NSW GOVERNMENT

Department of Planning, Industry and Environment

Initial treatment and care guidelines for rescued flying-foxes

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Cover photo: Grey-headed flying-fox (*Pteropus poliocephalus*) adult with pup. Janine Davies/WRSC

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1. Introduction

The purpose of this document is to standardise the initial treatment of flying-foxes requiring rescue or rehabilitation, in line with the Code of Practice for Injured, Sick and Orphaned Flying-foxes (the Flying-fox Code) (DPIE 2021).

Understanding that each case is different and should be assessed individually, this document aims to guide licensed wildlife rehabilitators in New South Wales on assessment and first aid treatment principles for flying-foxes first presenting for care.

> 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 flying-foxes.

Three species of flying-foxes occurring in New South Wales are grey-headed flying-foxes (*Pteropus poliocephalus)* (listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999)*, black flying-foxes (*Pteropus alecto*), and little red flying-foxes (*Pteropus scapulatus)*, both are not threatened, but are protected species under the *NSW Biodiversity Conservation Act 2016* (BC Act*)*.

This document advises on the initial care and management of flying-foxes following rescue, from capture to physical examination, initial stabilisation and treatment before presentation to a veterinarian. It advises on how to manage the more common rescue encounters in flying-foxes including trauma, heat stroke, burns, orphaning and starvation.

Safety first

Before considering handling flying-foxes, rescuers should be aware of possible safety risks and take necessary precautions to minimise harm to themselves and the animal. Sick, injured and dead wildlife can cause injury, 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.
- Rescue and handling of flying-foxes must be undertaken only by rabies-vaccinated individuals (as outlined in the NSW Department of Health guidelines) wearing appropriate PPE.
- Use PPE as a barrier where possible – wear gloves (preferably double-nitrile gloves), arm gauntlets or use a towel as a barrier.
- Wear a dust mask if available, particularly if the animal is showing signs of disease – this is important to reduce the risk of disease transmission from humans to flying-foxes.
- Wash your hands before and after handling animals and removing gloves, or use alcohol-based hand sanitiser (> 60% alcohol).
- If bitten or scratched, or in the event of other significant contact with a flying-fox, seek urgent medical attention and report to NSW Health on 1300 066 055. While waiting on medical assistance, wash any wounds thoroughly with soap and water for at least five minutes and apply a virucidal antiseptic (e.g. ‘Betadine’) after washing. If saliva enters

the eyes, nose or mouth, the area should be flushed thoroughly with water for 5 minutes (NSW DPI 2019).

Australian bat lyssavirus

Australian bat lyssavirus (ABLV) is a zoonotic virus closely related to the rabies virus. It is a significant health concern as it causes acute and fatal infection in people. Bats are natural hosts for the virus, and ABLV infections have been detected in all mainland flying-fox species in Australia (WHA 2019).

ABLV can be transmitted from bats to humans and between animals by the saliva of an infected animal introduced through a bite or scratch, or by contamination of mucous membranes or broken skin.

ABLV infection in bats is not always associated with clinical signs. Clinical signs in bats, which should raise suspicion of ABLV infection, include:

- abnormal behaviour – excitation, frenzied behaviour, aggression
- muscle weakness, inability to fly, loss of hindlimb function
- generalised trembling and seizures
- abnormal mouth function and unusual vocalisation
- respiratory difficulty.

All bats, regardless of their age or clinical signs, should be handled as if potentially infected with ABLV.

The use of appropriate PPE is essential for anyone handling bats. For detailed information on PPE for bat handlers, refer to the Wildlife Health Australia publication Personal Protective Equipment (PPE) for Bat Handlers.

Note: there is no guarantee that being vaccinated and having adequate titres offers complete protection against ABLV. For this reason, it is imperative that all bites, scratches and significant contact with a flying-fox should be reported to NSW Health and urgent medical attention sought.

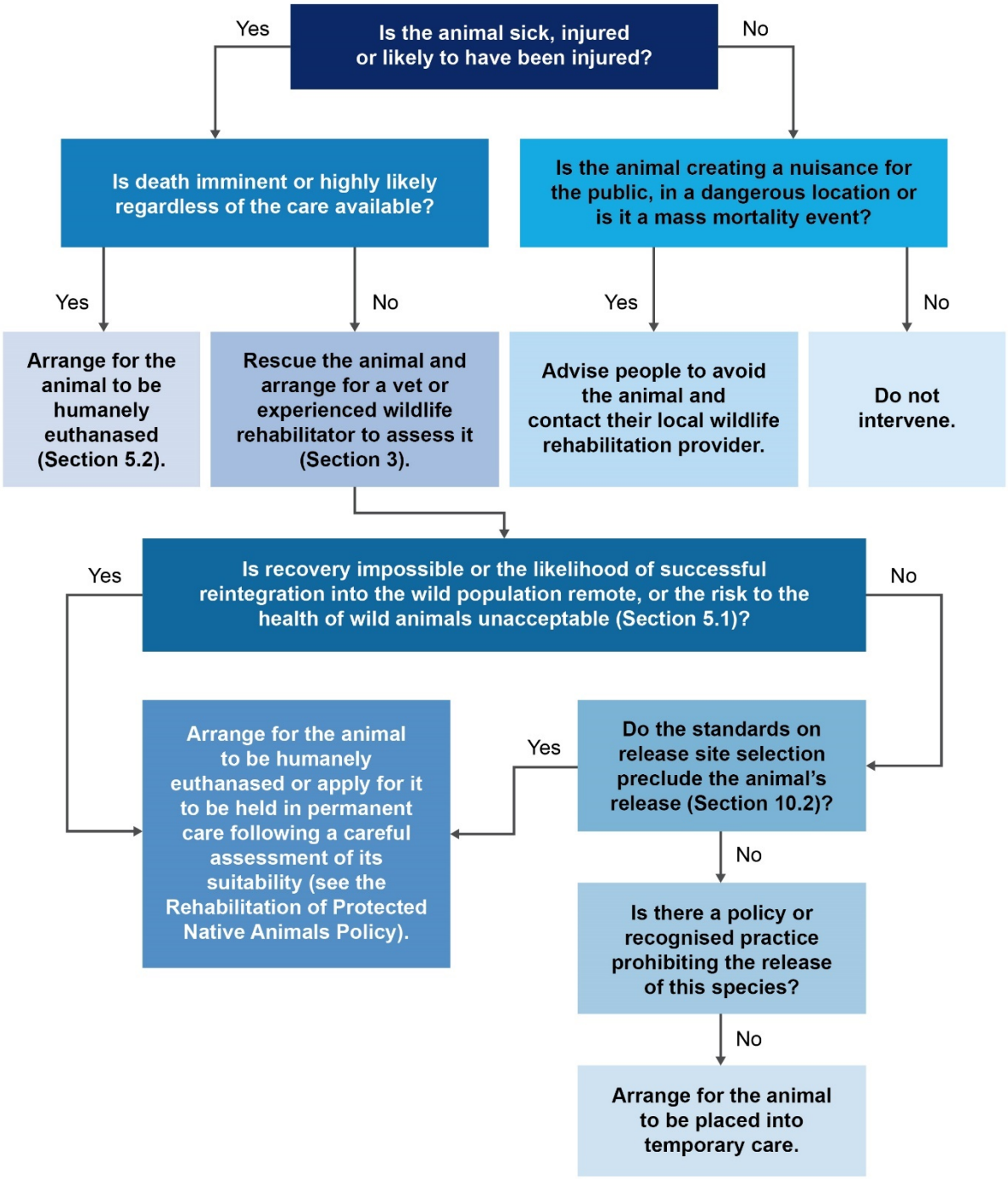

Figure 1 **Decision tree directing the course of action for flying-fox rescue encounters**
(From the Flying-fox Code. Section numbers refer to numbering used in the code)

2. Capture, restraint and transport of flying-foxes

As outlined in the Flying-fox Code, rescuers must arrange to have the flying-fox assessed by a wildlife veterinarian or experienced flying-fox rehabilitator within 24 hours of rescue to establish an accurate diagnosis and provide the best outcomes for the patient.

