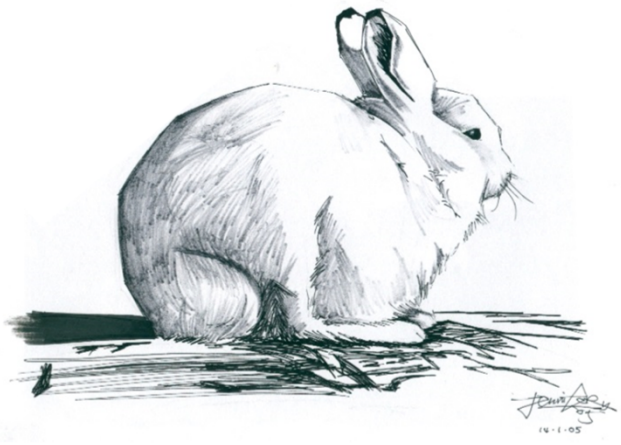
# WILDLIFE MONITORING AND ECOLOGICAL RESEARCH AT CFS ALERT

## SUMMARY FIELD REPORT 2018



15 November 2018

Université du Québec à Rimouski
Affiliation: Department of National Defence / 8 Wing Environment

| | FIELDWORK DATES |
|---|---|
| **PRINCIPAL INVESTIGATORS** | |
| Dominique Berteaux (Professor - HareForce) | 23 May - 7 Jun, 18 Jul - 01 Aug |
| François Vézina (Professor - SnowBird) | 18 May - 12 Jun, 18 Jul - 01 Aug |
| **RESEARCH TEAM** | |
| Audrey Le Pogam (PhD student - SnowBird) | 18 May - 12 Jun |
| Justine Drolet (MSc student - SnowBird) | 18 May - 01 Aug |
| Gabrielle Roy (BSc student - SnowBird) | 18 May - 29 Aug |
| Charline Couchoux (Postdoctoral researcher - HareForce) | 23 May - 01 Aug |
| Sandra Lai (Postdoctoral researcher - HareForce) | 23 May - 01 Aug |
| Émilie DesJardins (MSc student – SnowBird and HareForce) | 26 Jun - 29 Aug |

**TOTAL PERSON NIGHTS (18 May 2018 to 29 August 2018):** 485

**Suggested citation for this report:** Lai, S., Berteaux, D., Vézina F. 2018. Wildlife monitoring and ecological research at CFS Alert: Summary field report 2018. Université du Québec à Rimouski, Rimouski (Qc) Canada, 32 pages.

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# Abstract

A biodiversity/wildlife research program is conducted by Université du Québec à Rimouski at CFS Alert with the support of the Department of National Defence (8 Wing Trenton Environmental Management). 2018 was the first year of field activities. Highlights for this first field season are:

- We established the DND 8 Wing Environment / UQAR Alert Wildlife Research Laboratory.
- We produced the *Alert Wildlife Research Protocols version 1*, a 73-pages draft document summarizing goals and protocols for our first year of wildlife research at Alert.
- We confirmed the presence of 3 species of conservation concern on DND property and started to document their status:
  - The Red knot breeds on DND property; numbers and selected areas are unknown.
  - The Peary caribou uses DND property during reproduction; habitats are to be mapped.
  - The Ivory gull visits Alert and does not seem to breed on DND property.
- We obtained a satellite map of Alert and performed a first set of vegetation surveys to map wildlife habitats, starting around the Station.
- We observed that summer 2018 was unusually cold at Alert (as everywhere else in the Arctic). Some plants were not able to flower but effects on wildlife are unknown.
- We observed that many key wildlife species (e.g., lemmings, hares, wolves, long-tailed jaegers) were in low numbers or did not reproduce in 2018. This is not yet explained and may not be related to weather.
- We tested and refined many protocols to track annual variation in meteorological conditions, lake ice conditions, plant flowering time, wildlife abundance, wildlife reproduction, and wildlife use of the various habitats available on DND property.
- We found that adult snow buntings may be at risk of overheating when actively feeding nestlings at temperatures above 15°C. These birds may have to change their behaviour or reduce their breeding effort on the warmest days, which will become more and more common. Snow buntings have declined by more than 60% in some parts of Canada.
- We confirmed with automatic cameras that shorebirds gather around the sewage outfall in late May/early June (just after their arrival) and at the end of August (just before their departure). This could be useful to obtain demographic data on some species of conservation concern.
- We performed preliminary measurements of hare movements and hare behaviour (including reproduction) using GPS and accelerometers. This offers great promise to better understand the role of the main herbivore of the Alert ecosystem.
- Finally, we observed that snow banks melting late in the summer create snowbed habitats that are critical to sustain many plants and wildlife in the polar desert of Alert. These habitats seem to be highly vulnerable to disturbance from vehicles.

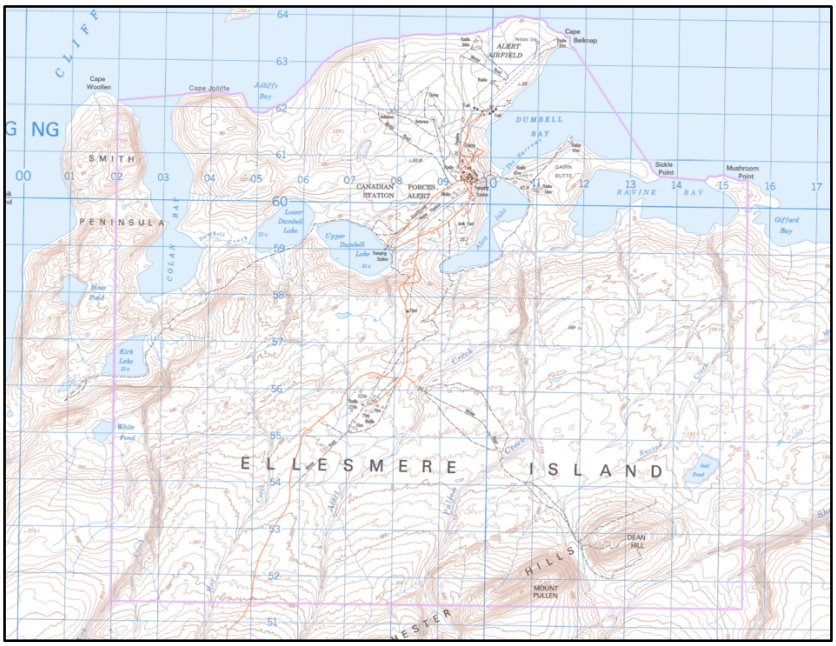
# Introduction

The Université du Québec à Rimouski and the Department of National Defence (8 Wing Trenton Environmental Management) have signed a Memorandum Of Understanding in April 2018 to establish a biodiversity/wildlife research program at the Canadian Forces Station Alert, Ellesmere Island, 82°30'N.

Alert is located 817 km from the North Pole and is the northernmost permanently inhabited place in the world. Building from the research interests of Université du Québec à Rimouski and the needs for Federal statutory and regulatory compliance related to the Species at Risk Act, we determined five related long-term research objectives:

1- Eco-physiology of migratory birds
2- Behavioural ecology of northern mammals
3- Ecology of the polar desert ecosystem
4- Biodiversity monitoring
5- Management plans for Species at Risk and other listed species.

This report summarizes field activities carried out during 2018, our first year of operation. When available, a few preliminary results illustrate our work. All field activities were performed on DND property, as shown by the purple rectangle in the 1:50 000 map below. All research activities were integrated into a single project, but specific projects were under the responsibility of D. Berteaux (HareForce) or F. Vézina (SnowBird), depending on expertise.



# 1. Environmental variables

## 1.1 Meteorology

Our monitoring of meteorology has one main objective: 1) collecting the meteorological data relevant for vegetation and wildlife ecology every year.

**Goals for 2018**
1. To inventory the meteorological variables collected by ECCC at Alert;
2. To select those variables that are important to us;
3. To establish a protocol to collect the data of interest every year from ECCC.

**Field activities**
We made contact with the Station Program Manager of Alert Weather Station (Meteorological Service of Canada, Environment and Climate Change Canada).
We also visited three weather stations installed by Natural Resources Canada in 2002 to measure air temperature, wind speed, and snow depth at three ground temperature boreholes.

