BIRD POPULATIONS

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BIRD MONITORING AT ZACKENBERG, NORTHEAST GREENLAND, 2006[1]

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Abstract. Bird populations were monitored during the breeding season of 2006 in the 19.3 km^2 designated bird census area at Zackenberg Research Station in central Northeast Greenland. Results presented herein are compared with those from previous seasons, 1995 to 2005. Changes in the phenology and numbers observed of most bird species in the BioBasis monitoring programme apparently reflect the extensive snow cover and late snowmelt in 2006. Wader (Charadrii) nest initiation in 2006 was generally very late; medians of the first egg dates were later than 25 June in four of the five species monitored. Nest success, however, was fairly high for Dunlin *Calidris alpina* and very good for Common Ringed Plover *Charadrius hiaticula*, whereas for Sanderling *Calidris alba* and Ruddy Turnstone *Arenaria interpres* nest success was very low. The all-wader predation rate was *c.* 63%, which is above average. Numbers of Arctic Fox *Alopex lagopus* encounters in the bird census area were high, and foxes were the likely predators of most nests, since no nests were found with clear signs of avian predation. For waders, mean clutch size was 3.4, which is lower than average. Juvenile wader numbers in two coastal deltas at low tide were extremely low compared to previous seasons.

Long-tailed Skua *Stercorarius longicaudus* breeding initiation was late, and only two nests were found within the bird census area. The number of pairs was similar to previous years and, hence, most pairs were non-breeding. The number of Barnacle Goose *Branta leucopsis* broods was among the lowest recorded so far, and the mean brood size was only 1.1 goslings per brood.

Sanderling territories were found in record high numbers; Dunlins and Ruddy Turnstones appeared in numbers above average. Common Ringed Plover and Red Knot *Calidris canutus* were recorded in numbers around the average of previous years. After high numbers of Snow Bunting *Plectrophenax nivalis* territories during the last two seasons', numbers in 2006 were lower, although still well above average. Five Rock Ptarmigan *Lagopus mutus* territories are more than have been recorded for years.

Key words: Arctic, avian monitoring, climate, geese, Greenland, Long-tailed Skua, waders.

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MONITOREO DE AVES EN ZACKENBERG, NORESTE DE GROENLANDIA, 2006

Resumen. Se monitorizaron las poblaciones de aves durante la temporada reproductiva de 2006 en los 19.3 km² del área de censos de aves de la Estación Científica de Zackenberg, en el noreste de Groenlandia. Los resultados presentados aquí son comparados con los de temporadas anteriores, de 1995 a 2005. Los cambios en la fenología y números observados en la mayoría de especies en el programa BioBasis parecen reflejar la abundante cobertura de nieve y el deshielo tardio de 2006. Las zancudas (Charadriidae) iniciaron la puesta generalmente tarde en 2006; las medianas de las fechas de puesta del primer huevo fueron posteriores al 25 de junio en cuatro de las cinco especies monitorizadas. El éxito de anidación, sin embargo, fue bastante alto para *Calidris alpina* y muy bueno para *Charadrius hiaticula,* aunque muy bajo para *Calidris alba* y *Arenaria interpres*. La tasa de depredación sobre zancudas fue cercana al 63%, lo cual supera la media. El número de encuentros con zorros árticos *Alopex lagopus* fue alto, y los zorros fueron los depredadores más probables, pues no se encontraron nidos con evidencia de depredación por aves. La puesta media para las zancudas fue de 3.4 huevos, por debajo de la media. El número de juveniles en dos deltas costeros con marea baja fue extremadamente bajo en comparación con otras temporadas.

El inicio de la reproducción de *Stercorarius longicaudus* fue tardia, y sólo dos nidos fueron encontrados en el área de censo. El número de pares fue similar al de otros años y por tanto muchas parejas no se reprodujeron. El número de pollos de *Branta leucopsis* fue entre los más bajos registratos hasta la fecha, y la puesta media fue de 1.1 huevos por puesta.

Hubo un número récord de territorios de Calidris alba; *Calidris alpina* y *Arenaria interpres* estuvieron presentes en números superiores a la media. *Charadrius hiaticula* y *Calidris canutus* mostraron números similares a años anteriores. Tras dos temporadas de un número elevado de territorios de *Plectrophenax nivalis*, el número en 2006 fue inferior, aunque todavía muy por encima de la media. Cinco territorios de *Lagopus mutus* son más de lo que se ha registrado en varios años.

Palabras clave: Artico, monitoreo de aves, clima, Groenlandia, zancudas.

