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Birds and Mammals of Prince Leopold Island, Nunavut, 1975–2012

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ABSTRACT. Prince Leopold Island is the most important marine bird colony in the Canadian High Arctic. An Environment Canada research camp on the island was occupied for varying periods (mean 37 days) during 18 summers from 1975 to 2012. Research concentrated on the biology of the marine bird colonies, but incidental notes were kept on other sightings of birds and mammals. Forty-seven species of birds, of which 12 bred, six species of terrestrial mammals, four seals, and three whales were recorded on or from the island. Sightings of Ivory Gull and Brant decreased over the period considered, while sightings of Peregrine Falcons and breeding records of Baird's Sandpipers increased. Collared lemmings invaded the island in 2009, and extensive evidence of their presence was found by 2012. Arctic fox presence has become more frequent. Some or all of these changes may be related to recent climate warming and increased precipitation in the area. Eleven species of small passerines that normally do not breed north of the tree line were recorded, most often in June, suggesting that their appearance was due to migration overshoot. The regular appearance of southern passerines suggests that colonization of the Arctic Archipelago by sub-Arctic species may occur rapidly if climate and vegetation become more suitable.

Key words: birds, mammals, High Arctic, climate change, migration

RÉSUMÉ. L'île Prince Leopold recèle la plus importante colonie d'oiseaux marins de l'Extrême-Arctique canadien. Un campement de recherche d'Environnement Canada installé sur l'île a été occupé pendant diverses périodes (d'une moyenne de 37 jours) échelonnées sur 18 étés, allant de 1975 à 2012. Bien que les études aient principalement porté sur la biologie des colonies d'oiseaux marins, des notes connexes ont été prises à l'égard de l'observation d'autres oiseaux et de mammifères. L'observation de quarante-sept espèces d'oiseaux, dont 12 étaient des oiseaux nicheurs, de six espèces de mammifères terrestres, de quatre phoques et de trois baleines a été consignée sur l'île ou à partir de l'île. Au cours des années à l'étude, les observations de mouettes blanches et de bernaches cravants ont diminué, tandis que les observations de faucons pèlerins et les observations de nidification de bécasseaux de Baird ont augmenté. Le lemming variable a envahi l'île en 2009, et de nombreuses preuves de sa présence ont été trouvées en 2012. La présence du renard arctique s'est également amplifiée. Une partie ou la totalité de ces changements pourrait être attribuable au réchauffement planétaire et aux précipitations accrues dans la région. Onze espèces de petits passereaux qui ne se reproduisent normalement pas au nord de la limite forestière ont été répertoriées, la plupart du temps en juin, ce qui suggère que leur présence était attribuable au dépassement de la migration. La présence régulière des passereaux du sud laisse entrevoir que la colonisation de l'archipel Arctique par les espèces subarctiques pourrait se produire rapidement si le climat et la végétation devenaient plus appropriés.

Mots clés : oiseaux, mammifères, Extrême-Arctique, changement climatique, migration

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INTRODUCTION

Prince Leopold Island, Nunavut (74˚01′ N, 90˚02′ W), 68 km^2 in extent, is situated at the junction of Barrow Strait with Prince Regent Inlet (Fig. 1). It lies 10 km northeast of Somerset Island, 180 km east of the nearest community, Resolute Bay, and 187 km west-northwest of the community of Arctic Bay. The island is the largest multispecies aggregation of breeding seabirds in the Canadian Arctic, and it is the site of an important avian research station established by Environment Canada in 1975 (Nettleship, 1977; Gaston and Nettleship, 1981). The island and surrounding waters (including a 5 km marine buffer) were declared a Migratory Bird Sanctuary in 1992 (EC, 2013). The International Biological Programme (Nettleship and Smith, 1975) recognized the island as an important site, and Birdlife International has named it an Important Bird Area (IBA Canada, 2012). Excluding visits of less than five days, Prince Leopold Island has been the site of research on birds in 18 summers since 1975.

The island has abundant evidence of previous occupation by Inuit, with house pits exposed on both Southeast and North Spits (Figs. 2, 3). Bowhead whale jaws and ribs, prominent at the sites in the 1970s, have since been

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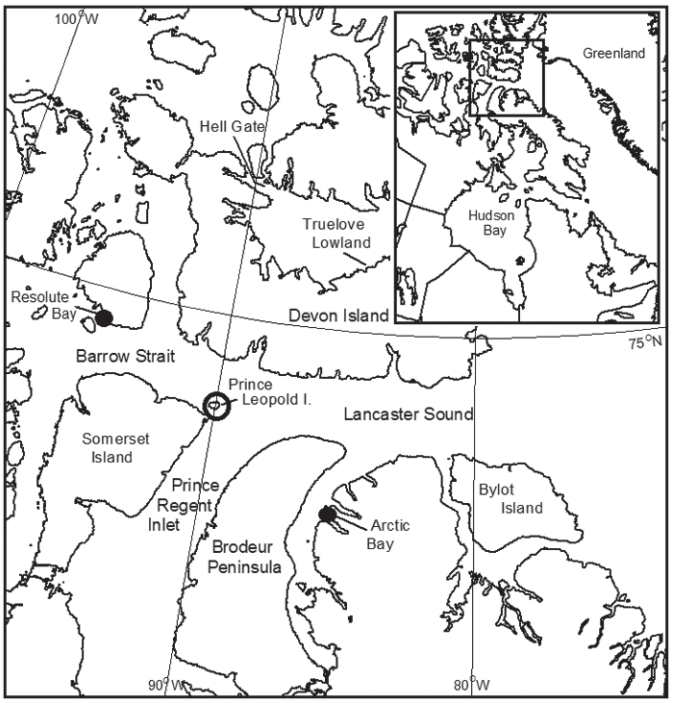

