Summary of the 2002 Bonaparte River fishway operation and enumeration of anadromous and non-anadromous *Oncorhynchus mykiss.*

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ABSTRACT

From April 2 to May 22, 2002, the Bonaparte River Fishway was maintained and operated by contracted employees of The Ministry of Environment, Lands and Parks through the B.C. Conservation Foundation. Funding was provided by the Habitat Conservation Fund. The purpose of the program was to enumerate and biologically sample anadromous steelhead *(Oncorhynchus mykiss)* and non-anadromous rainbow trout *(O. mykiss)* migrating upstream through the fishway to spawn. Enumeration of fish was achieved through the combined means of trapping and sampling fish and through the operation of an electronic counter that allowed fish to pass through the fishway unhindered. Additionally, in order to study the migratory behaviour of fish in relation to the Bonaparte Fishway structure, several mature steelhead and rainbow trout were radio tagged at the Thompson/Bonaparte confluence and at the trap site.

Total immigration of anadromous *O. mykiss* through the fishway during the period of operation was 261, of which 130 were trapped and 131 were enumerated with the electronic counter. Of the trapped steelhead, a total of 83 were female and 47 were male. The total immigration of non-anadromous *O. mykiss* was 238, of which 42 were trapped and 196 were enumerated with the electronic counter. Of the trapped rainbow trout, 32 were male and 8 were female and 2 were immature. None of the anadromous and non-anadromous *O. mykiss* captured none were adipose fin clipped, indicating that none of these fish were of hatchery origin.

The 2002 fishway operation experienced extremely high discharge levels resulting in a very high level of debris that required frequent clearing and eventually halted operations. It is likely that a percent of the fish which enter the fishway during times of debris accumulation may be deterred by constant fluctuations in water levels and never reach the trap cell, as indicated by the telemetry and resistivity counter results. Difficulties passing above the fishway as a result of the fluctuating flows during fishway operations, as well as, a structural gradient obstacle within the fishway itself (the gradient change between cells was verified this year and probably present since construction), may cause fish to spawn below the fishway or drop out of the Bonaparte River and migrate to other spawning streams. In both cases a significant percentage of the Bonaparte River steelhead and rainbow trout likely were not enumerated by trapping and electronic counter.

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1.0 Background

In 1979, the BC Ministry of Environment, Fisheries Branch, began releasing hatchery reared steelhead trout (*Oncorynchus mykiss*) and chinook salmon (*O. tshawytscha*) into the Bonaparte River. The objective was to establish anadromous populations and utilize the rearing habitat available upstream of an impassable falls, located 2.6 km from the Bonaparte/Thompson River confluence (Figure 1).

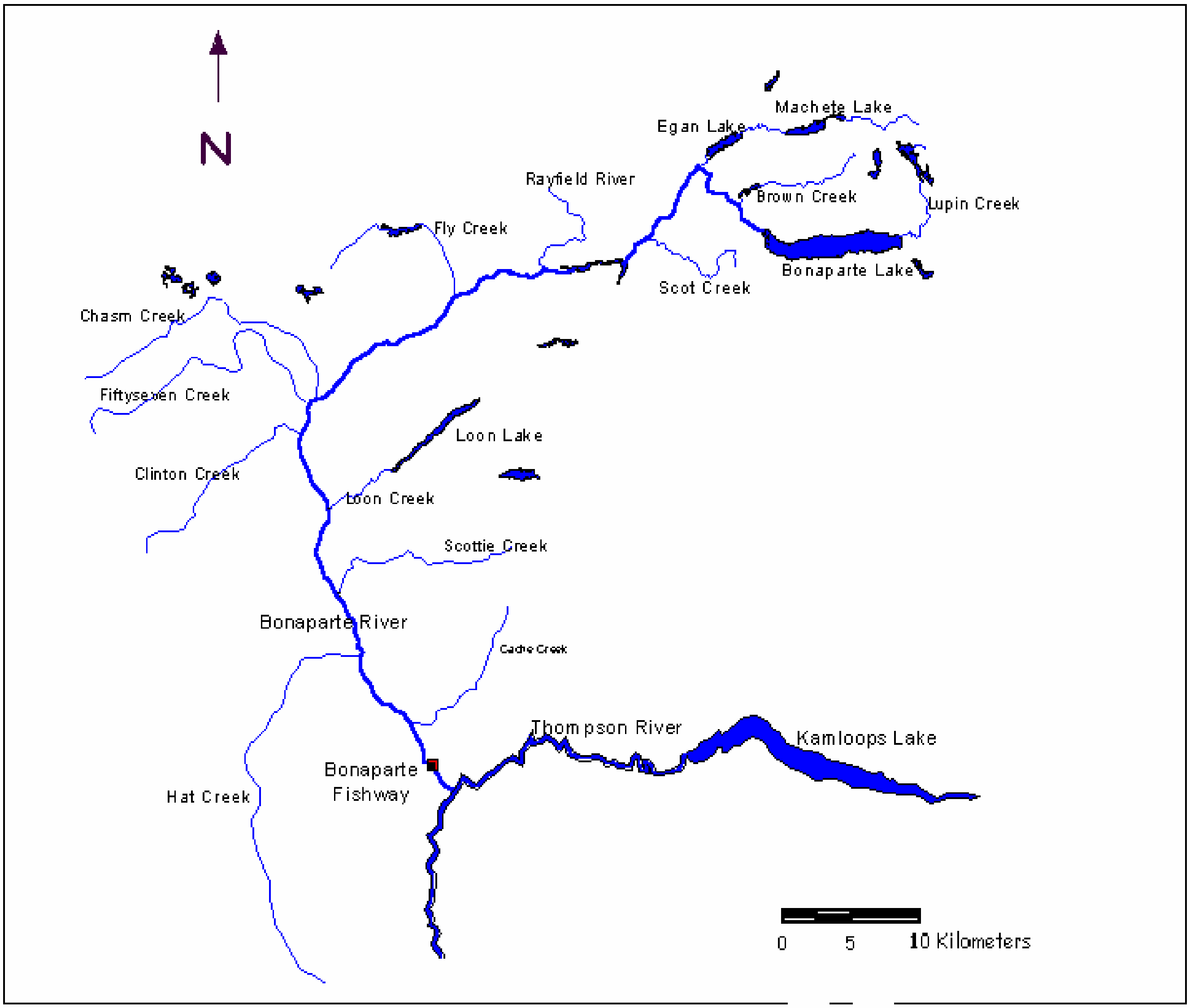

Figure 1. The Bonaparte River and its tributaries.

