Flying-fox Roost Management Guideline

Queensland Government

Prepared by: Wildlife and Threatened Species Operations, Department of Environment and Science

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1. Purpose

The purpose of this flying-fox roost management guideline is to provide information to local governments and flying-fox roost management permit (FFRMP) holders to:

- assist decision making regarding management options at flying-fox roosts
- maximise the effectiveness of any management action undertaken at flying-fox roosts
- minimise the likelihood of any management actions causing harm to flying-foxes.

While this document is primarily intended for Queensland local government officers and permit holders, it may also provide useful information for anyone interested in flying-foxes and flying-fox management.

2. Background

2.1 Acknowledgements

The Department of Environment and Science (the department) appreciates the time and valuable input that local governments, conservation groups and other organisations have provided during consultation, including various written materials that helped in the development of this guideline.

Special thanks are given to CSIRO, Australasian Bat Society, Tolga Bat Hospital, Local Government Association of Queensland, Brisbane City Council, Charters Towers Regional Council, Ipswich City Council, Gold Coast City Council, Moreton Bay Regional Council, Noosa Shire Council, Redland City Council, Sunshine Coast Council, and Toowoomba City Council for responding to requests for advice and for contributing case studies to this guideline. Thank you also to all the organisations and individuals who have provided important feedback and comments about flying-fox management over recent years and throughout the development of this guideline.

2.2 The legislative framework and supporting information

This guideline is non-statutory. It provides information about management options that is consistent with the legislative framework and informs decision making about roost management.

The *Nature Conservation Act 1992* is the primary legislation that regulates what management actions may, and may not, be undertaken at, or near, a flying-fox roost in Queensland. In some circumstances, other legislation may also apply, such as the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and local laws.

There are four species of flying-fox found in Queensland. The:

- black flying-fox (*Pteropus alecto)* **(Figure 1)**
- grey-headed flying-fox (*P. poliocephalus)* **(Figure 2)**
- little red flying-fox (*P. scapulatus*) **(Figure 3)**
- spectacled flying-fox (*P. conspicillatus)* **(Figure 4).**

All four of these species are protected under the *Nature Conservation Act 1992* with the spectacled flying-fox listed as Endangered. The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) also lists the spectacled flying-fox as Endangered, and additionally lists the grey-headed flying-fox as Vulnerable.

Section 41A of the Nature Conservation (Wildlife Management) Regulation 2006 provides local governments with an as-of-right authority to manage flying-fox roosts within designated 'urban flying-fox management areas' (UFFMA) provided they comply with the Code of Practice—Ecologically sustainable management of flying-fox roosts. Specific requirements of the code are discussed in further detail in **section 6** of this guideline.

Section 41B of the Nature Conservation (Wildlife Management) Regulation 2006 provides all persons

with authority to undertake low impact activities at roosts on their land where the activity is in accordance with the Code of Practice— Low impact activities at flying-fox roosts.

Additionally, local governments may apply to the department for an FFRMP by submitting a flying-fox roost management permit (FFRMP) application form. For example, local governments may wish to apply for a FFRMP to undertake management actions at a roost outside of an UFFMA or undertake management actions that are outside the scope of the code of practice.

Failure to comply with the provisions of the relevant codes of practice may constitute an offence under the *Nature Conservation Act 1992* or the *Animal Care and Protection Act 2001*.

Special care should be taken at roosts that contain spectacled flying-foxes due to their endangered status under both State and Commonwealth legislation.

For further information about flying-fox roost management, please visit https://environment.des.qld.gov.au/wildlife/animals/living-with/bats/flying-foxes/roost-management#toc-7

The 'National Flying-fox viewer' also provides information which may be useful in determining the range of various species and the location of various roosts, please visit http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf

2.3 Flying-fox species information

Flying-foxes are the largest flying mammals in the world with some Australian species having wingspans of up to one metre and weighing up to one kilogram.

They are highly social animals living in large groups that often include more than one species. They communicate through a combination of calls, scent from glands and, when necessary, brief scuffles. Communicating by smell and sound allows flying-foxes to avoid territories of other flying-foxes, locate dependant young, and warn others when a predator is nearby. This also helps structure the roost which

Figure 1. Black flying-fox

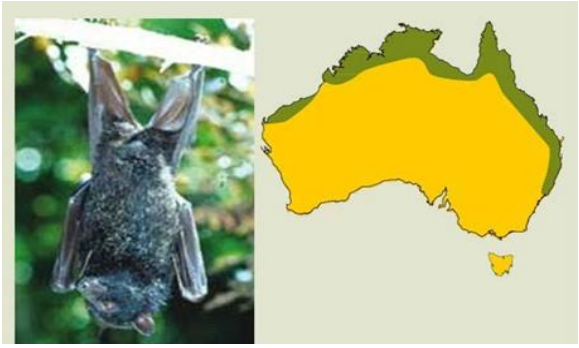
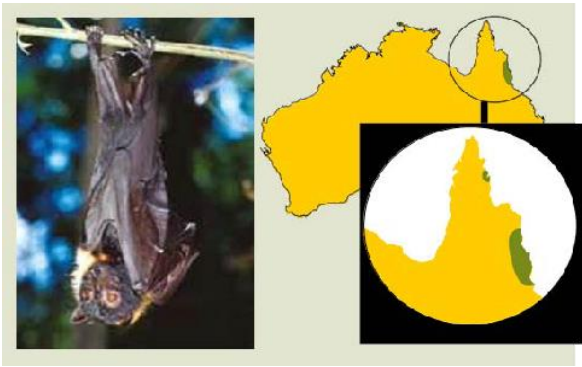


Figure 2. Grey-headed flying-fox

Figure 3. Little red flying-fox

Figure 4. Spectacled flying-fox



tend to orient the territories of dominant males and breeding females in the centre with non-breeding and sub-dominant and sub-adult individuals taking up position towards the edge the roost as sentries.

Flying-foxes have highly developed spatial memories and can navigate between their roosts and food trees ranging 50 kilometres in a night. Some flying-foxes have been tracked moving 1000 kilometres in less than a week. Little red flying-foxes migrate *en masse* with up to a million individuals moving from roost to roost as a local phase of flowering or fruiting ends and another one begins elsewhere.

This mobility underpins the unique role that flying-foxes play in distributing the seed and pollen of a range of forest trees. Many eucalypts attract flying-foxes by producing more nectar at night. The distances they can carry pollen and seed make them vital to the regeneration and genetic diversity of many species of native tree.

Figure 5. Generalised breeding cycle for black, grey-headed, and spectacled flying-foxes. Note: this is for general information only and timing of behaviours may differ depending on region and climatic conditions. Flying-fox behaviour should be confirmed by a site visit.

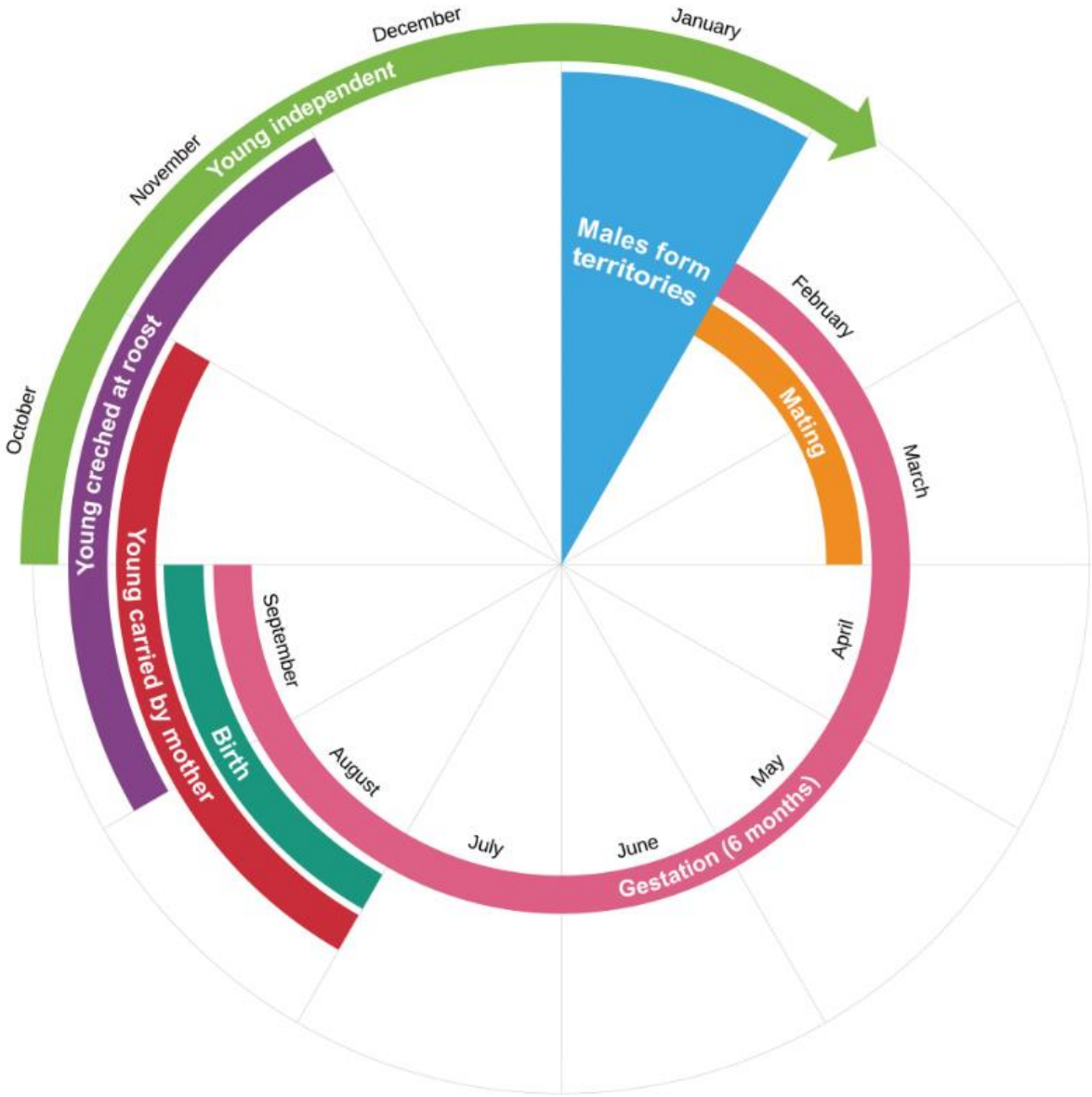
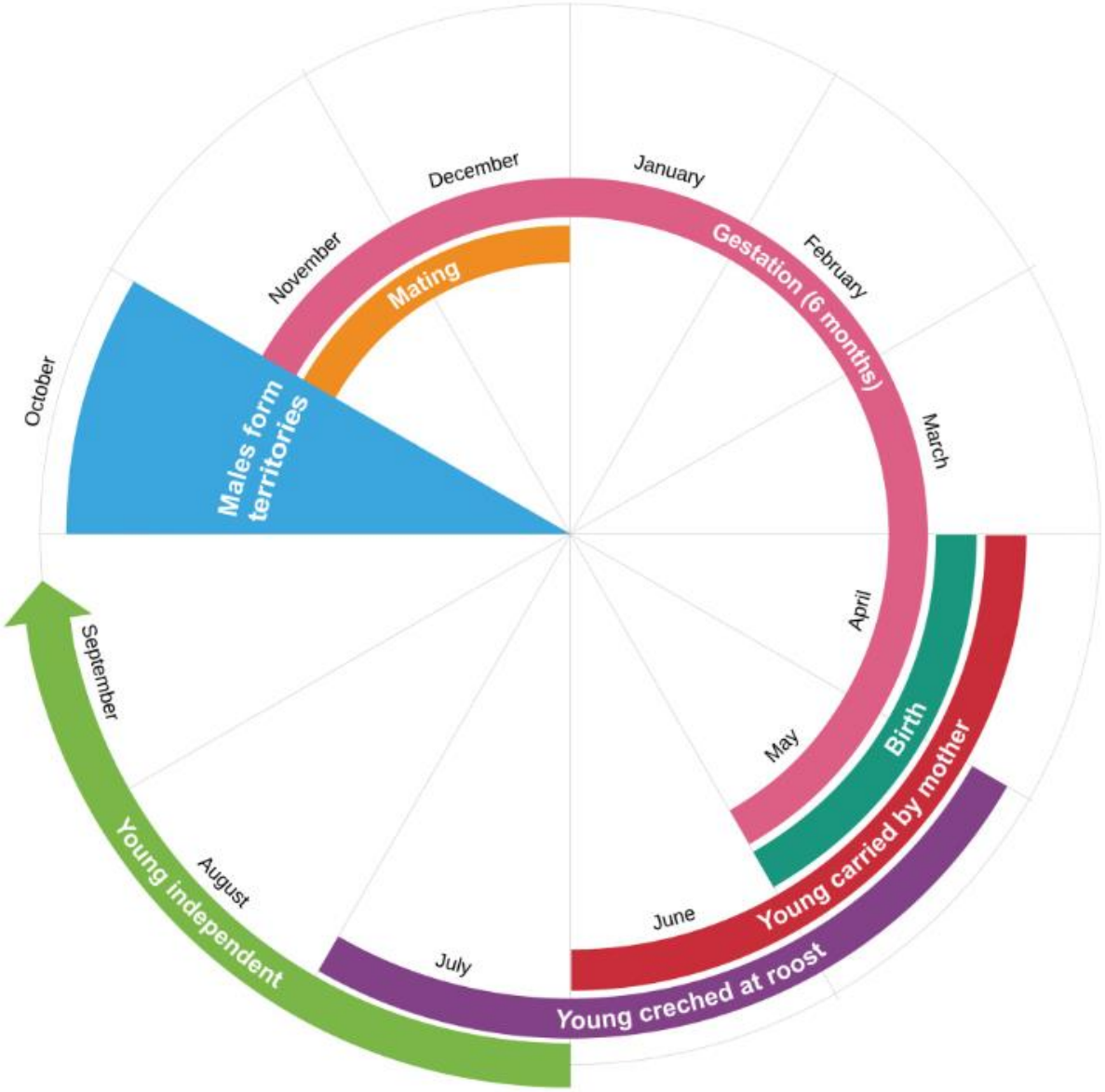


Figure 6. Generalised breeding cycle for little red flying-foxes. Note: this is for general information only and timing of behaviours may differ depending on region and climatic conditions. Flying-fox behaviour should be confirmed by a site visit.



