

**RIVERINE BIRD RESPONSE TO
HABITAT RESTORATION ON THE LOWER BRIDGE RIVER:
2005 Final Report**

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EXECUTIVE SUMMARY

The completion of the Terzaghi Dam in 1960 diverted water from the Bridge River to powerhouses located on the Seton Reservoir, leaving approximately 4 km of dry river bed below the dam. Feeder streams downstream of the dam contributed some water to the Bridge River, but flows downstream of the dam were much reduced compared to historic volumes and undoubtedly had a negative impact on populations of riverine birds. In August 2000, BC Hydro initiated an average annual release of 3 m³/s, converting the 4 km section of dry river bed into potentially usable habitat and increasing the flow of water in the system.

From 1999 to 2000, pre-release riverine bird surveys were performed on approximately 9 km of river below the Terzaghi Dam, from the Yalakom River confluence to the dry section 4 km below the dam. Four breeding seasons have passed since the initiation of the controlled release. Enough time has passed for riverine birds to respond to the increased water flow and to the creation of new habitat below the dam. In this study we examined the fifth year post-release response of riverine birds to increased water flows in the 15 km section below Terzaghi Dam. We conducted five surveys: 2 during the pair period (May) and 3 surveys during the brood-rearing stage (July).

Several species of riverine birds used this 15 km section during the pre-incubation and brood-raising periods. The most common species observed were Common Mergansers (*Mergus merganser*), Spotted Sandpipers (*Actitis maculatus*), Harlequin Ducks (*Histrionicus histrionicus*), Belted Kingfishers (*Ceryle alcyon*) and American Dippers (*Cinclus mexicanus*).

On the 4 km previously de-watered section below the Terzaghi Dam, numbers of Spotted Sandpipers and American Dippers continued to increase over the post release surveys of 2004 and 2005, suggesting that at least some riverine birds have steadily adapted to new opportunities presented by the controlled release. Over the 15 km river section between the Yalakom River and the Terzaghi Dam, however, overall numbers of riverine birds have not changed, with the exception of Spotted Sandpipers whose numbers have more than doubled, and American Dippers whose numbers appeared to have declined. There also appears to have been a response to the controlled release by American Dippers and Harlequin Ducks to shift their distribution from the higher volume downstream section to the previously low or de-watered section upstream.

The controlled release of 3 m³/s has successfully restored the 6 km of riverine bird breeding habitat most severely affected by the construction of the dam. Data from 5 years post-release, however, suggests that while birds have responded to the creation of new habitat 4 km below the dam, with the exception of Spotted Sandpipers, their overall numbers have not increased as expected in the 15 km between the Yalakom River confluence and Terzaghi Dam. We recommend further surveys should be conducted to determine if this unexpected effect is real or an artefact of small sample size.



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1.0 INTRODUCTION

Hydroelectric operations began on the Bridge River system in 1927 and culminated with the completion of the Terzaghi Dam in 1960. The Terzaghi Dam diverted water from the Bridge River to powerhouses located on the Seton Reservoir, leaving approximately 4 km of dry river bed below the dam. Springs and feeder streams downstream of the dam contributed some water to the Bridge River, but flows were much reduced compared to historic volumes and undoubtedly had a negative impact on fish and riverine bird populations.

In August 2000, BC Hydro initiated a permanent flow release at Terzaghi Dam. For the first four years flow was based on an average annual release of 3 m³/s, ranging from a baseflow in winter of 2.0 m³/s to 5.0 m³/s during the summer freshet (Wright 2004). On May 1, 2005, discharge was scheduled to switch to an average annual release of 1 m³/s for four years, to be followed by an average annual discharge rate of 6 m³/s for a final four year period. Due to a number of factors, it was decided to maintain the flow at 3 m³/s for the 2005/06 season (Jesse Brown, *pers. comm.*). At the end of the trial periods, a final flow rate will be determined.

From 1999 to 2000, surveys were conducted on the Bridge River to explore the possible impacts of hydroelectric operations on riverine birds, with most of the emphasis being focused on Harlequin Ducks (*Histrionicus histrionicus*; Wright 1998; Wright and Walton 2001a,b). Shorter surveys were also done in 2001 and 2002 on the 4 km of previously dewatered river directly downstream of Terzaghi Dam (Wright 2004). These data provide a unique opportunity to compare the effects of the controlled release with current conditions.

Four breeding seasons have passed since the initiation of the controlled release in August 2000. In this study we examined the fifth year post-release response of riverine birds to increased water flows in the 15 km section below the Terzaghi Dam. The main goal of this study was to determine how riverine birds in the breeding season responded to the increased flow by focusing on two sections of the river: the 4 km of newly created habitat immediately below the dam, and the 15 km section from the dam to the Yalakom River confluence. To achieve this goal, we conducted five riverine bird surveys: two surveys during the pairing period and three surveys during the brood-rearing stage. These results were compared to historic data to assess the effect of the controlled release.

2.0 STUDY AREA

Surveys were conducted from the confluence of the Yalakom River to the base of the Terzaghi Dam, a distance of 15 km along the Bridge River (Figure 1). Prior to the controlled release on August 1, 2000, the 4 km section from Mission Creek to the dam was essentially dry river bed and the river downstream of Mission Creek was fed only by inflowing creeks and springs. The 2 km section from Mission Creek to Aniah Creek (Figure 1) had especially low water levels. Water from the release created pools, riffles and islands, and it flooded much of the river bank vegetation, especially clusters of red



alder (*Alnus rubra*), making hiking along the river bank difficult in places. This section occurs in the IDFDk2 (Interior Douglas-fir dry cool zone) biogeoclimatic zone (Meidinger and Pojar 1991).

