Marine birds of the Hell Gate Polynya, Nunavut, Canada

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The importance of the Hell Gate Polynya to marine birds in High Arctic Canada has not been assessed for two decades. Our breeding season surveys in 2002–04 found 19 species of marine birds using the polynya, in annual numbers perhaps reaching 25 000 individuals. The site appears to support nationally significant populations of northern fulmar (*Fulmarus glacialis*), Thayer's gull (*Larus thayeri*) and High Arctic brant (*Branta bernicla hrota*), as well as locally important numbers of other species including common eiders (*Somateria mollissima borealis*) and black guillemots (*Cepphus grylle*). The polynya may be particularly important for migration, as many species are observed here earlier than elsewhere in the High Arctic.

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The abundance and distribution of marine wildlife around the vast Canadian Arctic archipelago remain poorly known. Many of the key marine bird sites in this region were discovered during early Arctic exploration (e.g. Sverdrup 1904), but remained unexplored by biologists until broad, regional surveys were conducted in the early 1970s (Nettleship 1974). For selected species, some additional information was gathered in the early 1980s (Stirling & Cleator 1981; Prach 1986; Reed 1986). However, the remote location, the associated high costs of Arctic field work, and higher priorities at other locations (e.g. Gaston & Nettleship 1981; Gaston et al. 1993) meant that little additional survey work was conducted between 1973 and 2002 (Mallory & Fontaine 2004). The lack of current data and the recent concern over some declining marine bird populations (e.g. Gilchrist & Mallory 2005) at a time of marine environmental changes (e.g. Vinnikov et al. 1999) prompted renewed investigation of marine birds in several sites in the High Arctic (Mallory & Gilchrist 2003).

In this paper we describe marine bird populations breeding near the Hell Gate–Cardigan Strait Polynya (hereafter Hell Gate Polynya), a key terrestrial and marine habitat site in Canada (Alexander et al. 1991; Mallory & Fontaine 2004), an Important Bird Area in Canada (CEC 1999), and previously recognized under the International Biological Programme (Revel 1981). This site is in the High Arctic, situated on Paleozoic carbonate and siliciclastic rocks (de Kemp 1999), with small ice caps resting on sedimentary headlands around the polynya. Four small and one large island are found near the typical polynya boundaries. Our goal was to survey the islands of the polynya, and much of the surrounding coastline, to document marine bird occurrence. This is the third in a series of recent papers highlighting the importance of polynyas to marine birds in the Canadian Arctic (Gilchrist & Robertson 2000; Mallory & Gilchrist 2003).

Methods

Field work in the Hell Gate Polynya between Ellesmere and Devon islands, Nunavut (Fig. 1) was conducted in July 2002, and May–August

