

**1 Long-term abundance time-series of the High Arctic terrestrial vertebrate
2 community of Bylot Island, Nunavut**

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26 The complete data set will be published as supporting information should the
27 manuscript be accepted for publication. Metadata document, raw data and codes will
28 also be archived in Dryad.

29 **Introduction**

30 The composition of ecological communities, defined as the abundance of each species
31 within a given community, is fundamental for understanding patterns and processes in
32 community ecology. Variations in community composition can help to detect spatial pat-
33 terns linked to environmental variations (Kemp et al., 1990), assess temporal trends of
34 different groups of species after disturbances (Philippi et al., 1998; Magurran, 2007), and
35 understand food web structures (Cohen et al., 2003). Additionally, community compo-
36 sition is essential for modeling the dynamics of ecological communities. Dynamic com-
37 munity modelling allows addressing important issues and questions in ecology, such as:
38 determining the relative strength of top-down versus bottom-up forces in communities
39 (Krebs et al., 2003; Legagneux et al., 2014), assessing the ecological resilience of commu-
40 nities under climate change (Griffith et al., 2019) and evaluating the cascading effects of
41 invasive species in food web (David et al., 2017; Goto et al., 2020). Dynamic community
42 modelling can also be applied to address practical challenges, including fishery manage-
43 ment (Plagányi, 2007) and the planning of protected areas (Okey et al., 2004; Dahood
44 et al., 2020).

45 Modeling food webs requires adjusting trophic flows based on the functional responses
46 of species, which necessitates time series data on the abundance of all species within
47 a community. However, determining the abundance of all species within a community
48 is rarely achievable. Consequently, empirical community models often reduce taxonomic
49 resolution by grouping species into large functional or taxonomic categories. Additionally,
50 food webs consist of species with varying body sizes depending on their trophic level,
51 with top-level species often being highly mobile and having large home ranges (McCann
52 et al., 2005). Therefore, community models must use landscape-wide estimates of species
53 abundance to accurately represent trophic fluxes. Due to these constraints, empirical
54 datasets with high taxonomic resolution that cover entire communities at broad spatial
55 and temporal scales are rare and often include incomplete or rough estimates.

56 The composition of ecological communities is influenced by various factors acting at dif-
57 ferent temporal and spatial scales, leading to noisy data and emphasizing the need for
58 long-term data sets (Magurran et al., 2010; Lindenmayer et al., 2012). Species abun-
59 dances are influenced by stochastic effects (Hubbell, 2001), environmental changes (e.g.,
60 climate warming), and species interactions, contributing to data variability. For instance,
61 the composition of a community could be driven simultaneously by intra-annual seasonal
62 variations, multi-year cyclic variations (e.g., El Niño) and slow but directional long-term
63 variations in the environment (Brown and Heske, 1990; Snyder and Tartowski, 2006).
64 Therefore, long-term data series are required to untangle the relative effects of diverse
65 abiotic and biotic factors on community composition (Magurran et al., 2010; Lindenmayer

66 et al., 2012).

67 Arctic environments are highly valuable systems for studying community structure and
68 dynamics due to their relatively low species richness (Payer et al., 2013; Legagneux et al.,
69 2014). However, logistical challenges in the Arctic limit the number of long-term bio-
70 diversity monitoring programs. Hence, the small number of Arctic communities with
71 long-term monitoring serve as highly valuable sites for holistic and empirical community
72 studies. Datasets on terrestrial communities are notably scarce, and this scarcity extends
73 to Arctic communities as well (Ims et al., 2013).

74 Within terrestrial Arctic sites, the south plain of Bylot Island in the Canadian High Arctic
75 (**Figure 1**) hosts one of the longest and most intensive biodiversity monitoring programs
76 (Gauthier et al., 2024b). Monitoring on Bylot Island began in 1989 with a focus on the
77 snow goose and it gradually expanded to other species over time. Currently, the program
78 encompasses all significant vertebrate species in the community with continuous monitor-
79 ing spanning more than a decade (Gauthier et al., 2024b). Monitoring is also conducted at
80 multiple spatial scales, including intensive and systematic observations conducted across
81 a landscape spanning approximately 400 km². This approach allows the scaling of local
82 density measurements to the landscape level when required and facilitates the estimation
83 of abundance for less common and rare species.

84 Previous work based on the tundra community of Bylot Island has already produced
85 several influential papers (Gauthier et al., 2011; Legagneux et al., 2012, 2014; Hutchison
86 et al., 2020; Duchesne et al., 2021; Gauthier et al., 2024a). These studies showed that
87 tundra communities may experience stronger top-down regulation than bottom-up reg-
88 ulation (Legagneux et al., 2012, 2014). They also revealed a heterogeneous response of
89 trophic levels to climate warming (Gauthier et al., 2013) and highlighted the effects of
90 indirect trophic interactions on the occurrence of species across the landscape (Duchesne
91 et al., 2021). However, those earlier papers were built on data from relatively short time
92 series, they were not always scaled at the landscape level, and some species or functional
93 groups were lacking abundance estimates. With over a decade of additional community-
94 wide monitoring compared to earlier studies, our goal is to synthesize and upscale the
95 data collected on the Bylot Island community since the 1990s to the landscape level. This
96 synthesis aims to provide readily accessible annual time series (or mean values in some
97 cases) of abundance and biomass for all vertebrate species in a tundra landscape, covering
98 approximately 400 km².

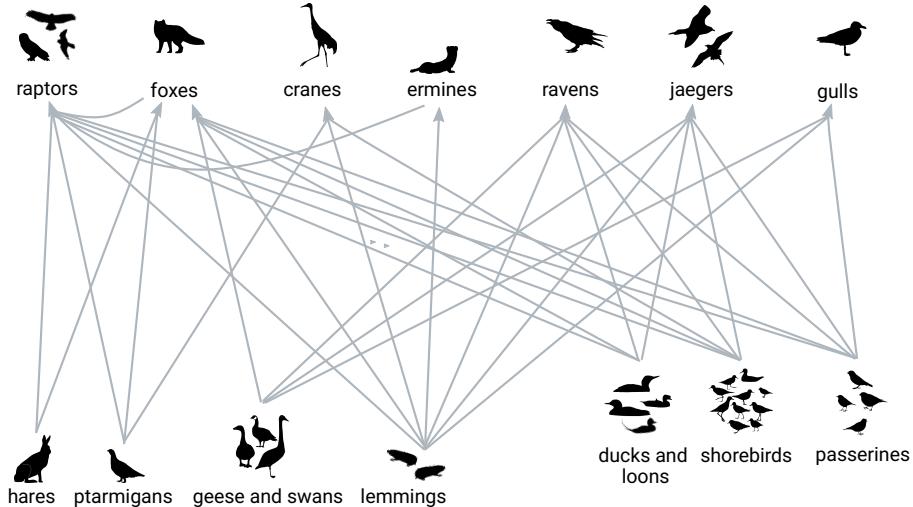


Figure 1: Synthetic vertebrate food web of the south plain of Bylot Island.

99

Objective

100 Our main objective is to provide readily accessible, long-term time series of annual abund-
 101 ances of all vertebrate species within the Arctic terrestrial community of Bylot Island
 102 during the breeding season (May to August). This includes both breeding and non-
 103 breeding individuals that stay in the study area for a significant period of time, and
 104 excludes non-breeding individuals that stop for only a few days during their migration.
 105 We focus on adults, except for lemmings for which we have not distinguished between
 106 juveniles and adults. Our focus extends to estimating abundances at the landscape scale,
 107 enabling the study of community and ecosystem dynamics, trophic interactions and the
 108 impacts of global changes on high-latitude environments. Additionally, we aim to pro-
 109 vide the average body mass for each species in the community, enabling the conversion of
 110 abundances into biomasses.

₁₁₁ **Class I. Data Set Descriptors**

₁₁₂ **A. Data set identity**

₁₁₃ Long-term abundance time-series of the High Arctic terrestrial vertebrate community of
₁₁₄ Bylot Island, Nunavut

₁₁₅ **B. Data set identification codes**

₁₁₆ BYLOT-species_taxonomy.csv
₁₁₇ BYLOT-species_abundance.csv
₁₁₈ BYLOT-species_body_mass.csv
₁₁₉ BYLOT-interannual_variation_nest_density.csv
₁₂₀

₁₂₁ **C. Data set description**

₁₂₂ **1. Originators**

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₁₃₆

₁₃₇ **2. Abstract**

₁₃₈ Arctic ecosystems present unique opportunities for community-wide monitoring, in part
₁₃₉ due to their relatively low species richness. However, conducting research in these remote
₁₄₀ environments poses significant logistical challenges, resulting in long-term monitoring be-

¹⁴¹ ing exceedingly rare. Here, we focus on the long-term, intensive ecological monitoring
¹⁴² efforts conducted on the south plain of Bylot Island (almost 400 km², Nunavut, Canada),
¹⁴³ which has generated a remarkable dataset spanning up to 30 years, a rarity in tundra
¹⁴⁴ ecosystems. Our goal is to synthesize this dataset and upscale vertebrate abundance data
¹⁴⁵ at the landscape level, a prerequisite to conduct community-level analyses. We have stan-
¹⁴⁶ dardized data obtained with different field methods to provide readily usable long-term
¹⁴⁷ time series of abundance for 35 vertebrate species (30 birds and 5 mammals) present
¹⁴⁸ in the study system. Monitoring data includes intensive capture-mark-recapture density
¹⁴⁹ estimates of lemmings on trapping grids, systematic or opportunistic nest monitoring con-
¹⁵⁰ ducted across the entire study area or within specific plots for all bird species, transects of
¹⁵¹ vertebrate counts distributed throughout the study area, daily incidental observations of
¹⁵² vertebrates and satellite tracking of fox movements. Annual abundance of species was es-
¹⁵³ timated at the landscape level, accounting for spatial variations. Furthermore, we provide
¹⁵⁴ body masses for each species, derived from empirical onsite measurements for 18 species
¹⁵⁵ and from the literature for the remaining species. Body mass is essential to convert species
¹⁵⁶ abundance into biomass for studies of trophic fluxes and ecosystem processes. Our dataset
¹⁵⁷ provides a unique opportunity for holistic empirical studies of ecological communities, al-
¹⁵⁸ lowing a deeper understanding of community structure and dynamics. Considering that
¹⁵⁹ the study site is a pristine and protected area that has experienced minimal anthropogenic
¹⁶⁰ impact, it can also provide an ideal baseline for investigating the impacts of global changes
¹⁶¹ on high-latitude terrestrial ecosystems.

¹⁶² D. Key words/phrases

¹⁶³ Arctic tundra, Biodiversity monitoring, Bylot Island, Canadian Arctic, Community com-
¹⁶⁴ position, Community structure, Food web, Long-term monitoring, Species abundance,
¹⁶⁵ Species biomass, Species body mass

¹⁶⁶ **Class II. Research origin descriptors**

¹⁶⁷ **A. Overall project description**

¹⁶⁸ **1. Identity**

¹⁶⁹ Structure and functioning of Arctic terrestrial ecosystems

¹⁷⁰ **2. Originators**

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¹⁸³ Canada

¹⁸⁴

¹⁸⁵ **3. Period of study**

¹⁸⁶ 1989 - continuing

¹⁸⁷ **4. Objectives**

- ¹⁸⁸ i) Develop models for the Arctic tundra food web that incorporate seasonality, migratory
¹⁸⁹ connectivity and interactions with marine and southern ecosystems.
- ¹⁹⁰ ii) Predict the effects of global changes on Arctic terrestrial food webs.

¹⁹¹ **5. Abstract**

¹⁹² Arctic terrestrial communities, characterized by relatively low species richness, offer unique
¹⁹³ opportunities for studying ecological patterns and dynamics in simplified systems. Despite
¹⁹⁴ their relative simplicity, these ecosystems feature complex species interactions, extreme

195 seasonal environmental changes, and a significant proportion of migratory species, making
196 it difficult to identify the key factors shaping their structure and functioning. As global
197 environmental changes accelerate, it is essential to understand the interacting processes
198 driving these communities to eventually predict future impacts on Arctic ecosystems. Our
199 research combines long-term biodiversity monitoring, a community-wide approach, and
200 food web modeling to address these challenges.

201 **6. Sources of funding**

202 Natural Sciences and Engineering Research Council of Canada, Fonds Québécois de
203 Recherche Nature et Technologies, Centre d'études nordiques, Natural Resources Canada
204 (Polar Continental Shelf Program), Network of Centers of Excellence Canada (Arctic-
205 Net), Canada First Research Excellence Fund (Sentinel North Program), Polar Knowledge
206 Canada, Environment and Climate Change Canada, Canada Foundation for Innovation,
207 Parks Canada Agency, International Polar Year program of the Government of Canada,
208 Crown-Indigenous Relations and Northern Affairs Canada (Northern Contaminant Pro-
209 gram), Ducks Unlimited Canada, Kenneth M. Molson Foundation (Kenneth M. Molson
210 Foundation's donation for wildlife research, conservation, and habitat), Garfield Weston
211 Foundation, First Air—Canadian North, Nunavut Wildlife Management Board, Uni-
212 versité Laval, Université du Québec à Rimouski

²¹³ **B. Specific subproject description**

²¹⁴ **1. Site description**

²¹⁵ **a. Site type**

²¹⁶ The study area (389 km^2) represents a relatively productive tundra ecosystem in the
²¹⁷ eastern Canadian High-Arctic. An important biological characteristic of the area is the
²¹⁸ presence of a large snow goose (scientific names of most vertebrate species can be found
²¹⁹ in **Table 1**) colony of around 25 000 breeding pairs (Reed et al., 2002) spanning ap-
²²⁰ proximately 70 km^2 . The vertebrate community within the study area comprises 30 bird
²²¹ species, with 29 of them being migratory or partially migratory, along with 5 mammal
²²² species (**Table 1**; Moisan et al. (2023); Gauthier et al. (2024b)). The study area experi-
²²³ ences significant temporal fluctuations in the population of small mammals (lemmings),
²²⁴ which in turn impact the occurrence and abundance of their avian and mammalian preda-
²²⁵ tors such as snowy owls, rough-legged hawks, long-tailed jaegers, ermines and Arctic foxes
²²⁶ (Legagneux et al., 2012; Duchesne et al., 2021). We exclude occasional visitors, namely:
²²⁷ i) species lacking confirmed breeding occurrences on the study site, ii) species observed
²²⁸ solely within a single year, and iii) species primarily breeding and foraging in nearby ma-
²²⁹ rine or coastal habitats (Moisan et al., 2023). The case of the red fox (*Vulpes vulpes*) was
²³⁰ ambiguous. While the presence of breeding pairs has been confirmed in the study area
²³¹ (Lai et al., 2022), the extent of population establishment remains unclear and sightings
²³² are rare. Therefore, we decided to exclude this species.

Table 1: Species of the vertebrate community of Bylot Island and their corresponding migratory status (i.e., resident, partial migrant or migrant).

