Breeding distribution of Dunlin *Calidris alpina* in Russia

E.G. Lappo & P.S. Tomkovich

Lappo, E.G. & Tomkovich, P.S. 1998. Breeding distribution of Dunlin *Calidris alpina* in Russia. *International Wader Studies* 10: 152-169.

Breeding records and breeding densities available from the literature, museum collections and unpublished data are summarised for six subspecies of Dunlin *Calidris alpina* in Russia. Differences in distribution and habitats found in subspecies and populations are used to outline their breeding ranges. Each subspecies or population has core areas where densities are high and habitats most diverse, but it was not possible to discover such core areas for all subspecies. Maximum densities are not the same in different subspecies, thus *centralis* never reaches densities that are as high as found in *alpina, sakhalina and kistchinski*. Coastal areas are often the most densely populated in European tundra and in the Far East. Dunlin avoid dense stands of dwarf birch possibly because large hydrophilous Enchytraeidae worms, their main food, are scarce there. This is probably the reason for Dunlin having a patchy distribution in southern tundra; only isolated breeding localities on bogs are known in areas where large dwarf-birch tundra belt is present.

E.G. Lappo, Department of Biogeography, Institute of Geography, Russian Academy of Sciences, Staromonethny Per. 29, Moscow 109017, Russia.
P.S. Tomkovich, Zoological Museum of Moscow State University, Bolshaya Nikitskaya Street 6, Moscow 103009, Russia.

Лаппо, Е. Г., Томкович, П. С. 1998. Гнездовое распространение чернозобика *Calidris alpina* в России. *International Wader Studies* 10: 152-169

Обобщены доступные в литературных источниках, музейных коллекциях и неопубликованных данных случаи гнездования и плотность гнездования для шести подвидов чернозобика *Calidris alpina* в России. Найденные различия в распространении и местах обитания у подвидов и популяций используются для того, чтобы определить их гнездовые ареалы. У каждого подвида или каждой популяции есть оптимумы ареала с высокой плотностью и наиболее разнообразными биотопами, но такие зоны не удалось обнаружить для всех подвидов. Максимальная плотность варьирует между различными подвидами, так что подвид *centralis* никогда не достигает такой высокой плотности, какая зарегистрирована для подвидов *alpina*, *sakhalina* и *kistchinski*. Прибрежные районы часто наиболее густо заселены в европейской тундре и в Дальнем Востоке. Чернозобики избегают густых зарослей ерника, может быть, потому что большие гидрофильные червни (Enchytraeidae: основной их корм) там редки. Именно поэтому, вероятно, чернозобики распространены неравномерно в южной тундре; известны лишь отдельные изолированные места гнездования на болотах, в районах, где встречается тундровый пояс с высокими и густыми зарослями ерника.

Introduction

Being a circumpolar species, Dunlin *Calidris alpina* has unprecedented geographic variability among arctic and subarctic birds (Cramp & Simmons 1983) with up to ten subspecies recognised. Knowledge of its breeding distribution is a basic requirement for other studies and conservation purposes: it is surprising, therefore that although short descriptions of this important feature can be found mainly in regional publications or generalised briefly in handbooks, there have been no detailed analyses.

About half the total breeding range of Dunlin is in Russia, with six subspecies distributed from temperate to high arctic areas (Stepanyan 1990), so one can expect that general phenomena can be traced in this part of the range. Available published descriptions of breeding distribution of Dunlin in this vast area are incomplete either because they were based on now partly obsolete data (Gladkov 1951; Kozlova 1961; Uspenski 1969) or because of brevity (Stepanyan 1990). Uspenski (1969) was the first author to outline the breeding range of Dunlin in Russia with the help of vegetation maps, but gave no evidence for his generalisation from records nor did he outline the methods used. A different analysis of Dunlin distribution for north-eastern Asia was given by Kistchinski (1988), based on data collected before the 1980s. He distinguished the core area and more local areas with high densities in sakhalina subspecies and paid attention to the differences in distribution of birds of *centralis* and *sakhalina* subspecies. Nevertheless, there is no detailed account of the breeding distribution of Dunlin in Russia, and this paper aims to fill the gap, as well as summarising more general patterns of the species distribution.

Methods

Data about breeding records, densities and habitats were taken from personal observations from 1972-1992 in different Siberian tundra areas, but the main bulk of data was obtained from numerous publications, mainly in Russian. Eggs and unfledged chicks from the collections of several European Museums were used additionally as breeding records. The most valuable data were found in the Zoological Museum of Moscow University (ZMMU), the British Museum of Natural History (BMNH), and the Zoological Institute of Russian Academy of Sciences in St. Petersburg (ZIR).

The precision, and sometimes quality, of the data differs considerably among publications. Therefore, records of nests, unfledged chicks and fledglings, as well as females containing eggs when they were collected, were considered as cases of proved breeding in a locality. Records of singing males, territorial pairs, birds with distraction displays or alarming constantly (characteristic behaviour near broods) and signs of families with fledged young constitute probable breeding. In some reports breeding criteria are not stated; although in some cases exact records were used, in others this was not the case and so possible breeding was assumed (Figures 1 and 2).

Apart from range contraction in the subspecies *schinzii* due to human activities (Malchevski & Pukinski 1983), no reliable data are available about long term-changes in the breeding distribution of Dunlin in Russia. Changes during this century found by comparing distribution maps in handbooks are the result of improved knowledge, not in bird distribution. Hence we have combined the data collected in different decades and even centuries.

Many different methods have been used for censusing and calculating densities and this makes comparisons between studies very difficult. Densities obtained by territory mapping on defined study plots should give the most reliable data when carried out accurately on quite large plots and at the appropriate time. Nevertheless, these results are probably under-estimates (Soloviev *et al.* 1996) and show only local densities unsuitable for large-scale extrapolations. It is, likely that there is a lower margin of error between mapping data and actual densities than when other methods are used.

Transect censusing methods with fixed or variable distances to recorded birds are in wide use in Russia. Data obtained this way should be more representative of populations in widespread, not local, areas. However, not only are such data influenced by the experience and methods of the observer, but also we do not know how data obtained in this way relates to real figures. Recently an attempt was made to check the latter issue (Soloviev 1995; Soloviev *et al.* 1996). Table 1 shows how widely breeding densities may vary between observers using similar transect methods (Ravkin 1967) and between transect results and those obtained by mapping. It can be seen that, on Vrangel Island, Dunlin densities were found to be five times higher by Stishov *et al.* (1991) than those reported by Dorogoi (1982) with both observers using the same transect method. Data from the Chukotski Peninsula show that mapping produces figures seven or eight times higher than those resulting from transects (Table 1).

Dunlins show strong site-fidelity, at least at Yamal, Taimyr and Chukoski Peninsulas (Ryabitsev 1993; Tomkovich 1994; Soloviev *et al.* 1996; Pyabitsev & Alekseeva 1998) and, as a result, there are no indications of large year-to-year variations in numbers in different localities: any changes are probably due to variations in breeding success and differences in departure times. The largest variation of densities recorded was only three times (0.67 - 2.0 pairs/km^2) during a ten year study on a plot of 4.5 km^2 in typical tundra on the Yamal Peninsula (Ryabitsev 1993). Thus, the between-observer differences on Dunlin densities for the same areas can, in most cases, be explained mainly by different methods of census and calculation. Therefore, we corrected data for the purpose of this paper and reduced Stishov's figures by 80%.

There are other sources of errors in breeding density estimates. For instance the transect census method does not differentiate between local breeders and migrants in a summer bird population (Soloviev 1995, pers. comm.), and usually populations of approximately the first and the second halves of a summer season are considered separately by observers. Authors of publications dealing with census results often do not give details of the status of the birds under study and this leads to further uncertainty. We feel that some of the unusually high breeding densities reported result from censusing migrants as well as breeders. In particular, at least some transect census data of Lobkov (1986) for Kamchatka Peninsula and of Estafiev (1991) for the north-east European tundra seem too high.
As real densities of breeding Dunlins cannot usually be established, we decided to simplify the data by assigning them to low, moderate or high density categories. This reduces errors resulting from different census methods and allows the inclusion of faunistic data, where densities were evaluated only

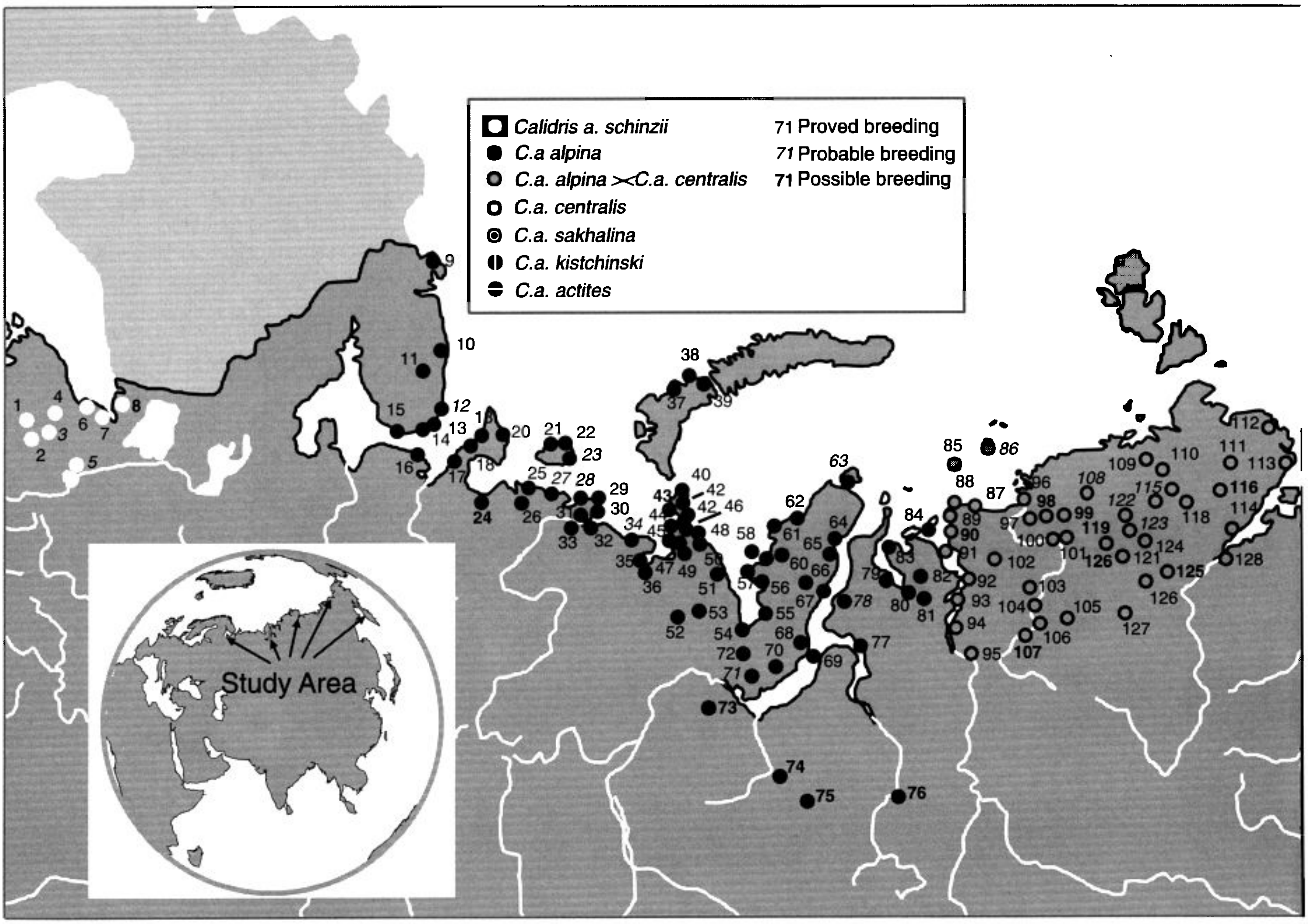

Figure 1a. Breeding records for Dunlin in Russia (Finland Gulf, European Russia, West and Central Siberia). Numbers relate to sites listed in the Appendix.

as rare, common or abundant. By using all available data, it is possible to determine their approximate ranges of each relative density category (Table 2).

To reconstruct the breeding range of Dunlin, we used the landscape extrapolation method (Brunov 1982) or extrapolation with the help of vegetation maps. For this purpose we used data about both the presence and absence of breeding records and also information about breeding habitats. We assumed that the species inhabits the entire area with the same type of vegetation (broad habitat category) shown on the vegetation map. The borders of the breeding range were determined in most cases according to tundra subzones and their type of vegetation. Different approaches to tundra zonation exist in Russia, but we followed the terminology of Gorodkov (1935) included in Chernov (1985): three subzones are recognised within tundra - southern, typical and arctic. In the European part of Russia, southern tundra is often divided into two belts: southern (large dwarf-birch) and northern (low dwarf-birch) (Gribova *et al.* 1980).

The vegetation map of the USSR (Belov *et al.* 1990) was used for most extrapolations. However, several other maps turned out to be more descriptive for some regions. These were Gribova *et al.* (1980) for north European Russia and Sochava (1976) for west Siberia.

