GREAT BLUE HERON BREEDING INVENTORY AND STEWARDSHIP IN THE COLUMBIA BASIN

Prepared for:

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Executive Summary

From May to August of 2004, Pandion Ecological Research Ltd. completed year three of a Great Blue Heron breeding inventory, habitat assessment and stewardship project in the Columbia Basin. This project was funded by the Columbia Basin Fish & Wildlife Compensation Program and Fortis BC. It was intended to provide resource management agencies with updated information on heron population estimates and breeding distributions, and to promote public awareness, stewardship, habitat protection and enhancement efforts aimed at this blue-listed species.

The following project objectives were included in year three and are summarized in this report:

1. Continue with systematic monitoring at historical, active and good potential sites in the Columbia Basin and assess breeding activity and productivity at active sites;
2. Monitor Bald Eagle activity and human disturbance and their respective impacts on heron nesting at active breeding sites;
3. Co-ordinate selected volunteers to assist with field surveys and observations;
4. Promote and assist heron habitat stewardship by:
   a) distributing heron habitat stewardship brochures to landowners where nesting herons are present, b) meeting with NGO groups to enlist their assistance with landowner contacts, negotiating covenants, stewardship agreements, and c) providing technical assistance in support of stewardship agreements where appropriate;
5. If resources allow, assess land status and stewardship options for heron overwintering sites;
6. Liaise with relevant agencies and update them on local inventory data, and monitoring and management efforts;
7. Produce a report that summarizes all project components including stewardship efforts and provides recommendations for future work; and
8. Extend the results of this initiative to basin residents and the general public to promote awareness, stewardship and conservation efforts directed at this species, its habitat, as well as specific sites of importance.

A total of 36.3 person-days were spent by biologists conducting field surveys during 2004. These days were supplemented by 14 person-days spent by CBFWCP technicians assisting with focal observations at selected breeding sites. Fourteen active heron breeding sites (2 new sites and 12 sites re-occupied from 2003) were confirmed in 2004. Ten were located in the East Kootenay and the remaining four were found in the West Kootenay. The largest known heron breeding colony in the East Kootenay located near Parson was abandoned in early May of 2004, and herons were observed building nests at a new site where they failed to produce young. During the three years of the inventory, a total of 34 breeding sites (14 active and 20 historical) were documented in the Columbia Basin.

Not counting re-nests, a total of 248 active heron nests were confirmed in 2004 (115 in the West Kootenay and 133 in the East Kootenay). These numbers are lower than those found during 2003 and 2002 (286 and 257 active nests, respectively). Active colonies had from 1–24 nest trees (mean ± SE = 9.9 ± 2.0) supporting 1–91 active nests (mean ± SE = 20.7 ± 7.1) and five large colonies with ≥20 active nests accounted for 77% of all active heron nests in the basin. Colony size was lower in 2002-2004 relative to sizes (29.6 ± 6.5 active nests) reported by Forbes et al. (1985a) for the Columbia Basin. Smaller colonies are reported to have consistently lower reproductive success and higher nest failure rates, so this trend could have negative implications for future heron recruitment.

Reproductive success in heron breeding colonies averaged 2.56 ± 0.22 chicks per successful nest (n = 127) and 1.78 ± 0.35 chicks per active nest (n = 194), based on a sub-sample of visible nests that were

consistently monitored. These rates are comparable to those obtained in 2003 and 2002. Active nest failure rates were very high in 2004 with 35% (67 of 194) of all active visible nests failing to produce young. This rate is substantially higher than failure rates of 20% and 24% in 2002 and 2003, respectively (Table 2). Failure rates were highest in the East Kootenay where more than half (44%) of all active nests failed to produce young. Higher rates were due to the failure of the Parson site as well as low nest success in the Sparwood and Gold Creek colonies.

The majority (67%) of antagonists detected at heron breeding sites were Bald Eagles and eagle activity was confirmed at seven of nine breeding sites where focal observations were conducted. Early season eagle activity was reported at both the Proctor and Parson Southeast colonies, however both sites were abandoned before the potential impact of eagles could be evaluated directly. Eagle incursions were clearly a factor in the abandonment of the Parson Northwest site. Other antagonists noted during observation sessions included Osprey (20% of encounters), humans (6%), American Crow (3%), Common Raven (3%), and Turkey Vulture (2%). Black bear sign was observed anecdotally in heron stands. Encounter rates for all antagonists combined were relatively low (average of 0.86 per hour). Heron mortality attributed directly to eagle incursions was not confirmed during 2004 observation sessions, however such incidents were observed in 2003.

Breeding sites were located mainly in drier biogeoclimatic variants from 4–1,300 m (mean ± SE of 180 ± 48 m) away from water bodies. Closest water bodies included large to small rivers (24%), small lakes and wetland complexes (24% each), reservoirs (12%) and large creeks (15% each) and large lakes (3%). Heron nest stands were characterized as pure coniferous (50%), cottonwood deciduous (44%), and mixed (6%). Breeding sites were in mature (68%), young (23%), and old forest (9%) structural stages and tended to have high levels of crown closure (67 ± 4%). Black cottonwood (*Populus balsamifera*) comprised 46% of nest trees, and all other nest trees were conifers (eight species in total). Nest trees tended to be live trees of large diameter and height, relative to trees available in surrounding stands.

Over half (57%) of the active breeding sites found in the basin during 2004 were located on private land, with the remainder in provincial wildlife management areas (29%), and on crown and city land (7% each). These findings emphasize the need to promote stewardship efforts and work cooperatively with private landowners to protect heron breeding habitat and minimize disturbance at active sites. General and site-specific stewardship activities conducted to date are summarized and additional recommendations for further monitoring, management and stewardship of heron habitat and specific sites are proposed. They include the following:

1. continue monitoring rates of nest activity and reproductive success (per active and successful nest) at known active heron breeding colonies in the Columbia Basin based on protocols established from 2002-2004;
2. continue to undertake stewardship activities aimed at securing conservation agreements, covenants or land acquisitions for active heron breeding sites based on the priorities and responsibilities summarized in this report;
3. conduct breeding surveys for Bald Eagles in the Columbia Basin (or portions thereof) to evaluate changes in population trends and establish a benchmark for comparison;
4. conduct late fall/winter heron searches in the basin (based on existing data in the sightings database), identify key overwintering sites, and make recommendations for stewardship and habitat protection;
5. establish a formal “heron-watch” program comprised of landowners and close neighbours willing to participate in order to supplement formal monitoring; and
6. undertake or encourage cottonwood protection projects at active and good potential heron breeding sites in the basin and develop a basin-wide cottonwood protection, management and recruitment strategy directed at both crown and private land.

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1.0 Introduction and Background

The Great Blue Heron (*Ardea herodias*) is a large and distinctive wading bird found throughout North America (Butler 1997). Two subspecies are recognized in British Columbia: coastal *A.h. fannini* and the inland continental *A.h. herodias*. Both subspecies are provincially blue-listed by the Conservation Data Centre (CDC 2004) because of habitat loss and disturbance in prime breeding and wintering habitats (Gebauer and Moul 2001). Based on systematic monitoring conducted over the last 30 years, the coastal subspecies appears stable or declining (Gebauer and Moul 2001; Vennesland 2003). Population trends are difficult to interpret for the interior subspecies because data on colony size, breeding activity, nesting success and productivity have been collected sporadically using non-standardized methods (Forbes et al 1985a; Machmer and Steeger 2004).

Herons nest along the margins of lakes, slow-moving rivers, wetlands and sloughs in small to large breeding colonies (Campbell et al. 1990; Butler 1992), and occasionally as single pairs (Machmer 1996; Butler 1997). They typically breed and roost in mature black cottonwood (*Populus balsamifera*) or coniferous trees along lakeshores, on lake islands, in wooded swamps, or other isolated locations near shallow water foraging habitat (Vermeer 1969; Forbes et al. 1985b; Butler 1992a; Machmer and Steeger 2003, 2004). Interior herons eat primarily fish (Forbes 1987a; Machmer 2002), but small mammals, amphibians, reptiles, invertebrates and birds may also be taken (Butler 1992a). As cool weather and freezing conditions approach, some interior herons migrate south, while others remain around ice-free watercourses with an adequate food supply (Campbell et al. 1990; Machmer 2002).

In the Columbia Basin, valley bottom riparian and wetland areas represent important breeding and wintering areas for herons (Gebauer and Moul 2001; Machmer 2001, 2002; Machmer and Steeger 2003, 2004). Forbes et al. (1983, 1985a) compiled information on 19 breeding colony sites known in the basin prior to 1983, however many of these sites are no longer occupied. Systematic monitoring of active breeding sites is essential to estimate population trends and identify critical sites for habitat protection (Gebauer and Moul 2001). Such monitoring was initiated in the Columbia Basin during 2002 and 2003 (Machmer and Steeger 2003, 2004). Sixteen active sites with 257 active nests were counted in 2002 and 286 active nests at 15 sites were documented in 2003. Rates of breeding colony failure were 25% and 7% in 2002 and 2003, respectively.

