

Victorian Wildlife Rehabilitation Guidelines

Part B: Mammals

Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.

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Chapter 1. **Bandicoots**



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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

When bandicoots come into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition, and an environment appropriate to the stage of rehabilitation. The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

1.1 Introduction

There are three species of bandicoot in Victoria: the long-nosed bandicoot, the eastern barred bandicoot, and the southern brown bandicoot. Registered carers with the appropriate skills, knowledge and experience can care for sick, injured or orphaned long-nosed bandicoots. Eastern barred bandicoots and southern brown bandicoots are both listed as endangered under the Victorian *Flora and Fauna Guarantee Act 1988* and the Australian *Environment Protection and Biodiversity Conservation Act 1999*.




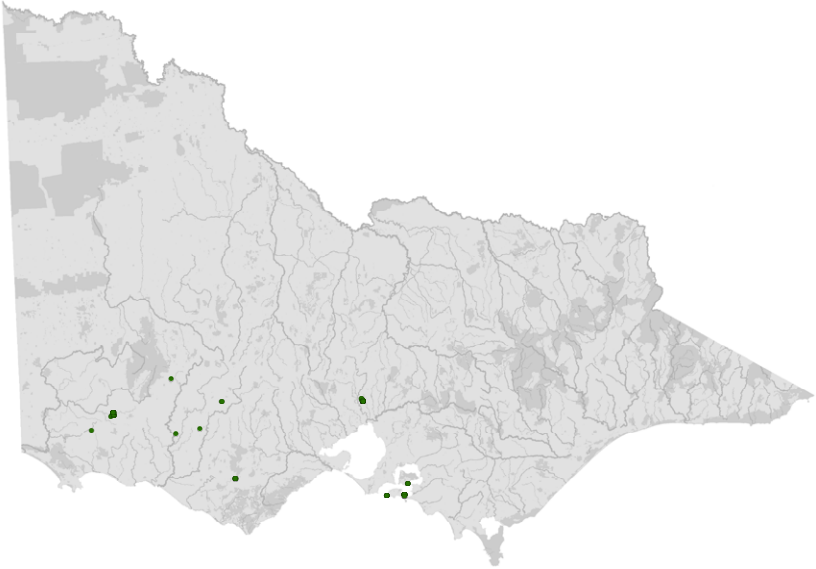
STOP – If an endangered species comes into care, please STOP and refer to your authorisation for mandatory conditions, including notification and release requirements.

1.2 Species information


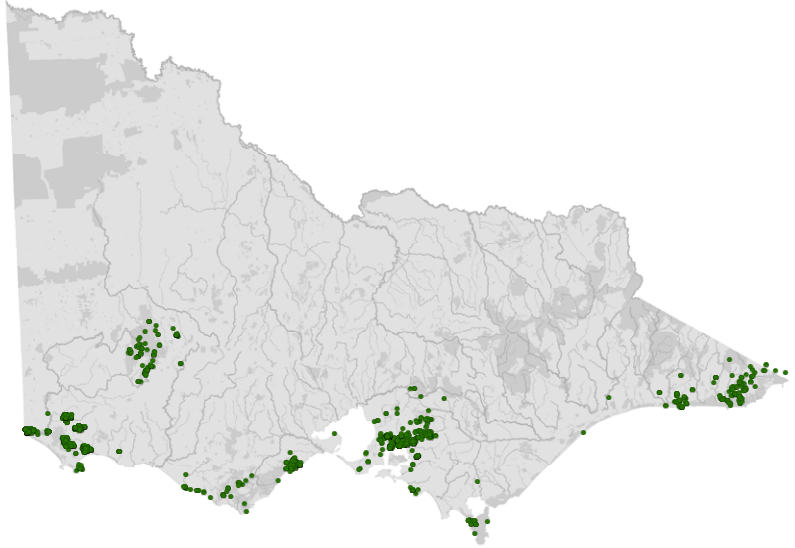


Profiles for the bandicoot species found in Victoria are detailed in **Table 1.1**. For assistance in identification of bandicoot species, refer to the recommended reading and reference material at the end of this chapter.


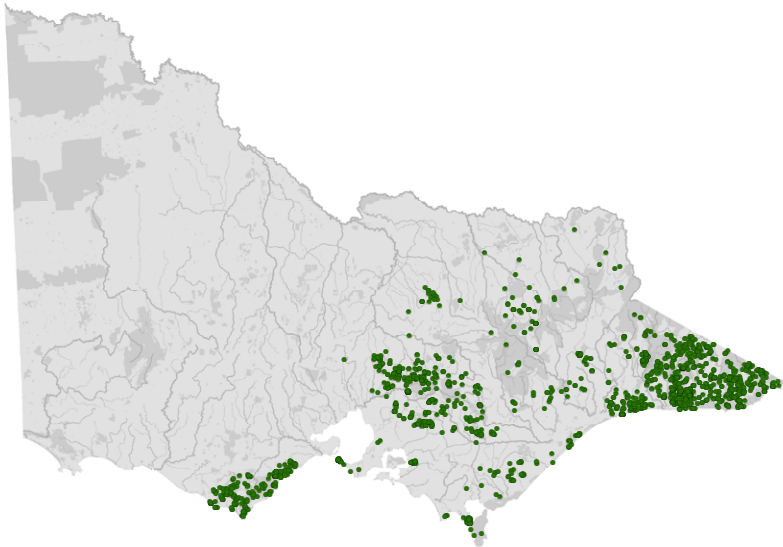
Table 1.1 Species profiles

Species	Eastern barred bandicoot (<i>Perameles gunnii</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Grey-brown fur with 3–4 pale/fawn/cream bars on hindquarters, short tail. Long muzzle</p>
<p>Conservation status*</p>	<p>Endangered</p>
<p>Sexual dimorphism</p>	<p>Males heavier and longer, with paired external testes in pedunculated, furred scrotum. Females have a backward-opening pouch with 8 nipples</p>
<p>Adult morphometrics</p>	<p>Body weight: 750–800 g Head and body length: 300–480 mm Tail length: 60–110 mm</p>
<p>Home range</p>	<p>Male: 4–13 ha Female: 1.9–6.4 ha Home ranges overlap</p>

Species	Eastern barred bandicoot (<i>Perameles gunnii</i>)
Behaviour	Principally nocturnal, some emerge at dusk. Solitary unless mating. Mutual avoidance common, males can be territorial
Diet	Omnivorous: range of adult and larval invertebrates (earthworms, cockroaches, crickets, moths, caterpillars); plant material (tubers, bulbs, fruits, berries of native and introduced plants)
Longevity	2–3 years on average
Sexual maturity	Male: 4 months Female: 3 months
Mating season	Year round
Gestation length	~12.5 days
Litters per year	Up to 5 (average 2–3 young per litter)

Species	Southern brown bandicoot (<i>Isodon obesulus</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Fur coarse, grey or yellowish brown above, with whitish belly. Small round ears, brown feet
Conservation status*	Endangered

Species	Southern brown bandicoot (<i>Isoodon obesulus</i>)
Adult morphometrics	Body weight: 400–1850 g Head and body length: 280–360 mm Tail length: 90–145 mm
Home range	Male and female: 0.5–5 ha
Behaviour	Nocturnal. Solitary unless mating. Territorial.
Diet	Omnivorous: range of adult and larval invertebrates (earthworms, cockroaches, crickets, moths, caterpillars); plant material (tubers, bulbs, fruits, and berries of native and introduced plants), occasionally moss
Longevity	Up to 4 years
Sexual maturity	Male: 7 months Female: 7 months
Mating season	Year round
Gestation length	~12 days
Litters per year	2–3 (2–3 young per litter)

Species	Long-nosed bandicoot (<i>Perameles nasuta</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>

Species	Long-nosed bandicoot (<i>Perameles nasuta</i>)
General appearance	Typically dark, greyish-brown fur, with creamy white below. Muzzle is long and pointed. Larger ears, white feet
Conservation status*	Least concern
Adult morphometrics	Body weight: 750–1100 g Head and body length: 310–445 mm Tail length: 120–160 mm
Home range	Male: 3–5 ha Female: 1–2 ha
Behaviour	Nocturnal. Solitary unless mating. Territorial
Diet	Omnivorous: range of adult and larval invertebrates (earthworms, cockroaches, crickets, moths, caterpillars); plant material (tubers, bulbs, fruits, and berries of native and introduced plants)
Longevity	Up to 3 years
Sexual maturity	Male: 5 months Female: 4 months
Mating season	Year round
Gestation length	~12 days
Litters per year	2–4 (2–3 young per litter)

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>

1.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care, this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for bandicoots is in **Section 1.6.2**.

The following information relates to human and animal health and safety considerations specifically related to the rehabilitation of bandicoots.

1.3.1. Human safety considerations

- Bandicoots can give a painful bite that can draw blood.
- Bandicoot hindlimbs can kick strongly, and their hind claws may break human skin.

1.3.2. Animal safety considerations

- Bandicoots can be very flighty and will jump when disturbed, and are highly stressed by human handling, so gentle but firm handling is required.
- Some bandicoots, particularly southern brown bandicoots, can lose significant amounts of fur in clumps during handling.
- Do not hold bandicoots by the tail or hind legs as they can kick back very strongly leading to joint dislocations, or fractures of the leg bones or vertebrae.
- Capture is ideally timed for when they are resting/sleeping in their daytime nests. Carers should be vigilant in detecting signs of excessive stress (panting, salivation, open mouth breathing, rapid/shallow respiration) as prolonged chasing or handling of bandicoots has been associated with death due to capture myopathy. Injuries such as fractures or damage to the nose, digits or nails are common if bandicoots jump or attempt to climb enclosure walls during capture. If not successful on the first attempt, leave the enclosure or area, and return once the animal has had time to recover.
- Bandicoots are sensitive to high temperatures and prone to development of hyperthermia. Capture, handling, and transport of bandicoots should not occur when temperature is $>25^{\circ}\text{C}$ unless there is an urgent need to capture the bandicoot for veterinary assessment. Transport should only occur in enclosed vehicles which can be maintained between $15\text{--}25^{\circ}\text{C}$.
- Bandicoots are solitary animals, and should always be housed individually, unless they are orphaned litter mates.

1.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in rehabilitation. See Section 1.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned bandicoots.

1.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement, and posture. Check for evidence of injury/severe disease or deterioration and assess their breathing as demonstrated in the following table.

Table 1.2 Visual health observations in bandicoots

What to look for	
Demeanour	<ul style="list-style-type: none"> As a small, shy prey species, healthy wild bandicoots are bright, alert and respond quickly to stressful stimuli such as noise, bright lights, sudden movements or the presence of people or other animals
Behaviour	<ul style="list-style-type: none"> Healthy bandicoots should be active at night, although some individuals may emerge from nest boxes at dusk Note that it is not unusual to see southern brown bandicoots out during the day Bandicoots forage for food using their forepaws and nose. If you don't see this behaviour directly, look for evidence in substrate which suggests it has occurred overnight Bandicoots drag nesting materials, such as dried leaf litter, grass or hay, into a nest (such as a nest box or tree hollow) to create a dense nesting area in which they sleep during the day
Movement and posture	<ul style="list-style-type: none"> Bandicoots can stand upright, with weight bearing completely on their hindlimbs Slow movement is described as a 'slow bunny hop', with both hindlimbs and then both forelimbs moving alternately. When moving fast, the use of limbs retains the same pattern, but is much faster and is described as a 'bound' or 'gallop'. This movement can often be in a zig-zag pattern When alert, the head is held upright, and the animal will respond to sound by moving the head or ears towards the sound

What to look for

Breathing	<ul style="list-style-type: none"> • Quietly observe the animal without disturbing. Since bandicoots are small animals, it may be difficult to visualise normal respiration in a healthy animal • Panting (rapid, shallow breaths, often accompanied by head bobbing) in an animal at rest may be a sign of severe stress or disease. It may indicate the onset of capture myopathy, severe debilitation, or respiratory disease, and is an indication that veterinary attention is urgently required. Keep handling/stress to a minimum until veterinary advice is sought
Enclosure sand pads	<ul style="list-style-type: none"> • Indirect visual observation of sand pads in an enclosure can indicate drag marks, activity around food bowls and faecal matter

1.4.2. Equipment

- **Cage Trap:** If cage trapping of an injured animal is needed, authorisation is required. Contact the Office of the Conservation Regulator (OCR) for advice regarding an Authority to Control Wildlife application available here: vic.gov.au/wildlife-management-and-control-authorisations.
- **Net:** Square or round commercially purchased nets are used (See **Figure 1.1**). Hoop diameter ~40 cm is suitable but should be padded with foam. Netting material should be removed from commercially purchased nets (it is abrasive and can cause injuries to eyes, digits/nails and nose) and replaced with a breathable material 'bag' such as an inside out flannel pillowcase.
- **Catch bag:** Breathable material bags can be used to confine the animal for short periods of time or to allow for physical examination (See **Figure 1.2**). Ensure there are no unfinished seams or loose threads inside, as these can lead to entanglement. Bags with an unfinished seam may be used inside out. A strong material (such as calico) is preferred as the strong claws can rip through a pillowcase. Bags can be secured with elastic bands/pipe cleaners or ties which are attached to one seam to prevent escape.
- **Transport container:** The transport container should be large enough to ensure the bandicoot can turn around, (~ 40 cm (L) x 20 cm (W) x 20 cm (H)). The transport container should close securely to prevent escape. A solid-walled container is preferred. Plastic pet carriers can be used for short distances and can be easily cleaned between uses. Wooden boxes are commonly used and sturdier, but harder to clean/disinfect. (See **Figure 1.3a** and **b**). Adequate ventilation is required and can be achieved by drilling small holes into the sides and top of the box, or by including a panel of small gauge mesh wire, lined on the internal surface with hessian or shade cloth to prevent injury to nose, digits and nails.

Figure 1.1 Nets suitable for bandicoot capture.



Photo credit: Zoos Victoria

Figure 1.2 Catch bag suitable for bandicoots.



Photo credit: Zoos Victoria

Figure 1.3 Suitable transportation boxes for bandicoots: **a.** Wooden transport box **b.** Suitable transportation boxes for bandicoots, collapsible pet pack.



Photo credit: Zoos Victoria

1.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

- Care should be taken when capturing bandicoots from enclosures with natural substrate. Naturally built nests can be hard to spot, and bandicoots can easily be stepped on. They can be identified by a small mound of soil in the ground or enclosure substrate. Bandicoots may also be nesting under logs, under tree branches or at the base of shrubs. Bandicoots can be very flighty, even when restrained in a bag or net, kicking out with their hind legs.
- All bandicoot handling should occur at ground level to minimise the risk of injury. For example, do not attempt to transfer from a net to a handling bag on a table or elevated surface, as the animal may kick and jump off the table causing injury.

- Free ranging bandicoots (in the wild, or in a captive enclosure with natural substrate) are most safely captured using a net. If the bandicoot is in a natural nest, place the net at the opening of the nest and gently encourage the bandicoot to enter the net using your hands to apply pressure from the other side. Quickly close off the net once the animal is inside by holding the top or twisting it and placing it back on the ground, to prevent the animal's escape and to restrict movement.
- To move the animal from the net to the handling bag there are two methods:
 - Turn the catch bag inside out, with hands inside and reach into the net to cup the individual. Lifting the animal up (within the net still), fold the catch bag around the individual so your hands are now on the outside of the bag; or place one hand into the net, not allowing too much light to enter, and position at the front end of the bandicoot. Once in place, lower the net (keeping the eyes covered), and place a second hand on the hind end of the bandicoot. Manually lift the bandicoot, keeping it in a firm semi-circle, and place into the catch bag.
- If the bandicoot is nesting in a box, you may need to part the nesting material to locate the animal and then roll down the catch bag, place the opening over the animal and gently use your hands to encourage the animal into the bag before closing.
- If the animal requires examination, this should be done with the animal still restrained within the catch bag, gently extracting each body part sequentially, as required. The bandicoot is less likely to struggle or attempt to escape if the eyes are covered.
- While manual restraint outside of a bag will rarely be required, this can be achieved by firmly and gently placing the thumb and index finger of one hand either side of the head, with the other hand used to support the back end of the body as demonstrated in **Figure 1.4** a and b. The hind limbs should be left free to allow the animal to kick freely. Restraining hind limbs can result in dislocations and fracture of the bones of the legs and spine.

Figure 1.4 a, b and c. Bandicoot manual restraint technique: Wrap your fore and middle finger of one hand firmly but gently around the neck behind the ears, while the other hand supports the body, leaving the feet free to kick out.

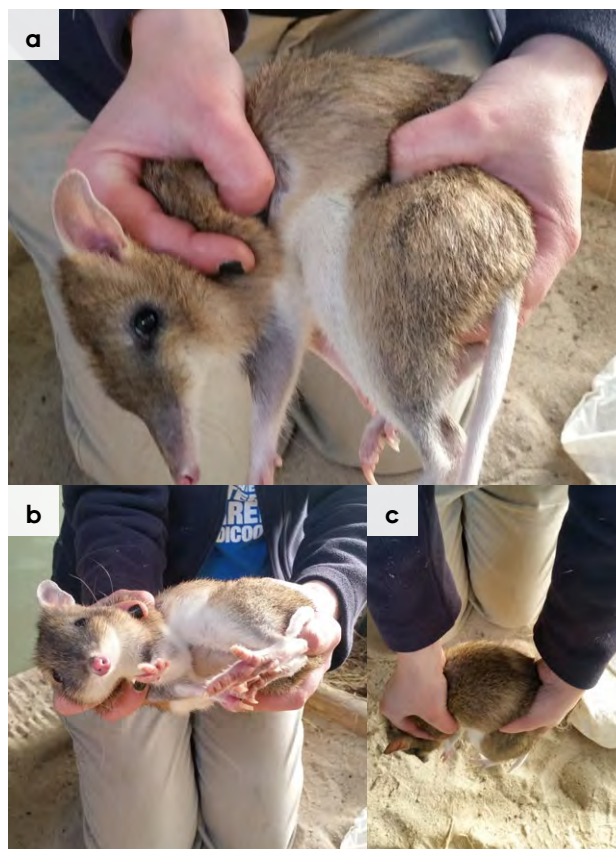


Photo Credit: Zoos Victoria

1.4.4. Transport

- When moving bandicoots, the transport box should be loosely filled with nesting material such as hay, grass or shredded paper, with a hole in the centre to provide a 'nest like' environment to provide security and reduce stress. Animals should be nested in the transport box without the handling bag to ensure adequate ventilation.
- Note that animals being transported for release should be transported in shredded paper to prevent the spread of unwanted grass seeds to release locations.
- Transport containers should only be opened in safe environments at ground level and handlers should be prepared for animals that might jump out (ensure a net is available nearby).
- Ideally temperatures should be kept between 18–25°C. Transporting animals on extremely hot days should be avoided.
- A quiet, air-conditioned, enclosed vehicle should be used for all transportation. Ensure that there is adequate ventilation, that the boxes are out of direct sunlight, and if transporting animals in a car, ensure air-conditioning is on, to reduce heat stress.
- Ensure that noise is minimal during transportation.

1.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release, should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and quickly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping of visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care through minimising human-animal interactions and stress to the animal, to maximise successful release back to the wild.

Please note: A common behavioural response to chronic high-level stress is 'learned helplessness'. This is exhibited as increasingly passive behaviour in response to aversive stimuli and can be misinterpreted as having 'settled in' or being 'relaxed' or 'chilled out'. Carers should always aim to treat animals as efficiently as possible, so that they can be returned to the wild in the shortest possible time. This section provides guidance on assessment of health on arrival and on effective monitoring of the health and welfare of animals up to the point of release back to the wild.

1.5.1. Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure weighing scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or an injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording Physical Examination findings can be found in the Appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from any domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examination of bandicoots should be conducted with the animal safely restrained inside the catch bag (See **Figure 1.4**).
- Specific parts of the body can be gently exposed as required for the physical examination.
- Bandicoots will be calmer during manual restraint if their eyes remain covered by the catch bag.
- Handling should be kept to a minimum as over handling can lead to weight loss.
- **Table 1.3** provides additional guidance on what to look for during physical examinations.

Table 1.3 Physical examination of bandicoots (See Section 1.6 for further information)

What to look for	
Body weight	<ul style="list-style-type: none"> • Will vary with age. • Record body weight on arrival and at least weekly whilst in care. • Bandicoots are prone to obesity in care – adults that present in good body condition should not gain more than 10% of body weight during rehabilitation. Orphaned bandicoots should gain weight according to the growth and development chart presented in Section 1.9 of this chapter. • A greater than 10% change in body weight over a week is cause for concern, and the carer should seek veterinary advice immediately. • Note that some animals can take between 1–3 weeks to acclimatise.
Body condition	<ul style="list-style-type: none"> • With the bandicoot safely restrained in the catch bag with its eyes covered, body condition can be assessed by carefully and gently palpating over the shoulders, spine, and rump. <p>Body condition can be described as follows:</p> <ul style="list-style-type: none"> • Under condition: The bones of the pelvis, vertebrae and scapular spine are very prominent, and are easily seen and palpated. There is very little muscle coverage over the pelvis and rump area. • Ideal condition: The pelvic bones, vertebrae and scapular spine can be palpated, but they are not protruding significantly. There is good muscle coverage over the hips and rump area, along the spine, and over the shoulders. • Over condition: A layer of fat/padding can be felt over the pelvis, spine and scapular spine, and the bones are difficult to feel. There are bulges of fat around the neck and abdomen.
Hydration status	<ul style="list-style-type: none"> • In healthy bandicoots, the skin slides easily over the shoulder blades/spine, and when the skin is 'tented' (or gently pinched up) over the spine/between the shoulder blades, it should fall back within one second. Bandicoots that are dehydrated have dry looking gums, sunken eyes and a slow skin tent.
Eyes	<ul style="list-style-type: none"> • With the bandicoot still restrained in the bag, expose one eye at a time for examination to minimise stress. • Basic internal structures of eyes (e.g. pupil, iris) appear symmetrical. • There should be no cloudiness or grey colour (See Figure 1.5). Eyelids open, with no discharge or crust. • If observed at night with a torch, eye-shine should be symmetrical, round, bright light from both eyes.

What to look for	
Ears	<ul style="list-style-type: none"> Ears are held alert and move quickly in response to noise. Some parasites (ticks and mites) may be present and can be left if there isn't an excessive load and there is no evidence of irritation/excessive scratching inside the ears. Healthy wild males may present with tears in their ears due to territorial disputes.
Mouth	<ul style="list-style-type: none"> With the bandicoot gently restrained in the bag, and both eyes covered, expose the mouth and gently lift the lip along one side to examine the teeth and gums. Look for any wartlike growths/masses on the lips (See Section 1.6, this chapter for more information). If present, the bandicoot should be seen by a veterinarian as soon as possible. Gums are pink and slightly moist, no excessive salivation or blood coming from inside the mouth. Teeth in healthy bandicoots have sharp pointy edges. Healthy aged bandicoots have worn teeth. Excessive wear of molars (down to gumline) is seen in geriatric bandicoots. Ulcers on the tongue have recently been seen in wild eastern barred bandicoots (see Figure 1.6), but the cause is unknown. If ulcers/lesions are seen on the tongue, the bandicoot should be seen by a veterinarian. An undershot jaw has been seen in some eastern barred bandicoot wild populations (See Figure 1.11)
Skin and coat condition	<ul style="list-style-type: none"> Healthy wild bandicoots, particularly males, may present with some fur patches missing, torn ears or tail injuries because of territorial disputes (see Figure 1.7). This is not a cause for concern. A small number of parasites (fleas, ticks, mites) is normal. Trombiculid mites are commonly seen in wild eastern barred bandicoots (See Figure 1.8). Raised wartlike lesions, particularly around the lips and eyes, on the feet (see Figure 1.9), around the pouch and surrounding the cloaca have been seen in wild bandicoots in Western Australia and are associated with a virus. If present, the bandicoot should be seen by a veterinarian as soon as possible.
Limbs, feet, and tail	<ul style="list-style-type: none"> Check all feet and nails (See Figure 1.10). Bandicoots can damage toes or pull nails as a result of capture, handling, and captive housing and transport. Examine each digit for injury to toes or nails. Nail loss is painful and can result in bone exposure and infection. Seek urgent veterinary assessment.
Sex determination	<ul style="list-style-type: none"> The sex of bandicoots is easily determined by the presence of testicles (males) or a pouch (females).
Pouch check	<ul style="list-style-type: none"> Faces backwards. Eight teats should be present. These may be elongated, with or without swollen mammary glands. If pouch young are present, count the number and assess age, as a lactating female may require additional food. Rehabilitators should minimise handling where possible when pouch young are present to reduce the chance that the mother will reject them.

1.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the Appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observation and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Schedule your health and welfare observations for times of the day when the animal is expected to be active.
- The use of infra-red cameras can allow monitoring of behaviour overnight.
- If the animal is being medicated, schedule treatment for the morning, use this time to perform a visual check. If the animal is receiving medication in the morning and evening, the evening medication may be delivered in a cricket, to minimise the need for extra handling.
- Ideally, physical observations should be undertaken at the beginning and/or end of the resting period to minimise disturbance and maximise the rest/sleep period for rapid healing and ensure ease of capture.
- If using sand for a portion of the substrate in larger housing, inspect and rake at the same time each day, ideally morning. This allows for observations of the animal's nocturnal activities and may identify any new injuries (e.g. dragging foot, different shape print).
- Food and water dishes may be placed in the sand area, this can indicate if the animal is visiting the food dish at night.
- If diarrhoea is noticed, a faecal sample should be collected and submitted to the veterinarian for assessment as soon as possible. Do not treat on suspicion of coccidiosis or a bacterial infection, as this can make definitive diagnosis very difficult and potentially prolong the course of the disease.

1.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 1.4 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to receiving veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying, or found dead at the same time, with similar signs – may indicate an animal disease emergency, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 1.4 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Clinical signs and possible causes	Possible Causes	Rehabilitator observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to walk or move normally</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fractures</p> <p>Dislocation</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in wire or netting, predation injury caused by raptor, fox, cat or dog, gunshot</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to veterinarian to apply first aid, other than to stop excessive bleeding. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not attempt to stabilise fractures as this is very painful, and risks making the injury worse. Fracture stabilization should only be attempted by a veterinarian following physical exam, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure/ box/bag to find the source of injury. Fix loose wire/ gaps or sharp edges before returning the animal to its enclosure. See Section 1.4 and Section 1.6 this chapter for further advice on housing and transport. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. Seek advice from species experts.

Clinical signs and possible causes	Possible Causes	Rehabilitator observations and response
<p>Swollen foot or toe</p> <p>Wound to foot or toe</p> <p>Bleeding foot or toe</p> <p>Damaged or missing nail</p> <p>Bleeding nail</p>	<p>Toe, foot or leg caught in netting, wire or bag</p> <p>Predation injury caused by raptor, fox, cat or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Seek prompt veterinary attention. Apply first aid to minor wounds (See Part A for First Aid guidance). • Injuries to nails are very painful and lesions can be very slow to heal. There is a risk of nail bed infection, veterinary management is required. Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure/ box/bag to find the source of injury. Fix loose wire/ gaps or sharp edges before returning animal to enclosure. See Section 1.4 and Section 1.6 this chapter for further advice on housing and transport. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. Seek advice from species experts.
<p>Bleeding</p> <p>Puncture wounds</p> <p>Bruising</p> <p>Fur loss</p>	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by raptor, fox, cat or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Bite wounds/scratches may not be immediately obvious, these can carry a very poor prognosis and animals often present as moribund, very lethargic, poorly responsive, and cold. Look for small clumps of dried fur stuck together with saliva, part the fur and look for very small puncture wound/s.

Clinical signs and possible causes	Possible Causes	Rehabilitator observations and response
<p>Swollen tail</p> <p>Wound under tail</p> <p>Swelling around/above cloaca</p>	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by raptor, fox, cat or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Seek urgent veterinary advice. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Injuries to tails are very painful and lesions can be very slow to heal. Veterinary management is required. Tail injuries can occur in captivity in stressed animals jumping in enclosure and causing tail trauma. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. Seek advice from species experts.
<p>Blindness</p> <p>Deafness</p> <p>Neurological signs</p> <p>Wobbly movement or ataxia</p> <p>Circling movement</p> <p>Strange behaviour, easily caught</p> <p>Lethargic</p> <p>Moribund, collapsed</p>	<p>Infectious disease, such as toxoplasmosis, bacterial meningitis, cranial trauma, toxicity (e.g. 1080 poisoning)</p>	<ul style="list-style-type: none"> • Seek urgent veterinary advice. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Carer may observe animal bumping into objects in enclosure or fail to respond to short sharp noises (such as a loud clap from behind animal). • Pupils may be fixed/dilated and not responsive to changes in light level. You should see pupils constrict if a pen light is shone in the eye. • If multiple animals are seen with similar signs, this may indicate a newly emerging infectious disease or a toxicity (such as plant toxicity or poisoning). Contact the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours) as soon as possible. • If unusual toxicity or infection is suspected, you or your veterinarian can contact the Veterinary Department at Zoos Victoria to discuss options for disease investigation.

Clinical signs and possible causes	Possible Causes	Rehabilitator observations and response
<p>Diarrhoea</p> <p>Loose, smelly faeces</p>	<p>Inappropriate diet, infectious disease, alteration of microbiome, stress, parasites, antibiotic treatment</p>	<ul style="list-style-type: none"> • Seek veterinary advice. • Seek urgent veterinary advice if diarrhoea does not resolve rapidly (e.g. within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. Do not treat on assumption of infectious disease (e.g. coccidia or bacterial infection) as this can make veterinary diagnosis more difficult if the animal does not improve. • If the animal has been otherwise stable and doing well, there are several responses carers may implement to try to resolve the diarrhoea. Consider any recent changes which may have led to the diarrhoea and remove the inciting cause where possible (such as rapid change in diet, unusual levels of sound/intervention or handling, contact with recently arrived animals). • Seek advice from species experts, ensure diet and husbandry practices are correct. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. • Be careful of rapid diet changes for animals undergoing hand rearing. • Do not mix oral rehydration fluids in with milk as it changes the digestibility of the milk. Oral rehydration fluids/water can be provided in between milk feeds. • Ensure excellent hygiene standards to prevent spread to other animals/carers and isolate this animal from any others in care, if possible.
<p>Skin irritation/ fur loss</p>	<p>Conspecific aggression, breeding season interactions, mite infestation</p>	<ul style="list-style-type: none"> • Seek veterinary advice or assessment. • Some fur loss/minor skin lesions are commonly seen due to fighting or in the breeding season and may not require any intervention. • A small number of ticks/mites can be normal, and do not require treatment or removal. However, if there is a very high number of ticks/mites seen, the animal is scratching/irritated, or the skin is red and inflamed, seek veterinary attention to treat ectoparasites.

Clinical signs and possible causes	Possible Causes	Rehabilitator observations and response
Raised wartlike lesions	Bandicoot papillomavirus	<ul style="list-style-type: none"> • Observation of these lesions may indicate a newly emerging disease issue, contact one of Zoos Victoria's Veterinary Departments as soon as possible. Raised wartlike lesions have been seen in wild bandicoots in Western Australia. These lesions are caused by newly identified viruses and are a newly emerging infectious disease issue in wild bandicoots.
Ulcerative lesions on tongue	Cause undetermined, rarely seen in eastern barred bandicoots	<ul style="list-style-type: none"> • Observation of these lesions may indicate a newly emerging disease issue, contact one of Zoos Victoria's Veterinary Departments as soon as possible. Tongue lesions/ulcerations have recently been seen in wild eastern barred bandicoots, but the cause is not known.
Emaciation Lethargy Poor coat condition Excessive tooth wear	Sick, diseased or injured animal, geriatric animal	<ul style="list-style-type: none"> • Seek veterinary assessment. • Geriatric bandicoots often present with worn teeth, this is a normal finding however, if a geriatric bandicoot has come into care because it is in poor health and thin, euthanasia may be the most humane outcome for this animal as it is at the end of its life.

Figure 1.5 a and b. Normal eyes are shiny, bright and open. Pupil will contract if a pen light is shone into the eye. Cloudiness in the eye (see b) can be caused by lens degeneration (e.g. cataracts) or severe inflammation/trauma to the cornea. If seen, seek veterinary advice.

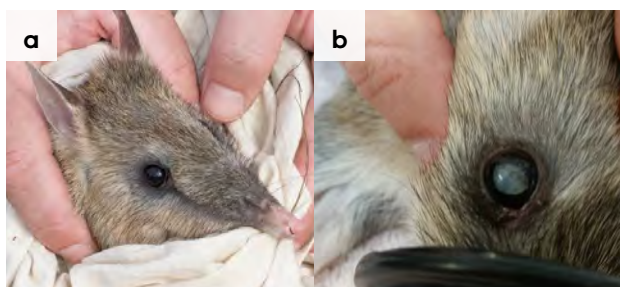


Photo credit: (a) David Paul, Museums Victoria and (b) Zoos Victoria

Figure 1.6 Tongue lesion in eastern barred bandicoot (viewed under anaesthetic).

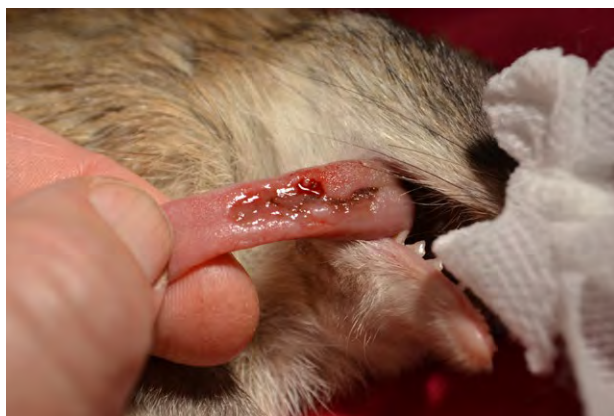


Photo credit: Zoos Victoria

Figure 1.7 A wild, adult bandicoot with patches of fur missing over its rump, likely due to fighting with another wild male. These patches can be associated with scratch marks and bruising and commonly occur in the wild.



Photo credit: David Paul, Museums Victoria

Figure 1.8 Trombiculid mites commonly cluster around the scrotum in males and around the edge of the pouch in females as seen here. Numbers are generally higher in summer and are known to cause irritation and inflammation on the skin. Seek veterinary advice.



Photo credit: Zoos Victoria

Figure 1.9 Bandicoot papillomavirus has been seen in western barred bandicoots and southern brown bandicoots in Western Australia. While it has not been seen in Victoria, carers should be aware of this as a potential emerging condition. If any raised, wartlike lesions are seen on bandicoots, seek veterinary advice urgently from Zoos Victoria.



Photo credit: Zoos Victoria

Figure 1.10 a. Healthy hind foot of eastern barred bandicoot, b. Evidence of toe lesions, c. Nail loss and bone exposed.

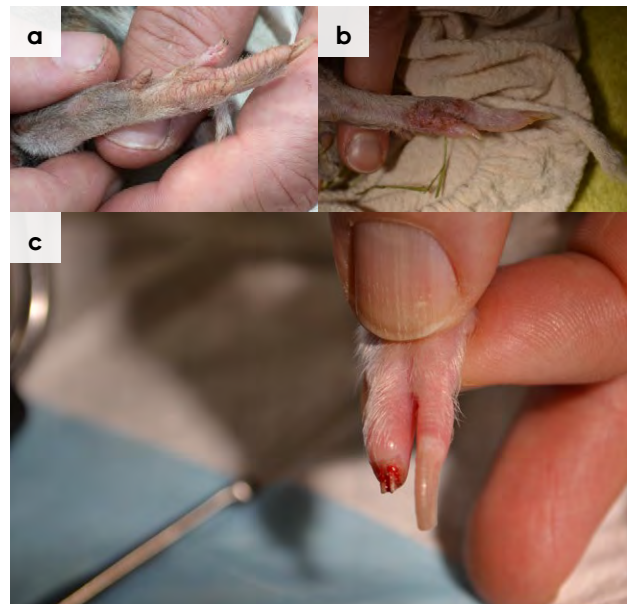
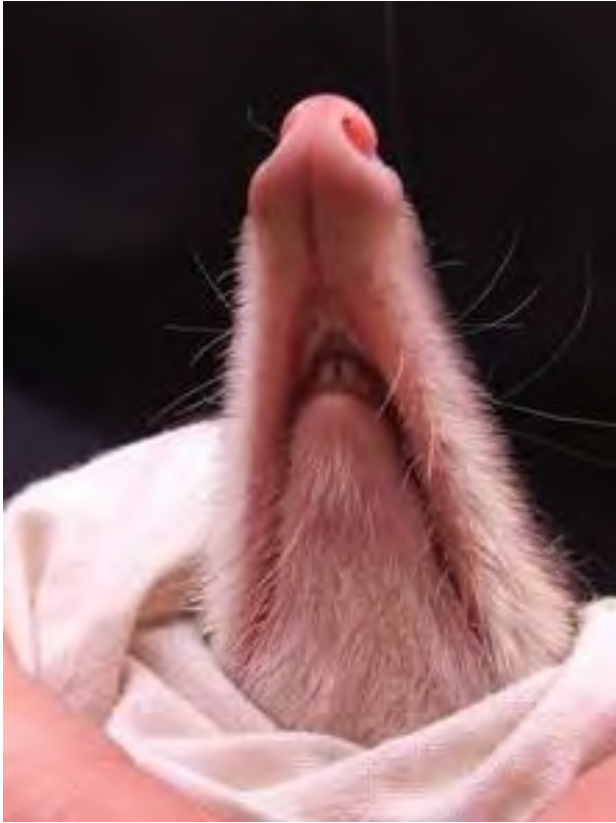


Photo credit: (a) David Paul, Museums Victoria, (b) & (c) Zoos Victoria

Figure 1.11 Undershot jaw seen in eastern barred bandicoot



- Oral medications can most easily be delivered in a 1mL or 3mL syringe directed into the cheek from the side of the mouth while the bandicoot is restrained in a catch bag. Palatable oral medicine may be delivered indirectly, by injecting a food item such as a mealworm or mixing with a high value reward such as blended fruit. Morning treatments may be delivered into the mouth during the daily examination, and bandage check, the animal can then be left to rest for the day. Evening doses can be given in a mealworm or cricket, reducing the need to handle again. Be sure to note the location of the medicated insect in the food dish and ensure it is eaten.
- Fruit is no longer provided in captive bandicoot diets because it causes dental disease and is not required for a balanced diet. However, judicious use of a small amount of chopped fruit, such as blackberries, blueberries or apples, mixed with the captive diet may help to encourage eating in a sick/stressed bandicoot. This should be discussed with a veterinarian. Sudden changes in diet should be avoided, as they can lead to constipation or diarrhoea.

1.5.4. Administering treatment

- Bandicoots housed in enclosures that support easy and frequent capture for intensive care will tolerate handling for medication or treatment twice a day for up to ~1 week (see **Table 1.5**).
- Toe injuries and nail avulsion which occur during captive care are very difficult to treat, are very painful and carry a poor prognosis. These lesions can be incredibly slow to heal and are prone to becoming non-healing wounds. These wounds should be managed by a veterinarian, including, bandage removal and wound assessment being performed by a veterinarian under general anaesthesia. Wildlife rehabilitators can support this process by ensuring bandages remain clean and dry and monitoring wounds daily. Pay particular attention to use of the affected limb and see a veterinarian promptly if lameness appears or increases or the bandage slips or appears too tight, evident by limb swelling.

1.6 Housing

Below are several key considerations when housing adult animals in care.

1.6.1. General housing information for bandicoots

- To reduce noise and disturbance, a bandicoot should be situated in quiet locations, away from noise, heavy foot or road traffic, aerial stressors, and domestic pets.
- Visual barriers can be incorporated into enclosures through the addition of vegetation.
- Since they are prone to hyperthermia, ambient temperature should remain between 15–25°C. Enclosures should be designed to provide protection from environmental elements while still ensuring adequate ventilation and access to sun and UV for basking.
- Bandicoots are nocturnal, so indoor enclosures need to consider provision of appropriate photoperiod (cycles of light and dark periods) and UV access.
- Since bandicoots are prone to severe, difficult to treat digit and nail injuries, care should be taken to ensure:
 - no gaps in corners/joins or holes in sheet metal in which a nose or limbs could get trapped
 - no sharp edges or rough finishes
 - sufficient substrate (min 15 cm) to prevent digging to wire
 - no furnishings with sharp/jagged edges
 - no mesh wire starting lower than 1.2 m.
- Bandicoots are solitary in the wild. Adult bandicoots being held in captivity for rehabilitation should be housed individually.
- Bandicoots being handled frequently for treatment or confined in very small spaces for prolonged periods can become increasingly stressed.

1.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain the highest levels of hygiene to avoid inadvertently transferring diseases between animals and from humans and, to protect the wild population where the animal will eventually return to.

Species specific considerations:

- Any direct or indirect exposure to cats should be avoided as bandicoots are extremely sensitive to toxoplasmosis, a disease transmitted through contact with cat faeces.
- Ideally, examination gloves should be worn and changed in between animals.
- Leftover food and faecal matter should be spot cleaned daily.
- Any wet/sodden or soiled organic furnishings, substrate or enrichment items should be removed as soon as possible and replaced with clean/dry alternative. When provided with sand substrate (on floor of enclosure or shallow tray) bandicoots often defaecate in this area. This provides an opportunity for monitoring faecal output and allows for easy spot cleaning.
- Since these enclosures are used to house sick/injured bandicoots, they should have all organic matter removed, and be cleaned/ disinfected after each animal has used it. Careful consideration of construction materials will improve hygiene and make cleaning easier.
- Enclosures should be disinfected with products such as F10 SC, bleach or Virkon S at the recommended concentrations and contact times. Virkon S and bleach must be rinsed off following the appropriate disinfection times.

- Soil substrate floors provide an opportunity for digging and are inexpensive, however they must be underwired to ensure animals do not escape. Use of soil substrate enclosures should be considered carefully. The risk of infectious disease transmission is increased, as they cannot be disinfected. Some bacteria and parasites will exist in soil for long periods of time.

1.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care.

Table 1.5 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 1.8**.

Table 1.5 Rehabilitation housing for adult bandicoots

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment – frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision where strict cage rest/ confinement is indicated</p>	<p>60 cm (L) x 40 cm (W) x 40 cm (H) (surface area 0.24 m²)</p> <p>Large enough for adult to stand and turn around comfortably</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Enclosed wooden/plastic tub with adequate ventilation, or purpose-built intensive care unit designed for small animals. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Newspaper, shredded paper or towels may be used to line the floor, changed daily. • A small hide should be provided – a variety of materials can be used (e.g. cardboard box, small nest box, PVC pipe or bark). • A small towel can be used to fully or partially cover any gaps to reduce stress. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Narrow temperature range ~20–23°C. • Reverse light cycle. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Fresh water (always available) and captive diet should be provided in stable dishes. • Regular check of substrate to ensure water has not spilt/ enclosure is not wet.

Intermediate housing (Treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care.</p> <p>Enclosure furnishings can be arranged to reduce opportunities to climb/dig or move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact</p>	<p>Enclosure: 1 m (L) x 1 m (W) x 1 m (H) (Surface area 1 m²)</p> <p>Nest box: 30 cm (L) x 30 cm (W) x 24 cm (H)</p> <p>Enclosure allows some movement and normal behaviour but movement is restricted. Handling for rehabilitation and/or medication is still required</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Solid floor/walls and roof with adequate ventilation. • The internal surface of any wire mesh walls should be fully covered with shade cloth to prevent damage to digits and nose. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • A 10–15 cm deep layer of clean, non-compactable organic matter is required to allow the bandicoot to forage (such as clean leaf litter, shredded paper, clean/dry straw). • Nesting opportunities should be provided (such as a wooden nest box, grass tussock, wooden board against the enclosure edge or bark/halved hollow log with hay underneath). • Fresh grass, straw or hay should be placed inside the enclosure to allow bandicoots to line their nest/hide, this allows the display of natural nesting behaviour. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Narrow temperature range ~20–23°C. • Reverse light cycle. • UVB light during daylight hours. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Fresh water (always available) and captive diet should be fed in stable dishes. • Regular check of substrate to ensure water has not spilt/ enclosure is not wet.

Pre-release

Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/ medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitoring/ assessment of behaviour (foraging, digging, nest building)</p> <p>Pre-release assessment</p>	<p>Enclosure: 4 m (L) x 4 m (W) x 2 m (H) (Surface area 16 m²)</p> <p>Nest box: 30 cm (L) x 30 cm (W) x 25 cm (H)</p> <p>Enclosure allows expression of a full range of natural behaviours</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Rodent proofing achieved with a solid floor (preferably concrete). If mesh flooring is used, minimum 15 cm soil covering to prevent nail/nose damage by digging, which significantly reduces the ability to clean/maintain hygiene. • Walls require solid surface to at least 1.5 m from ground level. Solid tin sheets/HDPE plastic sheeting can be used to cover mesh walls. Ensure no sharp edges if tin is used. • Adequate drainage to prevent pooling of water. At least 1/3 of the surface area of the enclosure should be completely covered (solid roof and solid walls to the roofline). • Commercially available bird/chicken aviaries can be suitable as a base/frame.

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
		<p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • A 10–20 cm layer of clean, non-compactable organic matter laid over the soil/concrete flooring to allow digging activity. Graded bark or leaf litter can be used (avoid anything dyed or treated and replace leaf litter frequently to prevent mould). • Nesting opportunities should be provided, this can be achieved by the provision of a wooden nest box, grass tussock, hollow log/bark, (40–80 cm long), wooden board leaning against the enclosure wall to create a cavity for nesting material, branches laid on the substrate or a halved plastic tub with hay (See Figure 1.12). • Fresh grass, straw or hay should be placed inside the enclosure to allow the bandicoot to line nest/hide – allows display of natural nesting behaviour. • Replace any hides/furnishings or substrate which is wet/soiled. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Sufficient areas with sunshine during the day to dry out materials and prevent mould under leaf litter etc. • Roof sprinklers/misters on open section of the enclosure – used to reduce ambient temperature when temperatures exceed 28°C. Bursts of 10–15 minutes are sufficient. Care should be taken to avoid flooding and creating a humid environment. • Use of shade cloth blinds (rolled up or down as required) on open parts of walls/roof provide flexibility/dynamic response to sunlight/heat. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Fresh water (always available), changed daily, provided in a sturdy/non-spill bowl or a fillable drinker. • Food scattered over a tray/shallow dish of fine whitewashed sand substrate placed in the roofed/protected area of the enclosure.

Figure 1.12 Young bandicoot in intermediate housing.



Photo credit: Zoos Victoria

Figure 1.13 Pre-release bandicoot enclosure, showing sheet metal to 1.5 m to avoid nail/digit damage, and enclosure furnishing as described in Table 1.5.



Photo credit: Zoos Victoria

1.7 Feeding and nutrition



Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how the animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of fully independent bandicoots in rehabilitation. Information on feeding orphaned bandicoots can be found under **Section 1.8 Hand raising**.

- Bandicoots are omnivorous and eat a wide range of invertebrates (mainly insects) and plant material. Wild bandicoot diets are presented in **Table 1.1**.
- Bandicoots have a high metabolic rate and wild bandicoots spend a significant proportion of their waking hours actively foraging for food. Bandicoots are prone to obesity when fed high volumes of calorie dense food without the need to expend energy foraging. Body weight and Body Condition Score should be measured and recorded at the time of arrival into care, and at least weekly until released to the wild.
- Rehabilitators should record the amount of food offered in the afternoon and measure the amount of food remaining in the morning so that they are aware of how much food the animal is consuming, or whether there is a diet item which the animal does not appear to like eating. Diets are formulated to provide balanced nutrition, so simply removing one diet item may lead to an unbalanced diet. If the animal continues to leave a single diet item, seek veterinary advice. For wild bandicoots not familiar with a captive diet, the addition of a judicious amount of one of the preferred diet items can encourage eating. Examples include a small quantity of canned dog food, highly palatable supplements such as Ilium Nutrigel or Nutripet (Troy High Energy Vitamin Concentrate) or a small volume of blended fruit (such as apple). However, it is important to reduce the volume of this high value feed over a few days (volume should be reduced by about 25% per day) once the bandicoot has started eating other diet items. Fresh water should always be available and provided in a stable/non-spill bowl or automatic drinker. Water should be changed daily.

Table 1.6 Daily feeding and diet guide for adult bandicoots during rehabilitation

Diet	<p>Meal worms are high in fat and should never comprise 100% of the invertebrate portion of the diet.</p> <p>The following diet should be fed:</p> <ul style="list-style-type: none"> • 20 g gut loaded, mixed live invertebrates (fly pupae, cockroaches, grasshoppers, crickets, mealworms, earthworms, isopods). The invertebrate portion of the diet should be made up of more than one species. • 20 g good quality puppy kibble. Note: where insects are not reliably available, increase puppy kibble portion to 40 g per day, and feed as many insects as possible. • 5 g greens (choose from endive, alfalfa sprouts or mung bean sprouts). • 20 g mixed diced (pea sized) vegetables (choose a combination of sweet potato, broccoli, corn, peas, zucchini).
Pre-release considerations	<ul style="list-style-type: none"> • If live invertebrates have not comprised 50% of the protein component of the diet until this time, the proportion of live food fed should be gradually increased so that 50% of the protein portion of the diet is comprised of live invertebrates at least two weeks prior to release. • The following diet change schedule can be followed: <ul style="list-style-type: none"> - Baseline diet: 40 g kibble/0 g live invertebrates. - Day 1: 35 g kibble/5 g live invertebrates. - Day 3: 30 g kibble/10 g live invertebrates. - Day 6: 25 g kibble/15 g live invertebrates. - Day 9: 20 g kibble/20 g live invertebrates. • Monitor appetite, behaviour and faecal consistency closely during diet change. If any change is noted, do not proceed to the next diet change step and seek veterinary advice. The length of time between percentage change in kibble offered can be increased to reduce potential impact on gut health. • A variety of live insects should be offered, scattered throughout the enclosure to encourage foraging behaviour. See Release Protocol at Section 1.9 below for more detailed information.
Frequency/time of feeding	<p>Feed once per day, in the late afternoon (just before sunset).</p>

1.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations are found in the Appendices to Part A in these guidelines.

1.8.1. Equipment required for hand raising

- **Milk provision:** Small/narrow silicon syringe teat (for example, those designed to fit the end of the hub of a syringe), eye dropper or a short length of human infant nasogastric feeding tube for smaller joeys. Shallow dish or plastic lid can be used for larger joeys once they are lapping (See **Figure 1.14**).
- **Bedding material:** Small pouch made from non-abrasive materials such as close-knit wool or polar fleece with a cotton or brushed cotton inner layer. A woollen beanie works well as an outer pouch layer.
- **Housing:** Refer to housing sections in species specific table in **Section 1.8.2**. While bandicoots have been hand raised successfully in simple transport boxes with a heat pad, a thermostatically controlled portable animal intensive care unit is ideal until the age of permanent emergence from the pouch. This ensures a constant thermal environment to avoid over or underheating.
- **Other:** Set of scales, record charts, digital thermometer/datalogger to monitor temperature inside the pouch/enclosure.

Figure 1.14 Young eastern barred bandicoot lapping milk from shallow lids.



Photo credit: Zoos Victoria

1.8.2. Growth, feeding and housing of orphaned offspring



STOP - Please refer to your authorisation for mandatory conditions regarding unfurred bandicoot joeys.

- Ensure enclosures are secure and are constructed in a manner which prevents injury. Bandicoot joeys are very nimble, energetic and have a flighty, nervous disposition. They are fast, and can easily slip through small spaces, and climb wire mesh. If joeys are housed at bench height be mindful of their speed, as they could dart out and fall from a height. The carer should place their torso across the box door opening to block the exit.
- Orphaned bandicoots imprint/bond easily with their rehabilitators. Handling should be kept to a minimum and they should be encouraged to lap from a small dish as soon as possible.
- **Milk:** Bandicoot milk is extremely high in fat which continues to rise during lactation, supporting one of the fastest marsupial growth rates. Bandicoots also wean at a relatively young age, making them much quicker to hand raise than many other Australian native species. Several different milk replacers have been used to successfully hand raise bandicoots (see Species **Table 1.7**, **Table 1.8** and **Table 1.9** below for detailed information). Rehabilitators are advised to follow package instructions to ensure appropriate concentration and volume is fed, and to contact providers with any questions.

- **Growth and development:** Since bandicoot joeys develop rapidly, close monitoring of weight and development is vital to identify concerns as soon as possible. A small amount of weight loss can be expected over the first few days in care, however, once settled, weight should steadily increase. While weight increases of up to 20 g per day have been documented, an average increase of 4–6 g per day is expected (see Species Tables below for detailed information).
- **Toileting:** Hand reared pouch young need to be stimulated to urinate and defaecate after each feed by gently wiping the cloaca using a warm moist cotton ball. Bandicoot joeys pass urine after each feed, and faeces 1–2 times per day. Maintaining daily records of urination/defaecation is vital. Seek veterinary advice if diarrhoea or constipation are seen over multiple feeds. If a joey does not drink well at a feed time, it is recommended to temporarily stop the feed and try stimulating first, then return to feeding.
- **Weaning:** As soon as weaning begins, food can be placed in a tray of fine sand to encourage natural digging and foraging behaviours while still allowing the carer to carefully monitor food consumption and see which food items are preferred. Choose solid food items from the adult diet items listed in **Table 1.6**. Live invertebrates should be adequately gut loaded to ensure muscle and bone development.

Table 1.7 Feeding and housing requirements for long-nosed bandicoots

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
40	50 g	<ul style="list-style-type: none"> • Eyes open • Fine fur emerging • Teeth erupt 	<ul style="list-style-type: none"> • Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer, Biolac M100 transitioning to M150 once fully furred. • Feed volume and frequency: 10–15% body weight per day divided evenly across all feeds; feed every 4 hours, aim towards spacing out over 12 hours (dusk till dawn) to allow rest during the day. • Feeding technique: Milk from syringe teat, small teat. • Toilet: after each feed. 	<ul style="list-style-type: none"> • Bedding material: Pouch can be left open to allow emergence. • Enclosure: Secure box or thermostatically controlled, portable animal intensive care unit. • Temperature range: 28–30°C.

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
45	65 g	<ul style="list-style-type: none"> Short, velvet fur 	<ul style="list-style-type: none"> Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer, Biolac M150 transitioning to M200 once pelleted faeces formed. Feed volume and frequency per day: 10–15% bodyweight, 4 times daily spaced over 12 hours (dusk till dawn) to allow rest during the day. Feeding technique: Milk from syringe teat, small teat, but also encourage lapping by providing small amount of volume in a dish/lid during each feed. Toilet: after each feed. 	<ul style="list-style-type: none"> Bedding material: Pouch can be left open to allow emergence. Enclosure: Inside in a large tub with leaf litter. Ensure sufficient ventilation. If wire is used in lid, cover inside with shade cloth. Temperature range: Ambient temp maintained around 28°C.
50	80 g	<ul style="list-style-type: none"> Fur becoming longer and changing colour 	<ul style="list-style-type: none"> Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer, Biolac M200. Feed volume and frequency: 10–15% bodyweight, 3 times spaced over 12 hours (dusk till dawn) to allow rest during the day. Feeding technique: Milk offered in dish only, no more bottle feeds. Offer gut-loaded invertebrates in evening. Toilet: toileting not required but monitor faecal output. 	<ul style="list-style-type: none"> Bedding material: Pouch kept closed to keep animal contained, placed within a wooden nest box. Enclosure: Inside in a large tub with leaf litter. Ensure sufficient ventilation. If wire is used in lid, cover inside with shade cloth. Temperature range: Ambient temp maintained around 28°C.

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
60	100–150 g	<ul style="list-style-type: none"> Fully furred 	<ul style="list-style-type: none"> Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer, Biolac M200. Feed volume and frequency: 10% bodyweight. Start to reduce milk feeds during this period, aiming for once a day only, by 150 g. Feeding technique: Milk offered in dish only. Offer gut loaded invertebrates, small amount of crushed dog kibble and mixed vegetables in the evening. Water: always available and provided in spill proof dish. Toilet: toileting not required, but monitor faecal output. 	<ul style="list-style-type: none"> Bedding material: Continue to use wooden nest box but remove pouch and offer nesting materials in box and enclosure floor to encourage nest building. Enclosure: Inside in a large tub with leaf litter. Ensure sufficient ventilation. If wire is used in lid, cover inside with shade cloth. Start to introduce to outside enclosure – e.g. supervised time during evening feed, weather dependent. Temperature range: no supplementary heating required; ambient temp maintained around 20–24°C.
70–80	200–250 g	<ul style="list-style-type: none"> Small adult in size and appearance 	<ul style="list-style-type: none"> Fully weaned, no milk feeds. Adult diet (see Table 1.6 above). 	<ul style="list-style-type: none"> Housing to follow recommendations in Table 1.5 above, pre-release enclosure.

Table 1.8 Feeding and housing requirements for eastern barred bandicoots

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
50–55	Head length 45–50 mm	<ul style="list-style-type: none"> • Emerging from pouch • Very short, fine velvet fur • Eyes fully open • Faeces soft, but formed and dark tan in colour 	<ul style="list-style-type: none"> • Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer supplemented with 10% canola oil. • Feed volume and frequency: ~15–20% body weight per day divided evenly across all feeds. Feed 4–5 times over eight hours. • Feeding technique: Milk provided in dish only, no more bottle feeds. Introduce solids by offering 1–2 invertebrates after milk feed, gradually increasing in number and variety of invertebrates offered. • Toilet: after each feed. 	<ul style="list-style-type: none"> • Bedding material: Pouch opened to allow emergence, placed within a wooden nest box. • Enclosure: Larger enclosure (e.g. 1200 mm length x 600 mm width x 570 mm height) but should still be kept indoors. • Temperature range: 28–30°C.

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
55–60	Head length 50–60 mm	<ul style="list-style-type: none"> • Fully out of pouch • Finely furred • Faeces become darker, firmer brown pellet (smaller but otherwise very similar in appearance to adult bandicoot faeces) 	<ul style="list-style-type: none"> • Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer supplemented with 10% canola oil. • Feed volume and frequency: ~15–20% body weight per day divided evenly across all feeds. Feed 4–5 times over eight hours. • Feeding technique: Milk provided in dish only, no more bottle feeds. Offer gut loaded invertebrates, and crushed kibble and vegetables in the evening. Joeys are likely to show less interest in milk. Monitor weight carefully to ensure sufficient food is being consumed to maintain growth rate. • Toilet: not required, but monitor faecal output. 	<ul style="list-style-type: none"> • Bedding material: Pouch opened to allow emergence, placed within a wooden nest box. • Enclosure: Larger enclosure (e.g. 1200 mm length x 600 mm width x 570 mm height), kept inside. Provide digging tray containing moist soil. Sand and mulch can be added to encourage digging/foraging. • Temperature range: From this point on, no heat mat/ supplementary heat should be provided. Ambient temperature: 26–28°C, can reduce lower end of thermal range to 24°C.

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
60–70	Head length 60–65 mm	<ul style="list-style-type: none"> Fully furred 	<ul style="list-style-type: none"> Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer supplemented with 10% canola oil. Feed volume and frequency: ~10% body weight per day divided evenly across all feeds. Feed 2–4 times over eight hours. Feeding technique: Milk provided in dish only, cease feeding milk if none being consumed. Offer gut loaded invertebrates, and crushed kibble and vegetables in the evening. Joeys likely to show less interest in milk. Monitor weight carefully to ensure sufficient food is being consumed to maintain growth rate – up to 10 g per day at this stage. Water: always available and provided in a spill proof dish. Toilet: not required but monitor faecal output. 	<ul style="list-style-type: none"> Bedding material: Continue to use wooden nest box. But remove pouch and offer nesting materials in box and enclosure floor to encourage nest building. Enclosure: Ward, or secure indoor room. Set up to encourage foraging and nest building with access to open pouch in box in hay. Can be set up in small outdoor enclosure if very well sheltered. Temperature range: Ambient temperature: 20–24°C. If moved outdoors, consider supplementary heat lamp.

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
70–75	Head length ~65 mm	<ul style="list-style-type: none"> Fully furred 	<ul style="list-style-type: none"> Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer supplemented with 10% canola oil – to be fed once per day only until fully weaned. Feeding technique: Offer adult diet in evening (See Table 1.6 above). Monitor weight carefully to ensure sufficient food is being consumed to maintain growth rate, up to 10 g per day. Water: always available and provided in a spill proof dish. Toilet: not required. But monitor faecal output. 	<ul style="list-style-type: none"> Bedding material: Continue to use wooden nest box but remove pouch and offer nesting materials in box and enclosure floor to encourage nest building. Enclosure: Ward, or secure indoor room set up to encourage foraging and nest building with access to open pouch in box in hay. Start to introduce to outside enclosure – e.g. supervised time during evening feed, weather dependent. Temperature range: Ambient temperature 20–24°C.
>75	250 g Head length 60–65 mm	<ul style="list-style-type: none"> Small adult in size and appearance 	<ul style="list-style-type: none"> Fully weaned, no milk feeds. Adult diet (see Table 1.6 above). 	<ul style="list-style-type: none"> Housing to follow recommendations in Table 1.5 above, pre-release enclosure. Supplemental heat should be considered during the transition to being fully outside, particularly if the ambient temperature is cool.

Table 1.9 Feeding and housing requirements for southern brown bandicoots

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
45	40 g Head length 45 mm	<ul style="list-style-type: none"> • Eyes opening • Short, fine fur appearing • Chewing food • Standing and walking, moves very fast and increasingly active • Olive velvet fur. 	<ul style="list-style-type: none"> • Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer supplemented with 0.5 ml of 'The Good Oil' or canola oil per 10 mL milk formula. • Feed volume and frequency: ~10–15% body weight per day divided evenly across all feeds, six times daily spaced over 12 hours. • Feeding technique: keep inside pouch during feeds. Feed using small syringe. Start to introduce lapping by offering small amount of each feed on a small dish. • Toilet: after each feed. 	<ul style="list-style-type: none"> • Bedding material: Pouch opened to allow emergence, placed within a wooden nest box. • Enclosure: Larger enclosure (e.g. 1200 mm L x 600 mm W x 600 mm H), Secure to prevent escape. Enclosure kept indoors. Introduce small amounts of natural substrate (e.g. dry tussocks, dirt, leaf litter). • Temperature range: 26 –30°C.
50–60	60 g	<ul style="list-style-type: none"> • Eyes open • Well furred, golden-brown coat • Emerging from pouch. 	<ul style="list-style-type: none"> • Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer supplemented with 0.5 mL of 'The Good Oil' or canola oil per 10 mL milk formula. • Feed volume and frequency: ~10–15% body weight per day divided evenly across all feeds, four times daily spaced over 12 hours • Feeding technique: Milk fed in small dish – cease bottle feeds. Introduce solids by offering 1–2 invertebrates after milk feed, gradually increasing in number and variety of invertebrates offered. • Water: available water provided in a spill proof dish. • Toilet: not required but monitor faecal output. 	<ul style="list-style-type: none"> • Bedding material: Pouch opened to allow emergence, placed within a wooden nest box. • Enclosure: Larger enclosure (e.g. 1200 mm L x 600 mm W x 600 mm H), Secure to prevent escape, Enclosure kept indoors. Introduce small amounts of natural substrate (e.g. dry tussocks, dirt, leaf litter). • Temperature range: 26–27°C.

Age (days)	Weight / Morphometrics	Observation	Feeding	Housing
60–70	100–180 g	<ul style="list-style-type: none"> • Fully furred • Fully out of pouch • Starting to nest build at night. 	<ul style="list-style-type: none"> • Milk formula: Wombaroo >0.7 Kangaroo Milk Replacer supplemented with 0.5 mL of 'The Good Oil' or canola oil per 10 mL milk formula. • Feed volume and frequency: ~10–15% body weight per day divided in two feeds only. • Feeding technique: Milk fed in small dish. Offer gut loaded invertebrates, and crushed kibble and vegetables in the evening. Joeys likely to show less interest in milk. Monitor weight carefully to ensure sufficient food is consumed to maintain growth rate – up to 10 g per day at this stage. • Water: available water always provided in a spill proof dish. • Toilet: not required. But monitor faecal output. 	<ul style="list-style-type: none"> • Bedding material: Continue to use wooden nest box but remove pouch and offer nesting materials in box and enclosure floor to encourage nest building. • Enclosure: Ward or secure indoor room or sheltered outdoor space. Set up to encourage foraging and nest building with access to open pouch in box in hay. Start to introduce to outside enclosure-- e.g. supervised time during evening feed, weather dependent. • Temperature range: No supplementary heating required, ambient temperature 25–27°C.
70– 90	180–350 g	<ul style="list-style-type: none"> • Small adult in size and appearance 	<ul style="list-style-type: none"> • Fully weaned, no milk feeds. • Adult diet (see Table 1.6 above). 	<ul style="list-style-type: none"> • Housing to follow recommendations in Table 1.5 above, pre-release enclosure.

1.9 Release protocol



Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for such individuals.

1.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

The following check list should be used to guide decision-making regarding release suitability for bandicoots:

- ☑ Individual is in a state of good health – presenting injury/sickness is completely resolved (consider pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 1.1**).
- ☑ Individual displays ability to actively forage for and consume natural foods.
- ☑ Individual displays ability to select suitable nesting site and build nest.

1.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered.

Bandicoots require the following:

- Note the various habitat types for the different bandicoot species to ensure they are released into suitable habitat.
- Suitable vegetation, including grasses and dense lower storey vegetation. Foraging areas need to be close to dense vegetation.
- Dense vegetation cover for building nests. Introduced species, such as *Lantana*, have been used by bandicoots.

- Soil soft enough for digging: most bandicoots will dig shallow, conical pits to retrieve invertebrates in the top layer of the soil or leaf litter.

For more information on the ecology and requirements of bandicoots that may help with their release, please refer to **Table 1.1**.

1.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Suitable vegetation is available, including grasses and dense lower storey vegetation.
- ☑ Ample foraging areas close to dense vegetation.
- ☑ Dense vegetation cover for nest building.
- ☑ Soil layer soft and suitable for foraging/digging.

Release Procedure

- ☑ Limit the number of people at the release.
- ☑ Appropriate timing (one hour after dusk – during natural peak activity).
- ☑ Open transport container away from yourself near dense cover, ensuring that people are standing behind the animal's flight zone.
- ☑ Allow the bandicoot to leave in its own time.
- ☑ Appropriate transport container padded with shredded paper (Note: Hay should not be used, to prevent the dispersal of seeds into the natural environment).
- ☑ Release around dusk to allow them time to settle prior to their peak natural activity in the wild.
- ☑ Release by opening the transport container away from yourself, allowing the bandicoot to leave the box in its own time.

1.10 Key references and additional reading

Brown, GW & Main, ML 2010, National Recovery Plan for the Southern Brown Bandicoot (*Isoodon obesulus*), Victorian Government Department of Sustainability, Melbourne.

Kingston, J. and McCracken, H. 2018. A review of and recommendations for hand rearing of the eastern barred bandicoot (*Perameles gunnii*) at Zoos Victoria.

Maher, C. 2006. Husbandry manual for long-nosed bandicoot (*Perameles nasuta*) <https://aszk.org.au/wp-content/uploads/2020/05/Mammals.-Long-nosed-Bandicoot-2006CM.pdf>

Pauligk, Y. 2021. Eastern barred bandicoot (*Perameles gunnii*) captive husbandry manual

Read, B.E. 2016. Husbandry guidelines for the southern brown bandicoot (*Isoodon obesulus*) <https://aszk.org.au/wp-content/uploads/2020/06/Southern-Brown-Bandicoot-Isoodon-obesulus-Read-B.-2016.pdf>

Chapter 2.

Dasyurids



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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

When wildlife comes into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition, and an environment appropriate to the stage of rehabilitation. The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

2.1 Introduction

Members of the family *Dasyuridae* are polyprotodont (with many front teeth) carnivorous marsupials ranging in size from the small antechinus to the larger Tasmanian devil. Information for some of the dasyurids that may come into care in Victoria is found in **Table 2.1**. Some of these are listed as endangered or vulnerable under the Victorian *Flora and Fauna Guarantee Act 1988* and the Australian *Environment Protection and Biodiversity Conservation Act 1999*.



STOP – If an endangered or vulnerable species comes into care, please STOP and refer to your authorisation for mandatory conditions, including notification and release requirements.

2.2 Species information



Profiles for the most common dasyurid species found in Victoria are detailed in **Table 2.1**. For further assistance in identification, refer to the recommended reading and reference material at the end of this chapter.

Note that antechinuses may be mistaken for introduced rats and mice by members of the public. They can be differentiated from introduced rodents by their teeth (as shown in **Figure 2.1**), snout, shape of their heads, feet, scent and scats. Antechinuses have a narrower snout compared with rodents that have a more rounded head. Male antechinuses have obvious testicles while rodent testicles are much less discernible. Rodents have a musky smell while antechinuses have no odour. Antechinus scats are larger and more cylindrical than rodent ones, which usually have pointed ends.

Figure 2.1 a. Large paired incisors of a rat. b. Small incisors and cheek teeth in the mouth of an antechinus. Antechinuses have eight small sharp front teeth (incisors) on the top arcade and six on the bottom arcade, plus one longer canine on the top and bottom arcades, on each side of the mouth. Rats and mice have only two long incisors on the top arcade, two on the bottom arcade and no canines.

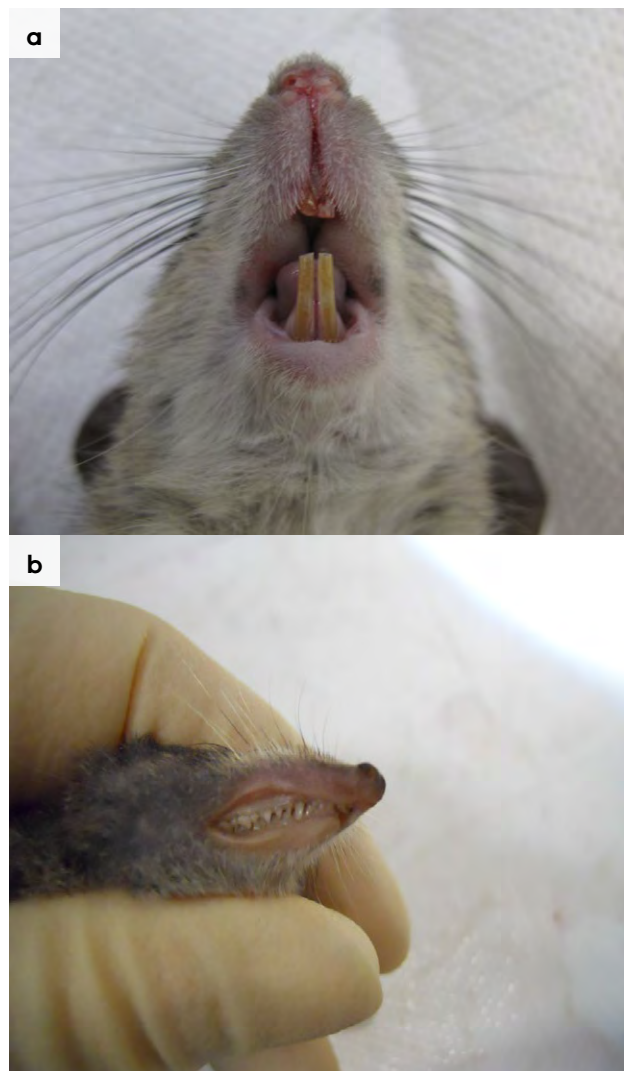

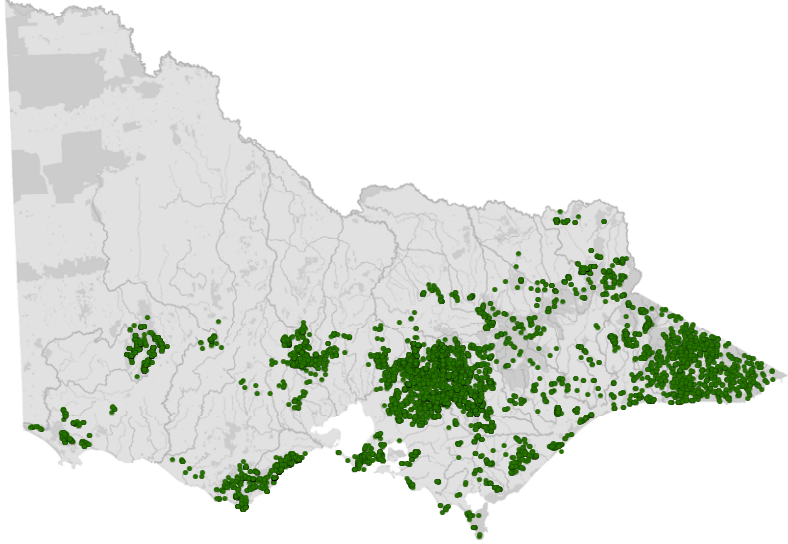


Photo credit: Zoos Victoria

Table 2.1 Species profiles

Species	Agile antechinus (<i>Antechinus agilis</i>)
 <p>Photo credit: David Paul Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Brown fur with pale fur on belly
Conservation status*	Common
Adult morphometrics	Body weight: Males 20–40 g, Females 16–25 g Head and body length: 80–116 mm Tail length: 75–102 mm
Habitat	Wet to dry forest
Home range	Male: 1.8–5.3 ha Female: 1.2–2 ha
Behaviour	Nocturnal. Communal nests. Not territorial
Diet	Invertebrates (beetles, weevils, spiders, cockroaches) Small vertebrates (lizards) Berries
Longevity	Male: 11 months Female: 24 months
Sexual maturity	Male: 9–10 months Female: 10–11 months

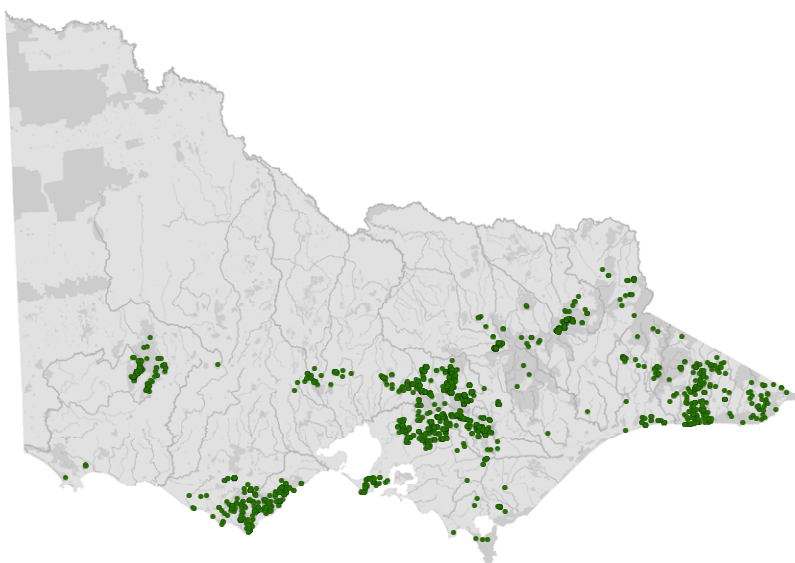
Species	Agile antechinus (<i>Antechinus agilis</i>)
Mating season	Late July to September
Gestation length	26–25 days
Litters per year	1 litter of 6–10

Species	Dusky antechinus (<i>Antechinus mimetes</i>)
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Photo credit: David Paul, Museums Victoria


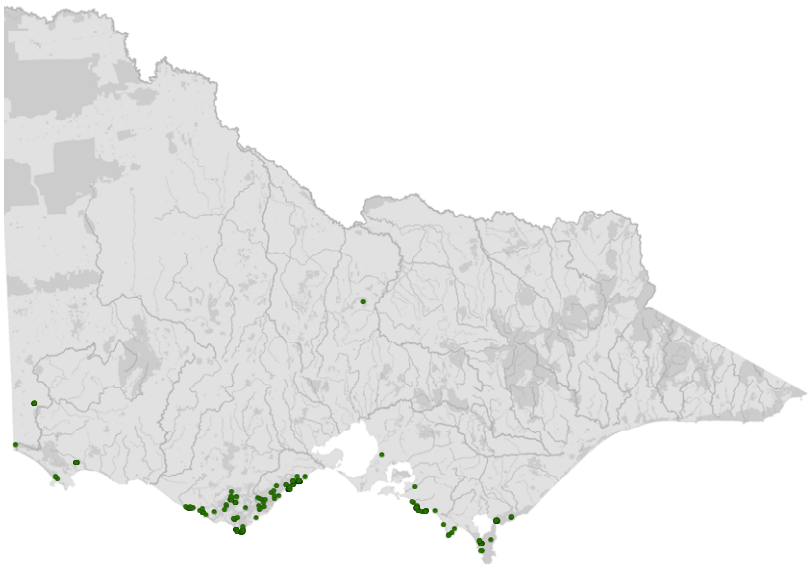
Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance	Largest of Victorian antechinuses, the dusky antechinus has brown-black or grey-brown fur
Conservation status*	Common
Adult morphometrics	Body weight: Male 43–130, Female 37–70 g Head and body length: 90–185 mm Tail length: 75–120 mm
Habitat	Dry to wet forest with dense undergrowth
Home range	Male: Likely to be 1–2 ha Female: Likely to be 1–2 ha
Behaviour	Diurnal and nocturnal. Solitary. Mostly ground dwelling

Species	Dusky antechinus (<i>Antechinus mimetes</i>)
Diet	Invertebrates (beetles, weevils, spiders, cockroaches) Small vertebrates (lizards) Berries
Longevity	Male: 11 months Female: 24–36 months
Sexual maturity	Male: 8 months Female: 11 months
Mating season	May–September (resource dependent)
Gestation length	29–36 days
Litters per year	1 litter of 6–10

Species	Swamp antechinus (<i>Antechinus minimus maritimus</i>)
 <p>Photo credit: Trevor Pescott with permission to use image by the State Wide Integrated Flora and Fauna Teams (SWIFFT)</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Medium sized antechinus, with golden brown rump and flanks, and grey head and shoulders. Pale belly and short hair on tail. Tail and ears short, and eyes small. Pale eye ring present

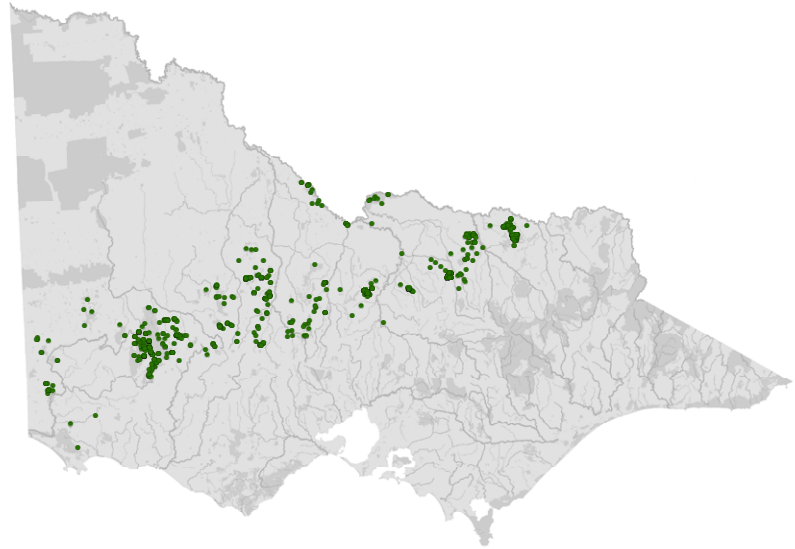
Species	Swamp antechinus (<i>Antechinus minimus maritimus</i>)
Conservation status*	Vulnerable
Adult morphometrics	Body weight: Male 50–129 g, Female 36–68 g Head and body length: 99–140 mm Tail length: 65–100 mm
Habitat	Coastal, damp forest, woodland, heathland, sedgeland and tussock grassland with dense undergrowth Close to drainage lines and reedy swamps
Home range	Male: 2.7 ha Female: 1.7 ha
Behaviour	Nocturnal or diurnal depending on the population Solitary, but communal burrows used Ground dwelling
Diet	Invertebrates (beetles, weevils, spiders, cockroaches)
Longevity	Male: 12 months Female: 18–36 months
Sexual maturity	Male: unknown (likely to be 8–10 months) Female: unknown (likely to be 10–12 months)
Mating season	May–August
Gestation length	28–32 days
Litters per year	1 litter of 6–8

Species

Yellow-footed antechinus (*Antechinus flavipes*)

Photo credit: Esky's Images


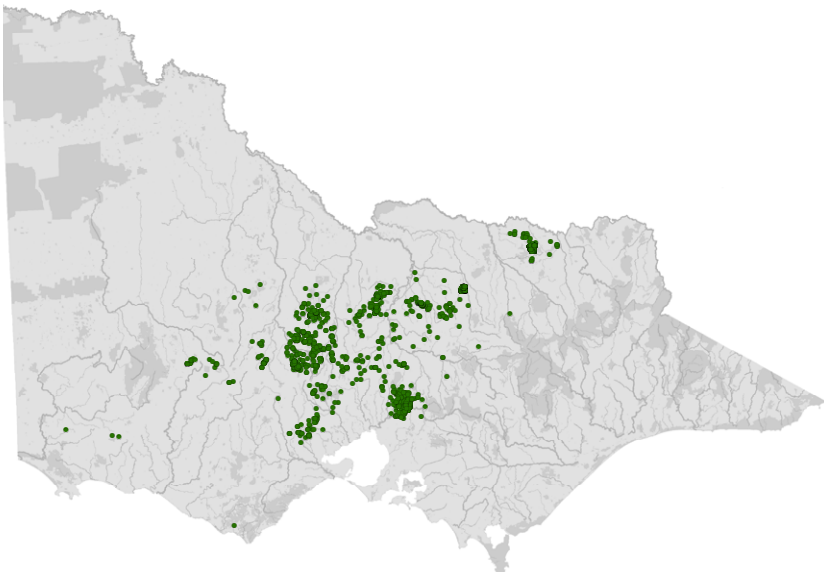
Distribution map



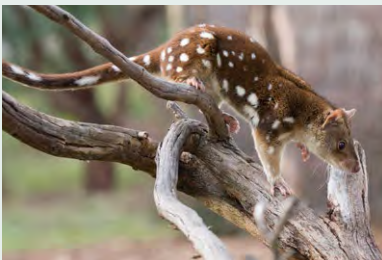
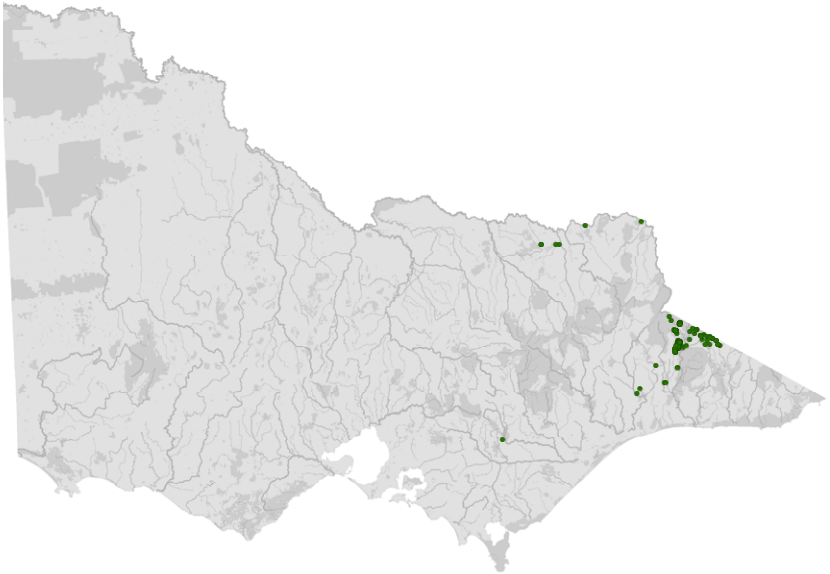
Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance	Fur colour change from a grey head to rufous rump, light eye rings, black tail tip. Sparse hair on tail
Conservation status*	Common
Adult morphometrics	Body weight: Male 26–79 g, Female 21–52 g Head and body length: 90–160 mm Tail length: 65–140 mm
Habitat	Dry woodland
Home range	Male: 0.27–0.31 ha, Female: 0.27–0.31 ha
Behaviour	Nocturnal
Diet	Invertebrates (beetles, weevils, spiders, cockroaches) Small vertebrates (birds, mice) Flowers, nectar
Longevity	Male: 11 months Female: 24 months
Sexual maturity	11 months


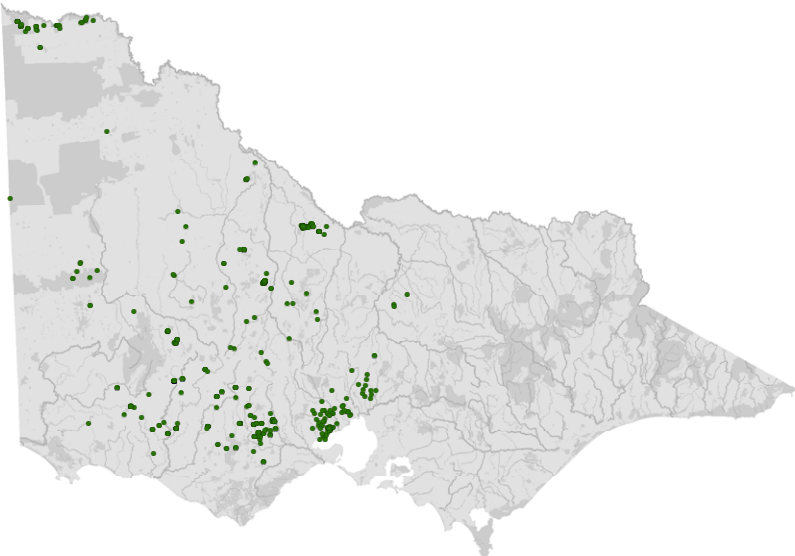
Species	Yellow-footed antechinus (<i>Antechinus flavipes</i>)
Mating season	July
Gestation length	30 days
Litters per year	1 litter of 10–14

Species	Brush-tailed phascogale (<i>Phascogale tapoatafa</i>)
 <p>Photo credit: Zoos Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Black bushy tail, naked ears, fine white rings around eyes
Conservation status*	Vulnerable
Adult morphometrics	Body weight: Male 175–311 g, Female 106–212 g Head and body length: 150–260 mm Tail length: 165–235 mm
Habitat	Dry woodland
Home range	Male: >100 ha Female: 20–40 ha
Behaviour	Nocturnal. Usually solitary. Climbs trees

Species	Brush-tailed phascogale (<i>Phascogale tapoatafa</i>)
Diet	Invertebrates (beetles, weevils, spiders, cockroaches) Small vertebrates (lizards) Nectar
Longevity	Male: 11 months Female: 24–36 months
Sexual maturity	Male: 8 months Female: 11 months
Mating season	May to July
Gestation length	30 days
Litters per year	1 litter of 6–8

Species	Spotted-tailed quoll (<i>Dasyurus maculatus maculatus</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Brown with white spots on body and tail
Conservation status*	Endangered
Adult morphometrics	Body weight: Male 1500–5000 g, Female 900–2500 g Head and body length: 350–750 mm Tail length: 350–550 mm

Species	Spotted-tailed quoll (<i>Dasyurus maculatus maculatus</i>)
Habitat	Wet to dry forest
Home range	Male: 2000–5000 ha Female: 180–1000 ha
Behaviour	Nocturnal. Climbs trees. Territorial.
Diet	Invertebrates, reptiles, birds, mammals, carrion
Longevity	11–60 months
Sexual maturity	Male: 11 months Female: 11 months
Mating season	May to August
Gestation length	21 days
Litters per year	1 litter of 4–6

Species	Fat-tailed dunnart (<i>Sminthopsis crassicaudata</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Tail shorter than body and swollen. Large ears

Species	Fat-tailed dunnart (<i>Sminthopsis crassicaudata</i>)
Conservation status*	Vulnerable
Adult morphometrics	Body weight: 10–20 g Head and body length: 60–90 mm Tail length: 45–70 mm
Habitat	Open woodland, spinifex grasslands
Home range	Not recorded
Behaviour	Nocturnal. Solitary. Can be communal in colder months
Diet	Invertebrates (beetles, weevils, spiders, cockroaches). Small vertebrates
Longevity	Male: 15 months Female: 18 months
Sexual maturity	Male: 4–5 months Female: 4–5 months
Mating season	July to February
Gestation length	13 days
Litters per year	Up to 2 litters of 8–10. (Only 5 make it to weaning)

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

2.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for dasyurids is in **Section 2.6.2**.