FIG. 1. Map of the Parry Channel region, showing the position of Prince Leopold Island and surrounding waterways and islands.

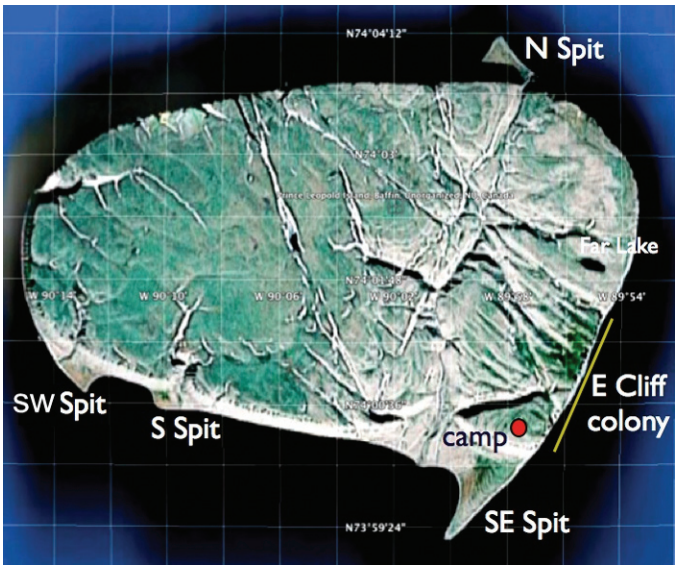

FIG. 2. Satellite image of Prince Leopold Island (from Google Earth), showing the principal features referred to. Note the bright green areas inland from the East Cliff seabird colony and at the base of the South and Southeast Spits, denoting relatively lush vegetation.

removed, but other marine mammal remains associated with the houses are still present. In 2013, the research camp (Fig. 2), situated near the southeast corner of the island, consisted of two plywood cabins (16′ × 16′ and 8′ × 12′) and two plywood platforms for the erection of Weatherhaven shelters. A Twin Otter landing strip is situated beside the camp.

Even before 1975, the island had been visited by ornithologists. H. Boyd (pers. comm. 2012) made a survey for geese in 1952; T.W. Barry surveyed the seabird colonies in 1958 (Barry, 1961); and R. Montgomerie (pers. comm. 2013) also observed the seabirds on 3–7 August 1973. In 1975–78, Prince Leopold Island was the site of intensive research on seabirds, with field crews present for more than 100 days annually during 1975–77 and 36 days in 1978. A party also visited the island for a few weeks in 1980. Sadly, the field records for those years were destroyed in a fire, and the only remaining information is based on field notebooks preserved by the author, which represent just his personal observations for the period 1975–77. No information is available for 1978 or 1980, when the author was not present. For other years, a checklist and annotated log of birds and mammals observed by all field crewmembers was maintained throughout the period when the island was visited. Records for 1988 were taken from Nettleship et al. (1989). The author was present in all years except 1978, 1980, 1988, 1993, 1998, and 2004. This paper presents a summary of the observations of birds and mammals accumulated to date, along with an account of weather conditions recorded on site and at nearby communities. It also assesses the extent of changes to the bird and mammal communities of the island, other than changes to the most abundant seabirds—Northern Fulmar (*Fulmarus glacialis*), Glaucous Gull (*Larus hyperboreus*), Black-legged Kittiwake (*Rissa tridactyla*), and Thick-billed Murre (*Uria lomvia*)—which were reported by Gaston et al. (2012).

THE STUDY SITE

Most of the island comprises a plateau with an altitude of 240–280 m, bisected near the east end of the island by a steep-sided gorge running from the north to the south coast. Several shorter canyons drain the plateau around the south and west sides. On the east side of the island, steep cliffs fall directly to the sea, being sheer or undercut in many places, especially at the northeast corner. Around the rest of the island there is a basal talus slope of varying width, and at four points along the south and north coasts there are gravel spits, the largest of which is at the southeast corner of the island (SE Spit) and extends away from the cliffs for approximately 1.8 km (Figs. 2, 3).

