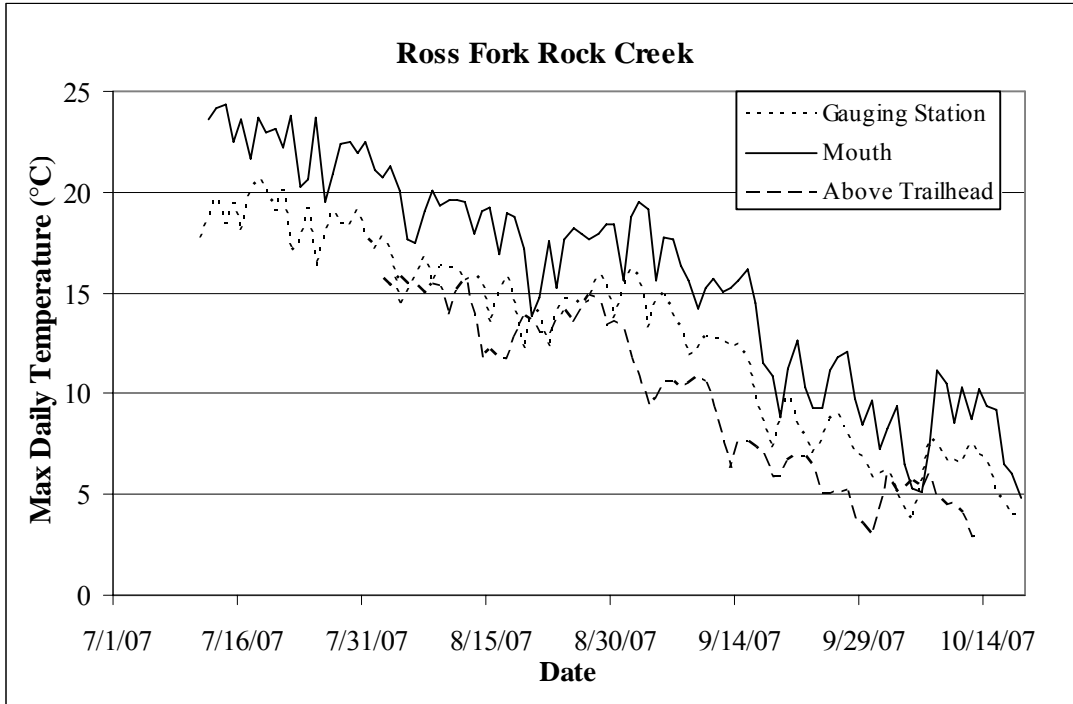
**Storm Lake Creek @ River Mile 6.3
Brook Trout Size Distribution**

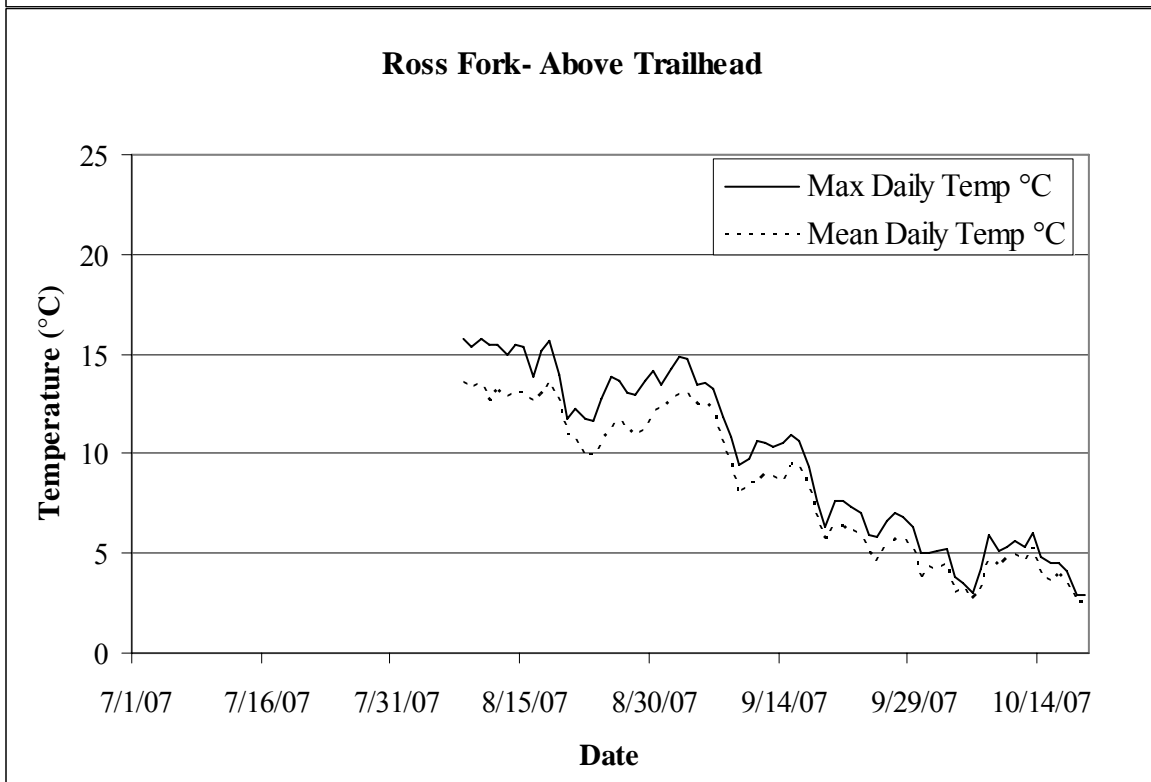
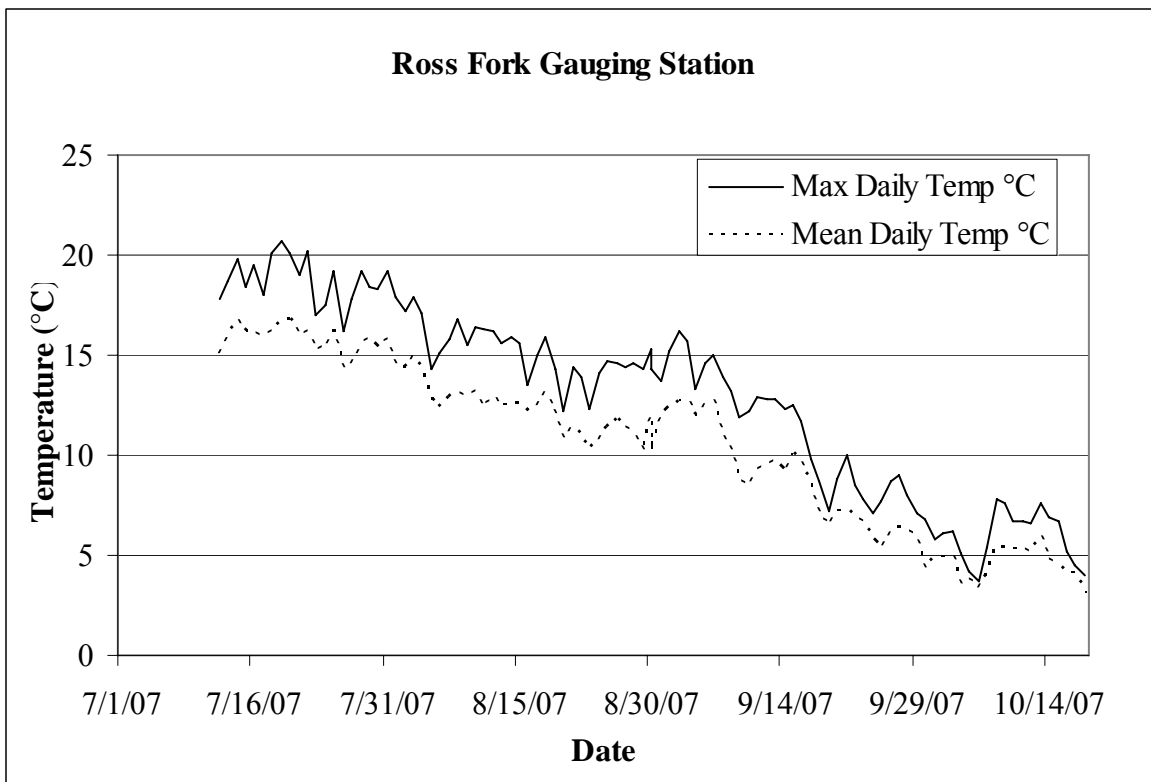


Appendix B

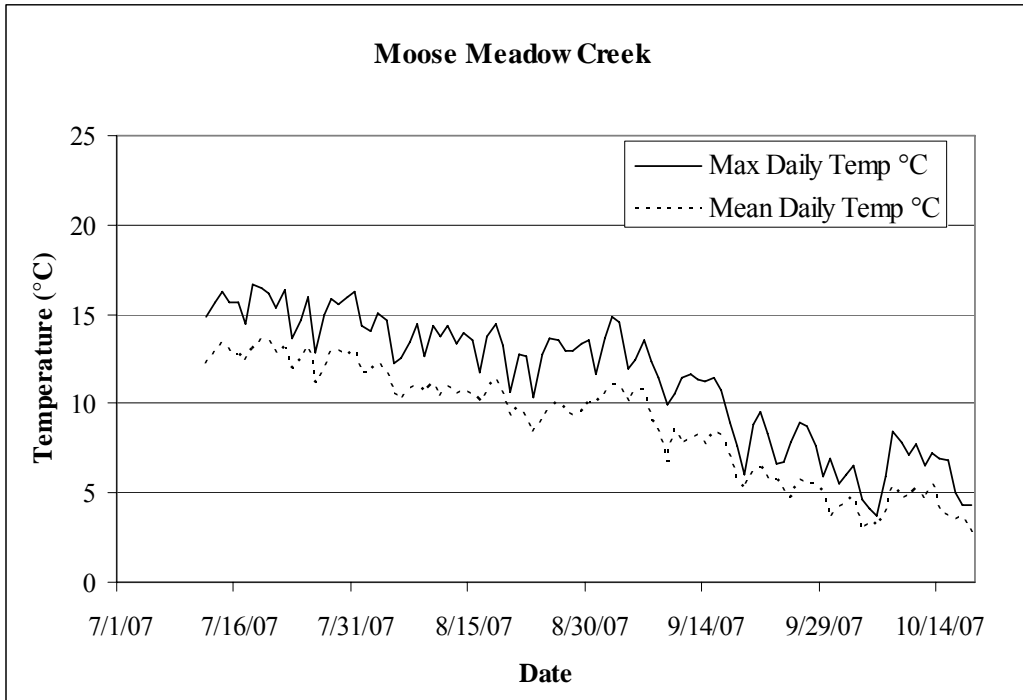
Ross Fork Rock Creek

Ross Fork Rock Creek

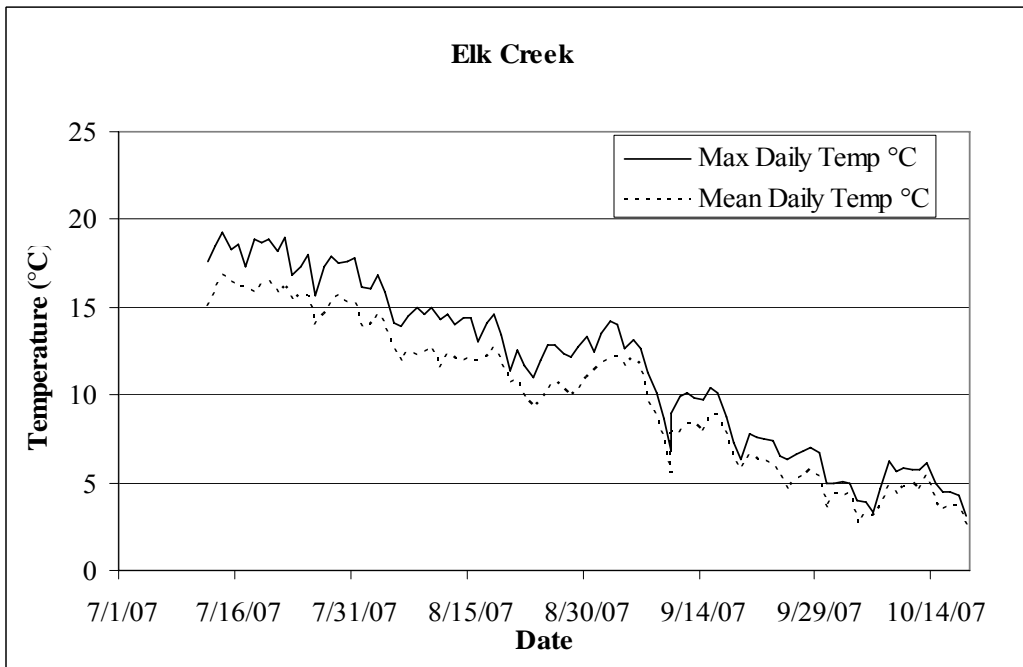




Moose Meadow Creek

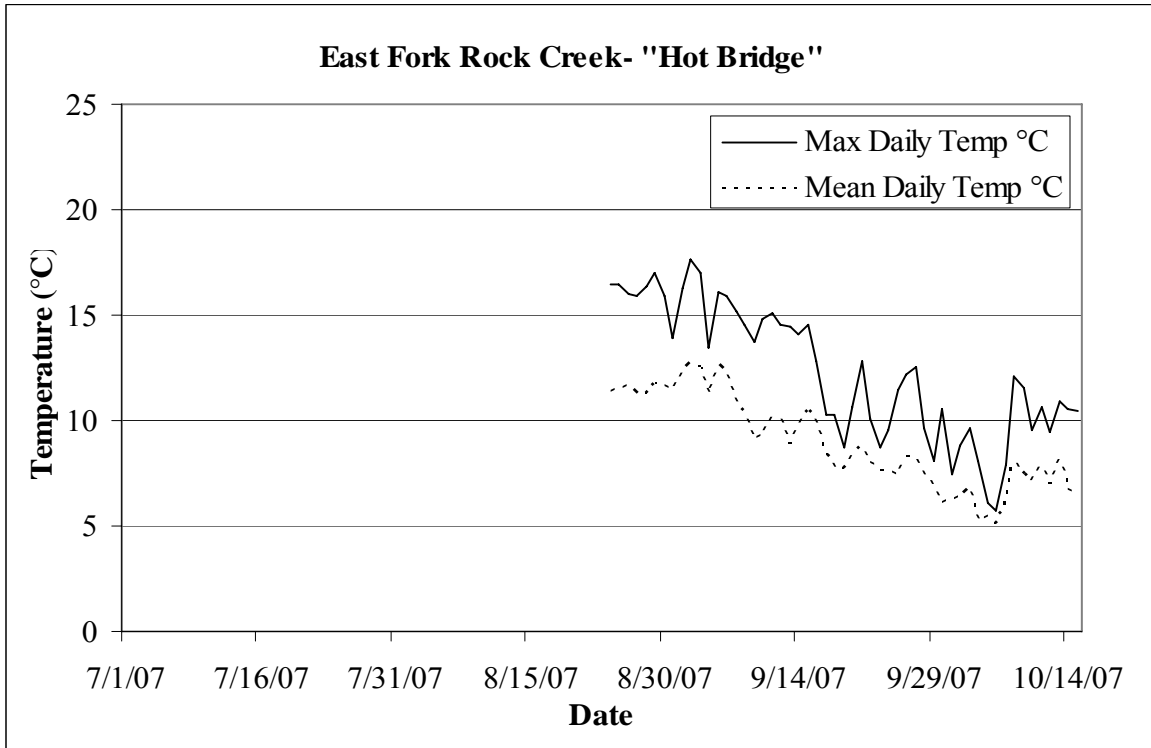


Elk Creek



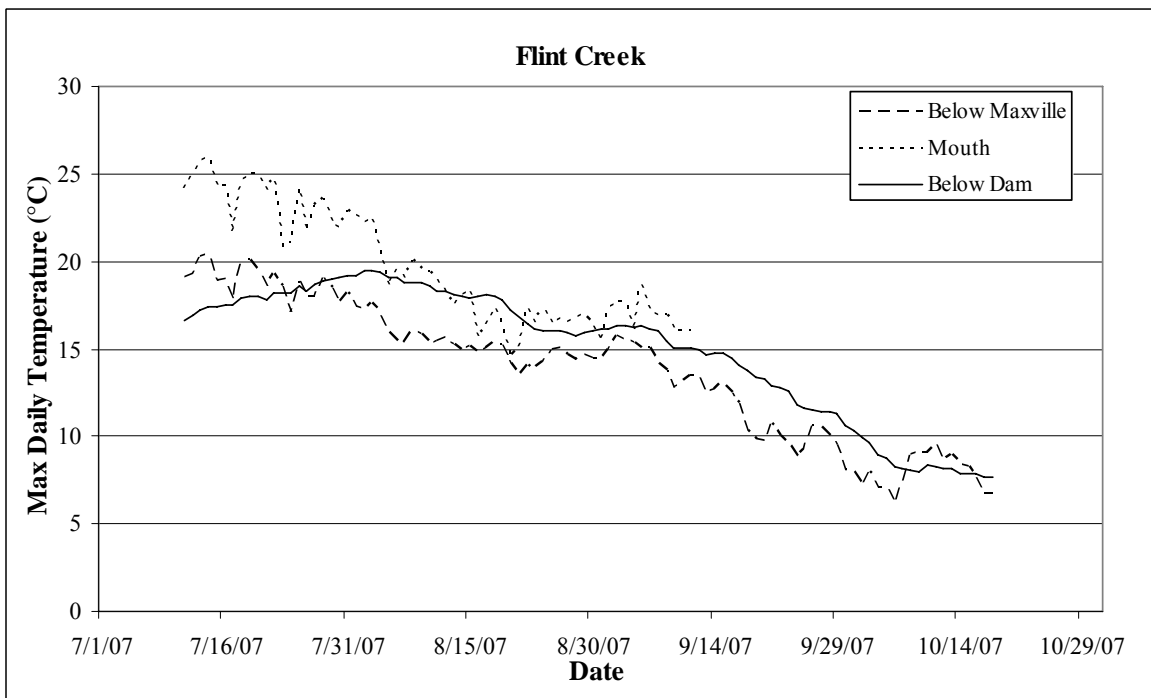
East Fork Rock Creek

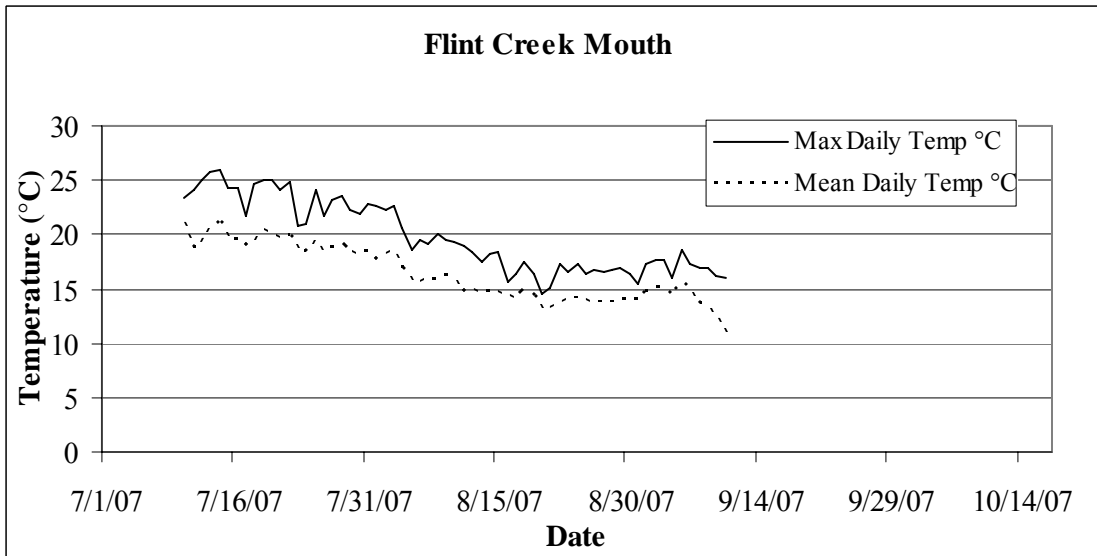
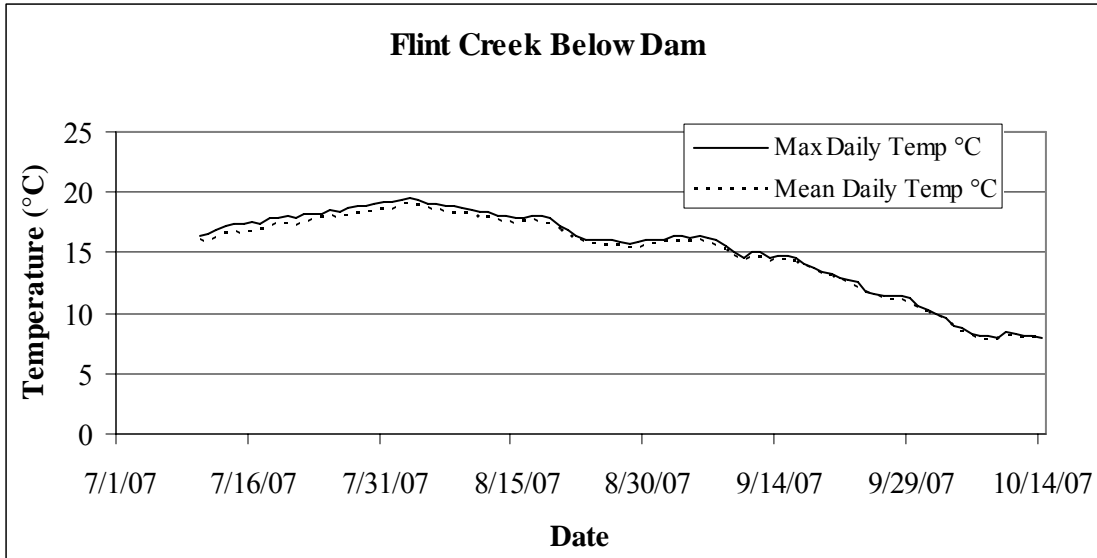
East Fork Rock Creek

