

WHAT SOOTY OWLS USED TO EAT

A HISTORY OF MAMMAL LOSSES IN EASTERN VICTORIA

It's a question that haunts nature-lovers – what was Australia like before European colonisation? Zoologist **Rohan Bilney** follows clues left by sooty owls in Gippsland.



Photo: Tim Bawden

Sooty owl roosts are gold mines of information.



A female sooty owl at her roost in a cave in Gippsland. Photo: Rohan Bilney

The rock and cave roosting sites of sooty owls are untidy places, strewn with bones and other regurgitated remains of the animals they have feasted on. Below roosts that have been used for thousands of years, the litter can be knee deep.

Sooty owls are top-order predators in the forests of eastern Australia, able to prey on any non-flying mammal up to about 1.5 kg – tree-dwelling gliders and possums, and ground-dwelling antechinuses, rats, bandicoots and potoroos among them – so the species represented in the debris in sooty owl roosts are usually highly diverse. By analysing old prey remains (also known as subfossils) and comparing them to the current diet of sooty owls, we can learn how populations of small mammals have changed over time. Sooty owl roosts are gold mines of information about the past.

Most ecological studies in Australia have been conducted since the 1950s, more than 160 years after European settlement, in highly altered and unnatural systems affected by clearing, burning, logging, exotic species, persecution, diseases and other changes. Because of the scantness of historical information, we are unable to even recognise some environmental changes, and often underestimate the magnitude of change. This distorts our perceptions of ecosystem condition.

This is particularly so for mammals in forests in southeastern Australia. Many are small and nocturnal, so early settlers and explorers had great difficulty identifying them. Some had not been described and field guides did not exist. Useful historical information exists mostly only for mammals over one kilogram.

Sooty owl subfossils can fill some of these information gaps.

Astonishing change

For six years, I investigated the diet of sooty owls in recent and historical times in eastern Victoria. By searching rainforest gullies for whitewash (faeces), regurgitated pellets, and the owls themselves, investigating all accessible rocky overhangs, ledges and shelters, I found 10 sites with subfossil bones and 45 with sooty owl pellets from recent meals. All up, I identified and counted the remains of more than 7500 individual mammals. The bones of some mammals now extinct in the region were radiocarbon dated.

This project revealed enormous changes in small mammal populations. Just prior to European settlement, sooty owls in Gippsland preyed regularly on at least 28 mammal species. Now, their diet in this area consists of only 10 species. This ►



The current and pre-European diets of sooty owls were compared by identifying the mammal remains in recent regurgitated pellets (left) and in subfossils (above). Photos: Rohan Bilney

THE STATUS OF MAMMALS EATEN BY SOOTY OWLS, BEFORE AND AFTER EUROPEAN COLONISATION



Sugar glider. Photo: Matt Summerville

Widespread and abundant	Before	Now
Sugar glider	16.1%	54.6%
Bush rat	12.1%	12.6%
White-footed dunnart	0.1%	0.1%
Feathertail glider	1.2%	1.1%
Agile antechinus	4.8%	3.0%
Dusky antechinus	2.6%	0.7%
Yellow-bellied glider	0.2%	0%
Greater glider	2.1%	21.1%
Common ringtail possum	15.6%	5.9%
Brushtail possum (<i>Trichosurus</i> species)	0.1%	0.5%

means that about three-quarters of the small mammal species in Gippsland have declined dramatically or disappeared.

The species suffering the greatest losses were ground-dwellers in woodlands and other dry open habitats. Those no longer present include the only extinct mammal from southeastern Australia – the white-footed rabbit rat – and three species that survive only in Tasmania – the red-bellied pademelon, eastern bettong and eastern quoll. Now-rare species that occupied eastern Victoria until recently include the Hastings River mouse (now found over 700 km away) and the eastern chestnut mouse (now over 400 km away). Other species still persist in eastern Victoria but are too rare to be regular prey for sooty owls.

