Platypus Fyke-netting Guidelines

Melody Serena[1], Josh Griffiths[2] and Geoff Williams[1]

[1] Australian Platypus Conservancy, Wiseleigh VIC (platypus.apc@westnet.com.au)
[2] **cesar**, Parkville VIC (jgriffiths@cesaraustralia.com)

Introduction

This document (drafted in September 2015) has the following major aims:

- To identify the most common welfare issues that can arise when a platypus is captured in a fyke net, and outline recommended protocols to reduce these risks (pages 1-3)

- To identify the most common welfare issues that can arise for vertebrate by-catch when fyke nets are set to capture platypus, and outline recommended protocols to reduce these risks (pages 4-6)

- To provide recommendations regarding the minimum amount of first-hand experience that new practitioners should gain before taking responsibility for carrying out a platypus live-trapping session (page 6)

- To describe recommended protocols for platypus transport and handling, how best to deal with captured animals that are hypothermic or entangled in litter, and how best to release a platypus back to the wild (Appendix 1)

- To identify the Victorian water bodies where a platypus is likely to be encountered when fyke nets are set, based on current available knowledge (Appendices 2 and 3)

Platypus welfare issues when captured in fyke nets

Drowning. By dropping its heart rate to as little as 1.2 beats per minute, an inactive platypus can survive underwater for up to 11 minutes (Evans *et al*. 1994). However, this interval is reduced to <3 minutes in the case of active animals (Grant *et al*. 2004). The platypus is accordingly vulnerable to drowning if confined inside a submerged fyke net. This is most likely to occur if water levels rise after nets have been set, e.g. due to rainfall. Increased water depth and/or velocity may inundate fyke nets or cause them to collapse after tearing them loose from their anchoring points, drowning any air-breathing fauna held inside.

Hypothermia. The platypus normally maintains a body temperature close to 32^{o}C in both air and water (Grant and Dawson 1978a; Grant 1983). Thermal insulation in the water largely relies on an air layer trapped in dense underfur, which can be dispersed and lost when fur rubs against netting (Grant and Dawson 1978b). In practice, Smyth (1973) reported that a platypus's body temperature dropped by about 10^{o}C after being held in a tank in 11.5^{o}C water for 3.5 hours; the temperature of animals entangled in mesh gill nets in winter typically drops by about 2^{o}C within periods of 15-30 minutes (Grant and Dawson 1978a). In our experience, signs of hypothermia (lethargy, chilling) are most likely to develop in fyke nets if two or more platypus occupy the same net in winter. In this situation, small individuals (e.g. juveniles) are particularly likely to become hypothermic, presumably after being squashed between netting and a larger animal.

Hyperthermia. Due to its low body temperature and limited sweating capacity, the platypus is vulnerable to overheating when held out of the water. The mean body temperature of a quietly resting platypus has been found to increase only modestly (from 32.1^{o}C to 32.9^{o}C) as air temperature increases from 25^{o}C to 30^{o}C (Grant and Dawson 1978a).

However, vigorous activity will generate additional metabolic heat, e.g. if an animal repeatedly tries to escape from a bag or struggles while being handled. Caution should be exercised whenever holding a platypus at ambient temperatures >25^{o}C, and exposure to temperatures >30^{o}C should be viewed as potentially life-threatening: a platypus reportedly lost consciousness ('fainted') after being held at 35^{o}C for 17 minutes (Martin 1902, described in Grant and Dawson 1978b).

Food and energy requirements. The platypus has a very small stomach, and typically feeds on macro-invertebrates for 8-16 hours a day (see papers cited in Serena and Williams 2012). The gut transit time (stomach to colon) is just five hours (Booth and Connolly 2008). Non-breeding adults consume the daily equivalent of around 15-25% of their body mass in prey items, increasing late in lactation to as much as 80% of body mass (Holland and Jackson 2002). No satisfactory technique has yet been developed to feed a platypus while it is confined in either a fyke net or a capture bag.

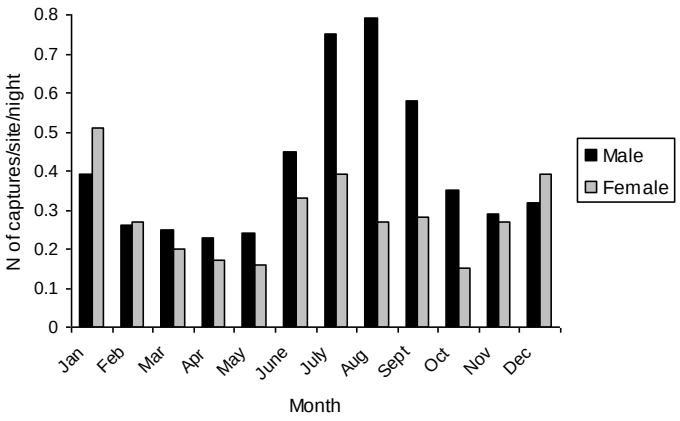
Capture-induced stress. McDonald *et al*. (1992) found that plasma concentrations of glucocorticoids (adrenaline and noradrenaline) rose sharply (from <50 nmol/l to about 300 nmol/l) in the first 30 minutes after a platypus was captured in a mesh gill net or fyke net. In the case of fyke nets, glucocorticoid concentrations dropped over the next two hours (though remaining at least twice as high as baseline levels) before rising to 600 nmol/l by c. 12 hours after capture. The magnitude of the platypus stress response to capture varies seasonally, with adult male and female responses respectively peaking in winter and spring.

Predation. Attempted predation of a platypus held in a fyke net has occasionally been recorded (MS and GW, pers. obs.). In one incident, a very large water-rat was observed standing on top of a net set at mid-channel while staring intently at the point where a small adult female platypus was hiding under a netting funnel. A second incident involved a fox that ran from a net containing an adult male platypus; the cod end of the net was located in very shallow water at a ford. In both cases, the netting of the final chamber had been bitten through extensively and it is considered likely that the platypus inside would eventually have been killed if researchers hadn't intervened. Water-rats presumably may sometimes attack a platypus when both species occupy a net at the same time, though this will be limited by the water-rat's propensity for freeing itself within a short time of being captured (see below). Long-finned eels *Anguilla reinhardtii* can grow to nearly 1.6 metres in length and weigh up to 16.8 kg (Cadwallader and Backhouse 1983); large specimens are likely to constitute a credible threat to platypus held in fyke nets though corroborating data are not available.

