

Two vertical bars on the left side of the page: a green bar on the left and a blue bar on the right, both extending from the top to the bottom of the page.

## **Bridge River Project Water Use Plan**

### **Lower Bridge River Riparian Vegetation Monitoring**

**Implementation Year 3**

**Reference: BRGMON-11**

**Study Period: 2014**

**Russ Walton and Ralph Heinrich**

**August 2014**

**RIVERINE BIRD RESPONSE TO  
HABITAT RESTORATION ON THE LOWER BRIDGE RIVER:  
2014 Report**



*Prepared by:*

Russ Walton and Ralph Heinrich  
Wildtech Biological Services  
643 Bissette Road  
Kamloops, BC  
V2B 6L3



With financial support from  
BC Hydro  
Under the  
Bridge River Water Use Planning (WUP) Monitoring Program

August 2014



## 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 4.1 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 m<sup>3</sup>/s, converting the 4.1 km section of dry river bed into potentially usable habitat and increasing the flow of water in the system. In May 2011, the average annual release was increased to 6 m<sup>3</sup>/s.

From 1999 to 2000, pre-release riverine bird surveys were performed on approximately 11.8 km of river below the Terzaghi Dam, from the Yalakom River confluence to the dry section 4.1 km below the dam. In 2004, a survey was conducted on the 6 km below the dam. In 2005, 2006 and 2008 we conducted full-length post-release surveys on the 15.9 km section from the Terzaghi Dam to the Yalakom River confluence under the average 3 m<sup>3</sup>/s flow regime. We repeated these surveys in 2011, 2012, 2013 and 2014, performing two pair surveys (May) and three brood surveys (July) in the first four years of the average 6 m<sup>3</sup>/s flow regime.

Several species of riverine birds used this 15.9 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*), American Dippers (*Cinclus mexicanus*) and Belted Kingfishers (*Ceryle alcyon*).

Surveys were conducted to test the hypothesis that the population increase of riverine birds in the Lower Bridge River corridor is directly related to the instream flow release from Terzaghi Dam. By 2014, only Harlequin Ducks had responded positively to both flow regimes, although Spotted Sandpiper numbers did increase during the 3 m<sup>3</sup>/s flow regime before returning to pre-release levels with the 6 m<sup>3</sup>/s flow. Common Merganser and American Dipper numbers have generally remained unchanged from pre-release levels, although Dipper numbers may have declined slightly at the higher flow. Weak evidence suggests that Belted Kingfisher numbers may have declined as well. The controlled release, however, has had positive effects on riverine bird breeding habitat in the 4.1 km most severely affected by dam construction, with all five major riverine bird species using this section. Other responses by riverine birds have been more subtle, with Dippers, Common Mergansers, Spotted Sandpipers and perhaps Harlequin Ducks shifting their distributions upstream, while Belted Kingfishers appeared to use the downstream half of the section more often since the controlled release. Results should be interpreted cautiously, however, given the 4 years of data available for the 6 m<sup>3</sup>/s flow rate in such a highly variable system.

Three more survey years are scheduled at the 6 m<sup>3</sup>/s flow rate (2016-2020). These additional surveys will help reduce the influence of year-to-year variation and to better



test the hypothesis that the population increase of riverine birds in the Lower Bridge River corridor is directly related to the instream flow release from Terzaghi Dam.



## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	1
1.0 INTRODUCTION.....	5
2.0 STUDY AREA.....	6
3.0 METHODS.....	9
4.0 RESULTS.....	11
4.1 Harlequin Duck Response .....	12
4.2 American Dipper Response .....	12
4.3 Common Merganser Response .....	13
4.4 Spotted Sandpiper Response .....	13
4.5 Belted Kingfishers .....	14
6.0 SUMMARY .....	21
7.0 ACKNOWLEDGEMENTS.....	22
8.0 REFERENCES.....	24

## LIST OF FIGURES

Figure 1 Map of the Survey Area. The bold line indicates the 15.9 km survey area from the Yalakom River confluence to the Terzaghi Dam. Faint lines indicate major creeks. The red dot denotes the location of the water measuring station and green lines indicate survey team starting locations.....	6
Figure 2 Pre- and post-release water depths at the upstream water measuring station by Mission Creek. The 3 m <sup>3</sup> /s post-release average is from 2008-2010. Refer to Figure 1 for location of this station.....	8
Figure 3 Flow release from the Terzaghi Dam. The red line is the average 3 m <sup>3</sup> /s flow from 2000 to 2004. The 6 m <sup>3</sup> /s flow regime began on May 3, 2011. ....	9
Figure 4. Average number of Harlequin Ducks per survey (+ 1 SE) from the Yalakom River confluence to Terzaghi Dam (4a,b) and upstream of Mission Creek (4c,d) for pair and brood surveys. Number of adult (4e) and juvenile (4f) Harlequin Ducks observed per km per survey above and below Aniah Creek (totalled over all 5 surveys).....	15
Figure 5. Average number of American Dippers per survey (+ 1 SE) from the Yalakom River confluence to Terzaghi Dam (5a,b) and upstream of Mission Creek (5c,d) for pair and brood surveys. Number of adult (5e) and juvenile (5f) American Dippers observed per km per survey above and below Aniah Creek (totalled over all 5 surveys).....	16
Figure 6. Average number of Common Mergansers per survey (+ 1 SE) from the Yalakom River confluence to Terzaghi Dam (6a,b) and upstream of Mission Creek (6c,d) for pair and brood surveys. Number of adult (6e) and juvenile (6f) Common Mergansers observed per km per survey above and below Aniah Creek (totalled over all 5 surveys). ....	17
Figure 7. Average number of Spotted Sandpipers per survey (+ 1 SE) from the Yalakom River confluence to Terzaghi Dam (7a,b) and upstream of Mission Creek (7c,d) for pair and brood surveys. Number of adult (7e) and juvenile (7f) Spotted Sandpipers observed per km per survey above and below Aniah Creek (totalled over all 5 surveys).....	18
Figure 8. Average number of Belted Kingfishers per survey (+ 1 SE) from the Yalakom River confluence to Terzaghi Dam (8a,b) and upstream of Mission Creek (8c,d) for pair and brood surveys. Number of adult (8e) and juvenile (8f) Belted Kingfishers observed per km per survey above and below Aniah Creek (totalled over all 5 surveys).....	19



### LIST OF TABLES

Table 1. Number of individuals of major riverine bird species observed on the 15.9 km survey route from the Yalakom River confluence to Terzaghi Dam in 2014. ....	11
Table 2. Summary of responses of the 5 main riverine species to the 3 m <sup>3</sup> /s and 6 m <sup>3</sup> /s controlled releases.....	22

### LIST OF APPENDICES

Appendix 1 Detailed riverine bird observations from the 2014 survey.....	27
Appendix 2 List of wildlife species encountered during the Riverine Bird Surveys conducted between May 6 <sup>th</sup> and July 28th, 2014.....	30
Appendix 3 Selected photographs from 2014 riverine bird surveys.....	34



## 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 4.1 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 to be based on an average annual release of 3 m<sup>3</sup>/s, ranging from a base flow in winter of 2.0 m<sup>3</sup>/s to 5.0 m<sup>3</sup>/s during the summer freshet (Wright 2004). On May 1, 2005, discharge was scheduled to switch to an average annual release of 1 m<sup>3</sup>/s for four years, to be followed by an average annual discharge rate of 6 m<sup>3</sup>/s for a final four year period. Due to a number of factors, it was decided not to reduce the flow to 1 m<sup>3</sup>/s (Jesse Brown, *pers. comm*). In early May 2011, an average discharge flow rate of 6 m<sup>3</sup>/s was initiated and flows will be maintained at this rate for a 10 year assessment period. The final flow rate has yet to be determined.

The effect of the flow release on riverine birds along the Bridge River was unknown and a long-term study was begun to explore the possible impacts, with most of the early emphasis being focused on Harlequin Ducks (*Histrionicus histrionicus*). In 1999 and 2000, pre-release surveys were conducted to establish a reference point for riverine bird numbers prior to initiation of the controlled release (Wright 1998; Wright and Walton 2001a,b). Shorter surveys were also done in 2001 and 2002 on the 4.1 km of previously dewatered river directly downstream of Terzaghi Dam (Wright 2004). This shorter survey was repeated in 2004 (Walton and Heinrich 2004) and longer surveys replicating the surveys of 1999 and 2000 were conducted in 2005, 2006, 2008, 2011, 2012 and 2013 (Walton and Heinrich 2005; Walton and Heinrich 2006; Heinrich 2008; Walton and Heinrich 2011; Walton and Heinrich 2012; Walton and Heinrich 2013).

Thirteen breeding seasons have passed since the initiation of the controlled release in August 2000. In this study we examined the 14th year post-release response of riverine birds to increased water flows in the 15.9 km section below the Terzaghi Dam. As outlined in the Bridge-Seton Water Use Plan, the main goal of this study is to determine how changes in the riparian community and instream flow conditions influence the capability of the Lower Bridge River corridor to support riverine bird populations. We will test the hypothesis that the population increase of riverine birds in the Lower Bridge River corridor is directly related to the instream flow release from Terzaghi Dam. More specifically, we will study how riverine birds in the breeding season responded to the increased flow by focusing on two sections of the river: the 4.1 km of newly created habitat immediately below the dam, and the 15.9 km section from the dam to the Yalakom River confluence.



We conducted five riverine bird surveys in 2014: two surveys during the pairing period and three surveys during the brood-rearing stage. These results were compared with past seasons to assess the influence of the controlled release and to test the hypothesis that the population increase of riverine birds in the Lower Bridge River corridor is directly related to the instream flow release from Terzaghi Dam.

## 2.0 STUDY AREA

Surveys were conducted from the confluence of the Yalakom River to the base of the Terzaghi Dam, a distance of 15.9 km along the Bridge River (Figure 1). Prior to the controlled release on August 1, 2000, the 4.1 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 IDFc (Interior Douglas-fir very dry cold zone) biogeoclimatic zone (Meidinger and Pojar 1991).

