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Waterbirds around the world

A global overview of the conservation,
management and research of the
world's waterbird flyways

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The Sivash Bay as a migratory stopover site for Curlew Sandpiper *Calidris ferruginea*

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ABSTRACT

During migration periods the Sivash Bay of the Azov Sea supports up to 1.5% of the world population of Curlew Sandpiper *Calidris ferruginea* (c. 66 000 – 120 000 birds). In spring most birds pass through in the first ten days of May. They stopover for four to five days during which they accumulate as much as 41% of extra body mass. Curlew Sandpipers' main prey during this time is Brine Shrimp *Artemia salina*, whose distribution is restricted to the hypersaline waters of the Sivash. Feeding upon Brine Shrimps is highly profitable: spending 79% of foraging time, with pecking rates of 90 per minute, birds are able to gain 4.3 g of reserve tissue daily. The flight range of birds departing from the Sivash in spring is estimated at 2 – 2 500 km. In autumn, Curlew Sandpipers leave for wintering grounds located all over the African continent with sufficient fat reserves to travel 4 – 4 500 km. Ringing recoveries link this stopover site with staging areas in the Mediterranean, Baltic and East-Atlantic. Birds breed in the Taimyr Peninsula, although morphometric data suggests that some birds may come from areas further east.

INTRODUCTION

Compared with the East-Atlantic flyway, stopover sites of waders in wetlands around the Mediterranean, Black and Caspian Seas, the Afro-Eurasian continental flyway corridor, remains rather poorly studied. Curlew Sandpipers show a clear preference for this continental flyway corridor in both spring and autumn (Eliot *et al.* 1976, Wilson *et al.* 1980). This paper summarizes results of several studies on Curlew Sandpiper in the Sivash Bay (Khomenko *et al.* 1999, Dyadicheva *et al.* 1999).

METHODS

Counts and mist-netting of Curlew Sandpipers were carried out during regular expeditions of the Azov-Black Sea Ornithological Station to the the Sivash Bay (S Ukraine, SE Europe) between 1992-1998. By 1998, a total of 6 400 Curlew Sandpipers were ringed and 79 long-distance recoveries (0.6%) obtained in the Southern Ukraine (including the Sivash). Spatial coverage of counts varied between years, the most complete censuses being carried out in May 1993, 1996 and August 1998. Since the periods of catching and ringing varied between years, all data from 1992 to 1998 was pooled by five day periods (Bertold's pentads) to analyze the seasonality of morphometrics, body mass dynamics and moult (19 pentads, 275 ± 424 birds per pentad analyzed). Only samples ≥ 20 adult birds were included in the analyses providing totals of 3 313 birds in spring and 1 414 birds in autumn. Birds were measured, weighed and aged according to standard methodologies (Prater 1977; pre-print by H. Schekkerman 1990). Plumage characteristics were described according to Chernichko (1988). The average wing to bill ratio was calculated for each sample to identify sex ratios (Khomenko & Dyadicheva 1999).

Time budgets were determined by activity scanning (184 hours of observations, six activities distinguished; for details see Khomenko *et al.* (1999). The average daily body mass gain was calculated by comparing the expenditure (BMR + activity costs + moult) and income (consumption of food per unit of time * energy equivalent * assimilation coefficient of the prey) of the energy budgets according to a standard evaluation procedure (Dolnik 1982). The production of 1 g of reserve tissue was considered to cost 34.2 kJ (Verkuil *et al.* 1993). The maximum flight distance (MFD, km) was calculated as the formula: $MFD=95.447 *$