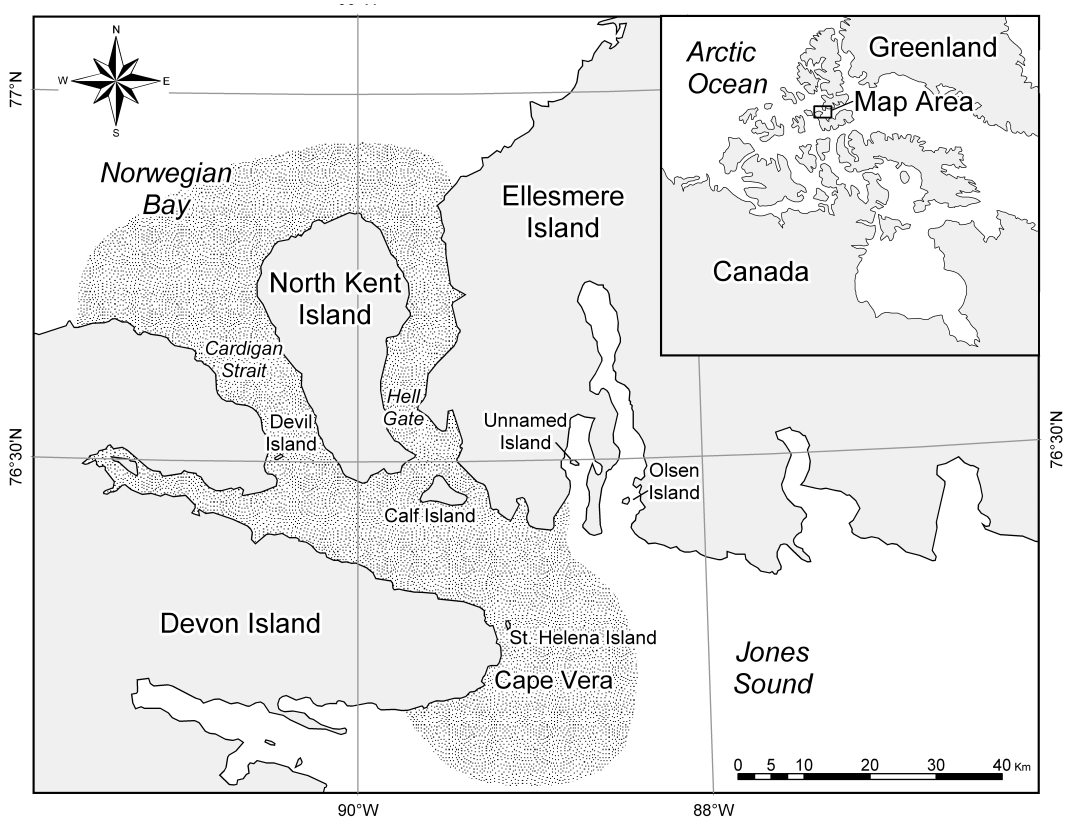

Fig. 1. Map of the typical Hell Gate Polynya configuration (stippled region) in mid July, including key islands surveyed for marine bird colonies. The floe edge is found where the stippled and white regions meet.

2003 and 2004 (Tables 1 & 2). Field investigations of marine birds were undertaken at Cape Vera (76° 15' N, 89° 15' W) and St. Helena Island (76° 18' N, 89° 5' W). At these locations we conducted a daily count of all bird species observed, both at the terrestrial sites and during scans of the polynya, and also recorded information on breeding phenologies and reproductive effort. Thus, in these studies we were able to monitor nests of selected species to observe hatching directly.

In addition to the focal research, we conducted ground and aerial surveys of the islands and partial coastline of the polynya. For St. Helena and Devil islands, the crew (2-4 people) landed and surveyed the island systematically on foot. This involved walking all shoreline and lowlands on the small islands, and scanning scree slopes and cliffs, to give complete coverage. All breeding

Table 1. Locations and characteristics of the islands in the Hell Gate Polynya, Nunavut, 2002–04. Survey methods are described in greater detail in text.

Island	Lat (°N)	Long (°W)	Distance to shore (km)	Size (km)	Survey method
St. Helena	76.28	89.17	2	1.25 × 0.5	Ground
Devil	76.50	97.47	1.2	1.25 × 0.4	Ground
Olsen	76.45	88.45	1.8	1.1 × 1.0	Air
Calf	76.43	89.50	2.5	7 × 3.5	Air
Unnamed	76.50	88.75	1.2	1.5 × 0.6	Air

