

## Migration patterns, population trends and morphometrics of Ruddy Turnstones *Arenaria interpres* passing through Ottenby in south-eastern Sweden

*Flyttningmönster, populationstrender och morfometri hos roskarlar Arenaria interpres vid Ottenby i sydöstra Sverige*

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### Abstract

We analysed 57 years' uninterrupted trapping data of autumn migrating Ruddy Turnstones *Arenaria interpres* at Ottenby, south-eastern Sweden (1593 full-grown birds in 1947–2003; of them 574 birds with standardised trapping in 1976–2003). Numbers trapped decreased significantly for both adult and juvenile birds in the total dataset (–0.34 and –0.57 ringed birds per year), and for juveniles in the 1976–2003 dataset (–0.51 per year). Median date for adults was 27 July and for juveniles 6 August. Adult females passed on average three days earlier than adult males (females 27 July, males 30 July). The mean body masses (juveniles 108.0 g, adults 108.4 g) correspond to a fuel load of 21–22% in relation to lean

body mass (89 g). Length of stay of retrapped birds was only 3.6 days. Thus, they continued the migration with small to moderate fat loads, comparable to reported fat loads elsewhere. Forty-four recoveries illustrate a narrow migration route along the western coasts of Europe, south to the wintering areas in tropical West Africa.

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### Introduction

Waders have been a focal group for many ornithological studies, because of their spectacular migrations and fascinating behavioural adaptations (Piersma et al. 1996). Most species inhabit wetlands during breeding, migration and wintering, and with increasing human pressures on these habitats, many wader species are currently showing declining trends in Europe (Piersma et al. 1996). To correctly assess long-term trends, especially for the less common species, there is an urgent need for quantitative datasets covering many years. Unfortunately such data are rare. The present paper is one of four recent ones analysing the migration of waders at Ottenby Bird Observatory, south-eastern Sweden (Waldenström & Lindström 2001, Blomqvist et al. 2002, Hedenström 2004). At Ottenby, trapping of waders for ringing has been carried out since 1946, in a small area and with nearly the same trapping effort over the years. This material enables analysis of population trends in several species of waders, as well as detailed studies on migratory strategies and the timing of migration.

The Ruddy Turnstone *Arenaria interpres* is a wader with circumpolar breeding range, from the temperate regions into the high-Arctic (Cramp & Simmons 1983). The nominate subspecies (*A. interpres interpres*), which is the subject of this study, breeds from Ellesmere and Axel Heiberg Islands in the Canadian Arctic (c. 90° W) along the coasts of northern and north-eastern Greenland, Scandinavia and Siberia, east to Alaska (c. 135° W; Summers et al. 1989). The most likely breeding areas for the populations passing Ottenby on autumn migration are Sweden, Finland and the Russian arctic, possibly east to the Taymyr Peninsula (e.g. Kistchinski et al. 1985). The autumn migration in northern Europe typically takes place from mid July to early September (e.g. Branson et al. 1978, Summers et al. 1989). In the non-breeding season, Ruddy Turnstones of the nominate race winter along the coasts of Western Europe down to West Africa, with a predominance of Canadian and Greenlandic birds in Europe, and Scandinavian birds predominantly in Africa (Branson et al. 1978, Summers et al. 1989). During spring migration Ruddy Turnstones, like several other Arctic breeding waders, often perform long-distance

migratory flights between traditional stopover sites, and their passage is generally much more concentrated in time during spring than during the autumn migration (Gudmundsson et al. 1991). For example, Ruddy Turnstones probably mostly migrate in one step from Iceland to Ellesmere Island in the Canadian Arctic, and from the Pribilof Islands in the Bering Strait to the Midway Islands, or even the Marshall Islands in the Pacific (Alerstam 1990, Gudmundsson et al. 1991). The distance to the latter is c. 5500 km, which means that the birds must gain extremely high fat loads to manage the flights. Migration strategies and distances flown, however, differ between populations of this widely distributed species (e.g. Cramp & Simmons 1983, Summers et al. 1989).

We analyse the trapping figures of Ruddy Turnstones at Ottenby, a migratory stopover site in south-eastern Sweden, situated on the southern point of the island Öland in the Baltic Sea. Ottenby Bird Observatory has ringed and observed birds from 1946 until present, providing a 57-year long time series, allowing analyses of long-term population trends in the Ruddy Turnstone and other waders. The ringing of Ruddy Turnstones has resulted in several recoveries, which we use to discern migratory flyways and wintering areas of the populations passing Öland. Furthermore, we describe the age- and sex-dependent migration pattern during autumn migration at Ottenby, with special reference to changes in body mass in re-trapped individuals.

## Material and methods

### *Ringling*

Ottenby Bird Observatory (56°12'N, 16°24'E) is situated on the southern point of Öland, an island c. 10 km off the coast in south-eastern Sweden. It was founded in 1946 following pilot studies in 1937–1938 (Bergström & Svärdsön 1938). The large aggregation of migrant waders in this area in autumn was described already by Kolthoff (1896), and was one of the reasons to start a bird observatory here – and waders were ringed already during the first year of the observatory's activity. Since then, ringling of waders has been carried out annually (Edelstam 1972, Waldenström & Lindström 2001). During all years the same trapping area has been used: a c. one km shoreline that surrounds the bird observatory. However, the water level and the amount of seaweed changes between years, as does the shape of the shoreline with build-up or erosion of gravel and sand after extreme weather

conditions. There is virtually no tide in this part of the Baltic Sea.

