COLUMBIA BASIN GREAT BLUE HERON INVENTORY AND STEWARDSHIP: FINAL REPORT 2016-2017 (COL-F17-W-1214)

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EXECUTIVE SUMMARY

This report summarizes the results of a two year inventory and stewardship project completed in the Columbia basin from March 2016 to October 2017. The project was intended to provide updated information on heron breeding distribution, population trends and habitat use in the Columbia basin, and to promote habitat stewardship efforts directed at this blue-listed species. Increasing rates of heron nest failure and abandonment in recent years (attributed to eagle harassment and predation) prompted a survey of eagle nest occupancy, to evaluate eagle population trends in critical heron breeding habitats.

Specific project objectives of this project were to: (1) establish a campaign to encourage public reporting of heron sightings and promote awareness of heron sensitivities and habitat needs; (2) complete an inventory of heron breeding sites in the Columbia basin, with emphasis on the North Columbia region, and determine nesting activity and success at occupied sites; (3) summarize the habitat characteristics and condition of occupied heron breeding sites, identify threats and limiting factors, and provide stewardship recommendations; (4) document occupied bald eagle nest locations; (5) provide data on heron wintering activity and for key locations, identify threats and limiting factors, and provide recommendations for stewardship follow-up; (6) conduct stewardship follow-up with landowners, land managers, government agencies, First Nations, NGOs, and the public to promote conservation and stewardship of breeding and key overwintering sites; and (7) provide a report summarizing all project activities, databases, and recommendations.

More than 530 heron sightings were received from 253 volunteers in 2016-2017. This level of public engagement was both inspiring and instrumental in finding several newly heron breeding and roosting sites.

Biologists spent 596 hours (74.5 person-days) conducting field surveys in the Columbia basin, and a total of 23 active heron breeding sites were confirmed over two years. Of 15 sites with 217 active nests in 2016, five sites and 113 nests failed (i.e., 33.3% of sites and 52.1% of nests failed, respectively). In 2017, five of 18 sites and 63 of 173 nests failed (i.e., 28% of sites and 36.4% of nests failed, respectively). Results in 2017 represent the lowest number of active nests (173) recorded to date, following a 2016 breeding season with the highest rate of nest failure (52.1%) documented, since monitoring was initiated in 2002. The average colony size plummeted to single digits (9.6 ± 2.3) in 2017, for the first time since monitoring began, with unknown implications for heron reproductive success and predation risk. Although heron nesting activity, success and colony size can vary considerably from year to year, heron breeding activity appears to be declining, as is average colony size, relative to previous monitoring years.

Bald eagle harassment and predation is a key driver of heron mortality and site abandonment, but other predators and scavengers (such as crows, ravens, etc.) play a significant and often synergistic role. Habitat development and associated disturbance is also affecting heron site fidelity and breeding success, as are natural factors, such as windstorms and competing species. These different factors interact, and lead to site abandonment and shifting of herons to one or more new sites.

With the exception of a breeding record at Legrand, no herons were confirmed during breeding surveys in the North Columbia region (north of Revelstoke) in 2017, even though many habitats

surveyed are suitable. Areas of highest suitability were found northwest of Tête Jaune Cache, where extensive shallow wetlands, creeks, river side channels, islands, and gravels bars occur, with adjacent denser forested habitat and rich food sources. The Tête Jaune Croyden FSR northwest to Dunster, the LeGrand area north of McBride, and Cranberry Marsh in Valemount also provide moderate to high value habitats, but some of the most suitable areas are currently occupied by eagles. Various types of development (e.g., forestry, land clearing for, livestock grazing and residential use, roads, trails and motorized recreation, etc.) are encroaching into valuable riparian and wetland habitats.

Herons were found breeding an average of 152.6 m (range of 0-1,000 m) from water, and closest water bodies were wetland complexes (43.4% of all sites), rivers (17.4%) and lakes (13%), large creeks (13%), and reservoirs (13%). Nesting stands ranged from age class 5-9, with moderate to high crown closure (46% average). Of 23 breeding sites, 15 (65%) were conifer-dominated, six (26%) were deciduous (mainly black cottonwood), and one was a mixed stand. Herons appeared to be selecting healthy trees of large diameter and height, relative to what was available. Twelve (52%) breeding sites were located on private land, nine (39%) were on crown land (three within designated WMAs), and two sites (9%) were on reserve lands.

The survey found a total of 91 and 93 occupied bald eagle nests in 2016 and 2017, respectively. This compares with 60 active nests documented during the last eagle nest survey in 2007, using the very same methods. This 51.7% increase over ten years represents substantial growth, and eagles continue to use black cottonwood predominantly (83%) for nesting. The apparent shift of herons from cottonwood to conifer-dominated breeding stands (64% of nest stands in this study) is likely the result of growing eagle populations displacing herons from preferred habitat.

Winter heron sightings and data gathered for this project indicate that more northerly parts of the basin and most areas of the east Kootenay only support scattered herons foraging as individuals during colder winter months. Herons in southernmost parts of the basin aggregate in small groups at selected sites with ice-free watercourses over winter. Management concerns are provided for key sites documented, along with stewardship recommendations to protect these habitats and minimize the risk of heron mortality.

A number of stewardship actions conducted in association with this project have increased public awareness of heron sensitivity, reduced levels of disturbance, and improved habitat protection at selected breeding sites. These are described and many additional general and site-specific management and stewardship recommendations are provided. They are intended to reduce levels of disturbance and risks of heron mortality, while improving habitat suitability and securement at heron breeding and overwintering sites on both crown and private lands across the Columbia basin.

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Conway, Marc-Andre Beacher, Maria Lerch, Mark Hall, Mark Tinholt, Mark Zehnder, Marlene Johnson, Marley Bassett, Max Helmer, Mel Behiel, Michael McMann, Michael Power, Marley Bassett, Michael Morris, Michael Power, Michelle Gadbois, Michelle Cushway, Mike Bentley, Mike Callas, Mike Cantle, Mike Holland, Myles Rubeniuk, Nadine Smith, Nadja Johnston, Natasha Olsoff, Nathan Smienk, Owen Box, Owen Torgerson, Pat Morrow, Patrick Stevaux, Patti Mauro, Paul Prappas, Paul Seaton, Penny Ohanjanian, Peter Kimmel, Peter Klopp, Peter Wood, Phil Machnik, Phil Payne, Rachel Darvill, Rachel Holt, Randy Hopkins, Randy Moody, Ray Lang, Ray Warden, Rhenda Moore, Rick Hoar, Rob Fox, Rob Whelan, Robin Thompson, Rocky Ehlers, Ron Parisotto, Ruth Zehnder, Ryan Gill, Sandee Greatrex, Sara Erickson, Sarah Currie, Sean Daley, Sharon Dulessis, Sharon Henderson, Sharon Laughlin, Sharon Love, Sheri Regnier, Shirley Aitken, Shirley Coffin, Skip Fennessy, Steve Arndt, Steve Conway, Steve Ogle, Steve Thompson, Stew Clow, Stewart Wilson, Stewart Wilson, Struan Robertson, Sue Monashee-View, Susie Armishaw, Tammy White, Tanna Patterson, Tara Clapp, Tecla Thompkins, Ted Antifeau, Teresa McSpurren, Terry Anderson, Terry Gereats, Terry Lowrey, Terry-Jo Henry, Tess Barnard, Thomas Gendron, Thomas Hill, Tome Rose, Tom Rothel, Tyson Ehlers, Ursula Lowrey, Valerie Davidson, Verena Shaw, Virginia Thompson, Walter Cwikula, Walter Volovsek, Wendy Pitcher, and Zoe Gariepy. Additional volunteers wished to remain anonymous.

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1.0 INTRODUCTION

Great Blue Herons (*Ardea herodias*) are found throughout North America and two subspecies occur in British Columbia (Vennesland and Butler 2011). Both are provincially blue-listed because of habitat loss and disturbance in prime breeding and wintering areas (Gebauer and Moul 2001; Vennesland and Butler 2004, 2011; Conservation Data Centre 2017). The coastal *A.h. fannini* subspecies is listed of Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2008), based on declines documented during surveys conducted over the last 20 years (Gebauer and Moul 2001). The status of the interior *A.h. herodias* subspecies has not been assessed by COSEWIC (R. Vennesland, pers. comm.).

The Fish and Wildlife Compensation Program completed a systematic inventory of heron breeding activity (active nests, colony size, nest success and productivity) in the Columbia Basin from 2002-2008 (Machmer and Steeger 2003, 2004; Machmer 2005, 2006, 2007, 2008, 2009). Since then, less intensive monitoring has been conducted periodically to document new heron breeding sites (Machmer 2010, 2013, 2015). Overall, monitoring trends suggest that there is tremendous variability from year to year in heron breeding activity and success across the basin, however overall numbers of active (and successful) nests found annually appear to be declining (from a high of 341 active nests in 2007 to a low of 191 active nests in 2014; Machmer 2014). Continued monitoring and stewardship follow-up is considered vital to support this vulnerable species and its sensitive wetland habitat. Furthermore northern areas of the Columbia basin have not been surveyed for breeding herons and merit focal inventory.

Consistent with other heron populations (Knight et al. 2016), interior herons breed along the margins of lakes, slow-moving rivers, wetlands and sloughs in proximity to rich food sources (Forbes et al. 1985b; Campbell et al. 1990; Machmer and Steeger 2003, 2004; Machmer 2005, 2006, 2007, 2008, 2009, 2010, 2013, 2015). Colonies vary from small to large in size, but herons will occasionally nest as single pairs (Machmer 1996; Butler 1997). Both deciduous and coniferous stands are used for nesting, typically near shallow water foraging habitats (Machmer and Steeger 2003, 2004; Machmer 2005, 2006, 2007). Herons eat fish and to a lesser extent, small mammals, amphibians, reptiles, invertebrates and birds (Forbes 1987a; Butler 1997; Machmer 2002, 2003). Some interior herons appear to migrate during the winter months, while others remain around ice-free watercourses with an adequate food supply (Campbell et al. 1990; Machmer 2002, 2003). In addition to Waldie Island (Machmer 2000, 2001, 2002), Hentze et al. 2015 identified the Creston and Castlegar areas as being important for overwintering herons. Overall, valley bottom riparian and wetland areas in the basin represent important breeding and wintering habitats for this species, but site-specific data is needed to identify and protect key sites of importance.

Herons are considered sensitive and typically abandon sites when disturbed, particularly during the early stages of nest building, pair formation and egg-laying (Quinney 1983; Butler 1997; Vos et al. 1985; Vennesland and Butler 2004, 2011). Bald Eagle (*Haliaeetus leucocephalus*) predation and human activity are significant sources of disturbance at heron colonies (Norman et al. 1989; Butler et al. 1995; Vennesland and Butler 2004, 2011; Machmer and Steeger 2003, 2004; Machmer 2005, 2006, 2007, 2008, 2009; van Damme and Colonel 2007) and both of these factors are negatively correlated with heron nesting productivity. Their combined effects are thought to be responsible for high rates of breeding failure observed in coastal colonies (Vennesland and Butler 2004; Chatwin et al. 2006; Vennesland and Butler 2011). Nest failure

rates have increased in Interior colonies since monitoring was initiated, and failure rates in some years are comparable to those in coastal heron colonies (Machmer 2009, 2015).

This report summarizes the results of a 2016-2017 systematic inventory of heron breeding sites in the Columbia basin, with special emphasis on the Northern Columbia, which has not been previously surveyed. Data on occupied bald eagle nests gathered opportunistically during the heron breeding inventory are also provided. Finally, this report summarizes heron observations during the winter of 2016/2017, as well as progress on stewardship activities completed over the two year period.

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1.1 Goals and Objectives

Specific objectives for 2016-2017 include the following:

1. Establish a campaign to encourage public reporting of heron sightings and promote awareness of heron sensitivities and habitat needs.
2. Complete an inventory of heron breeding sites in the Columbia basin and determine nesting activity and success at occupied sites.
3. Summarize the habitat characteristics and condition of occupied heron breeding sites, identify threats and limiting factors, and provide stewardship recommendations.
4. Opportunistically document occupied bald eagle nest locations during heron surveys.
5. Provide data on heron wintering activity and for key locations, identify threats and limiting factors, and provide recommendations for stewardship follow-up.
6. Conduct stewardship follow-up with landowners, land managers, government agencies, First Nations, NGOs, and the public to promote conservation and stewardship of breeding and key overwintering sites.
7. Provide a report summarizing all project activities, databases, and recommendations.

2.0 METHODS

The area for this inventory encompassed the entire Columbia Basin, including the East and West Kootenay, as well as the Robson Valley and Wildlife Extension area (roughly bordered by the Fraser River at Legrand to the north, Lower Arrow Lake to the west, and the Elk River to the east; Figure 1). The vast size of the study area and the available budget did not permit systematic surveys of all potential heron breeding habitat in the basin. Areas were therefore prioritized for field inventory based on (a) the nature and frequency of reported heron sightings in 2016-2017 and previous years reported by the public, (b) proximity to suitable riparian and wetland foraging habitat, and (c) accessibility within the constraints of the project budget. The survey area for the eagle inventory included only those areas that could be covered opportunistically in conjunction with the heron inventory.

2.1 Public Awareness Campaign

A public awareness campaign targeting residents and NGO groups in the Columbia basin was initiated in late February 2016 and involved the following steps:

- A brief presentation was delivered at the Kootenay Conservation Program (KCP) Stewardship workshop in late February 2016 to introduce the heron project and encourage reporting of sightings.
- A new “heron sightings wanted” poster was developed and >300 laminated color posters were posted on public info boards throughout the basin, with help from naturalist volunteers.

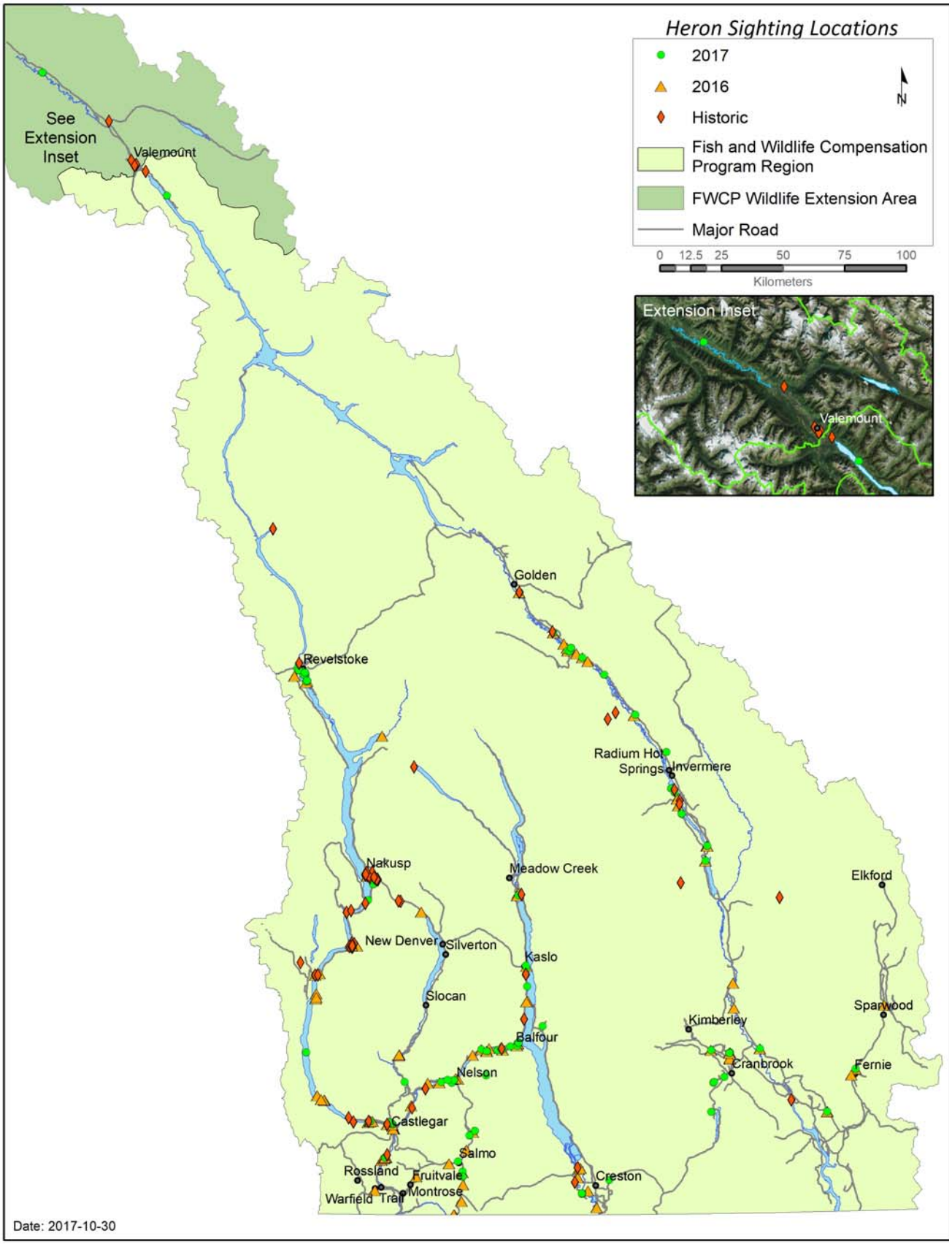


Figure 1. Great blue heron sighting locations submitted by the public for the Columbia basin survey area (East and West Kootenay, North Columbia and Wildlife Extension Area) from 2016-2017.

