



DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT

Guidelines for the initial treatment and care of rescued macropods



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Cover photo: Eastern grey kangaroo joeys in pouches. Photo: Filip Zahradnik.

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1. Introduction

The purpose of this document is to standardise the initial treatment of macropods requiring rescue or rehabilitation, in line with the *Code of Practice for Injured, Sick and Orphaned Macropods* (the 'Macropod Code') (OEH 2018).

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 macropods.

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 macropods.

'Macropods' is used in this document to refer to members of the superfamily Macropodoidea, a diverse group of animals including kangaroos, wallabies, wallaroos, potoroos, pademelons and quokkas. Macropod species relevant to this document are listed in Appendix 1 in the Macropod Code.

This document provides guidance on the initial care and management of macropods following rescue, from capture to physical examination, initial stabilisation and treatment before presentation to a veterinarian. It provides advice on how to manage the more common rescue encounters in macropods including trauma, burns and orphaned joeys.



Photo 1 Eastern grey kangaroo (*Macropus giganteus*) joeys in rehabilitation. Meredith Ryan/FAWNA

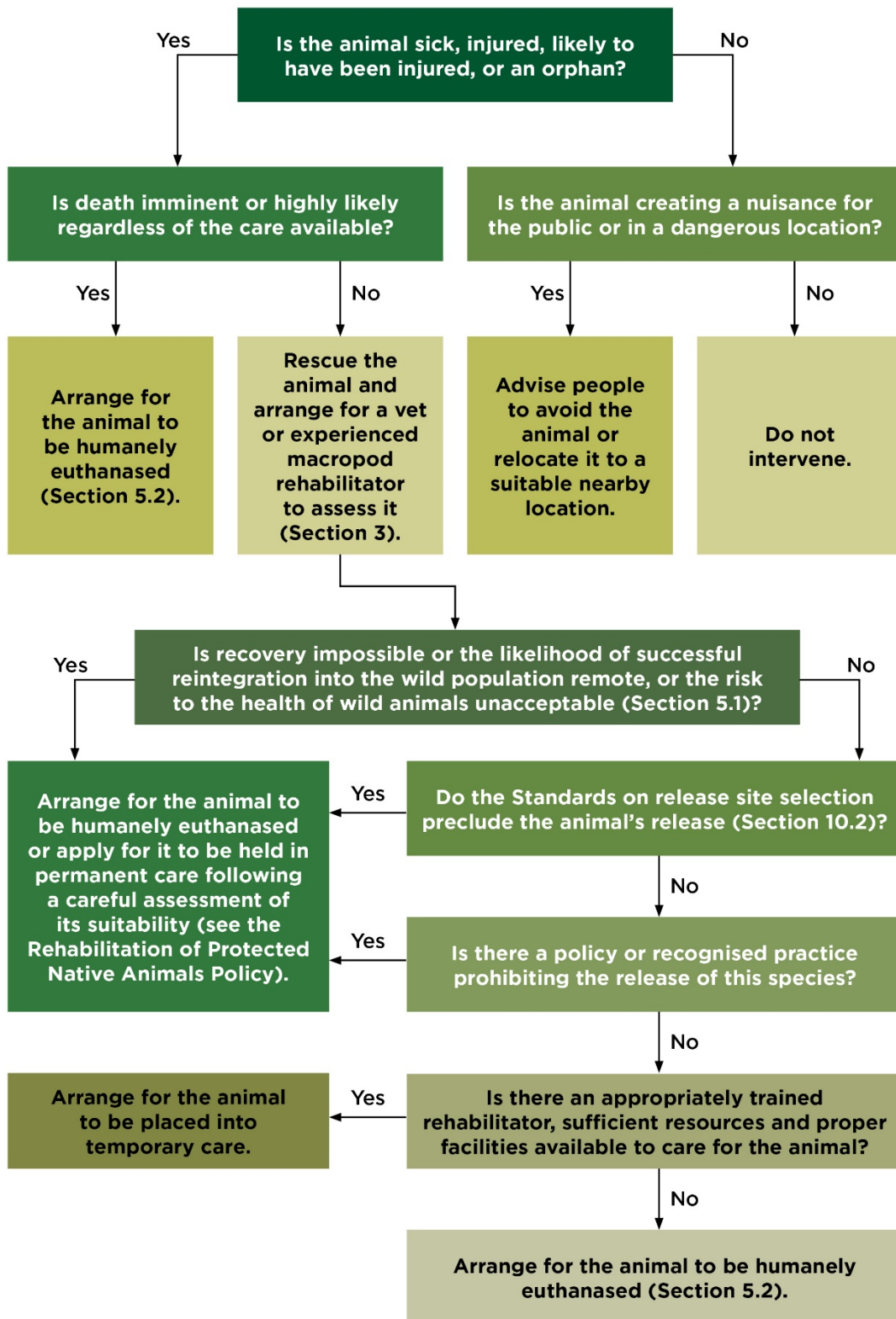


Figure 1 Decision tree directing the course of action for macropod rescue encounters (From the *Code of Practice for Injured, Sick and Orphaned Macropods*. Section numbers refer to numbering used in the Code.)

2. Capture, restraint and physical examination

As outlined in the Macropod Code, rescuers must aim to have the macropod assessed by a veterinarian or experienced macropod rehabilitator within 24 hours of rescue to establish an accurate diagnosis and provide the best outcomes for the animal. An experienced macropod rehabilitator is someone who has extensive knowledge of current rehabilitation techniques gained through training courses and many years of successfully caring for macropods.

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 macropod rescue cases. It is important to keep in mind that the ultimate goal of rescue and rehabilitation is to ensure successful reintegration of the individual into the wild population.

Personnel safety

Before handling macropods, rescuers should be aware of possible safety risks and take necessary precautions to minimise harm to themselves and the animal. Sick or injured wildlife can cause injury (bites or scratches) and disease transmission is possible both to and from humans.

- Protect yourself and the animal by using appropriate personal protective equipment (PPE).
- Avoid handling wildlife if it is not necessary or you do not feel confident and capable to do so.
- Use PPE as a barrier where possible – wear gloves or use a towel as a barrier.
- Wear appropriate clothing – robust long sleeves, covered shoes.
- 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 that you have been handling wildlife.

Distance examination

Initial assessment begins before the animal is captured. Macropods are prone to stress and have a well-developed flight response. Unless habituated to human presence, they are likely to flee when approached and can sustain considerable injury from obstacles, fences or moving traffic in the process. When attending a macropod rescue, conduct an initial distance examination to assess the situation and inform decision-making.

Animals should be observed from a safe distance for gait and posture, signs of pain or distress, and any obvious wounds or injuries. Binoculars are useful for this purpose as it allows monitoring from a safe distance. While observing the animal, assess its behaviour and the environment. Monitor for the presence of young as joeys may be thrown from the pouch during the incident and young at foot may be in the vicinity. Rescuers may have to revisit the area regularly to locate and capture these animals as they are still dependent on the mother for nutrition and protection.

- **Gait and posture:** Lameness or abnormal gait or posture can indicate musculoskeletal or neurological injuries or disease.

