# Breeding bird densities in the Ramsar site Heden, Jameson Land, East Greenland

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*(Med et dansk resumé: Tætheder af ynglefugle i Ramsarområdet Heden i Jameson Land, Østgrønland)*

**Abstract** During 11-26 June 2009, territories of breeding birds were censused in two study areas (in total 63 km²) in the north-western part of the Ramsar site Heden, Jameson Land, in high-arctic East Greenland. The purpose was to establish baseline knowledge on breeding bird densities in the area in order to evaluate possible impacts from proposed mining activities on these populations. Total densities of breeding waders varied between 5.7 and 8.2 territories/km² which are similar to the average density of 6.4 territories/km² (SD=4.1) of 42 other investigated high-arctic study areas in Northeast Greenland and Ellesmere Island. We discuss the correlation between densities, the chosen size of the study area and the study period. Important breeders were Sabine's Gull *Larus sabini* and Whimbrel *Numenius phaeopus* which both are considered near-threatened in Greenland. Pink-footed Goose *Anser brachyrhynchus* had densities of 4-5 nests/km² which indicate a much larger breeding population in Jameson Land than the 300-600 pairs estimated in the 1980s. We estimated the number of breeding pairs that may be displaced by the planned mining activities in the area and compared with the number of pairs in the proposed replacement Ramsar site Ørsted Dal, Jameson Land. The Ørsted Dal area can fully compensate the lost Ramsar status for most waders, Pink-footed Geese, Barnacle Geese *Branta leucopsis*, Long-tailed Ducks *Clangula hyemalis*, Long-tailed Skuas *Stercorarius longicaudus* and Snow Buntings *Plectophenax nivalis*, but no territories have been found in Ørsted Dal of Sabine's Gull, Red Phalarope *Phalaropus fulicarius*, Whimbrel and Lapland Bunting *Calcarius lapponicus.*

## Introduction

The Ramsar site Heden in high-arctic East Greenland (centre at 71°00'N 24°00'W) covers 2524 km² of the large Jameson Land lowland tundra area (Fig. 1). This is the southernmost lowland area on the generally rugged and mountainous east coast of Greenland. It was designated in 1988, primarily to protect internationally important populations of moulting Pink-footed Geese *Anser brachyrhynchus* and Barnacle Geese *Branta*

*leucopsis* (Greenland Home Rule 1990, Egevang & Boertmann 2001). At that time the area held 2% of the Iceland/Greenland flyway population of Pink-footed Geese and 7% of the Greenland flyway population of Barnacle Geese (Mosbech et al. 1989, Boertmann 1991). Of importance for the designation were also other breeding birds like Red-throated Diver *Gavia stellata*, Dunlin *Calidris alpina*, Ruddy Turnstone *Arenaria interpres*, Long-tailed Skua *Stercorarius longicaudus*, Arctic Skua *S. parasiticus*, Red Phalarope *Phalaropus fulicarius* and Red-necked Phalarope *Ph. lobatus*, as well as uncommon species like Sabine's Gull *Larus sabini* and Whimbrel *Numenius phaeopus* (50-100 pairs, Boertmann 2007). The Bureau of Minerals and Petroleum, Greenland Home Rule, designated the area an "area important to wildlife" (BMP 2000). Mineral exploration inside the area requires separate approval for specific periods.

Oil exploration was conducted by A/S ARCO Greenland in Jameson Land during 1985-1989, with an air strip and camp established at Constable Pynt in east Jameson Land as the basis for seismic winter and summer operations. In connection with these activities many studies were performed on the local environment, including the geese (Madsen & Boertmann 1982, Madsen et al. 1984a, 1984b, 1985, Madsen & Mortensen 1987, Mortensen et al. 1988, Mosbech et al. 1989, Mosbech & Glahder 1990, Mortensen 2000).

In 2008, the mining company Quadra Mining Ltd. was granted an exploitation license that covered the Malmbjerget area about 75 km north of the Ramsar site Heden. The company plans to exploit a large molybdenum ore body and develop the northwestern part of Heden (Cessford 2007, Quadra Mining Ltd. 2008). The planned activities inside the Ramsar site, around Gurreholm (Fig. 1-2), include the construction of a port, a gravel road and a 2000 m long airstrip. Trucks are planned to transport molybdenum concentrate to the port, to be shipped out of the area during the open-water period in July-October. About 100 flights per year with aircraft of different sizes are planned to service the area. At the moment (mid 2010) there is no information of a starting date. The Greenland Self-Government has claimed the mining project of "urgent national interests". The Ramsar Convention Secretariat is in dialogue with the Greenland Self-Government and has accepted that the project can proceed provided that the impact of the activities is monitored, and that an appropriate replacement area is found in advance (Salathe 2009).

