Guidelines for the Captive Management of Flying Foxes (*Pteropus sp.*) in South Australia.

Note: The *Animal Welfare Act 1985* creates offences for persons who fail to provide appropriate and adequate, food, water, living conditions (whether temporary or permanent), or exercise, or fails to take reasonable steps to mitigate harm suffered by an animal in their care. In addition, the *National Parks and Wildlife (Wildlife) Regulations 2001* prescribes standards for keeping protected animals.

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NOTE: *These guidelines are to be read in conjunction with the "General Guidelines for the Management of Protected Wildlife in Captivity in South Australia".*

1. BACKGROUND INFORMATION

Bats are the only mammal species capable of true flight and are a highly diverse group of animals. The fossilised remains of bats similar in appearance to modern species have been found dating back around 58 million years. Today there are more than 900 bat species recorded worldwide and they are the second most diverse order of mammals, making up about 20% of all living mammal species.

About 70% of bat species feed on insects, while the rest are primarily fruit and nectar feeders. Ecologically, bats have been identified as 'keystone species' and their roles in fruit pollination, seed dispersal and insect population control are critical for maintaining ecosystems. The presence of bats in urban locations demonstrates their ability to adapt to changing environments but has also caused an increase in human-bat interactions.

Bat species belong to the order "Chiroptera" (meaning "hand wing"), which is split into two "suborders"; the Megachiroptera (also known as Flying Foxes, Fruit Bats, megabats or Blossom Bats) and the Microchiroptera (also known as insectivorous bats or microbats).

Flying Foxes (unlike insectivorous bats) do not use echolocation to navigate and have excellent eyesight. They do not hibernate in winter and do not roost in tree hollows, caves and buildings typically used by insectivorous bats. Flying Foxes are colonial and roost in 'camps' in the exposed branches of canopy trees. When the camps are undisturbed their locations are generally stable through time, however camp sizes often fluctuate and may remain empty if food is not available nearby. A camp may contain anywhere from a few hundred to tens of thousands of individuals. Some Flying Fox camps in Australia have been in use for more than a century. They are very vocal animals and more than thirty different calls have been recorded being made by Grey-headed Flying Foxes.

Insectivorous bats are found in all areas of the world apart from the Arctic and Antarctica and some isolated oceanic islands, however Flying Foxes are restricted to the subtropical and tropical areas of Africa, India, Southeast Asia, Australia and the western islands of the Pacific. Worldwide there are about 186 species of Megachiroptera in existence, however only eight species are found on mainland Australia (including the lesser known tubenosed and blossom bats) with a further three species being recorded from offshore islands to the north of the mainland (see Table 1).

Two species of Flying Fox have been recorded in South Australia: the Little Red and the Grey-headed Flying Fox. The Little Red Flying Fox is the most widespread and nomadic of all Australian Flying Foxes and generally occurs in the coastal regions of northern and eastern Australia from Shark Bay to

northern Victoria, however it has also been recorded in northern SA in 1968 and 1986.

Table 1: Australian Megachiroptera Species.

Common Name	Species Name	Australian Distribution	Notes
Bare-backed Flying Fox	*Dobsonia moluccensis*	Far North Queensland	
Northern Blossom-bat	*Macroglossus minimus*	Northern Australia	
Eastern Blossom-bat	*Syconycteris australis*	Coastal eastern Australia	
Eastern Tube-nosed Bat	*Nyctimene robinsoni*	Coastal eastern Australia	1
Black Flying Fox	*Pteropus alecto*	Coastal northern Australia	
Spectacled Flying Fox	*P. conspicillatus*	North-eastern Queensland	2
Grey-headed Flying Fox	*P. poliocephalus*	Coastal eastern Australia	#,1, 2
Little Red Flying Fox	*P. scapulatus*	Northern & eastern Aust.	#
Torresian Tube-nosed Bat	*Nyctimene cephalotes*	Moa Island (Torres Strait)	
Large-eared Flying Fox	*Pteropus macrotis*	Boigu Island (Torres Strait)	
Black-eared Flying Fox	*P. melanotus natalis*	Christmas Island	

Notes:

#: Recorded in South Australia

1: Endemic to Australia

2: Federally listed as "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999*

The endemic Grey-headed Flying Fox is the largest of the Australian Flying Foxes and is recognisable by its grey head and a reddish-yellow neck, chest and shoulders. They are comparatively long-lived for a mammal of its size, with a lifespan of ten to 15 years in the wild and typically ten to 25 years in captivity.

The reproductive cycle of the Grey-headed Flying Fox is a lengthy process, which makes the species susceptible to decline. Female Flying Foxes do not reach sexual maturity until they are about 18 months of age. Mating generally takes place between March and May, and gestation is about 27 weeks with pregnant females generally giving birth to a single young between late September and November. Females carry young with them for the first three weeks of their life while they forage before the young are left in "crèches" while the females feed. Young Flying Foxes remain dependent on their mother for warmth and nutrition until they are able to fly out of the camp with adults around January to February. For the first two years of life Flying Foxes suffer a high rate of mortality.

Flying Foxes can fly up to fifty kilometres per night in search of food and play a major role in the regeneration of native hardwood forests and rainforests. Flying Foxes are the most effective seed dispersers and pollinators of rainforest and native hardwood forests in Australia. The comparatively large body size of Flying Foxes combined with a thick fur coat allows lots of pollen to stick to them and be transported potentially up to fifty kilometres in one night. This makes Flying Foxes far more effective pollinators than other

species such as birds, insects and small mammals. Flying Foxes can also carry small seeds of rainforest fruits in their gut for up to an hour, by which time they may have flown thirty kilometres away from where the fruit was eaten. Other pollinating species and the wind operate over much smaller areas. It is estimated that a single Flying Fox can dispense up to 60,000 seeds in one night.

