Stop-over strategy of Ruff *Philomachus pugnax* during the spring migration

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During eight spring migratory seasons Ruffs *Philomachus pugnax* were caught, ringed and dyed in Italy in order to assess the rôle of the first staging areas reached after non-stop flights from winter quarters. Controls and resightings suggested that the next stopover sites were not as far away as the theoretical range obtained from mean body mass at ringing sites, and provided evidence of a site-dependent refuelling strategy before departure.

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Во время восьми весенних миграционных сезонов в Италии были отловлены, окольцованы и окрашены турухтаны *Philomachus pugnax* с целью оценки роли первых достигнутых мест остановок после беспосадочных полетов из районов зимовки. Вторичные поимки и встречи навели на мысль о том, что следующие места остановок не так далеки, как это было теоретически предсказано, используя среднюю массу тела в местах кольцевания птиц, и привели доказательства теории стратегии дозаправки, зависящей от мест остановок перед отлетом.

Introduction

The Ruff *Philomachus pugnax* is one of the commonest and most abundant wader in Italian wetlands during the spring migration (*e.g.* OAG Münster 1989; Serra *et al.* 1990; Serra & Baccetti 1991). At least a proportion of the birds seem to follow a route related to the East Atlantic flyway, although two points should be noted: i) the overall picture may not concern the Atlantic in particular, being more shifted to the east, ii) the East Atlantic flyway has been identified for coastal species, and the Ruff does not strictly depend on coasts (*c.f.* Piersma *et al.* 1987; Smit & Piersma 1989). Flyways crossing or touching the Mediterranean basin (Smit & Piersma 1989; Kube *et al.* 1998), as well as the use of the flyway concept for non-coastal waders are, on the other hand, subjects urgently deserving further detailed studies and also discussion at a more general level.

Nevertheless, the spring movements of the Ruff across the central Mediterranean seem to indicate the existence of a well-defined flyway: large concentrations are formed every year at particular refuelling sites and recurrence of the same individuals in different years is beginning to be apparent. There are also other spring migrants (*e.g.* Black-tailed Godwit *Limosa limosa*, Spotted Redshank *Tringa erythropus*, *etc.*) showing a similar strategy in the choice and exploitation of staging sites.

Data from over 1,200 Ruff caught in spring at six Italian sites, during our eight-year long ringing activity, are now available and they allow some conclusions to be drawn on the most usual staging

patterns. Besides this, counts were made on a more or less regular basis at other sites, allowing a national overview to be attempted (Serra & Baccetti 1991). The main aims of our analysis were to define: i) the areas visited by Ruff immediately after their long non-stop flights from sub-Saharan Africa, ii) the use the birds make of these areas *i.e.* whether they remain there for some time, or immediately go further on, and iii) their strategy after leaving their stop-over sites.

Methods and Study Area

Regular catches were carried out every five days at three sites along the Tyrrhenian and Adriatic coasts of the Italian Peninsula. From south to north these were; San Rossore coastal marshlands on the Arno estuary; Cervia saltpans near Ravenna and Zavelea marsh on the edge of Comacchio Lagoon. A more precise habitat description of these sites is available in Grimmet & Jones (1989). Figure 1 shows the location of our regular ringing sites as well as those we visited irregularly, and the maximum daily counts obtained through spring surveys at this and other wetlands during the last ten years. All the birds ringed at our main sites were measured and usually dye-marked, according to standard techniques (Serra & Baccetti 1991). Only biometric data from the main sites and adult males are considered here. Mist-netting went on for some hours after sunset, usually close to known night-roosts; tape-lures were used. In some cases (Cervia, most often), the absence of roosts in the area could be confirmed as a result of these activities. Ringing was carried out between 20 February and 15 April. Yearly totals at each site are shown in Table 1. In one year, each catching site where colour-marking had occurred, together with the nearest feeding sites were visited at regular intervals, specifically to look for dyed birds.

