Final Report to NWMB

Project # 2-10-12

Multi-scale investigation of the population ecology of raptors in Nunavut

Licenses and Permits

Nunavut Wildlife Research Permit: WL 2010-009
Canadian Wildlife Service Banding Permit: 10742, 10742 G
University of Alberta Animal Care Protocol: 7381005

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- Government of Nunavut, Department of Environment
- Nunavut Wildlife Management Board
- Canadian Circumpolar Institute
- University of Alberta

Summary

Our 2008 project proposal outlined a cost-effective approach to fill data gaps for raptor species in Nunavut. This report summarizes research efforts and initial results for the 2009 and 2010 field seasons of Project # 2-10-12, "*Multi-scale investigation of the population ecology of raptors in Nunavut*" for 2010.

This is the Yearly Final Report for the 2010 field season only. The project is ongoing therefore this is not a Project Final Report, further analysis is under progress.

Introduction

The original proposal submitted in 2008 was in direct response to a request from the Nunavut Wildlife Management Board (NWMB) that the Government of Nunavut (GN) carries out fundamental research on raptors in their territory. We recommended that a minimum of 2 additional, geographically distinct study areas should be established to complement the long-term study located at Rankin Inlet, Nunavut. We proposed a cost effective, "phased-in" strategy for the additional study areas with three major focuses: (1) raptor species with potential economic benefit to Nunavut, (2) significant community involvement through local hiring and training, and (3) filling knowledge gaps regarding the status of Arctic raptors, which will aid the development of policy for a Total Allowable Harvest (TAH).

Although the Rankin Inlet Peregrine Project is considered among the best and longest studies of Arctic breeding raptors anywhere in the world, results from that project alone cannot be generalized to other areas of Nunavut. Franke et al. (2010) measured occupancy, reproductive performance and pesticide loads of breeding-aged peregrines on territory near Rankin Inlet from 1982 to 2009. Despite a decline in pesticide levels within peregrine tissues to below toxic threshold levels, overall reproductive success has declined over this time period. Approximately 3 fewer territories were occupied annually from 2002 to 2009 than were occupied from 1982 to 1989, and the average number of young from 2002 to 2009 was approximate half that from 1982 to 1989. If used to set a Nunavut-wide TAH, these findings would likely preclude a peregrine falcon take despite proposals to do so. Regionally, data are not available for regulators to assess if the observed declines are limited to Rankin Inlet or consistent across the territory.

In addition, despite growing concerns regarding climate change, few studies have investigated the effects of climatic conditions on survival in long-lived species. Franke et al. (in review) used re-observations of more that 250 marked birds encountered on more than 600 occasions to estimate the effect of climate on apparent survival during breeding, outward migration, wintering, and inward migration. We found that 35% of the variation in annual survival of peregrine falcons (0.70 for males and females) was best explained by the North Atlantic Oscillation Index during outward migration. These findings provide a broader context to regulators in the development of policy related to harvest of eyasses (nestlings) and passage birds (< 1 year old fledglings).

Capacity and expertise within the GN to undertake a project of this magnitude was limited, thus successful implementation relied on the acquisition of considerable funds and human resources external to the GN. Therefore, we recommended situating one of the additional 2 study areas at Steensby Inlet in partnership with Baffinland Iron Mine Corporation (BIMC), and placing the second additional study area at Wager Bay in partnership with Parks Canada (PC). Both organizations initially expressed interest in support of the proposed research. Unfortunately neither BIMC nor PC was able to support any work in 2009. The proponents of this work opted then to headquarter the project from the community of Igloolik, and to survey the region immediately west of Igloolik Island where local knowledge and appropriate nesting habitat indicated a high potential for breeding peregrine falcons, gyrfalcons and rough-legged hawks.

In the spring of 2009, Barry Robinson, a student from the University of Alberta finished his MSc. and joined the Arctic Raptor Project as a PhD student co-supervised by Dr. Alastair Franke and Dr. Andrew Derocher. His academic record combined with the strength of the Arctic Raptors research program resulted in Barry receiving one of three Alberta Ingenuity Fund Scholarships valued at $78 000.

Limited field work in the spring of 2009, followed by a more intense summer survey documented three active peregrine falcon nests that held a total of 9 nestlings, 5 of which were banded. Three additional sites held single peregrines. There were no adults captured, or formal prey surveys conducted (for either small mammals or avian prey) and no active gyrfalcon or rough-legged hawk nests were found. Approximately 430 km^2 was surveyed by snow machine, boat and on foot, resulting in a first and course estimate of breeding pair density: 1 pair/73km^2. Two motion-sensitive cameras were deployed at nest ledges documenting breeding behaviour with over 46,000 images.

We suggested that low breeding abundance resulted from a late spring snow melt over large regions of Nunavut in 2009, which may have delayed the arrival of migratory raptors, and/or reduced the number of ledges available for egg laying. In addition, we acknowledged that low survey effort during the critical window of time over which observations of territorial pairs was likely to be highest (courtship) may also have contributed to lower than expected breeding abundance. To rule out an effect of spring weather, snow cover and lower than anticipated survey effort on breeding abundance, we recommended that significant survey effort be undertaken in the spring of 2010 and that unspent funds from 2009 be carried over to the 2010 field season. Within this report, we outline the significant progress made during the 2010 field season and how it has contributed to achieving the objectives put forth in our original proposal.

Project Objectives

The overarching goal of this project is to establish 3 study areas in Nunavut that can provide detailed information that would support policy decisions required to set TAHs for raptors in Nunavut. As outlined in our original proposal, we have 4 long-term objectives each of which is informed by annual objectives.

