BREEDING CONDITIONS AND NUMBERS OF BIRDS ON TAIMYR, 2006

Report of the Wader Monitoring Project on Taimyr

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Front cover photo: Little Stint.

1. Introduction

In the recent years *monitoring* has become one of the focal points of research and conservation activities in the Arctic. At the 2002 World Summit on Sustainable Development, world leaders expressed their desire to achieve "a significant reduction in the current rate of loss of biological diversity". To achieve this goal, the Conservation of Arctic Flora and Fauna (CAFF) Working Group of the Arctic Council identified *monitoring* as a key objective for the conservation of Arctic biodiversity. Accordingly, CAFF has launched in September 2005 the Circumpolar Biodiversity Monitoring Program (CBMP, http://www.caff.is/sidur/uploads/Circumpolar%20Biodiversity.pdf) to "build on national and international work to implement a program to monitor biodiversity at the circumpolar level that will allow for regional assessments, integration with other environmental monitoring programs, and comparison of the Arctic with other regions of the globe". The CBMP is being developed by CAFF to serve as a coordinating entity for currently existing biodiversity monitoring programs in the Arctic, for data gathering and data analyses, and for coordinating the communication of results. Implementing of various elements of the CBMP will culminate in 2010, in conjunction with the Convention on Biological Diversity global target to significantly reduce the rate of biodiversity loss by 2010.

Arctic-nesting waders (or shorebirds) is one of the monitoring networks chosen by CAFF to provide adequate monitoring of circumpolar biodiversity as initial components of the CBMP (see http://www.caff.is/sidur/uploads/Shorebirds.pdf for details). Given that newly established monitoring programs cannot provide comprehensive results in a short time remaining until 2010, a primary goal of a circumpolar monitoring program is to ensure that existing monitoring programs continue to be well coordinated and supported, while simultaneously integrating them into a Holarctic program.

Monitoring of nesting and migration of birds, waterbirds in particular, has become especially important in the context of the spread of avian influenza, significant outbreaks of which were registered during the last years. Low pathogenic form of avian influenza virus (LPAI) was found in at least 105 species of birds, belonging to 28 families (Olsen et al., 2006). Birds of wetlands, i.e. representatives of orders Anseriformes (ducks, geese and swans) and Charadriiformes (gulls, terns and waders), belong to principal carriers of virus. The latter primarily affects lining cells of gastrointestinal tract in birds, and transmission of

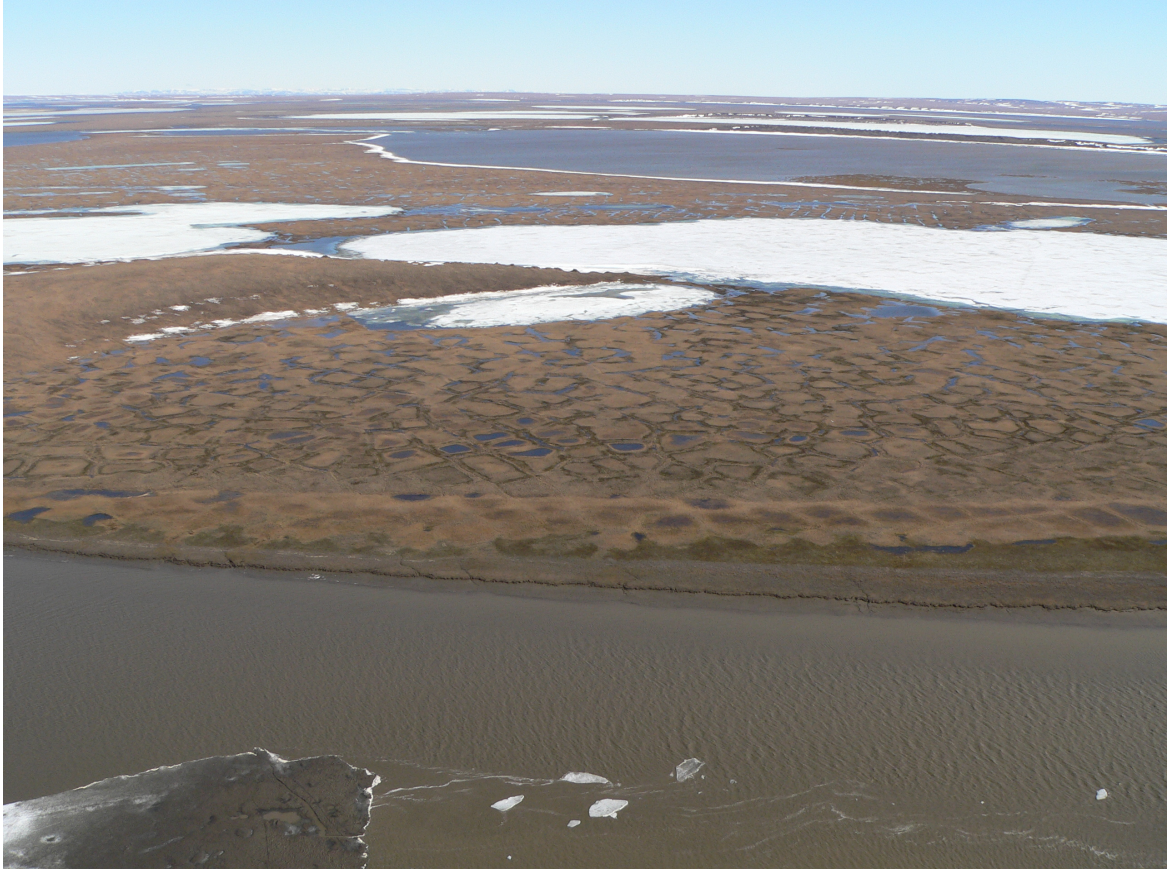
infection is greatly aided by output of virus with faeces to the water and further peroral infestation.

A majority of Anseriformes and Charadriiformes (and all birds of these orders breeding in the Arctic) undertake varying in direction and distance seasonal migrations, and accordingly can contribute to transmission of viruses even between different continents. Breeding birds of a certain geographic region can exploit the same migration route, for example, birds from Eastern Siberia migrate to southern and eastern Asia along the East Asian-Australasian Flyway. However, a degree of bird fidelity to specific flyways should not be overestimated as individual birds and whole populations can behave differently (e.g, see Carborenas 1992). Moreover, birds from different breeding populations can mix up at stop-over sites during migration and on wintering grounds, and vice versa the same breeding sites are used by birds wintering at different continents. High local density of birds at stop-over sites and on wintering grounds favours transmission of viruses, potentially among birds from different breeding, stop-over and wintering populations.

Wader Monitoring Project on Taimyr (WMP) was implemented in 1994-2006 in a framework of scientific cooperation between the National Park Schlezvig-Holstein Wattenmeer, the State Nature Reserve "Taimyrsky", the Working Group on Waders (CIS) and the Arctic Expedition of the Russian Academy of Sciences. The project primary goal was to relate among-year variation of numbers and nesting success of waders to environmental factors in tundra. The research was carried out on south-eastern Taimyr in 1994-2003, and on central Taimyr in 2004-2006. This background is making WMP an essential component of a circumpolar monitoring program, because it is one of two programs of intensive monitoring of waders existing in the whole Russian Arctic. Given that principal protocols of field data collection and processing in a framework of the WMP were maintained unchanged since 1994, this scheme represents a unique for the whole circumpolar region example of contiguous collection of data on Arctic biodiversity. WMP is also a single program in the Russian Arctic collecting data on breeding success of waders during 13 years in row.

Outline of the WMP, principal results and selected presentations are available at the project page at the website of the Working Group on Waders (http://www.waders.ru/taimyr.asp?lang=2 (English) and http://www.waders.ru/taimyr.asp?lang=1 (Russian)). Concise information about breeding conditions, environmental factors, numbers and breeding status of birds in the study areas for years 1994-2006 can be also obtained at the

WMP pages on website of the Arctic Birds Breeding Conditions Survey (http://www.arcticbirds.ru/).



View of Bolshoi Island on 19 June 2005. Polygonal bog of the plot #2 at the foreground and Figurnoe Lake (without ice) at the background

2. Study site and methods

2.1. Study site

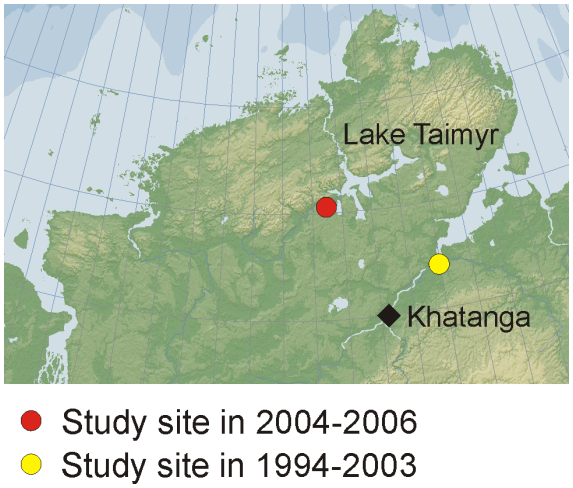


Figure 1. Study sites of the Wader Monitoring Project on Taimyr

Observations were carried out from 11.06 to 9.08.2006 in the area of approximately 87 km^2 belonging to the main territory of the State Biosphere Reserve "Taimyrsky", in the vicinity of the field camp with coordinates 74°09'N, 99°34'E, where surveyed had been conducted in 2004-2005. Study area and plots for bird surveys are shown on Fig. 2.

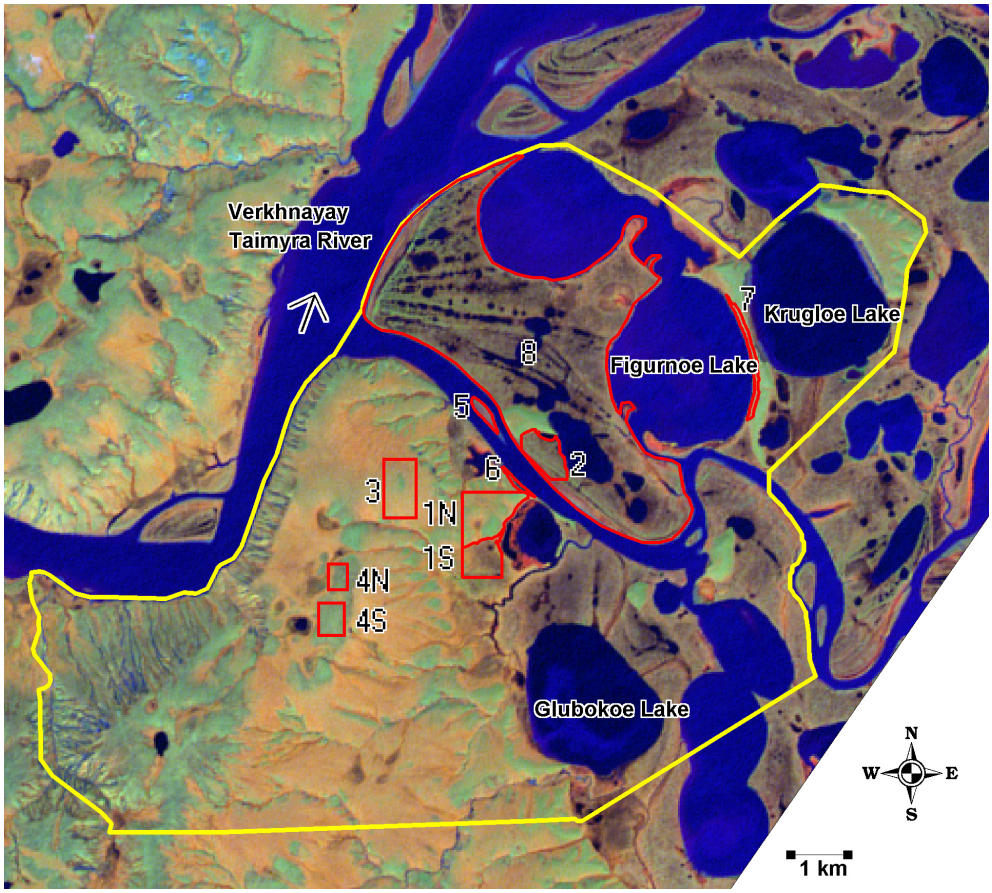


Figure 2. Study area in 2004-2006 (yellow outline) and plots for bird surveys (red outline) (see Table 2 for plot legend). Base map represents composite image, where red channel=4th Landsat band, green channel=5th band, and blue channel=2nd band.

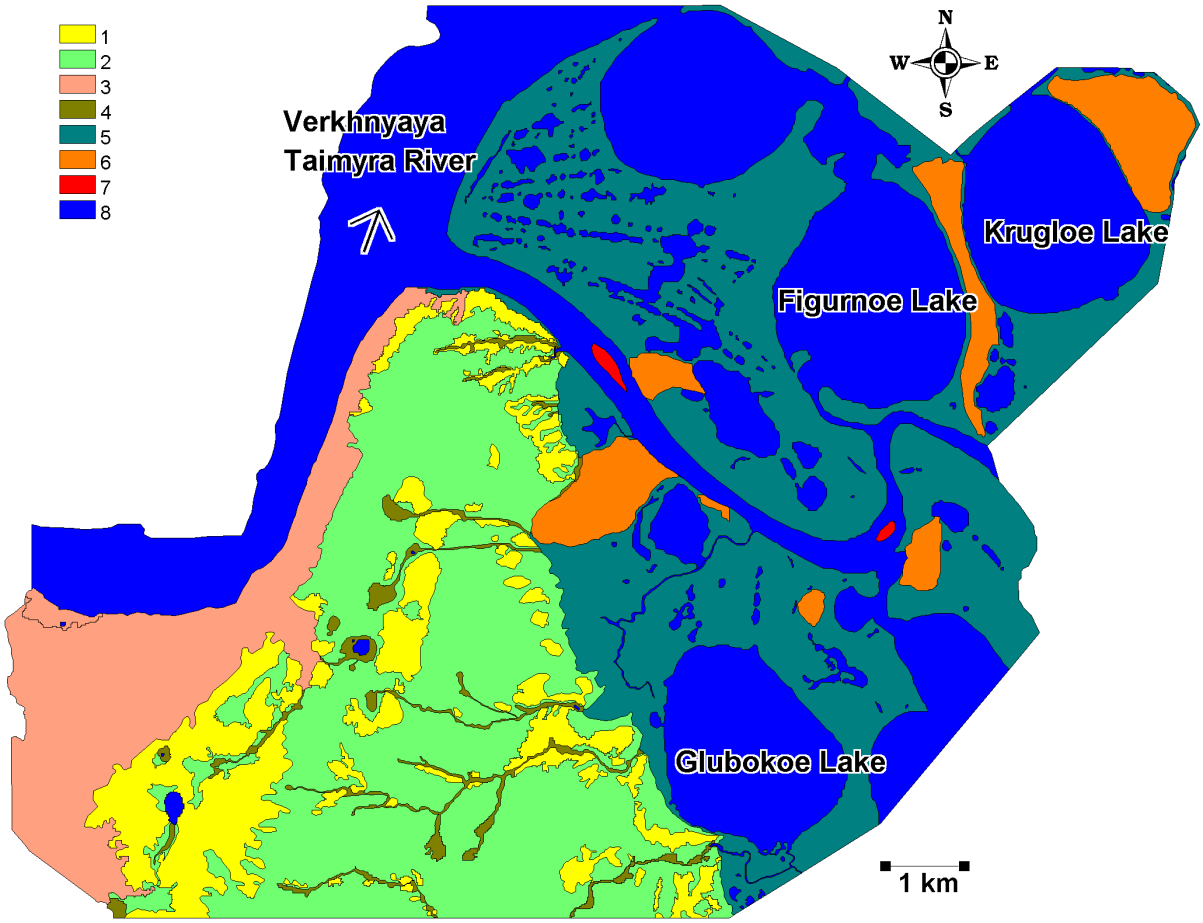


Figure 3. Habitats of the study area: 1 – dry (locally with gravel) spot dryad-moss tundra; 2 – wet cottongrass moss tundra; 3 – bed-rock bank of the Verkhnyaya Taimyra River; 4 – polygonal hypnum bog of the moraine plain; 5 – polygonal hypnum bog of the high floodplain; 6 – fragments of the first river terrace; 7 – small river islands with willow bushes; 8 – water bodies.