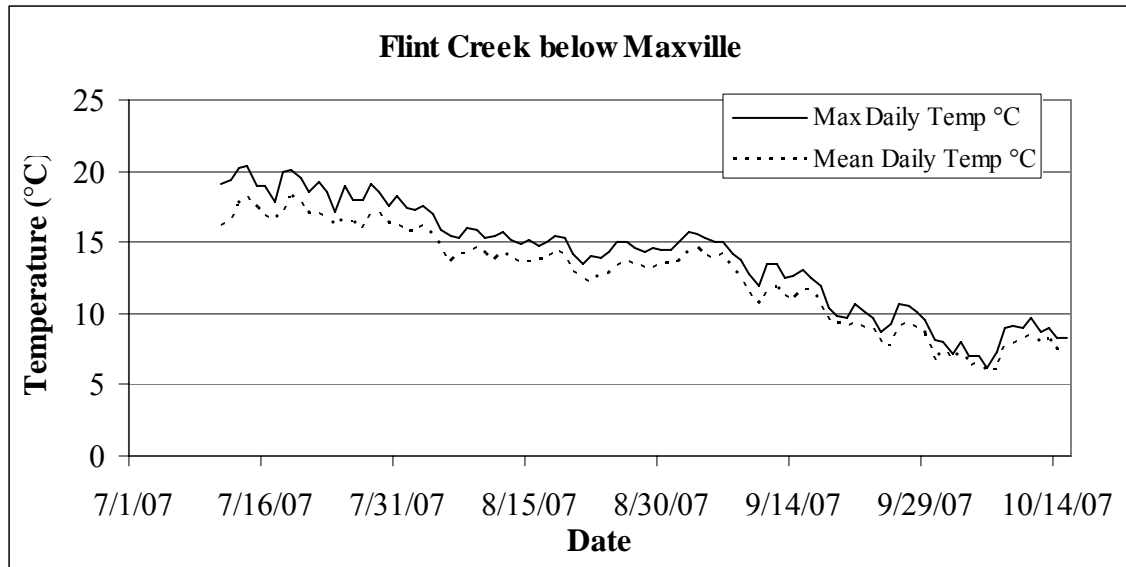


Flint Creek

Flint Creek

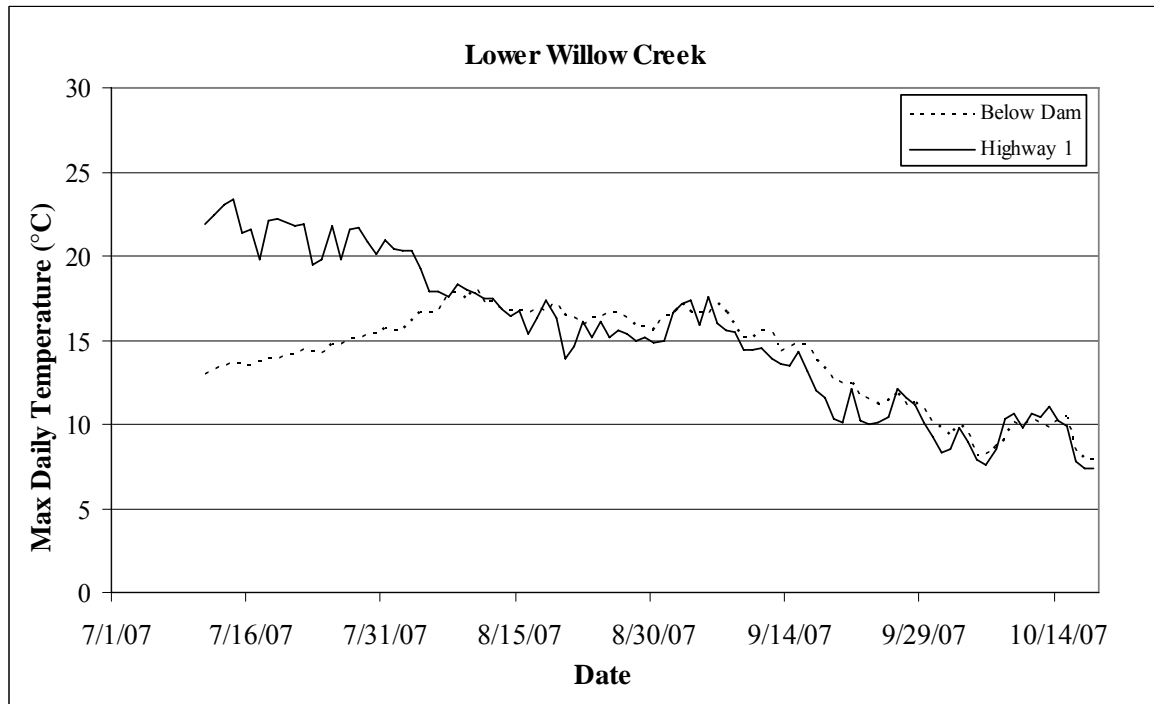




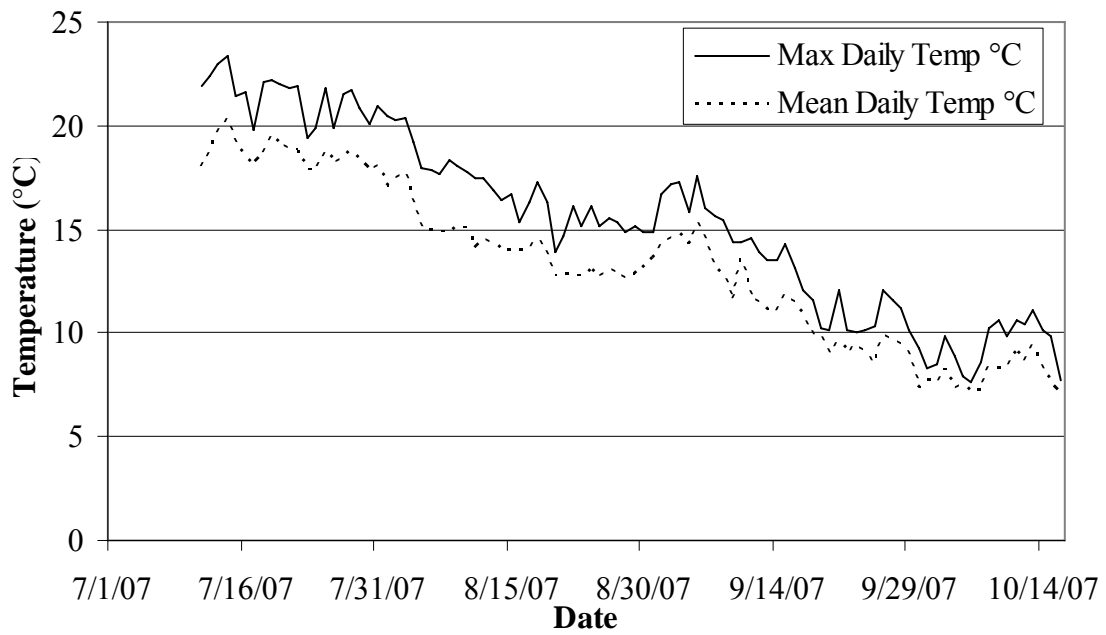


Lower Willow Creek

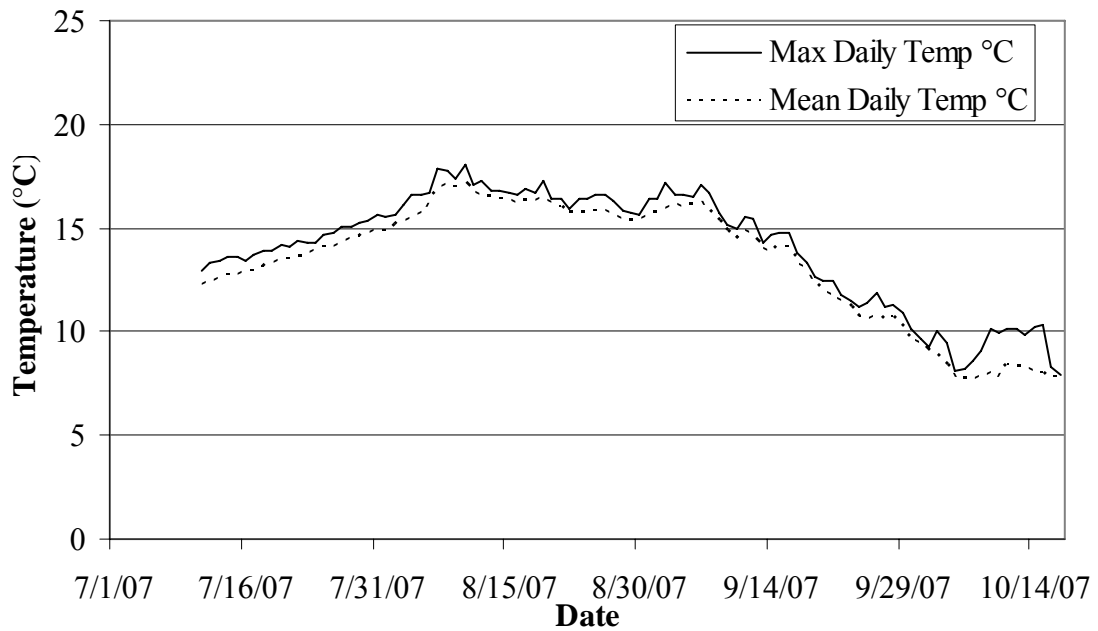
Lower Willow Creek



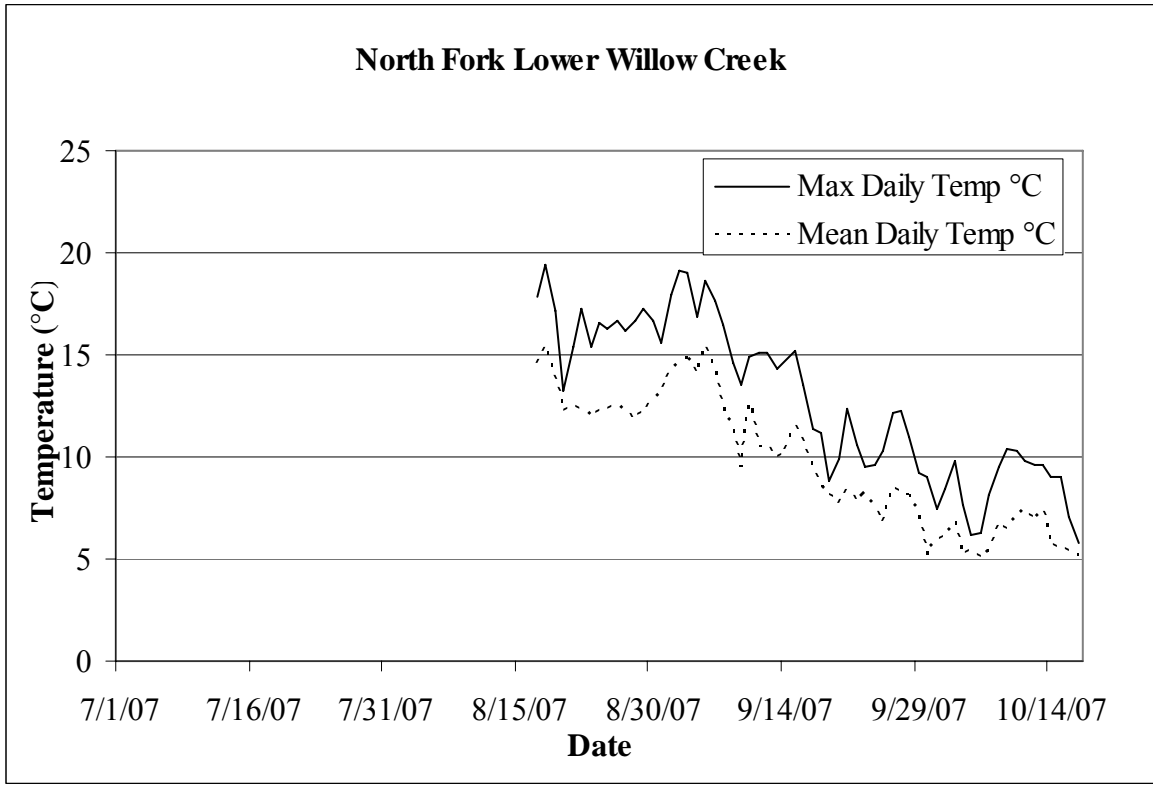
Lower Willow Creek @ Highway 1



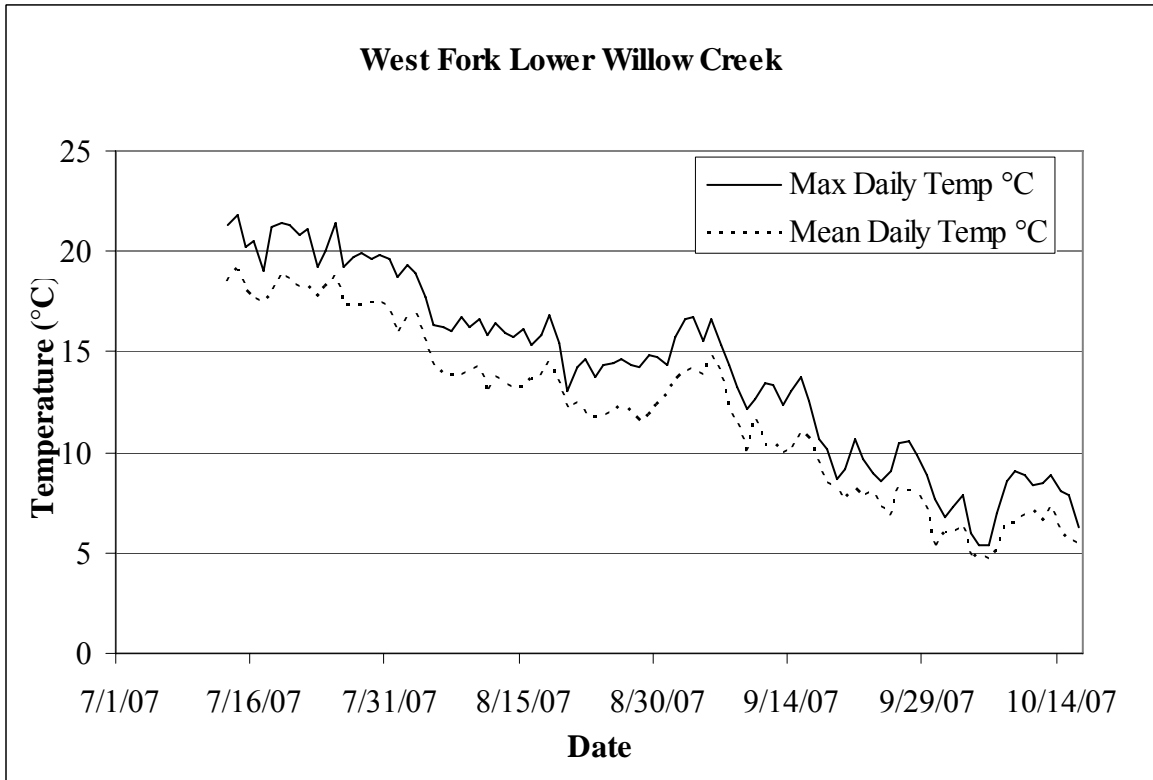
Lower Willow Creek Below Dam



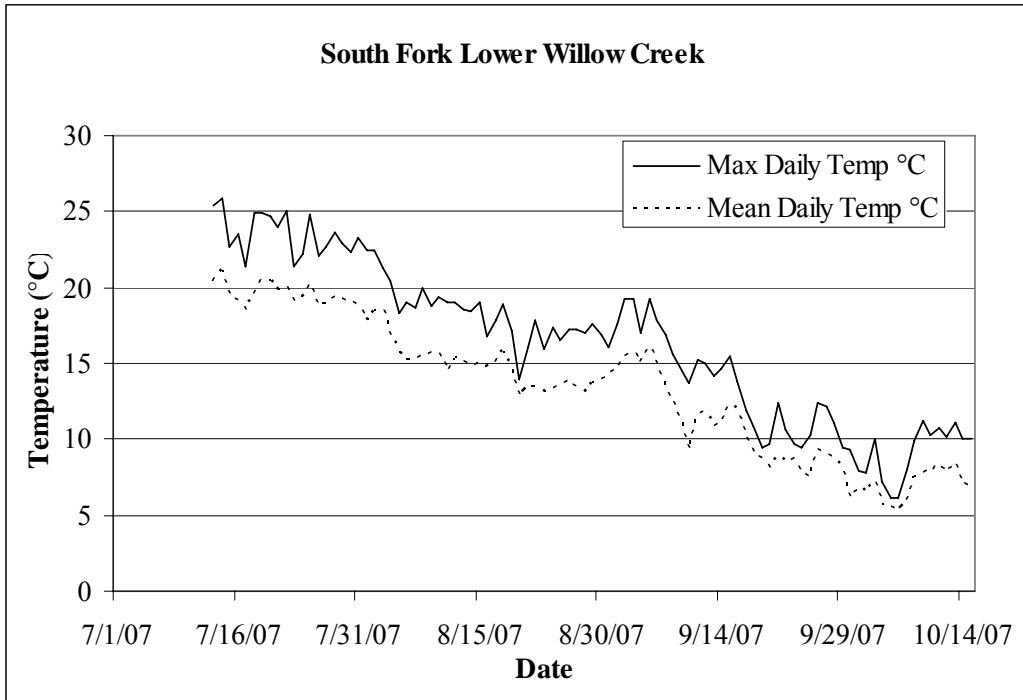
North Fork Lower Willow Creek



West Fork Lower Willow Creek

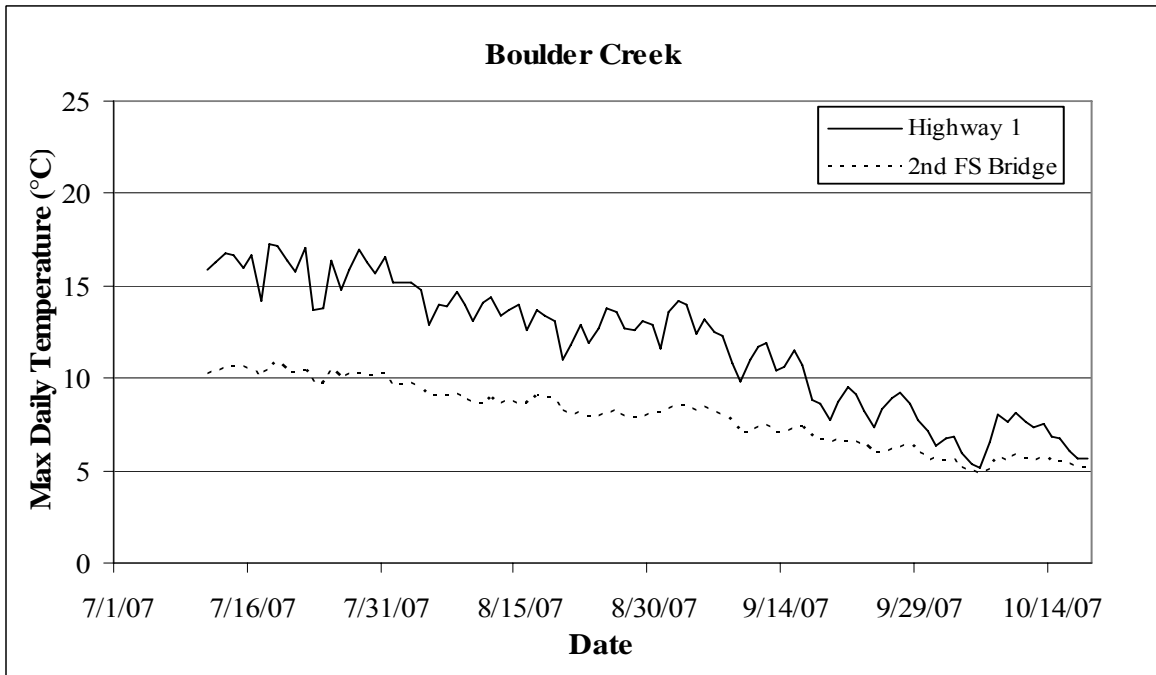


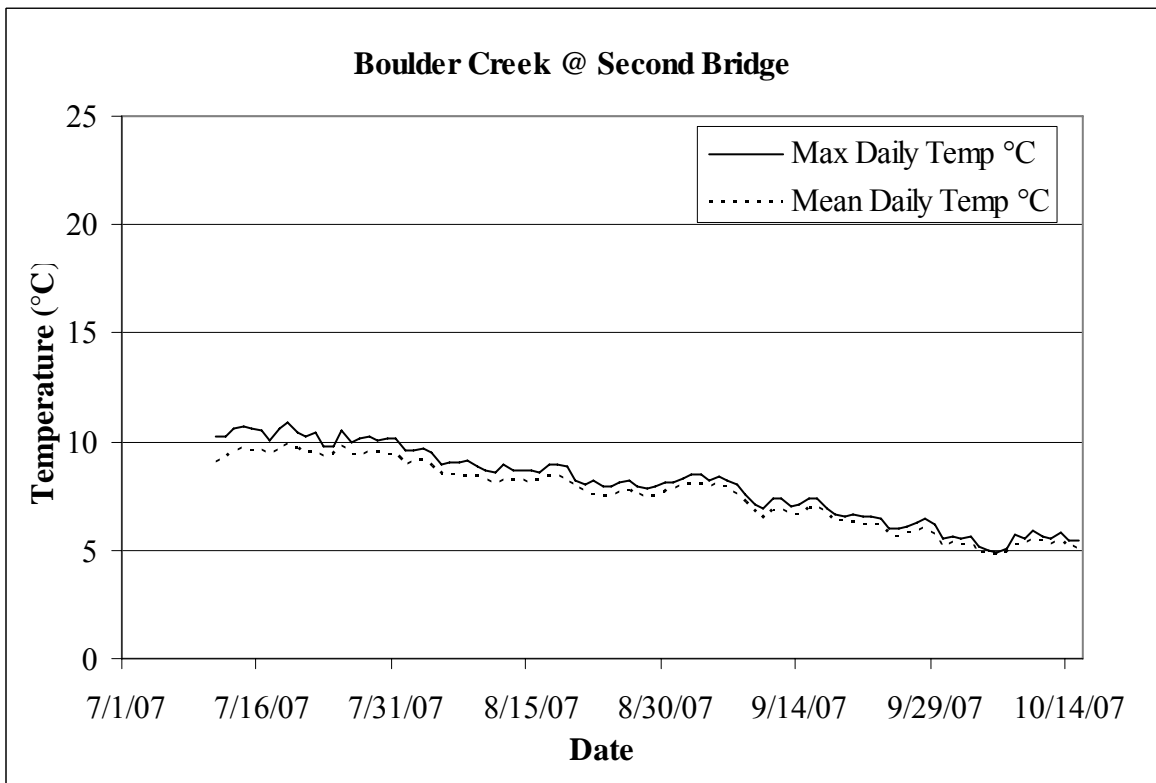
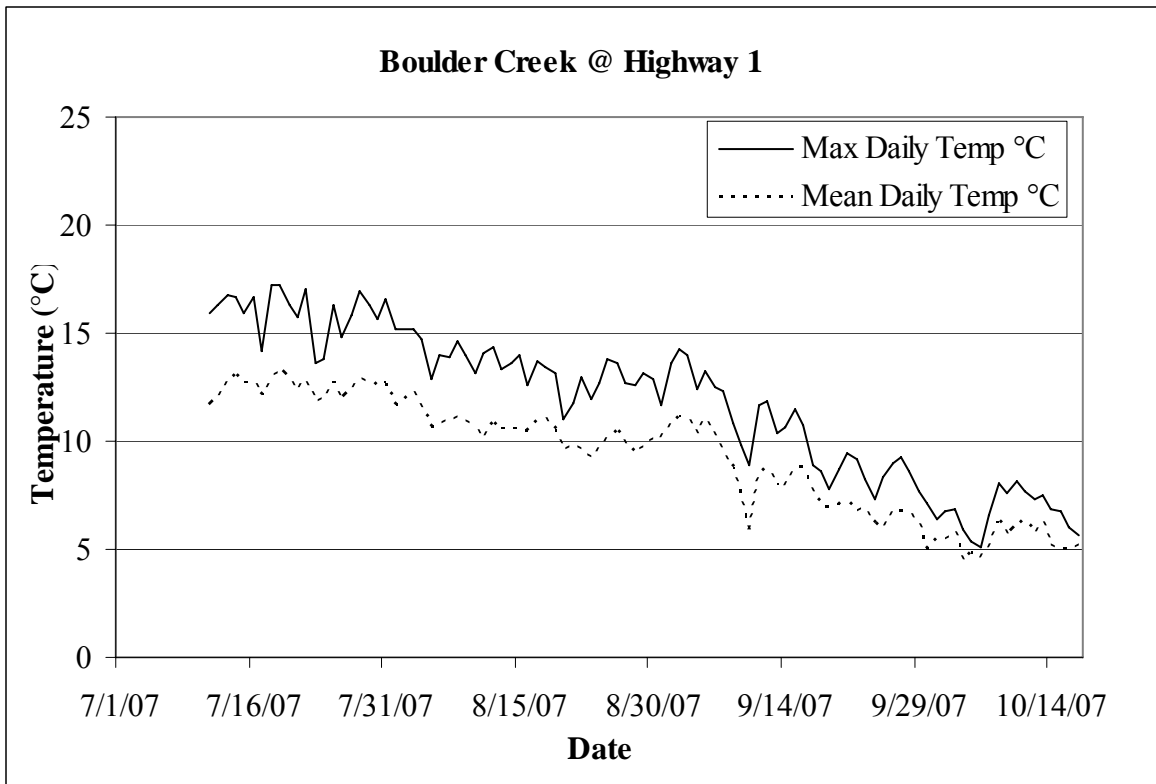
South Fork Lower Willow Creek



