Corella, 1993, 17(2): 52–57

ABUNDANCE, DIET AND FEEDING BEHAVIOUR OF THE WHIMBREL *Numenius phaeopus variegatus* IN RHYLL INLET, VICTORIA

P. DANN

Department of Zoology, University of Melbourne, Parkville, Victoria 3052
Present address: Penguin Reserve Committee of Management, P.O. Box 97, Cowes, Phillip Island, Victoria 3922

Received 6 December 1991

Information is presented on the numbers, diet and behaviour of Whimbrels feeding in the Rhyll Inlet in Western Port, Victoria in 1977–78. Monthly mean numbers increased gradually throughout spring to a maximum of 22 in 1977 in summer and 28 in 1978 in autumn. Crabs comprised 93 per cent of the prey items and shrimps made up the remaining 7 per cent of the diet. The most numerous prey species found in an analysis of regurgitated pellets was the Tasselled Crab *Pilumnus fissifrons*. Whimbrel preferred to feed out of the water in mudflat areas with a 10 per cent to 50 per cent covering of eelgrass and the majority of feeding actions observed (199) were pecks (39%) or jabs (38%) and the rest were probes (23%). Pecks were never seen to result in prey capture, whereas 12 per cent of jabs and 24 per cent of probes were followed by obvious handling and swallowing of food. The mean duration of six feeding periods in September and October 1978 was 240 minutes per diurnal tidal cycle (s.d. ± 56.0) and ranged from 170 to 300 minutes. The mean rate of feeding actions was 0.15 per second (s.d. ± 0.07) [or one feeding action every 6.7 seconds] and ranged from 0.08 to 0.33 during 62 minutes of observations. Their success rate was 0.02 prey items per second (s.d. ± 0.02) [or one prey capture every 50 seconds] and ranged from 0.004 to 0.06 prey per second. Crustaceans have been the only type of food from intertidal areas found in the diet of *variegatus* in Australia and New Zealand although molluscs have been recorded in the diet in India and Vanuatu.

INTRODUCTION

The distribution of the eastern Siberian race of Whimbrel *Numenius phaeopus variegatus* during the non-breeding season extends from the Bay of Bengal to Melanesia, Micronesia and Australasia (Cramp 1983). In Australia, it occurs in greatest numbers on the northern coast, although there are regular occurrences of small numbers at some southern sites (Lane 1987). In Western Port, most Whimbrel are usually found in the vicinity of Rhyll Inlet between spring and autumn (Dann *et al.*, unpubl. data).

Whimbrel feed at low tide on mudflats, rocky platforms, the banks of tidal creeks, coral rubble and reef flats (Domm and Recher 1973; Lane 1987; Dann, pers obs.). Although there have been studies of the feeding behaviour and diets of other races (Bannerman 1961; Ali and Ripley 1969), little is known of the feeding ecology of *variegatus* in Australia (Blakers *et al.* 1984; Lane 1987), its feeding behaviour or general ecology. In this paper I present information on the numbers, diet and behaviour of Whimbrel feeding in the Rhyll Inlet and on the Churchill Tidal Flats in Western Port.

METHODS

Western Port in Victoria, is a 680 km^2 bay, of which 270 km^2 is intertidal mudflat (Shapiro 1975). Whimbrels roosted at Observation Point which is in the Rhyll Inlet on the north-eastern side of Phillip Island and fed in the Inlet and on the adjoining Churchill Tidal Flats to the south-east. Counts were made in Rhyll Inlet at high-tide, two to four times each month from November 1976 to September 1978.

Feeding observations were made incidentally during a study of the feeding ecology of various other species of wader in the southern part of the bay in 1977–78. The birds were watched through 8 × 40 binoculars or ×20 telescope at ranges of 70–200 m. Limited observations were also made at night using an infra-red telescope but the resolution of the telescope was not adequate to determine any more than whether or not the birds were feeding. The duration of feeding periods in intertidal areas was measured from the time 50 per cent or more of the individuals at the roost commenced feeding until 50 per cent or more had stopped feeding and returned to the roost. The rate of feeding movements was recorded using a stopwatch and feeding individuals were observed for periods of two minutes or until they changed behaviour, at which time the observation was terminated. Observations were changed to a different individual between these periods. Feeding actions were divided into pecks (no penetration of the substrate), jabs (bill inserted up to half its length into the substrate) and probes (bill inserted half to full length into the substrate).

