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The Diet of the Madagascar Red Owl (*Tyto soumagnei*) on the Masoala Peninsula, Madagascar

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ABSTRACT.—Based on pellets collected at the first known nest of this endemic species, data are presented on the diet of the Madagascar Red Owl (*Tyto soumagnei*). This owl feeds almost exclusively on small mammals, the vast majority of which are native to the island. There is evidence that this species hunts at the forest edge and uses open human-degraded habitats. There is virtually no overlap in the diet of the Madagascar Red Owl and the Barn Owl (*T. alba*). *Received 17 July 1997, accepted 10 May 1998.*

Until recently, the endemic Madagascar Red Owl (*Tyto soumagnei*) was thought to be extremely rare and restricted to primary rain forest in the eastern portion of Madagascar (Collar and Stuart 1985, Langrand 1995). Over the past five years this species has been recorded at numerous localities in eastern Madagascar, and it is becoming increasingly clear that it is at best reclusive, rather than rare, and is widespread in disturbed habitats (Halleux and Goodman 1994; Powzyk 1995; Thorstrom 1996; Goodman et al. 1996; Thorstrom et al. 1997). Although information on the distribution and natural history aspects of the Madagascar Red Owl have been significantly augmented in the past few years, certain aspects of its life history remain poorly known and some published information is contradictory to that gathered from recent field work.

With the capture and radiotagging of an adult female Madagascar Red Owl in October

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1994 and the discovery of the first known nest of this species in August 1995 near Ambanizana (see below), new information is now available on aspects of this species' ranging behavior, roosting sites, and vocalization (Thorstrom et al. 1997). Further, on the basis of a preliminary analysis of pellet and prey remains found near roosts in 1994, it is known that small mammals are the dominant prey type taken by this owl (Thorstrom et al. 1997). Herein we present further information on the food habits of the Madagascar Red Owl based on pellets collected between 1994 and 1996 near Ambanizana. These data are compared to the diet of a congeneric owl, *T. alba,* occurring sympatrically with *T. soumagnei* in the rain forests of Madagascar.

STUDY AREA AND METHODS

The study site is located near Ambanizana (15° 37′ S, 49° 58′ E), on the western side of the Masoala Peninsula, in extreme northeastern Madagascar, and is a few meters above sea level. This area of the peninsula is relatively remote and composed of a mosaic of slash and burn agricultural fields, secondary growth, and primary forests. The lowland rain forest of the area has a canopy height less than 30 m with few emergent trees and high floristic diversity. Average annual rainfall recorded at another site on the peninsula between 1992 and 1996 was 6106 mm. Monsoon rains and cyclones occur between December and April, whereas rain falls steadily between May and August (Donque 1972).

The radio-tagged adult female Madagascar Red Owl was located at 22 roost sites; 50% of the locations were at the ecotone between forest and swidden fields, 36% in rice paddies, and 14% in large areas of swidden fields. Nine diurnal roost sites were discovered during the period from October 1994 to December 1996. After the discovery of the nest, a fledgling female was radio-tagged and followed to 12 diurnal roost sites. Regurgitated pellets were collected below 3 of 9 diurnal sites for the adult and 5 of 12 for the fledgling. In 1995 and 1996, regurgitated pellets, bone and fur samples were removed from the nest by a 1 m long stick with tape wrapped at one end. The stick had a tacky tape side exposed to adhere and extract pellet material resting on the floor of the cavity.

The pellet and prey remains were identified using the comparative osteological collections at the Field Museum of Natural History. Paired bones of any taxon were separated and the largest number of elements from either the left or right side was considered the minimum number of individuals (MNI) among prey items. Body masses of identified prey species are presented in Table 1, and when possible these data are from areas in northeastern Madagascar.

RESULTS

The minimum number of individuals of the total sample was 111, representing 8 different species of land vertebrates including reptiles and mammals (Table 1). All the prey species are endemic to the island except for *Rattus rattus,* an introduced rodent. No volant animals (bats or birds) or amphibians were identified from the remains. The largest sample is from 1995, with a MNI of 78.

Endemic mammals make up the vast majority of this owl's diet both by MNI and body mass. Prey species ranged in size from the 12.8 g *Microgale cowani* to the 102.7 g *Rattus rattus.* The largest endemic mammal taken was *Eliurus webbi* with a mean body weight of 71.9 g. Over the course of the three seasons for which dietary information is available, over 99% of the MNI and biomass of prey animals were mammals. Further, endemic mammals made up the vast majority of the prey species taken, both by MNI (95%) and biomass (97%).

DISCUSSION

All of the prey species taken by the Madagascar Red Owl have been reported to occur on the Masoala Peninsula or surrounding areas (Carleton 1994, Glaw and Vences 1994, Mittermeier et al. 1994, Stephenson 1995). The majority of these species are forest-dwelling, although a few can be found at the forest edge or in disturbed habitats (e.g., *Oryzorictes hova, Microgale talazaci,* and *Microcebus rufus*). *Rattus* on Madagascar generally live commensally or in open agricultural areas, but they are also known to invade both disturbed and intact native forest. All of the native rodents in the sample, belonging to the subfamily Nesomyinae, are thought to be forest-dwelling, but several species are known to tolerate moderate levels of habitat disturbance. On the basis of this analysis, the Madagascar Red Owl predominantly hunts small mammals, and we found no evidence that frogs make up any part of its diet (contra Lavauden 1932), although in captivity this owl readily consumed frogs (Halleux and Goodman 1994).

Movements of the radio-tagged individual indicate that the maximum convex polygon home range was 210 ha (Thorstrom et al.

