Australian Platypus Conservancy

USE OF MAN-MADE WATER BODIES BY RAKALI

GUIDELINES FOR DESIGNING LAKES, PONDS AND PERMANENT WETLANDS

Introduction

The rakali or Australian water-rat (*Hydromys chrysogaster*) is the largest of the old endemic Australian rodents, and is very well adapted to make use of aquatic habitats as a top-level carnivore. It has partly webbed hind feet, water-repellent fur, a stream-lined body and a thick, furry tail used as a rudder while swimming (Watts and Aslin 1981). It is also a habitat generalist that is found in both running and static water bodies and will feed in a wide range of man-made reservoirs, flood retarding basins, siltation ponds, farm dams and recreational and/or ornamental lakes and wetlands (Williams and Serena 2018).

Such water bodies can make a significant difference to the long-term viability of a regional rakali population by providing additional foraging habitat. In turn, this allows more animals to survive and potentially reproduce, contributing to population resilience and productivity.

Because rakali are highly mobile animals, new rakali-friendly water bodies are likely to be occupied within a short time of being established. For instance, an off-stream lake system built in 1999 for flood retention and amenity purposes near Hull Road, Lilydale in Victoria (as shown at right) was utilised by water-rats within one year of completion (and visited within two years by platypus originating in the nearby creek).

Any lake, pond, retarding basin or reliably filled wetland area developed as part of a new residential or industrial estate (or a recreational facility such as a golf course or suburban park) potentially provides an excellent opportunity to create additional habitat for the local rakali population.

Even if this species isn't currently known to exist nearby, incorporating rakali-friendly features may attract longer-term use by the species.

Relatively few studies have focused to date on rakali behaviour in the wild. The design guidelines outlined in the following pages have therefore mainly been extrapolated from what is known about rakali ecology.

Specific design requirements are of course expected to vary from project to project. If necessary, please contact the Australian Platypus Conservancy for more detailed technical advice.

1. Prioritising lakes and ponds for rakali use

It is reasonable to assume that not all of the lakes and ponds within any given development will be equally suitable for usage by rakali. Based on what is known about this species, the following generalisations apply:

Reliable surface water is an essential habitat feature – rakali will forage to some extent on land, but normally find most of their food in aquatic environments. For example, an Adelaide study found that rakali numbers dropped by two-thirds when a large on-stream weir was drained for a period of about 2 months (leaving only a small channel 1-2 m wide and ~0.5 m deep filled with water); numbers remained low for at least 8 months after the weir was allowed to refill (Leigh and Breed 2020). Similarly, rakali continued to be seen at Lake Wendouree in Ballarat as the water level dropped progressively from 2004 to 2006 during the Millennium Drought, but disappeared once the lake dried out entirely in early 2007. Although the lake refilled in 2010, rakali weren't spotted again until late 2013 (Williams and Serena 2018).

All else being equal, large water bodies are expected to support more rakali as compared to smaller water bodies. In practice, Lake Wendouree in Ballarat (with a surface area of ~2 km^2) supports one of the largest known populations in Victoria. However, sizeable populations are also associated with much smaller man-made water bodies, such as Lake Weeroona in Bendigo (~0.5 km^2), or systems that consist of a chain of ponds, such as that found at Point Cook in Melbourne's south-west.

Rakali can move long distances across land if necessary – a movement of more than 3 km from a creek to a reservoir has been recorded, probably via a gravel forestry track (Vernes 1998). However, all else being equal, man-made water bodies located near to a natural water course are likely to be used to a greater extent as compared to more isolated water bodies.

Recommendations

- **Large permanent lakes (or chains of permanent ponds with a large combined surface area) have the most potential to support a self-sustaining rakali population, and therefore are the highest priority systems to be developed and managed as rakali habitats.**

- **Small permanent lakes and ponds located close to a natural waterway (within ~50-100 metres) are likely to be used routinely by rakali if their habitat is otherwise suitable, and thereby qualify as the next highest priority systems to be developed and managed for this species.**

- **Small permanent lakes and ponds located more than ~100 metres from a natural waterway are most likely to be used routinely by rakali if they are connected to a natural water course by a protected route or corridor that facilitates access by this species (see Section 6). If such a route or corridor is already available (or can be developed), they qualify as the next highest priority systems to be developed and managed for this species.**

- **Lakes or ponds that regularly dry up may be used by rakali on a seasonal basis when holding water, but are properly regarded as being the lowest priority systems to be developed and managed for this species.**