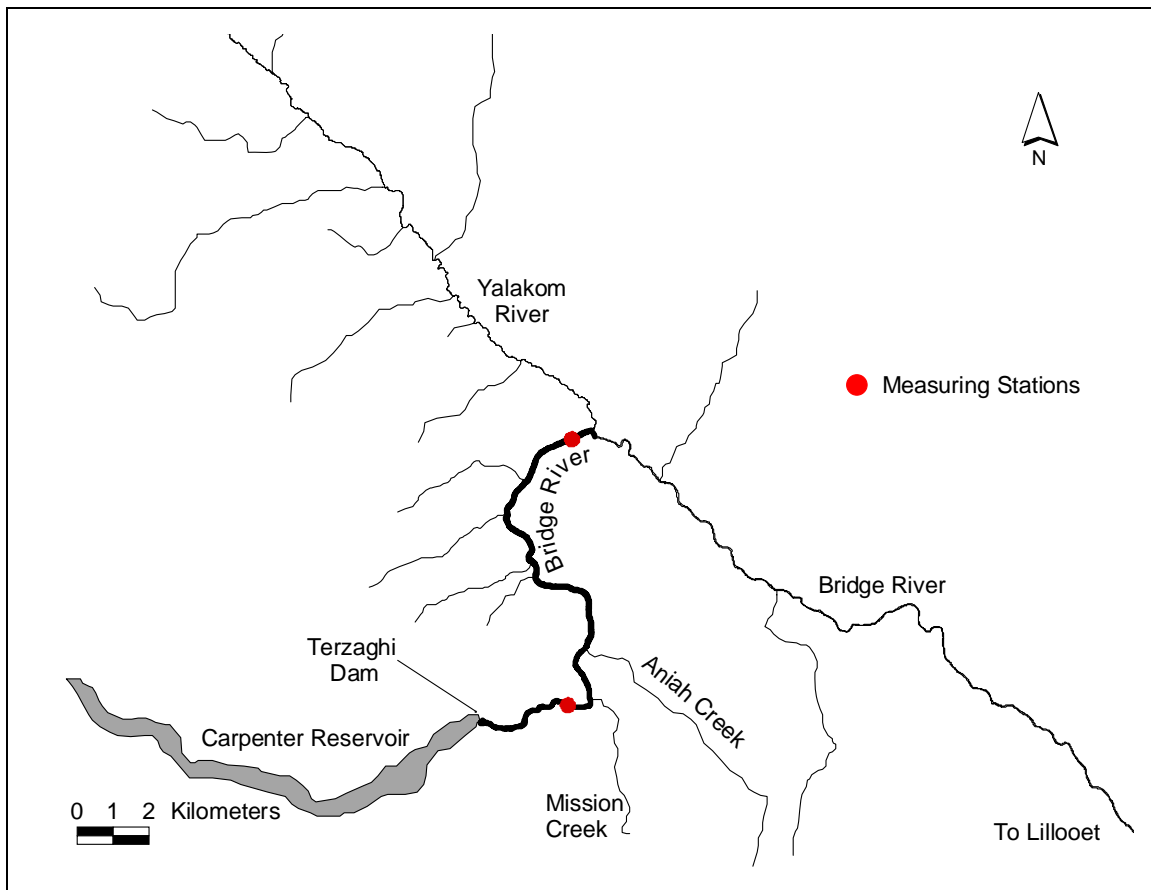


Figure 1. Map of the survey area in 2005. The bold line indicates the 15 km survey area from the Yalakom River confluence to the Terzaghi Dam. Faint lines indicate major creeks. Red dots denote locations of the upstream and downstream water measuring stations.

Water conditions pre- and post-release were assessed at two measuring stations: the upstream station at the upstream extent of the pre-release water, and the downstream station above the confluence of the Yalakom River. Water depth is shown in Figure 2. Flows were highly variable prior to the release in August 2000, especially in 1999, a year of higher than normal flows, and in 1997, when a spill occurred (Jeff Snee, *unpubl. data*). Post-release water depths emulate the general seasonal pattern, but within year variation is minimal. In June, water depths are approximately 3 times greater in the upstream station and 2 times greater in the downstream station than in pre-release conditions.

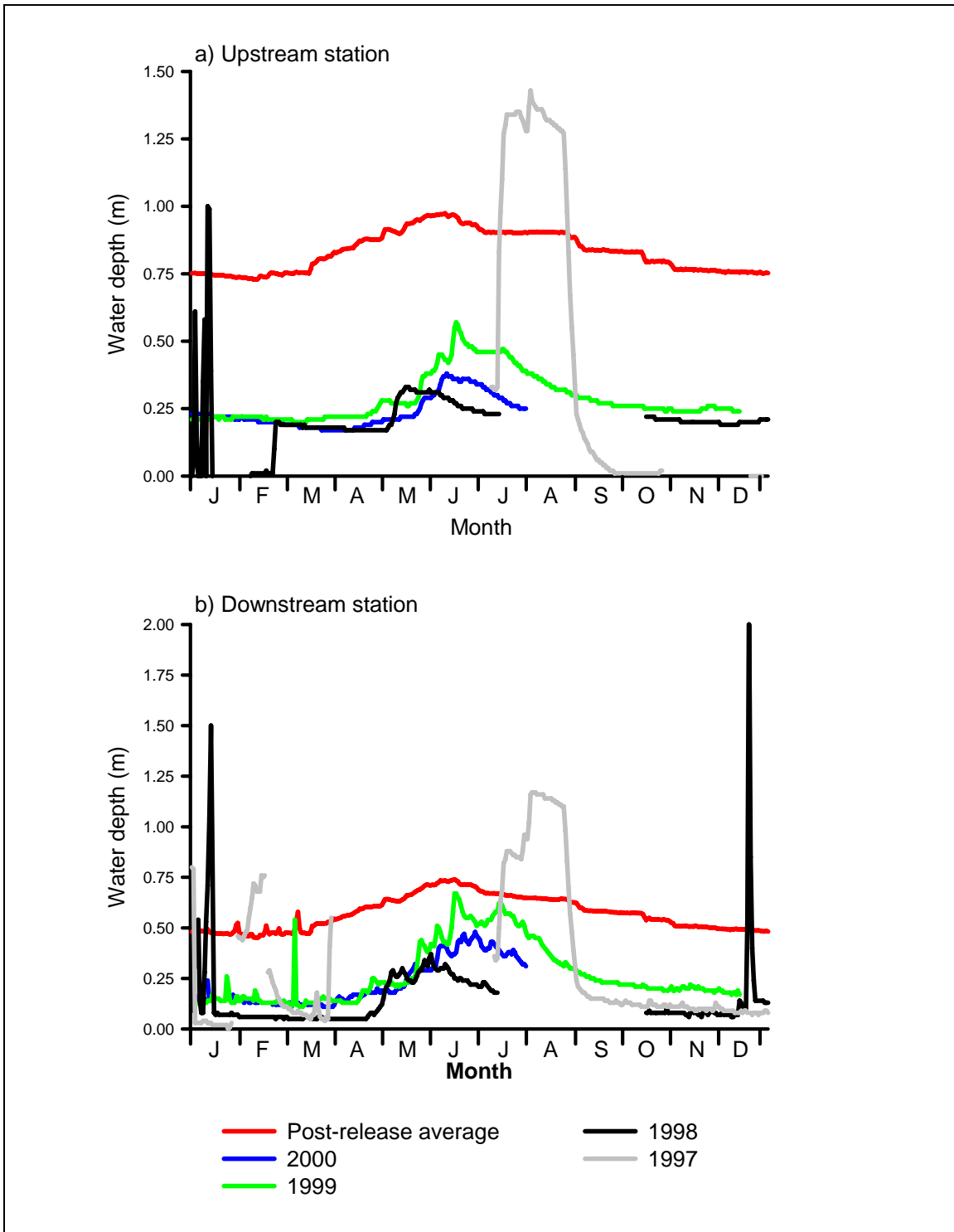


Figure 2. Pre- and post-release water depths at the a) upstream and b) downstream water measuring stations. Refer to Figure 1 for locations of the stations.



3.0 METHODS

Surveys were conducted by two teams of two observers hiking in an upstream direction along the western river bank to maximize bird detections. In 2004 surveys covered the 6 km below Terzaghi Dam; in 2005, the survey was extended another 9 km. The first team began at the Yalakom River confluence and the second team began approximately 1.2 km downstream of Aniah Creek. Teams alternated routes among surveys to guard against observer bias. Techniques follow those proposed by the Resources Inventory Committee (RIC 1997). Teams carried binoculars to assist with identification. Visual coverage was complete except for portions of channels on the opposite side of four small islands (approximately 250 m). Bird locations were fixed by GPS (Garmin E-trex, accuracies ranged from $\pm 7\text{m}$ to $\pm 35\text{m}$) and marked onto field maps. These were later plotted to correspond with TRIM features. Final bird locations are presented in Appendix 1.

We performed 5 surveys in total: 2 breeding pair surveys and 3 brood surveys. Surveys began between 8:00 – 9:00 a.m. and finished by 4:00 p.m. Pair surveys were conducted on May 6 and May 20. Brood surveys began on June 28 and were repeated on July 15 and July 29.

Documentation of all mammals, birds, and herptiles observed during the surveys are appended to this report (see Appendix 2).