TABLE 1. Summary of prey remains identified from Madagascar Red Owl pellets collected at Ambanizana, Masoala Peninsula.

Species	Mean mass (g)	Source of data	1994			1995			1996			Combined		
			MNI	% total individuals	% total biomass	MNI	% total individuals	% total biomass	MNI	% total individuals	% total biomass	MNI	% total individuals	% total biomass
Reptilia														
Uroplatus sp.	~29.0	a	1	4.2	2.5	—			—			1	0.9	0.5
Mammalia														
Lipotyphla														
Oryzorictes hova	34.0	b	4	16.7	11.8	1	1.3	0.8	1	11.1	7.8	6	5.4	3.5
Microgale cowani	12.8	c	1	4.2	1.1	2	2.6	0.6	—			3	2.7	0.7
Microgale talazaci	36.0	c	5	20.8	15.7	27	34.6	23.1	3	33.3	24.7	35	31.5	21.7
Rodentia														
Eliurus minor	36.9	d	5	20.8	16.1	7	9.0	6.2	1	11.1	8.5	13	11.7	8.3
Eliurus webbi	71.9	d	7	29.2	43.8	38	48.7	64.9	3	33.3	49.4	48	43.2	59.6
Rattus rattus	102.7	e	1	4.2	8.9	1	1.3	2.4	—			2	1.8	3.5
Primata														
Microcebus rufus	41.9	f	—			2	2.6	2.0	1	11.1	9.6	3	2.7	2.2
Total for Mammalia			23	95.9	97.4	78	100	100	9	100	100	110	99.1	99.5
Total for endemic Mammalia			22	91.7	88.5	77	98.7	97.6	9	100	100	109	97.3	96.0
Total individuals			24			78			9			111		

[a] Goodman et al. (1991).
[b] Goodman et al. (1996).
[c] Goodman and Jenkins (1998).
[d] Goodman and Carleton (1998).
[e] Goodman et al. (1993).
[f] Atsalis et al. (1996).

TABLE 2. Comparison of the food habits of the Barn Owl at Andasibe and Manombo (Goodman et al. 1993) and the Madagascar Red Owl on the Masoala Peninsula.

	Barn Owl		Red Owl
	Andasibe (MNI = 176)	Manomba (MNI = 90)	Masoala Peninsula (MNI = 111)
Amphibia			
MNI	38	8	—
% total individuals	21.7	8.9	
% total biomass	4.6	0.7	
Reptilia			
MNI	2	—	1
% total individuals	1.1		0.9
% total biomass	0.1		0.5
Aves			
MNI	15	1	—
% total individuals	8.5	1.1	
% total biomass	7.4	0.8	
Native Mammalia[a]			
MNI	19	—	108
% total individuals	10.8		97.2
% total biomass	4.8		96.0
Introduced Mammalia			
MNI	102	81	2
% total individuals	57.9	90.0	1.8
% total biomass	83.1	98.4	3.5

[a] Includes *Suncus madagascariensis*.

1997). A large portion of its roost sites and home range encompass slightly to heavily disturbed habitat. The bird was not recorded in nearby closed canopy forest. The Barn Owl is a relatively common species across eastern Madagascar and is often found in open and cultivated areas. Given the roosting sites and areas that the Madagascar Red Owl apparently hunts, it is almost certain that there is some overlap in the habitat used by these two owls. The Barn Owl's diet has been studied on Madagascar at other sites. Barn Owl pellets were collected at Andasibe in an area of disturbed forest, within 400 m of a relatively intact and extensive forest block and near Manombo (Farafangana) in a disturbed and open area, about 1 km from a relatively intact natural forest (Goodman et al. 1993). In Table 2 we compare the food habits of *T. alba* from these two sites with information on *T. soumagnei* from the Masoala Peninsula. In general the vast majority of prey taken by *T. alba*, whether measured by individuals or biomass, is small mammals and almost exclusively introduced species. This is in contrast to *T. soumagnei* which feeds mostly on native small mammals.

In general, *T. alba* is a species of open habitat, avoiding closed forest throughout much of its African and Malagasy range (Fry et al. 1988, Langrand 1995). Goodman and Langrand (1993) proposed that *T. alba* was able to colonize new areas of Madagascar in the wake of the opening of forested areas and the subsequent spread of introduced small mammals. If this is indeed the case, it is conceivable that in disturbed areas, particularly at the ecotone between forest and open areas, there could be overlap in prey species between *T. alba* and other species of owls. On the basis of our dietary analysis for *T. soumagnei* and published literature on *T. alba* from rain forest sites on Madagascar, the prey species taken by these two owls is different and there is no evidence of competition for food resources between them.

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Getting Stuck: A Cost of Communal Cavity Roosting

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ABSTRACT.—Multiple Acorn Woodpeckers *(Melanerpes formicivorus)* perished as a result of two group members getting stuck while attempting to exit a communal roost cavity simultaneously. Both birds died, as did other individual(s) trapped behind them. Although communal roosting may have many benefits, such mortality constitutes a risk of communal roosting that may help explain why Acorn Woodpeckers choose not to roost as communally as they could. *Received 28 July 1997, accepted 17 April 1998.*

Here I report an observation suggesting a potentially important cost of communal cavity roosting that may help explain its relative rarity. That communal roosting is typically advantageous is, of course, well documented. Individuals utilizing communal roosts compete for preferential access to the more protected interior roost sites (Swingland 1977, Weatherhead and Hoysak 1984), suggesting benefits of roosting both communally and in sheltered areas (Weatherhead 1983). Benefits of a sheltered roost site include not only greater protection from predators, but also lessened ex-

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