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

Distance examination

When attending a flying-fox rescue, conduct an initial distance examination to assess the situation and inform decisions on the type of intervention required. If you are unsure whether you should proceed with a rescue, seek the advice of an experienced flying-fox rehabilitator or wildlife veterinarian to better understand the risks and benefits of carrying out a rescue.

> When rescuing a flying-fox in a camp, the rescuer must consider the impact of the rescue on the entire camp (Flying-fox Code). During the distance examination, rescuers should assess the feasibility of capture as well as consider the outcomes of rescuing a few flying-foxes in a camp which may risk the lives of far more in a camp, especially during extreme heat events.

Flying-foxes should be observed from a safe distance for normal behaviours, signs of pain or distress, and any obvious wounds or injuries. Binoculars allow monitoring from a safe distance. A healthy wild flying-fox will be alert and have bright eyes and ears that are constantly changing direction. Flying-foxes will generally fly away when approached or disturbed by people. A flying-fox found alone and low in the tree during the day is not considered normal behaviour and requires investigation.

The safety to personnel as well as to other flying-foxes in a camp must always be considered when deciding to attempt a rescue or continue to monitor the animal and get advice or help. For example, the rescue of a lone orphan flying-fox can safely be undertaken alone, whereas rescuing an adult flying-fox from barbed wire or netting should involve two people trained in this method of rescue. Some flying-foxes with severe injuries may require euthanasia on site.

Attending to deceased flying-foxes

Entanglement and orphaning are two common scenarios requiring rescue of flying-foxes (DPIE 2020). A high percentage of these incidents may result in mortality or require euthanasia due to the severity and duration of injury.

When communicating with members of the public regarding dead flying-foxes, they must be instructed not to touch the flying-fox. Flying-fox carcasses pose a risk of ABLV transmission. If concerned about public safety, and if safe to do so, a member of the public can cover the bat with a clothes basket or box to prevent human or animal contact until a wildlife rehabilitator can attend to the rescue.

When dealing with mass casualty events, rehabilitators must notify the NSW National Parks and Wildlife Service (NPWS). With a mass mortality, the NSW Environment Protection Authority (EPA) must be contacted to arrange carcass disposal.

If a dead female has signs of active teats, examine the surrounding area for a pup. Pups older than 3 weeks may be in creche groups. If the creche location is known, where possible check over consecutive days for an alone distressed pup.

Capture of flying-foxes

The capture of flying-foxes must be performed by appropriately trained people and only by vaccinated individuals who have followed the NSW Department of Health guidelines for vaccination and boosters (Flying-fox Code).

> Personnel safety and animal welfare are primary considerations when undertaking flying-fox rescues.

If rescue is indicated, before attempting the rescue assess the appropriate capture technique, possible effects on other flying-foxes in the camp, equipment required, and the safety of the animal and personnel. Ensure the required equipment and facilities to transport and house the animal are organised before the rescue.

The additional stress resulting from handling and restraint can be detrimental to an injured flying-fox. To prevent additional stress and improve chances of recovery, rescuers should:

- avoid capture in hot weather
- avoid prolonged pursuit of flying-foxes
- reduce stressors – loud noise, onlookers, excessive and prolonged handling
- provide rehydration following rescue and prior to transport. Administration of fluids at the time of rescue and handling appears to aid recovery (Olsson & Woods 2008). See ‘Fluid rehydration’ in Section 6 for details on administration of fluids. Planning and preparation are vital to ensure capture of flying-foxes is efficient with minimal stress to the animal.

Considerations before rescue of adult flying-foxes include:

- **environmental conditions** – ambient temperature, topography, access to the animal, hazards (e.g. moving traffic)
- **severity of injury** – adult flying-foxes with severe injuries (e.g. obvious hard palate fractures, extensive membrane damage or multiple compound fractures) may require euthanasia on site. Ensure an experienced flying-fox rehabilitator can be contacted to assist with assessment
- **available facilities** – flying-foxes require specialised facilities for housing. Availability of resources and facilities for rehabilitation must be considered when rescuing adult flying-foxes
- **trained personnel and equipment** – rescued flying-foxes require first aid (e.g. fluid therapy) soon after rescue. Ensure personnel, equipment and veterinary support are available before starting the rescue.

Methods of capture

Hand capture is useful for brief handling, to place the animal in a transport container, to administer anaesthetics or sedatives and for brief examinations. For a thorough examination, sedation or anaesthesia is recommended to reduce stress associated with prolonged handling.

Hand capture

Flying-foxes can be restrained by wrapping them with a towel. Before attempting capture, ensure you are equipped with the appropriate PPE (see ‘Safety first’ in Section 2).

Approach the flying-fox calmly and confidently. Wrap the towel around the flying-fox and hold the towel closed with one hand (Figures 2, 3 and 4). Slightly twist the towel below the flying-fox’s head and fold the extra towel up so it is positioned at the level of the animal’s head. While supporting the flying-fox’s body, gently detach the feet from its hold and allow the flying-fox to grasp your hand with its hind claws. Once the flying-fox is restrained, different parts of the body can be carefully unwrapped for examination (see Section 4 ‘Physical examination’).

Following capture, the towel wrapped flying-fox can be placed into a transport container and the towel gently withdrawn while allowing the flying-fox to orient itself (Olsson & Woods 2008).

Figure 2 **Towel wrapped around the flying-fox and held closed with one hand (left), towel then twisted and folded at the level of the animals head (right)**

Photos: Mandi Griffith

Figure 3 **Flying-fox wrapped in a towel and held against the body to provide support (left), with feet allowed to grasp the hand to provide security (right)**

Photo: Mandi Griffith

Figure 4 **Flying-fox restrained in a towel while the wing is exposed for examination**

Photo: Mandi Griffith

Chemical immobilisation

Sedatives and anaesthetics with rapid induction and very large safety margin are recommended to facilitate rescue and capture in flying-foxes. Brief restraint is required to deliver injectable drugs or inhalational anaesthetics. This must be performed by a veterinarian or under the direct supervision of a veterinarian.

Transport

Flying-foxes must be transported in secure carriers appropriate for their condition, 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). Never wrap flying-foxes rescued due to extreme heat, as this will exacerbate hyperthermia.

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

The container must be designed to prevent the flying-fox from escaping or allowing claws or teeth to protrude. Pet carriers wrapped with a soft, light fabric (e.g. cotton) or shade cloth secured to the container are suitable.

The transport container must be tall enough for the flying-fox to hang by its feet without its head touching the floor. Padding must be included to prevent exacerbating injuries or wounds and to prevent excessive movement during transport. Injured animals can be placed in a sling for support, ensuring their feet are positioned higher than the head.

Ideally, transport flying-foxes individually to reduce the risk of disease transmission. There have been outbreaks of ABLV when multiple juveniles have been transported together with an ABLV-infected flying-fox.

Orphaned dependent flying-foxes must be wrapped and secured on ‘mumma rolls’ (Figure 5) and placed in a sling or in the transport cage with feet positioned higher than the head. When dealing with mass abandonment, it is not always possible to individually transport orphaned flying-foxes. They can be transported together but need to be closely monitored to ensure they are secure and do not injure one another during transport.

