

# EFFECTS OF HUMAN ACTIVITY ON THE BEHAVIOUR OF NORTHERN NEW ZEALAND DOTTEREL *Charadrius obscurus* *aquilonius* CHICKS

Andrea Lord,<sup>a</sup> Joseph R. Waas<sup>a</sup> & John Innes<sup>b</sup>

<sup>a</sup>Department of Biological Sciences, University of Waikato, Private Bag 3105, Hamilton, New Zealand

<sup>b</sup>Manaaki Whenua Landcare Research, Private Bag 3127, Hamilton, New Zealand

(Received 25 January 1996; accepted 23 September 1996)

## Abstract

Human disturbance is one of the factors that may contribute to low breeding success in the endangered New Zealand dotterel *Charadrius obscurus aquilonius*. This study examined how foraging and related behaviours of northern New Zealand dotterel chicks were affected by human presence. Chicks were observed both in the presence, and in the controlled absence, of people. Results showed that, when people were present, chicks spent less of their feeding time in the littoral zone, and more in the supralittoral zone, and in general spent less time feeding when people were present. These data suggest that the littoral zone may be more desirable for foraging than is the supralittoral zone, and that high levels of human disturbance may infer energetic constraints on New Zealand dotterel chicks. Fledging success of chicks may be enhanced if human access to feeding areas adjacent to breeding sites is reduced during the chick-rearing phase of the breeding season. © 1997 Elsevier Science Ltd

**Keywords:** disturbance, shorebirds, dotterel, foraging, *Charadrius*.

## INTRODUCTION

Humans appear to cause disturbance which decreases the breeding success of many bird species (Burger, 1981a and papers cited therein; see also Ollason & Dunnet, 1980 and Safina & Burger, 1983). Disturbance can be defined as 'the disruption of normal activity patterns'; its effects may range from the flushing of a foraging bird to the direct destruction of eggs or young (Senner & Howe, 1984).

Several behavioural responses by breeding birds to human disturbance may cause a decrease in breeding success. Human intrusion into breeding sites has been shown to cause parents to abandon eggs and chicks temporarily, leaving them open to intraspecific and interspecific predation (Kury & Gochfeld, 1975; Safina & Burger, 1983). For example, Mikola *et al.* (1994)

found that gulls killed velvet scoter *Melanitta fusca* ducklings more frequently in disturbed than undisturbed situations. Predations of auklet *Aethia* eggs and chicks by voles were also more frequent in highly disturbed areas (Piatt *et al.*, 1990). In addition, temporary egg abandonment may cause exposed eggs to overheat or cool (Hunt, 1972; Safina & Burger, 1983). Intrusions may even inhibit egg-laying (Tremblay & Ellison, 1979).

Wild birds appear to view humans as potential predators; that is, they avoid close proximity with humans (Roberts & Evans, 1993). In a study of the effects of human activity on non-breeding waterbirds, Burger (1981b) considered shorebirds to be the group most vulnerable to disturbance because they were easily displaced by people, as opposed to groups such as terns and gulls.

An individual's chance of survival might be maximised by optimising its energy intake and minimising the risk of predation (Mainini *et al.*, 1993). If birds are frequently disturbed by predators (including humans), foraging time and/or quality may decrease, while energy-expending behaviours such as fleeing (swimming, running, flying) may increase (Keller, 1991; Mainini *et al.*, 1993). For example, disturbance caused decreased feeding activity and increased swimming time in velvet scoter ducklings (Mikola *et al.*, 1994). Burger and Gochfeld (1991a) showed that sanderlings *Calidris alba* displayed a significant negative correlation between time spent feeding and time spent running or flying because of people.

The New Zealand dotterel *Charadrius obscurus* is a plover that is endemic to New Zealand. It is an endangered species (Collar *et al.*, 1994). Humans and their activities may contribute to the decline of the northern subspecies *C. o. aquilonius* by causing repeated brood desertion, crushing nests and increasing the chance of egg and chick predation, particularly by gulls (Dowding, 1993).

Northern New Zealand dotterels breed on sandy beaches, where they are exposed to disturbance by humans from recreational use; vehicles and dogs also pose significant problems (Dowding, 1989). New Zealand

dotterel chicks are precocial and nidifugous (Marchant & Higgins, 1993). Parents simply lead chicks to suitable feeding areas, so direct chick access to suitable food sources is crucial for growth and survival.

