Mammals of the
Avon Region

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Foreword by Dr. Tony Friend

Australian Government

wheatbelt natural resource management

Department of Environment and Conservation

WWF

Contents

Species name	Common name	Family	Status	Page
Perameles bougainville	Western-barred bandicoot	Peramelinae	endangered	54
Macrotis lagotis	Bilby	Peramelinae	vulnerable	56
Cercartetus concinnus	Western pygmy possum	Burramyidae	not listed	58
Tarsipes rostratus	Honey possum	Tarsipedoidea	not listed	60
Trichosurus vulpecula	Common brushtail possum	Phalangeridae	not listed	62
Bettongia lesueur	Burrowing bettong	Potoroidae	vulnerable	64
Potorous platyops	Broad-faced potoroo	Potoroidae	presumed extinct	66
Lagorchestes hirsutus	Rufous hare-wallaby	Macropodidae	endangered	68
Macropus eugenii	Tammar wallaby	Macropodidae	priority 5	70
Macropus fuliginosus	Western grey kangaroo	Macropodidae	not listed	72
Macropus irma	Western brush wallaby	Macropodidae	priority 4	74
Macropus robustus	Euro	Macropodidae	not listed	76
Macropus rufus	Red kangaroo	Macropodidae	not listed	78
Onychogalea lunata	Crescent nailtail wallaby	Macropodidae	presumed extinct	80
Pertrogale lateralis lateralis	Black-flanked rock-wallaby	Macropodidae	vulnerable	82
Lagostrophus fasciatus	Banded hare-wallaby	Macropodidae	vulnerable	84
Nyctophilus geoffroyi	Lesser long-eared bat	Vespertilionidae	not listed	86

Contents

Foreword

Early settlers in the Wheatbelt of Western Australia encountered a large number of mammals as they worked hard to clear the potentially productive land for European-style agriculture. Undoubtedly those who were interested learned much from the Indigenous people about the habits and characteristics of the marsupials, rodents and perhaps even the bats that displayed such spectacular diversity around them.

The Noongars who lived in the Avon region had long ago learned how to manage the environment sustainably and benefit from the resulting bounty, including the full larder of mammals it provided.

The English naturalist-collectors John Gilbert and Guy Shortridge worked on the western margin of the area covered by this book and provided two time-specific scientific snapshots of the mammal fauna, in 1840-43 and 1904-06 respectively. We are lucky also to have accounts of the early mammal fauna through the eyes of two long-time residents, Bruce Leake of Kellerberrin and Job Haddleton of Kojonup. These records and accounts paint the picture of a landscape full of life, occupied by many mammal species, well-adapted to the strong seasonal changes in temperature and water availability.

Mammal diversity would have been most marked in the fertile valleys which were selectively cleared for agriculture. The historic accounts contrast sharply with our observations today, as we struggle to maintain populations of a diminished range of these mammals in the often small reserves that form habitat islands in a sea of agricultural land.

In 1980, as a young PhD graduate, I was given a rather daunting task: to investigate why the last few populations of numbats had declined dramatically during the late 1970s and to recommend management measures to reverse the decline. After eliminating fire and drought as primary causes of numbat decline at Dryandra, I used an experimental approach to show that removing introduced red foxes by poisoning results in an increase in numbat numbers. At the same time, Dr Jack Kinnear carried out an elegant experiment on isolated granite rocks south of Kellerberrin that demonstrated that removal of foxes causes spectacular recovery of the dwindling black-flanked rock-wallaby populations. These two pieces of research switched the focus in management of threatened mammals in Western Australia towards fox control in their habitat and led ultimately to the Department of Environment and Conservation's (DEC's) successful *Western Shield* program.

We used recovering mammal populations to source animals for reintroduction to intact habitat once foxes were controlled. In the Avon region, such translocations have included numbats to Boyagin, Tutanning and Dragon Rocks nature reserves, quenda to Boyagin, Tutanning and Dongolocking nature reserves, chuditch to Lake Magenta Nature Reserve, and black-flanked rock-wallabies from Mount Caroline and nearby granite rocks further downstream to the Avon Valley National Park and adjacent Paruna Sanctuary.

Are we winning the fight to conserve the Wheatbelt's remaining mammals? In the 28 years during which I have been privileged to work on the fascinating mammals of this amazing area, we have seen major advances, like those described above, offset by a steady decline in habitat quality on many reserves. Reducing predation will only buy a small amount of time for our mammals if habitat degradation is allowed to continue. Reducing fragmentation by creating habitat linkages between reserves is also critically important, especially as climate change becomes a reality. I sense, that the growing awareness in Western Australians of the fantastic richness of our wildlife heritage and a strong desire to prevent more loss provide hope for the future of the mammals living in this area. The challenge is to demonstrate that remedial work can be done on farms while maintaining economic viability. This book provides up-to-date, accurate and easily digestible information on the mammals of the Avon region. It will be an important resource for those wishing to move the balance back in favour of the area's fabulous mammals.

Tony Friend
June 2009

The aim of this book is to promote awareness of the biology, ecology, threats and management of mammals that have occurred in the Avon region since European settlement. The Avon region is located within the central and eastern wheatbelt of south-western Australia. The Avon region comprises a total area of almost 120 square kilometres.

Western Australia has 53 species of 'declared threatened' mammals, of which 11 have been found in the Avon region. In addition there are 11 mammal species that are presumed to be extinct and a further 25 mammal species that are considered to be 'priority fauna'. Priority fauna are species that are poorly known, thought to be rare or under threat of extinction.

Extensive land clearing, continued disturbance and the introduction of exotic species have a direct impact on mammals in Western Australia while competition from weeds, climate change and inappropriate fire regimes threaten their habitat and food supplies. The fragmented nature of remnant native vegetation in the Avon region compounds these threats, as it compromises the natural gene flow between populations of native mammals. Remaining populations are left vulnerable to disease and predation due to the lack of suitable habitat.

History of land use

The original inhabitants of south-west Western Australia were the Noongar people. It is believed that they have inhabited the region for about 40,000 to 50,000 years and they have had a close association with the land. The first European explorers reached what was to

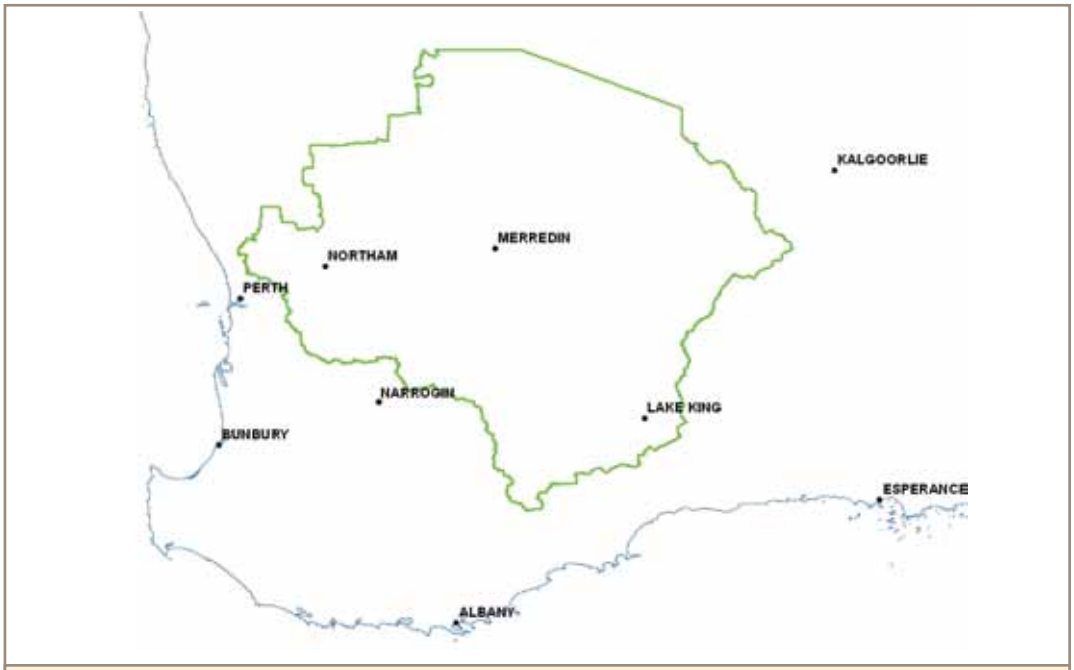


Figure 1: The Avon region

Figure 2: Granite outcrop (Image: Rowan Inglis)

become the Avon region in the 1830s, and the first pastoralists started expanding out from the Swan River Colony between the 1830s and 1840s. Not until the late 1890s, when the eastern railway opened to Southern Cross, did agricultural settlement accelerate and enable grain to be readily transported. Land clearing for agriculture accelerated in the Avon after the Second World War and peaked in the late 1970s and early 1980s.

Sandalwood cutters initially opened up the southern Avon region and were followed by brown mallet cutters; the bark of the brown mallet was used for tanning leather and was highly sought after. Once the area had been opened up, settlers moved in with their livestock and started to clear land to make way for pastures and crops. The area is now used extensively for the production of cereal crops and livestock.

Agricultural land use often conflicted with native fauna. Losses of native fauna occurred from the clearing process, the subsequent loss of habitat and the associated burning of bush. Many species were considered pests because they ate crops or worried livestock and were readily eaten (tammar wallaby), hunted or poisoned (burrowing bettong) by settlers.

Geology, landforms and soils

The granite outcrops scattered through the Avon region are an indicator of its origins. These outcrops are more than 2,500 million years old and comprise a visible expression of that part of the earth's crust known as the Western Shield. The soils of south-west Western Australia have been created by water and wind erosion of exposed surface rock, which has been leached of minerals over millions of years. High rates of weathering when the climate was more temperate to tropical have resulted in a landscape with low relief and a laterite profile of strongly weathered material.

The soils of the Avon region are best described by their position in the landscape. Infertile sandplains and lateritic soils are found high in the landscape, mid slopes are dominated by sandy and

gravelly loams while valleys consist of loams, saline loams and often salt lakes.

Climate

The climate of the Avon region can be described as extra-dry Mediterranean, where winter rainfall dominates and summer is long, hot and dry. The average rainfall decreases from 700 millimetres to 325 millimetres in a west to east direction and predominately falls during winter. During summer there are occasional erratic rainfall events associated with low pressure systems and thunderstorms that can bring heavy rain. Lightning strikes from these storms often trigger wildfires that can affect landscape dynamics both in the short and long term.

The ability of native fauna to cope with climatic stress depends upon many factors, including their ability to access and conserve water. A number of species are able to use and conserve water metabolically through food resources; however, many species are dependent on seasonal rainfall for their survival and ability to reproduce. This can lead to greater reliance on unnatural food and water sources such as crops and dams. This creates an undesirable and unsustainable situation for both the native species and land owners.

Vegetation

The Avon region lies within the Southwest Botanical Province. Within this area there is almost 50 per cent endemism, with an unusually high diversity of species within the Proteaceae (*Banksias, Hakeas* etc) and Myrtaceae (*Eucalyptus* sp.) families. Sixty per cent of the vascular plants found in the

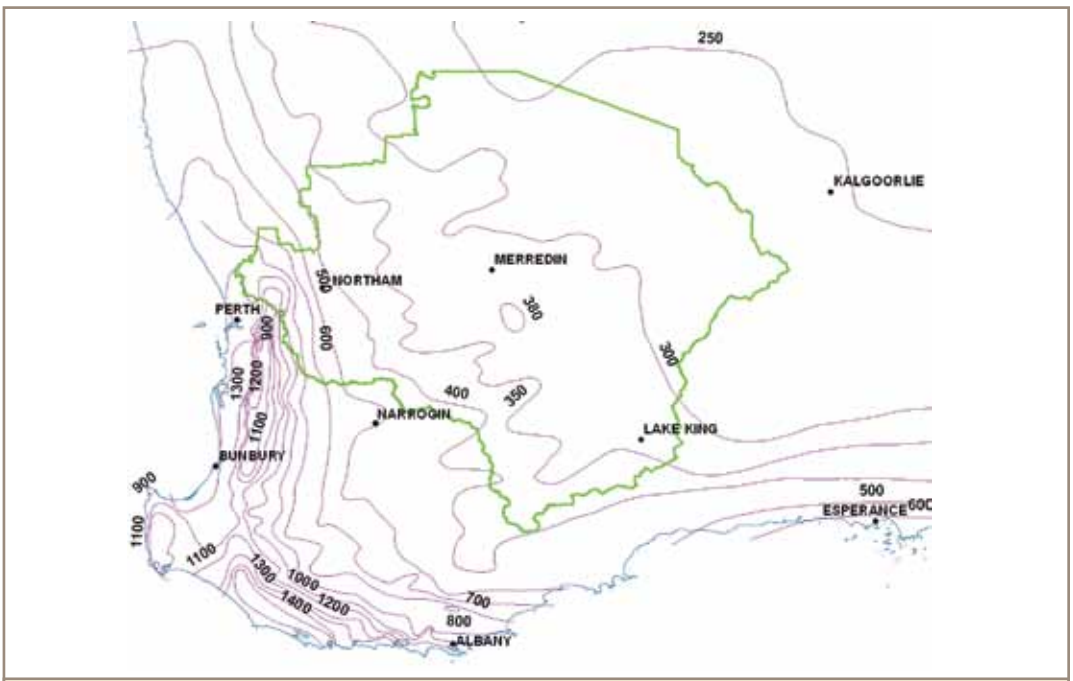


Figure 3: Isohyets indicating annual rainfall (in millimetres) within the Avon region

Avon region are thought to occur nowhere else in the world. Erosion has leached ancient soils of their nutritive value and the flora has adapted to the nutrient-poor soils of the province.

The flora of the Avon region comprises a complex mosaic of integrated plant communities closely related to the interspersed patterns of clay, loam, sandplains and laterite soils. The presence of granite outcrops, banded ironstone formations and lateritic breakaways has created small islands of unique flora species and communities throughout the landscape.

It is estimated that less than 10 per cent of pre-European native vegetation remains in the Avon region. Vegetation that remains is restricted to conservation reserves, crown reserves, unallocated crown land, road verges and areas of uncleared private land.

Interim Biogeographical Sub regions

The landforms of the Avon region are represented by seven Interim Biogeographical Regionalisation for Australia (IBRA) sub regions. Each sub region represents an area that is made up of a group of interacting ecosystems that are repeated in similar form across the landscape. The sub region is the reporting unit for assessing the status of native ecosystems, their protection in the national reserve system and for use in the monitoring and evaluation framework in the Australian Government's current Natural Resource Management initiatives. The sub regions are Avon Wheatbelt 1, Avon Wheatbelt 2, Coolgardie 2, Jarrah Forest 1, Mallee 2, Swan Coastal Plain 2 and Yalgoo 2.

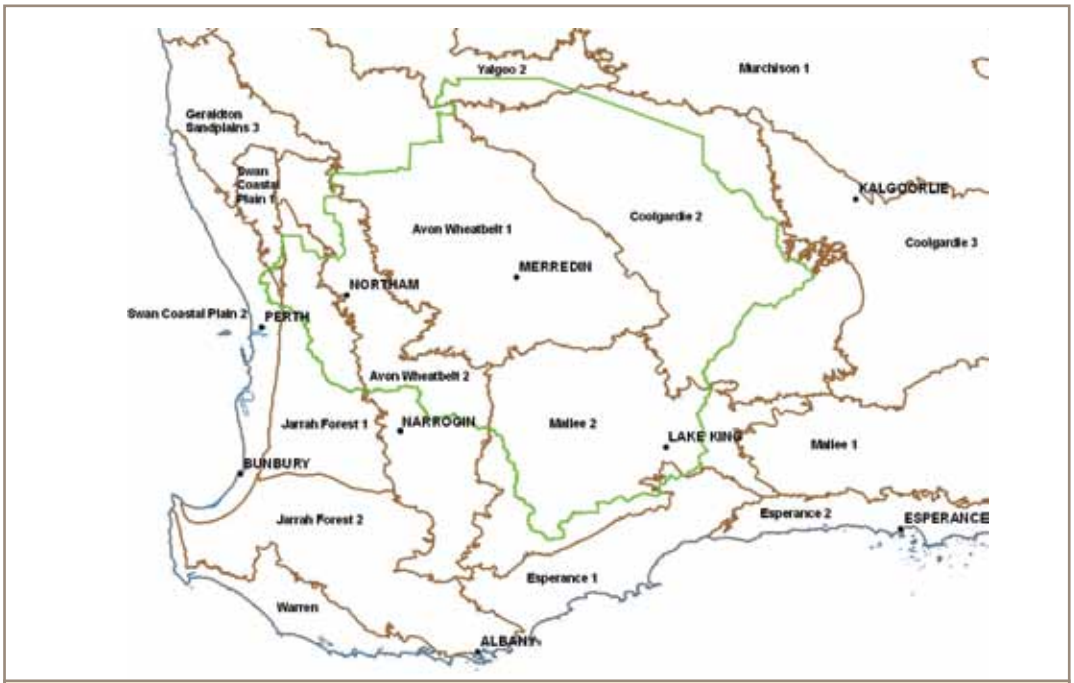


Figure 4: IBRA sub regions found within the Avon region

Figure 5: Typical remnant vegetation in Avon Wheatbelt 1 sub region (Image: Rowan Inglis)

Figure 6: Typical remnant vegetation in Avon Wheatbelt 2 sub region (Image: Rowan Inglis)

Avon Wheatbelt 1 (AW1 Ancient Drainage sub region)

The Avon Wheatbelt 1 sub region is an ancient eroded plain that has formed a gently undulating landscape with low relief. The drainage consists of relics of ancient rivers that have formed disconnected salt lake chains that now only flow in very wet years. Lake Campion, Lake Brown and Lake Wallambin are examples of salt lake chains that occur in AW1 within the Yilgarn region.

The vegetation varies from Proteaceous scrub-heaths on residual lateritic uplands and derived yellow sandplains to mixed eucalypt, rock sheoak and jam-york gum woodlands on Quaternary alluvial and eluvial deposits.

Avon Wheatbelt 2 (AW2 Rejuvenated Drainage sub region)

The Avon Wheatbelt 2 bio region is an area of active drainage in the Yilgarn Craton with continuous streams flowing in most years. The soils in this region are formed in colluvium or *in-situ* weathered rock.

Vegetation in this bio region includes populations of Proteaceous scrub-heaths on residual lateritic uplands, rock sheoak and jam-york gum woodlands on Quaternary alluvials and eluvials. Woodland wandoo, York gum and salmon gum are also found.

Coolgardie 2 (COO2 Southern Cross sub region)

The Southern Cross sub region has gentle relief, comprising low undulating uplands dissected by broad valleys with bands of low greenstone hills. The higher levels in the landscape are made up of eroded laterite forming yellow sandplain, gravelly sandplain and breakaways. These areas are dominated by mallee and scrub-heath rich in endemic wattle (*Acacia*) species and members of the Myrtaceae family. The valleys are comprised of Quaternary duplex and graduational soils, and include chains of flat saline lakes that only hold water after heavy rain. Diverse woodlands rich in endemic eucalypts occur around these salt lakes and low greenstone belts. The salt lake surfaces support dwarf shrublands of samphire. Lake Deborah and Lake Baladjie are large salt lake chains that occur within the COO2 sub region. Spectacular domed granite outcrops are also present in the landscape and support large thickets of *Acacia* and *Eucalyptus* species.

The Great Western Woodlands form part of the COO2 IBRA sub region and are located east of the clearing line where the rainfall is below 300 millimetres a year (east of the towns of Southern Cross and Bullfinch). Encompassing nearly 16 million hectares from the rabbit proof fence to the Nullarbor Plain, these vast woodlands cover undulating plains interspersed with granite outcrops. Rich in both plant and animal diversity, the Great Western Woodlands are Australia's, and perhaps the world's, largest remaining intact temperate woodlands.

Figure 7: Typical vegetation of the Coolgardie 2 sub region (Image: Hayden Cannon)

Figure 8: Vegetation structure in Jarrah Forest 1 sub region (Image: Rowan Inglis)

Figure 9: Vegetation community at Lake Cronin Nature Reserve (Image: Ben Lullfitz)

Jarrah Forest 1 (JF1 Northern Jarrah Forest sub region)

This bio region consists of duricrusted plateau of the Yilgarn Craton characterised by laterite gravels and clayey soils in eastern areas.

This area is dominated by jarrah–marri forest with bullich and blackbutt found in the valleys leading to eastern populations of wandoo and marri woodlands. *Banksia* species are found in isolated sand sheets with heath found on granite rocks.

Mallee 2 (MAL2 Western Mallee sub region)

The Western Mallee bio region forms the south-eastern section of the Yilgarn Craton. The landscape is gently undulating with closed drainage. The vegetation is dominated by mallee over myrtaceous-proteaceous heaths on duplex soils with *Melaleuca* shrubs in low lying areas, and low *Tecticornia* shrublands around closed saline drainage lines. Mallee communities occur in a variety of soil types with *Eucalyptus* woodlands mainly on fine-textured soils and scrub-heath on sands and laterite. The landscape is fragmented in places with certain soil types suitable for agriculture having been extensively cleared in the past.

Figure 10: Vegetation structure in Swan Coastal Plain 1 sub region (Image: Rowan Inglis)

Lake Cronin is an example of a freshwater wetland in the MAL2 sub region within the Yilgarn region. This lake supports unique plant communities which are adapted to intermittent freshwater inundation.

Swan Coastal Plain 1 (SWA1 Dandaragan Plateau sub region)

This bio region consists of ancient marine sediments that are mantled by sands and laterites. It is characterised by *Banksia* low woodland, jarrah–marri woodland, marri woodland, and by scrub-heaths on laterite pavement and gravelly sandplains.

Yalgoo 2 (YAL2 sub region)

The Yalgoo bio region extends westwards of the boundary of the south-west botanical district. It represents the inter-zone between the south-west bio region and the Murchison. It is characterised by low, open woodlands of *Eucalyptus, Acacia* and *Callitris* on red sandy plains of the western Yilgarn Craton and southern Carnarvon Basin. The Yalgoo sub region is particularly rich in ephemeral species. Mount Jackson Banded Ironstone Formations occur within the Yilgarn region. These formations are characterised by rich and endemic plant communities.

Benefits of conserving natural biodiversity in the Avon region

It is often asked why resources should be contributed to wildlife conservation. There is no single reason to conserve wildlife but several reasons exist, depending on your values, attitudes and previous interactions with wildlife. These reasons include:

- **Responsibility.** The principal factors that have resulted in the reduction of biodiversity in Australia can be traced back to human interference. This includes both directly hunting wildlife and removing their habitats, to indirect interference by introducing predators such as the feral cat and fox. Many individuals feel a responsibility to conserve nature and correct the impact humans have had on the ecosystem.
- **Production.** Many products used by people today are products from nature. A local example of this is the use of sandalwood for fragrance.
- **Aesthetics.** Many people enjoy the visual splendour of nature. Bushwalking is a popular activity as people have an opportunity to exercise in a natural setting and see the many aspects to an ecosystem.
- **Intrinsic and spiritual.** Many cultures have a spiritual bond with nature, particularly local Indigenous people.
- **Benefits to human interests.** Functioning native ecosystems assist agriculturalists by keeping the water table down thus reducing the risk of salinity, erosion and waterlogging which can damage crops. Protecting the habitat where insectivorous animals occur may help to control agricultural pests, lessening the reliance on pesticides.

Threats facing mammals in the Avon region

Mammals in the Avon region are facing a number of challenges that threatened their continued survival and reproduction within this highly fragmented natural environment.

Medium sized (35 – 5,500 gram) mammal species have faired particularly badly since early settlement. In many cases, animals are threatened by more than one process, often with disastrous results. Major threats to natural biodiversity in the Avon region are discussed below.

