PEACE/WILLISTON FISH & WILDLIFE COMPENSATION PROGRAM

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Dinosaur Reservoir
2002 Fish Collection Summary

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ABSTRACT

Dinosaur Reservoir was formed in 1979 with the completion of the Peace Canyon Dam, which backs up water in a bedrock canyon for 20.5 km to the tailrace of W.A.C. Bennett Dam. A number of enhancement projects aimed at addressing fish habitat limitations and entrainment problems are planned for the reservoir. In order to evaluate the effectiveness of these activities, baseline fish data was needed. In October 2001, boat electrofishing and trap netting projects were carried out in Dinosaur Reservoir to assess the effectiveness of this sampling gear and gather preliminary baseline data. In 2002, an electrofishing program was initiated and twenty-eight shoreline sites were sampled twice in July and once in October by boat electrofishing at night. Species captured in order of abundance were rainbow trout (41%), mountain whitefish (19%), peamouth chub (12%), longnose suckers (10%), bull trout (6%), lake whitefish (5%), kokanee (5%), and lake trout (2%). One white sucker was also captured along with slimy and prickly sculpins, and redside shiners which were not included in the count. To test the feasibility of a mark recapture study, 5,030 adipose clipped hatchery rainbow trout were released in the reservoir one week before the July electrofishing. On the first electrofishing pass all fish captured were marked to contribute to a second independent mark recapture study that was conducted 2 days later at the same sites. The two passes yielded 682 fish (18 of which were recaptured hatchery rainbow trout and 273 were wild rainbow trout). All of the recaptured fish were found at sites where they were originally marked. The index sites were sampled again in October and 390 fish were captured (151 wild and 6 hatchery rainbow trout; 7 rainbow were recaptured from July, 2 of which were of hatchery origin). The population estimates base on the marked hatchery rainbow trout were 186,000 fish and 77,000 rainbow trout in the reservoir. The estimates based on the fish tagged during the electrofishing was 6,800 fish and 1,700 rainbow trout, but this only applied to the electrofishing sites because the marked fish did not redistribute.

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INTRODUCTION

Dinosaur Reservoir was formed in 1979 after the completion of the Peace Canyon Dam. This run of the river reservoir is 23 km long and backs water up to the tailrace of W.A.C. Bennett Dam. Dinosaur reservoir has a 3 day water retention period and water level fluctuations of up to 2 metres daily. A number of studies have been conducted on this reservoir to evaluate fish stocking programs (Hammond 1984, 1986a, 1986b, 1986c, 1987a, 1987b, 1988, Joslin 2001 a & b, Murphy and Blackman 2003). Additional projects have focused on habitat limitations and potential enhancements (Pattenden and Ash 1993 [a&b], Ash and McLeod 1994, Aim Ecological Consultants 2000). Rainbow trout (*Oncorhynchus mykiss)* and Mountain Whitefish (*Prosopium williamsoni*) were the most abundant species captured in previous studies. Other species captured include Bull trout *(Salvelinus confluentus),* kokanee (*Oncorhynchus nerka),* lake trout (*Salvelinus namaycush),* lake whitefish (*Coregonus clupeaformis),* longnose sucker (*Catostomus catostomus),* peamouth chub (*Mylocheilus caurinus),* prickly sculpin (*Cottus asper),* redside shiner (*Richardsonius balteatus*) and white sucker (*Catostomus commersoni).*

Previous studies show limited rearing habitat in the reservoir and entrainment problems that limit the effectiveness of stocking programs. As a result, a number of enhancement projects aimed at addressing fish habitat limitations, entrainment and stocking assessments are planned for the reservoir. In order to evaluate the effectiveness of these activities, baseline fish data is needed. Preliminary boat electrofishing was effective at capturing a variety of species along the shoreline of the reservoir in October 2001 (Murphy and Blackman 2003).

The objectives of the 2002 program were to collect information on the species present and establish index electrofishing sites along the shoreline and in numerous small bays. These sites were sampled twice in July and once in October. Two separate mark recapture population estimates were conducted. The first estimate was based on 5,030 marked hatchery rainbow trout released on July 2nd just prior to the July electrofishing session. The second estimate was based on fish captured and marked during the first electrofishing pass. The objective was to determine whether boat electrofishing would be suitable for evaluating changes in the fish populations of Dinosaur Reservoir. Dispersal of the adipose clipped hatchery rainbow trout released at the W.A.C. Bennett Dam tailrace was of also of interest.

On October 17th a survey was conducted to find lake trout spawning areas but none were found.

Study Area

Dinosaur reservoir is a steep sided run of the river reservoir, 23 km long and covering an area of 805 ha, of which 400 ha is a bedrock river channel (Hammond 1984). Water levels are controlled by the Dam operations, with low water usually occurring at night. The reservoir is isothermal throughout the year (Pattenden and Ash 1993a), with intake water temperatures (from W.A.C. Bennett Dam) in the range of 2 to 5 ^{o}C from November to June, and seldom exceeding 10 ^{o}C even in August. Johnson and Gething Creeks are the only significant spawning and rearing tributaries for stream spawning fish populations in Dinosaur Reservoir (Pattenden and Ash 1993a). The length of accessible stream to fish from the reservoir is limited to 500 m of Johnson Creek, which has extreme silt load problems (pers. obs.), and 600 m of Gething Creek to the base of an impassable waterfall. There are several other smaller tributaries which have intermittent flows and very short accessible lengths due to fish passage barriers.

METHODS

The electrofishing boat used was an 18 ft Smith-Root powered by a 115 HP outboard jet, that enabled the boat to operate in the shallow water very close to shore. The electrofisher utilized was a Smith-Root GPP 5.0 unit powered by a 5,000 W generator on DC current at 60 Hz. The voltage was between 500 and 700 volts.

The 28 index sites were distributed throughout the reservoir, covering shoreline and bay habitat types (Figure 1). All shoreline sites were 200 m in length. Bay sites covered the shoreline of small individual bays and were frequently less than 200 m in length. Site selection was biased towards potential enhancement sites and areas adjacent those sites. Habitats with steep bedrock slopes and the upper bedrock canyon area have fewer sites. There were two sampling passes completed in July and the same index sites were sampled once in October. Electrofishing began at dusk and continued until sunrise or until the sites were completed. Additional sampling was done in October to locate potential lake trout spawning areas.

The mark recapture study started on July 8th, 2002. The middle of each site was marked with a red buoy, and the start and end point coordinates were obtained and recorded in a hand held GPS unit before the site was electrofished. Two people operated a sampling boat that followed the electrofishing boat from site to site. The second crew netted fish and placed them in holding tanks on the electrofishing boat, which moved slowly close to the shoreline and covered each area once. After the site had been electrofished, all fish were handed over to the sampling boat where they were identified, measured, weighed and marked with a caudal clip. All rainbow trout over 250 mm were tagged with "spaghetti" tags at the base of the dorsal fin. Scale samples were taken from all wild trout or char captured. Adipose clipped (hatchery) rainbows were also noted. Once the fish had been processed and marked, the sampling boat returned them to the middle of the site from which they had been captured.

On July 13th after all sites had been sampled once, a second sampling regime began. The same sites were electrofished and again the sampling boat was given all the fish to identify, measure and check for tags and clips. Additional spaghetti tags were applied to unmarked rainbow trout. Species codes and scientific names of species used in this report are listed in Appendix A.

Population Estimates

An adjusted Peterson mark recapture estimate was used to estimate sampled fish populations in the reservoir. The calculation was as follows:

$N = (M+1)(C+1)/(R+1)$
N = Population Estimate
M = number of fish tagged corrected for tag loss
C = number of fish captured
R = the number of recaptured tagged fish
Variance of (N) = $N^2 (C-R)/(C+1)R+2)$
Standard Error of N= $\sqrt{}$ variance

To be statistically valid, a minimum of 20% of the population (N) must be marked (M) to avoid bias because of low numbers (MC>4N).

A second boat was not used for the October 15-16 survey, so all fish were sampled on board the electrofishing boat. On October 17th additional sites (No. 36-43 Figure 1) were electrofished to locate potential lake trout spawning areas.

RESULTS

In July, 358 and 324 fish were captured on the two electrofishing sessions of the 28 index sites. In October, 390 fish were captured (Table 1).

Table 1. Numbers of fish captured at the index sites during the two sample sessions in July and the October session in 2002.