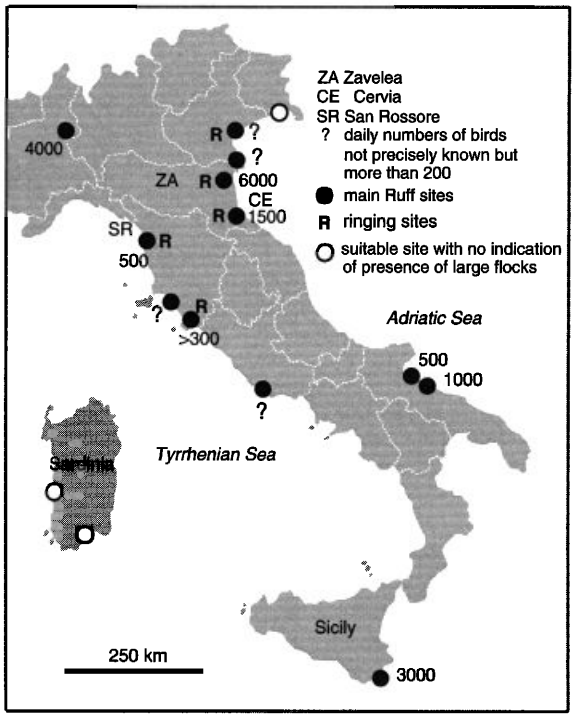

Figure 1. Map of sites mentioned in the text. Maximum counts are shown.

Results

Body mass analysis

Trapping allowed information to be collected on body condition and thus, indirectly, to investigate the stop-over strategy. In spring, we never retrapped any Ruffs ringed locally in the same season, therefore we necessarily had to use only the mean or maximum/minimum body mass values in the analysis.

The results show marked differences in the mean body masses at different sites, and in some cases, also in means from different years at the same site. Differences among five-day periods, within the same year and site (*e.g.* body mass increases), were usually masked by the quick turnover of birds, keeping means rather stable throughout a long period (Serra *et al.* 1990). At our most important site, Zavelea, mean body mass by five-day periods is shown in Figure 2, where different years can be visually compared. A positive correlation ($r = 0.4$, $p < 0.0001$) with time was found only in 1992, when values from the seasonal limits of the migratory period were also available: then, only lean birds were caught very early in the season, and only fat ones very late. Even in this case, however, the r-squared value is not very high (0.13) due to high turnover during the central period (*i.e.* the one investigated in all previous years). Spring 1989 (Figure 2) is clearly atypical, due to unfavourable habitat conditions at the roosting site (*c.f.* Serra *et al.* 1990).

Table 1. Annual ringing totals (20 February - 15 April) at the main catching sites.

Zavelea	151	-	-	154	43	-	256	189
Cervia	-	-	-	-	-	66	74	1
San Rossore	-	-	-	-	-	84	22	55
Other Sites	-	25	39	-	-	2	10	52
Total	151	25	39	154	43	152	362	297

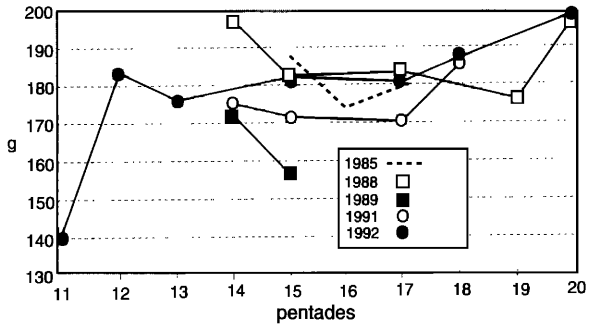

Figure 2. Variation of mean body mass of adult male Ruffs caught at the Zavelea roost during five spring seasons. Pentade 11 = 20-24 February; Pentade 20 = 6-10 April.

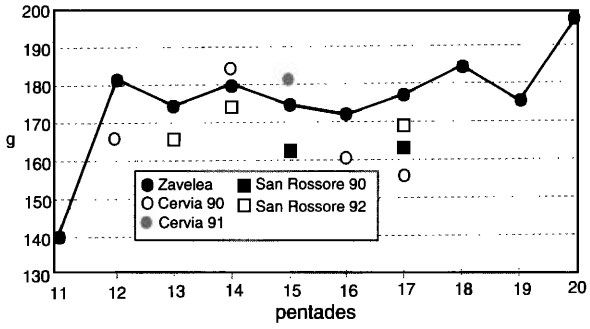

Figure 3. Body mass of adult male Ruffs at Zavelea roost (same springs as in Figure. 2, mean of means) and at other regular catching sites (all sample means are shown separately). Pentades numbered as in Figure 2.

Considering the other ringing sites, it seems that mean body masses both at Cervia and San Rossore are usually lower than in corresponding periods at Zavelea (Figure 3). This fact even seems to be reflected in the seasonal means, which in several cases are also significantly lower than at Zavelea (Tables 2 & 3). Since a particular sex/age class could not be regularly sampled at Cervia and San Rossore throughout a continuous series of five-day periods, a closer within-year comparison of the sites has so far been impossible.