Altered biogeochemical processes

Ninety-three per cent of the Western Australian wheatbelt has been cleared. Without the deep-rooted perennial vegetation to use up groundwater, the water table rises, bringing salt water to the surface. Once an area becomes saline, only salt-tolerant native plants will grow so in areas of remnant vegetation that become saline, some species of plants die out, thus changing the natural balance and reducing the range of foods available for animals. Naturally saline areas of the Avon region provide highly biodiverse habitat and are a valuable resource for wildlife. However, areas that become saline as a result of land clearing have 30 per cent fewer mammals species than areas that are naturally saline.

Changes in nutrient levels in soils and water bodies also affect plants and animals living in the area. In areas where erosion has removed the topsoil, nutrient levels can be reduced, resulting in lower quality browsing opportunities for animals. In areas where fertilisers have been used to grow crops, nutrient levels in adjacent bushland areas can increase, encouraging

the growth of weeds. If fertilisers drain or leach into wetland areas, they can become choked with algae. The algae blocks light from other water plants and uses up all the available oxygen in the water, killing aquatic animals. In some cases, the algae are toxic to animals that drink water from the wetland.

Climate change could have a huge effect on native animals living in the Avon. Many mammal species have specific requirements for food, triggers for breeding and, in the case of some bats, seasonal movement (for example, the white-striped free-tailed bat). Climate change can influence rainfall, food availability, breeding success and seasonal movements. Species such as southern ningaui are short-lived, seasonal breeders and would be severely affected by a trend towards a drier climate with fewer good seasons.

Impacts of introduced plants and animals

The introduction of plants or animals to an area almost inevitably causes changes to occur in the populations of native species. In the Avon region, numerous species have been introduced. Weeds such as veldt grass place stress on native vegetation communities by competing for available resources such as nutrients and water. They also change the structure of the ecosystem resulting in altered and more dynamic fire behaviour. Many animal species begin to decline in weed-infested areas as their food plants become less common and their desired shelter is depleted.

Feral animals also disturb ecosystems. Feral herbivores such as rabbits and goats destroy native vegetation by overgrazing. These animals also compete with native species for food. The introduced honey

Figure 11: A heavily cleared landscape in the Avon region (Image: Rowan Inglis)

bee can cause problems because they favour hollow trees as hive sites, thereby competing with native arboreal animals such as possums and phascogales for habitat. Introduced predators such as foxes and feral cats are a major threat to native animals which have not evolved to avoid these efficient hunters and are easy prey, especially in small remnant patches of bush with limited places to hide.

Mammals such as numbats declined in the Avon following the arrival of foxes in Western Australia in the first half of the twentieth century. Other species such as the boodie and crescent nailtail wallaby disappeared entirely. Pig-footed bandicoots and broad-faced potoroos began to disappear even before foxes became common and may have fallen prey to feral cats, which had already become established in the south-west of Western Australia.

Impacts of problem native species

Changes to the balance of the natural ecosystem in the Avon region have benefited some native animals at the expense of others. Kangaroos have increased in number in agricultural lands because of water supplied for stock and larger grassland areas for feeding. Large numbers of kangaroos overgraze bush remnants, damaging mature plants and preventing seedlings from becoming established.Grain-eating birds such as Australian ringnecks and galahs have also increased in cleared areas and are destructive to bush remnants. These birds not only strip leaves and shoots of plants but also use up all the available nest hollows preventing other birds and mammals such as bats, phascogales

European fox

and possums from using them. Galahs often damage the hollows by chewing them so that they no longer provide shelter for other species. The reduction in natural predators such as bilbies (which dig underground for ghost moth and beetle larvae), dunnarts (which are aggressive predators of grasshoppers and beetles) and predatory invertebrates has allowed populations of herbivorous insects to increase, sometimes reaching plague proportions and defoliating bush remnants. Overgrazing can reduce the diversity of plants in a remnant making it harder for animals such as honey possums, which require a range of flowering shrubs year round, to survive.

Impacts of disease

Plants and animals that are under stress are prone to disease. In the Avon region, the introduced plant pathogen *Phytophthora cinnamomi* causes dieback in *Banksia* and other plant species in degraded bushland remnants. The *Armillaria* fungus attacks susceptible species such as wandoo (*Eucalyptus wandoo*).

Disease can also affect animal populations. *Toxoplasmosis*, which is carried by feral cats, has been identified as a cause of death in many native mammal species. Degraded bushland habitat and limited food supplies can lead to malnutrition in animals making them prone to disease.

Detrimental physical disturbance events

Before the early settlers arrived in Australia, Aboriginal people had, for many thousands of years, maintained a mosaic of different ages of vegetation by 'patch burning' to drive out animals which were then captured for food. Fire also promoted regrowth which encouraged large herbivores (kangaroos, wallabies etc.) to graze in the area where they too would be hunted. This resulted in a fauna that was adapted to areas of long-unburnt vegetation and small patches of recently burnt plants. As traditional hunting methods disappeared with the movement of Aboriginal people to cities and towns, the fire regime changed to one of infrequent summer wildfires that burnt large areas. Many animals were unable to escape the fire front and those that survived had no food or shelter so became easy prey to native and introduced predators. In addition, fragmentation of the bush meant that animals from other areas could not move in as the vegetation recovered, leading to local extinction of many species in remnants following wildfire.

Some mammal species, such as the crescent nailtail wallaby, rapidly disappeared from the Avon region once European settlement started, probably

Figure 12: The impact of fire in the ecosystem (Image: Wendy Johnston)

as a result of changed fire regimes in combination with hunting and predation by foxes or cats. Other species which shelter in tree hollows such as red-tailed phascogales disappear from areas which experience wildfire. This is because their already diminished habitat is destroyed, along with the dense shrub layer which is vital in providing the species with a relatively safe means of moving through the landscape. Remaining populations of red-tailed phascogales survive in areas which are long-unburnt and still have an abundance of hollows and dense sheoak thickets.

Cyclones and drought are other physical processes which affect remaining populations of native species. Their impact is especially great in the fragmented landscape of the Avon region where natural recolonisation from other areas is difficult or impossible, resulting in local extinction. Short-lived species such as the southern ningaui are particularly susceptible to a succession of bad seasons as they are unable to reproduce successfully so their numbers decline significantly and, in some cases, localised extinction occurs.

Impacts of pollution

Pesticides and herbicides are a threat to native species, unless they are used with care near bush remnants. Pesticides can reduce the diversity of native invertebrates, reducing available prey species for species such as dunnarts and other insectivorous mammals. Bats that hunt over farmland may ingest contaminated insects and are at risk. Pollution from chemical spills can affect waterways and animals can become entangled in rubbish left in recreation areas.

Impacts of competing land uses

When land is used for more than one purpose, there is the potential for damage which can reduce its biodiversity. Unsustainable levels of wildflower and timber cutting can be detrimental to bush remnants. Agricultural practices such as grazing of remnants by stock can have an effect, as can mines and quarries in bushland areas. Poorly managed recreational activities can cause degradation of valuable areas. In the Avon, fragile areas such as granite outcrops can be degraded by uncontrolled vehicle access, resulting in trampling, reduction in habitat and weed introduction. The removal of any naturally occurring material such as loose granite for 'moss rock' in gardens is also detrimental as it reduces habitat for lizards, frogs, invertebrates and mammals that rely on it for shelter.

An unsympathetic culture

Positive community attitudes to conservation of our natural heritage can result in highly successful conservation projects and increased biodiversity. Unsympathetic community attitudes to conservation, however, can have a negative impact on the conservation of biodiversity. A lack of understanding of the value of natural heritage and its contribution to human quality of life can lead to a lack of motivation to protect the environment.

Insufficient resources to maintain viable populations

Even if the above threats are held constant, biodiversity will only be maintained if there are enough natural resources to ensure that viable populations can persist. In their environment, animals need to have enough food, water, oxygen, shelter,

access to mates and favourable conditions for them to breed, or their species will not survive in the long term. There must be sufficient individuals to maintain genetic diversity. There must also be sufficient space for populations to occur in more than one area. In this way, if one of the many threatening processes affects one area, the species will survive in other areas and can become re-established. Research has shown that in populations of medium-sized native mammals, once foxes have been controlled, the area of habitat available becomes the factor which limits population size. Habitat fragmentation is a major threat to many mammal species, especially animals with large home ranges such as the chuditch, numbat and western brush wallaby.

What is being done to address these threats?

Predator control programs

Control of introduced predators, particularly foxes, is having a huge impact on the survival of mammal species in the Wheatbelt. Foxes are baited with 1080 (sodium fluroacetate), a poison similar to a chemical that occurs naturally in some species of plants (particularly in the genus *Gastrolobium*) in the south-west of Western Australia. Many native animals have a high tolerance to 1080, having evolved in the presence of the naturally occurring toxin. As a result of the Department of Environment and Conservation's (DEC's) *Western Shield* program to control foxes, populations of animals such as numbats, chuditch, tammar and black-flanked rock-wallabies are recovering in parts of their former range.

Care is always taken to ensure that the impact of non-target native species taking poison baits is minimised.

Habitat management

Sometimes, management of bushland areas is required to help native mammals to survive. In some large areas of remnant vegetation, DEC officers have begun a regime of patch burning, similar to that carried out by traditional Aboriginal people, to try to recreate the mosaic pattern of vegetation ages to which native mammals are adapted. Species such as the bilby respond well to patch burning, in combination with fox control. In the Avon DEC, local natural resource management (NRM) and community groups have worked closely to develop best practice habitat management which includes the modification of agricultural practices to benefit both the natural environment and the farmer. The planting of native species such as brushwood and sandalwood, or alternative crops such as perennial lucerne, has been trialled with the aim of helping to protect areas at risk of becoming saline and increasing the habitat available for wildlife. Farm viability on marginal land may also improve. Revegetation of degraded areas and linkage of bush remnants using corridors of vegetation are important management activities which assist the survival of animal species including mammals in the Avon region. DEC and local NRM and community groups are working closely with landowners to encourage the concept of corridors on private property.

Population health monitoring

It is important to monitor the health of populations to ensure that management is helping to maintain and hopefully enhance the survival of mammals in the Avon. Monitoring helps researchers to understand more about species and their requirements, and allows them to detect

if animals are losing weight or becoming diseased, or if they are thriving and breeding. For example, populations of chuditch have been monitored following fox control and found to have increased, suggesting that fox control is a useful tool in the management of this species. Reintroduced populations of black-flanked rock-wallabies in the Avon are monitored to ensure that they are surviving and breeding (see Figure 13).

Reintroductions of fauna

Populations of the chuditch, numbat and black-flanked rock-wallaby have been successfully reintroduced to sites in the Avon region. Populations of these species are increasing. Reintroductions are only carried out if areas have ongoing fox control and appropriate habitat management. For example, rufous hare wallabies and bilbies survive better in an area that is burned in a mosaic pattern, producing vegetation of different ages.

Use of fauna surveys

Fauna surveys are carried out to determine which species occur in an area and how common they are. Surveys for determining the presence or absence of mammals may include pit traps, sand pads, spotlighting, evidence gathering (evidence might include animal scratchings on trees, diggings, or scats) and more recently the use of motion-sensing cameras. Survey techniques include recapturing and tagging individuals and data recording.

Protection of habitat

Protection of habitat can include fencing of bush remnants and reserves to exclude stock. Areas can also be protected by

Figure 13: Images from black-flanked rock-wallaby monitoring program including a trap (left) and a release (right) (Images: Rowan Inglis)

the construction of fire breaks and maintenance of strategic burnt buffer zones to provide protection for larger, long-unburnt vegetation. Species such as red-tailed phascogales require dense unburnt vegetation with an abundance of hollows and these areas need to be protected from wildfire.

Species-specific conservation plans

Some species of mammals are threatened with extinction and require specific management to ensure their survival. Specific conservation and recovery plans have been prepared, summarising the available information about the species and proposing the most effective way to conserve it. Often these plans are developed jointly by State and Federal government departments and interested community groups who work together for the protection of the species. Populations of mammals such as the bilby and numbat are being managed with the help of recovery plans.

Community education

The support of the community is essential for biodiversity conservation to succeed. Community education aims to promote an awareness of wildlife and the value of biodiversity. Workshops, websites, displays and publications are produced by government departments, community organisations and individuals to encourage the community to be active in supporting the conservation of biodiversity and become involved in conservation projects in the Avon. If everyone works together, the outcomes for conservation can be exceptional.

What can I do?

Whether you are a land owner, or are just interested in helping native mammals to survive in the Avon, there are many opportunities to help. Here are some suggestions:

- Become a volunteer or join another community organisation that focuses on fauna conservation. Conservation activities are most successful if people work together. Partnerships between government agencies, community organisations and individual landowners can produce enormous benefits for communities and biodiversity conservation. To find your nearest environmental community organisation, contact Landcare Australia on (08) 9368 3171 or www.landcareonline.com.
- If you are a landowner and wish to protect conservation values on your land, you can join the Department of Environment and Conservation's (DEC) *Land for Wildlife* program. Contact your local DEC office to find out what is involved. Or you can read about it on the DEC website; www.dec.wa.gov.au/management-and-protection/off-reserve-conservation/land-for-wildlife.html.
- Another method to protect your ecologically significant patch of vegetation is to enter into Voluntary Management Agreements (VMA) or voluntary Conservation Covenants with WWF–Australia. These legally binding agreements ensure that future property owners are obliged to manage native vegetation remnants as described by the terms of the covenant. While

VMAs typically apply for a 10-year period, covenants brokered by WWF's Healthy Ecosystems team protect native vegetation forever. If you would like more information please contact WWF–Australia on (08) 9387 6444 or www.wwf.org.au/ourwork/land/woodlandwatch.

- If you are a landowner, you can approach DEC and other agencies such as WWF–Australia for advice on how to manage habitats such as granite outcrops and remnant woodland on your property so they provide a range of habitats for fauna. Granite outcrops are valuable islands of vegetation and, if they are of good quality and have a range of habitats, they can support a variety of mammal species such as echidnas (if they have patches of soil and fallen timber), red-tailed phascogales (if they have sheoak thickets) and even black-flanked rock-wallabies (if they have extensive rocky areas and caves for shelter). Remnant bushland areas and granite outcrops are vitally important for the survival of native mammals in the Avon region. Simple measures such as fencing to exclude stock and controlling foxes can help to conserve these fragile areas.
- Landowners can create buffer strips on their properties, widen existing corridors and create new ones to link remnants both within and between private properties and reserves. Corridors increase the value of remnants enormously by allowing animals like honey possums and dunnarts to move between remnants, making their populations more resistant to local extinction after fire or other disturbance, and increasing the gene flow. Corridors may be designed to act as shelter belts, to reduce waterlogging and control salinity in addition to helping wildlife.
- You can report both recent and historical sightings of threatened animals to your nearest DEC office. Your information is vital to ensuring efforts in conserving threatened species can focus on areas of known habitation.
- Become a Wildlife Carer and help to rehabilitate injured wildlife for release back into the bush. For more information you can approach your local DEC office.
- Volunteers can assist landowners, land managers, community organisations and shires to create and manage a network of corridors for the benefit of a variety of native fauna, including mammals. By working together, these groups can help to maintain the viability of populations of mammals and other animals while enhancing opportunities for communities, agriculture and other commercial interests. Become a volunteer and help save the biodiversity of the Avon!

Fauna conservation rankings and codes used in this book

Each species has a ranking that has been obtained using a combination of World Conservation Union (IUCN) and the Department of Environment and Conservation's (DEC) ranking systems.

IUCN Red List Categories

The IUCN has developed a system of classification for a wide range of organisms according to their specific level of risk. They are as follows:

Critically Endangered (CR)

When an animal is considered to be 'critically endangered', it is considered to be facing an extremely high risk of extinction in the wild.

Endangered (EN)

When an animal is considered to be 'endangered', it is considered to be facing a very high risk of extinction in the wild.

Vulnerable (VU)

When an animal is considered to be 'vulnerable', it is considered to be facing a high risk of extinction in the wild.

Presumed Extinct (EX)

Animals are considered to be 'presumed extinct' if they have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all wild populations have been destroyed more recently, and have been gazetted as such, following approval by the State Minister for the Environment, after recommendation by the Threatened Species Scientific Committee.

DEC's Priority Fauna List

In addition to species listed as declared threatened fauna, DEC maintains a list of priority species that are not well known and require additional surveys to determine if they meet criteria for declared threatened fauna.

The following categories make up the priority list according to the degree of perceived threat:

Priority One (P1): Taxa with few, poorly known populations on threatened lands

These are species that are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Fauna conservation rankings and codes used in this book

Priority Two (P2): Taxa with few, poorly known populations on conservation lands

These species are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Three (P3): Taxa with several, poorly known populations, some on conservation lands

These are species that are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority Four (P4): Taxa in need of monitoring

These are species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

Priority Five (P5): Taxa in need of monitoring

These are species that are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

If you think you have seen any of the threatened or priority animals shown in this book (see Table 1), or you would like more information, please call your nearest Department of Environment and Conservation office.

Narrogin: (08) 9881 9200

Merredin: (08) 9041 2488

More information is available on the DEC website www.dec.wa.gov.au.

Table 1: Presumed extinct, declared threatened and priority mammals that have been found in the Avon region

Common Name	Scientific Name	Status
Burrowing bettong	*Bettongia lesueur*	VU
Pig-footed bandicoot	*Chaeropus ecaudatus*	EX
Chuditch	*Dasyurus geoffroii*	VU
Quenda	*Isoodon obesulus*	P5
Rufous hare wallaby	*Lagorchestes hirsutus*	EN
Banded hare wallaby	*Lagostrophus fasciatus*	VU
Lesser stick-nest rat	*Leporillus apicalis*	EX
Tammar wallaby	*Macropus eugenii*	P5
Western brush wallaby	*Macropus irma*	P4
Bilby	*Macrotis lagotis*	VU
Numbat	*Myrmecobius fasciatus*	VU
Long-tailed hopping mouse	*Notomys longicaudatus*	EX
Central long-eared bat	*Nyctophilus sp*	P4
Crescent nailtail wallaby	*Onychogalea lunata*	EX
Western barred bandicoot	*Perameles bougainville*	EN
Black-flanked rock-wallaby	*Petrogale lateralis*	VU
Red-tailed phascogale	*Phascogale calura*	EN
Brush-tailed phascogale	*Phascogale tapoatafa*	VU
Broad-faced potoroo	*Potorous platyops*	EX
Western mouse	*Pseudomys occidentalis*	P4
Heath mouse	*Pseudomys shortridgei*	VU

Distribution maps

Distribution maps have been drawn to illustrate where each species is found within the Avon region. It should be noted that many of the species described have a distribution expanding past the boundaries of the map. Dark green on each map identifies the current distribution of that species in the Avon region. Light green indicates that the species has been recorded in the area, however, it is now considered that the species is locally extinct. White indicates the species has never been found historically in that area.

Figure 14: Distribution map for chuditch (*Dasyurus geoffroii*) indicating distribution

Short-beaked echidna

Tachyglossus aculeatus

Family: Tachyglossidae

Conservation status: Not listed

Identification

The short-beaked echidna varies in colour from light brown to almost black depending on the individual animal and the location. Its spines are pale brown with black tips and the hair varies in colour from pale brown to dark and from short to long and shaggy depending on the area. Its long, beak-like snout is hairless and has a tiny mouth at the end, through which its long extendible tongue flicks out and draws in insects. The short-beaked echidna has strong claws which help it to dig through the soil. It has one particularly elongated claw on the second toe of its hind feet which is used for grooming between the spines on its back. Underneath, the echidna has coarse hair and no spines. Unlike other mammals, but like birds and reptiles, the echidna has only one external opening for the functions of reproduction and the elimination of wastes.

Habitat and distribution

Short-beaked echidnas are found in most parts of Australia. They even occur in areas that receive snow, and will hibernate for part of the year when conditions are inhospitable. In the Avon region, the short-beaked echidna occurs in bush areas, especially where fallen timber and dense shrub areas have been left as wildlife refuges. It is usually solitary, and shelters under dense bushes, piles of debris, in hollow logs or even in rabbit burrows when it is not digging for food.

Diet

Ants and termites make up almost all of the diet of the short-beaked echidna, although it has also been known to eat beetle larvae and other soil invertebrates. Echidnas ingest a large amount of soil, termite mound and ant nest material while licking up their prey. As a result,

their droppings are distinctively cylindrical and are composed mostly of sand and the hard, shiny, undigested exoskeletons of insects. Echidnas have no teeth; instead their prey is ground up between a hard plate at the back of the tongue and a similar structure on the palate.

Reproduction

Breeding begins in June and sometimes up to 10 male echidnas will follow a receptive female, looking for an opportunity to mate with her. The short-beaked echidna is one of the few mammals to lay eggs. Two weeks after mating, the female lays an egg into her strong, muscular pouch. The young is born 10 days later. The female echidna secretes a thick, rich milk though pores in the skin inside her pouch which the young sucks up through its snout. Once the young is about three months old, the mother leaves it in a den and seals up the entrance while she goes out to feed. She returns every one or two days to feed the young, usually for about half an hour at a time. The young gradually develop spines while in the den and it is thought that they are weaned at about eight months old. Independent young have been recorded around September to November, at about one year old.

Threats

Apart from occasional animals being killed on roads, adult short-beaked echidnas have few threats to their survival. When disturbed, an echidna rolls itself into a ball or uses its powerful claws and muscles to dig itself vertically down into the soil or lock itself between rocks, making it difficult for predators, including cats and foxes, to attack it.

Management actions

Adequate reserves, especially those with fallen timber and some dense bushes for cover, aid this species. The maintenance and replanting of wildlife corridors and refuges in farmland areas are also valuable. Fox control in conservation areas helps to reduce predation of young animals.

Short-beaked echidna facts

Size (head and body length)
300 – 450 mm

Size (tail)
85 – 95 mm

Weight
2 – 7 kg
Average 4.5 kg (females)
Average 6.3 kg (males)

Habitat
Occurs in virtually all land-based habitats except cities and intensive farming areas.

Diet
Specialises in ants and termites, occasionally takes beetle larvae and other invertebrates.

Reproduction
Egg-laying mammal. One egg is laid in the pouch. Young hatches in 10 days, is fed milk in pouch for 3 months, and then fed in burrow until 8+ months. Independent by one year.

Longevity
50+ years in captivity

Chuditch

Dasyurus geoffroii

Family: Dasyuridae

Conservation status: Vulnerable

Identification

The upper parts of the chuditch are covered in thick, orange-brown and grey fur with white spots scattered over the top of the head and down the back. Its tail is black and furry; it has pink, cat-like ears, a pink nose and pink feet. The hind feet have five toes and granulated pads on their soles. The claws are pinkish-cream and well developed for seizing its prey.

Habitat and distribution

Chuditch used to occur throughout Western Australia, except in the Kimberley, and most of central Australia. Early settlers complained that chuditch would steal domestic chickens from their pens unless they were 'chuditch-proofed'. Residents of Perth reported them nesting in roofs until the 1930s. Their range gradually reduced until, by the 1970s, they were found only in the jarrah forests of the south-west of Western Australia, a few small populations in the eastern Goldfields and in large wheatbelt reserves. The chuditch is usually nocturnal, but will occasionally hunt during the day when it is feeding young or when the nights are cold. Chuditch occur at low densities. Females have a home range of 55 – 120 hectares which does not overlap with other females. Male home ranges are larger, up to 400 hectares, but they often overlap with those of other males and females.

Diet

The chuditch is the largest carnivorous marsupial in Western Australia. A voracious hunter, it will eat whatever it can catch, which is mostly invertebrates. It hunts on the ground and among fallen timber, understorey and leaf litter but will also climb small trees in search of prey. Chuditch will take small mammals, birds and their eggs, small lizards, freshwater crayfish, crickets, beetles, spiders and scorpions. They have also been reported to eat fruits and flowers and the fleshy red outer coating of zamia seeds.

Reproduction

Breeding begins in May; there is a peak of births in June and July, although some are born as late as September. Gestation lasts 17 to 18 days and the female gives birth to between two and six young. By nine weeks old, they are too large for the pouch and the mother leaves them in a den while she goes out hunting. The young gradually grow fur and learn to eat solid food. They are weaned at four to five months, learn to hunt and then disperse in early summer. Both males and females can breed successfully in their first year.