Herons frequently abandon breeding sites when disturbed, particularly during the early stages of nest building, pair formation and egg-laying (Quinney 1983; Butler 1992a; Vos et al. 1985; Vennesland and Butler 2004). Significant sources of heron disturbance at colonies include Bald Eagle (*Haliaeetus leucocephalus*) attacks and human activity (Norman et al. 1989; Butler et al. 1995; Vennesland and Butler 2004). Both of these factors are negatively correlated with heron nesting productivity and their combined effects are thought to be responsible for higher rates of breeding failure observed at colonies in south-coastal BC (Vennesland and Butler 2004). Both human activity and Bald Eagle incursions were noted anecdotally at breeding colonies in the Columbia Basin during 2002 and 2003 (Machmer and Steeger 2003, 2004), however the frequency and implications of such disturbances have not been evaluated.

In the interior, most heron breeding sites are located on private lands where legislative provisions for habitat protection (e.g., wildlife management areas; wildlife habitat areas, old growth management areas, riparian management areas, wildlife tree patches, wildlife habitat features; federal, provincial parks) do not apply (Machmer and Steeger 2004). Protection of valuable heron breeding and/or foraging sites may best be achieved through land conservation agreements (e.g., purchase, trust, covenant) in such cases (Butler and Baudin 2000; Gebauer and Moul 2001; Vennesland 2004).

In 2004, Pandion Ecological Research Ltd. continued with the systematic breeding inventory and monitoring of heron colonies and focused also on promoting stewardship of active sites. Funding for this project was provided by the Columbia Basin Fish & Wildlife Compensation Program (CBFWCP) with assistance from Fortis BC.

1.1 Project Objectives

Specific objectives of this project in 2004 were to:

1. Continue with systematic monitoring at historical, active and good potential sites in the Columbia Basin and assess breeding activity and productivity at active sites;
2. Monitor eagle activity and human disturbance and their respective impacts on heron nesting at selected active breeding sites;
3. Co-ordinate selected volunteers to assist with field surveys and observations;
4. Promote and assist heron habitat stewardship by:
   a) distributing heron habitat stewardship brochures to landowners and land managers where nesting herons are present,
   b) meeting with NGO groups to enlist their assistance with landowner contacts, negotiating covenants, stewardship agreements, and
   c) providing technical assistance in support of stewardship agreements where appropriate;
5. If resources allow, assess land status and stewardship options for heron overwintering sites;
6. Liaise with relevant agencies and update them on local inventory data, and monitoring and management efforts;
7. Produce a report that summarizes all project components including stewardship efforts and provides recommendations for future work; and
8. Extend the results of this initiative to basin residents and the general public to promote awareness, stewardship and conservation efforts directed at this species, its habitat, as well as specific sites of importance.

This report describes project activities (objectives 1-8) and results completed from April 2004 to January 2005. Extension, stewardship and liaison activities are ongoing and will continue through to March 2005.

1.2 Study Area

The survey area for this inventory encompassed most of the Columbia Basin, as defined by the program mandate of the CBFWCP. This area includes the East and West Kootenays and the Robson Valley (roughly bordered by the Fraser River at McBride in the north, Upper/Lower Arrow Lakes to the west, and the Elk River to the east), but excludes the Okanagan, Similkameen and Flathead drainages.

The vast size of the study area and the available budget did not permit systematic aerial and ground-based surveys of all potential heron breeding habitat in the basin. Areas were therefore prioritized for field inventory based on (a) breeding activity and nature and frequency of reported heron sightings from 2002-2003, (b) proximity to suitable riparian/wetland foraging habitat, and (c) ease of access.

2.0 Methods

2.1 Breeding Inventory and Nest Site Monitoring

Ground-based surveys were conducted at historical, current, and good potential heron breeding sites in the Columbia Basin, based on 2002-2003 findings. Surveys were conducted during the incubation and

nestling periods (late April to early August) using standardized methods outlined by the Resources Inventory Standards Committee (1998) and Moul et al. (2001). Survey areas were generally accessed by vehicle or boat, and more intensive follow-up searches were conducted on foot. Ground-based surveys were supplemented with a fixed-wing aircraft survey of the Creston Valley on June 4th, 2004, in conjunction with their regular spring waterfowl inventories.

2.1.1 Assessment of Nesting Activity

All potential breeding sites were visited at least twice (and up to five times) during the season to quantify abundance (based on the total number of nests visible and the number of active nests). Potential nesting areas were approached cautiously to minimize disturbance, particularly early in the nesting period (April to early June). As the observer entered the colony, he/she searched for signs of activity including presence of eggshells, whitewash, boluses, incubating adults, or chicks in nests. A nest was considered active during the breeding season when a heron was present in the nest and/or fresh eggshells were observed on the ground below the nest (Moul et al. 2001). During initial visits, an accurate nest count was undertaken and the configuration of each colony (i.e., locations/numbers of nest trees and numbers of nests per tree) was mapped out.

2.1.2 Assessment of Nesting Success

Active breeding sites were re-visited in late June to determine nest success and to count the number of young in visible nests. Last visits were scheduled in an attempt to count chicks before they were "branching" away from their nests (i.e., preferably ≤6.5 weeks old) and a nest was considered successful if one or more chicks were observed in the nest at this time (Moul et al. 2001). Reproductive success was calculated based on (a) the number of chicks per successful nest and (b) the number of chicks per active (and visible) nest. Nest visibility was a limiting factor, particularly in large colonies characterized by dense stands of black cottonwood, where visibility deteriorated through the course of the breeding season.

2.1.3 Assessment of Breeding Disturbance

To investigate the frequency and potential impacts of eagle and human disturbance at heron breeding sites, focal observations were conducted at nine active sites. These sites were chosen based on a number of criteria (i.e., ease of site access, ease of viewing the site from a vantage point, previous anecdotal sightings of eagle/human activity) and each was visited 2-3 times from May to early June. Observation sessions ranged from 3-4 hours long and a total of 80.7 hours were spent observing nest sites. After establishing a concealed vantage (located >100 m away from the colony perimeter) and allowing herons to "settle" for 10 minutes, observations of each colony were initiated and efforts were made to minimize any disturbance while collecting observational data.

Data recorded on standardized sheets during these sessions included the following: start, finish and total time; observer(s), viewing location; and number of trees, active nests and nests with chicks (only for smaller colonies); number and duration of disturbances and incursions; heron responses (e.g., vocalizations, number of vacated nests, etc.); and occurrence of any predation/mortality events. A "disturbance" was defined as any adverse response from one or more herons when an antagonist was present, following Vennesland and Butler (2004). Antagonists included avian predators such as Bald Eagle, Osprey (*Pandion haliaetus*), etc., as well as human intruders present within 250 m of a nest colony. An "incursion" was defined as a disturbance resulting from the presence of an antagonist inside the colony at or below canopy level (Vennesland and Butler 2004). Detailed notes were also kept of all incidents. The number and hourly rate of presence, disturbance, and incursion by antagonists was

calculated for each of the nine breeding sites. Similarly, the presence of antagonists, disturbances and incursions was noted anecdotally during visits to five other active breeding sites where focal observations were not conducted. This information provides some evidence of mortality factors that can be linked to nest success and mean productivity at particular breeding sites.

2.1.4 Assessment of Breeding Habitat Characteristics

Assessments of breeding habitat and site characteristics were conducted during the last visit to new active breeding sites. The following site and habitat parameters were recorded during field visits: estimated distance (m) from water and closest water body; dominant forest type and structural stage (as defined by BC Ministry of Environment, Lands and Parks and BC Ministry of Forests 1998); slope and aspect; mean crown closure (defined as the average of four readings taken with a spherical densiometer in the middle of a colony); nest tree species; and estimated diameter [dbh in cm], height [m] and decay class (BC Wildlife Tree Committee 2001) of ≤5 randomly selected nest trees. The locations of all active and historical breeding sites were determined using GPS and mapped by Amy Waterhouse (CBFWCP). The biogeoclimatic zone/variant and land designation and ownership status for each breeding site was subsequently determined from maps, also with the assistance of Amy Waterhouse. A photo record was established for active and historical breeding sites, as well as other features of interest encountered during our surveys.

2.2 Stewardship Activities

Stewardship activities included talking directly with landowners at active and historical nest sites, distributing heron habitat stewardship brochures to landowners/land managers and discussing the options, preparing letters for selected landowners, contacting adjacent neighbours at active sites and enlisting their support with monitoring efforts, writing summary articles, and meeting with NGO groups to enlist their assistance with landowner contacts.

To facilitate possible future follow-up stewardship (e.g., land purchase, covenants, conservation agreements) or management initiatives, *core nest buffers* (and in some cases, *secondary management areas* encompassing important nearby foraging areas, flight paths and/or alternate nesting stands) were identified on maps prepared for each active nest site. Background information used to develop an approach to delineating core nest buffers and secondary management areas included the *Wildlife Habitat Areas* and *General Wildlife Measures* in the *Identified Wildlife Management Strategy* (Ministry of Water, Land and Air Protection 2004), as well as conservation and management information summarized in Butler (1992a, 1992b), Carlson and McLean (1996), Gebauer and Moul (2001), Quinn and Milner (2004) and references therein.

Generally, the approach taken involved evaluating the breeding site location relative to its surroundings and considering other relevant features (e.g., colony size, proximity to known or potential foraging sites, degree of isolation, presence of manmade or natural barriers, degree of habituation to disturbance, etc.) as well as field observations (e.g., flight patterns to/from nest stand, location of nearby foraging activity, location of suitable alternate nesting trees or nest-building activity, nature and direction of any observed disturbances, etc.). In some cases, breeding sites were literally surrounded by an abundance of wetland habitats suitable for foraging, and it was not deemed necessary to delineate secondary management areas to protect nearby foraging sites.