The study area belongs to northern part of the typical tundra subzone (Chernov, Matveeva, 1979). We used Landsat-7 image, acquired on 4 August 1999, to create habitat map (Fig. 3). The area is located at the joint of three different landscapes (Pospelov 2000), two of which were surveyed in course of studies in 2004-2006. Western part of the region, to the south of the Verkhnyaya Taimyra River, covers 40.2% of surveyed area and represents moraine rolling plain on underlying calculous clays with maximal heights reaching 160 m and rugged relief. Eastern part of the region represents flat alluvial plain of the Verkhnyaya Taimyra mouth, formed from sandy-silt river deposits overlaid with turf. Two landscapes are separated by the channel 150-430 m wide going from the main river-bed of the Verkhnyaya Taimyra to the southeast. The whole area to the east from the channel as well as the adjacent area up to 3 km wide to the southwest belongs to alluvial landscape. A major part of the

lowland is represented by Bolshoy Island, which actually consists of several islands isolated by channels and lakes.

Principal habitats differ between western and eastern parts of the area. Spot tundra with Dryad *Dryas sp.*, lichens *Cetraria sp*. and mosses occupy flat and bossed watershed surfaces (8.8% of the whole area). Cottongrass-moss tundra with dwarf shrubs covers wide areas of gentle slopes (*Eriophorum polystachion*, *Hylocomium sp*., *Salix reptans, S. polaris*, 20.4% of the whole area). This tundra type is characterized by almost complete absence of bare soil, low coverage of lichens and poor development of micro- and nanorelief. Slope of the Verkhnyaya Taimyra bed-rock bank with associated valleys represents the third important habitat in the western part of the area (10.4%). Considerable variation of altitude, reaching 140 m, and width of the latter habitat reaching 2.5 km resulted in high diversity and fragmentation of microhabitats, including patches of typical moss tundra, scars and stony tallus. This territory is heavily trampled by reindeers. Bogs in depressions and gravel placers on bossed heads occupy small portion of the area. Five small lakes occupy 8 hectares of the total area of 34.6 km^2, which is very low value for the tundra zone.

Polygonal hypnum bogs (*Carex concolor*, *Eriophorum rosseolum*, *Salix reptans*) is the principal habitat in the eastern part of the study area (29,1% of the total area). Bogs cover floodplain of Bolshoy Island, while marginal parts along banks of channels, lakes and on small islands are occupied by willow bushes with forbs and gramens (*Arctagrostis latifolia*, *Alopecurus alpinus*, *Calamagrostis holma*, *Trizetum litorale*, *Astragalus alpinus*, *Eguzetum borealis*, *Salix lanata*, *S. glauca*). Seven fragments of the first terrace varying from 0.04–1.3 km^2 in size represent a prominent feature of the eastern part of the area (3.7%). These elevations extend up to 23 m over floodplain, and are occupied by sedge-moss tundra (*Carex arctisibirica*, *Lusula nivalis*). Lakes are numerous in the eastern part of the area. Channels and lakes over 4.5 ha large occupy 27.4% of the total area. Numerous small lakes and ponds are incorporated in the polygonal bogs.

2.2. Collection of ornithological data

A majority of data on fauna, distribution and numbers of birds were collected on 7 study plots with a total area 221 hectare (Fig. 2, Table 1). Of these plots 6 were surveyed in all years, while plot #4, established on the watershed in 2005, was not surveyed in 2004. Plots #1-4 for nest counts were staked into hectare-large squares with 1 to 1.2 m high stakes. Staking was not necessary on small plots (#5-7), and was not possible for the survey area #8 used for counts of divers, gulls and skuas. Intensive nest searches on the plots were carried out from the start of mass nesting by waders until approximately 10 July. Nests were marked with wooden sticks 10-30 cm long, placed 5-8 m from the nest (larger distance for a larger species). Location of each nest was determined using GPS. Nest searches with rope were carried out on plots #1-4 in early July, and involved dragging a 54 m long synthetic rope (blue and 6 mm thick) along the staked lines. Seven 250 ml tins, with a few small stones in each, were attached to the rope at regular intervals. Nests were also found occasionally in course of ringing and other activities during the whole nesting period. Numbers of nests found in the area are presented in Table 2.

Directional movements of birds and observations of rare species were recorded during the whole season.

Table 1
Plots for bird counts

Plot #	Area, ha	Description
1N	55	forb-lichen-moss spot tundra on the first terrace
1S	33	polygonal sedge bog in high floodplain
2	32	polygonal hypnum bog in high floodplain of Bolshoy Island
3	45	cottongrass-moss tundra on the watershed slope
4*	32	spot dryad tundra on the watershed
5	7	willow bush with forbs and gramens on the island on channel from the Verkhnyaya Taimyra River
6	4	hillock complex on a slope of the fragment of the first terrace
7	13	willow bush with gramens on the fragment of the first terrace on Bolshoy Island
8	1200	survey area for counts of divers, gulls and skuas in polygonal bog with lakes in high floodplain of Bolshoy Island

* - plot on the watershed was established in 2005.

Table 2
Numbers of nests found in the study area in 2004–2006

Group of birds	**2004**	**2005**	**2006**
Passerines	79	101	132
Waders	186	210	200
Non-passerines (except waders)	90	153	83
Total:	**355**	**464**	**415**

Waders were caught by 'luchok'-traps (Priklonski 1960), a variation of the bow net (Bub 1991), on nests and near broods, ringed with steel rings and colour-marked with Darvic flags and bands. Ringing results are summarised in Table 6. Captured waders were weighed to the nearest 0.1 g (stints) or 0.5 g (other species) with Pesola spring balances. We measured flattened and straightened wing (Svensson 1984) with a stopped ruler to the nearest 0.5 mm, bill length from bill tip to the feather-line on the forehead, total head length and tarsus length with callipers (±0.1 mm). Stage of primary moult in Dunlin and plovers was determined according to Ginn & Melwille (1983).

Female Pectoral Sandpiper before releasing

2.3. Collection of data on abundance of invertebrates and weather data

Biomass of invertebrates was sampled on a weekly basis, using pitfall traps for surface-dwelling invertebrates (Byzova et al. 1987), window traps for flying insects and eclectors to collect invertebrates contained in soil samples. Results of these activities will be reported elsewhere.

Temperature regime during study period was accessed using mercury-filled thermometer, from which maximal, minimal and actual readings were taken daily at 9.00 AM, and by means of RTV2 datalogger (http://www.carat-ndt.ru/rtv2.htm), that took temperature readings once an hour. Both devices were installed in a sun-protected box at the height of approximately 0.15 m above the ground in the camp situated on terrace embankment, on the border of plot #1. Two additional RTV2 dataloggers were installed on plots 2 and 3 (floodplain and watershed, respectively).

Precipitation was collected using plastic bottle 9 cm in diameter and 20 cm high. Total daily precipitation was measured on days when it occurred at 24.00 AM, and its amount was later converted to mm. Strong wind could have resulted in evaporation of a substantial amount of water from the bottle, and we used occurrence of any precipitation events during a day as a qualitative measure of precipitation.

Statistical estimates and graphs were made using SYSTAT 7.01 for Windows (SPSS Inc., 1997).

3. Breeding conditions for birds

3.1. Weather

Snow melted on 50% of flat surface in 2006 on 15 June, which was an intermediate date between late melting in 2004 (20 June) and early melting in 2005 (9 June). However, most phenological events in plants and insects occurred in 2006 later than in 2004-2005 due to colder weather in June. Thus, mosquitoes appeared on 11 July only, compared with 5 July in 2004 and 27 June in 2005. Mean daily air temperatures did not exceed +8°C until 5 July, while in two previous years they reached +15°C by 25 June (Fig. 4). July temperatures in 2006 did not differ so markedly from the previous years, although the first half of month was slightly colder and the second slightly warmer than in 2004-2005.

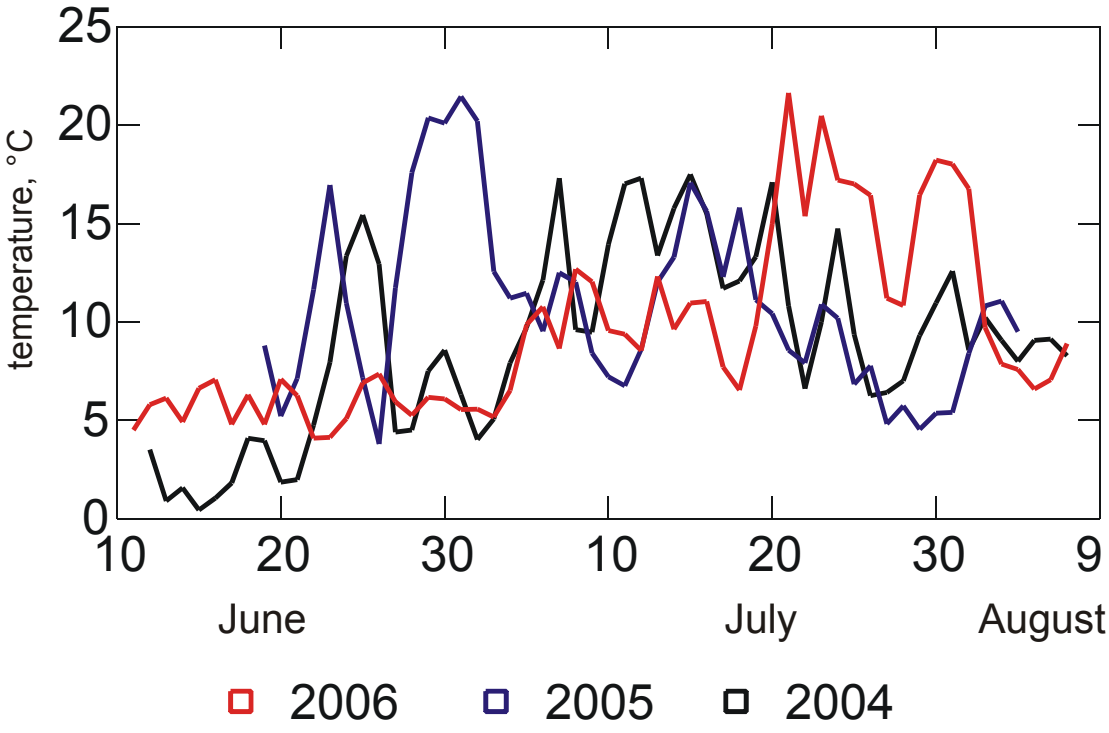


Figure 4. Mean daily air temperature in the study area in 2004–2006, estimated using readings of datalogger installed in the camp on river terrace (plot #1N)

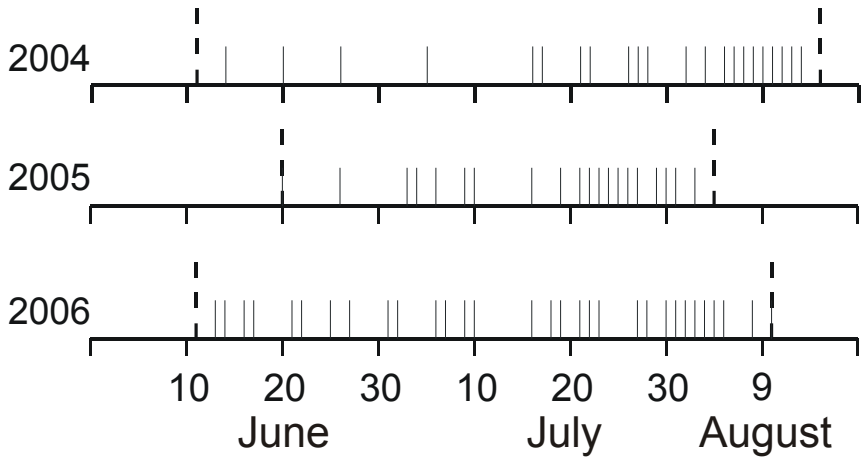


Figure 5. Distribution of days with precipitation in study seasons. Dashed lines delimit period of field studies.

Number of days with precipitation in June 2006 was notably higher than in 2004-2005 (Fig. 5), while in July it was close to this parameter in relatively wet season 2005. Accordingly, snowmelt was close to average in 2006, but June was cold and wet, while July – moderately warm and also wet. Extreme weather events were not recorded.

Collared Lemming

3.2. Lemming abundance

Lemming numbers were low in 2006, following the peak abundance in 2005. Five observers recorded 4 Siberian Lemmings (*Lemmus sibiricus*) in total during the period of surveys, which was a record low abundance since the start of monitoring project in 1994 (Fig. 6). On completion of snowmelt, on 30 June, lemming undersnow nests were counted on a transect, located on the slopes of the first river terrace and watershed slopes. A density of 1.25 nest/km was low, although not as small as could have been expected based on the number of rodents recorded in summer (4), given that the nest density was 3.25 per km in 2005 when 725 lemmings were reported during field season by 4 observers.

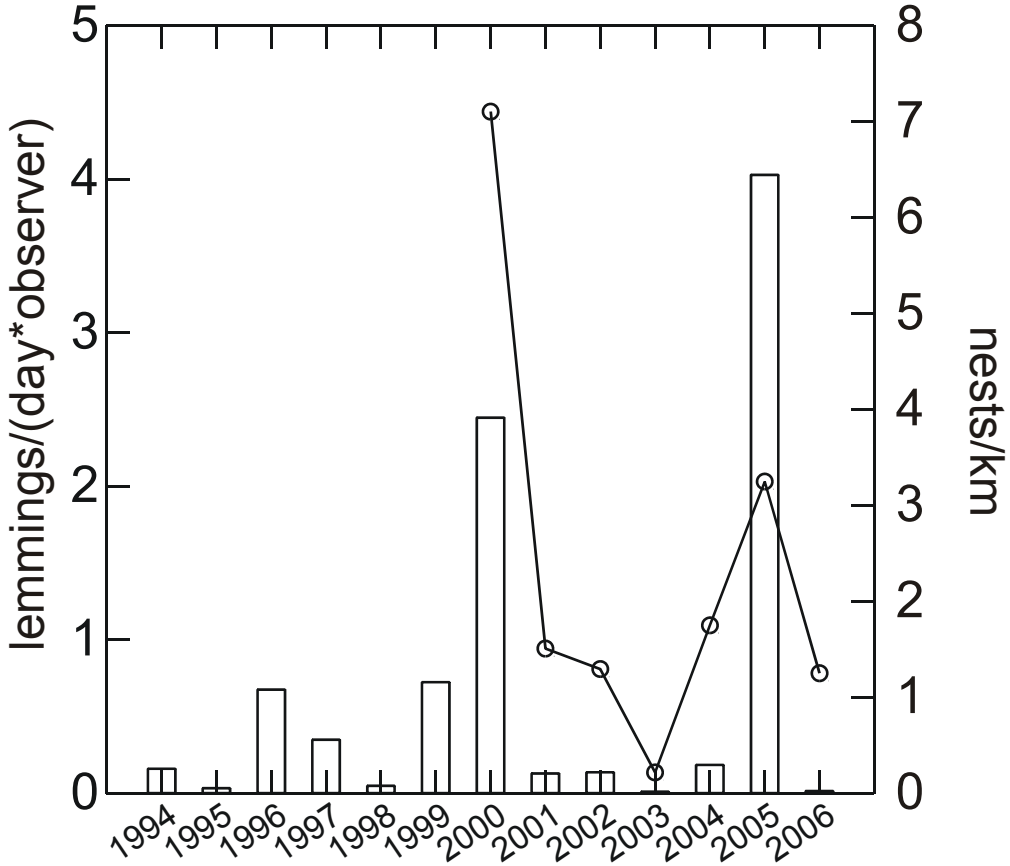


Figure 6. Number of lemmings observed during one day in the field per observer (bars, left axis) and number of undersnow nests of lemmings per km (line, right axis)

3.3. Numbers and reproductive performance of predators

Arctic Foxes *Alopex lagopus* did not bred in 2006 in study area (86 km^2), where 7 inhabited dens were recorded in 2005. Adult Ermine *Mustela erminea* was regularly observed in the camp vicinity from mid June to early August, apparently contributed to destroying of nests of passerine birds on the plot #5.

