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Birds and Mammals of the Lena Delta Nature Reserve, Siberia

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ABSTRACT. The Lena Delta is the largest arctic delta covered entirely by tundra. Protected since 1986, it is one of the richest areas in the Arctic north of 71° N for both species diversity and breeding densities. Between 6 June and 17 August 1997, 16 mammal species and 76 bird species were recorded in the Lena Delta Nature Reserve and the surrounding buffer zone. Several species are new to the region: far-eastern curlew, fieldfare, redwing, arctic warbler, red-breasted flycatcher, and common rat. New breeders are merlin and arctic warbler. These 1997 records, combined with those from earlier studies, give a total of 122 bird species for the region. Of these, 67 have been found breeding at least once. Densities ranging from 245 to 641 birds per km^2 were recorded in two restricted study areas. Such densities are unusually high north of 70° N for non-colonial breeding birds. Lapland longspur (100–300 individuals/km^2), red phalarope (up to 200 ind./km^2), and several *Calidris* species were the most common. Ruddy turnstone and dunlin had densities higher than those previously reported from the Lena Delta and other Siberian sites. Among the shorebirds, spotted redshank, pintail snipe, grey plover, dunlin, and curlew sandpiper may have extended their breeding range or increased in population during the last 15 years. But further evidence is still needed to confirm the westward extension of spectacled eider, long-billed dowitcher, and sharp-tailed sandpiper.

Key words: birds, densities, distribution, Lena Delta, mammals, predation, Siberia

RÉSUMÉ. Le delta de la Lena est le plus grand delta arctique totalement recouvert de toundra. Protégé depuis 1986, il est l'une des zones les plus riches de l'Arctique au nord du 71º de latitude N., tant par la richesse spécifique que par les densités d'oiseaux nicheurs. Seize espèces de mammifères et 76 espèces d'oiseaux ont été observées dans la Réserve naturelle du delta de la Lena et sa zone périphérique entre le 6 juin et le 17 août 1997. Plusieurs espèces sont nouvelles pour la région: courlis de Sibérie, grive litorne, grive mauvis, pouillot boréal, gobemouche nain et rat surmulot. Les nouvelles espèces nicheuses sont le faucon émerillon et le pouillot boréal. Combinés à ceux d'études plus anciennes, nos résultats portent à 122 le nombre total d'espèces d'oiseaux recensés dans cette région et à 67 celui des espèces s'y étant reproduit au moins une fois. Des densités comprises entre 245 et 641 individus au km^2 ont été trouvées sur deux zones d'étude restreintes, densités exceptionnelles au nord du 70º de latitude N. pour des espèces non coloniales. Les espèces les mieux représentées sont le bruant lapon (100-300 ind./km^2), le phalarope à bec large (jusqu'à 200 ind./km^2) et plusieurs espèces de *Calidris*.

Le tournepierre à collier et le bécasseau variable avaient des densités plus fortes que celles précédemment rapportées pour le delta de la Lena et d'autres sites sibériens. Le chevalier arlequin, la bécassine à queue pointue, le pluvier argenté, le bécasseau variable et le bécasseau cocorli font partie des limicoles qui semblent avoir étendu leur aire de distribution ou augmenté leur population durant les 15 dernières années, mais d'autres travaux seront nécessaires avant de confirmer l'extension occidentale de l'eider à lunettes, du limnodrome à long bec et du bécasseau à queue pointue.

Mots clés : delta de la Lena, Sibérie, oiseaux, mammifères, répartition, densités, prédation

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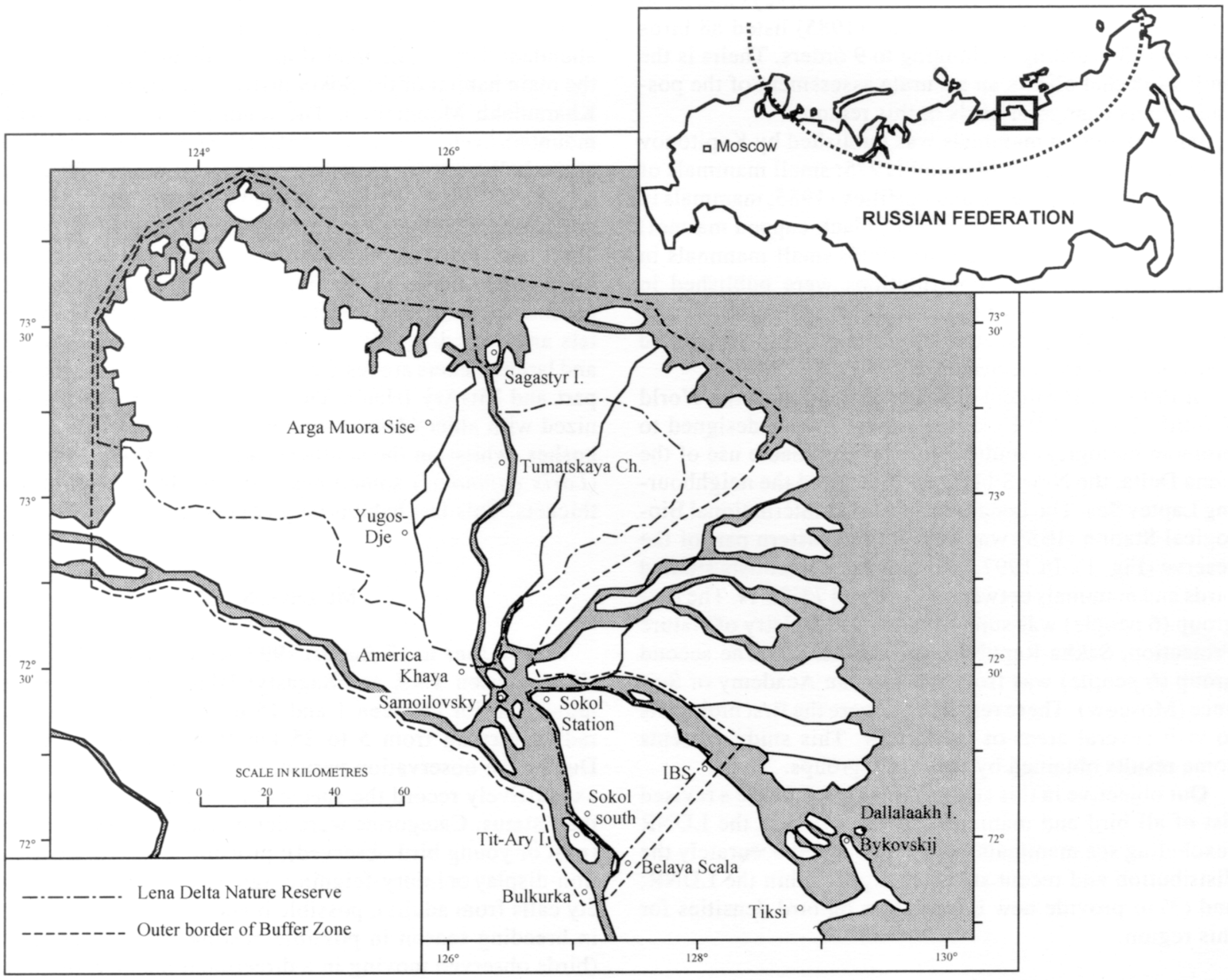

FIG. 1. Map of the Lena Delta region with boundaries of the Nature Reserve (excluding the New Siberian Islands) and sites listed in Table 1.

INTRODUCTION

The Lena Delta Nature Reserve (LDNR), as established in 1986, covered an area of 14 330 km^2. After its extension in 1996 to the New Siberian Islands and adjacent territories (59 320 km^2), the LDNR is now the largest protected area in Russia (73 650 km^2) and the fourth largest in the Arctic (CAFF, 1994; Prokosch, 1997).

But despite the delta's geographical and ecological importance, only a few scientists have carried out detailed studies on its birds and mammals. In his first detailed study on birds, Gladkov (1958) mentioned several rare species and noticed differences in species composition between areas, but he covered only the Tiksi Bay region. A few years later, Kapitonov (1962) described Tiksi Bay and the southern part of the Lena Delta. He was the first to find breeding curlew sandpiper in Tiksi Bay and he also provided interesting historical data on local hunting activity. Most other published studies date from the last 15 years. Artyukhov (1986), in a short note, completed the description of the southern part. Blokhin did important work in the central delta: most of his results were published by Laboutin et al. (1985), but rare birds, conservation, and northern breeding limits were also presented separately in smaller papers (Blokhin, 1986, 1990, 1991). More recently, Solovieva (1992) reported several new passerine species, while Pozdnyakov et al. (1996) updated the information on shorebirds. Only one of these studies (Laboutin et al., 1985) presented all the taxonomic orders and data from the whole area. For these reasons, Ilicev and Flint (1985) identified the deltas of the Olenok and Lena Rivers as one of the least documented regions (with respect to birds) of the former Soviet Union. It is difficult to understand some of the results in previous studies, as the methods used were rarely described. By joining historical information to the original data that they collected from 1981 to 1983 (by

100 km of foot surveys, 900 km of boat surveys and 3300 km of air surveys), Laboutin et al. (1985) listed 88 birds species (53 breeding) belonging to 9 orders. Theirs is the only work that allows an accurate assessment of the possible status change of birds in this region.