We recognised a core area (optimal part according to Brunov 1982) of the species' breeding range, which is characterised by several features (Brunov 1982). In this study, only two features of these were used to discover the core areas: the highest densities of birds and the largest diversity of habitats used for breeding. The maximum level of density for recognition of the core area was lower in *centralis*, than in other subspecies (see Discussion). Preliminary data about varying needs of different subspecies of Dunlin (Kistchinski 1988) alerted us to this difference. Therefore distribution, densities and habitats will be considered according to subspecies and even geographic populations within a subspecies when possible. Subspecific status of Dunlins from the Taimyr Peninsula is not yet quite clear so the Taimyr population is considered separately.

Results

C. a. schinzii

Distribution is sporadic and associated with the

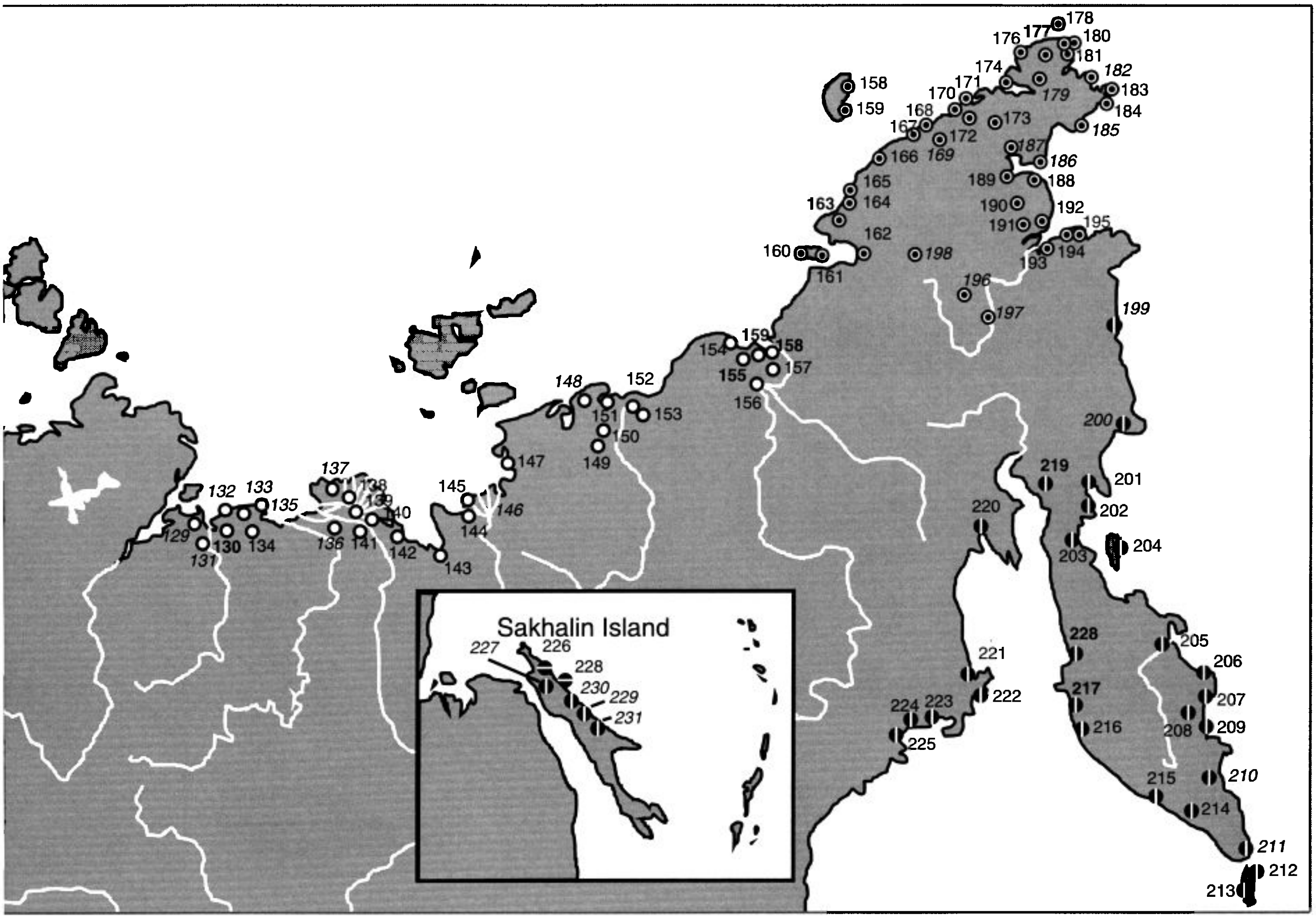

Figure 1b. Breeding records for Dunlin in Russia (East Siberia, Far East and Sakhalin Island). Numbers relate to sites listed in the Appendix.

Baltic region (Figure 1). Breeding is possible further south-east than was previously thought, more precisely at the floodplain of the Ilmen Lake, Novgorod Region (site 8 in Figure 1a) with unique water table fluctuations (Mistchenko & Sukhanova 1998). No densities are available. The few recent records were all made at grazed lowland meadows, but birds bred also on lightly and moderately vegetated marshes in tussocks in the late 19th century (Zarudny 1910).

C. a. alpina

Only a few breeding records are known from the Kola Peninsula. The species breeds in tundra areas which are spread over northern and eastern parts of the region. Dunlins also penetrate the south-eastern part of the peninsula following patches of damp tundra along the sea coast. Distribution is not uniform within the range because of the mountainous area where Dunlins may be too sparse to be found easily or do not breed at all. No breeding is known in the forest tundra. The tundra lowlands with lakes in north-central and eastern Kola Peninsula are the only known areas where Dunlins are common (Mikhailov 1993; Filchagov pers. comm. - see Figure 2a). Within the former area, in the upper reaches of the Yokanga River (site 11 in Figure 1a), they are even locally numerous where bogs with peat hillocks are available. Moss-sedge lake-side marshes and tussock tundra are among other favoured habitats.

In the region between the White Sea and the Pechora River, Dunlins are widely distributed in tundra landscapes but in varying numbers. They are rare in the southernmost coastal tundra areas (Figure 1a) and were not found breeding in the southern part of the Kanin Peninsula, but were common further north. The only mainland area where Dunlins were reported as common was Shoyna, NW Kanin (site 18 in Figure 1b; Avdanin, Filchagov, Leonovich, Vinogradov & Glukhovsky pers. comm.), but the area north and north-west from the Pechora River delta also seems to hold good numbers. The species is especially abundant on Kolguev Island (Morozov & Syroechkovsky Jr., pers. comm.). Damp tundra of different kinds forms breeding habitats, but the concentration near Shoina is on the fringe of the coastal marshes.

Further east in Europe, the southern limit of the Dunlin breeding range according to Morozov (in press) passes within the large dwarf-birch tundra belt recognised as the southern tundra subzone of

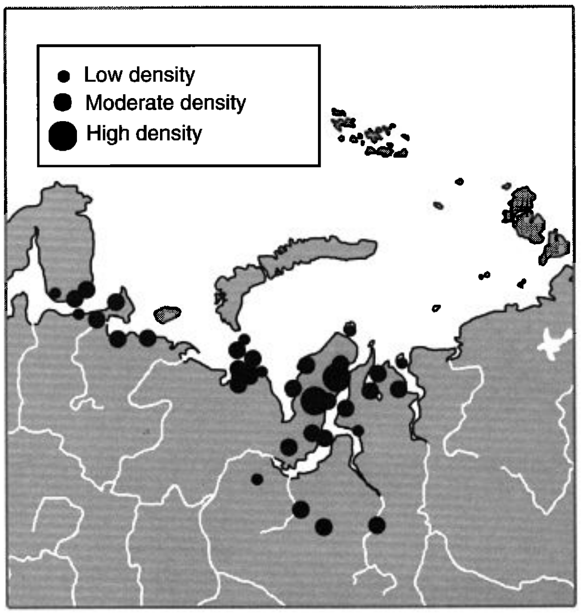

Figure 2a. Densities of breeding Dunlins in European Russia and West Siberia.

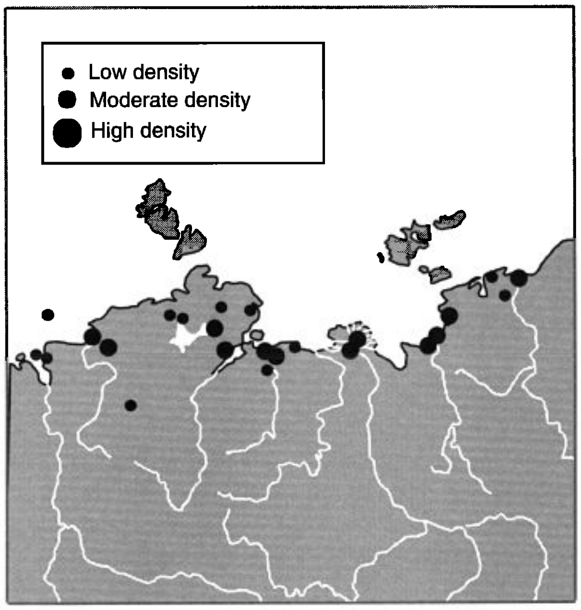

Figure 2b. Densities of breeding Dunlins in Central and East Siberia.

the region. However, only isolated breeding records are known within this belt. The species is common only in the typical tundra subzone of both the mainland and Vaigach Island (Figure 3). Further south, it is common only in coastal areas and is only a rare breeder inland. The prefered habitat is *Sphagnum* bog with sparse cotton grass (*Eriophorum* spp.) and sedge (*Carex* spp.) vegetation, and with flat peat hillocks. It seems that Dunlins are locally numerous at coastal moss-sedge tundra with lakes, but it is difficult to be certain from the data presented by Estafiev (1991).

Dunlins are known to breed in almost the entire Yamal Peninsula. They are very rare in southern parts, but common and locally numerous in the central and northern parts of the peninsula (Danilov *et al.* 1984). The birds are most abundant in plain moderately humid areas of tundra with sedges and

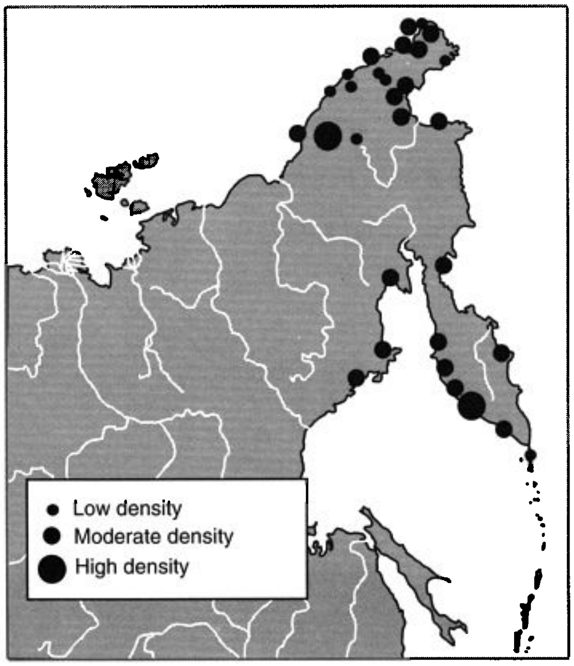

Figure 2c. Densities of breeding Dunlins in the Russian Far East.

grasses, with higher densities on uplands. Further east on the Tazovski and Gydanski Peninsulas, the species distribution is similar to that outlined for Yamal, but the densities reported are lower (Figure 2a). Dunlins were not found breeding on Tazovski within the large dwarf-birch tundra belt, they were rare in the low dwarf-birch tundra belt of the southern tundra subzone of Gydanski, but were common to the north. In the arctic tundra of Sibiryakov Island (site 84 in Figure 1a), they were quite rare (Figure 2a). Moss-sedge tussock tundra on slopes, and damp tundra with pools in depressions or lakes are among the best breeding habitats (Chernichko *et al.* 1994).

A separate breeding population of Dunlin, probably belonging to the nominate subspecies, was found recently on extensive palsa bogs sometimes with scattered depressed pine trees *Pinus sibirica* within the northern taiga natural zone of West Siberia (Vinogradov *et al.* 1991). Densities vary, locally reaching moderate values. No areas are known where the palsa bog and the tundra populations of Dunlin meet.

C. a. alpina>< *C. a. centralis*

Dunlins are widely distributed through the Taimyr Peninsula through the southern and typical tundra subzones penetrating along large rivers, western and eastern coasts into southern parts of the arctic tundra subzone and even on Sverdrup Island (site 85 in Figure 1a) within the high arctic. No Dunlins were found in open bogs within forest-tundra, northern taiga, or in mountain tundra on Putorany Plateau. There was only a single breeding record of a single brood at the northern limit of forest-tundra (site 105 in Figure 1a).