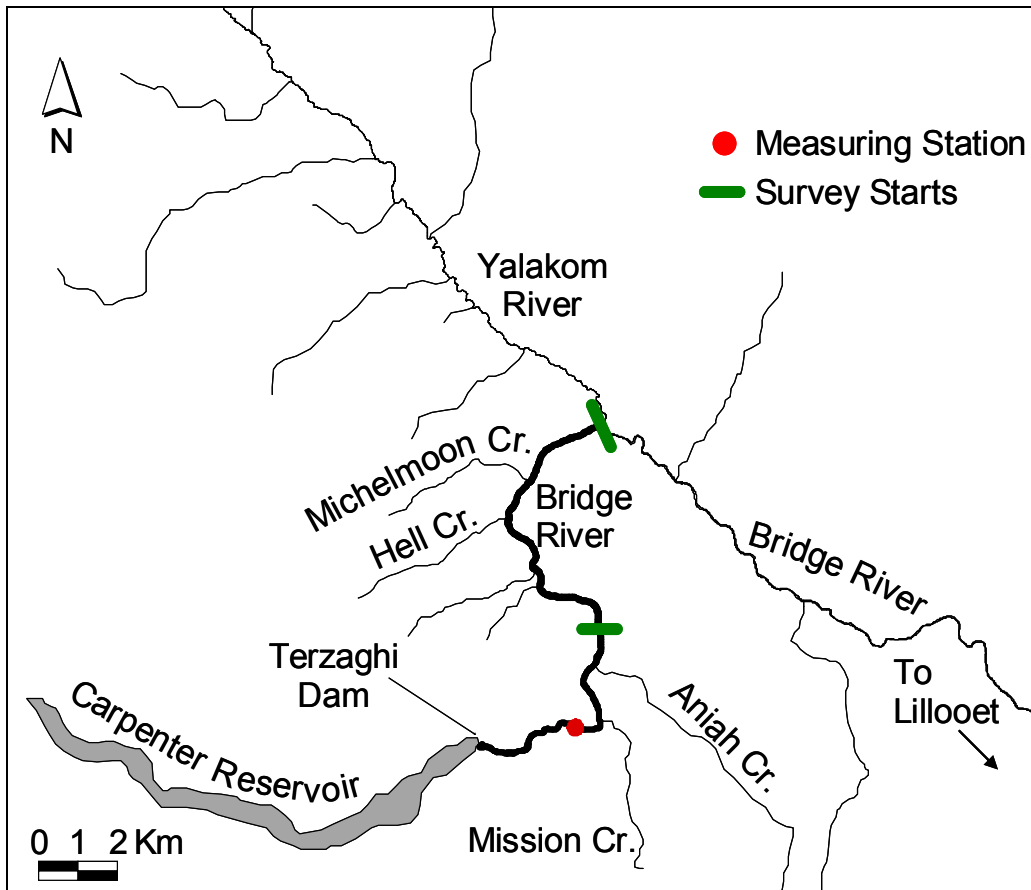


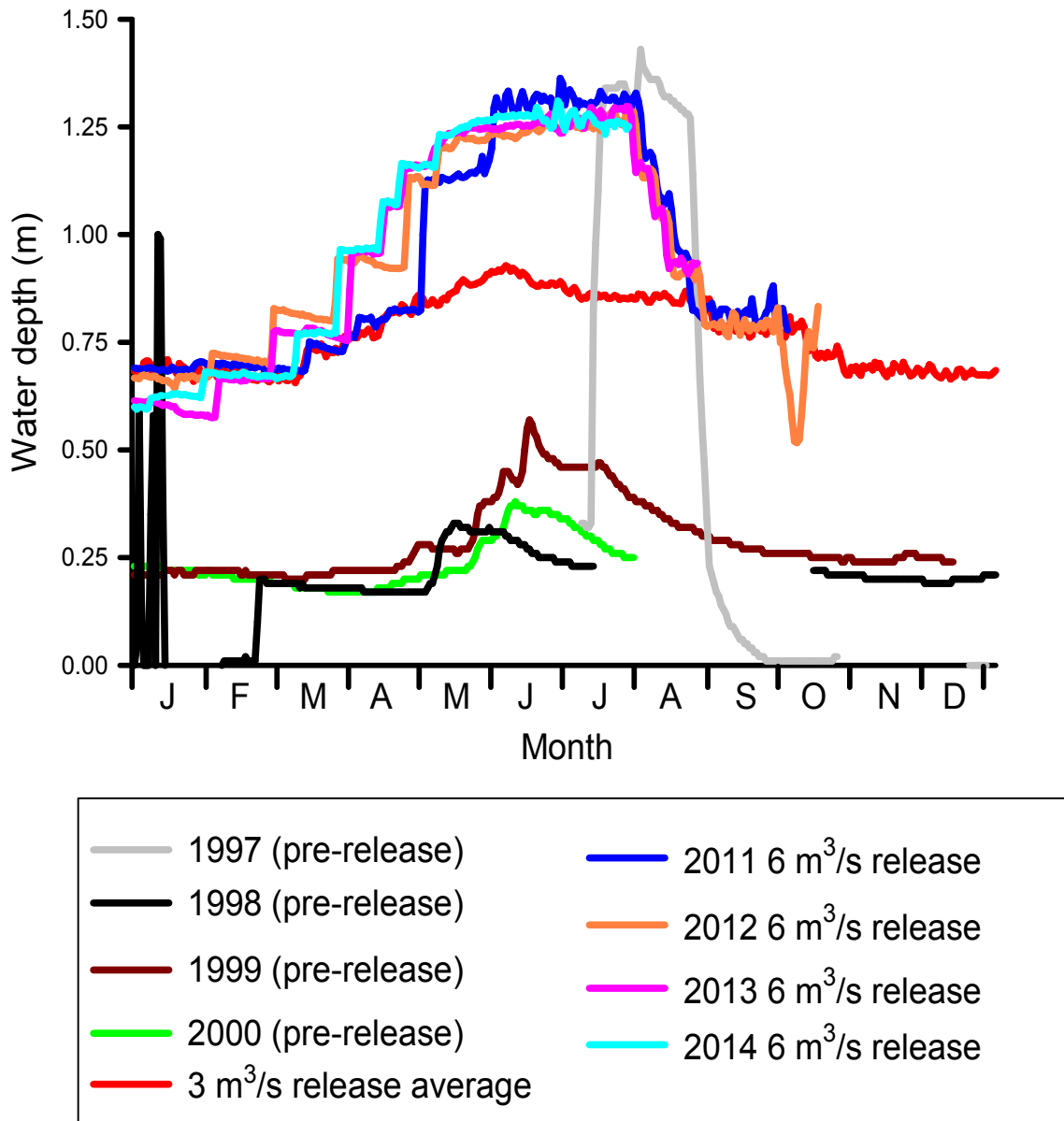
Figure 1 Map of the Survey Area. The bold line indicates the 15.9 km survey area from the Yalakom River confluence to the Terzaghi Dam. Faint lines indicate major creeks. The red dot denotes the location of the water measuring station and green lines indicate survey team starting locations.





Water conditions pre- and post-release were assessed at a measuring station at the upstream extent of the water prior to the August 2000 release (Figure 1). A water station just upstream of the Yalakom River confluence (not shown) had also been used in the past, but since it was moved 500m upstream in 2006, only water depths from the upstream station are discussed in this report. To be more specific, the water depth recorded at the measuring station is the water level above the transducer orifice mounted on the bank and it may or may not represent the deepest point near the station; for this report, we assume station data approximate water depth at that point in the river and focus more on the relative versus absolute values among flow regimes.

Flows were highly variable prior to the controlled release in August 2000 (Figure 2), especially in 1999, a year of higher than normal flows, and in 1997, when a spill occurred (Jeff Sneep, *unpubl. data*). Pre-release water levels generally increased in May and peaked in June. Post-release water depths emulate this general seasonal pattern but variation between and within years is minimal (VIA-SAT Data Systems Inc, *unpubl. data*). At peak flow, water depths at the station increased from approximately 0.3 m before the release to 0.9 m under the 3 m<sup>3</sup>/s release regime. Doubling the average release rate to 6 m<sup>3</sup>/s led to depths of approximately 1.3 m in June, a 150% increase over the 3 m<sup>3</sup>/s the flow regime and a 430% increase over pre-release depths.

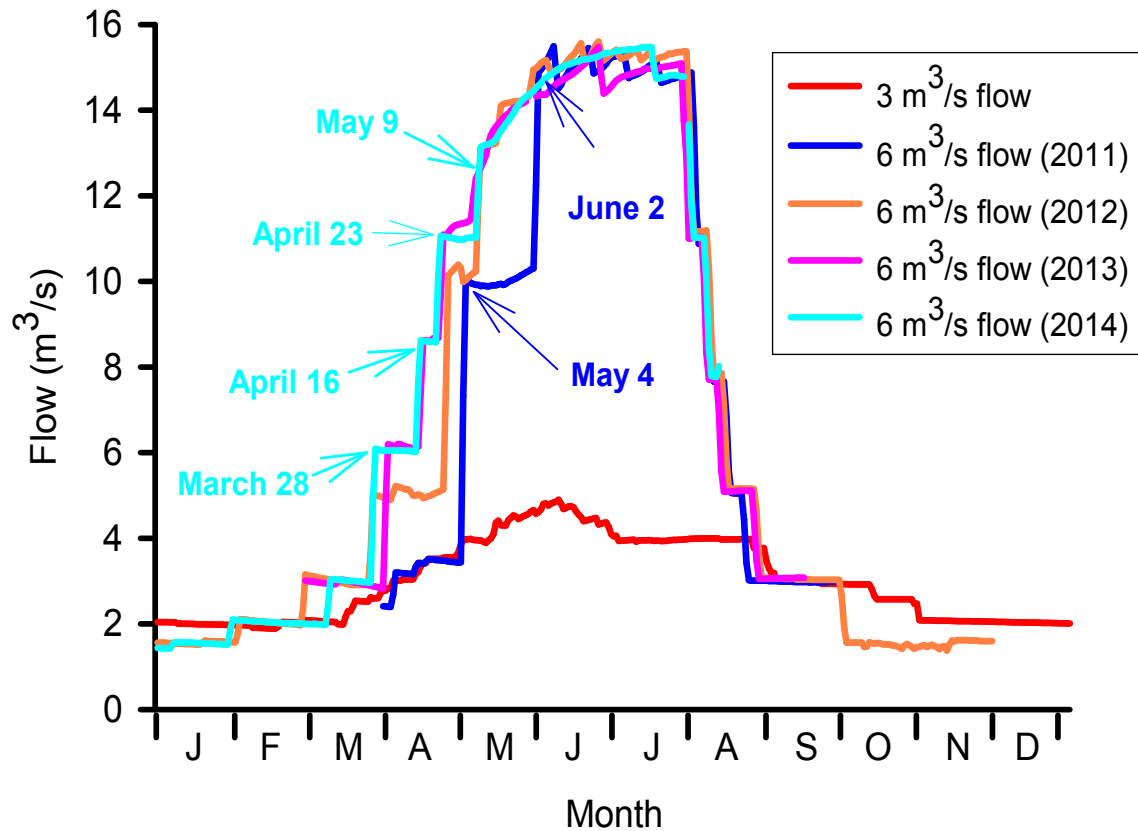


**Figure 2 Pre- and post-release water depths at the upstream water measuring station by Mission Creek. The 3 m<sup>3</sup>/s post-release average is from 2008-2010. Refer to Figure 1 for location of this station.**

Figure 3 compares the timing of the volume of water released at Terzaghi Dam between the two post-release flow regimes. In the 3 m<sup>3</sup>/s regime, the flow rate gradually increased for the spring and summer “freshet” beginning in mid-March until it peaked by mid-June, and then gradually declined to winter levels by late October. On May 3, 2011 the 6 m<sup>3</sup>/s flow began more abruptly, nearly doubling on the first day and increasing to 10 m<sup>3</sup>/s by the next. The second big increase occurred on June 2 and this peak was sustained until August 2 when flows rapidly declined to winter levels. Ramping up the release was done



more gradually after 2011, beginning in early March and increasing in stepwise increments to the peak flow by early June. Flows began to decline to winter levels in early August, after the riverine bird surveys had been completed. Flow levels in 2013 and 2014, in particular, were very similar.