Long-term Objectives

Concurrent monitoring over multiple years of several biotic and abiotic factors is required to characterize the breeding ecology (survival, breeding abundance, productivity, recruitment) of Arctic-breeding raptors. The following descriptions briefly reiterate each of our long-term objectives that were outlined in our original proposal.

Objective 1 – Estimate direct density independent mortality

Local weather conditions are known to correlate with reproductive performance in raptors (Bradley 1997). This long-term objective relies on first establishing the natural range of variation in precipitation, wind, and temperature as it relates to reproductive success, occupancy and breeding phenology. A nest-box experiment, where we provide breeding pairs shelter from inclement weather, may be conducted in later years as our sample size of breeding sites increases. The results from this experiment will be compared to base line weather and breeding data, and results from the nest-box experiment currently under way at Rankin Inlet.

Objective 2 – Estimate Indirect density independent mortality

Inclement weather is a known correlate with mortality of ground nesting passerines and shore birds, which comprise a major proportion of diet during the brood rearing phase of Arctic-nesting raptors specializing on avian prey. Frequent summer storms can significantly reduce the availability of juvenile avifauna in particular, and result in starvation of raptor species that rely on this resource. Describing variations in the diet of raptors and linking it with variations in prey availability may identify the factors that limit Arctic raptor populations, and the strategies that raptors employ to mitigate (e.g. prey switching) within season changes to the local prey base.

Objective 3 – Condition dependent reproductive delay in females

Allocation of limited resources to maintenance, growth, and reproduction inevitably force individuals to make trade-offs between current reproduction and survival, current reproduction and future reproduction, and the number and quality of offspring. The context for this research assumes the theoretical under-pinning that species specific reproductive strategies exist for Arctic-breeding raptors that vary with migratory status. For example, highly migratory raptors such as peregrines are probably condition-dependent capital breeders, and measures of productivity (such as clutch size) may be predicted on the basis of female body condition and date of arrival on the breeding grounds. We will determine the extent with which the arrival date and condition of female peregrines in the spring influences subsequent breeding success.

Objective 4 – Density dependent response in birth rate

Raptors compete for and vigorously defend breeding territories. Removal experiments were conducted at Rankin Inlet in the mid-1990’s, and are the classical test for the existence of floaters in avian studies. This involves removing territorial individuals and documenting whether or not replacement occurs. If new individuals settle into experimentally vacated territories, it is concluded that a lack of suitable habitats, combined with territorial behavior, limits breeding opportunities (Klomp 1972, Newton 1992). The long-term monitoring of peregrines at Rankin Inlet and continued monitoring around Igloolik will help us determine the influence of breeding density on population-level productivity.

2010 Objectives

Spring and Summer Survey and Monitoring of Breeding Raptor

We set out to locate, monitor and map all occupied breeding sites of raptors. Monitoring included recording arrival date of breeding aged adults on territory, laying date, clutch size, brood size, growth and development of nestlings, extent and cause of nestling mortality, deployment of rain gauges at all breeding sites, and collection of blood from nestlings once every 7 days (or diet analysis using stable isotopes. We also monitored various aspects of raptor breeding behaviour such as daily time budgets, and the composition and frequency of prey deliveries.

PTT Deployment on Peregrine Falcons

By equipping breeding females with solar powered Platform Transmitting Terminals (PTTs) we hoped to estimate home range (HR) size and overlap, and monitor departure date, migratory routes and wintering areas of female peregrine falcons breeding near Igloolik, Nunavut. In addition we wanted to indentify critical hunting areas for falcons and determine if they contained unique landscape features (e.g. terrain ruggedness, distance to water, prey density) different from surrounding areas not used for hunting. We initially proposed to deploy PTTs on male falcons, but work from the study in Rankin Inlet suggests PTTs may have a detrimental effect on males.

Band adult Peregrine Falcons and Nestlings

The purpose of this objective was to mark adults and nestlings with color coded visual identification bands. This objective will allow us to build and maintain an encounter history that will be used to estimate apparent survival and recruitment.

Small Mammal Trapping

Although lethal, small mammal trapping using snap traps provides data that describe regional patterns in abundance. During summer of 2011, we may employ live-trapping, which will provide a more accurate measure of population density using mark-recapture techniques. Productivity is related to lemming abundance for Arctic-nesting raptors, but in particular rough-legged hawks and peregrine falcons. These data will be related to prey deliveries at nest sites, and growth and development of nestlings.

Distance Sampling of Avian Prey

Arctic peregrine falcons frequently select avian prey species such as ground nesting passerines, shore birds and marine ducks (Court et al. 1988), but it is unknown how the intensity of use of these prey changes with availability. Our objective is to relate peregrine falcon prey use to availability and determine how this prey selection influences adult survival, productivity, and recruitment.

Partnering and Synergy

The overall goal of this project is to establish 3 long-term study areas to monitor raptors in Nunavut. This requires that the GN partner with external agencies and institutions for human and financial resources.

In this regard, ArcticNet, the GN, and the Canadian Circumpolar Institute have supported the project at Rankin Inlet (Phase I) since 2003. The NWMB also provided funding in 2005.

On the strength of seed funding support from the GN and NWMB, the Igloolik project (Phase II) raised an additional $125,000 in external funding over 3 years from the Natural Sciences and Engineering Research Council of Canada (NSERC), Alberta Ingenuity, the Canadian Circumpolar Institute, Indian and Northern Affairs Canada, and the Wilson Ornithological Society.

An opportunity for a Phase III study area at Steensby Inlet on Baffin Island now exists; Baffinland Iron Mine has agreed to provide food and accommodation, boat and motor, and charter flights for 3 personnel to the mine site annually and 40 hours of helicopter support. Surveys were conducted in the Steensby region in 2010 at no cost this project. ArcticNet, Baffinland and the GN contributed to costs associated with undertaking surveys in the Steensby region in 2010.