INTRODUCTION

The monitoring programme, Zackenberg Basic, based at the Zackenberg Research Station in central Northeast Greenland (Fig. 1), was initiated in 1995 in order to establish long-term data series on abiotic and biotic parameters in this high-arctic ecosystem in relation to climatic fluctuations and change. BioBasis is the biological part of Zackenberg Basic and monitors both floral communities, invertebrate occurrence, and mammalian and avian breeding performance and population trends (Meltofte et al. 2007a). This paper synthesises the bird monitoring part of BioBasis, and we present data from 2006, the 12th consecutive season of effort. The results presented here are partly available in the 12th ZERO Annual Report (Klitgaard et al. 2007). Similar reports are available for all previous field seasons (see www.zackenberg.dk/publications.htm#ZAR).

STUDY AREA AND METHODS

The study area is situated in the national park of North and Northeast Greenland, at the northern shore of Young Sund. Zackenberg Research Station (74°30'N, 21°00'W) is situated in the broad valley Zackenbergdalen. Details on the full BioBasis methodology are available at the home page of NERI (http://biobasis. dmu.dk). The current sampling protocol is found in Meltofte et al. (2007a), available through the authors.

The bird census area is a 19.3 km² designated area, stretching from sea level to 600 m a.s.l. on the south-western slopes of Aucellabjerg (Fig. 1). The extensive valley floor from 0 to 50 m a.s.l. is largely covered with dwarf scrub heath (mainly Mountain Avens Dryas spp., White Arctic Bell-heather Cassiope tetragona, and Arctic Willow Salix arctica) and wet fens. In some areas, more or less, barren gravel and fell field predominate.