Snowy Owls *Nyctea scandiaca* and Rough-legged Buzzards did not breed in the study area, where 3 nests of owls and 8 nests of buzzards were found in 2005. However, adult birds of both species were recorded during the whole season, and Snowy Owls were observed hunting successfully incubating White-fronted Geese *Anser albifrons*.

Pomarine Skuas *Stercorarius pomarinus* did not breed in 2006, while 23 nests and broods of this species were found in 2005 within intensively surveyed area of 30 km^2, yielding nesting density 0.77 nest/km^2. We found 14 nests of Long-tailed Skuas *Stercorarius longicaudus* in 2005, and chicks hatched in all nests of known fate (n=7). Three nests, all with clutch of one egg, were found in 2006, and none of them survived to hatching due to depredation. Arctic Skuas *Stercorarius parasiticus* occur in the study area at a stable low density: one nest was found in each of the years 2004-2006, but chick hatched successfully in 2006.

A single nest of Peregrine Falcon *Falco peregrinus* was found with a clutch of 3 eggs on 12 July 2005, while on 1 August it contained chicks. A nest of Peregrine Falcon was found with 1 egg on 13 June 2006 at a distance 440 m from the nest of the previous year, and 4 chicks were recorded in the nest on 24 July.

4. Breeding numbers and nest success of birds

4.1. Breeding phenology of birds

Most species of birds nested earlier in 2006 than in 2004, and later than in 2005 in accordance with annual differences in snowmelt (Fig. 7). Pectoral Sandpiper *Calidris melanotos* represented the most apparent deviation from the above pattern, as it showed the least difference in breeding dates between years. This species nested later than other species of waders, which, probably, relaxed dependence of breeding dates on snowmelt.

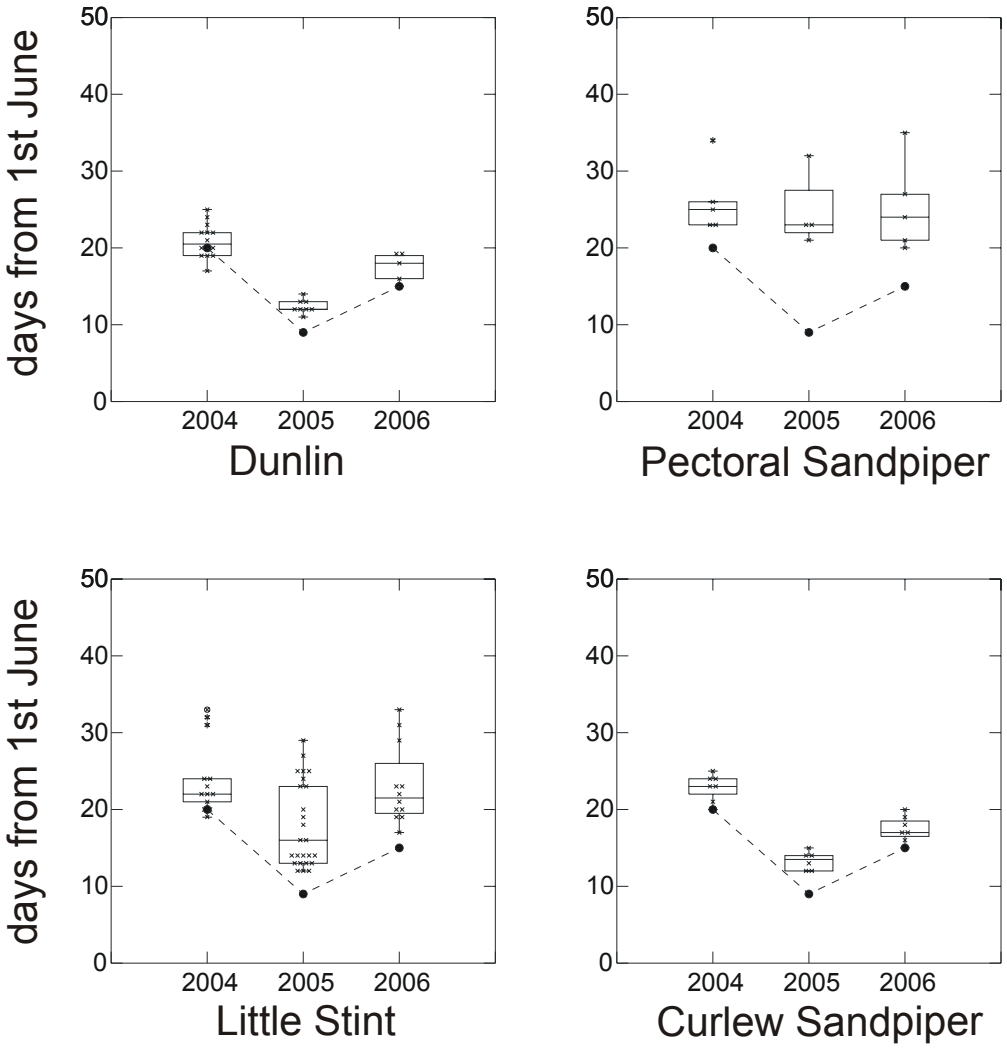


Figure 7. Dates of clutch initiation by birds in 2004–2006 (crosses), and dates of 50% snow-cover in the study area (filled circles). Crosses show actual date values; box plots show non-parametric statistics: central horizontal line marks the median of a sample, edges of box (hinges) mark quantiles, whiskers show range of values that fall within 1.5 inter-quartile range of the hinges

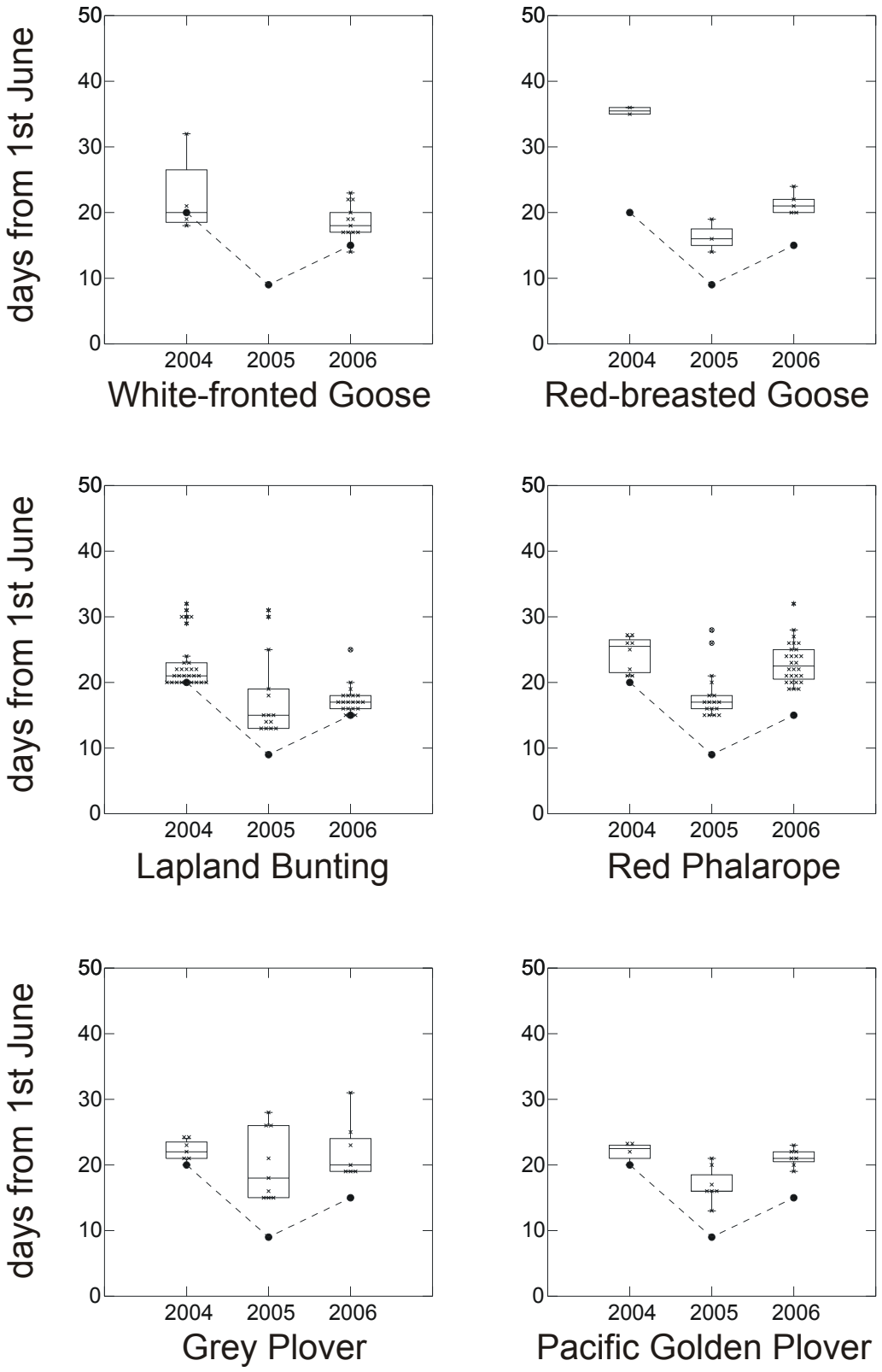


Figure 7 (continued). Dates of clutch initiation by birds in 2004–2006 (crosses), and dates of 50% snowcover in the study area (filled circles).

4.2. Breeding numbers of birds in the study area

Dynamics of numbers of common species of birds in 4 plots surveyed in all years from 2004-2004 is shown on Fig. 8. Grey Phalaropes *Phalaropus fulicarius* reached record high density in 2006 in the floodplain of Bolshoi Island, while numbers of another abundant species, the Little Stint *Calidris minuta*, in contrast, were the lowest for 3 years in most habitats. Grey Phalaropes demonstrated redistribution between habitats in 2006 compared with 2005, when their numbers were also high. Grey Phalaropes were the most numerous in the early season 2005 in the close to terrace polygonal bog (plot #1S), snowmelt in which occurs later than in polygonal bog of the Bolshoi Island (plot #2). In contrast maximal abundance of this species in the later season 2006 was recorded on the Bolshoi Island (plot #2). Numbers of Curlew Sandpipers *Calidris ferruginea* were low in most habitats in 2006, which contrasted with high abundance of this species in terrace habitats in the early season 2005. Numbers Pectoral Sandpipers and Ruffs *Philomachus pugnax* were low in most habitats in 2006.

Male Pectoral Sandpiper

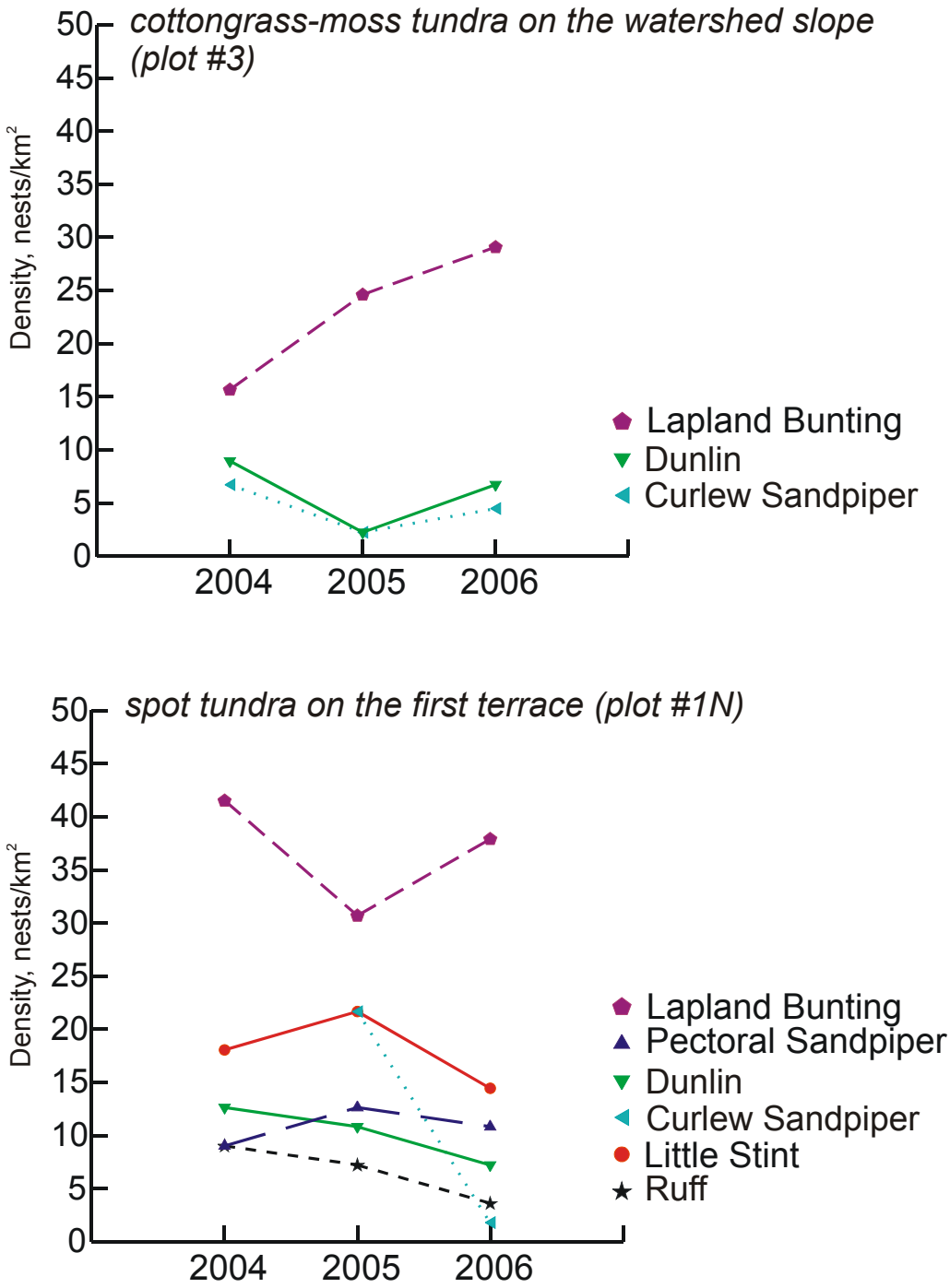
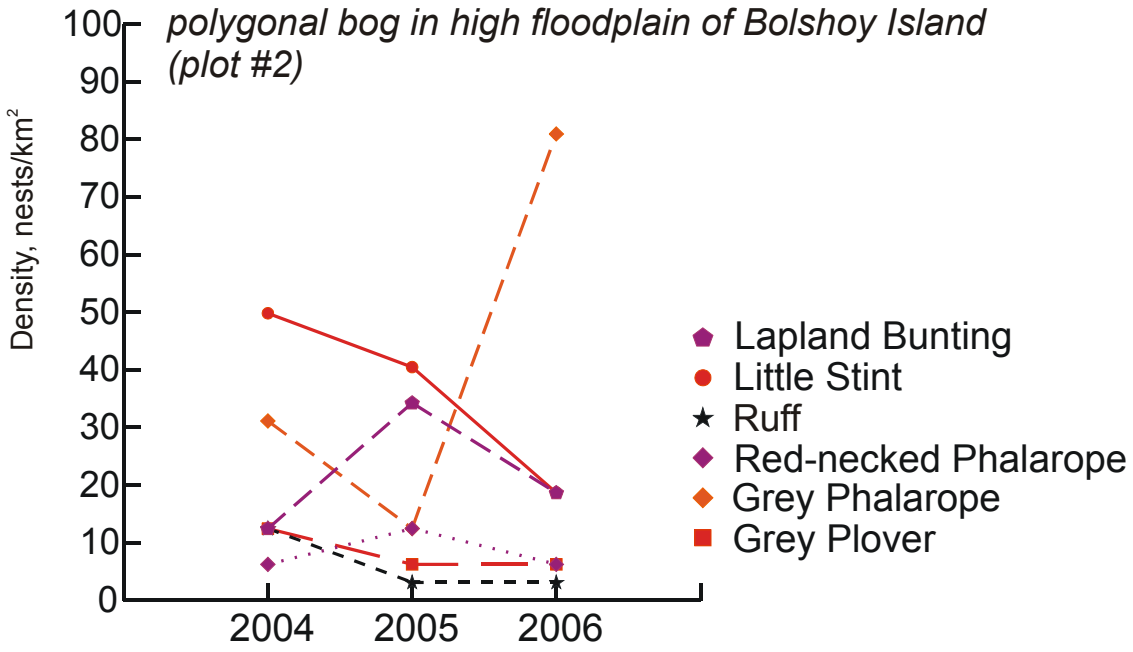