Two sources of earlier data can be compared to our surveys in 2005. As part of more extensive pre-release riverine bird surveys in 1999 and 2000 (Wright and Walton 2001a,b), pair and breeding surveys were conducted on the Bridge River from the Yalakom River confluence to the upstream extent of the watered area, roughly 800 m upstream of Mission Creek. Data from this section were compared directly to the survey results in 2005, including the extra 4 km of river upstream to Terzaghi Dam surveyed in 2005. We included the previously de-watered section in the comparison because we assumed that no riverine birds used this section prior to the release in August 1, 2000 and numbers could safely be interpreted as zeros. Surveys of the de-watered section on July 27 and August 3, 1999 supported this assumption (Ken Wright, *unpubl. data*), although 2-3 Spotted Sandpipers may have been using the de-watered section. Pre-release data were compared from the following ground survey dates: in 1999 (May 4, 18; June 30, July 15) and in 2000 (May 6, 20; June 28, July 15, 29). The third brood survey scheduled for the end of July 1999 was cancelled due to widespread brood failure from the unusually high freshet (Wright and Walton 2001a).

In 2001 and 2002, Ken Wright surveyed the previously dry 4 km section from Mission Creek to Terzaghi Dam (Ken Wright, *unpubl. data*), and we repeated this survey in 2004 (Walton and Heinrich 2004). We compared these earlier data to the same 4 km stretch surveyed in 2005. Only data from similarly dated survey sessions were used.



4.0 RESULTS

Table 1 presents the major riverine species observed during the 5 surveys. Detailed data and location coordinates for each observation are documented in Appendix 2. Other riverine species observed include Bald Eagles (*Haliaeetus leucocephalus*), Ospreys (*Pandion haliaetus*), a Ring-necked Duck (*Aythya collaris*) and a Great Blue Heron (*Ardea herodias*).

Numerically, Spotted Sandpipers (*Actitis maculatus*) were the most abundant species, followed by Common Mergansers (*Mergus merganser*). Harlequin Ducks, American Dippers (*Cinclus mexicanus*) and Belted Kingfishers (*Ceryle alcyon*) also used this section during the breeding season. All species except Belted Kingfishers were observed with young.

Table 1. Number of individuals of major riverine bird species observed on the 15 km survey route from the Yalakom River confluence to Terzaghi Dam. Values are totals of adults and juveniles combined. Numbers in parentheses indicate the number of juveniles observed.

Survey Type	American Dipper	Harlequin Duck	Spotted Sandpiper	Belted Kingfisher	Common Merganser	Total
Pair						
May 06	11	3	0	4	16	34
May 20	6	0	16	6	11	39
Brood						
June 28	3 (0)	8 (6)	22 (0)	4 (0)	18 (13)	55 (19)
July 15	10 (4)	1 (0)	20 (1)	1 (0)	5 (0)	37 (5)
July 29	2 (1)	6 (6)	28 (9)	3 (0)	2 (2)	41 (18)
Total	32 (5)	18 (12)	86 (10)	18 (0)	52 (15)	206(42)

The response of riverine birds to the release on the 15 km section from the Terzaghi Dam to the Yalakom River confluence is presented in Figure 3. Although year to year variation makes interpreting results difficult with just one year of post-release data, some trends are suggested. The most obvious change in use is by Spotted Sandpipers, whose numbers have more than doubled. American Dipper numbers, conversely, appeared to slightly decrease. Belted Kingfishers were more prevalent during the pair period but less prevalent during the brood period, which may be an artefact of the small number of sampling years. The more mobile Common Mergansers and Harlequin Ducks appeared to show a slight increase in numbers during the brood period, although between and within year variation was high.

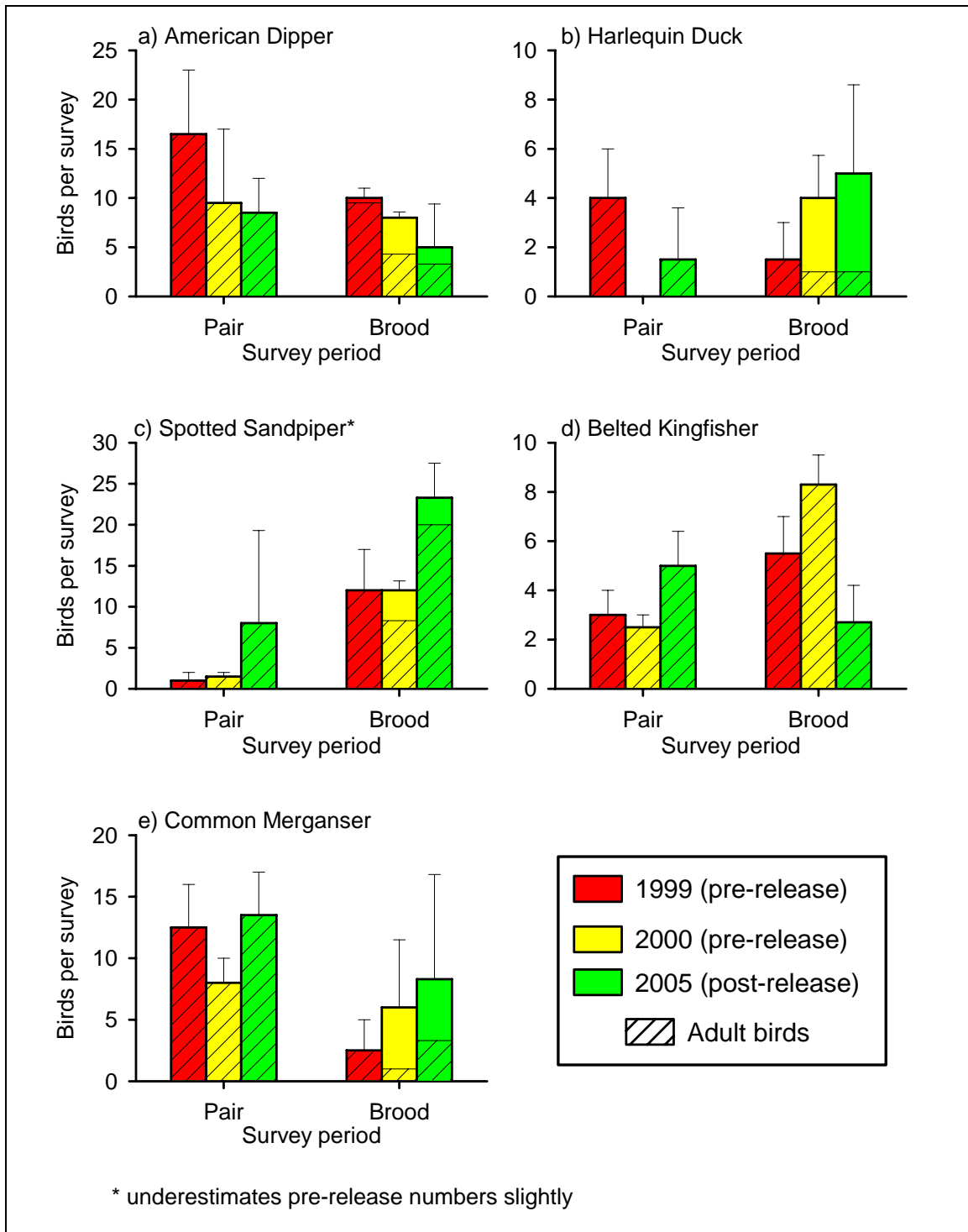


Figure 3. Average number of birds per survey (± 1 SE) 2 years pre-release and 5 years post-release during the pair and brood periods. Data include observations from the Yalakom River confluence to the Terzaghi Dam (see Methods). Adults and juveniles are included in totals; the average number of adults is indicated by cross-hatching.



