MEADOWBANK MINE

2019 WILDLIFE MONITORING SUMMARY REPORT

FINAL

APPENDIX L

2019 Whale Tail Raptor Report

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Background

Abundance and distribution of raptor nesting sites in the region surrounding the Whale Tail Project was unknown prior to 2015. The purpose of the raptor monitoring program from 2015 – 2017 focused on searching for nesting sites located near to, and far from proposed or existing infrastructure. Monitoring of raptors is outlined in the Agnico Eagle Meadowbank Division Terrestrial Ecosystem Management Plan (TEMP; Agnico Eagle Mine 2019). The TEMP outlines requirements for avoiding and managing disturbance to nesting raptors, as follows:

- Develop a nest-specific response plan for identified raptor nests within areas of concern to ensure that nesting success is not affected by development activities
- Follow GN-DoE guidelines for avoiding disturbance to raptor nests
- Discourage raptors from establishing nests on artificial structures, pit walls, or other facilities
- Active raptor nest monitoring

In addition, the TEMP also outlines the general monitoring approach, as follows:

- document and map raptor nesting sites (see Term or Condition 33)
- evaluate the success of mitigation to prevent disturbance to raptors or raptor nests,
- estimate project-related disturbance effects.
- develop nesting site-specific management plans for nests within 1.5km of project infrastructure, including minimum "no disturbance" buffers (see Commitment 32). In the event of deterrence of removal of a nest, AEM must contact the GN, and secure the required permits (see Term and Condition 36).

The GN provided additional raptor-specific feedback from information provided in 2018 Annual Report, as follows:

- the current monitoring does not have the power to detect and mitigate Project-related effects on raptor nesting success.
- the study design does support analysis that would allow detection of project-related nest failures (e.g., by examining nest success as a function of intensity of project-related disturbance.

Species Descriptions

Peregrine Falcon (*Falco peregrinus tundrius*)

The Arctic peregrine falcon (Figure 1) is medium- to large-sized falcon. It has a dark hood and face with distinct dark malar stripe, cream to white throat, slate-grey back; barred belly, legs, and tail. Long pointed wings, stocky body. Plumage of immature birds brown rather than grey, and the breast is streaked rather than barred. In adults, the cere and orbital ring are yellow, and bluish in immature birds. Compared with gyrfalcons, the peregrine is smaller and less stocky. In flight, the wings of peregrines appear narrower and more pointed. In peregrine falcons, wing tips extend to bottom of the tail when perched, while in gyrfalcons, wing tips extend two-thirds down the length of tail

F. p. tundrius breeds mainly north of the treeline from Alaska east throughout northern Canada to Greenland. It breeds throughout the taiga and tundra wherever suitable nesting habitat and sufficient prey are present. In Nunavut, peregrines appear to have their highest densities in the Kivalliq and

Kitikmeot regions. Highest breeding density on record is on the western shores of Hudson Bay in the Kivalliq Region.

F. p. tundrius is a long-distance migrant, wintering mainly throughout South and Central America, but also in southern United States and Mexico. Northern-breeding American and Arctic peregrines are highly migratory (Yates et al. 1988, Schmutz et al. 1991, Fuller et al. 1998), and although fall migration occurs over a broad geographic range (Fuller et al. 1998), Yates et al. (1988) indicated that "separate and distinct autumn migratory populations pass through the east and Gulf coasts" of the United States.

Peregrine falcons usually nests on cliffs and rocky outcrops, but also nest on hilltops, river canyons, rock screes, and on occasion directly on the ground (Court et al. 1988, Ratcliffe 1993). They prefer nesting in locations close to water in south-facing, rugged terrain. Hunting habitat includes rugged coastline areas and rolling tundra that consists of raised beaches, dry tundra, sedge meadows, wetlands, and lakes that are inhabited by a diversity of breeding songbirds and shorebirds.

Peregrine Falcons do not build a nest but make a depression (called a scrape) in the substrate on a cliff ledge. Scrapes are usually approximately 20 cm in diameter and 4 cm deep. Females usually do the majority of incubation, and brooding of small young. Males provision incubating females and provide most of the prey when nestlings are small. Thereafter, females do most of the feeding, beginning to hunt after young are large enough to thermoregulate on their own. Clutch size is typically 3 or 4 eggs in Nunavut. In Rankin Inlet and Igloolik, the median incubation period of the first egg was 36 days, and decreased 1 day for each additional egg. The incubation period of the 4th egg (33 days) was similar to what has been reported elsewhere (Burnham 1983).

The Arctic peregrine falcon is a generalist predator with a diverse diet that includes passerines, shorebirds , ducks , gulls, terns, jaegers, black guillemots, and, when available, collared lemmings, brown lemmings, and Arctic ground squirrels. Bradley and Oliphant (1991) indicated that, around Rankin Inlet, small birds (64% of prey items) represented the greatest portion of prey items, followed by microtine rodents (25%), large birds (8%), and Arctic ground squirrels (4%). The most important prey measured by percent biomass were large birds (43%), followed by small birds (25%), microtine rodents (18%), and Arctic ground squirrels (15%).

