



DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Initial treatment and care guidelines for rescued possums and gliders



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1. Introduction

The purpose of this document is to standardise the initial treatment of possums and gliders requiring rescue or rehabilitation, in line with the *Code of Practice for Injured, Sick and Orphaned Possums and Gliders* (the 'Possum and Glider Code') (DPIE 2021).

Understanding that each case is different and should be assessed individually, this document aims to provide guidance for licensed wildlife rehabilitators in New South Wales on initial assessment and first aid treatment principles for rescued possums and gliders.

The primary objective of rehabilitation is the successful reintegration of the individual into the wild population. This determines decision-making about the care and treatment of wild possums and gliders.

More than 27 species of possums and gliders are found in Australia, from six families within the suborder *Phalangeriformes*. There are 12 species from this suborder that have been recorded in New South Wales and are relevant to this document (see Appendix 1 in the Possum and Glider Code).

This document provides guidance on the initial care and management of possums and gliders following rescue, from capture to physical examination, initial stabilisation and treatment before presentation to a veterinarian. It provides advice on managing the more common rescue encounters in possums and gliders, including trauma, burns, orphaned joeys and disease syndromes including exudative 'stress' dermatitis.

2. Capture, restraint and physical examination

As outlined in the Possum and Glider Code, rescuers must aim to have the animal assessed by a veterinarian or experienced wildlife rehabilitator within 24 hours of rescue to establish an accurate diagnosis and provide the best outcomes for the patient.

The initial assessment aims to identify the severity of wounds, injuries or illness, to determine the best course of action.

Figure 1 provides an outline of the initial decision-making process for possum and glider rescue cases. It is important to keep in mind that the ultimate goal of rescue and rehabilitation is to ensure successful reintegration into the wild population.

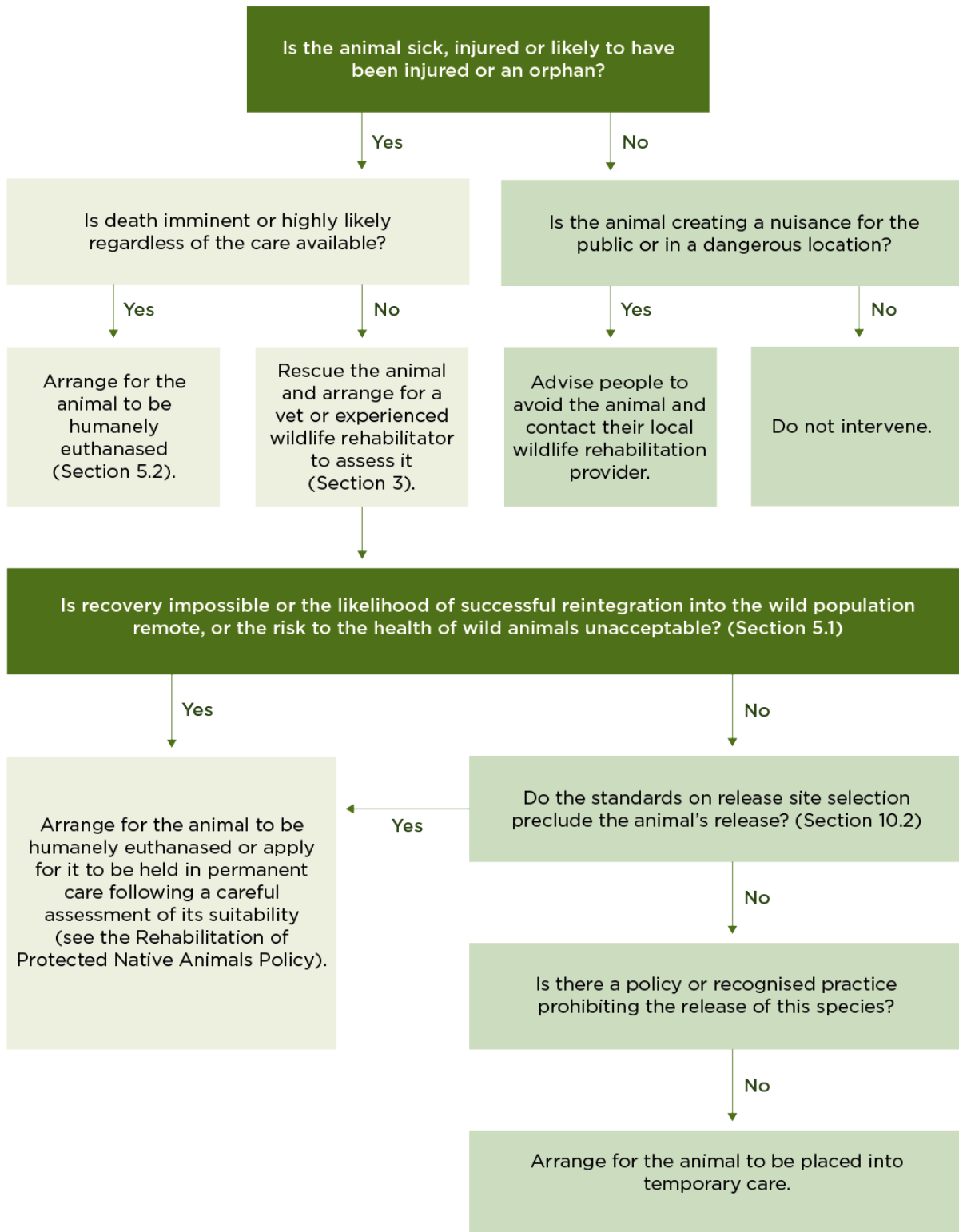


Figure 1 Decision tree for course of action when a possum or glider is encountered
 (From the Possum and Glider Code. Section numbers refer to numbering used in the Code.)

Personnel safety

Before handling possums and gliders, rescuers should be aware of possible safety risks to themselves, other people involved in the rescue and the individual animal. Frightened, cornered or injured wildlife are more likely to bite or scratch when handled. Possums and gliders may also potentially transmit disease (See Section 7 'Zoonotic disease').

- Protect yourself and the animal by using appropriate personal protective equipment (PPE).
- Avoid handling wildlife if it is unnecessary or you do not feel confident and capable of doing so.
- Wear appropriate clothing – robust long sleeves, covered shoes, long pants.
- Wear a dust mask if available and particularly if the animal is showing signs of disease.
- Wash your hands before and after handling animals and removing gloves (or use alcohol-based hand sanitiser).
- If bitten or scratched, clean the injury with warm water and soap (or disinfectant) and seek medical advice. Always tell medical staff you have been handling wildlife.
- When rescuing animals from heights (e.g. roofs or trees) and working with hazards including barbed wire, care must be taken to prevent injury. Thoroughly clean any injuries resulting from barbed wire (e.g. cuts and scratches) and seek medical advice.

Distance examination

Initial assessment begins before the animal is captured or handled. Identification of injuries such as lameness or obvious wounds may be visualised pre-capture by observing the animal and its behaviour and movement.

- **Mobility, gait and posture:** lameness or abnormal gait or posture can indicate musculoskeletal or neurological injuries or disease.
- **Signs of pain or distress:** possums and gliders can mask signs of pain and distress. Some animals may be quiet and minimally responsive, while others may react aggressively or vocalise. A possum or glider that can be easily captured and restrained or has obvious injuries or wounds should be assumed to be in pain.
- **Respiratory rate:** increased respiratory rate may be associated with pain or distress. Respiratory rates vary greatly amongst possum and glider species depending on the size of the individual. Panting, however, is uncommon in all species and if observed, indicates severe distress, pain or injury.
- **Behaviour:** possums and gliders are nocturnal. Animals observed in the open during the day warrant further investigation as this behaviour is considered abnormal.
- **External injuries and wounds:** observe the animal for any changes to the skin and coat, including hair loss, crusting and wounds, as this can indicate trauma or infectious disease.

A pouch check should be performed on all deceased female possums and gliders, checking for the presence of pouch young or evidence of teats that are in use (see Figure 2). It is helpful to take a photo of the deceased mother to aid rehabilitators in identifying the species of joey.



Figure 2 A ringtail possum 'pinkie' attached to the teat in the mother's pouch

Photo: Rebecca Robey.

Capture, restraint and handling

Capture and handling of possums and gliders can be difficult and pose a risk to the handler and the animal. Capture and handling should be undertaken only by appropriately trained and experienced personnel.

Care must be taken to ensure rescuer safety when capturing and handling possums and gliders as they can struggle when handled and inflict painful bites and scratches.

It is important to have a plan in place when approaching an animal for capture as possums and gliders are fast and very agile and will often evade the most experienced handler. Various techniques can be used for capture, including hand capture and the use of nest boxes, traps and nets. The technique for capture and restraint varies based on the species and size of the individual as well as on the type and severity of injury or illness and the rescue site.

Hand capture

Towels, pillowcases and artificial pouches can be used for capture. Towels can be used to cover most animals, allowing them to be restrained while ensuring the head and body are held and supported (see Figure 3). Artificial pouches with a washable inner layer made from a soft, breathable fibre (e.g. cotton, flannelette, bamboo) and an insulating breathable outer layer (e.g. wool) are ideal for joeys and smaller species of possums and gliders. Brushtail

possums can be restrained by securing the base of the head with one hand and the tail base with the other. Possums and gliders must not be caught by the tail alone, as this can damage the tail. Be aware that larger possums and gliders are very flexible and capable of swinging around to bite the handler if they are not appropriately restrained.



Figure 3 Restraining an adult ringtail possum with and without the use of a towel

Note: where possible keep the animal's head covered to reduce stress, and place the animal into a pouch or suitable transport container as soon as possible. Photos: Rebecca Robey.