Figure 5 Orphaned dependent flying-foxes secured in ‘mumma rolls’
Photo: Jacqui Maisey/NTWC

Table 1 **Ambient temperatures to be maintained during transport of flying-foxes** (adapted from the Flying-fox Code)

	Ambient temperature
Premature flying-foxes or animals in very poor condition	29–31°C
Juvenile	28°C
Adult	25–27°C

3. What makes an injured flying-fox a unique challenge?

As flighted mammals, flying-foxes rely on their well-developed pectoral muscles for flight. Their pectoral muscles generate twice the heat of any non-flighted mammal during exercise. Flight is extremely energetically expensive and produces much metabolic heat.

As a result, sick, injured or orphaned flying-foxes are at an increased risk of:

- dehydration – living on an almost fluid diet, flying-foxes have little need to conserve water, have a limited ability to concentrate urine and when challenged by a shortage of water, readily become dehydrated
- heat stroke – high metabolic rate and high energy outputs combined with the inability to sweat makes flying-foxes particularly susceptible to heat stroke. Struggling against restraint can trigger heat stroke even at relatively cool ambient temperatures
- low blood glucose (hypoglycaemia) – high metabolic rate also means they use glucose stores quickly and can become hypoglycaemic from exertion, stress or insufficient food supply
- myopathy (disorder of the muscles) – flying-foxes are adapted to long-distance flight. When they struggle or produce powerful short bursts of flight, they can develop myopathy and consequent metabolic compromise.

Many of these factors make rescuing and rehabilitating flying-foxes very challenging. Understanding the physiological processes occurring in injured flying-foxes can guide the early choices made in rescues and care, and contribute to rehabilitation and release back into the wild.

4. Physical examination

Following initial assessment and stabilisation (see Section 6 ‘Initial treatment – stabilisation’), the rehabilitator must aim to have the flying-fox assessed by a veterinarian or an experienced flying-fox rehabilitator within 24 hours of rescue. When the animal cannot be physically assessed, the rehabilitator should contact a veterinarian or an experienced flying-fox rehabilitator on the phone for advice on continued care of the patient until it can be transported.

A detailed examination, investigating the parameters described below, provides an overall health assessment necessary to determine treatment needs and prognosis. While progressing through the physical examination, ensure to take notes and keep records (see Section 9 ‘Record keeping’). It is recommended to have two people assisting with handling and examination when assessing flying-foxes, to ensure safety during the procedure and reduce stress to the flying-fox.

Physical examination should be thorough while minimising stress to the animal. Handling should be tailored to each animal based on its health status and temperament.

It is useful to maintain a routine when working through a physical examination. This ensures no information is missed and all necessary assessments are completed.

Juvenile flying-foxes are best examined while on a mumma roll, unwrapping and exposing parts of the body for examination, while keeping the flying-fox pup feeling as secure as possible.

During the physical examination, if the flying-fox is distressed, place the animal back in the transport carrier and contact a veterinarian or experienced flying-fox rehabilitator for advice.

Demeanour and behaviour

Observe the behaviour and demeanour of the animal during the physical examination and compare with what is expected based on its stage of development and condition.

A bright and alert flying-fox will be attentive, with ears up, and reactive, eyes moving normally, and pupils seeming to be the same size and reacting to light. Animals showing abnormal behaviour should raise suspicion of ABLV infection (see ‘Safety first’ in Section 2).

Although understanding normal behaviour in flying-foxes requires experience, observations from the initial physical examination can be used to discuss the animal’s condition with experienced flying-fox rehabilitators and as a comparison throughout rehabilitation.

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 veterinary intervention.

Body condition and body weight

Body weight is an important indicator of health. Body weight must be recorded soon after rescue, and will provide a baseline for each animal. Regular weighing throughout rehabilitation provides valuable information on the animal’s health and development.

Body condition is a subjective assessment and can be determined by palpating pectoral (chest) muscle mass. Body condition can be graded on a scale of one to five (Table 2).

Table 2 Guide to body condition scoring flying-foxes

Body condition score	Condition	Pectoral muscle mass
1	Severely emaciated	No palpable muscle over sternum (breast bone)
2	Poor	Minimal palpable muscle, sternum visibly prominent
3	Thin	Moderate muscle mass, easy to palpate sternum
4	Healthy	Good muscle mass, sternum less pronounced on palpation
5	Obese	Prominent muscle mass, moderate subcutaneous fat, difficult to palpate sternum

Determining age

Forearm length is used to estimate age in flying-foxes (see Table 3). Forearm length is measured from the elbow to the wrist using callipers (Figure 6). To maintain consistency with measurements, always use the right wing where possible.

Determining age is vital as it directs consideration of husbandry requirements and prognosis for each animal.

Comparing an animal's weight in relation to its age indicates its condition. For example, a flying-fox with a 63-millimetre forearm measurement would be estimated to be 4 days old. If this animal weighed only 88 grams it would be considered underweight for its age.

Figure 6 **Measuring flying-fox forearm length using callipers**

Photo: Mandi Griffith

Table 3 **Forearm length and weight in relation to age in one- to 4-day-old flying-foxes**

Note: these estimates relate to black and grey-headed flying-foxes.

Age (days)	Forearm length (mm)	Weight (g)
1	57	85
2	58	88
3	60.5	90
4	63	93

Adapted from Wimberley & McNeill (2010)

Sex

Males have prominent testicles and a penis. Determining reproductive status in females can be difficult. Pregnant females can sometimes be identified based on size and development of mammary glands, but this can be difficult to identify.

Hydration status

It is safe to assume that most rescued flying-foxes will be dehydrated to varying degrees. A combination of assessments can be used to estimate hydration in rescued flying-foxes (see Table 4). Parameters include:

- eye position – dehydrated animals may have slightly sunken eyes. Severe dehydration can result in corneal ulcers (open sore on the cornea)
- skin or membrane elasticity – dehydrated animals may have dry or wrinkly skin, and when gently pinched to lift or tent the skin it will be slow (taking more than one second) to return to normal position
- mucous membrane moisture and gum capillary refill time (CRT) – as animals become dehydrated, mucous membranes (e.g. gums) become tacky and dry. Lift the lips and assess the gums (see Figure 7). CRT can be assessed by placing digital pressure on the gums to cause blanching and assessing the time it takes for pinkness to return. Normally colour returns within 2 seconds after withdrawing your finger. Ensure the handler is wearing gloves and the animal is adequately restrained to prevent injuring the handler.

Table 4 Parameters to assess hydration in flying-foxes

	Mild dehydration (up to 5%)	Moderate dehydration (5–10%)	Severe dehydration (> 10–15%)
Eye position	Normal to slightly dull	Slightly sunken and dull	Dull and sunken, may have ulcers
Skin/membranes	Slightly inelastic	Inelastic, delayed skin tenting	Delayed skin tenting, tacky membranes
Gums	Normal (glisten) to slightly pale and slightly tacky	Pale and tacky	Pale and tacky
CRT	< 2 seconds	> 2 seconds	> 2 seconds
Demeanor	Bright, alert	Quiet, dull	Depressed, minimally responsive

Figure 7 Assessing flying-fox mucous membranes

Note the gums are moist (glisten) and pink. Photo: Tania Bishop

Eyes, ears and mouth

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. Constantly dilated pupils or irregular pupil size can indicate blindness, neurological dysfunction (head trauma) or systemic illness.

Examine the ears for wounds or discharge. Ears should be constantly moving and upright.

