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FEEDING ECOLOGY OF CURLEW SANDPIPER, *CALIDRIS FERRUGINEA*, DURING SPRING STOPOVER IN THE SIVASH BAY (UKRAINE)

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Feeding Ecology of Curlew Sandpiper, *Calidris ferruginea*, During Spring Stopover in the Sivash Bay (Ukraine). Khomenko S. V. — Curlew Sandpipers, *Calidris ferruginea* Pontoppidan, 1763, gathering in the galinic part of the Sivash are able to efficiently forage on Brine Shrimps (*Artemia salina*) using it as a main food. It has been proved, that the birds feed exclusively in day-time (up to 80% of the observation time). Additional energy income makes on average 146.3 ± 38.4 kJ/day. At the expense of this, sandpipers increase body mass at an average rate of 4.3 ± 1.1 g/day. During 5–6 day's stay at the Sivash their total body mass increases up to 33–41% compared to the average lean (winter) body mass. It is the Brine Shrimps, highly abundant and easily available food, that attracts tens of thousand migratory Curlew Sandpipers to the Sivash.

Key words: Curlew Sandpiper, feeding, Brine Shrimps, body mass increase, Sivash, Ukraine.

Экология питания краснозобика, *Calidris ferruginea*, на Сиваше (Украина) во время весенних миграционных остановок. Хоменко С. В. — Краснозобики, *Calidris ferruginea* Pontoppidan, 1763, которые скапливаются в соленой части Сиваша, способны высокоэффективно использовать артемию (*Artemia salina*) в качестве основного корма. Доказывается, что птицы питаются исключительно днем (до 80% времени наблюдений). Дополнительный энергетический доход составляет в среднем $146,3 \pm 38,4$ кДж/сут. За счет этого песочники ежедневно увеличивают массу тела в среднем на $4,3 \pm 1,1$ г. Общий прирост массы за 5–6 дней пребывания на Сиваше составляет до 33–41% усредненной массы тела зимой. Именно наличие на Сиваше такого массового и легкодоступного корма как артемия делает этот водоем привлекательным для десятков тысяч мигрирующих краснозобиков.

Ключевые слова: краснозобик, питание, артемия, прирост массы, Сиваш, Украина.

It is impossible to completely understand migration strategy of Curlew Sandpipers (*Calidris ferruginea* Pontoppidan, 1763) without special studies of their feeding ecology during stopover in the staging areas. Until now this topic has been poorly addressed in ornithological literature, especially concerning sites on the continental flyway of the species. To fulfil this gap, we undertook a research into the feeding ecology of Curlew Sandpiper in the Sivash Bay of the Azov Sea (Ukraine), the key staging area of this species in Europe (Dyadicheva et al, 1999; Khomenko, 2001). Results of the study enlighten some peculiarities of the species' migration strategy, such as distribution patterns in the Sivash as well as terms and dynamics of migration. They also provide opportunity to approximate the start-up body mass and flight range of birds departing from the Sivash in spring.

The study was carried out in the Dzhankoi district of the AR of Crimea in May 1996 at the Eastern (Zhankoi Bay) and Central (peninsula near village of Tselinnoe) Sivash. Time budgets of Curlew Sandpiper were studied according to Dolnik (1982) every four day's period from 1 to 26 May only in day time. Activities of, on average, a hundred birds ($x = 117 \pm 250$ ind.) were recorded every 15 minutes throughout a day. Number of complete observation days made up 13, totalling 195 hours. Number of pecking rate records (2–3 minutes long each) was 517. Average values of body mass

gain were obtained by comparing energy expenditure and income, taking into account cost of the reserve tissue production (for details see: Khomenko et al., 1999). Flight range was estimated according to Gavrilov (1992) with the lean body mass upon arrival 52 g and migration speed 65 km/h (Zwarts et al., 1990).