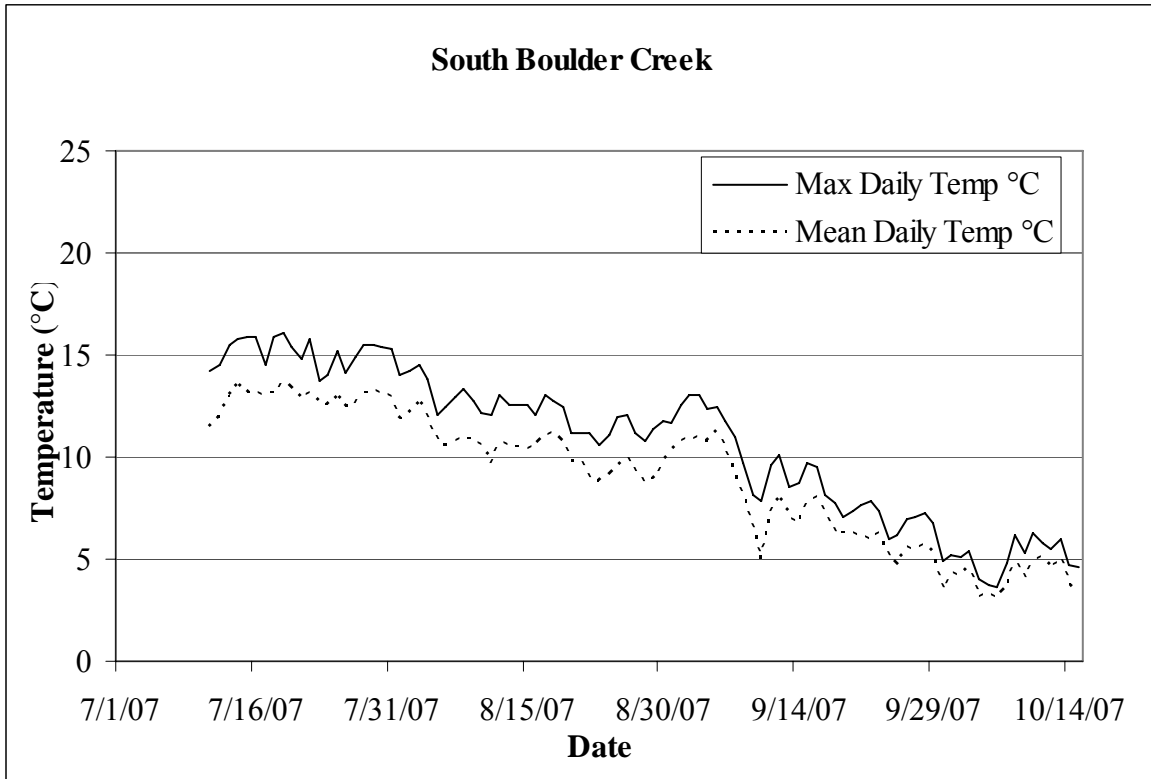
Boulder Creek

Boulder Creek

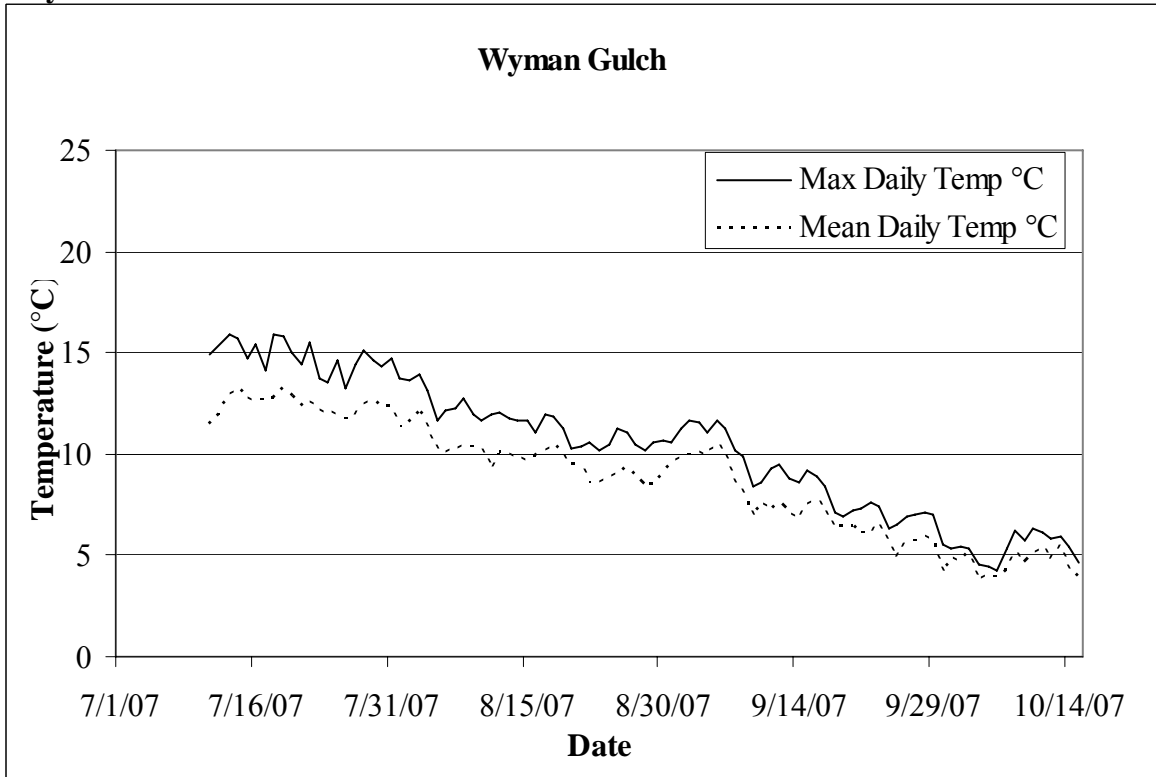




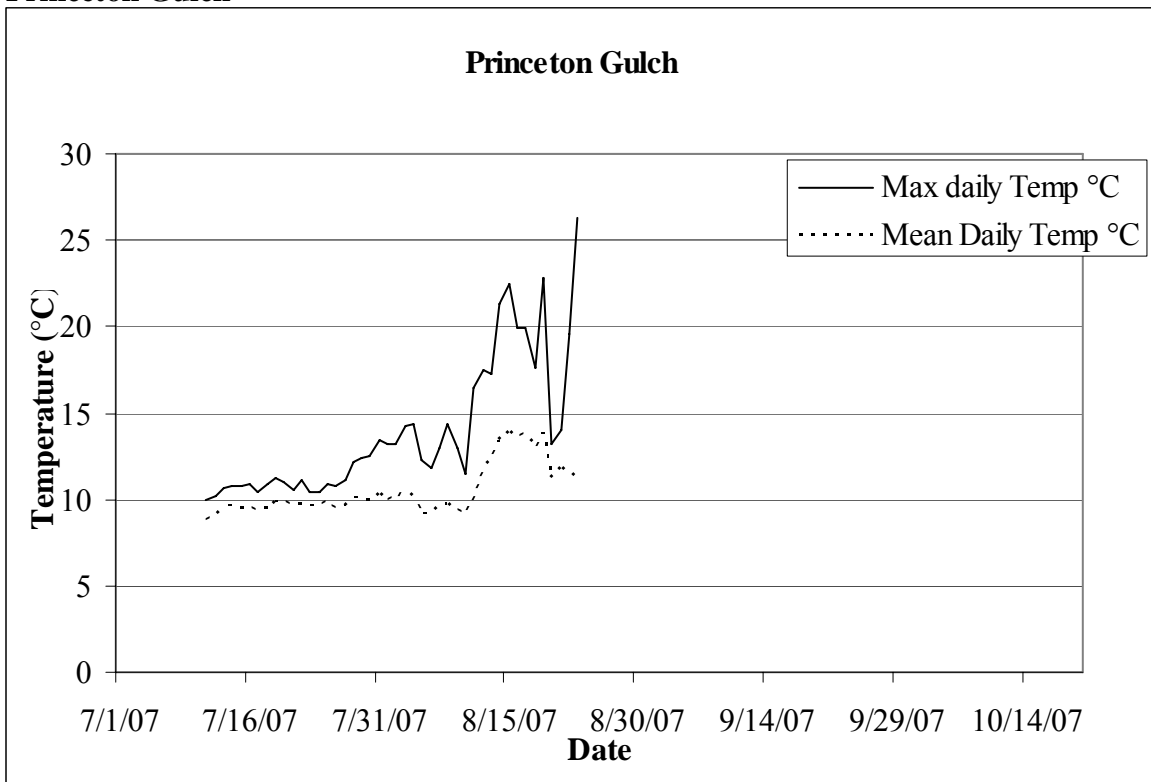
South Boulder Creek



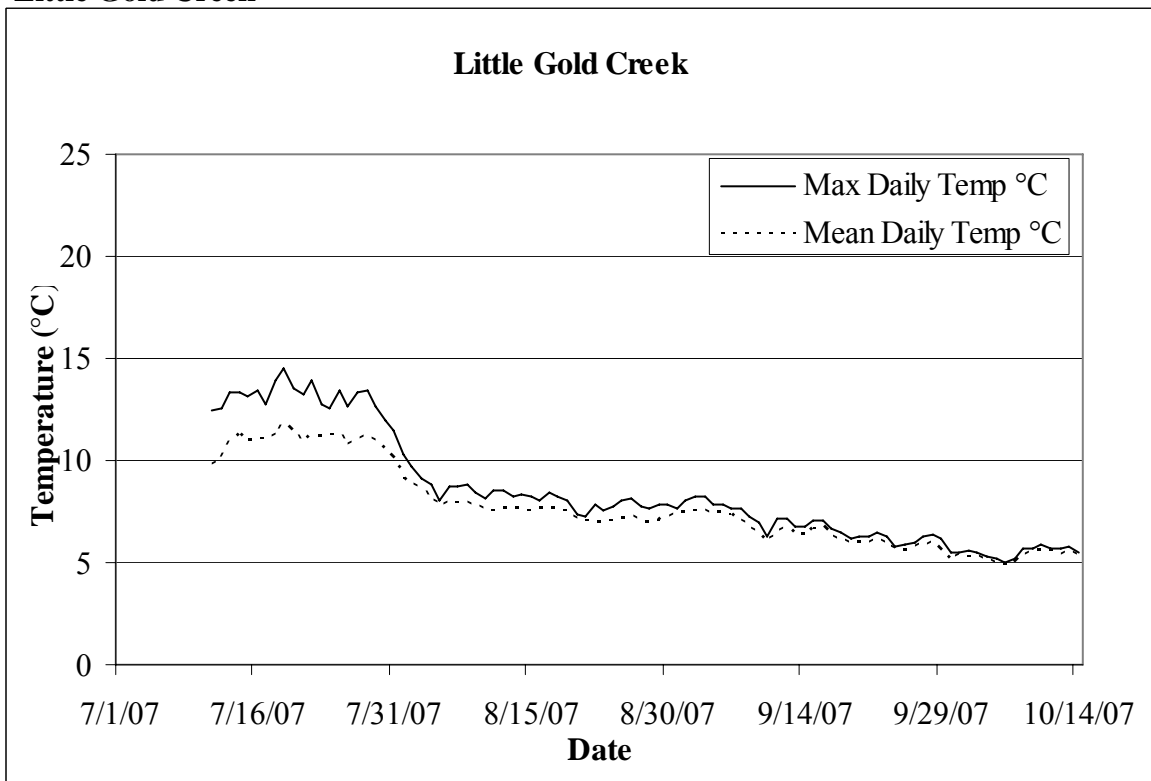
Wyman Gulch



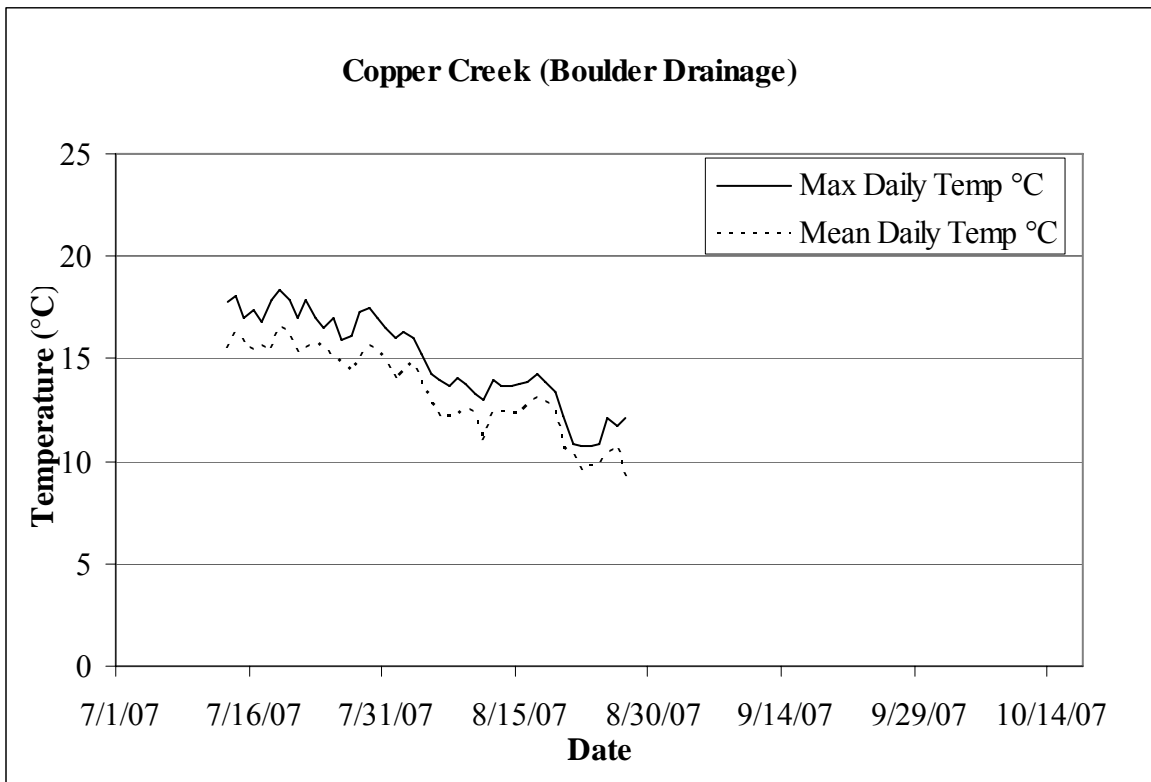
Princeton Gulch



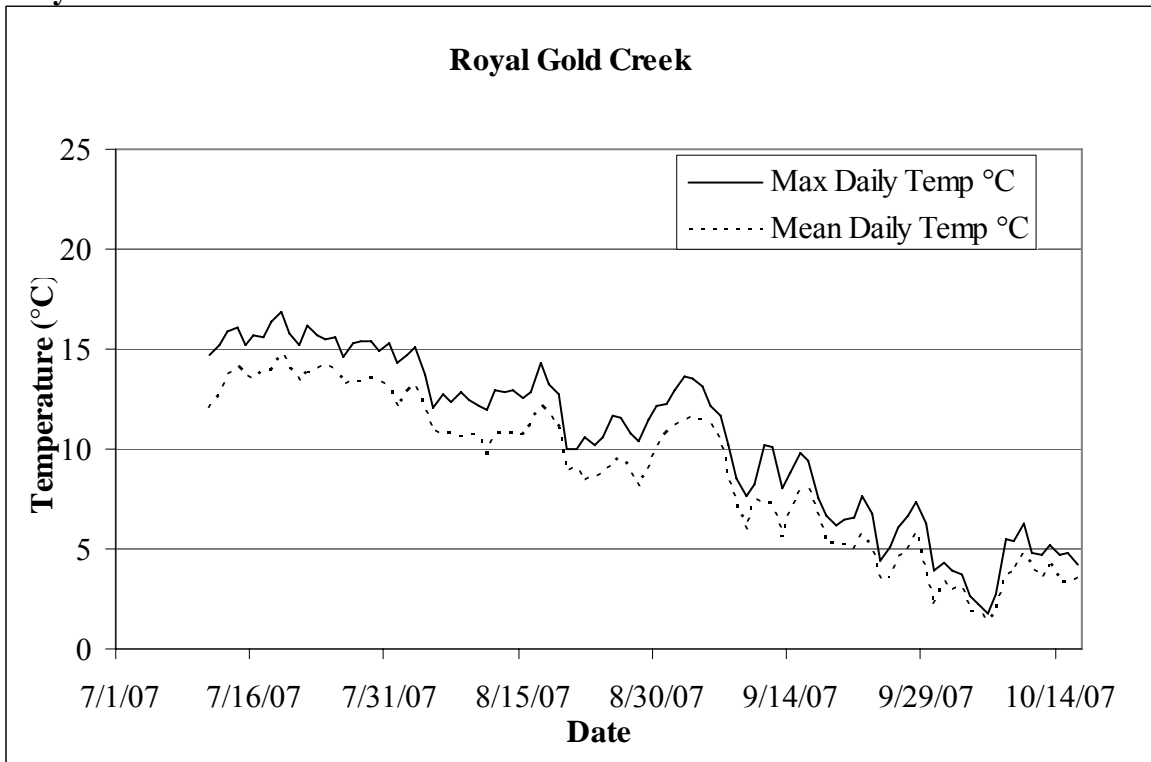
Little Gold Creek