- **Signs of pain or distress:** Licking of arms, chest or abdomen; teeth grinding (bruxism); shaking; vocalising or diarrhoea can indicate pain or distress. The absence of these signs should not be assumed as an absence of pain as macropods can hide signs of pain.
- **Respiratory rate:** Panting is an indicator of severe distress. Capture should be avoided in an animal observed panting. If capture is unavoidable, sedation or anaesthesia may be required.

During the distance examination, assess the feasibility of capture.

As capture of adult macropods is inherently risky for both the animal and personnel involved, a distance examination allows the opportunity to consider the need for continued monitoring of the animal, or whether immediate rescue is required (see 'Rescuing adult macropods', below). Adult macropods with severe injuries may require euthanasia on site.

Attending to deceased macropods

Motor vehicle-related injuries are the most common reasons for rescue in macropods (DPIE 2020). A high percentage of motor vehicle-related incidents result in mortality. When a deceased macropod is reported by a member of the public, it is important to assess the animal to determine if further intervention is required and, importantly, in females, to check the pouch for the presence of young.

When attending to a roadside rescue, always ensure personnel safety when working close to traffic.

Approach the macropod from behind, away from the hindlimbs, and assess if the animal is breathing or showing any signs of movement. To confirm death, place a hand on the animal's chest, at the level of the elbow, to feel for a heartbeat. Check for a corneal reflex by touching the animal's eye and confirming the lack of a blink response.

Once confident the animal is deceased and does not require immediate attention, a pouch check should be performed in female macropods (see 'Rescuing joeys'). Once the joey is removed from the pouch, the adult female should be assessed for injuries as this can provide information on the likelihood of injury in the joey. It is also useful to examine the female to identify and record the species as this will inform care and husbandry procedures for the joey. If unknown, a photograph of the head of the female will help experienced macropod rehabilitators to identify the species.

Capturing macropods

The capture of macropods should be performed only by appropriately trained people. Considerations about safety and methods of capture for large adult macropods vary significantly when compared to the capture of joeys; this is discussed below. Additionally, macropods are particularly prone to stress and resulting capture myopathy (see 'Capture myopathy').

Personnel safety and animal welfare are primary considerations when undertaking macropod rescues.

If rescue is needed, before undertaking the rescue determine the appropriate capture technique and equipment required, and assess the safety of the animal and personnel. Ensure the required equipment and facilities to transport and house the animal are organised before rescue.

Rescue of large adult macropods requires a minimum of two trained personnel. Refer to the Macropod Code for rescue standards.

Equipment to include in a macropod rescue kit includes:

- blankets or towels (or both) to cover an animal and cover its head
- large sacks (not hessian) or bags to carry animals, multiple sizes are ideal
- ropes or cable ties to securely close bags
- pouches for joeys, multiple sizes are ideal
- heat source (e.g. hot water bottle, thermos with hot water, heat packs)
- thermometer
- binoculars
- wire cutters
- sharp scissors – for cutting the pouch or teat of dead females to retrieve young
- large safety pins
- head torch or alternative light source
- PPE – disposable gloves, alcohol-based hand sanitiser, disinfectant, hi-vis vest.

Capture myopathy

Macropods are particularly prone to capture myopathy, a syndrome resulting from stress or muscular exertion. It involves a complex cascade of physiological changes resulting in reduced blood supply (ischaemia) to the muscles and vital organs, ultimately affecting organ function (e.g. heart failure, compromised kidney function, permanent muscle damage).

Capture myopathy is a primary consideration in the rescue and rehabilitation of macropods, and actions must be taken to prevent its onset.

Following a stressful incident, capture myopathy can present acutely, where animals may die soon after showing symptoms, or more chronically, whereby animals may die days or weeks after the initial incident.

The symptoms commonly associated with capture myopathy include muscular tremors, increased heart and respiratory rate, drooping head, weakness, red or brown urine, and collapse.

Capture myopathy has a high mortality rate, even with immediate intensive treatment. Animals suspected of developing capture myopathy should be assessed by a veterinarian and treatment started as soon as possible. Animals in advanced stages of capture myopathy or with severe symptoms are euthanised due to the poor prognosis for survival to release.

Actions must be taken to prevent the onset of capture myopathy, including:

- avoiding capture in hot weather
- avoiding prolonged pursuit
- reducing stressful events – avoiding excessive and prolonged handling, reducing exposure to environmental stressors.

Rescuing adult macropods

Adult macropods may require rescue for various reasons including motor vehicle trauma, entanglement and dog attack. They have a strong flight response and, in an attempt to flee, can cause considerable trauma to themselves or to people attempting rescue.

Planning and preparation are vital to ensure capture of adult macropods is efficient, with minimal stress to the animal.

Considerations before the rescue of adult macropods include:

- **Environmental conditions** – consider ambient temperature, topography and access to the animal, hazards (e.g. moving traffic).
- **Severity of injury** – adult macropods with severe injuries (e.g. vertebral fractures, hindlimb fractures, extensive third-degree burns) may require euthanasia on site. Ensure an experienced macropod rehabilitator or veterinarian can be contacted to assist with decision-making and triage.
- **Available facilities** – adult macropods require specialised facilities for housing, and in the majority of cases the use of particular management techniques including administration of long-active sedatives or tranquilisers to prevent the development of capture myopathy. Availability of resources and facilities for rehabilitation must be considered in the decision-making about the rescue.
- **Trained personnel and equipment** – adult macropods may require sedation or anaesthesia (or both) during or soon after capture. Before undertaking the rescue ensure personnel, equipment and veterinary support is available.

Methods of capture

Chemical immobilisation

Sedative and anaesthetic agents with a rapid induction time are recommended for the capture of larger free-ranging adult macropods (Jackson 2007; King et al. 2011; Vogelnest & Portas 2008). Chemical immobilisation must be performed with a veterinarian present or under the direct supervision of a veterinarian. Drugs can be delivered using darts fired from a tranquiliser gun or a blow pipe by an appropriately experienced and licensed operator or where it possible to do so safely, using an extended pole-syringe. An extended pole-syringe or blow pipe are usually only suitable for macropods that are habituated to humans (e.g. golf courses, campgrounds) as they require approaching to within five metres of the animal. Remote dart injection using a tranquiliser gun is preferred in most free-ranging adult macropods as there is a reduced risk of capture myopathy and stress (Vogelnest & Portas 2008).

Traps or netting

Various methods including hoop nets, temporary fences and traps can be used to capture macropods. Jackson (2007) provides detailed descriptions on the various capture techniques.

Hand capture

If able to approach the animal, grab the base of the tail. Smaller macropods can be lifted by the base of their tail and one hand placed around their chest for restraint, with the hindlimbs facing away from the handler (see Figure 2). The animal must be placed into a sack or bag

as soon as possible. Ensure the animal's head remains covered to keep it calm. Sedation, prescribed by a veterinarian, soon after capture is recommended to reduce stress and the risk of capture myopathy.



Figure 2 Demonstration of hand capture of a macropod joey

The handler is grasping the tail at the base (left) with a supporting hand around the chest (right).

Photo: Aditi Sriram/DPIE

Rescuing joeys

Dependent joeys are commonly rescued due to the injury or death of the mother or may be found apparently abandoned.

The pouch of any deceased adult female macropod should be checked thoroughly and all four nipples visualised and examined.