Figure 8. Densities of common birds on central Taimyr in 2004-2006



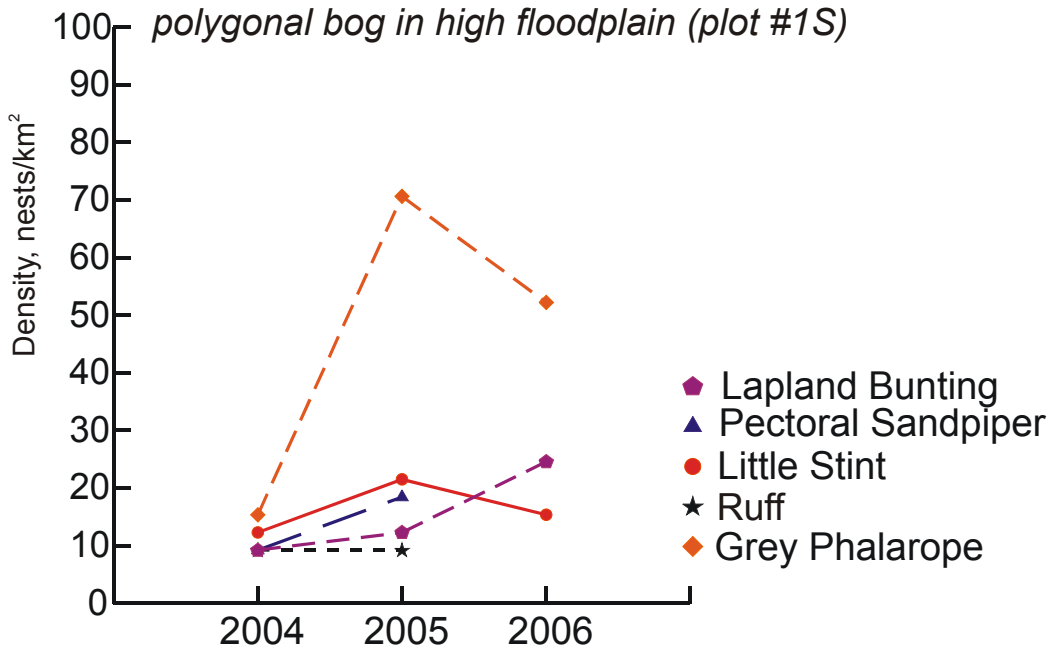


Figure 8 (continued). Densities of common birds on central Taimyr in 2004-2006

Table 3
Breeding densities of birds (nest/km^2) in the study plots in 2004-2006

Species	Plot number; size and short description in brackets																						
	1N (55 hectare, terrace)			**1S** (33 hectare, high floodplain)			**2** (32 hectare, high floodplain of Bolshoy Island)			**3** (45 hectare, watershed slope)			**4** (32 hectare, watershed)		**5** (7 hectare, willow bush on island)			**6*** (4 hectare, hillock complex on slope of terrace)			**7** (13 hectare, willow bush on slope of terrace)		
	2004	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**
Gavia stellata																							
Gavia arctica																							
Anser albifrons						3.1	9.4														7.7		7.7
Rufibrenta ruficollis					3.1										28.6	14.3							
Somateria spectabilis		3.6			3.1	3.1			9.4							14.3							
Clangula hyemalis							3.1		3.1						42.9	42.9	28.6						
Buteo lagopus																		(1)	(1)				
Lagopus mutus											2.2												
Pluvialis squatarola	1.8						12.5	6.3	6.3					3.1									
Pluvialis fulva	5.4	5.4	3.6								2.2	2.2	3.1										
Arenaria interpres							9.4																
Phalaropus fulicarius		3.6	1.8	15.4	70.6	52.2	31.3	12.5	81.3							14.3							

Species	Plot number; size and short description in brackets																						
	1N (55 hectare, terrace)			**1S** (33 hectare, high floodplain)			**2** (32 hectare, high floodplain of Bolshoy Island)			**3** (45 hectare, watershed slope)			**4** (32 hectare, watershed)		**5** (7 hectare, willow bush on island)			**6*** (4 hectare, hillock complex on slope of terrace)			**7** (13 hectare, willow bush on slope of terrace)		
	2004	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**
Phalaropus lobatus					6.1	3.1	6.2	12.5	6.3														
Philomachus pugnax	9.0	7.2	3.6	9.2	9.2		12.5	3.1	3.1					3.1									
Calidris minuta	18.1	21.7	14.5	12.3	21.5	15.4	50.0	40.6	18.8			4.4	3.1			14.3	85.7						
Calidris temminckii															85.7	128.6	100.0		(2)		30.8	46.2[5]	92.3
Calidris ferruginea		21.7	1.8	3.1	3.1	3.1	9.4	3.1		8.9	2.2	4.4	3.1	12.5									
Calidris alpina	12.6	10.8	7.2				9.4	6.3	3.1	8.9	2.2	6.7	3.1										
Calidris melanotos	9.0	12.6	10.8	9.2	18.4		6.3	6.3	3.1														
Limosa lapponica							3.1			2.2													
Stercorarius pomarinus		1.8			6.1																		
Stercorarius parasiticus																							
Stercorarius longicaudus						3.1	3.1		3.1	2.2	2.2												
Larus heuglini																							
Larus hyperboreus																							
Rhodostethia rosea																							

Species	Plot number; size and short description in brackets																						
	1N (55 hectare, terrace)			**1S** (33 hectare, high floodplain)			**2** (32 hectare, high floodplain of Bolshoy Island)			**3** (45 hectare, watershed slope)			**4** (32 hectare, watershed)		**5** (7 hectare, willow bush on island)			**6*** (4 hectare, hillock complex on slope of terrace)			**7** (13 hectare, willow bush on slope of terrace)		
	2004	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**	**2004**	**2005**	**2006**
Xema sabini							3.1									14.3							
Sterna paradisea							3.1		3.1						28.6	28.6	28.6						
Eremophila alpestris	1.8	1.8								2.2	4.4	2.2	12.5	12.5									
Motacilla alba																		(1)	(2)	(1)			
Anthus cervinus																14.3		(2)	(2)	(1)	+	23.1	38.5
Oenanthe oenanthe																		(1)	(1)	(2)	7.7		15.4
Luscinia svecica																			(3)	(3)	7.7[1]	69.2[3]	76.9
Turdus iliacus																					7.7		
Calcarius lapponicus	41.5	30.7	37.9	9.2	12.3	24.6	12.5	34.4	18.8	15.6	24.4	28.9	12.5	12.5									
Emberiza pusilla																28.6	28.6				38.5[2]	61.5[4]	30.8
Acanthis flammea																				(1)	84.6	46.2	46.2
Phylloscopus trochilus																					7.7[1]		7.7
Total:	**101.1**	**122.8**	**81.3**	**58.3**	**153.5**	**107.5**	**184.4**	**125.0**	**159.4**	**37.8**	**40.0**	**48.9**	**37.5**	**43.8**	**185.7**	**314.3**	**271.4**	**125.0**	**225.0**	**250.0**	**192.3**	**246.2**	**315.4**

Notes: * - numbers of nests rather than density are given for plot #6 (in brackets); + - species nested, but numbers were not assessed; [1] – one pair bred; the nest was not searched for; [2] – 5 pairs bred, 2 nests were found; [3] – 9 pairs bred, 5 nests and 4 broods were found; [4] – 8 pairs bred, 2 nests and 6 broods were found; [5] – 5 nests and 1 brood were found.

Information about status and abundance of all species of birds recorded during field studies in 2004-2006 is summarized in Table 4. Non-breeding of rodent specialists (Snowy Owl, Pomarine Skua and Rough-legged Buzzard) was the only significant change in abundance and/or status of common birds in 2006 compared with the previous years. Noteworthy is the confirmed breeding record of Dotterel *Eudromias morinellus* in the area.

Table 4
Status and abundance of birds recorded in 2004-2006 on Central Taimyr

Species	Year					
	2004		2005		2006	
	Status	Abun-dance	Status	Abun-dance	Status	Abun-dance
1. Gavia stellata	B	R/C	B	R/C	B	R/R
2. Gavia arctica	B	R/C	B	R/C	B	R/C
3. Gavia adamsii	B?	R	B	R/E	B?	R
4. Cygnus bewickii	B?	R	B?	R	B?	R
5. Anser fabalis	B	R/R	B	R/R	B	R/R
6. Anser albifrons	B	N/N	B	N/C	B	N/C
7. Branta leucopsis	–	–	V	E	–	–
8. Branta bernicla	M	R	–	–	M	R
9. Branta ruficollis	B	C/N	B	C/N	B	C/N
10. Anas crecca	–	–	S	E	S	R
11. Anas acuta	M	R	M	R	S	R
12. Somateria spectabilis	B	R/C	B	C/C	B	C/N
13. Polysticta stelleri	B?	R	B	R/R	B?	R
14. Clangula hyemalis	B	R/N	B	R/N	B	R/N
15. Melanitta nigra	V	E	–	–	S	R
16. Mergus serrator	V	E	–	–	–	–
17. Buteo lagopus	B	R/R	B	R/R	S	R
18. Aquila chrysaetos	–	–	V	E	–	–
19. Haliaeetus albicilla	–	–	V	E	–	–
20. Falco peregrinus	B?	E	B	E	B	E
21. Lagopus mutus	B	R/R	B	R/C	B	R/R
22. Lagopus lagopus	B?	E	–	–	–	–
23. Pluvialis squatarola	B	C/N	B	C/N	B	C/N
24. Pluvialis fulva	B	C/C	B	C/C	B	C/C
25. Eudromias morinellus	B?	R	B?	R	B	R/E
26. Charadrius hiaticula	B	R/C	B	R/C	B	R/C

Species	Year					
	2004		2005		2006	
	Status	Abun-dance	Status	Abun-dance	Status	Abun-dance
27. Arenaria interpres	B	R/C	B	R/R	B?	R
28. Tringa erythropus	–	–	B	E	–	–
29. Phalaropus lobatus	B	R/C	B	C/N	B	C/N
30. Phalaropus fulicarius	B	C/N	B	N/N	B	N/N
31. Philomachus pugnax	B	C/N	B	C/N	B	C/C
32. Calidris minuta	B	C/N	B	N/N	B	N/N
33. Calidris ruficollis	B	R/R	B	R/E	B	R/E
34. Calidris temminckii	B	R/N	B	R/N	B	R/N
35. Calidris ferruginea	B	C/N	B	C/N	B	C/N
36. Calidris alpina	B	N/N	B	C/N	B	C/N
37. Calidris acuminata	B?	E	B?	E	M	E
38. Calidris melanotos	B	R/N	B	R/N	B	R/N
39. Calidris canutus	B	R/E	B	R/E	M	R
40. Gallinago gallinago	B?	E	B?	E	S	E
41. Gallinago stenura	–	–	–	–	B?	E
42. Lymnocryptes minima	B?	E	–	–	B?	E
43. Limosa lapponica	B	R/R	B	R/R	B	R/R
44. Limnodromus scolopaceus	–	–	B	E	–	–
45. Stercorarius pomarinus	M	R	B	C/C	M	R
46. Stercorarius parasiticus	B	E	B	R/E	B	R/E
47. Stercorarius longicaudus	B	R/C	B	C/C	B	R/R
48. Larus heuglini	B	R/R	B	R/R	B	C/R
49. Larus hyperboreus	B	R/R	B	R/R	B	R/R
50. Rhodostethia rosea	B	E	–	–	–	–
51. Xema sabini	B	R/C	B	R/C	B	R/R
52. Sterna paradisea	B	R/C	B	R/C	B	R/C
53. Nyctea scandiaca	S	E	B	R/R	S	R
54. Alauda arvensis	V	E	–	–	–	–
55. Eremophila alpestris	B	R/C	B	R/N	B	R/N
*56. Hirundinidae sp.**	V	E	–	–	–	–
57. Motacilla alba	B	R/N	B	R/N	B	R/C
58. Motacilla citreola	–	–	V	E	V	E
59. Anthus cervinus	B	R/N	B	R/N	B	R/N

Species	Year					
	2004		2005		2006	
	Status	Abun-dance	Status	Abun-dance	Status	Abun-dance
60. Anthus rubescens	B	E	–	–	V	E
61. Phylloscopus trochilus	B	E	–	–	B	E
62. Luscinia svecica	B	R/C	B	R/N	B	R/N
63. Oenanthe oenanthe	B	R/N	B	R/N	B	R/N
64. Turdus pilaris	V	E	–	–	–	–
65. Turdus iliacus	B	E	–	–	V	E
66. Calcarius lapponicus	B	N/N	B	N/N	B	N/N
67. Emberiza pusilla	B	R/N	B	R/N	B	R/N
68. Emberiza pallasi	V	E	–	–	–	–
69. Plectrophenax nivalis	B	R/C	B	R/C	B	R/C
70. Acanthis hornemanni	B	R/N	B	R/N	B	R/N
71. Corvus cornix	–	–	–	–	V	E

* – species was not identified for a swallow seen on 6.07.2004;

Status: **B** – breeding (found nests with clutches or chicks, including fledglings); **B?** – probable breeding (territorial displays, mating or nest-building observed, or empty nests found); **M** – migrant (occurred on passage with stopovers); **S** – summer resident (recorded during the whole summer, but not signs of breeding recorded); **V** – vagrant (solitary birds seen outside of the known breeding ranges).

Abundance: **E** – very rare (density not exceeding 4 birds in the whole study area); **R** – rare (from 0.05–1 bird/km^2); **C** – common (1-10 bird/km^2); **N** – numerous (> 10 bird/km^2). Two grades are provided for breeding species: abundance across the whole area, including non-breeding birds, – to the left of the slash; abundance of breeding birds in optimal habitats – to the right of the slash. Abundance of non-breeding species is based of the average simultaneous number of specimens in the area in respective period.

4.3. Changes of nest success among seasons

In spite of low lemming abundance nest success of birds was not low in 2006. Proportion of nests, successfully surviving to hatching, was 63.2% in waders, 53.4% in other non-passerine birds and 88.6% in passerines, which at least in waders was above values recorded in 2004-2005 when lemming numbers were considerably higher (Fig. 9, Table 5). This, apparently was due to low abundance of Arctic Foxes and skuas. While several nests of Grey Phalaropes in floodplain of Bolshoi Island perished, because incubating birds were killed by skuas (were found numerous phalarope feathers in the vicinity of deserted nests), overall impact of predators on clutches and incubating birds was not high. Grey Phalarope was the only common wader species which nest success decreased considerably in 2006 compared with 2004-2005, presumably due to nesting preferred feeding habitats of skuas – polygonal bogs. Nesting success of Pacific Golden Plovers *Pluvialis fulva* and Grey Plovers *P. squatarola* was average.