Considerable synergy has been achieved, in part due to the www.ArcticRaptors.ca website and blog.

Materials and Methods

Long-term Objectives

See proposal for general methods associated with each of our long-term objectives.

2010 Objectives

Annual objectives were established in support of our overall project goal, and to inform one or more of the long-term objectives. This section describes the methods associated with each of our objectives for the 2010 field season.

Spring and Summer Survey and Monitoring of Breeding Raptor

Breeding abundance and distribution

We used topographic maps to identify cliffs that could provide nesting habitat for peregrine falcons, gyrfalcons and rough-legged hawks. Taking into account areas that had been searched in 2009, including known nesting sites and previous raptor sightings, we established a set of priority areas to search. Our strategy was to initially concentrate on areas inland where snow and lake ice conditions deteriorate first, followed by coastal cliffs where sea ice conditions allow access later into the spring.

We systematically approached cliffs in a survey area (Fig. 1), and played the peregrine falcon courtship (ee-chip) and/or territorial call (khak-khak-khak) using an iPod (Touch, Apple, Inc., Markham, Ontario) connected to a battery-powered amplifier. If we received no response from the playback call, we scanned the cliffs with binoculars to determine if there was any evidence of previous nesting by raptors, such as old stick nests, white-wash or orange lichen. Cliffs with significant sign of previous nesting were noted and re-surveyed later in the spring if possible. If a peregrine falcon responded to the playback call, or we observed any other raptor species, we spent time observing the bird to determine if it was exhibiting breeding behaviour and had a mate. We also documented cliffs containing individual raptors without mates and revisited them later in the spring.

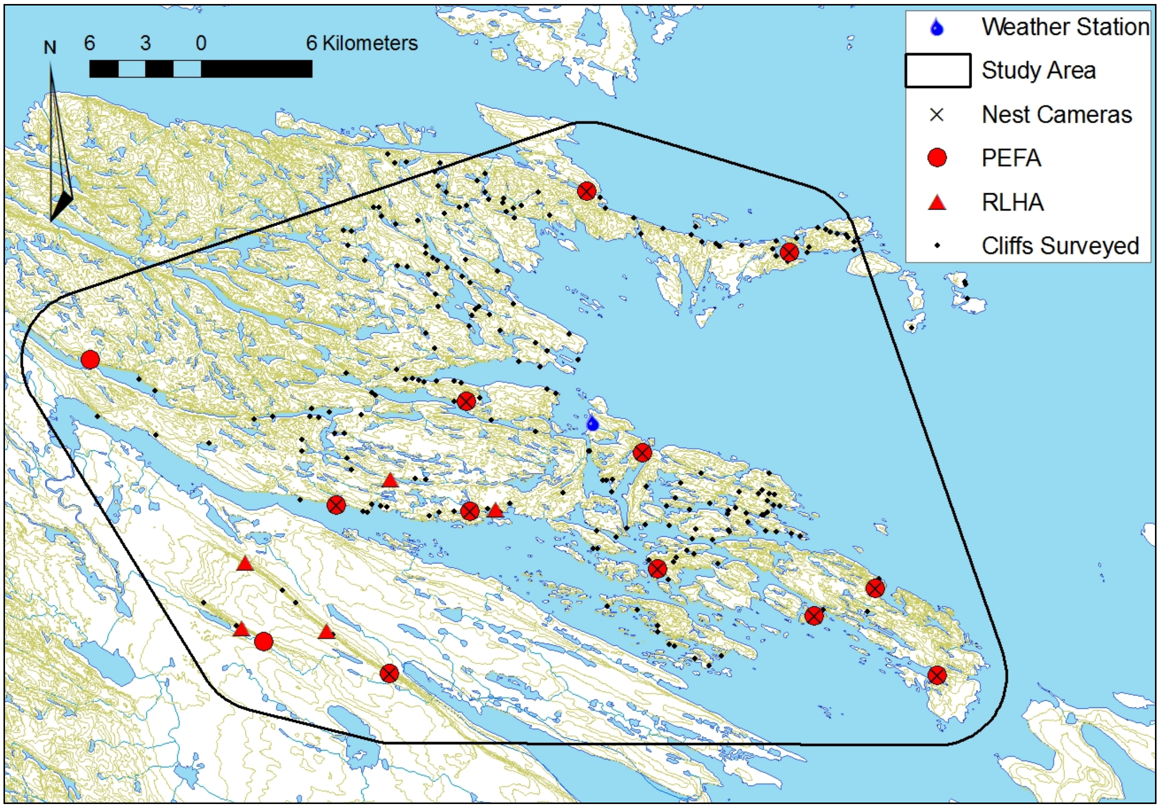

Figure 1. Boundary of the Melville study area as defined by Ratcliffe (1980), showing known peregrine falcon and rough-legged hawk nests, cliffs surveyed in 2010, and the location of nest cameras and weather stations deployed.

Breeding behaviour

We visited occupied territories once a week to monitor breeding phenology and for peregrine falcons, we deployed a motion-sensitive camera (PC85 Rapidfire or PC8000 Hyperfire, Reconyx Inc., Holmen, Wisconsin) power by 6 internal D-cell batteries and equipped with 16GB memory cards. This combination of battery power and memory allowed approximately 10,000 images to be collected over a 7 day period. We revisited nests equipped with cameras every 5-10 days to install fresh batteries and memory cards. Two cameras were modified to accept external solar powered gel packs, which allowed for less frequent nest visits. Motion sensitive cameras allowed continuous monitoring of nest activity in a non-intrusive manner. The cameras were deployed to document breeding phenology (laying dates, hatch dates, clutch size brood size), the cause of chick mortalities, and the composition and frequency of prey deliveries. In addition, bands can be read from the images, which allowed us to construct encounter histories required to calculate estimates of survival and recruitment.

