Biometrics and breeding phenology of Terek Sandpipers in the Pripyat' Valley, S Belarus

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We present data on the breeding phenology and biometrics of Terek Sandpipers from the isolated westernmost population in the Pripyat' river valley, S Belarus, close to the border with Ukraine. Studies were conducted on floodplain islands between the beginning of April and mid-July during 1996–1999 and 2002–2006. Over the years, the first arrivals appeared during 10–26 April (median 14 April), first eggs were laid during 24 April to 5 May (median 30 April) and the latest egg was laid on 25 May, first chicks hatched during 19 May to 1 June (median 25 May) and the first fledged juveniles were caught on 23 June. We present biometric data for juveniles (at the post-fledging stage) and adults. The mean wing length of juveniles, just before departure from the breeding grounds in mid June, reached 96% of that of adults. Juvenile total head lengths were 91% of adult, and bill and nalospi lengths 85% of adult, but tarsus and tarsus plus toe lengths were the same as adults. On average, juveniles left the breeding grounds about 11 g heavier than adults, which had a departure mass near the lowest known for the species.

INTRODUCTION

The biometrics and breeding biology of the Terek Sandpiper *Xenus cinereus* are not well known and only limited descriptions can be found in the literature (Dementev & Gladkov 1951, Kozlova 1961, Glutz von Blotzheim *et al.* 1977, Cramp & Simmons 1983). Moreover most published biometrics are based only on museum specimens, and relate to very large and ill-defined parts of the species' breeding range, such as "NW Russia" or "Siberia" (Dementev & Gladkov 1951, Kozlova 1961, Glutz von Blotzheim *et al.* 1977). The population breeding in the Pripyat' valley of Belarus was only discovered recently. Before the 1920s, the species was seldom recorded in Belarus, but since then it has bred regularly (Fedushin & Dolbik 1967). This westernmost population is isolated – it is 500 km from the main, continuous breeding range (Kozlova 1961). In the light of the literature and our data, it is apparent that the Belarus population, currently 100–130 pairs, is increasing. Moreover the latest breeding locations in the Pripyat' Valley are 100 km to the west of records from 1960s (Fedushin & Dolbik 1967, N. Karlionova & P. Pinchuk, unpubl. data). This isolated population breeds in both Belarus and Ukraine and the aim of this paper is to describe its biometrics and breeding phenology based on our studies in the Pripyat' Valley of Belarus.

METHODS

During spring and summer 2002–2005, we carried out studies of the spring migration and breeding biology of Terek Sandpipers on the floodplain meadows of the Pripyat' river in the vicinity of Turov town, Gomel Region, southern Belarus (52°04'N, 27°44'E; Fig. 1). Characteristically, the water level of the Pripyat River is subject to large seasonal and year-to-year fluctuations (Mongin & Pinchuk 1999), but every spring approximately the same floodplain islands are available for migrant and breeding waders. Terek Sandpipers were caught on these islands (in aggregate about 2 km^2), which are used for grazing during spring and summer. Each year, fieldwork was carried out from the end of March or beginning of April to the end of July. This period covered almost the entire spring migration and breeding season of Terek Sandpipers (Mongin & Pinchuk 1999). Most birds were caught in walk-in traps (Meissner 1998); mist-nets were also used occasionally. During the breeding season, birds were also caught on their nests.

All Terek Sandpipers caught were ringed and aged according to the criteria of Prater *et al*. (1977). Adults and second-year birds were caught throughout the study season, and from mid-June local juveniles were also trapped. Data on second-year birds have not been analysed as only four birds of this age-group were identified. Also, we caught too few chicks for meaningful analysis. All birds caught were weighed on an electronic balance to an accuracy of 0.1 g and the following measurements taken: wing length (maximum chord method, Evans 1986), total head length (Green 1980), bill length and nalospi length (Prater *et al*. 1977) (nalospi is from the bill tip to the distal end of the nostril), tarsus length (Svensson 1992), and tarsus-plus-toe length (Piersma 1984). The wing and tarsus-plus-toe were measured with a stopped rule to 1 mm and 0.5 mm, respectively. Callipers were used for the remaining measurements (accuracy 0.1 mm). In all years of the study, only two ringers measured birds and they were calibrated every year as recommended by Busse (2000).

