

Assessment of the Anadyr Lowland subspecies of Bar-tailed Godwit *Limosa lapponica anadyrensis*

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SUMMARY.—New specimens of breeding Bar-tailed Godwits *Limosa lapponica* in the Zoological Museum of Moscow State University have permitted a revision of the doubtful subspecific status of the isolated population that breeds in the Anadyr River basin, Chukotka, Russia. It is demonstrated that in spite of some intermediate characters between westerly *L.l. menzbieri* and the easterly *L.l. baueri*, birds of the Anadyr population should not be treated as a cline. Birds of this population differ significantly from one or both neighbouring populations in their back pattern, axillaries barring, number of bars on the axillaries, contrast of lines on the underwing-coverts and, in males, absence of a whitish patch on the bent wings formed by the upper greater secondary-coverts. Thus, the Anadyr population should be treated as a separate subspecies, *L.l. anadyrensis* Engelmoer & Roselaar, 1998.

Two new subspecies of Bar-tailed Godwit *Limosa lapponica* were described from Siberia in the late 20th century based on an in-depth analysis of specimens (Engelmoer & Roselaar 1998). In addition to the known East Siberian subspecies *L.l. menzbieri*, it was suggested to recognise *L.l. taymyrensis* and *L.l. anadyrensis* from western and easternmost Siberia, respectively. However, the necessity to name the easternmost Siberian population was subsequently questioned by Tomkovich & Serra (1999) because Engelmoer & Roselaar, (1) included both local and non-breeding specimens in their analyses, the latter from an area known to host godwits of at least two other subspecies (*L.l. menzbieri* and *L.l. baueri*) on migration, and (2) they based their assessment on only a few specimens of known nesting origin. Adding to the confusion is the continued uncertainty as to the geographic provenance of the holotype of *L.l. anadyrensis*. Since Engelmoer & Roselaar (1998), additional specimen records have expanded the known breeding range of godwits on the Anadyr Lowland, Chukotka Autonomous Area, Russia, but more importantly, new specimens of known breeding origin have become available, both from the Anadyr Lowland and Alaska. It is essential to have Alaskan specimens for direct comparisons with birds from Asia. Here I use this new information to reassess the taxonomic status of the population that currently bears the name *L.l. anadyrensis*.

Distribution

The eastern part of the species' breeding range is shown in Fig. 1. The breeding range of the putative *L.l. anadyrensis* population is very restricted and until recently known to encompass only a c.250-km-long stretch of the Kanchalan River, Anadyr Lowland (Kistchinski *et al.* 1983). Subsequent records in the first decade of the 21st century have shown godwits breeding or suspected of breeding in additional areas between 63°57'N and 65°50'N and from 174°56'E to 178°41'E (Lappo *et al.* in prep.; E. Koblik & Y. Red'kin pers. comm.). Recently, a godwit thought to be *L.l. baueri* was fitted with a satellite tag in New Zealand and tracked to the Belaya River valley (66°14'N, 173°50'E), a northern tributary of the Anadyr (Gill 2008), suggesting an additional possible breeding site for *L.l. anadyrensis*. Still no signs of breeding Bar-tailed Godwits have been found on the middle Anadyr River,