Threats

A number of factors have contributed to the spectacular decline of the chuditch since colonisation. Chuditch were hunted and poisoned by settlers who regarded them as a pest which threatened their domestic poultry. The chuditch's habitat has been damaged by the removal of hollow logs and den sites due to land clearing and frequent wildfire. Predation by foxes is an ongoing threat to remaining populations. By the 1980s, the total population in the wild was estimated to be less than 6,000 animals.

Management actions

The Department of Environment and Conservation is implementing a recovery plan to assist the recovery of this species. Important aspects of the recovery plan are fox control and habitat management including the maintenance of refuges in forest areas and protection from wildfire. Captive bred animals are released in conservation areas where they used to occur and where foxes are controlled. Research and monitoring of populations of chuditch, using techniques such as radio-tracking of individuals, are an important part of the recovery plan and are used to assess the success of management practices.

Chuditch facts

Size (head and body length)
310 – 400 mm (males)
260 – 360 mm (females)

Size (tail)
250 – 350 mm (males)
210 – 310 mm (females)

Weight
710 – 2185 g (males)
615 – 1130 g (females)

Habitat
Formerly all of WA except the Kimberley. Now confined to jarrah forest, large wheatbelt reserves, eastern Goldfields and relocation sites.

Diet
Small vertebrates and large invertebrates.

Reproduction
Breeds in winter, 2 – 6 young, which stay in pouch for 61 days, then left in a den. Young are weaned at 4 – 5 months and disperse in early summer.

Longevity
2 – 5 years in the wild
5+ years in captivity

Red-tailed phascogale

Phascogale calura

Family: Dasyuridae

Conservation status: Endangered

Identification

Noongar people call the red-tailed phascogale 'kingo'. An agile, tree-dwelling species, it is sometimes spotted leaping between tree branches, a flash of its red and black tail signalling its presence. Its back has soft, mid-grey coloured fur and it is cream underneath. The red-tailed phascogale has a pointed nose with a pink tip and large eyes. The ears are orange-red, the tail is reddish at the base and the lower half is covered in a brush of long, black hairs.

Habitat and distribution

Formerly found over much of southern Australia, the red-tailed phascogale is now restricted to scattered populations in the Western Australian wheatbelt. It shelters in hollows in eucalypt trees, in grass trees and is particularly associated with rock sheoaks (*Allocasuarina huegeliana*) and wandoo in the south-west of Western Australia. Until the 1930s it still occurred in the southern Great Sandy Desert in sand dune bloodwood woodland (*Eucalyptus chippendalei*) and Aboriginal people believe that there is a chance that it may still occur there. It shelters and nests in tree hollows and requires dense understorey vegetation for protection from predators.

Diet

The red-tailed phascogale catches small mammals, birds and invertebrates such as insects and spiders. It hunts in trees and also on the ground, scrambling over branches and logs in pursuit of prey. It does not need to drink, obtaining all the water it needs from its food. Although usually nocturnal, red-tailed phascogales will occasionally emerge during the day in search of food.

Reproduction

In the south-west of Western Australia, mating occurs during three weeks in July after which all the males die. A number of related species of marsupial also breed in this way. Males put all their energy into breeding so their metabolism becomes focused on reproduction, at the expense of other life-saving functions such as immune suppression, kidney and brain function. Females can store sperm for a few days before they ovulate and the ovaries can release up to 16 eggs at a time. Pregnancy lasts 28 to 30 days and up to 13 young are born. Each young is approximately five millimetres long and weighs about 15 milligrams. Only eight teats are available and so, as the young attach to the mother's nipples for the first 45 days of life, a maximum of eight young can survive. The young become independent in spring, at about 90 days old and weighing about 20 grams. They can breed when less than a year old.

Threats

Land clearing has had a large impact of the distribution of the red-tailed phascogale. Frequent fires are a threat to this species as they destroy hollows that the animal uses for nests and open up the understorey, allowing more predation by cats, foxes and native predators.

Management actions

Fire must be carefully managed in reserves to preserve patches of long-unburnt vegetation and nesting hollows. Numbers of phascogales are monitored in the wheatbelt and fox control is undertaken in reserves. On farms, maintenance of long-unburnt patches of bushland and replanting of refuge vegetation assists this species.

Red-tailed phascogale facts

Size (head and body length)
105 – 122 mm (males)
93 – 105 mm (females)

Size (tail)
134 – 145 mm (males)
119 – 144 mm (females)

Weight
39 – 68 g (males)
38 – 48 g (females)

Habitat
Eucalypt woodland especially with sheoak and wandoo, dense understorey and hollows. Formerly across most of southern Australia, now small scattered populations in the wheatbelt.

Diet
Small mammals, birds and invertebrates such as insects and spiders.

Reproduction
Breeding starts winter, males die after mating. Up to 8 young raised, independent in spring. They can breed when less than a year old.

Longevity
Males – 11 ½ months in the wild
(up to 5 years in captivity)
Females – 2 – 3 years in the wild

Brush-tailed phascogale

Phascogale tapoatafa

Family: Dasyuridae

Conservation status: Vulnerable

Identification

The most distinctive feature of this species, which is also called the wambenger, is its striking black, bottlebrush-shaped tail. It has mid-grey fur on its back and pale cream to white fur underneath. Two-thirds of the tail is covered by black hairs up to 55 millimetres long which 'fluff up' when the animal is alert. It has large, bulging, black eyes and large, hairless, pinkish-grey ears. Brush-tailed phascogales are strongly arboreal. They are equally at home running upwards, downwards, underneath or along the top of branches and can jump up to two metres between trees.

Habitat and distribution

The brush-tailed phascogale has a sparse distribution in dry forest, monsoon forest, and woodland. It avoids arid and semi-arid areas and is rare over most of its range due to habitat fragmentation. The south-west of Western Australia is the animal's stronghold. Brush-tailed phascogales sleep during the day in nests in tree hollows, stumps and sometimes old birds' nests. They have a large number of nests; sometimes up to 20 are used in a year.

Diet

Brush-tailed phascogales eat mostly invertebrates but will also take small vertebrate animals and even caged poultry if accessible. They also feed on nectar and will scamper around a heavily flowering eucalypt tree feeding from nectar-laden flowers. The brush-tailed phascogale is nocturnal and will feed any time from dusk to dawn on warm nights. On cold, winter nights, however, it may not appear until well after midnight. It will scamper around tree branches probing for invertebrates, sometimes tearing off pieces of bark with its teeth.

Reproduction

Males begin chasing females in early May then mating begins mid-May to early July. After breeding, the males die and so only breed once, whereas females can live for three breeding seasons. After a 30-day pregnancy, brush-tailed phascogales usually have between three and eight young (often seven to eight). The pouch forms a firm lip around the young so that they are enclosed in it until they are about five weeks old. A lactating female selects a large hollow with small, secure entrance and fills it with bark strips, fur and feathers, forming a spherical nest. When the young reach seven weeks old and weigh about four grams, the mother begins to leave them in the nest while she goes to forage, coming back every few hours to warm them up and feed them. As the young grow, she returns less frequently, finally weaning them at about 20 weeks old. After weaning, in mid-summer, the young males disperse, usually travelling many kilometres before settling in a new home range. Young females usually move to a nearby home range or occasionally share the mother's home range, although they rarely nest together unless environmental conditions are poor and the animals need to huddle together to conserve energy.

Threats

Low population and annual male die-off make this species vulnerable to local extinction. Land clearing, fire and predation by cats and foxes can tip the balance in favour of extinction in an area, resulting in fragmenting of the populations and reduction of genetic mixing between them.

Management actions

The Department of Environment and Conservation monitors this species in its reserves. Continued control of foxes and other feral species, fire management and maintenance of suitable habitat in reserves will help this species to survive.

Brush-tailed phascogale facts

Size (head and body length)
160 – 261 mm (males)
148 – 223 mm (females)

Size (tail)
175 – 234 mm (males)
160 – 226 mm (females)

Weight
175 – 311 g (males)
106 – 212 g (females)

Habitat
Dry forest, monsoon forest and woodland. Avoids arid and semi-arid environments, strongly arboreal, scampers over tree branches to hunt and nests in tree hollows.

Diet
Invertebrates, small vertebrates and nectar.

Reproduction
Mating occurs mid-May – July then males die. Females produce 3 – 8 young, but usually raise less. Young weaned at 20 weeks, young males disperse.

Longevity
Males – 1 year
Females – 3 years

Southern ningaui

Ningaui yvonnae

Family: Dasyuridae

Conservation status: Not listed

Identification

The southern ningaui is a tiny, pointy nosed predator that pounces on small animals, and then holds them with its front paws as it crunches them up with its rows of sharp pointed teeth. Its fur is greyish-olive with slight chestnut patches on the sides of the head, between the nose and eyes and between the eyes and the ears. The fur is pale grey underneath and the tail is about the same length as the body.

Habitat and distribution

This species occurs in the sandplains and semi-arid areas of southern Australia. Spinifex grasslands and mallee scrub and heath containing spinifex are its preferred habitats. The southern ningaui is rare over most of its range but can be common in some areas, particularly on red sandy plains with dense spinifex and occasional mallee trees. The southern ningaui is nocturnal and shelters in hollow logs, burrows, low bushes and grassy clumps during the day.

Diet

Invertebrates, including arthropods such as spiders, form the diet of the southern ningaui. It is a high energy animal and will often eat nearly its own weight in food in a single night. Animals often hunt in open areas, searching through leaf litter, but once they have captured their prey they dart back to the safety of dense vegetation to eat it. They are efficient hunters and kill their prey with a swift bite to the head, before consuming it head-first.

Reproduction

A single litter of between five and seven young is born in spring or early summer. The mother carries the young in her pouch for about 30 days after which she probably leaves them in a nest while she forages, although not much is known about this phase of the animal's life history. The young become independent at 70 to 80 days old. In some closely related marsupials, the males stop producing sperm immediately after the mating season is over and die soon after. Male southern ningaui do not exhibit a sudden die-off. They produce sperm until after January and then the testes regress. Females continue to produce eggs, suggesting that they may be able to produce a second litter in a season if conditions permit. The adults are short-lived however, only surviving until about 14 months of age. So the population consists of a single year-group for most of the year.

Threats

Climate change is a threat to short-lived animals such as the southern ningaui as their populations can be severely affected by a succession of bad seasons. Introduced predators such as cats and foxes also pose a threat.

Management actions

Conservation of sparsely distributed species can be difficult, however, appropriate management of suitable habitat is important, especially in areas where the ningaui is known to be common. Fox and cat control in semi-arid and arid areas reduces predation on small native marsupials such as the southern ningaui.

Image: Viridans Biological Databases

Southern ningaui facts

Size (head and body length)
48 – 81 mm

Size (tail)
53 – 71 mm

Weight
6 – 14 g

Habitat
Sandy soils, spinifex grasslands and heathland.

Diet
Invertebrates, including insects and spiders.

Reproduction
Late August to March. 5 – 7 young born spring – early summer. Independent at 70 – 80 days old. Males sexually mature at 8 months old. No male die-off after mating, but both sexes short-lived, only breeding in one season.

Longevity
14 months

Kultarr

Antechinomys laniger

Family: Dasyuridae

Conservation status: Not listed

Identification

The kultarr is a small, agile marsupial with distinctively long thin hind legs and feet. Although it looks like a tiny kangaroo, it does not hop but scampers quickly on all fours and can turn sharply and jump to avoid predators and catch its prey. The kultarr has large rounded ears and large bulging eyes, emphasised by distinctive, dark eye rings. The tail is longer than the body, thin and has a dark tuft of hair on the last third of its length. Its fur is grizzled beige-grey to yellowish-brown on its back and white underneath and it has a diffuse, dark line on its forehead.

Habitat and distribution

Stony, granite plains vegetated with *Acacia* and *Cassia* shrubland are the favoured habitat for the kultarr. It shelters in fallen logs, spinifex tussocks, saltbush and other low, dense shrubs, and under trees in the deep crevices that form in the soil. The kultarr will also shelter in the burrows of other animals such as hopping mice, lizards and trapdoor spiders. In captivity, it will dig a shallow burrow and cover it with grass but this has not been observed in the wild.

Diet

The kultarr feeds on insects and other small invertebrates, such as crickets, cockroaches, centipedes and spiders. Its manoeuvrability helps it to capture prey without being stung or bitten, a real danger for an animal that hunts potentially dangerous prey.

Reproduction

Breeding is triggered by changes in day length. The kultarr has a long breeding season and in south-western populations, breeding begins in August and continues until January. Most females become pregnant as soon as they become receptive. They have either six or eight teats and they usually carry a baby on every teat. The pouch forms during the breeding season from a crescent-shaped fold of skin around the teats. After the young leave the pouch it regresses until the next breeding season. When the young are about 30 days old, they measure 25 millimetres and become too big to be carried in the pouch. The mother leaves the young in a nest while she forages and returns to feed them. When they are older, they sometimes cling to the mother's back. If a young kultarr becomes separated from its mother it will call out and the mother will answer and retrieve it. Young are weaned at about three months old. Both males and females are capable of breeding in more than one season.

Threats

Populations of the kultarr fluctuate depending on the season. Habitat fragmentation through human activities such as clearing and grazing by stock degrade its habitat. Introduced predators will take kultarr if they can catch them.

Management actions

The kultarr can be conserved by protecting areas where it occurs and linking these areas where possible. Control of rabbits, foxes and other introduced predators in reserves will help to protect the kultarr and its habitat.

Kultarr facts

Size (head and body length)
80 – 100 mm (males)
70 – 95 mm (females)

Size (tail)
100 – 150 mm (males)
100 – 140 mm (females)

Weight
30 g (males)
20 g (females)

Habitat
Stony, granite plains vegetated with *Acacia* and *Cassia* shrubland.

Diet
Feeds on insects and other small invertebrates, for example spiders, crickets and cockroaches.

Reproduction
August to January. Newborn young are carried in the pouch. Older young stay in a nest or cling to the mother's back. Young weaned at about three months old.

Longevity
Possibly 2 – 3 years in the wild

Fat-tailed dunnart

Sminthopsis crassicaudata

Family: Dasyuridae

Conservation status: Not listed

Identification

The distinctive swollen tail of the fat-tailed dunnart is used as a food store, a useful tool in an unpredictable environment. All dunnarts have pointed snouts, but the fat-tailed dunnart's large ears, large eyes and dark eye rings help to separate it from other dunnarts. The soles of hind feet are another of the characters used to distinguish different species of dunnarts. This species has three fused pads underneath its toes and the soles of its hind feet are not haired. The fur on fat-tailed dunnart's back is fawn while the underparts are whitish.

Habitat and distribution

Clearing for farmland has probably favoured the fat-tailed dunnart as it has increased grassland habitat and low shrublands in south-western and south-eastern Australia. Fat-tailed dunnarts are common in rough pasture, on the edges of harvested paddocks, in bluebush, saltbush and gibber plain, claypans, tussock and hummock grasslands.
To protect itself from extremes of temperature, it shelters in nests of grasses and other plant matter under rocks, fallen logs or in deep cracks in soil. It is a solitary animal with a large, flexible home range, however, when conditions are very cold, groups of animals sometimes shelter together during the day to conserve body heat and save energy. On farms in the Avon region, this species shelters in piles of mallee roots in paddocks and becomes less common if the roots are removed.

Diet

The fat-tailed dunnart is nocturnal and forages in sparse, open areas for a variety of invertebrates adjusting their diet according to the season. They do not need to drink free water as they use their diet of invertebrates to provide them with enough water. During drought, they seek out spiders and cockroaches for extra moisture, while they prefer beetles, which are high in energy, at other times. When food is scarce, animals become torpid (deeply asleep, like a short-term form of hibernation) and use the fat store in their tail as an energy source. This usually occurs in winter.

Reproduction

The breeding season is July to February. The female has eight to 10 teats in her pouch and after a pregnancy of 12 days, eight to 10 hairless young are born. Usually, only five young survive to be weaned at about 10 weeks old. In captivity, sexual maturity is reached at five months of age, however, it is not known if animals breed in the wild at this age. In moist environments, the numbers of fat-tailed dunnarts in a population are fairly stable but in arid environments, populations can fluctuate dramatically with rainfall and the supply of invertebrates.

Threats

Although clearing for farmland has assisted this species, some intensive farming practices which involve removal of remnant wood piles can reduce populations.

Management actions

No specific management actions are required for the conservation of this species although the control of feral animals and management of conservation reserves and remnant vegetation on farms and road verges will assist in its persistence in the Avon region.

Fat-tailed dunnart facts

Size (head and body length)
60 – 90 mm

Size (tail)
40 – 70 mm

Weight
10 – 20 g

Habitat
Open habitats including grassland, saltbush, bluebush, gibber plain, claypan, shrubland, rough pasture and the edges of harvested paddocks.

Diet
A range of invertebrates, depending on the season and including beetles, spiders and cockroaches.

Reproduction
Breeding begins May – June, gestation 12 days. 8 – 10 young born, only 5 survive to weaning at 10 weeks of age. Populations fluctuate with supply of invertebrates.

Little long-tailed dunnart

Sminthopsis dolichura

Family: Dasyuridae

Conservation status: Not listed

Identification

As its names suggests, the most distinctive feature of the little long-tailed dunnart is its disproportionately long tail. The tail is thin, never swollen and noticeably longer than the body. The fur of this species is grizzled grey above. Its face, cheeks and a patch behind each ear are tinged with cinnamon and it has dark, narrow eye rings. The fur is whitish on the underside of the animal, including the throat, under the eyes and the feet, giving a strongly two-tone, grey and white appearance. The tail is grey above and white underneath and the ears are long and hairless. The soles of the feet (a diagnostic feature for separating species of dunnarts) have no terminal pads or hair underneath the toes.

Habitat and distribution

The little long-tailed dunnart is most common three to four years after a fire, probably due to the large numbers of invertebrates that are available for food. There are two separated populations, one in the Western Australian Goldfields to the Geraldton area and one in South Australia in the coastal area west of Port Augusta. This species is found in dry eucalypt forest, semi-arid woodland, mallee and heath. The male has a large, moveable home range which is probably an adaptation to unpredictable environmental conditions. The little long-tailed dunnart builds a nest of grass and leaves in a hollow log, grass tree, grass tussock or in the burrow of a hopping mouse, where it shelters during the day.

Diet

Invertebrates and other small animals are the little long-tailed dunnart's preferred prey. It is a vicious hunter of beetles, crickets, spiders and geckoes which it crunches up with its sharp teeth and strong jaws. In pitfall traps, it will kill other animals including house mice that have the misfortune to fall into the same trap.

Reproduction

Breeding takes place in winter and spring. Research suggests that most females have only one litter of up to eight young in a year, although some may have two; more study is needed to confirm the life history of this species. The young become independent when they weigh just five grams and spread out from the area where they were born to find available habitat. Females can breed when they are eight to nine months old and can live for two years. Males are able to breed when they are four to five months old. There appears to be no male die-off following mating, as occurs in some small species of marsupials, however, males probably only live for about 14 months in the wild.

Threats

This species is not endangered, however, populations fluctuate with changes in seasonal conditions. Land clearing has also reduced its habitat and it is preyed upon by foxes and cats.

Management actions

The little long-tailed dunnart occurs in a number of reserves and national parks. The maintenance of suitable habitat in reserves and control of feral animals will help to safeguard this species.

Little long-tailed dunnart facts

Size (head and body length)
63 – 99 mm (males)
63 – 92 mm (females)
Size (tail)
88 – 109 mm (males)
84 – 97 mm (females)

Weight

11 – 20 g (males)
10 – 21 g (females)

Habitat
Dry eucalypt woodland, woodland, mallee and heath, most common 3 – 4 years after a fire.

Diet
Aggressive hunter of invertebrates and other small animals such as geckoes.

Reproduction
Breeding season is in winter and spring. Usually one litter of up to 8 young per year. Young independent when 5 g in weight. No male die-off after mating, although males only live one season.

Longevity
Females – 2 years
Males – approximately 14 months

Gilbert's dunnart

Sminthopsis gilberti

Family: Dasyuridae

Conservation status: Not listed

Identification

Dunnarts are a complex group of animals and species and are difficult to identify in the field. Gilbert's dunnart is larger than the little long-tailed dunnart and has longer ears and longer hind feet. The white patches behind its ears and white ventral fur of Gilbert's dunnart are also distinctive. Like the little long-tailed dunnart, Gilbert's dunnart is light grey on its back with a slightly grizzled appearance. The tail of Gilbert's dunnart is less than or equal to the body length whereas the little long-tailed dunnart has a tail much longer than its body length. The tail is grey above and white below.

Habitat and distribution

Gilbert's dunnart occurs in two separate populations, one in the central and southern wheatbelt as far west as the Darling Scarp near Perth and the other population on the Roe Plain on the southern edge of the Nullarbor Plain. Near Perth, it is found on sandy loam soils with jarrah, marri and wandoo and shallow granite soils with heath dominated by bottlebrush and other flowering shrubs, zamias and grass trees. In the central and southern wheatbelt it occurs on gravelly soils with *Casuarina* shrubland and mallee heath. Further east, it occurs in mallee shrublands on sandplain, in salmon gum (*Eucalyptus salmonphyloia*) and giant mallee (*E. oleosa*) on loam. It probably makes a nest in a hollow log, dense shrub or grass.

Diet

Little research has been conducted on this species, however, like other dunnarts from southern Australia, Gilbert's dunnart hunts at night for a range of invertebrate prey which probably includes beetles, grasshoppers, crickets and spiders.

Reproduction

The breeding season is spring and early summer. Females have eight teats and have been observed with seven hairless babies attached. In October and November the females have pouch young and, like other dunnarts, not all the young will fit into the pouch so they hang down, still attached to the mother's teats. Juvenile animals are present in February. Adult males are still present in the population after breeding and do not appear to die off after mating as some other species of small marsupials do. However, they may only breed in one season.

Threats

Gilbert's dunnart has secure populations in nature reserves so is not under major threat. However, like many species of dunnarts in the south-west of Westerrn Australia, the species has lost habitat because of land clearing and is susceptible to predation by foxes and cats.

Management actions

The maintenance of suitable habitat in reserves such as Tuttaning, Dragon Rocks, Nuytsland nature reserves and Western Australian State Forest will help to conserve Gilbert's dunnart.

Gilbert's dunnart facts

Size (head and body length)
81 – 92 mm

Size (tail)
75 – 92 mm

Weight
14 – 25 g

Habitat
Granite soils with heath, loamy soils with mixed woodland of jarrah, marri and wandoo, salmon gum and giant mallee woodland on loam.

Diet
Invertebrates.

Reproduction
Breeding season is in spring and early summer, 8 teats, 7+ pouch young in October – November, independent young in January – February, no male die off after breeding.

White-tailed dunnart

Sminthopsis granulipes

Family: Dasyuridae

Conservation status: Not listed

Identification

As its scientific name suggests, the white-tailed dunnart has evenly granulated skin on the sole of its hind foot without smooth areas or hairs. Its fur is light fawn on the back, overlaid with dark brown tipped hairs which are blue-grey at the base, giving an overall impression of an ash-grey animal. The colour fades to white underneath. Its feet are pinkish-white. Its tail is also pinkish-white with a thin brown line along the top, always less than body length, and often swollen at the base. The back edge of the ears has a notch. Another common name for this species is the ash-grey dunnart and at first glance it can be confused with the ash-grey mouse (see *Pseudomys albocinereus* on page 114), a similarly coloured native rodent with which its range overlaps. On closer inspection, the shape of the snout makes identification easy; in dunnarts the snout is long and pointed whereas the ash-grey mouse has a short rounded muzzle.

Habitat and distribution

Initially thought to be rare, field studies have shown that the white-tailed dunnart is relatively common, but only in specific habitats within a limited range. It prefers low shrubland vegetation in sand, sandy loam and gravelly loam or sparse mallee over low, medium or dense shrubland. It occurs in coastal heathlands from Kalbarri south almost to Gingin and in the Western Australian Goldfields. The white-tailed dunnart seems to be more linked to structure of vegetation than to particular species of plants. Population densities of this species tend to increase after fire. In the Avon, it is found in the higher parts of the landscape.