Functional group	Scientific name	English name	Migratory status
Ducks and loons	<i>Gavia pacifica</i>	Pacific loon	migrant
Ducks and loons	<i>Gavia stellata</i>	Red-throated loon	migrant
Ducks and loons	<i>Somateria spectabilis</i>	King eider	migrant
Ducks and loons	<i>Clangula hyemalis</i>	Long-tailed duck	migrant
Geese and swans	<i>Branta hutchinsii</i>	Cackling goose	migrant
Geese and swans	<i>Anser caerulescens</i>	Snow goose	migrant
Geese and swans	<i>Cygnus columbianus</i>	Tundra swan	migrant
Raptors	<i>Buteo lagopus</i>	Rough-legged hawk	migrant
Raptors	<i>Falco peregrinus</i>	Peregrine falcon	migrant
Raptors	<i>Bubo scandiacus</i>	Snowy owl	migrant
Ptarmigans	<i>Lagopus muta</i>	Rock ptarmigan	resident
Cranes	<i>Antigone canadensis</i>	Sandhill crane	migrant
Shorebirds	<i>Pluvialis dominica</i>	American golden-plover	migrant
Shorebirds	<i>Pluvialis squatarola</i>	Black-bellied plover	migrant
Shorebirds	<i>Charadrius hiaticula</i>	Common-ringed plover	migrant
Shorebirds	<i>Arenaria interpres</i>	Ruddy turnstone	migrant
Shorebirds	<i>Calidris canutus</i>	Red knot	migrant
Shorebirds	<i>Calidris melanotos</i>	Pectoral sandpiper	migrant
Shorebirds	<i>Calidris bairdii</i>	Baird's sandpiper	migrant
Shorebirds	<i>Calidris fuscicollis</i>	White-rumped sandpiper	migrant
Shorebirds	<i>Calidris subruficollis</i>	Buff-breasted sandpiper	migrant
Shorebirds	<i>Phalaropus fulicarius</i>	Red phalarope	migrant
Gulls	<i>Larus hyperboreus</i>	Glauccous gull	migrant
Jaegers	<i>Stercorarius longicaudus</i>	Long-tailed jaeger	migrant
Jaegers	<i>Stercorarius parasiticus</i>	Parasitic jaeger	migrant
Ravens	<i>Corvus corax</i>	Common raven	partial migrant
Passerines	<i>Eremophila alpestris</i>	Horned lark	migrant
Passerines	<i>Anthus rubescens</i>	American pipit	migrant
Passerines	<i>Calcarius lapponicus</i>	Lapland longspur	migrant
Passerines	<i>Plectrophenax nivalis</i>	Snow bunting	migrant
Lemmings	<i>Lemmus trimucronatus</i>	Nearctic brown lemming	resident
Lemmings	<i>Dicrostonyx groenlandicus</i>	Nearctic collared lemming	resident
Hares	<i>Lepus arcticus</i>	Arctic hare	resident
Ermines	<i>Mustela richardsonii</i>	American ermine	resident
Foxes	<i>Vulpes lagopus</i>	Arctic fox	partial migrant

b. Geography

²³³ Our 389 km² study area is located on the southern plain of Bylot Island, Nunavut, Canada
²³⁴ (72.889 N, -79.906 W; **Figure 2**).

c. Habitat

²³⁵ The study area comprises a combination of mesic tundra mainly on hills (64 %), upland
²³⁶ plateaus of sedimentary rock with drier/rockier habitat at higher elevation (20 %), low-
²³⁷ lying wetlands interspersed with ponds (10 %) and larger bodies of water such as lakes
²³⁸ and rivers (6 %).

d. Geology

²⁴¹ See Klassen (1993) for a detailed description of the geology of the study area.

243 **e. Hydrology**

244 Wetlands were delineated by photo-interpretation of high-resolution satellite images (30
245 cm; Louis-Pierre Ouellet, unpublished data), whereas lakes were delineated with aerial
246 photos and rivers with google satellite images, resulting in a coarser delineation.

247 **f. Site history**

248 See Gauthier et al. (2024b,a) for a complete and detailed history of the site.

249 **g. Climate**

250 The mean annual air temperature since 1995 is -14.4°C, with mean seasonal temperature
251 of 4.7°C in summer (June to August), -11°C in fall (September to November), -32.4°C in
252 winter (December to February) and -19.4°C in spring (March to May; Centre of Northern
253 Studies and Laval University (2019)). The climate of the southern plain of Bylot Island
254 is generally milder than that of the surrounding latitudes, as the plain present a southern
255 exposure and the mountains to the north protect the plain from cold northerly winds
256 (Gauthier et al., 2024b). In summer, the study area received on average 77.5 mm of
257 precipitation (Centre of Northern Studies and Laval University, 2019). Additionnally, 102
258 days are frost-free annually on average (Centre of Northern Studies and Laval University,
259 2019) and the study area typically remains free of snow from mid-June to late September
260 (Gauthier et al., 2013).

261 **2. Experimental or sampling design**

262 **a. Permanent plots**

263 The study area is divided into 9 zones based on the sampling method and the level of field
264 effort applied in each zone (**Figure 2**). Long-term monitoring of the community began in
265 the 1990s in the Qarlikturvik valley (Gauthier et al., 2013, 2024b), which represents the
266 zone of the study area with the highest annual sampling effort. Within the Qarlikturvik
267 valley, the sampling is concentrated on the southern side of the glacial river (**Figure 3**),
268 where the main research infrastructure is located. Another zone with extensive sampling
269 efforts is Camp 2, located at the core of the snow goose colony, where the primary focus
270 is to monitor snow goose nests. However, nests of many other avian species are also
271 monitored within and around the colony in this zone. Camp 3, Pointe Dufour, Goose
272 Point, and Malaview are zones where intensive sampling efforts are conducted annually,
273 albeit for a relatively brief period (approximately one week) during the breeding season
274 of most species (Gauthier et al., 2024b). The upland zones in the study area (defined as
275 areas approximately 300 meters above sea level or more) are the Black Plateau, Southern
276 Plateau, and Camp 3 Plateau. These zones are primarily visited to assess raptor nesting
277 activity (Beardsell et al., 2016). The zone between the Qarlikturvik valley and Camp 3
278 received very little sampling effort and is therefore excluded from the study area.

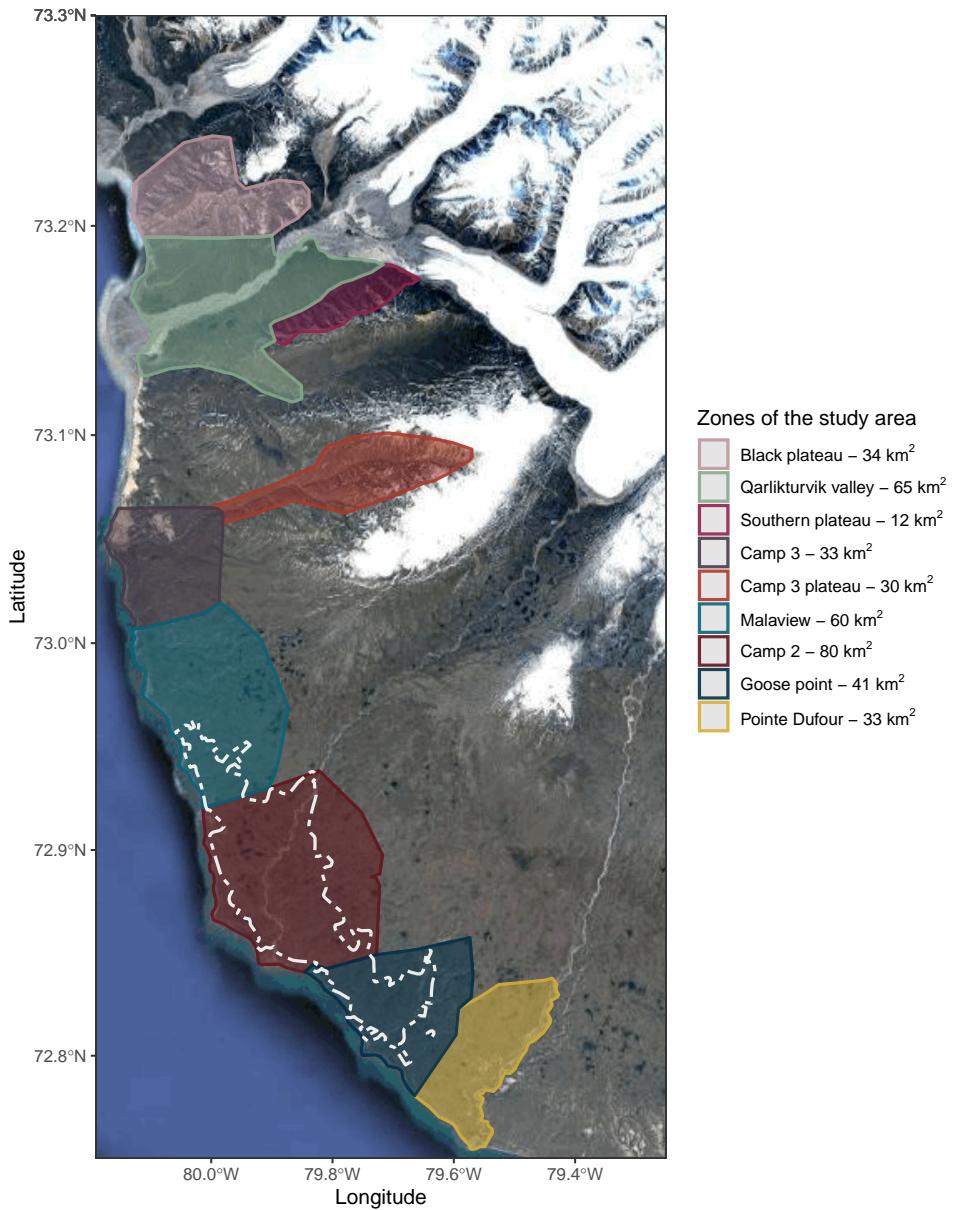


Figure 2: Map of the different zones (colored polygons) of the 389 km² study area located on the south plain of Bylot Island, Nunavut Canada. The perimeter of the snow goose colony is delineated by white dashes; we highlighted the perimeter in 2017 since it represents the average colony area (74 km²).

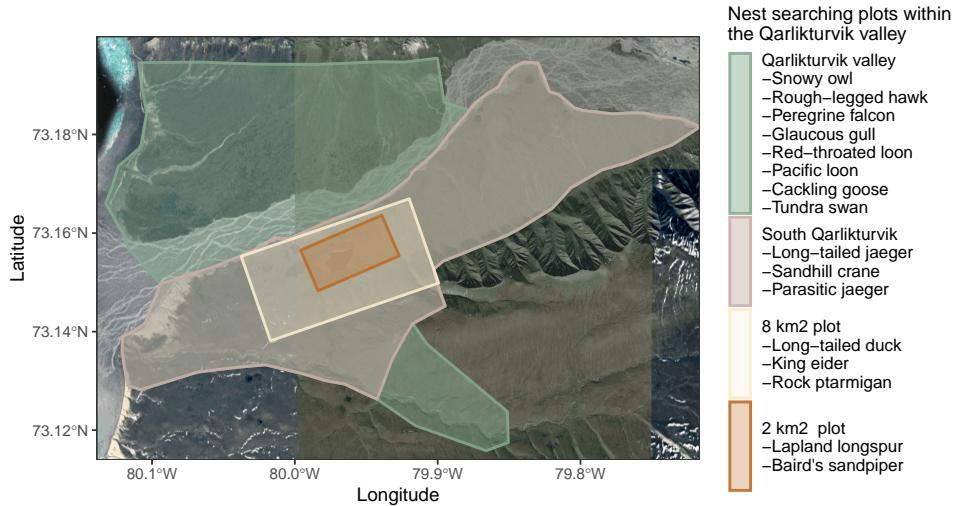


Figure 3: Intensive nests searching plots within the Qarlikturvik valley.

b. Avian nest monitoring

Avian nest monitoring was not conducted in 2020 and 2021 due to logistical constraints imposed by the COVID-19 pandemic. Systematic nest monitoring refers here to a systematic sampling approach aimed at documenting all nests within a specified area. Monitoring is considered opportunistic when there is a chance that some nests might not have been detected within a specific area. Nest densities derived from nest sampling could be underestimated due to early nest failure (i.e., failure that happened before our sampling period).

Pacific loon, red-throated loon, cackling goose, tundra swan and glaucous gull

Since 2004, systematic searches of wetland areas have been conducted on the southern side of the glacial river in the Qarlikturvik valley, and since 2017, in other zones of the study area. This sampling aimed to find all nests of the cackling goose and the glaucous gull. Nest locations of other large wetland-nesting species, including the tundra swan, the red-throated loon and the Pacific loon, were also noted, as these species nest in the same habitat (Duchesne et al., 2021; Gauthier et al., 2024b). Each year, all known or potential nesting sites were revisited. Observers detected nests by walking and scanning around ponds and lakeshores to identify any active nesting sites. These large species can be seen from a relatively long distance sitting on the nest or when flushing from the nest. Most of them (geese, swans and gulls) can also reveal their presence with alarm calls or nest defense displays. We are

Table 2: Summary of vertebrate species monitoring in the Bylot Island study area. In this paper, we excluded certain years for specific species due to reduced sampling efforts. As a result, duration of times series presented here may differ slightly from those in Gauthier et al. (2024b).

Species	Zone	Years	Number of years	Monitoring
Pacific loon	Qarlikturvik valley	2004-2019, 2022	(17)	systematic
Pacific loon	Whole study area	2017-2019, 2022	(4)	systematic
Red-throated loon	Qarlikturvik valley	2004-2019, 2022	(17)	systematic
Red-throated loon	Whole study area	2017-2019, 2022	(4)	systematic
King eider	Qarlikturvik (8 km ² plot)	2005-2019, 2022	(16)	opportunistic
Long-tailed duck	Qarlikturvik (8 km ² plot)	2005-2019, 2022	(16)	opportunistic
Cackling goose	Qarlikturvik valley	2004-2019, 2022-2023	(18)	systematic
Cackling goose	Whole study area	2017-2019, 2022-2023	(5)	systematic
Snow goose	Camp 2	1999-2019, 2022-2023	(23)	systematic
Tundra swan	Qarlikturvik valley	2004-2019, 2022	(17)	systematic
Tundra swan	Whole study area	2017-2019, 2022	(4)	systematic
Rough-legged hawk	Qarlik., Black & South plat.	2007-2019, 2022	(15)	systematic
Rough-legged hawk	Whole study area	2013-2019, 2022	(8)	systematic
Peregrine falcon	Qarlik., Black & South plat.	2007-2019, 2022	(15)	systematic
Peregrine falcon	Whole study area	2013-2019, 2022	(8)	systematic
Snowy owl	Qarlik., Black & South plat.	1996-2019, 2022-2023	(26)	systematic
Snowy owl	Whole study area	2012-2019, 2022-2023	(10)	systematic
Rock ptarmigan	Qarlikturvik (8 km ² plot)	2005-2019, 2022	(16)	opportunistic
Sandhill crane	South Qarlikturvik valley	2004-2019, 2022	(17)	opportunistic
Common-ringed plover	Whole study area	2015-2017	(3)	systematic
Baird's sandpiper	Qarlikturvik (2 km ² plot)	2005-2019, 2022-2023	(17)	systematic
Glaucoous gull	Qarlikturvik valley	2004-2019, 2022	(17)	systematic
Glaucoous gull	Whole study area	2017-2019, 2022	(4)	systematic
Long-tailed jaeger	South Qarlikturvik valley	2004-2019, 2022	(17)	systematic
Parasitic jaeger	South Qarlikturvik valley	2004-2019, 2022	(17)	systematic
Parasitic jaeger	Whole study area	2009-2019, 2022	(12)	opportunistic
Common raven	Whole study area	2013-2019, 2022	(8)	systematic
Lapland longspur	Qarlikturvik (2 km ² plot)	2005-2019, 2022-2023	(17)	systematic
Nearctic brown lemming	Qarlikturvik (trapping grids)	1995-2019, 2021-2022	(27)	systematic
Nearctic collared lemming	Qarlikturvik (trapping grids)	1995-2019, 2021-2022	(27)	systematic
American ermine	Whole study area	1993-2019	(27)	opportunistic
Arctic fox	Whole study area	2008-2016	(9)	systematic

300 confident that nest detection probability was high for these species given the open
 301 landscape.

