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Anschrift des Verfassers: Biologische Station, Rieselfelder, 4400 Münster.

Die Vogelwarte 28, 1976: 293–297

Recurrence of waders on autumn migration at sites in Morocco

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1. Introduction

Return of individuals of many bird species to the same breeding area has been well established, some examples among waders in Europe and North America being listed by SOIKKELI (1967). Recent studies in Africa, reviewed by MOREAU (1969, 1972), have shown that recurrence in winter quarters also occurs commonly, at least in passerines and waders. Further examples are given by EVANS (1966) for waders wintering in north-east England, by NICKEL (1968) for passerines in America and by McCLURE (1974) for birds in South-east Asia, and recurrence in some species of wildfowl is well known (e.g. Bewick's Swans *Cygnus columbianus* - SCOTT et al. 1972).

MOREAU (1972) queried whether birds remained faithful to sites on their migration routes, and also identified problems concerned with itinerancy: do individuals which spend parts of the non-breeding season in a series of different regions remain faithful to particular sites in each of these regions? This question is particularly relevant to wetland birds since their potential feeding sites may be separated by considerable distances, and not necessarily suitable in every year.

NØRREVANG (1959) gave records of individuals of several wader species recaptured on autumn migration in several years at the sites where first ringed in the Baltic region. Recurrences of passerines and other land birds at migration sites in Tunisia after up to two years, and particularly in spring after the trans-Saharan flight, have been reported by CASTAN (in MOREAU 1961), and McCLURE (1974) provides a few further examples of recurrence at migration sites, particularly among waders and the House or Barn Swallow *Hirundo rustica*.

While these studies demonstrate at least some degree of fidelity to particular migration routes, they do not indicate whether or not some sites on the route are favoured more than others by individual birds. In wintering areas, such preference for particular sites has been demonstrated for waders at The Wash, England, where birds of some species tend to return to the same sides of the estuary from year to year (MINTON 1975), and for various other birds, particularly Barn Swallows, in South-east Asia (MEDWAY 1973, McCLURE 1974).

The present paper presents evidence that individuals of several species of waders return to previously visited migration and moulting sites in Morocco, and that these sites may be visited by particular individuals more than some other sites within the same migration route.

¹⁾ Publication No. 12 of the University of East Anglia Expeditions to Morocco 1971–72.

2. Methods

Between mid-August and late September 1971, about 1000 waders of various species were caught and ringed at Sidi Moussa (33.00 N, 08.44 W), near El Jadida, on the Atlantic coast of Morocco. Over a similar period in 1972, simultaneous visits were made to Sidi Moussa (end July to mid-September) and to Puerto Cansado (28.02 N, 12.15 W) in Tarfaya Province, Morocco, ca. 650 km S.W. of Sidi Moussa (mid-August to mid-September). The numbers of birds caught and of retraps are given in table 1, which also includes data resulting from a further visit made to Sidi Moussa from early August to early September 1973.

These data allow the comparison of return rates to Sidi Moussa of two species of waders, the Dunlin *Calidris alpina* and the Curlew Sandpiper *C. ferruginea*, with rates of exchange between Sidi Moussa and Puerto Cansado (tables 1 & 2). For practical reasons, we were unable to revisit Puerto Cansado in 1973, so calculation of return rates there is not possible. The two study sites, together with Merja Zerga (34.50 N, 06.18 W), ca. 350 km N.E. of Sidi Moussa, are the three most important for waders on the Moroccan coast, but a number of smaller wetlands are also situated along this coast (see PIENKOWSKI 1975, PIENKOWSKI & KNIGHT 1976).

MOREAU's (1972) „recurrence rate“ has been included in table 1 to allow comparison with his data. However, while this index is useful in showing the high incidence of recurrence, it cannot be used for direct comparisons, as it does not allow for differences in catching intensity in different years, nor for the number of years for which observations continue. Therefore, also in table 1, comparisons for pairs of years are considered separately and an index calculated of number of retraps per 100 birds ringed in year 1 at site 1 per 100 birds caught in year 2 at site 2. As with „recurrence rates“, this method still suffers the disadvantage that the larger the population occurring at a particular site, the smaller the apparent return rate for given numbers of birds caught. In the present case, this problem may not be serious, as Sidi Moussa and Puerto Cansado are sites of fairly similar size (ca. 30 km²) and held numbers of waders of the same order (ca. 20,000) during the periods of study (PIENKOWSKI & KNIGHT 1974, PIENKOWSKI 1975).

3. Recurrence at Sidi Moussa

With the exception of the Kentish Plover *Charadrius alexandrinus*, the species in table 1 breed in temperate or arctic regions and migrate to Morocco where many individuals moult. Most Redshanks *Tringa totanus*, Dunlins and probably Ringed Plovers *Charadrius hiaticula*, and nearly all Little Stints *Calidris minuta* and Curlew Sandpipers subsequently move on to winter further south in West Africa (PIENKOWSKI 1975). Elsewhere, evidence has been presented to suggest that Dunlins and Redshanks migrate, in active wing-moult, along the north-west African coast, probably in relatively short flights between suitable areas and probably do not remain long at any one site (PIENKOWSKI & DICK 1975, PIENKOWSKI et al. 1976).