The distribution of the Grey-headed Flying Fox typically extends along the coast region of Australia from Rockhampton to western Victoria. Grey-headed Flying Foxes have undergone a substantial population decline over their traditional range along the eastern coast of Australia in the past twenty years and it is estimated that the species declined in numbers by about 30% between 1989 and 1999. As a result, the Grey-headed Flying Fox has been listed as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* and are a protected species in South Australia under the *National Parks and Wildlife Act 1972*. The species is potentially at risk of extinction and at the current rate of decline it has been estimated that Grey-headed Flying Foxes may be functionally extinct (as an effective pollinator and seed disperser) within fifty years and totally extinct within seventy years.

The major threats to Grey-headed Flying Foxes include:

- Habitat loss; the result of large-scale clearing of both coastal and upland habitats for sugar, grazing and urban development. Reliable winter food resources are limited to a narrow coastal strip in northern New South Wales and Queensland and these areas are undergoing intensive residential development.

- Disturbance of camps; disturbance of maternity camps during the breeding season can result in the death of dependent juveniles. Camps have been abandoned altogether as a result of shooting.

- Commercial conflict; Flying Foxes will feed on commercial fruit crops when pollen supplies and other native foods are scarce. The deliberate destruction of animals on orchards and harassment and destruction of roosts is estimated to result in the death of up to 100,000 animals annually. The impact on the population is probably even more substantial, as a large proportion of animals shot on orchards are pregnant or lactating females. The licensed destruction of Grey-headed Flying Foxes is being phased out in New South Wales over a three year period starting in 2011-2012. The destruction of the species is banned in Queensland and Victoria.

- Competition and hybridization; the distribution of the Black Flying Fox has undergone a substantial southerly shift since it was first described, extending further into coastal areas inhabited by the Grey-headed Flying Fox. Hybrids between Grey-headed and Black Flying Foxes have occurred in captivity.

- Pollutants and pathogens; urban-dwelling Grey-headed Flying Foxes have been recorded as having accumulated lethal levels of lead. The

effects of recently discovered pathogens such as Australian Bat Lyssavirus (ABL) and Hendra virus on the species is unknown, but in combination with other threatening processes these diseases may have a significant impact on the population.

- Environmental stress; heat-related deaths in Australian Flying Foxes have been documented repeatedly since European settlement. A heatwave in 2009 resulted in the death of around 5,000 Grey-headed Flying Foxes at Yarra Bend in Melbourne.

- Man-made obstacles; electrocution on powerlines, collisions with barbed wire, entanglement in fruit netting that is not properly installed and traffic deaths are all recorded causes of mortality. When a bat is electrocuted on a power line, it short-circuits electricity wires but usually does not disturb supply so the electrical authority has no record of the bats' death. As a higher proportion of Flying Foxes become resident in urban areas the significance of deaths from electrocution is increasing and kills a disproportionately high number of lactating females

- Predators; Flying Foxes have few natural predators, however individuals may be taken by birds of prey, snakes, large lizards and carnivorous mammals, including domestic pets.

Over the past decade the distribution of Grey-headed Flying Foxes has shifted southwards and westwards along the southern coast into South Australia, but the species has not established any long term camps to date.

Grey-headed Flying Foxes were first recorded in the south-east of South Australia in 1998. Since this time, the occurrence of the Grey-headed Flying Fox has increased across the South East, presumably in response to limited food availability elsewhere in the species' core range. During 2007, a record number of Grey-headed Flying Foxes were reported from several locations in the South East. The first recorded roosting camps in South Australia were identified in Naracoorte and Kingston in 2010, and small roosting camps were recorded in Fullarton in the eastern suburbs of Adelaide from the beginning of May 2010. These camps may have been the same individuals camped at different locations at different times. By the 21st May 2010, the main colony roosting at Fullarton had grown to around 1,300 individuals.

The species is considered to be a vagrant to South Australia as they do not usually reside and breed in the state, however the confirmed report of a female and young (estimated at approximately six days of age) found on powerlines in Salisbury on the 23rd November 2010 indicates that this status may be about to change. Information received at the time suggested that Grey-headed Flying Foxes had been roosting nearby for at least the previous month, however subsequent searches by DENR staff failed to locate the species in the area. Given that the colony of Flying Foxes at Fullarton disappeared around the end of May 2010, it is quite likely that the female and young located at Salisbury were amongst those camped at Fullarton and that they had overwintered in South Australia.

On the 19th January 2011 a group of approximately 20 adults and 10 young were sighted in the Adelaide Botanic Gardens. By the 1st March this number had risen to around 73 in total, and by the beginning of April the colony had increased to about 120 to 150 individuals.

2. SCOPE

These guidelines apply to members of the public that apply for and/or obtain a DENR "rescue permit" or a "permit to keep" a Flying Fox in captivity.

These procedures do not apply to Flying Foxes held in;

- Zoological Institutions and Wildlife Parks
- Veterinary Clinics
- Approved Research Programs
- Approved Population Management Programs

3. OBJECTIVES

The objectives of these guidelines are to:

- Provide recommendations which protect the welfare of Flying Foxes in captivity, identify when it is not appropriate to return a Flying Fox to the wild and to assist in meeting conservation objectives; and
- Provide recommended guidelines for the husbandry and housing of Flying Foxes kept in captivity; and
- Ensure a consistent state-wide policy for the rescue, captive holding, rehabilitation, release and euthanasia of Flying Foxes; and
- Provide a clear and consistent framework for DENR in developing and maintaining a partnership with wildlife rehabilitation groups and individuals in the management of Flying Foxes they encounter; and
- Ensure that holders of Flying Foxes are appropriately endorsed and accountable for their activities, and that rehabilitation activities are undertaken in the most appropriate, effective and efficient manner; and
- Contribute to the maintenance of biodiversity through the successful return of temporarily compromised Flying Foxes back into the wild where possible.

