Upper Clark Fork River Fish Sampling

2008-2010

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INTRODUCTION

The Upper Clark Fork River lies near the heart of western Montana flowing for over 120 miles in a northwesterly direction from its headwaters near Warm Springs to where it meets the Blackfoot River at Milltown, just east of Missoula. Throughout its upper reaches, the Upper Clark Fork River meanders through agricultural lands used primarily for producing hay and pasturing livestock. The Upper Clark Fork Basin has a long history of human disturbance beginning in earnest in the mid 1800s when placer mining for gold began on many basin streams. By 1896, copper had become the target metal and mining and smelting operations near the town of Butte, located near the headwaters of the Clark Fork, were processing over 4,500 tons of copper ore per day (Luoma et al., 2008). By the turn of the 20th century, one of the largest smelters in the world was constructed in Anaconda, about 25 miles northwest of the mines in Butte. Mining and smelting activities in the Butte and Anaconda areas continued into the early 1980s. While some mining activity still persists near Butte to this day, most of the operations have now been completely shut down and abandoned. Nevertheless, the environmental consequences of over 100 years of mining activity in the Upper Clark Fork Basin have left their mark. Enormous amounts of fine material, mostly mine tailings, were released into the drainage, and were transported and deposited downstream throughout the river system. These tailings proved toxic to aquatic life and negatively altered the aquatic biological community of the upper river.

For years, the Upper Clark Fork River was considered void of fish, and it wasn't until efforts were made to try and retain some portion of the toxic tailings in the Warm Springs Treatment Pond System that water quality improved to a level where trout could begin to re-colonize the lower sections of the river, upstream of Missoula. However, by that time, most of the trout in the river were introduced species, including rainbow and brown trout. Brown trout have been shown to have a higher tolerance to metals and degraded habitat conditions than other trout species (e.g. Lipton et al., 1995; Woodward et al., 1995), and it is likely because of this that the species dominates the current trout community in much of the Upper Clark Fork River. While trout are fairly common in the upper river today, past research has shown that trout populations are approximately one fifth of what is expected without contamination from mining wastes (Hillman et al., 1995).

The Clark Fork River from its headwaters to the former Milltown Dam site was designated a Superfund Priority site in 1986. While cleanup activities have been underway for a number of years on Silver Bow Creek near Butte as well as at Milltown Dam near Missoula, active remediation work has yet to commence in earnest on the mainstem Clark Fork River at the time this report was written. However, this work is expected to begin within the next several years. Cleanup of metals-contaminated soils along the Upper Clark Fork River is expected to improve water quality and allow for more tolerable conditions for fish and other aquatic life. However, other factors that affect habitat quality in the Upper Clark Fork will also need to be addressed to adequately restore the Upper Clark Fork River fishery. Irrigation withdrawal can have severe impacts on summer stream flows in the river upstream of Deer Lodge, especially during drought years. Low flows increase water temperatures to levels not suitable for trout, and extensive algae

and aquatic plant growth impact dissolved oxygen levels along much of the river. Riparian vegetation along the river also tends to be in rather poor condition from over a century of livestock use of lands adjacent to the stream. Addressing these factors in concert with cleaning up the extensive mine wastes along the river will significantly improve aquatic habitat conditions in the Upper Clark Fork River. This in turn should improve fish densities and the recreational trout fishery. The Upper Clark Fork currently provides important recreational opportunities for angling, hunting and boating, and it is expected that demands for these activities will only increase in the future.

Over the past 30 years, regular monitoring of trout populations in the Upper Clark Fork River has focused on the sampling of two primary sections. These sections include the pH Shack section near Warm Springs and the Williams-Tavenner Section located several miles downstream of Deer Lodge. Since 2008, two additional sections were added to the monitoring program to provide an increased knowledge of how fish distribution and densities vary throughout the upper river, as well as to establish better baseline data prior to superfund cleanup work on the Clark Fork River beginning. The sections added include the Phosphate Section near Phosphate (added in 2008) and the Below Sager Lane Section located several miles upstream of Deer Lodge (added in 2010). All sampling has consisted of mark and recapture electrofishing during the spring (typically during the month of April) with a boat mounted electrofishing unit to obtain an estimate of the number of trout per mile of river. The following report summarizes the annual fish sampling activities completed on the Upper Clark Fork River for the period: 2008-2010.

METHODS

Fish Collection

Trout populations in the Upper Clark Fork River were monitored with electrofishing completed annually during the spring (typically during April) from 2008 through 2010. Population estimates were made using a mark and recapture technique. Fish were collected with the use of a boat (14-foot long aluminum drift boat) mounted electrofishing unit with fixed booms. The system was powered by a 5,000-watt generator and current was modified with a Coffelt VVP-15 rectifying unit. Smooth direct current was used at all times. Crews consisted of two people, one controlling the boat and the other standing in the bow capturing fish with a dip net. Typically, estimates were made using two marking passes done on consecutive days with one or two recapture passes completed about one week later. The only exception to this was in 2009 when only a single marking pass (and a single recapture pass) was made on each sample section. The reason for this was that upper river was sampled continuously in this year instead of at several distinct sections. Limited time only allowed for single passes to be made. All captured trout were identified to species, weighed, measured, given a small fin clip unique to the sampling section and day, and then released. In each sample reach, multiple stops were made to process fish and make sure fish were well distributed throughout the section.

Sample Reaches

Reaches of the Upper Clark Fork River sampled from 2008 through 2010 varied in all years, but long-term monitoring sections including the pH Shack Section (near Warm Springs) and the Williams-Tavenner Section (downstream of Deer Lodge) were completed in all years. In 2008 and 2010, additional sections were added near Phosphate (Phosphate Section) and above Deer Lodge (Below Sager Lane Section), respectively. These sections were added to further our knowledge of fish distribution and abundance in the upper river, as well as to establish a stronger baseline of fish populations prior to the startup of remediation and restoration activities on the Clark Fork River. Extra stream length was also added to the Williams-Tavenner Section in 2010 in an effort to increase the number of fish marked and improve capture efficiency.

In 2009, we continuously sampled the Upper Clark Fork River from Warm Springs to Jens. This effort was completed to give us a better understanding of how fish abundance, distribution, and species composition varied longitudinally. A similar effort was completed by FWP in 1987, and the data obtained from this sampling was re-analyzed and is presented in this report for the purpose of comparison. While most of the 1987 sample reaches were the same as what was surveyed in 2009, a few had slightly different upper and lower boundaries based on descriptions provided in the raw data sheets. Appendix A contains location information for all reaches of the Upper Clark Fork River sampled from 2008 to 2010. It also includes descriptions for the continuous reaches sampled in 2009 and 1987.

Data Analysis

Data collected during these sampling efforts (including data from 1987) were summarized by sample reach and by year. Fishery data were summarized as the population estimate for the section (standardized to number of fish per mile), capture efficiency, the total number of fish handled during mark and recapture runs (not including recaptured fish), mean and range of fish lengths, and percent of species composition. Population estimates were generated using a modified Peterson estimator provided in Montana Fish, Wildlife and Park's Fisheries Analysis + software package. Estimates and capture efficiencies were only reported for brown trout greater than 175 mm (~7 in) in length, due to low numbers and/or poor capture efficiency of other species and size classes. Length-frequency histograms were completed for brown trout captured in all sections during all years, and are included as an appendix to this report (Appendix B).

RESULTS & DISCUSSION

pH Shack Section

The pH Shack Section is located just downstream of the confluence of Silver Bow Creek and Warm Springs Creek, as well as the discharge of the Warm Springs Settling Ponds. The Warm Springs Ponds serve as a water treatment system for water flowing into them from heavily mine-polluted Silver Bow Creek. Despite being a treatment facility for metals laden water, the ponds are relatively shallow and tend to be biologically productive. Because of this, the discharge leaving the ponds is rich in nutrients. Aquatic insect abundance tends to be very high in the stream channel downstream of the discharge site, and fish density in this segment of the stream

has generally been found to be the highest of any site sampled on the Upper Clark Fork River. Throughout much the 1980s, brown trout density in the pH Shack Section was estimated to be in the area of 2,500 fish per mile. In the 1990s, upgrades were made to the ponds to make them more effective at treating Silver Bow Creek water. Since the modifications were made, trout populations have decreased in the pH Shack Section indicating that the modifications may have lessened the tail-water effect to some extent. Nevertheless, trout density tended to remain relatively high in the pH Shack Section from the mid 1990s into the early 2000's, with density averaging about 800 brown trout per mile.

A break in sampling occurred at the pH Shack section in the mid 2000s, but was resumed in 2008. In this year, the brown trout estimate in the section was 708 fish per mile (Table 1), a value close to the average calculated since the mid 1990s. However, in 2009 a notable change occurred at this section. In this year the estimate was only 185 brown trout per mile. This was the lowest density ever estimated in the section since sampling commenced in the 1970s. In 2010, the estimate was 421 brown trout per mile, up from 2009, but still on the low end of the range of previously estimated densities. While average fish size tended to be relatively large in all years (> 300 mm), the average size of the brown trout captured in 2009 tended to be larger than in 2008 or 2010. This is a direct result of the relative absence of younger age classes of fish in this year (Table 1; Appendix B). In 2010, younger age classes of brown trout were much more common in the pH Shack Section (Appendix B). This had a direct effect on the low capture efficiency in this year, since smaller fish tend to be much more difficult to recapture after being marked. In all years, brown trout comprised at least 95% or more of the trout community in the reach (Table 1.)

The explanation for why trout densities were so low in 2009 is still not well understood, but is presumed to be related to water quality. Water quality information recorded at the discharge of the Warm Springs Ponds showed that there were periods in 2009 when flow from the ponds did not meet standards for copper and/or arsenic. Despite this, the values reported suggest that it is unlikely that this could have led to a massive fish kill. However, it is possible that while some fish may have died, others moved out of the section in an effort to avoid the elevated contaminants coming out of the ponds. Additionally, recent information has shown that ammonia is becoming an increasing problem in the pond system. Fish tend to avoid ammonia, so it is possible that elevated ammonia levels coming out of the ponds may be having an impact on fish presence in the reach immediately downstream of the discharge source. Spring turnover in the ponds may also be affecting recent observations at the pH Shack Section. In talking with representatives managing the Warm Springs Ponds system, spring turnover tends to occur in early April. This correlates with the time when fish sampling is conducted. There is a chance that fish are moving out of the section during turnover to potentially avoid poorer water quality coming out of the ponds during these events. Annual population monitoring in conjunction with more water quality and fish health data will hopefully allow for a better explanation of what is currently happening at the pH Shack Section with regards to the relative instability of the trout population in the reach.

Table 1. Electrofishing data collected on the Upper Clark Fork River at the pH Shack Section from 2008 through 2010. Population estimates and capture efficiencies are for brown trout greater than 175 mm (~7") in total length. Number following the population estimate (in parentheses) represents the 95 % confidence interval. Cutt x Rbow represents a phenotypic hybrid between a cutthroat and rainbow trout.

Year	Trout Species	Population Estimate (fish/mile)	Capture Efficiency (%)	# of Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
2008	Brown	708 (+/- 102)	26	567	318	88-461	99
	Rainbow	-	-	5	388	296-502	< 1
	Cutthroat	-	-	3	365	355-381	< 1
2009	Brown	185 (+/- 73)	22	116	357	96-500	95
	Rainbow	-	-	5	362	302-560	4
	Cutthroat	-	-	1	383	-	1
2010	Brown	421 (+/- 149)	15	232	300	111-615	95
	Rainbow	-	-	5	478	312-565	2
	Cutthroat	-	-	3	260	252-276	1
	Cutt x Rbow	-	-	3	357	338-392	1

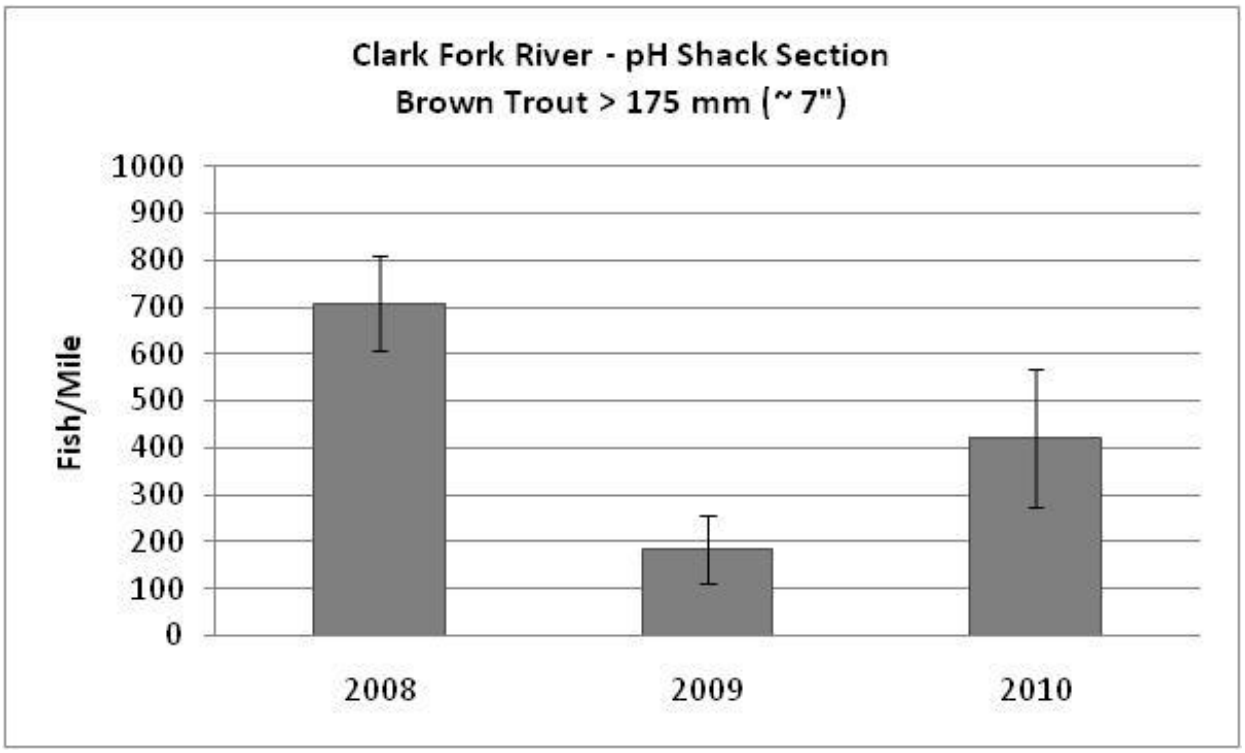

Figure 1. Population estimates for brown trout on the Upper Clark Fork River at the pH Shack Section from 2008 through 2010. Error bars represent the 95% confidence interval.

Below Sager Lane Section

The Below Sager Lane Section is located approximately 4.5 miles upstream of Deer Lodge, and was added to the monitoring program in 2010. The section is located downstream of many of the more significant irrigation diversions on the Upper Clark Fork, in a reach that can suffer rather severe dewatering during drought years. In 2010, the brown trout estimate was 262 fish per mile (Table 2). The species represented 99% of the trout community in the reach (Table 2). While average fish size was slightly less than 300 mm in total length, fish in the section tended to be dominated by young juveniles and larger adults (Appendix B). Middle age classes were noticeably less common.

Table 2. Electrofishing data collected on the Upper Clark Fork River at the Below Sager Lane Section in 2010. Population estimates and capture efficiencies are for brown trout greater than 175 mm (~7") in total length. Number following the population estimate (in parentheses) represents the 95 % confidence interval.

Year	Trout Species	Population Estimate (fish/mile)	Capture Efficiency (%)	# of Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
2010	Brown	262 (+/- 85)	14	383	293	93-525	99
	Brook	-	-	3	232	125-293	< 1
	Rainbow	-	-	1	645	-	< 1

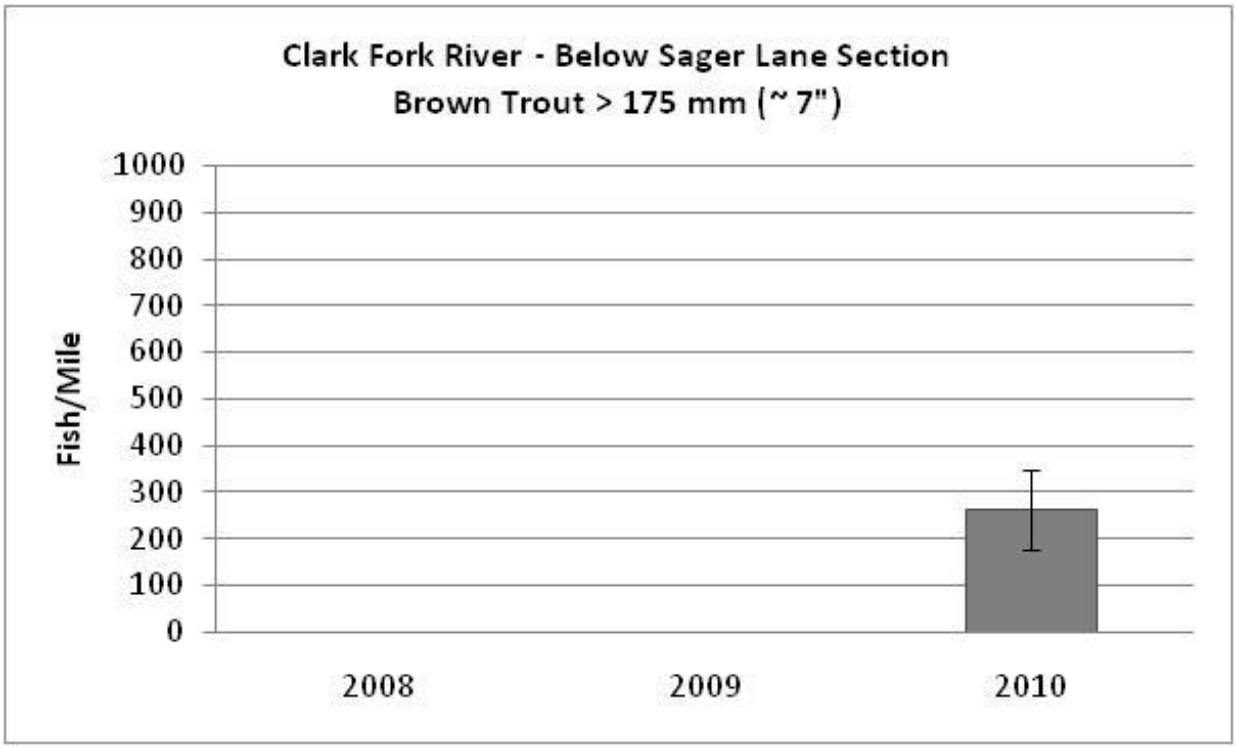

Figure 2. Population estimates for brown trout on the Upper Clark Fork River at the Below Sager Lane Section in 2010. Error bars represent the 95% confidence interval.