In July 2008 the National Environmental Research Institute (NERI), Denmark, conducted bi-

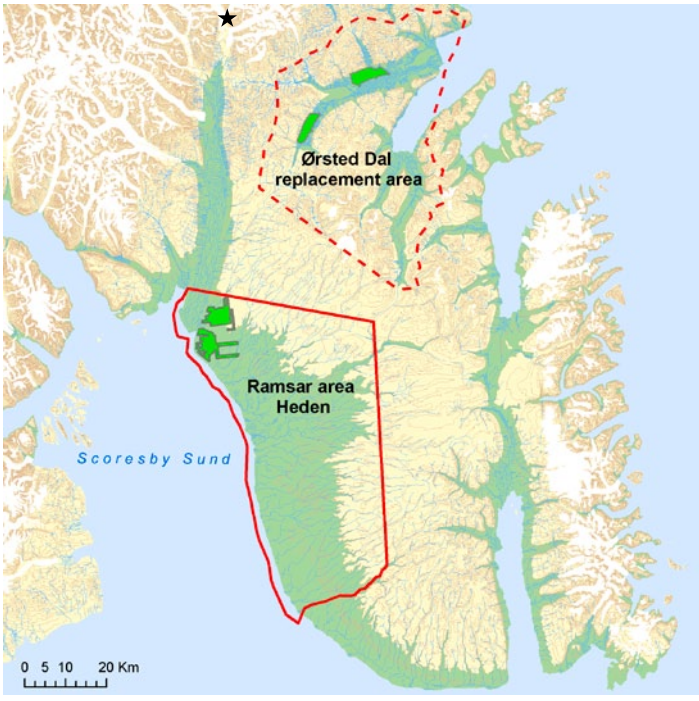


Fig. 1. The Ramsar site Heden in north-western Jameson Land, East Greenland, with the two study areas indicated. Shown is also the the proposed Ørsted Dal replacement area with the study areas of Meltofte & Dinesen (2010). The star indicates the molybdenum site at Malmbjerget.
*Ramsar-området Heden i det nordvestlige Jameson Land, med de to undersøgelsesområder angivet. Desuden er vist det foreslåede Ørsted Dal erstatningsområde med de to områder, der blev undersøgt af Meltofte & Dinesen (2010). Stjernen angiver stedet for molybdænforekomsten ved Malmbjerget.*

ological studies in the Ramsar site and other areas in Jameson Land. On the basis of different disturbance scenarios the number of possibly impacted geese and other bird species were assessed and a larger area around Ørsted Dal was suggested as a replacement area (Fig. 1, Glahder et al. 2010). In June 2009 NERI performed breeding-bird studies in the Gurreholm area, which could possibly be affected by mineral activities, and in the proposed Ramsar replacement area of Ørsted Dal. These studies are regarded supplementary to the studies performed in 2008. The Ørsted Dal study was reported by Meltofte & Dinesen (2010), while the Gurreholm study is reported in the present paper.

The purpose of the present study was to establish baseline knowledge on breeding bird species and their densities in the Gurreholm area in order to evaluate possible impacts from proposed mining activities on these populations. In the paper we compare our results with those from Ørsted Dal in order to assess if the number of breeding pairs which are likely to disappear from the Ramsar site due to mining activities is similar to the number of pairs in the proposed replacement area, so that the number of pairs protected under the Ramsar Convention remains unchanged. Also, we wished to compare the richness in breeding waders in our study areas with those from other high-arctic study areas (Meltofte 1985, Boertmann et al. 1991, Mortensen 2000, Meltofte 2006 and Meltofte & Dinesen 2010). The results from these different areas are not directly comparable, both because densities of territories depend on the study period (Meltofte 2001) and because we anticipate that densities in small study areas are higher than in large areas because small study areas may be selected for their abundant vegetation and rich fauna (e.g., Boertmann et al. 1991). In the present paper we test these assumptions by a 2-way analysis of variance.

## Study area

Jameson Land is situated around 71°15'N 23°30'W in East Greenland. It is a lowland area on the otherwise rugged and mountainous east coast of Greenland. The western and southern part is delimited by Scoresby Sund, the largest fiord system in the world, while the northern and eastern part is fringed by high mountains and open sea. The western part is covered by tundra and wetland areas. To the east the area gradually raises to drier tundra and low mountains of about 1000 m a.s.l. Jameson Land is intersected by many rivers and relatively lush valleys.