4. GUIDELINE DETAILS

4.1 Flying Fox Rehabilitation

The DENR Standard Operating Procedure for the Rescue and Release of Native Species states;

> "There is no conservation value in releasing a common animal back to the wild, particularly if it is behaviourally, physically or otherwise impaired."

However, this comment is qualified by the statement that;

> "The welfare of an individual animal and the preservation of an individual animal's life are intrinsically important."

DENR recognises that the work of wildlife rehabilitators contributes to conservation through research, community education and promotion of a respect for native wildlife.

NOTE: *Extreme care must be taken when handling Flying Foxes as they may carry Australian Bat Lyssavirus (ABL) which can cause serious illness in humans and other animals (see "Zoonotic Diseases" for further information).*

This document is not intended to be a manual for Flying Fox rehabilitation, but rather a general guide. Because of the specific husbandry, social and behavioural requirements of Flying Foxes, a networking relationship with other Flying Fox carers is crucial to successfully undertake the care and rehabilitation process.

Experienced wildlife carers may be approved by DENR to hold a permit to rescue and rehabilitate Flying Foxes under the *National Parks and Wildlife Act 1972*. Rescue Permits for Flying Foxes will only be issued to carers who can demonstrate that they:

- Have been fully vaccinated against ABL; and
- Have maintained Titre Levels as deemed necessary by the Health Department for effective protection against the virus; and
- Are part of a cooperative network of Flying Fox carers; and
- Do not reside adjacent to commercial orchards or where horses are being kept; and
- Do not keep permanent colonies of Flying Foxes which may act as a disease reservoir; and
- Agree to abide by the personal and public health protocols described in this document; and
- Have completed a DENR approved training course to rescue and rehabilitate Flying Foxes; or
- Have the required experience, expertise and resources available to them to effectively undertake the care and rehabilitation of Flying Foxes.

Considerations for the keeping of orphaned, sick or injured Flying Foxes include that carers must understand that:

1) The primary aim of keeping Flying Foxes under a Rescue Permit is to rehabilitate and return the animals to suitable habitat in the wild; and

2) Preparations to release a rehabilitated Flying Fox back into the wild must commence at the time of initial intervention and continue throughout the rehabilitation process; and

3) Flying Foxes are to be treated as wild animals and neither handled nor treated in a manner which domesticates or humanises them; and

4) A Flying Fox must not be released until it is assessed to be physically and behaviourally ready and likely to survive in the wild; and

5) A Flying Fox coming into care with an injury which clearly makes it unreleasable (e.g. blind or with both thumbs missing) must be euthanased; and

6) Rescued adult Flying Foxes must not be kept in care for longer than three months unless specific approval is provided by the DENR Fauna Permits Unit. The approval for extension is to be reviewed on a monthly basis; and

7) A Warden may remove a Flying Fox from private care at any time if legislative requirements or permit conditions are not being met, or if the health or well-being of a Flying Fox is compromised; and

8) The eventual fate of each Flying Fox will be determined by a Warden or other nominated DENR Officer.

A Flying Fox (or any other bat) that is found on the ground during the day is almost certainly sick or injured. All Flying Foxes should be evaluated immediately for any signs that might indicate ABL and carers must use either gloves or a wrapping cloth when handling rescue animals.
NOTE: *The general public must be advised to not handle Flying Foxes or other bat species (see "Zoonotic Diseases" for further information).*

All juvenile, sub-adult and adult Flying Foxes not euthanased on the day of rescue are to be quarantined in isolation cages for ABL observation for a minimum of three days.

Unless they are in quarantine or require restricted mobility housing (see section 4.3 Spatial Requirements), Flying Foxes should not be held in an enclosure alone. Should a single individual come into care, where possible it should be transferred to a carer that is holding other rescued Flying Foxes of a similar age as soon as possible. The DENR Fauna Permit Unit must approve the transfer of a Flying Fox from one carer to another.

Written permission must be obtained from DENR prior to the release of a rehabilitated Flying Fox. All Flying Fox carers will be required to follow the directions and instructions provided to them by a Warden or other nominated DENR Officer.

Upon rehabilitation, all Flying Foxes should be returned to the colony of origin if known or to the nearest colony to the point of rescue. Rehabilitated orphans should be released at the nearest colony site. Flying Foxes must not be released near commercial orchard areas or locations with horses.

To maximise the post-release survival of rehabilitated Flying Foxes, once they have completed their rehabilitation they should be released as soon as is practical. Juvenile Flying Foxes must be fully self sustaining and attain a minimum weight of 350 grams and a forearm measurement of at least 138mm before being released.

Prior to release, consideration must be given to current and post release climatic conditions, reproductive season, time of year and population movements. Release during heat waves, storms and other climatic extremes must be avoided. Flying Foxes should be released just prior to dusk when it is beginning to get active. Do not release during the hottest part of the day. Should circumstances or conditions preclude the release of rehabilitated Flying Foxes, consideration may be given to transporting the individual/s to specialist carers interstate to be integrated into local wild colonies.