**Figure 3** Flow release from the Terzaghi Dam. The red line is the average 3 m<sup>3</sup>/s flow from 2000 to 2004. The 6 m<sup>3</sup>/s flow regime began on May 3, 2011.

### 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. Teams carried binoculars to assist with identification. Survey techniques follow those proposed by the Resources Inventory Standards Committee (RISC 1997). When we spotted a bird we attempted to keep it in sight until we either saw it move downstream, we passed it as we moved upstream, or the bird flew out of sight upstream. If the bird flew out of sight upstream we used 2 approaches to avoid double counting. For American Dippers (*Cinclus mexicanus*) and Spotted Sandpipers (*Actitis maculatus*) with relatively short territories, we would not record a new sighting for a species if we saw a single bird within 100 m upstream of the last location; in other words, we would have to see 2 birds simultaneously to record 2



birds present within a 100 m section. For more mobile species like ducks, we would note the age and sex of birds that flew upstream and we would not count these birds again if we encountered them further upriver. We found birds generally landed within 1-2 km of their last location and, because they were restricted to the river, it was rare not to see the same groups again. In practice, most birds flew downstream after being disturbed a couple of times rather than flying upstream beyond the Terzaghi Dam.

In 2004 surveys began at Aniah Creek and covered the approximately 6 km below Terzaghi Dam; after 2004, surveys were extended downstream another 9.9 km to the Yalakom River. The first team began at the Yalakom River confluence and the second team began approximately 1.2 km downstream of Aniah Creek (Figure 1). Teams alternated routes among surveys to guard against observer bias. Visual coverage was complete except for portions of back-channels on the opposite side of four small islands (approximately 250 m). Initial bird locations were fixed by GPS (Garmin E-trex, accuracies ranged from  $\pm 7\text{m}$  to  $\pm 35\text{m}$ ) and later mapped 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 3:00 p.m. Pair surveys in 2014 were conducted on May 5 and May 20, and brood surveys were done on June 26, July 15 and 28. Documentation of all mammals, birds, and herptiles observed during the surveys are appended to this report (see Appendix 2). Some photographs of birds seen during the surveys are provided in Appendix 3.

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 from 2005 to 2014, including the extra 4.1 km of river upstream to Terzaghi Dam that we surveyed post-release. 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 this area. 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 an unusually high freshet (Wright and Walton 2001a).

In 2001 and 2002, Ken Wright surveyed the previously dry 4.1 km section from Mission Creek to Terzaghi Dam (Ken Wright, *unpubl. data*), and we repeated this survey beginning in 2004 (Walton and Heinrich 2004). We compared these earlier data to the same 4.1 km stretch surveyed in later years. Only data from similarly dated survey sessions were used.



#### 4.0 RESULTS

Numbers of major riverine species observed during the five surveys in 2014 are presented in Table 1. Detailed data and location coordinates for each observation are documented in Appendix 1. Other waterfowl species observed include 10 Buffleheads (*Bucephala albeola*), 8 Barrow’s Goldeneye (*Bucephala islandica*), 4 Lesser Scaup (*Aythya affinis*) and 3 Mallards (*Anas platyrhynchos*). These species were only seen on the May 5<sup>th</sup> survey, suggesting that they were observed while migrating to their breeding sites. We also saw 2 Ospreys (*Pandion haliaetus*) and 4 Bald Eagles (*Haliaeetus leucocephalus*), likely resident birds. For the second consecutive year, we observed Great Blue Heron (*Ardea herodias*) during the brood survey period. Five herons were seen on the second brood survey and 2 were spotted on the final survey, including 1 juvenile bird. Heron were seen at the Yalakom River confluence and at Eagle Pond, a wide shallow section approximately 1.5 km below Terzaghi Dam.

Numerically, Common Mergansers (*Mergus merganser*) were the most abundant species, followed by Spotted Sandpipers, Harlequin Ducks, American Dippers and Belted Kingfishers (*Ceryle alcyon*). More juvenile waterfowl were observed in 2014 compared to 2013, when no merganser young and only 2 Harlequin Duck young were seen by the end of July (Walton and Heinrich 2013).

**Table 1. Number of individuals of major riverine bird species observed on the 15.9 km survey route from the Yalakom River confluence to Terzaghi Dam in 2014. 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
<u>Pair</u>						
May 05	6	4	0	1	19	30
May 20	7	7	9	2	8	33
<u>Brood</u>						
June 26	7 (3)	11 (9)	11 (0)	1 (0)	8 (3)	38 (15)
July 15	5 (2)	9 (7)	17 (4)	1 (0)	9 (7)	41 (20)
July 28	3 (2)	13 (10)	10 (3)	3 (0)	15 (11)	44 (26)
<b>Total</b>	<b>28 (7)</b>	<b>44 (26)</b>	<b>47 (7)</b>	<b>8 (0)</b>	<b>59 (21)</b>	<b>186 (61)</b>



#### 4.1 Harlequin Duck Response

Adult Harlequin Duck numbers during pair surveys are variable and can be influenced by the presence of transient birds delaying migration to higher elevations in late springs. Despite this variability, adult Harlequin Duck numbers have been generally increased since the release in 2000, with a tendency for more Harlequin Ducks to be seen at the 6 m<sup>3</sup>/s flow regime than the 3 m<sup>3</sup>/s flow (Figure 4a). During the brood-raising period, the numbers of Harlequin Ducks increased almost linearly from pre-release levels until 2008, when overall numbers appeared to plateau at approximately 10 birds per survey, with the exception of a dip in numbers in 2013 (Figure 4b). This translates to approximately 2-4 Harlequin Duck females raising young on this section of river each year. Figure 4b also demonstrates how variable brood-rearing success is on this system, with complete brood failures in 1999, 2006 and 2011 for this ground-nesting species. Anecdotally, we observed several females with brood patches in brood-failure years, and we believe the higher numbers of adults observed in these years were likely caused by females from tributary creeks moving to the Bridge River after loss of their nests or young. Despite this annual variability, Harlequin Ducks have demonstrated they can successfully rear broods at both the 3 m<sup>3</sup>/s and 6 m<sup>3</sup>/s flow regimes.

Harlequin Ducks used the previously de-watered section upstream of Mission Creek in both the pair and brood periods, but numbers were highly variable among years along this 4.1 km stretch and there were no obvious differences between the 2 flow regimes (Figures 4c, d). 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 9.9 km of more substantial river downstream. Highly mobile, adult Harlequin Ducks appeared to use the sections upstream and downstream of Aniah Creek equally under the 3 m<sup>3</sup>/s flow regime (Figure 4e), but they showed a tendency to be found more often upstream of Aniah Creek than downstream under the 6 m<sup>3</sup>/s flow regime in all years except 2014 (Figure 4e). No patterns were obvious for juvenile Harlequin Ducks, although it is interesting to note that in 2012 and 2014, the years with highest brood production, juveniles were observed more often downstream of Aniah Creek (Figure 4f).

#### 4.2 American Dipper Response

From the Yalakom River confluence to Terzaghi Dam during pair and brood surveys, American Dipper numbers have not changed substantially since the release in 2000 (Figures 5a, b). However, 3 of the 4 years with lowest numbers have come under the 6 m<sup>3</sup>/s flow regime, suggesting that Dipper numbers may have declined slightly with the higher flow, although this may be an artifact of higher water levels and an inundated shoreline making spotting Dippers more difficult. Regardless, the decline, if real, is slight, and future scheduled surveys at the 6 m<sup>3</sup>/s flow should help detect any potential pattern. Juvenile production has remained relatively constant over all survey years for Dippers (Figure 5b), and Dippers are the only species of the 5 riverine species studied with at least 1 juvenile observed in all survey years.



Dippers used the previously de-watered section upstream of Mission Creek in both the pair and brood periods (Figures 5c, d), demonstrating that the controlled release has successfully increased the usable habitat for Dippers along the river. Juvenile Dippers were observed above Mission Creek in all survey years (Figure 5d). While overall numbers of Dippers on the river have not changed substantially, both adult and juvenile Dippers appear to have shifted their distribution upstream of Aniah Creek since the controlled release was initiated (Figures 5e,f). This shift seems to be especially strong for juvenile birds, suggesting that breeding success may be higher upstream of Aniah Creek after the release.

#### 4.3 Common Merganser Response

Like Dippers, the number of Common Mergansers observed during the pair and brood surveys has not changed substantially from the Yalakom River confluence to Terzaghi Dam since initiation of the controlled release (Figures 6a, b). The number of adults observed during pair surveys is particularly stable across all years, averaging approximately 13 birds per survey (Figure 6a). Juvenile production is highly variable (Figure 6b). For instance, for surveys at the end of July at the 6 m<sup>3</sup>/s flow, no young were observed on the river in 2 years, while 8 and 11 juvenile birds were observed in 2012 and 2014, respectively. Generally, in poor brood-rearing years few juvenile birds are seen during the first brood survey near the end of June, suggesting that most losses occur during nesting and incubation or soon after and not during the brood-raising period.

Common Mergansers used the newly watered habitat from Mission Creek to the Terzaghi Dam during both pair and brood surveys (Figures 6c, d). No differences were apparent in their use of this section between the two flow regimes, despite the unusually large number of juvenile birds observed in 2004. At the 3 m<sup>3</sup>/s flow, adult Common Mergansers were more often observed downstream of Aniah Creek than upstream (2 of 3 years), but this trend was reversed with initiation of the 6 m<sup>3</sup>/s flow (Figure 6e). With the highly variable number of juveniles observed among years, no pattern emerged for their distribution relative to Aniah Creek (Figure 6f).

#### 4.4 Spotted Sandpiper Response

Spotted Sandpipers are the last species to arrive on the river and are not usually seen until the final pair survey, so brood survey numbers are a better indicator for this species than birds seen in May (Figures 7a, b). Sandpipers seemed to benefit most from the 3 m<sup>3</sup>/s flow, more than doubling their numbers in 2005 on the section from the Terzaghi Dam to the Yalakom River confluence, and numbers remained elevated in 2006 and 2008 (Figure 7b). Since initiation of the 6 m<sup>3</sup>/s flow, however, Spotted Sandpiper numbers have declined or gone below pre-release levels (Figure 7b). Low numbers of observed juveniles (Figure 7b) should not, however, be considered an indicator of low productivity because of the difficulty in spotting camouflaged juveniles against a rocky shore.



