Notornis, 2019, Vol. 66: 164–167

SHORT NOTE

Egg-sized rocks found in nests of North Island saddleback (*Philesturnus rufusater*)

K. BEAVEN
Zealandia Centre for People and Nature, 31 Waiapu Road, Karori, New Zealand

C. VILLIARD
Agrocampus Ouest, 65 Rue de Saint-Brieuc, 35000 Rennes, France

R. EMPSON
Zealandia, 31 Waiapu Road, Karori, New Zealand

D.F. SHANAHAN*
Zealandia Centre for People and Nature, 31 Waiapu Road, Karori, New Zealand

North Island saddleback (tīeke, *Philesturnus rufusater*) were reintroduced to Zealandia sanctuary (Karori, Wellington) in 2002. Zealandia is a 225 ha restoration project surrounded by a fence that successfully excludes introduced mammalian predators, except mice (*Mus musculus*). Thirty-nine tīeke were translocated to Zealandia from Tiritiri Matangi Island, and monitoring during the first breeding season in 2002–2003 indicated that just 18 birds contributed to the founding population (*unpubl. data*). After an initial increase in the number of individuals, the 2004–2005 season began with just 5 pairs, bolstered later in the season by a further 4 pairs from the previous year's offspring. Since 2005 the population has increased significantly with estimates, using a distance sampling approach, at around 200–300 individuals (*unpubl. data*). Tīeke have also been detected on many occasions beyond the predator exclusion fence with some instances of successful nesting and fledging in that wider landscape (K.B. *pers. obs.*).

Received 16 April 2019; accepted 19 May 2019
*Correspondence: *danielle.shanahan@visitzealandia.com*

Despite the increasing population of tīeke at Zealandia in 2018, underlying issues related to inbreeding are of concern. The population has undergone severe population bottlenecks, first with their introduction onto Cuvier Island (29 individuals; Lovegrove 1996), then Tiritiri Matangi Island (24 individuals in 1984; Parker & Laurence 2008), and again with their subsequent reintroduction into Zealandia. The consequences of severe genetic bottlenecks are well documented with potential implications including reduced fitness, evinced by increased rates of hatching failure (Jamieson & Ryan 2000; Briskie & Mackintosh 2004; Mackintosh & Briskie 2005; Boessenkool *et al*. 2007), and reduced survival and recruitment (Amos *et al*. 2001; Kruuk *et al*. 2002).

Zealandia management established a nest monitoring project in 2018/2019 to begin examining the relevance of inbreeding depression, and to explore practicalities of potential genetic top-up methods (e.g. egg swaps; Jones 2004; Jones & Merton 2012). Twelve natural nests were found between October 2018 and February 2019 by staff and volunteers, and life-history parameters including clutch size, hatching success, and fledging success were determined.

In comparison to previous monitored years, the average clutch size and proportion of nests that successfully fledged chicks was low (Table 1). This could be related to population density, inbreeding effects, or climatic variables, among other possibilities.

Table 1. Comparison of available North Island saddleback (tīeke, *Philesturnus rufusater*) nesting statistics at Zealandia sanctuary (Karori, Wellington) from 2002/03 to 2018/19. Excludes nests where numbers of eggs or chicks hatched are unknown.

Breeding season (October–February)	No. of pairs monitored	No. of nests found	Clutch size (mean ± SD)	No. of chicks (% hatched)	No. of fledglings (% fledged)	% eggs fledged	% nests with fledging chicks
2002/3	10	21	2.62 ± 0.65	36 (65.5)	28 (77.8)	50.9	66.7
2003/4	13	29	2.59 ± 0.62	52 (69.3)	42 (80.8)	56.0	72.4
2004/5	8	15	2.46 ± 0.72	25 (65.8)	25 (100)	65.8	80.0
2005/6	10	16	2.30 ± 0.53	18 (51.4)	18 (100)	51.4	56.3
2018/19	11	12	1.83 ± 0.69	10 (45.5)	10 (100)	45.5	50.0

The most unexpected finding in the 20018/19 breeding season was the presence of single small, roughly egg-sized rocks in three nests (25% of 2018/19 nests found; Fig. 1). There were no nearby rockfalls or obvious mechanisms for rocks to fall into the nests accidentally. The eggs from each nest were unbroken alongside the rock, suggesting careful placement of the rock in the nest. One rock was retrieved (from the nest shown in Figure 1b), which weighed 6.5 g. We have no weight measurements of actual tīeke eggs to compare, but the rocks had a similar length and width dimensions as a tīeke egg (29 mm length x 22 mm width; compare with a retrieved rock at 28 mm in length at its longest point and 24 mm in width).

Figure 1. A. Rock in a tīeke nest at Zealandia; B. Location of nest shown in A.; C. view inside another tīeke nest where a rock was found alongside fledglings; D. rock found in nest shown in image C, which weighed 6.5 g.

Two rock nests were abandoned at egg-stage subsequent to discovery. The egg from one of these nests disappeared before it could be retrieved for investigation and the other was infertile. In the third nest, the rock was discovered alongside three chicks, which subsequently fledged.

We were unable to determine how the rocks got into the nests, but suggest that the tīeke placed them there. Human intervention is considered highly unlikely because the nests were difficult to find and off the trails at Zealandia. At 6.5 g, the rock that was retrieved weighed approximately 10% of adult tīeke body weight—we consider it plausible that adult birds could have moved this weight as tīeke are commonly observed forcefully prying into rotten logs and moving items on the ground during routine foraging (K.B. & D.F.S. *pers. obs.*).