Site	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	22	23	24	25	26	27	28	29	Total
July 8-12	11	30	62	9	10	13	16	18	7	17	8	5	7	7	6	2	15	16	4	16	4	15	24	17	6	4	2	7	358
July13-14	12	24	29	9	8	9	17	13	2	16	6	6	1	2	7	12	17	24	20	16	3	13	18	9	11	6	7	7	324
October 15-16	18	17	53	10	10	11	4	13	6	15	6	2	4	14	8	11	9	12	14	9	9	39	28	37	5	16	3	7	390
Total	41	71	144	28	28	33	37	44	15	48	20	13	12	23	21	25	41	52	38	41	16	67	70	63	22	26	12	21	1072

Rainbow trout were the most abundant species captured, followed by mountain whitefish and peamouth chub (Table 2). Suckers includes both white and longnose species. There were also a small number of prickly and slimy sculpins as well as redside shiners captured, which were not included in the calculations.

Table 2. Number of each species captured from Dinosaur Reservoir in 2002 by boat electrofishing.

Species	*Rainbow Trout	Mountain Whitefish	Peamouth Chub	Bull Trout	Lake Whitefish	Kokanee	Lake Trout	Longnose and White Suckers	Total Fish
July pass 1	154	64	31	6	15	15	18	55	358
July pass 2	137	55	30	21	18	12	3	48	324
October	158	87	63	39	17	24	1	1	390
October Lake Trout survey**	49	33	11	8	50	16	2	1	170

*includes both hatchery and wild rainbow.
**exploratory survey conducted to search for spawning lake trout.

Table 3. Average fork length, range and number of species captured on (pass 1) July 8th, 11th and 12th 2002.

Species	Rainbow Trout	Mountain Whitefish	Bull Trout	Lake Whitefish	Kokanee	Lake Trout	Peamouth Chub	Longnose and White Sucker
Mean (mm)	202	176	177	278	90	166	192	256
Min (mm)	106	82	153	107	75	80	110	100
Max (mm)	342	379	260	378	97	354	225	416
SD	38	78	35	87	7	80	19	87
n	154	62	8	15	15	18	31	55

The average fork length for most species was quite variable between summer and fall sample sessions (Tables 3, 4, 5 and 6). Some species, such as rainbow trout, were larger in October than July. Other species, such as mountain whitefish, were different each sample session.

Table 4. Average fork length, range and number of species captured on (pass 2) July 13th and 14th.

Species	Rainbow Trout	Mountain Whitefish	Bull Trout	Lake Whitefish	Kokanee	Lake Trout	Peamouth Chub	Longnose and White Sucker
Mean(mm)	204	220	199	260	98	218	187	217
Min	85	55	138	95	75	95	130	85
Max	370	365	415	367	205	365	234	380
SD	45	80	76	74	34	137	30	79
n	137	55	21	18	12	3	30	48

Table 5. Average fork length, range and number of species captured on October 15th and 16th.

Species	Rainbow Trout	Mountain Whitefish	Bull Trout	Lake Whitefish	Kokanee	Lake Trout	Peamouth Chub	Longnose and White Sucker
Mean (mm)	228	208	250	334	211	185	181	259
Min (mm)	125	64	171	258	63	185	97	259
Max (mm)	355	370	711	390	255	185	229	259
SD	44	72	119	36	49	0	31	0
n	158	87	39	17	24	1	63	1

Table 6. Average fork length, range and number of species captured during the Lake Trout survey on October 17th 2002.

Species	Rainbow Trout	Mountain Whitefish	Bull Trout	Lake Whitefish	Kokanee	Lake Trout	Peamouth Chub	Longnose and White Sucker
Mean (mm)	254	299	413	340	192	207	198	203
Min (mm)	159	78	210	250	61	129	166	203
Max (mm)	346	425	705	440	257	285	239	203
SD	43	80	234	49	58	110	22	0
n	49	33	8	50	16	2	11	1

*Tables 1, 2 and 3 in appendix B show complete numbers of all fish species captured at each site.

The mode size of rainbow trout captured was between 200 mm and 250 mm (Figures. 2, 3 and 4). For mountain whitefish it was different in each sampling period (Figures. 5, 6 and 7) and for peamouth chub it was 150-200 mm (Figures. 8, 9 and 10). Five wild rainbow trout, spaghetti tagged in July were recaptured in October, and all but 1 showed growth of more than 20 mm between captures (Table 7).

Table 7. Growth of rainbow trout tagged in July 2002 and recaptured in October 2002.

Tag #	Site #	FL (mm) in July	Recapture Site	FL (mm) at Recapture	Growth (mm)
49	3	202	3	235	33
114	8	230	23	262	32
116	3	222	3	242	20
*168	5	236	5	235	-1
243	2	235	2	283	48
**125	3	251	41	308	57

* second time recaptured at the same site.
** recaptured during lake trout spawner survey

The 358 fish captured on the first sampling pass in July were marked using a caudal fin clip and 70 of the rainbow trout were marked with spaghetti tags. On the second pass 324 fish were captured. Sixteen marks were recaptured, 6 tagged fish and 10 clipped fish, plus 5 adipose clipped hatchery rainbow trout (Table 8). An additional 8 spaghetti tags were applied to rainbow trout on the second pass.

Table 8. Fish captured, marked and recaptured in the 28 index sites during the three sample periods and the October Lake trout Surveys in 2002.

Species	July Pass #1 Marked	July Pass #2 Captured	July Pass #2 Recaptured	October 15-16 Captured	October 15-16 Recaptured	Total Captures	Total Recaptures	% of Species Marks Recaptured
Rainbow Trout (wild)	141	131	12	152	5	424	17	11
Rainbow Trout (hatchery)	13	6	0	6	0	25	0	0
Mountain Whitefish	62	55	2	87	0	204	2	3
Bull Trout	8	21	1	39	0	68	1	13
Lake Trout	18	3	0	1	0	22	0	0
Kokanee	15	12	0	24	0	51	0	0
Lake Whitefish	15	18	0	17	0	50	0	0
Peamouth Chub	31	30	0	63	0	124	0	0
Longnose and White Suckers	55	48	1	1	0	104	1	2
Total	358	324	16	390	5	1072	21	6

* 5,030 adipose clipped hatchery rainbow were released into Dinosaur Reservoir in July 2002.
** 8 additional rainbow trout were tagged on the pass #2 in July.

In October, 390 fish were captured from the 28 sites, including 4 tagged, 1 clipped and 6 hatchery rainbow trout. Three fish were recaptured at their release site and 2 were recaptured considerable distances away. One additional tagged rainbow trout and nine hatchery rainbow were captured during the lake trout spawner survey. Only one caudal clipped fish, a rainbow trout was observed in October.

Only 24 hatchery rainbow trout (6% of total) were captured from the index sites during three sampling sessions. An additional 9 were captured during the October Lake trout survey (Table 9). Most (63%) of the hatchery fish were captured at index sites near the Peace Canyon Dam, 20 km from the release site at the other end of the reservoir (Table 10). Seven of the nine hatchery rainbow trout captured during the Lake trout survey were close to the release site in an area not included in the index sites

Table 9. Rainbow trout captured at all sites during the sampling periods with the numbers and percentage of marked hatchery rainbow trout captured.

Sampling Period	Wild	Hatchery	Total	% Hatchery
July 8-12	141	13	154	8
July 13-14	131	5	136	4
October 15-16	152	6	158	4
October 1, 2017	49	9	58	16
Total	473	33	506	7

Table 10. Number of hatchery rainbow trout recaptured from all sites.

Distance (km) from release site	0-4.9	5-9.9	10-14.9	>15
No.of sites sampled *	5	25	36	26
No.of hatchery RB captured	7	2	7	17
Average catch/site sampled	1.4	0.1	0.2	0.7

* Index sites (1-29 Figure 1) were sampled three times but the sites sample during the Lake trout surveys (36-43) were only sampled once.

Two immature lake trout were captured during the lake trout survey in October from a total of 170 fish collected. At the sites immediately downstream from the W.A.C. Bennett Dam (sites 36-38), mountain and lake whitefish were so abundant that many were simply not collected because the main objective of that survey was to find spawning lake trout. This concentration may be indicative of prespawning behavior.

In October, more fish were captured in bays than shoreline sites. Both passes in July had higher capture rates in shoreline sites (Table 11).

Table 11. Average number of fish captured / site at bay and shoreline sites.

