

AUTUMN MIGRATION OF LIGHT-BELLIED BRENT GEESE *BRANTA BERNICLA HROTA* THROUGH NORTH-WEST GREENLAND

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Light-bellied Brent Geese arrive to north-west Greenland mainly from late August and most have left the area by mid-September in accordance with the arrival pattern in Iceland. At least some of the Brent Geese stage in coastal areas, mainly on Svartenhuk Peninsula and Disko Island. Most of the geese seem to arrive in the Svartenhuk/Disko area directly from Canada, and some via the Thule District and islands off north-west Greenland. The main pathway to the east coast of Greenland is probably from the Disko Bugt, but observations indicate that some may cross both north and south of this flyway. The low numbers recorded compared to the total flyway population suggest that a large part either went undetected by us, or migrate from Canada to the staging areas in western Iceland without stop-overs in north-west Greenland.

Keywords: *Light-bellied Brent Goose, Greenland, Autumn Migration, Staging Areas*

Light-bellied Brent Geese *Branta bernicla hrota* breeding on the Queen Elizabeth Islands in high-arctic Canada and wintering primarily in Ireland (Maltby-Prevett *et al.* 1975) pass through Greenland and Iceland during migration. The spring migration through Greenland has been described in several papers since early this century (eg Bertelsen 1921, Porsild 1922, Salomonsen 1950, 1967, Bennike 1990) and has recently been studied from an orientational and physiological point of view (Alerstam *et al.* 1986, Alerstam *et al.* 1990, Gudmundsson *et al.* 1995, Alerstam 1996). The autumn passage through Greenland is, on the contrary, poorly documented.

Brent Geese occur today in north-west Greenland as spring and autumn migrants and as occasional summer visitors (Boertmann 1994). They bred in this region early this century, as well as in north and north-east Greenland (Salomonsen 1950), but the breeding grounds of Greenland now seem to be restricted to the coastal parts of Kronprins Christian Land (Figure 1) between 80° and 82° N (Meltofte

1976, Håkansson *et al.* 1981, Meltofte *et al.* 1981, Bennike & Kelly 1986, Hjort *et al.* 1987, Hjort 1995). The flyway affinities of this particular population remain unclear, but they may be an off-shoot of the Svalbard breeding population (Alerstam *et al.* 1986, Hjort *et al.* 1987, Hjort 1995). In this paper we outline the autumn migration of Brent Geese through north-west Greenland, based on observations in 1987-1995.

Methods

Since 1992, the Danish National Environmental Research Institute, Department of Arctic Environment (NERI-AE), has conducted bird surveys over extensive parts of western Greenland. The surveys were environmental baseline programmes related to planning and mitigating the effects of mineral and petroleum exploration. Table 1 lists the NERI-AE surveys on which summering and autumn migrating Brent Geese were likely to have been detected, if present.