- An article and press release was prepared by Marlene Machmer (MM) on the heron project to accompany the poster. Angus Glass at FWCP promoted circulation to various media (newspaper and radio) outlets, and MM conducted follow-up radio interviews (this same process was repeated in spring 2017). Coverage included CBC Daybreak (Kelowna, Prince George, Vancouver), EZRock, Mountain FM, and Summit 107 FM. All major basin newspapers provided coverage, and additional coverage was purchased from Rocky Mountain Goat News (Valemount) in early 2017 to target the North Columbia region.
- The digital poster and article was distributed to various contacts in government (FLNRO, BC Parks, CWS, Regional Districts, First Nations), industry, and NGOs (KCP, West Kootenay Naturalists, Rocky Mountain Naturalists, Creston Valley Wildlife Management Area, Columbia Wetlands Waterbird Survey), They were also displayed on relevant web pages (Wings Over the Rockies, Creston Valley Bird Fest, West Kootenay Birder, Rocky Mountain Naturalist, Columbia Basin Watershed Network web page/newsletter, Ktunaxa Nation website and facebook page, Friends of a Feather facebook page).
- Angus Glass and MM worked together to provide content for an FWCP web page and web-based data form to solicit heron sightings. MM also solicited heron sightings in person at Critter Day in May of 2016 and 2017.
- MM worked with Sherri Regnier on a more in depth article on herons (Appendix 5) and Gary Davidson submitted a heron project article in his regular bird column for the Arrow Lakes News in April 2016.
- A “heron landowner stewardship brochure” (Appendix 3) was updated with new information for circulation to landowners, land managers and neighbours.
- MM contacted landowners, land managers and local "nest stewards" (established for previously occupied heron breeding sites) by email and telephone in spring 2016 to (a) get an update on site activity in 2015 and previous years, and (b) encourage site-specific reporting in 2016-2017.
- A 2016-2017 sightings database was established with details on contacts, dates, locations, nature of sightings and follow-up info.
- In the case of the North Columbia region, a much more targeted approach was required to gain historical information from local birders and naturalists (since no heron sightings were received for this region in 2016). MM therefore conducted telephone and in-person interviews with key local birders/naturalists (Elsie Stanley, Barb Zimmer, Ray Lang, Joan Nordli, Maria Lerch), photographers (Leon Lorenz), boaters and fishermen (Owen Torgerson, Jim Bartlett), to gather the best available information for prioritizing field surveys in this large area.
- In fall 2016, MM sent an email update to all contacts with a brief summary of 2016 findings, and a solicitation for winter sightings. A second update was sent in spring 2017 to solicit any new breeding sightings information.
- Angus Glass and MM prepared a 2016 project summary article for FWCP newsletter, along with a formal solicitation for heron winter sighting information.
- MM gave presentations on project interim findings at the KCP Fall gathering in October 2016, and at Kokanee Creek Park Visitor Centre in July 2017.

2.2 Heron Breeding Inventory

During the months of April to July in 2016 and 2017, biologist Marlene Machmer conducted periodic vehicle, foot, and boat-based searches for heron breeding sites along accessible survey routes within the Columbia basin. Expert birder Gary Davidson helped with some surveys in the Nakusp to Burton corridor (along Arrow Lakes and Whatshan Lake) and volunteer assistance was provided by Hugh Ackroyd and/or Dustin Steeger (where surveys required use of a boat, and/or travel in more

remote areas). MM also accompanied other FLNRO and BC Parks personnel on scheduled boat surveys of Arrow and Kootenay Lakes in summer 2016 and 2017, respectively.

General routes and survey areas covered by date in each year are listed in Appendix 1a. Surveys focused on areas with (a) breeding activity nearby in previous years (see Appendix 1b), (b) confirmed heron sightings from 2016-2017 and previous years (see Appendix 1c and d), and (c) good breeding potential based on current habitat availability. A modified approach was required for the Northern Columbia region, due to the lack of previous and 2016 sightings received. The latter region was surveyed only in 2017, which permitted time to gather sufficient background information and prioritize sites for broad-based field inventory.

A minimum of two visits (first visit in late April to early May to count active nests and the second visit in late June to early July to confirm presence of pre-fledged young) were conducted to occupied breeding sites, to estimate numbers of active and successful heron nests, to describe the habitat conditions, and to identify issues for stewardship follow-up. Where previously occupied sites were no longer active, intensive searches were conducted in surroundings areas to find new breeding sites. A nest was considered active when a heron was present in the nest and/or fresh eggshells were observed on the ground below the nest during the breeding season (Moul et al. 2001). At all active sites detected, attempts were first made to speak with the landowner and/or land manager to gain access permission. An accurate nest count was undertaken, the configuration of each colony (i.e., locations and numbers of nest trees and numbers of nests per tree) was sketched from the perimeter with the aid of binoculars and a spotting scope, and photographs were taken. Bald eagle, double-crested cormorant (*Phalocrocorax auritus*), common raven (*Corvus corax*), American crow (*Corvus brachyrhynchos*), wildlife, human, and/or other forms of disturbance were recorded opportunistically during site visits.

In the case of the Balfour heronry (located in a very tall conifer-dominated forest stand with very poor visibility from all sides), an opportunity arose to obtain drone photos of the nest stand. The drone operator was given UTMs of the active nest tree bases in early June and instructed not to approach closer than 40 m to the tree canopy during two flyovers. The stand was observed concurrently during the flyovers to ensure that herons did not fly off their nests. The photos were provided to MM digitally for viewing, and this provided a “pilot-test” of the drone survey approach. Later, the active nest count obtained from ground level (using whitewash, feathers, sticks, and other sign visible from the nest tree base) was cross-referenced with the count obtained from evaluation of aerial images taken by the drone.

Due to the lack of confirmed heron breeding sites, the North Columbia region was not re-visited in July to confirm breeding success on site. The only suspected heron with nesting potential was monitored by a Legrand resident and confirmation of breeding was received on August 10, 2017 (Jackie Edwards, pers. comm.). MM also maintained communication with other nest stewards (via phone and/or email) to verify that occupied sites continued to be active until young were fledged.

2.3 Assessment of Breeding Site Habitat and Condition

Visits to active sites included an assessment of breeding habitat and condition, usually on the second visit, closer to fledging, when herons are less sensitive (Vennesland 2010) and/or after occupied sites have failed. Selected data (i.e., tree diameter and height, crown closure) were estimated with binoculars, and the following site and habitat parameters were recorded: estimated distance (m) from water and the closest water body; dominant forest type and structural stage; slope and aspect; estimated average crown closure; nest tree species; and estimated diameter [dbh in cm], height [m] and decay class (BC Wildlife Tree Committee 2008)

of ≤5 randomly selected nest trees at a breeding site. Breeding site locations were determined with the aid of a Garmin GPS Map 76CX GPS. The biogeoclimatic zone/variant, land designation and ownership status for each breeding site was subsequently determined from maps with the assistance of GIS analyst Kathleen McGuiness. Photos were assembled for the breeding sites, as well as any other features of interest encountered during surveys. Any sources of disturbance, threats and limiting factors were noted during assessments. All habitat data for active and historically active heron breeding sites are summarized in Appendix 1e.

2.4 Bald Eagle Nest Survey

During the heron breeding inventory, any bald eagle nests detected on route were GPS-located, and data regarding occupancy and nest tree characteristics (species, decay class, description) were gathered. In many cases, eagle nests were located a distance away, at sites over water or otherwise inaccessible. In these cases, the distance (in meters) and bearing (degrees) from a known reference point was estimated, in order to minimize travel time but facilitate mapping. All data for occupied (i.e., nests with one or more adults and/or young in attendance) and vacant bald eagle nests are summarized in Appendix 1f.

2.5 Heron Wintering Observations

A survey of heron winter activity was conducted based on (a) follow-up of sightings provided by the public (in 2016-2017 and previous years; see Appendix 1c), and (b) visits to priority sites based on high habitat potential (i.e., valley bottom areas with ice-free watercourses and nearby rich foraging sites in the southern portion of the basin; see Appendix 1a for survey routes). For key locations only, habitat is described, threats and limiting factors are identified, and follow-up stewardship recommendations are provided.

2.6 Heron Stewardship Follow-up Activities

A wide range of general and site-specific stewardship activities were conducted from February 2016 to October 2017. These are summarized in the results section of the report and in the appendices detailing the stewardship follow-up actions undertaken at specific sites.

3.0 RESULTS

3.1 Public Awareness Campaign

A total of 530 separate sightings were received in 2016-2017 from 253 volunteers who took the time to submit their heron sightings (see Figure 1). This is in addition to more than 350 other individuals who have submitted heron sightings in past years (2002-2008). This level of engagement in the current inventory was very encouraging and was also instrumental in finding several newly occupied heron breeding and roosting sites in the basin. In all cases where people contributed sightings, they were followed up by MM (usually by telephone, but alternatively by email, and then later in the field, depending on the nature of the sighting). Where sightings led to the discovery of occupied sites, the contributors often became engaged as “stewards” and continued to report on ongoing heron use and disturbance issues. Such ongoing communication was invaluable in tracking the fate of specific sites and determining likely reasons for breeding failure, where this was the outcome. Although a very significant portion of the time and funding for this study was allocated to the public awareness and associated follow-up, it provided information that may not have been obtained directly, and

resulted in increased awareness and stewardship that may not have otherwise occurred. For all of the above reasons, and given that herons are large, conspicuous, recognizable, widely-distributed birds (although relatively uncommon from a conservation perspective), this project is ideal for inclusion of a "citizen science" component. MM gave a presentation at the 2016 KCP Fall Gathering in Creston (theme of "Benefits of Citizen Science") using this project to illustrate the value of engaging the public in specific types of field studies.

3.2 Heron Breeding Inventory

A total of at least 15 sites in 2016 and 18 sites in 2017 were confirmed occupied by breeding herons during this inventory (Table 1 and Appendix 1a). These sites are mapped in Figure 2 for 2016 and Figure 3 for 2017, and of the 23 total breeding sites, 15 and 8 are within the East and West Kootenay, respectively. They are shown relative to the locations of 50 previously occupied heron breeding sites in the Columbia basin, documented between 1990 and 2014 (see Appendix 1b for details). Comparing with these historical distributions, it is obvious that some portions of the West Kootenay that used to support small heronries (i.e., corridor from Nelson to Castlegar, Trail, Fruitvale and Pend d'Oreille Valley) no longer have confirmed activity, and a similar trend is apparent in the East Kootenay (in the corridor from Cranbrook south towards the US border on the Kootenay system, and in the segment between Invermere and Parson on the Columbia). There are no historical heron breeding data available for the Elk Valley, hence little can be said about changes to breeding site distributions in this area.

An additional breeding site in the Slocan Valley was suspected active in 2016 (based on subsequent confirmation of recently fledged young with an adult, combined with the subsequent discovery of a toppled nest in spring of 2017). Since heron breeding activity was not verified in summer 2016 when the site would have been active, it was not included in the breeding site tally. Detailed survey results for all 23 confirmed heron breeding sites are provided in Appendix 1e. Of the 15 sites and 217 nests confirmed occupied in 2016, five sites and 113 active nests failed (Table 1), which represents a failure rate of 33.3% of all sites and 52.1% of all nests active that year (Table 2). In 2017, five of 18 sites and 63 of 173 nests confirmed active failed (Table 1), which represents a failure rate of 28% of all sites and 36.4% of all nests active that year (Table 2). Results in 2017 represent the lowest number of active heron nests (173) ever recorded in the Columbia Basin, since monitoring was initiated back in 2002 (see Table 2). This result followed a 2016 breeding season with the highest rate of nest failure (52.1%) ever recorded, since monitoring was initiated in 2002 (Table 2). Furthermore, average colony size plummeted to single digits (9.6 ± 2.3) in 2017, for the first time since monitoring began.

In 2016, up to four additional sites (for a total of 19) may have been occupied (i.e., occupancy was suspected based on accounts received from landowners in 2017, however no sightings were received and the sites were confirmed only in 2017). These four suspected sites would have added only five additional active nests to the confirmed total of 2017 for 2016, hence they make little difference to the overall nest tallies. Overall, these heron breeding results suggest reason for conservation concern, especially considering the greater level of search effort (scope and budget) expended in 2016-2017, relative to previous survey years. Although heron nesting success, activity and colony size vary considerably from year to year, it does appear that heron breeding activity (measured as the number of active nests) is declining in the basin, as is average colony size, relative to historical patterns (compare with Table 2 and Figures 2 and 3). Reasons for these trends are varied (see comments in Table 1) and multiple threats appear to be acting to generate the poor end results (see Appendix 1e for details).