The Gurreholm study area in the north-western part of Jameson Land is a lowland area delimited to the west by Hall Bredning (Fig. 1-2). In the north-western part a huge silty delta area is formed at the mouth of the 3-4 km wide river Schuchert Flod. To the north and east the land gradually rises and become drier. Generally, the study area can

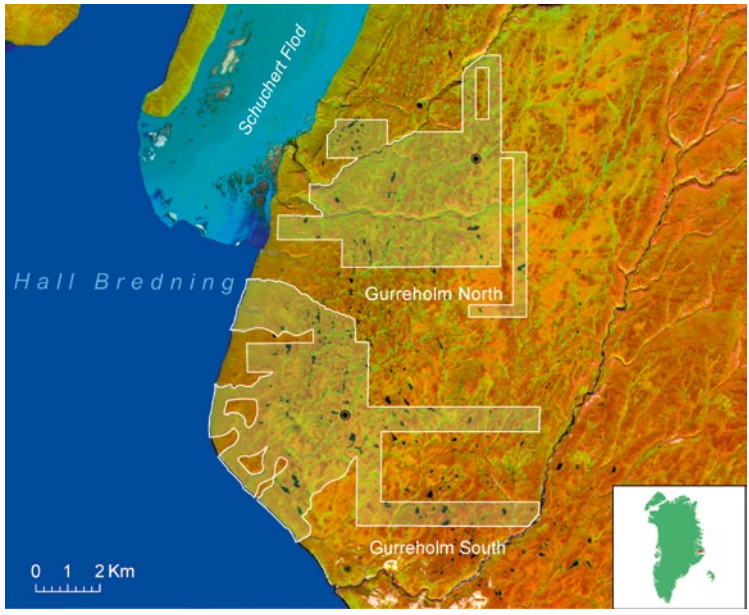


Fig. 2. The two study areas inside the Ramsar site Heden. Camp sites are indicated by circled dots. Hall Bredning is a part of the fjord Scoresby Sund. The satellite image is from 16 July 2004.
*De to undersøgelsesområder i Ramsar-området Heden. Lejrene er vist med omcirklede prikker. Hall Bredning er en del af Scoresby Sund. Satellitbilledet er taget d. 16. juli 2004.*

be classified as a wetland area with many marshes, ponds and lakes up to 500 m across, drained by streams of varying size. Mosses, cotton grass *Eriophorum* spp., sedge *Carex* spp. and flowering plants dominate the wet areas. On higher ground the vegetation is dominated by dwarf-scrub heath with species like arctic blueberry *Vaccinium uliginosum*, arctic bell-heather *Cassiope tetragona* and arctic willow *Salix arctica*. The two study areas, Gurreholm South and Gurreholm North (Fig. 2), were chosen to cover as much as possible of the northwestern corner of the Ramsar site Heden which possibly could be affected by future mineral activities. The southern area is the lower and wetter of the two areas.

The snow coverage within the study area was 30-35% at the time of arrival on 11 June 2009, rapidly decreasing to about 5% one week later. According to Meltofte & Dinesen (2010), snowmelt was very early in 2009. On average, the ice cover on 61 lakes and ponds in the Gurreholm South area was about 60% on 11 June and 35% on 18 June. Temperatures during the study period were 0-5 °C, visibility was good, and winds were light between south and west. It rained for 1-2 days. The first mosquitoes were encountered on 18 June, and on 20 June high numbers of larvae of the arctic woollybear caterpillar *Gynaephora groenlandica* had emerged and attracted a large flock of foraging Long-tailed Skuas. One arctic fox *Alopex lagopus* and one abandoned den were observed in Gurreholm South, and three foxes in Gurreholm North. No collared lemmings *Dicrostonyx groenlandicus* were seen, and neither were any summer burrows or winter nests.

## Methods

The authors studied the Gurreholm South area during 11-18 June and the Gurreholm North area during 19-26 June 2009, being transported by helicopter between Constable Pynt and the two camp sites (Fig. 2). We censused the study areas using the same method as Boertmann et al. (1991) and Meltofte et al. (2009). This method aims at mapping all territories based on territorial behaviour during the early breeding period before incubation. Meltofte (2001) recommended 12-20 June as the optimal period for such a census in high-arctic Greenland.

