

Use care in determining age-ratios in shorebirds: they may differ relative to flock position, flock location and behaviour

BRIAN HARRINGTON

Manomet Center for Conservation Sciences, Manomet, MA USA 02345. bharr@manomet.org

Harrington, B. 2004. Use care in determining age-ratios in shorebirds: they may differ relative to flock position, flock location and behaviour. *Wader Study Group Bull.* 104: 92–93.

I report variations in age-ratios within a flock of Red Knots and between flocks of Sanderlings. These observations have important implications for those attempting to measure the proportion of juveniles in whole populations.

INTRODUCTION

Sampling the proportion of juveniles among flocks of shorebirds during southward migration is a potential tool for gauging how successful annual reproduction has been for Arctic-breeding and other shorebirds. This note describes potential sampling bias that can occur due to the non-random distribution of juvenile and older/adult shorebirds in roosting flocks. Although I am aware of this issue in a variety of shorebird species, for simplicity's sake I will focus on two examples: a single group of Red Knots *Calidris canutus* roosting at a migration stopover site on the Georgia (Atlantic) coast of the United States and separate flocks of Sanderlings *C. alba* using a single Massachusetts beach.

METHODS

Red Knot

Observations were made at Little St. Simons Island, Georgia, USA (31°17'N, 81°17'W), on 12 September 2003 on a flock of about 2,250 Red Knots. They began an hour before a 1030h high tide, and continued for the following 2.5 hrs. Initially the knots were in a single flock, but after an hour, ocean waves washed into the roosting location and the single flock split into three groups of roughly equivalent size, one located close to the crest of the beach and the others roughly 15–30 m further west (inland).

Based on plumage characteristics (Hayman *et al.* 1986), the age of each knot was determined as juvenile or older. While grouped as a single flock, I counted juvenile: older ratios (a) near the centre of the flock, (b) at the edge of the flock, and (c) at 12 'random' point locations within the flock (with a goal of 30 birds at each point) along two imaginary transects, one running the length and the other running the width of the flock (the count at one point was incomplete because the flock flew).

About 30 minutes after the flock split into three groups, individual and small groups of knots began to walk from the two westerly flocks to join with the flock at the crest of the beach. I counted age ratios from these birds for about an hour as they walked between the flocks; this ended when a raptor flushed all the birds.

Sanderling

The observations of juvenile and older Sanderlings (see Hayman *et al.* 1986 for plumage descriptions) were made on Plymouth Beach, Massachusetts, a peninsular barrier beach extending about 5 km into Plymouth Harbor (42°05'N, 70°40'W, see Schneider & Harrington 1981 for map). All counts were made within 1.5 hr of high tide on 22 September 2003. At high tide most shorebirds cease foraging and fly to roost on nearby beaches. All Sanderlings on the beach were counted, but were found in only four of 14 survey sections. I sampled two of these sections again on 26 September, making a full count in one and sampling from larger numbers in the second, but taking care to ensure as best I could that the samples were representative by counting from different parts of the flock.

RESULTS

Knots in Georgia

The proportion of juveniles (Table 1) on the edge of the large flock was significantly higher than the interior of the flock ($\chi^2 = 13.47$, $p < 0.01$), and significantly higher than found in the 'random' sample ($\chi^2 = 8.03$, $p < 0.01$). The proportion of juveniles in the interior of the flock was not significantly different ($\chi^2 = 3.12$, $p > 0.05$) from the proportion found in the 'random' sample, a result that is not surprising given that a vast majority of the knots were in the interior versus the edge of the flock.

When, after the single, large flock split into three, I tallied the age ratios of birds walking between flocks, the proportion of juveniles was lower than in any of the previous samples (Table 1) and significantly lower than found in the 'random' sample ($\chi^2 = 24.32$, $p < 0.01$). Shortly before a raptor made all the birds fly, I noticed that the relatively small flocks remaining to the west (from which the walking birds had been departing) had a high proportion of juveniles, but I did not obtain counts before the raptor appeared.

Sanderlings in Massachusetts

I found Sanderlings in four of my survey sections on Ply-



Table 1. Differing age ratios of Red Knots relative to position in a flock and to behaviour.

	Juveniles	Older than juveniles	Per cent juveniles
Interior of flock	4	137	3
Edge of flock	17	83	17
'Random' location (see text)	24	313	7
Walking between flocks	27	1,353	2

mouth Beach on 22 September and in three of these all but a couple were juveniles; in the remaining section almost 90% were older birds (Table 2). I was not aware of any movement between the sections. On 26 September, two of these sections contained respectively 95% juveniles (N = 52) and 8% juveniles (N = 203).

DISCUSSION

This study demonstrates that adult and juvenile shorebirds do not necessarily sort randomly in high tide roosting flocks. This has important implications for those attempting to measure the proportion of juveniles in a population in order, for example, to estimate recruitment (see Clark *et al.*, this volume).

A number of studies have shown that age-ratios of shorebirds can vary with factors such as roost location (Swennen 1984, Durrell *et al.* 1996), vulnerability to raptors (Cresswell 1994), or foraging habitat (Warnock & Takekawa 1995). My observations show that juvenile Red Knots were not randomly dispersed within a single roosting flock, and that juvenile Sanderlings were not randomly dispersed between roosting flocks. This suggests that attempts to estimate age-ratios of a whole population need to be done using as random and representative a sampling process as possible. Ideally, samples should be taken from a wide range of sites across entire landscapes. Further, the results suggest that age-ratios can vary with differing behaviour, as for example among birds switching flocks.

Table 2. Uneven age ratios of Sanderlings in different flocks on the same beach, 22 September 2003.

	Juveniles	Older than juvenile	Per cent juvenile
South end of beach	3	0	100
North end of beach	17	1	94
Mid-north section	55	425	11
South of mid-north section	34	1	97

ACKNOWLEDGEMENTS

I am grateful for logistic support from naturalists and other staff of The Lodge at Little St. Simons Island, Georgia, from Brad Winn, Georgia Department of Natural Resources, and from the Manomet Center for Conservation Sciences. I thank Jacquie Clark for comments on the draft manuscript. Counts of Sanderlings were made as a part of work funded, in part, through a grant from the Delaware Coastal Programs with funding from the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration under award numbers NA17OZ2329 and NA17OR2479.

REFERENCES

- Cresswell, W. 1994. Age-dependent choice of Redshank (*Tringa totanus*) feeding location – profitability or risk. *J. Anim. Ecol.* 63: 589–600.
- Durrell, S.E.A. le V dit, S.J. Ormerod & P.J. Dare. 1996. Differences in population structure between two Oystercatcher *Haematopus ostralegus* roosts on the Burry Inlet, South Wales. *Ardea* 82A: 283–388.
- Hayman, P., J. Marchant & T. Prater. 1986. *Shorebirds: an identification guide to the waders of the world*. Houghton Mifflin, Boston.
- Schneider, D.C. & B.A. Harrington. 1981. Timing of shorebird migration in relation to prey depletion. *Auk* 98: 197–220.
- Swennen, C. 1984. Differences in quality of roosting flocks of Oystercatchers. pp. 160–176. In P.R. Evans *et al.* (eds). *Coastal waders and wildfowl in winter*. Cambridge University Press, Cambridge.
- Warnock, S.E. & J.Y. Takekawa. 1995. Habitat preference of wintering shorebirds in a temporally changing environment: Western Sandpipers in the San Francisco Bay estuary. *Auk* 112: 920–930.