High densities were found in suitable habitats in most places studied in western and central Taimyr

(Figure 2b) within the typical tundra subzone and near the Dudypta River mouth, western Taimyr, southern tundra subzone (site 106 in Figure 1a). Within typical tundra at eastern Taimyr, Dunlins are common near the Tonskoye Lake (site 126 in Figure 1a) in southern tundra. In border sites of the range, densities are low, and an average density (Figure 2b) was only found in the Pyasina delta area (site 96 in Figure 1a). Polygonal bogs and areas where dry tundra is interspersed with bogs and marshes have high densities of Dunlin. Only patches of such complex habitats are occupied by Dunlins at the northern border of the breeding range (pers. obs. at sites 85, 89 & 126 in Figure 1a). Both uplands with drier habitats and floodplains in areas with generally high densities are less populated.

C. a. centralis

This subspecies, not often recognised outside Russia, covers an area from at least the Khatanga River in the west to the Kolyma delta in the east. Breeding distribution is not fully known. Nevertheless, it is clear that in this region, as in the Taimyr, Dunlins are distributed from the tree-line formed by *Larix dahurica* northward through the southern and typical tundra subzones, and were found in southern parts of the arctic tundra close to the Indigirka River delta and near the Anabar River mouth (Figure 1a). However, the species was not recorded in the southern tundra subzone near the Anabar River (Gladkov & Zaletaev 1965) nor in the Yana delta (Kistchinski 1988; Syroechkovski Jr., pers. comm.). Spring records on Bolshoi Lyakhovsky Island (Rutilevsky 1958) do not necessarily indicate possible breeding on the New Siberian Archipelago. Birds do not breed within the forest-tundra even on extensive tundra-like bogs (Kistchinski 1988; Sorokin pers. comm.).

Unlike both the Taimyr population and *sakhalina* subspecies, no areas are known where *centralis* reaches high breeding densities, even locally. The only site with a locally high breeding density (12.7-16.9 pairs/km^2 on a plot in different years) was found near the mouth of the Khatanga River (site 128 in Figure 1a) (Soloviev 1995; Soloviev *et al.* 1996) probably belonging to the Taimyr population. Birds were found to be common only in a few places in the western half of the subspecies range (Figure 2b). They occupy plain tundra with a mixture of damp, wet and dry areas with dwarf shrubs; these are usually polygonal marshes or marshes with peat hillocks or ridges. When Dunlins breed in dry tussock or moss-lichen tundra, this is always close to marshes where they feed and to which they lead their young (Kondratiev 1982; Leonovich pers. comm.; pers. obs.). Even in the southernmost areas *centralis* avoids habitats with tall shrubs (Kistchinski 1988; pers. obs.).

C. a. sakhalina

No Dunlins are known to breed for at least 150 km east from the Kolyma Delta (Tundra Ecology -94 expedition data). The breeding range of *sakhalina* subspecies starts further east (Tomkovich 1986), occupying Aion Island, Vrangel Island, northern coastal mainland, Chukotski Peninsula and the Anadyr lowland. Chaun lowland in the north-west of the region supports a high-density population in a range of tundra habitats (Kondratiev 1982; Kretchmar *et al.* 1991). In a part of the northern coast of the mainland with arctic tundra, Dunlins are common in several areas and they are even locally numerous in arctic tundra on Vrangel Island. Similarly, they are locally abundant in different coastal areas of the Chukotski Peninsula and in coastal parts of the Anadyr lowland (Figure 2c), which belong to the typical and southern tundra subzones. Birds are most abundant in places where tussock tundra is formed mainly by *Eriophorum vaginatum* and is interspersed with marshy depressions and lakes. They readily use polygonal bogs and bogs with peat hillocks which are usually not extensive in the region. Our personal observations have shown that dwarf willow *Salix fuscescens* is characteristic of preferred habitats on the Chukotski Peninsula.

Dunlins are rare, or only locally common, in mountain areas with predominantly dry habitats, such as in the Amguema River valley (sites 171-173 in Figure 1b), (Portenko 1972; Dorogoi 1993a). This partly explains the absence or low densities of Dunlins in valleys less than 100 km inland from the northern mainland coast: Ekaenmyvaam River (69° 73'N; 177° 10'E), lower and middle Ekvyvatap River (sites 168 & 170 in Figure 1b), Kychakvaam and Pegtymel Rivers (65° 35'N 177° 50'E), and lower Kaveem River (69° 40'N 174° 30'E) (Stishov pers. comm.). Dunlins, do however breed, although at low density, in mountain tundra at elevations of 450-500 m a.s.l. in the Elgygytgyn Lake depression (site 198 in Figure 1b; Dorogoi 1993b) in the central part of the mountain region. The species was also found breeding at low density in non-flooded parts of the plain of the middle Anadyr River (sites 196 & 197 in Figure 1b), where Beringian forest-tundra is characteristic. Birds occupy extensive tundra-like polygonal bogs and lake-side marshes there, among areas covered by sparse dwarf pine trees *Pinus pumila* and tall shrubs of *Alnus fruticosa, Betula Middendorffii* (Kretchmar *et al.* 1991).

C. a. kistchinski

This recently recognised subspecies (Tomkovich 1986; Browning 1991) is known from the Kamchatka Peninsula, the southern Koryak Highland, the northern coast of the Sea of Okhotsk and the northern Kuril Islands (Figure 1b). Lack of data precludes details of distribution but it is clear from the counts of Lobkov (1986) and brief personal experience, that the lowland coastal belt with tundra landscape and numerous bogs and lakes along the western side of Kamchatka is quite densely populated by Dunlins. These waders have the same high breeding density in lowlands with similar habitats on the Kamchatka isthmus and probably near Gizhiga (site 220 in Figure 1b), north-east of the

Sea of Okhotsk (Figure 2c). Mountainous landscape with woodlands in eastern Kamchatka and on the northern coast of the Sea of Okhotsk, and the mountains of Koryak Highland do not leave much space for Dunlin habitat. Only small patches of coastal lowlands, usually near the mouths of rivers and near lagoons, are inhabited by Dunlins in these areas resulting in a discontinuous breeding range. Nevertheless, Lobkov (1986) considers Dunlin as a breeding species of Eastern Kamchatka also at altitudes of 400 to 650 m a.s.l. near lakes and in mountain depressions (site 208 in Fugure 1b).

In the Koryak Highland Dunlins are known only from coastal areas and are completely absent from inland mountain tundra valleys even in quite suitable habitats (Kistchinski 1980, 1988; pers. obs.). Therefore the breeding ranges of *kistchinski* and *sakhalina* seem connected only by a chain of narrow coastal lowlands inhabited by Dunlins, although only a few breeding records are known from there.

A wide range of breeding habitats has been described for birds of this subspecies. They breed on dry places in areas flooded irregularly by sea water (Leonovich pers. comm.), sometimes even on gravel with sand spits, on coastal meadows with dwarf shrubs (Gerasimov & Vyatkin 1973) and on different kinds of bogs. The main habitat, however, is the tussocky tundra with dwarf shrubs and with lakes interspersed with pools, as well as bogs with pools and ridges. Dwarf willow *Salix uscescens* was found in preferred habitats in Western Kamchatka (pers. obs.). Frequently, Dunlins can be found in places where such habitats are in forests (mainly *Betula ermanii*) or are covered with scattered tall shrubs of *Alnus kamchatica* and *Salix* spp. Lobkov (1986) states that the density of Dunlins on Kamchatka is directly related to the wetness of the tundra habitats and the number of lakes.

C. a. actites

The breeding grounds of Dunlin on Sakhalin Island were only found in 1975 (Nechaev 1979, 1991) and the birds were described as a separate subspecies, very distinct from *sakhalina* and *kistchinski* (Nechaev & Tomkovich 1987, 1988). There are no indications so far of a possible connection between the breeding ranges of *actites* and *kistchinski*; breeding Dunlins were not found near tidal meadows north from the Amur River mouth on the mainland (Babenko pers. comm.). On Sakhalin, Dunlins occupy tundra-like boggy habitats with numerous lakes spread on flat islets, and in narrow coastal areas of the north-east and probably in a few places in the northern and north-western parts of the island where numerous lagoons and shallow bays occur. Crowberry *Empetrum sibiricum* and dwarf willow *Salix fuscescens* are characteristic for elevations on bogs where Dunlins place their nests (Nechaev 1979, 1991; Nechaev & Tomkovich 1987). Blokhin (1998) states that Dunlin begin to breed well before the vegetation of helophytes starts, and, as a result, their population is rather stable even in dry seasons and birds are able to raise chicks before the period of summer heat.

A locally moderate density in Chaivo Bay (site 228

Table 1. Comparisons of breeding densities of Dunlins on the same or nearby areas obtained by different observers and/or methods.

Area and habitat	Method	Density (pairs/ km²)	Density (birds/ km²)	Source
Sibiryakov Island, Yenisei Bay				
Coastal lowland tundra	plot	*c.* 2.0		Chylarecki & Sikora pers. comm.
	transect		1.5	Koshelev pers. comm.
Logata Mouth, Central Taimyr				
Polygonal tundra	transect	68.0		Gavrilov pers. comm
	transect		16.1	Chupin pers. comm.
Malaya Logata Mouth, C. Taimyr				
Polygonal tundra	transect	44.9		Chupin pers. comm.
	transect		17.8	Gavrilov pers. comm
Novorybnaya, SE Taimyr				
Moss watershed near	plot	16.9		Soloviev (1995)
polygonal tundra	transect		4.6	Soloviev (1995)
Vrangel Island				
Moss-sedge tussock tundra	transect	15.0		Dorogoi (1982)
	transect		80-150	Stishov *et al.* (1991)
Northern Chukotski Peninsula				
Dry patchy coastal tundra and	plot	2-5		Tomkovich, unpubl.
dump tussock tundra	transect		10-50	Kondratyev (1982)
Uelen, Chukotski Peninsula				
Tussock tundra	transect	2-3		Kuzyakin in Portenko (1972)
	plot		17.8-23.4	Tomkovich & Sorokin (1983)

Table 2. Ranking of breeding densities of Dunlins, characterised by different survey methods.

Categories of density	Plot and transect (pairs/km²)	Transect (individuals/km²)	Transect (individuals/m)	Faunistic data
Low	<1	<2	<1	rare
Moderate	1-10	2-20	1-5	common
High	>10	>20	>5	abundant

in Figure 1b) was the only estimation for this rare subspecies (Blokhin 1998). The total number of birds in the population is *c.* 300 breeding pairs (Nechaev & Tomkovich 1987).

Discussion

The breeding distribution of Dunlin has been comparatively well studied in Russia considering the vast areas involved (Figure 1), but of course it is far from the detailed information available for western Europe (Cramp & Simmons 1983; Gjershaug *et al.* 1994; Hagemeijer & Blair 1997). It is unlikely that the situation will improve greatly in the near future. Nevertheless, the general characteristics of species distribution and, to a lesser extent, of densities are more or less clear for most of the regions described. These, together with the understanding of the environmental needs of the species, provide a fairly accurate picture of the distribution of Dunlin by a generalisation of available data. As stated above (see Methods) Dunlin is a conservative species with strong site tenacity and small density fluctuations. This leads to a relative stability of breeding range limits and a rarity of sites with irregular breeding, which happens with some other waders (Kistchinski 1988; Ryabitsev 1993).

The differences found in distribution patterns and environment demands of subspecies, and sometimes populations, of Dunlin must be borne in mind. The Baltic population of *schinzii* differs most from other subspecies, being mainly a temperate meadow bird. Nominate *alpina* is the most polytypic subspecies regarding distribution among those under consideration. Thus, the population of Kola Peninsula inhabits damp tundra and bogs just near the forest-tundra, while further east from Kanin Peninsula to the Yenisey only a few sporadic records are known within the large dwarf-birch belt of southern tundra close to forest-tundra. In the latter region, the main populations are concentrated in typical tundra and the southernmost part of arctic tundra subzones, and in coastal areas within the European part of the range. The Yamal population has high breeding densities on watersheds whilst on the Taimyr the main concentrations of Dunlin are on lowlands. The Yamal population, as expected, spans almost the whole arctic tundra of the peninsula, whereas at the Taimyr the species penetrates to the subzone only along valleys of large rivers.

It is almost certain that the breeding ranges of the palsa bog and tundra populations are separated in West Siberia. On Taimyr, where an intergradation of *alpina* and *centralis* is likely, Dunlins are found again in southern tundra close to the northern tree-line in good densities, but not on bogs within forested areas. The population shows a tendency to lower densities in the eastern part of the peninsula which probably reflects the general feature of *centralis* not to have high densities throughout its range.

Unlike *centralis*, high densities are characteristic of the easternmost subspecies *sakhalina* and *kistchinski* in favourable habitats. This difference between *centralis* and *sakhalina* was stressed by former observers (Vorobiev 1963; Kistchinski 1988). Dunlins of both Far Eastern subspecies mentioned can breed in boggy habitats with tall shrubs among forests, although in low densities. It is surprising that neither northern subspecies nor the southern one have spread into tundra of the central parts of the Koryak Highland situated between their ranges. Coastal areas support the highest densities and the widest distribution of these Dunlins. The *actites* subspecies of Sakhalin Island is exclusively coastal with adults breeding on tundra-like bogs but probably feeding for the whole season mainly on tidal areas, unlike Dunlins of all other subspecies which rely almost exclusively on tundra or boggy habitats.