302 *Snow goose*

303 Snow geese nest in a large colony in the study area (**Figure 2**), but also in small ag-
 304gregations distributed on the island, especially in years when snowy owls are nesting
 305 (Lepage et al., 1996; Reed et al., 2002). Since 1994, goose nests were systematically
 306 monitored on a 0.24 km² wetland at the center of the colony. Since 1999, nests were
 307 also systematically monitored on a variable number of plots, measuring 0.01 km² in
 308 wetland habitat and 0.04 km² in mesic habitat, randomly distributed throughout
 309 the goose colony (Gauthier and Cadieux, 2020b). The total area covered by the
 310 randomly distributed plots averaged 0.79 ± 0.37 km² per year. From 2010 onwards,
 311 except in 2020 and 2021, we opportunistically traced sections of the approximate
 312 boundary of the goose colony using a GPS receiver aboard a helicopter, taking ad-
 313 vantage of regular flights across the study area whenever the flight path passed over
 314 the colony border (Duchesne et al., 2021).

315 ***Rough-legged hawk, peregrine falcon and common raven***

316 Peregrine falcons, rough-legged hawks and common ravens nest on cliffs, near ravines,
317 and on large rocky outcrops and tend to reuse the same nesting sites from one year
318 to the next (Beardsell et al., 2016). Systematic monitoring of every known or poten-
319 tial nesting site has been carried out in the Qarlikturvik valley, Black plateau and
320 Southern plateau since 2007 and throughout the study area since 2013 (Beardsell
321 et al., 2016; Gauthier et al., 2020). Observers walked along ridges and scanned sur-
322 rounding areas from vantage points to detect nesting birds. These large species can
323 be seen from a relatively long distance sitting on the nest or when flushing from the
324 nest. They can also reveal their presence with alarm calls or nest defense displays.
325 We are confident that nest detection probability was high for these species. Each
326 year the observers use slightly different paths to sample the areas, but locate the
327 nests in the same positions, which supports a high probability of detection for these
328 species. Most nesting sites were located in the upland zones of the study area, which
329 include the Black Plateau, Southern Plateau and Camp 3 Plateau.

330 ***Snowy owl***

331 Snowy owls predominantly nest in habitats similar to other raptors, favoring ridges
332 in mountainous or hilly regions, although they can occasionally be found nesting
333 on mounds in lowland areas (Seyer et al., 2020). Since 1996, searches for snowy
334 owl nests have been conducted concurrently with searches for other raptor nests
335 in the Black and Southern plateaus, as well as during searches for jaeger nests
336 on the southern side of the glacial river in the Qarlikturvik Valley. Additionally,
337 since 2012, nests have been recorded across the entire study area by scanning the
338 landscape from hills and ridges during the nesting period (Duchesne et al., 2021).
339 Given that snowy owls nest on elevated mounds, exhibit contrasting colors with the
340 landscape, emit alarm calls, and display defensive behaviors, active nesting sites
341 have a high probability of detection.

342 ***Long-tailed jaeger, parasitic jaeger and sandhill cranes***

343 Since 2004, observers have walked parallel transects spaced 400 meters apart, cov-
344 ering the entire southern side of the glacial river in the Qarlikturvik Valley (33 km^2 ;
345 **Figure 3**), during the nesting period. The aim of those transects was to record nests
346 of long-tailed jaegers, parasitic jaegers, and sandhill cranes. Observers listened for
347 alarm calls to detect territorial birds, and then located nests by observing the birds
348 returning to their nests from elevated vantage points. We consider the sampling to
349 be systematic for long-tailed and parasitic jaeger, since those species tend to leave
350 their nest relatively far from the observer to perform mobbing behavior, and thus
351 increasing their detection probability. We consider the sampling to be opportunistic
352 for sandhill cranes, as individuals display defensive behaviors only at relatively close

353 distances from their nests (see opportunistic nest monitoring below).

354 ***Common-ringed plover***

355 Between 2015 and 2019, observers conducted surveys of the primary nesting areas of
356 the common-ringed plover. The survey involved walking in stony and sandy shores
357 and gravel bars with scarce vegetation along rivers. Nests were found by detecting
358 individuals exhibiting reproductive behaviors, such as incubation, alarm calls, or
359 distraction displays. The sampling effort was particularly intensive between 2015
360 and 2017. Small areas along the coast or on the banks of smaller rivers that could
361 potentially serve as nesting sites may have been overlooked.

362 ***Lapland longspur and Baird's sandpiper***

363 Since 2005, nests of passerines and sandpipers have been extensively monitored
364 across an 8 km² (4x2 km) area in the Qarlikturvik valley. We considered the sam-
365 pling to be most systematic within a core 2 km² (2x1 km) plot in this area (**Figure**
366 **3**). We excluded relatively large water bodies (0.26 km²) to calculate nest density
367 in the plot due to the presence of a large lake, which leaves an area of 1.74 km²
368 available for nesting. An observer conducted systematic searches of this plot during
369 the entire breeding season to locate and monitor as many passerine and shorebird
370 nests as possible. Assuming the observer can detect all nests within a 5 or 10 meter
371 radius, analysis of daily GPS tracks shows that the observer covered a minimum
372 area of 0.72 ± 0.12 (5 m) or 1.09 ± 0.17 km² (10 m) of the core area annually (n=
373 3 years). Additionally, several other observers conducting related field work in the
374 same zone reported all passerine and shorebird nests found opportunistically.

375 ***Opportunistic nest monitoring***

376 Since 2005, we also noted the nest location of any other bird species encountered
377 opportunistically during travel or while carrying out the protocols for the previously
378 described species. The sampling was particularly intensive in the defined 8 km² area
379 in the Qarlikturvik valley. The accuracy of nest monitoring in this plot thus depends
380 on the species detection probability. We are confident to obtain a realistic order of
381 magnitude for the number of nests present for relatively large bodied species in
382 this area (i.e., sandhill crane, rock ptarmigan, long-tailed duck and king eider).
383 Additionally, starting in 2009, a significant effort has been made each year, though
384 not systematically, to visit known nesting territories of parasitic jaegers throughout
385 the study area.

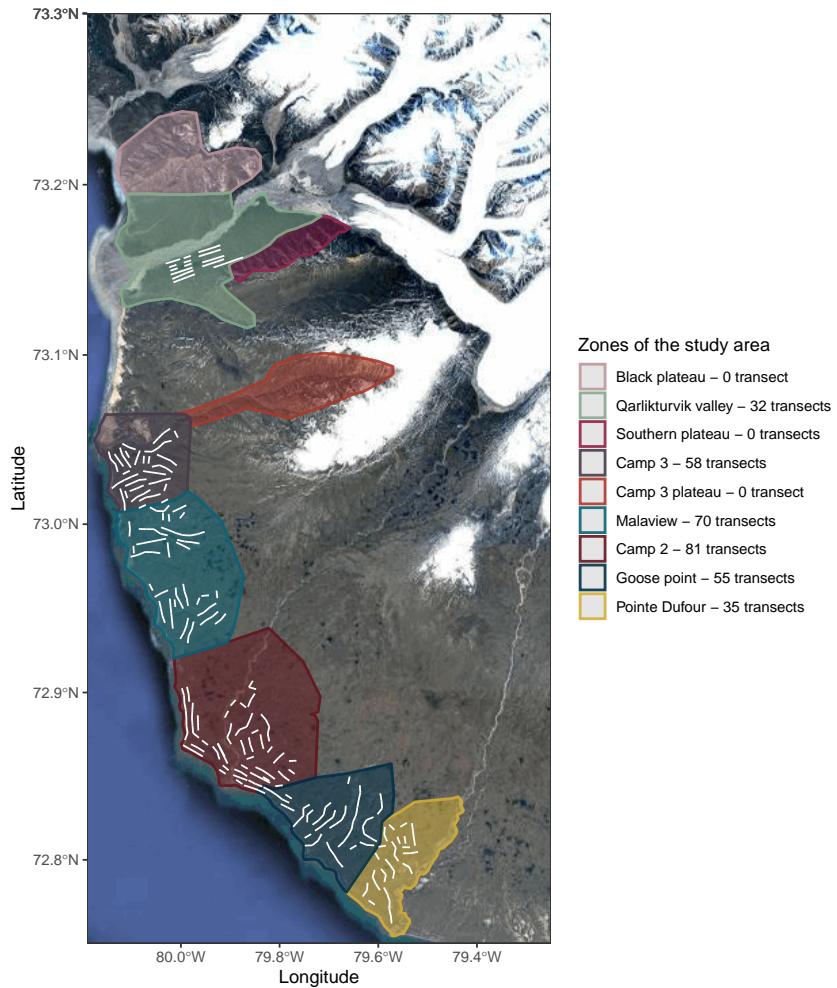


Figure 4: Spatial distribution of vertebrate count transects (white lines) on the south plain of Bylot Island (146 to 320 transects per year).

386 **c. Observation of individuals**

387 ***Vertebrate count transects***

388 From 2010 to 2023, observers walked 500-meter linear transects where all vertebrate
 389 individuals observed within 150 meters on either side were counted (146 to 320
 390 transects per year). Transects were distributed across all lowland zones of the study
 391 area, typically in mesic habitat, and were carried out during the nesting period
 392 (between June 21 and July 14; Duchesne et al. (2021); **Figure 4**). Furthermore,
 393 specifically for American golden-plovers, we measured the distance of each observed
 394 individual to the transect path.

395

396 ***Snow goose point count***

397 At the start, middle, and end of each vertebrate count transect, a point count with a
398 radius of 125 meters was conducted to determine the number of snow goose breeding
399 pairs. On average, 613 ± 142 point counts were sampled each year, covering an area
400 of $30 \pm 7 \text{ km}^2$.

401

402 ***Incidental observations***

403 Since 2007, observers have recorded all vertebrate species observed opportunistically
404 during field work and tallied the total number of individuals at the end of each day
405 (Gauthier and Cadieux, 2020a; Gauthier et al., 2024b). The number of hours spent
406 in the field served as a proxy for the sampling effort. We used the number of indi-
407 viduals observed per hour spent in the field calculated by Gauthier et al. (2024b)
408 as an index of relative abundance for each species. Moreover, we separated obser-
409 vations made in lowland from those in upland zones to have a relative abundance of
410 each species in each of these two broad categories (**Table 3**). Given that inciden-
411 tal observations lacked georeferencing, we opted to extract upland observations by
412 focusing on observations made during visits to rough-legged hawk nests, which are
413 mostly located in uplands.

Table 3: Index of relative abundance (i.e., number of individuals observed per hour) derived from incidental daily observations for selected vertebrate species in lowland (i.e., Qarlikturvik valley, Camp 3, Malaview, Camp 2, Goose point and Pointe Dufour) and upland (i.e., Black plateau, Southern plateau and Camp 3 plateau) zones of the Bylot Island study area. The ratio compares relative abundance indexes between these two types of zones, calculated by dividing the upland by the lowland index of relative abundance.

Species	Individuals/hour		
	Upland	Lowland	Ratio
Rock ptarmigan	0.03	0.03	1
Sandhill crane	0.42	0.287	1.5
American golden-plover	0.26	0.394	0.7
Black-bellied plover	0.02	0.032	0.6
Ruddy turnstone	0.01	0.007	1.3
Red knot	0.00	0.033	0
Pectoral sandpiper	0.02	0.034	0.6
Baird's sandpiper	0.31	0.32	1
White-rumped sandpiper	0.04	0.137	0.3
Buff-breasted sandpiper	0.00	0.001	0
Red phalarope	0.01	0.038	0.2
Horned lark	0.24	0.154	1.6
American pipit	0.34	0.024	14.2
Lapland longspur	1.93	2.641	0.7
Snow bunting	0.59	0.092	6.4
Arctic hare	0.02	0.009	2

414

415 ***Testimonials of ermine sightings***

416 There was no direct estimation of ermine abundance on Bylot Island as they are
417 quite difficult to obtain. The density estimates for ermine were derived from an
418 annual abundance index established by Bolduc et al. (2023), which relied on testi-
419 monials provided by observers across the whole study area from 1993 to 2019. The
420 testimonials provided by observers were used to create an abundance index ranging
421 from 0 to 3 (Bolduc et al., 2023). In this index, a score of 0 corresponds to the
422 absence of ermine sightings, 1 indicates a single sighting of a lone individual, 2 rep-
423 presents multiple sightings of lone individuals, and 3 signifies at least one sighting of
424 a family group. Scores of individual participants were averaged annually as detailed
425 in Bolduc et al. (2023).

426 **d. Capture of individuals**

427 ***Lemming trapping***

428 Since 2004, Nearctic brown and collared lemmings were live-trapped 3 times during
429 the summer (mid-June, mid-July, and mid-August) in two 11 ha grids. Each grid is
430 made of 144 traps separated by 30 m according to a cartesian plane, one in mesic
431 habitat and the other in wet habitat, located in the Qarlikturvik valley (Fauteux
432 et al., 2015; Gauthier, 2020). Density of each species was estimated at each occa-
433 sion using spatially explicit capture-recapture methods (see Fauteux et al. (2015)
434 for details). From 1995 to 2016 snap-trapping was performed once a year (mid-
435 July) along 2 groups of transects located in the same habitats than the trapping
436 grids (Gruyer et al., 2008). Index of abundance derived from snap-trapping were
437 transformed in density estimates in each habitat for the period 1995-2003 using the
438 equation provided by Fauteux et al. (2018) based on the period of overlap between
439 the two sampling methods (2004 to 2016).

441 ***Arctic fox movement tracking***

442 In order to assess fox abundance based on the size of their home range, 109 Arctic
443 foxes were fitted with Argos Platform Transmitter Terminals mounted on collars
444 between 2008 and 2016 (Lai et al., 2015; Christin et al., 2015; Dulude-de Broin
445 et al., 2023). Foxes were captured between May and August across the study area,
446 within and outside the goose colony (Dulude-de Broin et al., 2023). Sampling of
447 animal locations was set for an interval of 1 or 2 days and only locations between
448 May 1 and October 30 were retained (Dulude-de Broin et al., 2023).

450 ***Parasitic jaeger banding***

451 In 2009, a significant effort was made to band as many parasitic jaegers as possible
452 within the study area. This effort resulted in the banding of 17 adult individuals
453 (Therrien and Gauthier, unpublished data).

454 **e. Species body mass**

455 All vertebrate individuals captured for marking purposes were systematically weighed:
456 snow goose (G. Gauthier, M.-C. Cadieux and J. Lefebvre, unpublished data), snowy
457 owl (Therrien et al., 2012; Robillard et al., 2018), American-golden plovers (Lamarre
458 et al., 2021), common-ringed plovers (Léandri-Breton et al., 2019), other shorebirds (J.
459 Béty, unpublished data), glaucous gulls (Gauthier et al., 2015), long-tailed jaeger (Seyer
460 et al., 2019), parasitic jaegers (J.-F. Therrien and G. Gauthier, unpublished data), Lap-
461 land longspurs (J. Béty and G. Gauthier, unpublished data), lemmings (Gauthier, 2020),
462 American ermine (Bilodeau and Bolduc, unpublished data) and Arctic foxes (Lai et al.,
463 2015). When not available, we extracted mean body mass from the literature (Wilman
464 et al., 2014).

465 **3. Research methods**

466 **a. Field/laboratory**

467 We estimated the abundance of breeding individuals for most species, but there were
468 a few exceptions. For common ravens, parasitic jaegers, long-tailed ducks, and king
469 eiders, we suspect the presence of a significant number of non-breeding individuals in the
470 study area. Therefore, the estimates we provided for these species include both breeding
471 and potentially non-breeding individuals. Additionally, we did not distinguish between
472 breeding and non-breeding individuals for mammals such as brown and collared lemmings,
473 Arctic fox, American ermine, and Arctic hare. The methods used for each species are
474 summarized in (**Table 4**).