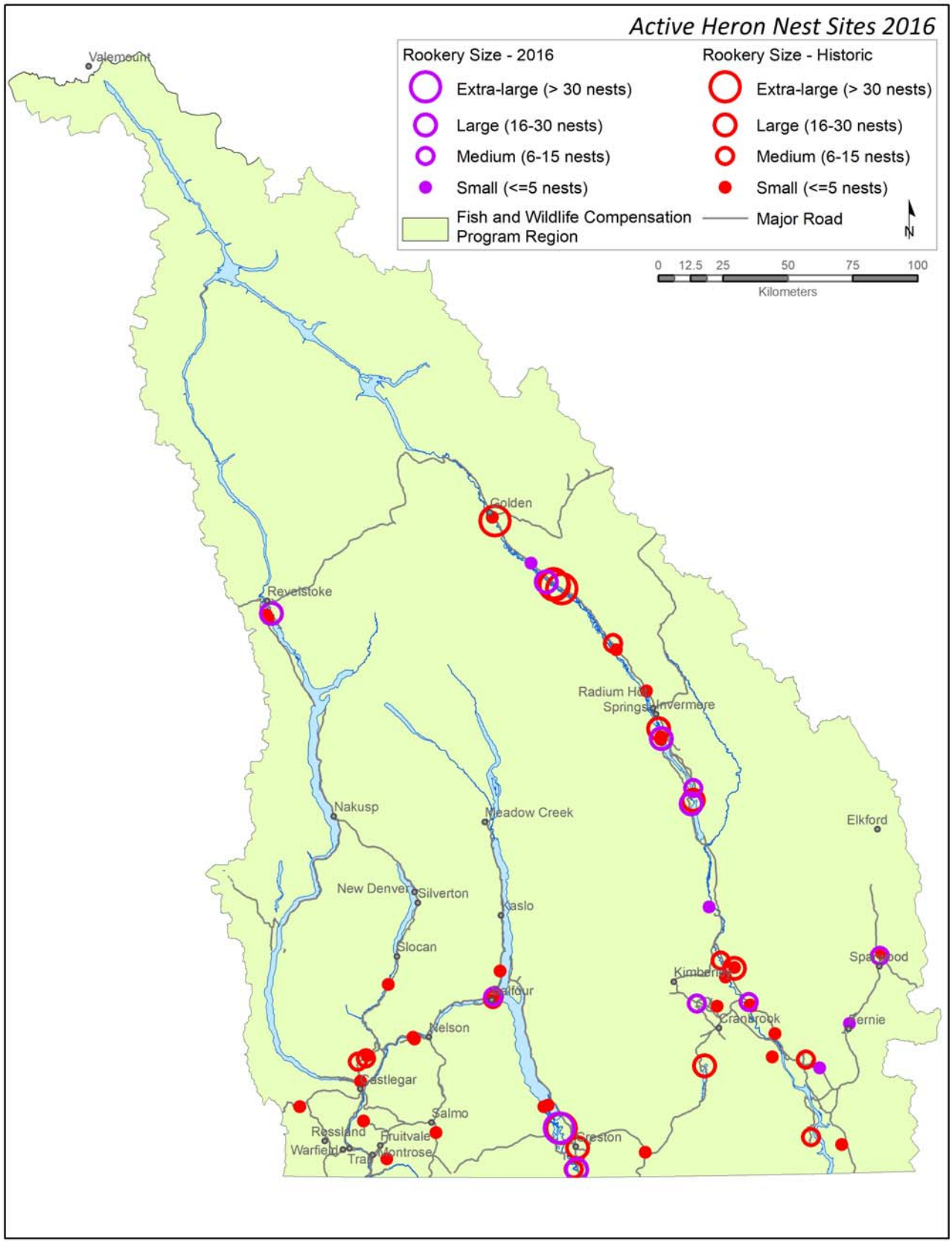


Figure 2. Comparison of 2016 active heron breeding sites relative to historical breedings sites (1990-2014).

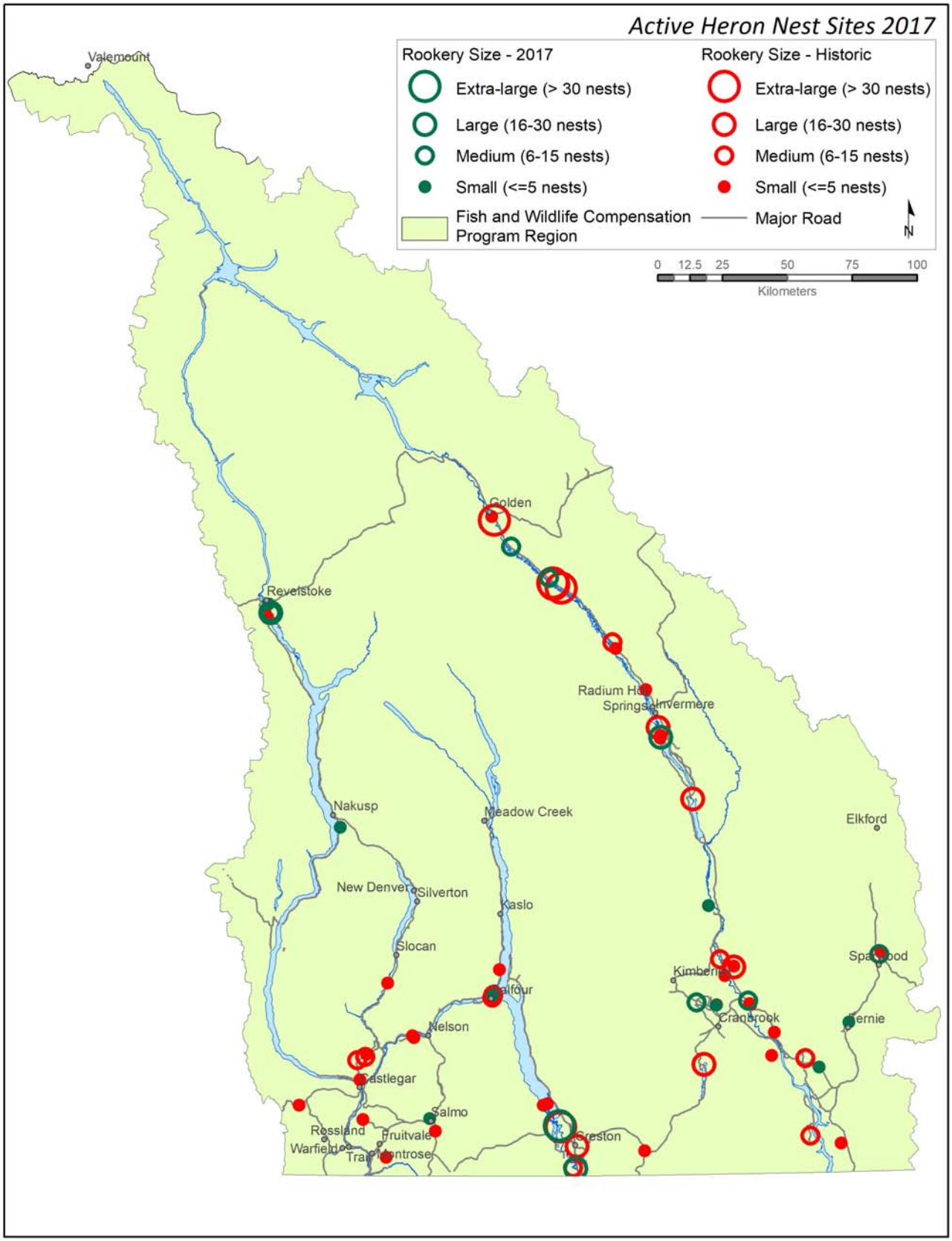


Figure 3. Comparison of 2017 active heron breeding sites relative to historical breedings sites (1990-2014).

Table 1. Summary of great blue heron breeding site information (breeding site occupancy, number of active and successful nests, additional comments) gathered in 2016 and 2017 seasons. For site occupancy, Y = yes, N = no, and S = suspected, based on accounts from landowners.

Breeding Site Name	2016 Breeding Season			2017 Breeding Season			Additional Comments
	Site Occupancy	Active Nests	Successful Nests	Site Occupancy	Active Nests	Successful Nests	
Lennard Drive, Revelstoke	Y	27	24	Y	18	0	2016: eagle harassment late in season. 2017: Disturbance and eagle attacks early on, ≥7 heron carcasses on ground in April, then abandoned on April 17.
Leach Lake CVWMA Creston	Y	40	16	Y	37	31	2016: Early nests failed and many re-nests, ≥117 DCCO nests active in heronry; 2017: 5-6 nests abandoned, 91 DCCO nests active in heronry.
South Reserve, Creston	Y	26	16	Y	19	17	2016 and 2017: Nest activity and success determined with scope because visibility poor and cannot access nest area directly.
Queens Road, Balfour	Y	7	6	Y	5	5	2016: 1-2 Dead chicks counted under nests in June 2016; mortality of several herons reported in this vicinity post-nesting season; eagle attacks both years.
Airport Road, Revelstoke	N	-	-	Y	7	0	2017: Became active in late April when Leonard Dr abandoned; a windstorm caused tree failure, chick injury, eagle harassment and abandonment in July.
Forest Drive Revelstoke	S	-	-	Y	1	0	2016: Possibly active but quiet in in 2016 based on landowner account; 2017: nest tree failed in windstorm and 2 young injured; 1 rehabbed and 1 died;
Bird Road, Nakusp South	S	-	-	Y	1	1	2016: Active with ≥1 chick fledged in 2016 based on landowner account; 2017: Reported late but 3 chicks close to fledging on 1st visit in mid-July.
2nd Street Cutblock, Salmo	S	-	-	Y	3	2	2016: Harvested in 2015; possibly active but quiet based on neighbor account; 2017: 3 chicks in 1 nest and 2 in other.
Elk River, Sparwood	Y	12	10	Y	8	8	2016: Extreme blowdown hazard; counted ≥20 chicks; 2017: 4 nests from last year empty; eagle attacks; 1 active RTHA nest mixed in with heronry
Maiden Lake, Fernie	Y	3	2	Y	2	2	2016 and 2017: Development encroaching near nest site and disturbance; Success determined with scope due to poor visibility and access.
Industrial Yard, Invermere	Y	24	16	Y	27	17	2016: Nest failures with re-nests, attributed to eagles, crows and ravens; 2017: ≥47 chicks, but some nests failed/fledged. Eagle predation both years.
Tamarack Creek, Skookumchuck	Y	1	1	Y	1	1	2016: At least 3 fledglings; 2017: Counted 4 fledglings.
Stump Lake, Fort Steele	Y	11	5	Y	10	7	2016: Successful but at least 3 herons killed by eagles; 2017: 6 dead chicks on ground; lots of aggression, stress, mortality.
Jaffray Ranch, Galloway	Y	5	0	Y	4	0	2016: Crow and raven attacks; cows fenced out but abandoned in May; 2017: Highway disruption, chicks hatch, eagle attacks in May, abandoned.
Columere Park, Fairmont	Y	21	0	N	-	-	2016: Dead adult heron and several chick carcasses and eggs on ground, eagle attacks with crows and ravens coming in too; failed.
Carbonate Creek, North Parson	Y	1	0	N	-	-	2016: heron showed up early but abandoned early in response to disturbance (construction/ ground maintenance) for recreational tenure.

Breeding Site Name	2016 Breeding Season			2017 Breeding Season			Additional Comments
	Site Occupancy	Active Nests	Successful Nests	Site Occupancy	Active Nests	Successful Nests	
St Mary's River, Wycliffe	Y	12	8	N	-	-	2016: 1 dead chick and 1 dead coyote under nest; 3 adult herons killed by eagles and ravens; 2 ravens, 1 coyote and 1 bobcat caught by landowner.
Lake Windemere, Fairmont	Y	8	0	N	-	-	2016: Dead heron chick being eaten by eagle, 2nd adult and juvenile eagle in stand with more dead heron remains on ground; abandoned.
Davidson Marsh, Parson	Y	19	0	N	-	-	2016: Repeated crow attacks reported, 17 herons leave their nests, 2 stay but whole colony eventually abandons, no current grazing.
Schiesser Road, Nicholson	S	-	-	Y	11	10	2016: Possibly active but quiet in 2016 based on landowner account; fenced crown land not subject to grazing; 2017: ≥29 chicks; eagle attacks.
St Eugene, Cranbrook	N	-	-	Y	2	1	2017: Herons present briefly at the 2014 heronry in March, but then left and returned in June; 2 nests initiated late but only 1 successful, raised 3 young.
Gas Line Bench, Wycliffe	N	-	-	Y	9	0	2017: active in late April but all nests with eggs abandoned by mid-May, likely due to harassment from eagles nesting in 2016 heronry nearby.
Eastside Yard, Parson	N	-	-	Y	8	8	2016: Roosted in June 2016 and built some nests but scared away by crows; 2017: built early and bred successfully; counted ≥14 chicks; eagle attacks.
Totals	≥15	≥217	≥104	18	173	110	

Table 2. Summary of heron breeding activity (number of active colonies and active nests, colony size) and reproductive success (% active nests failed, number and % active colonies failed) during monitoring years in the Columbia Basin.

Year	# Active Colonies	# Active Nests	Colony Size Mean ± SE	# of Active Nests Failed	% of Active Nests Failed	# of Active Colonies Failed	% of Active Colonies Failed
2017	18	173	9.6 ± 2.3	63	36.4	5	27.8
2016	≥15	217	14.5 ± 2.9	113	52.1	5	33.3
2014	11	191	17.4 ± 4.2	Unknown [a]	Unknown [a]	1	9.0
2008	16	314	19.6 ± 5.7	75	23.9	0	0.0
2007	16	341	21.3 ± 8.1	92	27.0	1	6.0
2006	13	332	25.5 ± 7.9	146	44.0	5	38.5
2005	12	302	27.5 ± 9.0	127	42.1	3	23.1
2004	13	248	20.7 ± 7.1	87	35.0	2	25
2003	15	286	19.1 ± 5.9	43	15.0	2	13.3
2002	16	257	16.1 ± 5.1	56	21.8	5	31.2

[a] The 2014 project budget did not permit revisits to all active breeding sites, so this value cannot be quantified.

Nine breeding sites failed in one or both years due to a variety of threats, which are discussed in the section:

Lennard Drive, Revelstoke – Eagle harassment was reported at this heronry (occupied since the 1990's or earlier) in 2016 and early 2017 (Tecla and Eric Thompkins, pers. comm.), as was disturbance in 2017 from nearby land-clearing activities on several neighboring properties. These factors led to significant adult and egg mortality, and abandonment. Reports of herons flying over the south side of Revelstoke in large groups were received over several days in the latter half of April, with "sentinels" flying over Lennard Drive periodically.

Upper L to R Leonard Drive nest stand; heron remains; nest site crown closure.
Lower L to R Adjacent property with clearing activity; heron flying over (A. Fraser photo).

L to R: Airport Road nest site crown closure; flagged nest tree bases, with nearby human activity.

Airport Road, Revelstoke - A portion of the Leonard Drive colony settled in a mature forest patch at the boundary of three private properties on Airport Road (a kilometer away) by April 30, 2017. Unfortunately, some eagle harassment was noted here too, and a severe windstorm on July 24, 2017 led to multiple nest tree failure, chick injury, mortality, and abandonment. One surviving chick was taken to the Kamloops Wildlife Park for rehabilitation.

Forest Drive, Revelstoke - Some Leonard Drive herons appeared to shift here when as many as 14 herons showed up in late April of 2017, but only one pair was confirmed nesting (Peter Kimmel. pers. comm.). Unfortunately, the very same windstorm on July 24, 2017 toppled an old hemlock nest tree, resulting in at least two injured chicks and nest abandonment. The neighbours took these two young (as well as a live chick from the Airport Road heronry) to Kamloops Wildlife Park for rehabilitation (Rocky Ehlers, pers. comm.). One chick was euthanized, but two young were released back in Revelstoke in September of 2017 (Adrienne Clay, pers. comm.).

L to R: Forest Drive breeding stand in Revelstoke subdivision; up to 12 herons were observed here after the abandonment of the Lennard Drive breeding site, a few flying with nest material (D. Viedemann photo).

Carbonate Creek, Parson North - Abandonments were observed at the Carbonate Creek heronry over several years, as a result of early season disturbance (from chainsaws, heavy equipment, etc.) associated with a recreational tenure operation. Despite considerable attention to this issue and repeated intervention beginning in 2009 by biologists, Ministry staff, the Conservation Officer Service, and adjacent residents, efforts could not prevent re-occurrences of disruption at this site, which were appeared to be linked to early abandonments in spring 2014 and 2015. The herons returned in spring 2016 but quickly abandoned and did not return in 2017. The tenure operator is currently applying to expand the scope and season of his recreational tenure operations.

Upper L to R: Carbonate Creek breeding stand; nearby infrastructure; Lower L to R: Excavator in riparian zone during early breeding season. (R. Darvill photo); cleared riparian habitat with heronry in background.

Highway 3 road re-alignment encroaching onto the wetland where Jaffray Ranch herons feed and nest.

