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Manual

Fauna Sensitive Transport Infrastructure Delivery Chapter 12: Species profile – Macropods

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1 Introduction

The term 'Macropod' describes the marsupial family Macropodidae and includes kangaroos, wallabies, pademelons, tree-kangaroos and hare-wallabies. There are around 60 species of macropod within Australia, and they all have long powerful hind legs and feet. While superficially similar to macropods, potoroos and bettongs are in the potoroo family and are described in the small mammal profile (Chapter 15). Macropods are widespread across Australia, with 33 species occurring in Queensland, including the eastern grey kangaroo (*Macropus giganteus*), red kangaroo (*Macropus rufus*), swamp wallaby (*Wallabia bicolor*), brush-tailed rock-wallaby (*Petrogale penicillata*) and the red-necked pademelon (*Thylogale thetis*). Nine of the 33 species from Queensland are listed as threatened under either the *Nature Conservation Act* 1992 (NC Act), the *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC Act) or both (Table 1.1).

1.1 Commonly encountered macropod species

Note that while many rock wallaby species have restricted ranges that individually are unlikely to be encountered on a transport project, grouped together they can cover a large extent. Additionally, because rock wallaby and tree kangaroo species are generally limited to small distribution and habitat niches, impacts that do occur in these areas can have significant conservation ramifications.

Table 1.1 – Threatened macropod species in Queensland likely to be encountered on transport projects

SCIENTIFIC NAME	COMMON NAME	DISTRIBUTION	HABITAT
Dendrolagus bennettianus	Bennett's tree-kangaroo	Occurs in north-eastern Queensland. Their range is restricted to an area between the Daintree River in the south, Mount Amos in the north and Mount Windsor in the west.	Their habitat ranges from highland tropical rainforest to lowland riparian forests. The species is generally found up in the canopy, however, will often come to the ground to feed on leaves and fruit that have fallen.
Dendrolagus lumholtzi	Lumholtz's tree-kangaroo	Species is restricted to north-eastern Queensland, mostly within the Wet Tropics Region. Their range extends from the Daintree River and Mount Carbine in the north, through to the Atherton Tablelands to the Herbert River Gorge near Ingham in the south.	Occurs at high elevations, above 300 metres, in upland rainforests.
Petrogale coenensis	Cape York rock-wallaby	Restricted to the Cape York Peninsula in northern Queensland.	It occurs in a variety of rock habitats including isolated rocky outcrops, vegetated ridges, rocky gullies, dry creek beds and pockets associated with vine thickets.

SCIENTIFIC NAME	COMMON NAME	DISTRIBUTION	HABITAT
Petrogale penicillata	Brush-tailed rock-wallaby	Range extends from South East Queensland to the Grampians in western Victoria, roughly following the Great Dividing Range. The species' distribution has declined significantly in the west and south and has become more fragmented.	The species occupies rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north.
Petrogale persephone	Proserpine rock-wallaby	Restricted to towns of the Proserpine and Airlie Beach, in the Whitsunday shire or northern Queensland. Occurs in western margins of Conway Range, Dryander National Park and within the town of Airlie Beach.	Lives exclusively within rainforest sites with large boulder piles, outcrops crevices, tunnels and overhangs associated with semi-evergreen, semi-deciduous or complex microphyll or notophyll vine forest.
Petrogale purpureicollis	Purple-necked rock-wallaby	Endemic to the Northwest Highlands bioregion of Queensland. Common in the Mt Isa and Dajarra areas, in addition to the north-west of and within Cloncurry.	Species occupies boulder piles, rocky slopes, cliffs and gorges in limestone areas, sandstone and quartzite outcrops within *Eucalyptus* and *Acacia* woodlands.
Petrogale sharmani	Sharman's rock-wallaby	Known from around 10 locations around the Seaview and Coane Ranges west of Ingham.	Habitat includes boulder piles, rocky slopes, cliffs, gullies and gorges in open forest or tropical woodland, generally with a grassy understorey. Habitats are typically dominated by narrow-leaved ironbark (*Eucalyptus crebra*), white mahogany (*Eucalyptus portuensis*) and bloodwood species (*Corymbia* spp.).
Petrogale xanthopus celeris	Yellow-footed rock-wallaby	Have a discontinuous range within Australia. Locally common in the ranges of Adavale Basin, south-west Queensland.	Inhabits rocky outcrops, boulder piles, cliffs, steep rocky slopes and gorges in semi-arid woodland environments.