We traversed the study areas along parallel transect lines separated by c. 200 m. On the first three days, we could use rivers and coast lines as guiding lines, but then changed to follow pre-chosen transect lines following the north-south and east-west UTM grid lines by use of handheld GPS receivers (Garmin Etrex & GPS Map 60CSX, UTM 27); the reason was the difficulties in following parallel transect lines in the rather featureless inland. Minor parts of the study areas were unintentionally left uncovered due to time constraints. Transect lines outside the core study area were drawn from the camp to randomly chosen points that were either 90 or 180° turning points. Routes were drawn on maps (1:26300) with 1000 m UTM grid lines, and observations were plotted on these maps in the field. We walked parallel transect lines simultaneously and communicated by small VHF radios, primarily to avoid double counts. All birds were recorded on the maps with notes on status and behaviour; birds in pairs, singing, giving alarm calls or other territorial behaviour, or (on rare occasions) connected with found nests were regarded as pair members holding a territory. Observed birds with no such indications of being local breeders were recorded as uncertain breeders, except that overflying birds were omitted from the census. For Pink-footed and Barnacle Geese most territories were determined by direct nest observations since these nest sites were easily detected, either because of the vigilant male or of the sitting female. In the few cases where we, against our intentions, flushed the geese we counted the number of eggs or, late in the period, goslings; eggs were covered after the count. Observations of mammals and fox dens were also recorded.

Observations from the field maps were transferred to a final map at camp shortly after each field session. Most observations were made between 10 am and 8 pm. In total we spent 104 man-hours in the field in the Gurreholm South area and 90 man-hours in Gurreholm North.

Total wader densities in the two Gurreholm study areas and in 40 high-arctic study areas reported in various papers, were statistically analysed for a relationship with the size of the study area and with the study period. Study areas less than 12 $km^2$ were grouped as "small", larger areas as "large"; similarly, studies performed before 1 July were grouped as "early", while studies performed from 1 July onwards as "late". Density data was log-transformed to fulfil the assumptions for parametric tests of normality (Shapiro-Wilk normality test, $P>0.05$) and homogeneity of variances (Bartlett test, $P>0.05$). The relationship between area and period was tested by a 2-way analysis of variance (ANOVA). Data were fitted to a logarithmic trend line.

Table 1. Breding bird number and densities in the two study areas at Gurreholm South and Gurreholm North. Density: territories/km$^2$.
*Antal og tætheder af ynglefugle i de to undersøgelsesområder, Gurreholm syd og Gurreholm nord. Tætheder: territorier/km$^2$.*

| **Species** *Arter* | **Gurreholm South** Area 34.13 km$^2$ | | **Gurreholm North** Area 29.09 km$^2$ | |
|---|---|---|---|---|
| | **Number** | **Density** | **Number** | **Density** |
| Common Ringed Plover *Charadrius hiaticula* | 7-10 | 0.21-0.29 | 1-2 | 0.03-0.07 |
| Eurasian Golden Plover *Pluvialis apricaria* | | | 2 | 0.07 |
| Red Knot *Calidris canutus* | 38-49 | 1.11-1.44 | 32-33 | 1.10-1.13 |
| Sanderling *Calidris alba* | 39-44 | 1.14-1.29 | 4-5 | 0.14-0.17 |
| Dunlin *Calidris alpina* | 101-120 | 2.96-3.52 | 105-114 | 3.61-3.92 |
| Purple Sandpiper *Calidris maritima* | 0-1 | | | |
| Ruddy Turnstone *Arenaria interpres* | 32-36 | 0.94-1.05 | 21-23 | 0.72-0.79 |
| Whimbrel *Numenius phaeopus* | 3 | 0.09 | 1 | 0.03 |
| Red Phalarope *Phalaropus fulicaria* | 7-13 | 0.21-0.38 | 0-3 | |
| Red-necked Phalarope *Phalaropus lobatus* | 4 | 0.12 | 0-4 | |
| Waders total *Vadefugle totalt* | 231-280 | 6.77-8.20 | 166-187 | 5.71-6.43 |
| | | | | |
| Red-throated Diver *Gavia stellata* | 2-5 | 0.06-0.15 | 3 | 0.10 |
| Pink-footed Goose *Anser brachyrhynchus* | 163-178 | 4.78-5.21 | 110 | 3.78 |
| Barnacle Goose *Branta leucopsis* | 27 | 0.79 | 7 | 0.24 |
| Northern Pintail *Anas acuta* | 1-2 | 0.03-0.06 | 0-1 | |
| King Eider *Somateria spectabilis* | 3-7 | 0.09-0.21 | 8-11 | 0.28-0.38 |
| Long-tailed Duck *Clangula hyemalis* | 20-26 | 0.59-0.76 | 17-24 | 0.58-0.83 |
| Rock Ptarmigan *Lagopus mutus* | 0-4 | | 0-2 | |
| Long-tailed Skua *Stercorarius longicaudus* | 9-32 | 0.26-0.94 | 18-27 | 0.62-0.93 |
| Arctic Skua *Stercorarius parasiticus* | 6-14 | 0.18-0.41 | 1-5 | 0.03-0.17 |
| Sabine's Gull *Larus sabini* | 12-16 | 0.35-0.47 | 0-1 | |
| Arctic Tern *Sterna paradisaea* | 4-6 | 0.12-0.18 | 1 | 0.03 |
| Raven *Corvus corax* | 1-2 | 0.03-0.06 | 0-1 | |
| Northern Wheatear *Oenanthe oenanthe* | | | 3 | 0.10 |
| Common/Arctic Redpoll *Carduelis flammea/ hornemanni* | 1-2 | 0.03-0.06 | | |
| Lapland Bunting *Calcarius lapponicus* | | | 14-18 | 0.48-0.62 |
| Snow Bunting *Plectophenax nivalis* | 87-98 | 2.55-2.87 | 192-200 | 6.60-6.88 |