Jaffray Ranch, Galloway – Four and five heron nests were established in 2016 and 2017, respectively, and fencing excluded livestock from the wetland and heronry area. Harassment from ravens, crows and eagles were issues in both years and this eventually led to site abandonment (Lee McCleese, pers. comm.). A highway 3 road widening project underway in spring 2017 (with constant traffic stoppages, delays adjacent to the roadside wetland where the herons forage) was likely also a factor in the 2017 nest failures.

Windermere Lake, Fairmont - A new heronry adjacent to Windermere Lake wetlands was also abandoned in June 2016 after repeated attacks by eagles nesting nearby, leaving behind many dead chicks eaten by eagles. The site was not re-occupied in 2017 and no alternate heron breeding sites were uncovered in the Fairmont area, despite considerable search effort.

Upper L to R Windermere Lake breeding stand with aspen-dominated structure; bald eagle feeding; Lower: Heron remains on forest floor.

Davidson Marsh, Parson - This heronry was first occupied in 2015 (Valerie Davidson, pers. comm.), but was abandoned in late May 2016 as a result of crow attacks; chicks in 19 nests were left behind and predated. Adults scattered, but sentinel birds were occasionally observed returning to the site. About eight pairs roosted just across the valley through the remainder of the summer but did not breed.

L to R: Davidson marsh nest stand in riparian zone; cottonwood-dominated stand structure.

Columere Subdivision, Fairmont – This heronry (occupied since at least 2011) was abandoned in 2016 after repeated attacks by crows, ravens and eagles over several years, leading to significant mortality of eggs, chicks and adults. Human encroachment was an issue in previous years, but good cooperation was achieved as a result of persistent follow-up in the sub-division, and several landowners taking a special interest in the breeding site.

Upper L to R: Columere nest stand; stand structure. Lower L: Heron remains after abandonment.

St. Mary's, Wycliffe – This breeding site was active in 2016 and fledged young, but sustained significant predation and mortality in that year. This was because of various predator attacks (bobcat, eagle, raven, coyote, red fox). Several herons died, but five of 11 nests appeared successful. Herons shifted breeding to a nearby (≈300 m) bench by a gas line ROW in 2017.

L: Wycliffe nest near St. Mary's River.
R: Red fox shot after killing several herons.

Gas Line Bench, Wycliffe - Although 12 heron pairs built nests and laid eggs, all nests failed, likely due to eagle harassment and predation. Ironically, the problem eagles built their nest within the 2016 Wycliffe heronry and fed on the herons nesting close by on the bench, till the new heronry was abandoned in later May.


L to R: Gas line bench breeding stand; associated stand structure.

Five breeding sites were occupied in both years and successfully fledged young in both years, despite having management issues:

Stump Lake, Fort Steele – This breeding site was active and fledged young in 2016, but sustained significant predation and mortality, due to a combination of opportunistic bald eagle attacks and adjacent disturbance (treehouse construction and use beside the heronry; Jim Ackison, pers. comm.). This site was re-occupied and successful in 2017, as use of the surrounding infrastructure was decreased, especially during the early part of the breeding season.


L to R: Stump Lake breeding stand showing wetland where herons feed; stand structure and nearby infrastructure.

Leach Lake, Creston – This site experienced considerable disruption from co-nesting cormorants (117 nests in 2016 and 91 nests in 2016), which may have been related to the failure of many heron nests and as well as relatively low reproductive success, compared to

previous years. The cormorant colony has grown immensely since first established in 1989, and heron breeding numbers and nesting success has declined concurrently in recent years (Machmer 2009, 2013, 2014). The construction of blinds at the periphery of the site has been an ongoing problem at this site and a previous site; hunters and/or photographers are likely responsible for the construction. A decision was made to defer removing this blind until after the breeding season (Marc-Andre Beaucher, pers. comm).

Upper L to R: Exposed Leach Lake breeding stand in early April; blind built by unknown party within stand.
Lower L to R: Herons and cormorants nests side by side; many herons failed and cormorant density very high.

Industrial Yard, Invermere - This heronry has experienced significant losses to bald eagles, crows and ravens in both years, despite excellent cooperation from Max Helmer Construction to pro-actively reduce all forms of disturbance on site. Numerous videos of eagle attacks and predation have been received from participating volunteers viewing this site from a distance, nevertheless it is currently one of the more productive sites in the basin.

Upper L to R: Fenced industrial yard with activity reduced and berms built in proximity to nest site; heron sunning. Lower L to R: Eagle in heron nest (R. Hopkins photo) after an attack on July 8, 2016; spruce-dominated nest stand structure.

Queens Road, Balfour – Eagle predation and associated mortality was witnessed in both years at this site, and this is an ongoing issue (Janet McCullough, pers. comm.). Blowdown in the stand, surrounding recreational disturbance, and the threatened sale and development of the adjacent private property are all issues of concern. Even of the young herons fledged in 2017, several were reported injured (two birds with broken wings) and died nearby at Balfour Beach Regional Park, Balfour, and Fraser Narrows, from August to October.

The drone flyovers generated photos which confirmed the presence of at least three occupied heron nests, but not the five confirmed active from the ground in early June. This technique needs refinement and would likely require flying lower at a much closer range (which in turn is more likely to disturb herons) to be used as a reliable tool for counts of active nests. Use of

drones may however provide opportunistic data on presence/absence as part of other surveys. Contacting drone operators undertaking surveys may generate useful information, especially for remote sites that cannot easily be visited on the ground.

Upper L to R: Nest stand structure with whitewash and eggshells at base of hemlock nest tree; high crown closure. Lower R: Dead heron chick on ground with head wound.

Maiden Lake, Fernie - This breeding site experienced encroachment from nearby campground construction in spring 2016. Although working with the proponent, FNLRO and City of Fernie staff, and local naturalists did eventually provide protection for the site, encroachment to feeding habitat and increased levels of disturbance were unavoidable, and one of three nests failed, with only two pairs returning in 2017.

Photos: Maiden Lake wetland and longstanding heron nest site; newly developed RV campground near nest site.

Three breeding sites was occupied in 2017 and successfully fledged young, despite having management issues:

St Eugene Mission, Cranbrook - Herons returned to this breeding site in spring 2017, however persistent disturbance associated with clearing and construction of a new RV campground close by led to abandonment in April 2017. The proponent was encouraged to defer all work till later in the breeding season, but this was not implemented. Interestingly, three pairs of herons re-appeared in June (after most of the construction work had ceased for the summer), but only one pair successfully fledged young in September, which is extremely late for herons, and which could have implications for the likelihood of survivorship to adulthood.




Upper L to R: Equipment mobilizing at St Eugene Mission breeding site in April 2017; site development in May. Lower L to R: Three pairs return to initiate late nests in June; only one pair fledges young late in September (S. Wilson photos).


L to R: Nest stand at Eastside Yard in Parson, with whitewash at base of fir nest trees; herons roosting.

Eastside Yard, Parson – Herons began nest-building here in July 2016 (after the Davidson Marsh site was abandoned), however breeding was not attempted. They returned in April 2017 and bred successfully, despite some harassment from eagles. An access road through this crown land heronry is used to access Canfor private land further upslope, potentially causing disturbance during the breeding season. The neighboring private property is also for sale.

L to R: breeding stand structure at Schiesser Road heronry; small wetland on private land adjacent to nest site.

Schiesser Road, Nicholson – There were reported accounts of eagle attacks during the season (Karen and Patrick Stevaux, pers. comm.) on this crown land site, however reproductive success was high and the site obviously benefits from the stewardship efforts of the adjacent landowners.

Five breeding sites were occupied and successfully fledged young in one or both years, without any serious management issues:

South Reserve (Lower Kootenay Band), Creston – There were no obvious disturbance, development or predation issues on this reserve site.

L to R: Cottonwood nest stand in early April; one of many successful nests in both years with large young (S. Wilson photo).

Tamarack Creek, Skookumchuck – There were no obvious disturbance and/or predation issues at this private land site, and the landowner is very engaged in stewardship at the fish-bearing creek and the surrounding lake and wetland areas.

L to R: Single nest tree in lodgepole pine at Tamarack Creek nest stand; Tamarack Lake foraging area nearby.

Second Street Cutblock, Salmo – This private land was harvested with some deciduous retention in 2015; it is not known if the herons were already breeding there at that time. The herons were nesting in veteran cottonwoods at the edge of the cutblock, about one km away from water, with no obvious disturbance and/or predation concerns.

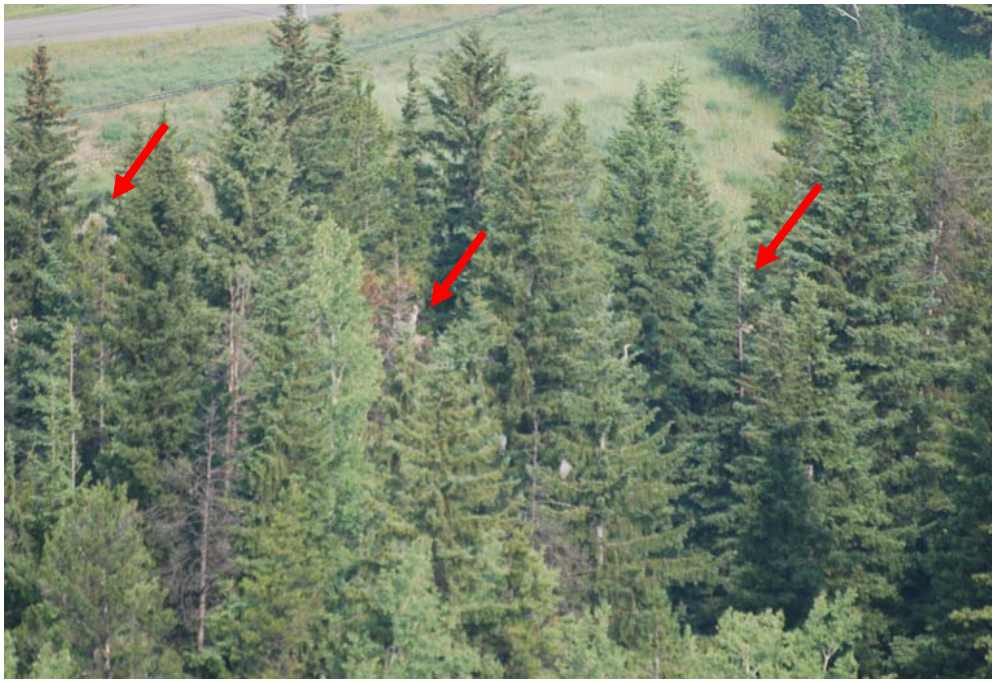
L and upper R: Heron nests in two large cottonwoods retained at the edge of a privately-logged cutblock off Second Street in Salmo. Lower R: Large Douglas-fir removed that were growing beside bases of veteran cottonwood.

Bird Road, Nakusp – This breeding site is in a creek gully on private land, adjacent to a BC Hydro road ROW and powerline. BC Hydro has been alerted to the nest site and potential seasonal sensitivities to access.

L: Heron nest stand on private land on Bird Road, Nakusp; Upper R: View of nest tree in distance from neighbor's yard. Lower R: Large Douglas-fir nest tree on slope above creek and overlooking Arrow Reservoir.

Elk River, Sparwood – There was no obvious disturbance and/or predation (although in 2017 a red-tailed hawk bred beside the herons in the same nest tree). Recent blowdown may potentially be a problem for site longevity of the veteran lodgepole pine nest trees. The site is leased by Teck to a landowner and minor communication issues around access restrictions to the site have been addressed.

Pooling all breeding sites from both years, 12 of 23 (≈52%) breeding sites surveyed had evidence of bald eagle harassment and or predation and four of these sites (including the long-standing colony in Revelstoke) failed in one or more years. Seven sites (≈30%) had recorded harassment by American crows and common ravens specifically, and three of these sites failed. Five sites (≈22%) were subject to nearby development and disturbance and two of these sites failed, while the others had reduced reproductive success relative to previous years. Three (13%) sites were impacted by storms, two of which were subsequently abandoned. One site (Leach Lake in Creston) is persistently affected by encroachment from double crested-cormorants (a blue-listed species), which leads to overcrowding, nest usurpation by cormorants, and potentially also nest failure, although these impacts remain to be quantified. Finally, one site was documented to be impacted by a range of predators (including eagles, crows, ravens, bobcat, coyote, fox) which caused mortality, which the landowner tried to deal with. This resulted in some chicks fledging, but the site was not re-occupied in the following year.



Upper L to R: Site location on Teck land; lush nest stand with scattered vets and blowdown. Lower L and middle: Several nests with young; blowdown; Lower R: Location between railroad tracks, Elk River and road.

Bald eagle harassment and predation is a key driver of heron mortality and site abandonment (Machmer 2009 2013, 2014), but other predators and scavengers (such as crows, ravens, etc.) play a significant and often synergistic role. Habitat development and associated disturbance is also affecting heron site fidelity and breeding success, as are natural factors, such as windstorms and competing species. These different factors typically interact, and may lead to site abandonment and shifting of herons to one or more new sites, often in proximity to the same long-standing foraging areas.

3.2.1 Heron Breeding Inventory in the North Columbia

Breeding surveys in the North Columbia region were postponed until spring 2017, to allow sufficient time to accumulate sightings (from the public awareness campaign) and information (from targeted interviews with birders, naturalists, photographers, boaters, fishermen, and other contacts). These sources yielded some sighting records mapped in Figure 1 (see also Appendix 1c), but almost all of the information is from previous years. For example:

- A heron breeding site was apparently active over several years (in the late 1990's to early 2000's, but prior to 2002) at Tête Jaune Cache, on the south side of the Fraser River, just east of the bridge crossing (Joan Nordli, pers. comm.). In those same years, herons were observed feeding along around Swift Creek and wetlands, Whiskey Fill Road, and Tete Jaune wetlands (Joan Nordli, pers. comm.).
- Within the last five years, individual herons have been seen feeding at Cranberry Marsh east of the highway (Maria Lerch, Owen Torgerson, pers. comm.), and along Cranberry Lake Road west of the highway. Activity ceased after construction of a pipeline under the ponds and when eagles moved in at Cranberry Marsh over the last three years at least (Maria Lerch, pers. comm.).
- Also in the last five years, individual herons were occasionally seen feeding near the Fraser River bridge further west at Dunster, and there may even have been a heron breeding site there, however eagles have nested at this same location over the last few years and herons have not been observed since (Elsie Stanley, Jim Bartlett, pers. comm.).
- Previous sightings are available along the Fraser River at McBride (Jim Bartlett, pers. comm.) and at nearby Horseshoe Lake wetland (Elsie Stanley, pers. comm.), but nothing in recent years.
- Previously, a wetland south of Valemount on the Thompson River bridge over Highway 5 was reported to have heron activity and possibly also a nest site (Elsie Stanley and Joan Nordli, pers. comm.).

The only current (2016-2017) heron sighting records were received from:

- Kerri-Lynne Fontaine (pers. comm.), who saw two herons feeding along the shores of Kinbasket Lake (between km 19 and 21 of Canoe Forest Service Road; Figure 1) in August 2016 (but not in 2017).
- Jackie Edwards, who sees 1-2 herons annually at Legrand, 20 km west of McBride (Figure 4). These birds feed regularly along Legrand Creek, a tributary of the Fraser, and they are assumed to nest relatively close by, likely on the north side of the river (Jackie Edwards, pers. comm.).

During field surveys in 2017, both of these areas were searched intensively. No herons were detected along accessible portions of Canoe Reach FSR. Sightings of a single adult heron were

confirmed at Legrand Creek and several days were spent searching for a breeding site. Access to the riparian zone (from Mountain View Road along the north side of the Fraser River) was poor in many areas, due to heavy rain and flooding. After conducting foot searches across the river from Legrand Creek mouth over several days, the search was ended (in favour of surveying other accessible areas with nesting potential). However, it is noteworthy that after learning to distinguish between adults and juveniles in summer 2017, Jackie Edwards was able to confirm a single juvenile feeding with an adult heron at Legrand Creek mouth on her property for the first time on August 11, 2017. Although the exact location of the breeding site remains to be determined, this sighting is considered adequate to confirm local breeding, when coupled with earlier adult sightings at the same location.