	July pass 1	July pass 2	October
Bay sites	7.9	7.1	14.2
Shoreline sites	13.6	11.9	13.5

DISCUSSION

Rainbow trout and mountain whitefish were the most numerous species captured (Figure 11, Table 2), as was the case in the initial electrofishing survey conducted in the fall of 2001 (Murphy and Blackman 2003). The total number of rainbow trout, mountain whitefish, kokanee, and lake whitefish, was similar in both July and October 2002 periods (Appendix B), which suggests the sampling protocol used was effective and was not affected by seasonal movements. The data collected is probably a good reflection of the species composition inhabiting the near shore areas but may not be indicative of the fish population in the reservoir as a whole or of the species composition in the upper bedrock canyon area.

The data collected from the index sites provides information on the juvenile rainbow trout population rearing in the near shore areas. The dominant size class of the rainbow trout captured in July was between 200-250 mm (Figures 2 and 3) and 80% were between 150 and 250 mm fork length. Based on size at age data collected in 1999 and 2000 (Joslin 2001 [a & b]) this size group would be predominantly one and two year old juveniles. The dominant size class of rainbow trout captured in October was 200-250mm but the second most abundant class shifted from 150-200 mm in July, to 250-300 mm in the fall (Figure 4). The average fork length increased 25 mm to 228 mm from July to October (Tables 2-5), which was confirmed by an average growth of 31 mm from individual rainbow trout tagged in July and recaptured in October. The average size (fork length) of rainbow trout captured in October during the lake trout surveys was 254 mm and 262 mm from the tailrace area (sites 36 and 37), both significantly larger ($p < 0.05$) than the trout captured from the index sites at that time. This was because the shoreline index sites were occupied by all size groups, but few smaller individuals were found offshore or near the tailrace.

The rainbow trout also appear to be have limited movement along the shoreline. The highest number of rainbow trout were captured at site 3 during all sample sessions. Site 3 is a shoreline area with overhanging trees and a large amount of sunken woody debris. On the second pass in July, the reservoir water level had dropped and most of the woody debris was exposed on the beach, but despite the fact that the cover was no longer available high numbers were still at that site. This suggests that rainbow trout remain near one location rather than moving along the shoreline. Nine of eleven recaptured spaghetti tagged rainbow trout were at the same site where they were released. There was no movement between sites in July despite that fact that there was only a short distance separating many of the sites. The two fish that moved (8 and 12 km) were recaptured in October. A higher percentage of rainbow trout were recaptured than the other species (Table 8). This was not a size or mark recognition effect since an equal percentage of larger spaghetti tagged and smaller fin clipped rainbow trout were recaptured. Either the rainbow trout are more easily captured by boat electrofishing or they are more closely associated to the shallow near shore areas than the other species.

Mountain whitefish and peamouth chub numbers were consistent in July and increased slightly in October. The dominant size class of mountain whitefish was different in each sampling session (Figures 5, 6 and 7). Different fish were captured each time, as only 2 fin clipped mountain whitefish were recaptured. Perhaps in the reservoir this species is more abundant and wide ranging than the rainbow trout. The most commonly captured size class for peamouth chub was between 150-200 mm each time the sites were sampled (Figures 8, 9 and 10). No peamouth chub were recaptured.

Bull trout numbers increased from 6 to 21 in the July sessions and 39 were captured in the October sampling. This could be a seasonal change as a result of dispersal from the tailrace of W.A.C. Bennett Dam (sites 36 and 37) where it is suspected that many of the large bull trout spend most of the year. In September many of these fish may leave to spawn in Gething Creek or other tributary streams.

Many of the bull trout captured in October were very large fish compared to those captured in July (Tables 3, 4 and 5). The large bull trout captured in October (after the Bull trout spawning period) were not found in a concentrated area but were spread throughout the reservoir at different sites. However, the largest bull trout captured during the lake trout survey was in the canyon area just downstream from Gething Creek (Figure 1, sites 38, 39 and 40) in an area not included in the index sites.

Sucker (longnose and white) numbers were much lower in October probably because this species may move to deeper water after spawning in the spring.

Lake trout numbers also decreased, but we have no explanation of this pattern. Eleven of the 22 lake trout captured from the index sites were less than 100 mm fork length and only 4 were greater than 200 mm. A reasonable assumption is that the juveniles of this species move to deeper water as the season progresses.

We realized that the mark recapture experiments would have some fairly significant flaws before the work was undertaken. However, it was felt the effort would be justified since marked hatchery rainbow trout were scheduled to be released into the reservoir anyway, and by marking fish captured during the electrofishing, we could also collect information on distribution and growth. One of the problems is Dinosaur Reservoir is not a closed system and the number of fish entrained through the two dams is unknown. There were an unknown number of similarly clipped rainbow trout in the reservoir from releases in 2001, but the number remaining in the reservoir after one year was assumed to be low, based on creel data (Joslin 2001[a & b]). Only data collected in July was used for the population estimates assuming that this would provide sufficient time for the marked trout to distribute but was close enough to the release date to minimize the effects of entrainment. Although the outcome of the mark recapture study was not statistically valid (Tables 12 and 13), some useful information did result.

The number of the hatchery rainbow trout captured from the index sites was positively correlated ($R^2 = 0.55$) to the number of wild rainbow trout (Figure 11). So distribution in the index sites was similar to that of the wild rainbow trout. However, a disproportionate number of the marked hatchery fish may have remained near the release site, which would make the estimated number of rainbow trout in the reservoir (Table 12) too high. The estimates for all fish and mountain whitefish are high for the same reasons and based on recaptures of fish marked during the electrofishing, rainbow trout populations do not appear to be distributed in the same proportions as the other species. Therefore marked rainbow trout may not be appropriate to use to estimate the populations of other species.

The population estimates based on the fish marked during the electrofishing (Table 13) would only apply to rainbow trout within the index sites. We must assume the marks were only distributed within the sites because all of the recaptures were from the same sites where the fish were released, despite the fact that many of the sites were separated by only short distances.

The recapture rate for species other than rainbow trout was too low, (Table 8. 2 of 62 mountain whitefish, 1 of 8 bull trout and 1 of 55 longnose suckers and no peamouth chub) so estimates should not be made for these species, although we have included the values for mountain whitefish and all species in Table 13.

Table 12. Reservoir fish population estimates using mark recapture analysis with marked hatchery rainbow trout. This would apply to the entire reservoir, assuming even distribution of the marked fish and that all fish had the same probability of capture as the marked fish.

	Mark	Capture	Recapture	Pop N	SE of N	% of est N Marked
Reservoir all fish	5030	682	18	180,851	39,873	3
Rainbow Trout	5030	291	18	77,300	16,717	7
Mountain Whitefish	5030	117	18	31,245	6,399	16

Table 13. July mark recapture analysis utilizing marks applied during electrofishing. This would apply to the population of fish in the electrofishing sites, assuming the marked fish remained at the same locations.

.	Mark	Capture	Recapture	Pop N	SE of N	% of est N Marked
All Fish	358	324	16	6,863	1,575	5
Rainbow Trout	154	137	12	1,758	403	10
Mountain Whitefish	62	55	2	1,176	572	5

The mark recapture data is not statistically valid due to insufficient recaptures. The percentage of the estimated population that is marked must exceed 20% to be valid. However the low number bias rule of (MC>4N) was met.

Most hatchery rainbow trout were found in index sites close to the Peace Canyon Dam but this distribution was similar to the wild rainbow trout distribution (Figure 11 and 12). However, hatchery rainbow comprised only 6% of all rainbow captured in 2002 (Table 9). The number of hatchery fish captured in the fall (6) is not notably lower than in the summer (pass 1: 13, pass 2: 5), despite a full season of angling pressure between July and October. Nine hatchery rainbow trout were also captured during the survey conducted to look at potential lake trout spawning areas. Most of these sites were not along the shore or were in the upper canyon areas and the increased percentage of hatchery fish vs. wild fish (18%) suggests that a high percentage of the hatchery fish remained near the release site, and are not sampled by the index project. The 6% contribution is much lower that the 35% contribution of hatchery fish (same stock and similar release size) to the creel reported in 2000 (Joslin 2001). Earlier creel surveys (Hammond 1986 [a & b], Pattenden and Ash [b] 1993) suggest that 35-59% of the rainbow trout harvested from Dinosaur Reservoir were of hatchery origin and that nearly 40% of the rainbow trout harvested from the Peace River below the reservoir were hatchery fish which had been released in Dinosaur Reservoir. In these previous studies the number of fish released and stock origins were quite variable. The fishery downstream from the reservoir at that time was substantial with an estimated 8,629 anglers fishing 16,898 hrs and capturing 4,469 rainbow trout (Hammond 1986b). Hatchery fish could be more vulnerable to the creel than wild stocks, may utilize different habitats and a substantial portion of the hatchery fish are entrained through the dam.