In Nunavut, the earliest documented arrival for Peregrine Falcons is 10 May at a known breeding site near Rankin Inlet. Although arrival timing varies with spring conditions, the majority of sites are occupied during the 3rd week of May. Median laying date in Rankin Inlet (9 June) is typically earlier than Igloolik (15 June) and northern Baffin Island (16 June). Median date of hatching ranges from 14 July at Rankin Inlet to 18 July on northern Baffin Island and 20 July at Igloolik (Jaffre et al. 2015). Birds depart the breeding grounds from mid-September through early October, arriving on the wintering grounds throughout Central and South America in November.

Gyrfalcon (*Falco rusticolus*)

The gyrfalcon (Figure 2) is large with pointed wings, but more rounded and broader than the wings of other falcon species. The tail is relatively long. When perched, wings extend 2/3 down the tail. The body is thick and powerful, particularly in females. Adults have yellow ceres, eye-rings and legs. As in all falcons, the eyes appear black. Three main color morphs occur: black, grey and white. White adults have almost pure white breasts and bellies, with dark wingtips (dipped-in-ink appearance). Grey adults have slate-colored back, with white underparts mottled with gray arrowhead-shaped markings. Dark

adults are dark-grey overall above and dark-streaked breasts and belly. There is extreme reverse sex dimorphism, with males being approximately 2/3 the size of females (Ferguson-Lees et al. 2001).

Gyrfalcons distribution extends throughout the circumpolar Arctic. Most of the breeding range occurs north of 60°N, but breeding pairs are known to exist as far south as 55°N, mainly along sea coasts in eastern Canada. Many adults remain within the breeding range throughout the year, but some disperse southwards in winter, small numbers reaching the norther. United States (Cade 1982, Poole 1987). Immature birds are much more likely to winter to south of breeding range, and females are thought to disperse more widely, with many males remaining relatively close to breeding territories throughout the year.

Ptarmigan are often cited as the most important prey species by biomass, but Arctic ground squirrel and Arctic hare are also important, as well as small mammals (mice and voles) and other birds (ducks, sparrows, buntings). In central Nunavut, Poole and Boag (1988) identified eleven species of birds and five species of mammals among the prey. Birds accounted for three quarters of the diet, and adult rock ptarmigan were the most common. Arctic ground squirrel and arctic hare, made up the bulk of mammalian prey.

Males occupy and defend nesting territories as early as the end of January, with females arriving in mid-March. In Nunavut, laying typically begin in the first week of May with most pairs laying by the end of the second week in May. Nestlings typically hatch in mid-June but hatching can occur throughout June. Nestlings fledge in late July or early August after 7 weeks in the nest. In Nunavut, gyrfalcon usually nest on cliff ledges, ideally beneath sheltering overhang; sometimes nests in trees or on man-made structures. Nests are generally on rock ledges or abandoned rough-legged hawk or common raven nests. Use of alternate nest sites is not uncommon. Pairs do not necessarily attempt breeding every year, depending on food supply. Typical clutch size is 3-4 eggs (Booms et al. 2008) that are incubated for 34-36 days mostly by the female (ca. 80%). The North American population including Nunavut is considered to be stable (Clum and Cade 1994, Kirk and Hyslop 1998). Although low spring temperatures are associated with later arrival at nesting territories in Nunavut (Poole and Bromley 1988), there was no effect on laying dates. However, (Poole and Bromley 1988) indicated that increased spring precipitation (snow) reduced reproductive success.

Rough-legged Hawk (*Buteo lagopus)*

The rough-legged hawk (Figure 3) is a medium-large bird of prey, with a fairly small beak, predominantly brown in colour and often mottled. Plumage is highly variable with recognized light and dark morphs. Extensive field experience is required to distinguish between males and females, and between adults and juveniles based on plumage alone. A broad chest band is evident in most plumage variations, and in flight, a dark carpal patch is characteristic in light morph individuals. One or more dark terminal bands appear on the tail. The wing tips are long enough to reach or extend past the tail when the animal is perched. Legs are feathered to feet (Ferguson-Lees et al. 2005).

Widespread throughout North America, breeding from the Aleutian Islands, the interior of Alaska, Yukon, northern Mackenzie, and across Nunavut to northern Labrador and Newfoundland and south to Manitoba and southeastern Quebec. In Nunavut, rough-legged hawks are present over most of the territory except for islands without lemmings (Bechard and Swem 2002).

Regularly hovers, or “kites” while facing into the wind scanning for prey. Soars with wings raised in a slight dihedral (V-shape). It is a diurnal raptor that still-hunts from prominent perching structure on both breeding and wintering grounds. Prey is captured on the ground. Courtship involves soaring and calling, with the male engaged in a flight display of repeated undulating stoops rising upward to mid-air stall. It is gregarious on migration, often travelling in large flocks, but small groups or individuals are not uncommon.

During the summer, breeding pairs prefer rugged terrain areas with steeper slopes in areas associated with primary production (i.e., vegetation), and were most likely to nest in large, productive valleys surrounded by high-elevation plateaus (Galipeau et al. 2016). It is widely distributed in winter, usually found in open habitat resembling the tundra such as prairies, plains, coastal marshes, agricultural fields, and airports (Johnsgard and Johnsgard 1990). More common in wintering areas typified by short growing seasons and low precipitation, with highest densities in the northern United States, Great Basin area, and the western shortgrass prairies (Bock and Lepthien 1976, Bock et al. 1977).