Table 3 provides a summary of all other areas searched for heron breeding activity in the North Columbia region. General location and corresponding UTMs for these areas are provided, along with a brief description of their habitat characteristics, a heron breeding habitat suitability rating (i.e., low, moderate, high, very high) of the feeding and breeding habitat suitability for herons, as well as photographs of each area.

Table 3. Description of general routes and areas searched in the North Columbia region of the Columbia Basin. Tree species abbreviations: Act = black cottonwood; At = trembling aspen; Ep = paper birch; Fd = Douglas-fir; Pl = lodgepole pine; and Sx = hybrid white spruce.

Date	Name (Photo #)	UTM	UTM	Description	Suitability (U, L, M, H, VH)
29-Apr-17	Cranberry Marsh East, Nature Trust Land	347595	5853961	Extensive wetland, surrounded by Pl and Sx-dominated forest; mostly Pl, Sx and occasional Fd, Ep, At; minor Act; eagle nesting at the marsh.	M-H feeding; M-H - breeding
29-Apr-17	McMurdy Rd Restoration Area and adjacent Wetlands	348954	5845211	Fuel management area adjacent to wetland, so all Pl (with mistletoe beetle) are being cut; only At retained; now looks too open for suitable heron nesting; active raven and red-tailed hawk nests here.	M- feeding; L-breeding;
29-Apr-17	Cranberry Lake Road Wetlands	346060	5852661	Very open ponds suitable for heron feeding, but a lot of areas cleared (for housing, livestock grazing, agriculture), and most treed areas thinned out, so retained forest is too open for nesting; ROW swath.	M- feeding; L-breeding;
29-Apr-17	Whiskey Fill Road wetlands	350149	5853424	Small wetlands with waterfowl, Cooper's Hawk hunting; mature Sx suitable for heron, but still quite open stands; many openings with "ranchettes" being built and encroaching on marginal habitat.	L-M- feeding; L-breeding;
29-Apr-17	Cedarside Road (to Kinbasket Reservoir)	350290	5852433	Pocket wetlands; 4x4s with ATVs and dirt bikes; area open and too disturbed for nesting; water/flow changes, sedimentation, erosion.	L – feeding; L – breeding;
29-Apr-17	Canoe FSR along Kinbasket Reservoir (km 1-23)	358158	5845783	Scattered Act up from high water mark, water level fluctuations, erosion and sedimentation results in poor habitat; 2 juvenile eagles (≈2 year-olds) perched by shore; trucks and ATVs using this area, based on tracks; disturbance in spring especially during low water, but may improve as water rises	U-L – feeding; L-M– breeding;

Date	Name (Photo #)	UTM	UTM	Description	Suitability (U, L, M, H, VH)
30-Apr-17	Jackman Flats Provincial Park and Wetlands	339383	5867531	Wetlands (FEN) with Pl and At dominant in open stand around; Fd rarer; Pl have mistletoe and pine beetle but has not been thinned yet; some bigger trees suitable for nesting.	M-H- feeding; M – breeding;
30-Apr-17	Tete Jaune Cache (Fraser River upstream and downstream and adjacent wetlands)	337367	5872151	By bridge close to old nesting site (cleared around with property more open); has many large trees and snags (mixed species) by river, suitable for nesting, but many surroundings areas are being developed with openings and encroachment into pocket wetland areas; clearing for livestock grazing and agriculture nearby	M – feeding; M – nesting;
30-Ap17	Tete Jaune Cache Junction Area Riparian Cottonwood	335384	5873137	Mixed stands with vet Act, Fd, Pl and creek nearby; people squatting here and informal camping area; disturbance from people and dogs.	M-feeding; M-H - breeding;
30-Ap17	Swift Creek spawning channel and wetlands, Valemount	346575	5856239	Spawning channel and small wetlands adjacent to town and homes; walkways and trails with disturbance, but extensive meandering channel with gravel bars flows into Fraser west of Tête Jaune Cache, so extensive feeder creek.	M-H -feeding; L- breeding;
1-May-17	Buffulo Backroad between Tete Jaune Cache and Valemount	339799	5864985	Small pocket wetlands are scattered all around the backroad area, but few dense stands with veteran trees to support heron nesting; new openings that have been logged with blowdown an issue.	M-feeding; L- breeding;
1-May-17	Tete Jaune Cache West on Fraser	336470	5872417	Large trees along river suitable for nesting, with some shallows along the river for feeding.	M-feeding; M- breeding;
1-May-17	LeGrand Area by Fraser River south side	673628	5921833	Mixed stands are At, Act, Ep, Sx with fish-bearing creeks including LeGrand Creek flowing into Fraser River nearby; gravel bars with shallows for feeding; train tracks close by.	M-H – feeding; M-H – breeding;
1-May-17	Mountain View Road and Fraser River north side	674586	5822759	Dense riparian mixed stand with veteran cottonwood suitable for nesting along river (many logged openings nearby); eroded river banks with some gravel bars, shallows and a few islands in mid channels; livestock grazing in riparian is an issue.	M-H – feeding; H – breeding;
2-May-17	Mountain View Road and Fraser north side continued	676268	5921949	Same as above; eroded banks, livestock grazing impacts to riparian habitat; large water fluctuations seasonally and currently flooded.	M-H – feeding; H – breeding;
2-May-17	Fraser River crossing area at McBride	690708	5909634	Good nesting stands of mixed conifer on one side but much of the land cleared for agriculture; some shallows and gravel bars for feeding; wetland nearby.	M– feeding; M – breeding;
2-May-17	Horseshoe Lake Bird Sanctuary, McBride	689559	5908732	Wetland with cattails and willow and some shallow open water; waterfowl abundant; mostly At and Sx, with minor Act; red-tailed hawk nesting here and eagles (adult/juvenile) detected.	M-H- feeding; M – breeding;

Date	Name (Photo #)	UTM	UTM	Description	Suitability (U, L, M, H, VH)
2-May-17	Holmes River and Natasha Boyd Conservation Area	698216	5904320	River shallow but flooded and full of sediment; marsh and FEN wetlands nearby with suitable larger trees scattered; open for heron nesting; eagles apparently nesting at mouth of Holmes River earlier; red-tailed hawk nesting here now.	M-H – feeding; M – breeding;
3-May-17	Dunster Bridge Fraser River upstream and downstream	310346	5891919	Eagle nesting just downstream on right bank in live Act; osprey nearby; a lot of land under cultivation and many trees cleared; nesting limited; some shallow gravel bar areas for feeding; few wetlands.	L-M – feeding; L-M – breeding;
3-May-17	Backroad between Dunster and Croydon Ferry Road	318297	5883347	Red-tailed hawk nesting here by river in At; most At and Sx; many openings and no wetlands here; feeding limited.	L-M – feeding; M – breeding;
3-May-17	Back Road from Croydon to Shere wetland	324377	5878591	Abundant trees for nesting but wetlands sparse; some gravel bars and islands; Act, Sx, At and Pl stands; wetlands by Shere, but heavy logging throughout this area with erosion into wetland.	M – feeding; M – breeding;
3-May-17	Tete Jaune Spawning Grounds and Recreation Site	334974	5870977	Nice shallow channel good for feeding, but interface hazard reduction treatments ongoing through this area and forest too open; recreation site adjacent with campers, dogs, fire pits and trails and potential for disturbance; need sites off limits to people and dogs to improve suitability for breeding and feeding; railway very close by.	M-H – feeding; L-M – breeding;
3-May-17	Wetlands and River Channel on Old Tete Jaune Cache Rd	331953	5873024	Forest stands of Sx, At, Act along braided river channels with some islands and many gravel bars; full banks with sloughing and erosion; also some wetland areas with good potential for breeding and feeding.	M-H – feeding; H – breeding;
3-May-17	Tete Jaune Croydon FSR to Red Pass Junction	330578	5873165	Ingrown cattail marshes near road and river bottom between 0.5 and 2 km on FSR; osprey at wetland and good potential for herons with lots of Sx, Act, At for nesting nearby;	M-H – feeding; H – breeding
3-May-17	Tete Jaune Croydon FSR further west to Red Pass Junction	330834	5872789	Extensive marsh and shallow open water but logging upslope right to margin of wetland, with road slumping and eroding into wetland; dogwood and willow cut right up to banks; this area needs rehabilitation to stabilize banks, reduce erosion and re-vegetate roadsides (i.e., an excellent potential restoration/enhancement project for a community group to undertake).	M-H – feeding; M-H – breeding
3-May-17	South on Highway 5 to Gosnell Rd by Thompson River bridge	355330	5816718	Marsh with cattails, veteran Act and conifers, and abundant snags on both sides of the road by bridge over Thompson River – high potential but a portion of the area is close to road and disturbance (historical nesting reported here).	H – feeding; M-H – breeding

Photos (upper): Cranberry Marsh; McMurdy restoration area; Whiskeyfill Road wetlands; Photos (middle): end of Cedarside Road at overlooking Kinbaslet reservoir; Canoe FSR (km 19-21); Jackman Flats recreation area; Photos (lower): Swift Creek spawning channels and wetlands; Fraser River riparian zone at Tête Jaune Cache; Buffulo Backroad between Tête Jaune Cache and Valemount.

Photos (upper): Legrand Creek spawning channel; mouth of Legrand Creek with large cottonwoods and suspected nest in mixed stand site across Fraser River.
Photos (lower): Mountainview Road area, Legrand, Natasha Boyd Conservation area, Dunster riparian zone by Fraser River crossing.

Photos (upper): Holmes River area; Croyden Ferry landing area by Fraser River; Tête Jaune Cache Creek, spawning channel and recreation area. Photos (middle): Fraser River riparian views from Tête Jaune Cache Rd; Tete Jaune Croydon FSR with extensive ingrown cattail marshes; logging adjacent to roadside by marsh; Photos (lower): sloughing and erosion into shallow open water marsh; cut roadside riparian vegetation; Fraser River views to Red Pass junction.

With the exception of Legrand Creek area, no herons were detected during the surveys in the North Columbia region, north of Revelstoke, even though many of the habitats surveyed are suitable. The areas of highest suitability (characterized by an abundance of wetland and riparian habitat providing a rich food source close to denser stands of suitable large trees) were found northwest of Tête Jaune Cache (between Swift Creek and the Fraser River). This area has extensive shallow wetlands, creeks, and river side channels, islands, and gravels bars with adjacent denser forested habitat, but there are also sites that require rehabilitation (due to upslope logging, wetland and riparian vegetation clearing associated with road-building and agriculture). The Tête Jaune Croyden FSR further northwest to Dunster, the LeGrand area north of McBride, and the Cranberry Marsh in Valemount also provide moderate to high value habitats for both feeding and breeding. Some of the more valuable areas are currently occupied by eagles, and various developments (forestry operations, land clearing for livestock grazing, residential and commercial ventures, etc.) are rapidly encroaching onto suitable habitats. Recreation, and in particular motorized recreation (such as boating, ATVs, dirt bikes, and even late season snowmobiling) is a significant and rapidly growing sector along Kinbasket Lake and through the Valemount to McBride corridor. Motorized recreational activities were abundant during surveys and clearly have potential to further reduce habitat suitability for breeding herons, as evidenced by the abundance of tire tracks along the margins of the reservoir in late April through early May.

3.3 Breeding Habitat and Condition

Table 4 and Appendix 1e provide a summary of data gathered on habitat characteristics and condition for all 23 breeding sites confirmed occupied in one or both years of the heron inventory. Herons in the Columbia basin were found using at least eight different biogeoclimatic subzone/variant units which ranged from 462 to 1,151 meters in elevation. Breeding sites were located an average of 152.6 $\pm$ 50.8 m (range of 5 – 1,000 m) from a water body, and ≈74% of sites were found within 200 m of water. Closest water bodies ranged from wetland complexes (n = 10 or 43.4% of all sites), rivers (n = 4 or 17.4%) and lakes (n = 3 or 13%), to large creeks (n = 3 or 13%), and reservoirs (n = 3 or 13%). Often, multiple water bodies were associated with the same breeding site and field verification would be required to confirm where individuals were feeding.

Fifteen (65%) of the 23 breeding stands were conifer-dominated, six were black cottonwood stands (26.1%), and one (at St Eugene Mission) was a mixed stand. These results differ dramatically from those presented for the Columbia basin in the early 1980's, when virtually all of the heron breeding stands were reported as cottonwood-dominated (Forbes et al. 1985a). The proportion of conifer-dominated breeding stands has increased again incrementally from ≈46% reported in the basin since the last comprehensive inventory (2002-2008; Machmer 2009). This result begs the question of whether the shift in heron breeding stand composition reflects a decline in the availability of "preferred" cottonwood stands (due to water level regulation impacts, reduced cottonwood availability and/or recruitment, targeted removal of cottonwood trees associated with developments and/or beavers, breeding site competition with eagles or other species), or whether it is some form of adaptive response to greater disturbance and predation (see Section 3.4). Conifer-dominated stands do appear to offer greater concealment early in the breeding season (pers. obs.), however as nestlings grow larger and produce greater amounts of whitewash, the contrast between darker coniferous foliage and whitewash increases, rendering nests in coniferous trees more visible than those in deciduous, as the breeding season progresses.

Table 4. Summary of data gathered on breeding habitat condition for 23 breeding sites confirmed occupied in one or both years.

Breeding Site	BEC Unit	Elev. (m)	Dist. H20 (m)	Forest Cover Composition	Age Class	Crown Cover %	Slope %	Aspect	Mean Tree Dia. (cm)	Mean Tree Height (m)	Median Tree Decay Class	Nest Tree Rep.	Ownership
Leonard Dr., Revelstoke	ICHmw3	462	600	CwHw	8 to 9	70	0	n/a	74	39	1	Cw(Hw)	private
Leach Lake, CVWMA	ICHxw	538	30	Act	7	60	0	n/a	>60	>30	1	Act	crown WMA
South Reserve, Creston	ICHxw	543	30	Act	7	60	0	n/a	n/a	>30	1	Act	reserve
Queens Road, Balfour	ICHxw	535	200	HwCw(FdLw)	7	80	0	n/a	60	>35	1	Hw	crown
Columere, Fairmont	IDFxk	853	450	FdPlAt(Sx)	6 to 7	60	0	n/a	>45	>30	1	Pl	crown
Carbonate Creek, Parson	IDFdk5	794	20	Act	6	10	0	n/a	>60	>30	2	Act	crown WMA
Maiden Lake, Fernie	ICHmk4	1031	5	Sx(Pl)	6	30	0	n/a	50	30	1	Sx	Crown (covenant)
Elk River, Sparwood	ICHmk4	1151	30	PlFdSx	7	60	0	n/a	>60	>35	1	PlSx	private
St Mary's River, Wycliffe	IDFxx2	883	40	FdPy	6 to 7	30	0	n/a	>60	>30	1	Py	private
Tamarack, Skookumchuck	IDFdm2	862	5	PlLwActEpSx	6	55	0	n/a	60	27	1	Pl	private
Lake Windemere, Fairmont	IDFxk	814	10	At stand	6	50	0	n/a	>40	>30	1	At	private
Industrial Yard, Invermere	IDFxk	808	40	Sx(willow)	4	10	0	n/a	<30	<20	1	Sx	crown WMA
Davidson Marsh Parson	IDFdk5	804	20	Act(AtSx)	6 to 7	47	0	n/a	66	>30	1	Act	private
Jaffray Ranch	IDFdm2	881	30	Act(SxPl)	6	30	0	n/a	74	33	1	ActSx	private
Eastside Yard, Parson	IDFdk5	845	250	Fd	5 to 6	45	0	n/a	47	>30	1	Fd	crown
Stump Lake, Ft Steele	IDFxx2	800	20	FdPy	6	60	0	n/a	50	>30	1	PyFdPl	private
Airport Road, Revelstoke	ICHmw3	462	180	CwHw	7	65	0	n/a	71	>30	1	CwHw	private
Forest Drive, Revelstoke	ICHmw3	480	10	CwHw(Ep)	6	10	0	n/a	>60	>40	2	Hw	private
St Eugene Mission	IDFxx2	820	10	ActSxFd	6	50	0	n/a	65	>30	1	ActFd	reserve
Gas Line Bench,	IDFxx2	922	210	FdPy(Lw)	6	30	20	270	63	>30	1	Py(Fd)	crown

Breeding Site	BEC Unit	Elev. (m)	Dist. H20 (m)	Forest Cover Composition	Age Class	Crown Cover %	Slope %	Aspect	Mean Tree Dia. (cm)	Mean Tree Height (m)	Median Tree Decay Class	Nest Tree Rep.	Ownership
Wycliffe													
Schiesser Road, Nicholson	IDFdk5	939	300	Fd	6	45	0	n/a	66	>30	1	Fd	crown
2nd Street Cutblock, Salmo	ICHdw1	792	1000	Act	2[a]	25	0	n/a	95	>35	1	Act	private
Bird Road, Nakusp	ICHmw2	541	20	Fd(HwCw)	7	70	50	230	87	>40	1	Fd	private

[a] The nests are in remnant veteran cottonwood located along the edge of a cutblock with patch and single wildlife tree retention.

