Baltic Sea windflats as spring staging site for Dunlins *Calidris alpina*

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From March and April onwards, about 3,000–6,000 Dunlins *Calidris alpina* stage before spring migration in three windflats at the island of Hiddensee (German Baltic Sea coast). In the evening hours between 27 May and 3 June, most birds depart in flocks of 10–500 birds in a north–north–easterly direction. The late departure indicates that these birds belong to Siberian breeding populations. Due to the lack of ringing recoveries it is not known whether the spring staging Dunlins from the Baltic belong to populations wintering along the European Atlantic coast or in the western Mediterranean Sea.

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INTRODUCTION

Before taking off for their arctic or boreal breeding areas, several wader species concentrate in only a few staging areas. As they have to deposit large amounts of nutrients as fuel for long–distance flights, the availability of suitable feeding conditions is an important prerequisite. Such conditions are found in the Wadden Sea, which has been shown to be the most important spring staging area for a number of wader species living along the East Atlantic Flyway (Prokosch 1988, Meltofte *et al.* 1994). Within the Wadden Sea, Knots *Calidris canutus* move from western to eastern parts in late April, perhaps to shorten the distance of the flight to the Arctic (Piersma *et al.* 1994). Located a further 300 km closer to the breeding grounds are some large sandflats at the southern coast of the Baltic Sea. Despite quite high numbers of waders staging there during autumn migration (mainly juveniles), only a handful of species is present in significant numbers in spring (Kube & Struwe 1994). The absence of specialized feeders such as the Knot can be explained by the lack of an adequate food supply (Dierschke & Rippe 1997). However, many species of wader usually rely on ragworms *Nereis diversicolor*, which are abundant at the Baltic Sea sandflats (Dierschke *et al.* 1999b). One of the species that commonly feeds on ragworms is the Dunlin *Calidris alpina* (Dierschke *et al.* 1999a), virtually the only wader staging in high numbers at the Baltic during spring migration. In this paper we describe the characteristics of the spring staging behaviour of Dunlins and try to place it into perspective within the migratory system of the species.

STUDY AREA

The spring staging behaviour of Dunlins was observed in three sandflats in the national park 'Vorpommersche Boddenlandschaft' at the German Baltic Sea coast (Mecklenburg–Vorpommern), situated between the islands of Rügen and Hiddensee and the peninsula of Zingst (Figure 1). These sandflats, which are commonly called 'windflats' because of their non–tidal but wind–induced fluctuations in water level, extend over 180 ha ('Bessin'), 1,500 ha ('Vierendehlgrund') and 1,100 ha ('Bock'). The distance between Bessin and Bock is about 15 km while Bock and Vierendehlgrund are divided only by a 750 m wide shipping lane. The macrozoobenthos of the windflats is characterized by a low species diversity with only three species occurring in high densities (ragworms *Nereis diversicolor*, amphipods *Corophium volutator* and mudsnails *Hydrobia ventrosa et ulvae*) (Kube 1994, Dierschke 1997). As the fluctuations in water level are irregular, the access to foraging substrate is unpredictable for waders, although long periods of

