

SHORT NOTE

Egg predation by South Island kaka (*Nestor meridionalis*)

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On 28 November 2000, JMW was inspecting rat trap stations for the Department of Conservation on the lower (c. 660 m) north-western slopes of the St Arnaud Range in Nelson Lakes National Park, when she observed a South Island kaka (*Nestor meridionalis*) eating eggs from a nest. Although the nest was partly obscured, it appeared to be an open cup, located c. 10 m above ground, about two-thirds of the way up a beech (*Nothofagus* sp.) tree. The predator was identified as a kaka and not a kea (*Nestor notabilis*) by its plumage, and by it being banded with the combination of one of several female kaka fitted with radio transmitters in the area at that time. The kaka was watched at the nest for c. 10 min and was observed to be eating the nest contents. It dropped a mostly-eaten egg (shell blue with red-brown speckles) to the ground.

The nesting birds were not seen but of the small, cup-nesting species in the area, three finches (redpoll, *Carduelis flammea*; goldfinch, *Carduelis carduelis*; chaffinch, *Fringilla coelebs*), and the blackbird (*Turdus merula*) are all reported to have blue or bluish eggs with red-brown markings (Cramp 1988; Cramp & Perrins 1994; Heather & Robertson 1996): the nest could have belonged to any of those species.

JMW mentioned the event to colleagues at the Department of Conservation, St Arnaud engaged in kaka management, and they were not surprised by the observation. However, a search of the general literature (Oliver 1955; Heather & Robertson 1996; Higgins 1999) did not reveal any instances of eggs or nestlings being included in kaka diet. Although Wilson *et al.* (1998) and Higgins (1999) both state that the kaka is omnivorous, and both list seeds, fruit, flowers, leaves, nectar, sap, insects, and insect larvae, neither records eggs or nestlings in kaka diet. St Paul (1977) also does not mention eggs or

nestlings in his observations of North Island kaka diet that included "native and exotic fruits, insects and their larvae, buds and shoots".

Nest robbing, at egg or nestling stage, would be a rich source of both energy and protein for kaka in an environment depleted by the activity of introduced wasps (*Vespula* spp.) (Beggs & Wilson 1991). A kaka eating honeydew had an average energy intake of c. 1.6 kJ/min (Beggs & Wilson 1991). The brush-tipped tongue that allows the kaka to feed on nectar, would also facilitate mopping up the contents of a ruptured egg. By feeding on eggs, and taking 10 min to eat the full clutch, as the female kaka observed at the nest in 2000 may have done, a full clutch of the possible prey species would have yielded substantially more energy for less effort (1.81-10.76 kJ/min, Table 1) than is possible from honeydew. Similarly, eggs would supply significant amounts of protein. The data for proportions of yolk, albumen, and non-lipid solids in yolk given in Table 1 of Sotherland & Rahn (1987), suggest that protein makes up at least 11% of the wet contents of an egg of the great tit (*Parus major*) (average content mass 1.4 g). Table 2 shows the potential protein available each minute spent eating passerine eggs, based on a protein component of 11% of wet content mass. Again, the values are higher than those that Beggs & Wilson (1987) estimated for a kaka that took 81 min to excavate a 177 g larva of the kanuka longhorn beetle (*Ochrocydus huttoni*). That bird benefited by only c. 13 mg of protein/min of effort.

Clearly, egg predation could provide substantial sources of energy and protein for kaka, if the birds could find sufficient nests each day and the search time per nest was short enough. The present depauperate passerine fauna in New Zealand forests (Holdaway *et al.* 2001) would make depending on nest predation a risky strategy for kaka now. Long-tailed cuckoos (*Eudynamis taitensis*) do take eggs and nestlings (Oliver 1955; Heather & Robertson 1996; Higgins 1999), but they are primarily insectivores and, at about one-third the mass of kaka, do not require as much energy each day.