In 1988, with the financial support of the Habitat Conservation Trust Fund, Fisheries and Oceans Canada and the BC Ministry of Environment, the Bonaparte Fishway was constructed at the falls to allow introduced anadromous species access to the mainstem Bonaparte River in order to utilize previously unavailable spawning and rearing habitat (Figures 2 and 3). The Habitat Conservation Fund has provided the funds needed to monitor and study the Bonaparte steelhead population.

HABITAT CONSERVATION TRUST FUND

Figure 2. Impassable falls located 2.6 km from the Bonaparte/Thompson confluence.

Figure 3. The Bonaparte River Fishway.

2.0 Introduction

The Bonaparte River Fishway was operated continuously for 51 days, from April 2 to May 22, 2002 by contracted employees of The Ministry of Water, Land and Air Protection through the B.C. Conservation Foundation. Funding was provided by the Habitat Conservation Trust Fund. The purpose of the program was to enumerate and biologically sample anadromous steelhead *(Oncorhynchus mykiss)* and non-anadromous rainbow trout *(O. mykiss)* migrating upstream through the fishway to spawn. Enumeration of fish was achieved through the combined methods of trapping and sampling fish and through the operation of an electronic counter that allowed fish to pass through the fishway unhindered (Appendix A).

Fish enumeration operations were curtailed on May 22, 2002 by the Ministry of Water, Land and Air Protection due to extreme high river flows and woody debris accumulation, necessitating the removal of the electronic counter equipment and preventing any further enumeration activities (Figure 4). Personnel remained on site until May 27, 2002 to continue monitoring river levels and fishway structure integrity.

Figure 4. **High water flows and debris accumulation at the Bonaparte Fishway, May 27, 2002.**

3.0 Methods

In 2002, the Bonaparte Fishway operation alternated between trapping and electronically counting steelhead and rainbow trout through the migration period (Appendix A). An electronic resistivity counter was installed, for which fish passage, fish sizing and counting accuracy were examined.

Additionally, a sample of steelhead and rainbow trout were radio tagged to study the migratory behaviour of these fish in relation to the entire Bonaparte Fishway structure.

3.1 Trap Operation

Fishway operations commenced on April 2, 2002, when a V-shaped lead grate and upstream trap panel was installed. The installation of the lead grate and upstream trap panel converted the uppermost cell into a one-way adult trap where fish were captured, enumerated, and sampled for relevant biological data. Stacked stop logs located under the upstream trap panel were used to maintain flows between 0.5 - 1.0 cms through the fishway.

Throughout the study period, the trap was operated for a total of 29 days. During operation, the trap was inspected two to ten times daily, depending upon debris accumulation and the number of fish migrating. The upstream trap panel was cleaned every two to four hours during the peak flow and debris accumulation period.

When fish sampling was to occur, pieces of plywood were installed in front of the upstream trap panel to reduce flows through the fishway to a manageable level. Upon first entering the trap, the lead panel was blocked to prevent the downstream escape of fish from the trap. The times were recorded at which the water was drawn down and returned to normal flows. Recording times of water drawdown were necessary as the electronic counter was operational during the trapping periods. (Appendix A).

Fish were captured from the trap using a 3 cm stretch mesh, cotton dip nets. Captured steelhead were enumerated and sampled for biological data which included, fork length, weight, scale samples, sex, presence/absence of an adipose fin clip, and presence/absence of a maxillary clip. Sexual identification was determined by using characteristics such as body size, head shape, adipose fin size, tightness of scales and girth. General comments regarding overall condition such as presence of abrasions, wounds, scars, net marks, red spots, parasites and degree of coloration were also recorded. A small round hole was made in the right operculum of each steelhead with a stationary punch in order to provide a positive means of identifying recaptured fish (Figure 5).

Figure 5. Male steelhead with operculum punch.

Captured rainbow trout were enumerated and sampled for biological data in a similar fashion to steelhead. However, girth and weight were not recorded for rainbow trout. The same criteria were used for sexual identification of non-anadromous trout but suspected males were confirmed by milking and suspected females were confirmed by belly fullness and the presence of an ovipositor. Instead of an operculum punch, individual rainbow trout with a fork length greater than 25 cm were tagged below the dorsal using sequentially numbered and colour coded floy tags. Tagging provided a means of positively identifying recaptured fish and may provide future information on the movement patterns of rainbow trout within the Thompson River system.

Water temperatures were recorded during morning and evening with a digital thermometer. Water temperatures were also digitally recorded each hour with a Stowaway Tidbit Temp Logger (TBI32-05+37) through the duration of the enumeration period. Discharge data was obtained from the Water Survey of Canada's Station No. 08LF002 in Cache Creek.

3.2 Resistivity Counter Operation

On April 5, 2002, a resistivity fish counter (2100C Logie Fish Counter) was installed within the upper most cell of the fishway to electronically enumerate steelhead and rainbow trout while allowing the fish to pass through the fishway unhindered (Figure 6). During trapping periods the two tubes remained in place and the counter was operational. The counter was utilized to enumerate fish exclusively for a total of 22 days. With both the V-shaped lead grate and upstream trap panel raised above the water surface, fish had open passage through the grate dividing the upper cell by means of two 18 inch (45 cm) diameter culverts that contained the electrodes of the counter. When the upstream trap panel was blocked and flows fell below the level of the counter, the counter would continuously log events created by air "noise" in the culvert. This would occur during fish sampling times and if debris accumulation was not removed frequent enough. Steps were taken to minimise the problem of air intake through the counter so that accurate fish enumeration would be possible during normal operation. General counter operations and results will be described in this report, while a more detailed analysis of the counter performance will be described in a separate and subsequent report by McCubbing et al. 2002.

Figure 6. Resistivity counter tubes in the trap cell of the Bonaparte River Fishway.

