BREEDING CONDITIONS AND NUMBERS OF BIRDS ON TAIMYR, 2008

Report of the Wader Monitoring Project on Taimyr

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Front cover photo: female Curlew Sandpiper.

1. Introduction

Taimyr Peninsula in the extreme north of Eurasia is a unique area of the Arctic in several respects. The northern-most mainland tundra in the world is found in this region, with natural zones shifted to the north, and many species penetrating farther northward there than elsewhere in the world. A contiguous gradient of conditions from sparse larch forest in the south, through well developed zonal varieties of tundra, to polar desert in the north can be hardly found elsewhere in the Arctic (CAVM Team 2003).

Similarly to the whole of the Arctic Taimyr region has been subject to global warming, and an increase in temperatures of 3°C in winter and up to 2°C in summer was predicted on Taimyr by the year 2050, with more pronounced trend having been expected in the south of the peninsula (Kokorin, Minin & Shepeleva 2004). In the recent years results of land-based and biological observations on the impacts of climate change in the Arctic were less alarming compared with melting of sea-ice and air temperature increase (Richter-Menge et al. 2008), however, there is little doubt that terrestrial ecosystems will be increasingly affected as well.

Arctic is often considered “a source of flyways” (Gudmundsson 2006), but the Taimyr Peninsula is particular in this respect, because birds breeding there migrate along five principal flyways of the Palearctic (East Atlantic, Black Sea/Mediterranean, West Asia/East Africa, Central Asia, East Asia/Australasia) to the opposite parts of the globe, and some species also penetrate into the Americas (Soloviev et al. 2007, Tomkovich et al. 2000). Waders (or shorebirds, Sub-order: Charadrii) constitute the dominant component of avian fauna in the Arctic, both in numbers of species and in population densities (Jarvinen and Vaisanen 1978, Boyd and Madsen 1997, Lindstrom and Agrell 1999), however, intensive focused studies of waders on Taimyr were conducted only in early 1990s in the framework of the large-scale International Arctic Expedition, coordinated by the Russian Academy of Sciences (Tomkovich et al. 1994.). These expeditions were characterized by a broad research scope, including intensive studies and ringing of geese (Syroechkovski 1999), and large-scale faunistic surveys across the Taimyr Peninsula (e.g., Hötker 1995). The next and necessary step was the establishment of a bird monitoring scheme, and the latter, as a “Wader monitoring project”, was initiated in 1994 on south-eastern Taimyr in a framework of scientific cooperation between the National Park Schlezvig-Holstein Wattenmeer and the State Nature Reserve “Taimyrsky”.

Wader Monitoring Project on Taimyr (WMP) was implemented in 1994–2007 with the primary goal to relate among-year variation of abundance and nest success of waders to environmental factors in the tundra. The long-term intensive studies proved successful, also because regularities that had emerged after the first several years of research, turned out considerably more complex when more seasons have been added to the time series. WMP has represented a unique for the whole circumpolar region example of contiguous collection of wader monitoring data for 14 years in a row with constant protocols of field data collection and processing through the whole period of monitoring. Since the start of WMP in 1994 we independently developed and employed in the project double sampling methodology (Bart & Earnst 2002), which has appeared the only reliable method to evaluate absolute densities of tundra breeding birds, and which had not been used for wader monitoring elsewhere in the Arctic before 2000s. In 2008 WMP has remained the last active program of intensive monitoring of waders in the entire Russian Arctic, after nature monitoring activities were discontinued at the Barents biological station at north-western Taimyr.

Outline of the WMP, selected presentations and reports 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)). Information about breeding conditions, environmental factors, numbers and breeding status of birds in the study areas for years 1994-2008 can be also obtained at the WMP pages on websites of the Arctic Birds Breeding Conditions Survey (http://www.arcticbirds.ru, http://www.arcticbirds.net). Project reports in the Russian language appeared in the “Archives of nature” of the Reserve “Taimyrsky”, and for years 2002-2007 they are available electronically at the reserve website (http://www.taimyrsky.ru/letopis/letopis.htm).

Continuation of studies in 2008 was initially planned on central Taimyr, where study site was relocated in 2004 with view of putting the previous decade-long research in broader context. However, uncontemplated cancellation of helicopter funding by the Russian party in May 2008 determined reversion of the field team to the study site on south-eastern Taimyr. Accordingly the research program on the central Taimyr remained uncompleted, however, an opportunity to investigate development of the situation at the previous monitoring site after interruption for four seasons can be appraised as an equally valuable alternative.

This reports presents information about the research activities carried out in summer 2008 at the Wader monitoring project site in the lower reaches of the Khatanga River and preliminary results of the conducted studies.

2. Study site and methods

2.1. Study site

Observations were carried out from 20.06 to 24.07.2008 in the area of approximately 65 km^2, located in the lower reaches of the Khatanga River, where studies had been carried out in the framework of the Wader monitoring project in 1994-2003 (Fig. 1). The field camp with coordinates 72°51'N, 106°02'E was located at a distance of 3 km from the Khatanga River and 7.5 km from the Novorybnoe settlement, inhabited by the Dolgan people.

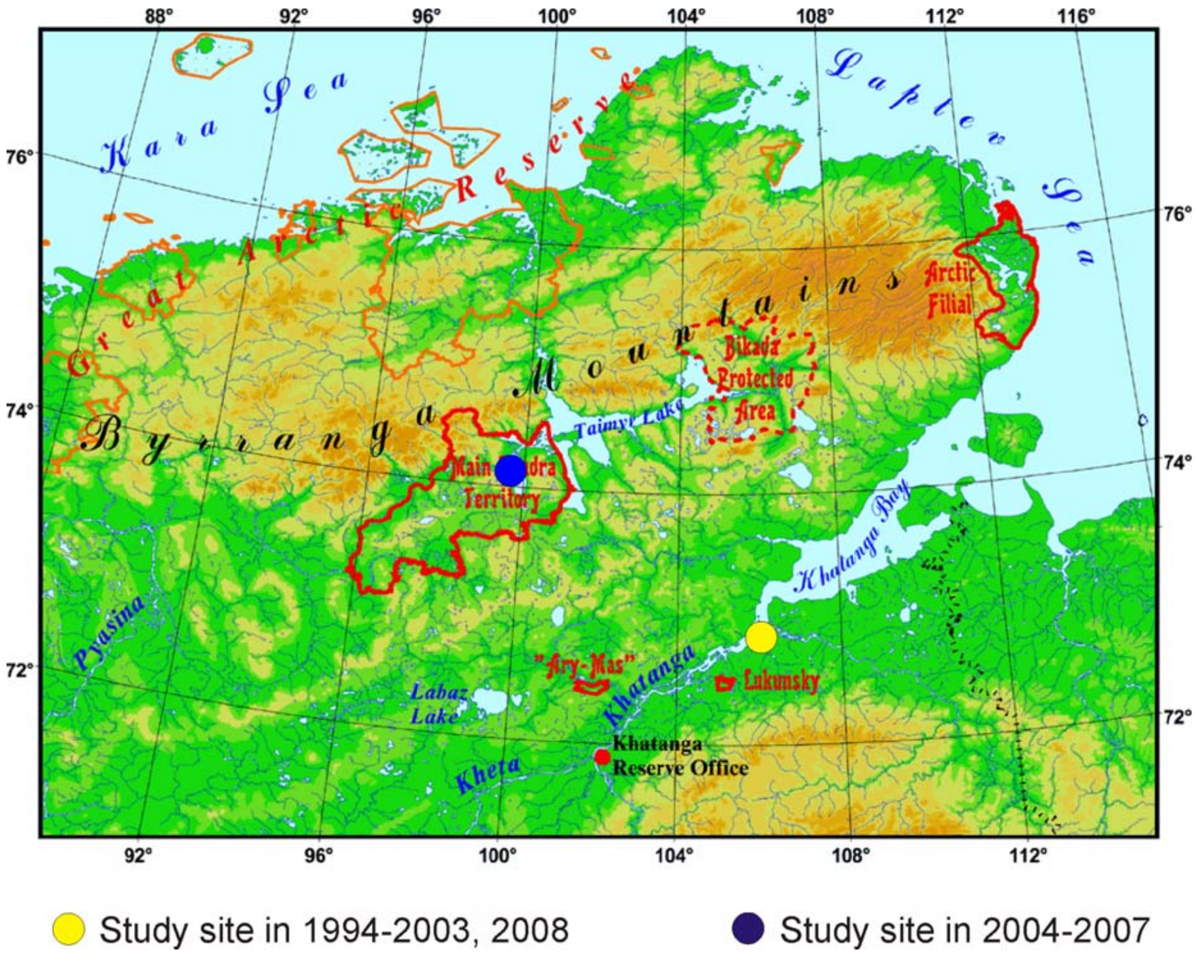

Figure 1. Study sites of the Wader Monitoring Project on Taimyr. Base map was obtained from the website of the Reserve "Taimyrsky" (http://www.taimyrsky.ru/ENG/frame.htm), which territories are shown with solid red line.

The study area is situated near the southern border of the typical tundra subzone with the southern tundra subzone. We used Landsat-7 image acquired on 5 August 2000 to create habitat map of the study area (Fig. 2).

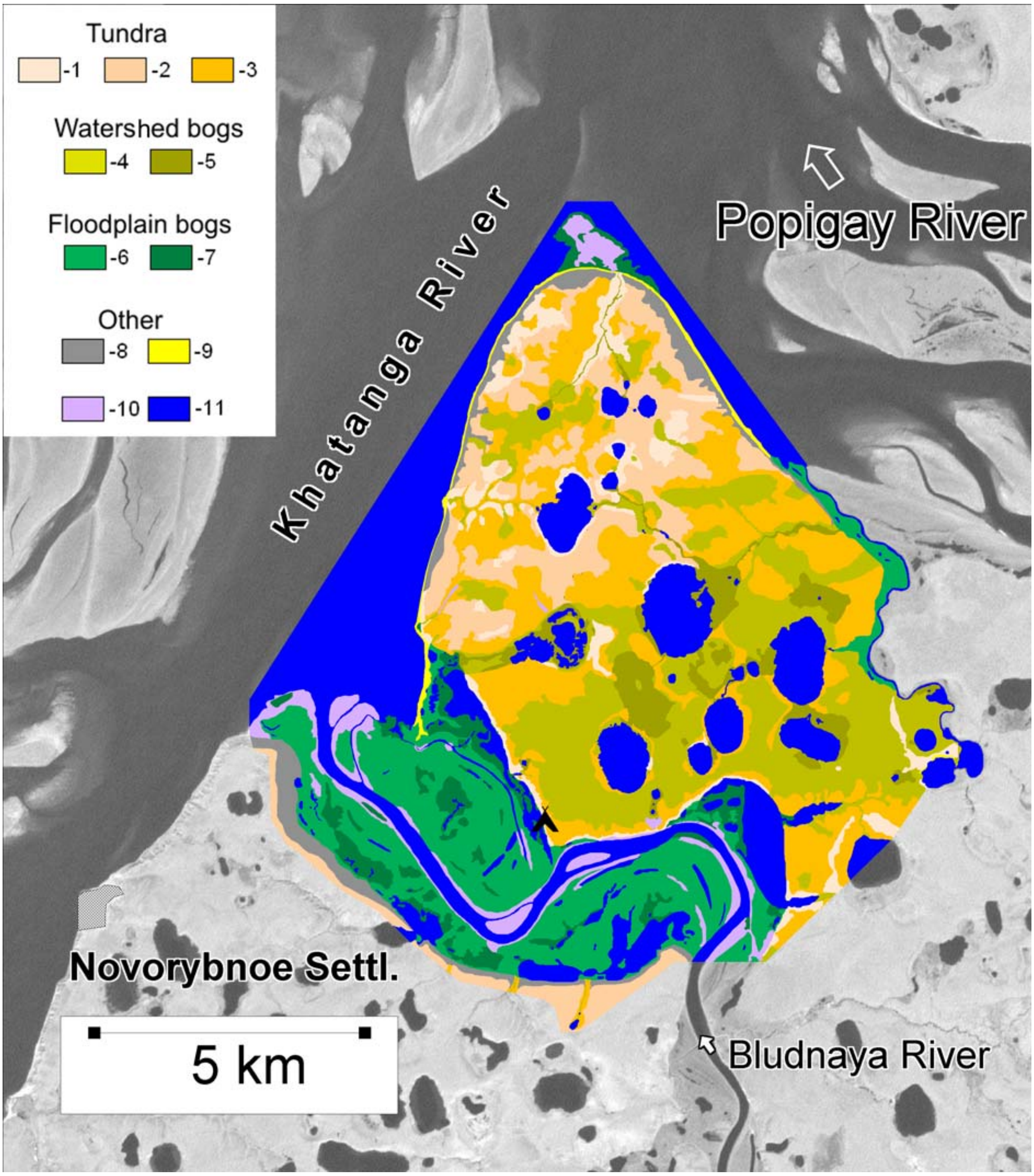

Figure 2. Principal habitats of the study area: 1 – dry dryas- tundra; 2 – watershed moss tundra; 3 – tussok sedge tundra; 4 – flat-hillock bogs; 5 – sedge bog; 6 – polygonal floodplain bog; 7 – sedge floodplain bog; 8 – bedrock river bank; 9 – sand and gravel spit; 10 – willow stands; 11 – water bodies. Panchromatic channel (15 m resolution) of the Landsat image was used as a gray-scale background. Hut symbol indicates field camp location.

2.2. Collection of ornithological data

A majority of quantitative data on fauna, distribution and numbers of birds were collected on 6 study plots with a total area of 268 hectares (Fig. 3, Table 1).

The main plot for nest counts and territory mapping was staked on the first river terrace adjacent to floodplain in 1994 at an area of 1.26 km^2 with 1 to 1.5 m high stakes, placed in lines 100 m apart. Two addition plots established in 1998 in the habitats, absent on the main plot – on hilly watershed (50 ha) and in the floodplain (35 ha) were surveyed in all the following years of studies at this site. The fourth plot (24 ha) was established in 2002 in sedge bog of near-lake depression, and surveyed in 2002-2003, and partially in 2008, as well as two small islands of the Bludnaya River (14 and 19 ha). The plots on islands were not staked, because it was not necessary on so small and narrow territories.