The following information relates to human and animal health and safety considerations specifically related to the rehabilitation of dasyurids.

2.3.1. Human safety considerations

- The smaller dasyurids have sharp teeth that can penetrate human skin. Bites are only mildly painful.
- Quolls have larger teeth and stronger jaws and can inflict more painful bites. Handle with caution as they can bite during capture and restraint.
- Dasyurids will defaecate and urinate if stressed during handling.
- Bacteria that can cause disease in people, such as *Salmonella*, have been found in dasyurid faeces.

2.3.2. Animal safety considerations

- Small species move quickly and can easily escape.
- Tail holds should not be used for capture and restraint.
- Smaller dasyurids should not be clasped too firmly as suffocation is possible.
- Take care when felling trees as brush-tailed phascogales and antechinus nest in tree hollows.
- Take care around the house as phascogales and antechinus also regularly nest inside roofs, in confined spaces such as under old hot water boiler tanks, or under pieces of timber or corrugated iron. Feathers, wool, or stripped pieces of bark may indicate the presence of a nest.

2.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 2.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned dasyurids.

2.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 2.2 Visual health observations in dasyurids

What to look for	
Demeanour	<ul style="list-style-type: none"> Bright, alert Should avoid capture
Behaviour	<ul style="list-style-type: none"> Actively moving in a co-ordinated manner. This may be quite rapid for the smaller dasyurids Investigating their environment
Movement and posture	<ul style="list-style-type: none"> Normal use of all four limbs. No evidence of lameness or open wounds. Older quolls may develop a swaying movement, instability and intermittent swaying of the hind legs as a result of intervertebral disc disease
Breathing	<ul style="list-style-type: none"> Regular. May be quite rapid for the smaller dasyurids Panting or open mouth breathing is abnormal and may indicate respiratory distress or over heating

2.4.2. Equipment

- **Net:** A cloth net can be used to catch quolls.
- **Catch bag:** A calico bag 0.3 m (L) x 0.3 m (W) or a pillow case can be used to restrain small dasyurids. Thick blankets, fleece bags or hessian sacks are suitable for quolls. Bags should be turned inside out so that any seams or potential loose threads are on the outside. When handling quolls, take care not to get bitten through the bag.
- **Transport container:** Solid-walled containers with ventilation holes can be used for transportation. Examples of suitable containers include wooden boxes, plastic tubs or small cardboard boxes for antechinuses or dunnarts. Pet packs are suitable for quolls. The dimensions of the transport container will vary with the size of the species. The enclosure needs to be large enough for the animal to turn around. Care should be taken to ensure appropriate ventilation during transport.

Figure 2.2 a. Two different sizes of cloth nets which may be used to catch quolls b. A catch bag to restrain small dasyurids



Photo credits: Zoos Victoria

2.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

- Antechinus and dunnarts can be handled with one hand holding the back of the neck, using two fingers or the thumb and index finger, while the palm of the same hand restrains the body. See **Figure 2.3**. This can be done with bare hands or through a bag. For phascogales a second hand is required to support the hind legs.
- Small dasyurids should not be held by the tail as this can lead to degloving injuries, where the skin is stripped off the underlying muscle.
- Quolls should be handled with two hands. With the quoll's body on the ground or on a bench, grip the back of the neck with one hand, using the thumb on the opposite side of the neck to all four fingers. With the second hand, hold the animal over the back around the pelvic region or at the base of the tail. Restraint through thick canvas, hessian or blankets is recommended.
- Dasyurids tend to quieten if their eyes are covered during handling.

Figure 2.3 Restraint of an antechinus in the hand



Photo credit: Zoos Victoria

Figure 2.4 A quoll is manually restrained



Photo credit: Zoos Victoria

2.4.4. Transport

- Dasyurids may be transported in a tied calico or hessian bag placed inside a solid-walled appropriately sized container.
- Alternatively, cover the transport box with a towel to darken the interior, while maintaining adequate ventilation.
- Secure the container to prevent rolling or sliding.
- Food and water do not need to be provided.
- Avoid travel at environmental temperatures greater than 25°C. If travel in hot conditions is unavoidable an air-conditioned vehicle should be used. Juvenile dasyurids such as phascogales have difficulty maintaining a constant body temperature and can overheat quickly.

2.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care. This is aided by minimising human-animal interactions and stress to the animal, maximising successful release back to the wild.

2.5.1. Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure weighing scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording**

physical examination findings can be found in the appendices to Part A of these guidelines.

Examinations should be conducted in a quiet location, away from domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examination of small dasyurids can be challenging as they will attempt to bite and wriggle out of the handler's grasp. Hold the individual in a cupped hand or bag and gently examine the various parts of the body.
- Physical examination of quolls can be conducted with the animal contained within the catch bag. The opening of the bag is peeled back, and individual body parts gently examined.
- Alternatively, the quoll can be restrained by one person and examined by a second person.
- Dasyurids will be calmer if their eyes are covered during the examination.
- Physical restraint and examination of any dasyurid is a stressful procedure and should be conducted as quickly and efficiently as possible.
- Only a cursory examination will be possible. More detailed examinations require the animal to be anaesthetised.
- **Table 2.3** provides additional guidance on what to look for during physical examinations.

Table 2.3 Physical examination of dasyurids

What to look for	
Body weight	<ul style="list-style-type: none"> Record body weight on arrival and at least weekly while in care. This can be done by putting the smaller species in a bag and weighing them while bagged, to reduce the chance of escape. Larger species such as the quoll can be weighed in a pet pack or similar container. A greater than 10% change in body weight is cause for concern, and the carer should seek veterinary advice immediately.
Body condition	<p>Body condition can be scored by palpation of the prominence of the scapula in relation to the muscle on either side. For smaller animals the prominence of the spine can be used. Condition can also be judged by body weight with reference to the normal weight range for that species. Body condition can be described as follows:</p> <ul style="list-style-type: none"> Under condition: Concave muscles either side of the scapula. Backbone can be easily felt on top and sides. Ideal condition: Flat muscle either side of the scapula. Backbone can only be felt on top. Sides are covered with muscle. Over condition: Convex muscles either side of the scapula. Difficult to feel the backbone.
Hydration status	<ul style="list-style-type: none"> The skin slides easily over the shoulder blades/spine, and when the skin is 'tented' (or gently pinched up) over the spine/between the shoulder blades, it should fall back within one second. Dasyurids which are dehydrated have dry looking gums, sunken eyes, and a slow skin tent.
Eyes	<ul style="list-style-type: none"> Eyes look bright. There should be no cloudiness or grey colour. Eyelids open, with no discharge or crust. Basic internal structures of eyes (e.g. pupil, iris) appear symmetrical.
Ears	<ul style="list-style-type: none"> Ears are held alert and move quickly in response to noise. Some parasites (ticks and mites) may be present and can be left if there isn't an excessive load and there is no evidence of irritation/excessive scratching inside the ears. Healthy wild males may present with tears in their ears due to territorial disputes.
Mouth	<ul style="list-style-type: none"> Gums are pink and slightly moist, no excessive salivation or blood coming from inside the mouth. Teeth have sharp pointy edges.
Skin and coat condition	<ul style="list-style-type: none"> Coat will look shiny and smooth. Males may have patches of fur missing during the breeding season.

What to look for	
Limbs, feet, and tail	<ul style="list-style-type: none"> • No broken nails or obvious wounds. • No crackling or grinding detected when the legs are manipulated. Legs not held at odd angles to the body. • No swelling or bruising on limbs, toes or tail.
Sex determination	<ul style="list-style-type: none"> • Determined by the presence of testicles (males) or a pouch (females).
Pouch check	<ul style="list-style-type: none"> • Antechinus have an open pouch while the pouches of other dasyurids are more enclosed. If pouch young are present, count the number and assess age, as a lactating female may require additional food, and carers should monitor for normal signs of development.

2.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Time your health and welfare observations for times of the day when the animal is expected to be active.
- The use of infra-red cameras can allow monitoring of behaviour overnight.
- If the animal is being medicated, schedule treatment for the morning, use this time to perform a visual check. In the morning is recommended.
- If the animal is receiving medication in the morning and evening, the evening medication may be delivered in a cricket, to minimise the need for extra handling.
- Ideally physical observations should be undertaken at the beginning and/or end of the resting period to minimise disturbance and maximise the rest/sleep period for rapid healing and ensure ease of capture.
- The animal should be observed at least daily.
- Note the animal's demeanour and behaviour every time food is introduced or taken away, medication is given, or the enclosure cleaned. Pay particular attention to any changes that have occurred since the previous day.
- If using sand for a portion of the substrate in larger housing, inspect and rake at the same time each day, ideally morning. Sand allows for observations of the animals nocturnal activities, and may inform of injuries (e.g. dragging foot, different shape print).
- Food and water dishes may be placed in the sand area, this can inform as to whether the animal is visiting the food dish at night.

- Quolls are particularly prone to stereotypic pacing. Observe the enclosure for worn paths, which may indicate that the quoll is walking back and forth. This may occur in anticipation of food. Treat by varying the feeding routine.
- Note faecal consistency daily. If diarrhoea is noticed, a faecal sample should be collected and submitted to the veterinarian for assessment as soon as possible. Do not treat on suspicion of a bacterial or parasitic infection, as this can make definitive diagnosis very difficult and potentially prolong the course of the disease.

2.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 2.4 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 2.4 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Injuries or clinical signs	Possible Causes	Rehabilitator observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Fracture</p> <p>Unable to walk or move normally</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fractures</p> <p>Dislocation</p>	<p>Found adjacent to road/suspect motor vehicle accident, caught in wire or netting, predation injury caused by raptor, fox, cat or dog, gunshot, poorly designed transport box/ enclosure capture injury, injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for the species and minimise stress. • Do not attempt to stabilise fractures as this is very painful and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical examination, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure/box/bag to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 2.4 and Section 2.6 for further advice on housing and transport. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. Seek advice from species experts.

Injuries or clinical signs	Possible Causes	Rehabilitator observations and response
<p>Bleeding</p> <p>Puncture wounds</p> <p>Bruising</p> <p>Fur loss</p>	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by raptor, fox, cat or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment, euthanasia may be the most humane response given the poor prognosis for survival. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/ shocked animals. • Bite wounds/scratches may not be immediately obvious, these may have a poor prognosis and animals often present moribund, (very lethargic, poorly responsive and cold). • Look for small clumps of dried fur stuck together with saliva. Part the fur and look for very small puncture wound/s.
<p>Blindness</p> <p>Deafness</p> <p>Neurological signs</p> <p>Wobbly movement, or ataxia</p> <p>Circling movement</p> <p>Strange behaviour, out in the daytime, easily caught</p> <p>Lethargic</p> <p>Moribund, collapsed</p>	<p>Infectious disease, such as toxoplasmosis, bacterial meningitis, cranial trauma, toxicity (e.g. 1080 poisoning)</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/ shocked animals. • Carer may observe animal bumping into objects in the enclosure or fail to respond to short sharp noises such as a loud clap from behind the animal. • Pupils may be fixed/dilated and not responsive to changes in light level. You should see pupils constrict if a pen light is shone in the eye. • If multiple animals are seen with similar signs, this may indicate a newly emerging infectious disease or a toxicity (such as plant toxicity or poisoning). Contact the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours) to report concerns. • If unusual toxicity or infection is suspected, you or your veterinarian can contact Zoos Victoria's Veterinary Departments to discuss options for disease investigation.

Injuries or clinical signs	Possible Causes	Rehabilitator observations and response
Thickened, ulcerated skin, fur loss, skin irritation	Conspecific aggression, breeding season interactions, mite infestation, mycobacteriosis, tumour	<ul style="list-style-type: none"> • Seek veterinary advice or assessment. • Some fur loss/minor skin lesions are commonly seen due to fighting or during the breeding season and may not require any intervention. • A small number of ticks/mites can be normal, and do not require treatment or removal. However, if there is a very high number of ticks/mites seen and the animal is scratching/irritated, or the skin is red and inflamed, seek veterinary attention to treat ectoparasites. • Mycobacteriosis and tumours can present as thickened areas of skin. Veterinary assessment is required.
Diarrhoea Loose, smelly faeces	Inappropriate diet, infectious disease (fungal, bacterial) alteration of microbiome, stress, parasites, antibiotic treatment	<ul style="list-style-type: none"> • Seek veterinary advice. • Seek urgent veterinary advice if diarrhoea does not resolve rapidly (e.g. within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. • Do not treat on assumption of infectious disease (e.g. coccidia or bacterial infection) as this can make veterinary diagnosis more difficult if the animal does not improve. • If the animal has been otherwise stable and doing well, there are a number of responses carers may implement to try to resolve diarrhoea. These include considering any recent changes which may have led to diarrhoea. Respond by removing the inciting cause where possible (rapid change in diet, unusual levels of sound, intervention or handling, contact with recently arrived animals). • Seek advice from species experts, ensure diet and husbandry practices are correct. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. • Be considerate of rapid diet changes for animals undergoing hand rearing. • Do not mix oral rehydration fluids in with milk as it changes the digestibility of the milk. Oral rehydration fluids/water can be provided in between milk feeds. • Ensure excellent hygiene standards to prevent spread to other animals/carers and isolate this animal from any others in care if possible.

Injuries or clinical signs	Possible Causes	Rehabilitator observations and response
Lameness Ataxia (wobbly movement) Blindness Paralysis	Intervertebral disc disease, brain degeneration in quolls	<ul style="list-style-type: none"> • Seek veterinary assessment.
Non-responsive Lethargic	Undetermined disease or injury. Torpor seen in antechinus, dunnarts and phascogales	<ul style="list-style-type: none"> • Seek veterinary advice or advice from a species expert. • Torpor is normal during cold weather. Determine if the individual is an adult or juvenile. Juveniles need other animals to maintain their body heat. They are likely to be in torpor on arrival and need to be warmed before feeding. Offer warmth for one to two hours at 25 to 28°C and reassess. Provide a heat source at one end of the enclosure so the animal can move away from the heat as needed. Continue to offer warmth at 25°C for 24 hours. All animals are sensitive to high temperatures and should be monitored for panting and wet forelimbs. If the animal revives and behaves normally, feed for 48 hours and release.
Depressed Moribund/ Poor condition often with fur loss	Post mating male mortality, undetermined disease or injury	<ul style="list-style-type: none"> • Seek veterinary advice or advice from a species expert. • Post mating male deaths occur normally at the end of the mating season (Aug–Sept) in antechinuses and phascogales.

Figure 2.5 a. Fur loss in a swamp antechinus. b. Fur loss in an agile antechinus. Note this degree of fur loss normally occurs during the breeding season when males fight and lose fur before die-off. This would not require intervention.

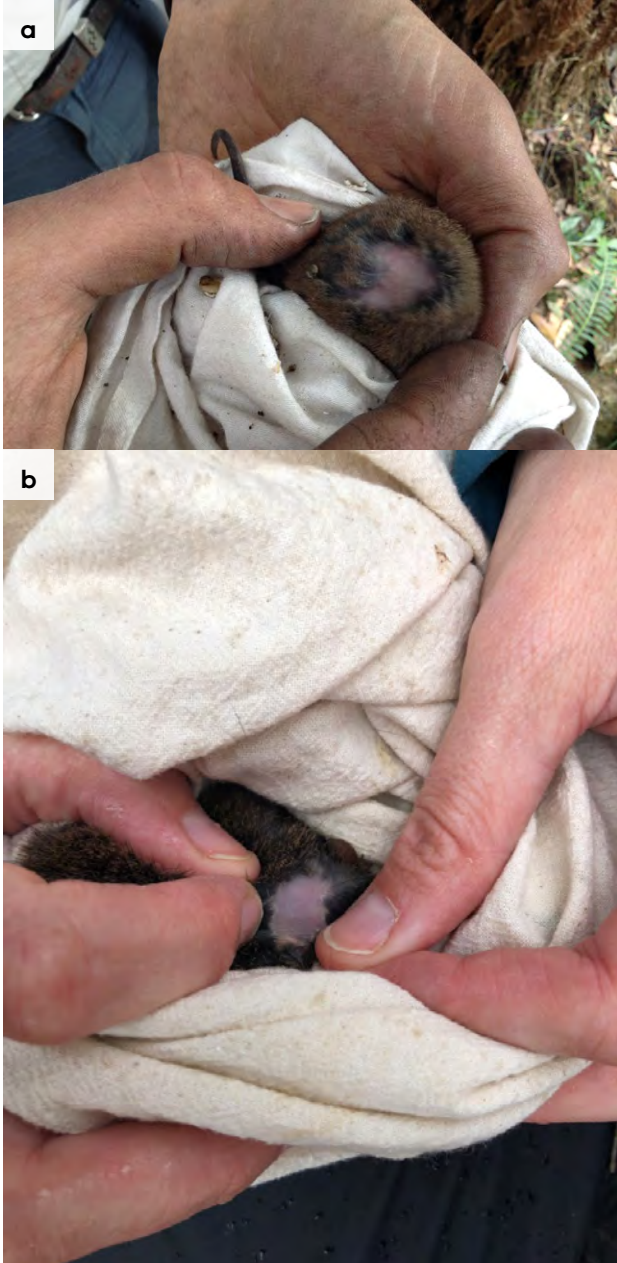


Photo credit: P Burns (a) and J Cripps (b)

Figure 2.6 Presence of mites around the pouch and cloaca of a swamp antechinus.



Photo credit: J Cripps

2.5.4. Administering treatment

- To avoid regular handling and minimise stress, it is preferable to administer medication in a food item, such as a mouse or chick, or it can be mixed through a small amount of Wombaroo Small Carnivore Mix or equivalent. The medicated item should be offered first to ensure the animal consumes it. Once it has been eaten, the rest of the diet can be provided.
- If the animal refuses to consume the medicated item, it will need to be restrained and medication delivered by syringe into the side of the mouth.
- This method is not recommended for quolls as there is considerable risk of being bitten. If the quoll does not eat for two consecutive days or refuses its medicated food item, seek veterinary advice.

2.6 Housing

Below are several key considerations when housing adult animals in care.

2.6.1. General housing information for dasyurids

- Dasyurids are aggressive and will fight each other. Except for orphaned young, only one animal should be housed in each enclosure. Locate enclosures in secure rooms to allow capture in the event of escape.
- Keep dasyurids in enclosures that are separate from domestic animals, so that they do not see, hear or smell them. Change out of clothes that have been worn around dogs or cats to minimise exposure to pet scent.

2.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

- Wash hands with soap and water after handling dogs and cats to minimise the risk of transferring disease agents such as *Toxoplasma gondii*, which can be found in cat faeces.
- Ideally, exam gloves should be worn and changed in between animals.
- Leftover food and faecal matter should be spot cleaned daily from enclosures to ensure good levels of hygiene are maintained.
- Any wet/sodden or soiled organic furnishings, substrate or enrichment items should be removed as soon as possible and replaced with a clean/dry alternative.

- Enclosures used to house sick/injured dasyurids, should be cleaned and disinfected between inhabitants. Substrate should be completely replaced and furniture, such as branches or boxes made of unsealed wood, should be discarded as they cannot be effectively disinfected.
- Enclosures should be cleaned with hot soapy water and then disinfected with products such as F10SC or bleach at the recommended concentration and contact time. Bleach must be rinsed before returning an animal to the enclosure.
- Quolls, dunnarts and phascogales may develop mycobacteriosis. If the veterinarian has diagnosed this disease, the enclosure should be cleaned with 6% hydrogen peroxide or 6% acetic acid (vinegar). Exposure to hydrogen peroxide or vinegar for 30 minutes has been shown to kill mycobacteria.

2.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care.

Table 2.5 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 2.8**.

Table 2.5 Rehabilitation housing for adult dasyurids

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment - frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision when strict cage rest/ confinement is indicated</p>	<p>Quolls:</p> <p>Floor area: 1 m x 1 m (1 m²)</p> <p>Height: 0.5 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Purpose-built incubators, such as a Vetario or fish tank with a close-fitting lid with adequate ventilation. • For quolls, a solid wood enclosure or plastic tub, as they can damage their teeth on the wire in caged enclosures. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • A timber nest box should be offered for adults. • Newspaper is suitable as flooring. • Orphaned young should be housed in pouches inside an escape-proof container that has adequate ventilation. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Heating is required until the young are furred. This may be supplied using a heat pad. • Monitor the temperature with a thermometer. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Fresh water should always be available and captive diet should be fed in stable dishes. • Regular check of substrate to ensure water has not spilt and enclosure is not wet.
	<p>Antechinus, dunnarts, phascogales:</p> <p>Floor area: 0.30 m x 0.20 m (0.06 m²)</p> <p>Height: 0.2 m</p>	

Intermediate housing (Treatment/cage rest)		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care</p> <p>Enclosure furnishings can be arranged to reduce opportunities to move excessively so that cage rest can be achieved with slightly more space/reduced contact</p>	<p>Quolls:</p> <p>Floor area: 1 m x 2 m (2 m²)</p> <p>Height: 1 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Antechinuses, dunnarts and phascogales can be housed in a fish tank or solid wooden container. • Quolls may be housed in aviaries with solid metal walls. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Leaf litter or mulch is suitable flooring. • For smaller dasyurids such as dunnarts, pine shavings can be used. • Offer native branches with grubs on the leaves for arboreal dasyurids, to encourage climbing. Furnishings can be arranged to reduce opportunities to climb/dig or move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact. • Nest-boxes should be offered as a sleeping area. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • This housing stage is suitable for weaned orphans and sick or injured adults that no longer require heating. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Offer insects in the leaf litter. • Fresh water should always be available and captive diet should be fed in stable dishes.
	<p>Antechinuses, dunnarts, phascogales:</p> <p>Similar to pre-release enclosure sizes</p>	

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/ medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitor/assess behaviour (foraging, digging, nest building)</p> <p>Enclosure allows expression of a full range of natural behaviours</p> <p>Pre-release assessment</p>	<p>Spotted tail quoll</p> <p>Floor area for one animal: 3 m x 2 m (6 m²)</p> <p>Height: 2 m</p> <p>Increased floor area for each additional animal: 1 m²</p> <p>Nest box: 25 cm x 30 cm. Height: 55 cm. Entrance hole diameter: 8.5 cm</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Quoll: Walls made of solid tin or wood. One third of the enclosure sheltered from the weather. • Nest boxes made from plywood. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Non-toxic pine shavings or newspaper. Concrete floors can damage feet. Wire mesh buried below the soil surface will prevent animals digging out. Offer nest material such as <i>melaleuca</i>, paperbark, sheep's wool or dried grass. • Quoll: Logs, rocks, tussocks, sturdy branches for climbing, nest box or hollow log. • Brush-tailed phascogale: vertical tree branches for climbing, tussocks, nest box or log for hiding. • Antechinus and dunnart: Deep leaf litter mulch, tussock clumps for hides and branches for climbing. They could be offered a running wheel for exercise. • Nest boxes lined with eucalyptus leaves or shredded paper. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Fresh water should always be available and changed daily, and captive diet provided in stable dishes. • Food can be placed into bark crevices, tree trunks and under leaf litter. A night light can be used to attract moths and encourage foraging behaviour.
	<p>Brush-tailed phascogale</p> <p>Floor area for one animal: 3 m x 1 m (3 m²)</p> <p>Height: 2 m</p> <p>Increased floor area for each additional animal: 0.10 m²</p> <p>Nest box: 25 cm x 17 cm. Height: 11 cm. Entrance hole diameter: 5 cm</p>	
	<p>Antechinus/Dunnart</p> <p>Floor area for one animal: 0.60 m x 0.50 m (0.30 m²)</p> <p>Height: 0.30 m</p> <p>Increased floor area for each additional animal: 0.15 m²</p> <p>Nest box: 14 cm x 12 cm. Height: 10 cm. Entrance hole diameter: 3.2 cm</p>	

Figure 2.7 Examples of a solid wooden container with a glass front that can be used for housing small dasyurids during the intermediate or pre-release stages. Note the nest box and branches are for climbing, and lid should be closed.



Photo credit: Zoos Victoria

2.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of fully independent dasyurids in rehabilitation.

Information on feeding orphaned dasyurids can be found under **Section 2.8 Hand raising**.

Note: Fresh water should always be available, provided in a stable/non-spill bowl or automatic drinker. Water should be changed daily.

Table 2.6 Feeding and diet guide for adult dasyurids during rehabilitation

Brush-tailed phascogale

- ½ day old chick or skinned mouse
- 1 g fly pupae
- 5 mealworms
- 3 moths every 2nd day
- 3 crickets every 2nd day
- Small Carnivore Mix
- 6 g grated cheese or egg
- 5 g fruit and vegetables: fig, apple, orange, sweet corn and peas all every 2nd day

Spotted-tailed quoll

- Offer a variety of: ½ rat, ¼ rabbit, 2 mice, 2 day-old chicks, Small Carnivore Mix
- Invertebrates: crickets, mealworms, cockroaches

Antechinus and dunnarts

- 10 g egg or cheese
- 2 mealworms
- ⅓ day-old chick (e.g. leg)
- 1 g fly pupae
- 2 crickets every 2nd day
- 2 earthworms every 2nd day
- 2 moths every 2nd day
- Native eucalypt flowers
- Dry dog food

Note: Diets are formulated to provide balanced nutrition. If the animal only consumes certain foods the diet may become unbalanced. If this happens consistently, seek veterinary advice.

Figure 2.8 A selection of food items that are suitable to feed to a small dasyurid.



Photo credit: Zoos Victoria

2.8 Hand raising

Hand raising recording templates for growth, development, feeding and other observations can be found in the appendices to Part A of these guidelines.

2.8.1. Equipment required for hand raising

- **Milk:** Wombaroo Kangaroo Milk >0.7 or Biolac M200. If using Wombaroo Kangaroo Milk to raise quolls, 1.0 ml of 'The Good Oil ' should be mixed in per 10 mL of milk. If this oil product is not available, canola oil can be used instead. It is not necessary to add oil to the milk if raising dunnarts, antechinuses or phascogales. Milk should be fed at about 36°C.
- **Teats:** Appropriately sized teats (Wombaroo suggests C size) and bottles.
- **Pouch:** Pouch consisting of an inner layer made from a natural fibre, such as cotton, and an outer layer made of wool for warmth.
- Intensive care unit or box containing a heat lamp/heat pad and thermometer.
- **Scales**
- **Record charts**

Figure 2.9 Appropriately sized teats (Wombaroo suggests C size) and bottles.

C Teat



Photo credit: Wombaroo, <https://www.wombaroo.com.au/wp-content/uploads/2020/06/Bottle-and-Teats.pdf>

2.8.2. Growth of orphaned young



STOP - Please refer to your authorisation for mandatory conditions, regarding unfurred pouch young.

- Where possible dasyurids should be raised with others of the same species. Handling should be minimised once the young are weaned.
- Always wash and disinfect hands before feeding and sterilise equipment prior to use.
- **Toileting:** Rub the cloaca with a damp piece of cottonwool to stimulate the young to urinate and defecate after each feed.
- **Weaning:** Once the teeth have emerged, commercially available Small Carnivore Mix can be added to the milk to make a slurry. Solid food, such as chicken pieces, mealworms and crickets can be offered. Milk quantity is then gradually reduced and solid food increased until milk is eliminated from the diet.
- Water should be provided in a water bottle or shallow water dish, so the animal cannot drown. This should be replaced daily.
- A summary of the feeding requirements for spotted-tailed quolls at various levels of development can be seen in **Table 2.7**. While similar charts have not been published for the other dasyurids, they can be hand raised in a similar manner to quolls, making allowances for their smaller size. Weaning occurs at 65–85 days for dunnarts and 90 –140 days for antechinuses and phascogales.

Figure 2.10 Holding a juvenile dunnart in a tissue for feeding.



Photo credit: Marissa Parrott

Table 2.7 Development chart for Spotted-tailed quolls (Used with permission from Wombaroo)

Milk	Age (days)	Tail (mm)	Crown-rump (mm)	Head width (mm)	Weight (g)	Feed (mL/day)	Notes
>0.7	90	110	125	31	190	21	Eyes open, body fully furred with coarse hair. Feed every 4 hours. Maintain joey at 30°C
	100	140	145	35	270	28	Incisors coming through. Introduce solid food
Weaning	110	175	165	38	Growth rate about 10 g per day	30	Gradually increase solid foods and reduce milk intake. Feed twice a day
	120	205	180	40		25	
	130	225	195	42		15	Independently foraging
	150	260	220	45		0	Fully weaned (~750 g)

2.9 Release protocol



Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for the animal.

2.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

The following check list should be used to guide decision making regarding release suitability for dasyurids:

- ☑ Individual is in a state of good health. Presenting injury/sickness is completely resolved (consider a pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 2.1**).
- ☑ Individual displays ability to actively forage for and consume natural foods.
- ☑ Brush-tailed phascogales and spotted-tailed quolls can climb tree trunks.
- ☑ Appropriate transport container with a towel or shredded paper (hay should not be used to prevent dispersal of seeds into the natural environment).

2.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered. Release with a nest box is preferred. Animals should have had access to a nest box for at least two weeks prior to release.

- **Brush-tailed phascogale:** this species is strongly territorial. The females stay close to the home range of their mother. However, the males disperse widely. Phascogales should be released with a nest box they have been using while in care. Examples of suitable tree species in which to place nest-boxes include: red box (*E. polyanthemos*), red stringybark (*E. macrorhyncha*), messmate (*E. obliqua*) and narrow leaf peppermint (*E. radiata*). Avoid smooth barked eucalypts, such as river red gum (*E. camaldulensis*), as they cannot gain purchase on the surface. They can cross open ground and can use tree corridors along roads for dispersal and foraging. Place the nest box 1.5–5 m above the ground in a tree with a diameter greater than 70 cm.
- **Antechinuses:** these species are not territorial and will find communal nests upon release. Place the nest box on the ground amongst bushes.
- **Spotted-tailed quolls:** this species has large home ranges. The females have a discrete home range while the male's home range will overlap with that of several females. Place the nest box on the ground in dense bushes.
- **Fat-tailed dunnarts:** this species is reported as having large, drifting home ranges. Place the nest box on the ground among rocks and litter.

For more information on the ecological characteristics and requirements of dasyurids that may help with their release, please refer to **Table 2.1**.

2.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Approximate release where the animal was found (where suitable or within home range).
- ☑ Suitable vegetation for foraging and nest building.
- ☑ Away from major roads.

Release Procedure

- ☑ Limit the number of people at the release.
- ☑ Release in the early evening.
- ☑ Open the transport enclosure adjacent to a suitable tree for phascogales or dense bush for antechinus, dunnarts and quolls.
- ☑ Alternatively, place the animal into the nest-box and observe from a distance to ensure the animal is showing natural behaviours, such as looking for food.
- ☑ Supplemental food can be placed in the nest box for up to a week to support the animal during the first few days post release.
- ☑ Monitor food consumption daily and gradually reduce the amount of food left in the box.

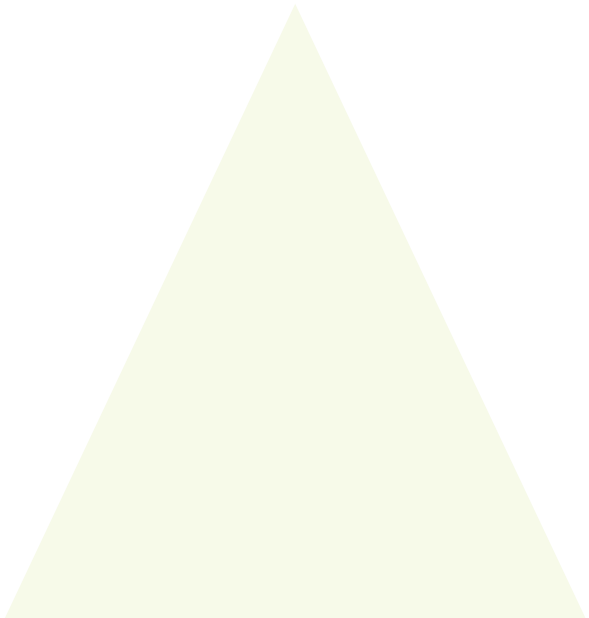
2.10 Key references and additional reading

Henderson, N. Antechinus housing and care. <https://www.michaelandnorma.com/wp-content/uploads/manuals/Antechinus.pdf>

Jones, M., Dickman, C., and Archer, M. (editors) 2003. Predators with pouches: the biology of carnivorous marsupials. CSIRO Publishing.

Marten, J. 2014. Husbandry guidelines for the spotted-tailed quoll (*Dasyurus maculatus*). <https://aszk.org.au/wp-content/uploads/2020/06/JMarten-HMG-STQuolls-FINAL.pdf>

Walker, K. 2012. Husbandry guidelines fat-tailed dunnart (*Sminthopsis crassicaudata*). <https://aszk.org.au/wp-content/uploads/2020/05/Mammals.-Fat-tailed-Dunnart-2012KW.pdf>



Chapter 3. Echidnas

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Photo credit: Mark Norman,
Museums Victoria



In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

These guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

3.1 Introduction

The short-beaked echidna, *Tachyglossus aculeatus*, is the only species of echidna in Australia, and one of only five species of living monotremes. Echidnas are found across a broad range of habitat types from alpine areas to grassy woodlands and coastal habitats. They can be found varying in colour from light blonde to dark brown, and they are Australia's most widespread native mammal.

When echidnas come into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition and an environment appropriate to the stage of rehabilitation. The focus should be on the animal's return to health and eventual release, which are facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours. However, these should not detrimentally affect its recovery, potentially necessitating a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare can be found in Part A of these guidelines.


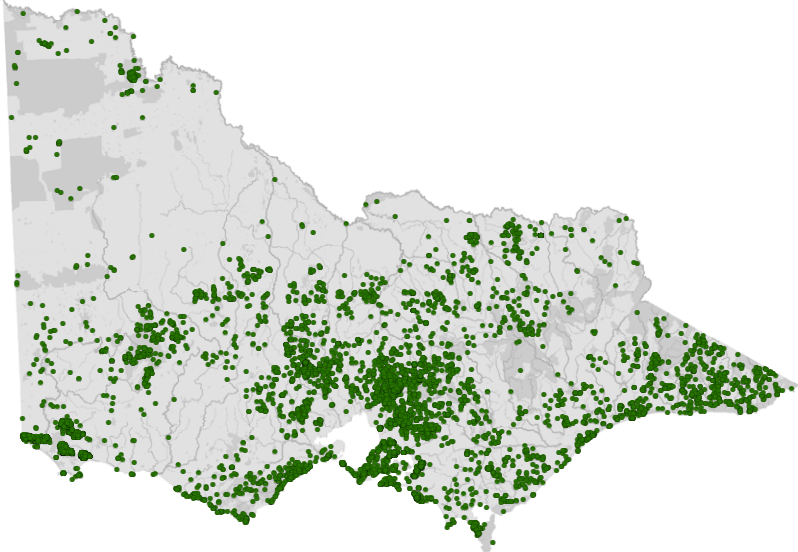
Echidnas require a specialised diet and are likely to injure themselves if not housed correctly. It is recommended that they are cared for by experienced shelters, or that care is carried out under close supervision, if the carer is less experienced.

3.2 Species information



The short-beaked echidna is profiled in **Table 3.1**. For further information on the echidna, refer to the recommended reading and reference material at the end of this chapter.

Table 3.1 Species profile

Species	Short-beaked echidna (<i>Tachyglossus aculeatus</i>)
 <p>Photo credit: Mark Norman, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Covered with cream to black spines and brown hair. Beak and strong claws. Hind limbs are rotated so that the feet point backwards at rest and when walking. The density of fur varies across the geographic range, with less dense fur seen in warmer areas and denser fur in colder climates</p>
<p>Conservation status*</p>	<p>Common</p>
<p>Adult morphometrics</p>	<p>Body weight: 2–6 kg Head and body length: 230–350 mm Tail length: 85–95 mm</p> <p>Variation is found across different habitat types and temperatures. Size and weight is not an indication of sex</p>

Species	Short-beaked echidna (<i>Tachyglossus aculeatus</i>)
Home range	Up to 250 ha (but generally 40–70 ha) Home range is highly variable and dependent on food availability
Behaviour	Solitary Diurnal or active at dusk and dawn, depending on temperature
Diet	Termites, ants and other soil invertebrates
Longevity	Up to 16 years in the wild (in captivity one individual reportedly reached 49 years)
Sexual maturity	Male: 5–7 years Female: 5–12 years
Mating season	July to September
Gestation length	Three weeks. After egg is laid and transferred to the temporary pouch, hatching occurs 10–11 days later
Litters per year	One young every 3–5 years

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

3.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnatural close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for echidnas is in **Section 3.6.2**.

The following information relates to the human and animal health and safety considerations specifically related to the rehabilitation of echidnas.

3.3.1. Human safety considerations

- Short-beaked echidna spines are often covered with soil. Minor skin irritations and/or infections can result if human skin is scratched or punctured by spines.
- When stressed, short-beaked echidnas may urinate and defaecate when handled. Since echidnas are known to carry *Salmonella*, which can cause severe gastrointestinal disease in people, excellent hand hygiene (washing hands with soap and water after handling or wearing gloves) is important. Echidnas should be held with their cloaca facing away from the handler.
- Echidnas are extremely strong diggers and can dig vertically downwards when feeling threatened. If attempting to pick up an echidna from such a position, be careful not to get your hands caught within the curled-up echidna and be aware of the risk of scratches and/or punctures from lateral spines and nails.

3.3.2. Animal safety considerations

- The beak or snout is a highly sensitive organ that is critical to the survival of the echidna. Rehabilitators and rescuers should exhibit extreme caution around this organ when caring for echidnas as fractures to this area often result in euthanasia.
- Fractures, dislocation, and bruising can occur when echidnas are held by one or both hindlimbs without supporting bodyweight. Echidnas should be handled with two hands underneath to support the body, handling by the hindlimbs is not an acceptable method of restraint.
- Wild echidnas often attempt to dig out of rehabilitation enclosures, and can damage the nails, soles of their feet, and the tip of their beak on enclosure wiring, drains embedded within the enclosure floor or any small gaps in walls/panels. Small gaps under doors/slides or between enclosure wall panels or drains should be closed off or sealed to prevent echidnas damaging their nails or snout.
- Enclosure substrate should be dry and thick to prevent sores (ulcerative pododermatitis) developing on the footpad or damage to the beak.
- If an echidna needs to be dug up from underground (when it is known to be sick or injured), small gardening trowels or hands are preferred. Shovels are not recommended as they can injure the echidna's legs and/or beak. If unavoidable, care should be taken to dig away from the echidna.

3.4 Capture, restraint, and transport



STOP – A visual examination must be done BEFORE the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 3.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned echidnas.

3.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement, and posture. Check for evidence of injury/severe disease or deterioration and assess their breathing as demonstrated in the following table.

The echidna's propensity to curl into a tight ball when stressed, and its sharp pointed quills, can make physical examination very difficult to conduct on a wild/stressed individual. Consequently, visual examination in this species is often the most useful way for a rehabilitator to obtain an accurate understanding of the initial health status of the animal, and to monitor for any changes in health status during time in care.

Visual examinations should initially be conducted in an area which is cool and quiet and not too bright. Quietly observe from a distance. This reduces the impact of behavioural responses to stress as a result of your observations during this exam. Patience is required to allow the echidna time to uncurl and start to sniff and investigate its surroundings. This will allow the carer an opportunity to assess the animal's demeanour, behaviour, movement, posture and breathing (following the advice in **Table 3.2**) as well as to look for any evidence of injury.

However, since underlying health concerns are easily missed in this process, a thorough veterinary assessment, under sedation or anaesthesia, is required as soon as possible.

Table 3.2 Visual health observations in echidnas

What to look for	
Demeanour	<ul style="list-style-type: none"> Wild echidnas should be alert and responsive to stimuli (such as loud noises or sudden movement)
Behaviour	<ul style="list-style-type: none"> Curls strongly and digs down when alerted by sound, movement or touch Many wild echidnas continue to forage even when humans are close by – this does not necessarily indicate poor health. Carers should continue to observe and assess other parameters in this table to determine whether the animal needs to have further assessment or not Echidnas are often observed sniffing the air while foraging; this is normal behaviour
Movement and posture	<ul style="list-style-type: none"> Wide-based waddle using all four legs Hindlimbs are normally rotated backwards Forelimbs are strong, both forelimbs used for digging
Breathing	<ul style="list-style-type: none"> Echidnas do not pant, so unusually rapid/shallow breathing may indicate significant underlying health concerns and should not be discounted Clear, mucous bubbles are often seen at the nostrils in a normal, healthy echidna. The presence of blood or difficulty breathing is abnormal and can indicate underlying infection or beak trauma (e.g. fracture) Wild echidnas make a loud snorting/hissing sound by blowing air through their nostrils when stressed, this should not be confused with difficulty breathing
Eyes, ears, mouth/beak, skin and coat condition, limbs and feet	<ul style="list-style-type: none"> See Table 3.3 for guidance on what to look for

3.4.2. Equipment

- Gloves:** While it may be tempting to wear thick gloves to pick up an echidna, to provide protection from the sharp quills, this will reduce dexterity and can lead to poor handling technique. Thin, leather gloves, such as gardening gloves, are recommended. This allows the carer to feel and respond to the echidna's movements and not inadvertently grip it too tightly. We recommend long gloves or a long-sleeved shirt to protect the forearms, as this will reduce the risk of irritation from spines scratching the skin (See **Figure 3.1a**).
- Towel:** A large towel can be placed over the echidna from above, and used to protect the arms if long sleeves/gloves are not available.
- Transport container:** The container should have solid sides, provide adequate ventilation, be robust and have a secure lid. Some examples include a tall garbage bin with holes in the lid but not the sides (See **Figure 3.1b**), a 20 L bucket or large plastic tub with holes in the lid, or a solid, smooth-walled cat carry cage. Unsuitable containers include cardboard boxes, bird cages, and eskies as echidnas can easily destroy, escape from, or injure their noses in these types of containers.

3.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

- A short-beaked echidna that is not injured can be gently encouraged off the road. If it is approached too suddenly it will curl into a ball, necessitating physical removal.
- Echidnas are expert diggers. When threatened they will attempt to dig. If the animal is not injured, it is better to let it move away of its own accord rather than dig it out. If removal is required, dig down and around the echidna.
- To lift the echidna, place hands under the middle of the echidna's body, between the front and back legs. (See **Figure 3.1a**). This should be attempted quickly in one swift movement as the echidna will attempt to dig back into the ground.
- Never pull or lift an echidna by its hind legs and feet, this is an unacceptable method of restraint as this increases stress and can cause injuries or dislocations.

3.4.4. Transport

- Never transport an echidna which is not restrained in a transport box as they are likely to seek refuge and curl up in small spaces such as underneath car seats and are difficult to remove without sedation.
- A towel or leaf litter can be placed on the bottom of the transport container. Do not use leaf litter if the echidna has a wound, as the wound could become contaminated.
- The container should be securely closed during transport to prevent the echidna escaping.
- Echidnas do not pant or sweat. To thermoregulate when ambient temperatures are high, they rely completely on behavioural responses (such as burrowing underground or moving to shaded areas). When echidnas are transported, they cannot adapt to heat. During transport, the ambient temperature

should be less than 25°C. Be mindful of the actual temperature within the transport container, as it is likely to be higher. Do not place transport boxes in the sun, ensure vehicles are parked in shaded areas or kept cool. Ideally, you should not leave an echidna in a transport box within a car for extended periods. Animals should be checked regularly during travel, and where possible, a datalogger or max/min thermometer such as a Kestrel© should be used to monitor the temperature of the vehicle during transport.

Figure 3.1 a. Restraint of a short-beaked echidna for examination. The hand is placed behind the front legs to stop the animal from curling. **b.** A plastic container, such as a garbage bin, with holes in the lid for ventilation can be used to transport the echidna.

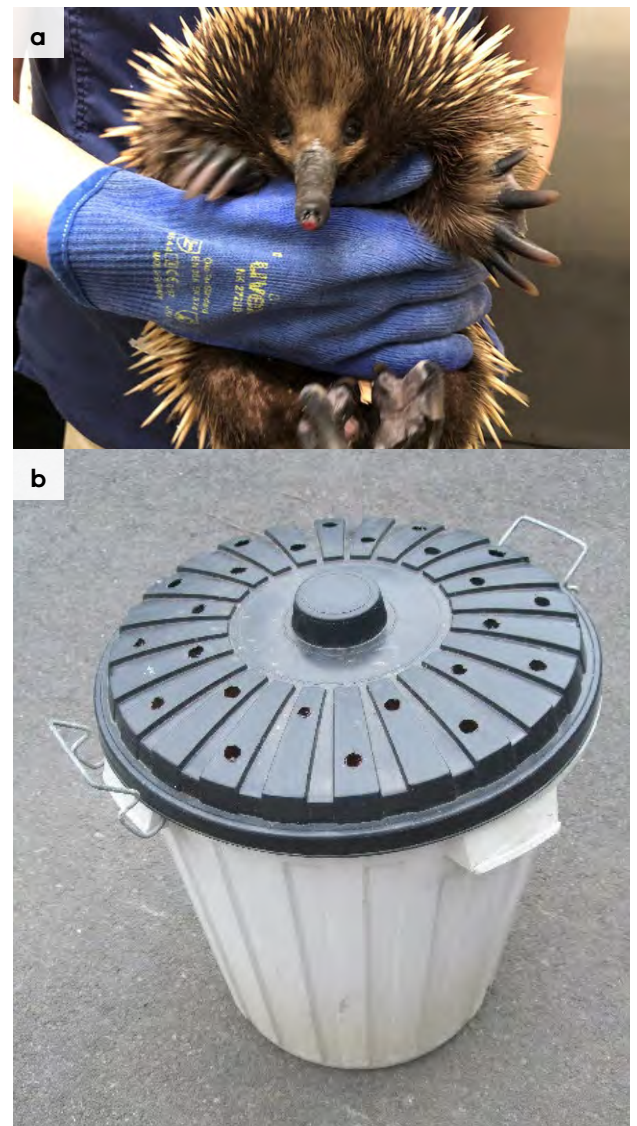


Photo credit: Zoos Victoria

3.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release, should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and quickly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping of visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessments on arrival and on effective monitoring of the health and welfare of individuals in care through minimising human-animal interactions and stress to the animal to maximise successful release back to the wild.

3.5.1. Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure weighing scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as

appropriate. **A template for recording Physical Examination findings can be found in the Appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examinations can be challenging in echidnas as they are extremely strong and tend to curl into a ball when handled. They will tuck their beak and all four legs into their body. Do not attempt to 'uncurl' an echidna; this may exacerbate underlying injuries and is extremely stressful for the animal. An echidna which is very easy to uncurl may be conditioned to human handling/imprinted (hand raised) or very debilitated and require veterinary assessment as soon as possible.
- If a physical examination is attempted, two people should be present to allow for one individual to hold the animal appropriately whilst the other attempts to look for and record information.
- When handled, echidnas may snort or hiss by blowing air through their nostrils, curl up around your hands and urinate or defecate.
- If an animal curls around you, stop moving and sit on the ground to allow the animal to uncurl and move away on its own.

Table 3.3 Physical examination of echidnas

What to look for	
Body weight	<ul style="list-style-type: none"> Record body weight on arrival and at least weekly while in care by placing the echidna on a set of scales in a bucket or bin. Ensure you know the weight of the bin, or tare it before adding the echidna. A greater than 10% change in body weight in adults over a week is cause for concern, and the carer should seek veterinary advice immediately.
Body condition	<ul style="list-style-type: none"> Body condition can be difficult to determine in echidnas because of the spines covering most of their body and their tendency to curl tightly when touched. However, there are several features to consider: <ul style="list-style-type: none"> Healthy echidnas have an even, rounded appearance over their back. When body condition is lean a 'dip' is visible on both sides of the spine, and they appear shrunken over the abdomen. In emaciated echidnas the spine may be visible. The foot pads of healthy echidnas are soft, leathery and smooth (See Figure 3.2a). When echidnas are in poor body condition the footpads are shrunken and lack the puffy appearance expected in healthy echidnas. Dehydration can also lead to a shrivelled appearance to the footpads. This needs to be considered in conjunction with hydration status. Captive echidnas can become overweight. In these cases, fat bulges can be observed around their head and neck.
Hydration status	<ul style="list-style-type: none"> Skin tent (of the furred areas of skin without quills, for example on the legs or abdomen) falls back to normal within one second. In dehydrated echidnas, the eyes appear sunken, and the conjunctiva around the eyes appears dry. The skin of the beak can also appear dry/wrinkled. The foot pads of hydrated echidnas are firm, and the skin feels elastic. In dehydrated or poorly conditioned echidnas the foot pads are 'flat', dry and wrinkled.
Eyes	<ul style="list-style-type: none"> Eyelids open, eyes clear, no discharge or crustiness around eyelids.
Ear slits	<ul style="list-style-type: none"> The external opening to the ear is a large, vertical 'slit' just behind the eyes. The ear slit should be dry and clean, with no blood or discharge present. Small numbers of ticks are commonly seen in the ear slits of healthy animals.
Mouth and beak	<ul style="list-style-type: none"> Long, pink tongue, may be covered in sticky mucous. See Figure 3.2b. Very small opening to the oral cavity, there are no teeth. Blood from the mouth or along the beak, protruding bones, or any deviation to the beak tip, are abnormal and indicate a traumatic injury (e.g. fracture). Bubbly, clear mucous from the nostrils is commonly seen in healthy echidnas and is believed to be one of the behaviours used by echidnas to cope with thermal stress (the moisture helps heat to escape through the nostrils).

What to look for

Skin and coat condition	<ul style="list-style-type: none"> • Quills should be intact, tapering to a point at the end, with healthy looking skin and fur in between. While a small number of broken spines may be normal, large areas of broken/short or missing spines, or crusty/flaking skin between spines may indicate an underlying health issue which requires further investigation. • A small number of ticks between quills are commonly seen in healthy wild echidnas. Large numbers of ticks may indicate underlying poor health.
Limbs and feet	<ul style="list-style-type: none"> • Forelimbs are short with long, forward facing nails. Hindlimbs are normally rotated backwards compared to most mammals, so that the feet point backwards at rest and while walking (Figure 3.3a). • There should be no broken nails or obvious wounds. • Asymmetry in the wearing of nails may indicate underlying injury to limbs/digits.
Sex determination	<ul style="list-style-type: none"> • Determining sex can be challenging because there are no external genitalia; size and weight are not indicative of sex. • Echidnas do not have a permanent pouch, and the ventral abdomen of males and females looks very similar unless the female is incubating an egg or is lactating. • The male penis is internal and is not normally visible or palpable. When protruded (for example under anaesthesia) the penis has four heads and is very easy to identify. • The presence of spurs on the hindlimbs is not indicative of sex as both males and females may have spurs (See Figure 3.3b). All juvenile echidnas have spurs. Adults may have spurs on both hindlimbs, one hindlimb or none at all.

Figure 3.2 a. The foot pads of healthy echidnas are soft, leathery and smooth. **b.** A healthy echidna's beak and tongue.



Figure 3.3 a. Echidna feet facing backwards.
b. An echidna's foot with spur.

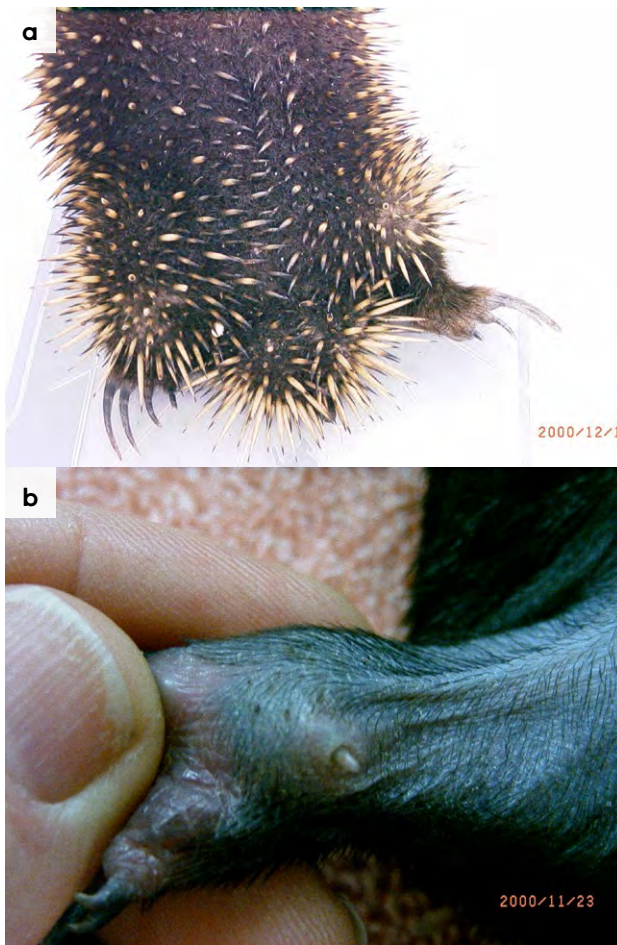


Photo credit: Zoos Victoria

3.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Carers should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the Appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence for overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Time your health and welfare observations for times of the day when the animal is expected to be active.
- If the animal is being medicated, a visual check in the morning is recommended.
- Ideally physical observations should be undertaken at the beginning and/or end of the resting period to minimise disturbance and maximise the rest/sleep period for rapid healing and ensure ease of capture.

- Echidnas held in small, hard floored enclosures for rehabilitation are prone to developing ulcerative lesions on their footpads. This is exacerbated by insufficient or wet/soiled substrate. A deep (~15–20 cm) layer of clean, dry substrate is required. Regular checks of the footpads of all echidnas in care should be part of the rehabilitation routine; this can coincide with the weekly check of weight/body condition (See **Table 3.4**).
- It is not unusual for wild echidnas to refuse to eat for the first 5–7 days in care. Since they have a low metabolic rate and are able to survive for up to two weeks without food, this is no cause for immediate alarm. However, this does require careful monitoring. While some echidnas can be encouraged to eat by adding formic acid to feed (see **Table 3.6**), there may be other underlying issues, including stress or pain, which are impacting food consumption. Careful monitoring of the animal's demeanour, response to food, body weight and body condition can help to ensure veterinary advice is sought as soon as possible (see **Table 3.3** for information on how to weigh echidnas).
- Faecal consistency should be monitored daily. Faeces of healthy wild echidnas are solid, cylindrical and consist mostly of soil, some plant matter and the undigested exoskeletons of invertebrates. Diarrhoea can result from the rapid change from the wild to captive diet, or where immune suppression/ stress allows overgrowth of organisms which are considered part of the normal 'gut flora' (including some bacteria, yeast or coccidia). If severe diarrhoea occurs, deterioration in demeanour is observed, or there is fresh blood in the faeces, veterinary attention should be sought as soon as possible. A sample of the abnormal faeces should be taken with the echidna for microscopic examination (wet prep and faecal float). No treatment should be provided **prior** to veterinary assessment, as medications can mask the underlying cause of disease, making a diagnosis and appropriate treatment plan very difficult to obtain.

3.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 3.4 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 3.4 Common and emerging health conditions seen on presentation or during care

Injuries and Clinical signs	Possible causes	Rehabilitator observations and response
<p>NOTE: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
Beak trauma Unable to walk or move normally Swollen limb Bruising Fractures Dislocation	<p>Found adjacent to road/suspect motor vehicle accident</p> <p>Caught in wire or netting, injury from garden tools</p> <p>Predation injury caused by raptor, fox, cat or dog, gunshot</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to a veterinarian even if there is excessive bleeding from the beak tip. This is extremely difficult to stop, and any pressure on a broken bone is highly stressful and painful. • Move animal to an appropriate transport box to restrict movement. Ensure temperature is appropriate for the species. • Do not attempt to stabilise fractures as this is very painful, and risks making the injury worse. Fracture stabilization should only be attempted by a veterinarian following physical exam, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side-effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure/box/ bag to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. Seek advice from species experts.
Bleeding Puncture wounds Bruising Quill loss	<p>Found adjacent to road/suspect motor vehicle accident</p> <p>Caught in wire or netting, injury from garden tools</p> <p>Predation injury caused by raptor, fox, cat or dog, poorly designed transport box/enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, due to stress</p>	<ul style="list-style-type: none"> • Seek urgent veterinary assessment. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side-effects, particularly in dehydrated/shocked animals.

Injuries and Clinical signs	Possible causes	Rehabilitator observations and response
<p>Bite wounds</p> <p>Unable to walk or move normally</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fracture</p>	<p>Predation injury, bite wounds caused by raptor, fox or dog</p> <p>Dog bites are commonly seen around hindlimbs/tail area</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Internal injuries resulting from predator attack are often more severe than they appear from the external appearance. Dog bite wounds in the hind limbs of echidnas are often associated with fractures or joint injury.
<p>Diarrhoea</p> <p>Abnormal/loose, smelly faeces</p>	<p>Inappropriate diet, infectious disease, alteration of microbiome, stress, antibiotic treatment</p>	<ul style="list-style-type: none"> • Seek veterinary advice. <ul style="list-style-type: none"> - Seek urgent veterinary advice if diarrhoea does not resolve rapidly (e.g. within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. • Do not treat on assumption of infectious disease (such as coccidia or bacterial infection) as this can make veterinary diagnosis more difficult if the animal does not improve. A small number of coccidian oocysts are present in the faeces of healthy, wild echidnas so this finding would not warrant treatment for 'coccidiosis'. • Excellent hygiene standards are required in case diarrhoea is caused by an infectious organism. Isolate the sick animal from others in care to reduce the risk of transfer (See Part A of these guidelines for information on managing quarantine and infectious disease). • Seek advice from species experts, ensure diet and husbandry practices are correct. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation.

Injuries and Clinical signs	Possible causes	Rehabilitator observations and response
<p>Skin condition/damaged spines,</p> <ul style="list-style-type: none"> • Ulcerated skin • Skin irritation • Damaged quills 	<p>External parasites, fungal or other skin conditions</p>	<ul style="list-style-type: none"> • Seek veterinary advice or assessment to diagnose the cause and advise on treatment. • Inflamed, flaky or crusty skin lesions have been reported in echidnas due to a wide range of infectious organisms (including fungus, bacteria and mange mites). Do not attempt to treat chronic or severe skin lesions until a veterinary assessment is obtained, as some antimicrobial creams can alter the wound, making an accurate diagnosis impossible to obtain. • Damaged or missing spines will regrow; however, this can take a very long time. Echidnas should not be kept in captivity until all spines are regrown, as this can take years. If the animal is otherwise healthy it should be released to the wild. • Heavy burdens of external parasites in animals may indicate an underlying disease or injury, these animals require veterinary assessment. • A small number of ticks on the skin between spines or around the ear slits is completely normal. The animal may not require treatment or handling to remove ticks unless they are excessive in number, the animal is otherwise debilitated, or there is associated skin irritation. • Ensure good hygiene and biosecurity practices.
<p>Burns</p>	<p>Recent bushfire, campfire injury, chemical burn</p>	<ul style="list-style-type: none"> • Seek urgent veterinary attention. • Burn injuries are extremely painful, treatment and bandage changes should only occur under anaesthesia and with adequate pain management. • Animals should be returned to a veterinarian for ongoing bandage changes. • Echidnas bury themselves underground during bushfires, or shelter in known burrows, and are susceptible to burns over their backs as a result of heat transfer through the soil from above. Severe burns can result in large patches of short, singed or missing spines. Like other animals, the appearance of burns to the skin change over time and are very painful. • House the animal in a fly-proof enclosure.
<p>Large mass under skin</p>	<p>Sparganosis (parasite), hernia</p>	<ul style="list-style-type: none"> • Veterinary advice should be sought to differentiate and treat appropriately.

Injuries and Clinical signs	Possible causes	Rehabilitator observations and response
Dull demeanour/ poorly responsive, weak (does not curl when stressed, does not resist uncurling)	Heat stress, torpor, infectious disease, toxicity	<ul style="list-style-type: none"> • Seek veterinary assessment to determine the cause. • Urgent veterinary attention is required to assess a heat impacted animal, to determine hydration status, and whether heat stress has led to more significant underlying organ damage. Heat stress is considered if the ambient temperature is $>25^{\circ}\text{C}$, and cloacal temperature is above 33°C. Place the animal in a cool environment and wrap the animal in a cold wet towel. • Seek species expert advice. Poorly responsive animals may present in a very similar manner regardless of the underlying cause, an assessment of environmental factors may help to understand whether the clinical signs seen are a response to thermal range or may indicate an underlying health condition. • Torpor may occur at low environmental temperatures. The echidna could display torpor at any time of the day or year, regardless of ambient temperature. If there are no signs of trauma, the animal is in good body condition, and there are no obvious signs of poor health, place the echidna in an environment of about 21°C and, if it becomes active and behaves normally over a period of 1–2 hours, reassess. If the animal is bright, alert and normally responsive, release it at its original location.

Figure 3.4 a. Extensive damage to an echidna's beak, requiring euthanasia. b. An echidna with a mild beak abrasion, which will heal uneventfully, allowing the echidna to be released.

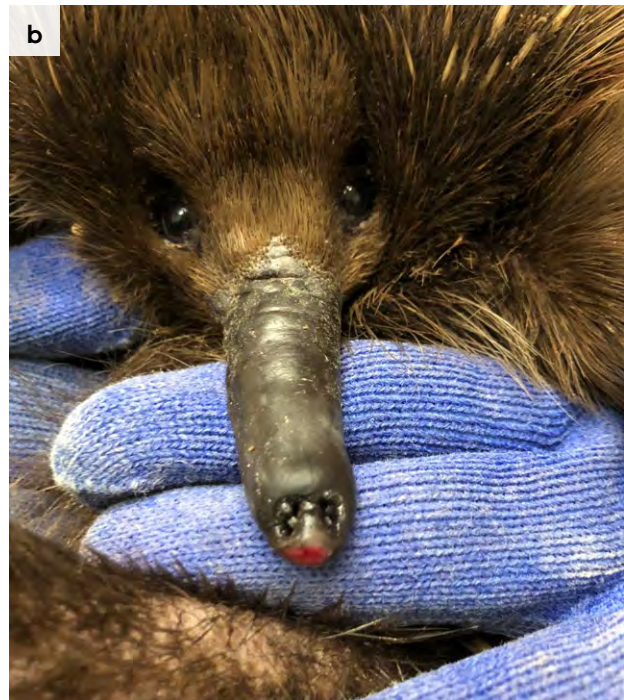


Photo credit: Zoos Victoria

Figure 3.5 Large mass under the skin of an echidna, indicative of sparganosis.



Figure 3.6 Burn on the back of an echidna.



Photo credit: Zoos Victoria

3.5.4. Administering treatment during rehabilitation

- Since oral medications cannot easily be delivered, they can be mixed into a small amount of food once echidnas are reliably consuming the captive diet. Morning medications can be mixed into a small portion of food and placed next to the echidna. The medication bowl should be removed once the contents are consumed. In the evening, medication can be presented prior to the main meal to ensure the entire amount is consumed.
- Since many wild echidnas refuse to eat when first in care, medication prescribed during this initial period often requires delivery by injection (under the skin or into the muscle). Injectable medications (which may include non-steroidal anti-inflammatory pain medication or antibiotics) should be prescribed by a veterinarian. The veterinarian is also responsible for ensuring the rehabilitator is comfortable with the technique required to administer medications correctly. Two people are required for delivering injectable medications to echidnas, one person restraining the animal (see **Section 3.4**), while the other injects the prescribed amount as directed by the veterinarian. The best site for injections is into the muscles of the outer thigh, which should still be accessible even if the echidna has curled into a ball. Since this process is highly stressful, medication should switch to 'in food' delivery as soon as possible.
- Since burns are extremely painful, sedation or anaesthesia is generally required for wound debridement or dressing changes. Wound dressing during the early stages of healing is very frequent (often every 2–3 days). It is preferable that burnt echidnas are transferred to an appropriately equipped veterinary hospital during this phase of treatment.
- Topical treatment prescribed for skin lesions can be applied to the skin between spines using a long-handled, disposable cotton tip swab.

3.6 Housing



Below are several key considerations when housing adults in care.

3.6.1. General housing information for echidnas

- Echidnas are solitary and should be housed individually during rehabilitation.
- Echidnas are very strong. They can climb and will readily attempt to escape from enclosures. They commonly use their beaks and claws to probe at small spaces, gaps under doors, drains/grills or loose enclosure wire and this can cause abrasions and cuts to the soft skin of the beak and footpads.
- A deep layer (~15–20 cm) of dry, clean substrate should be provided to allow echidnas to burrow down. This is an important behaviour which can help to reduce the stress of captivity. However, soiled/wet substrate material should be removed daily. If the soft skin of the foot pads is in direct contact with damp organic material, echidnas are prone to developing foot lesions. This is exacerbated if there are any rough/sharp edges to the floor of their enclosure.
- Prior to release, echidnas should be given adequate enclosure furniture to exhibit natural foraging behaviour. Gum branches and rotten logs can provide sensory experiences to support mental and physical wellbeing.
- **Thermal range (18–25°C):** Echidnas do not pant or sweat; they are completely reliant on behavioural responses such as burrowing underground, swimming or moving to shaded areas to thermoregulate during high heat events. When housed in rehabilitation enclosures, their ability to make appropriate choices for thermoregulation is significantly curtailed. While a range of 'optimal temperature ranges' have been published for echidnas, and likely vary across their natural distribution in the wild, it is generally recommended to maintain captive enclosures between 17–25°C. At the other end of the thermal range, Victorian echidnas enter torpor when temperatures drop below ~12°C.

3.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

- Coccidian oocysts are frequently found in the faeces of wild echidnas. While part of the normal flora of echidnas, they can cause disease in stressed or otherwise immune-compromised echidnas. Excellent hygiene, and daily spot removal of faeces, is required to reduce the build-up of coccidian oocysts in the environment.
- Coccidian oocysts are highly resistant to most disinfectants, including bleach and F10SC, and can remain viable (infective) in the environment for many months. Viability of coccidian oocysts is prolonged when they are protected by the presence of organic matter. All organic matter should be removed and the enclosure cleaned with boiling water, as this has been shown to kill oocysts. Rehabilitation facilities for echidnas should be designed and built using materials which are easy to clean and disinfect between occupants.

3.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care.

Table 3.5 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 3.8**.

Table 3.5 Rehabilitation housing for adult echidnas

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment - frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision where strict cage rest/ confinement is indicated</p>	<p>Floor area: 0.60 x 0.60 m (0.36 m²)</p> <p>Height: 0.90 m</p> <p>The adult echidna should be able to stand, stretch its head/neck out completely and turn around.</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A large plastic tub or wooden box with smooth walls (Do not house echidnas in enclosures with wire walls as they will damage their claws and beaks.). • Echidnas can escape out of enclosures which are not 'tall' enough or where there are any loose wires or gaps. The lid should close securely; it should have screws or a locking system to prevent the echidna pushing it open. • If the enclosure walls are less than one metre high, the 'lid' should be solid. Adequate ventilation should be provided in a solid enclosure. Rows of air holes, smaller in diameter than the echidna beak should be drilled into the 'lid' and along the top of the side walls. A wire grill can be used if the enclosure walls are tall enough to ensure the echidna cannot reach it. This is to prevent damage to the beak and feet. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Towels, newspaper, shredded paper or cardboard, or disposable absorbent bedding materials, including recycled paper cat litter, may be used as flooring. Change daily. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • No heating is required, and the enclosure should remain below 25°C to avoid overheating. A range of 18–25°C is appropriate. • Monitor with a thermometer or manage ambient temperature using a thermostat controlled split system. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Food and water bowls need to be made of a sturdy material, such as ceramic or steel, and have a low profile to prevent being tipped over (see Figure 3.8)

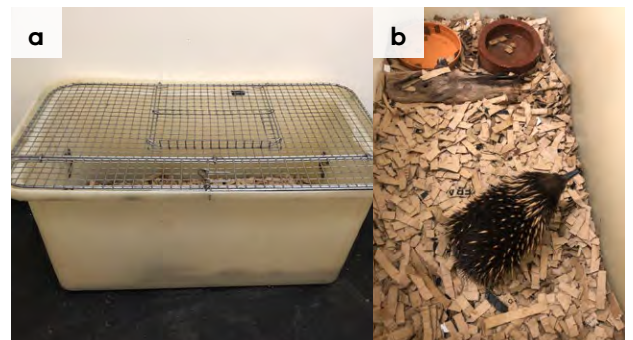
Intermediate housing (Treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care.</p> <p>Enclosure furnishings can be arranged to reduce opportunities to dig or move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact.</p>	<p>Floor area: 2 m x 1.2 m (2.4 m²) Height: 1 m</p> <p>The enclosure should be large enough to allow the animal to move around, and deep enough to provide substrate for digging.</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> While this stage of rehabilitation requires a larger enclosure, construction style and materials are the same as provided above for 'Intensive care housing'. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> An absorbable substrate, such as recycled cat litter, shredded paper or cardboard, or mulch can be provided in a deep layer (~15 cm deep) to provide opportunities for digging. Furnishings can be arranged to reduce opportunities to climb/dig or move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact. <p>THERMAL ENVIRONMENT</p> <ul style="list-style-type: none"> No heating is required, but ambient temperature should remain below 25°C to avoid overheating. Monitor with a thermometer or manage ambient temperature using a thermostat controlled split system. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Water bowls need to be made of a sturdy material, such as ceramic or steel, and have a low profile to prevent being tipped over (see Figure 3.8) Food can be presented in a low-profile ceramic plant pot saucer (see Figure 3.8)

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitor/assess behaviour (foraging, digging)</p> <p>Pre-release assessment</p>	<p>Floor area: 5 m x 4 m (20 m²)</p> <p>Height: 1.5 m</p> <p>The enclosure should be large enough, and contain suitable furnishing to enable assessment of natural foraging and digging behaviour prior to release</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> The enclosure should be placed in a shaded area and have solid walls (e.g., tin or recycled plastic sheeting) to at least 1–1.5 m height. The solid wall should extend at least one metre underground to prevent the echidna from digging out. Wire mesh or grills to prevent digging are not suitable, as they are likely to lead to nail/foot damage if the echidna attempts to dig out <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> Offer a substrate of mulch or leaf litter to promote digging and foraging for insects. Rotting logs naturally infested with termites can be provided as enrichment and a natural food source, provided the source of the logs is known, and there is no pesticide/other potentially toxic chemicals used in the area. A compost heap of grass and leaves will attract insects for foraging. <p>THERMAL ENVIRONMENT</p> <ul style="list-style-type: none"> A rock cave, burrow or hollow log will provide a cool area during high ambient temperatures. Ambient temperature should be monitored carefully, and echidnas moved temporarily inside/to a cooler enclosure on high heat days Since wild echidnas swim to cool off during extreme heat, provision of a pond dug into the ground to prevent it from tipping over can help prevent overheating. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Food and water bowls can be dug into the ground or surrounded with substrate. See Table 3.6 for information on pre-release diet considerations.

Figure 3.7 a. A plastic tub, suitable for intensive or intermediate care of a sick or injured adult echidna. The echidna is unable to reach the wire roof so that it cannot damage its beak. b. Short-beaked echidna in a plastic tub with shredded cardboard substrate. Note the sturdy, low-profile food and water bowls.

Photo credit: Zoos Victoria



3.7 Feeding and nutrition



Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how the animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of echidnas in rehabilitation. Information on feeding orphaned individuals can be found under **Section 3.8 Hand raising**.

Table 3.6 Daily feeding and diet guide for adult echidnas during rehabilitation

Diet	<ul style="list-style-type: none"> • There are several commercially available diets which have been developed in collaboration with a wildlife nutritionist, including the Wombaroo Complete Echidna Diet. This is the simplest way to provide a balanced diet during rehabilitation. It is generally well accepted by wild echidnas during rehabilitation. Feed according to instructions provided by manufacturer. • Formic acid, found in most ants (with a very strong smell), can be added to food to encourage eating. Start with one drop and increase by one drop daily, up to three drops to attract the echidna's interest. Once the echidna is reliably eating the captive diet, formic acid is not required. Note that faeces are often not as firm on the captive diet compared with the wild diet. However, since diarrhoea can indicate underlying health issues, monitor closely and seek veterinary advice if demeanour deteriorates, body condition is poor or if fresh blood is seen in faeces.
Frequency of feeding	<ul style="list-style-type: none"> • Food provided once per day for adult/weaned individuals. • Fresh water should always be easily available, provided in a stable/non-spill bowl or automatic drinker. Water should be changed daily.

Figure 3.8 A wild short-beaked echidna eating Wombaroo Complete Echidna Diet from a low bowl.



Photo credit: Zoos Victoria

3.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations can be found in the Appendices to Part A of these guidelines.

3.8.1. Equipment required for hand raising

- **Milk provision:** Since wild echidnas lack nipples (the puggle sucks milk directly from special glands in the skin of the pouch) no teat or bottle is required for hand raising them. Instead, milk is offered from a small, flexible bowl (see **Figure 3.11**). Alternatively, milk can be offered directly from the palm of a clean hand, noting that minimising interactions with humans is preferred. With appropriate hygiene, feeding from the palm is the most natural feeling for the young.
- **Bedding material:** small pouch made from non-abrasive materials such as soft flannelette/ cotton can be used until the echidna reaches 'burrow' stage (see growth and development **Table 3.7**). At this point, clean dirt/mulch or shredded paper can be used on the floor of the hand-rearing box/ enclosure as bedding/substrate.
- **Housing:** Refer to the growth and development **Table 3.7** where housing suitable for each stage of development is described. Echidnas can be raised successfully in simple, escape proof boxes, provided temperature regulation is possible. Thermostatically controlled portable animal intensive care units have also been used, particularly during the 'pouch' stage.
- **Temperature monitoring:** While monitoring pouch temperature is important with all orphaned marsupials, it is particularly important for orphaned echidnas given their propensity to overheat when temperatures are above 25°C. A max/min digital thermometer or datalogger for monitoring pouch/enclosure temperature is vital.
- **Other:** Set of scales, record charts.

