Eastern Black-tailed Godwits *Limosa limosa melanuroides* in the Selenga Delta, Lake Baikal, Siberia

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Keywords: shorebird, Black-tailed Godwit, *Limosa limosa melanuroides*, breeding biology, Selenga delta, Lake Baikal

The lower Selenga and its delta are among the main breeding sites of Eastern Black-tailed Godwit *Limosa limosa melanuroides*, but this area is quite isolated from other populations. During our expedition in May–June 2002, we found 21 Black-tailed Godwit nests and trapped 17 adults and 4 freshly hatched chicks. The median first egg date of the 21 nests was 26 May, but some may have been replacement clutches. Mean egg volume per clutch decreased over the course of the season. On the basis of numbers, the preferred breeding habitat was the wet grass and sedge areas of the central delta (15 nests) rather than the drier inner delta (six nests). However, this seems inconsistent with observations that more godwits breed when the water table is low. It is in such conditions that the population peaks at around 100 pairs. Though this is not large compared with recent estimates for *melanuroides* on the Australian wintering grounds of 160,000 the Selenga population is nevertheless of regional importance because of its isolation.

INTRODUCTION

Black-tailed Godwits *Limosa limosa* occur over a vast area from Iceland to E Asia. Two subspecies have been studied extensively: the nominate subspecies *limosa*, mainly in its agricultural breeding habitat in the Netherlands, and the Icelandic subspecies *islandica* in both its breeding grounds on Iceland and its marine wintering sites in the British isles. These subspecies show considerable divergence in habitat choice (Beintema *et al.* 1995, Gerritsen & Groen 1995, Groen & Yurlov 1999), with *limosa* occupying mostly man-made habitats both during breeding and wintering. In contrast, *islandica* inhabits more natural habitats. In the light of this divergence, we were particularly interested in the habitat choice of the third subspecies: the eastern Black-tailed Godwit *L.l. melanuroides*. Little has been published about this subspecies which has a disjunct breeding distribution between Lake Baikal in the west and the Chukotski Peninsula in the east. The plumage and size of *melanuroides* resembles the *islandica* more than *limosa*, as does its preference for marine habitats in winter. Our main aim in this contribution is to give a description of the habitat and reproductive biology of this subspecies in the Selenga delta, Lake Baikal, E Siberia.

The nominate subspecies of the Black-tailed Godwit, *limosa*, has shown a major decline over the last 40 years. It had probably reached a peak in the Netherlands in the mid 20th century, when agricultural methods were still extensive and fertilizers improved food availability resulting in increased breeding success. Currently the population is in sharp decline, largely as a result of agricultural intensification (Teunissen & Soldaat 2005). This is in contrast to the Icelandic subspecies that has increased its population (Gunnarsson *et al.* 2005), probably in response to man-induced habitat change in Iceland. To understand why Black-tailed Godwits are apparently able to adapt to a certain degree of habitat change but not more, we are interested in the habitat choice and breeding biology of the eastern Black-tailed Godwit, *melanuroides*, a subspecies that breeds mainly in natural and semi-natural habitats.

STUDY SITE

The lower Selenga River and its delta on the shores of Lake Baikal, E Siberia (106°15'–106°29'E, 52°12'–52°22'N), have been reported to be among the main breeding sites of *melanuroides* (Hayman *et al.* 1986, Beintema *et al.* 1995, Del Hoyo *et al.* 1997). The delta is one of the most extensive areas of marsh in the entire biogeographic region, covering 54,000 ha. It has a typical delta structure (Fig. 1), with many channels and winding streams, oxbows, small shallow lakes and regularly flooded meadows. It can be split into three main sections:

1. The inner delta (upstream) which is relatively dry with scattered trees and bushes, mainly Willow *Salix* species and wild apples *Malus*.