Different variants (all using the same principle) of walk-in funnel traps of the "Ottenby model" (Bub 1991) have been used, and in varying numbers during the years. From 1972 onwards standardised trapping has involved between 80 and 120 traps each year. These are operated from dawn to dusk and from around 10 July to mid or late September, depending on the availability of staging waders.

There are a few (usually 1–5) breeding pairs of Ruddy Turnstones in the vicinity of the trapping area (e.g. Pettersson et al. 1986a), so in order not to mix breeding and migratory birds in our sample, birds ringed before 10 June and birds ringed as pulli were excluded from our analyses. Following these criteria, a total of 1593 full-grown Ruddy Turnstones ringed in 1947–2003 were available for analysis. When calculating trends in median passage date, adults and juveniles were analysed separately. Years in which fewer than five birds of the specific age-class were ringed were excluded in order to reduce the possible impact of non-representative outliers.

### *Morphometrics*

Aged birds were only available for the periods 1947–1956, and again from 1976–2003. A total of 341 birds were classified as adults and 725 as juveniles. The plumage differences between these age-classes are distinct (Prater et al. 1977). Since 1976, birds in their second calendar year have also been identified, according to the criteria described by Prater et al. (1977). Since 1990, the body mass, measured to the nearest 0.1 g, has been recorded using either a Pesola spring balance or an electronic balance. Wing length has been measured on trapped individuals, using the maximum chord method (Svensson 1992), read to the nearest mm.

The lean body mass (LBM) was estimated at 89 g for adults and 87 g for juveniles, by averaging the five lowest body masses recorded in each group. In adult birds, these leanest individuals did not differ in wing length from others ( $155.2 \pm 3.3$  mm compared to  $157.1 \pm 4.2$ , one-way ANOVA  $F_{1,58} = 0.96$ ,  $p = 0.33$ ). In juvenile birds, however, the five lightest birds had significantly shorter wings than other individuals ( $150.2 \pm 6.1$  mm compared to  $154.6 \pm 4.5$ , one-way ANOVA  $F_{1,49} = 4.05$ ,  $p = 0.05$ ). Therefore, we used 89 g as an estimate of LBM for both adult and juvenile Ruddy Turnstones. Normality of data and the homogene-

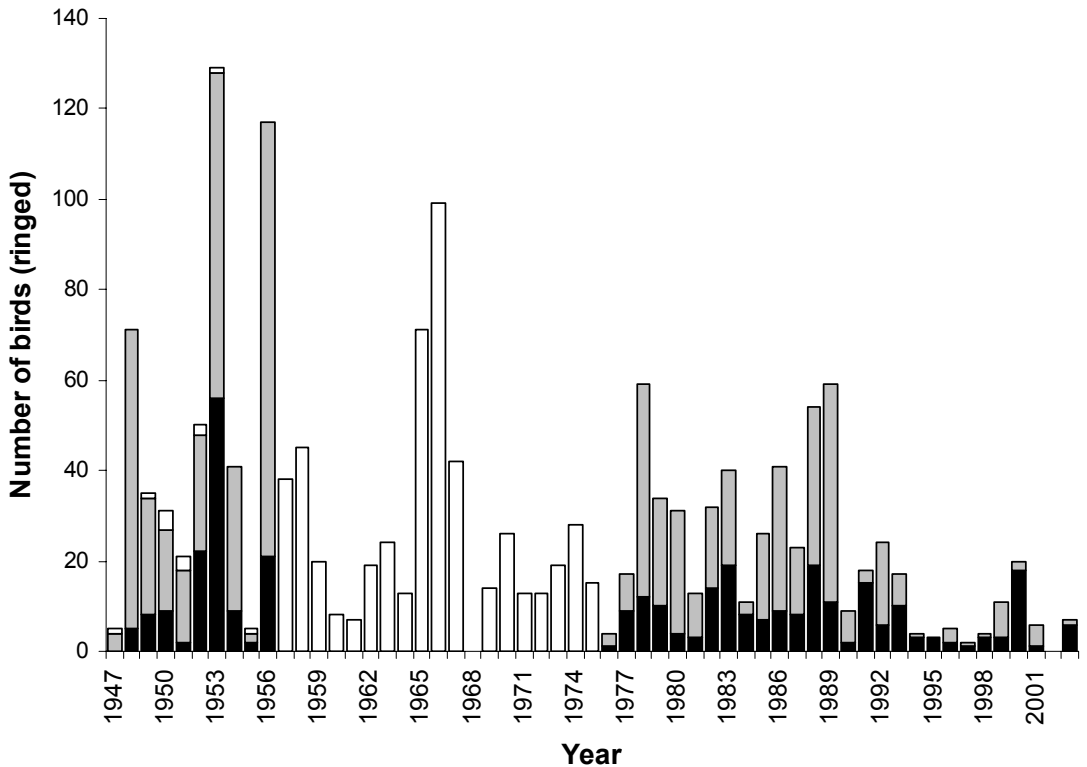


Figure 1. Annual ringing figures, from 1946 to 2003, of full-grown Ruddy Turnstones *Arenaria interpres* on autumn migration at Ottenby, Sweden ( $n = 1593$ ). Adults are shown by black columns, juveniles by grey, and white columns represent birds of unknown age.