Figure 3.9 An echidna is weighed on a set of scales.

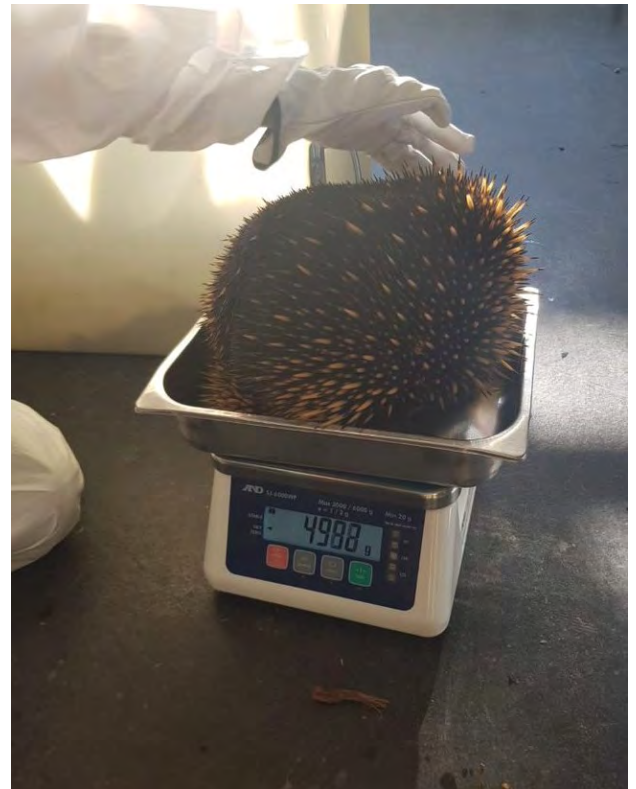


Photo credit: Zoos Victoria

3.8.2. Growth, development and care of orphaned young



STOP - Please refer to your authorisation for mandatory conditions, regarding unfurred puggles.

- Echidnas are rarely brought into care as orphans. For this reason they should be transferred to the Australian Wildlife Health Centre, Healesville Sanctuary or a rehabilitator experienced in hand raising echidnas.
- It is not recommended to attempt to hand raise echidna puggles weighing less than 100 g (approximately 30 days), as the success rate is very low.
- There are two distinct phases described for echidnas, from hatching to weaning: pouch life (first 50 days); burrow life (from 50–120 days). Burrow life is when the young are left in the burrow for extended periods, and the mother returns at intervals for feeding, until weaned.
- **Milk:** Short-beaked echidna milk is very high in fats and low in lactose. Milks used should imitate this natural diet. Wombaroo Echidna Milk provides sufficient energy and protein. Other milks require additives to provide correct nutrition, and for this reason they are not recommended.
- Wash hands thoroughly with hot soapy water before all feeds. If using hands ensure that hands are clean prior to offering any milk on the palm of the hand, if a soft silicone dish is used, make sure this is washed prior to use. Both these options enable the puggle to replicate the pushing motion into skin where glands produce milk that emerges on the skin for lapping.
- Immediately after feeding, return the echidna to the cleaned nursery burrow and do not disturb between feeds, except where necessary husbandry tasks are required such as weighing and cleaning of soiled enclosure.

Table 3.7 Feeding and housing requirements for young orphaned echidnas

Age	Weight / Morphometrics	Observation	Feeding	Housing
35–45 days	105–195 g	Stage 1: Pouch young <ul style="list-style-type: none"> • Eyes closed • No fur or spines • Pink skin • Faeces mustard colour and toothpaste consistency 	<ul style="list-style-type: none"> • Milk formula: Wombaroo Echidna Milk Early Lactation, transitioning to Wombaroo Echidna Late Lactation – follow instructions provided by Wombaroo. • Feed volume and frequency: Feed ~15–20% of body weight during a single feed. Initially, milk should be offered daily, however, once feeding well, increase the interval to every second day. Ensure all milk is digested from the previous feed prior to offering a new feed (milk is visible within the stomach at this young stage). • Feeding technique: Offer milk in a small bowl or on the palm of the hand. It may take some days for the puggle to learn how to lap/suck. • Toilet: Toileting is not required – echidna puggles will defaecate and urinate without stimulation. Given the slow digestion of echidnas, puggles may not defaecate after every feed. Record defaecation frequency. Urination may occur every 2–4 days. 	<ul style="list-style-type: none"> • Bedding material: Flannel or cotton pouch, folded over. • Enclosure: Smooth walled plastic tub • Temperature range: ~23–28°C. <p>Monitor temperature carefully, and where artificial heat sources are used (such as heat mat) make sure this is not in direct contact with pouch young.</p>
45–50 days	200–265 g	<ul style="list-style-type: none"> • Spines visible under skin • Fine hairs coming through 		

Age	Weight / Morphometrics	Observation	Feeding	Housing
50–60 days	300–390 g	Stage 2: Burrow young <ul style="list-style-type: none"> • Eyes open, • Fur still growing, small • Dark spines coming through 	<ul style="list-style-type: none"> • Milk formula: Wombaroo Echidna Milk Late Lactation, fed according to manufacturer instructions • Feed volume and frequency: When gaining weight consistently, feed 20% of body weight and gradually decrease feeding frequency to every 5 days • Feeding technique: Offer milk from bowl. • Toilet: as above – stimulation is not required, and as feed frequency decreases, the frequency of defaecation also decreases 	<ul style="list-style-type: none"> • Bedding material: no pouch required • Enclosure: Larger, smooth walled plastic tub (suggested dimensions 90 cm L x 60 cm W x 70 cm H) with ~ 20 cm dirt and mulch/leaves substrate. An artificial 'burrow' can be made by providing an upside-down wooden box or dark hide. • Temperature range: ~15–<21°C.
60–90 days	400–450 g	<ul style="list-style-type: none"> • Eyes open • Black fur • Spines 2 mm length • Faeces more formed 		
90–110 days	450–500 g	<ul style="list-style-type: none"> • Ear opening visible • Starting to climb and explore burrow 		
110–160 days	500–800 g	<ul style="list-style-type: none"> • Adult appearance but small size 		
7 months	800–1500 g	<ul style="list-style-type: none"> • Adult appearance 	<ul style="list-style-type: none"> • Weaning process: From ~800 g weaning begins. Over a period of four to five feeds, slowly reduce the amount of milk in each feed while increasing the solid component of the diet • Solid foods: Wombaroo Echidna Diet, range of invertebrates (see Table 3.6 above), small amount of 'termite mound dirt' mixed into slurry. 	<ul style="list-style-type: none"> • Housing to follow recommendations in Table 3.5 above, pre-release enclosure.
	1500+ g	<ul style="list-style-type: none"> • Adult in appearance • Release at over 1500 g 	<ul style="list-style-type: none"> • Adult diet (see Table 3.6 above) 	

Figure 3.10 a. A young short-beaked echidna at approximately 40 days of age. This animal would still live in the pouch of its mother. b. A young short-beaked echidna at approximately 70 days of age. This animal would be left in the burrow by its mother while she foraged.

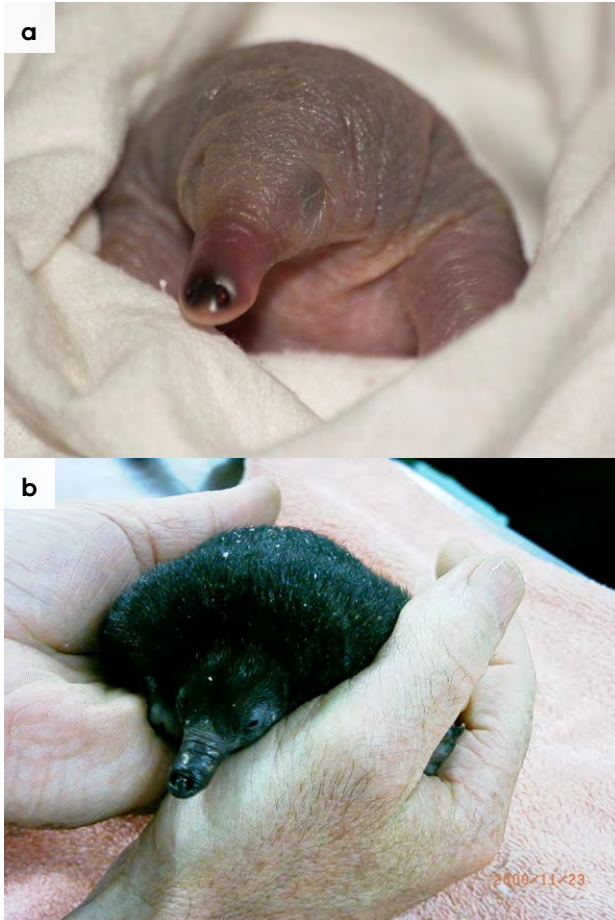


Photo credit: Zoos Victoria

Figure 3.11 A young echidna is offered milk from a soft plastic bowl.



Photo credit: Zoos Victoria

3.9 Release protocol



Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for such individuals.

3.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

The following check list should be used to guide decision-making regarding release suitability for echidnas:

- ☑ Individual is in a state of good health, presenting injury/sickness is completely resolved (consider a pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 3.1**).
- ☑ Individual displays the ability to actively forage for and consume natural foods, individual demonstrates that it can dig down when threatened and curl into a ball.
- ☑ Appropriate transport container.

3.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered.

Echidnas require the following:

- A supply of invertebrates.
- A variety of shelters, such as rocks, fallen wood, small caves or bushes.
- A thermal range which supports the activity levels required to find appropriate shelter and food in the post-release period.

For more information on the ecological characteristics and requirements of echidnas that may help with their release, please refer to **Table 3.1**.

3.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Approximate release where the animal was found (where suitable or within home range).
- ☑ Suitable vegetation for foraging.
- ☑ Suitable soil for digging.
- ☑ Away from major roads.

Release Procedure

- ☑ Limit the number of people at the release.
- ☑ Release when the temperature is between 18°C and 25°C. This may be in the early morning, except in the warmer months when it may be better to release the echidna in the evening. Avoid releasing on days of extreme weather.
- ☑ Release close to a hiding place such as the base of a tree, large mulch pile, rabbit or wombat burrow. Do not release an echidna in a hot, unsheltered area.
- ☑ Open the door of the transport container and allow the animal to leave in its own time. The animal may elect to burrow down immediately. If this occurs, leave the echidna alone and walk away.

3.10 Key references and additional reading

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Chapter 4. Flying Foxes

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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

satisfied. These include providing optimal nutrition (**Section 4.7**) and an environment appropriate to the flying fox's stage of rehabilitation (**Section 4.6**). The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

4.1 Introduction



There are two species of flying fox commonly found in Victoria – the grey-headed flying fox (*Pteropus poliocephalus*) and the little red flying fox (*Pteropus scapulatus*). Registered wildlife carers with the appropriate skills, knowledge and experience as well as appropriate enclosures can care for sick, injured or orphaned little red flying foxes. The grey-headed flying fox is listed as vulnerable under the Victorian *Flora and Fauna Guarantee Act 1988* and the Australian *Environment Protection and Biodiversity Conservation Act 1999*.



STOP – If a vulnerable species comes into care, please STOP and refer to your authorisation for mandatory conditions including notification and release requirements.

When flying foxes come into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are

IMPORTANT



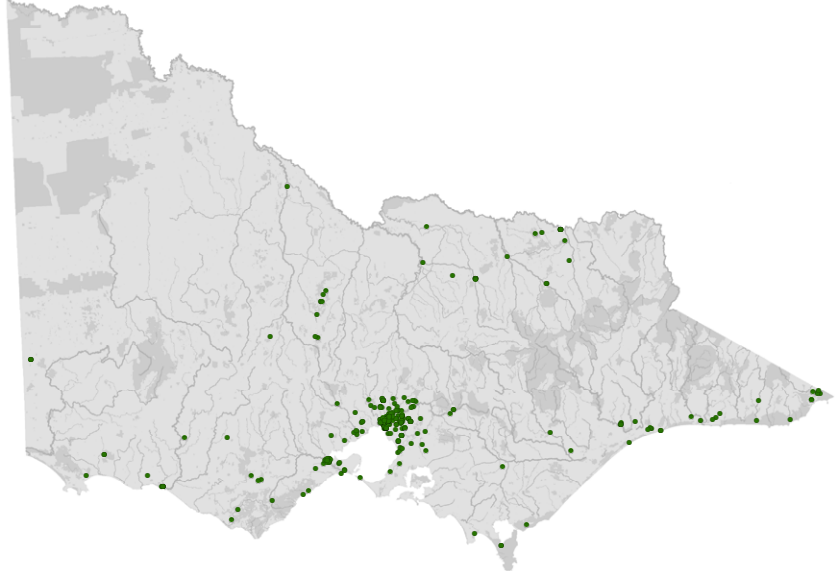
Australian bat lyssavirus (ABLV) has been identified in all four of the species of flying fox seen in mainland Australia, two of which occur in Victoria. Flying fox rescuers and rehabilitators are strongly recommended to be vaccinated against rabies to protect from ABLV, as detailed in the Australian Immunisation Handbook. The disease can be fatal in humans. It is important to always use appropriate protection when handling bats. Members of the public should not handle bats.

4.2 Species information


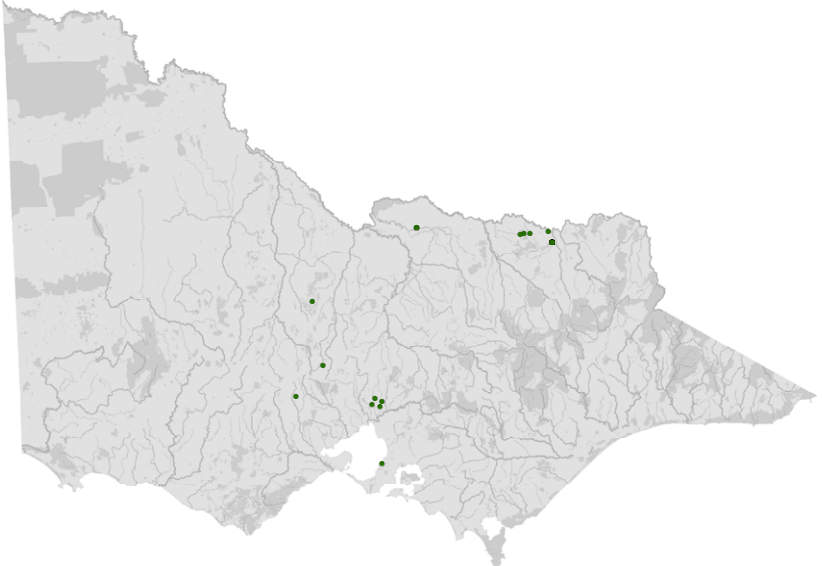


Profiles for the flying fox species found in Victoria are detailed in **Table 4.1**. For assistance in identification of flying fox species, refer to the recommended reading and reference material at the end of this chapter.

Table 4.1 Species Profiles

Species	Grey-headed flying fox (<i>Pteropus poliocephalus</i>)
 <p>Grey-headed flying fox with young.</p>  <p>Photo credit: David Paul, Museum Victoria.</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Reddish brown mantle encircling the neck. Lighter grey fur on head. Rest of the head and body covered in dark grey fur extending down the legs. Black wings</p>
<p>Conservation status*</p>	<p>Vulnerable</p>
<p>Sexual dimorphism</p>	<p>Average male body weight: 842 +/- 11 g</p> <p>Average female body weight: 675 +/- 10 g</p>
<p>Adult morphometrics</p>	<p>Body weight: 600–1100 g</p> <p>Forearm length: 138–180mm</p>
<p>Habitat</p>	<p>Rainforest, mangrove, wet and dry forest, urban parklands</p>
<p>Home range</p>	<p>Travel 20–50 km to feed– follow flowering</p>

Species	Grey-headed flying fox (<i>Pteropus poliocephalus</i>)
Behaviour	Grey-headed flying foxes are nocturnal and roost communally in permanent, seasonal and intermittent camps, often in gullies near water
Diet	Native fruits and blossoms, and nectar of eucalypts
Longevity	Up to 25 years in captivity
Sexual maturity	24–36 months
Mating season	February–April
Birthing season	September–January
Gestation period	6 months
Litters per year	1 (1 young)
Weaning	5–6 months

Species	Little red flying fox (<i>Pteropus scapulatus</i>)
 <p>Photo credit: Dave Pinson</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Reddish brown to dark brown all over. Brown wings. Young little red flying foxes in crèche
Conservation status*	Common
Sexual dimorphism	Males tend to be larger than females

Species	Little red flying fox (<i>Pteropus scapulatus</i>)
Adult morphometrics	Body weight: 350–604 g (males) 310–560 g (females) Forearm length: 125–156 mm (males) 125–148 mm (females)
Habitat	Semi-arid to wet and dry forests, mangroves
Home range	Travel 20–30km to feed – follow plants that are flowering
Behaviour	Little red flying foxes are nocturnal and roost communally in transient camps
Diet	Predominantly nectar but also some fruit, leaves, bark, sap and lerp
Longevity	Up to 16 years in captivity
Sexual maturity	18–24 months
Mating season	November–January
Birthing season	April–May
Gestation period	5 months
Litters per year	1 (1 young)
Weaning	5–6 months

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

4.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for flying foxes is in **Section 4.6.2**.

The following information relates to human and animal health and safety considerations specifically related to the rehabilitation of flying foxes.

4.3.1 Human safety considerations

- Australian bat lyssavirus (ABLV) has been identified in both species of flying fox seen in Victoria. The virus, which is closely related to rabies, can infect humans, and infection is potentially fatal. Three human deaths have occurred in Australia (as at 2022). Only people that have been vaccinated against rabies as per the Australian Immunisation Handbook, and who are competent handlers using appropriate personal protective equipment should handle bats. Refer to: <https://wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx> and https://wildlifehealthaustralia.com.au/Portals/0/Documents/ProgramProjects/PPE_Info_for_Bat_Handlers.pdf.
- The Australian Immunisation Handbook (<https://immunisationhandbook.health.gov.au/recommendations/people-with-ongoing-occupational-exposure-to-lyssaviruses-are-recommended-to-receive-booster-doses-of-rabies-vaccine>) provides guidance about antibody titres and booster vaccinations to ensure on-going protection against ABLV. Please refer to this handbook along with consultation from your GP for advice on maintaining antibody titres and the need for rabies vaccination boosters.
- ABLV transmission may occur from an infected animal via a bite or scratch, or from saliva contacting a wound or mucous membrane. Flying foxes can carry other viruses that have caused human deaths either directly or indirectly. As a precaution against transmission of any pathogens, wildlife rescuers and rehabilitators should avoid contact with blood, saliva, urine, faeces, ocular or nasal discharge and birth fluids from all bat species.

- The public should not handle bats. Instruct them to place a cardboard box or washing basket over the bat using a shovel or a broom, if safe to do so, and keep pets and people away from the animal until a vaccinated wildlife rescuer arrives. All flying foxes should be regarded as potentially infected with ABLV and handled with caution.
- In the event of a bat bite, scratch, or saliva contamination of a wound or mucous membrane:
 - Seek medical attention immediately as post-exposure treatment may be required.
 - Immediately wash the affected area thoroughly with soap and copious amounts of water for 15 minutes.
 - Apply a virucidal antiseptic to the area: povidone-iodine, iodine tincture, aqueous iodine solution or alcohol (ethanol).
 - ABLV can also be transmitted to other animals. Prevent pets and other animals from coming into contact with bats. If an animal might have been bitten or scratched by a bat, contact Agriculture Victoria or call the Emergency Animal Disease Watch Hotline on 1800 675 888.
 - ABLV is discussed further in **Section 4.5.4**.

4.3.2. Animal safety considerations

- Minimise handling time to reduce stress and prevent hyperthermia.
- Transport in cooler times of the day and never leave flying foxes in hot cars.

4.4 Capture, restraint, and transport



STOP – A visual examination should be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 4.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned flying foxes.

4.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 4.2 Visual health observations in flying foxes

What to look for	
Demeanour	<ul style="list-style-type: none"> • Bright, alert • Will rotate ears to listen to surroundings • Tend to make eye contact with observers at close range and will move away if threatened • Will vocalise when interacting with other flying foxes or when in pain or distress but generally silent when on their own and not threatened
Behaviour	<ul style="list-style-type: none"> • Active at night
Movement and posture	<ul style="list-style-type: none"> • Hangs with both feet • Holds wings close to the body with shoulders at the same height • Coordinated movement • Able to invert posture and hang from thumbs to urinate and defaecate normally • Able to use thumbs to do a vertical climb of tree trunk
Breathing	<ul style="list-style-type: none"> • Quietly observe the animal without disturbing. Breathing should be regular • Panting or open mouth breathing may indicate respiratory distress or overheating

4.4.2. Equipment

PPE: Refer to the Wildlife Health Australia document, "Personal Protective Equipment (PPE) Information for Bat Handlers": https://www.wildlifehealthaustralia.com.au/Portals/0/Documents/ProgramProjects/PPE_Info_for_Bat_Handlers.pdf

- PPE includes long-sleeved clothing and/or gauntlets that will prevent scratches to the forearms; safety glasses to protect the eyes from saliva, urine or barbed wire; thick gloves to reduce the risk of bites or scratches (note: these may reduce sensation during handling; leather rigger's gloves may be a suitable compromise).
- **Catch bag:** Flying foxes can be placed in a pillowcase, but they are more commonly wrapped in a towel, which supports the wings against the body and provides protection against scratches. It also allows the handler to visualise the head.
- **Transport container:** Flying foxes should be transported in containers tall enough for them to hang without hitting their heads, for example 30 cm (L) x 30 cm (W) x 50 cm (H). Suitable material suspended from the roof of the enclosure for the flying fox to hang on includes dowel, branches or rope. If a cardboard box is used, ventilation holes should be made in the sides of the box. A towel should be placed on the floor of the container in case the bat falls. See **Figure 4.1**. For bats that are too ill or injured to hang, they can be transported in a cat carry cage, pet pack or Rio basket. Containers holding flying foxes should be labelled: CAUTION: LIVE FLYING FOX.

Figure 4.1 a. Cardboard box used for transport. Note the ventilation holes and towel on the floor in case the flying fox falls.
b. Wire cat carry cage converted into a simple transportation container.



Photo credit: Dave Pinson

- **Additional rescue equipment:**
 - Thick towel to restrain the bat
 - Wire cutters to cut barbed wire
 - Long nose pliers
 - Sharp scissors to cut fruit tree netting
 - Ladder
 - Oral fluids
 - Water in a spray bottle
 - Fruit (grapes, apples or pear).

4.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

- Restrain the wings by folding them next to the body and wrapping in a towel with feet and head exposed (see **Figure 4.2**).
- Provide something for the flying fox's feet to hold onto, such as the towel, stick or top of the rescue basket.
- Allow flying foxes to hang with the head positioned towards the ground. Flying foxes that are unable to hang, or where hanging is contraindicated (such as suspected head injury) should be wrapped in a towel and laid down at a 45-degree angle with their feet elevated in a cat carry cage, pet pack or Rio basket.
- Flying foxes can overheat and succumb to heat stress within several minutes if they are overly wrapped. Towels should be removed from around the bat once it is safely contained. Bats from a heat event should not be wrapped at all.
- Note: Rescues can be complex and risky, and it is recommended that new rescuers attend with an experienced person to develop their skills.

Figure 4.2 a. A flying fox is restrained in a towel. Note that the feet are held in one hand and the other hand can be used to restrain the head through the towel. b. Protective gloves are worn during handling.



Photo credit: Dave Pinson



Photo credit: Zoos Victoria

Fruit tree netting entanglement

Required equipment includes scissors, ladder, basket and towel.

The goal is to remove the flying fox and netting in one piece rather than attempt to remove the animal from the netting while the netting is still hanging.

Wrap the towel around the animal. This will cover the face and body of the animal and support it while a wide cut through the netting is made.

Two people should be involved – one to hold the flying fox and the other to cut the netting.

Cut a wide circle around the bat to remove it from the tree.

Once the bat is restrained safely on the ground, cut away the netting, being careful not to cut the wing membrane. Use your hand on the underside of the wing to guide the scissors to avoid injury to the thin membrane.

Once the bat is removed it should be rehydrated using an oral electrolyte solution.

The use and sale of netting with holes bigger than 5 mm x 5 mm is illegal in Victoria (Prevention of Cruelty to Animals (POCTA) Regulations 2019). If nets that don't comply with this regulation are being used and the resident refuses to remove the net, call the police assistance line on 131 444. If a property owner refuses access to attend to a live trapped animal, the police assistance line should be called as this may be a breach of the *Prevention of Cruelty to Animals Act*, and the police will be able to mediate a solution. Where a crime is suspected, such as deliberate destruction of, or harm to, native wildlife, this should be reported to Crime Stoppers (1800 333 000). All other alleged non-compliance can be reported to DEECA on 136 186.

Flying foxes rescued from fruit netting, not presenting with obvious injuries, should be brought into care for observation. It may take up to three weeks for the full extent of the injury and membrane breakdown to become apparent. At the first sign of injury, swelling, bruising or membrane breakdown, the animal must be assessed by a veterinarian.

Barbed wire entanglement

Flying foxes are commonly entangled on barbed wire (see **Figure 4.3**).

Equipment required includes: long nose pliers, wire cutters, ladder, water in a spray bottle to wet entangled membranes, towels and transport cage.

Two people are required: one to hold the bat and the other to remove the bat from the wire.

Cover the bat's head with a towel and cover the adjacent wire strands with towels to prevent further entanglement. The towel can also be used as a support for the bat to lessen tension on the wings. It can be attached to the wire with clips or pegs.

Spray the wing membrane with water to keep the bat cool on warm days and to re-hydrate the wing membrane. This will make the membrane slippery, which assists in untangling the bat.

Attempt to unwind the bat around the wire to remove it. Do not cut the barbs off as this will make the unwinding process more difficult.

Do not under any circumstances cut the wing membrane of a flying fox. If the bat cannot be removed, cut the wire and transfer the bat to a veterinarian who will remove the wire with the bat anaesthetised. Before a wire fence is cut, permission from the property owner is required.

Flying foxes rescued from barbed wire should be brought into care for a minimum of three weeks, as the full extent of membrane breakdown will only become apparent over this timeframe.

Electrocution on powerlines

Never attempt to remove any animal from a powerline without the assistance of an authorised power company representative.

Flying foxes that are electrocuted on powerlines between October and March need to be checked for the presence of a surviving pup. The pup may be alive, even if the mother has died. In other circumstances, the flying fox may be thrown off the wire and found on the ground below the powerline. Always check around the ground for young if a dead adult is spotted above. Non-fatal electrocution cases (see **Figure 4.3**) have an extremely poor prognosis and should be euthanised. These will present with burns, singed fur, broken bones, missing limbs and an 'exit' wound where the current has left the body.

Figure 4.3 a. Black flying fox caught on a barbed wire fence. **b.** Grey-headed flying fox caught on powerlines.

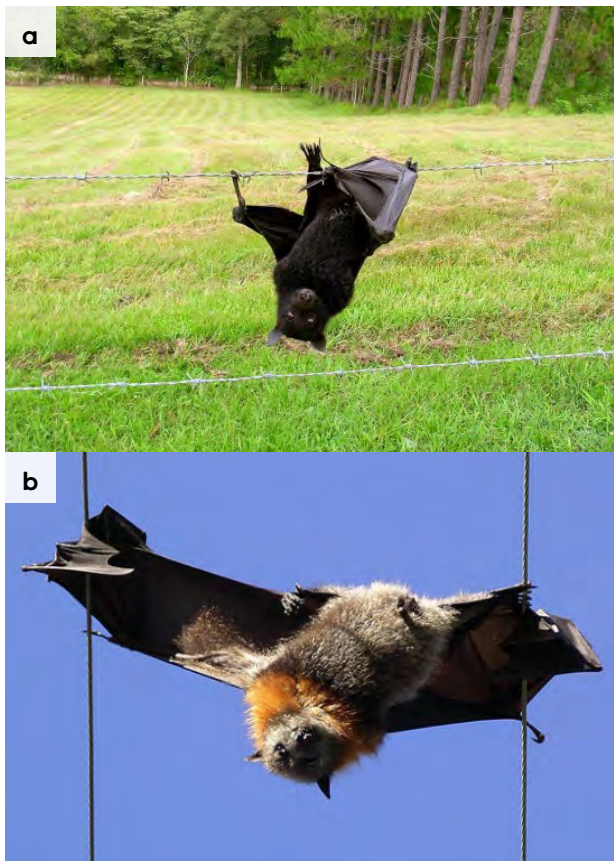


Photo Credit: Dave Pinson

On the ground

A flying fox may be found on the ground due to raptor attack, collision with a vehicle, electrocution or illness such as ABLV infection. The flying fox should be scooped up into a thick towel. Examine the site for any signs of what brought the flying fox to the ground; check for predators, overhead powerlines, or proximity to a road.

Pups may also be found on the ground. If the mother is still around (look for an animal circling and calling), then attempt to reunite the mother and pup. Place the pup in a location where the mother can safely land. This could be on the ground or in a tree, a site where the pup can be retrieved if the attempt is unsuccessful. If the pup is very small, care should be taken to avoid hypothermia during the attempt to reunite.

4.4.4. Transport

- Transport injured or unwell adult flying foxes individually. Pups can be transported together, as a group.
- Containers holding flying foxes should be labelled: CAUTION: LIVE FLYING FOX.
- Flying foxes can be transported upright, hanging from the top of the transport enclosure (be sure to secure in the vehicle to prevent the enclosure tipping). Alternatively, transport the animal lying down wrapped in a towel, this may help keep them calm. Ensure their feet are able to grip on something to help them feel secure. Animals suffering the impacts of extreme heat, should not be wrapped.
- Secure the container in the vehicle.
- It is not necessary to provide water or food when transporting flying foxes.
- A quiet air-conditioned enclosed vehicle should be used for transportation. Ensure there is adequate ventilation, the boxes are out of direct sunlight, and air-conditioning is at the right temperature to reduce heat stress. Ensure that noise is minimal during transportation.

Figure 4.4 Transport of flying fox pups.



Photo credit: Tamsyn Hogarth

4.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care through minimising human-animal interactions and stress to the animal to maximise successful release back to the wild.

4.5.1. Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure weighing scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording physical examination findings can be found in the appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examination of flying foxes can be challenging as they will attempt to bite and hook onto the handler with the claws on their thumbs and feet.
- For human safety reasons and to minimise stress in the flying fox, only a cursory examination will be possible. More detailed examinations require the animal to be anaesthetised.
- Physical examination will require two people. One person will either restrain the bat in a towel or else, while wearing gloves, restrain the bat's head while holding its wings against the bat's body. The second person, who is also wearing gloves, can then examine select body parts while carefully removing them from the towel or the handler's grasp.
- This procedure will be stressful for the flying fox who will likely struggle and vocalise.

Table 4.3 Physical examination of flying foxes

What to look for	
Body weight	<ul style="list-style-type: none"> • Record body weight on arrival and at least weekly whilst in care. • A change greater than 10% in body weight over a week is cause for concern and the carer should seek veterinary advice immediately.
Body condition	<p>Body condition is scored by palpating the scapula, its spine and adjacent muscles. Palpation of the pectoral muscles can also be used.</p> <p>Body condition can be described as follows:</p> <ul style="list-style-type: none"> • Under condition: The bones of the scapular spine are very prominent and are easily seen and felt. Concave muscles either side of the scapular spine and concave pectoral muscles either side of the sternum. • Ideal condition: Slightly curved muscle over the scapular spine. The scapular spine is just palpable. The pectoral muscles are well developed and rounded either side of the sternum. • Over condition: Curved muscle mass on either side of the scapular spine. It is difficult to feel the scapular spine. 'Obesity in wild flying foxes is rarely seen nor is generally a cause for concern as long as the flying fox is strong and fit.
Hydration status	<ul style="list-style-type: none"> • Hydration can be assessed by testing skin tent, done by pinching and lifting the skin between the shoulder blades. • Dehydration can be indicated by skin remaining 'tented' or a slow return to normal position. • Eyes can indicate hydration status; they should be bright, shiny and not sunken.
Eyes	<ul style="list-style-type: none"> • Eyes can indicate hydration status; they should be bright and shiny. Sunken eyes may indicate dehydration. • Bat follows movement with eyes. • Basic internal structures of eyes (e.g. pupil, iris) appear symmetrical.
Ears	<ul style="list-style-type: none"> • Ears swivel in response to sound.
Mouth	<ul style="list-style-type: none"> • Pink gums. No bleeding or broken teeth. • Lips are normal.
Skin and coat condition	<ul style="list-style-type: none"> • Wing membrane feels soft and supple. Small holes are normal. Dark surface.

What to look for

Limbs, feet, and tail	<ul style="list-style-type: none"> • No broken nails, obvious wounds or exposed bone. • No crackling or grinding detected when the legs are manipulated. Legs not held at odd angles to the body.
Sex determination	<ul style="list-style-type: none"> • The sex of the flying fox is determined by examination of the genital area for the presence or absence of a penis and testicles. • Adult females will often be lactating. Nipples are located near the armpit (2 nipples present).

Figure 4.5 A flying fox is weighed in a plastic container.

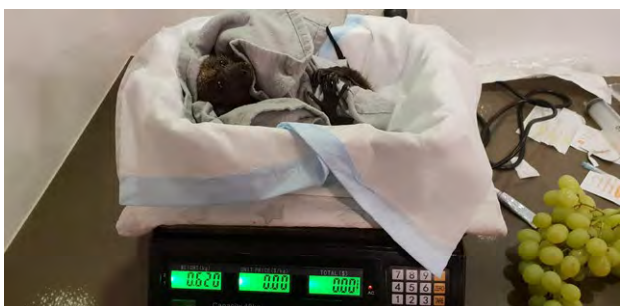


Photo credit: Tamsyn Hogarth

Figure 4.6 Example of body condition scoring by palpating the scapula.



Photo credit: Zoos Victoria

4.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being

provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Time your health and welfare observations for times of the day when the animal is expected to be active.
- The flying fox should be observed at least daily.
- Note the flying fox's demeanour and behaviour every time food is introduced or taken away, medications given, or the enclosure cleaned. Pay particular attention to any changes that have occurred since the previous day.

- Avoid disturbing sick/injured flying foxes during the daylight hours as rest/sleep is required for rapid healing.
- The use of infra-red cameras can allow monitoring of behaviour overnight.
- Be alert for signs of self-trauma. Flying foxes tend to chew sutures, bandages and damaged parts of their wings or legs. They may also damage teeth and gums by chewing on wire in their enclosure.
- Check wings daily for any sliminess or excessive moisture or trauma to the extremities, particularly over the wrists and ends of the digits.

4.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 4.4 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 4.4 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Injury or clinical signs	Possible causes	Carer observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to fly, fracture, dislocation, head trauma, wing membrane tears, bleeding, exposed bone on digits, eye ulcer</p>	<p>Netting and barbed wire entanglements, motor vehicle accident, predator attack, unknown trauma</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to veterinarian to apply first aid, other than to stop excessive bleeding. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimize stress. • Do not attempt to stabilise fractures as this is very painful, and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical exam, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Exposed bone on digit tips should not be trimmed without general anaesthesia and veterinary assessment.

Injury or clinical signs	Possible causes	Carer observations and response
Burns	Bushfire, electrocution	<ul style="list-style-type: none"> • Urgent veterinary attention is required to assess burns. Electrocution cases often carry a poor prognosis and euthanasia is often required.
Abrasions on wing tips that occur during time in care	Abrasions from sides of enclosure	<ul style="list-style-type: none"> • When abrasions occur during care reassess enclosure size and materials. Risks include <ul style="list-style-type: none"> - An enclosure that is an intermediate size, allowing flying foxes to flap but not achieve actual flight. Depending on the health status of the flying fox, consider moving it into a flight aviary, possibly with another carer if needed, or into a smaller enclosure that prevents attempts at flight. - Inappropriate social grouping: avoid housing flying foxes on their own or housing females with males, especially during breeding season where males may harass females. • Environmental stressors causing flying foxes to be agitated and flighty: look for stressors including presence of domestic animals (sight and/or smell), lights, noises and human activities that disturb flying foxes. • If abrasions do not resolve or worsen while in care, seek veterinary advice.
Bite wounds, punctures, bruising	Predator attack Motor vehicle accident	<ul style="list-style-type: none"> • Veterinary attention is required as soon as possible. • While bite wounds/scratches may not be immediately obvious, these carry a poor prognosis and animals often present moribund (very lethargic, poorly responsive, and cold). • Look for small clumps of dried fur stuck together with saliva. Part the fur and look for small puncture wounds.

Injury or clinical signs	Possible causes	Carer observations and response
<p>Neurological signs, aggression, inability to fly</p>	<p>ABLV infection, toxoplasmosis, poisoning, head trauma</p>	<ul style="list-style-type: none"> • Seek veterinary assessment. • Carer may observe animal bumping into objects in enclosure or fail to respond to short sharp noises (such as a loud clap from behind animal). • Pupils may be fixed/dilated and not responsive to changes in light level. You should see pupils constrict if a pen light is shone in the eye. • Given the very wide range of causes, and the possibility of ABLV infection, carers should seek veterinary advice as soon as possible. ABLV is a notifiable disease and affected flying foxes are likely to die. Contact Agriculture Victoria or call the Emergency Animal Disease Watch Hotline on 1800 675 888. For additional information consult the Wildlife Health Australia ABLV fact sheet: https://wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/mammals/Australian_Bat_Lyssavirus.pdf. • If multiple animals are seen with similar signs, this may indicate a newly emerging infectious disease or a toxicity (plant toxicity or poisoning): contact your the Emergency Animal Disease Watch Hotline on 1800 675 888 to report concerns. • If unusual toxicity or infection is suspected, you or your veterinarian should contact Zoos Victoria's Veterinary Departments to discuss options for disease investigation.
<p>Skin irritation/fur loss</p>	<p>Excessive mite infestation, bacterial or fungal infection</p>	<ul style="list-style-type: none"> • Seek veterinary assessment. • A small number of mites can be normal, and do not require treatment or removal. However, if many mites are seen, the animal is scratching/irritated, or the skin is red and inflamed – seek veterinary attention to treat ectoparasites.

Injury or clinical signs	Possible causes	Carer observations and response
<p>Slimy, pale, smelly wing membrane</p>	<p>Wing membrane infection, stress or poor husbandry conditions resulting in flying foxes urinating on themselves</p>	<ul style="list-style-type: none"> • Seek veterinary assistance if it does not clear up. • Clean the wings of orphans daily with unscented, alcohol-free baby wipes or dilute iodine and then dry thoroughly. • Antibacterial or antifungal creams can be applied to affected areas. Choice of creams should be directed by a veterinarian. • Provide opportunities for flapping and access to sunlight for 20 minutes daily. • Affected animals should be housed separately and strict hygiene observed to avoid cross-infection with other animals. • Wash all materials used (blankets, wraps, etc.) in an anti-fungal laundry wash.
<p>Heat stress</p> <p>Normal behaviours in response to an extended period of very high ambient temperatures combined with a low relative humidity: Panting, wing licking and flapping, shade seeking, hanging low in trees.</p> <p>Behaviours indicative of heat stress: Clustering and clumping low to or on ground, becoming unresponsive.</p>	<p>Extreme heat</p>	<ul style="list-style-type: none"> • Caution: Some intervention activities such as spraying and removal of individual animals for treatment, particularly at the wrong time, can jeopardise other animals in the colony, as disturbance has the potential to cause panic and exacerbate heat stress. It is therefore critical that flying fox heat stress is managed in accordance with the Victorian Plan for Heat Stress in Flying Foxes. • Do not intervene without direction from DEECA and/or land manager. • Do not approach. Continue monitoring from a distance. • Anyone who comes across flying foxes affected by heat stress can report these directly to DEECA via the Wildlife Emergency app or by phone on 136 186 or via Wildlife Victoria on 03 8400 7300. • The Wildlife Emergency app, which can be downloaded from either the Google Play store or the Apple store, allows individuals to describe and geolocate the animal by dropping a pin, as well as to upload a photo. This information is sent directly to DEECA for response. • DEECA and/or the land manager will coordinate response efforts in accordance with relevant Heat Stress Camp Plan.

Figure 4.7 Wing trauma caused by electrocution.



Photo credit: Zoos Victoria

4.5.4. Administering treatment during rehabilitation

- Ensure urine and faeces are cleaned away from the bat's wings and body when removing from the transport container and placing into an aviary.
- Dressings may be reapplied under manual restraint for some individuals. Others will require general anaesthesia by a veterinarian for dressing changes. Appropriate pain relief and careful bandaging is required to reduce the risk of self-trauma (bats chewing or licking wounds).
- It is preferable to administer medication in a food item, such as a piece of fruit or a bat smoothie (See **Section 4.7**). If the bat is not eating, oral medications can be delivered in a syringe directed into the cheek from the side of the mouth while the bat is restrained. Care is required to avoid being bitten or scratched while the bat is being medicated.
- If the bat does not eat for two consecutive days, seek veterinary advice.

4.6 Housing

Below are several key considerations when housing adult flying foxes in care.

4.6.1. General housing information for flying foxes

- Flying foxes are social and unless there are quarantine or medical reasons, animals should be housed in groups.
- Rehabilitators with a lone animal should move the animal to a carer with other bats as soon as possible.
- Bats are reliant on flight to stretch and flap and to source food. It is critical that any animals either raised or rehabilitated are in flight fit condition upon release, in order to survive. If you cannot provide flight fitness for an animal in your care, call on the services of those who can. Carers are encouraged to share resources for the best welfare outcomes.

4.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

IMPORTANT

Australian bat lyssavirus (ABLV) has been identified in both species of flying fox seen in Victoria. Flying fox rescuers and rehabilitators are strongly recommended to be vaccinated against rabies to protect from ABLV, as detailed in the Australian Immunisation Handbook. The disease can be fatal in humans. It is important to always use appropriate protection when handling bats. Members of the public should not handle bats.

Anyone who has been bitten or scratched by a bat must immediately contact their local hospital emergency centre or the Department of Health and Human Services Communicable Disease Unit on 1300 651 160.

- All flying foxes should be considered possible ABLV carriers and should only be handled while wearing appropriate PPE. The virus lasts up to 24 hours in saliva but is short lived in the environment. It is rapidly inactivated by heat, direct sunlight, soapy water and most disinfectants, including bleach and F10.

- Flying foxes can also carry other potential pathogens such as Hendra virus, *Leptospira* and *Salmonella*. The first two are transmitted through contact with urine while *Salmonella* are present in faeces. It is important to always wash hands with soap and water after servicing flying foxes and ensure that any open wounds are covered.
- Flying foxes frequently carry external parasites such as mites and bat flies. Bat fly bites may cause mild skin irritation in people.
- Left-over food and faecal matter should be spot cleaned daily.
- Since these enclosures are used to house

sick/injured flying foxes, they should be cleaned and disinfected between inhabitants. Items of furniture, such as branches or ropes, should be discarded as they cannot be effectively disinfected.

4.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care.

Table 4.5 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 4.8**.

Table 4.5 Rehabilitation housing for adult flying foxes

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>One adult</p> <p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment - frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision where strict cage rest/confinement is indicated</p>	<p>1 m (L) x 0.50 m (W) x 0.60 m (H)</p> <p>(Floor area: 0.50 m²)</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Purpose-built incubator such as a Vetario, cat carry cage or Rio basket. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • The animal will be resting on towelling. Towels need to be changed as soon as they are soiled with faeces or urine. • Absorbent material like puppy training pads will draw urine away from an animal's fur and body and should be used if an animal is resting rather than hanging. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Provide heat (approximately 28°C) using a heat pad, with a thermometer. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • The flying fox will likely need to be hand fed fruit pieces or 'smoothies' (see Table 4.6) or may take food and water from bowls connected to side of the enclosure at their head height.

Intermediate housing (Treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>One adult</p> <p>Provision of daily medication, dressings on wings, close monitoring once animal is stabilised and no longer requires intensive care.</p> <p>Enclosure furnishings can be arranged to reduce opportunities to move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact</p>	<p>1 m (L) x 1 m (W) x 1 m (H)</p> <p>(Floor area 1 m²)</p> <p>The dimensions should be large enough for the flying fox to be able to hang, move around and flap its wings.</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A mesh dome tent or net enclosure, canvas pet carrier or dog crate with mesh small enough to prevent bats getting their heads caught. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Newspaper or thin towelling substrate. • Towels or blankets should always reach the floor so any young that fall to the ground can climb back up. • Thick ropes or natural branches can be provided for flying foxes to hang from. • All perches need to be secure and strong enough to support the weight of the flying fox. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Ambient temperature. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Food bowls hung on the side of the cage (on the floor or above the perch/mesh). • Water is offered in open bowls or small animal water sippers hung from the roof.

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Up to 10 adults for soft release.</p> <p>Used to acclimatise flying foxes to the prevailing weather and develop/check fitness prior to release</p> <p>No longer require regular handling/medication</p>	<p>Floor area: 30 m²</p> <p>Height: 2 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • The pre-release aviary may be constructed of a synthetic polymer mesh, such as polyethylene, which is used for cricket nets. • The mesh size is 50 mm and the twine diameter ranges from 1.8 mm to 3.0 mm. • The enclosure should be built with a strong frame (steel) and have a double roof (i.e. a rigid mesh frame with soft netting hung from the inside). This will prevent predation by birds of prey and foxes. • The enclosure should be situated to offer sunlight and shade. • Pre-release housing should provide the animal with the opportunity to fly 10 wing lengths from one end of the enclosure to the other. • Wing tips need to be monitored for evidence of abrasions caused by rubbing on the aviary walls. • See Figure 4.5. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • A soft substrate like mulch should be used on the floor and be raked and cleaned daily to remove fruit spots and faeces. • Natural enrichment of native <i>Eucalyptus blossom</i> and leaves should always be provided (See Section 4.7). <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Food bowls are hung on the top side of the cage at a height that a bat can access while hanging or suspended from ropes/perching within the enclosure. They should not be placed on the floor. • Water can be offered in open bowls or using small animal water sippers hung from the roof (see Figure 4.5).

Figure 4.8 Water-sipper bottles suspended from the roof in a pre-release enclosure.



Photo Credit: Anne Fowler

Figure 4.9 Purpose-built flight aviaries, lined with soft netting.

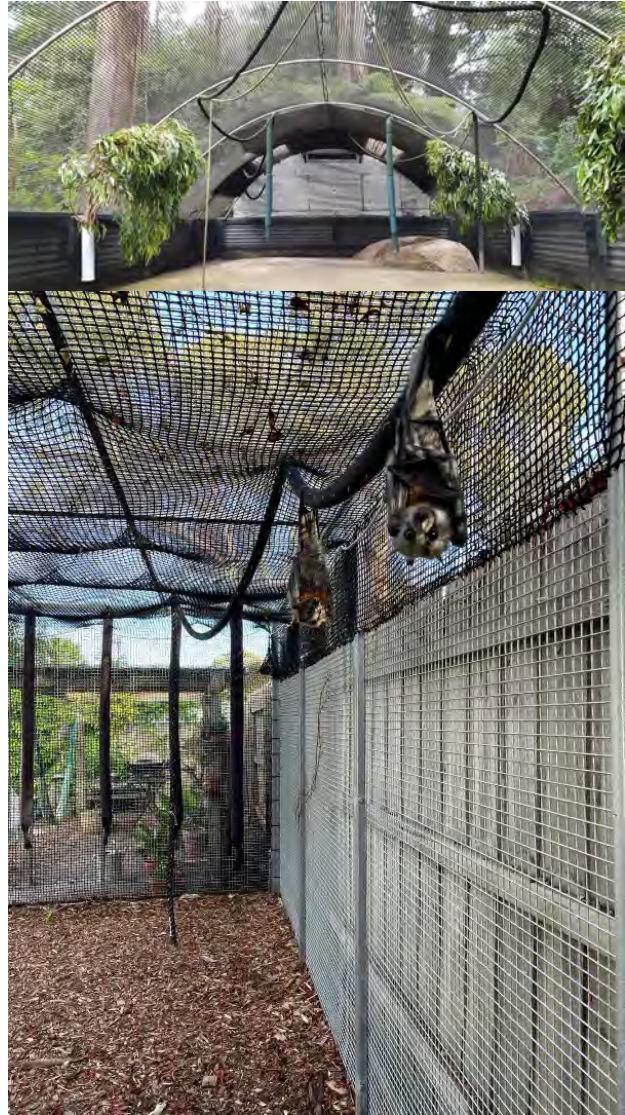


Photo Credit: Fly By Night Bat Clinic

4.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of flying foxes in rehabilitation. Information on feeding orphaned individuals can be found under **Section 4.8 Hand raising**.

Table 4.6 Daily feeding and diet guide for adult flying foxes during rehabilitation

Diet	<ul style="list-style-type: none"> • 350–400g fruit mix (two thirds apple by weight, one third two other fruits: pear, grape, melon, pawpaw). • No citrus or stone fruit as it encourages flying foxes to feed from netted trees. • Figs when available as they are high in calcium. • Flowering branches with both leaf and flowers such as <i>Eucalyptus</i>, lilly pilly, <i>Melaleuca</i>. • Sick flying foxes may be offered 'bat smoothies' and fruit mix. 'Bat smoothies' are made by combining pure apple juice, 2 tbsp honey yoghurt and 10 g high protein supplement (such as Wombaroo or Poly-aid Plus).
Supplements	<ul style="list-style-type: none"> • Mix 10 g or 2 tsp Wombaroo high protein supplement through 350 g fruit mix (see Figure 4.7).
Diet Frequency Feeding	<ul style="list-style-type: none"> • Food and fresh water provided daily. • Change and replace fresh fruit daily. • Cut fruit into pieces about the size of a matchbox. Use one container for every two flying foxes.

Figure 4.10 Fruit chopped for a flying fox prior to mixing with Wombaroo High Protein supplement.



Photo Credit: Dave Pinson

4.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations are found in the appendices to Part A of these guidelines.

4.8.1. Equipment required for hand raising

- Teats, bottle/syringe (see **Figure 4.11**)
- Milk provision: Wombaroo flying fox milk formula
 - Biolac flying fox milk
- Tissues for toileting
- Scales
- Breathable cloth wrap (mumma wrap)
- Enclosure cleaning equipment
- Record charts

Figure 4.11 Appropriate teat for flying foxes

F Teat



Photo credit: Wombaroo

4.8.2. Growth, development and care of orphaned young

- Flying foxes can be reared from birth.
- Orphans should be raised in pairs, minimum. If a single orphan enters care, contact other rehabilitators to identify bats of similar age to 'buddy' with this one.
- Flying foxes are fed milk in a bottle with their heads down and tilted to the side to permit milk to run out the side if too much is taken in at once.
- Toileting: Juvenile flying foxes need to be toileted after each feed until they are four to six weeks old. The pup is inverted, and a tissue is used to gently stroke the perineal area until the animal urinates and defaecates.
- Young flying foxes should get at least 20 minutes of sunlight each day for normal bone growth.
- A chart of the feeding and housing requirements for grey-headed flying foxes is in **Table 4.7**. A summary of the growth of little red flying foxes is in **Table 4.8**. While a feeding and housing chart has not been published for little red flying foxes, they can be hand raised in a similar manner to grey-headed flying foxes, making allowances for their smaller size. They will require approximately half as much milk and fruit at each feed as grey-headed flying foxes.
- Where possible, flying foxes should be raised in the company of other juvenile flying foxes. Hand-reared flying foxes should be placed in a crèche with other flying foxes once they are weaned (at about 12 weeks) and are making their first attempts at independent flight. A crèche is a group of young newly independent flying foxes. It aims to prepare animals for soft release by allowing flight development, socialising among members of the same species, and reduced contact with humans.

- Young should be placed in the crèche for a minimum of three weeks to give them sufficient opportunities to develop flight skills.
- The crèche should:
 - be housed in a secure flight enclosure and requires soft, thick knotless netting (mesh size, of 5 mm x 5 mm or less at full stretch) or similar material that allows the flying fox to hang and move around safely without damaging body parts or membrane
 - include an area that provides shade and shelter and areas exposed to natural weather
 - provide sufficient space to allow the flying fox to perform natural behaviours including free flight
 - house at least 10 animals to allow appropriate socialisation and provide animals with a social cohort on release
 - minimise interaction with people to prepare the animals for soft release.

Table 4.7 Feeding and housing requirements for grey-headed flying foxes.

Wt = Weight. FA = Forearm length (See Figure 4.12).

Age	Wt (g)	FA (mm)	Feeding (Milk and solids)	Housing
Newborn	85	57	4 ml 5 x per day	<ul style="list-style-type: none"> • Up to 4 orphans: 1 m x 0.5 m (0.5 m²) x 0.6 m. Rio basket or cane basket. • Wrapped in mummawraps – cloth made of natural, breathable material wrapped similarly to a nappy or a sock-mumma or swaddle (see Figure 4.8). • Clean wings daily. • Provide heat (approximately 30–32°C for newborn pups, 28°C for older pups) using a heat pad, with a thermometer.
1 week	99	69	5 ml 5 x per day	
2 weeks	117	79	6 ml 5 x per day	
3 weeks	133	87	7 ml 4–5 x per day	

Age	Wt (g)	FA (mm)	Feeding (Milk and solids)	Housing
4 weeks	150	93	10 ml 4 x per day	<ul style="list-style-type: none"> Two pups: 1 m x 1 m (1m²) x 1m. Large enough to be able to hang, move around and flap wings. A mesh dome tent or net enclosure, canvas pet carrier or dog crate with mesh small enough to prevent bats getting their heads caught. Newspaper or thin towelling substrate. No artificial heat from five weeks. Food bowls hung on the side of the cage. Offer natural enrichment, such as sticks, bark, fresh <i>Eucalyptus</i> blossom and leaves. Plastic toys should be avoided as they can cause injury.
5 weeks	167	99	11 ml 4 x per day	
6 weeks	184	104	12 ml 4 x per day	
7 weeks	201	109	13 ml 4 x per day. Introduce fruit – steamed, peeled apple, 2–4 pieces after feed	
8 weeks	217	114	13 ml 4 x per day. Feed steamed apple with peel on. Offer 50 g/day	
9 weeks	235	118	14 ml 4 x per day. Introduce fruit up to 3 types. Offer 2/3 apple, 1/3 other fruits. Eating 50–100 g/day	
10 weeks	252	122	15 ml 3–4 x per day. Fruit ½ steamed, ½ raw. Increase fruit by 25 g if eaten. Offer 100–200 g/day.	
11 weeks	269	125	15ml 1–2 x per day	
12 weeks	286	129	Wean. Offer >250 g fruit in the evening	
13 weeks	302	132	Offer 250–300 g fruit in the evening	
14 weeks	319	136		
15 weeks	336	139	Offer 300–350 g fruit in the evening	
16 weeks	353	143		<ul style="list-style-type: none"> Between 10 and 20 flying fox young: 20 m² floor area x 2 m. Between 20–50 flying fox young: 30 m² floor area x 2 m, constructed of a synthetic polymer mesh, such as polyethylene (used for cricket nets). Mesh size is 50 mm. Twine diameter ranges from 1.8–3.0 mm. Cyclone fencing should not be used as juveniles can escape or injure themselves by poking heads and limbs out. Provide natural browse such as <i>Banksia</i>, lilly pilly fruit, tea tree flowers and <i>Eucalyptus</i> branches with flowers. Offer ripe figs on branches and/or cored apples on ropes.

Figure 4.12 White line indicates where to take a forearm measurement in a flying fox, from the wrist to the elbow.



Photo credit: Zoos Victoria

Figure 4.13 a. Basket with handle used to house orphaned flying foxes. b. Heat-stressed orphaned pups housed in a lined box that permits them to hang.

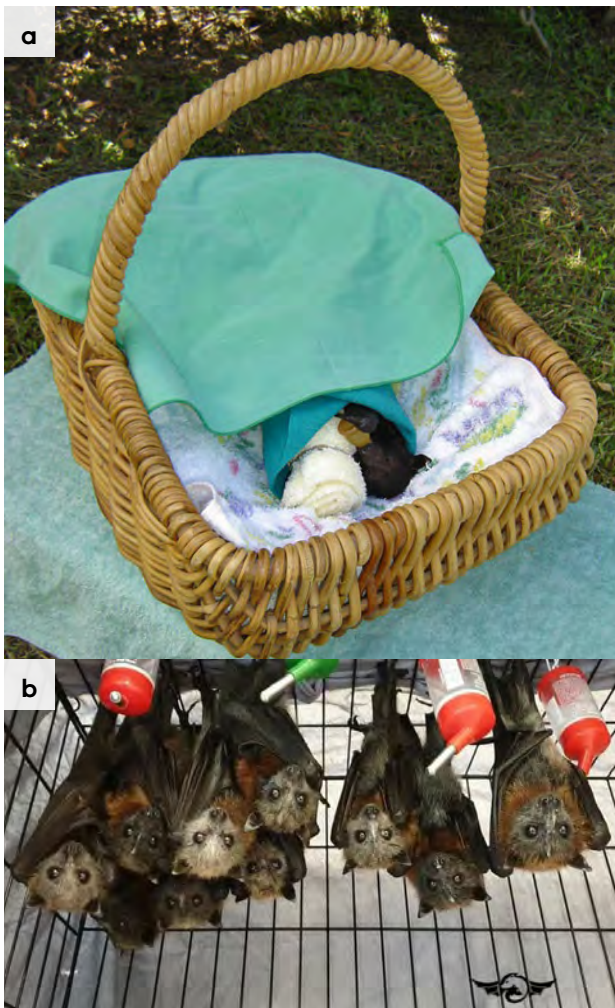


Photo credit: Dave Pinson (a) and Tamsyn Hogarth (b)

Figure 4.14 a. Forearm measurement of orphaned flying foxes should be taken on arrival and weekly during growth. b. Spectacled flying foxes wrapped into the 'mumma' wrap. Note the blind teat used as a dummy.



Photo credit: Anne Fowler

Figure 4.15 a. Cored apples suspended on a rope and a basket holding pieces of banana. b. Watermelon offered on metal spike.



Photo credit: Anne Fowler

Photo credit: Dave Pinson

Table 4.8 Development chart for little red flying foxes

Age	Weight (g)	Forearm length (mm)
Newborn	41	45
1 week	49	50
2 weeks	59	55
3 weeks	68	61
4 weeks	79	66
5 weeks	89	71
6 weeks	100	75
7 weeks	111	80
8 weeks	122	83
9 weeks	133	87
10 weeks	145	90
11 weeks	157	93
12 weeks	169	96
13 weeks	182	98
14 weeks	195	100
15 weeks	208	101
16 weeks	221	103

4.9 Release protocol

Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for the animal.

4.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

The following check list should be used to guide decision making regarding release suitability for flying foxes:

- ☑ Individual is in a state of good health – presenting injury/sickness is completely resolved (consider a pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 4.1**).
- ☑ Individual displays ability to actively forage for and consume natural foods.
- ☑ Individual can complete a minimum of 10 laps of the pre-release enclosure, without open mouth breathing.
- ☑ Individual can invert (using thumbs) to urinate and defaecate and is able to do a vertical climb of a tree trunk.

4.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered.

Adult flying foxes should be released back into the nearest established camp to where the animal was found. For information on the nearest grey-headed flying fox camp, contact your local DEECA officer. Hand raised pups should be soft released. They will not survive a hard release into the wild.

Adult flying foxes should be released during the day, so they have time to settle into the camp before the nightly flyout.

Adult flying foxes can be released at any time of year.

Avoid weather extremes such as forecast temperatures above 38°C for three or more consecutive days. Avoid wind and heavy rain or times when severe storms are predicted.

Little red flying foxes occupy regional camps on a seasonal basis. If an adult little red flying fox is in care for less than two weeks, it can be released at the point of capture as this may be where there is a current food source of flowering gums. If in care for longer, then the wildlife rehabilitator should contact DEECA on 136 186 to locate the nearest camp.

For more information on the ecological characteristics and requirements of flying foxes that may help with their release, please refer to **Table 4.1**.

4.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ For information on the nearest grey-headed flying fox camp, contact DEECA on 136 186.
- ☑ For release of little red flying foxes, that do not have established camps in Victoria, contact DEECA to discuss options.
- ☑ Some flying foxes may occupy regional camps on a seasonal basis, so it is important to check that the camp is still occupied.

Release Procedure – adult flying foxes

- ☑ Never place a flying fox for release in a tree. All releases should take flight.
- ☑ Ensure that no one is standing in the flying fox's direct line of flight.
- ☑ Release the flying fox at shoulder height and observe it taking strong flight. If a flying fox becomes grounded it will require further care.

Release Procedure – soft release of orphaned young

Flying foxes are unique in their requirement for a highly collaborative approach to a viable release. Because of this, it is pivotal that carers engage in robust coordination and cooperation. If you are unsure how to join your hand reared animals to an existing crèche and soft release program, contact DEECA on 136 186 for advice and assistance.

Soft release is a gradual process of familiarising young flying foxes with a new environment and introducing them into the wild population, while monitoring and continuing support by providing support feeding. The soft release facility should provide sufficient opportunity for the flying foxes to become familiar with their surroundings, and to build flight fitness and social skills, before being released back to the wild. The soft release process takes a minimum of six weeks for a single release cohort.

A soft-release enclosure should:

- ☑ be located within or adjacent to an occupied flying fox camp

- ☑ be lined with thick, soft knotless netting or similar that allows the animals to hang and move around safely without difficulty or damage to body parts or membrane
- ☑ include an area that provides shade and shelter and areas exposed to natural weather
- ☑ have a hatch that can be opened to allow animals to move out of the cage
- ☑ provide easy access to surrounding trees, and external accessible hanging points for graduated support feeding.
- ☑ Soft release should only be undertaken where:
 - ☑ an appropriate enclosure is available adjacent to an established flying fox colony
 - ☑ occupational health and safety measures are in place.
- ☑ Preferably soft release should occur as a group and not as a single animal. (If only one animal is to be released, talk to DEECA about options).
- ☑ Flying foxes should be at least 15 weeks old and have spent at least three weeks in a crèche facility.
- ☑ All animals should have had a thorough health check by a veterinarian or experienced flying fox carer.
- ☑ All animals should be flight tested on entry to the enclosure.
- ☑ Animals should be confined in the cage for 7–10 nights prior to release via a hatch.
- ☑ The hatch should be closed once no animals have remained in the cage for three consecutive nights.

The supportive feeding regime is as follows:

- The flying foxes are housed and fed within this aviary on site for one week.
- At the end of the first week, the aviary is left open to permit the flying foxes to leave and return to the aviary of their own accord.
- After the first two weeks the aviary should be closed but supplementary food provided on the outside of the enclosure.
- Supplementary feeding is gradually reduced and stopped after 6–8 weeks if no flying foxes are returning. Care should be taken to monitor for animals who return to the soft release site injured or malnourished. These animals will require further care or euthanasia.

Figure 4.16 Soft release aviary, Yarra Bend, Victoria.



Photo credit: Friends of Bats and Bushcare

4.10 Key references and additional reading

Churchill, S. 2009. Australian Bats, 2nd ed. Allen and Unwin, Crows Nest. 255 pp.

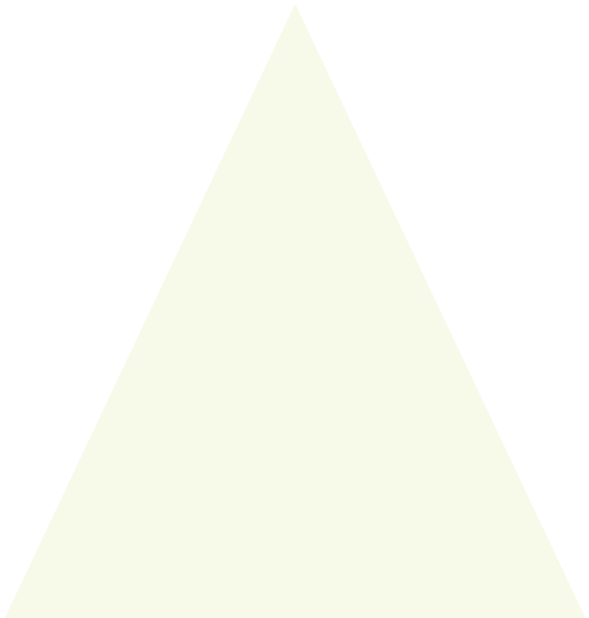
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Victoria's flying fox colonies, DEECA, <https://www.wildlife.vic.gov.au/our-wildlife/flying-foxes/victorias-flying-fox-colonies>



Chapter 5. **Koalas**

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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

When koalas come into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition and an environment appropriate to the stage of rehabilitation. The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

5.1 Introduction


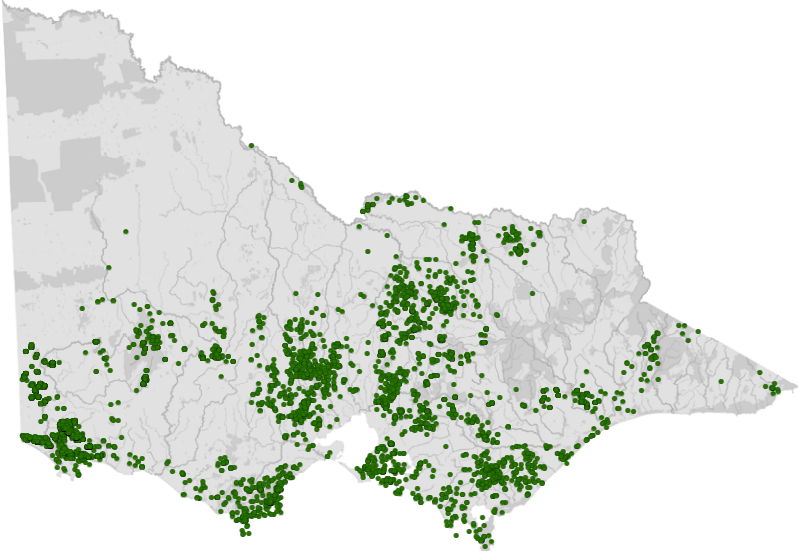
There is only one species of koala (*Phascolarctos cinereus*), distributed along the east coast of Australia and into South Australia. Koalas vary in size with larger animals found in the south and smaller ones in the north.

5.2 Species information



The Victorian koala is profiled in **Table 5.1**. For further information, refer to the recommended reading and reference material at the end of this chapter.

Table 5.1 Species profile

Species	Koala (<i>Phascolarctos cinereus</i>)
 <p>Photo credit: DEECA</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Victorian koalas are larger and have longer, thicker fur and more fur on their ears than koalas from New South Wales and Queensland</p>
<p>Conservation status*</p>	<p>Koalas are considered secure in Victoria, as opposed to populations in New South Wales, the Australian Capital Territory and Queensland where they are listed as endangered under the Australian <i>Environment Protection and Biodiversity Conservation Act 1999</i></p>
<p>Sexual dimorphism</p>	<p>Male: Prominent scent gland on the chest Female: No scent gland</p>
<p>Adult morphometrics</p>	<p>Body weight: Female: 7–11 kg. Male: 9.5–14.9 kg Head and body length: Female: 680–730 mm. Male: 750–820 mm</p>

Species	Koala (<i>Phascolarctos cinereus</i>)
Home range	0.5–11.26 ha
Behaviour	Mainly nocturnal. Solitary but aware of others near by
Diet	Koalas feed almost entirely on the leaves of <i>Eucalyptus</i> species. Preferred species include manna gum (<i>E. viminalis</i>), swamp gum (<i>E. ovata</i>) and blue gum (<i>E. globulus</i>)
Longevity	13–16 years. Females live longer than males
Physical maturity	Male: 48 months (12 kg) Female: 36–48 months (6 kg)
Sexual maturity	Male: 24 months but older males may restrict mating opportunities until 48 months Female: 24 months (6.6 kg)
Mating season	Spring–Summer
Litters per year	1 litter of 1 young (2 teats: in rare instances, may have 2 young)
Weaning	11 months on average
Age at full pouch emergence	7–8 months on average
Young dispersal	12 months (female joeys stay within vicinity of mother until about 15 months)

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

5.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for koalas is in **Section 5.6.2**.

The following information relates to the human and animal health and safety considerations specifically related to the rehabilitation of koalas.

5.3.1. Human safety considerations

- Koalas can give a painful and deep bite that will result in bleeding, bruising and damage to underlying structures such as tendons. Bites breaking the skin can result in serious infection and should be immediately washed thoroughly with soap and water and medical attention sought without delay.
- They can scratch hard enough to break the skin causing deep lacerations.
- Tree climbing to capture koalas is dangerous. Injury or death from falling for both the koala and the handler is possible. People at the base of the tree can be injured from falling tree limbs.

5.3.2. Animal safety considerations

- As koalas tend to sleep for long periods, it is important to minimise disturbance and provide them with a quiet environment.
- Minimise handling time to reduce stress.
- Koalas tend to panic if they are unable to grip anything solid with their paws while being handled or transported.
- Do not hold a koala around the chest, unless it is a habituated juvenile, as it can result in rib fractures and injury to the handler.
- Transport in cooler times of the day and never leave koalas in hot cars.

5.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 5.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned koalas.

5.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 5.2 Visual health observations in koalas

What to look for	
Demeanour	<ul style="list-style-type: none"> • Reactive to noise and touch • Avoids capture
Behaviour	<ul style="list-style-type: none"> • Sleeps in a tree fork for much of the day • Seen to consume eucalypt leaves • Appears relaxed and is not calling out, (which could indicate pain) • Does not appear restless or moving about frequently
Abdomen	<ul style="list-style-type: none"> • Full in profile – level or extends beyond rib cage profile
Movement and posture	<ul style="list-style-type: none"> • Sits in a tree fork, gripping the branch with both front feet • Climbs and walks using all four feet • No evidence of lameness
Breathing	<ul style="list-style-type: none"> • 10–15 breaths per minute

5.4.2. Equipment

- **Binoculars** to make a visual assessment of a koala in a tree.
- A **blanket, catch bag** or **large beach towel** can be used to place over the koala.
- **Transport container:** Recommended dimensions of transport containers for koalas are: 0.2 m² x 0.6 m (H). Bags are recommended to be 0.65 m x 0.45 m in size. Suitable transport containers include: a solid walled or slatted box; washing baskets placed one above the other and tied together; a dog pet carrier with a removable top and door (**Figure 5.1**) to allow the handler to restrain the koala; a garbage bin with holes in the lid for ventilation (suitable for short journeys on cool days only); a hessian sack or robust fauna bag with secure ties.
- Towelling is used as a floor covering during the transport of koalas. A rolled towel propped up against the side of the enclosure will give the koala something to hold onto during travel.
- Weak koalas may need to be supported with towels placed around their body and a pillow placed under their forearms to keep their head and chest elevated.
- The transport container may be covered in a sheet to reduce visual stimuli.
- Transport cages should contain gum leaves, which will potentially reduce koala stress levels.
- A **cherry picker** from a power company may be required to capture a koala up a power pole. If this is required, consult the power company first as they may need to use their own cherry picker or at least, to provide safety instructions.
- **Flagging poles** can be used to get koalas down to a level where capture can occur.

Figure 5.1 Dog pet carrier suitable for use as a koala transport crate.



Photo credit: DEECA

5.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

The method used to restrain a koala is dependent upon the situation and the temperament of the animal. The koala can be handled in the following ways:

- The koala is lifted by holding it high on the arms near the armpits (See **Figure 5.2**). This can be attempted with a towel which drapes over the koala's legs and protects the handler's arms from being scratched.
- Koalas may be handled by grasping them by the wrists and raising them slowly. Lateral traction may be required if they try to bite. This technique should only be used for very short periods. (See **Figure 5.3**).
- Neck and rump scruff: this technique is useful for aggressive koalas as the handler is less likely to be bitten or scratched (See **Figure 5.2**).
- Robust large fauna bags or large towels are useful for restraint and transport but, be aware koalas may bite through these.

Figure 5.2 a. A koala is lifted by holding it high on the arms. **b.** The 'neck and rump scruff' technique for holding a koala.

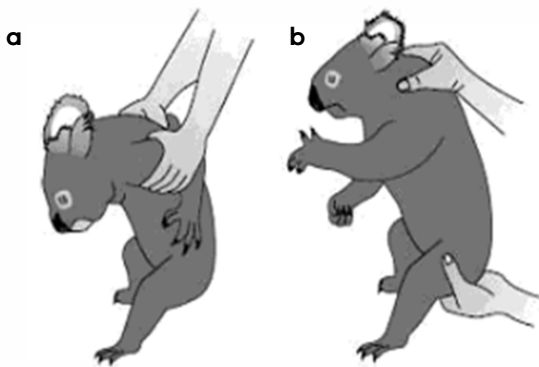


Illustration credit: Colleen Wood

Figure 5.3 A towel is used to lift the koala by the wrists.



Photo credit: Zoos Victoria

Figure 5.4 Koala manual restraint.



Photo credit: Zoos Victoria

Koala found on the ground

This is a common scenario for unwell koalas. If a koala is found at the bottom of a tree for longer than 24 hours, or is at risk of predation, then it requires capture and assessment. A koala on the ground may be approached quietly from behind, and a blanket or robust fauna bag placed over its head. It is then lifted and placed into a transport container. If a koala that has been on the ground quickly climbs a tree when approached, it may not need immediate capture. It should instead be observed *in situ* over several subsequent days as it may still be carrying injuries such as facial or jaw fractures.

Found next to the road

It is important to remember wildlife rehabilitator safety when rescuing koalas found next to roads. Koalas may still be mobile, and the capture may need to be planned with more than one person to keep the animal, wildlife rehabilitators and the public from harm. Contact the police assistance line on 131 444 to assist with traffic management, and where appropriate use signage to warn oncoming traffic. Place a blanket over the koala and lift it into a transport container.

Low in a tree

Healthy koalas tend to sit higher up in trees. It is less common for them to be found sitting low in a tree. Koalas may also be found lower in trees in hot weather and may be less likely to move in hot conditions. The koala should be observed to determine whether it requires assistance. A wide sack or robust large fauna bag can be placed over the head and shoulders. The koala may then either descend or climb up to escape, in which case it climbs into the sack or bag. It can then be restrained by the wildlife rehabilitator through the bag and lowered to the ground. Alternatively, a catch pole hooped around the neck and below one shoulder can be used to restrain a koala low in the tree. Care should be taken not to cause any nail damage. Never pull a koala directly off the tree.

High in a tree

It is normal for koalas to sit high in a tree. Tree-climbing to capture a koala is not recommended for safety reasons. A variety of methods can be used safely:

The capture of a koala high up a tree involves the use of flags on a pole waved in front of the animal to encourage it to climb down. One person with a flag for each main trunk of the tree is required for this capture technique. If flagging is unsuccessful after 20 minutes, the flagging should cease as the animal's level of stress and risk of injury increase with time.

Caution should be used around electric fences/ power lines/falling branches.

Koalas will leave a tree after a few days of their own accord, which may present another opportunity to catch them. Establishing temporary fencing around the base of the tree can aid in trapping the animal when the koala comes down to the ground. This should be monitored continuously.

5.4.4. Transport

- Koalas should be transported in a timely manner directly to a veterinarian for assessment or to an experienced koala rehabilitator.
- Koalas should not be left free to roam within a vehicle.
- If possible, avoid travel when the temperature is greater than 25°C as this may place koalas at risk of overheating.
- If this is not possible, the transportation vehicle should be temperature controlled to ensure the koala does not overheat nor get too cold. Avoid air conditioning vents blowing directly over koalas.
- Do not place koalas in the boot of the car, as there is often inadequate ventilation, and the rescuer cannot monitor the animal closely.
- Noise during transport (such as voices and radio) should be kept to a minimum.
- Domestic animals should not be present in the vehicle.
- Clean cages between use with an appropriate disinfectant such as F10SC.

5.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care through minimising human-animal interactions and stress to the animal to maximise successful release back to the wild.

5.5.1. Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required, any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure weighing scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or injury.






Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording physical examination findings can be found in the appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Assessment is best performed under sedation or general anaesthesia as this will allow a more thorough examination, including examining the teeth to determine the animal's age (see **Table 5.4** for information on aging koalas).
- Physical examination requires two people. One person will need to restrain the koala within a towel or bag. The second person can then expose specific body parts for examination.
- Unless the koala is extremely injured or unwell, it will likely resist any attempts to examine it. The koala may try to bite and scratch the handler and may urinate and/or vocalise.

Table 5.3 Physical examination of koalas

What to look for		
Body weight	<ul style="list-style-type: none"> Record body weight on arrival and at least weekly while in care. A greater than 10% change in body weight over a week is cause for concern, and the carer should seek veterinary advice immediately. 	
Body condition	<ul style="list-style-type: none"> Body condition is scored by palpation of the prominence of the scapula in relation to the muscle on either side, and palpation of muscles on the top of the head on either side of the sagittal crest. In Victoria, body condition is scored out of 5, details following: 	
Condition	Score*	Attributes
Excellent	5 	Obviously convex muscle masses on either side of the scapula. Strong muscle tone. Scapular spine and edges apparent on careful palpation.
Good	4 	Slightly convex muscle masses on either side of the scapula. Good muscle tone. Scapular spine readily palpable.
Fair	3 	Flat to barely convex muscles on either side of the scapula. Scapular spine is more prominent on palpation.
Poor	2 	Slight dishing of muscles on either side of the scapula. Scapular spine is very obvious on palpation.
Emaciated	1 	Edge of the scapula easily palpable. Concave muscles on either side of the scapula. In extreme emaciation there may be almost no muscle palpable on either side of the scapula.
* Adopted from Medicine of Australian Mammals, Vogelnest/Woods, CSIRO 2008.		
Hydration status	<ul style="list-style-type: none"> Skin over scapula slides smoothly when rubbed over tissue underneath. In dehydrated koalas, the skin over the scapula does not slide smoothly when rubbed and becomes increasingly tacky. 	
Eyes	<ul style="list-style-type: none"> Bright, clear. No discharge, pink or swollen conjunctiva. Not white or cloudy. 	
Ears	<ul style="list-style-type: none"> Sit up in normal position, follow sounds. Note: ear flicking/twitching can be a sign of stress. 	
Mouth	<ul style="list-style-type: none"> Upper incisors slightly overlap lower incisors. 	

What to look for	
Teeth	<ul style="list-style-type: none"> • Do not grow continuously, but wear down with age. • Expect to see discolouration. • Further information under 'Tooth Wear Class and Age Determination' and Table 5.4: 'Koala tooth wear chart'.
Skin and coat condition	<ul style="list-style-type: none"> • Fluffy fur over body. • Look for signs of 'wet bottom' - i.e. brownish staining and wet fur around the cloaca and rump due to constant wetting with urine which could indicate a chlamydia infection .
Limbs and feet	<ul style="list-style-type: none"> • Can walk and climb. • Claws intact.
Faeces	<ul style="list-style-type: none"> • Firm but moist when broken, oval, 2–3 cm long. • Small leaf particles when broken in half. • 100–200 pellets produced daily.
Sex determination	<ul style="list-style-type: none"> • The sex of a koala is determined by looking for the presence of a pouch or testicles. • Prominent scent glands in the middle of the chest in the breeding season indicate mature males. Juvenile males and females may have a slightly discoloured patch of fur on the chest in the same area.
Pouch check	<ul style="list-style-type: none"> • The opening is towards the bottom of the pouch, so that it can appear to be backward facing. • There are two teats in the pouch.

Tooth Wear Class and Age Determination












All koalas presenting to care must have their teeth checked to determine their tooth wear class to determine age.

To assess age check upper right, first and second cheek teeth (P4 & M1). Tooth is 3–5 mm in height

- Cheek teeth cusps are sharp.
- Old koalas have cheek teeth that are worn to the gum line with a flat chewing surface.
- See **Table 5.4** for a guide to aging koalas by teeth wear.
- Koalas with stage VI or VII teeth are approaching the end of their life, and are not good candidates for rehabilitation and release. Euthanasia is recommended in these cases.

Table 5.4 Koala tooth wear chart

This tooth wear chart is from the following source and is published with the permission of the author. McLean, N. (2003). Ecology and management of overabundant koala (*Phascolarctos cinereus*) populations. PhD thesis, Department of Zoology, The University of Melbourne

Stage I	Little or no wear on the upper premolar and incomplete eruption of the 4th molar.	< 1.25 years	
Stage II	All four molars fully erupted and wear on the upper premolar varied between none and slight wear on the buccal crest.	1.25–3.5 years	
Stage III	Wear on the buccal and lingual crests of the upper premolar. The wear may be a continuous line or spots of wear.	3.5–5.5 years	
Stage IV A	The wear has just formed a continuous circle, leaving a large-sized island of enamel in the centre of the surface of the upper premolar.	5.5–6.5 years	
Stage IV B	The wear has progressed from TWC IVA, leaving a medium-sized island of enamel.	6.5–7.5 years	
Stage IV C	The wear has progressed from TWC IVB, leaving a very small-sized island of enamel.	7.5–9 years	
Stage V	All the enamel has been worn off the cutting surface of the upper premolar, leaving a flat surface and an oval outline shape.	9–10 years	
Stage VI A	Small indentation in the premolar shape.	10–14 years	
Stage VI B	Moderate indentation in the premolar shape, extending approximately half way through the tooth.	10–14 years	
Stage VI C	Almost complete indentation across the surface of the premolar.	> 14 years	
Stage VII	Complete wear of the premolar shape and two separate roots are visible.		

