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Migration and morphometrics of the Broad-billed Sandpiper *Limicola falcinellus* at Ottenby, southern Sweden, 1950–2000

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The Broad-billed Sandpiper *Limicola f. falcinellus* is a little studied European wader species with unfavourable conservation status. We describe the migration of the Broad-billed Sandpiper at Ottenby, southeast Sweden, from 1950–2000 using data from ringing activities and field observations. Numbers of ringed and observed Broad-billed Sandpipers varied considerably between years. There was no trend in numbers trapped over the study period, but a positive trend in numbers observed (probably explained by improved identification skills and observation possibilities). The populations passing Ottenby during autumn migration have probably been relatively constant in size during the last 50 years. The species was only rarely seen during spring migration (median 29 May). As shown by autumn ringing data, adult birds pass mainly in July (median date 21 July) and juveniles mainly in August (median date 17 August). Adult birds had on average somewhat longer wings and longer total-head than juvenile birds, but there were no significant differences in body mass between age groups. Broad-billed Sandpipers carried an average fuel load proportional to 25% of lean body mass, which is relatively low for migrating waders, but some individuals may have had fuel stores of up to 50–70%. In recaptured birds, the highest recorded mass gain rate was 7.1% of lean body mass per day, which is close to the maximum predicted for a species of this size. Broad-billed Sandpipers seem to prefer migrating with relatively small fuel stores, making use of several stopover sites along the migration route.

1. Introduction

The Broad-billed Sandpiper *Limicola falcinellus* is considered to be a species with unfavourable conservation status in Europe (Tucker & Heath 1994). In addition, compared to other species of the *Scolopacidae* family, little is known about its biology (Piersma *et al.* 1996). Hence, more basic information is needed for a proper assessment of the species' status in Europe. The aim of this paper is twofold: 1) to present long-term population data, and 2) to describe the timing and fuel deposition pattern during migration.

The Broad-billed Sandpiper breeds in the Palaearctic with two subspecies; *falcinellus* and *sibirica*. The nominate race breeds in Norway,

northern Sweden, Finland and in the northwesternmost parts of Russia (Dementev & Gladkov 1969, Cramp & Simmons 1983, Piersma *et al.* 1996, Svensson *et al.* 1999). The main wintering areas have been suggested to be around the Red Sea and Persian Gulf and in India and Ceylon (Cramp & Simmons 1983). Intense studies in recent years have established that the Black Sea area is a major concentration area for western Broad-billed Sandpipers during migration (Diadicheva & Matsievskaya 2000). The breeding areas of the eastern sub-species *sibirica* are poorly known (Cramp & Simmons 1983), but are probably located in the northern parts of central and eastern Siberia (Piersma *et al.* 1996). These birds winter in south-east Asia, Indonesia and Australia (Cramp & Simmons 1983).

The breeding population in Northwest Europe has been estimated to include 10 000–15 000 pairs in northern Finland (Tucker & Heath 1994, Hagermeijer & Blair 1997, Väisänen *et al.* 1998), a few thousand pairs in the northern half of Sweden (Svensson *et al.* 1999), a few hundred pairs in Norway (Hagermeijer & Blair 1997) and 100–1000 pairs in Russia (Tucker & Heath 1994). In Finland, but not in Sweden and Norway, there are indications of a decline in the number of breeding pairs over the last decades (Tucker & Heath 1994, Väisänen *et al.* 1998). However, there is a lack of long term data series, making population trends uncertain.

Whereas waders as a group are generally well studied in terms of fuel stores and migration strategies (Alerstam & Lindström 1990, Zwarts *et al.* 1990), there are only few published accounts of the body mass and fuel stores of migrating Broad-billed Sandpipers (Glutz *et al.* 1975, Cramp & Simmons 1983, Fry 1989, Gavrilov *et al.* 1995). Knowing the amount of fuel deposited at various sites, and the rate of fuel deposition, are important parameters for understanding the migration strategy of a bird, including the number of stopover sites used and the relative importance of stopover sites in enabling a successful migration (Alerstam & Lindström 1990, Gudmundsson *et al.* 1991, Alerstam & Hedenström 1998).

