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Breeding success of northern New Zealand dotterels (*Charadrius obscurus aquilonius*) following mammal eradication on Motuihe Island, New Zealand

HESTER R. NEATE
School of Biological Sciences, University of Auckland, New Zealand

JOHN E. DOWDING
DM Consultants, Christchurch, New Zealand

KEVIN A. PARKER
Institute of Natural Sciences, Massey University, New Zealand

MARK E. HAUBER*
School of Biological Sciences, University of Auckland, New Zealand, and Department of Psychology, Hunter College of the City University of New York, 695 Park Avenue, New York, NY 10065, USA

Abstract Population size and breeding success of northern New Zealand dotterels (*Charadrius obscurus aquilonius*) were studied on the recently mammalian predator-eradicated Motuihe Island in the Hauraki Gulf, New Zealand. The island's entire breeding population was monitored during the austral breeding season from Nov 2007 - Feb 2008. Nine breeding pairs were identified and their breeding success recorded. A total of 41% of nesting attempts produced fledglings and 1.22 chicks fledged per pair for the season; each egg had a 38% chance of survival to fledging. The breeding success of this endemic shorebird was twice as high on Motuihe Island as that at unmanaged mainland sites, and is comparable to levels of breeding success at other managed sites with mammal trapping or predator-proof fencing. The only identified cause of nesting failure over the breeding season was avian predation. Suggestions are made to maintain and enhance breeding success at this locality.

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Keywords New Zealand dotterel; *Charadrius obscures*; mammal eradication; breeding success

INTRODUCTION

The northern New Zealand dotterel (*Charadrius obscurus aquilonius*, hereafter: dotterel) is a subspecies of the threatened New Zealand Dotterel, an endemic taxon which has suffered a long-term species-wide population decline from at least the late 19th century (Dowding 1994; 1999). More recently, population trends have been variable across parts of its range: some regions have experienced population growth and others decline, probably owing to differences in the levels of pest eradication and management of introduced mammals in the different sites (Dowding 2006). The main threats to surviving

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*Correspondence: *mark.hauber@hunter.cuny.edu*

dotterel populations are predation, flooding of nests, and anthropogenic disturbance during breeding; in a study at unmanaged sites, 60% of nesting attempts were lost to predation and 17% to flooding (Dowding 2006). Dotterels are long-lived as adults, and increasing productivity per breeding attempt and recruitment from eggs to breeding is the key to population growth in this taxon (Dowding 2006).

Management programmes for New Zealand dotterel aim to increase breeding success, primarily through predator control, the reduction of nest loss from flooding, and limiting anthropogenic (human-, vehicle-, and pet-related) disturbance by fencing breeding sites and by engaging in local advocacy (Dowding & Davis 2007). These measures have been successful in increasing breeding success of dotterels (e.g. Wills *et al.* 2003; Dowding 2006). Accordingly, the total population of the northern New Zealand dotterel appears to have increased between 1989 and 2004, when the most recent census showed the population consisted of *c*. 1,700 individuals, including *c*. 700 breeding pairs (Dowding & Davis 2007).

Despite the apparent success of management programmes, published data on the breeding success of dotterels in unmanaged or managed sites, including comparisons of pre- and post—management population demographics, are sparse (Dowding & Davis 2007). The large majority of dotterel pairs breed on the shores of New Zealand's North I mainland, where local mammalian predator control, through trapping and poisoning operations, must occur annually over the prolonged breeding season (Pye & Dowding 2002). In contrast, although the eradication of introduced mammals from offshore smaller islands around New Zealand incurs a high initial investment and cost, it potentially provides long-term opportunity for high breeding success without requiring further economic resources (Ortiz-Catedral *et al.* 2009). Here we provide data on the breeding success of dotterel population on Motuihe I, near Auckland, New Zealand, following the complete eradication of invasive mammals through aerial poison operations (Parker & Laurence 2008). Specifically, we report on the number of breeding pairs on Motuihe I, their breeding success, and we discuss the factors that influenced fledging success and failure.

METHODS

Motuihe I covers an area of 197 ha and lies in the Hauraki Gulf near the large metropolitan area of Auckland. The island has significant potential for conservation research, eco-tourism, and environmental education (Parker & Laurence 2008). Introduced mammalian pests, including Norway rats (*Rattus norvegicus*), house mice (*Mus musculus*), cats (*Felis catus*), and European rabbits (*Oryctolagus cuniculus*), were eradicated from the island by aerial poison drops in 1997 and 2002, and by dog (*Canis familiaris*) assisted trapping and shooting following the second poison drop (Parker & Laurence 2008). Motuihe I was identified as one of 3 high-priority sites for conservation management of New Zealand dotterel in the Auckland region (Dowding & Davis 2007). Ohinerau (South East) Beach is the only location on the island where dotterels regularly breed (Dowding 2006). This is probably because the beach experiences little human disturbance, as a long and shallow reef keeps recreational boats offshore and deters people from landing, and it is situated at the opposite end of the island from the commercial ferry's wharf and popular bathing beaches. The reef also provides an essential feeding ground for dotterels and other bird species (HRN, *pers. obs.*). Accordingly, in addition to dotterels, species breeding on Ohinerau Beach include variable oystercatchers *(Haematopus unicolor)*, southern black-backed gulls (*Larus dominicanus*) and Caspian terns (*Sterna caspia*).