*Antal ringmärkta flygga roskarlar *Arenaria interpres* på höstflyttning vid Ottenby ( $n = 1593$ ). Adulta fåglar representeras av svarta kolumner, juvenila av gråa samt fåglar av okänd ålder av vita.*

ity of variances in the different groups were tested with Levene's and Kolmogorov-Smirnov's tests, respectively. This estimate of LBM is equal to, or slightly lower than body mass recorded during the breeding season (e.g. Cramp & Simmons 1983, Summers & Waltner 1979).

#### *Migration routes and wintering areas*

The locations of all recoveries of Ruddy Turnstones ringed at Ottenby were analysed in the Oriana software (Kovach 2003).

## **Results**

### *Long-term population trends*

The number of birds ringed during one autumn varied between 0 (1968 and 2002) and 129 (1953), with an average of 27.9 (Figure 1). From 1976–

2003, when trapping has been standardised and individuals have been assigned to age-classes, on average 7.4 adult ( $n = 207$ ) and 13.1 juvenile ( $n = 367$ ) Ruddy Turnstones were trapped annually. The number of adults and juveniles were positively correlated (1947–2003: Pearson  $R = 0.593$ ,  $n = 57$ ,  $p < 0.001$ ; 1976–2003: Pearson  $R = 0.476$ ,  $n = 28$ ,  $p = 0.010$ ), thus a year with high trapping numbers of adult birds also yielded high numbers of juveniles.

Both the total number of individuals trapped from 1947–2003 (Pearson  $R = -0.393$ ,  $n = 57$ ,  $p = 0.002$ , Figure 1), and the age-specific trapping figures showed a marked decrease with time (adults: Pearson  $R = -0.339$ ,  $n = 37$ ,  $p = 0.040$ ; juveniles: Pearson  $R = -0.571$ ,  $n = 37$ ,  $p < 0.001$ , Figure 1). The same general pattern was also found in the restricted dataset from 1976–2003, with standardised trapping and the separation of age-classes,

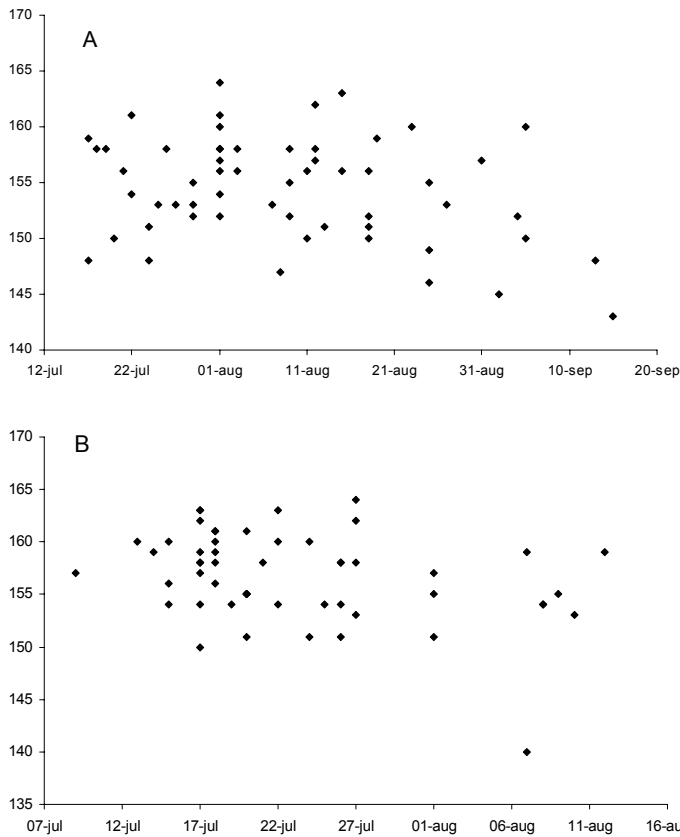


Figure 2. Variation in wing length (y-axis; measured in mm) with date for (A) juvenile ( $n = 57$ ), and (B) adult Ruddy Turnstones *Arenaria interpres* ( $n = 73$ ) ringed at Ottenby, Sweden.

*Vinglängdsvariation (y-axeln; mätt i mm) över tid hos (A) juvenila ( $n = 57$ ) och (B) adulta roskarlar *Arenaria interpres* ( $n = 73$ ) ringmärkta vid Ottenby.*

both for the total number of trapped birds and for juveniles (1976–2003 total: Pearson  $R = -0.502$ ,  $n = 28$ ,  $p = 0.007$ ; juveniles: Pearson  $R = -0.509$ ,  $n = 28$ ,  $p = 0.006$ ), but only with a weak tendency for decreased number of adults with time (adults: Pearson  $R = -0.285$ ,  $n = 28$ ,  $p = 0.141$ ). The mean number of adults caught per year from 1990–2003 ( $5.2 \pm 5.4$ ) was 46% lower than the mean number caught from 1976–1989 ( $9.6 \pm 5.3$ , Mann-Whitney  $U = 47.5$ ,  $n = 28$ ,  $p = 0.02$ ), and the mean number of juveniles caught from 1990–2003 ( $4.1 \pm 4.8$ ) was 82% lower than the mean number caught from 1976–1989 ( $22.1 \pm 14.5$ ,  $U = 16.0$ ,  $n = 28$ ,  $p < 0.001$ ).