The bedrock of the island is horizontally bedded Silurian limestone (Dixon and Jones, 1978), extremely frost-shattered on the surface and riven with many crevices and gullies. Consequently, surface water is uncommon after snow has cleared, and the island has only a small number of shallow permanent lakes. The largest of these (Far Lake, 0.5 km in length) is situated close to the east coast, to the north of the East Cliff seabird colony (Figs. 2, 3). The main drainage of the island is a perennial stream in the central ravine that flows out on the south coast to the west of the SE Spit.

Vegetation, where it occurs, consists mainly of cushion forb, lichen, and moss tundra, with sparse dwarf willow

FIG. 3. Some examples of island topography and vegetation: a) the south cliffs from near the tip of the SE Spit; b) a shallow valley 200 m inland from the East Cliff seabird colony at 260 m asl, showing the abundant vegetation in this zone; c) the East Cliffs, showing some of the observation sites for seabirds; d) dense nodding saxifrage *Saxifraga cernua* meadows 30 m inland of the seabird cliffs at 270 m asl; e) Far Lake; note the barren slopes in this area away from the seabird cliffs at 280 m asl; f) purple saxifrage *S. oppositifolia* on south-facing slopes at 260 m asl, near the seabird cliffs. For locations of East Cliff, SE Spit, and Far Lake, see Figure 2.

(*Salix* sp.) below about 50 m asl. Most of the top of the island is devoid of vegetation. In a few places on the gravel spits, seepage areas support dense sedge, forb, and moss communities, but none of these is more than 1 ha in extent. The area immediately inland of the seabird cliffs, especially in the region of the very densely occupied cliffs at the southern end of the east coast, supports a denser vegetation than elsewhere, dominated by mosses and saxifrages, principally purple saxifrage (*Saxifraga oppositifolia*) and nodding saxifrage (*S. cernua*), and Arctic poppy (*Papaver radicatum*). This area and the seepage areas on the Southeast and South spits stand out as a brighter green colour in Figure 2. Ledges on the south cliffs also support a dense vegetation, comprising mainly common scurvygrass (*Cochlearia officinalis*) and Arctic mouse-ear (*Cerastium arcticum*).

METHODS

Field crews (usually 3–5 people) were present for more than three days in 1975–78, 1984, 1987, 1988, 1993, 1998, 2000–04, 2008–10, and 2012. Periods for which records were available varied from eight to 98 days in a given year and in all years fell between 8 May and 3 September. The camp was occupied for a total of 673 days in 18 years, for a mean of 37 days annually.

Fieldwork involved in monitoring seabirds was described by Gaston and Nettleship (1981) and Gaston et al. (2005). Weather data at camp (270 m asl), including temperature (1970s, 2000–02, and 2012 only), wind speed and direction, barometric pressure, and visibility, were recorded at 0700 and 1900 h daily. Notes were made on precipitation (trace, light, heavy, etc.), but the exact amount was not measured. Additional weather information for the nearest communities at Resolute and Arctic Bay was obtained from Environment Canada (GC, 2013). Trends over time were analyzed by linear regression using Statistica 7.1 (Statsoft, 2005).

In the daily log maintained when the field camp was occupied, resident species were recorded only as present or absent. The numbers of other birds and mammals sighted were generally recorded, along with the locality and varying amounts of detail on behaviour, especially any evidence relating to breeding. Birds were regarded as breeding on the island if nests with eggs or chicks or newly fledged dependent young were seen. To examine interannual variation and variation with date, records were expressed as days of occurrence / total number of days the camp was occupied during that period (year, or for aggregated years, total days per ten-day period). Some species were seen only at the coast and did not occur on top of the island, where most of the research was conducted. The likelihood of encountering these species was low unless field parties descended to near sea level, and this happened only irregularly in most years. However, some visits to the lowlands were made in all years except 2010.

RESULTS

Weather Conditions

During the 1970s, temperatures at camp varied from −21˚C in May 1976 to +13˚C in June 1975 and in July 1976 and 1977. Higher maximum temperatures were recorded in the 2000s, with five days in July 2001, seven days in July 2002 and seven days in July 2012 registering maxima above 13˚. Temperatures did not rise above freezing until 28 May in 1975, 29 May in 1976, and 8 June in 1977. They fell below freezing after 28 August in 1975, 19 August in 1976, 1 September in 1977, and 16 August in 2001. Wind speeds up to 100 km h^{-1} were recorded at camp; higher wind speeds may have also occurred but could not be recorded accurately by the instruments available. Snow fell in all months, but most precipitation during July was rain. Rainfall in the 1970s, when it occurred, was light, but heavy rain was recorded in July 2001 (twice), July 2002 (twice), July (3 times) and August (twice) 2008, July 2010 (once), and July (once) and August (twice) 2012. Although rainfall at Prince Leopold Island was not measured, the weather notes give a strong impression that it increased over the period of study, from little rain (although much fog) in the 1970s to regular heavy rain in the period since 2000.