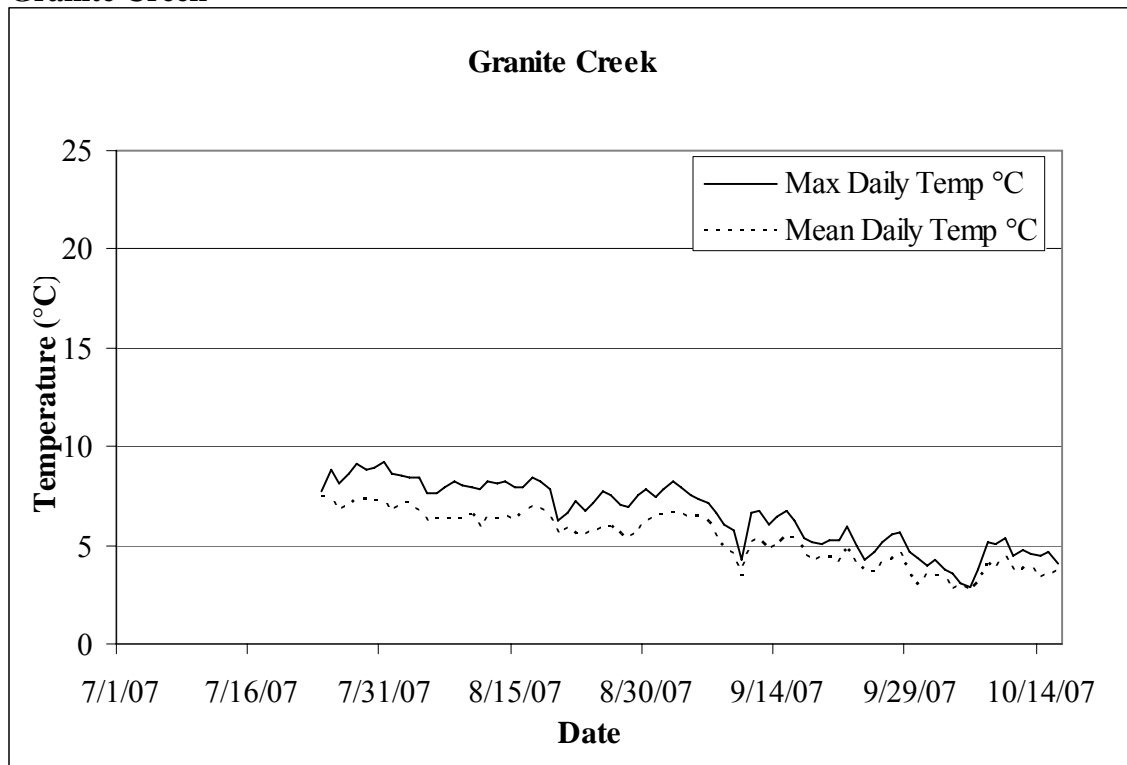
Copper Creek



Royal Gold Creek

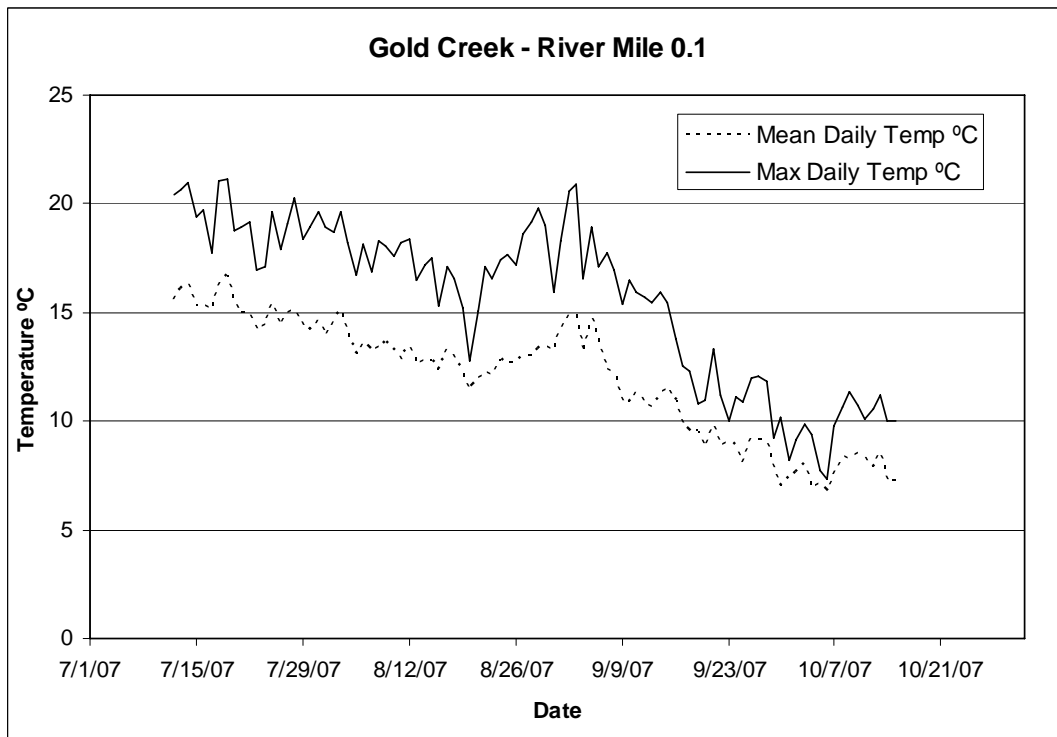
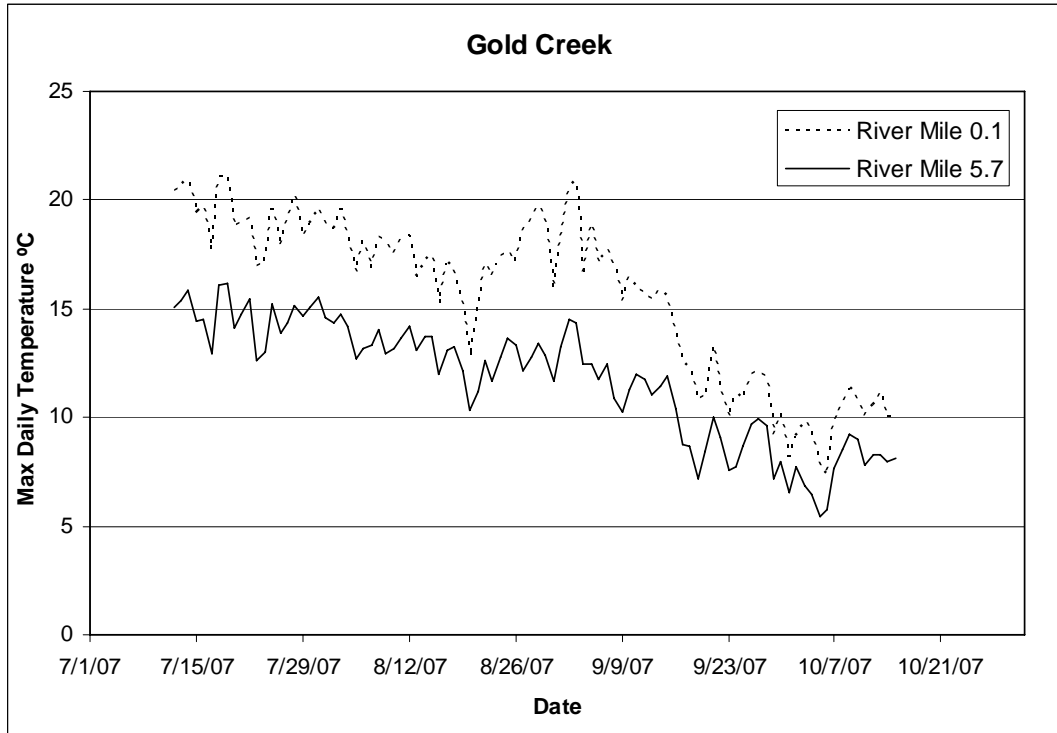


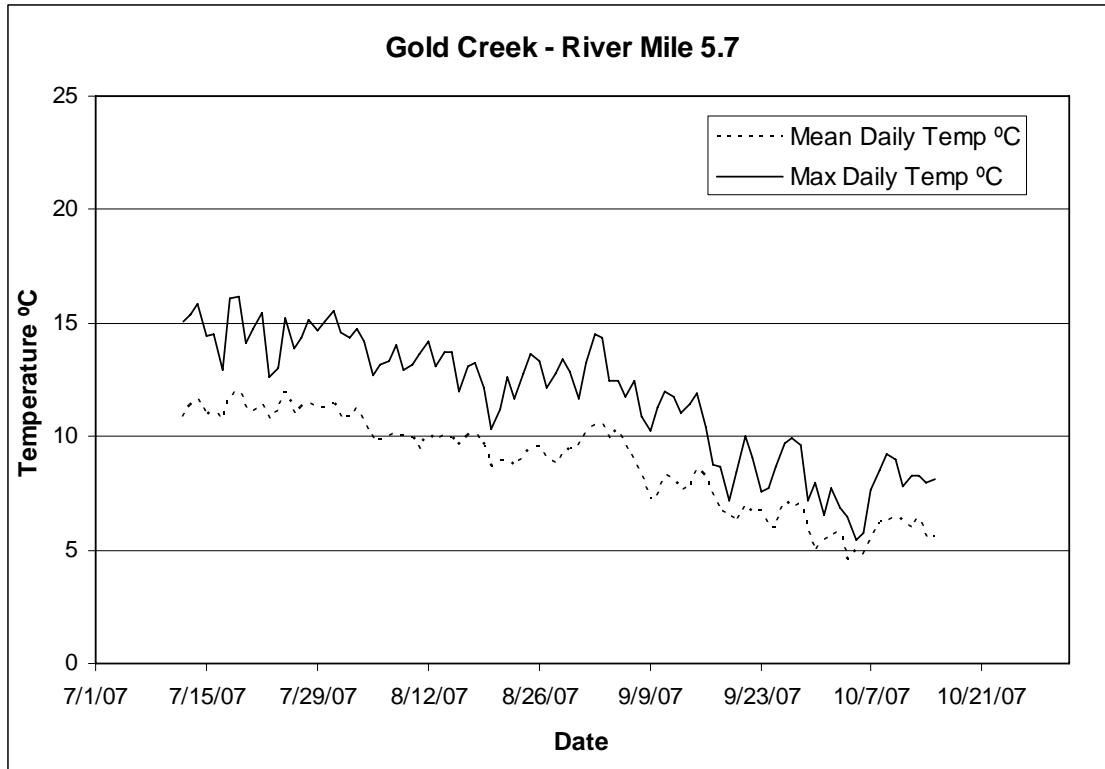
Granite Creek



Gold Creek

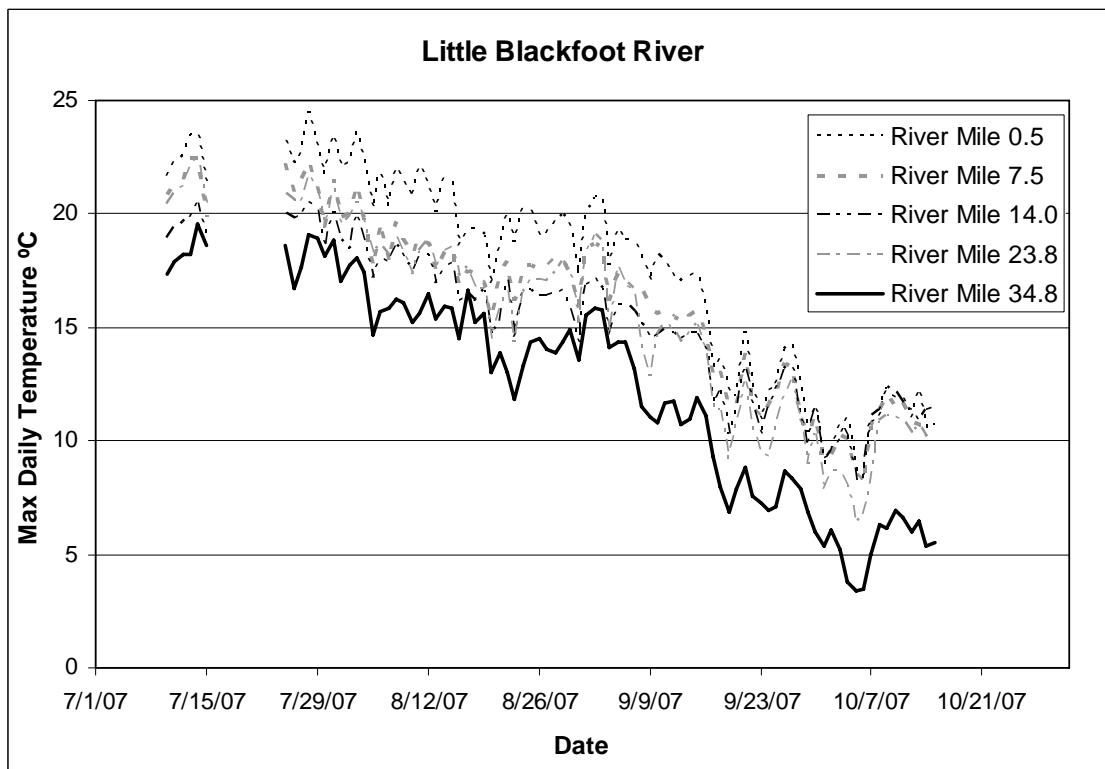
Gold Creek

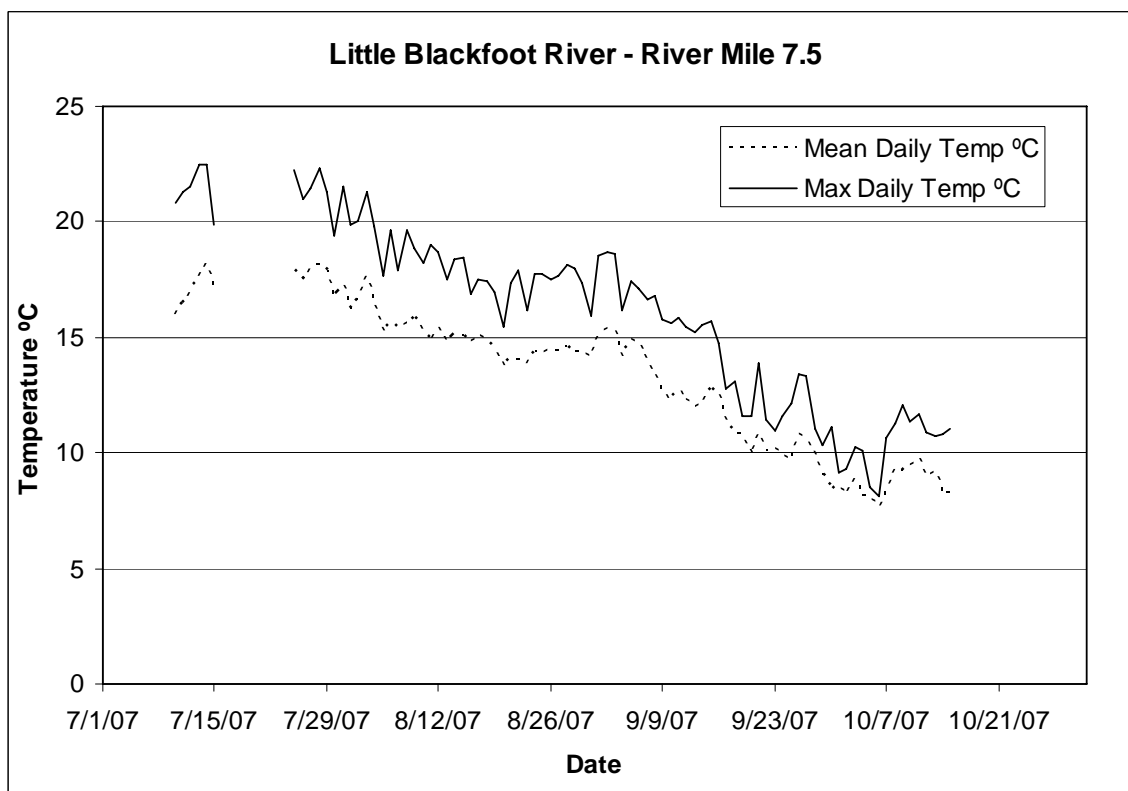
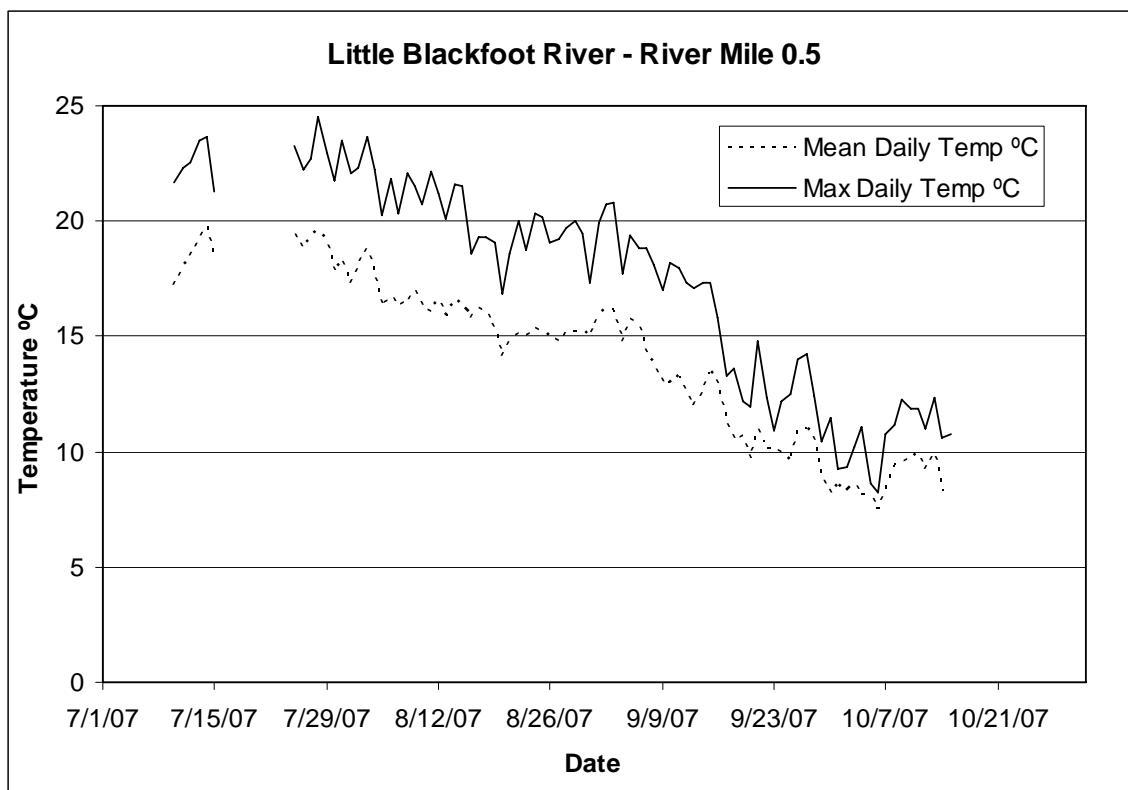