Aggression between adult males. The platypus breeding season in Victoria extends from about August to October (De-La-Warr and Serena 1999; Easton *et al.* 2009). Male aggressive behaviour and venom production both reach their annual peaks at this time (Temple-Smith 1973). Although agonistic interactions between wild males are probably rarely fatal, mortality has been recorded in captivity (Grant 2007). A similar outcome could arise if two adult males are held in the same fyke net, especially during the breeding season.

Miscellaneous accidents and injuries. One incident has been reported of a platypus drowning in a fyke net set in a suburban stream after someone untied the cod end from its supporting stake (possibly to release a duck) and failed to refasten it properly (R. Armistead, pers. comm.). On two occasions, an internal line in the final net chamber is known to have become twisted around the spur and hind leg of a captured adult male, resulting in ankle abrasions (MS and GW, pers. obs.). Shallow cuts or abrasions may also appear on a platypus's bill tip as a presumed outcome of an animal pushing vigorously against netting in a bid to escape. Although not directly related to the capture process, it is worth noting that many platypus occupying streams near Melbourne (and some found elsewhere) carry items of litter wrapped around the neck and/or body, sometimes associated with deep lesions (Serena and Williams 1998; Serena and Williams 2010). Persons setting fyke nets should therefore be equipped (with small scissors, forceps and antiseptic) and prepared to remove all items of litter before entangled animals are released ASAP back to the wild.

Temporal variation in capture rates. Mean monthly platypus capture rates in fyke nets vary substantially, with adult and subadult males most likely to be captured in the weeks leading up to the breeding season and females most likely to be captured at the peak of lactation (see graph at right). Capture rates also vary through the night, with 63% of adults/subadults and 73% of juveniles recorded in the first half of the night in overnight fyke-netting surveys (Serena and Williams 2012).



Net-setting protocols to protect platypus welfare in platypus surveys

- To protect platypus from drowning, the cod end of a net must be securely attached to a fixed object (e.g. tree, metal stake hammered into the channel) so a substantial air space is available in the end chamber and ideally along the entire length of the net.

- Adopt a proactive and cautious approach to ensure that nets do not become entirely submerged after being deployed. For example, do not set nets if appreciable run-off is expected to occur overnight, and promptly remove nets from water if water levels begin to rise after unexpected rainfall. (In practice, substantial run-off in urban areas may occur after as little as 5 mm of precipitation.)

- To avoid drawing the attention of foxes or other predators to captured animals, do not stretch the end of fyke nets onto the bank (and ideally place the end chamber in water that is $\geq$20 cm deep).

- To prevent captured animals becoming exhausted as a by-product of dealing with strong currents or turbulent flow, place the end chamber of nets in relatively slow-moving water (e.g. near the bank or sheltered by a log if flow is otherwise swift) and ideally angle the end chamber more or less across the current.

- Check all nets just before dark to ensure they are still set correctly and to release water birds or other vertebrate by-catch (see below).

- The frequency of nocturnal net-checking must vary with water temperature to reduce the risks that animals become hypothermic or incur large energy costs while confined in nets at low ambient temperatures. In practice:

    1. If water temperature at dusk is $\geq$15^{o}C (the presumed lower limit of the platypus's thermoneutral zone: Bethge *et al*. 2001), check all nets within the first 4 hours after dusk, and at intervals of <4 hours thereafter until nets are closed.
    2. If water temperature at dusk is <15^{o}C, check all nets at intervals of $\leq$2 hours, starting at dusk. Apply common sense: given that a platypus's metabolic rate is predicted to rise as water temperature declines, aim to minimise the amount of time that animals spend in nets, particularly if water is very cold.

- In waters where large long-finned eels are abundant, check nets at intervals of $\leq$2 hours in February-March, when small juvenile platypus enter the trappable population.

- To limit the amount of hunger and stress experienced by a captured platypus, ensure that the maximum interval that an animal remains captive (measured from the time when the net holding the platypus was previously checked to the time when the animal is released back to the wild) does not exceed 4 hours.

Welfare issues for non-target vertebrates in fyke nets deployed for platypus

The main non-target vertebrates entering platypus nets in southeastern Australia include Australian water-rats or rakali (*Hydromys chrysogaster*), water birds (mainly Pacific black duck *Anas superciliosa* but also wood duck *Chenonetta jubata*, chestnut teal *Anas castanea*, dusky moorhen *Gallinula tenebrosa*, etc.) and various fish species. Water-rats and water birds are more frequently captured in platypus nets (which normally block the entire channel) than in fish nets (which rarely block the entire channel). Turtles are typically not recorded very often in platypus fyke-netting surveys, but may sometimes occur in reasonably high numbers alongside platypus (e.g. in on-stream dams or lagoons/billabongs), thereby increasing the likelihood that turtles enter platypus nets set at these sites.

Water-rats/rakali

Drowning. Australian water-rats can (and generally do) escape from fyke nets elevated partly above the water by biting through netting to create an exit hole. The main exception involves small juveniles, which are occasionally found curled up (in a resting posture) on elevated netting at the cod end of a net (MS and GW, pers. obs.). Two water-rats drowned in submerged fyke nets set to survey fish near Bairnsdale in the 1970s (Beumer *et al*. 1981); drownings have also reportedly occurred more recently in submerged opera house traps and commercial fyke nets (APC unpub. data). We conclude that being confined underwater in a net constitutes a genuine mortality risk for this species.

Hypothermia. Water-rats are susceptible to becoming hypothermic in cold water, e.g. core body temperature typically drops from approximately 36^{o}C to 28^{o}C within 1-3 hours of entering 15^{o}C water (Fanning and Dawson 1980). However, given that only small juveniles are typically detained in fyke nets for any length of time, and that the water-rat breeding season extends from September to January in Victoria (McNally 1960), the risk that water-rats become hypothermic in fyke nets is low.

Water birds

Duckling mortality. In our experience, a large proportion of the water birds entering platypus fyke nets comprise ducklings captured in suburban streams. Some mothers accompany their offspring into the net, whereas others remain nearby without entering. Ducklings are normally freed without incident, but young birds have occasionally been found dead after their siblings and mother are released. It is presumed that mortalities occur accidentally when ducklings are shoved underwater or suffer a broken neck as their mother vigorously seeks to escape from approaching humans. In addition, one instance has been recorded of a duckling dying in a net after it was seized around the neck by a large crayfish (*Euastacus* spp.) (MS and GW, pers. obs.). To reduce the risk that ducklings die or are separated from their mother for any length of time, check all nets before dusk and release water birds immediately. When small ducklings and their mother have entered a net together, first restrain the female by firmly holding her wings against her body, then transfer ducklings by hand from the net to a suitable container (e.g. a bucket). Release the family together at a spot located $\geq$10 metres from the net (in the direction they were originally travelling), ideally near protective cover such as shrubs overhanging the water.

