Apparent age - segregation of Dunlin within Bolinas Lagoon - a preliminary study

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INTRODUCTION

Lomnicki (1988) suggests that in order to predict population dynamics it is vital to identify groups within a population which differ in mortality and reproductive rates. One important category for grouping organisms within a population is age (Lomnicki 1988, Marchetti & Price 1989). If substantial age-specific differences exist within species, particularly in species in which different age groups are difficult to discriminate physically, biased data may be collected regarding population dynamics (Catterall *et al.* 1989). Nevertheless, age of organism is often ignored in the study of habitat distribution.

The local distribution of several species of shorebirds has been shown to be, in part, affected by the age of the individual (Groves 1978, Puttick 1978, 1984, Burger 1980, Ens & Goss-Custard 1984, van der Have *et al.* 1984, Barnard & Thompson 1985, Goss-Custard & Durell 1987). Dissimilar segments of local habitats may expose birds to different levels of competition and predation. For some species of shorebirds, including Turnstones *Arenaria interpres* (Evans 1981), Oystercatchers *Haematopus ostralegus* (Goss-Custard & Durell 1984, Swennen 1984) and Dunlin *Calidris alpina* (Page & Whitacre 1975, van der Have *et al.* 1984, Kus *et al.* 1984), juvenile birds suffer substantially higher mortality rates than do adult birds. Differences in how birds utilize areas may account for these differences in mortality, yet little work has been done on within-site distributions of different aged shorebirds.

The aim of this paper is to investigate whether the North American Dunlin *Calidris a. pacifica* exhibits differential age distribution within one estuary.

STUDY AREA AND METHODS

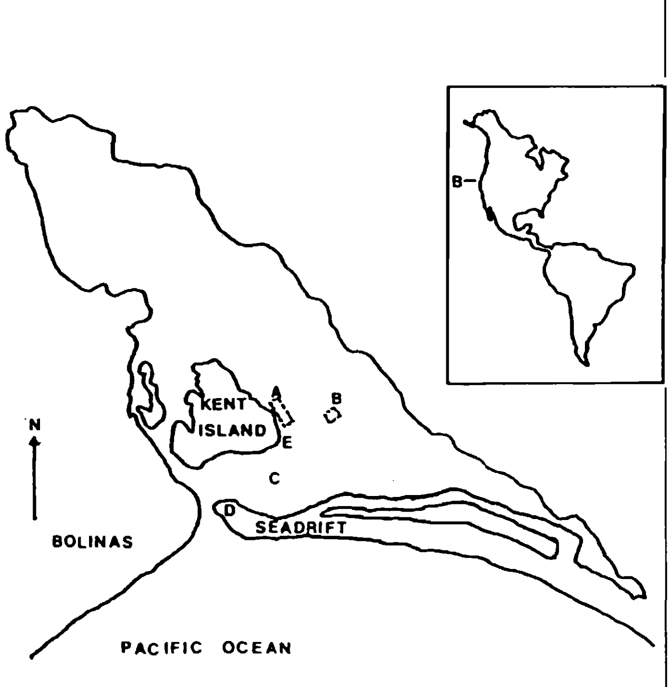
The Bolinas Lagoon is a small (570 ha) salt water lagoon located 24 km north of San Francisco, USA (see Page *et al.* 1979 for more detail). From August through May large numbers of shorebirds, including 1,000-3,000 Dunlin, utilize the lagoon as a wintering area. Since 1979 approximately 900 Dunlin have been individually color-banded at this site by researchers of Point Reyes Bird Observatory.

Dunlin were captured in nylon mist nets set up in the evening at the birds' roost sites. Birds captured were brought back to a laboratory and banded with a unique combination of UV-resistant color-bands. After being held overnight, the Dunlin were released at dawn on the lagoon where they were captured.

Each bird was measured and aged. Measurements included body mass, culmen length, head to the top of the bill, flat wing chord, natural wing chord and tarsus length. Dunlin were aged either as juvenile (first-year) or adult birds according to the presence or absence of buff-colored inner wing covert tips: adult Dunlin wing coverts are usually tipped in white (Page 1974, Prater *et al.* 1977, Gromadzka & Przystupa 1984).

Observations for this study were conducted at two sites within the lagoon (A & B in Figure 1). Both areas under study are tidal mudflats which become exposed when the tide falls below the 1.2 - 1.5 m level. Area A is approximately 250 m x 50 m. It is bordered on one side by Glasswort *Salicornia* and has a few small *Salicornia* islands within it. Area B is apprimately 100 m x 50 m and it is surrounded by mudflats and

Figure 1. The Bolinas Lagoon - feeding sites: A, B, E; roost sites: C, D.