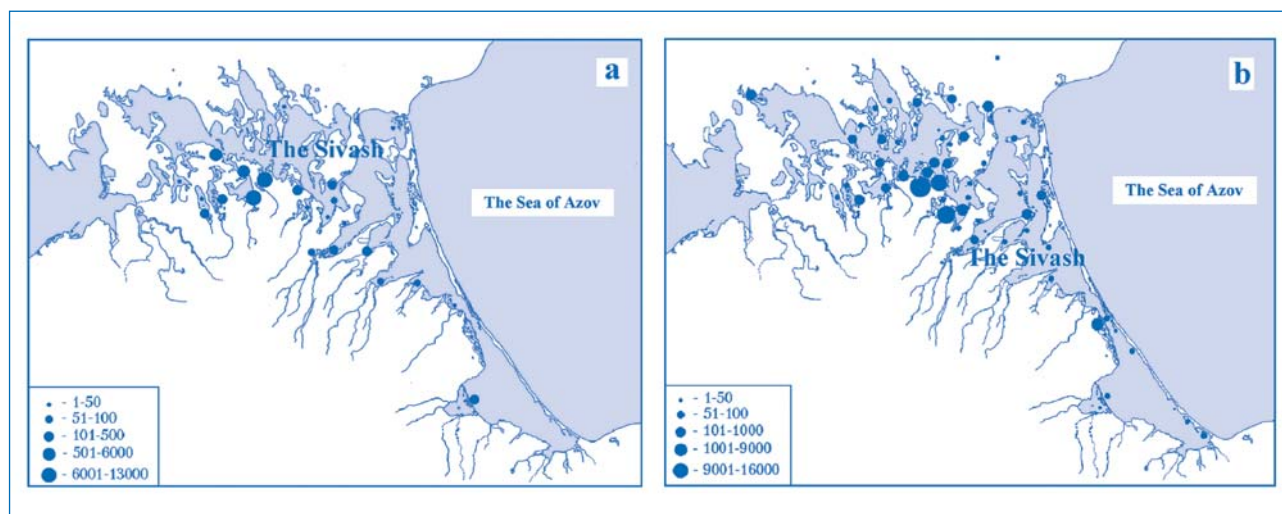


Fig. 1. Distribution of Curlew Sandpiper *Calidris ferruginea* gatherings in the Sivash according to absolute counts carried out in 1990-1998. Only maximum figures for each counting locality are presented. a – spring, b – autumn.

$V(T^{0.302} \cdot M^{0.302})$; where V – flight speed (km/h), T – initial body mass (g), M – arrival body mass (g) (Gavrilov 1992).

RESULTS

Numbers, distribution and migration pattern

The largest gatherings of Curlew Sandpipers were found in the southern part of the country, where birds occur in most coastal wetlands. In the Sivash area, c. 33 000 and c. 72 000 birds were counted here simultaneously at the peak of spring and autumn migration respectively. Smaller numbers, totaling up to c. 10 000, were counted in autumn in the estuaries of the Azov-Black Sea coast (Dyadicheva *et al.* 1999). The largest concentrations in both spring and autumn were in Central Sivash (Fig. 1).

Seasonal trends in the wing/bill ratio (Fig. 2) indicate that males migrate earlier than females in both spring and autumn (Cramp & Simmons 1983). In spring migration, two waves can be distinguished; the first, around 10 May with a maximum c. 33 000 birds counted simultaneously and a second, five times smaller, around 22 May. The migration pattern suggests that most birds stay in the area for five to six days. Autumn migration, which begins with the arrival of males in mid-July, is more prolonged. Most males leave the area by 8 August. A pronounced peak in numbers is recorded around 20 August, when females replace males in the staging area. In autumn, males and females are estimated to stay for two to four weeks, with females tending to have shorter stopover periods than males.

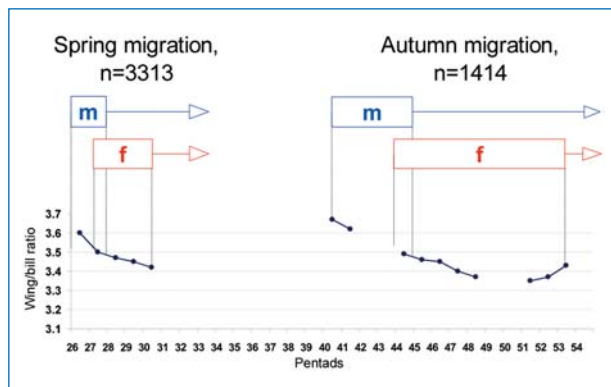


Fig. 2. Timing of male (m) and female (f) stopover in the Sivash according to the wing/bill ratio dynamics.

FEEDING ECOLOGY, PRE-MIGRATORY FATTENING AND FLIGHT RANGE

The habitat choice of Curlew Sandpipers in the Sivash (Fig. 2) clearly shows that birds prefer Brine Shrimps to other (mainly freshwater) prey species that are available (Khomenko *et al.* 1999). Contrary to many other waders (e.g. Zwarts *et al.* 1990) Curlew Sandpipers in both the Central and Eastern Sivash feed only during the daytime. Maximum feeding activity occurs in the morning (Fig. 3), during periods of maximum availability of Brine Shrimps. In the Central Sivash, Curlew Sandpipers foraged significantly longer ($79.4 \pm 22.3\%$) than in the Eastern