Amy Waterhouse and Mark Schnider prepared maps (1:20,000 orthophoto and/or forest cover) and then digitized core nest buffer and secondary management areas for each active breeding site.

2.3 Opportunistic Bald Eagle Nest Survey

In conjunction with the breeding inventory for herons, the locations and status (not active, active, active with chicks, number of chicks) of any Bald Eagle nests encountered opportunistically were noted. UTM coordinates were either determined with a GPS or estimated, where direct access to the nest site was not possible.

3.0 Results and Discussion

3.1 Breeding Inventory and Nest Site Monitoring

A survey log that lists areas surveyed by date, surveyor, and survey methods used is provided in Appendix 1. Biologists spent a total of 290.7 hours (36.3 person-days) conducting field surveys in 2004; these hours were supplemented by an estimated 112 person-hours (14 person-days) contributed by CBFWCP staff assisting with focal observations at selected nests.

Areas with a high potential for heron breeding activity (based on multiple sightings in previous years supplemented by any new information from the public) that were intensively searched in 2004 included the following: Edgewood/Inonoaklin Creek area, Slocan River/Bonanza Creek/Summit Lake corridor, Marsh Creek/Beaver Valley/Fruitvale corridor, Salmo area, Apex wetlands, and Pilot Bay/Crawford Bay/Riondel areas in the West Kootenay; Jaffray, Wardner, Fort Steele, Radium, Edgewater, Brisco, Spillimacheen, Harrogate and Golden areas in the East Kootenay (Appendix 1).

John Krebs conducted an aerial and ground search of the Hidden Lake to Holmes River area near on June 28th, 2004. Heron sightings have occasionally been reported from this area in previous years (Elsie Wayne, pers. comm.) and the area has good habitat potential for this species, however no herons were detected on that day.

3.1.1 Nesting Activity

A total of 34 heron breeding sites (14 active sites and 20 historical) were found during the course of this inventory (2002-2004; Figure 1 and Table 1). Of 14 active sites found in 2004, four were located in the West Kootenay and ten in the East Kootenay. Data pertaining to breeding site locations, breeding activity, reproductive success, and habitat characteristics are summarized in Appendix 2.

Two new breeding sites (Golden and Parson Northwest) were found in 2004 (Table 1). The Golden nest site was detected late in the season, but it did successfully fledge two young in late August. The largest heron colony in the East Kootenay (41 active nests) located southeast of Parson was re-occupied and then abandoned in the first week of May. The majority of birds from this colony appeared to rebuild (34 active nests) and re-initiate incubation at Parson Northwest, located approximately 1 km away. The latter site was abandoned by late May after being subject to repeated Bald Eagle harassment. Eagle disturbance was also implicated as the cause for abandonment of the original Parson Southeast site (R. van Vugt, pers. comm.), but this could not be verified through direct observation. The latter site had been occupied for at least 15 years.

The remaining 11 heron breeding sites active in 2004 were also occupied in 2003 and 2002 (Table 1). Conversely, 3 of 15 breeding sites active in 2003 (Goat River, Fort Steele and Toby Creek) were not re-occupied in 2004. The Goat River and Fort Steele sites successfully fledged young in 2003 and reasons for abandonment could not be conclusively determined. Typically wetted sloughs near the lower Goat River rookery were unusually dry in spring 2004 (B. Stushnoff, pers. comm., pers. obs.). Furthermore an

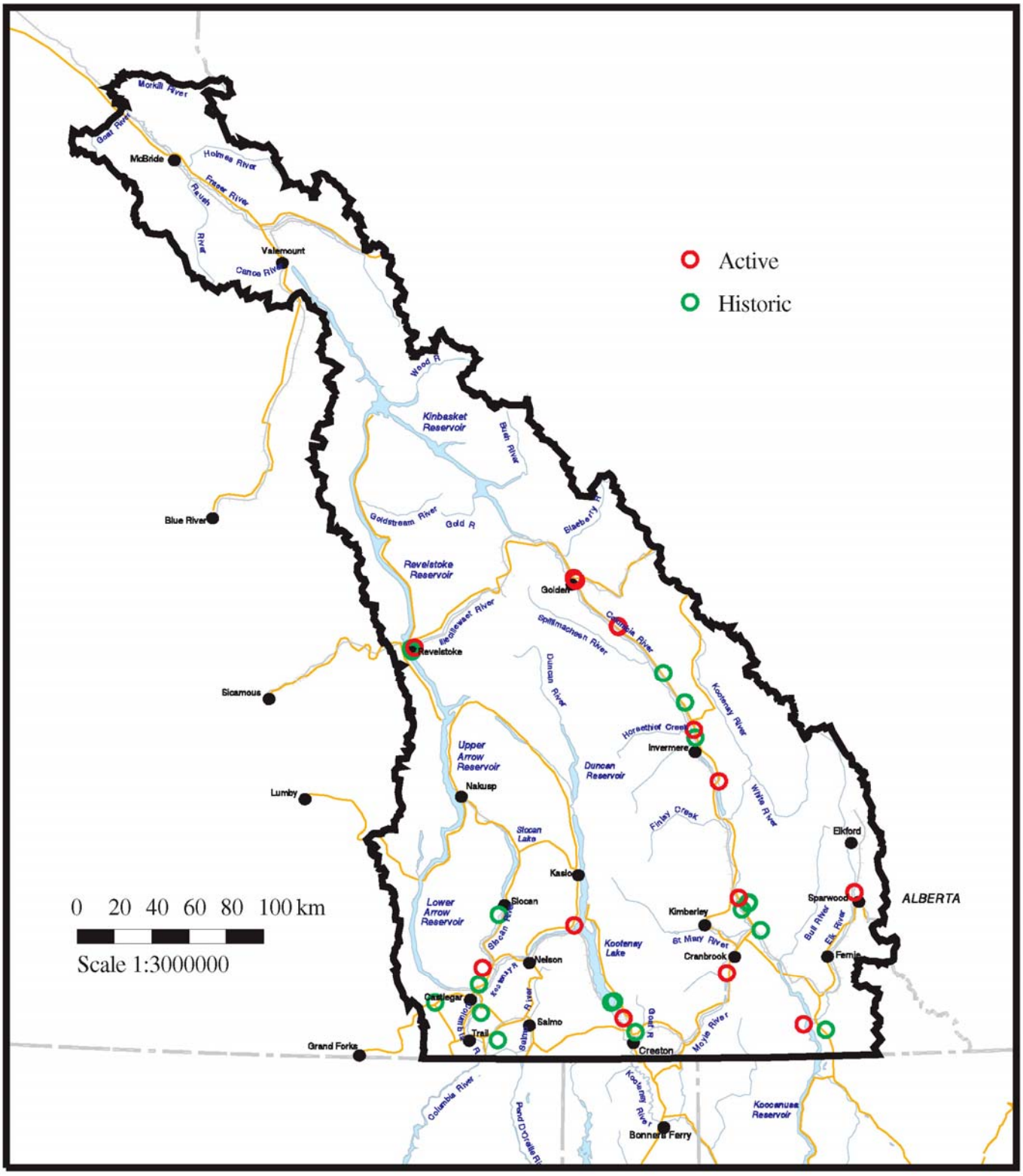


Figure 1. Locations of 14 active and 20 historical breeding sites found in the Columbia Basin during surveys conducted from 2002 to 2004.

Table 1. Summary of 2004 heron breeding site surveys, nest activity, and reproductive success (RS) at 14 active and 20 historical sites in the Columbia Basin.

Breeding Site Name	Nest Active	Nest Success	# Nest Trees	# Total Nests	# Active Nests	# Nests Successful	# Active Visible Nests	# Chicks Visible	Mean RS/ Successful Nest	Mean RS/ Active Visible Nest
Leach Lake	yes	yes	24	98	91	57	71	119	2.09	1.68
Proctor	yes	no	3	6	3	0	3	0	-	0.00
Revelstoke	yes	yes	21	22	21	6[1]	6	19	3.17	3.17
Goose Creek	yes	ND[2]	7	12	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]	ND[2]
Dutch Creek	yes	yes	12	54	35	12	16	31	2.58	1.94
Nicholson	yes	yes	7	15	13	13	13	42	3.23	3.23
Parson SE	yes	no	17	55	41[3]	0	-	-	-	-
Parson NW	yes	no	14	36	34	0	34	0	-	0.00
Wilmer	yes	yes	7	12	11	9	11	16	1.78	1.45
Gold Creek	yes	yes	8	13	11	6	11	13	2.17	1.18
Moyie Lake	yes	yes	5	14	8	8	8	31	3.88	3.88
Sparwood	yes	yes	5	9	4	1	4	2	2.00	0.50
Wasa Lake	yes	yes	12	18	16	14	16	38	2.71	2.38
Golden	yes	yes	1	1	1	1	1	2	2.00	2.00
Goat River	no	no	5	26	0	-	-	-	-	-
Toby Creek	no	no	2	2	0	-	-	-	-	-
Fort Steele	no	no	2	4	0	-	-	-	-	-
Creston West	no	no	3	5	0	-	-	-	-	-
Duck Lake	no	no	3	5	0	-	-	-	-	-
Saughum Lake 2002	no	no	14	27	0	-	-	-	-	-
Champion Lake	no	no	3	2	0	-	-	-	-	-
Waldie Island	no	no	1	5	0	-	-	-	-	-
Golden 2001	no	no	1	1	0	-	-	-	-	-
Saughum Lake 2001	no	no	1	1	0	-	-	-	-	-
Brisco	-	-	1	1	0	-	-	-	-	-
Thompson's Landing	-	-	0	0	0	-	-	-	-	-
Mud Lake	-	-	1	1	0	-	-	-	-	-
Perry Siding	-	-	1	1	0	-	-	-	-	-
Edwards Lake	-	-	5	0	0	-	-	-	-	-
Cherry Creek	-	-	4	4	0	-	-	-	-	-
Norbury Lakes	-	-	2	2	0	-	-	-	-	-
Pend d'Oreille	-	-	1	4	0	-	-	-	-	-
Begbie Falls	-	-	1	0	0	-	-	-	-	-
Begbie 1 & 2	-	-	2	0	0	-	-	-	-	-
Total for active nests	14	11	143	365	289 (248)[3]	127	194	313	2.56 ± 0.22	1.78 ± 0.35

[1] Success determined by counting chicks in 6 visible nests, based on hearing ≥1 or more chicks begging, an estimated 19 of 22 were thought to be successful.
[2] ND = Not determined because access to the nest stand was not permitted; it was assumed that this site fledged at least some young.
[3] To avoid double-counting, calculations exclude an estimated 41 active nests abandoned at Parson SW; 34 of these individuals re-nested at Parson NW..

