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2004 Assessment of Habitat Improvements in Dinosaur Reservoir

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The Peace/Williston Fish & Wildlife Compensation Program is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

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ABSTRACT

Dinosaur Reservoir was formed in 1979 with the completion of the Peace Canyon Dam, which backs water up into a bedrock canyon for 21 km to the tailrace of W.A.C. Bennett Dam. Several studies conducted on the reservoir have postulated that fisheries potential is low because of the steep drop off along most of the shoreline limits the amount of littoral habitat available. A lack of aquatic vegetation and structure in the existing littoral areas further reduces fisheries capabilities. In 2001, a boat electrofishing program was started to monitor fish populations in the littoral area. The boat electrofishing program established index sites along the shoreline of the reservoir. Wherever there was existing woody debris (fallen trees etc.) there was a noticeable increase in fish numbers (primarily rainbow trout). In 2002 a program was started to add woody debris to small sheltered bays in the reservoir. Boat electrofishing efficiency would be reduced at locations where the woody debris had been added, so in 2004 trap nets, minnow traps, and angling were used to evaluate the effectiveness of the woody debris at providing improved rearing habitat. This was accomplished by comparing the number of fish captured at the enhanced sites in comparison to control (un-enhanced) sites. Nearly five times as many fish were captured at five enhanced sites in comparison with five control sites (48 vs. 11) using the traps nets, and four times as many fish were capture by angling at the enhanced vs. control sites (8 vs. 2). Bull trout and mountain whitefish showed a high affinity for the woody debris sites compared with the controls from the trap net catches (11 vs. 0 and 14 vs. 0), but rainbow trout did not (4 vs. 5). Angling captured 6 rainbow trout and 2 bull trout from the woody debris sites in comparison to 2 rainbow trout captured from the control sites. Prior to the addition of the woody debris an average of 9 fish per site were captured at the sites that were enhanced and 8.3 fish per site were captured from the controls by boat electrofishing.

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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 21 km long and backs water up to the tailrace of W.A.C. Bennett Dam. BC Hydro as part of their water licence agreement have funded studies on this reservoir to evaluate fish stocking programs (Hammond 1984, 1986a, 1986b, 1986c, 1987a, 1987b, 1988, Joslin 2001 a & b) and assess habitat limitations and potential enhancements (Pattenden and Ash 1993, Ash and McLeod 1994, Aim Ecological Consultants 2000). Based on recommendations from these studies the Peace/Williston Fish and Wildlife Compensation Program (PWFWCP) have undertaken a number of projects to address fish habitat limitations, entrainment and stocking assessments. In order to evaluate the effectiveness of these activities, existing baseline fish data was needed.

In October 2001 preliminary boat electrofishing was initiated (Murphy and Blackman 2003) and during the surveys a propensity for rainbow trout to concentrate near woody debris was noted (pers. obs.). In 2002 a program was initiated to add woody debris to embayment areas throughout the reservoir. These enhanced woody debris structures are located in small sheltered bays and consist of a series of large trees cabled together and anchored to the shore. The area between the cabled trees and the shoreline is filled with woody debris and root wads collected from along the shoreline. These structures are typically 40-80 m in length and extend out from shore up to 5 m. Two structures were added in 2002, and five were added in 2003.

Twenty eight electrofishing index sites were established in 2002 (Murphy et al. 2004) and were sampled again in 2003 (Blackman et al. 2004). Electrofishing efficiency was assumed to be reduced at the large woody debris structures so alternate sampling techniques would be required.

The objectives of the 2004 assessments of habitat improvements in Dinosaur Reservoir were to compare the number of fish captured using trap nets, angling, and minnow traps, at the woody debris (enhanced) structures to sites with similar physical characteristics where woody debris had not been added (control).

Study Area

This steep sided run of the river reservoir (Fig. 1) is approximately 21 km long and covers an area of 805 ha (Hammond 1984). Most of the shoreline drops off steeply but there are several areas where shallow shoals extend out from shore and there are a number of small sheltered bays which provide shallow water habitats. Water retention time is about three days and daily water fluctuations are normally less than two metres (Fig. 2) but levels are determined by the operation of the two dams. The reservoir is isothermal throughout the year (Pattenden and Ash 1993) with intake water temperatures from W.A.C. Bennett Dam typically 2 to 5 ^{o}C from November to June and seldom exceeding 10 ^{o}C in August (records on file).