3.3 Radio Telemetry

In order to study the migratory behaviour of fish in relation to the Bonaparte Fishway structure, eleven steelhead and five mature rainbow trout were radio tagged at the mouth of the Bonaparte River (Appendix A, Figure 7) as well as three fish at the trap site. An additional steelhead from the Nicola River enumeration study entered the Bonaparte and was consequently used in the study. A stationary receiver with multiple antennae was set up to track fish at the following locations:

1. immediately downstream of the entrance to the fishway,
2. the length of the fishway,
3. within the trap, and
4. immediately upstream of the fishway.

Figure 7. Radio-tagged female steelhead being released at the mouth of the Bonaparte River.

Additionally, daily tracking was done with a hand-held antenna at the mouth of the Bonaparte/Thompson River confluence, upstream to the fishway. The results and analysis of the fixed radio telemetry portion of the study will be detailed in a separate document by McCubbing (2002).

4.0 Results

In 2002, 261 steelhead were enumerated at the Bonaparte River fishway by means of trapping (130 fish) and operating an electronic counter (131 fish). A total of 238 non-anadromous *O. mykiss* also enumerated in 2002, 42 by trapping and 196 with the counter.

Steelhead are known to utilize the lower 99.0 km of the Bonaparte River for spawning (96.4 km above the fishway and 2.6 km below the fishway). Telemetry studies conducted in 1989, 1990 and 1991 suggest that steelhead do spawn in the 2.6 km section of the Bonaparte River below the fishway, although the telemetry may underestimate the spawning population below the fishway (McCubbing 2002). If the Bonaparte River is estimated to have and equal number of steelhead per kilometre spawning in the 2.6 km section of river below the fishway, then approximately 7 additional steelhead spawned in the 2.6 km section below the fishway, resulting in a total estimate of 268 steelhead spawned in the Bonaparte River in 2002. The density of spawners in 2002 was therefore 268 spawners/99.0 km or 2.7 spawners/km. This calculation was used to estimate total steelhead in the Bonaparte Fishway since 1989 (Figure 8). A similar calculation is used to estimate the total rainbow trout spawning population (Figure 9). The extrapolation for the area below the fishway is likely biased low due to the naturally uneven way steelhead would distribute themselves throughout the Bonaparte River during spawning.

4.1 Trap Operation

The number of anadromous *O. mykiss* (referred to as steelhead) that were trapped in 2002 was 130, of which 47 were male (36%) and 83 were female (64%). This equals a male to female sex ratio of 1:1.7 (Table 2). One of the 83 female steelhead was a mort, from which otliths were collected for aging.

A total of 42 non-anadromous *O. mykiss* (referred to as rainbow trout) were trapped in 2002 and consisted of 32 males (76%) and 8 females (19%) and 2 immature (5%), resulting in a female to male sex ratio of 1:4.0 (Table 2). Two rainbow trout that migrated through the fishway were classified as immature as they did not show positive sexual characteristics. Of the 42 rainbow trout trapped, 21 (6 females and 15 males) were kept for age structure analysis (otolith, finray and scale) and fecundity sampling.

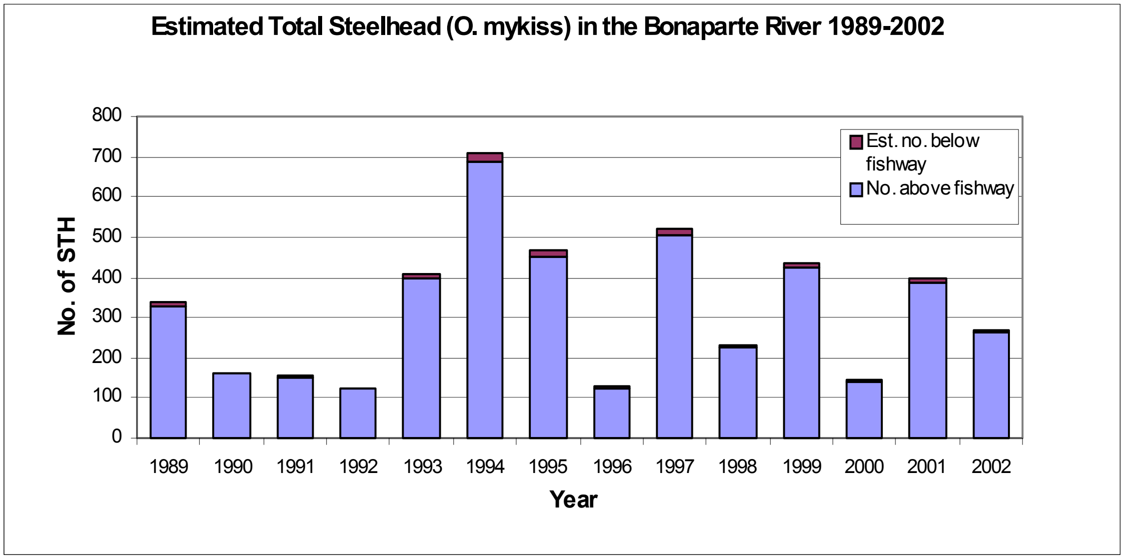

Figure 8. **Annual anadromous *O. mykiss* escapements in the Bonaparte River, 1989 to 2002. The lower portion of the stacked bars represents the number of steelhead that passed through the fishway. The upper portion indicates the estimated number of steelhead spawning below the fishway using steelhead/km calculation.**