The rough-legged hawk is a small mammal specialist; thus, its breeding activity is generally associated with local abundance of ground squirrels, voles, or lemmings (Hanski 1991, Potapov 1997). It will prey on birds when small mammals are scarce, particularly juvenile passerines and shorebirds, and will resort to consuming carrion opportunistically (Watson 1986). Usually reproductively mature at 2 years of age. Stick-nests are built soon after arrival on territory, typically on cliffs, on bluffs, or on the ground. Clutch sizes are variable (1-7 eggs), depending on food availability, but 3-5 eggs are usual and laid in May. Incubation 31-33 days, provided almost entirely by the female. Nestling period is 35-40 days, and fledglings remain dependent on adults for another 2 weeks. The male provisions the young and the female, which feeds the young. Pairs show nest site fidelity, and in locations where ground squirrels are entirely absent, they may forgo breeding or have small broods when lemmings are low, in contrast to Snowy Owls, which are truly nomadic (Bechard and Swem 2002). Bechard and Swem (2002) indicated that egg-laying date was associated with spring temperatures and snow-free ledges, but Potapov (1997) reported no effect of snow melting date or spring/summer temperatures on number of nesting pairs.

Methods

Terminology

The terminology used throughout this report follows (Franke et al. 2017). The following terms are highlighted in an effort to clarify terminology used in this report, and/or to distinguish terms used from similar terms that have distinct meaning:

nest — The structure made or the place used by birds for laying their eggs and sheltering their young (Steenhof and Newton 2007) regardless of whether eggs are laid in the nest in a given year or in any year (Millsap et al. 2015, Steenhof et al. 2017), see Scrape for Gyrfalcons.

nesting site — The substrate which supports the nest or the specific location of the nest on the landscape (Ritchie and Curatolo 1982, Millsap et al. 2015, Steenhof et al. 2017).

alternative nesting site — One of potentially several nests within a nesting territory that is not a used nest in the current year (Millsap et al. 2015).

nesting territory — An area that contains, or historically contained, one or more nests within the home range of a mated pair: a confined locality where nests are found, usually in successive years, and where

no more than one pair is known to have bred at one time (Newton and Marquiss 1984, Steenhoff and Newton 2007). Note that a nesting territory may or may not be defended (Postupalsky 1974), and probably does not include all of a pair's foraging habitat (Newton and Marquiss 1984, Steenhoff and Newton 2007).

occupancy — The quotient of the count of occupied nesting territories and the count of known nesting territories that were fully surveyed in a given breeding season (Franke et al. 2017).

brood size — The actual number of young hatched from a single nesting attempt by a pair of birds. For studies in which mortality that occurs between hatching and the first observation of the brood is unknown, it is appropriate to report brood size (i.e., number hatched) only for broods equal to, or less than 10 days of age. For broods older than 10 days of age, see Brood Size ≥10 days. Report mean and standard error, or standard deviation.

brood size ≥ 10 days — The number of young hatched from a single nesting attempt by a pair of birds. For studies in which mortality that occurs between hatching and the first observation of the brood is unknown, and nestlings are equal to, or greater than 10 days of age, but less than Minimum Acceptable Age for Assessing Success. Report mean and standard error, or standard deviation.

minimum acceptable age for assessing success — A standard nestling age at which a nest can be considered successful. An age when young are well grown but not old enough to fly and after which mortality is minimal until actual fledging. Typically 80% of the age that young of a species normally leave the nest of their own volition for many species, but lower (65–75%) for species in which age at fledging varies considerably or for species that are more likely to leave the nest prematurely when checked (Steenhof and Newton 2007).

nest survival — The probability that a nesting attempt survives over the complete nesting period. When Daily Survival Rate (DSR; Dinsmore et al. 2002) is assumed to be constant over time and E is the nesting period (usually expressed in days), nest survival is DSR^E; otherwise nest survival is the product of each estimated DSR. For raptors, nest survival is the equivalent of nesting success for egg-laying pairs (Steenhof et al. 2017).

productivity — The number of young that reach the minimum acceptable age for assessing success; usually reported as the number of young produced per territorial pair or per occupied territory in a particular year (Steenhoff and Newton 2007, Steenhof et al. 2017).

total production — The total number of young detected.

Field Surveys

Structured surveys were conducted from 2015 – 2017, and in 2019. The focus of these surveys was to search known nesting sites for the presence of cliff-nesting raptors. In addition to the structured surveys, favourable habitat was searched opportunistically when ferrying between known sites, camps or other mine infrastructure and when raptors or signs of site use (e.g., whitewash, orange-colored lichen, and unused nests) were observed. Sites were considered occupied if one or more adults displayed territorial or reproductive behavior (e.g., vocalization and/or flight behavior associated with defense of breeding territory or presence of nest building, nest, or eggs). Locations with partially built or unused nests without detection of breeding aged adults were noted as such (e.g., old stick nest; no birds detected). Raptor monitoring in 2019 involved one helicopter survey (13 – 17 June), and ground -

monitoring of potential nesting habitat (natural cliffs, quarries and borrow pits) along the Haul Road. A second survey to evaluate reproductive success, and provide an estimate of detection error was planned for 7 – 10 August, but was cancelled due to weather, and limitations associated with helicopter availability and travel logistics.