Williams-Tavenner Section

The Williams-Tavenner Section is located approximately 6.5 miles downstream of Deer Lodge, and 3 miles below the discharge point of the city of Deer Lodge's sewer treatment plant. The trout population in this reach has been monitored since the early 1980s. From this period through the early 2000s, the average brown trout density in the Williams-Tavenner Section was a little less than 200 brown trout per mile. Throughout the more recent period from the mid-1990s through the early 2000s, the average was a just over 100 brown trout per mile.

In 2008, the estimated brown trout density in the William-Tavenner Section was 324 fish per mile (Table 3; Figure 3). This was one of the highest estimates on record for the section, although there is no clear explanation for why density appeared to be up over past years. All of the trout captured in the reach were brown trout, and most tended to be of larger, older age classes as evidenced by the relatively large mean length of nearly 350 mm that was observed (Table 3, Appendix B). In 2009 and 2010, the population estimates for the section were 158 and 206 brown trout per mile, respectively (Table 3; Figure 3). In 2010, an estimate was also made for the extended Williams-Tavenner Section, which was lengthened by approximately 1.3 miles, more than doubling the original section length. In the lengthened section the estimate was 168 fish (brown trout) per mile (Table 4; Figure 3). All of these estimates were similar to the long term average for the site. Brown trout collected in the reach in both years continued to be of a relatively large size, and the species continued to dominate the trout community (Tables 3 & 4; Appendix B). While cutthroat trout were collected in the Williams-Tavenner Section in both 2009 and 2010, the species was very rare in both years.

Table 3. Electrofishing data collected on the Upper Clark Fork River at the original Williams-Tavenner Section from 2008 through 2010. Population estimates and capture efficiencies are for brown trout greater than 175 mm (~7") in total length. Number following the population estimate (in parentheses) represents the 95 % confidence interval.

Year	Trout Species	Population Estimate -fish/mile-	Capture Efficiency -%-	# of Fish Handled	Mean Length -mm-	Length Range -mm-	Species Composition -%-
2008	Brown	324 (+/- 84)	28	194	349	118-524	100
2009	Brown	158 (+/- 77)	19	77	341	132-527	99
	Cutthroat	-	-	1	279	-	1
2010	Brown	206 (+/- 59)	27	146	332	114-509	99
	Cutthroat	-	-	1	285	-	< 1
	Brook	-	-	1	145	-	< 1

Table 4. Electrofishing data collected on the Upper Clark Fork River at the lengthened Williams-Tavenner Section in 2010. Population estimates and capture efficiencies are for brown trout greater than 175 mm (~7") in total length. Number following the population estimate (in parentheses) represents the 95 % confidence interval.

Year	Trout Species	Population Estimate (fish/mile)	Capture Efficiency (%)	# of Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
2010	Brown	168 (+/- 30)	32	270	343	114-532	99
	Cutthroat	-	-	3	297	265-315	1
	Brook	-	-	1	145	-	< 1

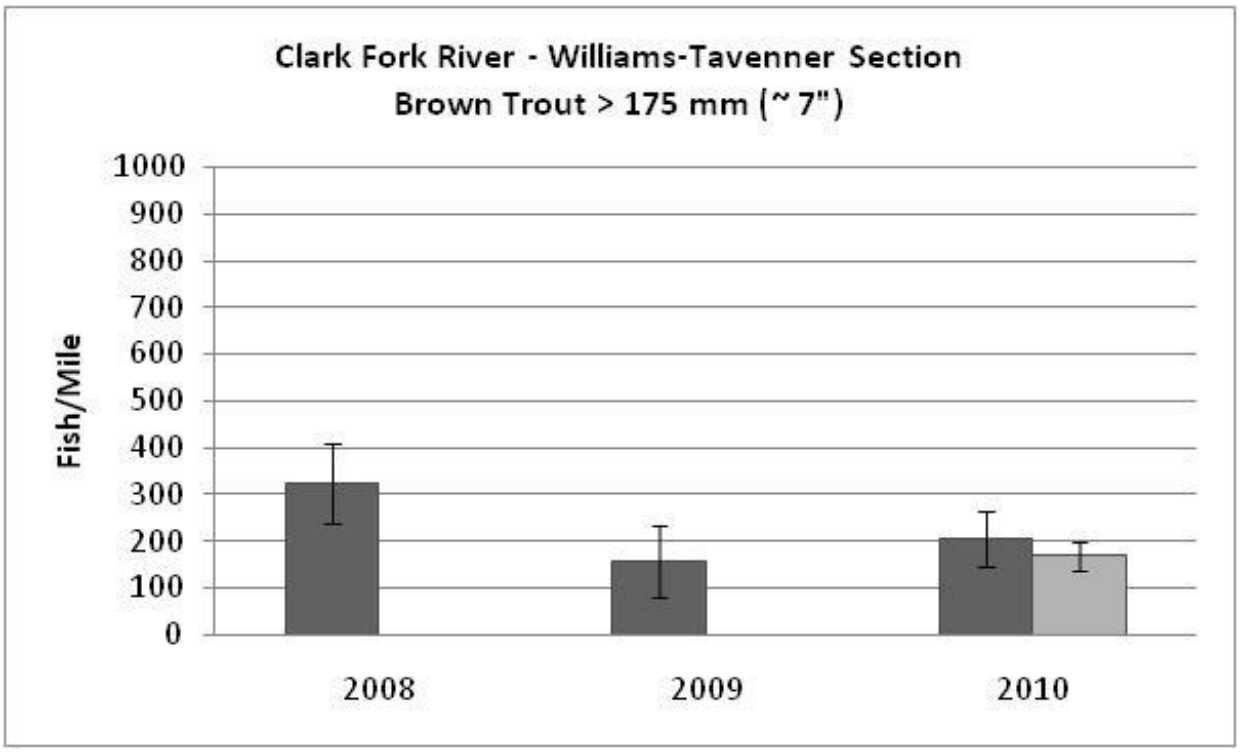

Figure 3. Population estimates for brown trout on the Upper Clark Fork River at the Williams-Tavenner Section from 2008 through 2010. 2010 includes estimates for both the original section (dark grey) as well as the lengthened section (light grey). Error bars represent the 95% confidence interval.

Phosphate Section

The Phosphate Section was added to the Upper Clark Fork River monitoring program in 2008, and is located approximately 5.5 miles downstream of the confluence of the Little Blackfoot River. After joining the Little Blackfoot near Garrison, the Clark Fork River roughly doubles in size. In 2008, the brown trout estimate in the Phosphate Section was 316 fish per mile (Table 5; Figure 4). The species represented 99% of the trout community in the reach, and most tended to be of larger, older age classes as evidenced by the relatively large mean length of over 330 mm that was observed (Table 5, Appendix B). In 2009 and 2010, the population estimates for the section were 292 and 233 brown trout per mile, respectively (Table 5; Figure 4). Brown trout collected in the reach in both years continued to be of a relatively large size, and the species continued to dominate the trout community (Table 5; Appendix B). While cutthroat trout were collected in the Phosphate Section in all sample years, the species was rare.

Table 5. Electrofishing data collected on the Upper Clark Fork River at the Phosphate Section from 2008 through 2010. Population estimates and capture efficiencies are for brown trout greater than 175 mm (~7") in total length. Number following the population estimate (in parentheses) represents the 95 % confidence interval.

Year	Trout Species	Population Estimate (fish/mile)	Capture Efficiency (%)	# of Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
2008	Brown	316 (+/- 58)	31	343	333	97-468	99
	Cutthroat	-	-	3	325	256-380	1
2009	Brown	292 (+/- 143)	13	159	334	125-465	99
	Cutthroat	-	-	1	274	-	1
2010	Brown	233 (+/- 46)	35	279	308	97-478	99
	Cutthroat	-	-	3	291	242-345	1

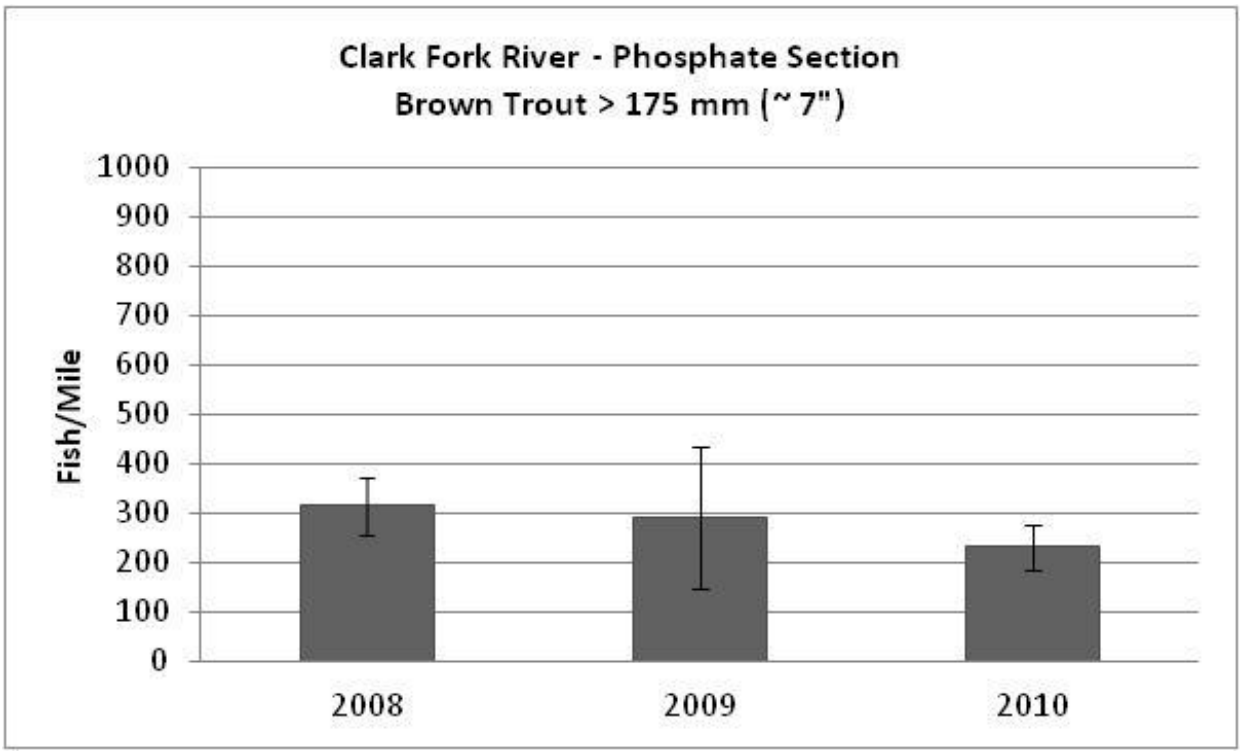

Figure 4. Population estimates for brown trout on the Upper Clark Fork River at the Phosphate Section from 2008 through 2010. Error bars represent the 95% confidence interval.

Continuous River Sampling - 2009 and 1987

Continuous sampling on the Upper Clark Fork River from Warm Springs to Jens in 2009 showed that trout densities were relatively similar throughout much of the river. Brown trout dominated the catch throughout the entire area; comprising 95% to 99% of the trout community in each of the sample reaches (Table 6). The average brown trout density among the 11 reaches surveyed was just over 200 fish per mile. Brown trout density was lowest below the pH Shack Section near river mile (RM) 338.1 at 58 fish per mile, and appeared to be the highest upstream of Deer Lodge (RM 322.8) at 324 fish per mile (Table 6; Figure 5). The estimate for the section upstream of Deer Lodge was likely biased high due to poor capture efficiency observed in the reach (Table 6). Average fish size for brown trout throughout the Upper Clark Fork River was very similar among the sampled reaches, and averaged a little over 350 mm among all the sites (Table 6). This relatively large average size indicated that much of the catch in the reaches was made up of larger, older age classes (Table 6, Appendix B).

Trout species other than brown trout were captured at all of the 11 sample reaches in 2009, but densities tended to be rather low. Westslope cutthroat trout were most common in reaches downstream of Deer Lodge, while rainbow trout and hybrids of rainbow trout and cutthroat trout were mostly found in the river above Deer Lodge, but in very low numbers. Most of the rainbow trout captured in the sample sections were rather large, deep-bodied fish that were likely out-migrant's of the Warm Springs pond system, which is stocked annually with rainbow trout. Brook trout were very rare in the Upper Clark Fork in 2009, and the few individuals observed were found in reaches closer to Deer Lodge. No bull trout were captured or observed in the Upper Clark Fork River above Jens during 2009 sampling.

Table 6. Electrofishing data collected continuously along the Upper Clark Fork River between Warm Springs (RM 339.5) and Jens (RM 285.5) in 2009. Population estimates and capture efficiencies are for brown trout greater than 175 mm (~7") in total length. Number following the population estimate (in parentheses) represents the 95 % confidence interval. Cutt x Rbow represents a phenotypic hybrid between a cutthroat and rainbow trout.

Top of Section -RM-	Trout Species	Population Estimate (fish/mile)	Capture Efficiency (%)	# of Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
339.5	Brown	185 (+/- 73)	22	116	357	96-500	95
	Rainbow	-	-	5	362	302-560	4
	Cutthroat	-	-	1	383	-	1
338.1	Brown	58 (+/- 29)	20	46	370	91-490	98
	Cutt x Rbow	-	-	1	345	-	2
336.9	Brown	105 (+/- 25)	31	228	362	100-595	99
	Rainbow	-	-	2	506	404-608	1

332.9	Brown	168 (+/- 56)	19	237	364	97-634	99
	Rainbow	-	-	1	345	-	< 1
	Cutthroat	-	-	1	217	-	< 1
328.8	Brown	202 (+/- 61)	23	246	374	86-578	99
	Rainbow	-	-	2	655	635-675	1
325.9	Brown	257 (+/- 88)	19	291	361	85-533	99
	Rainbow	-	-	1	301	-	< 1
	Cutt x Rbow	-	-	1	415	-	< 1
	Brook	-	-	1	170	-	< 1
322.8	Brown	324 (+/- 152)	7	390	359	105-533	98
	Brook	-	-	6	172	132-239	2
	Rainbow	-	-	1	640	-	< 1
	Cutt x Rbow	-	-	1	340	-	< 1
315.8	Brown	253 (+/- 61)	16	638	334	92-565	99
	Cutthroat	-	-	6	354	298-416	1
	Rainbow	-	-	1	480	-	< 1
	Cutt x Rbow	-	-	1	320	-	< 1
	Brook	-	-	1	357	-	< 1
308.6	Brown	201 (+/- 63)	19	303	341	106-527	95
	Cutthroat	-	-	16	307	255-372	5
304.4	Brown	263 (+/- 86)	12	592	335	96-570	97
	Cutthroat	-	-	18	281	230-366	3
294.5	Brown	275 (+/- 60)	16	750	338	89-508	99
	Cutthroat	-	-	7	299	178-353	1
	Cutt x Rbow	-	-	2	352	339-365	< 1

Continuous sampling on the Upper Clark Fork River from Warm Springs to Jens in 1987 showed that trout densities were relatively similar to those observed in 2009 for much of the river (Figure 5). However, a considerable difference was evident in the reaches closest to the Warm Springs pond system (Figure 5). In 1987, brown trout densities were estimated at nearly 2,000 fish per mile in the pH Shack Section (RM 339.5; Table 7, Figure 5). This was over 10 times the amount of fish estimated in 2009. However, as was discussed above in the summary of the pH Shack Section, the 2009 estimate was the lowest on record for that reach. Below the pH Shack Section, trout densities remained elevated above 2009 values, but decreased steadily to levels similar to what was observed in that year (Figure 5). Similar to 2009, brown trout dominated the catch in 1987 throughout the entire Upper Clark Fork; comprising 97% to 99% of the trout community in each of the sample reaches (Table 7). The average brown trout density among the 11 reaches surveyed was just over 500 fish per mile, a value heavily influenced by the relatively short reaches near the Warm Springs pond system where fish were abundant (Table 7, Appendix A). In 1987, brown trout density was lowest in the area between Kohrs Bend and Phosphate (RM 304.4 to RM 294.5) at 198 fish per mile, and was highest in the pH Shack Section below the Warm Springs pond system at 1,952 fish per mile (Table 7; Figure 5). Average fish size for brown trout throughout the Upper Clark Fork River in 1987 was 308 mm, which was slightly less than what was observed in 2009 (~ 350 mm) (Table 7). Average fish size tended to increase in a downstream fashion suggesting that younger, smaller fish were more abundant in the upper reaches than in the lower ones. Nevertheless, the relatively large average size indicated that much of the catch in the reaches was made up of larger, older age classes (Table 7, Appendix B).

Trout species other than brown trout were captured at all of the 11 sample reaches in 1987, but similar to 2009, densities tended to be rather low. Westslope cutthroat trout were most common in reaches downstream of Deer Lodge, while rainbow trout were mostly found in the river above Deer Lodge, but in very low numbers. This was similar to what was observed in 2009. Similarly, brook trout were very rare in the Upper Clark Fork in 1987, and the few individuals observed were found in reaches just above and below Deer Lodge. No bull trout were captured or observed in the Upper Clark Fork River above Jens during 1987 sampling.

Table 7. Electrofishing data collected continuously along the Upper Clark Fork River between Warm Springs (RM 339.5) and Jens (RM 285.5) in 1987. Population estimates and capture efficiencies are for brown trout greater than 175 mm (~7") in total length. Number following the population estimate (in parentheses) represents the 95 % confidence interval. Cutt x Rbow represents a phenotypic hybrid between a cutthroat and rainbow trout.