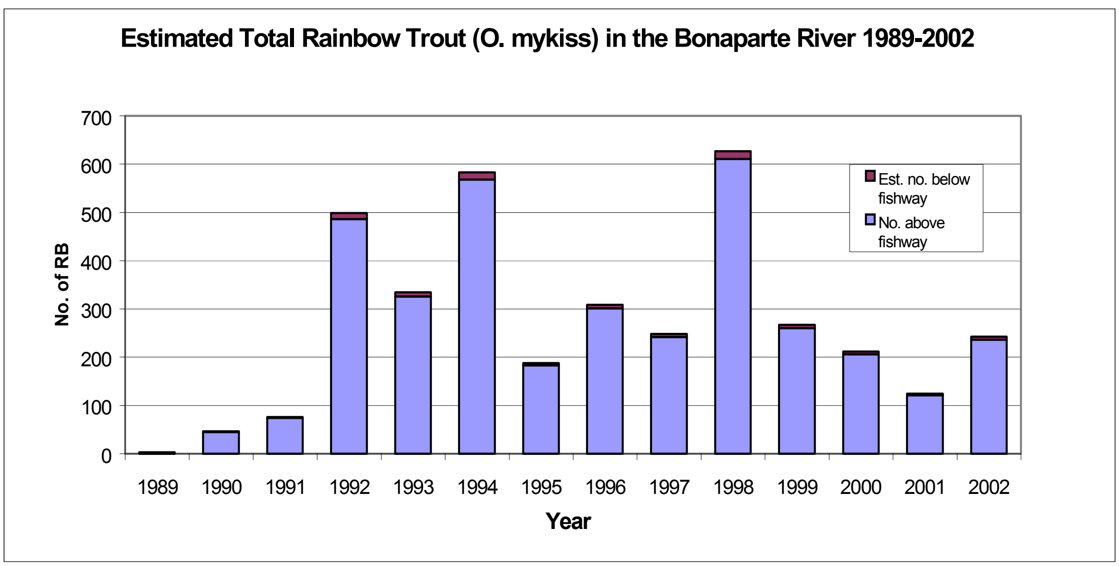

Figure 9. **Annual non-anadromous *O. mykiss* escapements in the Bonaparte River, 1989 to 2002. The lower portion of the stacked bars represents the number of rainbow trout that passed through the fishway. The upper portion indicates the estimated number of rainbow trout spawning below the fishway based on rainbow trout/km.**

Table 1. **Trends in Sex Ratios of anadromous and non-anadromous *O. mykiss* between 1990 and 2002.**

Year	Steelhead		Rainbow Trout		Steelhead Sex Ratio	Rainbow Trout Sex Ratio
	M	F	M	F		
1990	56	103	38	1	1:1.8	38:1
1991	50	100	69	2	1:2.0	34.5:1
1992	47	74	429	37	1:1.6	12.5:1
1993	159	239	258	60	1:1.5	4.3:1
1994	203	486	308	67	1:2.4	4.6:1
1995	139	314	48	8	1:2.3	6.0:1
1996	37	88	229	55	1:2.4	4.2:1
1997	160	345	180	62	1:2.2	2.9:1
1998	68	156	412	195	1:2.3	2.1:1
1999	178	243	177	81	1:1.4	2.2:1
2000	33	108	133	76	1:3.2	1.8:1
2001	84	305	85	33	1:3.6	2.6:1
2002	47	83	32	8	1:1.7	4.0:1

Male steelhead fork lengths ranged from 69.0 to 98.0 cm with a mean of 84.8 cm (S.D.= 5.9 cm), and girth measurements ranged from 31.5 to 47.5 cm with a mean of 40.6 cm (S.D. = 3.5 cm). Weights ranged from 4.0 to 9.5 kg with a mean of 6.6 kg (S.D.= 1.3 kg). Female fork lengths ranged from 63.5 to 87.5 cm with a mean of 78.4 cm (S.D.= 5.3 cm), and girth measurements ranged from 29.0 to 45.0 cm (S.D. = 2.9 cm). Weights for female steelhead ranged from 2.8 to 7.5 kg with a mean of 5.1 kg (S.D.= 1.0 kg) (Tables 3 and 4, Appendix A). Hatchery anadromous *O. mykiss* have not been released into the Bonaparte system since 1992 and there has not been and hatchery marked anadromous or non-anadromous through the fishway since the 1997 migration (Figures 10 and 11).

Male rainbow trout fork lengths ranged from 28.0 to 49.0 cm with a mean of 40.0 cm (S.D. = 5.1), and female fork lengths ranged from 35.0 to 46.0 cm with an average of 42.6 cm (S.D. = 3.9) (Table 5).

Table 2. **Comparison of Bonaparte River anadromous *O. mykiss* fork lengths between 1989 and 2002.**

Year	n	Male Mean Fork Length (cm)	Standard Error	n	Female Mean Fork Length (cm)	Standard Error
1989	75	82.2	0.62	255	76.0	0.24
1990	56	84.4	0.88	103	78.0	0.48
1991	49	85.8	0.83	98	79.5	0.43
1992	47	83.4	0.83	73	76.9	0.57
1993	159	84.8	0.47	239	79.3	0.27
1994	200	84.1	0.40	489	77.0	0.22
1995	139	85.8	0.40	314	80.4	0.27
1996	37	82.2	1.23	88	78.2	0.61
1997	160	84.0	0.48	345	78.3	0.26
1998	68	84.0	0.75	156	78.9	0.56
1999	174	83.5	0.39	242	77.9	0.31
2000	33	84.5	0.81	108	78.4	0.51
2001	84	85.1	0.60	305	78.8	0.25
2002	47	84.8	0.86	81	78.4	0.64

Table 3. **Comparison of Bonaparte River anadromous *O. mykiss* weights from 1990 to 1993 and 1995 to 2002.**

Year	n	Male Mean Weight (kg)	Standard Error	n	Female Mean Weight (kg)	Standard Error
1990	56	6.3	0.20	103	5.0	0.48
1991	49	6.6	0.20	98	5.3	0.43
1992	47	5.7	0.17	73	4.8	0.57
1993	159	6.0	0.10	239	5.1	0.27
1995	139	5.2	0.08	314	5.2	0.27
1996	37	5.5	0.25	88	4.9	0.61
1997	160	5.8	0.09	345	4.9	0.26
1998	68	6.0	0.23	156	5.0	0.56
1999	176	5.7	0.09	240	4.6	0.31
2000	33	6.8	0.30	105	5.8	0.51
2001	84	6.5	0.14	305	5.3	0.25
2002	40	6.6	0.21	78	5.1	0.11

Weights were not recorded in 1989 or 1994.