To our knowledge the presence of rocks in tīeke nests has not been previously observed, and we could find no record of them being discovered in other New Zealand forest bird nests, or indeed cavity or cup nesting forest birds in other places across the globe. However, it has been observed in many ground-nesting shorebird species such as Canada geese (*Branta canadensis*), gulls (e.g. *Larus occidentalis*), terns (e.g. *Sterna hirunda*), and avocet (e.g. *Recurvirostra americana*) (Conover 1985; Sudgen 1947; Coulter 1980; Langlois *et al*. 2012). Ground nesting common loons (*Gavia immer*) have been observed incubating rocks that have been accidentally used as nesting material (DeStefano *et al*. 2013), although it seems unlikely that tīeke would actively collect rocks while collecting nesting material.

There are other possible reasons for this behaviour. For example, it could be due to the 'mistaken egg hypothesis', where an adult bird mistakes a nearby rock for an egg that has fallen from the nest (Conover 1985). There may also be enhanced thermal regulation for remaining eggs (rocks may hold some heat to be released slowly when the incubating adult is foraging), or there could be some anti-predation adaptation through crypsis confusion for predators. Both enhanced thermal regulation and the use of rocks as an anti-predator mechanism have been observed with piping plovers (*Charadrius melodus*; Mayer *et al*. 2009). If this were the case with tīeke it may be expected that this behaviour could be found in other populations. Alternatively, the behaviour may have no adaptive function or occurs for other unknown reasons. Ultimately, we currently have no way of understanding why this pattern was observed, but should it be recorded in the future it may warrant further investigation.

LITERATURE CITED

Amos, W.; Wilmer, J.W.; Fullard, K.; Burg, T.M.; Croxall, J.P.; Bloch, D.; Coulson, T. 2001. The influence of parental relatedness on reproductive success. *Proceedings of the Royal Society of London. Series B: Biological Sciences 268(1480)*: 2021–2027.

Boessenkool, S.; Taylor, S.S.; Tepoly, C.K.; Komdeur, J.; Jamieson, I.G. 2007. Large mainland populations of South Island robins retain greater genetic diversity than offshore island refuges. *Conservation Genetics 8(3)*: 705–714.

Briskie, J.V.; Mackintosh, M. 2004. Hatching failure increases with severity of population bottlenecks in birds. *Proceedings of the National Academy of Sciences USA 101(2)*: 558–561.

Conover, M.R. 1985. Foreign objects in bird nests. *The Auk 102(4)*: 696–700.

Coulter, M.C. 1980. Stones: an important incubation stimulus for gulls and terns. *The Auk 97(4)*: 898–899.

DeStefano, S.; Koenen, K.K.G.; Pereira, J.W. 2013. Common Loon incubates rocks as surrogates for eggs. *Northeastern Naturalist 20(1)*: 143.

Heather, B.D.; Robertson, H.A. 2000. *The field guide to the birds of New Zealand*. Auckland, Viking/Penguin Books.

Jamieson, I.G.; Ryan, C.J. 2000. Increased egg infertility associated with translocating inbred takahe (*Porphyrio hochstetteri*) to island refuges in New Zealand. *Biological Conservation 94(1)*: 107–114.

Jones, C.G. 2004. *Conservation management of endangered birds. In*: Sutherland, W.J.; Newton, I.; Green R.E. (Eds) *Bird ecology and conservation: a handbook of techniques*, Oxford, UK, Oxford University Press. pp 269–293.

Jones, C.G.; Merton, D.V. 2012. A tale of two islands: the rescue and recovery of endemic birds in New Zealand and Mauritius. *In*: Ewan, J.G.; Armstrong, D.P.; Parker, K.A.; Seddon, P.J. (Eds) *Conservation Science and Practice Series: Reintroduction biology: integrating science and management*, Oxford, UK, Wiley-Blackwell Publishing Ltd and Zoological Society of London. pp 33–72.

Kruuk, L.E.; Sheldon, B.C.; Merila, J. 2002. Severe inbreeding depression in collared flycatchers (*Ficedula albicollis*). *Proceedings of the Royal Society of London. Series B: Biological Sciences 269(1500)*: 1581–1589.

Langlois, L.A.; Murböck, K.; Bulla, M.; Kempenaers, B. 2012. Unusual incubation: Long-billed Dowitcher incubates mammalian bones. *Ardea 100(2)*: 206–211.

Lovegrove, T.G. 1996. Island releases of saddlebacks *Philesturnus carunculatus* in New Zealand. *Biological Conservation 77:* 151–157.

Mackintosh, M.A.; Briskie, J.V. 2005. High levels of hatching failure in an insular population of the South Island robin: a consequence of food limitation? *Biological Conservation 122(3)*: 409–416.

Mayer, P.M.; Smith, L.M.; Ford, R.G.; Watterson, D.C.; McCutchen, M.D.; Ryan, M.R. 2009. Nest construction by a ground-nesting bird represents a potential trade-off between egg crypticity and thermoregulation. *Oecologia 159(4)*: 893–901.

Parker, K.A.; Laurence, J. 2008. Translocation of North Island saddleback *Philesturnus rufusater* from Tiritiri Matangi Island to Motuihe Island, New Zealand. *Conservation Evidence 5*: 47–50.

Sugden, J.W. 1947. Exotic eggs in nests of California Gulls. *Condor 49(3)*: 93–96.

Keywords: inbreeding depression, nest monitoring, foreign object in nest