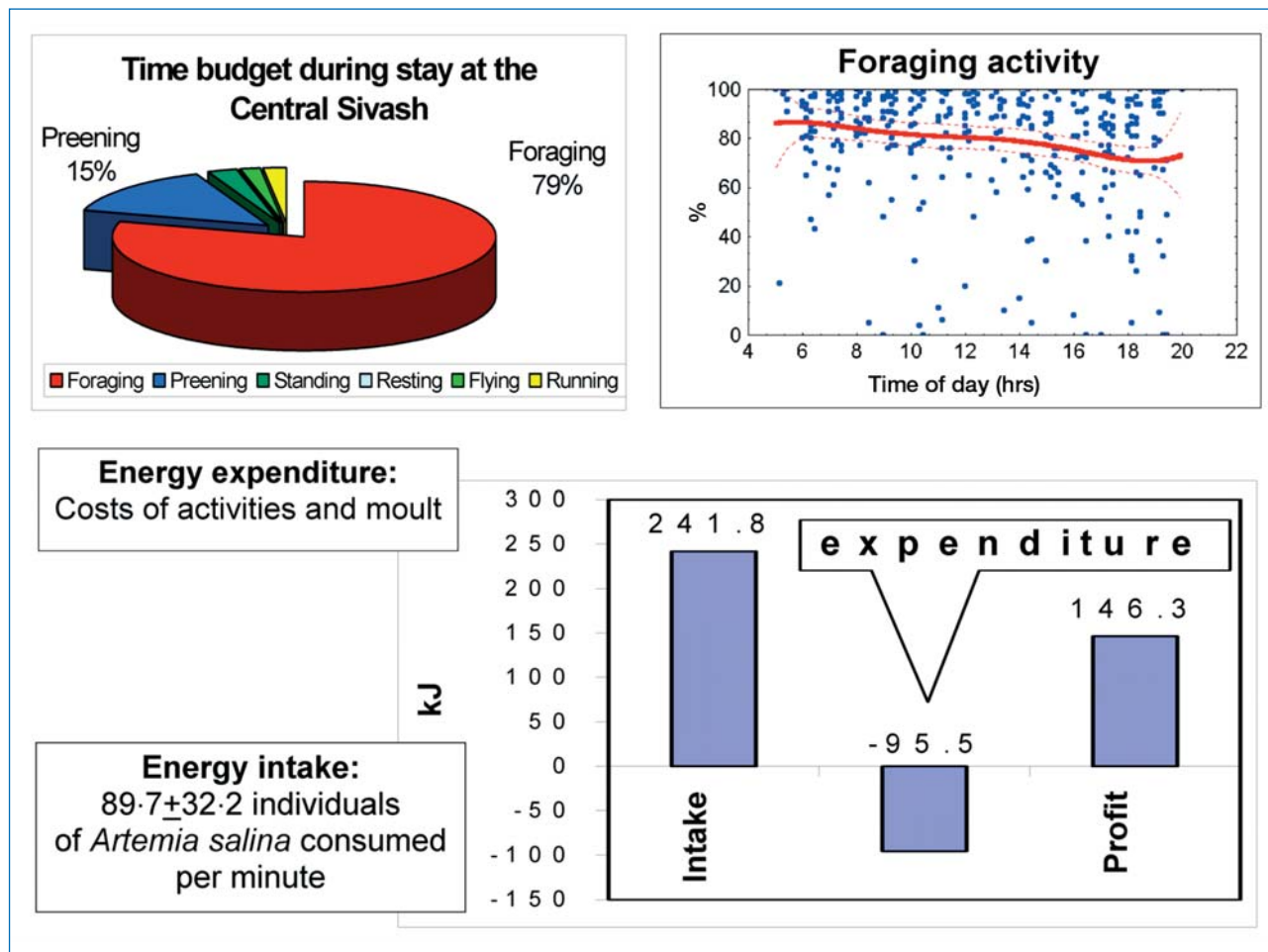


Fig. 3. Time and energy budgets of Curlew Sandpipers *Calidris ferruginea* foraging on Brine Shrimps *Artemia salina*.