birds (as indicated by birds on nests, or the presence of eggs) were recorded, and where breeding was not confirmed, individual counts of each species were noted. In 2003 and 2004, ground surveys on St. Helena Island were restricted to minimize disturbance of the nesting birds that were part of focal research, that is, we did not want to increase the chance that birds (principally eiders) monitored for long-term study would abandon due to our disturbance. Instead, the island was split into irregular sections (e.g. 25 × 40 m, varying due to terrain) which were counted from blinds or discreet locations using 10× binoculars or 60× spotting scopes. For Olsen and Unnamed islands, surveys were conducted by flying the complete coastline and interior of the islands in a Bell 407 helicopter, at altitudes of approximately 40 - 70 m. For Calf Island, we flew the complete coastline by helicopter at altitudes of 40 - 150 m, but we did not survey the central ice cap. Thus, we conducted complete surveys of the four smaller islands, and a partial survey of Calf Island, although the latter covered all of the probable breeding habitat for marine birds. We also surveyed the coastline between Olsen Island, Devil Island and Cape Vera (south of 76° 30' N; Fig. 1), flying along the beach or cliff faces, but not venturing inland more than 200 m. Finally, we monitored sections of the polynya and floe edge between Cape Vera and Olsen Island from helicopter on our way to and from survey sites when helicopters arrived or departed the research site.

Results and discussion

We recorded 19 species of marine birds around the Hell Gate Polynya in 2002–04, and 15 were recorded in earlier studies (Table 3). Six marine bird species were recorded nesting on the mainland at Cape Vera, and six species nested on St. Helena or Devil Island; terns and Thayer's gulls were only found nesting on islands, while fulmars and loons only nested on the mainland. Based on daily maximum counts for each species, approximately 13 500 marine birds were observed near the polynya in 2004.

Northern fulmar (*Fulmarus glacialis*)

The most abundant species was the northern fulmar, from the colony at Cape Vera. Surprisingly, during aerial surveys we observed very few fulmars on the water anywhere in the polynya except within 2 km of the colony, suggesting that birds were flying elsewhere to forage. We counted 10 150 northern fulmars from the base of the Cape Vera colony on 10 July 2004. Based on plot monitoring at the site from above the cliffs, approximately 3000 fulmars could not be observed from the base of the cliffs, meaning that roughly 13000 fulmars were probably at Cape Vera during our census. This fulmar colony appears to differ in size from previously published estimates. Alexander et al. (1991) noted the colony was about 7500 pairs, based on information from Prach (1986) who conducted surveys like ours from below the

Table 2. Species found on the islands. A "B" following the number of individuals for each species observed indicates that breeding was confirmed, whereas "N" indicates the number of active nests counted. Species codes are: Arctic tern (ARTE), black guillemot (BLGU), common eider (COEI), eastern High Arctic brant (EHAB), glaucous gull (GLGU), greater snow goose (GSNO), parasitic jaeger (PAJA), and Thayer's gull (THGU).

Island	Year	Date	ARTE	BLGU	COEI	EHAB	GLGU	GSNO	PAJA	THGU
St. Helena	2002	14 July	2 (1N)	11 (1N)	250 (52N)	0	10N	0	0	10N
	2003	7 – 17 July	14 (7N)	100 (B)	200 (100N)	45 (1N)	40 (20N)	0	2	36 (18N)
	2004	12 Jun – 1 Aug	12 (5N)	250 (30N)	200 (80N)	60 (10N)	44 (17N)	4	3	30 (15N)
Devil	2003	11 July	80 (7N)	20	15 (35N)	4B	7N	0	0	78 (19N)
	2004	5 July	80 (B)	60 (B)	<20 (8N)	2 (1N)	20 (5N)	2	0	80 (24N)
Olsen	2003	11 July	17	0	0	0	0	0	0	0
	2004	5 July	30 (B)	0	0	0	0	0	0	0
Calf	2003	11 July	0	39 (B)[a]	225 (B)	1	43 (B)	4	1	2 (N)
	2004	5 July	0	500 (B)	73 (B)	0	27 (B)	4	0	70 (B)
Unnamed	2003	11 July	4	0	0	0	0	0	0	0
	2004	5 July	0	0	0	0	0	0	0	0

