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FOOT-TREMBLING BY THE BLACK-FRONTED DOTTEREL

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ABSTRACT

Several puzzling cases of foot-trembling are described in the Black-fronted Dotterel *(Charadrius melanops)* in the southern part of the North Island, preceded by an account of its normal habitat and feeding methods during the year. The significance of foot-trembling is discussed in the light of discussion in *British Birds*. Similar observations on any New Zealand birds are called for.

INTRODUCTION

During a study of the Black-fronted Dotterel *(Charadrius melanops)* being carried out in the Wairarapa district since 1972 (Heather 1973), it has been found that this dotterel has in its repertoire of feeding methods a seldom-used version of "foot-trembling" (Simmons 1961a: 34). Since I do not recall having seen other waders in New Zealand using any version of specialised foot movements and since the purpose of such movements is still debatable, I hope by drawing attention to the subject to attract the records which other observers may have on any New Zealand species. The usual habitat and feeding of the Black-fronted Dotterel are outlined first, to give perspective to the foot-trembling habit.

NORMAL FEEDING

The Black-fronted Dotterel, which is a recent colonist from Australia, is a freshwater feeder which prefers the fine silty mud freshly exposed by falling river and pond levels. Normally it feeds in the typical plover manner by picking from the surface, with legs straight, pivoting from the hips. In some mud conditions it probes to a depth about half the length of its bill, which corresponds roughly to the extent of the black tip of its bill. While feeding, it walks carefully and quietly, picking as it goes, without the conspicuous run-and-stop, pick, run-and-stop, pick of the commonest New Zealand plover, the Banded Dotterel *(C. bicinctus)*.

On the Ruamahanga River in the Wairarapa the prime habitat for the Black-fronted Dotterel is any portion of river channel that has been dammed off by a shingle bank built up during the high river level of winter. The resulting backwater has a surface of soft fine wet silt, very slippery for humans. Often the silt remains moist with water filtering through the shingle bank. In such a site the birds will nest on the shingle ridge and feed themselves and their chicks on the nearby silt. Similar sites sometimes occur where shingle is excavated for human use.

In spring such feeding places are plentiful in the backwaters and runnels as the river drops. If the river remains low, the mud dries out and the dotterels spread out along the river to breed by the favoured places that remain. As the wet silt dries, the dotterels shift their feeding with the change in level, keeping to the freshly exposed slippery mud. In extreme summer conditions they will feed among the shingle at the water's edge, particularly where algal growth has been stranded and is rotting. Non-breeding birds seem then to wander the river. The dotterels do not move to the dry shingle of the river bed unless they are disturbed by an intruder or unless they are moving to or from a nest.

In these conditions I have seen them feed, during many hours of watching, only by picking and probing.

WINTER FEEDING

My observations since 1973 have been confined mainly to a six kilometre stretch of the Ruamahanga River above and below the mouth of the Waiohine River. This stretch supports five or six breeding pairs, a strong population for this district. It has been hardly practicable to cover the river banks and adjacent fields thoroughly in winter conditions and my few visits have been mainly to the most obvious and accessible places.

For as long as possible the birds remain in their summer quarters but, as the river rises, they are forced at first into small bickering groups and finally right off the river. Although all the places they use are not known, they do not seem to move far from the river since many return there whenever the river drops enough to expose silty margins on the higher channels. Occasionally birds are seen on effluent pits from milking sheds, and on muddy spots churned up by cattle or tractors, and such spots must abound in winter. Normal flooded pasture is not favoured.

Wintering birds have been most easily found on the two Greytown sewage ponds which are situated only 600 metres from the river, and on the banks of the Papawai Stream which flows past the sewage ponds, which discharge into it, on through open farmland to the Ruamahanga at the southern end of the study area. The stream has a controlled channel regularly cleared by drag-line, with the spoil

heaped along the top of one bank. When the river is in flood the stream floods also, depositing a thin layer of soft wet silt on the field that lies between them. Between 9 and 25 Black-fronted Dotterels have wintered on ponds and stream; fluctuation of numbers and sightings of colour-banded birds show that there is an irregular interchange of individuals.