Weather

To monitor general weather trends, we deployed a remote weather station (PortLog, Rainwise Inc., Bar Harbour, Maine) roughly in the centre of the study area (Fig. 1). The weather station recorded air temperature, relative humidity, dew point, barometric pressure, wind speed and direction, solar radiation, and rainfall every 30 mins from 15 Jun – 8 Sept. To monitor rainfall accumulation at nest sites, we deployed a rain gauge (00840, Acu-Rite, Schaumburg, Illinois) within 2 m of nest platforms. Miniature temperature data-loggers (iButtons® - DS1921G Thermochron®, Maxim Integrated Products Inc., Sunnyvale, Califonia) will be used to record temperature on nest ledges in subsequent field seasons, but these were not deployed in 2010.

Morphometrics

When adult birds were captured we recorded unflattened wing chord and tail lengths (details below), body weight, tarsus width and length, and a subjective assessment of condition (keel sharpness).

Unflattened wing chord - the length of the closed wing in a natural position from the bend to the tip of the longest primary (Gustafson et al. 1997). A thin ruler with a perpendicular stop at zero was used to measure wing lengths. The ruler was placed under the wing with the bend of the wing pressed snugly against the stop.

Tail Length - A thin ruler without a perpendicular stop at zero is used to measure tail length. The ruler is inserted between the central rectrices and placed firmly against the uropygium.

Blood samples

Once chicks were a minimum of 10 days old, we collected 1 mL blood samples every 7 days to monitor population genetics, diet via stable isotope analysis, stress hormone levels and organochlorine residues. To obtain blood samples, we extended the wing, separated the feathers, and cleaned the skin with an alcohol swab (also used to help keep the feathers out of field of view). A 25 gauge needle attached to a 3 mL syringe was inserted at a slight angle, bevel up, against the brachial vein on the underside of the wing. The syringe plunger was then slowly withdrawn to collect blood. Finally, the needle was removed and, in order to minimize the development of a hematoma, pressure was applied to the vein until the vessel was no longer bleeding. To prevent hemolysis, the blood was emptied and stored into a heparinised vacutainer.

PTT Deployment on Peregrine Falcons

Using protocols approved by the University of Alberta Animal Care Committee, we attempted to capture all breeding adult peregrine falcons in the study area. All captured females were equipped with solar power GPS Platform Transmitting Terminals (PTT-100 22 gram, Microwave Telemetry, Columbia, Maryland), which were programmed to collect locations every 2 hours. PTTs were attached dorsally along the midline between the falcon's wings using Teflon ribbon as backpack harnesses with neck and body loops (Kenward 2001). All harnesses were individually fitted to each falcon.

Band adult Peregrine Falcons and Nestlings

To monitor long-term survival we banded individual peregrine falcons with an alphanumeric color band on one leg and a United States Fish and Wildlife (USFW) band on the other (see below for details). .

USFW lock-on band - the longer flange is folded over the shorter flange, effectively locking the band in place. The band is made of relatively soft aluminum and can be removed by the bander, but not by the bird.

Alphanumeric color band - the band has two short flanges of metal that project out from the seam where the two ends of the band meet. These flanges each have two holes that receive rivets.

Small Mammal Trapping

We employed snap trapping from 15 – 17 July to determine the abundance of lemmings available to foraging raptors. We set out 2 trapping transects (1 in wet habitat, 1 in dry) each with 20 stations 15 m apart and 3 traps per station. Transects were placed systematically in areas we felt were representative of the overall landscape found in the study area (Fig. 2). Traps were baited with peanut butter, set for 3 consecutive nights and checked each morning.