Fig. 1. Location map of the study area (black dot) in the floodplain of the Pripyat' River in southern Belarus.

Breeding phenology parameters recorded were date of arrival on the breeding grounds, first egg date and hatching date. Every nest found was monitored daily. We have included in our analyses data from 1996–1999 (published in Pinchuk *et al*. 2002) as well as our data for the early part of the 2006 season. Each year 10–20 nests were found and monitored. We also recorded additional information, such as the physiological state of birds caught (e.g. the presence of a mature egg in the cloaca) or the date on which the first free-flying fledglings were caught.

Our analysis of the biometrics of adults is based on the measurements of 183 caught between mid-April and the end of June. The few adults caught during July were not included, as they could have been migrants from elsewhere. The analysis of the biometrics of juveniles is based on measurements taken at first capture of 32 individuals. These data were combined irrespective of catching date. We could not determine the exact age of these fledglings, as we did not know from which nests they originated. However, all these juveniles were at the post-fledging stage when they were caught and fully able to fly. In view of the date on which we recorded the first and last newly-hatched chicks, the youngest juveniles caught in both years would have been 22–28 days old, the oldest juveniles in 2004 would have been 40–48 days, and in 2005, 64–67 days. Our observations suggest that Terek Sandpiper chicks attain the ability to fly when they are 16–20 days old. In 2005, we caught a group of juveniles over 7–9 July and another group over 17–20 July. As all these birds would have been hatched at about the same time, we had the opportunity to compare the biometrics of juveniles of different age (not more than 54–56 days and not more than 64–67 days respectively). Data for three retraps were used to estimate the rate of increase in each measurement per day.

Table 1. Numbers of juvenile and adult Terek Sandpipers caught during April–July 2002–2005 at Turov bird ringing station in the Pripyat' Valley, S Belarus. (The numbers of retraps which are included in some analyses are given in parentheses.)

Years	Juveniles		Adults	
2002	–		62	
2003	–		44	
2004	12		51	
2005	17	(5)	24	(2)
Total	**29**	**(5)**	**181**	**(2)**

In order to estimate the body mass of juveniles and adults just before departure from the study area we took the mass of the latest juveniles to be caught (on 17–20 July) and of adults caught between 25 May (the latest date of egg-laying) and 23 June (departure of local adults). In this case, due to small samples, the mass of retraps on both ringing and recapture were used (4 juveniles, 2 adults).

Because our samples are small, in most statistical comparisons we used the non-parametric Mann-Whitney U-test or Kruskall-Wallis (K-W) test. In comparing the measurements of adults between years we used one-way ANOVA (Zar 1996). Statistical analyses were carried out with the software package STATISTICA 6 (Statsoft 2001).

RESULTS

The first Terek Sandpipers arrived in the study area during 1996–1999 and 2001–2006 between 10 and 26 April (median = 14 April, n = 10 years). The first egg was found about two weeks later, between 24 April and 5 May (median = 30 April, n = 8 years). Clutches of 2–4 eggs were completed in 4–5 days (n = 4 nests). The egg-laying period changed from year to year and averaged about 25 days. The latest date on which a female was caught with a mature egg in its cloaca was 25 May (2002). Incubation lasted 20–24 days (n = 12 nests) and the first chicks appeared between 19 May and 1 June (median = 25 May, n = 11 years). Chicks were seen until the second half of June; but the first fledged juveniles were caught as early as 23 June (2004). Juveniles were observed and caught in the study area until mid July after which they disappeared. Most local adults left the study area in mid June when most of the chicks had fledged. Later, until the end of July, only single

Table 2. Biometrics of adult and juvenile Terek Sandpipers breeding in the Pripyat' Valley, S Belarus, spring and summer 2002–2005.