Because of leakage problems, one or other of the two sewage ponds is always empty. The pond floor, formed from a willow swamp, is a roughly levelled confusion of pools, mud patches, irregular heaps of peaty soil mixed with clay and shingle, and charred willow stumps. Except when heavy rain has flooded the floor, many of the local dotterels have wintered here, sheltered from cold winds by the high gravel walls.

FOOT-TREMBLING

In the winter of 1974 I began to trap and colour-band Black-fronted Dotterels in the ponds. Early in May one pond was smoothed over by bulldozer, some effluent pumped in and then discontinued. Much of the floor was usually covered by shallow cloudy water but from one third to one half of the one hectare floor was a mixture of wet silt flats, bulldozer tracks filled with silty pools, and irregular heaps of waterlogged soil interspersed with silt-edged pools. These conditions lasted from mid-May to July, when the pond became flooded by heavy rain. From 9 to 11 birds were seen, not always the same individuals.

On 17 May foot-trembling was first noticed but I was preoccupied by trapping and assumed the trembling to be an attempt to shake off the bands. On 1 June, R. N. Cotter, M. L. Falconer and I noticed it again but were again too busy to take detailed notes. On 2 June, MLF and I, from a car on the top of the gravel wall, carefully studied the foot-trembling which all birds, whether banded or not, were doing from time to time. It was clear that the action was not to shake bands, water or mud from the feet but was a deliberate feeding device.

The whole tarsus and foot were held well above the ground, slightly lower than 45° from the vertical, and vibrated rapidly. Each vibration was often followed by a step forward and the other leg then vibrated, but equally often the same leg would be vibrated after a few steps. Sometimes there would be no apparent result but frequently a vibration was followed by a short dash forward or obliquely and a grab at what was usually an earthworm, fully visible to us and requiring a dragging action to secure. One bird even was trapped with an earthworm still protruding from its beak. Occasionally something else was taken, still large enough for the mandibles to be brought up in a partly open position with food visible between them. Normal surface picking, when food usually is not visible and the mandibles appear closed, was not used after trembling.

While trembling, although held stiffly hanging downwards, the foot did not touch the ground on any occasion so that, if the purpose was to transmit vibration to the ground, it could only have been through the stationary leg. On rare occasions, when a bird had moved into shallow water, trembling was continued once or twice when the foot, still held at the same angle, did touch the water, but there was no following dash and capture of food.

The trembling occurred whenever a bird was feeding on a patch of higher ground a few inches above water or silt level, where it was on the rich soil-clay-shingle mixture. As long as it remained on this soil, foot-trembling was used and worms captured. As soon as it moved in its wanderings to silt or shallow water the trembling stopped and normal picking was resumed.

In fact it was remarkable at the time that on that part of the pond where silt flats predominated, the birds were all picking, whereas on the part where soil heaps interlaced by bulldozer tracks predominated, birds were picking in the silty spots and foot-trembling on the soil parts. For instance birds feeding in the wet silt of the tracks would switch to foot-trembling on shifting to the soil thrown up at the edge of the tracks.

Although the soil was waterlogged and earthworms (small and probably *Allolobophora*) were abundant and unusually accessible to the dotterels, close to the surface, it is hard to see how the trembling could assist the capture of the worms. The consistency of the soil did not seem fluid enough for there to be a quicksand effect such as is achieved by the more familiar trampling and puddling movements of, for example, ducks and gulls; nor did the birds examine the ground about their feet as though expecting a result there.

FURTHER SIGHTINGS

The 1974 state of the pond has not been repeated. Foot-trembling was not seen again until 9 July 1976 when 17 Black-fronted Dotterels were feeding on the sloppy mud which had recently been dredged from the Papawai Stream and dumped on the bank. The birds were very restless, squabbling and displaying, and feeding as usual by picking from the surface. However, I noticed several birds foot-trembling several times, again without touching the surface, and at least twice earthworms were taken. Unfortunately the position was impossible to approach without disturbing the birds and I could learn nothing positive about their behaviour. On 24 July this mud had hardened and most birds were feeding on the fresh silt deposited by a recent flood on the adjoining pasture while others were on the stream bank. No foot-trembling was seen.

