Limits and structure of the breeding range of the Curlew Sandpiper *Calidris ferruginea*

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Breeding distribution and breeding abundance of Curlew Sandpiper are described on the basis of analysis of over 110 literature sources and a number of sources of unpublished information as well as museum collections. The species breeding range spans about 5,000 km of Arctic Siberia from at least 71°40' E on eastern Yamal Peninsula to 156°40'W near Barrow, Alaska, and from 67°05'N in the south in Chukotsky Peninsula to 77°23'N in the north at Taimyr. The range is most broad (>500 km) at Taimyr and in nearby areas as well as in the Lena River delta. Records farther west and east are distributed at seacoasts and on some islands. Curlew Sandpipers are most abundant at northern Taimyr and in several northern sites farther east in Yakutia. Both the species range limits and densities are the subjects of large annual fluctuations. Stretches of the arctic tundra subzone where Curlew Sandpipers breed on regular basis and at least sometimes in high numbers are suggested as the core areas of the species breeding range. No long-term changes of the range are documented.

INTRODUCTION

Knowledge of the breeding distribution of the Curlew Sandpiper *Calidris ferruginea* has been gained slowly, starting from the first nest found in the Yenisey Gulf in 1897 by Popham (1897). Eggs of this species were specially desired by the first British collectors in Siberia, and H. Seebohm considered his famous expedition to the Yenisey in 1877 "almost a failure" because he "had not succeeded in obtaining eggs either of the Knot, Sanderling or Curlew Sandpiper" (Vaughan 1992).

For the largest part of the 20th century, the breeding range of the Curlew Sandpiper was considered patchy and exclusively Siberian (Gladkov 1951, Kozlova 1962). It was only in 1965 that Uspensky (1965) suggested that the distribution was more widespread in northern Siberia than thought previously, and that its main breeding range was continuous at the gap between the Gydan Peninsula and the New Siberian Islands. At the same time, it was discovered that Curlew Sandpipers occasionally breed in Alaska (Holmes & Pitelka 1964, Pitelka *et al*. 1974, Gibson & Kessel 2006). Gradually information also accumulated about breeding densities in different parts of the range. This gradual progress is reflected in the distribution maps in handbooks and other publications at different times (e.g., Gladkov 1951, Kozlova 1962, Vorobiev 1963, Uspenski 1969, Cramp & Simmons 1983, Hayman *et al*. 1986).

Uspenski (1965, 1969) pioneered the use a vegetation map showing the tundra sub-zones (Chernov 1985) to suggest the potential breeding range of the Curlew Sandpiper. A recent trend of describing the structure of breeding ranges has resulted in the publication of a Curlew Sandpiper range in which core areas are indicated (Lappo 1996). However, no details were given in that paper to explain what original data were used to prepare the map, nor the methods of map compilation. The description of these procedures is the main aim of this paper, together with an update of information.

METHODS

More than 110 literature sources with breeding records and/or densities of Curlew Sandpipers from 133 localities formed the bulk of the data for a description of the breeding distribution for the species (Appendix). In addition, we used our personal data, collected at different sites in the Siberian Arctic since 1982, unpublished data from various sources (see Acknowledgements), and also the egg and chick collections of the Zoological Museum of Moscow State University (ZMMU) and of the Zoological Institute of Russian Academy of Sciences in St Petersburg (ZIR).

Curlew Sandpipers often form breeding pairs before arrival at their breeding sites (Tomkovich & Soloviev 2006), and may also signal alarm vigorously in the early stages of southward migration, after possible brood loss (Morozov 2006), making it difficult to interpret some observations. As a result, we considered breeding "confirmed" only when nests with eggs, unfledged chicks or fledglings were found, or when an egg-laying female (with an egg in her oviduct) was collected. Breeding was "probable" when settled pairs were seen among territorial, displaying males, or when birds actively performed the distraction displays characteristic of nesting and brood-rearing females. Breeding was "possible" when breeding was unconfirmed in the primary source, or only a single pair was recorded.

To evaluate densities of breeding Curlew Sandpipers in different parts of the breeding range, we compared estimates obtained by numerous researchers and by various methods. In a comparison done for the Dunlin *Calidris alpina*, inter-observer differences in densities for the same areas can be large and this can be explained mainly by different methods of census and calculation (Lappo & Tomkovich 1998). However, unlike the Dunlin, the Curlew Sandpiper is an opportunistic species, having large density fluctuations between years and sites (Lappo 1996, Tomkovich & Soloviev 2006). This prevents direct comparison of densities obtained from the same areas by different researchers and methods.

In the only study in which densities of Curlew Sandpipers (and other waders) were estimated in the same area by different methods (Finnish line transects, rope dragging and search for nests on a plot; Soloviev *et al*. 1996), the transect method gave highly variable results with large differences between pre-nesting and nesting periods. Nesting densities obtained in two seasons by the transect method were underestimated 2.6–4.0 times in comparison with nest mapping on a clearly delineated study plot. As a result, we decided to make density comparisons for this species on a three-level scale of density ranges (Table 1). Application of few density ranges is advantageous in that it enables the abundance estimates obtained during faunistic studies to be used.