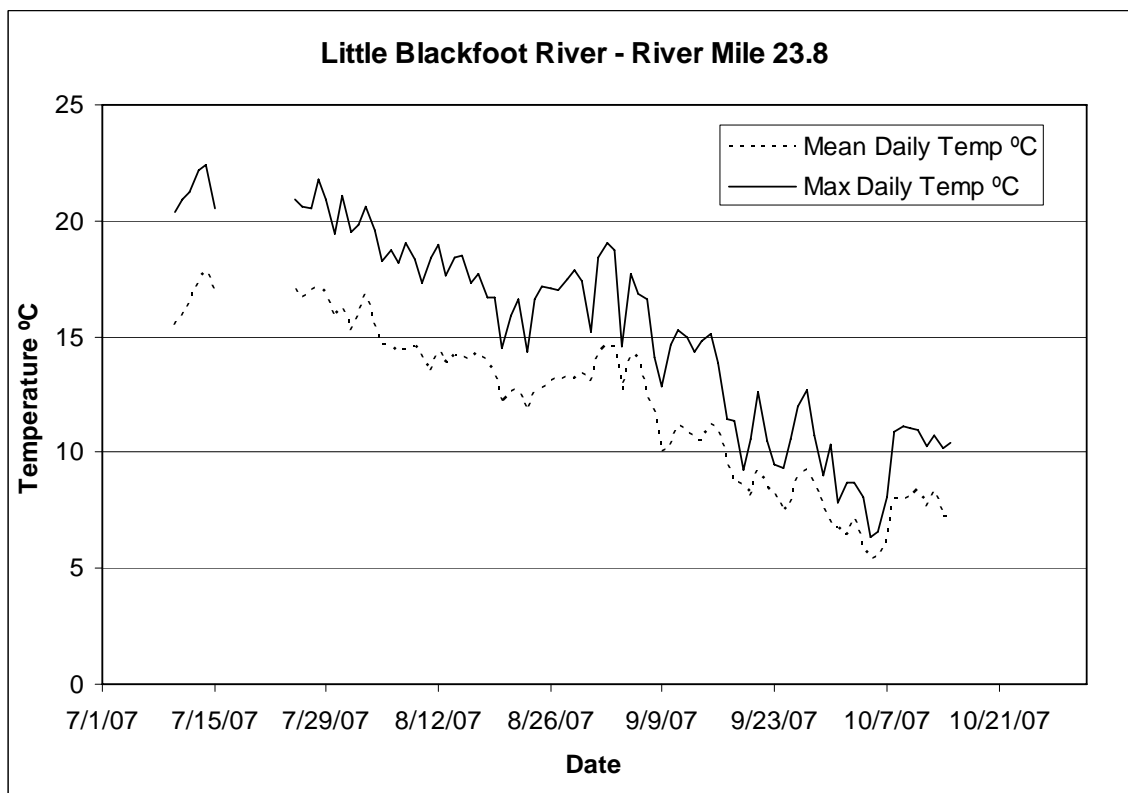
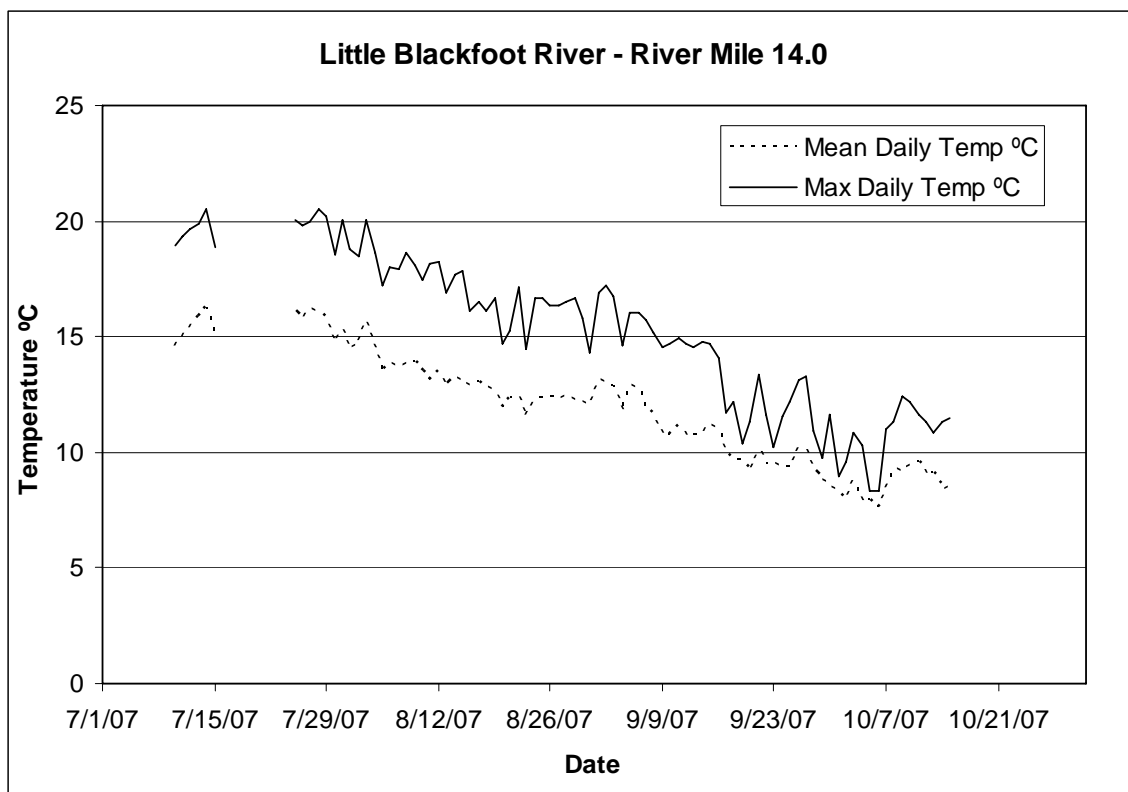


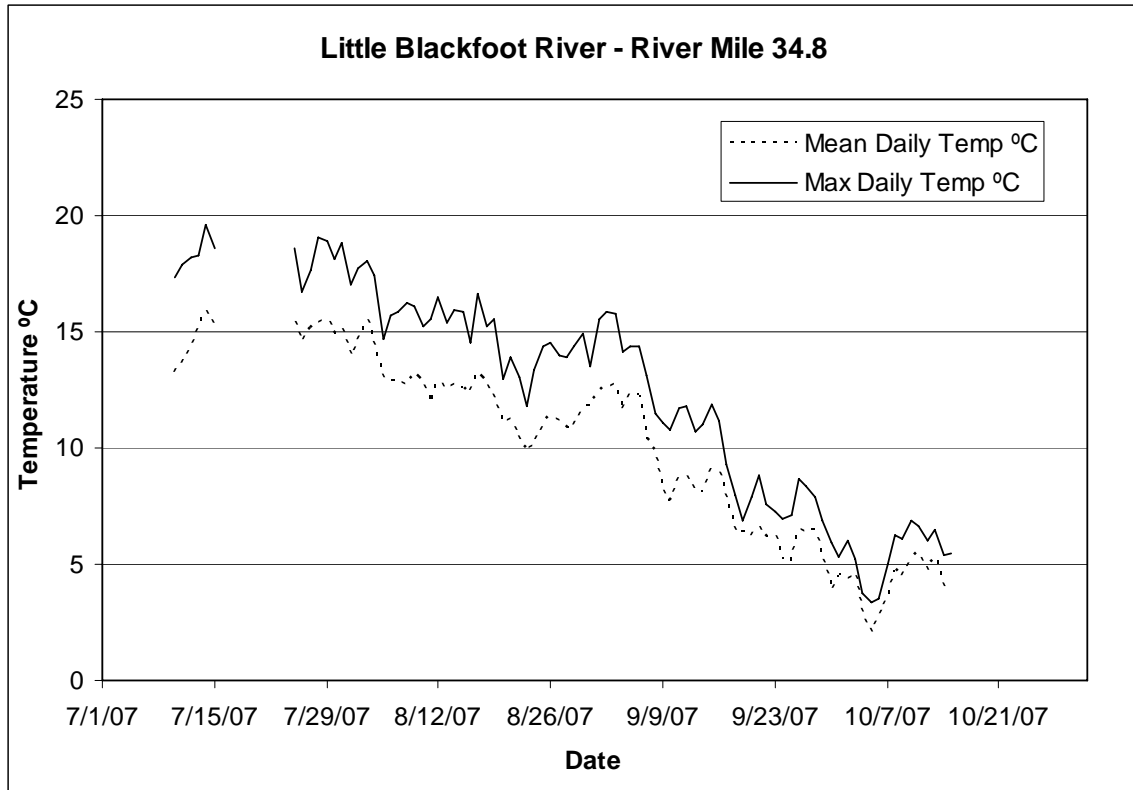
Little Blackfoot River

Little Blackfoot River

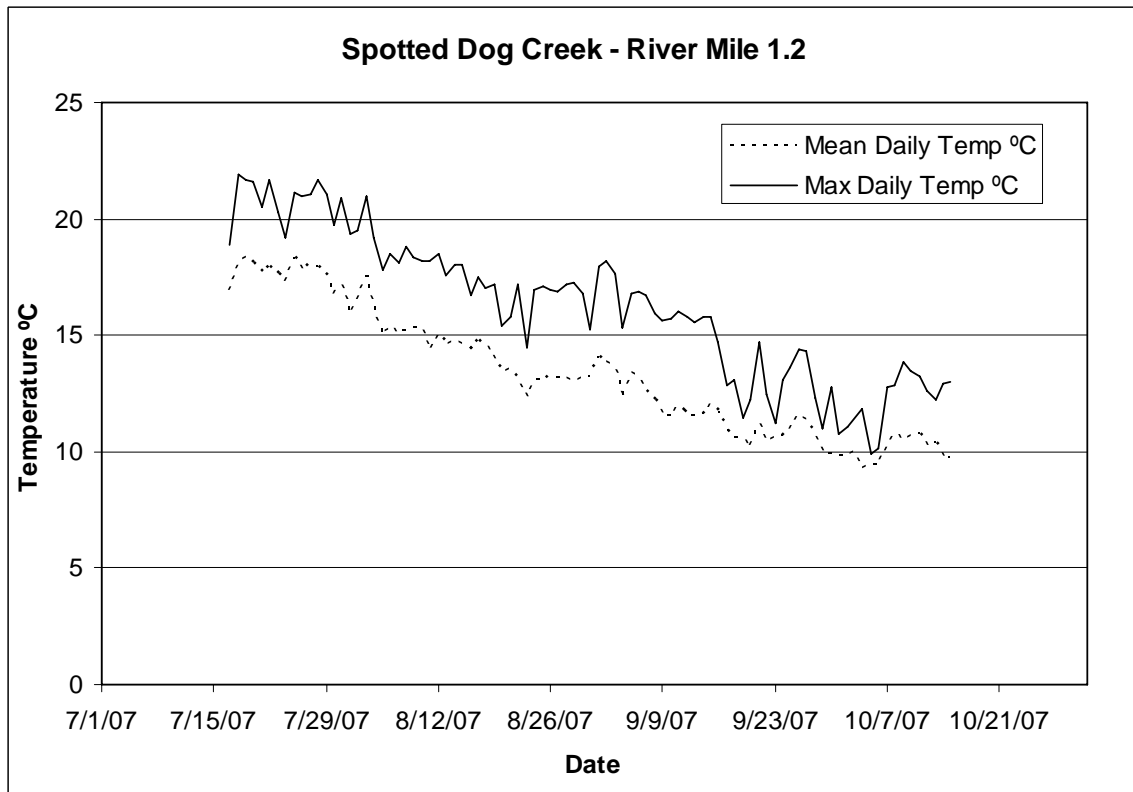




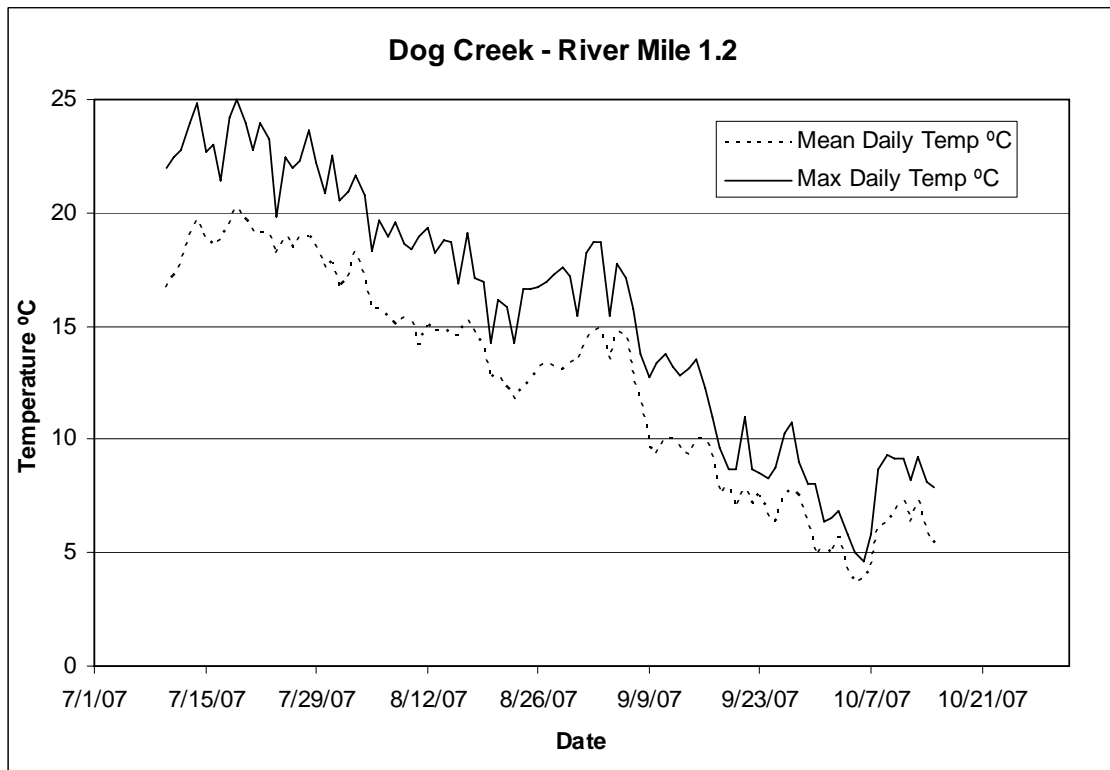
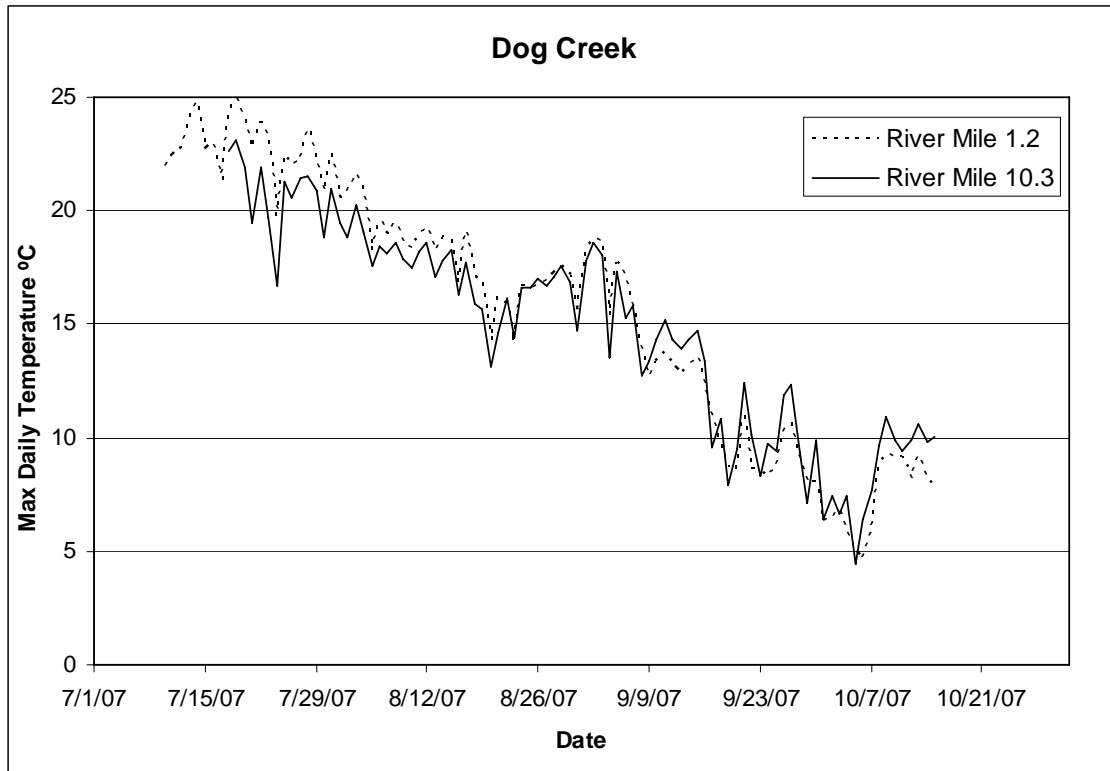