**Preliminary results**
We are now on the mailing list of the Station Program Manager of Alert Weather Station and receive their monthly Climate Snow Ice Reports. We also receive the monthly Magnetic Forecast Reports from Natural Resources Canada.

**Plans for 2019**
We will investigate how to obtain data from the Natural Resources Canada weather stations.
We will also investigate how to obtain data from the Airport weather station maintained by CFS Alert.

## 1.2 Snow cover

Our study of snow cover has one main objective: 1) monitoring snow accumulation and disappearance every summer.

**Goals for 2018**
1. To standardize a protocol for picture monitoring of snow accumulation in designated areas;
2. To establish several permanent plots to monitor snow disappearance;
3. To establish one or two permanent snow accumulation transects.

**Field activities**

*Camera monitoring* — We monitored snow melt on the eastern slopes of Alert Inlet using two Reconyx cameras placed on a pole (82.49757°/ -62.32962°; one is pointing towards Cairn Butte and the other towards the mouth of Pullen Creek). Cameras were programmed to take two pictures every day (00:00 and 12:00) from 29 May to 25 August.

*Permanent snow plots* — The same plots that were set up for monitoring plant phenology (see section 1.4) will be used to follow snow disappearance.

*Snow accumulation transects* — We evaluated one location to establish a snow accumulation transect (Start: 82.48770°/ -62.40209°; End: 82.48598°/ -62.40570°). We monitored snow melt by taking pictures every 2-3 days starting from 3 June until the complete disappearance of snow (30 June).

**Preliminary results**

*Camera monitoring* — The cameras performed well and collected pictures according to plans (**Fig 1.2.1**). Snow melt (< 5% of snow on the ground) was complete around 29 June for the slopes towards Cairn Butte and around 7 July for the other side.


**Figure 1.2.1.** Pictures from the two Reconyx cameras monitoring snow melt around Alert Inlet (2018-05-29 12:00).

*Permanent snow plots* — Snow was already melted when the plots for plant phenology were set up (see section 1.4), so we obtained no measure for this first summer.

*Snow accumulation transects* — We took 12 pictures documenting snow melt on the snow transect (**Fig 1.2.2**). However, water accumulating between the two slopes made it inconvenient for measuring snow depth.

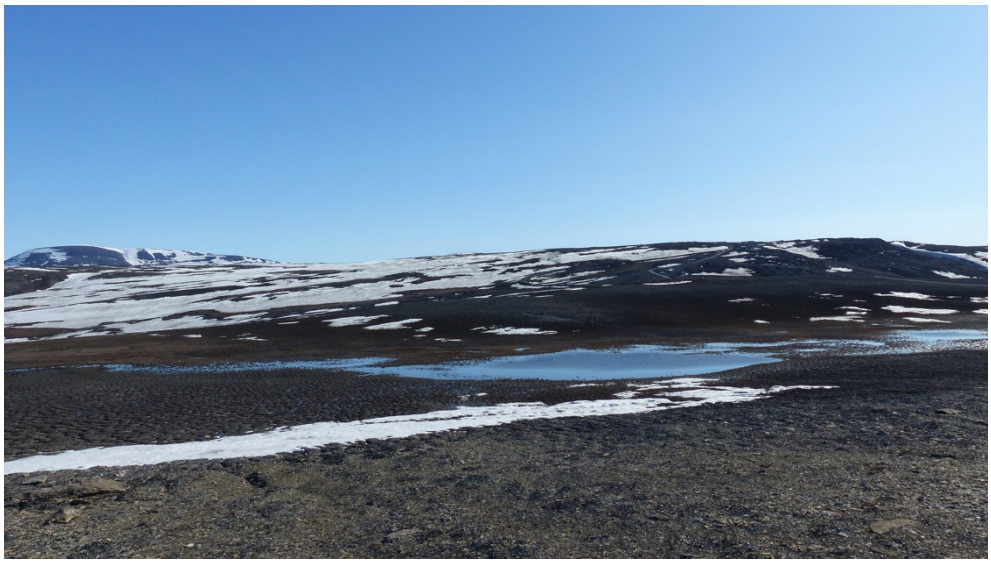


**Figure 1.2.2.** Picture of the snow transect showing water accumulation at the bottom of the slopes (2018-06-28).

**Plans for 2019**

We will continue using Reconyx cameras to monitor snow melt at two sites around Alert Inlet. We will also monitor snow melt with the same technique at a third site located in the delta located south of Lower Dumbell Lake. A metal stake was placed for that purpose (82.49522°/ -62.63975°).

We plan to monitor the snow melt of at least two snow banks, one located next to Upper Dumbell Lake (82.47891°/ -62.44307°) and one in Joliffe Bay (82.50793°/ -62.62807°; **Fig 1.2.3**).

We will monitor snow melt in the permanent plots set for plant phenology.

We will evaluate whether it is worth monitoring snow melt along a snow accumulation transect.

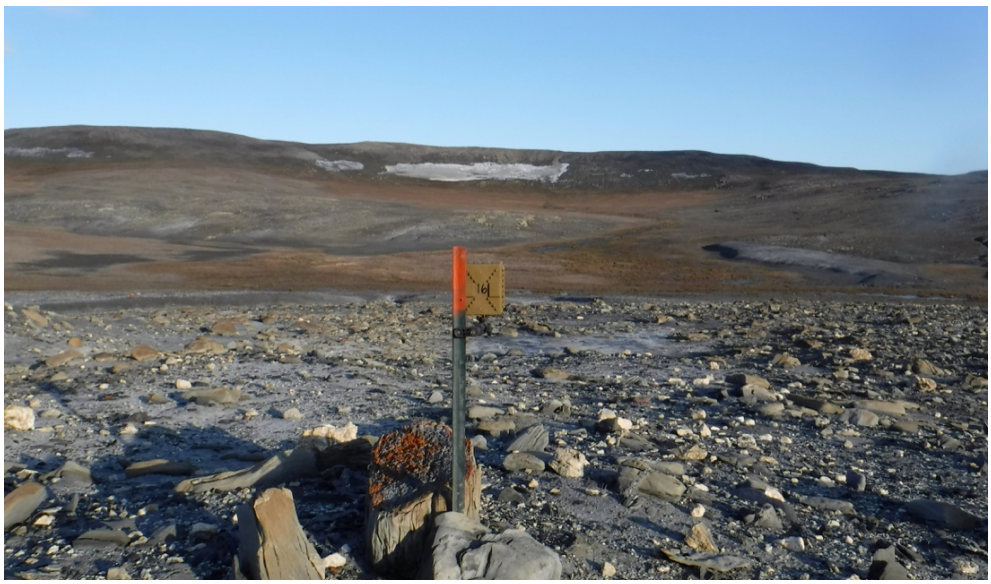


**Figure 1.2.3.** Picture of the Reconyx camera monitoring a snow bank in Joliffe Bay.

# 1.3 Ice cover

Our study of ice cover has one main objective: 1) monitoring ice phenology (break-up and freeze-up) of the main water bodies near CFS Alert every summer.

**Goals for 2018**
1. To identify water bodies suitable for ice monitoring;
2. To obtain preliminary data on ice phenology;
3. To test protocols for the long-term monitoring of ice phenology.

**Field activities**
*Visual monitoring* — From 23 May to 27 August, we monitored intensively 4 water bodies (Alert Inlet North; Alert Inlet South; Dumbell Bay and Upper Dumbell Lake) and opportunistically 6 water bodies (Lower Dumbell Lake, Kirk Lake, Ravine Bay, Colan Bay, Joliffe Bay, Hilgard Bay). We visually estimated ice stage and the percentage of ice cover (see p. 8-9 in the Alert Wildlife Research Protocols) every 3 days for the 4 main water bodies and whenever possible for the others.

*Camera monitoring* — We did not use Reconyx cameras this summer but placed metal stakes for next summer.

**Preliminary results**
*Visual monitoring* — Visual monitoring every 3 days was suitable to follow ice phenology of the 4 main water bodies and the required effort compatible with our other activities. Other water bodies were monitored less frequently and several stage transitions were missed. **Table 1.3.1** summarizes the break-up of the water bodies.