Flying-fox migrations translate into the movement of kilograms of seed and billions of pollen grains that would otherwise remain near their parent trees.

Though individual flying-foxes can be highly mobile, flying-foxes populations tend to develop strong affinities with roost sites. Individual animals may use a different roost site in the short term and even on a nightly basis. The presence and number of animals at a roost can also change with seasonal conditions and the availability and distribution of food across the landscape.

Some communities have large flying-fox roosts in, or close to, urban areas, for example, in town parks and cemeteries. Many of these places are known to the department and to local governments and are mapped and monitored.

Figures 5 and **6** shows the breeding calendar for the four common flying-fox species. For further information on flying-fox identification and distribution maps, refer to **Appendix A.**

2.4 Lifecycle and dynamics of flying-fox roosts

Note: The following summary of roost dynamics and behaviour is based on observations of grey-headed, black and spectacled flying-foxes (Nelson, 1965). Little red flying-foxes follow similar time frames and patterns, however they are six months out of phase with these three species.

Flying-foxes become sexually mature when they are two to three years old. Breeding roosts are structured around the territories of dominant males, which are in the centre of the roosts. The sub-dominant individuals (including males unable to form a territory, females that did not mate, and sexually immature flying-foxes) take up the more exposed sites around them.

In this phase, the flying-foxes are commonly in family groups made up of a male and female with her young from the previous breeding season. The remainder of the flying-foxes are in pairs (adult male and female) or groups of juveniles, with some taking on the role of guarding the roost.

The pregnant females and the males leave their territory and form separate groups that position themselves in different parts of the same tree or different sections of the roost.

Figure 7. Spectacled flying-fox with a dependant young under wing

Both males and females stay in the summer breeding roost with the young born after a six-month pregnancy (**Figure 7**).

Birth occurs between September and late October and by their third week the young are left while their mothers go out to feed. At four months, flying-foxes are weaned and become fully independent and move to a winter camp. They can fly at three months and have their adult teeth (losing the hooked premolars that kept them firmly attached to their mothers).

Young flying-foxes start leaving their mothers in January and form into separate groups of juveniles on the edge of their existing roost or at another site, for example, at bachelor or juvenile camps. The populations at these sites increase as the family groups break up and restructure into groups of young with a few adults; usually males. Group size peaks in late March and by April and June flying-foxes are dispersing into winter camps. Here the adult males and females are separate or in small (non-breeding) groups. Sexually immature individuals make up the majority of the flying-foxes present at the winter camp. These winter camps tend to be occupied temporarily but this is dependent on the continued existence of these areas.

These camps are used until September when the flying-foxes return to the summer roost to prepare to breed.

Being limited to having one young a year, with a lag period of three years before that individual can breed, exposes flying-fox populations to risks. Several poor breeding seasons can result in an ageing population that has difficulty recovering. To the casual observer there are still large numbers of flying-foxes, however, each year there will be a higher proportion of older individuals and fewer breeding pairs.

3. Human and flying-fox interaction

People living very close to flying-fox roosts can be affected by noise, smell, and droppings, and can be concerned about the perceived risk of disease and impacts on property values (Rose, 2011). Trees can also be significantly damaged in some situations.

3.1 Noise

Being social mammals, flying-foxes rely heavily on communication with each other to define territories, help mothers find their young within a roost, identify an intention and acceptance to mate, and warn others of any potential threats.

Roosts are typically noisiest when they are disturbed or when the flying-foxes are leaving or returning. Roosts also tend to be noisier during mating season when males are fighting over territories and when mating with females.

The sound that is most commonly heard at night is the vocalisations of flying-foxes squabbling over food. This is short-lived as the dominant flying-fox drives off the other animals, or the subdominant individual grabs what it can and flies away to somewhere safe to eat.

The little red flying-fox is often the noisiest and most active species (Markus and Hall, 2004). Compounding this is the species' habit of forming large roosts with hundreds of thousands of animals often tightly clustering into whatever space is available.

3.2 Smell

The smell from flying-fox roosts is usually the impact that draws the most complaints from people living nearby.

Humans can react strongly to certain smells and this aversion has evolved as a mechanism for warning us of the presence of potential sources of disease (e.g. rotten food, water contaminated with waste).

Most people believe the smell from a roost is due to the flying-fox droppings (Thomson, 2007), however it is actually due to male flying-foxes wiping scent from their shoulder glands on tree branches to mark their territories and attract mates. Juvenile flying-foxes also have a unique smell which is thought to help mothers identify their offspring when returning from foraging.

The smell at a flying-fox roost varies and is often particularly strong after rain (when males re-mark their branches), during hot and humid weather conditions, and when large numbers of flying-fox numbers are present.

3.3 Droppings and urine

Flying-fox mainly defecate at roosting or feeding sites. However, they also defecate immediately after taking flight to jettison any extra weight and make flying easier. This can affect nearby residents by soiling outdoor furniture, cars, washing on the line, solar panels and swimming pools. If not removed quickly, faeces can even damage the paint on cars. Flying-foxes that have fed on the fruit of the South American Cocos palm (*Syagrus romanzoffiana*) (**Figure 8**), can also have particularly sticky faeces.

Figure 8. A flying-fox feeding on Cocos palm

3.4 Hygiene and health concerns

Like any animal, flying-foxes can pose a range of hygiene and health concerns. Flying-foxes have a diet and digestive system that is adapted to allow them to both obtain energy and jettison any waste quickly. Their diet of fruit and nectar is made up of simple carbohydrates that are easy to digest. They also have a shortened gastrointestinal tract that allows them to digest food in 15–20 minutes.

As a result, flying-foxes need to eat regularly to replenish energy (nectar can be as much as 60% water, limiting the amount of energy it contains) and need to defecate regularly to remove excess weight that would otherwise have to be carried when flying.

Being highly mobile, and not discriminating when and where they defecate, means any exposed surface is a potential but inadvertent target for the brown splay of digested fruit pulp excreted by flying-foxes as they move between feeding sites.

All animal droppings are a possible hygiene hazard and could contain bacteria like salmonella or *Escherichia coli* or leptospirosis. Practising good hygiene standards, for example, through washing hands and cleaning any exposed surfaces before they are used, will remove any health risk from accidentally touching flying-fox droppings.

When undertaking management activities at or near a roost, appropriate personal protective equipment should be worn.

Flying-foxes can also carry zoonotic diseases (diseases that can be transmitted to humans). These are often serious diseases, however, they are difficult to catch. Transmission requires physical contact with the animal through its infected saliva, blood or other bodily fluid. The pathogen needs to get into a person's blood stream through a cut or the lining of the nose or mouth (i.e. mucous membrane).

Often, a bite or scratch occurs when people try to handle a live flying-fox, for example, attempting to rescue a flying-fox that is sick or injured.

The two most serious zoonotic diseases, Australian Bat Lyssavirus (ABLV) and Hendra Virus, can be fatal and are profiled below.

3.4.1 Australian Bat Lyssavirus

In Queensland, all four common species of flying-fox, and at least three species of insectivorous micro-bat, can carry ABLV. According to Queensland Health, surveys of flying-fox populations have indicated that less than 1% of the animals actually carry the virus. In sick and injured flying-foxes, around 7% have been found to carry the virus.

Stay safe. Do not handle flying-foxes.

ABLV transmission

Humans may become infected when they are bitten by a flying-fox carrying the virus or if a scratch or wound is contaminated by infected saliva. Therefore, if you do not touch a flying-fox there is no risk of transmission. In the rare event a person is bitten or scratched by a flying-fox, there is a post-exposure vaccination to minimise the possibility of transmission of ABLV.

Preventive vaccinations are also available for people who regularly work with flying-foxes such as wildlife carers or local government officers.

ABLV transmission myths

Coming into contact with flying-fox droppings, urine or blood does not pose a risk of exposure to ABLV, nor does living, playing or walking near flying-fox roosting areas. Humans are not exposed to the virus if flying-foxes fly overhead or feed in your backyard.

ABLV cannot be contracted from drinking or using water from rainwater tanks that is contaminated with flying-fox faeces. For households using rainwater for food preparation and drinking, the risk of getting gastroenteritis from flying-fox faeces is no different than from other animals such as birds.

ABLV is unlikely to survive outside the bat or in a dead bat for more than a few hours, especially in dry environments that are exposed to sunlight.

The health risk from domestic swimming pools affected by flying-fox faeces can be managed by maintaining effective pool disinfection.

ABLV treatment

Cleaning of a scratch or bite wound from a flying-fox reduces the risk of infection. If bitten or scratched by a flying-fox, wash (not scrub) the wound thoroughly with soap and water for at least five minutes, apply antiseptic. **Anyone that is bitten or scratched by a flying-fox should seek immediate medical advice.**

ABLV prevention

Reasonable and practical steps to avoid exposure to ABLV include the following:

- If you find an injured flying-fox, do not attempt to help the animal yourself or touch it in any way.
- Contact the RSPCA (1300 ANIMAL) or your local wildlife care group/rescuer/carer, or the department (1300 130 372) for assistance.
- Only trained and ABLV-vaccinated people should handle live flying-foxes—most bites and scratches occur when people are trying to help sick or injured flying-foxes.
- Vaccinated people should wear appropriate personal protective equipment to prevent or minimise bites and scratches (**Figure 9**).
- Personal protective equipment may include:
    - thick leather gloves, puncture-resistant gloves (e.g. nitrile) or 'double gloving'
    - long sleeve shirt, long pants and closed in shoes
    - forearm protection (gauntlets) as the forearm is a common site for scratches
    - eye protection.
- All reasonable and practical steps should be taken to prevent unvaccinated people having direct contact with flying-foxes.
- People should only pick up and dispose of flying-foxes if they are certain that they are dead. People have been bitten or scratched by flying-foxes that they assumed were dead.
- Dead flying-foxes should be collected using equipment such as a shovel and/or tongs, then wrapped and placed in a rubbish bin or landfill site, or buried.
- Consider installing first-flush diverters to reduce risk of rainwater tank contamination.

Figure 9. Personal protective equipment should be worn at all times during roost management works

3.4.2 Hendra virus

Flying-foxes are hosts for the Hendra virus which they can transmit to horses. There is no evidence that Hendra virus can be transmitted directly from flying-foxes to humans.

The virus can spread between horses and very rarely from a horse to a person through exposure to bodily fluids of infected horses (Smith et al.,

2014). Horses may become infected through eating food recently contaminated by flying-fox urine, saliva or birth products. The resulting infection can be fatal. The infections are rare which indicates that transmissions may only occur under very specific and extreme conditions.

A pre-exposure vaccination can protect horses against Hendra virus and is readily available through veterinary practices.

Exposure to Hendra virus can also be avoided by ensuring horse feed and water troughs are placed under a roof or cover and away from trees to prevent contamination.

More detailed information regarding potential health risks from flying-foxes is available from Queensland Health on 13 HEALTH (13 43 25 84) or visit the web site: <conditions.health.qld.gov.au/HealthCondition/condition/14/33/14/bats-and-human-health>

3.5 Negative biases

Flying-foxes and bats have been portrayed in numerous books and movies as scary creatures, often alongside vampires or the supernatural. These portrayals, combined with many people across the western world becoming increasingly disconnected from the natural environment, can contribute to a sense of fear and discomfort about flying-foxes. Psychological research (Kahneman, 2011) shows that emotive misinformation, once received, can be very difficult to counter, even with facts.

3.6 Damage to trees

Little red flying-foxes, in particular, can damage and even kill the trees they roost in. Damage to trees can occur quite rapidly especially when large numbers of little red flying-foxes arrive and roost in dense clusters.

Where trees are defoliated, there is increased light penetration allowing seeds from flying-fox faeces to germinate thereby introducing possible weed species (Roberts 2005).

4. Considerations before starting management actions

There are a number of things to consider before undertaking management actions:

- Local governments may—
    - consider developing a Statement of Management Intent (**Section 4.1**)
    - consider whether the roost is located within an Urban Flying-fox Management Area. i.e. does local government have an as-of-right authority to manage the roost? If not, is a flying-fox roost management permit required? (**Section 4.2**).
- Local governments and permit holders may—
    - assess whether they have adequate understanding of flying-fox ecology and behaviour (**Section 4.3**)
    - refer to the flying-fox breeding calendar (**Section 4.4**) and survey the breeding status of flying-foxes at the roost
    - ensure they know the signs of distress in flying-foxes (**Section 4.5**)
    - ensure they know what to do if a heat stress or mass dying event occurs (**Section 4.6**).

