Fuel stores of juvenile waders on autumn migration in high arctic Canada
Lindström, Åke; Klaassen, Marcel; Piersma, Theun; Holmgren, Noel; Wennerberg, Liv; Both, C
Published in:
Ardea

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2002

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):

Copyright
Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): http://www.rug.nl/research/portal. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.
FUEL STORES OF JUVENILE WADERS ON AUTUMN MIGRATION IN HIGH ARCTIC CANADA

ÅKE LINDSTRÖM1,2, MARCEL KLAASSEN3, THEUNIS PIERSMA1,4, NOEL HOLMGREN5 & LIV WENNERBERG2


Little is known about the fuel stores that arctic-breeding waders put on before departure from the breeding grounds. During a ship-based expedition to arctic Canada, we caught waders at seven, mainly coastal sites, within 68°-76°N and 139°-67°W, from 28 July to 31 August 1999. More than two hundred waders of twelve species were trapped, mainly White-rumped Calidris fuscicollis, Semipalmated C. pusilla, Baird’s C. bairdii and Buff-breasted Sandpipers Tryngites subruficollis. The vast majority of the birds were juveniles. Body masses and visual fat stores were low, close to the lowest values found anywhere during the non-breeding season for the different species. The relatively fattest birds were Buff-breasted Sandpipers, but they were still far from their maximum body mass on spring migration. We conclude that juvenile arctic waders depart from their natal areas with only small fuel stores, which is in concordance with a time-minimising migration strategy.

Key words: migration – waders – body mass – fuel deposition – arctic Canada

1Netherlands Institute for Sea Research (NIOZ), P.O.Box 59, 1790 AB Den Burg, Texel, The Netherlands; 2Department of Animal Ecology, Lund University, Ecology Building, S-223 62 Lund, Sweden. 3Netherlands Institute of Ecology, Centre for Limnology, Rijkstraatweg 6, 3631 AC Nieuwerluis, The Netherlands; 4Centre for Ecological and Evolutionary Studies (CEES), University of Groningen, P.O. Box 14, 9750 AA Haren, The Netherlands; 5Department of Computer Biology, Skövde University, P. O. Box 408, S-541 28 Skövde, Sweden. Address for correspondence: Department of Animal Ecology, Lund University, Ecology Building, S-223 62 Lund, Sweden. E-mail: ake.lindstrom@zooekol.lu.se

INTRODUCTION

Arctic-breeding waders are known for their spectacular migrations. In spring, some species increase in mass with 50-100% in preparation for long flights towards their breeding grounds (Morrison 1975; Johnson et al. 1989; Piersma & Jukema 1990; Gudmundsson et al. 1991). In autumn, equally large amounts of fuel are deposited in some species prior to trans-oceanic flights (McNeil & Cadieux 1972; Page & Middleton 1972; Piersma & Gill 1998). However, waders are also found to migrate with small to medium-sized fuel stores (Alerstam & Lindström 1990).

Comparatively little is known about the fuel deposition of arctic-breeding waders at the start of their autumn migration from high latitudes. In a limited number of species, such data are available for single, or few, post-breeding adults and juveniles, recorded at the end of intense breeding studies. None of these birds carried any substantial fuel stores (Musacchia 1953; Pitelka 1959; Parmelee & MacDonald 1960; Parmelee et al. 1967, 1968; Yarbrough 1970; Tulp et al. 2000). The only
larger data set we know of, concerns juvenile Little Stints *Calidris minuta* on autumn migration along the northern coast of the Eurasian Arctic. The Little Stints seem to leave their natal grounds with only small stores and more substantial fuel stores were only found late in the autumn, further along the migration route (Lindström 1998).