Little is known about the details of Broad-billed Sandpiper migration through northern Europe. In Sweden it is scarce during autumn, occurring singly or in very small flocks, and it is generally very rare in spring (SOF 1990). However, spring concentrations of more than twenty birds (maximum 100) are regularly found in the north along the Gulf of Bothnia (Olsson & Wiklund 1999).

One of the best sites in southern Scandinavia to observe Broad-billed Sandpipers during migration is Ottenby, at the southern tip of the island of Öland in southeast Sweden. Here we present data on numbers, timing, and morphometrics from Ottenby Bird Observatory for Broad-billed Sandpipers, gathered over a period of 51 years, 1950–2000.

2. Material and methods

Observations and ringing of birds have been carried out at Ottenby Bird Observatory (56°12′N, 16°24′E) yearly since 1946 (e.g. Edelstam 1972, Hjort & Lindholm 1978). Data from the earliest years, 1946–1949, were not accessible to us, so only data from 1950 onwards are used in this study.

2.1. Ringing

Waders are trapped in Ottenby walk-in funnel traps (Bub 1991) at the shoreline of the Baltic Sea. The traps are placed in combinations on rotting seaweed. The number of traps has been rather constant since 1972 — varying between 80–120. However, the water level and the amount of seaweed, and therefore trapping conditions, depend on the weather situation which differs between years. Traps are in use from around 1 July to late September, the time each year partly depending on seaweed conditions. Traps are checked and emptied every hour, from just before dawn to just after dusk.

2.2. Observations

A diary is kept at the bird observatory, where all species seen by the observatory staff during the day are recorded. For less common birds, like the Broad-billed Sandpiper, detailed notes are taken on maximum daily numbers and other aspects of their occurrence. Most field observations of Broad-billed Sandpipers come from the ringers and ringing assistants doing the hourly rounds to

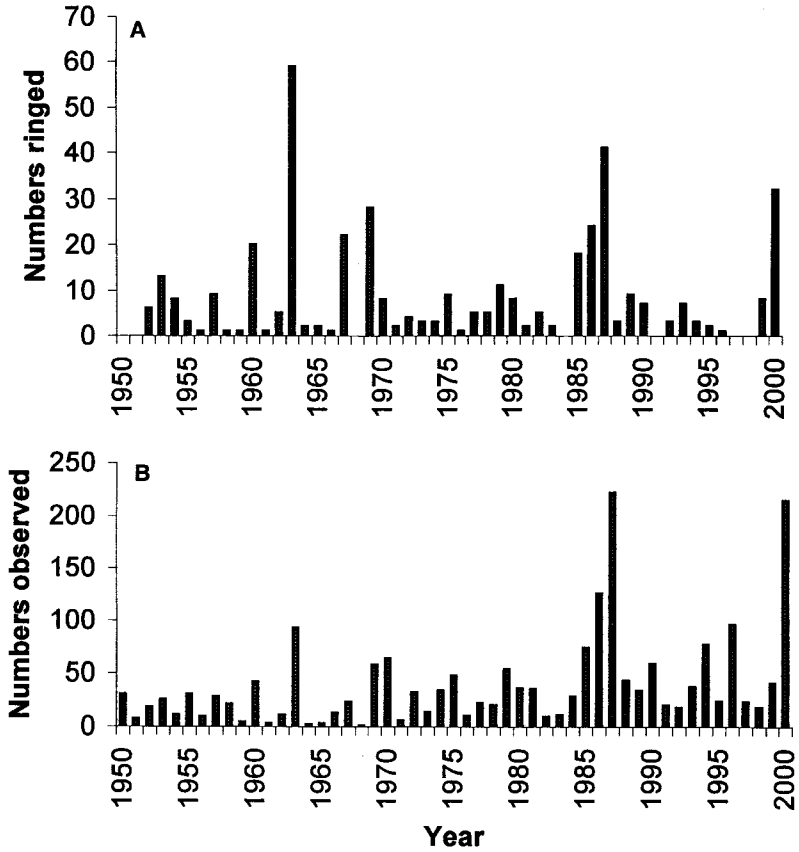

Figure 1. The annual totals of (A) ringed and (B) observed Broad-billed Sandpipers during autumn migration at Ottenby, SE Sweden, 1950–2000. In total, 1982 birds were observed and 408 birds were ringed.

empty the traps. The observation data is likely to be dependent on the observation skills of the observers, and can thus not be considered fully standardised.