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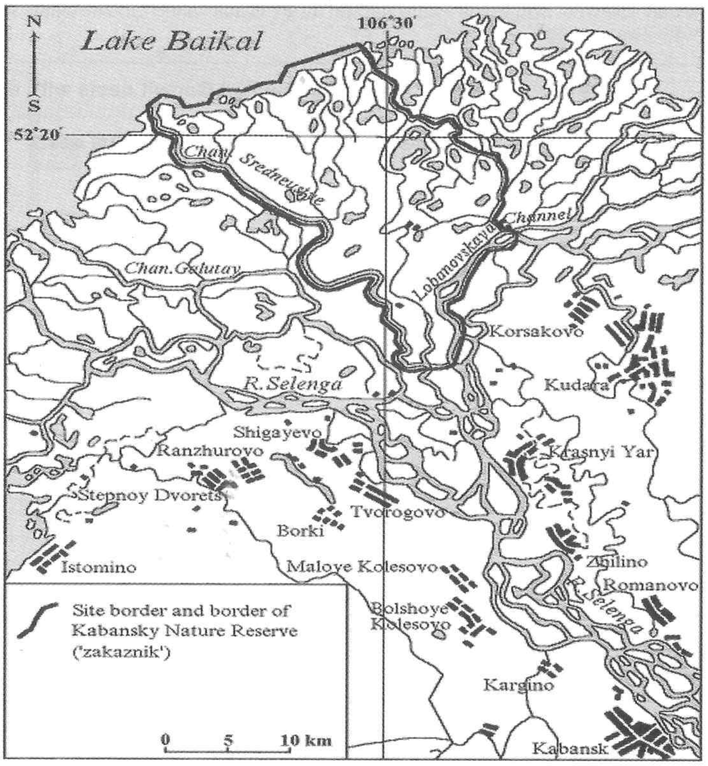

Fig. 1. Map of the Selenga Delta showing major settlements and channels. The Kabansky Nature Reserve is indicated by the bold line. (Map provided by and reproduced with the permission of Wetlands International).

2. The central delta consisting primarily of wet meadows covered with grasses Poaceae and sedges *Carex* grazed by cows and horses. Here are scattered small ponds fringed with Water Horsetail *Equisetum fluviatile* and patches of Common Reed *Phragmitus australis.*
3. The outer delta which is fringed by a shallow lagoon-like zone with floating water vegetation, such as *Nuphar pumila*, *Polygonum amphibium*. Scattered in the lagoon are sandbanks with colonies of terns *Sterna* spp. and gulls *Larus* spp.

Only 7% (4,062 ha) of the delta consists of meadows and temporarily flooded areas suitable for breeding Black-tailed Godwits (Galaziy & Beydeman 1981). Our research was concentrated in the south-west part of the central delta.

METHODS

Searching for nests

When we started fieldwork in May 2002, we surveyed potential Black-tailed Godwit breeding sites over about 1,500–1,800 ha of the central delta. After a few days, we selected ten study sites in the central delta and four sites on the communal lands close to the biological station. All sites were selected for their high densities of breeding godwits. Because we found that nests were clustered, our final study area was less then 300 ha.

We located territories and nests by flushing birds and watching them return. At each nest, clutch size, egg dimensions, and incubation stage was recorded, along with details of the vegetation characteristics around the nest. The volume of each egg was calculated by:

$$V = 0.5\,LB^2$$

where V = Volume, L = length, B = breadth or maximum diameter (after Hoyt 1979).

We monitored nesting success by visiting each nest every three to five days. From these data we calculated daily nest survival by applying the Mayfield method (1975). The formula we used was the one adapted by Beintema & Muskens (1987). In this, nesting success is defined as the daily survival of a nest, which is the probability (p) that a nest present one day will survive to the next day. The expected day of hatching was determined using an incubometer (van Paassen *et al.* 1984). Laying date (of the first egg in a clutch) was calculated as the expected hatching date minus 27 days (4 days of egg laying plus 23 days of incubation), and dates are expressed as days after 31 December (= Julian date). We carried out qualitative monitoring of the plant species present in the immediate surroundings of each nest (3.0 m) by recording all dominant plant species.