New Zealand dotterel adults defend territories (Marchant & Higgins, 1993); chicks appear to feed only in their parents' territory. Prey items known to be taken by adults include molluscs, insects, amphipods, crabs and fish (Marchant & Higgins, 1993). No data are available on the diet of chicks. Like most shorebirds, New Zealand dotterels forage both by day and by night (Evans, 1979; Marchant & Higgins, 1993).

The Wharekawa refuge, where the present study was conducted, is an important breeding site for New Zealand dotterels because it contains a high number of breeding pairs (Dowding, 1993); these occur in a relatively confined area, resulting in relatively small territories. The density probably reflects the suitability of the habitat.

The present experiment manipulated levels of human disturbance to assess how the presence of humans affected (1) foraging and related activities of northern New Zealand dotterel chicks, and (2) habitat (littoral or supralittoral) use.

## METHODS

### Study area

The study was carried out at the Wharekawa Wildlife Refuge on the east coast of the North Island of New Zealand. Eight to 10 pairs of dotterels nest in the refuge each year, along with approximately 18 pairs of the variable oyster catcher *Haematopus unicolor*. The refuge consists of a sandspit which has an area of approximately 3500 m<sup>2</sup> and very little vegetation (Fig. 1). Approximately 100–400 people visit the site per day over the height of the holiday season, and 20–40 per day at other times during summer. People are present mainly during receding and low tides in daylight hours. The supralittoral zone ('dry zone'), which is the nesting area, is fenced so that people may only enter the littoral area ('shore zone') surrounding it. Most of the shore zone is covered by water at high tide.

Territories were delineated by observing aggressive encounters between adults and noting where individuals normally resided. Each territory encompassed some dry zone plus a strip of shore zone (Fig. 1).

### Study animals

Chicks belonging to six pairs of adults were examined in this study. Each pair of adults had either one or two chicks (Table 1). For the purpose of this study, each family of chicks, whether it consisted of one or two chicks, was treated as one subject. This was decided because it was not always possible to distinguish between siblings and because they were observed to behave very similarly.

Families of chicks were numbered. They were identified by which territory they were in, their size and by which adults were accompanying them. Adults were recognised by colour-band combinations (four of the adults had been banded as part of a long-term study) and plumage patterns. Chick families could always be identified unambiguously.

The chicks that were studied were of a variety of ages, ranging from three to 60 days. All of the chicks were unfledged. Hatching was not synchronous between families, so while the last two chicks were being observed, most of the chicks of the other four families had fledged.

### Procedure

Observations were made using a 20× or 25× telescope from a hide (Fig. 1) and were carried out between 5 December 1994 and 18 January 1995. Observations were made only on receding tides, for 3-h periods, between 09.30 and 17.30 h (NZDT). These hours were chosen because people were more likely to be present as disturbing stimuli during this time.

Five-minute continuous samples were conducted on each territory, in turn, in a clockwise direction around the sandspit. If a chick could not be found in a territory, the observer shifted her attention to the next territory. Observations were dictated into a tape recorder and transcribed later, so that, for each 5-min period, a sum (in seconds) of the time spent on each behaviour could be calculated. There was wide variation in the number of samples taken between chicks (Table 1). At both the beginning and end of each sample, the presence or

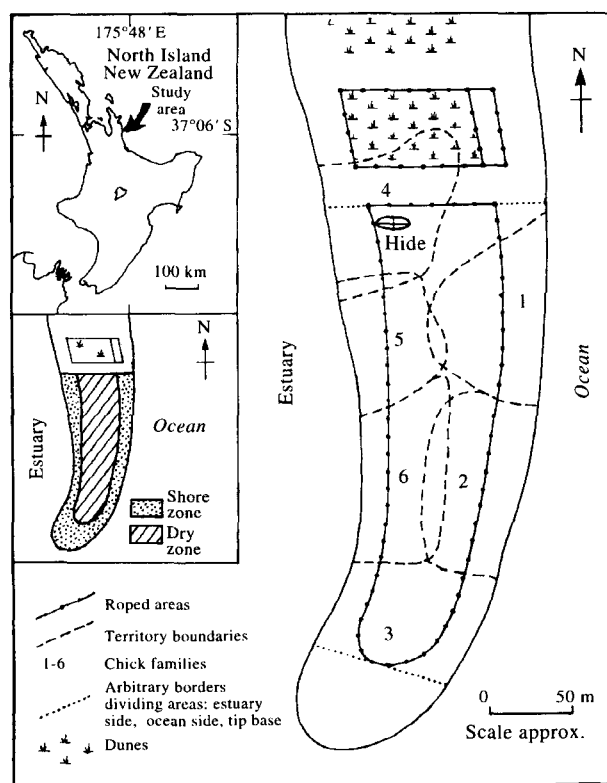


Fig. 1. Schematic diagram of Wharekawa sandspit.

absence of people on each area of the sandspit (estuary side, ocean side, tip or base — Fig. 1) was recorded.