Traps and nets

Cage traps can be used to capture many of the possum and glider species, and can be set on the ground (for brushtail possums) or in a tree (for arboreal species) (Johnson & Hemsley 2008). Traps are generally set just before dusk before activity begins (NHMRC 2014). The Possum and Glider Code provides standards and guidelines on the use of traps, including but not limited to ensuring the trap:

- is an appropriate size for the species
- is covered to protect from adverse weather and to provide a dark environment
- is continually monitored, and checked at first light in the morning.

Continually monitoring the trap includes checking the trap at least every four to six hours.

Some species, such as feathertail gliders, can be captured using suitably designed nest boxes attached to trees (NHMRC 2014). A net or bag on an extendable pole can also be used to capture possums and gliders. When using nets, ensure the animal in the net is not in a position that may restrict its breathing.

Small species such as feathertail gliders are notoriously good at escaping. Care should be taken to not only secure the pouch or bag, but also to ensure the animal does not get inadvertently trapped in the knot or bag-tie. Once the animal is in the pouch, gently feel the pouch to check the animal is at the bottom of the pouch. Then hold the middle of the pouch with one hand to prevent the animal from moving up while folding over the top of the pouch and knotting or tying the bag over the folded section. Hairbands and cable ties can be used to securely seal the open end of the pouch. Ensure the pouch is big enough to allow the animal to stretch and move around.

Once the animal is captured it must be transferred to an appropriate transport container as soon as possible.

Note: to reduce the risk of escape and the stress of handling, where possible, animals secured in a pouch can be placed into the transport container in the pouch.

If an injured female possum or glider with back young requires rescue, every effort must be made to ensure the adult and joey are both captured. Consideration must be given to the safety of both animals, as often the young will flee or jump off the female.

Initial examination before transport

If possible, it is beneficial to assess the individual before transporting it to a veterinarian or experienced wildlife rehabilitator. It is important to establish the following:

- Does the animal require immediate referral to a veterinarian for assessment and possible euthanasia due to extensive trauma, illness or compromised welfare? (See Section 3 'Euthanasia' for further information.)
- Could this animal have displaced young nearby? While possums and gliders are marsupials and carry their young in their pouch, many species also use dreys. It is important to observe the surrounding environment for dreys or joeys. Check pouch and teats on female possums for evidence of recent suckling (see Figure 4). Active teats are elongated and thicker than dormant teats and may even be slightly engorged or dripping milk. The number of active teats equates to the number of joeys. A high risk of mortality in pouch young occurs when the joey is big enough to fall out of the pouch but cannot return unaided. Unfortunately, in many species, the females do not assist their young in returning back to the pouch (Johnson & Hemsley 2008). Similarly, back young may jump off or may be separated from their mothers during capture. Keep in mind that some species have multiple joeys, so it is important to check the rescue site for siblings.

The initial examination should be done quietly and efficiently, always keeping the animal's stress levels and welfare in mind, as well as those of the handler. The brief initial examination does not replace a more thorough physical examination performed after the animal has been transported from the rescue site.



Figure 4 Pouch check in an adult female sugar glider showing two nipples (white arrows)

Photo: Rebecca Robey.

Transport

Possoms and gliders should be transported in secure carriers appropriate for their size, species and stage of development. Transport boxes should reduce the risk of escape as well as provide appropriate ventilation and security during transport.

Transport should be well-planned and efficient to reduce unnecessary transport time and to minimise stressors. Avoid domestic animals, loud music, voices, cigarette smoke and strong scents (e.g. perfumes).

During transport, maintain ambient temperatures appropriate for the age and condition of the possum or glider and regularly monitor the temperature (see Table 1).

Table 1 Ambient temperatures to be maintained during transport of possums and gliders

(Adapted from the Possum and Glider Code)

		Ambient temp.
Adults and subadults		26°C
Joeys	Velvet	30°C
	Unfurred	32°C

Orphaned pouch young should be transported within an artificial pouch which is then placed in a secure carrier with appropriate heating and protection from light and noise. Joeys requiring rescue are commonly hypothermic (cold). Supplementary warmth can be provided using heat packs or heat mats, ensuring the heat source is not in direct contact with the joey and that ambient temperatures are regularly monitored.

Physical examination

Following initial assessment and stabilisation (See Section 4 'Initial treatment and stabilisation') the rehabilitator must aim to have the possum or glider assessed by a veterinarian or an experienced wildlife rehabilitator within 24 hours of rescue.

In situations where it is not logistically possible to have the animal physically assessed, the rehabilitator should contact a veterinarian or an experienced wildlife rehabilitator on the phone for advice on continued care of the patient until it is able to be transported.

A detailed examination investigating the parameters described below provides the overall health assessment necessary to determine treatment needs and prognosis. While progressing through the physical examination, ensure to make notes and keep records (see Section 8 'Record keeping').

When performing a physical examination, the aim is to be thorough while minimising stress to the animal. Handling should be tailored to each animal based on its health status and temperament. Never push an animal beyond its pain or patience threshold.

Correct handling and restraint of an animal for the initial physical examination are important to ensure the safety of the rehabilitator and reduce stress for the animal. It is advisable to keep the possum or glider contained within the artificial pouch or wrapped in a towel, with their head covered to reduce stress. The handler can then extract and carefully examine one limb at a time and then the head, body, abdomen and tail. Larger animals or those that are fractious or stressed may require sedation or anaesthesia administered by a veterinarian in order to perform an examination.

Signs of stress

Before and during physical examination, it is important to continually monitor the animal for signs of stress. These can include:

- vocalising
- urinating and defecating
- clenched feet
- increased heart rate and respiration rate
- open-mouth breathing or panting – a sign of severe stress.

If an animal becomes distressed during examination, it is best to place the animal in a warm, dark secure location to allow it to settle, and contact an experienced wildlife rehabilitator or veterinarian for advice on how to proceed.

Demeanour and behaviour

A wild animal in captivity will usually try to protect itself and may vocalise, hide, and try to bite or scratch the handler in self-defence. If an animal is quiet and allows a person to easily pick it up without struggling, it may indicate the animal is either severely distressed, injured or sick, or a combination of all three.

Assessing an animal's demeanour and behaviour during rescue and initial examination can provide useful information about its health status.

Pygmy possums, as well as the feathertail, sugar and yellow-bellied gliders, have the ability to enter torpor in response to cold temperatures or decreased nutrient intake (Johnson & Hemsley 2008). In this torpor state, the animal will be minimally responsive to handling. This physical adaptation should be taken into consideration during physical examination.

Body weight and body condition

The body weight and body condition of an animal are useful indicators of its health status. Poor body condition can result from disease or may indicate the animal has an underlying illness affecting its ability to forage in the wild.

Measuring body weight on rescue and regularly while the animal is in care is helpful to assess the animal's health and progress. An individual that fails to gain weight in care requires veterinary intervention to investigate underlying causes for lack of weight gain.

An exact body weight is also important to be able to calculate accurate doses of medications such as analgesia (pain relief) and antibiotics, and to calculate nutritional requirements. The Possum and Glider Code recommends small possums and gliders, both orphaned joeys and adults, be weighed daily. Larger species such as ringtail and brushtail possums must be weighed daily until they display stable weight gain.

Possums and gliders can be weighed in a secure bag, pouch or pillow slip. Once the animal is removed from the pouch, body weight can be calculated by subtracting the weight of the bag or pouch from the total weight of the item and the animal.

Table 2 Body weight in adult possums and gliders

(Adapted from Johnson & Hemsley 2008)

Species	Body weight (g)
Common brushtail possum	1500–4000
Mountain brushtail possum	2500–4500
Common ringtail possum	660–900
Sugar glider	90–150
Squirrel glider	190–300
Feathertail glider	10–14
Greater glider	900–1700
Mountain pygmy-possum	30–80

Species	Body weight (g)
Eastern pygmy-possum	15–38
Yellow-bellied glider	450–750

Identification and age estimate of joeys

Verifying the species of a rescued joey can often be difficult but is imperative to the successful rehabilitation of the orphan. If the joey was found with its mother, then identification is easier. Many possum and glider species look very similar in the early developmental stages, and experienced wildlife rehabilitators or experts will often need to be called upon to help with species verification.

Species identification and age estimation should be carried out when a joey first comes into care. Determining age is vital as it directs decision-making about husbandry requirements and the prognosis for each animal.

Age factor is a numerical representation of age as a proportion of the total expected pouch life in marsupials. For example, an age factor of 0.4 indicates the pouch young has completed 40% of its expected pouch life. Each species varies in the time their young spend in the pouch. This formula is therefore an objective calculation used to determine the prognosis of successful hand-rearing and the nutritional and husbandry requirements for that species.

$$\text{Age factor} = \frac{\text{Age of joey}}{\text{Age when fully out of pouch}}$$

Various features are considered in determining the age of the joey and age factor. These include body weight, physical characteristics and body measurements.

Weight is an important consideration but can be influenced by factors other than age, such as recent meals, hydration, muscle mass, fat stores and illness. Body weight is also important for calculating medication dose rates and daily supplementary food requirements.

Physical characteristics such as the hair growth, ear position and if the eyes are open or closed are good indicators of developmental stage (see Appendix B).

Body measurements include the head and tail measurements as demonstrated in the [Wombaroo Feeding Guide](#) (Wombaroo 2020).

Growth charts calculating weight, physical characteristics, body measurements and the corresponding age factor specific to various possum and glider species can also be found in the [Wombaroo Feeding Guide](#) (Wombaroo 2020).

Possums and gliders in their early stages of development (non-furred, with their mouth fused and ear canal closed) are unlikely to be hand-reared to release and must be euthanased.