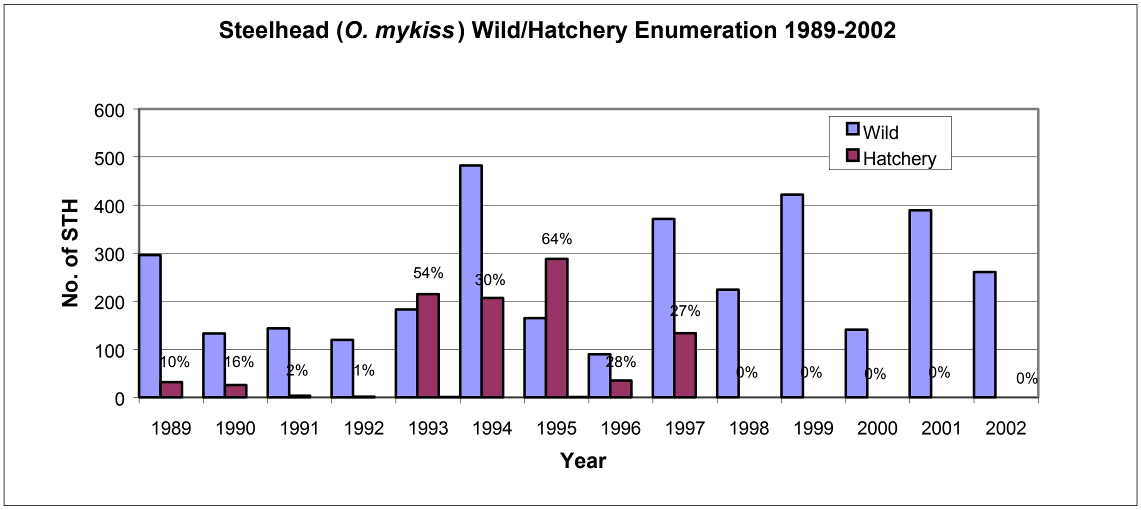

Figure 10. **Proportion of total escapement of anadromous *O. mykiss* composed of hatchery adults and wild adults, captured in the Bonaparte Fishway between 1989 and 2002.** ***Prior to 1988 not all hatchery fish released were marked with clipped adipose fins. 1992 was the last year that hatchery fish were released into the Bonaparte River system. Care should be taken when comparing data from 1993 and 1994 escapements as they may contain six year old steelhead without clipped adipose fins. The 2002 escapement is a combined total of fish enumerated by trapping and electronic counter.***

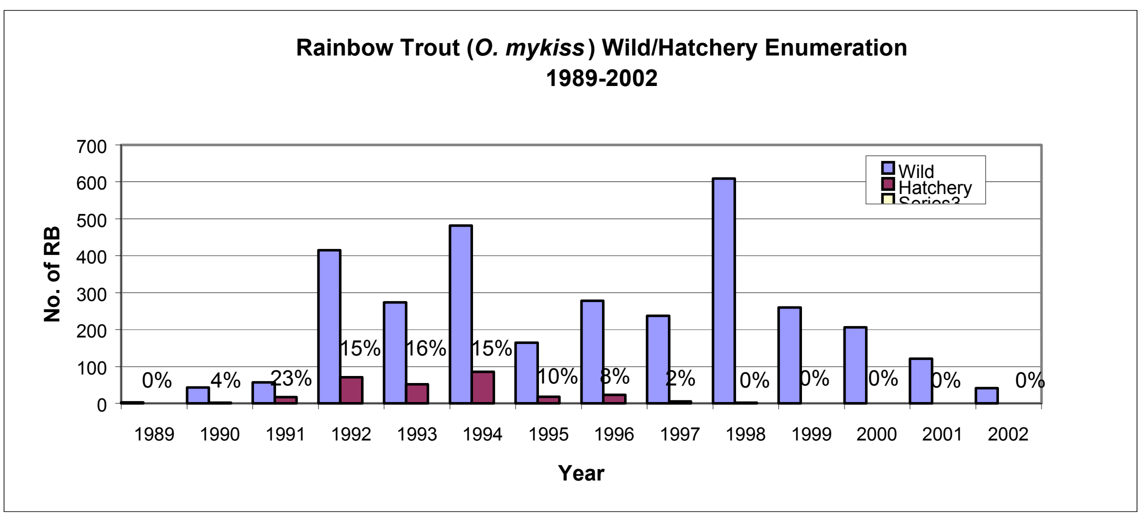

Figure 11. **Proportion of total escapement of non-anadromous *O. mykiss* composed of hatchery adults and wild adults, captured in the Bonaparte Fishway between 1989 and 2002.** ***In 1989, the intake screen for the fishway trap permitted rainbow trout passage and therefore, the number captured was low. The 2002 escapement is a combined total of fish enumerated by trapping and electronic counter.***

Table 4. **Comparison of Bonaparte River non-anadromous *O. mykiss* fork lengths between 1989 and 2002.**

Year	n	Male Mean Fork Length (cm)	Standard Error	n	Female Mean Fork Length (cm)	Standard Error
1989**	3	-		0	-	-
1990*	38	35.1	0.74	1	-	-
1991*	69	30.3	0.85	2	-	-
1992	425	35.1	0.20	37	35.5	0.64
1993	258	37.0	0.33	60	37.2	0.55
1994	308	37.1	0.38	67	37.7	0.81
1995	48	40.1	0.94	8	38.6	1.91
1996	229	40.2	0.37	55	42.1	0.50
1997	180	37.0	0.73	62	37.3	1.00
1998	412	35.7	0.87	195	37.9	0.64
1999	173	38.0	0.40	81	38.7	0.51
2000	133	39.2	0.51	76	39.0	0.46
2001	85	38.0	0.49	33	38.1	0.79
2002	31	40.0	0.92	8	42.6	1.40

** In 1989, the intake screen for the fishway trap permitted rainbow trout passage and therefore, the number captured was low.

* Female sample size was too small to analyze.

Steelhead immigration rates initially spiked on April 4, 2002 followed by fluctuating migration rates through to the end of April and into early May when the peak immigration rates occurred (April 27 – May 2, Figure 12). Minimum/maximum temperatures during this period averaged approximately 8/12 degrees Celsius. Determining peak periods of immigration rates of rainbow trout was difficult due to low numbers in rainbow trout immigration. Rainbow trout were first captured on April 13 and immigration after this date was erratic (Figure 13) and did not appear to correspond strongly to water temperature.