Table 1. Plots for bird counts

Plot #	Area, ha	Years surveyed	Description
1	126	1994-2003, 2008	Oligotrophic flat-hillock bog (60.1% of the plot area), wet tussok moss tundra (28.0%), dry patchy moss tundra (2.5%), complex of lichen dryas tundra on convex ridges and shrub moss tundra in concave depressions (8.5%), stream valley with convex hillock bog (0.9 %)
2	50	1998-2003, 2008	Watershed area with 2 types of moss tundra
3	35	1998-2003, 2008	Polygonal hypnum bog in central floodplain of the Bludnaya River
4	24	2002-2003, 2008 (partly)	Watershed wet sedge bog
5	14	2002-2003, 2008	Willow stands (70.3% of the plot area), forb habitats (14.0%), mud-sandy shores (15.7%).
6	19	2002-2003, 2008	Willow stands (75.8% of the plot area), forb habitats (16.8%), mud-sandy shores (7.3%).

Intensive nest searches on the plots were started immediately after the arrival in the study area on 20 June. Nests were marked with wooden sticks 10–30 cm long placed 5–8 m away from the nest (larger distance for larger species). Location of each nest was determined using GPS Garmin 12. Nest searches with rope were carried out on plots #1–3 from 6-11 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 the course of ringing and other activities during the whole nesting period. In total 287 nests were found, including 146 of waders, 114 of passerines and 27 of other birds.

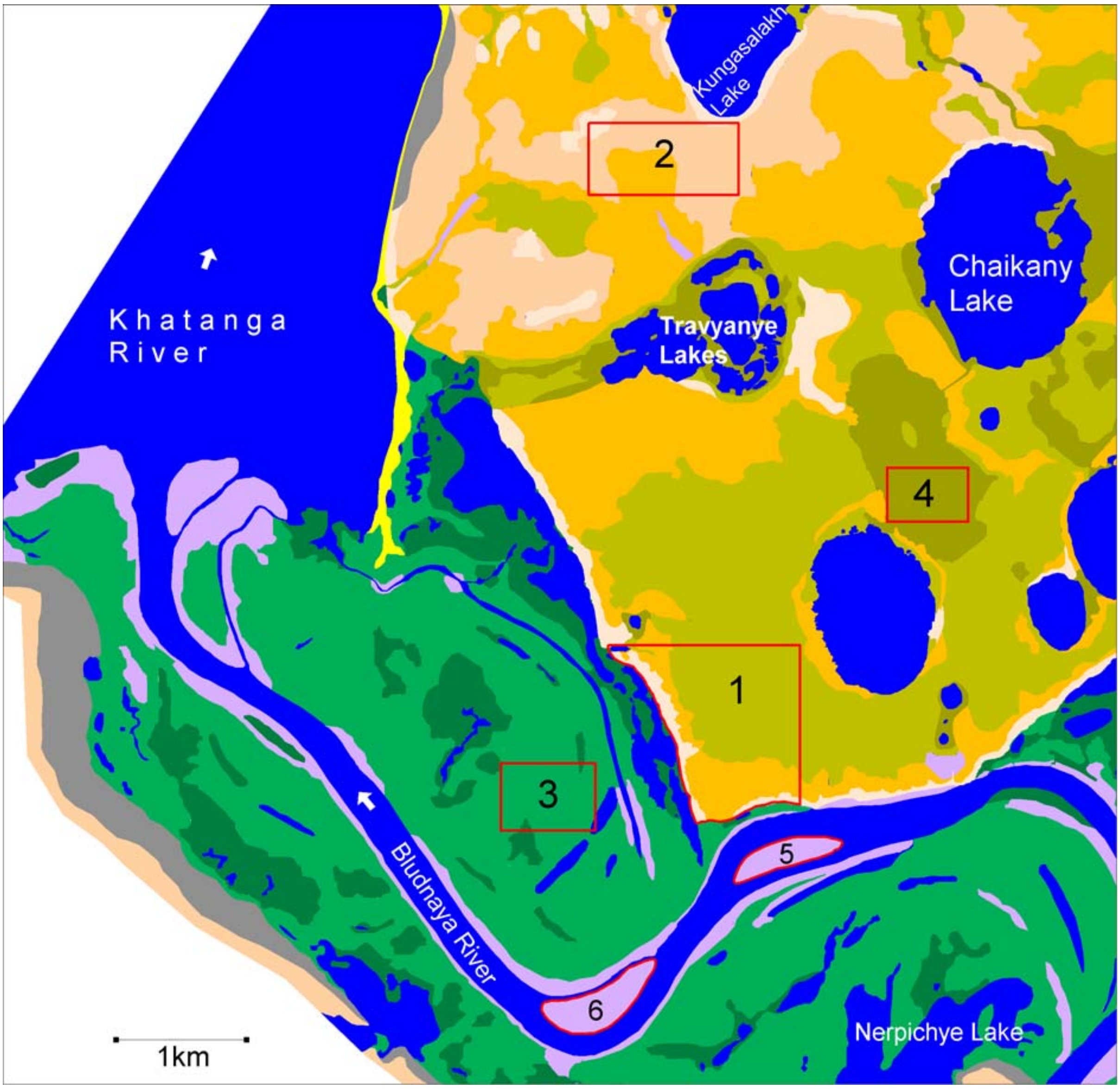

Figure 3. Plots for bird surveys in the study area. See Fig. 2 for habitat legend.

We conducted flotation tests for wader eggs with view of estimating their incubation stage according to Liebezeit et al. (2007). Egg angle, or floating egg angle and float height were measured for 2 eggs from every clutch.

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 9. 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 the 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).

2.3. Collection of environmental data

Weather conditions during the study period were accessed using Oregon Scientific WMR200 weather station (Fig. 4), with its outdoor sensors taking readings at one minute interval of maximal, minimal and actual air temperatures, wind direction, average speed and gust. We recorded these values daily at 9:00 AM, and the whole log of data was saved in the station build-in datalogger.

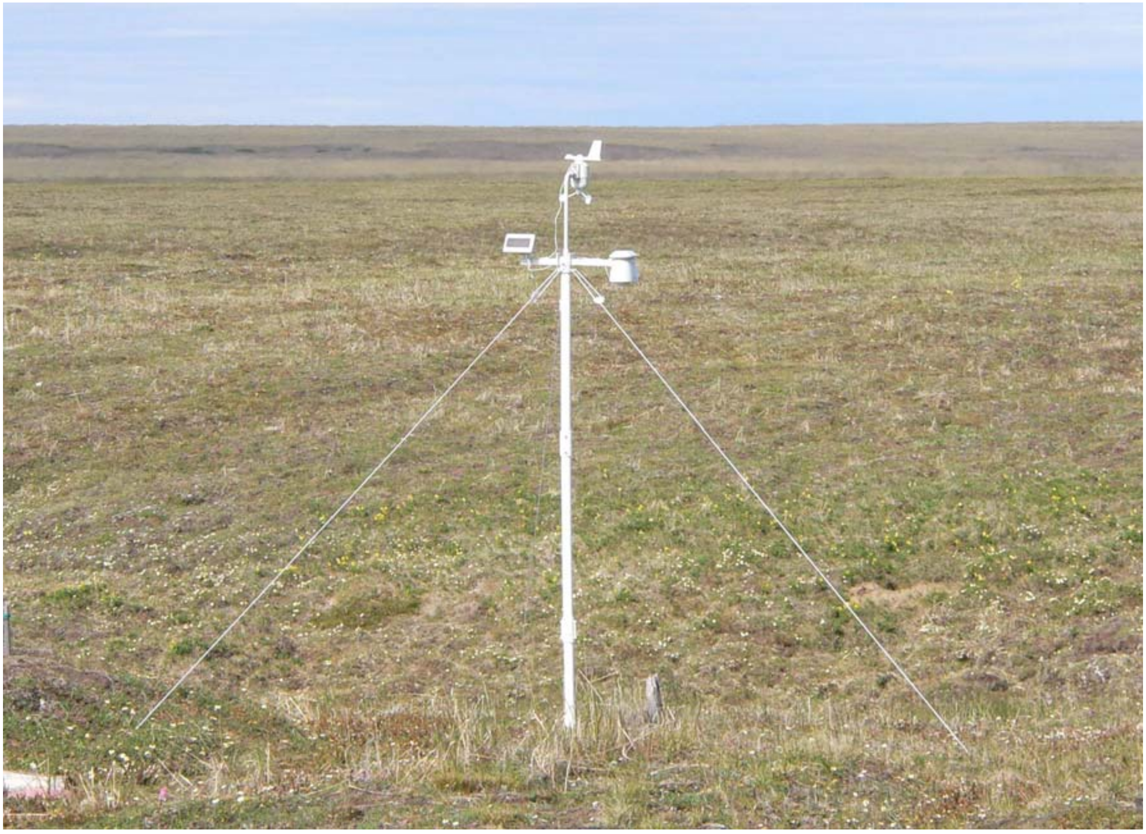

Figure 4. Temperature/humidity and wind outdoor sensors of the WMR200 weather station.

RTV-2 datalogger was installed in a sun-protected box at the height of approximately 0.15 m above the ground in the camp. This device recorded air temperature once an hour.

Precipitation was collected using plastic bottle 9 cm in diameter and 20 cm high. Total daily precipitation was measured at midnight, 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.

Our field weather data, however, were not very suitable for general assessment of long-term climatic trends due to considerable variation in duration and moment of initiation of our field studies, and we used weather station data to compensate for gaps. From the web-site of the World Meteorological Organization (National Climatic Data Center, USA, http://www.ncdc.noaa.gov/oa/climate/climatedata.html#daily) we obtained the mean daily air temperatures for all days in May, June and July for the period 1990-2008 for each weather station located to the north of 50° N latitude in the Russian Arctic. These values were interpolated across the whole Taimyr Peninsula using a multiquadratic function with no smoothing (Buhmann 2003) on a grid with a cell size of 50 km.

A regression of mean daily air temperature values interpolated for the lower Khatanga study area from the mean daily values measured using dataloggers in 2001-2003 and 2008 was highly significant ($P<0.000001$, $R^2 = 0.755261$), with values of slope (1.0010±0.0412) and intercept (0.7653±0.5056) not different significantly ($P>0.05$) from 1 and 0, respectively (Fig. 5). Thus, we concluded that the results of interpolation can be used as a substitute for the missing observational data.

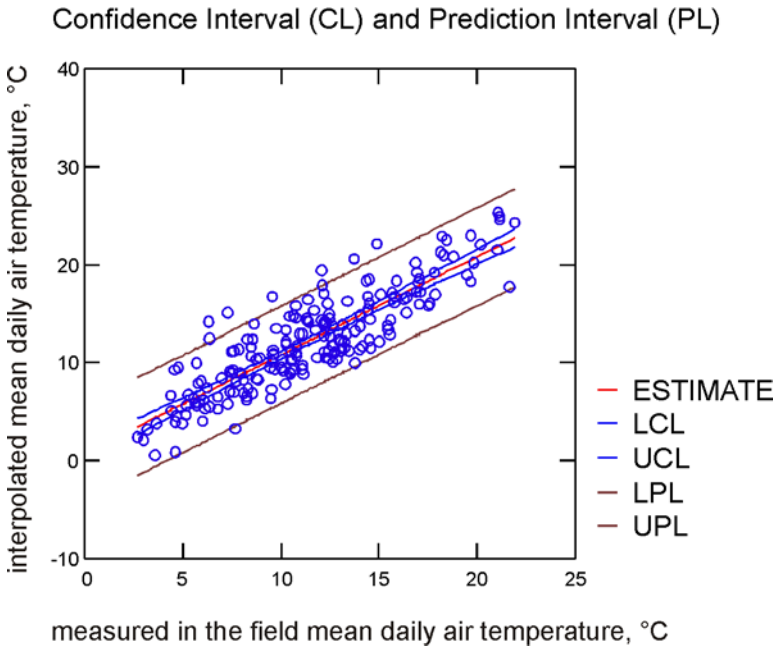

Figure 5. Interpolated air temperature data versus observational data.

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

3. Breeding conditions for birds

3.1. Weather

In the study area on south-eastern Taimyr mean monthly air temperature was –3.6°C, +6.1°C and +10.0°C in May, June and July in 2008, with the long-term average –6.0°C, +5.7°C and +11.6°C, for the respective months. Thus, in 2008 May was considerably warmer than average, June slightly warmer, and July considerably colder (Fig. 6).

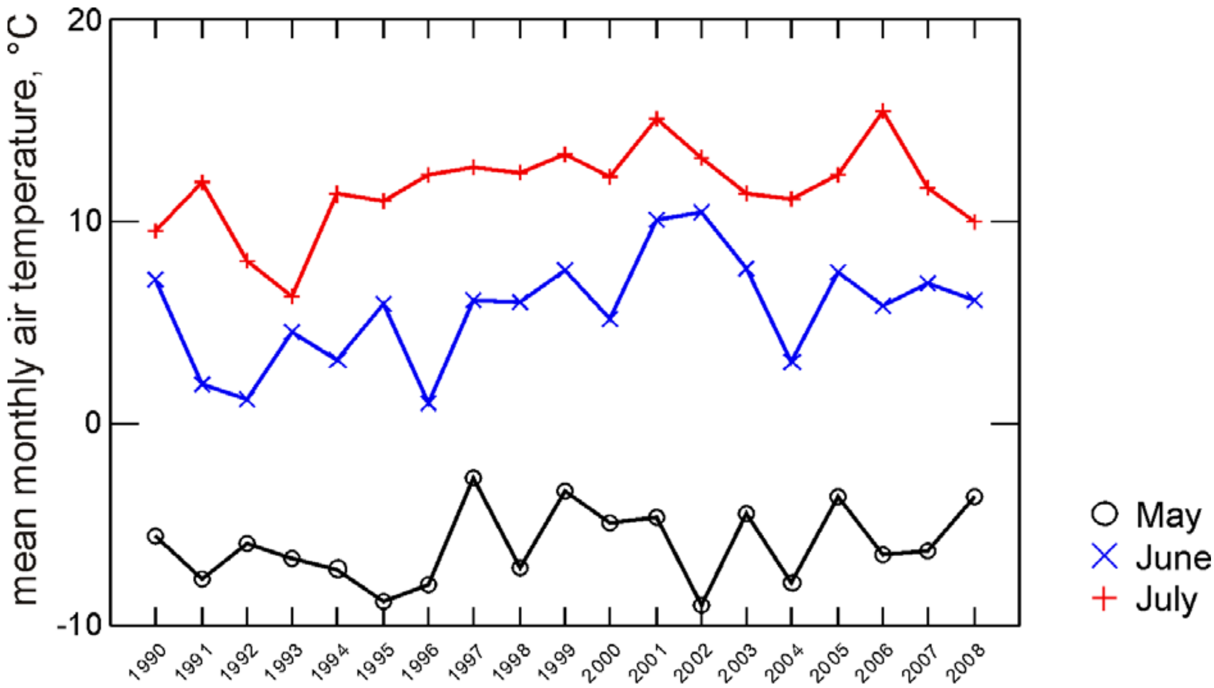

Figure 6. Dynamics of mean monthly air temperature in 1990-2008 in the study area on south-eastern Taimyr.