Information on mammals was published by Kapitonov (1961; northern pika), Mejenni (1975; small mammals of northern Yakutia), Revin and Perfiliev (1985; mammals in the LDNR), Vasiliev et al. (1996; black-capped marmot) and Volpert and Sapozhnikov (1996; small mammals in the LDNR). All these contributions were published in Russian, and all but two (Laboutin et al., 1985; Revin and Perfiliev, 1985) presented information from restricted areas or for a few species only.

In 1993, the President of Sakha Republic and the World Wildlife Fund (WWF) signed an agreement designed to promote biological studies and the sustainable use of the Lena Delta, the New Siberian Islands, and the neighbouring Laptev Sea. The Lena-Nordenskjold International Biological Station (IBS) was built on the eastern part of the reserve (Fig. 1). In 1997, two groups of scientists studied birds and mammals between 71°39′ and 73°25′ N. The first group (6 people) was supported by the Ministry of Nature Protection, Sakha Republic, and the LDNR. The second group (6 people) was from the Russian Academy of Science (Moscow). These researchers were the first biologists to visit several areas of the LDNR. This study presents some results obtained by these two groups.

Our objective in this study were (1) to provide a revised list of all bird and mammal species living in the LDNR (excluding sea mammals); (2) to document accurately the distribution and recent status changes within the LDNR; and (3) to provide new information on bird densities for this region.

STUDY AREA

The Lena is the second largest Siberian river after the Yenisei. It flows to the Laptev Sea through an extensive delta (ca. 30 000 km^2). The average annual water flow is 16 300 m^3/sec, and 15 million tons of sediment are transported annually (Solomonov, 1995). The Lena Delta, the largest in the Arctic covered by tundra, is crossed by a dense network of 6500 channels and has about 30 000 lakes. The maximum height of the land is only 75 m in the oldest sediment deposits in the west, 50 m in the east, and 23 m in the northeast. Most of the delta is covered by wet polygonal tundra and is flooded in spring. The original LDNR (excluding the New Siberian Islands; Fig. 1) is divided into two districts: the delta itself (13 000 km^2) and the northernmost continental part of the Kharaulakh mountains, called Sokol (1330 km^2). The New Siberian Islands are not included in this paper, and our use of "LDNR" refers only to these two districts.

Four major habitats are found in the LDNR (Table 1; Fig. 2). Wet polygonal tundra covers the delta district of the LDNR north of 72°20′ N, with sedge (*Carex* sp.) and cottongrass (*Eriophorum* sp.) communities being the most abundant. Dry continental slopes rising up to 450 m form the main habitat of the Sokol district (northern part of the Kharaulakh Mountains). The tundra is drier here, with mountain avens (*Dryas octopetala*) communities and white arctic bell-heather (*Cassiope tetragona*) heaths. The wet continental slopes are restricted to the lower parts and the northeastern shores of the Sokol district, mainly between Tiksi and Sokol Station. The vegetation and wildlife of these gentle slopes, covered mostly by hummocky tundra, are intermediate between those of the two previous habitats and very diversified. Finally, scattered alder bushes and larch thickets are restricted to the southern continental part and Tit-Ary Island. The sheltered valleys are colonized with alder (*Alnus fruticosa*) and willow (*Salix* sp.) bushes, whilst on the southern and driest slopes, larches (*Larix cajanderi*) sometimes form small, discontinuous thickets. This last habitat only covers small surfaces.

METHODS

From 6 June to 17 August 1997, we visited 14 different sites between Tiksi and Sagastyr Island. The sites were monitored for between 1 and 15 days (see Table 1) in a radius varying from 5 to 25 km from the base camps. During the observation period, every effort was made to exhaustively record the species present and to determine their status. Categories were defined as follows: breeder (nest or young bird observed); probable breeder (distraction-display or injury-feigning, agitated behaviour or anxiety calls from adults); possible breeder (species observed in breeding season in possible nesting habitat); migrant (birds observed moving in a directional manner, often in flocks, during spring or late summer); and transient (irregular visitor outside its known or suspected breeding area). All but one of these categories were adapted from Pearce et al. (1998). We have added a fifth category: probable breeders. This distinction was necessary during rope transects (see below) when most of the breeding birds were flushed and then seen feinting, but when no time was available to search for nests or young. When referring to the literature (especially in Table 2), we also made the distinction between breeders (regularly recorded by several authors) and occasional or rare breeders (only one or two cases of breeding confirmed in the past). Except for redpolls, bird names and classification follow Howard and Moore (1991).

Bird Densities

At two sites (on wet continental slopes at IBS and on wet polygonal tundra at Yugos-Dje), we measured the bird density using rope transects from 7 to 21 July. Rope transects could not be continued after 10 July for the Lapland bunting, and after 21 July for most of the other

TABLE 1. Sites visited in 1997.

Location	Coordinates	Period	Habitat Type	Personnel[1]
Tiksi[2]	71°39′ N, 128°50′ E	28 June–3 July	Dry and wet continental slopes	BS, DT, OG, RS
		6–9 June/18–21 July		CZ, GH, EL, ES, MS, TT
IBS[3,4]	72°12′ N, 128°03′ E	4–10 July	Wet continental slopes	BS, DT, OG, RS, VP
Sokol Station[3]	72°24′ N, 126°50′ E	3–11 July	Dry continental slopes	BS, CZ, DT, MS, OG, RS, TT, VP
Samoilovsky Island[4]	72°22′ N, 126°28′ E	11 July / 6–7 August	Wet polygonal tundra	BS, DT, OG, RS, VP
Bykovskij[2]	72°00′ N, 129°06′ E	12 July	Wet polygonal tundra	CZ, EL, MS, TT
Yugos-Dje[3]	72°50′ N, 125°49′ E	12–27 July	Wet polygonal tundra	BS, DT, OG, RS
Dallalaakh Island[2]	72°01′ N, 129°20′ E	14–17 July	Wet polygonal tundra	CZ, EL, MS, TT
Arga Muora Sise[3]	73°12′ N, 126°12′ E	27–29 July	Wet polygonal tundra	BS, OG, RS
Sagastyr Island[4]	73°25′ N, 126°38′ E	27 June–21 July	Wet polygonal tundra	DS, GH
		30 July–4 August		BS, DS, OG, RS
Tumatskaya Channel[3]	73°06′ N, 126°45′ E	4–6 August	Wet polygonal tundra	BS, OG, RS
Tit-Ary Island[4]	71°59′ N, 127°05′ E	7–8/12–17 August	Wet polygonal tundra/ Scattered alder bushes and larch thickets	BS, DS, OG, RS
Belaya Skala[3,4]	71°55′ N, 127°19′ E	9–11 August	Dry continental slopes/ Scattered alder bushes and larch thickets	BS, OG, RS
Bulkurka[4]	71°50′ N, 127°08′ E	15 August	Lena River shore	BS, OG, RS
Sokol south[3]	72°01′ N, 127°08′ E	16 August	Dry continental slopes/ Scattered alder bushes and larch thickets	BS, DS, OG, RS

[1] BS = Brigitte Sabard, CZ = Christoph Zöckler, DS = Diana Solovieva, DT = Dimitri Tsanos, EL = Elena Lappo, ES = Evgeny Syroechkovsky, GE = Goetz Eichhorn, MS = Markus Stensmyr, OG = Olivier Gilg, RS = Raphaël Sané, TT = Tony Tree, VP = Vladimir Pozdnyakov.

[2] not included in the LDNR.

[3] included in the LDNR.

[4] included in the LDNR buffer zone.

birds, because eggs had hatched and territories had began to break up. This method had previously been used in tundra regions (i.e., on Taimyr) and is particularly well suited for small waders and passerines. It gives more accurate results than territory mapping, which considerably underestimates densities when performed on large and rich areas or during short periods (Hötker, 1995). A rope 50 m long was extended between two people, who walked along in a straight line for 2 to 10 km (covering 10 to 50 ha). Transect lengths were calculated using a Global Positioning System. Two other people, walking a few metres behind, recorded all the birds flushed out by the rope and tried to determine their reproductive status. Alarmed and feinting birds were considered as probable breeders, while birds leaving the transects without any distinguishing behaviour were counted only as individuals. Birds crossing the transects in flight were not counted. Results are presented for individuals and probable breeding pairs per km^2 (minimum).