Marsupial pouch young with an age factor of < 0.4 (i.e. at less than 40% of their expected pouch life), are considered to have a poor prognosis of survival, and euthanasia should be considered in most species (Johnson & Hemsley 2008). Furless pouch young are much more difficult to rehabilitate than furred young, even in the hands of very experienced rehabilitators.

- Brushtail possum pouch young weighing less than 50 grams have an extremely poor chance of surviving to release.
- Ringtail possum pouch young weighing more than 50 grams have a much higher survival rate than younger joeys.
- Sugar glider pouch young less than 7 grams are difficult to successfully hand raise. However, furred sugar glider pouch young are relatively robust and have high rates of success in rehabilitation.

Sex identification

Female possums and gliders are identified by the presence of a pouch. Male possums and gliders have testicles contained in a visible scrotum.

Even at early developmental stages, furless pouch young have these distinguishable features, though the pouch may appear more like an abdominal fold or 'slit'.

Hydration status

A well-hydrated possum or glider should have moist pink mucous membranes. The best site to check is the animal's gums. Dry or tacky ('sticky') gums may indicate dehydration. Care must be taken to avoid injury to the handler when assessing the mouth.

Dry, wrinkly skin and sunken eyes may also indicate dehydration. The turgor or elasticity of the skin is a good indicator of hydration status in possums. When the skin between the shoulder blades is gently pinched and 'tented', it should immediately return to normal position in a well-hydrated animal, but may remain tented or slow to return in a dehydrated animal.

Coat condition and skin

A healthy, well-hydrated possum or glider in good condition should have a full, soft, thick, dry pelt. Traumatic wounds may be obvious, such as a compound fracture of a limb or an open bite wound. However, some injuries may be more subtle and require careful and thorough examination. Some indicators visible on the skin or coat of an injured or sick animal are:

- Patches of hair loss or areas of wet fur are often associated with predator attack. Gently part the fur to identify puncture wounds. In some cases, the overlying coat may appear unchanged and only by careful examination are puncture wounds identified.
- Dry, wrinkly skin can indicate dehydration, especially in pouch young.
- Matted or ungroomed fur may indicate a chronically ill animal that has not been able to groom itself.
- A heavy external parasite burden (e.g. ticks) could indicate a systemic illness. Many possums and gliders have a demonstrated resistance to infestation by the Australian paralysis tick (*Ixodes holocyclus*) (Johnson & Hemsley 2008). However, anaemia, weakness and paralysis may be seen in animals with compromised health status.
- Singed fur could indicate electrocution or burn injuries (see 'Burns' in Section 5).
- Bruising may be observed on the abdomen or chest of animals as a result of trauma including motor vehicle incidents. It can also be associated with rodenticide toxicity.
- Exudative dermatitis or 'stress' dermatitis is common in brushtail possums. Lesions can be mild and appear as a rash, or result in loss of digits in severe cases. It is important to always consider this condition in any brushtail possum with skin lesions or wounds. (See 'Exudative dermatitis in brushtail possums' in Section 5 for more information.)

Heart rate, respiration and circulation

Interestingly the hearts of marsupials are about 30% heavier than placental mammals of the same body mass (Dawson 2003); however, the basal metabolic rate is much lower.

Heart rates in possums and gliders, especially in joeys and smaller species, can be difficult to hear and assess due to the small body size and rapid heart rate. If available, place a stethoscope over the mid-chest region to count the heart rate. Heart rates are often elevated due to exposure to stressful situations such as being handled or being in a novel environment (e.g. a veterinary clinic).

- Brushtail possums can have a heart rate in the range of 150–220 beats per minute (bpm) (Kinnear & Brown 1967)
- Ringtail possums can have a heart rate in the range of 180–260 bpm.
- Heart rate in sugar gliders ranges between 200-300 bpm.
- Eastern pygmy-possums have been recorded as having maximum heart rates of 625 bpm.

As a general rule, for small possums and gliders, if the heart is beating faster than you can count it then it is most likely within normal limits.

Circulation is best assessed by carefully examining the colour of the animal's gums. In healthy, well-hydrated animals the gums should be pink in colour and moist to touch. Pale or tacky gums might indicate dehydration, shock, anaemia (from poisoning or blood loss) or chronic illness. If these signs are observed, immediate veterinary assessment is recommended.

Respiratory rate and respiratory effort are important indicators of stress, trauma or respiratory tract disease (infection, inflammation). Rehabilitators should listen closely to the respiration rhythm and rate as well as any abnormal sounds such as wheezing or gurgling. For example, an animal that has been hit by a car may have a collapsed lung or be bleeding into its chest cavity and as a result have harsh respiratory sounds and difficulty breathing. Similarly, a very stressed animal may hyperventilate. Any abnormality to the pattern or rate of breathing should be noted, and immediate veterinary attention sought. Abnormal signs may include:

- panting or open-mouth breathing
- rapid shallow puffs
- long drawn-out sucking-in breaths
- noisy respiration (clicking, gurgling, raspy wheezes, coughing)
- extremely slow and shallow breathing (it may be difficult to ascertain the animal is still breathing in these circumstances).

Body temperature

Resting body temperatures of marsupials are on average 2–3°C lower than that of placental mammals (Kerle 2001). For example, the common brushtail possum has a core body temperature of 36.2 °C. Core body temperature can be assessed by measuring the rectal temperature. Assessing the rectal temperature of a possum may be difficult due to the anatomy of the cloaca and the stress of handling and should only be performed by experienced rehabilitators. If the animal is distressed as a result of the handling, then it may be best not to continue the procedure.

It is safe to assume that most rescued orphaned, sick and injured possums and gliders require thermal support, especially joeys. Marsupial joeys are ectothermic at birth and unable to thermoregulate (Campbell-Ward 2019). They also lack brown fat deposits which assist placental young in maintaining body heat (Kerle 2001). In the wild, warmth is provided by the insulation of the pouch. It is, therefore particularly important to actively warm joeys. As they transition through pouch life, marsupials develop the ability of endothermy (self-regulating body temperature) (Campbell-Ward 2019).

The only exception to this may be an animal suffering from heat stress. If possums or gliders become trapped, e.g. in a bin or feeder or possum trap, they may be exposed to high ambient temperatures and present in a hyperthermic state. Brushtail possums can pant if they overheat and can evaporate water through their skin to keep cool. If the animal cannot do this effectively, it may require intravenous fluid therapy and veterinary intervention to prevent hyperthermia-related organ failure.

Eyes, ears and nostrils

Ticks are often found hiding in ears and ear folds. In unwell animals it is usually best to remove these ticks so as not to compromise the animal's health any further. Examine the ears for any wounds or discharge. Intraspecific (between the same species) aggression is common in male possums and gliders and can often result in injury and tears to the ears. The presence of such injuries are an indication of the status of the animal in the wild and must be taken into consideration when planning for its release.

The eyes should be open and clear of discharge. Any changes in the appearance of the transparent, outermost surface of the eye (cornea), discharge from the eyes, redness (inflammation of the conjunctival tissues) or crusting and thickening of the skin around the eyes can indicate trauma or infectious disease. The pupils in possums and gliders are usually very small and pinpoint (see Figure 5). Dilated pupils or irregular pupil size can indicate blindness, neurological dysfunction (head trauma) or systemic illness.

Note any scabs, swelling or redness around the conjunctiva, particularly in brushtail possums as this may be associated with exudative dermatitis.

Permanently vision-impaired possums and gliders are not suitable for release as they rely on binocular nocturnal vision.

Nasal discharge may indicate respiratory infection or trauma, particularly if the animal has epistaxis (bloody discharge from the nostrils). Check the nostrils carefully to ensure they are clear of discharge or bubbles, are symmetrical, and have no wounds or swelling. It is also important to listen for any loud nasal breathing sounds, which may indicate an obstruction of the nostrils.



Figure 5 Examination of eyes in a ringtail possum

Note the small and symmetrical pupils, a normal finding in ringtail possums. Photo: Rebecca Robey.

Oral examination and dentition

Possoms and gliders have diprotodont teeth, meaning the two lower incisors are enlarged and reclined (procumbent) to function as a single cutting tool (Johnson & Hemsley 2008) (see Figure 6). The molars and pre-molars have well-developed cusped surfaces for grinding plant material. Examination of the oral cavity and dentition may be difficult in conscious animals. Sedation or anaesthesia prescribed by a veterinarian are required for a thorough oral examination.

It is important to assess the oral cavity of joeys, particularly if they show signs of ill-thrift (failure to thrive) or inappetence. Thrush (infection caused by *Candida* sp.) can be a common finding in bottle-fed orphans and appears as ulcers or large white plaques on the gums and palate.



Figure 6 Examination of mucous membranes and teeth in an anaesthetised ringtail possum

Note the enlarged lower incisors. Photo: Rebecca Robey.

Abdomen

Most possums and gliders are hindgut fermenters, meaning they digest plant material by microbial fermentation in the caecum and colon (Johnson & Hemsley 2008). The different species have minor adaptations to the gastrointestinal tract depending on their dietary requirements. Specific dietary requirements in some species are listed below.

- Common brushtail possums eat a large variety of native leaves, flowers, browse and some grasses. They also eat insects, moths, bark and native fruits. In suburban areas, they will scavenge on opportunistic foods including rose bushes, citrus trees and food scraps.
- Greater gliders feed almost exclusively on eucalyptus leaves and as such, have a modified gut, comparable to a koala, to manage this diet.

