

Migration pattern of Curlew Sandpipers *Calidris ferruginea* on the south-western coastline of the Iberian Peninsula

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In the Bay of Cádiz, in south-western Iberian Peninsula, counts of Curlew Sandpiper over a four-year period showed peaks of migration in August and April; few birds used this site as their nonbreeding area. Numbers on northward and southward passage were similar. On southward passage, adult arrival took place between end July and early August; most had departed before the end of this month. In contrast, juveniles arrived at the end of August and at the beginning of September; passage was complete during October. In 1988, a particularly strong passage of juveniles on southward migration, observed in central and northern Europe, was not noticeable in Cádiz Bay.

INTRODUCTION

The south-western coastline of the Iberian Peninsula is an important stopover site and nonbreeding area for many wader species (Rufino & Araujo 1987, Encarnaçao 1992, 1995, Velasco & Alberto 1993, Hortas 1997a,b, Hortas & Pérez-Hurtado 1998). For the Curlew Sandpiper *Calidris ferruginea*, the available information on migration patterns for this area is limited and scattered (but see Wilson *et al.* 1980).

January counts carried out in coastal areas of the south-western Iberian Peninsula demonstrate that small numbers of

Curlew Sandpipers *Calidris ferruginea* spend the non-breeding season here (Rubio 1985, Rufino & Araujo 1987, Dominguez & Rabuñal 1989, Encarnaçao 1992, 1995, Pérez-Hurtado *et al.* 1993, Velasco & Alberto 1993, Pérez-Hurtado & Hortas 1994, Diaz *et al.* 1996, Garrido 1996). Less attention has been paid to the periods of migration, both northwards and southwards; in particular, little is known about the differences between juveniles and adults, and between males and females during these periods (Lorenzo & Rabuñal 1993, Hortas 1997a). Piersma (1987) considered that Curlew Sandpipers use a “jumper” strategy on migration, covering large distances between a small number of staging areas. There are differences in stopover patterns between males and females (Adams 1995, Figuerola & Bertolero 1996, 1998).

The objective of this study was to describe the migration pattern of this species in the south-western Iberian Peninsula, with special reference to southward migration and differences between timing migration of adults and juveniles.

METHODS

Our study site was an industrial saltpan (400 ha) and adjacent mudflats (28 ha) situated in Cádiz Bay (south-western Spain) (Fig. 1). We counted Curlew Sandpipers at irregular intervals over four consecutive years, making 103 counts between December 1985 and January 1990. The counts were carried out from two hours before until two hours after low tide, and also at high tide. The aim was to reduce the variations related to the behaviour and activity cycles of the species (Reed *et al.* 1983). We avoided double-counting due to the displacement of birds between sectors (Tellería 1986, Koskimies & Poysa 1989). We grouped data at monthly intervals taking the highest value for each month. Frequent surveys were made during the period of southward passage between the end of July and the first of October during 1988 and 1989; 22 surveys were made in both years. In this period we counted juveniles and adults separately based on plumage characteristics (Hayman *et al.* 1986).

The counts made during southward migration were grouped into five-day intervals beginning 17 July (Tiedemann 1992, Figuerola & Martí 1994). To investigate variation in number

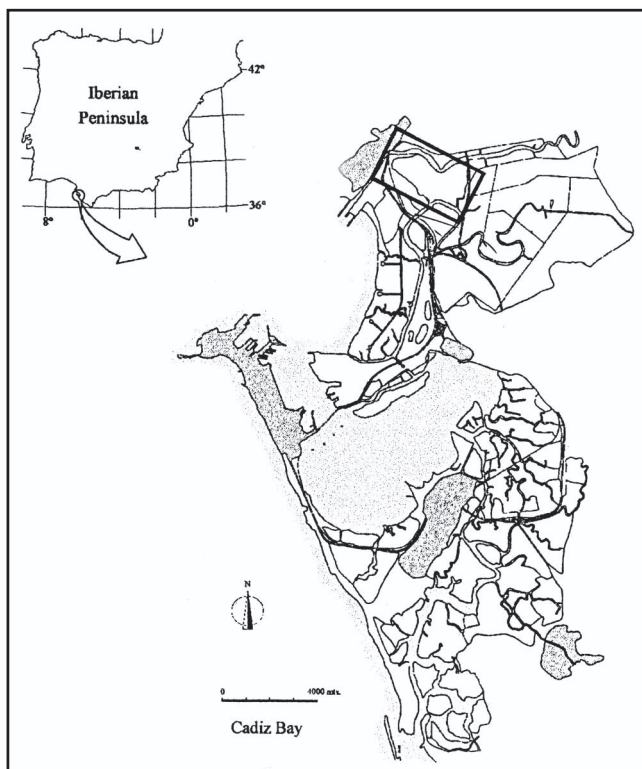


Fig. 1. Cádiz Bay and study area (in the rectangle).