There are indications that migrating waders in general behave according to a time-minimising strategy, i.e. they try to maximize speed of migration (measured in km d$^{-1}$, including the periods of fuel deposition). Alerstam & Lindström (1990) found a positive relationship between fuel deposition rates and departure fuel stores, and Gudmundsson *et al.* (1991) found evidence for overloads and skipping of potential stopover sites. These traits are expected for time-minimisers, but not for energy cost of transport-minimisers (Alerstam & Lindström 1990; Gudmundsson *et al.* 1991). Another prediction for time-minimisers is that if much better stopover sites (higher fuel deposition rates) can be expected further away along the route, only small stores should be put on (Gudmundsson *et al.* 1991). This was the pattern of fuel deposition in juvenile Little Stints (Lindström 1998).

The northernmost sites in the Nearctic where body mass data during autumn migration have been gathered more intensively are in southern Canada and northern United States, at latitudes of 40-55°N (Morrison 1984; Harrington *et al.* 1991; Gratto-Trevor 1992; Lanctot & Laredo 1994; Alexander & Gratto-Trevor 1997). When arriving at these sites, many arctic waders have already migrated between 1000 and 3000 km, for some species a considerable part of the whole autumn migration. Here are reported body masses and visual fat scores of more than 200 juveniles of 12 wader species trapped during autumn migration in high arctic Canada, showing that juvenile waders depart from their breeding grounds carrying only small fuel stores. This behaviour is in concordance with a time-minimising migration strategy.

**METHODS**

In the summer of 1999 we joined the expedition ‘Tundra NorthWest 1999’ which focused on the ecology of animals and plants in arctic Canada. Our part of the expedition aimed at studying the ecology of waders. The base for the expedition was the Canadian Coast Guard icebreaker ‘Louis S. St-Laurent’. Between 1 July and 3 September the ship traversed much of the archipelago of the Canadian Arctic. Researchers were flown ashore by helicopter at regular intervals, for study periods of 24-40 h at various sites. At the end of July, the shorebird work shifted its focus from breeding activities to studies of autumn migration. Within the general study areas along the route (that had been decided beforehand, at the expedition level), sites were picked where it was likely to encounter migrating waders. This normally meant river deltas and shore-lines, but also near-shore areas with small water bodies (see below).

Waders were trapped in portable and folding walk-in traps (‘Ottenby traps’, 120 x 35 x 35 cm). Maximally forty traps were used. Traps were checked at least once an hour. Alternatively, birds were driven towards mist nets and chased into the nets once they were within 1-2 m of a net. Within an hour of capture, all birds were ringed with metal and colour rings and weighed to the nearest 0.1 g with a Pesola spring balance. Visible fat in the intraclavicular pit was scored using the scale of Pettersson & Hasselquist (1986). This scale (with scores from 0 to 6) was developed for passerines, but works well also for small waders (Lindström 1998). In a study of captive waders that put on fuel stores close to what has been recorded in the wild, the scale had to be extended to include scores 7-9 (Å. Lindström and A. Kvist unpubl. data). Hence, birds in fat score 6 are far from being maximally fat. All fat scores were made by a single observer (ÄL).
Waders on autumn migration were trapped between 28 July and 31 August. During this period nine sites were visited (Fig. 1). Each of these sites (denoted by their official expedition site number) are described below, including general observations of waders and information about the number of waders trapped (see also Table 1).

**Banks Island (Site #9), just north of Radi Lake (71°43′N, 123°43′W), 28-29 July.** Groups of recently fledged and independent Semipalmated Plovers *Charadrius semipalmatus*, Baird’s Sandpipers *Calidris bairdii* and Buff-breasted Sandpipers *Tryngites subruficollis* were loosely associated with each other. We caught 21 juvenile birds of these three species in traps and mist-nets. Based on the appearance of seemingly ‘new’ unringed birds, there was probably a continuous turnover of young waders during our 36 h stay.

**Ivvavik National Park (Site #10), Firth River delta (69°32′N, 139°33′W), 4-5 August.** Waders were trapped in the delta land, approximately 1 km from the coast. More than 100 flocks of waders, containing up to 40 individuals, were seen flying low over the ground towards the east. Many flocks landed for short periods (minutes and hours) and the turnover of resting birds was large. Semipalmated Sandpipers *Calidris pusilla* dominated, but Baird’s, Buff-breasted and Pectoral Sandpipers *C. melanotos* were also seen in some numbers. We trapped 47 waders, all in cages. A large proportion of these birds probably belonged to the transient birds rapidly passing through the area.