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.

Oral examination and dentition

Adult flying-foxes can sustain injury to the mouth and hard palate from barbed wire entanglement. Congenital abnormalities such as cleft palate have also been identified in juvenile flying-foxes.

Assess the oral cavity, including hard palate and teeth for asymmetry or injury. Approach dental examination with care, as fractures or trauma can be painful. A plastic syringe can be used as a tool to gently open the mouth for examination. A thorough examination of the mouth and dentition may require sedation, veterinary expertise and equipment.

Tooth wear can indicate age. Tooth wear progresses with age, and aged animals with almost no teeth and in poor body condition have a poor prognosis for return to the wild (Figure 8). In young animals, teeth can be worn if the animal has relied heavily on food such as cocos palms due to malnourishment.

Figure 8 Oral examination of a flying-fox showing severe tooth wear

Note also the pale mucous membranes. Photo: Mandi Griffith

Limbs and wings

Carefully examine the wings and limbs for wounds, obvious fractures, asymmetry or abnormalities. Rehabilitators should try to assess if each limb can grip firmly and note whether there is any paralysis of limbs.

Assess the wing membranes for lacerations, abnormal colour or texture or injury. Assess the joints for swelling, which could indicate infection or dislocation.

Figure 9 Flying-fox with a swollen carpus (wrist) with erosive wounds

Photo: Mandi Griffith

Body temperature

Determining body temperature in flying-foxes can be difficult due to small body size and restraint required. Rectal temperature is assessed by inserting a lubricated thermometer into the rectum. This should be performed by experienced persons. Normal body temperature in flying-fox pups is between 37.5ºC and 38ºC. Normal body temperature in adults is usually maintained between 36ºC and 37ºC, as adult flying-foxes use specialised cooling mechanisms to regulate body temperature (McNab et al. 2001).

Juvenile flying-foxes with a rectal temperature of 36ºC or below require immediate attention and provision of warmth and glucose (see Section 6 ‘Initial treatment – stabilisation’). If a flying-fox’s body temperature is 41.5ºC or higher it has likely undergone irreparable damage, and euthanasia should be considered as the prognosis for recovery is poor.

Faeces and urine

Assess the quantity and quality of faeces and urine. Urine should be clear to pale yellow. Abnormal colour or consistency of faeces can indicate stress, infection, parasites or gastrointestinal dysfunction. Refeeding syndrome can present in malnourished flying-foxes that begin feeding after a period of starvation. It is commonly seen in juveniles and signs include undigested food in faeces. Dark, malodourous faeces can be associated with damage to the lining of the gastrointestinal tract which can occur after heat stroke (see ‘Heat stroke’ in Section 7) or infection.

Refeeding syndrome occurs when too much food or nutritional supplement is eaten during the first four to seven days following a period of malnutrition. It results from a potentially fatal shift in electrolytes and fluids associated with metabolic abnormalities in malnourished animals undergoing refeeding.

Monitor for signs of straining associated with defaecation or urination. Look for protrusion of the rectal lining (prolapse), which can result from straining. Flying-foxes with rectal prolapse should be presented to a veterinarian as soon as possible as early treatment of the underlying cause, pain relief and treatment of the prolapse is vital.

5. Euthanasia

As stated in the Flying-fox Code, a flying-fox must be euthanased when death is imminent or highly likely regardless of the treatment provided, the animal is suffering from chronic unrelievable pain, the animal is carrying an incurable disease that poses a health risk to wild animals, or its ability to consume food unaided is permanently impaired. The Flying-fox Code, including the decision-making tree (Figure 1), provides further standards on euthanasia.

Euthanasia should be performed by a veterinarian where available.

Intravenous barbiturate overdose, administered by a veterinarian, is the recommended method of euthanasia in flying-foxes. If intravenous access is not possible, barbiturates can be administered via the intracardiac or intrahepatic route in anaesthetised flying-foxes.

Where access to a veterinarian is not possible, a method appropriate for the size and condition of the flying-fox should be used, e.g. blunt force trauma to the head achieving immediate destruction of the brain, or gunshot to the brain with an appropriate firearm. Shooting should be undertaken by a licensed, skilled and experienced wildlife rehabilitation provider or an appropriate agency such as NPWS, the Royal Society for the Prevention of Cruelty to Animals (RSPCA) or NSW Police Force.

Safe disposal of deceased flying-foxes

The Flying-fox Code provides standards and guidelines on disposal of the carcass following euthanasia. Dead flying-foxes must only be handled by vaccinated individuals and must be handled with care, as transmission of ABLV to people is still possible.

The NSW Environment Protection Authority (EPA) must be contacted (call the Duty Incident Advice Coordinator on 0418 445 035) to report all mass mortalities to record vital information and arrange carcass disposal.

Carcasses can provide valuable information, and where possible, should be submitted to a veterinarian or research institution for necropsy (ensuring strict protocols to prevent exposure to ABLV). A post-mortem is a great tool for learning, not only for individual rehabilitators, but the wider community of rehabilitators. It is through this information that treatment can be instituted and practices modified where necessary to improve flying-fox rehabilitation.

6. Initial treatment – stabilisation

Fluid rehydration

Most rescued flying-foxes 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.

Rescued flying-foxes will benefit from fluids, applying glucose on the gums, lubricating the eyes (using false tears) and providing warm and secure housing.

Oral hydration

For flying-foxes able to control their head and swallow, and without signs of head trauma or neurological problems (see 'Neurological conditions' in Section 7), fluids can be given orally using a syringe with short plastic tubing or a pipette. It is important that oral rehydration at rescue should not be attempted unless you are sure the flying-fox is bright and strong enough to swallow volumes of liquid. If in doubt, avoid oral fluids and instead provide SC fluids, or contact an experienced flying-fox rehabilitator or veterinarian for advice.

Subcutaneous and intravenous fluid therapy

SC and IV fluids are recommended in moderately or severely dehydrated animals. Experienced rehabilitators, confident in administering SC fluids can use this method to rehydrate flying-foxes (Figure 10).

Administration of IV fluids requires veterinary expertise, sterile technique and appropriate equipment. Animals receiving IV fluids are closely monitored by veterinarians to ensure fluid rates are titrated depending on the animal's condition.

If severe dehydration is suspected, and in cases where oral fluid supplementation is not possible or inadequate, administer SC fluids. If there is no improvement in the animal's demeanour, seek urgent referral to a veterinarian for assessment and treatment.

Figure 10 Administering subcutaneous fluids to an anaesthetised flying-fox
Photo: Tania Bishop

Hypoglycaemia

Hypoglycaemia (low blood glucose) is common in rescued flying-foxes. As they have a high metabolic rate, pain, stress, exertion, forced flight and starvation can deplete glucose stores.

Pregnant and lactating animals are also at risk of hypoglycaemia especially when dealing with additional metabolic pressures from injury or illness.

Glucose can cross the mucous membranes into the blood stream and can offer an often life-saving energy source. Rescued flying-foxes benefit from a small amount of glucose applied on the gums as a gel or liquid.

Pain

Pain causes variable levels of psychological stress and the release of adrenaline and stress hormones. While stress aids survival during dangerous situations, when prolonged, it can result in immunosuppression, adversely affect healing and result in muscle wasting and weakness.

Unrelenting over-stimulation of nerve tracts, due to pain, creates a cascade of physiological events which increases sensitivity to subsequent stimuli. This is often referred to as ‘wind-up’. Animals experiencing ‘wind-up’ will have decreased tolerance to pain and it can be harder to manage. Appropriate and timely pain relief can significantly help prevent ‘wind-up’.

