

Preying Possum: Assessment of the Diet of Lace Monitors (*Varanus varius*) from Coastal Forests in Southeastern Victoria

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Abstract: Across much of its range, the lace monitor (*Varanus varius*) overlaps with a diversity of potential prey items. Previous dietary studies suggest that preferred prey tend to reflect common and often easily acquired prey including carrion. We investigated the diet of *V. varius* from relatively pristine mesic coastal forest in southeastern Victoria, Australia. In our study, the diet of *V. varius* was dominated by the ringtail possum, representing 63.15% of prey ingested. Carrion comprising swamp wallabies were the next most important food item and comprised 31.57% of the sample. We also noted a single observation (5.2%) of the consumption of a short-beaked echidna. Invertebrate prey comprising larvae and pupae of beetle, butterfly and moth species were also relatively frequently ingested. However, our results indicate a substantial preference for a single semi-arboreal prey item. The ringtail possum is also the staple for other predators in this area including introduced predators. We discuss the potential conservation and wildlife management implications between *V. varius* and introduced predators in light of their overwhelming preference for the ringtail possum.

Introduction

In eastern Australia, the lace monitor (*Varanus varius*) is one of the largest native terrestrial predators alongside the Dingo (*Canis lupus dingo*) and pythons. *Varanus varius* is distributed continuously along the east coast of Australia from Cape York Peninsula in Queensland to central Victoria, with a disjunct population also found in eastern South Australia (Cogger, 1994). This monitor lizard may exceed 2 meters in length and weight up to 7 kg (but much heavier in modified landscapes or captivity) (Cogger, 1994; Guarino, 2001; Weavers, 1989).

Varanus varius has a generalist diet (comprising

many different prey taxa), but still, it comprises predominantly small to medium-sized mammals, alongside the ingestion of large prey, via carrion, including kangaroos, wallabies and domestic livestock (Guarino, 2001; Weavers, 1989). In existing studies on *V. varius*, mammals represented on average 66-78% of the dietary items ingested (Guarino, 2001; Weavers, 1989). However, one limitation of previous dietary information was that study areas overlapped considerably with the availability of introduced mammals (domestic livestock or introduced pest species) that were ingested as prey

or carrion. For example, introduced rabbits, sheep and horses all feature predominantly in the diet of *V. varius* (Guarino, 2001; Weavers, 1989). The most common native prey in the diet of *V. varius* was also obtained from carrion and comprised large macropods including grey kangaroos (*Macropus giganteus*), red-necked wallabies (*M. rufogriseus*) and swamp wallabies (*Wallabia bicolor*). Carrion from macropods may be relatively common in habitats where drought is prevalent or rainfall variation drives pronounced food availability for native herbivores (Guarino, 2001). Such events result in pulses of macropod mortality that supplies carrion to the predator guild including *V. varius*.

Hence, an effect of exotic prey and high carrion availability is that it may result in *V. varius* diets that are likely to be substantially different from populations occupying more pristine mesic forest habitats. In this study, we examined the frequency and type of prey ingested by *V. varius* in relatively pristine mesic coastal forests in the East Gippsland area of southeast Victoria, Australia.

Methods

During the Australian summers of 2007/2008, 2008/2009 and 2009/2010, we captured 143 *V. varius* using box traps, hand capture and noose pole. All lizards were captured from the coastal forests in Cape Conran State Park and Murrungowar State Forest in East Gippsland. From these animals, we opportunistically collected 13 dietary samples as a result of incidental regurgitation by some individuals (body mass 1.25-5.4 kg). A further six direct observations of prey ingestion

by *V. varius* were also included for analysis.

Results

With respect to mammalian prey items found within the diet of *V. varius*, the ringtail possum (*Pseudocheirus peregrinus*) was by far the most common prey item representing 63.15 % of prey ingested (Table 1, Fig. 1). The majority of possums also appeared to have been swallowed whole as the regurgitated carcasses were largely intact (Fig. 2). In our study area, only two other mammalian items were recorded ingested by *V. varius*; the swamp wallaby (*W. bicolor*) comprising 31.57% of the diet, and a single observation of a short-beaked echidna (*Tachyglossus aculeatus*; Fig. 3). In all cases, consumption of swamp wallaby was obtained from carrion (from direct observations). Invertebrate prey was also found in the diet of *V. varius* and comprised predominantly larvae and pupae from unidentified beetle, butterfly and moth species.