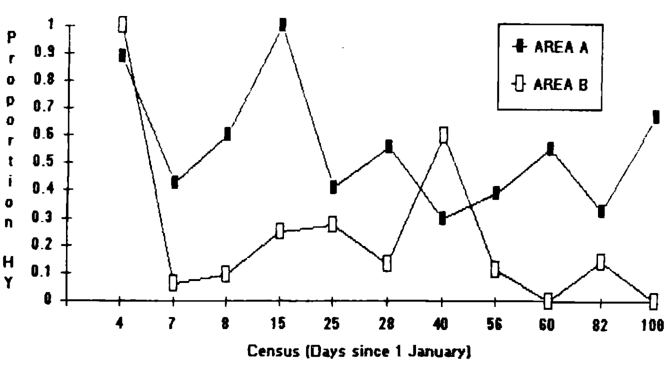


channels on all sides and has no vegetation. The two areas are approximately 300 m apart and separated by a deep channel of water.

Either one or both areas were censused on 33 different days between 2 January 1987 and 22 April 1987. Censuses were conducted as birds left their day-time, high-tide roost sites and resumed feeding. Data including band combination, date, time, area, activity and tide height were recorded in the field.

The majority of censuses were conducted by one person. Resighting generally began in area A (unless 2 people participated, in which case resighting was conducted simultaneously), and then weather permitting, area B was censused. Total census time for both areas generally took less than two hours.

Figure 2. Comparison of the proportion of color-banded juvenile Dunlin in Area A vs. Area B for days when both areas were censused simultaneously.



The number of juvenile and adult color-banded Dunlin feeding in Area A vs. Area B were compared. The proportion of juvenile color- banded Dunlin (number of juvenile banded Dunlin seen in an area divided by the total number of banded Dunlin seen in that area during one census) was calculated for each area on each census date.

Data from all of the censuses were pooled by the month. The proportions of juvenile color-banded Dunlin present per month for each area were calculated from these data. The mean and standard deviation of the proportion of juvenile color-banded Dunlin was calculated for each area using data from all the censuses, and using data from only the simultaneous censuses.

RESULTS

Movements of the Dunlins after the breakup of the day-time roost flock were as follows (see Figure 1 for area). Depending on the height of the day-time high tide Dunlin roosted either on a large sandbar near the mouth of the lagoon (area C), or directly at the mouth of the lagoon (area D). Other day-time roost sites were used less infrequently, and will not be discussed in this paper. Approximately an hour after the high tide, Dunlin began departing from the roosting areas and frequently began feeding on the SE corner of Kent Island (area E). Mudflats first became exposed at area A and quickly thereafter at area B. Typically, at this point, the roosting flock split in two directions. One group would fly out to area B and the surrounding mudflats while another group moved in a northerly direction along the east edge of Kent Island through area A.

The mean number of color-banded juvenile Dunlin found foraging in the two different areas were varied but area A usually had a higher proportion of juvenile color-banded Dunlin than Area B (Table 1). When using the data for simultaneous censuses only the average proportion of juvenile Dunlin foraging in area A, for all scores combined, was 0.56. The proportion of juvenile color-banded Dunlin found foraging in area B was 0.24. Similar proportions occurred when all the censuses were combined regardless of whether areas A and B were searched simultaneously. Colour-banded juvenile Dunlin represented 56% of the Dunlin foraging in area A but only 23% in area B.

The proportion of color-banded juvenile Dunlin for area A, using only the simultaneous censuses, ranged from 0.30 to 1.00 for the months of January through April, while in area B

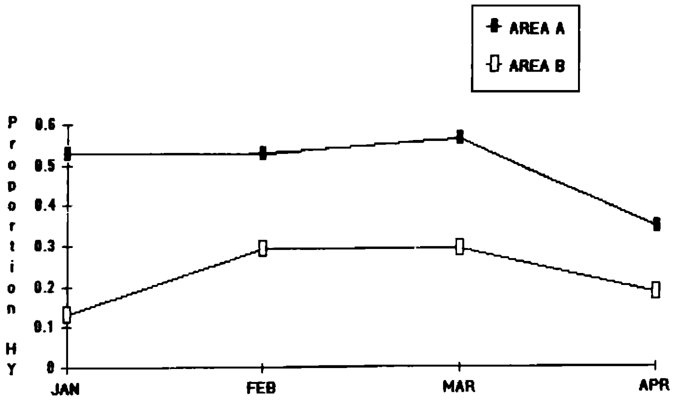
Table 1. Censuses for adult (AHY) and juvenile (HY) color-banded Dunlin foraging on Balinas Lagoon, during 1987. Simultaneous censuses of areas A & B are indicated by dates in bold.

	AREA A			AREA B		
Date	AHY	HY	HY/Total	AHY	HY	HY/Total
Jan2	1	9	0.90	-	-	-
4	1	8	0.89	0	4	1.00
6	9	8	0.47	-	-	-
7	12	9	0.43	17	1	0.06
8	2	3	0.60	20	2	0.09
10	-	-	-	32	3	0.09
13	-	-	-	42	5	0.09
15	0	5	1.00	3	1	0.25
18	4	2	0.33	-	-	-
19	-	-	-	1	0	0.00
25	16	11	0.41	11	3	0.27
28	12	15	0.56	21	3	0.13
31	10	6	0.38	-	-	-
Feb7	0	3	1.00	-	-	-
9	14	6	0.30	2	3	0.60
11	2	9	0.82	-	-	-
13	4	5	0.56	-	-	-
17	2	7	0.78	-	-	-
21	1	3	0.75	-	-	-
25	14	9	0.39	8	1	0.11
Mar1	5	6	0.55	4	0	0.00
4	3	5	0.63	-	-	-
8	14	7	0.33	-	-	-
11	-	-	-	10	7	0.41
16	-	-	-	7	3	0.30
23	2	1	0.33	6	1	0.14
Apr 1	1	1	0.50	-	-	-
3	-	-	-	3	4	0.57
6	-	-	-	8	1	0.11
10	1	2	0.67	12	0	0.00
13	16	3	0.16	-	-	-
20	10	7	0.41	-	-	-
22	5	4	0.44	-	-	-