5.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Time your health and welfare observations for times of the day when the koala is expected to be active.
- If the koala is receiving medication, a visual check in the morning is recommended.
- Ideally physical observations should be undertaken at the beginning and/or end of the resting period to minimise disturbance and maximise the rest/sleep period for rapid healing and ensure ease of capture.

- Change the koala's gum branches at least daily, providing fresh new branches and removing the old ones. Gum should be turned at least daily and water replaced in the browse pots also. This is the time to observe the koala, noting its demeanour and behaviour. Koalas should be alert and responsive during the branch change and will often start eating the new leaves as soon as they are introduced. Pay particular attention to any changes that have occurred since the previous day.
- Gum changes should occur at the same time each day. The koala should not be disturbed during the rest of the day.
- Determine food consumption by making an assessment of how much of the previous day's browse has been consumed. Koalas usually eat approximately 320– 660 g of leaf per day.
- Faecal pellets should be counted at the same time each day to accurately represent the koala's 24-hour faecal output, a healthy koala eating well should produce 90-200 pellets per 24 hours. Faecal consistency and size should be noted. Koalas have a very slow gut transit time. A decrease in faecal pellet output is indicative of reduced food intake that occurred approximately three days earlier.

5.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 5.5 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 5.5 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Injuries or Clinical signs	Possible Causes	Rehabilitator observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to walk or move normally</p> <p>Paralysis</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fractures</p> <p>Dislocation</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by raptor, fox or dog</p> <p>Gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity, for example fall from perch</p>	<ul style="list-style-type: none"> • Urgent Veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Move the animal to a small transport box to restrict movement. Ensure temperature is appropriate for species; attempt to relieve stress. • Do not attempt to stabilise a fractures as this is very painful, and risks making the injury worse. Fracture stabilization should only be attempted by a veterinarian following physical examination, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning the animal to enclosure. • See Section 5.4 Capture, restraint, and transport and Section 5.6 Housing in this chapter for further advice.
<p>Head trauma</p> <p>Bleeding from nose, mouth or eyes</p> <p>Swollen eye lids, blood present in eye</p> <p>Abnormal behaviour</p> <p>Mouth swelling, missing teeth</p> <p>Lethargy</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by raptor, fox or dog</p> <p>Gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity, for example fall from perch</p> <p>Cranial trauma, concussion</p>	<ul style="list-style-type: none"> • Urgent Veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Move the animal to a small transport box to restrict movement. Ensure the temperature is appropriate; attempt to relieve stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked or head trauma animals. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • See Section 5.4 Capture, restraint, and transport and Section 5.6 Housing in this chapter for further advice.

Injuries or Clinical signs	Possible Causes	Rehabilitator observations and response
Burns	Recent bushfire, campfire injury, chemical burn	<ul style="list-style-type: none"> • Seek urgent veterinary attention. • Euthanasia may be the most humane response if the wounds are extensive. • Burn injuries are extremely painful, treatment and bandage changes must only occur under anaesthesia and with adequate pain management. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Burn injuries to paws may result in nail damage, digit bone damage and tendon damage. Due to the complexity of these injuries veterinary management is required. • To ensure good welfare, animals must be returned to a veterinarian for ongoing bandage changes. • Burnt koalas may need supplemental nutrition as metabolic demands are high when healing burns.
Bleeding Puncture wounds Bruising Fur loss	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by raptor, fox or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, for example, fall from perch</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment. • Euthanasia may be the most humane response if the wounds are extensive. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • The severity of bite wounds/scratches may not be immediately obvious. • Look for clumps of dried fur stuck together with saliva. Part the fur and look for puncture wounds. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • See Section 5.4 Capture, restraint, and transport and Section 5.6 Housing in this chapter for further advice.

Injuries or Clinical signs	Possible Causes	Rehabilitator observations and response
<p>Nail injury</p> <p>Toe injury</p> <p>Swollen digit</p> <p>Bruised digit</p>	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by raptor, fox or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, for example, fall from perch</p> <p>Burn injuries</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment as these lesions are slow to heal and, where nail bed infection occurs, intensive veterinary management is required. • Apply first aid to minor wounds. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Burn injuries to paws may result in nail damage, digit bone damage and tendon damage, due to the complexity of these injuries, veterinary treatment is required. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • See Section 5.4 Capture, restraint, and transport and Section 5.6 Housing in this chapter for further advice.
<p>Blindness, closed eyes, ocular discharge, swollen conjunctiva, urine staining/dribbling around the rump, ulcerated/red cloaca, pain on urination, tooth grinding</p>	<p>Chlamydia infection</p>	<ul style="list-style-type: none"> • Seek veterinary attention. • Give saline bathing of the eyes. • Give medications as directed by the veterinarian. • House koalas individually to prevent spread to others. • Ensure a high level of biosecurity and hygiene, including hand washing between cases, dedicated equipment, and disinfection protocols of cages and cage furniture should be followed.
<p>Thickened, dry, crusty skin particularly on foot pads and wrists, fur loss</p>	<p>Sarcoptic mange, ringworm, other skin condition</p>	<ul style="list-style-type: none"> • Seek veterinary attention to determine cause and confirm diagnosis. • Give prescribed medication. • Ensure a high level of biosecurity and hygiene including, wearing dedicated protective clothing including gloves when handling infected koalas and wash hands thoroughly afterwards. Dedicated equipment and individual pens should be used and thoroughly cleaned and disinfected after use or between animals. • Sand or earth flooring is not recommended. Perches should be replaced before use with another animal. • Mange and ringworm are zoonotic, refer to Part A Chapter 4. Biosecurity and hygiene.

Injuries or Clinical signs	Possible Causes	Rehabilitator observations and response
Poor body condition, lethargy, increased thirst	Undetermined disease or underlying injury, old age, starvation, kidney insufficiency/failure	<ul style="list-style-type: none"> • Seek veterinary attention. • Provide a constant supply of fresh water in a bowl. • Koalas with kidney failure should be euthanased.
Poor body condition, low output of faecal pellets, small faecal pellets, faecal pellets contain large pieces of leaf	Undetermined disease or underlying injury, old age, Malnutrition due to severe tooth wear	<ul style="list-style-type: none"> • Seek veterinary attention. • Koalas with severely worn teeth should be euthanased.

Figure 5.5 Severe conjunctival proliferation associated with chlamydial infection.



Photo credit: Bree Talbot

Figure 5.6 Koala on the ground drinking water, renal failure should be considered.



Photo credit: Colleen Wood

Figure 5.7 a. A koala with crusts on its forearm. b. A koala with crusts on its face and ears. Both are caused by sarcoptic mange.



Photo credit: Pam Whiteley (L), Colleen Wood (R)

Figure 5.8 a. A koala with severe burns to both front feet. b. A severe burn on the hind foot. Both these injuries require a high level of pain relief and are best managed in a wildlife hospital.



Photo credit: Zoos Victoria

5.5.4. Administering treatment during rehabilitation

- If treating a koala with chlamydial infection, ensure any urine is cleaned away from the rump to prevent scalding. Wipe away any discharges from the eyes with a gauze swab soaked in tepid saline.
- Koalas in care may not eat for several days because they are debilitated, or their gastrointestinal bacteria have been disrupted by disease or antibiotic administration. These koalas will need to be provided with supplemental food to prevent excessive weight loss and malnutrition.
- Supplemental food can be administered into the koala's mouth with a syringe (See **Section 5.7.2**). If the koala accepts this, then any medications can be mixed with the supplement. Otherwise, medication will need to be administered in a separate syringe.
- Bandage changes for burns will need to be done by a veterinarian under general anaesthesia, as they are extremely painful. Burnt animals are critical patients and should be managed in a wildlife hospital to ensure they receive appropriate care and pain relief.

5.6 Housing

Below are several key considerations when housing adult koalas in care.

5.6.1. General housing information for koalas

- Koalas are sensitive to noise, and the sight and smell of domestic pets. They should be housed individually in a quiet area of the property.
- Koalas should have access to fresh water and a minimum of three species of fresh eucalypt leaves every day. Debilitated animals will require more. Gum should also be turned at least daily and the water in gum pots replaced at each gum change. The species of eucalypt offered should be the same as those from the area where the koala was found as their gut biota may be specialised, linked to a particular species of eucalypt. Gum must be kept fresh and stored in clean water at all times. As the only source of nutrition for recovering koalas, gum should be managed very carefully.

5.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations

- There are no documented cases of chlamydia in koalas infecting people. However, it is contagious for other koalas. If treating a koala with a chlamydial infection it should be serviced last. Water bowls, gum pots and other equipment should not be used with other koalas until they have been disinfected. Bleach, Virkon S and F10SC used at the recommended concentration and contact time are all effective. Bleach and Virkon S must be rinsed off. Wooden perches should be discarded as they cannot be adequately disinfected.
- Koalas with mange should be treated in a similar manner to those with chlamydia. Mange can spread to people. Gloves should be worn when these koalas are handled. Mites can survive for up to a week in the environment. Refer to Part A, chapter 4 Biosecurity & Hygiene.
- Remove faecal pellets at the same time each day, perform and record the pellet count.

5.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care.

Table 5.6 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 5.8**.

Table 5.6 Rehabilitation housing for adult koalas

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>This type of enclosure is intended for the intensive care of an extremely sick koala (See Figure 5.9). It is expected that a koala would be housed for less than seven days in an enclosure of this size.</p> <p>Spending extensive periods of time in small enclosures can lead to urine scalding, dermatitis and pressure sores.</p>	<p>Floor area: 0.60 m x 0.60 m (0.36 m²) Height: 0.6 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Very sick and immobile koalas can be housed in solid enclosures, such as a dog hospital enclosure, lined with towels and other absorptive material. Round fabric dog beds are comfortable and make excellent intensive care beds. • Alternatively, a plastic washing basket padded with pillows and towels, containing a rolled-up towel as a “branch” can be used. Another basket is placed over the top and secured in place with straps. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Faecal pellets should be counted daily in critical cases (See Section 5.7 for more information about this) and the bedding changed as often as it becomes wet. • A newspaper substrate is easily changed. • Towels can be used to absorb the urine from hospitalised koalas with limited mobility. • Where possible koalas should be provided with a low fork to sit in if they are able, supported with towels or bedding around it, if the koala needs support. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Enclosure should be placed into a warm temperature-monitored room, between 25°C and 28°C to ensure to ensure that the koala does not get hot/cold during recovery in this intensive stage. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Water should be offered in a bowl and changed daily. • The enclosure should be filled with browse so that the koala has food directly in front of it and feels secure and does not need to move to eat.

Intermediate housing (Treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care.</p> <p>Enclosure furnishings can be arranged to reduce opportunities to climb or move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact.</p> <p>Suitable for koalas that may still need treatment</p>	<p>Floor area: 1.50 m x 1.50 m (2.25 m²) Height: 1.50 m</p> <p>Where possible, moving koalas outside at this stage will benefit their welfare during rehabilitation.</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> The enclosure should be large enough for a koala to be able to sit in a tree fork off the ground. The fork should consist of an upright pole with a side branch of more than 50 mm diameter coming off at an angle of 45–60 degrees. Suitable flooring includes either a concrete floor or an earth floor covered with sand. The floor should be cleaned twice daily, and the faecal pellets counted (See Section 5.7). <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> A bowl of soil and moss taken from the base of a koala food tree is also placed in the enclosure and refreshed weekly as koalas may choose to eat soil, although the reason for this is unknown. Perching is organised so that small amounts of climbing, and other movement can be observed. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> Room temperature or outside temperature if over warmer months of the year. The sooner they are outside the better they will respond to treatment. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Water should be offered in a bowl and changed daily. The enclosure should be browsed out so that the koala has to move small distances but access to food is easy and accessible from all perching options. Gum is placed in pots where water is replaced daily.

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/ medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitoring/ assessment of behaviour (climbing, and other movement)</p> <p>Pre-release assessment</p>	<p>Minimum floor area is 20 m². Larger sizes are preferable. The enclosure should be completely enclosed with a 3 m high roof or surrounded by a fence at least 1.2 m high.</p> <p>Any climbable structure should be at least 1.8 m from the perimeter fence, as koalas can jump horizontally.</p> <p>Enclosure should be outdoors and allow expression of a full range of natural behaviours</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> The enclosure may have a covered area made from solid material such as tin or wood. However, most of the enclosure should be exposed to the weather to acclimatise koalas prior to release. Sturdy wire may be used. A pre-release enclosure can also be made by fencing a 10-40 m tree that is separate from other trees with pool fencing or tin fencing to a height of 1.5 m, as shown in Figure 5.12. An earth floor covered with sand is suitable. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> A bowl of soil taken from the base of a koala food tree should also be placed in the enclosure and refreshed weekly. Mobile koalas can be housed in tall enclosures that contain two Y-shaped forks, with a horizontal branch placed between the forks, ideally at a height more than 1.2 m above the ground. A near-vertical upright pole with a side branch (≥50 mm in diameter) coming off at an angle of 45–60°, no closer than 30–40 cm from the top of the upright, makes a suitable resting fork. A browse table can be situated outside the enclosure, to permit browse to be sorted without laying it on the ground. Ideally, the enclosure will contain rough and smooth tree trunks so that climbing on both types of tree trunks can be assessed while in care. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> Shade-cloth or a sprinkler system may be used to keep the enclosure cool in warm weather (ambient temperature >35°C). <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> A water bowl should be offered on the floor of the enclosure and the water changed daily. Large fresh eucalypt branches may be offered in 1 m long PVC pots, filled with water. The pots should be emptied, cleaned and re-filled daily with fresh water. At least two pots of browse for each koala should be placed in the enclosure. They may be placed at different heights.

Figure 5.9 Photo shows a koala in an intensive care enclosure. The koala is supported in a dog bed. Note access to a water bowl and the presence of leaf in the enclosure.



Photo credit: Australian Wildlife Hospital Beerwah

Figure 5.10 a. A padded stand for a joey. **b.** The same stand decorated with leaf.



Photo credit: Colleen Wood

Figure 5.11 Photo of an intermediate enclosure for hospitalised koalas.



Photo credit: Zoos Victoria

Figure 5.12 a. A pre-release enclosure for koalas: part of the enclosure is sheltered from the weather. **b.** A tree fenced inside an enclosure. Feed pots are placed near the base of the tree to provide supplementary leaf



Photo credit: Anne Fowler

5.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of koalas in rehabilitation. Information on feeding orphaned individuals can be found in **Section 5.8 Hand raising**.

5.7.1 Feeding adults

The importance of providing fresh, healthy and suitable leaf to koalas housed in captivity cannot be over-emphasised.

- Koalas need to be offered at least three to five different species of *Eucalyptus* tree leaves daily. These should be species eaten by koalas local to the area from which the rehabilitated koala has come. The species most usually eaten by the animal should be offered each day. The branch that is offered should contain both tips and mature leaves. Some sick koalas prefer to eat younger leaves, while some will prefer to eat bark, or more fibrous leaves such as *Melaleuca* species. A koala that is not eating or is eating poorly may be doing so because inappropriate or unrecognised species are being offered rather than the koala being truly ill. This emphasises the importance of variety and careful daily observation and record keeping.
- Joeys require extra fibre and will strip bark from branches as opposed to consuming the leaf.
- An adult koala will eat between 320 and 660 g (these quantities are mentioned in **Section 5.5.2**) of leaf daily. The koala will obtain this amount by being offered at least 5 kg of leafy branches. The branches can be

sprayed with water two to three times daily to keep the moisture levels in the leaves high. They can be rearranged at this time to stimulate eating. Gum should be kept in pots of water in the enclosure so that the gums maintain moisture during the day.

- Carers should grade the amount a koala eats over each 24-hour period. Inspection at the same time each day is recommended. Ideally a grading system using pictures will be established. Notes on which species are preferred should be made daily, as this may change.
- Branches that are not being fed that day should be stored upright in water containers such as buckets or garbage bins in a cool room. The water containers used to hold browse in the enclosure or in storage are scrubbed daily and the water is changed daily. The section of branch that is sitting in the water should be free of leaves so as not to dirty the water and decrease the longevity of the remaining branches.
 - Mist leaves with water during the hotter months to maintain hydration.
 - A council permit may be required to lop or prune native trees.

Figure 5.13 a. A browse table. Gum is cut and placed on the table to prevent it from touching the ground. b. Browse is offered in a PVC pot.



Photo credit: Gordan Lyall (a) and Jo Griffith (b)

- Faeces should be counted for each 24-hour period. Faecal output less than 100 pellets produced in 24 hours can indicate that the animal is unwell or not eating enough. Intervention may be required in the form of feeding supplements and oral fluids. Normal faecal output is 100–200+ pellets in a 24-hour period. The nature of the faecal pellet is also very important (size, consistency, moisture content). Animals in poor health may have dry, hard, small or narrow faecal pellets. Gut transit

time is very slow in koalas (up to 100 hours) and therefore changes in the faeces may reflect a lack of appetite or illness of several days' duration. Pellets produced by old koalas may contain gum fragments, as their worn teeth are no longer fully masticating the leaf.

Table 5.7 and **Table 5.8** list appropriate *Eucalyptus* species for feeding koalas. Koalas should be provided with species that are eaten by koalas in their locality.

Table 5.7 Some common *Eucalyptus* species fed to koalas

Common name	Scientific name
Swamp gum	<i>Eucalyptus ovata</i>
Manna gum	<i>Eucalyptus viminalis</i>
Forest red gum	<i>Eucalyptus tereticornia</i>
Grey gum	<i>Eucalyptus punctata</i>
River red gum	<i>Eucalyptus camaldulensis</i>
Tasmanian, Southern & Victorian blue gums	<i>Eucalyptus globulus</i>
Cider gum	<i>Eucalyptus gunnii</i>
Candlebark	<i>Eucalyptus rubida</i>
Bracelet honey myrtle	<i>Melaleuca armillaris</i>
Narrow leafed black peppermint	<i>Eucalyptus nicholii</i>

Table 5.8 Other, less preferred *Eucalyptus* species eaten by koalas

Common name	Scientific name
Narrow-leaved peppermint	<i>Eucalyptus radiata</i>
Broad-leaved peppermint	<i>Eucalyptus dives</i>
Messmate stringybark	<i>Eucalyptus obliqua</i>
Mountain ash	<i>Eucalyptus regnans</i>
Yellow gum	<i>Eucalyptus leucoxylon</i>
Mealy stringybark	<i>Eucalyptus cephalocarpa</i>
Southern mahogany	<i>Eucalyptus botryoides</i>

5.7.2. Supplements

- Sick koalas can be offered dietary supplements to provide extra nutrition, such as Vetafarm Koala Crittacare or Oxbow Critical Care for Herbivores. Finely blended eucalypt leaf can be added to the paste mixture to provide additional fibre.
- These can be mixed into a paste and given two to three times daily. The syringe is placed behind the incisors into the front of the mouth and the paste administered slowly, giving the koala time to swallow, before more paste is given.
- Koalas should always have their faces and fur wiped with a wet flannel after supplement feeding, or they can develop dermatitis and fur loss from spilled supplements. Wombaroo Impact can also be given to young and/or debilitated koalas to provide extra protein.

Figure 5.14 Convalescing koala being fed a mixture of blended eucalypt leaf and Crittacare from a syringe.



Photo credit: Zoos Victoria

5.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations are found in the appendices to Part A in these guidelines.

5.8.1. Equipment required for hand raising

- Teat (see **Figure 5.15**), bottle
- Pouch
- Tissues
- Milk: Wombaroo Koala Milk or Biolac M150 or M200
- Scales
- Heat source
- Thermometer
- Record chart

Figure 5.15 Appropriate teat sizes



Photo credit: Wombaroo

5.8.2. Growth, development and care of orphaned young



STOP - Please refer to your *authorisation for mandatory conditions, regarding unfurred koala joeys.*

- **Table 5.9** describes the appearance of koala joeys at various stages of development.
- Koala joeys require strict hygiene to prevent deaths from bacterial and fungal conditions.
- Very young koala joeys, that have not received pap from their mother, will need to be papped by the rehabilitator.
 - Pap is the caecal contents of the female koala. Papping occurs at the time of first emergence from the pouch. The joey stimulates the mother to produce pap from the mother's cloaca. The joey may eat pap for up to an hour. This may take place over one to five weeks.
 - Pap contains bacteria needed to digest *Eucalyptus* leaves. Without pap, joeys are unable to digest leaf and will die.
 - When a koala joey enters care, any faeces it passes should be collected and examined microscopically (refrigerate or freeze if this cannot be done immediately). This is particularly critical prior to pap or leaf being offered to a joey. Signs of leaf in these "wild" faeces are good evidence that the joey has already been papped by their mother. These joeys may not require papping if they are eating leaf well and gaining weight.

- All koala joeys less than 350 g should be given access to pap. Pap (in the form of caecal contents) may be collected from a freshly killed or euthanased koala, protected from air and stored in the refrigerator (do not freeze) for up to seven days. It is preferable that these joeys are placed with wildlife rehabilitators who are caring for other koalas. Koala joeys are very likely to imprint onto humans, and being raised in the presence of other koalas makes this less likely.
- Chlamydia free koalas must be used as donors as the organism can be transferred via pap to the joey.
- An emergency alternative is to offer the joey fresh faeces from a healthy adult. To do this place a faecal scat in a bottle of boiled water that has been allowed to cool but is still warm. Mix the faeces with the water and allow it to stand for ten minutes. Drain off the liquid and mix it into the joey's next feed at a rate of 20–30% of the milk volume. Repeat the process 12 hours later and as often as required until the joey is producing normal faeces.
- To prevent imprinting, young koalas should be raised in pairs, or in the company of adult koalas. It is important to determine that the adult koala is free of disease before a young koala is introduced to it. The adult must be screened for chlamydiosis with a PCR urogenital and ocular swab.
- If hand-reared by themselves, orphaned joeys should be moved to a facility with other koalas at 2 kg to facilitate socialisation.
- Koalas are readily fostered by adult female koalas once they reach the back riding stage. Other lactating females may assist in feeding orphaned joeys. Male koalas will also interact with joeys particularly outside the breeding season.

Table 5.9 Feeding and housing requirements for koalas (Used with permission from Wombaroo)

Milk	Age (d)	Weight (g)	Head length (mm)	Appearance	Feeds (mL/day)	Feeding frequency Daily	Activity	Housing
Early lactation	150	250	54	Eyes open	23	7 milk feeds (every 3 hours)	Head out of pouch	Intensive care 34°C In a pouch Inside a humidicrib
	160	310	56	Fine fur, Incisors through gum	27			
	165	345	58		21 mL early + 7 mL late			
Transition	170	380	59		14 mL early + 14 mL late	6 milk feeds – (every 4 hours)	Pap eaten	34°C Pouch with teddy
	175	415	60	Sleek fur Molars begin to erupt through gum	7 mL early + 21 mL late			
	180	450	61		28			
Late lactation	190	520	64		31	Offer leaf tip, mature leaf and bark	Begin to ride on mother's back	32°C. Inside a pouch with a teddy
	200	600	67		35			
	210	700	70		40			
	220	820	73		44			
	230	950	76		49			

Milk	Age (d)	Weight (g)	Head length (mm)	Appearance	Feeds (mL/day)	Feeding frequency Daily	Activity	Housing
Late lactation	240	1100	78	Sleek fur	55	4 milk feeds daily	Begin to ride on mother's back	28°C Heating only at night. Offer tree with perch and teddy
	250	1230	80	Molars begin to erupt through gum	60	Eating more gum tips		
	260	1360	82		64			
	270	1500	84	Fully furred,	70	3 milk feeds Eating 100 g leaf daily	Starting to leave mother Fully out of pouch at 9 months	Intermediate housing: No heating required Tree with teddy inside
	290	1900	88	Small adult appearance	83	3 milk feeds	Becoming more active	Outside during day, inside on tree at night
	310	2250	93		95	2 milk feeds Eating 200 g leaf daily	Start weaning, becoming independent	Pre-release housing: Outside during day
Weaning	330	2600	97		60	Milk volume depends on amount of leaf eaten	Climbing and active	Outside all the time
	350	2900	101	Full set of teeth	30			
	370	3200	104		0	Eating 300 g leaf daily	Fully weaned Release when the koala weighs above 4 kg	

5.9 Release protocol

Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for the animal.

5.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

The following check list should be used to guide decision making regarding release suitability for koalas:

- ☑ Individual is in a state of good health – presenting injury/sickness is completely resolved.
- ☑ Burns have healed and some hair regrowth has occurred, all digits must function normally (consider a pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 5.1**).
- ☑ Individual displays the ability to climb up and down tree branches quickly and confidently using all four limbs. Koalas are arboreal, so must be fit to climb before release.
- ☑ Individual readily consumes leaf from the area where it was found.

5.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered. Important site features or factors to consider before releasing a koala include:

- ☑ The density of koalas at a site is determined by the number of suitable food trees. A high population density at the release site does not preclude releasing a koala at its original location.
- ☑ Koalas should be released to their original location where possible to reduce the spread of disease between populations.
- ☑ If possible, a koala should be released back into the tree where it was found as they show site fidelity.
- ☑ If the specific tree of capture is not known, then a tree of medium size should be selected. Ideally, the tree selected is a food tree with rough bark, and a fork. Avoid wide, tall, smooth-barked trees as these are difficult for koalas to climb.
- ☑ For more information on the ecological characteristics and requirements of koalas that may help with their release, please refer to **Table 5.1**.

5.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Release where the koala was found (where suitable or within home range).
- ☑ Sufficient food trees present.
- ☑ Away from major roads.

Release Procedure

- ☑ Do not release a koala into a tree that already contains a koala.
- ☑ Koalas should ideally be released in late afternoon or early evening, as this is a normal time of greater activity.
- ☑ Do not release the koala if the weather is hot (over 38°C) or during severe storms.
- ☑ The koala's transport enclosure should be placed several metres away from the selected tree to allow the koala to orient and acclimatise itself before it begins to climb.
- ☑ The door can then be left open while people walk quietly away. The koala will emerge in its own time to climb the tree.
- ☑ Monitor the koala for a minimum of six weeks to ensure it disperses.

5.10 Key references and additional reading

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Chapter 6. Macropods

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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here:

<https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

When macropods come into care it is the responsibility of the rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition, and an environment appropriate to the stage of rehabilitation. The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

6.1 Introduction


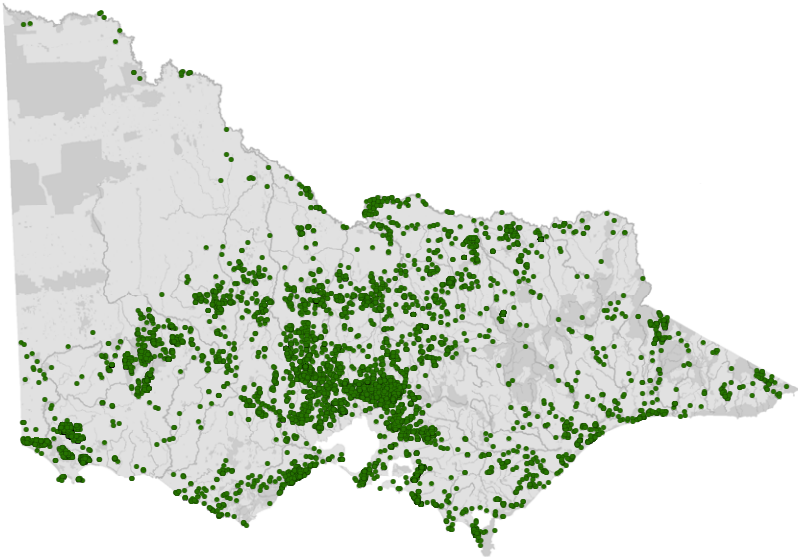
Macropods are the kangaroo and wallaby species. They have two incisors in the lower jaw (diprotodont), no canines and are either grazers or browsers. The second and third digits on the hind feet are fused at the base of the claws (syndactyly) but the claws themselves are separate. There are five species that commonly come into care in Victoria.

6.2 Species information


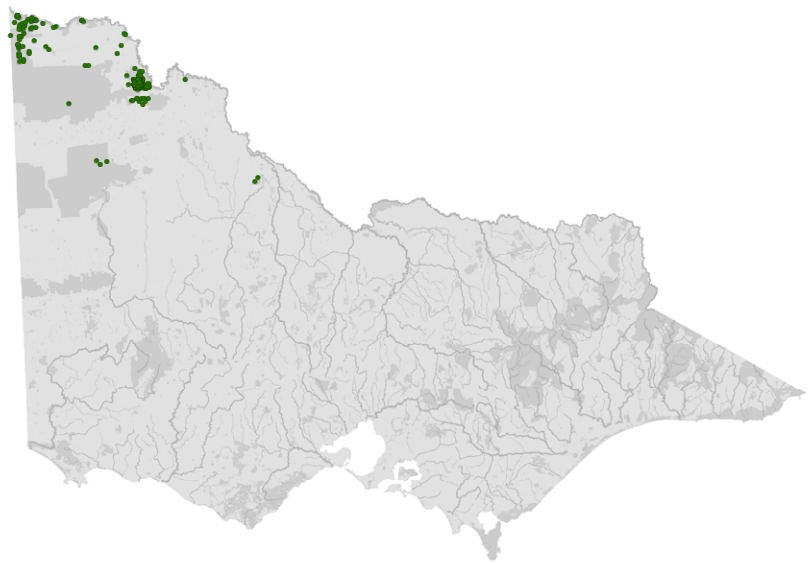


Profiles for the common macropod species found in Victoria are detailed at **Table 6.1**. It does not describe all macropod species found in Victoria. For assistance in identification of macropod species, refer to the recommended reading and reference material at the end of this chapter.

Table 6.1 Species profiles

Species	Eastern grey kangaroo (<i>Macropus giganteus</i>)
 <p>Photo credit: Rodney Start, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Light grey with a dark eye ring</p>
<p>Conservation status*</p>	<p>Common</p>
<p>Sexual dimorphism</p>	<p>Males are up to twice the weight of females and appear more muscular in the chest and forearms</p>
<p>Adult morphometrics</p>	<p>Body weight: Males: 19–89 kg. Females: 17–42 kg</p> <p>Head and body length: Males: 972–2302 mm. Females: 958–1857 mm</p> <p>Tail length: Males: 430–1090 mm. Females: 446–842 mm</p>
<p>Habitat</p>	<p>Grassland with adjacent cover, farmland</p>
<p>Home range</p>	<p>30–160 ha</p>

Species	Eastern grey kangaroo (<i>Macropus giganteus</i>)
Behaviour	Active at dusk, mobs
Diet	Grazer. Grasses comprise up to 99% of the diet
Longevity	6–20 years
Sexual maturity	Male: 18–48 months Female: 18–21 months
Mating season	Year-round
Oestrus cycle	36–55 days
Gestation length	34–38 days
Litters per year	1 litter of 1 per year
Weaning	15–18 months
Young dispersal	15–18 months

Species	Red kangaroo (<i>Osphranter rufus</i>)
 <p>Photo credit: Zoos Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	White markings on face, square jaw
Conservation status*	Common

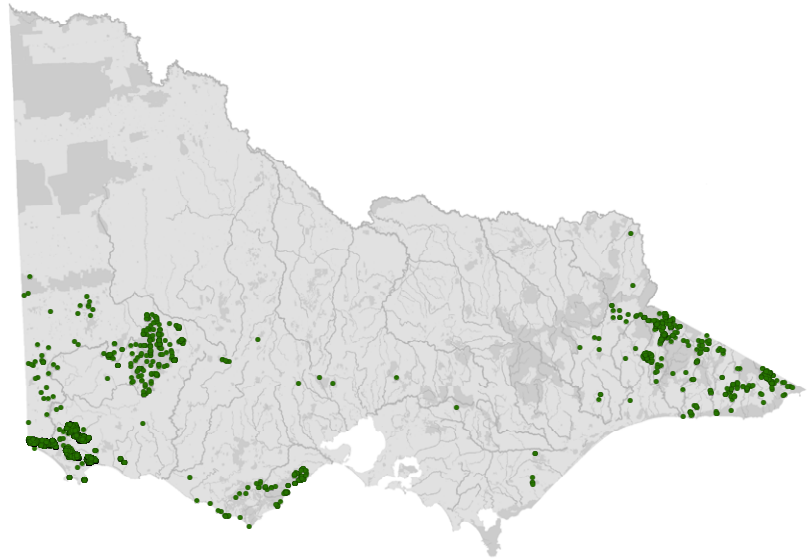
Species	Red kangaroo (<i>Osphranter rufus</i>)
Sexual dimorphism	Males are up to twice the weight of females. They appear red above while the females are blue grey. Both sexes are white underneath
Adult morphometrics	Body weight: Males: 22–92 kg. Females: 17–39 kg Head and body length: Males: 935–1400 mm. Females: 745–1100 mm Tail length: Males: 710–1000 mm. Females: 645–900 mm
Habitat	Scrub, Mallee, open woodland
Home range	2.5–5 km ² 250–500 ha
Behaviour	Active at dusk, mobs
Diet	Grazer consuming predominantly grasses and forbs
Longevity	8–12 years
Sexual maturity	Male: 20–36 months Female: 14–20 months
Mating season	Year round
Oestrus cycle	34–35 days
Gestation length	33–38 days
Litters per year	1 litter of 1 per year
Weaning	12 months
Young dispersal	More than 12 months

Species

Red-necked wallaby (*Notamacropus rufogriseus banksianus*)

Photo credit: Zoos Victoria


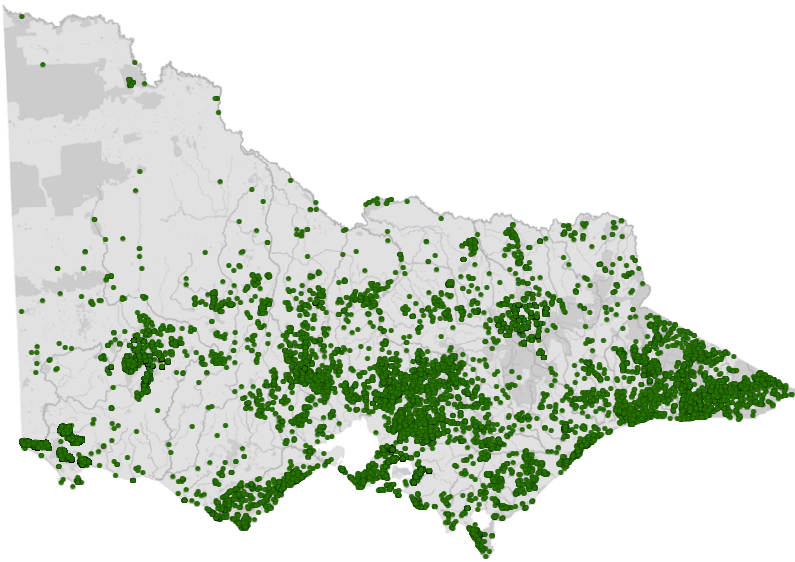
Distribution map




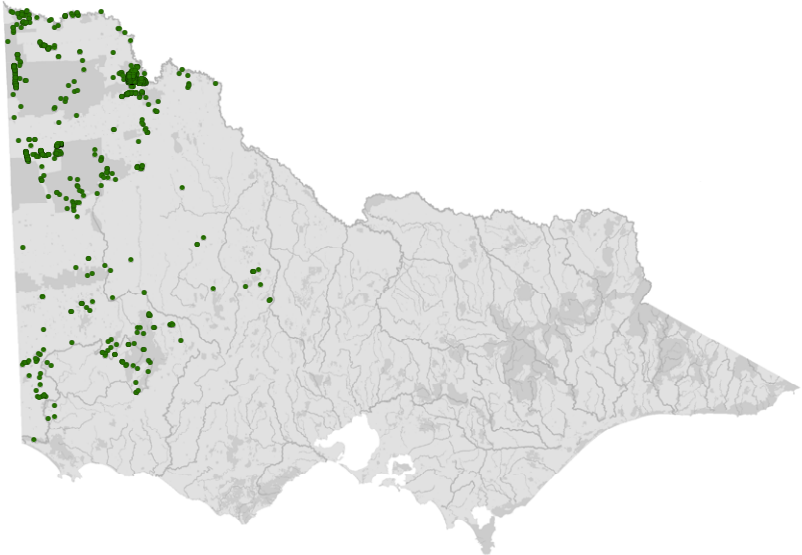
Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance	Pale stripe on jaw line, shoulders have reddish brown colour while coat is grey
Conservation status*	Common
Sexual dimorphism	Males are larger and appear grey to reddish above with a reddish-brown neck. Females are paler
Adult morphometrics	Body weight: Males: 15–27 kg. Females: 11–16 kg Head and body length: Males: 770–888 mm. Females: 708–837 mm Tail length: Males: 703–876 mm. Females: 664–790 mm
Habitat	Dense cover, heath, edges of forest and farm
Home range	Male: 0.10–0.32 km ² 10–32 ha Female: 0.05–0.12 km ² 5–12 ha
Behaviour	Active at dusk, solitary
Diet	Predominantly grasses and herbs. Occasionally browses shrubs or tree seedlings
Longevity	9–10 years

Species	Red-necked wallaby (<i>Notamacropus rufogriseus banksianus</i>)
Sexual maturity	Male: 13–19 months Female: 11–24 months
Mating season	Year round
Oestrus cycle	32–33 days
Gestation length	29–30 days
Litters per year	1 litter of 1 per year
Weaning	12–17 months
Young dispersal	12 months

Species	Swamp (black) wallaby (<i>Wallabia bicolor</i>)
 <p>Photo credit: Mark Norman, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Lighter area on cheek stripe, may have a white tip on thin, long tail
Conservation status*	Common
Sexual dimorphism	Males are larger. No difference in appearance between the sexes
Adult morphometrics	Body weight: Males: 12–20 kg. Females: 10–15 kg Head and body length: Males: 723–847 mm. Females: 665–750 mm Tail length: Males: 690–862 mm. Females: 640–728 mm

Species	Swamp (black) wallaby (<i>Wallabia bicolor</i>)
Habitat	Wet thick forest, heath, dense cover
Home range	0.16 km ² 16 ha
Behaviour	Active at dusk, solitary
Diet	Browser, consuming shrubs and bushes
Longevity	15 years
Sexual maturity	Male: 15–18 months Female: 15–18 months
Mating season	Year round
Oestrus cycle	29–36 days
Gestation length	33–38 days
Litters per year	1 litter of 1 per year
Weaning	12–15 months
Young dispersal	More than 15 months

Species	Western grey kangaroo (<i>Macropus fuliginosus</i>)
 <p>Photo credit: NW Longmore, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>

Species	Western grey kangaroo (<i>Macropus fuliginosus</i>)
General appearance	Darker grey brown colour with pale chest, longer ears
Conservation status*	Common
Sexual dimorphism	Males may be up to twice the weight of females and appear more muscular
Adult morphometrics	Body weight: Males: 18–72 kg. Females: 17–39 kg Head and body length: Males: 946–2225 mm. Females: 971–1746 mm Tail length: Males: 425–1000 mm. Females: 443–815 mm
Habitat	Dry forest, Mallee, dry heath
Home range	0.4–0.7 km ² 40–70 ha
Behaviour	Active at dusk, mob
Diet	Grazer, but will occasionally browse shrubs
Longevity	10–20 years
Sexual maturity	Male: 29–31 months Female: 14–36 months
Mating season	Year round
Oestrus cycle	30–39 days
Gestation length	28–33 days
Litters per year	1 litter of 1 per year
Weaning	15–18 months
Young dispersal	15–18 months

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

6.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for macropods is in **Section 6.6.2**.

The following information relates to the human and animal health and safety considerations specifically related to the rehabilitation of macropods.

6.3.1. Human safety considerations

- There are several diseases carried by macropods that can be transmitted to humans (zoonoses) such as Q fever, leptospirosis and salmonellosis. Persons handling macropods should protect themselves from such diseases by being vaccinated against Q fever and washing hands with soap and water or using hand sanitiser after handling animals or their equipment.
- Kangaroos can panic and/or try to defend themselves when attempts are made to handle them, or they feel threatened. Large kangaroos are very strong and can easily injure inexperienced handlers.
- Any conscious or semi-conscious kangaroo larger than approximately 10 kg should not be manually restrained due to safety risks to the handler and the associated welfare risks to the animal, such as capture myopathy. They should be appropriately sedated before attempts to handle them are made.
- Only an authorised person can possess and administer substances, such as anaesthetics and sedatives, covered by the *Drugs, Poisons and Controlled Substances Regulations 2017*. Therefore, it is mandatory that a veterinarian supervises the anaesthesia and/or sedation of kangaroos.
- These agents will often be administered using a tranquiliser gun, which requires a Category C firearms licence and a Public Place Permit from Victoria Police.
- Adult kangaroos can be heavy, up to 90 kg. Lifting should be done with enough people to avoid back injuries. Stretchers and bags are used for ease of transport.
- A kick from the legs of an adult kangaroo can cause serious bruising, and injuries that may require hospitalisation. Always approach a sedated or injured kangaroo from behind. A sedated animal could still kick or react violently.
- Care is required if cutting wire to remove a kangaroo caught in a fence, as it will recoil if it is under tension. Eye protection and gloves should be worn.
- Many kangaroos are found on roadsides either injured or requiring capture. It is important to remember wildlife rehabilitator safety, when rescuing macropods next to roads. Macropods may still be mobile; the capture may need to be planned with more than one person to keep the animal, wildlife rehabilitators and the public from harm. Contact the Police Assistance Line on 131 444 to assist with traffic management, and where appropriate use signage to warn oncoming traffic.

6.3.2. Animal safety considerations

- Minimise capture time (<10 minutes).
Kangaroos that have experienced high levels of stress for prolonged periods can suffer capture myopathy, which can cause death. Macropods should not be chased in order to catch them, given the risk of myopathy.
- Even severely injured kangaroos may still be able to get up and potentially hop into traffic. If this is at all possible, contact the Police Assistance Line on 131 444 or 000, in case of an emergency, to assist with traffic control.
- If the macropod cannot be captured quickly and safely, or could become a traffic hazard, then an authorised tranquilliser should be engaged.

6.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 6.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned macropods.

6.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 6.2 Visual health observations in macropods

What to look for	
Demeanour	<ul style="list-style-type: none"> Bright, alert
Behaviour	<ul style="list-style-type: none"> Hisses or grunts and attempts to move away when approached Licking forelegs usually indicates a hot or stressed macropod
Movement and posture	<ul style="list-style-type: none"> Uses all four legs equally when walking Uses both hind legs equally when hopping Adopts an upright posture when concerned
Breathing	<ul style="list-style-type: none"> Regular with no obvious effort Increased respiratory effort may indicate hyperthermia, stress or respiratory disease

6.4.2. Equipment

- **GPS and or map and street directory.**
- **Soft dark bag:** Shade-cloth is the preferred material. Hessian bags can also be useful, but they have been associated with trauma to the surface of the eye and overheating. Other suitable bags include a mail bag, rice sack or wool pack.
- **Ice pack or wet towels:** If it is a hot day to decrease the risk of hyperthermia and capture myopathy.
- **Towels and blankets:** These can be used to cover the eyes of the animal.
- **Veterinarian with a tranquiliser gun or injection pole:** They can be required to sedate an adult animal for assessment and transportation.
- **For capture of a joey:** The following items are required in addition to the general items:
 - Pouches and liners with a source of heat;
 - Sharp scissors to cut the teat off a dead mother. This minimises the risk of damaging the joey's mouth, which could result if it is pulled off the teat;
 - Brightly coloured spray paint to mark dead animals once pouches have been checked;
 - Disposable gloves to be worn when checking pouches or when body fluids are spilled or present.

Figure 6.1 a. A soft dark bag made of shade cloth used to transport sedated macropods. The bag opens at each end to facilitate entry of the macropod into the bag. The bag also has an opening along the side for ease of inspection during transport. **b.** A small wallaby is placed into a hessian sack. Note that the tail is held where it meets the body with the legs facing away from the handler.

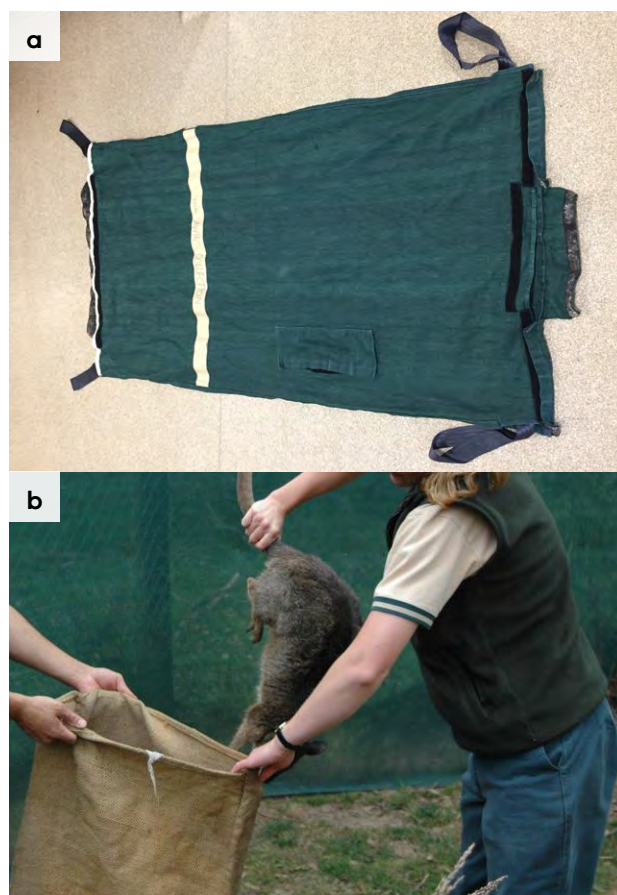


Photo credit: Zoos Victoria

6.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

- If the macropod is calm and/or depressed and weighs less than approximately 10 kg, restrain it by the base of the tail and place it into a bag, with legs held away from the handler (see **Figure 6.1**).
- Do not hold the bag against the body while the animal is being transported, as it can still kick or bite through the bag. If in doubt, it is better to err on the side of caution and sedate the animal first to minimise the risk to both the handler and the macropod.
- If the macropod has been sedated cover the animal's eyes first with a towel or blanket. Then place it in the bag or cover it with blankets. Keep the legs away from the handler at all times.
- Do not attempt to restrain or tie the legs due to risk of injury to the handler or animal.
- It is important to place the macropod into the bag with its neck extended and nose pointing forward. If the nose points down or the neck is kinked the macropod's airway can become occluded potentially resulting in suffocation.

Joey found in a dead mother's pouch



STOP – please refer to your authorisation for mandatory conditions including notification and capture requirements.

- Care needs to be taken when capturing joeys next to the road. Move the mother's body off the road to prevent the wildlife rehabilitator or potential predators from colliding with other vehicles. Mark the body with spray paint to show that the animal has been checked. Pouches can be quite large. Check the entire pouch and all four teats.
- Removal of the joey from the pouch:
 - A furred joey can be removed from the teat by firmly pressing the sides of the joey's mouth. Alternatively, the teat can be cut with a pair of scissors. The joey will then drop it out of its mouth.
 - Once removed, place the joey in a pouch.
 - Keep it warmed to about 28°C to treat shock and mimic the natural temperature of the mother's pouch.

Capture from a confined area

Displaced kangaroos may be trapped in confined areas such as backyards, factory blocks and paddocks. Assess the macropod for any injuries and survey the surroundings to determine if the animal is actually unable to escape. There are often exit points the animal can use that are not easily recognised by the general public; given time, the macropod may find its own way out. If the macropod is injured or stressed because of a perceived inability to escape it will need to be captured. An authorised tranquilliser gun operator should be contacted. Manual restraint should not be attempted. A police presence may be necessary for traffic and bystander control.

Trapped in a fence

- Check if the kangaroo is female, as a joey may be in the pouch or close by. Other people may be required to catch a dependent joey. Place a blanket over the head of the animal as soon as possible to keep it quiet. Veterinary involvement will be required to sedate the animal if handling is required. Wait until the sedative has taken effect before attempting to remove the animal from the wire.
- Permission from the property owner should be obtained before cutting the fence or wires. A short instrument (such as a spanner, branch or tyre jack) is used to untwist the wire. Protective eyewear and gloves should be worn if the fence wire is to be cut.
- If the kangaroo cannot be removed from the fence, euthanasia is required.

6.4.4. Transport

- Keep the duration of travel as short as possible. Adult animals should be anaesthetised by a vet or tranquillised by an authorised tranquilliser gun operator for the duration of the journey.
- Avoid travel at environmental temperatures greater than 30°C. If travel in hot conditions is unavoidable, the vehicle should have adjustable climate control facilities that ensure the area containing the animal is maintained at a temperature of 25°C or less for the duration of transport.
- During transport, the animal should be monitored at approximately 20-minute intervals for any signs of over-heating, such as panting or increased body temperature. Normal body temperature should be between 35 and 36.5°C and can be measured by inserting a thermometer in the cloaca. If the animal is too hot, ice packs can be placed in the groin or wet towels draped over the kangaroo's body.
- The kangaroo should be able to maintain a relaxed and safe position for the duration of transportation. Any form of receptacle used to contain individuals should be safe and appropriate for the age and size of the animal. Their eyes should be protected with a blindfold.
- Soft dark bags can be used to transport macropods. If one is not available, a large blanket or pouch could be used to cover the animal's head and body. Cotton wool balls can be placed into the ears to reduce the level of noise experienced by the macropod. Legs should not be tied together as this increases the likelihood of developing capture myopathy.
- The kangaroo should be laid flat; it should not slump, in case of airway constriction. A towel should be placed under the chest/shoulder area so that the nose points downwards. This reduces the risk of inhalation of saliva or food should the kangaroo regurgitate. A soft airline neck pillow is useful to ensure the head and neck is lying on a soft padded surface and ensures the neck does not kink during transport. Always ensure the head is lower than the shoulders.
- It is not necessary to provide water or food when transporting macropods.

6.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care through minimising human-animal interactions and stress to the animal to maximise successful release back to the wild.

6.5.1. Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure weighing scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures

any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording physical examination findings can be found in the appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examination of wild macropods that weigh more than approximately 10 kg is not possible, unless the animal is extremely ill, without seriously endangering both the macropod and the handler. Sedation/ anaesthesia is required by a vet. Physical examination of smaller macropods may be possible but will be extremely stressful and should be limited to a cursory examination only.
- If the macropod is contained within a bag or pouch, the opening is peeled back, and individual body parts gently examined. This method works well for hand reared joeys that are comfortable with being handled.
- Keep the macropod's eyes covered, if possible.

Table 6.3 provides additional guidance on what to look for during physical examinations.

Table 6.3 Physical examination of macropods

What to look for	
Body weight	<ul style="list-style-type: none"> Record body weight on arrival and weekly, if possible, whilst in care. Smaller macropods can be weighed in a bag. Larger macropods should be weighed if they are sedated or anaesthetised for any reason. A greater than 10% change in adult body weight is cause for concern, and the carer should seek veterinary advice immediately.
Body condition	<p>Body condition is scored by palpation of the muscle over the bones at the base of the tail. See Figure 6.2. Body condition can be described as follows:</p> <ul style="list-style-type: none"> Under condition: Tail vertebrae feel prominent, and the muscle feels concave. Ideal condition: Tail vertebrae can be felt; the muscle feels level with the bones. Over condition: Difficult to feel tail vertebrae and the muscle feels convex.
Hydration status	<ul style="list-style-type: none"> Hydration can be assessed by testing skin tent, done by pinching and lifting the skin between the shoulder blades. Dehydration can be indicated by skin remaining 'tented' or a slow return to normal position.
Eyes	<ul style="list-style-type: none"> Eyes can indicate hydration status; they should be bright, shiny and clear, with pupils the same size. Sunken eyes may indicate dehydration. Pupils constrict with bright light. No discharge or cloudiness.
Ears	<ul style="list-style-type: none"> Held upright. No visible tears or swelling.
Mouth	<ul style="list-style-type: none"> Gums are pink and moist. Teeth are not broken. No visible swelling or asymmetry in the jaw or cheek. No drooling or dropping food while eating.
Skin and coat condition	<ul style="list-style-type: none"> Dry, fluffy coat with no missing patches of fur. Pink cloaca without scabs, ulcers or evidence of diarrhoea. Forearms are not wet. Skin is not dry, scaly, red or ulcerated. No visible external parasites such as lice, flat flies, fleas or ticks.
Limbs, feet, and tail	<ul style="list-style-type: none"> Uses legs equally, even in length. No obvious wounds, swelling, broken nails. No crackling or grinding detected when the legs are manipulated. Legs not held at odd angles to the body.
Sex determination	<ul style="list-style-type: none"> Determined by the presence of testicles (males) or a pouch (females).
Pouch check	<ul style="list-style-type: none"> There are four teats. A teat longer than 4 cm is likely indicative of an 'at foot' joey.

Figure 6.2 Location where body condition is determined by feeling the muscles at the base of the tail.



Photo credit: Zoos Victoria

6.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- The macropod should be observed at least daily.
- If the macropod is being medicated, a visual check in the morning is recommended.
- Note the macropod's demeanour and behaviour every time food is introduced or taken away, the macropod is medicated, or the enclosure is cleaned. Pay particular attention to any changes that have occurred since the previous day.
- Gently encourage the macropod to move in order to assess its movement and demeanour.
- Note faecal consistency daily. If diarrhoea is noticed, a faecal sample should be collected and submitted to the veterinarian for assessment as soon as possible. Do not treat on suspicion of a bacterial or parasitic infection, as this can make definitive diagnosis very difficult and potentially prolong the course of the disease.

6.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 6.4 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 6.4 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Clinical signs and possible causes	Possible causes	Carer observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to walk or move normally</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fractures</p> <p>Dislocation</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in wire or netting, predation injury caused by raptor, fox, or dog, Gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Large macropods will require sedation/anaesthesia, in order to move them. • Do not attempt to stabilise fractures, as this is very painful, and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical examination, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • See Section 6.4 Capture, restraint, and transport and Section 6.6 Housing in this chapter for further advice.
<p>Head trauma</p> <p>Bleeding from nose or mouth</p> <p>Swollen eye lids, blood present in eye</p> <p>Abnormal behaviour</p> <p>Mouth swelling, missing teeth</p> <p>Lethargy</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by fox or dog,</p> <p>Gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity</p> <p>Cranial trauma, concussion</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Large macropods will require sedation/anaesthesia, in order to move them. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • See Section 6.4 Capture, restraint, and transport and Section 6.6 Housing in this chapter for further advice.

Clinical signs and possible causes	Possible causes	Carer observations and response
<p>Bleeding</p> <p>Puncture wounds</p> <p>Bruising</p> <p>Fur loss</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by fox or dog,</p> <p>Gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity</p> <p>Conspecific aggression, breeding season injuries</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Large macropods will require sedation/anaesthesia, in order to move them. • Euthanasia may be the most humane response if the wounds are extensive. • The severity of bite wounds/scratches may not be immediately obvious. • Look for clumps of dried fur stuck together with saliva. Part the fur and look for puncture wounds. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • See Section 6.4 Capture, restraint, and transport and Section 6.6 Housing in this chapter for further advice.
<p>Nail injury</p> <p>Toe injury</p> <p>Swollen digit</p> <p>Bruised digit</p>	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by fox or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity</p> <p>Burn injuries</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment as these lesions are slow to heal and, where nail bed infection occurs, intensive veterinary management is required. • Large macropods will require sedation/anaesthesia in order to move them. • Burn injuries to paws may result in nail damage, digit bone damage and tendon damage, due to the complexity of these injuries, veterinary treatment is required. • Apply first aid to minor wounds. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. • See Section 6.4 Capture, restraint, and transport and Section 6.6 Housing in this chapter for further advice.

Clinical signs and possible causes	Possible causes	Carer observations and response
<p>Burns</p> <p>Abnormal movement (note macropods with full thickness burns to their feet will no longer have feeling and will still hop)</p>	<p>Recent bushfire, campfire injury, chemical burn</p>	<ul style="list-style-type: none"> • Seek urgent veterinary attention. • Large macropods will require sedation/anaesthesia in order to move them. • Burn injuries are extremely painful, treatment and bandage changes must only occur under anaesthesia and with adequate pain management. • Burn injuries to paws may result in nail damage, digit bone damage and tendon damage, due to the complexity of these injuries, veterinary treatment is required. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • To ensure good welfare, animals must be returned to a veterinarian for ongoing bandage changes.
<p>Lameness, reluctance to move</p>	<p>Trauma, capture myopathy (caused by prolonged exertion due to being chased or caught in a fence)</p>	<ul style="list-style-type: none"> • Seek veterinary care as soon as possible. • Macropods with myopathy may have a high body temperature and respiratory rate. They may tremble and pass dark coloured urine. • Apply wet towels to the forearms and inner thighs to lower the body temperature.
<p>Blindness, neurological signs e.g. wobbly movement, convulsions</p>	<p>Undetermined infectious disease e.g. toxoplasmosis or bacterial or viral meningitis, cranial trauma, toxicity such as Phalaris or degenerative such as cataracts</p>	<ul style="list-style-type: none"> • Seek veterinary assessment to determine the cause. • Seek species expert advice. • Carer may observe the animal bumping into objects in the enclosure or fail to respond to short sharp noises (such as a loud clap from behind the animal). • Pupils may be fixed/dilated and not responsive to changes in light level. Pupils should constrict if a pen light is shone in the eye. • Phalaris toxicity is typically seen after animals graze on rapidly growing young plants, particularly following rain after a prolonged dry spell. Most cases occur in winter. Some affected animals will recover. Others will need to be euthanased.
<p>Vesicles or ulcers in the mouth, cloaca, penis</p>	<p>Undetermined infectious disease, for example macropod herpesvirus</p>	<ul style="list-style-type: none"> • Seek veterinary assessment as soon as possible. • Affected macropods may also appear depressed, uncoordinated or have conjunctivitis or a nasal discharge.

Clinical signs and possible causes	Possible causes	Carer observations and response
<p>Diarrhoea</p> <p>Loose, smelly faeces</p>	<p>Inappropriate diet, change in diet, infectious disease, alteration of microbiome, stress, internal parasites, antibiotic treatment</p>	<ul style="list-style-type: none"> • Seek veterinary advice to determine the cause. • Seek urgent veterinary advice if diarrhoea does not resolve rapidly (e.g. within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. • Do not treat on assumption of infectious disease (such as coccidia or bacterial infection) as this can make veterinary diagnosis more difficult if the animal does not improve. • Diarrhoea may result if inappropriate milk is fed e.g. cow's milk. • Seek species expert advice, ensure husbandry practices are correct. Consider any recent changes, which may have led to diarrhoea and remove the inciting cause where possible: rapid change in diet, unusual levels of sound, intervention or handling, contact with recently arrived animals. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. • If milk was recently changed, switch back to the previous milk, wait until diarrhoea has resolved and then implement a slower diet change. • Diarrhoea can occur due to over feeding (i.e. more than 8–15% body weight). • Do not mix oral rehydration fluids with milk as it changes the digestibility of the milk. Oral rehydration fluids/water can be provided in between milk feeds. • Some causes of diarrhoea are transmissible to people. Ensure excellent hygiene standards to prevent spread and isolate this animal from any others in care if possible. • Orphaned joeys may lack normal gut bacteria. Place a faecal scat from a healthy macropod in a bottle of boiled water that has cooled but is still warm. Mix the faeces with the water and allow it to stand for ten minutes. Drain off the liquid, then mix it into the joey's next feed at a rate of 20–30% of the milk volume. Repeat the process 12 hours later.
<p>Vomiting</p>	<p>Mercyism</p>	<ul style="list-style-type: none"> • Joeys make violent rhythmic jerking movements of the abdomen and food will occasionally squirt out of their mouth. • Normal behaviour: that is the macropod equivalent of chewing the cud.

Clinical signs and possible causes	Possible causes	Carer observations and response
Noising breathing	Aspiration pneumonia	<ul style="list-style-type: none"> • Seek veterinary advice as soon as possible. • A joey may have inhaled milk during feeding.
Increased drinking and urination	Kidney disease	<ul style="list-style-type: none"> • Seek veterinary care as soon as possible. • Seek species expert advice, ensure husbandry practices re correct. • Keep macropods well hydrated as kidney disease can occur secondary to dehydration. • Seen occasionally in hand reared eastern grey kangaroo pouch young. • There is no effective treatment.
Skin irritation, fur loss, wartlike lumps	Excessive mite, lice, flea, flat fly infestation, ringworm, poxvirus, toe/tail sucking in joeys	<ul style="list-style-type: none"> • Seek veterinary advice to determine the cause and treatment. • Some fur loss/minor skin lesions are commonly seen due to fighting, and do not require any intervention. • A small number of parasites can be normal and may not require treatment or removal. • If there are large numbers of parasites (the animal is scratching/irritated, or the skin is red and inflamed) seek veterinary attention. Consider if the parasite infestation is secondary to an underlying disease process. • Ringworm is zoonotic, refer to Part A, chapter 4 Biosecurity & Hygiene. • Poxvirus is spread by biting insects and usually resolves without treatment.

Figure 6.3 a. A joey with a cataract. b. Cloacal ulceration caused by macropod herpesvirus.



Photo credit: Zoos Victoria

Figure 6.4 a. Poxvirus lesions on both legs of an eastern grey kangaroo. b. Ringworm lesions on the front feet of an eastern grey kangaroo.

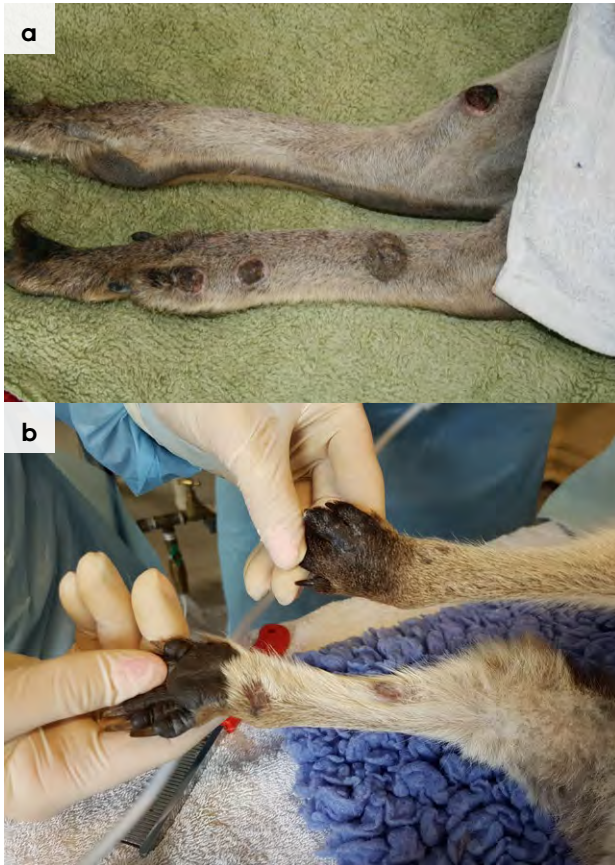


Photo credit: Zoos Victoria

Figure 6.5 Dehydrated kangaroo tenting between shoulder blades.



Photo credit: Zoos Victoria

Figure 6.6 Lumpy jaw. Note the swelling beneath the jaw, which likely represents an abscess.



Photo credit: Zoos Victoria

Figure 6.7 Macropod dental malocclusion.

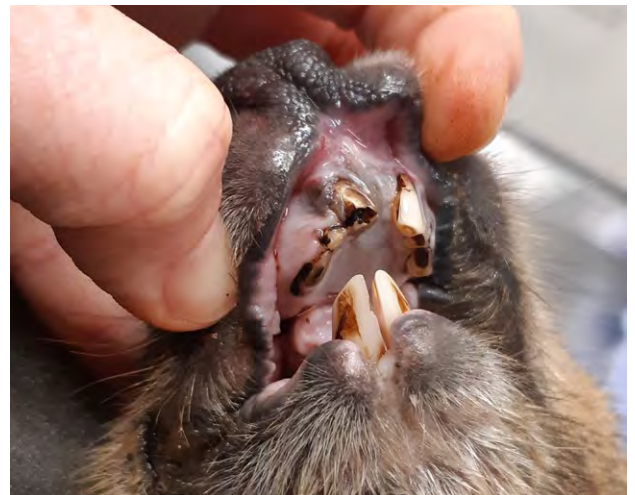


Photo credit: Zoos Victoria

6.5.4. Administering treatment during rehabilitation

- Oral medications can be given directly into the joey's mouth, allowing time for the joey to swallow, or else mixed into the joey's milk.
- Due to the inability to safely restrain large macropods, they are usually not medicated orally (e.g. some deworming drugs). If there is no alternative, medication can be mixed into the macropod's feed, as directed by a veterinarian.
- Injectable medications can be administered under the skin, between the shoulder blades, or into the large hind leg muscles, as directed by a veterinarian. Only experienced carers should give injections.

6.6 Housing



Below are several key considerations when housing adults in care.

6.6.1. General housing information for macropods

Macropods are sensitive to noise, and the sight and smell of domestic pets. They should be housed in a quiet area of the property. Macropods should have access to fresh water daily.

6.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

- Wash hands with soap and water after handling dogs and cats to minimise the risk of transferring disease agents such as *Toxoplasma gondii*, which can be found in cat faeces.
- Ideally, exam gloves should be worn and changed in between animals.
- Macropods should not be fed on the ground. Hay racks, dishes or troughs should be used to minimise contact with faeces and parasites.
- Left-over food should be removed daily.
- Rake paddocks daily to remove faeces. If possible, rest paddocks for 30 days during the warmer months to reduce the parasite load.
- Sheds with concrete floors should be completely cleaned out between inhabitants.
- Hay/straw should be discarded, and the floor disinfected with products such as F10 or bleach.

- All organic matter should be removed and the enclosure cleaned with boiling water, as this has been shown to kill coccidial oocysts. Rehabilitation facilities for macropods should be designed and built using materials which are easy to clean and disinfect between occupants.

6.6.3. Housing types

There are no national standards regarding enclosure size for macropods during rehabilitation. Each state has a different set of guidelines which contain a variety of recommended enclosure sizes. The dimensions recommended in this chapter are suggestions based on Healesville Sanctuary's enclosure sizes. There is no 'one size fits all' and it is important to continually assess the welfare of the macropod and tailor enclosures and enclosure size to suit the requirements of the individual.

Different set ups are required for animals at different stages of treatment and care.

Table 6.5 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 6.8**.

Table 6.5 Rehabilitation housing for adult macropods

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment – frequent medication, oxygen supplementation, temperature control</p>	<p>Enclosure: 2 m x 2 m (4 m²) Height 2 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A stable or enclosed area with solid walls and subdued lighting. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • The bedding should consist of a deep layer of straw, a dog bed or a foam mattress to provide support for recumbent animals. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Enclosures need to be in a quiet area, with minimal traffic. • Recumbent macropods are at high risk of myopathy and pressure sores over the points of the hips and legs. These complications should be expected and monitored as they adversely impact the welfare of the animal. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Easy access to grass and low-profile water bowls is required.
Intermediate housing (treatment/cage rest)		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care</p>	<p>Enclosure: 2 m x 2 m (4 m²) inside Height 2 m 5 m x 5 m (25 m²) outside. Height 2 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A stable or shed with solid walls is suitable. • Double hinged half door permits the animal to be checked without too much disturbance. • This housing should lead out to an enclosed yard with hessian or shade cloth lined fences that can be used during the day with the animal returned to intensive care housing at night. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • As kangaroos rest in areas of longer grass and shrubs, creating visual barriers using bales of straw or blankets hung as dividers may assist to reduce stress. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Access to grass and hay and low-profile water bowls is required.

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/ medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitoring/ assessment of behaviour (foraging, digging, nest building)</p> <p>Pre-release assessment</p>	<p>Pre-release juvenile kangaroo or wallaby less than 5 kg:</p> <p>5 m x 4 m (20 m²) X 2 m (H).</p> <p>5 m x 2 m (10 m²) increase in floor area for each additional animal</p> <p>Pre-release kangaroo or wallaby between 5 kg and 20 kg:</p> <p>10 m x 5 m (50 m²) X 2 m (H).</p> <p>5 m x 5 m (25 m²) increase in floor area for each additional animal</p> <p>Pre-release kangaroo greater than 20 kg: 20 m x 5 m (100 m²) X 2 m (H).</p> <p>10 m x 5 m (50 m²) increase in floor area for each additional animal</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> Fences for kangaroos need to be at least two metres high and predator proof. Chain mesh (50 mm x 50 mm) such as cyclone fencing can be used. Fence poles are placed on the outside of the enclosure to prevent climbing and injury when running along the fence. Fencing should have a visual barrier present. Options include Hessian or shade cloth lining, shrubs planted on the outside or solid wall fencing. The corners should be blocked off using shade cloth to prevent the kangaroo from running into them and injuring itself. Flooring may be grass, sand, soil or leaf litter. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> A feed shed with solid walls made from wood, brick or tin to keep food dry and offer shelter should be provided. The flooring is ideally concreted and covered with straw that is changed regularly. Poisonous plants that should not be used in the yard include oleander, rhubarb, deadly nightshade, green cestrum and azaleas. Wallabies may be offered various hides made by leaning wooden panels against logs or using basic A-frame structures. The provision of four to five hides per animal is recommended. Wallabies require a complex environment with logs, rocks and tussocks to provide opportunities to climb, exercise and learn vigilance. Kangaroo enclosures should not have obstacles around the perimeter as these will interfere with running along the fence line. They require some hides such as rocks, grass tussocks or wooden shelters. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> Trees and shrubs should be present for shade and privacy but not located near the fence-line to prevent injury and escape. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Hay and grass should be fed out of hay racks or troughs. It should not be fed on the ground as this will increase the risk of transfer of internal parasites and may contribute to lumpy jaw. Several bowls may be required to prevent the less dominant animals from missing out on feed. Metal or ceramic dog bowls or stock feed troughs may be used.

Figure 6.8 Eastern grey kangaroo in shed for hospitalisation.



Figure 6.10 A shed used for shelter in a pre-release pen for macropods.



Photo credit: Zoos Victoria

Figure 6.9 a. A macropod yard with a shed that can be used to confine adult animals for intensive care. b. Fence with cyclone fencing and shade cloth facing, inside the yard.

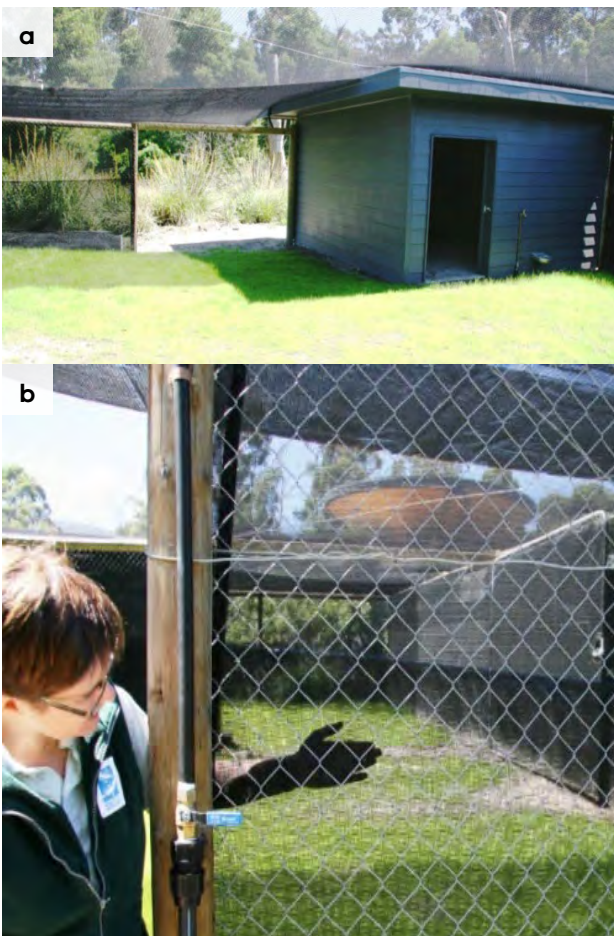


Photo credit: Zoos Victoria

6.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of macropods in rehabilitation. Information on feeding orphaned individuals can be found under **Section 6.8 Hand raising**.

Figure 6.11 A hay rack. Note that the hay is protected from the weather and the ground is raked daily to remove faeces.



Photo credit: Zoos Victoria

Table 6.6 Daily feeding and diet guide for adult macropods during rehabilitation

<p>Diet</p>	<p>Diets for sub-adult and adult macropods consist of the following items:</p> <ul style="list-style-type: none"> • Hay and fresh grasses. Suitable hays include lucerne and grass hay. This should make up most of the diet. Yards may need to be rested in between animals, to permit grass to regrow. • Suitable supplements such as macropod or pasture replacement pellets should make up less than 10% of the food volume offered daily. • Non-suitable food items include bread, grain mixes and molasses. Pellets for cattle should not be offered as they may contain coccidiostats that are fatal to macropods. <p>Suitable browse items for swamp wallabies include:</p> <ul style="list-style-type: none"> • <i>Grevillea</i>, <i>Hakea</i>, <i>Pomaderris</i>, <i>Lomandra</i>, <i>Lomatia</i>, <i>Allocasuarina</i>, <i>Callistemon</i>, tea tree, gum and wattle. • Fungi and ferns.
<p>Pre-release considerations</p>	<ul style="list-style-type: none"> • Kangaroos need to be exposed to a variety of native grasses prior to release. • Wallabies need to be fed a variety of at least five species of leafy browse daily throughout the intermediate and pre-release stages from weaning to release. • This food should be limited to plant species from the release site in the fortnight prior to release. • Supplementary foods such as pellets should not be offered in the fortnight before release to encourage macropods to consume the diet they will receive once released.
<p>Frequency/ time of feeding</p>	<ul style="list-style-type: none"> • Clean water is offered daily. • Three to five species of browse items are offered daily. Some may be used as food and also to create a hide.

6.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations are found in the appendices to Part A of these guidelines.

6.8.1. Equipment required for hand raising

- **Milk:** There are a variety of low lactose milk formulas available to raise macropods. Follow the manufacturer's instructions when making up the milk formula. Milks that can be used include:
 - Wombaroo Kangaroo Milks provide appropriate levels of protein, fat, carbohydrates and energy for all stages of growth.
 - Biolac produces three milks which provide sufficient protein, fat, carbohydrates and energy for all stages of growth.
- Di-Vetelact is an older product but many carers have had success with it. It is a single formula that is diluted according to the age of the joey.
- **Supplements:** Suitable supplements that may be added to milk include:
 - Wombaroo Impact is used to boost immunity and protein in orphaned joeys after the first month in care.
 - Critical Care for Herbivores is used to provide a source of easily digestible energy to sick joeys.
 - Do not add human infant vitamin supplements to the milk formula.
- **Housing:** Pouch, which usually has three layers:
 - An inner lining made from a natural fibre without exposed strands, which may be achieved by using French seams (a seam with the raw edges enclosed). It may have curved edges.
 - Outer pouch may be made from a variety of materials such as wool, polyfibre, cotton or synthetic fleece fabric.
 - Hanging pouch. This pouch suspends the inner pouches and hangs on a frame, in a basket or backpack.
- Pouch size will vary with the size of the joey. The pouch should be deep enough that the legs do not hang out. A young joey should feel snug, but the pouch will become more open with increasing age.
- **Intensive care unit** (such as Vetario) or box containing a heat pad with thermostat.
- **Appropriately sized teats and bottles.**
- **Other:** Set of scales, record charts, digital thermometer/datalogger to monitor temperature inside the pouch/enclosure.

Figure 6.12 A pouch for a macropod. A stand is used to support the pouch. Note the outer pouch, with layered material pouches inside.



Photo credit: Zoos Victoria

Figure 6.13 Macropod pouch placed on the floor and supported in a basket.



Photo credit: Zoos Victoria

6.8.2. Growth, development and care of orphaned young



STOP – Please refer to your authorisation for mandatory conditions regarding unfurred macropod joeys.

Table 6.8 to **Table 6.12** describe the appearance of macropod joeys at various stages of development.

Macropod joeys require strict hygiene to prevent deaths from bacterial and fungal conditions.

An orphaned joey should be housed in a pouch located in a quiet room of constant temperature away from pets, children, and human noises.

The ambient temperature is gradually reduced until pouch emergence when the joey is furred. This may be done by decreasing the setting on the thermostat unit or by increasing the distance between the heat unit and the animal. See **Table 6.8** to **Table 6.12** for heating recommendations.

A thermometer is used to monitor the temperature in the pouch by placing it between the inner and outer pouches.

Heating is provided using electrical heat pads that are covered with cloth and placed close enough to provide the correct temperature. The heat pad can be attached to a thermostat which will regulate its heat output.

To reduce the possibility of sucking extremities, a rubber teat can be pinned to the side of the pouch with a safety pin.

- Where possible, joeys should be raised in small groups of three to four for kangaroos and in pairs for wallabies. Do not encourage behaviours such as human play-boxing. This behaviour should be practised between joeys of similar weights and ages.
- Encourage the joey to lap milk from a bowl from first pouch emergence to full emergence to reduce imprinting onto humans.

No bottles should be fed in the month between weaning and release. At this age, young may attempt to drink from their mother but are discouraged. Do not feed macropods after release as this trains them to approach humans for food.

From first pouch emergence, the joey is permitted to stand and hop for one to two minutes. As the joey progresses, exercise may include short walks on the property or with supervision in the pre-release pen, building up to 30 minutes at least twice daily.

By full pouch emergence, the joey should be able to hop strongly and at speed.

By the time the joey is weaned and approaching release, it should easily hop at speed for several minutes.

Ensure the joey shows appropriate predator avoidance behaviour. Wildlife rehabilitators should make a hissing noise and thump their feet when other humans or dogs approach within 50 m of the joey. Do not house joeys within sight of pet dogs. Fear of dogs is instinctive in macropods and is decreased with continued exposure to canines.

Ensure the joey has reached the recommended weight and age prior to release. See **Table 6.7**.