Spotted Sandpipers used the newly watered habitat between Mission Creek and Terzaghi Dam after the controlled release. Numbers were generally higher under the 3 m<sup>3</sup>/s flow regime (Figure 7c, d). Compared to the section from the Yalakom River to Aniah Creek, adult sandpipers were more often found in the area upstream of Aniah Creek in all post-release survey years (Figure 7e). Despite this, juvenile sandpipers have only been observed upstream of Aniah Creek once since 2005 (Figure 7f), although this is likely an artifact.

#### 4.5 Belted Kingfishers

Belted Kingfishers, of all the 5 main riverine species studied, are the most difficult to observe during surveys. Most often they are seen briefly while flying from a tree perch along the river. As a result of this, juveniles are difficult to identify and observed numbers should be treated cautiously. Overall, however, Belted Kingfisher numbers appear to have declined since initiation of the controlled release in 2000, especially during brood surveys (Figures 8a, b). Only in 2 years were Kingfishers observed using the newly watered section upstream of Mission Creek during pair surveys but they were seen more often on this section during brood surveys (Figures 8c, d). In most years, adult Belted Kingfishers were seen more often downstream of Aniah Creek (Figure 8e); no juvenile kingfishers were identified after 2004 when survey data downstream of Aniah Creek were available (Figure 8f).



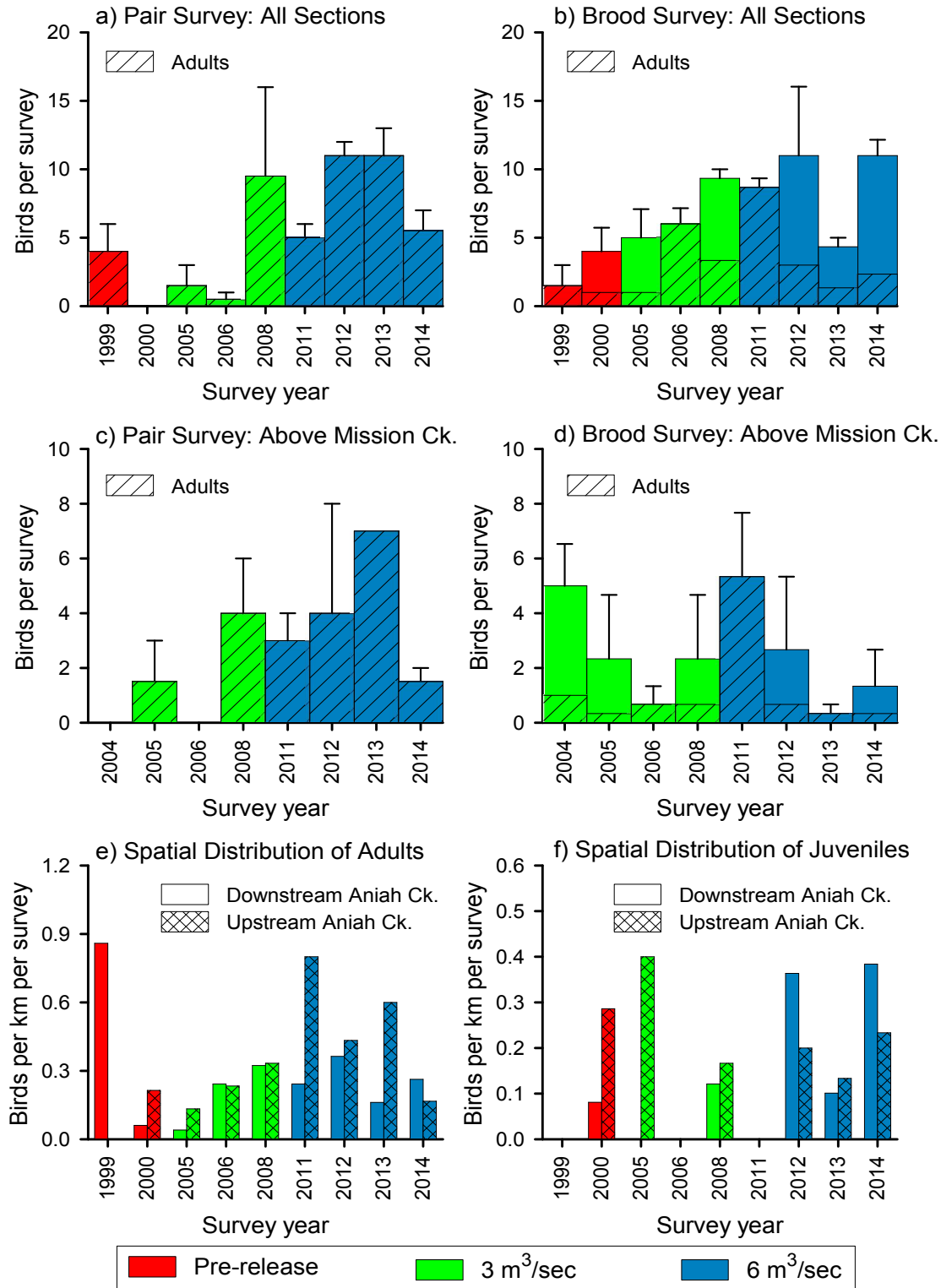


Figure 4. Average number of Harlequin Ducks per survey ( $\pm 1$  SE) from the Yalakom River confluence to Terzaghi Dam (4a,b) and upstream of Mission Creek (4c,d) for pair and brood surveys. Number of adult (4e) and juvenile (4f) Harlequin Ducks observed per km per survey above and below Aniah Creek (totaled over all 5 surveys).

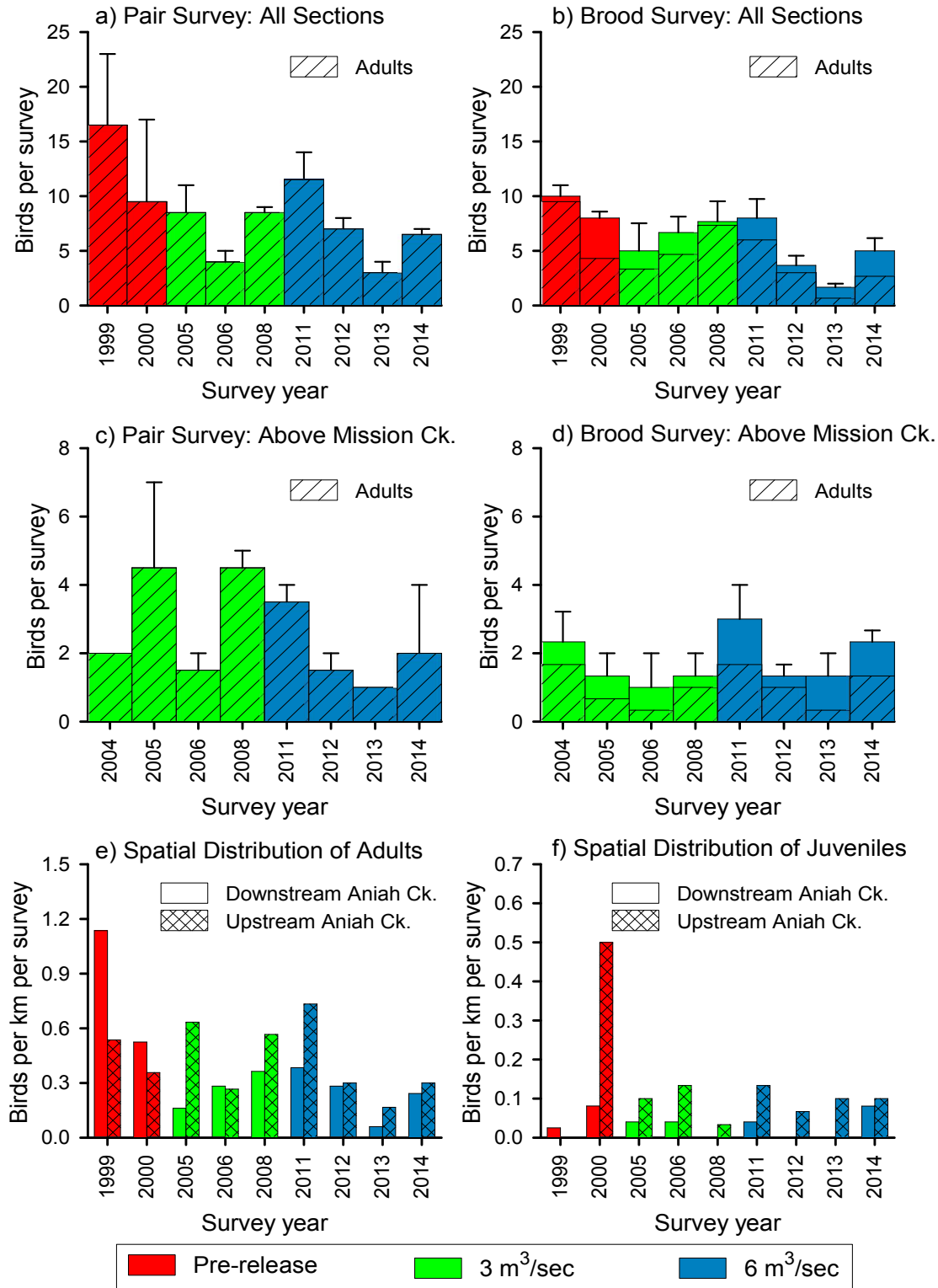


Figure 5. Average number of American Dippers per survey ( $\pm 1$  SE) from the Yalakom River confluence to Terzaghi Dam (5a,b) and upstream of Mission Creek (5c,d) for pair and brood surveys. Number of adult (5e) and juvenile (5f) American Dippers observed per km per survey above and below Aniah Creek (totaled over all 5 surveys).