Table 2. Summary of heron nest tree, nest, active nest, reproductive success (RS), and % nest and breeding site failure data for active sites in the CBFWCP area from 2002 to 2004.[1] Note that to avoid double counting, the Parson Southeast breeding site (where birds abandoned and then re-nested) was excluded from all calculations.

Active Breeding Site Location (# sites; # active nests)	Year	# Nest Trees mean ± SE (range)	# Nests mean ± SE (range)	# Active Nests mean ± SE (range)	RS/Active Nest[2] mean ± SE (range)	RS/Success. Nest mean ± SE (range)	Active Nests[1] Failed %	Active Sites Failed %
West Kootenay (4 sites; 115 active nests)	2004	16.0 ± 6.6 (3 – 24)	42.0 ± 28.4 (6 – 98)	38.3 ± 26.8 (3 – 91)	1.61 ± 0.91 (0.00 – 3.17)	2.63 ± 0.54 (2.09 – 3.17)	21% (17 of 80)	25% (1 of 4)
East Kootenay (9 sites; 133 active nests)	2004	7.9 ± 1.4 (1 – 14)	19.1 ± 5.4 (1 – 54)	14.8 ± 4.0 (1 – 35)	1.84 ± 0.41 (0.00 – 3.88)	2.46 ± 0.13 (1.78 – 3.88)	44% (50 of 114)	11% (1 of 9)
Overall (13 sites; 248 active nests)	2004	9.9 ± 2.0 (1 – 24)	24.8 ± 7.8 (1 – 98)	20.7 ± 7.1 (1 – 91)	1.78 ± 0.35 (0.00 – 3.88)	2.56 ± 0.22 (1.78 – 3.88)	35% (67 of 194)	15% (2 of 13)
West Kootenay (5 sites; 136 active nests)	2003	11.4 ± 4.3 (4 – 27)	30.2 ± 15.8 (7 – 92)	27.2 ± 15.2 (3 – 86)	2.03 ± 0.49 (0.70 – 3.00)	2.36 ± 0.25 (1.75 – 3.00)	20% (9 of 45)	0% (0 of 5)
East Kootenay (10 sites; 151 active nests)	2003	8.2 ± 1.8 (2 – 19)	20.0 ± 6.3 (2 – 61)	15.1 ± 4.8 (2 – 42)	1.90 ± 0.32 (0.00 – 3.00)	2.46 ± 0.13 (2.00 – 3.00)	20% (20 of 100)	10% (1 of 10)
Overall (15 sites; 286 active nests)	2003	9.3 ± 1.8 (2 – 27)	23.4 ± 6.5 (2 – 92)	19.1 ± 5.9 (2 – 86)	1.94 ± 0.25 (0.00 – 3.00)	2.43 ± 0.12 (1.75 – 3.00)	20% (29 of 145)	7% (1 of 15)
West Kootenay (8 sites; 92 active nests)	2002	6.4 ± 2.5 (1 – 21)	14.6 ± 7.8 (2 – 67)	11.5 ± 6.3 (1 – 53)	1.07 ± 0.49 (0.00 – 2.52)	2.14 ± 0.19 (1.90 – 2.52)	26% (11 of 43)	38% (3 of 8)
East Kootenay (8 sites; 165 active nests)	2002	7.6 ± 1.2 (2 – 12)	25.8 ± 8.9 (2 – 61)	20.6 ± 8.0 (1 – 66)	2.02 ± 0.28 (1.00 – 2.67)	2.42 ± 0.19 (1.88 – 3.00)	22% (9 of 41)	13% (1 of 8)
Overall (16 sites; 257 active nests)	2002	7.0 ± 1.3 (1 – 21)	20.2 ± 5.9 (2 – 77)	16.1 ± 5.1 (1 – 66)	1.50 ± 0.32 (0.00 – 2.67)	2.31 ± 0.14 (1.88 – 3.00)	24% (20 of 84)	25% (4 of 16)

[1] Data from previous years were re-analyzed to exclude the "Valemount" nest site reported by volunteers in 2002 and 2003 (this site lies outside the CBFWCP study area). Nest site sample sizes and means and standard errors differ slightly from those reported in Machmer and Steeger (2003, 2004) to reflect these updates.

[2] Only a subset of active nests that were visible during late season nest visits were included in these tabulations (see number of active nests visible in Table 1).

eagle nest was active within ≈1 km of this nesting site and both of these factors may have influenced re-occupancy. At Fort Steele, active logging was taking place throughout late winter and spring 2004 within about 2 km of the breeding site, but no closer disturbances were evident (S. Fennessy, pers. comm.).

The Goose Creek breeding site was clearly active in 2004 (based on sightings of as many as 14 adults feeding at a time in the adjacent wetland during late April and early May), however nest success and productivity could not be determined directly to the nest stand because access was not permitted. Stand watches at adjacent wetlands did not confirm the presence of any fledged young.

Historical sites listed in Table 1 include the three abandoned sites that were active in 2003 (Goat River, Fort Steele and Toby Creek), four sites last active in 2002 (West Creston, Duck Lake, Saughum Lake 2002 and Champion Lake), as well as 13 other sites where active heron nesting was reported in the past (i.e., exact locations could be verified by land management agency personnel and/or nearby residents). The latter sites had some evidence of nesting activity from previous years (old nest, marked/flagged tree, chewed or blown over nest tree, etc.) and were last occupied anywhere from 1992 to 2001.

The fourteen sites found active in 2004 supported a total of 289 active nests (115 in the West Kootenay and 174 in the East Kootenay; Table 2). Excluding the 41 active nests from Parson Southeast that re-nested, active nest totals for 13 sites are 248 (115 and 133 in the West and East Kootenay, respectively). Active colonies had from 1–24 nest trees (mean ± SE = 9.9 ± 2.0) with 1–91 active nests (mean ± SE = 20.7 ± 7.1). Colony size in the West Kootenay averaged more than double that in the East Kootenay, however this difference was due entirely to the one large colony (91 active nests) at Leach Lake (Tables 1 and 2). Overall, five large colonies with ≥20 active nests accounted for 77% of all active heron nests in the basin.

3.1.2 Nesting Success

Reproductive success in heron breeding colonies averaged 2.56 ± 0.22 chicks per successful nest (n = 127) and 1.78 ± 0.35 chicks per active nest (n = 194), based on a sub-sample of visible nests that were consistently monitored (Table 2). These rates are comparable to those obtained previously for the same study area in 2003 and 2002 (Table 2). They also fall within the range of variation reported for 15 heron colonies in southwestern BC monitored from 1977–1981 (overall mean of 2.5 and a range of 2.2–2.8 young per successful nest; Forbes et al. 1985b). Rates found in this study are somewhat higher than the reproductive success rates reported for 51 coastal heron (*A.h. fannini*) colonies in 2003 (overall mean of 2.25 ± 0.13 chicks per successful nest; McClaren 2003).

Active nest failure rates were very high in 2004 with 35% (67 of 194) of all active visible nests failing to produce young. This rate is considerably higher than failure rates of 20% and 24% in 2002 and 2003, respectively (Table 2). Failure rates were higher in the East Kootenay where more than half (44%) of all active nests failed to produce young, compared with 21% in the West Kootenay (Table 2). These higher rates were due to the failure of Parson Northwest as well as low nest success in the Sparwood and Gold Creek colonies. A breeding site failure rate of 15-21% (either 2 or 3 of 13 sites[3]) was recorded in 2004, compared with rates of 13% in 2003 and 25% in 2002 (Table 2). Breeding site failure rates averaging 33%[4] were reported in coastal heron colonies during 2003 (13 of 39 colonies; McClaren 2003), and these high rates were attributed mainly to eagle predation.

[3] The rate of 15% does not account for the abandonment of Parson Southeast that was excluded from these calculations. It also assumes the Goose Creek site successfully fledged some young, however this could not be confirmed during stand watches; if the latter site failed to produce young, the rate would be 23%. If re-nests are not excluded, the rate would be 29%.

[4] It is unclear whether this rate excludes re-nests, as was done in this study.

