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Truffle consumption by New Guinea forest wallabies

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ABSTRACT

Although the fungal diet of Australian mammals, including macropodids (kangaroos and wallabies), is reasonably well understood, no work has been done on mycophagy among New Guinea mammals. We examined stomach samples from the black forest wallaby, *Dorcopsis atrata* (one sample), greater forest wallaby, *Dorcopsis hageni* (two samples), lesser forest wallaby, *Dorcopsulus vanheurni* (five samples), and the dusky pademelon, *Thylogale brunii* (one sample), for the presence of spores of epigeous (mushroom-like) and hypogeous (truffle-like) macrofungi. All wallaby species were found to have consumed a range of fungal taxa as part of their diet, including those taxa that form symbiotic relationships with forest trees and produce truffle-like fruit-bodies. This is the first record of truffle consumption of fungi by mammals in New Guinea. Our work suggests that forest wallabies are important dispersers of fungi, and may play a significant role in maintaining mycorrhizal communities and healthy forest ecosystems in New Guinea.

Introduction

Mammals are the primary dispersal vectors for hypogeous (below-ground) ectomycorrhizal fungi that form symbiotic partnerships with many forest trees (Fogel & Trappe 1978; Johnson 1996). Mammals excavate the fruit body ('truffle') of the fungi during foraging, and the ingested spores are passed out in the faeces in a viable form that can be returned to the soil a considerable distance from where they were consumed (Johnson 1996), and experimentation has shown that dispersal of fungi by mammals can increase the likelihood that the spores will form new ectomycorrhizas on the roots of host plants (e.g. Claridge *et al.* 1992; Caldwell *et al.* 2005). For these reasons, mammal-mediated dispersal of fungi is widely considered to be an important ecosystem process (Johnson 1996; Claridge 2002).

In Australia, considerable work has been done to demonstrate that potoroids (bettongs and potoroos), a family of marsupials endemic to the Australian continent, are important dispersers of truffles (e.g., Claridge *et al.* 1993; Johnson 1996; Vernes *et al.* 2001; Nguyen *et al.* 2005). More recently, Vernes (2010) has shown that several Australian wallabies in the genera *Wallabia*, *Thylogale* and *Macropus*, that live in forested habitats, are also avid consumers of a great diversity of truffles. The islands of New Guinea are home to several marsupials that might consume macrofungi, including 11 species of ground-dwelling forest wallabies (excluding the tree kangaroos), most of which are endemic species (Jackson &

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Vernes 2010). Almost nothing is known of the dietary habits of these mammals (Flannery 1990, 1995a, b), and no evidence exists in the literature as to whether they consume fungi. However, the New Guinea pademelons (*Thylogale*) includes one species (the red-legged pademelon, *Thylogale stigmatica*) that also occurs in Australia, and that species does consume fungi at rainforest margins in tropical northeastern Queensland (Vernes & Trappe 2007), as well as in sub-tropical northeastern New South Wales (Vernes, unpublished data). Therefore, it is likely, that the New Guinea pademelons, and the other New Guinea forest wallabies in the genera *Dorcopsis* and *Dorcopsulus*, also consume fungi.

We analyzed the gut contents of New Guinea macropodids that exist in Australian museum collections to determine whether any of the ground-dwelling wallabies that occur in New Guinea eat fungi. The results demonstrate mycophagy by New Guinea forest wallabies, and suggest that forest wallabies are important dispersers of truffle spores.

Methods

A small sample of the gut contents from four species – the black forest wallaby (*Dorcopsis atrata*; 1 sample), the greater forest wallaby (*Dorcopsis hageni*; two samples), the lesser forest wallaby (*Dorcopsulus vanheurni*; five samples) and the dusky pademelon (*Thylogale brunii*; one sample), were taken from specimens housed in the Australian Museum, Sydney, and the South Australian Museum, Adelaide (Table 1). All specimens were collected in the wild from various localities in New Guinea (Fig 1); (Table 1). Specimens in the Australian Museum consisted of whole animals stored in alcohol, and for these animals we made a small incision in the wall of the digestive tract, through which were inserted tweezers so as to extract a sufficient quantity of wet material (roughly 1 cm^2) to fill a 5 ml vial containing 2.5 ml of 70 % alcohol. Where possible, we collected material from each major region of the forestomach (sacciform and tubiform regions) and from the hindstomach, as well as from pelletized material in the rectum. The data from samples of different regions along the digestive tract of any one animal were pooled for analysis. Material in the South Australian Museum consisted of whole gut contents stored in 70 % alcohol; for these samples we extracted an amount of material equivalent to what was taken from the whole specimens. Subsamples of all gut samples were then sieved through a 250 μm sieve using a vacuum filtration apparatus. The resultant supernatant was allowed to settle for several hours, after which a few drops were extracted with a glass pipette and spread across a glass slide with an equal amount of Meltzer's Reagent, and allowed to dry. Slides were preserved as permanent mounts using glycerol jelly and a glass coverslip. With the exception of the *T. brunii* sample, all samples came from adult animals. The *T. brunii* was a pouch young at an advanced stage of development (fully-furred), and at an age when it would have been periodically out of the pouch, and sampling solid foods.

Slides were scanned at 400× magnification, and if necessary, spores were observed at 1000× under oil immersion to confirm identification. Images of representative spore morphotypes were taken on an Olympus CX microscope with digital capture capability. Samples were also examined with a scanning electronic microscope (JEOL JSM-5600 SEM operating at 10 kV and 8–48 mm working distance) to obtain representative photographs of as many of the spores as possible. Identification using morphological characters (size, shape, ornamentation, wall thickness and symmetry) was made to genus where possible, although some spores could only be identified to family, while for a few spore types, no identification could be reliably assigned. All spores that we identified occurred more than once in any one sample, indicative of intentional ingestion of the spore-bearing material by the animals.

Results

Fungi in the diets of New Guinea wallabies

All wallabies consumed some fungi, including truffle-forming taxa. The greatest diversity of fungal taxa occurred in the guts of *D. vanheurni* (16 taxa) and *D. atrata* (12 taxa). Individual *D. vanheurni* samples from different localities contained a rich

Table 1 – Details of the mammal specimens from which digesta were collected and analyzed for the presence of fungal spores

Species	Common name	Museum	Specimen No(s).	Date collected	Latitude	Longitude	Approx. elevation (a.s.l.)
Dorcopsis atrata	Black dorcopsis	Australian Museum	19260	21 Aug. 1987	9°20′ S	150°14′ E	1 400 m
Dorcopsis hageni	White-striped dorcopsis	Australian Museum	19993	25 May 1987	5°22′ S	145°05′ E	100 m
Dorcopsis hageni	White-striped dorcopsis	South Aust. Museum	17264	May 1987	5°29′ S	145°26′ E	230 m
Dorcopsulus vanheurni	Small dorcopsis	Australian Museum	30727	11 Jun. 1994	4°01′ S	138°12′ E	2 900 m
Dorcopsulus vanheurni	Small dorcopsis	South Aust. Museum	31233-31236	17 May 1984	6°33′ S	144°50′ E	1 200 m
Thylogale brunii	Dusky pademelon	Australian Museum	29333	Unknown	5°37′ S	134°30′ E	40 m