Johnson and Gething creeks are the only documented spawning and rearing tributaries for wild sport fish populations in Dinosaur Reservoir (Pattenden and Ash 1993). The length of tributary streams accessible to fish from the reservoir is limited to 500 m of Johnson Creek, that has extreme silt load problems (pers. obs.), and 600 m of Gething Creek. Fish barriers and intermittent flows at several other smaller tributaries negate their use as spawning streams. Light penetration is poor (pers. obs.) much of the time because of high silt loads in the tributary streams after minor storm events. Seldom can one see the bottom at depths greater than one meter except after extended periods with no rain or high winds.

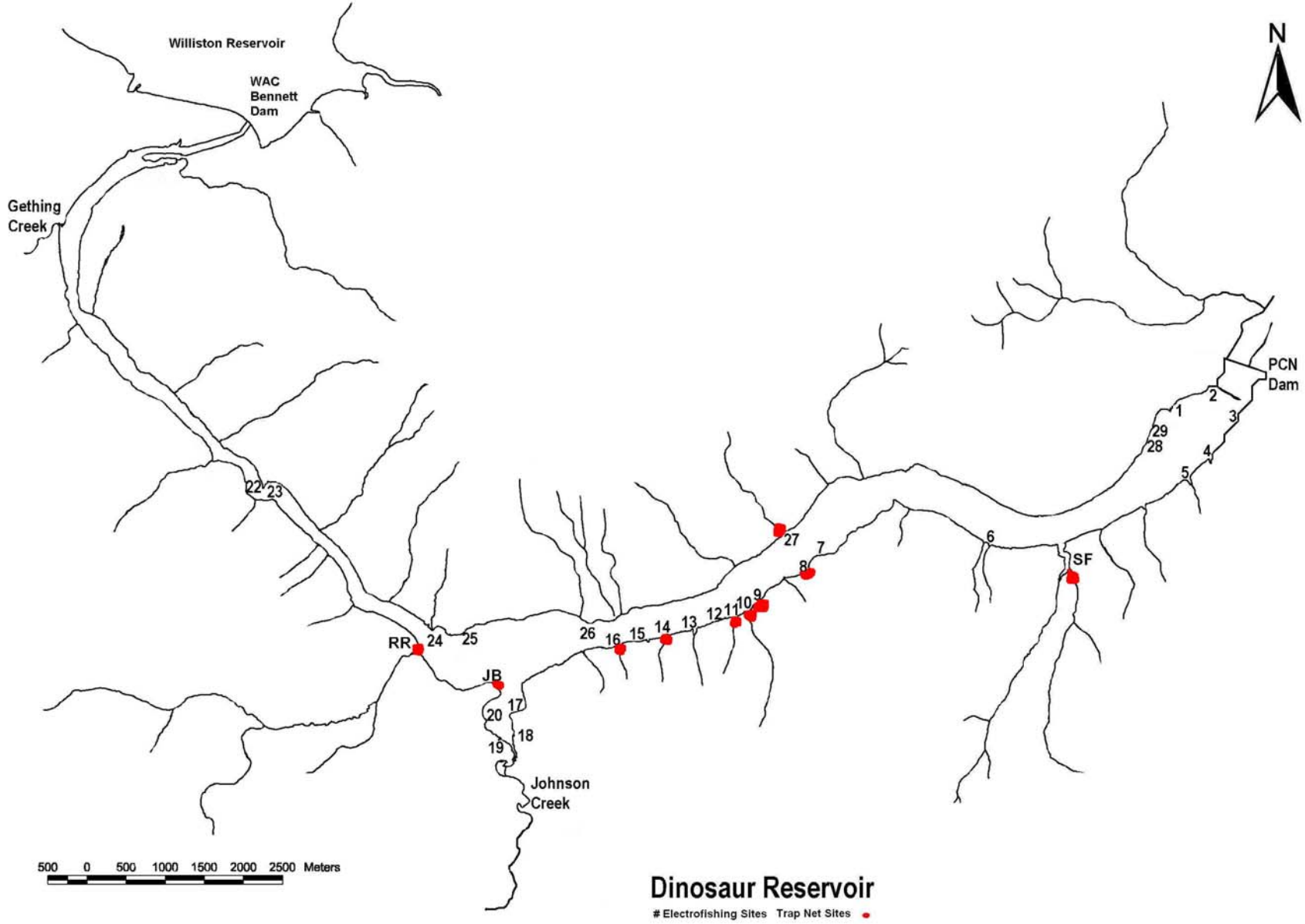

Figure 1. Dinosaur Reservoir Fish Sample Locations.

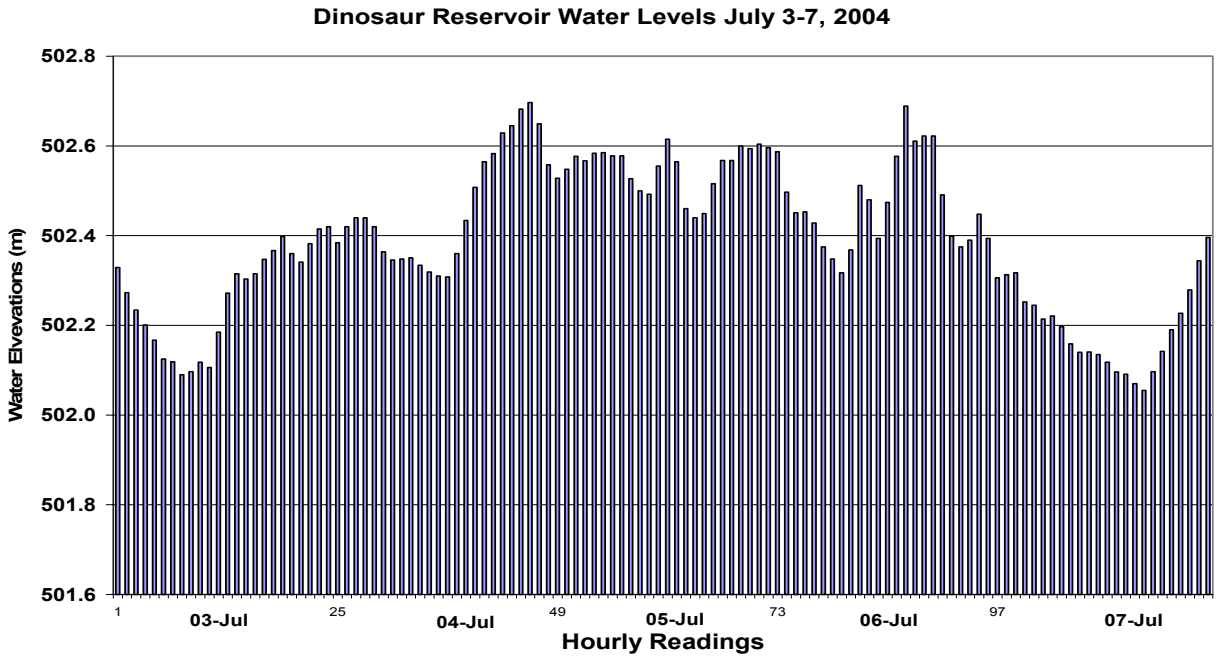

Figure 2. Dinosaur Reservoir hourly water levels (m) from July 3-7, 2004 the period during which the trap net data was collected.

METHODS

Trap netting

Two small sinking fine mesh (3 mm) trap nets (80 cm x 80 cm 15 m leads and 5 m wings) were used. Each afternoon one trap was set at an enhanced woody debris site (Fig. 3) and the other was set at a control (un-enhanced) site. The next morning the trap nets were retrieved and the fish sampled. The paired sites were selected to be as similar physically as possible. Bays were paired with bays and shoreline sites with shoreline sites. The traps were fished in pairs to ensure no bias by weather or possible water level fluctuations. The leads were set close to shore and the depth of the water at the trap box was recorded. The traps were set at a right angle to shore or from the back of the small bays.