Survey results from 2005 were compared to previous post-release data for the 4 km previously dewatered section (Figure 4). American Dipper and Spotted Sandpiper numbers have generally increased, most dramatically in the brood period. Trends were not as clear for Harlequin Ducks, Belted Kingfishers and Common Mergansers. Potential increases for Harlequin Ducks and Common Mergansers, in particular, could have been masked by high year-to-year variability in juvenile numbers.

Prior to the release, Aniah Creek, located approximately 6 km downstream from Terzaghi Dam, provided a natural break between the low or de-watered sections upstream and the 9 km of more substantial river downstream. The effect of the release on the distribution of birds upstream and downstream of Aniah Creek is presented in Figure 5. Dippers and Harlequin Ducks have shifted their use to the upstream section while Spotted Sandpipers generally have increased everywhere, but proportionately more upstream. Belted Kingfishers showed no shift in distribution and Common Mergansers demonstrated no obvious preference.

5.0 DISCUSSION

All five major riverine bird species used the 15 km section below Terzaghi Dam to the Yalakom River confluence for at least part of their breeding stages. No nests were observed on the surveys, but Belted Kingfisher, Spotted Sandpiper and American Dipper nests are difficult to find and there were undoubtedly some present. Previous work (Wright and Goudie 2000; Wright and Walton 2001a) suggested that some Harlequin Ducks nested on the Yalakom River and moved their young to the Bridge River for brood-rearing. Common Mergansers, a cavity-nesting species, may have nested along our survey route if trees with appropriate cavities were available.

Surprisingly, extending the survey a further 9 km downstream in 2005 did not result in a large increase in the numbers of birds observed. Walton and Heinrich (2004) recorded a total of 188 birds (92 juveniles) of the five major riverine species in just 6 km compared to 206 birds (42 juveniles) observed over 15 km in 2005. Part of this can be explained by high inter-year variability in brood production (especially for Common Mergansers), but there appears to have been a shift in distribution for some species from the downstream section to the previously low or de-watered section below Terzaghi Dam (Figure 5). This explains the apparently contradictory results of a decrease in American Dipper numbers over the 15 km river section (Figure 3) but an increase in their numbers in the previously low or de-watered sections (Figure 4). Harlequin Ducks, as well, seem to have shifted their use to the upstream river section, particularly for brood rearing. Dippers and Harlequin Ducks feed mostly on aquatic macroinvertebrates (Kingery 1996; Robertson and Goudie 1999). This shift in distribution by the two species most reliant on aquatic invertebrates may reflect a change in the abundance or species composition of their prey in the downstream section caused by the release. Another possibility is that the birds prefer the rockier, less vegetated shoreline in the upstream.

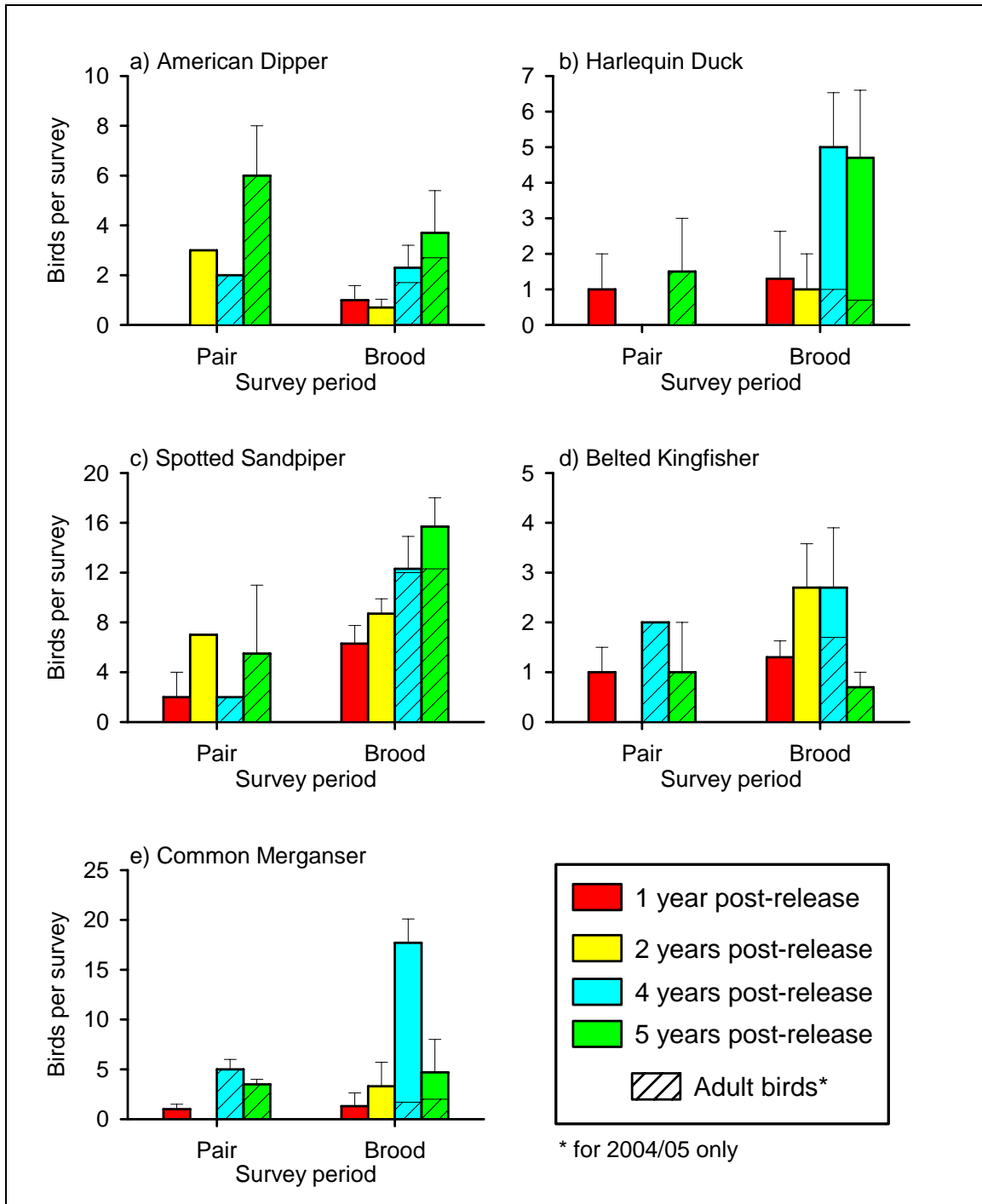


Figure 4. Average number of birds per survey (± 1 SE) upstream of Mission Creek. Adults and juveniles are included in the totals; the average number of adults is indicated by cross-hatching (only available for 2004 and 2005).