Fish

Predation. The remains of fish are sometimes recorded in platypus survey nets following apparent predation by larger fish (especially eels *Anguilla* spp.), water-rats, crayfish and (rarely) adult male platypus (APC unpub. data). The estimated incidence of predation would presumably be much higher if fish remains were readily detectable after being ingested.

'*Gilling' injuries*. Small fish (e.g. common galaxias *Galaxias maculatus*, roach *Rutilus rutilus*) occasionally become wedged in netting as they seek to escape from platypus fyke nets. In our experience, this normally involves no more than one fish per net. With care, some but not all individuals can be released without apparent harm by gently pushing them backwards.

Migration events. Because they block the entire channel, platypus fyke nets can potentially intercept or deter mass migratory movements by fish, with Australian grayling *Prototroctes maraena* believed to be particularly prone to being spooked by nets impeding their progress (Justin O'Connor, pers. comm.). Nineteen fish species found in Victorian freshwater habitats are known to move substantial distances to spawn or otherwise complete their life cycle (Table 1). Mass movements by Victorian species are particularly likely to be triggered when strong and sustained rises in flow (e.g. ≥30% above baseflow: Tony Steelcable, pers. comm.) occur but in some cases (e.g. juveniles of diadromous species such as tupong *Pseudaphritis urvilli*, Australian grayling and galaxiids *Galaxias* spp.) much smaller rises above baseflow may promote movement (Justin O'Connor, pers. comm.). In practice, we are aware of only one instance when a mass movement of fish has been intercepted by Victorian platypus nets: 116 common galaxias *G. maculatus* and 491 short-finned eels *Anguilla australis* were recorded (after being progressively released through the night) at a series of sites located along Diamond Creek (Yarra River catchment) in early December 2007 following a series of storms (Mitrovski 2008). The degree of risk posed by platypus fyke nets to migrating fish is presumably limited by the fact that experienced practitioners do not normally conduct surveys when flows have recently risen, in a bid to prevent unacceptably high quantities of leaves and other debris from accumulating in and immediately upstream of nets.

Turtles

Drowning. Turtles may drown if a fyke net contains internal hoops and/or funnels that become progressively narrower along its length, making it impossible for some animals to reach the elevated cod end to access air. In Victoria, this is most likely to occur in the case of broad-shelled turtles *Chelodina expansa* (Katie Howard, pers. comm.).

Net-setting protocols to protect non-target vertebrates captured in platypus surveys

Water-rats/rakali

The protocols described in this document to protect platypus welfare in fyke nets should adequately protect the welfare of water-rats entering fyke nets as by-catch.

Water birds

The protocols described in this document to protect platypus welfare in fyke nets should generally protect the welfare of water birds entering fyke nets as by-catch. See also the recommended protocols for releasing ducklings from nets as described in the previous section.

Fish

- To reduce predation risk in nets, routinely release fish and decapod crustaceans on each occasion that nets are checked (apart from declared noxious species, which should be killed humanely). (N.B. Releasing fish and crustaceans on a regular basis is also expected to reduce the number of water-rats entering nets, and hence the likelihood that platypus may escape via holes created by water-rats.)

- Adopt a vigilant and informed approach towards the possibility that mass movements of migratory fish may occur: be aware of any migratory species that could occur in a water body where platypus nets are being set and when (i.e. in what months) fish are likely to move; do not set nets along a water body supporting a migratory species (in the months when movements could occur) if stream flow has recently increased by ≥30%; and immediately remove all nets from the water if there is any evidence that a migratory event is in progress. In addition, routinely set nets with the wings in a V-shaped configuration so fish (particularly Australian grayling) are encouraged to enter the main body of a net rather than try to swim through the wings (Tarmo Raadik, pers. comm.). Finally, to reduce the risk that a migratory event is delayed unduly, avoid setting nets on consecutive nights along a water body supporting a migratory species in the months when movements could occur, particularly if flows have recently increased.

Turtles

The protocols described in this document to protect platypus welfare in fyke nets should generally protect turtle welfare, especially if an air space is maintained in all sections of the net. Routinely release captured turtles on each occasion that platypus nets are checked. If hoops/funnels become progressively narrower at any point along the length of a net, take special care to ensure that the entire net is partly suspended above the surface in water bodies where turtles (particularly *Chelodina expansa*) are likely to occur.

Recommended minimum training for new practitioners

Core competencies for carrying out the protocols described above include: (1) being able to set nets in a manner that will not inherently compromise the well-being of captured platypus or non-target vertebrates; (2) being able to remove a captured platypus from a net and transfer it to a bag in a safe manner without undue associated stress; (3) being able to restrain and handle a platypus quietly and effectively while the animals is in a bag; and (4) being able to release non-target vertebrates without undue stress from nets. As mandated by the latest NHMRC Code for the Care and Use of Animals for Scientific Purposes (National Health and Medical Research Council 2013), researchers working with platypus must also be familiar with the species' normal behaviour so they can identify signs of pain and distress if these occur.

It is accordingly recommended that persons having substantial prior experience (obtained over at least three years) with both setting fyke nets and handling wildlife should participate in a minimum of three platypus live-trapping sessions involving at least 10 animals being captured and removed from nets before taking primary responsibility for carrying out such work.

In the case of persons having less extensive relevant experience, it is recommended that they should participate in a minimum of 8-10 platypus live-trapping sessions involving at least 20 animals being captured and removed from nets before taking primary responsibility for carrying out such work.

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Table 1. List of Victorian fish species found in freshwater habitats that engage in mass movements over substantial distances at some stage(s) in the life cycle. * species is classified as Vulnerable or Near Threatened at state level; ** species is classified as Endangered at state level; *** species is classified as Critically Endangered at state level. Information provided courtesy of Biosis Pty Ltd (Melbourne Resource Group), based on Koehn and O'Connor (1990).