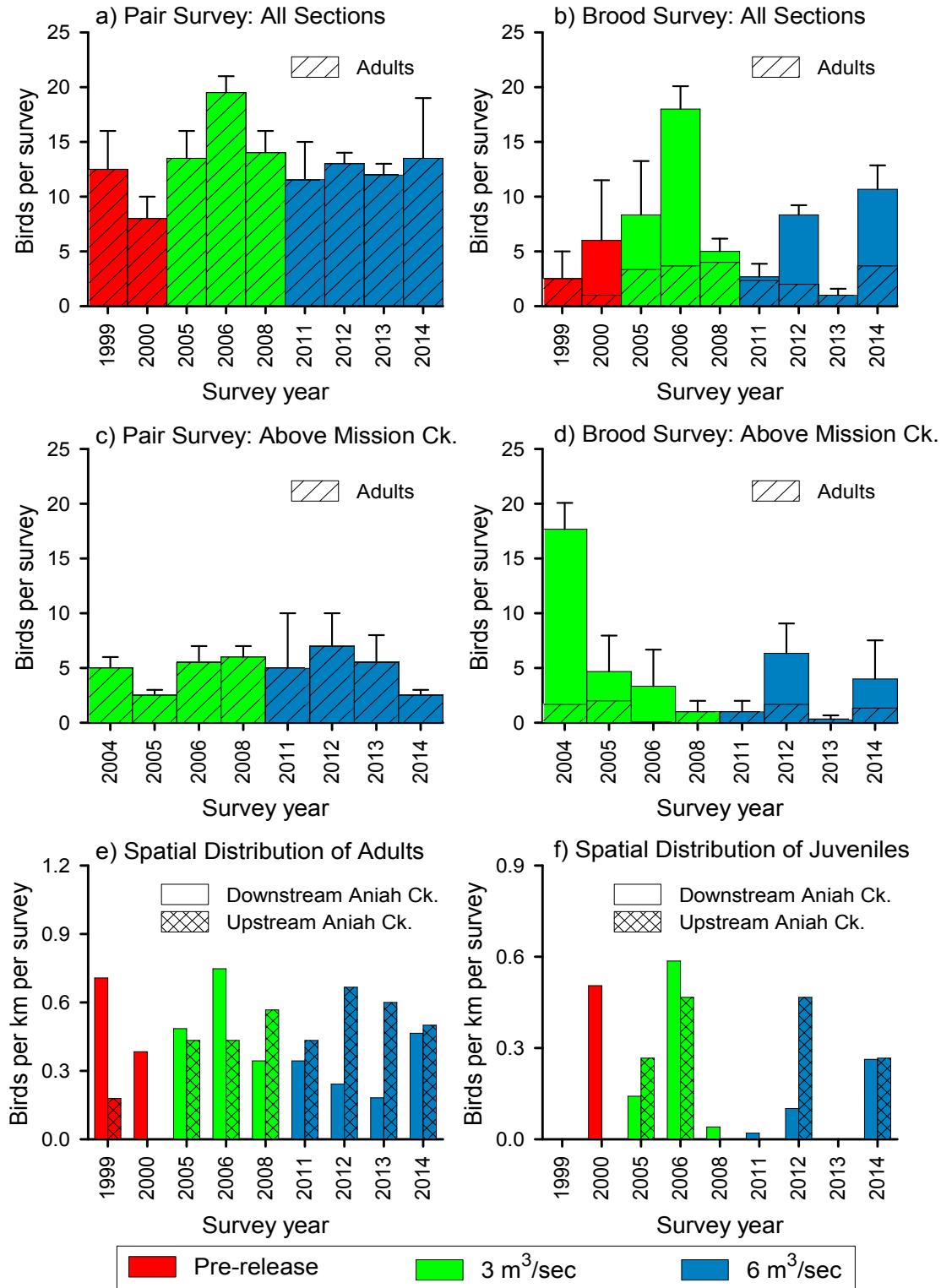


Figure 6. Average number of Common Mergansers per survey ( $\pm 1$  SE) from the Yalakom River confluence to Terzaghi Dam (6a,b) and upstream of Mission Creek (6c,d) for pair and brood surveys. Number of adult (6e) and juvenile (6f) Common Mergansers observed per km per survey above and below Aniah Creek (totaled over all 5 surveys).

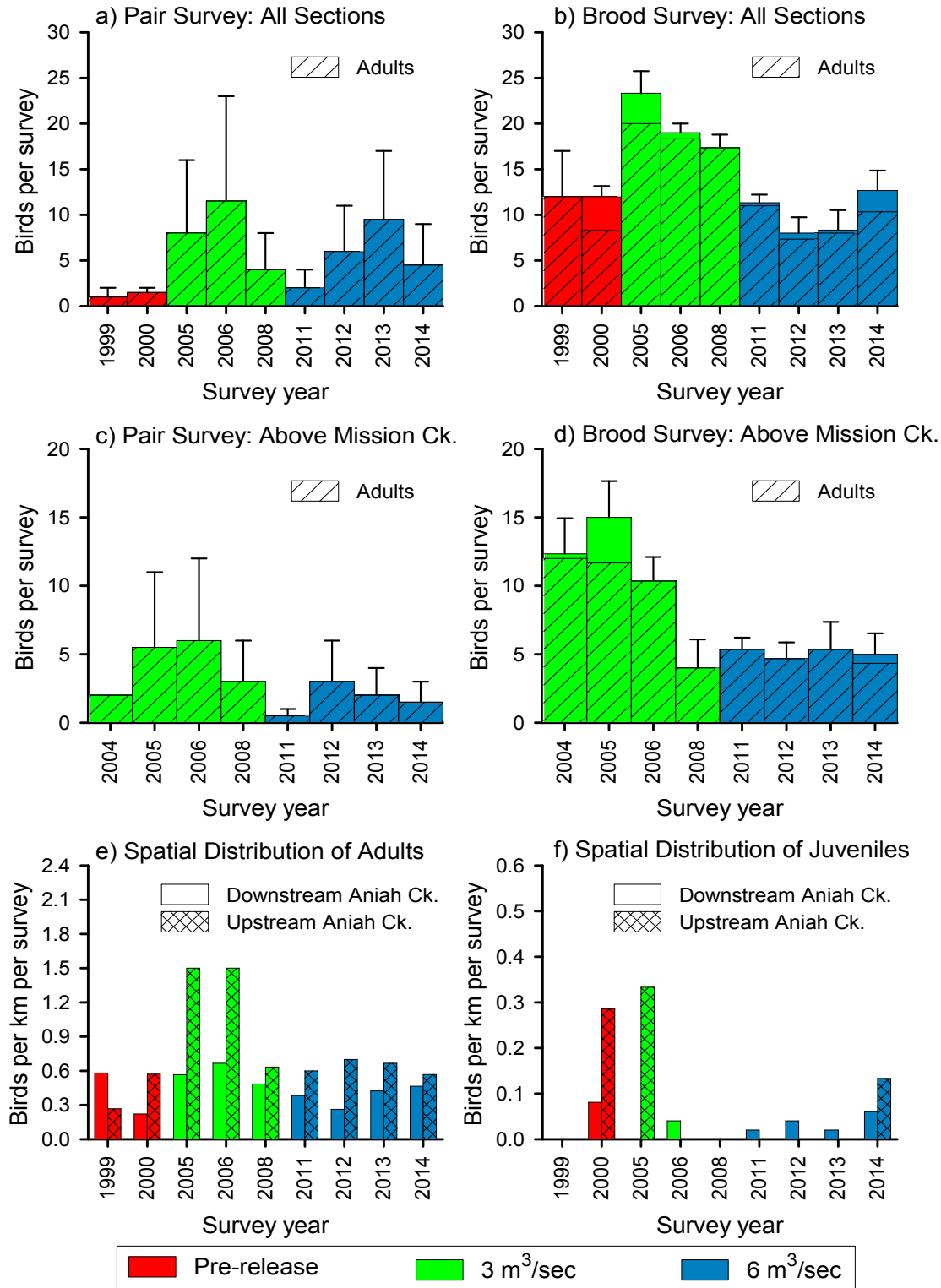


Figure 7. Average number of Spotted Sandpipers per survey ( $\pm 1$  SE) from the Yalakom River confluence to Terzaghi Dam (7a,b) and upstream of Mission Creek (7c,d) for pair and brood surveys. Number of adult (7e) and juvenile (7f) Spotted Sandpipers observed per km per survey above and below Aniah Creek (totaled over all 5 surveys).

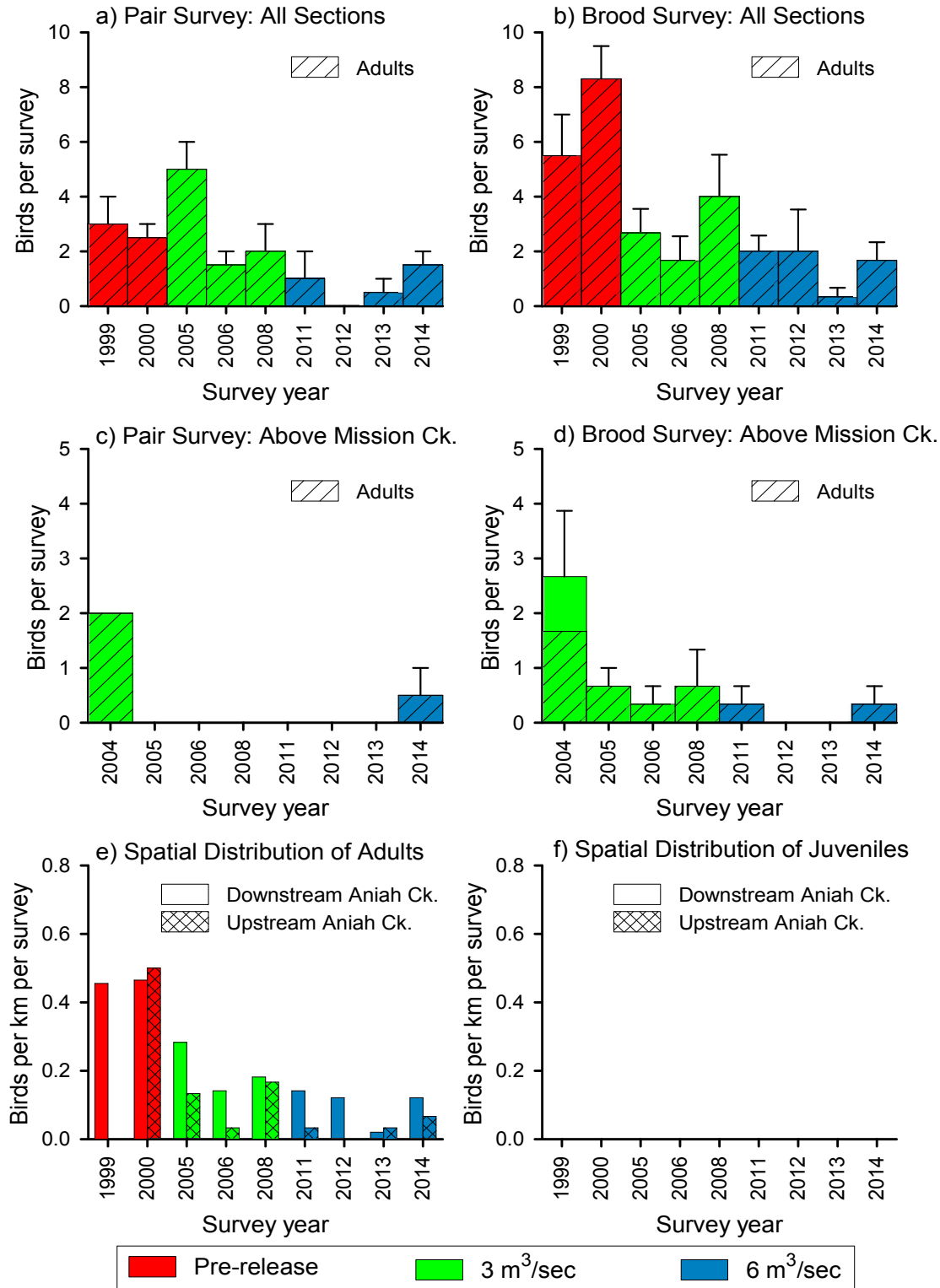


Figure 8. Average number of Belted Kingfishers per survey ( $\pm 1$  SE) from the Yalakom River confluence to Terzaghi Dam (8a,b) and upstream of Mission Creek (8c,d) for pair and brood surveys. Number of adult (8e) and juvenile (8f) Belted Kingfishers observed per km per survey above and below Aniah Creek (totaled over all 5 surveys).