Biometrics of adult Black-tailed Godwits

After a nest was located, the eggs were replaced with dummy eggs (to prevent breakage) and a self-releasing spring trap was placed over the nest in order to trap the adults (Groen 1993). We aimed to catch both parents at each nest, but catching was terminated if we failed to catch a bird after one hour. We only made one catching attempt at each nest. Measurements of bill length, total head length (head plus bill) and tarsus length were taken with callipers to the nearest 0.1 mm. Total body weight was measured with a Pesola spring balance to the nearest gram, wing length (from the carpel joint to the tip of the longest primary with the primaries flattened and

Table 1. Bird species breeding within 150 m of and in the same habitat as 21 Black-tailed Godwit nests in the Selenga Delta, Lake Baikal, E Siberia, in May–June 2002.

	Number (%) of Black-tailed Godwit nests with species present within 150 m		
	All 21 nests	**The 15 wet habitat nests**	**The 6 dry habitat nests**
Northern Pintail *Anas acuta*	3 (14)	3 (20)	
Northern Shoveler *Anas clypeata*	1 (5)	1 (7)	
Common Crane *Grus grus*	1 (5)	1 (7)	
Northern Lapwing *Vanellus vanellus*	20 (95)	14 (93)	6 (100)
Ruff *Philomachus pugnax*	4 (19)	4 (27)	
Eurasian Curlew *Numenius arquata*	13 (62)	7 (47)	6 (100)
Marsh Sandpiper *Tringa stagnatilis*	16 (76)	15 (100)	1 (17)
Asiatic Dowitcher *Limnodromus semipalmatus*	5 (24)	5 (33)	
Common Snipe *Gallinago Gallinago*	5 (24)	5 (33)	
Black-headed Gull *Larus ridibundus*	1 (5)	1 (7)	
Common Gull *Larus canus*	16 (76)	10 (67)	6 (100)
Common Tern *Sterna hirundo*	1 (5)	1 (7)	
Short-eared Owl *Asio flammeus*	1 (5)	1 (7)	
Citrine Wagtail *Motacilla citreola*	3 (14)	3 (20)	
Reed Bunting *Emberiza schoeniclus*	1 (5)	1 (7)	

straightened) and tail length were measured with a ruler to the nearest mm. Sexes of adult breeding birds were determined in the field by comparing characteristics of the plumage between pair members and by subsequent analysis of biometrics (Groen & Yurlov 1999). While waiting for the adult to return to the nest we recorded other breeding species present within about 150 m of the nest so that we could describe the meadowbird community of which the godwits formed part.

Table 2. Clutch size and egg measurements of Eastern Black-tailed Godwits in the Selenga Delta, Lake Baikal, E Siberia, in May–June 2002. (Note egg weight is not corrected for incubation stage.)

	Mean	SD	95% CI	N
Clutch size	3.52	±0.68	±0.30	21
Egg length	51.6	±2.09	±0.463	78
Egg width	35.2	±1.15	±0.255	78
Egg volume	33.6	±2.89	±0.642	78
Egg weight	31.4	±2.39	±0.537	76

Table 3. Vegetation composition within 3.0 m of six nests in dry habitat and 15 Black-tailed Godwit nests in wet habitat in the Selenga Delta, Lake Baikal, E Siberia, in May–June 2002. Summed cover index: 1 = cover <10%, 2 = cover 10–50%, 3 = cover 50–100%.

	No. nests plant present	Summed cover index
6 dry habitat territories		
Achillea species	5	6
Ranunculus species	8	8
Plantago species	5	5
Pimpinella species	4	4
Taraxacum species	5	5
Potentilla anserine	4	4
15 wet habitat territories		
Gramineae species	14	20
Carex species	13	32
Equisetum species	9	17
Caltha species	8	9

RESULTS

Bird community

Northern Lapwings, Eurasian Curlews and Common Gulls were breeding in the vicinity of most of the 21 Black-tailed Godwit nests including those in both the wet habitat of the central delta and the drier habitat of the inner delta (Table 1). Marsh Sandpipers were also characteristic of the wet habitat godwit nests, but less so of those in the dry habitat.

Nests and eggs

We found 21 godwit nests on ten different islands throughout the delta. There were 2 nests with two eggs, 6 nests with three eggs and 13 nests with five eggs and the mean clutch size was 3.52 (Table 2).