Mean monthly air temperatures in May did not show a significant trend during the last 19 years ($P>0.2$), while marginally significant increasing tendency was discovered in June ($P=0.051$) and July ($P=0.056$).

The beginning of the study period in June was characterized by variable weather (Fig. 7), which terminated on 27 June with a heavy rain. Precipitation occurred on most days until 7 July, including snowfalls on 30 June, when air temperatures were dropping to +0.8°C and strong wind was observed. The weather improved on 8-9 July, but then rains occurred for 3 days in a row. The remaining period from 13 to 25 July was relatively warm, although temperature was dropping on days with precipitation.

The total amount of precipitation in the study period in 2008 was 22.4 mm, which is very close to the median (21.4 mm; range 11.8-29.8 mm) for the same period in years 2003-2008 when quantitative assessment of precipitation was conducted. Number of days with precipitation was above average in the study period in 2008 (18 days), with the median 15 days in 1994-2008 (range 6-20 days).

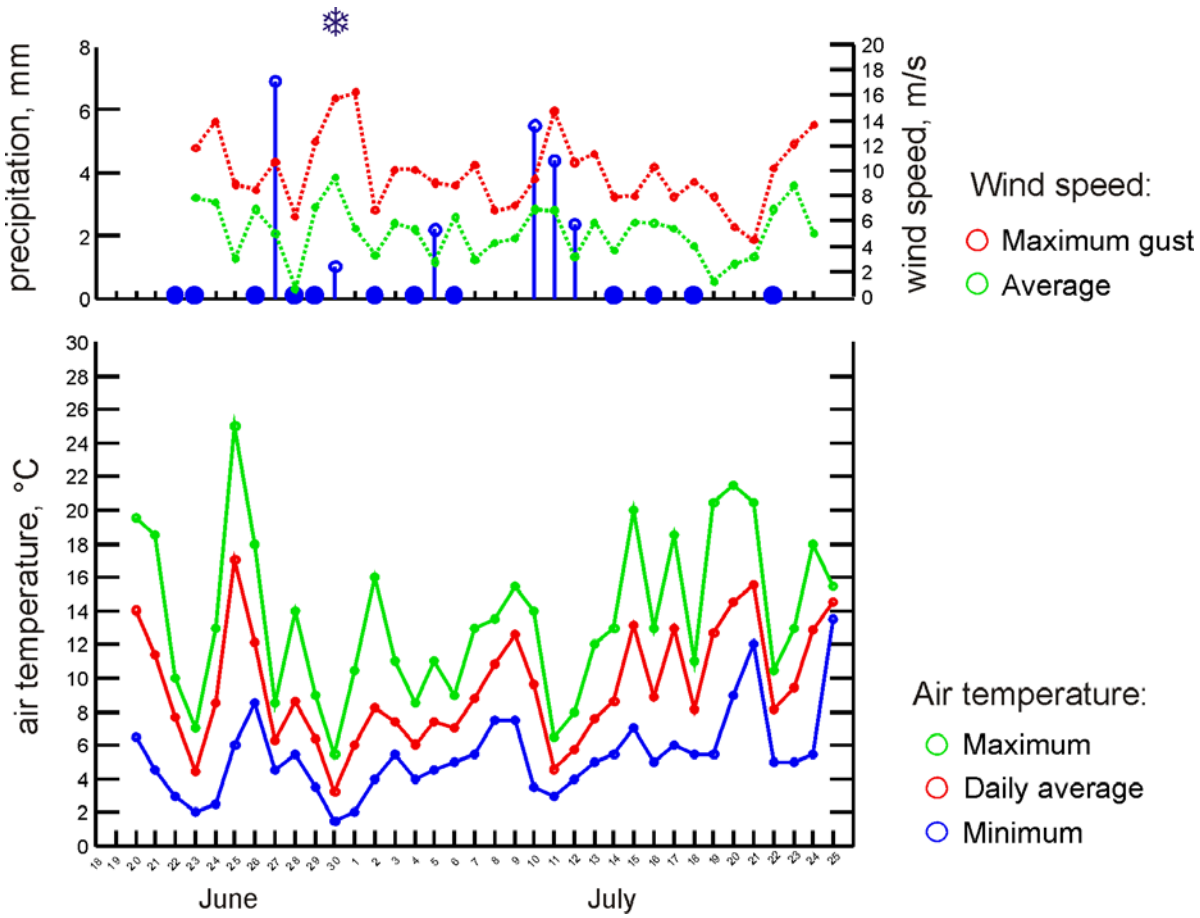

Figure 7. Dynamics of principal weather parameters during the period of studies in 2008 in the study area on south-eastern Taimyr. On the upper graph blue spikes indicate precipitation events that resulted in collection of measurable amounts of water in the rain gauge; blue filled circles indicate other precipitation events; snowflake symbol indicates snowfall.

Late arrival to the study area in 2008 did not allow to assess date of snow melt at 50% of flat surface, but the snow completely melted on the plot #1 by 24 June. This was a rather late date for south-eastern Taimyr (Fig. 8), and given higher than average mean May and June temperatures in 2008, we can only explain this by high accumulation of snow during the winter.

Dates of flowering of early plants in 2008 were very close to the average for the study area (Fig. 8). The first mosquito was recorded slightly earlier than average in 2008, but mass appearance of these insects, and, in particular, imago of crane-flies (Tipulidae), was considerably delayed (Fig. 8), apparently by cold and windy weather in late June – early July.

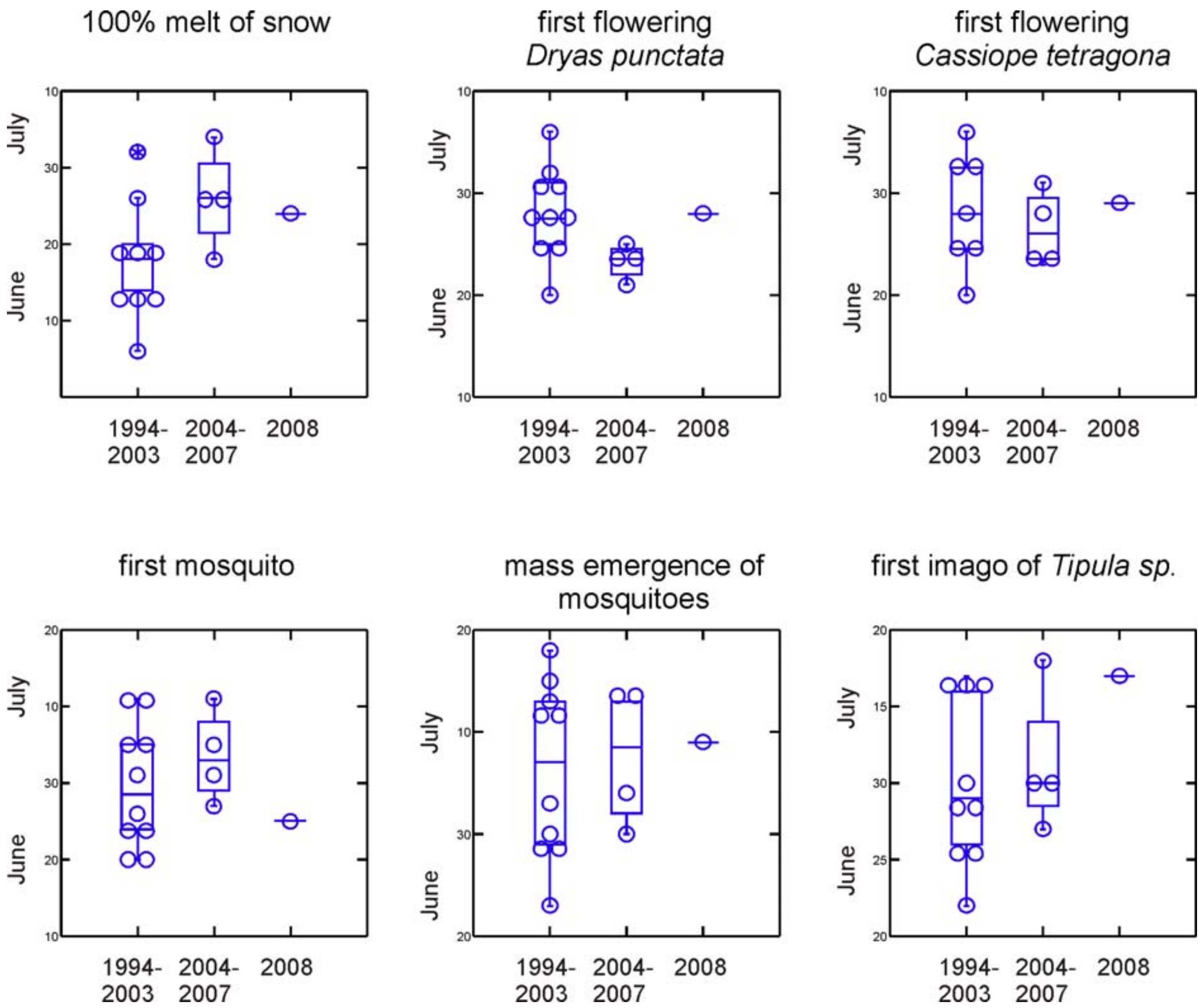

Figure 8. Dates of phenological events in the study area on south-eastern Taimyr in 1994-2003, 2008, and in the study area on central Taimyr in 2004-2007.

Snowfalls on 30 June and rains in July had no apparent adverse impact on breeding birds. Chicks did not hatch in any nests on 30 June when snowfalls occurred, and we recorded dead chicks later in July only in two nests of passerines. A desertion of two nests by waders could not be linked unambiguously with adverse weather events during the period of studies.

Flood was very low in 2008 (Fig. 9), and most of the middle floodplain of the Bludnaya River was not covered by water. Despite our late arrival to the study area we could be certain that there had been no flooding, because sufficient amounts of snow were present in floodplain habitats.

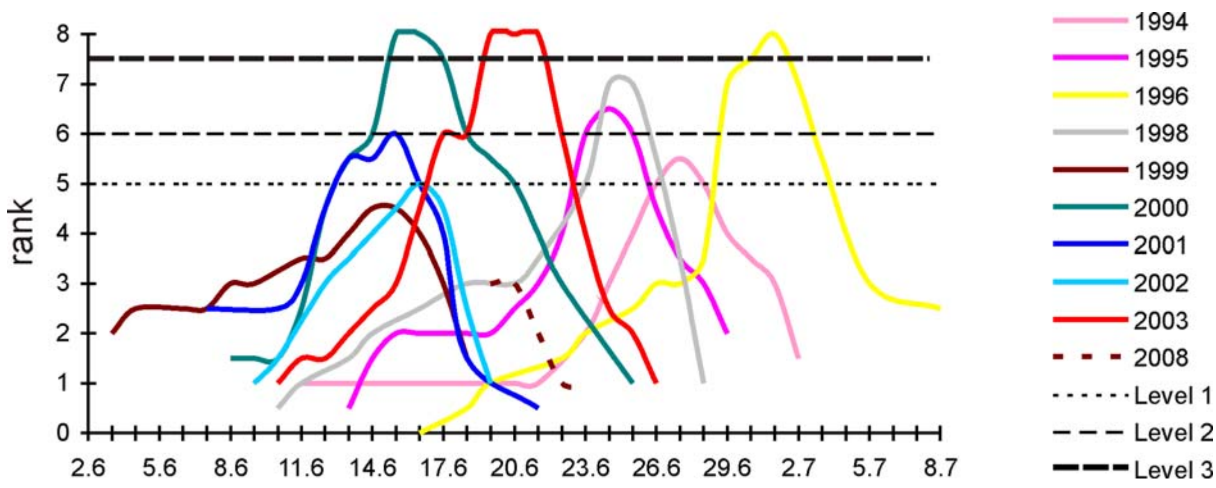

Figure 9. Flood dynamics on the Bludnaya River in the study area on south-eastern Taimyr in 1994-2003 and 2008. Level 1: partial flooding of middle floodplain; level 2: complete flooding of middle floodplain; level 3: complete flooding of high floodplain.

3.2. Lemming abundance

Lemming abundance was low in 2008 (Fig. 10), as well as the density of lemming undersnow nests recorded. Most lemming observations (14 animals) were made immediately after our arrival in the study area, in the period 20-28 June, and only 3 lemmings were observed in the following 3 weeks of July.

Siberian Lemmings (*Lemmus sibiricus*) prevailed over Collared Lemmings (*Dicrostonyx torquatus*) with 12 of 17 records among identified animals.

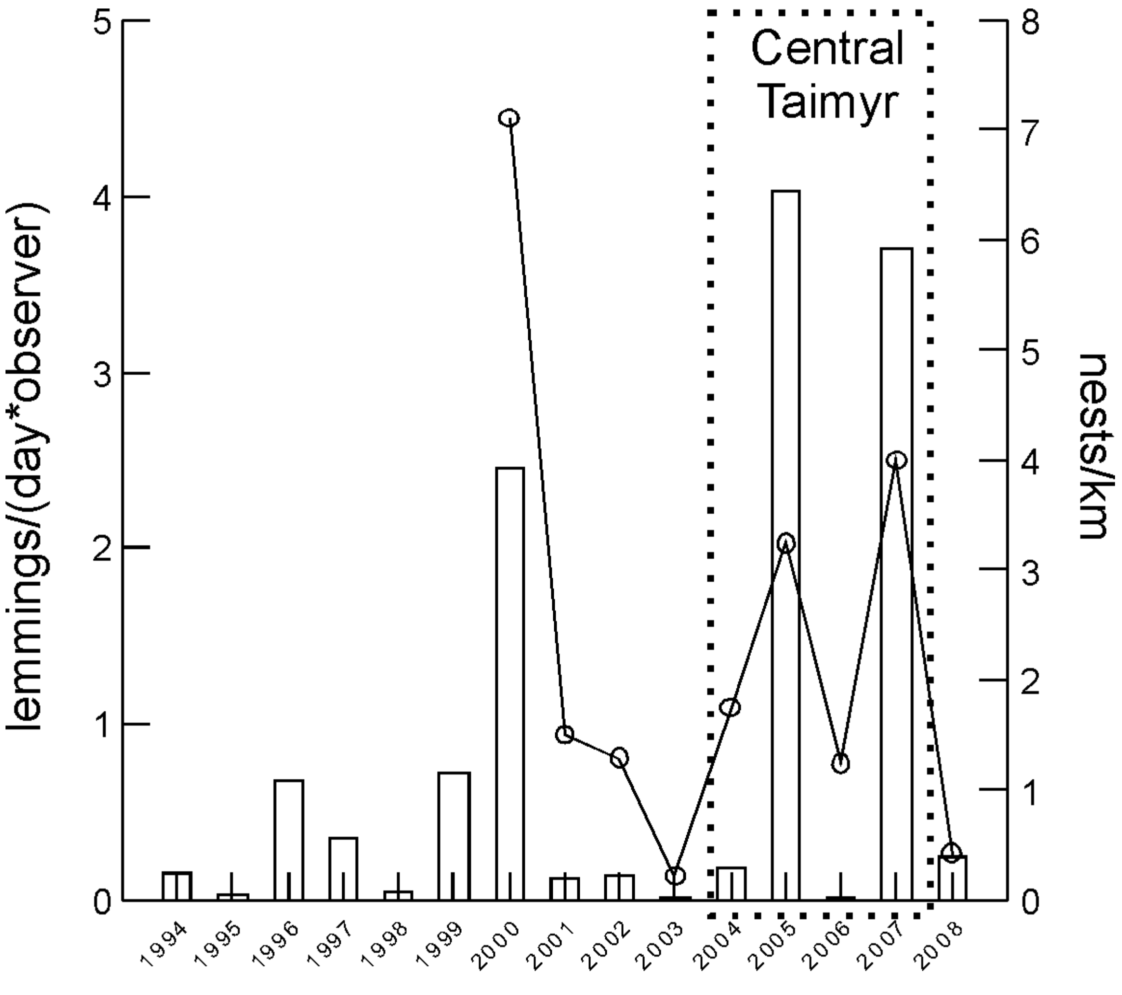

Figure 10. Number of lemmings observed during one day in the field per observer (bars, left axis) and number of undersnow nests of lemmings per km (line, right axis).