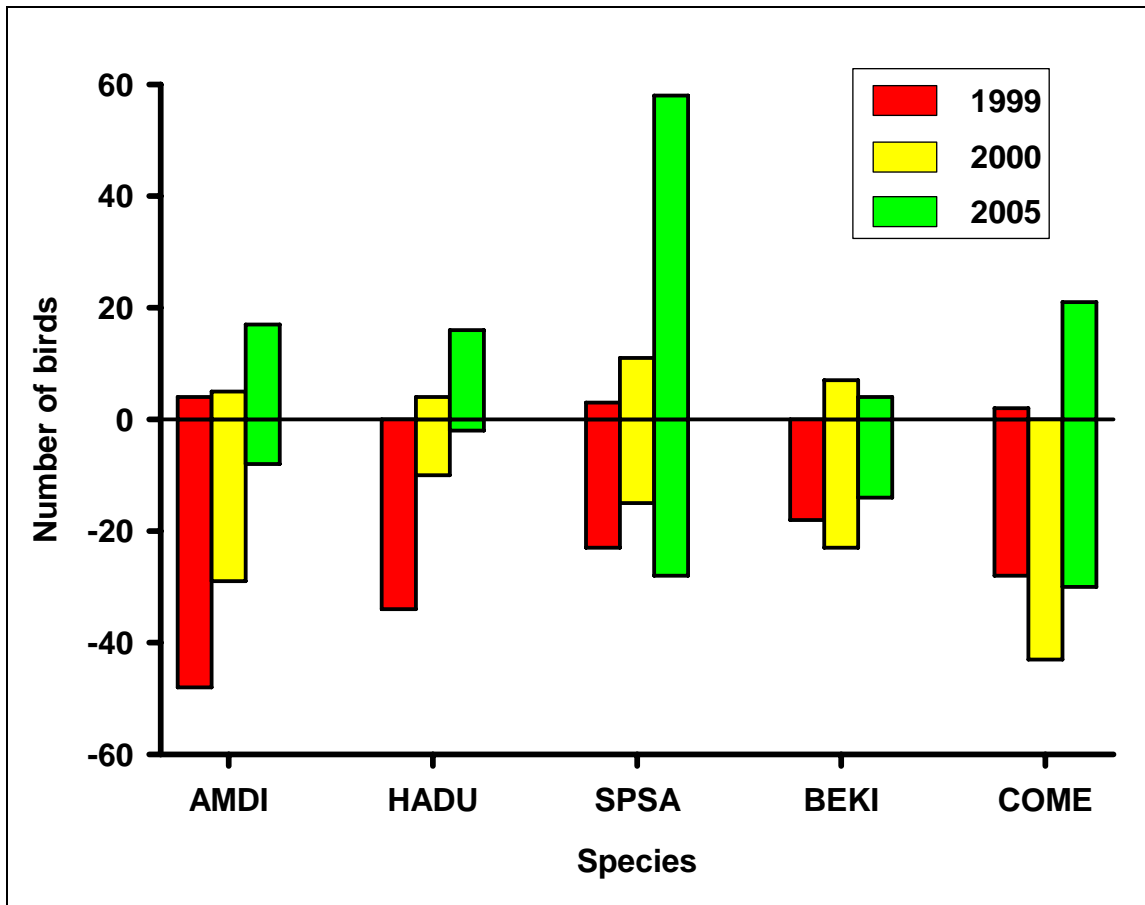


Figure 5. Distribution of riverine birds pre- and post-release. Values are the total number of birds observed on all 5 surveys. Negative values indicate birds recorded in the 9 km section downstream of Aniah Creek; positive values indicate birds observed in the 6 km section upstream of Aniah Creek. AMDI = American Dipper; HADU = Harlequin Duck; SPSA = Spotted Sandpiper; BEKI = Belted Kingfisher; COME = Common Merganser.

Spotted Sandpipers have benefited most from the new habitat created by the controlled release (Figures 3-5), more than doubling their pre-release numbers. Over the 15 km section, Harlequin Ducks, Common Mergansers and Belted Kingfishers did not show any obvious increase, although Harlequin Ducks did appear to shift their distribution upstream. American Dippers, on the other hand, appeared to have declined slightly in numbers since the release (Figure 3). This may reflect a real deterioration in overall Dipper habitat caused by the release or it may be an artefact of the small post-release sample size.

The numbers of juvenile Spotted Sandpipers, Belted Kingfishers and, to some extent, American Dippers, may have been underestimated in the brood surveys. These birds were often observed very briefly, not allowing enough time for positive age



classification. Belted Kingfishers, in particular, were usually observed in flight and their juvenile count will be under-represented.

Comparing absolute numbers of riverine birds among years should be done carefully because broad factors unrelated to the study area can influence breeding success. For example, in 1999 most broods failed due to severe flooding (Wright and Walton 2001a). Only with repeated monitoring can the effects of aberrant years be removed.

6.0 RECOMMENDATIONS

Overall, the controlled release has had positive effects on riverine bird breeding habitat in the 6 km most severely affected by dam construction. All five major riverine bird species use this area for at least one stage of their breeding period and evidence suggests that bird use has been increasing each year post-release. The impact is not as clear on the 15 km section between the Terzaghi Dam and the Yalakom River confluence. With the exception of Spotted Sandpipers, bird numbers have not changed substantially overall, although Dippers and Harlequin Ducks have shifted their use to the upstream section.

We have two major recommendations:

1. We recommend that surveys should be repeated from the Yalakom River confluence to the Terzaghi Dam to determine if changes in riverine bird numbers observed in 2005 reflect a real difference or simply an artefact the small sample size. This is particularly critical to see if the apparent decline in American Dipper numbers reflects a negative overall consequence of the controlled release.
2. Five years of the controlled release at 3 m³/s have passed. Negotiations are currently in place to determine if the next 4 year cycle will be set at 1 m³/s or 6 m³/s. Regardless of whether the flow rate is changed next year or maintained at 3 m³/s, we recommend repeating the surveys to monitor the effects of the flow. If the flow is maintained at the current level, another year will provide important baseline data; if the flow is increased or decreased, this needs to be monitored to assess the effects.

7.0 ACKNOWLEDGEMENTS

We would like to thank Ken Wright for providing data from past surveys and for his help and enthusiasm about the project in general. We would also like to thank Ed Hill (BC Hydro) for initiating the riverine bird work in 1997 and Janice Doane (BCRP) for her encouragement during the application process. Jesse Brown (BC Hydro) provided information about the status of the controlled release schedule. Thanks to Jeff Snee for providing the Terzaghi water station data. All field work was conducted by Ralph Heinrich, Russ Walton, Gerald and Elijah Michel, Raymond Edward, and Josh Wiesner. Funding for this study was provided by the BC Hydro Bridge River Coastal Fish and Wildlife Restoration Program.



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**APPENDIX 1**

Appendix 1. Detailed riverine bird observations from the 2005 survey. Coordinates are UTM Zone 10, NAD 83. Species codes: AMDI = American Dipper; BAEA = Bald Eagle; BEKI = Belted Kingfisher; COME = Common Merganser; GBHE = Great Blue Heron; HADU = Harlequin Duck; NWTH = Northern Waterthrush; OSPR = Osprey; RNDU = Ring-necked Duck; SPSA = Spotted Sandpiper.

