

EXPERIMENTAL EVIDENCE FOR THE USE OF VISUAL CUES BY FORAGING DUNLINS

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INTRODUCTION

Descriptions of the functional anatomy and foraging techniques of waders (e.g. Burton 1974) provide some insight into the sensory mechanisms used by the birds to detect and locate their prey. For instance plovers (Charadriidae) probably rely almost entirely upon sight (Dugan 1981, Pienkowski 1983). Sandpipers (Scolopacidae), equipped with an extremely sensitive bill, are generally considered as "tactile" foragers. Goss-Custard (1977) however, refers to redshanks *Tringa totanus* feeding by sight, and Evans (1979) points out that whilst sandpipers locate prey mainly by touch, they probably use the visual sense in the first element of prey capture. Data from laboratory experiments (van Heezik et al. 1983) suggest that dunlins *Calidris alpina* and Sanderlings *Calidris alba* can even use chemoreception to find their prey.

Greater knowledge of the mechanisms by which different wader species locate prey items would help our understanding of wader feeding ecology. For example in order to forage efficiently an individual must be able to assess the availability of prey in its immediate vicinity. Presumably this can be achieved more rapidly by visually scanning the substrate surface for signs of invertebrate activity than by a series of tactile probes.

Rather little is known about the relative importance of nocturnal foraging, although many waders do feed at night (Drinnan 1957, Davidson 1967, Heppleston 1971, Hulscher 1982). Such behaviour may be crucial to an individual's survival in periods of severe weather and/or low food availability (Goss-Custard 1969). The reliance placed upon the visual sense will probably affect the rate at which prey captures are made during darkness. The experiment described below was designed to test the extent to which visual cues are made by Dunlins during daylight.

METHODS

Nine captive dunlin were kept in an aviary (4 m x 4 m x 2 m). For details of capture and husbandry see Bradley (1982). Birds were provided with *ad lib* food, but starved for one hour before each trial. Trials were always conducted in daylight at about 14.00h. A tray (40 cm x 40 cm x 7 cm deep) was filled with moist sand. In each half of the tray a regular array of 20 holes (3 cm deep x 0.3 cm in diameter) were bored. In each hole was placed a freshly killed blowfly maggot pushed to the bottom so that it could not be seen. All prey were of approximately equal size, 1.5 cm long. One grid of holes, on the side referred to as "Featureless" (F) was carefully covered by sand so that no sign of the holes remained. The other side, designated "Visual Cue" (VC), was left untouched. The diameter of the holes was smaller than the largest invertebrate signs visible on the mudflats (left by *Hydrobia ulvae*), and the depth was such as to ensure that prey was within easy reach of all birds. Once prepared, the tray was placed in the aviary and trials were continued until 20 prey

had been taken or 1 hour had elapsed. During each trial the following behaviours were noted on a tape recorder:

- 1) Side of entry to tray ("F" or "VC").
- 2) When bird changed sides.
- 3) Every probe made (see Burton (1974) for definition).
- 4) Time spent standing or not actively foraging.
- 5) When a maggot was taken.
- 6) When bird left the tray.

Each visit of the bird to the tray was divided into a number of search periods. A search period commenced when the bird entered either half of the tray (or switched sides), or swallowed a prey item. The same period was terminated when the bird left that half of the tray or made a prey capture. A search period was defined as successful if terminated by prey capture, otherwise it was referred to as abortive. In all search periods time spent standing or not actively foraging was removed from the analysis. Six trials were performed, alternatively reversing the orientation of the tray to eliminate any possibility of observer presence affecting the results.

RESULTS

Only one individual fed on the tray with any regularity, and only data from this bird are reported here. Results are presented from individual trials and from all trials summed. Table 1 shows that significantly more prey were taken from, and a far higher percentage of search periods were successful on, the side with visual cues present. Furthermore success in terms of intake rate was higher (by up to 40%) on that side. Both the mean duration of successful search periods ("search time") and the mean number of probes were lower on the side with visual cues, although small sample sizes mean that the results are not significant for every trial.

DISCUSSION

It appears that dunlins can use visual cues to locate prey items within the substrate, thereby appreciably increasing their foraging success. This in itself is not perhaps surprising, but does have possible implications for the importance of nocturnal foraging to sandpipers. If there is insufficient light to detect visual cues, sandpipers may have reduced feeding efficiency when having to switch to purely tactile searching. Further experiments could profitably investigate the use of visual cues in falling light intensities, on patchily distributed prey, and on selection of prey items from mixed species/size classes.

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Table 1. Results for individual trials (1-6), and as totals or means for all six trials combined.

A) Maggots taken: In every trial more maggots were taken from the side with visual cues (VC) than the featureless side (F). This is significant in 5 trials (Fishers exact probability test) and for the total of all 6 trials (Fishers combining test).

B) Percentage of search periods successful: In all 6 trials a higher percentage of search periods were successful on side VC than on side F. This is significant (Sign test).

C) Duration (seconds) of successful search period: In every trial the mean duration of successful search periods was shorter on side VC than on side F. This is significant in trial 6, and for the mean of all trials combined (Mann-Whitney U test).

D) Number of probes per successful search period: In every trial this was less on side VC than on side F. This is significant in trial 4 and for the mean of all trials combined (Mann-Whitney U test).

For all parameters the significance levels are: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Values in C and D are mean \pm standard error.

Trial No.	A		B		C		D	
	Maggots taken		% of search periods successful		Duration of successful search period (sec)		No. probes per successful search period	
	VC	F	VC	F	VC	F	VC	F
1	10	0***	56	0	11.2 \pm 4.2	----	9.4 \pm 2.8	----
2	9	4	53	31	4.7 \pm 1.1	12.5 \pm 6.1	2.4 \pm 0.9	8.0 \pm 2.4
3	14	0***	82	0	5.5 \pm 1.1	----	2.8 \pm 0.9	----
4	15	4***	88	57	5.3 \pm 1.1	13.8 \pm 7.9	2.3 \pm 0.6	3.8 \pm 0.6*
5	13	3***	81	60	2.8 \pm 0.6	6.0 \pm 2.3	1.7 \pm 0.3	3.3 \pm 1.2
6	7	2*	88	50	3.1 \pm 0.9	9.0 \pm 2.0*	2.0 \pm 0.7	7.0 \pm 3.0
TOTAL	68	13***	73	34*	5.4 \pm 0.8	10.8 \pm 2.9*	3.3 \pm 0.6	5.5 \pm 1.0**

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