## Results

A total of 26 bird species were recorded as breeding or possibly breeding in the two study areas. The two areas were similar as regards the diversity of breeding species, with 23 species in the southern area and 24 in the northern (Table 1). Densities (territories/km$^2$) of breeding waders in the southern area were higher (6.77-8.20) than in the northern area (5.71-6.43), mainly due to a higher density of Sanderling *Calidris alba* (1.14-1.29) and Red Phalarope (0.21-0.38) in the southern area (Table 1). Among other bird species, the southern area had higher densities of Pink-footed Goose (4.78-5.21), Barnacle Goose (0.79) and Sabine's Gull (0.35-0.47), whereas Lapland Bunting was recorded only in the northern area, with densities of 0.48-0.62; in the same area, Snow Bunting densities (6.60-6.88) were twice as high as in the southern area.

The first Pink-footed Goose goslings were observed on 22 June, two days earlier than the earliest goslings reported from Ørsted Dal (Ferns & Green 1975, Meltofte & Dinesen 2010) and 9-11 days earlier than the earliest observed by Cabot et al. (1984) and Madsen et al. (1984a), likewise from Ørsted Dal. The average size of observed egg clutches was 3.57 (SD=1.75, n=21), while the average brood size was 2.86 (SD=0.90, n=7).

Among the more unusual observations were a flock of about 160 Long-tailed Skuas in Gurreholm North on 20 June, with a Ring-billed Gull *Larus delawarensis* among them.

The relatively lush and low-lying tundra of Heden stands in marked contrast to the high mountains west of Hall Bredning. Photo: C. M. Glahder.

The relationship between densities of wader territories in the 42 high-arctic study areas and size of study areas and timing of study showed no indication of an interaction effect ($F=1.25$, $P=0.27$), so the 2-way ANOVA was re-run without this term. This test showed that densities in the smaller areas were higher than densities in larger areas ($F_{1,39}=12.4$, $P=0.002$), and that densities early in the season were higher than densities later in the season ($F_{1,39}=5.27$, $P=0.03$).

## Discussion

The breeding bird study in the two Gurreholm areas was timed according to the recommendations by Meltofte (2001) concerning the optimal period for censusing breeding waders in the high Arctic. The number of recorded wader territories in the southern study area, studied during 11-18 June, may therefore be regarded as a maximum number, whereas the about 20% lower density of territories found in the northern study area could have been influenced by the later study period. This lower density was mainly a result of the few Sanderling territories found in the northern area, possibly because Sanderlings become very secretive when incubating, and probably even more so in case of double-clutching with both pair members incubating a clutch (Meltofte 2006).

The densities of wader territories in the two Gurreholm study areas were close to the average density per km² of 6.42 (SD=4.13) for 42 high-arctic study areas in Northeast Greenland and Ellesmere Island, compiled by Mortensen (2000) from Meltofte (1985) and Boertmann et al. (1991). To these we added the densities from Zackenberg (Meltofte 2006), Ørsted Dal (Meltofte & Dinesen 2010) and Gurreholm (present study) (Fig. 3). Total wader densities (territories per km²) vary between 1.11 (Kap Stewart, Jameson Land) and 16.59 (Danmarks Havn). These densities are primarily based on five species: Common Ringed Plover, Red Knot *Calidris canutus*, Sanderling, Dunlin, and Ruddy Turnstone.