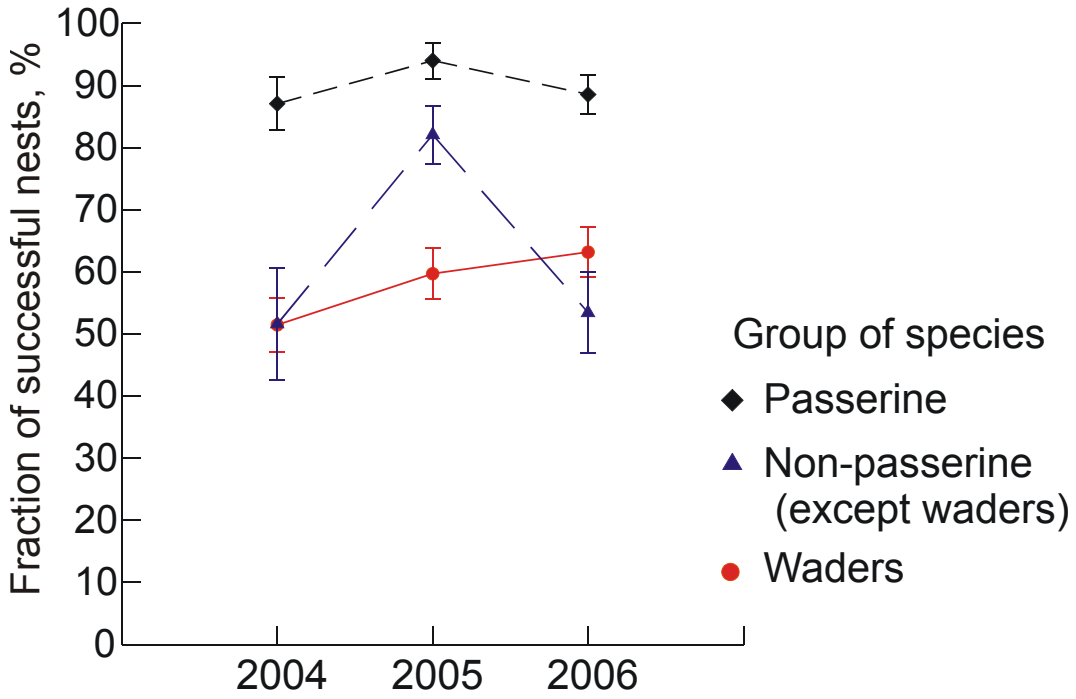


Figure 9. Nest success of principal bird groups in 2004-2006. Lines extend 1 standard error from the value in each direction

Nest success of ducks and skuas was low, while White-fronted and Red-breasted geese, in contrast, were unusually successful (81.8±8.2% (n=22) and 100±0% (n=5), respectively). White-fronted Geese *Anser albifrons* were, apparently, capable to protect their nests from skuas, while numbers of Arctic Foxes were low. All 5 nests of Red-breasted Geese *Branta*

ruficollis found in 2006 were located in the vicinity of a Peregrine Falcon nest, which provided them with the protection against predators. Two nests of White-fronted Geese perished because incubating females were killed by Snowy Owls.

Breeding success of waders was difficult to evaluate as we did not control fate of individual broods until fledging. However, most broods with individually marked adults disappeared soon after hatching and numbers of wader broods were generally low, which indicated strong predation pressure of skuas on chicks.

Table 5
Apparent nest success of birds in 2004-2006. %±SE, sample size in brackets. Hatching success is given for passerines

Species	Year		
	2004	**2005**	**2006**
Gavia stellata	100±0 (1)	100±0 (3)	0±0 (3)
Gavia arctica	0±0 (2)	100±0 (2)	0±0 (1)
Anser albifrons	33.3±27.2 (3)	50±35.4 (2)	81.8±8.2 (22)
Anser fabalis		100±0 (1)	50±35.4 (2)
Branta ruficollis	66.7±19.2 (6)	60±21.9 (5)	100±0 (5)
Somateria spectabilis		50±25 (4)	12.5±11.7 (8)
Clangula hyemalis	100±0 (1)	0±0 (3)	16.7±15.2 (6)
Buteo lagopus	87.5±11.7 (8)	100±0 (9)	
Falco peregrinus		100±0 (1)	100±0 (1)
Lagopus mutus		100±0 (1)	
Pluvialis squatarola	16.7±8.8 (18)	64.3±12.8 (14)	54.5±15 (11)
Pluvialis fulva	5.3±5.1 (19)	58.3±14.2 (12)	57.1±13.2 (14)
Charadrius hiaticula	100±0 (1)		100±0 (1)
Arenaria interpres	66.7±27.2 (3)		
Phalaropus lobatus	100±0 (1)	66.7±19.2 (6)	33.3±27.2 (3)
Phalaropus fulicarius	73.3±11.4 (15)	80±8.9 (20)	63±7.1 (46)
Tringa erythropus		0±0 (1)	
Philomachus pugnax	66.7±13.6 (12)	12.5±11.7 (8)	25±21.7 (4)
Calidris alpina	87.5±8.3 (16)	100±0 (10)	90.9±8.7 (11)
Calidris ferruginea	50±14.4 (12)	43.8±12.4 (16)	77.8±13.9 (9)
Calidris melanotos	77.8±13.9 (9)	23.5±10.3 (17)	44.4±16.6 (9)
Calidris minuta	50±9.8 (26)	67.6±7.7 (37)	65±10.7 (20)
Calidris ruficollis			0±0 (1)
Calidris temminckii	100±0 (2)	100±0 (3)	71.4±12.1 (14)
Limosa lapponica	50±35.4 (2)		100±0 (1)
Stercorarius longicaudus	33.3±27.2 (3)	100±0 (7)	0±0 (3)
Stercorarius parasiticus			100±0 (1)
Stercorarius pomarinus		93.3±6.4 (15)	
Larus hyperboreus	100±0 (1)	100±0 (1)	
Rhodostethia rosea	0±0 (1)		

Species	Year		
	2004	**2005**	**2006**
Xema sabini	0±0 (3)	40±21.9 (5)	100±0 (1)
Sterna paradisea	0±0 (2)	100±0 (4)	40±21.9 (5)
Nyctea scandiaca		100±0 (4)	
Eremophila alpestris	75±21.7 (4)	100±0 (5)	54.5±15 (11)
Motacilla alba	100±0 (2)	100±0 (2)	100±0 (1)
Anthus cervinus	100±0 (4)	100±0 (3)	88.9±10.5 (9)
Anthus rubescens	0±0 (1)		
Phylloscopus trochilus			100±0 (1)
Luscinia svecica	100±0 (1)	100±0 (8)	92.9±6.9 (14)
Oenanthe oenanthe	100±0 (3)	100±0 (2)	100±0 (4)
Turdus iliacus	100±0 (1)		
Calcarius lapponicus	90.9±5 (33)	90±4.7 (40)	92.9±3.4 (56)
Emberiza pusilla	100±0 (2)	100±0 (3)	100±0 (5)
Acanthis flammea	72.7±13.4 (11)	100±0 (4)	75±21.7 (4)
Passerines	**87.1±4.3 (62)**	**94±2.9 (67)**	**88.6±3.1 (105)**
Waders	**51.5±4.3 (136)**	**59.7±4.1 (144)**	**63.2±4 (144)**
Non-passerines, except waders	**51.6±9 (31)**	**82.1±4.7 (67)**	**53.4±6.5 (58)**

Clutch of White-fronted Goose during hatching

5. Distribution and numbers of geese (Anserinae, Anseriformes)

The Verkhnyaya Taimyra River drains the northern part of the North-Siberian plain and disgorges from the west into Taimyr Lake, forming relatively large delta. A considerable part of the river basin, including its mouth area, belongs to the Main territory of the State Biosphere Reserve "Taimyrsky". Available information about geese from this area is fragmentary, being based primarily on results of several short-term studies and representing mostly the data on numbers of moulting birds (Hötker, 1995; Gavrilov, Pospelov, 2001; Pospelov, 2002; Gavrilov, 2004). However, this area is an important breeding and moulting site for geese in the north of Central Siberia, where five species of subfamily *Anserinae* were recorded.

Bean Goose *Anser fabalis*. First Bean Geese, probably, appear in the area in late May, as they were observed on 27.05.2005 on the Kalamissamo River 55 km to the southeast (M.Y. Karbainov, pers. comm.). Single birds, pairs and trios were observed moving in different directions between free from snow patches on the boundaries of landscapes until 13.06.2006, 17.06.2004 and 25.06.2005. The largest for the early-nesting period group of 5 pairs was recorded on 20.06.2004 on the low flattened part of slope of the bedrock river bank in the north-west of the study area; a presumably nesting pair was observed on 21–22.06.2005 in the vicinity of a small watershed lake.

Two nests of Bean Geese was found in 2004 and 2005. One nest was found on 14.07.2004 in the lower part of slope of the bedrock bank of the Verkhnyaya Taimyra River, 190 m from the bank, in the centre of deep depression 39 m long and surrounded by 5 m high vertical walls, with forbs and short willow shrubs. Female was incubating single egg, and male was also near the nest. During the same day 4 alarming birds from presumably 3 breeding pairs were recorded 2.5-3 km to the south in different parts of a very deep valley cutting bedrock river bank. The second nest was found on 17.07.2005 in a patch of moss-lichen-forb vegetation on the narrow terrace-like side surface of a valley running to the river. The nest was situated 1.06 km from the river and 155 m from a nest of Snowy Owl. Both adult geese were sitting side by side on the nest with one chick and one egg without stars.

Two nests of Bean Geese were found in 2006 on the bank slope of the Verkhnyaya Taimyra River, 150 m from each other (Fig. 10). One of them was found on 20.06.2006 when female flew from it on approach of observer at 50 m. Chicks successfully hatched from a

clutch of 3 eggs on 11.07.2006 the latest. The second nest, also with a clutch of 3 eggs, was found incubating by female on 28.06.2006; it was depredated when checked on 04.07.2006.

All observations of Bean Geese with chicks were made on the same lake 0.06 km^2 large situated near the highest point of the study area. Unlike all other local lakes this one had gravel rather than marshy shores and was surrounded by hills from all sides except the southern with small valley occupied by a hummocky bog. We observed a pair of Bean Geese with 5 grown chicks and two moulting geese on this lake on 2.08.2004, two pairs with broods of one and three small chicks on 14.07.2005 and a pair with four grown chicks and one moulting adult bird on 31.07.2005. Broods of Bean Geese were not recorded in 2006.

All observations of breeding birds allowed to assume that the first pairs had started egg-laying not later than 17 June in 2005 (probably, later in 2004 and earlier in 2006), and that not more than 5 pairs bred annually in the area at a total approximate density 0.06 nest/km^2.

Other observations of, probably, departing to moulting areas birds include 5 and 3 Bean Geese on 11.07.2004 and 30.06.2005, respectively, flying to the southwest in the mouth of the Verkhnyaya Taimyra River. Other than reported above local records of moulting birds include observation of a single Bean Goose on 18.07.2005 in a flock of 500 White-fronted Geese on one of the channels in the east of the study area, and a flock of 20 Bean Geese on the western bank of the Verkhnyaya Taimyra River outside of the study area.

Thus, Bean Geese occurred in the study area in low numbers and inhabited (at least breeding birds) hilly moraine landscape with complex forms of relief, which made principal difference from preferred habitats of White-fronted Geese (see below).

Low numbers of the Bean Goose in the area could have reflected a general declining trend during the last decades of Anseriformes wintering in the south-east Asia (Rogacheva 1992; Syroechkovsky-jn. 1995б; Syroechkovsky-jn. 2001). One the other hand, some relatively recent observations have shown notable, at least locally, declines in numbers of birds from other populations on the western Taimyr compared with the numbers in 1970–1980s (Pavlov et al. 1983; Emel'yanov, Savchenko 2001; Kolpashchikov 2005). Furthermore, the study area does not belong to an optimal part of the Bean Goose range, although this species was found breeding to the northern limit of the Arctic tundra subzone on Taimyr (Lappo 1996; Kolpashchikov 2003). Ornithological reports from the areas adjacent to Taimyr Lake (Levinson-Lessing Lake, Ledyanaya Bay, Rysyukova Cape, Olen'ya and Bikada rivers) contain at best single records of nests or broods of Bean Geese (Yakushin1983; Hötker 1995;

Pospelov 2002; Pospelov unpublished data; Chupin 2002). Accordingly low numbers of Bean Geese in the study area most likely reflect natural state of the species population at the limit of its range in the northern part of Central Taimyr.

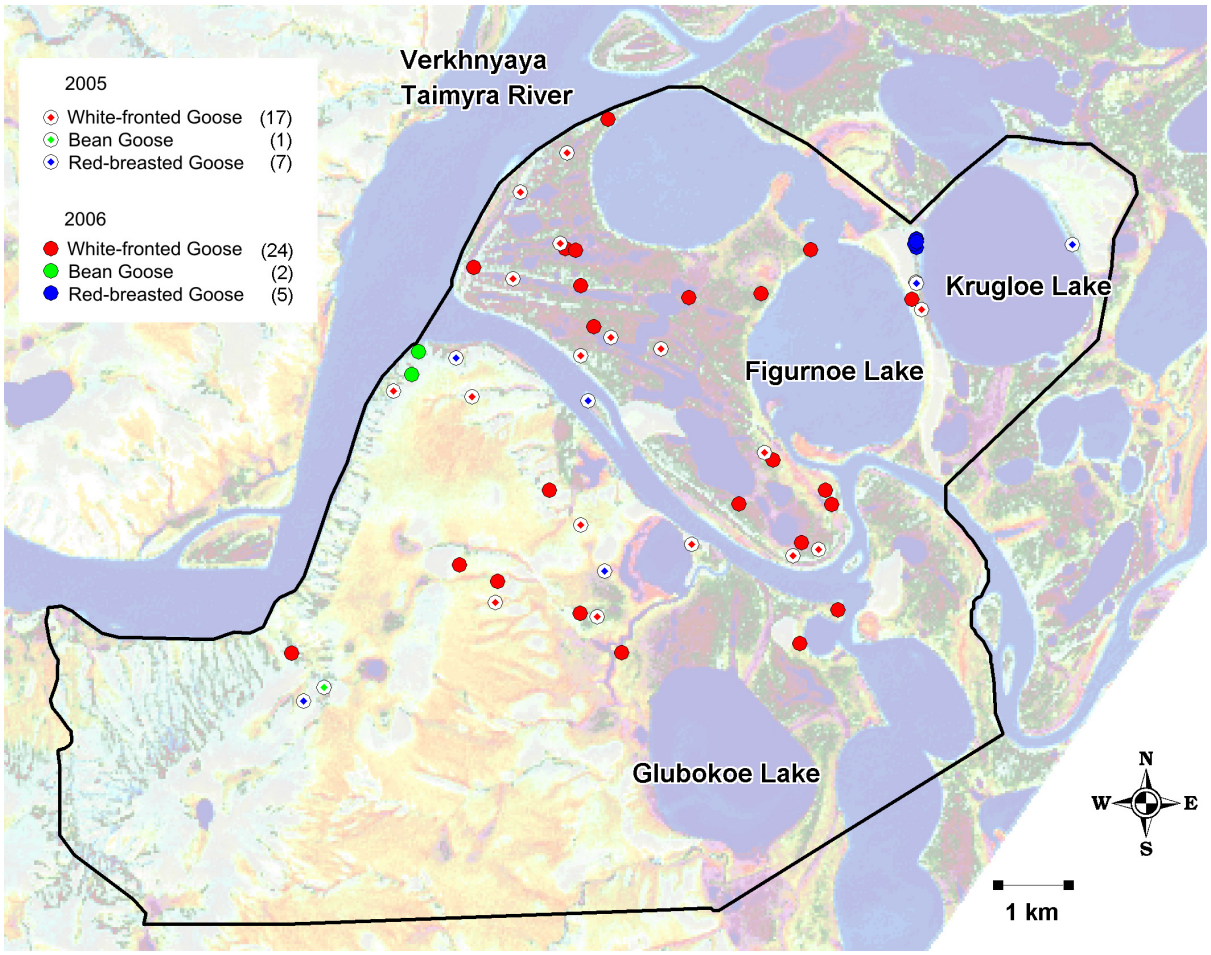


Figure 10. Distribution of geese nests in the study area in 2005–2006. Number of found nests in brackets.

White-fronted Goose *Anser albifrons*. The whole Taimyr Peninsula, with a possible exception of the easternmost parts, is inhabited by a nominative subspecies of the White-fronted Goose *A. a. albifrons*, wintering in the Middle East and Europe, primarily in the Danube basin, where effective conservation has probably contributed to the growth of species numbers during recent decades. (Rogacheva 1992; Mooij 1995; Madge 1998; Mooij, Zöckler 2000; Syroechkovsky-jn., 2001). Our study area belongs to the central part of the species breeding range on Taimyr. First Bean Geese, probably, appear in the area in early June, as they were observed on 31.05.2005 on the Kalamissamo River 55 km to the southeast (M.Y. Karbainov, pers. comm.). Nesting White-fronted Geese were mostly found in the eastern part of the study area (Fig. 10). Three nests were found in 2004–2005 within the moraine

plain, including one in wet cotton-grass moss slope tundra, one in hummocky tundra of a small spring valley with complex microtopography and in the middle part of a steep slope of the bedrock bank of the Verkhnyaya Taimyra River with small boulders and forb-moss tussocks. The latter nest was 12 m far from a nest of Rough-legged Buzzards. All three nests in the moraine landscape were established on slopes oriented towards alluvial plain, where broods presumably would gave moved with chicks in the case of successful nesting.