Species name	*Timing of movements*	*Distribution in Victoria*
Short-headed lamprey (*Mordacia mordax*)	Downstream Aug-Nov Upstream Aug-Dec	Patchy distribution in coastal drainages
Pouched lamprey (*Geotria australis*)	Downstream Jul-Aug Upstream Jul-Nov	Very patchy distribution in coastal drainages west of Lakes Entrance
Short-finned eel (*Anguilla australis*)	All year (at different stages)	Possible in all coastal drainages
Long-finned eel (*Anguilla reinhardtii*)	Jan-Jun (glass eels)	Possible in all coastal drainages east of Wilsons Promontory
Common galaxias (*Galaxias maculatus*)	Downstream Apr-Jun Upstream Sept-Dec	Possible in all coastal drainages
Broad-finned galaxias (*Galaxias brevipinnis*)	Downstream Apr-Jun Upstream Sept-Dec	Possible in all coastal drainages
Spotted galaxias (*Galaxias truttaceus*)	Downstream Apr-Jun Upstream Sept-Dec	Locally abundant in Otway Coast drainages; otherwise patchily distributed in coastal drainages
Tasmanian mudfish (*Neochanna cleaveri*)***	Upstream Sept-Nov	Possible in most coastal drainages, especially from Otway Coast to Bunyip River basin
Australian grayling (*Prototroctes maraena*)*	Downstream May-Aug Upstream Oct-Dec	Possible in all coastal drainages east of Warrnambool, notably Bunyip, S. Gippsland and Snowy River basins
Murray cod (*Maccullochella peeli*)*	Sept-Jan	Possible throughout the Murray-Darling Basin; also translocated to Yarra River Basin
Trout cod (*Maccullochella macquariensis*)***	Unknown	Murray, Goulburn and Ovens River basins
Macquarie perch (*Macquaria australasica*)**	Oct-Dec	Upper reaches of Ovens, Goulburn and Broken River basins; also translocated to Yarra River basin
Golden perch (*Macquaria ambigua*)	Jun-Dec	Possible in all drainages in Murray-Darling Basin
Estuary perch (*Macquaria colonorum*)	Jul-Dec	Possible in all coastal drainages except in Melbourne region
Australian bass (*Macquaria novemaculeata*)	Downstream Apr-Jul Upstream Aug-Oct	Coastal drainages east of Wilsons Promontory
Silver perch (*Bidyanus bidyanus*)***	Sept-Dec	Possible in all drainages in Murray-Darling Basin
Tupong (*Pseudaphritis urvilii*)	Jul-Aug	Possible in all coastal drainages
Striped gudgeon (*Gobiomorphus australis*)	Unknown	Distribution poorly known; recorded in and east of Snowy River basin
Cox's Gudgeon (*Gobiomorphus coxii*)	Unknown	Distribution poorly known; recorded in and east of Snowy River basin

Appendix 1. Recommended Platypus Handling, Transport and Release Protocols

How to remove a platypus from a fyke net

Check all nets for the first time just before dark to release water birds and rectify any changes to the way nets are set. After dark, the presence of a platypus in a net is usually indicated by the net wiggling slightly when first illuminated by torches: the animal itself will generally be hidden under the netting sleeve in the final chamber. However, platypus behaviour in traps varies considerably, with some animals being more active than others. It may be necessary to gently shake the net to elicit movement from a platypus that is hiding.

It is highly recommended that at least two persons should work together to remove a platypus from a fyke net, both for their own personal safety and to reduce the likelihood that an animal escapes. To reliably motivate a platypus to swim to the cod end with minimum fuss after dark, one person ('Person 1') should move to the front of the net and shine a torch towards the rear, where the second person ('Person 2') should be standing with his or her torch turned off. When the animal reaches the end, Person 2 should tie a precut piece of string or cord tightly around the netting just in front of the final hoop, thereby isolating the animal and restricting its forward movement. (If the trap contains two or more animals, remove them individually in sequence, taking care not to force remaining animals underwater without access to air.)

Once the platypus is isolated at the cod end of the net, Person 2 can untie the net from the stake or other structure to which it is secured. Person 1 should then firmly hold the final hoop horizontally in both hands (as if holding a dinner plate), so the platypus is resting, supported by netting, in the middle of the plate. Person 2 can then undo the knot securing the cod end and open the end of the net to look down at the platypus, holding up a reasonably high wall of netting around the animal to deter it from scrambling out. At this point animals will most typically be moving in a circular pattern around the edge of the dinner plate, looking for a way to escape. It is essential that Person 1 continues to hold the hoop firmly as the animal moves around – in our experience, the platypus will not attempt to spur hands holding the hoop (or apparently even register their presence as such). Some animals will also try to climb up towards the open top of the netting. Do not attempt to grab an animal if it does this! Instead, Person 2 should simply give the netting a brisk shake to dislodge the animal so it falls back onto the dinner plate.

Even a very active platypus will normally pause after a minute or two. When it's at rest and in a position that's clear of internal fyke net lines, Person 2 should immediately reach down into the net with one hand and firmly grasp the animal **around the end half only of its tail if it's an adult male or of unknown age/sex** (see additional comments below). Pull the animal from the net, inspecting the ankles for spurs if this hasn't already occurred. Animals will at this point often grab the hoop and/or netting with their front feet in a final bid to avoid being taken; Person 1 can assist by applying some downward pressure on the hoop or otherwise gently releasing the animal's grip. It is also now Person 1's responsibility to reach for a dry capture bag (which should previously have been draped over the shoulder or placed in another easy-to-reach spot), open it up wide so the platypus can be dropped inside, then immediately knot or tie the top shut so the platypus can't escape.

Recommended transport, handling and release protocols

If possible, process captured animals on site and return them to the water ASAP so they can resume feeding. Minor bleeding may occur after marking an animal with an implanted PIT identification tag (in line with elevated blood pressure following capture); if so, apply pressure with a gauze square or the equivalent until bleeding stops before returning the animal to the water.

If animals are to be taken to another location before being processed, transport each platypus in a cloth bag (about the size of a pillow case or a little longer). Place each bag individually in an open-topped box to reduce the risk of possible disease transfer between animals. Avoid unnecessary noise throughout the period that animals are held: e.g. speak quietly, turn off the car radio and close car doors as quietly as possible.

Following transport to a centralised location, transfer each animal as soon as possible to a fresh (i.e. dry) cloth bag. Keep an animal's eyes covered during handling and aim to complete all measurements and other procedures within 10 minutes. Only hold animals in dry, clean cloth bags: change bags if they become soiled with urine/faeces. Hold animals in individual boxes in a quiet, cool location and check occasionally that they are arranged comfortably inside bags in the period before they are released. Given the timing and direction of changes in post-capture glucocorticoid profiles (McDonald *et al*. 1992) and the fact that gut transit time in this species is 5 hours (Booth and Connolly 2008), the total interval that a platypus is detained (including both the length of time that it may have been in a net and the amount of time it is held out of the water) should be $\leq$4 hours.