Observations were made under two regimes, 'disturbed' and 'undisturbed'. During 'disturbed' sampling days, visitors to the refuge walked freely around it. However, a sample was defined as 'disturbed' only if a person was present on any area(s) of the sandspit that bordered the territory during the sample. 'Undisturbed' samples were obtained by cutting off human access to the refuge for three 3-day periods. At least five days elapsed between each of these periods. For the first two closures, the entire sandspit was closed. For the third closure, only the estuary side was closed because the number of visitors was too high to attempt a complete closure, and because the only unfledged chicks remaining on the spit had territories that bordered solely on the estuary side.

Due to the slope down to the sea, the curvature of the sandspit on the ocean side and the position of the hide on the estuary side (Fig. 1), it was impossible for the observer to see chicks with territories on the ocean side while they were in the shore zone. Therefore, the time chicks spent in this area was recorded but their behaviours could not be noted. This condition applied to chick families 1 and 2.

#### Statistical analysis

Balanced ANOVAs were carried out to determine whether the level of disturbance (disturbed vs undisturbed)

influenced the mean percentage of time that New Zealand dotterel chicks allocated to their activities. Chick families were used as replicates (i.e. the disturbance-chick interaction was used as an estimate of error). Residuals analyses were checked for normality. Analyses of the percentage of time spent on activities in specific zones allowed comparisons of zone choice to be made.

## RESULTS

The number of people on the territories of sampled chicks during sampling ranged from 1 to 14. People frequently passed within 3–5 m of the chicks, and were almost always unaware of their presence.

#### Foraging behaviour

While people were present, chicks spent a smaller proportion of time foraging in the shore zone than during undisturbed times ( $F = 110.0$ , 1 d.f.,  $p < 0.005$ , Fig. 2). This was not the case in the dry zone ( $F = 7.8$ , 1 d.f., n.s., Fig. 2). Less foraging overall was therefore performed in the presence of people, with the deficit occurring in the shore zone.

Habitat use was affected by the presence of humans. When people were present, chicks spent less time in the shore zone and more in the dry zone, ( $F = 74.6$ , 1 d.f.,  $p < 0.001$ , Fig. 3), and a greater proportion of the chicks'

Table 1. Hatch date, family size, fate and number of 5-minute observations of chicks

Chick family	Hatch date	No. of chicks	Fate of chicks	No. of observations	
				Disturbed	Undisturbed
1	Mid-October	2	Fledged	9	30
2	Early October	2	Fledged	2	20
3	Early October	1	Fledged	2	13
4	Early November	1	Fledged	3	26
5	Late December	2, then 1	Died	32	34
6	Late December	1	Died	28	26

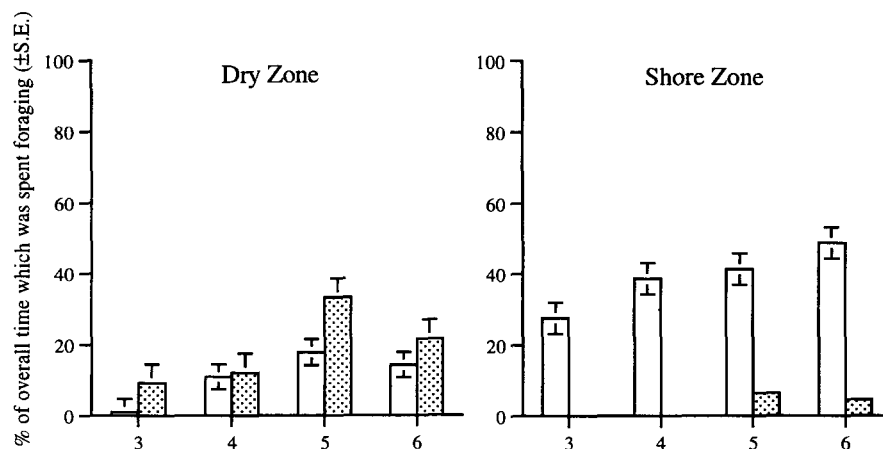


Fig. 2. The percentage of overall time during which foraging occurred (□, undisturbed; ▤, disturbed).

foraging time was spent in the (dry zone than the shore zone ( $F = 51.8$ , 1 d.f.,  $p < 0.05$ , Fig. 4).

