The Snow Bunting Report

CANADIAN SNOW BUNTING NETWORK

Welcome to the 8th annual newsletter !

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Newsletter editor – Sarah Payel
Photo : Hal Trachtenberg

We are happy to present the 8th edition of the Canadian Snow Bunting Network Newsletter! Thank to all of you who have in some ways participated to this project since its establishment and welcome to newscomers! Last year the COVID-19 pandemic has affected everyone's work in one way or another and we hope that in this new year things will get better, and some great projects can take place!

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In this issue, we put the light on the banders: Julie Bauer, Terry Skjonsberg and Nancy Furber tell us about their experiences! Ryan O'Connor shares these results on the low heat tolerance of buntings. Keta Patel presents a new technique to investigate reproductive success and population divergence in snow buntings. Finally, Sarah Payel, a new student of François Vézina and Oliver Love, present her project on snow bunting. We hope you enjoy this report!

CSBN Banders in the spotlight!

By Julie Bauer and Terry Skjonsberg - Banders in the Yukon

Having worked in 70's as a Fish and Wildlife Technician Julie has always been drawn to wildlife and wild spaces. "With the CWS (Canadian Wildlife Service) she was fortunate to work on projects such as raptor banding, a peregrine falcon hack station and snow goose banding at the McConnell River Sanctuary. My second profession has been nursing", says Julie.

CSBN bander Julie Bauer banding Snow buntings out of their mobile banding unit near Haines Junction (south-west Yukon near Kluane National Park)

Since 2002 Julie has volunteered at the two migration stations in the Yukon. She obtained a sub-permit in 2007 and changed to a master permit later. To date she has banded over 30,000 birds – an amazing feat!

In 2011 Julie responded to a request from the BBO (Bird Banding Office) for banders in Canada to band more snow buntings. Julie's retirement in 2014 was the first year to start their SNBU project. "It was a steep learning curve to trap buntings, and my husband Terry Skjonsberg has helped immensely. Once we started to use David Lamble's trap designs and realized that buntings are attracted to areas that have horses, our banded bird numbers increased", notes Julie. She and Terry have found that buntings love 'horse buns' (aka piles of horse manure) and establishing a trap location nearby has been very successful. Corn and Millet also help. Julie and Terry have three sites, all on private land that have horses present. Last year one site was even located in a pig pen that had been sown with oats. In this case the oats were the attraction, no pigs present!

Julie says the timing for banding runs from March 12 to April 15 and is very weather and snow dependent, usually 3 weeks of work. In 2019 with a very warm spring, snow disappeared very quickly, and the birds did not even attempt to band since buntings had food everywhere. "Unlike the all-winter banding in eastern Canada our buntings are in true spring migration. We have very few overwintering buntings".

Although the core banding team is made up of Julie and Terry, when things get really busy, they put out the call for scribes from our small community of Haines Junction, located to the south-west Yukon near Kluane National Park. Julie and Terry also involve youth as much as possible. As we all know, Julie remarks that "Kids love these easily handled birds, a bulging fat of 5 and what the heck is a crop?". We couldn't agree more Julie!

Julie's husband Terry (Skjonsberg) has helped their Yukon bunting banding efforts immensely

Total banding numbers to date are approximately 6,500 banded birds and 37 year to year recaptures. Julie and Terry also had two foreign recaptures, one recovery on a truck grill and the other bird released after capture during a project in Barrow, Alaska. Their best capture year so far was 2020 with 2,338 birds banded. They have over 970 already by the end of March 2021 with two weeks to go. Although many of our CSBN banders are focussed in Central and Eastern Canada, Julie and Terry are ever hopeful that banders in the west will become active. This is a major ongoing goal for the CSBN – having more banders in Saskatchewan, Alberta and British Columbia.

“We are hopeful for a McKay’s bunting someday, you never know! Our community has been fortunate enough to record the first Hawfinch in Canada!!”. Fantastic work Julie and Terry! Thank you for all of these huge efforts for helping us to understand a rarely studied bird.