Further information in relation to the rescue, holding and release of Protected Wildlife can be found in the "General Guidelines for the Management of Protected Wildlife in Captivity in South Australia".

4.2 Manner of Housing

1) Each animal must be housed in a manner which does not pose a risk to the wellbeing of the animal being held or to wild animals, and does not pose a risk to the safety of carers, visitors or other persons.

NOTE: *Flying Foxes may carry and transmit ABL, therefore access to the enclosure and contact with captive Flying Foxes should not be readily available to unauthorised persons.*

2) The size and shape of the enclosure must provide for:
   - Freedom of movement for the Flying Fox, both vertically and horizontally; and
   - Sufficient space to enable it to be protected from undue dominance and conflict with the same or other species; and
   - Appropriate exercise opportunities; and
   - Its husbandry needs; and
   - The minimisation of stress.

3) Regular inspection and evaluation of animal housing must take place when feeding and cleaning to monitor hygiene levels and to detect potential housing problems.

4) Flying Foxes are highly social animals and should not be housed alone unless for medical or quarantine purposes.

5) Flying Foxes undergoing rehabilitation or hand rearing are not to be housed with Flying Foxes under permanent care.

4.3 Spatial Requirements

Flying Foxes maintain a hierarchal group structure, and individual spatial requirements should be considered when constructing an enclosure. The dominant animal prefers certain areas within the enclosure, often being the highest point available, however it is important to allow all animals to maintain an elevated position within the enclosure.

Flying Foxes experience muscular atrophy if confined in a small space for periods of more than about four weeks. Where possible, a facility that accepts Flying Foxes for rehabilitation should have flight cages available for exercise.

The appropriate spatial requirements for Flying Foxes undergoing rehabilitation is dependant upon the nature of the disease or injury and the specifics of treatment and recovery. Recommended rehabilitation enclosure dimensions are based on differing space requirements during the recovery periods. These levels are restricted mobility, limited mobility, and unlimited mobility.

Restricted Mobility;
Restricted mobility means to hold an animal within a space small enough to facilitate easy capture and restrict almost all movement, but to provide enough room for the animal to maintain a normal posture and to stretch, but without allowing it to fly. Young Flying Foxes prior to weaning are included in this category.

Conditions requiring restricted activity include rehydration, hypothermia, and wing or leg injury. Any animal with a severely debilitating condition such as shock, toxicity, neurological impairment, or other conditions that require close supervision and management should have restricted mobility.

Limited Mobility;
Physical therapy and/or acclimatisation comprise the next phase of the rehabilitation process once the anatomical and/or physiological problem has been resolved. Movement should be encouraged as part of the rehabilitation process and limited mobility is appropriate when restriction of the individual's movement is no longer necessary due to ongoing treatment, but periodic capture and medical treatment may still be required. An anxious Flying Fox will generally stretch out both wings in a defensive stance when approached, so the width and length of a holding area should be at least 1.5 times the wingspan to avoid wing damage.

Unlimited Mobility;
Unlimited mobility uses large outdoor enclosures to provide physical and psychological conditioning or reconditioning through extended flights and other activities. This housing should allow an individual to improve their strength, develop stamina and coordination, restore muscle tone, and acclimate to ambient weather conditions. Unlimited activity caging should be used to condition hand raised Flying Foxes for release.

In accordance with current best practice, the following guidelines for minimum enclosure sizes for Flying Foxes in South Australia shall apply.

South Australian Minimum Flying Fox Rehabilitation Enclosure Sizes.

Enclosure Type	Enclosure Width (m)	Enclosure Length (m)	Number of Individuals	Enclosure Height (m)
Intensive Care	0.5	0.5	1	0.5
Intermediate Care	1	1	1	0.7
Crèche	2	5	5 - 20	2
Pre-release	4	10	30	2.5

South Australian Minimum Enclosure Sizes for Permanently Captive Flying Foxes (up to 6 adults).

Enclosure Width (m)	Enclosure Length (m)	Additional Area (m) per Flying Fox > 6	Enclosure Height (m)
4	4	1.5 x 1.5	2.5

4.4 Enclosure Construction

In holding Flying Foxes there are a number of general principles that should be followed in order to satisfy minimum conditions for the keeping of animals in captivity. Conditions include:

1) An enclosure must be constructed to ensure that:
   a) A Flying Fox cannot escape except in circumstances that cannot reasonably be foreseen and guarded against; and
   b) The risk of injury to the Flying Fox is minimised; and
   c) Animal carers are safe if they comply with directions and/or warning signage; and
   d) Flying Foxes are not subjected to undue levels of noise or vibration.

2) Each cage or enclosure is to provide protection to Flying Foxes against interference from, or contact with, wild animals (including wild Flying Foxes), domestic pets or people.

3) Enclosures must be designed to give Flying Foxes access to sunlight and opportunities to bask in the sun, however they must also be provided with adequate shading.

4) The walls and roosting areas of the enclosure must be non-abrasive to avoid abrasion injuries and should withstand regular cleaning.

Galvanized steel enclosures and wire should be avoided because Flying Fox urine corrodes tinned surfaces and may cause zinc toxicity if ingested. The use of vinyl coated or Teflon sprayed, non-galvanized wire or polyethylene mesh is preferred.

Enclosures should incorporate wire mesh buried to a sufficient depth (or other form of protection) to deter predators from digging under the enclosure walls.

The size of the openings in wire or mesh should be small enough to prevent animals from pushing a wing or foot through it, but not so fine that an animals' claws get caught in the mesh. Narrow gaps (approximately 5 mm) should be avoided in cage furnishings because bats can get wings wedged in the gap. A mesh size of 25mm square is optimal.