Before introduced mammalian predators reduced bird numbers and diversity in New Zealand (Holdaway 1999), there would have been more scope for a partially carnivorous diet for kaka. Indeed, the species may sometimes tackle larger prey than birds' eggs. W. T. L. Travers (cited in Oliver 1955) reported that kaka at Lake Guyon in the lee of the Spenser Range had diets similar to kea and were carnivores that ate flesh and "sheep's pluck" hung from a tree. The kea is known to eat the flesh of sheep (*Ovis aries*), red deer (*Cervus elaphas*), and other ungulates, and some individuals catch, kill, and eat

Table 1 Egg content mass, energy content, and percentage of daily energy requirement for a female kaka (*Nestor meridionalis*) provided by single eggs and full clutches of possible prey species at St Arnaud, Nelson Lakes National Park, 28 Nov. 2001. Data on egg mass from Cramp (1988) and Cramp & Perrins (1994), and on egg composition and energy content (4.7 kJ/g) from Sotherland & Rahn (1987). Daily energy expenditure for female kaka (573 kJ) from Beggs & Wilson (1991).

Taxon	Common name	Egg mass (g)		Normal clutch	Energy (kJ)		% of daily expenditure	
		Fresh	Contents		Egg	Clutch	Egg	Clutch
<i>Fringilla coelebs</i>	Chaffinch	2.24	1.74	4	8.18	32.7	1.43	5.7
<i>Carduelis carduelis</i>	Goldfinch	1.48	1.15	4-5	5.41	21.6-27.1	0.94	3.8-4.7
<i>Carduelis flammæa</i>	Redpoll	1.21	0.94	4	4.42	17.7	0.77	3.1
<i>Turdus merula</i>	Blackbird	7.2	5.6	3-4	26.3	79.0-105.2	4.6	13.8-18.4

Table 2 Estimated protein content for single eggs and normal clutches for potential prey species for a female kaka (*Nestor meridionalis*) at St Arnaud, Nelson Lakes National Park, 28 Nov. 2001, in comparison with yield/min from kanuka longhorn beetle larva. Data on egg content proportions from Table 1 in Sotherland & Rahn (1987); based on values for *Parus major*.

Taxon	Common name	Egg mass (g)		Normal clutch	Protein mass (g)		Protein intake/min (mg)
		Fresh	Contents		Egg	Clutch	
<i>Fringilla coelebs</i>	Chaffinch	2.24	1.74	4	0.19	0.77	77
<i>Carduelis carduelis</i>	Goldfinch	1.48	1.15	4-5	0.13	0.51-0.63	51-63
<i>Carduelis flammæa</i>	Redpoll	1.21	0.94	4	0.10	0.4	40
<i>Turdus merula</i>	Blackbird	7.2	5.6	3-4	0.62	1.85-2.46	185-246
<i>Ochrocydus huttoni</i>	Longhorn beetle						13

chicks of Hutton's shearwater (*Puffinus huttoni*) at the Kowhai River colony in the Seaward Kaikoura Range (Higgins 1999; R. Morris pers. comm.). The red-crowned (*Cyanoramphus novaeseelandiae*) and Antipodes parakeet (*C. unicolor*) both take fat and flesh from bird and seal carcasses when it is available (Higgins 1999) and the Antipodes parakeet has been observed to hunt and eat adult grey-backed storm petrels (*Garrodia nereis*) (Higgins 1999). As all the *Cyanoramphus* taxa are known to take insects to a greater or lesser extent, and both species of *Nestor* are at least partially carnivorous, the kakapo (*Strigops habroptilus*) therefore seems to be the only completely herbivorous parrot in New Zealand (Higgins 1999).

Although it is only a single observation, it is unlikely that JMW witnessed a unique event. Nest robbing involves specialised behaviours, but is likely to be rapid and cryptic, and does not involve the damage and effort that would attract observers to their efforts in locating large beetle larvae. It is difficult to detect nest predation without a specific monitoring programme, and so it is possible that kaka are regular, opportunistic, nest robbers, especially during the breeding season (as for the present observation) when there is a premium on acquiring energy and protein, and nests of other species are available. The observation is therefore

relevant to the interpretation both of nest losses of other species in areas where kaka are still present, and of dietary intake in kaka.

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