4.1. Statement of Management Intent (local governments only)

Local governments may develop a Statement of Management Intent (SoMI) in relation to its plans for roost management. The SoMI enables a local government to declare to its community how it intends to manage flying-fox roosts and flying-fox impacts across its urban areas.

The SoMI may include a broad, general statement of management intent for all flying-fox roosts within the UFFMA. Some local governments may also wish to include a general statement for the areas outside the UFFMAs. Please refer to the SOMI template in **Appendix B**.

Local governments may wish to consider including the following in a SoMI:

- the cost of various management actions, and who would contribute to these costs
- the number of each species of flying-foxes at the roost, and what the local government's intention would be should the flying-foxes be breeding or rearing their young
- the conservation status of the flying-fox species under the *Nature Conservation Act 1992* and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
- whether good outcomes may be achieved with minimal management interventions (such as community education) or moderate management interventions such as 'nudging' or 'buffering' processes.

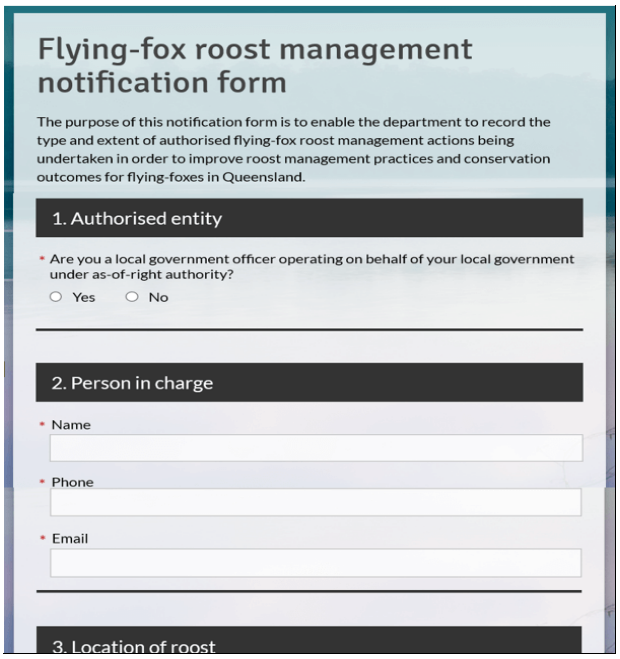
Local governments considering dispersal as a roost management method may wish to include:

- the number of years that flying-foxes have used a particular roost site
- the likelihood of flying-foxes relocating to a site of greater conflict with the community
- if spectacled and/or grey-headed flying-foxes are present (Commonwealth assessment may also be required under the EPBC Act)
- whether flying-foxes at the site might be heavily pregnant or not yet capable of independent flight at the time of year proposed for driving them away
- whether a proposed management action may cause harm to flying-foxes.

The SoMI may include advice to residents, that if a roost is on private land(s), low impact activities may be undertaken under the Code of Practice— Low impact activities at flying-fox roosts.

Should a resident be dissatisfied with a local government's approach at a roost site on the residents' private land, they may apply for a flying-fox roost management permit directly from the department.

Figure 10. The notification form for authorised management of flying-fox roosts is available on the department's website



4.2. As-of-right authority

Roost fidelity

Flying-foxes typically show fidelity to a number of roosts in a region and move between them over time, therefore attempts to entirely remove flying-foxes from a site can sometimes prove challenging and resource intensive, as different flying-foxes continue to visit the site over time.

Local governments have an as-of-right authority to manage flying-fox roosts within designated 'urban flying-fox management areas' (UFFMAs) provided they comply with the Code of Practice— Ecologically sustainable management of flying-fox roosts. (Note: This code includes a requirement to submit a notification form to the department prior to undertaking management actions (**Figure 10**).

4.2.1 Flying-fox roost management permit

All other roost management, either by a local government, or by another organisation or person,

requires authorisation through a flying-fox roost management permit. A permit may be granted for a period of one to three years. Permit holders are also required to submit notification form to the department prior to undertaking management actions (**Figure 10**).

4.2.2 Flying-fox management plan

Local governments may also develop a flying-fox management plan to cover their entire local government area. Such a plan could identify areas where flying-foxes roosts may be problematic and should be discouraged, and identify alternative sites where new roosts may be encouraged or left to establish with minimal intervention.

If such a plan is endorsed by the department as an 'approved property management plan', local governments gain access to extended three-year permits to manage flying-fox roosts (for example, across an entire local government area, including areas outside of UFFMAs).

4.3. Wildlife dimension

Understanding the wildlife dimension (how the animal uses its environment and accepting that wild animals learn and adapt their behaviours) and the human dimension (perceptions, attitudes, values, and knowledge) are critical. These are the two sides of wildlife management that make it complex.

Flying-foxes are intelligent with a good spatial memory that allows them to return to previous roosts and feeding sites. Being highly social, they have the opportunity to benefit from observational learning (Wilson, 2000) following others to food, responding to warnings from individuals who see a predator or other threat.

Management therefore needs to consider flying-foxes as intelligent individual animals, and as social animals communicating with others through sight, sound and smell. Their ability to learn and adapt could affect how flying-foxes respond to a given management action and the cost of resourcing it, and should be considered in contingency planning.

*Figure 11. Flying-fox breeding calendar to assist in determining best times to manage roosts**

	January	February	March	April	May	June	July	August	September	October	November	December
BFF	Young flying on their own	Mating territories formed	Conception		Gestation period - Nomadic movement related to food source				Birth – Young carried for 4-5wks			Most young left at camp (crèched)
GHFF	Young flying on their own	Mating territories formed	Conception		Gestation period - Nomadic movement related to food source				Birth – Young carried for 4-5wks			Most young left at camp (crèched)
SFF	Most young left at camp (crèched)	Young flying on their own	Mating territories formed	Conception		Gestation period - Nomadic movement related to food source				Birth – Young carried for 4-5wks		
LRFF	Gestation period - Nomadic movement related to food source			Birth – Young carried for 4-5wks			Most young left at camp (crèched)	Young flying on their own	Mating territories formed	Conception		Gestation

Key:

- Lower likelihood of heavily pregnant or dependant young being present
- Some likelihood of heavily pregnant or dependant young being present
- High likelihood of heavily pregnant or dependant young being present
- Seasonally lower risk of heat stress events
- Seasonally higher risk of heat stress events

*this is for general information only and timing of behaviours may differ depending on region and climatic conditions. Flying-fox behaviour should be confirmed by a site visit.

4.4. Breeding cycles and critical times

Particular consideration should be given to avoiding major activities at flying-fox roosts during flying-fox breeding and rearing seasons (**Figure 11**).

Reproduction in all Australian flying-foxes is seasonal. The reproductive cycle of black, spectacled and grey-headed flying-foxes usually commences in January, with conception in April or May. Females give birth to single pups in October or November and lactate until approximately March. These dates are indicative and can vary by a month or two regionally.

The breeding cycle of the nomadic little red flying-foxes is out of phase with the other species by about six months.

Individual flying-foxes reach reproductive maturity in the second or third year of life. This low reproductive potential inhibits the capacity of flying-foxes to recover from population declines.

Reproduction in flying-foxes can be disrupted by activities at roosts, therefore where possible, activities should be avoided when flying-foxes are in late stages of pregnancy or rearing their dependant young (**Figure 12**).

4.5. Signs of distress

Distress in flying-foxes may be caused from a variety of factors such as a lack of food, habitat destruction, human disturbance, high temperatures and other climatic extremes. Flying-foxes may respond differently to human disturbance in different circumstances, ranging from being largely comfortable with humans, to scattering at the slightest disturbance.

Indicators of distress in flying-foxes include:

- panting
- wing fanning (**Figure 13**)
- spreading saliva on their body by licking
- moving within two metres of the ground
- laboured flight or flying close to the ground
- remaining within the roost despite continuing causes of distress (e.g. too weak to move or protecting crèched young)
- more than 30% of the flying-foxes taking flight at one time during the day
- flying-foxes flying in circles above a flying-fox roost.

Figure 12. A flying-fox giving birth. Photo courtesy of Nick Edards.

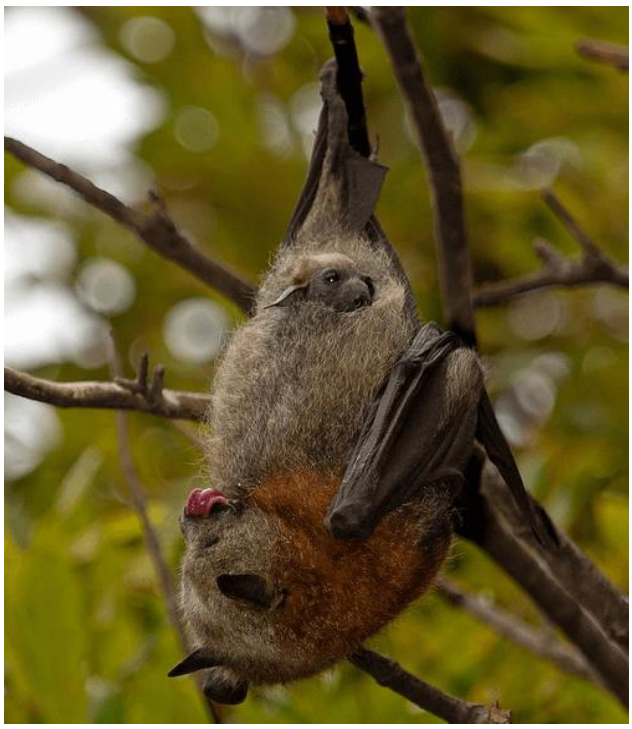


Figure 13. Black flying-fox fanning its wings to keep its baby cool during a minor heat stress event.

Though these are general signs of distress, a person knowledgeable about flying-fox behaviour would be able to determine if this behaviour is normal, or a sign of significant distress.

4.6. Heat stress events

Observations of past heat stress events indicate that flying-foxes suffer from heat stress when the ambient temperatures exceeds 38°C. Fatalities may occur when the temperature exceeds 42°C as the heat gradient reverses (i.e. the flying-fox cannot lose heat from its body as the ambient temperature is greater than its body temperature). Under these circumstances, a flying-fox attempts to reduce its temperature through wing fanning and wetting its body with saliva.

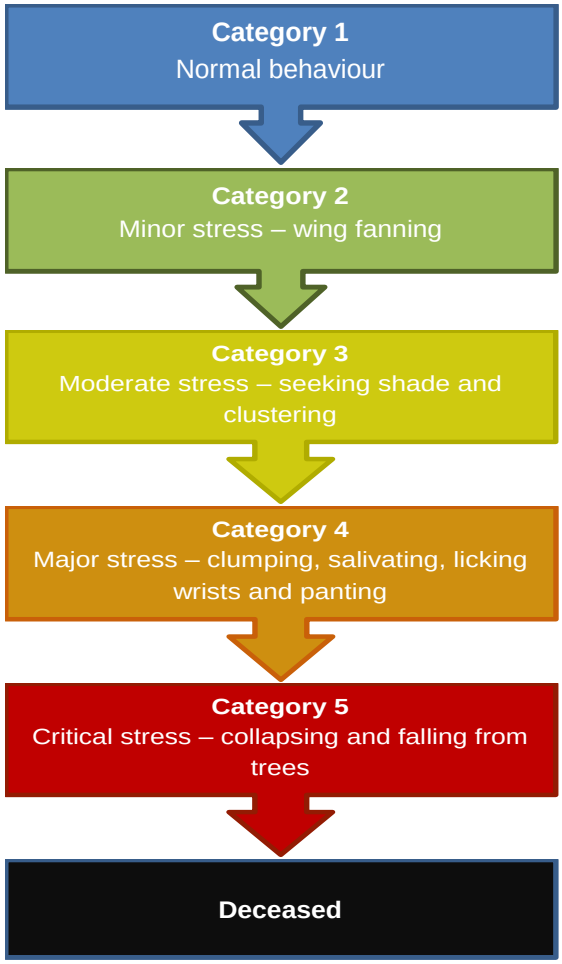
Heat stress events can lead to mass flying-fox deaths. Flying-foxes have been observed falling from trees suffering from hyperthermia or dehydration and dying on the ground (Welbergen *et. al.*, 2008) (**Figure 14**). The stages of heat stress are outlined in **Figure 15** (Bishop, T. *et al.*, 2019).

Figure 14. Mass deaths from a heat stress event. Photo provided by Bats and Trees Society of Cairns.

4.6.1 Relative humidity

Modelling indicates that in certain dry heat circumstances, spraying flying-foxes with water can greatly reduce the risk of dehydration and possible hyperthermia. However, there may be risks with spraying where the relative humidity is high, as it does not allow evaporative cooling to occur. Modelling of the effects of spraying where the relative humidity is

Figure 15. Stages of heat stress in flying-foxes.



70% to 80% indicates spraying could increase the risk of mortality under certain conditions.