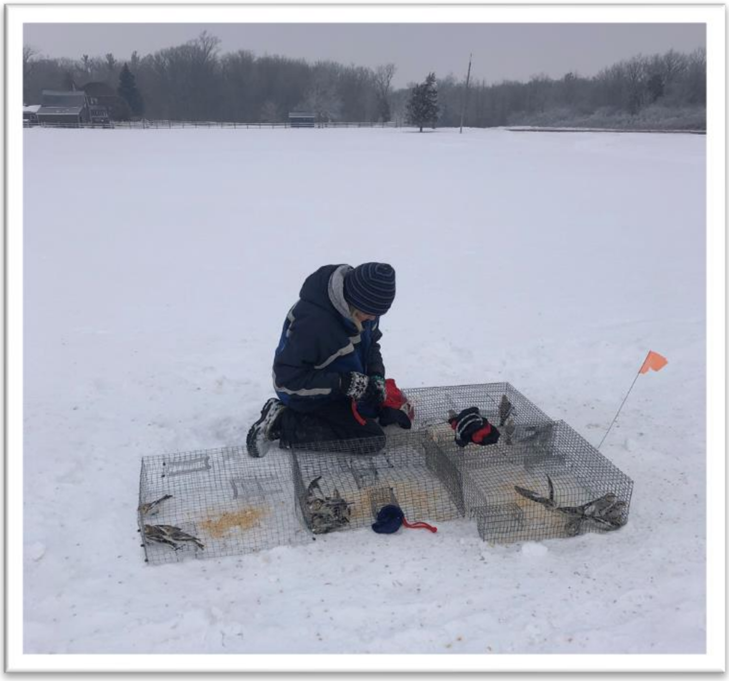
By Nancy Furber - Bander in Ontario

Since 2010 Nancy Furber has been participating in winter snow bunting banding with the CSBN working out of multiple sites in Haldimand County, Ontario. Through the early years, Nancy had six different locations as bait sites (all of which were successful) before she finally settled on one main site just outside of Hagersville, Ontario. For the past seven years that she has been banding there the birds have returned year after year to this same location. In Southern Ontario, Nancy notes that it’s not until later in the season when the weather is consistently cold enough and with a good snow base that the big swirling flocks of birds appear. Indeed, Nancy has found that the number of birds at the bait sites each year can drastically fluctuate depending on the presence or absence of snow.

CSBN bander Nancy Furber with Snow Buntings

Since 2010 Nancy has banded over 7,000 Buntings, and each winter she says she anticipates another new season and all the new birds it will bring. “The traditional winter weather of cold temperatures, snowstorms and clear, sunny days is what I embrace and hope for each year”, says Nancy. “I can combine my passion of banding and the love of winter when I’m monitoring Snow Buntings.” As Nancy also notes, winter banding can certainly have its many challenges, but it can be so rewarding for so many reasons!

For the current 2020-21 banding season, Nancy was able to establish two bait sites. One at her main site and the second nearby just outside of Cayuga, Ontario. “It was wonderful having the site at home where I could walk out each morning to feed the birds, and I could park in our driveway to band”, says Nancy. Since the two sites were four kilometers apart, on most days she could band only at one site, but feed the birds at the second site. On some days though she was able to spend time banding at both her sites and she quickly determined that birds were going between both sites, so they were always well fed! As many of us found during these odd Covid lock-down conditions “It was a memorable season, having the snow and the consistent cold to draw the Snow Buntings to the corn to set traps. The polar vortex weather in the month of February kept the flocks in the area, providing beautiful sunny days for observing and banding Snow Buntings”.



CSBN bander Nancy Furber that catches Snow Bunting with the walk-in traps system

Nancy noted in particular that one big snowstorm on February 15th/16th brought a blast of winter snow, providing ideal conditions and lots of buntings to band. As Nancy so eloquently puts it “When it’s cold and sunny, the flocks of Snow Buntings drop like snowflakes from the blue sky”.

In terms of her winter banding numbers, Nancy certainly did amazingly well. Using three traps, she banded 1,809 birds: 1,788 Snow Buntings (64% females, 36% males), 19 Horned Larks and 2 Lapland Longspurs. On top of all those great numbers Nancy had 13 foreign encounters: 12 Snow Buntings and 1 Horned Lark. Two of the Snow Buntings were birds originally banded in 2017 at her site! Nancy also enjoyed having socially distanced visits from 13 visitors who stopped and asked about the birds, wondering what they were and giving her the opportunity to talk about her banding project and the Canadian Snow Bunting Network. “Thanks to everyone for making this such a successful season!”