[a] Surveyors acknowledged many BLGU were missed

cliffs. Hatch & Nettleship (1998) listed the size as 50 000 individuals, based on a coarse estimate from aerial surveys. Some of these differences are attributable to the inherent difficulty of counting this species, as many birds in the Canadian Arctic are moderate to dark morphs which blend in against the colour of the cliffs (Hatch & Nettleship 1998). Undoubtedly the number of fulmars using this colony is higher than the 13 000 we observed, because we conducted the survey during incubation, when many members of pairs would have been off at sea foraging (Hatch & Nettleship 1998). If half of the birds we observed on the cliffs in July were breeders (see Hatch & Nettleship 1998: Fig. 4), then there may be as many as 19 500 individual fulmars using the Cape Vera colony. Thus, the Cape Vera colony probably represents 3 - 4% of the Canadian fulmar population (Mallory & Fontaine 2004).

Northern common eider (*Somateria mollissima borealis*)

We found common eiders in locations around the polynya, with a maximum daily count of 2000 birds observed on 7 June 2004, consistent with previous reports (Reed 1986). During our 2002 visit to St. Helena Island (Table 1), we found 52 active and 124 failed common eider nests. Active nests had 3.1 ± 0.7 SD eggs (n = 52). In 2003 and 2004, we did not walk through the breeding areas to minimize disturbance and abandonment for ongoing research, and thus we did not count total failed nests, but we counted approximately 100

Table 3. Number of individual marine birds counted in the Hell Gate Polynya, either through aerial surveys or observations from research sites, in the early 1980s and 2002–2004. Some species were known to breed in the area (nests or young observed in earlier studies), but data on nests or hatch dates were not available. A question mark appears where paired birds have been observed during the breeding season, but nests or young have not been recorded.

Species		Maximum number observed in year							
Common name	Scientific name	1980–1984 [a]	2002	2003	2004	Earliest observation	Breed	Clutch size (n)	Earliest hatch date
Red-throated loon	*Gavia stellata*	4		7	3	16 June	Y		
Pacific loon	*Gavia pacifica*			5	1	4 June	?		
Northern fulmar	*Fulmarus glacialis*	6569	>5000	>5000	10 150	9 May [b]	Y	1 (100)	19 July
Glaucous gull	*Larus hyperboreus*	244	>20	50	102	13 May	Y	2.2 (37)	4 July
Thayer's gull	*Larus thayeri*	110	>10	4	200	1 June	Y	2.9 (10)	12 July
Ivory gull	*Pagophila eburnea*	5		5	0	24 June	N		
Black-legged kittiwake	*Rissa tridactyla*	45		1		4 June	N		
Black guillemot	*Cepphus grylle*	1585 [c]	>50	47	800	30 May	Y	2.0 (30)	22 July
Thick-billed murre	*Uria lomvia*			1		4 June	N		
Pomarine jaeger	*Stercorarius pomarinus*			1		24 June	?		
Parasitic jaeger	*Stercorarius parasitica*				2	15 June	Y		25 July
Long-tailed jaeger	*Stercorarius longicauda*	P [d]		5	1	19 June	N		
Arctic tern	*Sterna paradisaea*	346	2	85	120	30 May	Y		
High Arctic brant	*Branta bernicla hrota*	391	600	550	257	30 May	Y		13 July
Common eider	*Somateria mollissima borealis*	1915 [c]	250	>200	2000	15 May	Y	3.2 (97)	22 July
King eider	*Somateria spectabilis*	1140		>20	85	15 May	?		
Long-tailed duck	*Clangula hyemalis*	40		5	20	29 May	?		
Canada goose	*Branta canadensis*			2	1	30 May	N		
Greater snow goose	*Chen caerulescens*	60		28	6	1 June	Y		

[a] Data from Prach (1986).
[b] Birds were already present at the colony on our arrival.
[c] Surveys in these years included areas not surveyed in 2002–04.
[d] Present; counts not provided.