Top of Section -RM-	Trout Species	Population Estimate (fish/mile)	Capture Efficiency (%)	# of Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
339.5	Brown	1952 (+/- 149)	31	1682	305	99-487	99
	Rainbow	-	-	8	301	256-330	< 1
	Cutthroat	-	-	1	403	-	< 1
338.1	Brown	772 (+/- 168)	20	445	302	110-445	99
	Rainbow	-	-	3	341	272-387	1

336.9	Brown	600 (+/- 151)	12	739	282	92-700	> 99
	Rainbow	-	-	3	302	215-370	< 1
332.9	Brown	331 (+/- 56)	28	621	297	108-440	99
	Rainbow	-	-	4	358	305-417	1
328.8	Brown	398 (+/- 85)	19	504	304	100-450	99
	Rainbow	-	-	2	335	303-366	< 1
	Cutthroat	-	-	1	273	-	< 1
	Brook	-	-	1	214	-	< 1
325.9	Brown	382 (+/- 82)	21	534	301	86-437	99
	Rainbow	-	-	3	324	317-335	< 1
	Brook	-	-	3	243	195-285	< 1
322.8	Brown	266 (+/- 44)	21	955	310	95-460	99
	Brook	-	-	8	253	180-343	1
	Cutthroat	-	-	2	288	260-315	< 1
314.2	Brown	272 (+/- 68)	14	569	323	128-460	99
	Cutthroat	-	-	3	333	267-386	< 1
	Brook	-	-	1	245	-	< 1
306.9	Brown	254 (+/- 84)	17	226	322	127-490	97
	Brook	-	-	4	281	237-331	2
	Cutthroat	-	-	2	287	278-296	1
304.4	Brown	198 (+/- 35)	19	781	320	119-504	98
	Cutthroat	-	-	13	311	224-371	2
	Brook	-	-	1	215	-	< 1
294.5	Brown	232 (+/- 40)	21	780	326	108-473	99
	Cutthroat	-	-	9	293	199-448	1
	Cutt x Rbow	-	-	1	282	-	< 1

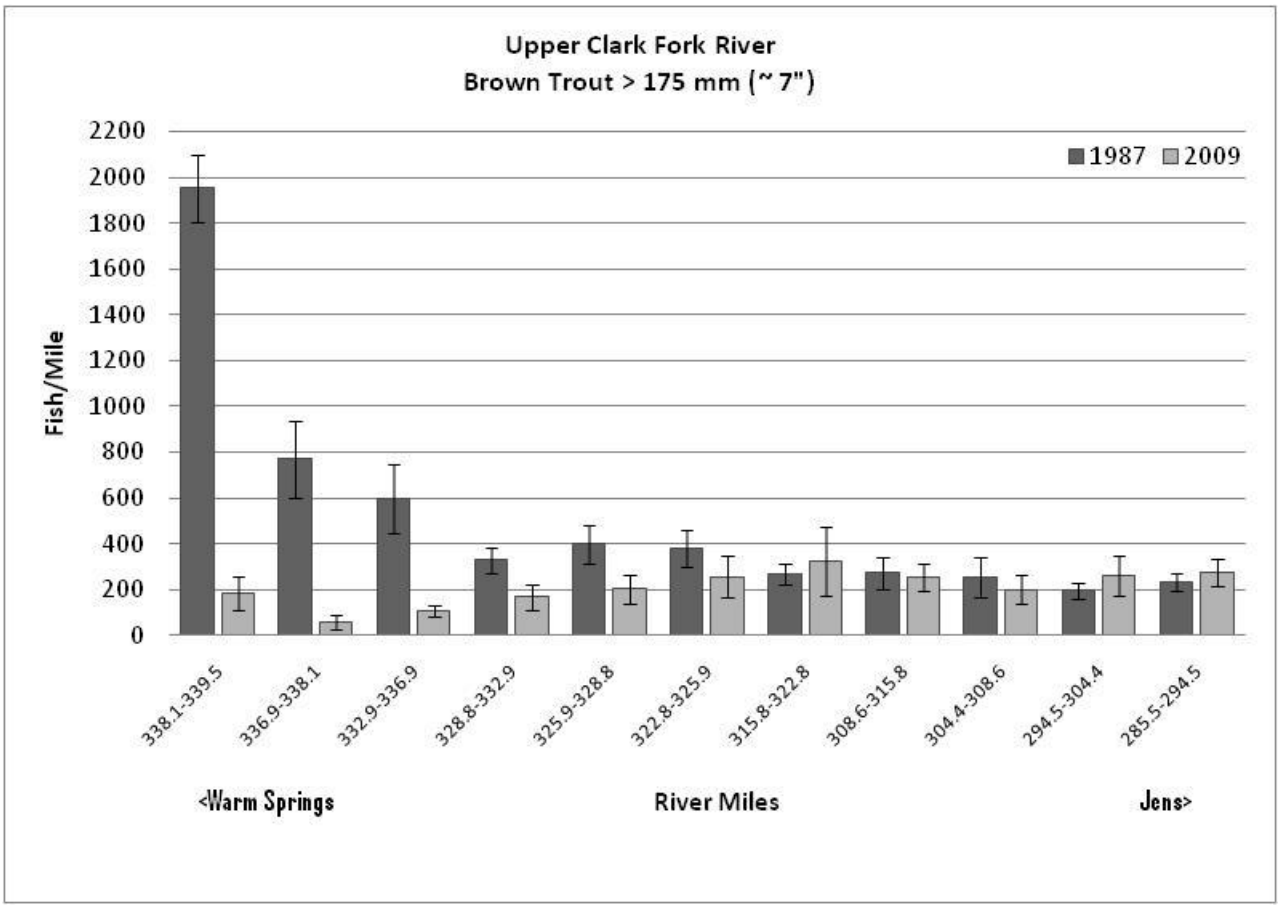

Figure 5. Population estimates for brown trout on the Upper Clark Fork River at continuous sample sections between Warm Springs and Jens in 1987 and 2009. Error bars represent the 95% confidence interval.

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Appendix A

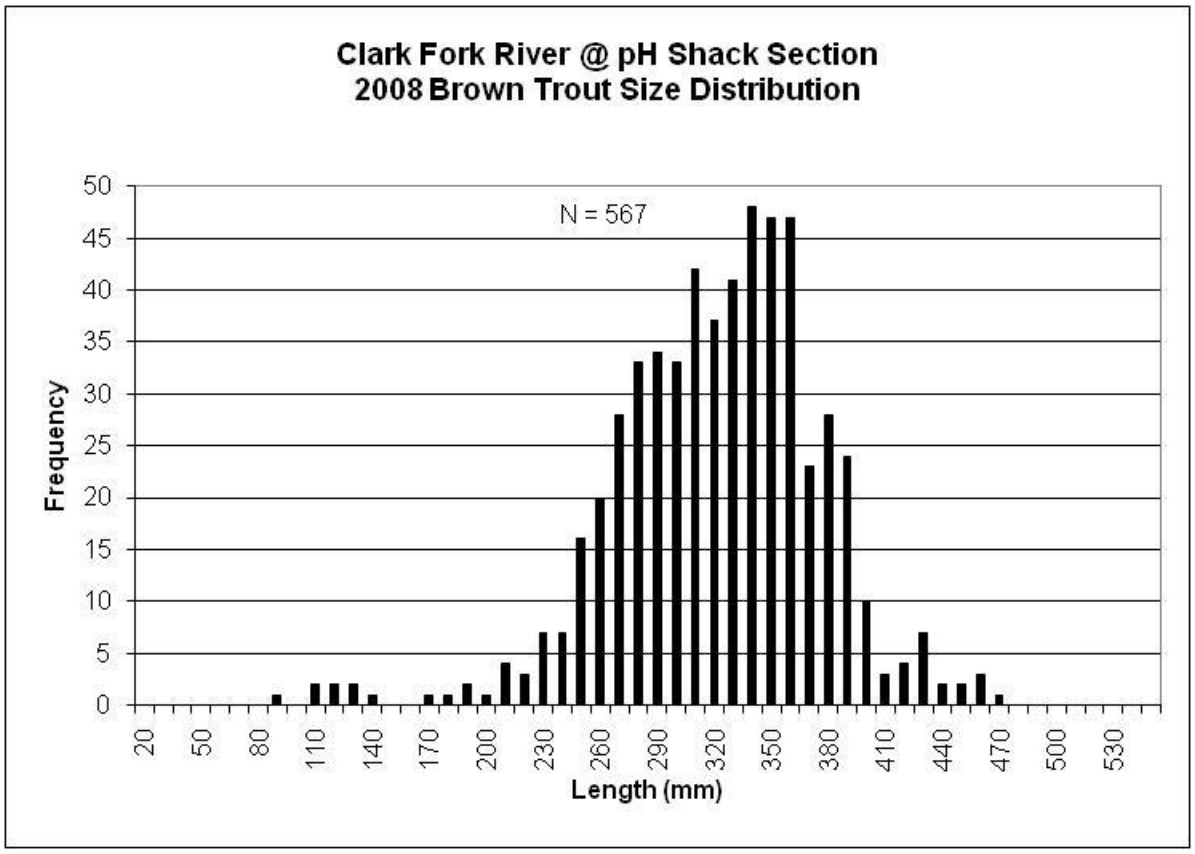
LONG-TERM SECTION	RM - Upper (Approximate)	RM – Lower (Approximate)	Reach Length (miles)
pH Shack	339.5	338.1	1.6
Below Sager Lane	321.5	318.7	3.2
Williams-Tavenner	308.0	305.7	1.2 Old/2.5 New
Phosphate	294.5	292.5	2.1

2009 CONTINUOUS SAMPLING SECTION	RM - Upper (Approximate)	RM – Lower (Approximate)	Reach Length (GIS Measured)
Warm Springs Bridge to Bottom of pH Shack Section (ph Shack Section)	339.5	338.1	1.6
Bottom of pH Shack Section to Perkins Lane	338.1	336.9	1.5
Perkins Lane to Galen Bridge	336.9	332.9	4.4
Galen Bridge to Racetrack Bridge	332.9	328.8	4.2
Racetrack Bridge to H. Long Property	328.8	325.9	3.3
H. Long Property to Sager Lane	325.9	322.8	3.7
Sager Lane to Arrow Stone Park	322.8	315.8	8.2
Arrow Stone Park to State Land Near FFA	315.8	308.6	8.2
State Land Near FFA to Kohrs Bend FAS	308.6	304.4	4.4
Kohrs Bend FAS to Phosphate Bridge	304.4	294.5	11.0
Phosphate Bridge to Jens Bridge	294.5	285.5	9.4

1987 CONTINUOUS SAMPLING SECTION	RM - Upper (Approximate)	RM – Lower (Approximate)	Reach Length (GIS Measured)
Warm Springs Bridge to Bottom of pH Shack Section (ph Shack Section)	339.5	338.1	1.6
Bottom of pH Shack Section to Perkins Lane	338.1	336.9	1.5
Perkins Lane to Galen Bridge	336.9	332.9	4.4
Galen Bridge to Racetrack Bridge	332.9	328.8	4.2
Racetrack Bridge to H. Long Property	328.8	325.9	3.3
H. Long Property to Sager Lane	325.9	322.8	3.7
Sager Lane to Deer Lodge	322.8	314.2	9.9
Deer Lodge to Veterinary Clinic	314.2	308.0	7.2
Williams-Tavenner Bridge to Kohrs Bend FAS	306.9	304.4	2.5
Kohrs Bend FAS to Phosphate Bridge	304.4	294.5	11.0
Phosphate Bridge to Jens Bridge*	294.5	285.5	9.4

* This is a combination of two reaches. One full reach and a part of another.

Appendix B


Clark Fork River @ pH Shack Section
2008 Brown Trout Size Distribution
N = 567
Frequency
Length (mm)
0
5
10
15
20
25
30
35
40
45
50
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80
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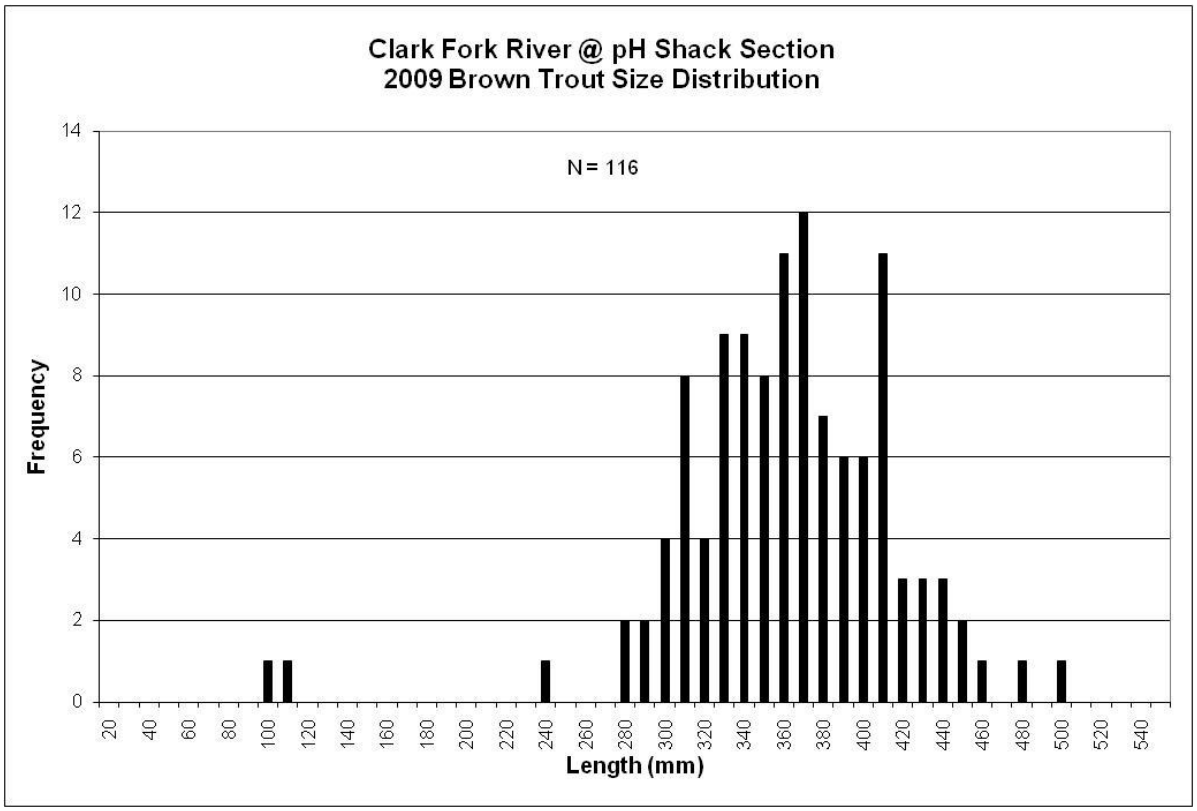
200
230
260
290
320
350
380
410
440
470
500
530


Clark Fork River @ pH Shack Section
2009 Brown Trout Size Distribution
N = 116
Frequency
Length (mm)
0
2
4
6
8
10
12
14
20
40
60
80
100
120
140
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320
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400
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480
500
520
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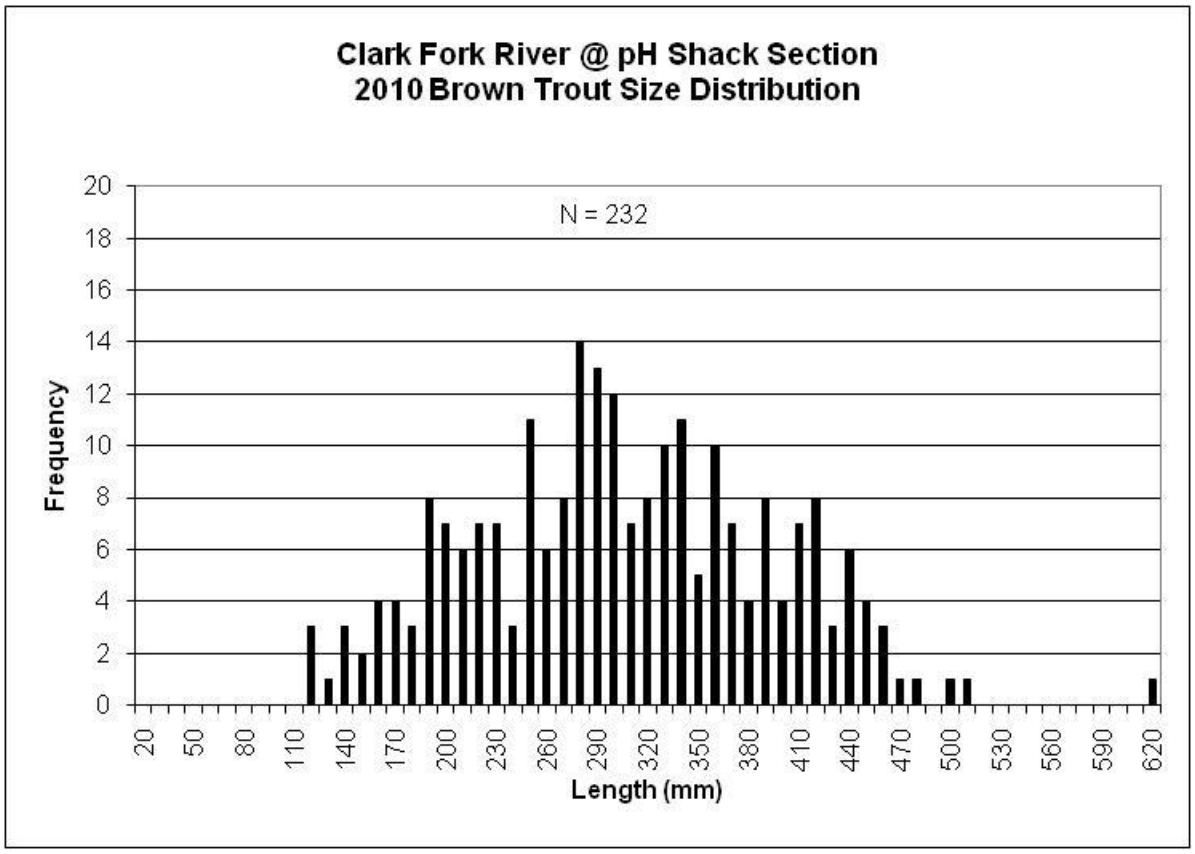
Clark Fork River @ pH Shack Section
2010 Brown Trout Size Distribution
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Frequency
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4
6
8
10
12
14
16
18
20
20
50
80
110
140
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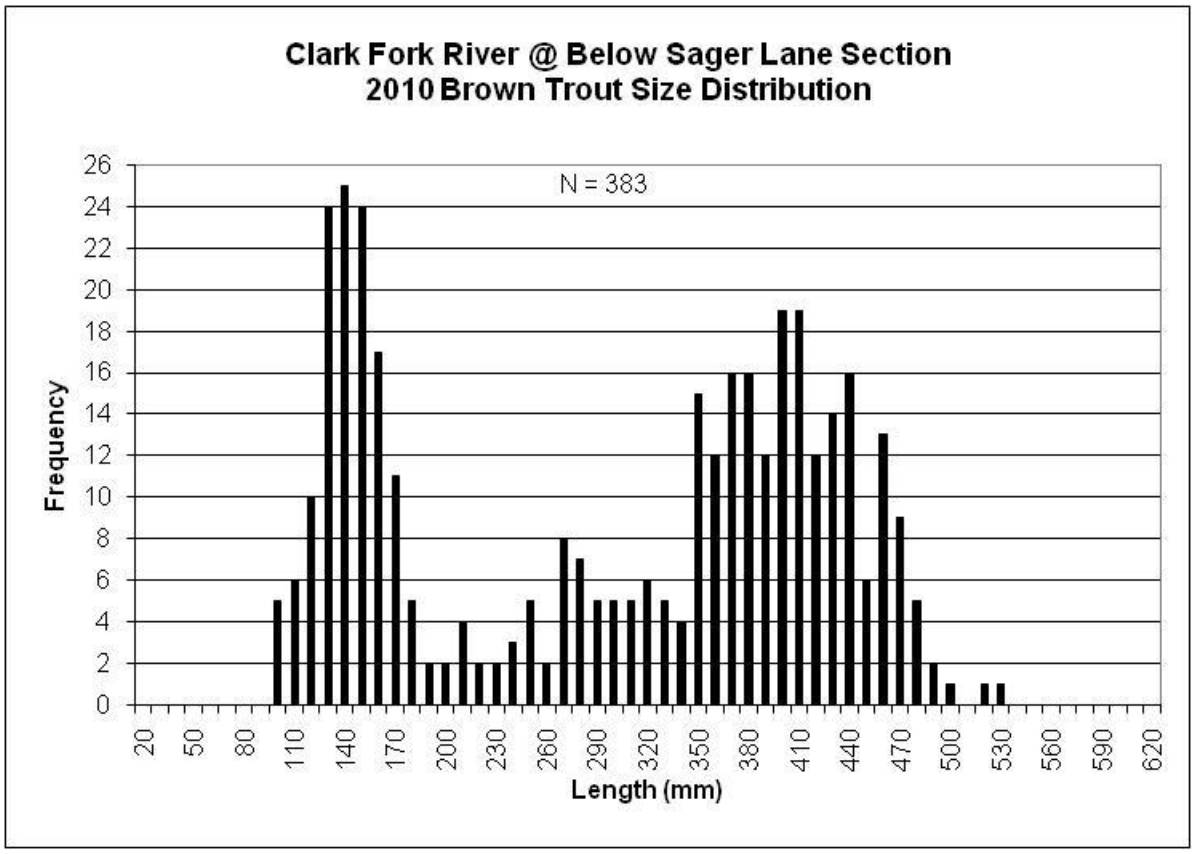
260
290
320
350
380
410
440
470
500
530
560
590
620
Length (mm)