Release animals a short distance (around 20 metres) upstream or downstream from their capture site (i.e. as opposed to right next to a net). In the case of small juveniles, release animals in the direction that will facilitate their backtracking to a burrow. In the case of older animals, release them in the direction they were originally travelling so they can continue to follow their preferred foraging route. Regardless of which side of the nets is chosen for release, there is a fairly low likelihood that an animal will be recaptured at a given site on the same night, particularly if researchers stand near nets immediately following its release with their torches on. If an animal is found to have re-entered a net when the site is next checked, remove both nets from the water before again releasing it. Do not release an animal that appears to be hypothermic (mildly or severely chilled and lethargic); hold the animal in a dry bag and allow it to warm up gradually until it is active and well co-ordinated.

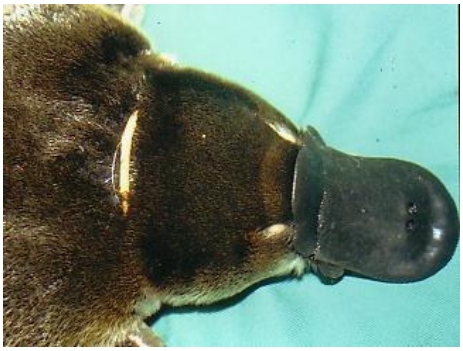
Take care to ensure that a captured platypus is not subject to heat stress while out of the water. Animals must never be held in bags for more than a few minutes if air temperature exceeds 25^{o}C, with exposure to temperatures >30^{o}C appropriately viewed as potentially life-threatening. Don't turn on a car heater when an animal is transported inside a vehicle, and hold and handle animals away from room heaters (or in shaded locations during the day). To help keep a platypus's body temperature from dropping at air temperatures below 15^{o}C, place a folded bag or the equivalent under the animal to provide insulation between its body and the surface below.

As a standard precaution, persons coming into contact with a platypus or used capture bag (particularly if contaminated with urine or faeces) should wash their hands thoroughly with soap (or apply hand sanitising solution) immediately after such contact. Place a washable plastic table cloth or the equivalent on the surface where animals are processed, and store used capture bags in a disposable plastic bag until they can be laundered in hot water.

Identifying and dealing with hypothermic animals

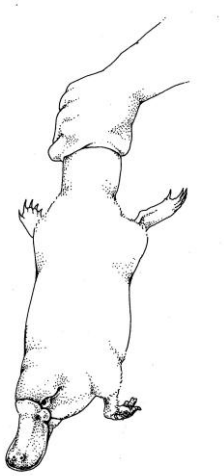
The feet and bill of a healthy platypus should feel slightly cool to the touch, as its body temperature is normally a few degrees lower than that of a human. If an animal's whole body feels chilled and/or it is noticeably lethargic when taken from a net, it is almost certainly hypothermic. In extreme cases, animals can effectively become moribund; the only animal we have seen in this state (a juvenile male confined in a fyke net with an adult male for no more than 2 hours in winter) was barely able to move its limbs and had crawled out of the water onto exposed horizontal netting at the cod end of the net, presumably in a bid to avoid drowning (MS and GW, pers. obs.). A hypothermic platypus should be dried as thoroughly as possible with a towel, transferred to a dry bag and encouraged to warm up gradually. It should not be released back to the wild until it is alert and lively, i.e. capable of avoiding predators, swimming efficiently and locating a burrow.

Identifying and dealing with animals entangled in litter



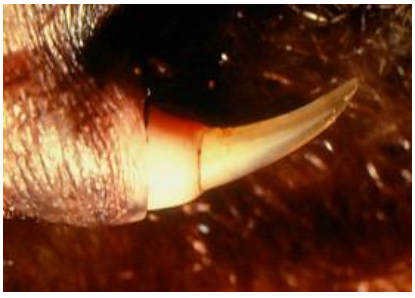
A substantial proportion of the platypus occupying urban streams (and some individuals found in other habitats) carry plastic or rubber loops or rings wrapped around the neck and/or body, e.g. elastic hair-ties, engine gaskets, food packaging materials, cable-ties, plastic bracelets and (as shown at right) fishing line and rubber bands. These materials gradually wear through the skin and underlying tissues and can cause horrific injuries (Serena and Williams 1998; Serena and Williams 2010). It is therefore imperative that any item of litter should be identified and removed (using scissors and forceps as required) before returning an animal to the water without delay so it can resume feeding and be spared further unnecessary stress.

Platypus spurs



When picking up a platypus, take care to avoid contact with the poisonous spurs located on the heels of adult males. An adult male (or animal of unknown age/sex) should only be carried by gripping the end half of the tail (but not the tail base, which a male can reach with his spurs) – see diagram at right. While holding a platypus in this manner, it should be easy to determine whether or not obvious spurs are present. While platypus venom is not life-threatening to humans, it can cause excruciating pain and spectacular swelling. Unless it is definitely known that a platypus is *not* an adult male, *never* place your hands or fingers against the animal's abdomen or between its hind legs, or use your legs or arms to support it from below (even if the animal is in a bag).

The size and appearance of platypus spurs can be used to help identify an animal's age class as well as its sex (Temple-Smith 1973; Williams *et al*. 2013). In the case of juvenile males (<1 year old), spurs are relatively stubby, more or less conical and initially covered in a sheath of whitish keratin (below left). The keratin sheath gradually wears away, exposing an off-white or amber-coloured true spur, typically 12-20 mm long. The spurs of subadult/second year males are generally best distinguished from those of older animals by the presence of a pale pink to white collar of skin that initially covers about one-third of the spur's total length (below middle). The collar skin gradually regresses and is very much reduced in width by the time that males become sexually mature at the age of two years. Spurs of mature males (below right) are sometimes stained darker brown, especially around the base, presumably due to the presence of dried venom.



Juvenile females have a vestigial brown or whitish 'spur', typically just 1-2 mm long, located on each hind ankle. This structure is often easier to feel than see and is normally lost at the age of about 9 months, leaving a small, shallow pit in the skin of older females.

Appendix 1. Presumed distribution of platypus in Victorian AWRC river basins. Distribution inferred from reliable sightings and live-trapping results (as of summer 2015), excluding the greater Melbourne area (see Appendix 3) and Murray River. Sightings records held by Australian Platypus Conservancy (unpub. data).