Date	Survey	Species	M	F	Unknown Sex	Adult Group Size	Brood Size	Easting	Northing
06-May-05	1st Pair	AMDI	0	0	2	2	0	558221	5634961
06-May-05	1st Pair	BEKI	0	0	1	1	0	558101	5634951
06-May-05	1st Pair	COME	0	2	0	2	0	556494	5633842
06-May-05	1st Pair	COME	1	0	0	1	0	556306	5633477
06-May-05	1st Pair	COME	0	1	0	1	0	556174	5633338
06-May-05	1st Pair	COME	0	1	0	1	0	555740	5632426
06-May-05	1st Pair	AMDI	0	0	1	1	0	555739	5632391
06-May-05	1st Pair	COME	0	1	0	1	0	555965	5632090
06-May-05	1st Pair	AMDI	0	0	1	1	0	555964	5626322
06-May-05	1st Pair	RNDU	1	0	0	1	0	555854	5626287
06-May-05	1st Pair	AMDI	0	0	1	1	0	555142	5626467
06-May-05	1st Pair	COME	1	0	0	1	0	557327	5630433
06-May-05	1st Pair	BEKI	0	0	1	1	0	557327	5630433
06-May-05	1st Pair	BEKI	0	0	1	1	0	557724	5630341
06-May-05	1st Pair	COME	1	0	0	1	0	558125	5630061
06-May-05	1st Pair	COME	1	2	0	3	0	558191	5629446
06-May-05	1st Pair	COME	1	0	0	1	0	558144	5628881
06-May-05	1st Pair	BEKI	0	0	1	1	0	558144	5628881
06-May-05	1st Pair	AMDI	0	0	1	1	0	557917	5628536
06-May-05	1st Pair	OSPR	0	0	1	1	0	557917	5628536
06-May-05	1st Pair	COME	1	1	0	2	0	558014	5627763
06-May-05	1st Pair	AMDI	1	1	0	2	0	558173	5626963
06-May-05	1st Pair	AMDI	0	0	1	1	0	557987	5626930
06-May-05	1st Pair	AMDI	0	0	1	1	0	557815	5626907
06-May-05	1st Pair	NWTH	0	0	3	3	0	557714	5626905
06-May-05	1st Pair	HADU	1	0	0	1	0	557664	5626921
06-May-05	1st Pair	HADU	1	1	0	2	0	557429	5627049
06-May-05	1st Pair	COME	0	1	0	1	0	556997	5626923
06-May-05	1st Pair	AMDI	0	0	1	1	0	556997	5626923
06-May-05	1st Pair	COME	0	1	0	1	0	557429	5627049
20-May-05	2nd Pair	COME	0	3	0	3	0	558133	5629654
20-May-05	2nd Pair	BEKI	0	0	1	1	0	558164	5629527
20-May-05	2nd Pair	AMDI	0	0	1	1	0	558000	5628601
20-May-05	2nd Pair	AMDI	0	0	1	1	0	557902	5628522
20-May-05	2nd Pair	BEKI	0	1	0	1	0	558007	5627777
20-May-05	2nd Pair	BEKI	0	1	0	1	0	558169	5627210



Date	Survey	Species	M	F	Unknown Sex	Adult Group Size	Brood Size	Easting	Northing
20-May-05	2nd Pair	COME	0	2	0	2	0	557700	5626911
20-May-05	2nd Pair	AMDI	0	0	1	1	0	557339	5627079
20-May-05	2nd Pair	SPSA	0	0	1	1	0	557179	5627102
20-May-05	2nd Pair	SPSA	0	0	1	1	0	556894	5626917
20-May-05	2nd Pair	SPSA	0	0	2	2	0	556735	5626929
20-May-05	2nd Pair	SPSA	0	0	2	2	0	556116	5626360
20-May-05	2nd Pair	AMDI	1	1	0	2	0	558234	5634962
20-May-05	2nd Pair	BEKI	0	0	1	1	0	558234	5634962
20-May-05	2nd Pair	COME	0	1	0	1	0	558234	5634962
20-May-05	2nd Pair	SPSA	0	0	1	1	0	558234	5634962
20-May-05	2nd Pair	SPSA	0	0	2	2	0	558047	5634931
20-May-05	2nd Pair	COME	1	0	0	1	0	556425	5633660
20-May-05	2nd Pair	SPSA	0	0	1	1	0	556115	5633283
20-May-05	2nd Pair	BAEA	0	0	1	1	0	556115	5633283
20-May-05	2nd Pair	COME	0	1	0	1	0	555820	5632775
20-May-05	2nd Pair	COME	1	1	0	2	0	556480	5631481
20-May-05	2nd Pair	SPSA	0	0	1	1	0	556411	5631372
20-May-05	2nd Pair	BEKI	0	0	1	1	0	557342	5630432
20-May-05	2nd Pair	BEKI	0	0	1	1	0	557361	5630432
20-May-05	2nd Pair	COME	0	1	0	1	0	555821	5626287
20-May-05	2nd Pair	SPSA	0	0	1	1	0	555517	5626314
20-May-05	2nd Pair	SPSA	0	0	1	1	0	555496	5626317
20-May-05	2nd Pair	AMDI	0	0	1	1	0	555472	5626322
20-May-05	2nd Pair	SPSA	0	0	3	3	0	555437	5626330
28-Jun-05	1st Brood	BEKI	0	0	1	1	0	558229	5634967
28-Jun-05	1st Brood	COME	0	1	0	1	0	558229	5634967
28-Jun-05	1st Brood	SPSA	0	0	1	1	0	558109	5634952
28-Jun-05	1st Brood	BEKI	1	0	0	1	0	557975	5634905
28-Jun-05	1st Brood	AMDI	0	0	1	1	0	556148	5633311
28-Jun-05	1st Brood	SPSA	0	0	1	1	0	555969	5633045
28-Jun-05	1st Brood	SPSA	0	0	1	1	0	555950	5632963
28-Jun-05	1st Brood	BEKI	0	0	1	1	0	555880	5632840
28-Jun-05	1st Brood	COME	0	1	0	1	5	555834	5632789
28-Jun-05	1st Brood	SPSA	0	0	1	1	0	555748	5632642
28-Jun-05	1st Brood	SPSA	0	0	4	4	0	555768	5632514
28-Jun-05	1st Brood	SPSA	0	0	2	2	0	556481	5631506
28-Jun-05	1st Brood	HADU	0	1	0	1	0	556595	5630776
28-Jun-05	1st Brood	OSPR	0	0	1	1	0	558148	5629579
28-Jun-05	1st Brood	AMDI	1	1	0	2	0	557998	5628601
28-Jun-05	1st Brood	SPSA	0	0	1	1	0	558181	5627135
28-Jun-05	1st Brood	HADU	0	0	0	0	6	557612	5626938
28-Jun-05	1st Brood	SPSA	0	0	2	2	0	557262	5627085
28-Jun-05	1st Brood	COME	0	2	0	2	0	557145	5627094



Date	Survey	Species	M	F	Unknown Sex	Adult Group Size	Brood Size	Easting	Northing
28-Jun-05	1st Brood	HADU	0	1	0	1	0	557145	5627094
28-Jun-05	1st Brood	SPSA	0	0	2	2	0	556977	5626917
28-Jun-05	1st Brood	SPSA	0	0	2	2	0	556703	5626908
28-Jun-05	1st Brood	BEKI	0	0	1	1	0	556586	5626828
28-Jun-05	1st Brood	COME	0	1	0	1	8	556490	5626822
28-Jun-05	1st Brood	SPSA	0	0	2	2	0	556279	5626512
28-Jun-05	1st Brood	SPSA	0	0	2	2	0	556032	5626352
28-Jun-05	1st Brood	SPSA	0	0	1	1	0	555283	5626415
15-Jul-05	2nd Brood	COME	0	1	0	1	0	558211	5629185
15-Jul-05	2nd Brood	AMDI	0	0	1	1	0	558167	5628917
15-Jul-05	2nd Brood	AMDI	0	0	0	0	2	558067	5628677
15-Jul-05	2nd Brood	HADU	0	1	0	1	0	558005	5628607
15-Jul-05	2nd Brood	AMDI	0	0	1	1	1	557921	5628538
15-Jul-05	2nd Brood	AMDI	0	0	1	1	0	557760	5628276
15-Jul-05	2nd Brood	AMDI	0	0	1	1	0	558079	5627622
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	558171	5627244
15-Jul-05	2nd Brood	AMDI	0	0	1	1	0	558181	5627131
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	558113	5626942
15-Jul-05	2nd Brood	SPSA	0	0	0	0	1	558056	5626931
15-Jul-05	2nd Brood	COME	0	3	0	3	0	557759	5626905
15-Jul-05	2nd Brood	AMDI	0	0	1	1	1	557408	5627056
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	557287	5627080
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	556944	5626912
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	556694	5626865
15-Jul-05	2nd Brood	SPSA	0	0	2	2	0	556574	5626829
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	556347	5626735
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	556279	5626572
15-Jul-05	2nd Brood	SPSA	0	0	2	2	0	556110	5626358
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	555672	5626295
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	555463	5626324
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	555268	5626423
15-Jul-05	2nd Brood	BAEA	0	0	2	2	0	558203	5634967
15-Jul-05	2nd Brood	COME	0	1	0	1	0	557468	5634669
15-Jul-05	2nd Brood	BEKI	0	0	1	1	0	556292	5633470
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	556124	5633286
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	555989	5633128
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	555772	5632555
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	556454	5631419
15-Jul-05	2nd Brood	SPSA	0	0	1	1	0	556465	5631178
29-Jul-05	3rd Brood	SPSA	0	0	1	1	0	556455	5633741
29-Jul-05	3rd Brood	SPSA	0	0	1	1	0	556292	5633464
29-Jul-05	3rd Brood	SPSA	0	0	1	1	0	555869	5632824
29-Jul-05	3rd Brood	SPSA	0	0	1	1	0	555827	5632778