Because we anticipate that densities of wader territories are higher in smaller areas (<12 km²) than in our study areas of about 30 km², we find it likely that the Gurreholm area actually is more important for breeding waders than the above comparison suggests. The idea of an area/density relationship was partly inspired by the wader study of Boertmann et al. (1991) in which the investigated areas on average were 6.1 km² (SD=2.8, n=14) and "were selected for their ap-

parently abundant vegetation and consequently rich fauna." Criteria for selection of study areas were not given by Meltofte (1985) or Mortensen (2000); the two areas selected by Meltofte & Dinesen (2010) should represent different patterns of wet and dry tundra in a possible Ramsar replacement area, and the areas in the present study were mainly selected to cover a substantial part of the area inside the Ramsar site that will possibly be affected by mineral activities. The five common species mentioned previously "most often breed within 50-100 m of fertile wet or moist sites" (Meltofte 1985), while the two phalarope species need open water near the nest. We therefore suppose that such wetland areas are often chosen for studies of breeding waders, and the smaller the study area, the higher a percentage of such prime habitat area is likely to be included. Larger study areas will be more likely to include substantial proportions of less optimal wader habitat, such as dwarf scrub heath.

Our analysis of the 42 arctic study areas showed that densities of wader territories did indeed depend on the size of the study area, so that larger areas had significantly lower densities than smaller areas. The analysis also showed that densities depended on the study period so that densities were significantly higher in early than in late study periods, a relationship previously discussed by Meltofte (2001). The relative number of areas that were studied late in the breeding season was slightly higher for larger areas (35%) than for smaller areas (28%), but since the interaction between the size of the study area and the study period was not significant, this difference is thought to be of minor importance. On Fig. 3 we have plotted the number of wader territories (territory density × size of study area) against the size of the 42 study areas and fitted a logarithmic trend curve. It is noteworthy that the two Gurreholm areas had more territories than expected from the trend curve, most pronounced in case of the southern study area. This indicates that the Gurreholm area is a more important wader breeding habitat than the density figures alone suggest, because much higher densities reported from other – but smaller – areas have inflated our expectations of what may be found in "good wader habitat".

Below we compare our results from the possibly impacted area inside the Ramsar site Heden with those from Ørsted Dal (Meltofte & Dinesen 2010), in order to evaluate the quality of the proposed Ramsar replacement area. Densities of breeding waders in the two Ørsted Dal areas in June 2009 of 8.5-9.2 (Upper Valley) and 5.2-5.8 (Central Valley) were similar to the densities in the Gurreholm study areas (Fig. 3, Table 1). The major differences were that Common Ringed Plover and Dunlin had much higher densities in the Ørsted Dal areas than in the Gurreholm areas, and that densities of Red Knot were higher in the Gurreholm areas. Also, a total of 10 breeding wader species were found in the Gurreholm study areas, compared with only six in the Ørsted Dal study areas (Meltofte & Dinesen 2010). The additional species found only at Gurreholm were Eurasian Golden Plover *Pluvialis apricaria* (only a single non-territorial bird seen in Ørsted Dal), Purple Sandpiper *Calidris maritima*, Whimbrel and Red Phalarope. Four other bird species were found breeding in the Gurreholm study areas but not in the Ørsted Dal study areas: Arctic Skua, Sabine's Gull, Northern Wheatear *Oenanthe oenanthe* and Lapland Bunting.

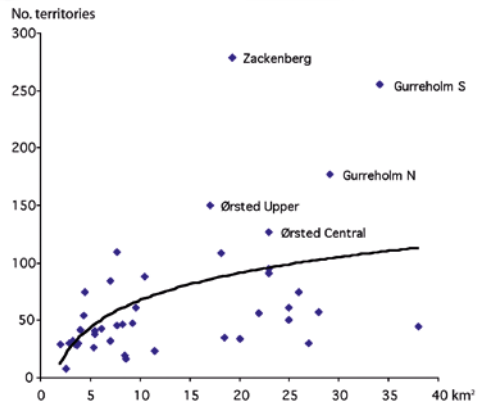


Fig. 3. The correlation between numbers of wader territories and the size in km² of 42 high-arctic study areas situated in Northeast Greenland and Ellesmere Island (Meltofte (1985), Boertmann et al. (1991), Mortensen (2000), Meltofte (2006), Meltofte & Dinesen (2010), present study). A logarithmic trend line is shown. Gurreholm S and N are the two areas in NW Jameson Land censused in the present paper. Ørsted Upper and Central are the two areas studied in NE Jameson Land (Meltofte & Dinesen 2010) and Zackenberg is the study area at the research station in central NE Greenland (Meltofte 2006).

*Sammenhængen mellem antal af vadefugleterritorier og størrelsen i km² af 42 højarktiske undersøgelsesområder fra Nordøstgrønland og Ellesmere Island. Der er lagt en logaritmisk trendlinje ind på figuren. De to områder der er undersøgt i forbindelse med denne artikel er Gurreholm S og N beliggende i det nordvestlige Jameson Land, Ørsted Upper og Central er de to områder i det nordøstlige Jameson Land undersøgt af Meltofte og Dinesen (2010), og Zackenberg er undersøgelsesområdet ved forskningsstationen i det centrale Nordøstgrønland (Meltofte 2006).*

Sabine's Gull, a prominent breeding species at Heden. Photo: C. M. Glahder.