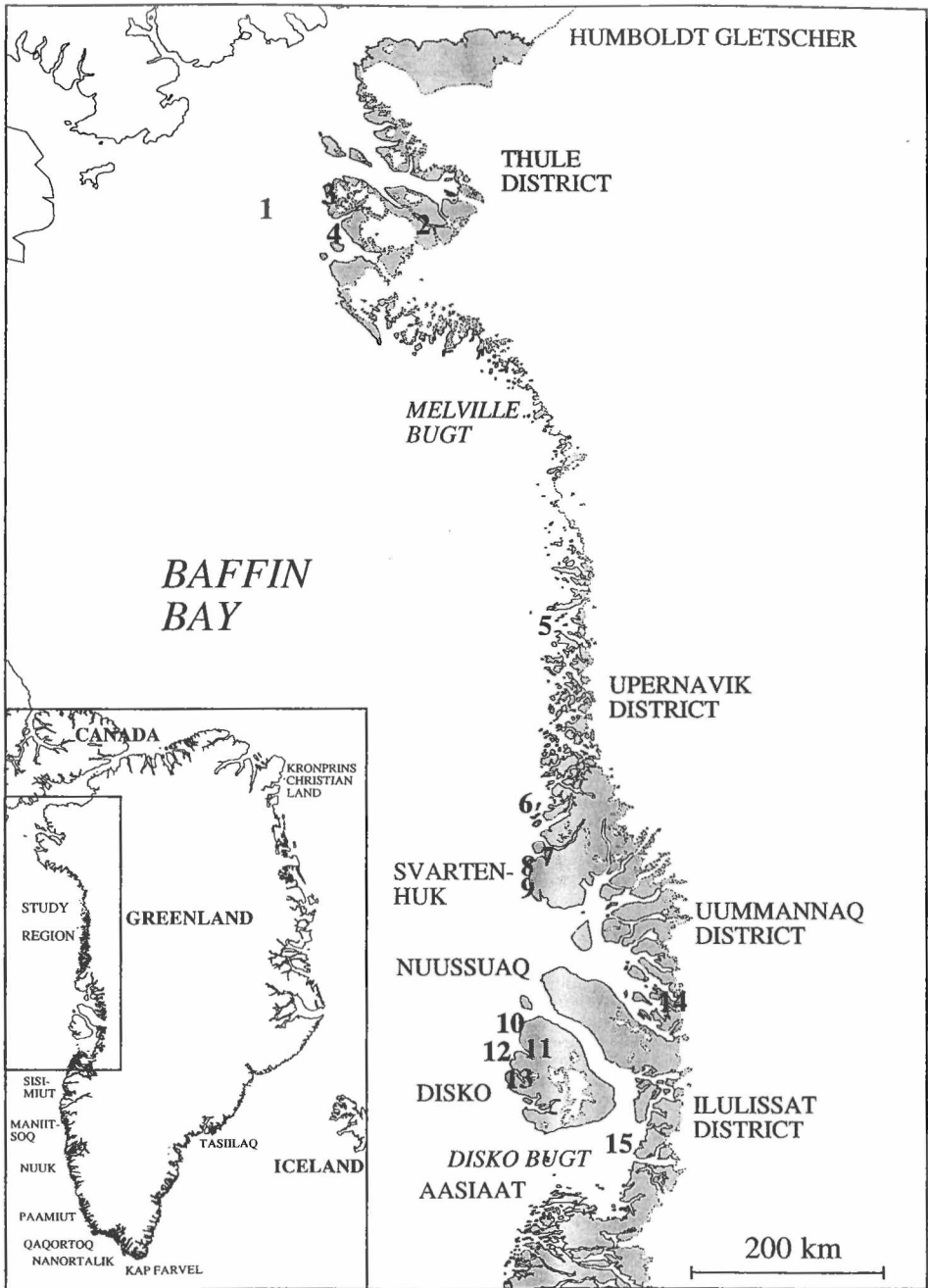


Figure 1. Sites in north-west Greenland where staging Light-bellied Brent Geese were observed during the autumns of 1987 and 1991-1995. Site numbers refer to localities given in Table 2. Dotted line indicates the border between ice free land (grey) and the icecap and large glaciers (white).

Table 1. Observation periods covering the autumn migration of Light-bellied Brent Geese in north-west Greenland 1987 and 1991-1995.

Period	Platform	Observer	Area
1 - 14 Aug 1987	Land	KK	Coast areas of central Thule District
13 - 16 & 25 - 26 Aug 1991	Land	OF	Mellemfjord, Disko
7 - 9 & 18 - 21 Sep 1991	Land	OF	Mellemfjord, Disko
9 - 23 Aug, 28 Aug - 4 Sep & 12-19 Sep 1992	Land	OF	Mellemfjord, Disko
12 Aug - 12 Sep 1992	Ship	NERI-AE	Mainly offshore areas between 64° and 69° N
22 Aug - 6 Sep 1992	Ship	NERI-AE	Coast and offshore areas between 64° and 71° N
20 - 26 July 1992	Aircraft	NERI-AE	Coast and inland areas between 67° and 72° N
23 - 30 Aug 1993	Aircraft	NERI-AE	Coast between 62° and 71° N
27 Jun - 20 July 1994	Boat	NERI-AE	Coast between 69° and 74,5° N
22 Aug - 9 Sep 1994	Land	NERI-AE	Nordfjord, Disko
22 Aug - 5 Sep 1994	Aircraft	NERI-AE	Coast between 68° and 78° N
27 July - 1 Aug 1995	Aircraft	NERI-AE	Coastal and inland areas between 67° and 72° N
23 Aug - 4 Sep 1995	Aircraft	NERI-AE	Coast between 68° and 79° N

KK = Kaj Kampp, OF = Ole Frimer, NERI-AM = National Environmental Research Institute, Dept. of Arctic Environment.