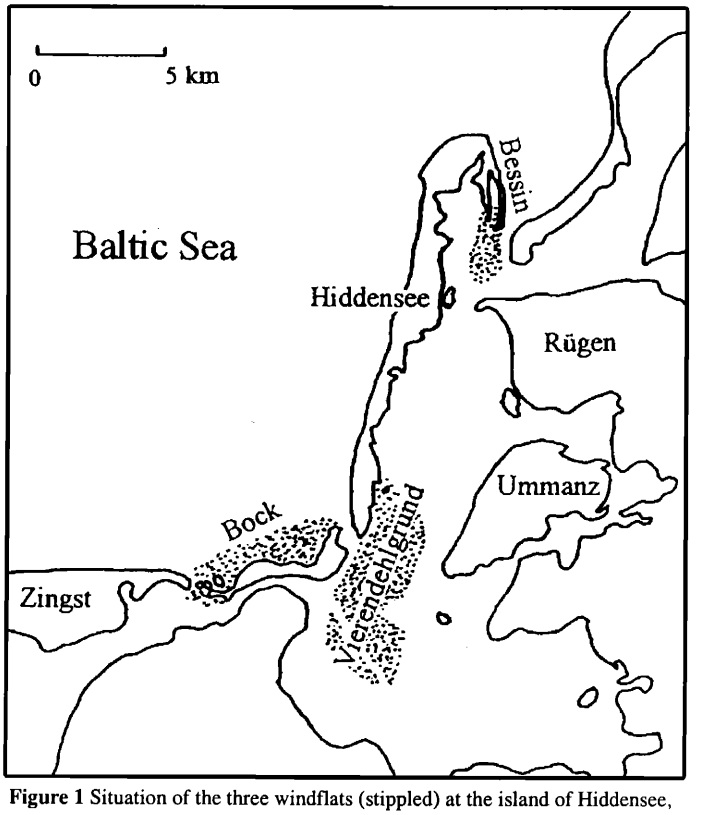

Figure 1 Situation of the three windflats (stippled) at the island of Hiddensee, German Baltic Sea coast.

unavailability are rare.

METHODS

During the spring migration season (early March to early June), Dunlins were counted at least once per five–day–period at Bessin in 1994–1997. From the two large windflats (Bock, Vierendehlgrund), to which access is restricted, only 1–4 counts per month were available. The total number of counts (March to 20 June, 1994–1997) is 208 for Bessin, 30 for Vierendehlgrund and 18 for Bock. During this four–year period, 15 synchronous counts were conducted at the three windflats (1994: 19 March, 16 April, 12 May, 28 May; 1995: 18 March, 15 April, 27 May; 1996: 16 March, 13 April, 18 May, 15 June; 1997: 15 March, 10 May, 24 May, 14 June).

In May and early June, most counts at Bessin and Vierendehlgrund took place in the evening hours in order to observe take–off behaviour. Attention was paid to vocalizations of Dunlins which were commonly given before take–off for migratory flights. The time, flock size and flight direction of departing birds was noted. Mean flock size was calculated as a) the arithmetic mean (Sx/n) and b) as the mean experienced by an average bird ($\Sigma x^2/\Sigma x$) with x as flock size and n as the number of flocks.

From late February to early June, staging Dunlins were scanned for their state of moult from winter to breeding plumage. The plumage was judged to be of one out of six categories according to coloration of the belly (see explanations to Figure 4).

RESULTS

As shown in Figure 2, Dunlin numbers vary considerably both within and between spring seasons on individual windflats, although the seasonal pattern of arrival and departure of different populations is relatively consistent between years. Synchronous counts revealed that the three windflats at Hiddensee held about 3,000 to 6,000 Dunlins in April and May (Table 1), staging for several weeks and occasionally switching between sites. Dunlins were regularly seen changing location in response to rising or falling water levels, particularly between the neighbouring windflats Bock and Vierendehlgrund. In extreme cases, when the windflat was completely inundated no Dunlins were present at Vierendehlgrund, (all counts in 1995 and sometimes in 1996 and 1997, Figure 2).

Depending on the weather situation, some Dunlins are present as early as February, but most birds seem to arrive in March and April (Figure 2). In 1996, when ice covered the windflats until early April, no Dunlins were present before the last days of March (Figure 2). In all years, departing flocks were seen between 27 May and 3 June, and numbers were below 50 birds from 8 June onwards. The departure in late May was coincident with the migration of Dunlins coming from other staging areas, leading to stopovers of additional birds during adverse migration weather such as strong head winds or heavy rain. Wind from northeast resulted in the maximum count of 6,920 Dunlins at Bessin on 30 May 1997 (with unusually large numbers of Grey Plover *Pluvialis squatarola* and Bar–tailed Godwit *Limosa lapponica* as well).