#### Mass gain and stopover

In the restricted dataset of sexed adult birds, body mass did not differ significantly between the sexes (females 105.8 g, males 111.1 g; T-test  $t = -1.192$ ,  $d.f. = 40$ ,  $p = 0.240$ ) and neither did wing length (females 156.8 mm, males 156.4 mm; T-test  $t =$

0.243,  $d.f. = 51$ ,  $p = 0.809$ ). For both adults and juveniles, wing length showed a negative trend over the season (adults: Pearson  $R = -0.319$ ,  $n = 73$ ,  $p = 0.006$ ; juveniles: Pearson  $R = -0.298$ ,  $n = 57$ ,  $p = 0.024$ ; Figure 2). In adult birds, there was no effect of sex (ANOVA  $F = 0.005$ ,  $d.f. = 1$ ,  $p = 0.945$ ) or the interaction of sex and date on wing length (ANOVA  $F = 0.810$ ,  $d.f. = 5$ ,  $p = 0.553$ ). For body mass, adult Ruddy Turnstones showed no trend with date (Pearson  $R = 0.127$ ,  $n = 60$ ,  $p = 0.332$ ) while juveniles showed a tendency towards a seasonal decline in mass (Pearson  $R = -0.273$ ,  $n = 51$ ,  $p = 0.053$ ). Ruddy Turnstones thus had on average shorter wings, and juveniles tended to weigh less, with the progress of the season. There were no long-term trends in body mass (adults: Pearson  $R = 0.09$ ,  $n = 60$ ,  $p = 0.475$ ; juveniles:  $-0.01$ ,  $n = 51$ ,  $p = 0.942$ ).

The mean body mass of adult birds was 108.4 g ( $n = 63$ ) and for juveniles 108.0 g ( $n = 55$ ). Using the estimated LBM of 89 g, the average fuel load (relative to LBM) was 22% in adult and 21% in

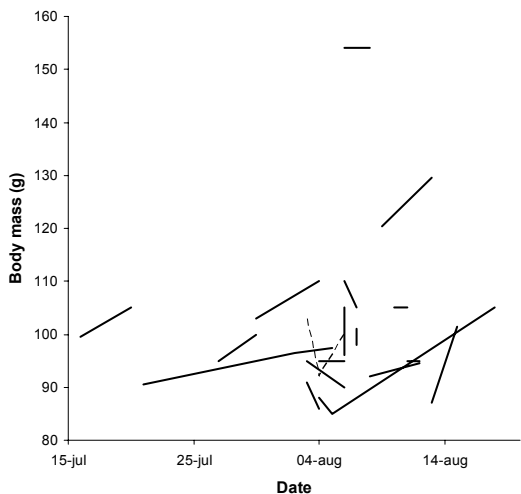


Figure 3. Changes in body mass (g) over time in recaptured full-grown Ruddy Turnstones *Arenaria interpres* on autumn migration at Ottenby, Sweden, 1987–2003 (n = 18). The dashed line indicates an adult, all other birds are juvenile.

Förändring i vikt (g) över tid hos flygga roskarlar *Arenaria interpres* på höstflyttning vid Ottenby, under perioden 1987–2003 (n = 18). Den streckade linjen visar en adult, alla andra är juvenila.

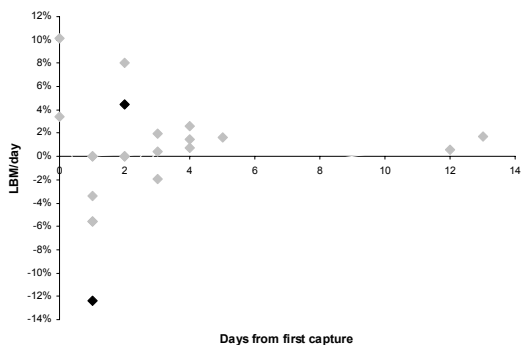


Figure 4. Rate of change in percent of lean body mass in recaptured full-grown Ruddy Turnstones *Arenaria interpres* on autumn migration at Ottenby, Sweden, 1987–2003. Black quadrangles indicate an adult, grey quadrangles indicate juveniles.

Viktförändringar i procent av den fettfria vikten per dag hos återfångade flygga roskarlar *Arenaria interpres* på höstflyttning vid Ottenby, 1987–2003. Svarta fyrkanter avser en adult fågel medan gråa avser juvenila fåglar.

juvenile Ruddy Turnstones. The heaviest bird, a juvenile, had a fuel store corresponding to 74% of LBM.