NERI-AE's Brent Goose observations were made mainly during aerial surveys for moulting Eiders, surveys which included most coastlines in the study region (**Figure 1**). The aircraft used was a Partenavia (PN 68) Observer, flying at 250 feet a.s.l. with a survey speed of 90 knots. The Disko Bugt area was surveyed in each year from 1993-1995, the coast between Disko Bugt and Thule District (79°N) in 1994 and 1995 and the coasts between Disko Bugt and Paamiut (62°N) in 1993. In 1994, the outer coastal areas between Disko Bugt and northern Upernavik District (74° 30'N), including many small offshore islands, were searched for seabird colonies by boat (Boertmann *et al.* 1996). In 1992 and 1995, NERI-AE performed aerial surveys for moulting Greenland White-fronted Geese *Anser albifrons flavirostris* in coastal and inland areas of central West Greenland between 67° and 72°N (C. Glahder *unpubl.*).

O. Frimer camped in Mellemfjord, western Disko Island at several times in 1991 and 1992 (**Table 1**). The main purpose was to study the moult ecology of King Eiders *Somateria spectabilis* (Frimer 1994, 1995), but observations on other birds including Brent Geese were also made.

Ring-recovery data and specimens of Light-bellied Brent Geese from Greenland and Iceland were studied in the Zoological Museum, Copenhagen (ZMUC).

A few observations by K. Kampp (*pers. comm.*), who stayed in Thule District in 1987 (**Table 1**), are also included in this study, as well as a few occasional observations by F. Salomonsen (*unpubl. field notes*), P. Grossmann (*pers. comm.*), S. Jürgensen (*pers. comm.*) and H. Meltofte (*pers. comm.*).

North-west Greenland is here defined as the coast from Disko Bugt (68°N) northwards to

Humboldt Gletscher (79°N), see **Figure 1**. Tasiilaq is the modern name of the town and district in south-east Greenland, which were formerly referred to as Ammassalik or Angmagssalik.

Results

Summer

Light-bellied Brent Geese were observed by us only once during summer: three individuals (two adults, one first-summer) on 13 July 1994 on the small offshore islands of Ederfugleøer in northern Upernavik District. The immature bird was in heavy wing moult, although able to fly. No Brent Geese were observed during the extensive surveys for moulting Greenland White-fronted Geese in the southern part of the study region in late July 1992 and 1995 (C. Glahder, NERI-AE, *unpubl.*).

Autumn

During the autumns of 1987 and 1991-1995, 33 flocks of staging Brent Geese were observed in 15 different localities (**Table 2**). Observations of flying geese, apparently on migration, are listed in **Table 3**.

It was generally not possible to age any birds in the flocks due to the observation conditions, and information on broods was recorded only from a single observation near Ilulissat town on 10 September 1987, where a flock of 15 held at least two broods (H. Meltofte *pers.comm.*).

Almost all resting flocks were seen on the sea. In Mellemfjord, the geese seem to rest on deep water in the central part of the fjord immediately upon arrival. Later they move to shallow water close to the coast, either off saltmarshes or in river deltas. A flock seen near Ilulissat town in 1987 also rested on the water where they fed just off the shoreline.

P. Grossmann (*pers.comm.*) reports observations from Sisimiut District (app. 67° N): 13 were shot 15 September 1969 at an inland lake; one was shot from a flock of seven on a coastal islet, 29 August 1976; five (two ads, three juvs) were shot from a larger flock on offshore islets on 12 September 1993.

During a stay in Thule District, F. Salomonsen (*unpubl.* field notes) observed two flocks of Brent Geese (22 and eight) on Carey Islands on 21 August 1978.

Autumn ring recoveries

Ten Brent Geese ringed abroad (on the Canadian breeding grounds and in Iceland) have been recovered in Greenland. Seven were recovered in autumn, four in west Greenland and three in east Greenland (**Table 4**).

Study skins

The collections at ZMUC include 34 specimens of Light-bellied Brent Geese from Greenland. 17 of these were obtained during autumn in west Greenland, from 1895-1978. Five were shot at the same site and on the same date as another skin, probably from the same flock or family party, leaving twelve distinct autumn records. Three specimens are autumn records from the Tasiilaq District, south-east Greenland (**Table 5**).

Discussion

Summer observations

The single summer record concerned non-breeding birds, probably moulting on a group of small offshore islands, resembling breeding habitats in Svalbard as described by Madsen *et al.* (1989). The islands may have been one of the previous breeding sites of northern Upernavik District referred to by Salomonsen (1950).

There is no indication of large numbers of non-breeders moulting in Greenland, supporting the belief that non-breeding Light-bellied Brent Geese, unlike many other goose populations (Salomonsen 1968), moult close to the breeding grounds.