Clark Fork River @ Below Sager Lane Section
2010 Brown Trout Size Distribution
N = 383
Frequency
Length (mm)
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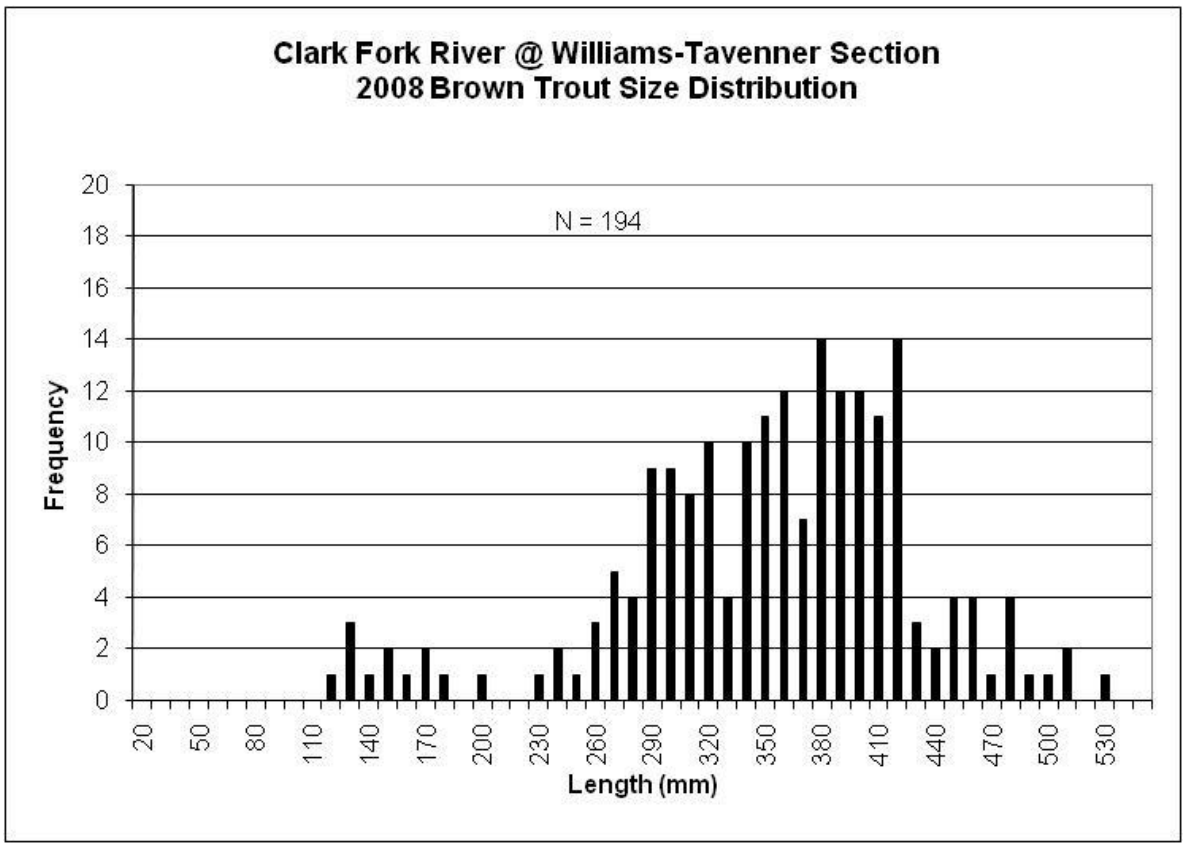
2
4
6
8
10
12
14
16
18
20
22
24
26
20
50
80
110
140
170
200
230
260
290
320
350
380
410
440
470
500
530
560
590
620


Clark Fork River @ Williams-Tavenner Section
2008 Brown Trout Size Distribution
N = 194
Frequency
Length (mm)
0
2
4
6
8
10
12
14
16
18
20
20
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140
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200
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260
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500
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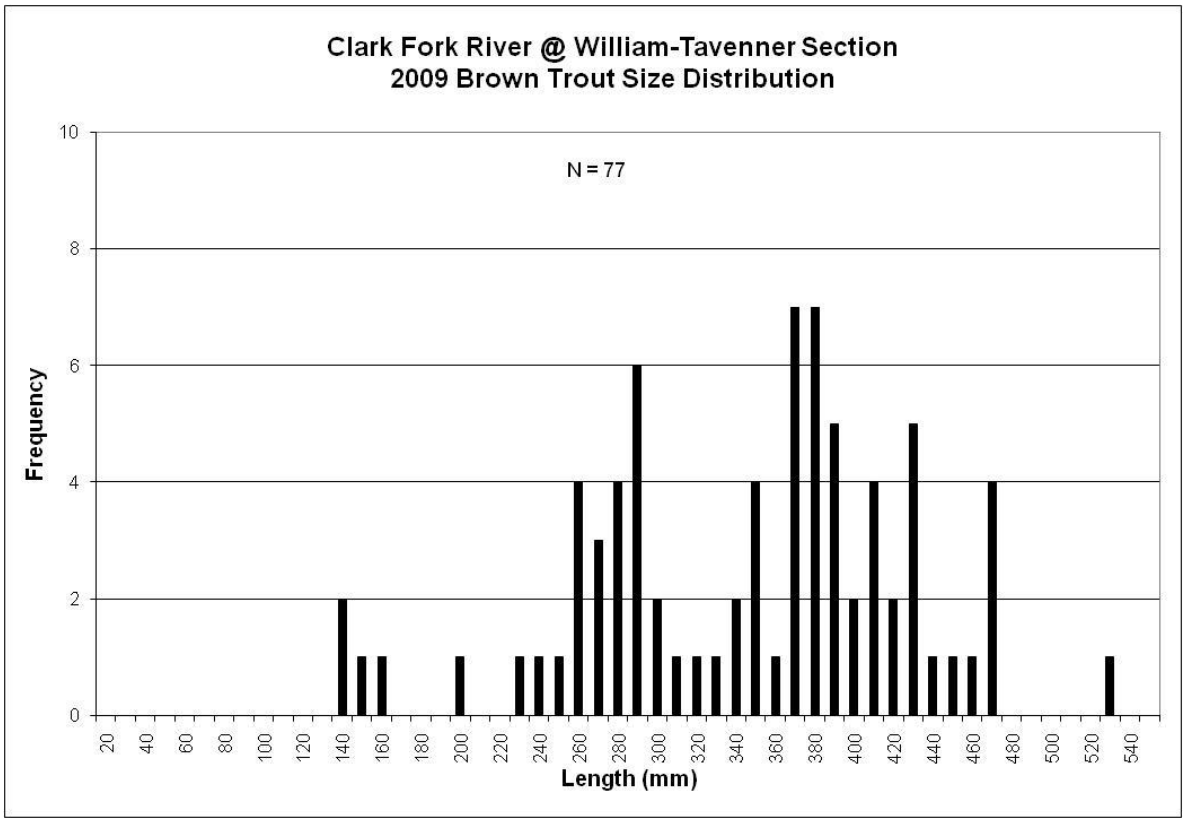
Clark Fork River @ William-Tavenner Section
2009 Brown Trout Size Distribution
N = 77
Frequency
Length (mm)
0
2
4
6
8
10
20
40
60
80
100
120
140
160
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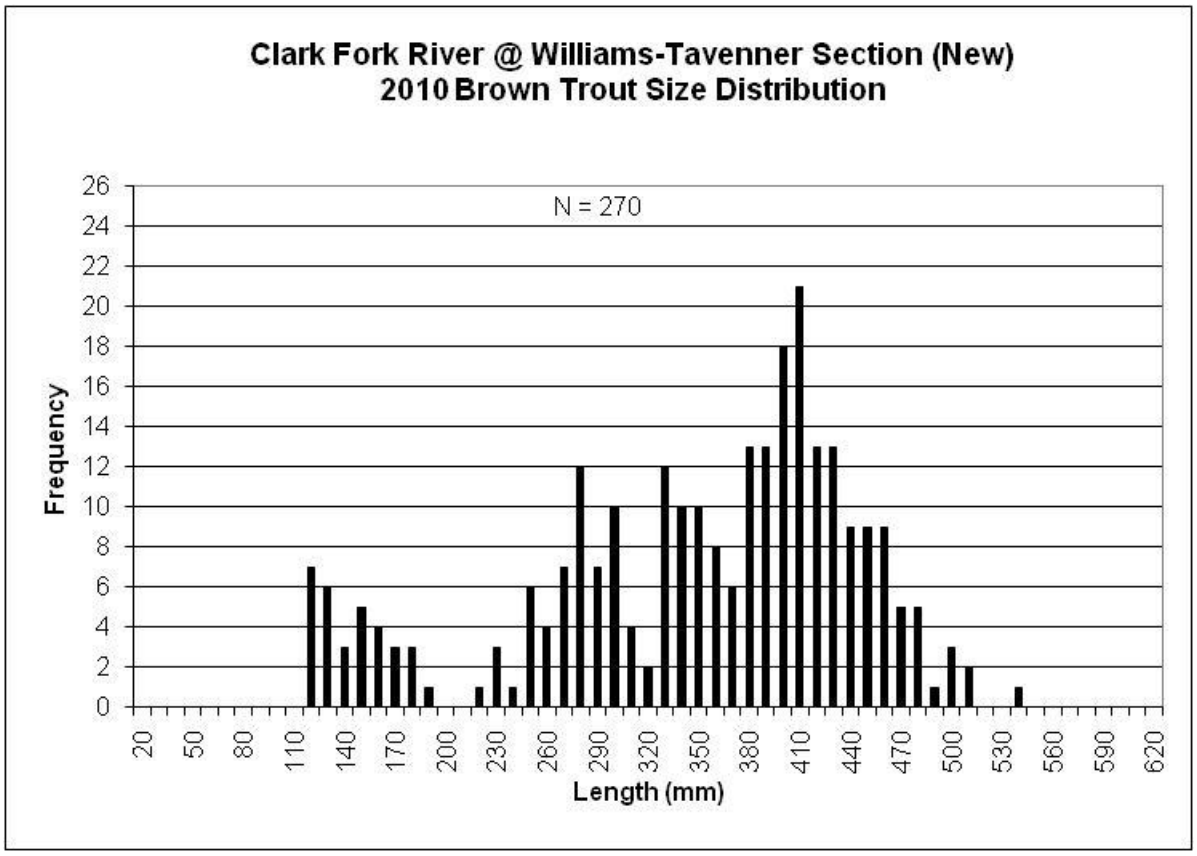
Clark Fork River @ Williams-Tavenner Section (New)
2010 Brown Trout Size Distribution
N = 270
Frequency
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2
4
6
8
10
12
14
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18
20
22
24
26
20
50
80
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350
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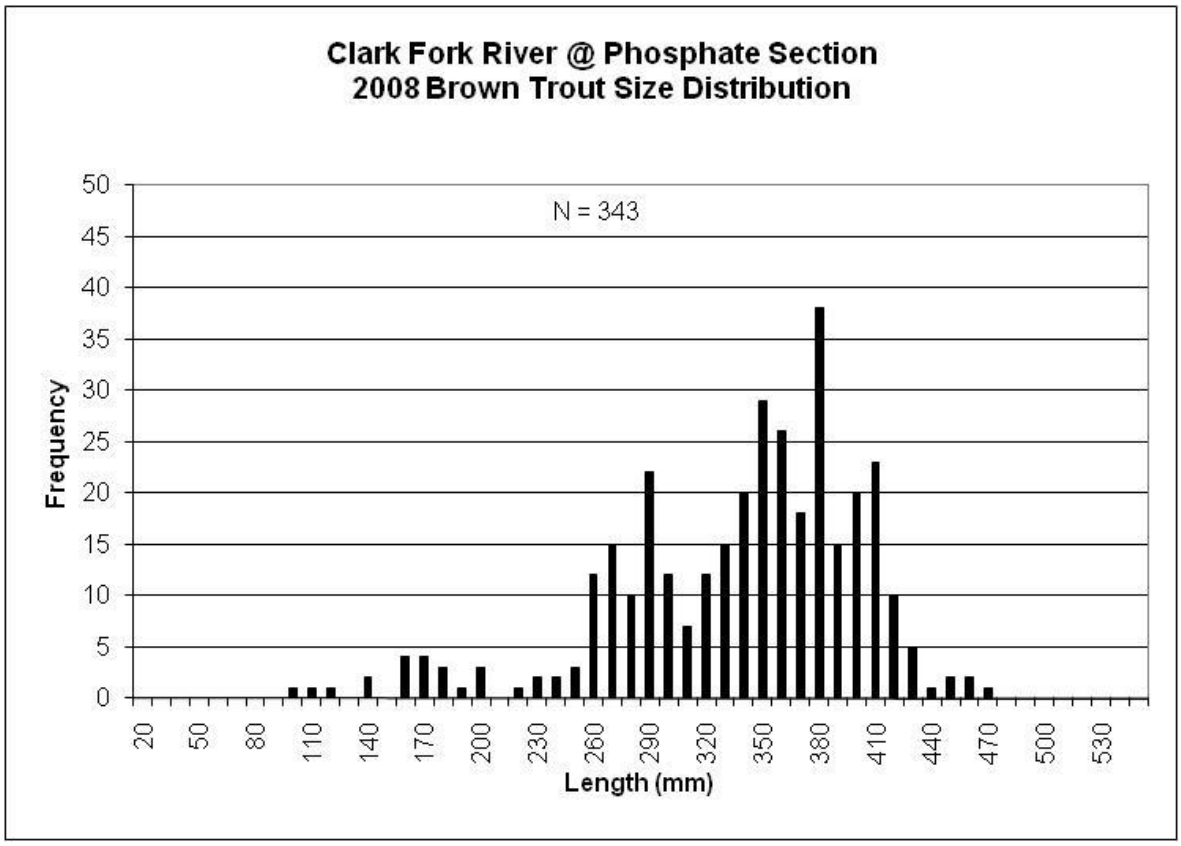
410
440
470
500
530
560
590
620
Length (mm)