In general, enclosure surfaces should be smooth and non-porous, and all contact surfaces should be non-abrasive. It is also important to ensure there are no sharp or penetrating surfaces where wing membranes or thumb hooks can be caught.

As Flying Foxes hang from the enclosure roof by their feet, a roof constructed of steel mesh can be cold in winter and hot during summer. The use of a lining such as thick gauge nylon netting is recommended where uncoated steel mesh is used in the construction of the enclosure roof (see Figure 1), however Flying Foxes must be prevented from climbing between the netting and the enclosure roof and becoming trapped. There should also be sufficient space between the suspended netting and the enclosure roof to prevent Flying Foxes from placing their feet through the netting and hanging from the wire mesh. The use of netting to line the roof of the enclosure will also protect Flying Foxes from attacks on their feet by climbing or flying predators.

Figure 1: Flying Fox enclosure lined with nylon netting.

4.5 Substrate and Drainage

1) The substrate must not be abrasive or irritating to Flying Foxes. A smooth concrete floor is ideal for rehabilitating groups of Flying Foxes. At lower animal densities, suitable substrates can include soil, sand, grass or mulch. When animals are first placed within an enclosure they should be monitored to ensure that they are not ingesting substrate materials.

2) The substrate must be easily cleaned or replaced to avoid the accumulation of faeces, waste food and urine.

3) The enclosure must have a drainage system that quickly removes excess water.

4) Unless it carries only surface water, a drain should be inaccessible to the animals.

4.6 Weather Protection

Sufficient shelter must be provided to allow protection from wind, rain and extremes in temperature. Protection against inclement weather can be

achieved by ensuring that approximately one third of the enclosure is completely sheltered.

The normal body temperature of the Grey-headed Flying Fox ranges from 35^0C to 40^0C, with 36^0C being the optimum resting temperature. In hot weather (above 38^0C) Flying Foxes will flap their wings to increase air circulation and thereby cool themselves. They can further reduce their body heat by urinating on their wing membranes - as the urine flows over blood vessels it cools the animal.

Access to adequate shade must always be provided and sprinklers or other cooling systems must be provided if the ambient temperature is over 38^oC. During periods of extreme hot weather (generally where temperatures reach 40^oC for consecutive days) there have been mass mortality events in the wild, with Flying Foxes succumbing to heat stress and dehydration.

Flying Foxes require access to sunning areas to maintain healthy wing membranes and appropriate levels of vitamin D. Enclosures should be well positioned in a location where they can make good use of sunshine, whilst providing adequate protection from weather extremes.

In cold weather, Flying Foxes maintain their body temperature by wrapping their wings around themselves, thereby raising the temperature between body and wing membrane as much as 10^0C compared to the outside temperature. Supplemental heat must be provided if temperatures drop below 24^0C for an extended period to prevent permanent damage to wing membranes and finger joints. Care must be taken to ensure that animals are unable to come into contact with hot surfaces, such as heat lamps.

4.7 Gates, Doors and Slides

1) A gate or door on the perimeter of the enclosure must be designed to minimise the opportunity for escape of enclosed animals or the entry of wild animals. Where possible, “double entry” gate systems should be used.

2) The design of a perimeter gate or door should facilitate the delivery and removal of feed, and the removal and replacement of enclosure furniture.

3) Gates and doors must be locked to prevent unauthorised access to the enclosure.

4.8 Enclosure Furniture

1) A network of branches and soft furnishings such as ropes of various diameter, towels and hessian sacks etc. should be provided to assist with climbing and roosting opportunities and to provide environmental enrichment for captive Flying Foxes.

2) Towels or flannelette squares can be placed at each end of the enclosure to provide suspended soft landing spots and encourage flight and landing

activity. These should be of sufficiently good quality not to tear easily and must be washed regularly to maintain hygiene.

3) Care must be taken in the placement of enclosure furniture to ensure that flight paths remain open and encourage flight.

4) All branches and other furniture should not have sharp edges that may cause wing tears or other injuries.

5) All climbing apparatus should extend to the ground to allow any individuals that come to the ground to easily climb back up to the roof or higher areas of the enclosure.

6) Natural branches and vines and other materials should be provided as perches and climbing furniture to help keep the nails from overgrowing.

7) Branches will need to be replaced occasionally and points of attachment should be designed to facilitate their easy replacement.

4.9 Electrical and Other Equipment

Electrical apparatus and other plant and fixed equipment must be installed so that:

a) It does not endanger the animals or carers; and
b) The animals cannot disrupt its operation; and
c) It does not pose a fire risk.

Care must be taken to ensure that Flying Foxes are unable to come into contact with heat lamps or other heat sources to prevent burns and other injuries.

4.10 Indoor Housing of Animals

1) Lighting in indoor housing for animals should be adequate to facilitate proper cleaning of the housing and the carrying out of routine health, hygiene and maintenance checks.

2) Indoor lighting should only be switched on for around 11 to 13 hours a day to simulate natural day-length.

3) Indoor housing for an animal must be provided with ventilation that:
   a) Is sufficient to maintain the health of the animal; and
   b) Is so designed as to minimise undue draughts, odours and moisture condensation.

4) Adult Flying Foxes are not to be housed inside domestic dwellings.

4.11 Hygiene

Good enclosure hygiene is essential to reduce insect and/or vermin infestation, and to reduce odours caused by faeces, urine and discarded fruit. Uneaten food will quickly spoil and ferment in warmer weather, therefore it is

important that the previous night's uneaten fruit is not available to Flying Foxes during the day.

