DISPERSION DURING FORAGING ,AND PREY CHOICE, OF WADERS IN THE NAKDONG ESTUARY, SOUTH KOREA

by Theunis Piersma

INTRODUCTION

Foraging of waders in flocks may decrease predation risk due to raptorial birds but at the same time lead to increased interference over food. Individuals of different wader species will make different choices depending on their feeding style, the behaviour of their prey and their risk of being taken by a raptor (Goss-Custard 1970, Myers 1984).

In this note, on estuarine waders in a part of the world where few such studies have hitherto been made, I aim to show that diet and dispersion patterns are correlated.

METHODS

The Nakdong Estuary (35°15'N 129°10'E) near Pusan in South Korea, was visited from 14 to 28 September 1984 (Piersma 1985 a & b). In addition to high tide and low tide counts of waders, notes were made on the dispersion type during foraging (i.e. solitary or flock feeding) of the different wader species (cf. Goss-Custard 1970, Myers & Myers 1979). The overall densities of waders on the intertidal feeding grounds were sufficiently low to categorize straightforwardly the dispersion type: some species foraged in tight flocks (moving in the same general direction and individuals were less than 10 bird-distances apart), others in clear flocks but with a looser distribution (individuals more than 10 bird-distances apart). In some species individuals foraged on their own (walking in contrasting directions and very far apart). Any opportunities to collect information on foraging behaviour and prey choice of waders were utilised. At two study sites foraging observations were made at close range from a hide over a total of four low tide periods.

RESULTS AND DISCUSSION

Table 1 summarizes the diet and dispersion type of 13 wader species in Nakdong Estuary in September 1984. The three curlew species, Whimbrel, Eurasian Curlew and Far Eastern Curlew, fed only on ocypodid crabs (most in the genus *Macrophthalmus*). Small ocypodid crabs such as *Scopimera globosa* and *Ilyplax pusillus* formed the most important prey (in terms of ingested energy) of Kentish Plovers, Terek Sandpipers and, perhaps, Greenshanks. Polychaete worms (the majority being nereids) made up the largest part of the diets of Grey Plovers, Lesser Sand Plovers, Dunlins, Bar-tailed Godwits and, perhaps, Great Knots. The last species also fed on bivalves. Although bivalves were neither rare nor unavailable in Nakdong Estuary, they provided an important part of the diet for very few wader species.

A relationship between diet and dispersion type is apparent (Table 1): crab-eaters (Whimbrel, Kentish Plovers, Terek Sandpiper, Greenshank, Eurasian Curlew and Far-eastern Curlew) foraged more dispersed than worm-eating waders (Grey Plover, Lesser Sand Plover, Dunlin, Great Knot, Bar-tailed Godwit). Average dispersion rank numbers were respectively 4.7 for crab-eaters (n=6) and 10.0 for worm-eaters (n=5). This difference is statistically significant (Mann-Whitney U test, p=0.009).

The reason for crab-eaters to feed in a relatively dispersed way is clear when we know that most, if not all, crabs which are fed upon by waders live in burrows. The crabs come to the surface of the sediment to forage during low tide, but flee back to their burrows when an approaching wader is 2-5 m away (pers. obs.). When deep down in their burrows (4-7 cm in *Scopimera* and 30-60 cm in *Macrophthalmus*, pers. obs.) they are unavailable for their main predators (Terek Sandpipers and the curlew species respectively). Therefore, crabs have to be captured 'by surprise' when on their way out of, or in, their burrows. Large densities of foraging conspecifics, and also of other species, would probably make the crabs stay out of reach continuously. An effect of 'trampling over' on the availability of worms and bivalves is not known, but would probably be less severe. Crab-eating waders would thus have difficulty obtaining adequate food when foraging in tight flocks. But why forage in flocks anyway? Could raptorial predation possibly be involved, in that birds in a flock would try to spread among others their risk of being taken by a predator?

During September 1984 one or two Peregrines *Falco peregrinus* were permanently present in the estuary. This raptor species is a well known, worldwide, predator of shorebirds (e.g. Bertochi *et al.* 1984) and the birds were actually observed while hunting wader flocks on several occasions. No successful hunts were witnessed, but I found the remains of a juvenile Great Knot that had clearly been caught by a Peregrine. It struck me that the only carcass I found belonged to one of the species occurring in the densest flocks. Terek Sandpipers, which foraged in very loose flocks or solitarily, always and immediately came together in tight flocks when alarmed by humans or Peregrnes. Goss-Custard (1970) gives a similar example for Redshanks *Tringa totanus* and Myers (1980) for Buff-breasted Sandpipers *Tryngites subruficollis*.

The acceptable degree of flocking during feeding may thus be related to diet. According to Goss-Custard (1970) it would be feeding method, and not diet *per se*, that would constrain flocking. For waders in Nakdong Estuary differences in diet are apparently so closely related to differences in feeding style, that it is impossible to tell the two factors apart.

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The stimulating review of J.P. Myers (1984) on 'spacing out' in shorebirds let me look at my data in terms of the predation/feeding

Table 1. Dispersion type during foraging of waders in the Nakdong Estuary, South Korea, in September 1984, in relation to their diet. The species are ranked in order of increasing tightness of aggregations. No individuals of any species were seen to defend feeding territories.

Rank number	Species	Dispersion type during foraging	Prey categories, in order of decreasing importance
1	Whimbrel *Numenius phaeopus*	solitary	crabs
2	Polynesian Tattler *Heteroscelus brevipes*	solitary	small macrobenthos
3	Kentish Plover *Charadrius alexandrinus*	solitary	small crabs
4	Terek Sandpiper *Xenus cinereus*	loose flocks and solitary	small crabs, polychaete worms, small bivalves
5	Greenshank *Tringa nebularia*	loose flocks and solitary	small macrobenthos, small crabs
6	Grey Plover *Pluvialis squatarola*	loose flocks	polychaete worms, small crabs
7	Eurasian Curlew *Numenius arquata*	loose flocks	large crabs
8	Far Eastern Curlew *Numenius madagascariensis*	loose flocks	large crabs
9	Lesser Sand Plover *Charadrius mongolus*	loose flocks	polychaete worms, small crabs
10	Dunlin *Calidris alpina*	loose flocks	small polychaete worms, other small macrobenthos
11	Red-necked Stint *Calidris ruficollis*	loose to tight flocks	meiobenthos, smallest macrobenthos
12	Great Knot *Calidris tenuirostris*	tight flocks	small bivalves, polychaete worms, small crabs
13	Bar-tailed Godwit *Limosa lapponica*	tight flocks	polychaete worms

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