

SHORT NOTE

Possible weka (*Gallirallus australis*) predation of kakapo (*Strigops habroptilus*) eggs

GRAEME ELLIOTT

Department of Conservation, Private Bag 5, Nelson
gelliott@doc.govt.nz

DARYL EASON

Department of Conservation, P.O. Box 10-420, Wellington

GIDEON CLIMO

18 Lord Rutherford Road, Brightwater, Nelson

Kakapo (*Strigops habroptilus*) are large flightless, nocturnal parrots which used to be widespread and common on the 3 main islands of New Zealand. Since the arrival of humans in New Zealand, their numbers have declined dramatically, and, as of November 2001, only 62 birds were known to survive. Predation by introduced dogs (*Canis familiaris*), stoats (*Mustela erminea*), cats (*Felis catus*), and rats (*Rattus* spp.) are the likely main causes of the kakapo's decline (Butler 1989). Kakapo are vulnerable to predation because they are flightless, slow moving, strongly scented, and because of their breeding behaviour. Kakapo are lek breeders (Merton *et al.* 1984) and the male plays no part in nesting. Female kakapo have to leave their nests unattended for long periods to find sufficient food for themselves and their chicks. While they are away their chicks and eggs are particularly vulnerable to predation. Between 1974 and 1997 all the survivors of the last known populations of kakapo on Stewart Island and in Fiordland were transferred to relatively predator-free Little Barrier, Maud, and Codfish Islands to prevent their continuing decline (Elliott *et al.* 2001).

Weka (*Gallirallus australis*) are large flightless rails, also confined to New Zealand. Weka are omnivorous and competent predators, and are known to take the eggs and chicks of a wide range of species (Marchant & Higgins 1993). Weka were abundant and widespread before the arrival of Europeans, but a combination of habitat loss, predation,

and perhaps disease, has caused a dramatic decline in their range, though on some islands and in some parts of the South Island they are still abundant (Marchant & Higgins 1993).

Though kakapo coexisted with weka throughout much of their range until the middle of the 19th century, kakapo were transferred to islands that either naturally had no weka or from which they had been eradicated. Little Barrier Island has never had weka, weka were removed from Codfish Island between 1979 and 1985 (Butler 1989) before kakapo were transferred there, and weka are continuously removed from Maud Island to counter the regular immigration of birds that swim from the mainland about 900 m away.

Although large, healthy kakapo populations can perhaps sustain some predation of their nests by weka, even a very low rate of predation is undesirable in a small, critically-endangered, population. This reasoning has been the basis for the removal of weka from kakapo islands despite there being no direct evidence that weka prey upon kakapo eggs and chicks.

Recent breeding by kakapo on Pearl Island has provided evidence that weka might prey on kakapo eggs. In April 1998, all the kakapo on Codfish Island were temporarily transferred to Pearl Island off the south-eastern coast of Stewart Island to facilitate the eradication of kiore (*Rattus exulans*) from Codfish Island. Although 3 species of rat (ship rat, *Rattus rattus*; Norway rat, *R. norvegicus*; kiore) (Atkinson & Taylor 1992) and weka (pers. obs.) are common on Pearl Island, these predators are no threat to adult kakapo, and it was planned to return the kakapo to Codfish Island before there was any possibility that they

Table 1 Kakapo nests (*Strigops habroptilus*) and eggs on Pearl Island in 1999. *, dummy egg removed by predator. **, real egg preyed on; Removed, date removed for artificial incubation; Age, age of egg when removed; Exposure, number of days between laying of 1st egg in clutch and removal of last real or dummy egg.