Eighteen birds were recaptured within the same season in 1987–2003 (Figure 3). One of those was adult, the remaining were juveniles. The time between first capture and last recapture varied between 0 and 15 days, with an average of 3.6 days. The mean body mass change was positive for two birds recaptured on the same day as they were first captured (6.8% of LBM), but was negative (−2.8% of LBM per day) for birds recaptured the day following first capture (n = 4). Birds recaptured from day two onwards (n = 12) showed a positive trend in mean body mass change (1.3% of LBM per day; Figure 4). The highest recorded mass gain rate (over two days or more) was 8.0% per day. However, the average body mass change, summed over all retrapped individuals, in relation to LBM was not significantly different from zero (One sample T-test,  $t = 1.128$ , d.f. = 17,  $p = 0.275$ ).

#### Migration and wintering areas

The median ringing date for adults was 27 July (n = 341) and for juveniles 6 August (n = 725; Figure 5; T-test  $t = 6.45$ , d.f. = 1578,  $p < 0.001$ ). Thus the average difference in passage between adult and juvenile Ruddy Turnstones was 10 days. Adult females passed through on average three days earlier in autumn than males (females 27 July, males 30 July; T-test  $t = -2.178$ , d.f. = 174,  $p = 0.031$ ). No significant trends over time in the median autumn passage date were found, for neither adults (Pearson  $R = -0.356$ , n = 23,  $p = 0.130$ ) nor juveniles (Pearson  $R = -0.193$ , n = 25,  $p = 0.356$ ).

A total of 44 Ruddy Turnstones ringed at Ottenby have been recovered elsewhere. Apart from three recoveries on presumed wintering sites (with a mean direction of  $216^\circ$  from Ottenby, n = 3, circular s.d. =  $11.3^\circ$ , Rayleigh test  $Z = 2.88$ ,  $p = 0.04$ ), all recoveries were from birds recovered either during spring or autumn migration (Figure 6). Birds ringed as juveniles at Ottenby and recovered elsewhere the same autumn had a mean direction of  $236^\circ$  (n = 16, circular s.d. =  $14.7^\circ$ , Rayleigh test  $Z = 14.98$ ,  $p < 0.001$ ), and the mean direction of adult birds (at the time of the recovery) recovered south of Ottenby during spring migration was  $237^\circ$  (n = 20, circular s.d. =  $6.4^\circ$ , Rayleigh test  $Z = 19.75$ ,  $p < 0.001$ ). There was no difference between the directions of the recoveries in spring and autumn (Watson-Williams F-test,  $F = 0.04$ , d.f. = 1, n = 36,  $p = 0.84$ ), but juvenile birds in autumn had

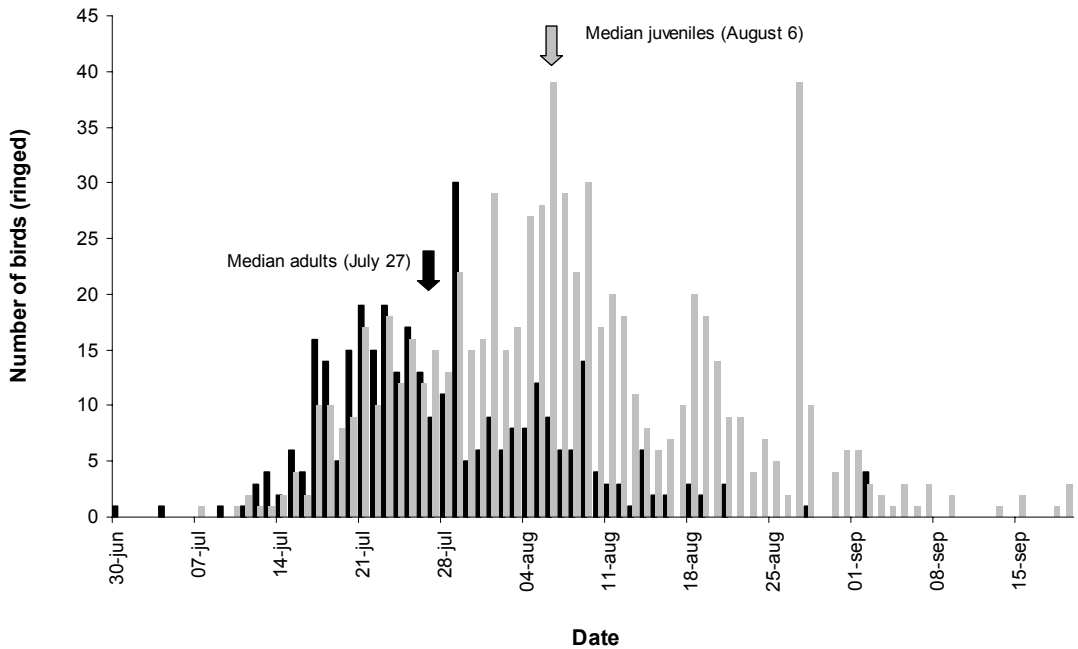


Figure 5. Age-dependent distribution of Ruddy Turnstones *Arenaria interpres* ringed during autumn migration at Ottenby, Sweden. Median dates are indicated for adults ( $n = 341$ ; black columns) and juveniles ( $n = 725$ ; grey columns). *Aldersfördelning hos ros Karl Arenaria interpres på höstflyttning vid Ottenby. Mediantdatum är markerade för adulta ( $n = 342$ ; svarta staplar) och juvenila ( $n = 725$ ; gråa staplar).*

a more scattered distribution compared to adult birds in spring (Marida-Watson-Wheeler test,  $W = 5.68$ ,  $n = 36$ ,  $p = 0.058$ ). One bird was found during spring migration in the former Soviet Union. This pattern of recoveries suggests that the Ruddy Turnstones passing through Ottenby follow the European coastline during the autumn migration (although one juvenile bird was recovered on Sicily) and spend the winter in tropical West Africa (cf. Cramp & Simmons 1983, Summers et al. 1989).