**Cape Bathurst (Site #11), Baillie Island (70°34′N, 128°16′W), 7-8 August.** We trapped birds in a 2 ha muddy lagoon, on the southern side of the island. A few migrating flocks heading east were seen. Up to a hundred waders at a time were present, most of them being Baird’s, White-rumped *Calidris fuscicollis* and Semipalmated Sandpipers (in order of abundance). A total of 80 waders were trapped in cages, mainly White-rumped and Semipalmated Sandpipers.

**Banks Island (Site #12), Parker River delta (73°39′N, 115°39′W), 10-12 August.** Our study site was a flat and sparsely vegetated delta land, with narrow streams and small lakes, about two km from the ice-covered coast. Buff-breasted Sandpipers were abundant with at least 100 birds spread out over the delta plain in small flocks, and Red Phalaropes *Phalaropus fulicaria* were seen in flocks of up to 20 foraging in small water bodies. A few flocks were seen departing in northerly directions. We trapped 21 waders, mainly in mist-nets.

**Melville Island (Site #13), Beverley Inlet (75°07′N, 107°41′W), 13-15 August.** We worked in the innermost part of a deep fiord. A few flocks of up to five individuals of Sanderling *Calidris alba*, Baird’s and White-rumped Sandpiper were seen on riverbeds and slightly muddy tidal shores, but no waders were caught.
Table 1. Average body mass (± SD), range and sample size of juvenile waders trapped at seven different sites in arctic Canada (for location of sites, see Fig. 1). The birds captured at site #9 may not have been structurally full-grown.

<table>
<thead>
<tr>
<th>Species</th>
<th>Site-specific values</th>
<th>Overall values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Site#</td>
<td>Mean ± SD, range, n</td>
</tr>
<tr>
<td>Semipalmated Plover</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charadrius semipalmatus</td>
<td>9</td>
<td>39.8 ± 0.3, 39.4-40.3, n = 3</td>
</tr>
<tr>
<td>Red-necked Phalarope</td>
<td>10</td>
<td>24.5, n = 1</td>
</tr>
<tr>
<td>Phalaropus lobatus</td>
<td>12</td>
<td>42.5 ± 3.0, 38.8-48.1, n = 9</td>
</tr>
<tr>
<td>Grey Phalarope</td>
<td>15</td>
<td>103.0, n = 1</td>
</tr>
<tr>
<td>Arenaria interpres</td>
<td>10</td>
<td>47.8, n = 1</td>
</tr>
<tr>
<td>Ruddy Turnstone</td>
<td>15</td>
<td>67.8 ± 4.8, 62.0-77.0, n = 8</td>
</tr>
<tr>
<td>Calidris himantopus</td>
<td>16</td>
<td>62.3, n = 1</td>
</tr>
<tr>
<td>Purple Sandpiper</td>
<td>17</td>
<td>51.5, n = 1</td>
</tr>
<tr>
<td>Calidris maritima</td>
<td>16</td>
<td>65.6 ± 6.7, 51.5-77.0, n = 10</td>
</tr>
<tr>
<td>Semipalmated Sandpiper</td>
<td>11</td>
<td>22.2 ± 1.3, 19.6-25.1, n = 43</td>
</tr>
<tr>
<td>Calidris pusilla</td>
<td>11</td>
<td>24.1 ± 2.2, 20.5-27.3, n = 17</td>
</tr>
<tr>
<td>Least Sandpiper</td>
<td>15</td>
<td>34.3 ± 2.3, 29.8-40.1, n = 56</td>
</tr>
<tr>
<td>Calidris minutilla</td>
<td>12</td>
<td>36.3, n = 1</td>
</tr>
<tr>
<td>White-rumped Sandpiper</td>
<td>15</td>
<td>36.7, n = 1</td>
</tr>
<tr>
<td>Calidris fuscicollis</td>
<td>16</td>
<td>37.6 ± 3.4, 32.4-46.2, n = 29</td>
</tr>
<tr>
<td>17</td>
<td>33.9 ± 2.4, 30.9-36.0, n = 4</td>
<td></td>
</tr>
<tr>
<td>Baird’s Sandpiper</td>
<td>16</td>
<td>35.6 ± 1.9, 31.6-38.9, n = 14</td>
</tr>
<tr>
<td>Calidris bairdii</td>
<td>11</td>
<td>34.4 ± 1.6, 33.1-37.1, n = 5</td>
</tr>
<tr>
<td>16</td>
<td>34.6, 34.4-34.8, n = 2</td>
<td></td>
</tr>
<tr>
<td>Pectoral Sandpiper (m)</td>
<td>10</td>
<td>75.2, n = 1</td>
</tr>
<tr>
<td>Calidris melanotos</td>
<td>10</td>
<td>49.4, n = 1</td>
</tr>
<tr>
<td>Pectoral Sandpiper (f)</td>
<td>12</td>
<td>50.2 ± 3.9, 48.0-56.0, n = 4</td>
</tr>
<tr>
<td>Tryngites subruficollis</td>
<td>12</td>
<td>57.7 ± 6.1, 48.6-68.4, n = 11</td>
</tr>
</tbody>
</table>