Climate Trends at Adjacent Communities

Daily weather records for Resolute Bay are available from 1947 to 2011, but those from Arctic Bay only from 1977 to 2007. From 1971 to 2010, monthly mean temperatures at both stations increased in all months, significantly so ($\alpha < 0.05$) in April and September–December at Resolute Bay and in March, August, and October at Arctic Bay. The strongest trend at both stations was in October (Fig. 4), with temperatures increasing by 4˚ at Resolute Bay and by 5˚ at Arctic Bay. Rainfall in July also increased significantly at both stations (Fig. 4), from about 10 mm to 30 mm at Resolute Bay and from 10 mm to 50 mm at Arctic Bay.

Birds

Forty-seven species were recorded at Prince Leopold Island during 1975–2012 (Table 1). The maximum number in a single year (27 species) was recorded in 1975, the year when camp was occupied the longest. There was a close correlation between the number of species recorded and the duration of the period for which the camp was occupied (Fig. 5; $R^2 = 0.73$, $p < 0.01$). Many non-breeding species were recorded on only one day in a given year. These once-only sightings tended to cluster in the first 20 days of June, falling to a minimum in early August (Fig. 6).

Nine species bred regularly on the island, probably in every year: Common Eider (*Somateria mollissima*), Northern Fulmar, Black-legged Kittiwake, Glaucous Gull, Parasitic Jaeger (*Stercorarius parasiticus*), Thick-billed Murre, Black Guillemot (*Cepphus grylle*), Common Raven

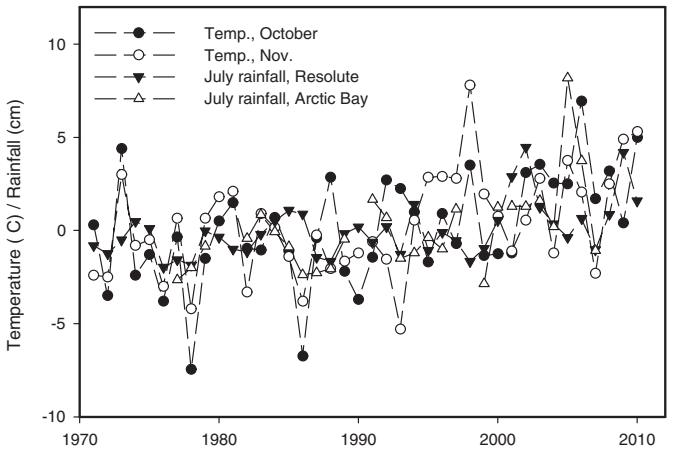

FIG. 4. Fall temperature trends and July rainfall trends at nearby weather stations: Resolute Bay (180 km WNW) and Arctic Bay (187 km ESE). Both are expressed as departures from the monthly means for 1970–2010. For temperature, the departures for the two stations are averaged.

(*Corvus corax*), and Snow Bunting (*Plectrophenax nivalis*). A further three species bred in at least one year: Baird's Sandpiper (*Calidris bairdii*) definitely bred in 2008, almost certainly in 2012, and probably in at least two other years (2001 and 2009). The other two species, Brant (*Branta bernicla*) and Northern Wheatear (*Oenanthe oenanthe*), have been proved to breed only once or twice, although brant was recorded in every year of the 1970s and probably bred regularly in that decade. The only other species that might have bred were Purple Sandpiper (*Calidris maritima*) and American Pipit (*Anthus rubescens*), seen in suitable breeding habitat in July, but no definite evidence of breeding was obtained for either.

Mammals

Five species of terrestrial mammals were recorded on Prince Leopold Island: wolf (*Canis lupus*), Arctic fox (*Vulpes lagopus*), Arctic hare (*Lepus arcticus*), collared lemming (*Dicrostonyx groenlandicus*), and caribou (*Rangifer tarandus*) (Table 2). The only terrestrial species seen frequently was the Arctic fox, which was not recorded in the 1970s, but was seen in 10 of 14 years thereafter. Collared lemmings were not recorded until a single sighting in 2009, but they had become common in the vicinity of the East Cliff seabird colonies by 2012. Observations of marine mammals were very sporadic because most work was carried out at the cliff tops. Sightings tended to occur mainly on fine days when fog and waves did not obscure visibility. Nevertheless, all species of seals (4) and whales (3) normally occurring in High Arctic waters were recorded. Beluga (*Delphinapterus leucas*), the most frequently sighted, was seen in all but one year (Table 2).

DISCUSSION

Most species were not recorded using uniform methods, but were noted incidentally in the course of studies of breeding seabirds on Prince Leopold Island. Thus, only tentative conclusions can be drawn from changes in the frequency of observations. Although the notes of other observers are not available for 1975–78, the author, being new to the Arctic at that time, took detailed notes, which also recorded sightings reported by others, so the records should be comparable with those for later years.