Immediate and effective relief of pain is vital and improves outcomes and animal welfare.

Flying-foxes can be stoic and may not always show obvious signs of pain. Behavioural changes associated with pain in flying-foxes can include:

- agitation
- breath-holding
- licking or chewing at areas
- vocalisation
- depressed demeanour.

Depending on the assessment of injuries, and in consultation with a veterinarian, appropriate drugs can be administered via various routes to alleviate pain. Certain medications are avoided in case of adverse effects, especially in young animals. Therefore, once assessed, consultation with a veterinarian regarding the most appropriate drug and route of delivery is imperative. Ensure animals are fully hydrated and normothermic before medications are administered to reduce the risk of adverse effects.

Wound care

Flying-foxes with wounds should be assessed by a veterinarian. Depending on their severity, surgery or medication (antibiotic) may be required.

Before veterinary assessment, superficial contaminated wounds can be flushed using lukewarm saline or dilute topical antiseptics such as chlorhexidine or povidone-iodine (‘Betadine’). 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 antiseptics, dilute solutions with warm water and avoid flushing around the eyes or mouth (oral cavity). If chlorhexidine enters the eyes, wash it out with saline immediately.

Bandaging

If wounds are oozing or wet (exudative), following flushing, temporary 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 temporarily bandaged in place with layers of wound care padding (e.g. ‘Soffban’) and a cohesive bandaging material (e.g. ‘VetWrap’) to stabilise the bandage (Figure 11), until the animal can be assessed by a veterinarian. Bandaging can also prevent desiccation, flystrike and further contamination of wounds. Ensure bandages are not constricting as this can disrupt blood supply and consequently healing.

Bandages should be maintained clean and dry and should be changed if fluid from the wound is wicking through to the bandage surface.

Figure 11 **Bandaging material commonly used for wound care: ‘Melolin’ (left), ‘Soffban’ (centre) and ‘VetWrap’ (right)**

Photo: Aditi Sriram

Husbandry

Husbandry requirements for flying-foxes in the initial period following rescue differ to requirements for flying-foxes in longer term care, and should be adapted to each individual depending on the animal’s developmental stage, injuries and health status. The following section advises on housing in the initial period following rescue.

Housing

House flying-foxes individually until they have been thoroughly assessed by a veterinarian or experienced wildlife rehabilitator. This functions as a period of quarantine to reduce the risk of disease transmission. The exception is during mass casualty events, where it may not be possible to individually house animals.

> Intensive care housing for flying-foxes should be designed to provide comfort and support, minimise stress and consider the safety of the rehabilitator when handling or accessing the flying-fox.

Intensive care housing must provide sufficient space for the flying-fox to maintain a normal posture, e.g. hang, and stretch its body and limbs, but not enough space to fly. The flying-fox must be allowed to hang by its feet from the top of the container, or if it is unable to hang, placed in a sling, so its feet are higher than its head (Figure 12).

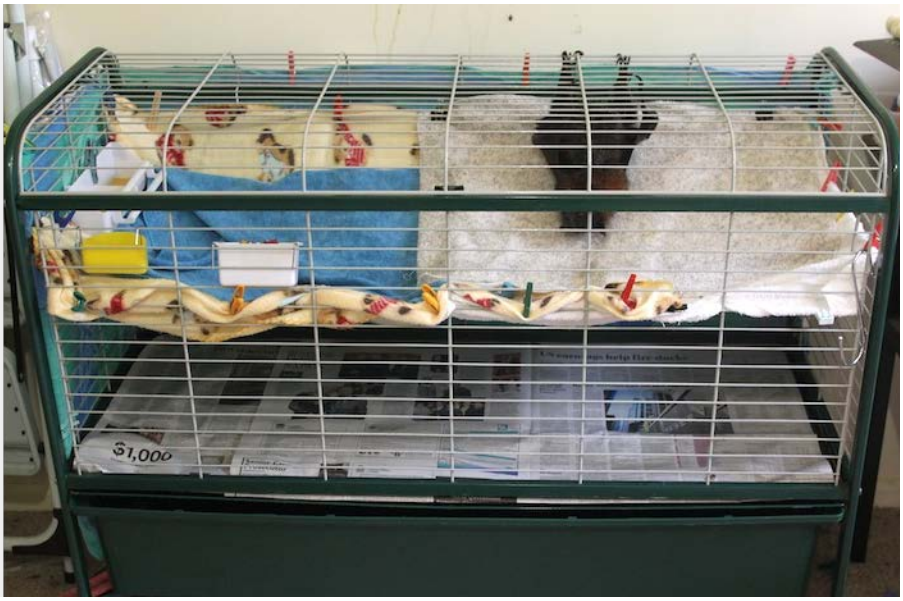

Figure 12 A pregnant female flying-fox supported by padding in a hospital cage

Photo: Mandi Griffith

Privacy curtains reduce stress for animals in care (Figure 13). Mesh cages allow good ventilation and provide opportunities for distance observation. A foot grip provides additional security whether the flying-fox needs to be lying flat or hanging (Figure 14). This can be provided using a soft piece of dowel at the end of a cage.

Figure 13 Use a curtain to provide security for a flying-fox in care

Photo: Mandi Griffith

Figure 14 A hospitalised flying-fox in a padded enclosure with a foot grip for security
Photo: Tania Bishop

The temperature in intensive care housing must be closely monitored and maintained at a range appropriate to the condition and life-stage of the flying-fox (see Table 5).

Table 5 Ambient temperatures to be maintained when housing flying-foxes (adapted from the Flying-fox Code)

	Ambient temp
Adult flying-foxes	25–27°C
Orphans	28°C
Premature flying-foxes or animals in poor condition	29–31°C

7. Common rescue encounters

The following section details some of the more common rescue encounters and the initial stabilisation of flying-foxes relevant to each scenario. Considerations specific to pregnant and lactating females and juvenile flying-foxes are also described.

Entanglement

Entanglement, in barbed wire or netting, is one of the most common reasons flying-foxes are rescued (DPIE 2020). The prognosis for a flying-fox with entanglement injuries depends on the severity of soft-tissue injuries (injuries to the wing membrane, muscle, bone and joints) and the severity of complications such as dehydration, heat stroke and myopathy due to exposure and exertion.

Early intervention is critical for recovery from entanglement injuries. Seek urgent veterinary assistance for flying-foxes rescued from entanglement.

Care must be taken when handling barbed wire or netting, ensuring PPE is worn to prevent injury to the handler. Once rescued, perform a physical examination (see Section 4 ‘Physical examination’), including measuring rectal temperature. Rectal temperatures higher than

41.5^{o}C are associated with a poor prognosis. Spraying animals with tepid water and increasing airflow over the animal help cool a hyperthermic flying-fox (see ‘Heat Stroke’ below).

Flying-foxes may be severely dehydrated and often in shock by the time they are rescued. Pain relief and rehydration are crucial in these animals. Flying-foxes rescued from entanglements likely can’t absorb oral fluids as the blood supply to and function of their gastrointestinal tract will be compromised by dehydration and heat stroke. Even though they appear desperately thirsty, do not provide oral fluids to weak and compromised animals as it may result in aspiration. Instead, apply a small amount of glucose gel or liquid onto their oral mucous membranes and seek urgent veterinary attention. Subcutaneous fluids can be provided in the interim; however, severely dehydrated animals require IV fluid therapy and pain relief prescribed by a veterinarian.

Hard palate injuries from barbed wire entanglement are common, but irreparable in severe cases (Figure 15).

