Habitat, weather and the growth rates of Common Sandpiper *Actitis hypoleucos* chicks

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Common Sandpiper chicks grow at similar rates around reservoirs in the Peak District and along streams in the Borders, but their growth rates vary between years. In a warm dry June (1992) they were significantly higher than in cooler Junes (1991 and 1993).

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INTRODUCTION

In documenting the growth of Common Sandpiper chicks, Holland & Yalden (1991) pointed out that body-weight and bill-length were strongly correlated during the middle period of chick growth (c. 4 days to 19 days old), and suggested that the relative values of these two parameters might provide a good indication of chick condition. It should be possible also to compare growth rates in different habitats and different years using these measurements. The regressions given by Holland & Yalden (1991) were derived from a study of a riverine population in the Peak District, in England, and the data were accumulated over 12 years. Since 1989, the study has extended to the nearby reservoir population, and enough chicks have been ringed there each year to allow comparisons between years. Furthermore, similar studies in the Borders region of southern Scotland, about 280 Km north of the Peak District, allow geographical comparisons. For other waders, striking differences in growth rates between chicks in different habitats have been documented (e.g. Lapwing *Vanellus vanellus*, Galbraith 1988; Redshank *Tringa totanus*, Thompson *et al.* 1990) and the impact of weather conditions on the growth-rates, particularly boody-weights and bill-lengths, of wader chicks has been described by Beintema & Visser (1989). Recently, Beintema (1994) has used a conditon index derived from these same measurements to indicate how much the growth rates of Lapwing, Black-tailed Godwit *Limosa lapponica*, Redshank *Tringa totanus* and Oystercatcher *Haematopus ostralegus* chicks vary between different years in The Netherlands. Our more modest data set offers a comparable example.

MATERIALS AND METHODS

Chicks in the Peak District had their bills measured with a transparent ruler to the nearest 0.5 mm, and were weighed with a 50 g "Pesola" spring balance to the nearest 0.1 g. Those from the Borders were measured more accurately, using dial callipers, to 0.1 mm. Bill lengths, in both cases, were taken from the edge of the feathering to bill tip.

Only chicks with bill lengths of 12 to 20 mm were used in the calculations, corresponding to chicks of 4-19 days old, and to the period of rapid growth documented by Holland & Yalden (1991). Reduced major axis regression was used, since both bill-length and mass are subject to measurement error and variability. Insufficient chicks were caught each year in the R. Ashop study area to allow comparisons between separate years, but the aggregate sample there for 1989-1993 has been used. The exponent comparing mass with bill-length has been taken as the basis of comparison, the presumption being that chicks would accumulate mass faster, relative to bill length, in a good growing season or in a better habitat. However, the predicted masses at 12 mm and at 20 mm (i.e. "fledging") bill lengths have also been calculated, as more understandable statistics.

RESULTS

Growth rates

The equation given by Holland & Yalden (1991) should have related mass (y) to bill length (x) as $y = 3.89x - 37.98$ (though an overlooked misprint resulted in the exponent appearing as 3.88 rather than 3.89). This gives calculated masses, at bill lengths of 12 mm and 20 mm, of 8.70 g and 39.84 g, respectively. Being based on 46 chicks, this equation is probably a reliable reference point, but because the data were accumulated over 12 years and from various sites (though mostly from the R. Ashop), it obscures potential sources of variation. A smaller sample from the R. Ashop population, for the years 1989-1993, produces a similar estimate of mass at fledging (Table 1).

The results from around the Ladybower Reservoir show an interesting variability. In 1992, the growth rate was comparable with those calculated from the R. Ashop, and produced a similar estimate of chick mass, over 38 g, at fledging. Conversely 1991 was evidently a poor season, and the calculated mass at a bill length of 20 mm was over 4 g lighter; it is uncertain whether a chick that has achieved lengths appropriate to fledging would actually be able to fly at such a light weight. The other three years produced intermediate results. The regression for 1991 was significantly different from both 1992 ($t = 7.64$, $p = < 0.001$) and 1993 ($t = 2.61$, $p = 0.01$); the result for 1993 was also significantly lower than for 1992 ($t = 4.24$, $p = < 0.001$).

In the Borders, the result for 1993 was also significantly lower than for 1992 ($t = 5.64$, $p < 0.001$). However, the results for 1992 at Ladybower and in the Borders were not different ($t = 1.03$, $p = 0.31$) and neither were they in 1993 ($t = 0.63$, $p = 0.53$).

Table 1. Regressions of chick body mass (y) with bill length (x), and calculated masses at bill lengths of 12 mm and 20 mm, for Common Sandpiper chicks in the Peak District (R. Ashop-riverine population, and around the Ladybower Reservoir complex) and in the Borders, 1989-1993.

