Differential departure of wintering adult and first-year Purple Sandpipers *Calidris maritima* from Helgoland (south-east North Sea)

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Differential timing of spring departure from a wintering site on the island of Helgoland (south-east North Sea) was found in adult and first-year Purple Sandpipers. In a colour-ringing study, most adults (n = 50) left the island between 11 April and 14 May (median date of last sighting 24 April), but the majority of first-year birds was last seen between 12 and 18 May (median date 15 May). As bill-length was independent of departure date, it would appear that differences related to sex or breeding origin did not occur. Although different spring migration strategies cannot be ruled out, it seems that the slightly poorer body condition of first-year birds is responsible for their delayed departure, with possible consequences in the breeding area (later breeding of first-year birds compared to adults).

INTRODUCTION

Arctic waders are known to have tight schedules during spring migration: a rapid accumulation of energy reserves is followed by a punctual departure from stopover or wintering sites such as the Wadden Sea or British estuaries (e.g. Pienkowski *et al.* 1979, Prokosch 1988, Piersma *et al.* 1994). In some wader species, first-year birds do not return to breeding areas and remain at the wintering site or linger at a wetland somewhere between main wintering and breeding ranges (Summers *et al.* 1995, Hockey *et al.* 1998). Purple Sandpipers differ in various respects from most other arctic waders: they spend the winter further north and mainly live in rocky intertidal habitats (Summers 1994). Over-summering of non-breeders in the wintering area does not occur (Becuwe 1973, Atkinson *et al.* 1981, Dierschke 1994, Hake *et al.* 1997). Moreover recently it was found that one-year-old birds breed in Iceland and Svalbard (Summers *et al.* 1988, Summers & Nicoll 2004).

Because an early arrival in the breeding area, including occupation of high-quality breeding territories is advantageous for (at least male) breeders (Hildén 1979, Myers 1981), at least some of the first-year birds (those starting to breed) and adults would be expected to depart from the wintering area at the same time in spring. Variation in departure times seems to be more likely with respect to breeding origin, because groups of Purple Sandpipers wintering in north-west Europe are known to comprise birds belonging to two or more breeding populations (Atkinson *et al.* 1981, Boere *et al.* 1984, Nicoll *et al.* 1988, Dierschke 1995, Hake *et al.* 1997). Therefore, as various breeding populations differ greatly in body size, which is particularly apparent from bill-length data (Boere *et al.* 1984, Summers 1994), size-related patterns of departure could occur (despite the strong sexual size dimorphism within populations, e.g. Nicoll *et al.* 1991). During a study on the wintering ecology of Purple Sandpipers on Helgoland (south-east North Sea) it was possible to investigate the time of departure of both adult and first-year birds with respect to their body size.

METHODS

On the island of Helgoland (1.5 km^2), 50 km off the German Wadden Sea coast in the North Sea (54°11'N, 07°55'E), 100–200 Purple Sandpipers winter in rocky intertidal habitats and on beaches (Dierschke 1993) and show high fidelity to this site from year to year (Dierschke 1998). In March 1990 and during the winter of 1990/91, a total 110 Purple Sandpipers were trapped with spring traps or torch lights (see Dierschke 1998 for details). According to plumage characteristics (Prater *et al.* 1977), birds were aged as adult (n = 70) or first-year (n = 40). All birds were measured (length of bill, total head, wing and tarsus–toe), weighed (to the nearest 0.5 g) and colour-marked individually with a combination of four colour-rings. Until late May, feeding sites and roosts of Purple Sandpipers were visited daily and birds were scanned for colour-ringed individuals. After the number of wintering birds (n = 150) had decreased by one third during a cold spell in February 1991, numbers remained constant during March (Dierschke 1998). Therefore, from March through May colour-ringed birds not resighted were treated as having departed on the day they were last observed.

