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Manual

Fauna Sensitive Transport Infrastructure Delivery Chapter 16: Species profile – Semi aquatic mammals

June 2024

Queensland Government

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1 Introduction

The platypus (*Ornithorhynchus anatinus*) and rakali (*Hydromys chrysogaster*) (formerly known as the water-rat) are Australia's only two true semi-aquatic mammals. Along with the short-beaked echidna (*Tachyglossus aculeatus*), the platypus is an egg laying mammal within the order called monotremes. The rakali is a large rodent and is a placental mammal that completes embryonic development inside the womb.

The platypus has a streamlined body with a large duck-like bill and broad flat tail. Its limbs are short and body covered in dense dark-brown to reddish-brown fur with a lighter undercoat (Figure 1(a)).

Rakali have large, streamlined bodies with a flattened head, long blunt nose, small eyes, and notably small ears that are positioned closer to the top of the skull when compared to terrestrial rodents (Figure 1(b)). Their colour is variable, with black, grey-brown fur on the upper portions of their body and white to orange fur on the lower portions, and a notable long tail with a characteristic white tip. They grow up to 35 centimetres in length and weigh between 1–1.5 kilograms when fully grown, similar to a ringtail possum (*Pseudocheirus peregrinus*).

Platypus and rakali are both cryptic and can be difficult to detect due to their shy behaviour and ability to stay under water for extended periods of time[1]. Both species are well adapted to semi-aquatic life with webbed feet and dense waterproof coats[2].

There are many other examples of semi-aquatic species that are reliant on waterways to varying degrees and are described in other chapters. These species include turtles (Chapter 17), water birds (Chapter 9), crayfish (Chapter 20) and bats such as the large-footed myotis (*Myotis macropus*) (Chapter 11). These species are also reliant on healthy, functioning aquatic ecosystems and many of the impacts and avoidance and mitigation measures that benefit rakali and platypus are also beneficial to these species.

Figure 1(a) – Platypus

Source: © Tim Dalton

[1] (Speldewinde et al. 2013, Hawke et al. 2019b)
[2] (Speldewinde et al. 2013)

Figure 1(b) – Rakali

Source: © Jannico Kelk, WSP

1.1 Conservation status and distribution of Platypus and Rakali

The platypus is listed as special least concern under the *Nature Conservation Act* 1992 (NC Act). In 2021 and 2022, the platypus was nominated by the public for listing under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). Despite apparent declines throughout parts of Australia[3], the species was not recommended for further assessment and was not listed under the EPBC Act because it was uncertain whether the degree of decline was enough to meet the thresholds required for it to be listed as a threatened species. While not listed under the NC Act or the EPBC Act, rakali are also declining throughout their range[4].

The platypus and rakali are distributed widely throughout Queensland and are concentrated on the east coast where permanent water is prevalent (Table 1.1).

Table 1.1 – Distribution of the platypus and rakali

SCIENTIFIC NAME	COMMON NAME	DISTRUBITION	HABITAT
Ornithorhynchus anatinus	Platypus	Eastern Australia, from near Cooktown in Queensland to the Victorian-South Australian border and Tasmania.	Occur in freshwater habitats from sea-level to >1600 m along the Great Dividing Range. Includes rivers, dams, lakes, and estuarine habitats with healthy vegetation cover, low pollution levels, and reliable water levels.

[3] (Bino et al. 2019, Hawke et al. 2019a)
[4] (Speldewinde et al. 2013)

SCIENTIFIC NAME	COMMON NAME	DISTRUBITION	HABITAT
Hydromys chrysogaster	Rakali	Widely distributed across eastern, northern, and south-western Australia and many offshore islands. Occur in and around water bodies across much of Queensland, excluding some dry western desert areas.	Occupy a diverse range of mostly freshwater systems, including natural rivers, lakes, and human-made dams and irrigation canals. Also occur in brackish/estuarine environments and sheltered ocean beaches.

2 Ecology

2.1 Biology

2.1.1 Platypus

Aquatic habitats are critical to the survival of the platypus. Platypuses feed only in water, where they hunt small aquatic macroinvertebrates along shallow riffles, under banks, and from submerged logs and branches whilst diving repeatedly to the bottom of water bodies. Platypuses are primarily crepuscular and nocturnal and can dive up to 1600 times per foraging session. Their diet is largely restricted to aquatic macroinvertebrates; however, small frogs and fish eggs are occasionally consumed[5].