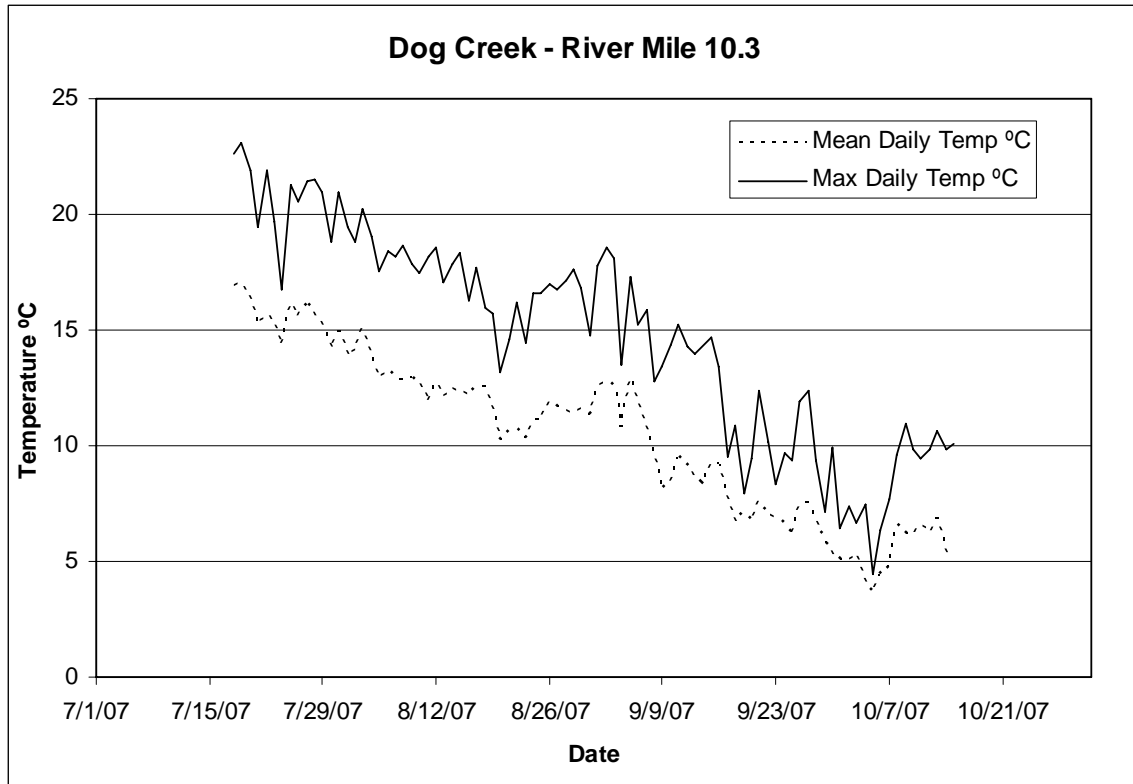


Spotted Dog Creek

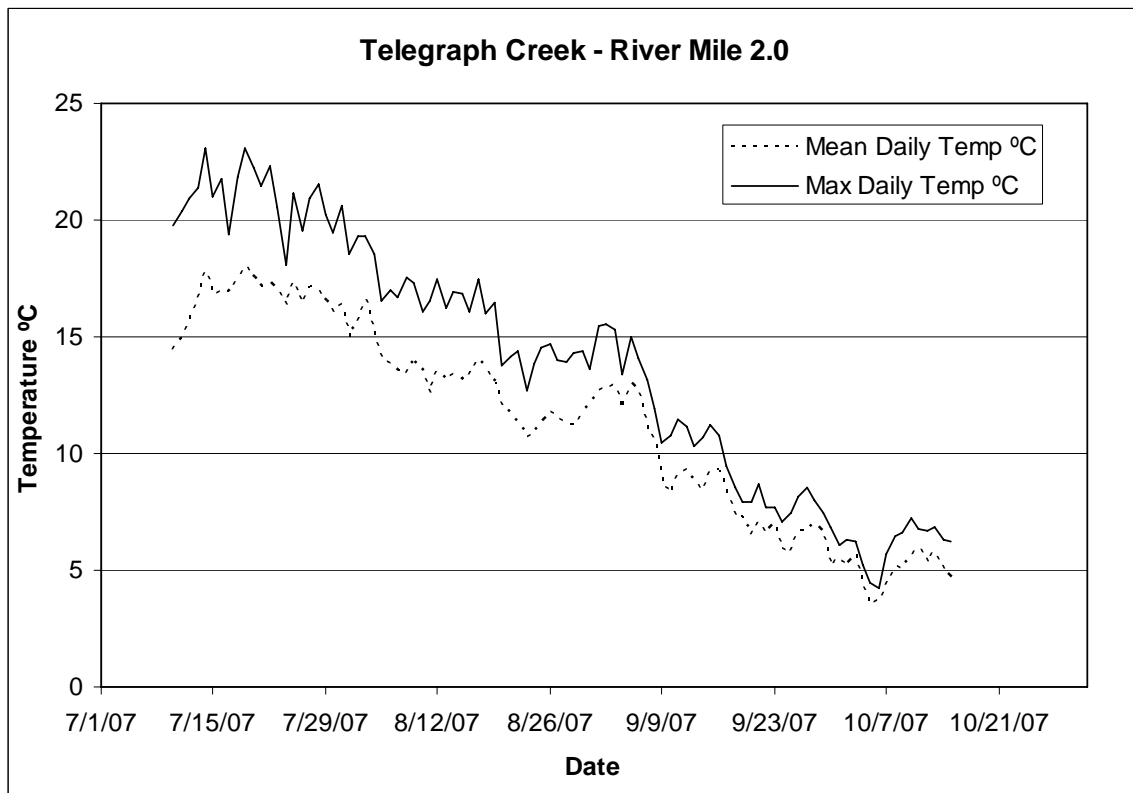


Dog Creek



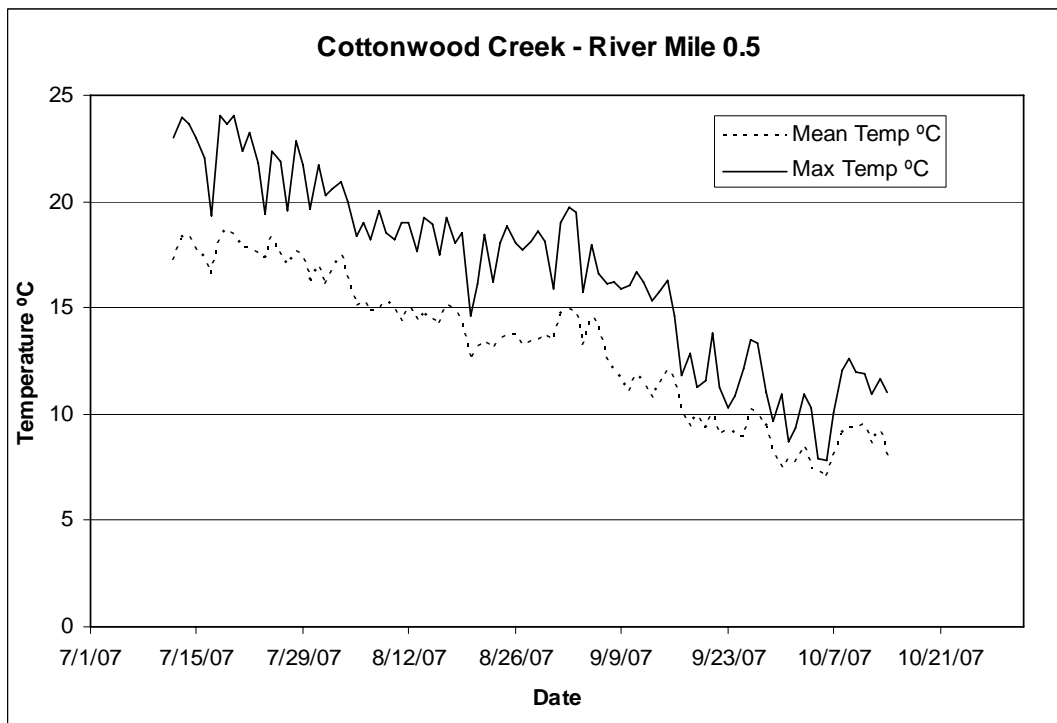
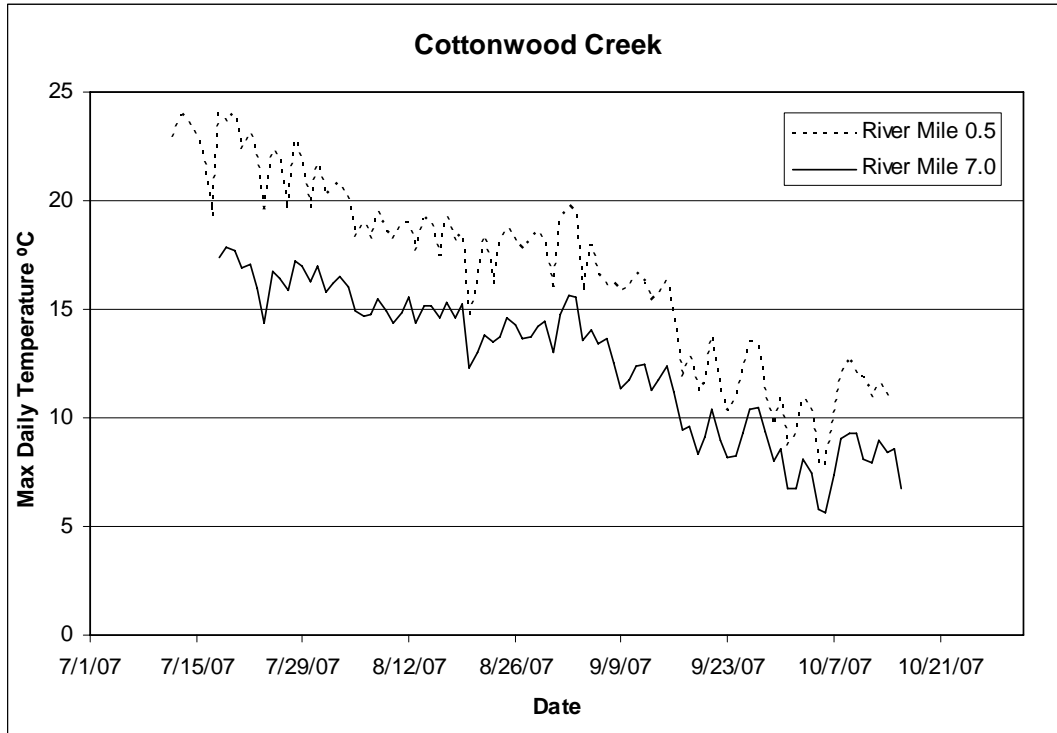


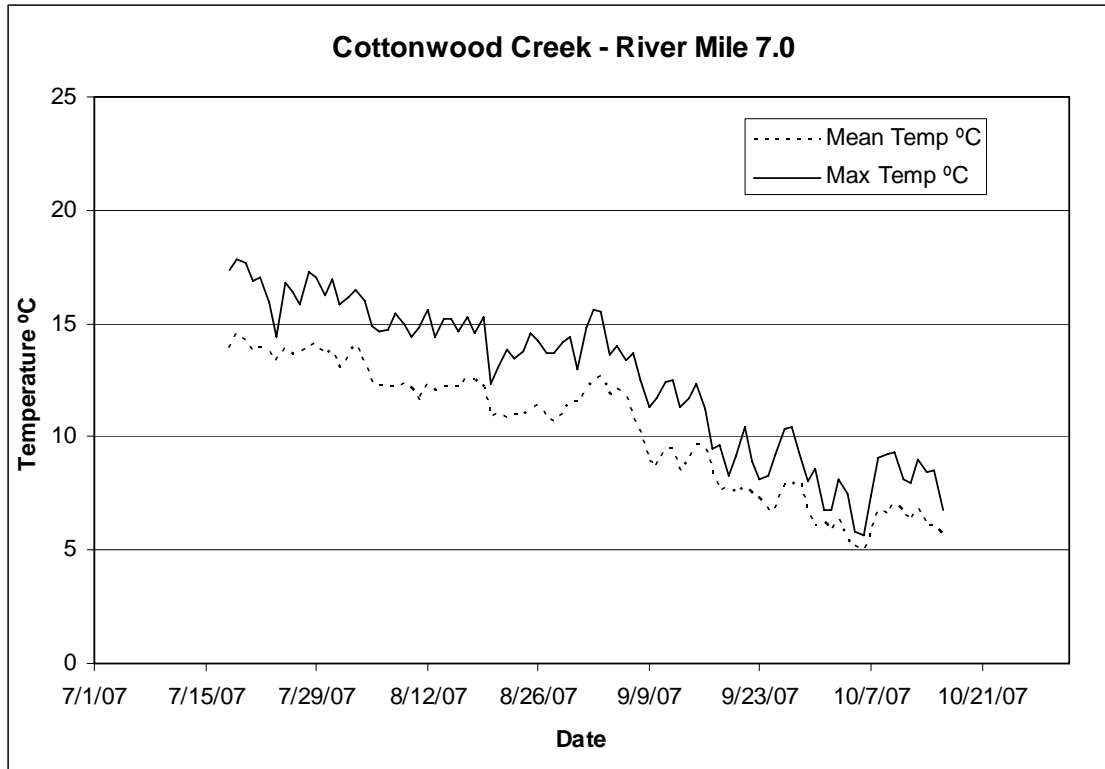
Telegraph Creek



Cottonwood Creek

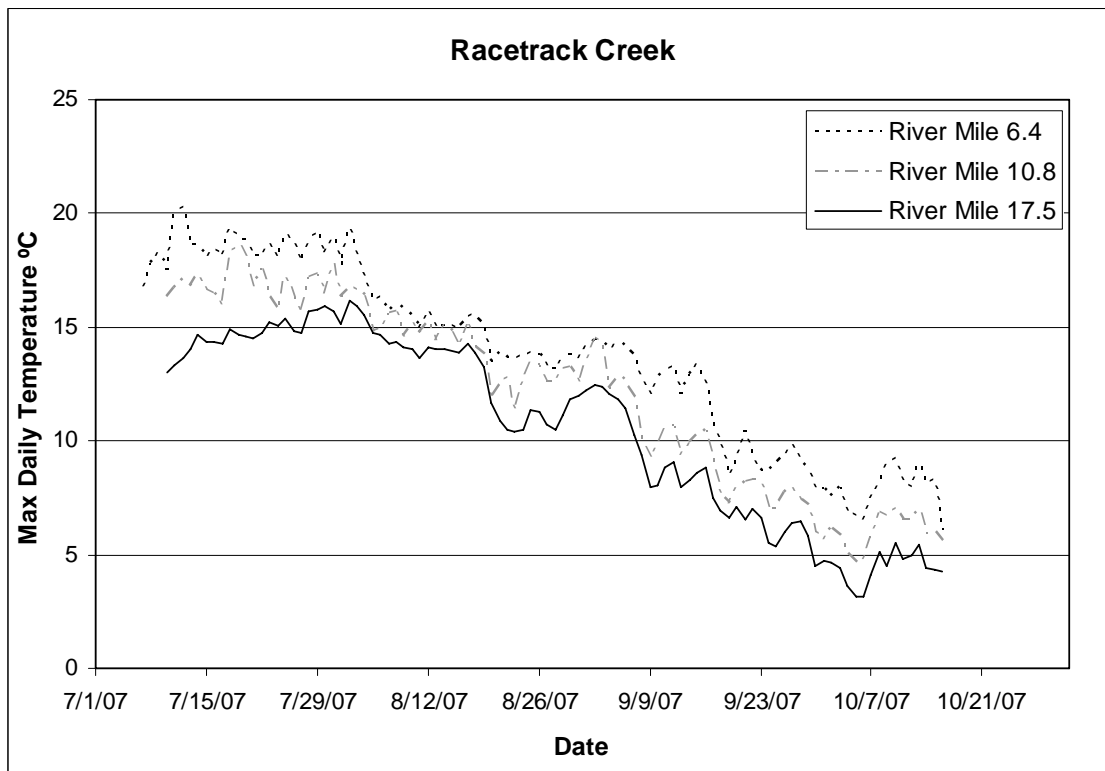
Cottonwood Creek

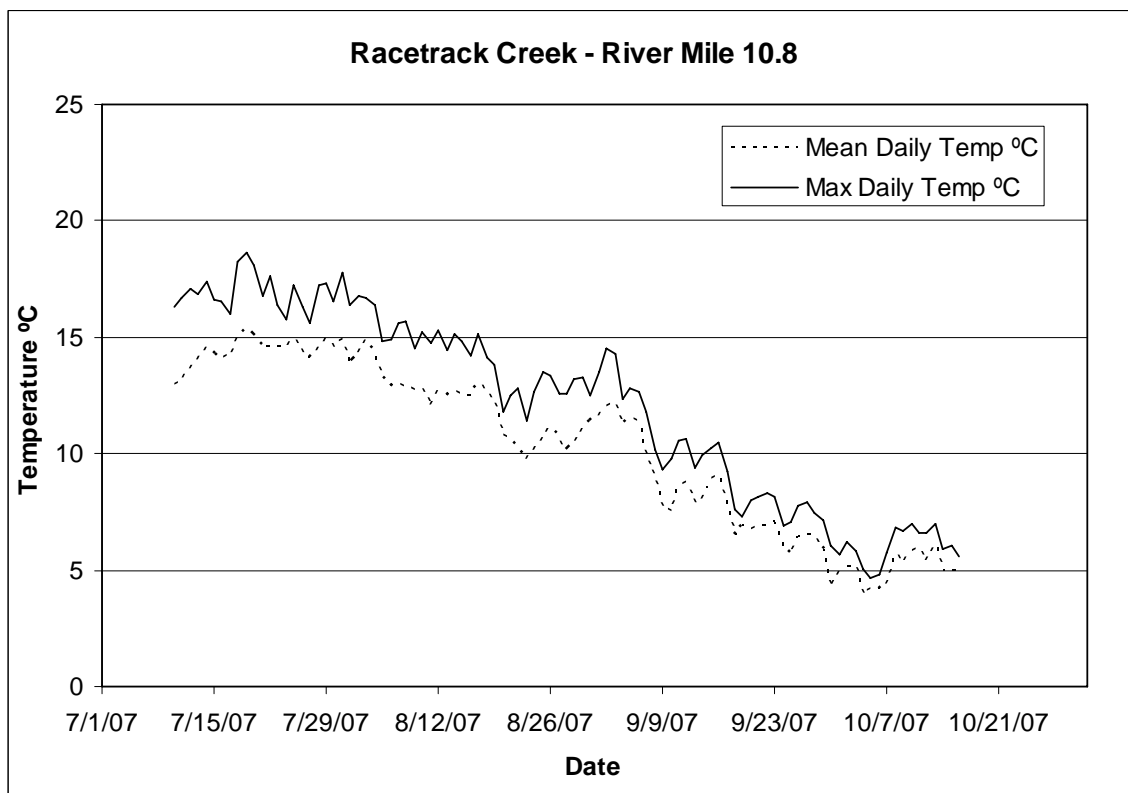
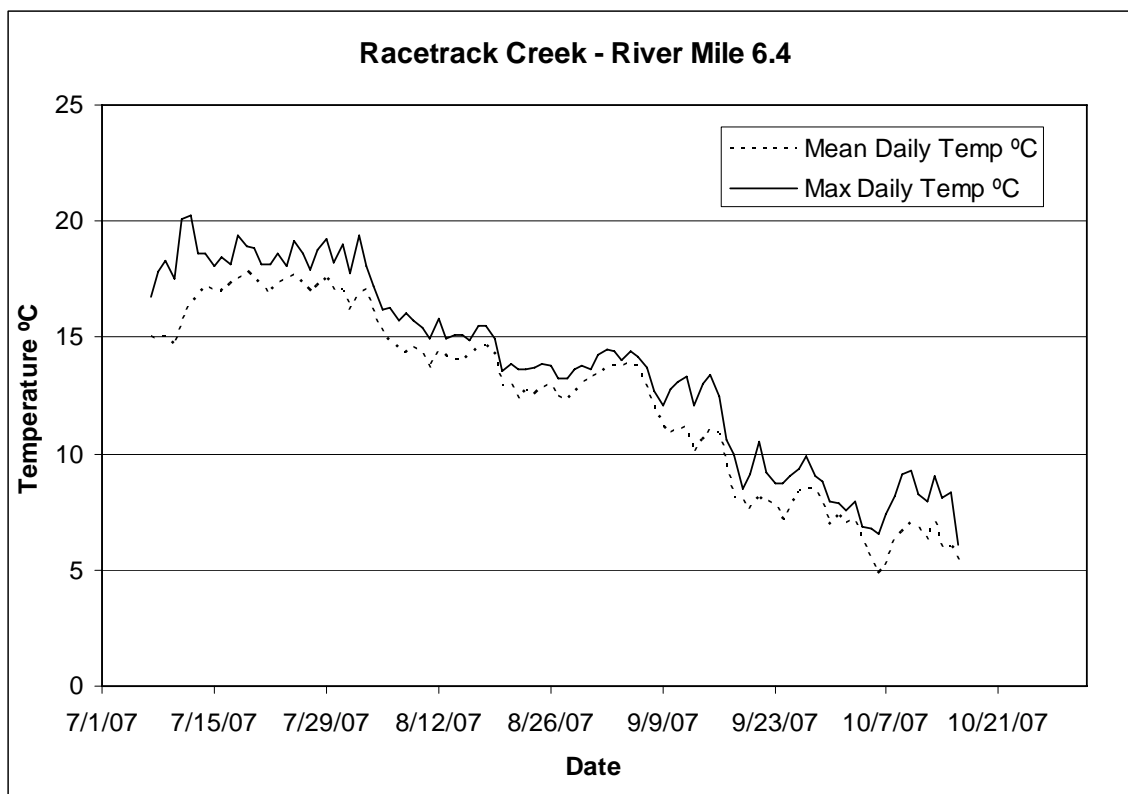