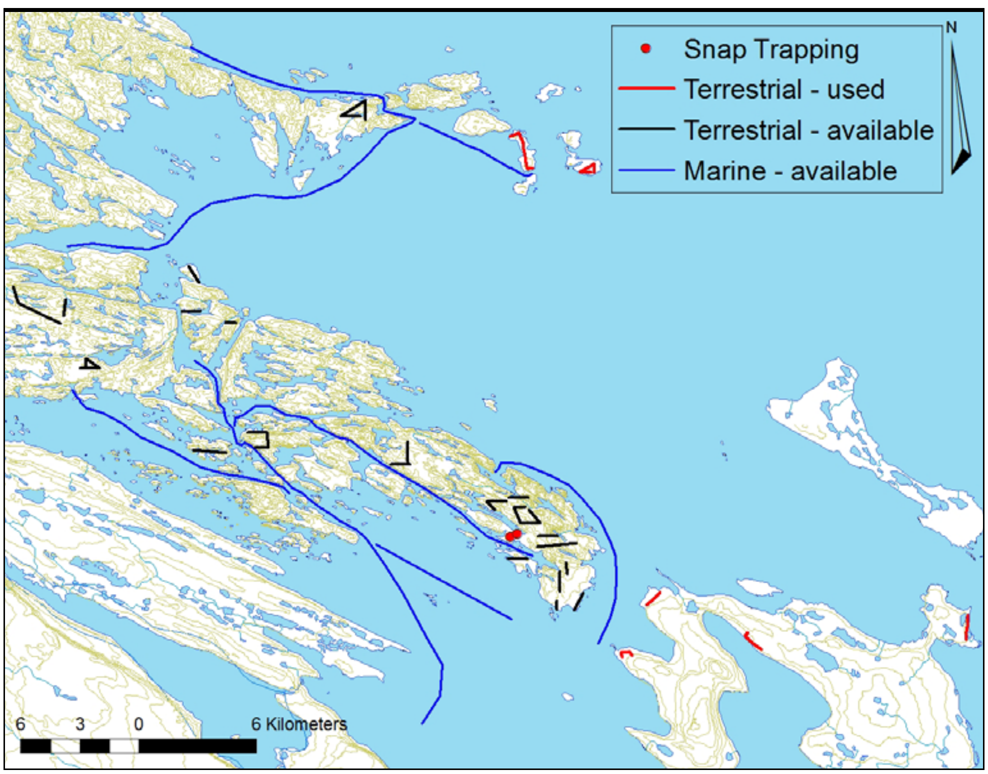

Figure 2. Distribution of transects sampled for prey during summer 2010. Used terrestrial transects were conducted in areas frequented by peregrine falcons wearing PTTs. Available terrestrial transects were randomly placed across the landscape and available marine transects were opportunistically sampled while traveling throughout the study area.

Distance sampling of Avian Prey

In distance sampling randomly placed transects are walked and every species observed is recorded along with its distance and bearing from the transect. This data can be used to calculate prey density taking into account sightability (Buckland et al. 2001). We placed 1 km transects throughout the study area by choosing random start location and compass directions. We surveyed terrestrial transects from 15 July – 30 Aug (Fig. 2), which will provide us with estimates of prey available to foraging raptors throughout the study area. We also conducted distance sampling along transects placed in areas frequented by falcons equipped with PTTs to determine if they were selecting to hunt in areas with a higher prey density than the rest of the landscape (Fig. 2). To estimate the density of marine prey, we opportunistically conducted distance sampling as we traveled among nest sites by boat (Fig. 2). Although these transects were not randomly placed, they provided a systematic sampling effort of the majority of coast lines within the study area.

Initial Results

2010 Objectives

Spring and Summer Breeding Raptor Survey and Monitoring

Breeding abundance and distribution

From 25 May – 3 June we observed very few raptors throughout the study site. As early as 27 May, we began seeing individual peregrine falcons. Starting on 3 June we began seeing large numbers of rough-legged hawks. Starting on 5 June we observed peregrine falcons exhibiting courtship behaviour around cliffs. From 5 – 15 June peregrine falcons were actively engaging in courtship and as a result, were conspicuously present at nest cliffs and very responsive to the playback calls.

During the spring survey we identified 13 occupied peregrine falcon territories (6 territories were previously identified in 2009 by survey or local knowledge) and 5 occupied rough-legged hawk territories. Using the method of Ratcliffe (1980) we delineated a study area boundary that encompassed 1330 km^2 (Fig. 1). Using this boundary, the Melville study area contains a breeding density of 1 pair/102.3 km^2 and 1 pair/266.0 km^2 for peregrine falcons and rough-legged hawks respectively.

Breeding behavior

We deployed motion-sensitive cameras at 10 peregrine falcon nests located throughout the study area (Fig. 1). The total number of images taken from each nests varied due to differing camera angles and distances from nests, and inconsistent battery life (Table 1).

Table 1. Date range during which motion-sensitive cameras were deployed and the total number of images taken from each nest site.

Nest Site	Date Deployed	Date Retrieved	# Images
1	23 Jun	24 Aug	44,504
2	15 Jun	22 Aug	61,234
3	21 Jun	19 Aug	112,538
4	22 Jun	21 Aug	40,518
5	02 Jul	02 Sep	28,425
6	02 Jul	30 Jul	16,734
7	22 Jun	16 Aug	30,161
8	02 Aug	22 Aug	52,283
11	21 Jun	28 Aug	59,272
12	09 Aug	22 Aug	22,523
13	31 Jul	01 Sep	48,537

Weather

The remote weather station we deployed successfully recorded weather data for the entire summer. Research conducted in Rankin Inlet has shown that nestlings are vulnerable to severe rain events. Although we documented 4 juvenile mortalities, none were recorded by cameras, so specific causes are unknown. We related timing of these mortalities to daily rainfall recorded by the weather station and found that all mortalities occurred within 5 days of a rain event (Fig. 3).

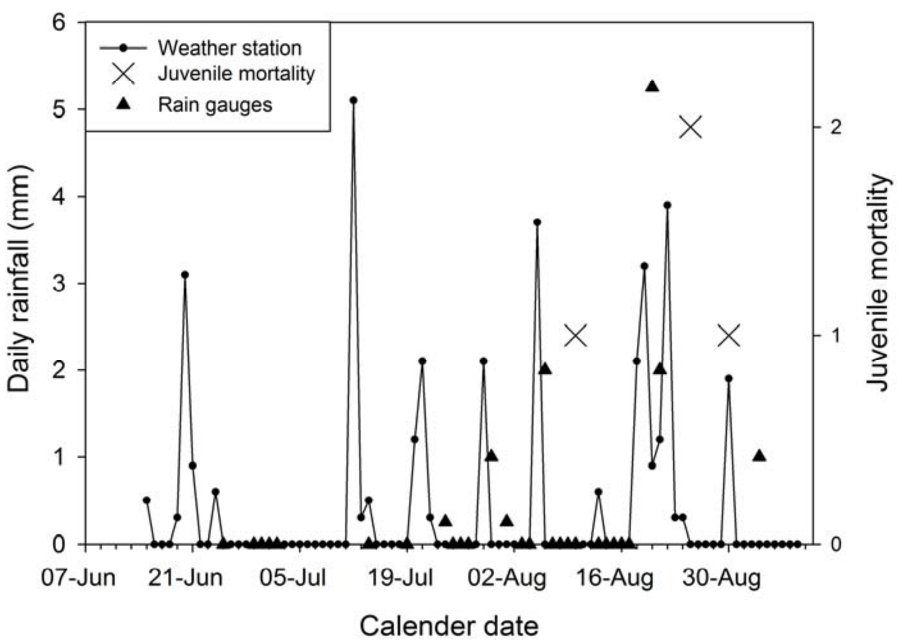

Figure 3. Daily rainfall for the Melville study area in relation to average rainfall accumulated at nest sites and the timing of known juvenile mortalities.