Ellef Ringnes Island (Site #14), Hospital Bay, Magnetic North Pole (79°02’N, 105°08’W), 18-20 August. The site was characterized by sandy lagoons and riverbeds, easily recognized as polar desert. The two Baird’s Sandpipers and two Red Phalaropes that flew over our camp were the only waders seen and no birds were trapped.

Ellesmere Island (Site #15), Muskox Fiord (76°25’N, 87°06’W), 22-23 August. Our study site contained a stony tidal mudflat, riverbeds and small lakes. Small parties of waders, mainly Purple Sandpiper *Calidris maritima*, Ruddy Turnstone *Arenaria interpres* and White-rumped Sandpiper were present. Nine birds were trapped, mainly Purple Sandpipers, all in mist-nets.

Devon Island (Site #16), Dundas Harbor (74°33’N, 82°50’W), 25-26 August. Our camp was situated in an area of relatively rich tundra with small stone-rich streams and small lakes, within one km from a rocky shore-line. Flocks containing 3-20 White-rumped Sandpipers, accompanied by some Baird’s Sandpipers, foraged in the streams where 32 birds were trapped in cages and nets.

Baffin Island (Site #17), Cape Hooper (68°25’N, 66°56’W), 30-31 August. We worked at a partly ice-covered lake with rocky shores. Up to ten White-rumped Sandpipers were observed around the lake, often seen picking food items out on the lake ice. Four White-rumped and one Purple Sandpiper were trapped in mist-nets.
RESULTS AND DISCUSSION

In total, 217 waders of 12 species were trapped in the post-breeding period at seven of the nine sites visited (no waders trapped at sites #13 and #14). Site-specific catches varied between 5 and 80 individuals (Table 1). Only two trapped birds were adults. A female Pectoral Sandpiper at Ivva-vik (site #10) on 5 August weighed 57.0 g. On Ellesmere Island (site #15), an adult Purple Sandpiper *Calidris maritima* was trapped weighing 68.0 g (fat score 4). The latter bird had just commenced its primary moult, having the four innermost primaries growing. The same predominance of juveniles at arctic stopover sites in August was found also during a similar expedition to the Eurasian Arctic in 1994 (Lindström 1998). Most adult waders set out on autumn migration already in July, well before the migration of juveniles (Pitelka 1959; Parmelee *et al.* 1967; Tulp *et al.* 1998).