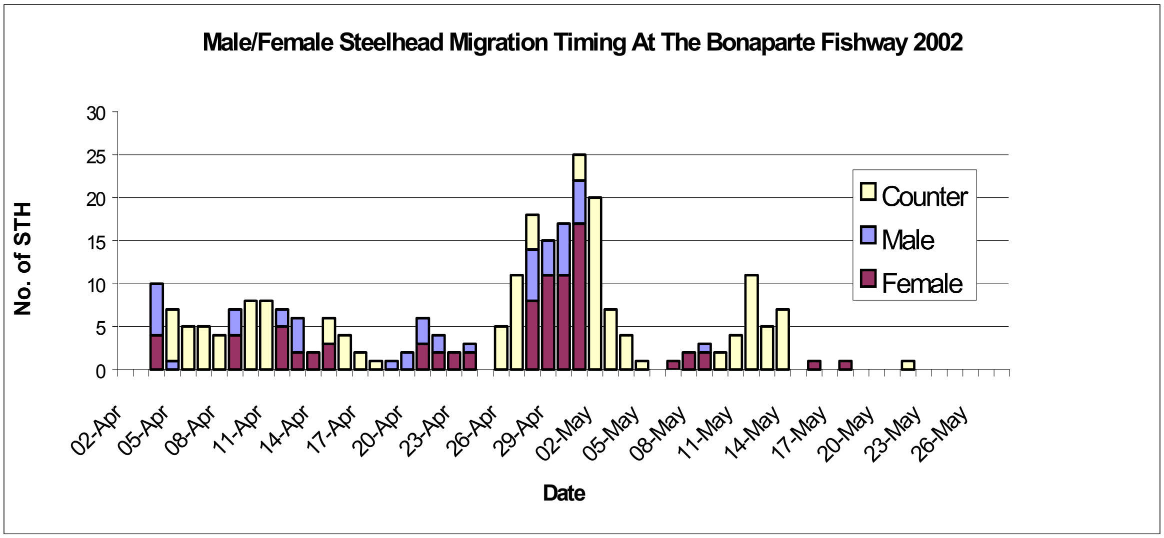

Figure 12. **Daily migration rates of anadromous *O. mykiss* at the Bonaparte Fishway April 2 – May 22, 2002.**

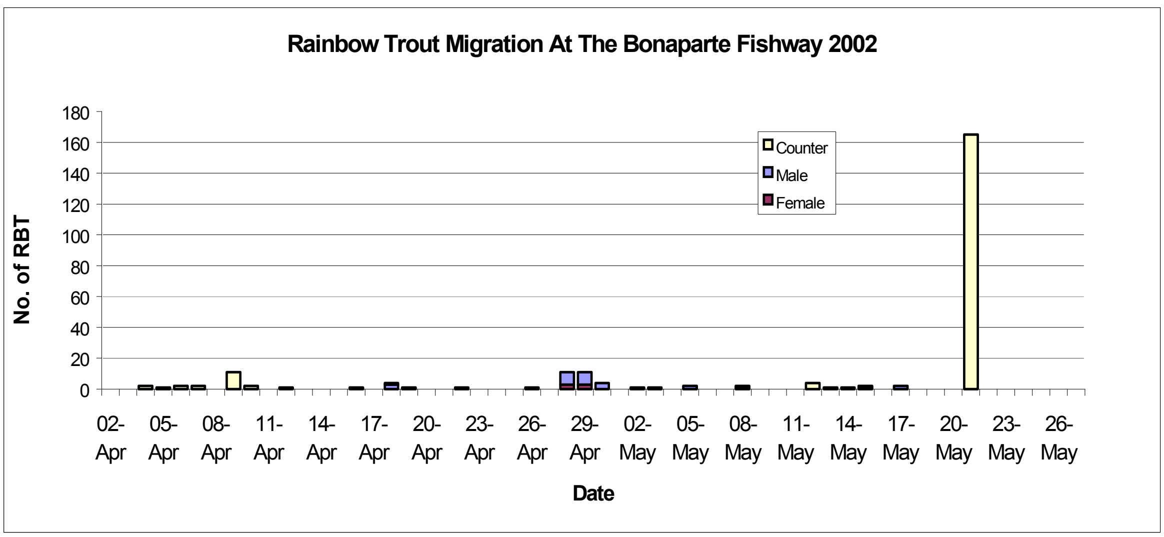

Figure 13. **Daily migration rates of non-anadromous *O. mykiss* at the Bonaparte fishway, April 2 – May 22, 2002.**

The initial rise in steelhead immigration rates in mid April preceded an increase in stream discharge (Figure 14). Discharge on the Bonaparte system peaked between May 18 - June 5. During this same period steelhead immigration was low. The peak steelhead immigration rates occurred approximately one week prior to when the peak discharge was reached. Due to the relatively low number in rainbow trout immigration trends with respect to discharge were difficult to detect (Figure 15). Steelhead immigration corresponded strongly with stream temperature in 2002. Steelhead moved in greater numbers when stream temperatures approached 8° C or greater, and numbers decreased as temperatures dropped below 8° C (Figure 16).

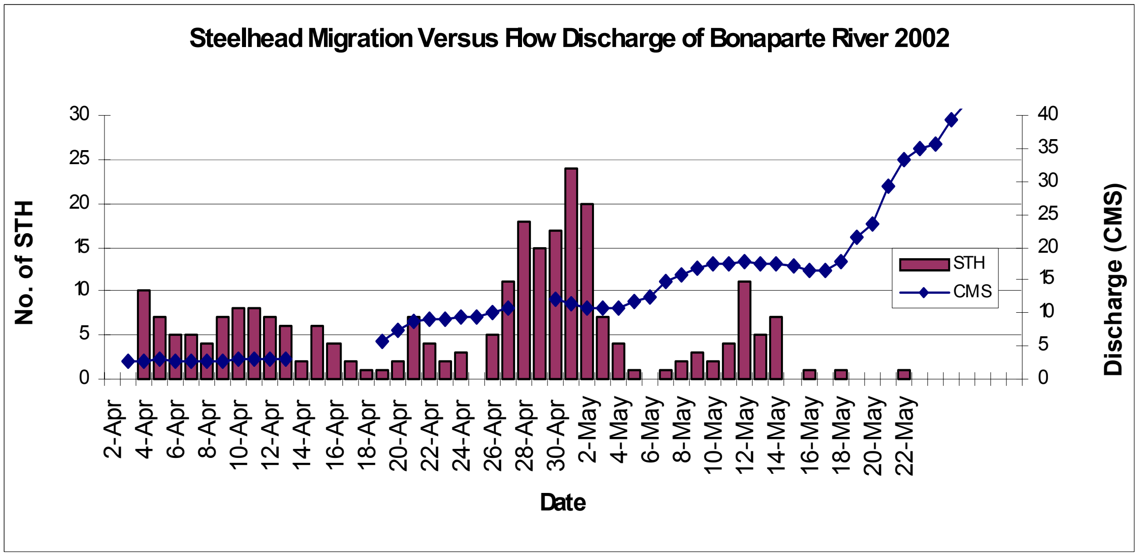

Figure 14. Daily migration of anadromous *O.mykiss* of the Bonaparte fishway in relation to flow discharge (CMS), April 2 – May 22, 2002