	Adults			Juveniles			*t*-test	
	N	Mean±SD	Range	N	Mean±SD	Range	*t*	*p*
Wing length (mm)	180	137.3±3.1	131–146	32	130.1±6.59	117–139	10.3	<0.001
Total head length (mm)	181	73.52±2.47	66.9–80.1	32	65.91±3.08	59.5–71.2	15.2	<0.001
Bill length (mm)	180	46.11±2.22	40.5–52.6	32	38.33±2.71	32.2–42.8	17.3	<0.001
Nalospi length (mm)	181	38.88±2.06	34.1–44.2	32	32.04±2.37	27.5–35.9	16.5	<0.001
Tarsus length (mm)	181	28.58±1.01	25.9–31.4	32	28.73±0.82	27.4–30.1	–0.6	0.56
Tarsus+toe length (mm)	180	53.83±1.69	50.0–58.0	32	53.95±1.42	51.0–57.5	–0.1	0.89
Body mass (g)	181	69.40±8.00	56.8–101.0	34	76.72±13.57	55.8–102.5	–3.4	<0.001

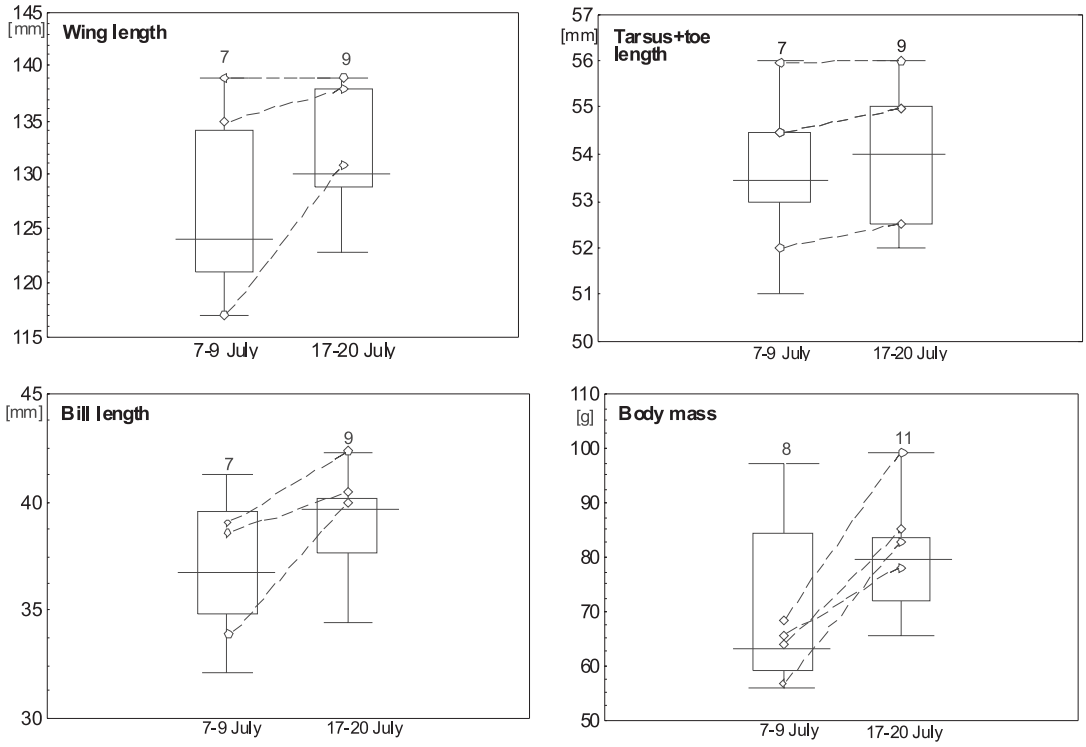

Fig. 2. Measurements of two groups of juvenile fledged Terek Sandpipers – caught on 7–9 July and 15–20 July in 2005 in the Pripyat' Valley, S Belarus. Horizontal lines crossing squares = medians, boxes = 25–75%, whiskers = range, sample sizes above boxes; lines connecting open circles join measurements of individual retraps.

adults (which could be migrants) were observed.