Recording of Small Mammals

The distribution and relative abundance of mammals was determined both by direct observation of animals, tracks and other signs and (for small mammals) by raptor pellet analysis. At each site, we visited as many potential raptor perches and breeding sites as possible to collect pellets. More than 2300 rodents were identified from ca. 1000 pellets by dental characteristics (Heptner et al., 1966; Banfield, 1974; Gromov and Polyakov, 1992). The pellets were either from snowy owl nests used in 1996 (814 pellets from eight localities) or from rough-legged buzzard nests used in 1996 and 1997 (188 pellets from three localities). Only on Samoilovsky Island was the pellet set a mixture of skua, raptor, and gull pellets. The geographical distribution of each species of prey can be considered reliable, since pellets are generally produced within 24 hours after consumption of the prey (Portenko, 1972) and were collected either on breeding sites or on regular perches. The relative abundance of small mammals is more difficult to assess because prey accessibility and predator preferences are not homogenous. Therefore, we present the results only in terms of the percentage of each species found in pellets (100 × number of individuals from the species/total number of rodents) and not as a density index of species.

RESULTS

Seventy-six bird species and 16 mammals were recorded in the LDNR and its surrounding buffer zone (Fig. 1) between 6 June and 17 August 1997.

Five bird species were found for the first time. Two far-eastern curlews (*Numenius madagascariensis*) were found in wet polygonal tundra near Bykovskij on 12 July. This species breeds in the middle Lena, close to the Viljuy River mouth, and in the upper Yana River (V. Pozdnyakov, unpubl. data). A group of seven fieldfares (*Turdus pilaris*) were recorded on 10 August at Belaya Skala. The previous northern limit in the Lena region was 68–69° N (Artyukhov, 1986; V. Pozdnyakov, unpubl. data). Redwings (*Turdus iliacus*) were seen daily on Tit-Ary Island between 10 and

FIG. 2. Major habitat types of the LDNR: a) Wet polygonal tundra on Yugos-Dje, during rope transect; b) Dry continental slopes in the Sokol district; c) Wet continental slopes and IBS buildings; d) Scattered alder and larch thickets on Tit-Ary Island in the southern part of the LDNR, with Kharaulakh Mountains in the background. (Photos: O. Gilg and B. Sabard)

14 August, often in mixed groups with dusky thrush (*T. naumanni eunomus*). One bird was ringed and measured on 14 August. The redwing resembles the dusky thrush and, as we saw more than 10 on Tit-Ary Island and one at Sokol south on 16 July, we think the presence of redwings could previously have been overlooked. Most of the birds were first-year birds. Their previous northern limit in the Lena region was 70.5° N (Artyukhov, 1986; V. Pozdnyakov, unpubl. data). Two adult arctic warblers (*Phylloscopus borealis*) and one pair with young were found at Belaya Skala on 9 August. The adults were still feeding the young. Another *Phylloscopus* bearing a wing stripe, seen on Tit-Ary Island on 13 August, could have belonged to this species. Finally, one dead red-breasted flycatcher (*Ficedula parva*) was found on 16 August north of Belaya Skala. Identification was confirmed by J.-L. Wilhelm (pers. comm. 1998) on the basis of feathers, skull, and tarsus length.

Laboutin et al. (1985) already listed 88 species in their study, but this study and other recent works (Solovieva, 1992; D. Solovieva and V. Pozdnyakov**,** unpubl. data) bring the total number of bird species recorded in the LDNR to 122 (Table 2). Evidence or behavioural signs of breeding were found for 58 of the 76 species recorded in 1997. If we add the historical information, the number of species that have been found breeding in the region is now 67. Two of these, merlin (*Falco columbarius*) and arctic warbler, had never been found breeding before. Curlew sandpiper (*Calidris ferruginea*) was found to be breeding on the continental part of the reserve for the first time.

Sixteen mammal species were also recorded in the LDNR in 1997. The common rat (*Rattus norvegicus*) was reported for the first time for the region. The location and nature of the contact are given in Table 3. Muskoxen (*Ovibos moschatus*), which are being introduced through an ongoing program, were also encountered at IBS.

We noticed important differences in the distribution and the status of some breeding birds and mammals within the Lena Delta, both spatial differences when comparing sites and temporal differences when comparing our results with the review of Laboutin et al. (1985). These differences can be summarized for each taxonomical orders as follows.

TABLE 2. Birds of the Lena Delta Nature Reserve.

Species		Continental part 1997					Delta part 1997						
	Historical status[1,2]	Tiksi	Belaya Skala	Tit-Ary Island	IBS	Sokol Station	Bykovskij	Dallalaakh Island	Samoilovsky Island	Yugos-Dje	Tumatskaya Channel	Arga-Muora Sise	Sagastyr Island
Red-throated Diver, *Gavia stellata*	B	-	B	B	B	-	B	B	(b)	b	-	b	B
Pacific Diver, *Gavia pacifica*	(b)	-	-	-	-	-	-	-	-	-	-	-	-
Black-throated Diver, *Gavia arctica*	B	-	B	B	-	-	B	B	B	b	b	B	B
White-billed Diver, *Gavia adamsii*	+	-	-	-	-	-	-	-	-	-	-	-	-
Red-necked Grebe, *Podiceps grisegena*	+	-	-	-	-	-	-	-	-	-	-	-	-
Grey Heron, *Ardea cinerea*	+	-	-	-	-	-	-	-	-	-	-	-	-
Bewick's (Tundra) Swan, *Cygnus colombianus bewickii*	B	-	-	-	-	-	-	B	-	B	b	b	-
Whooper Swan, *Cygnus cygnus*	B*	-	-	-	-	-	-	-	-	-	-	-	-
Bean Goose, *Anser fabalis*	B	-	-	-	-	-	-	-	-	B	-	-	-
Lesser White-fronted Goose, *Anser erythropus*	B*	-	-	-	-	-	-	-	-	-	-	-	-
White-fronted Goose, *Anser albifrons*	B	-	-	-	-	-	-	-	-	B	b	-	B
Snow Goose, *Chen caerulescens*	+	-	-	-	-	-	-	-	-	-	-	-	-
Brent Goose, *Branta bernicla*	B	-	-	-	-	-	B	B	-	-	-	-	B
Red-breasted Goose, *Branta ruficollis*	+	-	-	-	-	-	-	-	-	-	-	-	-
Green-winged Teal, *Anas crecca*	B*/M[3]	M	-	M	-	-	M	-	-	-	-	-	-
Baikal Teal, *Anas formosa*	+	-	-	-	-	-	-	-	-	-	-	-	-
Northern Pintail, *Anas acuta*	B*/M	-	-	M	-	-	-	-	-	-	-	-	M
Northern Shoveler, *Anas clypeata*	+	-	-	-	-	-	-	-	-	-	-	-	-
Eurasian Wigeon, *Anas penelope*	+	-	-	-	-	-	-	-	-	-	-	-	-
Greater Scaup, *Aythya marila*	+	-	-	-	-	-	-	-	-	-	-	-	-
Tufted Duck, *Aythya fuligula*	+	-	-	-	-	-	-	-	-	-	-	-	-
Common Eider, *Somateria mollissima*	+	-	-	-	-	-	-	-	-	-	-	-	-
King Eider, *Somateria spectabilis*	B	-	-	-	B	-	B	B	(b)	(b)	B	(b)	B
Spectacled Eider, *Somateria fischeri*	(b)	-	-	-	-	-	(b)	(b)	-	-	-	-	-
Steller's Eider, *Polysticta stelleri*	B	-	-	-	-	-	(b)	b	-	(b)	-	-	B
Long-tailed Duck, *Clangula hyemalis*	B	(b)	B	B	b	(b)	-	b	B	b	b	-	b
Black Scoter, *Melanitta nigra*	B*	-	-	-	-	-	-	-	-	-	-	-	-
Velvet Scoter, *Melanitta fusca deglandi*	+	-	-	-	+	-	-	-	-	-	-	-	+
American Scoter, *Melanitta nigra americana*	+	-	-	-	-	-	-	-	-	-	-	-	-
Red-breasted Merganser, *Mergus serrator*	B*	-	-	-	(b)	-	-	-	-	-	-	-	-
Smew, *Mergus albellus*	+	-	-	-	-	-	-	-	-	-	-	-	-
White-tailed Sea Eagle, *Haliaeetus albicilla*	+	-	-	-	-	-	-	-	-	-	-	-	-
Northern (Hen) Harrier, *Circus cyaneus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Rough-legged Buzzard, *Buteo lagopus*	B	-	B	B	-	B	(b)	-	-	B	-	(b)	-
Golden Eagle, *Aquila chrysaetos*	B*/+	-	-	-	+	-	-	-	-	-	-	-	-
Merlin, *Falco columbarius*	+	-	B	-	-	-	-	+	-	-	-	-	-
Common Kestrel, *Falco tinnunculus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Gyrfalcon, *Falco rusticolus*	B*	-	-	-	-	-	-	-	-	-	-	-	-
Peregrine Falcon, *Falco peregrinus*	B	-	B	(b)	(b)	B	-	-	-	-	-	-	-
Willow Grouse, *Lagopus lagopus*	B	-	-	B	B	-	b	b	-	B	-	-	B
Rock Ptarmigan, *Lagopus mutus*	B	-	-	-	b	-	-	-	-	b	b	b	-
Moorhen, *Gallinula chloropus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Common Crane, *Grus grus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Siberian White Crane, *Grus leucogeranus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Pacific Golden Plover, *Pluvialis fulva*	B/+	b	-	-	B	b	-	-	-	+	-	-	+
Grey Plover, *Pluvialis squatarola*	B	b	-	(b)	B	-	b	B	-	B	b	B	B
Dotterel, *Charadrius morinellus*	B/+	-	-	b	-	B	-	-	-	-	-	-	-
Ringed Plover, *Charadrius hiaticula*	B	b	-	b	b	-	B	-	b	B	-	-	-
Whimbrel, *Numenius phaeopus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Far-eastern Curlew, *Numenius madagascariensis*	-	-	-	-	-	-	+	-	-	-	,	-	-
Spotted Redshank, *Tringa erythropus*	B*	b	-	-	-	-	-	-	-	-	-	-	(b)
Wood Sandpiper, *Tringa glareola*	B*/+	(b)	-	-	-	-	-	-	-	-	-	-	-
Bar-tailed Godwit, *Limosa lapponica*	B*	-	-	-	-	-	-	-	-	-	-	-	-
Gray-tailed Tattler, *Heteroscelus brevipes*	+	-	-	-	-	-	-	-	-	-	-	-	-
Ruddy Turnstone, *Arenaria interpres*	B	-	-	-	B	-	b	B	-	B	(b)	B	B
Red-necked Phalarope, *Phalaropus lobatus*	B	-	-	B	b	-	-	b	-	-	-	-	-
Grey (Red) Phalarope, *Phalaropus fulicarius*	B	-	-	-	B	-	B	B	B	B	B	B	B
Jack Snipe, *Lymnocryptes minimus*	(b)	-	-	-	-	-	-	-	-	-	-	-	-
Pintail Snipe, *Gallinago stenura*	(b)/-	b	-	(b)	-	-	-	-	-	b	-	-	-
Common Snipe, *Gallinago gallinago*	B	b	-	(b)	-	(b)	-	-	b	b	-	-	-
Long-billed Dowitcher, *Limnodromus scolopaceus*	B*	-	-	-	-	-	-	(b)	-	b	-	-	-
Knot, *Calidris canutus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Great Knot, *Calidris tenuirostris*	+	-	-	-	-	-	-	-	-	-	-	-	-
Sanderling, *Calidris alba*	M/(b)	-	-	-	-	-	(b)	-	-	-	-	-	-
Rufous-necked Stint, *Calidris ruficollis*	B/+	B	-	-	B	B	-	-	-	-	-	-	-
Little Stint, *Calidris minuta*	B	(b)	-	-	B	(b)	B	B	B	B	b	B	B
Temminck's Stint, *Calidris temminckii*	B	b	-	b	B	-	B	B	B	B	B	-	B
Pectoral Sandpiper, *Calidris melanotos*	B	B	-	-	(b)	(b)	B	B	(b)	B	B	B	B