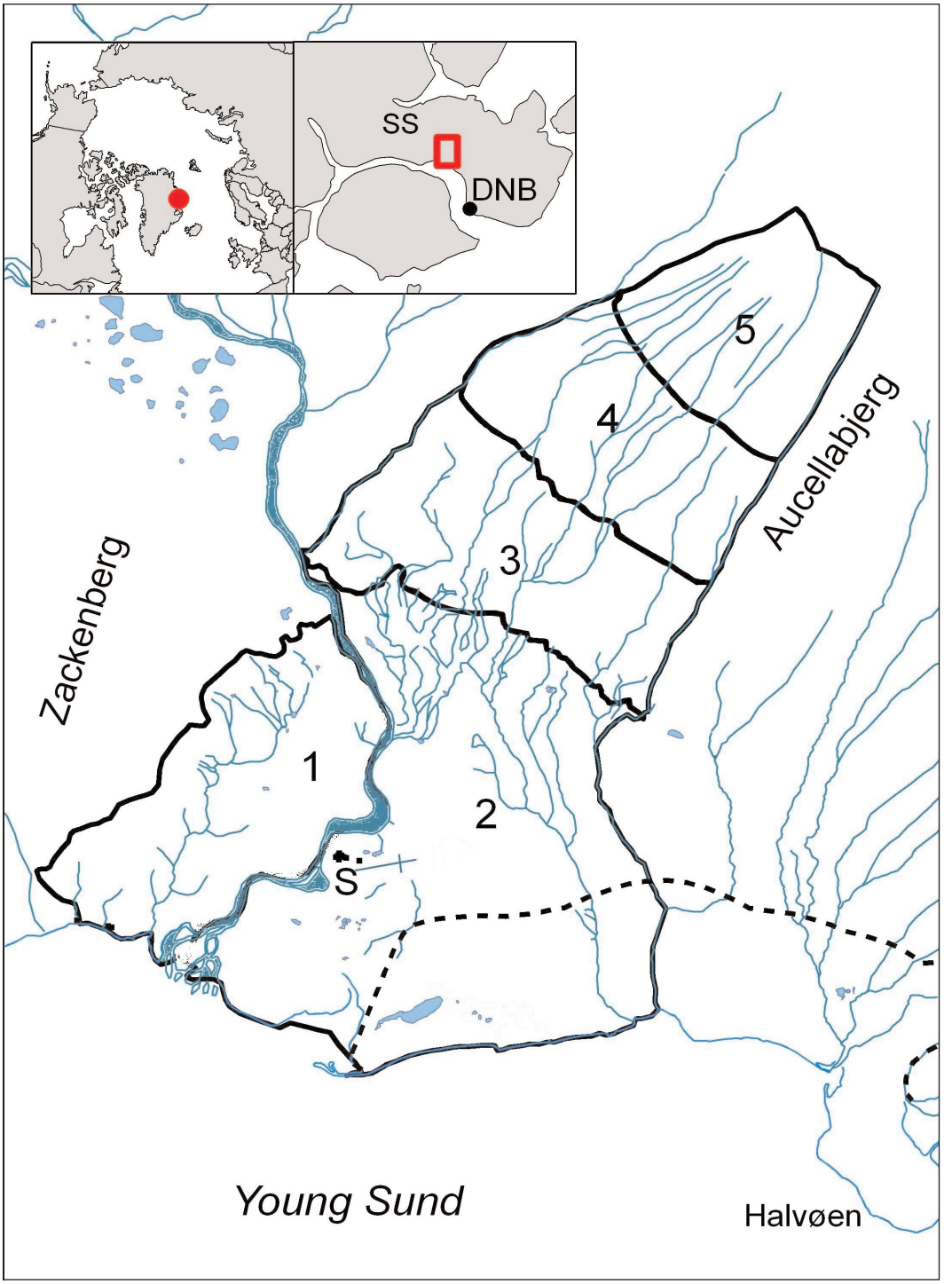

FIGURE 1. The study area in Zackenbergdalen, central Northeast Greenland, showing sections 1-5 of the bird census area. Also shown are place names mentioned in the text and the border of the closed goose molting area (broken line).

The area below 50 m a.s.l. is divided by the river Zackenbergelven into sections 1 and 2 (Fig. 1).

Between 50 and 150 m a.s.l. (section 3, Fig. 1) the terrain is hilly and more barren, but still with extensive grassland and fen areas. Between 150 and 300 m a.s.l. (section 4, Fig. 1) the slopes are dominated by Mountain Avens heath and have low inclinations (app. 7°-13°). From 300 to 600 m a.s.l. (section 5, Fig. 1) there are more areas with zones of grassland and some Mountain Avens heath. The plant communities are described in detail by Bay (1998).

The annual bird census takes place during mid to late June, and all birds present are mapped. During this period most birds are displaying and concentrated on snow-free areas where territories are established. This early timing aims to record the entire potential breeding population before incubators become hard to find, and before failed breeders begin to leave their territories (for further details, see Meltofte 2001, Meltofte et al. 2007a). However, it takes a week to cover the entire area, which means that some areas are surveyed later than what would be optimal (cf. Meltofte 2006a). Snow cover in June is usually high (Table 4), but it decreases rapidly during the census period.

Bird locations are plotted on maps in the field together with information on song, alarm calling, territoriality and pairs. Ultimately, these maps are used for a total territory map at the end of the census period. Information on nests and broods collected during the remaining breeding season is used to supplement and fine-tune the territory map (see Meltofte et al. 2007a).

From late June, goslings are counted in the valley and along the coast, in the closed goose molting area (Fig. 1).

BREEDING POPULATIONS

In 2006, the complete initial census of breeding birds within the census area (sections 1-5, Fig. 1) was performed between 17 and 26 June, which is a period later than usual due to the extensive snow cover. At that time, most parts of the 19.3 km^2 census area were snow free although to a lesser extent than the historical average. The entire census was performed in good weather conditions.

In addition, large parts of the area were censused regularly during June, July and most of August, exceptions being the Aucellabjerg slopes above 350 m a.s.l. and the closed goose molting area along the coast (Fig. 1). The slopes were censused on only three occasions due to fog (see below).

The results of the initial census, supplemented with records during the rest of the season (see above and Meltofte et al. 2007a), are presented in Table 1, and in Table 2 they are compared to the results of previous seasons.

Red-throated Divers *Gavia stellata* breed regularly at Zackenberg, but no nests were found in 2006. Four to five pairs were found during the census.

Long-tailed Ducks *Clangula hyemalis* are regular breeders at Zackenberg, and two nests were found in 2006. Pairs were seen in the census area from 7 June to 2 August, and ducklings from 30 July to 11 August; three broods in total were found.

After a string of years with low numbers, the Rock Ptarmigan *Lagopus mutus* population was high. At the opening of the station, many Rock Ptarmigan remains were found at active Arctic Fox *Alopex lagopus* dens and in other parts of the valley. From these remains we concluded that foxes in the bird census area took a minimum of 19 Rock Ptarmigans during winter and spring. At dens in adjacent areas, remains of an additional minimum of four Rock Ptarmigans were found.

During the census, 4-7 pairs of Rock Ptarmigans were registered. The nest of one of these pairs was found, containing eight eggs that all subsequently hatched. The brood was seen on 17 July for the first time, and survived at least another day. The re-emergence of breeding Rock Ptarmigans in the census area fits well with the expected synchrony for this species in Northeast Greenland (cf. Hansen et al., in prep.).

Among waders, Sanderlings *Calidris alba* were recorded in record high numbers, even a little above the previous peak of 2003. Dunlins *Calidris alpina* and Ruddy Turnstones *Arenaria interpres* also appeared in numbers above average. For Ruddy Turnstone, it seems that the population was at a low in 2002 and 2003, and that it has now risen to levels well above average. Most of these birds did not seem to breed this year, which is likely to be associated with the late snowmelt (see below). Common Ringed Plover *Charadrius hiaticula* and Red Knot

TABLE 1. Estimated numbers of pairs/territories in the five sectors of the 19.3 km² census area in Zackenbergdalen, 2006; altitude is shown a.s.l.