Those birds that seem clearly to have changed their status over the period covered are Ivory Gull (*Pagophila eburnea*), a regular visitor in the 1970s but not seen since 2003; Peregrine Falcon (*Falco peregrinus*), not seen in the 1970s, but seen frequently since 2000; and Baird's Sandpiper, recorded only once in the 1970s, but seen regularly since 2000 and proven to breed twice (Fig. 7). A decrease in sightings of Ivory Gulls is not surprising because the nearest known breeding sites, on the Brodeur Peninsula, Baffin Island, have mostly been deserted since 2002 (Gilchrist and Mallory, 2005), and numbers seen at sea in the region have declined since the 1990s (Chardine et al., 2004). Changes in the frequency of the other two species may relate to regional climate changes, especially in the case of Baird's Sandpiper, which made use of areas inland from the East Cliffs, where vegetation has increased substantially since the 1970s (A.J. Gaston, unpubl. data). There are also indications that Brant, not recorded breeding since the 1970s, may have become less common and that American Pipit (recorded in three years since 2000, but only once earlier) may have increased; however, the data are sparse. The wintering area of the Brant that bred on Prince Leopold Island is not known; they could have belonged to either the Atlantic or the Eastern High Arctic population, but both these High Arctic populations are depressed relative to their size during the 1960s (Ward et al., 2005), so some decrease in breeding activity at Prince Leopold Island might be expected. Elsewhere in Nunavut, Lok and Vink (2012) observed a decrease in Brant at Cambridge Bay between 1986 and 2011.

As elsewhere in the Arctic, environmental conditions at Prince Leopold Island have changed over the past 40 years. Increases in temperature, as well as rainfall (especially in July), were most obvious after 2000, corresponding with what has been described as "The Arctic Warm Period" (Overland et al., 2008). Similar recent trends were reported by Lok and Vink (2012) for Cambridge Bay. It is impossible to be certain whether the trends in birds and mammals reported here have been influenced by these changes in the physical environment. However, reductions in the High Arctic specialist Ivory Gull and increases in species with a centre of distribution farther to the south, such as Peregrine Falcon and Baird's Sandpiper, as well as increasing visibility of Arctic foxes, collared lemmings, and Arctic hares, could all be evidence of the influence of climate amelioration. The occurrence of bowhead whales (*Balaena mysticetus*) from 2003 onwards is presumably a symptom of the general recent increase of that species in Nunavut (COSEWIC, 2009).

Bird species lists for other High Arctic sites in Canada were summarized by Black et al. (2012). The number of

TABLE 1. Systematic list of birds recorded on Prince Leopold Island by Environment Canada research teams during 1975–2012 (order and nomenclature follow Gill and Donsker, 2012).