The mean estimated first egg date of the nests we found differed significantly between the habitats: for the dry habitat of the inner delta the mean was Julian date 140.2 (SD = 3.5, N = 5) while for the wet habitat of the central delta it was 145.5 (SD = 6.0, N = 16; two sample t-test, $t = -2.44$, d.f. = 12, $p = 0.031$) (Fig. 2).

The volume of Black-tailed Godwit eggs decreased significantly over the course of the season ($p = 0.001$, Fig. 3). Egg volume and egg mass were strongly correlated ($r = 0.81$, $p < 0.01$).

Habitat and habitat preference

On the basis of the number of nests found in each habitat, the preferred breeding habitat in the Selenga Delta is the wet grass and sedge areas (N = 15 nests) of the central delta. There are, however, territories in the inner delta (N = 6), where they breed in depressions among sandy river dunes. In almost all godwit territories, grasses and sedges dominated the vegetation (Table 3), but the vegetation composition of the drier inner delta was different to that of the wetter central delta. In the inner delta, dry habitat species, such as *Potentilla anserine* and *Agrostis stolonifera* were dominant, while in the wetter central delta godwits territories were abundant with sedges and *Equisetum*. Therefore both ends of the

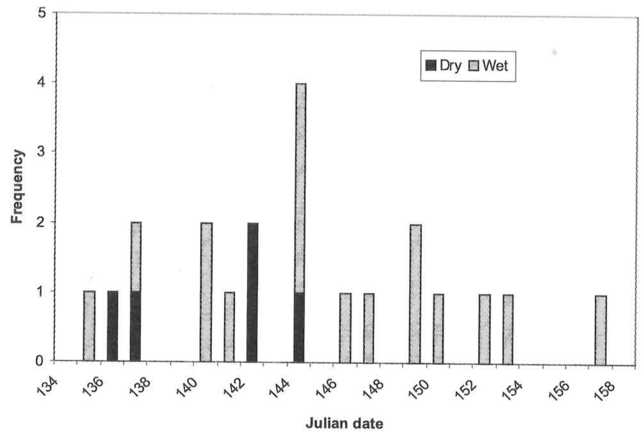

Fig. 2. Frequency distribution of estimated first egg date in 21 nests of Black-tailed Godwit breeding in dry and wet habitats in the Selenga Delta, Lake Baikal, E Siberia. The mean date is significantly earlier in the dry habitat than in the wet habitat (see text).

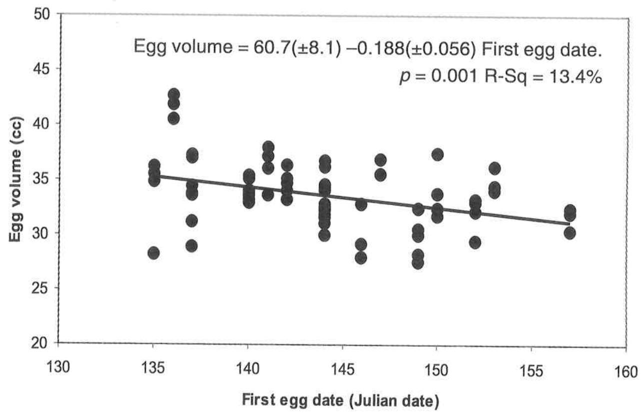

Fig. 3. Seasonal change in the volume of Black-tailed Godwit eggs during May–June 2002 in the Selenga Delta, Lake Baikal, E Siberia, plotted against first egg date.

dry–wet spectrum exist in the Selenga Delta and are inhabited by Black-tailed Godwits.

Nest survival

With 110 monitored nest days, the calculated daily nest survival rate (p) was 0.873. Therefore the probability of a nest surviving an incubation period of 25 days is: $0.873^{25} = 0.033$ (3.3%). This is consistent with our observation that only one nest of 21 under observation hatched (4.7%). We observed predation on nests by Red Fox *Vulpes vulpes*, Common Gulls and Carrion Crow *Corvus corone*.