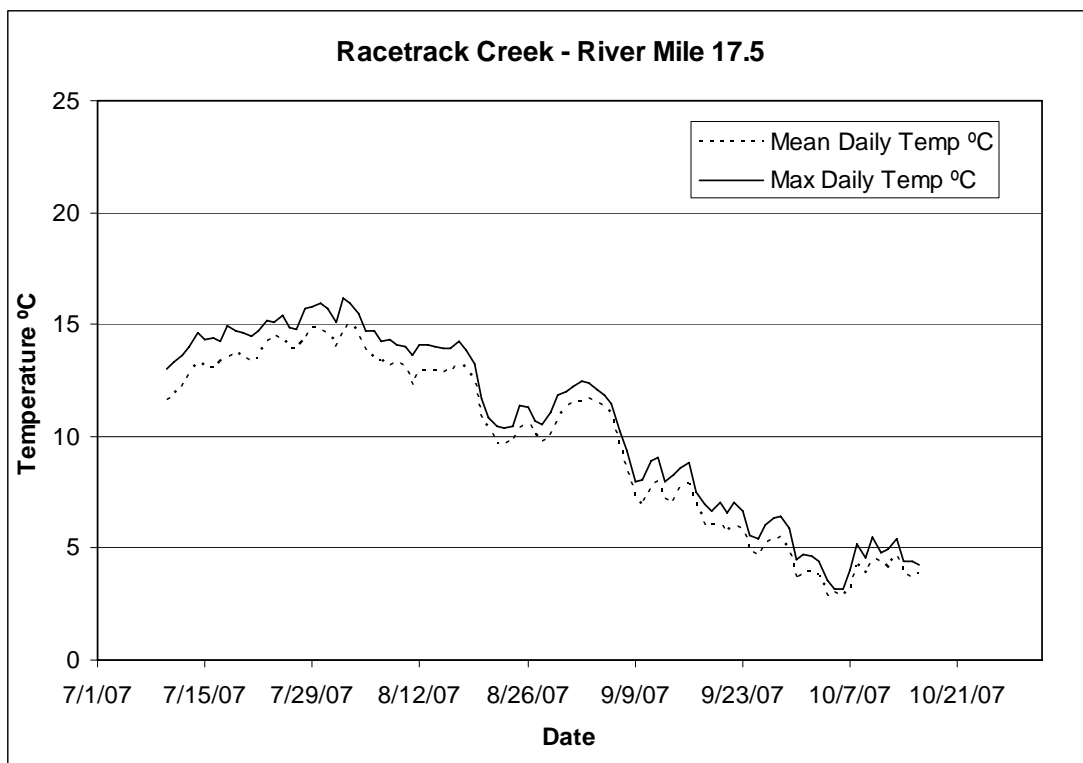


Racetrack Creek

Racetrack Creek

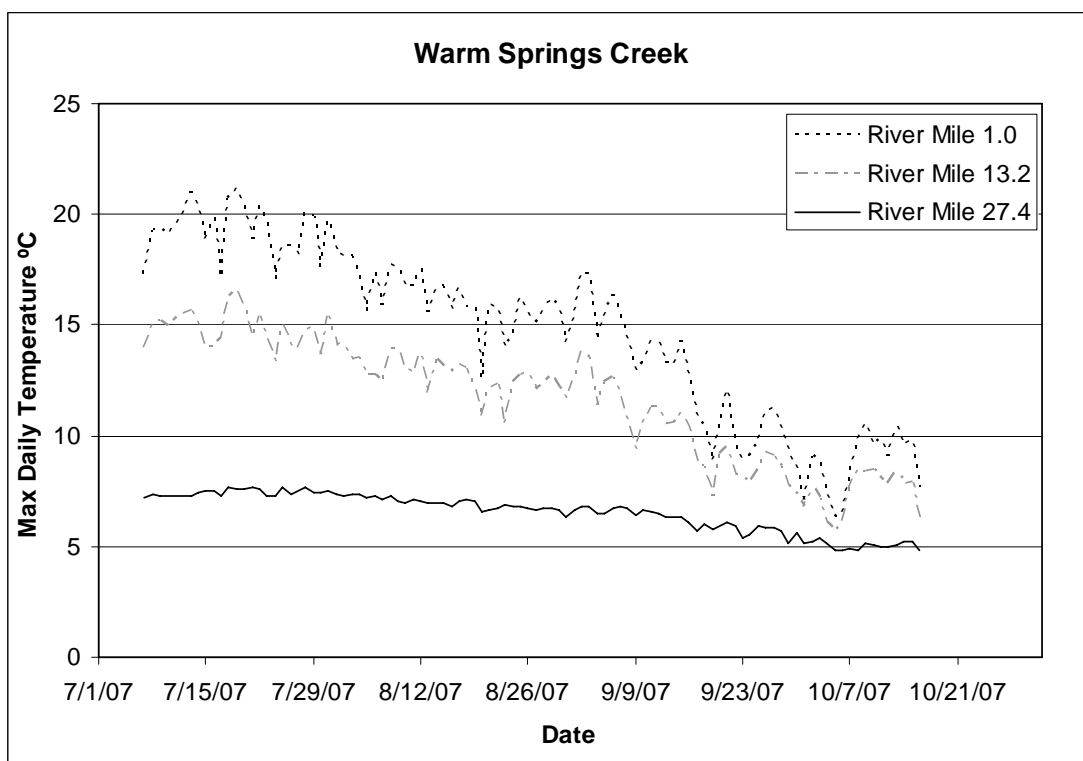


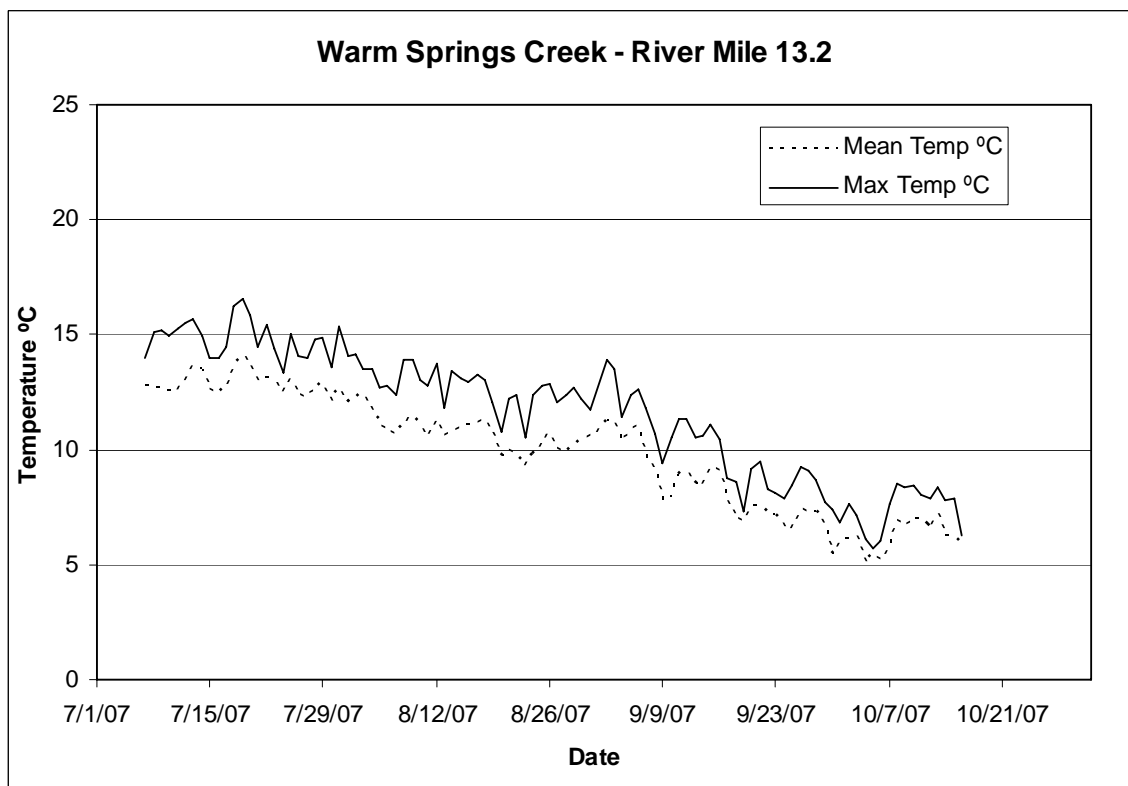
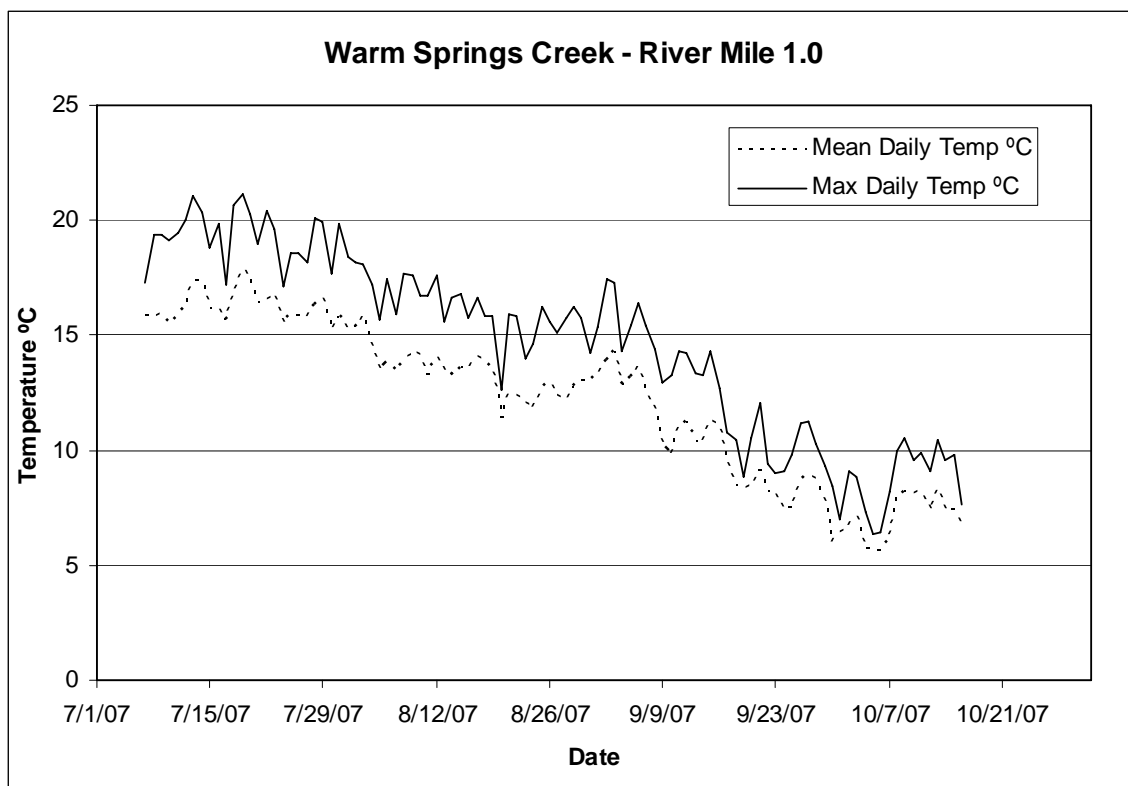


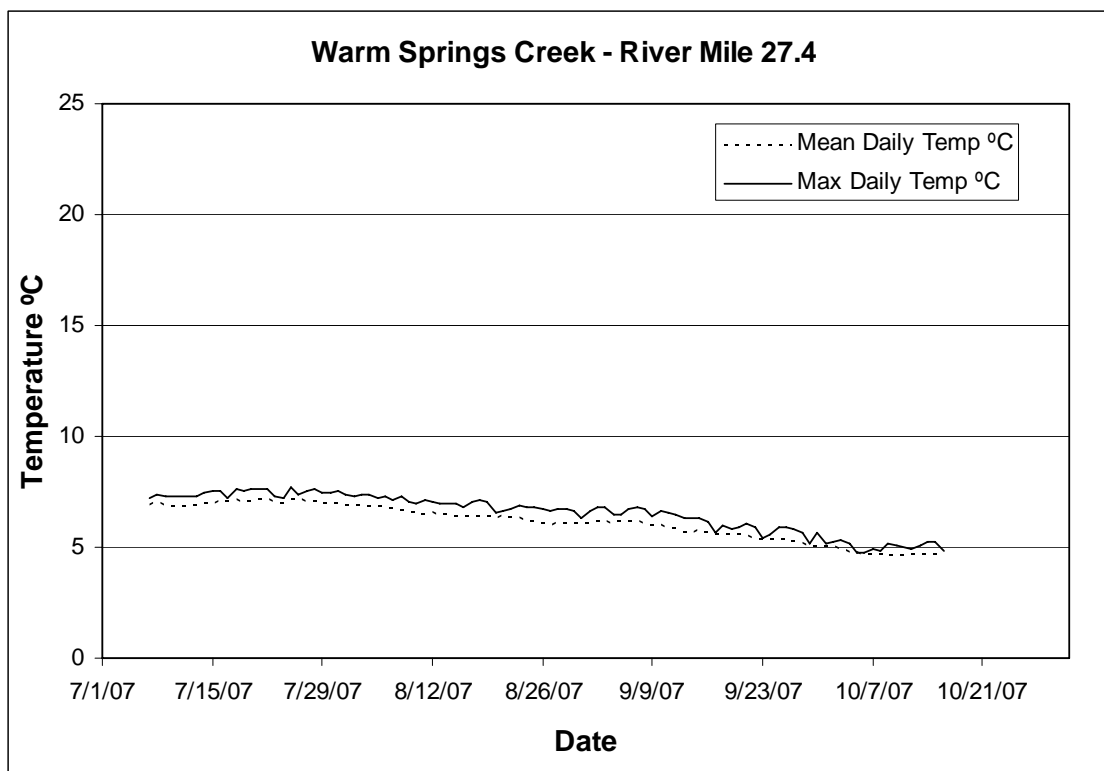


Warm Springs Creek

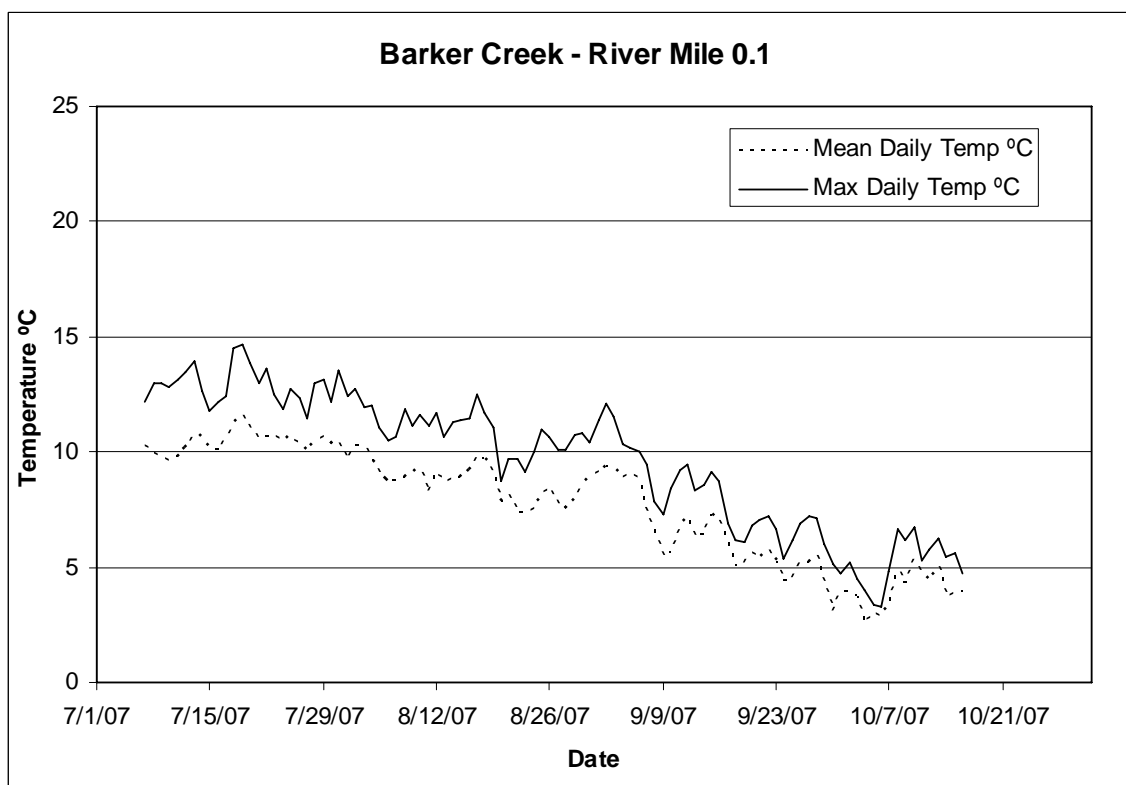
Warm Springs Creek



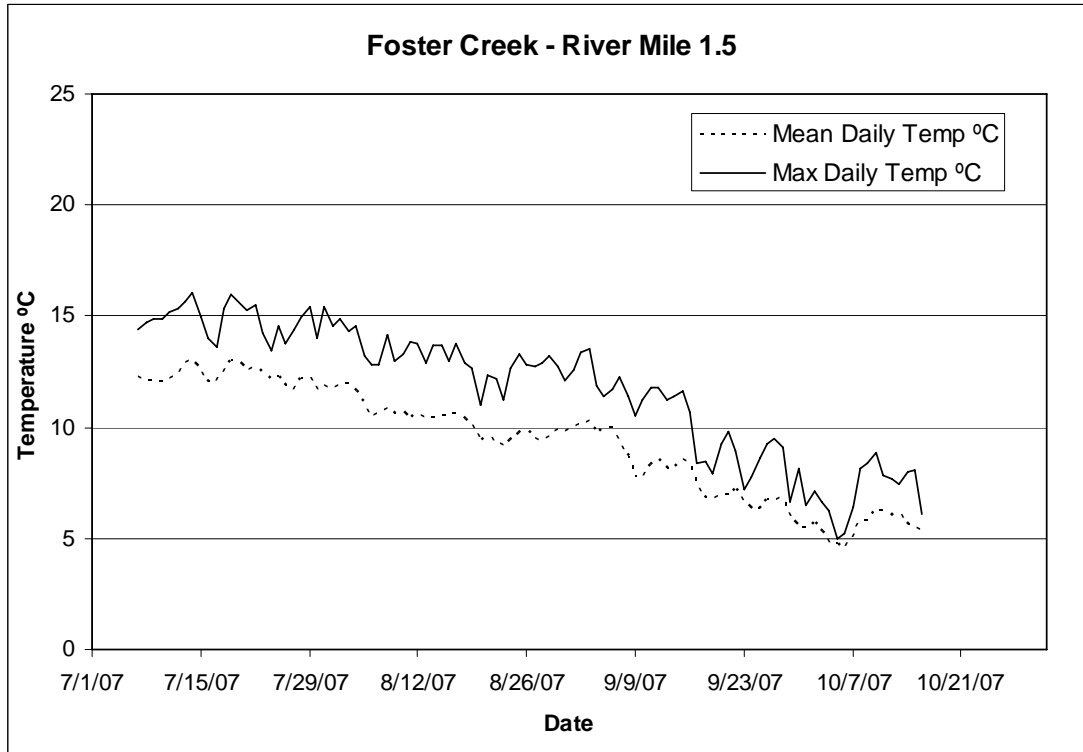




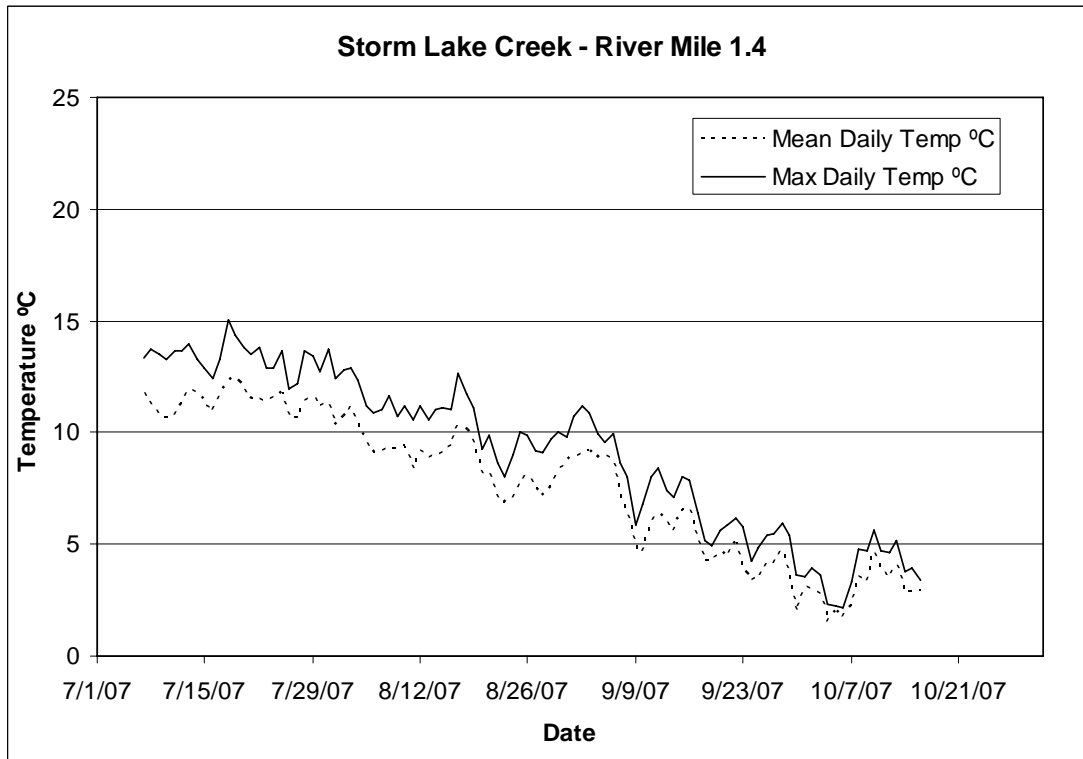
Barker Creek



Foster Creek



Storm Lake Creek



Appendix C

Environment Worksheet MT-1A
UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

RIPARIAN ASSESSMENT WORKSHEET

NAME OF STREAM: _____ REACH LOC OR ID: _____
DATE: _____ ID TEAM/OBSERVERS: _____
LENGTH OF REACH: _____ LAT/LONG - BEGIN/END: _____
MAP OR QUAD NAME: _____ PHOTO #S: _____
PRIMARY LAND USE: _____
PLANT COMMUNITY: _____ ROSGEN CHANNEL TYPE: _____
BFDEPTH: _____ BFWIDTH: _____
WIDTH/DEPTH RATIO: _____ CHANNEL SUBSTRATE : _____

Geomorphic Considerations

Question 1. Stream Incisement (Downcutting):

8 = Channel stable, no active downcutting occurring; or, old downcutting apparent but a new, stable riparian area has formed within the incised channel. There is perennial riparian vegetation well established in the riparian area (Stage 1 and 5, Schumm's Model Figure 2).

6 = Channel has evidence of old downcutting that has begun stabilizing, vegetation is beginning to establish, even at the base of the falling banks, soil disturbance evident (Stage 4, Schumm's Model Figure 2).

4 = Small headcut, in early stage, is present. Immediate action may prevent further degradation (Early Stage 2, Schumm's Model Figure 2).

2 = Unstable, channel incised, actively widening, limited new riparian area/floodplain, floodplain not well vegetated. The vegetation that is present is mainly pioneer species. Bank failure is common (Stage 3, Schumm's Model Figure 2).

0 = Channel deeply incised, resembling a gully, little or no riparian area, active downcutting is clearly occurring. Only occasional or rare flood events access the flood plain. Tributaries will also exhibit downcutting or signs of downcutting (Stage 2, Schumm's Model Figure 2).

The presence of active headcuts should nearly always keep the stream reach from being rated Sustainable.

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments:

Question 2. Streambanks with Active Lateral Cutting (inspect banks on both sides of the stream):

8 = Lateral bank erosion is in balance with the stream and its setting.

5 = There is a minimal amount of human-induced, active lateral bank erosion occurring, primarily limited to outside banks.

3 = There is a moderate amount of human-induced active lateral bank erosion occurring on either or both outside and inside banks.

0 = There is extensive human-induced lateral bank erosion occurring on outside and inside banks and straight sections.