Angling

Four anglers used three fly rods and one spinning rod to sample each site. At each site the boat was anchored in the middle of the bay or on shoreline sites within casting distance of the shoreline to maximize the probability of catching fish. All four anglers fished from the boat for a period of one half hour. Any fish captured were retained in a holding tub and sampled after the one half hour lapsed. To reduce the effects of time of day or weather conditions could have on success, angling sites were paired, and the enhanced and control sites were sampled immediately after one another.

Minnow Traps

Standard galvanized wire mesh “G” traps were used for minnow trapping. The minnow traps were fished three meters from shore at 5 m intervals. Ten traps were set in the woody debris and 10 were set along the adjacent shoreline where no wood had been added. Traps

were set in mid afternoon and picked up the following morning. All traps were baited with a fresh half opened can of sardines (all the same brand).

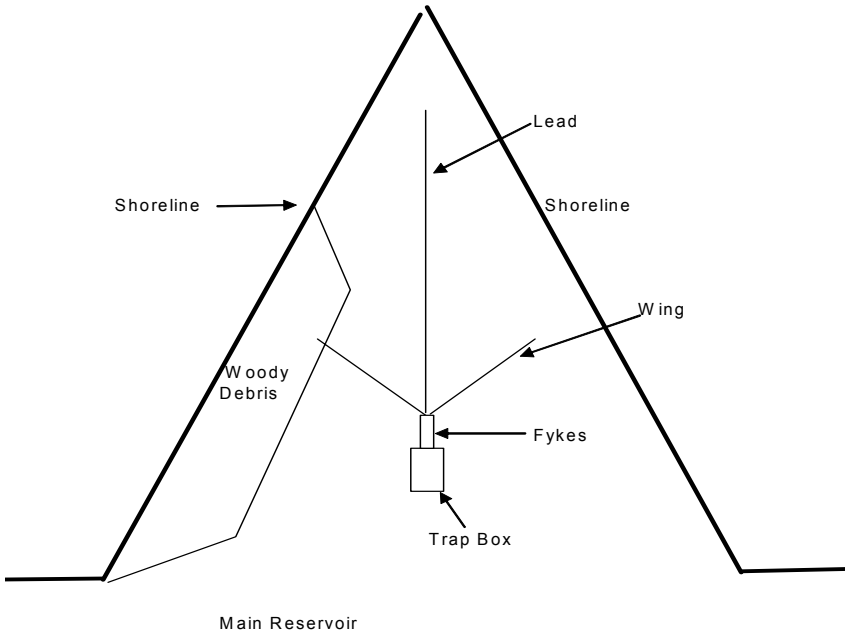

Figure 3. Trap net arrangement in small bays with woody debris.

RESULTS

Forty eight fish with a total weight of 6.4 kg were captured using the trap nets at the five enhanced woody debris sites while 11 fish with a combined weight of 1.1 kg were captured at the five control sites (Table 1, Fig.4). Six rainbow trout and two bull trout were captured by angling from the enhanced sites, while only two rainbow trout were captured from the control sites. The minnow trapping was relatively ineffective with only five prickly sculpins captured in the enhanced sites and two prickly and two slimy sculpins captured at the controls.

Table 1. The numbers of fish captured at the sites where woody debris was added (enhanced) in comparison with the control sites.

		Control Sites						Enhanced Sites				
Site #		27	9	8	JB	SF		10	11	16	RR	14
Species	Total						Total					
Rainbow Trout	5	2			3		4	2		2		
Mountain Whitefish	0						14	3	4	5		2
Lake Trout	1				1		1					1
Bull Trout	0						11	1	4	3		3
Kokanee	0						0					
Lake Whitefish	0						0					
Sculpins	2		2				4	3		1		
Peamouth Chub	0						13		1	12		
Largescale Sucker	3				3		1				1	
Total	11	2	2	0	7	0	48	9	9	23	1	6

Table 2. Number of fish captured by angling at the enhanced and control sites. Each site was fished by 4 anglers for a period of 30 minutes.

	Total	Control				Total	Enhanced			
Site		9	27	JB	W 17		11	14	RR	17
Rainbow Trout	2	0	1	1	0	6	3	1	2	0
Bull Trout	0	0	0	0	0	2	0	0	2	0

W17 is immediately west of site 17.

