Notornis, 2012, Vol. 59: 85-87
0029-4470

SHORT NOTE

Does hole-roosting behaviour of mohua (*Mohoua ochrocephala*) increase the risk of predation by introduced mammals?

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The mohua (or yellowhead, *Mohoua ochrocephala)* is a small, insectivorous, forest passerine endemic to the South I of New Zealand. Historical records show that they were once present in most forest habitats of the South I and Stewart I; however, they are now absent from 75% of their former range (O'Donnell & Dilks 1983; Gaze 1985). These large-scale population collapses are largely the result of predation by stoats (*Mustela erminia*) and rats (*Rattus rattus*), particularly during irruptions of these introduced mammals following beech forest mast (heavy seeding) events.

The greater impact of mammalian predators on mohua populations compared to some other forest passerines is thought to be linked to the mohua's hole-nesting behaviour (Elliott 1990; O'Donnell 1996). Hole-nesting birds may be particularly susceptible to small predatory mammals (*e.g.*, stoats and rats) because once the predator enters the cavity there is little chance for a bird to escape. Mohua nest from late Oct to Jan, using tree cavities with a moderate chamber diameter (250 mm) and a small entrance hole diameter (70 mm; Elliott *et al.* 1996). Despite studies showing that cavity-breeding females are particularly susceptible to on-nest predation (*e.g.,* Elliott 1996; Moorhouse *et al.* 2003; Low *et al.* 2010), little is known about roosting behaviour in cavity-nesting species and the potential for cavity roosts to increase adult predation risk during the non-breeding season. It is possible mohua also use tree cavities as night roosts and as a result become subject to predation in the same manner as nesting birds.

Year to year declines of mohua of >60% have followed mast events in the Hawdon Valley (1986-87 & 1990-91), Dart Valley (1990-91, 1996-7 & 2000), Eglinton Valley (2000-01), and Mt Stokes (1999-2000; O'Donnell 1996; *unpubl. data*), suggesting predation of more than just breeding females. To determine whether predation can also occur during roosting, we asked fieldworkers during a detailed study on mohua nest success (Lawrence *et al.* 2000) to note any observations of mohua roosting behaviour. Here we present these observations and discuss the potential consequence of hole roosting on mohua populations in the presence of elevated numbers of mammalian predators.

Received 14 Sep 2011; accepted 17 Feb 2012
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In the Caples Valley (44.853°S, 168.229°E) on 22 Nov 1999, a banded male mohua was observed (by ML) investigating several tree cavities before entering one at 2035 h. The entrance hole was then continuously observed for 45 minutes till almost dark without the bird reappearing. The following morning the tree was climbed and the hole examined. At this time of year, mohua entering a tree cavity for a prolonged period are assumed to be nesting. However, there was no nest in the hole; it was empty with the exception of 2 mohua body feathers and 1 faecal deposit. A similar observation was made 6 weeks later (10 Jan 2000) in the Dart Valley (44.629°S, 168.196°E) when an unbanded female mohua was observed entering a hole at 2110 h (by ML). The hole was then observed for half an hour till dark and the bird did not reappear. Examination of the cavity the following day found no nest and subsequent observations demonstrated no nest building activity associated with the hole. Both occasions suggest that the birds roosted overnight in these cavities. While the 1st observation was incidental to research undertaken at the time, the 2nd observation was the result of targeted effort to confirm overnight roosting behaviour in this species.

On-nest predation of adult female mohua by rats and mustelids has been confirmed by the disappearance of breeding females following nest predation, and observations of predation using in-nest video cameras (Dilks *et al.* 2003). However, predation of adult mohua during the non-breeding season can be inferred from monitored mohua populations where indices of predators are also maintained. Two examples are given here, 1 from Mount Stokes and 1 from the Dart Valley.

In 1999 at Mount Stokes in the Marlborough Sounds (41.091°S, 174.102°E), the mohua population collapsed from 51 adults in Feb to 31 adults in Nov (A. Spencer, *unpubl. data*), which represents a 40% loss of the adult population over winter. During this period, rat numbers significantly increased. In Dec 1999, during the mohua breeding season, stoat numbers began to increase alongside the rats – resulting in a further decline in the mohua population to 20 birds by Feb 2000. During the non-breeding season in 2000, all the remaining adults disappeared (Gaze 2001). This rapid decline strongly suggests significant predation of non-nesting mohua in the presence of rats and stoats.