Discussion

The forests of East Gippsland are largely intact and free of introduced prey items (*e.g.*, rabbits and livestock), hence the items ingested by lace monitors here may be presumed to reflect a natural diet. *Varanus varius* consumed both vertebrate and invertebrate prey but consumed ringtail possums above all other prey. This possum is the most common arboreal mammal in these coastal forests and its high rate of dietary preference by this lizard seems most likely to reflect its availability and ease of capture. *Varanus varius* are highly adept at

Table 1. Frequency of prey occurrence of taxonomic groups noted from stomach contents and via direct visual observations of *Varanus varius* (number of samples= 19).

Prey	Frequency	%
Mammals		
Ringtail possum (<i>Pseudocheirus peregrinus</i>)	12	63.15
Swamp wallaby (<i>Wallabia bicolor</i>)	6*	31.57
Short beaked echidna (<i>Tachyglossus aculeatus</i>)	1	5.2
Invertebrates		
Araenae (spiders)	1	5.2
Coleoptera (beetles)	2	10.54
Orthoptera (grasshoppers, crickets)	3	15.6
Lepidoptera (butterflies, moths)	3	15.6

* Prey type eaten as carrion



Fig. 1. A regurgitated dietary sample from a 3.6 kg *Varanus varius* captured in the coastal forests of southeastern Victoria. The prey items comprise ringtail possum and beetle larvae. Photograph by **Tim Jessop**.