In most cases, mapping of male territories and nests seems to be the most reliable method to get measures of density. Our personal experience of using this method, and some data from literature, permitted us to suggest an abundance scale in relation to three density and faunistic categories (Table 1).

Transect methods of censusing, with fixed distances to recorded birds, usually give densities lower than mapping (Soloviev *et al*. 1996, Lappo & Tomkovich 1998). Nevertheless, the available data are not sufficient to permit correction of transect estimates, and used these data as they were. We were not able to compare densities using line-transect estimates in which bird numbers were expressed per kilometre of line. Such data were available for only two studies (Sdobnikov 1959a; Igor N. Pospelov pers. comm.) and the ranges were scaled according to Cheltsov-Bebutov (1959). In one study, relative abundance was expressed in daily frequency of records (Tabor, Indigirka River; J. Pearce pers. comm.). This was assigned to density rank according to Isakov (1957).

In some situations it was clear that observers considered their Curlew Sandpiper densities differently to us. For instance, when density on the north-eastern Yamal reached 6 nests/km^2 in 1993, Ryabitsev *et al*. (1994) stated that "surprisingly large numbers were recorded", not having experienced really high densities in this species: this number is "moderate" when compared to densities in northern Taimyr. So, when possible, we used quantitative densities for a site, not observers' impressions of relative density. When no exact values were given, we used the observers' estimates, with two exceptions where it was possible to make corrections from additional explanations in the text.

Other sources of error in breeding abundance estimates are considered in Lappo & Tomkovich (1998). A special source of error in Curlew Sandpiper derives from males outnumbering females, at least in northernmost breeding sites (Tomkovich & Soloviev 2006). This means that, in some situations, large densities of displaying males do not translate into large densities of breeding females (e.g. at Camp Lidia in 1990; Hötker 1995, pers. comm.). In most cases, we were not able to take into account such differences in densities of sexes, especially where results of transect censuses of unsexed birds were given, but special attention should be paid to this issue in future. Departure of males from breeding grounds in early July (Tomkovich & Soloviev 2006) creates a similar problem, because estimates obtained by transect censuses do not account for this change in the population structure.

Recognising the impossibility, in most cases, of establishing real densities of breeding birds, we believe that we greatly reduced all the above-mentioned possible errors by assigning the available abundance estimates to three categories.

Large density fluctuations between years add variation to spatial unevenness in the Curlew Sandpiper distribution. Therefore, when available, we assigned the data to a range of abundance categories for a site, which reflects temporal (between years) and/or local spatial variation of densities.

The vegetation map of the USSR (Belov *et al*. 1990) and the Map of Terrestrial Wildlife Habitats of the Russian Arctic (Danilenko *et al*. 1996) were used for extrapolation to produce a reconstruction of the Curlew Sandpiper breeding range as described in Lappo & Tomkovich (1998). However, to distinguish the core area of the species breeding range, we had to use a different approach because of large fluctuations of numbers and range limits in Curlew Sandpiper.

Localities where birds breed annually, and in general have high densities, were considered to belong to the core area of this species (Lappo 1996).

RESULTS

According to currently available breeding records (Fig. 1), the Curlew Sandpiper's breeding range extends across northernmost Siberia, from the eastern Yamal Peninsula (possibly from north-western Yamal) to Chukotsky Peninsula and Barrow Cape, Alaska. July records of alarming birds in the extreme north-east of Europe are not reliable indications of breeding (Morozov 2006). Similarly, no reliable breeding records exist for Wrangel Island, although breeding is possible there (Stishov *et al*. 1991, Dorogoi 1997). The records form a rather broad (>500 km) belt on the Taimyr Peninsula and in nearby areas, as well as in the Lena River delta, but further west and east, records are distributed at sea coasts and on some islands. It is possible that Curlew Sandpipers also have a broad inland distribution on the promontory between the Yana and Indigirka rivers in East Siberia. The northernmost locality of supposed breeding is on Taimyr (77°23'N), the southernmost breeding record belongs to Chukotsky Peninsula (67°05'N), close to the Arctic Circle.

Table 1. Ranking of breeding abundances of Curlew Sandpiper, characterised by different survey methods.

Categories of density	Plot and transect		Transect individuals/km (ranking according to Cheltsov-Bebutov, 1959)	Faunistic data
	nests, pairs or females/km^2	individuals/km^2*		
Low	<3	<10	<0.1	rare
Moderate	3–8	10–20	0.1–0.999	common
High	>8	>20	>1	abundant

* The number of individuals is not simply a double number of nests, pairs or females. This is because males outnumber females in most cases (see Tomkovich & Soloviev 2006).