Pouch young still in pouch

- Lightly furred (velvet) and unfurred (pinkies) joeys may be attached to the teat of deceased adult females. If the joey cannot be manipulated off the teat by applying gentle pressure to the sides of the mouth, then no further effort to do so must be made. Instead, the teat can be cut, as close to the mother's body as possible, and the joey removed with the teat. Once out of the pouch, place a large safety pin into the teat to ensure the joey does not swallow it and place the joey into an artificial pouch. Alternatively, in smaller macropods, the dead female can be transported with the joey in the pouch, to an experienced rehabilitator.
- When removing lightly furred joeys from the pouch, ensure the tail or legs are not caught. Ideally, remove the joey with its back out of the pouch first and tail and legs to follow. Do not pull on the tail or legs alone. When attending to dead females with pouch young, blunt-ended scissors may be used to cut the pouch, being careful not to injure the joey.
- Larger, fully furred joeys can be difficult to manipulate out of the pouch and may try to escape. Grasp the base of the tail firmly when removing larger joeys from the pouch and direct their heads into the artificial pouch.
- Contact an experienced macropod rehabilitator as soon as possible.

Emerging joeys and young at foot

- During a pouch check, an elongated nipple in a female with an empty pouch suggests she was caring for an emerging joey or joey at foot (see Figure 3). Emerging joeys may

be thrown from the pouch during an accident or incident. Emerging joeys and young at foot are not yet weaned and are still dependent on the mother.

- Joeys at foot may remain in the vicinity of the dead female and may call for the mother. The surrounding area must be searched daily for several days.
- If an orphaned joey is observed, an experienced macropod rehabilitator must be contacted to assess if the joey requires capture and rehabilitation. Fully emerged joeys can be difficult to capture and restrain and are not ideal candidates for temporary captivity. Following an assessment by an experienced macropod rehabilitator, a decision can be made to leave the joey with the mob and regularly monitor the animal or capture the animal for assessment and care.



Figure 3 An unfurred macropod joey still in the pouch
Note the joey is attached to the teat (white arrow). Photo: Meredith Ryan/FAWNA

Transport

Macropods should be transported in secure carriers appropriate for their size and stage of development. Transport containers should be well-ventilated and ambient temperatures, appropriate to the individual animal, must be maintained and regularly monitored during transport (see Table 1).

Transport should be planned and efficient, with minimal stressors. Avoid domestic animals, loud music, voices, and cigarette smoke, and aim to keep transport times minimal.

Furred joeys and adult macropods can develop hyperthermia (overheating) during rescue and transportation and may require cooling before being transported. Transport of macropods should be avoided when ambient temperatures are high.

Table 1 Ambient temperatures to be maintained during transport of juvenile macropods (adapted from the Macropod Code)

	Developmental stage	Ambient temp.
Joeys	Unfurred (pinkie)	32°C
	Lightly furred (velvet)	30 °C
	Fully furred	28 °C

Suspending macropods in a sack or bag is the preferred method of transport. The sack must be large enough to allow the animal to lie comfortably. Care must be taken to ensure the animal is positioned such that the head and neck can move freely.

Adult macropods should be sedated before transport to reduce the risk of stress and capture myopathy. A suspended pouch or sack is ideal to transport adult macropods (Vogelnest & Portas 2008). As discussed previously, the rescue of adult macropods commonly requires euthanasia at the site. Due to the stress associated with handling and transport, the decision to transport an adult macropod should be made in consultation with an experienced macropod rehabilitator and with veterinary advice or assistance.

Joeys can be transported in artificial pouches. They must be able to lie comfortably within the pouch, in a position similar to being in the mother's pouch. Joeys requiring rescue are commonly hypothermic (too cold). Supplementary warmth can be provided using hot packs or hot water bottles, ensuring the heat source is not in direct contact with the joey. A thermometer should be used to monitor temperatures within the artificial pouch during transport.

Physical examination

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).

Adult and most subadult macropods will require sedation or a general anaesthetic (or both) in order to perform a thorough physical examination. Veterinary assistance should be sought for these animals as soon as possible to facilitate assessment.

This section on physical examination in macropods, therefore, refers to pouch young and emerging young of smaller macropod species, where a preliminary examination can be conducted in the majority of cases without the need for sedation or anaesthesia.

When performing a physical examination, the aim is to be thorough while minimising stress to the animal. Handling should be tailored to each individual animal based on its health status and temperament.

Pouch young can be examined while in the artificial pouch by extracting or uncovering different parts of the body for examination (see Figure 4). The pouch can be placed on the lap of the handler, with the curvature of the joey's spine resting against the handler's abdomen (McCracken 2008). This allows the joey to remain in the safety and security of the pouch with its head covered, reducing the stress associated with handling.

Prolonged or repetitive handling is stressful and detrimental to the health of the animal. Equipment required for the physical examination and possible treatment should be prepared and available before initiating handling.

It is important to continually monitor the animal for signs of stress during handling. If the animal starts showing signs of stress (see below), replace it in the pouch and let the animal settle in a warm, dark, quiet location. Contact an experienced macropod rehabilitator or veterinarian to advise on the management of the joey. Sedation prescribed by a veterinarian can facilitate examination in stressed joeys or those not tolerant to handling and restraint.

Signs of stress

Signs of stress in macropods can include:

- vocalising
- increased respiratory rate
- panting – a sign of severe stress
- teeth grinding.

As outlined in the Macropod Code, following initial assessment and stabilisation, the rehabilitator must aim to have the macropod assessed by a veterinarian or an experienced macropod 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 macropod rehabilitator on the phone for advice on continued care of the patient, until it is able to be transported.



Figure 4 Examining a joey restrained in a pouch

The hindlimbs (left) and forelimb (right) are extracted out of the pouch for examination while the joey remains within the pouch with its head covered. The joey is supported on the lap of the handler. Photo: Aditi Sriram/DPIE

Body weight

It is easiest to weigh joeys while they are still in the artificial pouch. Once the joey is out of the pouch, its weight can be calculated by subtracting the weight of the pouch from the total weight of the joey and the pouch.

Body weight is an important indicator of health. Recording an initial weight will provide a baseline for that animal and continued monitoring of weight at regular intervals throughout the rehabilitation process will provide valuable information on the health and development of the joey. Weight loss or failure to gain weight could indicate dehydration, malnutrition or

gastrointestinal problems (e.g. intestinal parasites, infections, dysfunction) and requires further investigation.

Identification and ageing of joeys

Macropod species vary in their behaviour, development and nutritional requirements therefore identifying the species and developmental stage in joeys is vital to providing optimal husbandry and care for each animal.

Species identification can be difficult in very young joeys and experienced macropod rehabilitators should be contacted for advice where necessary.

Determining age is vital as it directs decision-making about husbandry requirements and the prognosis for each individual animal.

Age factor is a numerical representation of age as a proportion of the total expected pouch life. As the length of time in the pouch varies for the different macropod species, age factor allows an understanding of the stage of a joey's development (Campbell-Ward 2019). For example, 0.4 is 40% of pouch life completed, therefore, an eastern grey kangaroo joey at age factor 0.4 (130–180 days old) is at a similar stage of development to a swamp wallaby at age factor 0.4 (110–150 days old).

