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NEST MONITORING AND PREDATOR VISITATION AT NESTS OF BANDED DOTTERELS

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Abstract. We used videocameras to monitor 39 nests of the Banded Dotterel (*Charadrius bicinctus*), a ground-nesting plover endemic to New Zealand that suffers from predation by introduced mammals. To test whether monitoring nests increased the chances of nests being visited by predators, 22 of the video-monitored nests were approached on foot daily to simulate conventional monitoring and 17 unapproached nests were monitored using videocameras only. The proportions of approached nests (46%) and unapproached nests (41%) that were visited by predators did not differ significantly, nor was there any evidence that predators used human scent trails to locate nests. This study provides some evidence that monitoring Banded Dotterel nests by regularly checking them does not influence their risk of predation.

Key words: Banded Dotterel, Charadrius bicinctus, *investigator disturbance, nest monitoring, predation, videocameras.*

Control de Nidos y Visita de Depredadores a Nidos de *Charadrius bicinctus*

Resumen. Usamos cámaras de video para controlar 39 nidos de *Charadrius bicinctus*, un ave endémica de Nueva Zelandia que anida en el suelo y es depredada por mamíferos introducidos. Diariamente nos acercamos a pie a 22 de los nidos controlados con cámaras para simular el modo convencional de seguimiento, y controlamos 17 nidos usando sólo las cámaras y sin acercarnos a ellos con el fin de examinar si el control convencional de nidos incrementa la probabilidad de visita de depredadores. La proporción de nidos personalmente examinados (46%) y no examinados en persona (41%) que fueron visitados por depredadores no difirió significativamente, y no hubo evidencia que los depredadores usan rastros de olores humanos para localizar los nidos. Este estudio sugiere que controlar

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regularmente los nidos de *Charadrius bicinctus* no influencia su riesgo de depredación.

Monitoring nesting success of birds involves a degree of disturbance by the researcher, and this may influence nest survival (reviewed in Götmark 1992). One effect of disturbance may be to alter predation rates, and it is widely believed that mammalian predators in particular pose a threat to nests visited by researchers (Bart 1977, Lenington 1979, Lloyd et al. 2000). However, research to date has provided contradictory results, with some studies concluding that researchers increased predation rates (Götmark et al. 1990, Esler and Grand 1993, Sandvik and Barret 2001) and others indicating that researchers either had no effect or reduced predation rates (O'Grady et al. 1996, Skagen et al. 1999, Lloyd et al. 2000). These results suggest that interactions between habitat, predator species, and prey species influence the effect of researchers on nest survival. Relatively few studies have examined this effect outside North America and Europe (Götmark 1992) and it is important to assess the effect of researchers in all nest success studies.

In the large, braided riverbed systems of the Mackenzie Basin, South Island, New Zealand, many researchers have monitored breeding success of both common and endangered ground-nesting bird species, many of which rely entirely on braided riverbeds for breeding (Maloney 1999), yet none have formally measured researcher impact on nest outcome. The main cause of nest failure in this environment is predation by introduced mammals such as feral cats (*Felis catus*), ferrets (*Mustela furo*), stoats (*M. erminea*) and hedgehogs (*Erinaceus europaeus*; Pierce 1996, Sanders and Maloney 2002).

Traditionally, assessing nest survival rates has involved regular visits to active nests. Now, remotely operated video systems are widely available and can be used to monitor nests with minimal disturbance (Innes et al. 1994, Pietz and Granfors 1996, Brown et al. 1998). We used videocameras at nests to (1) test whether regularly approaching nests resulted in increased visitation rates by predators; and (2) assess whether mammalian predators used human scent trails to locate nests. We also compared predation rates at video-monitored nests and nests that were inspected regularly but not video-monitored, to test whether the videocameras affected nest survival.

METHODS

We placed videocameras at nests of a small, common plover, the Banded Dotterel (*Charadrius bicinctus*) in the Ohau River, South Island, New Zealand (44°20′S, 170°11′E) from mid-September to the end of December, 1998 to 2000. We found nests by following breeding adults to their nests. Banded Dotterels usually lay three eggs in a shallow hollow in the gravel. Both parents share the incubation of the eggs (usually 28 days), average hatching success is 56% (Rebergen et al. 1998), and 83% of chicks leave the nest within two days of the last chick hatching (Sanders and Maloney 2002).