2. Lake depth and bottom profile

Rakali are believed to prefer feeding in relatively slow-moving water that is less than about 2 metres deep (Harris 1978; Speldewinde *et al*. 2013). Although Smart *et al*. (2011) reported that a minimum recorded water depth of 0.94 metres was associated with rakali populations occupying urban wetlands in and near Perth, it is likely that this value was mainly an indicator of the size and permanency of a wetland rather than marking the minimum acceptable depth for foraging. We have often observed this species feeding around woody debris or the trunks of drowned trees found very near the banks of man-made lagoons, or at the edge of reed beds where the water was so shallow that the animal could easily stand on the bottom (as shown at right).

Rakali have a highly generalised diet that includes not only fish but also aquatic insects and spiders, yabbies, freshwater shrimps, mussels and (to a lesser extent) waterbirds, frog and turtles; nutritious aquatic plants may also sometimes be eaten. At Barrenbox Swamp near Griffiths, New South Wales, the most commonly consumed fish species was goldfish *Carassius auratus*, followed by redfin perch *Perca fluviatilis* and mosquito fish *Gambusia affinis* (Woolard *et al*. 1978). These findings suggest that rakali are likely to do best in structurally diverse habitats supporting a wide range of potential prey species.

Recommendations

- **To provide rakali with ideal foraging conditions, water in man-made water bodies should be in the order of 0.2 to 2.0 metres deep, with enough reasonably deep water to support fish.**

- **Newly constructed lakes or ponds should be designed with a varying depth profile to help create a diverse range of aquatic habitats.**

3. Vegetation cover

Along with many other freshwater species, rakali are expected to benefit from the presence of indigenous terrestrial plants growing around a man-made water body. In particular, a positive relationship has been identified between the occurrence of rakali and dense low-growing vegetation (providing ≥ 50% cover); extensive taller canopy cover is apparently less important (Smart *et al*. 2011; Speldewinde *et al.* 2013). Appropriate ground cover plants have been found to include tussock-forming grasses and sedges such as *Lepidosperma*, *Juncus* and *Gahnia* species (Speldewinde *et al*. 2013). It has been postulated that the presence of abundant low-growing plants both reduces predation risk for rakali and provides habitat for prey such as insects and frogs (Speldewinde *et al.* 2013).

As noted in Section 2, rakali will often search for food in and around stands of aquatic reeds (both authors, pers. obs.). Clumps of reeds located in the water may also be utilised as feeding platforms (Section 4) and, reportedly, as nesting sites (Speldewinde *et al*. 2013).

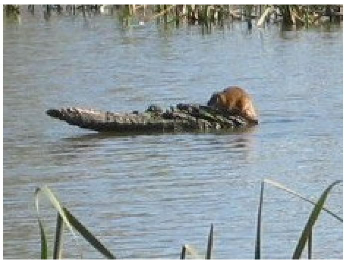
Recommendations

- **To provide rakali with foraging opportunities and adequate cover from potential predators (plausibly including birds of prey and feral and domesticated cats as well as foxes and domesticated dogs), emergent aquatic vegetation should be encouraged to grow in the littoral zone at the edge of a man-made pond or lake.**

- **For the same reasons as above, an unmown band of indigenous perennial vegetation (providing at least 50% ground cover) should be encouraged to grow on land around much (ideally all) of the perimeter of a man-made pond or lake. The vegetated zone should be at least 10 metres wide (though ideally more) to deter predators and provide habitat for rakali prey species.**

4. Woody aquatic habitat and feeding platforms

It is well established that partly or fully submerged logs and branches provide important feeding and breeding sites for aquatic invertebrates (e.g. Anderson and Sedell 1979; O'Connor 1991) which in turn constitute an important food resource for rakali. This species has been recorded foraging preferentially at items of wood in the water such as old fenceposts, logs and fallen trees as well as at reed clumps (Woollard *et al.* 1978).



Rakali normally carry prey items to an elevated feeding platform where they can sit comfortably out of the water while dining, as shown at right. Platforms commonly consist of logs, stumps, sizeable fallen branches or large flat rocks and are invariably located in or immediately next to the water.