3.3. Numbers and reproductive performance of predators

Arctic Foxes *Alopex lagopus* did not breed in the study area in 2008, but their abundance was the highest on record since the start of observations in 1994 (Fig. 11). There was no significant correlation between the abundance of lemmings and the abundance of Arctic Foxes (P=0.243 for Spearman's rank correlation coefficient).

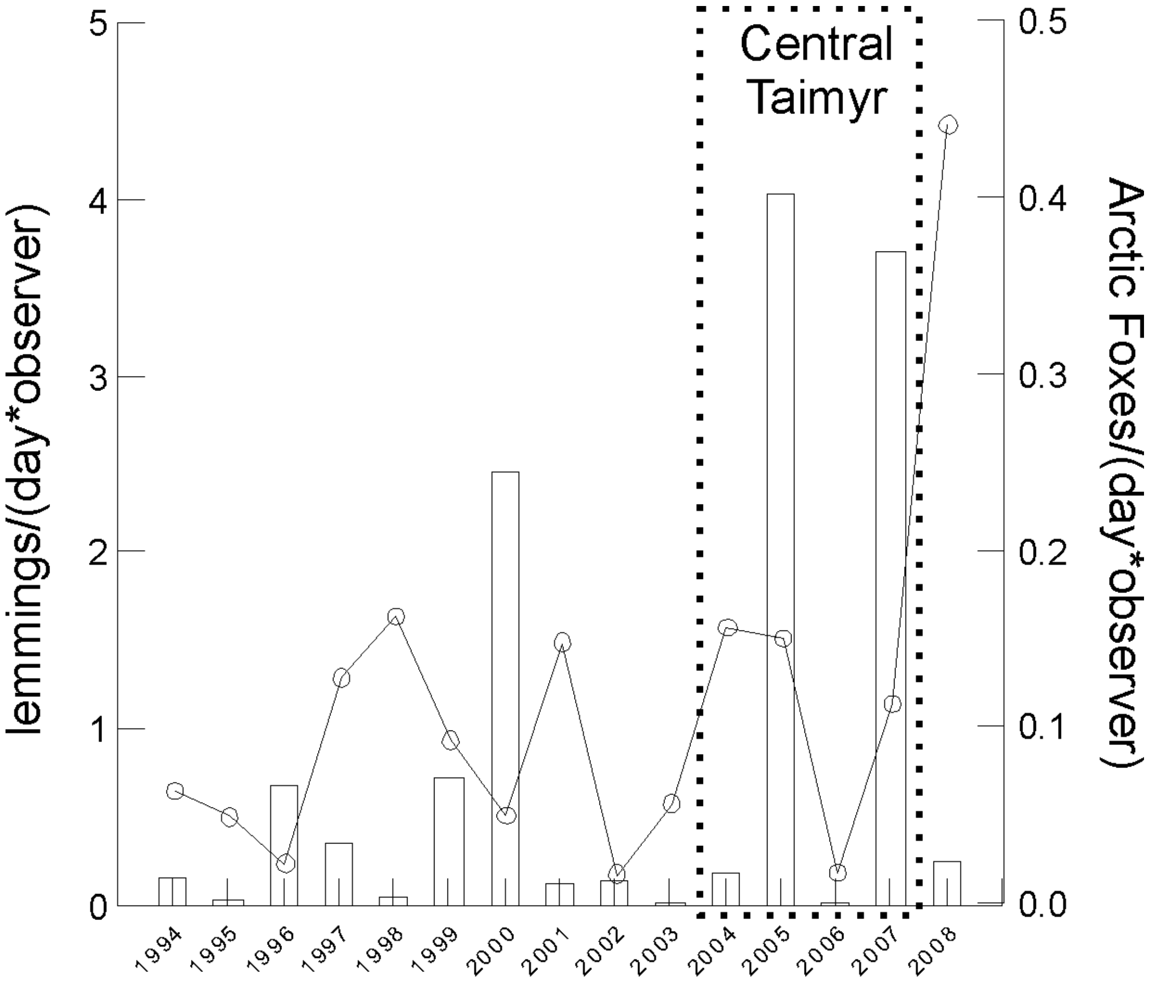

Figure 11. Number of lemmings observed during one day in the field per observer (bars, left axis) and number of Arctic Foxes observed during one day per observer (line, right axis).

Rough-legged Buzzards *Buteo lagopus*, Merlins *Falco columbarius*, Gyrfalcons *F. rusticolus*, Pomarine Skuas *Stercorarius pomarinus* and Long-tailed Skuas *St. longicaudus* were rare non-breeders in the area. This was the second year since the start of observations in 1994 when nesting of Long-tailed Skuas was not confirmed in this study area; the previous one was in 1998 when sparse pairs occupied territories in June, but did not nest, or lost clutches very soon after laying. Owls were not recorded. Arctic Skuas *Stercorarius* *parasiticus* bred at a typical for the area low density (0.07 nests/km^2). Chick hatched from one of two nests found, and fate of another nest remained unknown.

A nest of Peregrine Falcons with 1 egg was found on 20.06 by I.N. Pospelov on the bluffs of the Popigay River at a distance 8.5 km to the north-east from the camp. We learned about this record only after returning to Moscow, but a nest of Peregrine Falcons with 2 small downy chicks was found on 21.07 at a distance 1.5 km to the north-west from the first nest. The short distance between nests should have indicated that a replacement clutch was laid, although in this case the first clutch should have been lost immediately after being discovered on 20.06, to allow for appearance of chicks before 21.07, and provided minimal incubation period of 28 days.

Three nests of Herring Gulls *Larus argentatus* were dispersed in the area, at distances 2.2, 4.1 and 5 km from each other.

Siberian Lemming

4. Breeding numbers and nest success of birds

4.1. Breeding phenology of birds

In 2008 it was possible to collect sufficient data on breeding phenology of 3 species of waders and the Lapland Bunting (Fig. 12, 13). Apparently breeding phenology of Dunlins, Pectoral Sandpipers and Lapland Buntings was very close to the long-term average (slightly delayed), with a reservation that years 1994 and 1996 were obvious outliers with unusually late breeding by birds. Breeding of Red Phalaropes was considerably delayed in 2008 compared with breeding dates in all years on south-eastern Taimyr, and even compared with breeding dates on central Taimyr (Fig. 12).

This delayed breeding by Red Phalaropes can be related to dynamics of temperature regime in June 2008 (Fig. 14). Mean daily air temperatures in early June 2008 were lower than in most other years, while in the period from 6-9 June they even stayed below freezing point and dropped to –2.8°C on 7 June. These weather conditions could have retarded arrival and start of breeding by passerines and waders, in particular by phalaropes dependent on presence of ice-free pools of water.

In 2008 we obtained sufficient samples of bird breeding dates on the plot in the floodplain, which allowed comparisons with terrace habitats. The floodplain plot on south-eastern Taimyr was sampled in 1998-2003, however, in all years except 1999, the middle floodplain was partly or completely covered with water in spring which naturally resulted in delayed breeding dates. There was no flooding of the plot in 1999, but very high breeding bird abundance on the terrace plot did not allow to allocate time for nest control in the floodplain. In 2008 there was no flooding of the middle floodplain also, but the data available on two the most abundant species of birds indicated a delayed nesting in the floodplain compared with the terrace (Fig. 15).

The result for the Lapland Bunting is dubious, because a nest with probably incomplete clutch was found there as early as 20 June, in other words at the same moment when the initiation of clutches started in mass on the terrace. Also, the difference in breeding dates between the floodplain and terrace was so large in this species that allows to suppose that all floodplain clutches were actually replacement ones (dates of initiation of these clutches were very close to those in the small second wave of breeding on the terrace, apparently represented by replacement clutches as well).

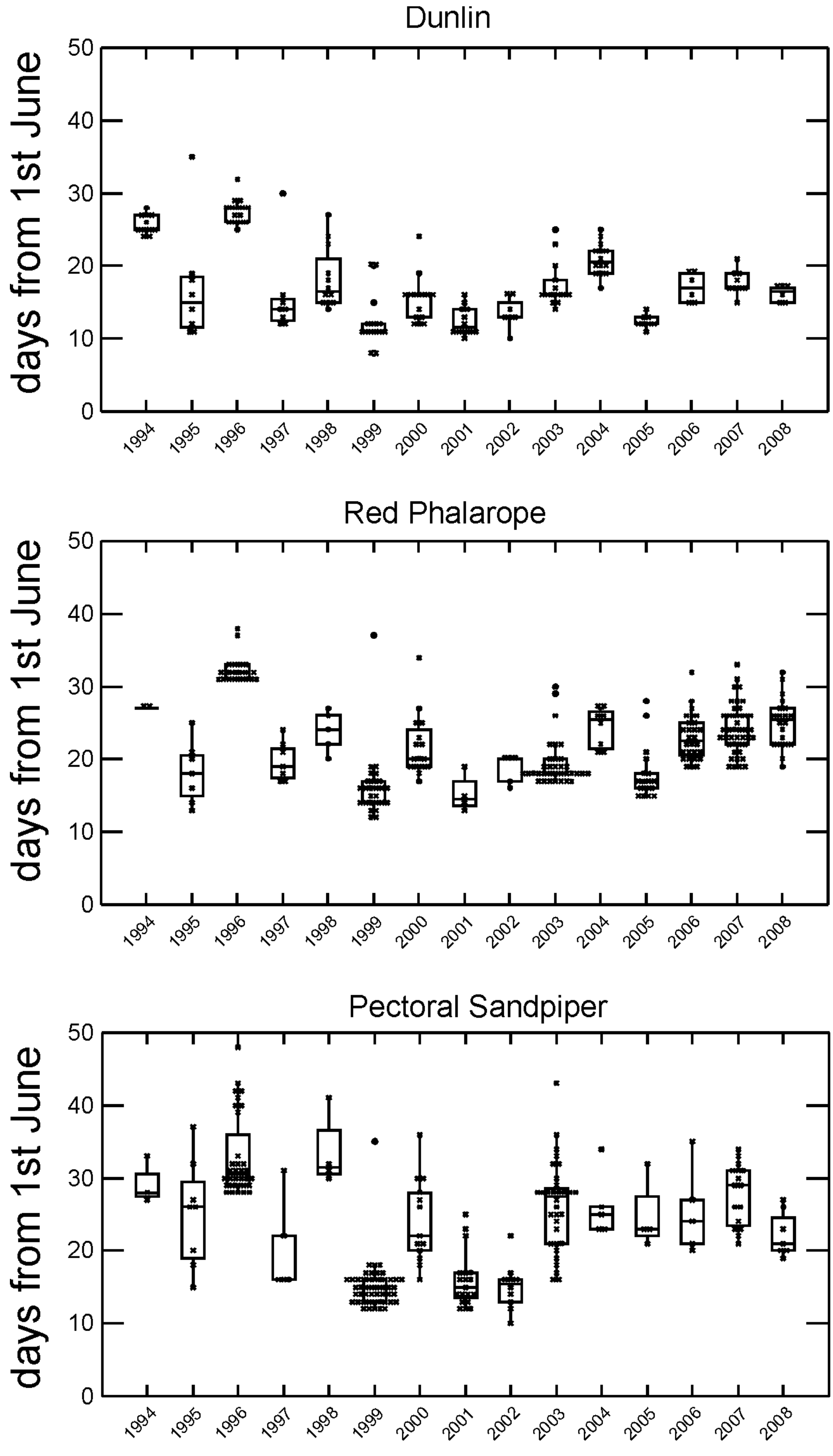

Figure 12. Dates of clutch initiation by selected species of waders in 1994–2003, 2008 on south-eastern Taimyr, and in 2004-2007 on central Taimyr. Crosses show actual date values; box plots show non-parametric statistics: central horizontal line marks the median of a sample, edges of box (hinges) mark quantiles, whiskers show range of values that fall within 1.5 interquartile range of the hinges.

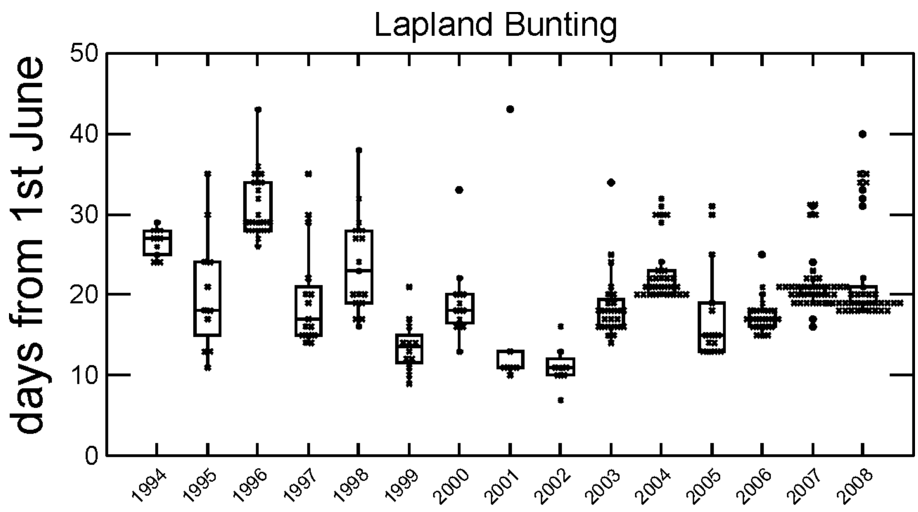

Figure 13. Dates of clutch initiation by Lapland Buntings in 1994–2003 and 2008 on south-eastern Taimyr, and in 2004-2007 on central Taimyr.