Some commonly encountered Queensland species that are not listed as threatened include:

- Agile wallaby (*Macropus agilis*)
- Black-striped wallaby (*Macropus dorsilas*)
- Eastern grey kangaroo (*Macropus gigenteus*)
- Euro wallaroo (*Macropus robustus*)
- Red kangaroo (*Macropus rufus*)
- Red-legged pademelon (*Thylogale stigmatica*)
- Red-necked pademelon (*Thylogale thetis*)

- Red-necked wallaby (*Macropus rufogriseus*)
- Swamp wallaby (*Wallabia bicolour*)
- Whiptail wallaby (*Macropus parryi*)

2 Ecology

2.1 Biology

There are many species of macropod in Australia, and each has a unique niche and ecosystem role. They provide essential ecosystem services including plant dispersal, soil health regulation and are a food source for predators, such as dingoes (*Canis familiaris*) (Chapter 21) and wedge-tail eagles (*Aquila audax*). Each species has a particular habitat preference and adaptation to the environment – some are tree-climbing specialists (e.g. the tree-kangaroos), others are adapted to arid rangelands (red kangaroo) and others burrow underground (e.g. the hare-wallabies).

Figure 2.1 – Macropod diversity; clockwise from top left, Lumholtz tree-kangaroo (Dendrolagus lumholtzi), Rufus bettong (Aepyprymnus rufescens), Common wallaroo (Osphranter robustus robustus), Brush-tailed rock-wallaby (Petrogale penicillate), Eastern grey kangaroo (Macropus giganteus), Red-necked pademelon (Thylogale thetis).

Source: © James Sparshott, © Matt Head

Macropod species are largely herbivorous, eating a variety of different vegetation. The larger macropod species including kangaroos, wallabies and wallaroos generally have a diet high in fibre and feed on grasses, sedges and herbs. They are adapted to a grazing lifestyle and will feed for long periods of the day. Species such as the red-necked pademelon feed more on shrubby vegetation, roots and tree bark than grass. They typically forage in the late evening and night, and do not generally stray far from thick cover.

Macropods all have a pouch, where a single young is raised and will suckle for some time before emerging and becoming independent. Gestation period and time in the pouch varies among species and all species have a strong mother-offspring bond. The breeding season also varies among species and for some species, reproduction can take place year-round, although the wet seasons are generally preferred. It is unclear how the timing of breeding influences the interaction between macropods and transport infrastructure. Macropods have a reproductive adaptation called ‘embryonic diapause’, where they can hold embryos dormant until better conditions arise. This adaptation allows adults to conserve energy until there is more food and water available for them and their offspring.

2.2 Behaviour

Some macropod species are sedentary while others are nomadic and move to follow the availability of food resources and track environmental conditions. The larger macropod species have more expansive home range sizes and are comparatively widespread. While many species live in social groups, others live mostly solitary lives, only coming together during the breeding season. The red-necked pademelon, for example, is mostly a solitary species; however, they are known to feed together in groups for safety. Kangaroos and many wallaby species live almost exclusively in mobs.

Macropods use a variety of vocalisations to communicate with each other in different situations. Species will communicate during stressful circumstance, to bond with their offspring, and between males when disputing territory. Many macropod species will thump their feet on the ground to warn others of a predator or other potential threats[1].

Large macropods, such as kangaroos, are mostly active at dawn, dusk and during the night. They will graze for extended periods of time and will find areas of shade to rest in during hot weather. Kangaroos will often not drink for long periods of time as their water requirements are sourced from the plant material they are consuming.