Thank you to all the banders! (Julio Mulero)

An expert in the cold, but a novice in the heat: snow buntings show signs of heat stress at comparatively low air temperatures

By Ryan O'Connor – Post-Doctoral Fellow, Université du Québec à Rimouski, with Dr. François Vézina and Dr. Oliver Love, University of Windsor

Anyone living in northern, temperate latitudes is well aware that the first days of autumn can feel quite cold after a summer of warm temperatures. Yet, amazingly, those same conditions that feel cold in the autumn feel quite warm in the spring after living through a long winter of below-freezing temperatures. It is likely this latter relationship that snow buntings have with temperature. Snow buntings are a circumpolar, migrant songbird that spends the majority of their life in snowy, sub-freezing climates. As such, snow buntings are extremely cold tolerant, having evolved a suite of physiological mechanisms allowing them to withstand extremely cold temperatures. However, being adapted to perpetually cold environments means buntings likely experience heat stress at temperatures otherwise benign to many species less well-adapted to extremely cold environments.

The study of heat tolerance in birds dates back decades and has been a topic of deep interest among ecological physiologists. However, these studies are overwhelmingly biased towards species inhabiting hot, arid climates with few studies on temperate zone birds and even fewer on Arctic birds. Although this lack of attention is not surprising given we don't often think of an Arctic animal experiencing heat stress, responses to temperature can be a relative matter and what may seem perfectly fine for one species may feel quite warm to another. This concept of subjectively experiencing heat becomes more prescient considering the Arctic is rapidly warming. In fact, the Arctic is warming at a rate twice that of the global average. Given the pace at which the Arctic is warming and the severely limited amount of information on how Arctic birds can tolerate increasing air temperatures, we sought to investigate how a known cold-specialist Arctic songbird tolerates increasing air temperatures.

To fill these gaps, we have been studying the heat tolerance of a wild population of snow buntings in Alert, Nunavut (82°N). This study is part of the multi-institutional ArcticSCOPE research project which seeks to understand how Arctic birds will be impacted by a rapidly warming Arctic. To study bunting's heat tolerance, we used a common method known as flow-through respirometry which consists of pushing a stream of air past an animal that is resting inside a darkened, airtight chamber. By using gas analyzers, we can measure the difference between the oxygen and water vapor concentrations entering and leaving the chamber which can then be used to calculate metabolic and evaporative water loss rates. Importantly, we can control the air temperature that the bird experiences inside the chamber, thus allowing us to collect metabolic and evaporative

Flow-through respirometry set-up used at Alert to measure the metabolic and evaporative water loss rates of snow buntings (Audrey Le Pogam) water loss data at specific air temperatures. By controlling the temperature, we can initially expose birds to low air temperatures and then gradually increase temperatures to examine their use of metabolic energy to stay cool. At the same time, we can measure the birds' body temperatures and their behaviour in real-time by placing an infra-red camera adjacent to the chamber.

Our results showed that snow buntings are comparatively heat intolerant, exhibiting signs of heat dissipation at temperatures lower than those reported in songbirds from warmer climates. These data thus suggest that the evolved adaptions of snow buntings to withstand cold environments may adversely impact their capacity to tolerate even moderate heat loads. We found that buntings have an extremely limited capacity to increase their rates of evaporative water loss at high air temperatures relative to resting values. Generally, the higher a bird's capacity to increase evaporative water loss means the more heat they can dissipate and, consequently, the higher the temperature they can tolerate. Indeed, the maximum air temperature buntings tolerated was 43°C compared to 46 °C and higher for songbirds from warmer habitats. Secondly, and perhaps most importantly, snow buntings are very inefficient at dissipating heat. The efficiency at which an animal can dissipate heat, termed the evaporative cooling efficiency, involves the relationship between heat lost through evaporation and heat produced through metabolism. Essentially, an animal wants to maximize heat loss and minimize heat produced through metabolism. We found that the majority of buntings could only evaporatively dissipate an amount of heat equivalent to 70% of the heat they were producing. In other words, most buntings could not even dissipate their own heat production stemming from metabolic processes. Snow buntings low evaporative cooling efficiencies certainly contributed to their inability to tolerate higher air temperatures.