4.6.2 Wind speed and shade

Modelling also indicates that relatively low wind speeds can increase the mortality of a heat-stressed roost unless individual flying-foxes have access to deep shade (i.e. 90% shade). It is therefore important that high levels of shade within roosts are retained and improved where possible. Conversely, increased wind speeds combined with low humidity and high temperatures increases dehydration in flying-foxes leading to increased stress and mortality.

While research into heat stress is progressing, there is still need for further investigation into suitable response mechanisms to assist flying-foxes during these events.

4.6.3 Planning for heat stress event responses

There is a range of activities that local governments and the community can undertake in preparation for heat stress events or mass death events in their area:

1 – Monitoring of flying-foxes

Flying-fox roosts should be monitored when the temperature is approaching 38°C. The Western Sydney University and University of Melbourne have developed a heat stress forecaster at: https://www.animalecologylab.org/ff-heat-stress-forecaster.html. In addition, there are other weather information sources that can be used to forecast the temperature in your region, for example, the Bureau of Meteorology. It is important to consider how a specific roost may be affected by changing temperatures. The structure and cover provided by the ground layer, understorey and canopy at a roost will influence what temperatures flying-foxes are exposed to.

> Pregnant females and juveniles are more susceptible to heat stress events. Black flying-foxes have been shown to suffer higher mortalities than grey-headed flying-foxes, indicating a lower tolerance to high temperatures. Little red flying-foxes have been found to have the greatest heat tolerance, coping with increases of 2°C. (Welbergen, 2012, Welbergen et al, 2008).

2 – Communicating with the community

Communicating with the public before, during, and after a heat stress event or mass death is very important. Local governments may consider

- preparing public information and advice in advance of predicted extreme heat.
- releasing media and public information once an event is occurring
- preparing scripts and frequently asked question responses for the local government public enquiries about the event
- publishing information on the local government website and social media pages.

Members of the public should be reminded not to handle flying-foxes. Only a vaccinated person trained in handling flying-foxes should attempt to interact with a flying-fox.

The RSPCA can be contacted on 1300 264 625 to respond to sick, injured, or orphaned flying-foxes.

3 - Mobilising people

When a heat stress event or mass death event occurs there should be a plan identifying the roles and responsibilities of those who will respond. This includes identifying local carers, flying-fox conservation groups, persons knowledgeable about flying-fox behaviour, appropriately trained persons and the person in charge. People not vaccinated against ABLV should be identified and given roles that do not involve contact with flying-foxes. Carers and trained people should be on standby to ensure any flying-foxes that are found alive are handled safely and given to a carer organisation or RSPCA for appropriate rehabilitation.

If there are dead flying-foxes to be removed, they should be checked to see if there are live immature flying-foxes under their wing membranes.

Dead flying-foxes should be removed as soon as possible to avoid public health concerns as well as causing concern and distress to anyone involved in assisting at a heat stress event.

Local government should have a contingency plan in place for how they will dispose of flying-fox remains. Special waste services may be required if a large number of flying-foxes have died.

Local governments are obliged to dispose of dead flying-foxes (and other wildlife) when there is a public health risk on council-managed land.

4 – Human well-being

It is important to plan ahead to ensure the well-being of everyone who may be involved. Heat stress events can be physically and emotionally exhausting for staff. Working with flying-foxes in distress or witnessing them dying during a heat stress event can also be extremely stressful for carers or volunteers.

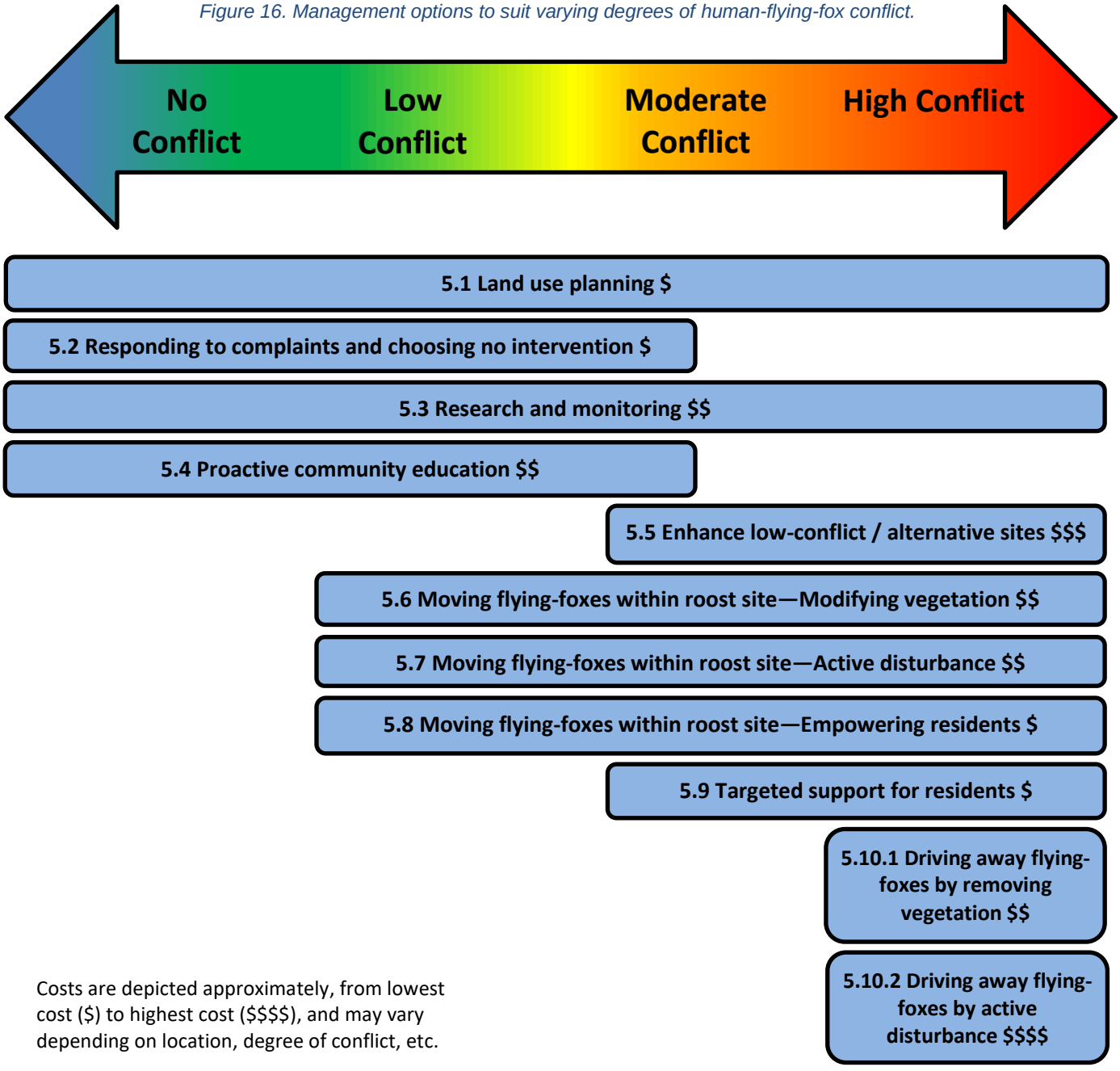
Everyone involved in these events should be given appropriate support during and after the event. Lifeline provides a 24 hour support phone line at 13 11 14.

5. Management options

From a management perspective, all flying-fox roosts have different management possibilities and constraints. Each roost site should be considered on a case-by-case basis through risk assessment and cost-benefit analysis. The management options listed in **Figure 16** can help local governments and permit holders decide the best approach for their situation.

These management options can be used individually however an effective management approach typically requires integrating multiple management options. The level of human–flying-fox conflict, cost, and likelihood of success in your particular circumstances are often the key considerations in determining a preferred management approach.

Figure 16. Management options to suit varying degrees of human-flying-fox conflict.



Costs are depicted approximately, from lowest cost ($) to highest cost ($$$$), and may vary depending on location, degree of conflict, etc.

5.1. Land use planning

To avoid future conflict between residents and flying-foxes, local governments can ensure adequate distances are maintained between future residential developments and existing or historical flying-fox roosts through their planning schemes (**Figure 17**). Refer to **Case study 1** for further information.

Options include:

- the use of zoning/overlays to identify existing or historical flying-fox roost sites.
- implementation of appropriate buffer areas around roost sites
- conditioning development applications to take into account existing roosts
- the inclusion of a note on relevant land titles advising of an adjacent flying-fox roost to - avoid a situation where owners purchase properties without prior knowledge of a flying-fox roost.

Land use planning is a long-term management option and is likely to be acceptable to many communities. It does not resolve existing land use issues however, it will address new issues from as soon as it is put in place.

Many flying-fox roosts have already been identified and are regularly monitored through the National Flying-Fox Monitoring Program. For further information refer to the National flying-fox monitoring viewer.

Case study 1 – Considering roosting habitat and land use conflicts in planning schemes

Advantages

- Use planning instruments to minimise land use conflicts at identified flying-fox roosts

Disadvantages

- Longer term solution – will not solve immediate conflict issues.

Sunshine Coast Council (SCC) in conjunction with the Queensland University of Technology conducted a study to determine what makes an area attractive to flying-foxes as a potential roost site. The results showed that only 12% of the total local government area contained suitable roosting habitat (Saint Ange, 2018).

Of the land that was suitable roosting habitat:

- 27% was a potentially high conflict zone i.e. within 100m of a building.
- 26% was a potentially medium conflict zone i.e. 100 – 300m from a building.
- 47% was a potentially low conflict zones i.e. more than 300m from a building.

This study has highlighted where potential human-bat contact areas are and their likely degree of conflict, and this information may inform future planning and management of development within the SCC.

Figure 17. Accounting for flying-fox roosts in planning schemes can avoid future issues by ensuring adequate distances between roosts and residential development. Image courtesy of Saint Ange, 2018.

5.2. Responding to complaints and choosing 'no intervention'

A local government may assess a roost site and decide that the best management option is to leave it undisturbed, i.e no on-ground or active management interventions. This option is best suited to roost sites which are in lower conflict areas (**Figure 18**). The 'no intervention' approach at higher conflict sites may lead to:

- negative community response to local government inaction
- illegal 'vigilante-style' driving away or culling activity by residents.

The 'no intervention' approach is often best used in conjunction with proactive community education, including speaking with affected residents living near to roost sites. Refer to **Case study 2** for further information.

Figure 18. Some flying-fox roosts become established near, or within, towns but do not significantly impact residents due to the low number of flying-foxes at the site, or due to the distance from houses being adequate.

Case study 2 – Responding to complaints and choosing no intervention

Advantages

- Low cost
- Better informed community if coupled with proactive community education

Disadvantages

- Requires time spent face-to-face or on the phone, with concerned residents
- Will not necessarily satisfy everyone

Many local governments have significant experience in dealing with residents' concerns about flying-foxes. Residents who live close to a particularly noisy or smelly roost may have strong and valid complaints while broader sections of the community may have been exposed to sensationalist media headlines about flying-fox disease, unbearable noise, smell and mess.

When people call to complain about flying-foxes nearby, the conversation should focus on:

- empathising with people's fears and concerns
- finding 'common ground' that shows an understanding of other peoples perspectives
- addressing any misinformation people have absorbed from the media
- building people's understanding of flying-foxes, including the reasons they are roosting close to residential areas, and the limited health risks they pose
- identifying how significant the issue is
- discussing options and likely outcomes of the different approaches available.

In some circumstances, by having the in-depth conversations with the residents living closest to a roost, significant attitudinal change can occur across the broader neighbourhood and can result in decreased levels of complaints overall. In circumstances where no management is the preferred approach, an informed neighbourhood is very important.

5.3. Research and monitoring

Research and monitoring of flying-foxes and their roosts can greatly improve local governments' knowledge and understanding of flying-fox behaviours, population size and seasonal movements. This knowledge is valuable when deciding how to manage different roosts and when talking to concerned residents regarding flying-foxes. Refer to **Case study 3** for information about the department's little red flying-fox research program with CSIRO.

Monitoring flying-fox roosts

When monitoring a flying-fox roost site, local governments should consider gathering the following information:

- species and numbers present
- evidence of mating behaviours, pregnancy and birthing
- presence of dependant young
- general health of flying-foxes, including any signs of distress or heat stress.

An example monitoring report sheet is provided in **Appendix C**.

The department coordinates roost monitoring across Queensland by staff and community members (**Figure 19**) and contributes data on a quarterly basis to the National Flying-Fox Monitoring Program (NFFMP). This project is coordinated by the Australian Government Department of Environment and Energy (DoEE) and Commonwealth Scientific and Industrial Research Organisation (CSIRO). The purpose is to establish a reliable baseline estimate of the flying-fox populations, abundance and distribution, and over time to estimate trends. Monitoring is performed by staff from CSIRO, some LGA's and the department as well as by registered volunteers. If you would like to participate in the National Fling-fox Monitoring Program in Queensland please contact the department by email: wildlife.management@des.qld.gov.au

The data is published in the NFFMP quarterly report and an interactive web viewer presents the census data on the Australian Government – Department of Environment and Energy website. Becoming a part of this program contributes to a collaborative approach for the management of flying-foxes at a national scale. It can also help a local government officer to meet the requirements of a 'person knowledgeable about flying-fox behaviour' under the relevant codes of practice.

Figure 19. Volunteer monitoring at Tooan Tooan roost.