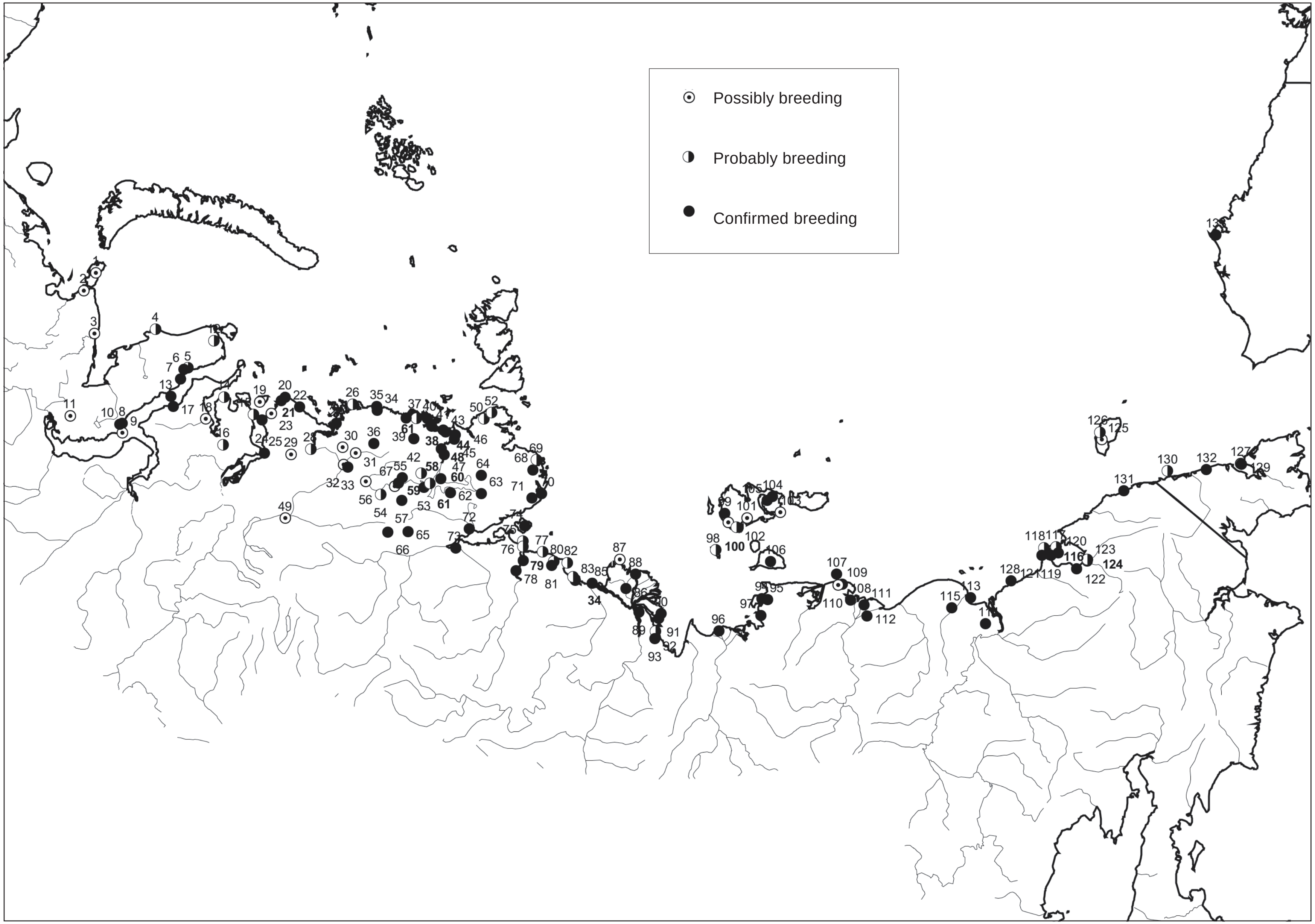

Fig. 1. Known breeding sites of Curlew Sandpipers. See the Appendix for information on sites as numbered here.