An interesting hypothesis was advanced by Andreeva (pers. comm.) to explain the southern limit in distribution of tundra Dunlin populations. According to her unpublished studies (see also Kondratyev 1982; Kondratyev & Kondratyeva 1988) large hydrophilous Enchytraeidae worms are one of the few basic foods of Dunlins breeding in tundra, and these worms are common or numerous in damp or wet mosses with sedges, cotton-grass and sometimes with willows, but are almost absent in soils where dwarf birches (*Betula nana, B. exilis*) form a dense mat as these plants cause drying out of the soil. Therefore, Dunlins cannot live in areas with dense stands of dwarf birch. The breeding distribution of Dunlins agrees well with this hypothesis: the tall dwarf-birch tundra belt of the southern tundra dominated by *Betula nana* found between the White Sea and the Yenisei is almost free of Dunlins, the few isolated records (Figures 1 and 3) come from bogs where dwarf willows and other dwarf shrubs predominate. When Dunlins were found close to the northern tree-line (Kola Peninsula, Taimyr, Indigirka basin, upper Anadyr), large boggy areas are present. Similarly, Stishov (pers. comm.) did not find breeding *sakhalina* Dunlins in several inland areas close to the northern mainland coast (see Results) where the tundra has

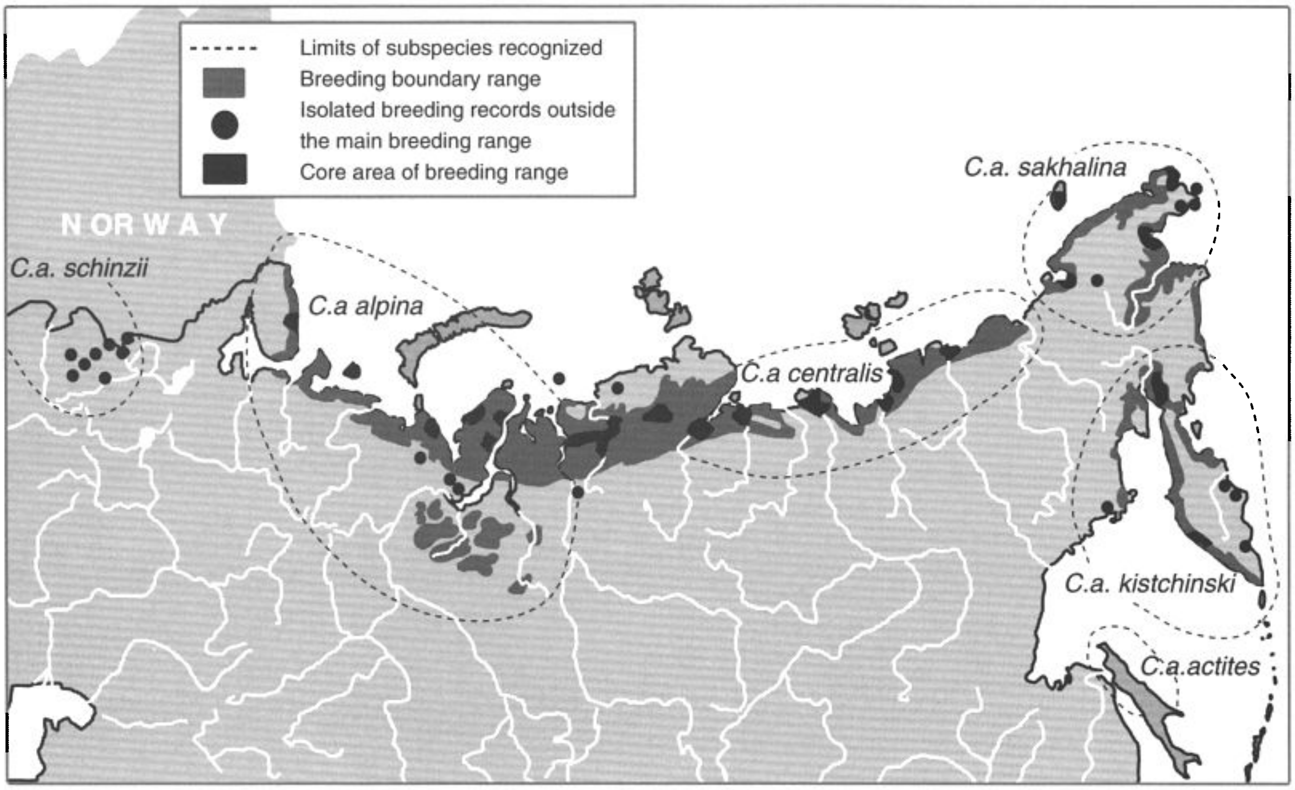

Figure 3. Reconstructed breeding ranges of Dunlin subspecies.

dense *B. exilis* stands.
These features and peculiarities of distribution, were used to outline the breeding range of Dunlin in Russia (Figure 3). This final map is not exhaustive of course, and further revision is necessary. Known areas where the species has high densities are also indicated on the map. However for *centralis*, characterised in general by lower densities, areas with moderate, not high densities are shown. Birds in such areas usually occupy the largest diversity of habitats, and that is why these can be considered as core areas of populations or subspecies.

The core area of *schinzii* most probably lies outside Russia. Lack of data prevents the delineation of core areas for *actites* and the palsa bog population of *alpina* in west Siberia. Of course, not all areas with high densities of breeeding birds have been found for other subspecies and populations, but the distribution of already known core areas, in our opinion, reflects the general situation quite well. Thus, among several small areas with high densities in the European range of *alpina*, the easternmost one probably belongs to the Yamal population where the core area can be expected to cover larger parts of the peninsula between 69° and 72°N. Western and central Taimyr contain extensive concentrations of Dunlins. For *sakhalina*, considerable differences can be found in the distribution of the areas with high densities shown by Kistchinski (1988) compared with Figure 3. This is the result of a different classification: areas where Dunlins were either abundant or common were considered by Kistchinski to be those with high densities. It is clear that the population in the Chaun Lowland is separate from that of the Chukotsky Peninsula and adjacent areas (see Tomkovich 1986 for morphological differences). It remains uncertain if the core areas shown for Kamchatka belong to different geographic populations, or to a single one stretching along the western side of the peninsula.

Definition of such core areas is interesting not only from a scientific point of view, indicating the density centres of populations, but is also important for conservation purposes. These areas with high densities provide the main stock of populations, and the general reproductive success and well-being of the populations is dependent primarily on the situation in these core areas. Any necessary conservation measures should be concentrated in these areas of major importance for the species.

Acknowledgements

We thank sincerely all our colleagues who made their unpublished data on Dunlin breeding densities and/or distributions available to us: V.O. Avdanin, A.Yu. Blokhin, Yu.Yu. Blokhin, G.C. Boere, I.I. Chupin, P. Chylarecki, I.V. Dorogoi, A.V. Filchagov, A.A. Gavrolov, V.V.Grichik, V.N. Karpov, Ya.I. Kokorev, A.V. Kondratiev, N.B. Konyukhov, A.I. Koshelev, Yu.P. Kozhevnikov, V.V. Leonovich, K.E. Mikhailov, V.V. Morozov, V.V. Nikolaev, I.V. Pokrovskaya, A.A. Romanov, G.T. de Roos, Yu. Roschevski, V.Yu. Semashko, A. Sikora, M.Yu. Soloviev, A.G. Sorokin, M.S. Stishov, E.E. Syroechkovki Jr., T.V. Sviridova, A.V. Tikhonov, V.G. Vinogradov, A.E. Volkov, P. Yesou and V.S. Zhukov. We particularly thank T.R. Andreeva for being permitted to use her ideas about the reasons for Dunlin distribution patterns. We thank S. Pushkaryov for his help with maps for our figures.

References

Allen, J.A. 1905. Report on the birds collected in north-eastern Siberia by the Jesup North Pacific expedition, with field notes by the collectors. *Bull. Amer. Mus. Nat. Hist.* 21: 219-257.

Belov, A.V., Gribova, S.A. & Kotova, T.V. 1990. *Vegetation map of the USSR*. Scale 1:4 000 000. Minsk, GUGK. In Russian.

Bianki, V.V., Krasnov, Yu.V. & Sorokin, V.E. 1982. Additional data on waders of the White Sea. *Ornitologiya* (Moscow) 17: 159. In Russian.

Bianki, V.V. & Krasnov, Yu.V. 1987. Materials to the knowledge of birds in the Pechora Delta area (Non-Passeriformes). *Ornitologiya* (Moscow) 22: 148-155. In Russian.

Blokhin, A.Yu. 1998. Breeding wader populations on the marine coasts of north-eastern Sakhalin. *International Wader Studies* 10: this volume.

Blokhin, Yu.Yu. & Blokhin, A.Yu. 1986. New data on breeding of waders in the Lena River delta. *In*: I.G. Solomonov (ed.), *Teriology, ornithology and nature conservation*, pp. 92-93. Abstracts of XIth All-Union Symposium "Biological Problems of the North". Yakutsk, USSR Acad. Sci. In Russian.

Browning, M.R. 1991. Taxonomic comments on the Dunlin *Calidris alpina* from northern Alaska and eastern Siberia. *Bull. B.O.C.* 111(3): 140-145.

Brunov, V.V. 1982. Methods of quick compilation of maps for ranges of birds. *Bull. of Moscow Soc. of Naturalists, Biol. Section*. 87(6): 66-73. In Russian.

Buzun, V.A. & Merauskas, P. 1993. Ornithological findings in eastern part of the Gulf of Finland. *Russ. J. Ornith.* 2(2): 253-255. In Russian.

Chernichko, I.I., Syroechkovski Jr., E.E., Chernichko, R.N., Volokh, A.M. & Andryushchenko, Yu.A. 1994. Contributions to fauna and populations of birds in the North-Eastern Gydan. *In*: E.V. Rogacheva (ed.), *Arctic tundras of Taimyr and Kara Sea islands: nature, fauna and conservation problems*, pp. 223-260. Inst. Ecol. and Evol., Russian Acad. Sci., Moscow. In Russian.

Chernov, Yu.I. 1985. *The Living Tundra*. Cambridge University Press, Cambridge.

Cramp, S. & Simmons, K.E.L. (eds.). 1983. The birds of the Western Palearctic. Vol. 3. Oxford, Oxford University Press.

Danilov, N.N., Ryzhanovsky, V.N. & Ryabitsev, V.K. 1984. *Birds of Yamal*. Moscow, Nauka. 333 pp. In Russian.

Dorogoi, I.V. 1982. Biotopical distribution of breeding birds in the tundra of Wrangel Island. *Ornitologiya* (Moscow) 17: 119-124. In Russian.

Dorogoi, I.V. 1993a. Fauna and population of birds. In: D.I. Bergmann (ed.), *Ecology of the Amguema River Basin (Chukotka)*. Part 1, pp. 140-163. Russian Acad. of Sci., Far-Eastern Branch, Vladivostok. In Russian.

Dorogoi, I.V. 1993b. The bird fauna in the vicinity of the Elgygytgyn Lake and upper Enmyvaam River. *In*: V.F. Bely & I.A. Chereshnev (eds.), *The nature of the Elgygytgyn Lake Basin (the problems of study and conservation*, pp. 178-189. Russian Acad. of Sci., Far-Eastern Branch, Magadan. In Russian.

Estafiev, A.A. 1983. Biotopical distribution and numbers of waders in the north-eastern European part of the USSR. *In*: I.V. Zaboeva (ed.), *Bird population structure in European North-East of the USSR*. Annals of Komi Branch of the USSR Acad. of Sci. No. 62 pp. 30-38. USSR Acad. of Sci., Syktyvkar. In Russian.

Estafiev, A.A. 1991. *Fauna and ecology of waders in Bolshezemelskaya Tundra and Yugorsky Peninsula*. Leningrad, Nauka. 145 pp. In Russian.

Firsova, L.V. & Leveda, A.V. 1982. Ornithological findings on the southern Koryak Highland. *Ornitologiya* (Moscow) 17: 112-118. In Russian.

Gavrilov, A.A. 1989. Bird species composition and population characteristics for the Malaya Logata River valley (Central Taimyr). *In*: A.I. Solomakha (ed.), *Mammals and birds of northern Central Siberia: morphology, ecology, and rational use*, pp. 157-162. Inst. for Agriculture of the Extreme North, Novosibirsk. In Russian.

Gavrilov, V.V. 1996a. Pukhovy Bay, South Island, Novaya Zemlya (72°40N; 52°45E). *In*: P.S. Tomkovich (ed.), Breeding conditions for waders in Russian tundras in 1994. *Wader Study Group Bull.* 79: 73.

Gavrilov, V.V. 1996b. Breeding conditions for waders in the tundras of Russia in 1995: Yugorsky Peninsula. *In*: P.S. Tomkovich (ed.), *Information Materials of the Working Group on Waders* 9: 23-24. In Russian.