Although given occasionally at other times during the second

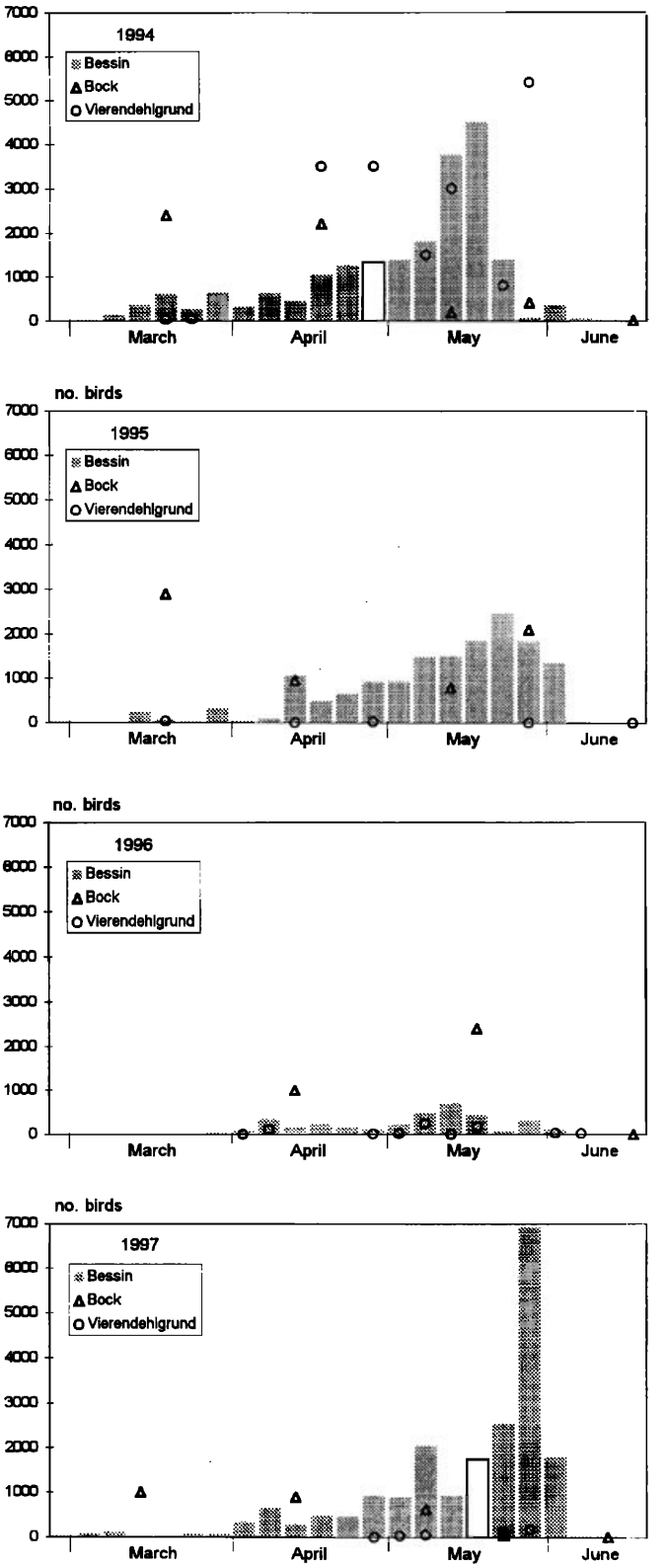

Figure 2 Maximum counts per five–day–period of staging Dunlins in the windflat areas Bessin (columns), Vierendehlgrund and Bock during spring migration in 1994–1997. Open columns refer to interpolated values.

Table 1 Synchronous counts of staging Dunlins in the three windflats of the national park 'Vorpommersche Boddenlandschaft' (Bessin, Vierendehlgrund, Bock) during spring migration.

	mid March	mid April	mid May	late May	mid June
1994	2464	6170	4009	5879	?
1995	2990	2021	?	3743	?
1996	0	1012	2900	?	2
1997	1008	?	2728	2373	10

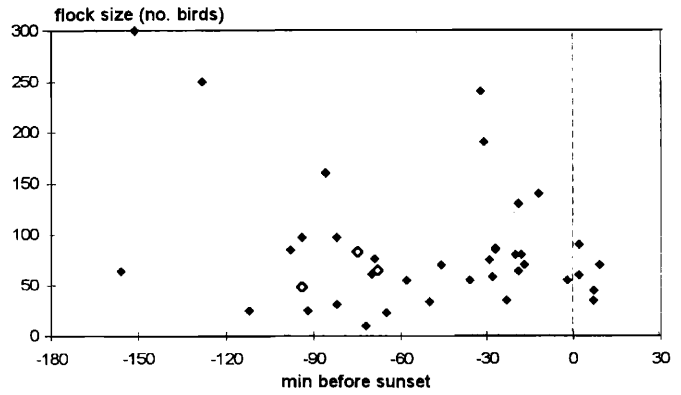

Figure 3 Flock size and time of departure of Dunlins leaving the windflat Bessin between 27 May and 3 June. Open symbols refer to flocks breaking off the departure. The broken line indicates the sunset.