2.3. Morphometrics

Autumn birds have been aged since 1977, based on the difference in plumage between worn adult individuals and fresh juveniles described by Prater *et al.* (1977). Since 1985, the following measurements have been taken: wing length, maximum flattened-chord from carpal joint to tip of wing (Svensson 1992), to the nearest mm; total head-length, from bill-tip to back of skull (Green 1980), to the nearest mm; and body mass to the nearest 0.1 g, either on a Pesola spring balance or on an electronic balance.

Following Alerstam & Lindström (1990) we describe the size of fuel stores, and the rate at which they are deposited, as a proportion of lean body mass (LBM). We have found no data for LBM based on dissected birds, but based on available data on low body masses we estimated an average LBM of Broad-billed Sandpipers to 30 g (Glutz *et al.* 1975, Cramp & Simmons 1983, Gavrilov *et al.* 1995, this study).

3. Results

3.1. Spring

Broad-billed Sandpipers are only rarely seen during spring migration at Ottenby. It was observed only 14 times (22 individuals in total) during the springs of 1950–2000. All observations were made between 17 May and 7 June (median 29 May). No birds have been ringed in spring.

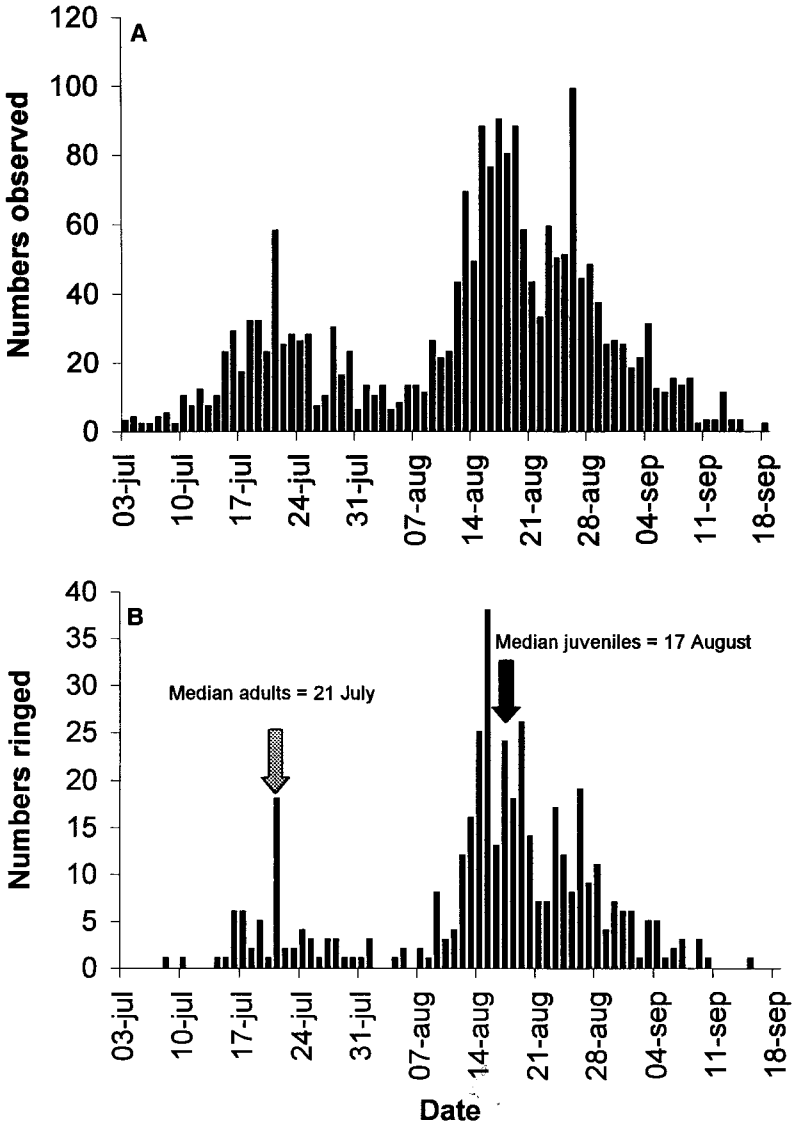

Figure 2. The phenology of (A) observed and (B) ringed Broad-billed Sandpipers during autumn migration at Ottenby, SE Sweden, 1950–2000 (median dates for ringed individuals of different ages in 1986–2000 are noted in Fig. 2B).

3.2. Autumn

3.2.1. Yearly variation in numbers

The number of ringed birds per year varied between 0 and 59 (Fig. 1a). Between 1 and 222 birds were observed yearly (Fig. 1b). In three years the species was particularly numerous: 1963, 1987 and 2000. In the ringing material, there was no clear trend or pattern in abundance over the 51 years ($r_s = 0.046$, ns, $n = 51$), but the number of birds observed increased ($r_s = 0.432$, $P < 0.01$, $n = 51$).

3.2.2. Phenology