Following initial stabilisation and veterinary review, flying-foxes that appear healthy should be held and observed for 4 weeks before release. This allows for monitoring and re-assessment of injuries such as membrane necrosis, which may develop or worsen in this time.

Figure 15 Severely damaged hard palate in a flying-fox
Photo: Tania Bishop

Eye injuries

Injuries to the eyes should be assessed by a veterinarian and treated immediately to prevent permanent vision loss. Traumatic eye injuries can result from fighting between bats, predation, misadventure or blunt force trauma. Impact to the skull can displace the lens from its normal position (lens luxation) or detach the retina (Figure 16). Penetrating injuries can quickly become infected and must be treated as a medical emergency.

Signs including squinting, cloudiness of the eye (Figure 17) or discharge from the eyes should be assessed by a veterinarian as soon as possible. Exposure ulcers are very common in dehydrated flying-foxes. Dehydration reduces the watery component of the tear film leaving the eye poorly lubricated, eventually damaging the cornea (outmost surface of the eye). Corneal injuries can be very painful and require veterinary attention for pain relief and thorough examination.

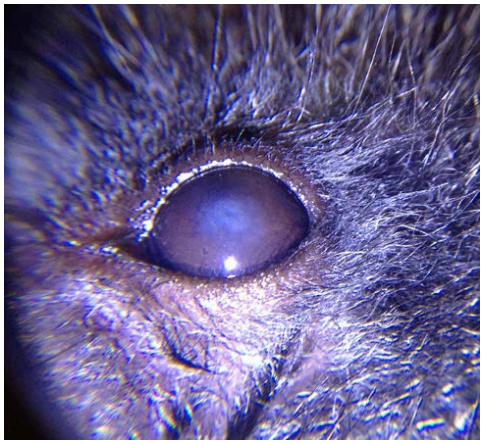

Figure 16 Slightly cloudy or opaque eye in a flying-fox
Photo: Mandi Griffith

Figure 17 Abnormal opacities in both eyes in a flying-fox
The right eye (white arrow) on thorough examination by a veterinarian was diagnosed as a lens luxation
Photo: Tania Bishop

In rescued flying-foxes with eye injuries, flush eyes with saline to remove foreign material. Do not try to touch or rub the eye to remove foreign material. Applying a gel-based lubricant in the eyes at rescue can help prevent the progression of exposure ulcers (Figure 18).

Figure 18 Saline flush (‘Eye Stream’) and lubricating gels (‘GenTeal Gel’) used to flush and lubricate eyes
Photo: Tania Bishop

Pneumonia

Pneumonia (inflammation of the lungs) can occur in flying-foxes following fighting during mating season or prolonged wet weather. In juvenile flying-foxes, aspiration pneumonia is common, where hypothermia, hypoglycaemia and weakness can lead to aspiration of gut contents. Aspiration pneumonia can progress rapidly to severe respiratory compromise.

Signs of pneumonia can be subtle and include:

- increased respiratory rate
- increased respiratory effort
- cheek puffing
- prolonged inspiration
- see-saw breathing (abdomen moves out and chest sucks in).

A flying-fox with signs of respiratory effort should be presented to a veterinarian for assessment as soon as possible. Early diagnosis and treatment will improve the prognosis.

Raptor attack

Raptor attacks are a common reason why flying-foxes require rescue. Penetration of the talons into the chest or abdominal cavity is common. Bacteria on the talons introduced into the puncture wounds and can cause severe infections. Flying-foxes injured by raptor attack are often in severe pain and can have collapsed lungs, peritonitis (inflammation of the abdominal wall and organs) and septicaemia (bacteria in the bloodstream). Mostly, there are very few visible signs of raptor attack in flying-foxes. Close examination can show puncture wounds with a characteristic pattern matching the position of raptor talons (Figure 19).

Raptor attack should be considered in flying-foxes that appear painful, quiet or depressed and where no other obvious signs of injury are identifiable. A thorough veterinary assessment is required to assess these animals.

Figure 19 **Puncture wounds on the wing membrane of a flying-fox, most likely associated with raptor attack**

Photo: Tania Bishop

Fractures

Fractures are common with trauma, and rescued flying-foxes should be examined for swelling, bruising, and abnormal position or function of joints and bones.

Fractures identified at rescue should be immobilised as best as possible to prevent further damage to blood vessels and nerves. This can be done by carefully and gently wrapping the flying-fox with a towel and placing it in a padded transport container.

Pain relief is crucial, and injured flying-foxes should be presented to a veterinarian for diagnostics and pain relief as soon as possible.

Concurrent injuries and the location and type of fracture, and viability of the blood and nerve supplies are considered in determining the prognosis for recovery.

Figure 20 Radiograph of a flying-fox with a fracture of the humerus (white arrow)
Photo: Tania Bishop

Bruising

Examine all rescued flying-foxes for bruising, which can develop up to 48 hours after injury. It is useful to shine a light through the wing membrane to highlight areas of bruising and necrosis (Figure 21). Sever bruising can result in necrosis of the wing and must be assessed by a veterinarian.

Animals with bruising should be assessed thoroughly by a veterinarian for concurrent injuries and be provided with pain relief. Topical treatment may be prescribed with an antiseptic to manage wing membrane injuries. Wing membranes should be closely monitored for infection, which can develop while in care.

Figure 21 **Shining a light through the wing membrane helps to highlight areas of bruising (white arrow)**

Photo: Mandi Griffith

Neurological conditions

Monitor rescued flying-foxes for neurological signs such as head tilt, incoordination and seizures. A flying-fox with any neurological signs should be taken to a veterinarian as soon as possible. Various conditions can result in neurological signs in flying-foxes, including:

- infectious disease (e.g. ABLV)
- hypoglycaemia (low blood sugar)
- head injuries
- heat stroke
- congenital problems
- rat lungworm (*Angiostrongylus cantonensis*)
- lead poisoning.

At rescue, avoid administering medications to flying-foxes with neurological signs as most medications will affect the treatment a veterinarian can administer, and some may exacerbate the problem. Contact an experienced flying-fox rehabilitator or veterinarian as soon as possible.

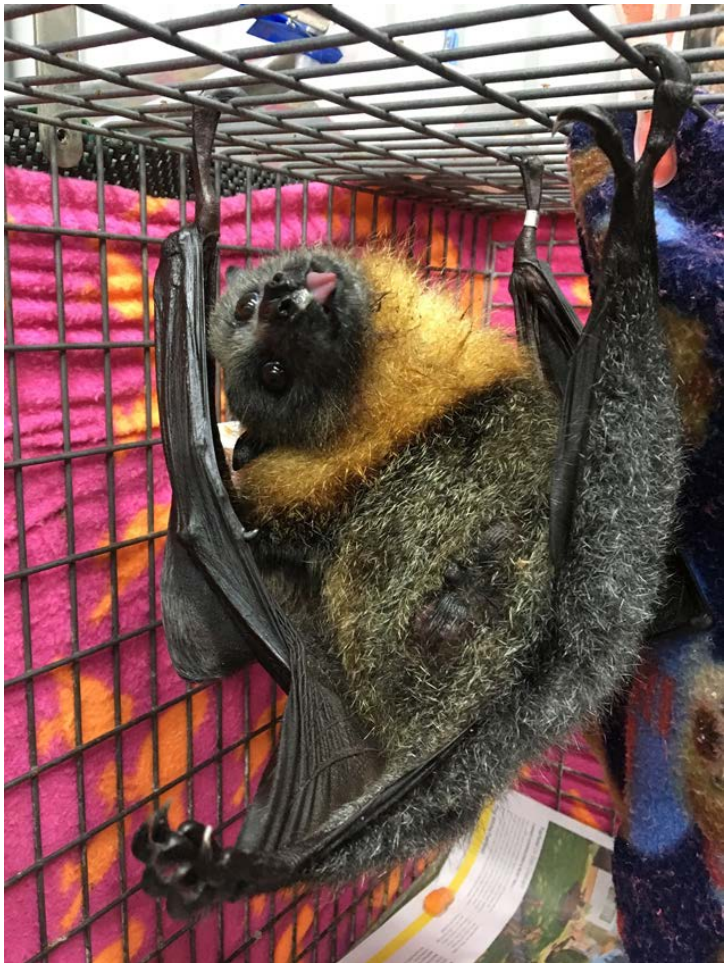

Figure 22 **A flying-fox with abnormal head position and posture, indicating neurological dysfunction**

Photo: Mandi Griffith

Heat stroke

Having high metabolic rates and huge pectoral muscles for flight, flying-foxes generate twice the body heat of any non-flighted mammal. This means that exposure to or physical exertion in high temperatures can generate heat beyond the ability of the flying-fox to dissipate.