and 80 active nests in July each year, respectively. Despite its similar size and its numerous nest cups, Devil Island supported fewer eider nests than St. Helena Island (Table 1). For both of these islands, the number of active nests was considerably lower than previously observed peak numbers (303 and 141 nests in 1981, respectively; Reed 1986). St. Helena Island supports about 300 nest cups, the use of which appears to vary among years (Reed 1986; this study). Because Devil Island is in a narrower part of the polynya (Fig. 1), we speculate that it may be more susceptible to ice jams and ice bridges to the mainland, making it more likely that Arctic fox (*Alopex lagopus*) and polar bear (*Ursus maritimus*) could reach the island and depredate nests. Also, the eider populations in this region could be reduced compared to historical levels due to decades of overharvest on their wintering grounds in western Greenland (Hansen 2002, Merkel 2004).

Black guillemots (*Cepphus grylle*)

Black guillemots are common in the polynya, and some may overwinter there (Renaud & Bradstreet 1982). The fact that this species nests in crevices and scree slopes makes breeding counts challenging at best, and we found 30 nests on St. Helena Island in 2004 (Table 2), although more nests were undoubtedly present. We observed approximately 800 guillemots in 2004, principally around Calf Island, although smaller colonies exist on other islands, and in the scree below the cliffs at Cape Vera. Prach & Smith (1992) provide more detailed guillemot counts, largely from coastal regions to the south including Skruis Point, but could only find a maximum of 1585 guillemots, considerably less than the possible 10 000 estimated by Nettleship (1980). A dedicated and careful survey of guillemots in this polynya is required to provide an accurate census; this is warranted given the potential for this region to support a considerable proportion of the North American black guillemot population if these higher population estimates are realistic (Renaud & Bradstreet 1980, Butler & Buckley 2002).

Thayer's (*Larus thayeri*) and glaucous gull (*L. hyperboreus*)

Thayer's gulls were observed on three of the islands (St. Helena, Calf and Devil) supporting at least 37 nests in any year (Table 2), and these gulls were always associated with eider colonies. Small glaucous gull colonies (5 - 20 nests; Table 2) were associated with each of the Thayer's gull sites, as well as with the Cape Vera fulmar colony, although there were a few small glaucous gull colonies on the northeast side of the polynya, remote from other species. Thayer's gull is the common race of the *L. glaucoides* complex at this site, with perhaps 100 pairs breeding in the vicinity of the polynya, representing up to 3% of the Canadian population (Snell 2002). This species is poorly understood, particularly in its relationships to sympatric glaucous gulls and sometimes Iceland gulls (*L. glaucoides glaucoides*). Glaucous gulls are top marine avian predators and scavengers (Gilchrist 2001), and we observed them consuming many eggs and chicks of fulmars and eiders. Nests on these islands are easily accessible, and thus this location provides an excellent site from which to derive new information on these species.

Eastern High Arctic brant (*Branta bernicla hrota*)

Canadian High Arctic brant use the coastal regions around the polynya in considerable numbers. Up to 600 were observed at Cape Vera (Table 3), and given that brant were observed in other locations around the polynya during the surveys, we suspect that 1000 brant used the islands and coastline of the polynya during spring migration and during moult. The current size of this population varies between 10 000 and 25 000 individuals (Robinson 2004), meaning that 2.4 - 10% of the global population may use the Hell Gate Polynya annually.

Ivory gull (*Pagophila eburnea*) and Ross's gull (*Rhodostethia rosea*)

Despite the similar latitude of this polynya to that in Penny Strait (Mallory & Gilchrist 2003), no ivory gulls were observed on any islands, nor were any observed during aerial surveys around the polynya. A few were seen flying by the research camp at St. Helena Island (Table 3), and one landed at the Cape Vera field camp in 2003. The lack of birds is somewhat unexpected, given that they nest in similar, glaciated habitats and latitudes on southeastern Ellesmere and Devon islands (Gilchrist & Mallory 2005). Chardine et al. (2004) found ivory gulls further north in Norwegian Bay during at-sea surveys, suggesting that undiscovered col-

onies may exist there. With so few observations of ivory gulls during surveys at this location or during research seasons over three months long, we suspect that the gulls we did observe may be non-breeders, or perhaps birds migrating to colonies further north.