TABLE 2. Birds of the Lena Delta Nature Reserve – *continued:*

Species	Historical status[1,2]	Continental part 1997					Delta part 1997						
		Tiksi	Belaya Skala	Tit-Ary Island	IBS	Sokol Station	Bykovskij	Dallalaakh Island	Samoilovsky Island	Yugos-Dje	Tumatskaya Channel	Arga-Muora Sise	Sagastyr Island
Sharp-tailed Sandpiper, *Calidris acuminata*	B*/(b)	-	-	-	-	-	-	(b)	-	(b)	-	-	-
Dunlin, *Calidris alpina*	B	-	-	(b)	B	B	B	B	b	B	B	B	B
Curlew Sandpiper, *Calidris ferruginea*	B	-	-	-	B	-	B	b	-	-	-	(b)	B
Ruff, *Philomachus pugnax*	B	B	-	B	b	B	B	b	B	B	(b)	B	(b)
Pomarine Skua, *Stercorarius pomarinus*	B	-	-	-	-	-	-	-	-	(b)	-	b	B
Arctic Skua, *Stercorarius parasiticus*	B	-	-	-	b	-	b	b	-	B	b	b	B
Long-tailed Skua, *Stercorarius longicaudus*	B	B	-	-	B	B	-	-	b	B	B	b	(b)
Black-legged Kittiwake, *Rissa tridactyla*	+	-	-	-	-	-	-	-	-	-	-	-	-
Ivory Gull, *Pagophila eburnea*	+	-	-	-	-	-	-	-	-	-	-	-	-
Mew Gull, *Larus canus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Herring Gull, *Larus argentatus*	B	(b)	B	B	(b)	(b)	B	B	b	b	b	b	B
Glaucous Gull, *Larus hyperboreus*	B	(b)	(b)	(b)	(b)	(b)	B	B	b	b	b	b	B
Ross's Gull, *Rhodostethia rosea*	B	-	-	-	-	-	B	B	-	(b)	-	-	B
Sabine's Gull, *Xema sabini*	B	-	-	-	-	-	b	B	-	b	b	b	B
Arctic Tern, *Sterna paradisaea*	B	-	-	-	B	-	b	B	(b)	B	-	B	B
Brünnich's Guillemot, *Uria lomvia*	+	-	-	-	-	-	-	-	-	-	-	-	-
Black Guillemeot, *Cepphus grylle*	+	-	-	-	-	-	-	-	-	-	-	-	-
Feral Rock Pigeon, *Columba livia*	-	(b)	-	-	-	-	-	-	-	-	-	-	-
Snowy Owl, *Nyctea scandiaca*	B	-	-	-	M	-	-	-	-	-	-	-	M
Short-eared Owl, *Asio flammeus*	+	(b)	-	-	-	-	-	-	-	-	-	-	-
Horned Lark, *Eremophila alpestris*	B	b	(b)	-	B	B	-	-	-	(b)	-	-	-
Barn Swallow, *Hirundo rustica*	B*/+	-	-	-	-	+	-	-	-	-	-	-	+
Sand Martin, *Riparia riparia*	+	-	-	-	-	-	-	-	-	-	-	-	-
Common (Northern) House Martin, *Delichon urbica*	+	-	-	-	-	-	-	-	-	-	-	-	-
Yellow Wagtail, *Motacilla flava*	+	-	-	+	-	-	-	-	-	-	-	-	-
White Wagtail, *Motacilla alba*	B	b	B	B	B	B	-	B	B	(b)	-	-	-
Red-throated Pipit, *Anthus cervinus*	B	B	(b)	B	B	B	-	-	B	-	-	-	-
Buff-bellied (American) Pipit, *Anthus rubescens*	B/-	-	B	-	b	B	-	-	-	-	-	-	-
Mountain (Siberian) Accentor, *Prunella montanella*	B/-	-	(b)	B	-	-	-	-	-	-	-	-	-
Bluethroat, *Luscinia svecica*	B/-	b	B	B	-	B	-	-	-	-	-	-	-
Northern Wheatear, *Oenanthe oenanthe*	B	b	B	b	-	B	-	-	B	-	-	-	-
Dusky Thrush, *Turdus naumanni eunomus*	B*/-	(b)	(b)	(b)	-	-	-	-	-	-	-	-	-
Fieldfare, *Turdus pilaris*	-	-	+	-	-	-	-	-	-	-	-	-	-
Redwing, *Turdus iliacus*	-	-	-	+	-	-	-	-	-	-	-	-	-
Yellow-browed Warbler, *Phylloscopus inornatus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Willow Warbler, *Phylloscopus trochilus*	B	-	b	b	-	-	-	-	-	-	-	-	-
Arctic Warbler, *Phylloscopus borealis*	-	-	B	(b)	-	-	-	-	-	-	-	-	-
Red-breasted Flycatcher, *Ficedula parva*	-	-	+	-	-	-	-	-	-	-	-	-	-
Willow Tit, *Parus montanus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Coal Tit, *Parus ater*	+	-	-	-	-	-	-	-	-	-	-	-	-
Great Grey Shrike, *Lanius excubitor*	+	-	-	-	-	-	-	-	-	-	-	-	-
House Sparrow, *Passer domesticus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Little Bunting, *Emberiza pusilla*	B	-	b	b	-	(b)	(b)	-	-	-	-	-	-
Pallas' Reed Bunting, *Emberiza pallasi*	+	-	-	-	-	-	-	-	-	-	-	-	-
Lapland Longspur, *Calcarius lapponicus*	B	B	(b)	b	B	B	B	B	B	B	B	(b)	-
Snow Bunting, *Plectrophenax nivalis*	B	B	(b)	(b)	B	B	B	B	B	B	B	B	B
Brambling, *Fringilla montifringilla*	+	-	-	-	-	-	-	-	-	-	-	-	+
Common Redpoll, *Carduelis flammea*	B	-	B	B	-	B	(b)	(b)	-	-	-	-	-
Hoary Redpoll, *Carduelis hornemanni*	B	b	-	(b)	B	b	-	-	b	b	-	-	-
Scarlet Rosefinch, *Carpodacus erythrinus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Arctic Rosy-Finch, *Leucosticte arctoa*	B	-	(b)	-	-	B	-	-	-	-	-	-	-
Siberian Jay, *Perisoreus infaustus*	+	-	-	-	-	-	-	-	-	-	-	-	-
Carrion (Eurasian) Crow, *Corvus corone cornix*	+	-	-	-	-	-	-	-	-	-	-	-	-
Common (Northern) Raven, *Corvus corax*	+	-	+	+	+	-	-	-	-	-	-	-	-

[1] - = never recorded; + = transient or rare to uncommon migrant; M = common or abundant migrant; B = breeder (B* = occasional or rare breeder); b = probable breeder; (b) = possible breeder.