## Discussion

### *Long-term population trends*

In the total dataset, from 1946–2003, the Ruddy Turnstone trapping numbers of adults, juveniles and combined age-classes decreased. This pattern held true also for juveniles and combined age-classes when restricting the analysis to the standardised period 1976–2003. Adult birds in that period did, however, only show a tendency of decrease using correlative analysis. If instead

non-parametric comparisons of the mean number of birds trapped during 1976–1989 and 1990–2003 are carried out, both adults and juveniles showed significant declines in numbers (equivalent to a 46% reduction for adults and 82% for juveniles). Given the assumption that the conditions for trapping Ruddy Turnstones at Ottenby have not changed significantly over the study period, these data imply either that the species has decreased in numbers, or that Ruddy Turnstones utilise Ottenby more infrequently as a stopover site in recent years. It should be noted that a strict standardisation of trapping conditions could never be fully attained at a site such as Ottenby. The amount of seaweed at the shoreline, the condition of the seaweed (*i.e.* how dry the seaweed is, how much invertebrate prey it contains), the local and global weather and the quality of alternative foraging sites outside the study area, are all likely to affect the number of trapped birds. Furthermore, trapping effort measured as numbers of days with active trapping per season is dependent on the number of staging birds. Late in the season, or during extreme high pressure weather situations,

there are few, if any, foraging waders at the point and traps have not been used. We could not, however, see any obvious systematic biases in the trapping effort that could explain the declining trends of Ruddy Turnstones at Ottenby.

The recoveries of birds ringed at Ottenby give few clues to the origin (breeding areas) of the populations migrating past Ottenby in autumn, as very few have been recovered during the breeding season (Figure 6). However, Ruddy Turnstones trapped at Ottenby most likely originate from Sweden, Finland and the Russian arctic. From Finland and Sweden, the Ruddy Turnstone has been reported to having declined in some areas during the last decades (Väisänen et al. 1998, Svensson et al. 1999, SOF 2002), but the large Norwegian population has apparently been stable in numbers (Bakken et al. 2003).

#### Mass gain and stopover

The average fuel loads for Ruddy Turnstones at Ottenby (22% in adults and 21% in juveniles) were similar to those observed during the same period in Broad-billed Sandpipers *Limicola falcinellus* (24% in adults and 29% in juveniles; Waldenström & Lindström 2001) and Temminck's Stints *Calidris temminckii* (32% in adults and 21% in juveniles; Hedenström 2004) at Ottenby. Fuel loads of around 20–30% are relatively low for many migrating wader populations, where they can be as high as 100% of LBM (Alerstam & Lindström 1990). Note, however, that lean body mass generally increases with fat mass, e.g. from changes in flight muscle and intestinal organ sizes, which will underestimate LBM and thus slightly overestimate fuel loads with the method used here (Landys-Ciannelli et al. 2003). During 1987–2003, only 6.8% of the ringed birds were recaptured in the same season, indicating that most of the Ruddy Turnstones only stay for a short time in the study area. The mean time between first capture and last recapture was 3.6 days, which is similar to the stopover time for Ruddy Turnstones at the Gulf of Gdańsk in Poland (3.9 days; Meissner & Koziróg 2001). Furthermore, adults seemed to stay shorter periods at Ottenby, although alternatively, they may have been harder to retrap than juveniles (57.9% of ringed individuals 1987–2003 were adults, but only one, 5.6%, of the retrapped birds was adult). Note, however, that the stopover duration times were censored and thus could have been overestimated; birds that stayed for shorter periods experience a lower probability of

