2008

Field report from Sand Island, Northeast Greenland - 2008

Carsten Egevang[1], **Iain J. Stenhouse**[2], **Lars Maltha Rasmussen**[1], **Mikkel Willemoes**[3] *and* **Fernando Ugarte**[1]

[1] Greenland Institute of Natural Resources

[2] National Audubon Society

[3] University of Copenhagen

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The photos in this report are all from the 2008 season, taken by the authors.

Background

The main aim of this study is to track the long-distance migration of two High Arctic breeding seabird species, the Arctic Tern (ARTE) and the Sabine's Gull (SAGU). By retrieving small geo-locator data loggers (which record ambient light level and thereby archive daily geographical position) attached to breeding birds in 2007, a full year of migration can be tracked from the breeding colony in Northeast Greenland to their wintering areas in the Southern Hemisphere, presumably between South Africa and Antarctica.

Fieldwork was conducted over the period of 16 July to 26 August, 2008, at Sand Island (N 74.263; W 20.160), Young Sound, Northeast Greenland. Sand Island is approximately 0.22 km^2 (920 m long by 380 m at the widest point), and peaks at only 2.5 meters above sea level at high tide. The substrate consists mostly of fine sand and gravel, but a raised section in the centre of the island supports sparse vegetation, mostly dominated by willow (*Salix* sp.).

The location of Sand Island in the middle of Young Sound and the low altitude of the island make the site extremely exposed to bad weather. The weather in the 2008-season was generally settled, with some sunny and "warm" days early in the season. At the end of the season (22-24 August), however, a severe weather system hit the Young Sound area with wind speeds of 20 m/s, gusting to 35m/s. The storm caused all lower parts of the island to be flooded, two of three tents in the camp to collapse, and significantly increased mortality amongst chicks that had not reached fledging.

Geo-locator data loggers

Of 50 geo-locator loggers attached to ARTEs in 2007, ten loggers (20%) were retrieved in 2008 – and of 30 loggers attached to SAGUs in 2007, eleven loggers (37%) were retrieved in 2008. However, the total number of individuals of both species with loggers observed in the colony was greater and "logger birds" were seen at Sand Island throughout the field season. This indicates that

Map of study area. Red arrow show location of Sand Island.


Arrival at Sand Island 16 July.


Arctic tern beeing released after logger removal.


Sabine's Gull with chick app. 4 days old.

a high proportion of the birds equipped with loggers in 2007 achieved the long distance migration to their wintering areas in the Southern Hemisphere and returned to breed on Sand Island in 2008. Furthermore, the behaviour of "logger birds" at the colony appeared to be completely unaffected by the presence of the logger and many of these birds are known to have successfully raised young in 2008 without any obvious sign of their abilities being compromised in any way.

None of the recaptured ARTEs were found breeding in the nest cup used the previous season, but 2008nests were found between 10 and 220 meters from the 2007 nest site. All ten birds were in good physical condition and no significant difference ($t=-1.57$, $p=0.133$, $df=18$, $n=10$) could be detected in body mass of individuals in 2007 (106.0 g $\pm$ 6.29) and 2008 (110.3 $\pm$ 5.95). The recaptured SAGUs also shifted nest site (estimated distance 5-150 m) and the body mass of individuals did not differ ($t=-0.29$, $p=0.769$, $df=16$, $n=9$) in 2007 (176.1 g $\pm$ 10.83) and 2008 (177.7 g $\pm$ 11.29).

We closely examined the legs and feet of all individuals at the time of logger removal. Other than slight wear from the edges of the logger ring on the legs of a four ARTEs and one case of slightly swollen tissue close to the logger, we saw no signs of harm to any of these individuals caused by the presence of the logger. There was no sign of wear caused by loggers on any of the SAGUs examined.

The retrieved geo-locators were not downloaded on location but instead transported to Denmark where data was downloaded to a computer in office. At present the geo-locators are being processed by the British Antarctic Survey, and preliminary results looks very promising.

Population size

The early season in the Young Sound area was characterized by a late snow melt in 2008, with much of the ground remaining snow covered until late June. This likely resulted in reduced area available for nest sites and altered the breeding distribution of birds on Sand Island compared with the 2007 season. For example, in 2008, SAGUs nested exclusively on the raised, central part (*The Plateau –section C, Fig. I*) of the island, whereas approximately 20% of SAGU nests were found outside this area in 2007. The ARTEs showed an even greater difference in breeding distribution


Arctic Tern on the wing


Searching for Polar Bears in the drift ice.