Diet

The white-tailed dunnart is nocturnal and hunts invertebrates, eating whatever it can catch. It has been recorded eating moths, bugs, ants, wasps, beetles, sawfly larvae (commonly called spit-fires) termites, cockroaches, horseflies, grasshopper eggs, web-building spiders, wolf spiders and centipedes. It is a fierce predator and researchers report that it will bite when handled; its sharp, pointed teeth easily puncturing unprotected skin.

Reproduction

Breeding begins in autumn and mating may occur between April and July. Females have between eight and 12 teats and give birth to their young in late winter. Females with four or five pouch young have been recorded from August to October. Juveniles, weighing less than 10 grams, become independent in late spring or early summer.

Threats

Land clearing has significantly reduced the area of suitable habitat for this species. Feral grazing animals can degrade remaining habitat reducing its suitability for the white-tailed dunnart. Degraded environments also allow feral predators like cats and foxes to hunt dunnarts more successfully.

Management actions

The white-tailed dunnart is still common in a number of conservation reserves in the wheatbelt area of Western Australia, including Dragon Rocks Nature Reserve, Jilbadji Nature Reserve in the eastern wheatbelt and Kalbarri National Park on the Mid-west coast. Continuing management of these reserves, including the control of feral animals, will ensure that the remaining populations remain secure.

White-tailed dunnart facts

Size (head and body length)
69 – 88 mm

Size (tail)
56 – 66 mm

Weight
18 – 37 g

Habitat
Low shrubland, sparse mallee over shrubland in sand, sandy loam or gravelly loam. Found from Kalbarri to Gingin and in the WA goldfields.

Diet
A wide range of insects and other invertebrates.

Reproduction
Breeding begins in April. Females have 8 – 12 teats and give birth in late winter. 4 – 5 pouch young, juveniles independent in late spring – early summer.

Numbat

Myrmecobius fasciatus

Family: Myrmecobiidae

Conservation status: Vulnerable

Identification

Also sometimes called the walpurti, the numbat is a pointy-nosed, reddish-brown animal with bold white transverse bands across its back and a long bushy tail. Its large, black eyes are framed by black and white eye stripes extending between the nose and the base of the ears.

The numbat is unusual among Australia's native mammals by being diurnal (active by day).

Habitat and distribution

The numbat was once found across most of southern Australia, however, its distribution is now restricted to several small populations in the south-west of Western Australia and a number of sites where they have been reintroduced. They are found in woodland and eucalypt forest with wandoo, powderbark wandoo or jarrah as the dominant tree species. Before foxes were present, numbats were also found in York gum woodland, mulga woodland and heath. They require fallen hollow logs to hide from predators and for nest hollows. Numbats also construct burrows, especially in winter, which they line with plant material including grass, shredded bark leaves and flowers.

Diet

The numbat is a specialised feeder, using its well-developed sense of smell to detect termites as they move around below the soil surface. Its long, sticky tongue is well adapted for reaching into termite runways and removing the tiny termites as they travel along their surface channels. A numbat's tongue collects 20,000 termites per day, as well as a few ants, probably by accident. Like their tongues, numbats' teeth are adapted to their diet and are small,

peg-like structures; termites do not need to be chewed very much. Numbats are one of the lightest of all the world's termite eaters because, rather than digging into rock-hard termite mounds, they specialise in licking up termites from the surface channels that radiate out from mounds.

Reproduction

Breeding in numbats starts in January. Pregnancy lasts for 14 days. The female has four teats and carries her young after birth, with one usually attached to each of teats. By July, the young are deposited in one of the female's burrows while she hunts. At night, she returns to feed them. By September, the young begin to emerge from the nest with their mother but stay around the burrow and return to the nest soon after she leaves for the day. Over the next six weeks, the young make short journeys away from the nest and by October they are weaned. The young gradually start to spend nights away from their mother and by mid-December they have left to find their own home range where they will usually stay for life. Female numbats are able to breed in their first year of life, males in their second year.

Threats

The numbat population began a spectacular decline from 1900 to 1950 following the introduction of foxes to the wheatbelt. The numbat survived in low numbers until the 1970s when it began a rapid decline in its remaining range, possibly due to habitat fragmentation from an increase in land clearing, in combination with continued, and perhaps increased, predation by foxes.

Management actions

The Western Australian government conducted a detailed research project during the 1980s which contributed to a greater understanding of the biology of the numbat and the reasons for its decline. A collaborative recovery plan has been implemented for the numbat which includes ongoing fox control in remaining numbat habitat and a highly successful translocation program which has re-established the species in a number of secure sites within its former range where fox control will be maintained.

Numbat facts

Size (head and body length)
200 – 274 mm (males)
200 – 272 mm (females)

Size (tail)
164 – 210 mm (males)
161 – 195 mm (females)

Weight
300 – 715 g (males)
320 – 678 g (females)

Habitat
Woodland and eucalypt forest dominated by wandoo, powderbark wandoo or jarrah trees.

Diet
Termites and some ants, probably by-catch.

Reproduction
Young born in January – February and weaned by late October. Females mature in their first year, males in their second year.

Longevity
Up to 5 years

Pig-footed bandicoot

Chaeropus ecaudatus

Family: Peramelinae

Conservation status: Presumed extinct

Identification

Also called the kantjilpa, the pig-footed bandicoot had long, slender legs with modified 'pig-like' toes. Its front feet had two functional toes and its back feet had one, suggesting that it was well adapted for running. It had a long narrow snout and ears and a thin, crested tail that was slightly more than half the length of the body. The fur on the back was grizzled grey with beige or chestnut tinges. Underparts were white or pale beige. Fur on the tail was black on top and grey or beige on the sides and underneath. The tail had a thin crest of black hairs along the last half of its length and a few white hairs at its tip.

Habitat and distribution

The pig-footed bandicoot once occurred in semi-arid and arid southern Australia from Carnarvon on the west coast to western New South Wales. There are records of it in the Murray River region of NSW in the 1850s although it was becoming rare even then. Reports from the nineteenth century suggest that it was relatively common when colonists first came but quickly became rare in the second half of the nineteenth century. Records of the animal suggest that it inhabited a large range of vegetation types and, although it disappeared from southern and coastal areas fairly quickly, it appears to have remained fairly common in central desert areas until the 1950s. It made a nest of leaves in a hollow in the ground and lined it with grass.

Diet

Not much is known about pig-footed bandicoots but the teeth and digestive tract of museum specimens suggest that they ate mostly plant material. Droppings from wild animals contained only grass. Some historical reports have suggested that termites, ants and meat were eaten, however Krefft (1866) kept some animals in captivity and reported that they ate "lettuce, barley grass, bread and some bulbous roots" and would not eat meat or mice. They may have been the most herbivorous of the bandicoots, the shape of their teeth suggesting that they may have specialised in foliage.

Reproduction

Little is known about the reproduction of the pig-footed bandicoot. Females had a backwards-facing pouch, like other species of bandicoot. Winter was probably the breeding season and although females had eight teats they apparently raised only two young at a time. The nests that they made for sleeping may also have been used for hiding young while the mother was feeding.

Threats

The pig-footed bandicoot had declined dramatically in south-western Australia by 1900, before rabbits and foxes had begun to have an impact, although feral cats were well established by that time and may have been a factor. An introduced disease has also been proposed as a possible cause for their presumed extinction. The last museum specimen to be collected was in 1916 but Indigenous people report pig-footed

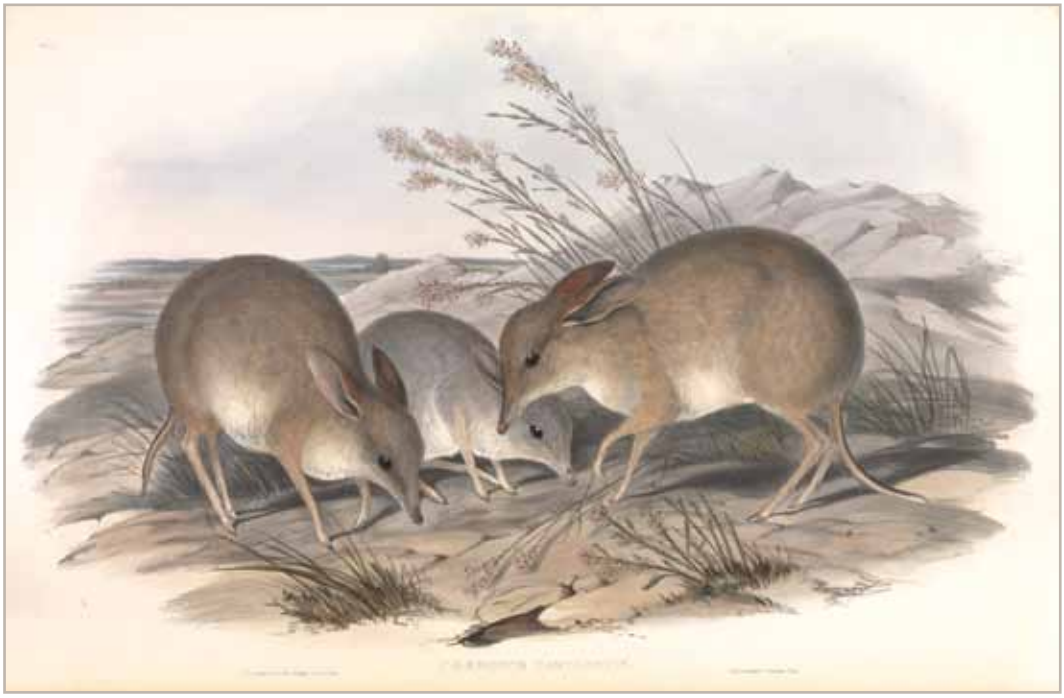


Illustration in John Gould's *'The Mammals of Australia'* reprinted courtesy of Museum of Victoria

bandicoots surviving in the southern Great Sandy Desert and northern Gibson Desert until the 1950s. Once the species had declined, the few remaining populations would have been subject to predation by feral cats and foxes, land clearing and altered fire regimes, grazing and soil compaction by rabbits, cattle and other large introduced grazing animals.

Management actions

No management action is possible for this species as it is thought to be extinct. There seems little likelihood of surviving populations being found. Efforts are being made to prevent further extinctions of Australia's remaining native mammal species.

Pig-footed bandicoot facts

Size (head and body length)
230 – 260 mm

Size (tail)
100 – 150 mm

Weight
200 g

Habitat
Arid and semi-arid southern Australia, in a wide range of habitats. By the twentieth century it was only common in the central desert country of Western Australia. Slept in a nest made of leaves and grass in a hole in the ground.

Diet
Mostly plant material.

Reproduction
Probably bred in winter, had 8 teats but raised only 2 young at a time.

Quenda

Isoodon obesulus

Family: Peramelinae

Conservation status: Priority 5

Identification

The quenda is the Western Australian form of the southern brown bandicoot or short-nosed bandicoot. Its fur is coarse and brindled dark greyish or yellowish-brown above. Fur on the belly is cream to yellowish-white. The tail and feet are dark brown. It has short, rounded ears that are mostly brown and a thin furred tail, much shorter than its body.

Habitat and distribution

The species occurs in pockets of remaining habitat in coastal, south-western Australia and at sites in the Avon and further north, where it has been reintroduced. Quendas are solitary animals with home ranges as large as seven hectares. They favour forest with dense understorey particularly along creek lines, heath and coastal scrub. Becoming uncommon in inland parts of its range, the quenda is still found in suburbs of Perth where domestic animals are controlled and some dense cover is still available. In the Avon, very few animals still occur, other than those that have been translocated from other areas.

Diet

The quenda's conical diggings are created when it fossicks on the ground and beneath the leaf litter for tubers, roots, fungi and invertebrates. The animals usually forage at night, but are sometimes active during the day using their sharp claws to break through the soil surface. When food supplies are plentiful, quendas' home ranges will overlap but if food is scarce then animals are more protective of their territory and there is less overlap.

Reproduction

Breeding begins in winter. Young are born late winter to late summer. Like all bandicoots, female quenda have a rear opening pouch which not only prevents sand from entering the pouch, but also means that young have only a short distance to crawl from the birth canal to the pouch. The quenda's pouch has eight teats and females can rear between one and six young (usually between two and four) in a litter. Two to three litters may be raised in a season. The young are weaned at about 60 days old, however, many young animals fail to survive. If a young animal finds a good feeding area that is not occupied by other quenda, it will have a better chance of survival than if the area has animals with well-established territories. Quendas are able to reproduce when they are just four or five months old, allowing populations to breed quickly when conditions are good. Adults live for a maximum of four years in the wild, probably due to predation, parasites and competition with other bandicoots for available food and shelter.

Threats

Land clearing, change in fire regimes and introduced predators are all threats to quenda populations, and are probably all involved in its disappearance from the Avon region. Domestic pets are also a threat to the quenda, which is a concern as some of the largest populations are close to urban areas.

Management actions

Quenda populations respond well to fox control. In areas where they still occur, populations rapidly recover following 1080 baiting for foxes, provided this is maintained. Animals are also translocated from areas to be developed and released in areas where foxes have been controlled, including a number of wheatbelt reserves. However, quenda populations still require monitoring. Continued fox control, research and management of the quenda's habitat will be required to ensure the survival of this species.

Quenda facts

Size (head and body length)
300 – 360 mm (males)
280 – 330 mm (females)

Size (tail)
90 – 140 mm (males)
80 – 140 mm (females)

Weight
500 – 1600 g (males)
400 – 1100 g (females)

Habitat
Dense scrubby vegetation in forest, heath and the edges of wetlands. Prefers sandy soils and a mosaic of burnt and unburnt vegetation.

Diet
Soil invertebrates, plant tubers, roots and fungi.

Reproduction
Young born late winter to late summer. May have up to 3 litters of 2 – 4 young in favourable conditions. Young weaned at 3 months, can reproduce when 4 – 5 months old.

Longevity
3 – 4 years in the wild

Western barred bandicoot

Perameles bougainville

Family: Peramelinae

Conservation status: Endangered

Identification

The extent of barring of the western barred bandicoot varies from two or three distinct pale and dark bars in some populations to faded shadowing in others. The fur is brownish-grey to light grey above and white underneath. It has white feet and large, upright ears. Its tail is thin and about half the length of the body.

Habitat and distribution

There are historical records of the western barred bandicoot from most of semi-arid southern Australia including the Avon region. There is some doubt about the identification of some early records due to the number of local common names for the animal; however, its spectacular decline on the mainland is not in doubt. It is now believed to be extinct on the mainland. The species is still found on Bernier and Dorre islands off Shark Bay, particularly in the white sand dunes close to the beach. It makes a nest of grass and other vegetation in a dense bush or hollow log to sleep in during the day. In south-western Australia, the species preferred dense scrub, particularly where *Allocasuarina* grows. Further east it lived in saltbush and bluebush plains and on stony ridges and scrub in the Murray-Darling river system in south and eastern Australia.

Diet

At dusk, western barred bandicoots emerge from their nests to dig for roots, seeds, herbs and the fruits of plants, if they are available, and to hunt for small animals including insects. In winter, the bandicoots are active until dawn but in summer they return to their nests well before dawn. Individuals feed within a home range which may overlap with those of other animals except for a core area which it defends. On Bernier and Dorre islands, female home ranges vary from 1.4 hectares when the animals are at high density to 6.2 hectares when the population is at low density. Male home ranges are much larger and also vary depending on the density of animals (2.5 to 14.2 hectares).

Reproduction

Most information known about the life-history of the western barred bandicoot comes from studies of animals on Bernier and Dorre islands. It is not known how much the mainland populations varied in their breeding habits. On the islands, the species breeds in autumn and winter, and young are produced continuously during that time. Between one and three young are carried in the pouch. The numbers of western barred bandicoots fluctuate dramatically in response to rainfall.

Threats

Island populations are very vulnerable to an introduction of predators, disease, wildfire or a series of frequent fires. On the mainland, the same threats exist for any animals reintroduced to 'islands of vegetation' in isolated reserves. Degradation of habitat by feral grazing animals such as rabbits and goats or an extended period of low rainfall could also threaten this species' survival in the wild.

Management actions

It has been reintroduced to some mainland sites. Some island animals have been translocated to the Francois Peron Nature Reserve on the Heirisson Prong at Shark Bay and Dryandra Woodland. Captive breeding and release in managed reserves where feral predators are controlled will help to protect the species from extinction. Continued monitoring of wild populations is necessary.

Western barred bandicoot facts

Size (head and body length)
171 – 280 mm

Size (tail)
60–102 mm

Weight
172 – 286 g

Habitat
Island populations: White sand dunes behind the beach, sleeps in nest in dense bush or hollow log.

South-west mainland populations: dense scrub particularly with *Allocasuarina.*

Diet
Roots, seeds, herbs, fruits and invertebrates.

Reproduction
Breeds in late winter – early spring. 1 – 4 (usually 2) young carried in a pouch.

Longevity
4+ years

Bilby

Macrotis lagotis

Family: Peramelinae

Conservation status: Vulnerable

Identification

The bilby almost looks like a cartoon animal. It is related to the bandicoots but has a unique collection of features that make identification easy. It has distinctive, long pink ears, a pointy nose, silky grey fur and a long, tri-coloured tail. The base of the tail is grey, the mid-section is black and there is a white, crested final section with a hairless tip.

Habitat and distribution

The first specimen of the bilby was collected in the Swan Valley, near Perth. Bilbies used to inhabit large areas of semi-arid and arid Australia, but they are now confined to sandy, desert areas where they shelter underground in extensive burrow systems to escape the heat of the day. The bilby was last recorded in the wheatbelt near Wagin in the 1940s, their disappearance coinciding with the arrival of foxes. There are scattered populations of bilbies in the Tanami Desert and between Broome and Warburton in north-west Australia as well as some in western Queensland. The bilby's burrow may be three metres long and 1.8 metres deep and its entrance is often built near a termite mound or small plant. Burrows are occupied by a single animal or a pair, sometimes with their young.

Diet

Invertebrates including larval and adult insects form a large part of the bilby's diet, as does plant material such as seeds, bulbs, fruit and fungi. Droppings often contain a large amount of sand as this is often licked up when the bilby is picking up items of food. Bilbies have poor eyesight so they locate their food primarily by smell and sound. They do not require fresh water as they can extract what water they need from their food. While searching for food, bilbies throw soil in all directions and leave numerous excavations, up to a depth of 25 centimetres.

Reproduction

In captivity, bilbies will breed all year round. In keeping with its burrow-dwelling lifestyle, the bilby's pouch faces backwards, unlike the familiar forward-facing pouches of kangaroos. A backward-facing pouch makes it easy for newborn young, since they have only a short distance to crawl from the birth canal into the pouch. In a digging animal, it also has the added advantage of preventing sand from covering the babies. Although bilbies have eight teats, they rarely carry more than two young. Young stay in the pouch for 80 days after which the female leaves them in the burrow while she forages, returning every few hours during the night to feed them. Once the young are weaned, they sometimes share the adults' burrow for a few weeks before heading out on their own.

Threats

Foxes, changing fire regime, grazing by rabbits and livestock and drought have probably all had an impact on the bilby. Habitat fragmentation through land clearing would also have been a factor in southern parts of their former range.

Management actions

A cooperative recovery plan is being implemented to save the bilby from extinction. Bilbies have been reintroduced to areas in the south-west of Western Australia where foxes and other feral animals are controlled and fire is managed to manipulate the diversity of habitats. At Dryandra Woodland in the Western Australian wheatbelt and the Francois Peron National Park in Shark Bay, small populations have established and require monitoring to ensure the animals continue to thrive.

Bilby facts

Size (head and body length)
300 – 550 mm (males)
290 – 390 mm (females)

Size (tail)
200 – 290 mm (males)
200 – 278 mm (females)

Weight
1000 – 1500 g (males)
800 – 1100 g (females)

Habitat
Arid sandy areas, lives in extensive burrow.

Diet
Invertebrates, seeds, bulbs, fruit and fungi.

Reproduction
Backward-facing pouch, 2 young in pouch for 80 days then in burrow until independent.

Western pygmy possum

Cercartetus concinnus

Family: Burramyidae

Conservation status: Not listed

Identification

The western pygmy possum or 'mundarda' is soft brown or grey-brown with reddish-tinged fur on its back. The underside is creamy white and bare skin areas on the nose, feet and tail are pink to pinkish-brown. The first third of the tail is furred on top but the remainder is almost hairless. To conserve energy when it is cold or when food is limited, the western pygmy possum can go into torpor, dropping its body temperature and entering a deep sleep. It has large eyes and soft, delicate ears that fold down when it is asleep. When it is active, it climbs and scampers through undergrowth using its hand-like front and back feet and prehensile tail to climb and balance. The western pygmy possum has an opposable hind toe and its second and third hind toes are fused.

Habitat and distribution

The western pygmy possum is widespread in the wheatbelt and the south coast of Western Australia and is known to occur in the Avon region. It is found in mallee heath, woodland and dry forest with understorey of *Banksia* and shrubby native myrtles. Occasionally the pygmy possum occurs in other areas, for example in mulga-saltbush country. It sleeps in a nest made of leaves in a hollow, dense bush or grass tree, or sometimes on the ground among leaf litter. It occasionally uses birds' nests and will use wooden nestboxes attached to trees. It can be quite opportunistic in its use of shelter; a female with three young was once found under a sheet of corrugated iron.

Diet

Invertebrates, nectar and pollen form the diet of the western pygmy possum. Nectar is an important energy source and pollen provides readily digested protein. Possums actively search for it, licking the pollen grains from the anthers of flowers of *Banksia, Grevillea, Hakea, Eucalyptus, Melaleuca* and other native species. It seems to choose its habitat based on the species of plants available for food, rather than the structure of the vegetation. The western pygmy possum is probably an important pollinator of flowering species, however, more research is required to confirm this. The possum is also an aggressive hunter; once it captures an insect, it holds the prey in its hands and crunches it up with its sharp, needle-like teeth. Researchers who handle these animals can confirm that their teeth are sharp as they readily bite when restrained.

Reproduction

The western pygmy possum will breed at any time of year if conditions are suitable. The female has six teats and may produce two or three litters of up to six young yearly. Young stay in the pouch for 25 days and then, while still pink and hairless, are left in a nest while the mother forages. She returns to feed them at intervals. The female may mate immediately after the birth of a litter but the embryos develop slowly and are born after about 50 days, when the previous litter is independent.

Threats

Cats and foxes prey on the western pygmy possum but because it can breed quickly it seems to be able to cope with predation pressure. The population has suffered habitat loss through land clearing for rural or urban development but is not endangered.

Management actions

The maintenance of suitable habitat in secure reserves helps to ensure the conservation of this species. The installation of nest boxes in degraded areas where tree hollows have been lost can provide secure sleeping places for western pygmy possums.

Western pygmy possum facts

Size (head and body length)
71 – 106 mm

Size (tail)
71 – 96 mm

Weight
8 – 20 g

Habitat
Heathland, forest and mallee with an understorey of shrubs.

Diet
Nectar, pollen and invertebrates.

Reproduction
Breeds throughout the year. 1 – 6 young. May have several litters in quick succession. Young stay in pouch for 25 days then are left in a nest.

Honey possum

Tarsipes rostratus

Family: Tarsipedoidea

Conservation status: Not listed

Identification

The honey possum is a delicate, long-nosed animal with grizzled grey-brown fur, long guard hairs and three obvious, longitudinal stripes on its back. The central stripe is dark brown with a paler, chestnut stripe on either side. Its large, dark eyes are positioned towards the top of its head. It has a brush tongue and a small number of insignificant, peg-like teeth. The fur underneath is pale cream.