Bird	Nest	Egg			Age	Dummy removed	Exposure (days)
		No.	Date laid	Removed			
Alice	1	1	22 Jan	24 Jan	2		
		2	28 Jan	30 Jan	2		
		3	31 Jan	8 Feb	8		17
	2	1*	10 Mar	10 Mar	0	17 Mar	
		2**	17 Mar	-			7
Sandra	1	1	1 Mar	7 Mar	6		
		2	4 Mar	7 Mar	3		6
Cyndy	1	1	23 Feb	3 Mar	8		
		2*	26 Feb	3 Mar	5	9 Mar	14
Suzanne	1	1	14 Jan	17 Jan	3	22 Jan	
		2	17 Jan	17 Jan	0	22 Jan	8
Zephyr	2	1	27 Jan	6 Mar	7		7
		1	1	25 Feb	4 Mar	7	15 Mar
		2	28 Feb	4 Mar	4	15 Mar	18

bred on Pearl. The eradication of kiore from Codfish Island took longer than expected and by the time the island was ready to receive the returning kakapo in November 1998, breeding activity had started on Pearl. It was decided to leave the birds on Pearl Island, but to reduce the risk of losing eggs to rats or weka by removing any kakapo eggs from their nests for artificial incubation and hand-raising.

Five female kakapo nested on Pearl Island between January and March 1999, and 2 birds renested, so that 7 kakapo nests, containing 14 eggs, were monitored. Most eggs were removed from these nests for artificial incubation by no more than 8 days after laying (Table 1). At 3 nests the eggs were replaced with plastic dummy eggs that were left for up to 11 further days. At 1 nest (*Alice's* 2nd) an egg was eaten and a dummy egg removed by a predator, and at another nest (*Cyndy's*) a dummy egg was removed. Both nests were robbed during the incubation phase. Searches were made for the dummy eggs but they could not be found.

Weka seem the most likely predator of the nests because: 1, only a few small fragments of the real egg in *Alice's* nest remained, which is consistent with a weka's having removed the egg by stabbing it and running off (Lindsay *et al.* 1959), and leaving behind only a few eggshell fragments broken off during the stabbing; 2, ship rats have been recorded removing small birds' eggs from nests by carrying them in their mouths (Major 1991), but kakapo eggs are certainly too large to be moved in this manner; 3, kiore have been observed rolling little shearwater (*Puffinus assimilis*) eggs (Booth *et al.* 1996) which are similar in size to kakapo eggs, but the shearwater eggs were only removed a short distance whereas

the kakapo egg and dummy eggs must have been moved a considerable distance; 4, the real egg in *Alice's* 2nd nest was broken, and therefore could not have been moved very far by rolling it, so it must therefore have been picked up to be removed from the nest and a rat would not be able to pick up such a large egg; 5, the floor of *Alice's* nest was dug over very deeply, and large tufts of the nest contents moved aside, which is a degree of disturbance more likely to have resulted from the actions of a large weka than a small rat; and 6, a weka was seen near *Alice's* 2nd nest both before and after it was robbed.

Kakapo are large birds that vigorously defend their nests against intruders (pers. obs.) so their nests are relatively safe from predators except when the female is away foraging. Although primarily nocturnal, kakapo spend some time off their nests just before sunset and just after sunrise (pers. obs.). All 3 rats are primarily nocturnal (Atkinson & Moller 1990; Moors 1990; Innes 1990) and weka are primarily crepuscular (A.J. Beauchamp pers. comm.) so both rats and weka are possible predators of kakapo nests.

Kakapo nest under cover in sites ranging from holes where the nest chamber is >1 m under ground, to nest chambers above ground amongst dense vegetation (pers. obs.). The 2 nests that were preyed upon were the most exposed of the 7 nests on the island and the eggs in both nests could be seen from outside when the female was not in attendance. However, the maximum length of time that any of the nests were exposed to predation was only 18 days, whereas unmanaged nests would be vulnerable to predation for the 30 days of incubation and also about 10 further days when the chicks were very small. Given sufficient time and an increase in

activity around the nest, predators are likely to have found even more of the nests. Only 2 of the 7 nests on Pearl Island were preyed upon, but had the eggs been left in all the nests, the rate of predation may have been higher.