Case study 3 - Flying-fox research

Research plays an important role in understanding flying-foxes. Much of today's general knowledge of flying-foxes has come from pioneering research by Francis Ratcliffe in the 1920-30's (Ratcliffe, 1931).

In 2016, the Queensland Government announced a $2.7 million research program into little red flying-fox migration and behaviour. The program is seeking scientifically-sound information to help improve the way urban flying-fox roosts are managed in Queensland.

$1.8 million of this funding is being used to conduct a four-year scientific study with CSIRO to investigate the movements and behaviour of the little red flying-foxes using satellite trackers. $0.9 million is being used to trial alternative roost management strategies on the ground in Charters Towers.

This research is revealing previously unknown roosts and adding to our knowledge of where little reds forage and roost throughout the year and how they respond to changing environmental conditions. These findings will aid future roost management decisions and flying-fox conservation across Queensland.

5.4. Proactive community education

Proactive community education allows people to learn about flying-foxes and their behaviours and better understand the issues that are associated with flying-fox roosts and their management.

There are two main target audiences for community education: Directly affected residents and the general community.

Directly affected residents can have strong negative attitudes toward flying-foxes. Understanding the residents' position is the starting point for effective community engagement. Understanding their position can help in framing a suitable response (e.g. if a resident is concerned about disease risks then highlighting the broader ecological services that flying-foxes provide will have no relevance to them until their disease concerns are addressed).

The general community, while largely unaffected by roost sites, may react to fears and anxieties regarding flying-foxes which tend to be sensationalised by some media. This may manifest into a general intolerance of flying-foxes by the larger community, and greater pressure to entirely remove flying-foxes without contemplating the practicalities, expense and consequences.

Proactive community engagement needs to acknowledge people's concerns (without portraying flying-foxes in a negatively biased way) then communicate positive, factual information about flying-foxes, and build understanding of flying-foxes themselves, e.g. why they are roosting close to residential areas, the real health risks that they pose, and the unique ecological services they provide. Refer to **Case study 4** and **Figure 20** for further information.

Where possible, use a storytelling narrative in education materials to assist people in absorbing information. For example, flying-foxes ability to carry seeds and pollen long distances makes them unique 'forest builders', helping native forest trees to evolve into the forests that exist today.

It is important to integrate proactive community education into annual management programs so that the right communication message is delivered to the right audience at the right time. For example, if there are predictable annual influxes of large numbers of flying-foxes, community education could be timed to give residents the necessary information before any negative attitudes can 'set in' across the community. E.g. a council may 'letterbox drop' flyers to broad areas around a likely roosting location a few weeks before their predicted arrival with tips and suggestions for directly affected residents regarding smell and mess, plus positive, factual information about flying-foxes.

Case study 4 – Building community awareness about flying-foxes

Advantages

- Cheaper than driving away
- A better understanding and appreciation of flying-foxes leads to reduced complaints.

Disadvantages

- For very high-conflict sites, proactive community education alone is often not enough.

Redland City Council (RCC) promotes positive community awareness about flying-foxes. For example, RCC have installed a series of interpretive signs positioned along a footpath next to their Black Swamp roost. In addition, RCC organise regular fly-out viewings as well as an annual guided Halloween fly-out event. A viewing platform was also constructed to provide a closer look at the flying-foxes.

The department also promotes community awareness about flying-foxes. For example, in October 2019, departmental wildlife officers attended 10 schools in Central Queensland and provided informative presentations to more than 600 students about flying-foxes, including information about feeding behaviour, breeding and rearing behaviour, and health and safety. These sessions were timed to coincide with flying-fox migrations in the region.

Figure 20. Signs installed near a roost by Logan City Council to educate anyone who visits the public space.

5.5 Enhancing low-conflict / alternative sites

Low conflict roost sites can be enhanced, or alternative sites can be developed, to potentially attract flying-foxes to locations where there are less people. This is typically a longer-term management option, with timeframes dependent on the condition of the proposed site, and how long it takes for any planted trees to reach a suitable height**.** Refer to **Case study 5** and **Figure 21** for further information).

Historically, factors influencing camp site-selection by flying-foxes have been poorly understood and attraction of flying-foxes to a specific location has very rarely been achieved (Roberts, 2005). However, a number of researchers have been studying this matter and creating maps using predictor variables such as elevation, forest perimeter, canopy height and distance to water, food and mangroves to highlight potentially attractive roost sites in areas which are less likely to cause human and flying-fox conflict.

Methods to make a site more attractive for flying-fox roosting may include:

- planting suitable local native trees
- removing weedy vines from the mid-storey layer
- ensuring there are appropriate buffers to avoid possible future conflicts
- choosing a site with close access to water and local native food trees such as eucalyptus, melaleucas and banksias.

Works that are being considered within existing roost sites must be conducted in accordance with the Code of Practice— Ecologically sustainable management of flying-fox roosts.

Figure 21. Planting future roosting trees at a suitable site near an existing roost in Hervey Bay.

Case study 5 – Establishing alternative roost sites and enhancing existing roost sites

Advantages

- Establishing alternative roost sites or enhancing existing sites can potentially encourage flying-foxes to move away from a higher-conflict area

Disadvantages

- No guarantee that flying-foxes will choose to roost at alternative/enhanced lower-conflict sites
- These are generally longer-term options

Establishing alternative roost sites

Charters Towers Regional Council is working closely with the department to establish an alternative roost site approximately four kilometres away from the current high-conflict roost site at Lissner Park. The alternative site was selected due to its remoteness, and established trees of the same species as the high-conflict site (mango, tamarind).

To make the alternative roost site even more attractive as a roost, further planned works include:

- planting additional similar tree species to the current high-conflict site, e.g. native *Ficus*
- creating a large, permanent, open water source to allow the flying-foxes to 'dip' and drink
- clearing weeds and unsuitable vegetation
- installing fences to keep out feral animals
- installing a solar powered bore and automatic watering system to ensure the site becomes significantly greener than surrounding landscape.

Enhancing existing low-conflict sites

Moreton Bay Regional Council has undertaken works to enhance an existing roost site at Redcliffe Botanic Gardens. Due to an expanding population of ibis at the same site, flying-foxes were pushed to the edge of the site in closer proximity to surrounding houses.

By removing vines and undertaking selected tree trimming, the ibis nesting areas were reduced and flying-foxes returned to roosting in the centre of the gardens and away from surrounding houses. These works occurred prior to flying-fox breeding season (to minimise disturbance to flying-foxes) and incrementally over five nights (to allow flying-foxes time to adjust).

5.6. Moving flying-foxes within a roost by modifying vegetation

Modifying vegetation is one technique to create a buffer between flying-foxes and houses.

Modifying vegetation can include:

- trimming or removing roost trees nearest to residents
- planting and maintaining low shrubs, grassy areas or mulched garden beds between roosts and residents
- planting a narrow screen of dense vegetation unsuitable as roost habitat

While removing vegetation along the edge of a flying-fox roost can sometimes be an effective buffering tool, it is important to consider the noise and visual barrier that the existing vegetation already provides. In some situations residents have reported increased noise impacts from the flying-fox roost after vegetation removal was completed. A more effective approach may be to begin with selective vegetation removal and continue incrementally until the best balance is achieved. Refer to **Case study 6** and **Figure 22** for further information.

To significantly reduce noise from a roost, a combination of the creation of a small buffer and modifying the affected built environment may sometimes be a cost effective option. For example a creating a 10-20 metre buffer as well as the installation of double glazed windows (see **section 5.9**) for nearby residences.

Figure 22: Works at Tallebudgera showing a grass and shrub buffer being planted along the edge of a roost.

Consider undertaking vegetation modification as soon as the flying-foxes have left the roost, that is, after evening fly-out or after seasonal movement to another roost site. If undertaking this management action whilst the animals are using the site, vegetation modification should be undertaken incrementally over a number of nights after fly-out to mitigate the risks of driving the flying-foxes away.

The person in charge may wish to consider using the 'Checklist for significant management actions' (refer to **Appendix D**) and must ensure that all actions are in accordance with the Code of Practice— Ecologically sustainable management of flying-fox roosts

Case study 6 – Creating buffers by selective vegetation removal

Advantages

- Council is seen to be actively addressing the issue
- Reduced complaints
- Cheaper than driving away
- Council does not need to worry about 'splinter' roosts forming at undesirable locations.

Disadvantages

- Resident and community consultation may be more time consuming

Prior to 2010, the Sunshine Coast Council (SCC) had attempted three times to drive away flying-foxes from different roosts at an estimated total cost of over $350,000. In 2010, a large number of little red flying-foxes joined the Emerald Woods roost, leading to heightened conflict between flying-foxes and nearby residents.

SCC decided to undertake selective tree removal at the Emerald Woods roost to create a buffer. First, a 10m buffer was created. Then, following community meetings about the buffer's effectiveness, it was increased to 30m behind the primary impacted property through further selective tree removal. In late 2015 canopy mounted sprinklers were added to the buffer area to better maintain the distance between residents and flying foxes.

Maintenance of the buffer is undertaken each April when the flying-foxes seasonally abandon this roost.

5.7. Moving flying-foxes within a roost by active disturbance

Instead of attempting to drive away flying-foxes entirely, local governments may wish to consider minor active disturbance techniques to move flying-foxes a short distance to a lower conflict location within the existing footprint of the roost, for example, moving flying-foxes to neighbouring trees, or further along a continually vegetated corridor. This is sometimes referred to as 'nudging'. Refer to **Figures 23** and **24**.

This technique requires a coordinated approach of low-level disturbance from a specific direction, for example, through using sprinklers, light and/or scarecrow devices approaching from one side of the roost, typically at a time when flying-foxes have settled in at the roost site for the day for example during mid-morning. If disturbance levels and techniques are appropriate, flying-foxes will move away from the disturbance without being driven away from the roost.

Attempts to move flying-foxes within a roost should typically be avoided early in the morning. If too close to 'fly-in' time, there is a higher risk of inadvertently driving away flying-foxes (Ecosure, 2015), which could lead to flying-foxes roosting in other undesirable locations Councils may wish to consider limiting all actions intended to move flying-foxes within a roost to twice a day or less with regular rest days of no disturbance. Excessive disturbance could cause the flying-foxes to leave the roost and create another splinter roost.

It is advisable to avoid carrying out dispersal actions when flying-foxes are heavily pregnant, have dependant young, or during extreme climatic occurrences such as heat events, fires, floods or periods of extreme food shortage.

The person in charge may wish to consider using the 'Checklist for significant management actions' (refer to **Appendix D**) and must ensure that all actions are in accordance with the Code of Practice— Ecologically sustainable management of flying-fox roosts

Case study 7 – Canopy mounted water sprinklers on timers

Advantages

- Reduced complaints
- Cheaper than driving away flying-foxes
- Council does not need to worry about 'splinter roosts' forming at undesirable locations.

Sunshine Coast Council has installed canopy-mounted sprinklers in a roost at Mooloolaba. The sprinklers were installed at the height flying-foxes typically roost and are on an automatic timer. They have proven very effective in creating a buffer between the flying-foxes and residences with minimal vegetation removal. (Refer to **Figures 24** and **25**).

Figure 23: Original roost footprint (before installation of sprinklers).

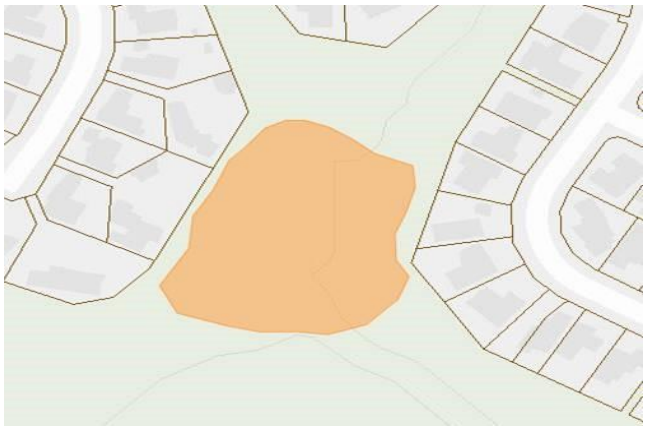


Figure 24: New roost footprint after use of sprinklers. (Pink dots denote placement of sprinklers behind the most impacted residences; purple shows spray arc of sprinklers).

5.8. Moving flying-foxes within a roost by empowering residents

Providing direct control over how close to homes flying-foxes are able to roost has proven to be a successful low-cost way of resolving issues for many directly affected residents. Directly affected residents are those whose properties closely adjoin a flying-fox roost (e.g. within 100 metres of a roost

The use of tree mounted sprinklers or flood lighting, for example, to deter flying-foxes from using certain areas is most suitable for permanent roost sites where there are suitable neighbouring trees for flying-foxes to move into for roosting.

Opportunities to provide directly affected residents with greater involvement in roost management should be considered under the following circumstances:

- if there is a mechanism whereby the residents can 'self-manage' the issue
- if this can be achieved without any risk to the residents or flying-foxes.

Refer to **Case study 8** and **Figure 25** for further information.

Figure 25. Sprinklers being installed in trees by Sunshine Coast Council

Case study 8 – Empowering directly affected residents

Advantages

- Less need for more costly management actions
- Creates a 'working relationship' between residents and flying-foxes.
- Cheaper than driving away / dispersal

Disadvantages

- May sometimes need to be combined with other management options such as double glazing windows (see **section 5.9**)

North Burnett Regional Council and Sunshine Coast Council and have both found strategies that work to decrease complaints about flying-foxes by empowering residents to maintain appropriate buffers between residences and the flying-fox roosts.