Direction from river	West	East	East	East	East	Total
Species	<50 m 3.47 km²	<50 m 7.77 km²	50-150 m 3.33 km²	150-300m 2.51 km²	300-600 m 2.24 km²	
Red-throated Diver	1	3-4	0	0	0	4-5
King Eider	0	1	0	0	0	1
Long-tailed Duck	0-1	5-6	0	0	0	5-7
Rock Ptarmigan	1-2	2-3	0	0-1	1	4-7
Common Ringed Plover	8-9	20-29	4-5	5	4-5	41-53
Red Knot	0	4-10	15-22	8	0	27-40
Sanderling	8-11	40-47	6-7	12-14	7-8	73-87
Dunlin	23-25	68-83	15-18	0	0	106-126
Ruddy Turnstone	7-9	36-41	18-23	2-5	0	63-78
Red-necked Phalarope	0	2	0	0	0	2
Red Phalarope	0	5-7	0	0	0	5-7
Long-tailed Skua	5-7	7-12	8-10	1	0	21-30
Glaucous Gull	1	0	0	0	0	1
Arctic Redpoll	0	0-1	0-1	0	0	0-2
Snow Bunting	17	22-24	23-24	9	9-10	80-84

TABLE 2. Numbers of territories of regular and irregular breeders in the 19.3 km² census area in 2006 compared to the average number of territories for the period 1996-2005.

Species	No. territories	Average min. and max. no. territories 1996-2005	No nests found[a]	Comments
REGULAR BREEDERS				
Red-throated Diver	4-5	2.5-2.9	3	
Common Eider	0	0.4	0	Flocks seen in June, females with chicks in Aug.
King Eider	1	1.9-2.8	0	Few other observations.
Long-tailed Duck	5-7	5.7-7.5	2	Broods seen from 30 July.
Rock Ptarmigan	4-7	3.8-4.3	1	
Common Ringed Plover	41-53	40.4-44.7	4	
Red Knot	27-40	26.8-31.6	0	
Sanderling	73-87	55.9-64.8	8	
Dunlin	106-126	94-104.4	14	
Ruddy Turnstone	63-78	46.1-51.7	4	Many non-breeders this season.
Red-necked Phalarope	2	0.8-1.7	0	
Long-tailed Skua	21-30	22.3-26	2	Many non-breeders this season.
Glaucous Gull	1	0.2	1	
Common Raven	(2-3)	-	0	Breed outside the census area.
Snow Bunting	80-84	59.4-61.3	1	Nests of passerines found opportunistically.
IRREGULAR BREEDERS				
Pink-footed Goose	0	0.6-0.7	0	Min. 532 immatures seen migrating northwards
Eurasian Golden Plover	0	0.1	0	1 individual, 31 May. 2nd earliest record at ZERO
Red Phalarope	5-7	0.2-0.3	1	First nesting record at Zackenberg
Snowy Owl	0	0.1	0	No observations this season
Northern Wheatear	0	0.2-0.5	0	No observations this season
Arctic Redpoll	0-2	0.5	0	One additional observation in adjacent areas

[a] Within the census area

Calidris canutus were recorded in numbers around the average of previous years (Tables 1 and 2).

Red Phalarope *Phalaropus fulicarius* territories were found in record high numbers in 2006 (Table 2) and a nest was found, the first of this species thus far in this monitoring effort. Possibly, the late snowmelt suited this high-arctic breeder.

The number of Long-tailed Skua *Stercorarius longicaudus* territories was average (Table 2). Early in the season, higher numbers were observed, possibly due to the fact that many birds were not breeding and therefore moved around a lot. Only two pairs nested in the census area (see below).

The last two seasons have shown rising numbers of Snow Bunting territories. This season numbers were lower again, although still the 3rd highest in total (Table 2).

REPRODUCTIVE PHENOLOGY IN WADERS

Likely due to the extensive spring snow cover, nest initiation by waders in the 2006 season was very late (see also Meltofte et al. 2007b). Only 6.25% of all wader clutches were initiated before 10 June, and medians of the first egg dates were after 25 June in four of the five species monitored (Tables 3, 4).

REPRODUCTIVE SUCCESS IN WADERS

Nest success was fairly good for Dunlin and very good for Common Ringed Plover, whereas the nest success for Sanderling and turnstone was very low. The all-wader predation rate was *c.* 63%, which is above average. Thirteen of 28 nests were found predated. The fate of five nests was unknown. All but one turnstone nests was unsuccessful (n = 4), compared to success in all Common Ringed Plover nests (n = 5). Of course, the few nests found, makes this result unclear. Not being a target species for us, Common Ringed Plover nests were found opportunistically. Had we sought nests of this species intensively, we would likely have found nests that would later suffer from predation. Unsuccessful nests not suffering from predation were either abandoned (n = 1) or the brood was predated during, or just after, hatching (n = 1). Also, all but two Sanderling nests were predated

TABLE 3. Median first-egg dates for waders at Zackenberg 2006, as estimated from incomplete clutches, egg floating, hatching dates, as well as weights and observed sizes of pulli.