Habitat and distribution

The honey possum is common in the coastal plain heath and *Banksia* woodland of south-western Australia, particularly in areas with a selection of different myrtles and *Banksia* so that flowers are available all year round. Populations can fluctuate wildly depending on the season. Honey possums populations can soar following good seasons and then crash when food resources become limited. They are a mobile species, following food supplies. One female with pouch-young is known to have moved one kilometre in a night. This species is still common in the Avon region where suitable habitat remains.

Diet

The honey possum's diet consists entirely of nectar and pollen from a range of plant species, depending on the season. Nectar provides energy while pollen is high in protein. Honey possums are nocturnal and spend their days sleeping, sometimes in a disused bird's nest or in the hollow bases of grass trees. To conserve energy, honey possums usually become 'torpid' during the day; allowing their body temperature to drop and becoming almost unconscious. In contrast, their nights are spent actively scampering from flower to flower consuming nectar and pollen. As it collects food from flowers of various species, the honey possum incidentally transfers pollen from one flower to another and is probably an important pollinator of the species on which it feeds.

Reproduction

Breeding may occur at any time of year when conditions are favourable but pouch-young are most common in autumn, winter and spring, when pollen and nectar are most plentiful. Newborn honey possums are the smallest of any mammalian baby, weighing less than five milligrams. Females have four teats in their pouch but usually only carry two or three young. The young remain in the pouch for eight weeks and then are left in a safe place while the mother feeds. The young are weaned at 10 weeks of age. They are fully grown at eight months and females are able to breed when less than a year old. Like several species of kangaroos, female honey possums can store fertilised eggs which begin to develop after a litter has left the pouch. This enables them to produce two litters in a year if conditions are good.

Threats

Introduced cats and foxes will catch honey possums but populations seem to be able to withstand this predation provided that sufficient dense, flowering heath is available for food and shelter. Fire and habitat fragmentation affect populations

of honey possums. After a fire, their food supply is interrupted and so honey possums must either move to another area, if available, or they will starve. If the habitat is fragmented, or the fire is very large, the animals may be unable to find an alternative feeding area.

Management actions

The protection of *Banksia* woodland and coastal heath areas is necessary to maintain populations of the honey possum. Equally, the honey possum is thought to be an important pollinator of heathland plants so the maintenance of honey possum populations is important in the conservation of some species of heathland plants.

Honey possum facts

Size (head and body length)
40 – 94 mm

Size (tail)
45 – 110 mm

Weight
7 – 9 g (males)
10 – 12 g (females)
Newborn young < 5 milligrams

Habitat
Coastal heath and *Banksia* woodland.

Diet
Nectar and pollen.

Reproduction
All year round with a peak over autumn, winter and spring.

Longevity
2+ years

Common brushtail possum

Trichosurus vulpecula

Family: Phalangeridae

Conservation status: Not listed

Identification

The common brushtail possum has thick, silver-grey fur on its back and white to pale grey fur underneath. It has long rounded ears and a bushy tail, although the thickness of the fur on its tail varies throughout its range. Near the end of the tail, it has a hairless area underneath which is used to grip against branches. Males are usually larger than females and often have reddish fur on their shoulders.

Habitat and distribution

Brushtail possums are very happy to live in urban areas, resting in roofs, provided that domestic animals are kept under control. Rare in central Australia, but common in areas with trees and fox control, the brushtail especially favours open forests and woodland. This species rests in hollows, rock cavities, hollowed out termite mounds or the ceiling space below the roofs of houses when it is inactive. It will travel between trees and forage on the ground but is predominantly a tree-dwelling species, using its claws, an opposable toe on its hind foot and its partly prehensile tail for climbing. It is present in the Avon region in remnant woodland and towns.

Diet

The brushtail possum eats leaves, flowers and fruits, depending on their nutritional value and availability. Like many species of mammals in south-western Australia, the common brushtail possum is very tolerant of toxins in plants found in parts of its range. It actively seeks out some poisonous plants such as *Gastrolobium* and suffers no ill effects from eating them, unlike most introduced mammals which are severely affected by the poison.

Reproduction

Most populations breed in autumn with some breeding taking place in spring. Possums will breed throughout the year in some parts of its range. Females usually start breeding at one year old. Pregnancy lasts 16 to 18 days and, after birth, the young stays in the pouch for between four and five months. The young then rides on its mother's back for another one or two months before it is weaned. One young is raised at a time but one or two young may be raised in a year. Young disperse at six to 18 months of age and many fail to survive as they try to find their own home range.

Threats

Young animals are susceptible to predation by dogs, cats and foxes. Land clearing and habitat fragmentation has also had an impact on this species, especially in the Avon region.

Management actions

Replanting of trees and conservation of remnant vegetation, in combination with fox control, will assist this species' survival in the Avon region.

Common brushtail possum facts

Size (head and body length)
350 – 550 mm

Size (tail)
250 – 400 mm

Weight
1.2 – 3.5kg (males)
1.3 – 4.5 kg (females)

Habitat
Most of Australia, uncommon in central Australia/arid areas.

Diet
Leaves flowers and fruits, depending on nutritional value and availability.

Reproduction
One or two young raised per year.

Longevity
Up to 13 years, usually less than 11 years

Burrowing bettong

Bettongia lesueur

Family: Potoroidae

Conservation status: Vulnerable

Identification

The burrowing bettong or 'boodie' is a stocky, yellowish-brown hopping marsupial with rounded ears and a short muzzle. Its dense fur is paler underneath. The tail is thick, shorter than the body and is yellow-brown for most of its length but darker towards the end, sometimes with a white tip (but not tufted). Bettongs are vocal animals, grunting, hissing and squeaking to communicate with each other or if they are disturbed. The burrowing bettong is the only member of the kangaroo group to shelter regularly in burrows.

Habitat and distribution

Preferring loamy soils, the burrowing bettong occurs in a wide range of vegetation types from eucalypt woodland to hummock grassland and scrub. Once widespread in arid and semi-arid areas of central southern and western Australia, the boodie is now restricted to several islands off the Western Australian coast and a handful of reintroduced colonies on the mainland. Groups of boodies dig huge warrens. These extensive burrow systems can house up to 100 animals. In the Avon region, burrow complexes are often associated with rocky areas and, although the species is extinct in the area, old burrow systems can still be found.

Diet

The burrowing bettong digs up and eats underground tubers and fungi, seeds, fruit, leaves and flowers, soil invertebrates and, on offshore islands, even consumes dead animals washed up on the beach. Bettongs appear to find their food by smell; they have been observed smelling the ground before they dig up items of food.

Reproduction

Burrowing bettongs carry one young at a time in their pouch, but will breed throughout the year when conditions are good, sometimes being able to produce three young in 12 months. Pregnancy lasts 21 days and young animals stay in the pouch for 115 days. Young are able to breed at five months of age so the population is capable of building up quickly in good conditions.

Threats

This species suffered a spectacular decline following the establishment of foxes in the Avon region. Before foxes arrived, boodies were regarded as pests and a bounty was paid for their ears. However, once foxes became established, the boodies were gone. The last mainland specimens of boodies were collected in south-western Australia in the 1940s. Desert Aborigines recalled boodies surviving there until 1960.

Management actions

A cooperative recovery plan including captive breeding and reintroduction of animals to secure sites with ongoing fox control will assist in the rescue of this species from the brink of extinction.

Burrowing bettong facts

Size (head and body length)
280 – 360 mm

Size (tail)
215 – 280 mm

Weight
900 – 1600 g

Habitat
Hummock grassland and scrub on loamy soil.

Diet
Underground tubers and fungi, seeds, fruit, leaves and flowers, soil invertebrates and even dead animals washed up on the beach.

Reproduction
Breeds throughout the year. 1 young raised at a time with up to 3 young raised in a year.

Broad-faced potoroo

Potorous platyops

Family: Potoroidae

Conservation status: Presumed extinct

Identification

The Noongar name for the broad-faced potoroo was 'moda'. The moda was grizzled brown on the upper parts and off-white below. It had a very broad forehead with a fairly narrow snout. The last specimen was collected in the 1870s, but the species may have survived for some time after the collection of this specimen.

Habitat and distribution

Subfossils indicate that the broad-faced potoroo was once widespread in the semi-arid and south-west of Western Australia and also in South Australia. The only specimens collected since colonisation was from the Western Australian wheatbelt and east of Albany. John Gilbert, an early collector for John Gould, reported collecting an animal from a thicket next to an inland salt lake. This is the only information that has been recorded about the habitat of this species. The broad-faced potoroo was probably already rare when colonists arrived.

Diet

Not known.

Reproduction

Not known.

Threats

This species became extinct before foxes and changes in fire regime could have had an impact. Feral cats were established by the time broad-faced potoroos began to decline so they may have been responsible for their extinction. Disease has also been suggested as a possible cause.

Management actions

This species is presumed extinct so no management is possible.

Illustration in John Gould's *'The Mammals of Australia'* reprinted courtesy of Museum of Victoria

Broad-faced potoroo facts

Size (head and body length)
243 mm

Size (tail)
183 mm

Weight
Not known

Habitat
Formerly southern WA and SA. The last specimens were found in WA wheatbelt and east of Albany in the nineteenth century.

Diet
Not known.

Reproduction
Not known.

Rufous hare-wallaby

Lagorchestes hirsutus

Family: Macropodidae

Conservation status: Endangered

Identification

Called the mala by the Pintubi people from the Tanami desert, the rufous hare-wallaby has long, soft fur that is rufous above, with paler fur underneath. The tail is brownish-black on top and rufous underneath. Animals from Bernier and Dorre islands are larger than mainland animals but have shorter tails and are greyish-brown above. Female animals are slightly larger than males.

Habitat and distribution

Once found across much of inland Australia as far south as the wheatbelt of Western Australia, the mala (the central desert subspecies of the rufous hare-wallaby) became extinct in the wild on the mainland as recently as the 1990s. It survives in reintroduced, protected populations on the mainland, including a protected population at Dryandra Woodland (descendants of the last wild animals from the Tanami Desert) and on Trimouille Island. The island subspecies still occurs on Bernier and Dorre islands. The rufous hare-wallaby was recorded from the Avon region historically.

Diet

Rufous hare-wallabies graze on green shoots and seed-heads of grasses, herbs and the leaves of some shrubs. In dry seasons, they will occasionally take insects. It sometimes feeds in salt flats and in recently burnt areas of vegetation when green shoots begin to emerge.

Reproduction

This species will breed continuously when conditions are favourable. Breeding is closely linked to rainfall. Pregnancy lasts less than four weeks and the young stay in the pouch for about 124 days. Males are capable of breeding at 14 months old. Females may begin breeding when they are between five and 19 months old and can rear up to three young per year. Females can delay implantation of a fertilised egg (embryonic diapause) so another pregnancy can begin as soon as the previous young are independent. Also, if an older young is lost, it can be replaced quickly with the delayed embryo to make the most of suitable conditions.

Threats

Changed fire regimes and predation by cats and foxes were probably responsible for the extinction of the mainland population of the rufous hare-wallaby. Grazing pressure and land degradation from rabbits and other grazing animals also contributed to their decline. Cats and foxes are also a threat to reintroduced populations.

Management actions

A captive breeding program is underway and animals have been reintroduced to a number of protected mainland reserves and to Trimouille Island on the west coast. The management of reserves includes mosaic burning to produce a mosaic of vegetation ages rather than allowing wildfires to burn large areas. Predator control is vital as reintroduced animals have fallen prey to cats and foxes in previous reintroduction attempts.

Rufous hare wallaby facts

Size (head and body length)
310 – 360 mm (males)
360 – 390 mm (females)

Size (tail)
260 – 280 mm (males)
245 – 305 mm (females)

Weight
800 – 1800 g (males)
780 – 1960 g (females)

Habitat
Hummock grassland, sandplain, desert sand dunes, sand ridges and gravelly plain.

Diet
Green shoots and seed-heads of grasses, herbs and shrubs occasionally insects in dry seasons.

Reproduction
All year round when conditions are favourable. Up to 3 young produced in a year.

Tammar wallaby

Macropus eugenii

Family: Macropodidae

Conservation status: Priority 5

Identification

The tammar wallaby has a white cheek stripe underneath the eye with a dark area between the nostril and the eye, and a dark mid-line on the forehead, between the ears. The tammar is a thickly furred, stocky wallaby that holds its forearms apart when it hops. It has a dark, grizzled grey-brown back and tail, grading to rufous on the flanks and limbs, especially in males. The underside is pale grey.

Habitat and distribution

This species is found in scrub, heath, dry forest, thickets in mallee and woodland. It rests in scrub during the day and emerges to feed in open grassy areas at night. Formerly widespread in south-western Australia, the tammar wallaby is now confined to offshore islands and a few small reserves on the mainland including Dryandra, Tutanning and Perup reserves. The tammar was once so common in the Avon region that it was regarded as a major source of food in the great depression of the 1930s. It even had a poem written about it:

> Tammars hot and tammars cold,
> Tammars young and tammars old,
> Tammars tender and tammars tough…
> Tammars…thank God we've got enough!!

Diet

The tammar wallaby feeds on green or dry grass, depending on what is available. Some island populations of tammars such as the Abrolhos Island and Garden Island populations, who do not have regular access to fresh water, are able survive and breed while drinking sea water and eating dry food.

Reproduction

The reproductive cycle of the Kangaroo Island population of tammars has been well studied. On Kangaroo Island, breeding is seasonal and highly synchronised. Young are born between January and March and remain in the pouch for eight to nine months. They are independent by 12 to 13 months of age. Females are sexually mature at nine months (before they are independent of their mother); males at nearly two years old. If a female has a dependent joey when she mates, development of the young is arrested and is reactivated soon after the older joey is weaned.

High mortality of juveniles occurs in their first summer, especially in poor years.

Threats

Predation by feral cats and foxes, and land clearing, are major threats to tammar wallabies.

Management action

There is a recovery plan in place. Populations are increasing throughout the species' range, wherever there is fox control and suitable habitat remains.

Tammar wallaby facts

Size (head and body length)
590 – 680 mm (males)
520 – 630 mm (females) Kangaroo Island

Size (tail) Kangaroo Island
380 – 450 mm (males)
330 – 440 mm (females)

Weight Kangaroo Island
6 – 10 kg (males)
4 – 6 kg (females)

Habitat
Heath, scrub, forest and mallee with thick patches of cover.

Diet
Green and dry grass.

Reproduction
Most young are born in January, February and March. Young are in pouch for 8 – 9 months and independent at 12 –13 months.

Longevity
Males to 11 years
Females to 14 years

Western grey kangaroo

Macropus fuliginosus

Family: Macropodidae

Conservation status: Not listed

Identification

The western grey kangaroo is a large, well-known species of marsupial. It is grey-brown in colour with a finely haired muzzle. The chest and belly are pale grey. The last third of tail and the paws are blackish. It hops in an upright posture with tail turned upwards. Western greys are social animals and communicate with a series of clucking noises. White and albino animals are quite common.

Habitat and distribution

This species is common and widespread in most habitats in southern and south-western Australia. It rests under trees or other vegetation during the middle of the day and emerges to feed at dusk, night and dawn. To assist survival in hot environments with limited food and water, western grey kangaroos can allow their body temperature to fall overnight and then absorb warmth during the heat of the day.

Diet

The western grey kangaroo grazes on grasses and herbs and sometimes also browses shrubs. Because much its diet is coarse, the teeth rapidly wear down. As with many of the kangaroo family, the cheek teeth (molars and pre-molars) are replaced from behind as they become worn down. The number of teeth available is limited, however, so very old animals can die from starvation when they have worn out all their teeth.

Reproduction

Western grey kangaroos can breed at any time of year, however, most young are born in summer after a 31-day pregnancy. They rear one young at a time and unlike some other kangaroos and wallabies there is no embryonic diapause (in which an embryo is retained within the womb without developing while the female is still suckling a joey). Young leave the pouch at 42 weeks but continue to suckle until 18 months old. Females can breed as soon as they are weaned. For much of the year and especially when breeding, western grey kangaroos are social, living in temporary and flexible mobs of up to 25 animals which include males and females. When they are not breeding, single-sex mobs of kangaroos are common. Males can be twice the weight of females and will fight each other for access to females in a group.

Threats

The western grey kangaroo is a common and adaptable species. Numbers have increased in parts of their range due to the provision of water and grass, and the removal of natural predators (dingoes and traditional hunters), but have declined in some intensively cleared areas without bush refuges.

Management actions

Western grey kangaroos are a protected species, however, where large numbers occur and cause damage to crops or conservation lands, permits are sometimes issued to control the numbers following consultation with the Department of Environment and Conservation.

Western grey kangaroo facts

Size (head and body length)
1200 mm (males)
900 mm (females)

Size (tail)
425 – 1000 mm (males)
443 – 815 mm (females)

Weight
18 – 72 kg (males)
17 – 39 kg (females)

Habitat
Adaptable and widespread in most habitats in southern and south-western Australia.

Diet
Coarse grasses and selected shrubs.

Reproduction
Young stay in the pouch for 42 weeks. Does not have embryonic diapause.

Western brush wallaby

Macropus irma

Family: Macropodidae

Conservation status: Priority 4

Identification

The western brush wallaby is pale grey with a distinct white facial stripe and black and white ears. The tail is black for much of its length, sometimes with a white tip. It is also known as the black-gloved wallaby because of its black paws and hind feet and as the brush-tailed wallaby because the long tail has a ridge of bristly hair towards the end. Western brush wallabies move quickly and with great agility, their heads down and tail extended. Some individuals have a series of indistinct bands on their backs and rumps.

Habitat and distribution

This species prefers dry forest, woodland and mallee, often with grassy understorey and always with thickets of shrubs. They tend to shelter in dense thickets during the day, becoming active in the late afternoon, remaining active for much of the evening, moving little through the middle of the night and again becoming active before sunrise.

Diet

The western brush wallaby grazes on grasses, shrubs and forbs. It rarely drinks even when water is available. It will sometimes excavate roots and is especially attracted to bushland regenerating after fire, but will not shelter in such bushland until thickets have developed. As a result, brush-wallabies are often seen in the late afternoon, moving into recently burnt areas to forage for the evening, and then again in the morning as they return to unburnt thickets to shelter during the day.

Reproduction

Young are born in April – May and leave the pouch in October – November. Adults are almost entirely solitary although females and large female young often remain together. Males have large home ranges (up to 9.9 hectares in one night and 69.2 hectares during a year) that overlap the home ranges (up to 5.3 hectares in one night and 32.5 hectares during a year) of several females. Unlike all other members of the kangaroo family, males and females are the same size.

Threats

The brush-wallaby has suffered across much of its range and particularly in the Avon from habitat loss and fragmentation due to clearing for agriculture. Although adults are probably too large to be taken by foxes, the species increases in abundance in response to fox control, probably because newly independent young are vulnerable to the predator.

Management actions

Where sufficient habitat remains, populations recover quickly when foxes are controlled. Because individuals require quite large areas of bushland, small patches of habitat may not be able to support the species. Therefore, linkage of such fragmented habitat through revegetation may enable the species to recolonise parts of its former range.

Western brush wallaby facts

Size (head and body length)
Up to 1200 mm

Size (tail)
540 – 970 mm

Weight
7 – 9 kg

Habitat
Dry forest, woodland, mallee with dense patches of shrubby undergrowth and grassy understorey.

Diet
Grasses and forbs.

Reproduction
Young born April – May. They leave the pouch October – November.

Euro

Macropus robustus

Family: Macropodidae

Conservation status: Not listed

Identification

The euro was one of three kangaroo species collected by Captain Cook's expedition in 1770. Euros have a distinctive bare, black muzzle and range in colour from red-brown to grey, with the result that they are sometimes confused with red kangaroos. In some parts of their range, the fur is thick and shaggy. Euros lack the facial markings of red kangaroos, however, and stand with their shoulders thrown back, elbows tucked in by their sides and their wrists raised. Males are twice the weight of females and are a darker colour. When disturbed, the euro utters a coughing cch-cch sound, and will also hiss.

Habitat and distribution

Euros are found in a wide variety of habitats, but usually occur near areas of rocky ridges and overhangs or deep valleys where the animals can shelter from the heat of the day. They emerge in the evening to feed. Euros are found over most of Australia except the extreme south and Cape York. They are usually solitary animals with a fairly small home range. The density of animals seems to be affected by the availability of food, shelter and water rather than territorial requirements. Competition with other grazing animals can have an impact of the numbers of euros in an area.

Diet

This species grazes on grasses and shrubs on the slopes and plains within its home range. It is well adapted to arid Australian conditions and can survive and breed on a low protein diet and little or no free water, provided that it can eat leaves of fleshy shrubs.

Reproduction

Euros become sexually mature between 18 months and two years of age. Breeding may take place at any time of year except during extended drought. Females become receptive immediately after giving birth and have embryonic diapause (they can store a fertilised ovum for future implantation). Gestation is 34 days and pouch life 244 days.

Threats

Euros remain common throughout their range, but may suffer from competition for food with livestock and goats.

Management actions

Euros are a protected species, however, where large numbers occur and cause damage to crops or conservation lands, permits are sometimes issued to control the numbers following consultation with the Department of Environment and Conservation.

Euro facts

Size (head and body length)
1107 – 1580 mm (males)
800 – 1100 mm (females)

Size (tail)
551 – 901 mm (males)
534 – 749 mm (females)

Weight
7.25 – 46.5 kg (males)
6.25 – 25 kg (females)

Habitat
Areas near rocky hills and overhangs for shelter adjacent to grassy slopes and plains.

Diet
Grass, fleshy leaves of shrubs. They can survive without free water if there is sufficient moisture in foliage.

Reproduction
Mature at 18 months – 2 years. Young in pouch for 244 days.

Red kangaroo

Macropus rufus

Family: Macropodidae

Conservation status: Not listed

Identification

As its name implies, the red kangaroo is usually a rich red colour on its back, although some are blue-grey, particularly adult females (often referred to as 'blue fliers'). The red kangaroo may be distinguished from the euro by white underparts, a broad white stripe from the side of the mouth to underneath the eye, and a black patch either side of the nose. The fur is also short, lacking the slight shagginess of the euro. The muzzle is hairless and dusky coloured, while the ears are long and pointed and the eyelids noticeably heavy. Red kangaroos hop with their body almost horizontal and tail in a shallow 'U' shape.

Habitat and distribution

The red kangaroo is common in semi-arid and arid areas of Australia. It avoids rocky areas and desert, preferring open woodland, plains and shrubland. Small groups of red kangaroos can often be found sheltering under trees during the heat of the day. They lie in shallow scrapes in the soil to help them keep cool.

Diet

Green grasses and herbs are the main diet of red kangaroos. Small groups can often be seen grazing in open areas during late afternoon or early evening. After heavy rains, large mobs of red kangaroos sometimes gather in an area to take advantage of the abundant green food. Females tend to remain within their home range but males, and particularly young males, may roam widely.

Reproduction

The red kangaroo breeds at any time of year when conditions are favourable but there is a peak of births in spring–summer. Following drought, red kangaroos can begin breeding very rapidly. Young remain in the pouch for approximately nine months. A female can be caring for three generations of babies at once: one that is living outside the pouch but still suckling occasionally, one inside the pouch and an embryo in suspended development within the uterus. The two suckling young get milk that is tailored to their age, differing in concentrations of fats and proteins. Long drought can cause high mortality of joeys, particularly young at foot.

Threats

Red kangaroos remain common throughout their range.

Management actions

Red kangaroos are a protected species, however, where large numbers occur and cause damage to crops or conservation lands, permits are sometimes issued to control the numbers following consultation with the Department of Environment and Conservation.

Red kangaroo facts

Size (head and body length)
935 – 1400 mm (males)
745 – 1100 mm (females)

Size (tail)
710 – 1000 mm (males)
645 – 900 mm (females)

Weight
22 – 85 kg (males)
17 – 35 kg (females)

Habitat
Semi-arid and arid plains, forest, woodland and mallee. Avoids rocky areas and desert.

Diet
Green grasses and herbs.

Reproduction
Peaks in spring – summer but can occur all year round in favourable conditions. Young remain in pouch for 9 months. Mature at 18 months to 2 years.