Feeding patches were differentiated on the basis of eelgrass (*Zostera muelleri*) cover (lightly grassed = 10–50% cover, medium = 50–<100% cover and completely grassed) or substrate (rock platform, sand, sandy-mud and mudflat) in bare areas. Areas of sand, sandy-mud and mudflat were distinguished on the basis of particle size. Sandy areas had the largest particle size and mudflats had the finest. The time each individual spent feeding in each area was recorded throughout two entire tidal cycles in September and October 1978.

Five horizontal feeding zones were recognized in relation to the edge of the water (Recher 1966): Zone A, consisted of areas above the water's edge not retaining a surface film of water; Zone B, consisted of areas above the water's edge retaining a surface film of water; Zone C, consisted of the water's edge and an area 0.5 m on either side [modified from Recher (1966)]; Zone D, was the area between 0.5 and 1.5 m below the water's edge [modified from Recher (1966)] and Zone E was the area beyond Zone D which was accessible to the birds when feeding. The number of birds in each zone was noted at five-minute intervals for one hour either side of low tide, once in September and once in October, 1978.

Ten regurgitated pellets from Whimbrel were collected early in the morning from the high-tide roost at Observation Point in January, 1978. Two other avian species produced pellets at the roost, Eastern Curlew *Numenius madagascariensis* and Pacific Gulls *Larus pacificus*, and pellets were identified on the basis of size, shape, cohesion, accompanying footprints and faeces, and position on the roost.

Each pellet was placed in an individual plastic bag at the roost, and soaked in water and sieved through a 0.5 mm mesh before analysis in the laboratory. The species composition of the samples was determined by comparison of the hard parts from the pellets with a reference collection from the Rhyll Inlet. All hard parts in the pellets were identified and represented a minimum of 61 prey items. Pellets were examined for hard remains of polychaetes (jaws and setae) and molluscs, but none were found. The number of each prey species was determined by dividing the number of recognisable hard parts (portions of claw or leg) by the appropriate number of a whole animal. This number was a minimum because claws and legs were often lost during prey capture. The nomenclature of Brachyurans was taken from Wescott (1976).

RESULTS

Numbers of Whimbrels

Monthly mean numbers increased gradually throughout spring to a maximum of 22 in February 1977 and 28 in April 1978 (Fig. 1). No birds remained in the Inlet in winter 1977, but three did so in 1978.

Diet

Whimbrel pellets were almost circular, approximately 20 × 15 mm, half the size of curlew pellets and, unlike curlew pellets, loosely bound. Although the pellets of Pacific Gulls were also circular and loosely bound, they were 3–4 times larger in diameter. In addition, accompanying footprints and faeces, and location on the roost, served as identifying features. Whimbrel pellets were extremely difficult to collect at Rhyll Inlet because of the Whimbrels' habit of roosting at the lower edges of the exposed shore and moving only when the water levels reached them. The pellets were often dropped in water and had disintegrated before they could be reached.

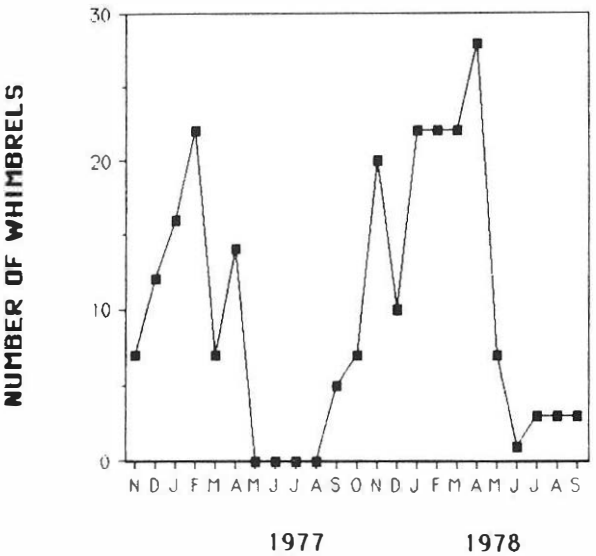


Figure 1. *The monthly mean numbers of Whimbrels roosting in the Rhyll Inlet from November 1976 to September 1978.*

TABLE 1

The number and frequency of occurrence of hard-shelled prey species found in ten Whimbrel pellets collected at Observation Point in January, 1978.