Biometrics

Female adult *melanuroides* were significantly larger than males in respect of all measurements except tail length (Table 4). They were also heavier than males.

DISCUSSION

Nests and eggs

Black-tailed Godwits laid eggs earlier in the dry habitat than in the wet habitat (Fig. 2). We may have missed some of the early clutches in the wet area, and this may be responsible for this effect. Alternatively, nest predation may have been higher in the wet area so many of the nests we found may have been late replacement clutches. Therefore we cannot be sure whether the difference in laying dates was a function of the birds' behaviour, the result of the way in which we did our fieldwork or an ecological factor, such as nest predation. However, this is clearly an aspect that merits further study. If it is proved that egg-laying is systematically earlier in the dry habitat, this could be interpreted as evidence that the dry habitat is preferred, perhaps because it is more stable and predictable than the wet habitat where water levels are uncertain. The banks on the inner delta are high and flooding of the islands is unlikely, so early breeders may choose this habitat to avoid the risk of flooding. However, predation on nests in the inner delta by gulls and foxes was high. On those islands with a fox den, all nests were depredated. That drier habitats are preferred would seem to be supported by long term observations that show that more Black-tailed Godwits nest in the Selenga Delta in years when the water table is low than when there is extensive flooding (Fefelov & Typitsyn 2004).

Egg volume decreased over the course of the breeding season (Fig. 3). This is consistent with evidence from other Black-tailed Godwit populations that eggs laid early in the season are larger than those laid later (Groen & Yurlov 1999, Schröder *et al.*, unpubl. data). This means that early clutches are likely to result in heavier chicks with a higher probability of survival.

At 0.873, the average daily nest survival rate was low com-

Table 4. Biometrics of eastern Black-tailed Godwits *L. l. melanuroides* from the Selenga Delta, Lake Baikal, E Siberia according to sex (all dimensions are mm). Birds were sexed on the basis of plumage and the relative dimensions of each bird in a pair.

	Females			Males			*t*-test	
	Mean	Range	N	Mean	Range	N	*t*	*p*
Wing length	210.1	201–216	9	201.7	198–205	6	3.76	0.002
Bill length	94.6	89.7–99.8	9	80.3	76.1–87.5	6	7.63	<0.001
Total head length	130.9	126.1–136.8	9	117.4	111.8–123.2	6	6.77	<0.001
Tarsus length	73.2	69.3–76.0	9	66.2	63.6–69.6	6	5.77	<0.001
Tail length	74.3	67–80	8	70.0	68–72	3	1.52	ns
Tarsus + toe	113.9	110–120	9	106.0	105–109	4	4.33	0.001
Tarsus + toe + nail	123	118–131	8	112.7	110–117	3	3.70	0.004
Weight (g)	248	210–274	9	210.8	190–230	6	4.37	<0.001

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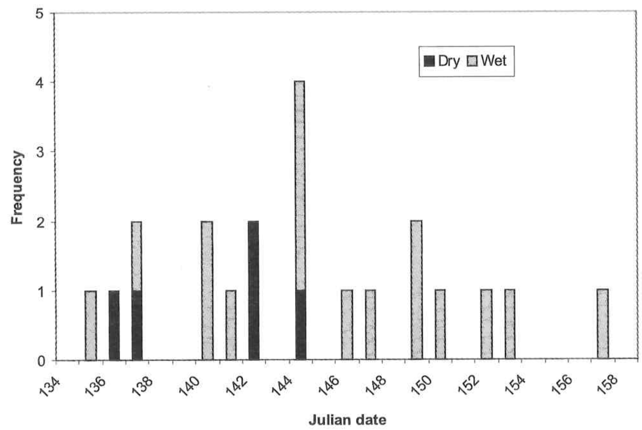