Crescent nailtail wallaby

Onychogalea lunata

Family: Macropodidae

Conservation status: Presumed extinct

Identification

Also known as the 'worong' by Noongar people and 'tjawalpa' by the people of the western desert area, the crescent nailtail wallaby was grey above, pale grey below and had crescent-shaped white patches on its body outlining its shoulders, and a less obvious white stripe in front of its hip. It had a hard, fingernail-like point on the end of its tail, hence the name. The function of this 'nail' is unknown, but a similar structure is also found on lions!

Habitat and distribution

The crescent nail-tailed wallaby used to occur through the Avon region and into the southern desert areas, preferring eucalypt and mulga woodland. It was apparently a very agile animal with accounts of individuals hopping up inside large, hollow trees when pursued by dogs.

Diet

It is thought to have eaten grass.

Reproduction

The reproductive trails of this wallaby are little known, but it probably had a similar reproductive pattern to other kangaroos in semi-arid and arid country.

Threats

The crescent nailtail wallaby is presumed extinct, probably due to predation by foxes and maybe from change in fire regimes altering the food supply and vegetative cover. It was last reported from the western desert in the 1940s and 1950s.

Management actions

As this wallaby is already presumed extinct, all that can be done is protect remaining native mammal species by the provision and management of appropriate reserves and the continuing control of feral animals.

Illustration in John Gould's *'The Mammals of Australia'* reprinted courtesy of Museum of Victoria

Crescent nailtail wallaby facts

Size (head and body length)
371 – 508 mm

Size (tail)
153 – 330 mm

Weight
3.5 kg

Habitat
Used to occur through the wheatbelt in WA and into the southern desert areas, preferring eucalypt and mulga woodland.

Diet
Not known.

Reproduction
Not known but probably similar to other kangaroos of the semi-arid and arid zone.

Black-flanked rock-wallaby

Petrogale lateralis

Family: Macropodidae

Conservation status: Vulnerable

Identification

The black-flanked rock-wallaby (otherwise known as the 'warru') has dark to pale grey-brown fur on the back and shoulders, with paler fur on the chest, and dark brown fur on the abdomen. There is a distinct black eye-stripe and white cheek-stripe, with white at the base of the ears. A white stripe and a dark stripe run along the side of the body. A dark brown to black dorsal stripe runs from between the ears to below the shoulders. The coat is thick and woolly, particularly around the rump, flanks and base of the tail. The tail has a slight brush on the end. The coat often becomes lighter and browner in summer.

Habitat and distribution

As the name suggests, black-flanked rock-wallabies live on rocky outcrops which are suitably fractured and provide adequate caves for them to rest in during the day. These outcrops help protect rock-wallabies from their natural predators (birds of prey) and also keep them cool during the summer months. When agricultural land lies behind their granite home, they have been seen to move onto machinery such as tractors, treating the equipment like a rock outcrop and sheltering under the engine and mudguards. Black-flanked rock-wallabies were originally found close to Perth and occurred throughout the Avon where there were suitable rocks. Their range extended to the Pilbara, Kimberley and desert.

Diet

At dawn and dusk, they will venture out from the rock outcrops to feed on vegetative matter including grasses, leaves and even the bark of trees. Rock-wallabies will drink water when it is available but for most of the year they will gain moisture from the food they eat and licking dew on rocks.

Reproduction

Rock-wallabies can breed all year round when conditions are favourable. A feature of this species' reproduction is embryonic diapause, where the developing embryo can become dormant until conditions are more suitable. When the young are too big for the pouch, they are deposited in a sheltered location while the mother searches for food. Young are eventually weaned after 11 months.

Threats

Like most other species of rock-wallaby, black-flanked rock-wallaby populations have declined dramatically during the twentieth century and their distribution is now highly fragmented. It is believed that predation from the red fox is most responsible for this decline, and Department of Environment and Conservation research on the species in the wheatbelt in the 1980s demonstrated for the first time that fox control was very effective in assisting declining native mammals. Land clearing between rocky outcrops has also deterred rock-wallabies from dispersing to other outcrops when food and shelter cannot be found.

Photo ©Hayden Cannon

Management actions

Baiting for foxes using 1080 baits has resulted in an increase in rock-wallaby numbers in the Avon. This has resulted in some rock-wallabies being translocated to other parts of the State in a bid to improve the survival of this species. Population health monitoring of rock-wallaby populations in the central wheatbelt is undertaken. Habitat restoration near rock outcrops is required in some areas to assist the species, as agricultural clearing has removed foraging habitat.

Black-flanked rock-wallaby facts

Size (head and body length)
497 – 529 mm (males)
446 – 486 mm (females)

Size (tail)
483 – 605 mm (males)
407 – 516 mm (females)

Weight
4.1 – 5.0 kg (males)
3.1 – 3.8 kg (females)

Habitat
Rock outcrops that are sufficiently fractured.

Diet
Feeds on grasses, leaves and even the bark of trees. Will drink water if available.

Reproduction
Will breed all year round when conditions are favourable. Young are weaned after 11 months.

Banded hare-wallaby

Lagostrophus fasciatus

Family: Macropodidae

Conservation status: Vulnerable

Identification

William Dampier described this species as "a sort of raccoon" when he saw it in 1699. The banded hare-wallaby has long, shaggy fur, with grizzled grey colouring on top, pale grey underneath and dark, transverse bands across its back and rump. Its tail is grizzled grey and sparsely furred with a black crest on the last third of its length. It may be distinguished from the burrowing bettong and the rufous hare-wallaby by being darker on top and by the transverse bands.

Habitat and distribution

The last mainland specimen of the banded hare-wallaby was collected near Pingelly, Western Australia, in 1906. Populations still exist on Bernier and Dorre islands and attempts are being made to reintroduce animals to other island and mainland sites. Formerly the distribution of the banded hare-wallaby included the Avon region, and there is fossil evidence from the southern Nullarbor as well as sites near the Murray River in South Australia and into New South Wales. Island populations occur in *Acacia* thickets.

Diet

Leaves of herbs and shrubs make up more than half the diet of the banded hare-wallaby, with the remainder made up of grasses. Since free water is not usually available, banded hare-wallabies rely on dew and the moisture in their food to provide their water needs.

Reproduction

Young are born from December to September, with most born in late summer. Some females mate after giving birth but delay implanting the second embryo until the older young is about to leave the pouch or is lost prematurely. Males aggressively defend their territories which overlap with those of a number of females.

Threats

The decline and extinction of the mainland banded hare-wallabies occurred before the arrival of the fox during the early days of clearing in the Avon, when they were also subjected to changes in fire regimes and predation by feral cats.

Management actions

Captive breeding and reintroductions of the species to parts of its former range (where suitable habitat remains) are taking place, but the reintroductions are only successful in the absence of introduced predators.

Banded hare wallaby facts

Size (head and body length)
400 – 450 mm

Size (tail)
350 – 400 mm

Weight
1.3 – 2.1 kg
(males occasionally reach 2.5 kg)
(females occasionally reach 3.0 kg)

Habitat
Dense scrubland. Shelters in low dense spreading shrubs during the day and feeds in open areas at night.

Diet
Grasses and leguminous shrubs.

Reproduction
Most births occur in late summer. Young spend 6 months in the pouch and are weaned at about 9 months old. Females usually only raise one young per year.

Longevity
6 years in the wild
8 years in captivity

Lesser long-eared bat

Nyctophilus geoffroyi

Family: Vespertilionidae

Conservation status: Not listed

Identification

This species is, as the name suggests, a small bat with long ears which are usually joined over the forehead. but sometimes fold down against the head. The shape of the skin that folds around a bat's nose can sometimes used to identify different species. The lesser long-eared bat has a characteristic Y-shaped ridge behind the nose leaf. Its wings are fairly short and broad in comparison with other species. The fur is grey-brown on the upper surface and pale whitish-grey underneath. The hairs on the back are bi-coloured; darker at the base and paler towards the end.

Habitat and distribution

The lesser long-eared bat is found throughout Australia except for the east coast of Queensland. It is found in all vegetation types including arid areas, grasslands, woodlands, tropical and temperate rainforest, alpine areas and urban areas. In natural areas, lesser long-eared bats roost in crevices under bark and in hollow logs but they will roost almost anywhere there is warm, humid shelter. This species has been found roosting under stones, in birds' nests, piles of bricks, rolled up blinds and clothes hung outside. It is common in cities and happily roosts in house roofs, which it will often share with chocolate wattled bats and other species. Roosts in large human structures are often made up of many more bats than natural roosts, sometimes numbering several hundred individuals. To conserve energy, the lesser long-eared bat goes into torpor during the day in winter, only waking up to feed. Roosts are often north-facing so they are solar heated, reducing the energy needed to keep warm. When the weather is warm, the bats maintain their body temperature and can wake up and fly off very quickly if disturbed.

Diet

This species catches insects in flight or gleans them from foliage or from the ground. It hunts low down in foliage and on understorey plants and is a very adept flyer. The lesser long-eared bat will land on the ground to capture invertebrates and can take off almost vertically. It can take off from water, a feat that not all bats can manage and hovers in a stationary position while hunting for prey. It will travel up to 12 kilometres from its roost site to forage.

Reproduction

Mating takes place in autumn and sperm is stored by the female over winter. Fertilisation takes place in spring. Young are born between October and early December in southern Australia, earlier in northern Australia. They commonly have twins. The bats form maternity colonies and, although the mothers are able to fly with their young while they are suckling, they tend to leave them in the roost site while they forage. The females move their young to a new roost every couple of days, carrying them one at a time when they become large. Young bats are able to fly when they are six weeks old but do not venture far from the roost site. The young bats then join their mother while hunting, gradually improving their flying skills. Females are able to breed in their first year of life.

Threats

Lesser long-eared bats have adjusted well to the changes brought about by colonisation. Buildings provide them with excellent roosting sites; clearing and urbanisation has not affected their numbers.

Management actions

This species is common and widespread and no specific management actions are required for its conservation.

Lesser long-eared bat facts

Size (head and body length)
40 – 50 mm

Size (tail)
33 – 41 mm

Weight
6 – 12 g

Habitat
Found throughout Australia except for the east coast of Queensland. Found in all vegetation types including arid, alpine and urban areas.

Diet
Insects caught in the air or gleaned from bushes or from the ground.

Reproduction
Two young born spring – early summer, carried with mother then left in roost. Young fly at 6 weeks and learn to hunt with mother.

Central long-eared bat

Nyctophilus sp *aff. timoriensis*

Family: Vespertilionidae

Conservation status: Priority 4

Image: Terry Reardon

Identification

The central long-eared bat is a compact, chunky bat with a large head, large ears and a broad snout. It has only recently been recognised as a distinct form and was previously classified along with populations in eastern Australia as the greater long-eared bat (*N. timoriensis*). The central long-eared bat is smaller than similar long-eared bats from eastern Australia and the populations are separated geographically. It is much bigger than the lesser long-eared bat (*N. geoffroyi*), which occurs in the same area, and lacks the Y-shaped nose leaf. It is separated from the western long-eared bat (*N. gouldi*) by having more widely spaced canine teeth at the gum line. Its fur is dark grey-brown on top and slightly bi-coloured, being slightly paler brown on the ends of the hairs. Females are larger than males and fly faster.

Habitat and distribution

This species is widespread in the semi-arid and arid environments of southern and western Australia. It roosts in hollows in trees, in foliage, under bark and in split branches. The central long-eared bat favours woodlands with salmon gum, gimlet and other small eucalypts and an understorey with dense thickets of flowering shrubs, as well as the edges of wattle and sheoak thickets around granite outcrops. It occurs in semi-arid parts of the Avon but much of its preferred habitat has been cleared for agriculture.

Diet

The central long-eared bat hunts low down in the canopy and around shrubs, gleaning invertebrates from foliage and from the ground as well as catching insects in flight. This species is sometimes caught in pitfall traps, probably as a result of scampering across the ground in pursuit of invertebrates. One study in *Banksia* woodland in Western Australia found that they ate mostly beetles. The flight is slow and fluttery and the bat uses its large ears as rudders to help manoeuvre it through dense foliage in pursuit of prey. It is believed that the size difference between the sexes may result in them targeting different prey species, thereby reducing competition for resources in an environment with limited food supplies.

Reproduction

Breeding begins in autumn and the young are born in late spring and early summer. Their life history is probably similar to other long-eared bats in southern Australia but more research is required.

Threats

Land clearing has affected this species' distribution and abundance in the Avon and in other agricultural and urban areas. Grazing and trampling by introduced animals degrades dense thickets and may have an impact on central long-eared bat populations. Cats and foxes prey on this species.

Management actions

Protection of remnant vegetation in conservation reserves, road verges and on farms is important to maintain populations of numerous species that occur in the Avon region, including the central long-eared bat.

Central long-eared bat facts

Size (head and body length)
55 – 60 mm (males)
61 – 65 mm (females)

Size (tail)
45 – 48 mm (males)
47 – 50 mm (females)

Weight
9.5 g (males)
12.7 g (females)

Habitat
Arid and semi-arid WA and SA in forests, woodlands with dense thickets and edges of granite outcrops. Roosts in hollows, under bark, in foliage and in split branches of trees.

Diet
Feeds low in the canopy and in shrubs. Eats flying and non-flying invertebrates, caught in flight, gleaned from bushes and on the ground.

Reproduction
Breeding begins in autumn. Young are born in late spring and early summer.

Gould's wattled bat

Chalinolobus gouldi

Family: Vespertilionidae

Conservation status: Not listed

Identification

The back and underside fur of the Gould's wattled bat is brown, with contrasting blackish fur on the head and shoulders. The snout is short and the ears are short and wide, extending to form a wattle (fleshy lobe of skin) at each corner of the mouth. The lower lip also has a long, fleshy lobe of skin. Bare areas of skin are pinkish-brown to blackish.

Habitat and distribution

Gould's wattled bat is found throughout Australia and on Norfolk Island in a wide range of vegetation types. It lives in deserts, forests, woodlands, alpine areas and even urban areas. It roosts in tree hollows, buildings and among leaves and will sometimes share roosts with other species of bats and even other small mammals. Single animals have even been found roosting in rolled up blinds and even in a tractor's exhaust pipe. Females roost in colonies of up to 30 individuals but males tend to roost alone. Individuals use several roost sites in an area, and usually use a site for two days before moving on. They will return to previous roost sites.

Diet

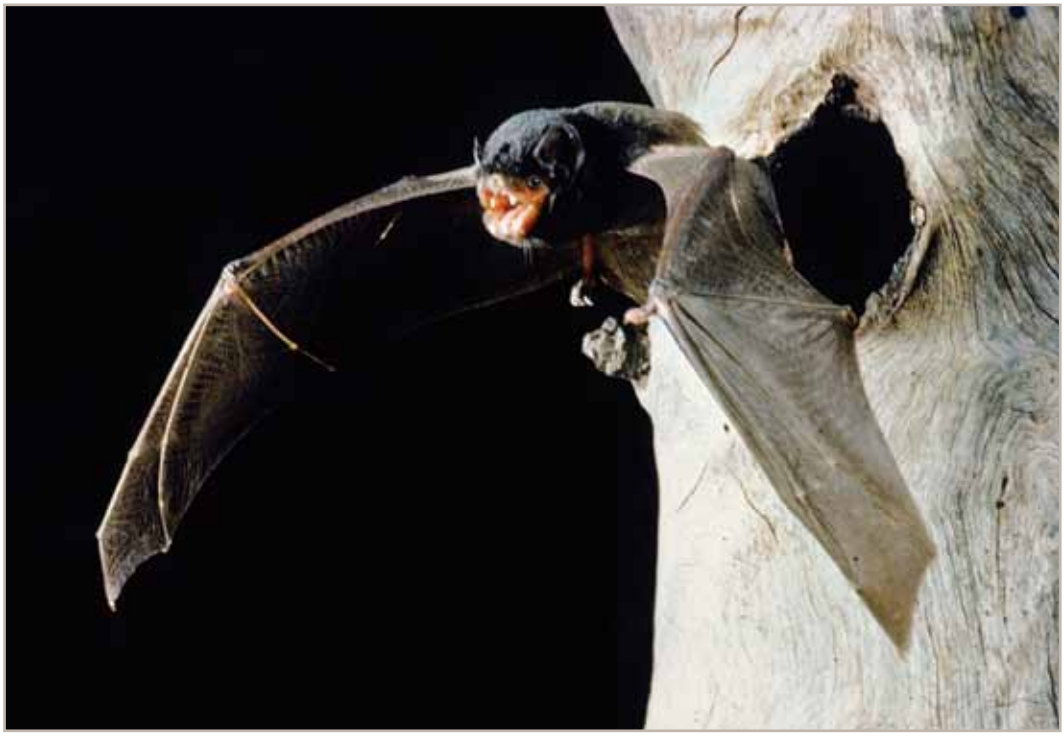
The Gould's wattled bat preys on flying and non-flying insects such as moths, caterpillars, grasshoppers, crickets, beetles, ants, cockroaches and plant bugs. Like most bats, this species locates its prey by echolocation. The bat emits ultrasound and assesses the vibrations that reflect from objects (including potential prey items) to determine their identity and position. They forage in open spaces above and below the tree canopy and at the edges of remnant vegetation in paddocks. Gould's wattled bats will forage up to 15 kilometres from their roost site and are one of the first species to begin hunting in an evening. They become active just after sunset, when it is still light and some daytime predators are still hunting. Their natural predators therefore include birds such as butcherbirds and falcons as well as owls.

Reproduction

Males' testes enlarge in March and mating occurs about June. The female then stores the sperm and fertilisation occurs towards the end of winter. Pregnancy lasts three months and the young (usually twins) are born between late September and November, depending on the latitude (earlier in the north and later in the south). Young are adult size and independent in six weeks.

Threats

Feral cats and foxes will eat bats if they catch them but they are not a big threat to this species provided secure roost sites are available. Large scale use of pesticides is a potential threat for this species.



Management actions

This is a common species and no specific management is required other than the maintenance of suitable vegetation and regulations governing the use of pesticides. Roosting boxes are sometimes installed in rehabilitation areas and are used by Gould's wattled bats when tree hollows are scarce.

Gould's wattled bat facts

Size (head and body length)
65 – 75 mm

Size (tail)
40 – 50 mm

Weight
8 – 18 g

Habitat
Almost all terrestrial habitats in Australia.

Diet
Flying and non-flying insects. Hunts within and below the tree canopy.

Reproduction
Mating occurs in June. Females store sperm until the end of winter. Usually 2 young born. Adult size and independent in 6 weeks.

Longevity
Up to eight years

Chocolate wattled bat

Chalinolobus morio

Family: Vespertilionidae

Conservation status: Not listed

Identification

As its name suggests, this species is covered in chocolate brown coloured fur. It has small fleshy lobes of skin at the corners of its mouth. Some animals from inland populations have slightly paler brown fur on the underside. The chocolate wattled bat lacks the contrasting black head and brown body of the Gould's wattled bat, and is noticeably smaller overall.

Habitat and distribution

The chocolate wattled bat is widespread in a variety of habitats in southern Australia and Tasmania. It occurs in wet and dry forest, woodland, mallee, shrubland and heathland. In inland areas, they are found around water courses, where large roost trees may be used.

They will roost in hollow trees, under bark, in caves as well as in houses, sheds and under bridges. Females will sometimes roost in colonies of up to 400 individuals in caves and 1,000 individuals in roofs but males usually roost alone.

Diet

This species prefers flying insects, depending on availability, particularly moths, flies, beetles, bugs, ants, termites and lacewings. They are very agile and have a fast, direct flight pattern. They will forage up to five kilometres from their roost site but are very faithful to their hunting area, tending to follow the same path each night. The chocolate wattled bat forages in the open area between the top of the understorey and the canopy or occasionally low down, along forest trails.

Reproduction

Mating takes place in autumn and the female gives birth to one and occasionally two young in late spring and early summer after a pregnancy lasting four to five months. The young are usually weaned by early February.

Threats

Foxes and cats will prey on chocolate wattled bats if they find them. Land clearing reduces their foraging areas and roost sites.

Management actions

The chocolate wattled bat is a common species so no specific management is required. However, maintenance of reserves with suitable habitat aids the conservation of this species.

Chocolate wattled bat facts

Size (head and body length)
50 – 61 mm

Size (tail)
45 – 50 mm

Weight
8 – 11 g

Habitat
Southern Australia, including forests, woodlands, mallee, shrublands, heath and tree-lined water courses of inland areas.

Diet
Flying insects, particularly moths, flies, termites, ants and lacewings.

Reproduction
Breeding begins in autumn. Usually 1, sometimes 2 young are born spring – early summer and weaned by February.

Inland broad-nosed bat

Scotorepens balstoni

Family: Vespertilionidae

Conservation status: Not listed

Images: Lindy Lumsden

Identification

When viewed from above, the inland broad-nosed bat's snout is broad and square, as is suggested by the name. Its body is slender and the fur is most commonly light grey-brown on the back with a pale brown underside but individuals vary from dark brown to a pale yellow beige. The fur is bi-coloured; the hairs are dark at the base and paler at their tip. The ears are relatively slender in comparison to other species of broad-nosed bats. Researchers report that this species is belligerent when caught and often bites when handled. There is a large size variation throughout its range and further research may divide this species into several distinct species or subspecies.

Habitat and distribution

A widespread species, the inland broad-nosed bat occurs over most of Australia's inland areas. It prefers dry environments such as open woodland, shrublands, mallee and grasslands and is sometimes observed over water bodies and along arid zone water courses. It roosts horizontally in tree hollows and in roofs, often sharing roost sites with larger colonies of southern free-tailed bats.

Diet

The diet is made up of flying and non-flying insects including cockroaches, termites, crickets, cicadas, grasshoppers, beetles, bugs, flies, moths and ants. Inland broad-nosed bats hunt within and below the forest canopy as well as in open areas.

They fly continuously, with rapid darting movements in pursuit of prey. They begin foraging at dusk and are often the first species to be recorded hunting in an evening.

Reproduction

Population studies have not taken place in all parts of its range so information is incomplete, however, in Victoria, mating occurs in late April and early May and one or two young are born in November. The mother carries the young with her for their first 10 days of life until they weigh four to five grams and are too heavy to carry. She then leaves them in a roost while she hunts. When the young are three weeks old, they begin to grow fur and their eyes open. Young inland broad-nosed bats can fly and hunt independently by six to eight weeks of age.

Threats

Land clearing for agriculture and change in fire regime is causing a gradual degradation of the habitat of this species in some parts of its range. Of particular concern is the reduction in the numbers of suitable hollows for daytime roosts.

Management actions

Protection of remnant vegetation, road verges and conservation reserves including fire management in the Avon and other agricultural areas is important for this species. In areas where hollows have been lost, artificial roosting boxes are sometimes used to provide secure sites for daytime roosts.

Inland broad-nosed bat facts

Size (head and body length)
42 – 60 mm

Size (tail)
29 – 42 mm

Weight
7 – 14 g

Habitat
Dry inland areas of Australia. Woodlands, shrublands, mallee and grasslands, roost in hollows and roofs.

Diet
Flying and non-flying insects including cockroaches, termites, crickets, cicadas, grasshoppers, beetles, bugs, flies, moths and ants.

Reproduction
Breeding begins late April – early May. 1 – 2 young born in November. Mother carries young for first 10 days until they weigh 4 – 5 g, and then leaves them in roost. They are furred and their eyes are open by 3 weeks. Young fly and hunt by 6 – 8 weeks old.

Inland forest bat

Vespadelus baverstocki

Family: Vespertilionidae

Conservation status: Not listed

Identification

There are two colour forms of this tiny little bat. One is light sandy brown on the back with bi-coloured hairs which are grey at the bases. The fur on the underside is much paler and the hairs are dark brown at the base and creamy white at the tip. The other colour form is brownish-grey with a paler underside. The skin on the face is greyish-pink and the ears and wings are pale grey. The tragus (a structure near the ear hole) is sometimes white. The males of some species of bats have distinctive genitalia and these may be used to identify the species. In male inland forest bats, the penis is pendulous and the end is swollen. The head of the glans penis is funnel-shaped but without lateral folds, unlike the southern forest bat, which has a funnel-shaped glans penis with lateral folds. Females of the two species can sometimes be identified by head measurements but often they require genetic testing.