- North Burnett Regional Council has positioned mobile floodlights to light up the canopy of trees adjoining buildings close to a motel and school in Monto and advised the school to turn on their floodlights at night to discourage flying-foxes from extending their roost footprint into these trees. A council officer observed that roosts were often established where it was dark and quiet, for example, where buildings and business premises were unoccupied and unlit at night. The use of lighting has established effective buffers and are being maintained at the motel and school.
- Sunshine Coast Council has installed canopy-mounted sprinklers within a roost site abutting residential properties. The residents are able to turn the sprinklers on whenever they deem the flying-foxes to be too close to their properties. SCC pays for the installation and maintenance of the sprinklers and residents pay for power and water usage.

Both of these approaches have addressed flying-fox complaints by empowering the directly affected residents and giving them a solution 'at the flick of a switch'.

5.9. Targeted support for residents

Local governments may consider offering financial or in-kind support to residents living immediately beside a roost. A relatively small spend (compared to the cost of driving flying-foxes away) can significantly reduce complaints. Some items or services it may be appropriate to subsidise for residents include:

- sound barriers such as double-glazing (**Figure 26**)
- air-conditioners and air fresheners
- high pressure hoses for cleaning
- car awnings
- shade structures and covers for outdoor living areas
- rate reductions or subsidies.

A targeted support management approach has been used successfully in a number of situations and has fostered good relationships between residents and the local government (Refer to **Case study 9**).

In many cases, this is a far more cost effective way of mitigating the effects of flying-foxes than attempting to drive flying-foxes away.

Figure 26: Providing double-glazed windows/doors and air conditioners to affected residents can be a more cost effective way of mitigating the effects of noise and smell than driving away flying-foxes.

Case study 9 – Small grants

Advantages

- Local governments seen to be proactively addressing the issue
- Improved amenity for those choosing incentives
- Reduced complaints from residents
- Cheaper than driving away / dispersal

Noosa Shire Council received a number of complaints about flying-foxes from residents near the Wallace Park Bushland Reserve in Noosaville.

Acknowledging that attempting to drive away flying-foxes was not a practical solution, council responded to these concerns with vegetation works that increased the buffer width between the flying-foxes and residential housing. Sprinkler systems were also installed to further extend that buffer.

In addition, council initiated a subsidy program to help neighbours who were being impacted by the flying-foxes. Residents within a 100metre radius of the reserve boundary were able apply for items and services such as clothesline covers, a solar panels cleaning service or pressure cleaners for driveways and outside furniture.

This initiative was well received by neighbouring residents and helped reduce much of the conflict over the issue for a total spend of $7,000.

5.10. Driving away flying-foxes

Driving away flying-foxes from a high-conflict roost site (sometimes referred to as dispersal) is a management approach that nearby residents often desire and a management approach local governments have previously considered their best, or only, option.

While in some cases it may be a viable option, over recent years there has been a gradual shift by many local governments toward other management options due to the expensive and unpredictable nature of attempting to disperse flying-foxes. For example, moving flying-foxes *within* a roosting site to put a greater distance between residents and flying-foxes (i.e. creating a buffer) is often equally effective in resolving nearby resident complaints and far less costly. See **section 5.6**, **5.7** and **5.8**.

5.10.1. Driving away flying-foxes by removing vegetation

One approach to ensure that flying-foxes won't return to a site is to render it completely unsuitable for roosting. This may be achieved by:

- complete removal of roost trees
- removal or trimming of a very large proportion of roost trees
- modification of a very large proportion of the mid or understorey to alter the microclimate at the site.

It is recommended that works are undertaken after evening fly-out and carried out incrementally over a number of nights, or after a seasonal roost site has been vacated. Refer to **Case study 10.1** and **Figures 27** and **28** for further information. The removal of vegetation should be significant. For example, the successful driving away of flying-foxes by Gold Coast City Council at the Bundall roost site required up to 90% vegetation removal.

The person in charge may wish to consider using the 'Checklist for significant management actions' (refer to **Appendix D**) and must ensure that all actions are in accordance with the Code of Practice— Ecologically sustainable management of flying-fox roosts

Case study 10.1 – Driving away flying-foxes by removing vegetation

Advantages

- Council seen to be proactively addressing the issue.
- Reduced complaints and improved amenity

Disadvantages

- Potential for formation of 'splinter roosts' in equally bad or worse locations.
- Costly and time-consuming.
- Potential negative impacts on flying-fox welfare.

In 2010 a roost of between 200 and 4,500 black and grey-headed flying-foxes established within the Gold Coast Equine Precinct. At that time, a vaccination against Hendra virus had not been available and a risk assessment found a very high risk of Hendra virus infection, warranting an attempt to drive the flying-foxes away.

Gold Coast City Council and its contractor progressively removed vegetation within the roost at night while the roost was vacant. Flying-foxes abandoned the camp after approximately 70% of canopy trees and 90% of understorey vegetation was removed. To reduce the likelihood of roost re-establishment, the canopy was further reduced by up to 90% in parts of the roost site. Flying-foxes from that roost are thought to have been amalgamated into one of several nearby roosts. This approach cost approximately $250,000.

Figure 27: Roost site at Boonah before management actions.

Figure 28: Roost site at Boonah after Council decision to remove significant amounts of the vegetation at the site. Photo courtesy of Justin Welbergen.

5.10.2. Driving away flying-foxes by active disturbance

Driving away flying-foxes by active disturbance is a complex process that has been attempted, often with limited success, at many locations in Australia using methods including sound, physical disturbance, noise, pyrotechnics, smell, taste, visual and a combination of all of the above. Refer to **Case study 10.2** and **Figures 29, 30**, and **31** for further information.

Active disturbance techniques that are too simple or predictable can lead to flying-foxes quickly learning and habituating to the techniques. Active disturbance appears to be more successful when using a variety of techniques with variable timing.

Early intervention

Acting early (e.g. in the first week) before a new roost firmly establishes in an undesirable location is often a key factor in successfully driving away flying-foxes by active disturbance.

Local governments that monitor flying-foxes may be better able to detect the early formation of new roost sites and 'splinter roosts'. This would enable the local government to plan and respond more quickly using appropriate active disturbance techniques for the new site. Please note – Driving away flying-foxes from a site requires submitting a notification form prior to management actions in accordance with the Code of Practice— Ecologically sustainable management of flying-fox roosts

Case study 10.2 – Driving away flying-foxes using active disturbance

Advantages

- Council seen to be proactively addressing the issue.
- Reduced complaints and improved amenity

Disadvantages

- Potential for formation of 'splinter roosts' in locations that create even greater conflict in the community.
- Costly and time-consuming.
- Potential negative impacts on flying-fox welfare.
- High possibility of flying-foxes returning to the site unless active disturbance techniques are continued for a period of months or years after the flying-foxes have vacated the roost.

In 2013 the Pittsworth District Alliance attempted to drive away flying-foxes from the town of Pittsworth.

After a period of a week of coordinated effort, the Pittsworth community successfully dispersed thousands of flying-foxes from their backyards to other surrounding low conflict areas.

Active disturbance methods included: - spotlights, floodlights, banging of saucepans, smoke drums, stock whips, gas guns, Bird Frite, whipper snippers, lawn mowers.

Active disturbance methods for driving away flying-foxes:

Noise disturbance. Temporally and spatially random noise has been shown to be effective in a number of circumstances (**Figure 29**). However, it can be labour intensive and/or costly. The installation of high-frequency emitting bat repellents has repeatedly been trialled however, flying-foxes do not use echolocation and high frequency sounds are inaudible to them. In fact, a flying-foxes hearing range is similar to that of humans, therefore, sounds that can potentially disturb flying-foxes may have an equally disturbing effect on

humans. Consequently, noise disturbance may be met with limited popularity in the community.

Figure 29: Operating a gas gun for noise disturbance as part of a coordinated attempt to drive away flying-foxes.

Water sprinkler disturbance. Sprinklers mounted in roost trees and set on automated random cycles may be effective. While they may initially be labour intensive, they may have a lower long term cost than other options. Costs will vary depending on the size and location of the site as sprinklers may need to be installed in multiple trees across a site.

Smoke/fogging disturbance. Smoke and/or fogging machines (which disperse non-toxic paraffin into the air), and smoke from small fires (**Figure 30**), has been used widely and somewhat effectively as labour and material costs are typically low. Success with these techniques can be greatly influenced by wind direction and speed, with windy conditions making it difficult to direct smoke into roost trees. These methods benefit from being mobile, therefore if using this method try to mobilise smoke/fog machines and small fires so that they may be transported quickly to disturb flying-foxes in various locations as required.

Visual disturbance. The use of visual disturbance techniques during active dispersals has had little success. However, North Burnett Regional Council has reported some success with using flood lights to create buffers between buildings abutting a flying-fox roost (refer to **Case study 8)**. Other visual techniques trialled have included hanging reflective objects such as CD's and plastic bags in trees, strobe-lighting and high intensity sweeping floodlights. All showed low and usually localised effectiveness resulting in flying-foxes quickly habituating to the disturbance.

Figure 30: Using a 'pull fire' for smoke disturbance as part of a coordinated attempt to drive away flying-foxes

Disturbance using smell. The use of smell deterrents has had variable success. Flying-foxes have been known to avoid the smell of PCB (paradichlorobenzene) found in toilet deodoriser blocks and the smell of aluminium ammonium sulphate found in common animal deterrents. However, in both these instances, the effect is usually localised and expensive to implement as large amounts of chemicals are required across large areas. Kerosene, fish paste and snake faeces have also been trialled. All showed low and localised effectiveness and in the absence of any actual threat the flying-foxes quickly habituated to the disturbance.

Bird scare disturbance. Bird scare cartridges have proven successful in some attempts to drive flying-foxes away, however this technique must be used only in accordance with the instructions. These cartridges should never be fired directly at flying-foxes or at a roost. Instead, they should be used in a coordinated way to 'herd' flying-foxes in a particular direction.

Drone disturbance. Drones have been used to manage wildlife such as sharks in Australia and seals and bears in other parts of the world. Further trialling is needed to understand how they might safely and effectively be used for flying-fox management (**Figure 31).**

Figure 31: Drones have potential uses in flying-fox management. More trialling is needed to understand how they might be used safely and effectively.

5.10.3. Driving away flying-foxes—is it the right approach in your situation?

In some situations, driving away flying-foxes may in fact be the preferred option. For example, where there are significant health or safety concerns, and other management options have been unsuccessful.

The biggest issues associated with attempting to drive away flying-foxes is cost and the uncertainty of outcomes. For example, attempts to drive away flying-foxes can cost $100,000 to $200,000 per attempt, with no guarantee of success, and flying-foxes can sometimes disperse to 'splinter roosts' at equally or even more unsuitable locations (Perry, 2012) leading to further management costs.

The underlying reason why attempts to drive away flying-foxes often fail is that people often don't want all the trees at a roost site removed, so the chosen approach is to attempt to drive away flying-foxes by active disturbance (see **section 5.10.2**).

Driving away by active disturbance alone is difficult. This is because the individual flying-foxes at a site change from day-to-day. So while active disturbance appears to work on day one, day two brings new individual flying-foxes to the site that also need to be driven away, and so on in a continuing daily cycle (Roberts et al., 2012b). Also, without continued (often costly) efforts at the site, the flying-foxes that were successfully driven away on day one may also eventually return to the site as flying-foxes have a high level of fidelity to previously used roost sites.

Attempts to drive away flying-foxes may be more successful when using a combination of significant vegetation modification (refer to **section 5.10.1**), and significant active disturbance (refer to **section 5.10.2**).

If considering attempting to drive away flying-foxes, local government should consider monitoring the initial roost site and surrounding areas (up to approximately 6kms) to enable a rapid response to the establishment of any 'splinter roosts' in unsuitable locations.

Attempts to drive away flying-foxes seem to be more successful with roost sites that are newly established (e.g. within the first week). For more well-established roost sites where flying-foxes have roosted for multiple years, local governments may need to continue some degree of ongoing management at the site for months or several years before flying-foxes permanently stop using a site.

In recent years, many local governments have begun investigating alternative and more innovative solutions. One of these solutions involves moving flying-foxes short distances within an existing roosting site to create a 'buffer' between the flying-foxes and residents. Research suggests that the creation of a 10 metre buffer may help mitigate smell and mess (Pearson. T & Cheng. K, 2018). A greater distance may be needed to help with issues of noise, however window glazing can also be used to mitigate noise (see **section 5.9**). For more information on ways to move flying-foxes within an existing roost see **sections 5.6**, **5.7**, and **5.8**.

6. Considerations during management actions

6.1. Compliance with laws

Ensure that you are aware of the laws applying to the management actions you are undertaking as non-compliance may have legal consequences.

You may wish to consider the following to ensure you are operating within the scope of the law.

- Code of Practice— Ecologically sustainable management of flying-fox roosts
- Code of Practice— Low impact activities at flying-fox roosts,
- conditions of a flying-fox roost management permit you may have been issued.
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Vegetation Management Act 1999*
- Local laws

6.1.1 What is a flying-fox roost?

The *Nature Conservation Act 1992* defines a flying-fox roost as 'a tree or other place where flying-foxes congregate from time to time for breeding or rearing their young'.