Shortly afterwards, M. Dennison reported that he and H. Robertson had seen Black-fronted Dotterels foot-trembling in the Manawatu district. The site was a 1000m^2 pit behind the Longburn freezing works

near Palmerston North, two kilometres from the Manawatu River. Into this pit by day trickled a stream of blood and offal washings which had accumulated to form a repulsive sludge up to a metre deep. During June 1976 between 15 and 39 dotterels were seen feeding here. Although no close study was made, 5 or 6 among a fairly close group of 15 on 16 June were noticed to be foot-trembling. Their action differed from the Wairarapa birds in that the foot trembled either in contact with or just above the surface, was then retracted and then the bird would pick at the spot. Birds gave the impression of testing the surface before moving ahead on it, although this is not intended to be an explanation. The 5 recognisable juveniles present were not foot-trembling. The birds which were, did so only intermittently, but one individual foot-trembled almost constantly during the fifteen minutes they were watched.

Foot-trembling was seen again on 4 September 1976 at a site in the Wairarapa near Featherston, reported by Miss H. Cook. This site was the ditches beside a gravel road giving access to the west bank of the Tauherenikau River, a river which has a small population of dotterels. The road is only 700 metres long and for 500 metres has ditches 2 metres wide with a sloping profile starting about 0.3 metre below road level and sloping away to about 0.6 metre deep. On the north side is a pig farm from which effluent has reached the ditches during the winter. On 28 August M. Dennison and I found two pairs of Black-fronted Dotterels feeding on different parts of the northern ditch which was filled with a soft porridge of sludge to MD's eye very similar to the Longburn sludge, but liberally sprinkled with unsightly plastic bread wrappings blown from the adjacent pig field. The surface was so soft that at each step the birds were sinking to about a third up the tarsus. Feeding was by picking and probing and both large and minute food was taken. Foot-trembling was seen once when a bird moved to the firm mud slope up to the road. The southern ditch had clearly been suitable for the birds until recently but had dried out to a firmly caked surface.

On 4 September the northern ditch had been flooded by recent rain but parts of the southern ditch had become sludgy and even the crust had softened and had small pools of sludge in its hollows. I spent an hour here, joined for the last quarter by M. L. Falconer, W. Cash and A. Gollop who had been looking for dotterels on the lower Tauherenikau. For the first quarter hour a single bird fed quietly on the only large soft portion. A second bird joined it for the second quarter hour. Both fed by picking and probing, sinking again to a third up the tarsus. Then a third bird, recognisable by a metal band, arrived and was chased away. On their return, the two original birds, which had not been out of sight, landed on a crusted portion of the ditch. Immediately one began to foot-tremble. It continued to do so for the final half-hour of watching, whether on the crust, the small pools or the original large soft portion, to which they returned for

the last few minutes. Its companion did no foot-trembling although always quite close. The trembling bird seemed a specialist, rather like one of the Longburn birds. The trembling and dash to grab food were as in the sewage pond except that, usually when the bird was sinking in a soft pool, its foot sometimes did touch the surface. This apparent foot-tapping produced no different behaviour than did the leg-shaking, and did not result in picking at the tapped spot, as at Longburn.

In spite of the leg-shaking of one, both birds seemed to feed with equal success on a variety of large and minute food and in the same sorts of place. There seemed no advantage in the circumstances by foot-trembling; it may simply have been triggered off by the crusty surface and continued whether appropriate or not. Earthworms were not present, although a small dark worm was commonly taken by all birds on both days.

In these cases from three unconnected populations, it seems that foot-trembling may be a response to some feature of the substrate which may in some circumstances be associated with earthworms. The threshold of this response varies in individuals.

DISCUSSION

Literature surveyed by Simmons (1961 a, b) and Sparks (1961) supports the view that foot-trembling is a specialty mainly of plovers. Cases are cited for the Lapwing *(Vanellus vanellus)*, Golden Plover *(Pluvialis apricaria)* and Dotterel *(Charadrius morinellus)* on farmland and the Ringed Plover *(C. hiaticula)*, Little Ringed Plover *(C. dubius)* and Kentish Plover *(C. alexandrinus)* on mud. The Three-banded Plover *(C. tricollaris)* is mentioned from Africa and Madagascar and, alone among scolapacine waders, the Black-tailed Godwit *(Limosa limosa)*. Foot-trembling on lawns by the American Hermit Thrush *(Hylocichla guttata)* widens the field of interest to the passerines.