Prey species	Number (%)	Frequency (n = 10)
Tasselled Crab *Pilumnus fissifrons*	37 (61)	7
Mottled Shore-Crab *Paragrapsus gaimardi*	8 (13)	4
Rough Rock-Crab *Nectocarcinus tuberculosus*	6 (10)	4
Two-Spined Crab *Lithocheira bispinosus*	5 (8)	2
MacCulloch's Shrimp *Synalpheus macculloch*	3 (5)	2
Smooth Pebble-Crab *Philyra laevis*	1 (2)	1
Snapping Shrimp *Alpheus euphrosyne*	1 (2)	1
Sentinel Crab *Macrophthalamus latifrons**		
TOTAL	61	

*found in December 1978 in disintegrated pellets not included in analysis.

All the prey remains in the pellets were of the Order Decapoda. Hard parts of molluscs and polychaetes were not found. The most numerous prey item was the Tasselled Crab *Pilumnus fissifrons*, which comprised 61 per cent of the prey items in the pellets (Table 1). Collectively, crabs comprised 93 per cent of the prey items and shrimps made up the remaining 7 per cent (Table 1). On one occasion (September 1978), several disintegrated pellets, containing the remains of Sentinel crabs *Macrophthalamus latifrons*, were found covered by water. This species was not found in the pellets collected in January 1978 and was not included in the analysis as it was not possible to determine the precise number of pellets involved.

Feeding Behaviour

Mudflats with a 10–50 per cent covering of eelgrass were the preferred feeding microhabitat in Rhyll Inlet (56%); followed by sandy-mud areas (29%); bare mudflats (13%) and rock platforms (2%). Bare sandbanks or mudflats with greater than 50 per cent eelgrass covering were rarely used although large areas were available (Table 2).

Whimbrel usually fed in close proximity to each other at the beginning of the tidal cycle and dispersed more widely as the water level dropped before aggregating again as the tide came in. Intraspecific aggression was rare and, when observed, most frequently followed the capture of a prey item. Most of their feeding was in areas away from the water's edge (80% of observations) and preference was shown for the drier parts of the shoreline (44% of observations) [Zone A in Fig. 2].

The majority of feeding actions observed (199) were pecks (39%) or jabs (38%) and the rest were probes (23%). When jabbing, an average-sized Whimbrel penetrated the substrate up to 38 mm (males) and 42 mm (females) and, when probing, up to 76 mm (males) and 84 mm (females) [Dann 1993]. Pecks were never seen to result in prey capture, whereas 12 per cent of jabs and 24 per cent of probes were followed by obvious handling and swallowing of food, suggesting that pecks were probably exploratory feeding actions. Most successful prey captures were preceded by runs of between 0.5 and 10 m with an average of 2–3 metres. A few resulted from a bird simply probing into a crab burrow, while twisting its head from side to side. Prey were often manipulated in the bill before swallowing which resulted in some of the legs and claws of crabs and shrimps being broken off but generally prey could not be identified by observation. On some occasions, food items were taken to a nearby pool and washed before being swallowed.

The mean duration of six feeding periods in September and October 1978 was 240 minutes per diurnal tidal cycle (S.D. = 56.0) and ranged from 170 to 300 minutes. No birds fed continuously for

TABLE 2

The relative use of different types of areas by Whimbrels feeding in Rhyll Inlet in spring and summer.

Microhabitat	Time spent feeding (mins)	%
Mudflats (bare)	1 471	13
(10–50% cover)	6 072	56
(>50% cover)	0	0
Sandy-mud areas	3 120	29
Rock platform	200	2
Bare sandbanks	0	0
Total	10 863	

the duration of the feeding period. Movements between feeding areas or due to disturbance, occasional interactions with other species or conspecifics, preening and brief periods of inactivity reduced the time spent feeding to approximately 70 per cent of the total feeding period. Whimbrel were also observed feeding during the night at low tide but the duration of these feeding periods could not be measured reliably.