There are two important take-home messages from our findings. Firstly, it would be reasonable to think that buntings will be fine under a warming Arctic since they presumably will never experience air temperatures of 43°C in the Arctic. However, wild animals do not experience air temperature in isolation, but instead experience what is termed "operative environmental temperature", which incorporates solar and thermal radiation with wind speed to generate "realized" temperatures well above air temperature. In fact, our preliminary data collected on bunting breeding grounds at Alert and East bay shows that environmental temperatures can exceed 30°C, despite air temperatures being much lower. Secondly, our data represent heat tolerance limits for resting buntings. However, wild birds are highly active, which results in higher metabolic rates and greater heat production. The increased heat production from activity will likely lead to buntings becoming heat stressed at lower environmental temperatures than observed in the current study. For instance, our ongoing work suggests that an active bunting feeding their nestlings in July will begin to experience heat stress at operative temperatures of 12.6°C. Above 12.6°C, buntings will be forced to reduce their nestling-rearing activities to maintain a normal body temperature. As the Arctic continues to warm, our work predicts that highly active snow buntings (e.g., breeding adults feeding young) will experience more periods of heat stress when they will be presented with thermoregulatory trade-offs between having to feed nestlings and having to reduce their activity to avoid overheating. Our future work will start to look at these potential trade-offs to determine whether breeding adults need to reduce their feeding rates to limit heat production when facing warmer Arctic summers.

A male snow bunting with a beak full of insects (François Vézina)

Using genetic approaches to investigate reproductive success and population divergence in snow buntings

Keta Patel - M.Sc. Candidate, University of Windsor with Drs. Daniel Heath and Oliver Love

The effects of climate change are being most severely felt in the Arctic; in fact, Arctic ecosystems are experiencing climate change at about twice the intensity of the global average. Arctic migratory birds are highly vulnerable to the detrimental impacts of climate change as they face shifts in species distributions, habitat range, migratory timing and reproductive ecology. Consequently, this can lead to reduction in population abundances, local extirpations, or worse, species extinction. It is therefore crucial to study whether natural selection has provided Arctic species with the tools to respond to climate change.

This is more important than ever in the case of Arctic-breeding snow buntings as North American populations have declined by more than 60% in last four decades, potentially due to climate change effects on their Arctic breeding grounds. Since snow buntings are vastly understudied from a genetics point of view, both within and between population-level studies are needed to identify which individuals are most successful (and why), and to pinpoint specific geographically-based populations that may be most resilient to stressors and therefore be worthy of management/conservation efforts.

My thesis first examines how individual variation in male quality impacts breeding success in a long-term population of buntings studied at Mitivik (East Bay) Island since 2007. Similar to many passerines, snow buntings are also genetically promiscuous (males can sire offspring in multiple nests), which must be taken into consideration when calculating the overall reproductive success of an individual. With this objective in mind, I first developed species-specific genetic (microsatellite) markers to quantify both within-pair and extra-pair reproductive success. I then examined whether variation in multiple male quality metrics predicted variation in reproductive success. Overall, my results indicate that within-pair success is correlated with plumage quality and physiological measures, whereas extra-pair success is correlated with arrival body condition and song quality (Figure 1).