Neither the linear measurements nor the body masses of adult Terek Sandpipers caught during 2002–2005 (Table 1) differed significantly between years (ANOVAs in respect of measurements: in all cases $p > 0.05$; K-W test in respect of mass: $H_{3, 181} = 2.01$, $p > 0.05$). Also, the juveniles caught in 2004 and 2005 (Table 1) did not differ significantly in measurements (Mann-Whitney U-test – in all cases $p > 0.05$). Therefore for both adults and juveniles we have combined the yearly datasets in our analysis of biometrics (Table 2).

Comparison of mean measurements of adults and juveniles birds showed that differences between two age classes in most cases were statistically significant (t-test, $p > 0.001$) (Table 2). Only tarsus and tarsus plus toe lengths of juveniles and adult birds were not statistically significantly (t-test, $p > 0.05$).

After the juveniles had fledged, their size and mass continued to increase, as shown by comparing the group caught on 7–9 July 2005 with the group caught 8–13 days later (Fig. 2). Although there were no statistically significant differences in the median measurements of birds from the two groups (Mann-Whitney U-test, in all cases $p > 0.05$), which could be the effect of small samples, the medians of wing length, bill length, tarsus plus toe length and body mass all increased with date and all three birds retrapped increased in almost all the same size parameters and in mass (Fig. 2). The growth rates ranged as follows: total head length: 0.2–0.6 mm/day; bill length: 0.3–0.6 mm/day; nalospi length: 0.3–0.4 mm/day. The growth rate for wing length was 0–1.4 mm/day, as one bird did not show any change and had presumably finished growing its primaries at the time it was first caught during 7–8 July (Fig. 2). There was only a tiny increase in the tarsus-plus-toe measurement, with one retrap showing no change (Fig. 2). The juveniles also increased their body mass during July at a rate of 1.8–2.8 g/day (Fig. 2). The wing length of juveniles caught in the second 10 days of June, just before their departure from the study area, averaged 96% of that of adults; total head length 91% of adults, bill length and nalospi length both 85% of adults, all statistically significant differences (Table 3). However, the tarsus and tarsus plus toe lengths of these juveniles were already of adult size (Table 3). Comparison of body mass before departure from the breeding grounds showed that adults left the area *c.*11 g lighter than juveniles (medians: adults = 69.0 g, n = 9; juveniles = 79.9 g, n = 8), but this was not a statistically significant difference, again possibly because of the small sample size (Mann-Whitney U-test: $Z = -1.54$, $p = 0.12$)

DISCUSSION

Breeding season phenology

Every year during our study, Terek Sandpipers laid their first eggs around the end of April or beginning of May. This is up to a month earlier than the earliest first-egg date (26 May) in the central part of the species' breeding range, at areas located *c.*1450 km to the east (Russia, Kazan region (Tetushi); Kozlova 1961). The difference in the first egg laying dates between years was up to 12 days, probably due to local conditions, especially temperature and water levels in the breeding area.

The incubation period we observed was 20–24 days, which is similar to that recorded in the literature of 23–24 days for the species generally (Cramp & Simmons 1983) and 21 days for Terek Sandpipers breeding across a wide area of the former Soviet Union (Kozlova 1961).

Biometrics

There can be a difference between measurements of live birds and museum specimens of 1–4 mm due to shrinkage of skins (Hoffmann 1957, Prater *et al.* 1977, Engelmoer *et al.* 1983). Therefore some caution is necessary in making comparisons between different datasets. Generally, there appears to be little size difference between breeding populations of Terek Sandpipers across most of their range from Fennoscandia to eastern Siberia, except for some populations of the Far East that winter in Borneo, Sumatra and Celebes (Kozlova 1961, Glutz von Blotzheim *et al.* 1977, Cramp & Simmons 1983). The ranges of measurements in the Pripyat' population compared with those given for other parts of the breeding range (Table 4) suggest that it is closest, biometrically, to birds breeding in the north-west of the former Soviet Union (Cramp & Simmons 1983). Large differences in values given for wide areas of Russia by Dementev & Gladkov (1951) and Kozlova (1961) might be caused by different methods of measuring museum skins.