An initial examination of a possum or glider in care should include a gentle palpation of the abdomen, which should feel soft when gentle pressure is applied. If the abdomen is very firm, painful on palpation or distended (appearing bloated) veterinary assessment should be sought as soon as possible. Ringtail possums are particularly predisposed to bloat, which may develop into a life-threatening condition. Bloat often results from consumption of an inappropriate diet in captivity (e.g. fruit) but can also occur as a result of stress or disturbances to the natural gut flora as a result of antibiotic administration. The gut flora of ringtail possums hand-reared from infancy can vary compared to parent-reared wild animals and can be a factor in the development of gastrointestinal dysfunction and bloat.

Limbs and tail

All four feet and limbs should be carefully examined for any wounds, obvious fractures, burns or abnormalities. The paws, in particular, should be closely examined for injuries, as possums have been known to jump up on barbecue hot plates or lose nails or digits while fleeing from predators. Being nocturnal, possums and gliders will often curl up in a ball during physical examination, making it difficult to assess the animal's mobility and locomotion. Rehabilitators should try to assess if each paw can grip firmly and note whether there is any paralysis of limbs or dragging of the feet. For larger species, it is often easier to assess mobility and function in a dark, enclosed cage with a tree branch. The locomotion and gripping ability of smaller animals can often be observed and assessed as they navigate inside an artificial pouch or along a small browse branch.

The hindlimbs of possums and gliders have an inner digit (thumb or hallux), referred to as a 'nub' (see Figure 7). The nub has no nail and opposes the remaining digits on the hindfoot. As stated in the Possum and Glider Code, an animal that has permanent loss or functional damage to both nubs must be euthanased.

The tail of possums and gliders varies in length and fur cover amongst species, and is heavily relied upon for grabbing, balance and mobility (Kerle 2001). Carefully examine the tail for any wounds, kinks or deformities as well as weakness or paralysis of the tail. The tail of ringtail and brushtail possums should curl and try to grip when the carer runs their finger gently along the underside. A lack of curl response may indicate nerve or muscle damage which requires further assessment by a veterinarian.



Figure 7 Hindlimb of a brushtail possum.

The inner digit or 'nub' is identified by the white arrow. Photo: Rebecca Robey.

Gliding membrane

Gliders can be distinguished from possums by the presence of a patagium, which is a gliding membrane extending from the hind limb to the forelimb (see Figure 8). Examine the patagium of gliders for any tears or wounds. Extensive or permanent damage to the patagium may result in an animal being unsuitable for release, requiring euthanasia. Veterinary assessment is recommended to assess the injury and determine prognosis for repair and return to function. In some cases, surgery can be performed to repair damaged membranes, particularly in barbed wire entrapment incidents. However, the long-term welfare of the animal and the prognosis for successful return to the wild must be assessed on an individual case-by-case basis in consultation with a veterinarian and an experienced wildlife rehabilitator.

As stated in the Possum and Glider Code, a glider must be euthanased when its ability to locomote normally is permanently impaired. This applies to gliders that have damage to their tail or leading edge of their gliding membrane.



Figure 8 An anaesthetised sugar glider displaying wing membranes

Photo: Rebecca Robey.

Urogenital area and pouch

The pouch of all female animals should be checked thoroughly for the presence of young or evidence of teat development, as mentioned previously. All possums and gliders have forward opening pouches, however, the number of teats varies between two and six depending on the species (Johnson & Hemsley 2008). Many possum and glider species commonly have multiple joeys, for example, the ringtail possum often has twins or occasionally triplets.

The cloaca and entire urogenital area should be examined for any evidence of staining, swelling or trauma. Trauma to the scrotum can result from intraspecific aggression, particularly in adult male brushtail possums. Assess the cloaca for any tissue swelling or signs of prolapse, which can occur in joeys secondary to diarrhoea.

Urine and faecal output should be monitored, especially in orphaned joeys. Urine should be clear to pale yellow. Darker yellow urine or brown or red-tinged urine can indicate dehydration, infection or trauma. While faecal colour and consistency can vary amongst species depending on diet and developmental stage, abnormalities in the faecal consistency or colour may also indicate gastrointestinal infection, dysfunction, parasites or poor diet.

3. Euthanasia

As stated in the Possum and Glider Code, euthanasia of an animal must be performed immediately and without exception when:

- death is imminent or highly likely regardless of the treatment provided
- it is suffering from chronic, unrelievable pain or distress
- it is carrying an incurable disease (e.g. Tularaemia, Buruli ulcer) that may pose a health risk to other wild animals
- its ability to consume food unaided is permanently impaired due to a missing or injured jaw, or missing or worn teeth
- an experienced wildlife veterinarian makes that recommendation
- it is at a stage of development where it is unlikely to be hand-reared to the point where it can be released (i.e. non-furred pouch young with its mouth still fused and ear canals not open, see Appendix B).

The welfare of the individual animal should always be the primary consideration when making decisions regarding euthanasia.

The recommended method for euthanasia in rescued possums and gliders is an intravenous barbiturate overdose administered by a veterinarian. Animals must be sedated or anaesthetised before euthanasia to reduce stress and facilitate successful venepuncture (Robert Johnson *pers. comm.*). Injection of a barbiturate into the liver (intra-hepatic) or abdominal cavity (intra-peritoneal) of anaesthetised, unfurred pouch young is an accepted method of euthanasia (Campbell-Ward 2019).

The Possum and Glider Code states that euthanasia with carbon dioxide or carbon monoxide must not be used for possums and gliders.

4. Initial treatment and stabilisation

Hypothermia

It is safe to assume that most orphaned, sick and injured possums and gliders will be hypothermic (low body temperature) when rescued and require thermal support, especially joeys.

Lightly furred and unfurred joeys are particularly prone to hypothermia due to their small body size and lack of fur and body fat (Campbell-Ward 2019).

Rescued pouch young are commonly hypothermic and require active warming to return to normal body temperatures (see Section 2 'Body temperature'). This can be done with external heat sources such as heat packs or heat mats. Ensure heat sources are not directly in contact with the joey, and the temperature is closely monitored with a thermometer or thermostat to prevent overheating. Aim to slowly correct body temperature over a two- to three-hour period (Campbell-Ward 2019). The use of thermostatically controlled warming devices such as incubators or humidicribs is preferred as they can be easier to control and maintain within a particular temperature range.

It is essential that all animals in care are warmed to their appropriate core body temperature before they are offered any food or given any treatments including fluids (oral or subcutaneous).

Hydration

Most rescued animals will require fluid therapy to correct dehydration. The route of rehydration is selected based on the animal's condition, availability of equipment and experience of the person administering fluids. Oral fluids are appropriate where the animal is mildly dehydrated. In severe cases of dehydration, veterinary assessment and subcutaneous (SC) or intravenous (IV) fluids are warranted. If dehydration is left untreated, it can progress to shock and ultimately death, particularly in joeys (Campbell-Ward 2019).

If severe dehydration is suspected, and in cases where oral fluid supplementation is not possible or adequate, urgent referral to a veterinary facility for intravenous fluids is warranted.

Oral hydration

Oral fluids can be offered to animals if they are conscious, able to hold their heads up and swallow, and once hypothermia is corrected. Electrolyte solutions such as 'Lectade' or 'Vytrate' can be offered with a dropper or syringe in tractable animals. Keep the animal warm and secure in a pouch when offering fluids. Some animals may lap from a shallow dish, and this can be provided where appropriate (see Figure 9).

Never force fluids into an animal's mouth as this can be distressing and may result in choking or aspiration (inhaling fluid).



Figure 9 Orphaned sugar glider joey lapping from a bowl

Photo: Rebecca Robey.

Orphaned joeys will require supplementary feeding with milk formula. It is important to correct hydration before offering an appropriate milk formula for their body weight and age estimate (see 'Orphaned joeys' in Section 5).

Subcutaneous and intravenous fluid therapy

If an animal is weak, unwell or distressed when offered oral fluids, no further attempt to do so must be made, and alternate routes of fluid therapy considered to correct hydration. Only experienced rehabilitators confident in the technique of administering subcutaneous injections should administer fluids to possums and gliders via this route. Various types of fluids can be administered, including sodium chloride 0.9%, Ringer's lactate solution (Hartmann's) or most preferable is a combined 0.45% sodium chloride and 5% glucose solution.

When administering subcutaneous fluids, aim to administer 3–5% of the animal's body weight each time, three to four times a day. For example, a 1000-gram possum will require 30–50 millilitres (mL) of subcutaneous fluids, three to four times a day (a total of 90–200 mL/day) until it is eating and drinking well on its own or is assessed by a veterinarian. Suitable sites for SC fluid administration are between the shoulders (inter-scapular region) or the inguinal area (see Figure 10). Multiple sites may be required for large volumes of fluid administration. Severely dehydrated animals require veterinary assessment and IV fluids to correct hydration.



Figure 10 Administration of subcutaneous fluids in the inguinal region of an adult ringtail possum

Photo: Rebecca Robey.

Hypoglycaemia

Hypoglycaemia (low blood glucose) is a common presentation in orphaned joeys. Blood glucose levels can decrease due to periods of inappetence (not eating) and can result in weakness, seizures and, if left untreated, even death.

If the animal's history suggests a prolonged period of being orphaned (delayed rescue), or if the joey appears weak, is unwilling to feed, or shows more severe symptoms (seizures, collapse), seek veterinary assistance as soon as possible to test and correct blood glucose levels.

If hypoglycaemia is confirmed by a veterinary blood test, depending on the severity, it can be treated with oral supplementation of glucose-containing fluids and feeding the animal. In cases of severe hypoglycaemia, hospitalisation for IV infusions of glucose, supportive care and careful veterinary monitoring are required.

Pain relief (analgesia)

Possums and gliders are wild animals, and as such, their survival instinct is generally to appear stoic and rarely to show signs of pain. Most injuries, including open wounds, fractures, bites or burns are painful and all will require pain relief. The choice of pain relief and the dose to be administered will depend on assessment of the injuries and must be prescribed by a veterinarian. Being hindgut fermenters, possums and gliders can be sensitive to certain medications, and medication must be given in consultation with a veterinarian to reduce the risk of potential adverse effects.