River basin	*Distribution and status*	*Comments*
Upper Murray	Widespread and locally common, especially in Mitta Mitta R and its tributaries (including streams flowing directly into L. Dartmouth and L. Hume)	Reliable sightings in last 10 years for Corryong/Nariel/Jeremal Ck, Thowgla Ck and Cudgewa Ck (Serena and Williams 2010c); numerous sightings in same period for widely distributed sites in Mitta Mitta R catchment. Capture rate (mean $\pm$ SEM) in platypus fyke nets set in Livingstone Ck at Omeo in 2012-2013 = 2.3 $\pm$ 0.2 animals/site/night (*n* = 5 surveys) (APC unpub. data)
Kiewa	Widespread and locally common	Numerous sightings in last 10 years at widely distributed sites in Kiewa R catchment, including Falls Creek ski area (c. 1650 m elevation) in 2008. Occasional sightings in stream drainages joining the Murray R at Wodonga, including Jack in the Box Ck (2010), House Ck (2005-2013) and Belvoir Park Lake (2010-2013)
Ovens	Widespread in Ovens R catchment (especially upstream of Wangaratta) and King R catchment (especially upstream of Boggy Ck confluence); may be locally common at sites that were characterised by reliable surface water/flow through the 2000s	Reliable sightings in last 10 years in Ovens R (Murray Valley Highway to Bright), Reedy Ck, Hodgson Ck, Happy Valley Ck, Buffalo R, Rose R, Dandongadale R, Buckland R, Bakers Gully Ck, Morses Ck, King R (Boggy Ck confluence to L. William Hovell), Boggy Ck, Hurdle Ck and Fifteen Mile Ck.
Broken	Mainly in Broken Ck upstream of Waggarandall Weir and (especially) Broken River; may be locally common at sites that were characterised by reliable surface water/flow through the 2000s	Sightings of live platypus made since 2000 in Broken R (Shepparton to Bridge Creek township), Broken Ck (sites upstream of Waggarandall Weir, McLaughlins Weir, Irvines Weir, outfall from channel No. 12 near Picola, Dip Bridge), Lima East Ck (Lima East), Ryans Ck (near Loombah Weir) and Hollands Ck; sightings in Hollands Ck dropped sharply after the very dry summer of 2005/06 (Serena and Williams 2010b).
Goulburn	Widespread; may be locally common at sites that were characterised by reliable surface water/flow through the 2000s	Numerous sightings in last 10 years reported for Goulburn R and many of its tributaries upstream of Goulburn Weir. Sightings in Goulburn R d'stream of Goulburn Weir at Murchison (2008, 2013), Toolamba (2013), Shepparton (2007, 2013), Undera (2007), Bunbartha (2012) and halfway between Shepparton and Murray R (2006); also in Creightons Ck, Castle Ck, Seven Cks and Faithfull Ck. 4 platypus captured as by-catch in fyke nets set to sample fish in Seven Cks (between Gooram and Kelvin View) in 2006 (C. Bloink, pers. comm.).
Campaspe	Widespread in Campaspe R (especially upstream of Campaspe Siphon) and Coliban R (especially near/upstream of Metcalfe); may be locally common at sites that were characterised by reliable surface water/flow through the 2000s	Capture rate (mean $\pm$ SEM) in platypus fyke nets set in Little Coliban R/Fernhill Reservoirs in 2000 = 1.1 $\pm$ 0.5 animals/site/night (*n* = 2 replicated surveys) (Serena *et al*. 2000). Mean capture rate in platypus fyke nets set in Coliban R near Malmsbury = 2.0 animals/site/night in 2001, 0.5 animals/site/night in 2010 (Williams 2010). $\geq$2 platypus captured as by-catch in fyke nets set for fish in Campaspe R (at Doakes Reserve, English's Bridge and Campaspe Park) from 2000-2003 (L. Serafini, pers. comm.). 8 platypus captured as by-catch in fyke nets set to sample fish in Coliban R (upstream of The Cascades) and Sandy Ck in 2002 (J. McGuckin, pers. comm.).

Loddon	Widespread in Loddon R and its tributaries upstream of (and including) Serpentine Ck. Rare (mainly dispersers/vagrants) downstream of Serpentine Weir, apart from small populations possibly found in Loddon Weir pool and in/downstream of Kerang Weir pool. Also occur in Gunbower Ck and many associated lagoons upstream of Cohuna Weir (Serena and Willliams 2011).	Reliable sightings in last 10 years in Serpentine Ck (between Knife Edge Weir and Durham Ox) and numerous sites along Loddon R and its tributaries upstream of the Serpentine Ck confluence. Seen in Loddon Weir pool and Kerang Weir pool in mid-2000s; an irrigation channel located c. 1 km west of intersection of Loddon R/Macorna Channel in mid-1980s (found dead at water wheel); Sheepwash Ck in 1960s. Capture rate (mean $\pm$ SEM) in platypus fyke nets set in Loddon R near Castlemaine in 2002 = 0.4 $\pm$ 0.2 animals/site/night (*n* = 2 replicated surveys) (Williams 2002). Mean capture rate in platypus fyke nets set in Campbells Ck at Campbells Creek township in 2001 = 0.7 animals/site/night (Williams 2001). 7 platypus captured as by-catch in fyke nets set to sample fish in Birch's Creek (1 at Smeaton; 6 at/d'stream of Nelson's Bridge) in 2014 (J. McGuckin, pers. comm.).
Avoca	Absent/rare	Very few sightings since the 1967 drought and none since the even more severe drought in mid-to-late 2000s: 1 sighting in Charlton Weir pool in late 1990s (Avoca R); 2 dead on banks of popular fishing hole in 2002 (Campbells Ck); 2 sightings near Coonooer Bridge in March 2003 (Avoca R); 4 dead in gill nets set at popular fishing hole at Avoca township in 2004 (Avoca R)
Avon-Richardson	Absent/very rare (vagrants only)	Reliable sightings (one each in 1950s and 2003) near Rich Avon Weir, presumed to be vagrants travelling from Wimmera R via Swede or Dunmunkle Cks when water was diverted for stock & domestic usage
Wimmera	Rare apart from Mackenzie River (especially upstream of Wartook township)	Only currently known to occur in Mackenzie River, especially upstream of Wartook township (Griffiths and Weeks 2014). Occasional reliable sightings elsewhere (e.g. Wimmera R at Campbells Bridge in 2014) may be of vagrants.
East Gippsland	Widespread and locally common	Reliable sightings in last decade reported for Bemm R, Combienbar R, Cann R, Tonghi Ck, Wingan R and (especially) Genoa R and Maramingo Ck. Several platypus captured as by-catch in fyke nets set to survey fish in Bemm R. in 2003 (c. 5-6 km upstream of mouth near edge of tidal limit) (J. Douglas, pers. comm.)
Snowy	Widespread and locally common in Brodribb R catchment and Snowy R catchment upstream of Orbost	In Victoria, reliable sightings in last 10 years for Snowy R (Orbost to McKillops Bridge), Buchan R, Murrindal R, Suggan Buggan R, Deddick R, Bonang R, Roger River, Brodribb R, Martins Ck and Cabbage Tree Ck. Capture rate (mean $\pm$ SEM) in platypus fyke nets set in Buchan R at Buchan township from 2009-2013 = 2.1 $\pm$ 0.7 animals/site/night (*n* = 5 surveys) (APC unpub. data)
Tambo and Nicholson	Widespread and locally common, especially in Timbarra R and Tambo R between Bruthen and Swifts Creek township	Reliable sightings in last 10 years for Tambo R (Tambo Upper to Swifts Creek), Ramrod Ck, Monkey Ck, Haunted Stream, Navigation Ck, Timbarra R, Mellick Munjie Ck, Little R and Nicholson R (Sarsfield to Waterholes). Capture rate (mean $\pm$ SEM) in platypus fyke nets set in Timbarra R near Timbarra township in 2013-2015 = 1.8 $\pm$ 0.1 animals/site/night (*n* = 5 replicated surveys) (APC unpub. data)
Mitchell	Widespread and locally common	Reliable sightings in last 10 years for Mitchell R (Bairnsdale to Angusvale), Wentworth R, Pheasant Ck, Wonangatta R, Castleburn Ck, Moroka R, Humffray R, Crooked R and Dargo R. Capture rate (mean $\pm$ SEM) in platypus fyke nets set in Wentworth R/Pheasant Ck in 2008 = 1.2 $\pm$ 0.4 animals/site/night (*n* = 2 replicated surveys) (Serena and Williams 2008)