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

Various features are considered in determining age factor including weight, body measurements and physical characteristics.

Weight is an important consideration but can be influenced by factors other than age, such as gut fill, hydration, muscle mass, fat stores and illness. Body weight is also important to calculate medication dose rates.

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

Body measurements include measurements of the head, tail and foot length (see Figure 5).

- Head length is measured from the tip of the nose to the back of the skull.
- Foot length is measured from the back of the heel to the tip of the longest toe (not including the nail).
- Tail length is measured on the underside of the tail, from the base to the tip, not including any hair protruding from the tip (Wombaroo Food Products 2020).

Growth charts calculating weight, physical characteristics, body measurements and the corresponding age factor specific to macropod species can be found at [Kangaroos and Wallabies](#) (see Appendix A).

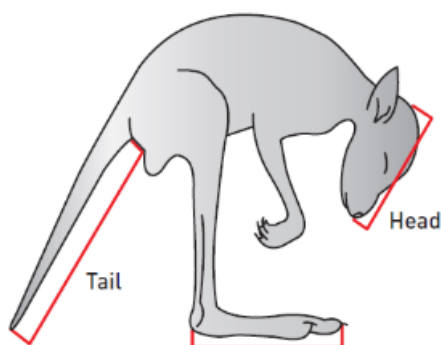


Figure 5 Standard body measurements used to age joeys
(Sharman et al. 1964)

Weight, physical characteristics and body measurements should be measured and recorded for pouch young during the physical assessment. Using this information and based on the health status of the joey, a decision on viability can be made in discussion with an experienced macropod rehabilitator. Joeys with an age factor of < 0.4 are generally considered poor candidates for rehabilitation as their prognosis for survival is very poor. They are highly dependent on immunity from the mother's milk, are at a vulnerable stage of development and require intensive and specialised care (McCracken 2008). To prevent further welfare compromise, euthanasia is generally recommended for orphaned joeys with an age factor of < 0.4

Demeanour

Behaviour and general demeanour of the animal must be noted during initial examination and compared to what is expected of the animal based on its stage of development. For example, joeys may be stressed at first rescue and exhibit behaviours such as vocalising, hiding and wriggling to avoid the handler.

Although an understanding of normal behaviour in macropods may require experience, findings from the initial physical assessment can be used to discuss the animal's condition with experienced macropod rehabilitators and as a comparison throughout the rehabilitation process.

A change in the animal's demeanour, from alert and responsive on initial assessment to quiet and lethargic a few hours later, may indicate deterioration in the animal's health and a requirement for further assessment and intervention.

Sex

Sex can be determined by the presence or absence of a pouch in females or external testicles in males.

Hydration status

Hydration status can be evaluated by assessing mucous membrane colour and tackiness, checking for skin tent and pulse quality. Adequately hydrated animals should have pink mucous membranes and good pulse quality (see Figure 7). Dehydrated animals will often have a weak, fast pulse. To assess pulse quality, gently palpate the medial aspect of the

hind leg (inner thigh) to locate and assess the femoral pulse. In dehydrated animals, skin may be dry, wrinkly and when gently pinched to tent the skin, it will be slow (> 1 sec) to return to normal position. Sunken eyes and pale, tacky gums are also indicators of more severe dehydration.

Eyes, nostrils and ears

Any changes in the appearance of the transparent, outermost surface of the eye (cornea), discharge from the eyes, or redness (inflammation of the conjunctival tissues) can indicate trauma or infectious disease. Compare the two eyes and check for asymmetry in the size of the pupil as this can be indicative of neurological dysfunction resulting from head trauma. A partially closed eye or squinting can be indicative of pain and these animals must be seen by a veterinarian for assessment and for pain relief to be administered as soon as possible.

Assess the nose for discharge, wounds or abnormal shape of the nostrils or the bridge of the nose. Ticks are commonly found in the ears, and ears should also be checked for wounds, discharge or any evidence of trauma. Detailed eye and ear exams require veterinary expertise and equipment.

Dental examination

Assess the face and jaw for symmetry and swelling (see Figures 6 and 7). Check the mouth for any evidence of discharge, and the incisors for malocclusion (faulty alignment between the upper and lower jaw) or breaks. Trauma resulting from motor vehicle accidents can result in significant damage to joeys in the pouch and resultant fractures or malalignment of the jaw. Approach dental examination with care as fractures or trauma can be painful. Examination of the cheek teeth requires veterinary expertise and equipment.



Figure 6 Dental examination of a joey
Note alignment and symmetry of incisors. Photo: Aditi Sriram/DPIE

Skin and coat condition

Furless pouch young have thin skin which is prone to damage and dehydration (Campbell-Ward 2019). Visual examination of the skin and feeling the coat in furred young can provide valuable information on the joey's condition and the presence of wounds, parasites or infection.

- Dry, rough and scaly skin can indicate exposure to poor environmental conditions. When removed from the pouch or exposed to unsuitable environmental conditions, joeys can develop dry, scaly skin and secondary infections.

- Large numbers of external parasites such as ticks can indicate poor condition and underlying disease processes. A thorough search for ticks should be performed, looking in the ears and around the face, body and the cloaca.
- Bruising or grazing wounds indicate trauma and will require a thorough veterinary assessment for internal injuries.
- Identify any wet patches or blood staining on the coat to check for deeper wounds or evidence of trauma (e.g. dog bite wounds).
- Papules or pustules – small, raised, circular lesions or vesicles on the skin – can indicate skin infection and requires a thorough assessment by a veterinarian.

Heart and respiratory rate

If available, use a stethoscope to listen to the heart by placing it over the mid-chest region. Alternatively, a pulse rate can be calculated by palpating the femoral pulse, on the inner thigh. Joeys may have a higher pulse rate than adults. Normal resting heart rates can vary between 70–200 beats per minute (McCracken 2008). Abnormally low heart rates in joeys are of concern and require further investigation for underlying causes (Campbell-Ward 2019).

Monitor for abnormal breathing sounds including wheezing or crackling. At rest, respiration should be effortless. Laboured breathing or increased respiratory rate (> 40 breaths per minute) can both indicate underlying respiratory disease.

Circulation

Circulation can be assessed by examining the colour of the gums. Healthy joeys should have pink, moist gums (see Figure 7). Pale or tacky gums can indicate shock, anaemia, blood loss or severe dehydration. In these cases, veterinary attention is warranted as soon as possible.



Figure 7 Assessing hydration and circulation in a macropod joey
Note pink gums and alignment of teeth. Photo: Aditi Sriram/DPIE

Limbs and tail

Palpate limbs and tail for swelling, wounds and pain. Dislocations and fractures, especially of the hindlimbs, are a common consequence of trauma. It is important to assess the 'ankle joint' for symmetry and swelling as calcaneal (heel bone) fractures are very common after motor vehicle accidents (see Figure 8). Any swelling or asymmetry of joints requires veterinary assessment including radiographs.