In late July and early August, many of the juveniles trapped still had downy feathers in neck and around bill. In the White-rumped Sandpiper, birds with these features are about 21-27 days old (Parmelee *et al.* 1968). At 27 days, there may still be minor traces of down in the neck. Many of the birds with down in neck also still had feather sheaths at the base of their outermost primaries, showing that wing feather growth was just about to be completed. Given that the birds fledge at an age of 16 days (Parmelee *et al.* 1968) it is clear that juvenile waders commence migration already within a week after fledging. The juveniles we trapped had joined migrating flocks and changed habitat from tundra to shorelines. Hence, the birds were, with possibly a few exceptions (some birds at site #9, see species accounts), independent juveniles that had entered, or started to prepare for, migration. A few birds carrying traces of down were also trapped in late August, reflecting a large temporal variation in the breeding schedule.

Body mass values indicated that most juvenile waders carried only small fat loads, including those trapped in late August (Fig. 2, Table 1). Of 189 birds scored for fat, as many as 146 (77%) had scores between 0 and 2. There are no studies of the correlation between visual fat scores and actual fuel load in waders, but in a small passerine (Willow Warbler *Phylloscopus trochilus*), fat scores 0-2 in the scale we used corresponded to a fuel load of about 5% above lean mass (Lundgren *et
There were, however, some examples of higher fat scores (3-6) among the migrants, notably among Buff-breasted Sandpipers and to some degree in White-rumped and Semipalmated Sandpipers (see below). Four species with larger data sets deserve some more detailed comments.

We compare our data for these species with published accounts on body mass, where the age of birds was not always clear. Given that adults may sometimes be structurally slightly larger than juveniles (for example, Johnson et al. 1989), and samples could consist of a mixture of age classes, the body masses reported for birds of unknown age may be somewhat higher than representative for juveniles.

Baird’s Sandpipers were clearly much more trap-shy than White-rumped Sandpipers, making them underrepresented in the catches. About half of the birds at site #9 had 5-10 mm left to complete wing growth, but they were still as heavy as the (fully grown) birds at other sites. All of the seven birds trapped on 8 and 25 August (sites #11 and #16) had fat scores between 0 and 2. Body masses were low at all three sites birds were trapped at, with no significant differences between sites (ANOVA, $F_{2,18} = 1.1, P = 0.36$). The average body masses of about 35 g at the three sites are similar to the 36 g of two juveniles collected in late August on Ellesmere Island (Parmelee & MacDonald 1960), but lower than the 41.5 g of two juveniles collected in mid August on Victoria Island (Parmelee et al. 1967). The highest body masses of juvenile Baird’s Sandpipers are 50-55 g when departing from Mexico during autumn migration and the lowest values, 30-35 g, were reported for juveniles just arriving in Mexico in autumn (Jehl 1979). Adult birds may be as heavy as 60 g (Jehl 1979).

Eleven Buff-breasted Sandpipers trapped on northern Banks Island (site #12) had a median fat score of 4.5 (range 3-6), with four birds in fat score 5 and one with score 6. Judging from wing length (males are larger, Lancot & Laredo 1994), they were six females and five males. These were the only birds, of any species, trapped with fat scores 5-6. The average body mass at northern Banks Island (site #12) was significantly higher than at southern Banks Island (site #9, ANOVA, $F_{1,13} = 5.1, P = 0.042$), but the birds at the latter site were still growing their outer primaries (average 110 vs. 132 mm at the two sites) and may not yet have been structurally fully grown (but see corresponding analysis for Baird’s Sandpiper). Buff-breasted Sandpipers at site #12 had the highest fat scores of all birds in this study, but were still not very fat on an absolute scale. Accordingly, their average body mass of 57.7 g is still comparatively low. An average body mass of 89 g has been reported for spring birds (unknown age) in Nebraska (Lanctot & Laredo 1994). The lowest reported mean mass in the literature, 51 g, was for three males (unknown age) in autumn in Suriname (Haverschmidt 1972).