The entire population of Pink-footed Geese in Jameson Land (9000 km²) was estimated at 300-600 breeding pairs in the 1980s (Madsen et al. 1985, Mosbech et al. 1989). Since then, during the last 20 years, the Iceland/Greenland flyway population of Pink-footed Geese has increased by a factor 1.5 (Mitchell 2008), which, if applied to Jameson Land, would mean a population of less than 1000 pairs today. However, about 430 successfully breeding pairs were recorded within 236 km² of Jameson Land in July 2008 (Glahder et al. 2010), and in 2009 (present report) we counted 273-288 nests or pairs in the Gurreholm study areas (63 km² in total), while Meltofte & Dinesen (2010) found 111 nests in the Ørsted Dal study areas (40 km²); combined, that is about 400 territories within 100 km². If we upscale to the present Ramsar site (2524 km²) and the Ørsted Dal replacement area (1977 km²), we get a population of roughly 18 000 pairs. The actual number is probably smaller, but the figures still suggest that it is considerable higher than 1000 pairs. This higher estimate apparently originates in the method used, detailed counts of nests and young broods, while the estimate from the 1980s was based on observation of goose families from the air in July, a method that is likely to underestimate the population.

From the present knowledge of the mining plans in the Gurreholm area of the Ramsar site (Cessford 2007) and the densities of breeding birds within the Gurreholm area (present study) and the proposed replacement area in Ørsted Dal (Meltofte & Dinesen 2010), it is possible to give a rough estimate of the number of pairs that will be displaced, and to assess if the future Ramsar status of the replacement area will protect at least a similar number of pairs. We estimate that mining-related activities at the port, the road along the

coast, and the airstrip (including a flight corridor) will affect a roughly rectangular area of 2 by 15 km, i.e. 30 km². Based on this crude estimate, the proposed Ørsted Dal Ramsar replacement site can fully compensate the lost Ramsar status for most waders, Pink-footed Goose, Barnacle Goose, Long-tailed Duck, Long-tailed Skua and Snow Bunting. However, no territories were found in Ørsted Dal of Sabine's Gull, Red Phalarope, Whimbrel or Lapland Bunting, and only one King Eider pair was seen. Sabine's Gull and Whimbrel are considered near-threatened in Greenland (Boertmann 2007), with Jameson Land being the only known breeding area for Whimbrel.

**Acknowledgements**
We wish to thank Hans Meltofte and Lars Dinesen who performed a similar study in Ørsted Dal, Jameson Land, for smooth collaboration during all phases of the study and for their useful comments on the manuscript. Ko de Korte and Kaj Kampp are thanked for their critical reviews and useful improvements of the manuscript. We had much help from the staff at Constable Pynt, especially from Henrik "Thy" Jensen, and excellent and safe support from Greenland Air Charter. Helene Schledermann, NERI, helped with data handling and figures, Mikkel Thamstorf, NERI, produced field maps and gave on-line help with GPS grid problems (UTM 27 grid), and Frank Riget, NERI, helped with statistical analyses of the data on wader territories. The present study was financed by the Bureau of Minerals and Petroleum, the Greenland Self-Government.

## Resumé

**Tætheder af ynglefugle i Ramsarområdet Heden i Jameson Land, Østgrønland**
I juni 2009 undersøgte vi tætthederne af ynglefugle i to undersøgelsesområder i den nordvestlige del af Ramsarområdet Heden. Området ligger i Jameson Land i Østgrønland (Fig. 1) og er placeret sydligst i det højarktiske område. Baggrunden for undersøgelserne er, at et mineselskab har planer om at bryde en forekomst af molybdænmalm nord for Jameson Land og udskibe den fra den nordvestlige del af Ramsarområdet. Selskabet planlægger derfor at anlægge en vej, en havn og en landingsbane i dette område. Vore undersøgelser skulle dels give et grundlæggende kendskab til ynglefugletætheder i området og dels give grundlag for at vurdere påvirkningen af mineaktiviteterne på områdets ynglefugle. På samme tid blev der af Meltofte & Dinesen (2010) udført lignende undersøgelser i Ørsted Dal i Jameson Land, der er foreslået som et erstatningsområde for det påvirkede område af Ramsarområdet Heden (Glahder et al. 2010).