2.3 Habitat

Macropods occupy almost all terrestrial habitats within Queensland and Australia, including rainforest, deserts, rocky outcrops, forests, woodlands and grasslands. Kangaroos and some wallaby species live in open grasslands, woodlands, open forests and desert environments. Rock-wallabies live in rocky habitats including rocky outcrops, gorges, rock slopes and mountainous areas. Some rock-wallabies are adapted to rainforest areas and others to central desert areas. Swamp wallabies live in dense forest, woodlands and swampy habitats, however, will move through other habitats to find optimal areas.

3 Direct impacts

3.1 Wildlife-vehicle collision

The rates of wildlife-vehicle collision (WVC) of kangaroos and wallabies has been well-documented across Australia, including far western New South Wales[2], southern New South Wales[3], semi-rural areas around Sydney[4], Brisbane[5] and Melbourne[6], and across Victoria[7]. A recurring theme of these studies is that all species of macropods are subject to WVC and, in many locations, are subject to very high rates of WVC due to their widespread distribution and high mobility. For example, macropod

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[1] (Bender 2005)
[2] (Lee et al. 2004, Klocker et al. 2006)
[3] (Ramp et al. 2005)
[4] (Ramp and Ben-Ami 2006, Burgin and Brainwood 2008, Green-Barber and Old 2019)
[5] (Bond 2014)
[6] (Rendall et al. 2021)
[7] (Coulson 1997, Visintin et al. 2016)

WVC made up 94.3% of native mammal mortality along the Snowy Mountain Highway in New South Wales between 1998 and 2002[8] and 79.7% within the Redland City area in South East Queensland between July 2010 and July 2012[9].

Many studies have attempted to identify the factors contributing to rates of increased WVC, and a consistent theme is the positive relationship between habitat quality and macropod population density. In other words, there are generally higher rates of macropod WVC in areas supporting more individuals[10]. Traffic speed is also an important factor, with generally higher rates of WVC occurring as traffic speed increases[11]. There is also a correlation between the timing of traffic and rates of WVC, including peaks at dawn and dusk for both vehicles and trains[12].

Other factors have been identified in some studies but are more complicated, including patterns associated with rainfall, drought, moon phase and vegetation height[13]. The relationship with vegetation height is assumed to be related to the ability of motorists to detect and avoid fauna and for fauna to detect and avoid vehicles. Regarding drought, the mortality rate of Red Kangaroos, wallaroos, and Western and Eastern Grey Kangaroos along the Silver City Highway in far western New South Wales was approximately 10 times higher during drought than non-drought conditions[14], largely because roadside and railway verges support vegetation growth which attracted kangaroos seeking food (Section 4.1).

There is an assumption that high rates of mortality of many ‘common’ macropods is not a conservation concern. However, population viability modelling of swamp wallabies in Royal National Park near Sydney demonstrated that WVC was a threat, and that the most effective approach to reversing the decline of wallabies in the park was by reducing road mortality by 20%[15]. Therefore, small and restricted populations of macropods should be considered vulnerable to the effects of road mortality.

Despite a large amount of data on rates of WVC, there is still little known about the behaviour and response of macropods to vehicles and trains. A study of the patterns of wallaby-vehicle collisions in South East Queensland found that road-crossing behaviour varied among individuals and between species[16]. For example, the number of pauses taken by red-necked wallabies while crossing the road was 45% higher on a higher-traffic volume road and wallabies were more likely to emerge directly from surrounding habitat without first stopping to assess traffic. Interestingly, wallabies were more likely to flee from approaching trucks (86% of interactions included fleeing) compared to 39% of interactions with smaller vehicles[17].

Collision with large macropods often causes significant damage to vehicles and trains and can result in motorist injury and death. Current damage cost statistics for macropod-vehicle collisions are not available for Australia but are substantial (Chapter 4). In Victoria, passenger trains are usually

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[8] (Ramp et al. 2005)
[9] (Bond 2014)
[10] (Visintin et al. 2016, 2017, Rendall et al. 2021)
[11] (Visintin et al. 2018)
[12] (Visintin et al. 2018)
[13] (Green-Barber and Old 2019)
[14] (Lee et al. 2004)
[15] (Ramp and Ben-Ami 2006)
[16] (Bond 2014)
[17] (Bond 2014)

removed from service, inspected for damage and cleaned after kangaroo-train collisions, resulting in significant delay and maintenance costs[18].