In the sites where woody debris structures were added (sites 10 and 16), the number of fish captured was similar to the number captured before the addition of wood. The structures themselves made sampling more difficult and access to the shoreline was limited. This may make evaluation of the effectiveness of woody debris additions more difficult and alternative sampling methods are being considered.

Management Implications

Boat electrofishing appeared to be an effective method of capturing fish in the shoreline areas of Dinosaur Reservoir when initially attempted in 2001 (Murphy and Blackman 2003). By electrofishing at the same locations each year it may be possible to identify population trends. Although it may be necessary to collect several more years of data in order to evaluate the resolution that can be obtained with this method. The distribution of electrofishing sites was intended to monitor changes in populations as a result of habitat enhancements. The limited number of electrofishing sites in the upper canyon area may be a shortcoming. This area may support a slightly different species composition and/or at the least different size classes. However, no habitat improvements are planned for this area and obtaining consistent sampling results in this type of habitat would be very difficult.

The population estimates had some inherent problems such that it will be difficult to obtain accurate estimates using these methods particularly in light of complications as a result of entrainment through the dams. The distribution of captured hatchery fish is interesting with the greatest numbers captured at the opposite end of the reservoir from where they were released and the reduced number of recaptures on the second pass in July. The increased proportion of hatchery fish captured during the lake trout survey was also surprising, as a higher number of fish remained near the release site than anticipated. Findings such as these illustrate how little we know of fish movement within the reservoir. The value of continued population estimates is limited but a continuation of fish marking and recapture may provide valuable insights into movement and habitat used. Evaluation of entrainment issues are beyond the scope of this program, and are probably in part species specific, dependant on flow, and seasonal effects and as such would be very difficult to determine. Entrainment may impact the reservoir fish populations, but only by monitoring the populations will we be able to determine if this is true. Additionally there have been concerns raised about the potential impact of what appears to be a growing lake trout population that may negatively impact the bull trout population. By monitoring stocks we may be able to obtain a clearer picture of the interaction between these two species.

The fluctuating water levels within the system also pose a sampling problem. Based on operation records, the water levels can rise or fall up to 40 cm / hr. Each time a site is sampled the water levels, and therefore the habitat availability, changes. It is not possible to sample at consistent water levels from year to year. However, despite different water levels, the overall number of fish captured, and those sites with the highest numbers of fish remained consistent during the sampling sessions. Also movement between sites of the marked fish was minimal. The assumption may therefore be made that fish will stay in the area even as the water levels fluctuate.

The addition of woody debris structures in small bays was initiated in 2001 and continued in 2002. It was assumed the addition of woody debris would increase fish numbers at the enhanced locations. However, the effectiveness of boat electrofishing may be reduced as the structures become larger and more complex. Other options such as the use of trap nets may need to be implemented to document increased numbers of fish in enhanced areas.

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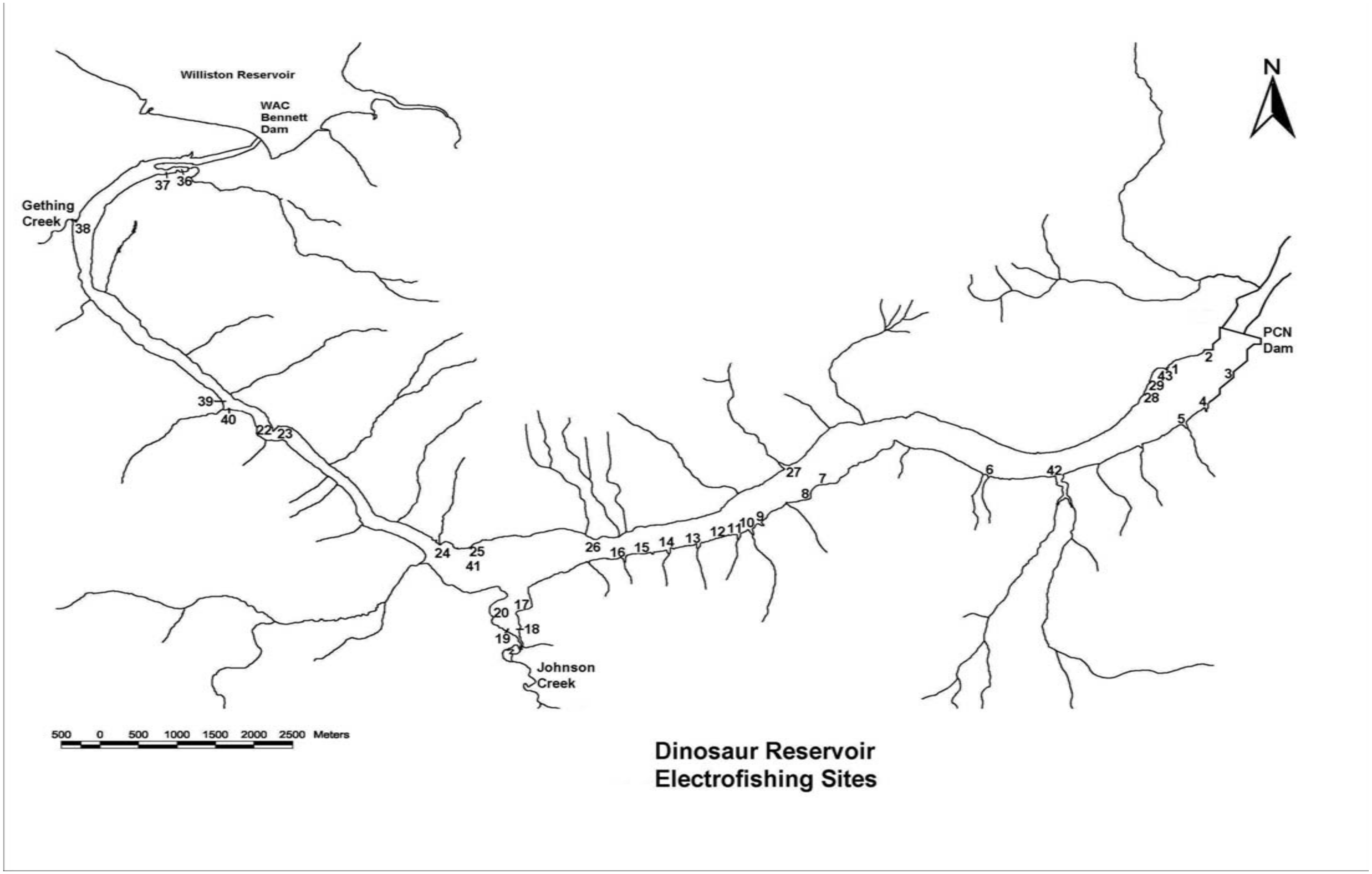

Figure 1. Electrofishing index sites (1-29) and lake trout sampling sites (36-43), 2002.

Figure 2. July pass 1 rainbow trout fork length frequency.