3.1.3 Breeding Disturbance

Of antagonists detected during focal observations, the majority (i.e., 67% or 43 of 64 encounters; Table 3) involved Bald Eagles. Other antagonists included Osprey (20% of encounters), humans (6%), American Crow (*Corvus branchyrhynchos*; 3%), Common Raven (*Corvus corax*; 3%), and Turkey Vulture (*Cathartes aura;* 2%). In some cases, antagonists acted synergistically (e.g., an incursion by an eagle or human was followed by crows or ravens flying into the nest stand). Encounter rates for all antagonists combined were relatively low, averaging 0.86 per hour. These were comprised of 16% incursions and 28% disturbances with a heron response (e.g., scream, take flight, mobb, etc.); the remainder involved antagonists within 250 m of heron nests, with no apparent heron response.

Human disturbance was observed anecdotally at the Sparwood breeding site in conjunction with an environmental monitoring program being conducted at the Goddard Marsh, where these herons have nested for several years. On both nest visits, two or more workers were recorded within 50 m of nests and herons were being flushed off. Similarly, herons at the Gold Creek site appeared extremely sensitive to disturbance and may have been negatively affected by stand watches conducted from a vantage. Black bear activity was evident at the Leach Lake and Dutch Creek sites.

Eagle activity was recorded at seven of the nine breeding sites where focal observations were conducted (Table 3). Early season harassment by eagles was noted at both the Proctor and Parson Southeast colonies (L. Iwanik and R. van Vugt, pers. comm., respectively), however both were abandoned before the potential impact of eagles could be evaluated directly. Eagle incursions were clearly a factor in the abandonment of the Parson Northwest site. An injured adult heron found on the shoreline in Proctor in early May 2004 was apparently harassed by an eagle prior to being rescued and brought to a bird shelter in Castlegar (C. Pettigrew, pers. comm.). This bird likely originated from the Proctor rookery and the attack may have influenced the abandonment of that site in 2004. Heron mortality attributed directly to eagle incursions was not confirmed during 2004 observation sessions, however such incidents were observed in 2003.

In 2003, one or more eagle incursions were recorded at 31% (5 of 16) of 2003 sites (i.e., Wilmer, Nicholson, Leach Lake, Moyie Lake and Toby Creek; Machmer and Steeger 2004). At the Wilmer colony, eagles were observed repeatedly landing on heron nests, attacking adults, removing nest contents, and carrying off chick, and only one of 11 active nests successfully fledged young. At Leach Lake, adult eagles were observed attacking adult herons at several nests, knocking at least one adult heron to the ground. This bird sustained a broken wing, and two other adult heron carcasses were found nearby on the ground. Repeated eagle incursions at the Toby Creek site may have been linked to nest failure, but appeared not to impact the Moyie Lake colony in 2003.

Bald Eagle depredation on heron nestlings, juveniles and adults has frequently been reported in BC (Simpson and Kelsall 1978; Forbes et al. 1985a; Forbes 1987b; Simpson et al. 1987; Norman et al. 1989; Butler et al. 1995; Butler 1997; Vennesland 2000; Vennesland and Butler 2004). Such depredation is responsible for reduced breeding productivity and increased abandonment of colonies (Norman et al. 1989; Vennesland and Butler 2004). High levels of human activity near heron colonies have also been linked to increased disturbance from eagles and these two factors can act synergistically (Vennesland 2000). Eagle populations have been steadily increasing in coastal BC (Blood and Anweiler 1994) and their impact on *A.h fannini* populations is thought to be increasing (Vennesland 2000, Vennesland and Butler 2004). Eagle populations in the interior are considered stable or increasing, although no systematic surveys have been undertaken (Blood and Anweiler 1994).

Table 3. Assessment of nesting disturbance by antagonists (i.e., humans, Bald Eagle, Ospreys and other avian predators) at nine active heron breeding sites in the CBFWCP area where focal observations were conducted during spring 2004.

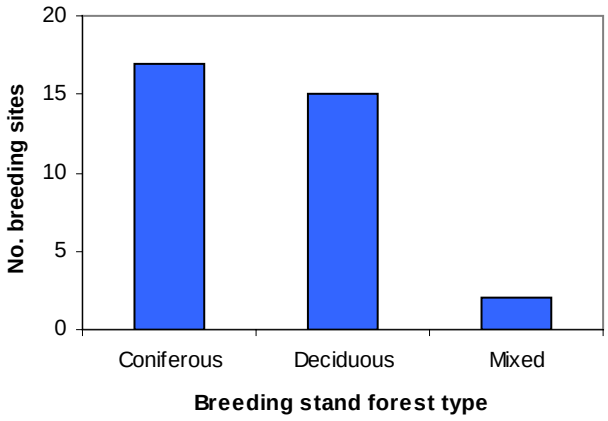
Breeding Site	Date	Observer(s)	Time (hrs)	No. Antagonists (Rate)	No. Disturbances (Rate)	No. Incursions (Rate)
Leach Lake	May 16	MM	4.0	2 BAEA; 1 OSPR	0	0
	May 25	TH/AR	4.1	2 BAEA	2 BAEA	1 BAEA
	June 4	MM	4.0	2 BAEA	0	0
Site Subtotal			12.1	7 (0.58/hr)	2 (0.17/hr)	1 (0.08/hr)
Revelstoke	May 29	TH/AR	3.0	0	0	0
	June 10	MM	4.0	1 CORA	0	0
Site Subtotal			7.0	1 (0.14/hr)	0 (0.00/hr)	0 (0.00/hr)
Dutch Creek	May 26	TH/AR	4.0	3 BAEA	2 BAEA	3 BAEA
	June 9	MM	4.0	3 BAEA; 1 OSPR	2 BAEA	0
Site Subtotal			8.0	7 (0.88/hr)	4 (0.50/hr)	3 (0.38/hr)
Nicholson	May 28	TH/AR	3.5	4 BAEA	0	0
	June 10	MM	4.0	3 OSPR	0	0
Site Subtotal			7.5	7 (0.93/hr)	0 (0.00/hr)	0 (0.00/hr)
Parson Northwest	May 28	TH/AR	3.5	0	0	1 BAEA; 1 AMCR
	June 9	MM	1.0	0	0	2 BAEA
Site Subtotal			4.5	0 (0.00/hr)	0 (0.00/hr)	4 (0.89/hr)
Wilmer	May 16	MM	4.0	2 BAEA	2 BAEA	1 BAEA
	May 27	TH/AR	3.08	2 BAEA; 1 OSPR	0	0
	June 9	MM	4.0	2 BAEA	0	0
Site Subtotal			4.5	7 (0.58/hr)	2 (0.17/hr)	1 (0.08/hr)
Gold Creek	May 26	TH/AR	3.78	0	1 OSPR; 1 CORA	1 human
	June 8	MM	4.0	2 OSPR; 1 AMCR	2 OSPR	0
Site Subtotal			4.5	3 (0.39/hr)	4 (0.51/hr)	1 (0.13/hr)
Moyie	May 25	TH/AR	3.33	1 BAEA	1 human	0
	June 7	MM	4.0	1 TUVU	2 BAEA	0
Site Subtotal			4.5	2 (0.27/hr)	3 (0.41/hr)	0 (0.00/hr)
Wasa	May 27	TH/AR	3.08	0	1 human	0
	June 8	MM	4.0	2 OSPR	1 BAEA; 1 human	0
Site Subtotal			4.5	2 (0.28/hr)	3 (0.42/hr)	0 (0.00/hr)
Total	-	-	80.7	36 (23 BAEA; 10 OSPR; 1 CORA; 1 AMCR; 1 TUVU)	18 (11 BAEA; 3 OSPR; 1 CORA; 3 human)	10 total (8 BAEA; 1 AMCR; 1 human)
Mean ± SE				0.45 ± 0.10/hr	0.24 ± 0.07/hr	0.17 ± 0.09/hr

3.1.4 Breeding Site Habitat Characteristics

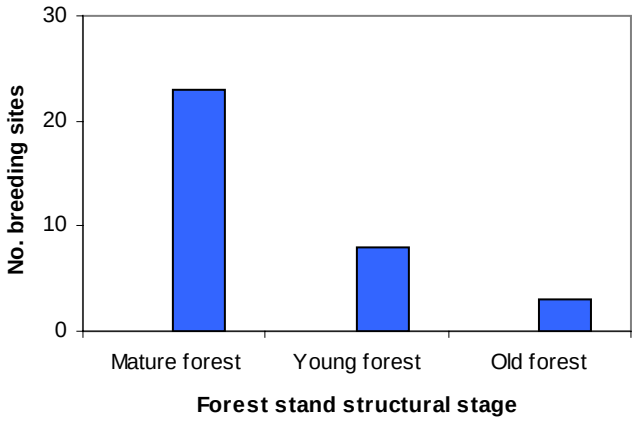
Appendix 3 provides a photo record with examples of active nesting stands and areas searched with good potential breeding habitat. Active and historical breeding sites were found in the following biogeoclimatic variants (see Appendix 2): IDFdm2 (n = 10 or 29.4%); PPdh2 (n = 6 or 17.6%); ICHxw (n = 5 or 14.7% of sites); ICHdw (n = 5 or 14.7%); IDFun (n = 3 or 8.8%); ICHmw3 (n = 3 or 8.8%); ICHmw2 (n = 1 or 2.9%); and MSdk (n = 1 or 2.9%). The vast majority (>80%) of breeding sites were located on flat ground, and the remaining sites had shallow slopes (overall mean ± SE = 3.2 ± 1.2%). Sites were located an average of 180 ± 48 m (range of 4–1,300 m) from a water body, but 73% of sites were found within 200 m of water. Closest water bodies ranged from rivers (n = 8 or 23.5% of sites) to small lakes and wetland complexes (n = 8 or 23.5% each), to reservoirs (n = 4 or 11.8%), large creeks (n = 5 or 14.7%) and large lakes (n = 1 or 2.9%). Often, multiple water bodies were associated with the same breeding site and field verification would be required to confirm where individuals were feeding. Two "islands" were included in our sample, however at least four additional sites in the Columbia wetlands were located on levees inundated for the bulk of the breeding season, and these essentially function as islands.