Table 3. Number of fish captured using minnow traps at the enhanced and control sites (ten minnow traps were fished overnight at each site). 17c and RRc were control sites on the shoreline adjacent to sites 17 and RR.

	Total	Controls			Total	Enhanced		
Site		17c	RRc	27		17	RR	14
Prickly Sculpin	2	0	2	0	5	2	2	1
Slimy Sculpin	2	2	0	0	0	0	0	0

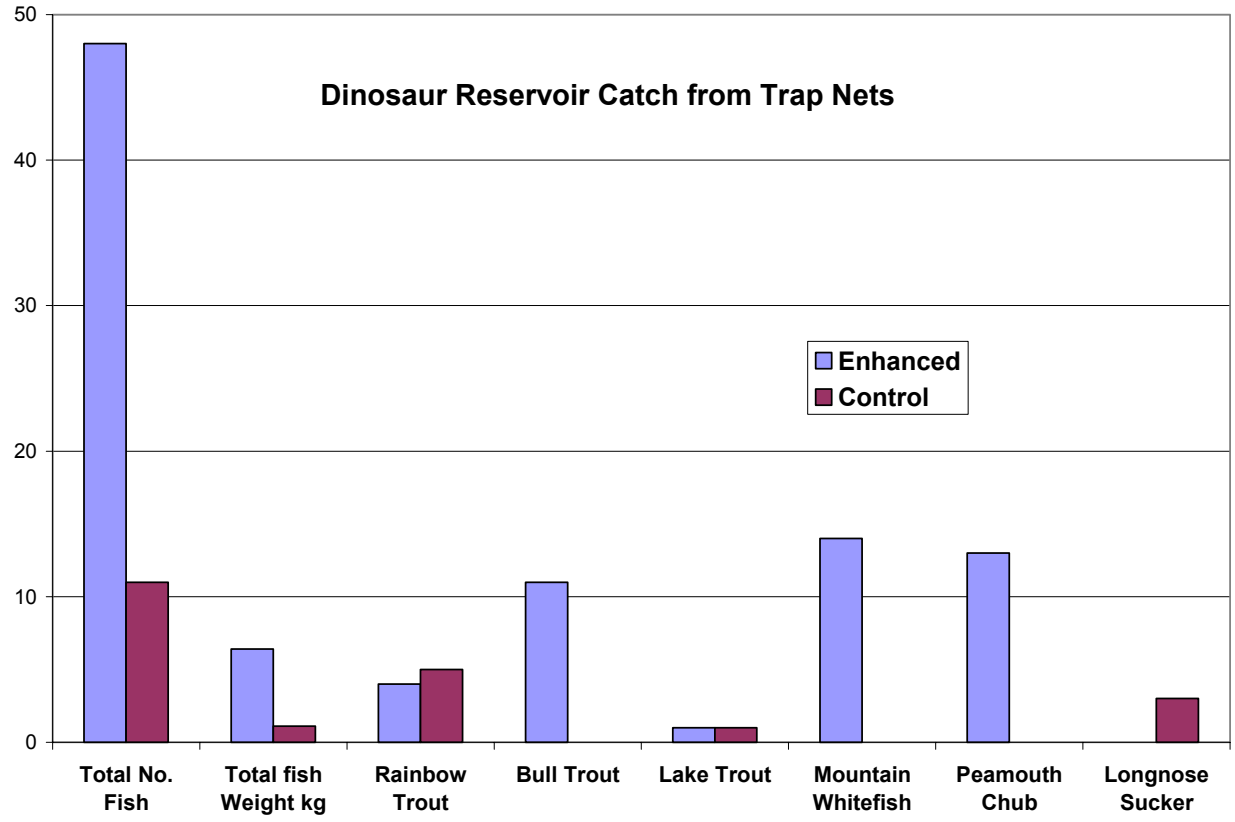

Figure 4. Total number of fish, total weight, and number of each species captured from the five enhanced and five control sites using trap nets.