Table 2. Mean body mass, standard deviation, range and sample size of adult male Ruffs from the main sites.

YEAR	SITE Zavelea	Cervia	San Rossore
1985	182.8±20.5 142-234 (71)		
1988	185.7±18.9 133-223 (56)		
1989	168.8±14.6 138-208 (33)		
1990		163.9±17.4 127-198 (39)	163.8±16.9 136-197 (45)
1991	174.9±13.7 136-207 (146)	179.3±17.6 152-220 (19)	
1992	180.3±16.8 135.5-225 (123)		173.1±17.5 138-205 (41)

Local resightings of dyed birds

Resightings could be made at both sites where roosts regularly formed, *i.e.* Zavelea and San Rossore, which were checked in 1988 and 1990 respectively. At Cervia, which was checked in 1990, no resightings were ever made. The maximum lengths of stay observed in this way were of at least 23 days at Zavelea and 13 days at San Rossore. These both seem to correspond well with the respective differences between minimum and maximum body mass values observed in the same year and site: 90 g (133 -223 g) at Zavelea, 61 g (136 - 197 g) at San Rossore, which might be gained by a male Ruff in 18 and 12 days respectively at a theoretical rate of 5 g/day (*c.f.* Davidson 1984).

Observations of dyed birds on feeding grounds close to the Zavelea roost allowed the identification of the areas used and the distances covered daily during the staging period (Serra *et al.* 1990).

Table 3. Results (p values) of statistical comparisons (t test) of body mass among seasonal samples of adult male Ruffs.

Site:	Zavelea					Cervia		San Rossore	
Year:	1985	1988	1989	1991	1992	1990	1991	1990	1992
1985	-	NS	.001	.001	NS	.001	NS	.001	.01
1988		-	.001	.001	NS	.001	NS	.001	.001
1989			-	.03	.001	NS	.03	NS	NS
1991				-	NS	.001	NS	.001	NS
1992					-	001	NS	.001	.02
1990						-	.003	NS	.02
1991							-	.002	NS
1990								-	.02
1992									-

Other resightings and direct recoveries

So far there have only been three recoveries abroad of our ringed Ruffs: from the Netherlands, Czechoslovakia and Murmansk region in Russia. There have been two controls of foreign-ringed birds (from Poland and Czechoslovakia, both birds ringed in the autumn). The recovery rates seem therefore even lower than those of many passerine birds, which might indicate that our migrating populations are not much studied elsewhere, or at least not with a constant effort.

Resightings of dyed birds were of course more numerous. Table 4 gives an overview of the results we have obtained so far (ten birds from five countries); it also includes two of the above mentioned recoveries, as they were recorded during the same season of ringing. The total number of dyed birds which the reports could refer to is approximately 600, including 213 birds marked in the springs of 1985 and 1986 at another site in the Po Plain (Forcellini 1989) but excluding all the birds we marked with dyes other than Picric and Rhodamin B, *i.e.* all of the 1991, and most of the 1989 and 1990 birds (Table 1). Only Ruffs dyed as above were actually resighted, other dyes used being much shorter-lasting and, we consider, totally useless. The resighting rate does not significantly differ (chi-squared) from that of birds dyed in Senegal, when there were 51 sightings out of 1,988 birds (OAG Münster 1989).

Some 1990 sightings were excluded from Table 4, two from Austria and one not far from the Italo-Slovenian border. These were birds which, from photos or complete descriptions, seemed to belong to those dyed in Tunisia, despite the very small number that were dyed there (van den Berk & van der Have 1990), rather than to those dyed in Italy (but see also the last note in Table 4). However, it is possible that the birds had been able to spread the dye on different body areas.

Local controls in different years

Although we never retrapped a bird from previous years at its exact ringing site, probably because the overall number of staging birds is very large, we had two controls which indicate at least some fidelity to the spring migratory route. These were ringed one and three years before, at distances of 62 km and 168 km from the control sites, along the same sea coast. A lot of such controls have also been made in the past by other ringers (*e.g.* Caterini 1967).

Discussion

The local differences we observed stress the importance of the link between the presence of a roost and the body mass of trapped birds. Ruffs which are already exploiting a site for refuelling are most likely to be found at night at their roost, where they can be captured. On wetlands where no roosts are formed and the birds move elsewhere at dusk after having been feeding there during the day, individuals trapped at night are usually lean birds, possibly migrants which have just landed or birds which for some reason did not leave the feeding sites to roost together with the rest of the flock at the usual time.