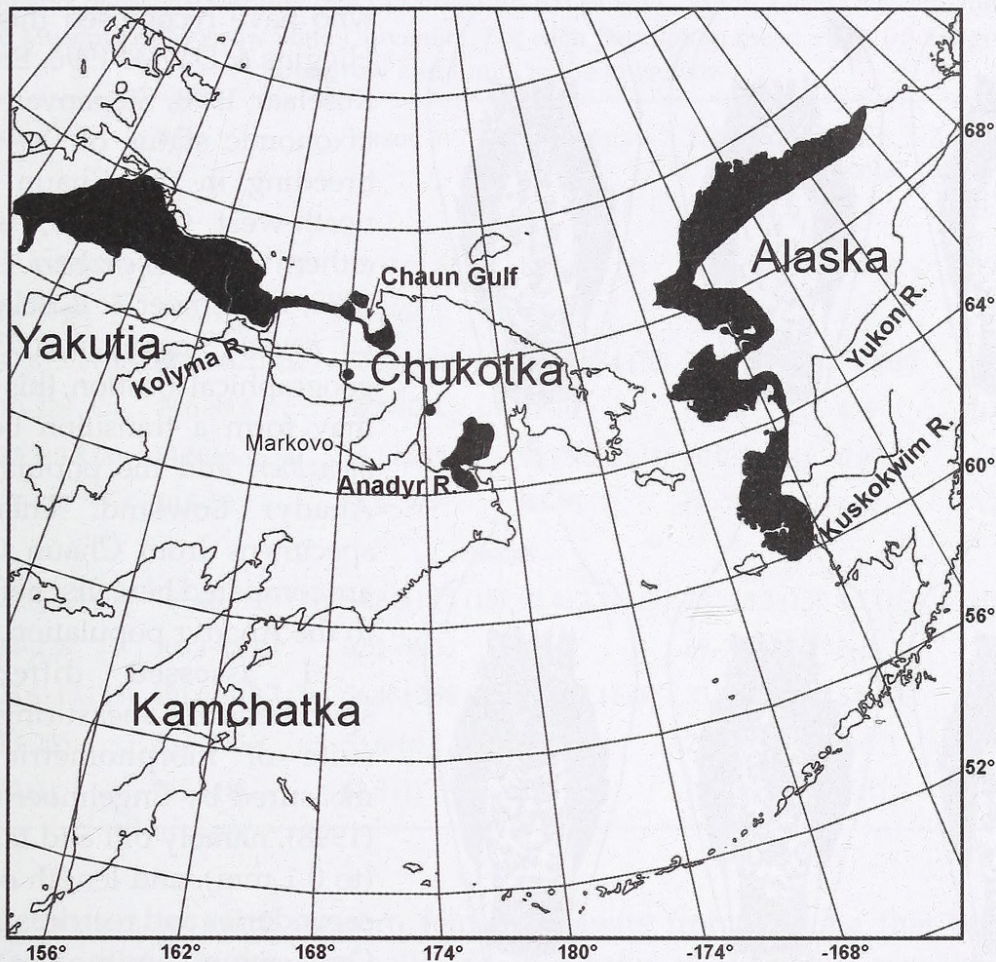


Figure 1. Eastern part of the breeding range of Bar-tailed Godwit *Limosa lapponica* in Siberia after Lappo *et al.* (in prep.) and in Alaska after McCaffery & Gill (2001).

in particular, broadly around Markovo (64°40'N, 170°25'E) (Portenko 1939, Kretchmar *et al.* 1991; A. V. Kondratyev pers. comm., E. Nesterov & I. Karagodin pers. comm.; PST pers. obs.), where the holotype of putative *L.l. anadyrensis* originates (Tomkovich & Serra 1999).

Material and methods

Specimens used in this study included, presumably locally breeding birds (based on their behaviour) from the Anadyr Lowland collected in 2005–06 ($n=8$) and adults guarding young on the Kanchalan River, north-eastern Anadyr Lowland in 1975 ($n=7$). These were compared with breeders from the Yukon-Kuskokwim Delta, Alaska, taken in 1976 ($n=1$) and 2006 ($n=4$), as well as with birds from the Chaun Gulf area, north-west Chukotka ($n=4$) and northern Yakutia ($n=20$) collected in 1912–96. All are housed in the Zoological Museum of Moscow University. Recently, museums have begun preparing skins with one wing detached and spread to facilitate more detailed studies of feathers and moult. In this study all specimens collected post-2000 were prepared accordingly. Unfortunately, no such spread wings are available for *L.l. menzbieri* for comparison with putative *L.l. anadyrensis*.