DISCUSSION

Different habitats, substrates, depths, slopes, etc at the sites sampled, could affect the number of fish present and the effectiveness of the trap nets. This could make the results suspect. However prior to adding woody debris in 2002 a boat electrofishing program was initiated (Murphy et al. 2004). Four of the 5 enhanced sites and 3 of the 5 controls were initially sampled by boat electrofishing in 2002. The average number of fish captured from the enhanced sites in 2002 was 9 and the average number of fish captured from the control sites was 8.3, indicating that fish were relatively evenly distributed. When those same sites were sampled by trap netting in 2004, after the woody debris was added, the average number of fish captured at the enhanced sites was 10.8, while only 0.7 fish were captured per site at the controls. Strong evidence that the fish preferred sites where woody debris had been added, however because of the small sample sizes and high variability, this difference is not significant at the $P<0.05$ but it is at $P<0.10$.

Table 4. Pre enhancement electrofishing data. The average number of fish captured during two July electrofishing sessions in 2002 before woody debris had been added.

	Total	Control Sites			Total	Enhanced Sites			
Site		8	9	27		10	11	16	14
Rainbow Trout	8.5	4	3	1.5	7	0.5	4	2	0.5
Mountain Whitefish	5	3		2	9	4.5	0.5	1	3
Lake Trout	0.5	0.5			2	1	0.5		0.5
Bull Trout	1		1		1.5		1	0.5	
Kokanee	0.5	0.5			2	1		1	
Lake Whitefish	3	1	0.5	1.5	2	1	1		
Redside shiner	0				1	0.5	0.5		
Peamouth Chub	0.5	0.5			0.5	0.5			
Longnose Sucker	6	6			11	8		2.5	0.5
Total	25	15.5	4.5	5	36	17	7.5	7	4.5
Average per site	8.3				9.0				

Table 5. The number of fish captured using traps nets in July 2004 after woody debris had been added at the enhanced sites.

	Total	Control Sites			Total	Enhanced Sites			
Site		8	9	27		10	11	16	14
Rainbow Trout	2			2	4	2		2	
Mountain Whitefish	0				14	3	4	5	2
Lake Trout	0				1				1
Bull Trout	0				11	1	4	3	3
Kokanee	0				0				
Lake Whitefish	0				0				
Redside shiner	0				0				
Peamouth Chub	0				13		1	12	
Longnose Sucker	0				0				
Total	2	0	0	2	43	6	9	22	6
Average	0.7				10.8				

Direct comparisons are difficult because the 2002 pre enhancement data was collected by boat electrofishing and the 2004 post enhancement data was collected with trap nets. Potential biases can be expected due to differences in site specifics, fish size and species

selectivity when using different sample gear (Beamesderfer and Rieman 1988). Although the trap nets and boat electrofishing would have different sampling biases the results provide fairly strong evidence that the addition of woody debris resulted in higher use of the enhanced areas by local fish populations.

Approximately 7 of the 54 km of the reservoirs shoreline could be enhanced, and to date only about 600 m have been completed. Availability of woody debris limits the number of structures that can be installed each year. In 2004 new woody debris structures installed were smaller in area and extended out, rather than along the shoreline. This design should allow more effective electrofishing at debris sites in the future.

Further long term evaluations should focus on electrofishing because of the greater number of sites and variety of habitats that can be sampled by electrofishing. Stratifying the existing electrofishing sites by littoral habitat type should make it possible to change the sampling design from non-probability to a probability type design (Wilde and Fisher 1996). Because of the low fish numbers and high variability, which may be influenced by seasonal variations and entrainment, it may be necessary to add additional electrofishing sites to meet the probability criteria and provide better confidence. However, this should over the long term allow documentation of changes in the fish use of the littoral habitats.

As sample sizes are too small to compare fish sizes and detailed habitat data is limited future efforts should collect data to quantify shoreline habitat features. If the electrofishing data in its present format is used as an index the literature suggests it would only apply to the sample sites. But if the shoreline is stratified the analysis should theoretically apply to the littoral populations.

Presently there is a strong sampling bias towards the shallow areas which do not drop off steeply and have some cover and disproportionately fewer sites are in areas with no cover and steep drop offs. If a good index of the littoral populations is desired, some minor modification may be necessary to improve the confidence of the data. The fact that we have non random fixed sites should not detract from the accuracy (King et al. 1981) if we know how much of each type of littoral habitat has been sampled.

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