Wound care

A veterinarian should assess wounds so they can be diagnosed and treated appropriately.

If a wound is bleeding, apply firm pressure to the wound with a piece of clothing or bandage and seek urgent veterinary attention. Never use a tourniquet as this may cause permanent damage to the blood supply of the limb or tail and result in necrosis. Similarly, if a wound is deep, there is exposed bone or internal organs, or contamination with maggots, seek urgent veterinary attention. Place a sterile dressing (preferably non-stick, e.g. 'Melolin') over the wound and transport the animal quickly and carefully. Ensure the animal is confined to restrict movement and has sufficient cushioning during transport.

Before veterinary assessment, superficial wounds can be flushed with lukewarm saline, dilute chlorhexidine (2% dilution) or dilute betadine/iodine. Take care to only use saline when flushing wounds around the eyes or mouth.

The benefits of flushing or irrigating wounds cannot be underestimated, as it helps clear debris, decreases potential for infection, hydrates tissues and optimises wound healing.

Manuka honey is a monofloral honey produced from the nectar of the manuka tree (*Leptospermum* sp.), which has proven antimicrobial properties (Johnston 2018). It is excellent in aiding wound healing and can be applied to most wounds as a first aid therapy until veterinary attention can be sought.

Bandaging

Sometimes it may be appropriate to bandage wounds on limbs or tails in larger species such as ringtail possums or brushtail possums. However, bandages should ideally only be applied by experienced wildlife rehabilitators or veterinary professionals as bandages can often cause more harm than good if placed too tightly or secured incorrectly.

Suitable bandaging material for wounds may include non-stick dressings such as 'Melolin', adequate padding such as 'Soffban' and a cohesive outer bandage material such as 'VetWrap' (see Figure 11). Bandages should be maintained to be clean and dry and should be changed if there is 'strike-through' – fluid from the wounds seeping through to external bandage layers. Possums and gliders are very dextrous and often quite skilled at removing their own bandages.



Figure 11 Bandaging material commonly used for wound care 'Melolin' (left), 'Soffban' (centre) and 'VetWrap' (right).

Fractures

Fractures are a common consequence of trauma. Joeys orphaned due to trauma-related incidents must be assessed for musculoskeletal injuries. The prognosis for recovery depends on the fracture type and location. Open fractures, where bone is exposed through the skin, generally carry a poorer prognosis when compared to closed fractures (skin overlying fracture is intact).

Where a fracture is suspected, veterinary assistance must be sought as soon as possible to relieve pain, confirm the diagnosis and prognosis, and provide appropriate treatment. In the interim, it is important to restrict movement and minimise stress. Ensure there is sufficient cushioning during transport.

Husbandry

These guidelines outline the intensive care husbandry recommendations for possums and gliders following rescue and before presentation to a veterinarian or experienced wildlife rehabilitator.

Housing

Ensure rescued possums and gliders are provided with an appropriately sized pouch or bedding (pillow slips, towels) in which they can hide. Pouch young must be provided with artificial pouches with a washable inner layer made from a soft, breathable fibre (e.g. cotton, flannelette, bamboo) and an insulating breathable outer layer (e.g. wool).

Most marsupials, even adults, feel most comfortable and secure when in a pouch (Benn Bryant *pers. comm.*).

As stated in the Possum and Glider Code, the animal should be kept in a secure, small carrier or cage that provides sufficient space for the possum or glider to sit upright, stretch out its body and limbs and be able to freely move away from urine and faeces. It is important to ensure the animal's movement is restricted during intensive care. Housing should be an appropriate size so the animal cannot climb during the initial 24 hours. The housing should be kept covered but well-ventilated, in a warm and dark area away from loud noises, domestic animals and noxious smells.

External heat sources (heat pads) can be used to maintain an appropriate ambient temperature (see Table 1) and must be regularly monitored with a thermometer and electrical heat sources regulated by a thermostat. Ensure heat pads are not in direct contact with the animal to avoid potential contact burn injuries.

Select types of browse (see 'Nutrition' below) or foliage can be offered to adult animals to provide shelter and security.

Unless rescued together (e.g. ringtail possum twins or females with pouch or back young), animals should be housed individually until assessed by a veterinarian or experienced rehabilitator. This functions as a period of quarantine to reduce the risk of disease transmission.

Gliders and small possums can easily escape through small holes and gaps, so always ensure enclosures are secure and appropriate to the species. The Possum and Glider Code outlines the specifications for intensive care enclosure dimensions and design specific to different species.

Nutrition

Marsupial milk undergoes significant changes in the composition of fats, proteins and carbohydrates over the period of lactation (Wombaroo 2020). The changes in milk composition are designed to meet the evolving nutritional requirements of the developing joey from a furless pinkie until weaning. For this reason, species identification and age estimation are imperative to be able to provide the correct nutritional requirements by selecting the most suitable supplementary food source (e.g. 'Di-Vetelact', 'Biolac M100', 'Wombaroo Possum Milk Replacer'). As well as choosing the most age-appropriate milk formula, it is important to correctly calculate the volume and frequency of feeds and the equipment (e.g. teat, syringe, cannula) specific to species and individual.

All species of possums and gliders, especially joeys, must be appropriately rehydrated and body temperature normalised before attempting to commence feeding or offering food.

Depending on the species, possums and gliders may be herbivorous, insectivorous, folivorous, nectivorous or omnivorous. Therefore, it is important to accurately identify the species and be familiar with its natural diet (see Appendix 4 in the Possum and Glider Code). Providing fresh browse suitable to the individual's diet helps promote natural feeding and provides sheltered cover and enrichment. Spray the leaves with water before offering them to the animal and ensure fresh browse is provided daily. Many possums and gliders, particularly ringtails, eat their own faeces (coprophagy), which is essential for maintaining normal hindgut function in these species.

Most native plants are suitable for being offered to possums and gliders, including but not limited to eucalypts, acacias, bottle brushes and grevilleas. If you are unsure whether the plant is native or not, do not offer it to the animal. It is best to contact an experienced wildlife rehabilitator to determine what food and nutritional supplements are appropriate for a possum or glider in care. Ringtail possums are susceptible to gastrointestinal dysfunction (e.g. bloat) resulting from inappropriate administration of antibiotics or inappropriate diet, e.g. a diet high in fruit and vegetables. Ringtail possums, less than 250 grams in weight, must not be offered fruit, vegetables or flowers (Possum and Glider Code).

5. Common rescue encounters

Trauma

Trauma is one of the most common reasons possums and gliders require rescue (Johnson & Hemsley 2008; DPIE 2020). Motor vehicle accidents and dog attacks make up the majority of causes of trauma in brushtail possums, while in ringtail possums and sugar gliders, cat attacks are more frequently reported as the reason for rescue.

Common ringtail possums tend to tolerate traumatic incidents and subsequent treatment poorly compared with the more robust common brushtail possums (Johnson & Hemsley 2008).

Dog and cat attacks

Predation by dogs and cats may result in life-threatening injuries, including severe spinal damage, collapsed lungs, severe head trauma, profuse bleeding (haemorrhage) or loss of limbs or tail. Injuries caused by cat attacks in small gliders are often fatal (Johnson & Hemsley 2008).

Cat bite wounds in particular frequently become infected, and if left untreated, can lead to infection, sepsis (overwhelming and life-threatening response to infection) and death. In most cases, the external bite wound may be very small, or non-existent, and belie the true extent of damage.

Examine rescued possums and gliders for any signs of bleeding, swelling or subtle signs of predation such as wet fur (saliva staining) or missing fur (see Figure 12).

The skin wounds associated with cat attacks may appear to have healed superficially, however, infection can still progress below the skin, resulting in continued illness or death.

A cat attack should always be suspected in any possum or glider that appears weak or debilitated with no other identifiable cause of injury or illness. Similarly, if a small possum or glider deteriorates in care over a few days, veterinary attention should be sought to investigate infection secondary to cat bite wounds.

Bite wounds are generally treated with antibiotics. However, it is extremely important to select an appropriate drug, dose and duration of treatment for each patient and each specific case. Antibiotics must be prescribed by a veterinarian. Indiscriminate use of antibiotics can be detrimental to the individual animal as well as potentiate antimicrobial resistance. Hindgut fermenters, such as possums and gliders, are very sensitive to the effects of certain antibiotics. In particular, sub-adult ringtail possums can develop a fatal dysbiotic syndrome when administered certain antibiotics, causing a debilitating disturbance to their vital normal gut flora (Johnson and Hemsley 2008).

Antibiotics must be prescribed by a veterinarian. Rehabilitators should not assume it is safe to give an animal antibiotics that have been prescribed for a different animal as it may not be appropriate and could result in illness for that individual.



Figure 12 Wounds associated with cat and dog bite

Patches of missing fur and puncture wounds (white arrows). Photo: Rebecca Robey.

Motor vehicle accidents

Due to their small size, many possums and gliders often do not survive motor vehicle accidents. Similarly, larger species such as brushtail possums may survive an initial impact but often the resulting shock and injuries can be life-threatening or severe enough to warrant immediate euthanasia (e.g. complicated compound fractures, severe head trauma).

Always check the pouch of any deceased female possum or glider. Joeys often can survive a high-impact motor vehicle accident and require rescue and rehabilitation.

Head trauma

Animals with head trauma may display a variety of clinical signs; care must be taken with handling these patients. Neurological injury can result in an inability to swallow; therefore be especially careful when offering oral fluids. Signs related to head trauma can include:

- blood from the nostrils, mouth or ears
- abnormal or irregular pupil size, indicating injury to the brain or nervous system
- head tilt, lack of coordination or inability to stand
- loss of consciousness, seizures.