**Table 1.3.1.** First observation of a given break-up stage for 10 water bodies around CFS Alert.

| Break-up stage | B0 No sign of break-up | B1 Open water on shore | B2 Open water offshore | B3 Ice in movement | B4 Final break-up |
|---|---|---|---|---|---|
| Alert Inlet North | 23-05-2018 | 01-07-2018 | 08-07-2018 or 09-07-2018 | 10-07-2018 | 19-07-2018 |
| Alert Inlet South | 23-05-2018 | 22-06-2018 | 04-07-2018 | 10-07-2018 | 19-07-2018 |
| Dumbell Bay | 23-05-2018 | 28-06-2018 | 10-07-2018 | 16-07-2018 | 19-07-2018 |
| Upper Dumbell Lake | 23-05-2018 | 25-06-2018 | 10-07-2018 | 22-07-2018 | 28-07-2018 |
| *Lower Dumbell Lake* | 24-05-2018 | 23-06-2018 | 10-07-2018 | 22-07-2018 | ~28-07-2018 |
| *Kirk Lake* | 24-05-2018 | - | ~08-07-2018 | - | Before 23-07-2018 |
| *Ravine Bay* | 22-06-2018 | - | ~13-07-2018 | - | Before 09-08-2018 |
| *Colan Bay* | 24-05-2018 | - | ~08-07-2018 | | Before 23-07-2018 |
| *Joliffe Bay* | - | - | - | ~31-07-2018 | - |
| *Hilgard Bay* | - | ~08-07-2018 | - | - | Before 18-08-2018 |

Freeze-up had not started when we left CFS Alert on 29 August 2018.

**Plans for 2019**
We will use Reconyx cameras to record ice break-up of the following water bodies:
- Alert Inlet North (82.49653°/ -62.18168°)
- Alert Inlet South (82.48857°/ -62.34680°)
- Upper Dumbell Lake (82.47891°/ -62.44307°)
- Lower Dumbell Lake (82.49883°/ -62.33262°)

Other water bodies will be monitored opportunistically.

# 1.4 Plant communities

Our study of plant communities has two main objectives: 1) inventorying the plant species present in the study area; 2) surveying vegetation to identify the main plant communities representing the various wildlife habitats available on DND property.

**Goals for 2018**
1. To identify Alert plant species;
2. To establish a protocol to perform vegetation surveys for plant community mapping;
3. To establish several permanent plots to monitor plant reproductive phenology.

**Field activities**
*Vegetation surveys* — We learned how to identify plants using the identification keys of the Flora of the Canadian Arctic Archipelago. We conducted vegetation surveys on 62 homogeneous areas delimited using a satellite picture taken on 11 July 2016 and obtained from sgt Mike Ward (**Fig 1.4.1**). These 62 vegetation surveys were carried out from 28 July to 24 August for a total of 93 hours of work. A given vegetation survey consisted in five 1-$m^2$ quadrats located at 5 m from a center point and placed at equal distance from each other (Bay 1998). A quadrat was delimited by a 1m x 1m wooden frame and distended ropes formed a grid pattern in two layers and 100 intersections per layer (**Figs 1.4.2 and 1.4.3**). The frame was placed horizontally, a pin was lowered along each rope intersection and plant species touching the pin were recorded. An index of cover for each plant species will be calculated from these data. Species that were present but not touched will be assigned an index of <1% cover. This method is called pointing-analysis or ITEX method and has become a standard. The plant communities were characterised by the cover of the plant species, moss and lichen. The type of rocks, landform, soil moisture, topography and surface roughness were also recorded. Biological data such as presence of faeces, casts, grazed plants, lemming holes and winter nests were noted. All this information will be used to classify and name the different plant communities or habitats.


**Figure 1.4.1.** Satellite picture and topographic map of CSF Alert with the locations (green dots) where vegetation surveys were done.

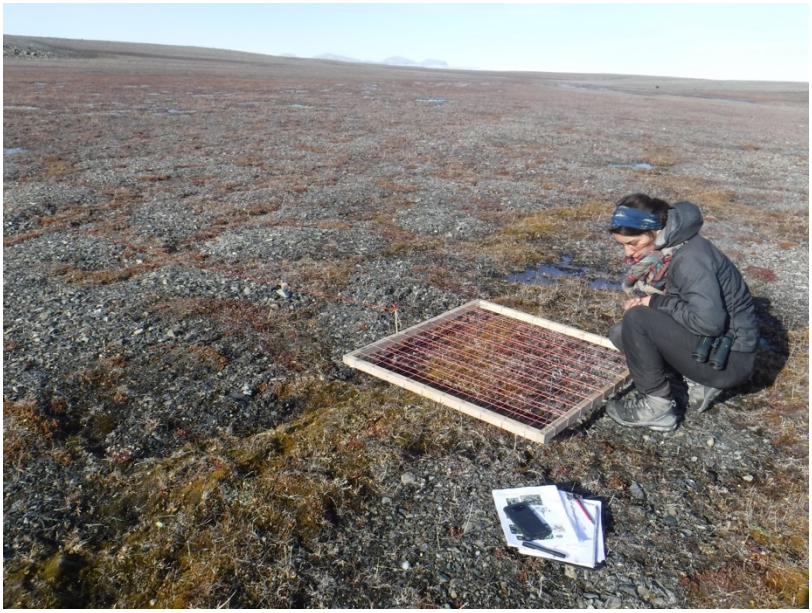


**Figure 1.4.2.** Setting up one of 5 quadrats during a vegetation survey.

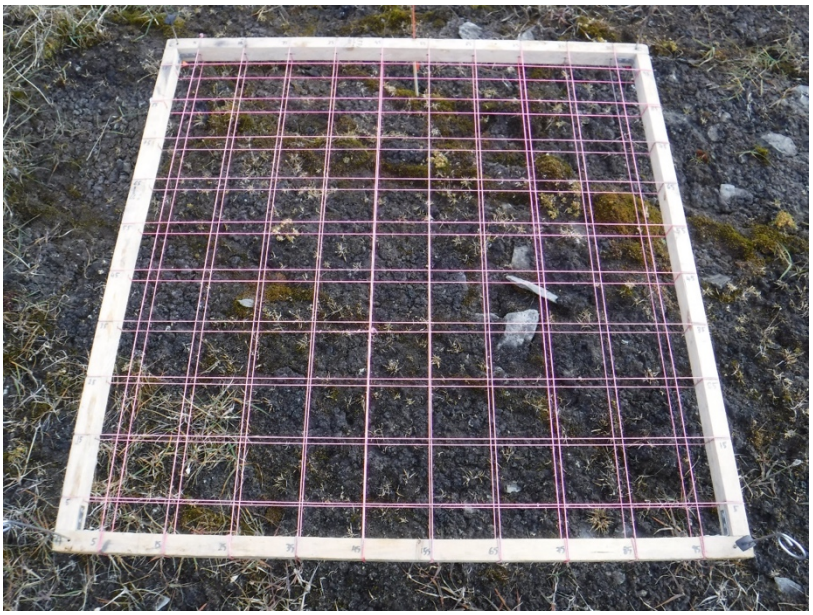


**Figure 1.4.3.** Top view of a quadrat. Intersections of ropes indicate where vegetation will be assessed with a pin lowered along the rope crossing.

*Plant phenology* — We identified two areas (Suicide Point and along Upper Dumbell Lake) in which the density of *Dryas integrifolia, Papaver radicatum, Salix arctica* and *Saxifraga oppositifolia* was high enough to allow annual survey of flowering phenology. We marked the plots (measuring a few $m^2$ each) with metal bars in each corner, as shown in **Fig.1.4.4**. Each plot includes at least 50 flowers of the same species (except for *S. arctica* where >100 flowers are needed to properly record phenology). We have four plots per species: two around Suicide Point and two along Upper Dumbell Lake (**Fig. 1.4.5**).