Date	Survey	Species	M	F	Unknown Sex	Adult Group Size	Brood Size	Easting	Northing
29-Jul-05	3rd Brood	SPSA	0	0	2	2	0	555758	5632687
29-Jul-05	3rd Brood	SPSA	0	0	2	2	0	555765	5632511
29-Jul-05	3rd Brood	BEKI	0	1	0	1	0	555765	5632507
29-Jul-05	3rd Brood	BEKI	1	0	0	1	0	556901	5630471
29-Jul-05	3rd Brood	COME	0	0	0	0	2	557886	5630310
29-Jul-05	3rd Brood	HADU	0	0	0	0	6	558084	5627613
29-Jul-05	3rd Brood	SPSA	0	0	2	2	3	558140	5626947
29-Jul-05	3rd Brood	AMDI	0	0	0	0	1	558135	5626945
29-Jul-05	3rd Brood	SPSA	0	0	2	2	0	557308	5627081
29-Jul-05	3rd Brood	SPSA	0	0	1	1	1	556967	5626915
29-Jul-05	3rd Brood	SPSA	0	0	1	1	2	556683	5626838
29-Jul-05	3rd Brood	AMDI	0	0	1	1	0	556415	5626790
29-Jul-05	3rd Brood	BEKI	0	0	1	1	0	556276	5626501
29-Jul-05	3rd Brood	SPSA	0	0	2	2	1	556132	5626365
29-Jul-05	3rd Brood	GBHE	0	0	1	1	0	555935	5626310
29-Jul-05	3rd Brood	SPSA	0	0	2	2	1	555931	5626309
29-Jul-05	3rd Brood	SPSA	0	0	1	1	1	555400	5626341



APPENDIX 2

List of wildlife species encountered during the Riverine Bird Surveys conducted between May 6th and July 29th, 2005.

Sources for Provincial and Federal rankings:

- <http://srmwww.gov.bc.ca/atrisk/> provincial endangered species tracking database;
- http://www.cosewic.gc.ca/eng/sct5/index_e.cfm Committee on the Status of Endangered Wildlife In Canada (COSEWIC); and
- Province of BC. 1999. Identified Wildlife Management Strategy: Species at Risk and the Forest Practices Code. Ministry of Forests and Ministry of Water, Land and Air Protection. 180pp. Also see: <http://wlapwww.gov.bc.ca/wld/identified/>

Mammals (Eder and Pattie 2001)

Common Name	Latin Name	Provincial List	COSEWIC ¹	Identified Wildlife	Bridge R. Status
Black Bear	<i>Ursus americanus</i>	Yellow	NAR	No	Resident
Mountain Goat	<i>Oreamnos americanus</i>	Yellow	N/A	Yes	Resident
Mule Deer	<i>Odocoileus hemionus</i>	Yellow	N/A	No	Resident
Red Squirrel	<i>Tamiasciurus hudsonicus</i>	Yellow	N/A	No	Resident
Yellow Pine Chipmunk	<i>Tamias amoenus</i>	Yellow	N/A	No	Resident
American Beaver	<i>Castor canadensis</i>	Yellow	N/A	No	Resident

Birds (Alsop 2002, Campbell *et al* 1997a, 1997b and 1997c, and Ehrlich *et al* 1988)

Common Name	Latin Name	Provincial List	COSEWIC ¹	Identified Wildlife	Bridge R. Status
Great Blue Heron	<i>Ardea herodias</i>	Blue	SC	No	Breeding Migrant
Harlequin Duck	<i>Histrionicus histrionicus</i>	Yellow	N/A	No	Breeding Migrant
Ring-necked Duck	<i>Aythya collaris</i>	Yellow	N/A	No	Breeding Migrant
Common Merganser	<i>Mergus merganser</i>	Yellow	N/A	No	Resident
Hawks, Eagles and Ospreys (Acipitridae)					
Osprey	<i>Pandion haliaetus</i>	Yellow	NAR	No	Breeding Migrant
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Yellow	NAR	No	Resident
Golden Eagle	<i>Aquila chrysaetos</i>	Yellow	NAR	No	Resident
Red-Tailed Hawk	<i>Buteo jamaicensis</i>	Yellow	NAR	No	Resident
Falcons (Falconidae)					
American Kestrel	<i>Falco sparverius</i>	Yellow	N/A	No	Breeding Migrant
Merlin	<i>Falco columbarius</i>	Yellow	NAR	No	Breeding Migrant
Grouse, partridges and pheasants (Phasianidae)					
Ruffed Grouse	<i>Bonansa umbellus</i>	Yellow	N/A	No	Resident
Sandpipers and					



Common Name	Latin Name	Provincial List	COSEWIC ¹	Identified Wildlife	Bridge R. Status
Phalaropes (Scolopacidae)					
Spotted Sandpiper	<i>Actitis Macularia</i>	Yellow	N/A	No	Breeding Migrant
Hummingbirds (Trochilidae)					
Rufous Hummingbird	<i>Selasphorus rufus</i>	Yellow	N/A	No	Breeding Migrant
Kingfishers (Alcedinidae)					
Belted Kingfisher	<i>Ceryle alcyon</i>	Yellow	N/A	No	Resident
Woodpeckers (Picidae)					
Hairy Woodpecker	<i>Picoides villosus</i>	Yellow	N/A	No	Breeding Migrant
Red-Naped Sapsucker	<i>Sphyrapicus nuchalis</i>	Yellow	N/A	No	Breeding Migrant
Northern Flicker	<i>Colpates auratus</i>	Yellow	N/A	No	Resident
Flycatchers (Tyranidae)					
Dusky Fly Catcher	<i>Empidonax oberholseri</i>	Yellow	N/A	No	Breeding Migrant
Pacific Slope Flycatcher	<i>Empidonax difficilis</i>	Yellow	N/A	No	Breeding Migrant
Vireos (Vireonidae)					
Red Eyed Vireo	<i>Vireo olivaceus</i>	Yellow	N/A	No	Breeding Migrant
Solitary Vireo	<i>Vireo solitarius</i>	Yellow			
Warbling Vireo	<i>Vireo gilvus</i>	Yellow	N/A	No	Breeding Migrant
Jays, Crows and Ravens (Corvidae)					
Clark's Nutcracker	<i>Nucifraga columbiana</i>	Yellow	N/A	No	Resident
Black-billed Magpie	<i>Pica hudsonia</i>	Yellow	N/A	No	Resident
American Crow	<i>Corvus brachyrhynchos</i>	Yellow	N/A	No	Resident
Common Raven	<i>Corvus corax</i>	Yellow	N/A	No	Resident
Swifts (Apodidae)					
Vaux's Swift	<i>Chaetura vauxi</i>	Yellow	N/A	No	Breeding Migrant
Swallows (Hirundinidae)					
Tree Swallow	<i>Tachycineta bicolor</i>	Yellow	N/A	No	Breeding Migrant
Violet Green Swallow	<i>Tachycineta thalassina</i>	Yellow	N/A	No	Breeding Migrant
Northern Rough-Winged Swallow	<i>Stelgidopteryx serripensis</i>	Yellow	N/A	No	Breeding Migrant
Chickadees (Paridae)					
Black-Capped Chickadee	<i>Poecile atricapilla</i>	Yellow	N/A	No	Resident
Mountain Chickadee	<i>Poecile gambeli</i>	Yellow	N/A	No	Resident