Two-footed feeding movements (variously termed paddling, puddling, trampling, dancing, marking time, jumping, and so on) are better documented, probably because more conspicuous and often involving larger birds. Scolapacine waders such as the Woodcock *(Scolopax rusticola)*, Dunlin *(Calidris alpina)*, Semipalmated Sandpiper *(C. pusilla)* and Redshank *(Tringa totanus)* are cited, as well as various gulls and a mention of ducks, geese, swans, flamingoes, herons and the Sandwich Tern *(Sterna sandvicensis)*.

Because the terminology of foot movements is confused in literature and to clarify future discussion I propose, following Simmons, to divide the movements into (a) *foot-trembling*, involving the use of one leg at a time, which I would sub-divide into *foot-tapping*, where the foot clearly hits or stirs the surface, and *leg-shaking*, where the foot does not touch the surface; (b) *foot-paddling*, involving both feet together or in rapid succession, which may be sub-divided into *trampling* and *jumping*.

As a result of their discussion Simmons and Sparks agree on the hypothesis that foot movements are adapted " to exploit the properties of intertidal muddy sand, in order to expose or incite movement in cryptic invertebrates of the intertidal zone " (Sparks 1961: 340). It is persuasively argued that the purpose of the movements is not to capture marine worms, generally too deep for small waders and gulls to reach, however much they punish the surface. Rather the purpose is to produce local quicksand conditions from which amphipods and other invertebrates will scurry, thus revealing themselves. Similar views had been expressed earlier by Tinbergen (1953: 33-35).

They disagree however on whether similar foot movements on firm surfaces inland are a carry-over from estuarine habits which is functionless (Sparks) or still serves to stimulate movement, however slight, from invertebrates close to or at the surface (Simmons). They agree in doubting the traditional belief that earthworms are the cause, since earthworms are often on or near the surface in winter conditions anyway and are therefore likely to be commonly taken. Tinbergen (1953, 1962) believes strongly that earthworms can be the purpose of inland paddling by Herring Gulls *(Larus argentatus)*.

Simmons and Sparks reach their conclusions by considering mainly sea-shore examples. The Black-fronted Dotterel however is not an estuarine bird and its foot-trembling cannot be a secondary use of an estuarine habit, although it may have originally evolved as one. Therefore the birds' foot-trembling cannot be a functionless action and is a response to special but still obscure circumstances in its environment, and persists as an efficient feeding method in these circumstances. While it is reasonable to accept that foot-tapping, as used by the Longburn birds, will produce localised quicksanding, on analogy with the more vigorous actions of foot-paddling, it is surprising that the Black-fronted Dotterel does not use this method in its normal habitat. Paddling in gulls can be innate (Rothschild 1962) and modified by experience but were this the case with dotterels, one could expect to see foot-trembling used most by juveniles, which is not true.

The cases of foot-trembling considered by Simmons and Sparks seem to be cases of foot-tapping and can therefore plausibly be thought to function by quicksanding. The leg-shaking of the Black-fronted Dotterel is unlikely to have much quicksanding effect, especially on firmer ground such as at the Greytown pond where the birds were not expecting food to appear at their feet. The vibrations are presumably enough to pass through the water of waterlogged soil and stimulate slight movement by invertebrates on or just below the surface. The presence of earthworms in the ponds may have been coincidental but the birds certainly *appeared* to be deliberately seeking them instead of their usual minute food. The fact remains that leg-shaking is used, as far as we know so far, only in circumstances when the surface is firmer and less homogeneous than the usual smooth silt, and when earthworms and other larger prey than normal are taken.

Further sightings and also food studies will be needed to shed more light on the function of foot-trembling in the Black-fronted Dotterel.

OTHER NEW ZEALAND BIRDS

Birds have limited feeding devices and one can expect other surface-feeding birds in New Zealand to use specialised foot movements. I lack the resources for a full search but a glance through some New Zealand literature reveals, as expected, reference to foot-paddling of Red-billed Gulls *(Larus novaehollandiae)* and Black-billed Gulls *(L. bulleri)* (Dawson 1966; Edgar, Hamel & Poppelwell 1972) and to foot-paddling (Edgar 1961) and foot-trembling (Soper 1963) of the South Island Robin *(Petroica australis)*. Other episodes must be known and often unpublished.

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