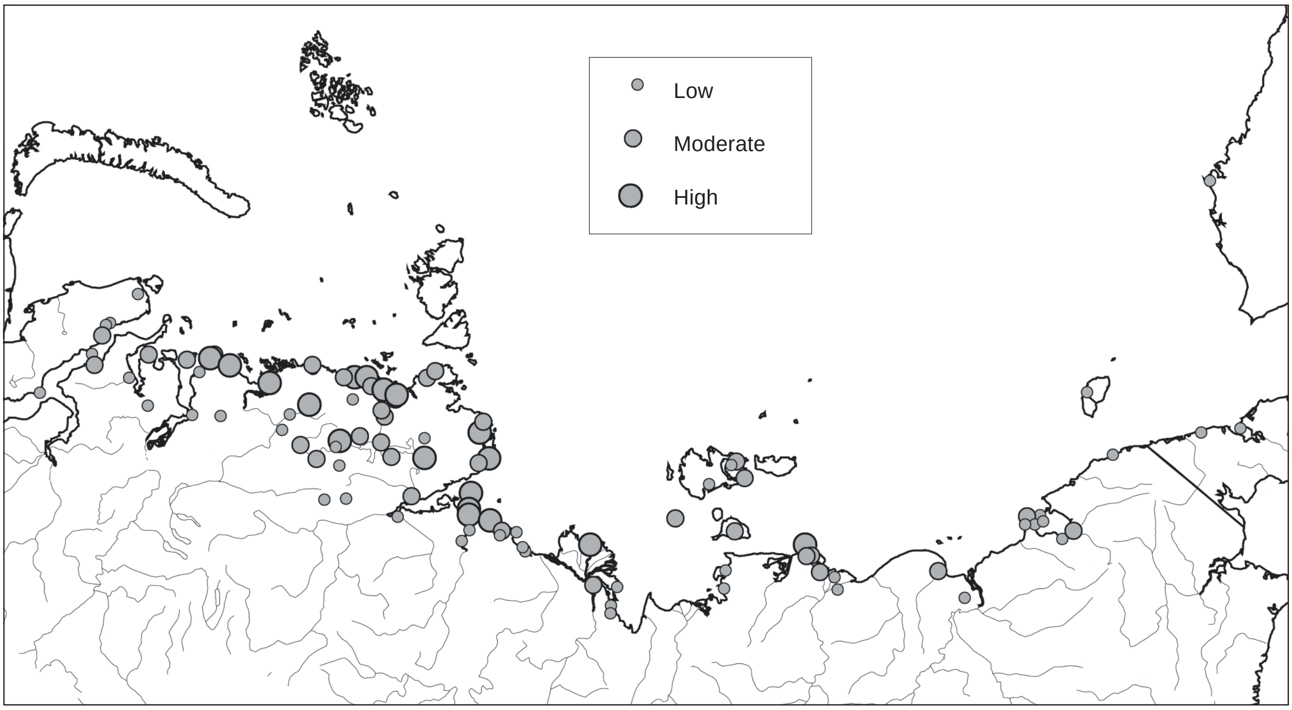

Fig. 2. Breeding abundance of Curlew Sandpipers.

If one considers breeding abundances (Fig. 2), high values of abundances were recorded at northern Taimyr and in several northern sites further east in Yakutia. The great majority of these were concentrated within the arctic tundra subzone (according to Chernov 1985). More southerly high abundances are known only from around Taimyr Lake. Medium abundances were recorded further south at Taimyr (typical tundra subzone), and on New Siberian Islands, as well as at some coastal localities close to the western and eastern limits of the species' breeding range. Low abundances were recorded throughout the breeding range, but most of these, together with single nest records, were from the southern rim of the breeding range and the easternmost localities of the range.

Localities where breeding is known to occur annually are not numerous, partly because of a lack of relevant studies. Similarly with high abundance localities these localities of regular breeding were concentrated mainly in the arctic tundra sub-zone, but in the typical tundra sub-zone, regular breeding was recorded in two sites, in central and southeastern Taimyr.

DISCUSSION

Few known breeding sites at the eastern extreme of the species' breeding range (Fig. 1) does not necessarily indicate absence of birds in between. East Siberia and northern Far East have been explored rather poorly, and the total number of Curlew Sandpipers breeding there is possibly lower than further west. So far, no breeding has been proved in the European Arctic, however, rare cases of species nesting at the extreme north-east of this region seem possible.

Both high abundances and regular breeding of Curlew Sandpipers occur mainly in the arctic tundra sub-zone between the Yenisey and Kolyma rivers. Therefore, it is safe to suggest that the species' core area (Fig. 3) coincides with stretches of this subzone on northernmost mainland promontories and on some arctic islands (Begichev, Lyakhovskie and Aiyon). Regular breeding but largely at low densities is found in north-eastern Yamal (Ryabitsev & Alekseeva 1998) and on the lower Khatanga River (Golovnyuk *et al*. 2004). If one considers regular breeding as the main indicator of the species' core area, then the core area should be enlarged to include these localities.

Three major core areas can be recognised on the extrapolated breeding distribution map of Curlew Sandpiper (Fig. 3). The largest one is on the northern Taimyr Peninsula and lower Anabar River. The Lena River delta represents another patch of the core area. The third covers the coastal stretch of the arctic tundra sub-zone between the Yana and Indigirka rivers. We expect that core area is larger then we depict on the Fig. 3 and may cover other adjacent areas such as northern Gydan Peninsula, New Siberian (Novosibirskie) Islands and coastal stretch between Indigirka and Kolyma Rivers. Lack of data on regularity of reproduction and on abundance of the species in these areas prevent us to consider them as core areas.

Outside the core areas, Curlew Sandpipers were recorded quite often further south of the western core area within the tundra landscape, but only on sea coasts further east. This may reflect a difference in (1) requirements of populations that inhabit western and eastern parts of the species' range (Tomkovich & Soloviev 2006), and/or (2) the width of the tundra sub-zones in Central Siberia and more easterly regions. Outside the core areas, Curlew Sandpipers can be found irregularly and in low (rarely in moderate) numbers. At least on Taimyr, such southerly breeding influxes usually coincide with late and cold spring seasons. The species' preference for coastal areas for breeding, outside of the core areas, most likely reflects the cooling effect of the Arctic seas that promote development of high arctic-like habitats in the narrow coastal zone.