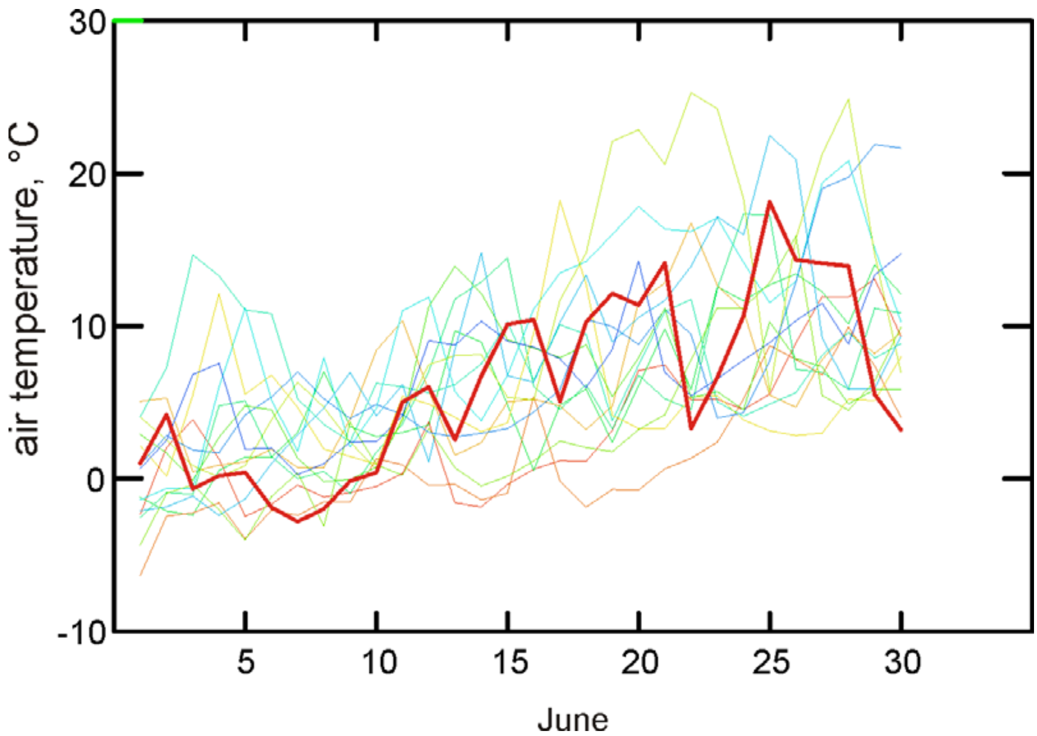

Figure 14. Dynamics of temperature regime in June 2008 (thick red line) and other years in the period 1994-2007 on south-eastern Taimyr.

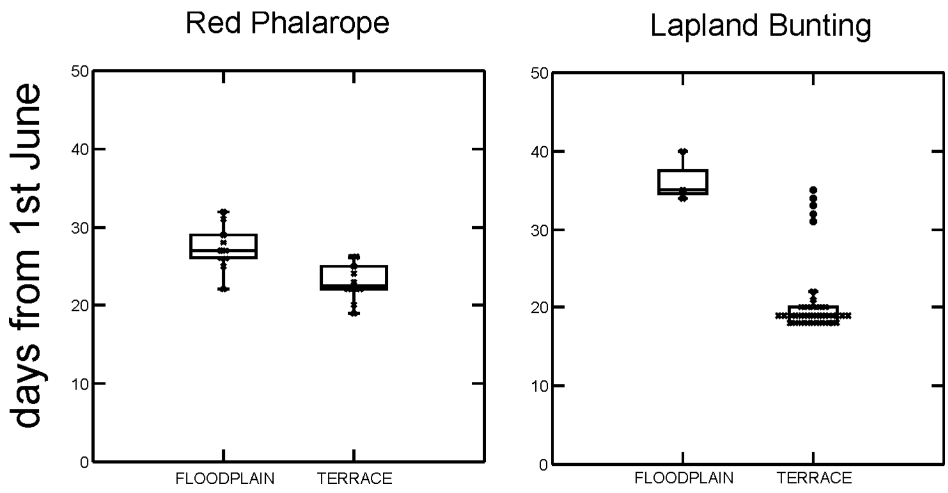

Figure 15. Dates of clutch initiation by Red Phalaropes and Lapland Buntings in the floodplain and on the terrace in 2008.

In the case of the Red Phalarope the difference of several days in breeding dates between the floodplain and the terrace appears genuine, and can have different explanations. At arrival to the study site on 20 June the snow covered less than 5% of the terrace plot, according to visual evaluation, while a respective proportion for the floodplain plot was around 20% with most snow concentrated in polygons. Thus, around 23 June (median) when mass nesting started on the terrace the amount of suitable habitat in the floodplain could have been yet insufficient for mass breeding by phalaropes. Another interesting hypothesis could be that phalaropes in the floodplain delay breeding until receiving some clear indicator in the environment that their habitat will not be flooded by water. This hypothesis requires further investigation.

4.2. Breeding numbers of birds in the study area

Breeding density of waders was considerably below average in 2008 at the main study plot on the river terrace (Fig. 16), the lowest on record at the watershed plot and the second highest on record in the floodplain. High density of waders in the floodplain can be explained by the absence of flooding in this habitat (Fig. 9), which, probably, increased its attractiveness to Grey Phalaropes (Fig. 17, 18). A response by Ruffs and Pectoral Sandpipers to the absence of flooding of the polygonal bog was less pronounced, because numbers of these species in the area are probably dependent on general patterns of spring development on their flyways.

The abundance of passerines was very high everywhere on behalf of the Lapland Bunting (Fig. 16, 17, 18), while other than waders non-passerines were not found at all on the terrace and watershed plot, while their numbers in the floodplain were close to average. In 2008 on the watershed plot, for the first time since the start of observations there in 1998, waders were not the dominant group of birds, as their numbers dropped below numbers of Lapland Buntings (Fig. 16).

Significant trends in numbers of birds were confirmed for the period 1994-2008 neither for individual species, nor for their groups ($P>0.1$ for Spearman correlation), although a decreasing tendency in waders appears obvious (Fig. 16). Apparently a time-series of 11 seasons is still too short, given pronounced variation in breeding density.

Breeding density of birds on Upper Island of the Bludnaya River (plot # 5) reached the record high value for the area (171.4 nests/km^2), mostly on behalf of very high breeding density of Arctic Redpolls (Table 6). However, this value should be interpreted with caution, given very small area of the island. We discovered a marginally significant negative relationship between duration of flooding of the island in spring and breeding density of birds there ($R= -0.87$; $p=0.054$).

In 2008 interesting observations of birds included breeding record of Raven, which nest was found on wooden carcass of a light-house; the northern-most breeding record of this species in Eurasia (72°55' N).

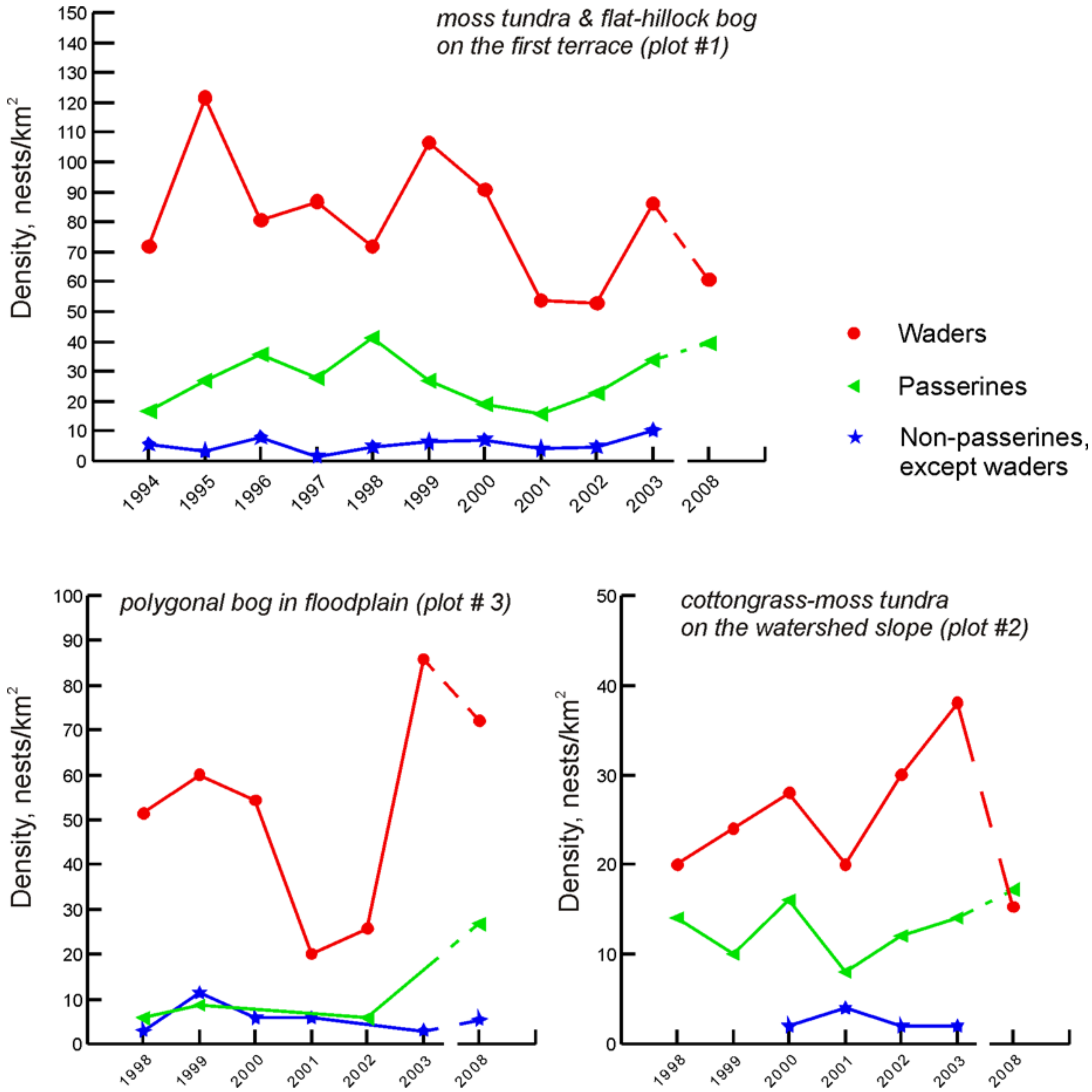

Figure 16. Abundance of principal groups of birds in different habitats in 1994–2003 and 2008 on south-eastern Taimyr.

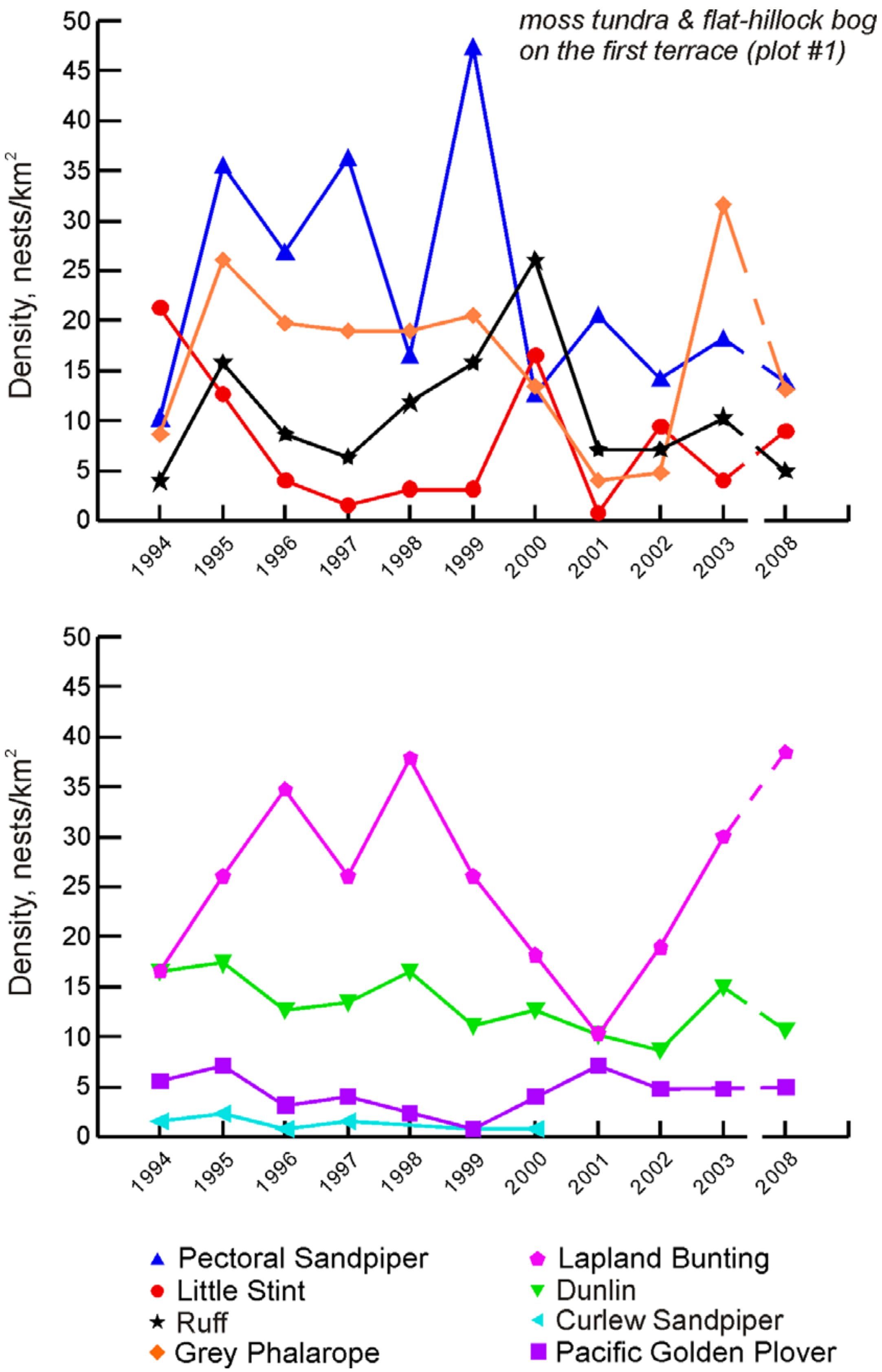

Figure 17. Densities of common birds on the main plot on the river terrace in 1994–2003 and 2008 on south-eastern Taimyr.