Habitat and distribution

Found throughout most of inland semi-arid and arid Australia. The inland forest bat is found in low woodlands of *Acacia, Callitris* and *Casuarina*, mallee, open eucalypt woodland, shrub and grassland environments. Their small size means that they can roost in very small crevices and hollows. They are found in many areas without large trees and find roost sites in tiny hollows of trees only a few metres high. One colony of more than 60 bats was found squeezed into the crack around an old door frame in an abandoned railway building.

Diet

Not much information is available about the diet of the inland forest bat but they have a fast, manoeuvrable flight and probably hunt a range of small invertebrates. They hunt over a wide area around their roost site and are often captured while flying low over dams, tanks and waterholes to drink or catch food.

Reproduction

Male's testes become enlarged between December and April. Maternity colonies are formed in early summer; the females are pregnant by November and are lactating by December. The female gives birth to one young that she carries with her for the first week after which she leaves it in the roost while she feeds. The young are flying and independent in January. Young males may breed in April of their first year of life.

Image: Lindy Lumsden

Threats

This species is common and there appear to be no serious threats to its survival provided that its habitat is protected. Land clearing and land degradation by grazing are potential threats, however, more research is needed to better understand the requirements of this species.

Management actions

No specific management actions are undertaken for this species other than protection of remnant habitat.

Inland forest bat facts

Size (head and body length)
36 – 43 mm

Size (tail)
26 – 34 mm)

Weight
3 – 6 g

Habitat
Semi-arid and arid central Australia, low woodland, sparse mallee, shrubland and grassland.

Diet
Not well known but probably small invertebrates.

Reproduction
Males' testes are enlarged between December and April. Maternity colonies form in early summer. Females are pregnant in November, lactating in December and produce one young, independent in January. Young males may breed in April of their first year.

Southern forest bat

Vespadelus regulus

Family: Vespertilionidae

Conservation status: Not listed

Identification

A small bat, the southern forest bat has reddish-brown fur on its back and is paler on its underside. The hairs are bi-coloured, being darker at the bases of the hairs. The skin on the ears and wing membranes is grey. As is the case with inland forest bats, male southern forest bats have distinctive genitalia and these may be used to identify males of the species. The penis is pendulous and has a funnel-shaped glans with lateral folds, unlike the inland forest bat which lacks the lateral folds. Females of the two species can sometimes be identified by head measurements but often genetic testing is required.

Habitat and distribution

This species occurs in southern Australia and Tasmania, in rainforest, wet and dry forest, shrubland and low shrub woodland, mixed temperate woodland, mallee and open woodland. Colonies of up to 100 individuals roost in hollow trees but they will also roost in man-made structures and often share their roost site with other species of bats. The sexes usually roost separately except during the mating season. Large roosts tend to contain only females, whereas males tend to roost in small groups of three to six.

Diet

Flies, moths, beetles, bugs, ants and termites are the preferred prey of the southern forest bat. It is a fast flying aerial acrobat, spiralling and darting after flying insects. Moths are a particularly favoured prey item. It will fly close to vegetation and through gaps in foliage in pursuit of prey, usually in the lower half of the canopy and often as low as one metre from the ground.

Reproduction

Mating takes place in autumn, then sperm is stored over winter and fertilisation occurs in spring. Pregnancy lasts three months and one young is born in late November or early December. The young are weaned at six weeks and are independent by January. Young males show some enlargement of their testes in January and February and may breed in their first year.

Image: Lindy Lumsden

Threats

The main threat to southern forest bats is land clearing that reduces available habitat.

Management actions

The maintenance of suitable habitat in reserves, road verges and on farms is the most important management action for the continued survival of this species in the Avon region and other parts of the species' range.

Southern forest bat facts

Size (head and body length)
36 – 46 mm

Size (tail)
28 – 39 mm

Weight
4 – 7 g

Habitat
Southern Australia and Tasmania, rainforest, wet and dry forest, shrubland woodland and mallee.

Diet
Flies, moths, beetles, bugs, ants and termites.

Reproduction
Mating in autumn then sperm stored until spring, 1 young born November – December. Weaned at 6 weeks, independent in January. Males may breed in their first year.

South western free-tailed bat

Mormopterus sp.

Family: Molossidae

Conservation status: Not listed

Image: Viridans Biological Databases

Identification

The south western free-tailed bat has shaggy, dark brown fur on top which is bi-coloured (the bases of the hairs are paler than the ends). The fur on the underside is paler and the bare skin on the wings and snout is dark brown. This species has triangular-shaped ears which distinguish it from the white-striped free-tailed bat. Males have a long penis (4 – 5.5 mm) compared to the inland free-tailed bat.

Habitat and distribution

This bat is common over south-western Western Australia including most of the Avon region. It prefers dry forest, heath and mallee shrubland. Small groups of about 10 individuals may be found sheltering under bark or occasionally under roofs in urban areas. Sometimes, colonies of up to 100 animals are found. This species will share its roost with other species of bats.

Diet

Like the inland free-tailed bat, the south western free-tailed bat snaps up insects in flight. Its flight is fast and direct when it flies above the canopy, travelling at 25 to 30 kilometres per hour. In common with other free-tailed bats, this species also scurries around on tree branches and on the ground catching its prey. This behaviour helps the free-tailed bats to use a slightly different resource to other bats which occur in the same areas.

Reproduction

South-western free-tailed bats produce a single young around early December. Heavily pregnant females are often seen in November. More research is required to record the details of this species' life history.

Threats

Land clearing has resulted in a loss of habitat for this species. Wildfire and intense grazing cause the degradation of its feeding areas and the destruction of roosting sites. Widespread use of pesticides is a potential threat.

Management actions

The continued protection of conservation reserves, remnant vegetation on road verges and farms helps this species to survive. Retention of habitat trees in areas that need to be cleared is also an advantage for this species.

South western free-tailed bat facts

Size (head and body length)
50 – 65 mm

Size (tail)
30 – 40 mm

Weight
10 – 14 g

Habitat
Forest, woodland areas of south-western Australia. Forages above the forest canopy and along tree-lined creeks and waterholes.

Diet
Insects and other invertebrates, in the air, on trees and on the ground.

Reproduction
Spring – summer breeder. Single young born in December.

Inland free-tailed bat

Mormopterus sp.

Family: Molossidae

Conservation status: Not listed

Identification

The inland free-tailed bat has short charcoal grey fur on the upper surface and is paler underneath. Its ears are triangular and not joined over the forehead. Its head and body are flattened, allowing it to slide into small crevices. The bare skin is grey or pink. The upper lip overhangs the lower lip and has a stiff 'moustache' along the edge of the top lip. Males have a short penis (two to three millimetres) compared to the south-western free-tailed bat.

Habitat and distribution

This species is found in arid and semi-arid areas of southern Australia. It occurs in forest, woodland and mallee. Colonies usually have less than 10 individuals, although occasionally they can contain up to 100 bats. In areas where trees are sparse, or in agricultural areas, inland free-tailed bats move between roosts, usually spending a couple of days in each roost site.

Diet

Inland free-tailed bats forage for insects and other invertebrates in flight. They fly fast and high over the trees, over waterholes and along tree-lined tracks. They also scurry along tree branches and on the ground pursuing their prey. This species is gentle to handle but is aggressive to other bats. It has been observed fighting in mid-air, presumably over food resources. This suggests that the animals have feeding territories which they defend.

Reproduction

Inland free-tailed bats breed in spring. Heavily pregnant females have been found in late November and a single young is born, probably in December. Little other information is available about this species as it has only recently been recognised as distinct from other species that were recognised under the scientific name *Mormopterus planiceps*.

Threats

Land clearing is probably the major threat to this species.

Management actions

Ongoing management of remaining native vegetation in reserves, road verges and farms will assist this species' survival.

Inland free-tailed bat facts

Size (head and body length)
47 mm (average)

Size (tail)
26.5 mm (average)

Weight
7.9 – 14.8 g

Habitat
Forest, woodland and mallee. Forages along tree-lined waterholes and creeks and above the forest canopy.

Diet
Insects in flight, also on tree branches and on the ground.

Reproduction
Breeds in spring and young are born in December.

White-striped free-tailed bat

Tadarida australis

Family: Molossidae

Conservation status: Not listed

Identification

The white-striped free-tailed bat is the largest of Australia's free-tailed bats. It has a chocolate brown to black upper surface and is slightly paler below. As suggested by its name, it has an obvious white stripe along the side of the belly and onto the wings. Some individuals can be all black on the chest or have large, white patches. It has a large throat pouch and large, heavily wrinkled lips. The ears are separate, not joined across the top of the head as they are in some species of free-tailed bats. The call is a repetitive metallic "ting… ting… ting…" which is given as they fly high over the canopy. They also call when flying low but this call is inaudible to humans.

Habitat and distribution

The species is found across southern Australia except for Tasmania. It is an adaptable animal and occurs in forests, woodlands, grasslands, shrublands and even urban areas. It hunts either above the canopy, particularly along creek lines, or on the ground, scurrying around chasing crawling insects. Small groups of less than 20 animals roost in tree hollows. Single animals may be found roosting under bark, in buildings and in crevices in dead trees. Maternity roosts are much larger, sometimes numbering several hundred individuals. White-striped free-tailed bats migrate from southern Australia in winter, moving north and returning in spring.

Diet

High-flying moths are targeted by this species and its long narrow wings are well adapted for fast, high flight. It can travel up to 50 kilometres from its roost in search of food. Some researchers report that it will also scurry around on the ground chasing ground-dwelling insects such as beetles, bugs, grasshoppers and ants. They are able to do this by folding their wings away neatly so that their forearms are free, retracting their tail membrane and scampering around on their thumbs and hind feet. They have also been observed flying into water while in pursuit of prey.

Reproduction

Breeding begins in late August, the females are pregnant in spring and early summer and give birth to one young between mid-December and late January. It is not known if sperm is stored or embryo development is delayed over winter. White-striped free-tail bats have an asymmetrical uterus, with only one horn, so produce one young at a time. Young are weaned by May and the females are sexually mature by August, in time for the next breeding season.

Threats

Land clearing and disturbance or removal of roost sites in urban areas can cause local extinction of a population. Frequent wildfire can also degrade the habitat of bats, damaging or destroying nest hollows.

Image: Parks Victoria

Management actions

Maintenance of reserves and urban bushland is important for the persistence of this species near human activity. Identification and protection of important roost sites in an area can protect the population when land is being developed.

White-striped free-tailed bat facts

Size (head and body length)
85 – 100 mm

Size (tail)
40 – 55 mm

Weight
25 – 40 g

Habitat
Southern Australia in forests, woodlands, shrublands, grasslands and urban areas.

Diet
Flying and ground invertebrates including moths, beetles, grasshoppers and ants. Hunts high above the canopy or scampers on the ground to catch its prey.

Reproduction
Breeding starts in August, young are born December – January and weaned by May. They are able to breed in their first year of life.

Lesser stick-nest rat

Leporillus apicalis

Family: Muridae

Conservation status: Presumed Extinct

Identification

Unfortunately, lesser stick-nest rats are believed to be extinct so the only sources of information available are reports of the animal written by early settlers and observations made from museum specimens. The animals were grey-brown on the back grading to pale grey on the flanks. The underside was pale grey-white. The tail was heavily furred and had a distinctive white tuft over a third of its length.

Habitat and distribution

The lesser stick-nest rat was widespread across arid areas of Western Australia, the Northern Territory and South Australia. Until the 1930s, it occurred in most of Western Australia except for the Kimberley and the extreme south-west corner. The last specimen was collected near Mount Crombie in 1933 although desert Aboriginal people reported its presence until the 1950s. A reliable sighting of the rat was made near the Canning Stock Route in 1970, raising hope that the animal still survived. Occasionally people have found a few green pieces of plant material added to an old nest but no further sightings of the species have been made. Although the animals seem to have disappeared, it is still possible to find their old stick and stone nests in caves throughout central Australia. Fossils of the lesser stick-nest rat have been found in the Avon region, indicating that it occurred there historically.

Diet

This species was apparently an herbivore. It selected fleshy stems and leaves, particularly saltbush.

Reproduction

Little is known about the species' life history except that it lived in communal stick and stone nests. Young were presumably raised in these nests.

Threats

The lesser stick-nest rat is presumed extinct probably due to competition for food from cattle, sheep and rabbits. Introduced grazing animals altered the suite of plant species available to native species and it is possible that the rat's requirements could no longer be met. Predation by cats and foxes was probably also a factor.

Management actions

A slightly larger species, the greater stick-nest rat, survives on islands off the coast and animals have been reintroduced to fenced, mainland colonies where foxes and cats are controlled. Unfortunately, no living lesser stick-nest rats have been found so no recovery program is possible.

Illustration in John Gould's *'The Mammals of Australia'* reprinted courtesy of Museum of Victoria

Lesser stick-nest rat facts

Size (head and body length)
170 – 230 mm

Size (tail)
220 – 240 mm

Weight
Up to 150 g

Habitat
Formerly occurred in shrubby areas of rocky ranges, breakaway country, mulga flats and mallee.

Diet
The fleshy leaves and stems of plants such as saltbush, some seeds.

Reproduction
Little known. They lived communally in stick and stone nests or tree hollows.

Spinifex hopping mouse

Notomys alexis

Family: Muridae

Conservation status: Not listed

Identification

Called dargawarra in the central desert region, the spinifex hopping mouse uses its large hind legs to move in a hopping motion, with its body and tail held horizontally. Hopping mice have a bare, glandular area on the outside of the throat with a low fleshy ridge behind it. Males also have a similar structure on their chest. Fur is light brown on top with black guard hairs down its back. It is greyish-white below. The long tail is pink underneath, brownish-pink on top and has a fine white tuft on the end. Its incisors are not grooved, which helps to distinguish it from the introduced house mouse.

Habitat and distribution

This species is common throughout most of arid western and central Australia, including arid areas of the Avon region. It is found in hummock grasslands and sandy dunes with spinifex and also uses loamy mulga areas. Like many arid-zone animals, the spinifex hopping mouse can breed quickly after heavy rain resulting in a population explosion. When it is dry, it stays in sandy areas then spreads out to use other habitats after heavy rains produce good conditions for breeding. The spinifex hopping mouse has an extensive burrow system for protection from desert extremes of heat and cold. The burrow has a large chamber, lined with leaves, grasses and twigs, up to a metre below the surface. This nest chamber is linked to the surface by a number of vertical bolt holes.

Diet

Spinifex hopping mice emerge from their burrows at dusk to forage for seeds, shoots, stems and roots. They are also partial to invertebrates, which are nutritious and help to provide extra water when conditions are dry and green shoots are in short supply.

Reproduction

The spinifex hopping mouse, like many arid zone animals, is a rapid breeder, able to exploit good conditions when they occur. It most frequently breeds in spring but will breed at any time of year after rain. Females have four teats but can raise up to six young, although three or four is more common. The young are left in the nest while the parents are out foraging. The male helps to care for the young, retrieving them if they wander away from the nest. Gestation is 32 days except if the female is still feeding a previous litter, in which case development of the embryos is delayed. Young animals become sexually mature at about two months old and have a high survival rate. In good conditions, this species can become extremely common and then the animals stop breeding, perhaps as a result of social interactions in their crowded burrows. Then, as the number of predators increase and the supply of food declines, the population will crash and return to its former low numbers.

Threats

This species is common and widespread throughout its range. Foxes and cats will prey on them if they are active and not in their burrow. Habitat degradation and trampling from grazing animals can damage food plants and burrows.

Management actions

The spinifex hopping mouse is a common species and so requires no specific action other than the continued management of conservation areas and control of feral animals, particularly in the arid zone.

Spinifex hopping mouse facts

Size (head and body length)
95 – 112 mm

Size (tail)
131 – 150 mm

Weight
27 – 45 g

Habitat
Arid areas of WA and central Australia. Sandy and loamy soils in desert hummock grasslands and dunes with spinifex and mulga.

Diet
Seeds, leaves, shoots, stems, roots, invertebrates, depending on availability.

Reproduction
Will breed at anytime of year when conditions are good, after heavy rains. They have 4 teats, up to 6 young but usually 3 - 4. Young stay in the burrow. The mother feeds, and the father helps care for the young.

Long-tailed hopping mouse

Notomys longicaudatus

Family: Muridae

Conservation status: Presumed Extinct

Illustration in John Gould's *'The Mammals of Australia'* reprinted courtesy of Museum of Victoria

Identification

The long-tailed hopping mouse was the largest of the hopping mice and had a distinctively long tail. Males have been reported to have an oval-shaped gland in the throat region.

Habitat and distribution

This species is probably extinct. The long-tailed hopping mouse was found throughout central and mid-western Australia in semi-arid and arid areas. They apparently preferred firm, clay soils, *Acacia* and eucalypt woodlands, hummock grassland and low shrubland. The first specimens of this species were collected by John Gilbert near New Norcia in 1843 when he was collecting for John Gould. Another early specimen was collected near Toodyay. A number of other specimens were collected from the Northern Territory between 1894 and 1902.

Diet

Little information about this species has been recorded. However, long-tailed hopping mice probably ate plant material including grasses, seeds and leaves like most species of hopping mice. John Gilbert noted that long-tailed hopping mice, in common with Mitchell's hopping mice, liked raisins.

Reproduction

The reproductive tract of museum specimens has been studied and is similar to that of the fawn hopping mouse (*N. cervinus*) found in the Northern Territory and south eastern Queensland. It differs from the spinifex hopping mouse and Mitchell's hopping mouse, suggesting that its pattern of breeding may have been different, perhaps making it more vulnerable to the impacts of colonisation.

Threats

It is interesting that this species declined so dramatically following colonisation in comparison to Mitchell's and spinifex hopping mice. It is possible that these two species' preference for sandy soils and extensive burrow systems meant that they were better protected from feral cats than the long-tailed hopping mouse. Their breeding biology may also have been a factor.

Management actions

There is a remote possibility that a long-tailed hopping mouse might be recorded as part of ongoing fauna surveys but it is considered unlikely.

Long-tailed hopping mouse facts

Size (head and body length)
102 – 164 mm

Size (tail)
132 – 204 mm

Weight
100 g

Habitat
Formerly semi-arid and arid areas with clay soil, *Acacia* and eucalypt woodland, hummock grassland and shrubland.

Diet
Probably seeds, leaves and other plant matter.

Reproduction
Little known. The reproductive tract is similar to the fawn hopping mouse of the NT.

Mitchell's hopping mouse

Notomys mitchelli

Family: Muridae

Conservation status: Not listed

Identification

Named after Sir Thomas Mitchell who collected the first specimen, Mitchell's hopping mouse has slightly grizzled pale brown to dark grey-brown fur on its back and pale greyish-white fur underneath. Its tail is pinkish-brown with a pale brown tuft on the end and pale grey underneath. A distinctive feature is the large patch of shiny, white fur on its throat and chest. It has large, dark eyes and rounded pink or pink-brown ears and, like other hopping mice, has long hind limbs and can hop off with surprising speed when an owl or a python is in pursuit.

Habitat and distribution

Mitchell's hopping mouse is found in southern Australia from south-western Western Australia to Victoria. Formerly found as far east as the Murrumbidgee and Murray rivers, its range has been reduced by clearing for agriculture. In Western Australia, its distribution has also been affected by agriculture, including in the Avon region. It occurs in areas with sandy soils, mallee shrubland and heath. Although it digs deep burrows like the spinifex hopping mouse, occasionally it will choose to make its nest in a hollow log. Farmers sometimes disturb them when clearing scrub, suggesting that they may also use surface nests in dense vegetation. When they are not breeding, Mitchell's hopping mice share a burrow with up to three other animals. The group usually has more than one burrow, sometimes up to 150 metres apart.

Diet

This species has been recorded to favour the roots of plants, but will also eat seeds, shoots, leaves, fungi and invertebrates. It seems to need more access to free water than other species of hopping mice which probably explains its distribution in southern Australia.

Reproduction

Unlike the spinifex hopping-mouse, Mitchell's hopping mouse does not usually breed opportunistically after rain. The breeding season is July to November and very few females become pregnant outside this time of year. Pregnancy lasts 38 to 40 days and between one and five young are produced (usually three or four). The young are weaned at 35 days. Some members of the population stay in one area, however, others are mobile. In the Western Australian goldfields, individuals have been recorded moving two kilometres in a few weeks.

Threats

Land clearing has reduced the range of this species. Feral cats and foxes will prey on them if they are above ground.

Management actions

For Mitchell's hopping mouse, the maintenance of high quality conservation reserves is vital to their long-term survival. Their range overlaps with major areas of human activity in southern Australia and they do not survive well in disturbed areas.

Mitchell's hopping mouse facts

Size (head and body length)
100 – 125 mm

Size (tail)
140 – 155 mm

Weight
40 – 60 g

Habitat
Southern Australia, in sandy soils, mallee shrubland and heath.

Diet
Seed, green plants and a few insects.

Reproduction
Late winter – spring or at other times of year if conditions are suitable. 1 – 5 young, usually 3 – 4. Gestation is 38 – 40 days and young are weaned at about 35 days.

Longevity
5 years in captivity

At least 2 years in the wild

Ash-grey mouse

Pseudomys albocinereus

Family: Muridae

Conservation status: Not listed

Identification

Also called the noodji, the ash-grey mouse has long, soft mid-grey fur on its back and face with white areas on its underside and under its eyes and snout. Its tail is slightly longer than the body, is sparsely furred and pale pink except for a narrow brown line along the upper surface near the base. The soles of its hind feet are highly granulated and the pads under the toes are larger near the tips of the toes than further back. It is gentle and docile when handled, unlike the introduced house mouse which wriggles and bites. The eyes and ears of the ash-grey mouse are also larger and the fur is longer and softer, giving the animal a 'cute' appearance in comparison to the house mouse.

Habitat and distribution

The ash-grey mouse is found only in south-west of Western Australia, from Shark Bay on the west coast to Israelite Bay on the south coast, and Bernier and Dorre islands. It prefers sandplain heath, tall shrubland with tussock-grass understorey and mallee shrubland. While the ash-grey mouse may be locally abundant in undisturbed habitat it becomes rare or locally extinct in fragmented or degraded habitats. It shelters in deep burrow systems or hides in hollow logs or leaf litter. In the Avon region, it is confined to small reserves of uncleared vegetation surrounded by cleared land so populations are fragmented.

Diet

Green plant material, seeds and invertebrates are the favoured food of the ash-grey mouse. The species is remarkably agile and able to scamper up bushes and grasses in search of food. It is well adapted to dry conditions and can survive for four to seven months with little or no free water by eating vegetation with high moisture content. When plants start to dry out, the ash-grey mouse eats invertebrates to provide its water requirements.

Reproduction

In the west of its range, breeding begins in August. Between two and six young are born in spring after a 37 to 38 day gestation and usually only one litter is produced in a year. Young grow to full size over summer and autumn and are able to breed in their first year. In the eastern part of its range, it breeds more opportunistically. A study near Gingin found that three to four years after a fire, when food is plentiful, this species will also breed in autumn.

Threats

Land clearing and habitat fragmentation have reduced the range of this species. Introduced predators such as foxes and feral cats hunt ash-grey mice. Domestic cats and dogs and are also a threat in developed areas.

Management actions

Control of introduced predators, maintenance of large refuge areas in reserves, protection of remnant vegetation and rehabilitation and replanting of blocks of native vegetation on farms will help this species survive. Control of introduced predators is also important.

Ash-grey mouse facts

Size (head and body length)
63 – 95 mm (males)
63 – 85 mm (females)

Size (tail)
95 – 105 mm (males)
85 – 97 mm (females)

Weight
30 – 40 g (males)
14 – 29 g (females)

Habitat
South-west of WA, sandplain heath, shrubland, mallee heath. Shelters in deep burrows, hollow logs and leaf litter.

Diet
Green plant material, seeds and invertebrates, especially when conditions are dry.