Large annual fluctuations of both the species' range limits and densities are characteristic of Curlew Sandpiper (Lappo 1996; this study) that can be explained only by annual redistribution of birds within the range. Therefore, the reconstructed species breeding range (Fig. 3) depicts the maximal (or potential) range that can be occupied in different years. The breeding range that is occupied in any particular year,

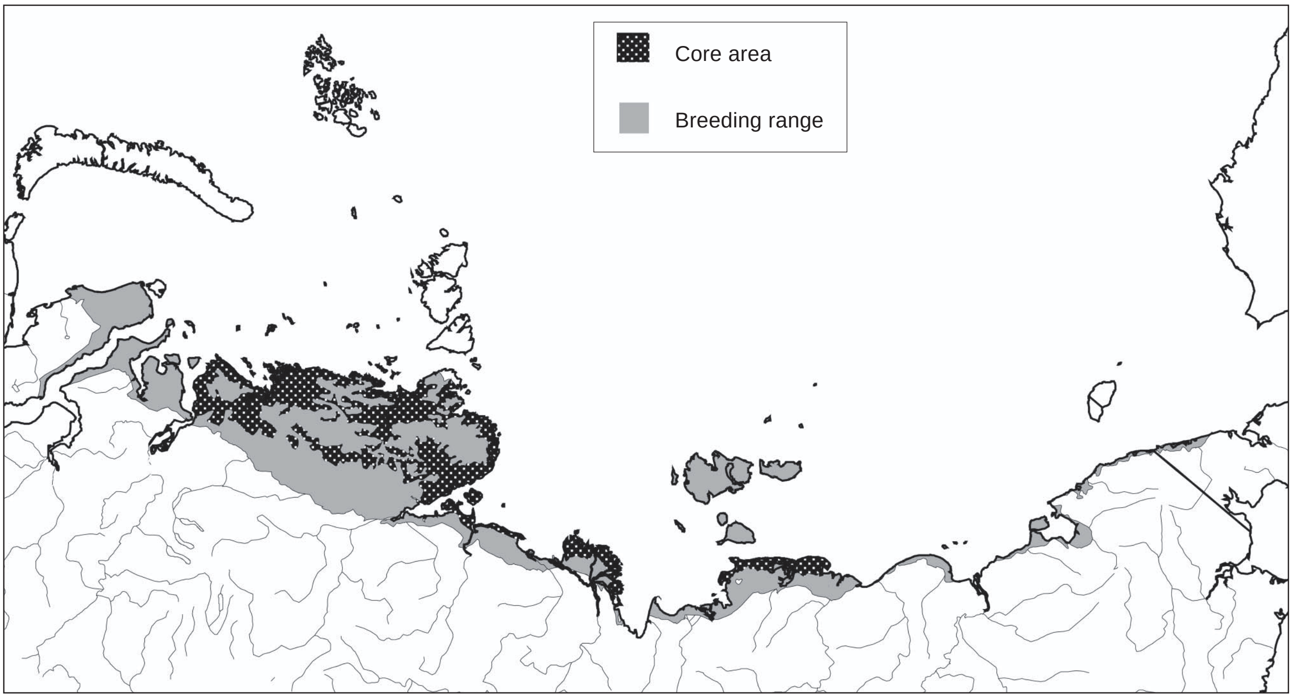

Fig. 3. Breeding range of Curlew Sandpipers.

and the density distribution, are variable at least in response to regional snow and weather conditions at the beginning of the breeding season. Thus, the shape and structure of the Curlew Sandpiper's breeding range are thought to fluctuate on an irregular basis. Nevertheless, no long-term change of the range can be documented with currently available data.

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APPENDIX

Breeding records and abundance ranks of Curlew Sandpipers

See map (Fig. 1) for the location of the sites; the site numbers correspond. **Site:** R.: river; L.: lake; P.: peninsula; I.: island; C.: cape.
Status: (corresponds to breeding records in Fig. 1): 1 – possible breeding; 2 – probable breeding; 3 – confirmed breeding.
Breeding abundance: (corresponds to breeding abundance ranks in Fig. 2): 0: no data; 1: low; 2: moderate; 3: high.
Source: ZMMU: Zoological Museum of Moscow State University; ZIN: Zoological Institute of Russian Academy of Sciences in St Petersburg; TE-94: 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, V.O. Yakovlev (Russia), P.E. Jonsson, A. Lindstrom, N. Holmgren, N. Kjellen, E. Isaksson (Sweden) and R.E. Gill, Jr. (USA).