Clark Fork River @ Phosphate Section
2008 Brown Trout Size Distribution
N = 343
Frequency
Length (mm)
0
5
10
15
20
25
30
35
40
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50
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200
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260
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440
470
500
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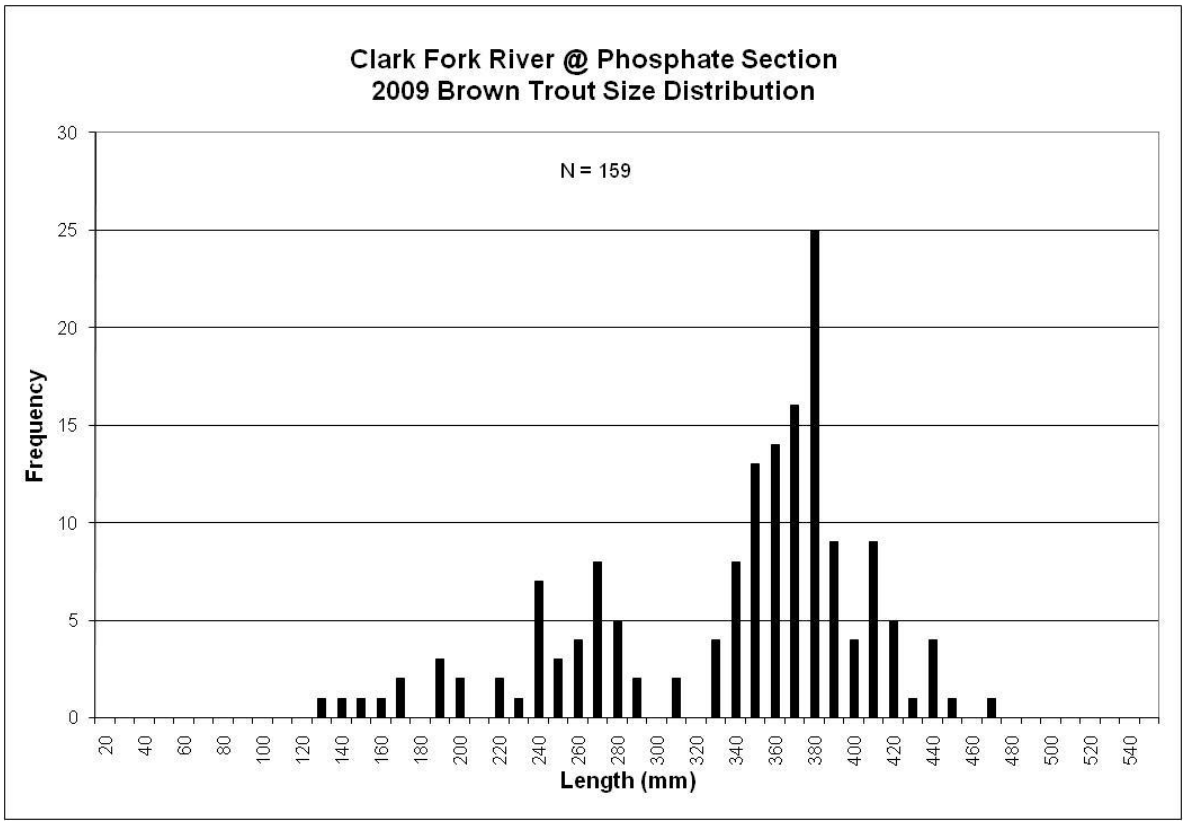
Clark Fork River @ Phosphate Section
2009 Brown Trout Size Distribution
N = 159
Frequency
Length (mm)
0
5
10
15
20
25
30
20
40
60
80
100
120
140
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500
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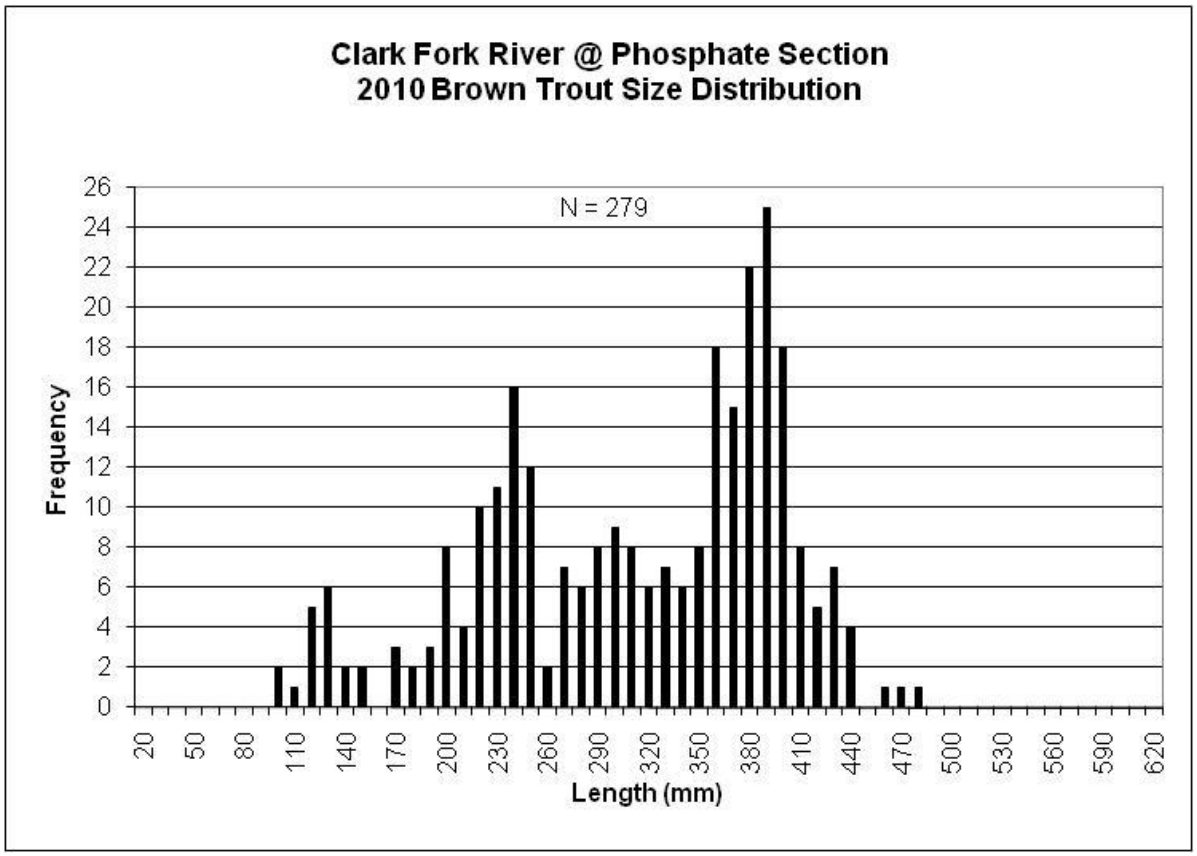
Clark Fork River @ Phosphate Section
2010 Brown Trout Size Distribution
N = 279
Frequency
0
2
4
6
8
10
12
14
16
18
20
22
24
26
20
50
80
110
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290
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410
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470
500
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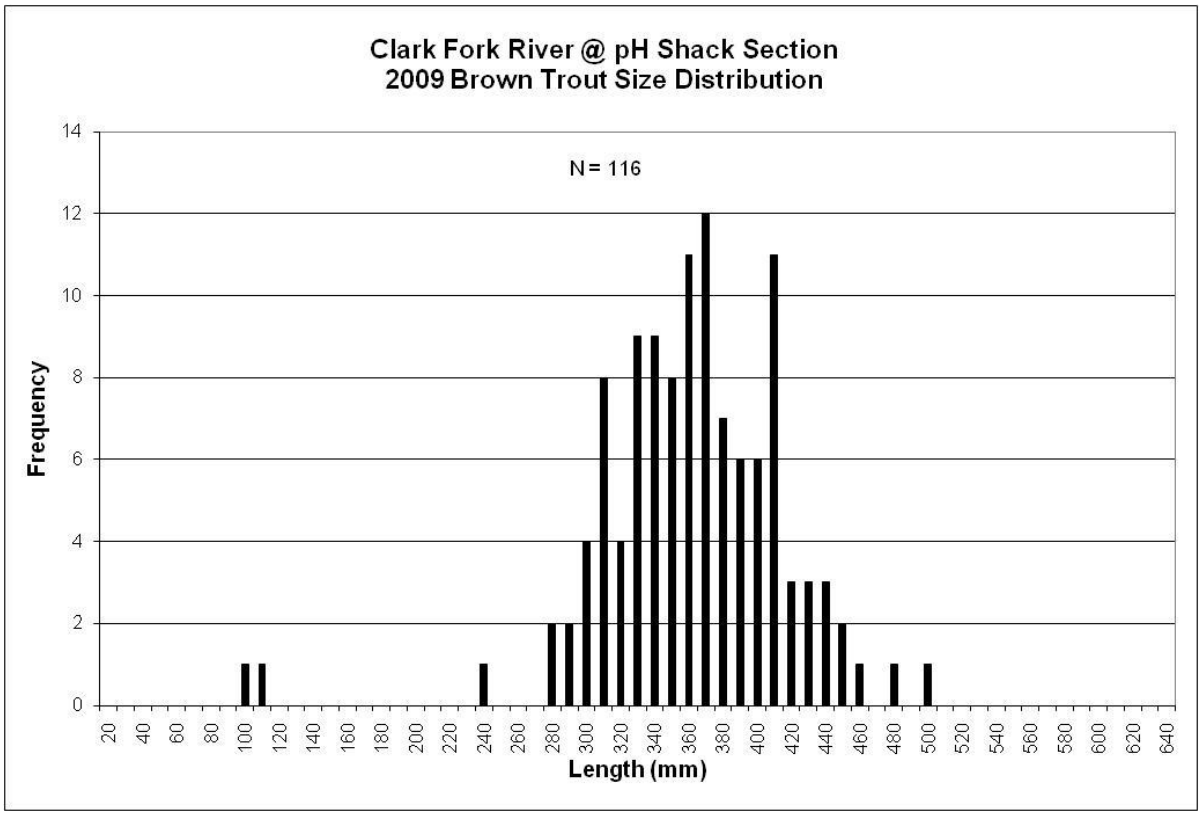
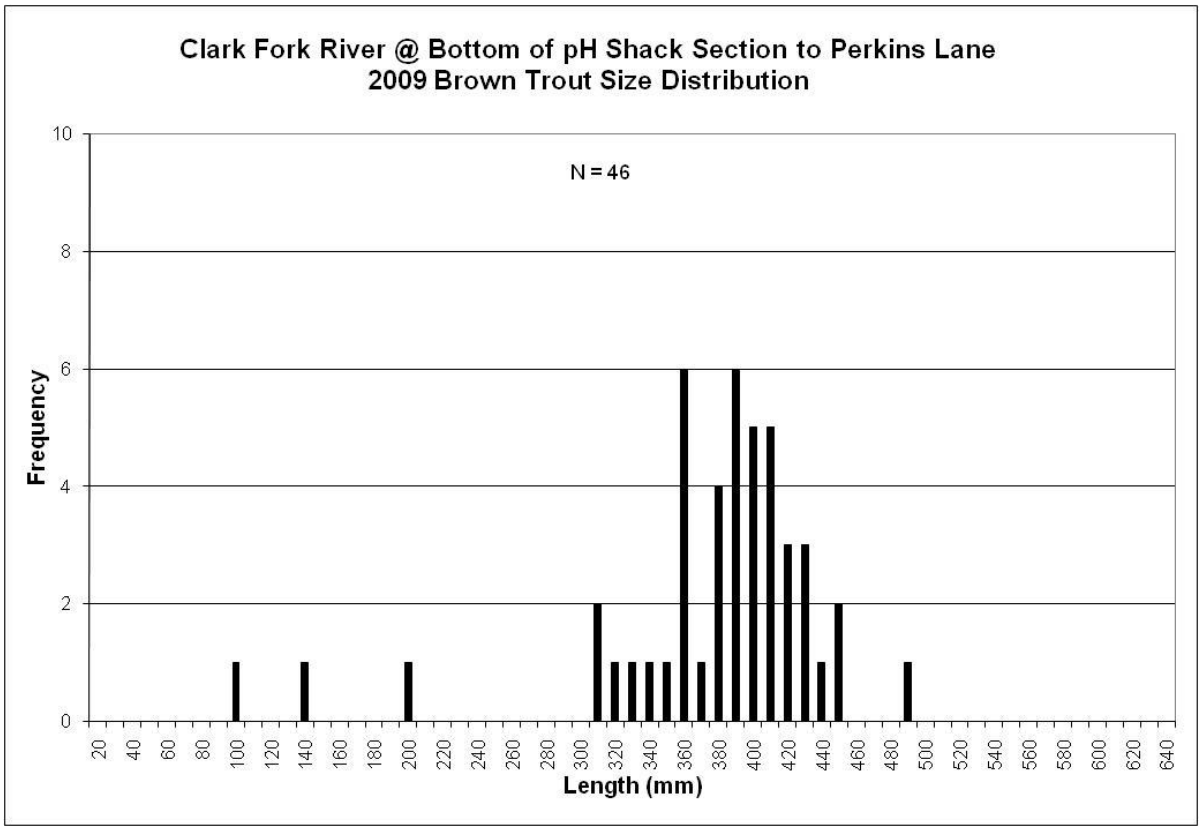
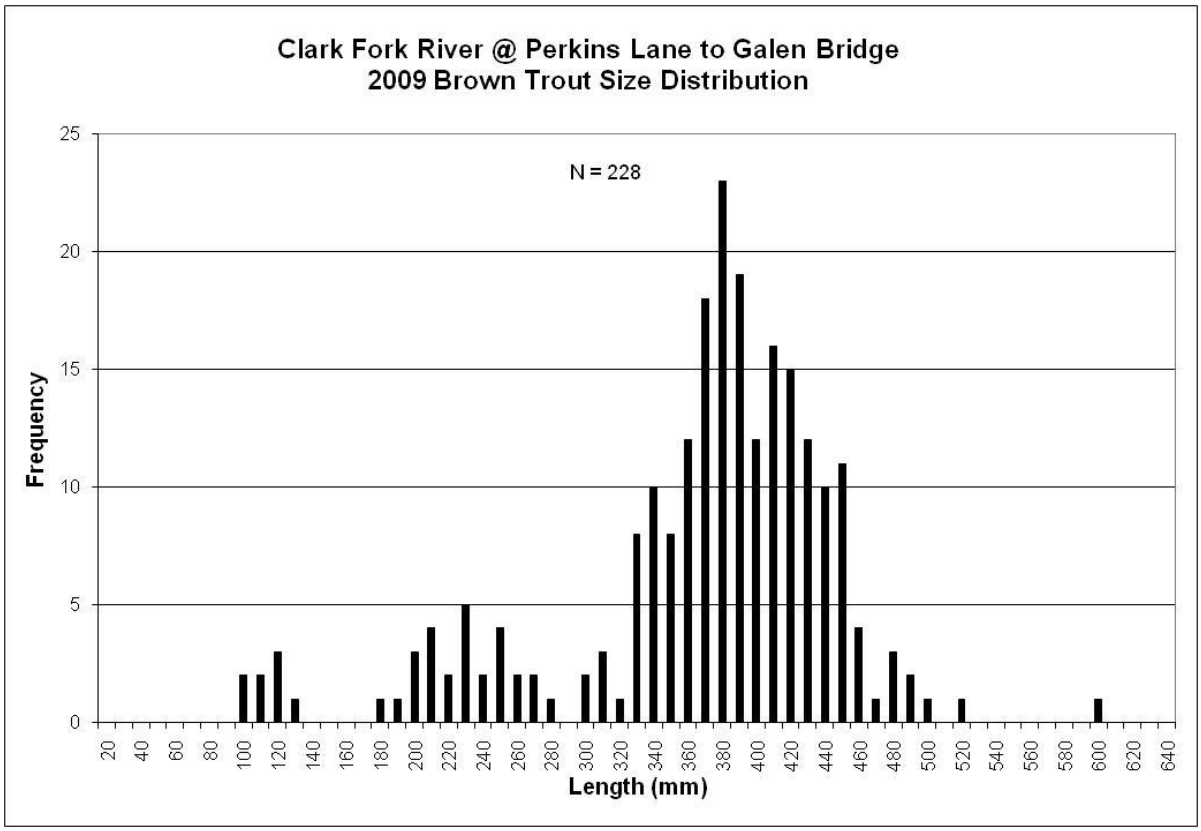
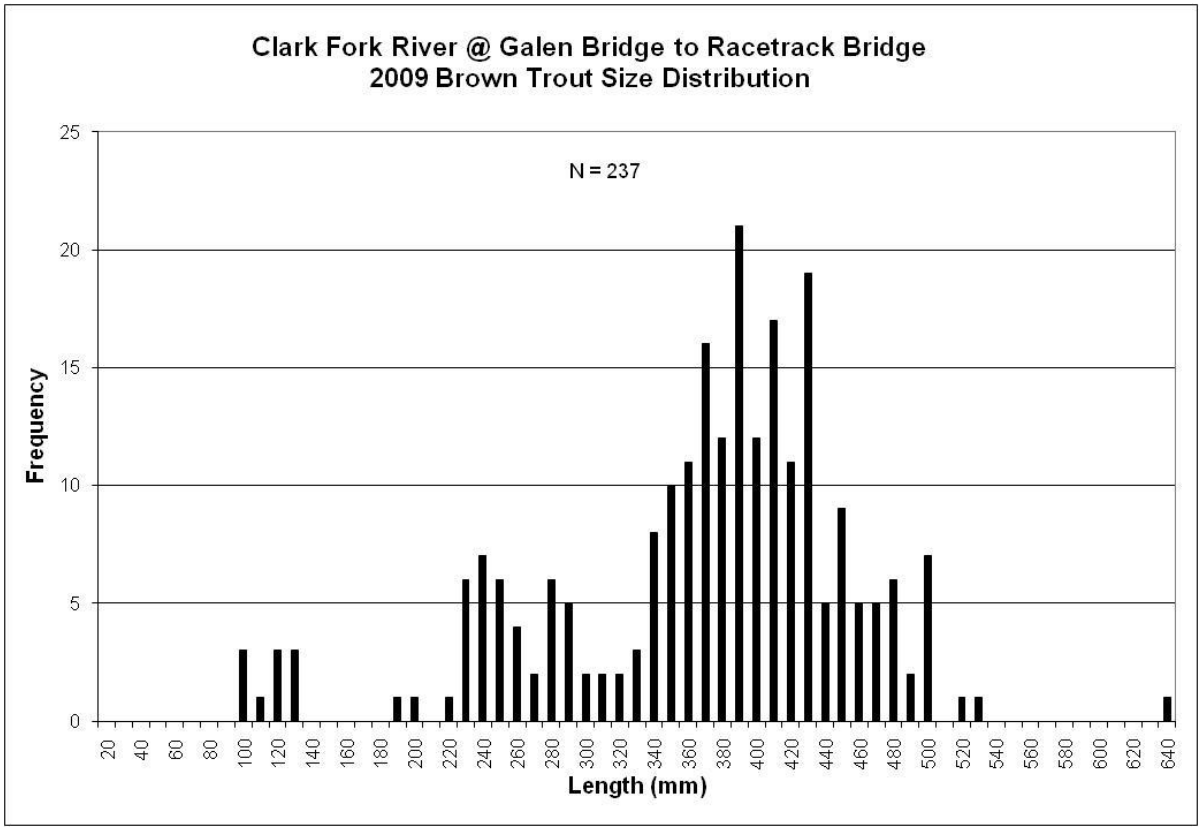
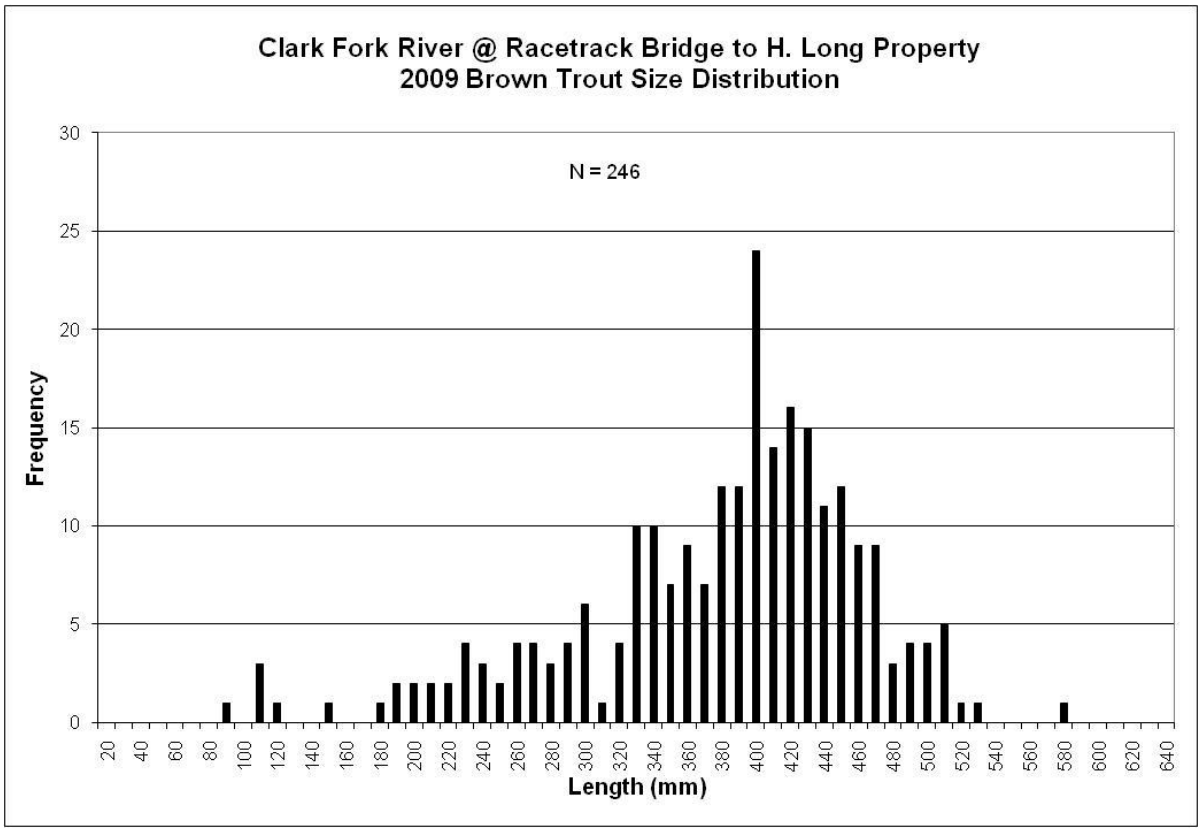
560
590
620
Length (mm)