Common Eider duckling.


Deploying satellite transmitter on a Walrus bull.

between the two years. In 2007, ARTE nests were distributed over most of the Island with very few sites completely without nests. In 2008, the late snow melt probably reduced the area of the island available for nesting during the early breeding season when territories are established. The majority of the ARTE population nested on "The Plateau" in 2008, resulting in a considerably higher nest density compared with 2007. The remainder of the island was either without breeding ARTEs or with extremely low nest densities. The only exception to this was the northernmost tip of the island (*section A, Fig. I*) where 150-200 pairs nested. The late snow melt also resulted in a prolonged and asynchronous breeding season for ARTEs (See *phenology*).

Given the focus on retrieving geo-locators, no actual counts of the breeding population were conducted in 2008. However, the 2008 population was estimated to be of similar magnitude to that of 2007 (700-1000 ARTE pairs and 60-65 SAGU pairs).

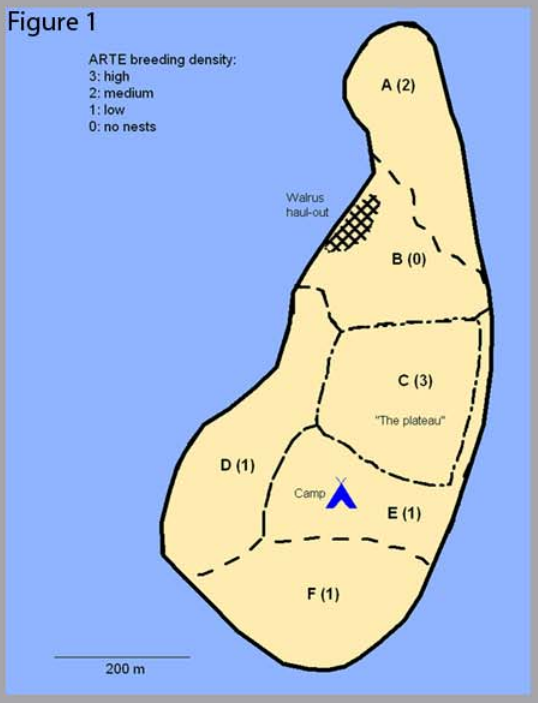
In late July, numbers of ARTEs and SAGUs at Sand Island seemed markedly lower compared to the beginning of the field season. This was likely a result of non-breeders and failed breeders leaving the colony, perhaps combined with adult breeders spending more time at sea during the chick-provisioning period.

A total of 80-100 Common Eiders nested across Sand Island in 2008, in sharp contrast to the situation in 2007 where only a single active nest of this species could be found (due to Arctic fox predation early in the season). Consequently, in late July and early August 2008, many large crèches of Common Eider ducklings were observed on the shores and in the water around the island.

In the early season, up to four female Long-tailed Ducks were observed on Sand Island in 2008. Although evidence of only one Long-tailed Duck (unsuccessful) nest was found there may have been several other breeding attempts. One pair of Lesser Black-backed Gulls nested in the central part of the island amongst breeding ARTEs, SAGUs, and Common Eiders. Up to five additional Lesser Black-backed Gulls visited the island on several occasions.

Besides the breeding birds on Sand Island, a number of other bird species were observed during the field season. Shorebirds (Sanderling, Red Knot, Dunlin, Ruddy Turnstone, Purple Sandpiper, and Red Phalarope) were observed in passage using Sand Island as

Figure 1



Map of Sand Island drawn from GPS track, 2008. Sections of the island and ARTE breeding density are indicated by capital letters and a number in parenthesis.

Setting the trap for SAGU catching.

Pack ice close to Sand Island.

a short stop-over site. For a complete list of avian species observed on Sand Island in 2008, see appendix I.

Phenology

To follow ARTE hatching rate, chick growth and survival, a study plot ("N") was established at the northern part of the island (section A, Fig. I) where 50 nests were encircled with 'chicken wire' enclosures to insure consistent daily measurements of hatching status and chick mass/wing length. Due to a different behaviour in SAGU chicks (which move over larger distances) this method was not appropriate at SAGU nests and growth measurements for this species were more opportunistic.