In this study, I compared specimens of the population breeding on the Anadyr River lowland with neighbouring subspecies (Fig. 1). Bar-tailed Godwits from Alaska have always been recognised as *L.l. baueri*, unlike Siberian birds which are assigned to one or another subspecies (e.g., Portenko 1936, 1939, Engelmoer & Roselaar 1998, McCaffery & Gill 2001, Stepanyan 2003). The population breeding between the Yana and Kolyma rivers, northern Yakutia, Siberia, is definitely considered to be *L.l. menzbieri* according to Portenko

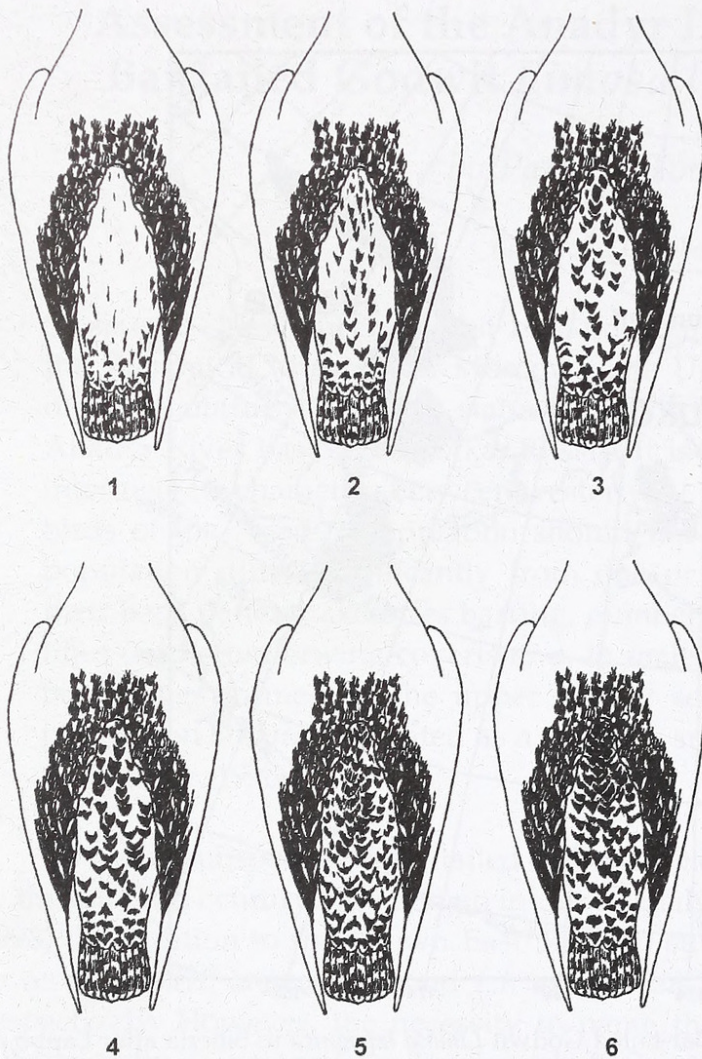


Figure 2. Patterns of back plumage of Siberian and Alaskan Bar-tailed Godwits *Limosa lapponica* used for scoring. Depicted specimens are from the Zoological Museum of Moscow State University: (1) R-114825 from the Yamal Peninsula, West Siberia; (2) R-118470 from the Gydan Peninsula, West Siberia; (3) R-117372 from the Taimyr Peninsula; (4) R-100996 from the Indigirka River, Yakutia; (5) R-120159 from the Anadyr Lowland, Chukotka; and (6) R-123155 from the Yukon-Kuskokwim Delta, Alaska.

measure straightened wings on skins. Thus, wing length measurements obtained in this study cannot be compared directly with those of Engelmoer & Roselaar (1998).

I also scored the pattern of light and dark barring on the axillaries (after Engelmoer & Roselaar 1998: Fig. 13) and counted the number of dark bars on the outer web of the axillaries. The barring varies on the different axillary feathers; therefore the longest axillary feather on a specimen was used for pattern scoring and counting of dark bars.