475 ***Pacific loon, red-throated loon, cackling goose, tundra swan and glau-***
476 ***cous gull***

477 Based on the systematic and intensive search for the glaucous gull, cackling goose,
478 tundra swan, red-throated loon and Pacific loon nests in wetlands, we are con-
479 fident that we have found nearly all nests across the study area from 2017 to 2019
480 and in 2022. We observed a relatively strong correlation between the nest density
481 of glaucous gulls in the Qarlikturvik valley and the nest density across the entire
482 study area ($R^2 = 0.7$, $p = 0.16$, $n = 4$). Consequently, we estimated the density of
483 glaucous gulls at the scale of the study area between 2004 and 2016 based on the
484 nest density in the Qarlikturvik valley ($y = 0.12409x + 0.13774$). However, we did
485 not observe such strong relationships for loons and swans and thus we did not ex-
486 tend the time series. Regarding cackling geese, we observed signs of an exponential
487 increase over time based on the annual number of nests found in various zones of the
488 study area. We thus fitted an exponential model using the number of nests found
489 annually over two distinct periods: in 1996 when the first nest was discovered, and
490 then from 2017 to 2023 when sampling effort was systematic across the whole study
491 area (**Figure 5**). We used the fitted model to estimate abundance between 1996
492 and 2016 when monitoring was less systematic, which could potentially underesti-
493 mate observed abundance as seen on **Figure 5**. We multiplied nest density by two
494 to obtain the abundance (assuming two individuals per nest).

495 ***Snow goose***

496 Between 1999 and 2023, we assessed the abundance of snow geese in the study area
497 through a multi-step process. We calculated the mean annual density of snow goose
498 nests separately in the mesic and wetland habitats of the area occupied by the
499 goose colony annually. We made slight adjustments to the goose colony perimeter
500 defined from helicopter flights to include all snow goose point counts where at least

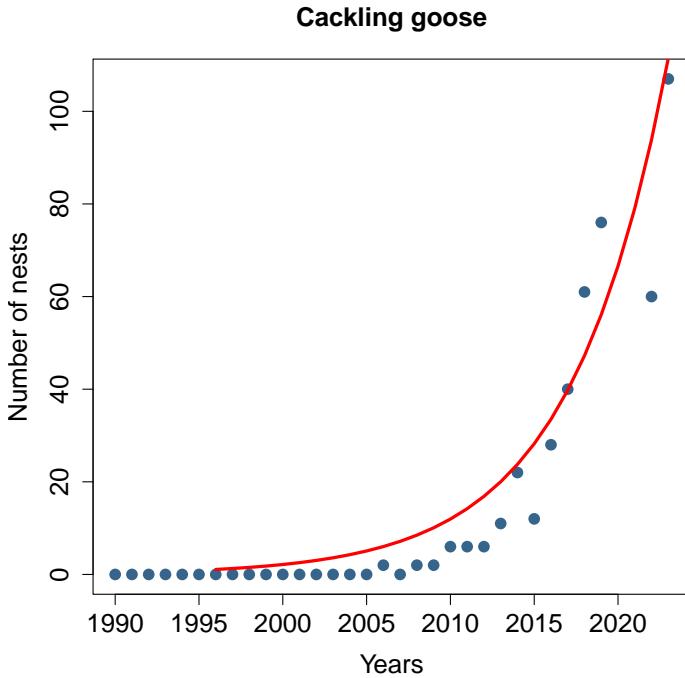


Figure 5: Number of cackling goose nests found across the study area over time. The red line represents the fitted model over the period 1996-2023 ($y = e^{0.1717x - 342.684}$), which was used to estimate the annual abundance of cackling goose between 1996 and 2016. The model presents a strong visual fit with the number of nests found between 2017 and 2023, when nest monitoring was systematic across the study area.

one breeding pair had been observed (**Figure 6**). To determine the mean density of nesting geese in wetlands, we divided two times (assuming two individuals per nest) the total number of nests found during systematic nest searches by the total area of wetlands sampled. The density of geese nesting in mesic habitat, a less preferred nesting habitat (Lecomte et al., 2008), was averaged from three independent methods: systematic nest searches, vertebrate count transects, and snow goose point counts. Systematic nest searches were highly precise, but covered a relatively small area, whereas transects and snow goose point counts were less precise but covered larger areas. For each method, we calculated the mean density of breeding individuals in mesic habitat by dividing the number of birds (or nests) recorded by the area sampled. Despite methodological differences, the three approaches showed similar inter-annual variations, supporting the use of a mean values to estimate nest density in mesic habitat **Figure 7**). Lastly, to transform the densities in total abundance, we determined the annual proportion of wetland and mesic habitats within the goose colony and multiplied the area of each habitat by the density of breeding individuals. For the period 1999 to 2009, we used the average limits of the colony over the period 2010 to 2023 because we did not conduct aerial survey of the colony. Moreover, nest density in the mesic habitat was derived from a single

method (**Figure 7**).



Figure 6: Map showing the region occupied by the snow goose colony in 2017 (green polygon) as an example. The perimeter was first defined opportunistically using a GPS receiver aboard a helicopter, taking advantage of regular flights across the study area whenever the flight path passed over the colony border. The perimeter was then slightly adjusted to include all snow goose point counts where at least one breeding pair had been observed in that year (green dots). Snow goose point counts where no breeding geese were observed in that year are presented as red dots.

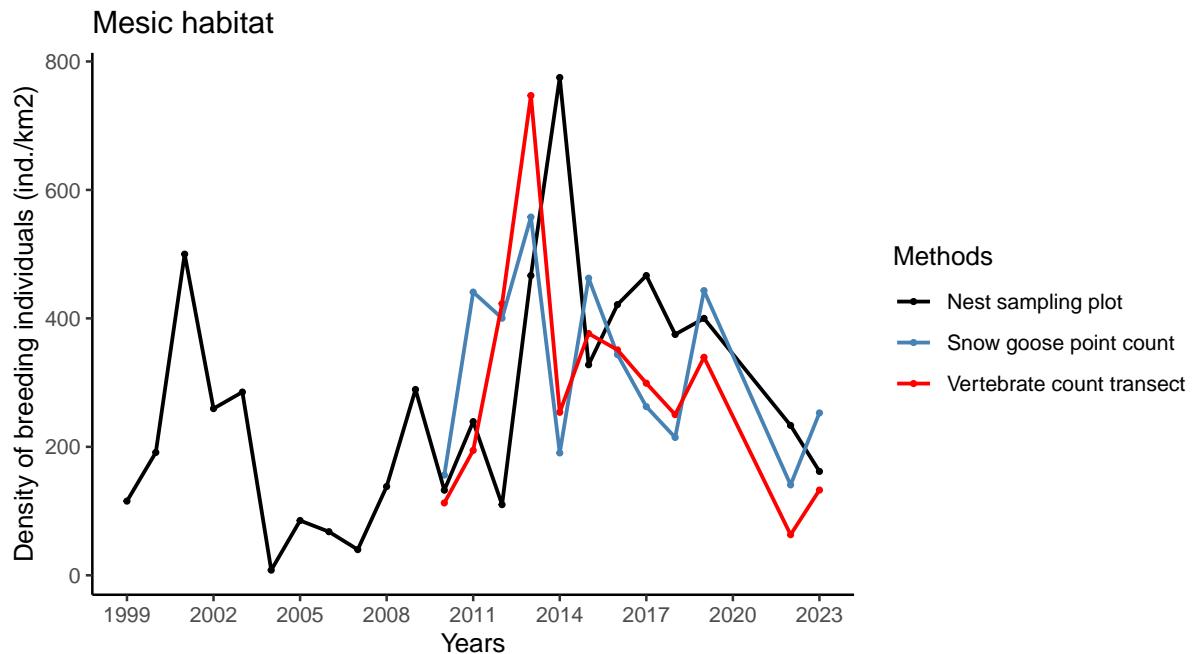


Figure 7: Estimates of breeding goose density in mesic habitat within the Blyot Island snow goose colony using three independent methods: Nest sampling plot, Snow goose point count, Vertebrate count transect.

520 *King eider and long-tailed duck*

521 We first estimated the abundance of both king eiders and long-tailed ducks based on
 522 the annual nest density of each species found in the 8 km² extensive nest search area
 523 located in the Qarlikturvik valley. We extrapolated the mean nest density in the
 524 wetlands of the Qarlikturvik valley to the wetlands of the study area (38.35 km²).
 525 We transformed nest density to abundance of breeding individuals by multiplying
 526 it by a factor of two (assuming two individuals per nest). We acknowledge that the
 527 opportunistic monitoring of these species likely underestimated their true nest den-
 528 sity. However, considering the extensive sampling effort deployed annually within
 529 this area, we are confident to obtain a realistic order of magnitude for the number
 530 of nests present. Because duck sightings are frequent throughout the breeding pe-
 531 riod, yet only a few nests are found, we believe there may be a significant portion
 532 of non-breeding individuals. Therefore, we employed an additional method to es-
 533 timate the overall duck populations without differentiating between breeding and
 534 non-breeding individuals. As an alternative approach, we estimated the abundance
 535 of ducks based on the indices of relative abundance (i.e., the number of individuals
 536 observed per 100 hours) presented by Gauthier et al. (2024b). We assumed that the
 537 ratios between relative and actual abundance are the same (i.e., similar detection
 538 probability) in duck and loon species. We therefore derived the absolute abundance
 539 of long-tailed ducks and king eiders from their relative abundances using the ratio
 540 between relative and absolute abundances of red-throated loons as a reference.

541 ***Rough-legged hawk, peregrine falcon and snowy owl***

542 We estimated the abundance of breeding rough-legged hawks, peregrine falcons and
543 snowy owls based on systematic nest monitoring conducted throughout the study
544 area for these species. To convert the number of nests into breeding abundance,
545 we multiplied it by two (assuming two individuals per nest). For snowy owls, we
546 extended the time series from 1996 to 2011 based on a linear regression between
547 nest density in the Qarlikturvik valley and nearby plateaus (Black and Southern
548 plateaus) and nest density across the entire study area ($y = 0.68867x - 0.00173$;
549 $R^2 = 0.98$; $p < 0.0001$, $n = 10$). We used the same approach for rough-legged hawks
550 ($y = 0.49851x$, $R^2 = 0.99$, $p < 0.0001$, $n = 8$) to extend the time series from 2007 to
551 2012. We did not extend the time series for peregrine falcons because the correlation
552 is not as strong ($R^2 = 0.20$, $p = 0.27$, $n = 8$).

553 ***Rock ptarmigan***

554 We estimated the abundance of rock ptarmigans based on the annual nest density
555 measured in the 8 km² extensive nest search area of the Qarlikturvik valley. While we
556 acknowledge that the opportunistic monitoring of this species likely underestimates
557 nest density, the extensive sampling effort deployed annually within this area gives
558 us confidence in obtaining a realistic number of nests. We then extrapolate the
559 density to the whole study area, without distinction between mesic, wetland and
560 upland habitats (**Table 3**). Among the 6 nests found in the study area, 4 were
561 located in mesic habitat, while one nest was found in a wetland and another in
562 an upland habitat. To convert the number of nests into breeding abundance, we
563 multiplied it by two (assuming two individuals per nest).

564 ***Sandhill crane***

565 We determined the mean nest density of sandhill cranes from the nest sampling
566 between 2004 and 2023 on the southern side of the glacial river in the Qarlikturvik
567 valley. We determined mean nest density by dividing the mean annual number
568 of nests recorded by the area of the surveyed zone (33 km²). We estimated total
569 abundance by multiplying mean nest density by the total area of the study area.
570 We assumed a uniform density across the study area, as sandhill crane nests have
571 been observed in wetland, mesic, and upland habitats.

572 ***American golden-plover and black-bellied plover***

573 We used a distance sampling approach to estimate the abundance of American
574 golden-plovers in the lowland zones of the study area between 2014 and 2023. Ob-
575 servations of plovers were made along vertebrate count transects mainly in mesic
576 habitat. Perpendicular distance between detected individuals and the transect path
577 were used ($n = 1015$) to estimate a detection function with the *ds* function from

578 the *Distance* package (Miller et al., 2019). To determine the detection function, we
579 applied a truncation distance of 150 m (i.e., maximum distance on either side of
580 the observer where observations have been considered) and selected the model with
581 the lowest AIC, which included a "hn" key and a single "cos" adjustment term. We
582 excluded observations of groups with more than four individuals, as these likely in-
583 dicated groups of non-breeders. We did not estimate abundance in wetland habitat
584 because American golden-plovers nest almost exclusively in mesic habitat (Parmelee
585 et al., 1967). We estimated the abundance in the upland zones (i.e., plateaus) by
586 applying a correction factor to the abundance in lowland zones. This correction
587 factor was based on the relative abundance ratio between the upland and lowland
588 zones (**Table 3**).

589 To determine the abundance of black-bellied plovers, we used the mean number of
590 black-bellied plovers and American golden-plovers observed per transect as an index
591 of relative abundance. We assumed that the ratios between relative and actual
592 abundance are the same (i.e., similar detection probability) among those species.
593 This assumption is realistic as those species present similarities in size, color, and
594 reproductive behavior. We therefore derived the absolute abundance of black-bellied
595 plovers from their relative abundance using the ratio between relative and absolute
596 abundances of American golden-plover as a reference. As an alternative approach to
597 determine black-bellied plover abundance, we used the same approach as previously
598 described, but with the indices of relative abundance presented by Gauthier et al.
599 (2024b), which was derived from incidental daily observations.

600 ***Common-ringed plover***

601 To estimate the abundance of common-ringed plovers in the study area, we relied
602 on the total number of nests recorded annually from 2015 to 2017, during which
603 the primary nesting sites underwent intensive sampling. We multiplied the total
604 nest count by two to represent the abundance of breeding individuals (assuming
605 two individuals per nest).

606 ***Lapland longspur and Baird's sandpiper***

607 We estimated the mean abundance of Lapland longspurs in the different lowland
608 zones of the study area based on a relation between nest density and the number of
609 individuals observed per transect (**Figure 8**). For Baird's sandpiper, we employed a
610 similar approach, but instead of using the mean number of individuals observed per
611 transect, we used the mean proportion of transects where at least one individual
612 was detected. We made this adjustment because this species was less frequently
613 observed. In this relationship, nest density for these two species came from the
614 intensive nest sampling conducted within the core 2 km² area of the Qarlikturvik

615 valley and observations of individuals from transects carried out in the larger 8 km²
 616 area in which the core area was located (**Figure 3**). This approach allowed us to
 617 incorporate a larger sample size from the transects while focusing on a measure
 618 of nest density determined systematically. Transects observations in lowland were
 619 then converted into nest density using the regressions equation, and then in total
 620 number of individuals by multiplying by the area and a factor 2. We estimated
 621 the density of both species in the upland zones by applying a correction factor to
 622 the annual mean density in lowland zones. This correction factor was based on the
 623 relative abundance ratio between the upland and lowland zones (**Table 3**). We
 624 acknowledge that the relation for Baird's sandpiper is weaker; however, it offers
 625 some refinement compared to assuming a uniform density throughout the study
 626 area.