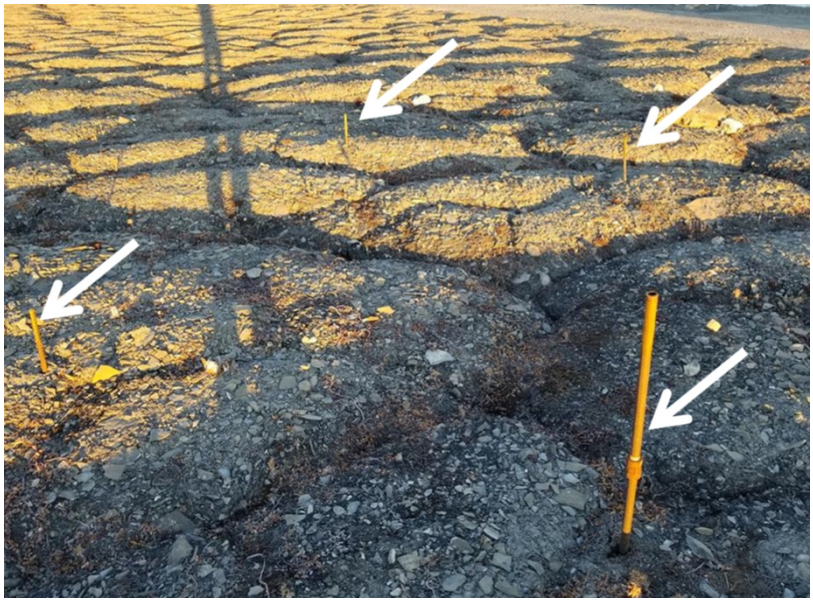


**Fig 1.4.4.** Phenology plot with a metal stake at each corner.

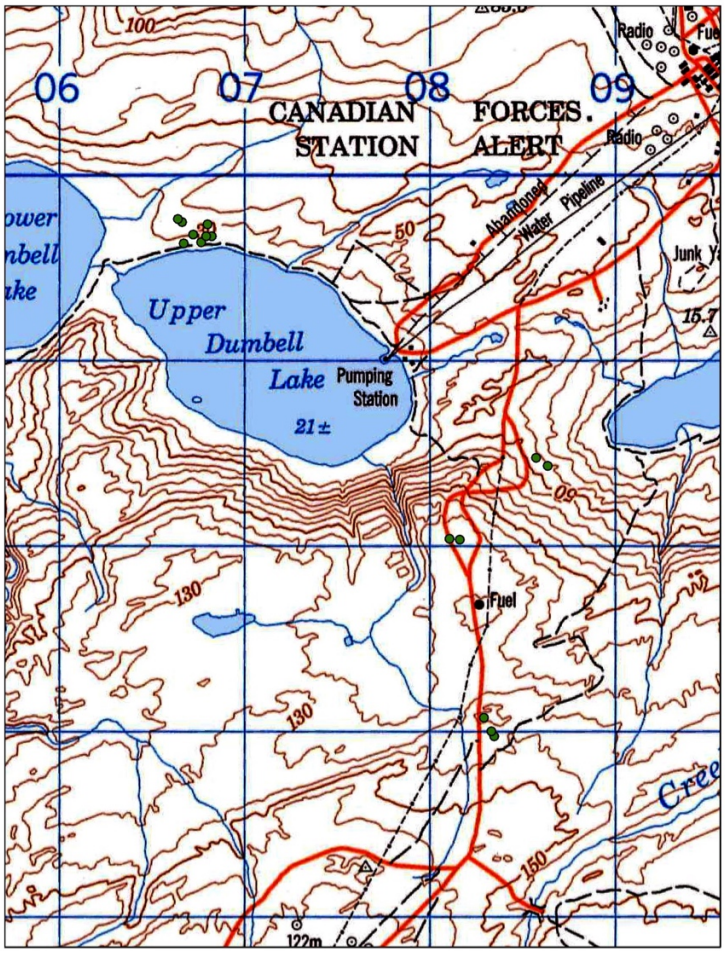



**Fig 1.4.5.** Locations (green dots) of the plant phenology survey plots

**Preliminary results**

*Vegetation surveys* — We collected data on species cover, soil, rocks and animal presence at 62 surveyed vegetation plots. We identified 44 species of plants at Alert (**Table 1.4.1**).

**Table 1.4.1.** List of plant species recorded at CFS Alert in summer 2018.

| | | |
|---|---|---|
| *Alopecurus magellanicus* | *Equisetum variegatum* | *Puccinellia angustata* |
| *Arctagrostis latifolia subsp. latifolia* | *Festuca brachyphylla* | *Puccinellia phryganodes* |
| *Bistorta vivipara* | *Juncus biglumis* | *Ranunculus hyperboreus* |
| *Braya glabella subsp. purpurascens* | *Luzula nivalis* | *Ranunculus sabinei* |
| *Cardamine bellidifolia* | *Micranthes nivalis* | *Ranunculus sulphurous* |
| *Carex aqualitis subsp. stans* | *Minuartia rubella* | *Salix arctica* |
| *Carex fuliginosa subsp. misandra* | *Oxyria digyna* | *Saxifraga cernua* |
| *Cerastium alpinum* | *Papaver radicatum subsp. labradoricum* | *Saxifraga cespitosa* |

| | | |
|---|---|---|
| *Cochlearia groenlandica* | *Pedicularis hirsute* | *Saxifraga oppositifolia* |
| *Draba alpina* | *Phippsia algida* | *Saxifraga platysepala* |
| *Draba subcapitata* | *Pleuropogon sabinei* | *Silene uralensis subsp. arctica* |
| *Dryas integrifolia* | *Poa abbreviata* | *Stellaria longipes* |
| *Eriophorum angustifolium* | *Poa arctica* | *Taraxacum phymatocarpum* |
| *Eriophorum scheuchzeri* | *Poa hartzii* | *Trisetum spicatum* |
| *Equisetum arvense* | *Potentilla pulchella* | |

*Plant phenology* — We recorded the dates of first flowering of the four species that will be monitored in 2019. The first flowers appeared on 13 June for *Saxifraga oppositifolia*, 27 June for *Salix arctica*, 29 June for *Papaver radicatum*, and 15 July for *Dryas integrifolia*.

**Plans for 2019**

We will continue the vegetation surveys in order to cover the entire study area.

Plant reproductive phenology will be monitored in the permanent plots once a week from June to August.

# 2. Wildlife species

## 2.1 Arctic hares

Our study of arctic hares has three main objectives: 1) monitoring the population dynamics (abundance, reproduction, survival); 2) tracking adult hare movements to understand space and habitat use; 3) studying anti-predatory behaviours and social interactions.

**Goals for 2018**
1. To obtain an estimate of hare abundance in the study area;
2. To capture and tag individuals for population dynamics, movement and behavioural studies;
3. To perform repeated behavioural observations of tagged animals;
4. To measure movements and space use by adult hares with GPS collars fitted during summer.

**Field activities**
*Monitoring of hares* — We monitored hares near the Station, starting from the beginning of Caribou road to the end of the Air Strip (Beacon road). We did 4 visual counts of hares from 10 observation points along the roads (see p. 14-15 in the Alert Wildlife Research Protocols).

We trapped adult hares using collapsible cages visited every hour. We trapped every night from 25 May to 24 June and opportunistically (when an untagged hare was seen) until 20 July. We captured leverets using a hand-made butterfly net. Upon capture, hares were measured, weighted and ear-tagged using unique 4-colors codes (adults) or 2-colors codes (leverets) (**Fig 2.1.1**). This tagging system was designed specifically for this study. Tagging will also allow determination of survival, mortality, site fidelity, dispersal and social behaviours, including mother-offspring pairings.

*Movements and space use* — We tested three GPS collars, two Axy-Trek with accelerometers (**Fig 2.1.1**) and one IgotU, to follow the movements of adult hares during summer.

*Behavioural observations* — We visited the study area (from the beginning of Caribou road to the end of Beacon road) at least once a day to spot tagged hares and record their location. We filmed individuals from 1 June to the end of July to record vigilance (anti-predatory behaviour), adult social interactions (group foraging) and nursing.

**Fig 2.1.1.** Adult hare with ear-tags (Violet-Violet/Red-Red) wearing an Axy-Trek collar (left) and litter of 3 tagged leverets (right).

**Preliminary results**

*Monitoring of hares* — The four visual counts yielded highly consistent results and indicated a low abundance of hares in the area near the Station (Range = 8-12 hares per count; Mean = 9.75 ± 1.7 adult hares). A very low number of hares were observed further away from the Station. In comparison, similar counts conducted in 2017 by Berteaux during a site visit yielded ca. 40 hares.