Unbanded dotterels were captured in a noose leg-trap, measured, and fitted with individual colour combinations at the onset of the study in Nov 2007. Colour banding allowed pairs to be identified and the number of floaters (members of the population without a breeding territory or mate) to be estimated. The population was censused by direct counts each week of the study until 31 Jan 2008, and the numbers of actively breeding pairs were recorded by locating nests, by sighting chicks, or witnessing parental displays indicating the presence of chicks in the area. In most cases, monitoring was easily achieved, as pairs maintained clearly separated linear territories along the length of the beach, and almost all birds were colour banded. Parental alarm behaviours to approaching humans were used to indicate the presence of nests; nests were then located by watching birds from a distance as they returned to them. In some cases, however, nests were not located to minimise disturbance after prolonged searches. Breeding success was calculated as productivity (number of chicks fledged per breeding pair), as well as the proportion of eggs laid that survived to fledging. When egg or chick losses occurred, any indications of the cause were noted.

RESULTS

Population size and breeding success

The weekly censuses repeatedly documented the presence of 23 individual adults. This included 9 unique pairs. The remaining 5 birds were unpaired; conceivably they were juveniles as

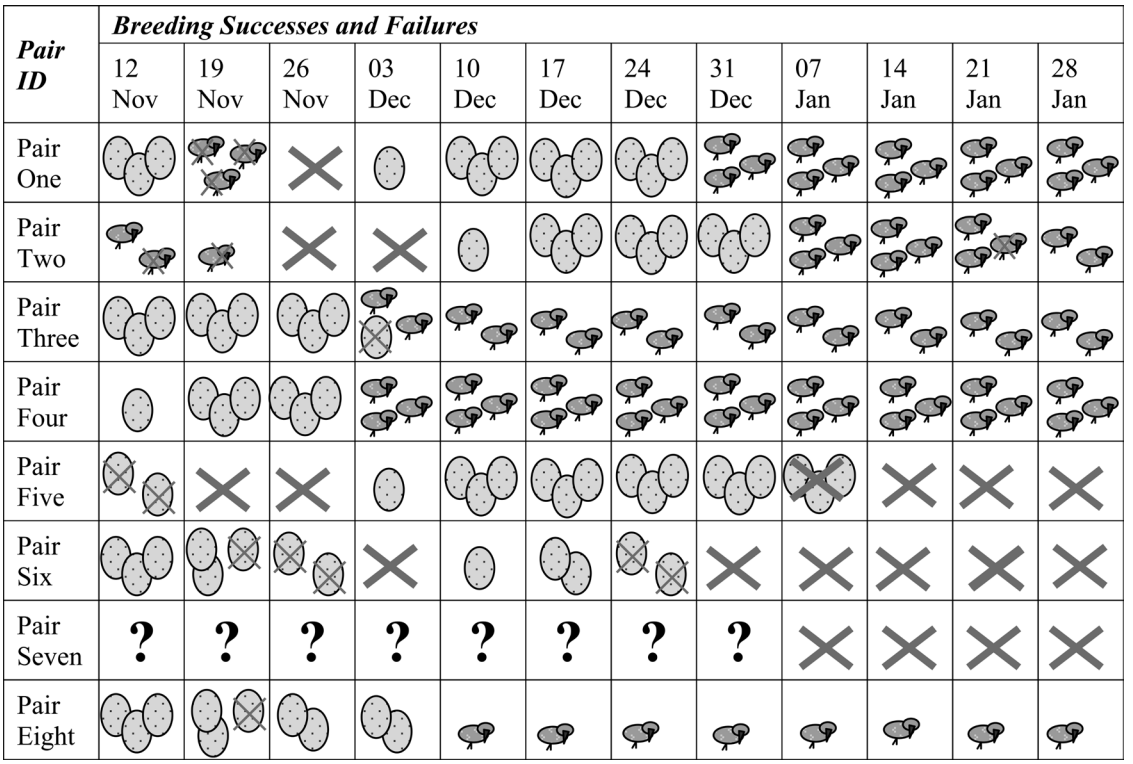

Fig. 1. Weekly summaries of breeding progress for 8 pairs of northern New Zealand dotterel on Ohinerau Beach during the 2007-2008 austral breeding season on Motuihe I, New Zealand.

dotterel normally begin breeding when 2 years old (Dowding 2001).