Autumn migration

The Brent Goose goslings of Queen Elizabeth Islands fledge generally in the second half of August (occasionally into early September) and moulting non- and failed breeders resume flying

Table 2. Observations of staging Light-bellied Brent Geese in north-west Greenland 1987 and 1991-1995.

Locality	Locality on Figure 1	Date	Flock Size	Habitat
Carey Øer, Thule	1	9 Aug 1987	4	Small offshore rocky islands
Carey Øer, Thule	1	10 Aug 1987	18	Small offshore rocky islands
Carey Øer, Thule	1	11 Aug 1987	≥4	Small offshore rocky islands
Ilulissat town, Ilu.	15	10 Sep 1987	15*	Shoreline
Mellemfjord, Disko	13	25 Aug 1991	c. 200	On fjord
Mellemfjord, Disko	13	7 Sep 1991	34	Low coast in fjord
Mellemfjord, Disko	13	28 Aug 1992	c. 300	Low coast in fjord
Mellemfjord, Disko	13	29 Aug 1992	c. 150	Low coast in fjord
Mellemfjord, Disko	13	4 Sep 1992	19, 36, 75	Low coast in fjord
Mellemfjord, Disko	13	23 Aug 1994	c. 300	Low coast in fjord
Carey Øer, Thule	1	24 Aug 1994	4	Small offshore rocky islands
Olrik Fjord, Thule	2	24 Aug 1994	35	Low coast in fjord
Milloorfik, Svartenhuk	7	27 Aug 1994	30	Low coast in fjord
Narsaq, Svartenhuk	9	27 Aug 1994	15	Low coast behind barrier
Store Fladø, Upv.	6	29 Aug 1994	15	Low island with extensive tundra
Nordfjord, Disko	11	2 Sep 1994	3	Low coast in fjord
Nordfjord, Disko	11	3 Sep 1994	42	Low coast in fjord
Booth Sund, Thule	3	26 Aug 1995	3	Low exposed coast
Manson Øer, Thule	4	26 Aug 1995	2	Small rocky island in fjord
Carey Øer, Thule	1	29 Aug 1995	5, 8, 35	Small offshore rocky islands
Qeqertat, Upv.	5	31 Aug 1995	55	Small rocky and exposed islands
Milloorfik, Svartenhuk	7	1 Sep 1995	75	Low coast in fjord
Svartenhavn, Svartenhuk	8	1 Sep 1995	90	Low coast in fjord
Nordfjord, Disko	11	3 Sep 1995	6, 65, 85	Low coast in fjord
NW coast of Disko	10	3 Sep 1995	90	Low exposed coast
Qasigissat, Disko	12	3 Sep 1995	10	Low coast in bay
Sermerlat Kangerluat, Umq.	14	4 Sep 1995	45	Small rocky island in fjord

Total in 1991: c. 234; in 1992: 580 (mean flock size: 116.0); in 1994: 444 (mean flock size: 55.6); in 1995: 574 (mean flock size: 41.0). Upv. = Upernavik District, Umq. = Uummannaq District, Ilu. = Ilulissat District. * incl. two broods.

Table 3. Observations of migrating Light-bellied Brent Geese in north-west Greenland 1987 and 1991- 1995.

Locality	Date	Flock size	Heading
Carey Islands, Thule	11 Aug 1987	25	W
Mellemfjord, Disko	4 Sep 1992	c. 150	SE through the fjord
South of Uumannaq town	29 Aug 1992	120	S
Ilulissat town, Ilu.	23 Aug 1994	84	SE

Ilu. = Ilulissat District.

late July to early August (H. Boyd *pers.comm.*, M. O'Briain, A. Reed & S. D. MacDonald *pers.comm.*). In non-breeding or failed breeding seasons all Brent Geese have left the study areas on Bathurst Island by mid August (O'Briain *pers.comm.*) suggesting that the geese observed by Kaj Kampp 9-11 August in Thule District were early post moulting non- or failed breeders.

Our (Table 2) and F. Salomonsens (in 1978) observations indicate that the first autumn migrating Brent Geese arrive about 21-25 August. Considering the time when the goslings fledge (see above), these early birds are probably without broods.

The more or less simultaneous arrival at the Thule District and the Disko/Svartenhuk-region suggests that the geese observed in the last region had crossed Baffin Bay on a direct flight from Canada perhaps from breeding grounds in the western part of the range such as Bathurst Island. The geese observed in Thule District in late August may have their origin from rather close breeding grounds (eg Ellesmere Island).

Only a single flock has been seen in central Upernavik District and none in Melville Bugt, indicating that most of the geese passing the Thule District subsequently fly across the Melville Bugt to Disko/Svartenhuk rather than following the coast.