Common Name	Latin Name	Provincial List	COSEWIC ¹	Identified Wildlife	Bridge R. Status
Nuthatches (Sittidae)					
Red Breasted Nuthatch	<i>Sitta canadensis</i>	Yellow	N/A	No	Resident
Wrens (Troglodytidae)		Yellow	N/A	No	
Winter Wren	<i>Troglodytes troglodytes</i>	Yellow	N/A	No	Resident
Dippers (Cinclidae)					
American Dipper	<i>Cinclus mexicanus</i>	Yellow	N/A	No	Resident
Bluebirds, Solitaires and Thrushes (Turdidae)					
Townsend's Solitaire	<i>Myadestes townsendi</i>	Yellow	N/A	No	Breeding Migrant
Swainson's Thrush	<i>Catharus ustulatus</i>	Yellow	N/A	No	Breeding Migrant
American Robin	<i>Turdus migratorius</i>	Yellow	N/A	No	Breeding Migrant
Wagtails and Pipits (Motacillidae)					
American Pipit	<i>Anthus rubescens</i>	Yellow	N/A	No	Migrant
Waxwings (Bombycillidae)					
Cedar Waxwing	<i>Bombycilla cedrorum</i>	Yellow	N/A	No	Breeding Migrant
Wood-Warblers (Parulidae)					
Nashville Warbler	<i>Vermivora ruficapilla</i>	Yellow	N/A	No	Breeding Migrant
Yellow Warbler	<i>Dendroica petechia</i>	Yellow	N/A	No	Breeding Migrant
Yellow-Rumped Warbler	<i>Dendroica coronata</i>	Yellow	N/A	No	Breeding Migrant
Townsend's Warbler	<i>Dendroica townsendi</i>	Yellow	N/A	No	Breeding Migrant
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	Yellow	N/A	No	Breeding Migrant
Wilson's Warbler	<i>Wilsonia pusilla</i>	Yellow	N/A	No	Breeding Migrant
Tanagers (Thraupidae)					
Western Tanager	<i>Piranga ludoviciana</i>	Yellow	N/A	No	Common Breeding Migrant
Tohees, Sparrows and Buntings (Emberizidae)					
Song Sparrow	<i>Melospiza melodia</i>	Yellow	N/A	No	Common Breeding Migrant
Chipping Sparrow	<i>Spizella passerina</i>	Yellow	N/A	No	Common Breeding Migrant



Common Name	Latin Name	Provincial List	COSEWIC ¹	Identified Wildlife	Bridge R. Status
Dark-Eyed Junco (Oregon Race)	<i>Junco hyemalis</i>	Yellow	N/A	No	Common Breeding Migrant
Pine Siskin	<i>Carduelis pinus</i>	Yellow	N/A	No	Common Breeding Migrant

Reptiles (St John 2002 and Gregory and Campbell 1984)

Common Name	Latin Name	Provincial List	COSEWIC ¹	Identified Wildlife	Bridge R. Status
Northern Alligator Lizard (Northwestern)	<i>Elgaria coerulea principis</i>	Yellow	NAR	No	Common Resident
Common Garter Snake (Valley Garter Snake)	<i>Thamnophis sirtalis fitchi</i>	Yellow	N/A	No	Common Resident
Western Terrestrial Garter Snake (Wandering Garter snake)	<i>Thamnophis elegans vagrans</i>	Yellow	N/A	No	Common Resident



**SCHEDULE A
FINANCIAL REPORT**

	Income	Expensed	
Income			
<i>BCRP</i>	\$ 8,325.00		
(List other income)	None		
Total Income			
Expenses		BCRP	(other)
<i>Project Personnel</i>			
Wage		\$ 7,100.00	
Consultant fees			
<i>(List others as required)</i>			
Equipment & Expenses			
Equipment rental			
Equipment purchase			
<i>Materials purchased</i>			
Travel expenses		\$900.00	
Permits			
<i>(List others as required)</i>			
<i>Overhead</i>		\$250.00	
Office supplies		\$15.00	
Photo copies & printing		\$15.00	
Postage (Courier)		\$27.96	
<i>(list others as required)</i>			
Subtotal		\$8,307.96	
GST		441.55	
Total Expensed		\$ 8,749.52	
Balance		* \$-424.51	

*Unspent BCRP financial contribution to be returned to:

BC Hydro, BCRP
6911 Southpoint Drive (E16)
Burnaby, BC. V3N 4X8



APPENDIX B
PERFORMANCE MEASURES

Performance Measures – Target Outcomes

Project Type	Primary habitat benefit targeted of project (m ²)	Primary Target Species	Habitat (m ²)											
			Estuarine	In-stream Habitat – Mainstream	In-stream Habitat – Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland		
Impact Mitigation														
Fish passage technologies	Area of habitat made available to target species													
Drawdown zone revegetation/stabilization	Area turned into productive habitat													
Wildlife migration improvement	Area of habitat made available to target species	Riverine Birds (Including Harlequin Ducks, American Dippers, Ospreys etc)		15 km		15 km		15 km						
Prevention of drowning of nests, nestlings	Area of wetland habitat created outside expected flood level (1:10 year)													
Habitat Conservation														
Habitat conserved – general	Functional habitat conserved/replaced through acquisition and management													
	Functional habitat conserved by other measures (e.g. riprapping)													
Designated rare/special habitat (subset)	Rare/special habitat protected													
Maintain or Restore Habitat forming process														
Artificial gravel recruitment	Area of stream habitat improved by gravel placement													
Artificial wood debris recruitment	Area of stream habitat improved by LWD placement													
Small-scale complexing in existing habitats	Area increase in functional habitat through complexing													
Prescribed burns or other upland habitat enhancement for wildlife	Functional area of habitat improved													
Habitat Development														
New habitat created	Functional area created													
New Habitat assessment	Functional area of habitat improved	Riverine Birds (Including Harlequin Ducks, American Dippers,		15 km		15 km		15 km						



		Ospreys etc)												
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APPENDIX C
CONFIRMATION OF BCRP RECOGNITION

Ralph Heinrich will be presenting the results of this project at the following conference:

Federation of BC Naturalists Fall Meeting 2005
 September 29th to October 2nd
 Lillooet, B.C.

The talk and slide show presentation is scheduled for Friday September 30th, 10:00 – 11:00 a.m.