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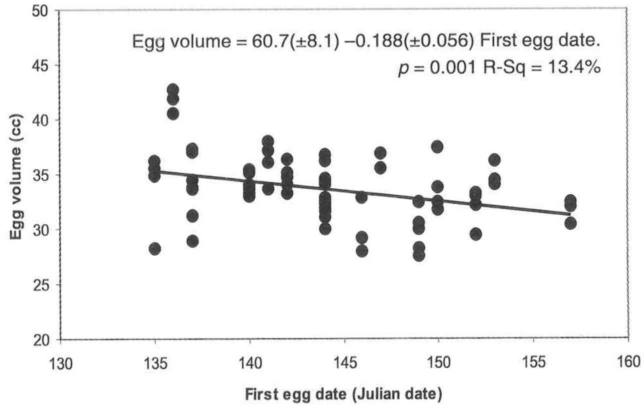

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DISCUSSION

Nests and eggs

Black-tailed Godwits laid eggs earlier in the dry habitat than in the wet habitat (Fig. 2). We may have missed some of the early clutches in the wet area, and this may be responsible for this effect. Alternatively, nest predation may have been higher in the wet area so many of the nests we found may have been late replacement clutches. Therefore we cannot be sure whether the difference in laying dates was a function of the birds' behaviour, the result of the way in which we did our fieldwork or an ecological factor, such as nest predation. However, this is clearly an aspect that merits further study. If it is proved that egg-laying is systematically earlier in the dry habitat, this could be interpreted as evidence that the dry habitat is preferred, perhaps because it is more stable and predictable than the wet habitat where water levels are uncertain. The banks on the inner delta are high and flooding of the islands is unlikely, so early breeders may choose this habitat to avoid the risk of flooding. However, predation on nests in the inner delta by gulls and foxes was high. On those islands with a fox den, all nests were depredated. That drier habitats are preferred would seem to be supported by long term observations that show that more Black-tailed Godwits nest in the Selenga Delta in years when the water table is low than when there is extensive flooding (Fefelov & Typitsyn 2004).

Egg volume decreased over the course of the breeding season (Fig. 3). This is consistent with evidence from other Black-tailed Godwit populations that eggs laid early in the season are larger than those laid later (Groen & Yurlov 1999, Schröder *et al.*, unpubl. data). This means that early clutches are likely to result in heavier chicks with a higher probability of survival.

At 0.873, the average daily nest survival rate was low com-

Table 4. Biometrics of eastern Black-tailed Godwits *L. l. melanuroides* from the Selenga Delta, Lake Baikal, E Siberia according to sex (all dimensions are mm). Birds were sexed on the basis of plumage and the relative dimensions of each bird in a pair.

	Females			Males			*t*-test	
	Mean	Range	N	Mean	Range	N	*t*	*p*
Wing length	210.1	201–216	9	201.7	198–205	6	3.76	0.002
Bill length	94.6	89.7–99.8	9	80.3	76.1–87.5	6	7.63	<0.001
Total head length	130.9	126.1–136.8	9	117.4	111.8–123.2	6	6.77	<0.001
Tarsus length	73.2	69.3–76.0	9	66.2	63.6–69.6	6	5.77	<0.001
Tail length	74.3	67–80	8	70.0	68–72	3	1.52	ns
Tarsus + toe	113.9	110–120	9	106.0	105–109	4	4.33	0.001
Tarsus + toe + nail	123	118–131	8	112.7	110–117	3	3.70	0.004
Weight (g)	248	210–274	9	210.8	190–230	6	4.37	<0.001

Table 5. Comparison of the biometrics of Black-tailed Godwits of the race *melanuroides* from the Selenga Delta, Lake Baikal, E Siberia (this study), with those of the race *islandica* (data from Gerritsen & Groen 1995).