Reproduction
In the west of their range, young are born in spring and only one litter is produced in a year. In the eastern part of their range and 3 – 4 years after fire, they breed more opportunistically.

Longevity
2 – 3 years in captivity

Bolam's mouse

Pseudomys bolami

Family: Muridae

Conservation status: Not listed

Image: Viridans Biological Databases

Identification

Bolam's mouse has large eyes and long, rounded ears and long hind feet. The fur on its back is yellowish-brown to olive-brown overlaid with fine black guard hairs. Its tail is noticeably longer than its body and covered with brown fur above and paler fur below. Bolam's mouse co-exists with the sandy inland mouse but can be identified by its darker fur, larger ears, longer hind feet and longer and more heavily furred tail. They also have significant genetic differences. Bolam's mouse has larger ears and eyes than the introduced house mouse and no notch on its upper incisors.

Habitat and distribution

This species is found in arid and semi-arid southern Australia from Woolgangie and Norseman in the west, to the Murray Mallee in South Australia and Nanya Station in south-western New South Wales. It is found on clay soils in sparse *Acacia* and mallee woodland with occasional small shrubs and in mallee shrubland with a well-developed shrub layer. It favours bluebush areas and is often found in the lower parts of the landscape.

Diet

Seeds, green shoots and some invertebrates form the Bolam's mouse diet. Individuals have been observed eating large numbers of bluebush seeds as well as spiders and beetles. This species is often found in areas of bluebush, indicating it is probably an important food source. Bolam's mouse is a mobile species so individuals can move into an area to exploit food resources when they are plentiful.

Reproduction

Independent young have been found in spring and early summer but Bolam's mouse probably breeds opportunistically in good conditions after rain. Populations can explode to more than 10 times their former size following an extended period of heavy rain. Females give birth to a maximum of six young and the young can breed after they reach a weight of nine grams.

Threats

Overgrazing by sheep and cattle and other grazing animals degrades bluebush habitat and is a threat to this species. Land clearing and feral predators also threaten this species.

Management actions

The appropriate management of conservation reserves is required to maintain populations of this species. The control of feral grazing animals helps to prevent land degradation in conservation reserves. More research is required on this species in order to best conserve it.

Bolam's mouse facts

Size (head and body length)
57 – 77 mm

Size (tail)
78 – 96 mm

Weight
10 – 21 g

Habitat
Arid and semi-arid southern Australia, loamy or clay soils in *Acacia* and mallee woodland and shrubland, most common in the lower parts of the landscape.

Diet
Seeds (particularly bluebush), green shoots and invertebrates.

Reproduction
Spring – summer or opportunistically in good conditions. Maximum of 6 young. Can breed when 9 grams in weight.

Sandy inland mouse

Pseudomys hermannsburgensis

Family: Muridae

Conservation status: Not listed

Identification

The sandy inland mouse has soft, pale ginger to greyish-brown fur on its back, overlaid with fine black guard hairs. The fur colour grades to a brighter cinnamon on the sides of the animal while the underparts, including the chin and throat, are white, giving a two-tone effect. It is a delicate, slender animal with the tail obviously longer than the body. The tail is sparsely furred, pinkish-brown on top and paler underneath.

The sandy inland mouse has similar features to several other species of native rodent which are distinguished by the size and shape of their feet and ears. It is also similar to the introduced house mouse. However, the house mouse has smaller eyes and ears, a more pointed head, a notch in the upper incisors and a musty smell.

Habitat and distribution

It is found in central and western Australia in arid and semi-arid environments. It inhabits a wide range of vegetation types and is particularly common in loamy soil with mulga scrub and sand dune country with spinifex. The sandy inland mouse digs a burrow up to 50 centimetres deep where it spends the day. It is a sociable species and up to 20 individuals share a burrow; often the burrow is also shared with the central knob-tailed gecko (*Nephurus levis*).

Diet

Seeds and invertebrates are reported to be this species' preferred food, although they have also been found to eat shoots, roots and tubers. The sandy inland mouse is nocturnal and feeds close to vegetation whereas the spinifex hopping mouse, which often occurs in the same area, feeds in open areas.

Reproduction

This species is opportunistic and breeds following rain, when there is a plentiful supply of food. As a result, populations fluctuate widely. Even in dry years some females will become pregnant in spring and summer. Females have four teats and give birth to three to four young. Newborn young are not left in a nest but are carried with the mother, attached to her teats.

Threats

This species' range has not contracted greatly since colonisation, despite competition with introduced house mice and predation by cats and foxes.

Management actions

No specific management actions are required for this species other than the ongoing maintenance of reserves and protection of its habitat.

Sandy inland mouse facts

Size (head and body length)
65 – 85 mm

Size (tail)
70 – 90 mm

Weight
9 – 14.5 g

Habitat
Western and central Australia in arid and semi-arid areas, particularly loamy soils with mulga scrub and sand dune country with spinifex.

Diet
Roots, tubers, green shoots, seeds, invertebrates.

Reproduction
Opportunistic, breeds following rain but can also breed in spring and summer in dry years.

Western chestnut mouse

Pseudomys nanus

Family: Muridae

Conservation status: Not listed

Identification

The western chestnut mouse is a large, stocky mouse with short legs and ears. Its tail is dark brown above and whitish below and noticeably less than the body length, with obvious scales. The fur on the back is pale orange-brown and overlaid with long dark guard hairs. The sides are chestnut, grading into white underparts. It has a pale eye-ring and makes a high-pitched whistling call. This species has a trusting nature and is mostly nocturnal.

Habitat and distribution

John Gilbert collected specimens of the western chestnut mouse near New Norcia and Moore River in 1843. Fossil and sub-fossil remains have been found in caves but no other live specimens have been found in the area, and it now seems to be restricted to northern Australia and Barrow Island. In northern Australia, it occurs in low eucalypt woodland with an understorey of tussock grasses in lateritic and sandy volcanic soils. It builds a grassy nest but it is not known if it digs a burrow or whether the nest is built in grasses or hollows.

Diet

Its diet seems to consist mostly of a variety of grasses although more research is needed into its preferred foods.

Reproduction

Breeding is opportunistic. It probably breeds all year round except when conditions are dry. Like many arid zone species, the western chestnut mouse can breed rapidly under good conditions. Pregnancy lasts 22 to 24 days; young are well furred at seven days, open their eyes at 12 days and are often weaned by 21 days. There are usually three young but as many as five can be born in a litter. It is well adapted to the conditions of northern Australia. Its rapid breeding cycle means it can exploit the plentiful food available following the wet season but with less chance of the nest being burned in a fire or washed away in a flood.

Threats

Feral animals are a threat to this species in the remaining parts of its range. Introduced foxes, cats and rats are potential predators and introduced grazing animals such as rabbits, buffalo, donkeys and goats can degrade the grasslands on which this species depends.

Management actions

Researchers continue to search for fossil evidence of this and other species that are rare or extinct over part of their range. Boats servicing Barrow Island are monitored to ensure feral animals do not colonise the island, threatening populations of a number of mammals including the western chestnut mouse.

Western chestnut mouse facts

Size (head and body length)
80 – 140 mm

Size (tail)
70 – 120 mm

Weight
25 – 50 g

Habitat
Grasslands with low eucalypt trees on laterite or sandy volcanic soils.

Diet
A variety of grasses.

Reproduction
Rapid breeding cycle in good conditions. Has 3 – 5 young that are furred after 7 days, eyes open after 12 days and weaned at 21 days.

Western mouse

Pseudomys occidentalis

Family: Muridae

Conservation status: Priority 4

Identification

The western mouse has been described as a 'roman-nosed' rodent which is an accurate description of this species' rounded snout. Its fur is dark grey and yellowish-buff, overlaid with black guard hairs. The underside is pale, greyish-white and the paws are white. The tail is long and distinctively marked; it is pale grey with a dark brown line down either side of the upper surface. The soles of the hindfeet are only slightly granulated and the pads under the toes are small near the tips of the toes and larger further back.

Habitat and distribution

The western mouse was historically found in a band across south-western Western Australia to the southern Nullarbor plain and the south coast near Ravensthorpe. The species is now restricted to the Ravensthorpe Range, Fitzgerald River National Park and several small reserves in the Avon region. It occurs in long-unburnt vegetation on sandy loam or sandy clay loam, often with patches of gravel. The vegetation can include a variety of species but usually includes patches of very dense shrubs and often quandong and sedges. The first specimen of this species was collected in Tambellup in 1930. The Western Australian Museum also collected this species during surveys in scattered wheatbelt reserves in the 1970s. The western mouse is a social animal and spends its days in a group, down a burrow 20 to 40 centimetres deep. The burrow has a single vertical entrance which connects to a large semi-circular loop two to three metres in diameter. A nesting chamber is situated opposite the entrance.

Diet

Seeds, plant stems, fruits, flowers and some invertebrates, including beetles and moths form the diet of the western mouse. It is an agile animal and climbs low shrubs when foraging for fibrous plant material, such as flowers of *Hibbertia* and *Acacia* and seeds of *Banksia* and *Hakea*. It chews holes in quandong nuts to eat the protein-rich and oil-rich kernels. Feeding areas appear to be used over a long period of time as shown by piles of chewed and decomposing nuts which cover the ground in areas near mature quandong trees.

Reproduction

Pregnant females are found in early to mid-spring. The young are born from mid to late spring and weaned in early summer. The young are fully grown by May or June. Juveniles can breed by July or August, when less than a year old. Population sizes can fluctuate from year to year depending on conditions.

Threats

The western mouse has particular habitat requirements so clearing of these habitats has been detrimental to this species. Changes in fire regimes may also have been a factor, as large wildfires remove the dense shrub layer over a wide area so the animals lose their feeding areas and cover from predators. Western mice are usually found in long-unburnt vegetation (30 to 50 years since fire). Remnant populations in small reserves are vulnerable to predation by introduced cats and foxes, particularly if the reserve is burnt. Degradation of vegetation by rabbits and other grazing animals is also a concern.

Management actions

Management priorities include the control of feral predators, grazing animals and weeds in conservation reserves. The prevention of wildfire is also important, particularly in dense long-unburnt vegetation and stands of quandong trees. Replanting of quandong is also carried out in some areas.

Western mouse facts

Size (head and body length)
90 – 110 mm

Size (tail)
120 – 140 mm

Weight
33 – 53 g

Habitat
Semi arid and arid WA, in sandy clay and loam with dense shrubs including quandong and sedges. Reduced population restricted to isolated wheatbelt reserves and sites on the south coast.

Diet
Seeds, plant stems, fruits, flowers and some invertebrates.

Reproduction
Breeding begins in winter, young are born from mid-late spring and weaned in early summer. Young can breed in their first year.

Heath mouse

Pseudomys shortridgei

Family: Muridae

Conservation status: Vulnerable

Identification

The heath mouse, also called the dayang, is a chunky rat-sized animal with a broad face, short snout and small, rounded ears. Its fur is greyish-brown with long dark guard hairs on the upper surface and paler fur below. The tail is shorter than the body, dark brown above and pale below. It has a hairy tail and may be distinguished from introduced rats by the lack of rings on the tail.

Habitat and distribution

Before colonisation, the heath mouse was found in mallee and coastal heathland from Jurien Bay on the west coast to Bremer Bay on the south coast of Western Australia. The first specimen was collected in 1906 from the central wheatbelt area of Western Australia. Its range has reduced dramatically and it is now found in only two, widely separated populations; one in south-western Victoria and the other in the south-western Australian heath country of the Fitzgerald River National Park, Ravensthorpe Range and Dragon Rocks and Lake Magenta nature reserves. In Victoria, the heath mouse occurs in recently burnt vegetation but the population in Western Australia prefers habitat that has not been burnt for 15 to 30 years or more, with mature stands of mallee, *Banksia* and a diverse range of mixed shrubs.

Diet

The heath mouse consumes a range of plant material depending on its availability. It prefers nutritious foods with high water content such as flowers, seeds, berries and green shoots, although it will also eat the stems and leaves of grasses and sedges when conditions are poor and high quality food is unavailable. Underground fungi are also eaten after autumn rains when seeds and flowers are not available.

Reproduction

Breeding takes place in late spring and summer when there is a plentiful supply of nutritious food. The animals form pairs which stay together for the four-month breeding season. An average of three young is produced in a litter and a female can give birth to one or two litters in a season. Young do not reach sexual maturity until nearly one year old.

Threats

Land clearing is a major threat to the heath mouse. It results in fragmented populations and reduced genetic diversity so that the population is less able to adapt to change. Change in the fire regime is also an important factor in the species' disappearance from large areas of its former range. Predation by cats and foxes is also a threat, particularly when vegetation is degraded.

Management actions

A recovery plan is being implemented for this species. More research is required to better understand how to manage the populations. Fire management is required to maintain patches of long-unburnt vegetation in Western Australian mallee heaths.

Heath mouse facts

Size (head and body length)
90 – 120 mm

Size (tail)
80 – 110 mm

Weight
55 – 90 g

Habitat
15 years unburnt vegetation in WA and recently burnt vegetation in Victoria.

Diet
Plant material.

Reproduction
Forms pairs and breeds in late spring and summer. Has 1 – 2 litters per season, each with 3 young.

Longevity
Up to 4 years in the wild

Dingo

Canis lupus dingo

Family: Canidae

Conservation status: Not listed

Identification

Dingoes typically have a ginger-coloured coat which may vary from sandy yellow to red-ginger. Occasionally they are black and tan or white. Most dingoes have white paws, a whitish tip on the tail and often a white patch on the chest. Some dingoes have a black muzzle. Their tail is bushy and their ears stand upright and point forward. Dingo–domestic dog hybrids may be distinguished from purebred dingoes as the hybrids often have a dark stripe down the middle of the back and speckling in the white areas. Dingoes can be distinguished from domestic dogs by their larger canine and carnassial teeth and the shape of their ear canal and skull (dingoes have a narrower snout).

Habitat and distribution

The dingo is a relative newcomer to Australia. It is descended from the Asian wild dog and was brought into the country by Asian and Aboriginal people 3,500 to 4,000 years ago. Dingoes have stable home ranges and form packs when conditions are good but during drought the packs break up and the animals hunt alone. It is found throughout mainland Australia but is extinct in most developed areas.

Diet

Dingoes are carnivores that hunt in packs or individually for a variety of animal prey from insects, reptiles and small mammals to magpie geese, rabbits, wallabies and kangaroos. They hunt whatever is the most common animal in the area and adjust their group size and hunting technique to suit their prey. If rabbits are the common prey species in an area, dingoes have more success hunting alone, whereas it is easier for them to hunt in a pack for large kangaroos.

Reproduction

One of the distinctive features that separates the dingo from the domestic dog is that it breeds only once a year. Females become sexually mature at two years old. Breeding starts in autumn and pregnancy lasts for 63 days. The mother gives birth to between one and 10 pups (usually about five) in a den dug into the ground. They become independent at about three to four months old unless they are in a pack, in which case they remain with the family group until the following breeding season.

Threats

Interbreeding with domestic dogs is diluting the gene pool of dingoes in all parts of their range. Dingoes are protected fauna unless they threaten agricultural values.

Management actions

Efforts are being made to maintain the genetic integrity of the dingo. Captive breeding is one option. It is difficult to prevent crossbreeding of dingoes and dogs in the wild. Potential conflicts occur where dingo populations occur near farmland. Dingoes will take livestock as well as feral and native animals. There is evidence however, that disrupting the hierarchy of dingo packs by the removal of some members can actually increase the number of females in the pack that successfully rear young. The control of dingo populations in agricultural areas is a complex issue which requires further research.

Dingo facts

Size (head and body length)
860 – 1220 mm

Size (tail)
260 – 380 mm

Weight
9.6 – 24 kg

Habitat
Most of northern and central Australia. Less common in farmland areas and densely settled areas.

Diet
Everything from insects, frogs, lizards, small mammals to kangaroos and even buffalo. Will also eat carrion.

Reproduction
Breeds once a year during winter. Gestation is 63 days. 1 to 10 pups born, usually in a den. Independent at 3 – 4 months or before next breeding season if living in a pack.

Glossary

Alluvial

Sand, silt, clay, gravel or other matter deposited by flowing water, as in a riverbed, floodplain, delta or alluvial fan. Alluvium is generally considered a young deposit in terms of geologic time.

Arboreal

Adapted for living and moving about in trees.

Arthropod

Any invertebrate of the phylum Arthropoda, having a segmented body, jointed limbs and usually a shell that undergoes moultings, including the insects, spiders and other arachnids, crustaceans, and myriapods.

Biogeochemical

The relationship between the geochemistry of a given region and its flora and fauna, including the circulation of such elements as carbon and nitrogen between the environment and the cells of living organisms.

Biogeographical

The geographical distribution of living things.

Carnivore

An animal that eats flesh.

Conical

Having the form of, resembling, or pertaining to a cone.

Declared Threatened Fauna

Fauna that is rare or is likely to become extinct.

Cylindrical

Having the form of a cylinder.

Dieback

A condition in a plant in which the branches or shoots die from the tip inward, caused by any of several bacteria, fungi or viruses or by certain environmental conditions. In Western Australia this is predominantly caused by *Phytophthora cinnamomi.*

Diurnal

Active by day.

Echolocation

The system used by bats to detect and locate objects by emitting usually high-pitched sounds that reflect off the object and return to the animal's ears.

Ecosystem

A system formed by the interaction of a community of organisms with their environment.

Eluvial

Residual deposits of soil, dust, and rock particles produced by the action of the wind.

Embryo

An organism in its early stages of development, especially before it has reached a distinctively recognisable form.

Embryonic diapause

The temporary cessation of development of an embryo.

Endemic
Native to or confined to a certain region.

Erosion
The process by which the surface of the earth is worn away by the action of water, glaciers, winds, waves, etc.

Fertilisation
Creation by the physical union of male and female gametes; of sperm and ova in an animal or pollen and ovule in a plant.

Gene
The basic physical unit of heredity.

Glans
The bulbous head or tip of the penis.

Habitat
The area or natural environment in which an organism or population normally lives.

Herbivore
An animal that feeds mainly or only on plants.

Hibernation
Cessation from or slowing of activity during the winter; especially slowing of metabolism in some animals.

Invertebrate
Any animal lacking a backbone or notochord.

Isohyets
A line drawn on a map connecting points having equal rainfall at a certain time or for a stated period.

Lactating
To secrete or produce milk.

Laterite
A red, porous, claylike soil formed by the leaching of silica-rich components and enrichment of aluminum and iron hydroxides.

Loam
Soil composed of a mixture of sand, clay, silt and organic matter.

Marsupial
Any of various mammals of the order Marsupialia, whose young are undeveloped when born and continue developing outside their mother's body attached to one of her nipples.

Mammal
Any of various warm-blooded vertebrate animals of the class Mammalia, whose young feed on milk that is produced by the mother's mammary glands.

Nectarivore
An animal which eats the sugar-rich nectar produced by flowering plants.

Nocturnal
An animal that is most active at night.

Noongar
The Indigenous Australian people who live in the south-west corner of Western Australia.

Pendulous
Hanging loosely; suspended so as to swing or sway.

Glossary

Pollinator

To convey pollen to the stigma of (a flower).

Predator

Any organism that exists by preying upon other organisms.

Quaternary

The geologic time period after the Neogene period roughly 2.588 million years ago to the present.

Rodent

Any of various mammals of the order Rodentia, characterised by large incisors adapted for gnawing or nibbling.

Sexual maturity

The age by which an animal is able to produce offspring.

Spherical

Having the form of a sphere.

Taxon

A taxonomic category or group, such as a phylum, order, family, genus or species.

Torpid

A condition of biological rest or suspended animation.

Tragus

The projection of skin-covered cartilage in front of the meatus of the external ear.

Translocation

The transfer of plants and animals from one part of their range to another.

Weathering

The various mechanical and chemical processes that cause exposed rock to decompose.

Wean

To accustom the young of a mammal to take nourishment other than by suckling.

Bibliography

Bamford, M. 1995. *Exploring Wheatbelt Woodlands,* Department of Conservation and Land Management, Como, Western Australia.

Bamford, M.J. and Bamford, A.R. 2002. *A Study of the Brush or Black-gloved Wallaby Macropus irma (Jourdan 1837) in Whiteman Park.* Western Australian Planning Commission, Perth, Australia.

Burbidge, A.A. 2004. *Threatened animals of Western Australia.* Department of Conservation and Land Management, Kensington, Western Australia.

Churchill, S. 1998. *Australian Bats.* Reed New Holland, Sydney, Australia.

Garkaklis M.J., Bradley J.S. and Wooller R.D. (2000). *Digging by vertebrates as an activity promoting the development of water repellent patches in sub-surface soil. Journal of Arid Environments*, 45: 35-42.

How, R.A., Cooper, N.K. and Bannister, J.L. 2001. *Checklist of the mammals of Western Australia* in Records of the Western Australian Museum Supplement No. 63. Western Australian Museum, Perth, Western Australia.

Hussey, B.M.J., Hobbs, R.J. and Saunders, D.A. 1989. *Guidelines for bush corridors.* Department of Conservation and Land Management, Kensington, Western Australia.

Hussey, B.M.J. 1998. *How to manage your granite outcrops.* Land for Wildlife Program. Department of Conservation and Land Management, Kensington, Western Australia.

Hussey, B.M.J. 1999. *How to manage your wandoo woodlands.* Land for Wildlife Program. Department of Conservation and Land Management, Kensington, Western Australia.

Hussey, B.M.J. and Wallace, KJ. 2003. *Managing your bushland.* Department of Conservation and Land Management, Kensington, Western Australia.

Jackson, S. 2003. *Australian Mammals. Biology and Captive Management.* CSIRO Publishing, Collingwood, Australia.

Lindenmeyer, D., Claridge, A., Hazell, D., Michael, D., Crane, M., MacGregor, C., and Cunningham, R. 2003. *Wildlife on farms – how to conserve native animals.* CSIRO Publishing, Australia.

Lullfitz, B, Konnur, A, Alderton, J, Jolliffe, D, Squire, M. (2008). *Threatened and poorly known flora of the Yilgarn Region.* Department of Environment and Conservation, Perth, Australia.

May, J. E and McKenzie, N. L (eds) (2003) *A biodiversity audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Perth, Australia.

McArthur W.M., Churchward H.M. and Hick P.T. (1977). *Landforms and soils of the Murray River catchment area Western Australia. CSIRO Australia Division of Land and Resources Management Series*, 3: 1-23.

Menkhorst, P. and Knight, F. 2001. *A Field Guide to the Mammals of Australia.* Oxford University Press, South Melbourne, Australia.

Ride, W.D.L. 1980. *A Guide to the Native Mammals of Australia.* Oxford University Press, Melbourne, Australia.

Sanders, A. 2002. *How to conduct a community fauna survey.* Land for Wildlife Program. Department of Conservation and Land Management, Kensington, Western Australia.

Smith, A. and Hume, I. 1984. *Possums and Gliders.* Surrey Beatty and Sons Pty Limited, Chipping Norton, NSW, Australia.

Strahan, R. (ed) 2000. *The Mammals of Australia (Revised Edition).* Reed New Holland, Sydney, Australia.

Bibliography

Triggs, B. 1996. *Tracks, Scats and Other Traces. A Field Guide to Australian Mammals.* Oxford University Press, South Melbourne, Australia.

Van Dyck, S. and Strahan, R. (eds) 2008. *The Mammals of Australia (Third Edition).* New Holland, Sydney, Australia.

Wallace, K.J., Beecham, B.C. and Bone, B.H. 2003. *Managing natural biodiversity in the Wheatbelt – a conceptual framework.* Department of Conservation and Land Management, Kensington, Western Australia.

Walraven, Erna. 2004. *Care of Australian wildlife – for gardeners, landholders and wildlife carers.* New Holland, Australia.

Walton, D.W. and Richardson, B. J. (eds) 1989. *Fauna of Australia. Mammalia. Vol. 1B pp. 410 – 1227.* Australian Biological Resources Study, Australian Government Publishing Service, Canberra, Australia.

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