There were two distinct peaks of occurrence during autumn (Fig. 2): one in July comprising mainly adult birds and one in August of mainly juvenile birds. In birds with known age, 90% of the 48 adult birds ringed were trapped between 7 July–8 August, with 21 July as the median date. Similarly, of the 86 juveniles ringed, 90% were trapped between 13 August–4 September (median 17 August).

3.2.3. Morphometrics

Females are on average larger than males (Cramp & Simmons 1983) and, in order to look for seasonal differences in passage between the sexes (cf. Gavrilov *et al.* 1995), we analysed whether the morphometrics varied with season. However, none of the variables correlated significantly with date: juveniles — wing length ($r = 0.181$, $P = 0.10$, $n = 85$), total-head ($r = -0.183$, $P = 0.09$, $n = 85$) and body mass ($r = 0.059$, $P = 0.60$, $n = 85$); adults — wing length ($r = -0.181$, $P = 0.22$, $n = 47$), total-head ($r = -0.086$, $P = 0.56$, $n = 48$) and body mass ($r = -0.040$, $P = 0.79$, $n = 48$). Adult birds had on average longer wings (ANOVA: $F_{1,130} = 19.42$, $P < 0.001$) and longer total-head than juvenile birds (ANOVA: $F_{1,131} = 5.93$, $P = 0.02$, Table 1).

Body mass did not differ significantly between the age classes (ANOVA: $F_{1,131} = 2.24$, $P = 0.14$, Table 1). Assuming a lean body mass of around 30 g, the average fuel load (relative to lean body mass) of adult and juvenile Broad-billed Sandpipers at Ottenby was 24% and 29%, respectively. The heaviest birds, nine birds between 45 and 50 g (in one individual 54.7 g) had fuel stores of about 50–67% (in one individual 82%).

3.2.4. Recaptures

Recapture data were available for 28 individuals in the years 1987–2000 (Fig. 3). For these birds, the time between first capture and last recapture varied between 1 and 13 days with a mean of 3.4 days. Mean mass change was negative on first day after first capture (–1.7% of LBM per day), but positive in the following days (Fig. 4). Among individuals with an overall increase in body mass ($n = 20$), the average mass gain rate was 3.4%. Highest recorded mass gain rate was 7.1% (two birds that both increased 8.5 g in 4 days).

