

Acknowledgements

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Diet of the Speckled Boobook *Ninox punctulata* in north Sulawesi, Indonesia

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Introduction

The ecology of most of Sulawesi's owl species is poorly known (Bishop 1989, Debus 2002, Fitzsimons 2010). The Speckled Boobook *Ninox punctulata* is one of four *Ninox* species that are endemic to Sulawesi and its satellite islands, although the recent discovery by Madika *et al.* (2011) could bring up this number to five. It occurs throughout the island and inhabits forests and disturbed lowland habitats (White & Bruce 1986, Coates & Bishop 1997). König *et al.* (2008: 469) stated it to be 'widespread and common within its restricted range'.

Despite being one of the commoner *Ninox* species on Sulawesi, little is known about its diet. Marks *et al.* (1999: 236) suggested that there is 'almost no information on diet'. König *et al.* (2008: 469) described its food as 'presumably mainly insects' and that 'the biology and ecology...of this species needs study'. Coates & Bishop (1997: 363) noted it 'has been recorded foraging along narrow streams within primary forest'. Rozendaal & Dekker (1989) reported a bird killing a Swift Fruit Bat *Thoopterus nigrescens* 'in a net over a river in dense primary forest'.

Here we describe components of the diet of the Speckled Boobook based on prey remains and pellets collected at a sheltered roost site in north Sulawesi, with a view to increasing ecological understanding of this species, and possibly helping predict its sensitivity to ecological disturbance.

Methods and study area

Pellets of the Speckled Boobook were located by JAF and JLT on 19 July 2009 in an abandoned, dilapidated but sheltered dwelling at the headquarters of Bogini Nani Wartabone National Park at Toraut, north Sulawesi (0°34'N 123°54'E; 220 m asl). The site borders the extensive rainforest that makes up the 287,000 ha national park, a river and an area of agricultural land in the Dumoga

Valley (for a description of rainforest at Toraut see Whitmore & Sidiyasa 1986).

This dwelling was a known roost site for Speckled Boobook (e.g. Farrow 2008), and an individual of this species was heard by JAF, JLT and park rangers within metres of the dwelling on the night of 18 July 2009. Both Sulawesi Masked Owl *Tyto rosenbergii* and Sulawesi Scops Owl *Otus manadensis* also use habitat in this area, and both were heard on the night of 18 July 2009. Sulawesi Masked Owl is known to roost in one of the large rainforest trees near the park headquarters (Fitzsimons 2010). Based on various forms of evidence (known roost site, presence of Speckled Boobook feathers, pellet size and composition), we determined that the pellets were those of *Ninox punctulata* and not the other species.

Approximately ten separate piles of pellet material (each pile most likely consisting of multiple pellets) in varying states of decomposition were located throughout the dwelling, with only one pellet seemingly intact. Ants were removing insect material from these pellet remains at the time and moth pupae were also causing disintegration of the material.

Prey remains were analysed by EM, in consultation with Sulawesi small mammal expert Guy Musser, by visually comparing the lower mandibles within the sample. We compared these to descriptions in the taxonomic literature for small mammals in Sulawesi (e.g. Musser 1972, 1981a,b, 1982, 1991, Ruedi 1995). Tooth cusp patterning was also examined for distinguishing features. The minimum number of prey individuals was recorded (by counting skulls and matching left and right jawbones) and weights sourced from the published literature.

Although the remains of invertebrates were in a degraded state at the time of analysis and could not be systematically or accurately assessed, we identified key distinguishing features such as beetle wings.

Results

It was not possible to quantify the number or type of invertebrate material in the pellets, owing to their state of decomposition. However, beetles (Coleoptera) were identified as present.

Based on the obvious presence of a diastema and tooth shape on the mandible, all mammal specimens were all identified as rodents. No remains of insectivorous mammals were found. Fifteen of the mandibles were identified as from Pacific Rat *Rattus exulans* and seven from Black Rat *Rattus rattus* complex (previously, individuals from this complex in Sulawesi were considered a separate species, Tanezumi Rat *Rattus tanezumi*: Musser & Carleton 2005, G. Musser pers. comm. 2012).

Measurements on the maxillary tooththrow (LM¹⁻³ in Musser 1979) were only possible on a few maxillary fragments. These were inconclusive as to species identity, and it is possible that other small rodent species were among the vertebrate remnants.

Discussion

Both the Pacific Rat and Black Rat are introduced fauna in Sulawesi, and are common in disturbed areas. These species also inhabit degraded forests, but are absent in primary forests where tracks are not present (G. Musser pers. comm. 2012). In contrast, the entire (native) murid fauna of Sulawesi originally evolved in forested habitats (Musser 1987), although some native species can occupy secondary growth and scrub but usually only if good forest is nearby (G. Musser pers. comm. 2012). Interestingly, Durden (1986a,b) found the native Musschenbroek's Spiny Rat *Maxomys musschenbroekii* to be the most commonly trapped rodent in forests near our study site, while other native species (Yellow-tailed Rat *Rattus xanthurus*, Hoffmann's Rat *R. hoffmanni*, Sulawesi Giant Rat *Paruromys dominator* and Hellwald's Spiny Rat *Maxomys hellwaldii*) were also present (Durden & Watts 1988).