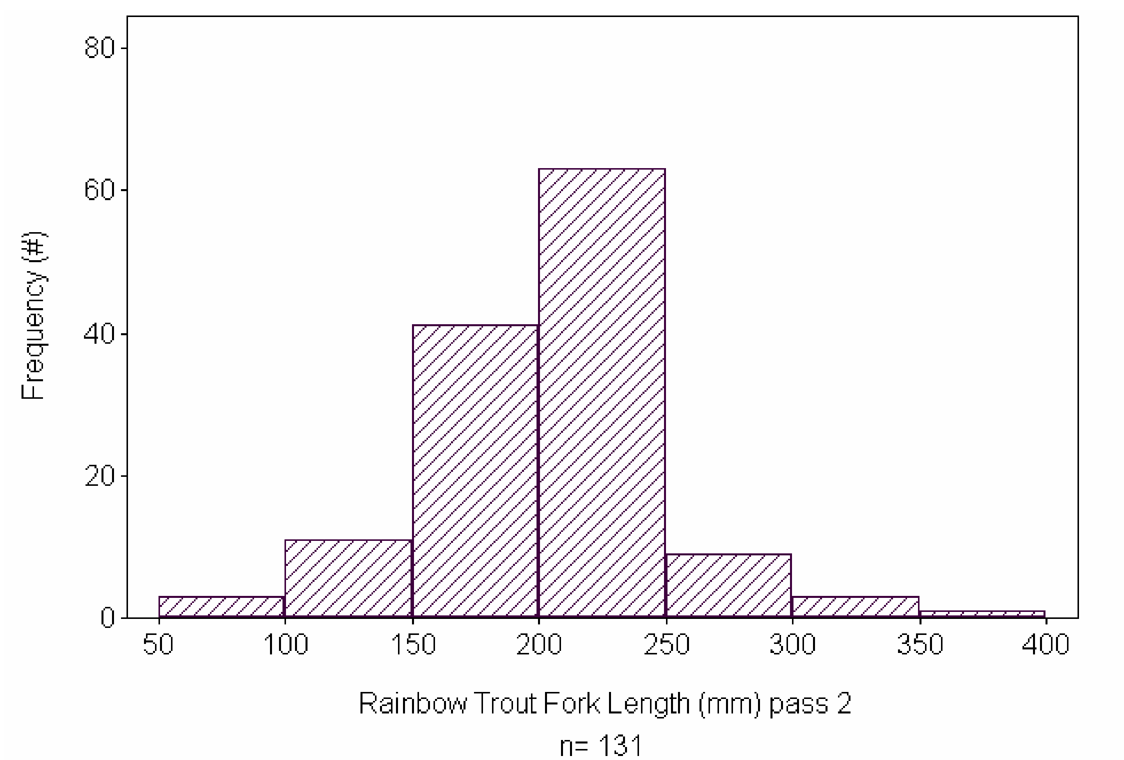

Figure 3. July pass 2 rainbow trout fork length frequency.

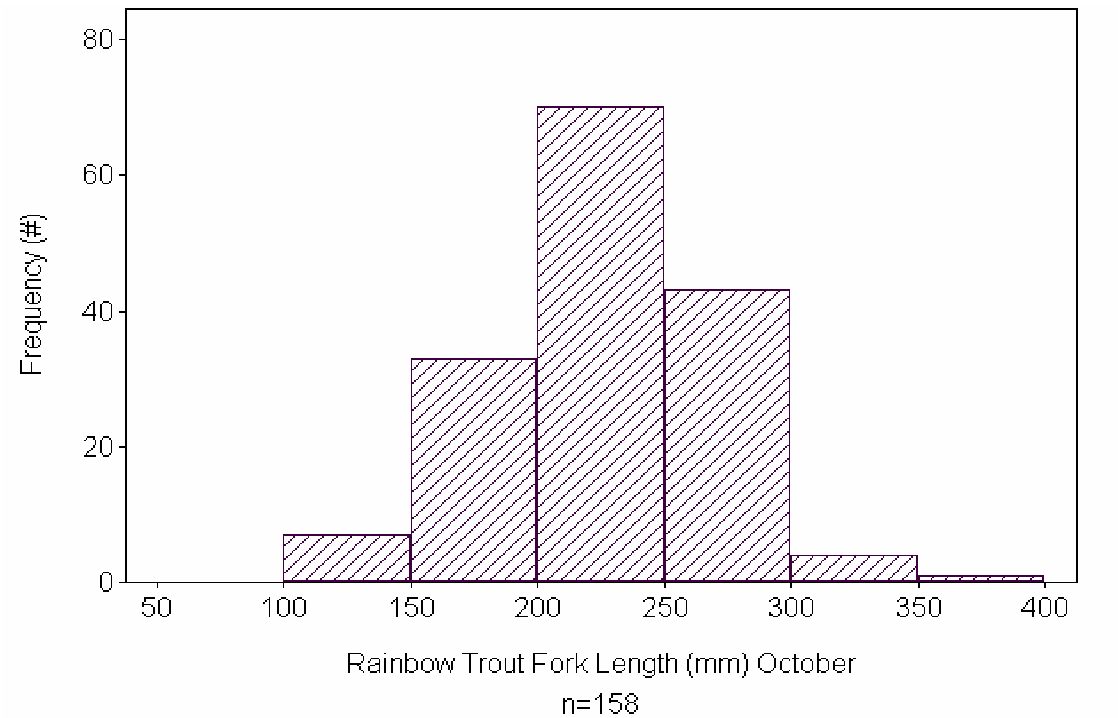

Figure 4. October rainbow trout fork length frequency.

Figure 5. July pass 1 mountain whitefish fork length frequency.

Figure 6. July pass 2 mountain whitefish fork length frequency.

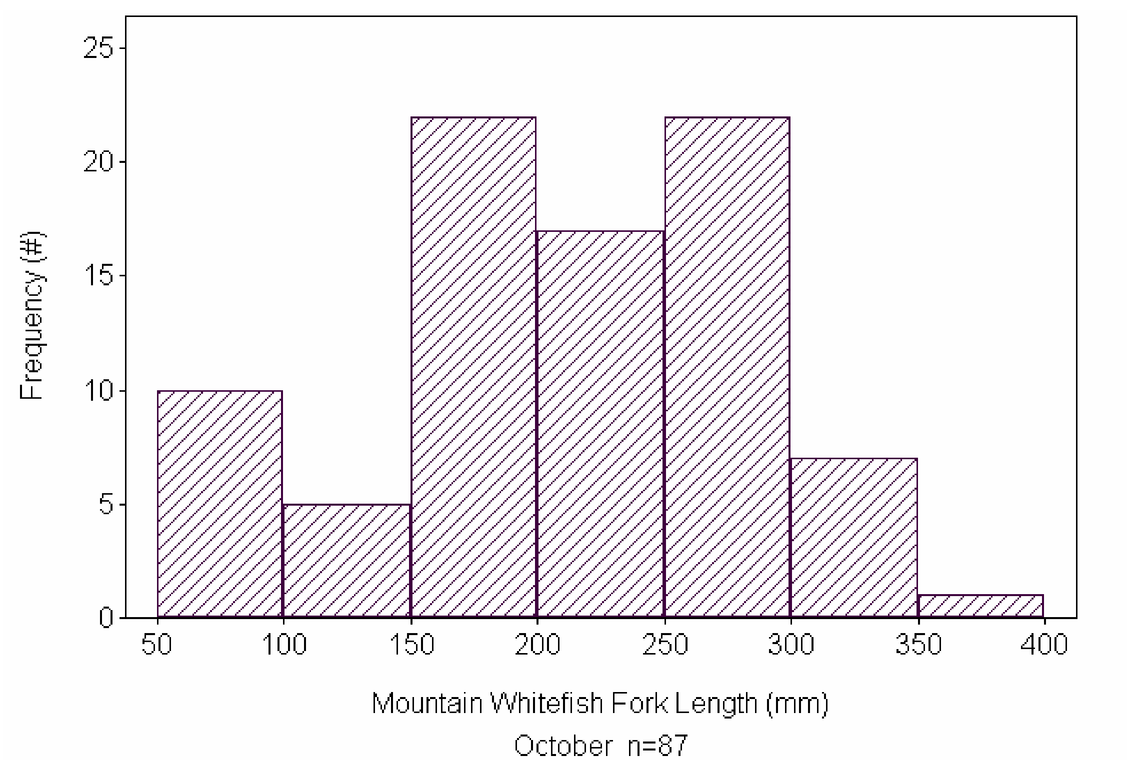

Figure 7. October mountain whitefish fork length frequency.