The late snow melt in 2008 combined with absence of Arctic Fox throughout the breeding season (see *Predation*) resulted in a different breeding phenology from the 2007 season. Egg hatching was fairly synchronous in 2007, but hatching in both ARTEs and SAGUs was protracted in the 2008 season. Generally, ARTEs breeding on the plateau hatched earlier than ARTEs breeding elsewhere on the island.

The first ARTE chicks (estimated to be 3-4 days old) were observed at "The Plateau" on our arrival (16 July), which is approximately 2 weeks earlier than the first observed ARTE chick in 2007. From this date ARTE chicks were increasingly often observed, however nests, both within the boundaries of the plateau and especially outside, showed a markedly dispersed hatching in 2008. The median hatching date for study plot "N" was 1 August (0.25/0.75 quartile: 26 July/3 August, n=76 recorded hatching dates). Hatching was observed over a broad range of dates, however, with the first chick observed in plot N on 22 July and the last on 12 August.

The first ARTE fledgling was observed on 2 august in 2008, approximately the same date as the first hatchling was observed in 2007. Adults were leaving the colony by late August. On 21 August, the number of ARTEs on "The Plateau" was notably low and only 25-30 ARTEs were alarm calling. After the storm on 25 August, only one bird was observed in this area.

SAGUs also showed a protracted and "early" breeding season in 2008. The first chick (4-5 days old) was observed on 16 July, 10 days earlier than in 2007. The first SAGU fledgling was observed on 5 August. As in the ARTEs, hatching did not appear to be highly


Weighing Sabine's Gull chick.


Satellite transmitter on the back of a Walrus.


Lesser Black-backed Gull


Arctic tern defending its nest.

synchronous and chicks observed around 1 August included near-fledglings, mid-sized chicks, and newly hatched chicks.

Recently-hatched Common Eider ducklings were observed on our arrival on the island (16 July) and last chicks were observed on 6 August, when a clutch of two near the camp left the nest for the water.

Table 1: Mean clutch size, egg size, and calculated volume of Arctic Tern and Sabine's Gull eggs, Sand Island, 2008.

	Arctic Tern (SD)	*n*	Sabine's Gull (SD)	*n*
Clutch size	1.65 (0.50)	60	1.93 (0.77)	28
Length (L) all eggs (mm)	40.14 (1.69)	73	41.52 (1.60)	30
Width (W) all eggs (mm)	29.15 (0.92)	73	30.65 (1.11)	30
IEV all eggs (ml)	16.40 (1.42)	73	18.77 (1.88)	30
IEV A-egg (ml)	16.52 (1.42)	44	19.75 (1.54)	15
IEV B-egg (ml)	16.23 (1.43)	29	18.36 (1.89)	9
IEV C-egg (ml)	-	-	16.39 (1.04)	3

IEV: Internal Egg Volume=0.00048 L W^2 (Suddaby & Ratcliffe 1997)

Reproductive outcome

The average clutch size of ARTEs in 2008 was 1.65 with no 3-egg clutches observed (Table 1). The hatching success in plot "A" was 85.9% (SD=35.03, n=85 eggs) where addled eggs, chicks that died during hatching, and predated eggs are included in "unsuccessful eggs". Chick survival (chicks from hatched eggs that survived until fledging or assumed fledging) was 69% (SD=46.6, n=71 chicks) and the average productivity in plot "A" in 2008 was 1.04 chicks per nest (SD=0.771, n=48 nests). Both chick survival and productivity is relatively high compared with studies in West Greenland and most other places where ARTEs have been studied. Furthermore, in several (15 of 48 nests) ARTE nests, the parents were able to produce two fledglings per nest – something that was only rarely observed in comparative studies conducted in West Greenland 2002-2006 – indicating that favourable feeding conditions were likely present in Young Sund during the 2008 breeding season. The


ARTE chick being fed with zooplankton (*Themisto*)


Measuring SAGU chicks.


Glaucous gull predationg on ARTE chick.


Visit by the MarineBasic group.

high survival/productivity may well be biased by the fact that ARTE chicks could only be followed until 24 August when a severe storm system hit the Young Sund area. This event likely had a massive effect on chick survival which could not be recorded systematically.