[2] Major sources: Gladkov (1958), Kapitonov (1962), Laboutin et al. (1985), Artyukhov (1986), Blokhin (1986, 1990, 1991), Solovieva (1992), Pozdnyakov et al. (1996), V. Pozdnyakov and D. Solovieva (unpubl. data).

[3] When two different categories are given for the historical status, the first refers to the continental part and the second to the delta part.

TABLE 3. Mammal records[1] and relative abundance of microtine species[2] in the LDNR in 1996 and 1997.

Species	Tiksi	Bulkurka	Belaya Skala	Tit-Ary Island	IBS	Sokol Station	Samoilovsky Island	America-Khaya	Yugos-Dje	Tumatskaya Channel	Arga-Muora Sise	Sagastyr Island
Tundra Shrew, *Sorex tundrensis*			P									
Varying Hare, *Lepus timidus*	T		T		T				T			
Northern Pika, *Ochotona hyperborea*	D	D										
Black-capped Marmot, *Marmota camtschatica*			D		D	D						
Common Rat, *Rattus norvegicus*	D-P											
Brown Lemming, *Lemmus sibiricus*	++		++	++	++		+++	+++	+++	+++	+++	+++
Collared Lemming, *Dicrostonyx groenlandicus*	++		+++	++	+++		++	++	++	++	++	++
Narrow-skulled Vole, *Microtus gregalis*	+		+	++				++	+			
Middendorff's Vole, *Microtus middendorffi*	+++		+		+							
Tundra (Root) Vole, *Microtus oeconomus*			++	+								
Wolf, *Canis lupus*			D		D				T			
Arctic Fox, *Alopex lagopus*	D	T	T	T	D	T	T		D	D	D	D
Stoat, *Mustela erminea*	D		T		D	D			D		T	D
Least Weasel, *Mustela nivalis*				P						T?	T?	D
Wolverine, *Gulo gulo*			D									
Reindeer, *Rangifer tarandus*	T	T	T	T	T		T		D	D	D	D

[1] D = Direct observation; P = found in pellets; T = Tracks (feces, droppings or footprints).

[2] +++ = more than 50% of the prey found in raptor pellets; ++ = 10 to 50%; + = less than 10%.

Gaviiformes

Red-throated diver (*Gavia stellata*) and black-throated diver (*Gavia arctica*) were found throughout the area, but the first is more frequent in the northern delta, where groups of 10 to 30 adults were already gathered by the end of July. Black-throated divers are more abundant in the central delta, but most of the birds in 1997 (see discussion) were nonbreeders or failed breeders. Laboutin et al. (1985) noticed the same geographical pattern. They recorded 1.9 black-throated divers/km^2 in the north, while we counted 1.35 pairs/km^2 in the central delta in 1997.

Anseriformes

The white-fronted goose (*Anser albifrons*) is the most common goose in the delta. Laboutin et al. (1985) estimated that 59 to 84% of the *Anser* species found in the central delta were white-fronted. In 1997, 77% of the *Anser* spp. we saw were also white-fronted. Bean geese (*Anser fabalis*) were seen only in the central delta. Brent geese (*Branta bernicla*) were recorded only in the northern parts of the delta, as they breed and moult close to the sea. All the birds seemed to belong to subspecies *nigricans*, but mixed pairs with subspecies *bernicla* were found in 1997 in the neighbouring Olenok channel (Syroechkovski and Zöckler, 1997).

King eiders (*Somateria spectabilis*) are rarer in the continental part than in the central and northern delta, and only one nest was found there. However, despite the discovery of 13 nests in 1997, only three successful breeding records were reported, and flocks of 20 to 70 nonbreeding females indicate poor breeding conditions that year. Steller's eider (*Polysticta stelleri*) is common only in the northern part, but it is still rarer than king eider and long-tailed duck (*Clangula hyemalis*). As in the case of king eider, breeding was very poor for steller's eider in 1997 (see discussion). Laboutin et al. (1985) found this species breeding 100 km from the sea, and we also recorded it at Yugos-Dje in the central delta. Breeding spectacled eiders (*Somateria fischeri*) have never been found here, but we found two females on the eastern delta on a possible favourable habitat. Long-tailed duck were found all over the delta. Both for Laboutin et al. (1985) and for us, they were the most common wildfowl species in the delta, sometimes forming large flocks in the north (several hundred moulting birds northeast of Sagastyr Island at the beginning of August).

Falconiformes

Golden eagle (*Aquila chrysaetos*) has been found breeding only once, in the Primorski range close to IBS in 1963 (Egorova, 1965), but we found a dead immature eagle close to IBS on 9 July. The rough-legged buzzard (*Buteo lagopus*) is the most common raptor in the LDNR. It can be seen all over the delta, but it becomes rarer in the north where there are no cliffs. Peregrine falcon (*Falco peregrinus*) is a common breeder only in the continental part of the LDNR, on the steep cliffs bordering the Lena River. Merlin (*Falco columbarius*) has been seen in the southern part of the LDNR (D. Solovieva, unpubl. data) but has never been found breeding, and the species was not mentioned by Laboutin et al. (1985). However, we discovered a breeding site on 16 August at south Sokol. The female was feeding a fledgling that had just started to fly. Another bird was seen at Bykovskij on 12 July.

Galliformes

Two species are common breeders in the LDNR, but the willow grouse (*Lagopus lagopus*) is generally more common that the rock ptarmigan (*Lagopus mutus*), especially

in the south (Laboutin et al., 1985). Indeed, we found more willow grouse in 1997 in the south (IBS) than in the central delta. We also found more willow grouse remains than rock ptarmigan remains in raptor pellets, but, surprisingly, we found more rock ptarmigan than willow grouse at IBS. This was an unexpected situation that we could not explain.

Charadriiformes

Despite three records from the delta part, we found breeding pacific golden plover (*Pluvialis fulva*) only in the southern part of the LDNR (coastal slopes). In this continental part, it is a more common breeder than the grey plover (*Pluvialis squatarola*). Laboutin et al. (1985), who considered the pacific golden plover rarer than the grey plover, were probably referring only to the delta part. We found grey plover densities higher than those previously recorded by these authors (9–10 vs. 1–4 ind./km^2). The ringed plover (*Charadrius hiaticula*) is an uncommon breeder in the delta, especially north of 72°30′ N, where gravelly beaches and terraces, the preferred breeding sites, become rarer. The dotterel (*Charadrius morinellus*) is a regular breeder in the continental part, but is only occasionally seen in the delta part north to Sagastyr Island (Pozdnyakov et al., 1996).

The spotted redshank (*Tringa erythropus*) was not considered as a breeder by Laboutin et al. (1985), but it bred at least once in the LDNR in 1995 (D. Solovieva, unpubl. data). In 1997, we saw the species displaying at Tiksi on 9 June. The ruddy turnstone (*Arenaria interpres*) breeds everywhere in the region but is more common in the south: at IBS, it was the second most common species. Densities previously recorded in the delta by Laboutin et al. (1985), who considered this species rarer than the grey plover, were far lower than those recorded in 1997, but probably referred only to the central delta. Two phalarope species are breeding in the LDNR. The red-necked phalarope (*Phalaropus lobatus*) is restricted to the southern part of the delta, at least up to Samoilovsky Island (Pozdnyakov et al., 1996), and is uncommon. The grey (red) phalarope (*Phalaropus fulicarius*) is much more abundant than the previous species and prefers polygonal tundra in the central delta (where it is the most common shorebird) and the northern delta. Densities recorded for the grey phalarope in the central delta were similar to those published by Laboutin et al. (1985).

Previous authors considered the common snipe (*Gallinago gallinago*) as a breeder, whereas the pintail snipe (*Gallinago stenura*) was regarded only as a possible breeder near Tiksi and had never been recorded in the delta (Gladkov, 1958; Laboutin et al., 1985). In 1997, snipes were heard and seen displaying in three locations: the pintail snipe at Tiksi and Yugos-Dje; the common snipe at Tiksi, Yugos-Dje, and Samoilovsky Island. Undetermined snipes were also recorded daily at Belaya Skala and on Tit-Ary Island, where the birds occasionally shot are mostly common snipes (D. Solovieva, unpubl. data).