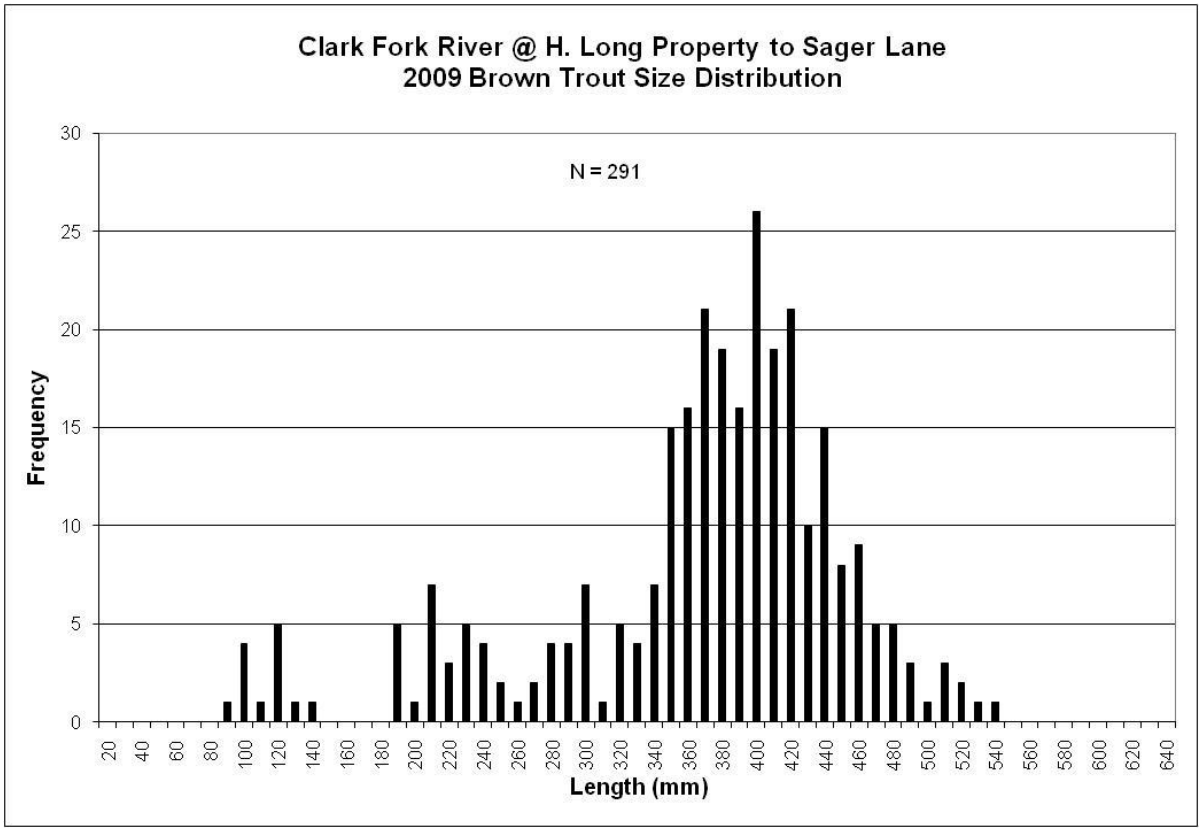

Clark Fork River @ pH Shack Section
2009 Brown Trout Size Distribution
N = 116
Frequency
Length (mm)

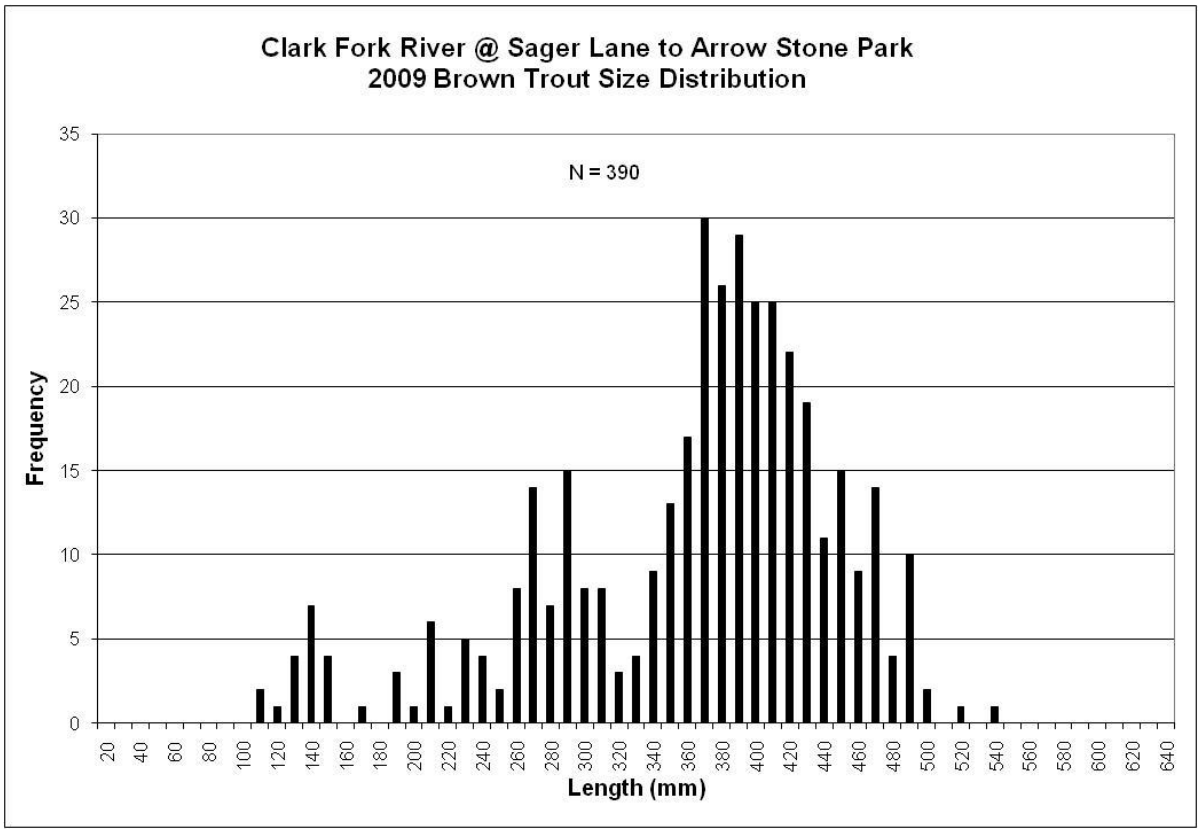

Clark Fork River @ Bottom of pH Shack Section to Perkins Lane
2009 Brown Trout Size Distribution
N = 46
Frequency
Length (mm)

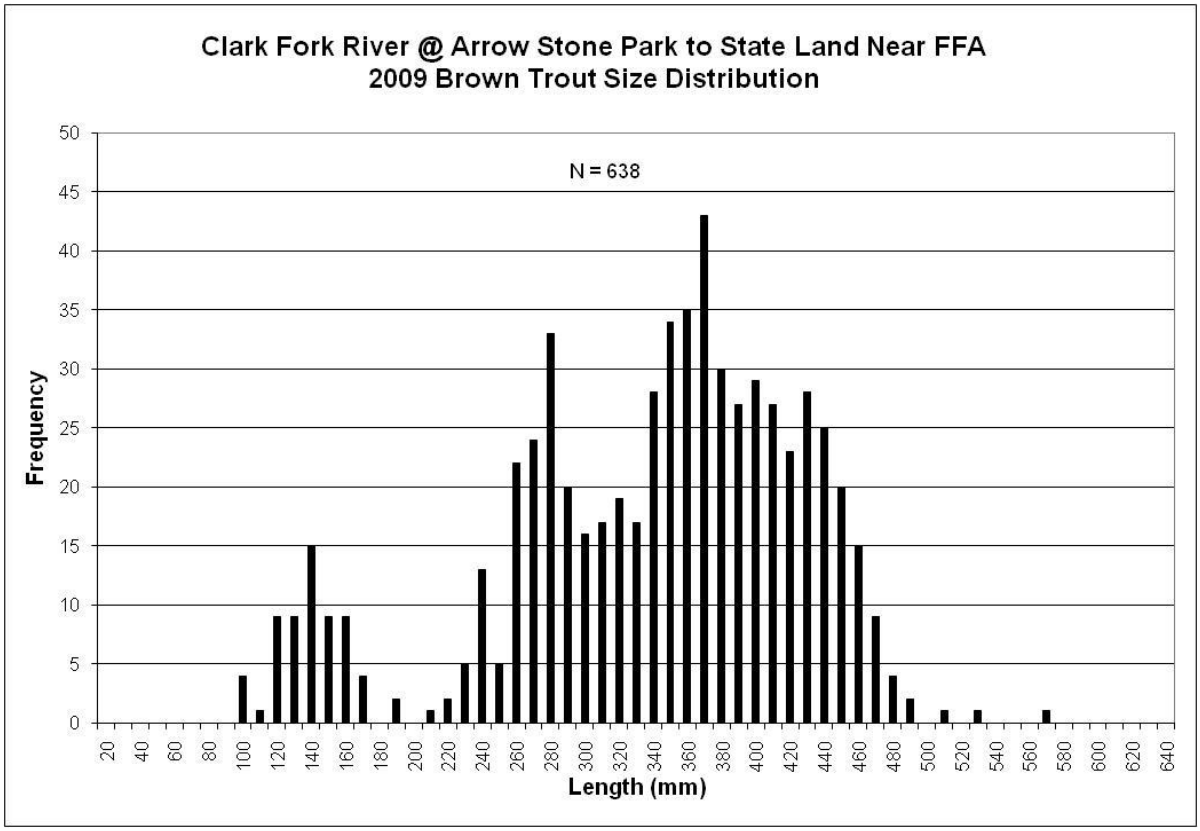

Clark Fork River @ Perkins Lane to Galen Bridge
2009 Brown Trout Size Distribution
N = 228
Frequency
Length (mm)

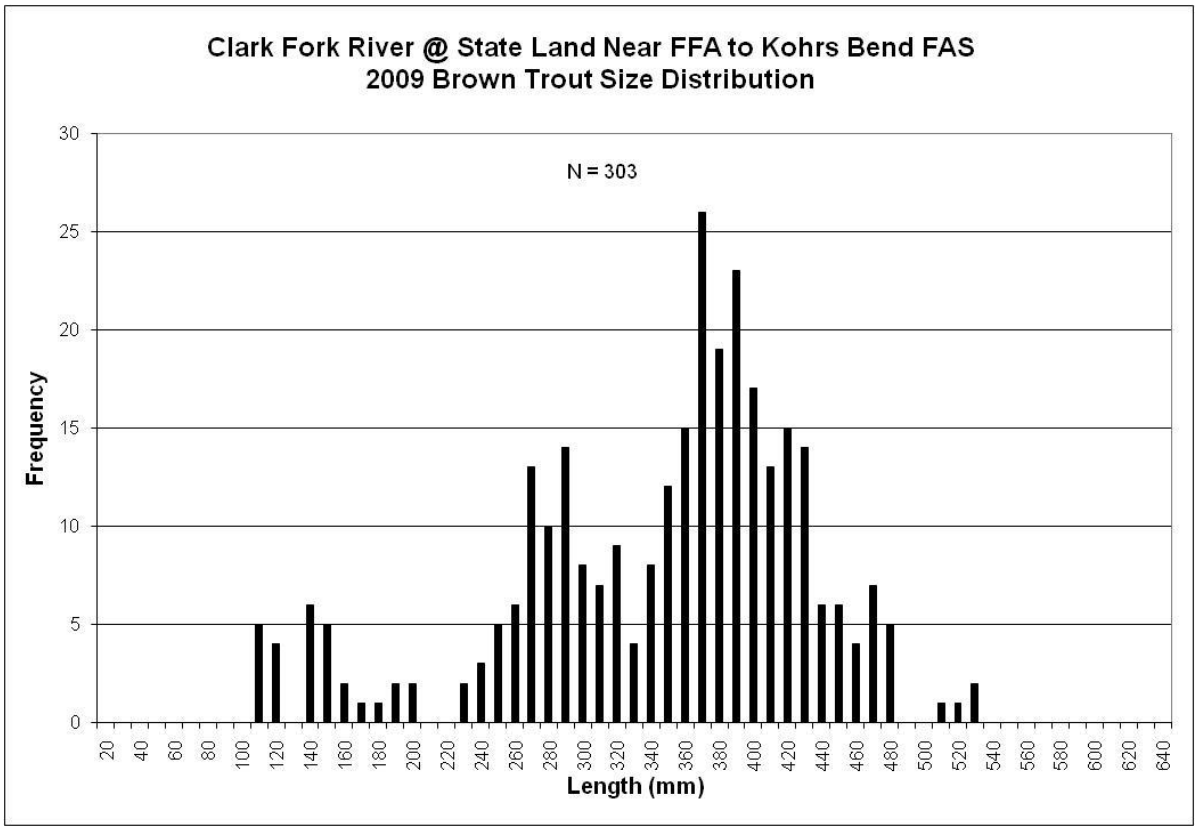

Clark Fork River @ Galen Bridge to Racetrack Bridge
2009 Brown Trout Size Distribution
N = 237
Frequency
Length (mm)

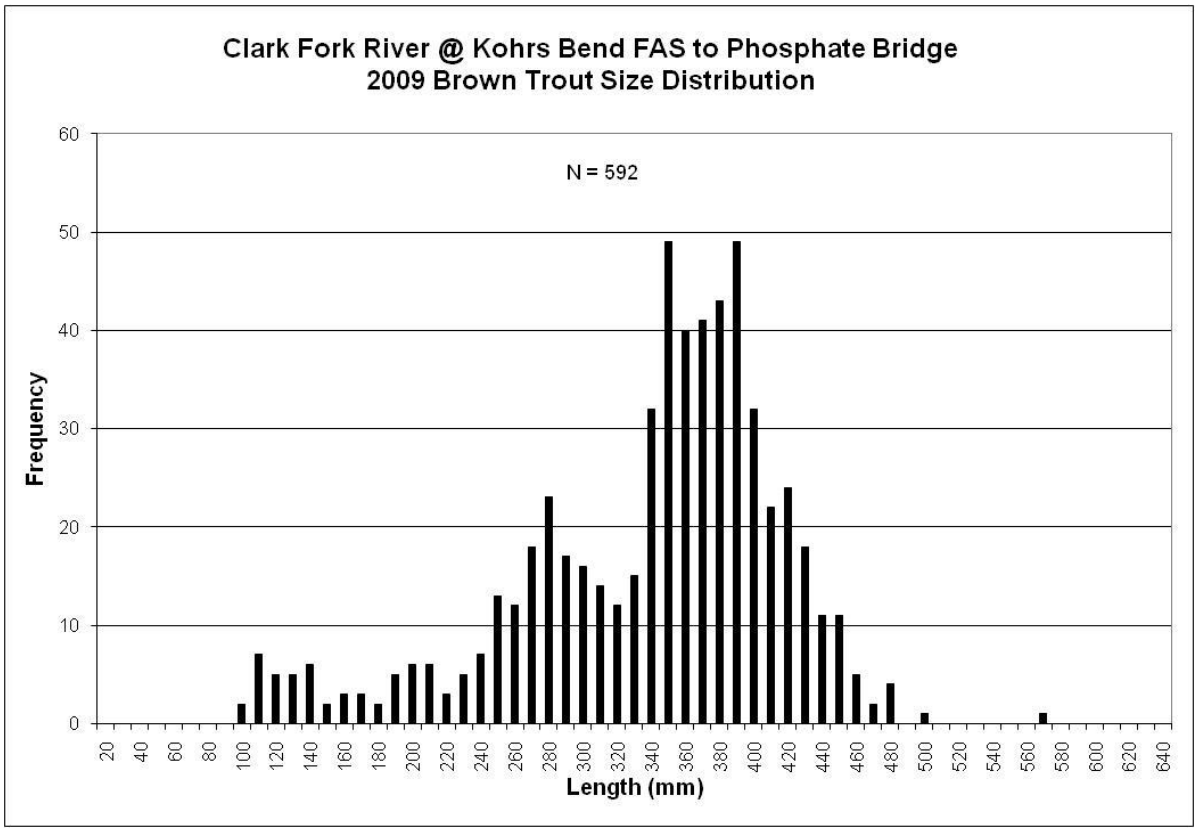

Clark Fork River @ Racetrack Bridge to H. Long Property
2009 Brown Trout Size Distribution
N = 246
Frequency
Length (mm)

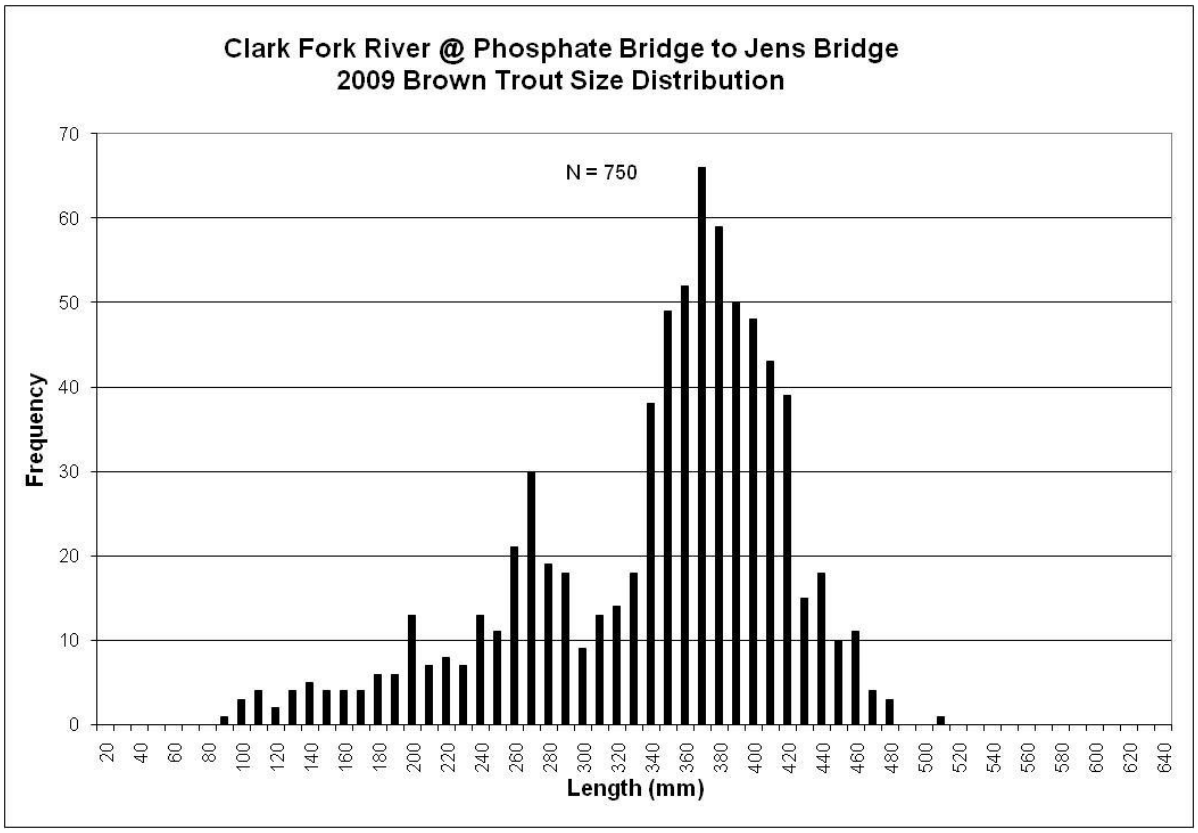

Clark Fork River @ H. Long Property to Sager Lane
2009 Brown Trout Size Distribution
N = 291
Frequency
Length (mm)