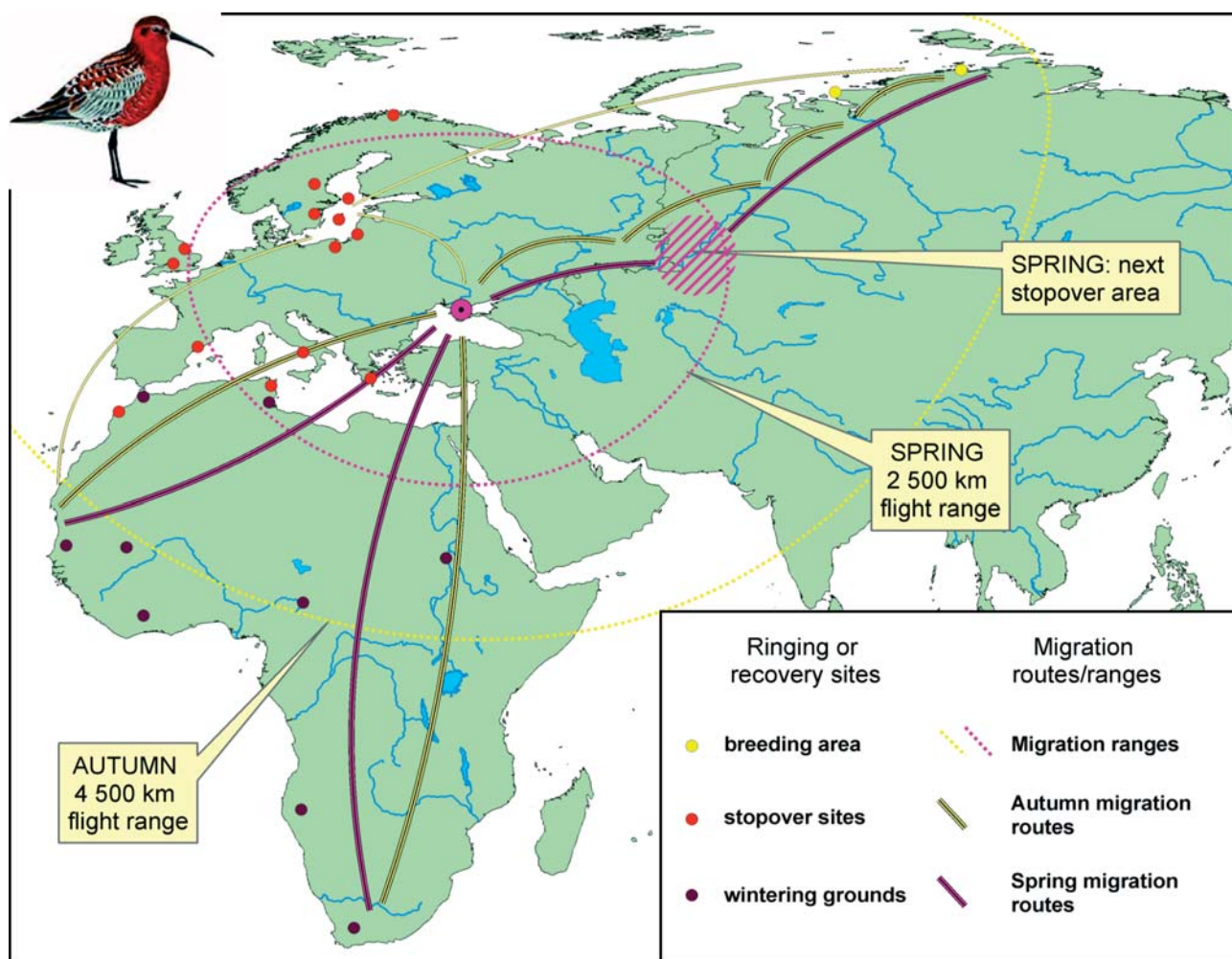


Fig. 4. Recoveries of Curlew Sandpipers *Calidris ferruginea* ringed or recovered in the S Ukraine by seasons (wintering, migration and breeding) and scheme of migration routes and estimated flight ranges.

($74.5 \pm 23.8\%$), mainly due to a decreasing time for resting from 6.7 ± 12.0 to $0.2 \pm 0.5\%$ (Mann-Whitney test, $p < 0.01$).

Pecking rates of Curlew Sandpipers in the Central Sivash were measured ($n=517$) to estimate the consumption of this prey per unit of time. It averaged 89.7 ± 32.2 specimens per minute, which was significantly higher than in Dunlin (Mann-Whitney test, $p < 0.01$). Energy intake was estimated on the basis of daily food consumption (Fig. 3). Dependent on the time spent foraging it varied from 180.8 to 273.8 kJ/day (average = 241.8 ± 32.5 kJ/day). This fully compensated estimated daily energy expenditures leaving an average of 146.3 ± 38.4 kJ/day (72.1 – 185.5 kJ/day) available for building up fat reserves. With this amount of energy Curlew Sandpipers were estimated to gain body mass at a rate of 2.1–5.4 g/day (on average 4.3 ± 1.1 g/day). During the spring staging period, which is estimated to be no longer than five to six days (Khomeenko *et al.* 1999), birds can gain as much as 33–41% of extra body mass. Their flight range should then be around 2 000–2 500 km, which is clearly not enough to go directly to the breeding grounds (Fig. 4). In autumn, average body mass is generally in the range of 70 to 78 g. The estimated flight range to the wintering grounds is approximately 4 000–4 500 km.