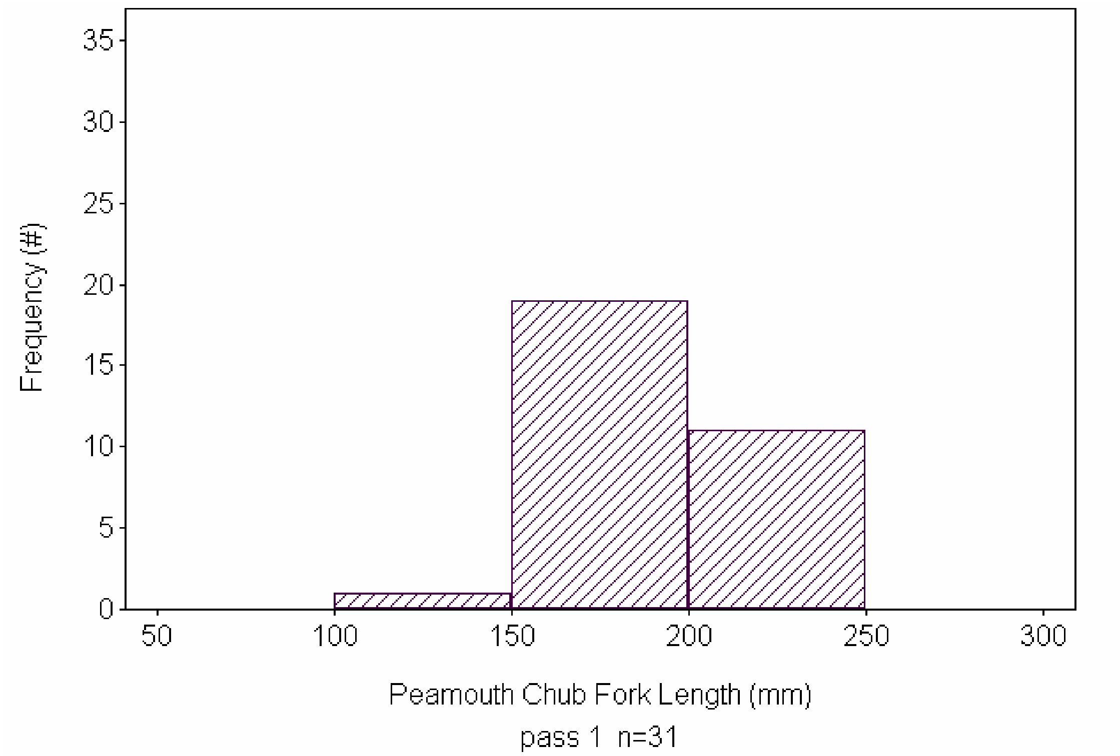

Figure 8. July pass 1 peamouth chub fork length frequency.

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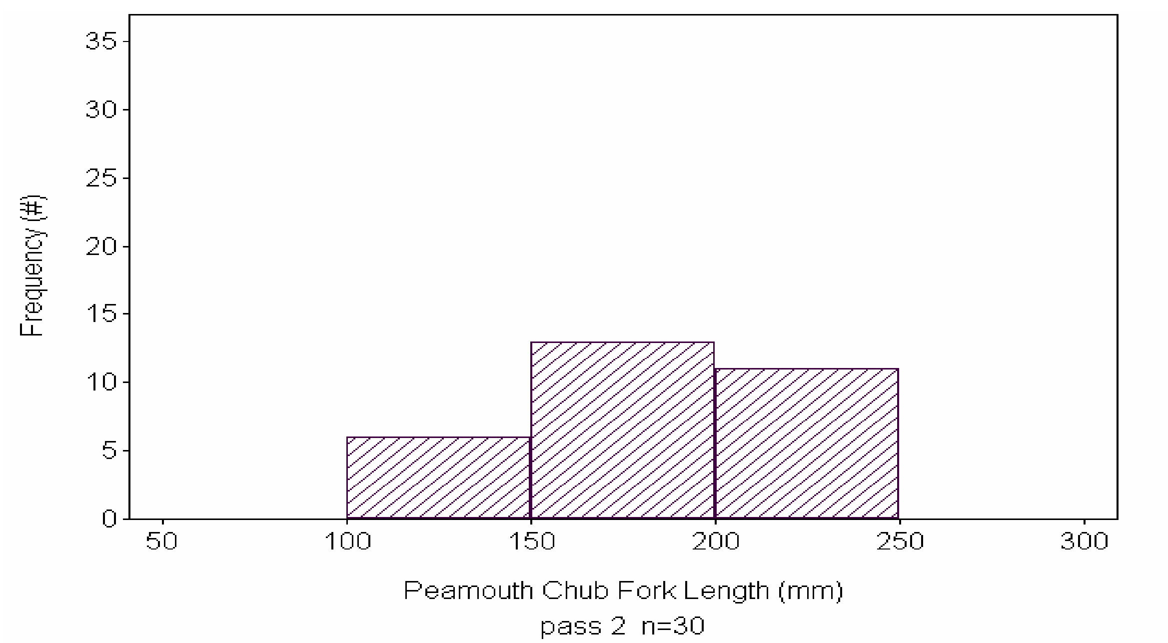

Figure 9. July pass 2 peamouth chub fork length frequency.

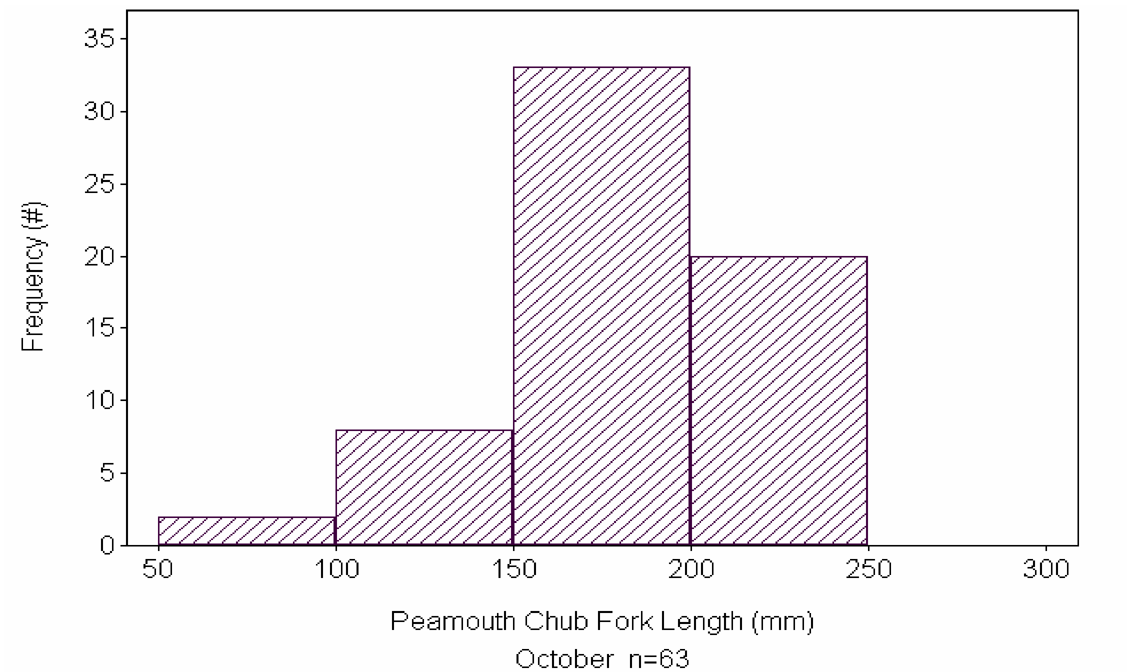

Figure 10. October peamouth chub fork length frequency.