Ideal refuelling areas, with large roosts formed by birds at every stage of fattening, actually seem to be very few. The size of a roost is apparently proportional to the observed stop-over duration, and indicates the suitability of a given area for refuelling: sites with small roosts, or with roosts composed of a single body mass category of birds,

Table 4. Re-sightings of Ruffs marked in Italy with Picric or Rhodamin B. Distances given are those between sighting area and northernmost ringing site.

Year	No. dyed birds	Ringing site	Distance (km)	Finding coordinates	District	Country	Month
1985	307*	?	876	48°40'N 22°05'E	Michalovce	Czechoslovakia	May
1985	307*	?	940	52°13'N 17°54'E	Poznan	Poland	April
1985	307*	?	1,034	52°59'N 05°43'E	Friesland	Netherlands	April
1985	307*	Zavelea	1,037	53°06'N 06°00'E	Friesland	Netherlands	March
1985	- **	Zavelea	1,038	52°59'N 05°25'E	Friesland	Netherlands	April
1985	- **	Zavelea	2,916	67°18'N 37°03'E	Murmansk	Russia	before August
1986	82*	?	936	52°10'N 17°54'E	Poznan	Poland	April
1986	82*	?	975	52°15'N 05°27'E	Utrecht	Netherlands	March
1989	31***	Zavelea	876	48°40'N 22°05'E	Michalovce	Czechoslovakia	March
1990	84****	San Rossore	779	47°36'N 21°18'E	Hajdu	Hungary	April
1992	100	?	763	47°37'N 21°06'E	Hajdu	Hungary	May
1992	100	Zavelea	877	48°40'N 22°02'E	Michalovce	Czechoslovakia	March

*including 156 birds marked in April-May at another site in the Po Plain in 1985 and 57 in 1986 (*c.f.* Forcellini 1989);
**ringing recovery; for the Murmansk bird, date is unknown, letter arrived 15.9.85;
***same colour used in Israel, on a single bird marked before 31.3;
****same colour used in Tunisia, on seven birds (Tunisia: all underparts; Italy: in front of the legs).

either lean or fat, often indicate that local conditions are sub-optimal and the roost itself will not last very long. Such a picture seems fully confirmed by our local resightings of dyed birds. These remarks have some practical importance for site management, as they allow the rôle played by different wetlands to be defined and then used for the implementation of the most urgent conservation measures.

It should be noted that the minimum body masses, which were much lower than theoretical lean values, were similar at all ringing sites, suggesting that freshly-landed migrants can be found at sites located on both Italian coasts (*i.e.* south or north of the Apennine chain), while birds with premigratory body mass values regularly occur only at the most favourable site (*i.e.* Zavelea).

The distribution of foreign sightings is probably affected by that of potential observers, with a possible over-estimation of the importance of the Netherlands. The median distance of sightings and direct recoveries from our most northerly ringing site (Zavelea) is 938 km. This value does not change if Murmansk is excluded. Such a distance could be covered by male Ruffs carrying a reserve load of only 15-18 g above their lean mass (151 g, Koopman 1986). This fact would imply that all our samples show a mean mass which would allow longer flights. But it has to be kept in mind that at destinations further than 1,000 km away, on the route that many birds are expected to follow, the chances of birds being observed decrease dramatically, so that it is extremely hard to identify the true average distances covered with non-stop flights by birds which have refuelled in northern Italy.

The Dutch control/sightings indicate once more the critical distinction between the East Atlantic flyway and more easterly routes. There is no doubt that Ruffs leaving Senegalese wetlands, staging in Italy (as confirmed by many sightings, OAG Münster 1989) and then reaching the Netherlands and northern Europe, are still on, or near, the westernmost route of the Palearctic-African system, *i.e.* on the equivalent of the East Atlantic flyway of coastal waders. As a consequence, it might be expected that our birds resighted abroad just belong to populations which are not heading very far away, though it is difficult to explain the absence of data from Senegal-dyed birds visiting eastern Europe after refuelling at Mediterranean latitudes. Birds which originate from wintering grounds other than the westernmost African countries (*e.g.* Senegal) may belong to more easterly flyways. Once in the Mediterranean they may gain more fuel, resulting in the higher mean body masses observed and overfly the countries where dyed birds are likely to be detected.

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