## 5.0 DISCUSSION

All five major riverine bird species used the 15.9 km section below Terzaghi Dam to the Yalakom River confluence for at least part of their breeding stages. One Spotted Sandpiper nest with eggs was observed during the 2014 surveys (Appendix 3) but, given the difficulty in spotting camouflaged nests, more nests were likely present. A Dipper nest was also discovered on a small cliff face upstream of Mission Creek (Appendix 3), but it was uncertain if the nest was from the current year. Although Harlequin Duck nests were found on the Bridge River after the release in 2000 (Ken Wright, pers. comm.), 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, probably nested along our survey route where trees with appropriate cavities were available, and their numbers may be limited by this availability. Anecdotally, beaver numbers appear to have increased with higher water flows along the Bridge River, and beavers may threaten the availability of some of the larger cottonwood and trembling aspen favoured by cavity-nesting birds (Bunnell 2013). We recommend that beaver use of this stretch of river should be evaluated for their potential effect on the availability of large deciduous trees; an increase in beavers may be an unintended consequence of the controlled release program.

Surveys in 1999 and 2000 covered approximately 11.8 km, from the Yalakom River confluence to the upstream extent of the water just above Mission Creek. The controlled release of August 2000 created 4.1 km of new habitat for riverine birds. Considering only the five most common riverine species, the cumulative count observed in pre-release years averaged 137.5 ( $\pm 6.5$  SE) riverine birds (note that a third bird survey was not done in 1999). At the 3 m<sup>3</sup>/s flow, this number increased to 196.3 ( $\pm 9.7$  SE) birds annually, with much of the increase driven by the spike in Spotted Sandpiper numbers. At the 6 m<sup>3</sup>/s flow, the annual cumulative number of birds settled approximately halfway between the pre-release and moderate release values, at 157.50 ( $\pm 14.6$  SE) birds. Part of this reduction at the highest flow regime may have been caused by flooding in the riparian vegetation making it more difficult to spot riverine birds, but much of the gravel and rocky shoreline that Spotted Sandpipers rely upon was flooded with the 6 m<sup>3</sup>/s flow, likely reducing their habitat. Whether this is a temporary or a permanent reduction remains to be seen.

Until 2011, Spotted Sandpipers had benefited most from the new habitat created by the controlled release, more than doubling their pre-release numbers; since the initiation of the 6 m<sup>3</sup>/s release, however, their numbers have declined to pre-release levels. Harlequin Duck numbers, particularly during the brood surveys, have generally increased since the release began, although much of this increase comes from the successful production of juvenile birds. American Dipper and Common Merganser numbers have essentially remained unchanged since the release but both species appear to have shifted their distributions upriver. Overall, despite the initial surge by Spotted Sandpipers under the 3



m<sup>3</sup>/s flow regime, only Harlequin Ducks have shown any increase in numbers after the controlled release, and most of this has been driven by brood production.

As a caveat, numbers of juvenile Spotted Sandpipers, Belted Kingfishers and, to some extent, American Dippers, are likely underestimated in the brood surveys. These birds were often observed very briefly, not allowing enough time for positive age identification. Belted Kingfishers, in particular, were usually observed in flight and their juvenile count will be under-represented. As well, Spotted Sandpipers are the last migratory species to arrive in this system, typically between the first and second pair surveys, so numbers of Spotted Sandpipers counted during the pair period will also be underestimated.

Comparing absolute numbers of riverine birds among years should be done carefully, because extrinsic 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). Again in 2006 and 2011, Harlequin Ducks failed to raise broods (Walton and Heinrich 2006; Heinrich 2008 and Walton and Heinrich 2011) and Common Merganser young were not observed in 2013. Only with repeated monitoring can the effects of aberrant years be removed and general trends detected.

Despite this variability, the timing of implementing the 6 m<sup>3</sup>/s flow regime should be considered carefully. Harlequin Ducks, for instance, typically build their nests on the ground not far from the water's edge. Pairs of Harlequin Ducks usually arrive in late April to early May and nests are initiated from early May to early June (Wright and Goudie, 2000). In 1999 we observed 2 female Harlequin Ducks incubating on the Yalakom River on May 18 and 19, respectively (Wright and Walton, 2001a). In 2011 under the new 6 m<sup>3</sup>/s regime, flow was increased significantly in early May and again in early June, likely after many of the Harlequin Duck nests had been established, and this may have resulted in nest flooding. Sudden higher flows can also increase the turbidity of the water, making it more difficult for young birds to find food. This may partly explain why Common Mergansers, a tree nesting species, also had poor brood success in 2011. Since 2011 the increased flow has begun earlier, and we believe this has contributed to better brood production. When possible, we recommend that the largest increase in flow should be begun by late April, prior to nest initiation, and that the flow increase should be done in a more gradual manner to minimize the effects on riverine birds during the nesting and brood-rearing periods.

## 6.0 SUMMARY

Surveys were conducted to test the hypothesis that the population increase of riverine birds in the Lower Bridge River corridor is directly related to the instream flow release from Terzaghi Dam. Table 2 summarizes findings for the 5 main riverine species. As Table 2 indicates, only Harlequin Ducks have responded positively to both flow regimes, although Spotted Sandpiper numbers did increase during the 3 m<sup>3</sup>/s flow regime. The controlled release, however, has had positive effects on riverine bird breeding habitat in



the 4.1 km most severely affected by dam construction, with all five major riverine bird species using this section. Other responses have been more subtle, with Dippers and Common Mergansers shifting their distributions upstream, while Belted Kingfishers appeared to use the downstream section more often since the release.

**Table 2. Summary of responses of the 5 main riverine species to the 3 m<sup>3</sup>/s and 6 m<sup>3</sup>/s controlled releases.**

Species	Increase in Numbers From Yalakom River to Terzaghi Dam?		Newly Watered 4.1 km below Terzaghi Dam Used by Adults and Juveniles?		Distribution Changes Upstream or Downstream?	
	3 m <sup>3</sup> /s	6 m <sup>3</sup> /s	3 m <sup>3</sup> /s	6 m <sup>3</sup> /s	3 m <sup>3</sup> /s	6 m <sup>3</sup> /s
Harlequin Duck	Yes	Yes	Yes	Yes	None	~ Increase upstream
American Dipper	No change	No change or possibly lower	Yes	Yes	Increase upstream	Increase upstream
Common Merganser	No change	No change	Yes	Yes	~ Increase downstream	Increase upstream
Spotted Sandpipers	Yes	No change	Yes	Yes	Increase upstream	Increase upstream
Belted Kingfishers	No change or lower	No change or lower	Yes	Yes	Increase downstream	Increase downstream

As part of the Water Use Planning process, more surveys are scheduled for 2016, 2018 and 2020. While high annual variability precludes identifying small changes in riverine bird densities among flow regimes, this study can identify important “threshold” changes such as the potential inability of a species to raise broods over several seasons under the new flow regime. Without this monitoring, nothing would be known of the status of these birds.

## 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. Janice Doane (BCRP) provided support and encouragement during the early stages of this project. This support and encouragement was continued from 2006 to 2008 by Scott Allen (BCRP) and Andrew MacDonald (BCRP). In 2011 Dave Hunter incorporated the Riverine Bird Monitoring into the Bridge River Water Use Planning Monitoring program. Jesse Brown (BC Hydro) provided information about the status of the controlled release schedule. Many thanks to Jeff Snee for providing access to the BCRP database and for answering many questions about the data and methodology. Also thanks to Alexis Hall (BC Hydro), Dorian Turner (BC Hydro) and Paul Rocchetti from VIA-SAT Data Systems for providing recent water





station data. All field work in 2014 was conducted by Ralph Heinrich, Russ Walton, John Terry, Daniel Peter, Keith Durban, Andrew Joseph, John Redan and Cory Laroche. We would especially like to thank Gerald Michel from Xwisten for arranging for field technicians. Kim North (Splitrock Environmental Ltd) also provided St'át'imc technicians when needed. Funding for this study was provided by BC Hydro's Bridge River Water Use Planning Monitoring Program.



## 8.0 REFERENCES

- Alsop, J.A. III. 2002. *Birds of Canada*. Dorling Kindersley Limited. Toronto ON. Canada. 687pp.
- Bunnell, F.L. 2013. Sustaining cavity-nesting species: patterns of cavity use and implications to forest management. *ISRN Forestry* 2013: 1-33.
- Campbell R.W., A.K. Dawe, I. McTaggart-Cowan, J. Cooper, G. Kaiser, M.C. McNall and G.E. John Smith. 1990a. *Birds of British Columbia, Volume 1 of 4, Introduction, Loons through waterfowl*. UBC Press with Environment Canada (Canadian Wildlife Service) and British Columbia Ministry of Environment, Lands and Parks. University of British Columbia, Vancouver, BC. 514pp.
- Campbell R.W., A.K. Dawe, I. McTaggart-Cowan, J. Cooper, G. Kaiser, M.C. McNall and G.E. John Smith. 1990b. *Birds of British Columbia, Volume 2 of 4, Non-passerines, Diurnal Birds of Prey Through Woodpeckers*. UBC Press with Environment Canada (Canadian Wildlife Service) and British Columbia Ministry of Environment, Lands and Parks. University of British Columbia, Vancouver, BC. 635pp.
- Campbell R.W., A.K. Dawe, I. McTaggart-Cowan, J. Cooper, G. Kaiser, M.C. McNall and G.E. John Smith. 1997. *Birds of British Columbia, Volume 3 of 4, Passerines, Flycatchers Through Vireos*. UBC Press with Environment Canada (Canadian Wildlife Service) and British Columbia Ministry of Environment, Lands and Parks. University of British Columbia, Vancouver, BC. 693pp.
- Eder T. and D. Pattie. 2001. *Mammals of British Columbia*. Lone Pine Publishing. Vancouver, BC. Canada. 296pp.
- Ehrlich P. R., D.S. Dobkin and D. Wheye. 1988. *The Birder's Handbook: A field Guide to the Natural History of North American Birds*. Simon and Schuster Inc. New York, New York. 785pp.
- Gregory, P.T. and R.W. Campbell. 1984. *The Reptiles of British Columbia*. British Columbia Provincial Museum Handbook. Victoria, B.C.
- Heinrich, R. 2008. *Riverine bird response to habitat restoration on the Lower Bridge River: 2008 Report*. Report to Bridge Coastal Restoration Program (BC Hydro).
- Meidinger, D. and J. Pojar. 1991. *Ecosystems of British Columbia*. B.C. Ministry of Forests, Victoria, B.C. Special Report Series 6:330pp.