Data Exploration

Nearest Neighbour Distances

Nearest neighbour distances (NND) were calculated in R (R Development Core Team 2017) using the sp, rgeos, and geosphere packages to transform nesting site locations into spatial objects, calculate pairwise distances, and identify the shortest distance between known neighbouring nesting site locations.

Distance to disturbance

Spatial objects (lines and polygons) describing the project footprint were acquired from Agnico Eagle. Euclidean distances from nesting sites to the nearest spatial object were calculated in R (R Development Core Team 2017) using the sp, rgeos, and geosphere packages. Summary data were generated using the hist, boxplot and summary functions in R.

Assigning Nesting Sites to Nesting Territories

In the absence of marked individuals, it can be challenging to definitively identify alternative nesting sites. Failure to account for alternative nesting sites can lead to underestimating demographic parameters such as annual productivity. To address this problem, a rule-based approach was used to estimate the number of alternative nesting sites within the study area (Figure 4):

- If two species-specific nesting sites were separated by a distance of ≤ 1 km they were considered alternative nesting sites in a single nesting territory.
- If two nesting sites within 1 km of each other were occupied by the same species in a given year, they were considered separate territories.
- If multiple species-specific nesting sites were within 1 km of one another, discrete geographic landforms or discontinuities in cliff structure were used to separate or combine sites into territories.

Temporal patterns of multi-species occupancy were used to assess the plausibility of decisions based on the application of the three rules listed above. For example, if two nesting sites were located within 1 km of each other and were occupied by two different species in alternating years, these nesting sites were identified as distinct alternative nesting sites for each species.

Assigning Identification Numbers (ID) to Nesting Territories was conducted according to the following rule set:

- Nesting Territory IDs were assigned within species only (e.g., Nesting Territory IDs for PEFA and RLHA were never shared).
- Nesting Territory IDs were assigned using the Identification Number of one of the Nesting Sites in the cluster according to the following rule set, in order of priority:
    i. Length of tenure (i.e., nesting sites with the longest tenure)
    ii. First tenure (i.e., nesting sites with the first tenure in the event length of tenure was equal).

Occupancy

Although it is not possible to estimate detection error without multiple surveys (i.e., fully surveyed), point estimates without corresponding estimates of error can be calculated as the quotient of the count of occupied nesting territories and the count of known nesting territories that were surveyed in a given breeding season, even if they were not fully surveyed. For each species separately, we first tallied the total count of known nesting sites across all surveys combined. We then adjusted the year-specific count of known nesting sites to account for nesting sites that were not known in that year (i.e., had not been found). Using the methods to assign nesting sites to nesting territories described in the previous section, we tallied the number year-specific nesting territories. We then calculated the year-specific proportion of known nesting territories that were occupied as a proportion of the known nesting territories that were surveyed. For visualization purposes only (i.e., no statistical assessment of trend was attempted), we then used Loess Regression to smoothen the available time series

Results

Data Exploration

Across five different surveys (see Table 1), one-hundred and fourteen locations considered to be typical of raptor nesting habitat were surveyed at least once from 2015 – 2017, and 2019 (n.b., no surveys were conducted in 2018). Of the 114 locations surveyed (Figure 5), nesting raptors have been detected at 58 nesting sites (Table 2). Peregrine falcons have been documented at 43 nesting sites, rough-legged hawks at 23 nesting sites and gyrfalcons have been documented at six nesting sites. The mean nearest neighbour distance (i.e., occupied sites only) was 1.15 km (range = 0.11– 5.36 km). Mean distance from known occupied nesting sites to the haul road was 13.05 km (range = 0.06 – 29.02 km); one nesting site fall within 1.5 km of the Haul Road, and is considered a candidate for development of a site-specific management plan (see Management Plans). A second survey location falls with the "no disturbance" buffer, but nesting raptors have not been detected at this location to date. Mean distance from known occupied sites to the Whale Tail footprint was 17.46 km (range 0.66 – 51.66 km). Two nesting sites fall within 1.5 km of the Whale Tail footprint, and are considered candidates for development of a site-specific management plan (see Management Plans). However, neither are with the 600m limit identified in Government of British Columbia (2013).

After applying the rule-based approach to assign nesting sites to nesting territories, we assessed one peregrine falcon nesting site to be an alternate site within one nesting territory resulting in total of 41 peregrine falcon nesting territories. For rough-legged hawks and gyrfalcons, two nesting sites for each species were considered to alternates, resulting in 21 nesting territories for rough-legged hawks and four for gyrfalcons.

Point estimates for occupancy indicate that peregrine falcons (mean = 0.63) and gyrfalcons (0.63) have been stable (Table 1, Figure 6). For rough-legged hawks, mean occupancy was equal to 0.46, however, data indicate that a peak occurred in 2017 (0.76), which is a well-known for small-mammal specialists which respond to microtine rodent cycles (Gilg et al. 2006).