In the immediate vicinity of the park headquarters where the pellets were collected, the range of habitats—scrub, forest with tracks, agricultural fields—is likely to contain both introduced *Rattus* species. This situation suggests that Speckled Boobooks in this locality are using some or all of these habitats for hunting. Both Pacific and Black Rats inhabit the ground, but are also good climbers. Thus it is not possible to infer whether Speckled Boobooks have a preference for hunting ground-dwelling or arboreal prey.

As indicated above, the only previously documented prey of the Speckled Boobook is Swift Fruit Bat, a species which, although physically larger than the rodents in our study, weighs 67–99 g (Bergmans & Rozendaal 1988)—thus falling between the average weights of rodents from our study (40 g for *Rattus exulans* and 280 g for *R. rattus*: Dickman & Watts 2008, Watts & Aplin 2008). Considering the diversity of insectivorous mammals in Sulawesi (namely shrews: Ruedi 1995), and the similar sizes and general behaviour of these mammals to rodents, it is interesting that they were not present in the Speckled Boobook's diet, although admittedly our sample size is small.

When first describing Cinnabar Boobook *Ninox ios*, which she suggested may take soft-bodied insects in flight, Rasmussen (1999: 462) described the Speckled Boobook (along with some Melanesian taxa) as 'strikingly different in plumage and morphology [from other Sulawesi *Ninox* species], with short tails, very heavy tarsi, and *Athene*-like plumage pattern and toe bristles; in fact some had been placed in that genus (among others) in the past'. There is limited information on the weight of Speckled Boobooks: König *et al.* (2008: 415) stated 'about 200 g', and Marks *et al.* (1999: 236) stated 'one male [weighed] 151 g'. Considering the average weight of Black Rats is 280 g, this suggests that the Speckled Boobook is able to take prey almost twice its own weight. The comparatively heavier Southern Boobook *N. novaeseelandiae* boobook in south-eastern Australia (males 194–360 g, females 170–298 g: König *et al.* 2008), while known to take Black Rats (and occasionally birds up to rosella

Platycercus size), prefers smaller mammals such as House Mouse *Mus musculus* and insects (e.g. Trost *et al.* 2008).

As the insect remains within the Speckled Boobook pellets were being removed by ants and being eaten by moths when we collected them, we cannot comment on the importance of vertebrates vs invertebrates in the diet of this owl species. Problems in determining the proportions of vertebrates and invertebrates in diets are also evident in the comparatively better-studied *Ninox* species, the Southern Boobook (e.g. Rose 1996, McNabb 2002, Fitzsimons & Rose 2007, Trost *et al.* 2008, Olsen 2011); survey methods and condition of pellet material contribute to significant differences. Our findings should not be taken as representative of the total diet of Speckled Boobooks in north Sulawesi, but potentially representative of vertebrates in their diet.

The old building in which the Speckled Boobook in our study roosted has been used regularly for a number of years (see Farrow 2008, De Win 2010; 2009 photos and videos on Internet Bird Collection—<http://ibc.lynxeds.com/species/speckled-hawk-owl-ninox-punctulata>). Another small *Ninox*, the Southern Boobook, is also known to use such buildings (e.g. Fitzsimons & Rose 2007).

Our findings suggest that the Speckled Boobook feeds on both small mammals (rodents) and insects. In our study area, the species appears to select prey species that predominate in open agricultural and scrub areas or forest edges, rather than primary forests, suggesting considerable ecological flexibility. However, more research is required to obtain a better understanding of this species's diet, hunting preferences, and habitat. The increased number of ornithologists, as well as birdwatching tours to Sulawesi, and Wallacea more generally, which often promote themselves on locating endemic owl species, provides an opportunity to increase our knowledge of the basic ecology of little-studied owls in this region.

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Mobbing to death of a Japanese Long-eared Bat *Plecotus sacrimontis* by two species of tit

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Introduction

Mobbing is a widespread antipredator behaviour that occurs when individuals approach and cooperatively drive off a potential predator (Wilson 1975, Curio 1978). Birds use mobbing against a variety of predators (e.g., hawks, owls and snakes). This behaviour includes distinctive calls that attract additional mobbers from the same and different species (Curio 1978, Hurd 1996). Some species of bird have evolved the ability to adjust their mobbing response according to the predator species (Griesser 2009, Suzuki 2011, 2012). On the other hand, there are several reports of birds occasionally mistaking harmless animals as targets for mobbing. For example, tits have been documented mobbing Common Cuckoo *Cuculus canorus* mounts at winter feeders because the

plumage coloration and patterns of cuckoos mimic those of Sparrowhawks *Accipiter nisus* (Davies & Welbergen 2008). Nighthawks (Caprimulgidae) are similar to owls of the family Strigidae in their cryptic plumage, and occasionally induce mobbing by forest birds (Marks *et al.* 2011).

I describe an instance in which a Willow Tit *Poecile montanus* and a Great Tit *Parus major minor* simultaneously mobbed a flying Japanese Long-eared Bat *Plecotus sacrimontis*, a small nocturnal mammal that measures approximately 50 mm in size, including the head and body (Ohdachi *et al.* 2009). This bat preys exclusively on arthropods (Ohdachi *et al.* 2009) and poses no threat to birds, although some other bat species in other geographic regions have been reported to prey on birds (reviewed in Ibáñez *et al.* 2001).