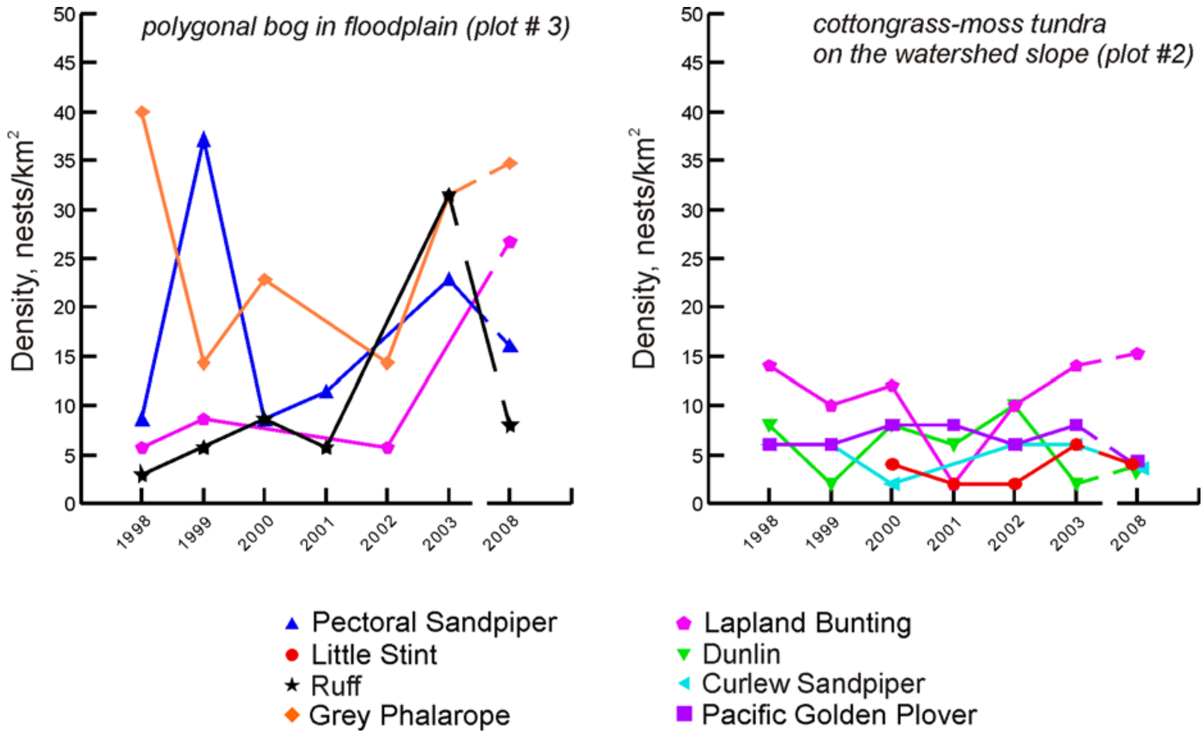

Figure 18. Densities of common birds on the plots #2-3 in 1998–2003 and 2008 on south-eastern Taimyr.

Table 2.
Breeding densities of birds (nest/km^2) on the study plot # 1 in 1994–2003 and 2008 on south-eastern Taimyr

Species	**Year**											**Average**
	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2008**	
1. *Anas acuta*	0.0	0.0	0.8	0.0	0.0	0.0	1.6	0.0	0.0	0.0	0.0	0.22
2. *Clangula hyemalis*	0.8	0.0	1.6	0.0	1.6	1.6	0.8	0.8	0.0	0.8	0.0	0.73
3. *Somateria spectabilis*	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.14
4. *Polysticta stelleri*	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.07
5. *Melanitta fusca*	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.07
Total ducks:	**1.6**	**0.8**	**3.2**	**0.0**	**1.6**	**1.6**	**2.4**	**0.8**	**0.0**	**1.6**	**0.0**	**1.24**
6. *Pluvialis squatarola*	1.6	0.8	1.6	1.6	1.6	0.8	1.6	0.8	1.6	0.8	1.6	1.31
7. *Pluvialis fulva*	5.6	7.1	3.2	4.0	2.4	0.8	4.0	7.1	4.8	4.8	4.8	4.42
8. *Tringa erythropus*	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.14
9. *Phalaropus fulicarius*	8.7	26.2	19.8	19.0	19.8	20.6	13.5	4.0	4.8	31.7	12.7	16.4
10. *Phalaropus lobatus*	0.0	0.0	1.6	0.8	0.0	0.0	0.8	0.8	0.0	0.0	0.0	0.36
11. *Philomachus pugnax*	4.0	15.9	8.7	6.3	11.9	15.9	26.2	7.1	7.1	10.3	4.8	10.7

Species	Year											Average
	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2008**	
12. Calidris minuta	21.4	12.7	4.0	1.6	3.2	3.2	16.7	0.8	9.5	4.0	8.7	7.8
13. Calidris ruficollis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.07
14. Calidris temminckii	0.8	0.8	2.4	0.0	0.0	0.8	0.8	0.8	0.8	0.8	0.0	0.73
15. Calidris ferruginea	1.6	3.2	0.8	1.6	0.0	0.8	0.8	0.0	0.0	0.0	0.0	0.8
16. Calidris alpina	16.7	17.5	12.7	13.5	16.7	11.1	12.7	10.3	9.5	15.1	10.3	13.3
17. Calidris melanotos	10.3	35.7	27.8	37.3	17.5	48.4	12.7	20.6	14.3	18.3	13.5	23.3
18. Gallinago gallinago	0.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.22
19. Limosa lapponica	0.8	1.6	0.0	1.6	0.0	1.6	0.8	0.8	0.8	0.8	0.0	0.8
20. Limnodromus scolopaceus	0.8	2.4	0.0	0.8	0.0	1.6	0.8	0.8	0.0	0.0	0.8	0.73
Total waders:	**72.2**	**123.8**	**82.5**	**88.1**	**73.8**	**107.9**	**91.3**	**54.0**	**54.0**	**86.5**	**57.9**	**81.1**
21. Eremophila alpestris	0.0	0.8	0.8	1.6	2.4	0.8	0.8	3.2	2.4	1.6	0.8	1.38
22. Alauda arvensis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.07
23. Anthus cervinus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	1.6	0.0	0.29
24. Acanthis hornemanni	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.8	0.8	0.8	0.0	0.29
25. Emberiza pusilla	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.07
26. Calcarius lapponicus	16.7	26.2	34.9	25.4	38.1	26.2	18.3	10.3	19.0	30.2	36.5	25.6
Total passerines:	**16.7**	**27.0**	**35.7**	**27.0**	**41.3**	**27.0**	**19.0**	**15.9**	**23.0**	**34.9**	**37.3**	**27.7**
27. Lagopus lagopus	2.4	0.8	1.6	1.6	1.6	0.0	1.6	0.0	2.4	5.6	0.0	1.6
28. Stercorarius longicaudus	0.8	0.8	0.8	0.0	0.0	1.6	1.6	1.6	0.8	0.8	0.0	0.8
29. Rhodostethia rosea	0.0	0.0	0.0	0.0	0.0	2.4	0.0	1.6	0.0	0.0	0.0	0.36
30. Sterna paradisaea	0.8	0.8	2.4	0.0	1.6	0.0	1.6	0.8	1.6	2.4	0.0	1.09
31. Asio flammeus	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.07
Total other species:	**4**	**2.4**	**4.8**	**1.6**	**3.2**	**4.8**	**4.8**	**4**	**4.8**	**8.7**	**0.0**	**3.92**
Total birds:	**94.4**	**154.0**	**126.2**	**116.7**	**119.8**	**141.3**	**117.5**	**74.6**	**81.7**	**131.7**	**95.2**	**113.9**
Portion of ducks in population, %	1.7	0.5	2.5	0.0	1.3	1.1	2.0	1.1	0.0	1.2	0.0	1.0
Portion of waders in population, %	76.5	80.4	65.4	75.5	61.6	76.4	77.7	72.4	66.1	65.7	60.8	70.8
Portion of passerines in population, %	17.7	17.5	28.3	23.1	34.5	19.1	16.2	21.3	28.2	26.5	39.2	24.7
Portion of other species in population, %	4.2	1.6	3.8	1.4	2.7	3.4	4.1	5.4	5.9	6.6	0.0	3.5
Breeding species:	**17**	**17**	**18**	**14**	**14**	**18**	**19**	**20**	**17**	**19**	**11**	**16.7**

Table 3.
Breeding densities of birds (nest/km^2) on the study plot # 2 in 1998–2003 and 2008 on south-eastern Taimyr

Species	1998	1999	2000	2001	2002	2003	2008	Ave-rage
1. *Pluvialis fulva*	6.0	6.0	8.0	8.0	6.0	8.0	4.0	6.6
2. *Phalaropus fulicarius*	0.0	2.0	0.0	0.0	0.0	2.0	0.0	0.57
3. *Philomachus pugnax*	0.0	0.0	2.0	0.0	2.0	4.0	0.0	1.14
4. *Calidris minuta*	0.0	0.0	4.0	2.0	2.0	6.0	4.0	2.57
5. *Calidris ruficollis*	0.0	2.0	2.0	2.0	4.0	8.0	0.0	2.57
6. *Calidris ferruginea*	6.0	6.0	2.0	0.0	6.0	6.0	4.0	4.29
7. *Calidris alpina*	8.0	2.0	8.0	6.0	10.0	2.0	4.0	5.71
8. *Calidris melanotos*	0.0	6.0	2.0	0.0	0.0	2.0	0.0	1.43
9. *Limosa lapponica*	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.29
Total waders:	**20.0**	**24.0**	**28.0**	**20.0**	**30.0**	**38.0**	**16.0**	**25.14**
10. *Clangula hyemalis*	0.0	0.0	0.0	4.0	0.0	2.0	0.0	0.86
11. *Lagopus lagopus*	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.29
12. *Stercorarius longicaudus*	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.29
13. *Eremophila alpestris*	0.0	0.0	4.0	6.0	2.0	0.0	2.0	2.0
14. *Calcarius lapponicus*	14.0	10.0	12.0	2.0	10.0	14.0	18.0	11.4
Total non-waders:	14.0	10.0	18.0	12.0	14.0	16.0	20.0	14.9
Total birds:	34.0	34.0	46.0	32.0	44.0	54.0	36.0	40.0
Portion of waders in population, %	58.8	70.6	60.9	62.5	68.2	70.4	44.4	62.3
Portion of passerines in population, %	41.2	29.4	34.8	25.0	27.3	25.9	55.6	34.2
Portion of other species in population, %	0.0	0.0	4.3	12.5	4.5	3.7	0.0	3.5
Breeding species:	**4**	**7**	**10**	**8**	**9**	**10**	**6**	**7.7**

Table 4.
Breeding densities of birds (nest/km^2) on the study plot # 3 in 1998–2003 and 2008 on south-eastern Taimyr

Species	1998	1999	2000	2001	2002	2003	2008	Average
1. *Pluvialis squatarola*	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.41
2. *Phalaropus fulicarius*	40.0	14.3	22.9	0.0	14.3	31.4	37.1	22.9
3. *Phalaropus lobatus*	0.0	2.9	0.0	0.0	2.9	0.0	5.7	1.64
4. *Philomachus pugnax*	2.9	5.7	8.6	5.7	0.0	31.4	8.6	8.99
5. *Calidris minuta*	0.0	0.0	2.9	0.0	2.9	0.0	2.9	1.24
6. *Calidris alpina*	0.0	0.0	2.9	0.0	0.0	0.0	2.9	0.83
7. *Calidris acuminata*	0.0	0.0	2.9	0.0	0.0	0.0	0.0	0.26
8. *Calidris melanotos*	8.6	37.1	8.6	11.4	0.0	22.9	17.1	15.1
9. *Gallinago gallinago*	0.0	0.0	5.7	2.9	5.7	0.0	0.0	2.04
Total waders:	**51.4**	**60.0**	**54.3**	**20.0**	**25.7**	**85.7**	**77.1**	**53.5**

Species	1998	1999	2000	2001	2002	2003	2008	Average
10. Clangula hyemalis	0.0	2.9	2.9	2.9	0.0	0.0	0.0	1.24
11. Somateria spectabilis	0.0	0.0	0.0	0.0	0.0	2.9	2.9	0.83
12. Stercorarius parasiticus	0.0	0.0	0.0	2.9	0.0	0.0	0.0	0.26
13. Rhodostethia rosea	0.0	8.6	0.0	0.0	0.0	0.0	0.0	1.23
14. Sterna paradisaea	2.9	0.0	2.9	0.0	0.0	0.0	2.9	1.24
15. Calcarius lapponicus	5.7	8.6	0.0	0.0	5.7	0.0	28.6	6.94
Total non-waders:	8.6	20.0	5.7	5.7	5.7	2.9	34.3	11.8
Total birds:	60.0	80.0	60.0	25.7	31.4	88.6	111.4	65.3
Portion of waders in population, %	85.7	75.0	90.5	77.8	81.8	96.7	69.2	82.4
Portion of ducks in population, %	0.0	3.6	4.8	11.3	0.0	3.4	2.6	3.7
Portion of passerines in population, %	9.5	10.8	0.0	0.0	18.2	0.0	25.7	9.2
Breeding species:	**5**	**7**	**9**	**5**	**5**	**4**	**10**	**6.4**

Table 5.
Breeding densities of birds (nest/km^2) on the study plot # 4 in 2002–2003 and 2008 on south-eastern Taimyr

Species	2002	2003	2008	Average *
1. Phalaropus fulicarius	12.5	12.5	(2)	12.5
2. Phalaropus lobatus	12.5	12.5	(1)	12.5
3. Philomachus pugnax	29.2	29.2	(1)	29.2
4. Calidris melanotos	4.2	4.2	-	4.2
5. Limicola falcinellus	12.5	4.2	(2)	8.4
Total waders:	**70.8**	**62.5**	**-**	**66.7**
6. Somateria spectabilis	0.0	8.3	-	4.2
7. Rhodostethia rosea	0.0	8.3	-	4.2
8. Sterna paradisaea	4.2	8.3	-	6.3
Total birds:	**75.0**	**87.5**	**-**	**81.3**
Portion of waders in population, %	94.4	71.4	-	82.9
Portion of other species in population, %	5.6	28.6		17.1
Breeding species:	**6**	**8**	**-**	**7.0**

* – based on 2002-2003 data only; number of found nests is shown in brackets for 2008.