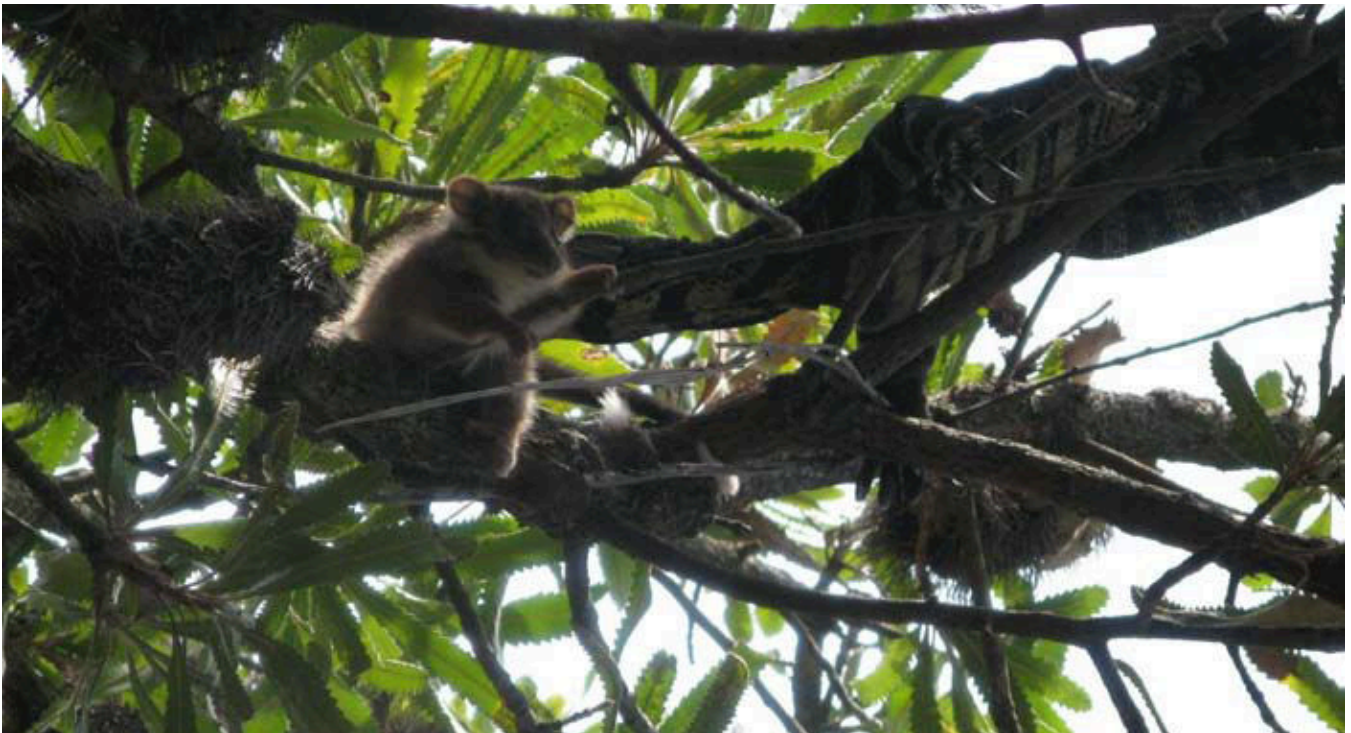


Fig. 2. A sub-adult *V. varius* (ca. 1 kg) attacking a juvenile ringtail possum (ca. 0.5 kg) that it subsequently consumed. Ringtail possums are inactive during the day and often reside in dreys (a leaf, grass and stick shelter) constructed in the branches of trees, including saw banksias (*Banksia serrata*) as pictured here. Presumably this makes the possums easy and conspicuous prey, and hence, the apparent high preference for such prey in the diet of *V. varius*. Photograph by **Jake Urlus**.



Fig. 3. Quills from a juvenile short-beaked echidna (*Tachyglossus aculeatus*) were found within the regurgium of a *V. varius* and indicate the potential, albeit rare, for these lizards to consume some awkward prey. Photograph by **Tim Lockwood**.

climbing, enabling them to seek out ringtail possums, which are nocturnal, but shelter by day within arboreal dreys (shelters comprising leaves, sticks and grass). These results contradict those of other studies which have shown that arboreal mammals such as possums and gliders are relatively rare in the diet of *V. varius* (Guarino, 2001). The frequency of large macropod prey (*e.g.*, swamp wallabies) ingested as carrion (31.6%) in this study was similar to the 26 and 30% (*e.g.*, grey kangaroo/red-necked wallabies) found in other dietary studies (Guarino, 2001; Weavers, 1989). However, the source of mortality providing macropod carrion in our study appeared to be largely due to road fatalities, compared to the environmental reasons noted elsewhere (Guarino, 2001; Weavers, 1989). Consequently, in the more remote forest areas where road traffic is absent or minimal, availability of carrion may be reduced, requiring a greater reliance on active foraging by *V. varius* to meet their nutritional requirements. This is likely to suggest that *V. varius* favors the most profitable prey in its landscape, and this leads to significant spatial variation in diet of this species pending the composition of the prey or carrion base.

Our results confirm that the diet of *V. varius* reflects a preference for both common and easily-acquired prey

items within its coastal forest landscape. Interestingly, the mammalian diet of *V. varius* reported here is also very similar to that of introduced predators inhabiting this region of eastern Victoria (Triggs *et al.*, 1984). Like *V. varius*, foxes, cats and dogs were also found to ingest ringtail possum at high frequencies ranging between 38-58% of total prey consumption (Triggs *et al.* 1984). From a conservation and management perspective, the overlap of marsupial prey items between *V. varius* and introduced predators in the lowland coastal forest area of southern Australia suggests the possibility for resource-based competition. Conceivably, introduced predators should have a competitive advantage over native predators as native prey lack co-evolutionary history with novel predators and are therefore more easily preyed upon (Glen *et al.*, 2009). If sufficiently strong, competition could lead to multiscale responses in native predators. In the case of *V. varius*, like most ectotherms with indeterminate growth, a reduction in prey availability (*e.g.*, ringtail possums) could lead to delays in growth to sexual maturity and reproductive effort. Such individual level responses would reflect nutritional constraints imposed by introduced predator competition. If severe, such competition could have broader implications for the demography of varanid

populations and potentially cause declines. However, to date, no studies have been undertaken within the context of understanding the potential impacts of introduced predators on monitor populations. Hence, we strongly advocate natural resource managers consider the impacts of introduced predators on *V. varius* to assess their vulnerability to resource competition.

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