Figure 8 Macropod joey restrained in a pouch, showing the ‘ankle joints’

The animal is supported on the lap of the handler, and hindlimbs are exposed for examination. The ‘ankle joints’ are indicated by the white arrows. Photo: Aditi Sriram/DPIE

Assess motor function in the limbs (the animal’s ability to consciously move limbs). Depending on the joey’s developmental stage, this can be performed by placing the joey on the ground in a small, quiet room and assessing mobility and balance. As removing a recently rescued joey from the pouch can cause considerable stress, the gait exam may best be performed once the joey has been stabilised. Lightly furred and older pouch young should be able to stand and hop (McCracken 2008). Abnormalities in gait or movement can indicate muscular or neurological dysfunction.

Body temperature

Assessing body temperature in joeys can be difficult due to small body size and cloacal anatomy. Rectal temperature is assessed by inserting a lubricated thermometer into the cloaca. This should be performed by experienced persons. Normal body temperature in macropod pouch young is between 35.5°C and 37°C (McCracken 2008). Alternatively, feeling the animal’s ears, digits and feet and measuring the temperature in the pouch can provide a crude idea of whether the body temperature is likely to be low (hypothermia) or high (hyperthermia).

Cloaca

Check urine and faecal output. Assess the quantity and quality of faeces and urine produced. Faecal colour and consistency can vary with age in macropod joeys. Urine should be clear to pale yellow. Abnormal colour or consistency of faeces can indicate infection, parasites, poor diet or gastrointestinal dysfunctions. Darker yellow urine or brown- or red-tinged urine can indicate dehydration, infection or trauma.

3. Euthanasia

As stated in the Macropod Code, euthanasia is necessary where recovery is not possible, the animal is suffering from an incurable disease that poses a risk to wild animals, death is imminent, the animal is suffering from chronic unrelievable pain, or the likelihood of reintegration into the wild population is remote. The Macropod Code, including the decision tree (Figure 1), provides guidance regarding euthanasia.

Euthanasia should be performed by a veterinarian where available.

Intravenous barbiturate overdose, prescribed by a veterinarian, is the recommended method of euthanasia in macropods in care. Animals should be sedated or anaesthetised before euthanasia as this provides a better opportunity for venous access and reduces the stress associated with restraint. In very small, attached, unfurred pouch young, where intravenous access is difficult, barbiturates can be administered via the intra-hepatic (into the liver) or intra-peritoneal (into the abdominal cavity) routes in an anaesthetised animal (Campbell-Ward 2019).

Where access to a veterinarian is not possible, a method appropriate for the species, ensuring minimal pain and suffering, should be employed, e.g. shooting with an appropriate firearm. Shooting should only be undertaken by licensed and skilled operators. Refer to the National Code of Practice for the Humane Shooting of Kangaroos and Wallabies for Non-Commercial Purposes (DEWHA 2008) and A Guide to the Care and Use of Australian Native Mammals in Research and Teaching (NHMRC 2014).

4. Initial treatment – stabilisation

Emerged joeys and adult macropods require specialised facilities and the use of sedation or anaesthesia (or both) to facilitate handling. Although the principles for initial treatment are similar for adults and joeys, this section refers primarily to pouch young.

Temperature

Marsupials are ectothermic at birth (body temperature is variable and depends on the surroundings) and therefore they rely on the pouch environment to maintain body temperature. As they transition through pouch life, they develop endothermy (self-regulating body temperature) (Campbell-Ward 2019).

Lightly furred and unfurred joeys are particularly prone to hypothermia due to their small body size (high surface area to volume ratio) 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 (35.5°C for pouch young). This can be done with external heat sources such as heat packs, hot water bottles or heat mats. Ensure heat sources are not directly in contact with the joey and that 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 are preferred as they can be easier to control and maintain within a particular temperature range.

Fluid rehydration

It is safe to assume the majority of rescued macropods will present with dehydration and if left untreated, dehydration can progress to shock (Campbell-Ward 2019). Orphaned joeys or unwell anorexic joeys can develop dehydration as result of reduced fluid intake. Dehydration can also result from excess fluid losses due to diarrhoea.

The primary routes of fluid supplementation in macropods are intravenous (IV), subcutaneous (SC) or oral (PO). Mild dehydration can be treated by the PO and SC routes. In severe cases of dehydration the animal should be referred to a veterinarian for assessment and IV fluid treatment.

Oral supplementation

For macropods able to hold their head up, and without signs of head trauma or neurological deficits (see 'Trauma' in Section 5), fluids can be given orally using an appropriately sized teat attached to a syringe or bottle. Supplementing with water is preferred, alternatively, half-strength electrolyte solutions such as 'Lectade' or 'Vytrate' can be used. Fluids should be warmed to approximately 30–35°C and the syringe and teat sterilised before use. Quantities of fluid supplementation are based on calculation of fluids losses and will depend on how willing the joey is to accept oral fluids.

Do not to force the animal if it is not willing to drink, as this results in stress, increases the risk of aspiration (fluid in the airways) and is counterproductive.

Oral fluids can be provided by applying gentle pressure to the sides of the mouth and placing the teat centrally between the front teeth. Monitor the joey for active swallowing. It is preferable to offer fluids to the joey while it is in the pouch in a quiet, dark environment with its eyes covered. Advice should be sought from experienced macropod rehabilitators on the use of teats particular to the species and stage of development, and the quantity and frequency of oral fluids to be delivered.

Intravenous and subcutaneous fluid therapy

These are the recommended routes for rehydrating a moderately or severely dehydrated animal, however, they require qualified and experienced rehabilitators (for SC) or a veterinarian (for IV), sterile techniques and appropriate equipment.

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

Hypoglycaemia

Hypoglycaemia (low blood glucose) is a common presentation in orphaned joeys. Blood glucose levels can decrease due to periods of inappetence (lack of appetite) and can result in weakness, seizures and, if left untreated, can result in the animal's death.

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

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

Pain relief (analgesia)

Macropods are generally stoic and may not show obvious signs of pain. Lack of appetite (inappetence), hunched posture, lethargy and teeth grinding, although non-specific, can be subtle indicators of pain in macropods.

In the majority of rescue cases, especially with signs of trauma, pain relief is **crucial** for the welfare of the animal. The provision of pain relief must be a priority and should be based on veterinary advice.

Depending on the assessment of injuries, and in consultation with a veterinarian, appropriate drugs can be administered to alleviate pain. Certain medications are avoided in case of adverse metabolic effects, especially in young developing animals. Therefore, once initially assessed, consultation with a veterinarian regarding the most appropriate drug and route of delivery is imperative. Ensure animals are hydrated before or in addition to the provision of certain medications to reduce the risk of adverse effects of the medication.

Nutrition

The composition of marsupial milk changes significantly during the different stages of development of the joey (Wombaroo Food Products 2020). This caters to the joey's requirements during development. Hand-reared joeys must be offered lactose-free milk substitutes appropriate to their stage of development. Hand-rearing also requires the use of specific equipment and techniques, i.e. using the correct teat size and shape, type, frequency and quantities of milk formula, knowledge of feeding technique, and sterilisation of feeding equipment.

It is vital that joeys are assessed and stabilised (dehydration corrected, temperature normalised) and medical intervention provided where necessary before initiating feeding. Following stabilisation, transfer joeys to an experienced macropod rehabilitator for continued care as soon as possible.

Hypothermia **must** be corrected, and joeys rehydrated, before feeding.