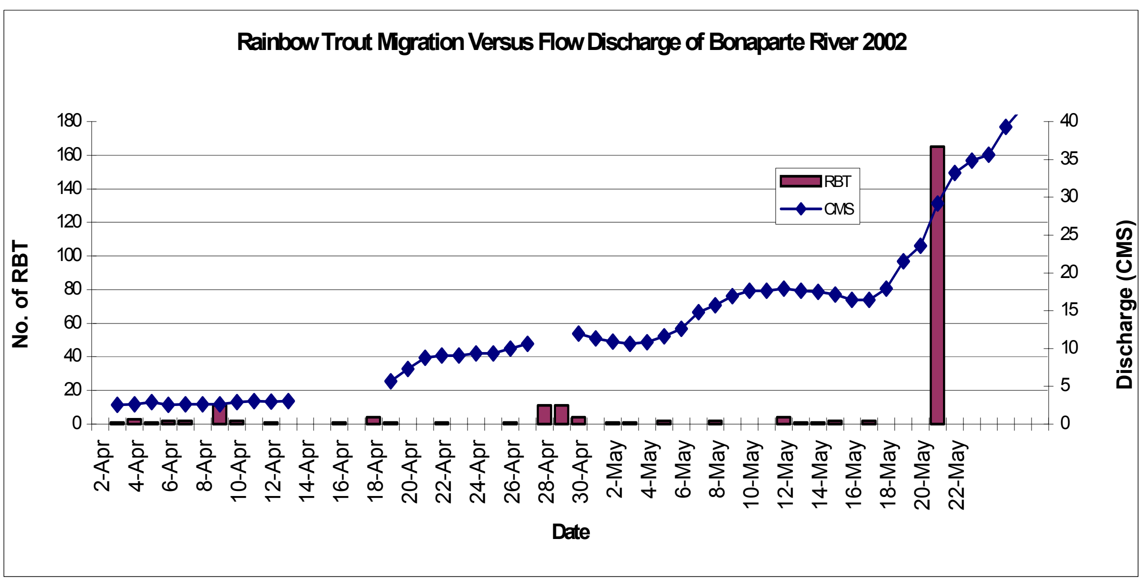

Figure 15. Daily migration of non-anadromous *O.Mykiss* of the Bonaparte fishway in relation to flow discharge, April 2 – May 22, 2002.

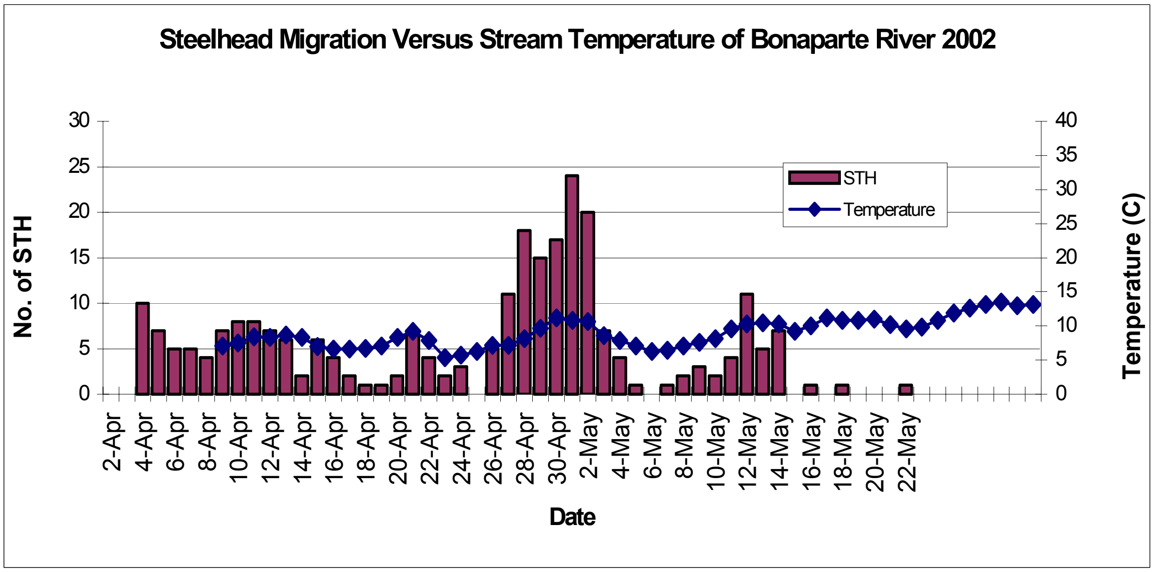

Figure 16. Daily migration of anadromous *O.mykiss* of the Bonaparte fishway in relation to stream temperature, April 2 – May 22, 2002

Previous reports (Thompson 2000, Bennett 1999) have showed immigration timing with some correlation with water temperature. Renn (1996) found, on the Deadman River, that migration occurred in two main pulses, with each being proceeded by a sharp rise in water temperature. Bison (1991) and Renn (1996) both found that migration did not occur at significant rates until water temperatures approached 8 degrees Celsius.

4.2 Resistivity Counter Operation

An additional 131 steelhead were enumerated through the electronic counter, for a total steelhead escapement of 261 in 2002. An additional 196 rainbow trout were enumerated throught the electronic counter, for a total rainbow trout escapement of 238 in 2002.