The average daily chick mass gain in the linear growth period (day 4-14) was 5.99 g (Fig. 2), and the average daily wing growth (day 4-14) equalled 8.27 mm (Fig. 3).

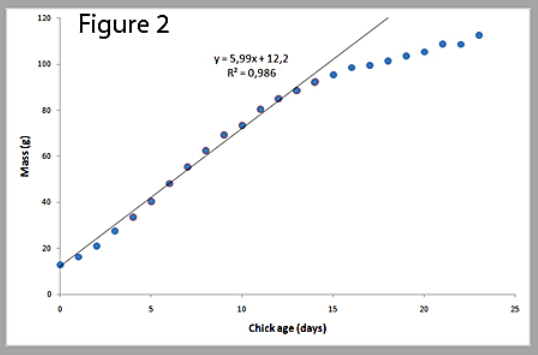
The SAGU clutches in 2008 were of one, two, or three eggs, with an average clutch size of 1.93 eggs (Table 1). It was not possible to obtain standardized estimates of SAGU hatching rate, chick survival, or productivity in 2008, but from daily random measurements of ringed SAGU chicks (n=34 chicks of both known and unknown age) growth rates could be addressed. The average daily SAGU chick mass gain in the linear growth period (day 4-14) was 13.16 g (Fig. 4), and the average daily wing growth (day 5-14) equalled 11.34mm (Fig. 5). Although no systematic estimates of chick survival was possible in 2008, the random measurements shows that at least 14 (41%) of 34 SAGU chicks reached an age of 14 days (where survival to fledgling is high). Furthermore, a census for SAGU fledglings on and close to Sand Island on 17 August revealed only ten fledglings – of which at least two were without rings. However, SAGU fledglings may have left the proximity of Sand Island by this date and the number of chicks surviving could have been higher.

Common Eider nests on Sand Island contained between one and six eggs with an average clutch size of 3.3 eggs per nest (*n*=52 nests, SD=0.92).

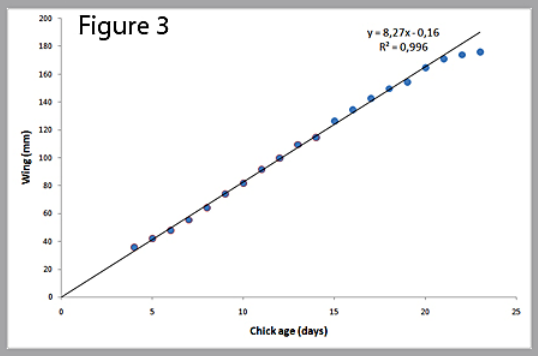
The Lesser Black-backed Gull nest was first visited on 17 July and contained one egg (63.2 x 46.0 mm). This egg had not hatched on 22 August (likely addled) and the nest was abandoned on 25 August after the storm, so the most northerly known breeding pair of Lesser Black-backed Gulls was not successful in 2008.

Feeding observations

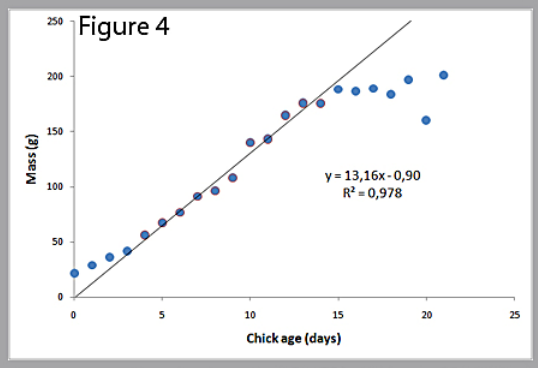
Large multi-species feeding concentrations (including ARTEs, SAGUs, and Common Eiders) were regularly observed throughout the incubation and food provisioning period. They usually formed relatively close to shore and were seen on all sides of the island, although most often in the waters immediately to the south and to



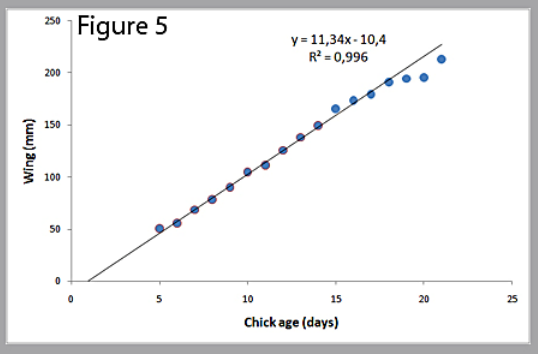
Average growth rates (mass) of ARTE chicks (n=76 chicks).