Figure 2. Forest types (a) and structural stages (b) of active and historical heron nesting stands (2002-2004).

a)



b)

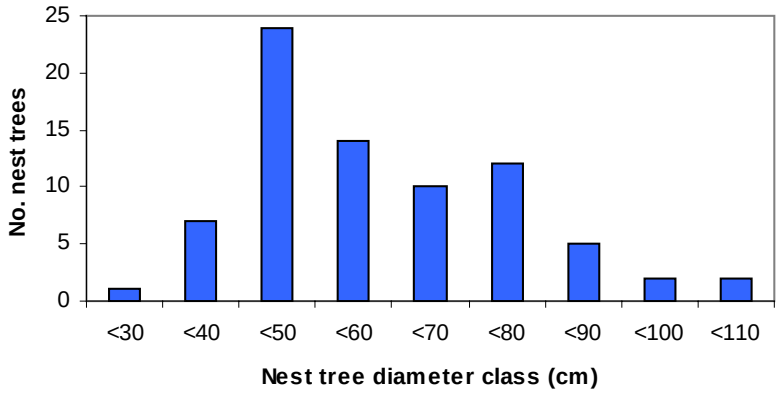


Active and historical nesting stands were characterized either as deciduous (cottonwood), coniferous, or mixed stands (Figure 2a). Half of the nest stands were coniferous, a proportion higher than that suggested by Forbes et al. (1985a) based on surveys of the same study area 20-25 years ago. In terms of structural stage, 68% of sites were classified as mature (i.e., age class ≥6), with the remaining 23% and 9% in young forest and old-growth forest stages, respectively (Figure 2b). Crown closure in these stands tended to be high (overall mean ± SE = 67 ± 4%), but a broad range (25–93%) was observed.

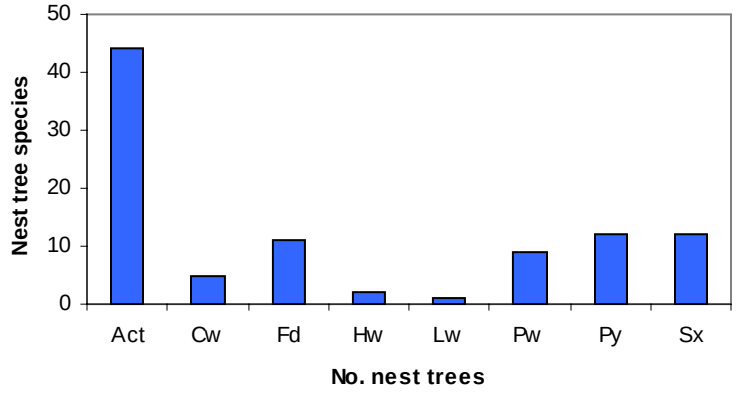
The diameter at breast height (cm), height (m), and decay class of a minimum of 76 sample nest trees (≤5 per nest stand) was visually estimated during nest visits. Sample sizes differ slightly by parameter because flooding occasionally obscured the base of a tree and hindered diameter estimation, but tree species and decay class could still be determined. Diameter, height, species, and decay class distributions of nest trees are shown in Figure 3 (a-d). A wide range of nest tree sizes were used by herons, however

Figure 3. Diameters [estimated breast height in cm] (a), heights [estimated in m] (b), tree species (c), and decay classes (d) of a random sub-sample of heron nest trees in active and historical nesting stands (2002-2004).

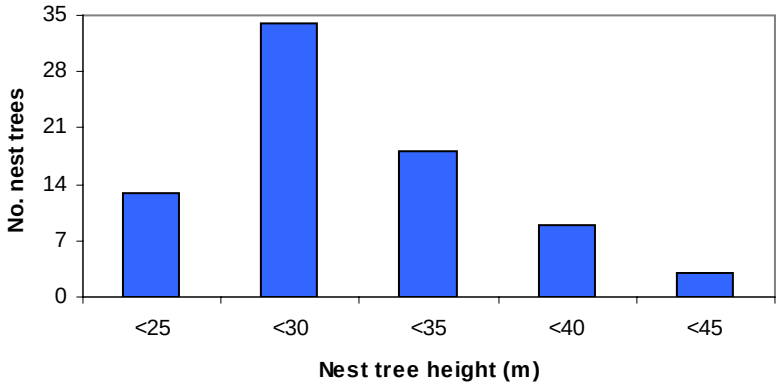
a)



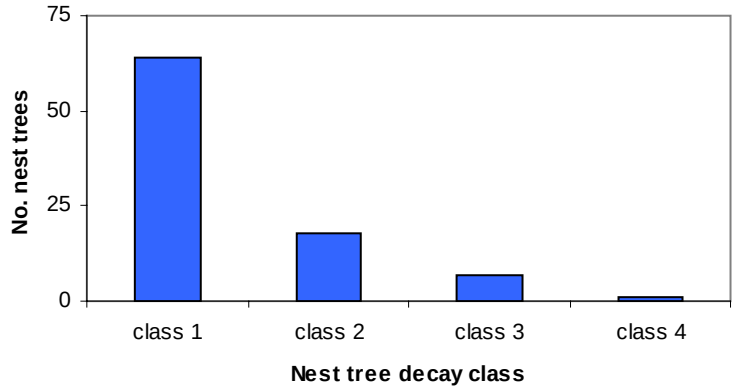
c)



b)



d)



most trees were of relatively large diameter and height (Figure 3a,b). The sizes of random trees were not measured for comparison, however it appeared that herons were selecting trees of large diameter and height, relative to what was available in the surrounding stands. Herons nested in eight tree species (Figure 4c). Black cottonwood (*Populus balsamifera; Ac*) comprised 46% of all nest trees. Coniferous species combined [Douglas-fir (*Pseudostuga menziesii; Fd*), western white pine (*Pinus monticola; Pw*), hybrid white spruce (*Picea glauca x engelmannii; Sx*), ponderosa pine (*Pinus ponderosa Py*), western red cedar (*Thuja plicata; Cw*), western hemlock (*Tsuga heterophylla; Hw*), and western larch (*Larix occidentalis*; Lw)] accounted for 54% of the total. The vast majority of nest trees were alive, but a few had recently died (Figure 3d). Historical breeding stands tended to have more dead trees and whether these trees had already died at the time they were first used for nesting is unknown.

3.1.5 Other Observations

The Dutch Creek and Leach Lake breeding sites had abundant black bear sign and black bears (female and two yearling cubs) were encountered in the latter stand during nest visits. Black bear damage to two nest trees was evident at Dutch Creek. In 2004, fresh beaver activity was noted only at the Parson Southeast and Nicholson colonies. Most trees in these colonies have already been protected with wire mesh, but additional wrapping of cottonwood nest trees at the periphery of both colonies may be warranted. Nearby dominant cottonwoods that could function as recruitment nest trees in the event of nest tree failure are quite limited at the Parson sites, as well as at Nicholson and Wilmer. Physically protecting the bases of existing nest trees from beavers is the easiest and most cost-effective method to ensure suitable breeding habitat in the short term.

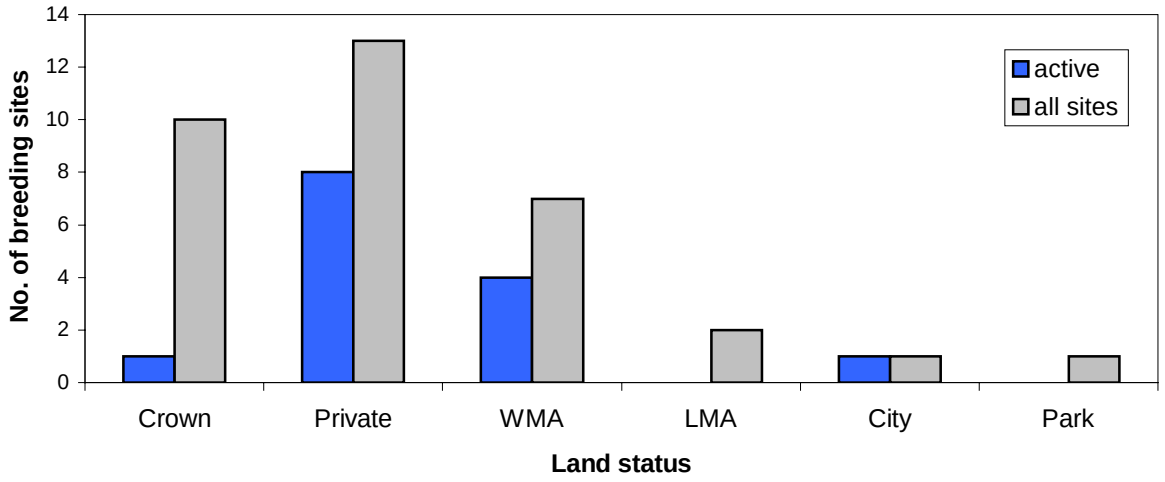
However, in portions of the Columbia wetlands, the supply of older cottonwood stands appears to be declining (Jamieson and Hennan 1998), and an active cottonwood recruitment strategy will be needed to ensure that adequate densities and distributions of these habitat elements are maintained through time.