Clark Fork River @ Sager Lane to Arrow Stone Park
2009 Brown Trout Size Distribution
N = 390
Frequency
Length (mm)


Clark Fork River @ Arrow Stone Park to State Land Near FFA
2009 Brown Trout Size Distribution
N = 638
Frequency
Length (mm)


Clark Fork River @ State Land Near FFA to Kohrs Bend FAS
2009 Brown Trout Size Distribution
N = 303
Frequency
Length (mm)


Clark Fork River @ Kohrs Bend FAS to Phosphate Bridge
2009 Brown Trout Size Distribution
N = 592
Frequency
Length (mm)


Clark Fork River @ Phosphate Bridge to Jens Bridge
2009 Brown Trout Size Distribution
N = 750
Frequency
Length (mm)
0
10
20
30
40
50
60
70
20
40
60
80
100
120
140
160
180
200
220
240
260
280
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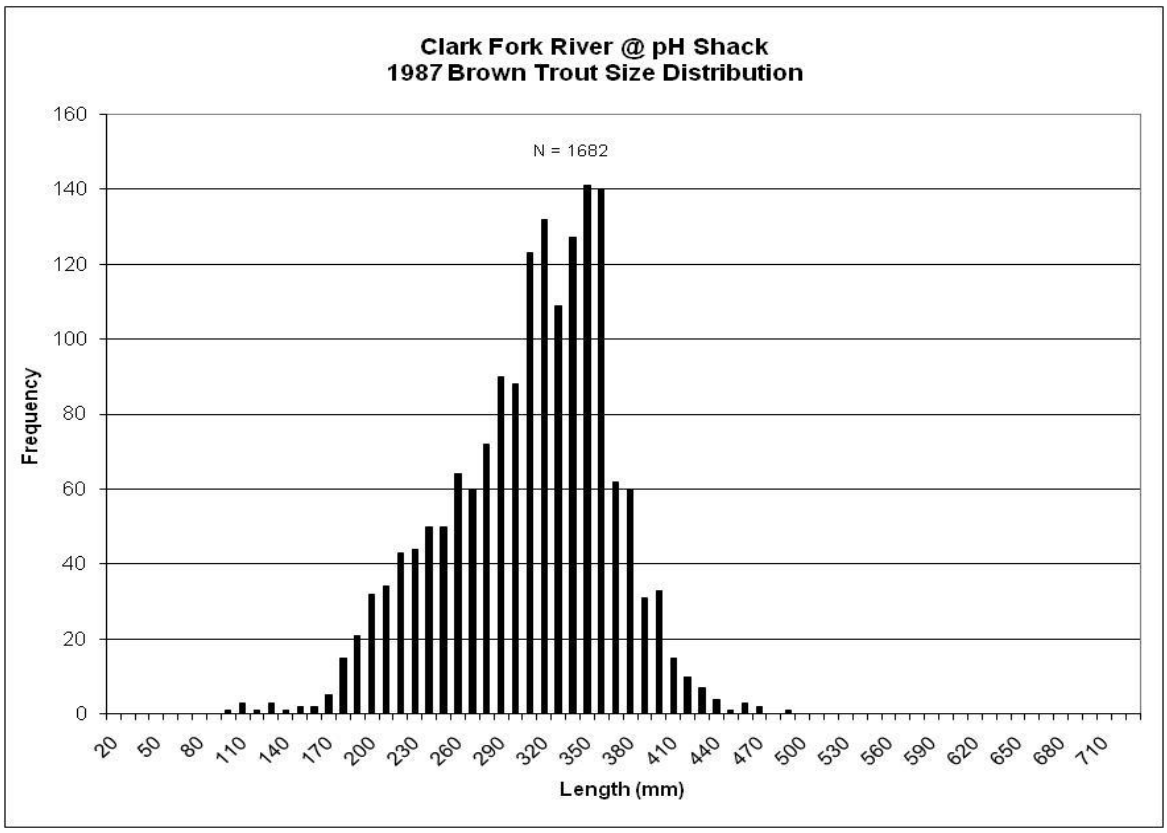
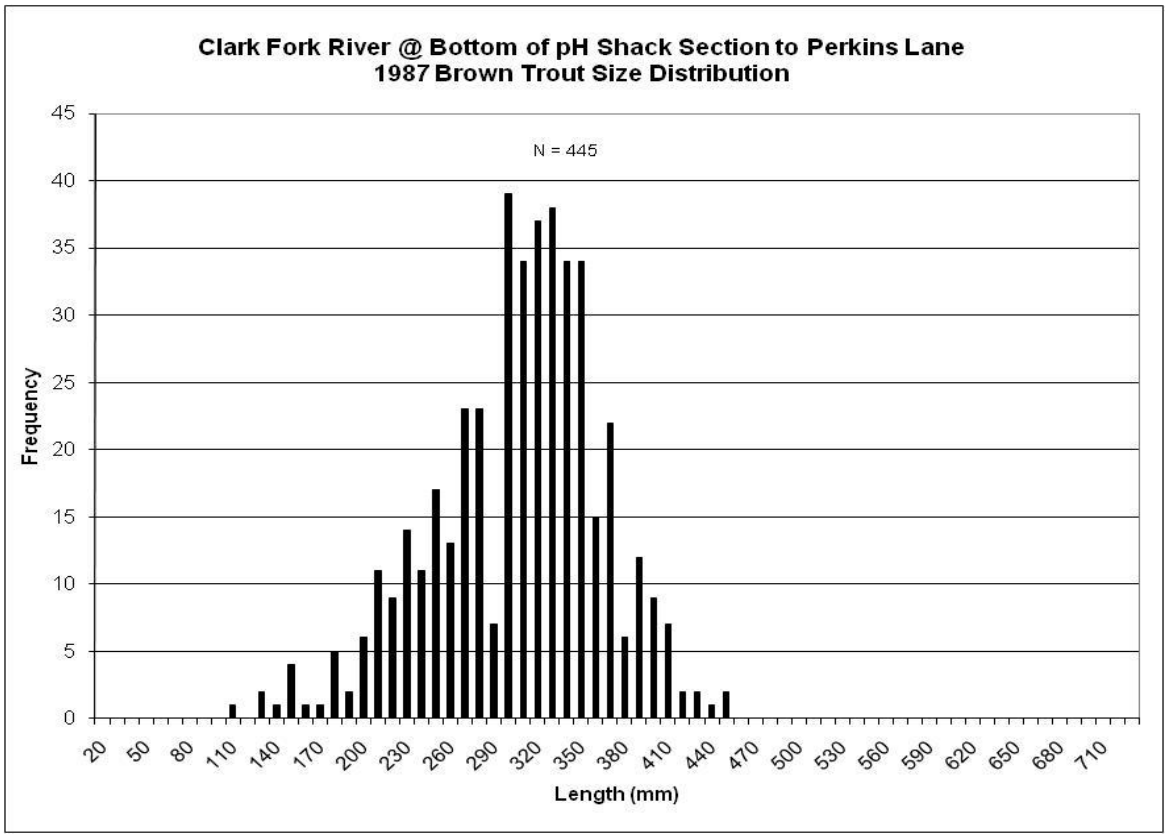
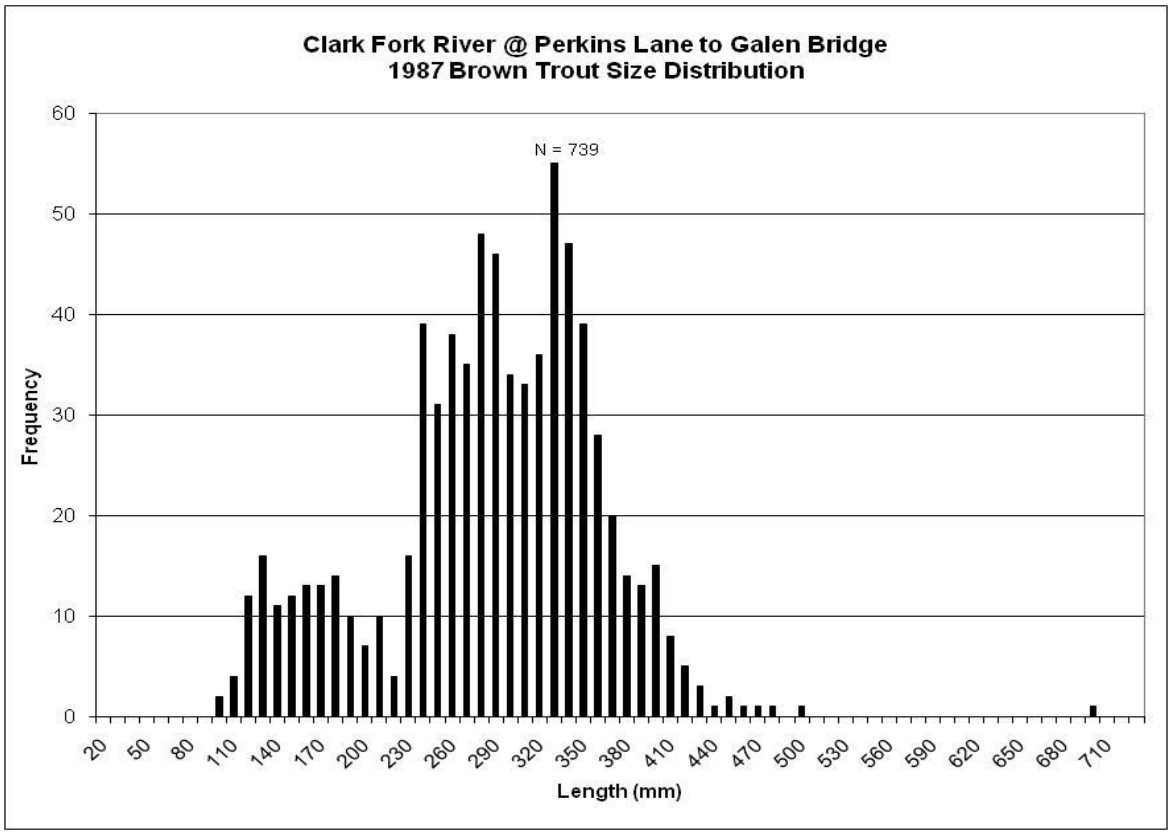

Clark Fork River @ pH Shack
1987 Brown Trout Size Distribution
N = 1682
Frequency
Length (mm)


Clark Fork River @ Bottom of pH Shack Section to Perkins Lane
1987 Brown Trout Size Distribution
N = 445
Frequency
Length (mm)


Clark Fork River @ Perkins Lane to Galen Bridge
1987 Brown Trout Size Distribution
N = 739
Frequency
Length (mm)
0
10
20
30
40
50
60
20
50
80
110
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200
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350
380
410
440
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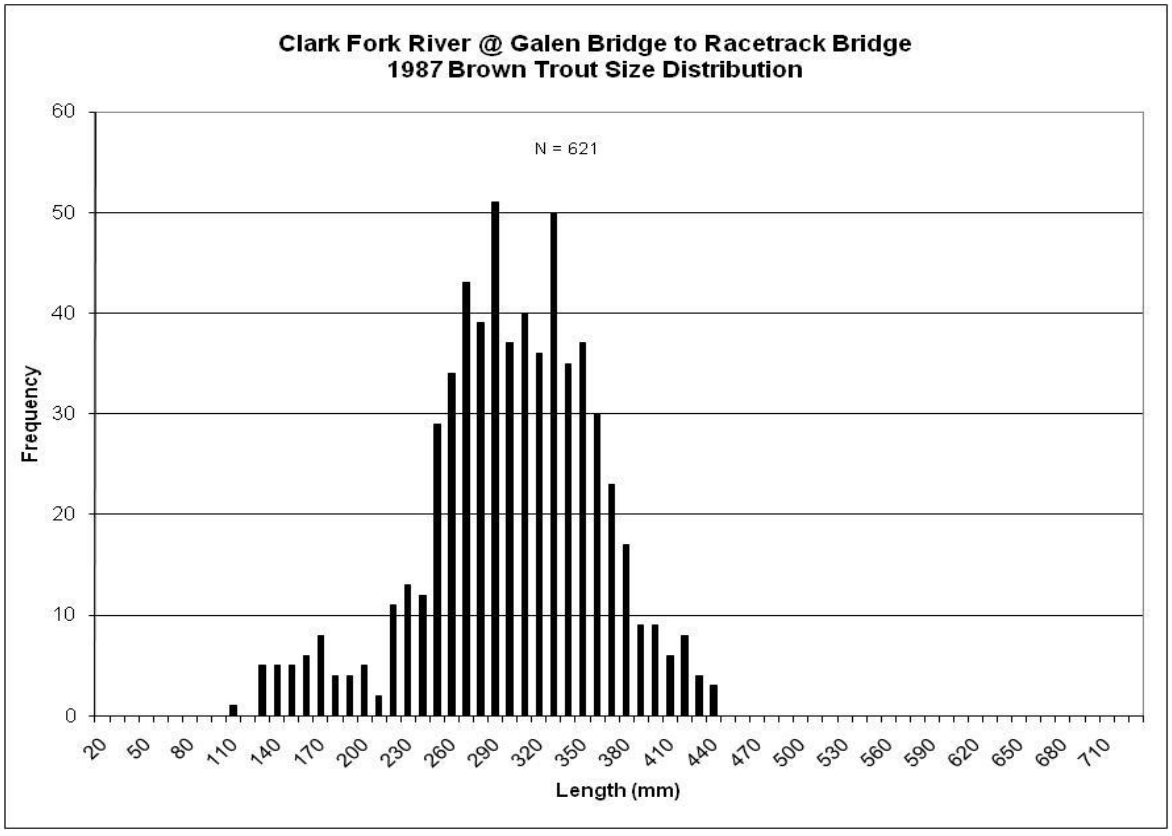
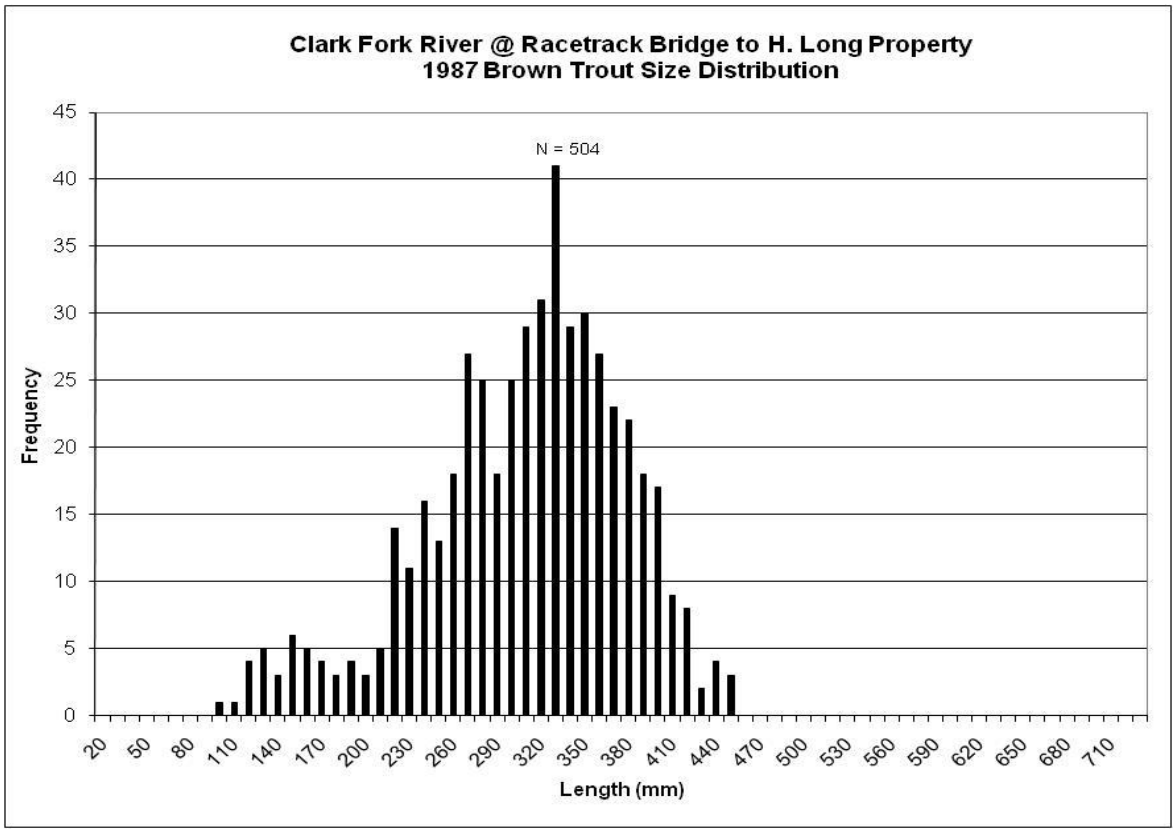
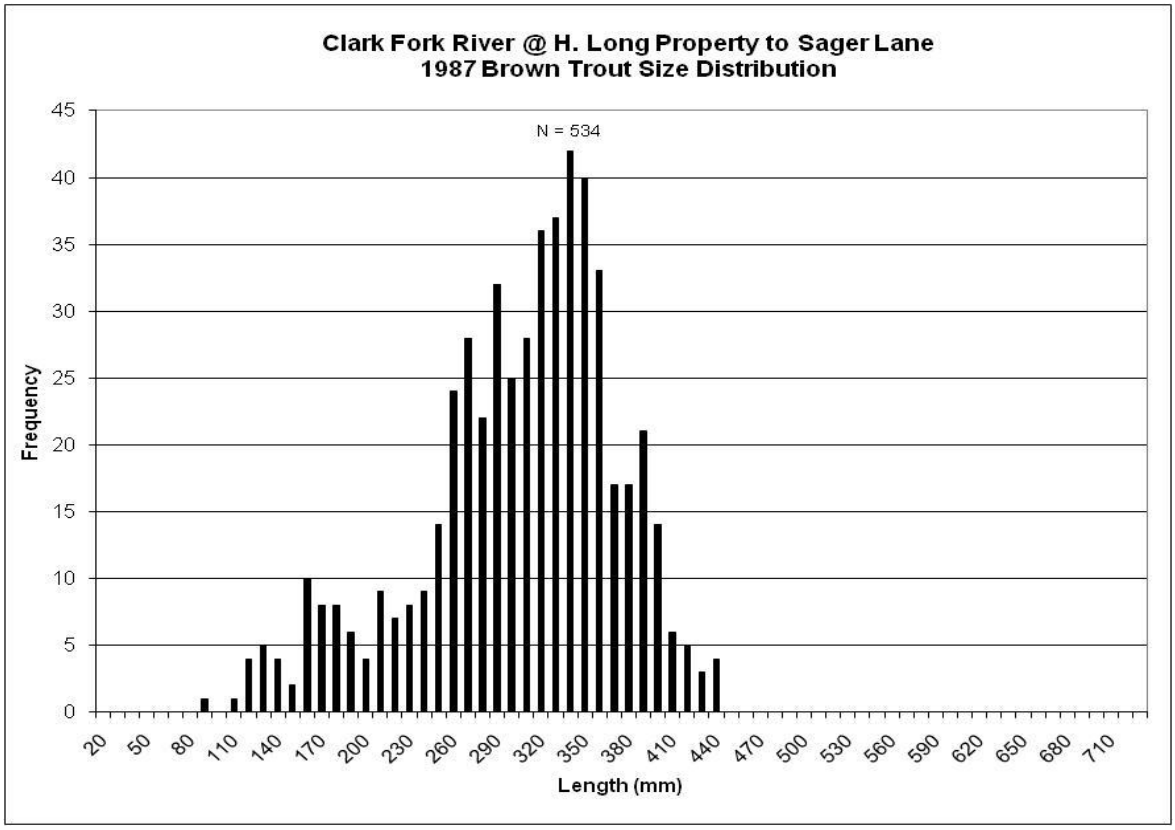
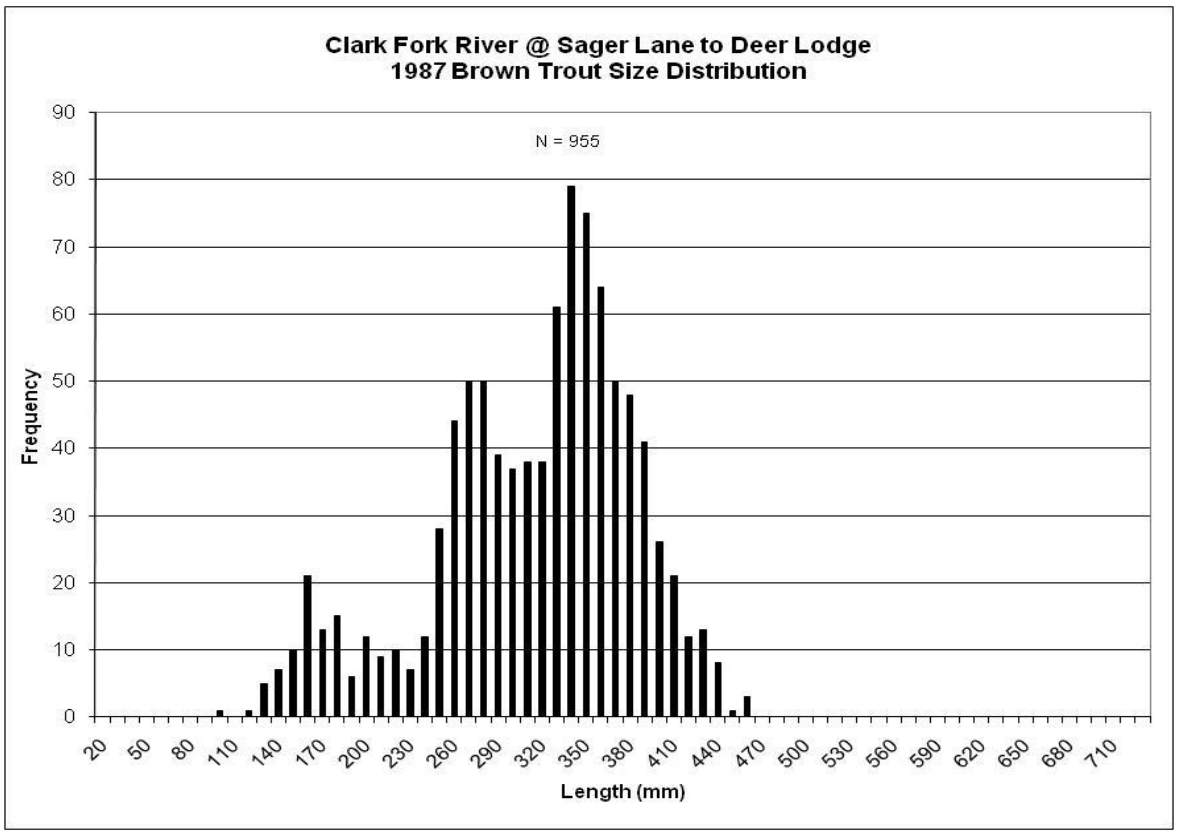
500
530
560
590
620
650
680
710