Undersøgelserne blev udført i to delområder, Gurreholm syd (34 km², 11.-18. juni) og Gurreholm nord (29 km², 19.- 26. juni), jf. Fig. 2. Begge områder er dækket af tundra og indeholder mange større og mindre søer, damme, elve og kær. Det sydlige område ligger nærmere kysten end det nordlige og er generelt lavere og har flere vådområder. Ved vores ankomst 11. juni var 30-35% snedækket, men allerede en uge senere var der kun ca. 5% snedækkede områder tilbage. Områderne blev gennemvandret i parallelle linjer med en transektbredde på 100 m til hver side. For at undgå dobbeltregistreringer kommunikerede vi vha. små VHF-radioer. Par og individer, der sang eller på anden måde markerede et territorium, blev anset for at repræsentere et sikkert territorium, mens andre individer regnedes for at repræsentere et usikkert territorium. Alle fugleobservationer blev noteret på kort. I alt registrerede vi 26 arter som ynglende eller muligt ynglende (Tabel 1). Den fundne vadefugletætheder – 6,8-8,2 territorier/km² i det sydlige område og 5,7-6,4 territorier/km² i det nordlige område – ligger omkring gennemsnitet på 6,5 territorier/km² (SD=4,1) for 42 undersøgte områder i højarktis (Meltofte 1985, Boertmann et al. 1991, Mortensen 2000, Meltofte 2006, Meltofte & Dinesen 2010, denne undersøgelse). Tætheden af vadefugleterritorier var signifikant lavere i de store højarktiske undersøgelsesområder end i de små, hvilket skyldes, at små produktive vådområder ofte vælges som undersøgelsesområder, mens store områder som oftest vil inkludere dele med ringe ynglehabitat, som f.eks. dværgbuskhede. Både små og store områder optalt før 1. juli havde signifikant højere tætheder end tilsvarende områder talt efter denne dato. Da Gurreholm-områderne begge er store, er deres betydning for ynglende vadefugle større end den umiddelbare sammenligning med andre højarktiske undersøgelsesområder viser (Fig. 3).

Vadefugletætheder i Gurreholm-områderne ligger nær tætheder i de to områder i Ørsted Dal. De største forskelle mellem Gurreholm og Ørsted Dal er, at der i sidstnævnte område var langt højere tætheder af Stor Præstekrave og Almindelig Ryle, mens der var større tætheder af Islandsk Ryle i Gurreholm. Desuden blev der i Gurreholm registret fire ynglende vadefuglearter (Hjejle, Sortgrå Ryle, Lille Regnspove, Thorshane) og fire andre ynglefuglearter ( Almindelig Kjove, Sabinemåge, Stenpikker, Laplandsværling), som savnedes i Ørsted Dal.

I 1980erne blev ynglebestanden af Kortnæbbet Gås i hele Jameson Land skønnet til 300-600 par (Madsen et al. 1985, Mosbech et al. 1989). En simpel fremskrivning, baseret på en registreret stigning i den islandsk-grønlandske bestand med en faktor 1,5 i de sidste 20 år (Mitchell 2008), giver knap 1000 ynglepar i Jameson Land, mens der i 2009 i Gurreholm blev talt 273-288 territorier (reder) på 63 km² og i Ørsted Dal 111 territorier på 40 km², eller i alt ca 400 reder på 100 km². Med samme tætheder ville der i hele Ramsarområdet Heden (2524 km²) og det foreslåede Ørsted Dal erstatningsområde (1977 km²) være 18 000 par, og selv om det faktiske antal formentlig er væsentligt mindre, må det formodes at ligge betydeligt over 1000 par. Dette højere estimat skyldes dels, at det bygger på detaillerede optællinger i yngleperioden og dels, at ynglebestanden

i 1980erne blev skønnet ud fra gåsefamilier observeret fra fly i juli måned, en metode som formodedes at ville underestimere bestanden.

På baggrund af vores nuværende kendskab til mineplanerne, og tæthederne af ynglefugle i Gurreholm og Ørsted Dal områderne, kan vi dels give et groft skøn over antallet af ynglepar, der bliver fordrevet, og dels anslå hvor mange fugle, hvis yngleområde vil miste henholdsvis få Ramsar status. Mineaktiviteterne inden for Ramsarområdet Heden antages at ville påvirke ca 30 km$^2$ ved Gurreholm. Ud fra dette skøn vil Ramsar kompensationsområdet ved Ørsted Dalen, med mindst 500 km$^2$ egnet ynglehabitat, fuldt ud kunne kompensere for de fordrevne ynglepar af de fleste vadere, Kortnæbbede Gæs, Bramgæs, Havlitter, Små Kjover og Snespurve, men Sabinemåge, Thorshane, Lille Spove og Laplandsværling tilsyneladende ikke yngler i Ørsted Dal området.

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