Despite the problems referred to above, the recurrence rates of migrant waders in autumn in Morocco over 3 years are comparable to those in winter in Kenya over 4 years. In the latter area, the overall recurrence rate was 1.6%, with most specific figures ranging from 0.6% to 9.5% (MOREAU 1972).

The inclusion in table 1 of Kentish Plovers, which breed and are partly resident at Sidi Moussa (PIENKOWSKI 1975), gives a further baseline for comparison with the return rates of migrant birds. While the values for migrants are much lower than those for Kentish Plovers, it must be remembered that most migrants were probably present and available for catching on a few days each year while partial residents may have been present throughout the catching periods. Furthermore, the catching periods did not cover the whole of the migration and moult period, so that some individuals would not have been available for sampling. It is likely that individuals of wader species breeding in northern latitudes differ in their timing of migration from year to year due to the variability of weather conditions on the breeding grounds and the high egg predation rate, both factors leading to great variation in dates of departure from the breeding grounds (e. g. SOIKKELI 1967, PARMELEE 1970, PIENKOWSKI & GREEN 1976). Adult waders at Sidi Moussa showed con-

Table 1. Return rates in subsequent autumns of waders ringed in autumn in Morocco.

	<i>Charadrius hiaticula</i>	<i>Charadrius alexandrinus</i>	<i>Tringa totanus</i>	<i>Calidris minuta</i>	<i>Calidris alpina</i>	<i>Calidris ferruginea</i>
(i) Retrap rates per 100 birds ringed in year & site a per 100 birds caught in year & site b						
¹⁾ SM 71 – SM 72	²⁾ 3(141/83)2.56	4(49/75)10.88	8(169/100)4.73	0(75/104)0	6(345/444)0.39	0(12/280)0
SM 72 – SM 73	0(83/28)0	5(75/47)14.18	3(100/154)1.95	3(104/157)1.84	5(444/249)0.45	2(280/91)0.78
SM 71 – SM 73	0(141/28)0	0(49/47)0	6(169/154)2.31	0(75/157)0	1(345/249)0.12	0(12/91)0
SM 71 – PC 72	³⁾ –	–	–	–	0(345/352)0	0(12/99)0
PC 72 – SM 73	–	–	–	–	0(352/249)0	0(99/91)0
(ii) Recurrence percentages (after MOREAU 1972)						
SM 71	⁴⁾ 3(2.1)	4(7.3)	13(7.4)	0	7(1.9)	0
SM 72	0	5(5.9)	3(2.9)	3(2.8)	5(1.1)	2(0.7)

Notes: ¹⁾ SM = Sidi Moussa, PC = Puerto Cansado. Figures indicate years.²⁾ Retrap rates given as number of recorded movements from site & year a to site & year b [x] (number of different individuals ringed at site & year a [y]/ number of different individuals caught at site & year b [z]) retrap rate = x/ [y x z].³⁾ Dashes indicate species where catch totals at Puerto Cansado were too low to allow comparison.⁴⁾ Recurrence percentages (given in parentheses) are calculated as number of birds recaptured at least once in subsequent years, divided by the number originally ringed in the year under consideration. Actual number of retrapped birds given before parentheses.Table 2. Comparison of number of Dunlins *Calidris alpina* ringed in 1971 at Sidi Moussa and retrapped in 1972 at Puerto Cansado plus those ringed at Puerto Cansado in 1972 and retrapped at Sidi Moussa in 1973, with retraps at Sidi Moussa in the same two periods.

	Sidi Moussa in 1972	Puerto Cansado in 1972
a) number caught in 1972 at:	444	352
b) ringed at Sidi Moussa in 1971 and retrapped at:	6	0
c) retrapped at Sidi Moussa in 1973, having been ringed at:	5	0
observed retraps (sum of (b) & (c))	11	0
expected retraps on the null hypothesis (in the ratio of catch totals: line (a))	6.14	4.86

 $\chi^2 = 8.71$, with 1 degree of freedom; $P < 0.01$.

siderable variation in migration timing, with up to 48 days difference in dates of capture in different years. Also, adults of many wader species tend to migrate earlier than do juveniles (e. g. PIENKOWSKI & KNIGHT 1976).

The lack of recaptures of Kentish Plovers after two years is difficult to account for, but two possibilities can be mentioned. Firstly, this partly resident species could retain some territorial tendencies in the early autumn such that slight changes in position of the netting sites might result in a tendency for different individuals to be caught. Secondly, the presence of this species throughout the year in a highly saline, sandy area could result in a high percentage of ring loss, due to abrasion and corrosion. The rings on several birds of other species were seen to be badly worn after two years, and those on two Redshanks in 1973 could not be fully read but had almost certainly been placed on the birds two years earlier.