The home range length of male platypus in Victorian waterways is typically 6–11 kilometres[6]. Female home ranges are smaller, generally 2–4 kilometres in length. Male home ranges often overlap multiple female ranges. And most adults occupy stable home ranges for periods that last several years[7].

Platypuses use burrows in the banks of waterways for shelter and raising young (Section 2.2). Burrows are generally between one and two metres long and entrances can be located underwater, beneath an undercut bank, or under overhanging vegetation (Figure 2.2.1)). Camping burrows are used by animals outside the breeding season and nesting burrows are occupied by animals that are caring for eggs or young. Platypus normally occupy two or more camping burrows, and – in some cases – they are used by other unrelated platypuses[8].

2.1.2 Rakali

While largely dependent on water, the semi-aquatic rakali can range far from water in search of prey. Their diet primarily consists of crustaceans, molluscs, fish, carrion, waterbirds, eggs, frogs, and small reptiles. Rakali can forage at all times of day, with a preference for nocturnal behaviour, and are often found swimming along banks or between semi-submerged logs[9].

In riverine habitats, rakali remain close to the water's edge and tend to utilise riparian vegetation when out of the waterway. Home ranges have been reported as 1–2 kilometres of waterway length and 7–

[5] (Bino 2019)
[6] (Bino 2019)
[7] (Bino 2019)
[8] (Bino 2019)
[9] (Speldewinde et al. 2013)

30 hectares in size[10]. Little is known about social aspects of the species, however home ranges of adults of the same sex appear to overlap less than those of the opposite sex and age classes[11]. In captivity, individuals form strict hierarchies where only dominant females successfully reproduce[12]. Individuals in high density populations appear to display high levels of aggression, demonstrated by a high frequency of bite marks on tails and hindfeet[13].

Rakali generally build burrows or utilise hollow logs located near water for resting and reproduction. Additionally, the species exploits artificial shelter such as pipes, drains, rock banks, and car tyres (Figure 2.2.2)[14].

2.2 Behaviour

Both species utilise similar aquatic and riparian habitat for reproduction, including permanent bodies of fresh water, such as rivers, streams, creeks, lakes, and dams[15]. Additionally, rakali utilise brackish and saline water environments such as estuaries, breakwaters, and coastal islands, specifically Stradbroke, Moreton, and Macleay Island in South East Queensland[16].

2.2.1 Platypus

Platypuses have been recorded breeding in Queensland in winter and spring. They do not form lasting pairs, and males may court multiple females. Females rear young without male assistance[17].

Females gather materials for nesting burrows approximately 1–2 weeks after mating. A clutch of 1 – 3 eggs are laid approximately 2–3 weeks after mating and are incubated for 10 – 11 days in a nesting burrow. The young are largely undeveloped upon hatching and rely fully on the female for survival, including supply of milk[18]. Young platypuses generally leave the burrow in summer when they are at approximately 80% of their adult size.

Sexual maturity is reached in two years; however, females may not raise young until four years or older. Reproductive success can be constrained by low water flow, resulting in less food resources, and major floods that may drown dependant young in nesting burrows[19]. Construction activities, including dewatering and submerging areas, can similarly affect platypuses and should be considered when planning and scheduling construction (Section 7).

[10] (Speldewinde et al. 2013)
[11] (Gardner and Serena 1995)
[12] (Gardner and Serena 1995)
[13] (Speldewinde et al. 2013, Williams and Serena 2018)
[14] (Speldewinde et al. 2013)
[15] (Hawke et al. 2019b)
[16] (Speldewinde et al. 2013, Atlas of Living Australia 2022)
[17] (Bino 2019)
[18] (Bino 2019)
[19] (Bino 2019)

Figure 2.2.1 – Hidden Platypus burrow

Source: © Australian Platypus Conservancy.