We captured 28 adult hares (10 males, 18 females). Only one of the six females marked in 2017 during Berteaux' site visit was resighted and recaptured. The total number of captures, including recaptures, was 109. We also captured and tagged 11 leverets (6 males, 5 females).

A total of 14 females were pregnant or lactating upon capture. The first leverets were found on 27 June. We found the nursing spot of five females (all tagged), with litter sizes at their maximum ranging from two to six leverets (Mean = 3.6 ±1.8). We did not find the mothers of one tagged leveret from the Air Strip and of three untagged leverets (one behind the WhiteHorse Building, one at the start of Beacon Road and one at Suicide Point). Overall, the breeding success of hares appeared to be low in 2018.

*Movements and space use* — The three collars were deployed on 10 individuals, with one individual equipped twice and one equipped three times. One collar was recovered after the individual was predated by wolves. Collars were on individuals from 1 to 20 days (Mean = 8 ± 6 days), for a total of 98 hare-days. All collars were retrieved before the end of the field season. Movement data are now being analysed.

*Behavioural observations* — We filmed 340 videos, totaling around 10 hours of footage, on vigilance, group foraging and nursing. We recorded a total of 115 nursing events. One female lost her litter after 3 days, but all the four others kept at least one leveret until 30 July.

**Plans for 2019**
We will continue trapping, tagging and performing behavioural observations. We will use new hand-made cages and nets to maximize captures.

We will deploy 30 GPS collars to extend the study of hare space use and habitat use.

# 2.2 Collared lemmings

Our study of collared lemmings has one main objective: 1) monitoring the relative abundance of lemmings across years and across habitats at Alert.

**Goals for 2018**
1. To test a new technique (chew cards) to obtain an estimate of lemming abundance in two different habitats.

**Field activities**
*Chew cards* — We chose two sites located within 2 km of CFS Alert, one in a mesic habitat and one in a xeric habitat, to conduct the chew cards experiment (see p. 21-22 in the Alert Wildlife Research Protocols). Two transect lines were installed in July in each habitat (Mesic habitat - Transect A: 82.52313° / -62.26565° to 82.52158° / -62.28175°; Transect B: 82.52564° / -62.26212° to 82.52422° / -62.27852°; Xeric habitat - Transect C: 82.50889° / -62.48397° to 82.50741° / -62.49926°; Transect D: 82.51110° / -62.48808° to 82.50914° / -62.50071°). Transect lines consisted of 20 stations each (with 3 chew cards at each station). All the stations were baited with peanut butter on 25 July and checked for three consecutive nights.

**Preliminary results**
*Chew cards* — No cards were chewed by lemmings, indicating either a very low abundance of lemmings or an inefficiency of the technique. Our daily observations (only three lemming sightings during the summer) and the lack of reproduction by long-tailed jaegers suggest that 2018 was a year of exceptionally low abundance of lemmings.

**Plans for 2019**
We will do the chew cards experiment again next summer.

# 2.3 Mammalian predators

Our study of mammalian predators has three main objectives: 1) determining which mammalian predators are present in the study area and where; 2) monitoring their reproductive efforts; 3) determining their prey base.

**Goals for 2018**
1. To record all mammalian predator sightings in the study area;
2. To sample predator faeces for future diet analyses.

**Field activities**
*Predator sightings* — We recorded all mammalian predator sightings (wolf, arctic fox, ermine), including the number of animals (sex if known), the date and the location. We included polar bear sightings, even though they are not terrestrial mammals.

*Camera monitoring* — We recorded all predators present in the pictures taken by the Reconyx cameras (see section 3.1.).

*Collection of faeces* — We sampled fresh faeces whenever encountered.

**Preliminary results**
*Predator sightings and camera monitoring* — The main terrestrial arctic predators (wolves, arctic foxes and ermines) were observed by our team this summer. Camera monitoring confirmed our visual observations.

The wolf pack was observed very regularly at the Station. It was initially composed of one older female and a young wolf (presumably her pup from last summer). No activity was recorded at the known wolf den. A new wolf was observed alone behind Pusher Shack on 9 July. This wolf (potentially a male, as suggested by his raised-leg urination) seems to have joined the two others; the pack of three was observed together near the Met Shack on July 27.

Based on molt patterns and fur color, a minimum of five foxes, including one blue morph (a rare morph in Canada), were seen near the Station (11 sightings). One pair seems to have a territory around Suicide Point, while another pair had a territory around the Air Strip. One fox at the Air Strip was observed twice with an egg in its mouth (probably a King eider egg, based on color and size). One unused fox den was found in Joliffe Bay (82.50353°/ -62.60348°).

Ermines were sighted twice at the Station and one was photographed at Suicide Point. As ermines may move over large distances and are difficult to tell apart, it is unclear if there was one or several individuals in the area.

One polar bear (presumably a male) was seen at the Station (Air Strip) on 18 June around 21:00. It was seen again a few times by our team and people at the Station, as well as on our Reconyx

cameras (Air Strip, Sewage, Pumping Station). A bear alert issued by CFS Alert was lifted on 27 June at 08:30. On 26 July, fresh polar bear tracks were seen in the river delta located south of Lower Dumbell Lake.

*Collection of faeces* — We collected five samples of wolf faeces, three samples of arctic fox faeces and three samples of ermine faeces. We also collected all old faeces present on the wolf den that was active in summer 2017. Faeces will be analysed later on.

**Plans for 2019**
We will continue to monitor the presence of terrestrial predators.

## 2.4 Caribou and muskoxen

Our study of Peary caribou and muskoxen has 3 main objectives: 1) determining when, where and at what abundance Peary caribou and muskoxen use the study area; 2) locating their preferred habitats; 3) understanding their relations with wolves and humans in the study area.

**Goals for 2018**
1. To record caribou and muskox sightings in the study area;
2. To identify observation points that can be easily accessed and from which large herbivore counts can be done over large areas with binoculars and spotting scopes.

**Field activities**
*Caribou and muskox sightings* — We recorded all caribou and muskox sightings, including the number of animals (sex if known), the date and the location.

*Observation points* — Using ATVs, we traveled the study area to evaluate the best options for conducting observation transects for caribou and muskox counts (and also wildlife sightings) that would cover the majority of the study area.

**Preliminary results**
*Caribou and muskox sightings* — Caribou, including some fawns, were observed 11 times in the study area (number of individuals: 1-9) and muskoxen were observed 3 times (number of individuals: 1-4). Both caribou and muskoxen were mostly seen at the bottom of Dean Hill (Crystal Mountain) and near Self Pond. Fresh muskox tracks were observed in the Delta area (south of Lower Dumbell Lake). While caribou did not appear to be disturbed by the presence of people and vehicles, sometimes even at close distance (a few meters), muskoxen reacted (regrouped) more quickly and from a larger distance (a few hundred meters). From these preliminary observations, muskoxen may be more sensitive to human presence than caribou.

*Observation points* —Three observation transects covering 3 areas were determined for counting wildlife next summer (**Fig 2.4.1**).