The few recent observations of autumn Brent Geese reported in the literature (Kampp & Kristensen 1980, Bennike 1990) are in accordance with our observations.

There are no recent observations of Brent Geese in north-west Greenland later than 10

September, but a single ringed goose (juv.) was shot 16 September 1985 in Disko Bugt (Table 4). Although our observation effort in mid- and late September is low, the lack of observations in Mellemfjord during two observation periods (18-21 September 1991 and 12-19 September 1992) suggests that the great majority have left north-west Greenland by mid-September.

This timing of the autumn migration (late August to mid-September) is markedly earlier than stated by Salomonsen (1950, 1967) and other historical sources (Winge 1898, Bertelsen 1921). However, it fits perfectly into the arrival pattern in Iceland, which begins in late August, peaks 10-15 September and ceases around 20 September (Petursson 1986, G. Gudmundsson *pers.comm.*, A. Sigfusson *pers.comm.*).

The Brent Goose autumn migration through the Tasiilaq District in east Greenland has been described by Helms (1926) based on observations by J. Petersen from 1895 to 1923: Three records (all of flocks) are from the period 1-3 September, 13 records from 13-24 September concerned flocks (often staging and including many juveniles), while single flocks (including juveniles) were observed on 1, 7 and 15 October. J. Rosing (*pers.comm.*) often observed staging Brent Geese through September in the vicinity of Tasiilaq town during the late 1930s. Recent observations of Brent Geese in Tasiilaq are very few. S. Jürgensen, living there, writes (*pers.comm.*) that Brent Geese today occur in low numbers during autumn, and he has only one Brent Goose observation with an exact date, a flock of 200 staged for two days close to the town on 19-20 September 1976.

Table 4. Autumn ringing recoveries of Light-bellied Brent Geese in Greenland.

Recovery area	Date	Age when ringed	Time since ringing
West Greenland			
Ilulissat (69° N)	3 Sep 1975	ad	4 years
Paamiut (62° N)	9 Sep 1987	pull/juv	same year
Paamiut (62° N)	11 Sep 1978	ad	6 years
Qasigiannugit (68,8° N)	16 Sep 1985	juv	same year
East Greenland (Tasiilaq District)			
Kuummiit (66° N)	26 Aug 1992	-	0.5 year*
Tasiilaq (65,7° N)	18 Sep 1986	ad	9 years
Tasiilaq (65,7° N)	10 Oct 1975	ad	1 year

* ringed during spring migration in Iceland. All others were ringed on Canadian breeding grounds (Seymour, Bathurst, Axel Heiberg, Ellesmere and Melville Islands).

This later timing of the autumn migration recorded previously in Greenland may be explained by the fact that the population then (before 1930) probably was much larger (Boyd 1979), and the temporal and spatial window for the autumn migration probably was somewhat wider than today. As the comparatively late records often concerned juveniles or families, there is no reason to believe that the geese migrate earlier now. It is more likely that the early geese recorded by us are non- or failed breeders which passed more or less unnoticed through Greenland, and that the geese recorded (shot) previously were mostly family parties, which staged for longer periods, particularly in Tasiilaq. The few present day records of family parties or juveniles are late (9, 10, 12, 16 September (**Tables 2 and 4**, P. Grossmann *pers.comm.*), supporting the hypothesis that family parties migrate later through Greenland than non- or failed breeders, and in agreement with the observations from Tasiilaq early this century.

Staging areas in north-west Greenland

Almost all of our Brent Geese were observed in the outer coastal areas of north-west Greenland, on small rocky offshore islands or low coasts with salt marshes or river deltas.

Only two flocks were seen in heads of fjords far from the outer coast. This is in agreement with the general statements of earlier authors (Winge 1898, Bertelsen 1921, Salomonsen 1950, 1967). Moreover, have Brent Geese occasionally been observed at lakes far inland (Salomonsen 1950, P. Grossmann *pers.comm.*).

The observation of a flock in the head of a fjord in Uumannaq District (no. 14), 10 km from the edge of the icecap, suggests that Brent Geese may cross the icecap north of the route between Disko Bugt and Tasiilaq.

Occurrence in south-west Greenland (south of 68°N)

The great majority of the Brent Geese probably perform a transglacial flight from Disko Bugt to the Tasiilaq area. However, Brent Geese are occasionally reported from the region to the south of Disko Bugt as the observations by P. Grossmann (*pers.comm.*) in Sisimiut District (67°N), and the two ringed Brent Geese recovered from Paamiut District (62°N) (**Table 3**), show.