RESULTS

Of those colour-ringed Purple Sandpipers which remained until March, adults departed between 24 March and 14 May, with most birds disappearing between 11 April and 14 May (Fig. 1; median date of last sighting: 24 April, 95 % C.I. 17 April to 28 April, n = 50). First-year birds disappeared between 4 March and 21 May, but mainly from 12 to 18 May (Fig. 1; median date of last sightings: 15 May, 95 % C.I. 12 to 18 May, n = 20). The departures of first-year Purple Sandpipers were significantly later than those of adults (Mann-Whitney U-test, $P < 0.01$).

There was no significant association between bill length and date of departure (Fig. 2). In a stepwise multiple regression of bill-length against age and departure date, age was included in the model ($t = 3.44$, $P = 0.001$), but departure date

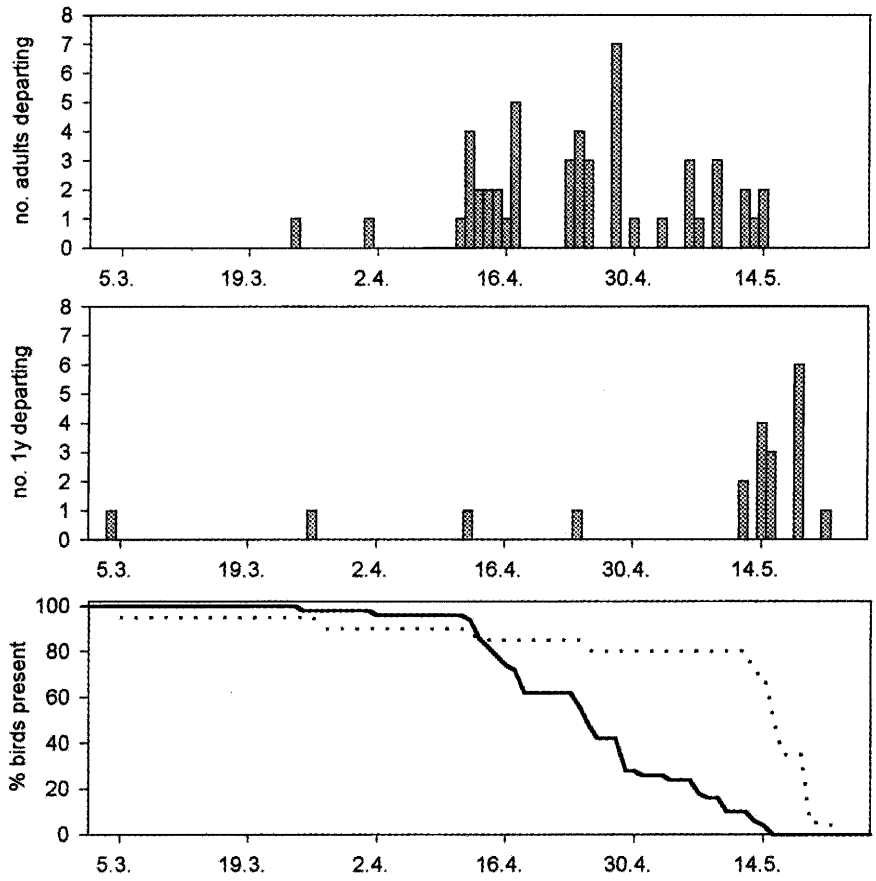

Fig. 1. Dates of last resightings of colour-ringed Purple Sandpipers on Helgoland in spring 1991 (top: adults; middle: first-year birds). Bottom: Percentages of adults (continuous line, n = 50) and first-year birds (dotted line, n = 20) still present.

was rejected (t = 1.20, P = 0.234). Thus, it seems that the sexes (males have shorter bills than females; Tatarinkova 1977, Boere *et al.* 1984, Nicoll *et al.* 1991) and birds of different breeding populations (there is much variation in bill-length among breeding populations; Boere *et al.* 1984, Summers 1994) do not differ in their date of departure from Helgoland.