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Morphometrics

Table 2. Morphometric data from adult peregrine falcons captured during summer 2010. Condition is a subjective assessment of keel sharpness, where 5 is the best condition and 1 is the worst.

	Weight (g)		Wing cord (mm)		Tail length (mm)		Tarsus length (mm)		Tarsus width (mm)		Keel (1-5)	
Site	M	F	M	F	M	F	M	F	M	F	M	F
1	561	843	301	361	137	171	55.0	64.0	6.0	7.0	2	2
3	-	853	-	351	-	157	-	64.0	-	7.0	-	3
7	592	-	311	-	140	-	56.5	-	6.5	-	3	-
8	613	931	317	351	146	161	58.5	66.0	6.0	7.5	3	3
13	521	847	306	353	137	157	56.5	64.0	5.5	7.0	3	3

Blood Samples

We obtained 2-4 blood samples from each chick over the breeding season for a total of 71 blood samples. We also obtained 3 mL blood from all captured adults (N=8) for a total 79 blood samples. These samples have been archived in freezer space at the University of Alberta, where they will be held until analyzed.

PTT Deployment on Peregrine Falcons

We successfully deployed PTTs on 4 adult female peregrine falcons. Data from these PTTs indicated that females spend a significant portion of their time away from the nest, particularly toward the end of the breeding season as chicks grew larger (Fig. 4). There was a drastic difference in home range size across females (Table 3, Fig. 4), which warrants further investigation. The range over which females hunt may be related to prey availability, which could influence productivity and survival.

Although preliminary, migratory routes and movement behaviour for the 4 birds instrumented at Igloolik indicate that as of October 28, all birds had reached their wintering grounds in Colombia, Mexico, the Bahamas and Cuba (Fig. 5).

Table 3. Home range size and number of locations obtained (05 Aug – 15 Sept) from 4 female peregrine falcons wearing PTTs. Home ranges are based on the 90% volume contour of the utilization distribution estimated using a kernel density estimator.

Nest Site	Home range size (km^2)	# Locations
1	36.16	447
3	145.52	495
8	230.95	379
13	14.99	319

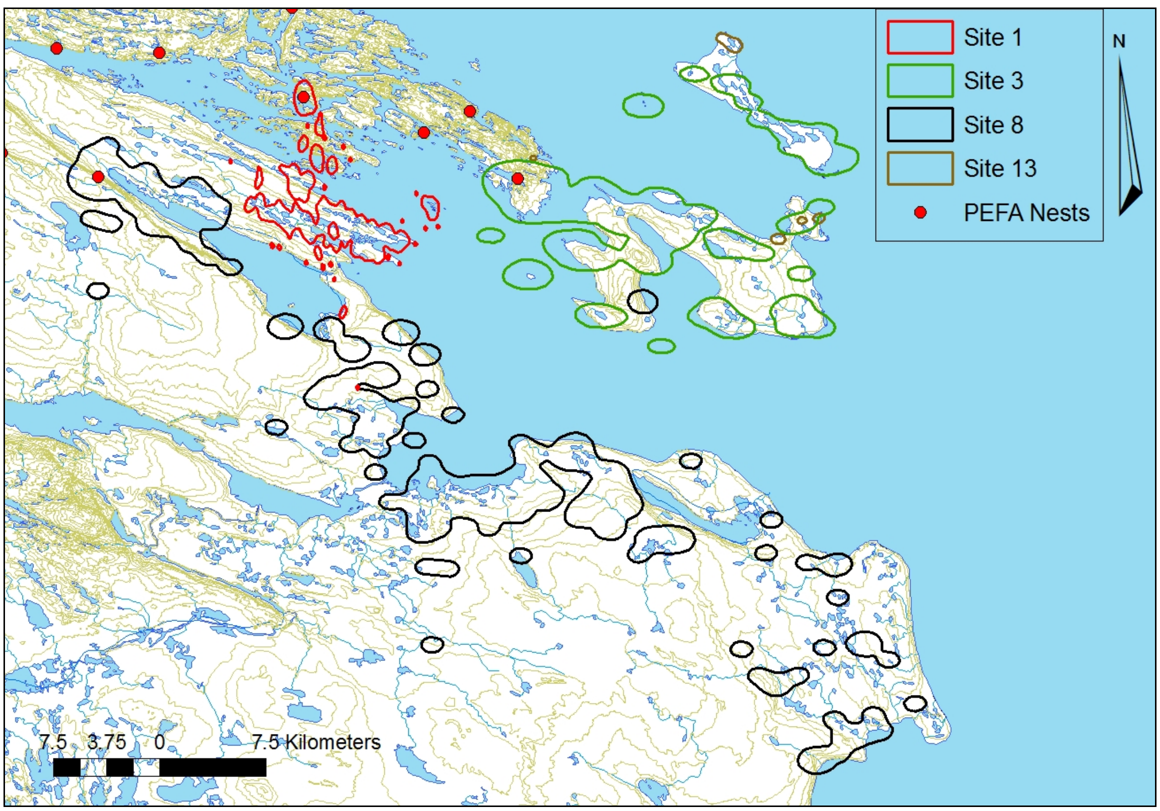

Figure 4. Home ranges (05 Aug – 15 Sept 2010) of 4 female peregrine falcons wearing PTTs. Home ranges are based on the 90% volume contour of the utilization distribution estimated using a kernel density estimator.