Lastly, though Engelmoer & Roselaar found no differences in the degree of whiteness of the uppertail-coverts among stocks of godwits, I nevertheless scored this region and also that of the back using a score of 1–6 (Fig. 2). Plumage of study skins was compared also in other respects, but without a quantitative approach. All measurable differences were compared using Systat (version 7.01, SPSS Inc. 1997) with critical values considered where $P \leq 0.05$.

Results

Only four specimens, all females, of Bar-tailed Godwit are available from the Chaun Gulf, north-west Chukotka, and they are identical (t -test & Mann-Whitney test, $P > 0.1$)

(1936) and all subsequent researchers who have recognised this race (e.g., Higgins & Davies 1996, Engelmoer & Roselaar 1998, Stepanyan 2003). The taxonomic status of the population breeding in the Chaun Gulf area, north-west Chukotka, is assigned either to *L.l. menzbieri* (Kistchinski 1988, Engelmoer & Roselaar 1998) or *L.l. baueri* (Stepanyan 2003). From its geographical location, this population may form a transition between *L.l. menzbieri* and the population of the Anadyr Lowland. Therefore the specimens from Chaun Gulf coasts are compared here first before turning to the Anadyr population.

I assessed differences in specimens by measuring the same suite of morphometric variables measured by Engelmoer & Roselaar (1998), namely bill and tarsus length (to 0.1 mm), and length of the wing, secondaries and rectrices (to 1.0 mm). Only wing length was measured differently. Engelmoer & Roselaar (1998) used the maximum length of the wing, i.e. wing maximally straightened and flattened against a ruler. I measured flattened but not straightened wing length on a ruler, because straightening seems to give a much more variable characteristic and it is not always possible to

TABLE 1

Measurements of eastern samples of adult breeding Bar-tailed Godwits *Limosa lapponica* held in the Zoological Museum of Moscow State University. For each population mean \pm S.D. (*n*) are given in the upper row and limits in the lower row.

Population	Wing	Bill	Tarsus	Secondary	Tail	Back score	Axillary score	No. of bars on axillaries
males								
Yakutia-Chaun	210.6 \pm 3.8 (8)	85.09 \pm 3.41 (7)	52.21 \pm 1.61 (9)	87.1 \pm 1.9 (9)	68.7 \pm 5.6 (9)	4.0 (9)	(9)	8.4 (9)
	208–219	81.4–91.2	49.2–54.3	85–90	55–75	4–5	D, E, G	7–10
Anadyr	217.6 \pm 5.7 (10)	82.43 \pm 4.21 (10)	53.82 \pm 2.28 (10)	89.5 \pm 1.84 (10)	71.3 \pm 3.9 (10)	5.1 (10)	(10)	9.4 (10)
	210–228	75.0–89.5	50.6–57.6	87–92	66–78	4–6	E, G	8–11
Alaska	227.3 \pm 3.8 (4)	84.60 \pm 4.16 (4)	56.1 \pm 2.43 (4)	91.75 \pm 2.21 (4)	70.0 \pm 0.8 (4)	6 (4)	(4)	10 (4)
	223–232	80.5–90.4	54.4–59.7	90–95	69–71	6–6	G	10–10
females								
Yakutia-Chaun	220.0 \pm 4.0 (14)	107.46 \pm 5.88 (14)	54.84 \pm 1.73 (15)	93.4 \pm 2.32 (15)	73.3 \pm 3.5 (15)	4.1 (15)	(15)	8.1 (15)
	214–228	100.1–119.9	52.1–58.3	90–97	69–79	3–5	E	7–10
Anadyr	224.6 \pm 10.1 (5)	101.62 \pm 10.7 (5)	56.46 \pm 2.98 (5)	94.2 \pm 3.11 (5)	73.0 \pm 2.9 (5)	5.6 (5)	(5)	9.8 (5)
	213–235	85.8–115.9	53.6–60.2	91–98	70–77	5–6	E, G	9–10
Alaska	240 (1)	113.7 (1)	63.5 (1)	100 (1)	73 (1)	6 (1)	G (1)	9 (1)

in all characteristics to more western female godwits from Yakutia that belong to *L.l. menzbieri*. Comparison of females collected in Chaun and Anadyr revealed that they differ significantly in back score and number of bars on the axillaries (Mann-Whitney test, $P<0.05$). Following these results, samples from Yakutia and Chaun were lumped in further analyses.