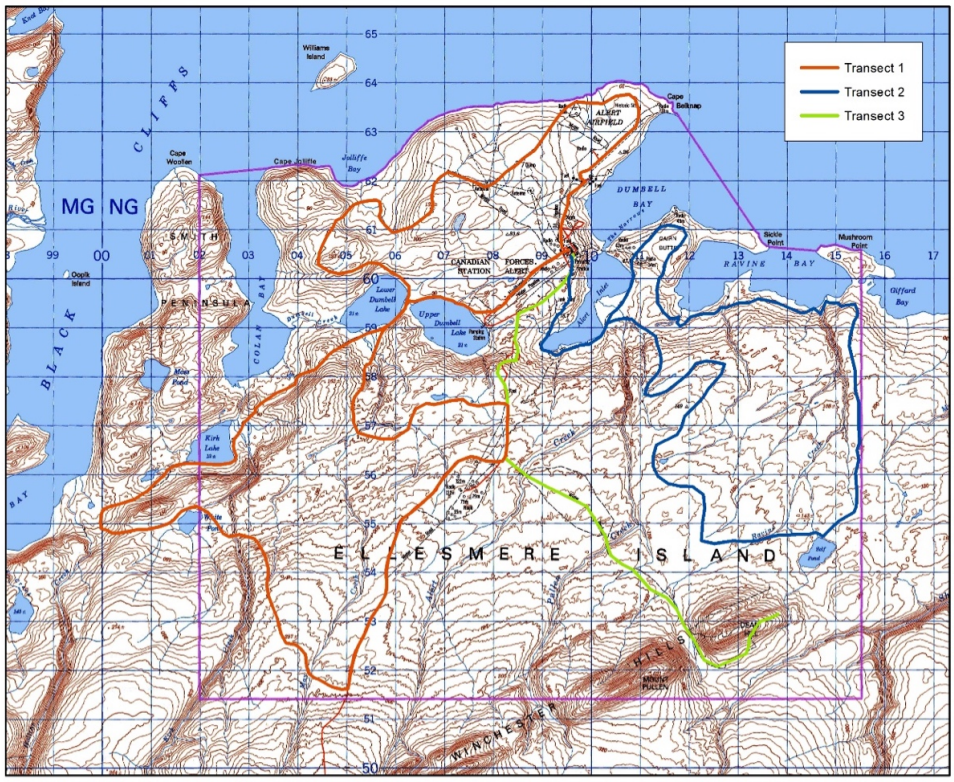



**Figure 2.4.1** Three observation transects for wildlife sightings.

**Plans for 2019**
We will continue to monitor the presence of caribou and muskoxen opportunistically (as in 2018), but will add regular counts (weekly if possible) from standardized observation transects.

# 2.5 Snow buntings

Our snow bunting studies aims at: 1) understanding phenotypic (body, physiological) changes occurring from their arrival to breeding to departure; 2) determining whether mildly warm, but rising, temperatures constrain thermoregulation and breeding capacity in these declining cold-specialized songbirds; 3) determining the location of their breeding habitats; 4) identifying the wintering ground of the birds found at Alert.

**Goals for 2018**
1. To determine the arrival date of the first snow bunting at Alert;
2. To document physiological changes (condition, cold endurance, heat tolerance) in snow buntings at three life-history stages: (A) arrival and period preceding breeding, (B) territory defense, (C) nestling provisioning (peak of energy demand at the warmest time of summer);

3. To complete data collected in previous years;
4. To determine return rate of birds banded on previous years;
5. To develop our technique for nest detection.

**Field activities**

*Captures and sampling* — First snow bunting captures happened on 19 May and continued until 17 August. Early captures were made around the sewage outfall on birds clearly still in winter flock formation. Later, birds were captured defending breeding territories scattered in the tundra. Then, breeding individuals were captured while feeding nestlings. These birds were temporarily brought back to the laboratory for collecting data on condition (body mass, visual scores of fat, ultrasound measurement of flight muscles thickness) and metabolic performance (cold endurance and heat tolerance). We also collected blood samples for further analyses.

This year, our work also included blood sampling for a genomics project in collaboration with Dr. Oliver Love (student K. Patel) from the University of Windsor to determine the provenance of snow buntings that breed at Alert from DNA.

**Preliminary results**

*Monitoring of snow buntings* — The first snow buntings were reported by Alert personnel Keven Bruce (Met Tech) on 24 April. Our observations strongly suggest that the first birds arriving at Alert (those captured from mid to end of May) do not stay long on site and continue on their migration. Without tracking data, we cannot determine where they come from or where they are going.

Return rate also seem low. Of the 160 birds banded in 2017, only one has been seen again in 2018. However, birds captured in 2017 were mostly caught early in the season. Breeding birds might be more site faithful than early migrants. More data is needed to determine this.

*Captures and sampling* — In total, 100 snow buntings were caught in 2018. 49 birds (14 females and 35 males) were caught before breeding (19 May to 3 June), 14 males were caught during territory defense (5 June to 30 June). 10 nests were found (light green dots on **Fig 2.5.1**) and 16 birds (7 females and 9 males) were caught during nestling provisioning (30 June to 25 July). More nests could have been found if more time could have been allowed to nest searching. The 2018 season also confirmed that we can capture juvenile snow buntings later in the season, before their departure. 36 juvenile buntings (12 females and 24 males) were captured between 18 July and 17 August. Since 2015, 295 snow buntings have been captured and banded at Alert.

A total of 100 blood samples on filter paper were collected in 2018 for DNA analysis.

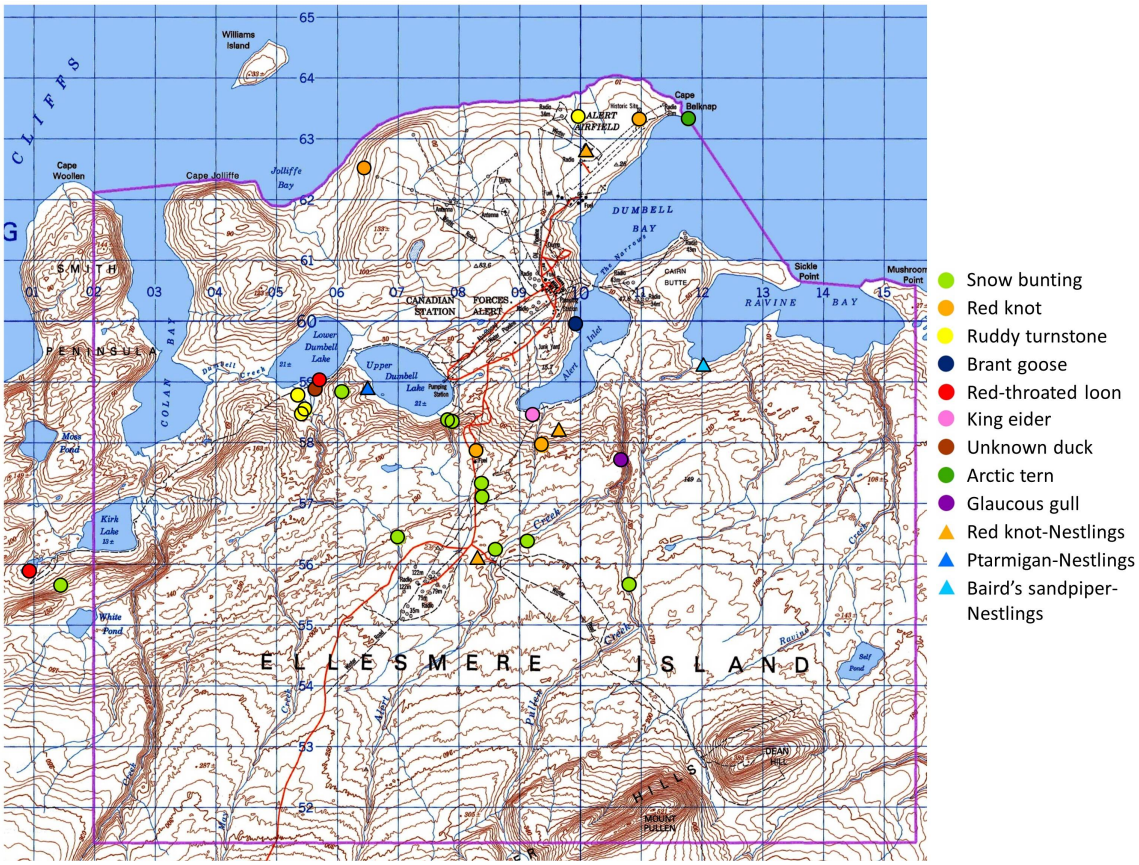



**Figure 2.5.1.** Locations of all bird nests (dots) and adults with nestlings (triangles) found in 2018.

*Physiological changes over time* — Our observations (PhD A. Le Pogam) suggest that snow buntings arrive at Alert with physiological capacities comparable to what is observed when wintering at lower latitudes (but still in winter cold environments). They have high cold endurance and high body mass. These parameters then decline as soon as the birds begin defending territories (**Fig 2.5.2**). Anecdotal observations of breeding birds also suggest that energy demands during breeding prevent adults from investing in self-maintenance, potentially explaining the loss of mass.

