Production, survival and catchability of chicks of Common Sandpipers *Actitis hypoleucos*

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Previous estimates of Common Sandpiper chick survival confound the different ages at ringing with subsequent survival. Most chicks in our Peak District study site, the source of previous estimates, are ringed at 3–5 days old, but elsewhere, and previously in the Peak District, many chicks were ringed in the nest. Survival rates of newly hatched Common Sandpiper chicks are 0.77 on their first day, and improve over the first week so that chicks older than 6–10 days apparently have a 100% survival rate. Over the 19 days to fledging, the survival rate is 0.54. Applying the apparent mortality rates to the potential number of chicks in the observed/ringed broods suggests that 9–21% of mobile chicks at various ages were caught for ringing, despite the previous perception that the youngest chicks should be easiest to catch.

INTRODUCTION

During population studies of Common Sandpipers in the Peak District (Holland *et al.* 1982, Holland & Yalden 1991a), we estimated that 40% of the chicks ringed survived to fledging. This was an aggregate figure, based on all chicks ringed in 1977–1989. However, it seems certain that survival of younger chicks is much lower than of older chicks, but this is confused by the fact that chicks are ringed at all ages from hatching to fledging. This account attempts to unravel this confusion by examining the different ages of chicks at ringing, and estimating their subsequent survival rates. Green (1984) suggested that wader chicks could be aged from bill length, and this prompted us to start to measure chicks at ringing (Yalden & Dougall 1994, Dougall *et al.* 1995); Beintema (1991) has revealed the value of this approach.

METHODS

Most of this account analyses the Common Sandpipers studied in the Ashop–Alport river system (Yalden 1986), over the period 1989–2003. The additional birds studied elsewhere, particularly by the Ladybower–Derwent–Howden and Goyt Valley Reservoirs (Holland & Yalden 2002), could not be followed through to fledging, but they provide some comparative data, as do those ringed in the Scottish Borders (Yalden & Dougall 1994, Dougall *et al.* 1995). Chicks caught for ringing were weighed to 0.5 g (using Pesola spring balances) and their bill lengths measured (to 0.5 mm, from the feathering, using a transparent ruler); bill lengths provide a good indication of age (Holland & Yalden 1991b). Most Ashop–Alport parents were colour-ringed and their territories known. By following their behaviour, DWY could check whether they had successfully reared at least one chick to fledging (if their parental guarding behaviour lasted at least 3 weeks), and could usually count the fledglings accompanying them after fledging. The whole study area was surveyed every Wednesday from late April to late July, 1989–2003, with supplementary visits at weekends, especially if chicks were expected in particular territories. Deaths of chicks were never recorded directly, only their apparent survival to fledging (and for supplementary sites, even that was not known). Conventional analysis of mortality rates (e.g. Mayfield, Kaplan-Meier) is therefore not possible. Moreover, since it is suspected to change (decline) with age, methods that assume a constant rate of mortality across the period to fledging (e.g. Mayfield) are inappropriate. However, if brood size at ringing at successive ages can be estimated robustly, the ratio of brood sizes at different ages gives an estimate of survival rates between those ages. For the purposes of this paper, the brood size at ringing, its age, and whether any, and if so how many, chicks fledged, are the basic data. Age 0 comprises chicks still in the nest. Brood size at any age includes both chicks ringed at that age and those known to be present, either because they were seen but evaded capture on the date their sibs were ringed, or were ringed on a later date. In some cases, it was considered that only one of a brood of 3 or 4 chicks, ringed when young, had survived to fledging, but not always which one; for the present analysis, this does not matter. It is highly likely that some fledglings were completely missed (cf. Holland & Yalden 1994), and the figures used are minima. The extent of this bias can be estimated later.

RESULTS

Over the 15 years, 138 chicks from 72 broods were ringed; 62 chicks (45%) were believed to survive to fledging, to accompany another 21 ringed as fledglings (Table 1). Although young chicks might seem most easily located, in fact those aged 3–5 days were the most numerous class.

For comparative purposes, the ages of chicks ringed elsewhere in the Peak District and in the Borders are presented in Table 2. They too show a peak catch of older chicks, rather

Table 1. Age at ringing (days) and survival to fledging of Common Sandpiper chicks ringed in the Ashop study area, 1989–2003. Common Sandpipers usually fledge at about 19 days. Pulli total is for non-fledged (<20 day) chicks.

	Age (days)								
	0	1	2	3–5	6–10	11–19	20+	Total	Pulli
Number ringed	14	33	23	39	13	16	21	159	138
Number fledged	2	16	8	20	11	15	21	83	62
Number that failed	12	17	14	19	2	1	0	65	65
% survival to fledging	14	48	35	51	85	94	100	52	45

Table 2. Age (days) at ringing of Common Sandpiper chicks at Ashop, other Peak District sites and in the Scottish Borders.

	Age (days)								
	0	1	2	3–5	6–10	11–19	20+	Total	Pulli
Number ringed Ashop	14	33	23	39	13	16	21	159	138
%	9	21	14	25	8	10	13		
Number ringed other Peak District	62	46	28	67	92	44	12	351	339
%	18	13	8	19	26	13	3		
Numbers ringed Scottish Borders	95	69	72	128	103	85	17	569	552
%	17	12	13	22	18	15	3		

than of the youngest age classes. Indeed the peak for other Peak District birds, around 6–10 days, is slightly older than for the Ashop or Borders birds.