The mean rate of feeding actions was 0.15 per second (S.D. = 0.07), or one feeding action every 6.7 seconds, and ranged from 0.08 to 0.33 during 62 minutes of observations. During the same observation periods, their success rate was 0.02 prey items per second (S.D. = 0.02), or one prey capture every 50 seconds, and ranged from 0.004 to 0.06.

DISCUSSION

Fluctuations in numbers in Rhyll Inlet

In December 1979, close observation revealed that 17 of the 22 birds roosting in the Inlet were moulting their middle primaries (numbers 5–7) whereas the remaining five were not. The usual pattern of primary moult in waders is for birds in their first year not to undergo a full primary moult while older birds moult their primaries in late summer and autumn (Hale 1980). Some first year birds of some wader species do moult their outer primaries but this does not appear to be the case for Whimbrel (Cramp 1983). Therefore it is likely that the three birds present in the winter of 1978 were birds in their first year.

Diet

Field observations of prey captures were inadequate to confirm directly the representiveness of the prey found in the pellets in the diets of Whimbrels in the Rhyll Inlet. While the pellets suggested that the diet was predominantly crabs and shrimps, it is possible that molluscs and polychaetes were taken also because these groups could be consumed without the ingestion of hard parts. However, the high frequency of active pursuit and rapid handling of many prey suggest that molluscs were not an important component of the diet. The feeding behaviour of Whimbrels was markedly different from Bar-tailed Godwit *Limosa lapponica* which were often observed to feed on polychaetes in the Inlet. Godwits fed by rapid probing into the substrate, whereas

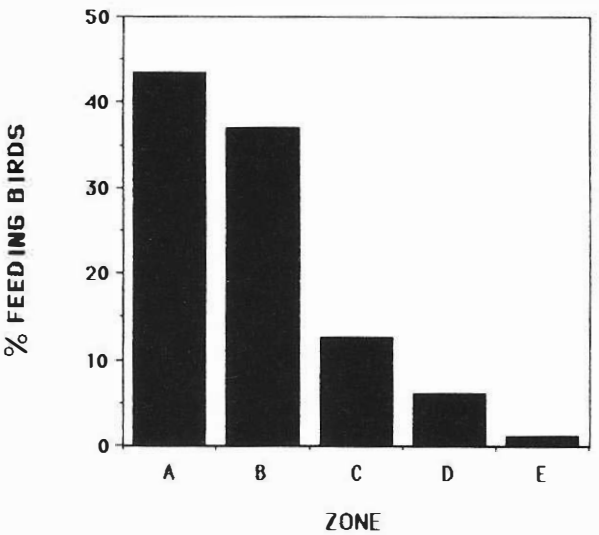


Figure 2. *The feeding zones used in relation to the water's edge in Rhyll Inlet for one hour either side of low-tide during two diurnal tidal cycles in September and October, 1978. Feeding zones were defined as follows: Zone A — area above the water's edge not retaining a surface film of water; Zone B — area above the water's edge retaining a surface film of water; Zone C — the water's edge and the area 0.5 m on either side; Zone D — area between 0.5 and 1.5 m below the water's edge and Zone E — area beyond Zone D which was accessible to the birds when feeding.*

Whimbrels usually made single feeding actions interspersed with relatively large, and often rapid, locomotory movements. This suggests that they were locating their prey by sight and often pursuing them across the mudflat or intercepting them at the entrances to their burrows.

Crabs have been the prey most frequently recorded in the diets of this subspecies of Whimbrel at other locations (Table 3). However, it is apparent that other races of Whimbrel, and *variegatus* in other circumstances, often feed on other groups of marine organisms. Ali and Ripley (1969) recorded the food of *variegatus* as chiefly molluscs and crabs (*Uca*, *Thalamita crenata* and *Sesarma longipes*) on Indian coasts. Also, a specimen of *variegatus* in the Australian Museum, collected from the New Hebrides (now Vanuatu), contained 'shell' as well as 'crab debris' (Table 3), indicating that molluscs may have been part of the diet there. In Europe (Cramp 1983), the diet

TABLE 3

The types of prey recorded in the diets of *variegatus* at various localities.