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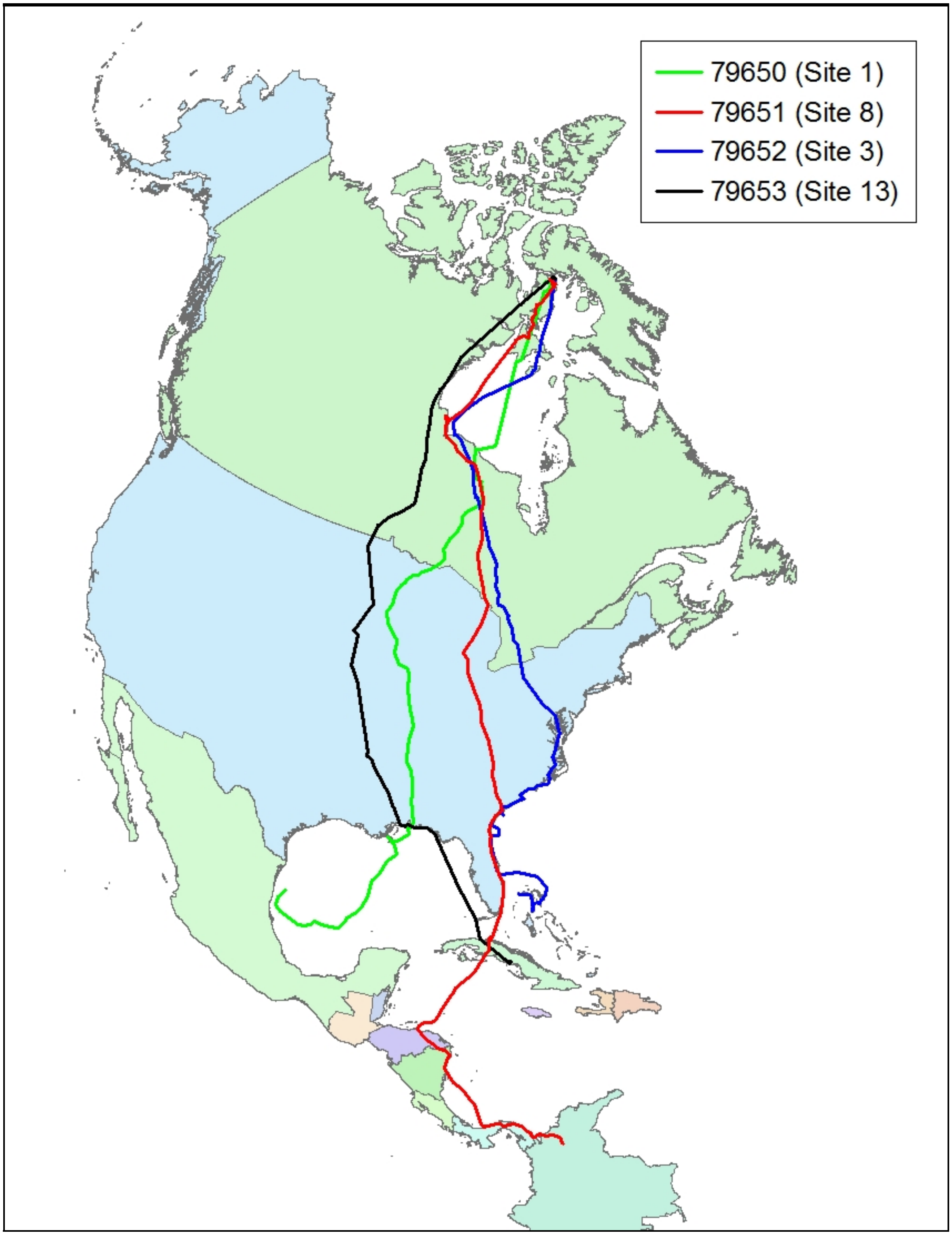

Figure 5. Outward migration routes of the 4 female peregrine falcons instrumented with PTTs in the Melville study area during summer 2010. Routes represent travel from 15 Sept – 28 Oct.

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Band adult Peregrine Falcons and Nestlings

A total of 38 eggs were laid across 12 occupied territories. Of these eggs, 30 peregrine falcon chicks hatched from 12 nests, 29 of which survived to banding age (Table 4). Of the 29 banded chicks we documented only 4 pre-fledging mortalities from 3 nests. Accounting for the 4 known mortalities that occurred post banding, a maximum of 2.17 chicks/nest (Table 2) were fledged. To be consistent with previous studies of Arctic peregrine falcons, we assumed productivity to be the average number of chicks/occupied territory that survived to ~ 20 days old. Productivity in 2010 was 2.42 chicks/occupied territory. In addition, we successfully captured, banded, and took blood and feather samples from 8 adults from 5 different nests (Table 3).

Table 4. Number and date of eggs laid and hatched, and number of chicks fledged from known peregrine falcon nests. Note that lay and hatch date for each nest represents the median date across eggs..