1) Excrement and other animal waste, leftover food, introduced rubbish and foreign objects should be removed daily. This is required to minimise vermin infestation and disease hazards and prevent the ingestion of potentially harmful objects.

2) Food and water dispensers should be replaced with fresh, clean containers on a daily basis.

3) Soil and sand substrates should be raked daily and concrete floors should be swept and then hosed daily to remove food waste, faecal material and urine.

4) Contaminated substrate material must be removed and replaced as necessary.

5) Branches and other enclosure furniture should be replaced as necessary and be maintained in a clean and hygienic condition, free from the accumulation of food, faeces and urine.

6) Blankets/polar fleece should be removed and washed as required and fresh blankets hung as the soiled blankets are removed to minimise disturbance.

7) When disinfecting solid surfaces within the enclosure these surfaces should be rinsed before animals come in contact with them again. The disinfectants are to be of a kind approved by, and used in compliance with, veterinary advice.

4.12 Behavioural Enrichment

Flying Foxes in the wild have a life that is filled with varied activities such as avoiding predators, searching for and acquiring food, social interaction and producing viable offspring. In captivity, the primary survival needs of bats are fulfilled by their carers, leaving the animals with limited activity options.

Enclosure furniture and foraging devices are two separate but connected elements that provide environmental enrichment to bats. The aim is to stimulate natural foraging activity such as flight, manipulation with thumbs and feet, and locomotion on branches.

<u>Enclosure Furniture:</u>

Enclosure furniture can be used to stimulate natural foraging activity such as flight, manipulation with thumbs and feet, and locomotion on branches. Flying Foxes wear down their nails by moving on a variety of surfaces. This type of enrichment can improve animal husbandry by reducing nail breakage and reduce the need to trim overgrown nails. Enclosure furniture that is conducive to foraging enrichment includes ropes, ladders (plastic mesh, cargo netting, rope, etc.), natural branches, live trees and bushes, and small shallow pools

(see Figure 2). Enclosure furniture should vary in diameter and in placement, allowing for both horizontal and vertical access while also ensuring that flight paths remain unencumbered.

Figure 2: Enclosure furniture as behavioural enrichment.

Dietary and Foraging Enrichment:

Dietary and foraging enrichment is often the most popular and simplest form of behavioural stimulation. Flying Foxes in the wild feed on a wide variety of plant species that are unavailable in captivity and they also spend a higher proportion of their daily activity budget searching for, processing and eating food. In contrast, the captive diet is relatively stable and unchanging due to economics, nutrition, enclosure restrictions and husbandry practices.

Dietary enrichment can be in the form of novel fruits, vegetables and juices that are not in the standard diet. Presentation can be changed by not peeling fruit, offering novel shapes, or by offering whole food. Fruits, vegetables and juices can be presented frozen as “popsicles” or mixed with gelatine to make “bat jellies”. Fresh herbs such as parsley, thyme or mint can be used as behavioural enrichment olfactory tools. Juice or flavoured water can be offered in self feeding water bottles or nectar feeders.

Foraging enrichment aims at offering the diet in less accessible ways by placing food in areas where it must be searched out. Fruit and vegetables can also be provided to bats in novel items such in grapevine “wreaths” or placed into open pinecones.

Fruits and vegetables can be strung on stainless steel rods to make "fruit kebabs". Pieces of food can also be placed on shower curtain rings, which can be attached to plastic chain (see Figure 3), “bungee cords”, ladders, or ropes. Alternatively, a wire cage (such as that used for feeding wild birds) can be used. Soft fruit placed within the cage and suspending the cage from the aviary roof encourages the animal to ‘work’ to obtain their feed (see Figure 4).

Figure 3: Flying Fox feeder.

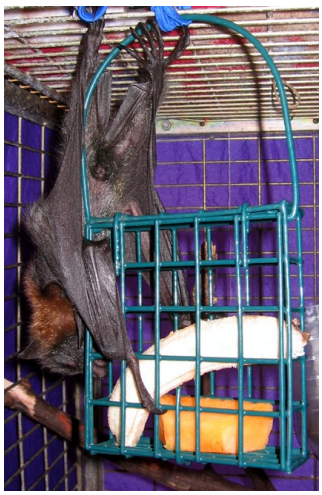

Figure 4: Flying Fox feed "cage".

Food can also be placed into small plastic buckets and suspended from the roof. This will cause individuals to reach and hang over the food buckets rather than just hanging from the side of the enclosure to feed from dishes attached to the wall. Once familiar with this system, the buckets can be suspended on thick ropes to encourage the Flying Foxes to fly, leap or clamber down the ropes to reach the food.

In the wild, Flying Foxes will feed on flowers (nectar, pollen, petals, and bracts) and they can serve as both dietary and olfactory enrichment. Flowers and browse offered must be non-toxic, pesticide and fertilizer free and checked for hidden pests. Flowers and browse can be tied in bundles and hung in the enclosure and smaller flowers can be placed in bowls that are secured to vertical posts.

Social Enrichment:

Flying Foxes are social creatures and social contacts can provide a tremendous psychological benefit. The addition of companions, however, can introduce several potential hazards such as aggression and increased competition for food, water, or preferred roosting sites. At times, Flying Foxes must be separated from the group for medical reasons, and direct contact with each other is not possible. Social enrichment can be indirect by allowing visual, vocal, and olfactory communication.