Food Recorded	Location	Source
Crabs (various, see Table 1)	Rhyll Inlet, Victoria	This study
Shrimps (*Synalpheus, Alpheus*)	Rhyll Inlet, Victoria	This study
Crabs	New Hebrides	Australian Museum*
Molluscs (shell in gut)	New Hebrides	Australian Museum*
Crabs	Northern Australia	McLennan (1917)
Tunnelling Mud Crab (*Helice crassa*)	Maketu Estuary, New Zealand	Latham (1978)
Crabs (*Ocypode* sp.)	Kermadec Islands, New Zealand	Merton (1970)
Crabs (*Uca, Thalamita crenata* and *Sesarma longipes*)	India	Ali and Ripley (1969)
Molluscs	India	Ali and Ripley (1969)

*Information on specimen No. 044560.

of *phaeopus* in coastal littoral zones includes molluscs (*Littorina* and *Nucella*), crustaceans (crabs, sand-hoppers and shrimps) and annelids (polychaete worms, including *Arenicola*).

Feeding Behaviour

The run-snatch feeding mode of Whimbrels, with its obvious pursuit component, suggests that they were detecting and capturing their prey by visual cues. The main food species in the pellets was Tasselled Crabs but the daily and tidal activity patterns of this crab do not fit with the observed feeding behaviour of Whimbrel during daylight. In aquaria, Tasselled Crabs were active only when covered with water or at night (Dann, unpub. data). During daylight, when uncovered by water, these crabs remained motionless, partially buried at the base of seagrass plants or under rocks. The pellets were collected early in the morning and therefore probably came from a nocturnal feeding period when these crabs were active at low tide. It seems more probable that the Sentinel Crab, which is one of the few crab species active at low tide during daylight in the Inlet, and was found in disintegrated pellets on a separate occasion, is the main prey during daylight.

In Guinea-Bissau, West Africa, *phaeopus* feeding on the deep-burrowing fiddler crab *Uca tangeri*, also caught their prey after running some distance, but the prey were usually captured on the surface and were not washed before swallowing (Zwarts 1985). In Rhyll Inlet, most crabs were caught by jabbing and probing, after they had apparently retreated to their relatively shallow burrows. The encrusting sediment on the crabs resulting from this method of capture presumably necessitated washing on some occasions.

By feeding in areas with little or moderate cover of eelgrass, the Whimbrels are likely to be increasing their efficiency of prey capture by greater visual perception of prey coupled with less effective escape responses of prey in the structurally simpler habitat. Evans (1976) drew attention to the possible detrimental effects of weather on the hunting efficiency of predators hunting by sight in water. Wave action may destroy signs of prey and the position of prey may be distorted by the change in refractive index between air and water. The strong preference of Whimbrels for feeding in dry and wet mud out of water (A and B zones in Fig. 2) compared with submerged areas may be determined by these constraints, despite the likelihood that some species of crabs may be more active when immersed. The suggestion that using visual cues when foraging is more effective out of the water in bare and lightly grassed areas in Western Port is supported further by the feeding behaviour of the Double-banded Plover *Charadrius bicinctus*. This species also feeds predominantly in these types of areas and is thought to use visual cues when detecting and capturing prey (Dann 1991).

ACKNOWLEDGMENTS

This work was conducted as part of a broader study of the feeding of waders in Western Port financed by the Environmental Studies Section of the Ministry for Conservation (now Department of Conservation and Environment) in Victoria. The encouragement and support of Dr Angus Martin are greatly appreciated. I am also grateful to Walter Boles for permission to examine the specimens at the Australian Museum and to Durno Murray and an anonymous referee for their helpful comments on the manuscript.

REFERENCES

Ali, S. and Ripley, S. D. (1969). 'Handbook of the Birds of India and Pakistan', Vol. 2. (Oxford University Press: Delhi.)

Bannerman, D. A. (1961). 'The Birds of the British Isles', Vol. X. (Oliver and Boyd: Edinburgh.)

Blakers, M. S., Davies, S. J. J. F. and Reilly, P. N. (1984). 'The Atlas of Australian Birds' (RAOU and Melbourne University Press: Carlton.)

Cramp, S. (1983). 'Handbook of the Birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic', Vol. 3. (Oxford University Press: Oxford.)