Age classes of nest stands ranged from 2-9 (5-9 excluding the Salmo nest stand, in which remnant veteran cottonwood nest trees were located along the edge of a cutblock with patch and single tree retention), with a median age class of 6. Estimated crown closure ranged from 10-70%, with an average of 46%, which is lower than the 59% reported in previous years (Machmer 2009). Over 87% of sites were located on flat ground, and two sites were located on slopes (20% and 50%), with an overall average of 3% slope. Aspects of the two sloped sites ranged from southwest to west.

Based on the sample of nest trees characterized, dominant species in coniferous stands include Douglas-fir (*Pseudostuga menziesii*), hybrid white spruce (*Picea glauca x engelmannii*), ponderosa pine (*Pinus ponderosa*), lodgepole pine (*Pinus contorta*), western red cedar (*Thuja plicata*) and western hemlock (*Tsuga heterophylla*). Sample nest trees (≤5 per nest stand) at the 23 active sites averaged 64.8 ± 2.5 cm in diameter at breast height (n = 51), ≥30 m in height, and their median decay class was 1 (range = 1-2). Herons appear to be selecting healthy trees of large diameter and height, relative to what is available in the surrounding stands, although characteristics of random available trees were not quantified directly. In terms of land ownership of the 23 active breeding sites, 12 sites (52%) are located on private land, nine sites (39%) are on crown land (and of these, three are within designated Wildlife Management Areas). Two additional sites (9%) are located on First Nations Reserve lands in Creston and Cranbrook.

3.4 Bald Eagle Nest Survey

Results of the opportunistic bald eagle surveys (including visit dates, nest locations, nest tree descriptions and nest status) conducted in 2016 and 2017 are provided in Appendix 1f, and active eagle nests are mapped in Figure 4. As expected (based on the survey routes and areas of emphasis), some of the highest concentrations of eagle nests were found in the Columbia Wetlands Wildlife Management Area (CWWMA), the Creston Valley Wildlife Management Area (CVWMA), and along the West Arm of Kootenay Lake. Lower densities of eagle nests were found along Kootenay and Columbia River between Nelson and the US border.

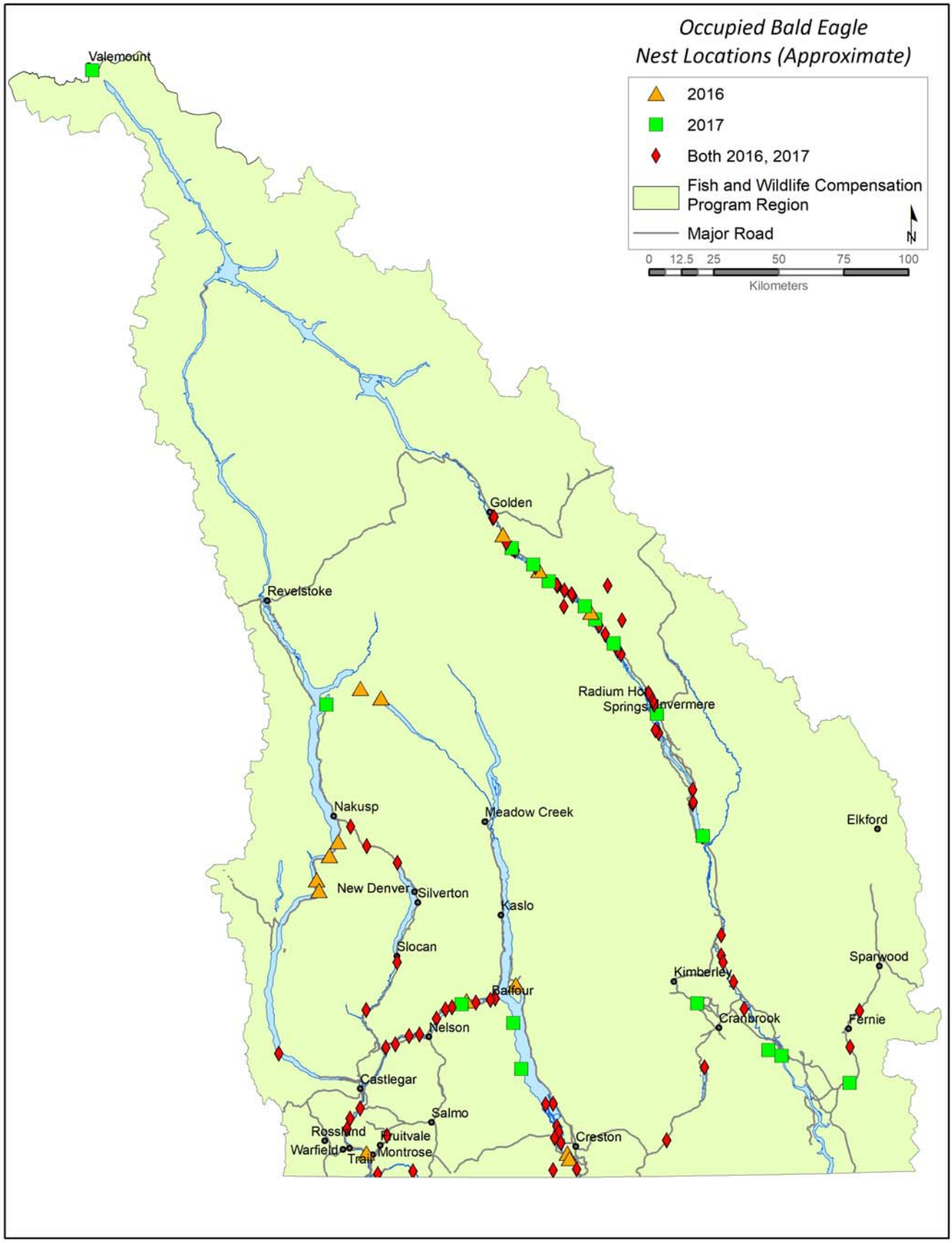


Figure 4. Occupied bald eagle nests surveyed in the Columbia Basin during 2016-2017.

Table 5. Summary of bald eagle breeding survey results from this study (2016-2017) and other previous surveys for portions of the Columbia Basin.

Survey Area	Year	# Active Nests	Source
Columbia Basin (excluding North Columbia)	2017	91	This report
Columbia Basin (excluding North Columbia)	2016	91	This report
Columbia Basin (excluding North Columbia)	2007	60	Machmer 2008
Columbia Basin (excluding North Columbia)	2006	37	Machmer 2007
Columbia Basin (excluding North Columbia)	2005	17	Machmer 2006
East Kootenay	2017	56	This report
East Kootenay	2016	49	This report
East Kootenay	2007	32	Machmer 2008
East Kootenay	2006	25	Machmer 2007
East Kootenay	2005	14	Machmer 2006
West Kootenay	2017	35	This report
West Kootenay	2016	42	This report
West Kootenay	2007	28	Machmer 2008
West Kootenay	2006	12	Machmer 2007
West Kootenay	2005	3	Machmer 2006
Columbia Wetlands Wildlife Management Area	2017	39	This report
Columbia Wetlands Wildlife Management Area	2016	36	This report
Columbia Wetlands Wildlife Management Area	2007	28	Machmer 2008
Columbia Wetlands Wildlife Management Area	2006	22	Machmer 2007
Columbia Wetlands Wildlife Management Area	1994	22	Blood and Anweihler 1994[1]
Creston Valley Wildlife Management Area	2017	8	This report
Creston Valley Wildlife Management Area	2016	10	This report
Creston Valley Wildlife Management Area	2007	6	Machmer 2008
Creston Valley Wildlife Management Area	2006	7	Machmer 2007
Creston Valley Wildlife Management Area	1997	5	McMann 1997
Creston Valley Wildlife Management Area	1996	5	McMann 1996
Creston Valley Wildlife Management Area	1982	4	Forbes & Kaiser 1982

[1]The survey area within the Columbia Wetlands was slightly different, ranging from Athalmer to Donald.

For the most part, eagle and heron nesting sites appear to overlap in most areas although eagle nests are much more widely distributed (compare Figure 4 with Figures 2 and 3).

Eagle survey results are summarized in Table 5 and compared with available data for previous years. The survey found a total of 91 active eagle nests in 2016 (42 in the West Kootenay and 49 in the East Kootenay), and 93 active nests in 2017 (35 in the West Kootenay, 56 in the East Kootenay, and 2 in the North Columbia Region). This compares with 60 active nests (28 and 32 in the West and East Kootenay, respectively) documented during the last eagle nest survey in 2007, using the very same methods (Machmer 2008). The latter survey included only the East and West Kootenay, so the incremental increase in those areas only is 31 nests (from 60 to 91), which represents a 51.7% increase in the last ten years. This trend follows other reported increases from previous years. For example, only 37 active nests (12 and 25 in the West and East Kootenay, respectively) were reported in 2006, and the basin total was only 17 in 2005 (Table 5). The latter changes were attributed to greater survey effort (outside the CWWMA and the CVWMA), and to eagle nest sighting information provided by the public in 2007. Changes

from 2005 to 2006 were attributed to more systematic counts and additional nests found through aerial surveys. However, the 51.7% increase in eagle nests in the last 10 years cannot be attributed to differing methods or survey effort, so there does indeed appear to be substantial growth in numbers of occupied eagle nests.

The CVWMA and CWWMA represent portions of the basin where survey effort has been relatively consistent from 2006 onwards. Comparing these two areas, there seems to be an increasing trend in nest activity (Table 3), especially when compared with previous surveys (Forbes and Kaiser 1984; McMann 1996, 1997; Blood and Anweihler 1994). These differences, as well as the more recent increase between 2007 and the present, provide good support for growing eagle breeding populations.

As previously indicated, surveys in all years have been conducted opportunistically, focussing on survey routes likely to support nesting herons. No reports of breeding herons have been received from the Meadow Creek to Trout Lake and Beaton Arm segments of the basin in the last two years, hence these areas were not emphasized for surveys. The number of eagle nests along this corridor is likely under-represented for this very reason.

In terms of bald eagle nest trees, 88 of 106 (83%) visible nest trees over one or both years were in black cottonwood trees (83 live and 5 dead), and the remaining 18 were in coniferous tree species (7.5% ponderosa pine, 3% Douglas-fir, 3% hybrid white spruce, 1.9% western red cedar, and 1% each of western larch and lodgepole pine). These results suggest that bald eagles in the Columbia basin are using black cottonwood disproportionately for nesting, as herons reportedly did in the 1980's (Forbes et al 1985a). The apparent shift of herons from breeding primarily in cottonwood to conifer-dominated stands (which are often located further away from water) may be the result of increasing eagle populations displacing herons from preferred habitat. One might also interpret the heron shift as a predator avoidance response (i.e., opting for greater concealment in conifers and reduced overlap with eagles), but the full implications of such shifts (e.g., increased travel time to forage, differences in concealment with season, etc.) merit further study. However the fact that some herons nest stands have been usurped directly by eagles (pers. obs.), lends some support to the displacement hypothesis.

3.5 Heron Wintering Observations

A survey of heron overwintering activity (loosely defined as November 1 to February 30) was conducted based on (a) follow-up of sightings provided by the public (in 2016-2017 and previous years; see Appendix 1c), and (b) visits to priority sites based on high habitat potential (i.e., valley bottom areas with ice-free watercourses and nearby rich foraging sites in the southern portion of the basin; see Appendix 1a for survey routes). Overwintering locations are mapped in Figure 5 and detailed in Appendix 1g.

Results indicate that more northerly parts of the basin (i.e., areas just downstream of Revelstoke and east in the Columbia Wetlands, near Parson) only support herons occasionally foraging as individuals during the colder winter months. Similarly, where temperatures are cooler further to the south in the in East Kootenay Trench, only scattered individuals were confirmed in winter, foraging along flowing ice-free watercourses (e.g., St Joseph's Creek and a creek flowing south of Ft. Steele). Individual herons were also sighted by Kaslo and Nakusp in the winter months, and 1-2 herons were documented at the north end of Kootenay Lake, by Meadow Creek to Argenta. Typically more are reported at the south end of the Kootenay Lake in the Creston Valley (pers. obs.). In past years, as many as 5-10 herons have been reported

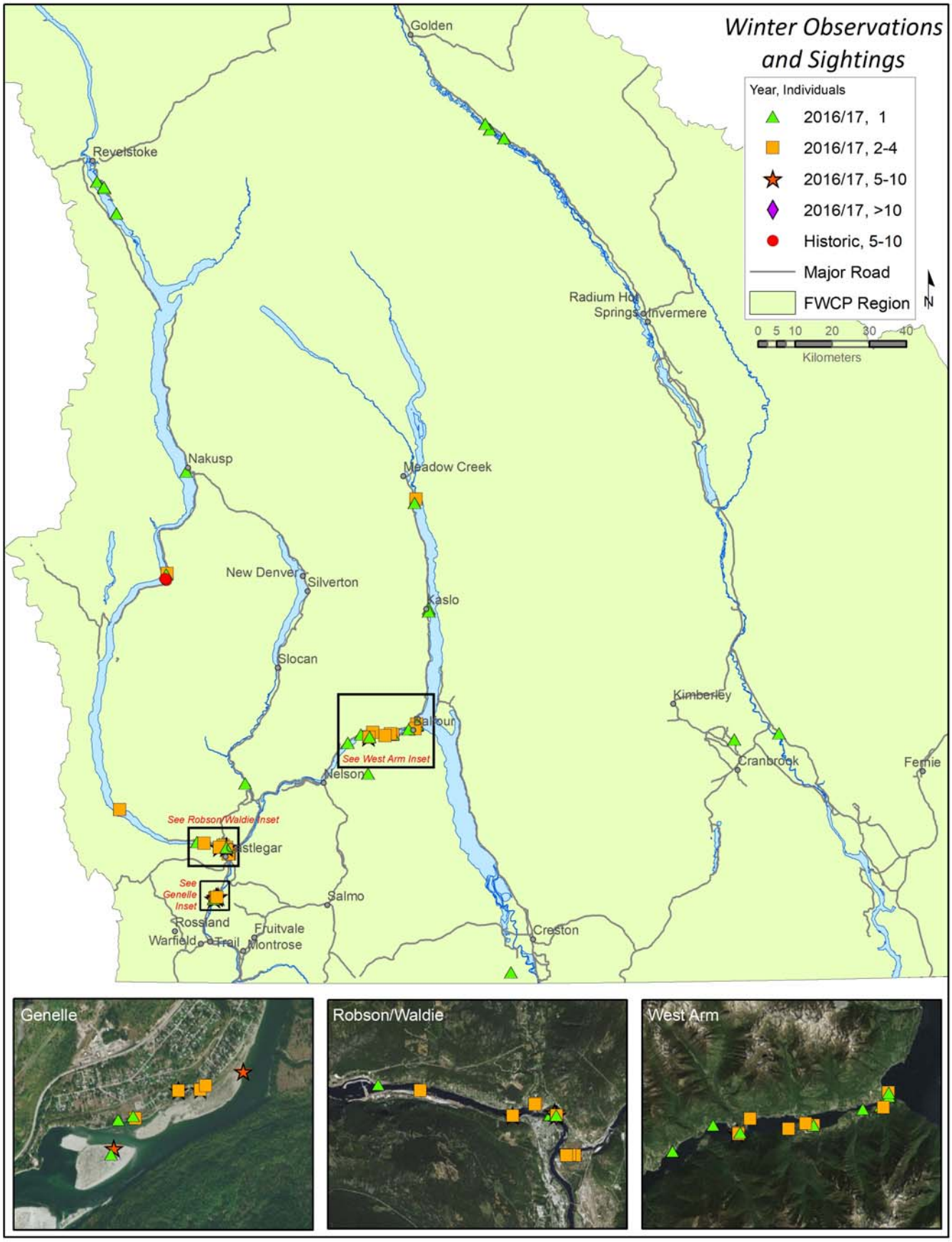


Figure 5. Observations and sightings of herons during winter months (November to February).

arriving at Burton Creek by late summer, and then staying through early fall and persisting through at least a part of the winter (pers. obs,; Gary Davidson pers. comm.). Apparently MacDonald Creek Provincial Park is an area where herons are sometimes aggregated in fall and winter (Terry Anderson, pers. comm.), although none were confirmed there in winter 2016).