Average growth rates (wing) of ARTE chicks (n=76 chicks).



Average growth rates (mass) of SAGU chicks (n=33 chicks).



Average growth rates (wing) of SAGU chicks (n=33 chicks).

the north, where tidal currents were particularly strong. These feeding concentrations formed quickly, moved rapidly, and were often short-lived. Thus, their ephemeral nature suggests that specific oceanographic conditions were required for birds to access this particular resource.

Table 2. Distribution of prey species observed in Arctic Tern chick feeds, Sand Island, August 2008.

Prey Species	Numbers (% of total)	Average size[1] (± SD)
Fish larvae	1063 (71.0)	0.9 (0.16)
Polar cod (juvenile)	84 (5.6)	1.3 (0.51)
Small unidentified fish	34 (2.3)	1.2 (0.20)
Fish larvae (round fish)	21 (1.4)	1.0 (0.10)
Unidentified fish	9 (0.6)	1.9 (0.17)
Crustaceans	168 (11.2)	0.7 (0.60)
Krill	76 (5.1)	0.7 (0.21)
Polychaetes	42 (2.8)	0.7 (0.37)
Total	**1497 (100)**	

[1]: Size = adult ARTE bill length (app. 3.2 cm)

When the SAGU chicks reached fledging age, they moved to the shore with the adults. In these days the SAGUs formed flocks of fledged young and adults, either roosting on the shore or on the water close to the shore. The numbers of adults present, however, indicated that not only parents joined these flocks. The fledglings were not seen participating in feeding flocks, and were most likely still being fed by their parents, although their flight skills were well developed. The ARTEs also formed roosting flocks of young-of-the-year and adults late in the breeding season, but were always observed roosting on shore. Roosting flocks of the two species always remained separate and distinct.

The diet of ARTEs, SAGUs, and most other seabirds in Northeast Greenland is largely unknown and, in 2008, effort was made to observe chick feedings on Sand Island. Between 5 and 21 August (the chick-rearing period), standardised feeding observations (total: 50 hours and 51 min) were conducted on ARTEs from a movable hide in plot A. The majority (81%) of feeds to ARTE chicks


Common Eider nesting close to camp.


Arctic Tern being chased by an Arctic Skua.


Greenland film crew documenting research activities.


Common Eider at midnigth.

were made up of fish, with fish larvae (likely Polar Cod) being most important in terms of numbers (Table 2). Crustaceans (especially a *Thysanoessa*-type) were also important prey species and comprised approximately 16% of the items brought to the chicks. Furthermore, polychaetes (likely *Nereis*) were occasionally observed in chick feeds (approx. 3%).

Besides feeding observations from a hide, random observations of ARTE flying with prey in their bill (*display fish* used in courtship behaviour) was made early in the season. These were made up of fish species (Polar cod of 8-14 cm) and in some cases long (10-12 cm), reddish polychaetes.

No standardised feeding observations were conducted on SAGUs, but random chick feeding was observed on a few occasions and sometimes adult SAGUs regurgitated food when captured. Fish - two of considerable size (more than 12 cm) - and tiny zooplankton were seen on these occasions.

Predation

No mammalian predators were observed on the island during the period of fieldwork in 2008, and judging from the high number of active Common Eider nests, it is likely that sea ice around Sand Island broke up early in the season, preventing Arctic Foxes from accessing the island. Thus, in 2008, predation risk was limited to avian predators. An adult Peregrine Falcon was observed hunting in the colony on one occasion – this is well north of the documented distribution of the species in Northeast Greenland. An adult male Gyrfalcon visited the colony 2-4 times a day from 5 to 9 August. These visits normally lasted ½-1 hour and caused massive disturbance. This Gyrfalcon was observed killing a Common Eider and an adult ARTE. Two other Gyrfalcons (identified from photos) visited the island between 2-9 times daily from the 17 to 22 August, when they preyed on ARTE fledglings. The single pair of Lesser Black-backed Gulls that was resident on the island was observed preying on ARTE/SAGU chicks on several occasions. The presence of these birds was the catalyst for much mobbing by both ARTEs and SAGUs. Glaucous Gulls were frequent visitors to the island, usually an individual bird or two, but up to five were seen at one time. Common Ravens were also regular visitors, but tended to remain close to the walrus haul out early in the breeding season. During chick-rearing Common Ravens were observed predating ARTE chicks daily. Long-tailed Skuas and Arctic Skuas


Severe storm caused the camp to collapse.