A total of 29 eggs were detected during the period of monitoring, with 17 chicks successfully hatched and 11 of these chicks fledged or alive at the end of the study period on 31 Jan 2008 (Fig. 1). A follow-up visit on 24 Feb 2008 re-sighted 11 hatch-year birds, confirming our estimate of fledging success during the 2007/08 breeding season. Out of 11 breeding attempts monitored, 5 produced fledglings (41%). The egg-to-fledging success for each egg discovered was 38%. Overall, 55% of pairs bred successfully (i.e., fledged at least 1 chick per season), with each pair having produced an average of 1.22 fledglings per season (Fig. 1).

Factors related to breeding success

In 2 cases, avian predators were identified as direct or suspected causes of chick or egg loss. The pukeko (*Porphyrio porphyrio*) was suspected of preying on 2 eggs belonging to pair 5 (Fig. 1). This nest was checked on 2 days consecutively and the remains of broken eggs were discovered along with fresh pukeko droppings within 5 cm of the nest on the second visit. While we cannot conclude that pukeko destroyed these eggs, they are known to prey on the eggs and young of dotterel (JED, *pers. obs.*) and other birds (Pierce 1986). In turn, of the 6 chicks that were lost, one was directly observed to be depredated: HRN, JED and MEH witnessed a black-backed gull adult that caught and ingested a dotterel chick. The cause of the loss of the other eggs and chicks could not be determined.

DISCUSSION

Nesting of New Zealand dotterels normally begins in Sep or Oct (Pye & Dowding 2002), but monitoring on Motuihe I did not begin until Nov. Although no chicks would have fledged by the time monitoring began, it is possible that some nests were initiated earlier, and either were lost or hatched eggs but the chicks were lost (Fig. 1). The egg-to-fledging success we report here is therefore likely to be an over-estimate for the whole season; however, the total number of fledglings produced by the population should reflect the actual level of productivity.

The New Zealand dotterel recovery plan considers that management would be effective if it resulted in productivity of 0.5 fledglings per breeding attempt or more averaged over 3 years

or longer (Dowding & Davis 2007). Although no data are available on dotterel breeding success prior to mammalian eradication on Motuihe I, our observations on breeding success can be compared with those from other unmanaged and managed sites elsewhere in northern New Zealand (e.g., Dowding 2006). At unmanaged sites (i.e., no mammalian predator control), productivity normally averages 0.30 chicks fledged per pair per season or less, while at managed sites (trapping and poisoning of mammals), it is typically in the range 0.5-1.0 chicks fledged per pair (Dowding 2006). Specifically, comparable or longer-term datasets are also available from 3 managed, mammalian-predator controlled sites: (1) at Opoutere Sandspit, Coromandel Peninsula (management: mammal trapping near dotterel breeding sites), where productivity ranged between 0.13 and 1.29 (average 0.62) chicks fledged per pair over 14 seasons; (2) at Matakana I, Bay of Plenty (management: mammal trapping near dotterel breeding sites), where it ranged between 0.74 and 1.08 over 6 seasons; and (3) at Tawharanui Peninsula, north of Auckland (management: poison drop and predator-proof fence installed in 2004; mice were not eradicated and there are ongoing incursions by cats necessitating ongoing cat control: Goldwater 2007), where productivity varied between 0.5 and 1.89 (average 1.17) chicks fledged per pair during the 2006 - 2010 breeding seasons (Stanes 2010).

The levels of breeding success we recorded here on Motuihe I (1.22 chicks fledged per pair) in 2007 - 2008 are relatively high and suggest a critical conservation success for the management of this species on the island following the mammalian pest-eradication effort. Measures to monitor the future breeding success of New Zealand dotterel remain critical and might be mitigated on Motuihe I through protection of dotterel nest sites from native avian predators (particularly, pukeko and black-backed gulls). However, controlling predatory native species will also represent a conservation conundrum of balancing management goals between endemic and native taxa.

With at least 9 pairs formed and a high rate of nesting success, Motuihe I appears to constitute a site of international importance for New Zealand dotterel under the Ramsar Convention criteria (Dowding & Davis 2007). This population's elevated breeding productivity provides an important boost for the regional population, especially because dotterel show high levels of natal dispersal (Dowding 2001), and so chicks fledged on Motuihe I will likely disperse and supplement the mainland population in the greater Auckland region. If the high level of breeding success recorded in our study is to continue on this site, it will likely be contingent on the detection (Russell *et al.* 2005) and continued exclusion of occasionally reinvading mammalian predators (Department of Conservation 2008). Ensuring that levels of human disturbance do not increase markedly as visitor numbers increase on the island via commercial ferry traffic will also be important. We recommend periodic monitoring similar to that reported here to check that breeding success remains high at this site, and we encourage collecting new data for comparisons with other conservation management initiatives in the region to determine their effectiveness to increase productivity of this and other native shorebird species.

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