3.2 Barrier effects

There have been few studies that have specifically focussed on quantifying the barrier effects of roads and railways on macropods. One notable exception was a study on Phillip Island, Victoria, that fitted GPS transmitters to 47 swamp wallabies and investigated road crossing frequency, road avoidance, and factors influencing rate of crossing[19]. It found that whilst swamp wallabies avoided crossing roads, males crossed roads at night more than females, who crossed more often during the day. In addition, the likelihood that wallabies crossed high-speed roads increased with vegetation density during the day, but not at night. In contrast, vegetation density had no influence on crossing locations along roads with lower speed limits during the day or night.

The research at Phillip Island is instructive for swamp wallabies but is of limited value to infer barrier effects for other species of macropod, other habitats and other road types, especially high-volume multi-lane freeways. Nevertheless, roads and railways are more likely to be barriers or filters to the movement of macropods under the following situations:

- Multi-lane highways with high traffic volume and high traffic speeds.
- Railways and roads with steep cuttings and embankments.
- For smaller-sized macropods with lower mobility and those that freeze in response to oncoming traffic.
- Roads and railways with fauna exclusion fencing, often designed to prevent collision with macropods.

3.3 Habitat loss and modification

The majority of macropod species subject to high rates of WVC are typically generalists with large and widespread populations and are unlikely to be significantly impacted at a species level by the loss of habitat associated with transport projects. Nevertheless, localised extinctions can occur as common species are fenced into or fenced out of small habitat patches, which has occurred in urban-rural fringe area. In addition, specialist macropods and those with restricted habitats and smaller home ranges, may be impacted by transport infrastructure if they pass through or in close proximity to their populations.

3.4 Noise and light pollution

The majority of research on rates of macropod-vehicle collision have been undertaken on species that persist in modified landscapes, such as on the urban-rural fringe and farmland. This degree of co-occurrence suggests that noise and light pollution has little impact on the behaviour of species such as the eastern grey kangaroo, swamp wallaby and red-necked wallaby. However, this may simply be an artefact of lack of specific research, and further studies are needed, especially for more cryptic and sensitive species.

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[18] (Visintin et al. 2018)
[19] (Fischer et al. 2021)

4 Indirect impacts

4.1 Habitat degradation due to weed invasion

The main indirect impacts of roads and railways on macropods result from the attraction to roadside and railway verges to feed on grass and other palatable vegetation that proliferates in the altered environment[20]. Regular mowing and increased water and nutrient availability from road / railway-runoff can create a rich environment that supports vegetation growth. This food source can attract kangaroos and wallabies to the roadside, potentially leading to an increased rate of WVC.

Weed invasion can also be problematic for some macropods if it changes the structure of the vegetation type. For example, dense weed growth (e.g. lantana) is likely to reduce kangaroo movement and will also reduce food availability for some species.

5 Avoidance and minimisation

Avoiding important habitat is the most effective method of reducing impacts of roads and railways on macropods. Careful planning of new projects to avoid splitting habitat for species that shelter in one habitat and feed in another will also benefit macropods, especially for species like the eastern grey kangaroo.

6 Mitigation

6.1 Crossing structures and fencing

The primary mitigation methods for macropods are crossing structures and fauna exclusion fencing. While not necessarily a conservation concern[21], the high rate of WVC with abundant large-bodied macropods is an animal welfare concern and a concern to human safety.

Fencing on new large arterial roads is a standard practise to reduce the rate of WVC and there are standard designs for effective fencing (Chapter 6). Fencing should rarely be considered a stand-alone strategy because it increases the barrier effect of the infrastructure, with long-term impacts on movement, dispersal, and geneflow.

Wildlife crossing structures are effective at facilitating the movement of kangaroos and wallabies. They include culverts, bridge underpasses and land bridges. The size of fauna underpasses is relative to the target species' body size and is provided in Chapter 6. Underpasses along the East Evelyn Road were not used by tree kangaroos[22] and further research is required to develop effective crossing structures for this group of species.