Gerasimov, N.N. 1968. Breeding of Red-necked Phalarope at Kamchatka Peninsula. *Ornitologiya* (Moscow) 9: 344-345. In Russian.

Gerasimov, N.N. & Vyatkin, P.S. 1973. New data on breeding of waders in Kamchatka. *In*: V.E. Flint (ed.), *Fauna and Ecology of Waders* 2: 25-28. Moscow Univ. Press, Moscow. In Russian.

Gerasimov, N.N., Sokolov, A.M. & Tomkovich, P.S. 1992. Birds of the ornithological sanctuary "Moroshechnaya River", Western Kamchatka. *Russ. J. Ornithol.* 1(2): 157-208. In Russian.

Gjershaug, J.O., Thingstad, P.G., Eldøy, S. & Byrkjeland, S. (eds.) 1994. *Norsk Fugleatlas*. [*Norwegian Bird Atlas*]. Norsk Ornitologisk Forening, Klæbu. 552 pp.

Gladkov, N.A. 1951a. Birds of Timanskaya tundra. *In*: S.S. Turov (ed.), *Archives of Zool. Mus. of Moscow Univ.*, 7: 15-89. Moscow Univ. Press, Moscow. In Russian.

Gladkov, N.A. 1951b. Order Limicolae. *In*: G.P. Dementiev & N.A. Gladkov (eds.), *Birds of Soviet Union*, pp. 3-372. Sovetskaya Nauka Press, Moscow: In Russian.

Gladkov, N.A. 1958. Birds of Yakutia north from the Arctic Circle (Tiksi Bay). *In*: D.I. Scherbakov (ed.). *Problems of the North*, 2: 169-193. USSR Acad. of Sci. Press, Moscow. In Russian.

Gladkov, N.A. & Zaletaev, V.S. 1965. Bird observations in Anabar tundras (Arctic Yakutia, North-West). *In*: N.A. Gladkov (ed.), *Archives of Zool. Mus. of Moscow Univ.*, 9: 38-62. Moscow Univ. Press, Moscow. In Russian.

Glushchenko, Yu.N. 1984. Materials on the ornithofauna of south-eastern Kamchatka. *Ornitologiya* (Moscow) 19: 177. In Russian.

Gorodkov, B.N. 1935. *Tundra zone vegetation of the USSR.* USSR Acad. Sci. Publ. House, Leningrad. 142 pp. In Russian.

Gribova, S.A., Isachenko, T.I. & Lavrenko, E.M. (eds.) 1980. *The vegetation of the European part of the USSR.* Nauka, Leningrad. 430 pp.

Gritchik, V.V. 1995. On the fauna and breeding performance of birds of Yugorsky Peninsula (extreme north-east of the European Russia). *In*: I.K. Lopatin (ed.), *Fauna and taxonomy. Archives of Zool. Mus. of Byelorussian Univ.*, Vol. 1, pp. 271-288. Nauka i tekhnica, Minsk. In Russian.

Hagemeijer, E.J.M. & Blair, M.J. (eds.) 1997. *The EBCC atlas of European breeding birds: their distribution and abundance.* T. & A.D. Poyser, London. 903 pp.

Hötker H. 1995. Avifaunistical records of the WWF expeditions to Taimyr in the years 1989, 1990 and 1991. *In*: P. Prokosch & H. Hötker (eds), Faunistik und Naturschutz auf Taimyr - Expeditionen 1989-1991. *Corax* 16: 34-89.

Kalyakin, V.N. 1986. Birds of interriver area of Baydarata and Enzor-Yakha rivers. *In: Fauna of vertabrate animals of Ural mountaines and adjacent areas*, pp. 96-102. Yural University Press, Sverdlovsk. In Russian.

Kalyakin, V.N. 1994. European Arctic (from Kanin Nos Point to Yugorsky Peninsula and the Vaigach). *In*: P.S. Tomkovich (ed.), Breeding conditions for waders in Russian tundras in 1993. *Wader Study Group Bull.* 75: 28.

Karpov, V.N., Syroechkovski, E.E. Jr., Sviridova, T.V., Frohlich, D.R. & Dorogov, V.F. in press. Bird fauna of the area of the Tonskoe and Labaz Lakes (North-Siberian Lowland). *In*: H.V. Rogacheva (ed.), *Birds and mammals of Taimyr and Putorana mountains.*

Kapitonov, V.I. 1962. Ornithological observations in low reaches of Lena river. *Ornitologiya* (Moscow) 4: 40-63. In Russian.

Khrabry, V.M. 1984. Results of faunistic studies in Vyborg Reserve. *In*: M.I. Falkovich & V.M. Khrabry (eds.), *Annals of the Zoological Institute*, 123: 116-146. Zool. Inst., USSR Acad. of Sci., Leningrad. In Russian.

Kiryuschenko, S.P. 1973. On the biology and numbers of waders on Chukotski Peninsula. *In*: V.E. Flint (ed.), *Fauna and ecology of waders*. Part 2, pp. 37-41. Moscow Univ. Press, Moscow. In Russian.

Kistchinski, A.A. 1968. *Birds of Kolamsky Highland.* Nauka, Moscow. 188 pp. In Russian.

Kistchinski, A.A. 1980. *Birds of Koryak Highland.* Nauka, Moscow. 336 pp. In Russian.

Kistchinski, A.A. 1988. *Avifauna of North-East Asia: history and modern state.* Nauka, Moscow. 288 pp. In Russian.

Kistchinski, A.A., Tomkovich, P.S. & Flint, V.E. 1983. The Birds of Kanchalan River basin, Chukotsk Autonomous Area. *In*: V.E. Flint & P.S. Tomkovich (eds.), *Archives of Zool. Mus. of Moscow State Univ.* Vol. 21, pp. 3-76. Moscow Univ. Press, Moscow. In Russian.

Kokhanov & Skokova. 1967. Fauna of birds on Anovy Islands. *In*: N.N. Kartashov (ed.), *Annals of the Kandalaksha State Nature Reserve,* Vol. 5, pp. 185-267. Moscow, Lesnaya Promyshlennost. In Russian.

Kokorev, Ya.I. 1983. Ornithofauna of the Pura River basin (Western Taimyr). *In*: B.M. Pavlov (ed.), *Birds of Taimyr (ecology, conservation and practical use)*. Sci.-technical Bull., Issue 7, pp. 15-19. Siberian Sect. of Acad. Agric. Sci., Novosibirsk. In Russian.

Kokorev, Ya.I. & Lisenko, E.V. 1989. Avifauna of the middle reaches of the Binyuda and Tareya rivers (western Taimyr). *In*: A.I. Solomakha (ed.), *Mammals and birds of northern Central Siberia: morphology, ecology, and rational use*, pp. 151-157. Inst. for Agric. of the Extreme North, Novosibirsk. In Russian.

Kolonin, G.V. 1980. Ornithological observations at Chukotka and Wrangel Island. *Ornitologiya* (Moscow) 15: 197-200. In Russian.

Kondratyev, A.Ya. 1982. Biology of waders in tundras of the North-East of Asia. Nauka, Moscow. In Russian.

Kondratyev, A.Ya. & Kondratyeva, L.F. 1988. Some results of the helminthological examinations for the analysis of trophic in waders. *In*: V.E. Flint & P.S. Tomkovich (eds.), *Waders in the USSR: Distribution, biology and conservation*, pp. 73-82. Nauka, Moscow. In Russian.

Kozhevnikov, Yu.P. 1982. The influence of landscape changes on the avifauna in the southeastern part of the Byrranga Mountains (Taimyr). *Spatial structure of ecosystems.* Issue 12: 110-119. Nauka, Leningrad. In Russian.

Kozlova, E.V. 1962. Charadriiformes. Suborder Limicolae. *In*: *Fauna of the USSR.* Birds. Vol. 2, issue 1, part 3. Academy of Sci. of the USSR, Moscow & Leningrad. In Russian.

Kretchmar, A.V. 1966. Birds of western Taymyr. *Annals of the Zoological Institute, USSR Acad. Sci.*, Vol. 39, pp. 185-312. Biology of birds. Nauka, Leningrad. In Russian.

Kretchmar, A.V., Andreev, A.V. & Kondratyev, A.Ya. 1991. *Birds of northern plains.* Nauka, Leningrad. In Russian.

Labutin, Yu.V., Degtyarev, A.G. & Blokhin, Yu.Yu. 1985. Birds. *In*: Andreev, V.N. (ed.), *Plant and animal world of the Lena River delta*, pp. 88-110. USSR Acad. of Sci., Yakutsk. In Russian.

Lobkov, E.G. 1986. *Breeding birds of Kamchatka.* Far-Eastern Branch, USSR Acad. of Sci., Vladivostok. In Russian.

Malchevski, A.S. & Pukinski, Yu.B. 1983. *Birds of Leningrad Region and adjacent areas: history, biology, conservation.* Vol. 1. Leningrad Univ. Press, Leningrad. In Russian.

Malyshevski, R.I. 1962. Summer observations on birds of Terski coast of the White Sea. Ornitologiya (Moscow) 5: 13-27. In Russian.

Malyshevski, R.I. 1963. Once more about summer ornithofauna of Terski coast of the White Sea. *Ornitologiya* (Moscow) 6: 475. In Russian.

Mikhailov, K.E. 1993. Avifauna of zonal tundras of the northern part of the Kola Peninsula. *Russ. J. of Ornith.* 2(1): 7-28. In Russian.

Mineyev, Yu.N. & Mineyev, O.Yu. 1997. Birds at Lovetski Island. In: V.R. Ryabitsev (ed.). *Materials on bird distribution at Urals, in the area west from Urals and in west Siberia.* Ekaterinburg, Ekaterinburg Publishing House: 104-108. In Russian.

Mischenko, A.L. & Sukhanova, O.V. 1998. Waders of the Novgorod Region: peculiarities of their distribution and important breeding areas. *International Wader Studies* 10: this volume.

Mork, K., Holstad, R.L., Saetre, S. & Kalinin, A. 1994. *Ornithological registrations in the Uboynaya area, NW-Taymyr, July 1994.* Norsk Ornithologisk Forening Rapport Nr. 4-1994, Klaebu. 32 pp.

Morozov, V.V. 1987. New data on fauna and distribution of birds for the eastern part of Bolshezemelskaya Tundra. *Ornitologiya* (Moscow) 22: 134-147. In Russian.

Morozov, V.V. 1998. Distribution of breeding waders in the north-east European Russian tundras. *International Wader Studies* 10: this volume.

Naumov, S.P. 1931. Mammals and birds of Gydan Peninsula (North-West Siberia). *Annals of Polar Commission.* Vol. 4, 1-106. USSR Acad. Sci. Publishing House, Leningrad. In Russian.

Nechaev, V.A. 1979. New materials on distribution and biology of birds at Sakhalin Island. *Ornitologiya* (Moscow) 14: 108-111. In Russian.

Nechaev, V.A. 1991. *Birds of Sakhalin Island.* USSR Acad. of Sci., Far-Eastern Branch, Vladivostok.

Nechaev, V.A. & Tomkovich, P.S. 1987. A new subspecies of the Dunlin, *Calidris alpina litoralis* ssp.n. (Charadriidae, Aves), from the Sakhalin Island. *Zool. Zhurnal* 66(7): 1110-1113. In Russian.

Nechaev, V.A. & Tomkovich, P.S. 1988. A new name for Sakhalin Dunlin (Aves, Charadriidae). *Zool. Zhurnal* 67(10): 1596. In Russian.

Ostapenko, V.A. 1973. Avifauna of the Chaun delta. *In*: V.L. Kontrimavichus (ed.). *Biol. Problems of the North* 2: 59-73. Magadan, Institute for Biological Problems of the North. In Russian.

Pavlov, B.M., Beilmann, A.A. & Krashevsky, O.R. 1983. On the avifauna of the Verkhnaya Taimyra River basin. *In*: B.M.Pavlov (ed.), Birds of Taimyr (ecology, conservation and practical use). Sci.-technical Bull., Siberian Sect. of the Acad. for Agric. Sci., Novosibirsk. Issue 7, pp. 9-14. In Russian.

Podkovyrkin, B.A. 1956. Materials on breeding biology of some birds at Northern Kuril Islands. *Zool. Zhurnal* 35(12): 1892-1901. In Russian.

Portenko, L.A. 1939. *Fauna of the Anadyr Land. Birds.* Part I. Glavsevmorput Press, Leningrad. In Russian.

Portenko, L.A. 1972. *Birds of Chukotsky Peninsula and Wrangel Island.* Part 1. Nauka, Leningrad. In Russian.

Pozdnyakov, V.I., Solovieva, D.V. & Sofronov, Yu.N. 1996. Charadriiform birds in the Lena River delta. *In*: V.N. Vasilyev & V.I. Pozdnyakov (eds.), *Soils, flora and fauna in Arctic Yakutia*, pp. 54-65. Russian Acad. Sci., Yakut Sci. Centre, Yakutsk. In Russian.