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments:

Question 3. The Stream is in Balance with the Water and Sediment Supplied by the Watershed:

6 = The width to depth ratio appears to be appropriate for the stream type and its geomorphic setting. There is no evidence of excess sediment removal or deposition. There are no indications that the stream is widening or getting shallower. There may be some well-washed gravel and cobble bars present. Pools are common. Rosgen "B" and naturally occurring "D" channel types are exceptions.

4 = The stream has widened and/or has become shallower due to disturbances that have caused the banks to become unstable or from dewatering which reduces the amount of water and energy needed to effectively move the sediment through the channel. (Note: Sediment sources may also be from offsite sources.) Point bars are often enlarged by gravel with silt and sand common, and new bars are forming. Pools are common, but may be shallow. Rosgen "B" and naturally occurring "D" channel types are exceptions.

2 = The width to depth ratio exceeds what is appropriate for the stream type. Point bars are enlarged by gravel with abundant sand and silt, and new bars are forming that often force lateral movement of the stream. Mid channel bars are often present. For prairie streams there is often a deep layer of sediment on top of the gravel substrate. The frequency of pools is low. Rosgen "B" and naturally occurring "D" channel types are exceptions.

0 = The stream has poor sediment transport capability which is reflected by poor channel definition. The channel is often braided having at least 3 active channels. Naturally occurring Rosgen "D" channels types are exceptions. Pools are filled with sediment or are not existent.

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments:

Vegetative Considerations

Question 4. Streambank with Vegetation (Kind) having a Deep, Binding Rootmass:

Note: For stream types where riparian vegetation is not required for sustainability, this question can be skipped and given an N/A, with an explanatory note or comment. Be sure to adjust the potential score if this question is skipped.

(See Appendix I for stability ratings for most riparian, and other, species.)

6 = The streambank vegetative communities are comprised of at least four plant species with deep, binding root masses.

4 = The streambank vegetative communities are comprised of at least three plant species with deep, binding root masses.

2 = The streambank vegetative communities are comprised of two plant species with deep, binding root masses.

0 = The streambank vegetative communities are comprised of one or no plant species with deep, binding root masses.

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments:

Question 5. Riparian/Wetland Vegetative Cover (Amount) in the Riparian/Floodplain Area:

Note: For stream types where riparian vegetation is not required for sustainability, this question can be skipped and given an N/A, with an explanatory note or comment. Be sure to adjust the potential score if this question is skipped.

6 = More than 85% of the riparian/wetland canopy cover has a stability rating > 6

4 = 75%-85% of the riparian/wetland canopy cover has a stability rating > 6

2 = 65%-75% of the riparian/wetland canopy cover has a stability rating > 6

0 = Less than 65% of the riparian/wetland canopy cover has a stability rating > 6

NOTE: A low score for this item may be enough to keep the stream reach from being rated Sustainable

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments:

Question 6. Noxious Weeds in the Riparian Area:

3 = None of the riparian area has noxious weeds present.

2 = Up to 5% of the riparian area has noxious weeds (a few are present).

1 = Up to 10% of the riparian area has noxious weeds present (abundant).

0 = Over 10% of the riparian area has noxious weeds (very apparent and extensive distribution).

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments: (NOTE: List all noxious weed species)

Question 7. Disturbance-Caused Undesirable Plants in the Riparian Area:

3 = 5% or less of the riparian area with undesirable plants (very few present).

2 = 5-10% of the riparian area with undesirable plants (few are present).

1 = 10-15% of the riparian area with undesirable plants (commonly distributed).

0 = Over 15% of the riparian area with undesirable plants (abundant over much of the area).

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments: (NOTE: List all nuisance weeds and undesirable plants)

Question 8. Woody Species Establishment and Regeneration: Note: For stream types where riparian vegetation is not required for sustainability, this question can be skipped and given an N/A, with an explanatory note or comment. Be sure to adjust the potential score if this question is skipped.

8 = All age classes of desirable woody riparian species present (see Table 3).

6 = One age class of desirable woody riparian species is clearly absent, all others well represented. Often, it will be the middle age group(s) absent. For sites with potential for both trees and shrubs there may be one age class of each absent. Having mature individuals and at least one younger age class present indicates the potential for recovery.

4 = Two age classes (seedlings and saplings) of native riparian shrubs and/or two age classes of native riparian trees are clearly absent, or the stand is comprised of mainly mature species. Other age classes well represented.

2 = Disturbance induced, (i.e. facultative, facultative upland species such as rose, or snowberry) or non-riparian species dominate. Woody species present consist of decadent/dying individuals. (Refer back to Question 1 if this is the situation. The channel may have incised.)

0 = A few woody species are present (<10% canopy cover), but herbaceous species dominate (at this point, the site potential should be re-evaluated to ensure that it has potential for woody vegetation); or, the site has at $\geq 5\%$ canopy cover of Russian olive and/or salt cedar. On sites with long-term manipulation or disturbance, woody species potential is easily underestimated.

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments:

Functional Considerations

Question 9. Utilization of Trees and Shrubs: Note: For stream types where riparian vegetation is not required for sustainability, this question can be skipped and given an N/A, with an explanatory note or comment. Be sure to adjust the potential score if this question is skipped.

4 = 0-5% of the available second year and older stems are browsed.

3 = 5%-25% of the available second year and older stems are browsed (lightly).

2 = 25%-50% of the available second year and older stems are browsed (moderately).

1 = More than 50% of the available second year and older stems are browsed (heavily). Many of the shrubs have either a “clubbed” growth form, or they are high-lined or umbrella shaped .

0 = There is noticeable use (10% or more) of unpalatable and normally unused woody species

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate

Comments:

Question 10. Floodplain Characteristics for Dissipating Energy and Capturing Sediment.
8 = Active flood or overflow channels exist in the floodplain. Large rock, woody debris, and/or riparian vegetation appropriate for the setting are sufficient to adequately dissipate stream energy and trap sediment on the floodplain. There is little evidence of excessive erosion or disturbance that reduces energy dissipation and sediment capture on the floodplain. There are no headcuts where either overland flow and/or flood channel flows return to the main channel.

6 = The floodplain meets the characteristics of the description in Question 8 above, but demonstrates slight limitations in the kind and amount of large rock, woody debris, and/or riparian vegetation present. Riparian vegetation structure is below that required to dissipate energy. There may be occasional evidence of surface erosion and disturbance, but generally not extensive enough to have affected channel development.

4 = Large rock, woody debris, and/or riparian vegetation is present, but generally insufficient (quality or quantity) to fully dissipate stream energy. Some sediment may be captured, but greater evidence of incipient erosion and/or headcuts is readily present.

2 = Inadequate Large rock, woody debris, and/or riparian vegetation is available for dissipation of energy or sediment capture. There is very little evidence of sediment capture. There is some streambank erosion due to human disturbance or alterations, and occasional headcuts where overland flows or flood channel flows return to the main channel.

0 = Floodplain area reflects the following conditions: 1) The floodplain area is very limited or not present and is inadequate to dissipate energy; 2) flood or overflow channels do not exist; and 3) large rock, woody debris, and/or riparian vegetation is not adequate to dissipate stream energy and trap sediment on the floodplain. Streambank and/or floodplain erosion and/or evidence of human alteration are common. "G"- and "F"-type channels (Rosgen) typically reflect these conditions.

SCORE: Potential _____ Actual _____

Please clarify the rationale for your score, including comments regarding potential and capability and document with photograph if appropriate.

Comments:

SUMMARY SCORE

POTENTIAL /ACTUAL /POSSIBLE

QUESTION 1: Stream Incisement 0, 2, 4, 6, 8

QUESTION 2: Lateral Cutting 0, 3, 5, 8

QUESTION 3: Stream Balance 0, 2, 4, 6

QUESTION 4: Deep, Binding Rootmass N/A, 0, 2, 4, 6

QUESTION 5: Riparian/Wetland Vegetative Cover * N/A, 0, 2, 4, 6

QUESTION 6: Noxious Weeds 0, 1, 2, 3

QUESTION 7: Undesirable Plants 0, 1, 2, 3

QUESTION 8: Woody Species Establishment N/A, 0, 2, 4, 6, 8

QUESTION 9: Browse Utilization N/A, 0, 1, 2, 3, 4

QUESTION 10: Riparian Area/Floodplain Characteristics * N/A, 0, 2, 4, 6, 8

TOTAL (60 total possible)

(POTENTIAL SCORE FOR MOST BEDROCK OR BOULDER STREAMS) (36)

(questions 1, 2, 3, 6, 7, 10)

(POTENTIAL SCORE FOR MOST LOW ENERGY "E" STREAMS) (48)

(questions 1 – 7, 10)

RATING: = Actual Score X 100 = % rating

Potential Score

80-100% = SUSTAINABLE

50-80% = AT RISK

LESS THAN 50% = NOT SUSTAINABLE

* Only in certain, specific situations can both of these receive an "N/A".

Please clarify the rationale for your rating, including comments regarding potential. Can the limitations be addressed by the decisionmaker?

NOTES

TREND: Does the reach appear to be improving or declining? Explain.

NRCS, MT

September 2004

FISH HABITAT ASSESSEMENT WORKSHEET

Name of Stream _____ Reach Loc or ID _____

Date _____ Reach Length _____ Observer(s) _____

Question 1. Fish habitat quality as related to available cover*

10 = Excellent – A reach exhibits EXCELLENT fish habitat when there is an even mix of cover components including large woody debris, large pools, root wads, overhanging vegetation, boulders and undercut banks. A reach with EXCELLENT fish habitat should also have a fair amount of shallow areas and small side channels at the stream margins that provide habitat for young-of-the-year and juvenile fish.

7 = Good – A reach exhibits GOOD fish habitat when the above cover components are present but may be somewhat lacking in quantity or quality in one or more of those components.

3 = Fair – A reach exhibits FAIR fish habitat when one or more of the above cover components is severely limited in quantity or quality or is completely absent from the reach.

0 = Poor – A reach exhibits POOR fish habitat when all or most of the above cover components are absent or are severely limited.

SCORE: Potential _____ Actual _____

Notes: Be sure to note instream cover components present within the surveyed reach as well as their general quantity and quality. Note the potential for future recruitment of large woody debris to the channel (i.e. are there trees within one tree length of the channel?). Also, note if the reach appears to provide potential spawning habitat (i.e. glide/run habitats with well sorted and clean gravels).

*** Some channel types may not require all cover components to be considered healthy. For example, E channels typically do not require abundant large woody debris or boulders as critical components of fish habitat, and healthy A and B channels do not necessarily require a significant proportion of undercut banks. It is best to think about what cover components would be expected under pristine conditions given the channel type and riparian vegetation present (THIS IS THE POTENTIAL).**

NAME OF STREAM: _____ REACH ID: _____

DATE: _____

SUPPLEMENTAL ATTRIBUTES

Note: These attributes are used to help characterize the condition of aquatic habitat and water quality associated with the riparian reach. As appropriate, complete a separate form for each reach. Check the most appropriate narrative criterion for the reach along with entering notes to explain the rationale for the value. A score is not calculated for this supplemental assessment. Please clarify the rationale for your rating, including comments regarding potential and document with photograph(s), if appropriate.

1) AQUATIC LIFE SUBSTRATE HABITATS

Excessive sediment deposited on the substrate often suffocates fish eggs and destroys macroinvertebrate habitat, especially if it occurs in fast moving/riffle dominated streams. For prairie streams the excessive sediment may also bury the aquatic vegetation. Excessive silt and sand often fills the interstices between the cobbles and gravel causing them to become embedded (cemented together or difficult to move).

Stream Bottom (For Fast moving/Riffle dominated streams)

___ Stony substrate of several sizes packed together, interstices obvious. Some silt may be present. Substrate is easily moved.

___ Stony substrate is interspersed with silt and sand. Cobbles are partially embedded and not easily moved. There are also usually slight depositions of sand and silt at the fringes of the stream channel and in the pools.

___ Bottom of silt, gravel and sand, cobbles are fully embedded and extremely difficult to move.

___ Uniform bottom of sand and silt loosely held together, stony substrate absent or buried.

Stream Bottom (For slow moving/pool dominated streams)

___ Mixture of substrate material with gravel or firm sand prevalent and/or vascular root mats and submerged vegetation abundant.

___ Mixture of gravel with soft sand and silt common; and/or some vascular root mats and submerged vegetation.

___ Mixture of soft sand, silt or clay; gravel is not common and little or no vascular root mats or submerged vegetation present.

___ All mud or clay, or channelized with sand bottom and no vascular root mats or submerged vegetation

Comments:

2) FISH HABITATS

Fish and their fry need a variety of habitat types to flourish. This usually includes a mix of deep and shallow pools and security cover that are created by vegetation, woody debris, boulders, undercut banks, etc. The type of habitat that is important is dependant of the stream type. For example, woody debris and overhanging vegetation are often important for small Rosgen “A” and “B” streams that are in a forested environment while large deep pools and aquatic vegetation are important for Rosgen “C” channels in the prairie. Please note that short-term climatic effects such as high flows or drought should be considered when assessing fish habitat.

___ Even mix of deep, shallow, large and small pools (prairie streams would expect long deep pools); habitats created by woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or abundant aquatic vegetation.

___ Shallow pools more prevalent than deep pools; limited habitats created by woody debris, overhanging vegetation, boulders, root wads, undercut banks and/or aquatic vegetation are limited.

___ Majority of pools are small and shallow or pools are absent; Habitats created by woody debris, overhanging vegetation, boulders, root wads, or undercut banks and/or aquatic vegetations are rare or nonexistent.

___ There is not enough water to support a fishery due to human-induced dewatering

___ Streams would not support fish under natural conditions due to insufficient flow.

Comments:

3) TEMPERATURE INDICATORS

Elevated temperatures often have a negative impact on the fishery and aquatic life, especially for cold-water streams that are located within the mountains, intermountain valley and prairie foothills of western Montana. For small streams the lack of shade from riparian vegetation or other physical features such as undercut banks are often an important factor that causes elevated temperatures. While for all streams the storage of water by small dams or the widening of a stream channel and decrease in pool depth that exposes a larger volume of the stream's water to solar radiation will often cause the temperature to increase during the summer. Another practice that can severely elevate the stream temperature is irrigation, either by chronic de-watering or through returning warm surface irrigation water to the stream. Also, intensive land uses within the watershed can decrease rainfall or snowmelt infiltration, change runoff patterns (i.e., streams often have a flashier hydrograph) and reduce the amount of groundwater (which tends to be cold) that is discharged into the stream during the late summer when the air temperatures are high.

___ The stream has adequate shading, stable geomorphology and sufficient flow or return flow to prevent the water temperature from becoming a stressor (Note: prairie streams and E channels may not have much potential for shading from vegetation and elevated temperatures from beaver ponds are considered to be natural stressors).

___ The shading, stream width, flow and presence or water storage (i.e., presence of water impoundments) have been ___ The shading, stream width, flow or water storage (i.e., presence of water impoundments) has been altered sufficiently enough where the temperature will likely become moderately elevated and aquatic life are impacted. Intensive land uses within the watershed may have an effect on the amount of groundwater discharging into the stream during the summer.

___ The shading, stream width, flow or water storage (i.e., presence of water impoundments) has been altered sufficiently enough where the temperature will likely become elevated to a level where aquatic life are severely impacted. Intensive land uses within the watershed may have a severe effect on the amount of groundwater discharging into the stream during the summer.

Comments:

4) FLOW

The lack of flow or unnatural flow alterations often negatively impact aquatic life habitats for a variety of reasons including loss of habitat or increased salinity (i.e., low flow in prairies streams) or increased sediment. The effects from de-watering should be assessed during critical low flow periods or else you should inquire locally about this with fish biologists, anglers, landowners, etc. You should also consider and evaluate the effects from local land uses, inter-basin transfer (too much water) and hydrologic alterations such as dikes and dams which may prevent a stream's ability to access its historic flood plain or cause a stream reach to become de-watered, etc.

___ There is no noticeable alteration to the flow.

___ Change in flow is noticeable; however flow appears to be adequate for aquatic life.

___ Flow supports aquatic life, but habitat, especially riffles are drastically reduced or impacted and the pools are shallow; or there may not be a sufficient amount of flow during the spring runoff that accesses the floodplain (impacts of storage reservoirs). Or there are unnatural flows (volume and/or duration) that are likely to impact aquatic life. Intermittent prairie streams may have pools with high salinities caused by evaporation.

___ Water is present but not sufficient enough to support a diversity of aquatic life, especially fish. Pools dominate and are shallow and disconnected.

___ All water has been diverted from the stream channel or flows are so low that they would not support aquatic life.

Comments:

5) NUTRIENT INDICATORS

Nitrogen and phosphorus are macronutrients that are usually associated with aquatic plant growth and abundance. Algal biomass, and in some cases vascular aquatic plants, are response variables to nutrient concentrations and directly affect the beneficial uses of a stream. A few detrimental effects of excessive algae include: reduced aesthetic and recreational opportunities; impairment of aquatic life caused by the depletion of dissolved oxygen; clogging of pumps for agricultural and industrial uses; or an unpleasant taste or odor that may impact the ability to use the water as a source of drinking water.

Algal biomass and in some cases vascular aquatic plants are response variables to nutrient concentrations and directly affect recreation use (and aesthetics), aquatic life and possibly other uses. Nitrogen and phosphorus concentrations usually limit the growth and abundance of algae. Microalgae (diatoms) are useful ecological indicators because they are found in abundance in most aquatic environments. A healthy stream has a sufficient amount of microalgae to cause the rocks to be slippery. These algae are often observed as a green or brown growth on the stream substrate (e.g., cobbles). Excessive microalgae growth is often an indicator of high nutrient levels. Large amounts of filamentous algae are usually good indicators of high nutrient levels. However, there are exceptions. For example, filamentous algae can be found in cold clear streams that are near ground water discharge areas. In these cases, the filamentous algae tend to be short and patchy, the density is usually low, and occurrences are not widespread. Phytoplankton is algae that is suspended in the water column and causes the water to appear to be turbid and green. It is usually found in unstable prairie streams where aquatic plants and benthic algae communities are not able to establish. Do not confuse algal growth with that of vascular plants such as macrophytes. Healthy prairie streams and low gradient mountain and foothill streams often have well established macrophyte (submerged and emergent) communities that indicate stable conditions. The abundance of algae is often used as an indicator of nutrient enrichment. However, the assessor should be aware that toxics, light, temperature, de-watering, and scouring also affect algae growth. Please include comments regarding the current condition that stimulate or hinder the growth of algae, including weather, light, temperature, scouring, etc.

Estimate the percent of the substrate that is covered with filamentous algae or aquatic plants ____%.

____ A thin layer of algae is barely visible or rocks are slippery, patches of filamentous algae are short and occur occasionally.

____ Accumulation of algae layer is easily visible on cobbles and along the channel edge. Filamentous algae may be present but filaments are short and patchy and occurrences are not widespread.

____ There are thick micro-algae (diatom) layers on the cobble and/or filamentous algae are common. Prairie streams (pools) may appear to be green or have small-suspended particles (not clay or silt) due to phytoplankton growth or abundant rooted pondweeds (macrophytes) are present.

____ Algae mats cover the bottom (hyper enriched conditions) or plants not apparent and rocks not slippery (toxic conditions; e.g., from mining drainage).

Comments:

OBSERVATIONS

1) DESCRIBE ANY POSSIBLE FISH BARRIERS OR ENTRAINMENT OF FISH INTO WATER DIVERSIONS. Culverts, water diversions, dams and other structures can often have a serious impact on fish populations by either preventing access to an upper or lower stream reach or by literally removing the fish from the stream.

2) DESCRIBE ANY OBSERVATIONS OF SURFACE OILS, TURBIDITY, SALINIZATION, PRECIPITANTS OR WATER ODOR.

3) DESCRIBE THE MACROINVERTEBRATE COMMUNITY. For flowing waters are there black fly larva on cobbles that would indicate organic enrichment? Are macroinvertebrates rare or absent or does there appear to be a diverse macroinvertebrate community?

4) FULLY DESCRIBE ALL LAND USE ACTIVITIES THAT MAY IMPACT WATER QUALITY OR HABITAT that are adjacent to the stream such as concentrated livestock operations, wastewater discharges, mines, row crops, etc. Review aerial photography and talk to the landowners to determine historic land uses and current management approaches.

5) IF YOU HAVE A METER, RECORD THE PH, TEMPERATURE, SPECIFIC CONDUCTIVITY AND DISSOLVED OXYGEN. Include the time of day and estimated or measure discharge for the time period in which these measurements were taken.

6) IS THERE EVIDENCE OF ICE SCOUR OR RECENT FLOODING? If so, please describe the extent and impacts (such as scoured stream banks with exposed soil) that ice scour or flooding may have on stream bank or channel stability.

7) LEVEL OF CERTAINTY. Please describe the level of certainty of the assessment based on the degree of accessibility to the stream reach. Rank the level of certainty (1-4) according to the following narratives:

Level 1 No access. The stream reach was not walked at any location. Only aerial interpretations were made.

Level 2 Limited on stream access. The stream reach was accessed at 1-3 locations and observations from an adjacent road were minimal.

Level 3 Multiple points along the stream reach were accessed and/or a large percentage of the stream was viewed from an adjacent road (in combination with several access points).

Level 4 The entire stream reach was accessed.

The level of certainty for the assessment:

NRCS, MT
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