3.1.6 Land Ownership and Protection of Breeding Sites

The proportional breakdown of breeding sites for all sites and active sites only is shown in Figure 4. Considering all sites, most are located on private (n = 13) and crown (n = 10). Seven are protected within designated provincial Wildlife Management Areas (WMAs) and two are managed by other land management agencies (LMA; i.e., The Nature Trust of BC). Additional sites are located within a provincial park (n = 1) and on municipally owned land (n = 1). When only active breeding sites are considered, 8 sites (57%) are on private land, 4 (29%) are in WMAs, and the remaining 2 sites (7% each) are on crown and city land, respectively. The 29% of heron breeding sites (representing 54% of all active nests in the Columbia Basin) located within provincial WMAs are currently protected under this designation. The Great Blue Heron, its' nests and eggs are also legally protected year-round from direct persecution and harassment by the *British Columbia Wildlife Act* and the *Migratory Birds Convention Act*.

More than half of heron nest stands in the Columbia Basin are located in mature coniferous stands, and there is a potential conflict between forestry operations and heron habitat protection. Under the *Results Based Code* and the *Forest Practices and Range Act*, some critical nesting and foraging habitats could be addressed through the establishment of *Old Growth Management Areas* (OGMAs), *Riparian Management Areas* (RMAs), *Wildlife Tree Patches* (WTPs) and *Wildlife Habitat Areas* (WHAs). "No disturbance" buffers around heron nesting stands are not currently enabled under the WHA designation (Ministry of Water, Land and Air Protection 2004), however licensees may voluntarily maintain a buffer to minimize disturbance and protect the integrity of nesting habitat. The *Results Based Code* offers no

Figure 4. Proportional (%) breakdown of the land/ownership status of all heron breeding sites and active breeding sites only found from 2002-2004 (WMA = provincial Wildlife Management Area; LMA = Land Management Agency).



protection for the majority (≈57%) of active breeding colonies in the Columbia Basin located on private land. This emphasizes the need to promote heron awareness and voluntary stewardship amongst private landowners and the general public. Municipal zoning bylaws may have some potential to protect breeding sites on private land within city limits (Ministry of Water, Land and Air Protection 2004).

3.2 Stewardship Activities

Activities conducted to promote greater awareness of herons in the Columbia Basin during 2004 included the following:

- A presentation entitled "Great Blue Heron Breeding Inventory and Habitat Assessment in the Columbia Basin" was delivered at the Columbia Mountains Institute Researchers Meeting held on April 28, 2004 in Nakusp, BC.
- An afternoon field trip to Waldie Island attended by the Young Nelson Naturalists was conducted on November 28, 2004. The session focused on herons and their ecology in the Columbia Basin, but also touched on identifying other local waterfowl and water birds. An estimated 30 children (most accompanied by their parents) attended this event.
- A powerpoint presentation on herons at the "Columbia Basin Sense of Place" workshop held at the Pilot Bay "Tipi Camp" on August 21, 2004, that was attended by 32 adults from all over the Columbia Basin.
- A brief heron update article was prepared for the summer 2004 Creston Valley Wildlife Management Area Wetlander.
- A summary article on the heron project (2002-2003) was drafted for the summer 2004 CBFWCP Update brochure.
- An article summarizing the findings of this project is being prepared for local newspapers in collaboration with Ed Beynon and Angus Glass.

In addition to activities promoting a greater public awareness of herons, stewardship efforts have targeted landowners, land managers and adjacent neighbors at heron breeding sites. Over the three years of this study, private landowners and land managers were contacted personally and informally consulted at

active breeding sites[5]. Each party was informed of the presence and location of active heron nesting on their property and information regarding heron status, habitat needs, breeding ecology, and sensitivity to disturbance was provided. The vast majority of landowners and managers were receptive and expressed an interest in obtaining additional information on herons. In 2004, this information was provided in the form of a *Heron Stewardship Brochure* presented in person (or mailed, in the case of absentee landowners). An attempt was also made to identify and contact adjacent landowners, in order to obtain additional background information about breeding activity and to informally enlist their support with ongoing monitoring and protection efforts.

Stewardship activities completed and/or underway at specific breeding sites are summarized in Table 4, along with a summary of site-specific management concerns and recommendations. These sites are prioritized for follow-up stewardship/management action and the party responsible for such action is identified.

Although funding for this project did not permit a survey of areas with high overwintering potential for herons, the use of the wetland at the north end of Slocan Lake as a year-round foraging site has become obvious over the last three years. A heron habitat stewardship brochure was sent to the corresponding landowner, in response to the interest he expressed.

3.3 Opportunistic Bald Eagle Nest Survey

A total of 21 Bald Eagle nests (6 in the West Kootenay; 15 in the East Kootenay) were noted opportunistically in conjunction with the heron inventory. Appendix 4 provides the name, location, UTM coordinates, visit date and status (not active, active, active with chicks, number of chicks) for each nest. UTM coordinates were either determined with a GPS or estimated, where direct access to the nest site was not possible.

Of the 21 nests detected, 3 (14.3%) did not appear active, 6 (28.6%) were clearly active (i.e., eagle in attendance at nest) but no young were detected, and the remaining 12 (57.1%) were active with young. Of the latter nests, 1 had 3 chicks visible, 10 had 2 chicks visible, and 1 nest had only 1 chick visible. Ideally, eagle nests should have been visited earlier in the season to determine whether nests were active, and again later, to accurately determine productivity.

4.0 Conclusions and Recommendations

An estimated 496 adults (248 active nests excluding the nests at Parson Southeast) and 313 pre-fledged young were counted during this inventory. These are minimum estimates, because some active colonies were likely not detected, and herons frequently relocate or re-nest after nest failure or predation (Dodd and Murphy 1995). This makes it problematic to obtain accurate counts of large colonies and creates considerable age variation among chicks. During visits, some chicks were already branching while others were still relatively young, and selecting the most appropriate window to count chicks is difficult. Acknowledging these limitations, numbers of active nests in 2004 were relatively comparable to those counted during 2002 (257 active nests) but considerably lower than those in 2003 (286 active nests).

Relative to the previous inventory of the Columbia Basin in the late 1970's and early 1980's (Forbes et al 1985a), heron breeding colony sizes appear to have decreased in recent years (i.e., 18.6 ± 6.1 active nests

[5] The Golden site with a single active nest found late in the 2004 season on land belonging to the City of Golden has not yet been reported. Single nests tend to have low rates re-occupancy and prior to alerting municipal authorities, the decision was made to wait and see if this site was re-occupied next year.

per colony in 2002-2004 versus 29.6 ± 6.5 during the previous inventory). A similar decreasing trend in colony size has been reported in Washington State (Seattle Audobon 2002). Smaller colonies are reported to have consistently lower reproductive success and higher nest failure rates (Forbes et al. 1985b; Vennesland 2000, 2003), so this trend could have negative implications for future heron recruitment. The recent abandonment and failure of several large colonies in the Columbia Basin (e.g., Parson and Goat River in 2004) and the poor reproductive success of some longstanding colonies in recent years (e.g., Wilmer and Goose Creek in 2003) reinforces the need for some level of pre-cautionary population monitoring. We therefore make the following recommendations:

- Continue monitoring rates of nest activity and reproductive success (per active and successful nest) at known active heron breeding colonies in the Columbia Basin, according to protocols established in 2002-2004. During visits, opportunistically quantify antagonist presence, disturbances and incursions at heron breeding sites and report this information for comparison, using the terminology established in 2004. Also document any incidences of adult or chick injury or mortality. This information will serve as background to interpret rates of site/nest abandonment, nest failure, and reproductive success. This data should be provided to provincial (MWLAP, CDC) and federal (CWS) agencies.

- Continue with stewardship activities aimed at securing conservation agreements, covenants or land acquisitions for active heron breeding sites in the Columbia Basin, based on the priorities and responsibilities set out in Appendix 5. Also contact land managers of heron colonies on crown lands and update them on the status of active colonies and the importance of ensuring protection of core buffer areas and secondary management zones through appropriate follow-up. Maps prepared for each active nest site delineating these areas should be used as a basis for discussion with landowners/managers. Activity restrictions and timing will vary site-specifically and should be determined for each site in consultation with the landowner/manager with input from M. Machmer. The boundaries of these zones may be subject to field-truthing in some cases.

- Undertake breeding surveys for Bald Eagles in the Columbia Basin (or portions thereof) to evaluate changes in eagle population trends and establish a current benchmark for the BC portion of the Columbia Basin. Ideally, surveys should attempt to address the entire basin using the same approach taken by the heron project in 2002-2003 (i.e., solicit nest information from the public and supplement with biologist follow-up of sightings and coverage of more remote areas). If this is not an option, then prioritize surveys in those areas of the basin where (a) eagle predation on herons is most likely to be a significant issue (i.e., in large colonies found in the Creston Valley and Columbia wetlands, for example), and where (b) previous breeding inventory data for eagles is available as a benchmark (Blood 1982; Forbes and Kaiser 1984; Machmer and Steeger, unpublished data; McMann 1996, 1997).