Table 6.7 Recommended release age and weight

Species	Fully emerged (months)	Weaning age (months)	Release age (months)	Release weight range (kg)
Eastern grey kangaroo	11	15–18	15–18	15–20
Western grey kangaroo	10	15–18	15–18	15–20
Swamp wallaby	8	12–15	>13	8–10
Red-necked wallaby	10	12–17	15	11
Red kangaroo	8	12	>12	18

Table 6.8 Eastern grey kangaroo development (Used with permission from Wombaroo)

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
0.4	160	191	113	640	6	75	Eyes open, ears up, fine fur on head	Intensive care: in hospital box inside pouch 30°C.
	170	209	123	780		90	Stand at each feed for 30 – 60 seconds	
	180	228	133	950		100	Head coming out of the pouch	
Transition	182	232	135	990		100	75 mL 0.4 + 25 mL 0.6	
	185	238	138	1050		100	50 mL 0.4 + 50 mL 0.6	
	188	244	141	1110		100	25 mL 0.4 + 75 mL 0.6	
0.6	190	248	143	1150	5	100	Offer grass and roots in pouch	Intensive care: housed inside with 28°C.
	200	268	153	1350		110	Chest covered with fur	
	210	288	163	1550		120	Faeces: green toothpaste	
Transition	212	292	165	1600		120	90 mL 0.6 + 30 mL >0.7	
	215	298	168	1675		120	60 mL 0.6 + 60 mL >0.7	
	218	305	171	1750		120	30 mL 0.6 + 90 mL >0.7	

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
>0.7	220	309	173	1800	4	120	Small adult in appearance with short fur	Exercise: hop for 30 minutes twice daily.
	230	329	183	2070	4	135	Will eat grass on ground while in pouch	Intermediate housing: Human portable cot or play-pen (1 m x 2 m) can be used inside and a 4 m x 4 m yard with a shed can be used outside. The joey is taken outside for 1–2 hours a day, increasing to 4 hours by 2.7 kg for exercise and exposure to sunlight.
	240	350	194	2350		145	Faeces: soft to firm green pellets. Start to self-toilet out of pouch.	
	250	371	204	2700	3	155	Emerging from pouch, head out for short periods. Offer grass and dirt.	Intermediate housing: outside all day, inside at night. Provide heat at night.
	260	392	214	3150		165		
	270	414	224	3600	3	185	Offer supplements: pellets. Offer grass and hay	Pre-release yard: Outside all day, locked into outside shed at night.
	280	436	234	4100	200	Longer fur, not waterproof		
	290	458	244	4600	2	220		Pre-release yard: outside day and night.
	300	480	254	5100		240	Faeces: firm green pellets	
	310	495	259	5600	2	250	Fully out of pouch	Pre-release yard: outside day and night.
	320	510	264	6100		260	Growth now 60 g/d. furred, waterproof	

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
Weaning	330	Growth rate now about 50 g per day			2	240	Feed volume depends on amount of solids consumed	
	360					180		
	390				1	120	Gradually increase solid food and reduce milk intake	Pre-release yard. Does not use shed, seeks natural cover. Grazing day and night.
	420					60		
	450					0		

Table 6.9 Western grey kangaroo development (Used with permission from Wombaroo)

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
0.4	160	174	102	460	6	61	Eyes open, ears up, fine fur on head	Intensive care: in hospital box inside pouch 30°C.
	170	191	111	560		68		
	180	208	120	680		80		
	182	212	122	712		80		
Transition	185	217	125	760		80	40 mL 0.4 + 40 mL 0.6	
	188	222	127	808		80	20 mL 0.4 + 60 mL 0.6	

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
0.6	190	226	129	840	5	80	Offer grass and roots in pouch	Intensive care: housed inside with 28°C.
	200	244	139	1000		90		<i>Exercise:</i> 5 minutes of hopping at end of feed.
	210	263	148	1160		100	<i>Faeces:</i> green toothpaste. Fine fur covering body	Water available for lapping.
Transition	212	267	150	1190		100	75 mL 0.6 + 25 mL >0.7	
	215	273	153	1250		100	50 mL 0.6 + 50 mL >0.7	
	218	378	155	1310		100	25 mL 0.6 + 75 mL >0.7	

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
>0.7	220	282	157	1350	4	100	Small adult in appearance with short fur	Exercise: hop for 30 minutes twice daily.
	230	302	167	1550		110	Will eat grass on ground while in pouch	Intermediate housing: at pre-release yard.
	240	322	176	1770	3	120	Faeces: soft to firm green pellets. Start to self-toilet out of pouch.	Out for 1–2 hours a day, increasing to 4 hours by 2.7kg. Latest age for buddying.
	250	342	185	2050		130	Emerging from pouch, head out for short periods. Offer grass and dirt.	
	260	362	195	2400	2	145		
	270	383	204	2800		155	Offer supplements: pellets. Offer grass and hay	Intermediate housing: outside all day, inside at night.
	280	406	214	3250	2	170	Longer fur, not waterproof	Pre-release yard: Outside all day, locked into outside shed at night.
	290	428	224	3700		190		
	300	446	232	4200	2	210	Faeces: firm green pellets	
	310	455	235	4700		230	Fully out of pouch	Pre-release yard: outside day and night.
	320	463	237	5200		240	Growth now 60 g/d. furred, waterproof	

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
Weaning	330	Growth rate now about 40–50 g per day			2	240	Feed volume depends on amount of solids consumed	
	360					180		
	390	1			120	Gradually increase solid food and reduce milk intake		
	420				60			
	450	0			0	Fully weaned.	No longer fed supplements, on native diet for 2 weeks prior to release.	

Pre-release yard Does not use shed, seeks natural cover. Grazing day and night.

No longer fed supplements, on native diet for 2 weeks prior to release.

Table 6.10 Red-necked wallaby development (Used with permission from Wombaroo)

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing	
0.4	140	142	75	320	6	47	Eyes open. Fine hair begins	Intensive housing: In hospital box inside pouch at 32°C. Fed inside pouch.	
	150	158	83	390		55			
	160	177	92	470		60	Velvet appearance to fur begins		
Transition	162	181	93	488		60	45 mL 0.4 + 15 mL 0.6		
	165	187	96	515		60	30 mL 0.4 + 30 mL 0.6		
	168	192	98	542		60	15 mL 0.4 + 45 mL 0.6		
0.6	170	196	100	560		60	Head starts to come out of pouch. Can stand for 30s. Start to offer grass with roots in pouch.	Intermediate housing: housed inside, in pouch at 28°C. Sunshine for 10 minutes daily during feed.Λ	
	180	217	110	660		65	Faeces: toothpaste		5 minutes of activity at end of each feed.
	190	239	120	780		72	Short, sleek fur		Stands for assisted toileting.
Transition	192	243	122	808		72	54 mL 0.6 + 18 mL >0.7		
	195	250	125	853		72	36 mL 0.6 + 36 mL >0.7		
	198	258	128	898		72	18 mL 0.6 + 54 mL >0.7		

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
>0.7	200	263	130	930	4	72	Average weight gain 12 g/d. Will lap water. Offer grass, hay, browse Hopping strongly for 30 minutes twice daily	Pre-release housing: Grazes outside for most of day. Inside at night in pouch.
	210	289	140	1100		80	Offer native browse	
	220	319	148	1310		95	Faeces: soft to firm dark green. Will start to toilet by self. Confident out of pouch	Outside during day. Can be housed in outside shed in paddock at night
	230	350	156	1540		105	Average weight gain 23 g/d. Fur has good coordination. Fur becomes more dense	
	240	378	163	1770	3	120	Fur becomes dense and waterproof	Able to thermoregulate
	250	403	168	2000		130		
	260	415	174	2250		140		
	270	428	179	2500	2	150	Average weight gain 30 g/d. Fur is waterproof Faeces: formed, dark green	Pre-release housing: outside day and night. Grazing through day and night. Uses natural shelter in yard rather than shed.
	280	440	183	2750		155		

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds daily	Feed (mL/day)	Appearance/feeding	Housing
Weaning	290	Growth rate now about 25 g per day			2	140	Appearance is a small adult	Pre-release housing: outside day and night. Grazing through day and night. Uses natural shelter in yard rather than shed.
	310					100	Active, fit, wary	
	330				1	60	Start wean	
	350					30	End wean , on native browse only	
	370				0	0	Release	

Table 6.11 Swamp wallaby development (Used with permission from Wombaroo)

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Feeds a day	Feed (mL/day)	Appearance and feeding	Housing
0.4	110	68	48	145	6	24	Faeces: yellow custard	Intensive care: in hospital box inside pouch at 32°C.
	120	75	56	190		31	Eyes open, ears up	
	130	82	65	240		36	Dark colour on hands is fur under skin	
	140	95	74	300		45		
	150	102	82	370		50	Fine covering of fur	
Transition	152	105	84	380		50	40 mL 0.4 + 10 mL 0.6	Intensive care: in hospital box in pouch at 30°C. At least 1 feed daily outside. Exercise: 5 minutes at end of each feed.
	155	108	86	405		50	25 mL 0.4 + 25 mL 0.6	
	158	111	88	430		50	10 mL 0.4 + 40 mL 0.6	

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Feeds a day	Feed (mL/day)	Appearance and feeding	Housing
0.6	160	115	90	450		50	Faeces: dark yellow custard. Starts to have head out of pouch for short period.	Intensive care: in hospital box in pouch at 30°C. At least 1 feed daily outside. <i>Exercise:</i> 5 minutes at end of each feed.
	170	122	99	550	5	60	Faeces: green-yellow toothpaste. Start to offer grass and roots in pouch. Fur on chest	Intensive care: in house in pouch at 28°C. <i>Exercise:</i> 7 minutes at end of each feed.
	180	132	106	670		65	Offered grass and browse daily in pouch Starting to emerge from pouch	Intermediate housing: outside for most of day with access to pouch. Yard has shrubs and hides. <i>Exercise:</i> hops for 30 minutes twice daily.
Transition	182	134	107	695		65	50 mL 0.6 + 15 mL >0.7	
	185	136	109	735		65	30 mL 0.6 + 35 mL >0.7	
	188	138	111	785		65	15 mL 0.6 + 50 mL >0.7	
	190	141	112	820		65		
>0.7	200	152	119	1000	4	75	Faeces: toothpaste green Short fur	
	210	164	125	1180		85	Eating more grass and browse	Will be out of pouch for much of day.

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Feeds a day	Feed (mL/day)	Appearance and feeding	Housing
>0.7	220	Tail is adult size	131	1370	4	100	Starts to self-toilet. Long fur not waterproof	<p>Pre-release housing: house outside during day. In shed at night.</p> <p>Exercise: out of pouch and active for much of the day</p>
	230		137	1580		110		
	240		142	1830	3	120	Faeces: soft to firm green	
	250		134	2100		135		
	260		148	2350		145	Fully emerged from pouch. Fur is dense and waterproof. Faeces: formed, green	
Weaning	270	Growth rate now about 25 g per day			2	125	Start to wean: will tend to wean itself quickly	<p>Pre-release housing: housed outside during day and night. Access to natural shelter in shrubs, hides in yard. No longer has access to pouch.</p>
	280					100	Appearance: small adult	
	300					60		
	320				1	30	End wean	
	340				0	0	Release from 8kg onwards	

Table 6.12 Red kangaroo development (Used with permission from Wombaroo)

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds a day	Feed (mL/day)	Appearance and feeding	Housing
0.4	100	112	67	240	6	36	Eyes open, ears up	Intensive housing: In hospital box inside pouch at 32°C.
	110	128	77	315		47		
	120	145	89	405	55	Fur under skin on arms		
	130	162	102	510	64			
	135	171	109	570	68	Starts to have head out of pouch		
Transition	137	175	111	594	68	50 mL 0.4 + 18 mL 0.6		Intensive housing: Inside hospital box, inside pouch at 30°C.
	140	181	115	630	68	34 mL 0.4 + 34 mL 0.6		
	142	185	118	658	68	18 mL 0.4 + 50 mL 0.6		
	145	192	122	705	68			
0.6	150	203	128	785	4	73	Offer grass with dirt inside pouch	In room in house inside pouch at 28°C. <i>Exercise:</i> 5 minutes after each feed.
	160	226	142	970		85		

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds a day	Feed (mL/day)	Appearance and feeding	Housing	
Transition	162	231	145	1016	4	85	65 mL 0.6 + 20 mL >0.7	Intermediate housing: At pre-release yard. Outside for 1–2 hours a day with access to pouch. Inside in pouch without heating at night.	
	165	238	149	1085		85	40 mL 0.6 + 45 mL >0.7		
	168	245	153	1154		85	20 mL 0.6 + 65 mL >0.7		
>0.7	170	250	156	1200	4	85	Faeces: green toothpaste Starting to eat grass and hay offered outside pouch	Intermediate housing: At pre-release yard. Outside for 1–2 hours a day with access to pouch. Inside in pouch without heating at night.	
	180	275	169	1450		100	Hopping strongly for 30 min twice daily		
	190	302	180	1800		120	Emerging from pouch. Furred, not waterproof		
	200	330	191	2250	3	140	Faeces: soft and become formed over weeks		
	210	360	202	2750		155	Ready to lap milk and water.		
	220	393	211	3375		175	Eating grass, hay, pellets, browse		
	230	430	220	4100		205			
	240	467	227	4900		240			
									Outside during day. Locked into shed in yard at night.

Milk	Age (d)	Tail (mm)	Foot (mm)	Weight (g)	Milk feeds a day	Feed (mL/day)	Appearance and feeding	Housing
Weaning	250	Growth rate now about 75 g per day			2	240	Fully out of pouch	Pre-release housing: outside all day and night. Exposed to natural weather
	270				180	Faeces: formed green pellets Furred, waterproof		
	290	1			120	Start weaning		
	310	1			80	Finish weaning		
	330	1			40	Release weight		
	350	0			0			
							No supplements fed two weeks prior to release	

Figure 6.14 Joey foot measurement.



Photo credit: Zoos Victoria

6.9 Release protocol



Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome the animal.

6.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

- ☑ Individual is in a state of good health – presenting injury/sickness is completely resolved (consider a pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 6.1** and **Table 6.7**).
- ☑ Individual displays ability to actively forage and consume natural foods.
- ☑ Individual displays appropriate predator avoidance behaviour. For kangaroos and red-necked wallabies, if a predator approaches within 50 m of the mob, they should take flight. If unable to take flight, they should stop grazing, stand up facing the predator and watch its behaviour. Swamp wallabies should demonstrate increased vigilance and seek cover.

6.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered.



STOP – please refer to the conditions of your authorisation on release location requirements.

- ☑ Kangaroos should be transported and released in the early morning to reduce the risk of capture myopathy, while wallabies should be released at dusk.
- ☑ Avoid times when heavy rain and strong winds are forecast.
- ☑ Avoid release in summer when temperatures are expected to be greater than 38°C for more than three consecutive days.
- ☑ For more information on the ecological characteristics and requirements of macropods that may help with their release, please refer to **Section 6.1** of this chapter.

For more information on the ecological characteristics and requirements of macropods that may help with their release, please refer to **Table 6.1**.

6.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Approximate release where animal was found (where suitable, or within home range).
- ☑ Suitable vegetation is available, including grasses and dense lower storey vegetation.
- ☑ Away from major roads, fences and dams.

Release Procedure

- ☑ Limit the number of people at the release.

Release without ongoing support

- ☑ If the animal has been sedated for transportation, place it quietly on the ground in a bag until it has recovered.
- ☑ A non-sedated animal can be left partly in the bag in a shady area to permit itself to orient to the surroundings before being removed from the bag.
- ☑ Open the bag away from trees, fences or people.
- ☑ It is important that all people move and speak quietly.
- ☑ Observe the animal until it moves away.

Release using a temporary pen

- ☑ The pen can be constructed of Hessian cloth suspended by wooden poles.
- ☑ After acclimatisation, the gate to the temporary pen can be left open in the early morning and the animals move out in their own time.
- ☑ Permission from land holders should be sought prior to using this release technique.

6.10 Key references and additional reading

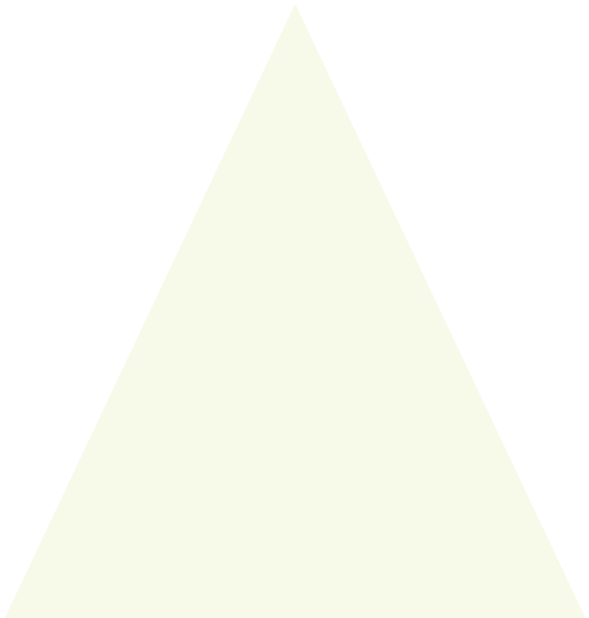
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Chapter 7. Microbats

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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here:

<https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.



STOP – If a threatened species comes into care, please STOP and refer to your authorisation for mandatory conditions including notification and release requirements.

The distribution of microbat species most likely to enter care in Victoria is shown in the species profiles at **Table 7.1**. The species of bat may be identified from a range of characteristics including the weight, forearm length, whether the tail is enclosed in the tail membrane, the colour of the fur and the shape of the ears and penis.

Identification can provide clues to distribution, natural diet, behaviour, roosting and the type of flight. All microbats have an insectivorous diet and roost in a variety of spaces, including natural caves, disused mines, tree hollows, under bark on trees, or in building roof or wall-spaces.

7.1 Introduction



A total of 23 species of insectivorous bats, also called microbats, are found in Victoria. These are distinguished from flying foxes by their smaller size and presence of a tail membrane. Variation in weight occurs with seasons. Hand-rearing of neonatal microbats is possible but requires expertise and experience.

Eastern horseshoe bats, bent-winged bats, southern long-eared bats and yellow-bellied sheath-tailed bats are listed as threatened in Victoria under the *Flora and Fauna Guarantee Act 1988*.

IMPORTANT: Australian bat lyssavirus (ABLV) has been identified in microbat species seen in Victoria. Microbat rescuers and rehabilitators are strongly recommended to be vaccinated against rabies to protect from ABLV, as detailed in the Australian Immunisation Handbook. The disease can be fatal in humans. It is important to always use appropriate protection when handling bats. Members of the public should not handle bats.


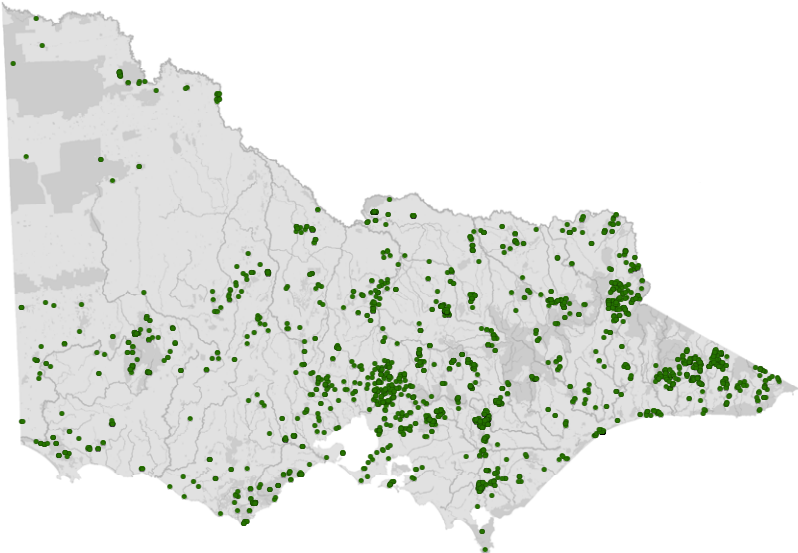
When microbats come into care it is the wildlife rehabilitator's responsibility to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition (**Section 7.7**) and an environment appropriate to the microbat's stage of rehabilitation (**Section 7.6**). The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

Some female microbats are able to store sperm from mating with the male over late autumn and winter before they become pregnant in spring. Bent-winged bat females do not store sperm but have delayed implantation. Any female brought into care after late autumn has the potential to become pregnant and give birth up to six or seven months later.

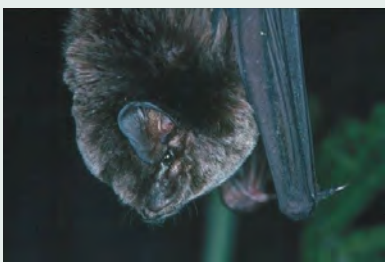
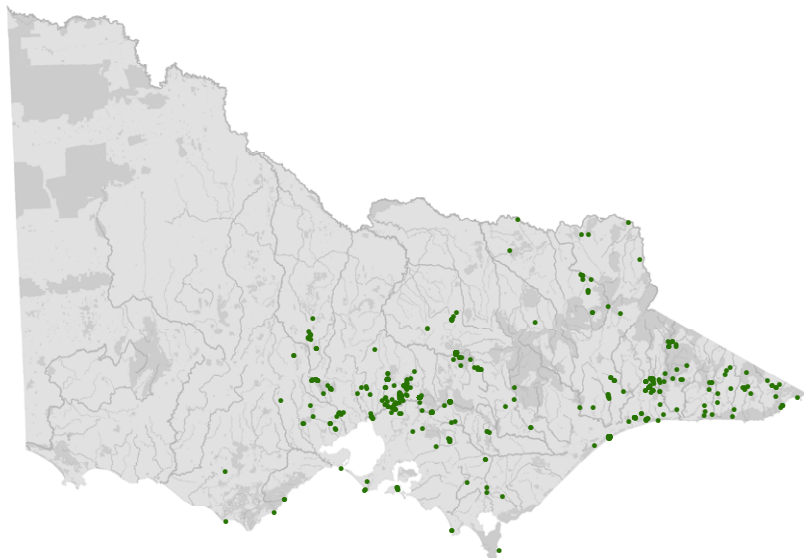
7.2 Species information

Profiles for the microbat species most likely to come into care and found in Victoria are detailed in **Table 7.1**. For assistance in identification of microbat species, refer to the recommended reading and reference material at the end of this chapter.


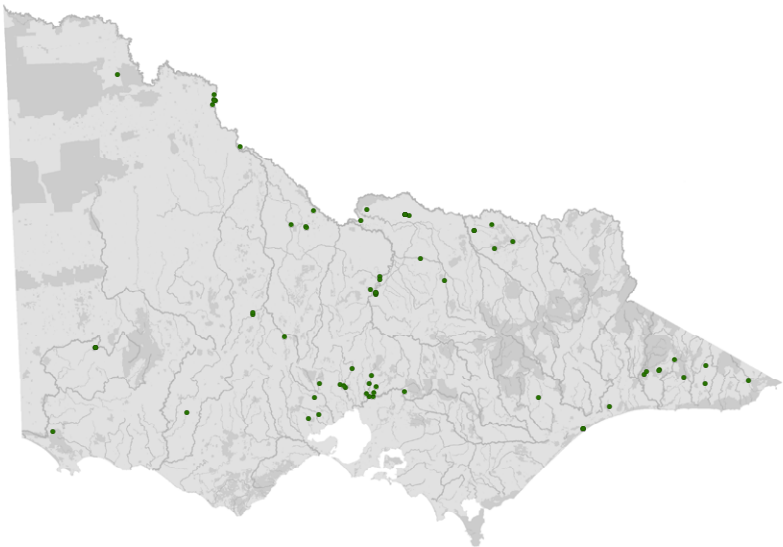
Table 7.1 Species profiles

Species	Chocolate wattled bat (<i>Chalinolobus morio</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Chocolate-coloured fur on back and belly. Fleshy lobes on the lower lip and between ear and mouth. They have a distinctively domed forehead</p>
<p>Conservation status*</p>	<p>Common</p>
<p>Adult morphometrics</p>	<p>Weight non-pregnant adult: 8–11 g Adult forearm length: 34–42 mm Tail length: 45–50 mm</p>
<p>Roost site</p>	<p>Tree hollow, building</p>
<p>Foraging: home range</p>	<p>Up to 10 km</p>
<p>Foraging style</p>	<p>Aerial, moderately fast flying</p>


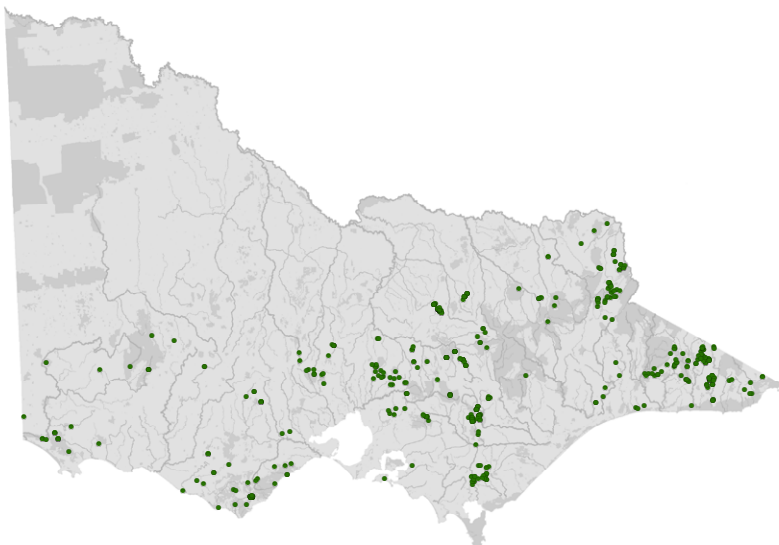
Species	Chocolate wattled bat (<i>Chalinolobus morio</i>)
Mating	April–May
Pregnancy	August–November
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	1 year

Species	Eastern bent-wing bat (<i>Miniopterus orianae oceanensis</i>)
 <p>Photo credit: Lindy Lumsden</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Short triangular ears; domed head; long third digit which is folded back on itself while roosting. The eastern bent-winged bat occurs in central and eastern Victoria. They do not commonly come into care and are frequently mistaken for chocolate wattled bats or Gould's wattled bats
Conservation status*	Critically endangered
Adult morphometrics	Weight non-pregnant adult: 11–16 g Adult forearm length: 46–51 mm Tail length: 52–58 mm
Roost site	Cave, mine

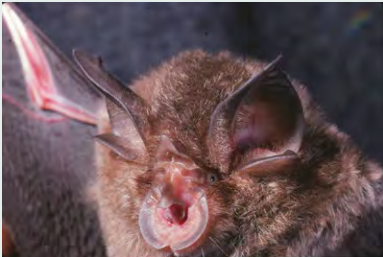
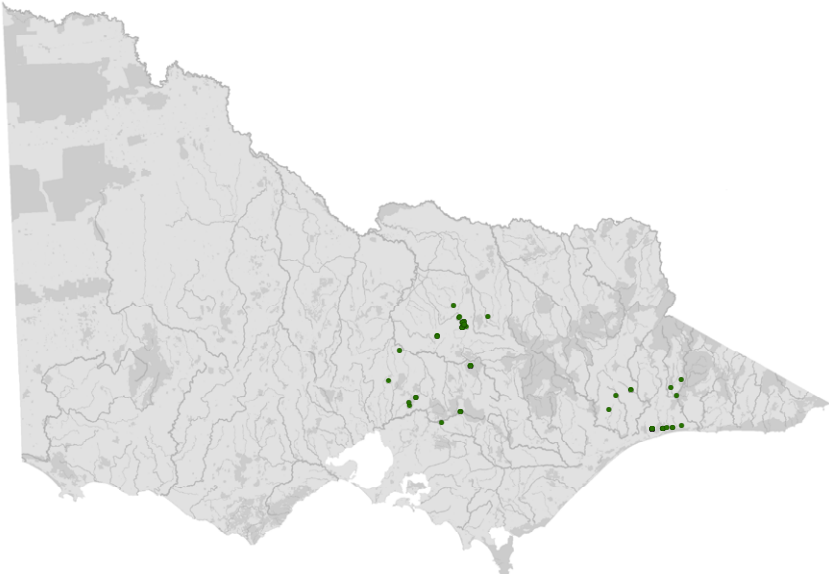
Species	Eastern bent-wing bat (<i>Miniopterus orianae oceanensis</i>)
Foraging: home range	Up to 35 km
Foraging style	Aerial, fast flying
Mating	May–June
Pregnancy	May–December
Lactating	November–December
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	2 years

Species	Eastern free-tailed bat (<i>Ozimops ridei</i>)
 <p>Photo credit: Lindy Lumsden</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Chocolate brown above, slightly paler below. Ears triangular. Upper lip overhangs lower lip. Penis length less than 5 mm. Tail bone extends beyond the end of the tail membrane
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 8–13 g Adult forearm length: 31–35 mm Tail length: 28–34 mm
Roost site	Tree hollow, building


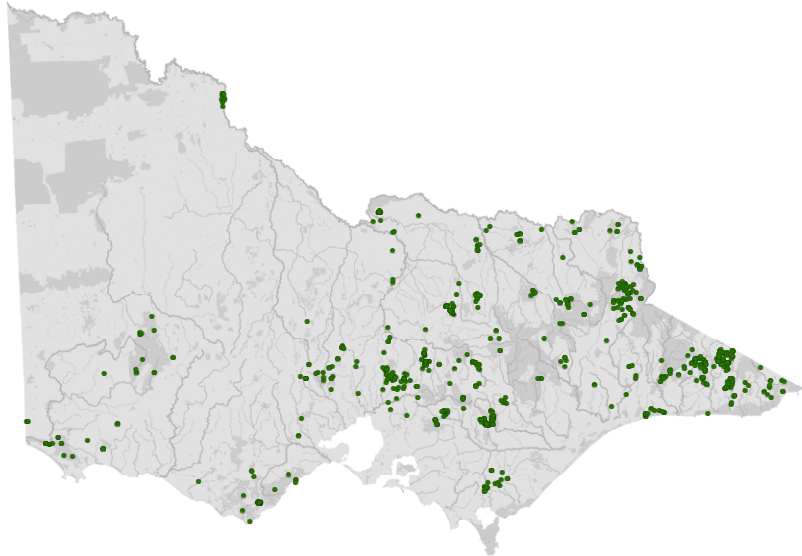
Species	Eastern free-tailed bat (<i>Ozimops ridei</i>)
Foraging: home range	Up to 15 km
Foraging style	Aerial, fast flying
Mating	April–August
Pregnancy	September–December
Lactating	December–February
Young dependent	February–March
Age at independence	2–3 months
Age at sexual maturity	1–2 years

Species	Eastern falsistrelle (<i>Falsistrellus tasmaniensis</i>)
 <p>Photo credit: Lindy Lumsden</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	The eastern falsistrelle is a large bat with a simple, dog-like face and a broad nose
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 16–28 g Adult forearm length: 45–56 mm Tail length: 40–52 mm


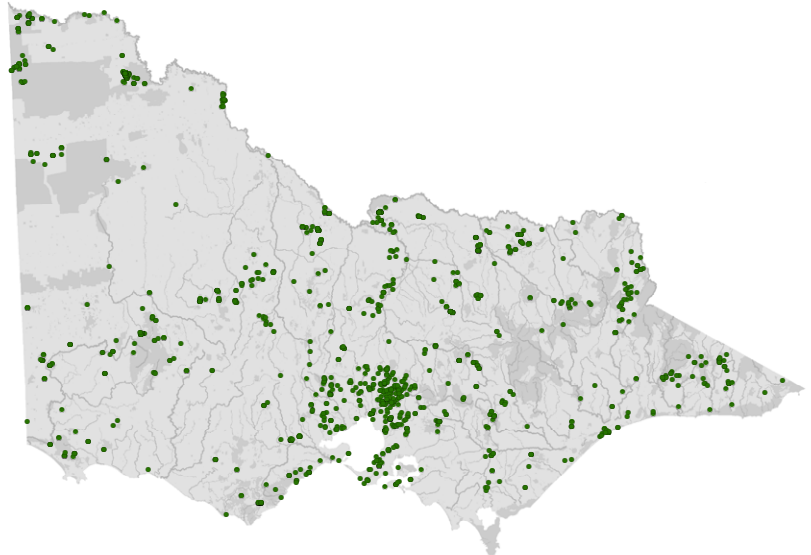
Species	Eastern falsistrelle (<i>Falsistrellus tasmaniensis</i>)
Roost site	Tree hollow
Foraging: home range	Up to 15 km
Foraging style	Aerial, moderately fast flying
Mating	April–May
Pregnancy	August–November
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	1 year

Species	Eastern horseshoe bat (<i>Rhinolophus megaphyllus megaphyllus</i>)
 <p>Photo credit: Lindy Lumsden</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Long, broad ears and distinctive horse-shoe shaped nose leaf
Conservation status*	Endangered
Adult morphometrics	Weight non-pregnant adult: 10–13 g Adult forearm length: 45–52 mm Tail length: 38–43 mm

Species	Eastern horseshoe bat (<i>Rhinolophus megaphyllus megaphyllus</i>)
Roost site	Cave, mine
Foraging: home range	Up to 3 km
Foraging style	Aerial, slow–moderate flying
Mating	May–July
Pregnancy	July–November
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	2–3 years

Species	Gould's long-eared bat (<i>Nyctophilus gouldi</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Gould's long-eared bat can be distinguished from the lesser long-eared bat by its slightly larger size and T-shaped nose leaf. In the far northwest of Victoria there is a third species of long-eared bat: the threatened south-eastern long-eared bat <i>Nyctophilus corbeni</i>
Conservation status*	Common

Species	Gould's long-eared bat (<i>Nyctophilus gouldi</i>)
Adult morphometrics	Weight non-pregnant adult: 9–13 g Adult forearm length: 40–48 mm Tail length: 45–55 mm
Roost site	Tree hollow, under bark
Foraging: home range	Up to 10 km
Foraging style	Aerial as well as taking invertebrates off foliage and/or the ground, highly manoeuvrable
Mating	April–June
Pregnancy	August–November
Lactating	October–January
Young dependent	December–February
Age at independence	2–3 months
Age at sexual maturity	1 year

Species	Gould's wattled bat (<i>Chalinolobus gouldii</i>)
 <p>Photo credit: Lindy Lumsden</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>

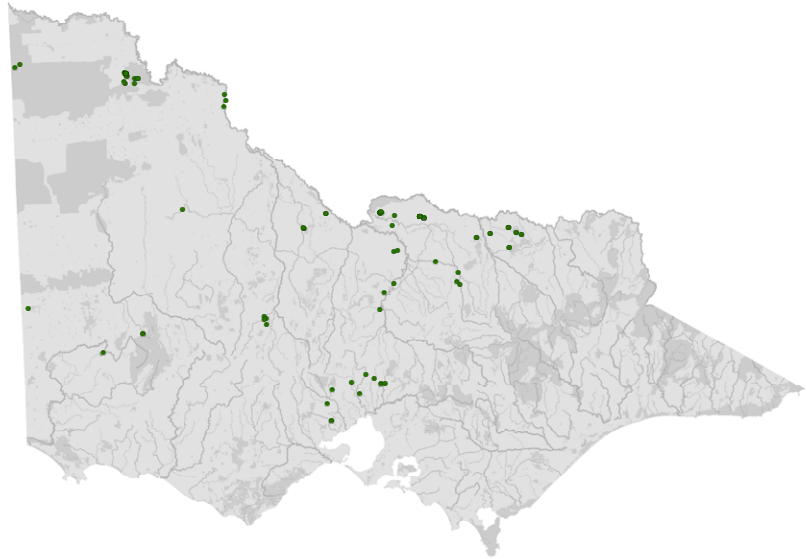
Species	Gould's wattled bat (<i>Chalinolobus gouldii</i>)
General appearance	The black fur on the head and shoulders contrasts with brown fur on the rest of the bat and is distinctive for this species. In NW Victoria there is another species of wattled bat, the little pied bat <i>Chalinolobus picatus</i>
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 10–20 g Adult forearm length: 37–47 mm Tail length: 40–50 mm
Roost site	Tree hollow, building
Foraging: home range	Up to 15 km
Foraging style	Aerial, moderately fast flying
Mating	April–July
Pregnancy	September–November
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	1 year

Species

Inland broad-nosed bat (*Scotorepens balstoni*)

Photo credit: Lindy Lumsden

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

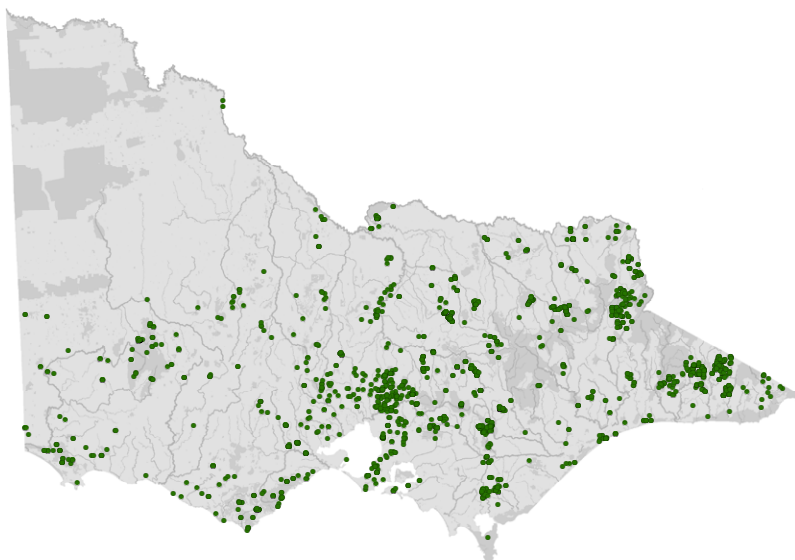
General appearance	This species (and the closely related eastern broad-nosed bat <i>Scotorepens orion</i> from eastern Victoria, and the little broad-nosed bat <i>S. greyii</i> from far NW Victoria) have a broad bare muzzle and short dense fur
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 7–14 g Adult forearm length: 32–41 mm Tail length: 29–42 mm
Roost site	Tree hollow, building
Foraging: home range	Up to 15 km
Foraging style	Aerial, moderately fast flying
Mating	April–June
Pregnancy	September–December
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	1 year

Species

Large forest bat (*Vespadelus darlingtoni*)

Photo credit: Lindy Lumsden

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

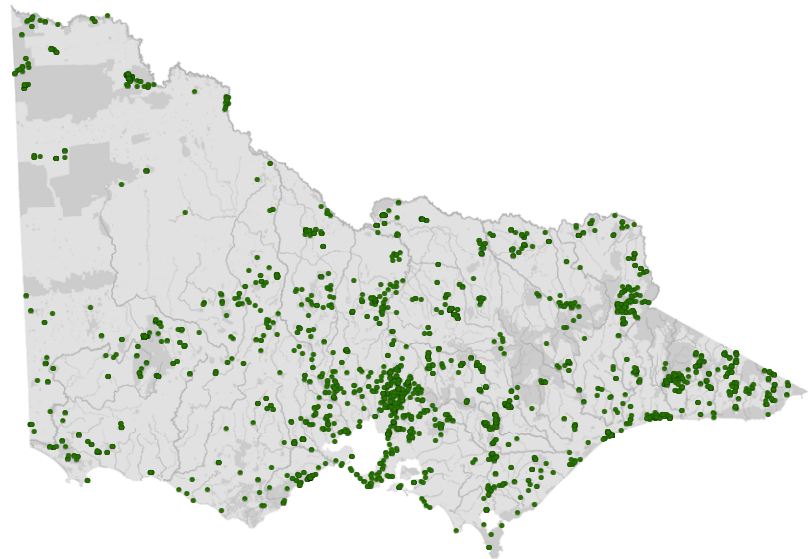
General appearance	The large forest bat is slightly larger than the other two species of forest bats and has darker fur that is uniform in colour over the body
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 6–10 g Adult forearm length: 32–37 mm Tail length: 32.4–38.6 mm
Roost site	Tree hollow, building
Foraging: home range	Up to 8 km
Foraging style	Aerial, slow to moderate flying
Mating	April–June
Pregnancy	August–December
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	1 year

Species

Lesser long-eared bat (*Nyctophilus geoffroyi*)

Photo credit: Lindy Lumsden

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance	The smallest of the Victorian long-eared bat species. Long ears, grey back fur with pale belly, Y-shaped groove on muzzle
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 6–12 g Adult forearm length: 32–41 mm Tail length: 31–40 mm
Roost site	Tree hollow, under bark, building
Foraging: home range	Up to 13 km
Foraging style	Aerial as well as taking invertebrates off foliage and/or the ground, highly manoeuvrable
Mating	April–June
Pregnancy	August–November
Lactating	October–January
Young dependent	December–February
Age at independence	2–3 months
Age at sexual maturity	1 year

Species

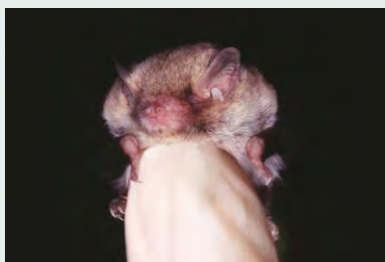
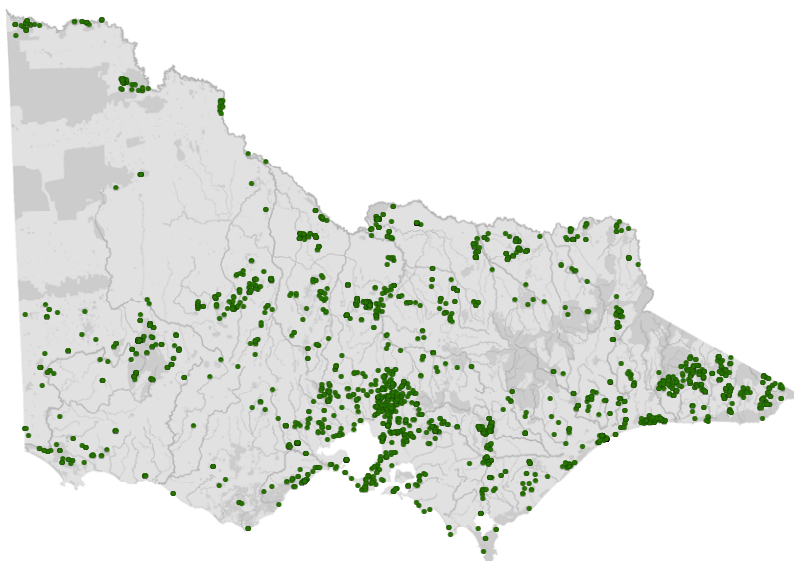
Little forest bat (*Vespadelus vulturnus*)

Photo credit: Lindy Lumsden

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

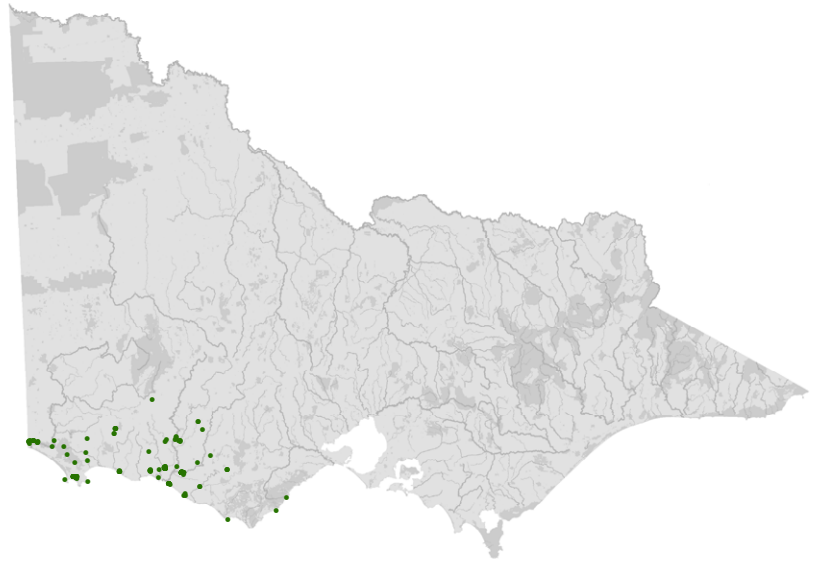
General appearance	Long, grey-brown fur, bicoloured. The little forest bat is the smallest Victorian species, shown here in relation to the size of a thumb
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 3–6 g Adult forearm length: 25–31 mm Tail length: 27–35 mm
Roost site	Tree hollow, building
Foraging: home range	Up to 8 km
Foraging style	Aerial, slow to moderate flying
Mating	March–July
Pregnancy	September–December
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	1 year

Species

Southern bent-winged bat (*Miniopterus orianae bassanii*)

Photo credit: Emmi van Harten

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

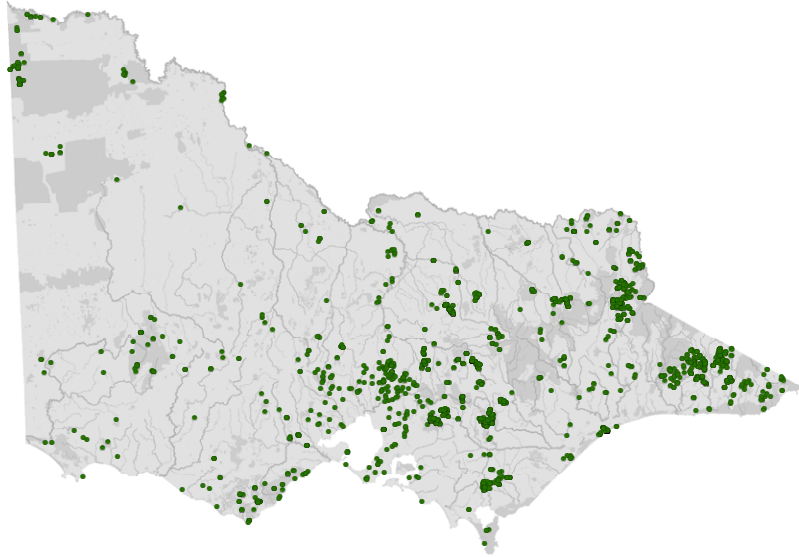
General appearance	Short triangular ears, domed head, long third digit which is folded back on itself while roosting. Often misidentified as an eastern bent-winged bat
Conservation status*	Critically endangered
Adult morphometrics	Weight non-pregnant adult: 11–18 g Adult forearm length: 45–50 mm Tail length: 52–58 mm
Roost site	Cave
Foraging: home range	Up to 70 km
Foraging style	Aerial, fast flying
Mating	May–June
Pregnancy	May–December
Lactating	November–January
Young dependent	January–March
Age at independence	2–3 months
Age at sexual maturity	2 years

Species

Southern forest bat (*Vespadelus regulus*)

Photo credit: Lindy Lumsden

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

Long, often rufous fur; two-toned fur with dark base. The southern forest bat (and the closely related inland forest bat *Vespadelus baverstocki* from far NW Victoria) can have a sandy or red fur colour

Conservation status*

Common

Adult morphometrics

Weight non-pregnant adult: 4–7 g

Adult forearm length: 28–34 mm

Tail length: 28–39 mm

Roost site

Tree hollow, building

Foraging: home range

Up to 8 km

Foraging style

Aerial, slow to moderate flying

Mating

April–June

Pregnancy

August–December

Lactating

November–January

Young dependent

January–March

Age at independence

2–3 months

Age at sexual maturity

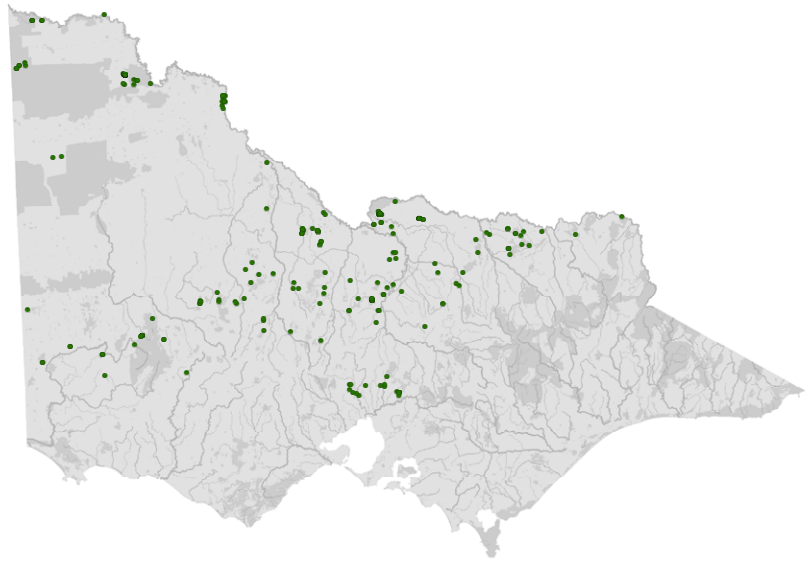
1 year

Species

Southern free-tailed bat (*Ozimops planiceps*)

Photo credit: Lindy Lumsden

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

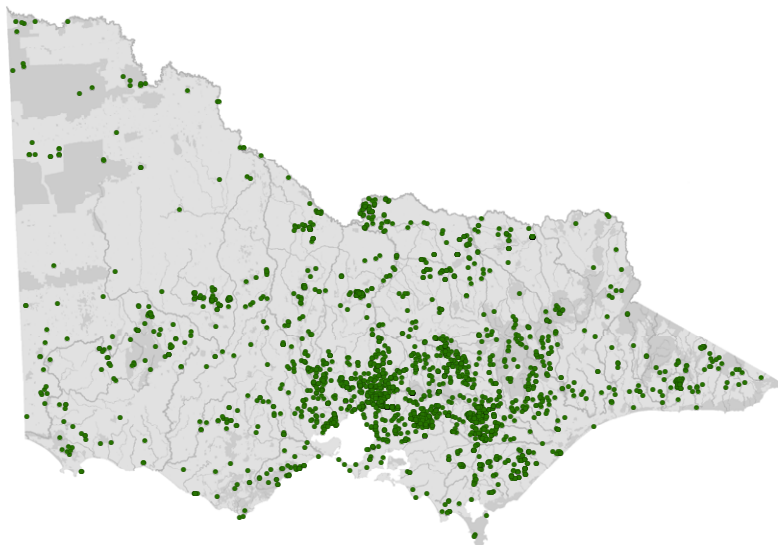
General appearance	The tail bone extending beyond the tail membrane is the distinguishing feature of the free-tailed bats (including the closely related inland freetail bat <i>Ozimops petersi</i> from NW Victoria). The southern freetail bat often gets called the long penis form due to its 9–10mm long penis
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 7–13 g Adult forearm length: 32–35 mm Tail length: 27–36 mm
Roost site	Tree hollow, building
Foraging: home range	Up to 15 km
Foraging style	Aerial, fast flying
Mating	April–August
Pregnancy	September–December
Lactating	December–February
Young dependent	February–March
Age at independence	2–3 months
Age at sexual maturity	1–2 years

Species

White-striped free-tailed bat (*Austronomus australis*)

Photo credit: Lindy Lumsden

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

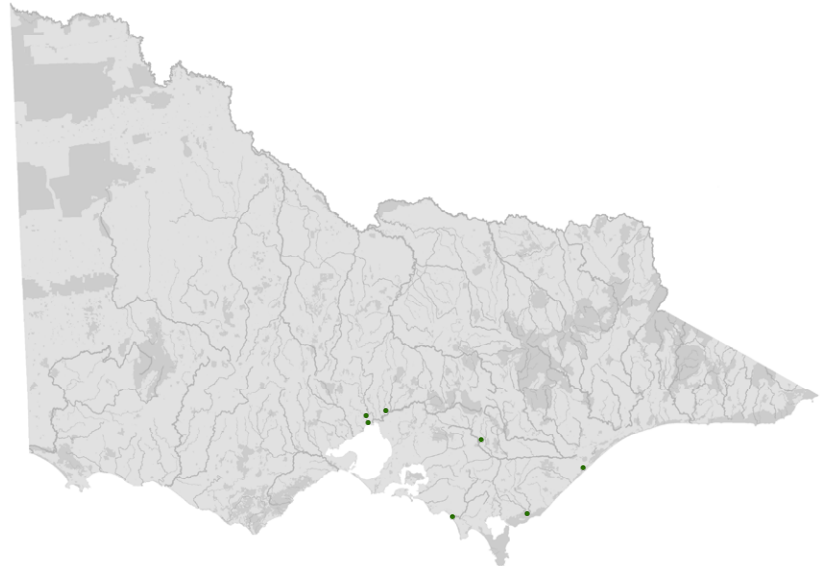
General appearance	Large, black fur on back; white stripes on belly where wings join; tail extends beyond membrane. Large, rounded ears, wrinkled lips and white stripes either side of the belly
Conservation status*	Common
Adult morphometrics	Weight non-pregnant adult: 30–40 g Adult forearm length: 57–67 mm Tail length: 40–55 mm
Roost site	Tree hollow
Foraging: home range	Up to 20 km
Foraging style	Aerial, fast flying
Mating	August
Pregnancy	August–December
Lactating	December–February
Young dependent	February–March
Age at independence	2–3 months
Age at sexual maturity	1–2 years

Species

Yellow-bellied sheath-tailed bat (*Saccolaimus flaviventris*)

Photo credit: Lindy Lumsden

Distribution Map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance	The yellow-bellied sheath-tailed bat is unusual in having jet black fur on the back and white or cream fur on the belly. It is the largest microbat in Victoria. Tail extends beyond membrane. Most Victorian records are of individuals coming into care
Conservation status*	Vulnerable
Adult morphometrics	Weight non-pregnant adult: 30–60 g Adult forearm length: 65–82 mm Tail length: 20–35 mm
Roost site	Tree hollow
Foraging: home range	Up to 20 km
Foraging style	Aerial, fast flying
Mating	August–November
Pregnancy	December–March
Lactating	January–May
Young dependent	March–June
Age at independence	2–3 months
Age at sexual maturity	1–2 years

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>

7.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for microbats is in this chapter.

The following information relates to the human and animal health and safety considerations specifically related to the rehabilitation of microbats.

7.3.1. Human safety considerations

- Australian bat lyssavirus (ABLV) has been detected in the yellow-bellied sheath-tailed bat. Antibodies have been detected in a range of other species of microbats. Therefore, all Australian microbats should be considered susceptible to infection with this virus. ABLV is closely related to rabies and can infect humans. Infection is potentially fatal. Three human deaths have occurred in Australia at the time of publication, one of which was due to a microbat. Only wildlife rehabilitators that follow the Australian Immunisation Handbook guidelines for rabies vaccination, booster vaccination and titre testing, and are using appropriate personal protective equipment and are experienced should handle bats.
- The Australian Immunisation Handbook (<https://immunisationhandbook.health.gov.au/recommendations/people-with-ongoing-occupational-exposure-to-lyssaviruses-are-recommended-to-receive-booster-doses-of-rabies-vaccine>) provides guidance about antibody titres and booster vaccinations to ensure on-going protection against ABLV. Please refer to this handbook along with consultation from your GP for advice on maintaining antibody titres and the need for rabies vaccination boosters.
- Prior to handling, cover any cuts and abrasions with dressings and disposable gloves. ABLV transmission occurs through a bite or scratch, or infected saliva contacting a wound or mucous membrane. Flying

foxes can carry other diseases that infect humans. These have not been documented in Australian microbats. As a precaution, wildlife rehabilitators should avoid contact with urine, faeces or birth fluids from all bat species, by wearing gloves when handling bats.

- The public should not handle bats. Instruct them to place a cardboard box over the bat and wait until a vaccinated wildlife rehabilitator arrives. All microbats should be regarded as potentially infected with ABLV and handled with caution.
- In the event of a bat bite, scratch or saliva contamination of a wound:
 - Seek medical attention immediately. Post-exposure treatment may be required.
 - Wash the affected area thoroughly with soap and copious amounts of water for fifteen minutes.
 - Apply a virucidal antiseptic to the area: povidone-iodine, iodine tincture, aqueous iodine solution or alcohol (ethanol).
- ABLV can also be transmitted to other animals. Prevent pets and other animals from coming into contact with bats. If an animal might have been bitten or scratched by a bat, contact Agriculture Victoria or call the Emergency Animal Disease Watch Hotline on 1800 675 888.
- ABLV is discussed further in Part A, Chapter 4, Biosecurity and Hygiene, in these guidelines.

7.3.2. Animal safety considerations

Microbats should be transported at temperatures below 25°C. Their thermoneutral zone is 30–35°C. At higher temperatures microbats become heat stressed.

7.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 7.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned microbats.

7.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 7.2 Visual health observations in microbats

What to look for	
Demeanour	<ul style="list-style-type: none"> Bright, alert if not in torpor. Horseshoe bats swivel ears in response to sound. Bat follows movement with eyes
Behaviour	<ul style="list-style-type: none"> Active at night
Movement and posture	<ul style="list-style-type: none"> Hangs upside down if provided with a vertically hung towel on which to cling Holds both wings close to the body with shoulders at the same height Coordinated movement
Breathing	<ul style="list-style-type: none"> Observe the bat without disturbing it. Breathing should be fast but regular Panting or open mouth breathing is abnormal and may indicate respiratory distress or overheating (not to be confused with an alert bat that has its mouth open because it is echolocating)

7.4.2. Equipment

- **PPE:** Refer to the Wildlife Health Australia document, "Personal Protective Equipment (PPE) Information for Bat Handlers": https://www.wildlifehealthaustralia.com.au/Portals/0/Documents/ProgramProjects/PPE_Info_for_Bat_Handlers.pdf.
- **Gloves:** Fine leather gloves, nitrile gloves or fine cloth gloves should be worn when handling the smallest species of microbats for identification and examination as they should prevent a bite from breaking the skin. Be aware that larger species of microbats may have a stronger bite so thicker handling gloves will be needed.
- **Catch bag:** Microbats can be restrained and transported in a calico bag or small joey pouch, in sizes such as: 0.15 m (L) x 0.15 m (W). Use calico bags with the seams on the outside and check they have no loose threads to entangle feet or wings. Each bag should be tied securely at the top.
- **Transport container:** The calico bag can be placed inside a solid container, such as a cardboard box or small pet carrier. Suggested dimensions are at least 0.2 x 0.2 m (0.04 m²) x 0.2 m (H) (See **Figure 7.1**).
- **Callipers:** Used to measure the forearm length for species identification (See **Figure 7.2**).
- **Scales:** Scales accurate to 0.1 g are used to weigh microbats. This will assist in species identification and monitoring weight throughout care.

Figure 7.1 Example of a microbat transport container.



Photo credit: Zoos Victoria

7.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

- Cup the bat loosely in the hand with the thumb covering the back and the head, but without putting any pressure on the head (See **Figure 7.2**). The bat typically sits quietly in this position as it feels secure being enclosed, and rarely attempts to bite. Areas for examination can then be exposed. Horseshoe bats tend to become stressed more easily than other species and need to be handled very gently and quietly.
- When yellow-bellied sheath-tailed bats come into care they can appear calm and quiet, but this can be a sign of extreme stress. They often have a wide-eyed look with a blue ring apparent around the eyes. They need to be kept in a quiet, low stress environment.
- Rescued microbats can be given a glucose slurry (Glucodin Powder: 1 tablespoon into 10 mL water) as stressful situations can cause their blood glucose to drop and hypoglycaemia to occur. Glucose is readily absorbed through the gums, so the bat does not have to swallow the slurry to benefit.

Figure 7.2 Restraint of a microbat for forearm length measurement using callipers. Bats sit calmly if enclosed with no pressure, especially if their feet are able to grip onto something.



Photo credit: Lindy Lumsden

Inside a building

Microbats are sometimes discovered inside houses. They may be roosting in the roof or wall space and enter through small gaps. During winter they may be in torpor. This is a state of lowered metabolism and body temperature that microbats can adopt when the weather is cold, in order to conserve energy. Bats in torpor will appear sluggish and poorly responsive. If the microbat is inactive, it can be picked up using a calico bag which is then turned inside-out over the microbat. These bats should be examined and, if required, treated for dehydration (See **Section 7.5.4**). If the microbat is uninjured, it should be released at the same location on the same or following evening.

Microbats can also fly into a house while foraging. The bat should be encouraged to fly out by opening doors and windows, turning the lights down inside, and turned on outside. Then let it find its own way out. If the microbat lands on a curtain, it can be picked up using a calico bag or tea towel and taken outside.

Microbats have distinct home ranges that include regular roosting sites and are likely to return to the roost site within the house again. Blocking any gaps allowing the bats access to the inside of the house can often solve the problem. However, if still causing concerns, microbats can be excluded from roosting in a roof or wall space by finding the exit point and blocking it using a 'bat sleeve'. This is made from a black plastic bag that is taped around the opening, leaving a tube of plastic that the microbat can exit from but cannot crawl back up into upon return. The microbats will then use another roost nearby. The exit point should be permanently closed at a later stage, once it is certain that all microbats have left the roost. This should not be undertaken during the breeding season when young are left inside the roost (October to February), or when bats enter periods of torpor (May to September).

On the ground

Any microbat found on the ground or in an exposed position outside requires assessment. Young bats that are learning to fly will sometimes crash to the ground. Adults are found on the ground, with or without obvious injuries, due to predation, accidental injury, vehicle trauma, or exhaustion. They will require a veterinary assessment. Bats on the ground can be picked up using a calico bag turned inside-out over the microbat. Gloves should be worn when capturing microbats as animals affected with ABLV may also be found on the ground.

Roost disturbance

One or more bats may be discovered inside disturbed roost sites like lopped tree limbs or firewood piles. These bats should be captured, examined and, if required, treated for dehydration (see **Section 7.5.4**) and injuries.

They may also just be in torpor. If uninjured, release the bat on the same evening at the same location. Bats typically have multiple roost sites, so the animal is likely to return to an undisturbed site within its home range.

Stuck on fly strips

Microbats can be found caught on adhesive fly strips. Unless these microbats are found soon after becoming stuck, they quickly become dehydrated and use up their energy reserves. The animal will need to be removed from the fly strip with an adhesive solvent, such as Zoff or De-Solv-It. All adhesive removers should then be washed off with a gentle, unscented baby shampoo. This procedure will need to be performed under anaesthesia by a veterinarian to reduce the risk of injury to the microbat. These animals will require veterinary assessment and fluids (See **Section 7.5.4**). Their chances of survival are related to the length of time they were stuck to the strip. All bats removed from fly paper should be kept in care until recovery and normal flight observed.

The sale and use of sticky insect traps that are not confined to protective cages is now illegal in Victoria. Glue traps should be removed and reported to Animal Welfare Victoria if used at commercial premises (<https://agriculture.vic.gov.au/livestock-and-animals/animal-welfare-victoria/pocta-act-1986/humane-vertebrate-pest-control/glue-traps>).

7.4.4. Transport

- Transport microbats individually.
- Microbats can be transported in a bag placed in a solid container, or loose in the solid container. If the microbat is loose in the container, a towel should be placed on the floor to give the bat something to grip and all food and water containers should be removed, as well as any bigger items such as bark or wood.
- Secure the container in the vehicle so that it cannot slide or roll over.
- It is not necessary to provide water or food when transporting microbats.
- In hot weather, transport the bat in an air-conditioned vehicle.

7.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care through minimising human-animal interactions and stress to the animal to maximise successful release back to the wild.

7.5.1 Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or an injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording physical examination findings can be found in the appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from any domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation, or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examination of microbats can be challenging because of their small size.
- For human safety reasons and to minimise stress in the microbat, only a relatively quick examination will be possible. More detailed examinations require the animal to be anaesthetised.
- Gloves should be worn.
- The microbat should be cupped in the hand, as described in **Section 7.4.2**. With the other hand extend the wings and legs and check for tears, exposed bone and obvious fractures.

- Check the fur for saliva or blood, which may be indicative of a predator bite wound.
- The forearm length assists in the identification of the microbat. Measure the distance between the elbow and wrist (See [Section 7.4.2](#)).
- The age of the bat is determined by looking for the presence of growth plate bands in the joints between the finger bones as shown in [Figure 7.3](#). Microbat age should not be determined by coat length or size. Juvenile microbats grow extremely fast and can reach 90–95% of adult size and 70% of adult weight by four to seven weeks of age, but will not be weaned. They are virtually adult size once they start flying. Microbat age classes are shown in [Table 7.3](#).

Figure 7.3 Ageing microbats by examining the bands of cartilage on the finger bones, reproduced with permission of Lindy Lumsden.

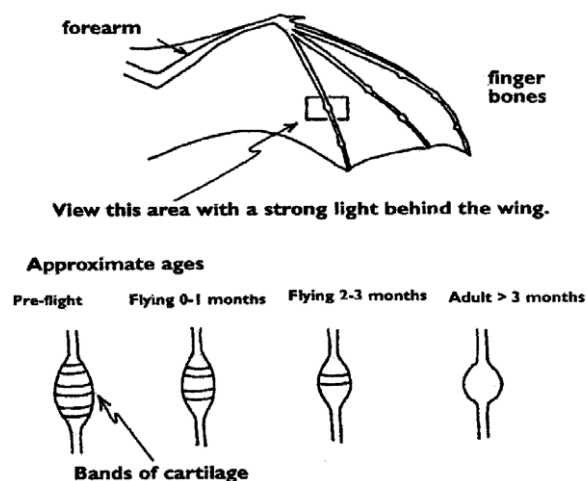


Table 7.3 Age classes

Age class	Wing bones	Teeth	Nipples
Adult	No cartilage between bones; joints are round and white	May be worn	Likely to have large nipples
Sub-adult	Small band of cartilage; joint elongated	Unworn	Tiny nipples
Juvenile	Large bands of cartilage between bones; joints elongated; increased blood supply to joints making the area appear redder	Unworn	Tiny nipples

Table 7.4 Physical examination of microbats

What to look for	
Body weight	<p>See species profiles (Table 7.1) for healthy weight range for microbat species.</p> <ul style="list-style-type: none"> • Record body weight on arrival and at least weekly while in care. • A greater than 10% decrease in body weight over a week is cause for concern, and the carer should seek veterinary advice immediately.

What to look for	
Body condition	<p>Body condition is scored by palpating the scapula, its spine and adjacent muscles. Palpation of the pectoral muscles can also provide an indication of body condition. Body condition scoring needs to take time of year into consideration. Wild bats can gain up to almost 50% of their body weight in autumn in readiness for winter. This is a natural process and provides the bats with sufficient fat and energy reserves to survive until spring. Bats released in autumn should be in the 'over condition' category.</p> <p>Body condition can be described as follows:</p> <ul style="list-style-type: none"> • Under condition: Concave muscles either side of the scapular spine, which is easily felt. The bat's body has an hourglass shape when viewed from above. • Ideal condition: Flat muscles either side of the scapular spine, which is just palpable. • Over condition: Curved muscle mass on either side of the scapular spine, which is difficult to feel.
Hydration status	<ul style="list-style-type: none"> • Skin tent between the shoulder blades falls down within 1 second. The wing membrane should appear glossy.
Eyes	<ul style="list-style-type: none"> • Bright, open, symmetrical.
Ears	<ul style="list-style-type: none"> • No tears.
Mouth	<ul style="list-style-type: none"> • Pink gums.
Wing membrane	<ul style="list-style-type: none"> • Feels soft and supple. Small holes are normal. Dark surface.
Limbs, feet, and tail	<ul style="list-style-type: none"> • Able to hold wings close to body. Hangs with both feet. Coordinated movement.
Sex determination	<ul style="list-style-type: none"> • The sex of the microbat is determined based by the presence or absence of a penis.
Anus	<ul style="list-style-type: none"> • Healthy but captive bats may urinate or defaecate on themselves.
Ability to fly	<ul style="list-style-type: none"> • Bat should be able to fly continuously, maintaining height and manoeuvring easily (assuming the bat is warm, and the space is large enough).

Figure 7.4 Examining the wing of an eastern bent-wing bat.



Photo credits: Zoos Victoria

Figure 7.5 Assessing body condition.



Photo credits: Zoos Victoria

7.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Time your health and welfare observations for times of the day when the animal is expected to be active, which is late afternoon and into the evening.
- If the animal is being medicated, a visual check in the morning when the microbat is least active is recommended. The microbat should be observed at least daily.
- Ideally physical observations should be undertaken at the beginning and/or end of the resting period (from dawn to late afternoon) to minimise disturbance and maximise the rest/sleep period for healing and ensure ease of capture.
- Note the microbat's demeanour and behaviour every time food is introduced or taken away, the animal is medicated or the enclosure is cleaned. Pay particular attention to any changes that have occurred since the previous day.
- The use of infra-red cameras can allow monitoring of behaviour overnight.
- Be alert for signs of self-trauma. Microbats tend to chew sutures, bandages and damaged parts of their wings or legs.
- Check wings daily for any sliminess or excessive moisture or trauma to the extremities, particularly over the wrists and ends of the digits.

7.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 7.5 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 7.5 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Injury or clinical signs	Possible causes	Carer observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to fly, fracture, drooping wing, swollen wing, bruising over wing, dislocation, head trauma, wing membrane tears, bleeding, exposed bone on digits</p>	<p>Netting entanglement, window collision, found adjacent to road/suspect motor vehicle accident</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Do not attempt to stabilise fractures as this is very painful, and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical examination, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Exposed bone on digit tips must not be trimmed without general anaesthesia and veterinary assessment. • The wing membrane of microbats heals readily without treatment (Figure 7.6). Do not tape or attempt to sew the hole closed as this causes ripping and further damage. If the hole in the membrane is small and there are no other injuries the bat can be released immediately. If the hole is large, or the membrane is ripped, the microbat will need to remain in care until the wing membrane repairs sufficiently to allow flight. This may take from two weeks to two months. A small amount of pure vitamin E oil can be applied to the edges of membrane holes to prevent the healing edge constricting.

Injury or clinical signs	Possible causes	Carer observations and response
(continued)	Netting entanglement, window collision, found adjacent to road/suspect motor vehicle accident	<ul style="list-style-type: none"> • Optimum environmental temperature and nutrition are required to prevent the bat entering torpor, as this will delay healing. • The animal should be reassessed throughout rehabilitation to ensure healing is progressing as expected and is tolerating the time in care. • Flight training will be required to complete the rehabilitation process for broken bones.
Bite wounds, bleeding, bruising	Predator attack, motor vehicle trauma, window strike	<ul style="list-style-type: none"> • Urgent veterinary attention is required. • While bite wounds/scratches may not be immediately obvious, these carry a poor prognosis and animals often present moribund, that is they are lethargic, poorly responsive and cold. Animals in this condition must be urgently assessed by a veterinarian. • Look for small clumps of dried fur stuck together with saliva, part the fur and look for small puncture wounds. • Treatment with antibiotics is crucial for cat attack victims and veterinary assessment is time critical: begin this treatment as soon as possible - as prescribed by a veterinarian.
Neurological signs, aggression, inability to fly	Australian Bat Lyssavirus (ABLV) infection, toxoplasmosis, poisoning, head trauma	<ul style="list-style-type: none"> • Urgent veterinary attention is required. • Animals presenting with any of these signs should be urgently assessed by a veterinarian. This is because there can be a wide range of causes and there is the additional risk of ABLV infection. ABLV is a notifiable disease and affected microbats are likely to die. Contact Agriculture Victoria or call the Emergency Animal Disease Watch Hotline on 1800 675 888. For additional information consult the Wildlife Health Australia ABLV fact sheet: https://wildlifehealthaustralia.com.au/Portals/0/Documents/FactSheets/mammals/Australian_Bat_Lyssavirus.pdf • If multiple animals are seen with similar signs, this may indicate a newly emerging infectious disease or a toxicity (such as plant toxicity or poisoning). Contact the Emergency Animal Disease Watch Hotline on 1800 675 888 to report concerns. • If unusual toxicity or infection is suspected, you or your veterinarian can contact Zoos Victoria's veterinary departments to discuss options for disease investigation.

Injury or clinical signs	Possible causes	Carer observations and response
Skin irritation/fur loss	Excessive mite or bat fly infestation, bacterial or fungal infection	<ul style="list-style-type: none"> • Seek veterinary assessment. • A small number of mites and/or bat flies can be normal, and do not require treatment or removal. However, if many mites and/or bat flies are seen, the animal is scratching/irritated, or the skin is red and inflamed, seek veterinary attention.
Lethargy, tacky skin	Dehydration	<ul style="list-style-type: none"> • Animals presenting may benefit from offering of oral fluids. This may be cooled boiled water or oral rehydration fluids such as Vytrate, Lectade (Jurox), Gastrolyte, or Spark (Vetafarm) with a syringe into the corner of the mouth. Bats should not be given oral fluids unless they appear keen to drink. • If an animal is not keen to drink, do not persist. • Allow the animal to settle and try again later. Microbats are likely to be more responsive to oral fluids once warmed. Cold animals are unlikely to drink. • Moderately to severely dehydrated animals should be assessed by a veterinarian as soon as possible.
Juvenile bat on the ground	Orphan	<ul style="list-style-type: none"> • Orphaned bats must be assessed for injury, dehydration and illness. • It is not possible to return a cave dwelling orphan to the colony as this will severely disturb the colony. In many cases the cave ceiling will be too high to access. • It may be possible to return a tree or building dwelling orphan to its roost. The pup should be monitored to ensure that its mother accepts it. Otherwise the orphan will need to be hand raised.

Figure 7.6 Tear in the wing membrane of a microbat.



Photo credit: Lindy Lumsden

Figure 7.7 Microbat bone fracture.



Photo credit: Zoos Victoria

Figure 7.8 Bat fly on a southern bent-wing bat.



Photo credit: Zoos Victoria

7.5.4. Administering treatment during rehabilitation

- Due to the small size of the bat, it is difficult to change dressings under manual restraint. It will be easier and less stressful if the bat is anaesthetised by a veterinarian for dressing changes. Appropriate pain relief and careful bandaging is required to reduce the risk of self-trauma (bats chewing or licking wounds), which is more likely to occur if the bandage is too tight or inappropriately applied.
- Oral medications can be delivered in a syringe directed into the side of the mouth while the bat is restrained. Care and protective gloves are required to avoid being bitten.
- Injectable medications can be administered under the skin, between the shoulder blades. Only experienced carers should give injections.

7.6 Housing

Below are several key considerations when housing adults in care.

7.6.1. General housing information for microbats

Microbats enter torpor during periods of cooler weather. Housing during rehabilitation should take this into consideration. For optimal immune function, drug metabolism and recovery from injury microbats should be kept in their thermoneutral zone.

7.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

- All microbats should be considered possible ABLV carriers and should only be handled while wearing appropriate PPE. The virus lasts up to 24 hours in saliva but is short lived in the environment being rapidly inactivated by heat, direct sunlight, soapy water and most disinfectants including bleach and F10.
- Microbats can also carry other potential pathogens such as *Salmonella*, which are present in faeces. It is important to always wash hands with soap and water after servicing microbats.

- Microbats frequently carry external parasites such as mites and bat flies. Bat fly bites may cause mild skin irritation in people.
- Enclosures should be cleaned and disinfected between inhabitants. Items of furniture, such as bark, should be discarded as they cannot be effectively disinfected.

7.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care.

Table 7.6 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 7.8**.

Table 7.6 Rehabilitation housing for adult microbats

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment – frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision where strict cage rest/confinement is indicated</p>	<p>0.2 x 0.1 m (0.02 m²)</p> <p>Height: 0.1 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Small plastic containers, eskies, if well ventilated, or a purpose built incubator, such as a Vetario or Brinsea can be used. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Place some type of fabric, such as a piece of blanket or pillowcase without threads, on the floor. This should be changed daily. • Provide thread-free cloth as a roost for the bat to hide. Cloth should be hung for bats to roost in natural positions and should have multiple layers so the bat can roost between the fabric layers and feel safe. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Humidity should be between 55 and 80%. Heat (31–38°C) may be provided in a plastic container by resting a covered heat pad against one side of the enclosure. • Severely ill or injured microbats should be housed in an incubator in order to provide stable temperature and humidity, as ill bats may crawl away from heat mats in order to enter torpor. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Provide water in a minimum of two small shallow bowls, such as bottle lids, as bats frequently defaecate in their water sources. • The containers need to be small enough to prevent the bat from falling into the water. • Marbles can be placed in water sources to avoid drowning. • Water sources left inside humidicribs will dry quickly and require more frequent replenishment.

Intermediate housing (Treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care</p> <p>Enclosure furnishings can be arranged to reduce opportunities to move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact</p>	<p>0.8 x 0.5 m (0.4 m²)</p> <p>Height 0.6 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Vivariums of various sizes as shown in Figure 7.9, or canvas pet carriers. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • A heat mat should still be made available at one end of the enclosure so the bat can choose to roost on or away from heat. • Newspaper or other disposable material can be used as flooring. • It should be changed daily. • Multiple cloth hangings or bark may be used as roost sites during this stage. • Cloth hangings should be changed as required. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Suitable temperatures during this stage will allow the animal to heal and feed without further heating. • Heating during night at the cooler times of the year may be required. • Maximum summer temperatures of 25–28°C and minimum winter temperatures of 22–23°C will prevent the microbat from entering prolonged periods of torpor. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Shallow lids from jars and bottles can be used as food and water bowls. • Deeper containers are needed to keep mealworms from escaping.

Pre-release		
Indications for use	Suggested min. dimensions for one to three bats	Suggested requirements
<p>No longer require regular handling/medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitoring and assessment of behaviour. This style of housing will allow microbats to fly and allow assessment of flight</p> <p>Pre-release assessment</p>	<p>Little forest bat, lesser long-eared bat, Gould's wattled bat:</p> <p>3 x 3 m (9 m²)</p> <p>Height: 2 m</p> <p>Large microbats and those with long wings and a fast flight style, such as free-tailed bats:</p> <p>8 x 8 m (64 m²)</p> <p>Height: 4 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A mesh tent that can be bought from camping stores is a suitable enclosure. These tents have an attached floor, which prevents escape. • Wire cages can damage the wings of microbats and should not be used. • 3 x 3 m gazebo structure can also be used for smaller bats. Provide wooden bat boxes, pieces of bark and wood, and towels/blankets hanging over rope for roosts. • Microbats should be warmed in the hand for five minutes before test flying. Ensure that disposable gloves are worn. Two days of flight training is required for every week spent confined in care. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Provide some cloth or branches that reach from the floor to the walls so that the bats can climb up to the roosts if they land on the floor. Avoid placing too many branches in the enclosure as they may reduce the space for flight. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Offer food in shallow bowls, noting a bowl should be deep enough so that meal worms are not able to climb out. • Provide more than one elevated feed station large enough for a bat to land upon. • If the bat is in an outside enclosure, place an insect-attracting light outside at night. • If the bat is in an indoor enclosure, collect insects outside in a light trap and then introduce them into the flight enclosure. • Provide fresh water daily, on the elevated feed station.

Figure 7.9 A wooden box used for housing injured microbats. Note the bark and cloth roosts and water bowl.



Photo credit: Zoos Victoria

7.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of microbats in rehabilitation. Information on feeding orphaned individuals can be found under **Section 7.8 Hand raising**.

Fresh water should be always available, provided in a stable/non-spill bowl that is shallow enough to prevent drowning and includes a way to climb out, if needed. An automatic drinker could also be considered. Water should be changed daily.

Table 7.7 Daily feeding and diet guide for adult microbats during rehabilitation

Diet	<ul style="list-style-type: none"> • Microbats are predominantly fed on mealworms. Mealworms are the larvae of the darkling beetle (<i>Tenebrio molitor</i>). • Do not offer food until hydration has been addressed. • Bats should be warm prior to feeding. Feed one to two large live mealworms per gram of bodyweight, for example a 10 g bat will need at least 10 large mealworms daily. • Only feed mealworms, do not substitute with other invertebrates. • Some microbats will not be able to feed on an intact mealworm and exposing the internal gut by removing the head may be required until the bat is feeding reliably. • Never leave live mealworms in enclosures with debilitated bats. • Bats usually need assisted feeding initially. Remove the mealworm's head and squeeze the gut contents into the microbat's mouth (Figure 7.10). Initially, the bat might only take mealworm innards however the entire mealworm is required to provide a balanced diet. Once the bat is used to taking whole mealworms, they can be fed without taking the head off by presenting the back of the mealworm's head to the bat's mouth. Weigh the microbat daily. If the animal is losing weight, increase the number of mealworms fed so that the microbat remains in the normal weight range for the species. • A mealworm custard can be given to sick bats or bats that are resistant to whole mealworms. See Table 7.8 for the recipe. • A slurry of Wombaroo Carnivore mix can also be offered to sick bats.
Mealworm Care	<ul style="list-style-type: none"> • Mealworms should be housed in a plastic tub on a substrate of 50:50 oat bran and Wombaroo Insect Booster, replaced weekly. Offer sliced sweet potato or carrot, replace daily. Include a piece of open weave hessian as a hide for mealworms. Dust the mealworms with Wombaroo Small Carnivore Mix immediately prior to feeding.
Frequency/time of feeding	<ul style="list-style-type: none"> • Daily. Bats entering torpor during the cooler months may only need to be offered food every third day. Once the bat is self-feeding, offer a continuous supply of mealworms so the bat can eat when needed.

Table 7.8 Recipe for mealworm custard (Introduction to the Care and Rehabilitation of Microbats*)

Ingredients	<ul style="list-style-type: none"> • 1.5 cups frozen mealworms • ½ cup cold water • 2 teaspoons Wombaroo Small Carnivore Mix or equivalent • 2 teaspoons vitamin powder such as Soluvet • ½ teaspoon Liquid Oral Care • ½ teaspoon Megaderm • 1 scoop S26 Infasoy or equivalent
Method	<p>On high speed in a blender, gradually add the frozen mealworms to ½ cup cold water and blend until it is the consistency of honey. Add the remaining ingredients, blend and then store in ice cube trays within a snap locked bag in the freezer. This can be kept for up to 30 days. When needed, defrost a cube in the fridge. Once thawed, the mixture will keep for 3 days in the fridge. Each cube will feed approximately 6–8 small bats/night. Hand-feed the mixture to the bat via a syringe, ensuring the mouth and surrounding fur are cleaned well afterwards to prevent fungal infections.</p>

*The details of this reference are found in **“Key references and additional reading”**.

Figure 7.10 A microbat is fed gut contents from a mealworm.

Photo credit: Zoos Victoria

7.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations are found in the appendices to Part A of these guidelines.

7.8.1. Equipment required for hand raising

- Humidicrib
- **Milk:** Wombaroo Bat Milk Replacer
 - Alternative for most bats: 100 mL goat's milk mixed with 1.5 scoops of S26 Infasoy powder (or equivalent), 2 mL Megaderm, 2 level teaspoons of dried egg white powder or the white of one medium egg and ¼ teaspoon Human Paediatric Probiotic Powder
 - Alternative for freetail bats (Mollosidae): 100 mL goat's milk mixed with 2 scoops of S26 Infasoy powder (or equivalent), 3 mL Megaderm and ¼ teaspoon Human Paediatric Probiotic Powder (Alternative milk recipes taken from 'Introduction to the Care and Rehabilitation of Microbats'. Details of this reference are found in Key references and additional reading)
- Catheter, eye dropper, foam eye shadow applicator
- Syringes
- Multiple layers of soft cloth for the young microbat to roost in
- Cotton buds
- Digital scales
- Record charts.

7.8.2. Growth, development and care of orphaned young



STOP - Please refer to your authorisation for mandatory conditions, regarding hand-raising orphaned young.