Gyrfalcon bloody after eating common eider..


Common Raven predation on ARTE chick.


SAGU fledgling.

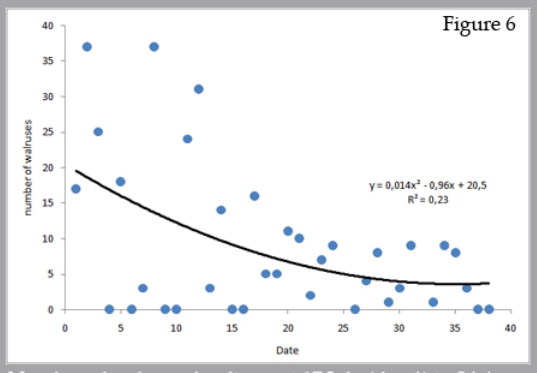
visited the island occasionally throughout the season. While on and around the island, they focused their attention on harrying ARTEs which were returning to the island with obvious fish. They did not appear to chase SAGUs on a regular basis, probably because food-provisioning SAGUs are not clearly identifiable – they carry a mass of small food items in their throat and not large, single items in the bill, as ARTEs do.

Walrus

In addition to the bird study on Sand Island in 2008, a second aim of the fieldwork was to test the performance of a new generation of satellite transmitters on walruses. This type of sender has been used on walruses in West Greenland and has been found to tends to transmit signals for a shorter time period than expected. By attaching senders into individually recognisable walruses that periodically haul out in an accessible site, we expected to follow the fate of the senders through a combination of direct visual observations and analysis of the received satellite data. This study was also conducted as a pilot study for an assessment combining aerial surveys with information from satellite transmitter, scheduled for 2009.

Sand Island is one of the few terrestrial walrus haul outs in Greenland and daily counts of walruses were conducted at the beach on the north-western part of the island (Section B, Fig. I). From mid-July to 24 August, the number of walruses hauled out varied from 0 to 37 animals with a declining trend over time (Fig. 6). As in 2007, on days with strong wind and heavy rain, no or very few walruses were observed. In 2008, however, we also observed several quiet and sunny days in which no walruses hauled out.

The average number of walruses using Sand Island as a haul out site in 2008 was 8.9 per day (+10.51, n=36 days), notably lower than in 2007, where on average 17.4 animals (11.81, n=22 days) used the beach per day. We can only guess about the cause(s) for this, but the low numbers correlate with a relatively high level of disturbance in 2008. Besides our presence, a total of four film crews visited Sand Island to film the walruses at close range. Furthermore, visitors of various kinds (researchers, staff, and visitors at Daneborg etc.) visited the walruses during the season. On 13 August a helicopter from the Danish Navy flew low over the haul out – likely to film the walruses.



Number of walruses hauling out 17 July (day 1) to 24 August.


Film crew at the walrus houl-out.


Satellite sender on arrow


"Broken double tusk" after satellite sender deployment

On 18 July, 2008, three walruses were equipped with satellite transmitters (shot with $C0_2$ gun) and these animals were followed through the season. We tagged individuals that were easy to recognise due to broken tusks, and took identification photographs of the rostrums and tusks for future reference. The haul out site was visited several times a day to see if the tagged animals were back on the beach. When a tagged animal was observed, notes on the status of the tag (wounds, bleeding etc.) were kept, and a picture of the tag was taken using a lens with long focal length.

Bearded seals, the only other marine mammals seen in the area, were observed feeding around the island on several occasions.

Other activities

In 2008, a TV film crew of two persons, Journalist Thomas Grue Jakobsen (Gruefilm) and Photographer Ulrik Bang (Bang.gl) from Nuuk, Greenland, documented the research activities at Sand Island over the period of 24 to 30 July.

As in 2007, the extent of Sand Island was recorded by walking along the shoreline (mid-tide) of the island with a tracking GPS.