4. Site fidelity

For two species, Dunlin and Curlew Sandpiper, the numbers of birds caught at Sidi Moussa and Puerto Cansado allow a comparison of exchange rates with retrap rates at Sidi Moussa. In fact, there were no exchanges of ringed birds between Sidi Moussa and Puerto Cansado, compared with 12 returns of Dunlins and 2 of Curlew Sandpipers at Sidi Moussa. A comparison of exchanges between the two sites and retraps at Sidi Moussa is made for Dunlins in Table 2. The null hypothesis that the likelihood of occurrence in the subsequent year at the non-ringing site was the same as of the recurrence at Sidi Moussa was discounted ($\chi^2 = 8.71$, $P < 0.01$). The lack of exchanges of Dunlins between the two sites is surprising in view of the suggested tendency of this species to migrate in short flights along the coast. It seems that, despite this, individual birds tend to visit some sites and not others, or at least spend more time at such favoured sites. Presumably, once a juvenile Dunlin has found some suitable sites on its migration route, it will tend to utilize these sites, rather than others, in subsequent years if the sites remain suitable.

It is, of course, possible that birds pass through Puerto Cansado considerably later than through Sidi Moussa, in which case catches at the same date might favour recaptures at Sidi Moussa rather than exchanges between sites. However, as indicated above, individuals may differ by well over a month in timing of migration in different years, so that the possibility of this bias may be small.

The sample size for Curlew Sandpipers was too small to allow significance testing, but the pattern conforms with that of Dunlin.

Acknowledgements This paper is the result of work by the University of East Anglia Expedition to Morocco 1971, the U.E.A. Expedition to Tarfaya Province, Morocco 1972, the Cambridge Sidi Moussa Expedition 1972, and the Oaklands Sidi Moussa Expedition 1973. I am grateful to D. J. STANYARD and F. B. ARGYLE who led the latter two expeditions, and to all the expedition members. Financial and other supporters are acknowledged in the expedition reports (PIENKOWSKI 1972, 1975). Cannon-netting equipment was loaned by the Wash Wader Ringing Group, and its leader, Dr. C. D. T. MINTON, gave valuable advice. It is a pleasure to acknowledge the co-operation of the Moroccan Administration des Eaux et Forêts, and the Institut Scientifique Chérifien, Rabat, particularly B. ELKAÏM and M. THÉVENOT. For helpful comments on earlier drafts of this paper, I thank Dr. P. R. EVANS, G. H. GREEN, P. J. KNIGHT and Mrs. A. E. PIENKOWSKI.

5. Summary

Waders of several species were caught and ringed during autumn migration and moult on the Atlantic coast of Morocco, at Sidi Moussa in 1971, 1972 and 1973 and at Puerto Cansado in 1972. Methods of calculating return rates are discussed briefly.

Most migrant species showed fairly high return rates to Sidi Moussa in subsequent years and these rates are compared with that of a partly resident species at Sidi Moussa, and with published rates at a wintering site in East Africa. Individual waders showed considerable differences in timing of migration in Morocco in different years.

Dunlins and Curlew Sandpipers were caught in considerable numbers at both Sidi Moussa and Puerto Cansado, but no exchanges of ringed birds between the two sites were recorded. Dunlins were significantly more likely to return to Sidi Moussa during migration in subsequent years than to occur at the non-ringing site.

6. Zusammenfassung

Über die Rückkehr von Watvögeln während des Herbstzuges an Rastplätze in Marokko

An der atlantischen Küste Marokkos wurden 1971, 1972 und 1973 bei Sidi Moussa und 1972 auch bei Puerto Cansado Watvögel verschiedener Arten zur Zeit ihres Herbstzuges und der Mauser gefangen und beringt. Die Berechnung und Deutung von Rückkehrraten wird kurz diskutiert.

Für die meisten der bei Sidi Moussa durchziehenden Watvogel-Arten ließ sich in den folgenden Jahren eine relativ hohe Rückkehrrate nachweisen. Die Ergebnisse werden verglichen mit den Befunden für eine bei Sidi Moussa zum Teil als Standvogel lebende Art und mit publizierten Rückkehrdaten, die an einem ostafrikanischen Überwinterungsplatz ermittelt sind. Die Zug durch Marokko lag in den verschiedenen Jahren für einzelne Watvogel-Individuen zeitlich recht unterschiedlich.

Alpenstrandläufer (*Calidris alpina*) und Sichelstrandläufer (*Calidris ferruginea*) wurden sowohl bei Sidi Moussa als auch bei Puerto Cansado in jeweils beträchtlichen Zahlen gefangen, doch konnte zwischen den beiden Plätzen kein Wechsel beringter Vögel festgestellt werden. Während des Herbstzuges in Sidi Moussa beringte Alpenstrandläufer kehrten in den folgenden Jahren gesichert häufiger dorthin zurück als zu der zweiten Beobachtungsstelle in Puerto Cansado.

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Zeitschrift/Journal: [Vogelwarte - Zeitschrift für Vogelkunde](#)

Jahr/Year: 1976

Band/Volume: [28_1976](#)

Autor(en)/Author(s): Pienkowski Michael W.

Artikel/Article: [Recurrence of waders on autumn migration at sites in Morocco 293-297](#)