- Pups should be raised in small groups where possible.
- White-striped free-tailed bats are the only microbat species susceptible to imprinting. This is prevented by housing them with others of the same species and limiting human contact.
- Drip milk onto the end of a foam eyeshadow make up applicator, which is then placed in the bat's mouth, stimulating it to suckle. Free-tailed bats are reluctant to lap and will often only feed this way.
- If the bat refuses to feed from the sponge, offer milk via a catheter and syringe.
- Feed with the bat's body horizontal or with its head slightly raised.
- Wipe the bat's mouth clean afterwards.
- Pups should be fed when their stomachs are near empty. In furless pups, milk can be seen through the abdominal wall. For furred pups, gently feel the abdomen to determine if the stomach is near empty.
- Do not overfeed. Bloat is a common cause of death in microbat pups. The pup's abdomen should be slightly rounded and of similar diameter as the rib cage. Microbat pups will not refuse food when full and there is the potential to fatally distend or perforate the stomach through over feeding.

- Hairless (or pinky) pups become dehydrated extremely quickly. Even pups feeding well may need to be supplemented with subcutaneous fluids.
- **Toileting:** Stimulate the genital area by gently stroking with a moist cotton bud before and after each feed to encourage urination and defaecation. Microbats are born knowing how to defaecate and urinate. Stimulation may or may not be required and should be determined on an individual basis.
- Hand-reared microbats will require a minimum of four weeks of flight training prior to release. This should commence as soon as bats are self-feeding on solid food and fully furred.
- **Flight training:** place bat on the flat of the gloved hand and lift and lower the hand to encourage spreading of the wings. Training may take several weeks. Exercise in a closed room is ideal; with initial practice over a bed to provide a soft landing if they fall.
- Provide flying insects, such as moths, in the two to four weeks prior to the release of hand reared juveniles. This may be done by placing a black UV light outside the enclosure to attract insects.
- The growth and feeding requirements for Gould's wattled bats are in **Table 7.9**. These principles can be extrapolated to other species of microbats. However, they are only a guide, as microbat size and growth rate varies, depending on latitude.

Table 7.9 Gould's wattled bat developmental stages, produced with input from Wombaroo and Ericka Tudhope

Age (days)	Forearm length (mm)	Weight (g)	Milk (mL/day)	Notes
1	21.0	3.0	1.0	Keep in a temperature and humidity-controlled enclosure such as a Brinsea or Vitario. Enclosure temperature 35–38°C, humidity 80–90%, furless, pink, 2 hourly feeds
3	24.0	3.5	1.1	Eyes opening
5	26.0	4.0	1.2	3 hourly feeds
7	28.0	4.5	1.3	Enclosure temperature 32–34°C, humidity 60%, fur growing on head and neck
9	29.5	5.2	1.4	Fur growing on belly
11	31.0	5.9	1.6	
14	33.0	7.0	1.8	Thickly furred, 4 hourly feeds, start adding mealworm custard to milk
17	35.0	8.5	2.1	
20	37.0	10.0	2.4	Beginning to thermoregulate, 28–32°C, add mealworm viscera and replace some milk feeds with mealworm custard
24	39.5	11.7	2.7	5 hourly feeds

Age (days)	Forearm length (mm)	Weight (g)	Milk (mL/day)	Notes
28	41.5	13.1	2.8	Can thermoregulate. Enclosure temperature 22–28°C. Offer mealworms with heads removed. Mealworm custard can still be fed. Encourage to self-feed as soon as bat is readily taking mealworms by holding a bowl of mealworms close to the bat's face
32	43.5	14.1	2.4	Gradually reduce milk intake and increase solid food
36	45.5	14.5	1.6	House at room temperature, offer heating at night, 7 hourly feeds, self-feeding
42	47.0	15.0	0.0	Access to outside temperature ranges, fully weaned, adult size

7.9 Release protocol

Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for the animal.

7.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support better outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

The following checklist should be used to guide decision making regarding release suitability for microbats:

- ☑ Individual is in a state of good health – presenting injury/sickness is completely resolved (consider a pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 7.1**). Use a set of scales that can measure down to 0.1 g or 0.01 g, such as jewellery scales. Kitchen scales that only measure down to 1 g are not accurate enough.
- ☑ Weights vary throughout the year. Typically bats put on weight during autumn to prepare for the lack of insects over winter when they enter torpor. They will be at the high end of their weight range at the end of autumn/early winter. Weights are typically lowest at the end of winter and spring, except for pregnant females which can be 30% heavier prior to giving birth in early summer.
- ☑ Individual can gain height, negotiate objects and maintain continuous flight for at least several minutes.

7.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered, including the following:

- Microbats found within buildings are released outside the building at the same address.
- If it is not possible to release them exactly where they were found, microbats should be released as close as possible to the site. As they have a large home range, they can be released up to one kilometre away from the finding site. For more information on the ecological characteristics and requirements of microbats that may help with their release, please refer to **Table 7.1**.
- If the location of a microbat's original home range is unknown, then contact DEECA via the Customer Centre on 136 186 to determine a suitable site for release.

7.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Release after dusk to avoid predation by diurnal birds.
- ☑ Hand-reared young should be released in late summer to early autumn. This is the natural dispersal time and a time of high insect activity. Adults can be released at any time of the year.
- ☑ Do not release if the weather is cold, wet or windy.
- ☑ Conditions should be warm on dusk, with no forecast rain or strong wind for the following two nights.

Release Procedure

- ☑ Provide the microbat with 50% of its daily intake of mealworms on the day of release.
- ☑ Warm the bat in a gloved hand for five minutes prior to release.
- ☑ Do not throw the bat up into the air but permit it to fly from the hand.
- ☑ If the bat does not fly from the hand, after being warmed adequately, the animal should be reassessed.
- ☑ If uninjured, then release may be attempted on the following night with the bat moved around in the hand to encourage activity and then flight.
- ☑ Free-tailed bats need to drop from a height to start flying. These bats need to be held higher than 2 m off the ground or they may crash when attempting to fly from the hand.

7.10 Key references and additional reading

Barnard, S.M. 2002. Insectivorous bats. In: Hand-rearing wild and domestic mammals, Gage. L.J. (ed). Iowa State Press, Ames, Pp. 96 – 103.

Churchill, S. 2009. Australian Bats, 2nd ed. Allen and Unwin, Crows Nest. 255 pp.

Lollar, A., and Schmidt-French, B. 2002. Captive Care and Medical Reference for the Rehabilitation of Insectivorous Bats, 2nd ed. Bat World, Mineral Wells. 340 pp.

Lyons, R., and Wimberley, T. 2014. Introduction to the Care and Rehabilitation of Microbats. Wildcare Australia Inc., Nerang. 132 pp.

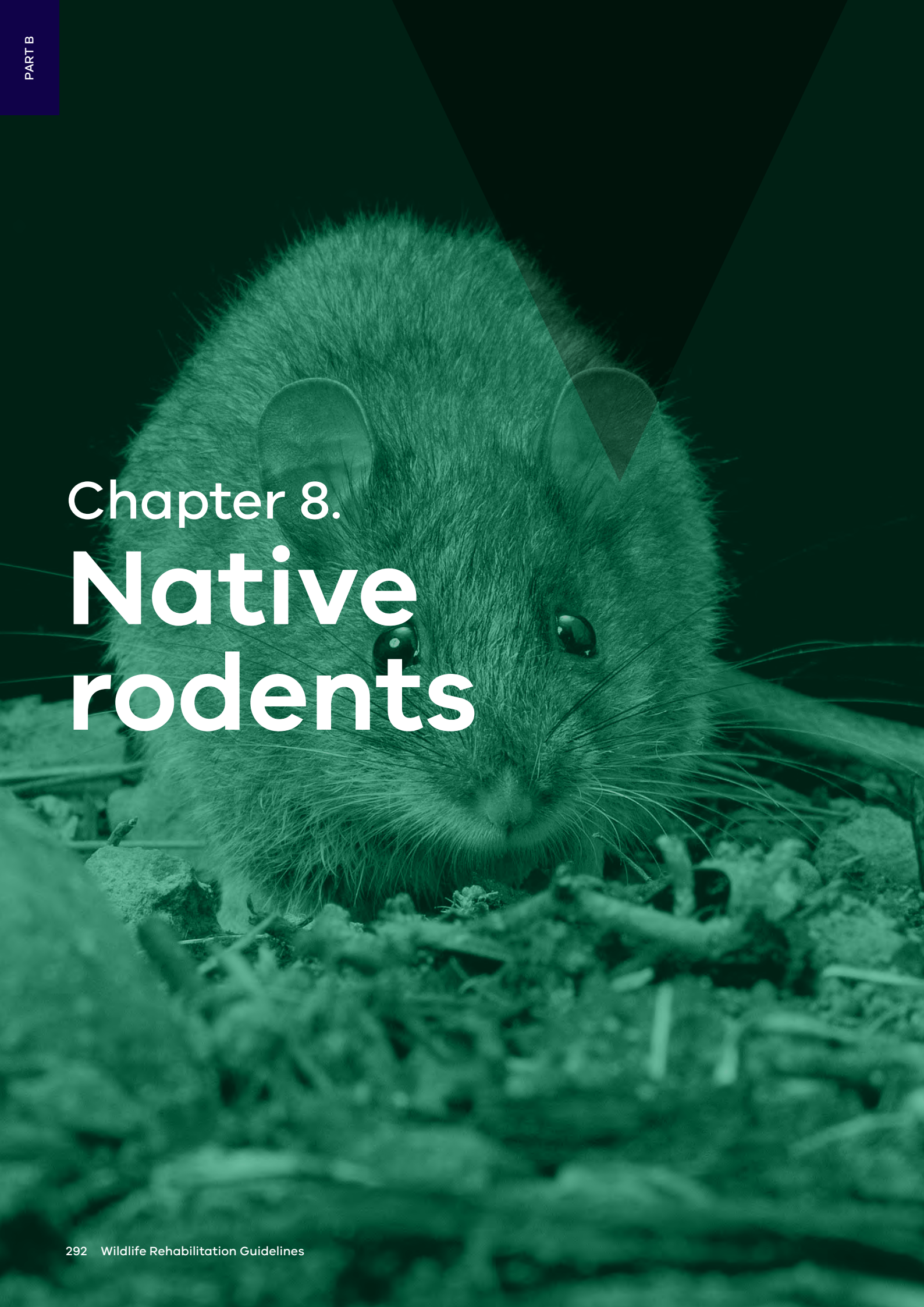
Department of Agriculture webpage, **Rabies and Australian bat lyssavirus | Important animal diseases | Animal diseases | Biosecurity | Agriculture Victoria.**

<https://agriculture.vic.gov.au/biosecurity/animal-diseases/general-livestock-diseases/rabies-and-australian-bat-lyssavirus#h2-3>.

Wildlife Health Australia (WHA), BAT HEALTH FOCUS GROUP webpage. **<https://wildlifehealthaustralia.com.au/ProgramsProjects/BatHealthFocusGroup.aspx>**.

Wildlife Health Australia (WHA), PERSONAL PROTECTIVE EQUIPMENT (PPE) INFORMATION FOR BAT HANDLERS. **https://wildlifehealthaustralia.com.au/Portals/0/Documents/ProgramProjects/PPE_Info_for_Bat_Handlers.pdf**

The Facebook group, Australian Microbat Rehabilitation Forum, is a useful group for microbat rehabilitators to join. It offers a free, digital manual with detailed instructions on rescuing and caring for microbats (Introduction to the Care and Rehabilitation of Microbats). This manual was developed by Rachel Lyons and Trish Wimberley, prominent microbat carers in Queensland, with the help of bat ecologists and veterinarians.



Chapter 8.
**Native
rodents**

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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

When native rodents come into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition, and an environment appropriate to the stage of rehabilitation. The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

8.1 Introduction



Currently in Victoria there are 12 extant species of rodent; nine species native to Australia and three introduced species. Under the Victorian *Flora and Fauna Guarantee Act 1988* and the Australian *Environment Protection and Biodiversity Conservation Act 1999* three of the species are listed as endangered and another two are listed as vulnerable or near threatened.




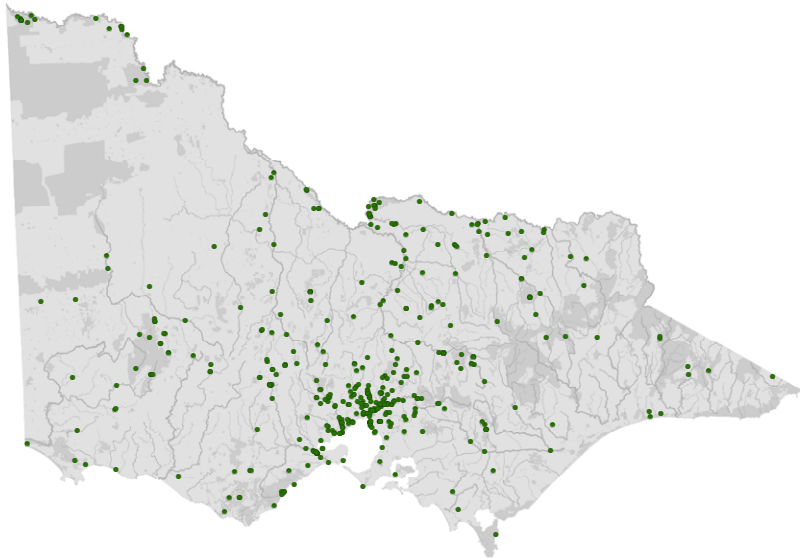
STOP – If an endangered, vulnerable or near threatened species comes into care, please STOP and refer to your authorisation for mandatory conditions including notification and release requirements.

8.2 Species information



Profiles for the native rodent species found in Victoria are detailed in **Table 8.1**. For assistance in identification of native rodent species, refer to the recommended reading and reference material at the end of this chapter.

Table 8.1 Species Profiles

Species	Water rat – Rakali (<i>Hydromys chrysogaster</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Water rats are easily identified by their aquatic nature, size, thick-furred white-tipped tail which is used as a rudder in the water, and their webbed-hind feet.</p> <p>Their body shape is streamlined, notably with small ears, small eyes and abundant whiskers.</p> <p>Their fur colour is variable being near black, grey to brown or reddish, with cream to golden-orange underparts.</p>
<p>Conservation status*</p>	<p>Least concern</p>
<p>Sexual dimorphism</p>	<p>Males can be slightly larger than females</p>

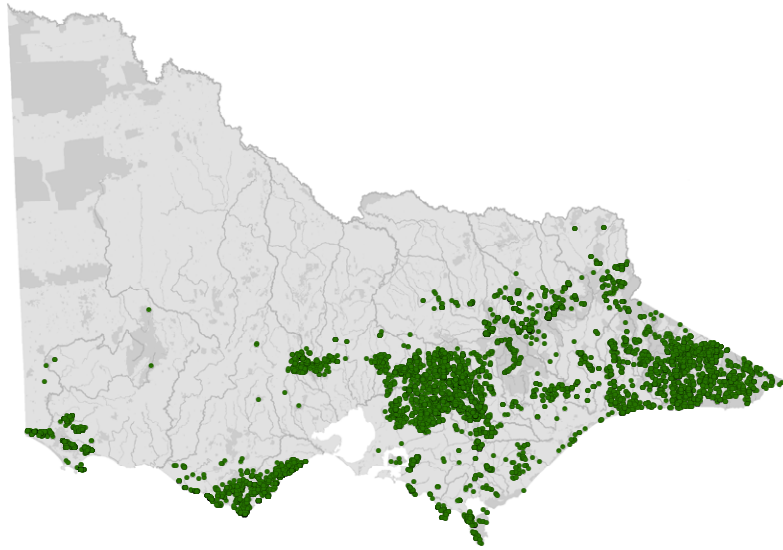
Species	Water rat – Rakali (<i>Hydromys chrysogaster</i>)
Adult morphometrics	Body weight: 620–1200 g Head and body length: 300–390 mm Tail length: 230–320 mm
Habitat	The water rat is one of Australia’s largest rodents. It is an aquatic species, widespread and common throughout most of Victoria’s waterways, living in burrows alongside lakes and river banks
Home range	Approximately 12 ha or less for both males and females, they are highly territorial and scent-mark their territories
Behaviour	Solitary. Urban and suburban habitats may be heavily impacted by pollution, plastic waste and introduced feral and domestic predators. Water rats are mostly nocturnal but can be active at sunset and sometimes during the day, often seen swimming with top of head and back visible. The white tip on the tail can also be very visible and used to identify the species.
Diet	Consists of large insects, crustaceans, mussels, fish, frogs, lizards, small mammals and birds. The water rat will usually forage under water and eat its prey at a regular feeding site which may be identified via shells, bones and other debris
Longevity	3–4 years
Sexual maturity	Male: approximately 4 months (full sperm production) Female: 8 months approximately (as early as 6 months)
Mating season	Late winter to early summer (potentially breed all year)
Gestation length	5 weeks
Litters per year	Average 1 to 2, but can produce up to 5 litters per year

Species

Australian bush rat – Mootit [*Rattus fuscipes (subspecies assimilis)*]

Photo credit: David Paul,
Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

Highly variable in body size and fur colouration with soft dense fur that in the upperparts is reddish brown to grey-brown, and the underparts are pale brown, grey or cream. Flanks may have a rust-coloured tinge. Tail is equal to or slightly shorter than head-body length and is naked with obviously overlapping rings of scales. Feet are pale pinkish-brown and hind feet have an elongated posthallucal pad. The eyes and rounded ears are quite prominent. They have a distinctive smell, more musky than other locally occurring native rodents

Conservation status

Least concern

Sexual dimorphism

Males are larger than females

Adult morphometrics

Weight: 65–225 g (average 125 g)

Head and body length: 100–214 mm

Tail length: 100–195 mm

Habitat

Bush rats are found in moist vegetation, gullies and areas with dense ground cover, from woodland, coastal scrub, forest and rainforest, through to alpine boulder-fields. They can be found from sea level to the highest Victorian alps

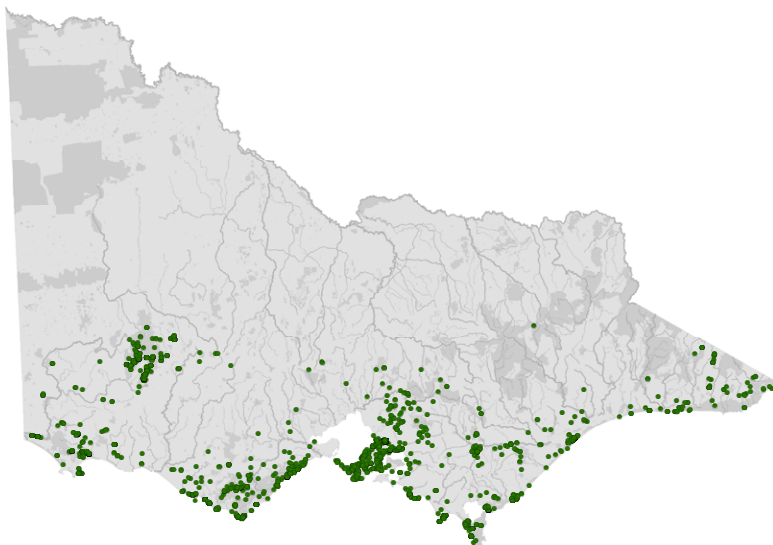
Species	Australian bush rat – Mootit [<i>Rattus fuscipes (subspecies assimilis)</i>]
Home range	Both males and females have small home ranges (one study found 0.6–1.2 ha), with the female ranges expanding in spring, and males dispersing or vastly increasing their home ranges as they leave winter and start to breed. Male home ranges may overlap with other males and females. A male can travel more than 1 km per night in favourable conditions
Behaviour	The bush rat is nocturnal and stays close to cover and densely vegetated areas, so is rarely seen in the wild. They are solitary and make shallow underground burrows with nest chambers lined with grasses and other vegetation. Population numbers and breeding success can be closely associated with rainfall and success declines in drought or following bushfire. Bush rats tend to avoid areas impacted by human activity
Diet	Bush rats are omnivorous and can survive on a variety of foods though can selectively favour mycorrhizal fungi and leaf-litter dwelling insects. They eat fungi, fruits, seeds, stems of particular grasses, lillies and invertebrates. They have been observed eating nectar from flowers
Longevity	Bush rats are short lived and few survive to a second breeding season. Most adult males and many adult females die in the autumn following their first breeding season. The over-wintering population often largely consists of young born the previous spring or summer
Sexual maturity	Both males and females reach sexual maturity by around 4 months old. Young born in spring may reproduce in the same season (before the following winter) when conditions are favourable
Mating season	In Victoria bush rats can breed throughout the year, but generally do not breed in winter, especially in more southern or alpine areas
Gestation length	22–24 days. Young are weaned at 4–5 weeks
Litters per year	Up to three litters of 4–5 young may be produced in a good spring-autumn season

Species

Australian swamp (velvet-furred) rat – Koota (*Rattus lutreolus*)

Photo credit: David Paul,
Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

The Australian swamp (or velvet-furred) rat has very dense, long, soft fur which is reddish-brown, dark brown to black on the upperparts and lighter brown, yellow-cream to grey fur on its underparts. The fur on the upper body may be golden tipped. The feet are dark brown above with very dark brown to black soles (which can distinguish it from some other native rodents). The tail is dark coloured grey, brown or black, is sparsely haired and is clearly shorter than the head-body length (about two thirds the length of the head-body). Ears are dark, rounded, quite short and can be obscured by fur. The eyes are not prominent

Conservation status

Least concern

Sexual dimorphism

Males are larger than females

Adult morphometrics

Weight: 55–160 g

Head and body length: 120–200 mm

Tail length: 56–156 mm

Habitat

They are found in a variety of thicker, wet vegetation, which can include along water courses and swampy areas, heath, grassland, sedgeland, ferny areas and scrub

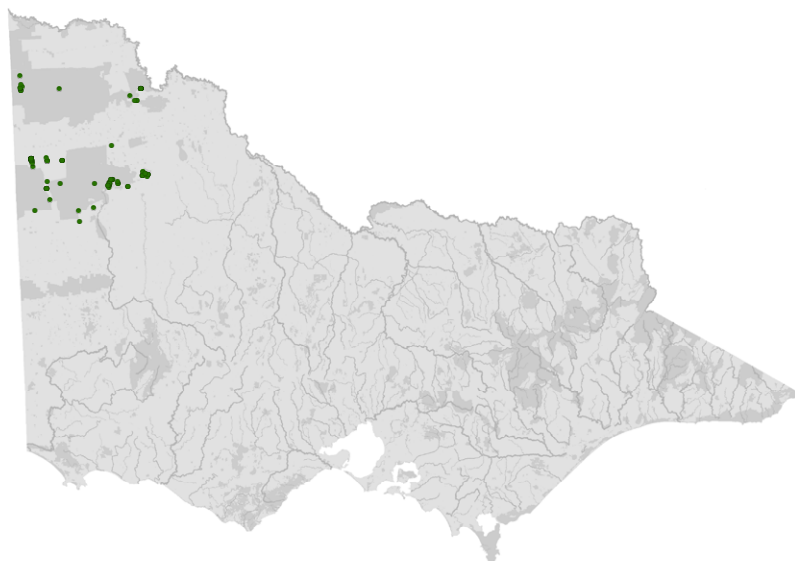
Species	Australian swamp (velvet-furred) rat – Koota (<i>Rattus lutreolus</i>)
Home range	In winter, males and females require a home range size of at least 0.2 ha to survive colder months when food may be less abundant. In females, this range expands to 0.5 ha from spring as animals start to breed and females will become territorial towards other females. Males may have a home range up to 4 ha, but do not appear territorial and move across multiple female territories. Females can be aggressive towards males except during mating. The size of territories (and therefore the density of the population) may be dependent on resource availability. After weaning, young animals move, often, more than 2 km to find and establish their own territory
Behaviour	Swamp rats make extensive shallow burrow systems underground, with multiple entrance tunnels which can be easily seen, as well as tunnel systems through vegetation. They can make nests up to 1 m deep, but in wetter or flood prone areas can make nests in grass tussocks. They may be active during the day and night.
Diet	Swamp rats are largely herbivorous, eating the stems and leaves of grasses and sedges, as well as reeds and seeds. They also eat insects and fungi
Longevity	Up to 29 months
Sexual maturity	Females born early in spring-summer may produce young in the same season as their birth, but those born later in the season will generally not produce until after their first winter
Mating season	Breeding can be throughout the year, but generally occurs in spring to autumn
Gestation length	23–27 days. Young are weaned at 3–4 weeks of age
Litters per year	Females can produce several litters of 3–5 young (average 2.5) in a spring-autumn season when conditions are favourable

Species

Mitchell's hopping mouse – Pankot (*Notomys mitchellii*)

Photo credit: David Paul,
Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

The Mitchell's hopping mouse is a bipedal native rodent with large back legs and the only hopping mouse species found naturally in Victoria, occurring in the northwest of the state in Mallee country. However, it is also a commonly held domestic pet under a basic wildlife license.

The mouse's upperparts are a sandy-rufous grey or tawny-olive colour with a pale white chest and underbelly. The long tail is bicoloured, with a pink-brown upper, pale grey below and a pale brown tuft at the tip of the tail.

The native rodent is the largest member of the *Notomys* genus, and both the male and female lack the throat pouch and chest gland present in other *Notomys* sp.

Note: all rats and mice in Victoria can move in a 'hopping' motion, this is not a diagnostic characteristic.

Conservation status

Least concern

Sexual dimorphism

Females are slightly larger on average than males

Adult morphometrics

Body weight: 40–60 (52) g



Head and body length: 100–125 mm

Tail length: 140–155 mm

Habitat

Logs and deep burrows. Constructs a nest chamber of leaves and other plant material in a horizontal tunnel

Species	Mitchell's hopping mouse – Pankot (<i>Notomys mitchellii</i>)
Home range	Hopping mice in general have small home ranges, though have been noted to disperse up to 15 km to find water, and up to 2 km in a single night
Behaviour	The Mitchell's hopping mouse is a semi-arid, nocturnal, gregarious species
Diet	Omnivorous. Majority of the diet is seeds, roots, green shoots and leaves, but will also eat fungi and insects
Longevity	The species is documented as living for a maximum of 5 years in captivity, but likely shorter in the wild
Sexual maturity	Male: 90 days Female: 73 days
Mating season	Most births will occur in late winter or spring, but the species will breed in any month if conditions are desirable
Gestation length	Approximately 40 days. Young are weaned at approximately 35 days
Litters per year	Approximately 3–4 litters of 3–5 young per year, depending on resource availability

Species	Silky mouse – Nalpo (<i>Pseudomys apodemoides</i>)
 <p>Photo credit: Shutterstock, James Trezise</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>

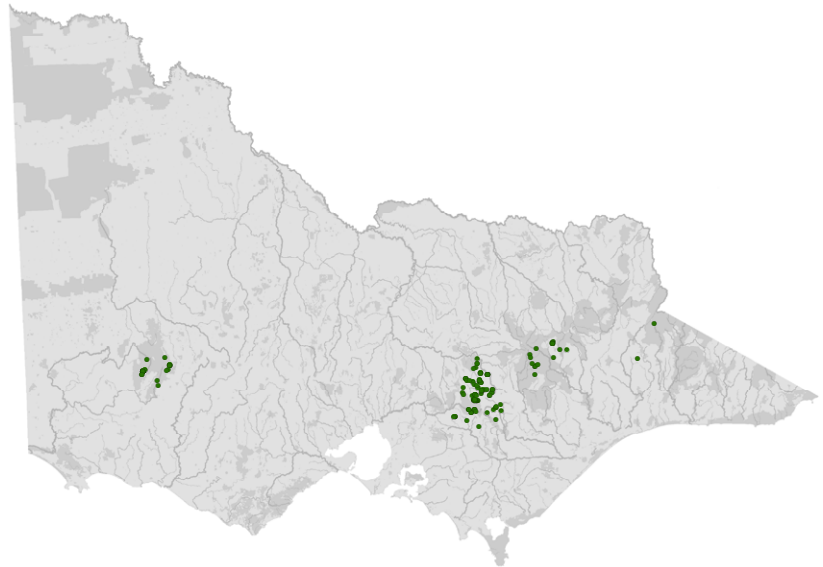
Species	Silky mouse – Nalpo (<i>Pseudomys apodemoides</i>)
General appearance	The silky mouse has dense, soft fur, with the upper parts a smoky grey colour and dark guard hairs mottled throughout. The underside is pale white, including the underside of the lips and muzzle. The ears are pinkish grey and larger than the house mouse. The tail is pale pink with white hairs, and brown on the upperpart. The tail is longer than the body length, and if disturbed it is known to carry its tail on a horizontal angle or across its back
Conservation status	Least concern
Sexual dimorphism	No sexual size dimorphism
Adult morphometrics	Body weight: 15–22 g Head and body length: 68–80 mm Tail length: 90–105 mm
Habitat	In Victoria, the species prefers to inhabit dry mallee-heathland in the west of the state. Diverse vegetation producing seeds year-round is needed. Adults may share burrows, and several litters at various developmental stages have been found in a single burrow system
Home range	Movements within study sites ranged from 60–130 m, with 3 km being the maximum recorded distance travelled by a silky mouse
Behaviour	Silky mice are nocturnal and will shelter in extensive, deep burrow systems with multiple entry points, usually covered by dense vegetation. The burrowing system is often located at the base of the desert banksia (<i>Banksia ornata</i>)
Diet	The silky mouse has a variable diet, being omnivorous, and will eat seeds year round, fruits, flowers, fungi, nectar (from desert banksia which is a major food source over winter) and insects
Longevity	2–3 years
Sexual maturity	Male: In birth year Female: In birth year
Mating season	The silky mouse is an opportunistic breeder, mating occurs when conditions are favourable for the species. As vegetation productivity declines, breeding becomes seasonal with some populations breeding in winter and others in late spring to summer
Gestation length	38–39 days. Young are weaned around 40 days
Litters per year	During favourable conditions, successive litters of 1–6 young can be born throughout the year

Species

Smoky mouse – Konoom (*Pseudomys fumeus*)

Photo credit: David Paul,
Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

Very distinctly coloured, with light blue-grey to darker slate blue-grey fur on its upper parts and white or pale grey underside.

The feet, underside of the tail, and tip of the nose are a pale pink with white hairs. The ears are dark grey at the outer edges, fading to pale pink in the centre. The tail is longer than the body and is bicoloured, with dusky-brown colouration above and soft pink below.

Conservation status*

Endangered

Sexual dimorphism

Males may be slightly larger than females

Adult morphometrics

Body weight: 45–80 (50) g
 Head and body length: 85–136 (120) mm
 Tail length: 105–150 (135) mm

Habitat

Lives in a wide variety of habitats from 0–1,800 m above sea level, including dry sclerophyll forests, wet forests, subalpine and coastal heathlands


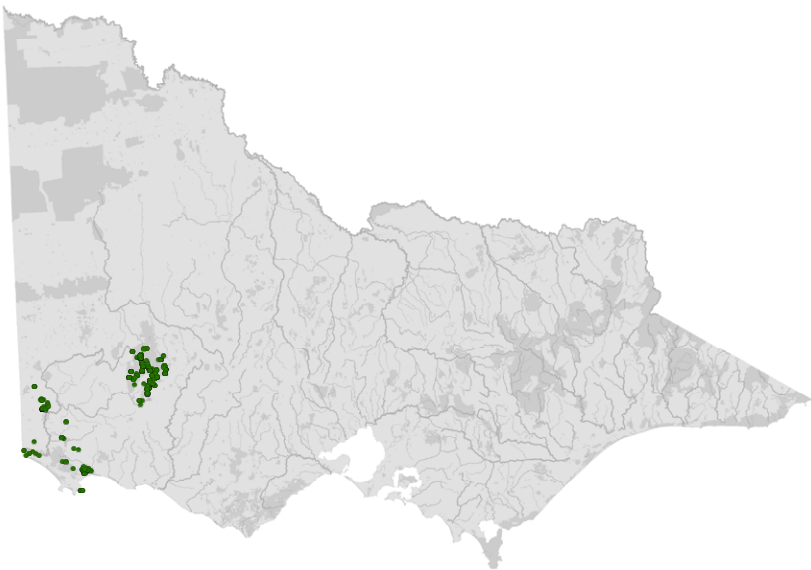
Home range

The home range of the smoky mouse is most likely resource dependent, between 2–10 ha. The species has been recorded moving over 1 km in a single night

Behaviour

The smoky mouse is a nocturnal, social species and nests communally in complex burrow systems, with up to five females sharing a burrow and giving birth at the same time

Species	Smoky mouse – Konoom (<i>Pseudomys fumeus</i>)
Diet	The species is omnivorous, consuming seeds, flowers and fruit, insects such as beetle larvae and Bogong moths, and a higher proportion of fungi over winter
Longevity	1–4 years in the wild
Sexual maturity	Male: Not recorded Female: Not recorded
Mating season	Smoky mice breed seasonally in spring and summer
Gestation length	30 days
Litters per year	1–2 litters of 3–4 young per annual breeding season

Species	Heath mouse – Dayang (<i>Pseudomys shortridgei</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Heath mice are thickset with a broad face, short muzzle and have brown coloured fur with long black guard hairs. The under parts are grey-white and the ears are short and rounded with a dark colour, covered with fine, soft hairs. The tail length is shorter than the body length and is bicoloured (upper tail dark and under white) and is well haired. The upper surfaces of the feet have long grey hairs.
Conservation status*	Endangered

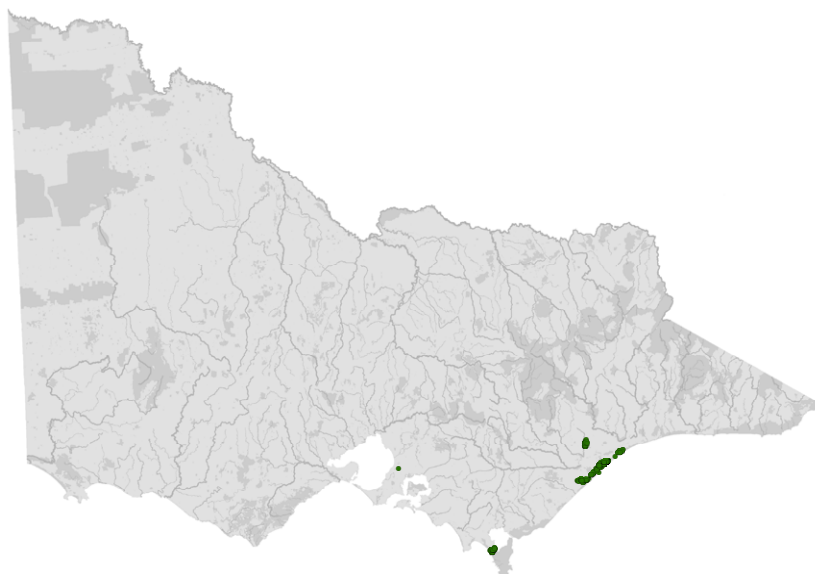
Species	Heath mouse – Dayang (<i>Pseudomys shortridgei</i>)
Sexual dimorphism	Males are larger than females
Adult morphometrics	Body weight: 55–90 (70) g Head and body length: 90–120 mm Tail length: 85–100 mm
Habitat	The species uses well defined pathways and nests on the surface or shallow burrows amongst dense ground cover
Home range	Approximately 0.75–5.5 ha, most likely determined by food availability
Behaviour	Docile and partly diurnal
Diet	The heath mouse has a herbivorous diet including flowers, seeds and berries, eaten spring through summer. As these food resources decline the native rodents alter their diet to the stems and leaves of grasses, lillies and sedges and, after autumn rains begin, will also eat fungi
Longevity	Maximum of 4 years in the wild
Sexual maturity	Young are precocious and grow rapidly, juveniles can reach adult size in 3–4 months. Male: 10–12 months Female: 10–12 months
Mating season	Breeding occurs from spring to summer when adults form pairs for the 4-month breeding season
Gestation length	28–34 days
Litters per year	The heath mouse has 1–2 litters of 2–3 young per year

Species

New Holland mouse – Pookila (*Pseudomys novaehollandiae*)

Photo credit: David Paul,
Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

Appearance: Has a sandy grey-brown coloured upper parts and white to light grey coloured underparts. The feet and underside of the tail are pale pink with white hairs. The bicoloured tail is fine and delicate, and longer than the body.

The species can be readily distinguished from the introduced house mouse by its distinctive colouration, including light pink feet and bicoloured tail, larger eyes and ears and the absence of a mousey odour. House mice that co-occur with the new Holland mouse in Victoria are usually a darker, more uniform brown with dark feet and tail.

Conservation status*

Endangered

Sexual dimorphism

Females may be slightly larger than males

Adult morphometrics

Body weight: 15–24 (18) g

Head and body length: 65–90 mm

Tail length: 80–105 mm

Habitat

The new Holland mouse is found in open coastal heathlands, heathy woodlands and vegetated sand dunes in small patches at Wilsons Promontory and the Gippsland Lakes region


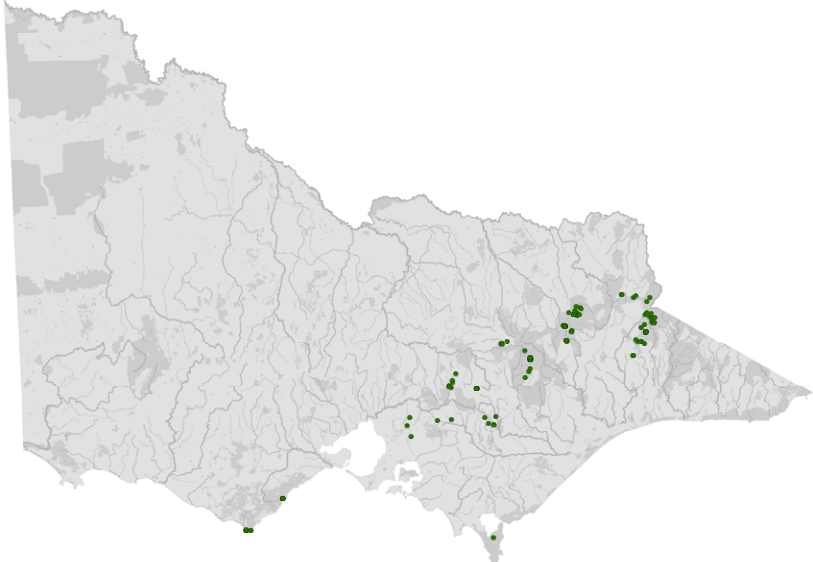
Home range

0.5–2 ha

Behaviour

The new Holland mouse is nocturnal and gregarious, living in burrow systems up to several metres long

Species	New Holland mouse – Pookila (<i>Pseudomys novaehollandiae</i>)
Diet	Omnivorous, with seeds forming a large portion of their diet. They also eat leaves, flowers, green stems, fungi and invertebrates
Longevity	1–2 years
Sexual maturity	Male: 20 weeks Female: 7–13 weeks
Mating season	Breeding occurs late spring to early autumn
Gestation length	Approximately 31.5 (29–33) days
Litters per year	1–2 litters of 2–6 young (average 2.6 young survive to weaning) per year


Species	Broad-toothed rat – Tooarrana (<i>Mastacomys fuscus mordicus</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>


Species	Broad-toothed rat – Tooarrana (<i>Mastacomys fuscus mordicus</i>)
General appearance	<p>The broad-toothed rat is a compact native rodent of south-eastern Australia. Often described as 'chubby cheeked', it has a broad short head with a rotund body shape and a hunched posture.</p> <p>As the name suggests, the species has wide molars and incisor teeth, though this is often not visibly apparent, except in museum specimens.</p> <p>The fur of the species is fine and dense, upper parts are sandy-dusky brown, heavily flecked with rufous colouration, buff grey under parts and black guard hairs. Feet are dusky brown with a rounded posthallucal pad. The ears are short, round, broad and have small tufts of hair in the ear (the swamp and bush rat lack the small tufts of hair in the ear). The tail is also short, brown upper and slightly paler below, covered with rings of visible scales and sparsely haired. Fresh scats are a bright green colour, though fade to dark brown and then pale tan with time.</p>
Conservation status*	Vulnerable
Sexual dimorphism	Males are larger than females
Adult morphometrics	<p>Body weight: 95–145 g</p> <p>Head and body length: 145–175 mm</p> <p>Tail length: 100–130 mm</p>
Habitat	The broad-toothed rat is found from coastal to high altitude environments. Population strongholds persist in subalpine to alpine areas. The species prefers dense ground cover of grasses and sedges with some shrubs present, often along valley floors near streams, or along roadsides
Home range	<p>Female: 0.1–0.16 ha</p> <p>Male: 0.1–0.27 ha</p> <p>The males home ranges will overlap with several females</p>
Behaviour	The nocturnal species is shy, builds nests in dense cover and creates 'runways' to move through the landscape in dense ground vegetation and beneath snow. These above ground tunnels can make the species particularly susceptible to attack by predators, and exposure via loss of cover following habitat destruction or fire. In alpine environments during winter both sexes are found huddled together in communal nests
Diet	The broad-toothed rat is herbivorous, feeding primarily on the stem, leaves and seeds of sedges, grasses, herbs and heaths
Longevity	2 years in the wild


Species	Broad-toothed rat – Toarrana (<i>Mastacomys fuscus mordicus</i>)
Sexual maturity	Male: 8 to 10 months Female: 8 to 10 months
Mating season	November–March
Gestation length	35 days
Litters per year	1–2 litters per season, with 2–3 rats born per litter with relatively slow growth

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

Table 8.2 Introduced species commonly found in Victoria

Introduced Species	House mouse (<i>Mus musculus</i>)
General appearance  Photo credit: Shutterstock	<p>The house mouse was introduced to Australia via European ships in the late 1700s. It is now ubiquitous across Australia, including numerous offshore islands. The species is variable in colour ranging from blackish to mid grey, grey-brown or yellow-brown (above parts), with lighter underparts of whitish, pale cream-yellow or pale grey-brown. The tail is pinkish-brown to dark brown, sparsely haired and approximately equal to or slightly longer than the head-body length. The ears are large and rounded, and the eyes are quite small (especially in comparison to some <i>Pseudomys</i> species). Female house mice have five pairs of teats, compared with two pairs in <i>Pseudomys</i>. The house mouse has a strong musty odour and can be aggressive when handled</p>
Sexual dimorphism	No sexual size dimorphism
Adult morphometrics	Body weight: 8–25 g Head and body length: 60–100 mm Tail length: 75–95 mm

Introduced Species	Black rat - (<i>Rattus rattus</i>)
<p>General appearance</p>  <p>Photo credit: Shutterstock</p>	<p>Black rats were introduced to Australia, via European ships, likely with the First Fleet, and are now found across many urban, rural and natural environments. They have sleek, shiny fur with colours ranging from black to mid-grey or pale creamy brown (above parts), and with creamy white to pale yellow underparts. The fur on the tops of their feet is pale to white with black guard hairs. Notably their tail length is significantly longer than their head-body length, and their tail is slender and sparsely haired with obvious overlapping rings of scales. They have a long nose, large eyes and long rounded ears. They are very good climbers and are often found in roofs and trees, unlike native Victorian rodents. They are social and the presence of one rat generally indicates the presence of many others</p>
<p>Sexual dimorphism</p>	<p>Males are slightly larger than females</p>
<p>Adult morphometrics</p>	<p>Body weight: 95–340 g Head and body length: 165–220 mm Tail length: 185–245 mm</p>

Introduced Species	Brown rat (<i>Rattus norvegicus</i>)
<p>General appearance</p>  <p>Photo credit: Shutterstock</p>	<p>Despite its species name (<i>norvegicus</i>, Norway rat) the brown rat is originally from Central Asia. This is a larger (up to double the size) species than the black rat and can be more aggressive when cornered or handled. They are a stockier rat with a rounded head and blunter muzzle than the black rat. They are generally a warm dark brown (above parts), with darker shading on their heads and paler shading on their flanks. The underparts are yellow-grey to cream coloured. However, the colours can be very variable with uniformly very dark or very pale animals possible</p> <p>The brown rat has smaller eyes and shorter ears than the black rat, and longer whiskers. Their tail is grey-brown and shorter than their head-body length and is quite thick with overlapping scales. They are not particularly adept at climbing but are good swimmers. The species is most found in coastal and urban areas</p>
<p>Sexual dimorphism</p>	<p>Males are larger than females</p>
<p>Adult morphometrics</p>	<p>Body weight: 200–500 g Head and body length: 180–255 mm Tail length: 150–215 mm</p>

8.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for native rodents is in **Section 8.6.2**.

The following information relates to human and animal health and safety considerations specifically related to the rehabilitation of native rodents.

8.3.1. Human safety considerations

- Physical injury such as bites and scratches.
- Disease risk particularly from faeces, urine, saliva and nesting material.

8.3.2. Animal safety considerations

- Stress and shock.
- Overheating.
- Injuries – wounds, broken limbs.
- Risk of injury to the tail – the tails of most Australian rodents are highly fragile and should not be held to restrain animals.
- Restrain and contain animal securely to prevent further injury.

8.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 8.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned native rodents.

8.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 8.3 Visual health observations in native rodents

What to look for	
Demeanour	<ul style="list-style-type: none"> Healthy rodents should be alert and exhibit natural behaviours such as foraging, grooming, swimming (species dependent)
Behaviour	<ul style="list-style-type: none"> Rodent should be alert to movement and sound (ears moving and listening), and exhibit predator avoidance by fleeing from stimuli such as noise and movement If the rodent is unwell, it may not move away quickly or at all Nose sniffing the air, preening whiskers, hopping, swimming, balancing on hind legs etc. are all normal, healthy rodent behaviours
Movement and posture	<ul style="list-style-type: none"> Movement should be a fluid movement, no limping on a particular foot/leg If the rodent is unwell its movement may be slow or a 'wobbly' type movement The posture should be symmetrical and look similar on either side of the rodent The posture should not look 'hunched over' and swaying. A hunched appearance with higher shoulders than head or hips is indicative of an unwell rodent All limbs should be functional including the tail (not dragging or trailing)

What to look for

Breathing

- Breathing should not be laboured/extremely fast paced
- Open mouth breathing instead of through the nose indicates potential breathing issues
- Wheezing, gurgling or crackling sounds while breathing may also indicate breathing difficulties
- There should be no blood or coloured discharge from the mouth or nose
- There should be no excessive salivation

8.4.2. Equipment

- **Traps:** Elliott trap – small rodents; cage trap – larger rodents (see trap images).
- **Hand net:** Material or mesh net (see image), to prevent the animal becoming entangled or escaping.
- **Catch bag:** Calico bags or thick cotton bags (see **Figure 8.1**) are best and prevent injury to the native rodent once inside the bag. Turn bags inside-out for use, so the rodent cannot catch their nails on the threads.
- **Towel**
- **Transport container:** Ventilated plastic (see image) or wooden container lined with a cotton t-shirt, towel or any suitable material that will not entangle the rodent (no loops in fabric that may snag nails).
- **Gloves:** Gloves (see image) to protect rescuer/handler from bite injuries.

Figure 8.1 a. Elliott trap. b. Cage trap. c. Hand net. d. Gloves. e. Calico bag. f. Transport container



8.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts for further advice. Inexperienced rescuers should request assistance where possible.

- Rodents can be restrained with one hand holding either side of the back of the head, using the thumb and index finger, while the palm of the same hand restrains the body. This can be done with bare hands or through a bag or towel. Be firm but careful not to block the rodent's airway. For larger rodents, such as water rats, a second hand is required to restrain the base of the tail.
- Never restrain by the tail alone, as this can lead to degloving injuries (the skin is stripped off the underlying muscle).
- Restraint time should be kept as short as possible.

Figure 8.2 Restraint technique for a small rodent (shown on an antechinus).



Photo credit: Zoos Victoria

8.4.4. Transport

- All native rodents should be transported as quickly, efficiently and as safely as possible to minimise stress to the animal.
- Once the animal is in the transport container, ensure the container is securely locked and/or closed.
- In the vehicle, place the transport container in the passenger cabin of the vehicle to minimise container movement. Strap the transport container securely with the seat belt so it doesn't move around in the vehicle, and ensure the vehicle is as quiet as possible.
- Native rodents can easily over-heat when stressed. Once the transport container is inside the passenger cabin of a vehicle ensure temperature is maintained around 18–22°C.
- If the transportation time will be longer than 20 minutes, consider adding, for example, shredded paper or an old t-shirt for shelter.
- Shade container from direct sunlight through the vehicle windows using, for example, towels or a jacket as a makeshift window cover.

8.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

Please note: A common behavioural response to chronic high-level stress is 'learned helplessness'. This is exhibited as increasingly passive behaviour in response to aversive stimuli and can be misinterpreted as having 'settled in' or being 'relaxed' or 'chilled out'. Carers should always aim to treat animals as efficiently as possible so that they can be returned to the wild in the shortest possible time.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care. Minimising human-animal interactions and stress to the animal maximises successful release back to the wild.

8.5.1 Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated as required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical

exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or an injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording physical examination findings can be found in the appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from any domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation, or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examination of native rodents can be difficult due to their size. They may bite and can be difficult to restrain without harming the animal, due to their small size. An anaesthetic by a veterinarian may be needed.
- **Table 8.3** provides additional guidance on what to look during physical examinations.
- Observation through a clear sided container or while in a calico bag may facilitate a conscious exam.

Table 8.4 Physical examination of native rodents

What to look for	
Body weight	Weight ranges are variable between species, juveniles, subadults and adults. Weights given in Table 8.1 are for adults.
Body condition	<p>A healthy rodent will have a rounded body shape.</p> <p>Body condition can be assessed for smaller animals by the prominence of the spine. Condition can also be judged by body weight with reference to the normal weight range for that species. Body condition can be described as follows:</p> <p>Under condition: Backbone can be easily felt (and seen) on top and sides.</p> <p>Ideal condition: Backbone can only be felt on top. Sides are covered with muscle.</p> <p>Over condition: Difficult to feel the backbone.</p>
Hydration status	<p>The skin slides easily over the shoulder blades/spine, and when the skin is 'tented' (or gently pinched up) over the spine/between the shoulder blades it should fall back within 1 second. Do not pinch suspected <i>Pseudomys</i> or <i>Notomys</i> species as their skin can be delicate.</p> <p>Rodents which are dehydrated may have dry looking gums, sunken eyes and a slow skin tent.</p>
Eyes	<p>The eyes should be 'clear', open and have no discharge.</p> <p>Not white or cloudy.</p>
Ears	Clean, no blood or discharge present, intact and functional.
Mouth	Should be dry around the edges – no signs of drooling or blood.
Skin and coat condition	Skin and coat should be smooth and clean. No infected wounds, rashes or lumps on skin present. There shouldn't be excessive hair loss/patches, but rodents may have patchy hair loss naturally from fighting.
Limbs, feet, and tail	<p>All rodents should have four limbs present and functional. Note missing toes, missing tail.</p> <p>A healthy rodent will move well on all limbs.</p> <p>Missing or damaged tails are not a cause for concern. Animals should not be taken into care for old tail injuries.</p> <p>Native rodent tails may be easily broken or removed under pressure, which is likely a natural technique to escape predator attack. Animals should not be taken into care for tail injuries. Exposed tail bone in <i>Pseudomys</i> species will be dealt with by the animal itself.</p> <p>Never hold a native rodent by the tail or apply pressure to the tail if it is suspected to be a <i>Pseudomys</i> species. <i>Pseudomys</i> and some other native rodent species may slough off their tail skin if pressure is applied.</p>

What to look for

Sex determination

- Sex can be determined by examining the animal gently for testes in males (or a darker patch in juveniles where the testes will develop in some species), and for obvious nipples in lactating females.
- Males have a longer distance between the base of the genital papillae and the anus, while females have a shorter distance (often by up to half), but this can be difficult to determine unless experienced with each species.

Figure 8.3 Physical examination for sex determination. **a.** Lactating female new Holland mouse. **b.** Male adult new Holland mouse.

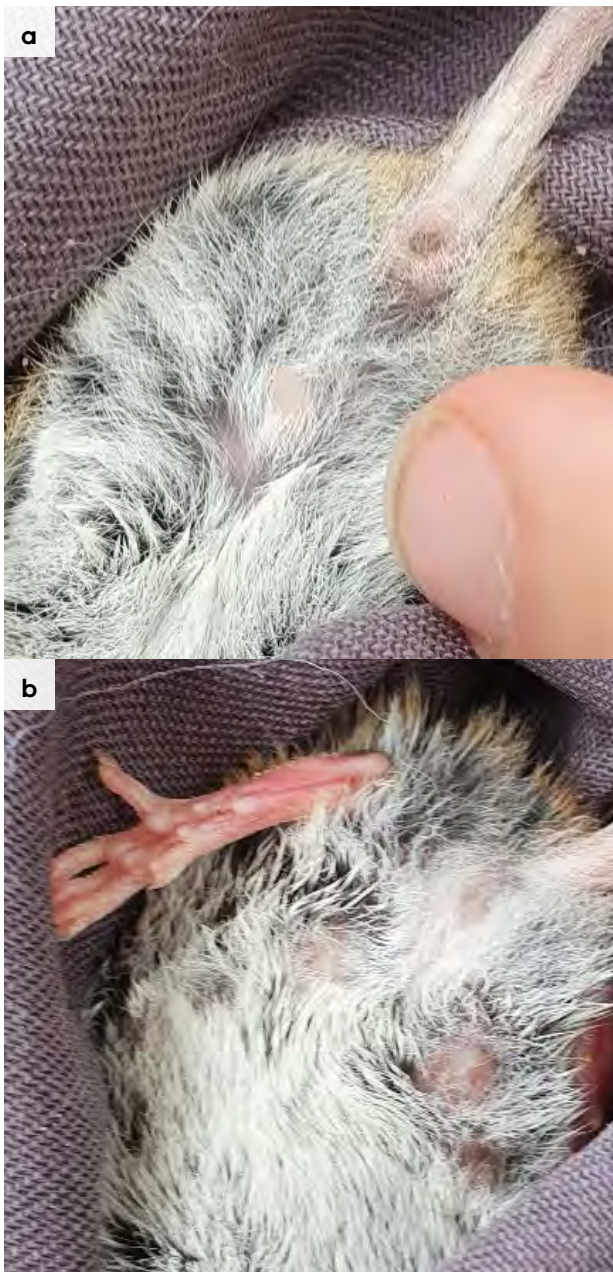


Photo credit: Kristy Williams, Zoos Victoria

8.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Time your health and welfare observations for times of the day when the rodent is expected to be active, for example, is the species nocturnal? Most Australian native rodents are nocturnal, though some may be active in daylight hours. The animal should be observed at least daily.
- If the animal is being medicated, a visual check in the morning is recommended.
- Ideally physical observations should be undertaken at the beginning and/or end of the resting period to minimise disturbance and maximise the rest/sleep period for rapid healing and ensure ease of capture.
- Note the animal's demeanour and behaviour every time food is introduced or taken away, the animal is medicated, or the enclosure is cleaned. Pay particular attention to any changes that have occurred since the previous day.
- Note faecal consistency daily. If diarrhoea is noticed, a faecal sample should be collected and submitted to a veterinarian for assessment as soon as possible. Do not treat on suspicion of a bacterial or parasitic infection as this can make definitive diagnosis difficult and potentially prolong the course of the disease.

8.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 8.4 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 8.5 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Injuries or Clinical signs	Possible causes	Carer observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to walk or move normally</p> <p>Paralysis</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fractures</p> <p>Dislocation</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by raptor, bird, fox, cat or dog</p> <p>Conspecific fighting</p> <p>Capture injury</p> <p>Injury sustained in captivity</p> <p>Being crushed</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to veterinarian to apply first aid, other than to stop excessive bleeding. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimise stress. • Do not attempt to stabilise fractures as this is very painful, and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical exam, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 8.6 for Housing information.
<p>Head trauma</p> <p>Bleeding from nose, mouth or eyes</p> <p>Swollen eye lids, blood present in eye</p> <p>Abnormal behaviour</p> <p>Mouth swelling, missing teeth</p> <p>Lethargy</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by raptor, bird, fox or dog,</p> <p>Capture injury</p> <p>Injury sustained in captivity</p> <p>Cranial trauma, concussion</p> <p>Being crushed</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to veterinarian to apply first aid, other than to stop excessive bleeding. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimise stress. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals or animals with head trauma. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 8.6 for Housing information.

Injuries or Clinical signs	Possible causes	Carer observations and response
Bleeding Puncture wounds Bruising Fur loss	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by a bird, raptor, fox, cat or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment. • Euthanasia may be the most humane response if the wounds are extensive. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • While bite wounds/scratches may not be immediately obvious, these carry a very poor prognosis and animals often present moribund – very lethargic, poorly responsive and cold. • Look for small clumps of dried fur stuck together with saliva, part the fur and look for very small puncture wound(s). • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning the animal to enclosure. See Section 8.6 for Housing information.
Blindness or poor vision Neurological signs Wobbly movement or ataxia Deafness	<p>Infectious disease (e.g. toxoplasmosis or bacterial meningitis), cranial trauma, toxicity (e.g. 1080 poisoning)</p>	<ul style="list-style-type: none"> • Given the very wide range of causes, carers should seek veterinary advice as soon as possible. • If unusual toxicity or infection is suspected, you or your veterinarian can contact Zoos Victoria's veterinary department to discuss options for disease investigation. • If multiple animals are seen with similar signs, this may indicate a newly emerging infectious disease or a toxicity (e.g. plant toxicity or poisoning) – contact the Emergency Animal Disease Watch Hotline on 1800 675 888 to report concerns. • The carer may observe the animal bumping into objects in enclosure or fail to respond to short sharp noises (e.g. loud clap from behind animal). • Pupils may be fixed/dilated and not responsive to changes in light level. You should see pupils constrict if a pen light is shone in the eye. • Repetitive squinting may indicate that the eye is painful.

Injuries or Clinical signs	Possible causes	Carer observations and response
<p>Weakness, lethargy, lack of fear of humans, uncharacteristic daytime activity</p>	<p>Rat bait and other poisoning</p>	<ul style="list-style-type: none"> • Rat bait poisoning is common in black rats observed during daylight hours in urban areas. Animals may be seen hunched over and seemingly unaware of the presence of humans. Baited animals will appear weak and lethargic, not eating. • Do not mistake with natural daytime grazing behaviours of swamp rats. Swamp rats may commonly be seen foraging, particularly in the morning and evening, and may be unphased by human presence, particularly along popular walking tracks. This is natural and the animals should not be interfered with. • Baited animals should be euthanised.
<p>Diarrhoea Loose faeces</p>	<p>Inappropriate diet, infectious disease, alteration of microbiome, stress</p>	<ul style="list-style-type: none"> • Urgent veterinary advice is required if diarrhoea does not resolve rapidly (within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. • Do not treat on assumption of infectious disease (e.g. coccidia or bacterial infection) as this can make veterinary diagnosis more difficult if the animal does not improve. • Seek taxon expert advice. • If the animal has been otherwise stable and doing well, there are a number of responses carers may implement to try to resolve diarrhoea. For example consider any recent changes which may have led to diarrhoea and respond by removing inciting cause where possible – e.g. rapid change in diet, unusual levels of sound/intervention or handling, contact with recently arrived animals. • If milk has recently changed, immediately switch back to previous milk, wait until diarrhoea has resolved and then implement a slower diet change. • Do not mix oral rehydration fluids in with milk as it changes the digestibility of the milk. Oral rehydration fluids/water can be provided in between milk feeds. • Ensure excellent hygiene standards to prevent spread to other animals/carers and isolate this animal from any others in care, if possible.

Injuries or Clinical signs	Possible causes	Carer observations and response
<p>Skin irritation</p> <p>Fur loss</p> <p>Presence of mites</p>	<p>Excessive mite infestation, seasonal behaviours, conspecific aggression</p>	<ul style="list-style-type: none"> • Some fur loss/minor skin lesions are commonly seen due to fighting and mating and do not require any intervention. • A small number of ticks/mites can be normal, and do not require treatment or removal. However, if there is a very high number of ticks/mites seen, the animal is scratching/irritated, or the skin is red and inflamed – seek veterinary attention to treat ectoparasites.
<p>Bleeding tail injury</p> <p>Tail fracture</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by raptor, bird, fox, cat or dog</p> <p>Conspecific fighting</p> <p>Capture injury</p> <p>Injury sustained in captivity</p> <p>Being crushed</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to veterinarian to apply first aid, other than to stop excessive bleeding. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimise stress. • Do not attempt to stabilise fractures as this is very painful, and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical exam, x-rays and under general anaesthesia. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure to find the source of the injury. Fix loose wire/gaps or sharp edges before returning the animal to its enclosure. See Section 8.6 for information on Housing. Never hold a native rodent by the tail or apply pressure to the tail if it is suspected to be a <i>Pseudomys</i> species. <i>Pseudomys</i> and some other native rodent species may slough off their tail skin if pressure is applied.

Figure 8.4 Tail crop on a pookila which is common for native rodents. No intervention is required.



Photo credit: P Burns

Figure 8.5 Fur loss in a spinifex hopping mouse. This could be due to fighting, mating or a mite infection. The latter can be diagnosed by a skin scraping.



Photo credit: Zoos Victoria

Figure 8.6 Mites associated with fur loss in spinifex hopping mice.



Photo credit: Zoos Victoria

8.5.4. Administering treatment during rehabilitation

- To minimise stress and disturbance to the rodent, service the enclosure (fresh food/water, clean the enclosure) and provide medical treatment at the same time.
- If possible, provide treatment in a favourite food item.
- If there is no alternative and the rodent requires manual restraint to administer medication, prepare the surrounding area prior to treatment, for example have medication ready, towels or calico bag to gently restrain the rodent, and secure the room before removing the rodent from the enclosure.
- Most rodents will be too small to inject so medications are likely to be given orally. A small towel or calico bag can be used to restrain the animal and expose just the mouth for medications.

8.6 Housing



Below are several key considerations when housing adults in care.

8.6.1. General housing information for native rodents

- Adult rodents may be aggressive when stressed and fight each other.
- Except for orphaned young or females with their own young, only one animal should be housed in each enclosure.
- Locate enclosures in secure rooms to allow capture in the event of escape.
- Visual barriers may be placed around enclosures to prevent fear response or aggressive interactions with nearby housed rodents.
- Provide a quiet area and minimise disturbance by shutting doors to rooms containing rodent enclosures.
- Loud noise and disturbance are a stressor for rodents.
- Keep rodents in enclosures that are separate from domestic animals so that they do not see, hear or smell them.
- Change out of clothes that have been worn around dogs or cats to minimise exposure to pet scent.

8.6.2. Enclosure hygiene and biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

- Wash hands with soap and water after handling dogs and cats to minimise the risk of transferring disease agents such as *Toxoplasma gondii*, which can be found in cat faeces.
- Left-over food and faecal matter should be spot cleaned daily from enclosures to ensure good levels of hygiene are maintained.
- Any wet/sodden or soiled organic furnishings, substrate or enrichment items must be removed as soon as possible and replaced with a clean/dry alternative.
- Since these enclosures are used to house sick/injured rodents, they must be cleaned and disinfected between inhabitants.
- Substrate should be completely replaced and furniture, such as branches or boxes made of unsealed wood, should be discarded as they cannot be effectively disinfected.
- Enclosures should be cleaned with hot soapy water and then disinfected with products such as F10 or bleach at the recommended concentrations and contact times.

8.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care.

Table 8.6 describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 8.8**.

Table 8.6 Rehabilitation housing for adult native rodents

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment – frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision where strict cage rest/confinement is indicated</p>	<p>Water rats:</p> <p>Floor area: 1 m x 1 m (1 m²)</p> <p>H: 0.5 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Purpose-built incubators, such as a Vetario (see image) or strong fish tank with a close-fitting lid with adequate ventilation. • A solid wood enclosure or plastic tub for water rats as they can damage their teeth on wire in cage enclosures. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • A timber nest box should be offered for adults (see Figure 8.10). • Newspaper is suitable as flooring. • Orphaned young should be housed in nests inside an escape-proof container that has adequate ventilation. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Sick adult rodents are kept on a heat gradient with the warm end at 28°C. • Heating pads are commonly used. • All heating should be monitored with a thermometer. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Access to fresh water, changed daily, and captive diet should be provided in stable dishes. • Regular check of substrate to ensure water has not spilt/ enclosure is not sodden.
	<p>Small to medium mice and rats</p> <p>Floor area: 0.30 m x 0.20 m (0.06 m²)</p> <p>H: 0.2 m</p>	

Intermediate housing (Treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care.</p> <p>Enclosure furnishings can be arranged to reduce opportunities to move excessively so that cage rest can be achieved with slightly more space/ reduced contact.</p>	<p>Water rats: Floor area: 1 m x 2 m (2 m²) H: 1 m</p> <p>Small to medium mice and rats Similar to pre-release enclosure sizes</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Mice and smaller rats can be housed in a glass tank (see Figure 8.8) or solid wooden container. • Water rats may be housed in aviaries with solid metal walls. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Leaf litter or mulch is suitable flooring. • For smaller rodents, pine shavings can be used. • Furnishings can be arranged to reduce opportunities to climb/dig or move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact. • Nest-boxes should be offered as a sleeping area. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • This housing stage is suitable for sick or injured adults that no longer require heating. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Offer insects and seeds in the leaf litter. • Access to fresh water, changed daily, and captive diet should be provided in stable dishes.

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/ medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitor/assess behaviour (foraging, digging, nest building)</p> <p>Enclosure allows expression of a full range of natural behaviours</p> <p>Pre-release assessment</p>	<p>Water rat</p> <p>Floor area for one animal:</p> <p>3 m x 2 m (6 m²)</p> <p>H: 2 m</p> <p>Nest box:</p> <p>25 cm x 30 cm.</p> <p>H: 55 cm.</p> <p>Entrance hole diameter:</p> <p>8.5 cm</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> Water rats require walls made of solid tin or wood. One third of the enclosure sheltered from the weather. A shallow pool to be provided for swimming. Nest boxes made from plywood. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> Non-toxic pine shavings or newspaper. Concrete floors can damage feet. Wire mesh buried below the soil surface will prevent animals digging out. Offer nest material such as Melaleuca, paperbark or dried grass. Logs, rocks, tussocks, sturdy branches for climbing, nest box or hollow log. Deep leaf litter mulch, tussock clumps for hides and branches for climbing. Nest boxes lined with eucalyptus leaves, washed and dried sea grass (check local authority for sea grass collection approval) or shredded paper. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> This housing stage is suitable for sick or injured adults that no longer require heating and are nearing release. They should be exposed to ambient outdoor temperatures with sheltered exposure to prevalent weather conditions. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Access to fresh water, changed daily, and captive diet provided in stable dishes.
	<p>Medium sized rodents</p> <p>Floor area for one animal:</p> <p>1.5 m x 1.0 m (1.5 m²)</p> <p>Nest box:</p> <p>25 cm x 17 cm.</p> <p>H: 11 cm.</p> <p>Entrance hole diameter: 5 cm</p>	
	<p>Small rodent</p> <p>Floor area for one animal:</p> <p>0.60 m x 0.50 m (0.30 m²)</p> <p>H: 0.30 m</p> <p>Nest box:</p> <p>14 cm x 12 cm.</p> <p>H: 10 cm.</p> <p>Entrance hole diameter:</p> <p>3.2 cm</p>	

Figure 8.7 Vetario, suitable for intensive care.



Figure 8.8 Glass tanks – Intermediate housing examples (treatment/rest)



Figure 8.9 Large glass tank enclosure



Figure 8.10 Medium to small rodent timber nest box



Photo credits: Zoos Victoria

8.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of weaned and adult native rodents in rehabilitation. Information on feeding orphaned individuals can be found under **Section 8.8 Hand raising**.

- Fresh water must be always available, provided in a stable/non-spill bowl or automatic drinker. Water must be changed daily. Care must be taken that small animals cannot become trapped or drown in the water dishes.
- Ensure food is provided in an aluminium or ceramic dish that is easily sterilised and cannot be chewed on.
- Always provide fresh food daily, cut to appropriate size.

Table 8.7 Daily feeding and diet guide for adult native rodents during rehabilitation

Species	Water rat
Diet – daily diet options per animal	<ul style="list-style-type: none"> • 4–6 yabbies or 8–10 yabby tails (approximately 180 g total), or • 1–2 medium size fish (e.g. pilchards/whiting), or • 2 x day-old chicks, or • ½ packet prawns and 8 pippis/mussels
Pre-release considerations	<ul style="list-style-type: none"> • The rodent must be able to swim, dive and feed without aid prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily, preferably late afternoon as they are nocturnal
Species	Swamp rat
Diet	<ul style="list-style-type: none"> • 10–15 g seed (millet, sorghum, safflower mix) • 10 g fruit (1 cm cube) (may include carrot) • 10 g greens e.g. silverbeet, sow thistle, spinach • 2 mealworms • 2 g rodent pellets • Native sedges, grasses
Pre-release considerations	<ul style="list-style-type: none"> • The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily

Species	Australian bush rat
Diet	<ul style="list-style-type: none"> • 10 g seed (millet, sorghum, safflower mix) • 10 g fruit (1 cm cube) (may include carrot) • 10 g greens e.g. silverbeet, sow thistle, spinach • 2 mealworms • 2 g rodent pellets • Fungi (mushroom) – as available
Pre-release considerations	<ul style="list-style-type: none"> • The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily, preferably late afternoon as they are nocturnal

Species	Silky mouse
Diet	<ul style="list-style-type: none"> • 10 g seed (millet, sorghum, safflower mix) • 10 g fruit (1 cm cube) (may include carrot) • 10 g greens e.g. silverbeet, sow thistle, spinach • 2 mealworms • 2 g rodent pellets
Pre-release considerations	<ul style="list-style-type: none"> • The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily, preferably late afternoon as they are nocturnal

Species	Smoky mouse
Diet	<ul style="list-style-type: none"> • 10–15 g high fibre vegetables (broccoli, sweet potato, carrot) • 10–15 g seed (millet, sorghum, safflower mix) (or acacia/banksia) • 10–15 g fresh greens, vegetation (silverbeet, grass, browse) • 2 mealworms • Fungi (mushroom) – as available
Pre-release considerations	<ul style="list-style-type: none"> • The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily, preferably late afternoon as they are nocturnal

Species	Heath mouse
Diet	<ul style="list-style-type: none"> • 10 g seed (millet, sorghum, safflower mix) • 10 g fruit (1 cm cube) (may include carrot) • 10 g greens e.g. silverbeet, sow thistle, spinach • 2 mealworms • 2 g rodent pellets
Pre-release considerations	<ul style="list-style-type: none"> • The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily

Species	New Holland mouse
Diet	<ul style="list-style-type: none"> • 2–4g seed (millet) • 4 g high fibre vegetables (broccoli, sweet potato, carrot) • 10 g greens e.g. silverbeet, sow thistle, spinach • 2 g rodent pellets
Pre-release considerations	<ul style="list-style-type: none"> • The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily, preferably late afternoon as they are nocturnal

Species	Mitchell's hopping mouse
Diet	<ul style="list-style-type: none"> • 10 g Wombaroo Macropod Pellet • 2 g spinach – chopped • 8 g broccoli – chopped • Twice weekly: • 4 g mushroom – chopped • 1 mealworm or cricket
Pre-release considerations	<ul style="list-style-type: none"> • The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none"> • Fed daily, preferably late afternoon as they are nocturnal

Species	Broad-toothed rat
Diet	<ul style="list-style-type: none">• 20 g Wombaroo Macropod Pellet• 15 g seed (millet, sorghum, safflower mix)• 20–25 g greens e.g. silverbeet, sow thistle, spinach• Native sedges, grasses• Fungi (mushroom) – as available
Pre-release considerations	<ul style="list-style-type: none">• The native rodent should be able to move well and eat unaided prior to release
Frequency/time of feeding	<ul style="list-style-type: none">• Fed daily, preferably late afternoon as they are nocturnal

8.8 Hand raising

Hand raising recording templates for growth, development, feeding and other observations can be found in the appendices to Part A of these guidelines.

8.8.1. Equipment required for hand raising

- Catheter, pipette, fine paintbrush
- Small teat
- Syringes
- Pouches
- Scales
- Cotton tips, soft cotton cloth, tissues – for toileting
- Small ruler for measurements
- Kettle (or stove top) for boiling water
- Puppy formula
- Sterilising solution such as Milton
- Heat pad, hot water bottle (filled with warm water only and wrapped in a towel)
- Soft t-shirt material or blankets.

8.8.2. Feeding orphaned young

Ensure standard hygienic practices are implemented for hand rearing orphaned young, including:

- Washing hands prior to and after each feed
- Mixing formula with boiled water only – cooled to lukewarm prior to feeding
- Sterilise feeding equipment
- Provide clean bedding
- Stimulate toileting.

Young rodents cannot clean themselves, so it's important you maintain standard hygiene practices.

Note: When toileting a young rodent extreme care is required. Gently stimulate the area. Do not over-stimulate as this may result in a bowel prolapse. If the animal has not urinated or defaecated within 30 seconds – or is not showing signs that it is about to, cease toileting.

Table 8.8 Feeding and housing requirements for juvenile native rodents

Age	Weight/ morphometrics	Observations	Feeding	Housing
10–20 days	<p>Water rats 100 g/18 cm</p> <p>Medium rats 20–45 g/6–10 cm</p> <p>Mice 3–6 g/2.5–4 cm</p>	<ul style="list-style-type: none"> Water rats can swim at 14 days, and dive to and from the nest at 19 days Eyes open Ears open Covered in fur Guard hair has grown 	<p>Milk formula:</p> <ul style="list-style-type: none"> Puppy milk replacement (e.g. Wombaroo) follow the manufacturer's instructions <p>Feed volume and frequency:</p> <ul style="list-style-type: none"> Young should be fed 10–20% of their body weight each day Teeth should have erupted, start offering solids such as small slices of apple, sweet potato, broccoli, greens (silverbeet, spinach) Milk feeding schedules can be reduced depending on the young rodent's weight (should be increasing), overall body condition and quantity of solid foods being eaten <p>Feeding technique:</p> <ul style="list-style-type: none"> Use a small teat. You can also start to offer a small amount of the formula in a small 'rodent sized' dish i.e. a small non-tippable petri dish made of glass or ceramic The rodent will start to transition itself off the formula and become more interested in nibbling at the solid foods offered <p>Toilet:</p> <ul style="list-style-type: none"> After feeding, young must be stimulated to toilet, very gently, with a soft, disposable cloth, tissue or cotton tip, dipped in warm water. At this stage young rodents may be starting to toilet on their own, monitor. 	<p>Bedding material:</p> <ul style="list-style-type: none"> Soft t-shirt material, blankets (no knitted material the mice can become entangled in) Add in wood shavings, sphagnum moss, native grasses <p>Enclosure:</p> <ul style="list-style-type: none"> Secure box or thermostatically controlled, portable animal intensive care unit <p>Temperature range:</p> <ul style="list-style-type: none"> 20–28°C (at this stage remove any 'chewable' heat sources if not chew proof) It is important to continually monitor temperature range

Age	Weight/ morphometrics	Observations	Feeding	Housing
4–6 weeks	<p>Water rats</p> <p>620–1200 g/30–39 cm</p> <p>Medium rats</p> <p>160–225 g/20–23 cm</p> <p>Mice</p> <p>13–18 g/ 5–6 cm</p>	<ul style="list-style-type: none"> • Weaning age • First moult can occur 	<p>Milk formula:</p> <ul style="list-style-type: none"> • Puppy milk replacement (e.g. Wombaroo) follow the manufacturer's instructions <p>Feed volume and frequency:</p> <ul style="list-style-type: none"> • Young should be fed 10–20% of their body weight each day • A small amount of formula may still be offered in a small 'rodent sized' dish i.e. a non-tippable small petri dish made of glass or ceramic • Majority of the diet offered will be solids such as small slices of apple, sweet potato, broccoli, greens (silverbeet, spinach) • Fresh water in a very small dish should now be supplied <p>Feeding technique:</p> <ul style="list-style-type: none"> • Offer a small amount of the formula in a small 'rodent sized' dish i.e. a small petri dish made of glass or ceramic • The rodent will start to transition itself off the formula and become more interested in nibbling at the solid foods offered <p>Toilet:</p> <ul style="list-style-type: none"> • At this stage young rodents may be starting to toilet on their own, monitor. • If not, young must be stimulated to toilet after feeding, very gently, with a soft, disposable cloth, tissue or cotton tip, dipped in warm water 	<p>Bedding material:</p> <p>Water rat</p> <ul style="list-style-type: none"> • Nest box: 25 cm x 30 cm. H: 55 cm. Entrance hole diameter: 8.5 cm, lined on the base with towels • You can provide native plants e.g. <i>Eucalyptus</i> sp., <i>Acacia</i> for nesting material and to chew on <p>Medium rats and mice</p> <ul style="list-style-type: none"> • Add in wood shavings, sphagnum moss, native grasses • Add in wood shavings, native grasses <p>Enclosure:</p> <p>Water rat</p> <ul style="list-style-type: none"> • At day 19, water rats require a small secure area with access to a waterbody such as a clam pool. Swimming must always be monitored to prevent drowning • Nest box should have a heat source at one end <p>Medium rats and mice</p> <ul style="list-style-type: none"> • Rodents should have access to a secure area with a nest box • Nesting material (e.g. wood shavings, native grasses, eucalyptus leaves) provided <p>Temperature range:</p> <ul style="list-style-type: none"> • 15–25°C

8.9 Release protocol



Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for the animal.

8.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release. The following check list should be used to guide your decision-making regarding release suitability for native rodents:

- ☑ Rodent is in a state of good health – presenting injury/sickness is completely resolved (consider pre-release veterinary check).
- ☑ Rodent is within a healthy weight range and appropriate body condition (see **Table 8.3**).
- ☑ Rodent displays ability to actively forage for and consume natural foods.
- ☑ Rodent displays ability to build nests and seek cover.

8.9.2. At the release site

When releasing animals back into the wild, it is important to consider certain features of the release site and approaches to the release to maximise survivorship. Native rodents require:

- Suitable cover of native vegetation to retreat from predators and provide shelter.
- Wild food source available in species habitat.
- Minimal disturbance by people and traffic to the area.
- Minimal threats including forestry, habitat destruction, pollution and low predator numbers.
- Released where found and where known same species live in the area.

8.9.3. Release checklist

Have you checked to see if you are meeting all the requirements of your authorisation and considered the following:

Release location

Suitable vegetation is available, including grasses and dense lower story vegetation.

- ☑ Ample foraging areas close to dense vegetation.
- ☑ Dense vegetation cover for nest building.
- ☑ Soil layer soft and suitable for foraging/ digging.
- ☑ Same species living in the wider area.
- ☑ No obvious threats (for example future land clearing, pollution).

Release Procedure

- ☑ Limit the number of people at the release.
- ☑ Appropriate timing (one hour after dusk – during natural peak activity).
- ☑ Open transport container away from yourself near dense cover, ensuring that people are standing behind the rodent's 'flight' zone.
- ☑ Allow the rodent to leave in its own time.
- ☑ The nest box may be left in a safe, well-covered and hidden location. Supplemental food can be placed in the nest box for up to a week to support the animal during the first few days post release.
- ☑ Monitor food consumption daily and gradually reduce the amount of food left in the box.

8.10 Key references and additional reading

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Chapter 9.

Possums and Gliders

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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

Greater gliders, yellow-bellied gliders and Leadbeater's possums are considered specialist animals and should be rehabilitated by a wildlife shelter operator experienced in their care in the region that they are found.

When possums and gliders come into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition and an environment appropriate to the stage of rehabilitation. The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

9.1 Introduction

Squirrel gliders, southern greater gliders, yellow-bellied gliders, mountain pygmy-possums and Leadbeater's possums are listed as threatened in Victoria.



STOP – If a threatened species comes into care, please STOP and refer to your authorisation for mandatory conditions including notification and release requirements.


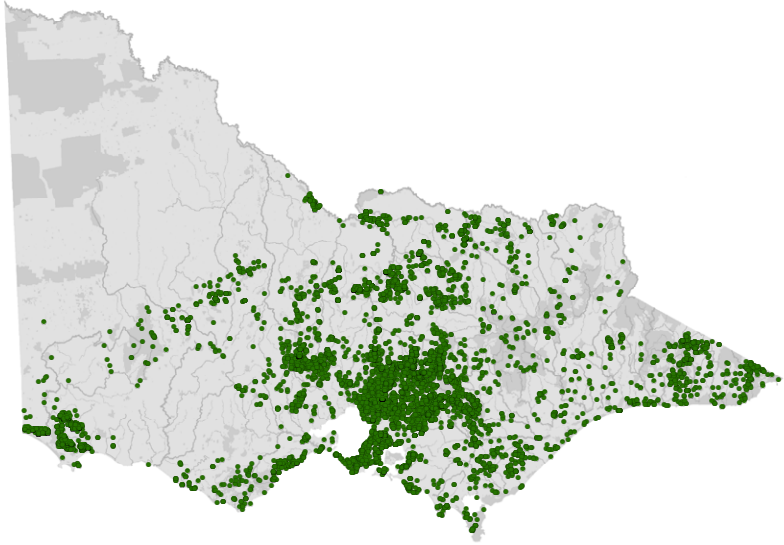
The four pygmy possums found in Victoria, the mountain pygmy-possum (*Burramys parvus*), the eastern pygmy-possum (*Cercartetus nanus*), the western pygmy-possum (*Cercartetus concinnus*) and the little pygmy-possum (*Cercartetus lepidus*) require accurate identification.