In cooperation with the Marine-Basic-group, a fish and zooplankton survey was conducted in the waters around Sand Island on 2 August. A 5 mm mesh net, designed to trawl only in the upper layer of the water column, was used to sample prey in areas with high densities of foraging ARTEs and SAGUs.

Co-workers

The 2007/2008 study in Northeast Greenland is a joint venture of the Greenland Institute of Natural Resources, the National Environmental Research Institute in Denmark, and the British Antarctic Survey. The fieldwork is conducted in close cooperation with the Marine-Basic group under the Zackenberg Ecological Research Operations (ZERO) monitoring programs.

This study on ARTE migration has been adopted by the CAFF seabird group and is part of a larger coordinated effort, with parallel and concurrent research projects being carried out in Iceland and Alaska.


Walrus with satellite transmitter.


Arctic Tern chasing Glaucous Gull.


ARTE and SAGU at the central part of Sand Island.


Geo-locator data logger on ARTE leg.

Acknowledgements

We wish to express our gratitude to the Marine-Basic crew, whose support contributed to the success of the fieldwork in 2008. We also thank the Sledge patrol SIRIUS, the Danish Polar Centre, and POLOG for logistic support over the course of the study. We are grateful to Erik Born for the loan of essential field equipment. Dr. Stenhouse is grateful to the National Audubon Society for supporting his participation in this project in 2008. The fieldwork at Sand Island was jointly funded by the Danish Energy Agency (the climate support program to the Arctic), The Commission for scientific Research in Greenland (KVUG), and by Greenland Institute of Natural Resources.

The Environment and Nature Agency of the Greenland Home Rule provided us with the needed permits for handling birds and walruses on Sand Island.

Geo-locator on SAGU legs.

The camp with Clavering Island in the background.

At-sea survey for prey species.

Storm in Young Sund with giant waves.

For further information on the Sand Island study, please contact Carsten Egevang: egevang@natur.gl

Appendix I

Avian species observed on Sand Island, Northeast Greenland, in 2008. **Bold** indicates breeding species.

English	Danish	Greenlandic	Scientific
Northern Fulmar	Mallemuk	Qaqulluk	*Fulmarus glacialis*
Pink-footed Goose	Kortnæbbet gås	Nerleq siggukitsoq	*Anser brachyrhynchus*
Barnacle Goose	Bramgås	Nerlernarnaq	*Branta leucopsis*
Common Eider	**Ederfugl**	**Miteq**	***Somateria mollissima***
Long-tailed Duck	**Havlit**	**Alleq**	***Clangula hyemalis***
Ruddy Turnstone	Stenvender	Taliffak	*Arenaria interpres*
Ringed Plover	Stor præstekrave	Tuujussuaq	*Charadrius hiaticula*
Dunlin	Almindelig ryle	Saafaarsorlak	*Calidris alpina*
Red Knot	Islandsk ryle	Qajorlak	*Calidris canutus*
Sanderling	Sandløber	Siorarsiooq	*Calidris alba*
Purple Sandpiper	Sortgrå Ryle	Saarfaarsuq	*Calidris maritima*
Red Phalarope	Thorshane	Kajuaraq	*Phalaropus fulicarius*
Long-tailed Skua	Lille Kjove	Papikkaaq	*Stercorarius longicaudus*
Arctic Skua	Almindelig kjove	Isuungaq	*Stercorarius parasiticus*
Great Skua	Storkjove	Isunngarujussuaq	*Stercorarius skua*
Glaucous Gull	Gråmåge	Naajarujusssuaq	*Larus hyperboreus*
Lesser Black-backed Gull	**Sildemåge**	**-**	***Larus fuscus***
Black-legged Kittiwake	Ride	Taateraaq	*Rissa tridactyla*
Ivory Gull	Ismåge	Naajavaarsuk	*Pagophila eburnea*
Sabine's Gull	**Sabinemåge**	**Taateraarnaq**	***Xema sabini***
Arctic Tern	**Havterne**	**Imeqqutaalaq**	***Sterna paradisaea***
Brünnich's Guillemot	Polarlomvie	Appa	*Uria lomvia*
Gyrfalcon	Jagtfalk	Kissaviarsuk	*Falco rusticolus*
Peregrine	Vandrefalk	Kiinaaleeraq	*Falco peregrinus*
Common Raven	Ravn	Tulugaq	*Corvus corax*