Both median fat scores and average body masses of White-rumped Sandpipers differed significantly between sites (fat score: Kruskal-Wallis test statistics = 42.4, $n = 64, P < 0.001$; body mass: ANOVA, $F_{4,86} = 7.8, P < 0.001$). Whereas all of the 29 White-rumped Sandpipers scored for fat on Baillie Island (site #11) had fat scores of 0 and 1 (median 0), 19 out of 29 (66%) had fat scores of 2-4 on Devon Island (site #16), with a median of 2. Average body mass at these two sites were 34.3 g and 37.6 g, respectively. A random sample of the White-rumped Sandpipers were sexed genetically (L. Wennerberg et al., unpublished data) and the sex ratio was very close to 1:1 at both sites #11 and 16, showing that the differences in body mass were not caused by differences in sex ratio. The average mass at Baillie Island, where 43 out of 56 birds still had down in the neck, is very similar to the average body mass of 34.0 g of four newly fledged White-rumped Sandpipers, aged 17-27 days (Parmelee et al. 1968). Most White-rumped Sandpipers seem to leave North America via stopover sites in southeast Canada (Harrington et al. 1991). The Devon site is somewhat too far to the north to be a likely stopover site for birds from the westernmost part of the breeding distribution (like those trapped at site #11). It is therefore possible that the difference between the samples reflects the difference.
between birds with different origins. Alternatively, White-rumped Sandpipers may gradually put on larger stores later, or further east, during migration (cf. Lindström 1998). But then, the average mass (33.9 g) of the four birds trapped on Baffin Island in late August is surprisingly low. Possibly, these particular birds experienced very difficult conditions, feeding mainly on the ice of a lake. Notwithstanding the significant differences in mass between our study sites, in the light of the range of average body mass recorded for this species in Brazil (unknown age), from 32.4 g in February to 55.9 g in April/May (Harrington et al. 1991), White-rumped Sandpipers are clearly comparatively lean while migrating out of arctic Canada (Fig. 2).

Semi-palmated Sandpipers were only trapped at the two westernmost sites, Ivvavik NP (site #10) and Baillie Island (site #11). Average fat scores were low at both sites (median 2 and range 0-4, and median 1.5 and range 0-4, respectively) and not significantly different ($U$-test statistics = 246.5, $n_1 = 36, n_2 = 13, P = 0.77$). However, average body mass was significantly higher at site #11 (24.1 g) than at site #10 (22.2 g; ANOVA, $F_{1.58} = 18.3, P < 0.001$). As for the other species, juvenile Semipalmated Sandpipers are fairly lean at high latitudes - the lowest and highest averages reported for juveniles of this species are 21.2 g in Suriname in autumn (lowest mass for any age class) and 27.5 g in Bay of Fundy in autumn. The highest value for the species is 32.5 g in adults in Bay of Fundy in autumn (Gratto-Trevor 1992).

**DISCUSSION**

Although we only visited a few sites in a huge geographical area, we believe our results to be of general interest, since only little information is available from these remote areas, and from this part of the annual cycle of waders. For most species we can not know whether the birds trapped at different sites belonged to one population sharing the same migratory route, or if they belonged to different populations with different migratory performance. Nevertheless, the overall picture is clear. The generally low body masses and fat scores recorded, supplemented with scattered information in the literature, strongly indicate that the first part of migration through the Canadian Arctic is carried out in short hops. A similar pattern of small fuel stores was found in Little Stints in the Eurasian Arctic (Lindström 1998). The small energy stores in the north are in strong contrast to the substantial amounts of fuel put on by many of these species at stopover sites in southern Canada and USA before making long flights to wintering grounds in Central and South America (Jehl 1979; Page & Middleton 1972; Harrington et al. 1991).

Earlier studies on waders have indicated that they largely follow a time-minimising strategy (Alerstam & Lindström 1990; Gudmundsson et al. 1991), and also the pattern of fuel deposition in our data set are in accordance with such a strategy. Time-minimising birds that can expect increasing fuel deposition rates further away along the route should depart with smaller stores than otherwise (Gudmundsson et al. 1991). We have no information about fuel deposition rates at the sites we visited, but the fuel deposition rates found at the more southern stopover sites in North America (Page & Middleton 1972; Morrison 1984; Alexander & Gratto-Trevor 1997) are among the highest found for any waders (Zwarts et al. 1990, Lindström 1991). If there are higher quality stopover sites further south, a time-minimising migrant is expected to migrate with small fuel stores out of the high Arctic. We conclude that the waders we studied behaved according to a time-minimising strategy.