Wound care

Joeys with wounds should be assessed by a veterinarian to diagnose and treat the wounds appropriately. Depending on the severity of wounds, surgery or medical (antibiotic) therapy may be required.

Before veterinary assessment, superficial contaminated wounds can be flushed using lukewarm saline or topical disinfectants such as chlorhexidine or povidone iodine. Use a syringe with an 18-gauge needle attached to create pressure and direction when flushing.

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.

When using disinfectants, dilute solutions with saline and avoid flushing around the eyes or mouth (oral cavity). If chlorhexidine does get into the eyes, wash it out with saline immediately.

Bandaging

If wounds are oozing or wet (exudative), following flushing, bandaging can be applied to try and wick exudate away from the wound. Superficial dressings such as low-adherent, absorbent wound dressing (e.g. 'Melolin') can be applied and bandaged in place with layers of wound-care padding (e.g. 'Softban') and a cohesive bandaging material (e.g. 'Vet Wrap') to stabilise the bandage (Figure 9). Bandaging can also prevent desiccation, flystrike and further contamination of wounds. Ensure bandages are not constricting as this can disrupt blood supply and impair healing.

Bandages should be maintained clean and dry and should be changed if there is 'strike-through' – fluid from the wound wicking through to external bandaging layers.



Figure 9 Bandaging material commonly used for wound care ‘Melolin’ (left), ‘Softban’ (centre) and ‘Vet Wrap’ (right). Photo: Aditi Sriram/DPIE

Managing bleeding (haemorrhage)

For external bleeding wounds, apply pressure using gauze swabs and bandage with wound padding (e.g. ‘Softban’) and cohesive bandaging (e.g. ‘Vet Wrap’) to apply even pressure. Ensure the bandage is applying pressure but is not constricting, as this can impede blood supply and damage tissue below the bandaged area. If you can still pass a finger between the skin and the bandage, that is adequate pressure. For wounds that are in a location that cannot be bandaged, apply digital pressure using gauze swabs and hold the pressure for a minimum of three to five minutes.

If there is profuse blood loss from a wound, or the source of bleeding is from deeper tissues (e.g. muscle rather than superficial skin wounds), apply a bandage and contact a veterinarian as soon as possible for advice.

Fractures

Fractures are a common consequence of trauma (motor vehicle trauma, dog attacks). Joeys orphaned due to trauma-related incidents must be assessed for fractures and 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). Hindlimb fractures in macropods carry a poor prognosis due to their unusual locomotion and the mechanical forces placed on the macropod hindlimb, which in turn can result in complications during the healing and recovery stage.

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

Husbandry

Husbandry requirements for macropods in the initial period following rescue differ to requirements for macropods in longer term care, and should be adapted for each individual depending on its developmental stage, injuries and health status.

Adult macropods require specialised rehabilitation facilities and will likely require medical intervention (e.g. long-acting tranquilisers) to reduce stress and anxiety associated with captivity. This section refers to husbandry for pouch young and emerging joeys and provides guidelines on housing in the initial period following rescue. It is important to have the joey transferred to an experienced macropod rehabilitator as soon as possible.

Housing

Macropods should initially be housed individually, until they have had a thorough assessment by a veterinarian or experienced macropod rehabilitator. This functions as a period of quarantine to reduce the risk of disease transmission.

Macropods should be maintained in 'intensive care' housing for the initial 24 hours at least.

Joeys must be housed in a warm and quiet environment free from environmental stressors including loud noises, domestic pets, and noxious smells.

Pouch young are housed in artificial pouches mimicking the natural pouch environment as closely as possible. Artificial pouches consist of an inner liner (e.g. cotton) and an insulating outer layer (e.g. wool) (See Figure 10). Ensure there are no loose threads or seams on the inside of the pouch as this can result in entanglements or ingestion of threads.

Artificial pouches are generally suspended close to the ground, with the joey lying in a position mimicking the position in the mother's pouch. If musculoskeletal injuries are suspected, e.g. hindlimb or pelvic fractures, joeys should be housed lying flat in a padded, well-secured container (e.g. large crate). Keeping the crate covered and minimising noise is important for reducing stress.

The inner liner of the pouch should be changed regularly if soiled and pouches washed in unscented laundry detergent. It is important to ensure joeys are not disturbed or handled unnecessarily.



Figure 10 Macropod joey in an artificial pouch

Note the inner lining and insulating outer layer. Photo: Meredith Ryan/FAWNA

External heat sources (heat pads, hot water bottles) can be used to maintain temperatures appropriate to the developmental stage of the joey (see Table 1). Ensure heat pads and hot water bottles are not in direct contact with the joey to avoid burn injuries. Ambient temperature must be monitored regularly with a thermometer or thermostat.

Minimising stress

Pouch young are particularly vulnerable to the detrimental effects of stress, resulting in immune suppression and disease (McCracken 2008). Excessive handling, exposure to humans and domestic animals, and exposure to unfamiliar environments must be minimised while the joey is in care.

5. Common rescue encounters

Trauma

Trauma is the most common reason requiring rescue of macropods in New South Wales (DPIE 2020). Trauma can be related to a range of incidents such as motor vehicle trauma, dog attack and fence entanglement. The majority of cases of trauma are fatal. Where this is not the case, the welfare of the animal and the probability of successful recovery to release must be considered.

Follow the basic principles for initial stabilisation (as set out above). After a traumatic incident, the majority of animals will be in shock. Therefore, following an initial assessment, it may be useful to allow the animal to rest in a warm, quiet location while preparing for treatment. If there are severe injuries requiring immediate medical attention, treatment should not be delayed, and the animal referred for veterinary care as soon as possible.

Motor vehicle trauma

Head trauma

Animals with head trauma may display a variety of clinical signs and 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 include:

- blood from the nostrils, mouth or ears
- abnormal or irregular pupil size, indicating injury to the brain or nervous system
- head tilt or incoordination, inability to stand.

Spinal fractures

Spinal fractures are a common result of trauma in macropods and are diagnosed by radiography. Macropods are particularly predisposed to cervical (neck) fractures due to their skeletal anatomy and poorly developed neck muscles (McLelland 2019). Spinal fractures usually result in collapse, or paralysis of one or more limbs. The consequences of spinal injuries are severe and if the victim survives the initial trauma, euthanasia is usually indicated.

Skull or jaw fractures

Drizzling from the mouth or blood in and around the mouth, nostrils or eyes can be a common presentation of skull fractures. Macropods with jaw fractures may have a malaligned jaw or hold their mouth open. Radiographs or more advanced imaging techniques are required to accurately assess suspected fractures of the skull or jaw, therefore assessment by a veterinarian is necessary. Broken or missing teeth, especially incisors, carry a poor prognosis and must also be assessed by a veterinarian.

Haemorrhage

Check for signs of external bleeding. Additionally, the following signs might 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 (see Figure 11).