half of May, vocalizations resembling territorial song in the breeding area indicated days with departures. Song became more frequent and formed a kind of chorus immediately before and while flocks took flight. From Bessin and Vierendehlgrund, Dunlins departed in flocks of 10–500 birds with a mean flock size of 104 birds. The average individual migrated in a flock of 186 birds (Table 2). Most flocks took off from Bessin between 90 minutes before and 15 minutes after sunset (Figure 3; median of both flocks [n=37] and individuals [n=3206] is 32 minutes before sunset). However, as Dunlin numbers on the following day were usually lower than expected from the counts of departing birds, a proportion of the birds seem to start migration at night. Only three flocks were seen to abandon departure and return to the windflat, all in the early phase of departure (Figure 3). Compared to the north–south alignment of the coast of the Bessin peninsula, flight direction of departing Dunlins was judged as north (65% of flocks, 60% of individuals), north–northeast (14% of flocks, 9% of individuals) and northeast (22% of flocks, 31% of individuals; n=37 flocks and n=3206 individuals, respectively). Climbing behaviour was not measured, but varied between ending up at a flight height of c. 50 m and rapid climbs up to several hundred metres.

Before mid April, only a few Dunlins showed signs of breeding plumage (Figure 4). Progress in moult was strongest in late April and early May, with almost all birds in more or less complete breeding plumage thereafter (Figure 4).

DISCUSSION

Despite the fluctuations in numbers observed in every single windflat area, probably about 3,000 to 6,000 Dunlins use the complex of sandflats at Hiddensee as a fuelling site preceding homeward migration. In contrast to some other wader species, which on spring migration stay only for a few hours without much time spent foraging (pers. obs.), Dunlins are present for several weeks (although this still has to be shown on an individual basis) and feed extensively on exposed sandflats and in shallow water (Dierschke 1997). Ragworms, as the main prey of Dunlins in Baltic Sea windflats (Dierschke *et al* 1999a), are present in high numbers in April and May (Kube 1994, Dierschke *et al.* 1999b). When there was a strong reduction in ragworm stocks following severe winters (Dierschke 1997) or long periods of windflat exposure in spring (Kube 1994), Dunlins have the opportunity to switch a) between the three windflats and b) to other prey species. As an example, large numbers of mudsnails *Hydrobia* spp. were present at the Bessin windflat in spring 1996, when ragworms were missing due to mortality in the preceeding severe winter (Dierschke 1997). Despite comparable feeding conditions, other (but smaller) windflats at the German Baltic Sea coast do not serve as staging areas for Dunlins in spring, but may hold up to a few hundred migrants during brief stopovers (Kube *et al.* 1994, Vogelwarte Hiddensee unpubl.).

location	season	n	mean$_1$	mean$_2$	max.	sources
spring migration						
Banc d'Arguin, Mauritania	March - May	135	41	115	380	Piersma *et al.* 1990
Helgoland, North Sea	March - June 1991-94	24	10	31	65	Dierschke 1997
Hiddensee, Baltic Sea	27.5.-3.6.1994-97	43	104	186	500	this study
autumn migration						
Hiddensee, Baltic Sea*	17.7.-27.8.94-97	16	12	20	41	pers. obs.
Schleimünde, Baltic Sea*	6.7.-11.8.1986	118	5	9	35	Dierschke 1997
Blavandshuk, North Sea, Denmark*	22.7.-6.8.1970/71	?	7			Noer 1979
Helgoland, North Sea	July - Sept. 1991-94	305	3	6	17	Dierschke 1997
Dutch Delta & Wadden Sea	autumn	18	18	59		Piersma *et al.* 1990

Table 2 Flock sizes of departing (only Mauritania and Hiddensee in spring) and migrating Dunlins (*only adults). Mean^1 refers to the arithmetic mean of observed flocks, while mean^2 is the flock size in which an average bird migrates.