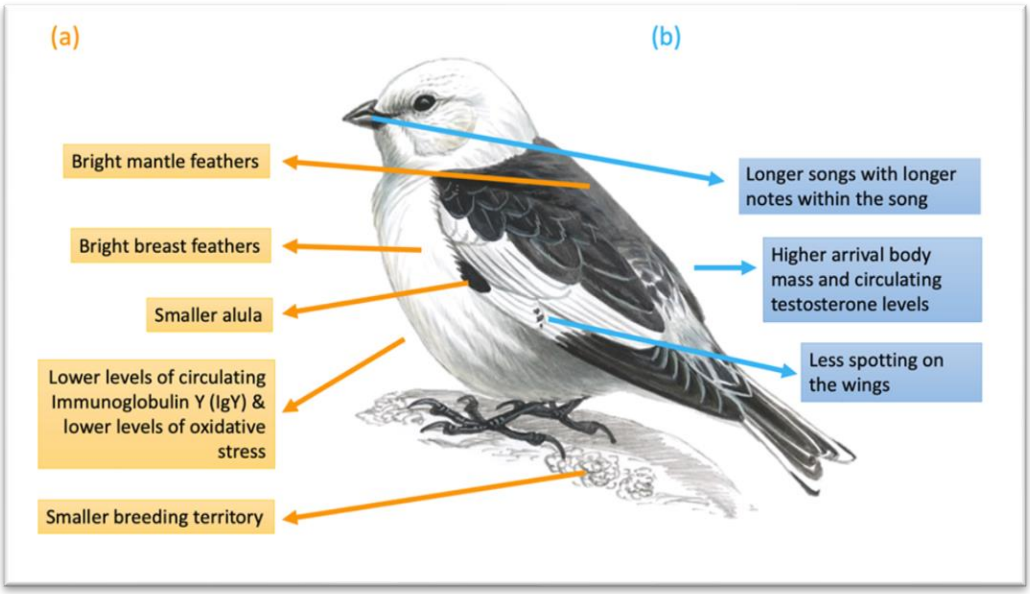


Figure 1: Male quality measures as predictors of an increase in (a) within-pair and (b) extra-pair reproductive success in male snow buntings at Mitivik (East Bay) Island

These results suggest males match their paternity strategies to their own inherent quality resulting in a greater diversity of strategies in the face of environmental change. This is good news in that these results suggest snow buntings may be able to adjust some aspects of their breeding strategies to environmental change.