Clark Fork River @ Galen Bridge to Racetrack Bridge
1987 Brown Trout Size Distribution
N = 621
Frequency
Length (mm)
0
10
20
30
40
50
60
20
50
80
110
140
170
200
230
260
290
320
350
380
410
440
470
500
530
560
590
620
650
680
710


Clark Fork River @ Racetrack Bridge to H. Long Property
1987 Brown Trout Size Distribution
N = 504
Frequency
Length (mm)


Clark Fork River @ H. Long Property to Sager Lane
1987 Brown Trout Size Distribution
N = 534
Frequency
Length (mm)


Clark Fork River @ Sager Lane to Deer Lodge
1987 Brown Trout Size Distribution
N = 955
Frequency
Length (mm)
0
10
20
30
40
50
60
70
80
90
20
50
80
110
140
170
200
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260
290
320
350
380
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440
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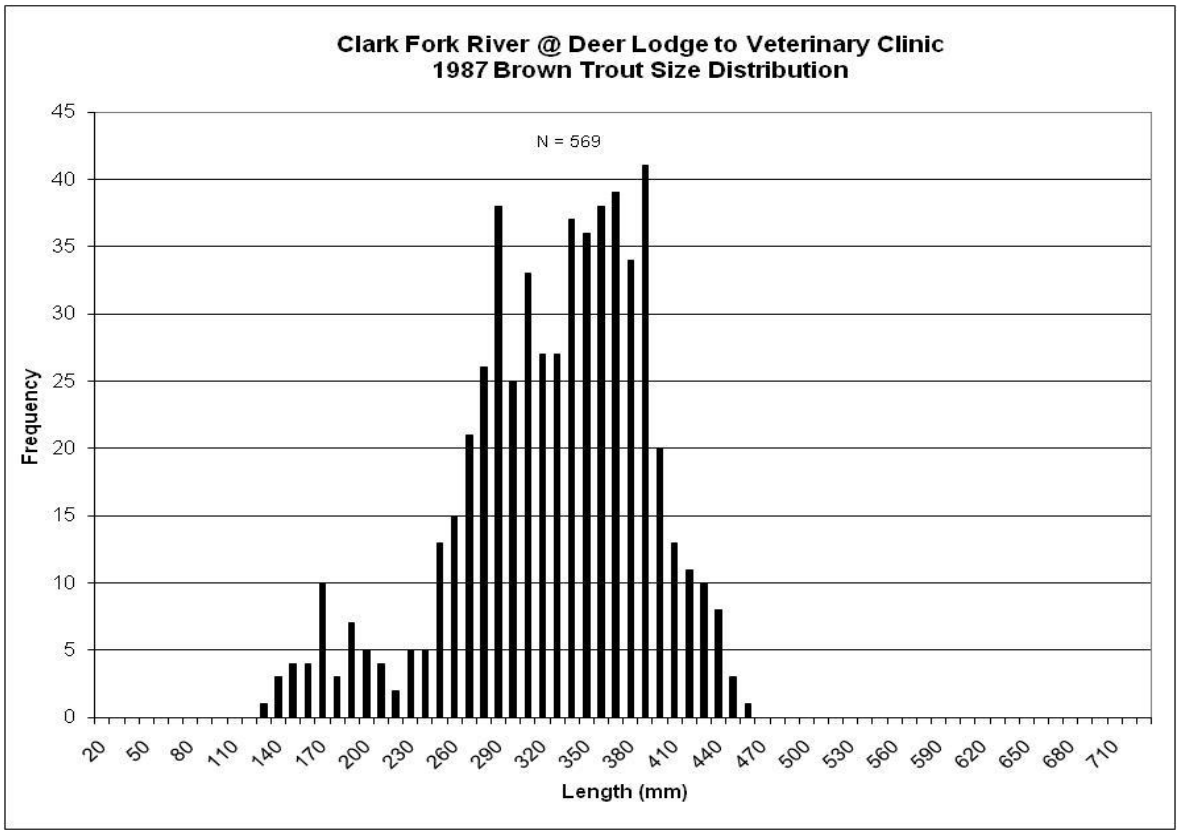
500
530
560
590
620
650
680
710


Clark Fork River @ Deer Lodge to Veterinary Clinic
1987 Brown Trout Size Distribution
N = 569
Frequency
Length (mm)
0
5
10
15
20
25
30
35
40
45
20
50
80
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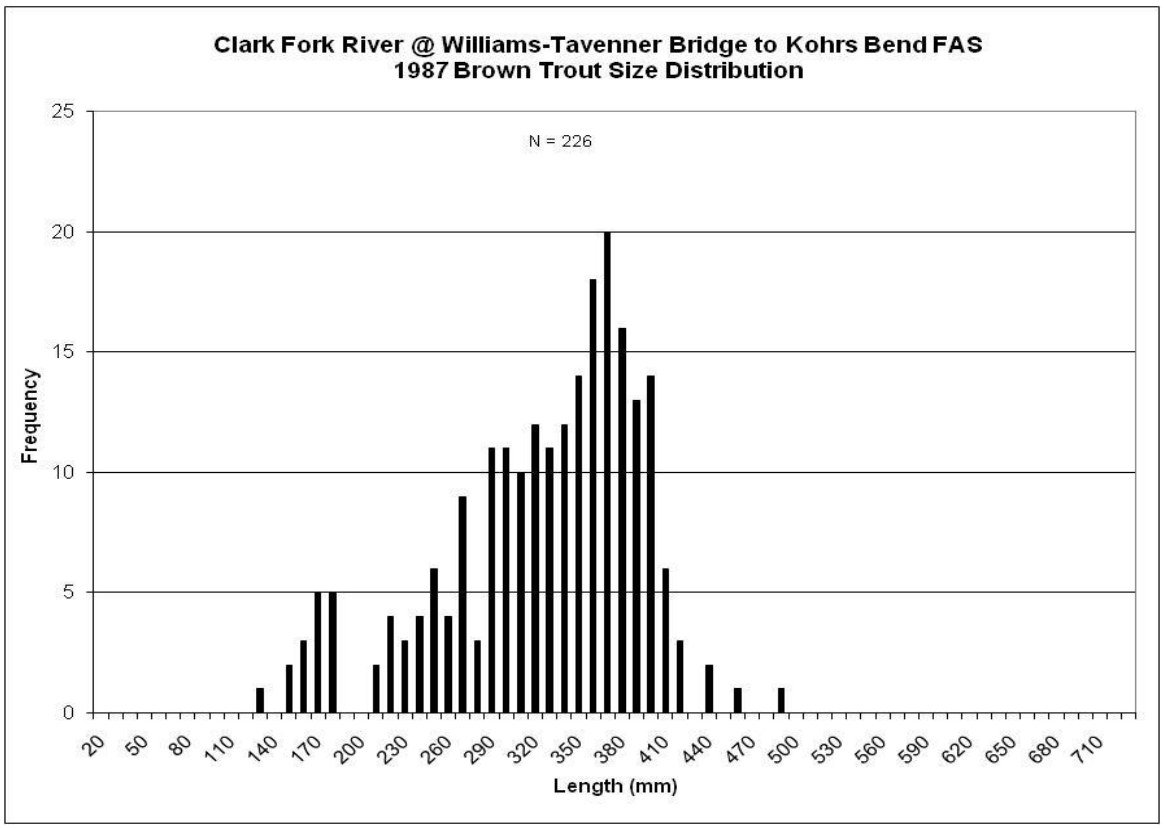
Clark Fork River @ Williams-Tavenner Bridge to Kohrs Bend FAS
1987 Brown Trout Size Distribution
N = 226
Frequency
Length (mm)
0
5
10
15
20
25
20
50
80
110
140
170
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290
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410
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500
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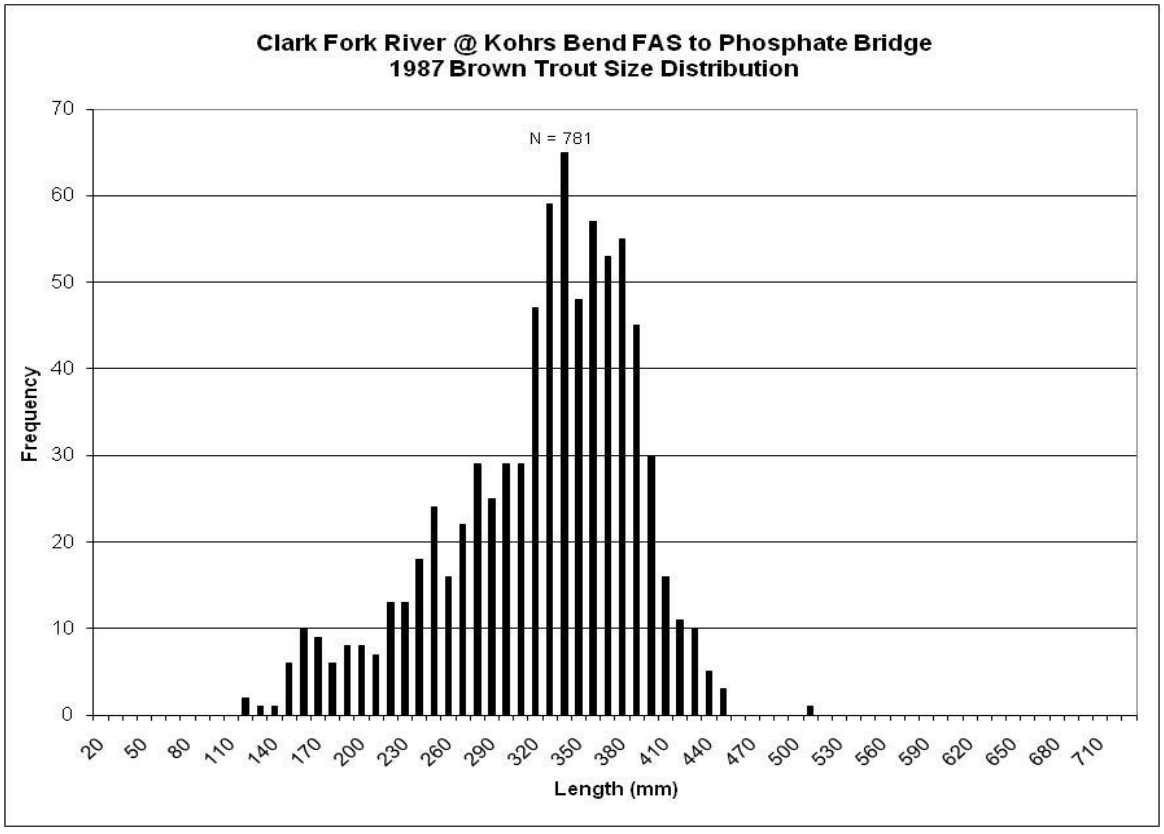
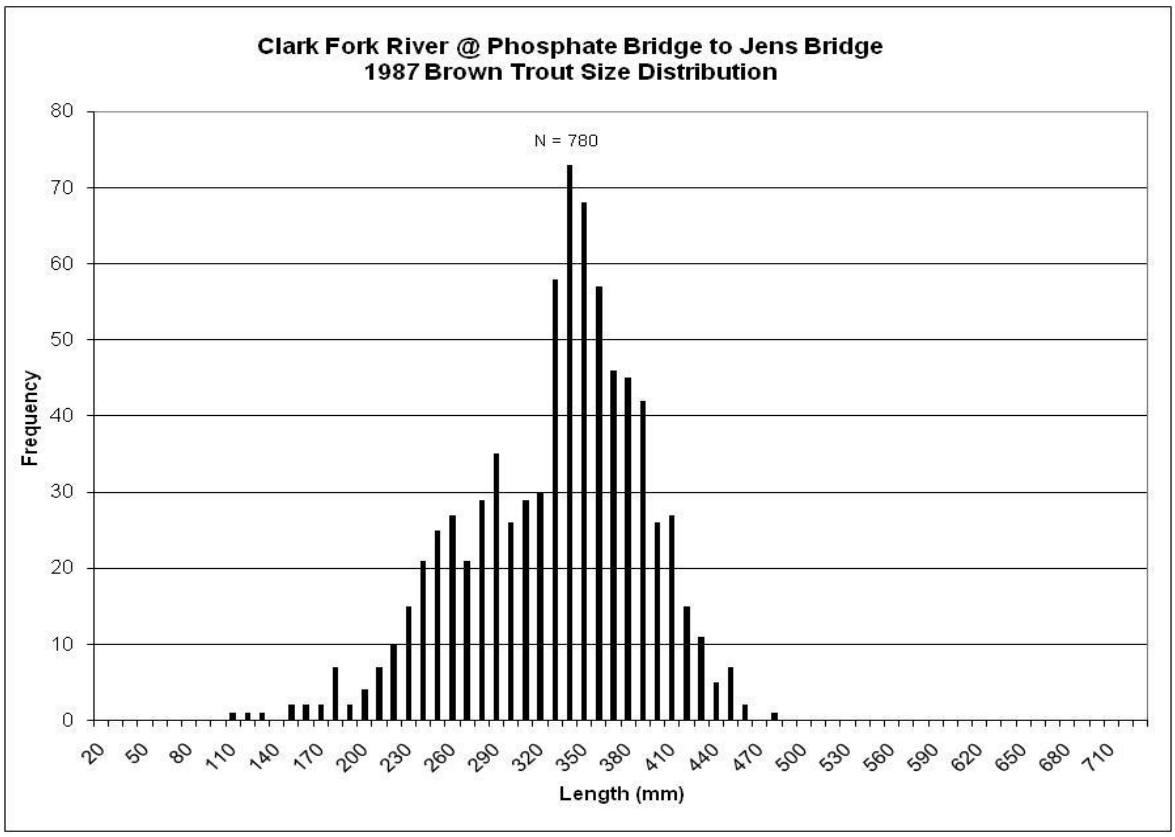
620
650
680
710


Clark Fork River @ Kohrs Bend FAS to Phosphate Bridge
1987 Brown Trout Size Distribution
N = 781
Frequency
Length (mm)
0
10
20
30
40
50
60
70
20
50
80
110
140
170
200
230
260
290
320
350
380
410
440
470
500
530
560
590
620
650
680
710


Clark Fork River @ Phosphate Bridge to Jens Bridge
1987 Brown Trout Size Distribution
N = 780
Frequency
Length (mm)
0
10
20
30
40
50
60
70
80
20
50
80
110
140
170
200
230
260
290
320
350
380
410
440
470
500
530
560
590
620
650
680
710