Species	Median date	Range	N
Common Ringed Plover	28 June	19 June - 29 June	5
Red Knot	-	-	0
Sanderling	30 June	20 June - 10 July	12
Dunlin	27 June	16 June - 4 July	20
Ruddy Turnstone	21 June	13 June - 29 June	4
Red-necked Phalarope	-	-	0
Red Phalarope	1 July	1 July	1

TABLE 4. Snow cover (%) on 10 June together with median first-egg dates (in June) for waders at Zackenberg, 1995-2006. Data based on <10 nests/broods are in brackets, those <5 are omitted. The snow cover is pooled (weighted means) from section 1, 2, 3 and 4 (see Klitgaard et al. 2007), from where the vast majority of the nest initiation dates originate.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Snow cover (%), 10 June	84	82	76	80	91	53	84	79	83	48	28	*
Sanderling		(16)	18	18	23.5	16	22.5	17	13	8	(15)	30
Dunlin	(18)	11.5	13	16.5	22	11.5	25	8	12	12	12	27
Ruddy Turnstone	(12)	18.5	13	12.5	24	11	23	9	8	8	11	

* Yet to be estimated, but high.

(n = 12). Numbers of Arctic Fox encounters in the bird census area were high (Table 5), and foxes were the likely predator of most nests, as no nests were found with clear signs of avian predation.

With a mean clutch size across species of 3.4, mean clutch size was lower than the average for previous years (Table 6). One Ruddy Turnstone nest and one Dunlin nest held only one egg each, and one Sanderling nest and three Dunlin nests held only two eggs. Only one Red Phalarope nest was found, and it contained four eggs.

In July and early to mid-August, alarm-calling parents, and later juveniles, were found in the census area. Juvenile Ruddy Turnstones were only seen late in the season, most often in connection with low-tide feeding, indicating that most of these hatched outside the census area.

From 16 July, flocks of up to 12 Long-tailed Skuas roamed the lower slopes of Aucellabjerg and the lowlands (sections 1-3, Fig. 1) making survival of wader chicks more difficult.

The number of juvenile waders in the two deltas (Fig. 1) at low tide was extremely low compared with previous seasons; Common Ringed Plover was the only species having a near-average number (Table 7). The reason for this was probably a combination of poor breeding success in the region and deterioration of the habitat of the present delta of Zackenbergelven due to a surge flood in 2005. In total, 78% of all waders observed during low tide were recorded in the former delta, including 71% of all adult and almost 93% of all juvenile waders. The waders might simply have chosen other areas in which to forage. Indeed, minor deltas exist at several rivulet mouths along the coast of Young Sund (Fig. 1).

Note: from 2007 and onwards low tide counts will no longer be part of the permanent monitoring. Results of the counts over the years are summarised and analysed by Meltofte and Berg (2004) and Meltofte et al. (2007).

TABLE 5. Mean hatching success, 1996-2006, according to the modified Mayfield method (Johnson 1979). Poor data (<125 nest days or five predations) are given in brackets. Data from species with <50 nest days have been omitted (-: no nests at all). Nests with at least one pipped egg or one hatched young are considered successful. Also given are total numbers of adult foxes observed by the bird observer in the bird census area during June-July (away from the research station proper).

Species	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	1996-2006
Common Ringed Plover				(60)		(38)				-	(100)	62-100
Red Knot	-	-			-		-			-	-	(18)
Sanderling	(72)	(33-100)	(88)	40	(46)	19	(33)	45	71-85		(7.4)	37-41
Dunlin			28-47	65	68	(75)		63	93	(43)	47	60-65
Ruddy Turnstone	21-68	67-100	16	23-28	29	(60)	52	21-27	83			38-45
All waders	33-63	52-100	32-37	42-44	44	43	43	42-44	87-90	22	37	45-52
No. nests	17	31	44	44	47	32	21	51	55	15	28	385
No. nest days	163	274	334	521	375	328	179	552	700	104	332	3860
No. Lemming nests km^{-2}	77	176	346	158	89	156	152	46	210	144	129	
Fox encounters	14	5	7	13	11	14	21	11	16	18	22	