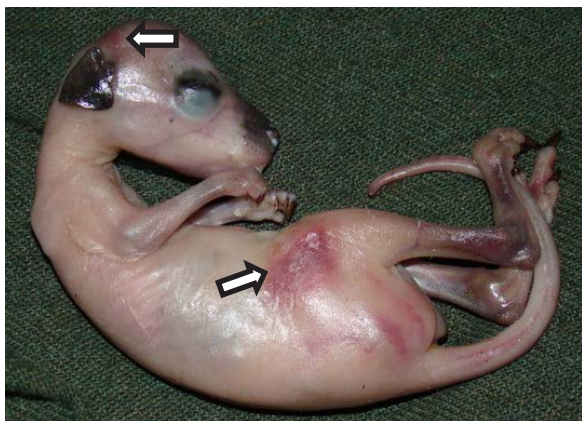


Figure 11 Macropod joey rescued from the pouch of a female following motor vehicle trauma

Note the bruising around the head and hindlimb (white arrows). Photo: Joan Reid/DPIE

Limb fractures and dislocations

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

Immobilising a fracture, by bandaging or confinement, is vital to reduce pain and tissue trauma.

Pouch young can be immobilised by housing in a confined, cushioned carrier. The patient should be assessed by a veterinarian as soon as possible and kept confined, within minimal handling, until then. Adult macropods with fractures or dislocations generally carry a grave prognosis and euthanasia is recommended in most cases as the stress of capture, confinement and treatment often results in poor outcomes for the animal.

Open fractures (where the fractured bone is exposed) are at increased risk of infection and other complications and carry a grave prognosis. Animals with open fractures should be taken to a veterinarian for assessment as soon as possible. In the interim, again, ensure the patient's mobility is restricted.

Fence injuries

Injuries resulting from fence entanglements are common in macropods (See Figure 12). Rescued macropods will require a thorough assessment of the severity of injuries following rescue and in the majority of cases will require a protracted course of treatment and care. Common injuries associated with fence entanglements include lacerations, tendon injuries, neurological dysfunction, dislocations and myopathy (Austen 2008).

Macropods will require sedation, and anaesthesia for large adults, to allow for restraint and assessment. Veterinary support for chemical restraint, evaluation and treatment (IV fluids, pain relief, wound care) will be required and preparations should be made before rescue. Severe injuries in larger adult macropods will likely require euthanasia on site.



Figure 12 Macropod entangled in a barbed wire fence. Photo: Diana Woodward/DPIE

Dog attack

Internal injuries are often more severe than they appear to be externally. Often the only noticeable signs will be saliva staining of the fur, but on more thorough assessment, puncture wounds or grazes may be identified. Superficial injuries might appear minimal, however, injury to deeper structures such as muscle, bone or joints may be severe. In animals with bruising or wounds around the chest or abdomen, internal injuries must be assessed, and this usually requires veterinary assessment and advanced imaging techniques (e.g. radiographs or ultrasound). Severe dog attack injuries generally require surgical and antibiotic treatment prescribed by a veterinarian.

- Ensure a thorough physical examination has been performed once the animal is stabilised, and part fur to check for puncture wounds and bruising.
- Dog bite wounds are contaminated wounds and require antibiotic treatment. Antibiotics need to be prescribed by a veterinarian, and the choice of medication and duration of treatment will depend on the severity and extent of injuries.
- Flush and treat external wounds as described in 'Wound care' in Section 4.

Burns

Rescuer safety is vital when working in fire grounds. Information about safety, logistics and training required for rescues on fire grounds is outside the scope of this document. Coordination with relevant authorities before accessing firegrounds is advised. Only qualified personnel with appropriate training should attend to rescues on fire grounds.

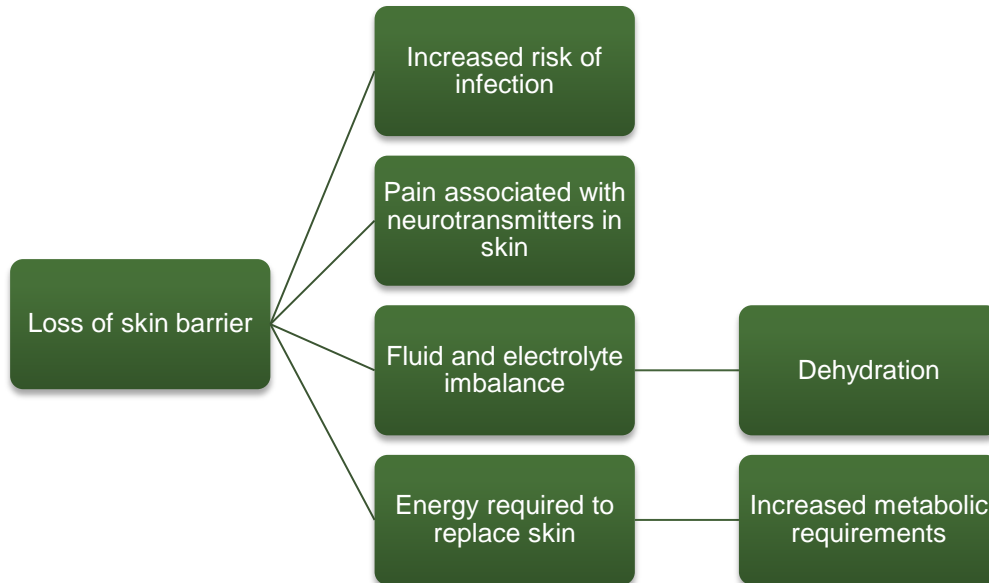


Figure 13 A brief outline of the pathology of burns

Burn injuries should be classified based on their severity, location 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. Capture myopathy from exertion and stress is one of many concurrent complications seen in macropods with burns injuries.

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.

Depth of burns

The classification of the depth of burns can be subjective depending on the experience of the person assessing the patient. Table 2 provides some guidance on classifying burns as superficial, partial or full thickness burns.

Extent and location of burns

Veterinary consultation is recommended to determine prognosis based on the extent and location of burn injury in macropods.

- Significant burns to the face or feet carries a poor prognosis and euthanasia must be considered.
- In macropods, the feet, and in most species the tail, are important weight-bearing surfaces. It is difficult to immobilise these areas to allow healing and this must be considered especially when working with larger species of adult macropods. Scarring

and deformity can lead to permanent dysfunction and the deeper tissues, including bone, may become progressively devitalised.

- Burn injuries require intensive wound care and veterinary oversight, and in adult macropods, this requires repetitive captures and immobilisation for treatment. For these reasons, and following assessment, most adult macropods will require euthanasia on site.

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.

Table 2 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 (dead tissue) 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

Stabilising the patient

Following classification of the burn injury, veterinarians or experienced macropod rehabilitators should be contacted to discuss how best to stabilise the animal before transfer to a specialist facility. General guidelines for stabilising macropods 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. IV fluids administered by a veterinarian is the recommended route of rehydration. If not possible, provide oral fluid replacement.
- For burns to the eyes or face, flush the eyes or face with tepid saline.
- 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. 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 create a humid chamber.

- Recovering from burns markedly increases metabolic requirements, therefore nutritional support is important. Appropriate diets should be provided to macropods based on their species and life-stage. In severely affected animals, additional veterinary intervention such as the placement of a feeding tube may be required to ensure nutritional support is provided. In many cases, this may not be feasible 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.