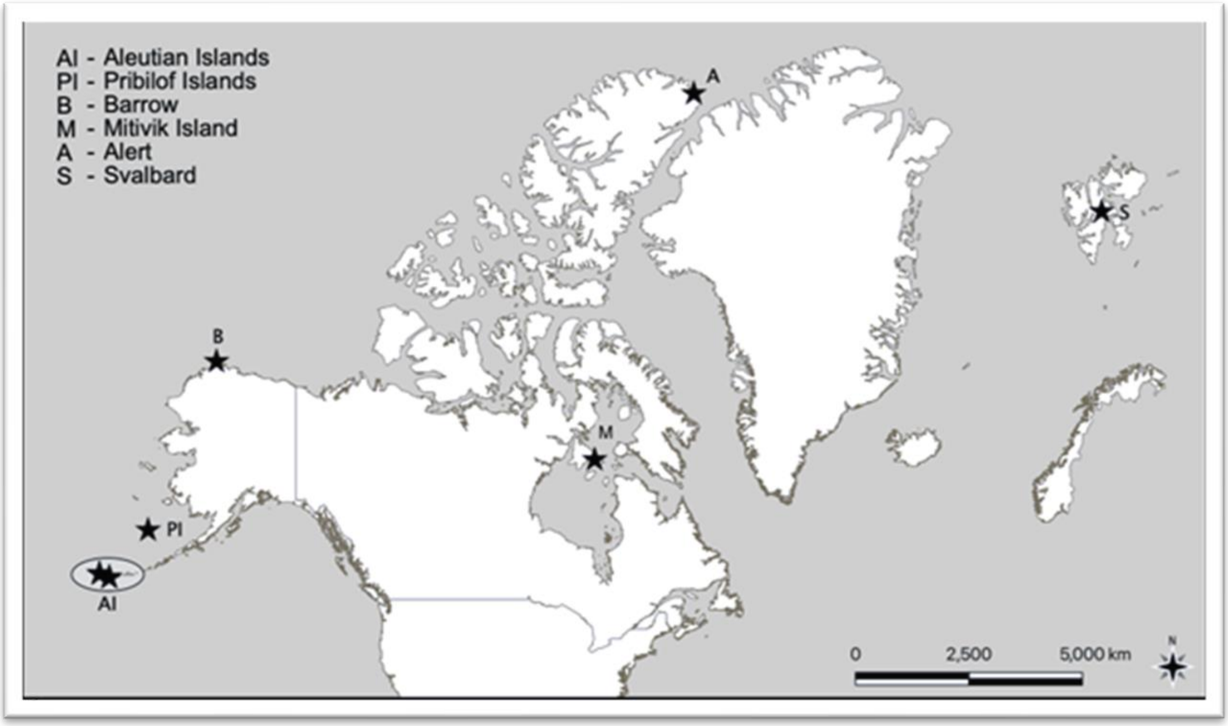


Figure 2: Comparisons across six populations of breeding snow buntings revealed both genetic diversity and local adaptation to environmental change

I am also using genetics to assess whether different bunting populations have evolved specific traits and responses to deal with environmental change. We developed an international network of collaborators for the first time ever to examine genetic diversity and local adaptation in this species using six geographically isolated breeding populations (Figure 2). From a technical point of view we identified variation in transcriptome-derived single nucleotide polymorphism (SNPs) within functionally relevant genes that should evolve in response to selective pressures such as environmental variation; these metrics provide a meaningful way to measure genetic diversity and population divergence. Using this approach, we found there is evidence for diversifying selection at specific genes meaning that different populations appear to have altered specific tools within their overall bunting toolboxes to succeed in their own local environments. Our results also indicate two additional and new findings: first, the non-migratory Aleutian and Pribilof islands populations are genetically distinct from all other populations suggesting birds are locally-adapted to their habitats (Figure 3). Perhaps even more impressive is that our own Mitivik (East Bay) Island population is actually most genetically similar to the Svalbard breeding population (Figure 3)! Overall these new molecular tools provide our team with a baseline to assess how resilient populations will be as climate change alters local habitat characteristics so that we can identify populations with high levels of genetic diversity and adaptive potential to further environmental change.

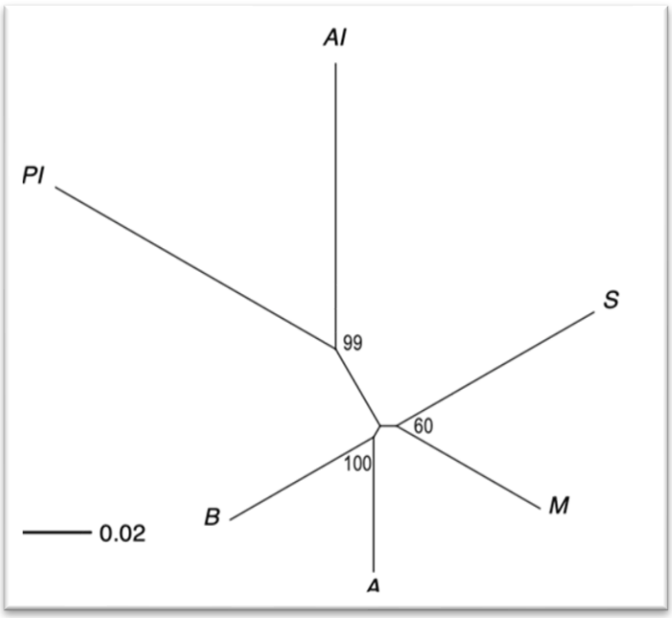


Figure 3: Unrooted neighbor-joining tree based on functional Single Nucleotide Polymorphisms (SNPs) data showing populations of snow buntings at Mitivik (East Bay) (M) Island and Svalbard (S) have similar genetic structures. The scale displays genetic distance and the numbers show bootstrapping support for SNP loci used

Welcome to the snow bunting team!
Are anthropogenic effects responsible for the decline of snow buntings?

Sarah Payel - PhD Candidate, Université du Québec à Rimouski, with Dr. François Vézina and Dr. Oliver Love, University of Windsor.