Table 6.
Breeding densities of birds (nest/km^2) on the study plot # 5 in 2000–2003 and 2008 on south-eastern Taimyr

Species	**2000**	**2001**	**2002**	**2003**	**2008**	**Average**
1. Melanitta nigra	0.0	0.0	0.0	7.1	0.0	1.42
2. Melanitta fusca	0.0	7.1	7.1	7.1	14.3	7.12
3. Lagopus lagopus	0.0	0.0	7.1	0.0	0.0	1.42
4. Calidris temminckii	28.6	21.4	21.4	35.7	21.4	25.7
5. Phylloscopus trochilus	0.0	0.0	14.3	0.0	14.3	5.72
6. Acanthis hornemanni	14.3	28.6	71.4	35.7	85.7	47.14
7. Emberiza pallasi	0.0	0.0	0.0	7.1	14.3	4.28
8. Emberiza pusilla	0.0	0.0	28.6	0.0	0.0	5.72
9. Calcarius lapponicus	0.0	0.0	0.0	0.0	21.4*	4.28
Total birds:	**42.9**	**57.1**	**150.0**	**92.9**	**171.4**	**102.8**
Portion of ducks in population, %	0.0	12.4	4.7	15.4	8.3	8.2
Portion of waders in population, %	66.7	37.5	14.3	38.4	12.5	33.9
Portion of passerines in population, %	33.3	50.1	76.2	46.2	79.2	57.0
Breeding species:	**2**	**3**	**6**	**5**	**6**	**4.4**

* - including 1 brood.

Table 7.
Breeding densities of birds (nest/km^2) on the study plot # 6 in 2000–2003 and 2008 on south-eastern Taimyr

Species	**2000**	**2001**	**2002**	**2003**	**2008**	**Average**
1. Anas crecca	0.0	0.0	5.3	0.0	0.0	1.06
2. Melanitta fusca	0.0	5.3	15.8	0.0	0.0	4.22
3. Philomachus pugnax	0.0	5.3	26.3	15.8	0.0	9.48
4. Calidris temminckii	47.4	31.6	73.7	36.8	94.7*	56.8
5. Gallinago gallinago	0.0	0.0	0.0	0.0	5.3	1.06
6. Anthus cervinus	0.0	5.3	0.0	5.3	0.0	2.12
7. Acanthis hornemanni	15.8	15.8	26.3	47.4	31.6	27.4
8. Emberiza pallasi	0.0	0.0	0.0	0.0	5.3	1.06
9. Calcarius lapponicus	0.0	0.0	0.0	0.0	5.3	1.06
Total birds:	**63.2**	**63.2**	**147.4**	**105.3**	**142.1**	**104.2**
Portion of ducks in population, %	0.0	8.4	14.3	0.0	0.0	4.5
Portion of waders in population, %	75.0	58.4	67.8	50.0	70.4	64.3
Portion of passerines in population, %	25.0	33.4	17.8	50.0	29.6	31.2
Breeding species:	**2**	**5**	**5**	**4**	**5**	**4.2**

* - including 2 broods.

4.3. Nest success of birds

Nest success of waders was close to intermediate values in 2008 (Fig. 19). It was lower than in other years since 2000, but not at all as low as in typical seasons with heavy egg predation (1994, 1995, 1997, 1998). Hatching success of passerines and other than waders non-passerines was below average, but again more in the intermediate than low range of values. Thus, despite apparently low abundance of lemmings and record high abundance of Arctic Foxes, depredation of bird clutches turned out to be moderate. This could have depended to some extent to very low numbers of avian predators (2 pairs of Arctic Skuas in the whole study area, no Long-tailed Skuas), but low pressure by Arctic Foxes was still difficult to explain, as they are generally capable to destroy most nests in tundra at a lower occurrence rate than in 2008. It could be that a virtual absence on plots of breeding ducks, grouse and other non-passerines with relatively large eggs and clutches made these areas less interesting for foxes compared with other (unknown) habitats.

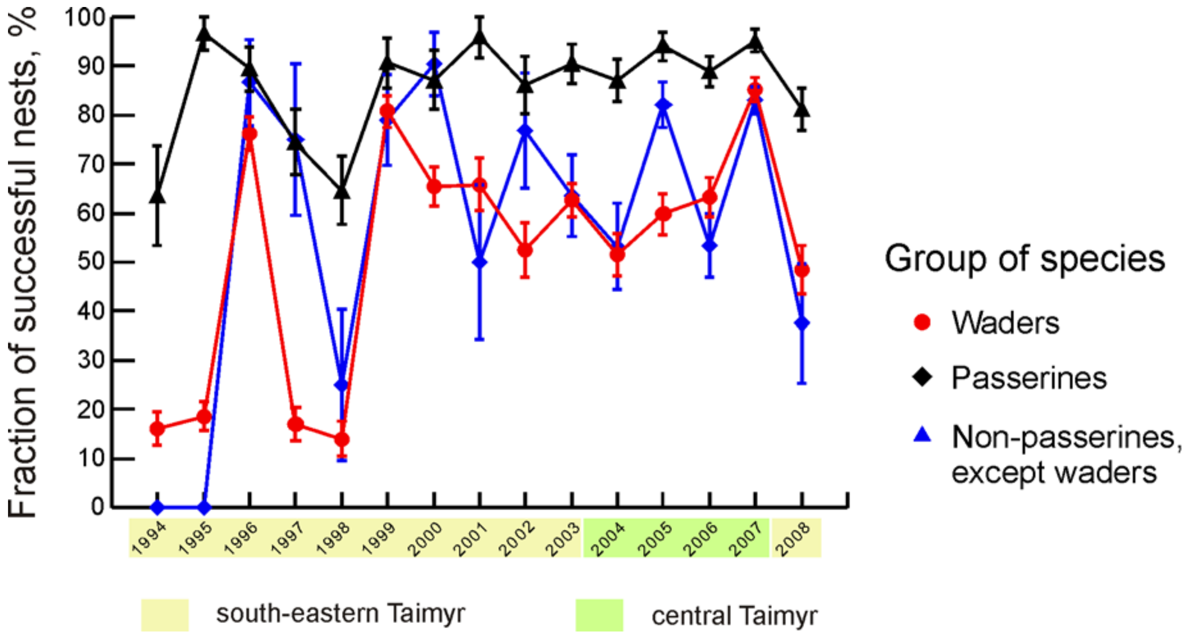

Figure 19. Nest success of principal bird groups in 1994–2008. Lines extend one standard error from the value in each direction.

In respect to nest success of individual species of birds noteworthy is the high variation between different species of waders in 2008 (Fig. 20), the highest for the study site on south-eastern Taimyr. Nest success ranged in 2008 from 18.2% in Little Stints to 66.7% in Grey Phalaropes, among common species of waders.

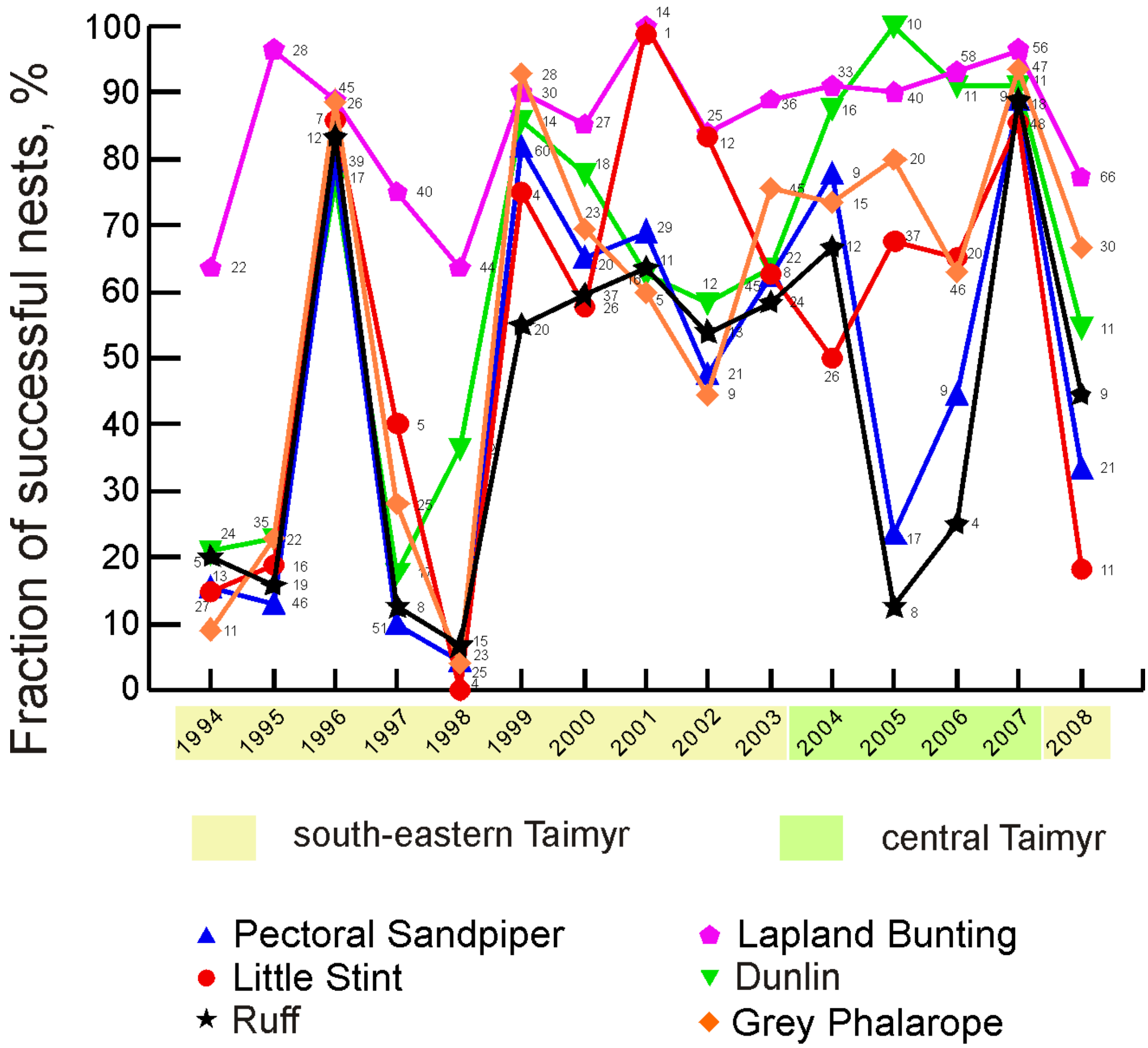

Figure 20. Nest success of common birds in 1994–2008. Numbers near symbols indicates sample sizes.

Nest success dynamics was highly correlated in 6 common species of birds, and principal components analysis on variables corresponding to nest success of 6 species revealed single important factor responsible for 75.8 % of the whole variation in a sample of the full time series of 15 years and 81.9% in a sample of 11 years on south-eastern Taimyr. Correlation structures were, however, somewhat different for the combined sample from two sites and for the sample from south-eastern Taimyr only (Fig. 21). On the south-eastern Taimyr the Lapland Bunting was separated from all species of waders, and among the latter nest success dynamics in the Little Stint had less in common with other species. Inclusion of the sample from central Taimyr resulted in a very high correlation of nest success between the Little Stint and Grey Phalarope (which was very high indeed P=0.0002 for Pearson correlation coefficient), an increase of correlation between the Lapland Bunting and Dunlin, and a decrease of correlation between the Ruff and Pectoral Sandpiper. These changes can be partly due to differences in spatial associations of species at two study sites. On south-eastern Taimyr Little Stints often nest on hillocks of flat-hillock bog, which are also preferred by Lapland Buntings, while on central Taimyr Little Stints occur in high numbers in the polygonal bog, which is preferred for nesting by Grey Phalaropes. A detailed analysis of the influence of habitat associations on nest success will be reported elsewhere.

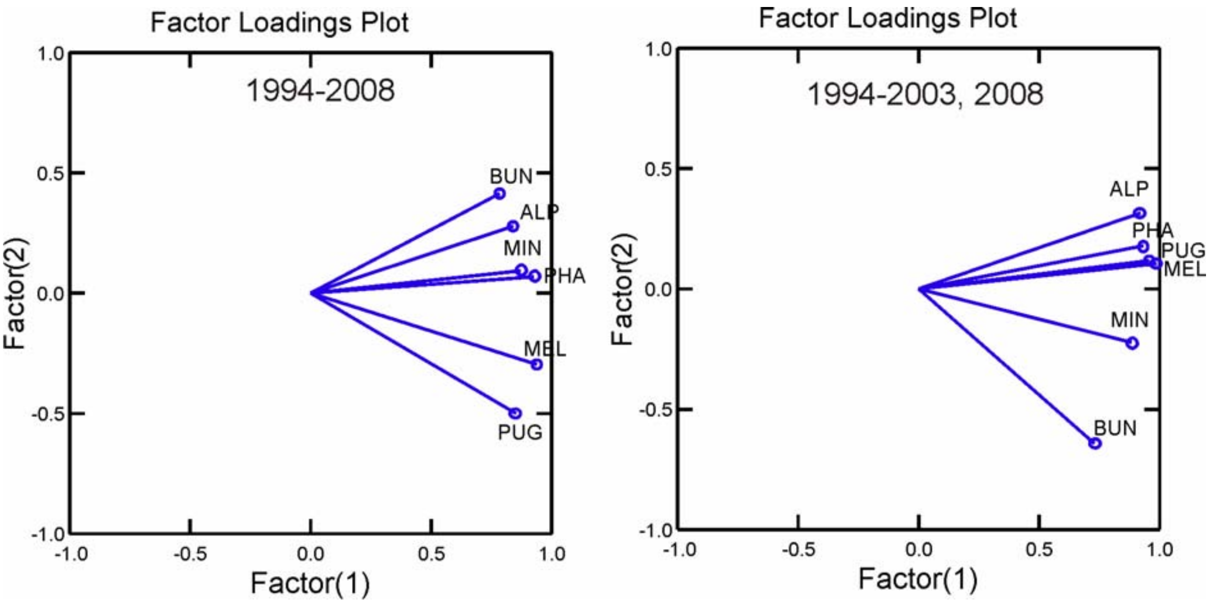

Figure 21. Ordination of nest success variables. Left graph: south-eastern and central Taimyr, right graph: south-eastern Taimyr. Species abbreviations: ALP= Dunlin; BUN=Lapland Bunting; MIN= Little Stints; MEL=Pectoral Sandpiper; PHA=Grey Phalarope; PUG=Ruff.