DISCUSSION

Given the assessment of Curlew Sandpiper numbers in the Sivash it seems that the area is probably one of the most important

stopover sites for this species in the world. If the turnover rate is taken into account, according to our estimates up to 9% (c. 66 000 birds) of the African wintering population pass the area in spring and around 21% (c. 160 000 birds) – during autumn migration. These figures correspond to 0.5 and 1.5% of the world population of Curlew Sandpiper (Rose & Scott 1994). Nowhere else have such large concentrations of Curlew Sandpiper been recorded.

There is no doubt that large numbers of birds are attracted to the area by high densities of Brine Shrimps. Research has shown that Curlew Sandpipers using this food during pre-migratory fattening can gain body mass at a daily rate close to the maximum ever recorded (5.5 g/day, sedimentation fields in Bahrain, Hirschfeld *et al.* 1990). Therefore, fat reserves sufficient for flying some 2–2 500 km can be accumulated in an extremely short period of time (four to five days). It is important to stress the fact that most birds depart from the Sivash with 33–41% of extra body mass as early as mid-May, which is approximately one month before their arrival at the breeding grounds. They have one more stopover area on route to the breeding grounds, which is most likely to be located somewhere in the south of Western Siberia (Fig. 4).

The particular preference of Curlew Sandpiper for hypersaline environments has also been recorded in Hungary, where up to 61% of birds occurred in salt pans (Sterbetz 1993). This raises the question as to whether the species may be dependent on the

food resources of galinic water bodies during migrations via continental Eurasia. The exclusively diurnal feeding and high efficiency of foraging upon Brine Shrimps recorded in the Sivash clearly distinguish Curlew Sandpiper from other sandpiper species, and Dunlin in particular (Khomenko *et al.* 1999). These peculiarities of its feeding ecology suggest that birds do not just feed on Brine Shrimps by chance, but to a certain extent, specialize on such food. Moreover, it is known that saline water bodies (e.g. Manych-Gudilo, the Caspian coast, salt lakes of the south of Western Siberia) predominate in the areas Curlew Sandpipers pass through during migration to the breeding grounds and back.

Breeding grounds of Curlew Sandpipers ringed or recovered in S Ukraine are located in NW and N Taimyr (n=2), although analysis of morphometrics suggest (Khomenko *et al.* 1999) that a faction of smaller-billed birds may come from the areas to the east (up to the Lena River mouth). Wintering areas are apparently rather large and include N, W, S and Central Africa. Many recoveries (n=25) link S Ukraine and NW Europe (mostly Scandinavia and Baltic). Frequent re-trapping of birds between these two areas indicate that some Curlew Sandpipers using the East-Atlantic Flyway in autumn may move from NW Europe to S Ukraine via the Dnipro River valley just like Dunlins (Chernichko 1982). Another frequently used route links S Ukraine and the Mediterranean area (n=37). Two direct recoveries (in Spain and Italy) indicate a south-western movement in autumn. The seasonal distribution of recoveries suggests that birds use the Mediterranean flyway both during spring and fall migrations. The distribution of ringing recoveries suggests a wide wintering range of birds passing the Sivash (Fig. 4). Also the pattern of connections between the area and other stopover sites along the East-Atlantic flyway (as well as wintering and breeding grounds) seems to be more complicated than originally thought (Eliot *et al.* 1976, Wilson *et al.* 1980). The most likely migration routes taken by Curlew Sandpipers staging over in the Sivash are shown in Fig. 4. The scheme proposed by Eliot *et al.* (1976) and Wilson *et al.* (1980) can be accomplished by combining the Baltic – Black Sea route (which is apparently used by birds during autumn passage to the southern African wintering grounds) and the supposed Black Sea – south of Western Siberia route (which brings birds to the next stopover area on route to the breeding grounds).

Although both the Central and Eastern Sivash have already been designated as Ramsar sites, the future development of agricultural irrigation poses a serious threat to Curlew Sandpipers. A large-scale discharge of irrigation and drainage waters would freshen the saline lagoons and reduce availability of halophytic Brine Shrimps. Therefore, efforts should be made to safeguard this unique stopover site from the threat of possible desalination which would help to protect migratory populations of Curlew Sandpiper at a global scale.

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