		Selenga Delta (*melanuroides*)			Iceland (*islandica*)			*t*-test	
	Sex	Range	Mean	N	Range	Mean	N	*t*	*p*
Bill length (mm)	F	89.7–99.8	94.6	9	87.8–101.8	94.66	22	0.96	ns
	M	76.1–87.5	80.3	6	73.0–85.0	78.7	15	–0.86	ns
Wing length (mm)	F	201–216	210	9	218–242	226.6	22	8.68	<0.001
	M	198–205	201.7	6	210–226	218.2	11	5.45	<0.001
Tarsus length (mm)	F	69.3–76	73.2	9	67.1–82.5	75.68	22	2.7	0.011
	M	63.6–69.6	66.2	6	61.2–72.3	67.11	15	0.59	ns
Weight (g)	F	210–274	248	9	07–357	333.3	22	–16.1	<0.001
	M	190–230	210.8	6	232–295	262.6	15	6.81	<0.001

Table 6. Comparison of the biometrics of breeding Black-tailed Godwits of the race *melanuroides* from the Selenga Delta, Lake Baikal, E Siberia (this study), with those of the race *limosa* in the West Siberian forest steppe (data from Groen & Yurlov 1999).

		Selenga Delta(*melanuroides*)			West Siberia(*limosa*)			*t*-test	
	Sex	Range	Mean	N	Range	Mean	N	*t*	*p*
Bill length (mm)	F	89.7–99.8	94.6	9	104.7–128	113.9	14	8.93	<0.001
	M	76.1–87.5	80.3	6	90.1–105.9	99.0	11	7.69	<0.001
Wing length (mm)	F	201–216	210	9	228–240	233.1	14	12.6	<0.001
	M	198–205	201.7	6	210–226	218.2	11	7.15	<0.001
Tarsus length (mm)	F	69.3–76	73.2	9	83.5–95.7	89.1	14	13.2	<0.001
	M	63.6–69.6	66.2	6	73.4–85.8	79.3	11	7.41	<0.001
Weight (g)	F	210–274	248	9	297–347	330.8	14	11.7	<0.001
	M	190–230	210.8	6	247–292	265	11	7.94	<0.001

pared with 0.98 in a Dutch population of the subspecies *limosa* (Groen & Hemerik 2002). This rate is far too low to compensate for the annual losses through mortality, because it has been estimated that adult Dutch Black-tailed Godwits need to produce 0.4–0.6 fledglings per pair for a population to remain stable (Groen & Hemerik 2002). It is possible that our presence may have contributed to the high nest mortality by drawing them to the attention of predators. However, it is also likely that predation risk varies strongly from year to year as a result of rodent cycles. Therefore our study may have coincided with a year of high predator abundance and low rodent numbers with the result that predators specialised on bird nests.

Meadow bird community

The meadow bird community of the Selenga Delta (Table 1) shows a striking resemblance to that of the West Siberian forest steppe (Groen & Yurlov 1999) and to a lesser extent to that of the Netherlands in the days before agricultural intensification.

Comparison of *melanuroides* with other races

Generally *melanuroides* is similar in body dimensions and plumage to *islandica* (Gerritsen & Groen 1995). However, our results show that *melanuroides* is significantly smaller than *islandica* in terms of the wing lengths of both sexes and the tarsus lengths of females (Table 5). *Melanuroides* is also significantly smaller than the nominate *limosa* from Central Siberia (Table 6, Groen & Yurlov 1999). This means that *melanuroides* is by far the smallest race of the species *Limosa limosa*. There is some indication that sexual dimorphism in body weight is smaller in *melanuroides* than in the two other subspecies, with females being only 17% heavier than males, while the value for *islandica* is 27% and for *limosa* 25% (Tables 5 & 6). However, for the structural measures of tarsus, bill and wing length, sexual dimorphism is very similar among the three subspecies.

Population estimate of *melanuroides*

The population of *melanuroides* in the East Asian–Australian flyway is currently estimated at 160,000 (Wetlands International 2002). The size of the breeding population of the Selenga Delta seems to be sensitive to the water levels. In years with floods, such as 1992 and 1995, densities are low, whereas in relatively dry seasons, such as 1990 and 2002, densities in some places are as high as 5 pairs/ha and the delta population is estimated at close to 100 pairs (Fefelov & Typitsyn 2004). If therefore the Selenga population is of the order of 200 individuals, it may not be large in terms of the flyway population, but is nevertheless of regional importance on account of its isolation, there being no other known breeding population within 100 km. The nearest population is to the south of the delta on the soda lakes (Beloye lakes) of Southern Buryatia.

The fact that more godwits breed in drier years seems