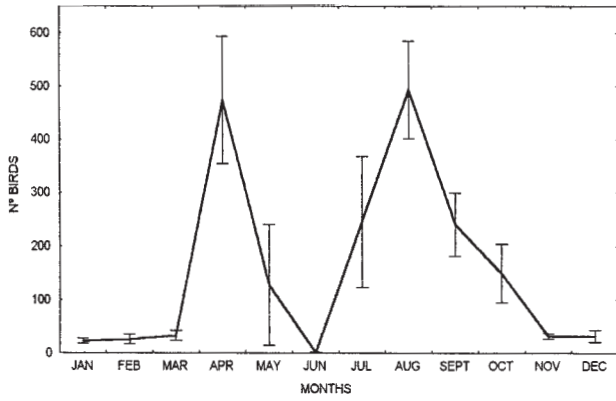


Fig. 2. Phenology of Curlew Sandpipers (mean and SD) in a saltpan and adjacent mudflats in the Bay of Cádiz between 1986 and 1989.

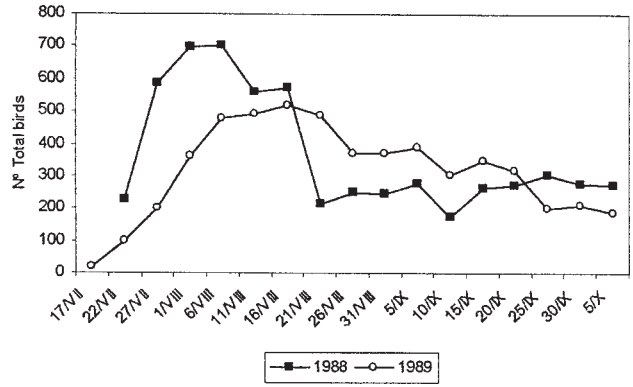


Fig. 3. Southward migration of Curlew Sandpiper in Cádiz Bay in 1988 and 1989.

and phenology between years, counts were grouped into 10-day periods beginning 22 July. This grouping enabled us to apply mixed model two-way ANOVA, where the year and period were considered as independent variables and the counts as dependent variable, with two censuses for each 10-day period. The periods were fixed for the analysis, since the purpose of the study was to establish the southward migration and the years were selected as random factors (Tiedemann 1992). Assuming that the data follow a Poisson distribution, they were transformed before the analysis by calculating the square root of the two census results in each 10-day period (Sokal & Rohlf 1979). Prior to transformation 0.5 was added to all observations, as in Tiedemann (1992). The counts, once transformed were approximately normally distributed (Zar 1984).

Southward migration

The total numbers of birds peaked during the first half of August (Fig. 3). Significant differences were not found with respect to number of birds between the periods ($F_{7,1} = 1.92$, $P = 0.2$) and years ($F_{7,1} = 1.08$, $P = 0.3$). However, the migration pattern was different between 1988 and 1989 ($F_{7,1} = 4.73$, $P = 0.005$).

Adult arrival varied between the last days of July and the beginning of August; most had departed before the end of this month. In contrast, juveniles arrived at the end of August and at the beginning of September and passage was completed during October (Figs 4a and 4b). There were significant differences in numbers of juveniles between years ($F_{7,1} = 10.5$, $P < 0.005$).

RESULTS

Annual migration pattern

In the Bay of Cádiz, there were peaks of migration in April and August with few birds remaining for the nonbreeding season (Table 1, Fig. 2). The numbers of Curlew Sandpipers observed during northward and southward passage were similar. Apart from two birds in June 1988, no birds were observed during the breeding season. Differences in total numbers between years were not significant (Kruskal-Wallis $H = 1.08$, $P = 0.78$).

Table 1. Maximum number of Curlew Sandpipers per month in a saltpan and adjacent mudflats in the Bay of Cádiz from 1986 to 1989.