4. Discussion

4.1. Variation in numbers

The yearly variations in numbers of ringed and observed birds were large. We do not know if and how trapping efficiency in 1950–1971 differs from that in 1972–2000. In the latter standardised period, there is no clear trend in the numbers trapped. Field identification skills and observation possibilities (better telescopes and binoculars) have certainly improved over the 50-year period. This may explain why there is a positive trend in the number of birds observed, but not in the ringing material. Despite these methodological uncertainties, we conclude that it is unlikely that any dramatic changes in the numbers of Broad-billed Sandpipers passing Ottenby have occurred during the last 50 years. The general picture in Europe is that the population size of Broad-billed Sandpipers has been stable in Sweden, Norway and Russia, but shows a decline in Finland (Hagermeijer & Blair 1997, Väisänen *et al.* 1998, BirdLife International/European Bird Census Council 2000). To date, there are no recoveries from the breeding grounds of birds ringed at Ottenby, but given the generally southeasterly migration route from northern Europe in autumn, the birds recorded at Ottenby may originate mainly from Swedish and Norwegian breeding grounds.

Table 1. Morphometrics of Broad-billed Sandpipers *L. falcinellus* trapped at Ottenby Bird Observatory, 1986–2000.

Age	Measurement	Mean	Range	SD	n
Juvenile	Wing length	107.3	102–117	3.0	85
	Total-head	52.2	48–57	2.1	85
	Body mass	37.2	26.5–49.0	4.9	85
Adult	Wing length	110.3	104–119	4.3	47
	Total-head	53.1	49–57	2.0	48
	Body mass	38.6	30.2–54.7	5.1	48

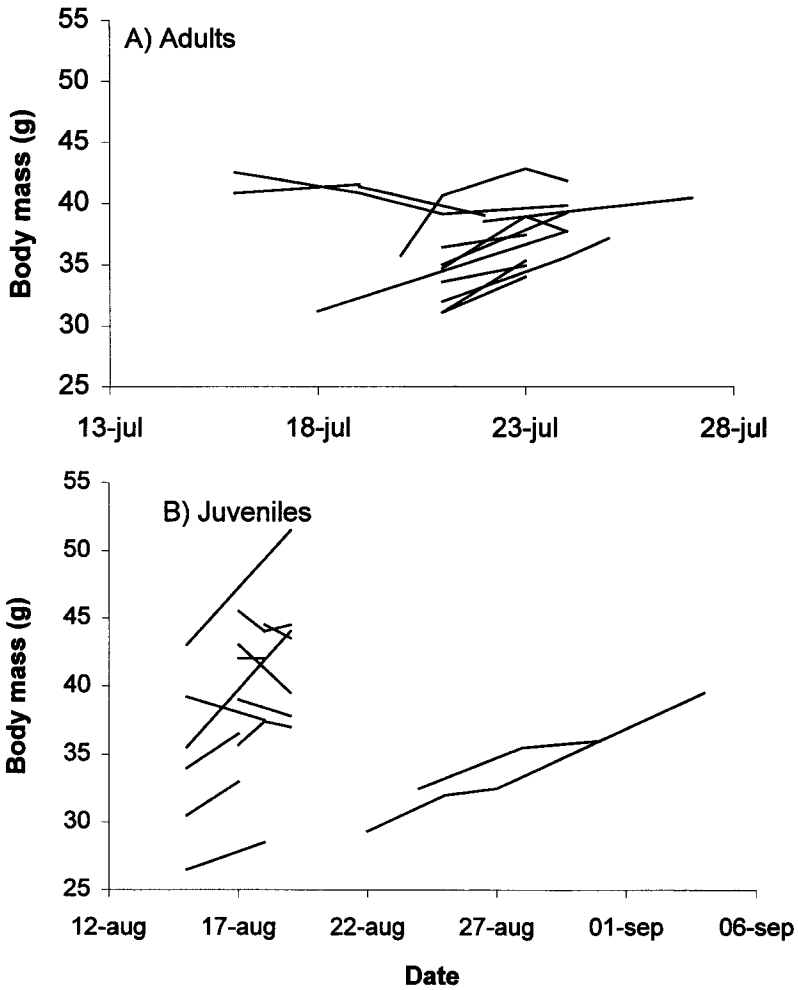

Figure 3. Changes in body mass (in g) of recaptured individuals in relation to date, for (A) adult and (B) juvenile Broad-billed Sandpipers ringed at Ottenby, SE Sweden, during autumn migration 1987–2000.