Further south, wintering herons are commonly seen in the Robson area, from Hugh Keenleyside Dam downstream to Waldie Island (a well-known wintering habitat; Walter Volovsek, pers. comm.). In past years, close to 30 herons roosted on main forested Waldie Island, across at Breakwater Island, and on associated gravel bars in the river channel, while foraging from Hugh Keenleyside downstream to Pass Creek and towards Brilliant (Machmer 2002, 2003). A maximum of 15 were counted at Waldie Island on November 17, 2016 (Caroline Halligan, pers. comm.), and daily counts conducted from November to late February indicated that heron numbers fluctuated considerably, but definitely peaked in mid to late November and then started to decline by early December, with some individuals lingering till late February (Caroline Halligan, pers. comm.). These trends are entirely consistent with those reported earlier (Machmer 2002, 2003). In winter 2016, water levels were very high in all areas downstream of Hugh Keenleyside Dam, and even the trees on main Waldie Island were partially submerged by increased flow levels (pers. obs.). This leaves herons little in the way of options for foraging and loafing in lentic, shallow water habitats where they are buffered from disturbance (i.e., people, dogs and other predators).

From August onward in both years, herons were also aggregated at a second site further downstream on the Columbia River at Genelle. Consistently, 5-6 herons were roosting here (either perched in trees downstream of Whispering Pines Trailer Park, or standing on gravel bars and nearby islands in shallow water (Debbie Kennedy, pers. comm.). As water levels rose in November, the gravel islands became submerged and only the shoreline bars were still available for perching, occasionally leading to conflicts between herons and people using this area (for ATVing, walking, and especially dog-walking; pers. obs.).

Another area where herons are reliably seen in winter is the West Arm of Kootenay Lake, with most sightings reported from Kokanee Creek Provincial Park (Joanne Siderius, pers. comm.), Sunshine Bay (Harrop) Wetlands Regional Park (Susie Armishaw, Charlie Zinkan, pers. comm.) and Balfour Beach Regional Park (pers. obs.). In all three areas, herons roost in trees and on nearby gravel bars, feeding along ice-free watercourses. All three areas are intensively used by people for winter recreation, typically leading to displacement of herons. Dog-walking in particular is a very popular activity, and conflicts between unleashed dogs and herons have been documented in all three locations, leading to displacement and risk of injury/mortality for herons.

Although not related directly to winter observations, at least five herons were reported injured and/or dead between late July and October of 2017:

- one heron with an injured wing reported at Fraser Narrows on July 24, 2017 (Nathan Smienk, pers. comm.);
- one dead juvenile heron reported along the shoreline at Pass Creek Regional Park on September 22, 2017 (Alison Lutz, pers. comm.);
- one dead and one injured heron (both with broken wings) that subsequently died at Balfour Beach Regional Park on October 5 and 7, 2017, respectively (pers. obs.);
- a second hand account of a heron washed up in Balfour in late September of 2017 (Laura Dunsmore, pers. comm.); and
- one dead heron being devoured by crows and ravens in the Six-Mile Beach area in late October after several days of loafing nearby (Dave Afford, pers. comm.).

Table 6. Wintering areas with heron aggregations, land ownership, management concerns and stewardship follow-up recommendations.

Wintering Area	BEC Unit	Ownership	Documented Management Concerns	Stewardship Follow-up Recommendations
Burton Creek	ICHmw2	Crown	Motorized use (ATVs, dirt bikes, 4x4's), unleashed dogs and displacement by people. Note: Similar concerns were also documented on gravel bars at MacDonald Creek Provincial Park in previous years, although not confirmed in 2016.	Work with local stewardship groups, stakeholders and FLNRO to develop signage, improve awareness of herons and impacts, establish motorized activity restrictions with compliance/ enforcement in Burton Creek estuary and associated gravel bars/wetland areas; establish remote cameras to further investigate conflicts; pursue WHFs designation and/or and securement with BC Hydro. Investigate possible conflicts at McDonald Creek.
Creston	ICHxw	Crown (WMA)	No concerns documented	n/a
Waldie/ Robson	ICHxwa	Crown/Nature Trust	Displacement from key roosting and foraging areas by people and unleashed dogs, with risk of injury/mortality; extremely high and low flows, with both ends of the spectrum reducing suitable roosting and feeding habitat	Work with Nature Trust, FLNRO, RDKB and stewardship groups to improve awareness of herons and impacts at Waldie Island and Pass Creek RP, increase compliance/enforcement; reconsider existing use (dog use), given the proliferation of other walking trails in Castlegar; establish remote cameras to gather evidence of conflicts. Engage with BC Hydro on improvement to flow management.
Genelle	ICHxw	Crown	Motorized recreation (ATVs, dirt bikes) and Displacement from key roosting and foraging areas by people and unleashed dogs, with risk of injury/mortality; with both ends of the spectrum reducing suitable roosting and feeding habitat	Work with local stewardship groups, stakeholders and FLNRO to develop signage, improve awareness of herons and impacts; establish access controls and motorized activity restrictions with follow-up compliance/enforcement; designate WHFs. Engage with BC Hydro on improvement to flow management.
Kokanee Creek	ICHxw	Crown (PP)	Displacement from key roosting and foraging areas by people and unleashed dogs	Work with BC Parks, local stewardship groups, and FLNRO to develop signage, improve awareness of herons and impacts, and increase follow-up compliance/enforcement, especially from October-March, when the campground is "closed" but day use is permitted; establish remote cameras to further investigate conflicts.
Harrop Wetlands	ICHxw	Private/Crown (RP)	Displacement from key roosting and foraging areas by people and unleashed dogs, with risk of injury and mortality; occasional motorized use	Work with RDCK, local stewardship groups, and FLNRO to reconsider use (ATVs, dogs), develop explicit signage, improve awareness of herons and impacts, and increase follow-up compliance/enforcement, establish remote cameras to further investigate conflicts (see recommendations in Appendix 4).
Balfour Beach	ICHxw	Crown (RP)/ Private	Displacement from key roosting and foraging areas by people and unleashed dogs, with risk of injury and mortality;	Work with RDCK, local stewardship groups, and FLNRO to reconsider uses (dog-walking), develop explicit signage, improve awareness of herons and impacts, and increase follow-up compliance and enforcement, establish remote cameras to further investigate conflicts (see recommendations in Appendix 4).

Causes of injury/mortality remain unknown and are likely varied, however apparent conflicts between herons and unleashed dogs were noted during fieldwork at both Balfour Beach and Sunshine Bay (Harrop) Regional Park in winter 2016 and summer 2017.

For key locations documented to support winter aggregations of herons only, preliminary management concerns are summarized in Table 6 (although these merit further evaluation), and general follow-up stewardship recommendations are provided.

3.6 Heron Stewardship Follow-up Activities

A number of general and site-specific stewardship follow-up recommendations that could not be completed under this contract budget are provided in Section 5, Table 6 and Appendix 2 of this report. Appendix 2 also provides details of all stewardship follow-up actions conducted from February 2016 to October 2017 at specific sites; for confidentiality reasons, only general stewardship follow-up actions are described here:

- A member of the public requested information from the FWCP (Larry Ingham) regarding drone use to take pictures of birds. He wondered if there were any rules or guidelines on using a drones for photography of herons, eagles, ospreys, and other wildlife species. MM researched this issue and provided a response on behalf of the FWCP and updated the heron landowner/land manager brochure to reflect this issue.

- MM prepared a referral response to a Section 57 Application (Rosebery to Summit Lake Rail Trail) for a proposed motorized loop trail and bypass trail through the Bonanza biodiversity corridor. MM provided information on 2016 heron sightings in this corridor, as well as previous sightings and likely impacts of the proposed recreational development on local heron breeding activity.

- In collaboration with West Kootenay Naturalist members Peter Woods and Ed Beynon, MM met with BC Hydro environmental representatives (Mary Anne Coules, James Baxter and Susan Pinkus) regarding flooding of high value heron roosting and foraging habitat during winter months on the lower Columbia, and at Waldie Island in particular.

- As a member of the Revelstoke 6 Technical Working Group representing the Ktunaxa, MM participated in four workshops from 2016-2017 where she raised concerns regarding impacts of Revelstoke dam operations (and incremental impacts of the Revelstoke 5 and 6 projects) on downstream heron populations. Issues discussed included impaired heron foraging habitat availability, suitability and success resulting from increased water levels, peak flows, and associated erosion and sedimentation. Potential mitigations were also discussed focused on this species in areas downstream of Revelstoke and Hugh Keenleyside dams.

- MM responded to a request from BC Hydro (Phil Bradshaw) to provide historical and current data on breeding occupancy and success for heron breeding sites on the Lower Arrow/Columbia River system, which could be linked to reservoir operations and heron winter use of Waldie Island.

- MM conducted site visits to Balfour Beach Regional Park and Sunshine Bay (Harrop) Regional Park with Joe Chirico and Cary Gaynor to discuss various management concerns with respect to herons, their habitat, and conflicts between herons and people as well as unleashed dogs. MM subsequently developed and submitted a series of recommendations and mitigation measures to reduce conflict and improve protection for herons at both these parks, and potentially others (e.g., Pass Creek Regional Park, Kokanee Creek Provincial Park, etc.

- Confidential heron nest location data were submitted to RDCK, RDEK, RDKB planners (Tom Dool, Andrew McLeod, Donna Dean, pers, comm.) for inclusion in their GIS mapping layers. The same data was submitted to the BC Conservation Data Centre and is being reformatted for submission to Wildlife Species Inventory (WSI) database.

- MM worked with local residents and communicated with veterinarian Adrienne Clay at BC Wildlife Park to facilitate the transfer of injured heron chicks from Revelstoke to Kamloops and the subsequent re-introduction of two young to Revelstoke. Similar efforts were made to address injured herons with a rescue group and local residents in the Balfour area, however both injured birds subsequently died.

- MM is working with Lindsay Anderson and Lisa Tedesco to improve protection for specific eronries located on crown land. Interim designation of Wildlife Habitat Features and longer term designation of Wildlife Habitat Areas (assuming sites remain occupied based upon monitoring) will be sought for at least three sites.

- MM shared heron/eagle/cormorant data for CVWMA with Marc-Andre Beaucher, discussed strategies and shared information to deal with drone use and the establishment of blinds at CVWMA heronries by members of the public (possibly photographers and/or hunters).

- MM responded to Daybreak Prince George host George Baker regarding Nexus LNG plant pre-assessment work and heron abandonment at Dodge Cove.

- MM gave a presentation on the heron project at the 2016 KCP Fall Gathering in Creston (November 25, 2016), under the theme of “Benefits of Citizen Science” using the heron project as a model. She also attended the KCP Landowner Outreach Workshop (October 19, 2016), Steering Committee meeting (January 9, 2017) and Stewardship Committee Conservation Toolbox meeting (October 17, 2017), where there were opportunities to discuss various initiatives, using the heron project as an example.

- MM worked with Sherri Regnier at Trail Black Press on a heron article promoting awareness of listed critters in lower Columbia (see Appendix 5). MM followed up with Sherri in mid-October and she would like to do a follow-up article highlighting the inventory findings and stewardship follow-up actions. In particular, the article would bring greater awareness to recent heron mortalities, sensitivities of herons in winter at key sites and how the public can help.

- MM gave a slide presentation on the long term inventory, monitoring and stewardship results of the heron project on July 18, 2017, as part of BC Park’s Tuesday night “Science in the Park” series.

- MM collaborated with the Columbia Wetlands Waterbird Monitoring Group regarding the sharing of relevant heron and eagle data gathered for 2016-2017, which was later provided to Rachel Darvill.

- MM will forward a digital copy of this final project report to all members of the Pacific Northwest Heron Working Group to update other transboundary heron researchers on the status of inventory, monitoring, management and stewardship efforts in the BC portion of the Columbia River basin.

4.0 DISCUSSION

More than 530 discrete heron sightings were received in 2016-2017 from more than 250 volunteers. This level of public interest and engagement was extremely encouraging and instrumental in finding several newly heron breeding and roosting sites in the Columbia basin. Various general and site-specific stewardship follow-up actions were conducted, which has improved public awareness of heron sensitivities, and achieved greater protection and reduced disturbance at selected sites. Additional recommendations are provided for improving public awareness (next section), follow-up stewardship actions at specific breeding sites (Appendix 2) or overwintering areas (Table 6 and Appendix 4), reconsideration of land use and greater compliance and enforcement actions on conservation or park lands (Table 6), establishment of WHAs/WHFs on crown land, and land securement on private land.

Although heron nesting success, activity and colony size can vary considerably from year to year, inventory findings for the 23 heron breeding sites confirmed in 2016-2017 indicate high rates of breeding failure (52.1% and 36.4% of active nests failed in 2016 and 2017, respectively) and a declining trend in active heron nests. The 2017 results represent the lowest number of active nests (173) ever recorded in the basin (despite the greater search area, time and effort spent), since monitoring was initiated in 2002. Furthermore, average heron breeding colony size plummeted to single digits (9.6 ± 2.3) in 2017, for the first time since monitoring began, and this decline has unknown implications for heron reproductive success, vulnerability to predation, nest site defense and detection.

Overall, it is clear that bald eagle harassment and predation is a key driver of heron mortality and site abandonment (Machmer 2009 2013, 2014; this study), but other predators and scavengers (such as crows, ravens, etc.) play a significant and often synergistic role. Habitat development and associated disturbance is also affecting heron site fidelity and breeding success, as do natural factors, such as windstorms and competing species. These different factors typically interact, and may lead to site abandonment and/or shifting of herons to one or more new sites, often in proximity to the same longstanding foraging areas. The long term implications of breeding site shifts and/or splintering of large heron colonies into several smaller ones is not well understood, but monitoring suggests it may be a more frequent phenomenon, compared with historical patterns (Forbes et al. 1982). Some might argue that colony site abandonment and splintering is an adaptive response to nest predation (by eagles and other predators), which “spreads the risk” and may also reduce conspicuousness and detection of heron breeding sites. Conversely, herons may be less able to defend themselves when in smaller colonies, and further study is needed to better understand the dynamics and outcomes of such shifts.