Haemorrhage

Check for signs of external bleeding. Additionally, the following signs may indicate significant blood loss, including internal haemorrhage:

- pale or blue-tinged mucous membrane colour
- blood in the urine, coughing up blood, or blood in the saliva
- bruising of the skin.

Limb fractures and dislocations

These are common trauma complications and can result in lameness or a focal area of pain and swelling.

Immobilising a fracture, using bandaging or confinement, is vital for reducing pain and tissue trauma.

Pouch young can be immobilised by housing them in a confined, cushioned carrier to help reduce pain and further tissue trauma. The patient should be assessed by a veterinarian as soon as possible, and in the meantime kept confined, with minimal handling.

Open fractures (where there are external wounds or bone is exposed) have an increased risk of infection and complications, and carry a poor prognosis. Animals with open fractures should be taken to a veterinarian for anaesthesia and assessment as soon as possible. In the interim, ensure the patient's mobility is restricted.

Spinal fractures

Spinal fractures are a common result of trauma in possums and gliders and are diagnosed by radiography. Spinal fractures usually result in compromised neurological function and signs can include collapse, or paralysis of one or more limbs or tail. The consequences of

spinal injuries are severe and require immediate veterinary attention for pain relief and thorough assessment.

Entanglement

Entanglement in barbed wire or netting is a frequent reason for rescue in possums and gliders. In many cases, barbed wire entanglement requires euthanasia due to the severity of resulting injuries, however, some animals may suffer only superficial injuries with a good prognosis for recovery if provided with appropriate treatment and rehabilitation.

Entangled animals are often very distressed and may suffer heat stress. Rescue can be a lengthy process and may require cutting away and removing part of the fence along with the animal (with the property owner's permission). Two handlers are required in complex cases of entanglement, one to hold and contain the possum or glider and the other to manage the net or wire.

Animals rescued from entanglements should be referred to a veterinarian for assessment as soon as possible, as treatment required may include providing pain relief, treating for shock or heat stress, and may require anaesthesia to remove entangled debris and examine injuries.

Superficial wounds can be flushed to remove debris and may require antibiotics prescribed by a veterinarian.

In the case of a glider, once the animal has been stabilised, assess for any damage to the gliding membrane (patagium). If the patagium is irreversibly damaged and cannot return to full function and elasticity, the animal must be euthanased. Consideration must also be given to the time in care for entanglement wounds to heal. Poor outcomes may be observed in many of the smaller glider species when maintained in a captive environment for extended periods of time. Each individual case must be assessed by a veterinarian and experienced wildlife rehabilitator to determine the feasibility of treatment and prognosis.

Tail injuries

Possums and gliders have long tails, and depending on the species, varying degrees of prehensile ability (Kerle 2001). Most tails have a hairless friction pad on the underside. Gliders will use their tail as a rudder during flight.

Tail trauma can result from entrapment (e.g. doors, bins, feeders), dog or cat bites, and also bites from conspecifics during fighting (Scheelings 2019). Injuries can vary from superficial wounds and lacerations to deeper muscle, nerve or bone damage. Early veterinary assessment and treatment is imperative to ensure the injury does not progress to deeper bone infection (osteomyelitis) or tissue death (necrosis).

Carefully examine the tail for any wounds, swellings, kinks or deformities as well as weakness or paralysis ('limp tail'). The tail of ringtail possums and brushtail possums should curl and try to grip when the carer runs their finger gently along the underside. If it does not curl there may be nerve or muscle damage that must be assessed by a veterinarian.

Treatment of tail injuries in possums and gliders requires careful consideration. Veterinary assessment and consultation with an experienced wildlife rehabilitator is required to assess each case and make a decision on the viability of treatment. The functionality of the tail and suitability for release must be a primary consideration. Full-length tail amputation must not be performed as all possums and gliders rely heavily on the function and prehensility of their tails for survival. Tail injuries require close monitoring for several days to weeks following treatment, to ensure infection or necrosis does not progress and the animal can climb normally despite its shorter tail tip.

As set out in the Possum and Glider Code, a possum or glider must be euthanased when its ability to locomote normally (i.e. climb, walk or glide) is permanently impaired due to the loss of more than 30% of a possum's tail or any damage to a glider's tail.

Burns

Rescuer safety is vital when working in fire grounds. Information about safety, logistics and training required for rescues on fire grounds are outside the scope of this document. Only qualified personnel with appropriate training must attend to rescues on fire grounds.

Burn injuries should be classified based on their severity and extent. This is an important indicator of prognosis and will direct treatment. In addition to a burns assessment, an overall physical examination should be performed to check vital signs and identify any concurrent injuries or illnesses present.

Keep welfare in mind when triaging burns cases, as burn injuries are severely painful and the experience in itself is traumatic. Assessment and provision of pain relief by a veterinarian should be sought as soon as possible.

Figure 13 outlines the pathology of burns and the secondary complications resulting from burn injuries.

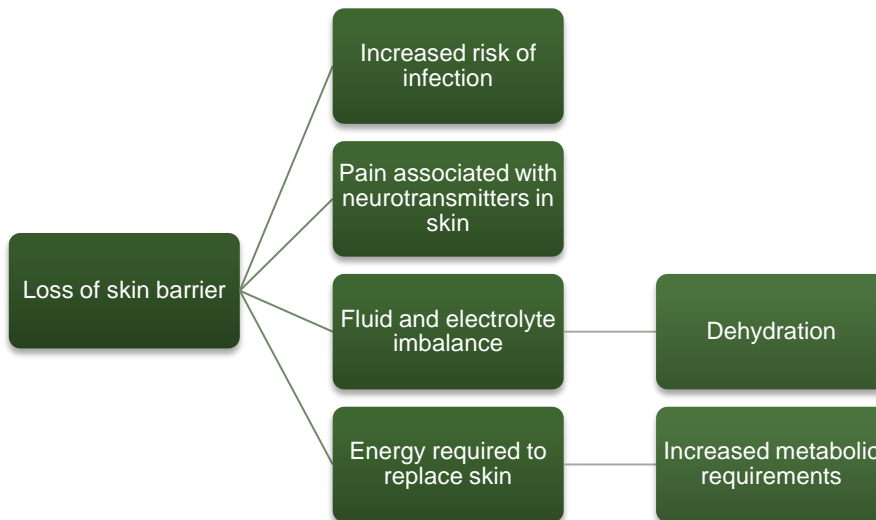


Figure 13 Brief outline of the pathology of burns

Similar to most traumatic injuries, shock can be life-threatening for burn victims, and stabilisation and transfer to a veterinarian should be arranged immediately. Similarly, dehydration can be a common consequence of burns and appropriate rehydration should be implemented.

Depth of burns

Burn injuries can be classified based on their appearance and pathology, however, this classification (see Table 3) can be subjective and requires experienced personnel and often multiple assessments over time.

Extent and location of burns

Veterinary consultation is necessary to determine a prognosis based on the extent and location of burn injury in possums and gliders.

- Significant burns to the face, genitals, digits, nail beds, tail or feet carries a poor prognosis and requires euthanasia.
- Burns to the feet can result in injury to deeper structures, including tendons and bones. Scarring and deformity can lead to permanent dysfunction and the deeper tissues, including bone, may become progressively devitalised.
- As arboreal animals, possums and gliders rely heavily on their tail and limbs for streamline locomotion. Therefore, burn injuries to the tail or limbs severe enough to warrant amputation must be euthanased (Fowler 2013).

Radiant burns do not manifest until several weeks post exposure. Radiant burns should be suspected in any animal with singed fur, and these animals are required to be kept in care for several weeks to adequately assess the extent and development of injuries.

The treatment of burns victims can be prolonged and very painful and stressful for the animal, often requiring multiple sedation or anaesthetic procedures. All these factors must be carefully weighed up when assessing burn victims, both initially and at every step of the treatment process.

Table 3 Classification of burns

	Superficial	Partial thickness	Full thickness (3rd degree)
Pathology	Epidermis and upper dermis, most adnexal structures intact*	Epidermis and part of the dermis. Superficial adnexal structures affected	Epidermis, dermis and cell adnexal structures destroyed
Appearance	Red, pale pink	Dark pink to red	Dry, leathery, white, black (charred) or yellow. Eschar* may be present
Blisters	Large within hours	May be present	None
Sensation	Very painful	Less painful	Absent

Adapted from T Duratovic (2016)

*Epidermis: outermost layer of skin

*Dermis: layer of skin below the epidermis

*Adnexal structures: skin associated structures such as hairs, sweat glands, nails

*Eschar: dry, dark scab or falling away of dead skin

Stabilising the patient

Following classification of the burn injury, veterinarians or experienced possum and glider rehabilitators should be contacted to discuss how best to stabilise the animal before transfer to a veterinary facility. General guidelines for stabilising possums and gliders with burn injuries are:

- If the burns are 'fresh', there is a high likelihood there is remnant heat in the wounds, therefore flush the wounds with lukewarm saline flushes or cover the wounds with saline-soaked gauze swabs.