To some extent, the biometrics of juvenile Terek Sandpipers presented in this paper must reflect birds at different stages of development because the difference between the earliest and latest clutches was about six weeks. Moreover, in 2004, juveniles were caught 1 to 2 weeks earlier than in 2005 when juveniles were still growing in July as shown by birds in sequential catches (Fig. 2). Kozlova (1961) gives measurements of (poorly) flying juveniles that had wing lengths of 87–89 mm. All juveniles analysed here had wing lengths over 117 mm (Table 2) and were caught in mist-nets as flying birds. Thus all the values given here clearly refer to birds that are well past the fledging stage. The maximum measurements for juveniles relate to birds that were just about to depart from their breeding grounds.

Table 3. Comparison of linear measurements of adult Terek Sandpipers caught during the whole breeding season (mid April to the end of June) with those of the last juveniles just before departure from the breeding grounds during 17–20 July. (Measurements in mm.)

	Adults		Last juveniles		Mann-Whitney	
	N	Median	N	Median	*Z*	*p*
Wing length	180	137.0	7	130.0	2.86	$p < 0.001$
Total head length	181	73.5	7	66.7	4.36	$p < 0.0001$
Bill length	180	46.2	7	39.7	4.44	$p < 0.0001$
Nalospi length	181	39.0	7	33.0	4.40	$p < 0.0001$
Tarsus length	181	28.6	7	28.5	–0.07	0.94
Tarsus + toe length	180	53.8	7	54.0	–0.06	0.95

Juvenile growth and body mass at departure

In many waders, e.g. Redshank *Tringa totanus*, Northern Lapwing *Vanellus vanellus*, Black-tailed Godwit *Limosa limosa* and Common Snipe *Gallinago gallinago*, tarsus and middle toe, are already well developed at hatching, and they quickly reach almost full adult size (Green 1985, Beintema & Visser 1989, Thompson *et al.* 1990). We have confirmed that this is also the case in Terek Sandpiper because flying juveniles had already reached 100% of the adult size of tarsus and tarsus-plus-toe by two weeks before they left the breeding grounds (Fig. 2). Quick development of the terrestrial movement apparatus (legs) in the case of the precocial chicks of waders can have an adaptive importance for predation avoidance and effective feeding (Thompson *et al.* 1990), but sometimes the development of leg bones in juveniles may be not complete by the time they leave the breeding grounds. However, any small difference compared with adult size may be compensated by higher content of cartilage in the joints (Cymborski & Szulc-Olechowa 1967). This can mean that juvenile legs may even, temporarily, be longer than their final size, as described, for example, in Ruddy Turnstones *Arenaria interpres* (Meissner & Koziróg 2001) and Grey Plovers *Pluvialis squatarola* (Krupa & Krupa 2002) during autumn migration.

The analysis of growth of the wing length in Terek Sandpipers showed that some juveniles (probably from the earliest clutches) attained final wing length in the first ten days of July, while in others rapid primary growth occurred during the last ten days before departure (Fig. 2). In other waders – Redshank, Black-tailed Godwit and Lapwing – the wing continues to grow for some time after fledging (Beintema & Visser 1989). By the time of departure, juvenile Terek Sandpipers attained 96% of the wing length of adults, which is similar to Redshanks (97.3%, Thompson *et al.* 1990). It is likely that there is little further growth because in non-breeding quarters in NW Australia in October juvenile Terek Sandpiper wing lengths are still significantly shorter than in adults (97.5%) despite the fact that adult primaries are more worn (C.D.T. Minton pers. comm.). Similarly, during southward migration juvenile Ruddy Turnstones, Grey Plovers, Red Knots *Calidris canutus* and Bar-tailed Godwits *Limosa lapponica* have shorter wings than in adults (96–99%; Meissner & Koziróg 2001, Krupa & Krupa 2002, Meissner & Kamont 2005).