Nests on flattened upper parts of terrace fragments within the alluvial plain were established in hummock moss tundra with *Salix reptans*, which habitat was generally similar to slope tundra of the moraine landscape. Microhabitat distribution of nests was more diverse on terrace slopes. One pair nested in 2004 on a split top of a clay hillock with isolated *Artemisia sp.* plants, in dangerous conditions as this clay hillock devolved in 2005 with the former nest. Three nests were found in forb-moss tundra on small horizontal surfaces near terrace bench crests. Nests of White-fronted Geese on terrace benches were well protected by complex microtopography and successfully survived to hatching, however our observations indicated that chicks from these nests were exposed to higher risk of falling in one of numerous crevices on their way to waterbody.

A vast majority of White-fronted Geese nested in polygonal bog of the high floodplain, where nests were usually established on typical hillocks with sedge, moss and willow *Salix reptans* and polygon edges (n = 15), or on flat islets 1–10 m^2 large in the marginal parts of small lakes (n = 3). Nests were established on average 178 m from nearest waterbodies (*lim* 0–919 m; *SD* = 207.6; n = 29). Thus, breeding White-fronted Geese were associated in the study area with the alluvial landscape and a narrow adjacent band of slopes of the moraine landscape.

In total 29 nests of White-fronted Geese were found in 2004 and 2005 combined, and 24 nests in 2006 (a considerable increase of the number of nests found in 2006 was due to special searches of nests undertaken in the latter season across the whole study area, and not on plots only as in the previous years). A maximal local nesting density 9.4 nest/km^2 was recorded in 2004 on plot #2, but generally densities were considerably lower. Estimated nesting density for an area representing polygon including all found nests and extended by half a distance between neighbouring nests was 0.59 nest/km^2 (S = 20.22 km^2, n = 12) in 2004 and 0.49 nest/km^2 (S = 34.56 km^2, n = 17) in 2005. These values most likely represent an underestimate as targeted searches of goose nests were undertaken only on survey plots, at 2.5 % of

the whole study area only. On the other hand, chances of missing many nests in intensively surveyed part of the study area were not high due conspicuousness of these large birds.

The earliest clutches were initiated by geese not later than 16.06 and 13.06 in 2004 and 2005, respectively. Egg-laying was started in 2006 in similar dates to 2004. Mean size of complete clutches was 4.1 egg (*lim* 2–6; *SD* = 1.6; *n* = 8) in 2004, 5.1 egg (*lim* 3–8; *SD* = 1.2; *n* = 14) in 2005 and 4.3 egg (*lim* 1–6; *SD* = 1.35; *n* = 21) in 2006. The first chicks should have appeared from 14–17.07 in 2004, while actually hatching occurred in known nests from 19.07 to 22.07. In 2005 the first chicks were found in nest on 12.07, while in 2006 hatching occurred from 12.07 to 20.07.

Mean brood size was 3.5 chicks in 2004 (*lim* 2–5; *SD* = 1.4; *n* = 6) and 3.7 chicks in 2005 (*lim* 1–8; *SD* = 2.0; *n* = 23). Pairs with broods were recorded near shores of channels and lakes, including small ones, in 2004, but were rare in general. An aggregation of 6 broods with 2-5 goslings was observed on 30.07 in the north-western part of Krugloe Lake. A pattern of brood occurrence changed in 2005, as groups of several broods became common along with observations of single pairs with chicks. The largest aggregations were recorded on 18.07 on Krugloe Lake and on 1.08 in the channel near the southern part of Figurnoe Lake and contained 11 pairs with chicks in both cases. A group of 30 adult geese and 40 chicks (presumably 10 pairs with chicks and moulting birds) was recorded 1–2.08 on a lake (S = 0,3 km^2) outside of the study area, within the moraine plain 9 km to the southwest of the field camp. These geese should apparently have bred in the close neighbourhood, as the lake was separated from the alluvial plain by a belt of hilly tundra 4.6 km wide. Most broods were recorded in 2006 on the banks of a spring running from the north to the channel of the Verkhnyaya Taimyra River, and on the banks of the closets to the camp lake. Individual pairs with chicks and groups of several broods were observed there in late July – early August 2006. The largest group, seen on 31.07.2006, contained 18 adult geese and 32 chicks. Another group of 8 adult geese and 15 chicks was recorded on 01.08.2006 outside of the study area on the eastern bank of the Verkhnyaya Taimyra River.

Verkhnyaya Taimyra River is a famous moulting area for White-fronted Geese. Thus, aerial survey from a helicopter revealed 15000 moulting birds on 28.07.1989 (Hötker 1995) in the whole delta. Considerable numbers of geese specifically in our study area were reported by S.E. Pankevich (pers. comm.), based on observations in 2000, and other researchers (Chupin 2002; Gavrilov 2004). According to our observations approximately 4500 White-fronted Geese were moulting annually in 2004-2005 in the western part of the delta at an

area of 51 km^2, which corresponds to a density 88 bird/km^2. A targeted count of mounting geese was undertaken from 17:00 to 19:00 on 1.08.2006 by 5 observers from elevated points and on transects with view of simultaneous assessment of numbers of moulting birds on all waterbodies (lakes and channels) in the area of 105 km^2 (study area and its close vicinity). At least 7100 moulting White-fronted Geese were present in this area based on the count data (Fig. 11).

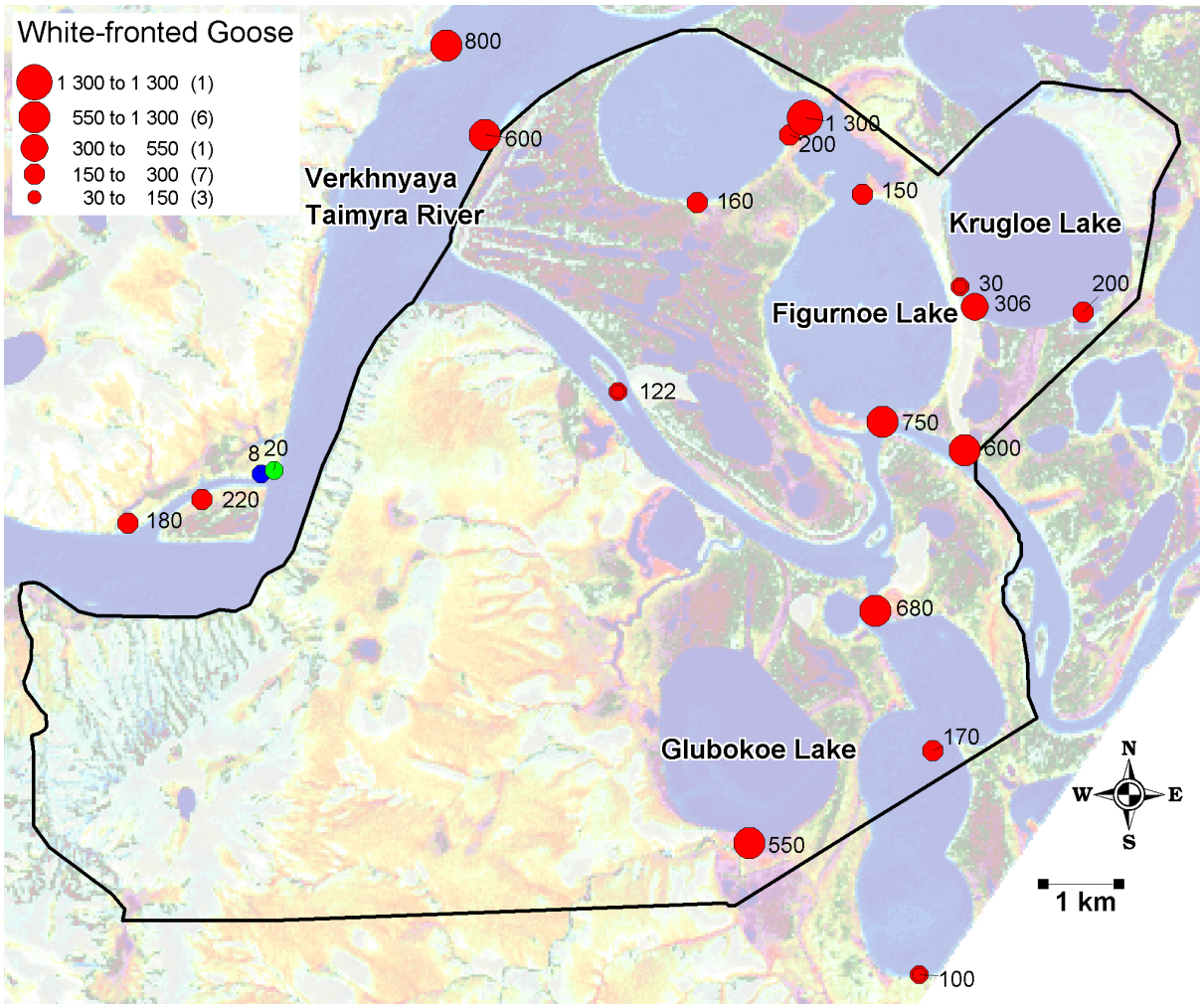


Figure 11. Distribution of moulting aggregations of geese in the study area (black line) and its close vicinity. Blue and green circles denote groups of Red-breasted and Bean geese, respectively. Number of aggregations of given size range is given in brackets

Date of start of geese arrival to the study area for moult from other regions was difficult to determine, because a fraction of local birds could have cancelled breeding and along with failed breeders undertake movements within the area. Arrival and migration were the most intensive from 4.07–8.07 in 2004, while the last flocks undertaking directional migration were seen until 27.07. Similar events occurred from 28.06–1.07 and until 23.07 in 2005. In

2006 geese migration was the most intensive on 7–8.07. We did not employ standardized methods of migrating birds counts and cannot give exact number of passing geese, dynamics of the migration can be characterized by the following numbers. 13 flocks of 210 birds (*lim* 3–30; mean 16.2; *SD* = 10.6) passed on 4.07.2004 during 3 hours (16:14–19:14) in a belt 4 km wide to the south of the Verkhnyaya Taimyra River mouth, 26 flocks of 409 geese (*lim* 4–65; mean 15.7; *SD* = 12.9) on 30.06.2005 from 11:40 to 14:43, and 871 bird with a maximal flock size of 54 on 08.07.2006 from 11:54 to 14:54; all observations were made during the period of intensive migration at sunny windless weather. Geese flew in the general eastern direction, following the valley of the Verkhnyaya Taimyra River. After reaching the lowland plain some flocks immediately landed on lakes, while others passed farther eastward. The first birds unable to fly were observed on 10.07.2004 on Figurnoe Lake, where 2 geese from a flock of 200 failed to take-off. In 2005 the first unable to fly geese were seen on a channel also on 10.07, but this observation could have been delayed.

Large lakes (with area exceeding 3.5 km^2) where geese concentrated for moult in all years were connected with each other by channels 50–100 m wide, which allowed moulting birds to move freely between lakes. The following observations were made of an individually identified due to partial albinism goose, which arrived for moult on 13.07.2004 and stayed in the study area until the end of field studies. This bird was observed in flocks ranging in size from 10 to 1300 birds, while the farthest points where it was recorded were separated by a distance around 8 km by water. The largest flocks of moulting geese were observed on 12.07 and 30.07.2004 on Figurnoe Lake (1100 and 1300 birds), 16.07.2004 and 11.07.2005 on large lake to the west of Baikuraturku Bay (3000 and 2000), 24.07.2004 and 20.07.2005 on Glubokoe Lake (2000 and 1500), and on 26.07.2006 and 01.08.2006 on Figurnoe Lake (>1500 and 1300). Flocks of moulting birds fed within a distance of 100 m from the nearest waterbody. Specific zoogenic habitats developed locally on the shores visited by geese in high numbers. In the case of elevated peat shores these habitats represented belts up to 50 m wide, covered by excrements and feathers, completely free from forbs with rare moss cover and isolated dead willow plants. In the case of muddy shores of channels it was shortly cropped grassland with *Deschampsia borealis*. Very conspicuous meadow-like habitats developed on low wet shores where bright red and green vegetation formed by *Arctophila fulva* and *Eriophorum medium* contrasted in the second half of summer with surrounding brown and yellow tundra. Development of these meadows was, probably, enabled by tillering of grasses cropped by birds and fertilized with excrements in very wet environment. Geese con-

centrated in these meadows in spring during snowmelt and after termination of moult. These zoogenic habitats can be easily distinguished on multizonal satellite images, which can be used for identification of sites of geese concentrations.

Movements of small flocks of over-moulting geese became notable from 3.08.2004, 1.08.2005 and 30.07.2006. As more birds were acquiring ability to fly large flocks split into smaller and more evenly distributed in the east of the region, including inner parts of large lake and bog networks.

Previously few geese were recorded moulting along the Verkhnyaya Taimyra River watercourse (Gavrilov, Pospelov 2001). Several times we observed there small flocks, of which the largest of 250 geese was recorded on 2.08.2004. This locality in the delta vicinity is, probably, considered dangerous by geese, because feeding habitats along the northern bank are separated from the water by a muddy bar up to 200 m wide, while the southern bank represents steep slope with a limited field of view.

Generally, high abundance and uneven spatial distribution was typical for White-fronted Geese in the study area. Abundance of White-fronted Geese was much higher than Bean Geese, which contrasts with proportions of these species in some other localities on Taimyr (Zyryanov, Kokorev, 1983; Rogacheva, 1992; Kokorev, 2003).

Red-breasted Goose *Branta ruficollis*. Study area belongs to the northern part of the species wide breeding range on Taimyr, which currently spreads from the forest zone in the south (Kotuy River, 71°00’ N, 102°42’ E) (I. N. Pospelov, pers. comm.) to the Arctic tundra subzone (Lower Taimyra River, 75°31’ N, 99°20’ E) (Syroechkovsky-jn., 1995a; Chupin 1995). Red-breasted Geese arrive, probably, in the middle or end of the first decade of June, as they were observed on 5.06.2005 on the Kalamissamo River 55 km to the southeast (M.Y. Karbainov, pers. comm.). In spring, before start of nesting, birds have been relatively common in the eastern part of the area, where they either flew in different directions or were feeding in pairs or small groups on snow-free shores together with White-fronted Geese and Brent Geese. The largest flock of 26 birds was seen on 13.06.2004 on a lake shore. Directional migration was not recorded, and most birds presumably terminate migration in the study area.

We found 8 nests of Red-breasted Geese in 2004 and 7 nests in 2005 (Fig. 10). Among nests within the moraine plain of the western part of the study area, one was established in cotton-grass moss tundra of the upper part of gentle slope, and another – in a dry dryas moss

tundra of a terrace-like surface near edge of the plain. Besides, one pair, probably, nested in 2005 in cotton-grass moss tundra of the hill slope foot, where birds were seen in spring and a brood of chicks 2-3 days old was found later. Other nests were found in the east of the area within the alluvial landscape. Most birds nested there on benches of the first river terrace, and established nests on clay tops of hillocks, covered with forbs side walls of hills and in relatively dense willow and gramineous vegetation developed in the crevices. Three nests were found on a flat island 0.07 km^2 large, situated in a large channel. One of these nests was established between two long boards in belt of dry grass and debris brought by flood in the previous years, another in a shallow crevice among very low willow stand and the third in the willow stand up to 25 sm high formed by *Salix lanata* and *S. glauca*. One pair nested in 2005 on a small moss hummock in the marginal part of the polygonal bog.