Ravkin, Yu.S. 1967. On the census methods of birds in forest habitats. In: A.A. Maksimov (ed.), *Nature of the tick encephalit hotbeds at the Altai*, pp. 66-75. Nauka, Novosibirsk. In Russian.

Rutilevsky, G.P. 1958. Birds of Bolshoi Lyakhovsky Island. *Problems of Arctic* 4: 79-90. In Russian.

Rogacheva, E.V. 1992. *The birds of Central Siberia.* Husum Druck und Verlagsges, Husum.

Romanov, A.A. 1989. Bird population of southeastern coast of Cheshskaya Gulf. *In*: Yu.P. Yazan (ed.), *Organization of the forms of nature-reserve fund objects*, pp. 157-162. USSR Institute for Nature Conservation, Moscow. In Russian.

Ryabitsev, V.K. 1993. *Territorial relations and communities dynamics of birds in Subarctic.* Nauka, Ekaterinburg. 297 pp. In Russian.

Ryabitsev, V.K. & Alekseeva, N.S. 1998. Nesting density dynamics and site fidelity of waders on the middle and northern Yamal. *International Wader Studies* 10: this volume.

Sdobnikov, V.M. 1959. Biotopes of the Northern Taimyr and population densities of animals inhabiting these. *Zool. Zhurnal* 38(2): 243-252. In Russian.

Schaanning, H.T.L. 1916. Bidrag til Novaja Semjas Fauna. *Dansk Ornith. Foren. Tidskr.* 10: 145-190.

Schadilov, Yu.M. & Bouler, D. 1996. Breeding conditions for waders in the tundras of Russia in 1995: south-eastern part of Russky Zavorot Peninsula. *In*: P.S.Tomkovich (ed.), *Information Materials of the Working Group on Waders* 9: 23. In Russian.

Seebohm, H. 1985a. *The birds of Siberia: To the Petchora Valley.* Alan Sutton, Gloucester.

Seebohm, H. 1985b. *The birds of Siberia: The Yenisei.* Alan Sutton, Gloucester.

Sochava, V.B. (ed.) 1976. *Vegetation map of West Siberian lowland.* Scale 1:1 500 000. GUGK, Moscow.

Soloviev, M.Yu. 1995. Wader monitoring project at the Taimyr: preliminary results of census methods comparison. *Bird Census News* 8(2): 80-93.

Soloviev, M.Yu., Dementiev, M.N., Golovnyuk, V.V., Pronin, T.A. & Sviridova, T.V. 1996. *Breeding conditions and numbers of birds at south-eastern Taimyr, 1994-1996.* Final report on the wader monitoring at Taimyr, Moscow. 43 pp.

Soloviev, M.Yu. & Syroechkovski, Jr., E.E. 1995. Wader Monitoring Project at the Taimyr: preliminary results of comparisons of censusing methods. *Information Materials of the Working Group on Waders* 8: 11-12.

Sosin, V.F. & Paskhalny, S.P. 1995. Materials on fauna and ecology of terrestrial vertebrates of Bely Island. *In*: V.S. Balakhonov (ed.), *The current state of vegetation and animal world of the Yamal Peninsula*, pp. 100-140. Nauka, Ekaterinburg. In Russian.

Spangenberg, E.P. & Leonovich, V.V. 1960. Birds of northeastern coast of the White Sea. *In:* G.A. Novikov (ed.), *Annals of Kandalaksha State Nature Reserve*, 2: 213-336. Murmansk Book Press, Murmansk. In Russian.

Stepanyan, L.S. 1990. *Conspectus of the ornithological fauna of the USSR.* Nauka, Moscow. In Russian.

Stishov, M.S. 1990. In-landscape distribution of birds in the typical tundra subzone (based on the example of the Aiyon island, West Chukotka). *Zool. Zhurnal* 69(9): 73-83. In Russian.

Stishov, M.S. 1993. Materials on fauna and bird population on Aachim peninsula (West Chukotka). *Bull. of Moscow Soc. of Naturalists. Biol. section* 98(4): 17-25. In Russian, with English summary.

Stishov, M.S., Pridatko, V.I. & Baranyuk, V.V. 1991. *Birds of Wrangel Island.* Nauka, Novosibirsk. In Russian.

Syroechkovski Jr., E.E. & Lappo, E.G. 1994. Data on fauna and ecology of birds of the Izvestiy TSIK Islands and Sverdrup Island. *In*: E.V. Rogacheva (ed.), *Arctic tundras of Taimyr and Kara Sea islands: nature,* *fauna and conservation problems* 1: 111-150. Inst. Ecol. and Evol., Russian Acad. Sci., Moscow. In Russian.

Tatarnikova, I.P. 1983. Nesting of waders on Ainovy Islands. *Ornitologiya* (Moscow) 18: 181. In Russian.

Tolmachev, A.I. 1928. To avifauna of Kolguev Island. *Yearbook of Zool. Mus. of the USSR Acad. of Sci.* 27(3): 355-365. In Russian.

Tomkovich, P.S. 1986. Geographical variability of the Dunlin in the Far East. *Bull. of Moscow Soc. of Naturalists, Biol. Section* 91(6): 3-15. In Russian.

Tomkovich, P.S. 1988. The birds of the southern coast of the Buor-Khaya Gulf, Northern Yakutia. *In*: V.E. Flint & P.S. Tomkovich (eds.), *Archives of Zool. Mus. of Moscow Univ.* 26: 3-38. Moscow Univ. Press, Moscow. In Russian.

Tomkovich, P.S. 1994. Site fidelity and spatial structure of populations of Rock Sandpiper *Calidris ptilocnemis* and Dunlin *Calidris alpina* on Chukotsky Peninsula. *Russ. J. Ornithol.* 3(1): 13-30. In Russian with English summary.

Tomkovich, P.S., Masterov, V.B. & Soloviev, M.Yu. 1991. On the avifauna of Mys Shmidta, the Chukchi Sea. *Ornitologiya* (Moscow) 25: 175-176. In Russian.

Tomkovich, P.S. & Sorokin, A.G. 1983. The bird fauna of Eastern Chukotka. *In*: V.E. Flint & P.S. Tomkovich (eds.), *Archives of Zool. Mus. of Moscow Univ.* 21: 77-159. Moscow Univ. Press, Moscow. In Russian.

Tomkovich, P.S. & Vronski, N.V. 1988. The bird fauna of Dikson vicinity, northern Taimyr. *In*: V.E. Flint & P.S. Tomkovich (eds.). *Archives of Zool. Mus. of Moscow Univ.* 26: 39-77. Moscow, Moscow Univ. Press. In Russian.

Tomkovich, P.S. & Vronski, N.V. 1994. Birds of lower reaches of the Uboynaya River (North-Western Taimyr). *In*: E.V. Rogacheva (ed.), *Arctic tundras of Taimyr and Kara Sea islands: nature, fauna and conservation problems* 1: 161-206. Inst. Ecol. and Evol., Russian Acad. Sci., Moscow. In Russian.

Trevor-Battye, A. 1895. *Ice-bound on Kolguev. Notes on the birds recorded*, pp. 418-440. Archibald Constable and Company.

Tugarinov, A.Ya. & Tolmachev, A.I. 1934. Materials for the avifauna of eastern Taimyr. *Annals of the Polar Commission of the USSR Acad. of Sci.* 16: 5-47. In Russian.

Tulp, I., Bruinzeel, L., Jukema, J. & Stepanova, O. 1997. *Breeding waders at Medusa Bay, Western Taimyr, in 1996.* WIWO Report 57, 90 pp. Zeist.

Underhill, L.G., Prys-Jones, R.P., Syroechkovski, E.E. jnr., Groen, N.M., Karpov, V, van Roomen, M.W.J., Rybkin, A., Shekkerman, H., Spiekman, H. & Summers, R.W. 1993. Breeding of waders (Charadrii) and Brent Geese *Branta bernicla bernicla* at Pronchischeva Lake, northeastern Taimyr, Russia, in a peak and decreasing lemming year. *Ibis* 135: 277-292.

Uspenski, S.M. 1965. Materials on bird fauna of northern Anabar tundra. *In*: N.A. Gladkov (ed.), *Archives of Zool. Mus. of Moscow Univ.* 9: 63-97. Moscow Univ. Press, Moscow. In Russian.

Uspenski, S.M. 1969. Die Strandlaufer Eurasiens (Gattung *Calidris*). Die Neue Brem-Bucherei. A. Ziemsen verlag, Wittenberg Lutherstadt.

Uspenski, S.M., Boehme, R.L., Priklonski, S.G. & Vekhov, V.N. 1962. Birds of North-Eastern Yakutia. *Ornitologiya* (Moscow) 4: 64-86. In Russian.

Vinikurov, A.A. 1971 Fauna of vertebrate animals in the area of the Taimyr field station (western Taimyr). *In*: B.A. Tikhomirov (ed.). *Biogeocenoses of Taimyr and their productivity.* Leningrad, Nauka: 212-230. In Russian.

Vinogradov, V.G., Krivenko, V.G. & Panfilov, A.D. 1991. Hotbed of tundra ornithofauna in the upper part of the Pur River basin. *In*: V.D. Ilychev (ed.), *Materials of the All-Union Ornithol. Conf.* Part 1, pp. 52-53. Nauka i tekhnika, Minsk. In Russian.

Vronski, N.V. 1987. Materials to the avifauna of northwestern Taimyr. *In*: E.E. Syroechkovski (ed.), *Fauna and ecology of birds and mammals of Central Siberia*, pp. 28-38. Nauka, Moscow. In Russian.

Vorobiev, K.A. 1963. *Birds of Yakutia.* USSR Acad. of Sci. Press, Moscow. 336 p. In Russian.

Voronin, A.Yu. & Korolyova, M.N. 1996. The center of Taimyr Peninsula, area of Sarytaturku Lake (73°40'N; 96°45'E). *In*: P.S. Tomkovich (ed.), Breeding conditions for waders in Russian tundras in 1994. *Wader Study Group Bull.* 79: 76.

Yakimenko, V.V. 1996. Lower reaches of Muksunikha and Mungui Rivers (Lower Yenisei). *In*: P.S. Tomkovich (ed.), Breeding conditions for waders in Russian tundras in 1994. *Wader Study Group Bull.* 79: 76.

Yurlov, A.K. 1982. Populations and distribution in the summer bird community in the lower reaches of the Pyasina River (west Taimyr). *In*: V.I. Evsikov (ed.). *Distribution and numbers of vertebrates in Siberia.* Novosibirsk, Nauka: 181-189. In Russian.

Zarudny, N.A. 1910. Birds of Pskov Province. *Memoirs of Russian Academy of Sci., Series* 8, 25(2): 1-181. In Russian.

Zhukov, V.S. 1998. Seasonal changes in distribution, abundance and numbers of waders in relation to lemming population cycles in the west Siberian tundra. *International Wader Studies* 10: this volume.

APPENDIX

Breeding records of Dunlin in Russia

Key
No. Site locations on Figures 1a & 1b.
approximate location and co-ordinates of sites.

Stat. Status of breeding records:
1 proved breeding (nests, unfleged chicks, fledglings are found, female with egg inside is collected);
2 probable breeding (singing males, territorial pairs, characteristic behaviour near broods, and families with flying young);
3 possible breeding (indication of "breeding" without details given).

* pers. comm.
** unpublished data collected by members of the "Tundra Ecology-94" Russian-Swedish expedition: C. Minton and D. Rogers (Australia); T. Piersma (The Netherlands); E. Syroechkovski Jr., I. Chupin, V. Karpov, E. Lappo and V. Yakovlev (Russia); P.E. Jönsson, A. Lindström, N. Holmgren, N. Kjellen and E. Isakson (Sweden); and R. Gill (USA).