Species	Notes
Rock Ptarmigan (*Lagopus muta*)	One seen on 9 June 2003 in the central valley and one, near camp, on 14 July 2012. Several were reported in September 1975, evidently stopping on migration (P. Taylor, pers. comm. 1975).
Snow Goose (*Chen caerulescens*)	Small flocks recorded in June (8) and July (12) 2003 and July 2004 (number not recorded).
Brant (*Branta bernicla*)	Reported as "numerous" in 1952 (H. Boyd, pers. comm. 2012), seen by R. Montgomerie in 1973 and recorded breeding in 1975 and 1976, when several pairs were present. Otherwise, flocks of eight birds were seen on 15 June 2003 and 14 July 2009.
King Eider (*Somateria spectabilis*)	Flock of 35 seen on 2 August 2008 and flock of 10 on 1 July 2012.
Common Eider (*Somateria mollissima*)	Recorded in nine years, with nests found with eggs in four (1975, 1976, 2008, and 2012). Maximum number recorded 30, on 11 July 2012.
Long-tailed Duck (*Clangula hyemalis*)	Single birds seen twice in June 1975.
Pacific Loon (*Gavia pacifica*)	One on the sea close to shore on 24 June 2001.
Northern Fulmar (*Fulmarus glacialis*)	Breeds in large numbers on most of the coastal cliffs except for the central portion of the north coast and inland from the major gravel spits. The population in the early 2000s was estimated to be approximately 26 000 Apparently Occupied Sites (Gaston et al., 2006).
Gyrfalcon (*Falco rusticolus*)	Single birds recorded in eight years: six pale morph and two dark morph.
Peregrine Falcon (*Falco peregrinus*)	Not recorded in the 1970s and only once in the 1980s. Since 2001 it has been seen in five of eight years, including 15 dates in 2002 and seven dates in 2012, when plumage variation indicated that at least two different individuals were present. One bird was flushed from the still-warm carcass of a Black Guillemot in 2012. No evidence of breeding has been obtained, but sightings spread from 12 June to 10 August in 2002, indicating that at least one bird may have been present throughout the season.
Sandhill Crane (*Grus canadensis*)	One seen on 1 July and two on 3 July in 2012.
American Golden-Plover (*Pluvialis dominica*)	Single birds seen on 24 August 1976 and 14 June 2002 and two on 5 July 2009.
Black-bellied Plover (*Pluvialis squatarola*)	One on 7 June 1975.
Ruddy Turnstone (*Arenaria interpres*)	Two on 12 August 2008.
Semipalmated Sandpiper (*Calidris pusilla*)	Recorded in 2001 and 2003, but both records were tentative and might have referred to the more common Baird's Sandpiper.
White-rumped Sandpiper (*Calidris fuscicollis*)	One on 7 August 2010.
Baird's Sandpiper (*Calidris bairdii*)	Only one record in the 1970s and one in the 1980s. Since 2000, the species has been recorded in all but two years, with up to seven birds seen in one day (2012). Birds performing alarm calls and distraction displays were seen on 31 July 2000 and 21 July 2012. A pair with a chick was seen on 22 July 2001, and a pair with two chicks on 27 July 2008. All evidence of breeding behaviour was in the well-vegetated area inland of the East Cliff seabird colony.
Purple Sandpiper (*Calidris maritima*)	Single birds were seen on two days in June 2000, two days in June 2002, four days in August 2002 and one day in July 2012.
Black-legged Kittiwake (*Rissa tridactyla*)	Breeds in large numbers at the East Cliff and North Spit colonies, with the total population estimated at 29 000 pairs in 1980. Numbers on the East Cliffs have increased rapidly since the late 1990s (Mallory et al., 2009; Gaston et al., 2012).
Ivory Gull (*Pagophila eburnea*)	Up to four birds recorded on 15 dates in 1975–77. Subsequently, seen on nine days in four years, the last sighting being on 20 August 2003.
Sabine's Gull (*Xema sabini*)	One seen on 10 July 1975.
Ross's Gull (*Rhodostethia rosea*)	Singles on 4 July 1975 and 8 July 1977.
Glaucous Gull (*Larus hyperboreus*)	Common breeder around most of the coastal cliffs but concentrated near the East Cliff murre colony, although numbers have declined from an estimated 200 breeding pairs in the 1970s to 60–70 pairs in 2012 (see Gaston et al., 2012). Some details of breeding biology are given by Gaston et al. (2009). In 2008–10, flocks of up to 80 birds in adult plumage gathered on the SE Spit in August. No birds in sub-adult plumage were ever recorded at the island.
Thayer's/Iceland Gull (*Larus thayeri*/*glaucoides*)	These two species are difficult to separate in the field because hybrids and intergrades occur (Weir et al., 2000). Six records occurred in June (three years), one in July, and one in August.
Arctic Tern (*Sterna paradisaea*)	One on 21 July 1975.
Parasitic Jaeger (*Stercorarius parasiticus*)	Present and probably breeding in all years. One or two pairs were present on each of the gravel spits (N, SE, S, and SW) in most years, but nests or chicks were found only in 1975 and 1976, when a pair nested in a shallow valley to the west of the East Cliffs, and in 2002, when a nest with one egg and one dead chick was found on the South Spit on 24 July. Colour morphs recorded: 1975, 4 dark; 2000, 5 pale; 2001, 2 pale, 1 dark; 2002, 2 pale; 2008, 2 pale; 2010, 2 pale; 2012, 8 pale.
Thick-billed Murre (*Uria lomvia*)	Breeds in large numbers along the southern part of the East Cliffs and in a second, smaller, aggregation to the east of the North Spit. The current population is approximately 100 000 pairs (Gaston et al., 2012).
Black Guillemot (*Cepphus grylle*)	Several thousand pairs breed in crevices on cliffs along the south and west coasts and adjacent to the North Spit (Gaston et al., 2012).

TABLE 1. Systematic list of birds recorded on Prince Leopold Island by Environment Canada research teams during 1975–2012 (order and nomenclature follow Gill and Donsker, 2012) – *continued*:

Species	Notes
Common Raven (*Corvus corax*)	Recorded in all years except 1984. Pairs accompanied by recently fledged young seen in 1977, 2000, 2001, 2002, 2003, 2008, and 2012.
Horned Lark (*Eremophila alpestris*)	Two records in 1975 and two in 2002, one involving a male and female together on 10 June. Size and plumage was characteristic of the Arctic race *E. a. hoyti* (Pittaway, 1994).
Tree Swallow (*Tachycineta bicolor*)	Two seen on 20 June and one on 21 June 2002 hawking along the edge of the cliffs.
Northern Wheatear (*Oenanthe oenanthe*)	Recorded only on 21 July 1984, when a pair, behaving as though they had a nest, was present on talus slopes at the foot of the cliffs to the south of camp.
American Pipit (*Anthus rubescens*)	Single records in 1977, 2008, and 2012. In 2002, one or two birds were seen on nine dates, and it is possible that they attempted to breed; however no evidence was found.
Common/Hoary Redpoll (*Acanthis flammea*/*hornemanni*)	One on 10 June 2002.
Blackpoll Warbler (*Setophaga striata*)	One on 25 June 1993.
Palm Warbler (*Setophaga palmarum*)	One seen frequently between 17 June and 6 August 1975.
Yellow-rumped (Myrtle) Warbler (*Setophaga coronata*)	One present on five dates in June and on 4 August 2002.
Harris' Sparrow (*Zonotrichia querula*)	One male seen frequently from 24 June to 30 July 1975, mostly feeding in gullies on the East Cliff seabird colony.
White-crowned Sparrow (*Zonotrichia leucophrys*)	Males heard singing on 17 June and 9 July 1975 and seen on 17 and 20 July 2008.
White-throated Sparrow (*Zonotrichia albicollis*)	One male on 16 June 1975.
Dark-eyed Junco (*Junco hyemalis*)	Singles on 15 June 1975 and 4 July 2002.
Savannah Sparrow (*Passerculus sandwichensis*)	Single birds seen on 1–4 August 2000, on 18 June 2001, on six dates between 29 June and 23 August 2002, and on 12 August 2003.
American Tree Sparrow (*Spizella arborea*)	Three records in July and August 1975.
Chipping Sparrow (*Spizella passerina*)	One on 19 and 27 July 2008.
Lapland Longspur (*Calcarius lapponicus*)	Recorded in six years, with six of 11 records in June.
Snow Bunting (*Plectrophenax nivalis*)	Recorded breeding in every year, with many pairs holding territories along the cliffs above the seabird colonies and nesting in crevices just below the cliff edge. Young were noted on the wing from 15 July onwards, and flocks of juveniles were abundant at least until late August.