> **Heat stress** is the state in which hyperthermic flying-foxes are trying to lower their body temperature to normal. **Heat stroke** is the damage done to enzymes and organs by high body temperature and when temperature control mechanisms are overwhelmed.

Heat stroke can occur due to:

- physical exertion, for example when a flying-fox struggles against restraint, entanglement or due to forced prolonged flight
- high ambient temperatures, especially with high humidity, overwhelming the flying-fox's ability to maintain normal body temperature.

Heat stress can affect some flying-fox species more than others. Black flying-foxes (*Pteropus alecto*) are most affected, followed by grey-headed flying-foxes (*Pteropus poliocephalus*) and little red flying-foxes (*Pteropus scapulatus*). Age and sex also influence heat stress outcomes, with dependent young and lactating females predominantly affected.

However, males have been most affected during heat stress events in March and April, during the breeding season.

Flying-foxes cannot sweat to lose heat. They use radiation (dilating blood vessels) and evaporative cooling, both physiologically costly mechanisms, to reduce body temperature. Heat stroke can rapidly progress to become life threatening. Consequences of heat stroke include:

- dehydration – severe fluid loss due to panting and licking (Figure 23). Flying-foxes panting and wrist-licking lose significant fluids to achieve evaporative cooling
- vasculopathy (disease affecting blood vessels) – heat stroke damages blood vessels and consequently organs
- direct cell damage to brain and associated blood vessels – animals may present depressed, seizing or in severe cases, comatose
- myopathy – high body temperature damages cells and with muscle activity from active fanning, can result in myopathy.

Initial treatment for individual flying-foxes

Where individual flying-foxes with heat stroke are rescued, the following actions to assess and initially stabilise the animal are recommended:

- brief physical examination, including measuring rectal temperature – animals with rectal temperatures over 41.5^{o}C have a poor prognosis and euthanasia may be indicated
- rehydration – provide SC fluids at rescue. Oral fluids should be avoided due to risk of aspiration. Where possible, transport the animal to a veterinarian as soon as possible for IV fluid therapy and stabilisation
- careful cooling while continually monitoring body temperature – wetting flying-foxes with tepid water and ensuring air circulates around the animal will facilitate evaporative cooling. Do not wrap the flying-fox in a wet cloth. The aim is to gradually reduce body temperature. Rapid cooling can induce shivering, which can produce heat and is therefore counterproductive. Stop active cooling measures when body temperature reaches 40^{o}C
- applying lubricating gel to the eyes
- applying a small amount of glucose gel on the gums.

Directly wetting an animal with tepid water will facilitate evaporative cooling. Spraying water around the animal increases the humidity surrounding the flying-fox, hampering evaporative cooling and worsening heat stroke.

Managing heat stress in a flying-fox camp

Before attempting a rescue at a flying-fox camp, contact an experienced flying-fox rehabilitator to assess the situation. It is critical to consider the effects of the rescue on the entire camp before initiating any intervention.

Where rescue is recommended, prioritise identifying bats requiring euthanasia. If removing flying-foxes for treatment, follow the initial stabilisation actions listed above.

Figure 23 **Flying-foxes panting and wrist-licking to aid heat loss**
Photo: Mandi Griffith

Burns

Rescuer safety is vital when working in fire grounds. Information pertaining to 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.

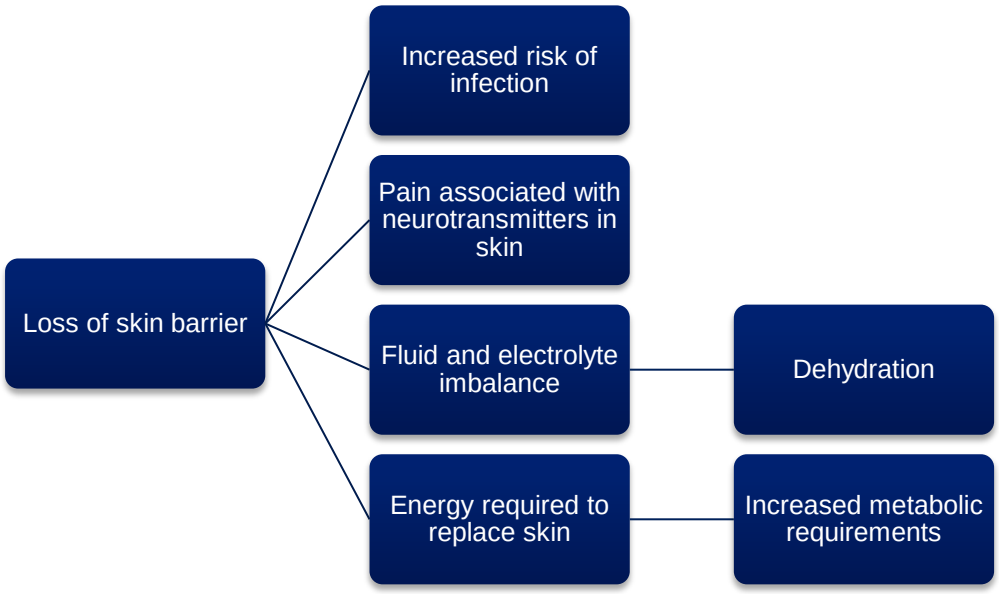

Figure 24 **A brief outline of the pathology of burns**

Burn injuries should be classified based on severity, location and extent. This is an important indicator of prognosis and directs treatment. In addition to a burns assessment, an overall physical examination should be performed to check vital signs and identify concurrent injuries or illnesses. Capture myopathy from exertion and stress is one of many concurrent complications seen in flying-foxes with burns.

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

Depth of burns

Classifying burn depth is subjective and depends on the experience of the assessor. Table 6 provides guidance on classifying burns as superficial, partial or full thickness.

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

Table 6 Classification of burns

	Superficial	Partial thickness	Full thickness (3rd degree)
Pathology	Epidermis & 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 flying-fox rehabilitators should be contacted to discuss how best to stabilise the animal before transfer to a specialist facility. General guidelines for stabilising flying-foxes 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 or cover the wounds with saline-soaked gauze swabs
- fluid therapy is vital as animals can develop shock from severe dehydration. Administer intravenous fluids if possible.
- for burns to the eyes or face, flush the eyes or face with tepid saline and seek prompt veterinary advice. Apply lubricating gel to the eyes in the interim
- for smoke inhalation or respiratory burns, observe the animal for signs of respiratory distress, such as open-mouth breathing, panting or increased respiratory rate. Smoke inhalation can damage the lungs and cause pneumonia. Oxygen therapy should be

provided but 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, create a nebulising chamber using blankets or towels

- recovering from burns markedly increases metabolic requirements, therefore nutritional support is important. Appropriate diets should be provided to flying-foxes 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 provide nutritional support. 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
- sedation or anaesthesia and pain relief are vital in managing burn injuries. Transfer the animal to a veterinary facility as soon as possible.