Some questions a person or organisation may wish to consider in determining whether a particular tree may meet the definition of a flying-fox roost include:

1. Is the tree currently occupied by flying-foxes that may be breeding or rearing their young? To determine this you may wish to consider:
   a. Is it in a month that is typically breeding or rearing time for the species?
   b. Has a site visit occurred to check for breeding activity, pregnancy, crèched young, dependant young?
   c. If in doubt, have you considered consulting an expert?
2. Has the tree previously been occupied, for example in this season or last season, by flying-foxes who may have been breeding or rearing their young? To determine this you may wish to consider:
   a. Is the site listed on the National Flying-fox Viewer as previously used for roosting <http://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf>?
   b. Are there any other known records of flying-foxes using this site?
   c. If in doubt, have you considered consulting an expert?

If you are satisfied that a tree does not meet the definition of a flying-fox roost, the roost management framework does not apply. However, other laws may still apply, for example, it is an offence to kill or harm wildlife under section 88 of the *Nature Conservation Act 1992*.

In the absence of complete information, a person or organisation may sometimes wish to act cautiously and manage the tree as if it were a flying-fox roost. A person or organisation is responsible for ensuring they are compliant with all relevant laws.

6.2. Work stoppages and recommencement

6.2.1 Work stoppages

The relevant codes of practice require work to stop in a range of circumstances, for example, under both codes work must stop when a flying-fox is found dead, injured or on the ground, and for low impact activities work must stop when flying-foxes remain airborne for five minutes or more.

In all circumstances where flying-foxes leave a roost and remain airborne for some time, it is important to record how long they remain in the air due to the potential for flying-foxes to over-exert or overheat during extended periods of 'active' flight. Refer to the relevant codes of practice regarding stopping work under these circumstances. See inset 'the energetics of flight in flying-foxes' for further information.

The energetics of flight in flying-foxes

A flying-fox requires a lot of energy to fly, with about 25% of its energy being used in the actual 'work' of flying and the rest lost as heat. Flying-foxes feed on high water content food such as nectar which is heavy to carry in flight.

Flight muscles need oxygen to metabolise. In flight, flying-foxes breathe in with each power stroke and this provides enough oxygen to maintain 'cruising' flight. At lift off and during 'active' flight, flying-foxes increase wing beat cycle and their breathing rate. This extra exertion creates an oxygen demand that is greater than it can be supplied and heat builds up in the flight muscles. When a roost is disturbed, flying-foxes can remain in 'active' flight mode, their body temperature can rise sharply, and overheating or even death can sometimes result. High temperatures and humidity can sometimes further compound this issue.

Thomas, S.P. (1975). Thomas, S.P. (1980). Wilson, D.E. and Gardner, A.L. (eds.). 1980.

6.2.2 Notifications to the department

Where work is required to stop under a relevant code of practice, the department must be notified. A simple notification email is all that is required to be submitted (see inset below). The department will contact you if further information is required.

Example work stoppage notification:

Hi, I am writing to notify you that one flying-fox has been injured while undertaking [insert activity] at [insert location].

We have ceased activities and intend to recommence [in x hours / tomorrow].

[name, organisation]

6.2.3 Determinations by the person in charge

Where work is required to stop under a relevant code of practice, the person in charge must determine whether recommencing work would pose a risk to other flying-foxes. The person in charge should consider the following questions:

- If the cause of the injury, death or lifting of flying-foxes is known, can the management action be altered to limit repeat incidents?
- Are any flying-foxes displaying distress behaviours, for example, continual lifting out of the trees, clustering or 'clumping', panting?
- Have flying-foxes been airborne for a period of time that may lead to exhaustion?
- If the conditions are currently hot or humid, are the flying-foxes displaying any signs of heat stress, for example, panting, fanning their wings, licking wing membranes.
- Are there any other factors you are aware of that might make recommencing works a significant risk to other flying-foxes?

The decision tree at **Figure 32** may also be of assistance.

6.3. Person knowledgeable about flying-fox behaviour

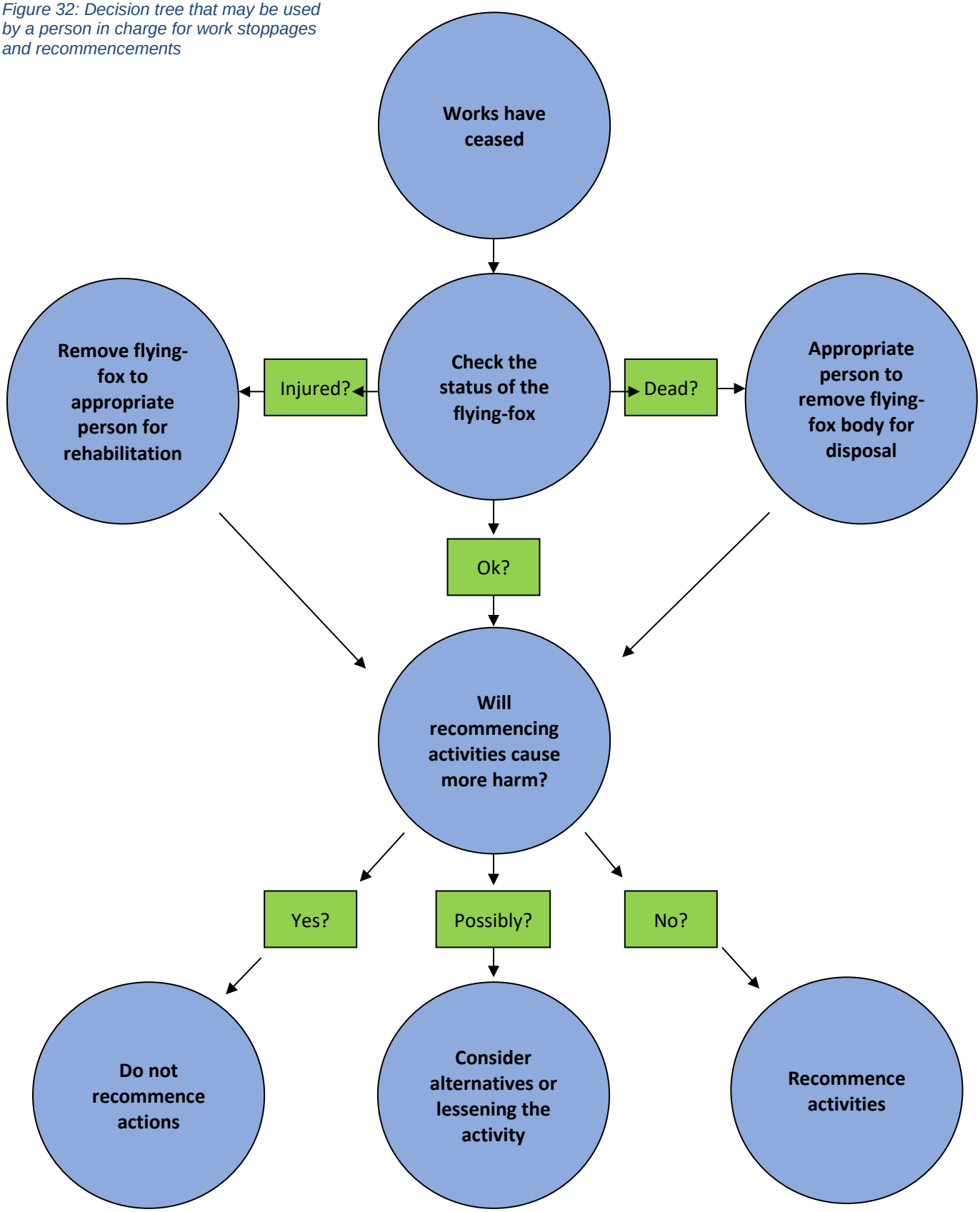
Under the Code of Practice— Ecologically sustainable management of flying-fox roosts, if attempting to drive away flying-foxes, a person knowledgeable about flying-fox behaviour is required on site for the first two days and required to be available for the remainder of the time to provide advice to the person in charge.

Attempts to drive away flying-foxes can be unpredictable, unsuccessful, and can sometimes lead to the creation of multiple 'splinter roosts' in new, sometimes undesirable, locations. A person knowledgeable about flying-fox behaviour should be able to recognise flying-fox behaviours that indicate how they are responding to management actions, and provide advice to the person in charge.

There are several organisations and groups that may be able to provide details of persons knowledgeable about flying-fox behaviour in your local area:

- Australasian Bat Society Flying-fox Expert Group

Figure 32: Decision tree that may be used by a person in charge for work stoppages and recommencements



- Bat Rescue Qld
- Bat Conservation and Rescue Inc.
- Bats and Trees Society of Cairns.
- Cairns and Far North Environment Centre
- CSIRO
- Environmental consulting organisations
- North Queensland Wildlife Care Inc.
- Tolga Bat Hospital
- Wildlife Preservation Society of Queensland.

This list is not exhaustive or an endorsement of any particular group. Further research may provide contact details for persons knowledgeable about flying-fox behaviour in your local area.

6.3.1 Who can be considered a 'Person knowledgeable about flying-fox behaviour'?

A person knowledgeable about flying-fox behaviour is defined in the relevant codes of practice as a person able to demonstrate experience in successfully:

a) classifying flying-fox species
b) assessing flying-fox population numbers in particular roosts
c) identifying flying-fox breeding cycles including evidence of breeding and rearing activity in particular roosts
d) recognising signs of (and circumstances which may result in)—
    - distress in flying-foxes, and
    - harm to flying-foxes, and
    - abandoned dependant young flying-foxes.

A person knowledgeable about flying-fox behaviour may be a local government employee.

To assist in determining if a person meets this standard, some considerations may include:

a) classifying flying-fox species

Are they able to identify (individually and within a roost) the different characteristics of:

- black headed flying-foxes?
- grey headed flying-foxes?
- little red flying-foxes?
- spectacled flying-foxes?

b) assessing flying-fox population numbers in particular roosts

Are they capable of conducting a roost survey using the following counting methodologies:

- total animal count?
- individual animal count per tree multiplied by number of trees?
- Area or length count multiplied by total roost area or roost length?
- fly-out count?

Are they able to determine the most appropriate counting methodology in particular circumstances by taking into account:

- the size of the roost?
- the accessibility of the roost?
- visibility at the roost?
- the extent to which the animals tolerate the disturbance of surveying?

c) identifying flying-fox breeding cycles including evidence of breeding and rearing activity in particular roosts

Are they able to recognise population structures within a flying-fox roost including:

- pregnant females?
- a flying-fox crèche site after fly-out?
- the sex of adult flying-foxes?
- adults, independent and dependant young?
- vocalisations within a roost, for example, mating vocalisations, vocalisations of young to their mothers and vice versa?

d) recognising signs of (and circumstances which may result in)—
    - distress in flying-foxes, and
    - harm to flying-foxes, and
    - abandoned dependant young flying-foxes.

Are they able to recognise each of the following behaviours as being a possible indicator of distress or harm:

- flying-foxes hanging lower in trees, closer to the tree trunk or nearer to the ground than normal?
- clustering or 'clumping' of flying-foxes?

- panting due to prolonged flight?
- panting due to heat stress?
- licking wrists and wing membranes?
- continual lifting out of the trees?
- distress vocalisations such as juveniles calling out for lost mothers, barking sounds from adults, increase in noise due to flying-foxes fighting for space?

6.4. Appropriately trained person

An 'appropriately trained person' is a person with experience and training in safe handling of flying-foxes and who is appropriately vaccinated.

Should an appropriately trained person be required, the person in charge should consider whether that person is appropriately vaccinated, and has the necessary experience and/or training to safely and competently handle flying-foxes on site. Some considerations may include:

- Do they have experience in handling sick or injured flying-foxes?
- Do they have appropriate personal protective equipment?
- Do they have appropriate vaccinations?

The groups listed in **section 6.3** may be able to provide details of appropriately trained persons in your local area. Further research may provide contact details for appropriately trained persons in your local area.

6.5. Considering critical timeframes and threatened species

Condition 2.6 in both of the relevant codes of practice includes compulsory considerations in certain circumstances, i.e. for management and activities:

- during certain times of the year, for example, when flying-foxes are in the late stages of pregnancy or there are dependant young present
- during or immediately after events such as high temperatures, food shortages, cyclones and bushfires
- which may negatively affect the conservation of flying-fox species listed as threatened wildlife under the Act.

Consider documenting your decision making process to ensure thorough compliance with condition 2.6 of the code.

As a guide, you may follow these steps:

Step 1: Identify the flying-fox issue you believe requires management, and think about what your preferred outcome would be, along with some other acceptable outcomes.

Step 2: Think about all of the management options available for achieving one of these outcomes. See section 5 of this guideline for information.

Step 3: In your particular circumstances, weigh up the potential benefits against potential negative impacts of each management option, such as, risks to people in the community, risk to flying-foxes, risks to staff required to undertake the action, financial cost, time, resources, timing of the management action, etc.

Step 4: Determine the preferred option.

Step 5: Create a plan for implementing the preferred option including contingency planning.

If you are unsure whether you have properly considered the matters, it is recommended that you seek advice from a 'person knowledgeable about flying-fox behaviour'.