Discussion

This report retroactively applies GN-DoE guidelines (Government of British Columbia 2013) to assess potential disturbance to known nesting sites that have been identified over the course of five survey-

years (i.e., active baseline monitoring). Agnico Eagle has developed nest-specific response plans for raptor nesting sites within areas of concern to evaluate potential effect of development activities on breeding success. To date, Agnico Eagle has not detected instances of raptors establishing nests on artificial structures, pit walls, or other facilities along the Haul Road or Whale Tail site. Furthermore, mitigation of disturbance has not been necessary as Agnico Eagle has not detected any raptor nests within 1.5km of existing infrastructure.

To date, monitoring has focused on searching for, documenting and mapping nesting sites for three raptor species (peregrine falcons, rough-legged hawks, and gyrfalcons). Study design has been limited to single surveys conducted annually since 2015 (except for 2018), which does not allow for estimation of detection error in estimates of occupancy (i.e., project-related disturbance effects). To address this limitation, starting in 2020, the study design shall be updated to incorporate multiple surveys annually, and will take advantage of the distribution of known nesting sites to monitor occupancy and reproductive success as a function of distance to project-related disturbance, and other covariates as available (e.g. small mammal abundance).

This report meets Term and Condition 33 by documenting and mapping raptor nesting sites (Figure 5, Table 2), and presenting site-specific management plans (see below) for nests within 1.5km of project infrastructure, including minimum "no disturbance" buffers (see Commitment 32).

Management Plans (Commitment 32)

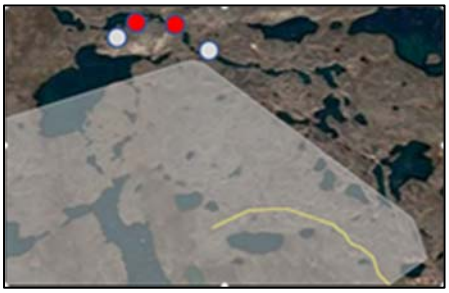
Nesting Site 42

This nesting site (red circle) is located 0.488 km from the Haul Road (yellow line) at latitude 65.110917, longitude -96.104477 (road marker km 121). It was checked in 2015 and 2017, but raptors were not detected. It was occupied by peregrine falcons in 2019 (post Haul Road construction). Ongoing monitoring will be required to determine whether this nesting site is regularly occupied in future years. It is located in a narrow gulley between two rock outcrops, and is not within direct view of the road. Direct disturbance risk (access by people, noise from road traffic) is considered to be low.

Site 43

This site (grey circle) is located 1.005 km from the Haul Road (yellow line) at latitude 65.273917, longitude -96.450046 (road marker km 153). It has no history of use, and is not considered to be at risk of disturbance due to it distance from the Haul Road (i.e., >600m), and its history of use. It is within the 1.5 km "no disturbance" buffer, but greater than the 600m buffer recommended in Government of British Columbia (2013). Agnico Eagle will continue to monitor this potential nesting site annually for presence of nesting raptors, but a management plan is not considered necessary for this cliff.

Sites 58 and 119



Both sites have been checked annually since 2015, and have been regularly occupied (119 by rough-legged-hawks, and 58 by peregrine falcons). Both sites are on the same cliff, and are located within 1.5 km of the expected Whale Tail Project footprint. Both sites are located beyond the 600m buffer (119 = 825m and 58 = 661m) recommended in Government of British Columbia (2013). Furthermore, the nesting cliff faces north, and direct exposure of incubating birds and nestlings to the Whale Tail Project footprint is minimal. Agnico Eagle will continue to monitor these nesting sites annually for presence of nesting raptors, but a management plan is not considered necessary for this cliff.

Tables

Table 1

Table 1. Survey effort and occupancy for peregrine falcons, rough-legged hawks and gyrfalcon breeding near the Whale Tail Project, Nunavut from 2015 – 2019.

Survey effort

Year	2015		2016		2017		2018		2019	
Type	Occupancy	Productivity	Occupancy	Productivity	Occupancy	Productivity	Occupancy	Productivity	Occupancy	Productivity
Date	28 – 30 May	N/A	May 18 - 20	Jul 21 -23	28 – 30 May	N/A	N/A	N/A	13 – 15 Jun	cancelled
Hours	12	N/A	10	10	12	N/A	N/A	N/A	10	cancelled

Occupancy metrics

Year	2015			2016			2017			2018	2019		
	occupied	known	occupancy	occupied	known	occupancy	occupied	known	occupancy	N/A	occupied	known	occupancy
PEFA	24	30	0.80	22	37	0.59	23	41	0.56	N/A	23	41	0.56
RLHA	4	14	0.29	9	20	0.45	16	21	0.76	N/A	7	21	0.33
GYRF	4	4	1.00	2	4	0.50	2	4	0.50	N/A	2	4	0.50

Table 2

Table 2. Geographic coordinates (decimal degrees), distance to nearest neighbour (D2NN), distance to road (D2RD), and distance to footprint (D2FP) for 58 occupied nesting sites surveyed between 2015 and 2019.