- Resource Inventory Committee. 1997. Measuring components of British Columbia's biodiversity: Riverine Bird Inventory Manual. Wildlife Branch, Victoria, British Columbia.
- St. John A. 2002. Reptiles of the Northwest. British Columbia to California. Lone Pine Publishing. Vancouver, BC. Canada. 272pp.
- Walton, R. and R. Heinrich. 2004. Monitoring the response of riverine birds on the Bridge River to the Terzaghi Dam flow release: 2004 Report. Report to Bridge Coastal Restoration Program (BC Hydro).
- Walton, R. and R. Heinrich. 2005. Riverine bird response to habitat restoration on the Lower Bridge River: 2005 Report. Report to Bridge Coastal Restoration Program (BC Hydro).
- Walton, R. and R. Heinrich. 2006. Riverine bird response to habitat restoration on the Lower Bridge River: 2006 Report. Report to Bridge Coastal Restoration Program (BC Hydro).
- Walton, R. and R. Heinrich. 2011. Riverine bird response to habitat restoration on the Lower Bridge River: 2011 Report. Report to Bridge Coastal Restoration Program (BC Hydro).
- Walton, R. and R. Heinrich. 2012. Riverine bird response to habitat restoration on the Lower Bridge River: 2012 Report. Report to Bridge River Water Use Planning Monitoring Program (BC Hydro).
- Walton, R. and R. Heinrich. 2013. Riverine bird response to habitat restoration on the Lower Bridge River: 2013 Report. Report to Bridge River Water Use Planning Monitoring Program (BC Hydro).
- Wright, K.G. 1998. A Preliminary survey of Harlequin Duck broods and other riverine birds on the Bridge and Yalakom Rivers, British Columbia. Harlequin Conservation Society report to BC Hydro Power Supply Environmental Services, Burnaby, British Columbia.
- Wright, K.G. 2004. Monitoring of Harlequin Ducks and other riverine birds on the Bridge and Seton Rivers: 2001 Report. Report to BC Hydro Power Supply Environmental Services, Burnaby, British Columbia.
- Wright, K.G., and R.I. Goudie. 2000. Harlequin Duck (*Histrionicus histrionicus*) ecology and hydroelectric operations on the Bridge River, British Columbia: 1998 Report. Harlequin Conservation Society report to BC Hydro Power Supply Environmental Services, Burnaby, British Columbia.



Wright, K.G., and R.A. Walton. 2001a. Habitat use, nesting ecology and distribution of Harlequin Ducks on the Bridge River System, British Columbia: 1999 Report. Harlequin Conservation Society Report to BC Hydro.

Wright, K.G., and R.A. Walton. 2001b. Harlequin Duck distribution, abundance and nesting on the Bridge and Seton River Systems, British Columbia: 2000 Report. Harlequin Conservation Society Report to BC Hydro.



**APPENDIX 1**

**Appendix 1 Detailed riverine bird observations from the 2014 survey.**

Coordinates are UTM Zone 10, NAD 83. Species codes: AMDI = American Dipper; BAEA = Bald Eagle; BAGO = Barrow’s Goldeneye; BEKI = Belted Kingfisher; BUFF = Bufflehead; COME = Common Merganser; GBHE = Great Blue Heron; HADU = Harlequin Duck; LESC = Lesser Scaup; MALL = Mallard; OSPR = Osprey; SPSA = Spotted Sandpiper.

Date	Survey	Spp	M	F	Unknown Sex	Adult Group Size	Brood Size	Easting	Northing
05-May-14	1st Pair	COME	1	3	0	4	0	558191	5634965
05-May-14	1st Pair	BAGO	1	3	0	4	0	558179	5634965
05-May-14	1st Pair	BAGO	0	4	0	4	0	558149	5634961
05-May-14	1st Pair	COME	0	1	0	1	0	558108	5634953
05-May-14	1st Pair	MALL	2	1	0	3	0	555975	5633060
05-May-14	1st Pair	AMDI	0	0	1	1	0	555924	5632886
05-May-14	1st Pair	AMDI	0	0	1	1	0	555848	5632798
05-May-14	1st Pair	BEKI	0	0	1	1	0	555768	5632557
05-May-14	1st Pair	AMDI	0	0	1	1	0	555739	5632402
05-May-14	1st Pair	AMDI	0	0	1	1	0	555844	5632161
05-May-14	1st Pair	COME	2	0	0	2	0	555844	5632163
05-May-14	1st Pair	COME	1	0	0	1	0	556340	5631849
05-May-14	1st Pair	COME	2	0	0	2	0	556480	5631521
05-May-14	1st Pair	HADU	1	1	0	2	0	556529	5631130
05-May-14	1st Pair	AMDI	0	0	1	1	0	556764	5630492
05-May-14	1st Pair	BUFF	0	3	0	3	0	558136	5629749
05-May-14	1st Pair	COME	2	1	0	3	0	555041	5626475
05-May-14	1st Pair	AMDI	0	0	1	1	0	558228	5629070
05-May-14	1st Pair	COME	1	0	0	1	0	557934	5628550
05-May-14	1st Pair	COME	3	0	0	3	0	557934	5628551
05-May-14	1st Pair	COME	2	0	0	2	0	557942	5627887
05-May-14	1st Pair	OSPR	0	0	1	1	0	558002	5627790
05-May-14	1st Pair	HADU	1	1	0	2	0	557965	5626929
05-May-14	1st Pair	BAEA	0	0	1	1	0	557076	5627008
05-May-14	1st Pair	BUFF	1	4	0	5	0	556257	5626442
05-May-14	1st Pair	LESC	0	4	0	4	0	556254	5626443
05-May-14	1st Pair	BUFF	1	1	0	2	0	556187	5626382
20-May-14	2nd Pair	HADU	0	1	0	1	0	558156	5628903
20-May-14	2nd Pair	AMDI	0	0	1	1	0	558154	5628897
20-May-14	2nd Pair	HADU	0	2	0	2	0	558022	5628623
20-May-14	2nd Pair	AMDI	0	0	1	1	0	557998	5628601
20-May-14	2nd Pair	AMDI	1	1	0	2	0	558114	5626942
20-May-14	2nd Pair	BEKI	0	0	1	1	0	558113	5626942
20-May-14	2nd Pair	HADU	1	0	0	1	0	556689	5626846
20-May-14	2nd Pair	SPSA	0	0	1	1	0	556688	5626845



Bridge River Riverine Bird Surveys 2014

Date	Survey	Spp	M	F	Unknown Sex	Adult Group Size	Brood Size	Easting	Northing
20-May-14	2nd Pair	BAEA	0	0	1	1	0	556649	5626823
20-May-14	2nd Pair	COME	0	2	0	2	0	556169	5626380
20-May-14	2nd Pair	SPSA	0	0	1	1	0	556198	5626388
20-May-14	2nd Pair	AMDI	0	0	1	1	0	556182	5626384
20-May-14	2nd Pair	SPSA	0	0	1	1	0	556067	5626358
20-May-14	2nd Pair	AMDI	0	0	1	1	0	555019	5626474
20-May-14	2nd Pair	HADU	2	0	0	2	0	558209	5634964
20-May-14	2nd Pair	HADU	0	1	0	1	0	557825	5634832
20-May-14	2nd Pair	COME	6	0	0	6	0	557820	5634832
20-May-14	2nd Pair	SPSA	0	0	1	1	0	557820	5634829
20-May-14	2nd Pair	SPSA	0	0	1	1	0	557715	5634747
20-May-14	2nd Pair	SPSA	0	0	1	1	0	557660	5634737
20-May-14	2nd Pair	BAEA	0	0	1	1	0	557271	5634596
20-May-14	2nd Pair	AMDI	0	0	1	1	0	557137	5634537
20-May-14	2nd Pair	SPSA	0	0	1	1	0	556758	5634337
20-May-14	2nd Pair	SPSA	0	0	1	1	0	556557	5634016
20-May-14	2nd Pair	BEKI	0	0	1	1	0	556101	5633266
20-May-14	2nd Pair	SPSA	0	0	1	1	0	556481	5631514
26-Jun-14	1st Brood	BAEA	0	0	1	1	0	557787	5634815
26-Jun-14	1st Brood	SPSA	0	0	1	1	0	557722	5634759
26-Jun-14	1st Brood	HADU	0	1	0	1	3	557517	5634687
26-Jun-14	1st Brood	SPSA	1	1	0	2	0	557403	5634641
26-Jun-14	1st Brood	COME	1	1	0	2	0	557257	5634585
26-Jun-14	1st Brood	COME	0	1	0	1	3	557227	5634575
26-Jun-14	1st Brood	COME	0	1	0	1	0	556548	5633988
26-Jun-14	1st Brood	BEKI	0	0	1	1	0	556102	5633269
26-Jun-14	1st Brood	SPSA	0	0	1	1	0	555758	5632568
26-Jun-14	1st Brood	SPSA	1	1	0	2	0	555741	5632485
26-Jun-14	1st Brood	AMDI	0	0	0	0	1	555765	5632517
26-Jun-14	1st Brood	HADU	0	1	0	1	6	555742	5632405
26-Jun-14	1st Brood	SPSA	1	1	0	2	0	556382	5631312
26-Jun-14	1st Brood	AMDI	0	0	1	1	0	556438	5631201
26-Jun-14	1st Brood	AMDI	0	0	0	0	1	558168	5628919
26-Jun-14	1st Brood	AMDI	0	0	1	1	0	558093	5628728
26-Jun-14	1st Brood	AMDI	0	0	1	1	0	558168	5626959
26-Jun-14	1st Brood	SPSA	0	0	1	1	0	557305	5627082
26-Jun-14	1st Brood	AMDI	0	0	1	1	1	556821	5626932
26-Jun-14	1st Brood	SPSA	0	0	1	1	0	556823	5626932
26-Jun-14	1st Brood	COME	0	1	0	1	0	556280	5626508
26-Jun-14	1st Brood	SPSA	0	0	1	1	0	556155	5626369
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	558208	5629286
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	558110	5628809
15-Jul-14	2nd Brood	AMDI	0	0	1	1	1	558094	5628741
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	557848	5628460
15-Jul-14	2nd Brood	BEKI	0	0	1	1	0	558017	5626932
15-Jul-14	2nd Brood	AMDI	0	0	0	0	1	557847	5626910