Treating burn wounds

- Treatment should be undertaken only once the patient is stabilised. This may be 24 hours after initial presentation. Sedation and pain relief are primary considerations in macropods with burn injuries.
- Wear gloves when handling burn injuries to reduce the risk of wound contamination.
- Prepare the required bandaging equipment beforehand so treatment can be performed quickly and efficiently.
- Flush burns with lukewarm saline to remove debris and gently pat dry. Apply topical treatments such as 'Solosite', 'Acticoat' or 'Flamazine' (silver sulfadiazine) to wounds and bandage to protect wounds from further trauma, prevent desiccation and relieve pain from exposed nerve endings. Ensure bandages are not too tight or constricting, and when bandaging weight-bearing surfaces (hindlimbs) ensure bandages are well-padded. Bandage wounds with a low-adherent, absorbent dressing such as 'Melolin' as the primary dressing then use a padded bandaging material ('Softban') and a cohesive bandage ('Vet Wrap') as consecutive layers.

In most cases, sedation or anaesthesia is required to perform bandage changes, therefore following initial stabilisation, transfer to a veterinary facility is advised. A veterinarian can confirm the severity of burns and determine the requirement for sedation or anaesthesia and frequency of bandage changes (which may be as frequent as once every two to three days).

Orphaned joeys

Joeys requiring care are commonly rescued from injured or deceased females, due to misadventure, or may be rescued from members of the public. It is not uncommon for joeys to be cared for by a member of the public before being brought to a licensed wildlife rehabilitator. In all cases, collecting a thorough history about the orphaned joeys is vital as it informs and directs the health assessment of the joey.

Along with a physical assessment, the species and developmental stage of the joey must be accurately identified (see 'Physical examination' in Section 2) to guide decision-making regarding viability of the joey.

Following initial rescue, long-term care of joeys should be undertaken by or directly supervised by experienced wildlife rehabilitators as it is an intensive process requiring experience and time commitment. Aim to contact an experienced wildlife rehabilitator as soon as possible for advice on husbandry, feeding and care of joeys until the animal can be transferred.

Rescued joeys with a history of poor husbandry and diet may present with gastrointestinal, respiratory or dermatological disease. Inappropriate or inadequate nutrition can result in diarrhoea, lethargy, dehydration and in some cases cataracts (Campbell-Ward 2019). Inappropriate feeding technique can result in aspiration (inhalation of formula or food) and respiratory illness, presenting with lethargy, increased respiratory rate and effort, and nasal

discharge. Pouch young can develop scaly, dry skin and secondary skin infections as a result of inappropriate pouch environment or malnutrition. A thorough history is vital in such cases and veterinary referral is recommended for further diagnosis and treatment.

6. Quarantine and managing infectious disease

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

Treat all macropods 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 macropod rehabilitator.
- If an animal shows any signs of disease (sneezing, coughing, diarrhoea, skin lesions, unusual behaviour), it must be quarantined and managed as potentially infectious until assessed by a veterinarian.
- Animals in quarantine must have their own 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.
- 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, alcohol-based hand sanitiser, dust mask, eye protection (see 'Personnel safety' in Section 2).

Glutaraldehyde or chloramine-based disinfectants (or 'F10') should be used to clean equipment and enclosures between animals. Let disinfectant soak for 5 to 10 minutes before rinsing it off.

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 transmissible from animals to humans. As a group, wildlife rehabilitators are at increased risk of zoonotic disease due to regular and close contact with wildlife (Hulst 2019). Knowledge of the disease, appropriate PPE, hygiene practices, and vaccination where available, are vital in reducing the risk of disease transmission. Zoonotic diseases of specific importance to macropods are listed below. Further information can be found on the DPI website: [Zoonoses – animal diseases that can infect people](#).

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 macropods: Macropods 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 Ministry of 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, handling faeces or biological materials from macropods (NSW Ministry of Health 2019) should also be employed, however, these are not adequate alternatives to vaccination.

Salmonellosis

Transmission: The bacteria is shed in faeces and can be contracted through direct contact or indirect contact through fomites (objects or material likely to carry infection, e.g. clothing, utensils).

Symptoms in macropods: Most animals that shed salmonella are asymptomatic. In some macropods that show clinical signs, these are non-specific and can include diarrhoea, lethargy and anorexia (Wildlife Health Australia 2017).

Symptoms in people: Symptoms can include nausea, vomiting, diarrhoea, fever, and abdominal pain and cramps.

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

Dermatophytosis (ringworm)

Transmission: Transmission can occur through direct contact or via fomites.

Symptoms in macropods: Affected animals will have well-demarcated areas of hair loss, redness and flaking of the skin and should be assessed by a veterinarian. Animals without any skin lesions can also be carriers of the fungus (Hulst 2019).

Symptoms in people: Symptoms include redness and flaky lesions on the skin, in areas which have contacted the fungus.

Prevention: Personal hygiene and appropriate PPE (gloves) are necessary when handling animals with suspicious skin lesions.

8. Record keeping

Accurate records must be maintained to track the progress and outcomes for macropods in care. If the macropod 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 contact details of people involved
- individual identification of macropod – species, stage of development, sex, identification (e.g. microchip or tag) if present
- initial physical examination findings
- daily notes – including treatments provided, progression or development of symptoms, weight, food intake, faecal output etc. Maintain record sheets while the macropod 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 euthanised, or if the animal died while in care.

9. References and further reading

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Appendix A

Table 3 Developmental milestones for macropods based on age factor
(Modified from Milk Replacers and Food Supplements for Native Animals, Wombaroo Food Products 2020.)

Age factor	Stage of development	Nutritional considerations
0 (birth)	Eyes closed; front legs developed; buds for hind legs.	Low energy milk, with a low fat content. Digestive system is not well developed – milk contains easily digested carbohydrates and proteins. Immunoglobulins to boost immune system. Limited gut flora.
0.2	Eyes closed; ears folded flat on top of head; ear-canal closed; membrane joining lip; small hole at front of mouth for teat; hind legs formed.	
0.3	Membrane between lips has disappeared; whiskers growing. Runny yellow faeces.	
0.4	Eyes still closed; ears still flat but starting to become upright; animal fully formed.	
0.5	Eyes now open; dark colouring on back of hands, bridge of nose, tips of ears; fur about to come through skin; poking head out from pouch occasionally. Faeces yellow custard to toothpaste consistency.	
0.56	Fur colour visible under skin on entire body; fur forming on bridge of nose and head.	Steadily increasing energy content of milk. Protein contains sufficient levels of sulfur-containing amino acids (cysteine and methionine) for the onset of hair and nail growth. Still limited gut flora.
0.6	Fur lengthening rapidly all over the body; fur appears last on belly/chest; leaning from mother's pouch and eating dirt to establish gut flora, starting to thermoregulate. Faeces darkening and forming.	
0.7	Joey grazing from pouch making use of green feed; secondary coat appearing, the animal looks like a miniature adult. Faeces soft to firm green pellets.	Peak carbohydrate content in milk with high levels of associated digestive enzymes. Able to handle higher fat levels in milk.
0.8	Joey starting to emerge from the pouch; spends longer and longer periods outside the pouch; feeding, urinating, defecating outside the pouch.	
0.9	First incisor teeth erupting through gum; full length fur growth.	
1.0	Joey fully emerged from the pouch; still drinking milk; solid food plays a large part in the diet.	