- Fluid therapy is vital as animals can develop shock from severe dehydration. Intravenous fluids administered by a veterinarian is the recommended route of rehydration. If not possible, provide oral or subcutaneous fluid replacement.
- For burns to the eyes or face, flush the eyes or face with tepid saline or clean water.
- For smoke inhalation or respiratory burns, observe the animal for any signs of respiratory distress, such as open-mouth breathing, panting or increased respiratory rate. Any animals showing these signs should be presented to a veterinarian as soon as possible. Smoke inhalation can result in damage to the lungs and possible pneumonia. Ideally, oxygen therapy can be provided, but this requires specialist equipment. In the interim, improving humidity with nebulisers can improve clinical signs. If the animal will not tolerate a nebuliser mask held up to the face, a nebulising chamber can be created using blankets or towels to increase humidity.
- Recovering from burns markedly increases metabolic requirements; therefore optimal nutritional support is important. Appropriate diets should be provided to possums and gliders based on their species and life stage. In severely affected animals, additional veterinary intervention such as the use of a feeding tube may be required to ensure nutritional support is provided. This may not be feasible in many cases due to the stress associated with intensive care and management of severely affected animals. Euthanasia must be considered in species prone to stress associated with such interventions.
- Electrical burns (e.g. resulting from electrocution) are generally associated with a poor prognosis as the injuries almost always result in necrotic tissue after the blood supply to the area has been permanently interrupted. The extent of these injuries often do not become apparent for several days or even weeks after the event. Animals with suspected electrical burns should be closely and regularly monitored.

Treating burn wounds

Treatment for burn wounds should be undertaken only once the patient is stabilised. Sedation and pain relief are primary considerations in possums and gliders with burns injuries.

Burn wounds can be initially treated by flushing with saline or lukewarm water gently poured onto the affected area. Wear gloves when handling burn injuries to reduce the risk of wound contamination. Applying topical treatments specific for burns such as 'Flamazine' (silver sulfadiazine) can be a reasonable first aid approach after the wound has been flushed with saline or water and before veterinary attention is available.

Bandaging of burns will require sedation or anaesthesia prescribed by a veterinarian, however, non-stick dressings such as 'Melolin' can be applied to protect the wounds and prevent desiccation. Application of topical treatments and dressings to cover and protect burn wounds can provide mild temporary pain relief while veterinary attention is sought.

Orphaned joeys

Orphaned joeys are commonly rescued from injured or deceased females. In some cases, dependent joeys may be rescued from members of the public who may have been in possession of the animal following its initial rescue. Obtaining a thorough history of exactly where the joey was found, and what injuries the mother had sustained, can provide useful information on the condition of the joey. For example, if the female appears to have been deceased for several hours or even days, the joey will likely be severely dehydrated, hypothermic and hypoglycaemic. If the mother appears to have traumatic injuries, it is also important to assess the joey for signs of trauma.

Reuniting joeys with their mothers is sometimes possible, particularly with ringtail and brushtail possums, however, it must be done as soon as possible and by an experienced rehabilitator who can monitor and observe the interactions closely to ensure a successful reunion.

A pouch check must be performed in deceased female possums and gliders. Unfurred and lightly furred joeys may still be attached to the mother's teat and can be removed by cutting the teat close to the mother's body. Ensure you have assessed the adult female to confirm death beforehand. An animal can be declared deceased if there is no heartbeat, no evidence of respiration, no response to external stimuli such as pinching the toes, no corneal or blink reflex when the eyes are touched, or if the animal is cold and stiff from rigor mortis. If there is any doubt or uncertainty about whether an animal is dead, it is best to seek advice from an experienced wildlife rehabilitator or veterinarian.

Contact an experienced wildlife rehabilitator as soon as possible for advice on husbandry, feeding and care of joeys until the animal can be transferred.

Once rescued, place the animal in a suitable pouch within an escape-proof carrier and place it in a dark, warm and secure environment. Following this, an initial physical examination should be performed including identifying the species and developmental stage of the joey (see 'Physical examination' in Section 2).

Maintaining hygiene is extremely important when caring for joeys to reduce the risk of disease transmission (See Section 6 'Quarantine and managing infectious disease').

Following initial rescue, rehabilitation of unfurred and lightly furred joeys must only be undertaken by experienced possum and glider rehabilitators. Rehabilitation of joeys is an intensive process requiring experience, dedication and expertise.

Exudative dermatitis in brushtail possums

An exudative (moist, ulcerative) dermatitis is commonly observed in brushtail possums and is often referred to as 'stress dermatitis'. Early signs may appear mild: patches of fur loss or reddened skin but this can then progress into ulcerative wounds with scabs. Severe cases will have large, deep ulcerative lesions with a moist, sometimes purulent (containing pus) discharge and often with areas of necrosis (dead tissue) (See Figure 14).

The exact cause of exudative dermatitis is unknown, however, multiple factors are likely to contribute to the disease and progression of the lesions, including hypersensitivity, bacterial or fungal agents, trauma, skin parasites and stress (Vogelnest 2019).

The condition is most commonly observed in subadult and adult males, particularly where population density is high such as in urban areas. It has been hypothesised that social stress and territorial displacement act as predisposing factors for the development of the disease. Other suggested contributing factors are prolonged periods of rain and high humidity (Johnson & Hemsley 2008).

Brushtail possums with skin changes or superficial wounds indicative of exudative dermatitis should have a thorough veterinary assessment.

Various factors are considered when assessing prognosis in brushtail possums with exudative dermatitis, most importantly the animal's likelihood of survival when released back into the wild (Johnson & Hemsley 2008).

Euthanasia should be considered in possums with severe exudative dermatitis, as prognosis for return to good health and successful survival in the wild is very poor. For possums with exudative dermatitis, criteria for euthanasia are:

- more than 20% of its body is affected
- there is extensive scarring around the face
- movement is affected
- it is a subadult dispersing male
- there is no significant recovery after 14 days of treatment.

The welfare of displaced males, young or geriatric, in overcrowded urban areas should also be considered, as the prognosis for survival of these animals is very poor, and there is a high likelihood of recurrence of exudative dermatitis (Portas 2019).

In most cases, animals with exudative dermatitis will require euthanasia due to the often debilitating nature of the wounds, the multiple causative factors, and the potential for long-term compromise to welfare, particularly in the case of displaced males in overcrowded areas.

While there is no specific treatment for exudative dermatitis in brushtail possums, mild cases may be managed symptomatically with antibiotic treatment, surgical debridement of wounds, supportive care (fluids and nutrition), and bandaging.

However, the time in captivity and the distress caused to the animal as a result of regular anaesthetics or bandage changes should be seriously considered. Where the welfare of the animal is likely to be compromised then euthanasia may be required.



Figure 14 Severe, exudative dermatitis lesions in a brushtail possum

Photo: Australian Registry of Wildlife Health.

Swollen paw syndrome in ringtail possums

Swollen paw syndrome is a condition observed in ringtail possums. Affected animals will often present with swelling of one or more paws, and in some cases, necrosis or complete loss of digits or the entire paw is observed. Initially, the wounds can resemble burns or bite

wounds but will eventually progress to swelling, loss of blood supply to the paw, and necrosis.

The exact cause is unknown, however, there are many theories including bacterial or viral infection, electrocution, thermal injury, photosensitisation or fungal infection.

If a wildlife rehabilitator suspects swollen paw syndrome, or has a ringtail possum with injuries to the digits or paws, the animal should be examined by a veterinarian to identify possible causes of injury and determine appropriate treatment. Where a diagnosis of swollen paw syndrome is likely, euthanasia is warranted as treatment has shown to be largely ineffective (Johnson & Hemsley 2008).

Wobbly possum disease

Wobbly possum disease (WPD) is a disease affecting brushtail possums in Australia and New Zealand. It causes severe neurological dysfunction and until recently, the exact cause was unknown. Recent studies have identified a novel marsupial nidovirus as the causative agent (Chang 2019).

Animals affected by WPD typically present with neurological signs such as a head tilt, turning in circles, loss of balance, lack of coordination, difficulty climbing and unusual locomotion. They are often found weak and emaciated. Some individuals may be observed showing abnormal behaviours such as feeding out in the open during the day. Blindness is a common sign associated with WPD and can be diagnosed by observing dilated pupils and an inability to navigate obstacles (WHA 2019).

It has been theorised that in the wild, WPD may be transmitted through fighting, wound contamination from infected urine, and possibly through contaminated food sources. Close contact has been identified as a primary factor for disease transmission (Scheelings 2019).

Brushtail possums with neurological signs should be assessed by a veterinarian. Acute concussion or head trauma may mimic the signs of WPD, therefore veterinary assessment is vital for diagnostic evaluation. There is no treatment for WPD and affected animals, or animals suspected of having the disease should be euthanased.

6. Quarantine and managing infectious disease

Quarantine practices are vital in controlling and preventing infectious disease being transmitted between animals in care.

Treat all possums and gliders as potentially infectious, and take precautions to minimise disease transmission between animals, to humans and from humans.

- House animals separately until disease status is determined by a veterinarian or experienced wildlife rehabilitator. Orphaned young from the same mother should be housed together.
- If an animal shows any signs of disease (skin lesions, sneezing, coughing, diarrhoea, unusual behaviour), it must be quarantined and managed as potentially infectious until assessed by a veterinarian.
- Animals in quarantine must have their own cleaning equipment, feeding equipment and pouches, which are not to be shared with other animals.

- Thoroughly clean all enclosures, food and water bowls and equipment between animals. Cleaning feeding dishes, water bowls, and other cage furniture is best done by removing organic material by cleaning in a sink with detergent followed by additional cleaning and sanitising them by running them through a dishwasher.
- Ensure pouches, towels etc., in enclosures are thoroughly cleaned before and after use.
- Ensure biological materials such as leaves, wood, branches etc., are disposed of after use to prevent contamination between animals.
- Wash hands thoroughly before, after and between treating and handling individual animals.
- Use PPE as required: disposable gloves, covered clothing, alcohol-based hand sanitiser, dust mask, eye protection (see 'Personnel safety' in Section 2).