6.2 Signage

Signage is often employed to warn motorists of the potential risk of WVC and hundreds of thousands of kangaroo signs have probably been installed across Australia. Numerous studies have shown that signage has a limited effect on reducing the rate of WVC, and the high rates of macropod mortality on Australian roads further supports these studies. Enhanced signage (Figure 6.2), such as those that (i) only operate at high-risk times of the day, (ii) detect vehicle speed and alert drivers if they are speeding, and (iii) report in near-real time the number of WVC may slightly increase sign

[20] (Lee et al. 2015)
[21] (but see Ramp et al. 2006 for an exception)
[22] (Goosem 2003, Shima et al. 2018)

effectiveness[23]. Pavement stencils (Figure 6.2) may also marginally reduce rates of WVC because they are still a novel form of signage, but there has been little study of this approach. Nevertheless, even enhanced signs may become ineffective over time if motorists perceive them as advisory only, and an over-saturation of any type of sign will lose effectiveness as people become accustomed to them. In summary, signs have not proved to be an effective strategy for significantly reducing the number of macropod-vehicle collisions.

Figure 6.2 – Different types of 'enhanced' signage that may be slightly more effective than standard signs

Source: Photographs by Rodney van der Ree, WSP.

6.3 Virtual fences, reflectors, and sonic deterrents

Roadside deterrents, including reflectors, auditory devices and lights have been trialled for a range of herbivore species around the world, including kangaroos in Australia[24]. The appealing concept behind roadside deterrents is that they only operate (i.e. emit noise and/or light that disturbs fauna and encourages them to move away from the road) when vehicles approach, and therefore leave the road 'open' for safe crossings when vehicles are absent. However, studies of the effectiveness of reflectors for reducing ungulate mortality over many years in Europe have repeatedly failed to show any significant reduction in rates of mortality[25]. A recent meta-analysis of the effectiveness of mitigation measures at reducing rates of WVC calculated that reflectors resulted in a 1% reduction[26]. Studies of roadside deterrents in Australia have similarly shown little success, and those that do show effectiveness have been criticised for poor study designs[27].

Vehicle-mounted sonic deterrents have been shown to be similarly ineffective[28], although some motorists and wildlife advocates are adamant they work. Sonic-deterrents mounted on trains have shown some success at reducing rates of collision with ungulates, however further research is needed.

Transport and Main Roads do not currently support the use of acoustic or visual deterrents to reduce macropod-vehicle collisions (Chapter 6).

[23] (Huijser et al. 2015)
[24] (D'Angelo and van der Ree 2015)
[25] (see references in D'Angelo and van der Ree 2015)
[26] (Rytwinski et al. 2016)
[27] (Bender 2003, Muirhead et al. 2006, Fox et al. 2018, Coulson and Bender 2019, Englefield et al. 2019, Stannard et al. 2021, Coulson and Bender 2022)
[28] (D'Angelo and van der Ree 2015)

7 Construction

Standard measures to minimise impacts of construction on fauna should also be applied to macropods. One particular consideration for transport projects on the urban-rural fringe is the trapping and isolation of mobs of eastern grey kangaroos or other macropods between the project and adjacent developments. In such cases, kangaroos can be land-locked and trapped within construction fencing and other barriers, such as other fencing and industrial or residential land-uses. If kangaroos are at risk of being trapped in small areas, they should be allowed to disperse naturally (if safe to do so) or removed prior to the installation of fencing, especially for projects lasting many months.

8 Maintenance and operation

The maintenance of vegetation on roadsides and railway verges should consider the impacts on macropods, especially kangaroos and wallabies that frequently feed on such vegetation. Regular slashing in areas with kangaroos will likely reduce the attractiveness of such areas as food sources, as well as increase visibility, potentially reducing rates of WVC (Chapter 6). Regular weed maintenance may also be required in areas of dense weed growth (i.e. lantana) to prevent further barrier effects.

However, frequent slashing and mowing may impact other species, including small mammals (Chapter 15) and invertebrates (Chapter 20), that may be living along roads and railways. Alternative approaches should be trialled, such as revegetating with less palatable vegetation like shrubs.

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