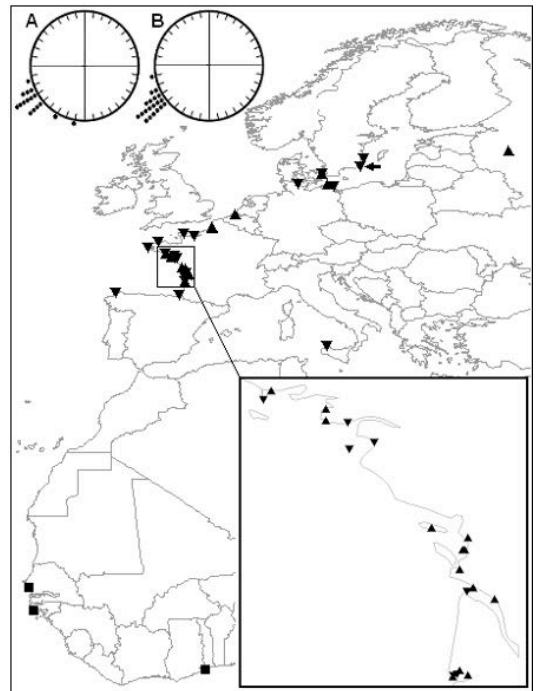


Figure 6. Recoveries of Ruddy Turnstones *Arenaria interpres* ringed at Ottenby, Sweden ( $n = 44$ ). The symbols indicate during what period of the year a bird is found (■ = winter, November–February,  $n = 3$ ; ▲ = spring, April–May,  $n = 21$ ; ▼ = autumn, July–October,  $n = 20$ ). The arrow points out the ringing site. The inset circular figures show (A) directions of recoveries from birds ringed as juveniles at Ottenby and recovered elsewhere the same autumn (mean direction =  $236^\circ$ ,  $n = 16$ , circular s.d. =  $14.7^\circ$ , Rayleigh test  $Z = 14.98$ ,  $p < 0.001$ ), and (B) directions of adult birds (at the time of the recovery) recovered south of Ottenby during spring migration (mean direction =  $237^\circ$ ,  $n = 20$ , circular s.d. =  $6.4^\circ$ , Rayleigh test  $Z = 19.75$ ,  $p < 0.001$ ). The dots representing the recoveries are shown in the direction of the closest  $5^\circ$ .

Återfynd av roska! *Arenaria interpres* ringmärkta vid Ottenby ( $n = 44$ ). Symbolerna visar under vilken tid på året fågeln är återfunnen (■ = vinter, november–februari,  $n = 3$ ; ▲ = vår, april–maj,  $n = 21$ ; ▼ = höst, juli–oktober,  $n = 20$ ). Pilen utmärker ringmärkningslokalen. De infällda cirkeldiagrammen visar (A) riktningar för återfynd av roska! ringmärkta som juvenila vid Ottenby och återfunna annorstädes samma höst (medelriktning =  $236^\circ$ ,  $n = 16$ , cirkulär standardavvikelse =  $14,7^\circ$ , Rayleigh test  $Z = 14,98$ ,  $p < 0,001$ ), och (B) riktningar för adulta roska! (vid tiden för återfynd) återfunna söder om Ottenby under vårflyttning (medelriktning =  $237^\circ$ ,  $n = 20$ , cirkulär standardavvikelse =  $6,4^\circ$ , Rayleigh test  $Z = 19,75$ ,  $p < 0,001$ ). Punkterna som representerar återfynden är angivna i riktning från närmaste  $5^\circ$ .

being retrapped. Retrapped birds at Ottenby had on average lost mass the first day after first capture, but later increased in body mass. The initial drop could be due to handling effects at trapping, or to settling costs for newly arrived individuals (Thompson 1974, Alerstam & Lindström 1990). The rate at which retrapped individuals gained mass (maximum 8.0% of LBM per day) shows that at least some Ruddy Turnstones have the potential of rapid mass gain at Ottenby, even if the average body mass change of all retrapped individuals did not differ from zero.

The body masses at Ottenby were approximately 10 g higher than for Ruddy Turnstones on autumn migration in northern Poland (adults 98.9 g, juveniles 99.0 g; Meissner & Koziróg 2001), but c. 60 g lower than for birds ready for spring departure northwards in Victoria, Australia (Houston & Barter 1991) and c. 50 g lower than for birds ready to leave Iceland for NE Canada in spring (Gudmundsson *et al.* 1991). Similarly, birds departing on autumn migration from the Pribilof Islands towards the Hawaiian Islands had mean body mass of 153 g, with the heaviest recorded individual weighing 195 g (Thompson 1974). From Ottenby during spring migration, eight Ruddy Turnstones trapped 23 May–3 June 2004, individual body masses ranged between 105.1 and 162.2 g (mean  $126 \pm 18.5$  g). The heaviest individual thus had 54 g higher body mass than the mean body mass observed at the same site in autumn. Ruddy Turnstones at Ottenby during autumn thus only seem to prepare themselves for short- to medium-distance migrations to the next stopover site.

There was a decreasing trend in wing length with the progress of the autumn for both age-classes, and a tendency to lower body masses in late migrating juveniles. Shorter wings later in the autumn could be due to wear of the tips of the longest primaries, females migrating earlier than males, or, it could indicate a shift in which population of Ruddy Turnstones that was trapped. We did not find that differential passage of the sexes could have influenced the results, at least not in the adult birds which are easy to sex. Nor did we find a clear pattern in the literature regarding population-specific differences in wing lengths, and, thus, we cannot conclusively tell what factors that are responsible for the observed trend.

#### *Migration routes and wintering areas*

The difference between median ringing dates for ringed adults and juveniles was 10 days, which is

shorter than the differences seen in Temmink's Stints (23 days; Hedenström 2004) and Broad-billed Sandpipers (27 days; Waldenström & Lindström 2001) at the same locality, and juvenile Ruddy Turnstones occurred already in mid July (Figure 5). Perhaps these early juveniles belonged to local populations breeding close to Ottenby? Adult females migrated on average three days earlier than adult males. Both the females and the males care for the young in this species, but females may leave before the young are fledged, hence leaving the males behind (Nettleship 1973).

Only five of the adult birds since 1976 ( $n = 207$ ) were aged as first summer individuals. This low proportion supports the hypothesis that most first-summer birds remain south of their breeding range (Prater *et al.* 1977, del Hoyo *et al.* 1996).