Quantitative characteristics of birds of the population breeding on the Anadyr Lowland and neighbouring subspecies are presented in Table 1. Information presented in this table supports the findings of earlier authors that large sexual differences exist in most morphometrics, particularly in the length of the wing, bill, tarsus and secondary feathers. These large size differences between males and females are shown in all three compared populations.

In wing length, tarsus length and secondary feather length, Anadyr males and females are intermediate in average between the other two populations (Table 1), in accordance with their central geographical position, while bill length in both sexes of Anadyr birds is on average smallest and does not differ significantly from either neighbouring population. Analyses of variance revealed a high degree of specificity of Anadyr males in wing length ($P<0.001$), tarsus length ($P=0.017$) and secondary feather length ($P=0.002$), but not in bill length ($P=0.4$). Differences in females do not reach the significant level in any of the morphometrics, possibly partly because of the small Alaskan sample size (one bird). The same result is achieved by discriminant analysis applied to the three most important measurements, wing length, bill length and tarsus length ($P=0.002$ for males; $P=0.099$, n.s. for females).

As to plumage variables under comparison, no significant sexual difference was found within the Yakutia-Chaun and Anadyr populations (Mann-Whitney test, $P>0.1$), but this could not be tested for the Alaskan birds with only one female available. This differed from males in only one of the considered characteristics—it is the only Alaskan

specimen at my disposal that has nine not ten dark bars on the longest axillary. This result agrees well with the finding of Engelmoer & Roselaar (1997) concerning absence of sexual differences in scored plumage variables; because of this, sexes were combined for quantitative comparisons of plumage between the populations in this study. The studied plumage characteristics in Bar-tailed Godwits of the Anadyr region are intermediate on the gradient in eastern populations, but they are significantly specific (ANOVA for each: back pattern, axillary pattern and number of bars on the axillary feather, $P < 0.001$). The Anadyr population also differs from the two others according to discriminant analysis when all three characteristics are considered ($P < 0.001$). However, differences are smaller when comparing only Anadyr and Alaskan birds, being significant only for back pattern (Mann-Whitney test, $P = 0.014$).

Two additional plumage characteristics useful for distinguishing the populations were found, but these were not quantified. First, the contrast of dark lines on the underwing-coverts of Bar-tailed Godwits decreases eastward, which difference can be seen best on the greater underwing primary-coverts. Only a few spread wings are available for comparison with none from the Yakutia-Chaun region, making statistical analysis impossible. Second, on folded wings the greater upperwing-coverts in the Anadyr population are of the same general colour as the other wing-coverts, although they often have narrow whitish edges or fringes. Anadyr birds share this character with Yakutia-Chaun birds, but Alaskan males differ markedly: the four birds examined are not uniform grey-brown, but show a slight whitish tinge and broad greyish-white fringes to the greater upperwing-coverts; the only Alaskan female checked does not have these prominent whitish fringes to the wing-coverts. As a result, folded wings of the Yakutia-Chaun and Anadyr population specimens are rather uniformly coloured above, whilst a whitish wing patch is shown by Alaskan males (Fig. 3). This difference in coloration of male wings does not seem to be due to the feathers being



Figure 3. Coloration of the wings in specimens from the Anadyr (two lower birds) and Alaskan (two upper birds) populations of Bar-tailed Godwit *Limosa lapponica*; females two central birds, males upper and lower birds

slightly fresher in specimens collected in Alaska, because no difference is observable when comparing the one Alaskan male taken in July with three others collected in May.