Cameras and infrared lights were placed 1–2 m from nests and connected to a video recorder and 12-V battery that were hidden 30–60 m away. Nests were filmed continuously until hatching or failing, and tapes and batteries were changed daily. Full details of the camera configuration are available in Sanders and Maloney (2002).

Nests monitored with cameras were alternately assigned one of two treatments: "approached," where nests were approached on foot daily from the same direction each time (simulating traditional nest monitoring); and "unapproached," where nests were not approached between initial camera set-up and the end of incubation. Approached and unapproached nests were distributed evenly over the length of the river (10 km) in each year. For approached nests, we used the same direction of approach as we had when the nest was first located.

Videotapes were watched daily and nests were categorized as visited or not visited by predators. The proportions of approached and unapproached nests that were visited were compared using contingency table analyses. Data from all three years were pooled because sample sizes were too small to test for differences among years. Ten nests that hatched or failed within three days of the camera set-up were excluded from the data set to rule out any potential effects of the initial camera set-up, and because we considered that human scent trails would still be fresh at unapproached nests for at least this length of time.

To assess whether predators followed human scent trails to the nest, the direction of predator and human approaches to the same nest were compared using the Rayleigh test for circular uniformity (Zar 1999). The direction of human approach was set at 0° and each predator visit was categorized into one of twelve 30° segments relative to the human approach path (0°, 30°, 60°, etc., up to 360°).

To assess whether the videocameras affected predation rates, we used contingency table analysis to compare predation rates at the 39 videotaped nests with those at 227 Banded Dotterel nests that were monitored by field observers in a concurrent study on the Ohau River (RJK, unpubl. data). Nests were classified as preyed upon if one or more eggs were lost to predators. Human-monitored nests were visited every 2–4 days until the nesting attempt ended. As with the video-monitored nests, nests that hatched or failed within three days of discovery were excluded from analysis. There were no significant differences in predation rates at video-monitored and human-monitored nests among years; thus data from all three years were pooled. Percentages are reported with 95% binomial confidence intervals.

RESULTS

We videotaped outcomes for 22 approached nests and 17 unapproached nests over the three years. Filming effort (mean days filming per nest ± SE) was similar at approached (15.3 ± 1.3 days) and unapproached (13.8 ± 1.8 days) nests.

We recorded predator visits to 10 approached nests and seven unapproached nests. Two visits resulted in the predation of newly hatched chicks and at one of those nests an adult was also taken. Seven visits were nonlethal and during the remaining visits one or more

TABLE 1. Details of predator visits to video-monitored Banded Dotterel nests that were either approached daily (approached nests) or not approached after the initial camera set-up (unapproached nests). Unless otherwise stated, each item represents a single nest. Numbers in parentheses indicate the difference in degrees between the approach paths of human observers and predators. No angle is given for the magpie visit because it approached from above.

	Predator visits to nests	
Year	Approached nests (n = 22)	Unapproached nests (n = 17)
1998	Cat ate 1 of 2 eggs (30°) Mouse visited nest (300°)	Mouse visited nest, 5 days later cat ate 1 of 3 eggs Australian Magpie ate 3 chicks Cat visited same nest on 3 nights
1999	Cat ate eggs at 3 nests (30°, 180°, 180°) Cat ate 3 chicks and 1 adult (120°) Hedgehog ate 3 eggs (210°) Cat visited nest (120°)	Cat ate 3 eggs Hedgehog visited nest
2000	Hedgehog ate 3 eggs (210°) Australian Magpie visited nest	Hedgehog ate 3 eggs Australasian Harrier ate 3 eggs
Total nests visited	10	7

of the eggs were preyed upon (Table 1). The same species of predators were recorded at both approached and unapproached nests. Listed in decreasing order of visits, they included feral cats, hedgehogs, mice (*Mus musculus*), Australian Magpie (*Gymnorhina tibicen*) and Australasian Harrier (*Circus approximans*).