Electrocution

Electrocution can be primary or secondary, with the former almost invariably fatal.

Primary electrocution occurs where 2 or more points contact electrical wires with the current earthing through the flying-fox (Figure 25). Secondary electrocutions are usually seen in juveniles attached to electrocuted mothers. The attached pup may receive a shock, but the current has not earthed through their body. In juveniles, burn injuries and injuries resulting from being thrown from the mother by the electrocution are common.

Figure 25 Primary electrocution where two or more points contact electrical wires

Photo: Tania Bishop

Primary electrocution cases usually present with singed fur, burns and concurrent physical injuries indicating an earthing point on the body (Figure 25). The prognosis for recovery in animals with primary electrocution is poor, as even if they survive initially, most experience multi-organ failure due to the damage caused by the earthing current.

Pain relief and prompt veterinary assessment of flying-foxes with suspected electrocution injuries is crucial. Hyperaesthesia (extreme nerve pain) is commonly associated with electrocution and is difficult to control even with access to effective pain relief medication. Initial stabilisation principles for burn injuries can be applied to flying-foxes with suspected electrocution (see ‘Burns’ above).

Figure 26 **Burn injuries on the wing membrane of a flying-fox sustained due to secondary electrocution**

Photo: Mandi Griffith

Lactating and pregnant females

Pregnant and lactating flying-foxes are under great metabolic strain. When sick or injured, keeping them calm, pain-free, well-hydrated and meeting their energy needs is vital for successful treatment for both mother and pup. Injured pregnant females should be provided with a hammock-style housing in the cage to provide support.

Pregnant flying-foxes may not be readily identifiable. A foetus can sometimes be identified by gently palpating the abdomen. This can be difficult in either obese or emaciated flying-foxes.

When caring for a mother and pup, it is important to monitor the pup's hydration and the female's milk production as this can decrease with stress and injury. When a female flying-fox with a dependent young is rescued, assess if the female is still lactating. Examine the juvenile, checking its hydration status as part of an initial physical examination. Keeping pups together with their mother is recommended. If the female is no longer lactating, ensure the pup is provided with additional nutritional support.

Stress can lower blood glucose and induce seizures in pregnant and lactating females. Managing stress is key to reducing the risk of abortion in pregnant females. This requires managing physiological and psychological stressors. Sedation and pain relief prescribed by a veterinarian can reduce pain and stress.

Injured, sick, abandoned and orphaned flying-fox pups

Orphaned dependent pups

Dependent flying-fox pups are commonly rescued from injured or dead females or found abandoned. At rescue, juveniles are generally dehydrated, hypoglycaemic, hypothermic and weak. On examination, the pup may be cold to touch, poorly responsive and may have abnormal respiration. Following physical examination, provide fluids, warmth and glucose.

Forearm measurements and weight correlation are important to identify the condition of rescued juveniles (see 'Determining age' in Section 4).

Malnutrition can be maternal (due to an old or compromised mother) or result from abandonment and starvation. The gastrointestinal system in flying-foxes requires almost constant and regular passage of food and digestion to retain function. Starvation can result in loss of digestive function. In juveniles with suspected starvation, feeding needs to be started gradually, with small amounts frequently, to prevent complications due to refeeding syndrome. Slow and graduation feeding of small volumes frequently allows the gastrointestinal tract to adjust and function normally. Regurgitation and passing undigested formula in faeces are signs of refeeding syndrome in juveniles. Contact an experienced flying-fox rehabilitator for advice on feeding orphaned juveniles.

Premature flying-fox pups

Premature flying-fox pups can be identified by the lack of fur on the entire front body and may still have an umbilical cord attached. They may still have their eyes closed and ears down and their wing membranes may appear thinner (Figure 27).

Premature flying-foxes require specialised care and their rehabilitation must be undertaken by experienced flying-fox rehabilitators.

Figure 27 **Non-viable premature flying-fox pup (left) and premature flying-fox pup with eyes closed and ears down (right)**

Photo left: Tania Bishop, right: Mandi Griffith

Congenital problems

Any pup failing to thrive, not meeting developmental milestones, or developing neurological signs in care should be assessed by a veterinarian to investigate possible underlying congenital problems. Congenital problems may not be readily diagnosable at rescue.

Congenital problems observed in flying-foxes include:

- cleft palate – a congenital split in the roof of the mouth (Figure 28)
- hydrocephalus – a condition where fluid accumulates in the brain
- hydranencephaly – a condition where the cerebral hemispheres are replaced by sacs filled with cerebrospinal fluid
- microphthalmos – where one or both eyes do not develop fully
- forward-facing wings – where there is disproportionate growth of the bone against the non-elastic membranes between the digits resulting in the digits buckling and wings facing forward (Figure 29). This condition is irreversible and renders the flying-fox unable to fly. The cause is unknown.

Note: joint inflammation and trauma can also cause malposition of the wings and may be treatable. This should not be confused with forward-facing wings seen in younger bats, usually around 8 to 10 weeks old, which is not reversible.

Figure 28 Cleft palate in a juvenile flying-fox

The white arrow indicates the defect in the hard palate. Photo: Tania Bishop.

Figure 29 Forward-facing wings in a juvenile flying-fox

Photo: Tania Bishop.

8. Quarantine and managing infectious disease

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

Treat all flying-foxes as potentially infectious, and take precautions to minimise disease transmission between flying-foxes and humans.

- House animals separately until disease status is determined by a veterinarian or experienced wildlife rehabilitator. The exception to this is during mass casualty events where isolating individuals may not be possible.
- If an animal shows signs of disease (aggression, strange vocalisations, excessive salivation, agitation, diarrhoea, discharge from the eyes or nose), it must be isolated and managed as infectious until assessed by a veterinarian.
- Animals in quarantine or isolation must have their own cleaning equipment and feeding equipment which are not to be shared with other animals.
- Thoroughly clean all enclosures and equipment between animals. Cleaning feeding utensils and other cage furniture is best done by removing organic material by cleaning them in a sink with detergent, followed by additional cleaning and sanitising by running them through a dishwasher on a hot cycle.
- Ensure towels and ropes 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: gloves, wetsuit arm gauntlets, covered clothing, alcohol-based hand sanitiser, dust mask, eye protection (see ‘Safety first’ in Section 2).

A range of 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 a flying-fox is suspected of carrying a notifiable disease (e.g. ABLV), or an unusual disease or mortality 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.

9. Record keeping

Accurate records must be maintained to track the progress and outcomes for flying-foxes in care. If the flying-fox is transferred to another rehabilitation provider or referred to a wildlife hospital, these records provide vital clinical information to determine 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 – species, stage of development, sex, identification (microchip) if present
- initial physical examination findings, including body weight and forearm length

- daily notes – including treatments provided, progression or development of symptoms, weight, food intake, faecal output, behaviour etc. Maintain daily record sheets while the flying-fox 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, if the animal died while in care, or if the animal was released.

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More information

- Biodiversity Conservation Act 2016
- Code of Practice for Injured, Sick and Orphaned Flying-foxes
- NSW Department of Health guidelines
- Personal Protective Equipment (PPE) for Bat Handlers