TABLE 6. Mean clutch sizes in waders at Zackenberg, 1995-2006. Samples of <5 clutches are given in brackets.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Mean
Common Ringed Plover	(4.00)	(4.00)	(3.50)	(4.00)	(3.50)	(4.00)	(3.50)	(4.00)	(4.00)	(4.00)		(3.75)	3.84
Red Knot				(4.00)	(4.00)		(4.00)		(4.00)	(4.00)			4.00
Sanderling	(4.00)	4.00	3.86	4.00	3.67	4.00	3.43	3.83	4.00	4.00	3.75	3.63	3.85
Dunlin		(4.00)	(3.75)	3.90	3.70	3.93	3.63	(4.00)	4.00	3.92	4.00	3.13	3.81
Ruddy Turnstone		3.71	3.79	3.82	3.58	3.80	3.75	4.00	3.77	3.92	3.86	(3.00)	3.73

TABLE 7. Total numbers of juvenile waders recorded at low tide in the former and the present deltas of Zackenbergelven, on the basis of 15 counts performed every third day during the period 18 July – 28 August, 1995-2006. Data from missing counts have been substituted by medians from previous and following counts. Note that the total number also includes juvenile Red Knots, which are not otherwise featured in this table.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Common Ringed Plover	96	126	249	42	44	142	320	140	170	253	176	166
Sanderling	304	726	149	333	445	366	540	156	242	346	78	72
Dunlin	325	360	323	232	509	273	326	554	309	308	173	91
Ruddy Turnstone	80	108	82	109	23	73	162	183	75	19	52	28
Waders total	810	1342	803	722	1021	854	1351	1040	803	928	479	357

REPRODUCTIVE PHENOLOGY AND SUCCESS IN LONG-TAILED SKUAS

Only three Collared Lemmings *Dicrostonyx groenlandicus* were seen during field work by the bird observer during June and July, indicating a moderate lemming season. This was also reflected in the low number of lemming winter nests found (see Table 5). In accord, only two Long-tailed Skua nests, each with only one egg, were found within the census area. These would have been initiated as late as 16 and 22 June, respectively. As mentioned above, the number of pairs was similar to other years and, hence, most pairs were non-breeding.

The egg of one skua nest never hatched, although it was incubated well beyond the normal incubation period, while the egg of the other nest hatched (Table 8). The chick is believed to have survived for a maximum of 10 d.

Possibly, Long-tailed Skua reproduction was generally low in eastern Greenland in 2006, as no Long-tailed Skua chick fledged at Karupelv, on Traill Ø, either (B. Sittler, pers. comm.).

No observations of juvenile birds were made at Zackenberg in 2006.

BREEDING AND MOLTING GEESE

On 9 June 2006, an old Barnacle Goose *Branta leucopsis* colony west of the census area was revisited, and the call of one Barnacle Goose was heard from the upper terraces of the southern face of the Zackenberg mountain (Fig. 1). Two smaller flocks were foraging at the foot of the mountain. From this observation and later observations of traffic towards that part of the mountain, it is assumed that a modest level of breeding activity took place here in 2006.

The first family with a gosling was seen on 30 June in the former delta (Fig. 1), foraging with seven other adults. The number of broods along the coast was among the lowest recorded so far (Table 9), and the maximum number of goslings seen within a brood at one time was only five. The mean number of broods seen for the period 1995-2005 was 16. Also, in adjacent areas, very few young were seen. On 16 July, two families with one and two goslings, respectively, were observed with four other adults and 112 immatures at the coast of Halvøen in the south-eastern part of the valley. The other broods were observed within the closed goose molting area (Fig. 1).

TABLE 8. Median clutch initiation dates, breeding effort and success in Long-tailed Skuas at Zackenberg, 1996-2006. The numbers of clutches found include replacement clutches. Mean hatching success according to the modified Mayfield method (Johnson 1979). Poor data (<125 nest days or five predations) are given in brackets. Nests with at least one pipped egg or one hatched young are considered successful. Also given are numbers of lemming winter nests within the ca. 2 km^2 lemming census area.

Species	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Median 1st egg date		7.6	12.6	17.6	18.6	15.6	9.6	15.6	8.6	8.6	19.6
No. clutches found	8	17	23	8	5	21	14	7	21	8	2
No. young hatched	1	25	16	2	2	18	14	5	36	6	1
Nest success % (Mayfield)		(80.6)	24.1	(18.1)	(17.5)	39.5	44.1	(76.2)	(100)	(51.8)	(50)*
Estimated no. young fledged	0	5	6	1	0	5	4	2	22	1	0
Lemming nests km^{-2}	77	176	346	158	89	156	152	46	210	144	129

TABLE 9. Average brood size of Barnacle Geese in Zackenbergdalen during July and early August, 1995-2006, together with the total number of broods led to the valley from nearby colonies. Samples of <10 broods are given in brackets. Average brood size during autumn and winter on the Isle of Islay, Scotland, is given for comparison, including the percentage of juveniles in the population (M. Ogilvie, unpubl. data).