Discussion

Identity of birds from the Chaun Gulf area and north-eastern Yakutia confirms the view of Kistchinski (1988) and Engelmoer & Roselaar (1997) that they belong to *L.l. menzbieri*, for which the type locality is the Indigirka River delta, Yakutia (Portenko 1936).

The above analysis showed that most studied characters of size and scored plumage variables show signs of gradual change west to east, but they nevertheless significantly differ between the eastern populations of Bar-tailed Godwit. Colour contrast on the folded wing of males does not follow this pattern, being present in the Alaskan and absent in both the Anadyr and Yakutia-Chaun populations. Hence Anadyr godwits are distinct in several characters from both westerly Yakutia-Chaun (*L.l. menzbieri*) and easterly Alaska (*L.l. baueri*) birds. Differences in plumage (back pattern, axillary barring pattern, number of bars on the axillary feather, contrast of lines on the underwing-coverts, and uniformity of colour on the bent wing) are responsible for the significant peculiarity of Anadyr birds.

Engelmoer & Roselaar (1997) stated that, in comparison with Alaskan birds, 'secondary lengths are longer' in *L.l. anadyrensis*. The present findings do not support this conclusion. These authors described *L.l. anadyrensis* on the basis of morphometrics (mostly intermediate among eastern races), and they remarked that this population and Alaskan *L.l. baueri* 'share the dark axillaries and upper tail coverts'. These statements differ from the findings of the current study in respect of several plumage characteristics separating eastern populations quite well from each other. It also merits noting that wing length measurements in this study were consistently smaller than those given by Engelmoer & Roselaar (1997), which reflects methods of measuring this parameter and therefore are not surprising.

From the above analysis it is certain that the Anadyr population of Bar-tailed Godwit differs from other populations morphologically, and hence is meritorious of a separate name. As was clearly shown by Engelmoer & Roselaar (1997) on the basis of morphometrics none of the four old names given to non-breeding birds of the southern Pacific can be applied to either of the Bering Sea breeding populations, therefore their name *L.l. anadyrensis* should be used for the Anadyr population. As a result of this study a new diagnosis for *L.l. anadyrensis* can be suggested.

Diagnosis.—Bent wings of males are uniformly coloured similar to westerly *L.l. menzbieri* but unlike easterly *L.l. baueri*, which have a whitish patch formed by the upper greater secondary-coverts (Fig. 3). Measurements of the sexes given in Table 1 (although not significant in females), back pattern (score 5 is most typical), axillary barring pattern (score E or G), number of bars on the longest axillary feather (9 and 10 are typical), are all intermediate between *L.l. menzbieri* and *L.l. baueri*. Contrast of the lines on the underwing-coverts increases in comparison with *L.l. baueri*.

Notes on the holotype.—There are uncertainties as to the origin of the holotype of *L.l. anadyrensis* (Tomkovich & Serra 1999), no. 45871 in the Zoological Institute in St. Petersburg, Russia. The holotype is a female with brood patches, supposedly collected on 3 June 1897 near Markovo, on the middle Anadyr River, where the species is unknown to breed. Information concerning the breeding of Bar-tailed Godwit near Markovo (Marcova) was based on a report by N. P. Sokolnikoff in Allen (1905) and the data originating from Markovo and the Anadyr Gulf area is confusing (Portenko 1939). This fact together with the early date for a female to have developed brood patches and indication of male sex on the specimen label instead of female (real sex is obvious from morphometrics and plumage), all raise doubts about the specimen and / or its label. It was suggested that

labels of two specimens, the holotype female and a migrant male Bar-tailed Godwit, delivered to the St. Petersburg Zoological Institute in late 19th century were exchanged at some stage (Tomkovich & Serra 1999).