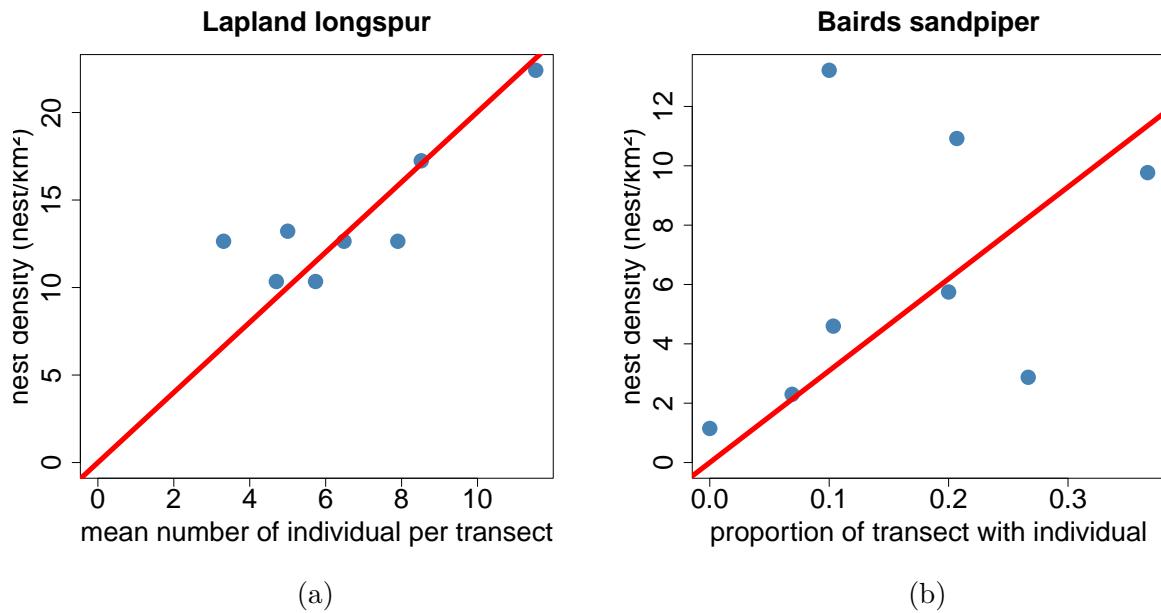


Figure 8: a) The red line shows the linear relation between nest density and the number of individuals observed per transect, described by the equation nest density = $2.0031 \times$ number of individuals per transect. The relation was forced through the origin. Blue dots represent annual values (2014–2019 and 2022–2023) of nest density and mean number of individuals per transect from the core sampled area of the Qarlikturvik Valley. We assumed that the relation between nest density and observations on transects is linear. b) The red line shows the linear relation between nest density and the proportion of transects with at least an individual, described by the equation nest density = $30.9519 \times$ proportion of transects with at least one individual. The relation was forced through the origin. Blue dots represent annual values (2014–2019 and 2022–2023) of nest density and mean proportion of transects with at least an individual from the core sampled area of the Qarlikturvik Valley. We assumed that the relation between nest density and observations on transects is linear.

627

Other passerines and sandpipers

We estimated the abundance of other passerines (horned lark, American pipit, and snow bunting) in the lowland zones of the study area with the regression equation between number of individuals per transect and nest density of the Lapland longspur (see section *Lapland longspur and Baird's sandpiper*). We assumed here a similar detection probability for all species. We used the same approach for other sandpiper species (white-rumped sandpiper, pectoral sandpiper, buff-breasted sandpiper, red knot, ruddy turnstone and red phalarope) based on the regression equation for the Baird's sandpiper (see section *Lapland longspur and Baird's sandpiper*). For all these species, we estimated the density in the upland zones by applying a correction factor to the mean density in lowland zones. This correction factor was based on the relative abundance ratio between the upland and lowland zones (**Table 3**). Nest density was then converted in number of individuals by multiplying by the area and a factor 2. As an alternative approach, we estimated the abundance of other passerines and sandpipers based on the indices of relative abundance (i.e., the number of individuals observed per 100 hours) presented by Gauthier et al. (2024b). We assumed that the ratios between relative and actual abundance are the same (i.e., similar detection probability) among both passerine and sandpiper species. We therefore derived the absolute abundance of other passerine and sandpiper species from their relative abundances using respectively, the ratios between relative and absolute abundances of Lapland longspur (passerines) and Baird's sandpiper (sandpipers) as references.

Long-tailed jaeger

We determined the annual nest density of long-tailed jaegers from the systematic nest sampling between 2004 and 2023 on the southern side of the glacial river in the Qarlikturvik valley. We determined nest density by dividing the annual number of nests recorded by the area of the surveyed zone (33 km^2). As long-tailed jaegers typically nest in mesic habitat (Andersson, 1971), we multiplied the area occupied by mesic habitat across the study area by the nest density obtained in the surveyed zone and by two to obtain the total abundance of breeding individuals (assuming two individuals per nest).

Parasitic jaeger

Based on the opportunistic nest monitoring of parasitic jaegers across the study area, an average of 4 nests is found annually, a small number considering that parasitic jaegers were frequently observed at the study site (Gauthier et al., 2024b). This suggests that there may be non-breeding individuals present at the study site, or alternatively, individuals may regularly travel long distances, potentially from outside the study area, to forage during the breeding season. Due to limited data availability for estimating the abundance of non-breeding parasitic jaegers, we relied

666 on the maximum number of adults banded during a single year (17 individuals in
667 2009; Therrien, unpublished data) as the minimum abundance on the study area.
668 This corresponds to a density of 0.04 individuals/km². For comparison, Taylor
669 (1974) measured a density of 0.06 individual/km² on Bathurst Island.

670 ***Common raven***

671 Despite the intensive nest searches for raptors in upland zones, we never found more
672 than one common raven nest each year, a small number considering the frequent
673 raven observations at the study site (Gauthier et al., 2024b). This indicates the
674 potential presence of non-breeding individuals or individuals that breed outside
675 the study area but use it for foraging throughout the breeding period. Therefore,
676 we opted for alternative approaches based on individual counts to estimate the
677 abundance of both breeding and non-breeding ravens. As a first approach, we based
678 our estimate of ravens on the number of glaucous gulls observed per transect. We
679 assumed that the ratios between relative and actual abundance are the same (i.e.,
680 similar detection probability) among those species. This assumption is reasonable
681 as those species present similarities in size and foraging strategy. We therefore
682 derived the absolute abundance of common ravens from their relative abundance
683 using the ratio between relative and absolute abundances of glaucous gulls as a
684 reference. Independently, we estimated the abundance of common ravens with the
685 same approach but using the indices of relative abundance presented by Gauthier
686 et al. (2024b), which was derived from incidental daily observations, rather than
687 observations from the transects.

688 ***Nearctic brown and collared lemming***

689 Between 1995 and 2003, we used the density estimates derived from the snap-
690 trapping indices obtained in late July in each habitat. Between 2004 and 2007,
691 annual abundance of each lemming species was based on the late-July density esti-
692 mates on trapping grid in wet and mesic habitats. However, starting from 2008, es-
693 timates were derived from the mean density recorded in mid-July and mid-August,
694 except for two instances: 2019 and 2021. In 2019, due to an exceptionally early
695 snowmelt and thus an early decline in lemmings during the summer, we only re-
696 tained value from mid-July. In 2021, we relied solely on data gathered in August
697 because it was the only trapping period carried out that year. To scale the esti-
698 mated densities from the wet and mesic grids to the entire study area, we used the
699 proportions of mesic habitats (64%) and wet habitats (10%) measured within the
700 study area.

701 ***Arctic hare***

702 Arctic hares are primarily observed in the upland zones of the study area, where

sampling effort is limited. We thus derived abundance of hares from the estimated abundance of Arctic foxes based on indices of relative abundance presented in (Gauthier et al., 2024b), which were derived from incidental daily observations. We doubled the density of Arctic hares in the upland zones (i.e., plateaus), as twice as many individuals were observed per hour of fieldwork there compared to lowland zones (**Table 3**). However, it is worth noting that assuming a similar detection probability between foxes and hares might lead to an overestimation of hare detection probability due to behavioral differences between the species. Therefore, we most likely underestimate the actual abundance of Arctic hares in the study area.

American ermine

We estimated the annual abundance of ermines by transforming the annual index of relative abundance provided in Bolduc et al. (2023) into individual density. Annual values ranged from 0, indicating no ermine sighting, to 2.88, which signifies that nearly all observers observed at least one family group during their field season. We independently obtained measures of minimum (0.02 ind./km²) and maximum (0.4 ind./km²) ermine density, which were determined from estimates of individual home range obtained from radio-tracking data, observations on Bylot Island, and existing literature (Legagneux et al., 2012; Bilodeau, 2013). We associated the minimum and maximum scores of relative abundance with the minimum and maximum density of individuals, respectively. Ultimately, we calculated the ermine density by linearly interpolating between these two density extremes using the annual index of relative abundance.

Arctic fox

We estimated the abundance of Arctic foxes in the study area based on their estimated home range size inside and outside the goose colony. We used the data and methodologies outlined in Dulude-de Broin et al. (2023) to estimate home range size. However, here, we did not account for annual variations in lemming density as presented in Dulude-de Broin et al. (2023) in order to obtain mean fox home range. Given that foxes are territorial and exhibit an average spatial overlap with adjacent territories of 18% (Clermont et al., 2021), we converted home range size into individual density using the following formula: $\text{density of individuals} = \frac{2}{0.82 \times \text{home range}}$. We used two as numerator because we assumed each territory was held by a pair of fox, either breeding or non-breeding fox pair, without accounting for potential nomadic or transient individuals. We used values of 12.26 km² to represent the mean home range of foxes within the goose colony and 20.02 km² for foxes outside the goose colony. We estimated the mean density of foxes in each zone of the study area according to the mean proportion of the zone covered by the goose colony. We derived the mean annual proportion of each zone covered by the goose colony from

741 the colony outline between 2010 and 2023. We estimated a mean density of 0.14
742 individuals/km² for the study area. Previously, the minimum density of foxes in the
743 study area was estimated to be between 0.03 and 0.13 individuals per km² based on
744 camera traps (Royer-Boutin, 2015).

Table 4: Summary of the lowest, highest, mean and standard deviation of the estimated abundance of each vertebrate species in the vertebrate community of the southern plain of Bylot Island (389 km²). In some cases, two independent approaches have been used to estimate the abundance of the same species as a proxy for uncertainty. We provide a qualitative measure of the method quality based on data available, method used for extrapolation (if necessary), and in some cases, from the fit of statistical models to estimate density. The star (*) refers to the estimate of breeding individuals only.

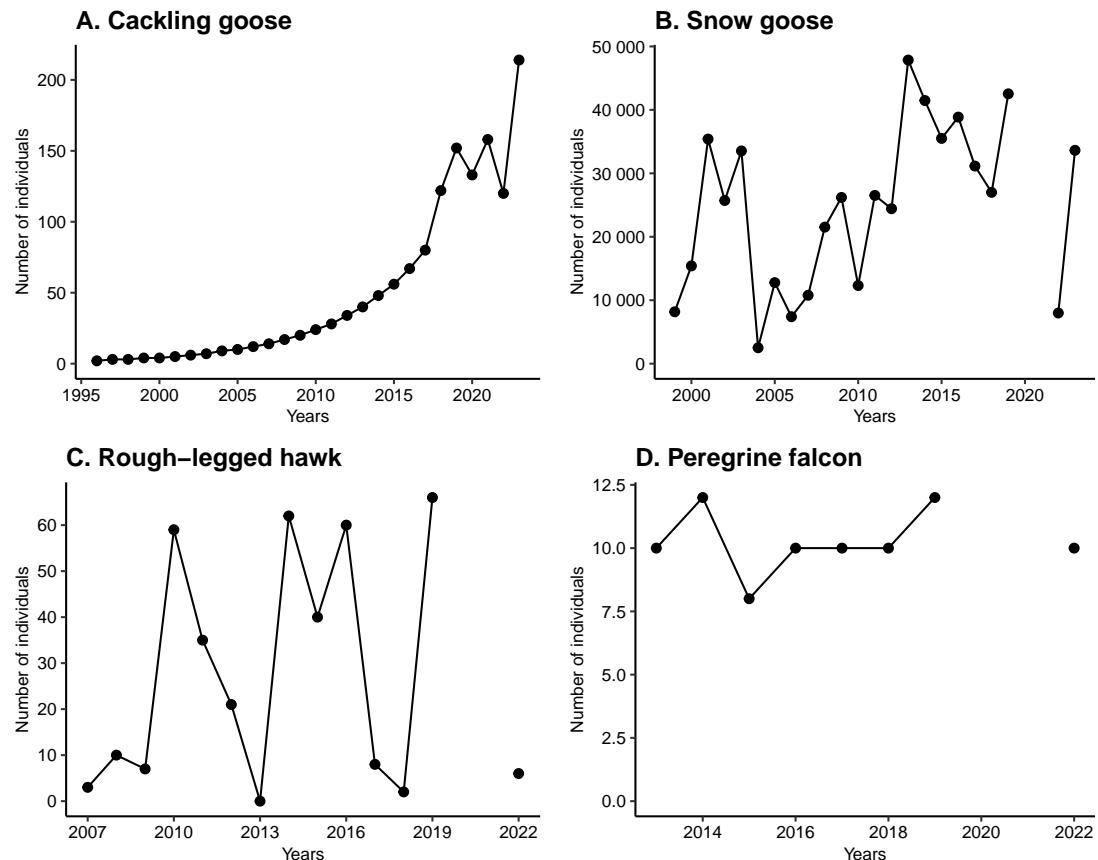
Species	Method	Method quality	Justification	Lowest abundance	Highest abundance	Mean abundance	sd	n
Pacific loon	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	0*	6*	4*	3	4 (2017-2019, 2022)
Red-throated loon	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	42*	76*	64*	15	4 (2017-2019, 2022)
King eider	Intensive, but opportunistic nest monitoring (8 km ²) extrapolated by habitat	very low	Intensive, but opportunistic monitoring at relatively small spatial scale, but does not include potential non-breeding individuals			25*		
King eider	Derived from the abundance estimate of red-throated loon using incidental observations	low	Derived from high quality estimate of another species			106		
Long-tailed duck	Intensive, but opportunistic nest monitoring (8 km ²) extrapolated by habitat	very low	Intensive, but opportunistic monitoring at relatively small spatial scale, but does not include potential non-breeding individuals			20*		
Long-tailed duck	Derived from the abundance estimate of red-throated loon using incidental observations	low	Derived from high quality estimate of another species			191		
Cackling goose	Extrapolation from exponential model of growth (strong visual fit with empirical data)	moderate	Strong correlation with opportunistic nest monitoring	2*	158*	31*	41	23 (1996-2016, 2020-2021)
Cackling goose	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	80*	214*	138*	50	5 (2017-2019, 2022-2023)
Snow goose	Nest monitoring plots extrapolated to mean goose colony area	moderate	Relatively small sample size and uncertainty on goose colony area	2505*	35404*	18129*	11037	11 (1999-2009)
Snow goose	Intensive study area-wide monitoring based on a combination of methods (transects, point counts and nest monitoring plots) and annual colony outline	high	Multiple independent methods and annual colony outline	7982*	47859*	30771*	11962	12 (2010-2019, 2022-2023)
Tundra swan	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	0*	2*	1*	1	4 (2017-2019, 2022)
Rough-legged hawk	Extrapolation from intensive nest monitoring (111 km ² , R ² =0.99, p<0.0001, n=8)	high	Strong correlation with study area-wide nest density	3*	59*	22*	21	6 (2007-2012)
Rough-legged hawk	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	0*	66*	30*	29	8 (2013-2019, 2022)