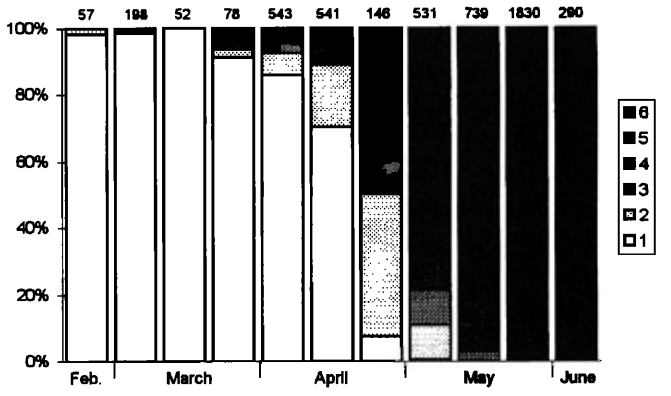

Figure 4 Colouration of belly patch in Dunlins during staging at the windflats Bessin and Vierendehlgrund in spring (ten–day–periods, i.e. thirds of months). 1: white, 2: traces of black, 3: more than ten black feathers, 4: black as area, 5: black with white feathers, 6: completely black. The number of birds is given above the columns (n=72 scans).

It appears that the windflats at Hiddensee are an outpost of the Wadden Sea, bringing part of the population 300 km closer to the migratory goal even before departure on long–distance flights. As underlined by Piersma *et al.* (1994), even a few percent saving in flight costs and preparation time can be regarded as biologically important for long–distance migrants with a tight time schedule and energy budget. Another advantage of being closer to the destination could be the better detectability and more efficient use of weather systems providing tail winds which allow further saving of flight costs (Piersma & van de Sant 1992, Piersma *et al.* 1994). There are, however, no ringing recoveries available which allow us to classify the Dunlins staging at the southern Baltic in spring as belonging to populations wintering along the European Atlantic coast. It might well be that these Dunlins represent winterers from the western Mediterranean Sea which possibly migrate overland through central European.

Like the winter origin, breeding areas of the Dunlins staging at the southern Baltic are not confirmed by ringing recoveries. The presence of some birds already with signs of breeding plumage in March indicates the occurrence of a few birds belonging to the Baltic breeding population (*C. a. schinzii*). Thereafter, the schedule of moult into breeding plumage exactly corresponds to the Wadden Sea (Rösner 1997), but data about possible differences between various breeding populations in northern Eurasia are lacking. Although the majority of birds is heading to the north, it is unlikely that they belong to populations breeding in northern Norway, as those birds have already arrived there in the first half of May and start breeding in late May (Väisänen 1977, Rösner 1997). The timing of departure from the southern Baltic in late May and early June a) fits well the breeding schedule of northwestern or even northern Siberian Dunlins which arrive on their breeding grounds in the first half of June (Syroechkovski & Lappo 1994), and b) is synchronous with the departure of birds assigned to Siberian populations from the Wadden Sea (Goede *et al.* 1990, Meltofte *et al.* 1994) and from the Black Sea (Zharikov 1995).

Behaviour shown by Dunlins shortly before and during departure for migratory flights strongly resembles those described from various wader species at other spring staging sites (Alerstam *et al.* 1990, Piersma *et al.* 1990, 1991, Tulp *et al.* 1994). In line with another study about a coastal wader (Semipalmated Sandpiper *Calidris pusilla*) in a non–tidal habitat (Lank 1989), most Dunlins departed in the last hours of daylight (or in darkness). In contrast, waders feeding in habitats influenced by tides often take off after low tide feeding sessions at any time of the day (Alerstam *et al.* 1990, Lank 1989, Piersma *et al.* 1990, Tulp *et al.* 1994). Observed flock sizes at Hiddensee are larger than those described from various sites during spring and autumn migration, even when compared to departing flocks at the start of spring migration in Mauritania (Table 2).

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