Brood size at ringing generally declines, predictably, with age at ringing (Table 3), but there are statistical nonsenses in these results. The brood size appears to be larger at 2 than 1 day old, and at fledging than at 6–10 or 11–19 days old. The first is presumably a stochastic effect of small samples, the latter probably indicates the success of older chicks in avoiding detection. These can be overcome by averaging brood sizes to achieve a smooth decline, from 3.6 for the youngest chicks to 2.0 for the older ones. The ratio of successive brood sizes then gives an estimate of survival rate between each stage, and the product of these gives an overall survival rate to fledging of 54%. The larger brood size at fledging suggests that older chicks (after 6 days) have close to 100% survival.

Not enough nests are found in the Ashop study area alone to justify analysing nest records, but combining all 40 nests found in the Peak District during these years gives a mean clutch size of 3.65, and a hatching success of 0.60 of clutches (or 0.58 of eggs). From 91 eggs in the 25 clutches which hatched, 85 chicks hatched (0.93). Extrapolating from this clutch size and hatching success, the 72 broods from which the 159 chicks (of Table 1) were ringed should have contained 244 newly hatched chicks. If the survival rates from Table 3 are applied to this figure, the expected number of chicks can be calculated, and compared with those actually ringed (Table 4). It is evident that DWY was failing to find nests with newly hatched young still in them (= day 0), and was most successful at locating chicks aged 3–5 days old. If there really were 138 fledglings produced by this population over these years, the 83 ringed (Table 1) were only 60% of them. However, ringing over the fledging period of the

Table 3. Brood size at ringing at successive ages (days) for Ashop Common Sandpiper chicks. Smoothed brood size combines the mean brood size data as shown by the brackets.

	Age (days)						
	0	1	2	3–5	6–10	11–19	20+
1-chick broods		2	1	2	4	3	1
2-chick broods	1	4	3	8	3	3	5
3-chick broods		4	1	6		2	3
4-chick broods	4	3	4	4	1		
Total broods	5	13	9	20	8	8	9
Total chicks	18	34	26	52	14	15	20
Mean brood size	3.6	2.6	2.9	2.6	1.7	1.9	2.2
Smoothed brood size	3.6		2.7	2.6		2.0	
Age-to-age survival		0.75		0.96		0.75	

Table 4. Predicted number of chicks of successive ages (using mortality rates from Table 3) expected from the nominal 66 broods from which chicks were ringed (Table 1), compared with numbers actually ringed.

	Age (days)					
	0	1–2	3–5	6–10	11–19	20+
Predicted	244	188	184	138	138	138
Ringed	14	33	39	13	16	21
%	6	18	21	9	12	15

chicks is accumulative. If the chicks ringed at each successive age are multiplied by the survival rates from Table 3, and added to the next age class, to accumulate the potential numbers of fledglings ringed (Table 4) 128 of the 138 should have been ringed, 93%. This calculation implies that some 7% of the older ringed chicks reached fledging without this being recorded.

DISCUSSION

Newly hatched chicks of precocial waders are usually found together close to the nest site. They are weaker, less able to run off and hide and more vulnerable than when they are older. Therefore this is the chick age-class that should be the one that is most easily found and ringed in greatest abundance. This was the case in studies by Dutch ringers of Northern Lapwings *Vanellus vanellus* and Redshanks *Tringa totanus* (Beintema 1991). It is evident from the present analysis, however, that in the Common Sandpiper it is somewhat older chicks that are more easily caught. This is similar to Dutch studies of Black-tailed Godwit *Limosa limosa* and Eurasian Oystercatcher *Haematopus ostralegus* chicks. Beintema remarks that, as they get older, godwit chicks tend to run, rather than hide, making them easier to find and catch. The alarming behaviour of Common Sandpiper parents may protect them from predators (dogs certainly are distracted and follow the parents away from their chicks, pers. obs), but they reveal the nearby presence of chicks to a determined researcher, and perhaps (pers. obs.) to corvids too.

The fact that the peak age at ringing was older (6–10 days) at the reservoirs than in the Ashop study area (3–5 days) probably reflects the usual pattern of visits: 3–4 day intervals at Ashop and 6–7 day intervals elsewhere.

The brood size recorded at ringing of very young chicks, 3.6, matches reasonably well that calculated from clutch size and hatching rate ($3.65 \times 0.93 = 3.4$), particularly given that the sample of youngest broods was small. The calculation that the 83 young ringed during this study is only 65% of the theoretical 128 fledglings is a fair match for the calculation made, on similar data and assumptions from the previous decade, that the 164 fledglings seen were only 70% of the expected 235 (Holland & Yalden 1994). The most useful statistic for population modelling to come from this study is the better estimate of chick survival, 0.54 of hatched chicks surviving to fledging, replacing the aggregate estimate of 0.40 which we have used previously (Holland & Yalden 1991, 1994, 2002). It suggests that we ringed more younger chicks, often at the nest, in the earlier decade, as seems to be the case for our other study areas; a similar analysis of the overall survival rates of chicks from the reservoirs in the Peak District produced a figure of 0.41, and of 0.40 for chicks from the Borders (cf. Dougall *et al.* 1995). In both cases, and as for our earlier surveying, broods were not always followed through to fledging, and the true survival rates are therefore higher than these estimates.

The poorer survival of younger chicks is no surprise; it is revealed by similar studies of Lapwings (Galbraith 1988), of radio-tagged Eurasian Golden Plover *Pluvialis apricaria* chicks (Pearce-Higgins & Yalden 2001), and two (Lapwing, Oystercatcher) of the four species studied by Beintema (1991). However, there have been relatively few studies that document this effect. For Redshank and Black-tailed Godwit, Beintema's data suggested instead rather even mortality throughout the chicks' growing period. Given the poor thermoregulatory ability and general vulnerability of very young wader chicks, the former seems a more probable pattern of survival, but it is not clear whether the other pattern reflects statistical averaging of data from many ringers and years, or a genuine difference brought about by differences in ecology, weather or habitat.

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