Thomson, Macalister and Avon	Widespread; may be locally common at sites characterised by reliable flow and/or substantial and reliable surface water	Reliable sightings in last 10 years in Thomson R (Wurruk to Thomson Reservoir Easton Portal), Rainbow Ck, Aberfeldy R, Macalister R (Maffra to Licola), Wellington R, Barkly R, Avon R (Wombat Flat) and Valencia Ck. Capture rate (mean ± SEM) in platypus fyke nets set in Valencia Ck in 2008 = 0.5 ± 0.1 animals/site/night (*n* = 2 replicated surveys); capture rate in platypus fyke nets set in Mt Skene Ck/Barkly R in 2008 = 1.1 ± 0.3 animals/site/night (*n* = 2 replicated surveys); capture rate in platypus fyke nets set in Aberfeldy R/Donnelly Ck in 2008 = 0.3 ± 0.1 animals/site/night (*n* = 2 replicated surveys) (Serena and Williams 2008)
Latrobe	Widespread in Latrobe R and tributaries upstream of Yallourn North and Tyers and Morwell R catchments (may be locally common in areas characterised by reliable flow); also in Traralgon Ck and Flynns Ck. Rare/uncommon in Latrobe R downstream of Yallourn North	Reliable sightings in last 10 years for Latrobe R (Yallourn North to Noojee), Loch R, Toorongo R, Tanjil R (upstream and downstream of Bluerock Lake), Moe R (also Shady Ck, Narracan Ck), Morwell R (also Little Morwell R, Ten Mile Ck, Wilderness Ck, Billys Ck), Tyers R, Jacobs Ck, Traralgon Ck, Jeralang Ck and Flynns Ck. A few sightings reported for Latrobe R downstream of Yallourn North, e.g. at Tyers R confluence in about 2001, Traralgon in 1995, Rosedale in 1993 and Longford in late 1950s.
South Gippsland	Absent/rare in Bass R and probably rare/possibly absent in Powlett R catchments; otherwise widespread and locally common	Multiple sightings in last 10 years for Merriman Ck, Bruthen/Reedy Cks, Tarra R/Greigs Ck, Jack/Albert R, Franklin R/Deep Ck, Stockyard Ck and (especially) Agnes R and Tarwin R catchment. Last reliable sightings in Bass R (near Loch) in mid-2000s, in Allsop Ck (near Loch) in 1980s, in Powlett R (near Wonthaggi) in 1990s. A few reliable sightings in last 10 years in Foster Ck (near Kongwak). Five platypus carcasses were recovered from 2 commercial fyke nets set c. 1 km upstream of the legal commercial eel-netting area in the Tarra R in 2008 (Serena and Williams 2010a).
Moorabool	Widespread; may be locally common at sites that were characterised by reliable surface water/flow through the 2000s	Capture rate (mean ± SEM) in platypus fyke nets set in Moorabool River downstream of Lal Lal Reservoir (Dollys Ck to Midland Highway) from 2003-2006 = 1.1 ± 0.1 animals/site/night (*n* = 3 replicated surveys) (Williams and Serena 2006)
Barwon	Widespread; may be locally common at sites that were characterised by reliable surface water/flow through the 2000s	Capture rate (mean ± SEM) in platypus fyke nets set in Barwon R (Birregurra to Buckleys Falls) from 2001-2003 = 1.4 ± 0.1 animals/site/night (*n* = 3 replicated surveys) (Williams and Serena 2002, 2003); capture rate in platypus fyke nets set in Leigh R (lowest 3 km) from 2001-2003 = 1.3 ± 0.4 animals/site/night (*n* = 3 replicated surveys) (Serena *et al*. 2001, 2002a; Williams and Serena 2003)
Lake Corangamite	Absent/rare	No reliable sighting since the 1940s (Woady Yaloak Ck)
Otway Coast	Absent/rare in Curdies R (Serena *et al*. 2002b) and Anglesea R (vagrants possible); otherwise widespread, common in some catchments	Reliable sightings in last 10 years for Painkalac Ck (Painkalac Reservoir), St George R (Allen Dam), Skenes Ck and (particularly) Barham R, Aire R, Ford R and Gellibrand R catchments. Reliable sightings in last 10 years also available for Erskine R, Carisbrook Ck, Smythes Ck and Wild Dog Ck.
Hopkins and Merri	Widespread; may be locally common at sites that were characterised by reliable surface water/flow through the 2000s	Reliable sightings in last 10 years for Hopkins R (Tooram Stones to Ararat), Fiery Ck, Cave Hill Ck, Mt Emu Ck (many locations), Burrumbeet Ck and Brucknell Ck (at Naringal East). Reliable sightings in last 10 years for Merri R at Bushfield, Grassmere and Woodford; also at Wollaston Rd bridge (Warrnambool) as recently as 2014. Capture rate (mean ± SEM) in platypus fyke nets set in Hopkins R near Mortlake from 1999-2001 = 1.2 ± 0.3 animals/site/night (*n* = 3 surveys) (Williams *et al*. 2002); capture rate in platypus fyke nets set in Mt Emu Ck near Skipton in 2003-2004 = 1.7 ± 0.5 animals/site/night (*n* = 2 replicated surveys) (Williams 2004).