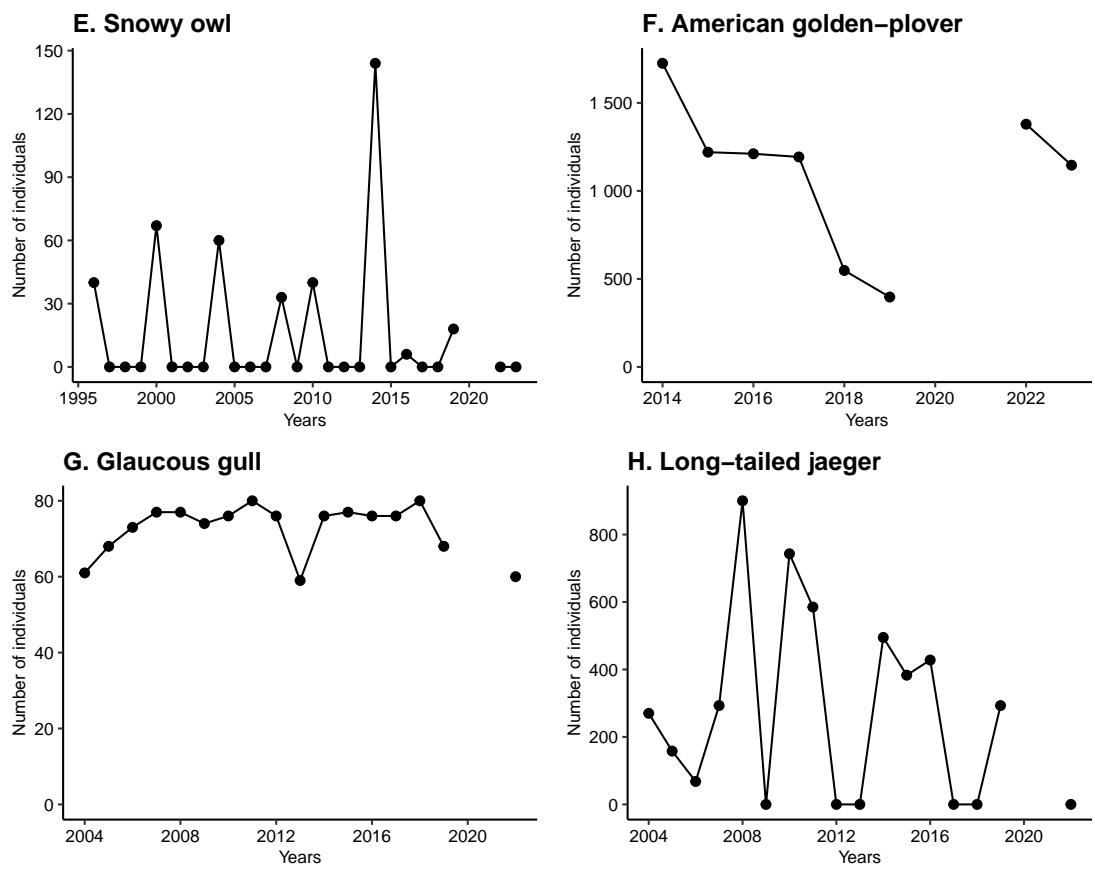
Peregrine falcon	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	8*	12*	10*	1	8 (2013-2019, 2022)
Snowy owl	Extrapolation from intensive nest monitoring (111 km ² , R ² =0.98, p<0.0001, n=10)	high	Strong correlation with study area-wide nest density	0*	67*	15*	24	16 (1996-2011)
Snowy owl	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	0*	144*	17*	45	10 (2012-2019, 2022-2023)
Rock ptarmigan	Intensive, but opportunistic nest monitoring (8 km ²) extrapolated to study area	very low	Intensive, but opportunistic monitoring at relatively small spatial scale and prime nesting habitat not well sampled			24*		
Sandhill crane	Intensive nest monitoring (33 km ²) extrapolated to study area	moderate	Nest density is extrapolated uniformly across the study area			36*		
American golden-plover	Distance sampling throughout lowland (313 km ²)	high	Large sample size	397*	1725*	1102*	432	8 (2014-2019, 2022-2023)
Black-bellied plover	Derived from the abundance estimate of American golden-plover using transects observations	low	Derived from high quality estimate of another species			29*		
Black-bellied plover	Derived from the abundance estimate of American golden-plover using incidental observations	very low	Derived from high quality estimate of another species, but potentially includes transient migratory individuals			87*		
Common-ringed plover	Nest monitoring on the main breeding sites	moderate	Intensive monitoring, but not exhaustive to study area	44*	62*	55*	9	3 (2015-2017)
Ruddy turn-stone	Derived from the abundance estimate of Baird's sandpiper using transects observations	low	Derived from moderate quality estimate of another species			36*		
Ruddy turn-stone	Derived from the abundance estimate of Baird's sandpiper using incidental observations	very low	Derived from moderate quality estimate of another species, but potentially includes transient migratory individuals			47*		
Red knot	Derived from the abundance estimate of Baird's sandpiper using transects observations	low	Derived from moderate quality estimate of another species			59*		
Red knot	Derived from the abundance estimate of Baird's sandpiper using incidental observations	very low	Derived from moderate quality estimate of another species, but potentially includes transient migratory individuals			206*		
Pectoral sandpiper	Derived from the abundance estimate of Baird's sandpiper using transects observations	low	Derived from moderate quality estimate of another species			71*		

Pectoral sandpiper	Derived from the abundance estimate of Bairds sandpiper using incidental observations	very low	Derived from moderate quality estimate of another species, but potentially includes transient migratory individuals			226*		
Baird's sandpiper	Extrapolation from intensive nest monitoring (2 km ²) and transects observations	moderate	Uncertain relation between nest density and transects observations			2170*		
White-rumped sandpiper	Derived from the abundance estimate of Bairds sandpiper using transects observations	low	Derived from moderate quality estimate of another species			878*		
White-rumped sandpiper	Derived from the abundance estimate of Bairds sandpiper using incidental observations	very low	Derived from moderate quality estimate of another species, but potentially includes transient migratory individuals			1005*		
Buff-breasted sandpiper	Derived from the abundance estimate of Bairds sandpiper using transects observations	low	Derived from moderate quality estimate of another species			5*		
Buff-breasted sandpiper	Derived from the abundance estimate of Bairds sandpiper using incidental observations	very low	Derived from moderate quality estimate of another species, but potentially includes transient migratory individuals			7*		
Red phalarope	Derived from the abundance estimate of Bairds sandpiper using transects observations	low	Derived from moderate quality estimate of another species			124*		
Red phalarope	Derived from the abundance estimate of Bairds sandpiper using incidental observations	very low	Derived from moderate quality estimate of another species, but potentially includes transient migratory individuals			240*		
Glaucous gull	Extrapolation from intensive nest monitoring (111 km ² , R ² =0.7, p=0.16, n=4)	high	Strong correlation with study area-wide nest density	59*	80*	73*	6	13 (2004-2016)
Glaucous gull	Intensive study area-wide nest monitoring (389 km ²)	high	No extrapolation	60*	80*	71*	9	4 (2017-2019, 2022)
Long-tailed jaeger	Intensive nest monitoring (33 km ²) extrapolated by habitat	high	Relatively large spatial coverage of sampling	0*	900*	272*	285	17 (2004-2019, 2022)
Parasitic jaeger	Maximum number of individuals banded in a year	low	Based on a single year and potentially not all individuals were captured			17		
Parasitic jaeger	Maximum number of nest found annually during study area-wide opportunistic nest monitoring	very low	Monitoring does not include potential non-breeding individuals			8*		
Common raven	Derived from the abundance estimate of glaucous gull using transects observations	very low	Derived from moderate quality estimate of another species, but potential difference in detectability between species			14		

Common raven	Derived from the abundance estimate of glaucous gull using incidental observations	very low	Derived from moderate quality estimate of another species, but potential difference in detectability between species			18		
Horned lark	Derived from the abundance estimate of Lapland longspur using transects observations	low	Derived from moderate quality estimate of another species			310*		
Horned lark	Derived from the abundance estimate of Lapland longspur using incidental observations	low	Derived from moderate quality estimate of another species			352*		
American pipit	Derived from the abundance estimate of Lapland longspur using transects observations	very low	Derived from moderate quality estimate of another species and prime nesting habitat not sampled			46*		
American pipit	Derived from the abundance estimate of Lapland longspur using incidental observations	low	Derived from moderate quality estimate of another species and prime nesting habitat not well sampled			74*		
Lapland longspur	Extrapolation from intensive nest monitoring (2 km ²) and transects observations	moderate	Uncertain relation between nest density and transects observations			6080*		
Snow bunting	Derived from the abundance estimate of Lapland longspur using transects observations	very low	Derived from moderate quality estimate of another species and prime nesting habitat not sampled			15*		
Snow bunting	Derived from the abundance estimate of Lapland longspur using incidental observations	low	Derived from moderate quality estimate of another species and prime nesting habitat not well sampled			236*		
Nearctic brown lemming	Rigorous density estimates at small spatial scale (0.22 km ²) extrapolated by habitat	moderate	Intensive sampling, but small spatial coverage and extrapolation by habitat	0	447630	54043	93530	27 (1995-2019, 2021-2022)
Nearctic collared lemming	Rigorous density estimates at small spatial scale (0.22 km ²) extrapolated by habitat	moderate	Intensive sampling, but small spatial coverage and extrapolation by habitat	0	39302	8128	10334	27 (1995-2019, 2021-2022)
Arctic hare	Derived from the abundance estimate of Arctic fox using incidental observations	very low	Derived from moderate quality estimate of another species, prime nesting habitat not well sampled and difference in detectability between species			6		
American ermine	Indices of relative abundance derived from testimonials converted to abundance using home range size	moderate	Indirect indices and uncertainty on ermine home range size estimates	8	156	40	37	27 (1993-2019)
Arctic fox	Derived from extensive fox home range size studies (n=109)	moderate	Indirect indices, but large sample size			53		

Figure 9: Time series of the estimated annual abundance of vertebrate species on the southern plain of Bylot Island (389 km^2). Estimated abundance represents adult individuals, with the exception of lemmings, for which juveniles were also included in the estimate. Time series shorter than 5 years are not presented.





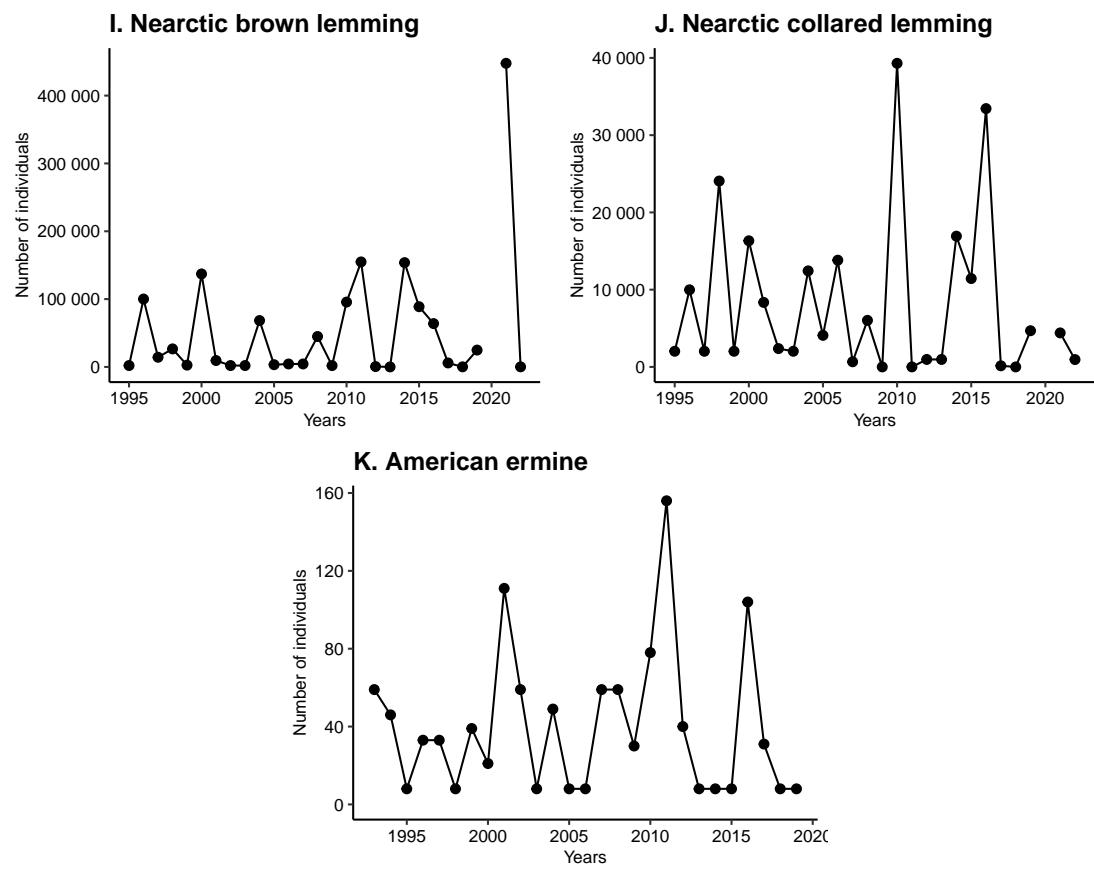


Table 5: Due to the absence of confidence intervals in our abundance estimates, we present uncertainty intervals based on field expert judgment. Experts derived these intervals by considering the given abundance estimate, estimates for other species for comparaison, and their field expertise. For species with time series data (several years of estimates), the intervals are presented for the lowest and highest abundance reached within the given time series. These intervals reflect the interval within which the actual abundance lies according to field experts. For species without time series, the intervals are presented for the mean only.

Species	Period	Annual abundance (individuals)		
		Lowest	Highest	Mean
Pacific loon	2017-2019, 2022	[0-6]	[6-10]	
Red-throated loon	2017-2019, 2022	[42-62]	[75-100]	
King eider	Mean abundance			[60-250]
Long-tailed duck	Mean abundance			[80-300]
Cackling goose	1996-2016, 2020-2021	[2-10]	[58-220]	
Cackling goose	2017-2019, 2022-2023	[80-110]	[214-244]	
Snow goose	1999-2009	[2500-10000]	[35000-60000]	
Snow goose	2010-2019, 2022-2023	[6000-10000]	[45000-60000]	
Tundra swan	2017-2019, 2022	[0-2]	[2-6]	
Rough-legged hawk	2007-2012	[0-8]	[50-90]	
Rough-legged hawk	2013-2019, 2022	[0-4]	[66-86]	
Peregrine falcon	2013-2019, 2022	[8-12]	[12-20]	
Snowy owl	1996-2011	0	[50-100]	
Snowy owl	2012-2019, 2022-2023	0	[144-170]	
Rock ptarmigan	Mean abundance			[10-60]
Sandhill crane	Mean abundance			[15-45]
American golden-plover	2014-2019, 2022-2023	[300-600]	[1000-2500]	
Black-bellied plover	Mean abundance			[6-30]
Common-ringed plover	2015-2017	[44-60]	[60-100]	
Ruddy turnstone	Mean abundance			[10-30]
Red knot	Mean abundance			[10-30]
Pectoral sandpiper	Mean abundance			[20-100]
Baird's sandpiper	Mean abundance			[1500-3500]
White-rumped sandpiper	Mean abundance			[1000-2000]
Buff-breasted sandpiper	Mean abundance			[2-10]
Red phalarope	Mean abundance			[20-80]
Glaucous gull	2004-2016	[50-80]	[70-100]	
Glaucous gull	2017-2019, 2022	[60-80]	[80-100]	
Long-tailed jaeger	2004-2019, 2022	[0-10]	[300-900]	
Parasitic jaeger	Mean abundance			[15-50]
Common raven	Mean abundance			[30-75]
Horned lark	Mean abundance			[200-600]
American pipit	Mean abundance			[50-300]
Lapland longspur	Mean abundance			[6000-10000]
Snow bunting	Mean abundance			[50-300]
Nearctic brown lemming	1995-2019, 2021-2022	[100-2000]	[200000-450000]	
Nearctic collared lemming	1995-2019, 2021-2022	[100-2000]	[20000-50000]	
Arctic hare	Mean abundance			[15-50]
American ermine	1993-2019	[0-10]	[50-200]	
Arctic fox	Mean abundance			[30-60]

745

b. Taxonomy and systematics

746 Birds taxonomy was obtained from the IOC World Bird List 14.2 (Gill et al., 2024) and
747 mammals taxonomy from the Mammal species of the world: a taxonomic and geographic
748 reference (Upham et al., 2024).

749

c. Permit history

750 All research involving animals on Bylot Island has been approved by an institutional
751 Animal Care Committee. In 1999, the study area became part of Sirmilik National Park,
752 managed by Parks Canada. Since then, all research activities in the park have been
753 approved by a Joint Park Management Committee.