2.2.2 Rakali

Breeding mainly occurs in spring and summer and females give birth to up to three litters per year. Litter size generally ranges from three to five young, however, successful reproduction is dependant on available resources and environmental conditions. Litters are raised in burrows, hollow logs, or suitable artificial shelter such as pipes or rock piles (Figure 2.2.2). Collectively, gestation and juvenile dependency last approximately nine weeks. As soon as juveniles are dependant, they disperse from the females' home range. Adults older than four years are generally not reproductive and are unlikely to live much longer[20].

Figure 2.2.2 – Rockwall at St Kilda, Victoria that rakali use as a den

Source: © Earthcare St Kilda

[20] (Williams 2019)

2.3 Habitat

2.3.1 Platypus

Platypuses rely heavily on healthy freshwater systems. There is a strong relationship between the amount of cover provided by vegetation on the banks and the quality of platypus foraging and burrow habitats which are critical for breeding. Healthy, dense riparian vegetation stabilise banks and prevent erosion, provide shade, and keep water temperatures lower. Lower temperatures improve the availability of dissolved oxygen for aquatic macroinvertebrates which are an important food source. Dense riparian vegetation in urban and other disturbed habitats greatly reduces the impacts of artificial light, litter, and pollutants, restricts access by unsupervised pets, and reduces trampling by humans and livestock[21].

2.3.2 Rakali

Rakali prefer low-lying (less than one metre in height) dense riparian vegetation with minimal overstorey canopy cover. This habitat provides shade, shelter, protection from predators, and food resources. Permanent water bodies are a critical component of suitable habitat for rakali. The loss and disturbance of wetlands and swamps for development and groundwater extraction for urbanisation and agriculture are major threats to rakali populations due to the reduction and pollution of permanent water bodies. The loss or modification of riparian vegetation is also a major threat to Rakali[22].

3 Direct impacts

Research investigating the impacts of transportation infrastructure on platypus and rakali is limited, partly due to their limited aquatic habitat, cryptic nature and not being listed as threatened.

3.1 Wildlife-vehicle collision

Whilst platypus and rakali primarily exploit aquatic habitats, both species will leave waterways and attempt to cross transport infrastructure if required. Subsequently, mortalities of both species due to wildlife-vehicle collisions (WVC) have been recorded throughout Australia. Rates of platypus road mortalities are highly variable in different regions and are almost certainly underreported. For instance, between 1980–2009 only five platypuses were recorded to suffer road mortality in Victoria[23] while seven individuals died during a 12-month study in Tasmania[24].

There is a paucity of rakali road mortality records. Out of 40 community-based mortality records of rakali in Victoria between 2000–2017, only five were attributed to WVC[25].

3.2 Barrier effects

While there are no direct studies of the barrier effects of transport infrastructure on rakali or platypus, it is expected to be minimal where the waterway continues uninterrupted underneath a bridge. Barrier effects are more likely where the waterway passes through a culvert with high water velocity and/or where the culvert does not maintain a base flow. In these situations, both species may leave the waterway and attempt to cross the infrastructure at grade, exposing them to predators and vehicle

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[21] (Bino 2019)
[22] (Williams 2019, Leigh and Breed 2020)
[23] (Serena and Williams 2010)
[24] (Connolly et al. 1998)
[25] (Williams and Serena 2018)

collision, and leading to mortalities[26]. Wide roads and roads with high traffic volume are likely barriers to their movement where they undertake this behaviour. While platypus and rakali can climb natural steep banks, they are unable to climb vertical or near vertical concrete or metal structures[27].

3.3 Habitat loss and modification

A major cause of platypus and rakali decline is the loss and modification of habitat due to urbanisation, intensive agriculture, and other development[28]. Due to their dependence on riparian and aquatic habitats, impacts to platypuses and rakali can be significant if transportation infrastructure near waterways do not avoid clearing areas of critical habitat.

3.4 Noise, vibration and light pollution

The development of transport infrastructure leads to increased human activity and often results in adverse impacts on local platypus and rakali populations. Noise can cause foraging platypus to move to quieter areas, essentially decreasing the amount of suitable foraging habitat available to them[29]. Interestingly, platypus were observed to forage and be active within 50 m of the driving of two piles on each bank over two days of bridge repair works in Eungella National Park near Mackay, Queensland[30]. It is unknown if this apparent lack of disturbance was because the pile driving was conducted in short bursts (5–10 minutes each time) with quiet intervals in between, and over a short duration (two days), and/or if it was because the population of platypus were used to human disturbance.