Laboutin et al. (1985) considered the long-billed dowitcher (*Limnodromus scolopaceus*) as a very rare breeder, but it is unclear whether they confirmed breeding. Pozdnyakov et al. (1996) suspected breeding several times, but failed to find any nests or young. Similarly, in 1997, breeding was strongly suspected at Yugos-Dje (several birds were seen daily), and another individual was recorded on Dallalaakh Island. According to Tomkovich (1992), this species is extending its breeding range westwards.

Seven *Calidris* species are known to breed in the LDNR. The rufous-necked stint (*Calidris ruficollis*) is the only species restricted to the continental part of the LDNR, and the birds seen close to Bykovskij in mid July 1997 were the only ones seen in the delta, where breeding was never confirmed. The two other stints breed all over the LDNR but are more common in the central delta. The little stint (*Calidris minuta*) inhabits the polygonal tundra, and the Temminck's stint (*Calidris temminckii*) is found in the willow flooding zone, where it is often associated with the presence of driftwood. In the northern part of the delta, the little stint is generally the second most common shorebird after the grey phalarope (Laboutin et al., 1985), but breeding was relatively poor for this species in 1997. The pectoral sandpiper (*Calidris melanotos*) was also found breeding all over the delta with densities similar to those previously reported by Laboutin et al. (1985). The sharp-tailed sandpiper (*Calidris acuminata*) is much rarer and has been found breeding only once, close to Tiksi (Kozlova, 1962). In 1997, we saw one nonbreeding adult on Dallalaakh Island and another one at Yugos-Dje, a site where Blokhin (1986) had already seen this species in 1984. The dunlin (*Calidris alpina*) is a common breeder all over the delta. We found densities much higher than those previously recorded by Laboutin et al. (1985) and other authors in central Siberia, but according to Lappo (1996), the Lena Delta is one of the core areas of this species in Siberia. Finally, the curlew sandpiper (*Calidris ferruginea*) was previously known only from Tiksi Bay (Kapitonov, 1962), and Laboutin et al. (1985) failed to find it breeding in the delta. More recently, D. Solovieva (unpubl. data, 1997) found the species breeding on Sagastyr Island. In 1997, in addition to breeders found at Bykovskij, Dallalaakh Island, and Sagastyr Island, four broods were also located on the continental part of the LDNR at IBS (Fig. 3), where the curlew sandpiper had never been found breeding before. This is one of the most common breeding species on the neighbouring New Siberian Islands, where densities reach 70 birds/km^2 in late July (Pozdnyakov, 1994). The ruff (*Philomachus pugnax*) is a breeder recorded in all but two of the visited sites. We found densities similar to those recorded by Laboutin et al. (1985).

Three skua species breed in the LDNR. Pomarine skua (*Stercorarius pomarinus*) is an irregular breeder, dependent on lemming densities, and is generally more abundant in the northern part (Pozdnyakov et al., 1996). In 1997, a low lemming year, birds were seen in several locations,

FIG. 3. Breeding curlew sandpiper at IBS on 9 July 1997. (Photo: O. Gilg and B. Sabard)

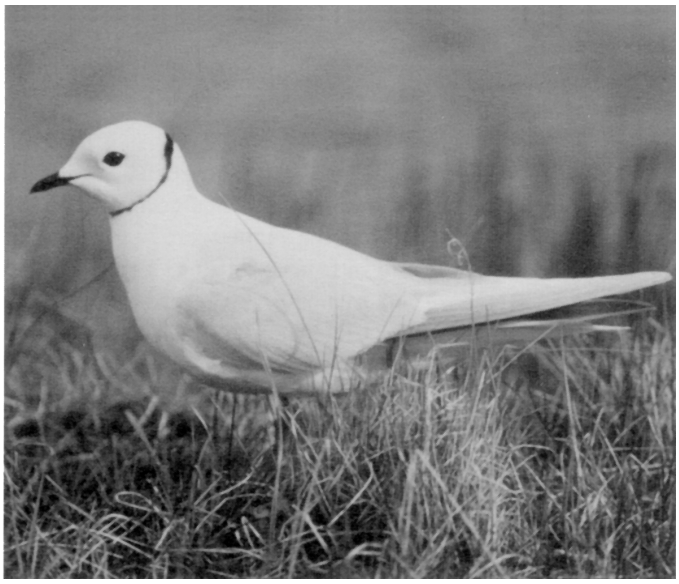

FIG. 4. Breeding Ross's gull on Dallalaakh Island on 16 July 1997. (Photo: C. Zöckler)

but only one nest was found, on Sagastyr Island. Arctic skuas (*S. parasiticus*) and long-tailed skuas (*S. longicaudus*) are less dependent on lemmings and breed annually. Several nests were found for both species.

Among the four gull species breeding in the LDNR, herring gull (*Larus argentatus*) and glaucous gull (*Larus hyperboreus*) are the only common species breeding all over the area, herring gull being the more abundant. Ross's gull (*Rhodostethia rosea*) (Fig. 4) and Sabine's gull (*Xema sabini*) are rarer breeders and are more common in the northern part. They are often found breeding in mixed colonies, sometimes with arctic terns (*Sterna paradisaea*). Arctic terns are regularly found breeding in small colonies or isolated pairs and are also more common in the delta.

Strigiformes

The snowy owl (*Nyctea scandiaca*) is an irregular breeder, reproducing only when lemming numbers are high, as in 1996. In 1997, a relatively poor lemming year in the Lena Delta, only single birds were recorded. However, old nests were found at Yugos-Dje, and the remains of five dead birds were collected from three different locations.

Passeriformes

Historical information on passeriformes is rare. For most of the species, we can present only the distribution pattern within the LDNR. The horned lark (*Eremophila alpestris*) is a regular breeder in the continental part, but we recorded the species only once in the delta, at Yugos-Dje. The white wagtail (*Motacilla alba*) is a more common breeding species than the horned lark and is absent only from the northernmost region of the delta. The red-throated pipit (*Anthus cervinus*) is found breeding mainly in the continental part, but one breeding pair was also found at Samoilovsky Island. The buff-bellied (American) pipit (*Anthus rubescens*), first mentioned by Blokhin (1990), is a common breeder in the valleys of the continental part of the LDNR and had probably been overlooked by previous observers. The mountain (Siberian) accentor (*Prunella montanella*), bluethroat (*Luscinia svecica*), dusky thrush (*Turdus naumanni eunomus*), willow warbler (*Phylloscopus trochilus*), and little bunting (*Emberiza pusilla*) were not found breeding by Laboutin et al. (1985). Breeding evidence for these species was provided by Solovieva (1992), Y. Sofronov (pers. comm. 1995), and V. Pozdnyakov and D. Solovieva (unpubl. data) and all but one (dusky thrush) were also found breeding in 1997 in the southern part of the LDNR. The northern wheatear (*Oenanthe oenanthe*) is more common in the southern continental part but is also breeding in the delta.

The lapland longspur (*Calcarius lapponicus*) and the snow bunting (*Plectrophenax nivalis*) are the only passerines breeding almost all over the area. Except in the north, where it becomes rarer (and even absent on Sagastyr Island), the lapland longspur is the most common breeding bird in the LDNR. The snow bunting is found everywhere, but in much lower numbers than the lapland longspur, and is rarer in the south. Breeding dates for snow bunting differed significantly with change in latitude. Finally, the arctic rosy-finch (*Leucosticte arctoa*) is restricted to the continental and mountainous part of the LDNR.

Insectivora

The tundra shrew (*Sorex tundrensis*) was the only shrew we found from the three species reported in the nearby Taiga zone. Volpert and Sapozhnikov (1996)

had already found this species on Tit-Ary Island and at Belaya Skala.

Lagomorpha

According to Tavrovsky (in Revin and Perfiliev, 1985), the varying hare (*Lepus timidus*) is more common in the continental part than in the delta. None were seen in 1997, but droppings were found in four locations (Table 3). The northern pika (*Ochotona hyperborea*) is present only in the continental part of the LDNR and in the Tchekanovski range, where it is known to reach 72˚48′ N. (Romanov, 1941; Kapitonov, 1961; Revin and Perfiliev, 1985). Several individuals were seen close to Tiksi, and a small colony (at least five individuals) was found ca. 10 km south of Tit-Ary Island (Bulkurka), on a small rockfall on the shore of the Lena River.