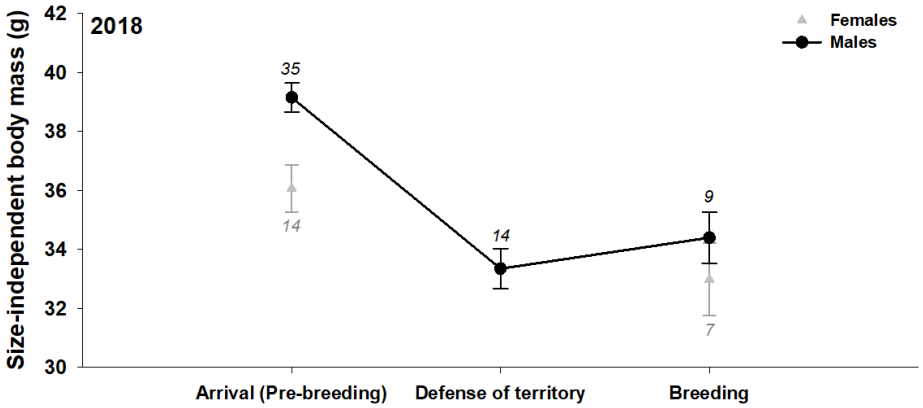



**Figure 2.5.2.** Body mass variation of snow buntings in 2018.

In 2018, we began (MSc J. Drolet) measuring thermal tolerance in snow buntings as we have indication that this cold specialist may have very low tolerance for mild and rapidly warming temperatures. In 2018, we conducted 94 measurements (four variables measured on a total of 43 birds) to generate thermal range data for the species. From these measures we were able to predict air temperatures at which a decline in maximal performance ($VO_2$max) would be expected and the temperature at which birds would risk overheating during sustained investment comparable to that of nestling provisioning. These values are surprisingly low.

| Period | Estimated temperature threshold of decline in maximal exercise capacity ($VO_2$ max) | Estimated temperature threshold for overheating in birds maintaining constant sustainable exercise comparable to nestling provisioning |
|---|---|---|
| **Arrival** | -3.15°C | 10.37°C |
| **Territory defense** | 1.31°C | 13.62°C |
| **Breeding** | 8.25°C | 15.65°C |

**Plans for 2019**

We will continue to gather data on physiological changes in buntings from their arrival to the preparation for fall migration. Ideally, we would begin the work around mid-April to obtain data on arriving birds as, currently, our first observations have been conducted on birds potentially already at Alert since a month.

In 2019, we will begin monitoring operative temperature (air temperature corrected for heat exchange due to radiation, wind, etc.) in snow bunting breeding habitats using 3D printed bird models. This is a crucial step to translate laboratory measurements into meaningful predictions based on field temperature data. This will allow for determining whether these birds are currently experiencing challengingly warm temperatures in their northernmost breeding habitat.

If time allows, we will also conduct an experiment on the decline of condition over the breeding season in this sensitive species.

# 2.6 Shorebirds

Our study of shorebirds has four main objectives: 1) monitoring the condition on arrival and before departure of the two most common species, ruddy turnstones (*Arenaria interpres*) and special concern red knots (*Calidris Canutus*); 2) finding and monitoring the most commonly used shorebirds breeding habitats; 3) monitoring shorebirds breeding success; 4) estimating survival from return rate of banded birds.

**Goals for 2018**

1. To capture, band and obtain condition (health) data for shorebirds on arrival (at and around the sewage outfall);
2. To test new capture techniques for red knots at and around the sewage outfall;
3. To determine the proportion of birds banded on arrival or before that breeds at Alert;
4. To test nest monitoring protocol for determining breeding success;
5. To determine whether shorebirds can be captured before departure, at the end of summer at and around the sewage outfall.

**Field activities**

*Captures and nest monitoring* — Shorebird captures have been conducted around the sewage outfall from the end of May to 13 June, time at which most birds spread out on the tundra. Nest searches have been conducted at several sites by foot and ATV (along Alert Bay, Dumbell lakes delta, Joliffe Bay, Kirk Lake, Crystal Mountain area, Suicide Point area) when schedule allowed. They have also been conducted opportunistically when possible. Captures at the sewage resumed from 2 August to 25 August. All shorebird observations from team members were also compiled.

**Preliminary results**

*Arrival period* – The first shorebirds were observed at Alert around the quarry and sewage on 25 May and the first captures happened on 30 May. We were able to capture and band 59 ruddy turnstones and 4 red knots from that date until 13 June, time at which most birds spread out on the tundra. Of those birds, 10 turnstones were recaptured up to 3 times. We collected condition data on all these individuals. First observations show a steady decline in flight (pectoral) muscle size over that period, as proteins are likely used to rebuild reproductive organs in prevision of breeding.

Captures used passive potter traps, which are very effective for turnstones. We also tested an Ottenby funnel trap and a bow net during this period to determine whether these methods could allow for capturing red knots. The bow net works but is time consuming and has a low success rate. The Ottenby trap does not work at Alert, likely due to permanent day light.

*Breeding period* – Searches were conducted from 25 June and through the month of July. 2018 was likely a bad year for nesting due to late snowmelt and weather conditions. Bear safety also reduced the team's time allowable for searching nests. Overall, we found 4 red knot nests and 4 turnstone nests, including one from an individual banded in 2018. We also found 3 adult red knots and one adult Baird sandpiper walking with nestlings, possibly indicating recent nesting in the area (**Fig 2.5.1**).

*Pre-departure period* – Between 2 August and 25 August, 51 shorebirds have been captured (50 turnstones, including 10 individuals recaptured at least twice and one red knot). Turnstone captures included several juvenile birds born in 2018. Observation data suggest that there is a large affluence of turnstones in the first two weeks of August. Numbers of turnstones but also red knots seemed to increase again by the end of the month, time at which our last team

member had to leave the Station. Preliminary analyses show that we can monitor pre-departure increase in body mass (fuelling) and condition (health) during this period. They also show an increase in blood oxygen carrying capacity, as birds prepare for long distance non-stop migration. This is likely to be a crucial period for these shorebirds at Alert.

**Plans for 2019**
Our objectives for 2019 will be to improve the monitoring of shorebirds, if possible through the launch of a PhD project. We hope to expand the monitoring later into September to obtain more data on condition of pre-departure birds, a critical but nearly unknown period where health could affect the capacity to migrate of these animals. We also plan on improving catching techniques (red knots) and nest monitoring, if time allows, by targeting potential breeding habitats identified in 2018.

Discussions are ongoing to determine whether a new generation of GPS tags could be tested in 2019 on shorebirds departing Alert. The ICARUS tags are monitored by the International Space Station. As the ISS is not flying over Alert, these tags would remain passive (non emitting) while at Alert and begin emitting data only once the birds reach a latitude monitored by the ISS. Assuming their approval by DND, the first tests could be conducted in 2019, in collaboration with the University of Western Ontario.

Given that juvenile turnstones can be captured at the end of summer before their first migration in life, these individuals could potentially be used as models to monitor for contaminants in blood and feathers. Their level of contamination (if any) would be reflecting the Alert site as these birds would not have been exposed to any other contaminant in life.

## 2.7 Other bird species

Our study of other bird species has three main objectives: 1) monitoring the bird species observed at Alert; 2) determining which species breed within the Alert premises (other than snow buntings and shorebirds); 3) monitoring breeding success of the observed nests.

**Goals for 2018**
1. Generate a list of species observed by the team in 2018;
2. Position nests on a map to gather data on the location of species best breeding habitats;
3. Monitor breeding success of all nests found.

**Field activities**
*Visual observations* — All team members reported their bird observations and the data has been compiled in a common database.

*Nest monitoring* — All nests discovered on the Alert premises have been geo-located by GPS. Nests have been monitored at least a second time to determine breeding success, when possible.

**Preliminary results**

*Visual observations* — In total, 22 avian species have been observed at Alert during the season 2018, as listed below:

| | | |
|---|---|---|
| Ivory gull (SAR) | Black-bellied plover | King eider |
| Glaucous gull | Common ringed plover | Long-tailed duck |
| Thayer's gull | Baird sandpiper | Long-tailed jaeger |
| Sabine's gull | Red phalarope | Common raven |
| Arctic tern | Snow bunting | Snowy owl |
| Red knot (Special Concern) | Lapland longspur | Red-throated loon |
| Ruddy turnstone | Brant goose | |
| Sanderling | Snow goose | |

*Nest monitoring* — The nests of 6 avian species (other than snow buntings and shorebirds), have been found during the 2018 season (**Fig 2.5.1**; **Table 2.7.1**). However, in most cases, it was not possible to determine breeding success as the birds were still incubating at the second visit and further visits were not always possible. One female rock ptarmigan was observed with nestlings.