Bridge River Riverine Bird Surveys 2014

Date	Survey	Spp	M	F	Unknown Sex	Adult Group Size	Brood Size	Easting	Northing
15-Jul-14	2nd Brood	GBHE	0	0	5	5	0	556284	5626516
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	556159	5626368
15-Jul-14	2nd Brood	SPSA	1	1	0	2	2	556035	5626353
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	555865	5626290
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	555452	5626326
15-Jul-14	2nd Brood	AMDI	0	0	1	1	0	555414	5626337
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	555031	5626488
15-Jul-14	2nd Brood	COME	0	1	0	1	3	557984	5634909
15-Jul-14	2nd Brood	SPSA	0	0	1	1	2	557705	5634751
15-Jul-14	2nd Brood	HADU	0	1	0	1	3	557629	5634723
15-Jul-14	2nd Brood	SPSA	0	0	1	1	0	557410	5634646
15-Jul-14	2nd Brood	HADU	0	1	0	1	4	556066	5633234
15-Jul-14	2nd Brood	AMDI	0	0	1	1	0	555758	5632494
15-Jul-14	2nd Brood	COME	0	1	0	1	4	555739	5632406
15-Jul-14	2nd Brood	SPSA	0	0	2	2	0	556479	5631511
28-Jul-14	3rd Brood	GBHE	0	0	1	1	0	558232	5634962
28-Jul-14	3rd Brood	BEKI	0	0	1	1	0	557598	5634706
28-Jul-14	3rd Brood	BEKI	1	1	0	2	0	557210	5634566
28-Jul-14	3rd Brood	COME	0	1	0	1	3	556678	5634260
28-Jul-14	3rd Brood	HADU	0	1	0	1	3	556195	5633363
28-Jul-14	3rd Brood	SPSA	0	0	1	1	0	555955	5632978
28-Jul-14	3rd Brood	SPSA	0	0	1	1	0	555743	5632478
28-Jul-14	3rd Brood	SPSA	0	0	0	0	1	555802	5632244
28-Jul-14	3rd Brood	OSPR	0	0	1	1	0	556168	5631974
28-Jul-14	3rd Brood	SPSA	0	0	1	1	0	556420	5631718
28-Jul-14	3rd Brood	AMDI	0	0	0	0	1	556530	5631131
28-Jul-14	3rd Brood	HADU	0	1	0	1	4	557888	5628504
28-Jul-14	3rd Brood	SPSA	0	0	0	0	1	557848	5628459
28-Jul-14	3rd Brood	SPSA	0	0	0	0	1	558179	5627153
28-Jul-14	3rd Brood	COME	0	1	0	1	0	558192	5627025
28-Jul-14	3rd Brood	HADU	0	1	0	1	3	558054	5626934
28-Jul-14	3rd Brood	SPSA	0	0	1	1	0	558055	5626934
28-Jul-14	3rd Brood	COME	0	1	0	1	4	557777	5626905
28-Jul-14	3rd Brood	AMDI	0	0	1	1	0	556735	5626929
28-Jul-14	3rd Brood	GBHE	0	0	1	1	1	556700	5626887
28-Jul-14	3rd Brood	SPSA	0	0	1	1	0	556628	5626822
28-Jul-14	3rd Brood	COME	0	1	0	1	4	556518	5626834
28-Jul-14	3rd Brood	AMDI	0	0	0	0	1	556336	5626720
28-Jul-14	3rd Brood	SPSA	0	0	1	1	0	556275	5626543
28-Jul-14	3rd Brood	SPSA	0	0	1	1	0	556144	5626368



## APPENDIX 2

### Appendix 2 List of wildlife species encountered during the Riverine Bird Surveys conducted between May 6<sup>th</sup> and July 28<sup>th</sup>, 2014.

#### Mammals (Eder and Pattie 2001)

Common Name	Latin Name	Provincial List	COSEWIC <sup>1</sup>	Identified Wildlife	Bridge R. Status
Black Bear	<i>Ursus americanus</i>	Yellow	NAR	No	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 <sup>1</sup>	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
Mallard	<i>Anas platyrhynchos</i>	Yellow	N/A	No	Breeding Migrant
Barrow's Goldeneye	<i>Bucephala islandica</i>	Yellow	N/A	No	Migrant
Bufflehead	<i>Bucephala albeola</i>	Yellow	N/A	No	Migrant
Lesser Scaup	<i>Athya affinis</i>	Yellow	N/A	No	Migrant
Hooded Merganser	<i>Lophodytes cucullatus</i>		N/A	N/A	Breeding Migrant
Common Merganser	<i>Mergus merganser</i>	Yellow	N/A	No	Resident
<b>Hawks, Eagles and Ospreys (Accipitridae)</b>					
Osprey	<i>Pandion haliaetus</i>	Yellow	NAR	No	Breeding Migrant
Bald Eagle	<i>Haliaeetus leucocephalus</i>	Yellow	NAR	No	Resident
Red-Tailed Hawk	<i>Buteo jamaicensis</i>	Yellow	NAR	No	Resident
<b>Falcons (Falconidae)</b>					
American Kestrel	<i>Falco sparverius</i>	Yellow	N/A	No	Breeding Migrant
<b>Grouse, partridges and pheasants (Phasianidae)</b>					
Ruffed Grouse	<i>Bonansa umbellus</i>	Yellow	N/A	No	Resident
<b>Sandpipers and Phalaropes (Scolopacidae)</b>					
Spotted Sandpiper	<i>Actitis Macularia</i>	Yellow	N/A	No	Breeding Migrant
<b>Hummingbirds (Trochilidae)</b>					





Common Name	Latin Name	Provincial List	COSEWIC <sup>1</sup>	Identified Wildlife	Bridge R. Status
Rufous Hummingbird	<i>Selasphorus rufus</i>	Yellow	N/A	No	Breeding Migrant
<b>Kingfishers (Alcedinidae)</b>					
Belted Kingfisher	<i>Ceryle alcyon</i>	Yellow	N/A	No	Resident
<b>Woodpeckers (Picidae)</b>					
Northern Flicker	<i>Colpates auratus</i>	Yellow	N/A	No	Resident
<b>Flycatchers (Tyranidae)</b>					
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
<b>Vireos (Vireonidae)</b>					
Red Eyed Vireo	<i>Vireo olivaceus</i>	Yellow	N/A	No	Breeding Migrant
Warbling Vireo	<i>Vireo gilvus</i>	Yellow	N/A	No	Breeding Migrant
<b>Jays, Crows and Ravens (Corvidae)</b>					
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
<b>Swallows (Hirundinidae)</b>					
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
<b>Chickadees (Paridae)</b>					
Black-Capped Chickadee	<i>Poecile atricapilla</i>	Yellow	N/A	No	Resident
Mountain Chickadee	<i>Poecile gambeli</i>	Yellow	N/A	No	Resident
<b>Nuthatches (Sittidae)</b>					
Red Breasted Nuthatch	<i>Sitta canadensis</i>	Yellow	N/A	No	Resident
<b>Wrens (Troglodytidae)</b>					
Pacific Wren	<i>Troglodytes pacificus</i>	Yellow	N/A	No	Resident
<b>Dippers (Cinclidae)</b>					
American Dipper	<i>Cinclus mexicanus</i>	Yellow	N/A	No	Resident
<b>Bluebirds, Solitaires and Thrushes (Turdidae)</b>					
Townsend's Solitaire	<i>Myadestes townsendi</i>	Yellow	N/A	No	Common



Bridge River Riverine Bird Surveys 2014

Common Name	Latin Name	Provincial List	COSEWIC <sup>1</sup>	Identified Wildlife	Bridge R. Status
					Breeding Migrant
Swainson's Thrush	<i>Catharus ustulatus</i>	Yellow	N/A	No	Common Breeding Migrant
American Robin	<i>Turdus migratorius</i>	Yellow	N/A	No	Common Breeding Migrant
<b>Wagtails and Pipits (Motacillidae)</b>					
American Pipit	<i>Anthus rubescens</i>	Yellow	N/A	No	Migrant
<b>Waxwings (Bombycillidae)</b>					
Cedar Waxwing	<i>Bombycilla cedrorum</i>	Yellow	N/A	No	Breeding Migrant
<b>Wood-Warblers (Parulidae)</b>					
Nashville Warbler	<i>Vermivora ruficapilla</i>	Yellow	N/A	No	Breeding Migrant
Yellow Warbler	<i>Dendroica petechia</i>	Yellow	N/A	No	Common Breeding Migrant
Yellow-Rumped Warbler	<i>Dendroica coronata</i>	Yellow	N/A	No	Common 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	Migrant
<b>Tanagers (Thraupidae)</b>					
Western Tanager	<i>Piranga ludoviciana</i>	Yellow	N/A	No	Common Breeding Migrant
<b>Towhees, Sparrows and Buntings (Emberizidae)</b>					
Spotted Towhee	<i>Pipilo maculatus</i>	Yellow	N/A	No	Resident
Song Sparrow	<i>Melospiza melodia</i>	Yellow	N/A	No	Common Breeding Migrant
Dark-Eyed Junco (Oregon Race)	<i>Junco hyemalis</i>	Yellow	N/A	No	Common Breeding Migrant

**Reptiles** (St John 2002 and Gregory and Campbell 1984)

Common Name	Latin Name	Provincial List	COSEWIC <sup>1</sup>	Identified Wildlife	Bridge R. Status
Northern Alligator Lizard (Northwestern)	<i>Elgaria coerulea principis</i>	Yellow	NAR	No	Common Resident
Common Garter	<i>Thamnophis sirtalis</i>	Yellow	N/A	No	Common



Snake (Valley Garter Snake)	<i>fitchi</i>				Resident
Western Terrestrial Garter Snake (Wandering Garter snake)	<i>Thamnophis elegans vagrans</i>	Yellow	N/A	No	Common Resident
Rubber Boa	<i>Charina bottae</i>	Yellow	SC	No	Resident

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](http://www.cosewic.gc.ca/eng/sct5/index_e.cfm) Committee on the Status of Endangered Wildlife In Canada (COSEWIC); and
- Province of BC. 2004. 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/>



### APPENDIX 3

Appendix 3 Selected photographs from 2014 riverine bird surveys. a) Harlequin Duck pair, b) male Harlequin Duck, c) Dipper nest above Mission Creek, d) juvenile Dipper, e) adult Spotted Sandpiper, f) Spotted Sandpiper nest, g) female Common Merganser and brood, h) Great Blue Heron at Eagle Pond