No.	Site	Lat.	Long.	Observation year	Status	Breeding abundance	Source
1	Dolgaya Bay	70.08	59.42	1984	1	0	Kalyakin 1988
2	Chaika C.	69.50	60.58	1984	1	0	Yestafiev 1991, Yestafiev 1995
3	Khende-To L.	69.28	64.58	1983	1	0	Yestafiev 1991, Yestafiev 1995
4	Kharasavey C.	71.17	66.75	1975	2	1	Danilov *et al.* 1984
5	Tambey	71.47	71.75	1974	2	1	Danilov *et al.* 1984
6	Sabettayakha	71.33	71.67	1975	3	1	Danilov *et al.* 1984
7	Yaybari	71.07	72.33	1988–1991; 1993; 1994	3	1 or 2	Ryabitsev 1993, Ryabitsev *et al.* 1993
8	Khanovey	68.67	72.87	1983	3	0	Ryabitsev *et al.* 1995
9	Kamenny C.	68.50	73.58	1961	1	1	Uspenski 1965
10	Nurmayakha R.	68.58	72.83	1983; 1987	3	0	Danilov *et al.* 1984, Ryabitsev *et al.* 1995
11	Khadytayakha R.	67.33	70.00	1980	1	0	Danilov *et al.* 1984
12	Yakhady–Yakha R.	72.67	70.73	1981, 1983	2	1	Paskhal'ny 1985, Sosin *et al.* 1985
13	Bely I.	70.50	73.25	1981	3	1	Sosin & Paskhalny 1995
14	Mamonta P.	71.92	76.33	1990	2	2	Zhukov *et al.* 1992, Zhukov 1998
15	Leskino	72.33	79.67	1977	2	0	Rytilevski 1977
16	Khosein-To L.	70.92	80.08	1927	2	1	Naumov 1931
17	Tadibeyakha	70.37	74.17	1988	3	2	Zhukov 1989,1998, Zhukov unpubl.

No.	Site	Lat.	Long.	Observation year	Status	Breeding abundance	Source
18	Yuribey	71.00	77.00	1989	1	1	Zhukov & Golubev 1990, Zhukov 1990, 1998
19	Sibiryakov I.	72.75	79.08	1989; 1992	1	2	Koshelev & Dyadicheva 2000
20	Dickson I.	73.50	80.50	1982–1983; 1995	3	2	Tomkovich & Vronski 1988, Volkov & Peter 1996, ZMMU
21	Medusa Bay	73.33	80.50	1993; 1994; 1996; 1997; 2000	3	1 or 2 or 3	Hertzler & Gunter 1994, Sviridova *et al.* 1994, Rybkin *et al.* 1995, Tulp *et al.* 1997, Khomenko *et al.* 1998, Kharitonov 2002
22	Uboinaya R.	73.63	82.42	1984; 1994	3	2 or 3	Tomkovich & Vronski 1994, Mork *et al.* 1994, Klaasen & Cottar unpubl.
23	Rogozinka R.	72.80	80.83	1982	1	1	Vronsky 1987
24	Krestovski I.	72.42	80.75	1897	3	0	Haviland 1915
25	Golchikha R.	71.75	83.50	1914; 1982	3	1	Haviland 1915, Rogacheva 1992
26	Kolosovykh I.	74.95	86.67	1991	2	0	Hötker 1995
27	Lidiya R.	74.12	86.83	1993; 1994; 1995	3	1 or 2 or 3	Morozov 1993, Van Dijk *et al.* 1994, Hötker 1995, Popov 1995, Popov & Kokorev 1996, Vonk 2003
28	Pura R.	72.92	86.67	1961	2	0	Kretchmar 1966
29	Pura station	72.35	85.55	1980–1981; 1995; 1996	1	1	Kokorev 1983,1997, Zöckler *et al.* 1997
30	Binyuda R.	73.67	89.25	1988	1	0	Kokorev & Lisenko 1989
31	Koreulakhbigai R.	73.80	90.83	1988	1	1	Kokorev & Lisenko 1989
32	Ust-Tareya	73.25	90.57	1979	1	0	Yurlov 1982
33	Tareya R.	73.28	91.17	1960–1961; 1966–1968	3	1	Vinokurov 1971, Leonovich unpubl., ZMMU
34	Lenivaja R. (North)	75.33	89.50	1983	3	1	Tomkovich & Vronski 1988
35	Sterlegov C.	75.42	89.17	1990; 1991; 1994	3	1 or 2	Hötker 1995, Tulp *et al.* 1998
36	Lenivaya R. (South)	74.42	91.83	1991	3	3	Hötker 1995