At only 85% of adult length, the bills of juvenile Terek Sandpipers appear to be the least developed part of the body at the post-fledging stage. By October, however, there is no difference between the bill lengths of adults and juveniles in NW Australia (C.D.T. Minton pers. comm.). At fledging in

Table 4. Ranges of measurements of Terek Sandpipers from different localities (sample sizes where known are given in brackets).

Wing length (mm)	Bill length (mm)	Tarsus length (mm)	Body mass on breeding grounds (g)	Age	Area	Source
131–146 (181)	40.5–52.6 (180)	25.9–31.4 (181)	56.8–101.0 (183)	Adults	Pripyat' Valley	Our data*
121–136 (81)	37–52 (20)	26–34 (20)	47.5–76.0 (5)	Unspecified	Former Soviet Union	Dementiev & Gladkov 1951
124–137	41.5–53.5	26.5–30.5	56.0.3–121.0	Unspecified	Former Soviet Union	Kozlova 1961
128–140 (18)	43.0–52.0 (19)	27–31(23)	58–108 (31)	Adults	NW former Soviet Union	Cramp & Simmons 1982
124.5–142.0 (97)	42.0–54.0 (96)	27.1–31.2 (96)	58.5–108 (19)	Adults	Former Soviet Union	Glutz von Blotzheim *et al.* 1977
129–142 (54)	42–52 (53)	26–32 (65)	–	Adults	–	Prater *et al.* 1977

* Our data are for live adult Terek Sandpipers, the remainder are for museum skins.

other waders, especially longer-billed species, such as Redshank and Black-tailed Godwit, bills are still in a phase of rapid linear growth in contrast to other parts of the body (Beintema & Visser 1989). However, juvenile Redshanks can attain almost the same bill length as adults before leaving their breeding grounds (Thompson *et al.* 1990). In some waders, such as Grey Plover and Red Knot, juveniles migrate with slightly shorter bills than adults (95%; Krupa & Krupa 2002, Meissner & Kamont 2005), but in a longer-billed species, Bar-tailed Godwit, juvenile bills were much shorter (88%; Thompson *et al.* 1990), which is close to the value we obtained for Terek Sandpipers. Therefore it seems that long-billed species, including Terek Sandpiper, continue to grow their bills for some time after fledging, but adult length is attained quite quickly. As the bill is vital feeding apparatus, it would probably be a selective disadvantage to have a short bill and this may be the reason its rapid growth.

Juvenile Terek Sandpipers in Belarus increased their body weight during July (Fig. 2). No doubt this is partly the effect of growth, but it seems likely that they also accumulated fat reserves for migration, as they departed from the study site about 11 g heavier than the adults (Table 2). This is consistent with the fact that in July the juveniles formed flocks and spent most of the time feeding. This is in contrast to the behaviour of juvenile waders of other species breeding in the High Arctic. There, juvenile Little Stints *Calidris minuta*, White-rumped Sandpipers *C. fuscicolis* and Semipalmated Sandpipers *Calidris pusilla* left their nesting areas at low weight (Lindström *et al.* 2002). Departure from breeding grounds with low fat reserves is thought to be typical of time-minimising migrants at the first stage of their autumn migration, when they can expect better foraging sites further south (Gudmundsson *et al.* 1991). Possibly inexperienced juvenile Terek Sandpipers accumulate greater fat reserves to guard against the risk of meeting unfavourable conditions en route. Adult Terek Sandpiper left the breeding grounds with very low fat reserves, close to the lowest known for the species (Table 4). It may be that they move to a better foraging site close to the breeding area.

Our studies of the unique breeding population of Terek Sandpipers in the Pripyat' Valley are continuing and we hope soon to be able report more fully on its biology and ecology.

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