Red-breasted Geese nested at an average distance 103 m from waterbodies (*lim* 3–880 м; *SD* = 219.1; *n* = 15), i.e. closer than White-fronted Geese. Four of 8 nests found in 2004 were in the vicinity of a nest of Rough-legged Buzzards, while remaining pairs were not associated with birds of prey or each other. In 2005 one pair of Red-breasted Geese was associated with a nest of Rough-legged Buzzards, two pairs with two nests of Snowy Owls, two pairs with a nest of Peregrine Falcons, and two pairs were not associated with birds of prey. It is noteworthy that 17 pairs of Rough-legged Buzzards bred in total in 2004–2005 in the study area, a pair of Peregrine Falcons bred in 2005-2006 and 3 pairs of Snowy Owls bred in 2005 only. While 6-9 pairs of Glaucous Gulls *Larus hyperboreus*, 3–6 pairs of Herring Gulls *Larus argentatus taimyrensis* and 14–18 pairs of Sabine Gulls *Xema sabini* bred in 2004 and 2005 in the study area, nesting Red-breasted Geese were not found in their vicinity. Nests of Red-breasted Geese were found at an average distance 21.5 m from nests of Rough-legged Buzzards (*lim* 1,5–41 м; *SD* = 16,8; *n* = 5), at a distance of 20 and 28 m from a nest of Peregrine Falcons and at a distance 95 and 159 m from nests of Snowy Owls.

All 5 nests of Red-breasted Geese found in 2006 were established in a compact group in the vicinity of a nest of Peregrine Falcons.

Spatial distribution of nests of Red-breasted Geese in the study area differed to some extend from observed elsewhere in the species breeding range (Chupin 1995; Kharitonov 2005; Kharitonov et al., 2005). In particular, high proportion of pairs not associated on nesting with birds of prey, and nesting of some pairs in plain tundra and in bogs are noteworthy.

Complete clutches contained 4–6 eggs in 2004 (mean 4.8 egg; *SD* = 0.75; *n* = 6), 3–8 eggs in 2005 (mean 6.3 egg; *SD* = 1.86; *n* = 6) and 3–6 eggs in 2006 (mean 5 eggs; *SD* = 1.22; *n* = 5). Back estimation allowed to determine that first clutches were initiated approximately on 17.06.2004 and not later than 18.06.2005. Chicks hatched successfully in all 5 nests found in 2006 from 18-21.07.2006. It was not possible to find all nests in 2004 and 2005, but the estimated total number of breeding pairs of Red-breasted Geese was 8-11 in 2004 and 14-15 in 2005, taking into account supposedly breeding birds. Accordingly, the species nesting density was 0.09–0.17 nest/km^2 in the study area, and 80 % of pairs nested in the alluvial landscape.

Solitary pairs with chicks were recorded in 2004 on channels and lakes in the vicinity of nests only in the first days after hatching. Aggregations of broods were observed twice in 2005 along with records of solitary pairs. Three pairs with broods of 3-7 chicks were recorded on 26.07 on a muddy shore of a small spring running into the Verkhnyaya Taimyra River from the north 2 km from the river mouth, and a group of 11 adult birds and 32 chicks (presumably 5 broods) was observed on 1.08 on a narrow chain of pools along foot of the terrace near western shore of Krugloe Lake. The latter locality was 80 m from an active nest of Peregrine Falcons. Aggregation of broods apparently occurred also in 2006: a pair of Red-breasted Geese with 8 chicks was observed on 28.07 on a shore of spring running from the south into the channel of the Verkhnyaya Taimyra River, while two pairs with at least 12 chicks were recorded in this place on 4.08. A group of Red-breasted Geese including 10 adult birds and 11 chicks was observed on the eastern bank of the Verkhnyaya Taimyra River on 1.08.2006.

Red-breasted Geese moulted in the study area in relatively small number. Tens of birds in a single group were regularly recorded among flocks of White-fronted Geese from 10-30 July on a channel near southern edge of Figurnoe Lake. Groups contained 75 Red-breasted Geese on 28.07.2004, 27 on 11.07.2005 and 82 on 30.07.2006. Flocks of moulting Red-breasted Geese on several occasions were observed unrelated to White-fronted Geese, for example, 11 birds were seen on 13.08.2004 on a small spring close to the field camp and 5 birds on 1.08.2005 on a lake to the south of Krugloe Lake. These groups could have consisted from birds that started moult later due to the loss of clutches or broods. It is noteworthy, that flocks of 6-15 birds of unclear status were occasionally observed flying in different directions during July–August.

In total approximately 100 Red-breasted Geese inhabited the study area during summer annually, which corresponded to a slightly higher than 1 bird/km^2 density.

Brent Goose *Branta bernicla*. The principal migration route of the Brent Goose follows sea coast (Rogacheva 1992; Syroechkovsky-jn., Litvin 1998), however, the study area represented a persistent stop-over site for considerable numbers of Brent Geese on their spring migration in the eastern direction, which contrasted with most other inland regions. In total 192 birds in 7 flocks were recorded until 24.06 in 2004. The species was not observed in 2005, apparently due to late start of field studies (19.06) in this early season. Brent Geese were observed until 14.06 in 2006, and occurred on migration both in single species flocks (the largest one of 24 birds) and in mixed flocks with White-fronted Geese.

Brent Geese are known to nest in small numbers along the northern shore of Taimyr Lake (Lappo 1996; Pospelov, Gavrilov 2001; Pospelov 2002). Birds migrating through the study area were, probably, traversing the Taimyr Peninsula to the south of Byrranga Mountains on their way to the Laptev Sea coast.

Barnacle Goose *Branta leucopsis*. One bird was recorded on 30.06.2005 г. in a flock of 11 White-fronted Geese arriving from the west to moult. It was the first record of the species on Taimyr, and approximately 1350 km to the northeast from the nearest breeding grounds on the Yugorsky Peninsula (Ryabitsev 2001).

Thus, geese occurred in high numbers, primarily on behalf of the White-Fronted Goose, and were distributed unevenly in the mouth area of the Verkhnyaya Taimyra River. Highly favourable conditions for breeding, moult and stop-over on migration were created by the presence of a vast alluvial plain with numerous lakes, normally not flooded in spring, and complete absence of direct human pressure due to the area remoteness and protection regime of the Reserve “Taimyrsky”. An importance of the area for conservation will be, probably, increasing in the context of increasing economic activities, particularly in the west of the Taimyr Peninsula.

6. Status of other species of Anseriformes in the study area

Besides geese Anseriformes of the study area were represented by two species of eiders – King Eider and Steller's Eider, Long-tailed Duck, Pintail, Teal, Common Scoter, Red-breasted Merganser and Bewick's Swan.

Three species of ducks of 7 recorded in the area belonged to nesting species: both eiders and Long-tailed Duck. Nests of **King Eider** *Somateria spectabilis* were found in 2005 (8 nests) and 2006 (9 nests) (Fig. 12); although nests were not found in 2004, a brood was recorded on 24.07.2004. The first chicks of King Eider were observed on 19.07 in 2006. Breeding of **Steller's Eider** *Polysticta stelleri* was confirmed in 2005 only, when one nest and 3 broods were recorded. Both species of eiders were observed until mid July in the study area in pairs and in joint flocks of males and females (the largest flocks of approximately 165 King Eiders and 28 Steller's Eider were recorded on 18.06.2004 and 12.06.2006, respectively). Only female King Eiders were seen after 10 July in 2004 and 2005, while in 2006 г. males in pairs and small flocks were recorded until 20 July. Non-breeding Steller's Eider of either sex were never seen after mid July. **Long-tailed Duck** *Clangula hyemalis* annually nested in the study area in small numbers (5 nests in 2004, 4 in 2005 and 6 in 2006) (Fig. 12). Flocks of up to 35 birds were recorded in 2004 and 2005 until mid July, while in 2006 males and females, probably non- or failed breeders, were seen as single birds, in pairs or small flocks until early August.

Nests or broods of other ducks were not observed in the study area in 2004–2006.

Single birds or flocks of 9–20 birds of **Pintail** *Anas acuta* were regularly seen from 23.06–15.08.2004 г., while 3 records only were made in 2005: a pair on 22.06, 3 males on 25.06 and single female on 18.07. Pintails were observed on 6 occasions from 13.06–11.07 in 2006, and the largest flock of 15 birds (most or all males) flew on 7.07 to the south-west.

Teals *Anas crecca* were not recorded in 2004, while single males were seen at least 4 times in 2005 (in early July and on 24.07). Teals were seen on several occasions in mid June 2006; observations included flocks of 5, 16, 10, 11 and 18-19 birds (males + 1–2 females), a group of 3 pairs and 3 records of single males. Teals were moving between lakes and pools of thaw water.

Common Scoter *Melanitta nigra* was recorded in the study area in 2004 and 2006: a female on watershed lake on 2.08.2004, and 2 groups of males of 5 and 2 birds on Krugloe Lake on 19.07 and 24.07, respectively.

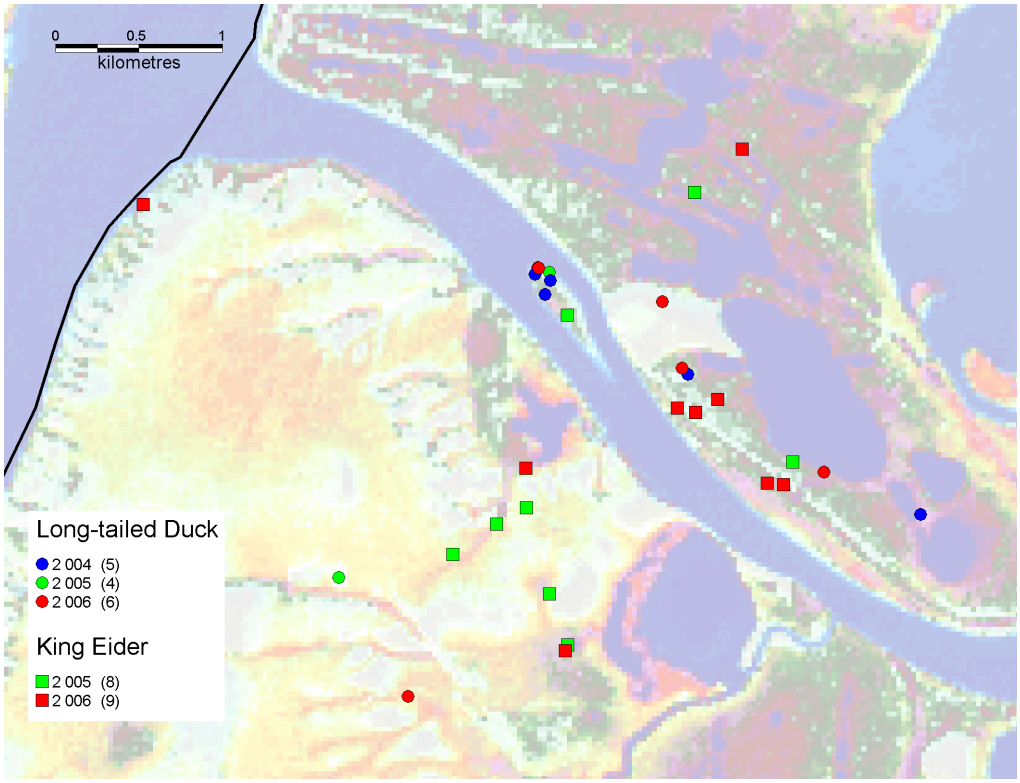


Figure 12. Distribution of duck nests in intensively surveyed part of the study area. Number of found nests in brackets

Red-breasted Merganser *Mergus serrator* was recorded once in three year: male flew over the field camp to the south on 18.07.2004.

Breeding of the **Bewick's Swan** *Cygnus bewickii* was not recorded in the study area, although the birds were regularly seen in all years from mid June to mid August. Swans were observed feeding or resting on lakes in the alluvial landscape, or flying in different directions. Single bird or pair were recorded in most case, although trios were seen annually as well, and a group of 5 swans was recorded on 10.07.2004.

7. Ringing activities in 2006 and related observations

We ringed 602 birds of 24 species (9 species of passerines, 13 species of waders and 3 chicks of terns and gulls), including 60 adult birds and 542 chicks and juveniles in 2006 in the study area (Table 6).

Table 6
Ringing results in 2006.

Species	Adult birds	Chicks
Pluvialis fulva	12	28
Pluvialis squatarola	4	17
Charadrius hiaticula	2	6
Eudromias morinellus	0	3
Limosa lapponica	0	5
Phalaropus fulicarius	2	59
Phalaropus lobatus	0	6
Calidris alpina	9	35
Calidris ferruginea	5	26
Calidris melanotos	4	2
Calidris minuta	16	60
Calidris temminckii	3	17
Philomachus pugnax	1	2
Sterna paradisea	0	1
Xema sabini	0	2
Eremophila alpestris	0	15
Anthus cervinus	0	37
Luscinia svecica	1	53
Motacilla alba	0	6
Oenanthe oenanthe	0	18
Emberiza pusilla	0	17
Phylloscopus trochilus	0	2
Calcarius lapponicus	0	119
Acanthis flammea	1	6
Total:	**60**	**542**

Ringing efforts in the previous years resulted in two noteworthy long-distant recoveries. A female Pectoral Sandpiper ringed on nest on 18.07.2003 in the lower Khatanga River area (south-eastern Taimyr, 72°51' N, 106°02' E, Wader Monitoring Project site in 1994-2003) was found dead on 17.07.2006 in Guatemala, central America (14°18' N, 89°37' W). While Pectoral Sandpipers have been known to winter in South America, this recovery provided the first direct evidence of migration connection between that part of the world and Taimyr.

Another recovery was from Rough-legged Buzzard ringed on 13.08.2004 as a chick in the nest in the current study area on central Taimyr, and found dead on 28.10.2006 in an interstream area of the Irtysh and Tobol Rivers, south of West Siberia (57°27° N, 68°15° E).

Incubating White-fronted Goose

8. Migration links and wintering grounds of birds, breeding on Central Taimyr

Taimyr Peninsula represents a unique example of a region connected by migration links with continents of the world (Fig. 13).

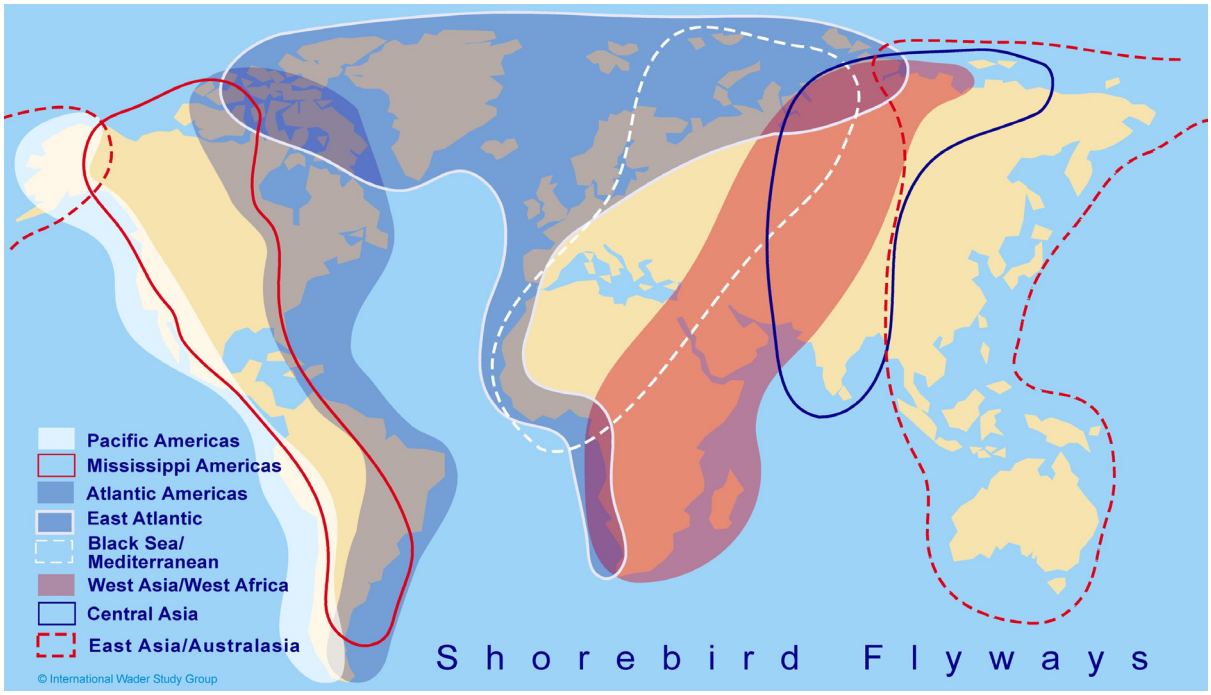


Figure 13. Principal flyways of waders (material of the International Wader Study Group)

Birds of certain species breeding on Taimyr can belong to different wintering populations. Thus, Taimyr Curlew Sandpipers belong to 3 populations, one of which winters in southern Europe, the second in southern Africa and the third in Australia (Kharitonov 2003). Connections of Taimyr Curlew Sandpipers with African non-breeding grounds was evidenced by ring recoveries from Europe, Baltic and Black seas (Tomkovich et. al. 2000). The use of continental flyway by Curlew Sandpipers on migration via Black, Azov and Caspian seas, as well as dynamics of their numbers and distribution at migration stop-over sites on Sivash and other wetlands in Ukraine was subject to a special study (Khomenko 2004). We captured a brood-rearing female Curlew Sandpiper in the study area (74°09'N, 99°34'E) on 20.07.2004, which was previously ringed on 19.07.1998 in the Vistula River mouth, Poland (54°22' N, 18°56' E) at an age > 1 year (all data on ringing and recoveries unless otherwise stated were obtained from the Bird Ringing Centre, Moscow, Russia). Given that a male Curlew Sandpiper ringed in Australia was captured in early 1990s in the northern Taimyr at site with longitude 98°00' E, finding bird from Europe 1.5° farther eastward can

indicate overlapping of areas used for breeding by African and Australian non-breeding populations of the species. E. V. Rogacheva supposed that Taimyr Curlew Sandpipers could winter also in western Africa, as well as on eastern coasts of China and India (Rogacheva 1992). A possibility of switching migration flyways by individual birds is evidenced by recovery in India of a bird, which was previously ringed on non-breeding grounds in Australia (Tomkovich et. al. 2000).