Vulnerability of kakapo nests to predation probably varies throughout the nesting cycle. Nests are relatively safe during the first few days of incubation because female kakapo rarely leaves their nests, but nest vulnerability increases thereafter as they spend more time away. While the female has eggs or small chicks she is absent for up to 1.5 h each night, and this period increases as the chicks grow (Elliott *et al.* 2001). However, their vulnerability presumably decreases again as the chicks become too large for weka and rats to tackle. Because the 2 nests were robbed soon after the females had started incubating, it appears that weka or rats or both are able to take kakapo eggs even when a nest is relatively well attended by a female.

Predators cannot confidently be identified from sign they leave in the nests of small birds (Brown *et al.* 1998), and we cannot be sure of the identity of the predators of these kakapo nests. However, it is known that weka are capable nest predators and the evidence presented here suggests that they prey on kakapo eggs. Therefore as long as kakapo are critically endangered, and as long as weka are less endangered than kakapo, it is a sound conservation strategy to exclude weka from islands on which kakapo are placed to breed.

The high rate of predation suffered by kakapo nests on Pearl Island illustrates the vulnerability of kakapo nests to predators and the unsuitability of Pearl Island for breeding kakapo. To make Pearl Island suitable for a breeding population of kakapo the 3 species of rat and the weka would have to be removed from the island, but all would probably reinvade from the nearby Stewart Island mainland and Anchorage Island.

ACKNOWLEDGEMENTS

We thank all the Department of Conservation staff and volunteers who were involved in the kakapo breeding season on Pearl Island, and Kerry Brown and Graeme Loh for valuable comments on an early draft.

LITERATURE CITED

- Atkinson, I.A.E.; Moller, H. 1990. Kiore. pp. 175-192 In: King, C.M. (ed.) *The handbook of New Zealand mammals*. Auckland, Oxford University Press.
- Atkinson, I.A.E.; Taylor, R.H. 1992. Distribution of alien mammals on New Zealand islands (second edition). New Zealand Department of Scientific and Industrial Research Land Resources contract report no. 92/59.
- Brown, K.P.; Moller, H.; Innes, J.; Jansen, P. 1998. Identifying predators at nests of small birds in a New Zealand forest. *Ibis* 140: 274-279.
- Booth, A.M.; Minot, E.O.; Fordham, R.A.; Innes, J.G. 1996. Kiore (*Rattus exulans*) predation on the eggs of the little shearwater (*Puffinus assimilis haurakiensis*). *Notornis* 43: 147-153.
- Butler, D. 1989. *Quest for the kakapo*. Auckland, Heineman Reed.
- Elliott, G.P.; Merton, D.M.; Jansen, P.W. 2001. Intensive management of a critically endangered species: the kakapo. *Biological conservation* 99: 121-133.
- Innes, J.G. 1990. Ship rat. pp. 206-225 In: King, C.M. (ed.) *The handbook of New Zealand mammals*. Auckland, Oxford University Press.
- Lindsay, C.J.; Phillipps, W.J.; Watters, W.A. 1959. Birds of Chatham Island and Pitt Island. *Notornis* 8: 99-106.
- Major, R.E. 1991. Identification of nest predators by photography, dummy eggs, and adhesive tape. *Auk* 108: 190-195.
- Marchant, S.; Higgins, P.J. (ed.) 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Vol. 2. Raptors to Lapwings*. Melbourne, Oxford University Press.
- Merton, D.V.; Morris, R.B.; Atkinson, I.A.E. 1984. Lek behaviour in a parrot: the kakapo *Strigops habroptilus* of New Zealand. *Ibis* 126: 277-283.
- Moors, P.J. 1990. Norway rat. pp. 192-206 In: King, C.M. (ed.) *The handbook of New Zealand mammals*. Auckland, Oxford University Press.

Keywords kakapo; *Strigops habroptilus*; weka; *Gallirallus australis*; nests; predation