9.2 Species information


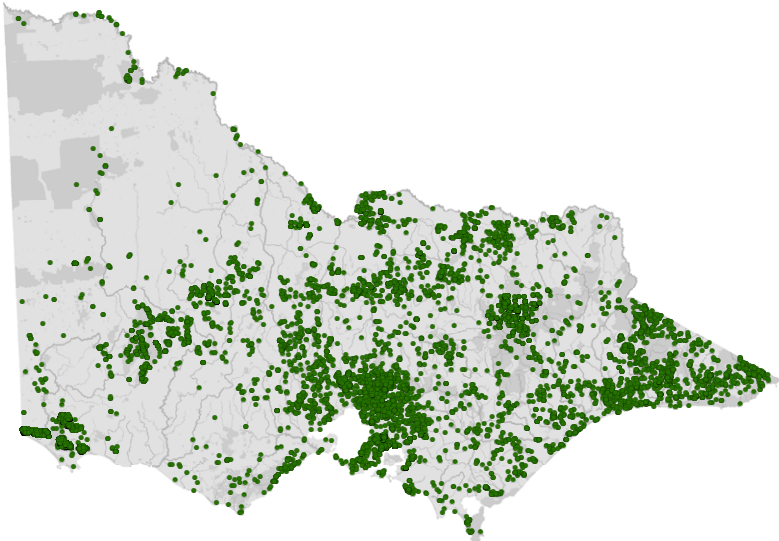


Profiles for possum and glider species found in Victoria are detailed in **Table 9.1** and **Table 9.2**. For assistance in identification of a possum or glider species, refer to the recommended reading and reference material at the end of this chapter.


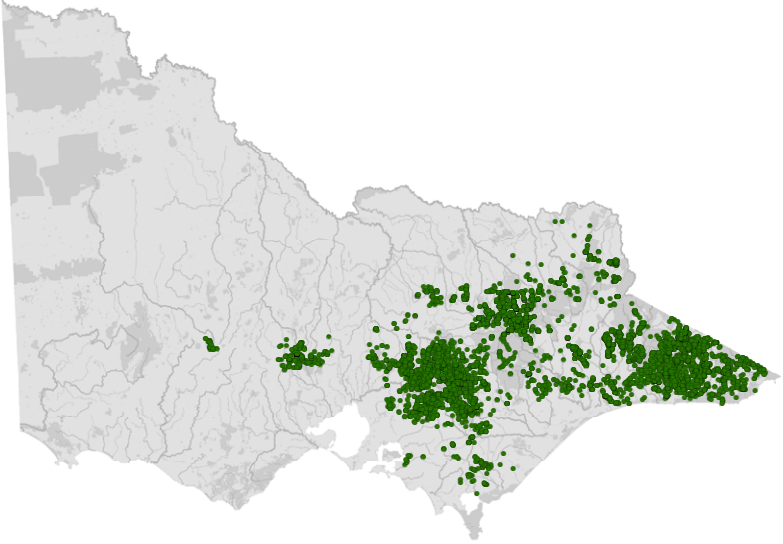
Table 9.1 Species Profiles

Species	Common ringtail possum (<i>Pseudocheirus peregrinus</i>)
 <p>Photo credit: Ian R McCann, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Grey/brown with black tipped fur with pale patches behind the eyes and usually a cream coloured belly. It has a thinly haired, long prehensile (meaning “to grasp”) tail with a white tip over 25% of its length, and small, curved ears (30 mm)</p>
<p>Conservation status*</p>	<p>Common</p>
<p>Adult morphometrics</p>	<p>Body weight: 650–1100 g</p> <p>Head and body length: 30–35 cm</p> <p>Tail length: 30–35 cm</p>
<p>Habitat</p>	<p>Rainforest, forest, woodland and scrub</p>
<p>Nest site</p>	<p>Drey or tree hollow</p>

Species	Common ringtail possum (<i>Pseudocheirus peregrinus</i>)
Nest sharing	Yes
Home range	2 ha
Population density per ha	0.2–34
Behaviour	Nocturnal. Communal
Diet	Myrtaceae leaves (including eucalyptus), flowers, fruit, sap. Coprophagic during the day
Longevity	3–6 years
Sexual maturity	Male: 12 months Female: 12 months
Mating season	March to November
Gestation length	20–26 days
Litters per year	1–2 (usually 2 young)
Pouch life	120 days
Weaning age	6–7 months
Dispersal age	8–12 months

Species	Common brushtail possum (<i>Trichosurus vulpecula</i>)
 <p>Photo credit: David Paul, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>

Species	Common brushtail possum (<i>Trichosurus vulpecula</i>)
General appearance	About the size of a domestic cat with pointed ears and grey fur with a buff coloured belly. The tail is bushy and black but young can have a white tip. The tail is prehensile and naked on its underside
Conservation status*	Common
Adult morphometrics	Body weight: 1.2–3.5 kg (females), 1.3– 4.5 kg (males) Head and body length: 35–55 cm Tail length: 25–40 cm
Habitat	Forests, semi-arid areas and urban areas. Occurs in most habitats except Mallee scrub
Nest site	Tree hollow
Nest sharing	Uncommon
Home range	Male: 5.4 ha Female: 2.4 ha
Population density per ha	0.2–4.0
Behaviour	Nocturnal. Solitary
Diet	Eucalypt leaves, flowers, shoots, fruits and seeds. They may also consume animal matter such as insects, birds' eggs and chicks, and other small vertebrates, though this is only occasional
Longevity	11–13 years
Sexual maturity	Male: 14 months Female: 12 months
Mating season	All year with autumn and spring peaks
Gestation length	16–18 days
Litters per year	1 (1 young)
Pouch life	145 days
Weaning age	6–7 months
Dispersal age	8–18 months Males disperse earlier than females

Species	Mountain brushtail possum (<i>Trichosurus cunninghami</i>) or Bobuck
 <p>Photo credit: Ian R McCann, Museums Victoria</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
<p>General appearance</p>	<p>Larger than the common brushtail possum, with round, short ears (40 mm). The fur is often dark, with a black, bushy tail which is hairless underneath. The belly is cream coloured</p>
<p>Conservation status*</p>	<p>Common</p>
<p>Adult morphometrics</p>	<p>Body weight: 2.4–4.2 kg</p> <p>Head and body length: 49–54 cm</p> <p>Tail length: 34–37 cm</p>
<p>Habitat</p>	<p>Tall wet forests and rainforests, altitude above 300 m (typically). Recently found in lowland swamp coastal habitat in south-west Gippsland</p>
<p>Nest site</p>	<p>Tree hollow</p>
<p>Nest sharing</p>	<p>Yes</p>
<p>Home range</p>	<p>5.6–6.4 ha</p>
<p>Population density per ha</p>	<p>0.7–2.3</p>
<p>Behaviour</p>	<p>Nocturnal. Solitary</p>
<p>Diet</p>	<p>Acacia sp, (Silver wattle preferred), fungi, lichens, bryophytes. <i>Eucalyptus</i> and tea tree (lowland)</p>

Species	Mountain brushtail possum (<i>Trichosurus cunninghami</i>) or Bobuck
Longevity	Male: 6–15 years Female: 9–17 years
Sexual maturity	Male: 36 months Female: 22–36 months
Mating season	March to May
Gestation length	15–17 days
Litters per year	1 (1 young)
Pouch life	175–200 days
Weaning age	8–9 months
Dispersal age	18–36 months

Species	Leadbeater's possum (<i>Gymnobelideus leadbeateri</i>)
 <p>Photo credit: TBD</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Grey with prominent mid-dorsal stripe. Tail broader at tip compared to base. No gliding membrane. Short face. Black stripe down middle of head
Conservation status*	Critically endangered

Species	Leadbeater's possum (<i>Gymnobelideus leadbeateri</i>)
Adult morphometrics	Body weight: 100–166 g Head and body length: 150–170 mm Tail length: 145–180 mm
Habitat	Mixed-age eucalypt stands with acacia mid-storey
Home range	1–3 ha
Den	Tree hollow with spherical nest of shredded bark
Behaviour	Nocturnal. Torpor: no. Territorial. Communal (groups of 1–8). Forages alone
Diet	Plant excretions (a range of wattle saps and exudates) make up 80% of their energy intake. Lerp and arthropods (spiders, crickets, termites and beetles) are also eaten
Captive lifespan	5–9 years
Sexual maturity	Male: 26 months Female: 14 months
Mating season	February–October
Gestation length	15–20 Days
Pouch life	80–93 days, March–December
Den young	May–December
Litters per year	1–2 litters of 1–2 young
Weaning	120 days
Dispersal	10–15 months

Species

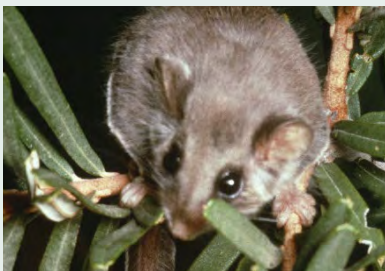
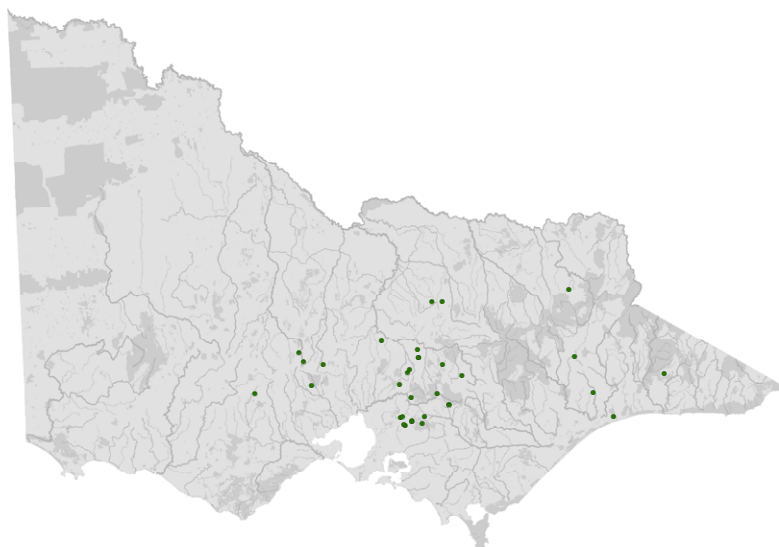
Feathertail glider (*Acrobates pygmaeus*)

Photo credit: Ian R McCann,
Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

Appearance: Smallest glider, about the size of a mouse. Flat hairs perpendicular to the tail look like a thin feather. Soft, uniform greyish brown fur, white on the belly, dark rings around the eyes, moderately large ears and there are a large number of whiskers. Gliding membrane from elbow to knee

Conservation status*

Common

Adult morphometrics

Body weight: 10–15 g
Head and body length: 65–80 mm
Tail length: 70–80 mm

Habitat

Range of forest types

Home range

0.1–2 ha

Den

Tree hollow, with nest of leaves

Behaviour

Nocturnal. Topor: yes. Territorial. Communal (groups of 4–40).
Forages alone


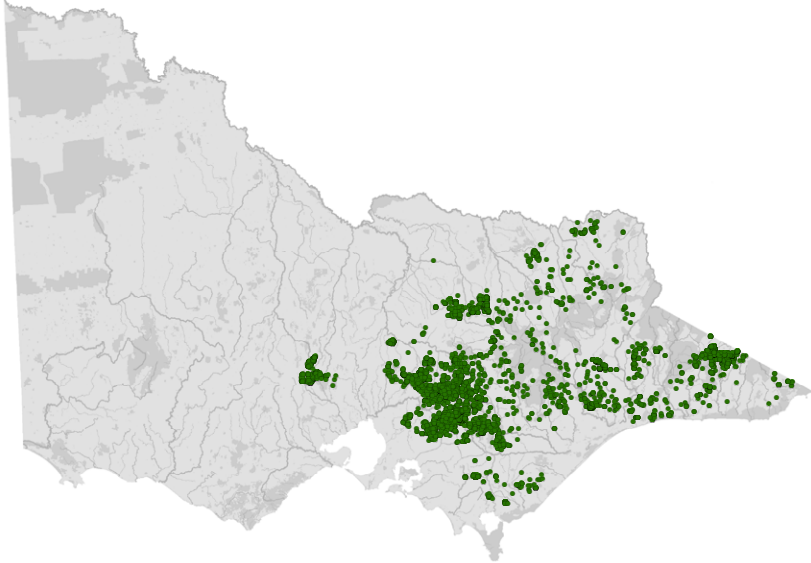

Diet

Nectar, pollen and insects such as such as moths, ants and termites

Lifespan

5 years

Species	Feathertail glider (<i>Acrobates pygmaeus</i>)
Sexual maturity	Male: 7–18 months Female: 6 months
Mating season	Most of the year (July to January commonly in Victoria)
Gestation length	First litter 15–30 days and second litter 65–100 days – this species has embryonic diapause
Pouch life	65 days, most of the year
Den young	Most of the year
Litters per year	1–2 of up to 4 young
Weaning	100 days
Dispersal	3–4 months

Species	Southern greater glider (<i>Petauroides volans</i>)
 <p>Photo credit: Colleen Wood</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
 <p>Photo credit: Doug Gimesy</p>	
General appearance	Long bushy tail, long fur, coat may be cream to black, with a pale belly. Large ears. Gliding membrane from elbow to ankle
Conservation status*	Vulnerable

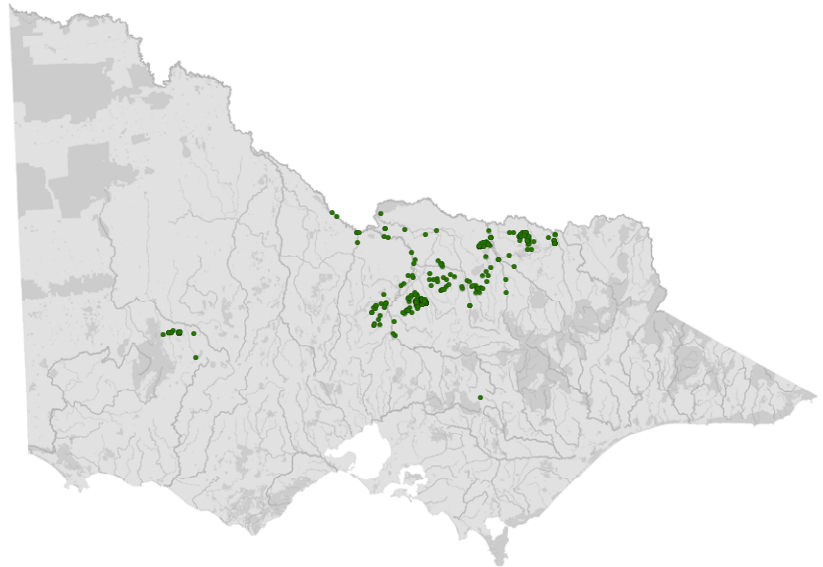
Species	Southern greater glider (<i>Petauroides volans</i>)
Adult morphometrics	Body weight: 900–1700 g Head and body length: 35–46 cm Tail length: 45–60 cm
Habitat	Mature, wet eucalypt forests
Home range	1–3 ha
Den	Tree hollows
Behaviour	Nocturnal. Topor: yes. Territorial. Solitary. Forages alone
Diet	Almost exclusively feeds on eucalypt leaves and buds
Captive lifespan	15 years
Sexual maturity	Male: 18 months Female: 24 months
Mating season	March–June
Gestation	Unknown
Pouch life	90–120 days, April–October
Den young	June–January
Litters per year	1 litter of 1 young
Weaning	240–300 days
Dispersal	12 months

Species

Squirrel glider (*Petaurus norfolcensis*)

Photo credit: David Paul,
Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance	Larger than Krefft's glider. Longer face than Krefft's glider. Longer nose. Bushy tail, thicker at base. White belly fur. Scent gland in adult situated middle of the forehead. Gliding membrane from wrist to ankle
Conservation status*	Vulnerable
Adult morphometrics	Body weight: 190–300 g Head and body length: 189 – 230 mm Tail length: 220 – 300 g
Habitat	Dry forests and woodlands
Home range	5–7 ha
Den	Tree hollows with nest of leaves
Behaviour	Nocturnal. Topor: yes. Territorial. Communal (groups of up to 10 individuals) Forages alone
Diet	Nectar, pollen, plant exudates (acacia gum, eucalypt sap), invertebrates, honeydew
Captive lifespan	3–5 years
Sexual maturity	Male: 12 months Female: 12 months

Species	Squirrel glider (<i>Petaurus norfolcensis</i>)
Mating season	June–August
Gestation length	20 days
Pouch life	August–December
Den young	120 days, October–January
Litters per year	1 litter of 1–2 young
Weaning	120 days
Dispersal	12–18 months

Species	Krefft's glider [<i>Petaurus notatus</i>] (Formerly sugar glider [<i>Petaurus breviceps</i>])
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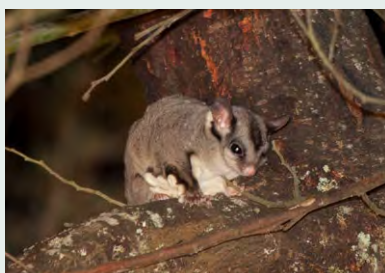
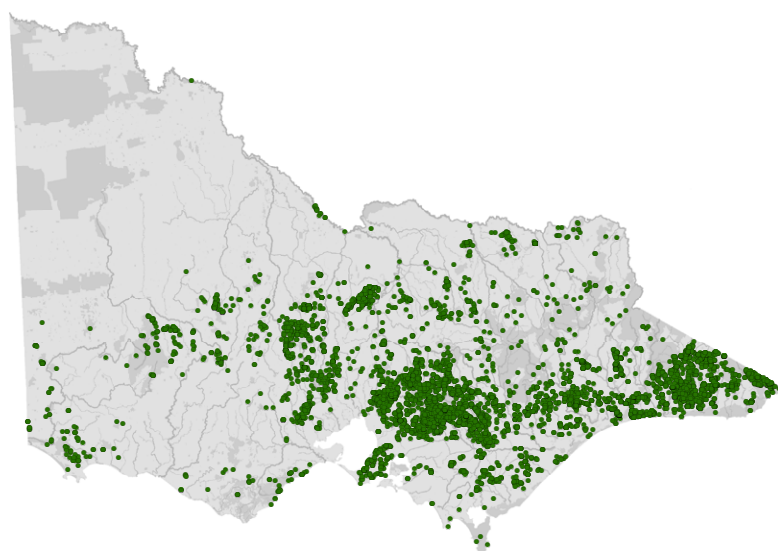


Photo credit: Tracey-Ann Hooley, Museums Victoria

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023
www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance	40 cm long, nose to tail. Black stripe down middle of head. Short face and ears. Sometimes white tip on tail. Gliding membrane from wrist to ankle
Conservation status*	Common
Adult morphometrics	Body weight: 115–160 g (male) 95–135 g (female) Head and body length: 160–210 mm Tail length: 165–210 mm

Species	Krefft's glider [<i>Petaurus notatus</i>] (Formerly sugar glider [<i>Petaurus breviceps</i>])
Habitat	Eucalupt forest with wattles
Home range	0.5–7 ha
Den	Tree hollow with nest of leaves
Behaviour	Nocturnal. Topor: yes. Territorial. Communal (groups of 2–12), forages alone
Diet	Acacia gum, nectar, pollen, eucalypt sap, invertebrates and invertebrate exudates
Captive lifespan	12–15 years (4–9 in the wild)
Sexual maturity	Male: 8 months Female: 8 months
Mating season	June–December
Gestation length	15–17 days
Pouch life	70 days, August–October
Den young	October–December
Litters per year	1 litter of 1–2 young
Weaning	120 days
Dispersal	7–10 months

Species

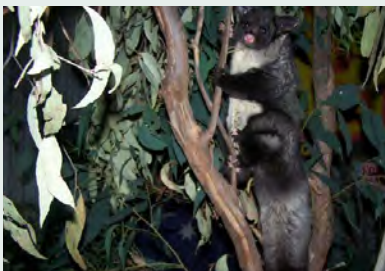
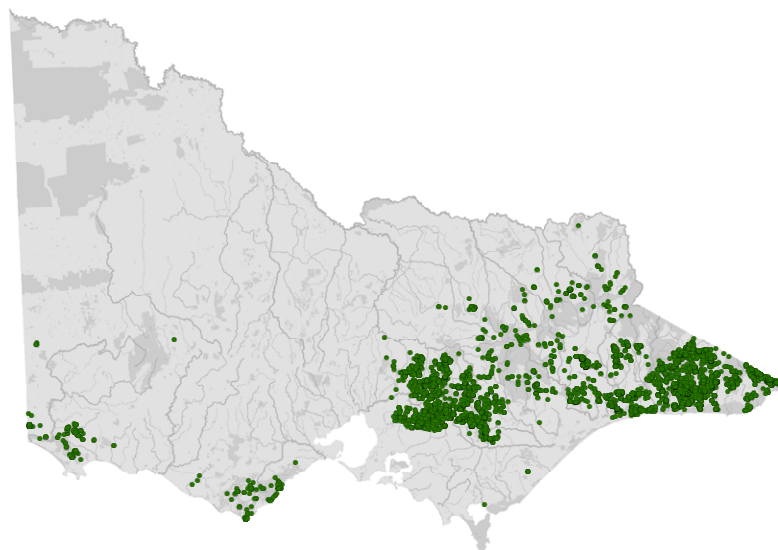
Yellow-bellied glider (*Petaurus australis*)

Photo credit: Geoff Sands

Distribution map



Data source: Victorian Biodiversity Atlas Jan 2023

www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas

General appearance

Fat bushy tail. Grey above and cream below. Scent gland in adults situated middle of the forehead. Gliding membrane from elbow to ankle

Conservation status*

Vulnerable

Adult morphometrics

Body weight: 470–725 g (male)
435–660 g (female)
Head and body length: 24–31 cm
Tail length: 38–47 cm

Habitat

Mixed mature eucalypt forest

Home range

20–85 ha

Den

Tree hollow with nest of leaves

Behaviour

Nocturnal. Torpor: yes. Territorial. Family groups (3–6 individuals), forages in a family group

Diet

Eucalypt nectar/sap (30–80% of diet), pollen, honeydew, manna, lerps, insects and spiders

Lifespan

6–10 years

Sexual maturity

Male: 24 months
Female: 24 months

Species	Yellow-bellied glider (<i>Petaurus australis</i>)
Mating season	All year round (Victoria, August–December)
Gestation length	Unknown
Pouch life	100 days, year round
Den young	60 days, year round
Litters per year	1 litter of 1–2 young
Weaning	180–240 days
Dispersal	18–24 months

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

9.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for possums and gliders is in **Section 9.6.2**.

The following information relates to the human and animal health and safety considerations specifically for the rehabilitation of possums and gliders.

9.3.1. Human safety considerations

- If there is any doubt about the safety of approaching an animal at height, a person with the appropriate training (arborist/tradesman/climber) should be contacted.
- All possums/gliders can give a painful bite which may be deep enough to damage the underlying tendons and muscles of the handler.
- Possums/gliders may also scratch deeply and draw blood.
- Possums/gliders can climb up their own tail to turn and bite the handler.
- Possums/gliders can carry zoonotic diseases.

9.3.2. Animal safety considerations

- Rough handling of the possum/glider can result in skin and tissue trauma and fur loss.

9.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 9.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned possums and gliders.

9.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/ severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 9.2 Visual health observations in possums

What to look for	
Demeanour	<ul style="list-style-type: none"> • Bright, alert • May freeze, but if given space should attempt to avoid capture • Brushtail possums may be vocal • Abnormal observations include: <ul style="list-style-type: none"> - No attempt to avoid capture - Slow responses
Behaviour	<ul style="list-style-type: none"> • Actively moving in a co-ordinated manner • Investigating their environment • Looking for an escape route • Ringtail possums rarely bite • Abnormal observations include: <ul style="list-style-type: none"> - No fear of humans - No attempt to escape

What to look for	
Movement and posture	<ul style="list-style-type: none"> • Normal use of all four limbs. No evidence of lameness or open wounds • Climb quickly • Abnormal observations include: <ul style="list-style-type: none"> - Favouring a limb - Lack of co-ordination - Dragging limbs and/or tail - Will not climb
Breathing	<ul style="list-style-type: none"> • Regular but may be quite rapid for stressed animals • Abnormal observations include: <ul style="list-style-type: none"> - Panting or open mouth breathing is abnormal and may indicate respiratory distress or over heating - Struggling to breathe, gasping breaths

Table 9.3 Visual health observations in gliders

What to look for	
Demeanour	<ul style="list-style-type: none"> • Vocal • Reacts to handling • Bright, alert • May freeze (especially greater gliders), but if given space should attempt to avoid capture • Abnormal observations include: <ul style="list-style-type: none"> - Curled into tight ball - No attempt to avoid capture - Slow responses
Behaviour	<ul style="list-style-type: none"> • Actively moving in a co-ordinated manner • Investigating their environment • Looking for an escape route • Greater gliders and yellow-bellied gliders rarely bite, but will scratch attempting to escape • Abnormal observations include: <ul style="list-style-type: none"> - No fear of humans - No attempt to escape

What to look for	
Movement and posture	<ul style="list-style-type: none"> • Normal use of all four limbs. No evidence of lameness or open wounds • Climb quickly • Abnormal observations include: <ul style="list-style-type: none"> - Favouring a limb - Lack of co-ordination - Dragging limbs and/or tail - Will not climb
Breathing	<ul style="list-style-type: none"> • Regular. May be quite rapid for stressed animals • Can be difficult to observe • Abnormal observations include: <ul style="list-style-type: none"> - Panting or open mouth breathing is abnormal and may indicate respiratory distress or over heating - Struggling to breathe, gasping breaths

9.4.2. Equipment

- **Towel:** A thick towel is preferred to provide protection for the handler and also to provide suitable restraint for the animal.
- **Leather gloves:** may be used for handling adult common brushtail possums if a towel is not available.
- **Trap:** (operating under authorisation) common brushtail possums may be trapped in cat treadle traps or dedicated wire possum traps. The latter use a basket design, rather than a treadle. An apple with peanut butter can be placed in the basket. Possums should not be moved inside the cage but **transferred** to a bag. Moving possums while inside the trap is very stressful. Traps, if placed outdoors, should have their rear one-third covered with non-transparent, waterproof plastic.
- **Net:** may be used to catch before transfer to a bag or transport container.
- **Catch bag:** Possums/gliders can be secured inside a thick cloth, hessian or calico bag.
- **A towel, calico bag or pillow case, and a tie:** can be used to restrain a possum or glider.
- **Transport container:** standard pet carriers are usually adequate.

Figure 9.1 a. Two different sizes of cloth nets which may be used to catch possums and gliders. b. A catch bag to restrain small possums or gliders.



Photo credits: Zoos Victoria

Figure 9.2 Leather gloves



Figure 9.3 Soft sided pet packs can be used for transport



Image: Zoos Victoria

9.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

9.4.3.1 Possums

Restraint of wild adult possums, particularly brushtails, can be difficult. Manual restraint is only useful for short examinations and medicating. A brief examination can be done while keeping the possum inside a bag, and only exposing parts of the possum at a time. This works reasonably well so long as the head can be kept covered and it is undertaken by an experienced handler.

Possums can also be restrained by placing a thick towel over the possum ensuring the head is covered. Use one hand to grip the possum's tail at the base (as close to the animal's body as possible) and the other hand to restrain the head and shoulders with the thumb and index finger on either side of the neck. Do not place any pressure on the throat when restraining the possum to allow it to breathe normally. Restraint time should be kept as short as possible. Note that damaging the tail is possible if held part way down the length of the tail.

Thorough examination requires general anaesthesia. Possums may be restrained in a bag for anaesthesia induction by mask or injection by a veterinarian.

Figure 9.4 a. A common ringtail possum held with one hand restraining the tail and hind-legs and the other hand around the neck and head. **b.** An adult common brushtail possum restrained in a towel.



Photo credit: Zoos Victoria

On or close to the ground

Possums may be found on the ground as a consequence of predation, heat stress or vehicle trauma. Often the animal can be approached and covered with a towel before being scooped up and placed into a suitable container or cloth bag. Debilitated animals that are still mobile may reach the low branches of shrubs and can be captured using a towel placed over their head and body.

Confined spaces

Examples of confined spaces from where possums may be captured include drains, between walls, and inside fireplaces and wood-heaters.

If possible, attempt to release the possum from the confined space without handling it. This may be suitable for possums confined in wheelie bins, dumpsters, wall spaces or water tanks. The possum may be encouraged to climb out of a confined space by securing a rope to the side of the space, allowing the animal to leave in its own time. Never damage property (for example, cutting a hole in a wall to retrieve an animal) without the owner's permission.

Animals can be retrieved or captured using a flag on a pole to give an extended reach into a narrow space. The flag can be used to direct the animal to an exit point.

Wildlife rescuers should avoid entering confined spaces due to the potential risk of becoming trapped inside.

If capture is attempted, the possum may be covered with a towel. This covers the claws and gives the animal something to bite. The possum may be restrained for a short period by holding onto the base of the tail.

Possums may also become trapped in garage roller-doors. The capture may be attempted with two people – one to control the roller door movement and the other to support the possum. Sedation may result in less struggling

and injury to the possum. If the tail is caught in the cable, slowly reversing the door may help release the tail.

Brushtail possums can be very difficult to extract from tight spaces as they strongly resist being pulled out by curling into a ball and digging in their nails. In these situations, seek veterinary assistance as sedation by a vet may be required to extract the animal.

In the roof

Common brushtail possums favour tree hollows for their dens but in urban areas they may seek the dark shelter of house roofs to sleep during the day. Common ringtail possums rarely enter house roofs.

Most possums found in roofs are capable of getting out of their own accord. Before attempting to capture the possum, check to see if the animal already has an escape route. The best way to get a possum out of a roof is to watch for the possum to emerge from the roof after dark and then block off the access point(s). One-way doors on escape routes can also be used.

Cat treadle traps, or dedicated possum traps, may be used either in the roof space or at the entrance. They should be opened in the late afternoon, checked by dawn and kept closed during the day as the roof space can become extremely hot in summer. Trapped possums should be released on the same property, in their own territory, at night, as daytime releases are very stressful, and the possum will be disorientated. It is recommended that a nest box is placed in a tree on the property to give an alternative den space for common brushtail possums.

9.4.3.2 Gliders

Restraint should occur through a calico bag or small towel. Use the index and middle finger of one hand on either side of the head. Wrap the rest of the fingers around the body of the animal. Expose each part of the body in turn for examination.

Figure 9.5 a. Restraint of a Krefft's glider within a cloth. b. The same restraint is shown without the cloth. Note that the head is restrained between the thumb and first finger.

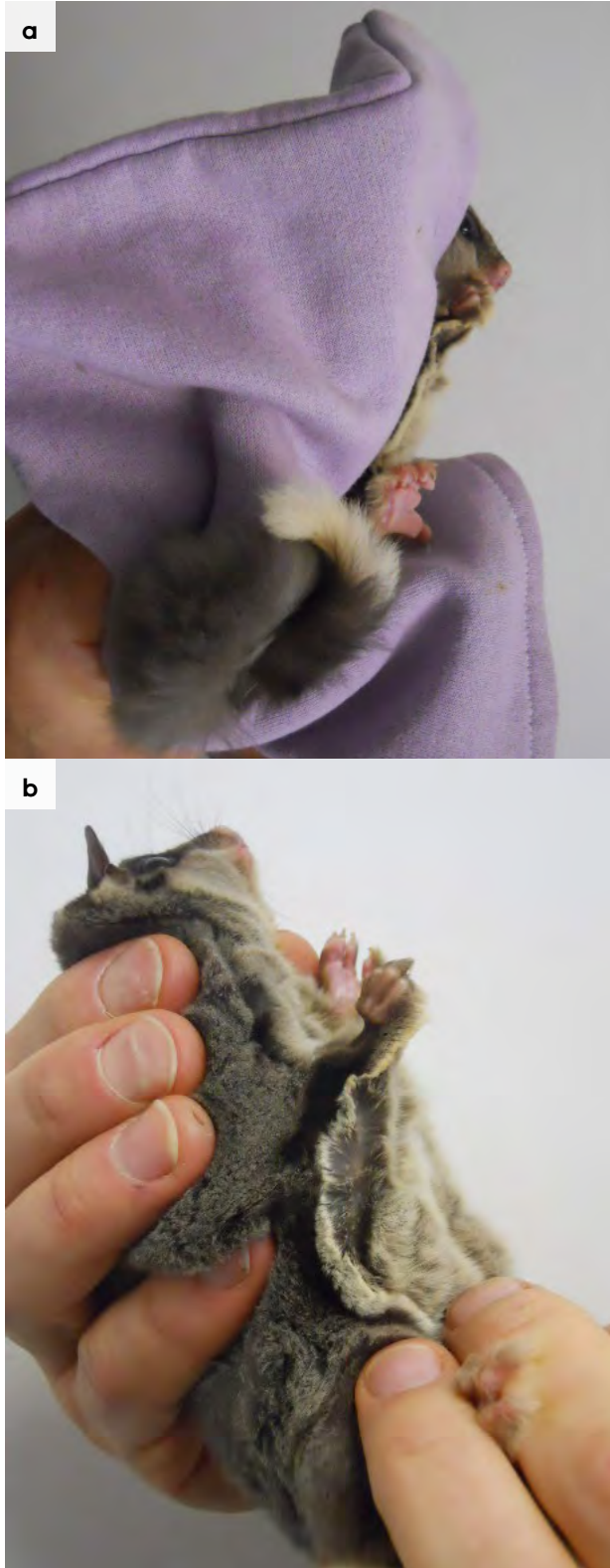


Photo credit: Zoos Victoria

On or close to the ground

Gliders may be found on the ground or on low branches after predation, when in torpor or when they have been injured. They can be captured by placing a cloth bag or towel over their head and body.

Confined spaces

Gliders may seek small spaces to nest, such as piles of firewood. Accidental injury can occur when firewood is disturbed. If in torpor and uninjured, the animal may only require repositioning. Crush injuries can be difficult to identify. If in doubt seek veterinary advice.

Do not enter confined areas (for example, building roof space) if there is a risk of becoming trapped. Property should only be modified (for example, cutting a hole in a wall) by a qualified tradesperson and only with the property owner's consent. It may be possible to allow the glider to escape from the wall cavity by providing a means of escape, such as a rope hanging in the space.

Caught in barbed wire fence

Restrain the glider in a towel, cover its head and support its body weight. It may be easier to remove the glider from the wire while it is still under tension. Releasing tension may cause the wire coils to further trap tissue. If the wire needs to be cut, obtain permission from the property owner first. Wire strainers, and potentially a wire bridge, should be used at all times when cutting barbed wire to prevent injury from the wire snapping back into the face. Protective eye wear and gloves should be worn. All barbed wire injuries to the glider should be assessed by a veterinarian. An anaesthetic will be required to remove wire that has been cut but is still embedded in the glider's skin.

9.4.4. Transport

Possums

If the possum is trapped in a dedicated animal trap (cat or possum), a large bag or hessian sack should be used to remove the animal from the trap. Approach the trap quietly and calmly. Place the front of the trap over the lower leading edge of the sack opening, while the top of the sack is taken in, so there is no gap between the cage and sack. Use one hand to lift the bar over the trap door to open the door. The sack now covers the whole opening of the trap, and one hand continues to firmly hold onto the bag. If the possum does not walk into the sack on its own, which does sometimes happen, encourage the possum to move into the sack by an escalation of the following actions: a) gently tap the back of the trap; b) give short, sharp air blows aimed at the end of the possum furthest from the sack; c) turn the trap 90 degrees, so you can see the possum without the plastic cover interfering and continue with blowing air at the possum; d) tilt the trap with the back end up and the front pointing down, while continuing to tap and blowing air. In most cases, this should get the possum into the sack.

If this is still unsuccessful, the possum can be removed manually, with heavy duty welding gloves. However, this is the most stressful method for the possum, and has the highest risk of injury to the operator. Once the possum is in the sack, the opening needs to be firmly closed with a string. Do not let go of the sack as possums will try to run off in the sack. Also, do not place your

hand on the sack, other than the end that has been tied off, to avoid being bitten or scratched.

Travel should be as quiet as possible to reduce stress. Minimise the number of people in the car and keep the radio off. Don't slam car doors. Transport directly to the desired location with no extraneous stops.

Common brushtail possums should be held in a heavy cloth bag, or even better a hessian sack, as they can tear through a pillowcase or cardboard box. They can be transported in a pet carrier covered with a towel to reduce noise and light. Never transport possums in the trap.

Common ringtail possums can be transported in a secured cloth bag inside a solid enclosure such as a plastic tub with ventilation holes or a pet carry pack.

Animals should be housed separately during transportation.

If possible, avoid transportation on hot days (that is, above 30°C). Ideal ambient temperature range for transportation is 10–20°C.

Gliders

Gliders should be placed in a cloth bag and transported in a pet carrier covered with a towel to reduce noise and light.

Animals should be housed separately during transportation.

The ideal ambient temperature range for transportation is 10–20°C.

9.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

Please note: Carers should always aim to treat animals as efficiently as possible, so that they can be returned to the wild in the shortest possible time. This section provides guidance on assessment of health on arrival and on effective monitoring of the health and welfare of animals up to the point of release back to the wild.

9.5.1 Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure weighing scales are available and ready to use before capturing the animal. Physical examinations are also required

if the carer notices any changes suggestive of deteriorating health or an injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible, and the carer can plan release as soon as appropriate. **A template for recording physical examination findings can be found in the appendices to Part A of these guidelines.**

Examinations should be conducted in a quiet location, away from any domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress – such as panting, salivating, vocalisation, or sudden deterioration in demeanour. If these are seen, the examination should be stopped immediately, and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Examination of a sick or injured possum or glider is best performed under general anaesthesia by a veterinarian. Physical examination may be possible but will be extremely stressful and should be limited to a cursory examination only.
- If the possum/glider is contained within a bag or pouch, the opening is peeled back and individual body parts gently examined. This method works well for hand reared joeys that are comfortable with being handled.
- Keep the animal's eyes covered, if possible.
- **Table 9.4** and **Table 9.5** provide additional guidance on what to look for during physical examinations.

Table 9.4 Physical examination of possums

	What to look for
Body weight	<ul style="list-style-type: none"> Record body weight on arrival and at least weekly while in care. A greater than 10% change in body weight is cause for concern, and the carer should seek veterinary advice.
Body condition	<p>Body condition of possums is scored by palpation over the hips and chest.</p> <ul style="list-style-type: none"> Under condition: Ribs are obvious, abdomen appears sunken, pelvic bones are prominent. Ideal condition: Ribs covered when felt. Spine can just be felt. Points of the hips can be felt. Over condition: Ribs and rump all well covered.
Level of hydration	<ul style="list-style-type: none"> Hydration can be assessed by testing skin tent, done by pinching and lifting the skin between the shoulder blades. Dehydration can be indicated by skin remaining 'tented' or a slow return to normal position.
Eyes	<ul style="list-style-type: none"> Open, clear surface, no discharge, even pupil size. Eyes can indicate hydration status; they should be bright and shiny. Sunken eyes may indicate dehydration.
Mouth	<ul style="list-style-type: none"> Pink gums and tongue. Teeth are even. Adequate wear.
Ears	<ul style="list-style-type: none"> Erect, clean.
Limbs	<ul style="list-style-type: none"> Feet can turn backward, can walk, climb, nails sharp and intact.
Pouch	<ul style="list-style-type: none"> If young, the pouch is small. If there is a long teat and swollen mammary glands the animal has back young or nest young. A mature pouch has a scant, watery reddish-brown secretion.
Faeces	<ul style="list-style-type: none"> Formed, dark green or brown pellets, oval shaped.
Skin and fur	<ul style="list-style-type: none"> No fur loss. Few ectoparasites seen on skin. Thick fur.
Sex determination	<p>Determined by the presence of testicles (male) or a pouch (females). See Figure 9.6.</p>
Pouch	<p>Young may be present – indicated by swollen mammary gland with milk able to be expressed.</p>

Table 9.5 Physical examination of gliders

What to look for	
Body weight	<ul style="list-style-type: none"> Record body weight on arrival and at least weekly while in care. A greater than 10% change in body weight is cause for concern, and the carer should seek veterinary advice.
Body condition	<p>Body condition of gliders is scored by palpation over the hips and chest. Note that greater gliders naturally feel thin. Their thick fur gives an appearance of being rotund, however their bones are easily felt.</p> <ul style="list-style-type: none"> Under condition: Ribs are obvious, abdomen appears sunken, pelvic bones are prominent. Ideal condition: Ribs covered when felt. Spine can just be felt. Points of the hips can be felt. Over condition: Ribs and rump all well covered.
Level of hydration	<ul style="list-style-type: none"> Hydration can be assessed by testing skin tent, done by pinching and lifting the skin between the shoulder blades. Dehydration can be indicated by skin remaining 'tented' or a slow return to normal position.
Eyes	<ul style="list-style-type: none"> Clear globe with shiny smooth surface. Eyes can indicate hydration status; they should be bright and shiny. Sunken eyes may indicate dehydration.
Mouth	<ul style="list-style-type: none"> Pink gums and tongue. Teeth are even. Adequate wear.
Skin and fur	<ul style="list-style-type: none"> Furred. Few parasites. Scent glands on head and chest.
Limbs	<ul style="list-style-type: none"> Walking on all legs.
Gliding membrane	<ul style="list-style-type: none"> Intact along length.
Sex determination	<ul style="list-style-type: none"> Determined by the presence of testicles (male) or a pouch (females).
Pouch	<ul style="list-style-type: none"> Young may be present – indicated by swollen mammary gland with milk able to be expressed.

Figure 9.6 Photos of juvenile ringtail possums demonstrating the pouch and testicles.

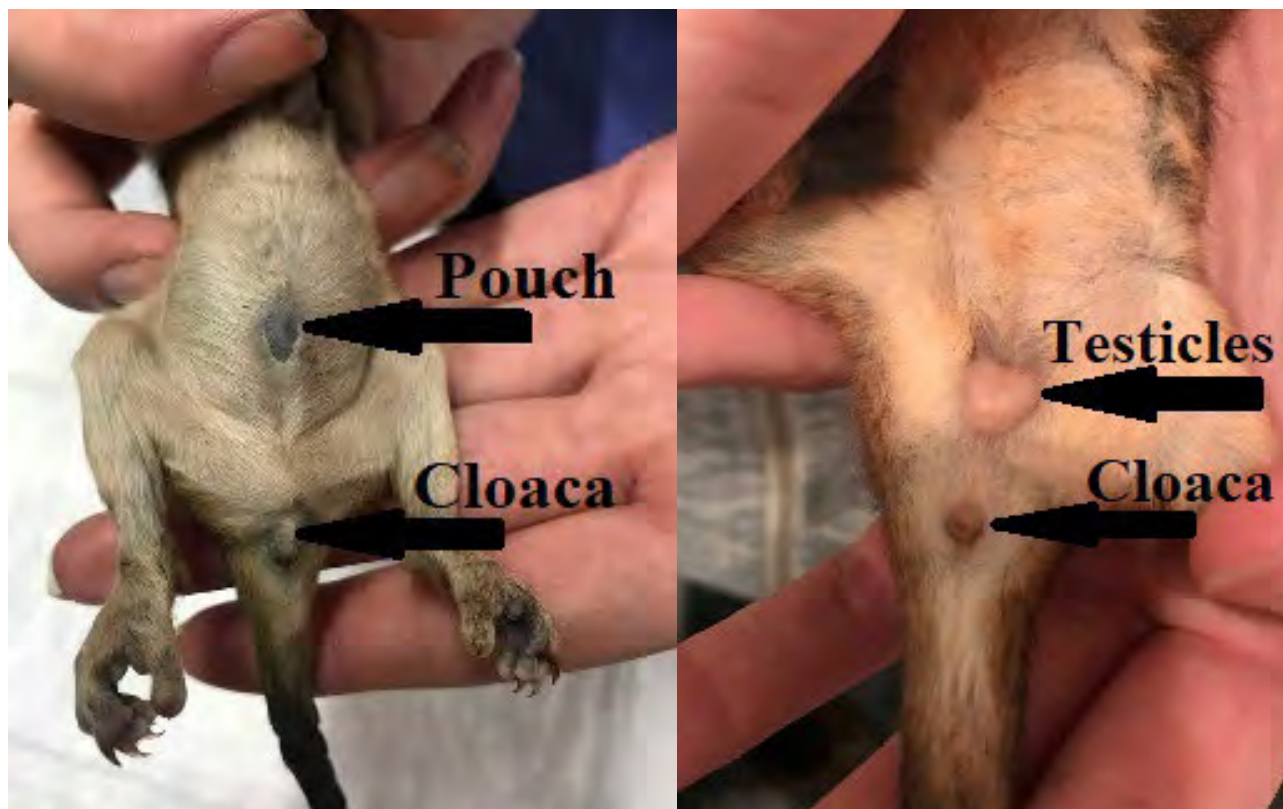


Photo credit: Megan McKay

9.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- The possum/glider should be observed at least daily.
- If the possum/glider is being medicated, a visual check in the morning is recommended.
- Note the animal's demeanour and behaviour every time food is introduced or taken away, the animal is medicated, or the enclosure is cleaned. Pay particular attention to any changes that have occurred since the previous day.
- Gently encourage the possum/glider to walk and climb to assess its movement and demeanour.

- Note faecal consistency daily. If diarrhoea is noticed, a faecal sample should be collected and submitted to the veterinarian for assessment as soon as possible. Do not treat on suspicion of a bacterial or parasitic infection, as this can make definitive diagnosis very difficult and potentially prolong the course of the disease.

9.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 9.6 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 9.6 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Clinical signs and possible causes	Possible causes	Rehabilitator observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to walk or move normally</p> <p>Paralysis</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fractures</p> <p>Dislocation</p> <p>Abraded claws</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Entrapment</p> <p>Predation injury caused by raptor, fox, cat or dog, gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity, for example fall from perch</p>	<ul style="list-style-type: none"> Urgent veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. Do not attempt to stabilise fractures, as this is very painful, and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical examination, x-rays and under general anaesthesia. Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species; attempt to relieve stress. If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 9.4 and Section 9.6 this chapter for further advice on housing and transport.

Clinical signs and possible causes	Possible causes	Rehabilitator observations and response
<p>Head trauma</p> <p>Bleeding from nose, mouth or eyes</p> <p>Swollen eye lids, Blood present in eye</p> <p>Abnormal behaviour</p> <p>Mouth swelling, missing teeth</p> <p>Lethargy</p>	<p>Cranial trauma, concussion</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in fence or wire</p> <p>Predation injury caused by raptor, fox, cat or dog,</p> <p>Gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity, for example fall from perch</p>	<ul style="list-style-type: none"> • Urgent veterinary attention is required. Do not delay transfer to a veterinarian to apply first aid, other than to stop excessive bleeding. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked or head trauma animals. • Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species; attempt to relieve stress. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 9.4 and Section 9.6 this chapter for further advice on housing and transport.
<p>Bleeding</p> <p>Puncture wounds</p> <p>Bruising</p> <p>Fur loss</p>	<p>Conspecific aggression, breeding season injuries</p> <p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Predation injury caused by raptor, fox, cat or dog</p> <p>Poorly designed transport box/ enclosure</p> <p>Capture injury</p> <p>Injury sustained in captivity, for example, fall from perch</p>	<ul style="list-style-type: none"> • Seek prompt veterinary assessment. • Euthanasia may be the most humane response if the wounds are extensive. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • The severity of bite wounds/scratches may not be immediately obvious, look for clumps of dried fur stuck together with saliva. • Check, particularly if it is a ringtail, for puncture wounds or saliva, which are commonly found around the neck and shoulders but may be obscured by fur. • Check gliders for punctures/tears in gliding membrane. • If suspected as the cause, assess the enclosure to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 9.4 and Section 9.6 this chapter for further advice on housing and transport.

Clinical signs and possible causes	Possible causes	Rehabilitator observations and response
Burns	Recent bushfire, campfire injury, chemical burn, electrocution, hot surface burn, for example tar roads on a hot day	<ul style="list-style-type: none"> • Seek urgent veterinary attention. • Burn injuries are extremely painful, treatment and bandage changes must only occur under anaesthesia and with adequate pain management. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Burn injuries to paws may result in nail damage, digit bone damage and tendon damage, due to the complexity of these injuries, veterinary management is required. • To ensure good welfare, animals must be returned to a veterinarian for ongoing bandage changes. • Burnt possums or gliders may need supplemental nutrition as metabolic demands are high when healing burns.
Depression, lameness, weakness, sudden death, neurological signs	Undetermined infectious disease for example toxoplasmosis, Tyzzer's disease	<ul style="list-style-type: none"> • Seek veterinary attention as soon as possible to determine the cause.
Skin ulcers/scabs, fur loss, reddened or crusty skin, swollen paws	Undetermined infectious disease, for example <i>Mycobacterium ulcerans</i> infection (Bairnsdale ulcer/Buruli ulcer), ectoparasites, swollen paw syndrome, bacterial infection, stress dermatitis, electrocution, photosensitisation, plant toxins, unknown	<ul style="list-style-type: none"> • Seek veterinary attention as soon as possible to determine the cause. • Some fur loss/minor skin lesions are commonly seen due to fighting and may not require any intervention. • A small number of parasites can be normal, and do not require treatment or removal. However, if there are large numbers of parasites, the animal is scratching/irritated, or the skin is red and inflamed the animals must be assessed by a veterinarian. A heavy burden of parasites may indicate an underlying disease process. • Swollen paw syndrome is only seen in ringtail possums. • <i>Mycobacterium ulcerans</i> is zoonotic, refer to Part A, Chapter 4, of these guidelines for additional information on Biosecurity & Hygiene including zoonoses and minimising disease risks to animals and carers.
Neurological signs/salivation/bleeding without trauma	Undetermined disease, toxicity, for example 1080 poisoning, rodenticide	<ul style="list-style-type: none"> • Seek veterinary attention as soon as possible to determine the cause.

Clinical signs and possible causes	Possible causes	Rehabilitator observations and response
<p>Diarrhoea</p> <p>Loose, smelly faeces</p> <p>Cloacal prolapse</p> <p>Bloat</p>	<p>Gastrointestinal disease</p> <p>inappropriate diet, infectious disease, alteration of microbiome, stress, internal parasites, antibiotic treatment</p>	<ul style="list-style-type: none"> • Seek veterinary attention as soon as possible to determine the cause. • Seek urgent veterinary advice if diarrhoea does not resolve rapidly (e.g. within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. • Do not treat on assumption of infectious disease (for example, coccidia or bacterial infection) as this can make veterinary diagnosis more difficult if the animal does not improve. • Chronic diarrhoea may lead to cloacal prolapse. If this occurs, keep the prolapse moist with KY jelly and seek urgent veterinary attention. • Some causes of diarrhoea are transmissible to people. Refer to Part A, Chapter 4, of these guidelines for additional information on Biosecurity & Hygiene including zoonoses and minimising disease risks. • Ensure excellent hygiene standards to prevent spread and isolate this animal from any others in care if possible. • Seek species expert advice, ensure diet and husbandry practices are correct. • Offer appropriate food items. Restrict fruit, as this can impact caecal bacteria. • Diarrhoea may result if inappropriate milk is fed, for example cow's milk. • Consider any recent changes, which may have led to diarrhoea and remove the inciting cause where possible – for example rapid change in diet, unusual levels of sound/intervention or handling, contact with recently arrived animals. • If milk was recently changed, switch back to the previous milk, wait until diarrhoea has resolved and then implement a slower diet change. • Diarrhoea can occur due to over feeding. • Do not mix oral rehydration fluids with milk as it changes the digestibility of the milk. Oral rehydration fluids/water can be provided in between milk feeds. • Orphaned joeys may lack normal gut bacteria. Place a faecal scat from a healthy possum in a bottle of boiled water that has cooled but is still warm. Mix the faeces with the water and allow it to stand for ten minutes. Drain off the liquid and mix it into the joey's next feed at a rate of 20–30% of the milk volume. Repeat the process 12 hours later. • Offer gum tips rather than <i>callistemon</i> and <i>grevillea</i> when starting orphan possums onto solids as the high sugar and low-fibre content of flowers may prevent the gut from developing normally. • High-fibre supplements such as Oxbow Critical Care and Vetafarm Crittacare* may prevent the condition, as they offer a high-fibre source of nutrition.

Clinical signs and possible causes	Possible causes	Rehabilitator observations and response
<p>Possums (usually ringtail) found uninjured on the ground, weak, dull demeanour/ poorly or non-responsive</p>	<p>Heat stress, torpor, undetermined infectious disease, toxicity</p>	<ul style="list-style-type: none"> • Seek veterinary assessment to determine the cause. • Urgent veterinary attention is required to assess a heat impacted animal, to determine hydration status, and whether heat stress has led to more significant underlying organ damage. • To transport, place the animal in a cool environment and wrap the animal in a cold wet towel. • Be mindful of actively cooling small animals, with a small surface area, hypothermia (low body temperature) is a risk. • Seek species expert advice. Poorly responsive animals may present in a very similar manner regardless of the underlying cause, an assessment of environmental factors may help to understand whether the clinical signs seen are a response to thermal range or may indicate an underlying health condition. • Torpor normally occurs in gliders during cold weather. • The glider may be found in its nest in a tree that has been cut down or possibly on the ground, cold and inactive with or without visible wounds. • Offer warmth at 25–28°C and assess response. Gliders are sensitive to high temperatures and should be monitored for panting, increased respiratory rate and wet forelimbs. • Nectar or an electrolyte solution (for greater gliders) may be offered into the glider’s mouth. • If the glider has not responded within 24 hours, veterinary advice should be sought.

*Please note: Food suppliers and specific products mentioned in the Victorian Wildlife Rehabilitation Guidelines are intended as examples only. Other suitable products may also be available.

Figure 9.7 A common ringtail possum with extensive predation wounds over the shoulders.



Photo credit: Zoos Victoria

Figure 9.8 Common ringtail possums with swollen paw syndrome.



Photo credit: Zoos Victoria

Figure 9.9 A common brushtail possum with a prolapse of the cloaca.



Photo credit: Anne Fowler

Figure 9.10 Trauma to the gliding membrane of a glider, likely caused by being caught in a barbed wire fence.



Photo credit: Zoos Victoria

Figure 9.11 Common ringtail possum with burnt feet.



Photo credit: Zoos Victoria

Figure 9.12 Ringtail possum with deep Buruli ulcer lesions on right hind paw, revealing bone, and scrotum.



Photo credit: Jean Lee, Doherty Institute

9.5.4. Administering treatment during rehabilitation

- Oral medications can be delivered in a syringe directed into the side of the mouth while the animal is restrained. Care is required to avoid being bitten.
- Injectable medications can be administered under the skin, between the shoulder blades. Only experienced carers should give injections.
- Fluids (Lectade or Hydralyte) are best administered orally to address dehydration. If the animal voluntarily takes the fluid, it indicates that it is thirsty, that it can swallow and does not require subcutaneous fluids.
- Subcutaneous fluids should only be given under anaesthetic by a vet as the administration is painful. Possums and gliders do not have a good subcutaneous space, so multiple sites may need to be used.

9.6 Housing

Below are several key considerations when housing adults in care.

9.6.1. General housing information for possums and gliders

There are no national standards regarding enclosure size for possums and gliders during rehabilitation. Each state has a different set of guidelines which contain a variety of recommended enclosure sizes. The dimensions recommended in this chapter are suggestions based on Healesville Sanctuary enclosure sizes. There is no 'one size fits all' and it is important to continually assess the welfare of the possum or glider and tailor enclosures and enclosure size to suit the requirements of the individual.

Please note: specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

9.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

- Wash hands with soap and water after handling dogs and cats to minimise the risk of transferring disease agents such as *Toxoplasma gondii*, which can be found in cat faeces.
- Ideally, examination gloves should be worn and changed between animals.

- Left-over food and faecal matter should be spot cleaned from enclosures daily to ensure good levels of hygiene are maintained.
- Any wet/sodden or soiled organic furnishings, substrate or enrichment items should be removed as soon as possible and replaced with a clean/dry alternative.
- Enclosures should be cleaned and disinfected between inhabitants. Substrate should be completely replaced and furniture, such as branches or boxes made of unsealed wood, should be discarded as they cannot be effectively disinfected.
- Enclosures should be cleaned with hot soapy water and then disinfected with products such as F10SC or bleach at the recommended concentration and contact time. Bleach must be rinsed.
- Ringtail possums may develop skin infections caused by *Mycobacterium ulcerans*. This infection is transmissible to people and can cause similar skin ulcers. If the veterinarian has diagnosed this disease, the enclosure should be cleaned with hydrogen peroxide or vinegar at the recommended concentration and contact times, as these agents have been shown to kill these particular bacteria.

9.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care. **Tables 9.7–9.10** describe the housing type, suggested housing and nest box dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 9.8**.

Table 9.7 Rehabilitation housing for adult possums

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment – frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision where strict cage rest/ confinement is indicated</p>	<p>Enclosure: 45–60 cm(L) x 30–40 cm (W) x 30–40 cm (H)</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A cat carry pack, Rio basket or Vetario makes a suitable intensive care enclosure. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Newspaper may be used as substrate for intensive care enclosures. Towels or thin blankets add warmth and padding. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Sick adult possums are kept on a heat gradient with the warm end at 28°C. Heating pads are commonly used. All heating should be monitored with a thermometer and layers of towel placed between the possum and the heating unit to provide the correct level of heat. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Water should be available in a shallow bowl. • Food and water may need to be syringe/bottle fed during this intensive period of care.

Intermediate housing (treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care</p> <p>The increased size of this stage of housing provides the opportunity to explore. This is when a nest box is introduced for the first time</p> <p>As for the intensive care housing, adult possums should be housed individually unless they arrive with young</p>	<p>Enclosure:</p> <ul style="list-style-type: none"> Suggested dimensions of the enclosure are 1 m (L) x 1 m (W) x 1–2 m (H) 	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> A small aviary is a suitable size. Large wire bird enclosures can be used. Line the enclosure with shade-cloth or fly wire to provide a visual barrier and prevent escape. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> Newspaper may be used as a substrate for this enclosure. Nest box constructed of timber, with a hinged lid to enable cleaning and placement of bedding material. A hole on the side of a size that will allow easy entry and exit by the possum. Recommended dimensions and construction details of nest boxes for each species are given below, under Pre-release housing. The nest box should be mounted high in the enclosure with branches positioned to give access to the entry hole. It should be easily removable so that it may be cleaned regularly as possums may defaecate and urinate inside. Bedding such as dried leaves or towels/ small blankets should be provided in the box. The pouch can be hung inside or placed inside a nest box. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> Animals housed in these should be able to cope with ambient temperatures. Nest boxes should be positioned out of direct sun and offer protection from rain and wind. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Browse is kept in containers with water that is changed daily. Plastic cups, stainless-steel or ceramic bowls can be used as food and water bowls.

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/medication</p> <p>Development of fitness/strength prior to release</p> <p>Pre-release housing aims to provide sufficient space to develop a reasonable level of fitness for climbing and jumping</p> <p>As for the intensive care housing, adult possums should be housed individually unless they arrive with young</p>	<p>Enclosure: 3 m (L) x 2 m (W) x 2 m (H)</p> <p>Increased floor area for each additional possum: 3 m². Larger dimensions than this are preferred as they give more opportunities for possums to gain fitness.</p> <p>Nest box: Common ringtail possum: 20 cm x 25 cm. Height 43 cm. Entrance hole diameter: 3.2 cm. Diameter of tree: 0.20–1.43 m</p> <p>Common brushtail possum: 25 cm x 30 cm. Height 55 cm. Entrance hole diameter: 8.5 cm. Diameter of tree: 0.55–1.43 m</p> <p>Mountain brushtail possum: 25 cm x 30 cm. Height 55 cm. Entrance hole diameter: 12–25 cm. Diameter of tree: >1.40 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> Galvanised wire with a diameter of 10 mm can be used for possums. Shade-cloth on the walls of the enclosure will provide a visual barrier from predators. Nest box made from marine ply with drainage holes in the bottom and painted with non-toxic paint in subdued colours (See Figure 9.14). Use metal hinges for the lid as Velcro and rubber deteriorate over time. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> Mulch is recommended for flooring. This is replaced when soiled. Sand and gravel can be placed under the mulch to create a floor that does not trap moisture. Ropes of varying diameter and tension are placed in the aviary to encourage climbing. The nest box that the possum will be released with should be hung in the aviary with a branch near the entry hole for easy access. The possum needs to spend between a week to a month in the nest box if it is to use it after release. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> Branches with leaves may be placed in the aviary as furniture, separate from food leaves. The branches are changed weekly to create a varied environment. They are held in place by octopus straps, cable ties or wire. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Browse pots (for example sealed at the bottom PVC pipes) can be used to hold the food browse in water and are placed at a height so that the tops of the leaves are close to the roof of the aviary. The water in the browse pots is changed daily. Do not leave pots containing water without browse as the possum may drown if it falls into the pot. Food leaves are replaced daily. Supplementary food may be placed in small containers suspended on the wire of the enclosure to encourage movement. Do not place food containers on the floor. Insects such as mealworms may be placed under pieces of bark on the branches.

Figure 9.13 a. A young common ringtail possum in a pouch in a Rio basket. It is being fed using bicycle tubing attached to a syringe. b. A large pet carry pack is used as intermediate housing for a young mountain brushtail possum.

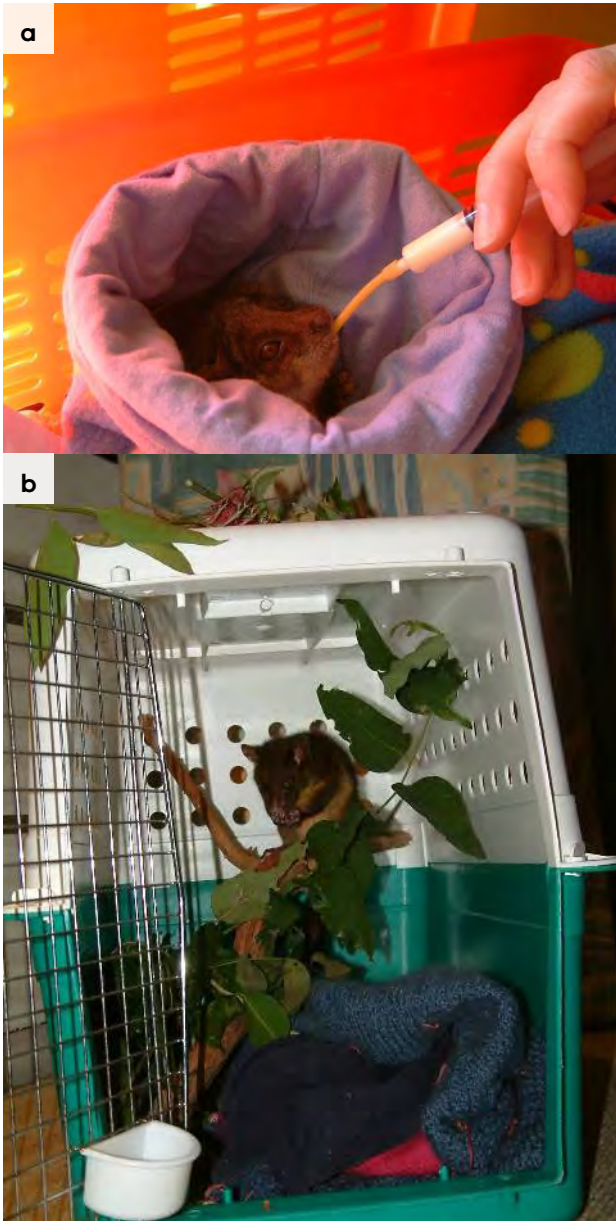


Photo credit: Anne Fowler

Figure 9.14 a. Short-term housing for a ringtail possum. Note the presence of a nest-box and branches to encourage climbing. b. An aviary set up as a pre-release enclosure for possums.



Photo credit: Zoos Victoria

Table 9.8 Rehabilitation housing for adult gliders

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>This type of housing is suitable for sick or injured adults during their first week in care. Adults are housed individually unless they arrive as part of a colony, in which case they are kept together</p>	45cm (L) x 30cm (W) x 30 cm (H)	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A Rio basket, Vetario, Rcom intensive care unit, Kimani incubator or small pet carry cage can be used. The basket should be lined with fly wire to prevent the escape of small gliders. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Adult gliders should be offered a nest box in their intensive care enclosure. This may be a wooden or cardboard box. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Heating pads or incubators, set between 25–28°C, can be used to provide heating. • A thermometer should be used to monitor the heat provided. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Use drink bottle lids to provide nectar. Small containers help prevent the animal walking in the nectar and matting their coats. • Fresh water should be provided with food in shallow water dishes.

Intermediate housing (treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>This stage of housing is suitable for the injured adult glider or juvenile and sub-adult gliders that are old enough to be moving around. It provides the glider with some space and is small enough to allow easy capture.</p> <p>As for the intensive care housing, adult gliders should be housed individually unless they arrive as a colony.</p>	<p>Feathertail glider</p> <p>Enclosure: 0.45 m (L) x 0.30 m (W) H: 0.25 m</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> A small aviary or modified wardrobe is suitable. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> Newspaper may be used as a substrate for the intermediate enclosure. Branches are placed in the enclosure to encourage the glider to exercise. Provide a nest box of cardboard or wood. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> A heat mat covered with towels to provide the correct temperature may be placed under half of the nest box during weaning, particularly where there are few animals in the enclosure. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> Change water in browse containers daily. Keep food containers off the floor. Use small food bowls so that the glider's fur does not drag through nectar mixes. Examples include drink lids, sipper bottles or bird seed containers. For yellow-bellied gliders a fresh eucalypt limb should be offered every second day to enable the glider to have access to sap.
	<p>Greater glider, yellow-bellied glider</p> <p>Enclosure: 1 m (L) x 1 m (W) (1 m²) H: 1 m</p>	
	<p>Leadbeater's possum, squirrel glider, Krefft's glider</p> <p>Enclosure: 0.5 m (L) x 0.5 m (W) (0.25 m²) H: 1 m</p>	

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/ medication</p> <p>This stage of housing is suitable for adult gliders that have recovered from their injuries and juvenile gliders that are being prepared for release. The housing needs to be large enough to allow the glider opportunities to glide and jump from branch to branch to develop gliding fitness prior to release. A long and high aviary works well.</p>	<p>Feathertail glider</p> <p>Floor area for one animal: 1 m (L) x 1 m (W) (1 m²) H: 1 m</p> <p>Increased floor area for each additional animal: 0.5 m²</p> <p>Nest box: 14 cm x 12 cm. Height: 10 cm. Entrance hole diameter: 3.2 cm. Max colony size: 6</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> Galvanised wire with a mesh diameter of no more than 10 mm can be used to line the aviary. Cover the wire with fly mesh to prevent escape. Use shade-cloth or fly wire on the walls of the enclosure to provide a visual barrier from humans and predators. Nest box made from marine plywood, thick hardwood or thick recycled plastic. Paint with non-toxic paint in subdued colours like green or brown. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> Use a leaf litter floor that is changed when soiled. A substrate of sand or gravel under the mulch will help to reduce the build-up of moisture. Place ropes and leafy branches in the aviary as furniture. Be sparing. Leave sufficient free space for the glider to glide. Offer bark from stringy-bark trees as nesting material. Encourage climbing with branches that run vertically. Place nest boxes under a covered area. Offer more than one nest box to mimic the natural use of multiple nest boxes by gliders in the wild. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> Temperature should be ambient at this stage of rehabilitation. Adequate shelter from rain and wind should be available. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> If applicable offer fruit and vegetables on kebab skewers placed in the aviary. Food bowls should be offered at height (not on the ground). Containers, such as lengths of PVC, can be used to hold fresh browse for food. The water should be changed daily. Ensure that gliders cannot get into the browse containers and drown. Supplementary food may be placed in small containers suspended on the wire of the enclosure at various locations to encourage movement. Sap branches can be hung in the enclosure.
	<p>Greater glider</p> <p>Floor area for one animal: 10 m (L) x 2 m (W) (20 m²) H: 2 m–4 m</p> <p>Increased floor area for each additional animal: 10 m²</p> <p>Nest box: 25 cm x 30 cm. Height: 55 cm. Entrance hole diameter: 8.5 cm. Max colony size: Solitary</p>	
	<p>Leadbeater's possum, squirrel glider, Krefft's glider</p> <p>Floor area for one animal: 2 m (L) x 1 m (W) (2 m²) H: 2 m</p> <p>Increased floor area for each additional animal: 1 m²</p> <p>Nest box: 17 cm x 20 cm. Height: 11 cm. Entrance hole diameter: 5.0 cm. Max colony size: 1 adult, breeding pair or family group</p>	
	<p>Yellow-bellied glider</p> <p>Floor area for one animal: 10 m (L) x 2 m (W) (20.00 m²) H: 2 m</p> <p>Increased floor area for each additional animal: 10 m²</p> <p>Nest box: 20 cm x 25 cm. Height: 43 cm. Entrance hole diameter: 6.5 cm. Max colony size: 3–6</p>	

Figure 9.15 A Vetario set up for an injured Krefft's glider. Note the nest box, some browse and small, shallow bowls.



Photo credit: Zoos Victoria

Figure 9.16 A pre-release aviary for gliders is shown under construction. Note the height required to permit gliders to be able to glide. Thin bird wire and shade-cloth are then used to cover the aviary.



Photo credit: Anne Fowler

9.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of possums and gliders in rehabilitation. Information on feeding orphaned individuals can be found under **Section 9.8 Hand raising**.

Possums

- A council permit may be required to lop or prune native trees.
- Browse should be placed in containers filled with water, which is changed daily.
- Fresh leaf is provided daily. It is preferable to pick leaf in the late afternoon to ensure that it has a high water content when consumed.
- Do not collect from within 5 m of roads or where herbicidal sprays have been applied.
- Do not enter a resident's property to collect foliage unless authorised.
- Clippings should not be taken repeatedly from the same trees as they can build up toxins which may be harmful if fed to possums.
- Suitable tree species for each possum species are listed at **Table 9.9 – Table 9.11**. An alternative approach is to visit the release area at night and look for possums, noting the trees in which they are sitting/feeding.
- Common brushtail possums should be offered a minimum of seven to 10 branches, approximately 1 m long, of five to eight species of browse daily (see **Table 9.9**). Species that are offered should be from the local area. Common brushtail possums in the wild also eat insects (such as caterpillars, beetles and grasshoppers) and small birds and their eggs.
- Offer fresh water daily in bowls hung on the sides of the aviary or on the ground.

Table 9.9 Tree species eaten by common brushtail possums

Common name	Scientific name	Common name	Scientific name
Acacia sp, silver wattle	<i>Acacia dealbata</i>	Hazel pomaderris	<i>Pomaderris aspera</i>
Blackwood	<i>Acacia melanoxylon</i>	Myrtle beech	<i>Nothofagus cunninghamii</i>
Eucalyptus spp.	<i>Eucalyptus maculata</i> , <i>E. viminalis</i> , <i>E. tereticornis</i> , <i>E. ovata</i> , <i>E. radiata</i> , <i>E. obliqua</i>	Satin wood	<i>Nematolepis squamea</i>
Mountain gum	<i>E. dalrympleana</i>	Mistletoe	<i>Lysiana exocarpi</i>
Alpine ash	<i>E. delegatensis</i>	Wild tobacco	<i>Solanum mauritianum</i>
Native plum	<i>Davidsonia species</i>	Ferns, mosses	
Lilly pilly	<i>Syzygium oleosum</i>	Fruits: figs	<i>Ficus species</i>
Leatherwood spp.	<i>Eucryphia species</i>	Weeds: Dandelion dock, e.g.: ruby dock, fireweed groundsel	<i>Taraxacum species</i> <i>Acetosa vesicaria</i> <i>Senecio linearifolius</i>
Southern sassafrass	<i>Atherosperma species</i>	Introduced plants: Pine needles and cones Purple prunus leaves Apricot leaves and fruit Oak Peppercorn tree	<i>Pinus radiata</i> <i>Prunus species</i> <i>Prunus armeniaca</i> <i>Quercus palustris</i> <i>Schinus molle</i>

An adult common ringtail possum eats 130–180 g of leaf tips daily from a variety of species (see **Table 9.10**). This may be found in 20 branches, 30–50 cm long that are at least half tip and half mature leaf. Three tree species should be offered daily as a minimum, however, five to eight different species is preferable. This is broken down into three gum species, one *Callistemon/Grevillea* and one *Melaleuca/Leptospermum* species.

Table 9.10 Tree species eaten by common ringtail possums

Name of species	Latin name	Name of species	Latin name
Broad-leaved peppermint	<i>Eucalyptus dives</i>	Narrow leaved wattle	<i>Acacia muronata</i>
Narrow-leaved peppermint	<i>E. radiata</i>	Silver wattle	<i>Acacia dealbata</i>
River red gum	<i>E. camaldulensis</i>	Blackwood	<i>Acacia melanoxylon</i>
Spotted gum	<i>E. maculata</i>	Coastal tea tree	<i>Leptospermum laevigatum</i>
Manna gum – rough bark	<i>E. cygnetensis</i>	Swamp paperbark	<i>Melaleuca ericifolia</i>
Manna gum – ribbon gum	<i>E. viminalis</i>	Scented paperbark	<i>Melaleuca squarrosa</i>
Swamp gum	<i>E. ovata</i>	Hazel pomaderris	<i>Pomaderris aspera</i>
Messmate stringy-bark	<i>E. obliqua</i>	Shining cassinia	<i>Cassinia longifolia</i>
Forest red gum	<i>E. tereticornis</i>	Willow myrtle	<i>Agonis flexuosa</i>
Southern mahogany	<i>E. goniocalyx</i>	Lilly pilly	<i>Syzygium oleosum</i>
Mountain ash	<i>E. regnans</i>	Acorn oak	<i>Quercus robur</i>
Lemon-scented gum	<i>Corymbia citriodora</i>	Pussy willow	<i>Salix caprea</i>
Japonica	<i>Chaenomeles sp.</i>	Musk daisy bush	<i>Olearia argophylla</i>
Bottlebrush	<i>Calistemon sp.</i>	Grevillea	<i>Grevillea sp.</i>

Mountain brushtail possums are offered a diet similar to common brushtail possums (as per [Table 9.11](#)).

Table 9.11 Tree species eaten by the mountain brushtail possum

Common name	Latin name	Common name	Latin name
Myrtle Beech	<i>Nothofagus cunninghamii</i>	Montane wattle	<i>Acacia nigrescens</i>
Silver wattle	<i>Acacia dealbata</i>	Victorian Christmas bush	<i>Prostanthera lasianthos</i>
Hazel Pomaderris	<i>Pomaderris aspera</i>	Fungi, both above/ below ground species	
Blackberry	<i>Rubus allegheniensis</i>	Tree ferns	
Bidgee-widgee	<i>Aceana novae-zelandiae</i>	Pine cones (male), bark	<i>Pinus radiata</i>

Figure 9.17 a. The minimum amount of leaf to offer a common ringtail possum over 24 hours is shown. The leaf in the left hand shows the amount to feed, with the amount left after consumption shown in the right hand. b. Leaf offered to a common brushtail possum. There are three *Eucalyptus*, two wattle and three shrubs.



Photo credit: Zoos Victoria (a) Anne Fowler (b)

Gliders

- A variety of food items can be offered:
- Offer fresh water daily in bowls hung on the sides of the aviary. In the wild, gliders drink from small pools of water that form in hollows on eucalypt trees. They do not come down to the ground to drink water.
- Fresh leaves and native flowers:
 - Offer fresh browse daily, including insect galls. Select browse at least 50 cm long with insect activity on it (live insects, galls).
- Offer pollen daily. Trees and shrubs with bee activity are likely to have a high pollen content.
- Change the water in pots holding browse daily.
- Contact the local council as permission may be required to lop or prune native trees.
- Squirrel gliders prefer insects to sap and gum from plants.
- Greater gliders solely eat eucalypts such as silvertop (*Eucalyptus sieberi*), manna (*E. viminalis*) and blue gum (*E. globulus*).
- Fruit mixes:
 - A range of fruits should be offered to feathertail, yellow-bellied, squirrel and sugar gliders, including apple, pear, banana, stone fruit, watermelon, fig, kiwi fruit and berries.
 - All fruit should be mixed with Wombaroo High Protein supplement at a rate of 2 g supplement mixed into 20 g fruit.
 - Fruit should be chopped into 0.5–1 cm cubes.
- Vegetables:
 - A range of vegetables can be offered. These include pumpkin, zucchini, sweet potato, spinach and corn for feathertail gliders and greens (kale, endive, spinach, silverbeet, bok choy), peas, corn, sweet potato, carrot and pumpkin for squirrel and sugar gliders.
- Insects:
 - Insects such as moths, mealworms, crickets, and fly pupae may be placed under pieces of bark. Mealworms should be raised in bran and Wombaroo Insect booster or can be fed Vetafarm InsectaPro for 24 hours prior to being fed to gliders.

- Wild insects may be harvested from around the house.
- Look for aphids, mealy bugs, thrips, mites and gall-forming insects on native branches to offer as food.
- Nectar mixes:
 - Nectar mix is made by mixing 30 g Wombaroo Lorikeet/Honeyeater mix with 80 mL warm water.
- The natural diet of the gliders is based on insects and substances found on eucalypt trees:
 - **Manna** is a white carbohydrate-rich crystal substance on eucalypt leaves.
 - **Honeydew** is a carbohydrate-rich secretion from sap-feeding, lerp-forming insects.
 - **Pollen** from flowers is a source of dietary protein.

Table 9.12 Captive diets for gliders

Species	Captive diet offered daily per animal	Examples of browse offered daily
Feathertail glider	8 mL Wombaroo Lorikeet and Honeyeater mix, 15 g fruit and vegetables, 1 g invertebrates	<i>Grevillea, Eucalyptus, Banksia, Kunzia, Acacia</i>
Greater glider	50 g of leaf: 10–15, 1 m lengths of gum tips with young leaves	<i>Eucalyptus</i> : see Table 9.13
Leadbeater's possum	25 mL Wombaroo Lorikeet and Honeyeater mix, 2 g invertebrates	<i>Acacia</i>
Squirrel glider	12 mL Wombaroo Lorikeet and Honeyeater mix, 5 g Wombaroo Small Carnivore Food, 20 g fruit and vegetables, 2 g invertebrates	<i>Eucalyptus, Acacia, Banksia,</i> Spotted gum, Grey ironbark
Sugar glider	10 mL Wombaroo Lorikeet and Honeyeater mix, 1 g Wombaroo Small Carnivore Food, 12 g fruit and vegetables, 2 g invertebrates	Cut <i>Acacia</i> to produce sap Flowers of <i>Eucalyptus</i> , <i>Grevillea, Banksia</i>
Yellow-bellied glider	30 mL Wombaroo Lorikeet and Honeyeater mix, 15 g fruit and vegetables, 5 g invertebrates	<i>Eucalyptus</i> and – thick trunks so they can chew and tear bark, and suck sap

Figure 9.18 a. Nectar provided to a feathertail glider outside its nest box in a small plastic lid. b. Browse offered to a greater glider. Note the green PVC pipe filled with water that is used to hold the browse.



Photo credit: Zoos Victoria

Greater gliders need to be offered three to five species of *Eucalyptus* daily. Twenty branches, each about 50–60 cm long, are offered fresh daily. The gum is offered in PVC pipes containing water to prevent the leaves dehydrating.

Table 9.13 Tree species eaten by the greater glider

Common name	Scientific name	Time of the year when eaten
Narrow-leaved peppermint	<i>Eucalyptus radiata</i>	All
Manna gum	<i>Eucalyptus viminalis</i>	All
Brown barrel	<i>Eucalyptus fastigata</i>	All
Blue gum	<i>Eucalyptus globulus</i>	All
Silvertop gum	<i>Eucalyptus sieberi</i>	All
Mountain grey gum	<i>Eucalyptus cypellocarpa</i>	All
Messmate	<i>Eucalyptus obliqua</i>	All
Swamp gum	<i>Eucalyptus ovata</i>	All
White stringybark	<i>Eucalyptus globoidea</i>	All
Young cones of pines	<i>Pinus radiata</i>	Winter, spring
Mistletoe leaves	<i>Lysiana exocarpis</i>	Occasionally

9.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations can be found in the appendices to Part A of these guidelines.

Wildlife rehabilitators are not recommended to hand rear possums or gliders that have not reached certain stages of development due to low survival rates associated with hand-rearing of very young animals and the risks of imprinting. Animals that are unfurred, with eyes closed and ears down should be euthanised.