Additionally, artificial light at night (ALAN) near aquatic habitats increases the likelihood of predation by foxes and feral cats and reduces the abundance of platypus food by diverting insect activity and movement away from water[31](Chapter 20).

3.5 Erosion and sedimentation

The rates of erosion and sedimentation are exacerbated along waterways that flow through poorly designed culverts and bridges because they can accelerate waterflow, scouring, and the transportation of sediment, resulting in increased turbidity[32].Consequently, it is a requirement that the flow rate through culverts and bridges is similar to those occurring upstream and downstream of the structure. Erosion and sedimentation is a significant risk during construction, especially during bulk earthworks. Increased sedimentation smothers stream beds and decreases the abundance of aquatic macroinvertebrates, reducing the amount of suitable foraging habitat for both rakali and platypuses.

3.6 Environmental pollution

Waterway pollution caused by road run-off or rubbish generated by traffic can lead to a decline in preferred prey species for both the platypus and rakali[33]. While rakali are often observed in built up or degraded habitats, the platypus is more sensitive and less able to persist in such areas. In addition,

[26] (Serena and Williams 2010)
[27] (Serena and Williams 2010)
[28] (Grant and Temple-Smith 2003, Speldewinde et al. 2011)
[29] (Australian Platypus Conservancy 2021b)
[30] (Aurecon Australasia Pty Ltd 2018)
[31] (Australian Platypus Conservancy 2021b)
[32] (Forman and Alexander 1998)
[33] (Speldewinde et al. 2013, Bino 2019)

they can get stuck within in-stream structures (e.g. pipes), which can lead to drowning[34], and they can be severely affected by urban pollution. For example, plastic or rubber loops such as engine gaskets, cable ties, and hair-bands have been recovered from the neck or torso of 40% of platypuses captured in a study conducted near Melbourne[35]. Platypuses are unable to remove these foreign objects and they ultimately cause deep lesions with a high likelihood of mortality[36].

4 Indirect impacts

4.1 Habitat degradation due to weed invasion

The construction and operation of transport infrastructure can facilitate the dispersal of weeds through earthworks, the transportation of soil, improper weed hygiene, and accidental transfer of weeds by motorists[37].

Radio tracking of platypuses in Victoria showed that they foraged significantly longer in the presence of large native trees and foraged less in areas dominated by invasive flora[38].

Habitat loss and disturbance to riparian vegetation can increase the amount of sunlight reaching the waterway. Increased water temperatures can dramatically reduce the abundance and diversity of aquatic macroinvertebrates that platypus primarily feed on[39].

5 Avoidance and minimisation

Transport infrastructure that avoids and minimises the amount of riparian habitat impacted by construction and permanent structures will have positive outcomes for platypus and rakali.

Avoidance and minimisation measures include:

- Decreasing the amount of riparian vegetation and land impacted.
- Decreasing the width of the transport infrastructure, including the construction footprint in riparian areas.
- Avoiding construction during the breeding season and when dependent juveniles are in the dens. Note that the breeding season can vary regionally.
- Undertaking targeted surveys to locate platypus and rakali, and their burrows, and using that to inform the design.

6 Mitigation

6.1 Wildlife crossing structures

To date, there are no underpasses specifically designed to facilitate the movement of platypus or rakali. However, both bridge underpasses and large pipes and culverts with uninterrupted flow of water are used by both species. Given that both species normally build and sleep in burrows, it is intuitive that they will traverse culverts of considerable length, although minimum sizes and maximum

[34] (Bino 2019)
[35] (Serena and Williams 2010)
[36] (Bino 2019)
[37] (Pickering and Mount 2010)
[38] (Serena et al. 2001)
[39] (Grant and Temple-Smith 2003)

lengths are not known. Tagged platypuses have been found to routinely travel through a 45 metre long and 1.3 metre diameter concrete culvert with a water depth of approximately 250 millimetres[40]. However, perched culverts with entrances above the stream bed may prevent or discourage platypuses from utilising them, effectively forcing them to cross roads and increasing their likelihood of road mortality[41].