754

d. Project personnel

755

Principal and associated investigators

756 Gilles Gauthier, Austin Reed, Jean-François Giroux, Dominique Berteaux, Joël
757 Béty, Josée Lefebvre, Dominique Gravel, Jean-François Therrien, Nicolas Lecomte,
758 Dominique Fauteux, Pierre Legagneux (see Gauthier et al. (2024a))

759

Students

760 By combining animal and plant ecology, 24 doctoral theses and 56 master theses
761 have been completed in relation to the study area located on the south plain of
762 Bylot Island (see Gauthier et al. (2024a)).

763 **Class III. Data set status and accessibility**

764 **A. Status**

765 **1. Latest update**

766 November 8, 2024

767 **2. Latest archive date**

768 November 8, 2024

769 **3. Metadata status**

770 November 8, 2024

771 **4. Data verification**

772 The methods employed to estimate species abundance were subject to several rounds of
773 revision by the authors.

774 **B. Accessibility**

775 **1. Storage location and medium**

776 The complete data set will be published as supporting information should the manuscript
777 be accepted for publication. Metadata document, raw data and codes will also be archived
778 in Dryad.

779 **2. Contact persons**

780 ***Overall project***

781 Joël Béty; *joel_bety@uqar.ca*; 418 723-1986 #1701; 300 allée des Ursulines, Ri-
782 mouski, Québec, Canada, G5L 3A1, Office B-002

783 ***Specific subproject description***

784 Louis Moisan, *louis.moisan.bio@gmail.com*

785 **3. Copyright restrictions**

786 None

787 **4. Proprietary restrictions**

788 **a. Release date**

789 None

790 **b. Citation**

791 Please cite this document when using the data.

792 **c. Disclaimer**

793 None

794 **5. Costs**

795 None, the data can be used free of charge.

796 **Class IV. Data structural descriptors**

797 **A. Data set file**

798 **1. Identity**

- 799 a. BYLOT-species_taxonomy.csv
800 b. BYLOT-species_abundance.csv
801 c. BYLOT-species_body_mass.csv
802 d. BYLOT-interannual_variation_nest_density.csv
803

804 **2. Size**

- 805 a. 35 records, not including header row (4.3 kB)
806 b. 271 records, not including header row (35.1 kB)
807 c. 53 records, not including header row (3.7 kB)
808 d. 18 records, not including header row (1.1 kB)

809 **3. Format and storage mode**

810 All files are in a comma-separated value format (.csv).

811 **4. Header information**

812 a. BYLOT-species_taxonomy.csv

813 class; order; family; genus; species_scientific; species_en; species_fr; species_code;
814 functional_group; migratory_status

815 b. BYLOT-species_abundance.csv

816 species_en; year; breeding_status; abundance; method_description; method_quality

817 c. BYLOT-species_body_mass.csv

818 species_en; site; mean_body_mass_g; sample_size; reference

819 d. BYLOT-interannual_variation_nest_density.csv

820 species_en; zone; mean_nest_density_km2; sd_nest_density_km2; number_years

821 **5. Alphanumeric attributes**

822 Mixed

823 **6. Special characters/fields**

824 Unavailable values are indicated by NA.

825 **7. Authentication procedures**

826 Sums of the numeric columns:

827 b. BYLOT-species_abundance.csv: abundance= 2278553

828 c. BYLOT-species_body_mass.csv: body_mass_g= 49617; sample_size= 13902

829 d. BYLOT-interannual_variation_nest_density.csv: mean_nest_density_km2= 20.447;

830 sd_nest_density_km2= 9.529; sample_size_nest_density_km2= 186

831 **B. Variable information**

832 **1. Variable identity**

833 See Table 6

834 **2. Variable definition**

835 See Table 6

836 **3. Units of measurement**

837 See Table 6

Table 6: Summary of variable definition and unit of measurement.

Data file	Variable identity	Variable definition	Units
a.	class	Taxonomic class for birds (Gill et al., 2024) and mammals species (Upham et al., 2024).	NA
a.	order	Taxonomic order for birds (Gill et al., 2024) and mammals species (Upham et al., 2024).	NA
a.	family	Taxonomic family for birds (Gill et al., 2024) and mammals species (Upham et al., 2024).	NA
a.	genus	Taxonomic genus for birds (Gill et al., 2024) and mammals species (Upham et al., 2024).	NA
a.	species_scientific	Taxonomic species for birds (Gill et al., 2024) and mammals species (Upham et al., 2024).	NA
a.	species_en	Common names of species in English.	NA
a.	species_fr	Common names of species in French.	NA
a.	functional_group	Functional group for each species. The classification of species into functional groups is based on Moisan et al. (2023).	NA
a.	migratory_status	Migratory status of each species. The classification of species migratory status is based on Gauthier et al., (2011) and Moisan et al. (2023).	NA
b.	species_en	Common names of species in English.	NA
b.	year	Year corresponding to the estimate of annual abundance. If abundance has not been calculated for a given series of years, but rather as a general average, then NA has been assigned.	years
b.	breeding_status	Reproductive status of the individuals.	NA
b.	abundance	Estimate of the annual number of individuals found within the 389 km ² study area located on the southern part of Bylot Island during the breeding season (May to August). This includes both breeding and non-breeding individuals that stay in the study area for a significant period of time, and excludes non-breeding individuals that stop for only a few days during their migration. The estimates only consider adults, with the exception of lemmings, for which no distinction has been made between juveniles and adults.	individuals
b.	method_description	Brief overview of the method used to estimate the species abundance.	NA
b.	method_quality	Qualitative measure of the method quality based on data available, method used for extrapolation (if necessary), and in some cases, from the fit of statistical models to estimate density.	NA
c.	species_en	Common names of species in English.	NA
c.	site	Site where individual body mass measurements were taken.	NA
c.	mean_body_mass_g	Mean individual body mass.	grams
c.	sample_size	Number of individuals measured.	individuals
c.	reference	Reference from which estimate of mean body mass were derived.	NA
d.	species_en	Common names of species in English.	NA
d.	zone	Sampled zone of the study area (see figure 2 and 3).	NA
d.	mean_nest_density_km2	Estimate of the mean annual nest density measured within the corresponding zone of the study area.	nests per square kilometer
d.	sd_nest_density_km2	Standard deviation of the annual nest density measured within the corresponding zone of the study area.	nests per square kilometer
d.	number_years	Number of years consider in the calculation of the nest density.	years

838 **4. Data type**

839 **a. Storage type**

840 See Table 7

841 **b. List and definition of variable codes**

842 See Table 7

843 **c. Range for numeric values**

844 See Table 7

845 **d. Missing value codes**

846 Unavailable values are indicated by NA.

847 **e. Number of digits**

848 See Table 7

Table 7: Summary of variable storage type, code definition, range and number of digit.

Data file	Variable identity	Storage type	Definition variable codes	Range	Number digits
a.	class	string	NA	NA	NA
a.	order	string	NA	NA	NA
a.	family	string	NA	NA	NA
a.	genus	string	NA	NA	NA
a.	species_scientific	string	NA	NA	NA
a.	species_en	string	NA	NA	NA
a.	species_fr	string	NA	NA	NA
a.	functional_group	string	NA	NA	NA
a.	migratory_status	string	resident: Individuals performing movements within the study area throughout the annual cycle.; partial migrant: A combination of resident and migratory and/or individuals performing long-distance foraging trips outside the study area during the non-breeding period.; migrant: Individuals performing seasonal and highly synchronous movements between the study area and a distant non-breeding ground.	NA	NA
b.	species_en	string	NA	NA	NA
b.	year	integer	If abundance has not been calculated for a given series of years, but rather as a general average, then NA has been assigned.	1993-2023	0
b.	breeding_status	string	undetermined: Individuals present on the study area during the breeding period (June to August) that might have breed or not.; breeding: Individuals present in the study area during the breeding period (June to August) and having attempted and/or completed breeding.	NA	NA
b.	abundance	integer	NA	0-447630	0
b.	method_description	string	NA	NA	NA
b.	method_quality	string	very low: Sampling might not encompass prime nesting habitat, excludes transient migratory individuals or includes potential non-breeding individuals. If abundance is derived from the abundance estimate of another species based relative abundance, detection probabilities may differ.; low: Abundance is derived from the estimate of another species based on indices of relative abundance.; moderate: Small to intermediate scale sampling with spatial extrapolation.; high: Large scale intensive sampling, with some spatial extrapolation in a few cases.	NA	NA
c.	species_en	string	NA	NA	NA
c.	site	string	bylot: Southern plain of Bylot Island, Nunavut, Canada.; undetermined: Data were not retrieved from original publications.	NA	NA
c.	mean_body_mass_g	integer	NA	21 - 6378	0
c.	sample_size	integer	NA	1 - 6405	0
c.	reference	string	NA	NA	NA

d.	species_en	string	NA	NA	NA
d.	zone	string	qarlikturvik (2x1 km plot): Intensive search plot (2 km2) for Lapland Longspur and Baird's sandpiper nests on the south side of the glacial river in the Qarlikturvik valley.; qarlikturvik (4x2 km plot): Intensive search plot (2 km2) for Sandhill crane, Long-tailed duck, King eider and Rock ptarmigan nests on the south side of the glacial river in the Qarlikturvik valley.; qarlikturvik valley: Intensive search area (33 km2) for long-tailed jaeger nests on the south side of the glacial river in the Qarlikturvik valley.; whole study area: Entire study area (389 km2) located on the southern plain of Bylot Island.	NA	NA
d.	mean_nest_density_km2	numeric	NA	0.001-14.088	3
d.	sd_nest_density_km2	numeric	NA	0.001-4.871	3
d.	number_years	integer	NA	3-17	0

849 **C. Data anomalies: Description of missing data, anomalous data, calibration errors, etc.**

851 If abundance of a given species has not been calculated for a series of years, but rather as
852 a general average, then NA has been assigned as "year".

853 **Class V. Supplemental descriptors**

854 **A. Data acquisition**

855 **1. Data forms or acquisition methods**

856 See Section **2. Experimental or sampling design**

857 **2. Location of completed data forms**

858 Raw data and codes will be archived in Dryad.

859 **3. Data entry verification procedures**

860 The methods used to extract final species abundance estimates were subject to several
861 rounds of revision by the authors.

862 **B. Quality assurance/quality control procedures**

863 Final abundance estimate were revised by the authors.

864 **C. Computer programs and data-processing algorithms**

865 **1. Program**

866 R version 4.3.2 (2023-10-31)

867 **2. Operating system**

868 Data preparation was performed on x86_64-pc-linux-gnu (64-bit) with Ubuntu 22.04.3
869 LTS.

870 **3. Packages**

871 dplyr (Wickham et al., 2023a), tidyverse (Wickham et al., 2024), sf (Pebesma et al., 2018),
872 stringr (Wickham, 2023), xtable (Dahl et al., 2019), Distance (Miller et al., 2019), ggplot2
873 (Wickham, 2016), lme4 (Bates et al., 2015), AICcmodavg (Mazerolle, 2023), scales(Wickham
874 et al., 2023b), ggmap (Kahle and Wickham, 2013)

875 **4. Codes**

876 Raw data and codes will be archived in Dryad.

877 **D. Archiving**

878 **1. Archival procedures**

879 The complete data set will be published as supporting information should the manuscript
880 be accepted for publication. Metadata document, raw data and codes will also be archived
881 in Dryad.

882 **2. Redundant archival sites**

883 None

884 **E. Publications and results**

885 The presented estimates of species abundance have not been integrated in publications
886 to date. Previous estimates of species abundance on the southern plain of Bylot Island
887 were presented by Legagneux et al. (2012), however, the temporal series presented here
888 is longer, the methods are refined and the taxonomic resolution is higher.

889 **F. History of data set usage**

890 **1. Data request history**

891 None

892 **2. Data set update history**

893 None

⁸⁹⁴ **3. Review history**

⁸⁹⁵ None

⁸⁹⁶ **4. Questions and comments from secondary users**

⁸⁹⁷ None

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908 **References**

- 909 M. Andersson. Breeding behaviour of the long-tailed skua *stercorarius longicaudus* (vieil-
910 lot). *Ornis Scandinavica*, 2(1):35–54, 1971.
- 911 D. Bates, M. Mächler, B. Bolker, and S. Walker. Fitting linear mixed-effects models using
912 *lme4*. *Journal of Statistical Software*, 67(1):1–48, 2015.
- 913 A. Beardsell, G. Gauthier, J.-F. Therrien, and J. Béty. Nest site characteristics, patterns
914 of nest reuse, and reproductive output in an arctic-nesting raptor, the rough-legged
915 hawk. *The Auk: Ornithological Advances*, 133(4):718–732, 2016.
- 916 F. Bilodeau. Effet du couvert nival, de la nourriture et de la prédatation hivernale sur
917 la dynamique de population des lemmings. Master’s thesis, Université Laval, Québec,
918 Québec, 2013.
- 919 D. Bolduc, D. Fauteux, C. A. Gagnon, G. Gauthier, J. Béty, and P. Legagneux. Tes-
920 timonials to reconstruct past abundances of wildlife populations. *Basic and Applied
921 Ecology*, 68:23–34, 2023.
- 922 J. H. Brown and E. J. Heske. Temporal changes in a chihuahuan desert rodent community.
923 *Oikos*, 59(3):290–302, 1990.
- 924 Centre of Northern Studies and Laval University. Long-term climate observations on
925 bylot island. <https://bylot.cen.ulaval.ca/en/climatetrend.php>, 2019. Accessed:
926 2024-10-03.
- 927 S. Christin, M.-H. St-Laurent, and D. Berteaux. Evaluation of argos telemetry accuracy
928 in the high-arctic and implications for the estimation of home-range size. *PLoS One*,
929 10(11):e0141999, 2015.
- 930 J. Clermont, A. Grenier-Potvin, É. Duchesne, C. Couchoux, F. Dulude-de Broin,
931 A. Beardsell, J. Béty, and D. Berteaux. The predator activity landscape predicts the
932 anti-predator behavior and distribution of prey in a tundra community. *Ecosphere*, 12
933 (12):e03858, 2021.
- 934 J. E. Cohen, T. Jonsson, and S. R. Carpenter. Ecological community description using
935 the food web, species abundance, and body size. *Proceedings of the national academy
936 of sciences*, 100(4):1781–1786, 2003.
- 937 D. B. Dahl, D. Scott, C. Roosen, A. Magnusson, and J. Swinton. *xtable: Export Tables
938 to LaTeX or HTML*, 2019. URL <https://CRAN.R-project.org/package=xtable>. R

- 939 package version 1.8-4.
- 940 A. Dahood, K. de Mutsert, and G. M. Watters. Evaluating antarctic marine protected
941 area scenarios using a dynamic food web model. *Biological conservation*, 251:108766,
942 2020.
- 943 P. David, E. Thebault, O. Anneville, P.-F. Duyck, E. Chapuis, and N. Loeuille. Impacts
944 of invasive species on food webs: a review of empirical data. *Advances in ecological
945 research*, 56:1–60, 2017.
- 946 É. Duchesne, J.-F. Lamarre, G. Gauthier, D. Berteaux, D. Gravel, and J. Bêty. Vari-
947 able strength of predator-mediated effects on species occurrence in an arctic terrestrial
948 vertebrate community. *Ecography*, 44(8):1236–1248, 2021.
- 949 F. Dulude-de Broin, J. Clermont, A. Beardsell, L.-P. Ouellet, P. Legagneux, J. Bêty,
950 and D. Berteaux. Predator home range size mediates indirect interactions between
951 prey species in an arctic vertebrate community. *Journal of Animal Ecology*, 92(12):
952 2373–2385, 2023.
- 953 D. Fauteux, G. Gauthier, and D. Berteaux. Seasonal demography of a cyclic lemming
954 population in the canadian arctic. *Journal of Animal Ecology*, 84(5):1412–1422, 2015.
- 955 D. Fauteux, G. , M. J. Mazerolle, N. Coallier, J. Bêty, and D. Berteaux. Evaluation of in-
956 vasive and non-invasive methods to monitor rodent abundance in the arctic. *Ecosphere*,
957 9(2):e02124, 2018.
- 958 G. Gauthier. Lemming monitoring on bylot island, nunavut, canada.
959 <https://nordicana.cen.ulaval.ca/dpage.aspx?doi=45400AW-9891BD76704C4CE2>,
960 2020.
- 961 G. Gauthier and M. Cadieux. Relative abundance of tundra bird and mammal
962 species encountered daily on bylot island, nunavut, canada, v. 1.0 (2007-2019).
963 <https://nordicana.cen.ulaval.ca/dpage.aspx?doi=45645CE-A24D883A6676492E>,
964 2020a.
- 965 G. Gauthier and M. Cadieux. Monitoring of greater snow goose reproduction on bylot
966 island, nunavut, canada. <https://nordicana.cen.ulaval.ca/dpage.aspx?doi=45570CE-2D00DCA728074FA7>, 2020b.
- 968 G. Gauthier, D. Berteaux, J. Bêty, A. Tarroux, J.-F. Therrien, L. McKinnon, P. Legag-
969 neux, and M.-C. Cadieux. The tundra food web of bylot island in a changing climate
970 and the role of exchanges between ecosystems. *Ecoscience*, 18(3):223–235, 2011.