Site/Year		Regression	n	Mass at bill length 12 mm	Mass at bill length 20 mm
Holland & Yalden (1991)		$y = 3.89x - 37.98$	46	8.70	39.84
R. Ashop					
	1989-1993	$y = 3.51x - 31.48$	11	10.64	38.73
Ladybower					
	1989	$y = 3.18x - 28.92$	11	9.24	34.69
	1990	$y = 3.20x - 26.80$	11	11.58	37.16
	1991	$y = 2.91x - 24.45$	18	10.51	33.82
	1992	$y = 3.57x - 32.64$	12	10.18	38.47
	1993	$y = 3.11x - 27.81$	20	9.55	34.46
Borders					
	1992	$y = 3.65x - 35.13$	20	8.73	37.97
	1993	$y = 3.17x - 28.46$	37	9.54	34.87

(Correlation coefficients for these regressions range from 0.85 to 0.97, and all are highly significant, $p = < 0.001$).

Table 2. Relative growth rate (exponent and calculated mass at 20 mm bill length) for Common Sandpiper chicks at Ladybower Reservoir, compared with climatic data for June from Buxton weather recording station. Data ranked in order of growth rate. Maximum and minimum temperatures are the means of the daily maxima and minima for the month. Rainfall and sunshine figures are monthly totals. Rain-days are those with > 0.2 mm.

Year	Exponent	Mass at 20 mm (g)	Max. Temp.	Min. Temp.	Mean Temp.	Rainfall (mm)	Rain days	Sunshine (hrs)
1992	3.57	38.47	19.2	10.0	14.6	59.6	6	206.2
1990	3.20	37.16	15.5	9.0	12.3	109.3	21	106.3
1989	3.18	34.69	17.7	8.1	12.9	104.7	10	228.1
1993	3.11	34.46	17.4	9.2	13.3	91.9	13	177.0
1991	2.91	33.82	13.9	6.9	10.4	104.8	25	141.6
30-year average			16.4	8.4	12.4	93.7	-	155.1

Thus the growth rates of Common Sandpiper chicks do not show any consistent differences between habitats or sites, in our samples: the reservoir birds apparently perform similarly to the riverine ones, and the Peak District birds are comparable with those from the Borders. However, it is evident that chick growth rates differ between years, presumably related in some way to the weather.

Weather

Most Common Sandpiper chicks hatch in the first 10 days of June, and are fledged by the first week of July, so their growth is likely to be most directly influenced by the weather in June. Climatic data from Buxton weather station are given in Table 2. Of the five years 1989-93, 1992 was much warmer and drier, and had fewer rain days, than the others. It was also sunny, though not so sunny as 1989. Conversely, 1991 was much colder than the other years and had more rain days. Though remembered as a cool, wet, June, total rainfall that month was infact very similar to that in the other three years. Thus the climatic data match the growth rates in so far as 1992, with the highest growth rate, also had the warmest June, while 1991, with the lowest growth rate, had much the coldest June. Taking all five years, however, although the exponent (growth rate) and temperature were correlated, the result was not statistically significant (with minimum June temperature, which gave the best correlation, $r = 0.85$ but $p = 0.15$).

DISCUSSION

These comparisons vindicate the suggestion that the relationship between mass and bill-length might prove a useful indicator of chick condition in Common Sandpipers (Holland & Yalden 1991) and, by extrapolation, for other waders too (Green 1984; Beintema 1994). It seems that reservoirs and rivers are probably comparable feeding habitats for Common Sandpiper chicks; equally, the chicks grow as well in the Peak District (near the edge of their range) as in the Borders. However, the results also highlight the significant differences between years.

The fact that these yearly differences can be related to weather is not very surprising: the warm, dry, sunny June of 1992 produced the best growth rate, and the cold, overcast June of 1991 resulted in the poorest growth rate. However, the three intermediate years were not so easily explained and overall confounded the attempt to find a significant correlation between growth rate and weather. In particular, 1990 had, apparently, the second highest growth rate, yet the second coldest, and the wettest, June, of the five years under consideration. It is often the case that climatic variables readily explain the extremes of biological performance, but only poorly reveal the factors applying in the more normal years.

It may be that other climatic variables are important - for example, May was also warmer than usual in 1992, 1990 and 1989, but 1991 was cooler. If this results in high insect populations at the beginning of June, as the earliest chicks hatch, it might be reflected in higher growth rates. However, that ought also to result in the young chicks being heavier, and therefore in smaller intercepts (given that the intercepts are negative - Table 1). This seems to be true for 1990, but in other years/sites the size of the intercept appears to be inversely correlated with the size of the exponent. This suggests that statistical artefacts might also be part of the explanation for differences between less extreme years. Additional years' data, and perhaps larger sample sizes resulting from the lumping of data from different sites, might resolve this issue.

Beintema (1994), with much more data, pointed to possible changes in the circumstances of wader chicks in pasture during their growing season, with young chicks being vulnerable to heavy rainfall but older chicks being susceptible to drought. However, he also pointed out that lumping data from larger areas could obscure the real changes occurring within small study populations.

Wader chicks remain difficult to study!

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