There are very few published observations from south-west Greenland, Oldenow (1933) refers to a single specimen shot in Nuuk District on 19 September 1926 and Salomonsen (1950) mentions the records also

documented by skins in ZMUC (Table 5). It is remarkable that the majority of the south-west Greenland records are late (late September and October).

The geese occurring in Sisimiut District may also be heading towards Tasiilaq in east Greenland, as some geese in spring seem to cross the icecap south of the Tasiilaq-Disko Bugt flyway (Gudmundsson *et al.* 1995). Salomonsen (1950, 1967, 1979) supposed that Brent Geese recorded further south than Sisimiut, either were heading towards wintering grounds in eastern USA, or used an alternative route via Kap Farvel to Iceland or directly to Ireland. The late occurrence of the south-west Greenland records may be in favour of the last hypothesis.

Numbers

The population of Brent Geese passing Greenland during autumn numbers about

20,000 birds (Madison *et al.* 1991). If we summarise our observations for each year, the maximum totals about 730 in 1992 (Tables 2 and 3). This comparatively low number could be explained by: important staging areas not located by us, particularly in the tail of the migration period when our observation effort is low; and/or only a small segment of the population actually stages in north-west Greenland, while the majority migrate more or less directly to Iceland (like in spring in the opposite direction). More detailed studies are needed to enlighten these possibilities.

It is, however, reasonable to assume that non- and failed breeders are capable of flying directly from Canada to Iceland without stop-overs in Greenland. While it is questionable that the juvenile geese would be capable of performing the extremely demanding transglacial flight (Gudmundsson *et al.* 1995) without staging. Either in north-west Greenland or perhaps more likely in east Greenland. The fact that

Table 5. Brent Goose Autumn specimens of Light-bellied Brent Geese from Greenland lodged in the Zoological Museum, Copenhagen.

Date	District	No. and age
West Greenland		
16 Aug 1909	Nanortalik	1 imm.
30 Aug 1917	Maniitsoq	1 imm.
30 Aug 1978	Disko	2 imm
1 Sep 1925	Disko	2 ads
8 Sep 1899	Nuuk	1 ad.
28 Sep 1904	Maniitsoq	1 juv.
-- Oct 1913	Qaqortoq	1 imm.
10 Oct 1903	Sisimiut	1 juv.
10 Oct 1913	Nuuk	1 ad.
12 Oct 1912	Qaqortoq	1 ad. + 1 imm.
20 Oct 1908	Qaqortoq	1 ad. + 1 juv.
22 Oct 1895	Nuuk	1 ad. + 1 juv.
South-east Greenland		
7 Aug 1936	Tasiilaq	1 imm.
7 Sep 1933	350 km NE of Tasiilaq	1 ad.
15 Oct 1901	Tasiilak	1 juv.

ad. = adult, imm. = immature (second calander-year), juv. = juvenile.

Brent Geese often stage in Tasiilaq District indicates that they have crossed the icecap with low fat deposits (light and consequently with a relatively high climbing performance see Gudmundsson *et al.* (1995)) rather than with full energy reserves, and reducing the need for staging in north-west Greenland.

Conservation

The Brent Geese observed were concentrated in two areas between 69° 30' - 72° N: western Disko Island and western Svartenhuk Peninsula. Both areas are characterised by exposed tertiary basalts (Escher & Pulvertaft 1995) and extensive low coasts. Saltmarshes are widespread along these coasts, compared to the Precambrian bedrock coasts elsewhere in west Greenland.

Except for occasional (and illegal) shooting, there are no acute threats to the Brent Geese staging in north-west Greenland. However, there are extensive offshore areas with hydrocarbon potential, and future exploration is expected. Incidental oil spills may reach the low coasts and foul the Brent Goose habitats. Moreover, the geese are exposed to oil spills because they often rest on the water off the shoreline where they feed. But as they seem to be rather dispersed along the coasts, as they stay in north-west Greenland for a brief period and an unknown segment perhaps do not stage at all, only small proportions of the population may be affected by an oil spill on this coast.

Further research on the Brent Geese and their staging areas in north-west Greenland is needed to mitigate potential oil spill effects on the small and vulnerable Brent Goose population (Tucker & Heath 1994) passing through north-west Greenland. Such research should include tracking of geese equipped with satellite transmitters on the breeding grounds to test whether substantial numbers overfly north-west Greenland or we simply have failed to locate them during our surveys.

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