	site	latitude	longitude	D2NN (km)	D2RD (km)	D2FP (km)	Mgt. Plan
1	4	65.26865	-96.2974	2.49	4.716	20.0762	No
2	5	65.43728	-96.5821	0.3	4.347	3.471654	No
3	8	65.44396	-96.6014	0.12	4.677	3.495891	No
4	9	65.45078	-96.6041	0.43	5.351	4.010533	No
5	10	65.44697	-96.6058	0.18	4.933	3.62981	No
6	14	65.44189	-96.7278	0.25	5.283	2.493361	No
7	16	65.44494	-96.7334	0.24	5.711	2.898658	No
8	21	65.53657	-96.9563	2.96	20.159	16.49045	No
9	23	65.54697	-96.7894	0.91	17.052	14.48342	No
10	24	65.54884	-96.7702	0.91	16.94	14.41999	No
11	25	65.56906	-96.82	0.43	19.867	17.26577	No
12	26	65.57202	-96.8261	0.43	20.281	17.66797	No
13	27	65.5984	-96.9029	0.75	24.467	21.5935	No
14	28	65.60489	-96.9071	0.75	25.198	22.33922	No
15	32	65.11769	-95.8505	0.51	9.003	46.83729	No
16	34	65.28798	-96.3603	0.23	2.266	16.49749	No
17	38	65.48439	-96.1955	1.36	21.47	20.86524	No
18	39	65.52728	-96.298	1.15	20.527	19.67945	No
19	40	65.57981	-96.2658	0.69	25.839	24.98003	No
20	42	65.11092	-96.1045	2.15	0.488	39.34663	Yes
21	44	64.9376	-96.2774	2.53	0.059	51.65769	Yes
22	46	65.34242	-96.4942	0.25	1.643	7.833974	No
23	49	65.26724	-96.3507	1.56	2.678	18.5599	No
24	51	65.09825	-96.1389	0.63	2.592	39.5332	No
25	52	65.07079	-96.152	2.49	1.654	41.63656	No
26	54	65.1041	-96.2826	2.51	8.472	35.12121	No
27	55	65.28111	-96.6848	2.36	9.379	9.346625	No
28	58	65.43157	-96.6778	0.54	3.186	0.661308	Yes
29	59	65.47422	-96.7106	1.72	8.174	5.653718	No
30	61	65.17494	-95.8958	5.36	10.453	41.11073	No
31	63	65.11243	-96.3323	2.51	10.638	33.07526	No
32	65	65.20558	-96.6023	0.48	7.011	18.36187	No
33	67	65.20154	-96.6061	0.48	7.371	18.75303	No
34	68	65.21639	-96.7209	0.79	11.656	16.49884	No
35	73	65.45661	-96.7737	0.45	7.88	4.730445	No
36	74	65.4548	-96.7583	0.29	7.277	4.309077	No
37	75	65.45524	-96.7645	0.29	7.491	4.448234	No
38	77	65.44382	-96.6637	0.79	4.357	1.987167	No
38	78	65.45267	-96.4856	1.45	8.503	7.655634	No
40	79	65.45624	-96.3541	4.49	13.675	12.88288	No
41	83	65.50426	-97.2294	3.45	28.553	24.04926	No
42	85	65.50109	-97.0226	0.56	19.917	15.65364	No
43	86	65.50602	-97.02	0.56	20.128	15.91137	No
44	87	65.5096	-97.0309	0.22	20.77	16.55399	No
45	89	65.52295	-97.0726	0.14	23.203	18.98755	No
46	90	65.52388	-97.0747	0.14	23.342	19.1282	No
47	91	65.46928	-96.4458	1.63	11.116	10.26902	No
48	92	65.49034	-96.2212	1.36	20.91	20.10259	No
49	94	65.45977	-96.9551	1.72	14.928	10.47587	No
50	95	65.51802	-97.1627	2.82	26.451	22.05913	No
51	97	65.57796	-96.9643	0.28	23.99	20.65109	No
52	99	65.5352	-96.7453	1.91	15.141	12.6275	No
53	107	65.21393	-96.7367	0.79	12.44	16.80833	No
54	108	65.53874	-97.1977	0.11	29.011	24.67434	No
55	109	65.5396	-97.1966	0.11	29.017	24.6861	No
56	116	65.54353	-97.1504	0.65	27.465	23.22592	No
57	117	65.44444	-96.9512	0.55	14.114	9.563901	No
58	119	65.43146	-96.6896	0.34	3.397	0.824742	Yes

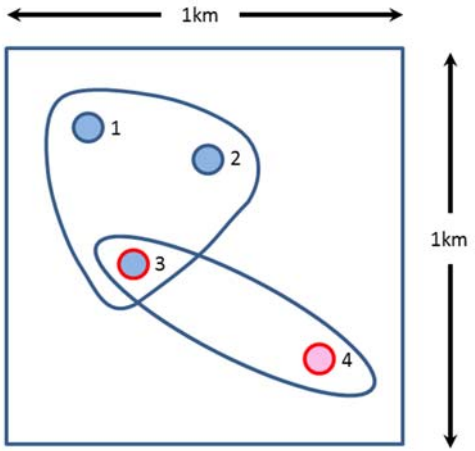
Figures

Figure 1

Figure 2

Figure 3

Figure 4



NS ID	PEFA NT ID	RLHA NT ID	2011	2012	2103	2014	2015	2016	2017
1	**1**	**-**	PEFA	PEFA	NBD	NBD	NBD	PEFA	PEFA
2	1	-	NBD	NBD	PEFA	NBD	PEFA	NBD	NBD
3	1	4	NBD	NBD	NBD	PEFA	RLHA	RLHA	NBD
4	-	4	RLHA	RLHA	NBD	RLHA	NBD	NBD	RLHA