Rodentia

The black-capped marmot (*Marmota camtschatica*) is well represented and regularly distributed in the continental part (Kharaulakh Mountains) of the LDNR as compared with the other known breeding places in Yakutia (Vasiliev et al., 1996). At IBS, we found a breeding site with at least three individuals on 4 July and another den on 7 July. Around Sokol Station and Belaya Skala, the species was fairly common on the steep coastal slopes. The common rat (*Rattus norvegicus*) had not been reported in the area before (Volpert and Sapozhnikov, 1996). We saw this species and found remains of three individuals (in snowy owl pellets) at Tiksi. Nevertheless, because of the amount of maritime traffic and human infrastructures, the presence of this species is not surprising in this town. The brown lemming (*Lemmus sibiricus*) is present everywhere in the LDNR. By far the most common microtine species in the delta area, it is rarer than the collared lemming (*Dicrostonyx groenlandicus*) on the dryer continental part. According to the analysis of raptor pellets (2309 microtine prey items were identified), the brown lemming accounted for 15 to 35% of total microtine numbers south of Sokol Station and for 60 to 90% north of this location. Despite low densities in 1997, following the peak phase of 1996, lemmings were seen regularly and more frequently by the end of July upon moving north. An inspection of 139 collared lemming winter nests showed high winter predation by the stoat, large numbers of nests later occupied by brown lemmings, and a high proportion of isolated nests (more than 50%). According to Sittler (1995) and the senior author's experience in NE Greenland and the Canadian Arctic, a high proportion of isolated nests is a good indicator of low collared lemming densities during the winter. Collared lemming densities were still low during the summer season, and only very few living animals were seen. The narrow-skulled vole (*Microtus gregalis*) had previously been recorded in the southern part of the delta and the area around Tiksi (Mejenni, 1975). At Tiksi, Belaya Skala, and Yugos-Dje, this species accounted for only about 5% of the total number of microtine prey items that we found in pellets. The highest frequencies were reached on islands in the southern delta: 14% at America-Khaya and up to 33% on Tit-Ary Island (total number of individual microtines: n = 42 and 115). The Middendorff's vole (*Microtus middendorffi*) was recorded only in raptor pellets collected in the continental part of the LDNR and at Tiksi. At Belaya Skala and IBS, it accounted for less than 5% of the total number of microtine prey (n = 74 and 87) but at Tiksi, 14 out of 25 prey were Middendorf's vole (but these were found mostly in the pellets collected in flooded meadows, known to be the main habitat of this species in the region; Volpert and Sapozhnikov, 1996). Like Middendorff's vole, the tundra (root) vole (*Microtus oeconomus*) was reported only from the continental part. At Belaya Skala and on Tit-Ary Island, it accounted for 19% and 2.6% respectively of the total number of microtine prey items found in pellets (n = 74 and 115).

Carnivora

We observed spring tracks (in dried mud) of wolf (*Canis lupus*) at Yugos-Dje on 17 July, and local residents found a den with young at Belaya Skala in July. A single wolf was also seen on Sobo-Size Island (north of IBS) on 18 and 19 July (M. Exo and I. Hertzler, pers. comm. 1997). Arctic fox (*Alopex lagopus*) was seen everywhere from Tiksi to Sagastyr Island. At Yugos-Dje, several dens were found, but reproduction could be ascertained in only one instance. We discovered two other dens with young, at Arga Muora Sise and Tumatskaya Channel. Stoat (*Mustela erminea*) and stoat tracks were recorded in eight locations. At Yugos-Dje, six lemming winter nests had been used by stoat during the previous winter. Most of them were located close to an old hut, where lemming and passerine remains, mixed with several hundred stoat scats, suggested regular activity in the area. A high proportion of predated winter nests (> 2%) is a normal pattern in winters following a lemming peak (Sittler, 1995). A winter caching site containing about 50 lemmings was also discovered under a pile of driftwood south of Sagastyr Island. The only living least weasel (*Mustela nivalis*) was reported from Tumat (Sagastyr Island), where one individual was regularly seen in July in an inhabited house, and where a winter caching site containing 35 lemmings was discovered. Remains from two least weasels were also found in the 99 rough-legged buzzard pellets collected on Tit-Ary Island. The wolverine (*Gulo gulo*) is rare in the LDNR, but is seen annually north to Sagastyr Island (mostly in winter) according to local residents. In 1997, one was seen in July north of Belaya Skala (Y. Semenov, pers. comm. 1997).

Artiodactyla

After having spent the winter in the Kharaulakh Mountains and farther south, large numbers of reindeer (*Rangifer*

tarandus) migrate to the delta for the summer season. The local population (estimated 50 000–65 000 individuals in 1983) has increased since 1960 (Laboutin et al., 1985). Scattered individuals (adults and young) were seen all over the surveyed area, but their numbers increased toward the north.

Bird Densities

Mean bird densities recorded in 1997 reached 320 birds/km^2 at Yugos-Dje and 500 birds/km^2 at IBS (range: 245–641 birds/km^2; see Table 4). The minimum number of probable breeding pairs per km^2 (without the lapland bunting) was 88 on Yugos-Dje and 86 on IBS.

Lapland longspur was the most common species in both locations, with 111 to 271 ind./km^2. Among the shorebirds, the grey phalarope was dominant at Yugos-Dje (96 ind./km^2, with a maximum of 107 pairs/km^2). The dunlin was the second dominant species at this location, with 27 ind./km^2 (max. 105), but it was the most common shorebird at IBS (81 ind./km^2; max. 130). Pectoral and Temminck's sandpipers were much more common in the wet central delta (14 and 9 ind./km^2 at Yugos-Dje) than on the continental slopes of IBS (1.23 ind./km^2). Little stint had relatively low densities in both places (10 ind./km^2), especially in the central delta, where Laboutin et al. (1985) had found 50–67 ind./km^2. Ruddy turnstone was very common at IBS (35 ind./km^2; second dominant shorebird) but had the same low densities (1–2 ind./km^2) in the central delta as previously reported by Laboutin et al. (1985). Grey plover had similar densities at IBS and Yugos-Dje (9–10 ind./km^2), while pacific golden plover, breeding only at IBS, was more common (16 ind./km^2). Curlew sandpiper was found breeding only at IBS (5 ind./km^2), while ruff was found only at Yugos-Dje (7.7 ind./km^2; max. 18). All other shorebird species had densities of less than 2.5 ind./km^2.

TABLE 4. Mean bird densities (individuals and minimum probable breeding pairs per km^2) at IBS and Yugos-Dje.

Taxonomic Order, Species	IBS[1]		Yugos-Dje[2,3]	
	Individuals /km^2	Breeding Pairs/km^2	Individuals /km^2	Breeding Pairs/km^2
Gaviiformes				
Red-throated Diver	1.23	1.23		
Black-throated Diver			2.76	0.00
Anseriformes				
King Eider	3.68	1.23	7.18	0.00
Long-tailed Duck	9.82	0.00	4.42	0.00
Galliformes				
Willow Grouse	6.13	1.23	1.66	0.00
Rock Ptarmigan	11.04	0.00		
Charadriiformes				
Pacific Golden Plover	15.95	3.68	0.55	0.00
Grey Plover	9.82	1.23	8.84	2.76
Ringed Plover			2.21	1.10
Ruddy Turnstone	34.36	12.27	1.66	0.55
Red-necked Phalarope	2.45	0.00		
Grey (Red) Phalarope	7.36	2.45	96.13	51.93
Undetermined Snipe			2.21	0.00
Long-billed Dowitcher			2.21	0.00
Rufous-necked Stint	2.45	1.23		
Little Stint	9.82	3.68	9.94	6.63
Temminck's Stint	1.23	0.00	9.39	4.42
Pectoral Sandpiper	1.23	0.00	13.81	6.08
Sharp-tailed Sandpiper			0.55	0.00
Dunlin	80.98	42.94	27.07	11.05
Curlew Sandpiper	4.91	4.91		
Ruff			7.73	1.10
Long-tailed Jaeger	4.91	1.23	1.10	0.00
Sabine's Gull			2.21	0.00
Arctic Tern			1.66	0.55
Passeriformes				
Horned Lark	2.45	1.23		
White Wagtail	6.13	3.68		
Lapland Longspur	271.17	96.93	111.05	n.d.
Snow Bunting	11.04	2.45	6.08	2.21
Hoary Redpoll	2.45	1.23	0.55	0.00
Total	500.61	182.83	320.97	88.38

[1] IBS: 81.5 ha (7–9 July 1997).

[2] Yugos-Dje: 181 ha (13–21 July 1997).

[3] Total number of breeding pairs/km^2 does not include lapland longspur.

DISCUSSION

With an updated total of 122 bird species recorded, 67 of them being confirmed breeders, the LDNR is one of the richest areas in the Arctic above 71° N in terms of species diversity. In eastern Siberia, 77 breeding species were found in the Chaun River delta (Krechmar et al., 1991), but this area is at only 69° N, and most of the other coastal regions studied had fewer than 50 breeding species (see Pearce et al., 1998). In western Siberia, between the Kola and Taimyr peninsulas, Svensson (in Grönlund and Elander, 1994) failed to find any coastal area with more than 40 species. Nevertheless, on Taimyr peninsula, 65 breeding species were recorded during intensive surveys between 1989 and 1991 (Hötker, 1995). According to Rogacheva (1992), several other species were already found breeding north of 71° N, but one should remember that the taiga zone reaches 72°30′ N in this large peninsula. All the other Arctic regions located above 71° N (the Canadian Arctic Archipelago, Greenland, and Svalbard) belong to the High Arctic zone (Sage, 1986), and we couldn't find evidence that any area compares in richness to the LDNR.