**Table 2.7.1.** Species for which nests were found in 2018, and their observed breeding success.

| Species | Number of nests | Location of nest | Success |
|---|---|---|---|
| Red-throated loon | 2 | Dumbell lakes delta<br>Lake west of Kirk lake | Undetermined<br>Hatched |
| King eider | 1 | Alert Inlet | Hatched |
| Brant goose | 1 | Alert inlet | 3 nestlings + 1 egg |
| Arctic tern | 1 | Beacon road | Undetermined |
| Glaucous gull | 1 | Pullen creek | 2 nestlings |
| Unknown duck | 1 | Dumbell lakes delta | Failed |
| Rock ptarmigan | No nest | Upper Dumbell lake | 5 nestlings |

**Plans for 2019**

For 2019, we will continue monitoring species. As much as possible, we will also work on improving nest surveillance to improve the monitoring of breeding success.

# 2.8 Arthropods

Our study of arthropods has for main objective to obtain data on arthropod phenology and abundance as this is the main food source for several bird species during breeding, including snow buntings and shorebirds.

**Goals for 2018**

1. To install two arthropod monitoring stations representative of a mesic and dry environment;

2. To test a monitoring protocol commonly used at other sites for comparison purpose.

**Field activities**

*Monitoring of arthropods* — Two monitoring stations were installed in the study area. Each of them had 5 insects traps placed 10 meters away from each other (for a 40 m total transect). One station was installed on the plateau south of the Station in a xeric habitat (82° 28,182' N, 62° 25,836' W). The other station was installed in a mesic habitat along the runway (82° 31,035' N, 62° 17,621' W). Traps were installed on 14 June in the xeric area and on 18 June in the mesic area (one trap was installed on 24 June due to the flood on the spot where the trap was supposed to be). Traps were emptied every two days at approximately the same time in late afternoon or at night.

Samples were brought back to the lab and arthropods were identified to the orders (Aracneae, Collembola, Acari, Diptera, Hymenoptera, Lepidoptera and Coleoptera) and counted.

**Preliminary results**

*Monitoring of arthropods* — In total, we had 33 harvests for the xeric traps and 31 harvests for the mesic traps. The most common orders were Aracneae (spiders) and Diptera (flies).

**Plans for 2019**

We will continue monitoring arthropod phenology in 2019.

# 3. Ecosystem monitoring

## 3.1 Monitoring of wildlife: additional protocols

Our wildlife monitoring has three main objectives: 1) monitoring the diversity and abundance of vertebrates present in the study area; 2) documenting the timing of their presence; 3) locating their preferred habitats.

**Goals for 2018**
1. To record wildlife sightings, including the number of animals, the date and the geographic area;
2. To identify areas that may represent biodiversity hotspots to monitor.

**Field activities**
*Camera monitoring* — The sewage is highly used by animals. We placed four Reconyx cameras on permanent metal stakes at the Sewage (**Fig 3.1.1**). These cameras were motion-triggered (see p. 49-50 in the Alert Wildlife Monitoring Protocols) and collected data from 26 May to 26 August.

**Fig 3.1.1** Reconyx cameras placed at the Sewage.

We also placed Reconyx cameras in locations that may be visited by wildlife in the study area:
- Suicide Point (two cameras: 82.47792°/ -62.45450° and 82.47802°/ -62.45917)
- Alert Inlet (82.49269°/ -62.25141°)
- Upper Dumbell Lake (82.49072°/ -62.46943°)
- Met Shack Pond (81.51798°/ -62.29537°)
- Wood Pile (end of Beacon road) (82.52443°/ -62.20824°)
- Lake Road (82.49748° / -62.38430°)
- Kirk Lake (82.45834° / -62.92464°)
- Cairn Butte (82.49146° / -62.20804°)
- West plain of Gaw lab road (82.47056° / -62.46848°)

We identified ponds used by shorebirds. For some ponds, metal stakes for installing the cameras were planted in the ground for the next summer.

*Daily observations* — Incidental observations were noted as described in the Daily observations protocol (see p. 51-53 in the Alert Wildlife Research Protocols).

*Participative science* — We encouraged people at the Station to report their wildlife sightings to us using data sheets pinned on the common board. These included species sightings and tagged individuals (hares).

**Preliminary results**

*Camera monitoring* — The four cameras at the Sewage took pictures according to plans. The other monitoring cameras took a total of 12,652 pictures (not all pictures contain animals). These are currently being processed.

*Daily observations* — Results were reported in previous sections.

*Participative science* — CFS Alert personnel reported about 60 wildlife observations on the data sheets. Some of these observations were extremely useful as they allowed us to direct our field efforts to some new areas, or establish contact with people who had valuable experience to share. The sightings of 26 tagged hares and 7 untagged hares were also reported on the hare data sheets. Several other hare sightings were reported directly to us and helped us locate individuals and nursing sites.

**Plans for 2019**

At the start of the field season, we will install Reconyx cameras where we planted metal stakes:
- Sewage (4 cameras, as pictured in **Fig 3.1.1**)
- Met Shack pond (3 cameras: 82.51798°/ -62.29483°; 82.51857°/ -62.29442°; 82.51866°/ -62.29856°)
- West plain Gaw Lab pond (82.47255°/ -62.52303°)

Cameras will remain all summer.

Daily observations and participative science will continue as in 2018.

## 3.2 Monitoring of herbivory: Herbivore turd transects

The herbivore turd transects have one main objective: 1) determining herbivore presence and abundance based on faeces counts in different habitats.

**Goals for 2018**
1. To repeat the faeces counts in the herbivore turd transects started during a preliminary site visit in 2017.

**Field activities**
*Herbivore turd transects* — Six herbivore turd transects (each measuring 1x20 m) were placed in summer 2017 in some xeric and humid habitats, and cleaned of all faeces. In July, we counted the new faeces that had accumulated along these transects during the last 12 months.

**Preliminary results**
*Herbivore turd transects* — All turd transects had accumulated fresh faeces during the preceding 12 months. Humid habitats accumulated more faeces than xeric habitats, and most faeces were from arctic hares. This shows that 1- turd transects accumulate enough faeces during 12 months to provide an index of habitat use by herbivores, 2- habitats differ in how much they are used by herbivores, 3- in 2017-2018, arctic hares were the main herbivores grazing in the habitats covered by our turd transects.

**Plans for 2019**
We will revisit the 6 turd transects already in place and will increase sample size, habitat diversity, and study area coverage by adding >15 herbivore turd transects.

## 3.3 Monitoring of predation: Artificial nests

The artificial nest experiment has two main objectives: 1) estimating predation pressure on ground-nesting birds at CFS Alert; 2) comparing the predation pressure between Alert and other Arctic sites.

**Goals for 2018**
1. To conduct the artificial nest experiment during the early and late incubation periods.

**Field activities**
*Artificial nest experiment* — We randomly placed 50 artificial nests (4 quail eggs; 25 nests covered with vegetation and 25 uncovered) from the start of Caribou Road to the end of Beacon Road. The experiment was started on 29 June during the early incubation period (check at 48h) and on 14 July during the late incubation period (checks at 48h and 96h).

**Preliminary results**

*Artificial nest experiment* — For the early incubation period, no nest was predated. For the late incubation period, one nest was totally predated at 96h by an avian predator. This shows a relatively low predation pressure at CFS Alert.

**Plans for 2019**

We will conduct the artificial nest experiments again next year.

# Conclusions

We went through a steep learning curve during our first year of activities at CFS Alert. This involved the writing and testing of new scientific protocols, going through the practicalities of establishing a new laboratory, getting familiar with the study area, understanding CFS Alert rules, learning how to interact with CFS Alert personnel, and learning how to work safely in the habitat of species such as Arctic wolves and polar bears. This was done in a training environment where students were also learning their profession of field biologist.

We successfully reached most of our first year objectives, thanks to the support provided by the Department of National Defence (8 Wing Trenton Environmental Management) and the collaborative environment found at CFS Alert.

It is clear that the wildlife inhabiting the polar desert of Alert has important conservation and scientific values. We are now in an excellent position to gather during the next years the information required to write a Biodiversity Management Plan for CFS Alert, and to advance scientific knowledge about some wildlife species living in one of the most extreme environments on Earth.