The very bad condition of the holotype prevented its transportation from St. Petersburg to Moscow for this study. Based on photographs and some additional notes kindly made by Dr V. M. Loskot, it is clear that the specimen fits the description of not only *L.l. anadyrensis* but also *L.l. menzbieri*. It has an appropriate back pattern (score 5, which can be found also in *L.l. menzbieri*) and uniformly coloured bent wing (identical in these two races). Measurements of the specimen (in Engelmoer & Roselaar 1997) fit any of the eastern races, apart from wing length, which is incomparable between this study and that of Engelmoer & Roselaar (1997), but does not accord well with the range of *L.l. menzbieri* females (Wilson *et al.* 2007). It is thus certain that the holotype is not a typical example of *L.l. anadyrensis*. Moreover, doubts persist concerning its original label.

Biology and migration.—No focused study on the breeding ecology, biology and / or migrations of *L.l. anadyrensis* has been undertaken, and no nest has been found. Nevertheless, several facts, related mostly to breeding phenology are available.

Until very recently nothing was known concerning the migration routes and wintering grounds of *L.l. anadyrensis*. However, it was suggested that thousands of godwits on passage in coastal west-central Kamchatka, Russian Far East, during mid May possibly belong to this population (Wilson *et al.* 2007). In 2007, during a study of Bar-tailed Godwits that spend the non-breeding season in New Zealand, one of 15 birds fitted with a satellite transmitter migrated from Golden Bay, New Zealand, to the Yellow Sea and then to the Belaya River valley, a northern tributary of the Anadyr, where the bird spent the entire breeding season (Gill 2008). This male paused en route at the base of Kamchatka Peninsula and arrived at its presumed breeding area on 22 May. Bar-tailed Godwits have been recorded migrating north along the west Kamchatka coast between 10 May (in some years as late as 16 May) and 2 June (Gerasimov & Gerasimov 1998). Observations and / or collection of several migrants near Markovo were made on 27 May–5 June (Portenko 1939), but nothing is known as to their racial identity; Portenko considered all four specimens from that area as *L.l. menzbieri*, not *L.l. baueri*, while he identified both races at the lower Anadyr. An opinion concerning the presence of migrant *L.l. baueri* on eastern Chukotka has been indirectly supported by a USA ring recovery there in spring (Tomkovich 2003).

According to the behaviour of birds in the second to fourth weeks of June, Bar-tailed Godwits on the Anadyr Lowland defend territories, chase avian predators and not very actively mob humans (Y. A. Red'kin pers. comm., N. N. Yakushev pers. comm.; PST pers. obs.), which indicates the incubation period. The only find of downy chicks (4–5 days old) was made on 3 July 1975 and agitated behaviour of other birds in that year was recorded after 30 June (Kistchinski *et al.* 1983), suggesting young hatched in very late June and early July. Recently fledged young accompanied by a group of adults were recorded on 30 July (Kistchinski *et al.* 1983). Not a single *L.l. anadyrensis* has ever been ringed on the breeding grounds. An adult Bar-tailed Godwit bearing a New Zealand ring was shot on 2 October in south-west Kamchatka (Riegen 1999) and a sighting of seven birds with New Zealand colour flags on 12–18 August (Schuckard *et al.* 2006) possibly marks the post-breeding migration route of *L.l. anadyrensis*. On southbound migration Bar-tailed Godwits are more abundant in west Kamchatka than during May. However, large numbers of birds colour-flagged in north-west Australia were seen in west Kamchatka (Schuckard *et al.* 2006), which may mean that *L.l. anadyrensis* and *L.l. menzbieri* mix there, because north-west Australian Bar-tailed Godwits belong to the latter subspecies (Wilson *et al.* 2007). Surprisingly, not a single record of a Bar-tailed Godwit marked in eastern Australia

is known from Kamchatka, which might indicate that the non-breeding grounds of *L.l. anadyrensis* are mostly in New Zealand.

It is clear that *L.l. anadyrensis* is currently the least-studied race of Bar-tailed Godwit in the Pacific region and hence its small population should be a priority for research in the near future.

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