All censuses pooled	N = 26	N = 18
	$\bar{x}$ = 0.56	$\bar{x}$ = 0.23
	s = 0.23	s = 0.26
Only simultaneous censuses	N = 11	N = 11
	$\bar{x}$ = 0.56	$\bar{x}$ = 0.24
	s = 0.75	s = 0.30

the range for proportion of juveniles was 0.00 to 1.00 (Figure 2). Using the combined censuses, area A had a range of 0.34 to 0.56 color-banded juvenile Dunlin for the months January - April while area B had a range of 0.18 to 0.29 juvenile Dunlin (Figure 3).

Figure 3. Mean proportion of color-banded juvenile Dunlin in Area A vs. Area B: all days pooled by month.



DISCUSSION

Non-random age distributions of shorebirds may be common within estuaries. Adult shorebirds aften displace juvenile birds from areas of abundant food supplies. In a study of European Oystercatchers *Haematopus ostralegus* Goss-Custard & Durell (1987) demonstrated that more profitable mussel beds were dominated by adult birds during periods of high densities. Likewise, adult Ruddy Turnstones *Arenaria interpres* always won aggressive interactions over food with juvenile Turnstones forcing the juveniles to feed elsewhere (Groves 1978). Similarly juvenile Lapwings *Vanellus vanellus* were less successful in competing for food, more open to kleptoparasitism by gulls, and may be forced into lower quality areas by adult Lapwings (Barnard & Thompson 1985).

Van der Have *et al.* (1984) found that different locations within the Dutch Wadden Sea had different percentages of juvenile Dunlin. Dunlin distribution was likened to an overflow system in which at periods of high densities juvenile Dunlin were forced into less preferred habitats. In California, Ruiz *et al.* (1989) have shown that Dunlin segregate by age and sex within roost flocks, yet reasons for this phenomenon are unclear.

At the Bolinas site, it appears that differences in the age distribution of Dunlin exist over very short distances. Furthermore, I suspect that such age distribution in Dunlin may be common and perhaps density dependent. During periods of high Dunlin densities, flocks of Dunlin often feed in locations within the lagoon where they are not normally seen feeding. Banded Dunlin resighted in these areas are almost always juvenilebirds (Warnock unpublished data). This may result from juveniles being forced into less desirable habitat as suggested by van der Have *et al.* (1984).

Other reasons for a differential distribution may be equally valid. Patchiness of food may influence distribution. Juvenile Dunlin may have a "learning period" in which they need to learn the location of the most profitable food patches (van der Have *et al.* 1984). On the Bolinas Lagoon, preliminary data suggest that invertebrates such as clams and worms are more patchily distributed in area A than in area B (Warnock, unpub. data). Adult Dunlin may be flying directly out to areas where they know they will find food.

In addition, raptor predation may influence distribution. On the Bolinas Lagoon raptors take significantly more juvenile Dunlin than adults (Page & Whitacre 1975, Kus 1982; Kus *et al.* 1984). Adult Dunlin may learn (*cf.* van der Have *et al.* 1984) where areas of higher risk of predation are and avoid these areas whereas juveniles are still unaware of these high-risk areas.

Preliminary results of this study suggest that the age composition of Dunlin differs between areas A and B within Bolinas Lagoon. Since only two areas were compared, and sample sizes were often small, care must be taken in interpreting these data with regard to other Dunlin populations. Further investigation of this phenomena is in progress.

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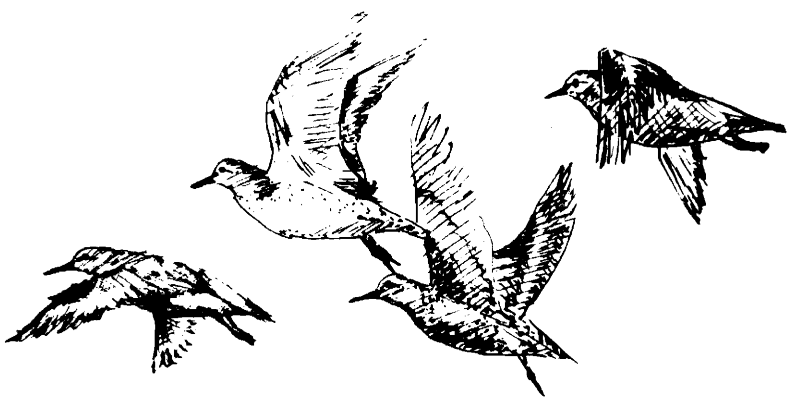

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