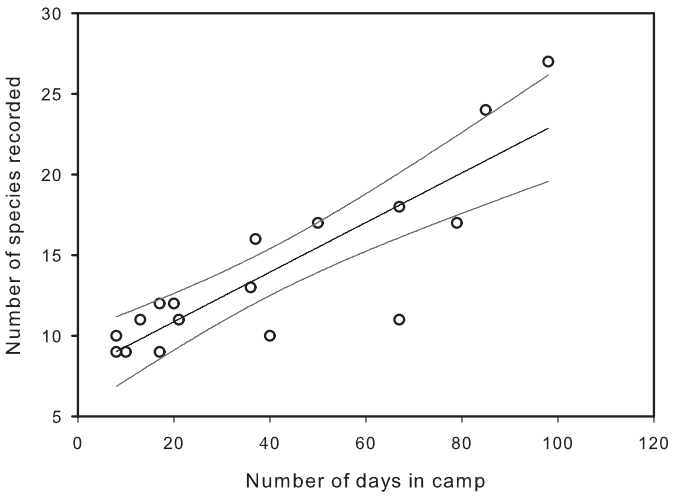

FIG. 5. Numbers of species recorded per year in relation to the number of days during which the camp was occupied.

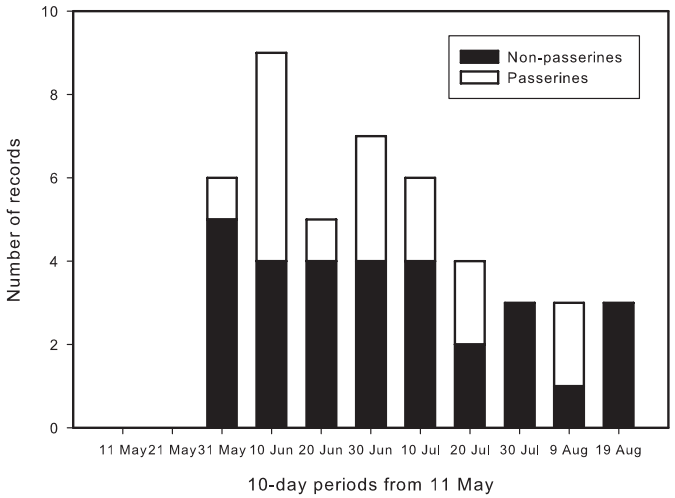

FIG. 6. Numbers of vagrant species recorded at Prince Leopold Island during 1975–2012 in relation to time of year.

bird species recorded at Prince Leopold Island (47 species) is similar to the 48 species reported from the Hell Gate polynya by Black et al. (2012) and the 43 species reported by Pattie (1990) at Truelove Lowland, Devon Island. Both of those lists were based on multi-decadal observations. Given that the majority of observations at Prince Leopold Island were made on the island's upper plateau, at an elevation above 250 m asl, it is not surprising that the numbers and diversity of land birds were low, but the manuring effect of the seabirds close to the cliff edge has created a zone of vegetation that would otherwise be absent and which probably attracts stray migrants, accounting for the similarity between the current list and those of stations close to sea level, such as Truelove Lowland and Hell Gate.

The vagrant songbirds recorded at Prince Leopold Island were mostly far to the north of their typical range and well

TABLE 2. Systematic list of mammals recorded on Prince Leopold Island during 1975–2012 (nomenclature follows Wilson and Reeder, 2005).