### Other behaviours

Running, walking and standing behaviours were not affected by human presence in either zone ( $F < 5.2$ , 1 d.f., n.s.).

Figure 5 shows the time budget for all chicks in the presence and absence of people. Head-bob, feather maintenance, flight practice and brood activities were relatively rare, and were included in the 'other' category within the time budget. The brooding of chicks was observed only twice, both times close to high tide when there was a high percentage of cloud cover and temperatures were below average. Humans were absent from the sandspit during both occasions.

### DISCUSSION

New Zealand dotterel chicks spent less time feeding when people were present in their habitat. This result

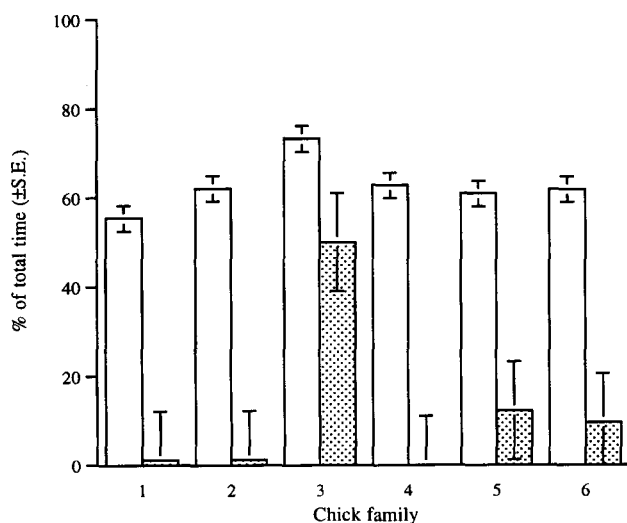


Fig. 3. The mean percentage of total time that was spent in the shore zone (□, undisturbed; ▨, disturbed).

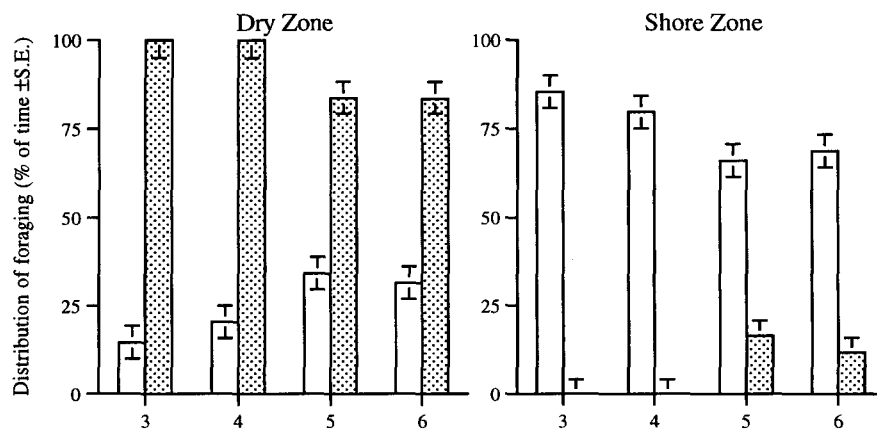


Fig. 4. Distribution of foraging time (□, undisturbed; ▨, disturbed).

highlights the obvious danger that, if people are present much of the time, chicks may not consume enough food to meet their energy requirements. Results similar to ours were recorded for velvet scoter ducklings, which spent less time feeding and more time swimming when disturbed (Mikola *et al.*, 1994). Burger and Gochfeld (1991a) also showed that adult sanderlings foraged less, and flew or ran more, as the number of humans present increased. Human presence reduced the foraging time available to green-backed herons *Butorides striates* (Kaiser & Fritzell, 1984).

The threat of an encounter with humans appears to be resolved by chicks leaving the shore zone and entering the roped-off dry zone. However, the shore zone seems to be important for foraging, because the chicks spent more time there when people were not present. Foraging was disrupted more by human presence in the shore zone than in the dry zone. This is logical, as people did not enter the dry zone. During the time that chicks did spend in the shore zone whilst disturbed, they foraged less than during time spent in the shore zone whilst undisturbed. The presence of people, therefore, seems to keep chicks from foraging in this preferred area. The rope surrounding the dry zone at the study site may accentuate the difference between the two zones. The fact that more time is spent within the roped-off dry zone when people are present indicates that the birds may treat this as a 'safe' area.