- 971 G. Gauthier, J. Béty, M.-C. Cadieux, P. Legagneux, M. Doiron, C. Chevallier, S. Lai,
972 A. Tarroux, and D. Berteaux. Long-term monitoring at multiple trophic levels suggests
973 heterogeneity in responses to climate change in the canadian arctic tundra. *Philosophical*
974 *Transactions of the Royal Society B: Biological Sciences*, 368(1624):20120482, 2013.
- 975 G. Gauthier, P. Legagneux, M.-A. Valiquette, M.-C. Cadieux, and J.-F. Therrien. Diet
976 and reproductive success of an arctic generalist predator: Interplay between variations
977 in prey abundance, nest site location, and intraguild predation. *The Auk: Ornithological*
978 *Advances*, 132(3):735–747, 2015.
- 979 G. Gauthier, M. Cadieux, Y. Seyer, and J. Therrien. Monitoring of avian predator reproduction on bylot island, nunavut, canada.
980 <https://nordicana.cen.ulaval.ca/dpage.aspx?doi=45591AW-F9B906CC647948E0>,
981 2020.
- 983 G. Gauthier, D. Berteaux, J. Béty, P. Legagneux, D. Fauteux, D. Gravel, and M.-C.
984 Cadieux. Scientific contributions and lessons learned from 30 years of ecological mon-
985 itoring of the bylot island tundra ecosystem. *Frontiers in Ecology and Evolution*, 12:
986 1359745, 2024a.
- 987 G. Gauthier, M.-C. Cadieux, D. Berteaux, J. Béty, D. Fauteux, P. Legagneux,
988 E. Lévesque, and C.-A. Gagnon. Long-term study of the tundra food web at a hotspot of
989 arctic biodiversity, the bylot island field station. *Arctic Science*, 10(1):108–124, 2024b.
- 990 F. Gill, D. Donsker, and P. Rasmussen. Ioc world bird list (v14. 2), 2024.
- 991 D. Goto, E. S. Dunlop, J. D. Young, and D. A. Jackson. Shifting trophic control of
992 fishery–ecosystem dynamics following biological invasions. *Ecological Applications*, 30
993 (8):e02190, 2020.
- 994 G. P. Griffith, H. Hop, M. Vihtakari, A. Wold, K. Kalhagen, and G. W. Gabrielsen.
995 Ecological resilience of arctic marine food webs to climate change. *Nature Climate*
996 *Change*, 9(11):868–872, 2019.
- 997 N. Gruyer, G. Gauthier, and D. Berteaux. Cyclic dynamics of sympatric lemming popu-
998 lations on bylot island, nunavut, canada. *Canadian Journal of Zoology*, 86(8):910–917,
999 2008.
- 1000 S. P. Hubbell. *The Unified Neutral Theory of Biodiversity and Biogeography*. Princeton
1001 University Press, Princeton, 2001. ISBN 9781400837526.
- 1002 C. Hutchison, F. Guichard, P. Legagneux, G. Gauthier, J. Béty, D. Berteaux, D. Fauteux,

- 1003 and D. Gravel. Seasonal food webs with migrations: multi-season models reveal indirect
1004 species interactions in the canadian arctic tundra. *Philosophical Transactions of the*
1005 *Royal Society A*, 378(2181):20190354, 2020.
- 1006 R. Ims, D. Ehrlich, B. Forbes, B. Huntley, D. Walker, and P. A. Wookey. Terrestrial
1007 ecosystems (chapter 12). In H. Meltoffe, A. B. Josefson, and D. Payer, editors, *Arc-
1008 tic Biodiversity Assessment: Status and trends in Arctic biodiversity*, pages 385–440.
1009 Conservation of Arctic Flora and Fauna (CAFF), 2013.
- 1010 D. Kahle and H. Wickham. ggmap: Spatial visualization with ggplot2. *The R Journal*, 5
1011 (1):144–161, 2013.
- 1012 W. Kemp, S. Harvey, and K. O’neill. Patterns of vegetation and grasshopper community
1013 composition. *Oecologia*, 83:299–308, 1990.
- 1014 R. Klassen. *Quaternary geology and glacial history of Bylot Island, Northwest Territories*,
1015 volume 429. Geological Survey of Canada, 1993.
- 1016 C. J. Krebs, K. Danell, A. Angerbjörn, J. Agrell, D. Berteaux, K. A. Bråthen, Ö. Danell,
1017 S. Erlinge, V. Fedorov, K. Fredga, J. Hjältén, G. Högstedt, I. S. Jónsdóttir, A. J. Ken-
1018 ney, N. Kjellén, T. Nordin, H. Roininen, M. Svensson, M. Tannerfeldt, and C. Wiklund.
1019 Terrestrial trophic dynamics in the canadian arctic. *Canadian journal of Zoology*, 81
1020 (5):827–843, 2003.
- 1021 S. Lai, J. Béty, and D. Berteaux. Spatio-temporal hotspots of satellite-tracked arctic
1022 foxes reveal a large detection range in a mammalian predator. *Movement ecology*, 3
1023 (37):1–10, 2015.
- 1024 S. Lai, C. Warret Rodrigues, D. Gallant, J. D. Roth, and D. Berteaux. Red foxes at
1025 their northern edge: competition with the arctic fox and winter movements. *Journal
1026 of Mammalogy*, 103(3):586–597, 2022.
- 1027 J.-F. Lamarre, G. Gauthier, R. B. Lanctot, S. T. Saalfeld, O. P. Love, E. Reed, O. W.
1028 Johnson, J. Liebezeit, R. McGuire, M. Russell, E. Nol, L. Koloski, F. Sanders, L. McK-
1029 innon, P. A. Smith, S. A. Flemming, N. Lecomte, M. A. Giroux, S. Bauer, T. Emmeneg-
1030 ger, and J. Béty. Timing of breeding site availability across the north-american arctic
1031 partly determines spring migration schedule in a long-distance neotropical migrant.
1032 *Frontiers in Ecology and Evolution*, 9:710007, 2021.
- 1033 D.-J. Léandri-Breton, J.-F. Lamarre, and J. Béty. Seasonal variation in migration strate-
1034 gies used to cross ecological barriers in a nearctic migrant wintering in africa. *Journal
1035 of Avian Biology*, 50(6):e02101, 2019.

- 1036 N. Lecomte, G. Gauthier, and J.-F. Giroux. Breeding dispersal in a heterogeneous land-
1037 scape: the influence of habitat and nesting success in greater snow geese. *Oecologia*,
1038 155:33–41, 2008.
- 1039 P. Legagneux, G. Gauthier, D. Berteaux, J. Béty, M.-C. Cadieux, F. Bilodeau, E. Bolduc,
1040 L. McKinnon, A. Tarroux, J.-F. Therrien, L. Morisette, and C. J. Krebs. Disentangling
1041 trophic relationships in a high arctic tundra ecosystem through food web modeling.
1042 *Ecology*, 93(7):1707–1716, 2012.
- 1043 P. Legagneux, G. Gauthier, N. Lecomte, N. M. Schmidt, D. Reid, M. Cadieux,
1044 D. Berteaux, J. Bety, C. Krebs, R. Ims, N. G. Yoccoz, R. I. G. Morrison, S. J. Ler-
1045 oux, M. Loreau, and D. Gravel. Arctic ecosystem structure and functioning shaped by
1046 climate and herbivore body size. *Nature Climate Change*, 4:379–383, 2014.
- 1047 D. Lepage, G. Gauthier, and A. Reed. Breeding-site infidelity in greater snow geese:
1048 a consequence of constraints on laying date? *Canadian Journal of Zoology*, 74(10):
1049 1866–1875, 1996.
- 1050 D. B. Lindenmayer, G. E. Likens, A. Andersen, D. Bowman, C. M. Bull, E. Burns, C. R.
1051 Dickman, A. A. Hoffmann, D. A. Keith, M. J. Liddell, A. J. Lowe, D. J. Metcalfe, S. R.
1052 Phinn, J. Russel-smith, N. Thurgate, and G. M. Wardle. Value of long-term ecological
1053 studies. *Austral Ecology*, 37(7):745–757, 2012.
- 1054 A. E. Magurran. Species abundance distributions over time. *Ecology letters*, 10(5):347–
1055 354, 2007.
- 1056 A. E. Magurran, S. R. Baillie, S. T. Buckland, J. M. Dick, D. A. Elston, E. M. Scott, R. I.
1057 Smith, P. J. Somerfield, and A. D. Watt. Long-term datasets in biodiversity research
1058 and monitoring: assessing change in ecological communities through time. *Trends in
1059 ecology & evolution*, 25(10):574–582, 2010.
- 1060 M. J. Mazerolle. *AICcmodavg: Model selection and multimodel inference based on
(Q)AIC(c)*, 2023. URL <https://cran.r-project.org/package=AICcmodavg>. R pack-
1061 age version 2.3.3.
- 1062
- 1063 K. S. McCann, J. Rasmussen, and J. Umpanhowar. The dynamics of spatially coupled
1064 food webs. *Ecology letters*, 8(5):513–523, 2005.
- 1065 D. L. Miller, E. Rexstad, L. Thomas, L. Marshall, and J. L. Laake. Distance sampling in
1066 r. *Journal of Statistical Software*, 89(1):1–28, 2019.
- 1067 L. Moisan, D. Gravel, P. Legagneux, G. Gauthier, D.-J. Léandri-Breton, M. Somveille,

- 1068 J.-F. Therrien, J.-F. Lamarre, and J. Béty. Scaling migrations to communities: An
1069 empirical case of migration network in the arctic. *Frontiers in Ecology and Evolution*,
1070 10:1077260, 2023.
- 1071 T. A. Okey, S. Banks, A. F. Born, R. H. Bustamante, M. Calvopiña, G. J. Edgar, E. Es-
1072 pinoza, J. M. Fariña, L. E. Garske, G. K. Reck, S. Salazar, S. Shepherd, V. Toral-
1073 Granda, and P. Wallem. A trophic model of a galápagos subtidal rocky reef for eval-
1074 uating fisheries and conservation strategies. *Ecological Modelling*, 172(2-4):383–401,
1075 2004.
- 1076 D. F. Parmelee, H. Stephens, and R. H. Schmidt. *The birds of southeastern Victoria
1077 Island and adjacent small islands*. Number 78. Queen's Printer, 1967.
- 1078 D. C. Payer, A. B. Josefson, and J. Fjeldsa. Species diversity in the arctic (chapter 2).
1079 In H. Meltoffe, A. B. Josefson, and D. Payer, editors, *Arctic Biodiversity Assessment:
1080 Status and trends in Arctic biodiversity*, pages 67–77. Conservation of Arctic Flora and
1081 Fauna (CAFF), 2013.
- 1082 E. J. Pebesma et al. Simple features for r: standardized support for spatial vector data.
1083 *The R Journal*, 10(1):439–446, 2018.
- 1084 T. E. Philippi, P. M. Dixon, and B. E. Taylor. Detecting trends in species composition.
1085 *Ecological applications*, 8(2):300–308, 1998.
- 1086 É. E. Plagányi. *Models for an ecosystem approach to fisheries*. Food and Agriculture
1087 Organization of the united nations, 2007.
- 1088 A. Reed, R. J. Hughes, and H. Boyd. Patterns of distribution and abundance of greater
1089 snow geese on bylot island, nunavut, canada 1983-1998. *Wildfowl*, 53:53–65, 2002.
- 1090 A. Robillard, G. Gauthier, J.-F. Therrien, and J. Béty. Wintering space use and site
1091 fidelity in a nomadic species, the snowy owl. *Journal of Avian Biology*, 49(5):jav–01707,
1092 2018.
- 1093 P. Royer-Boutin. Effets des cycles de lemmings sur le succès de nidification d'oiseaux
1094 différent par leur taille corporelle et leur comportement. Master's thesis, Université du
1095 Québec à Rimouski, Rimouski, Québec, 2015.
- 1096 Y. Seyer, G. Gauthier, L. Bernatchez, and J.-F. Therrien. Sexing a monomorphic plumage
1097 seabird using morphometrics and assortative mating. *Waterbirds*, 42(4):380–392, 2019.
- 1098 Y. Seyer, G. Gauthier, D. Fauteux, and J.-F. Therrien. Resource partitioning among
1099 avian predators of the arctic tundra. *Journal of Animal Ecology*, 89(12):2934–2945,

- 1100 2020.
- 1101 K. Snyder and S. Tartowski. Multi-scale temporal variation in water availability: im-
1102 plications for vegetation dynamics in arid and semi-arid ecosystems. *Journal of Arid
1103 Environments*, 65(2):219–234, 2006.
- 1104 P. S. Taylor. Summer population and food ecology of jaegers and snowy owls on bathurst
1105 island, nwt emphasizing the long-tailed jaeger. Master’s thesis, University of Alberta,
1106 Edmonton, Alberta, 1974.
- 1107 J.-F. Therrien, G. Gauthier, and J. Bêty. Survival and reproduction of adult snowy owls
1108 tracked by satellite. *The Journal of Wildlife Management*, 76(8):1562–1567, 2012.
- 1109 N. Upham, C. Burgin, J. Widness, S. Liphardt, C. Parker, M. Becker, I. Rochon, D. Huck-
1110 aby, and J. Zijlstra. Mammal diversity database, 2024.
- 1111 H. Wickham. *ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York,
1112 2016. ISBN 978-3-319-24277-4. URL <https://ggplot2.tidyverse.org>.
- 1113 H. Wickham. *stringr: Simple, Consistent Wrappers for Common String Operations*, 2023.
1114 URL <https://CRAN.R-project.org/package=stringr>. R package version 1.5.1.
- 1115 H. Wickham, R. François, L. Henry, K. Müller, and D. Vaughan. *dplyr: A Grammar of
1116 Data Manipulation*, 2023a. URL <https://CRAN.R-project.org/package=dplyr>. R
1117 package version 1.1.4.
- 1118 H. Wickham, T. L. Pedersen, and D. Seidel. *scales: Scale Functions for Visualiza-
1119 tion*, 2023b. URL <https://CRAN.R-project.org/package=scales>. R package version
1120 1.3.0.
- 1121 H. Wickham, D. Vaughan, and M. Girlich. *tidyR: Tidy Messy Data*, 2024. URL <https://CRAN.R-project.org/package=tidyr>. R package version 1.3.1.
- 1122 H. Wilman, J. Belmaker, J. Simpson, C. de la Rosa, M. M. Rivadeneira, and W. Jetz.
1123 Eltontraits 1.0: Species-level foraging attributes of the world’s birds and mammals:
1124 Ecological archives e095-178. *Ecology*, 95(7):2027–2027, 2014.