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Early July		(3.0)	3.1	(2.9)	1.9	(3.2)	(1.8)	2.4	(1.8)	2.6	(1.7)	(2.0)
Mid July		(2.3)	2.7	2.3	1.8	(3.1)	(1.7)	2.4	(1.2)	2.3	2.7	(1.5)
Late July	(2.0)	(3.0)	2.6	2.2	1.7	3.1		2.3	(1.1)	2.3	(2.2)	(1.1)
Late August	(2.3)	(2.3)	2.4		1.8		(2.0)	2.2	(1.2)	(1.9)		(1.5)
No. broods	≥7	6-7	19-21	≥18	29	11	4	32	8	26	14	9
Scotland	2.00	2.30	1.95	2.28	1.92	2.20	1.94	2.23	1.59	2.35	1.67	1.15
Juveniles (%).	7.2	10.3	6.1	10.5	8.1	10.8	7.1	12.5	6.4	15.9	6.3	3.2

The mean 2006 brood size, 1.1 young per brood, equals the lowest late July figures recorded so far,. From Isle of Islay, western Scotland, it was reported that the percentage of young in flocks at their wintering quarters also was very low (Table 9; M. Ogilvie, pers. comm.)

Large numbers of immature Icelandic and Greenlandic Pink-footed Geese *Anser brachyrhynchus* as well as Greenlandic Barnacle Geese *Branta leucopsis* molt in Northeast Greenland. At Zackenberg, fair numbers, especially of Barnacle Geese, molt in our study area (cf. Meltofte 2006b). Due to disturbances from our activities, Pink-footed Geese numbers have declined during the monitoring period, whereas immature Barnacle Goose numbers have increased in some areas, with record high numbers in 2006 (Table 10).

OTHER WATERBIRDS

Common Eiders *Somateria molissima* have bred at Zackenberg on a few occasions (Meltofte 2006b), but breed in great numbers at a colony at Daneborg, 23 km southeast of Zackenberg (for details see Meltofte 1978). At Zackenberg, the first female eider was seen on 12 June, and the first two males were seen with a flock of 14 females on 21 June. The last male was seen 7 July, and the first ducklings on 7 August; the

TABLE 10. The number of immature Pink-footed Geese and Barnacle Geese molting in the study area at Zackenberg, 1995-2006. The closed area is zone 1c in Figure 1.

Study Area	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
PINK-FOOTED GOOSE												
Closed molting area & further east	310	246	247	5	127	35	0	30	41	11	17	27
Transect Daneborg - Zackenberg	0	0	0	0	0	0	0	0	0	20	0	-
Coast west of closed area	230	40	60?	0	29	0	0	0	0	10	0	3
Upper Zackenbergdalen	0	0	15	0	0	0	0	0	0	0	0	1
Outer Store Sødal	20	12	21	0	5	0	16	8	11	0	2	8
Inner Store Sødal	20	55	144	123	21	56	69	28	27	-	34	-
Pink-footed Goose total	>580	>353	<487	128	182	91	85	66	79	>41	53	39
BARNACLE GOOSE												
Closed area at Lomsø & Kystkærene	21	0	29	21	60	84	137	86	120	81	87	148
Coast east of closed area	>120	150?	96	55	66	0	109	80	45	0	2	218
Coast west of closed area	0	0	0	0	0	30	0	0	0	0	29	29
Upper Zackenbergdalen	41	85	2	75	<57	27	60	0	14	0	25	30
Outer Store Sødal	114	46	97	114	117	150	150	81	78	81	161	108
Inner Store Sødal	>19	61	63	184	87	78	46	57	71	-	108	389
Barnacle Goose total	>315	<342	287	449	<387	369	502	304	328	<162	412	922

TABLE 11. Visitor and vagrant bird species recorded at Zackenberg, 1995-2006. For 1995-2005, the number of individuals is given; for 2006, both the number of individuals and observations are listed.