It is not impossible that at one or a few sites (for example, site #17), feeding conditions were so poor that the birds simply did not manage to put on fuel. This is, however, an unlikely general explanation for the small fuel stores recorded. To be able to move rapidly over large distances, and there were many examples of intense movements at the study sites, the birds must also be able to fuel up rapidly, even if they only put on small amounts at a time (Alerstam & Lindström 1990; Lindström 1991).
ACKNOWLEDGEMENTS

We thank the Swedish Polar Research Secretariat for allowing us to participate in ‘Tundra Northwest 1999’ and for providing superb logistics. CCGS ‘Louis S. St-Laurent’ and its crew formed an excellent basis for our work. S. Lidström, J.-E. Johansson, S. Åkesson, U. Ottosson, L. Amagoalik, M. Joe, G.A. Gudmundsson and M. Green helped with catching birds and made pleasant company in the field. Rings and ringing permit were supplied with prompt and generous help from L. Metras, R.I.G. Morrison, C. Gratto-Trevor and E. Levesque. Thanks also to the Nunavut authorities, Canadian Wildlife Service, and Yukon National Parks for permits to carry out research at the different sites. We thank Gregor Scheiffarth and Hans Schekkerman for constructive comments on an earlier draft. Our study was supported by a PIONIER grant of the Netherlands Organisation for Scientific Research (NWO) to AL. This is NIOZ-publication 3459 and publication 2804 of the Netherlands Institute of Ecology, Centre for Limnology.

REFERENCES


SAMENVATTING

Hoewel arctische steltlopers op veel plaatsen intensief worden bestudeerd, weten we bitter weinig over de gewichten en de energievoorraad die aan het einde van het broedseizoen op de toendra worden opgebouwd. Gaan de vogels er met lage vertrekgewichten vandoor, daarmee steeds maar kleine afstanden overbruggend tot ze in de zuidelijker gelegen doortrekgebieden aanko- men, of leggen ze een grote energievoorraad aan om in één keer van de toendra naar een wetland in gematigde streken te vliegen? Tijdens een verblijf op een ijsbreker op een expeditie door de Canadese Arctis in 1999 lukte het om van 29 juli tot 31 augustus op zeven plaatsen in het gebied omsloten door 68° en 76° NB en 67° en 139° WL, meer dan 200 steltlopers van 12 verschillende soorten te vangen. De steltlopers liepen strategisch geplaatste inloopkooien in of werden gevangen door ze bij daglicht in een mistnet te drijven. Bonapartes Strandlopers Calidris fuscicollis, Grijze Strandlopers Calidris pusilla, Bairds Strandlopers Calidris bairdii en Blonde Ruiters Tryngites subruficollis waren het meest talrijk in de vangsten. Het overgrote deel van de aanwezige en gevangen vogels was jong en nog maar net vliegvlug. Oude vogels ontbraken waarschijnlijk vooral omdat ze de arctische broedgebieden al eerder hadden verlaten. In alle gevallen waren de gemeten lichaams- en de visueel bepaalde vetscores erg laag. De gewichten lagen in de buurt van de laagste waarden die voor de verschillende soorten in de literatuur werden vermeld. Alleen van de Blonde Ruiter werden enigszins vette individuen gevangen. Jonge steltlopers proberen dus met kleine energievoorraad uit de toendra weg te komen. Als opvetten voor een verdergaande trek sneller plaats kan vinden naarmate de vogels zuido- lijk komen, dan zou een strategie zoals uit de gegevens naar voren komt, tijdwinst kunnen opleveren.

Received 10 February 2001, accepted 30 May 2001
Corresponding editor: Christiaan Both