Ringing recoveries of Ruddy Turnstones trapped during autumn migration at Ottenby and later recovered elsewhere are strongly concentrated on the coastlines of Western Europe and West Africa (Figure 6). All except one recovery seem to be from birds that have continued the autumn migration route by following the European coastline, and there were no differences in routes between spring and autumn – mean angle for birds recovered south of Ottenby was nearly identical, c.  $236^\circ$ , in both seasons. Only one autumn recovery was made outside the Atlantic coast – a juvenile bird recovered on Sicily, Italy. Juvenile birds during autumn tended to have a larger scatter in migratory directions as detected from the recoveries. However, the recoveries of juvenile birds also showed a remarkable level of concentration, in comparison to other wader species (e.g. Pettersson *et al.* 1986b). Some birds of the eastern populations of Ruddy Turnstone migrate across the European continent to the Mediterranean area and onwards to East Africa (Summers *et al.* 1989), and it is possible that the recovery from Italy came from such an eastern bird. Furthermore, there was a single recovery of a bird in the former Soviet Union which additionally indicates that, at least sometimes, eastern birds also pass through Ottenby.

Unfortunately, we have no recoveries of Ottenby Ruddy Turnstones from breeding areas or vice versa, which makes it difficult to identify what populations pass Ottenby. However, given the species' general distribution, and the known recruitment areas for other waders passing Ottenby, these Ruddy Turnstones most likely belong to the Swedish, Finnish and arctic Russian populations.



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## Sammanfattning

Roskarlen *Arenaria interpres* tillhör en av de vadare som årligen fångas vid Ottenby fågelstation i sydöstra Sverige. Den ringmärks aldrig i några större antal, men eftersom vadarfångsten på stationen startade redan 1946 har ringmärkningssiffrorna byggts på med tiden. Många vadare minskar i antal. Roskarlen hör till de mindre drabbade ar-

terna, men uppgifter om minskande antal kommer från både Finland och Sverige. Det är dock svårt att övervaka populationsförändringar hos vadare, eftersom de ofta förekommer i låga tätheter över stora områden. Ringmärkningsserien vid Ottenby spänner över hela 57 år och kan därför användas som ett mått på antalsförändringar över tiden. Fångsten har bedrivits inom samma geografiskt begränsade område, stränderna runt Ölands södra udde, och är sedan 1972 standardiserad med avseende på fångstinsatsen. Morfometriska och biometriska data har också samlats in och analyseras här.

Under åren 1947–2003 ringmärktes 1593 flygga roskarlar under höstflyttning vid Ottenby, i genomsnitt 27,9 per år (Figur 1). Både adulta och juvenila roskarlar minskade signifikant i antal under hela undersökningsperioden. Under delperioden 1976–2003, då samtliga roskarlar har åldersbestämts, uppvisade de juvenila roskarlarna en signifikant minskning jämfört med delperioden 1947–1956, medan de adulta endast visade tendens till en nedgång. Om man istället för korrelationer använder ickeparametriska test är minskningen mellan perioderna 1976–1989 och 1990–2003 signifikant även för aduler. I procent motsvarar minskningen 46% för gamla fåglar och 82% för ungfåglar.

Medelvikten för adulta roskarlar var 108,4 g och 108,0 g för juvenila. Medelfettmängden i relation till den fettfria vikten (89 g) var 22% hos adulta och 21% hos juvenila. Detta är något lägre än hos många andra flyttande vadare. Även myrsnäppa *Limicola falcinellus* och mosnäppa *Calidris temminckii* som studerats vid Ottenby under hösten

flyttar med relativt låga fettreserver, och tvingas därmed göra fler stopp längst vägen till övervintningsområdena. Möjligheter för snabb fettupplagring finns dock vid Ottenby, vilket visas av den snabba viktökningen som en del återfångade fåglar uppvisade (Figur 3 och 4). En juvenil roskarl som återfångades hade ett fettlager motsvarande 74% av den fettfria vikten.

Arton roskarlar återfångades minst en gång under samma säsong under åren 1987–2003. Av dessa var sju ton juvenila och endast en adult, trots att det under angivna period ringmärktes fler adulta än juvenila roskarlar. Medel mellan första och sista fångst var 3,6 dagar. Från andra dagen och framåt kunde vi konstatera en daglig ökning i vikt med i snitt 1,3% av den fettfria vikten. Högsta noteringen var en juvenil fågel som ökade i vikt med 8,0% per dag i relation till den fettfria vikten.

Mediandatum för ringmärkta adulta roskarlar var 27 juli och 6 augusti för juvenila. Adulta honor flyttade i genomsnitt tre dagar tidigare än adulta hanar. Detta kan bero på att honorna ofta lämnar ungarna innan de är helt flygga, medan hanarna väntar med att flytta tills ungarna är flygga.

Totalt har ringmärkningen av roskarl vid Ottenby resulterat i 44 återfynd. Såväl höst- som vårsträcket är starkt koncentrerat till Atlantkusten. Ett höstfynd från Sicilien, Italien, kan indikera att ett fåtal väljer att flytta över kontinentala Europa. De tre rena vinterfynden som gjorts härstammar från västra Afrika. Vart roskarlarna som fångas vid Ottenby häckar är delvis oklart, men troligen kommer de flesta från Skandinavien och arktiska Ryssland.