A range of available disinfectants is available, with varying levels of efficacy against different pathogens. Follow the manufacturer's instructions when using disinfectants as contact time and dilution rates vary between products. Only surfaces that are impervious to water and completely free of organic material can be disinfected. Before disinfection, ensure surfaces are cleaned to remove organic debris.

If an unusual disease or mortality event is suspected, the wildlife rehabilitator must immediately contact their species coordinator to notify the Department of Primary Industries (DPI) Emergency Animal Disease Watch Hotline (24 hours) on 1800 675 888 for immediate assessment of emerging health threats.

7. Zoonotic disease

Zoonotic diseases are diseases that can be transmitted from animals to humans. People who have close, regular contact with wildlife, such as veterinarians and wildlife rehabilitators, are considered to be more at risk of contracting zoonotic diseases (Hulst 2019). Knowledge of the disease, appropriate PPE, hygiene practices and vaccination where available are vital in reducing the risk of disease transmission. Zoonotic disease of specific importance to possums and gliders are listed below. Further information about zoonotic diseases can be found on the DPI website: [Zoonoses – animal diseases that can infect people](#).

Tularaemia

Tularaemia is a highly infectious, rare, zoonotic disease caused by the bacterium *Francisella tularensis*. Worldwide it has been identified in multiple animal hosts, including rabbits, hares and rodents. In 2011 (Tasmania) and 2020 (New South Wales) there were confirmed cases of tularaemia in humans secondary to bites and scratches from common ringtail possums (WHA 2020).

Transmission: Transmission to people occurs via a bite or scratch from an infected animal. There must be a break in the skin to enable transmission of the bacteria. In the northern hemisphere, speculation over an arthropod vector is currently being investigated. There is currently no evidence of human-to-human transmission.

Symptoms in possums: While it is still not known exactly what affects, if any, tularaemia has on ringtail possums (Scheelings 2019), infected possums have been described as being lethargic and generally unwell. Acute death, possibly as a mass mortality event, has also been described (WHA 2020). On post-mortem examination, possums with tularaemia were

most often found to have acute necrotising enteritis (inflamed intestines) or hepatitis (inflamed liver) (WHA 2020).

Symptoms in people: People exposed to the bacteria through bites and scratches to their skin may develop an ulcer at the site of the injury. Other symptoms which can appear within two weeks of exposure include fever, lethargy, body aches, enlarged lymph nodes, night sweats, headache and nausea (NSW Health 2020).

Prevention: Where possible, avoid unnecessary contact with common ringtail possums. Use appropriate PPE such as gloves and long sleeves when handling ringtail possums and if bitten or scratched, wash the area immediately with water and seek medical advice. For more information visit the NSW Health website: [Tularaemia fact sheet](#).

Salmonellosis

Transmission: The bacteria are shed in faeces and can be contracted through direct contact or indirect contact through fomites.

Symptoms in possums: Most animals that shed salmonella are asymptomatic. Young joeys, stressed animals in care, or immune-compromised animals with salmonella infection may exhibit clinical signs such as weight loss, inappetence and diarrhoea. Septicaemia and haemorrhagic enteritis may be observed in animals with salmonellosis, particularly juvenile ringtail possums (Johnson & Hemsley 2008).

Symptoms in people: The nature of the infection is often self-limiting, and signs can include nausea, vomiting, diarrhoea, abdominal cramping and fever.

Prevention: Hygiene and PPE are vital in protecting against salmonellosis. This includes hand washing, regular disinfection of equipment and isolation of affected animals.

Leptospirosis

While the risk posed to people from possums has not been quantified (Johnson & Hemsley 2008), infection with the bacteria *Leptospira* spp. appears to be common in brushtail possums in New Zealand. Surveys in Australia indicate a generally lower level of infection.

Transmission: Indirect transmission is most common through contaminated water bodies. Direct transmission can occur through contact of mucosa or broken skin with the urine of an infected animal.

Signs of illness in possums: Possums, which act as the reservoir host, exhibit no signs of illness.

Symptoms in people: The illness is related to fevers and liver disease and as such signs and symptoms include headaches, muscle ache, vomiting, nausea, abdominal pain and jaundice. Severe cases may progress to renal, liver or respiratory failure or meningitis.

Prevention: The use of appropriate PPE, such as gloves when handling possum urine, is important to reduce the risk of disease transmission as are good hygiene practices like hand washing and disinfecting animal enclosures and bedding.

Q fever

Transmission: The bacteria (*Coxiella burnetii*) is shed in birthing products, urine, faeces, colostrum and milk, and can be contracted through direct contact with infective material on broken skin or through inhalation of infective material (e.g. inhalation of faeces aerosolised during lawn mowing or cleaning enclosures).

Symptoms in possums and gliders: Animals shedding the bacteria are asymptomatic.

Symptoms in people: Infections can be asymptomatic or result in acute or chronic illness in people. Acute illness presents with flu-like symptoms, fevers, muscle aches and sweats. Few people develop chronic infections with a range of problems, including heart problems. About 10% of people can develop a chronic-fatigue-like illness (NSW Health 2019).

Prevention: Vaccination for people at risk is the best way to prevent Q fever. Hygiene practices such as washing hands (with soap and water or > 60% alcohol-based hand sanitiser); covering cuts and wounds; wearing a dust mask when mowing, cleaning enclosures, handling faeces or biological materials from possums and gliders (NSW Health 2019) should also be employed, however, these are not adequate alternatives to vaccination.

8. Record keeping

Accurate records must be maintained to track the progress and outcomes for possums and gliders in care. If the animal is referred for treatment at a wildlife hospital, these records provide vital clinical information useful in determining continued treatment and outcomes. They are also a useful resource for research and government organisations.

Records to be maintained include:

- encounter details – date, circumstances, location, name and details of people involved
- individual identification of possum or glider – species, stage of development, sex, identification (microchip) if present
- initial physical examination findings
- daily notes – including treatments provided, progression or development of symptoms, weight, food intake, faecal output etc. (maintain daily record sheets while the possum or glider is in care)
- outcome – record the outcome for each individual coming into care (for example, whether the animal was transferred to a wildlife rehabilitator or veterinarian, if the animal was euthanased or if the animal died while in care).

These records are required to be submitted to the NSW National Parks and Wildlife Service (NPWS) as part of annual reporting requirements.

9. References and further reading

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Appendix A

Table 4 Possums and gliders relevant to these guidelines

(From the Possum and Glider Code)

Bionet Atlas code	Common name	Scientific name	BC Act 2016 NSW listing	EPBC Act 1999 Federal listing
Pygmy Possums: Family Burramyidae				
1156	Mountain pygmy-possum	<i>Burramys parvus</i>	Endangered	Endangered
1151	Western pygmy possum	<i>Cercartetus concinnus</i>	Endangered	
1150	Eastern pygmy-possum	<i>Cercartetus nanus</i>	Vulnerable	
Brushtail possums and cuscuses: Family Phalangeridae				
1735	Short-eared possum	<i>Trichosurus caninus</i>		
1736	Mountain brushtail possum	<i>Trichosurus cunninghami</i>		
1113	Common brushtail possum	<i>Trichosurus vulpecula</i>		
Ringtailed possums and allies: Family Pseudocheiridae				
1133	Greater glider	<i>Petauroides volans</i>		Vulnerable
1133	Greater Glider population in the Mount Gibraltar Reserve area	<i>Petauroides volans</i>	Endangered population	Vulnerable
1133	Greater Glider population in the Seven Mile Beach National Park area	<i>Petauroides volans</i>	Endangered population	Vulnerable
1133	Greater Glider population in the Eurobodalla LGA	<i>Petauroides volans</i>	Endangered population	Vulnerable
1129	Common ringtail possum	<i>Pseudocheirus peregrinus</i>		
Yellow belied glider, squirrel glider and sugar glider: Family Petauridae				
1136	Yellow-bellied glider	<i>Petaurus australis</i>	Vulnerable	
1136	Yellow-bellied Glider population on the Bago Plateau	<i>Petaurus australis</i>	Endangered population	
1138	Sugar glider	<i>Petaurus breviceps</i>		
1137	Squirrel glider	<i>Petaurus norfolcensis</i>	Vulnerable	
1137	Squirrel glider in the Wagga Wagga LGA	<i>Petaurus norfolcensis</i>	Endangered population	
1137	Squirrel glider on Barrenjoey Peninsula north of Bushrangers Hill	<i>Petaurus norfolcensis</i>	Endangered population	
1147	Feathertail glider	<i>Acrobates pygmaeus</i>		

Appendix B

Table 5 Stage of development for possums and gliders

(From the Possum and Glider Code)

Stage	Fur	Eyes	Ears	Teat attachment	Pouch	Mobility
Unfurred – pinkie						
Stage 1	No	Closed	Fused	Fused	In	None
Stage 2	No	Closed	Fused	Mouth open	In	None
Stage 3	Just under skin	Starting to open	Starting to open	Mouth open	In	None
Lightly furred – velvet						
Stage 1	Fine, flat	Open	Erect	Mouth open	In	None
Stage 2	Fine, sleek and short	Open	Erect	Mouth open	In	None
Furred						
Stage 1	Short and dense	Open	Erect	Mouth open	In and out	Start to explore outside pouch
Stage 2	Thick and fluffy	Open	Erect	Mouth open	In and out	Longer times out
Emerged	Fully furred	Open	Erect	Mouth open	Out	Clings closely to mum
Juvenile	Fully furred	Open	Erect	Mouth open	Out	Moves independently
Subadult	Fully furred	Open	Erect	Mouth open	Out	Weaned, independent and ready for release
Adult	Fully grown, sexually mature and exhibit normal behaviour for an adult of the species					
Geriatric	Display an array of problems associated with old age Arthritis, worn down teeth and a tatty coat are indicators of an elderly animal					