A summary of the exercise, housing and feeding requirements for possums at various levels of development can be seen in **Tables 9.18–9.20** and for gliders in **Tables 9.21–9.24**. The Krefft's glider table can be used for Leadbeater's possums and the greater glider table can be used as a guide for yellow-bellied gliders.

9.8.1. Equipment required for hand raising possums and gliders

- Milk: Wombaroo or Biolac
- Pouch: An inner lining of natural fibre, such as cotton is recommended. An outer lining is made from knitted wool, microfibre fleece or similar fabrics. Pouches should have rounded edges at the bottom to prevent suffocation.
- Intensive care unit or box containing a heat pad with thermostat
- Thermometer
- Scales
- Record Charts
- **Teats** for hand-rearing orphan possums and gliders that have been used include:
 - Wombaroo teats
 - Miki kitten teats
- IV catheters
- Bicycle tubing
- Paint-brushes
- Eye-droppers.

9.8.2. Growth, development and care of orphaned young

Possums

- Suitable milks to rear possums include Wombaroo Possum milk and Biolac.
- Do not add human infant multivitamins to milk formula.
- Wombaroo Impact colostrum supplement may assist with immune function.
- Although fruit and vegetables can be offered as part of the diet of brushtail possums, it is recommended that these make up less than 10% of the diet of a growing possum. The remainder of the diet must be browse with the occasional native flower.
- Ringtail possums should not be fed any fruit or vegetables and must only be given browse with the occasional native flower.
- Lilly pilly leaf can be used to stimulate young and rescue possums to start eating as they find it extremely appetising.
- Provide 100% natural food from the proposed release area for the two weeks prior to release.

Gliders

- Suitable milks to rear gliders include Wombaroo Possum milk >0.8 and Biolac M100.
- Add Wombaroo High Protein supplement as 2 teaspoons mixed into 100 g of fruit and vegetables.
- Do not add human infant multivitamins to milk formula.
- It can be difficult to provide 100% natural foods such as manna and pollen leading up to release, but at least 50% of the diet should be insects and native browse. Branches with insect damage and activity should be offered.

Prevent imprinting

- Minimise handling by promoting drinking milk from a bowl as soon as possible.
- Common ringtail possums should be doing this by 100 g and common brushtail possums from 150 g. This will reduce the association between humans and the provision of food.
- Place food leaves in the aviary in the early afternoon before possums/gliders emerge from the nest box.
- Do not permit possums to climb on your body. Do not carry possums inside your clothes.
- Buddying will reduce imprinting onto humans and teach natural social behaviour. See **Table 9.14**.
- Possums that have been buddied to teach normal behaviour will not need to be released together. Research has shown that possums which have been hand-reared together separate within a few days after release.

Table 9.14 Guidelines for the introduction of young possums for buddying

Species	Recommended size for introductions	Number of animals for each nest box or enclosure
Common ringtail possum	<ul style="list-style-type: none"> • Buddy upon arrival. • Can be paired at any weight. • When pairing, pair similar sized possums. 	Maximum of 4
Common brushtail possum	<ul style="list-style-type: none"> • Need to be a similar size. • Pair up around 350 g. • Monitor back-riding and separate if it occurs. • May benefit from housing adjacent to, but not with, other common brushtail possums. 	Maximum of 2
Mountain brushtail possum	<ul style="list-style-type: none"> • Unlikely to be more than one in care at any one time. 	Maximum of 2

- Like possums, minimise handling of gliders by promoting milk drinking from a bowl as soon as possible. This will reduce the association between humans and the provision of food.
- Buddying will reduce imprinting onto humans and teach social behaviour. See **Table 9.15**. For gliders, buddying can be done throughout their pouch life. To introduce a new glider, leave each glider in their inner pouch lining but in the same nest box during the day before removing one pouch in the afternoon.
- Older gliders that normally live communally (feathertail, yellow-bellied, Krefft's and squirrel gliders and Leadbeater's possums), can be introduced into a group by providing them with their own nest box in the aviary. The new nest box and glider should be placed in the aviary during the day, which may accustom the resident group to the smell of the new glider before the main period of activity at night.

Table 9.15 Recommended numbers for buddying young gliders

Species	Buddying recommended numbers
Feathertail glider	2–6
Greater glider	Not required
Leadbeater's possum	2–8
Squirrel glider	2
Krefft's glider	2–7
Yellow-bellied glider	2–6

- Hand-reared possums and gliders must have attained their minimum release weight before being returned to the wild.
- Recommended release weights for orphaned possums and gliders are listed in [Table 9.16](#) and [Table 9.17](#).
- There is no distinct juvenile dispersal time, so young possums/gliders can be released at any time of the year.

Table 9.16 Recommended release weights for possums

Species	Weight at release (kg)
Common ringtail possums	0.5–0.6
Common brushtail possums	1.0–1.5
Mountain brushtail possum	>2

Table 9.17 Recommended weights and ages for release of hand-reared gliders

Species	Approx. Weight (g)	Age (months)
Feathertail glider	8	6
Greater glider	900	10–12
Leadbeater's possum	100	10–15
Squirrel glider	150	7–10
Krefft's glider	100	7
Yellow-bellied glider	450	12

Table 9.18 Stages of development for the common ringtail possum (Used with permission from Wombaroo)

Milk	Age (d)	Weight (g)	Head (mm)	Tail (mm)	Appearance	Feed frequency	Feeding (mL/day)	Housing		
<0.8	90	52	35	120	Eyes open at ~50 g	Milk every 3 hours	12	Intensive stage: Incubator or cat carry pack with heating 30–32°C		
	Transition	92	54	35					123	
Transition	95	57	36	128	Fine soft fur	Milk every 4 hours	9 mL <0.8 + 3 mL >0.8	Cat carry pack with heating to 30°C		
	98	60	37	132			6 mL <0.8 + 6 mL >0.8			
							3 mL <0.8 + 9 mL >0.8			
>0.8	100	62	38	135			12	Cat carry pack with heating 28–30°C Toileting by itself May start to explore enclosure		
							Offer gum tips, no flowers			
	110	74	41	150			Emerging from pouch	12		
	120	90	45	165			Short fur, begin to pellet	14	Starting to lap	Exploring confidently in enclosure
	130	110	48	180			Fully out of pouch	Milk every 5 hours	16	Intermediate stage: Nest-box inside an enclosure housed inside room
	140	135	51	195	Back rider age	Milk every 6 hours	18	Heating no longer required if kept in a group or pair. Offer heat on cool nights.		

Milk	Age (d)	Weight (g)	Head (mm)	Tail (mm)	Appearance	Feed frequency	Feeding (mL/day)	Housing	
Weaning	160	Growth rate about 3–6 g/day			Back rider age	Milk every 12 hours	12 Offer wide variety of leaf Start to wean	Pre-release stage: Earliest age to enter aviary with nest-box	
	180				Independent		Stop milk	Finish weaning (approx. 310 g)	Pre-release stage: Large aviary, native browse changed daily, nest-box
	210				Small adult in appearance			Completely weaned (approx. 490 g). Offer food from release site	

Table 9.19 Stages of development for the common brushtail possum (Used with permission from Wombaroo)

Milk	Age (d)	Weight (g)	Head (mm)	Tail (mm)	Appearance	Feed frequency	Feeding (mL/day)	Housing
<0.8	100	80	45	98	Eyes open	4 hourly around clock	17	Intensive stage: Incubator or cat carry pack with heating to 30–32°C
	110	105	49	116	Starting to emerge from pouch. Fine fur begins		20	Pouch inside cat carry pack 28–30°C
Transition	112	112	50	120		15 mL <0.8 + 5 mL >0.8		
	115	125	51	125		10 mL <0.8 + 10 mL >0.8		
	118	140	53	131	5 mL <0.8 + 15 mL >0.8			

Milk	Age (d)	Weight (g)	Head (mm)	Tail (mm)	Appearance	Feed frequency	Feeding (mL/day)	Housing
>0.8	120	150	54	135	Emerging from pouch Fine soft fur over body	5 hourly feeds, starts to lap	20 Start to offer tips of native trees	Pouch inside cat carry pack with heating to 28°C. May explore outside pouch for short periods
	130	210	58	155	Fully furred		26 Start to offer gum tips	Intermediate stage: Large enclosure inside with pouch inside nest box Can maintain body temperature
	140	290	61	168	Short dense fur	6 hourly feeds	32 Offer gum tips	No longer requires heating Toileting by self from this age
	150	390	64	181	Fully emerged from pouch	8 hourly feeds	40 Offer gum tips and insects	Buddying can be attempted at 350 g

Milk	Age (d)	Weight (g)	Head (mm)	Tail (mm)	Appearance	Feed frequency	Feeding (mL/day)	Housing
Weaning	160	Growth rate about 7–15 g/day			Dense fully furred	Feed every 12 hours	40 Offer wider variety of leaf, grass, vegetables	Large enclosure housed inside with nest-box, active at night
	180					Feed milk once daily in evening	20 Begin weaning, finished by 700–800 g	Pre-release stage: Large aviary, native browse changed daily, nest-box
	200				Adult in appearance. Becoming independent	Food offered in evening	Weaned off milk	Large aviary, native browse changed daily, nest-box only. Pouch removed
	250							Release age

Table 9.20 Stages of development for the mountain brushtail possum (Used with permission from Wombaroo)

Milk	Age (d)	Weight (g)	Head (mm)	Foot (mm)	Appearance	Feed frequency	Feeding/day	Housing
<0.8	120	90	48	31	Eyes open	4 hourly around clock	18 mL	Intensive stage: Incubator or cat carry pack with heating to 30–32°C
	130	105	51	35	Starting to emerge from pouch.		21 mL	
	140	130	54	39			24 mL	
Transition	142	136	55	40	Fine fur begins	4 hourly around clock	18 mL <0.8 + 6 mL >0.8	Pouch inside cat carry pack 28–30°C
	145	145	56	41			12 mL <0.8 + 12 mL >0.8	
	148	156	57	42			6 mL <0.8 + 12 mL >0.8	

Milk	Age (d)	Weight (g)	Head (mm)	Foot (mm)	Appearance	Feed frequency	Feeding/day	Housing
>0.8	150	165	58	43	Emerging from pouch Fine soft fur over body	5 hourly feeds, starts to lap	24 mL Start to offer tips of native trees	Pouch inside cat carry pack with heating to 28°C May explore outside pouch for short periods
	160	215	61	48	Fully furred		26 mL Start to offer gum tips	Intermediate stage: Large enclosure inside with pouch inside nest box Can maintain body temperature
	170	275	64	53	Short dense fur	6 hourly feeds	31 mL Offer gum tips	No longer requires heating Toileting by self from this age
	180	360	68	56	Fully emerged from pouch	8 hourly feeds	38 mL Offer gum tips & insects	Buddying can be attempted at 350 g

Milk	Age (d)	Weight (g)	Head (mm)	Foot (mm)	Appearance	Feed frequency	Feeding/day	Housing
Weaning	200	Growth rate about 8 g/day			Dense fully furred	Feed every 12 hours	40 mL Offer wider variety of leaf, grass, vegetables	Large enclosure housed inside with nest-box, active at night
	220					Feed milk once daily in evening	20 mL Begin weaning, finished by 700–800 g	Pre-release stage: Large aviary, native browse changed daily, nest-box
	240				Adult in appearance. Becoming independent	Food offered in evening	Weaned off milk	Large aviary, native browse changed daily, nest-box only. Pouch removed
	300							Release age

Table 9.21 Stages of development of the feathertail glider (used with permission from Wombaroo)

Milk	Age (d)	Weight (g)	Head length (mm)	Appearance	Feeding frequency	Housing
>0.8	70	3.0	15	Eyes open, light fur Emerging from pouch	Feed milk every 3–4 hours, 1.0 mL/day	Intensive stage (in nest): Secure pouch at 32–34°C
	75	3.6	16	Fringe hairs on tail 0–1 mm		
	80	4.3	17		Feed milk every 4–5 hours, 1.4 mL/day Start weaning onto solids	Small hops, back-rider Use small fish tank Heat gradient to 28–32°C
	90	5.7	19	Fully furred Fringe hairs on tail 1–2 mm	Feed milk every 12 hours, 1.7 mL/day Offer insects, fruit and nuts	
Weaning	100	7.0	20	Small adult in size Adult size	Fully weaned Feed insects, fruit/nut mix	Needs to be in a group from this age Inside enclosure with fly-wire Branches and nest box offered
	110	7.5			Native browse in aviary	
	115	8				
	120	10				Release

Table 9.22 Stages of development of the greater glider (used with permission from Wombaroo and Colleen Wood)

Milk	Age (d)	Weight (g)	Appearance	Activity	Feeding frequency	Housing
>0.8	90	95–150	Eyes open Short fur Cutting teeth	Poking head out of pouch	6 feeds/day	Intensive stage: In pouch heated to 28–30°C
	120	150–200	Short thick fur Tail furred flat, not fluffy Teeth more prominent	Emerging from pouch	4–5 feeds/day Offer gum tips and flowers	Heated to 28°C Starting to explore Use short furred surrogate mother (short furred washable toy)
	150	200–300	Fur longer, tail fluffier	Mostly out of pouch Final pouch exit around 170 days	3–4 feeds/day Start drinking milk from a bowl Increase amount of foliage offered	Intermediate stage: Ambient temperature In cage 1 m (L) x 1 m (W) x 1 m (H) Toy strapped to the side of the cage for glider to climb onto
	180	400–500		Exploring enclosure more	2 feeds/day Drinking milk from a bowl Continue offering foliage	
Weaning	210–270	500–800	Small adult size		1 feed/day Weaned 210–270 days	Pre-release stage: Outdoor aviary with nest box
	300	800			Release	

Table 9.23 Stages of development of Krefft's glider (used with permission from Wombaroo)

Milk	Age (d)	Weight (g)	Head length (mm)	Appearance	Activity	Feeding frequency	Amount milk fed in 24 hours (mL)	Housing
>0.8	70	22	26	Eyes opening Fur beginning on legs	In nest, may back-ride	Milk each 4–5 hours	4	Secure pouch becoming more open Heat pouch at 30–32°C
	80	33	29	Flat furred	Buddy as soon as possible, starting to hop. Out of pouch	Milk each 6 hour, start lapping	6	Heat pouch at 28–30°C in carry basket
	90	44	32	Thicker fur Fur thickening on tail		Milk each 6 hours	7	Intermediate stage: Nest box in 1 m (L) x 1 m (W) x 1 m (H) cage housed inside
	100	54	35	Fully furred	Emerging from nest	Milk each 12 hour, offer fruit mix	7–8	housed inside No longer requires heating

Milk	Age (d)	Weight (g)	Head length (mm)	Appearance	Activity	Feeding frequency	Amount milk fed in 24 hours (mL)	Housing
Weaning	110	Growth rate around 1 g/day		Small adult in size	Becoming mobile Offer opportunity to glide	Weaning begins Offer food in evening	8	Pre-release stage: Move to outside aviary Nest box present Outside aviary large enough to glide in
	120			Small adult in size	Weaning off milk Start to buddy if not already done	Milk once daily Weaning ends Food left in cage at night	9	
	210			Adult size	Pairing up for release occurs between 3–7 months Release at 100–110 g	More native food of insects, leaf, fruit mix offered	0	

Table 9.24 Stages of development of the squirrel glider (used with permission from Wombaroo)

Milk	Age (d)	Weight (g)	Head length (mm)	Appearance	Activity	Feeding frequency	Amount milk fed in 24 hours (mL)	Housing
>0.8	70	25	27	Fine fur starts on legs Eyes open	Emerging from pouch In nest, may back-ride	4 hours milk	5	Intensive stage: In pouch heated to 32–34°C
	80	40	30	Furred on stomach Eyes open	Starting to hump Back-rider Starts to lap	5 hours milk	8	In pouch, heated to 28–30°C
	90	55	33	Fur thickening on tail and starting on belly	Explores and begin to glide Begins solid foods in evening	6 hours milk	10	In pouch, heated to 28–30°C Open pouch for 2 hours in evening, then close
	100	71	36	Fully furred	Exploring enclosure more Begins to be active at night	8 hours milk	11	In pouch, heated to 24–28°C Pouch open for longer time
	110	85	39	Small adult size	Begin to leave nest	12 hours milk	13	Intermediate stage

Milk	Age (d)	Weight (g)	Head length (mm)	Appearance	Activity	Feeding frequency	Amount milk fed in 24 hours (mL)	Housing
Weaning	120	Growth rate 1–3 g/day		Small adult size	Offer native branches with insects, insects and fruit	1 milk feed	Milk volume depends on other food consumed	In nest box in 1 m (L) x 1 m (w) x 1 m (H) with fine wire
	130			Small adult size	Offer native branches with insects, insects and fruit Wean off milk			Pre-release aviary with nest box
	210–300			Adult in size	Release. Diet of native insects, leaf, flowers	1 daily, at night		

9.9 Release protocol



Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for the animal.

9.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release. The following is a check list to guide your decision-making regarding release suitability for possums and gliders:

- ☑ Individual is in a state of good health – presenting injury/sickness is completely resolved (consider a pre-release veterinary check). A glider presented with a membrane tear can glide satisfactorily.
- ☑ Individual is within a healthy weight range and appropriate body condition (refer to **Table 9.2**).
- ☑ Individual displays ability to actively forage and consume natural foods.
- ☑ Juvenile common ringtail possums may begin to demonstrate the ability to construct a drey from branches and leaves but do not need to demonstrate that they can completely construct a drey before release.
- ☑ Possums and gliders should instinctively avoid domestic pets. Once in the aviary, the animal should startle when humans approach.

9.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered.



STOP – please refer to the conditions of your authorisation on release location requirements.

It is important to ensure that the site remains suitable for release of the animal. Important site factors to consider before releasing a possum or glider include:

- Place a nest box in a tall tree that does not already have nest hollows.
- Select an elevated site to attach the box. See **Table 9.25**.
- Face the nest box away from prevailing winds. This may be north to north-east depending upon the region.
- Attach the nest box to the tree by placing wire around the trunk. Protect the tree from the wire by covering it in plastic tubing, such as a length of garden hose or the Habisure system, which allows room for tree growth.
- Common ringtail possums are more likely to use dreys in heath and shrubby areas and nest in hollows in forests.

- Successful release of gliders is likely to be dependent upon providing more than one nest box, particularly for Leadbeater's possums, yellow-bellied gliders, Krefft's gliders and squirrel gliders, which prefer nesting in family groups. This provides the glider with other nesting sites in case it is ejected after a social dispute and a greater chance to avoid predation.
- Nest boxes should not be placed in food tree species but in nearby trees. Gliders do not nest in their food trees to reduce the risk of predation.
- Common ringtail possums should be released into an area that has dense undergrowth. Canopy connectivity is important to reduce the risk of predation, which occurs when this species travels across the ground. The presence of other common ringtail possums at the original location does not preclude release as they are a communal species.
- For more information on the ecological characteristics and requirements of possums that may help with their release, please refer to **Table 9.1**.
- Krefft's gliders require an understorey of *Acacia* with a forest of iron-bark, eucalypt, box or stringy-bark with mature trees with nest hollows. Look for wattles with tooth marks where sap has been taken.
- Squirrel gliders and Krefft's gliders both inhabit drier forests.
- Feathertail gliders can use smaller tree hollows than larger gliders.
- Greater gliders prefer forests with peppermint, manna gum, mountain ash and brown barrel species. They require high nutrient eucalypt leaves to survive. High hollows in large, old trees are also required.
- Yellow-bellied gliders require old, mature trees, with stags for nest hollows.
- Leadbeater's possums live in predominantly ash forests with dense understorey and dead hollow bearing trees, but they can also use lowland swamp forest and snow gum woodlands.

Table 9.25 Nest box position for possums and gliders

Species	Height above ground
Common ringtail possum	>6 m
Common brushtail possum	3–6 m
Mountain brushtail possum	5–6 m
Feathertail glider	2–4 m
Greater glider	>6 m
Leadbeater's possum	4–8 m
Squirrel glider	4–6 m
Krefft's glider	>6 m
Yellow-bellied glider	>6 m

9.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Approximate release where animal was found (where suitable, or within home range).
- ☑ Away from major roads, fences and dams.
- ☑ Suitable vegetation is available, including tall trees and dense lower storey vegetation.
- ☑ Ample food trees close to dense vegetation.
- ☑ Dense vegetation for nest building.

Release Procedure

- ☑ Limit the number of people at the release.
- ☑ Avoid times when heavy rain and strong winds are forecast.
- ☑ Avoid release when temperatures are expected to be greater than 30°C.

Release with a nest box

- ☑ Hand raised possums and gliders should be released with a nest box as this increases release success.
- ☑ Permission of the landowner or manager is required prior to erecting a nest box.
- ☑ Likelihood of success is increased if the possum has spent at least a month in the nest box at the shelter prior to release.
- ☑ Closed nest boxes are placed in a suitable tree at the original location during the day to allow the animal to acclimatise.
- ☑ Open the nest box just prior to dusk.
- ☑ Ideally, the site should be monitored post release to ensure the animal disperses.

Release without a nest box

- ☑ Release at the original location without a nest box is acceptable for adult possums/gliders as these individuals already have an established territory. Loss of territory is minimised if the possum/glider is released within two weeks of coming into care.

Reuniting orphaned young with their mother

- ☑ It may be possible to reunite orphaned back riding common ringtail (65–120 g) and common brushtail (100–200 g) possums with their mothers.
- ☑ Place the young possum near its mother with a hot water bottle. If the young possum starts calling, the mother may come and collect it.

Staged release of possums using a temporary aviary at the original location

- ☑ This technique is used for the release of hand-reared young.
- ☑ A temporary aviary is made on a box trailer, which is left in the release area for two weeks.
- ☑ Situate under trees that touch the roof of the aviary, providing an avenue out of the aviary.
- ☑ Feed the possum browse from the location during this time to familiarise it with local food trees.
- ☑ At the end of two weeks, open the aviary to allow the possum to leave.
- ☑ The nest-box from inside the aviary is moved to a tree nearby and the box trailer is removed from the site.

9.10 Key references and additional reading

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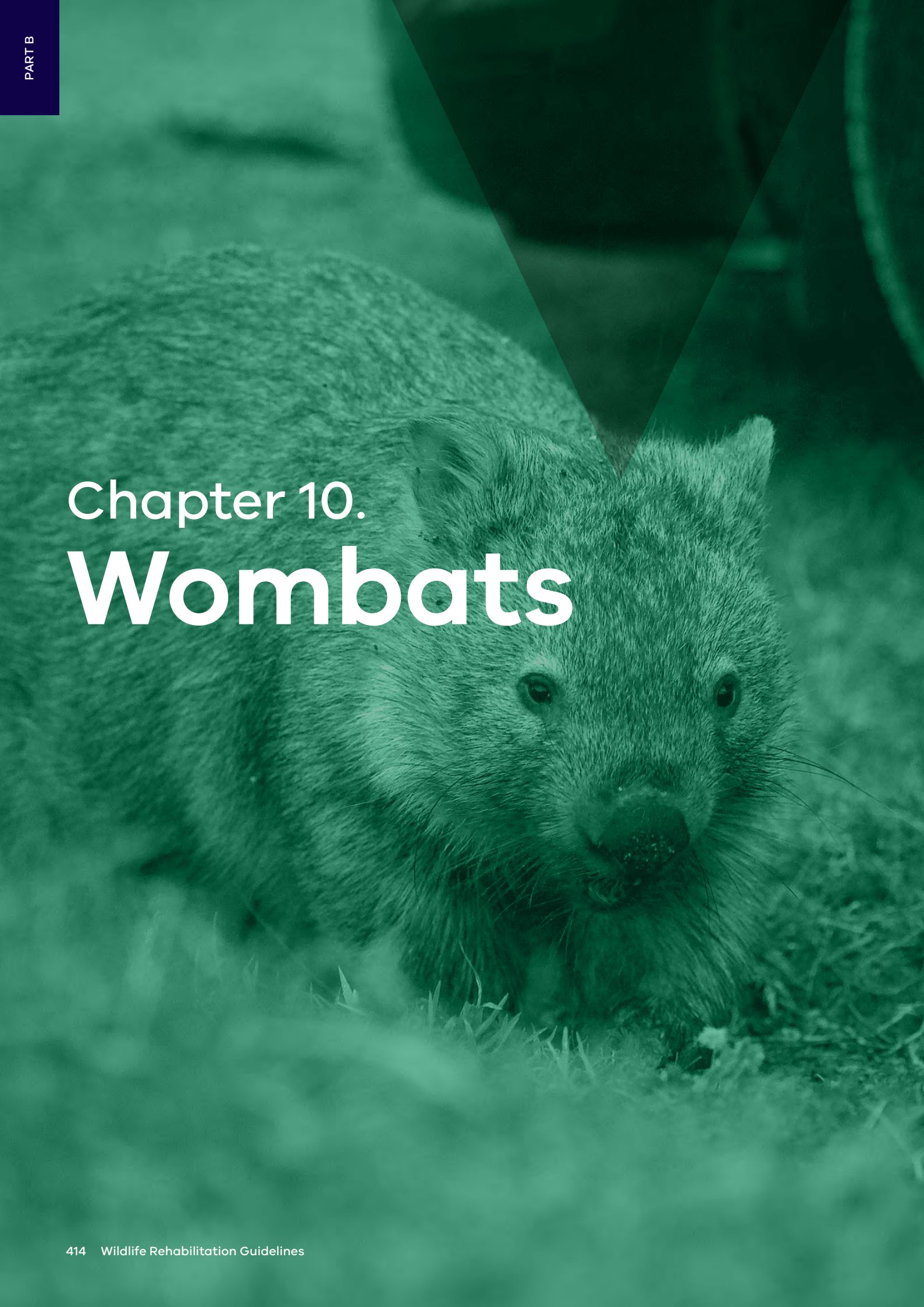
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Chapter 10. **Wombats**

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In Victoria, sick, injured or orphaned wildlife can only be rehabilitated by a wildlife shelter operator or foster carer who is authorised under section 28A of the Victorian *Wildlife Act 1975* (Wildlife Act). Wildlife rehabilitators are subject to strict conditions. The mandatory requirements that they must meet are set out in the Wildlife Shelter and Foster Carer Authorisation issued under the Wildlife Act. These conditions enforce the minimum standards required for the humane treatment and successful rehabilitation of wildlife in care. The Wildlife Rehabilitator Authorisation Guide: Things You Need To Know explains how wildlife rehabilitators can meet these mandatory requirements and can be found here: <https://www.vic.gov.au/wildlife-rehabilitation-shelters-and-foster-carers>.

The Victorian Wildlife Rehabilitation Guidelines have been developed to incorporate evidenced-based best practice in wildlife care and rehabilitation to equip rehabilitators to deliver positive welfare outcomes for individual animals in their care from first aid to post-release into the wild.

You must comply with the conditions of your authorisation. These guidelines must be read in conjunction with the conditions of your authorisation.

When wombats come into care it is the responsibility of the wildlife rehabilitator to ensure that the five domains of animal welfare are satisfied. These include providing optimal nutrition and an environment appropriate to the wombat's stage of rehabilitation. The focus should be on the animal's return to health and release, which is facilitated through regular collaboration with a veterinarian. It is also important to consider the animal's mental state and ability to exhibit normal behaviours without detrimentally affecting its recovery. Welfare may be temporarily compromised by the necessity of a gradual return to normal activity, depending on its stage of rehabilitation. Further information about the five domains of animal welfare is in Part A of these guidelines.

10.1 Introduction




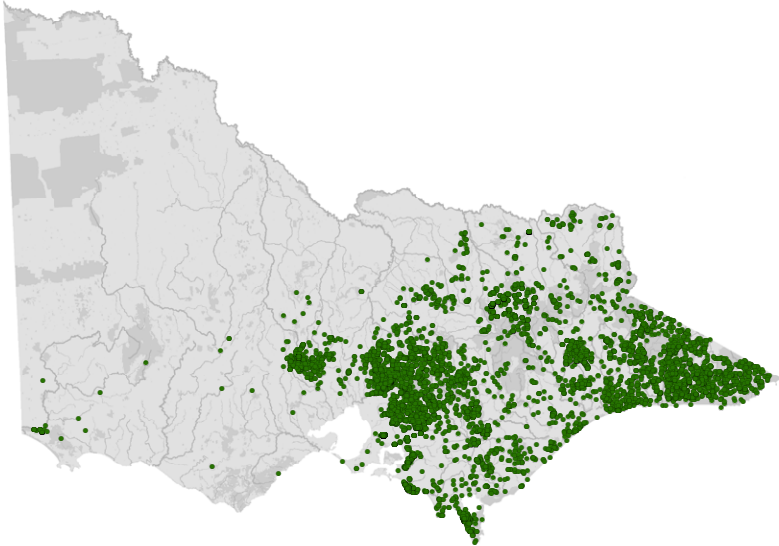
There is only one species of wombat that comes into care in Victoria, the common wombat or bare-nosed wombat, (*Vombatus ursinus*).

10.2 Species information



A profile for the wombat species found in Victoria is detailed in the following table (Table 10.1).

Table 10.1 Species Profile

Species	Common wombat / bare-nosed wombat (<i>Vombatus ursinus</i>)
 <p>Photo credit: Emily Small</p>	<p>Distribution map</p>  <p>Data source: Victorian Biodiversity Atlas Jan 2023 www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas</p>
General appearance	Large animal with coarse fur; nose lacks fur. The coat colour varies from dark brown to grey, as well as sandy coloured
Conservation status*	Common
Sexual dimorphism	Similar in appearance, but female has a pouch, and the male has testicles
Adult morphometrics	Body weight: 20–38 kg Head and body length: 84–115 cm
Home range	2–82 ha: reflects availability of food
Behaviour	Wombats are mainly nocturnal and are usually solitary Wombats live in a burrow that they make by digging. Wombats are territorial but will share a burrow if territories overlap. Although only one wombat may permanently reside in one burrow at a time, the burrow may be shared with other wombats over time

Species	Common wombat / bare-nosed wombat (<i>Vombatus ursinus</i>)
Diet	The common wombat eats a wide variety of grasses, roots and shrubs
Longevity	Up to 11 years in the wild
Sexual maturity	2 years
Mating season	November to July however, the timing of mating and birth is dependent upon local conditions. Sub-alpine wombats may breed at a different time of year to wombats in warmer areas
Gestation length	20–21 days
Litters per year	One young, born every two years Wombats stay in the pouch for approximately 6–10 months and wean at 14–15 months. Young may disperse through all months of the year from approximately 18 months onward

*From the *Flora and Fauna Guarantee Act 1988* Threatened List June 2023. This list is updated regularly throughout the year. For the most current list, please visit <https://www.environment.vic.gov.au/conserving-threatened-species/threatened-list>.

10.3 Animal and human safety considerations



In general, animals in the wild have limited contact with people, pets, and the hustle and bustle of our daily lives. When sick, injured or orphaned wild animals come into care this unnaturally close contact can carry risks to the health and safety of both people and animals. For general information on biosecurity and approaches to minimise these risks see Part A of these guidelines. Specific information on enclosure hygiene and biosecurity for wombats is in **Section 10.6.2**.

The following information relates to human and animal health and safety considerations specifically related to the rehabilitation of wombats.

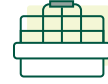
10.3.1. Human safety considerations

- Wild adult wombats can be aggressive and dangerous, making manual restraint difficult if not impossible. Chemical sedation via injection or dart (requiring veterinary support) may be needed.
- Wombats have strong jaws and sharp teeth. They can produce a painful bite resulting in bleeding and bruising.
- Wombats can push a person over when they charge toward them.
- Adult wombats are heavy (20–38 kg) and may require more than one person to lift them. Two people will be required for most adult wombat captures.
- Wombats can carry *Sarcoptes* mites which are readily transmissible to humans. This mite results in a skin rash.

10.3.2. Animal safety considerations

- Common wombats do not sweat and can suffer from heat stress when transported at temperatures greater than 24°C, even if only for a short period of time.

10.4 Capture, restraint, and transport



STOP – A visual examination must be done **BEFORE** the animal is captured. This applies to the initial capture from the wild as well as prior to captures which occur during time in captive care. See Section 10.4.1 for information on what to look for when conducting a visual health assessment.

Refer to Part A of these guidelines for general advice on wildlife welfare, biosecurity and hygiene, and record requirements. The following information relates to the capture, restraint, and transport of sick, injured and orphaned wombats.

10.4.1. Visual observations

Visual observations of wildlife should be conducted prior to any attempts to capture the animal. This is just as important prior to the first capture from the wild as it is before any capture conducted while an animal is in captive care. Observations should be conducted quietly, by

one person, and from a distance which provides a clear view of the animal with as little disturbance as possible. Visual observation should focus on the animal's demeanour, behaviour, movement and posture, looking for evidence of injury/severe disease or deterioration and observe their breathing as demonstrated in the following table.

Table 10.2 Visual health observations in wombats

What to look for	
Demeanour	<ul style="list-style-type: none"> • Bright, aggressive, (screaming or growling is normal) • Abnormal observations include: <ul style="list-style-type: none"> - No attempt to avoid capture, or little struggle - Slow responses
Behaviour	<ul style="list-style-type: none"> • Moves away rapidly when approached • In burrow during the day • Abnormal observations include: <ul style="list-style-type: none"> - No fear of humans, poor attempt to escape - Wandering in the middle of the day
Fur condition	<ul style="list-style-type: none"> • Sleek, with or without patches of hair loss on back (from wombat aggression) • No crusting on ears, eyes or sides • Often carry ticks (normal) • Abnormal observations include: <ul style="list-style-type: none"> - Crusting around eyes, ears, elbows, sides, belly - Weeping wounds that smell

What to look for

Movement and posture

- Able to walk
- No evidence of lameness
- Abnormal observations include:
 - Not walking
 - Lamé
 - Walking in circles

Breathing

- 10–15 breaths per minute
- Abnormal observations include:
 - Shallow, rapid breathing
 - Gasping, open mouth breathing

10.4.2. Equipment

- **Trap:** Cage traps may be required at some sites (operating under authorisation).
- **Net:** Robust hoop nets can be utilised.
- **Catch bag:** Hessian sacks or large strong capture bags.
- **Transport container:** Sturdy plastic tub with ventilation or a large dog carry crate: (80 cm (L) x 60 cm (W) x 50–60 cm (H)). Recommended size for a transport container will depend on the size of the wombat. See **Section 10.4.4.**
- **Thick blanket:** to wrap the wombat.
- **Wooden panels** or **garbage lids:** to herd wombats.
- **Spray can** to mark an animal as checked.

Figure 10.1 Hoop net used for catching a wombat.



Photo credit: A. Sriram

10.4.3. Technique

It is beyond the scope of these guidelines to outline techniques for every situation that may be encountered. Examples of techniques for some specific situations are outlined in the following section.

In addition to this information, for further advice please also refer to the recommended reading list, zoological institutions, veterinarians and/or wildlife experts. Inexperienced rescuers should request assistance where possible.

- Manual restraint of large, wild wombats should never be attempted by inexperienced rehabilitators. Chemical restraint administered by a veterinarian is usually the preferred option regardless of operator experience.
- If chemical sedation is not available, the wombat should be approached from behind so that it cannot reverse and is less able to bite the operator. The hands hold the shoulders firmly in place and move back towards the armpits, where one arm slides under the armpit and across the chest. The animal is then picked up with one arm under both armpits and the second arm supporting the rump. This technique cannot be used on large or highly aggressive individuals, as they will struggle vigorously and attempt to turn their heads and bite.
- Juvenile or large docile wombats can be picked up in a similar manner, with one arm held high under their forearms while the other arm supports the weight of the animal (See **Figure 10.2**).

Figure 10.2 A large tame docile wombat is lifted under its arms.



Photo credit: Jenny Mattingley

Wombats found under a house or in a confined space

Following an injury, wombats may sleep or seek safety under a house, or in a drain or similar structure. They will usually emerge on dusk or during the evening and may be lured out with food. The entry point can be blocked while the wombat is foraging during the night. Do not go under a house to chase the wombat, due to risk of injury. If the wombat leaves the confined space of its own accord, it does not require capture. If cage trapping an injured animal is needed, authorisation is required. Contact the Office of the Conservation Regulator (OCR) for advice regarding an **Authority to Control Wildlife application**.

Wombats found next to a road

Be careful near roads. Park the car off the road with hazard lights on and wear reflective vests during the capture. Contact the police assistance line on 131 444 to assist with traffic management.

A sub-adult or adult wombat may be injured from vehicle trauma and require capture and treatment. Even with broken limbs, wombats can still move quickly. A wheelie bin placed on its side may be used to contain the wombat. For animals that are unable to move, roll them gently onto a blanket and lift, using a person on either end of the blanket.

Wombat joeys may be retrieved from the pouch of the mother, who has died from vehicle trauma. Safely remove the mother's body from the road before attempting to remove the joey. The pouch faces backwards and may need to be cut to remove the joey, taking care not to injure the joey. If a pouch is empty, check teats for evidence of feeding. 'At-foot' young that survive vehicle trauma may hide in nearby burrows. Attempts should be made to locate these animals as they are not yet independent and are unlikely to survive by themselves. Mark the mother's body with spray paint to indicate that the pouch has been checked.

10.4.4. Transport

Recommended size for a transport container will depend on the size of the wombat.

Construction

- Wombats can be transported in a sturdy plastic tub or a large dog carry crate, 80 cm (L) x 60 cm (W) x 50–60 cm (H). This will be adequate for most adult wombats, but too small for the largest wombats. For a large wombat, a carrier of around 100 cm (L) x 60 cm (W) x 100 cm (H) will be required. A wheelie bin can be used for short trips (less than 30 minutes). Adequate ventilation is required, and the lid/gate should be securely fastened (See **Figure 10.3**).
- A soft bag made of shade cloth or hessian (as utilised for kangaroos) can be used to restrain a wombat. It should not be used to transport wombats for longer than 30 minutes, due to the risk of overheating.
- Pouch young can be transported in a home-made pouch or pillowcase.
- Use air-conditioning in the vehicle and monitor the animal regularly during transport. Wet towels could be used on the floor of the transport enclosure.

Figure 10.3 a. A solid wooden container used to transport large wombats. b. A large dog carry pack can be used.

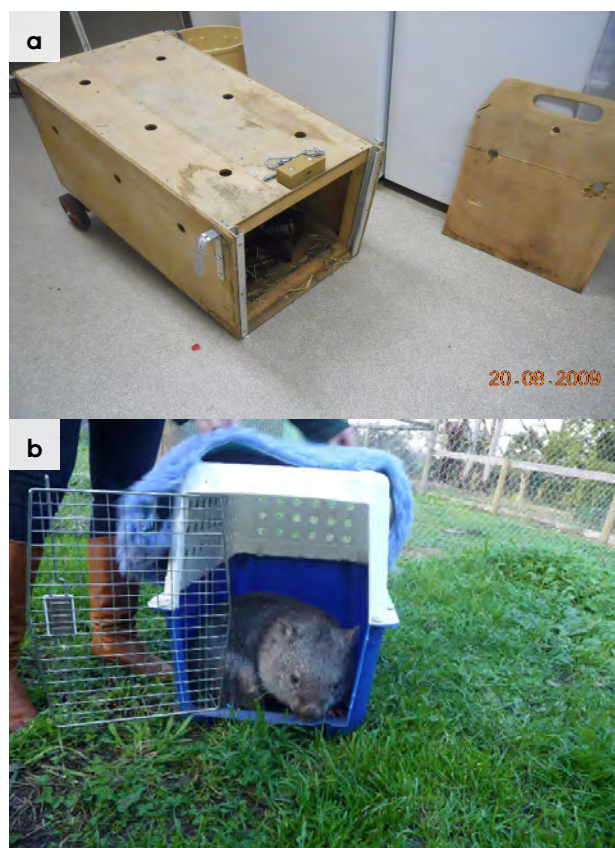


Photo credit: Jenny Mattingley

10.5 Monitoring animal health and welfare



The goal of wildlife rehabilitation is to address health and welfare concerns quickly and effectively so wildlife can be released back to the wild as soon as possible. Decision-making from the time of capture through to release should be guided by an accurate understanding of the animal's true state of health and welfare. Careful monitoring throughout the rehabilitation period ensures that significant issues, or deterioration in health condition, are identified immediately and rapidly addressed.

It is preferred that all sick, injured or orphaned wildlife be assessed by a veterinarian to ensure that non-obvious signs of trauma or disease can be assessed and treated as soon as practicable. No medication should be provided prior to this assessment, as this can mask clinical signs and make an accurate health assessment by the veterinarian very difficult.

Templates for record-keeping visual and physical observations and daily care can be found in Part A of these guidelines.

This section provides guidance on health assessment on arrival and on effective monitoring of the health and welfare of individuals in care through minimising human-animal interactions and stress to the animal to maximise successful release back to the wild.

Please note: Carers should always aim to treat animals as efficiently as possible, so that they can be returned to the wild in the shortest possible time. This section provides guidance on assessment of health on arrival and on effective monitoring of the health and welfare of animals up to the point of release back to the wild.

10.5.1. Physical examination

Once visual observations are complete, and the animal is stable enough to withstand capture and handling, a basic physical examination should be conducted. This can be repeated when required any time the carer has the animal in the hand, such as for an enclosure change. However, if a full physical exam is not conducted, body condition and weight should be assessed every time the animal is in the hand for other reasons. Carers should make sure scales are available and ready to use before capturing the animal. Physical examinations are also required if the carer notices any changes suggestive of deteriorating health or an injury.

Always record the physical examination findings, so that you can compare findings as the animal's rehabilitation progresses. This ensures any health concerns are identified as soon as possible and the carer can plan release as soon as this is appropriate. **A template for recording Physical Examination findings can be found in the Appendices to Part A in these guidelines.**

Examinations should be conducted in a quiet location with no access to burrows, away from any domestic animals. Only one person should handle the animal, while a second person takes notes. All other people should move away, and noise kept to a minimum. Handling should also be kept to a minimum, with careful monitoring for any signs of distress (such as panting, salivating, vocalisation or sudden deterioration in demeanour). If these are seen, the examination should be stopped immediately and the animal returned to its catch bag, transport box or enclosure and allowed to recover.

Species specific considerations:

- Physical examination of adult wombats can be difficult due to their size and strength and will often require sedation by a veterinarian.
- It is important that the animal is first assessed awake so the veterinarian can direct the examination at the problem.
- **Table 10.3** provides additional guidance on what to look for during physical examinations.

Table 10.3 Physical examination of wombats

What to look for	
Body weight	<ul style="list-style-type: none"> • Will vary with age. Record for reference.
Body condition	<ul style="list-style-type: none"> • Wombats in ideal condition should be rounded and feel firm all over. The spine should not be easily felt.
Hydration status	<ul style="list-style-type: none"> • Skin tent in inguinal (groin) area falls down within 1 second. Note that skin between shoulder blades is naturally tight and not representative.
Eyes	<ul style="list-style-type: none"> • Basic internal structures of eyes (e.g. pupil, iris) appear symmetrical. • There should be no cloudiness or grey colour. • Eyelids open, with no discharge or crust.
Ears	<ul style="list-style-type: none"> • Erect, no crusting. • Some parasites (ticks and mites) may be present and can be left if there isn't an excessive load and there is no evidence of irritation/excessive scratching inside the ears.
Mouth	<ul style="list-style-type: none"> • No blood visible. • Incisors intact and aligned. • Gums are pink. • A full dental assessment can only be performed by a veterinarian under anaesthesia.
Skin and coat condition	<ul style="list-style-type: none"> • Skin is smooth, pale pink. • It is normal to have a moderate burden of ticks (1–20), but 100s can indicate ill health. While a healthy wombat would be expected to be covered in normal fur, it is not unusual for some hair loss to occur over the back from wombat aggression. However, deep wounds may need treatment. • Crusty, thickened skin, perhaps with cracking may indicate mange.
Limbs and feet	<ul style="list-style-type: none"> • Able to walk normally. • Nails should not be broken. • Foot pads should be intact, free of wounds.
Sex determination	<ul style="list-style-type: none"> • The sex of the common wombat is determined by looking for the presence of a pouch or testicles.
Pouch check	<ul style="list-style-type: none"> • The pouch should be checked for a joey. An enlarged teat and mammary gland may indicate a joey is still dependent on the mother.

Figure 10.4 Physical examination of an anaesthetised wombat, mother with joey in pouch.



Photo credit: Phillipa Mason

Figure 10.5 Examination of the teeth, normal incisors.



Photo credit: Phillipa Mason

10.5.2. Ongoing monitoring of health and welfare

The aim of wildlife rehabilitation is to ensure animals recover and can be released back to the wild as quickly as possible. Careful, daily monitoring is required to ensure that animals are responding as expected to the treatment being provided and so that any deterioration or welfare concerns can be identified and addressed as soon as possible. Rehabilitators should ensure that record-keeping is a priority to maximise positive welfare outcomes. Templates to assist wildlife rehabilitators to record and monitor wildlife health and welfare can be found in the appendices to Part A of these guidelines. These records will be valuable tools to share with veterinarians to support decision-making.

The following is recorded daily:

- demeanour
- food consumption
- faecal/urine output
- behaviour observed
- medical treatment provided
- evidence of overnight activity.

The following is recorded weekly:

- weight
- body condition.

Over time, regular monitoring will also help to develop carer skills and knowledge, as regular observations and recording will result in a deep understanding of the expected behaviour and response to treatment for the species in care.

Species specific considerations:

- Ideally, physical observations and medications should be undertaken at the beginning and/or end of the resting period to minimise disturbance and maximise the rest/sleep period for rapid healing and ensure ease of capture.
- The wombat should be observed at least daily.
- Note the animal's demeanour and behaviour every time food is introduced or taken away, the animal is medicated, or the enclosure is cleaned. Pay particular attention to any changes that have occurred since the previous day.
- Gently encourage the wombat to walk, in order to assess its movement and demeanour.

- Note faecal consistency daily. If diarrhoea is noticed, a faecal sample should be collected and submitted to the veterinarian for assessment as soon as possible. Do not treat on suspicion of a bacterial or parasitic infection, as this can make definitive diagnosis very difficult and potentially prolong the course of the disease.

10.5.3. Common and emerging health conditions

Clear guidance on conditions that may require euthanasia can be found in Part A of these guidelines.

Table 10.4 lists common clinical signs and possible causes of injury/disease. Carers should be aware that these are not exhaustive. Aside from first aid, carers should avoid administering medications prior to the provision of veterinary advice.

Unusual clinical signs or mass mortality events – a number of animals dying or found dead at the same time, with similar signs – may indicate an emergency animal disease, an emerging/new infectious disease or an environmental/human related toxicity which needs further investigation. Report these immediately to the Emergency Animal Disease Watch Hotline on 1800 675 888 (24 hours).

Table 10.4 Common injuries and clinical signs of emerging health conditions seen on presentation or during care

Injury or clinical signs	Possible causes	Rehabilitator observations and response
<p>Note: Do not provide pain relief or other medication, including antibiotics, unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. Use of antibiotics when not indicated can contribute to antimicrobial resistance and reduce drug efficacy.</p>		
<p>Unable to walk or move normally</p> <p>Swollen limb</p> <p>Bruising</p> <p>Fractures</p> <p>Dislocation</p> <p>Nail injury, missing nail</p>	<p>Found adjacent to road/suspect motor vehicle accident,</p> <p>Caught in wire or netting, predation injury caused by raptor, fox, cat or dog, gunshot</p> <p>Capture injury</p> <p>Injury sustained in captivity</p>	<ul style="list-style-type: none"> Urgent veterinary attention is required. Do not delay transfer to veterinarian to apply first aid, other than to stop excessive bleeding. Move animal to a small transport box to restrict movement. Ensure temperature is appropriate for species and minimise stress. Do not attempt to stabilise fractures as this is very painful, and risks making the injury worse. Fracture stabilisation should only be attempted by a veterinarian following physical exam, x-rays and under general anaesthesia. Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. If suspected as the cause, assess the enclosure/box/bag to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 10.4 and Section 10.6 this chapter for further advice on housing and transport.

Injury or clinical signs	Possible causes	Rehabilitator observations and response
Thickened, cracked skin, crusting around ears and eyes	Sarcoptic mange	<ul style="list-style-type: none"> • Present to a veterinarian for assessment, to confirm diagnosis and direct treatment. • If indicated, give medications to kill parasites and treat any secondary infection, as prescribed by a veterinarian (see Figure 10.7). • Where wildlife rehabilitators have more than one wombat or other mammal species in care, strict biosecurity procedures are required to reduce the risk of spread of mange from infected to non-infected individuals. • Dispose of bedding from in-contact animals by placing it into a bag and incinerating it or placing in general waste. Towels, pouches, etc. should be machine washed in hot water. Affected wombats should be housed separately to other wombats. Feed and clean them last, to reduce risk of transmission to others. After release or euthanasia, the enclosure should be cleaned and then isolated for a minimum of three weeks before using again. • Sarcoptic mange is a zoonosis. Refer to Part A Chapter 4 of these guidelines for additional information on Biosecurity & Hygiene including zoonoses and minimising disease risks.
Fur loss Skin irritation, itching	External parasites, other skin condition	<ul style="list-style-type: none"> • Seek veterinary advice or assessment to diagnose the cause and advise on treatment. • Heavy burdens in animals may indicate an underlying disease or injury, these animals require veterinary assessment • For light burdens, generally no treatment is required. However, if in care, consider other animals in care contracting parasites. • Ticks can be manually removed. For heavy burdens apply medication as directed by a veterinarian. • Ensure good hygiene and biosecurity practices.

Injury or clinical signs	Possible causes	Rehabilitator observations and response
Blindness Deafness Neurological signs Wobbly movement, or ataxia Circling movement Strange behaviour (out in the daytime) Easily caught Lethargic Moribund, collapsed	Infectious disease, such as toxoplasmosis or bacterial meningitis, cranial trauma, toxicity (e.g. 1080 poisoning)	<ul style="list-style-type: none"> • Seek prompt veterinary assessment. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • Carer may observe the animal bumping into objects in enclosure or fail to respond to short sharp noises (such as a loud clap from behind animal). • Pupils may be fixed/dilated and not responsive to changes in light level. Pupils should constrict if a pen light is shone in the eye. • If multiple animals are seen with similar signs, this may indicate a newly emerging infectious disease or a toxicity (such as plant toxicity or poisoning). Contact the Emergency Animal Disease Watch Hotline on 1800 675 888 to report concerns. • If unusual toxicity or infection is suspected, you or your veterinarian can contact Zoos Victoria's Veterinary Department to discuss options for disease investigation.
Burns	Recent bushfire, campfire injury, chemical burn	<ul style="list-style-type: none"> • Seek urgent veterinary attention. • Burn injuries are extremely painful, treatment and bandage changes must only occur under anaesthesia and with adequate pain management. • Animals must be returned to a veterinarian for ongoing bandage changes. • Give other medication as prescribed by a veterinarian. • House the wombat in a fly-proof enclosure.
Joey failing to pass faeces Bloating	Constipation in joeys, other gastrointestinal problems	<ul style="list-style-type: none"> • Seek veterinary advice or assessment. • Seek urgent veterinary advice if constipation does not resolve rapidly (e.g. within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. • Constipation may be seen in orphaned young as a result of dehydration. Offer the appropriate milk for the age of the joey. If the joey feeds well, no additional treatment should be necessary. If the joey is dehydrated, adequate hydration in the first week of care is vital. This is achieved by offering oral electrolyte replacers in between milk feeds. • Seek advice from species experts.

Injury or clinical signs	Possible causes	Rehabilitator observations and response
Weight loss, reluctance to eat	Tooth malocclusion (misalignment), other dental disease, failure to thrive, other disease or injury	<ul style="list-style-type: none"> • Seek veterinary assessment to determine the cause. • Dental problems can only be assessed properly by a veterinarian with the animal under anaesthesia (see Figure 10.8).
Nails loss/toe injury Swollen foot or toe Wound to foot or toe Bleeding foot or toe Damaged or missing nail Bleeding nail	Toe, foot or leg caught in netting, wire or bag Predation injury caused by raptor, fox or dog Poorly designed transport box/ enclosure Capture injury Injury sustained in care due to stress	<ul style="list-style-type: none"> • Seek prompt veterinary attention. • Injuries to nails are very painful and lesions can be very slow to heal. There is a risk of nail bed infection, veterinary management is required. • Do not provide pain relief or other medication unless under veterinary guidance and supervision, as these can have severe side effects, particularly in dehydrated/shocked animals. • If suspected as the cause, assess the enclosure/box/ bag to find the source of injury. Fix loose wire/gaps or sharp edges before returning animal to enclosure. See Section 10.4 and Section 10.6 of this chapter for further advice on housing and transport. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. Seek advice from species experts.
Bleeding Puncture wounds Bruising Fur loss	Conspecific aggression, breeding season injuries Found adjacent to road/suspect motor vehicle accident, Predation injury caused by raptor, fox or dog Severe case mange Poorly designed transport box/ enclosure Capture injury Injury sustained in captivity, due to stress	<ul style="list-style-type: none"> • Seek prompt veterinary assessment, euthanasia may be the most humane response if the wounds are extensive. • The severity of bite wounds/scratches may not be immediately obvious, but they are frequently encountered in wombats. If they are deep, they can take a long time to heal and may become flyblown.

Injury or clinical signs	Possible causes	Rehabilitator observations and response
<p>Diarrhoea</p> <p>Loose, smelly faeces</p>	<p>Inappropriate diet, change in diet, infectious disease, alteration of microbiome, stress, internal parasites, antibiotic treatment</p>	<ul style="list-style-type: none"> • Seek veterinary advice. • Seek urgent veterinary advice if diarrhoea does not resolve rapidly (e.g. within 24–36 hours), or if there is any evidence of dehydration, blood in faeces or change in demeanour. • Do not treat on assumption of infectious disease (such as coccidia or bacterial infection) as this can make veterinary diagnosis more difficult if the animal does not improve. • If animal has been otherwise stable and doing well, there are a number of responses carers may implement to try to resolve diarrhoea. Consider any recent changes which may have led to diarrhoea remove inciting cause where possible. These could include: rapid change in diet, unusual levels of sound/intervention or handling, contact with recently arrived animals. • If milk has recently changed, immediately switch back to previous milk, wait until diarrhoea has resolved and then implement a slower diet change. • Seek advice from species experts, ensure diet and husbandry practices are correct. • If stress is deemed a factor, consider whether the animal is a candidate for rehabilitation. • Do not mix oral rehydration fluids with milk as it changes the digestibility of the milk. Oral rehydration fluids/water can be provided in between milk feeds. • Ensure excellent hygiene standards to prevent spread to other animals/carers, and isolate this animal from any others in care, if possible.
<p>Skin irritation/fur loss</p>	<p>Conspecific aggression, breeding season interactions, mite infestation</p>	<ul style="list-style-type: none"> • Seek veterinary advice or assessment. • Some fur loss/minor skin lesions are commonly seen due to fighting or in the breeding season and may not require any intervention. • A small number of ticks/mites can be normal, and do not require treatment or removal. However, if there is a very high number of ticks/mites seen, the animal is scratching/irritated, or the skin is red and inflamed, seek veterinary attention to treat ectoparasites.

Figure 10.6 Head trauma caused by collision with a motor vehicle.



Photo credit: Zoos Victoria

Figure 10.7 a. A common wombat with severe sarcoptic mange. **b.** the mite that causes sarcoptic mange.

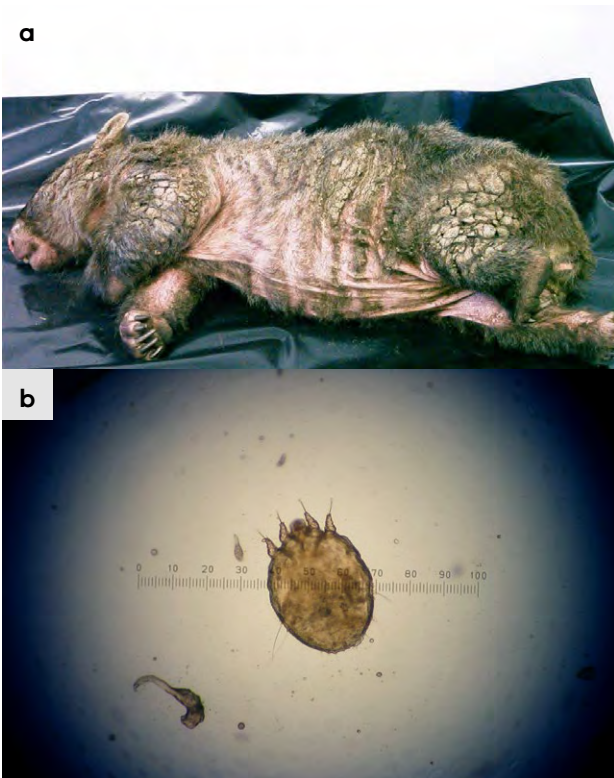


Photo credit: Zoos Victoria

Figure 10.8 a. Malocclusion of the right upper incisor in a young common wombat caused by vehicle trauma. **b.** Spurs visible on the cheek teeth (arrow) due to malocclusion. If left untreated they will lacerate the tongue and cheeks.

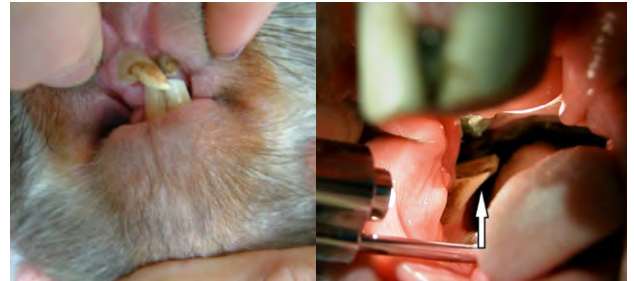


Photo credit: Anne Fowler and Zoos Victoria

Figure 10.9 Wombat with a cataract.

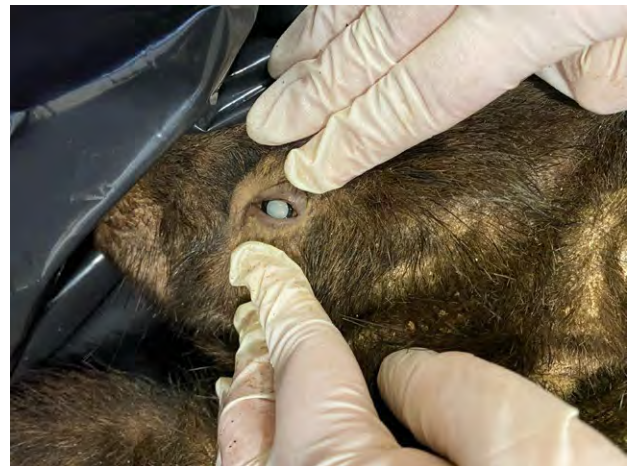


Photo credit: Zoos Victoria

10.5.4. Administering treatment

- Oral medications can be delivered in a syringe directed into the side of the mouth while the animal is restrained. Care is required to avoid biting.
- Injectable medications can be administered under the skin, between the shoulder blades. Only experienced carers should give injections.
- Fluids (Lectade or Hydralyte) are best administered orally to address dehydration.
- Subcutaneous fluids should be given under anaesthesia as it is a painful process. Wombats do not have a good subcutaneous space and the skin is very thick.

10.6 Housing



Below are several key considerations when housing adult animals in care.

10.6.1. General housing information for wombats

- Housing adult wild wombats for any length of time can be very difficult and often causes significant stress to the animal. Consideration needs to be given as to where the animal will go for treatment/rehabilitation.
- Wombats are sensitive to noise, and the sight and smell of domestic pets. They should be housed individually in a quiet area of the property.
- Wombats should have access to fresh water and fresh grass every day.
- Wombats are very strong and will try to escape if they are not too sick. Enclosures should be very sturdy; flooring should be solid so they cannot dig out.
- Adult wombats are reluctant to eat and difficult to feed adequately in captivity so housing for periods of over a week may necessitate euthanasia for welfare reasons.

10.6.2. Enclosure hygiene & biosecurity

General information about hygiene and biosecurity can be found in Part A of these guidelines. New diseases emerge frequently and sick and injured animals in care are often more susceptible to picking up pathogens from the environment. It is important to maintain excellent levels of hygiene to avoid inadvertently transferring diseases between animals, and from humans, and to protect the wild population where the animal will eventually return to.

Species specific considerations:

- All straw and grass used in enclosures or for feeding should be free of cat faeces to prevent the introduction of *Toxoplasma*.
- Wombat enclosures that have housed wombats with mange should be thoroughly cleaned and left empty for at least three weeks.
- Remove faeces daily to prevent a build-up of coccidial and other parasitic oocysts.
- The only way to eliminate coccidia from an enclosure with a soil floor is to remove the top layer of soil. Regular topsoil removal should be part of a shelter biosecurity management plan. A concrete floor can be cleaned with boiling water, as this has been shown to kill oocysts.
- Enclosure furniture and bedding must be replaced in between animals.

10.6.3. Housing types

Different set ups are required for animals at different stages of treatment and care. **Table 10.5** describes the housing type, suggested dimensions and requirements at each stage of care. For information on housing animals during hand raising see **Section 10.8**.

Table 10.5 Rehabilitation housing for adult wombats

Intensive care housing		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>Short term critical care (<48 hours)</p> <p>Intensive veterinary treatment – frequent medication, oxygen supplementation, temperature control</p> <p>Longer periods under veterinary supervision where strict cage rest/ confinement is indicated</p>	<p>A recommended size is 1 x 2 m with a wall height of 2 m (H).</p> <p>It should be large enough for the animal to turn around, but small enough to permit easy capture.</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A small stable or enclosed area with solid walls and floor and subdued lighting is recommended. • Solid walls (at least to 1 m) are required for wombat enclosures, as animals may injure themselves while attempting to climb mesh walls. • It is expected that the wombat would be housed for less than seven days in an enclosure of this size. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • The bedding may be a deep layer of straw to provide support for recumbent animals. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • Warmth should be provided if the animal is recumbent, but adult wombats don't need temperatures above 25°C. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Easy access to grass and low-profile water bowls are required.

Intermediate housing (Treatment/cage rest)

Indications for use	Suggested min. dimensions	Suggested requirements
<p>Provision of daily medication, close monitoring once animal is stabilised and no longer requires intensive care.</p> <p>Enclosure furnishings can be arranged to reduce opportunities to climb/dig or move excessively so that 'cage rest' can be achieved with slightly more space/reduced contact</p>	<p>Suggested minimum size is 2 x 3 m with walls of 2 m (H).</p> <p>It should be large enough for the animal to move around, but small enough to permit easy capture.</p>	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • A stable or shed with solid walls and floor is suitable. • A double hinged half door permits the animal to be checked without too much disturbance. • It is ideal if this housing leads directly out to the pre-release pen. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • As for the intensive housing enclosure with the addition of a wooden box (120 cm x 50 cm x 50 cm), large dog carry pack or wooden A-frame which can be used as a temporary burrow. • The flooring may be soil or concrete. However, wombats may damage their nails on concrete floors if housed for a long period of time. If flooring is soil, it will need buried wire to stop the wombat digging out. • Provide some bedding using grass, hay or straw. <p>ENVIRONMENTAL VARIABLES</p> <ul style="list-style-type: none"> • No heat should be needed at this stage. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Access to fresh grass and water is required.

Pre-release		
Indications for use	Suggested min. dimensions	Suggested requirements
<p>No longer require regular handling/medication</p> <p>Development of fitness/strength prior to release</p> <p>Monitoring/assessment of behaviour (foraging, digging)</p> <p>Pre-release assessment</p>	10 m x 5 m x 2 m high	<p>ENCLOSURE CONSTRUCTION</p> <ul style="list-style-type: none"> • Solid sides to 1 m preferred. • Natural ground to dig preferred, but buried wire or concrete will be necessary to stop escape or burrow formation. <p>ENCLOSURE FURNISHING</p> <ul style="list-style-type: none"> • Artificial burrows can be made from concrete pipes, wooden boxes or metal drums. It is important to ensure that metal drums or artificial boxes are covered with adequate soil or cover to prevent them from overheating. • Offer material for bedding such as hay, grasses, bracken fern, gum leaves and bark. • The wildlife rehabilitator should be able to access the burrow. <p>THERMAL ENVIRONMENT</p> <ul style="list-style-type: none"> • Ambient. <p>PROVISION OF FOOD/WATER</p> <ul style="list-style-type: none"> • Access to fresh grass and water is required.

Figure 10.10 A stable that is suitable to house an injured adult wombat. Note the solid walls and easy access to both grass and pellets.



Photo credit: Jenny Mattingley

Figure 10.11 A pre-release yard with tin fencing.



Photo credit: John Merrick

Figure 10.12 An artificial burrow under construction in a pre-release yard.



Photo credit: John Merrick

Figure 10.13 Artificial burrow entrances may need to be reinforced with wooden sleepers.



Photo credit: Anne Fowler

Figure 10.14 Pre-release wombat enclosure. Note solid walls, artificial den with door for easy access and food placed in a tray on concrete flooring for ease of cleaning and to minimise faecal build up.



Photo credit: Zoos Victoria

10.7 Feeding and nutrition

Keeping daily records of food offered (item and volume fed) and food consumed is good practice and will allow the rehabilitator to observe how an animal is responding to food on offer and inform future choices.

Please note: Food suppliers and specific products mentioned in these guidelines are intended as examples only. Other suitable products may also be available.

This section refers to feeding and nutrition of older hand-raised and adult wombats in rehabilitation. Information on feeding orphaned individuals can be found below under **Section 10.8 Hand raising**.

Table 10.6 Daily feeding and diet guide for adult wombats during rehabilitation

Species	Adult wombats
Diet	<ul style="list-style-type: none"> • Food to offer older hand-reared wombats or adults includes: <ul style="list-style-type: none"> - One to two shopping bags by volume of freshly picked, native and introduced grasses. These should be offered once the teeth begin to emerge. The roots and dirt should be left on and, where possible, the grass clumps should be secured, so that the wombats use their teeth and jaw muscles, as they would in the wild, to pull the grass out of the ground. This is equivalent to about 2 kg of grass per day. Suitable grass species are shown in Table 10.7. - One to two biscuits of commercially produced grass (meadow) hay daily. - One new tussock of native grass daily. - Bark and sticks from native tree branches such as stringybark. - Charcoal (ensure it was burnt native hardwood). - Water. • Animals with a lack of appetite can be offered the following palatable items: <ul style="list-style-type: none"> - Freshly picked green grass. - Grass based pellets, which should constitute no more than 10% of the daily diet and should be low in protein and Vitamin D. Suitable pellets include those for horses, goats and macropods. Avoid medicated pellets such as cattle and chicken pellets as these may contain medications (for example coccidiostats) that may be fatal to wombats.
Pre-release considerations	<ul style="list-style-type: none"> • Grasses from the release area should be fed and consumed by the wombat before release.
Frequency/time of feeding	<ul style="list-style-type: none"> • Wombats should be fed daily in the evening. • Fresh water should always be available, provided in a stable/non-spill bowl or automatic drinker. Water should be changed daily.

Table 10.7 Grasses eaten by adult, wild common wombats

Native species	Latin name	Introduced species	Latin name
Tussock grass	<i>Poa sp</i>	Oat grass	<i>Avena sativa</i>
Kangaroo grass	<i>Themeda australis</i>	Perennial rye grass	<i>Lolium perenne</i>
Wallaby grass	<i>Danthonia pencillata</i>	Annual rye grass	<i>Lolium rigidum</i>
Australian salt grass	<i>Distichlis distichophylla</i>	Sorghum	<i>Sorghum sp</i>
Spear grass	<i>Stipa sp</i>	Parramatta grass	<i>Sporobolus africanus</i>
Weeping grass	<i>Microlaena stipoides</i>	Paspalum	<i>Paspalum dilatatum</i>
Club rushes	<i>Scirpus sp</i>	Yorkshire fog grass	<i>Holcus lanatus</i>
Marram grass	<i>Ammophila arenaria</i>	Meadow fescue	<i>Festuca pratensis</i>
Hairy spinifex	<i>Spinifex hirsutus</i>	Cocksfoot	<i>Dactylis glomerata</i>
Reed bent grass	<i>Deyeuxia quadriseta</i>		
Tall sedge	<i>Carex appressa</i>		
Spiny-headed Mat-rushes	<i>Lomandra longifolia</i>		
Bark from stringybark tree	<i>Eucalyptus baxteri</i>		
Roots apple bark	<i>Eucalyptus bridgesiana</i>		

10.8 Hand raising

Hand raising record templates for growth, development, feeding and other observations can be found in the appendices to Part A of these guidelines.

10.8.1. Equipment required for hand raising

- **Housing:** Initially joeys will be housed in pouches which are then housed in a pet carrier or cot. Many carers raise them in pairs (though they are almost always solitary offspring and will be solitary as adults) as they spend the first 15–18 months with their mother.

Figure 10.15 Housing for orphaned joeys. The pouch is placed inside a child's playpen.



Photo credit: Jenny Mattingley

- **Milk:** There are a variety of low lactose milk formulas available to raise wombats. Follow the manufacturer's instructions when making up the milk formula. Milks that can be used include:
 - Wombaroo Wombat Milks provide appropriate levels of protein, fat, carbohydrates and energy for all stages of growth.
 - Biolac produces three milks which provide sufficient protein, fat, carbohydrates and energy for all stages of growth.
 - Di-Vetelact is an older product but many carers have had success with it. It is a single formula that is diluted according to the age of the joey.
- **Supplements:** Suitable supplements that may be added to milk include:
 - Wombaroo Impact is used to boost immunity and protein in orphaned joeys after the first month in care.
 - Critical Care for Herbivores is used to provide a source of easily digestible energy to sick joeys that have started eating solids.
 - Do not add human infant vitamin supplements to the milk formula.
- **Pouches:** Pouches are usually constructed as follows:
 - An inner lining made from a natural fibre without exposed strands, which may be achieved by using French seams. It may have curved edges.
 - Outer pouch may be made from a variety of materials such as wool, polyfibre, cotton or synthetic fleece fabric.
 - This pouch can then be placed in a hanging pouch which can be suspended on a frame. For wombats this should still rest on padding on the bottom of the enclosure so they can climb in (they don't roll in like a macropod).
- Pouch size will vary with the size of the joey. A young joey should feel snug, but the pouch will become more open with increasing age.
- **Thermometer**
- **Scales**
- **Record Charts**
- **Appropriately sized teats and bottles:** A variety of teats are available, but the best shape for wombats is a broad, elongated teat.

Figure 10.16 a. LD teat suitable for in pouch wombats. b. FM teat suitable for out of pouch wombats.



Photo credit: Wombaroo

Figure 10.17 Joey being nursed. Eyes and body are covered with blanket.



Photo credit: Zoos Victoria

10.8.2. Growth, development and housing orphaned young



STOP - Please refer to your authorisation for mandatory conditions regarding unfurred joeys.

- Raising wombats to the point of release can take up to two years. Wombats are usually released at around 18 to 24 months of age, or approximately 18 kg.
- The ambient temperature is reduced slowly until pouch emergence when the joey is furred. See the developmental chart in **Table 10.8** for heating recommendations. To avoid burns, a heat pad/heat pack/hot water bottle should never be placed directly against the animal's skin, especially if the joey is not yet furred. A thermometer is used to monitor the temperature in the pouch by placing it between the inner and outer pouches.
- Buddying joeys with others, improves success rates and should occur as soon as possible.
- Offer grasses with roots and dirt.
- See **Table 10.8** for details on growth, development and housing of orphaned young.
- Foods that should **not** be fed to wombats include:
 - Processed cereals – such as bread, cereal biscuits or muesli mixes. These predispose to gum infections, bloat and are inadequate in fibre.
 - Chaff (made from short, chopped hay (such as lucerne chaff) is easily trapped between teeth and may predispose to gum infections.
 - Carrots are used as bait for rabbit control. Feeding carrots to hand-reared young wombats may teach them that this food is safe in the wild, when it is not.
 - Fresh clover and cabbage leaves, as these may cause stomach bloat.
 - *Phalaris* grass, as it can be difficult to determine whether mould is present.
 - Dog and cat food as the vitamin and mineral levels are not suitable for wombats.
- **Toileting:** While in the pouch, joeys will need to be stimulated to urinate and defaecate after each feed. This is done by gently wiping a damp cloth over the cloaca. This usually requires less than 10 wipes to stimulate the joey to toilet.
- Food and water bowls should be low profile and sturdy to prevent spillage.
- Wombats at the burrow stage will seek a dark, quiet place to toilet. Place faeces in a part of the yard that is to become the wombat toileting area. (A cat litter tray can be used in a porta-cot.)

Table 10.8 Feeding and housing requirements for wombats

Age (days)	Weight (kg)	Morphometrics (where relevant)	Observation	Food type, amount, and frequency	Housing
120	0.38	Body Length = 169 mm	<ul style="list-style-type: none"> • Eyes open, lips part open, unfurred 	<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Intensive stage inside pouch 28–30°C
130	0.51	Body Length = 175 mm	<ul style="list-style-type: none"> • Faeces: custard consistency 	<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Pouch 28–30°C
140	0.65	Body Length = 182 mm	<ul style="list-style-type: none"> • Fine fur, eyes open, lips open 	<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Pouch 28°C
150	0.8	Body Length = 188 mm	<ul style="list-style-type: none"> • Fine fur, lower incisors erupting 	<ul style="list-style-type: none"> • Offer dirt outside pouch • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Pouch • 24–26°C
160	0.96	Body Length = 195 mm	<ul style="list-style-type: none"> • Faeces: toothpaste consistency 	<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Pouch and cot
170	1.14	Body Length = 201 mm		<ul style="list-style-type: none"> • Can offer dry grasses • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Budding can begin
180	1.43	Body Length = 208 mm	<ul style="list-style-type: none"> • Short fur, upper incisors erupt 	<ul style="list-style-type: none"> • Offer dry grasses with roots and dirt • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Intermediate stage
190	1.58	Body Length = 214 mm		<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Beginning to emerge from the pouch

Age (days)	Weight (kg)	Morphometrics (where relevant)	Observation	Food type, amount, and frequency	Housing
200	1.8	Body Length = 221 mm		<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	
210	2.2	Body Length = 228 mm	Fully furred, pink soles of feet	<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency • Solid food can be introduced • Free access to grass 	<ul style="list-style-type: none"> • Faeces: soft pellets • Emerge from pouch to burrow
220	2.52	Body Length = 234 mm		<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Out during the day
240	3.26	Body Length = 247 mm	Full fur End of good buddying time Can start short walks	<ul style="list-style-type: none"> • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • No heating required • Faeces formed pellets
260	4.06	Body Length = 260 mm	Soles of feet are darker	<ul style="list-style-type: none"> • Pellets can be introduced as part of the diet • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Permanently leaves pouch between 8–10 months of age. • Starts to dig
290	5.40	Body Length = 280 mm	Small adult in appearance Longer walks daily	<ul style="list-style-type: none"> • Eating more grass • Milk: see product instructions for amount and frequency 	<ul style="list-style-type: none"> • Pre-release stage • Outside at night • Access to burrow
300–390	6–10			<ul style="list-style-type: none"> • Weaning off milk • Completely weaned by 8–10 kg 	<ul style="list-style-type: none"> • Outside all the time

Age (days)	Weight (kg)	Morphometrics (where relevant)	Observation	Food type, amount, and frequency	Housing
450	15			<ul style="list-style-type: none"> • Offer grasses and tussocks from release area 	<ul style="list-style-type: none"> • Seeks burrow for safety • Starts to defecate in prominent places
540	18–20			<ul style="list-style-type: none"> • Offer grasses and tussocks from release area 	<ul style="list-style-type: none"> • Independent. Ready for release

Figure 10.18 A common wombat at the minimum age to rear: note that the eyes and mouth are open.



Photo credit: Jenny Mattingley

Figure 10.19 A common wombat weighing about 1 kg.



Photo credit: Jenny Mattingley

10.9 Release protocol



Ideally, wild animals will be rehabilitated and released in a short timeframe. If this is not possible and the animal is in care for significant extended periods, ensure that the animal is regularly assessed against the welfare domains to support decision-making. Animals in care for extended periods may have a reduced ability to survive in the wild. Talk to your veterinarian and consider whether euthanasia will provide the best welfare outcome for the animal.

10.9.1. Pre-release assessment

Pre-release assessment of animals in care is essential to support improved outcomes once back in the wild. Animals should be assessed based on body condition, fitness and the ability to engage in natural species-specific behaviours prior to release.

The following check list should be used to guide decision-making regarding release suitability for wombats:

- ☑ Individual is in a state of good health; presenting injury/sickness is completely resolved (consider pre-release veterinary check).
- ☑ Individual is within a healthy weight range and appropriate body condition.
- ☑ Individual displays ability to actively forage for and consume natural foods found in the release location.
- ☑ Individual shows appropriate fear responses to humans and dogs.

10.9.2. At the release site

Post release survival will be maximised by ensuring that both the release site and the way in which the animal is released are carefully considered.

Important factors about the site to consider before releasing a wombat:

- Sloping ground to assist in making a burrow, some forest cover to avoid predators and the presence of grass for feed.
- Wombat burrows are commonly found within 200 m of a watercourse.
- For more information on the ecological characteristics and requirements of common wombats that may help with their release, please refer to **Table 10.1** of this chapter.

10.9.3. Release checklist

Check all of the requirements of your authorisation are being met, and consider the following:

Release location

- ☑ Release where the wombat was found (where suitable, or within home range).
- ☑ Suitable vegetation is available, including grasses and dense lower storey vegetation.
- ☑ Ample foraging areas close to dense vegetation and away from roads.
- ☑ Dense vegetation cover for burrow building.
- ☑ Soil layer soft and suitable for foraging/ digging.

Release Procedure

- ☑ Limit the number of people at the release.
- ☑ Appropriate timing (one hour after dusk – during natural peak activity).
- ☑ If possible, find a suitable, unoccupied burrow within approximately 150 m of where the wombat was originally found. Occupied burrows will have scats, tracks, and loose soil at the entrance. A wombat should not be released into an occupied burrow.
- ☑ Open transport container away from yourself, near dense cover, ensuring people are standing behind the animal's flight zone.
- ☑ Allow the wombat to leave in its own time.

Figure 10.20 a. An occupied burrow. A wombat is visible at the entrance, which appears clear of vegetation and has a worn path leading from it. b. An unoccupied burrow. Vegetation has grown around the entrance and no paths leading from the burrow are seen.

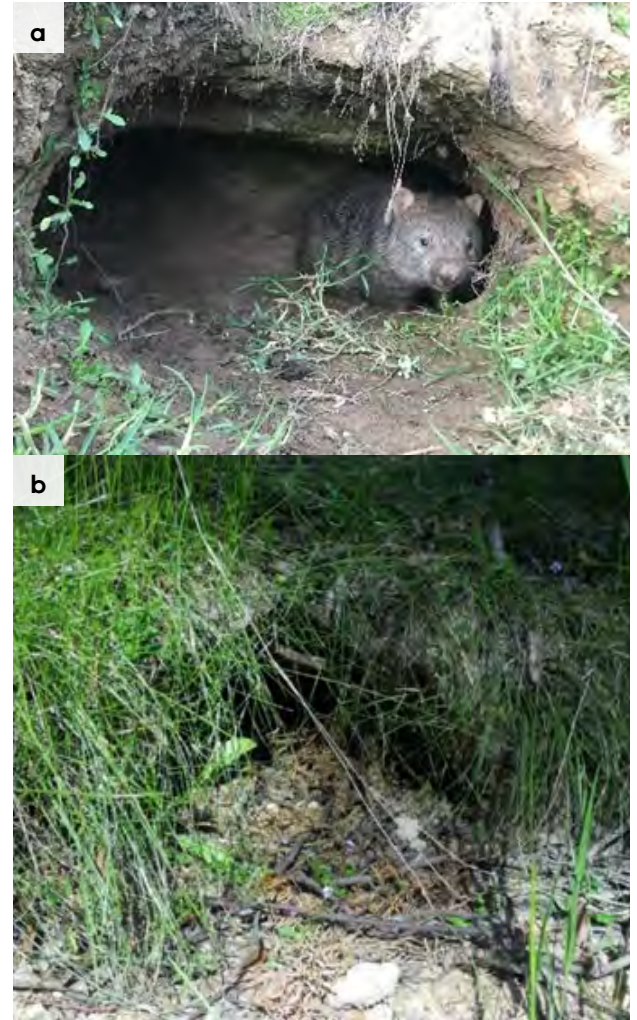


Photo credit: Anne Fowler, Emily Small

10.10 Key references and additional reading

http://www.australasianzookeeping.org/Husbandry%20Manuals/wombat_husbandry_manual.pdf

<https://taswildlife.org/wp-content/uploads/2016/12/Bare-Nosed-Growth-and-Feeding-Chart.pdf>

[http://nswfmpa.org/Husbandry%20Manuals/Published%20Manuals/Mammalia/Common%20Wombat%20\(Elliott\).pdf](http://nswfmpa.org/Husbandry%20Manuals/Published%20Manuals/Mammalia/Common%20Wombat%20(Elliott).pdf)

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