4.13 Diet and Feeding

Although Flying Foxes are also commonly known as Fruit Bats, their favoured food is actually the pollen and nectar of eucalypt blossoms, followed by other native hardwood blossoms, such as melaleuca (paperbark) and banksia, and rainforest fruits including lilly pillies and figs. Exotic fruits are generally not preferred, but a lack of native food sources will often force Flying Foxes into orchards and backyard fruit trees. For a list of feed species utilised by Grey-headed Flying Foxes in NSW, please refer to Appendix 1.

As seasonal food sources may be unreliable and widespread, Flying Foxes have adapted to seasonal changes by being nomadic and they can travel

great distances in search of food. Logistically, it is virtually impossible to replicate the wild diet of nectars, pollens and fruits wild Flying Foxes may encounter in one night.

Flying Foxes feed on fruit by chewing it to extract the nutrients and then swallow the juice and spit out the pulp. The Flying Fox digestive system does not easily tolerate fibre so homogenised and pureed fruits should be avoided. While the precise nutrient requirements of Flying Foxes remains unclear, the American Zoo Association Bat Taxon Advisory Group suggest the following requirements;

Target Nutrient Levels (dry matter basis)

Nutrient	Daily Diet Composition
Crude Protein (%)	2.0 – 15.0
Fat (%)	5.0 – 9.0
Vitamin A (IU/g)	4.0 –14.0
Vitamin D2 & D3 (IU/g)	0.2 – 2.0
Vitamin E (mg/kg)	11.0 – 56.0
Calcium (%)	0.5 – 1.0
Phosphorus (%)	0.4 – 0.9

Each enclosure must be provided with multiple feed stations (ideally one per animal), appropriately spread throughout the area to minimise aggressive behaviour over food (see Figure 5). Food stations and water bottles for holding blossoms must be provided in locations that provide Flying Foxes with easy access.

Figure 5: Flying Fox feed stations.

Flying Foxes quickly become dehydrated during hot weather and water must always be available in at least two different locations within the enclosure.

Water bowls can be used within the enclosure at an elevated position, however Flying Foxes will often visit a water bowl during feeding and the water can quickly become fouled by foodstuffs.

Water drippers, such as that used for feeding rodents, can be positioned outside the cage with the dispenser tip protruding through the mesh of the wall. This will help to keep the water clean and fresh and facilitates quick and easy replenishment and cleaning during warmer weather. Water drippers should be checked regularly for malfunctions.

4.14 Adult Diet

Adult Flying Foxes will consume 25-35% of their body weight in fruit daily, so each average sized adult should be offered approximately 350gms of chopped fruit per day (plus supplements). At least three varieties of fruit should be offered, ensuring that approximately 2/3rds of the diet is comprised of hard fruit such as apple and pear (which are needed to keep teeth clean and exercise jaw muscles) with the remaining 1/3 being made up of soft fruit such as rockmelon, pawpaw, grapes, melon, fresh figs, mangos and any soft fruit in season.

Some individuals fly with food to a feeding roost and are capable of carrying large pieces. Food stealing is a common activity and Flying Foxes may fill their mouths with food and then fly off to eat in a more secure location. Fruit should be chopped into bite sized pieces to minimise wastage.

Due its high fibre content, bananas should be offered sparingly. Although not common, some Flying Foxes like citrus fruits, so mandarins and orange can be occasionally added along with sweet vegetables such as canned corn kernels.

Dietary supplements must be added to chopped fruit. Wombaroo produces a "High Protein Supplement" which meets the protein requirements of fruit and nectar eating animals. If Wombaroo is not available other products such as 'Complan' can be used.

Other occasional supplements can be added to the fruit such as:

- Glucosamine, Chondroitin
- Vitamin C powder
- Sandoz Calcium Syrup
- VetaFarm Blossom Nectar

A salt block or mineral lick should be available to further supplement dietary requirements.

4.15 Juvenile Diet

Female Flying Foxes continue to lactate until their young are approximately five to six months of age, however the young are capable of flying out with the colony and foraging for food at approximately four months of age.

Young Flying Foxes require milk to provide their protein and vitamin requirements, however extra energy (carbohydrate) is needed as the animal becomes more active. Introducing fruit to the diet provides the dietary requirements and teaches feeding skills rehabilitated animals will require to survive when released.

In captivity, mother-reared young begin licking juice from their mother at approximately six to seven weeks of age, eat small pieces of fruit from the fruit their mother is eating at seven to eight weeks of age, and are capable of eating adult size fruit by ten to twelve weeks of age.

Bowel problems such as constipation and in some cases bowel prolapse have been associated with excessive fibre in the diet of young Flying Foxes. When fruit is introduced to the diet, the animal must be able to extract the juice (pulp) and discard (spit out) the fibre.

4.16 Hand Rearing

Minimising stress is a major factor to the successful rearing of an infant Flying Fox pup. Many pups come into care after their mother has been killed, so it will already be compromised physically, psychologically and/or both. The first consideration should always be to provide an environment with reduced external stimulus and minimal stressors for the pup to begin recovery and development.

Housing of orphaned pups should be:

- Quiet; and
- Free from domestic pets, children and domestic noise; and
- Hygienic; and
- Escape proof; and
- Free of hazards and obstacles; and
- Of an appropriate temperature; and
- Adequate protection from outside elements (rain, sun etc); and
- Comfortable and secure; and
- Able to evolve as the animals mature and their housing requirements change.

Until the pup is furred (approximately four weeks of age) they do not thermoregulate and so require a heat source to maintain ambient air temperature at around 28°C.

Unlike Australian marsupials, Flying Foxes are not lactose intolerant and therefore a variety of milk substitutes can be used for feeding infants. The most commonly used:

- Wombaroo Flying Fox Milk Replacer
- Nan 1 infant formula
- Digestelac/Divetelact
- Cow's Milk (should not be used for premature pups)

The pup's faeces, condition and weight gain are good indicators of the suitability of the milk formula used.