Figure 6.1 – Rakali using the log ledge in an inundated box culvert

Source: © WSP

Platypus and rakali are at risk of drowning in long culverts that are filled to capacity, as evidenced by platypus mortality in a long-piped section of the Upper Canal in the Nepean section of Sydney's water supply[42]. Rakali have been observed using ledges above water level in permanently inundated box culverts along Healesville-Koo Wee Rup Road near Melbourne, Victoria (Figure 6.1).

Platypus – and potentially rakali – can also be deterred from utilising underpasses or culverts by high velocity water. The Australian Platypus Conservancy recommends that designs aim for a maximum water velocity of 0.3 metres per second[43]. Further Australian Platypus Conservancy recommendations include:

- Pipes should be at least 250 millimetres in diameter to allow both species to turn around.
- The aperture of grids across pipes and culverts should be at least 120 millimetres to allow both species to pass through. The aperture of grids designed to exclude rakali or platypus should be less than 30 millimetres.
- Box culverts and underpasses should have a natural base or be soil-lined and not have perched entrances or exits.

In general if a culvert is designed to meet fish passage requirements (Chapter 19) it will have suitable flow rates and bed levels for movement of platypus and rakali.

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[40] (Australian Platypus Conservancy 2021a)
[41] (Grant and Temple-Smith 2003)
[42] (Australian Platypus Conservancy 2021a)
[43] (Australian Platypus Conservancy 2021a)

6.2 Fencing

There are no specific designs for platypus and rakali exclusion fences that have been developed and tested. However, exclusion fencing for amphibians (Chapter 6 and Chapter 18) are probably suitable. A key consideration will be that they are fitted with an overhanging lip to prevent rakali from climbing over, the base is buried into the ground to prevent burrowing underneath and they are built of a material that rakali are unable to chew through.

6.3 Other mitigation measures

Noise and light walls constructed along roads and at underpasses may assist in minimising the impacts of ALAN and traffic noise on rakali and platypus. Standard noise and light walls should be effective for platypus and rakali.

Efforts to recreate wetland habitat and restore healthy waterways will assist in supporting rakali and platypus populations and should be a high priority for all transport infrastructure projects that potentially impact these species.

Water quality is a significant factor in the degradation of aquatic habitats. Measures to improve water quality, such as vegetated swales and sedimentation wetlands, should be used to minimise impacts of pollution, sedimentation and turbidity where stormwater flows directly into potential or known habitat. While gross pollutant traps are required to ensure habitat quality, consider the entrapment risk when choosing the placement and type of gross pollutant trap.

7 Construction

A primary consideration of transport construction projects is the potential impacts to waterways. This can include dewatering activities and any earthworks that destroy burrows on banks and increased sedimentation. Targeted surveys should be conducted prior to undertaking works that may impact either platypus or rakali to ensure the area does not support burrows. If burrows are present, then ensure they are not being used at the time of the works.

Temporary and permanent access tracks should be placed as far from the water's edge as possible, minimising clearing of riparian vegetation and reducing the risk of erosion and sedimentation of waterways. Furthermore, construction activities (i.e. dewatering and submerging areas) and poorly designed and/or maintained erosion and sediment control devices that are used during construction can affect water quality and alter water flow. This can impact the reproductive success of some species, like the platypus. The International Erosion Control Association best practice guidelines for erosion and sediment controls should be used when preparing Erosion and Sediment Control Plans for construction activities.

Where gabion baskets have been included as scour protection around in-stream structures, care needs to be taken that that the baskets have been properly constructed and placed. Voids in gabion baskets created when the rock fill moves can be an entrapment risk for platypuses.

8 Maintenance and operation

It's important to undertake regular and ongoing vegetation maintenance and weed eradication throughout the operational phase of transport infrastructure. Doing so ensures habitat quality is maintained which is an important requirement, especially for the platypus which is particularly sensitive to disturbance and degraded habitat conditions.

Similarly, routine culvert and sediment basin cleanout schedules would be beneficial to remove rubbish and dangerous foreign objects that can pollute and severely injure platypus and rakali.

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