Distorted perceptions

The research showed that small mammal declines in the forests of southeastern Australia have been much more severe than previously realised. Many species were thought to have disappeared from this region thousands of years earlier, following vegetation and climate change since the last glacial period. Instead, they were until recently occupying a wider range of habitat types, often in great numbers. For example, Leadbeater's possums and



Long-nosed potaroo. Photo: Sharon Wormleaton

Major decline	Before	Now
Eastern pygmy possum	3.4%	0.05%
Swamp rat	1.3%	0%
New Holland mouse	0.3%	0%
Smoky mouse	2.8%	0%
Broad-toothed rat	3.9%	0%
Leadbeater's possum	1.3%	0%
Long-nosed bandicoot	3.3%	0%
Southern brown bandicoot	8.0%	0%
Long-nosed potaroo	7.8%	0%
Spotted-tailed quoll	0.5%	0%

broad-toothed rats, which now mainly occur in damp vegetation types at high elevation, were recently also in low elevation dry forests. The sites occupied by some threatened mammals that used to be in Gippsland are likely to be their last refuges rather than optimal or preferred habitats under natural conditions. They are victims of what is called 'niche-denial' – kept out of former habitats and regions by cats and foxes, and by changes in vegetation due to altered fire regimes, grazing, exotic herbivores and logging.

Because so many species have been reduced to tiny patches of their former ranges or tiny populations, our understanding of their ecology is probably distorted. The ecological potential of species such as the rare southern brown bandicoot is much broader than would be indicated by its current close association with dense vegetation, for historically it was one of the most common and widespread small mammals in southeastern Australia. If certain threats could be managed, some species are likely to be more resilient than we'd expect based on modern studies. The recovery of many small mammals is compromised by high densities of exotic predators that prey on them after fire has destroyed dense shelter sites. By suppressing cat and fox populations, we may find that threats such as fire and climate change are not as severe.

We are likely to have wrongly evaluated the conservation status of many species, especially those considered habitat specialists or affected by multiple threats. Some species considered common – such as long-nosed bandicoots and eastern pygmy possums – have actually declined greatly, and could be more vulnerable to further decline than we realise.

The discrepancies between our perceptions of ecosystem condition and ecological reality limit our ability to conserve species and ecological communities. By accepting current conditions as close to natural, we underestimate the conservation dilemmas we face.



Eastern chestnut mouse. Photo: Angus McNab

Extinct from Gippsland	Before	Now
Eastern chestnut mouse	0.1%	0%
Hastings River mouse	4.9%	0%
Brush-tailed phascogale	0.7%	0%
Squirrel glider	1.7%	0%



White-footed rabbit-rat. Painting: John Gould & Henry Richter

Extinct globally	Before	Now
White-footed rabbit rat	2.5%	0%

■ % of sooty owl diet before European colonisation
 ■ % of current diet



Eastern quoll. Photo: Edwinna Bartley

Extinct from the mainland	Before	Now
Eastern quoll	1.2%	0%
Eastern (Tasmanian) bettong	1.7%	0%
Red-bellied pademelon	0.01%	0%

The loss or decline of 18 mammal species in Gippsland forests shows that animals cannot be saved just by protecting their habitat. Unless exotic species and unfavourable fire regimes can be better managed, national parks will fail to retain all their species.

Threats to most small mammals are as serious as ever, and further declines are inevitable without substantial intervention. Exotic species are thriving and spreading, and new invaders, including pathogens, are emerging. Prescribed burning is mostly done with limited understanding of how native species respond, logging continues within areas of high conservation value, and clearing is ongoing, albeit at a slower rate.

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The losses are desperately sad but instead of lamenting the impoverished nature we have inherited, we can take heart that only one vertebrate species – the white-footed rabbit rat – has gone forever from the southeastern forests, and that some changes are reversible. The hope for the future is that by getting better at managing threats we can reintroduce the other missing species. The potential for recovery is enormous ■

READING: Bilney R, Cooke R, White J. 2010. Underestimated and severe: Small mammal decline from the forests of south-eastern Australia since European settlement, as revealed by a top-order predator. *Biological Conservation* 143(1):52–59 ■ Bilney RJ. 2014. Poor historical data drive conservation complacency: the case of mammal decline in south-eastern Australian forests. *Austral Ecology* 39: 875–886.

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The losses have undoubtedly affected ecosystem function and health. Many small mammals perform important roles – digging, spreading fungal spores and nutrients, pollinating, and consuming organic matter. In particular, the loss of many small herbivores such as rodents and small macropods has probably changed vegetation structure and composition, also affecting fire behaviour and severity. Many mammals are important food for native predators, thereby influencing their ecology and conservation, one reason why native predators such as the spotted-tailed quoll are rare. The true environmental consequences of mammal declines could take centuries to manifest, especially considering the age of forests and natural regeneration cycles.

The extreme environmental changes raise questions about sustainability, the concept supposed to underpin management of ecosystems. How do we define sustainability within landscapes so altered, when original conditions remain poorly understood, and many species are either missing or unable to perform important functions?