Apparent nest success of all species of birds in the period 1994-2008 is presented in Table 8.

Table 8
Apparent nest success of birds in 1994–2008, %±SE, sample size in brackets. Hatching success is given for passerines

Species	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Pluvialis fulva	6.2±6.1 (16)	4.2±4.1 (24)	69.4±7.7 (36)	16.7±15.2 (6)	33.3±19.2 (6)	100±0 (1)	57.1±18.7 (7)	50±17.7 (8)	16.7±15.2 (6)	54.5±15 (11)	5.3±5.1 (19)	58.3±14.2 (12)	57.1±13.2 (14)	66.7±13.6 (12)	40±21.9 (5)
Pluvialis squatarola	33.3±15.7 (9)	100±0 (5)	57.1±18.7 (7)	25±21.7 (4)	25±21.7 (4)	100±0 (2)	50±35.4 (2)	0±0 (1)	33.3±27.2 (3)	62.5±17.1 (8)	16.7±8.8 (18)	64.3±12.8 (14)	54.5±15 (11)	66.7±13.6 (12)	20±17.9 (5)
Charadrius hiaticula							100±0 (1)	100±0 (1)			100±0 (1)		100±0 (1)	100±0 (1)	
Limosa lapponica	0±0 (1)	0±0 (2)		0±0 (2)		50±35.4 (2)	100±0 (1)	100±0 (1)	0±0 (1)	0±0 (3)	50±35.4 (2)		100±0 (1)	100±0 (3)	
Tringa erythropus		100±0 (1)			0±0 (1)							0±0 (1)			0±0 (1)
Arenaria interpres											66.7±27.2 (3)				
Phalaropus lobatus			66.7±27.2 (3)	0±0 (1)			100±0 (1)	0±0 (1)		33.3±27.2 (3)	100±0 (1)	66.7±19.2 (6)	33.3±27.2 (3)	100±0 (1)	66.7±27.2 (3)
Phalaropus fulicarius	9.1±8.7 (11)	22.9±7.1 (35)	88.5±6.3 (26)	28±9 (25)	4±3.9 (25)	92.9±4.9 (28)	69.6±9.6 (23)	60±21.9 (5)	44.4±16.6 (9)	75.6±6.4 (45)	73.3±11.4 (15)	80±8.9 (20)	63±7.1 (46)	93.6±3.6 (47)	66.7±8.6 (30)
Gallinago gallinago						66.7±27.2 (3)	50±35.4 (2)								100±0 (1)

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Limnodromus scolopaceus	100±0 (1)	0±0 (3)		0±0 (1)		100±0 (2)	100±0 (1)	100±0 (1)							0±0 (1)
Calidris ruficollis									0±0 (1)	25±21.7 (4)			0±0 (1)		
Calidris minuta	14.8±6.8 (27)	18.8±9.8 (16)	85.7±13.2 (7)	40±21.9 (5)	0±0 (4)	75±21.7 (4)	57.7±9.7 (26)	100±0 (1)	83.3±10.8 (12)	62.5±17.1 (8)	50±9.8 (26)	67.6±7.7 (37)	65±10.7 (20)	85.4±5.1 (48)	18.2±11.6 (11)
Calidris temminckii	0±0 (1)	100±0 (1)	50±25 (4)	100±0 (1)		100±0 (2)	100±0 (1)	100±0 (1)	100±0 (2)	100±0 (5)	100±0 (2)	100±0 (3)	71.4±12.1 (14)	91.7±8 (12)	100±0 (3)
Calidris melanotos	15.4±10 (13)	13±5 (46)	79.5±6.5 (39)	9.8±4.2 (51)	4.3±4.3 (23)	81.7±5 (60)	65±10.7 (20)	69±8.6 (29)	47.6±10.9 (21)	62.2±7.2 (45)	77.8±13.9 (9)	23.5±10.3 (17)	44.4±16.6 (9)	88.9±7.4 (18)	33.3±10.3 (21)
Calidris acuminata							100±0 (1)	100±0 (2)		100±0 (3)					
Calidris alpina	20.8±8.3 (24)	22.7±8.9 (22)	76.5±10.3 (17)	17.6±9.2 (17)	36.4±10.3 (22)	85.7±9.4 (14)	77.8±9.8 (18)	62.5±12.1 (16)	58.3±14.2 (12)	63.6±10.3 (22)	87.5±8.3 (16)	100±0 (10)	90.9±8.7 (11)	90.9±8.7 (11)	54.5±15 (11)
Calidris ferruginea	0±0 (4)	0±0 (4)	0±0 (1)	0±0 (2)		100±0 (1)	100±0 (1)			40±21.9 (5)	50±14.4 (12)	43.8±12.4 (16)	77.8±13.9 (9)	66.7±12.2 (15)	
Limicola falcinellus						100±0 (1)		100±0 (1)		42.9±18.7 (7)					100±0 (2)
Philomachus pugnax	20±17.9 (5)	15.8±8.4 (19)	83.3±10.8 (12)	12.5±11.7 (8)	6.7±6.4 (15)	55±11.1 (20)	59.5±8.1 (37)	63.6±14.5 (11)	53.8±13.8 (13)	58.3±10.1 (24)	66.7±13.6 (12)	12.5±11.7 (8)	25±21.7 (4)	88.9±10.5 (9)	44.4±16.6 (9)
Anser fabalis												100±0 (1)	50±35.4 (2)	100±0 (1)	

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Anser albifrons											50±25 (4)	50±35.4 (2)	81.8±8.2 (22)	81.8±6.7 (33)	
Rufibrenta ruficollis											66.7±19.2 (6)	60±21.9 (5)	100±0 (5)	100±0 (6)	
Anas acuta			0±0 (1)			0±0 (1)	50±35.4 (2)								
Somateria spectabilis	0±0 (1)		100±0 (1)							25±21.7 (4)		50±25 (4)	12.5±11.7 (8)	83.3±7.6 (24)	0±0 (1)
Polysticta stelleri			0±0 (1)											33.3±15.7 (9)	
Clangula hyemalis	0±0 (1)		100±0 (2)		0±0 (2)	50±35.4 (2)	100±0 (2)	0±0 (1)		100±0 (1)	100±0 (1)	0±0 (3)	16.7±15.2 (6)	50±20.4 (6)	0±0 (1)
Melanitta nigra										100±0 (1)					
Melanitta fusca		0±0 (1)							100±0 (1)	50±35.4 (2)					
Gavia stellata							100±0 (1)	100±0 (1)		100±0 (1)	100±0 (1)	100±0 (3)	0±0 (3)	100±0 (12)	
Gavia arctica						100±0 (1)	100±0 (1)	100±0 (1)	100±0 (1)	100±0 (3)	0±0 (2)	100±0 (2)	0±0 (1)	100±0 (4)	66.7±27.2 (3)
Gavia adamsii														100±0 (1)	

Species	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Buteo lagopus				100±0 (1)							87.5±11.7 (8)	100±0 (9)		85.7±13.2 (7)	
Falco peregrinus												100±0 (1)	100±0 (1)	100±0 (1)	50±35.4 (2)
Lagopus lagopus	0±0 (2)	0±0 (1)	100±0 (3)	50±35.4 (2)	0±0 (2)		100±0 (3)		100±0 (5)	75±15.3 (8)				100±0 (1)	
Lagopus mutus												100±0 (1)		33.3±27.2 (3)	
Stercorarius pomarinus							100±0 (2)					93.3±6.4 (15)		88.2±5.5 (34)	
Stercorarius parasiticus							100±0 (1)		0±0 (1)				100±0 (1)	100±0 (2)	100±0 (1)
Stercorarius longicaudus	0±0 (1)	0±0 (1)	100±0 (2)	0±0 (1)		100±0 (6)	100±0 (2)	50±35.4 (2)	0±0 (1)	0±0 (1)	33.3±27.2 (3)	100±0 (7)	0±0 (3)	50±17.7 (8)	
Larus argentatus				100±0 (2)		100±0 (1)								100±0 (4)	
Larus hyperboreus										100±0 (1)	100±0 (1)	100±0 (1)		100±0 (5)	
Rhodostethia rosea						75±21.7 (4)	100±0 (1)	0±0 (2)		33.3±19.2 (6)	0±0 (1)			0±0 (1)	33.3±27.2 (3)
Xema sabini											0±0 (3)	40±21.9 (5)	100±0 (1)	90±9.5 (10)	

Species	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Sterna paradisea	0±0 (1)	0±0 (1)	100±0 (5)	100±0 (2)	50±25 (4)	100±0 (3)	83.3±15.2 (6)	66.7±27.2 (3)	75±21.7 (4)	80±17.9 (5)	0±0 (2)	100±0 (4)	40±21.9 (5)	100±0 (10)	20±17.9 (5)
Nyctea scandiaca												100±0 (4)		100±0 (6)	
Asio flammeus						0±0 (1)									
Alauda arvensis								100±0 (1)							
Eremophila alpestris		100±0 (1)	100±0 (1)	50±35.4 (2)	66.7±27.2 (3)	100±0 (1)	100±0 (3)	75±21.7 (4)	66.7±27.2 (3)	100±0 (3)	75±21.7 (4)	100±0 (5)	54.5±15 (11)	100±0 (5)	100±0 (2)
Motacilla alba											100±0 (2)	100±0 (2)	100±0 (1)	100±0 (2)	100±0 (1)
Anthus cervinus				100±0 (1)		100±0 (1)		100±0 (1)	100±0 (1)	100±0 (2)	100±0 (4)	100±0 (3)	88.9±10.5 (9)	100±0 (3)	
Anthus rubescens											0±0 (1)				
Luscinia svecica							100±0 (1)			50±35.4 (2)	100±0 (1)	100±0 (8)	92.9±6.9 (14)	85.7±13.2 (7)	100±0 (1)
Oenanthe oenanthe											100±0 (3)	100±0 (2)	100±0 (4)	100±0 (3)	
Turdus iliacus											100±0 (1)				
Phylloscopus trochilus													100±0 (1)		

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Emberiza pusilla										100±0 (3)	100±0 (2)	100±0 (3)	100±0 (5)	100±0 (1)	
Emberiza pallasi										100±0 (1)					66.7±27.2 (3)
Calcarius lapponicus	63.6±10.3 (22)	96.4±3.5 (28)	88.9±4.7 (45)	75±6.8 (40)	63.6±7.3 (44)	90±5.5 (30)	85.2±6.8 (27)	100±0 (14)	84±7.3 (25)	88.9±5.2 (36)	90.9±5 (33)	90±4.7 (40)	93.1±3.3 (58)	96.4±2.5 (56)	77.3±5.2 (66)
Plectrophenax nivalis														100±0 (1)	100±0 (1)
Acanthis hornemanni			100±0 (1)		100±0 (1)			100±0 (4)	100±0 (7)	100±0 (6)	72.7±13.4 (11)	100±0 (4)	75±21.7 (4)	75±21.7 (4)	100±0 (7)

6. Ringing activities in 2008 and related observations

We ringed 145 birds of 15 species in 2008 (Table 9), which was the lowest number on record, and was explained by the smallest for the Wader monitoring project field team of 2 researchers, having had higher priority of determining nest density and evaluating nest success.

Table 9
Ringing results in 2008

Species	Adult birds	Chicks
Pluvialis fulva	4	6
Charadrius hiaticula	0	1
Phalaropus fulicarius	0	40
Phalaropus lobatus	0	7
Calidris alpina	0	14
Calidris melanotos	3	10
Calidris minuta	0	6
Calidris temminckii	0	13
Acanthis flammea	0	14
Anthus rubescens	0	1
Luscinia svecica	0	2
Motacilla alba	0	4
Emberiza pallasi	0	10
Calcarius lapponicus	0	9
Plectrophenax nivalis	0	1
Total:	**7**	**138**

New long-distant recovery of a bird, previously ringed in cause of the Wader monitoring project, was reported in 2008 by R. Klaassen and R. Bom, conducting wader studies at Barr al Hikman in Oman. On 29 December 2008 they observed Dunlin at 20°40’41’’N, 58°37’59’’E with a combination of colour flags and metal ring, matching combination used to band an adult female at a nest with chicks on 16 July 2004 at the central Taimyr at 74°08’47’’N, 99°33’28’’E.

This was an interesting observation, because Taimyr Dunlins were previously reported from stop-over sites on migration, but never from their final wintering grounds.

7. Principal results of studies in 2008

Breeding conditions

1. At the study site on south-eastern Taimyr May was considerably warmer than average in 2008, June slightly warmer, but with cold spell in the beginning of the month, and July considerably colder than usual. Precipitation occurred more often than average during the study period from 20 June to 24 July. Cold and windy weather in late June – early July with snowstorm on 30 June resulted in delayed phenology of insects, particularly the appearance of imago craneflies (Tipulidae). Flood was very low, and floodplain habitats were not flooded.

2. Lemming abundance was low, and only 3 animals were observed in July.

3. Arctic Foxes did not breed in the study area in 2008, but their relative abundance was the highest on record since the start of observations in 1994. Rough-legged Buzzards, Merlins, Gyrfalcons, Pomarine Skuas and Long-tailed Skuas were rare non-breeders in the area. Owls were not recorded, while Arctic Skuas and Herring Gulls bred at a typical for the area low density.

Phenology, numbers and nest success of birds

4. Breeding phenology was close to the long-term average in Dunlins, Pectoral Sandpipers and Lapland Buntings, but considerably delayed in Grey Phalaropes.

5. Breeding density of waders was considerably below average in 2008 at the river terrace, the lowest on record at the watershed and the second highest on record in the floodplain, which was not flooded in spring. Lapland Buntings were numerous breeders in all habitats. Significant trends in numbers of birds for the period 1994-2008 were not found.

6. Nest success of waders was close to intermediate values in 2008 (48.5%), but varied considerably among species. Hatching success of passerines and other than waders non-passerines was below average. Thus, despite low abundance of lemmings and high abundance of Arctic Foxes, depredation of bird clutches was moderate.

Other results

7. Breeding record of Raven made in the lower Khatanga River area in 2008 was the northern-most (72°55' N) for this species in Eurasia.

8. A recovery in Oman in December 2008 of Dunlin ringed on the nest at the central Taimyr in 2004 was the first one directly linking breeding and wintering grounds of the supspecies *centralis*.

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