	1986	1987	1988	1989
January	18	22	32	31
February	53	18	17	15
March	57	11	26	34
April	473	228	797	395
May	466	18	6	19
June	0	0	2	0
July	0	193	584	203
August	257	493	703	518
September	168	127	279	387
October	72	42	271	212
November	44	25	36	20
December	75	31	28	6

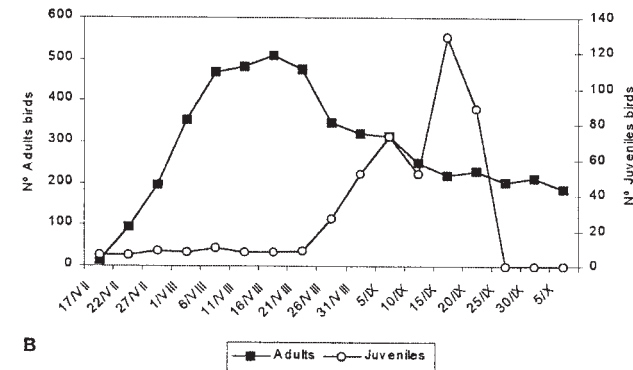
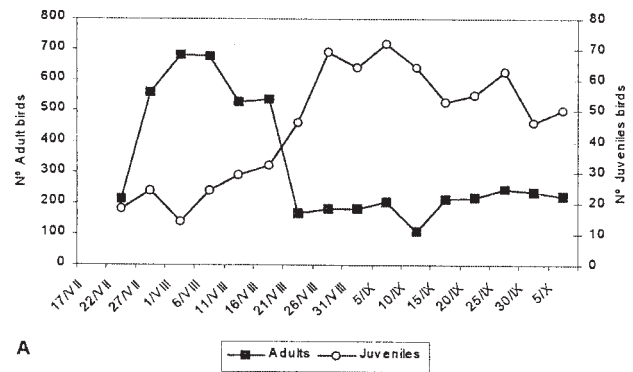


Fig. 4. Southward migration of adult and first-year Curlew Sandpiper in Cádiz Bay in 1988 (A) and 1989 (B).



DISCUSSION

Migration pattern

The migration pattern obtained in Cádiz Bay was similar to that at Odiel Marshes (Huelva) (Rubio 1985, Garrido 1996, Hortas 1997a,b) and at the wetlands of the Straits of Gibraltar; there were peaks at the end of April–May and in August–September (Pineau & Giraud-Audine 1979, Finlayson & Cortés 1987, GOES 1993). At other sections of the eastern coastline of the Iberian Peninsula, such as Ría Formosa (Portugal), there were peaks in March and September and few birds during the nonbreeding season (Encarnaçao 1992, 1995) (Fig. 6). These results confirm the pattern of migration in Europe described by Meltofte *et al.* (1994) and support the idea of Blomqvist & Lindström (1995) that small numbers of Curlew Sandpipers regularly migrate north along the European coast. An adult ringed in Cádiz Bay at the beginning of September 1993 and recovered in Oland (Sweden) the following year in mid July (Cantos & Gómez-Manzanaque 1996), shows that some birds migrate in both directions along the European coastline, as suggested by Blomqvist & Lindström (1995).

Southward migration patterns of juveniles and adults

Weather conditions during migration and breeding success on the tundra are the key factors explaining variations in numbers between years. The results here confirmed that most juveniles arrive later than the adults (Wilson *et al.* 1980,

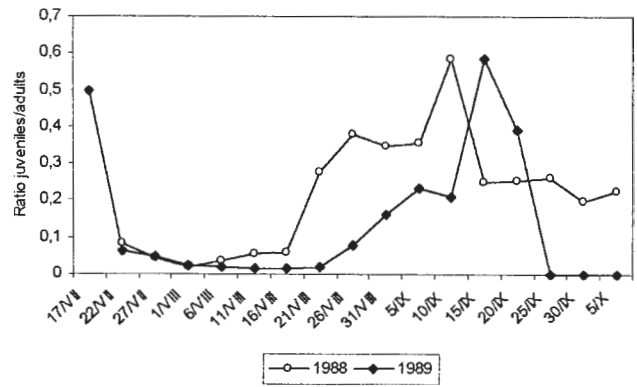


Fig. 5. Seasonal variations of Curlew Sandpipers along the south-eastern Iberian Peninsula. Data from Finlayson (1992) (Strait of Gibraltar); Hortas (1997a) (Cádiz Bay and Odiel Marshes); Encarnaçao (1992, 1995) (Ría Formosa).