Based on monitoring findings, numbers of occupied bald eagle nests are increasing in the basin. This increasing trend is associated with a breeding shift (and some anecdotal displacement) of herons from prime riparian cottonwood-dominated breeding stands to conifer-dominated stands, which tend to be further from riparian/wetland foraging sites. If herons are being forced out of breeding sites more frequently (due to eagles, other predators, disturbance/development), then it is critical that they have alternate breeding sites close by to use, which are in proximity to traditional and often limiting foraging areas (Knight et al. 2016). This requirement is a key consideration for land securement and conservation covenants to protect breeding habitats, as well as the establishment of Wildlife Habitat Area (WHAs). To justify the time and effort needed for their establishment, WHAs must include active and several suitable alternate candidate nest sites within an overall nesting area in proximity to known rich foraging areas. The latter can take

1-2 years to establish, because of consultation and administrative requirements (pers. obs.). In the interim, designating a Wildlife Habitat Feature (WHF) may offer some short-term restrictions on activities around occupied breeding sites, and this designation may also be applicable to certain key wintering sites on crown land.

Finally, it is interesting to note that eight or more of the 14 successful breeding sites in one or both years were confirmed to have ospreys (*Pandion haliaetus*) nesting very close by, which were active in nest defense (i.e., alarm vocalizations, aerial pursuit) when the sites were approached. The Elk River site in Sparwood actually had a red-tailed hawk nesting within ≈2 m of a heron nest, and the Leach Lake and Salmo cutblock breeding stands had red-tailed hawks nesting within ≈150 m. The presence of some other raptors (and the nest defense behaviors they exhibit when intruders approach) may serve a beneficial early warning nest site defense function, especially in the case of bald eagles and aerial predators (Machmer 2014; pers. obs.), despite observed conflicts between herons and these other raptors. Such interactions merit further study and if validated, one strategy to improve heron reproductive success may be to install osprey nest platforms in proximity (≈200 m) to established heron breeding sites, with the objective of conferring some nest defense benefit.

The North Columbia region does appear to support isolated heron breeding activity (at Legrand, for instance), although in general, heron occurrence was relatively low, and based on sightings, activity may be diminishing in areas that were previously active. Potential factors impacting localized heron activity include water level fluctuations, erosion and sedimentation, logging and land clearing for development, livestock grazing, interface fuel treatment, pipeline construction and associated riparian/wetland degradation; and motorized and other recreational activities. Nevertheless, some areas visited had relatively high habitat potential (for heron breeding and feeding) and evidence of previous activity. Some restoration and/or enhancement actions (to address impacts of upslope logging, erosion and riparian vegetation clearing along roadsides (extending from Tête Jaune Cache FSR westward to Red Pass junction; see Table 3) could improve the potential for future re-occupancy.

Winter represents an energetic bottleneck for herons, and winter sightings and data gathered for this project indicate several key areas where herons appear to be aggregating in southernmost portions of the basin. Management concerns were identified with respect to key sites only, and stewardship recommendations were provided, in light of observed land use conflicts and the apparent risk of injury and mortality to listed herons.

5.0 RECOMMENDATIONS

A suite of site-specific stewardship recommendations for new and some previously existing heron breeding sites active in 2016 and/or 2017 are provided in Appendix 2. The following general recommendations are proposed in conjunction with this project:

- Study results indicate that great blue heron breeding activity (measured as numbers and success of active nests) has declined in the basin since monitoring was initiated in 2002. It is important that agencies responsible for managing heron populations and tracking their conservation status at the provincial and broader level (i.e., FLNRO, BC CDC, CWS, Canadian Pacific Northwest Heron Working Group) are made aware of these trends, the main threats, and associated concerns. Copies of the final report will be provided to relevant agencies and groups.

- Given the record low numbers of active nests (despite the greater level of survey effort and scope in 2016-2017), it is recommended that emphasis be placed on stewardship follow-up actions in 2018, while systematic monitoring (i.e., based on a minimum of two visits per site, including an early visit to count active nests and a late visit to monitor nest success and productivity) continue at least every second year, according to the same established protocols. Surveys should involve targeted and opportunistic searches for new nests, with the help of established nest stewards and the public. It is also important to continue to document eagle incursions, adult/chick injury or mortality, human and other disturbances, as well as habitat-related impacts, so these can be integrated into follow-up actions.

- There appears to be some potential for herons to return to breeding sites that were abandoned in previous years, even after one or more intervening years (e.g., St Eugene Mission, Carbonate Creek). Hence it is advisable to re-visit previous sites for re-occupancy, even when an intervening year of no use has occurred. Notably, Section 34 of the Wildlife Act protects heron nest trees for up to five years after last confirmed occupancy and it is important for landowners and managers to be aware of this.

- Continue to work with land managers and relevant agency personnel to establish WHAs and WHFs at selected breeding heron sites=. Also further investigate the applicability of the WHFs designation for wintering sites on crown land outside of parks or protected areas. Consider other potential mechanisms (e.g., land securement, conservation agreements, stewardship initiatives with a local NGO, etc.) to increase private land protection, as detailed in Table 6 and Appendix 2.

- Liaise directly with the Nature Trust, RDCK, RDKB, and BC Parks to re-evaluate and refine existing land use, access restrictions, fencing and interpretive signage to improve protection and awareness of herons and their habitat (see Table 6 for site-specific recommendations). Improving awareness and compliance in parks and protected areas (to maintain dogs on leash in designated non-sensitive areas only, for example) will require a public awareness campaign (supported by evidence of wildlife-human conflict and risk of wildlife mortality), as well as greater local enforcement. Installation of remote cameras at key sites may be helpful.

- Surveys in the North Columbia region confirmed suitable habitats, with previous heron breeding records. Many opportunities for restoration and enhancement were documented (Table 3), notably along the Tête Jaune Cache to Croyden FSR, where extensive shallow wetlands, creeks, river side channels, islands and gravels bars occur. A stewardship group could be encouraged to undertake restoration in this area.

- Interface fuel reduction treatment permits on crown land are being issued without formal referral to FLNRO/MOE (to screen for potential treatment impacts to SAR species and their habitat). This work is contracted to regional districts, so the obligation to refer to governing agencies is left to the discretion of contractors (John Cathro, pers. comm.). There is an apparent need for FLNRO to work on an internal review with MOF Forest Tenures (who provide the authority to complete this type of work) to ensure that referrals pertaining to SAR species and habitats occur. Areas surrounding the Queen's Road heronry received fuel treatment in December 2014 (although the area under the nest trees was not treated). Since then, the stand has experienced very high levels of blowdown (with reduced habitat suitability) and larger untreated buffers are likely necessary to fully protect nest stands.

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APPENDIX 1: Heron Database 2016-2017 (Confidential)

a. Survey Routes

b. Breeding Sites

c. Heron Sightings Database

d. North Columbia Sightings

e. Breeding Site Details

f. Bald Eagle Nest Database

g. Winter Sightings

APPENDIX 2: Stewardship Actions and Recommendations for Heron Breeding Sites (Confidential).

APPENDIX 3: Landowner and Manager Brochure

STEWARDSHIP OF GREAT BLUE HERONS IN THE COLUMBIA BASIN

Adult heron feeding near nest site near Golden, BC

INFORMATION FOR LANDOWNERS, MANAGERS AND THE PUBLIC

The Great Blue Heron (*Ardea herodias*) is a large wading bird found in riparian ecosystems throughout southern British Columbia. In the interior, herons breed near lakes, slow-moving rivers and wetlands in small to large colonies. They feed in shallow water and eat mainly fish, but their diet also includes small mammals, amphibians, reptiles, birds and invertebrates. Herons may remain near open water with access to adequate food throughout the winter.

Herons are known to be in decline in parts of their range in southern B.C. They are "blue-listed" (i.e., vulnerable and of special concern) by the BC Conservation Data Centre, due to habitat loss and disturbance in prime breeding habitats. Environmental contaminants, severe winters, and depredation by eagles can also impact herons.

Valley bottom wetland and riparian areas in the Columbia River Basin are important breeding and overwintering sites for herons. A 2002-2006 inventory found ≤16 active breeding sites in the basin in a given year and >70% of sites are on private land. Collaborative partnerships with landowners is critical to maintain and protect these sites.

Characteristics of Nesting Areas

Herons nest in small to large colonies and select sites within 1.5 km of shallow water feeding areas. Mature coniferous, deciduous and mixed stands with high canopy cover are preferred. Herons typically nest in large live black cottonwood and in a range of conifer tree species. Mature riparian stands represent potential breeding habitat for herons, irrespective of tree species composition.

Habitat suitability also depends on proximity to feeding areas and sufficient buffering from disturbance by humans and predators. Buffers can be in the form of forested stands providing visual screening or a waterway surrounding a site that prevents encroachment into the nest stand. Once established and productive, breeding sites may be re-used for many years.

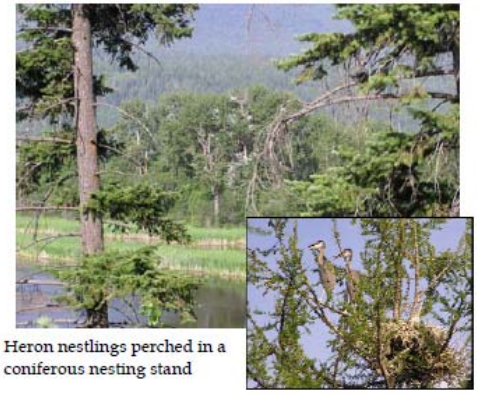
Heron nesting stand in black cottonwood, Creston, BC

Heron adult with young at a nest in a spruce tree

Herons may abandon breeding sites because of disturbance, particularly during the nest-building, egg-laying and incubation phases.

Disturbance examples: clearing of trees in riparian habitat (left) and watercraft active near heron breeding site (right)

Human disturbances that have led to abandonment at breeding sites in the southern BC include nearby forest clearing, construction, road-building, logging, silviculture, motorised activity, livestock grazing, nearby camping, aircraft, helicopter and drone use, etc. Beaver and cormorant activities have also led to nest site failure or takeover, respectively.



Heron nestlings perched in a coniferous nesting stand

Protection of Heron Habitat

Wetlands that are home to Great Blue Herons are some of the richest habitats in the Columbia Basin. Maintaining suitable habitat for herons will protect many other wetland-dependent species as well.

Heron nesting sites are becoming increasingly rare due to:

- hydro-electric power developments that have reduced the quantity and quality of wetland habitats;
- wetlands being drained for various uses (e.g., agriculture, housing and commercial/industrial developments);
- fragmentation of suitable riparian forest stands and loss of existing and potential nest trees to forestry operations and other land clearing and development activities;
- disturbance at breeding and foraging sites by humans and bald eagle depredation; and
- accumulation of persistent environmental contaminants released into the food chain.

What Can the Public Do?

Actions to reduce heron habitat loss and disturbance include:

- avoid cutting mature and old trees;
- retain and protect existing wetlands; and
- avoid disturbance and recreational activities near active heron breeding, feeding, roosting and overwintering sites;
- avoid aircraft, helicopter or drone use near active heron breeding sites.

What Can Landowners and Managers Do?

***** Minimizing disturbance and maintaining nesting and feeding habitats are the key stewardship elements *****

- Minimize disturbance from people, ORVs, machinery, livestock and pets within *a core area* (≈300 m radius) around heron nesting areas during *the breeding season* (March 1 – August 15).
- Avoid tree harvesting and road-building within core areas.
- Maintain non-fragmented forest, existing and suitable alternate nest and roost trees, and nearby riparian feeding habitats.
- Where modifications are unavoidable within the core area, maintain and plant vegetative screening between the activity/modification and the colony. Also consider constructing a fence or other barrier between the activity and the screening to buffer the site.

Longer Term Options for Occupied Sites

- Explore the possibility of a land conservation agreement (e.g., purchase, covenant, trust) for the site.
- Consider the broader landscape context and prioritise conservation of areas where several suitable sites are present with foraging habitat nearby.
- Monitor and protect the site from other possible stressors (e.g., beavers)

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Columbia Basin trust

FWCP Fish & Wildlife COMPENSATION PROGRAM

APPENDIX 4: Regional Park Recommendations (Confidential)

APPENDIX 5: Heron Article

Study of great blue herons underway; public encouraged to report sightings

This heron was spotted near the marsh land below Oasis last week. The Fish and Wildlife Compensation Program is asking for the public's help in tracking great blue herons in the Kootenays. Guy Bertrand photo

SHERI REGNIER
Trail Times

The population trend of birds is very telling of how well an ecosystem functions.

So the decline of any given bird species, in this case, the great blue heron, can be a foreboding that something is not quite right with Mother Nature.

Human disturbances such as land development and operation of dams in the Columbia River Basin, as well as natural predation, prompted a breeding inventory and habitat assessment of the great blue heron this year, with funding from Columbia Basin Trust and the Fish & Wildlife Compensation Program (FWCP).

The great blue heron is a regal sight, characterized by subtle blue-grey plumage and slow, rhythmic wing beats. Rarely venturing far from bodies of water and wetlands, the bird often stands motionless as it scans for prey or wades belly deep with long, deliberate steps. They move slowly, but can strike like lightning to grab a fish or snap up insects and sometimes small mammals, like rodents.

"Various forms of development and human activity in areas where herons breed and feed is the biggest factor that lead to greater habitat fragmentation (and) disturbance," explains project leader Marlene Machmer of Pandion Ecological Research Ltd. "Followed by site abandonment, lower reproductive success and declining heron populations over time."

Machmer's project actually began in 2002 (supported by the FWCP) because systemic heron surveys had not been undertaken in the Basin since the 1980s, and heron studies in coastal B.C. were indicating dramatic declines in populations.

For six years, public sightings throughout the region were followed up by a biologist, adding to ground-based and aerial surveys - but monitoring became less intensive and mostly voluntary in 2008.

The project picked up speed earlier this year after recent data showed the lowest number of breeding sites and active nests every recorded since the program began - and once again Machmer is asking the public for help.

"We know it has been tough for breeding herons in many parts of the basin; at one rookery near Golden, for example, all of the 25-plus active nests were abandoned in 2011 due to suspected eagle harassment and predation, " she explained.

Wetland drainage, changes to water level management regimens, tree and brush clearing along lake shores and the riverine, incursions by foot or motor into breeding and feeding areas are other factors, she added.

"Nest disturbance, failures and colony abandonment are common. We want to develop an updated and comprehensive picture of heron breeding activity, success and habitat use across the Basin, to be follow up with actions to help this species at risk."

Anyone in the East and West Kootenay or North Columbia region who spots a heron, a heron nest, active breeding colonies, or large groups of the birds gathering to feed, is urged to report the sighting to the West Kootenay Naturalists' Association.

Observations will be followed up by Machmer and Basin volunteers, to help update heron breeding population estimates and alert biologists to new breeding and wintering sites that could potentially benefit from habitat protection or enhancement.

"It is beneficial for the public to learn about declining heron populations trends, so that they have a heightened awareness of this species, its habitat and conservation concerns they currently face," says Machmer. "So that they are more likely to be attentive and act to improve habitat protection and reduce threats."

Herons are large, noticeable and easily identifiable bird with a broad patchy distribution in wetland and riparian habitats across the basin, so it is not possible for one biologist to systematically survey herons in all potentially suitable areas.

"People are curious, observant, active and continuously exploring the outdoors," says Machmer. "By engaging interested volunteers and the general public across the basin, there is an opportunity to raise awareness and capitalize on the eyes, ears and sighting of many more observers."