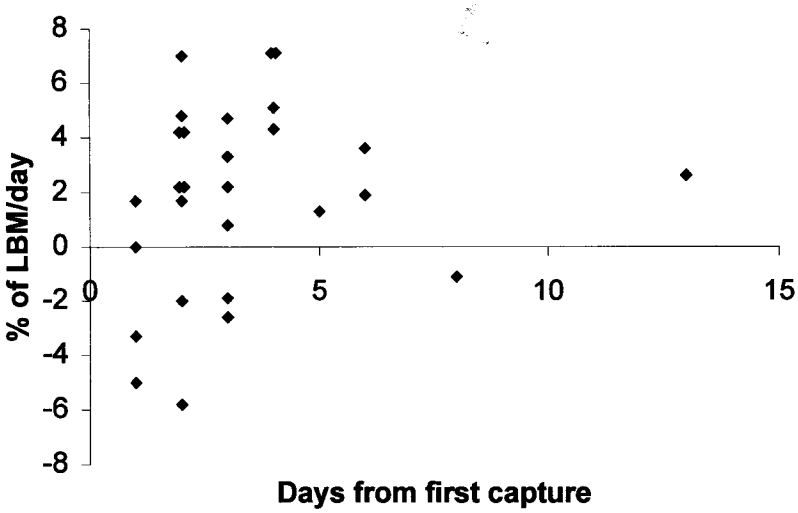

Figure 4. Changes in body mass in percent of lean body mass per day in recaptured Broad-billed Sandpipers during autumn migration at Ottenby, SE Sweden, 1987–2000. For sake of clarity, when data were overlapping, the symbols have been moved fractionally sideways.

4.2. Seasonal occurrence

Broad-billed Sandpipers are only rarely seen in spring at Ottenby, nor are they common at other southerly migration sites in Sweden (SOF 1990). The few birds seen were all from the end of May to the beginning of June, indicating a fast and concentrated spring migration. The median date of passage of 29 May is surprisingly late. It coincides in timing with the spring migration of Little Stint (*Calidris minuta*), Curlew Sandpiper (*C. ferruginea*) and Sanderling (*C. alba*) that pass south Sweden with median dates of 24, 25 and 29 May, respectively (Blomqvist & Lindström 1995). These species are all bound for the Arctic tundra, where the possibility to start breeding ought to come later in spring than for the more southerly breeding Broad-billed Sandpipers. Also, given that favourable stopover sites close to the breeding grounds may be lacking (cf. Alerstam *et al.* 1986), the best strategy is to put on large fuel stores at distant stopover sites and make one long flight into the breeding grounds late in spring (Gudmundsson *et al.* 1991).

In autumn, Broad-billed Sandpipers appear at Ottenby in two distinct waves: adult birds pass in mid July and the juveniles on average a month later. The same pattern was found by Gavrilov *et al.* (1995) in their study of Broad-billed Sandpiper migration in Kazakhstan, and it is a pattern common in most other migratory wader species (Kolthoff 1896, Edelstam 1972). In Kazakhstan (Gavrilov *et al.* 1995) adult Broad-billed Sandpipers peak in late July (median 26 July) and juvenile individuals in late August (median 25 August). This is about a week later than at Ottenby (median 21 July and 17 August, respectively).

4.3. Morphometrics

Morphological parameters did not change significantly within season. In Kazakhstan, Gavrilov *et al.* (1995) found a slight decrease in wing length and weight of adult birds over the autumn migration period, indicating that females passed through the area earlier than males. Also in our study, wing length, total-head and weight of adults decreased with date, but these differences were small and non-significant, only partly supporting the hypothesis of differential migration of the sexes.