The relatively warm fresh waters arriving in the cold marine waters are mainly responsible for this higher diversity and richness of both marine and terrestrial ecosystems compared with those of adjoining territories (Solomonov, 1995). The geographical situation of the delta region, between the Atlantic and Pacific migration flyways and close to the treeline, also explains why wildlife is so rich there.

Nevertheless, the distribution of birds and mammals is not homogenous within the LDNR, and many species are restricted to or more abundant in one of the four

phytoecological zones described in the study area section. The wet polygonal tundra that covers the delta district of the LDNR north of 72˚20′ N is the largest and richest habitat for wildfowl and shorebird populations. Bewick's swan, geese, Steller's eider, red phalarope, little stint, and small gulls are typical of this habitat, while brown lemming is the most abundant mammal species. Several other species are restricted to the dry continental slopes, the main habitat in the Sokol district: these include dotterel, ruffous-necked stint, buff-bellied pipit, arctic rosy-finch, and, among the mammals, black-capped marmot. However, bird densities are lower here than in the three other habitats. In the wet continental slopes (gentle slopes covering the lowest parts and the northeastern shores of the Sokol district between Tiksi and Sokol Station), the vegetation and wildlife composition is intermediate between those of the two previous habitats and very diverse. Pacific golden plover is the most typical species of this habitat, while turnstone, dunlin, and lapland longspur have higher densities here than in the other habitats. The wet continental slopes also seem to be the main habitat for Middendorff's vole in the LDNR. Scattered alder bushes and larch thickets cover only small regions (sheltered valleys in the southern continental part and on Tit-Ary Island), but because these areas are suitable for taiga species, most of the vagrant and rare breeding passerines of the LDNR (e.g., mountain accentor, thrushes, warblers) are found in this fourth habitat.

The 200 000 wildfowl believed to live in the Lena Delta (Laboutin et al., 1985) are far from the total which should be found in such a large protected area. Hunting pressure was very high in the delta during the first half of this century: Kapitonov (1962) reported up to 3000 moulting geese killed in one day in 1929. According to Egorova (1965) and Laboutin et al. (1985), goose and swan populations continued to decline in the delta between the 1960s and the 1980s (geese to 1/3 and swans to 1/6 of their former numbers) for various reasons, including hunting. Nowadays, Yakutia has the lowest hunter density in all Russia (less than 3.5 hunters/100 km^2; Kostin, 1996), and because of the protection afforded by the LDNR and the remoteness of the area, professional hunters are no longer present here. Sagastyr Island, Bykovskij, and Tit-Ary Island are home to a few Even, Yakut, and Russian fishermen who also hunt a few birds and mammals for their own use (mostly wildfowl and reindeer), but this hunt is largely sustainable (less than one hunter/1000 km^2 in summer in the central delta) and is generally taking place outside the boundaries of the nature reserve. According to most authors (Sabano et al., 1996; Syroechkovski, 1996; Andreev, 1998), the past and present decline in east Siberian wildfowl populations (geese population sizes are thought to be less than 10% of what they were 40–50 years ago; Madsen et al., 1996) seems to be due to habitat loss and to hunting on their Asian wintering grounds, rather than to disturbance on their breeding grounds. Monitoring of these populations and the protection of major staging and wintering grounds should therefore be increased in the future to allow these species to recover their former densities (Vinogradov, 1996).

Recent changes in the status of shorebirds are also hard to assess, especially because Laboutin et al. (1985) is about the only other work that can be used for this purpose. A comparison of our results with this work suggests that some bird species (spotted redshank, pintail snipe, grey plover, dunlin, curlew sandpiper) may have extended their breeding range or increased their population during the last 15 years, but indicates no obvious decrease (the low little stint densities in 1997 were probably accidental according to V. Pozdnyakov, who found much higher densities in 1996). The LDNR is located at the limit of the breeding range of several eastern Siberian species (spectacled eider, long-billed dowitcher, and sharp-tailed sandpiper). Recent extension of Siberian wader breeding ranges was discussed by Tomkovitch (1992), and some confirmed or probable breeding records have already been reported for the LDNR (Kozlova, 1962; Laboutin et al., 1985; Pozdnyakov et al., 1996; this study), but further evidence is still needed.

Nowadays, the bird densities found at IBS and Yugos-Dje, the two sites where rope transects were conducted, are among the highest ever recorded in the Arctic for noncolonial birds. Mean density was 500 birds/km^2 at IBS and 320 at Yugos-Dje (range: 245–641). For all but a few species, the number of individuals was found to be more than twice the number of probable breeding pairs (Table 4). This result can be explained by the use of too strict a criterion for defining probable breeding birds and the presence of nonbreeding birds, including failed breeders. Nevertheless, our results are in line with Blokhin's (1990) densities from the Lena Delta (218–551 birds/km^2). Densities recorded in Siberia on Taimyr (Vinokurov et al., 1971; Hötker, 1995) and in Chukotka (Stishov, 1992) varied from 6 to 391 birds/km^2, with averages between 100 and 250 birds/km^2. In comparison, densities reported from North American low-Arctic coastal lowlands rarely exceed 100 pairs/km^2 north of 70˚ N (Sage, 1986), where average densities are generally between 10 and 30 pairs/km^2 (Sage, 1986; Forbes et al., 1992; Lepage et al., 1998). Higher densities (up to 1000 pairs/km^2) have previously been reported from central Siberia (Rogacheva, 1992) and the Indigirka region (Uspenskii, 1984), but these were calculated on small plots and included colonial nesting species.

The species with the highest densities were shorebirds and the lapland bunting. Species that have been found elsewere in Siberia with similar high densities are grey plover (10 ind./km^2 in central Siberia: Rogacheva, 1992), grey phalarope (178 ind./km^2 in Chukotka: Stishov, 1992), and pectoral sandpiper (11–31 ind./km^2 in Chukotka: Stishov, 1992). Species that have been found elsewere in Siberia with lower densities are pacific golden plover (5–10 ind./km^2 in central Siberia: Rogacheva, 1992), ruddy turnstone (max 12–22 ind./km^2 in west, central and east

Siberia: Tomkovich and Vronsky, 1988; Stishov, 1992; Dobrinskii, 1995), grey phalarope (33–53 ind./km^2 at the Prysina River and on the New Siberian Islands: Yurlov, 1982; Pozdnyakov, 1994), dunlin (52 ind./km^2 in central Siberia: Yurlov, 1982; Ryabitsev, 1993; Dobrinskii, 1995), and lapland longspur (223 ind./km^2 in Chukotka: Stishov, 1992).

The importance of lemming population levels in determining the densities and breeding success of various bird species has been studied and discussed for Siberia by several authors (Sdobnikov, 1971; Litvin et al., 1985; Summers, 1986; Greenwood, 1987; Dorogoi, 1990; Syroechkovski et al., 1991; Spiekman and Groen, 1993; Underhill et al., 1993). Although no specific experiments were carried out in 1997, empirical data suggest similar trends in the LDNR. Following the 1996 lemming peak, 1997 was a poor-to-medium lemming year, and several bird species had low breeding densities or poor breeding success. At Yugos-Dje, for example, 35 territorial pairs of black-throated diver were found on 26 km^2, but no nests or young were discovered despite active searches between 12 and 27 July. On Sagastyr Island, 200 brent goose nests were counted in June, but only 20 of these produced young, and only two goslings were still alive on 31 July. Reasons for poor breeding conditions include bad weather and snow, but these can hardly be regarded as the only factors (Pehrsson, 1986). In 1996, a summer in which the snow melted exceptionally late in the Lena Delta (mid-August on Sagastyr Island), egg-laying was postponed for several species, but breeding success was far higher than in 1997. Other reasons for poor breeding include interaction with predator species (Sittler et al., 2000). On Sagastyr Island, for example, where Steller's eiders breed close to pomarine skua nests during lemming peaks, 25 pairs of Steller's eider nested in 1996, while only one failed breeder was found in 1997 on the same study area. The explanation is that because skuas defend their territory against other predators, they protect eider nests from fox and gull predation (Solovieva, 1997). When the lemming population is in a low phase, as in 1997, pomarine skua do not breed. Steller's eider eggs are then rapidly predated, and most of the females do not even attempt to breed. Similar protective nesting patterns are known for several other arctic birds and predators (Litvin et al., 1985; Blomquist and Elander, 1988; Dorogoi, 1990; Summers et al., 1994; Tremblay et al., 1997).

Further investigations in the LDNR should include the long-term monitoring of bird densities in relation to lemming population dynamics and further exploration of the northwestern and northeastern parts of the delta. Such studies could be centred around the IBS station, which is well located between the continental and the delta zones and offers good logistical and scientific facilities.

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