Portland Coast	Absent/rare	Consistently negative sightings reports from long-time landowners along Moyne R, Shaw R and Eumeralla R. A few reliable sightings in Darlots Ck (1982, 2000 or 2001) and near Fitzroy R mouth (2000 or 2001) may represent vagrants/dispersers from Hopkins/Merri or Glenelg R systems
Glenelg	Widespread, especially in Glenelg R downstream of Rocklands Reservoir and Wannon R/Grange Burn; may be locally common in habitats characterised by reliable surface water/flow through the 2000s	Reliable sightings in last 10 years for Glenelg River (lower Glenelg River National Park to Balmoral), Wannon R (Glenelg R confluence to Bulart), Grange Burn and Crawford R
Mallee and Millicent Coast	Absent/rare (populations presumably were extinguished by drought in mid-to-late 2000s)	Two reliable sightings made in Mosquito Ck near Langkoop in 2002

Appendix 2. Known and presumed distribution of platypus (derived from live-trapping surveys and reliable sightings) in AWRC river basins of the greater Melbourne region as of spring 2014. Capture rates as reported in Kelly *et al*. 2013 and Griffiths *et al*. 2014.

River basin	*Distribution and status*	*Comments*
Werribee	Patchy distribution in Werribee River and tributaries from Ballan to Werribee Park Golf Club. Absent/rare in upper Lerderderg R upstream of Lerderderg Gorge, Little R, Stony Ck, Skeleton Ck and Kororoit Ck	Capture rate (mean ± SEM) in platypus fyke nets set in Werribee R in Werribee township from 2008-2013 = 0.18 ± 0.07 animals/site/night (*n* = 10 surveys). Occasional captures in platypus fyke net surveys in Werribee R at Bacchus Marsh from 2008-13 (*n* = 10) and Ballan from 2012-14 (*n* = 4). Occasional sightings and incidental by-catch from fish surveys in other reaches of Werribee R.
Maribyrnong	Occurs throughout Jacksons Ck and in Riddells Ck, Deep Ck and Maribyrnong R upstream of Western Ring Rd	Capture rate (mean ± SEM) in platypus fyke nets set in: • Jacksons Ck from Organ Pipes NP to upstream of Sunbury from 2008-2013 = 0.42 ± 0.1 animals/site/night (*n* = 11 surveys). • Deep Ck near Darraweit Guim township from 2008-2013 = 0.05 ± 0.03 animals/site/night (*n* = 10 surveys). • Deep Ck near Bulla township from 2008-2013 = 0.51 ± 0.2 animals/site/night (*n* = 6 surveys)..
Yarra	Widespread in Yarra R and tributaries upstream of Bulleen. Occasional vagrants occur farther downstream, e.g. in Merri Ck and Darebin Ck. Captures from 2008-14 in Plenty R downstream of Mernda, Diamond Ck, Mullum Mullum Ck, Andersons Ck, Olinda Ck, Wandin Yallock Ck, Woori Yallock Ck, Sassafras Ck, Emerald Ck, Chum Ck, Watts R, Badger Ck and Big Pats Ck. May be locally common in Yarra R and tributaries upstream of Warburton. Absent/rare in Toorourrong Reservoir system, Arthurs Ck, Running Ck, Steels Ck, Dixons Ck, Pauls Ck, Stringybark Ck	Numerous sightings along Yarra R upstream of Bulleen. In tributaries, platypus are generally most abundant at sites relatively near the Yarra R confluence. Capture rate (mean ± SEM) in platypus fyke nets set in: • Lower Plenty R near Lower Plenty from 2008-2013 = 0.1 ± 0.05 animals/site/night (*n* = 11 surveys). • Middle Plenty R near Plenty Gorge from 2008-2013 = 0.12 ± 0.04 animals/site/night (*n* = 10 surveys). • Diamond Ck near Eltham from 2008-2013 = 0.17 ± 0.06 animals/site/night (*n* = 11 surveys). • Mullum Mullum Ck near Templestowe from 2008-2013 = 0.43 ± 0.17 animals/site/night (*n* = 12 surveys). • Olinda Ck near Lilydale from 2008-2013 = 0.37 ± 0.05 animals/site/night (*n* = 12 surveys). • Wandin Yallock Ck near Seville from 2008-2013 = 0.26 ± 0.06 animals/site/night (*n* = 10 surveys). • Woori Yallock/Sassafras Cks near Monbulk from 2008-2013 = 0.4 ± 0.04 animals/site/night (*n* = 10 surveys). • Chum Ck near Chum Creek township from 2009-2013 = 0.4 ± 0.12 animals/site/night (*n* = 7 surveys). • Little Yarra R near Yarra Junction from 2008-2013 = 0.27 ± 0.08

		animals/site/night (*n* = 10 surveys). • Tributaries of Yarra R near Warburton from 2008-2013 = 0.65 ± 0.09 animals/site/night (*n* = 10 surveys).
Dandenong	Occurs in Monbulk Ck system upstream of Ferny Ck confluence. Absent/rare in upper Dandenong Ck/Dobsons Ck and Dandenong Ck downstream of Liverpool Retarding Basin, Ferny Ck and Eumemmerring Ck	Capture rate (mean ± SEM) in platypus fyke nets set in: • Lower Monbulk Ck near Lysterfield from 2008-2013 = 0.18 ± 0.04 animals/site/night (*n* = 12 surveys). • Upper Monbulk Ck near Belgrave from 2008-2013 = 0.18 ± 0.07 animals/site/night (*n* = 13 surveys).
Bunyip	Occurs in Tarago R and Bunyip R (including tributaries where reliable water is present, e.g. Cannibal Ck, Labertouche Ck, Snake Ck). Also found in Cardinia Ck upstream of Beaconsfield township. Sparse occurence in Lang Lang R and Minnieburn Ck	Capture rate (mean ± SEM) in platypus fyke nets set in: • Lower Tarago R near Longwarry North from 2008-2013 = 0.52 ± 0.1 animals/site/night (*n* = 10 surveys). • Upper Tarago R upstream of Tarago Reservoir from 2009-2013 = 0.31 ± 0.1 animals/site/night (*n* = 8 surveys). • Labertouche Ck near Labertouche from 2008-2013 = 0.32 ± 0.07 animals/site/night (*n* = 10 surveys). • Lower Bunyip R/Cannibal Ck near Pakenham from 2008-2013 = 0.35 ± 0.15 animals/site/night (*n* = 6 surveys). • Upper Bunyip R/tributaries (Bunyip State Park) from 2008-2013 = 0.1 ± 0.05 animals/site/night (*n* = 10 surveys). • Lang Lang R near Athlone from 2008-2013 = 0.1 ± 0.05 animals/site/night (*n* = 9 surveys).