The average body mass of adults and juveniles differed only slightly between birds trapped at Ottenby and birds trapped in Kazakhstan (Gavrilov *et al.* 1995). The birds at Ottenby were on average 1.0 g (adults) and 3.1 g (juveniles) heavier. Data from two studies conducted during autumn migration in Finland show very similar values, where the mean weight was 37 g for a sample of adult Broad-billed Sandpipers (n = 10, range 32–42 g), and 36.9 g (n = 14, range 29–49 g) for a mixed data set consisting of both juveniles and adults (Glutz *et al.* 1975). Hence, average fuel stores of 25–30% of lean body mass seem to be predominant in Broad-billed Sandpipers during autumn migration, although some birds put on as much as 50–70%. Fuel stores of 30% are at the lower side of what is normally found in migratory wader populations, even when excluding populations about to cross large ecological barriers (Alerstam & Lindström 1990). In Australia, birds belonging to the *sibirica* subspecies increased in body mass from a winter average of 37 g, to 55 g in April prior to spring migration departure (Fry 1989). The departure mass represents an average fuel load of 83%. Obviously, the birds on autumn migration in Fennoscandia and Kazakhstan do not make use of their full storage capacity. In contrast, the birds wintering in Australia have to migrate over large open waters in order to reach nearest stopover sites in South East Asia, which most certainly explain the very high body masses prior to migration.

Retrapped birds on average lost mass the first day after capture, but later increased in mass, a common pattern for birds on stopover (Alerstam & Lindström 1990). The highest mass gain rate was 7.1% of lean body mass per day in the recaptured individuals, which is somewhat higher than in Kazakhstan (6.3%, Gavrilov *et al.* 1995). It is close to the theoretical maximum gain of 7.2% for a species of this size (Lindström 1991), showing that some Broad-billed Sandpipers at Ottenby have the potential to gain mass at very high speed. Estimates of average fuel deposition rates from this study (3.4%) is on a level with observations from other wader species (3.7%; Lindström 1991). Given the species potential to rapid mass gain both at Ottenby and in Kazakhstan, the low body masses recorded are most likely not caused by

poor feeding possibilities, but rather are a part of the species' normal autumn migration strategy. This indicates that the Broad-billed Sandpipers of the Western Palaearctic prefer to migrate relatively short distances at a time, making use of several stopover sites along the migration route.

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Sammanfattning: **Myrsnäppans *Limicola falcinellus* flyttning och morfometri vid Ottenby i södra Sverige 1950–2000**

Myrsnäppans *Limicola f. falcinellus* ekologi och status i Europa är relativt dåligt känd vi beskriver myrsnäppans flyttning vid Ottenby (sydöstra Sverige) med hjälp av ringmärkningsdata och fältobservationer insamlade under åren 1950–2000. Mellanårsvariationen både i antal observerade och ringmärkta fåglar under hösten var stor, men antalet ringmärkta fåglar förändrades inte nämnvärt över studieperioden. Dock kunde en ökning skönjas i antalet observerade fåglar, men den kan delvis bero på förbättrad kunskap i fältbestämning och tillgång till bättre kikare under senare år. Avsaknaden av tydliga långsiktiga trender betyder troligen att de populationer som passerar Ottenby har hållit sig på en relativt stabil nivå under studieperioden. Arten sågs endast sällsynt under vårsträcket (mediandatum 29 maj). Adulta fåglarnas höststräck, baserat på ringmärkningsdata, sker i huvudsak i juli (mediandatum 21 juli) och ungfåglarnas sträck i augusti (mediandatum 17 augusti). Det fanns ingen signifikant skillnad i kroppsvikt mellan åldersgrupperna, men adulta fåglar hade i genomsnitt något längre vinge och huvud-näbb än yngre fåglar. Myrsnäpporna bar i genomsnitt fettreserver motsvarande 25 % av den fettfria vikten. Detta är en relativt låg siffra för flyttande vadare, men enskilda individer hade värden på uppemot 50–70 %. Hos återfångade fåglar noterades viktökningar på upp till 7.1 % av den fettfria vikten per dag, vilket är i närheten av den teoretiska maxhastigheten för en art av den storleken. Myrsnäppan föredrar uppenbarligen att flytta med relativt små fettreserver och därmed att utnyttja flera rastplatser längs flyttningsvägen.

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