R. river — BMNH = British Museum of Natural History
L. lake — ZMMU = Zoological Museum of Moscow University
P. peninsula — ZIR = Zoological Institute of Russian Academy of Sciences in St.Petersburg
I. I-s (islands)

C. a. schinzii

No.	Stat.	Regions	Co-ordinates	Sources
1	1	Pskovskoye L.	58°00'N 27°30'E	Zarudny (1910)
2	1	Pskovskoye L.	57°55'N 28°20'E	Zarudny (1910)
3	2	Chudskoye L., Samolva	58°18'N 28°00'E	Leonovich*
4	1	Chudskoye L., Gdov	58°45'N 27°47'E	Malcheuski & Pukinski (1983)
5	2	Ilmen L., Novgorod	58°30'N 31°15'E	Mischenko & Sukhanova (1998)
6	1	Finland Gulf, Kurgaksky P.	59°45'N 28°10'E	Buzun & Merauskas (1993)
7	1	Finland Gulf, Kernovo	59°50'N 29°00'E	Malchevski & Pukinski (1983)
8#	3	Finland Gulf, Berezovye Is.	60°17'N 28°40'E	Khrabry (1984)

C. a. alpina

No.	Stat.	Regions	Co-ordinates	Sources
9	1	Bolshoi Ainov I.	69°50'N 31°35'E	Tatarinkova (1983); Kokhanov & Skokova (1967)
10	1	Kola P., between Kharlovka & Vostochnaya Litsa Rivers	68°38''N 37°25'E	Semashko*
11	1	Kola P., middle Yokanga R.	67°55'N 37°50'E	Mikhailov 1993
12	2	Kola P., Kachkovsky Bay	67°24'N 41°01'E	Tundra Ecology**
13	1	Kola P., lower Ponoi R. area	67°18'N 41°10'E	Filchagov*, Tundra Ecology**
14	1	Kola Pen., lower Ponoi R.	67°00'N 41°10'E	Biankeki *et al.* (1982)
15	1	Kola P., Pyalitsa	66°20'N 40°10'E	Malyshevski (1962, 1963), ZIR
16	1	White Sea coast Koida	66°25'N 42°15'E	Spangenberg & Leonovich (1960)
17	1	Kanin P., Chizha	67°05'N 44°20'E	Spangenberg & Leonovich (1960)
18	1	Kanin P., Shoina	67°55'N 44°20'E	Vinogradov & Avdanin*; Leonovich*
19	1	Kanin P., Torna	68°02'N 44°12'E	Spangenberg & Leonovich (1960)
20	1	Kanin P., Vostochnaya Kambalnitsa	68°32'N 45°16'E	Tundra Ecology,**
21#	1	Kolguev I., Artelnaya R.	69°25'N 49°15'E	Tolmachev (1928); Trevor(1895)
22	1	Kolguev I., Peschanka R.	69°08'N 50°00'E	Tundra Ecology**; Syroechkovski & Morozov*
23	2	Kolguev I., Paarchikha R.	69°00'N 49°55'E	Tundra Ecology**; Syroechkovski & Morozov*
24	3	Malozemelskaya Tundra, Pesha R.	66°55'N 47°40'E	Romanov (1989)
25	1	Timanskaya tundra, Indiga	67°52'N 49°30'E	Gladkov (1951a)
26	1	Timanskaya tundra, Ikcha R.	67°40'N 49°40'E	Gladkov (1951a)
27	2	Timanskaya tundra, near Sengeisky Strait	68°19'N 50°47'E	Morozov*
28	1	Russky Zavorot P.	68°48'N 53°07'E	Tundra Ecology**
29	1	Russky Zavorot P., Omulevka R.	68°52'N 53°29'E	Tundra Ecology**
30	1	Russky Zavorot P. , Khabuika L.	68°32'N 53°53'E	Schadilov & Bouler (1996)
31	1	near Pechora delta, Lovetski I.	68°20'N 53°55'E	Schadilov & Bouler (1996), Mineyev & Mineyev (1997)

32	1	near Pechora delta, Korovinskaya Gulf	68°20'N 53°30'E	Bianki & Krasnov (1987)
33	1	near Pechora delta, former Alekseevka	68°00'N 54°00'E	Seebohm & HarvieBMMU; Seebohm (1985)
34	2	Varandey	68°50'N 58°00'E	Kalyakin (1994)
35	1	Khaipudyrskaya Gulf (south)	68°22'N 59°20'E	Tikhonov*
36	1	MoreR. mouth	68°20'N 59°45'E	Estafiev (1983, 1991)
37	1	Novaya Zemlya, Pukhovy Bay	72°40'N 52°45'E	Gavrilov (1996a)
38	1	Novaya Zemlya, Pankova Zemlya near Gribovaya Gulf	73°10'N 53°20'E	Kuzyakin, ZMMU
39	1	Novaya Zemlya, Matochkin Shar	73°15'N 54°20'E	Schaanning (1916)
40	1	Vaigach I., Vaigach settlement	70°23'N 58°52'E	Morozov (1998)
41	3	Vaigach I., Lyamchina Gulf	69°55'N 59°15'E	Romanov*
42	1	Vaigach I.	70°17'N 59°05'E	Morozov (1998)
43	1	Vaigach I.	69°50'N 60°15'E	Morozov (1998)
44	1	Vaigach I.,	69°43'N 60°05'E	Morozov (1998)
45	1	Yugorsky P., Bely Nos	69°36'N 60°13'E	Gavrilov (1996b)
46	1	Yugorsky P., Yugorsky Shar	69°50'N 60°40'E	Grichik*
47	1	Yugorsky P., Chaika Cape	69°30'N 60°35'E	Estafiev (1991)
48	1	Yugorsky P., Tonky Cape	69°50'N 60°45'E	Grichik (1995); Morozov (1998)
49	1	Yugorsky P., Bolshaya Oyu R.	69°27'N 61°20'E	Estafiev (1991)
50	1	Yugorsky P., Amderma	69°45'N 61°45'E	Estafiev (1991)
51	1	Yugorsky P., Karskaya Gulf	69°17'N 64°35'E	Estafiev (1991)
52	1	Vorgashor	67°40'N 63°50'E	Morozov (1987)
53	1	Khalmer	67°50'N 64°50'E	Morozov (1987)
54	1	Baidaratskaya Gulf (south)	68°10'N 68°23'E	Kalyakin (1986)
55	1	Western Yamal P., Ust	68°55'N 69°30'E	Flint, ZMMU
56	1	Western Yamal P., Nyabyyakha R.	69°38'N 67°36'E	Tundra Ecology**
57	1	Western Yamal P., Marre	69°45'N 66°50'E	Danilov *et al.* (1984)
58	1	Western Yamal P., Mordyyakha R.	70°14'N 66°17'E	Tundra Ecology**
59	1	Western Yamal P., Mordyyakha R.	70°20'N 67°41'E	Tundra Ecology**
60	1	Western Yamal P., Mordyyakha R.	70°25'N 68°02'E	Tundra Ecology**
61	1	Western Yamal P., Charasavey	71°10'N 66°45'E	Danilov *et al.* (1984); Morozov*
62	1	Western Yamal P., Syadoryakha R.	71°40'N 68°15'E	Danilov *et al.* (1984); Morozov*
63#	2	Bely I.	73°02'N 70°10'E	Sosin & Paskhalnyi (1995)
64	1	Eastern Yamal P., Tambey	71°28'N 71°45'E	Sosin & Paskhalnyi (1995)
65	1	Eastern Yamal P., Yaibari	71°15'N 71°45'E	Ryabitsev (1993)
66	1	Eastern Yamal P., Yasaveiyakha R.	70°08'N 71°15'E	Danilov *et al.* (1984)
67	1	Eastern Yamal P., Seyakha R.	70°10'N 72°35'E	Danilov *et al.* (1984)
68	1	Eastern Yamal P., Khanovey	68°33'N 72°45'E	Ryabitsev (1993)
69	1	Eastern Yamal P., Kamenny Cape	68°30'N 73°35'E	Danilov *et al.* (1984)
70#	1	Southern Yamal P., Porsyakha	67°40'N 71°20'E	Danilov *et al.* (1984)
71#	2	Southern Yamal P., middle Khadytayakha R.	67°20'N 70°00'E	Danilov *et al.* (1984)
72#	1	Southern Yamal P., Schuchya R.	67°35'N 69°15'E	Kozlova (1962); Andreeva*; Kalyakin*
73	3	Oblowland, Poluy R.	65°55'N 68°45'E	Pokrovskaya*
74	3	ObYenisey lowland, Nadym R.	65°00'N 74°10'E	Pokrovskaya*
75	3	Oblowland, Pyakupur R.	64°40'N 77°00'E	Vinogradov *et al.* (1991)
76	3	Oblowland, Taz R.	65°35'N 82°25'E	Pokrovskaya*
77	1	Gydan P., Antipayuta	69°05'N 76°55'E	Zhukov (1998)
78	2	Gydan P., Tadibeyakha	70°22'N 74°10'E	Zhukov (1998)
79	1	Gydan P., Yuribey	71°00'N 77°00'E	Zhukov (1998)
80	1	Gydan P., Gyda R.	70°55'N 79°15'E	Blokhin, ZMMU
81	1	Gydan P., KhoseinL.	70°55'N 80°05'E	Naumov (1931)
82	1	Gydan P., Yeniseiskoye L.	71°25'N 79°45'E	Chernichko *et al.* (1994)
83	1	Gydan P., Mamonta P.	71°55'N 76°20'E	Zhukov (1998)
84	1	Yenisei Gulf, Sibiryakov I.	72°45'N 79°05'E	Syroechkovski Jr*; Chylarecki & Sikora*

C. a. alpina><*C. a. centralis*

No.	Stat.	Regions	Co-ordinates	Sources
85	1	Kara Sea, Sverdrup I.	74°35'N 79°20'E	Syroechkovski Jr. & Lappo (1994)
86	2	Kara Sea, Arcticheskogo Instituta I.	75°05'N 82°01'E	Tundra Ecology94**
87	1	Western Taimyr, lower Uboinaya R.	73°38'N 82°25'E	Mork *et al.* (1994)
88	1	Western Taimyr, Dikson	73°30'N 80°30'E	Tomkovich & Vronski (1988); ZMMU
89	1	Western Taimyr, Meduza Bay	73°20'N 80°30'E	Sviridova*; Hertzler & Gunther*

90	3	Western Taimyr, Rogozinka R.	72°48'N 80°50'E	Vronski (1987)
91	1	Western Taimyr, Yenisey Gulf, Korsakovski I.	72°17'N 81°00'E	Popham, BMNH
92	1	Western Taimyr, Golchikha R.	71°45'N 83°30'E	Popham, BMNH; Chernikov*
93	1	Western Taimyr, Pustoye	71°10'N 83°15'E	Popham, BMNH; Chernikov*
94	1	Western Taimyr, Mungui R.	70°25'N 83°30'E	Yakimenko (1996)
95	1	Western Taimyr, Sukhaya Dudinka R.	69°48'N 85°10'E	Seebohm, BMNH; Seebohm (1985b)
96	1	Pyasina R. basin, Lidiya mouth	74°07'N 86°50'E	Hötker (1995)
97	1	Western Taimyr, Chadyrymota R.	74°00'N 87°00'E	Kokorev*
98	3	Western Taimyr, Binyuda R.	73°40'N 89°15'E	Kokorev & Lisenko (1989)
99	3	Western Taimyr, Koreulakhbigai R.	73°48'N 90°50'E	Kokorev & Lisenko (1989)
100	1	Western Taimyr, lower Tareya R.	73°17'N 91°10'E	Vinokurov (1971); ZMMU
101	1	Western Taimyr, Ust	73°15'N 90°34'E	Yurlov (1982)
102	1	Western Taimyr, middle Pura R.	72°23'N 85°25'E	Kokorev*
103	1	Western Taimyr, Purinskiye L.	71°50'N 88°40'E	Kretchmar (1966)
104	1	Western Taimyr, Agapa mouth	71°25'N 89°20'E	Leonovich*; Kozhevnikov*
105	1	Western Taimyr, middle Dudypta R.	71°11'N 92°13'E	Lappo & Syroechkovski Jr.*
106	1	Western Taimyr, Dudypta R., Kresty	70°50'N 89°55'E	Kretchmar (1966)
107#	3	Western Taimyr, upper Pyasina R.	70°40'N 89°30'E	Kozhevnikov*
108#	2	Northern Taimyr, middle Lenivaya R.	74°25'N 91°50'E	Hötker (1995)
109	1	Northern Taimyr, Nizhnyaya Taimyra R.	75°32'N 99°10'E	Kokorev*
110	1	Northern Taimyr, Trautfetter mouth	75°25'N 99°52'E	Chupin*
111	1	Eastern Taimyr, Ledyanaya R.	75°28'N 107°25'E	Kozhevnikov (1982); Rogacheva (1992)
112	1	Eastern Taimyr, Neizvestnaya R.	76°11'N 111°23'E	Tundra Ecology 94**
113	1	Eastern Taimyr, Pronchischeva L.	75°16'N 112°28'E	Underhill *et al.* (1993)
114	1	Eastern Taimyr, Bolshaya Balakhnya R.	73°36'N 106°40'E	Yakovlev, ZMMU; Yesou & Chupin*
115	2	Central Taimyr, Rysyukov Cape	74°22'N 100°05'E	Hötker (1995)
116	1	Central Taimyr, Ozhidaniya Bay	74°40'N 101°00'E	Sdobnikov (1959)
117	3	Central Taimyr, Bikada R.	74°45'N 106°00'E	Rogacheva (1992)
118#	1	Central Taimyr, YamuTarida R.	74°25'N 102°50'E	Tugarinov & Tolmachev (1934)
119#	3	Central Taimyr, Luktakh R.	73°16'N 93°44'E	Pavlov *et al.* (1983)
120	3	Central Taimyr, Logata R.	73°12'N 95°55'E	Chupin*
121	1	Central Taimyr, lower Logata R.	73°07'N 96°10'E	Kokorev*
122	2	Central Taimyr, Bolshaya Bootankaga R.	73°50'N 96°55'E	Gavrilov*
123	2	Central Taimyr, Sarytaturku L.	73°40'N 96°45'E	Voronin & Koroleva (1996)
124	1	Central Taimyr, Malaya Logata R.	73°23'N 98°24'E	Gavrilov (1989); Hötker (1995)
125#	3	Central Taimyr, Novaya R.	72°38'N 100°40'E	Volkov*
126	1	Central Taimyr, Tonskoye L.	72°16'N 98°50'E	Karpov *et al.* in press.
127#	1	Central Taimyr, Boganida R.	71°20'N 97°00'E	Middendorff, ZIR