Dann, P. (1991). Feeding Behaviour and Diet of Double-banded Plovers *Charadrius bicinctus* in Western Port, Victoria. *Emu* **91**: 179–184.

Dann, P. (1993). Sexual dimorphism in bill length — Whimbrel. In: Data Exchange *Corella* **17**: 57.

Domm, S. and Recher, H. F. (1973). The Birds of One Tree Island with notes on their yearly cycle and feeding ecology. *Sunbird* **4**: 63–86.

Evans, P. R. (1976). Energy balance and optimal foraging strategies in shorebirds: some implications for their distribution and movement in the non-breeding season. *Ardea* **64**: 117–139.

Hale, W. G. (1980). 'Waders.' Collins New Naturalist Series. (Collins: London.)

Lane, B. A. (1987). 'Shorebirds in Australia.' (Nelson: Melbourne.)

Latham, P. C. M. (1978). Asiatic Whimbrel catching crabs. *Notornis* **25**: 355.

McLennan, W. (1917). North Australian Birds. *Emu* **16**: 205–231.

Merton, D. V. (1970). Kermadec Islands Expedition Reports: A general account of birdlife. *Notornis* **17**: 147–188.

Recher, H. F. (1966). Some aspects of the ecology of migrant shorebirds. *Ecology* **47**: 393–407.

Shapiro, M. A. (1975). 'Westernport Bay Environmental Study, 1973–1974.' (Ministry for Conservation: Melbourne.)

Wescott, G. (1976). The Intertidal Crabs of Victoria: an introduction, checklist and key to adults. *Vic. Nat.* **93**: 237–245.

Zwarts, L. (1985). The winter exploitation of fiddler crabs *Uca tangeri* by waders in Guinea-Bissau. *Ardea* **73**: 3–12.

DATA EXCHANGE

SEXUAL DIMORPHISM IN BILL LENGTHS OF WHIMBREL *Numenius phaeopus variegatus*

Measurements of exposed culmens of twelve females and fourteen males from museum collections in Brisbane, Sydney and Melbourne were taken to nearest 0.1 mm.

Males (mean ± S.D.): 76.5 mm ± 3.8 (range 69.3–81.3), n = 14.

Females (mean ± S.D.): 84.6 mm ± 3.6 (range 80.1–89.7), n = 12.

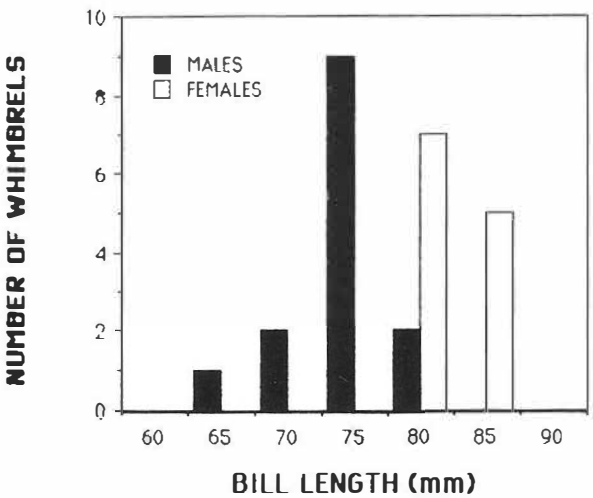
Females had significantly longer bills ($t = -5.7$, d.f. = 24, $p < 0.005$). Sexual dimorphism in bill length has been recorded for *variegatus* previously from birds collected in Indonesia (Cramp, S. 1983). However, Ali and Ripley (1969) noted that 'in this race *(variegatus)* there is apparently no difference in size between the sexes'.

I am grateful to Glen Ingram, Walter Boles and Belinda Gillies for access to the collections under their care.

References

Ali, S. and Ripley, S. D. (1969). 'Handbook of the Birds of India and Pakistan'. (Oxford University Press: Delhi.)

Cramp, S. (1983). 'Handbook of the Birds of Europe, the Middle East and North Africa. The Birds of the Western Palearctic' No. 3. (Oxford University Press: Oxford.)



P. Dann

Penguin Reserve Committee of Management
P.O. Box 97, Cowes, Phillip Island, Vic. 3922.

(Received 6 December 1991)