At the end of the breeding season in Feb 2007, at least 16 adult mohua were known to reside at Mill Flat in the Dart Valley (44.710°S, 168.361°S). By May, repeated searches found only 2 birds (12% survival; B. Lawrence, *unpubl. data*). During this period rat numbers, as measured by tracking tunnels, were high (60-100% tracking). It is inferred that rats were responsible for the mohua decline, because in an adjacent forest where rats were being controlled, adult mohua survival during this time was significantly higher (at least 87%; $n = 33$; Fisher's exact test: $p < 0.001$). The decline of mohua at Mill Flat differed from other species which are assumed not to roost in tree cavities; 5-minute counts ($n = 72$) over a wider area of the Dart and Caples Valleys where rats were present, showed riflemen (*Acanthisitta chloris*) and grey warbler (*Gerygone igata*) numbers remained steady, from Oct 2006 to Oct 2007, while mohua counts declined by 90%.

Our observations of mohua cavity-roosting behaviour contribute to an understanding of field data relating to predation of these birds even during the non-breeding period. If small mammalian predators can trap and kill adult mohua within tree cavities at any time of the year (*i.e.*, in nests while breeding, and in roosts during non-breeding), then this species is at risk of catastrophic predation during mammal irruptions regardless of the season as described in the examples above. Despite our explanation for the susceptibility of mohua to non-breeding predation events being based on 2 behavioural observations, we believe our results highlight the need for managers to consider nest predators as potential threats year-round in this, and perhaps other endangered species.

ACKNOWLEDGEMENTS

Many Department of Conservation field workers were involved in collecting the data summarised in the instances above. Thanks to Bruce McKinlay and the anonymous reviewers for their comments on the manuscript. ML dedicates this paper to the memory of Barry Lawrence.

LITERATURE CITED

Dilks, P.; Willans, M.; Pryde, M.; Fraser, I. 2003. Large scale stoat control to protect mohua (*Mohoua ochrocephala*) and kaka (*Nestor meridionalis*) in the Eglinton Valley, Fiordland, New Zealand. *New Zealand Journal of Ecology 27*: 1-9.

Elliott, G.P. 1990. *The breeding biology and habitat relationships of the yellowhead*. Ph.D. Thesis. Victoria University of Wellington, Wellington, New Zealand. 183 pp.

Elliott, G.P. 1996. Productivity and mortality of mohua (*Mohoua ochrocephala*). *New Zealand Journal of Zoology 23*: 229-237.

Elliott, G.P., Dilks, P.J., O'Donnell, C.F.J. 1996. Nest site selection of mohua and yellow-crowned parakeets in beech forest in Fiordland New Zealand. *New Zealand Journal of Zoology 23*: 267-278.

Gaze, P.D. 1985. Distribution of yellowheads (*Mohoua ochrocephala*) in New Zealand. *Notornis 32*: 261-269.

Gaze, P. 2001. *Mohua on Mount Stokes – the rise and fall of a population*. Nelson: Department of Conservation, New Zealand.

Lawrence, B., Palmer, D., van Hal, J., Low, M., McInnes, K., McLeod, J., Molloy, R. 2000. *Report on field trial of trapping for stoat control: Dart and Upper Caples Valleys, Upper Wakatipu, 1999-2000*. Queenstown: Department of Conservation, New Zealand.

Low, M., Arlt, D., Eggers, S., Pärt T. 2010. Habitat-specific differences in adult survival rates and its links to parental workload and on-nest predation. *Journal of Animal Ecology 79*: 214-224.

Moorhouse, R.; Greene, T.; Dilks, P.; ., Powlesland, R.; Moran, L.; Taylor, G.; Jones, A.; Knegtmans, J.; Wills, D.; Pryde, M.; Fraser, I.; August, A.; August, C. 2003. Control of introduced mammalian predators improves kaka *Nestor meridionalis* breeding success: reversing the decline of a threatened New Zealand parrot. *Biological Conservation 110*: 33-44.

O'Donnell, C.F.J. 1996. Predators and the decline of New Zealand forest birds: an introduction to hole-nesting bird and predator programme. *New Zealand Journal of Zoology 23*: 213-219.

O'Donnell, C.F.J. 1996. Monitoring mohua (yellowhead) populations in the South Island, New Zealand. *New Zealand Journal of Zoology 23*: 221-228.

O'Donnell, C.F.J.; Dilks, P.J. 1983. Trends in mohua populations in Westland, New Zealand, 1860-1983. Unpubl. Report. Christchurch: New Zealand Wildlife Service.

Keywords mohua; roosting behaviour; predation risk; *Mohoua ocrocephala*