Another species which remote wintering populations can mix up on the Taimyr breeding grounds is the Ruff. These birds can arrive to Taimyr from Europe, Africa and south Asia. Ruffs ringed during winter in Kenia, Sweden and India were recovered on Taimyr (Tomkovich et. al. 2000). A bird ringed on Nakuru Lake in Kenia was shot in Pirovsky district of the Krasnoyarsky Krai, while two Ruffs wearing Indian rings were found in the Severoeniseiski district and near Norilsk (Rogacheva 1992). Migration routes and stop-over sites can also be diverse in this species. For example, Ruff ringed in autumn 1996 in the Nizhni Novgorod vicinity (Volga region in European Russia) was found to the north-east of Yakutsk (eastern Siberia) in May 1999 (Matsyna 2000), which indicated existence of transcontinental migration route between African wintering areas and Siberian breeding grounds.

A subspecies status of Bean Geese breeding in the study area on central Taimyr remains still unclear. Most Bean Geese from Taimyr, probably, belong to the west-Palaearctic subspecies *Anser fabalis rossicus*, migrating to Western Europe. However, some researchers think that birds from central Taimyr and farther eastward belong to subspecies *A. f. serrirostris*, wintering primarily in China (Scott, Rose 1996; Miyabayashi, Mundkur 1999; Mooij, Zöckler 1999; Litvin 2001).

Teals most probably arrive to Taimyr from the wintering areas in South-East Asia, from China to Japan, like other birds of this species belonging to east-Siberian part of population. However, birds from European wintering population nest from Great Britain to the Yenisei River (Migrations of birds ..., 1997). An origin of Teals appearing on Taimyr remains unknown, and accordingly probabilities of their spring arrival from Europe or South-East Asia are currently equal.

Population status of Pintails occurring on central Taimyr is also unclear. Three eastern populations were distinguished in this species by some authors: east-Siberian, wintering in China, far-eastern, wintering in Japan, and Chukchi, wintering in Canada and USA of North America (Shevareuva 1959, 1968). Pintails, breeding in West Siberia, predominantly winter in India (Migrations of birds ..., 1997). Given broad overlapping zones between all distin-

guished populations, Pintails from the Taimyr Peninsula can equally belong to east-Siberian or west-Siberian populations. S. P. Kharitonov believes that "Taimyr Pintails tend to winter in India" (Kharitonov 2003, p. 99).

White-fronted Geese, breeding on central Taimyr, migrate in the western direction to the wintering areas in southern and western Europe, with stop-overs in northern Kazakhstan and southern regions of Russia (Litvin, Gurtovaya 2003). This was confirmed by observations of geese ringed in summer 1989 on the Logata and Verkhnyaya Taimyra rivers, which until and including 1993 constituted 4 records in Kazakhstan and 1 in Russia on migration, as well as 2 records in Turkey, 1 in Romania, 3 in Germany, 5 in the Netherlands, 1 in Belgium and 3 in the UK (Mooij 1995). Brent Geese from wintering grounds in countries of north-western Europe (the Netherlands and the UK), as well as from western France, Denmark and northern Germany (Madge 1998) do not breed in the study area on central Taimyr, but migrate through in spring, also in mixed flocks with other species of geese.

The Red-breasted Goose represents another species of Anseriformes breeding on central Taimyr and migrating to southern **Europe**, primarily Bulgaria and Romania, as well as to Ukraine and southern regions of Russia. Most birds follow the Tobol and Ob' rivers on spring migration, while a smaller proportion arrive to Taimyr along other rivers and watershed lakes of West Siberia. The principal migration route in autumn also goes along the valley of the Ob' River and farther southward and westward, across the valley of the Tobol River and lakes in Kazakhstan. At this time Red-breasted Geese can be encountered elsewhere in the vast area between the Ural Mountains and Central Siberia (Ryabitsev 2001). After leaving the Ural Mountains to the north Red-breasted Geese fly to the western coast of the Black Sea, and recoveries of birds ringed on Taimyr were obtained from almost an entire species flyway (Kharitonov 2003). Less intensive migration to the south traverses mountains of Siberia in the probably direction of wintering areas in the south of Asia (Ryabitsev 2001). It is noteworthy that Red-breasted Geese appeared in small numbers on the wintering grounds in China on the edge of 1970s–1980s (Syroechkovsky et al. 2000).

Several species of waders breeding on Taimyr also spend winter in Europe. A connection of Grey Plovers from Taimyr with western wintering grounds was confirmed by the following ring recoveries: a bird ringed as chick in the nest in summer 1986 was re-captured in January in the north-west Spain (Tomkovich, Vronsky 1994), while male which we ringed on 8.07.1994 in the lower Khatanga River area was re-captured on 8.10.2002 in the Netherlands (Schiermonnikoog, Oosterkwelder, 53°28′ N, 06°15′ E). The latter recovery is of spe-

cial interest because it confirmed that Grey Plovers even from eastern Taimyr still belonged to the East-Atlantic Flyway. However, a possibility cannot eliminated for breeding Grey Plovers from south-eastern Taimyr to use West-Siberian-African and Central-Asian-Indian migration routes along with the European connection (Tomkovich et. al. 2000).

Some species migrate from central Taimyr in the south-western direction and winter in the **Middle East**. While Dunlins from western Taimyr migrate to western Europe, a sub-species *Calidris alpina centralis* was not found in the latter area, which allowed to suppose that it winters in the Middle East (Tomkovich et. al. 2000). Ringing in the study area on central Taimyr allowed to obtain a long-distant recovery from an adult male Dunlin, which was captured on the nest on 14.07.2004 and re-captured on 14.09.2004 in the central Sivash area in Ukraine (46°00' N, 36°14' E). Given that a Dunlin chick ringed in nest on 8.07.2003 on south-eastern Taimyr (72°51' N, 106°02' E) was re-captured on 23.09.2003 also on the central Sivash, a migration link of Dunlins from central and eastern Taimyr with stop-over sites on the Black Sea received sound confirmation. However, employment of molecular biology methods in the recent studies allowed to show that North-Atlantic Flyway was used by at least two populations of Dunlin, differing in gaplotypes of mtDNA: all birds wintering in the north-west Africa had "western" ("European") gaplotypes, while all Dunlins wintering in Europe had "eastern" ("Siberian") gaplotypes (Lopes, Wennerberg 2004).

Ringed Plovers *Charadrius hiaticula* from Taimyr spend winter primarily in eastern and southern **Africa** (Cramp, Simmons 1983), although a possibility that a portion of birds from this breeding population migrates to countries of western and southern Europe cannot be eliminated (Migrations of birds …, 1985). Turnstones *Arenaria interpres* most probably spend winter in the east and south Africa (Underhill 1995; Tomkovich et. al. 2000). Little Stints also winter in the South Africa, after overpassing Israel and Arab countries (Kharitonov 2003), which was confirmed by ring recoveries: a birds ringed as chick in a nest on north-western Taimyr in summer 2000 was recorded in Israel in September 2000 (Yosef 2002), and a Little Stint ringed on the Arabian Peninsula was captured in 1993 in the Pyasina River delta area, north-western Taimyr (Syroechkovsky-jn. 1994). However, Little Stints area also known to winter in India, and some researchers think that birds from west and east Siberia migrate to the latter wintering grounds (Rogacheva 1992). A recovery of Little Stint ringed in Indian and nesting on the Gydan Peninsula, to the west of Taimyr, gave grounds to P. S. Tomkovich to suppose that Taimyr was inhabited both by birds migrating through Europe and by birds wintering in India (Tomkovich et. al. 2000, p. 462). Red Knots *Calidris*

canutus breeding on Taimyr migrate along coasts of the Arctic Ocean to stop-over sites in western Europe, and then apparently reach wintering areas in western Africa. Red Knots ringed in the Knipovich Bay, northern Taimyr, were recaptured in Germany, Denmark and France (Tomkovich et al. 1994). Despite absence of recoveries from wintering grounds all recoveries from Europe in the period of migration indicate that Taimyr Knots belong to afro-Siberian population (Tomkovich et. al. 2000).

Bar-tailed Godwits *Limosa lapponica* from Taimyr, probably, also spend winter in western Africa. Numerous ring recoveries connect both western and eastern Taimyr with stop-over sites in western Europe (Tomkovich et. al. 2000). For example, Bar-tailed Godwit ringed in Belgium was shot in 1993 in the Dudinka area, western Taimyr (Syroechkovsky-jn. 1994); a bird ringed in Germany was shot 1995 in the Khatanga vicinity, south-eastern Taimyr (Information materials ..., 1996). Male Bar-tailed Godwit ringed in April 1986 on Helgoland Island, Germany, was found on 30.07.2000 in the lower Khatanga River area, south-eastern Taimyr.

Ringing allowed to confirm migration connection of certain Taimyr-breeding waders with non-breeding grounds in **Australia**: a Red-necked Stint *Calidris ruficollis* colour-banded sometime since January 1990 in Victoria (38°00' S, 145°00’ E) (C. Minton, pers. comm.), was resighted on 27.06.2002 on south-eastern Taimyr (72°53’ N, 106°02’ E), 12 687 km from the place of banding. Sharp-tailed Sandpipers *Calidris acuminata*, probably, spend winter in Australia (Kozlova 1962), as well as some Curlew Sandpipers (Tomkovich et. al. 2000; Kharitonov 2003) and Pectoral Sandpipers (Tomkovich et. al. 2000).

Several species of birds breeding on Taimyr spend winter in North and/or South **America**. Steller’s Eiders and Long-tailed Ducks ringed in Alaska were found on Taimyr in summer (Migrations of birds ..., 1989; Kharitonov 2003). Male Steller’s Eider ringed on 15.09.1995 in Alaska (Kudobin Island, 56°00′ N, 160°50′ E), was shot in June 1996 in the upper reaches of the Popygai River (71°54′ N, 110°51′ E); another male ringed in 1994 in Alaska (55°10′ N, 162°40′E) was shot in summer 1995 in the Portnyagyno Lake area, eastern Taimyr (74°10′ N, 107°20′ E). Female Steller’s Eider ringed in the latter area in September 1993 was shot in June 1998 in the Postoyannaya River mouth to the north of Taimyr Lake (74°37′ N, 102°00′ E). King Eider ringed on Saint Lawrence Island was found in the vicinity of Novorybnoe settlement, south-eastern Taimyr (Migrations of birds ..., 1989).

Pectoral Sandpiper migrate from Taimyr to the southern part of **South America** (Kharitonov 2003), overpassing eastern Siberia and then North America (Tomkovich et. al.

2000). We found Pectoral Sandpiper ringed on 16.05. 2001 in the Squaw Creek National Wildlife Refuge, north-western Missouri, USA, on 18.07.2001 in the lower Khatanga River area, south-eastern Taimyr. A female Pectoral Sandpiper ringed on nest on 18.07.2003 in the lower Khatanga River area (south-eastern Taimyr, 72°51' N, 106°02' E, Wader Monitoring Project site in 1994-2003) was found dead on 17.07.2006 in Guatemala, central America (14°18' N, 89°37' W). Some Pectoral Sandpiper, presumably juvenile birds, reach Australia, Oceania and Africa (Tomkovich et. al. 2000).

Long-billed Dowitchers *Limnodromus scolopaceus* from central Taimyr spend winter in the south of **North America** and, probably, in central America (Kozlova 1962; Paulson 1993, cited after Tomkovich et. al. 2000). Migration route of this species can overpass the Far East of Russia. A chick which we ringed in a nest on 18.07.1999 in the lower Khatanga River area, south-eastern Taimyr, was shot on 20.09.1999 in the Okhotsk district of Khabarovsky Krai (59°18′ N, 142°57′ E), 2180 km from the place of ringing. This recovery is noteworthy, because demonstrates a considerable southward deviation of this bird from a normal for the species migration route to America.

Migration connections of passerines breeding on Taimyr are also diverse. While recoveries of birds ringed on Taimyr during breeding are absent, general information about migration routes and wintering grounds allows to suppose that Taimyr passerines winter in central and southern Europe (Skylark *Alauda arvensis*, White Wagtail *Motacilla alba*), central Asia (Skylark *Alauda arvensis,* Shorelark *Eremophila alpestris*), South Asia (Red-throated Pipit *Anthus cervinus,* Bluethroat *Luscinia svecica,* White Wagtail *Motacilla alba,* Yellow-headed Wagtail *Motacilla citreola),* South-east Asia *(*Little Bunting *Emberiza pusilla*, Pallas's Reed Bunting *Emberiza pallasi)*, Africa (White Wagtail *Motacilla alba,* Red-throated *Anthus cervinus,* Willow Warbler *Phylloscopus trochilus*, Wheatear *Oenanthe oenanthe,* Bluethroat *Luscinia svecica)* (Ryabitsev 2001).

9. Principal results of studies in 2006

Breeding conditions

1. Timing of snowmelt was close to average in 2006, but June was cold and wet, while July – moderately warm and also wet. Extreme weather events were not recorded.
2. Lemming numbers were extremely low in 2006, following the peak abundance in 2005.
3. Arctic Foxes, Snowy Owls, Pomarine Skuas and Rough-legged Buzzards did not breed in the study area, while numbers of breeding Arctic Skuas and Long-tailed Skuas were low.

Phenology, numbers and nest success of birds

4. Most species of birds nested earlier in 2006 than in 2004, and later than in 2005 in accordance with annual differences in snowmelt.
5. Similarly to 2004-2005 Little Stint and Grey Phalarope were the most numerous species of waders in 2006.
6. In spite of low lemming abundance nest success of waders was above average in 2006, apparently due to low abundance of Arctic Foxes and skuas. However, most broods with individually marked adults disappeared soon after hatching and numbers of wader broods were generally low, which indicated strong predation pressure of skuas on chicks and low reproductive success. Nest success of geese was high.

Other results of research in 2006

7. Geese occurred in high numbers, primarily on behalf of the White-Fronted Goose, and were distributed unevenly in the mouth area of the Verkhnyaya Taimyra River. Abundance of ducks was low in the study area.
8. Taimyr Peninsula is connected by migration links with all continents of the world. Different wintering populations of several species of waders can mix up on Taimyr breeding grounds.

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