4.3 Radio Telemetry

Radio-tagged steelhead and rainbow trout were tracked by means of a fixed receiver station set up at the top of the fishway and by mobile tracking with vehicle, boat and on foot (Appendix A). Ten of the 13 steelhead and 1 of the 5 rainbow trout tagged at the mouth of the Bonaparte River migrated upstream towards the fishway with only 2 steelhead successfully migrating above the fishway. One steelhead migrated upstream while the counter was operating, while the second steelhead appears to have escaped the trap, likely through a broken aluminum bar on the upstream trap panel. One additional radio-tagged steelhead entered the trap, was processed and released upstream. This fish held directly above the fishway for a short period after being released, then dropped back down over the falls. Of the remaining 7 steelhead, one entered the trap and subsequently moved back through the lead panel downstream and out of the fishway. Four fish made runs at the fishway, but never entered the trap or passed through the counter.

An additional two steelhead and one mature female rainbow trout were radio-tagged immediately after being captured from the trap. Upon release, these fish held immediately above the fishway for a short period, and then dropped back downstream over the falls.

5.0 Discussion

In previous assessments, the estimation of steelhead escapement into the Bonaparte River was conditional on the assumption that the fishway and the methods of operation have no affect on the spawning distribution of steelhead. However, this years findings indicate that fish may have difficulties passing through the fishway as a result of the fluctuating flows during fishway operations, as well as, a structural gradient obstacle within the fishway itself.

In 2002, 261 steelhead were enumerated at the Bonaparte River Fishway, with 130 fish being trapped and an additional 131 fish enumerated with the electronic counter. This number represents the fifth highest return of wild steelhead since fishway operations began in 1989 (eighth largest return including hatchery fish) and a considerable decrease from the 1997 brood year when 505 (371 wild/ 134 hatchery) steelhead were counted at the fishway. This results in the third lowest return per spawner ratio since the Bonaparte fishway operations began. In comparison, the Deadman River resistivity fish counter showed an escapement of 321 steelhead in 2002. Since no data is available for the 1997 Deadman River, similar return per spawner ratio comparisons cannot be made. The steelhead population size for the 2002 return for the Thompson River is estimated at approximately 1700 steelhead (pers. comm R. Bison 2002).

Tracking data for the radio-tagged steelhead indicate that a large proportion of fish encounter difficulties ascending the fishway. It appears that there may be a structural gradient obstacle between fishway cells which discourage fish from ascending the fishway (pers. comm. Jim Bomford 2002). A gradient assessment of the fishway cells in 2002 indicated that there is a gradient change between cells approximately halfway up the length of the fishway which may deter upstream fish migration (pers. comm. Jim Bomford 2002). Another factor which may be problematic is that as fish are in the process of ascending the fishway and water flows are decreased during trapping periods or during debris accumulation, fish may move back out of the fishway. A review of the fish emigration timings out of the fishway verses trap processing/flow reduction timings show that there was not a strong correlation. The telemetry data indicates that radio-tagged fish which were in the fishway during trap processing/flow reduction times remained in the current cell and did not move up or drop down during this period. These fish did often drop down to a lower fishway cell in the day(s) following these trap processing/flow reduction timings (Appendix A, BFW Summary). Only two of the radio-tagged steelhead were able to successfully migrate through the fishway to the trap during trap operations.

Due to a rain on snow event in mid-May, the 2002 fishway operation experienced extremely high discharge levels resulting in a very high level of woody debris that required frequent clearing, and eventually curtailed fish passage. The peak migration of steelhead in 2002 occurred prior to the peak discharge period (Figure 8). Debris accumulation caused water levels to fall every 2-4 hours, below levels at which steelhead can migrate. This leaves very short windows of opportunity for migrating steelhead to negotiate the fishway. It is probable that a significant proportion of the fish which enter the fishway at this time were deterred by fluctuating water levels and never reach the trap cell. Therefore, the period that supported the largest steelhead migration, may not necessarily be the most favourable time for migration but the only time at which water levels in the fishway provide adequate flows for migration to occur. A review of previous fishway run timing results would likely show that without exception, the peak of the migration had occurred prior to the high debris/flow period (pers. comm S. Maricle 2002).

The results of the tracking component for the Bonaparte Fishway indicates that the number of fish which have been enumerated passing through the fishway may be only a portion of the actual population of steelhead which enter the Bonaparte River with the intent to spawn. Difficulties passing above the fishway as a result of the fluctuating flows during fishway operations, as well as, the structural gradient obstacle within the fishway itself may cause fish to spawn below the fishway or drop out of the Bonaparte River and migrate to other spawning streams, or fail to reproduce.

Hagen et al. (2002) collected steelhead parr density data for the Thompson River mainstem and all tributary streams, which included the Bonaparte River. The parr density (fish/100m) was 21, the lowest density of the study area streams, although the Bonaparte River has the greatest stream length (109.0 km) of the all the tributary streams of the Thompson River which were sampled. In comparison, the Deadman River had a parr density of 30 fish/100m with a stream length of 39.1 km. The low parr densities within the Bonaparte River could be partially explained by the difficulty steelhead appear to have immigrating through the Bonaparte River Fishway.

Structural changes to the Bonaparte Fishway are necessary to alleviate fishway water flow and debris accumulation problems such as those observed in 2002. The construction of a debris deflector immediately upstream of the fishway will reduce the need for staff to continually clear the debris, and help to minimize fluctuating water levels within the fishway. This will allow fish easier passage upstream throughout the migration period. As well, a water supply that bypasses the trap cell to maintain constant water levels during periods of trap inspection could be used to reduce stress on fish within the fishway, as well as, prevent trap avoidance. Additional structural assessment and modifications to the lead panel and upstream trap panel should be done to decrease the chance of steelhead escaping fro the trap box. In 2002, a radio-tagged steelhead escaped the trap and migrated upstream, likely through a broken bar on the upstream trap panel, indicating that other steelhead (and rainbow trout) have likely passed through without being enumerated.

The telemetry and counter studies were designed in manner which allowed us to examine both trap avoidance and movement patterns about the fishway. The results were unexpected and much was learned. Similar studies will be required to determine the effectiveness of any future improvements to fish passage. Without such studies, opportunities to produce informative data time series for fishery management will be frivolous

6.0 References

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APPENDIX A:

2002 BONAPARTE FISHWAY DATA