Recommendations

- **To boost rakali food resources and provide suitable resting sites for rakali, a variety of logs, stumps, branches and boulders should be included in the design of a new man-made water body. Consideration could also be given to including heaped piles of rocks, logs or branches in the design to further contribute to habitat diversity.**

5. Banks and burrows

The presence of relatively steep (in the order of 60°) and well-consolidated banks has been found to be positively associated with the occurrence of rakali (Smart *et al*. 2011), presumably because these bank attributes mean that suitable burrow habitat is available. Similarly, Serena *et al*. (1998) reported that platypus preferentially place their burrows at sites where the banks rise relatively steeply for a distance of around 1 metre or more above the water and are well-consolidated by tree roots and lower growing vegetation.

Gardner and Serena (1995) found that rakali occupied burrows resembling those excavated respectively by swamp rats *Rattus lutreolus* and by platypus *Ornithorhynchus anatinus*, implying that they will inhabit den sites created by other species. In addition, two juvenile rakali (presumed sisters) sheltered diurnally in a hollow log (bole diameter = 1 metre; located 7 metres from the water's edge).

Rakali will also apparently use (or possibly further excavate) the crevices found between large tumbled rocks as shelter sites, for example where these have been employed around the Gippsland Lakes to stabilise the lake banks (Williams and Serena 2014).

Recommendations

- **The perimeter of a man-made water body should ideally feature at least one section of reasonably steep and consolidated soil rising 1 metre or more above the water to provide habitat for rakali burrows.**

- **To maximise opportunities for rakali to create burrows, concrete should not be used as a binding agent along banks. Similarly, large tumbled rocks provide a better substrate for this purpose as compared to gabion baskets.**

- **If it isn't feasible to provide habitat suitable for rakali burrows, consider placing hollow logs around the perimeter of a man-made water body for use as diurnal resting sites.**

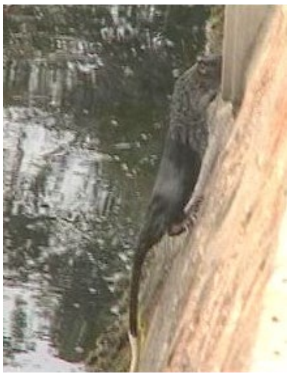
6. Surface channels and drains

Water-rats travel quite readily along all types of surface drainage lines and channels, as often observed in irrigation districts. These can be developed as routes to encourage this species to find and use man-made water bodies that are located at a distance from natural water courses.

Recommendations

- **To provide cover from predators, shrubby overhanging vegetation should be encouraged to develop along the length of shallow (or seasonally dry) surface channels that are likely to be used by rakali to access man-made lakes or wetlands.**

7. Drop structures and culverts



Rakali can climb nearly vertical concrete surfaces and are also willing to enter concrete drainage pipes (as illustrated at right), implying that most drop structures are likely to be navigable by this species. Of course, the same is not true for many other creatures that share the rakali's environment (including some prey species), so water entering and exiting man-made water bodies should ideally be conveyed via gently graded structures that are constructed using natural materials and substrates.

It is also important to recognise that grilles or mesh barriers placed across pipes, culverts and drains (for example, to keep out unauthorised persons or filter out litter) may also prevent rakali and other aquatic animals from travelling through the structures.

Recommendations

- **Pipes or culverts that are likely to be accessed by a rakali should have a minimum internal diameter of ~20 cm to ensure that large adults can easily turn around if they wish to do so after entering.**

- **A grille or mesh barrier placed across a pipe or culvert that is likely to be used by a rakali should ideally have grid spacings no smaller than 10 x 10 centimetres to allow adults to fit through.**

8. Pump intake points

Rakali (especially small juveniles) can die after being sucked into or against a pump intake point. If pumps are deployed in a man-made water body on a permanent or temporary basis, it is therefore important that appropriate safeguards are adopted.

Recommendations

- **An appropriate mesh guard designed to exclude rakali (and other wildlife) should be fitted around the intake point of any pump used in a man-made water body.**

9. Fencing

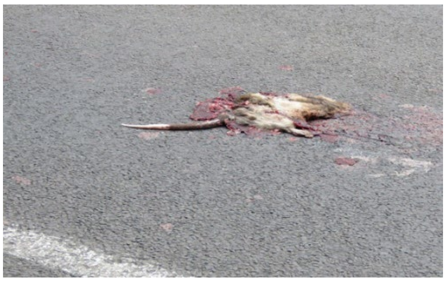
Fencing may be installed for many reasons around a water body, and may be highly desirable from the viewpoint of rakali if it excludes predators or livestock. At the same time, fencing may substantially constrain the options for rakali to access the water body, particularly if tall chain-link fencing is installed with its bottom edge running just above (or, worse yet, below) the soil.