Site	# Eggs	Lay Date	# Hatched	Hatch Date	Max # Fledged
1	3	21 Jun	1	23 Jul	1
2	3	23 Jun	2	21 Jul	2
3	4	21 Jun	3	21 Jul	3
4	4	22 Jun	4	21 Jul	3
5	3	23 Jun	3	21 Jul	3
6	3	23 Jun	0	-	0
7	3	22 Jun	3	25 Jul	1
8	4	24 Jun	4	22 Jul	4
9	0	-	0	-	0
11	3	21 Jun	3	23 Jul	3
12	4	20 Jun	4	18 Jul	3
13	3	23 Jun	3	21 Jul	3
Mean	3.08	22 Jun	2.50	21 Jul	2.17

Small Mammal Trapping

Of the 351 trap nights conducted we caught only 1 lemming (*Dicrostonyx* sp.) resulting in an abundance estimate of 2.85 lemmings/100 trap nights.

Distance Sampling of Avian Prey

We conducted distance sampling of 32 terrestrial transects located randomly throughout the study site, 6 transects located in areas female falcons consistently used for hunting, and 7 marine transects (Fig. 2). These data have not yet been summarized.

Discussion and Management Implications

Data collected at Igloolik provided unique insight into the differences that can exist over larger spatial scales when simple comparisons are made with the study located at Rankin Inlet. The study population at Rankin Inlet is encompassed within a 455 km^2 study area and at its peak, the density of breeding birds has been estimated at 1 pair/15 km^2, a density that is among the highest for the species in the world and the highest recorded in the tundra biome. Although we anticipate that additional sites will be found in the Igloolik study area, it is unlikely that the northern Melville Peninsula (currently at 1 pair/102 km^2) supports a density similar to that found at Rankin Inlet. In addition, it appears that many aspects of breeding phenology are delayed by approximately 10-12 days in Igloolik when compared to Rankin Inlet.

The mean date for clutch initiation was 10 June and 22 June for Rankin Inlet and Igloolik respectively. Mean hatch date in Rankin Inlet was 10 days earlier (11 July) than in Igloolik (21 July). Preliminary data indicate that clutch size in Igloolik is slightly smaller (about 1 egg) than in Rankin Inlet. If this pattern remains consistent over the long-term, it is likely related to differences in breeding latitude (snow cover) influencing arrival date in Igloolik (1st week of June) relative to Rankin Inlet (last week of May).

Generally, it appears that peregrine falcons breeding near Igloolik, arrive later, initiate clutches later, and lay fewer eggs than those breeding in Rankin Inlet. Therefore, it is surprising that productivity in Igloolik was more than two times greater (2.42 chicks per occupied site) than it was in Rankin Inlet (0.87 chick per occupied site, Table 5.). In Rankin Inlet, pairs laid 3.34 eggs for every chick that reached ~20 days of age compared to 1.37 eggs laid for every chick in Igloolik.

Table 5. Comparison of occupancy (# pairs), # eggs laid and reproductive success at 3 sites surveyed in Nunavut in 2010.

Study Area	# Pairs	# eggs	# chicks banded	Eggs:chicks	Productivity[1]
Rankin Inlet	31	97	27	3.59	0.87
Igloolik	12	37	29	1.28	2.42
Steensby Inlet	18	-	32	-	1.80[2]

1 – based on the number of chicks that survived to ~20 days old

2 – no spring survey in Steensby, therefore assumes there were no sites that failed

These data may be useful to regulators interested in setting TAH policy; for example, an eyass harvest would likely be compensatory in Rankin Inlet where Franke et al (2010) have suggested that the higher mortality recently observed at Rankin Inlet may be related to changing patterns in average summer temperature and precipitation. In Igloolik, long-term monitoring may show that breeding abundance is sufficiently high and that pairs are able to replace themselves over 1 or 2 breeding seasons, indicating that a limited and well regulated eyass harvest is feasible.

We enjoyed much success over the course of 2010 and apart from the specific recommendations below, we plan on repeated this work in 2011 and build on the body of work that has been accumulating at Rankin Inlet, Igloolik and Steensby Inlet.

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Recommendations for Igloolik

1. Spring surveys, should begin Monday May 30, 2011.
2. Survey effort will focus on areas where search effort has been low or absent, and in areas that have been searched but topography and spacing of known sites suggests that a breeding pair may have been missed.
3. We will increase spring trapping effort at known sites where birds are unmarked.
4. Resighting effort will be made at sites where birds have been previously marked.
5. Ttemperature data loggers (iButtons® - DS1921G Thermochron®, Maxim Integrated Products Inc., Sunnyvale, Califonia) will be deployed at all nest sites.
6. Deploy up to 6 additional PTTs on female peregrine falcons.
7. September site visits for post-fledging observations
8. Increase effort towards monitoring of rough-legged hawk (breeding abundance and distribution, phenology, blood samples from nestlings, banding of nestlings)
9. Switch from snap trapping to live trapping of small mammals.
10. Collection of prey specimens to calibrate stable isotopes
11. Opportunistic collection of pellets and prey remains at nest sites
12. Construct a relational database

Recommendations for Phase 3 Study Area (Steensby Inlet)

1. Complete survey of footprint of Baffinland Iron Mine
2. Limited monitoring of raptors (no cameras, no prey survey, no PTT deployment)
3. Band all nestlings
4. Trap and band adults (depends on personnel availability)

Reporting to Communities

Community input was sought through a map in the Iglulik HTO office in which we asked for community knowledge of past and present nest locations. This was done in correlation with presenting the project, seeking input, and requesting support for the project. The HTO did support the project. Knowledge of the areas that were to be surveyed was also attained through informal communication with community members including which areas were safe and not safe to travel as ice conditions changed. Results of this year's efforts and a proposal outlining next year's research will be presented during a winter HTO.

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Budget

The project brought in an additional $128,500 above the $30,000 supplied by the GN. We have not gone over budget and currently have less than $2,500available. We are looking to continue this project for 2 more years at this level. However, once the baseline data has been collected, yearly monitoring will be a minimal financial commitment.

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