Species	Notes
Collared Lemming (*Dicrostonyx groenlandicus*)	One seen on 21 July 2009 close to the East Cliff seabird colony. Not seen in 2010, but two sightings in 2012, when numerous latrines and evidence of sub-nivean runways were found throughout the well-vegetated area inland from the East Cliff seabird colony.
Arctic Hare (*Lepus arcticus*)	Single sightings in June 1993 and 1998. Solitary individuals were seen on several occasions in 2001–03, both on the top of the island and on the coastal gravel spits.
Wolf (*Canis lupus*)	Fresh tracks were found in snow on 13 June 2002.
Arctic fox (*Vulpes lagopus*)	No sightings in the 1970s and only single sightings in 1984, 1988, and 1998. Thereafter seen regularly in most years, with at least two, possibly three animals present in 2002. One animal in 2002 repeatedly attacked field staff, attempting to bite them, and was driven off only with difficulty. The animal was presumed to be rabid, shot, and taken to Resolute Bay for disposal by the Wildlife Officer. Evidence for predation by foxes on Northern Fulmars, Thick-billed Murres, and Snow Buntings was found in several years. The absence of Arctic foxes in the 1970s is very surprising, given their ubiquity on Arctic islands and their propensity to travel over ice (Tarroux et al., 2010).
Polar Bear (*Ursus maritimus*)	Sightings or tracks recorded in all years except 2001, mostly along the coast or on the SE Spit, but one solitary male and one female with a cub were seen on top of the island, and additional tracks and droppings indicated that bears occasionally visit most parts of the island.
Walrus (*Odobenus rosmarus*)	Single records in 2000, 2008, and 2009.
Bearded seal (*Erignathus barbatus*)	Single records in 1988, 2001, and 2008.
Harp seal (*Pagophilus groenlandicus*)	Several groups of 10–20 seen on 8 and 10 July 2001 off the east coast and one group of 10 on 20 July 2008
Ringed seal (*Pusa hispida*)	Recorded daily in years when fast ice was present at the island, but not seen otherwise.
Caribou (*Rangifer tarandus*)	Bones and antlers were found in several places, and two carcasses of animals that presumably had died the previous winter were found just inland of the East Cliffs in 1993. In 1984, four adult caribou were seen on the South Spit on 23 July and on several dates inland from the East Cliff seabird colony. Their small stature corresponded to the High Arctic race *R. t. pearyi* (Banfield, 1974).
Bowhead Whale (*Balaena mysticetus*)	Single animals seen in July or August in four years from 2003 onwards.
Beluga (*Delphinapterus leucas*)	Recorded in all years except 1998, frequently in groups of 10–300. Some groups dived repeatedly in the same area, clearly feeding. On 19 July 2008, more than 100 belugas, including many calves, fed for several hours within 200 m of the south coast, accompanied by about 20 narwhal and a few hundred northern fulmars.
Narwhal (*Monodon monoceros*)	Less common than beluga and not recorded until 1987, but thereafter groups of up to 78 were seen in six years, all between 24 June and 5 August.

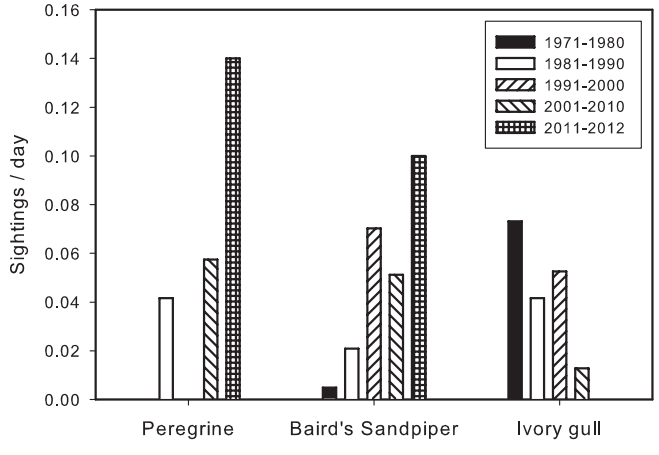

FIG. 7. Trends since 1975 in number of sightings per day at Prince Leopold Island for Ivory Gull, Baird's Sandpiper, and Peregrine Falcon.

outside the limits of records currently available via e-bird (www.ebird.org/ebird/canada/map). Only American Tree Sparrow (*Spizella arborea*), Savannah Sparrow (*Passerculus sandwichensis*), White-throated Sparrow (*Zonotrichia albicollis*), White-crowned Sparrow (*Z. leucophrys*), and Yellow-Rumped Warbler (*Setophaga coronata*) have previously been reported farther north (Geale, 1971; Freedman and Svoboda, 1982; Pattie, 1990; Black et al., 2012). However, all of the sparrows and warblers seen, with the exception of the Palm Warbler (*S. palmarum*), are boreal and sub-Arctic species regularly reported as far north as the lower MacKenzie Valley. There was a peak in records of vagrant sightings in June (Fig. 6), when migrants would have been arriving in the northern part of their range. Most observations probably involved birds that had overshot their intended breeding area. Similarly, records of vagrant sub-Arctic passerines on Bylot Island and at Resolute, Nunavut also occurred in June (Geale, 1971; Lepage et al., 1998). The arrival of a wide range of southern vagrants suggests that as the climate warms, range expansion of sub-Arctic species into the High Arctic could be rapid.

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