37	Middendorf Bay	75.97	93.80	1994	3	2	TE-94
38	Opalovaya R.	75.92	94.18	1994	2	3	TE-94
39	Tolevaya R.	75.73	93.10	1994	3	2	TE-94
40	Zarya P.	76.13	95.38	1907	3	3	Walter 1902, Biryulya 1907, Pleske 1928
41	Shturmanov P.	76.00	96.50	1989	3	0 or 1 or 2	Hötker 1995, Zöckler *et al.* 1997
42	Mamonta R.	75.33	95.50	1949	3	1	Portenko ZIN 1959
43	Khipovich Bay	76.08	98.53	1990–1992	3	1 or 3	Tomkovich *et al.* 1994
44	Baklund P.	76.10	98.08	1949; 1990–1992	3	3	Sdobnikov 1959, Tomkovich *et al.* 1994
45	Fomin I.	76.03	100.03	1990	3	2	Lappo unpubl.
46	Nuzhnaya Taimyra R.	76.17	99.83	1990	3	3	Hötker 1995
47	Trautfetter R.	75.42	99.87	1979	3	2	Dorogov & Kokorev 1981
48	Shrenk R.	75.53	99.17	1990	3	2	Chupin 1992
49	Byrranga Mountains	70.67	89.50	1980	1	0	Kozhevnikov 1982
50	Tessem R.	77.08	102.22	1994	2	2	TE-94
51	Tolevaya R.	75.73	93.10	1994	3	2	TE-94
52	Anzhelika R.	77.38	102.85	1994	2	2	TE-94
53	Verkhnyaya Taimyra R. mouth	74.15	99.77	1989; 2004	3	0	Zöckler *et al.* 1997, Soloviev *et al.* unpubl.
54	Logata R.	73.20	95.92	1984	2	1 or 2	Chronicle of nature (Taimyr Nature Reserve) unpubl.
55	Fad'yu-Kuda R.	74.05	96.95	1997	3	3	Pospelov & Koroleva 1998
56	Luktakh R.	73.27	93.73	1979–1980	1	2	Pavlov *et al.* 1983
57	Malaya Logata R.	73.41	98.33	1989; 1997	3	1	Gavrilov 1989, Hötker 1995, Artyukhov 1998, Shtilmark unpubl., ZMMU
58	Levinson-Lessinga L.	74.50	98.58	1993; 1996	2	2	Koroleva 1994, Koroleva & Pospelov 1997, Chupin unpubl.
59	Sarytaturku L.	73.67	96.75	1994	1	0	Voronin & Koroleva 1995
60	Ozhidaniya Bay	74.67	101.00	1947; 1948	3	1 or 2	Sdobnikov 1959
61	Rysyukov C.	74.37	100.08	1989	2	0	Hötker 1995
62	Yamy-Tarida R.	74.42	102.83	1928	3	2	Tugarinov & Tolmachev 1934
63	Bikada R. Mouth	74.83	106.33	1998; 1999	3	2 or 3	Hötker 1995, Gavrilov & Pospelov 2001, Pospelov 2002
64	Nyun' karakutari R.	75.38	105.37	1998	3	1	Pospelov 2002
65	Novaya R.	72.63	100.67	1987	3	1	Volkov unpubl.
66	Tonskoye L.	72.27	98.83	1992	3	1	Karpov *et al.* 1992
67	Bol'shaya Bootankaga R.	73.83	96.92	1991; 1995	3	1	Kozhevnikov 1994, Voronin unpubl.
68	Neizvestnaya R.	76.17	111.45	1994	3	3	TE-94
69	Topographa R.	76.52	111.47	1994	2	2	TE-94
70	Pronchischeva Bay	75.50	113.50	1978	3	3	Chernov 1978, Leonovich & Veprintsev 1980
71	Pronchischeva L.	75.27	112.47	1991–1992	3	1 or 2	Syroechkovski *et al.* 1992, Underhill *et al.* 1993, Schekkerman & van Roomen 1995, ZMMU
72	Bol'shaya . Balakhnya R	73.60	106.67	1934; 1991	3	2	Nikolayev *et al*. 1977, Yesou 1994
73	Bludnaya R.	72.85	106.17	1993; 1994–1998	3	1	Chupin 1994, Soloviev *et al.* 1997
74	Bol'shoi Begichev I.	74.33	112.67	1973	3	3	Telegin 1994
75	Khorgo C.	73.83	113.00	1959	2	3	Uspenski 1965, Uspenski unpubl., ZMMU
76	Paksa C.	73.67	113.17	1959	2	3	Uspenski 1965