No Ross's gulls (*Rhodostethia rosea*) were observed in any year, despite their historical occurrence at similar latitudes in the Penny Strait Polynya (MacDonald 1978). This finding was not surprising, as Ross's gulls prefer wet, vegetated tundra habitat (Béchet et al. 2000) that is uncommon in the Hell Gate Polynya.

Other colonial marine birds

Although a few were observed in the polynya (Table 3), there were no black-legged kittiwakes (*Rissa tridactyla*) nor thick-billed murres (*Uria lomvia*) breeding in this area, despite that thousands of kittiwakes breed on Coburg Island only 250 km east and at Baillie-Hamilton Island 150 km west, and hundreds of thousands of murres breed at Coburg Island (Robards et al. 2000). Moreover, these species are known to associate with polynya habitats (Brown & Nettleship 1981; Stirling 1997). We speculate that the Hell Gate Polynya itself may not provide suitable food for these species at the right time of year. The fulmars from Cape Vera all appear to fly at least 250 km to the east to feed in the North Water Polynya, except for a few non-breeders, which we observed feeding on zooplankton near freshwater stream outlets. Black guillemots are common, as mentioned above, but they feed close to colonies on benthic fishes. Murres and kittiwakes are not able to commute as far for food to provision their young as fulmars (Gaston & Nettleship 1981; Hatch & Nettleship 1998), which means that the fulmar breeding strategy (distant foraging) cannot be used at this site by kittiwakes and murres.

Use of this polynya by dovekies (*Alle alle*) has been reported by Sverdrup (1904) and Prach (1986), but we observed none in three years of observations. There are no known breeding sites for dovekies in this area, so the polynya appears to be used intermittently by non-breeding birds.

Comparison to the Penny Strait Polynya

As with many other polynyas (Stirling 1997), the Hell Gate Polynya supports a diverse marine bird assemblage at high latitude. However, the islands and surrounding habitat of this polynya contrast sharply with those of the Penny Strait Polynya, which is located at the same latitude and only 175 km to the west. The Hell Gate Polynya is surrounded by steep, eroded, sedimentary cliffs of Ellesmere and Devon Islands (de Kemp 1999), and the small islands in the polynya tend to have considerable topography, sharp, eroded cobble, and small cliffs. In contrast, islands in the Penny Strait Polynya have little relief, and are generally low and comprised of alluvial gravels, often with moss and lichen growth. These physical differences appear to contribute to the markedly different bird communities. The Penny Strait islands support many breeding Arctic terns as well as numerous eider colonies nesting in gravel (Mallory & Gilchrist 2003), whereas the islands of the Hell Gate Polynya are dominated by gull and guillemot colonies, with few terns and only a few small and widely scattered eider colonies.

Our recent survey results suggest that the Hell Gate Polynya supports more than 1 % of the Canadian population of at least three species of marine birds (fulmar, Thayer's gull, High Arctic brant), and it has been previously shown to support important marine mammal populations of walrus (*Odobenus rosmarus*) and polar bear (*Ursus maritimus*; Stirling & Cleator 1981). Many marine birds arrive at this location before other sites in the High Arctic islands (Table 1; Parmalee & MacDonald 1960; Geale 1971; Hussell & Holroyd 1974; Renaud & Bradstreet 1980; Prach & Smith 1992), confirming its importance to early migrants. Collectively, it appears that at least 25 000 marine birds rely on this polynya for breeding, feeding or migration stopover annually, particularly considering that we did not survey the northern part of the polynya, where other important colonies have been found (Prach 1986; Prach & Smith 1992). Clearly the recent data continue to support the recognition of this area as a key marine site in the Canadian High Arctic, and formal protection of this area under Canadian legislation would be warranted.

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