Meltofte *et al.* 1994). The adults arrived at the beginning of August, decreasing towards the end of the month, when juveniles started to arrive. A similar pattern was observed at the Wash (Adams 1995). At the Ebro Delta in north-eastern Spain, juvenile passage starts in mid August and peaks at the beginning of September (Figuerola & Bertolero 1996). As at the Wash in England proportions of juveniles were greater in good breeding years (Adams 1995).

The results obtained by Lorenzo & Rabuñal (1993) in 1988 in Galicia, north-western Spain, and at Tenerife, Canary Islands, for juveniles, coincided with those of Cádiz Bay for this year. In 1988, a particularly strong passage of juveniles

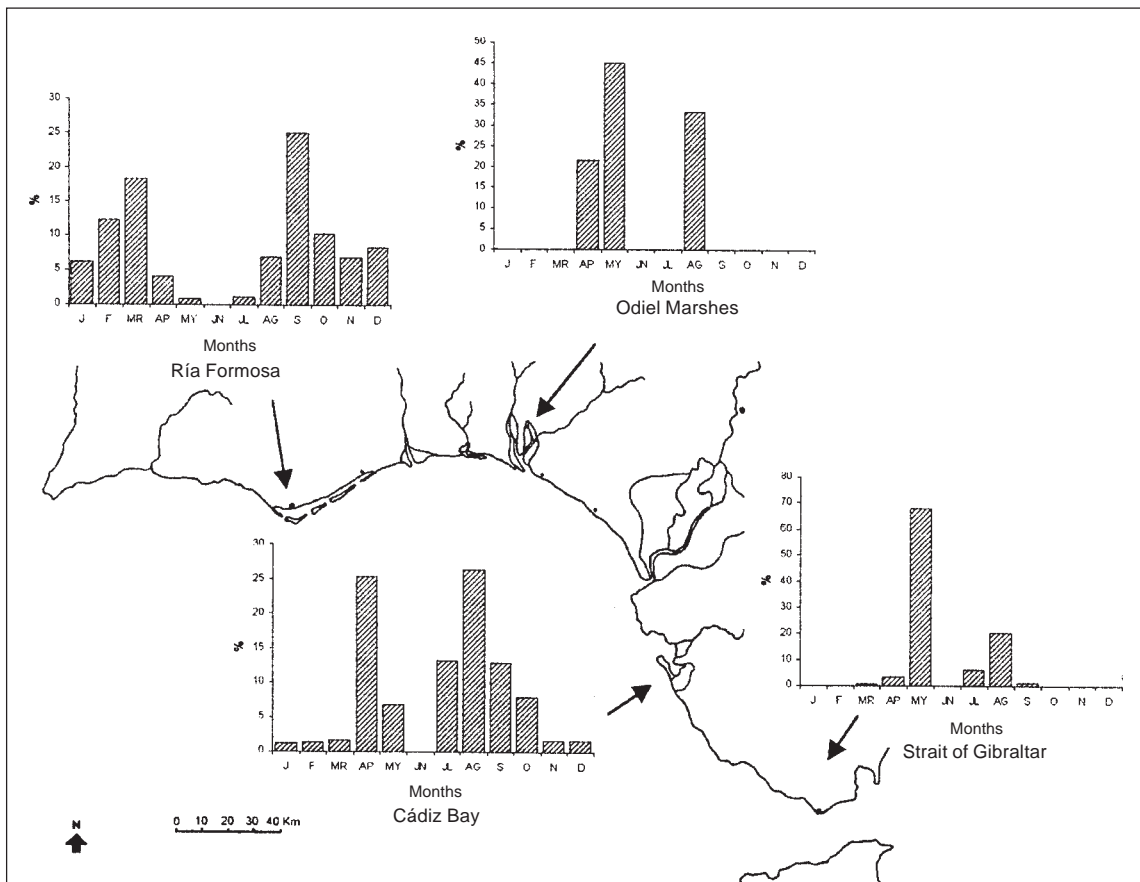


Fig. 6. Seasonal variations of Curlew Sandpipers on the south-Atlantic coast of the Iberian Peninsula. Data from Finlayson (1992) (Strait of Gibraltar), Hortas (1997a) (Cádiz Bay and Odiel Marshes) and Encarnaçao (1992, 1995) (Ría Formosa).



was observed in central and northern Europe (Kirby *et al.* 1989). This was not noticeable in Cádiz Bay, because the total number of Curlew Sandpipers on passage in 1989 was similar to that in 1988 (Figs 3 & 4). Furthermore, in 1989, there was a larger proportion of juveniles than in the previous year.

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