No.	Site	Lat.	Long.	Observation year	Status	Breeding abundance	Source
77	Peschanaya R.	73.67	115.50	1959	2	3	Uspenski 1965
78	Uryung-Khaya	72.83	113.25	1961; 1998	3	1	Gladkov & Zaletayev 1962, Zaletayev 1965, Lappo & Syroechkovski Jr. unpubl.
79	Tostuya	73.22	113.67	1998	3	1	Begerhauzen & Kuppel unpubl.
80	Oyulakh-Yuryakh R.	73.45	117.00	1991	2	2	Syroechkovski Jr. *et al.* 1992, Lappo unpubl.
81	Chaidakh-Yuryakh R.	73.30	116.92	1994	3	1	TE-94
82	Terpyai-Tumus P.	73.50	118.58	1994	2	1	TE-94
83	Ust'-Olenyok	72.98	119.82	1997	3	1	Lappo & Syroechkovski Jr. unpubl.
84	Olenyok R. Delta	73.08	119.50	1997	2	1	Lappo & Syroechkovski Jr. unpubl.
85	Stannakh-Khocho	72.98	121.72	1986	3	0	Blokhin unpubl., ZMMU
86	Lena R. Delta	72.92	125.50	1981–1983; 1985	3	0	Labutin *et al.* 1985, Blokhin & Blokhin 1986
87	Dunai I.	73.87	124.50	1990	1	0	Solovieva unpubl.
88	Sagastyr I.	73.42	126.50	1984; 1993–1995; 1997	3	0 or 1 or 2 or 3	Blokhin & Blokhin 1986, Pozdnyakov *et al.* 1996, Solovieva 1996, Pozdnyakov *et al.* 1996, Solovieva *et al.* 1998, Gilg *et al.* 2000, Volkov unpubl.
89	Lena-Nordensheld	72.18	127.07	1996; 1997	3	2	Pozdnyakov 1997, Gilg *et al.* 2000
90	Ary-Bykovskoye	72.15	129.42	1997	3	1	Lappo unpubl.
91	Bykovskiy C.	72.00	129.17	1997	3	0	Lappo unpubl.
92	Tiksi Bay	71.58	128.83	1956; 1997	2	1	Gladkov 1957,1958, Kapitonov 1962, Lappo *et al.* 1998
93	35 km south of Tiksi	71.33	128.83	1956	3	1	Kapitonov 1962
94	Shirokostan P.	72.37	140.27	1994	3	1	TE-94
95	Ular R.	72.30	140.83	1994	3	0	TE-94
96	Malyi Samandon R.	71.50	135.33	1972	3	0	Kistchinski unpubl., ZMMU
97	Yukagir	71.83	139.83	1996	3	1	Syroechkovski Jr. *et al.* 1997
98	Stolbovoi I.	74.17	135.83	1956	2	2	Rutilevkski 1967
99	Kotelny I. (Nerpalakh R.)	75.33	137.50		3	0	Pleske 1928, Kozlova 1962, Rutilevski unpubl.
100	Kotelny I.	75.02	137.75	1994	1	0	TE-94
101	Kotelnyi I. (Balyktakh R.)	75.07	140.17	1994	1	1	TE-94
102	Kotelnyi I. (Khomurgannakh R.)	74.82	138.72	1994	2	0	TE-94
103	Faddeevski I.	75.02	144.42	1994	1	2	TE-94
104	Faddeevski I. (Ulakhan-Yuryakh R.)	75.58	144.00	1939; 1994	3	1 or 2	Rutilevski unpubl., TE-94
105	Faddeevski I.	75.50	143.23	1994	3	1	TE-94
106	Bol'shoi Lyakhovski I.	73.50	142.00	1939	3	2	Rutilevski 1958
107	Kitisno	72.53	148.67	1960	3	3	Uspenski *et al.* 1962
108	Lopatka P.	71.58	149.20	1994	3	2	TE-94
109	Mogotoevo L.	72.15	148.92	1994	3	2	TE-94
110	Lopatka P.	72.18	148.43	1994	1	2	TE-94
111	Indigirka R. (Tabor)	71.28	150.33	1994–1995	3	1	Degtyarev 1995, Pearse unpubl.
112	Indigirka R. (Stanchik)	70.90	150.20	1999	3	1	Zöckler unpubl.
113	Bol'shaya Chukochya R.	70.00	150.83	1957; 1983–1984	3	2	Dorogoi 1988, Kretchmar *et al.* 1991, Vorobiev 1963
114	Khalerchinskaya Tundra	69.00	160.00	1984	3	1	Kondratiev 1982, Kretchmar *et al.* 1991
115	Konkovaya R.	70.00	158.00	1957	3	0	Vorobiev 1958, Vorobiev 1963
116	Ayon I.	69.92	168.33	1958	2	2	Lebedev & Filin 1959
117	Ayon I. (North-East)	69.78	169.29	1987	2	1	Stishov unpubl.
118	Ayon I. (North-West)	70.00	168.39	1987	2	2	Stishov unpubl.
119	Ayon I. (South)	69.66	168.45	1987	3	1	Stishov unpubl.
120	Ayon I. (South-East)	69.57	169.16	1987	3	1	Stishov unpubl.
121	Ayon I. (South-West)	69.84	167.81	1987	3	1	Stishov unpubl.
122	Ust'-Chaun R.	68.78	169.50	1971; 1972	3	1	Zasypkin 1981
123	Chaun R. Delta	68.75	170.67	1972; 1975; 1977; 1978; 1982	3	1 or 2	Zasypkin & Stepnov 1973, Zasypkin 1981, Kondratiev 1982, Kretchmar *et al.* 1991
124	Pucheveem R. Delta	68.80	170.75	1970	2	0	Ostapenko 1973
125	Wrangel I.	71.25	179.75	1965	1	0	Leonov & Shvetsova 1970
126	Wrangel I. (Tundrovaya R.)	71.45	–179.79	1984	2	1	Stishov e*t al.* 1991
127	Dzhenretlen C.	67.12	–174.33	1879	1	0	Palmen 1887, Portenko 1972, Kretchmar *et al.* 1978
128	Bol'shoi Baranov C.	69.75	164.08	1912	3	0	Thayer & Bangs 1914, Portenko 1972, Dorogoi 1997
129	Belyaka Spit	67.08	–173.30	1973–1974; 1986	3	1	Kondratiev 1977, Kretchmar *et al.* 1978, Kondratiev 1982, Tomkovich & Soloviev 1987
130	Mys Shmidta	68.92	–178.58	1987	2	0	Tomkovich *et al.* 1991, Dorogoi 1997
131	Yakan C.	69.58	177.50	1990	3	1 or 2	Stishov & Maryukhnich 1992
132	Amguema R. mouth	67.92	–176.42	1989	3	1	Dorogoi 1993, Dorogoi 1997
133	Barrow C	71.33	–158.67	1962	3	1	Holmes & Pitelka 1964