Figure 5

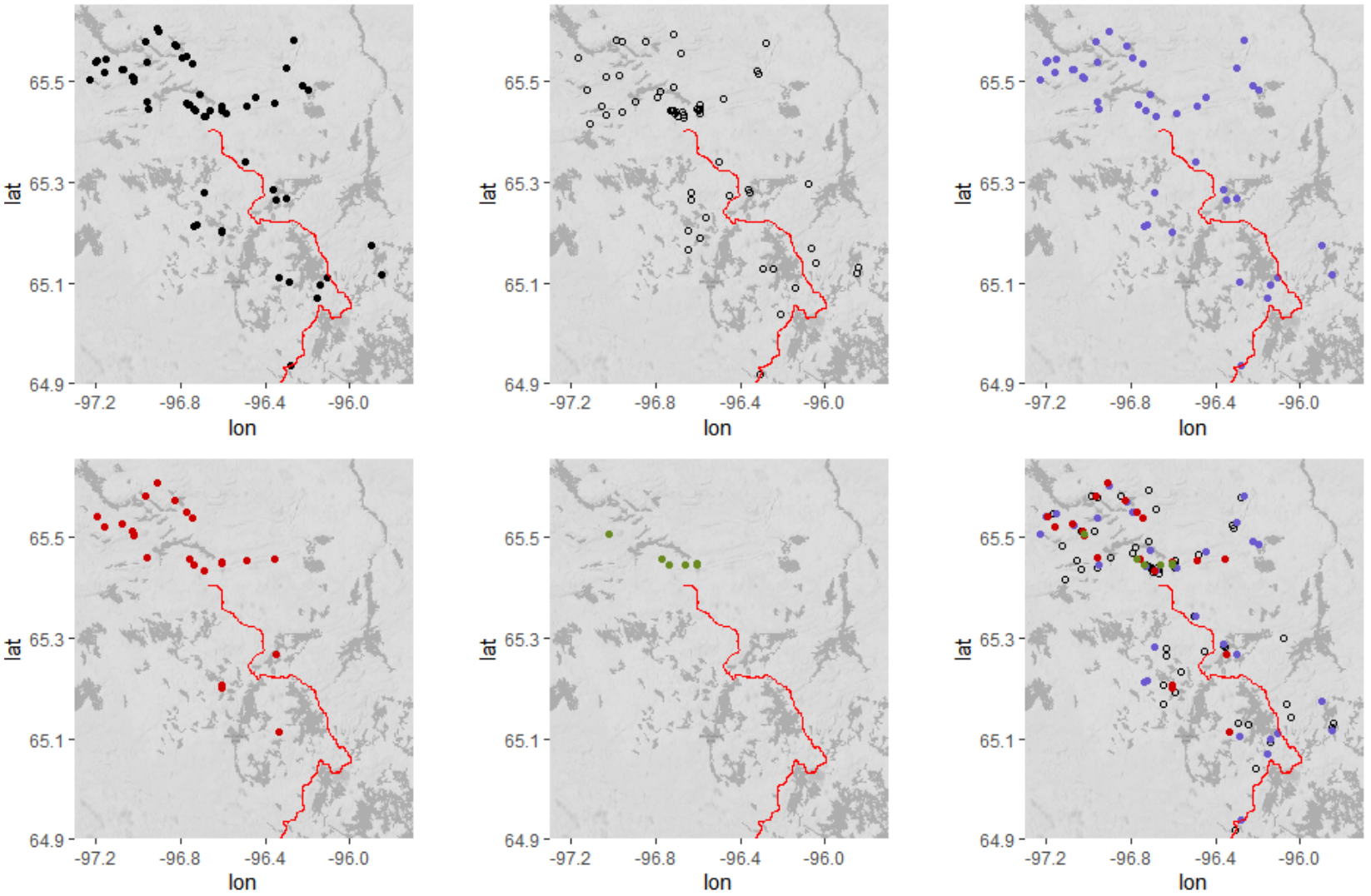
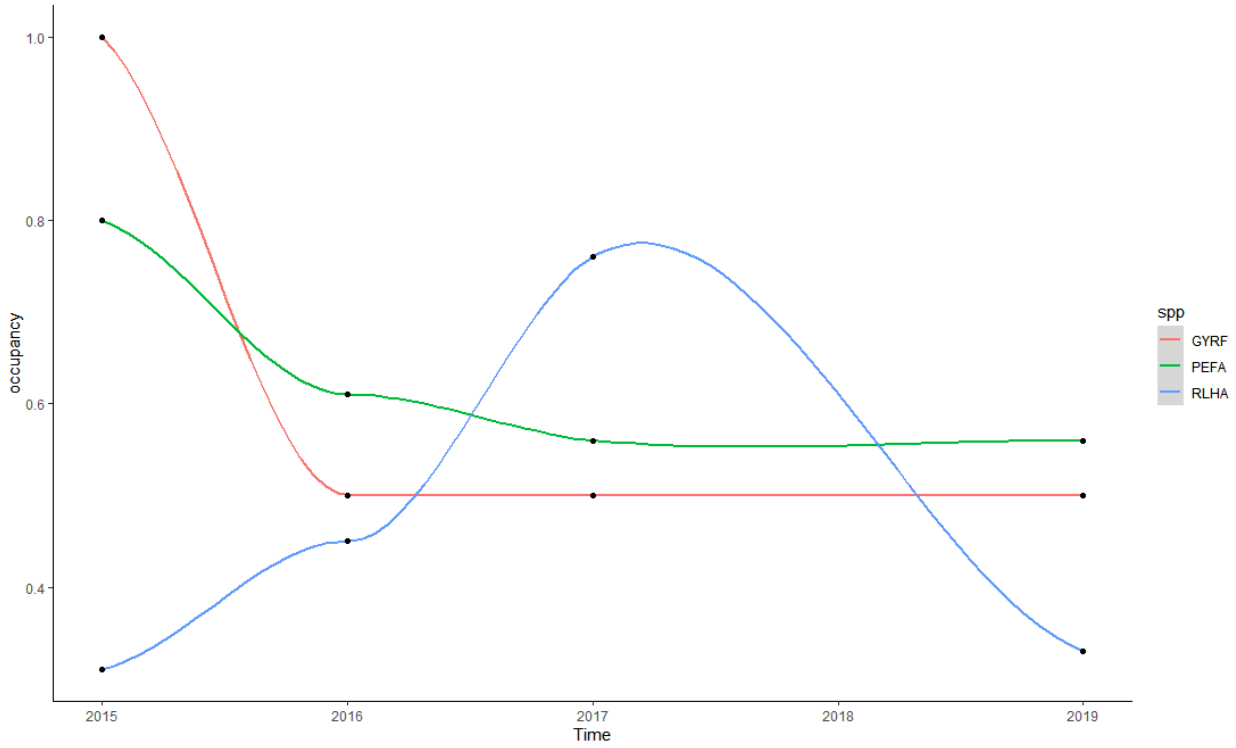