Recommendations

- **The design of boundary fencing around a man-made water body should explicitly allow for access points by desirable wildlife species, including rakali.**

10. Walking tracks and roadways

Walking tracks encourage the community to appreciate the environmental values of man-made lakes and wetlands. However, if tracks run along the edge of the water for a substantial distance, they can also facilitate access by predators such as foxes and contribute to banks being trampled or becoming eroded.



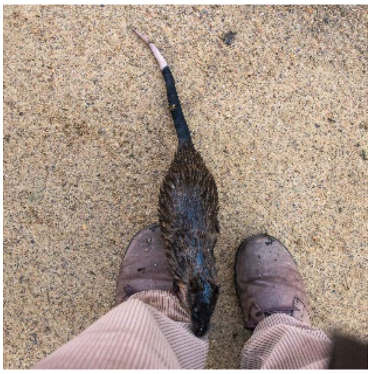
Reflecting the fact that *Hydromys* is a very active and wide-ranging species, these animals are killed surprisingly often while crossing roads located near lakes and wetlands. For example, at least 11 individuals are known to have died on roads near Lake Wendouree in the period from 2017 to 2022 (as shown in the photo at left).

Recommendations

- **A vegetated buffer zone (see Section 3) should normally be allowed to grow between a walking track and lake banks to provide intervening cover for wildlife.**

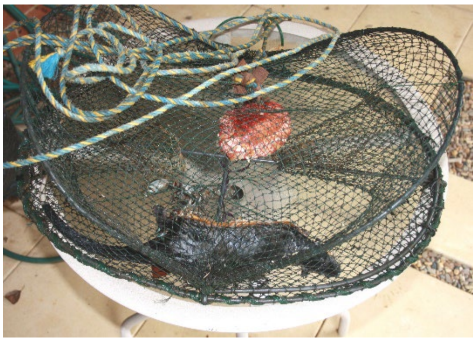
- **Where a road runs near a water body known to support a substantial rakali population, a combination of 'rakali-crossing' warning signs and/or speed humps should be installed to reduce the likelihood of road-kills occurring.**

11. Managing human-rakali interactions



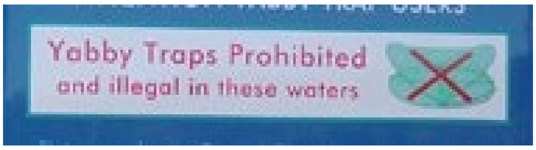
Rakali are very attractive animals, and are correctly regarded by most persons as being an interesting and valuable component of aquatic ecosystems. Rakali are also a very adaptable species that can easily become habituated to humans and – when persons start feeding them regularly – be a nuisance by exhibiting aggressive begging behaviour (see photo at left). Feeding this carnivorous species with (most typically) stale bread is also predicted to engender poor health outcomes for the animals themselves.

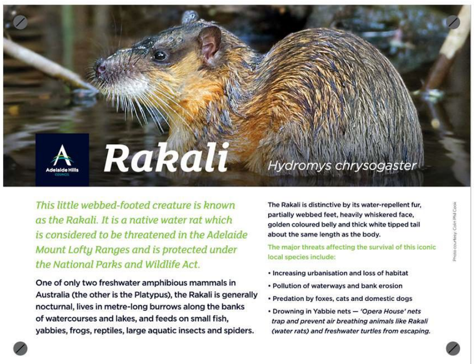
In addition, rakali are vulnerable to being killed or injured as a by-product of fishing activities, particularly the use of enclosed yabby traps such as opera house traps (as shown at right). Horrifyingly, up to seven rakali have been found drowned in a single opera house trap (APC unpub. data). Though use of enclosed yabby traps is now prohibited in most states and territories, some deployment of traps continues to occur even where these traps have been banned.



Recommendations

- **Signage should be routinely developed for any major new lake or wetland that describes how the habitat is expected to contribute to wildlife conservation. In places where rakali are likely to be encountered often (e.g., many urban water bodies and popular angling sites), targeted messaging should occur to outline why it's important not to feed the animals and also explain the need for other rules on their behalf, including how easily they drown in enclosed yabby traps.**





Acknowledgements

Images in this document are used courtesy of Australian Platypus Conservancy, except for those reproduced, with sincere thanks, in Section 2 (credit: Sally Grundy), Section 10 (credit: Lissa Ryan), at the top left in section 11 (credit: Carol Hall) and middle right in section 11 (credit: J. Spirek).

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