As far as one can judge from the distribution pattern of Curlew Sandpiper in the Sivash (Dyadicheva et al., 1999; Khomenko, 2000), the birds clearly prefer Brine Shrimps *Artemia salina* (which are abundant only in the Central Sivash) to the rest of the local food species set. Observations show, that feeding time of the sandpipers is limited exclusively to the day-time period both in the Central and Eastern Sivash, while at night birds rest in dense gatherings. This is a particular feature of their behaviour, which is noticeably different from the majority of waders (Zwarts et al., 1990).

Activity patterns of Curlew Sandpipers slightly differ between the Central and Eastern Sivash. At the Central part maximum feeding activity is recorded in the morning, while at the Eastern Sivash it is observed in the mid-day. The most intensive foraging is observed in the periods of maximum availability of main food species, namely Brine Shrimps in the Central Sivash and sand hoppers (*Gammarus* sp.) in the Eastern Sivash. In its turn, availability of food is basically determined by wind speed and direction.

Time budgets of the birds differ between the two localities: at the Central Sivash Curlew Sandpipers forage significantly (Mann-Whitney test, $p < 0.01$) longer ($79.4 \pm 22.3\%$) than at the Eastern ($74.5 \pm 23.8\%$), mainly due to decreasing time for resting (from 6.7 ± 12.0 to $0.2 \pm 0.5\%$). These differences show that at the Central Sivash birds are able to use up the day time more efficiently.

To estimate actual efficiency of feeding upon Brine Shrimps, we recorded pecking rate of the Curlew Sandpiper at the Central Sivash, which, as it has already been shown (Verkuil et al., 1993; Khomenko et al., 1999), is close to the consumption of the shrimps per unit of time. The consumption averaged 89.7 ± 32.2 specimens per minute. Taking into account that, the energy cost of an average individual Brine Shrimp and assimilation coefficient (Verkuil et al., 1993), we estimated daily food consumption and energy income. On average it comes up to 241.8 ± 32.5 kJ/day, which does not only compensate, but sufficiently overcomes the daily expenditures (for 146.3 ± 38.4 kJ/day). With this amount of energy Curlew Sandpipers gain body mass at a rate of 2.1–5.4 g/day (on average 4.3 ± 1.1 g/day). Therefore, it is no surprise that up to 96% of Curlew Sandpipers passing the Sivash in spring occur in its galinic Central part, where they forage almost exclusively on Brine Shrimps.

Spring migration of Curlew Sandpipers is so rapid, that duration of their stay does not exceed 5–6 days (Khomenko et al. 1999). But even that little time is enough for the birds to gain some 33–41% of extra body mass. According to our calculations, with that fat reserve they are expected to cover 2–2.5 thousand kilometres to the next stop-over area.

In combination with published data (Wilson et al., 1980; Zwarts et al., 1990) these results make us consider the species' tendency to migrate mainly via continental fly-ways not simply as a way to cut short flight distances. Curlew Sandpipers seem to be, to some extent, dependent on the food resources of galinic waterbodies. Exclusively diurnal activity and high efficiency of foraging on Brine Shrimps, recorded in the Sivash, clearly distinguish Curlew Sandpiper from other sandpiper species, and Dunlin (*Calidris alpina* Linnaeus, 1758) in particular. These peculiarities of the sandpiper's feeding ecology suggest that the birds not just utilise Brine Shrimps by chance, but are, to a certain extent, specialized on such a kind of food. We think, that tens of thousand Curlew Sandpipers concentrate in the Sivash not as much due to its geographical location, as because the bay provides such a mass and easily available (in day-time!) food as Brine Shrimps.

It is known, that galinic waterbodies (e. g. Manych-Gudilo, the Caspian coast, salt lakes of the South of Western Siberia) are widely distributed over the territories Curlew Sandpipers pass during migration to the breeding grounds and back. Unfortunately, feeding ecology of Curlew Sandpipers at these localities, as well as in the other stopover areas, remains so far either absolutely unknown or poorly studied.

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