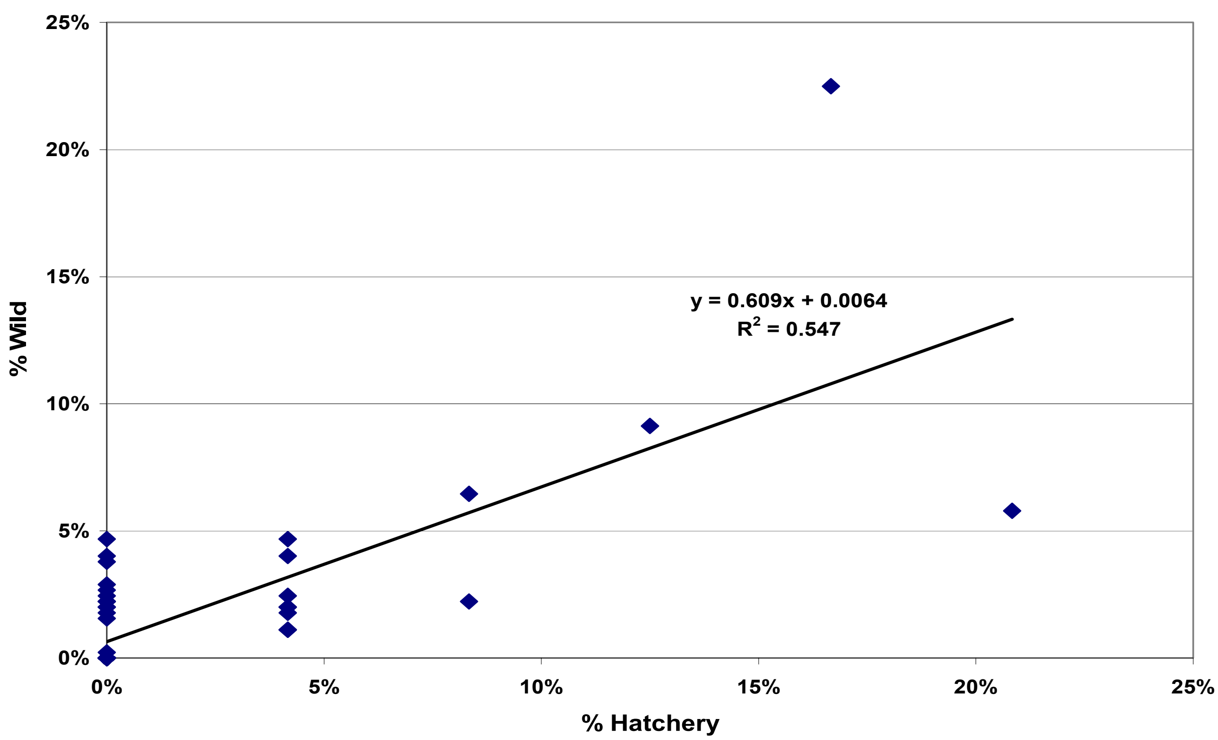

Figure 11. Catch distribution of wild vs hatchery rainbow trout. A comparison of the percentage of the wild vs. hatchery rainbow trout captured at each index site. The percentage of the catch was used because only 24 hatchery rainbow were captured compared to 449 wild rainbow trout. Sites where a higher percentage of wild rainbow trout were captured were the same sites where more hatchery fish were captured.

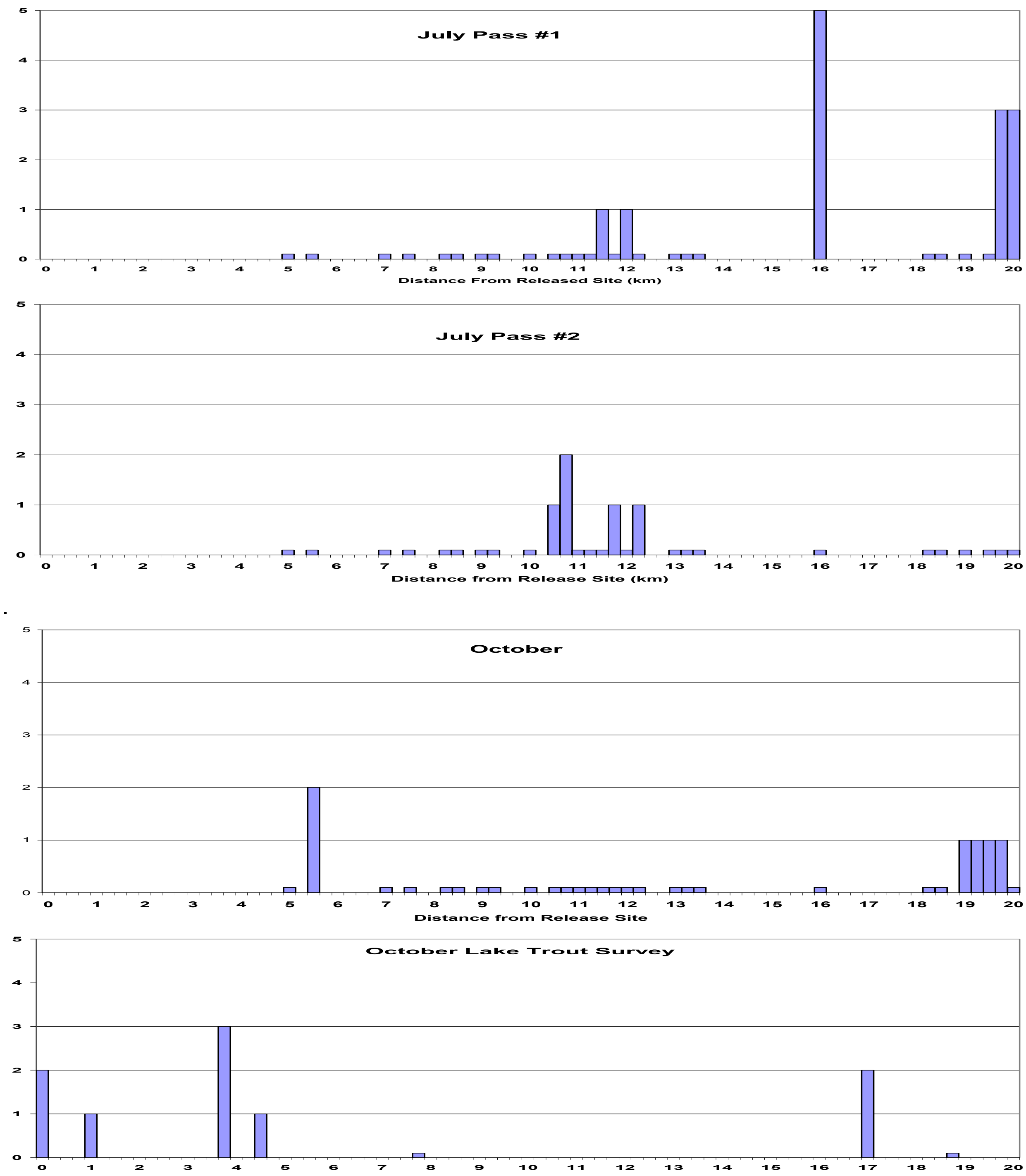

Figure 12. The number (y axis) of hatchery rainbow trout captured vs distance from the release site (0) to Site One Dam (21) during the first July sample period (top), second July period, October and October Lake trout Survey (bottom) with the number captured at each location and sample locations

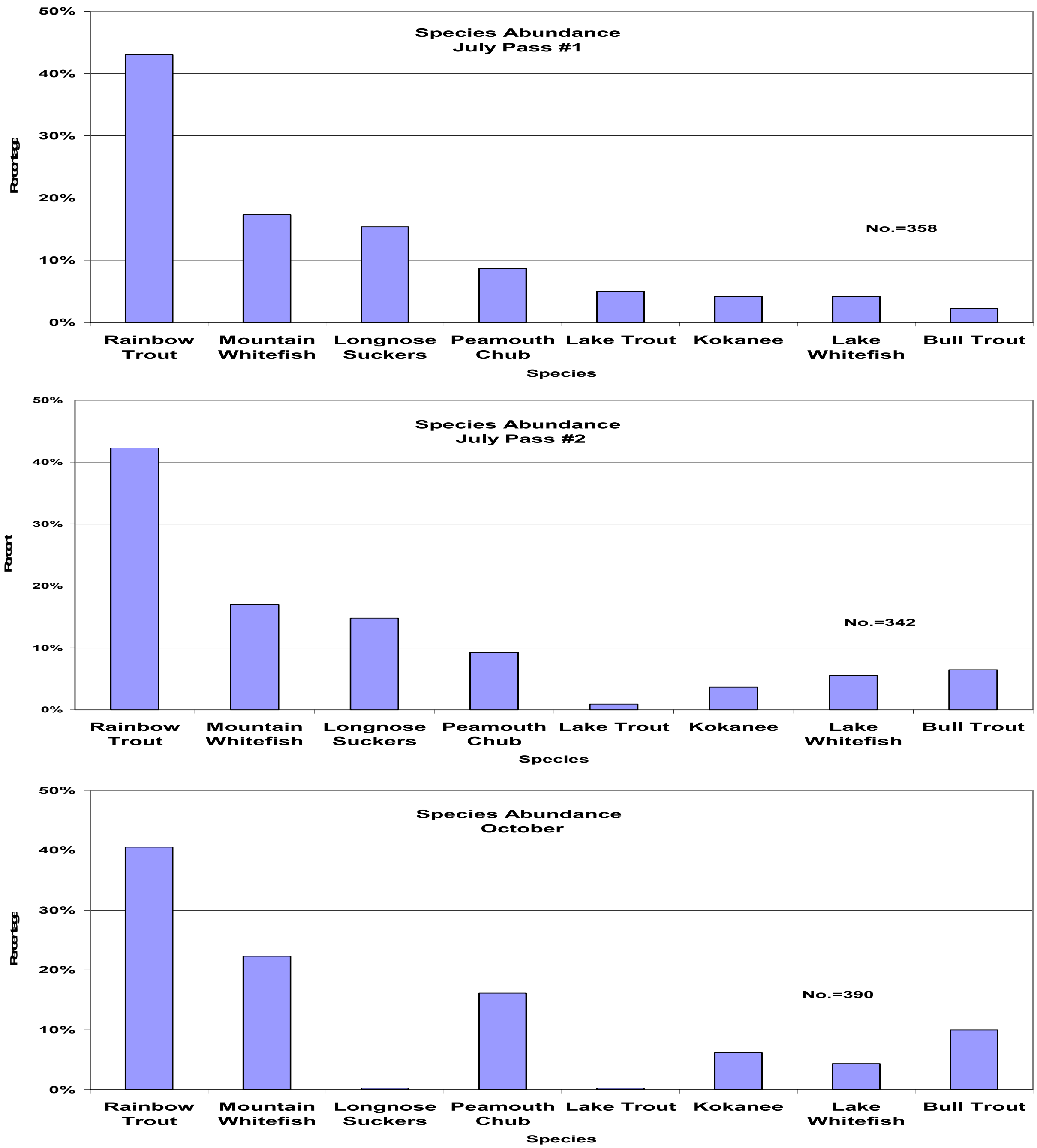

Figure 13. Relative abundance of species captured from the 28 index sites on Dinosaur Reservoir in 2002 during the first sample session in July (top), the second July session (middle) and the October sample session.