C. a. centralis

No.	Stat.	Regions	Co-ordinates	Sources
128	1	Khatanga R., Novorybnoye	72°51'N 106°02'E	Chupin*; Soloviev (1995), Soloviev *et al.* (1996)
129	2	Anabar tundra, Paksa P.	73°40'N 113°00'E	Uspenski (1965)
130	3	Anabar tundra, Uele R.	73°20'N 114°10'E	Uspe'nski (1965)
131	3	Anabar tundra, Yuryung-Khaya	72°50'N 113°12'E	Gladkov & Zaletayev (1965)
132	2	Anabar tundra, lower Peschanaya R.	73°40'N 115°30'E	Gladkov & Zaletayev (1965)
133	2	Anabar tundra, Oyulakh-Yurgakh R.	73°27'N 117°00'E	Lappo*
134	1	Anabar tundra, Chaidakh-Yurgakh R.	73°18'N 116°55'E	Tundra Ecology**
135	2	Anabar tundra, Terpyai-Tumus P.	73°30'N 118°35'E	Tundra Ecology**
136#	2	Anabar tundra, Kuogastakh R.	72°25'N 124°20'E	Pozdnyakov *et al.* (1996)
137#	2	Lena Delta,Khaas-Khaata-Aryta I.	73°15'N 125°20'E	Labutin *et al.* (1985)
138#	1	Lena Delta, Yuggyus-D'ie L.	72°50'N 126°10'E	Labutin *et al.* (1985); Blokhin & Blokhin (1986)
139#	1	Lena Delta, upper Bolshaya Tumatskaya	72°25'N 126°20'E	Blokhin*
140	1	Lena Delta, Nordenskiold station	72°13'N 127°55'E	Boere*
141#	1	Lena Delta, Bulkurskaya	72°10'N 126°03'E	Posdnyakov *et al.* (1996)
142	2	Tiksi Bay	71°35'N 128°50'E	Gladkov (1958); Kapitonov (1962)
143	1	Sytygan-Tala Bay,	70°42'N 131°20'E	Tomkovich (1988)

144	1	Yana delta, Ilin Shar	71°20'N 134°50'E	Syroechkovski; Roschevski*
145	1	Yana delta, lower Maly Samandon	71°30'N 135°20'E	Kistchinski, ZMMU; Kistchinski (1988)
146	2	Yana delta, Nizneyansk	71°30'N 136°10'E	Syroechkovski
147	1	Yana delta, Yukagir	71°50'N 139°50'E	Syroechkovski; ZMMU
148#	2	Khromalowland	72°05'N 147°55'E	Uspenski *et al.* (1962)
149	1	Khromalowland, Berelyakh	70°50'N 146°55'E	Tomkovich*; Leonovich*; Flint, ZMMU
150#	1	Khromalowland, Batyntai L.	70°57'N 147°30'E	Flint, ZMMU
151	1	Khromalowland, Gusinaya Bay	71°35'N 149°14'E	Tundra Ecology**
152#	1	Khromalowland, Indigirka delta, Keremesit	71°05'N 150°40'E	Flint, ZMMU
153#	1	Khromalowland, Indigirka delta, Kolesovo	71°00'N 151°20'E	Kistchinski (1988), ZMMU
154#	1	Kolyma lowland, lower Chukochya	70°15'N 159°25'E	de Roos*
155#	3	Kolyma lowland, lower Konkovaya R.	69°45'N 159°37'E	Kretchmar *et al.* (1991)
156#	1	Kolyma lowland, Vankhotveem	69°00'N 158°30'E	Kretchmar *et al.* (1991); Kondratyev (1982)
157#	1	Kolyma lowland, Khalerchinskaya tundra	69°00'N 160°00'E	Kretchmar *et al.* (1991); Kondratyev (1982)

C. a. sakhalina

No.	Stat.	Regions	Co-ordinates	Sources
158#	1	Wrangel I.	71°15'N 179°45W	Portenko (1972); Dorogoi (1982); Stishov *et al.* (1991), ZIR
159	1	Wrangel I., Mamontovaya R.	70°54'N 179°33'E	Tundra Ecology*
160#	1	Chaun Gulf, Ayon I.	69°55'N 168°20'E	Stishov (1990)
161	1	Chaun Gulf, Ayon I.	69°48'N 168°38'E	Tundra Ecology*
162	1	Ust	68°45'N 170°40'E	Ostapenko (1973); Kondratyev (1982); Kretchmar *et al.* (1991)
163	3	North Chukotka, Nolde Bay	69°45'N 173°20'E	Dorogoi*
164	1	North Chukotka, Cape Aachim	69°50'N 173°35'E	Stishov (1993)
165	1	North Chukotka, Shalaurova Izba	69°50'N 174°30'E	Stishov (1993)
166	1	North Chukotka, Cape Yakan	69°35'N 177°30'E	Stishov (1993)
167	1	North Chukotka, Shmidta Cape	68°55'N 179°25'W	Tomkovich *et al.* 1991; Dorogoi,*
168	1	North Chukotka, lower Ekvyvatap R.	68°43'N 178°55'W	Stishov (1993)
169	3	North Chukotka, middle Ekvyvatap R.	68°18'N 179°50'W	Stishov (1993)
170	1	North Chukotka, Ukouge lagoon	68°08'N 177°08'W	Portenko (1972); Kitschinski (1988)
171	1	North Chukotka, lower Amguema R.	67°55'N 177°35'W	Portenko (1972); Kitschinski (1988)
172	1	North Chukotka, middle Amguema R.	67°40'N 178°45'W	Dorogoi (1993a)
173	1	North Chukotka, middle Amguema R.	67°02'N 178°55'W	Portenko (1972); ZIR
174	1	North Chukotka, Belyaka spit	67°05'N 174°42'W	Leonovich*; Tomkovich*; Kondratyev (1982)
175	2	North Chukotka, Rekokaurer Cape	66°20'N 173°35'W	Flint*
176	1	North Chukotka, Cape Serdtse	66°55'N 171°45'W	Leonovich*; Portenko (1972)
177	3	East Chukotka, Uteveem R.	66°15'N 170°45'W	Portenko (1972)
178	1	East Chukotka, Uelen	66°10'N 169°50'W	Portenko (1972); Tomkovich & Sorokin (1983); ZMMU
179	1	East Chukotka, Koolen L.	65°55'N 171°10'W	Dorogoi*
180	1	East Chukotka, Puotenveem mouth	65°50'N 170°40'W	Tomkovich & Sorokin (1983)
181	1	East Chukotka, Lavrentiya	65°35'N 171°00'W	Portenko (1972); Kiryuschenko (1973); Tomkovich & Sorokin (1983)
182	2	East Chukotka, Arakamchechen I.	64°45'N 172°25'W	Dorogoi*
183	1	East Chukotka, Chaplino	64°25'N 172°15'W	Kuzyakin*; Tomkovich & Sorokin (1983)
184	1	East Chukotka, Provideniya Bay	64°18'N 173°35'W	Portenko (1972)
185	2	East Chukotka, Kurupkan delta	64°40'N 174°15'W	Konyukhov*
186	2	Kresta Bay, Notapelmen	65°35'N 178°20'W	Portenko (1972)
187	2	Kresta Bay, Egvekinot	66°20'N 179°10'W	Dorogoi*; Tomkovich*
188	1	Kresta Bay, Uelkal	65°30'N 179°20'W	Portenko (1972); Yakobi*; Leonovich*
189	1	upper Kanchalan valley	66°10'N 179°10'E	Kistchinski *et al.* (1983); Kistchinski (1988); Flint, ZMMU

190	1	middle Kanchalan valley	65°35'N 178°20'E	Kistchinski *et al.* (1983); Kistchinski (1988); Flint, ZMMU
191	1	lower Kanchalan valley	65°15'N 177°25'E	Kistchinski *et al.* (1983); Kistchinski (1988); Flint, ZMMU
192	1	Anadyr estuary, Shakhtersky	64°45'N 177°35'E	Dorogoi*; Portenko (1939); Kiryuschenko (1973)
193	1	Anadyr estuary, Anadyr	64°45'N 177°30'E	Leonovich*; Portenko (1939); Kolonin (1980)
194	1	Anadyr estuary, Avtatkuul R.	64°05'N 178°20'E	Kondratyev*
195	1	Anadyr estuary, Tumanskaya mouth	64°00'N 178°35'E	Portenko (1939)
196	2	middle Anadyr R., between Anadyr R. & Main R.	65°10'N 171°30'E	Kretchmar *et al.* (1991)
197	2	middle Anadyr R., Krestovskaya R.	65°20'N 171°40'E	Kretchmar *et al.* (1991)
198	2	Elgygytgyn L.	67°30'N 172°07'E	Dorogoi (1993b)

C. a. kistchinski

No.	Stat.	Regions	Co-ordinates	Sources
199	2	Koryak Highland, Khatyrka lagoon	62°08'N 175°28'E	Kistchinski (1980)
200	2	Koryak Highland, Apuka mouth	60°25'N 169°45'E	Kistchinski (1980, 1988)
201	1	Koryak Highland, Tilichiki	60°27'N 166°03'E	Kistchinski (1980)
202	1	Koryak Highland, Geka Bay	60°00'N 165°10'E	Kistchinski (1980); Firsova & Levada (1982)
203	1	Kamchatka P., Ossora	59°55'N 163°05'E	Gerasimov*
204	1	Karaginski I., Markelovskaya	58°50'N 164°15'E	Gerasimov & Vyatkin (1973)
205	2	East Kamchatka, Ust	56°14'N 162°12'E	Ryabushinski, ZIR
206#	1	East Kamchatka, Bolshaya Chazhma R.	55°04'N 161°47'E	Lobkov (1986)
207	1	East Kamchatka, Kronotskaya R.	54°30'N 160°40'E	Lobkov (1986)
208	1	East Kamchatka, Uzon volcano	54°30'N 160°25'E	Lobkov (1986)
209	1	East Kamchatka, Semyachiksky lagoon	54°10'N 160°00'E	Lobkov (1986)
210	2	East Kamchatka, Avacha mouth	53°05'N 158°30'E	Gerasimov (1968)
211	2	South Kamchatka,Kambalnaya R.	51°10'N 156°50'E	Gerasimov, ZMMU
212	1	Shumshu I.	50°40'N 156°20'E	Podkovyrkin (1956)
213	1	Paramushir I.	50°30'N 156°00'E	Golovushkin*
214	1	West Kamchatka, Plotnikova R.	52°55'N 156°35'E	Gluschenko (1984)
215	3	West Kamchatka, Bryumka R.	54°30'N 155°50'E	Lobkov (1986)
216	1	West Kamchatka, Moroshechnaya R.	56°30'N 156°30'E	Gerasimov *et al.* (1992); ZMMU
217	3	West Kamchatka, lower Khairyuzova R.	57°10'N 156°47'E	Lobkov (1986)
218	3	West Kamchatka, lower Tigil R.	58°10'N 158°20'E	Lobkov (1986)
219	3	West Kamchatka, Parapolski depression, Talovskoe L.	61°20'N 164°40'E	Lobkov (1986)
220	1	Shelikhova Bay, Gizhiga	62°00'N 160°30'E	Allen (1905)
221	1	Shelikhova Bay, Yamsk	59°35'N 154°05'E	Kistchinski (1968); Kondratyev*
222	1	Shelikhova Bay, Babushkina Bay	59°12'N 153°45'E	Kistchinski (1968); Kondratyev*
223	1	Magadan area, Ola delta	59°30'N 151°05'E	Dorogoi*
224	1	Magadan area, Arman	59°40'N 150°10'E	Dorogoi*
225	1	Magadan area, Ojra	59°45'N 149°50'E	Leonovich*

C. a. actites

No.	Stat.	Regions	Co-ordinates	Sources
226	1	North Sakhalin, Piltun Bay	53°10'N 143°15'E	Leonovich*; Nechaev & Tomkovich (1987); Nechaev (1991)
227	2	North Sakhalin, Chaivo Bay (north)	52°30'N 143°15'E	Blokhin*
228	1	North Sakhalin, Chaivo Bay (south)	52°20'N 143°10'E	Nechaev (1979, 1991); Nechaev & Tomkovich (1987)
229	2	North Sakhalin, Dagi Bay	52°15'N 143°07'E	Nechaev & Tomkovich (1987); Nechaev (1991)
230	2	North Sakhalin, Nyisky Bay	52°07'N 143°05'E	Nechaev & Tomkovich (1987); Nechaev (1991)
231	2	North Sakhalin, Nabilsky Bay	51°35'N 143°23'E	Nechaev & Tomkovich (1987); Nechaev (1991)