	Visitors and Vagrants - Previous Records											Visitors and Vagrants - 2006		
Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	No. individuals	No. observations	Notes
Great Northern Diver	0	0	0	0	0	0	1	0	0	0	0	0	0	
Whooper Swan	0	0	0	0	0	4	0	0	0	0	0	0	0	
Snow Goose	0	0	0	0	0	2	11	0	23	0	0	0	0	
Canada Goose	0	0	0	0	0	0	0	0	0	0	0	4	3	b,c
Merlin	0	0	0	0	0	1	0	0	0	0	0	0	0	d
Gyr Falcon	1	1	1	3	0	4	5	1	3	4	2	0	0	
Pintail Duck	0	0	0	1	0	0	0	0	0	0	0	0	0	g
Common Teal	0	0	0	0	0	0	0	1	0	0	0	0	0	
Eurasian Golden Plover	0	3	1	3	1	0	11	1	0	1	1	1	1	
White-rumped Sandpiper	0	0	0	0	0	0	1	0	0	0	1	0	0	
Pectoral Sandpiper	0	0	0	1	0	0	0	1	0	0	0	1	2	
Purple Sandpiper	0	0	0	0	0	0	0	1	0	0	0	0	0	
Red Phalarope	0	0	0	4-5[a]	0	0	4[a]	0	1	0	2[a]	11[a]	7	
Whimbrel	0	0	0	0	0	1	1	0	0	2	1	0	0	
Pomarine Skua	0	0	0	0	0	0	2	0	0	0	0	0	0	
Arctic Skua	0	0	11	6	0	2	7	4	3	2	0	1	1	
Great Skua	0	0	0	4	0	0	0	1	0	0	0	0	0	
Lesser Black-backed Gull	0	0	0	0	0	0	1	0	1	2	1	4	2	e
Iceland Gull	0	0	0	0	0	0	0	0	0	0	0	2	1	b
Great Black-backed Gull	0	0	0	0	0	1	3	0	0	0	0	0	0	
Black-legged Kittiwake	0	0	0	0	0	0	0	0	14	0	0	0	0	f
Arctic Tern	≈200	2	1	2	0	14	0	0	32	0	0	0	0	
Snowy Owl	0	0	2	1	1	1-2	min. 4[a]	0	0	0	0	0	0	
Meadow Pipit	0	0	0	1	0	0	0	0	0	0	1	2	2	g
White Wagtail	0	1	0	0	0	0	0	0	0	0	0	0	0	
Northern Wheatear	4	8[a]	4	3a	1-2[a]	0[h]	0	0	0	0	2	1	1	
Arctic Redpoll	7	9	16	23	8	5	3	6	31[i]	12	3[a]	2	2	
Lapland Longspur	0	0	0	0	1-2	0	1	0	0	0	1	0	0	

[a] One or more territories, possible territories or breeding found, see table 1
[b] 2006: First records at Zackenberg
[c] Subspecies *interior*
[d] Immature Merlin, 1 and 14 July.
[e] Increasing in East Greenland (Boertmann 2008)
[f] 10 adults, 4 juveniles 28 August 2003.
[g] Northernmost records in East Greenland (*cf.* Boertmann 1994)
[h] One dead individual found
[i] 20 of these, a flock of juveniles in August

latter date is extremely late. These ducklings were most likely from the colony at Daneborg, where personnel from the Sirius dog sledge patrol counted 1,554 active nests. Extensive snow cover hindered full use of the colony area, and an estimated 15-20% of the females did not nest. The average number of nests (2002-2005) was 2,174 (range: 1614-2606). King Eider *Somateria spectabilis* breeds regularly at Zackenberg (Meltofte 2006b), and in 2006 a pair was seen on 24 June.

VISITORS AND VAGRANTS

Two new species were added to the Zackenberg avifauna : Canada Goose *Branta canadensis* and Iceland Gull *Larus glaucoides* (Table 11). The first Canada Goose was observed on 29 May, and on 14 June, two were foraging in fens at the research station. Lastly, three pairs were foraging in the coastal fens on 24 June. Three subspecies have been recorded in Greenland, and the birds at Zackenberg were *Branta canadensis interior*, a subspecies known to be expanding in Greenland (Kristiansen and Jarrett 2001, Fox et al. 2006).

Two Iceland Gulls were seen among 60 Glaucous Gulls *Larus hyperboreus* in the delta of Zackenbergelven on 25 July.

One Eurasian Golden Plover *Pluvialis apricaria* was seen near the research station on 31 May, thus keeping the species as a near-annual visitor. The third record of Pectoral Sandpiper *Calidris melanotos* at Zackenberg was made in the fens south of the research station on 6 July. Most likely, it was the same individual, presumably a female that was found in a fen just north of the research station on 7 July. The Pectoral Sandpiper is a rare visitor to eastern Greenland (Boertmann 1994). On 22 July, an Arctic Skua *Stercorarius parasiticus* was observed near the coast. Arctic Skuas are less common in the fjords areas than at the outer coast, and also have a more southerly distribution than the Long-tailed Skua (Boertmann 2003). Sporadic observations of Lesser Black-backed Gulls *Larus fuscus* were made from 23 June to 28 July. The species is steadily expanding northwards in eastern Greenland (Boertmann 2008). Two records of Meadow Pipits *Anthus pratensis* in 2006 represent the third season that this species was seen at Zackenberg. Only one record, on 18 August, was made of a Northern Wheatear *Oenanthe oenanthe*, once a breeding bird to the area. A male Lapland Longspur *Calcarius lapponicus* was observed in the fens north of the research station on 23 June.

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