Appendix A

Species Codes used in this report.

Code	Common Name	Scientific Name
RB	Rainbow Trout	Oncorhynchus mykiss
BT	Bull Trout	Salvelinus. confluentus
DV	Dolly Varden	Salvelinus malma
EB	Brook Trout	Salvelinus fontinalis
LT	Lake Trout	Salvelinus namaycush
WF	whitefish general	
PW	Pygmy whitefish	Prosopium coulteri
MW	Mountain Whitefish	Prosopium williamsoni
LW	Lake Whitefish	Coregonus clupeaformis
GR	Arctic grayling	Thymallus arcticus
C	minnows general	all cyprinids
RSC	Redside shiner	Richardsonius balteatus
STC	spottail shiner	Notropis hudsonius
CBC	chub general	
LKC	lake chub	Couesius plumbeus
PCC	Peamouth Chub	Mylocheilus caurinus
NSC	Northern Pike Minnow (Squawfish)	Ptycheilus oregonensis
LNC	Longnose Dace	Rhinichthys cataractae
SU	suckers general	catastomus sp
CSU	Largescale or coarsescale sucker	Catastomus macrocheilus
WSU	White sucker	Catastomus commersoni
LSU	Longnose, fine-scale sucker	Catastomus catastomus
CC	sculpins general	Cottus sp
CAS	Prickly sculpin	Cottus asper
CCG	Slimy sculpin	Cottus bairdi

Appendix B

Total of each species caught per site for each sampling period.

Table 1. Fish captured by boat electrofisher in Dinosaur Reservoir pass 1 July 8th, 11th and 12th, 2002.

Site #	RB	MW	BT	KOK	PCC	LT	LW	LSU	Total
Site 1	1	3	0	0	0	2	1	4	11
Site 2	13	2	0	2	4	0	1	8	30
Site 3	40	2	0	5	9	1	3	2	62
Site 4	4	1	0	0	0	1	1	2	9
Site 5	6	1	0	0	1	0	1	1	10
Site 6	11	2	0	0	0	0	0	0	13
Site 7	0	10	0	0	0	1	1	4	16
Site 8	5	4	0	0	1	0	0	8	18
Site 9	4	0	2	0	0	0	1	0	7
Site 10	1	4	0	1	0	2	0	9	17
Site 11	5	1	1	0	0	1	0	0	8
Site 12	5	0	0	0	0	0	0	0	5
Site 13	0	2	0	0	0	4	0	1	7
Site 14	0	6	0	0	0	1	0	0	7
Site 15	3	1	0	0	0	2	0	0	6
Site 16	1	1	0	0	0	0	0	0	2
Site 17	5	0	1	0	4	0	0	5	15
Site 18	4	0	1	0	8	1	1	1	16
Site 19	2	0	0	0	0	0	0	2	4
Site 20	8	1	2	0	3	1	0	1	16
Site 22	4	0	0	0	0	0	0	0	4
Site 23	6	4	0	3	0	0	2	0	15
Site 24	8	8	0	3	0	0	2	3	24
Site 25	3	9	1	1	0	1	0	2	17
Site 26	5	0	0	0	1	0	0	0	6
Site 27	3	0	0	0	0	0	1	0	4
Site 28	2	0	0	0	0	0	0	0	2
Site 29	5	0	0	0	0	0	0	2	7
Total	154	62	8	15	31	18	15	55	358

Table 2. Fish captured by boat electrofisher in Dinosaur Reservoir pass 2 July 13th and 14th 2002.

Site #	RB	MW	BT	KOK	PCC	LT	LW	LSU	Total
1	0	5	0	4	2	0	0	1	12
2	19	0	2	0	2	0	1	0	24
3	26	0	1	0	2	0	0	0	27
4	9	0	0	0	0	0	0	0	9
5	7	0	1	0	0	0	0	0	7
6	9	0	0	0	0	0	0	0	9
7	0	8	1	1	1	0	1	5	17
8	3	2	0	1	0	1	2	4	13
9	2	0	0	0	0	0	0	0	2
10	0	5	0	1	1	0	1	8	16
11	3	0	1	0	0	0	2	0	6
12	2	0	0	0	4	0	0	0	6
13	0	0	0	1	0	0	0	0	1
14	1	0	0	0	0	0	0	1	2
15	4	1	1	0	1	0	0	0	7
16	3	1	1	2	0	0	0	5	12
17	8	1	2	0	3	0	1	2	17
18	3	4	2	0	3	0	1	11	24
19	0	5	2	0	3	0	1	9	20
20	7	4	0	0	4	1	0	0	16
22	2	0	1	0	0	0	0	0	3
23	6	4	0	1	0	1	1	0	12
24	0	9	2	0	2	0	4	1	18
25	1	2	3	1	1	0	1	0	9
26	11	0	0	0	0	0	0	0	11
27	0	4	0	0	0	0	2	0	6
28	7	0	0	0	1	0	0	0	6
29	5	0	1	0	0	0	0	1	6
Total	137	55	21	12	30	3	18	48	324

Table 3. Fish captured by boat electrofisher in October 15th and 16th 2002.

Site#	RB	MW	BT	KOK	PCC	LT	LW	LSU	Total
1	4	3	0	10	0	0	1	0	18
2	9	5	0	3	0	0	0	0	17
3	35	7	3	3	3	1	0	1	53
4	5	1	0	1	3	0	0	0	10
5	8	1	1	0	0	0	0	0	10
6	6	4	0	0	0	0	1	0	11
7	0	2	1	1	0	0	0	0	4
8	2	11	0	0	0	0	0	0	13
9	3	3	0	0	0	0	0	0	6
10	8	2	2	0	3	0	0	0	15
11	3	3	0	0	0	0	0	0	6
12	1	0	0	0	0	0	1	0	2
13	1	2	0	0	1	0	0	0	4
14	8	3	1	2	0	0	0	0	14
15	3	2	1	0	0	0	2	0	8
16	1	7	1	1	1	0	0	0	11
17	4	0	2	0	3	0	0	0	9
18	1	5	1	0	4	0	1	0	12
19	5	3	4	0	1	0	1	0	14
20	3	1	5	0	0	0	0	0	9
22	4	1	1	0	2	0	1	0	9
23	17	5	0	1	10	0	6	0	39
24	2	12	2	0	10	0	2	0	28
25	8	3	7	1	17	0	1	0	37
26	5	0	0	0	0	0	0	0	5
27	6	1	4	1	4	0	0	0	16
28	3	0	0	0	0	0	0	0	3
29	3	0	3	0	1	0	0	0	7
Total	158	87	39	24	63	1	17	1	390

Table 4. Fish captured by boat electrofisher October 17th 2002.

Site #	RB	MW	BT	KOK	PCC	LT	LW	LSU	Total
36	9	4	0	8	0	0	18	1	40
37	6	0	1	1	0	0	2	0	10
38	2	15	1	0	0	0	6	0	24
39	16	7	2	4	9	1	1	0	40
40	6	2	1	0	1	1	6	0	17
41	1	3	1	2	0	0	17	0	24
42	9	0	1	0	1	0	0	0	11
43	0	2	1	1	0	0	0	0	4
Total	49	33	8	16	11	2	50	1	170