It is likely that more prey (or better quality prey) were available in the shore zone than in the dry zone. Lower prey-availability in dry versus wet substrates has been shown in other studies (e.g. Evans, 1976; Pienkowski, 1983). If this were the case at the study site, it would mean that it is particularly detrimental to restrict chicks from this zone. Local studies comparing prey availability between the two zones are, however, necessary.

The failure of chicks to access adequate food resources may lead to decreased growth rates and decreased chances of fledging. Although this was not examined in the present study, Kersten and Brenninkmeijer (1995) showed that this was the case in the oyster catcher *Haematopus ostralegus*.

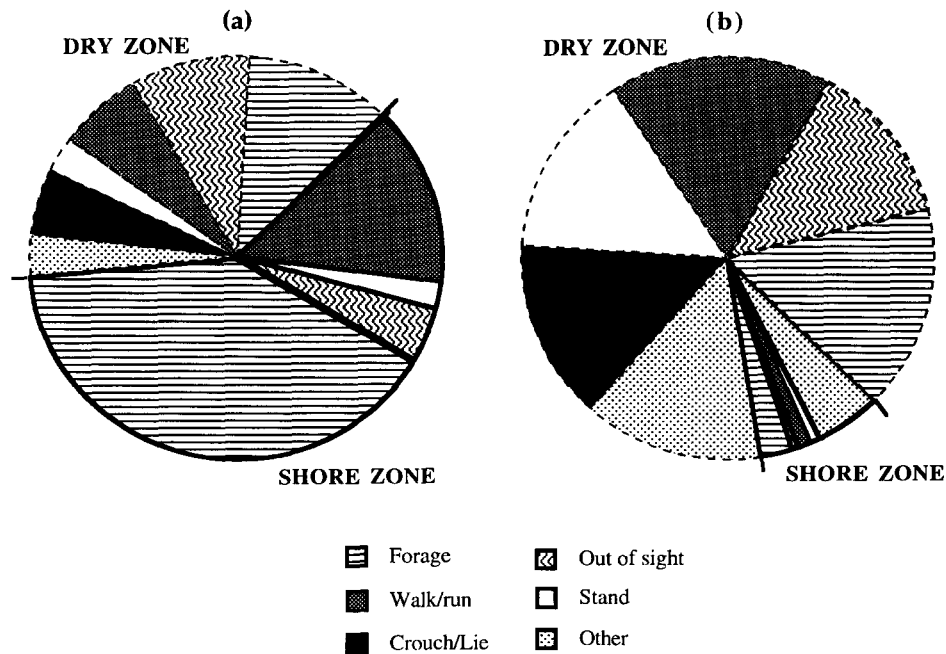


Fig. 5. New Zealand dotterel chicks' mean time budget in (a) the absence and (b) the presence of people. (Note: the 'other' category includes head-bob, feather maintenance, brood and flight practice.)

It is possible that chicks foraged more at night to compensate for lost foraging time caused by disturbance during the day. This has been noted in sanderlings, which foraged more by night as the number of humans they encountered during the day increased (Burger & Gochfeld 1991a).

## CONCLUSIONS

This study has shown that one of the ways that humans may disturb the endangered New Zealand dotterel is by reducing the time available to chicks for foraging, therefore imposing energetic constraints on chicks. The more severe the disturbance (i.e. the more people present and the longer they are present), the greater the impact it is likely to have on chick foraging. Restricting people's access to the feeding areas adjacent to breeding sites during the chick-rearing phase of the breeding season may increase chick fledging success.

## ACKNOWLEDGEMENTS

We would like to thank the Royal Forest and Bird Protection Society (Waikato branch), the Royal Society of New Zealand and the Department of Biological Sciences, University of Waikato for funding this work. The Department of Conservation (especially Dr Theo Stephens, Peter Carter and Gillie Adam) provided logistical support.

We also thank the following people for additional support: Bev Woolley, Bruce Collier, staff of the Opou-tere Youth Hostel and the Opou-tere Park Beach Resort, Dr John Dowding, Rachel Lander, Michael Rodding, David and Lorraine Hutt, Ian Graves, Ada Lord, Dr Ray Littler, Dr Michael King, Dudley Bell, Frank Bailey and Caroline Bagshaw. Thanks to Carolyn Miller King for commenting on the manuscript.

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