6.6. Public safety and wildlife rescue

Members of the public are discouraged from approaching or disturbing flying-foxes themselves and may wish to contact their local government if they have an issue with flying-foxes on, or close to, their property.

If you find a flying-fox on your property that is sick, injured, orphaned, or appears dead, take the following action:

- Never approach or disturb flying-foxes.
- Contact an authorised wildlife carer or RSPCA Qld (1300 264 625) to remove the animal.

- In any situation where flying-foxes are found to be sick, injured, orphaned, or appear dead, notify the department (refer to **section 6.2.2**) and RSPCA Qld (1300 264 625).

A flying-fox must be euthanised if it is:

- sick or injured to the extent that the animal is unable or unlikely to recover from the sickness or injury
- unable or unlikely to survive in the wild because the animal is orphaned and cannot be rehabilitated for eventual release into the wild.

Euthanasia by barbiturate overdose must only be performed by a veterinary surgeon or a competent and appropriately trained person authorised by the chief executive of Queensland Health to possess and use restricted drugs for veterinary purposes.

Refer to the Code of practice - Care of Sick, Injured or Orphaned Protected Animals in Queensland for further information: https://environment.des.qld.gov.au/wildlife/animals/caring-for-wildlife

6.7. Disease

If you sustain a bite or scratch from a flying-fox, it is very important that you:

1. Wash the wound thoroughly with soap and water for at least five minutes
2. Apply an antiseptic with antiviral action (e.g. povidone-iodine or alcohol)
3. Seek urgent medical attention from a doctor or nearest Public Health Unit (https://www.health.qld.gov.au/system-governance/contact-us/contact/public-health-units). Further information is available by calling the 13HEALTH information line (13 432584)

For further general information relating to flying-foxes and human health please refer **Section 3.3** and the Queensland Health website at: http://conditions.health.qld.gov.au/HealthCondition/condition/14/33/14/bats-and-human-health

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Definitions

Some terms from nature conservation legislation and relevant codes of practice are used in this guideline (such as management action, person in charge, and appropriately trained person). To remove any doubt when they are used in this guideline they have the same meaning as in the nature conservation legislation and codes of practice.

Appendix A: Flying-fox identification and distribution maps

Little red flying-fox (LRFF)

Identifying features:

- Reddish brown to dark brown.
- Fur on neck, shoulders, around the eyes and under the wing varies from brown to yellow. The top of the head tends to be grey.
- Distinguishable from other common flying-foxes by its small size; forearm length 125–156 mm and head and body length 195–235 mm.
- There is little to no fur on the legs.
- The ears are prominent.

Black flying-fox (BFF)

Identifying features:

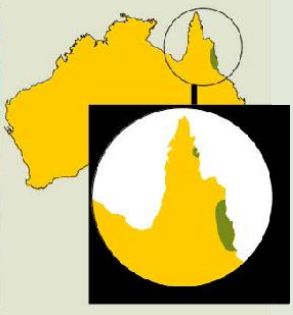
- Short black fur with a slight silver frosting in older individuals.
- Brown rings around the eyes are found on some individuals which usually have dark grey-brown to light yellow hind neck and shoulder fur.
- There is no fur on the lower leg of this species.
- Largest of the Australian flying-foxes with a forearm length of 150–191 mm and a head and body length of 240–280 mm.

Grey-headed flying-fox (GHFF)

Identifying features:

- Head and body covered in thick grey fur, with a reddish-yellow collar completely encircling the neck.
- Fur extends to the ankle.
- Large species with a forearm length of 138–180 mm and a head and body length of 230–289 mm.

Spectacled flying-fox (SFF)



Identifying features:

- Almost black with prominent yellow neck ruff and prominent straw-coloured fur surrounding the eyes and along the muzzle. The ruff and head is silver-blond in some individuals.
- Yellow rings (spectacles) around the eyes.
- There is no fur on the lower leg of this species.
- Size of forearm is 160–189 mm and head and body length is 220–240 mm.

Appendix B: Statement of Management Intent - Flying-fox roost management

Statement of Management Intent

for

Flying-fox roost management

in

[INSERT NAME OF LOCAL GOVERNMENT]

This Statement of Management Intent was endorsed on [date] and has effect from [insert date of commencement] until superseded

[Local government logo or other signifier may be inserted here]

[INSERT NAME OF LOCAL GOVERNMENT]

1. Authority

Under the *Nature Conservation Act 1992*, local governments in Queensland have an as-of-right authority to undertake roost management at flying-fox roosts in designated Urban Flying-Fox Management Areas (UFFMAs) provided they comply with the 'Code of Practice – Ecologically sustainable management of flying-fox roosts'. An UFFMA for a local government area is defined by maps available from the website of the Department of Environment and Science (the department).

Outside an UFFMA, a local government requires a flying-fox roost management permit (FFRMP), available from the department. A local government also has the option to apply for a FFRMP should it wish to use roost management techniques that are not covered by the Code of Practice. A landholder requires an FFRMP irrespective of whether the roost is within the UFFMA or not.

Further information on the Queensland Government's roost management framework is available at the following webpage:

< https://environment.des.qld.gov.au/wildlife/animals/living-with/bats/flying-foxes/roost-management >.

The Statement of Management Intent (SoMI) will articulate the approach the local government intends to take with respect to roost management across the UFFMA, any rationale the local government considers appropriate to declare and any specific plans local government has in relation to roost management.

2. Purpose

The purpose of this SoMI is to articulate the approach that [insert name of local government] will take to the management of flying-fox roosts in [name of local government area].

3. Location of the UFFMA in [insert local government name]

The local government may consider including a map of the UFFMA for the local government area. Maps are available at the following webpage: < https://environment.des.qld.gov.au/wildlife/animals/living-with/bats/flying-foxes/management-areas >. The local government may also consider directing residents who wish to view a map of their own property in relation to the UFFMA to: < https://environment.des.qld.gov.au/wildlife/animals/living-with/bats/flying-foxes/management-areas/map-request >.

4. Local government intentions and considerations

The SoMI may include a broad, general statement of management intent for all flying-fox roosts within the UFFMA.

The SoMI may also include specific statements of management intent for specified flying-fox roosts within the UFFMA.

Local governments may also wish to include a general statement for the areas outside the UFFMA.

The SoMI may include details of factors that local government would consider before deciding whether to take any action at particular sites, such as:

- the well-being, impacts and concerns that nearby residents are experiencing;
- whether local government considers that there are any risks to human health or well-being from the roost

• whether the roost is on local government land or private land, and if on private land, whether the local government will agree to provide management assistance, consent for local government to undertake management has been provided by all relevant landholders.

The SoMI may include details of additional factors that local government would consider in deciding the most appropriate action to take at particular sites, such as:

• the cost of various management actions and who would contribute to these costs

Note: Potential management actions can range from minimal intervention, through to moderate vegetation modification, through to complete clearing of roost vegetation and driving flying-foxes away. Costs increase significantly with increased management interventions

• the number of each species of flying-foxes at the roost, and what the local government's intention would be should the flying-foxes be breeding or rearing their young

• whether good outcomes may be achieved with minimal management interventions such as community education; or moderate management interventions such as 'nudging' or 'buffering' processes by which the impact of an existing roost may be reduced.

The SoMI may include details of additional factors that local government might consider for the potential driving away of flying-foxes at a particular roost, such as:

• the number of years that flying-foxes have used a particular roost site

Note: Flying-foxes are known to have strong affinities with roost sites, and driving flying-foxes away from an established roost may, in some circumstances, prove challenging and resource intensive

• the likelihood of flying-foxes relocating to a site of greater conflict with the community

• whether flying-foxes at the site are capable of independent flight at the time of year proposed for driving them away

• whether a proposed management action may cause harm to flying-foxes.

The SoMI may also advise residents, that if a roost is on private land(s), low impact activities may be undertaken by the landholder(s) as-of-right under the relevant code of practice. The Code of Practice – Low impact activities affecting flying-fox roosts is available at the following webpage:

< https://environment.des.qld.gov.au/wildlife/animals/living-with/bats/flying-foxes/roost-management#toc-1 >.

The SoMI may include advice to residents that, should they be dissatisfied with local government's approach at a particular roost site, they may apply for a permit directly from the department. The permit application form is available at the following webpage:

< https://environment.des.qld.gov.au/wildlife/animals/living-with/bats/flying-foxes/roost-management#toc-5 >.

The SoMI may advise residents that anyone, local government or resident, wishing to undertake roost management actions must do so in compliance with the Code of Practice—Ecologically sustainable management of flying-fox roosts, which is available at the following webpage:

< https://environment.des.qld.gov.au/wildlife/animals/living-with/bats/flying-foxes/roost-management#toc-0 >.

The SoMI may include any further information the local government considers relevant to residents.

5. Further information

The SoMI may provide contact details within local government, should residents wish to discuss roost management activities with the local government. The SoMI may also refer residents to local offices of the department or to the department's website should residents require further information.

Appendix C: Monitoring report

Monitoring Report						
Roost Name:			**Roost Location:**			
Surveyor(s)				**Date/Time**		
Population Information						
Species Present (check box)		**Count**	**Ratio (%)**	**Pregnant flying-foxes present (check box)**	**Dependant young present (check box)**	**Crèched young present (check box)**
Black headed flying-fox	☐			☐	☐	☐
Grey headed flying-fox	☐			☐	☐	☐
Little Red flying-fox	☐			☐	☐	☐
Spectacled flying-fox	☐			☐	☐	☐
Total flying-foxes:			**100%**			
Flying-foxes absent	☐	**Approximate date flying foxes departed:**				
Counting Method						
		Count all animals ☐	Individual tree count x # of trees ☐	Area/length count x total area/length ☐	Fly – out ☐	
Comments						

For more information on monitoring methodology refer to Australian Government Department of Environment and Energy: https://www.environment.gov.au/biodiversity/threatened/species/flying-fox-monitoring

Appendix D: Checklist for significant management actions

Ensure all requirements of the relevant code of practice are followed in all circumstances:

- Code of Practice— Ecologically sustainable management of flying-fox roosts.
- Code of Practice— Low impact activities at flying-fox roosts.

Site assessment and notification

- ☐ Consider any risk factors for flying-foxes at the site, e.g. presence of females in late stages of pregnancy, presence of dependant young, recent events (e.g. cyclones, bushfires) that might cause food shortages, and presence of flying-fox species that are *threatened wildlife*.
- ☐ If any management actions are proposed at the site, a notification form is required to be submitted at least two business days prior to commencement. For further requirements see the relevant code of practice.

Stakeholder engagement

- ☐ Identify stakeholder's e.g. Residents, Business owners, Indigenous community, Wildlife Care groups, Veterinarians, nearby horse owners.
- ☐ Identify and appoint 'Person in charge' and identify and engage 'Person knowledgeable about flying-fox behaviour'

Community engagement

- ☐ Provide notification to residents about the type of management planned and the goals.
- ☐ Notify residents about the applicable laws and safety precautions regarding flying-foxes
- ☐ Provide contact details of person in charge.
- ☐ Tell residents what to do if flying-foxes move to their property etc.
- ☐ Provide mental health contact (especially during attempts to drive away flying-foxes)

Management activities

- ☐ Assemble team of trained personnel (team to consist of person in charge, knowledgeable person and any personnel involved in active disturbance or vegetation modification activities).
- ☐ Plan management activities and communicate plan with team.
- ☐ Ensure appropriate communication channels between all members of the team especially in the event of immediately ceasing management actions in accordance with the code of practice.
- ☐ Ensure team is aware of all elements of the legal framework they are operating under.Schedule briefings directly before management actions begin and schedule debriefings directly after management actions have ceased to discuss and re-evaluate management activities.
- ☐ Consider monitoring reports to evaluate roost management actions and measure effectiveness of management actions.
- ☐ Monitoring can be useful in assessing current and future management actions in-situ or at other roosts. Monitoring can also assess impacts on animal welfare and nearby residents and ensure compliance with the relevant codes of practice.

Health & Safety considerations

- ☐ Team to wear protective clothing including long sleeves and pants; consider additional items such as eye protection and a hat. Clothes should be washed daily and appropriate hygiene practices should be adopted such as washing hands with soap and water before eating/smoking.
- ☐ Schedule regular breaks for team. Be mindful of fatigue.
- ☐ Any member of the team likely to come into direct contact with flying-foxes need to be vaccinated against Australian bat lyssavirus with current titre levels.
- ☐ Set up a wash station on site during works along with an antiseptic (e.g. povidone, iodine or another iodine preparation or ethanol alcohol should someone be bitten or scratched.
- ☐ Details of the nearest hospital or doctor who can provide post-exposure vaccinations should be kept on site.

Flying-fox welfare considerations

- Consider having an appropriately licensed wildlife carer or veterinarian on call during management works

Post-work evaluation

An evaluation form is required to be sent within 6 weeks of the notification detailing flying-fox species and numbers before and after management works, methods used, and whether the management works were successful each day. For local government records and learnings consider including:

- Monitoring results before and after management works
- presence of new/splinter roosts that have formed in the area
- possible impacts at other locations directly resulting from management, and suggested mitigation measures
- an assessment of how the flying-foxes reacted to the works – i.e. what was effective, what wasn't and recommendations for future attempts to drive away flying-foxes.
- an assessment of how the community responded to the works, including details on the number and nature of complaints before and after the works
- further management actions planned which may include a schedule of works
- expenditure (financial and in-kind costs)