- Winter represents an energetic bottleneck for Great Blue Herons and severe winters are associated with high rates of juvenile and adult mortality in the Columbia Basin (Blus and Henny 1981; Butler 1992; Machmer 2002). Relatively little is known about the winter distribution of herons in the basin (R. Butler, pers. comm.), however identifying and protecting sites where herons aggregate in winter should be a key component of an overall conservation strategy for this species. Based on concentrations of fall/winter sightings provided in previous years (e.g., near Hills, Nakusp, Edgewood, Renata, Castlegar, Duncan River, Creston, Wardner and Wilmer), conduct late fall/winter (November – January) heron searches at selected sites in the basin. Based on findings, identify key overwintering sites used by herons, summarize their habitat characteristics, use, ownership/status, and make recommendations for habitat protection and enhancement.

- Formalize a "heron-watch" program comprised of landowners and their immediate neighbors willing to "keep an eye on" active heron breeding sites. This could be accomplished by contacting parties (many of which have already been approached) and soliciting their participation, providing them with information on (a) monitoring objectives, (b) a list of parameters to watch for from a distance (e.g., arrival dates, numbers of herons seen and corresponding dates, presence of antagonists, etc.), and (c) an easy-to-use data card for recording and mailing the information. Alternatively, willing participants could be telephoned 2-4 times per breeding season for this information as a way of informally monitoring occupancy and potential disturbance issues at particular sites. This "heron watch" could serve as a supplement to more intensive breeding site monitoring in some years. Ideally, one or more contacts (the landowner and one or more parties living closeby) would participate at each active site. To set up this program, landowners and known neighbors could be contacted to gage their willingness to participate, and then a list could be established.

- The CBFWCP should continue to place a strong emphasis on the inventory, management and conservation of riparian cottonwood habitat as part of its program mandate. The development of a basin-wide cottonwood management and recruitment strategy should be undertaken, to ensure that adequate densities and distributions of these habitat elements are maintained through time. This strategy must also address private land and provide an incentive program to promote protection of veteran cottonwood stands. On crown land, penalties for cottonwood removal are currently negligible (Tracy Pearce, MOF, Castlegar, pers. comm.) and a public lobby to increase penalties and better enforce existing infractions is required.

- Some active and historical rookeries in the Columbia wetlands have been impacted by beaver activity. Although most nest trees have already been protected with wire mesh, some additional protection is warranted in the Nicholson, Wilmer, and Parson rookeries. This would involve wrapping the bases of any unprotected nest trees (as well as nearby veteran and dominant cottonwoods for nest tree recruitment) with wire mesh. The CBFWCP should also encourage and fund non-profit societies, outdoor groups, youth groups, etc. to undertake additional cottonwood protection projects in the wetlands under their direction.

- Acknowledge the efforts of all contributors and volunteers involved in the study over the last three years with an article summarizing the main findings of the project to date and thanking all of the contributors.

- During any future field surveys, heron brochures should be on hand for distribution to key target groups (e.g., representatives of forest companies, landowners and their neighbors, land and resource managers, non-government organizations and naturalist groups, etc.).

- Best management practices or "guidelines" provided to landowners and land managers in future should include (but not be limited to) the following:

  - Minimize disturbance to the core nesting area (i.e., ≈200-300 m radius area, depending on the site) during the breeding season (March 1 to August 31).

  - Maintain important structural elements for nesting and foraging (i.e., suitable nest trees, non-fragmented forest around nest trees, wetland characteristics for foraging if applicable, roost trees, and ground barriers to exclude mammalian predators) within the core area.

  - Maintain the integrity of foraging habitats and adjacent roosting trees.

- In areas where human disturbance is a concern, restrict access during the breeding season and maintain or incorporate boundaries (e.g., ditches, fences, water) that may act as barriers to humans wherever possible (see Carlson and McLean 1996). [Landowners willing to establish such barriers should be given funding consideration by the CBFWCP, or other funding agencies].

- Do not develop roads or trails or recreational structures or facilities within the core area. Limit access to existing roads and trails during the breeding season (March 1 to August 31).

- Do not conduct harvesting or silvicultural activities within the core area.

- Do not develop recreational trails, structures or facilities within the core area.

- Avoid mechanized activities in the core area during the breeding period (March 1 to August 31).

- Where permanent activities or habitat modifications take place within the core area, vegetative screening should be planted or maintained between the activity/modification and the colony. Where possible, the trees/shrubs planted should be a mixture of deciduous and coniferous, and half should be of the same species currently used for nesting. Consider constructing a fence or other barrier between the activity and vegetative screening. [Landowners willing to establish such barriers should be given funding consideration by the CBFWCP, or other funding agencies].

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Appendices

1. **Biologist Survey Log (confidential information; contact CBFWCP for access)**
2. **Breeding Site Database (confidential information; contact CBFWCP for access)**
3. **Photo Record**
4. **Bald Eagle Nest Site Database**
5. **Management Concerns, Stewardship Recommendations and Actions Conducted to Date (confidential information; contact CBFWCP for access)**

APPENDIX 1: Biologist Survey Log (confidential information; contact CBFWCP for access)

APPENDIX 2: Breeding Database (confidential information; contact CBFWCP for access)







APPENDIX 3: Photo Record

Active breeding sites (left to right):

Upper: fledglings at Wilmer; dead chick at Dutch Creek; Bald Eagle nest with young at Fairmont.

Middle: adult heron from abandoned Parson Northwest site; Dutch Creek; Leach Lake.

Lower: Wetland feeding area near Revelstoke nesting site.

Selected active nest stands (left to right):

Upper: Wilmer, Revelstoke; Gold Creek.

Middle: Sparwood, Wasa.

Lower: Moyie; Leach Lake








Selected areas searched with good heron breeding potential, some heron activity, but no nests confirmed (left to right):

Upper: Summit Lake; Edgewood wetland; Bonanza Creek wetland.

Middle: Salmo wetlands; small private lake near Crawford Bay; Crawford Bay

Lower: Lake Windermere; Fort Steele area

APPENDIX 4: Bald Eagle Nest Database

Bald Eagle Breeding Site Name	Breeding Site Location Northing	Easting	Location Description	Visit Date	Active/No. Chicks
Slocan Lake North Wetland	5549500	466000	in Act along margin of small wetland at north end of Slocan Lake	18-May	active - 1 adult; no chicks visible
West Arm of Kootenay Lake	5493776	491631	in Act along shoreline opposite Kokanee Creek Provincial Park	10-Aug	active – 2 adults and 3 chicks
Creston Valley North	5457000	523700	in large Act on outer levee between Six Mile Slough and West branch of Kootenay River	7-May	not active (seen from tracks)
Goat River, Creston	5436500	532200	in Act along between the old Goat and Kootenay River Channels	25-May	active - 2 chicks
Moyie Provincial Park	5470015	584987	SW side of Highway 3, 120 m from highway in Moyie Provincial Park lowlands	14-May	active - juvenile around
Cameron Pond, Wasa	5513000	594500	Cameron Pond Access Road east of Highway 3	14-May	active - 2 chicks
Nicholson Heron Rookery	5679990	504000	0.5 km south of Nicolson heron rookery	15-May	not active
Parson Crossing (2)	5658000	525000	400 m south of 2nd (middle) Parson crossing on levee	15-May	active - 2 adults
Well's Landing, Parson	5655750	527000	0.5 km south of Well's Landing B&B and 1 km south of 1776 Highway 6	15-May	active - 2 chicks
Hatch Creek, Harrogate	5646000	541200	between Harrogate & Spillimacheen on levee (107 km on rail line) - Hatch Creek Road forks off to right	15-May	active - 2 chicks
Brisco North	5632000	550500	2.5 km N of Bugaboo Glacier Turnoff on main channel	15-May	active
Wilmer Heron Rookery	5600560	567189	on levi between 2 islands in Wilmer Refuge accessed from east side	15-May	active - 2 chicks
Peters Road, Crawford Bay	5525000	510500	accessed from Peters Road or through trail from main beach site	3-Jun	active - 2 chicks
Wilmer Slough	5600100	567400	on levee in slough by Wilmer canoe launch	21-Jun	active- 2 chicks

Bald Eagle Breeding Site Name	Breeding Site Location Northing	Easting	Location Description	Visit Date	Active/No. Chicks
Slavin Road, Castledale	5653400	532300	north of Slavin Road and 500 m south of Quinn Creek campground	21-Jun	active-2 adults
Mitchell Road, Nicholson	5670100	512000	7 km south of Nicholson turnoff	21-Jun	not active
Riverside, Fairmont	5576488	581345	west of access road to Riverside, beside Creek	22-Jun	active - 2 chicks
Cherry Creek, Wasa South	5550000	595500	at mouth of Cherry Creek, near Bummer's Flats	22-Jun	active - 2 chicks
Yahk South	5441861	570280	5 km south of Yahk on west side of road - near jade place	22-Jun	active - 2 chicks?
Radium-Thompson's	5612500	563400	between Radium & Thompson's Landing on main river in live Act, east side	4-Jul	active - adult
Edgewater South	5616300	562400	between Thompson's Landing & Edgewater off main river in levee on Sx - east side	4-Jul	active - 1 chick?
Total: 20 nests					nests not active = 3; nests active but no chicks visible = 6; nests active with chicks visible = 12

APPENDIX 5. Management Concerns, Stewardship Recommendations and Actions Conducted to Date (confidential information; contact CBFWCP for access).