The proportion of approached (46%, 24–68% CI) and unapproached (41%, 18–67% CI) nests visited by predators did not differ significantly (χ^2_1 = 0.1, P > 0.7). There was no evidence to suggest that the directions of approach by visiting predators and by humans were correlated (n = 9; z = 0.8, P > 0.20; magpie visit excluded). The proportions of video-monitored (31%, 17–48% CI) and human-monitored (24%, 18–30% CI) nests that were depredated did not differ significantly (χ^2_1 = 0.5, P = 0.46).

DISCUSSION

In this study, sample sizes in each year were small, a direct limitation of the number of cameras available. Although the proportions of approached and unapproached nests visited by predators were similar, a power analysis of the data indicated that with the given sample size, 0.44 was the minimum difference between the two proportions that could have been detected (with α = 0.1, β = 0.9). Therefore, there may have been a difference in visitation rates between the two treatments that we could not detect. However, we approached nests daily, which is more frequent than usual for nest monitoring, and the lack of a strong effect of frequent monitoring on predator visitation rates suggests that traditional nest monitoring every 2–4 days is even less likely to influence nest survival.

Our results also suggest that approaching nests had little influence on how predators located nests. Again, sample sizes were small, but predators approached nests from seemingly random directions that did not correlate with human scent trails to nests. Observations of predator behavior have shown that cats tend to use visual cues to locate nests (Fitzgerald 1990, Sanders and Maloney 2002), whereas ferrets and hedgehogs use olfactory cues (Lavers and Clapperton 1990, Sanders and Maloney 2002). No ferret depredations were recorded in this study, but ferrets were responsible for 21% of 69 videotaped predations at braided-river bird nests (Sanders and Maloney 2002). If ferrets do hunt by smell, there is a possibility that monitoring nests may increase ferret predation rates. However, given that cats and hedgehogs together account for over two-thirds of depredations at nests (Sanders and Maloney 2002), and that there was no evidence that either of these species used human scent trails to locate nests (this study); it is unlikely that nest monitoring has any appreciable effect on nest survival in this braided-river environment.

Our comparison of predator visits to nests assumes that videos yield an unbiased picture of what happens at nests. This is difficult to test because any method of observation potentially has an effect. Conspicuous nest markers, such as videocameras, may increase nest predation rates (Götmark 1992). The videocameras used in our study were up to 40 cm high, and some of the infrared lights emitted small amounts of visible light at night; thus the cameras or lights may have provided visual cues to attract either mammals or birds to the nests. However, our comparison showing no difference in predation rates at video-monitored and human-monitored Banded Dotterel nests suggests this is not the case. Also, behavioral observations have shown that mammalian predators approached the nests and not the camera (Sanders and Maloney 2002); and although avian predators such as Australasian Harriers and Australian Magpies are abundant in the braided-river environment (Keedwell and Brown 2001) they were responsible for fewer than 3% of 69 videotaped predations (Sanders and Maloney 2002) and are therefore unlikely to be using videocameras to locate nests. Video-monitored and human-monitored nests of the Black-fronted Tern (*Sterna albostriata*), a species that shares the habitat of the Banded Dotterel, also showed no significant difference in survival between the two treatments (Sanders and Maloney 2002, RJK, unpubl.

data), which further suggests that videocameras do not have a detrimental effect on nest survival.

The use of videocameras helped us investigate the effects of nest monitoring because the cameras recorded nest fates without physical nest checks. Without cameras, the only other method for testing researcher effect is to alter the frequency of monitoring, because nests must be approached at some stage to determine outcome (e.g., Nichols et al. 1984, Major 1990, Sandvik and Barret 2001). Videocameras also increase the amount of information available by providing data on whether predators use human scent trails to locate nests and whether nest monitoring attracts different species of predators.

Video-monitoring provides valuable opportunities to compare different methods of nest monitoring on other species. Although the financial costs associated with running videocameras may be high, we believe video monitoring provides a comprehensive method for investigating the relationships among nest survival, nest monitoring, and the effects of predators.

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