Agriculture is an activity that can lead to strong landscape modifications and generate pollution through the use of pesticides, potentially leading to negative impacts on the environment and biodiversity. Snow buntings are associated with many southern areas of Canada's agricultural environments during winter and spring migration. Preliminary analyses suggest that the species is in sharp decline in North America (by as much as 65% in the past 40 years; Audubon Christmas Bird Count). However, we know little about details of whether Canadian populations are in decline to the same degree, and whether all provincial wintering populations are faring the same. Moreover, studies on the potential causes of this decline, including agricultural intensity, variable body condition, or even the effect of pesticide/herbicide exposure are rare or non-existent. My PhD project at UQAR aims to first quantify wintering population trends for Canada and the provinces, then use this information to expand our knowledge on internal mechanisms (e.g., condition, physiology) and external mechanisms (e.g., agricultural intensification, changes in weather) as predictors of population declines.

To examine declines in snow buntings across Canada, we are using historical data from the Audubon Christmas Bird Count from 1965 to 2019. Our preliminary analyses confirm the previous North American declining trend, but also indicate a strong signal of decline in most of Canada and many of the provinces. Once I have established regional variation in population declines, I will examine the link between these declines and temporal changes in agricultural landscapes between 1965 and 2019. We predict that a move away from low-impact farming to the intensification of many crops (e.g., wheat in the prairie provinces) may predict declines in populations. However, it is also possible that increases in crops such as corn and canola in provinces such as Manitoba, Ontario and Québec may benefit birds during the winter as they feed on unharvested seed. Because climatic conditions during winter have also been changing alongside the ongoing increase in agricultural intensification over time, we will also be exploring whether changes in regional temperature and snow cover are playing an additive role in the declines.

Figure 1: A snow bunting during the blood markers experiment (Sarah Payel)

To examine spatio-temporal variation in body condition of wintering birds, I will also be validating a technique to measure the fattening rate and condition of birds from small blood samples. We have already observed that two blood markers (triglycerides and beta hydroxybutyrate) appear to be good indicators of a bird that has eaten or a bird that has fasted, respectively, which could be used as indicators of the birds' fed state. These tests were done in birds living in outdoor aviaries during the

Figure 2: Snow bunting spring migration route along an agricultural gradient from high (south) to low (north)

summer. I am currently repeating the experiment in winter with these same birds to obtain data for the winter period (Figure 1).

The high energy demand during winter and migration requires high food consumption, which increases the risk of exposure to persistent contaminants, among other things. Once our technique is experimentally validated, my objective is to examine the physiological condition of free-ranging birds during winter and migration. I will use these blood markers together with measures of oxidative stress and quantify pesticide exposure to determine the relationship between these variables and agricultural intensity. To do this, I will work in collaboration with volunteer banders from the Canadian Snow Bunting Network (CSBN), at different sites (from Ontario to Newfoundland, Figure 2) along a gradient of agricultural intensity (high to low) to obtain crucial data on these birds during winter and migration. It is possible that birds may not eat pesticide-treated seeds or may avoid eating treated seeds, in this case their conditions may not be affected by the use of pesticides. However, as buntings are known to frequent agricultural environments (Figure 3) and the use of pesticides is widespread, my hypothesis is that condition during winter and migration as well as daily fattening rates decline while oxidative stress and pesticide contamination increase with agricultural intensity across eastern Canada. After examining the birds condition based on farming intensity and pesticide use data, I will study how pesticides may influence buntings' health and performance. More precisely, I will investigate how pesticides affect two key performance indicators that allow the birds to survive winter and successfully migrate in the spring: cold endurance and physical endurance. Since the correlative link between population decline and agricultural intensity may be through this mechanism, my hypothesis is that persistent pesticides reduce cold endurance and physical endurance, and that this decline in ability is related to a loss of condition that could be one of the potential causes of the decline of snow bunting.

Figure 3: A snow bunting on a cob (John Haslam)

Special thanks goes out to …

… all the banders that have contributed to observations and data to this ongoing research and collaborative conservation program. Thanks also to the James L. Baillie Memorial Fund of Bird Studies Canada, the Ontario Bird Banding Association, Environment Canada, the University of Windsor, the Love Lab, the University of Quebec at Rimouski, the Laboratory of Avian Ecophysiology, the Nunavut Research Institut, the Nunavut Artic College, Mitacs and Audubon for their funding and logistical support.

Have a great year and take care of yourself!

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