Figure 6


1.0
0.8
0.6
0.4
occupancy
2015
2016
2017
2018
2019
Time
spp
GYRF
PEFA
RLHA

Captions

Figure 1. Adult male peregrine falcon. Note the dark hood and face with distinct dark malar stripe, white throat, slate-grey back, and barred belly, legs, and tail. Wing are long and pointed. Note the yellow legs, cere and eye ring.

Figure 2. Adult female gyrfalcon. Note that wings are more rounded and broader than the peregrine falcon. The tail is relatively long. When perched, wings extend 2/3 down the tail. The body is thick and powerful, particularly in females. Adults have yellow ceres, eye-rings and legs.

Figure 3. Adult male rough-legged hawk. Note predominantly brown in colour and mottled. A broad chest band is evident, and dark carpal patches (not evident here) are characteristic in light morph individuals. One or more dark terminal bands appear on the tail. The wing tips are long enough to reach or extend past the tail when the animal is perched. Note that legs are feathered to feet

Figure 4. Rule-based approach used to assign nesting sites to nesting territories. A cluster of four nesting sites within 1 km of one another that exhibit a site occupancy history among seven years for two species (PEFA and RLHA). Nesting Sites 1 and 2 (blue circles with blue borders) have been occupied solely by PEFA. Nesting Site 4 (red circle with red border) has been occupied solely by RLHA. Nesting Site 3 (blue circle with red border) has been occupied by both PEFA and RLHA. In this example, Nesting Sites 1, 2 and 3 are grouped into a single PEFA Nesting Territory and assigned Nesting Territory ID 1 based on PEFA–specific tenure length (Nesting Site 1 has the longest tenure) and first tenure. Nesting Sites 3 and 4 are grouped into a single RLHA Territory and assigned Nesting Territory ID 4 based on RLHA–specific tenure length (Nesting Site 4 has the longest tenure) and first tenure. Unique nesting locations are ultimately defined by a Nesting Territory ID and a Nesting Site ID (E.g., NT ID 1, NS ID 2). NBD = no birds detected.

Figure 5. Distribution (2015 – 2019) of nesting sites occupied at least once (black circles, upper left panel), potential nesting sites with no history of occupancy (open circles, upper middle panel), nesting sites occupied by peregrine falcons (purple circles; upper right panel), nesting sites occupied by rough-legged hawks (red circles; lower left panel), nesting sites occupied by gyrfalcons (green circles; lower middle panel), all species combined (lower right panel). The Haul Road (red line), Whale Tail Project footprint (grey polygon), and regional study area (black line) are shown relative to the distribution of nesting sites.

Figure 6. Trend (visualizations purposes only, loess smoothing) in occupancy for peregrine falcons (green line), rough-legged hawks (blue line), and gyrfalcons (red line) from 2015 – 2019. Annual occupancy point estimates for each survey year (black circles) are also presented (see Table 1 for details).

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