DISCUSSION

Differences in times of snow melt and thus possible times of arrival in the arctic breeding areas of Purple Sandpipers wintering on Helgoland (northern Norway, probably north-east Canada, possibly northern Siberia and Svalbard; Dierschke 1995) suggest that population-specific departure times occur in this species as has been shown or suggested to occur in Red Knots *Calidris canutus*, Bar-tailed Godwits *Limosa lapponica* (Prokosch 1988) and Dunlins *Calidris alpina* (Goede *et al.* 1990). In view of the large scatter of bill-lengths compared with the dates of departure of individual Purple Sandpipers from Helgoland, neither the origin of a bird nor its sex seems to play an important role in the timing of its departure. A possible reason is that in some but not all cases Purple Sandpipers visit stopover sites for refuelling between departure and arrival on the breeding grounds. Such stopovers are confirmed by adult individuals colour-ringed on Helgoland and retrapped in the Orkney Islands on 7 May (Summers 1994) and resighted in Southern Norway on 14 April (V.D. unpubl. info.), respectively. From southern Sweden, stopovers of Purple Sandpipers on food-rich seaweed banks are reported to occur in spring (Hake *et al.* 1997).

Departures from Helgoland differ only with age, with first-year birds migrating significantly later than adults. Different migration strategies with respect to the use of the stopover sites (Gudmundsson *et al.* 1991) cannot be ruled out, because according to optimal migration theory (Alerstam & Lindström 1990), the priority of migration speed, energy expenditure during migration and safety from drift or predation may vary among age classes. However, it is more likely that the reason for later departures of young birds relates to body condition. In Norway and Scotland, adults are usually 2–3 g heavier than first-year birds during winter (Summers *et al.* 1990, 1992), and in Scotland a 2 g difference was also found in May (Summers *et al.* 1992). On Helgoland, there is a switch to habitats allowing high intake rates in May (Dierschke 1993), underlining the need to accumulate body reserves. Body mass differences mentioned above and findings about lower feeding efficiencies of first-year birds compared to adults in other wader species (reviewed by Hockey *et al.* 1998) suggest that lower feeding proficiencies during pre-migratory fattening delay the moment of departure in young birds. Whereas in long-distance migrants (e.g. South Africa to Siberia) such age differences select for remaining in the winter quarters instead of migrating towards the breeding area in first-year birds (Summers *et al.* 1995, Hockey *et al.* 1998), shorter distances between wintering and breeding sites allow young birds to visit the breeding area. As demonstrated in Purple Sandpipers, one-year old birds breed later than adults (Summers

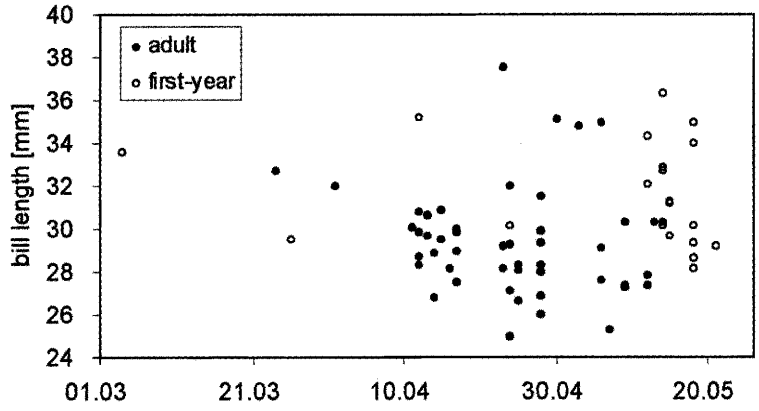

Fig. 2. Bill lengths and dates of last resighting of colour-ringed Purple Sandpipers on Helgoland in spring 1991 (adults: n = 50; first-year birds: n = 20).

& Nicoll 2004), perhaps due to later arrival in the breeding area. If not breeding, Purple Sandpipers (probably mainly young birds) may form flocks of non-breeders in the breeding area (Kozlova 1962). It remains to be shown that lower feeding efficiencies really cause delayed fuelling and departures in first-year Purple Sandpipers, and how this impacts on the proportion of first-year birds breeding.

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