Hygiene is critically important to ensuring the wellbeing of the Flying Fox pup and a carer must:

- Provide clean housing, including cage, roost and bedding materials; and

- Maintain high standards of personal hygiene to protect both the bat and carer from diseases; and
- Use pre-boiled water when mixing up milk formulas; and
- Clean the pup of spilt milk, faeces and urine after each feed; and
- Stimulate the pup to toilet before and after each feed; and
- Thoroughly wash all feeding equipment using detergent and then sterilise; and
- Wash all soiled bedding using a sterilising agent to remove contaminants and/or fungus.

A young Flying Fox must be fed every four hours up to six times a day, depending upon its age, and as it develops it must be introduced to blossoms and fruit.

Flying Fox pups are very reliant on their mother up to the age of about twelve weeks, however at around this age they become semi-weaned and begin to spend more time hanging away from mother and exploring. At this stage they require interaction with other juveniles of a similar age and form juvenile "crèches". Forming crèches creates a socialising stage of development for orphans and under normal birthing conditions will occur around January. Orphaned pups in care need to be kept in crèche groups so that normal bat socialisation behaviour can be practiced ready for integration into the colony.

Flying Fox pups placed into crèche groups must be;
- Weaned from milk and be eating solids; and
- Weigh a minimum of 300 grams with a forearm length of 128mm

Orphans must not be crèched later than sixteen weeks of age and must be crèched for a minimum of three weeks.

Interstate, the minimum number of juvenile Flying Foxes required to form a crèche is five animals (ten to 25 is the preferred number), however this may be difficult to achieve in South Australia and it may be required to transport individuals to crèches interstate for integration into their colonies.

4.17 Identification

Whilst it may take a while for a new carer to familiarise themselves with each individual within a captive colony, generally Flying Foxes are easily identified by their individual markings. Some individuals have dark facial fur, some are nearly ghost grey, some have a dark red ruff, whilst others may have a ruff of a caramel colour. Body size, weight and sex can also be used to help identify individual animals.

Should distinguishing marks and other attributes not be a feasible means of recognition, temporary marking can be achieved by;
- Plastic bird bands - temporary identifiers for juvenile animals but can be easily removed by the Flying Fox
- Nail polish – can be easily applied to toe nails and thumb claws and is less easily tampered with by the Flying Fox. Various colours/locations can be used and markers remain visible for up to a month after application.

A permanent method of identification is required for individual animals prior to their release to the wild. The preferred method of identification is the application of an Australian Bird and Bat Banding Scheme (ABBBS) band by a qualified bander registered under the ABBBS.

Alternatively a microchip placed subcutaneously between the scapulae and to the left of the spine can be implanted by an experienced carer or veterinarian. The use of microchips can involve significant additional costs, however they may also be used to track individuals as they leave or enter the release cage, allowing researchers to collect valuable data.

4.18 Regular Health Checks

Parasites and diseases tend to affect Flying Foxes more when they are under stress (by lack of food, camp disturbance, etc). When the immune system is low, Flying Foxes are more susceptible to infection and parasites that have adapted to living in the population without causing undue illness suddenly start to make their hosts sick.

Arrangements must be made for the health of each animal to be checked at least once a day.

On approaching the enclosure the observer should be aware of the positioning and demeanour of individuals. For example, it should be noted whether individuals are:

- With or apart from the group
- Roosting in their normal groups or whether their allegiances have shifted to other individuals
- Hanging near or from the door awaiting your arrival
- Underneath shade or hanging in direct sunlight
- Hanging low down
- Hanging with their wings wrapped around the body
- Asleep or awake and alert
- Relaxed or anxious and wary
- Hanging near or above the food bowls, and/or the food bowls are empty and licked clean
- Dry and well groomed or wet with poor fur condition (note that they may have just taken a urine bath so be aware of associated odours as wet fur does not necessarily indicate illness)
- Making any unusual vocalisations/sounds.

Whilst cleaning the enclosure, animals should be observed as they rest and move around. Injuries may not immediately be apparent, but can become noticeable as the animal moves. The consistency and colour of the droppings on the cage floor should be observed for any unusual changes.

In particular, a record should be made in relation to an animal suffering from:

a) Obvious mal-nourishment or weakness
b) Discharges from the nose, eyes, ears etc.

c) Dermatitis or bare spots in fur covering
d) Wing membrane infection, discolouration or tears
e) Lethargy
f) Ectoparasites
g) Eating pattern changes (feeding only after others are finished)
h) Heat stress or dehydration
i) Unusual odours or discharges
j) Sores or open wounds
k) Broken bones or other physical injury.

Other diseases of Flying Foxes include;

- *Toxocara pteropodis* (Ascarid Nematode)
- Ringworm
- "Slimy Wing" (candida fungal infection of wing membrane)
- Roundworm
- *Angiostrongylus cantonensis* (Rat Lungworm)

If poor physical health of an animal is detected, all reasonable steps must be taken to restore the animal to good physical health. This will ordinarily require consultation with a veterinarian. If the animal is unresponsive to treatment it must be humanely euthanized.

4.19 Carer and General Public Safety

NOTE: *A small proportion of Flying Foxes (and other Australian bat species) carry the Australian Bat Lyssavirus (ABL), a rabies-like virus which has been responsible for two human deaths in Australia, both of which occurred in Queensland. ABL is usually transmitted to humans via bites or scratches. Less commonly, transmission is through the exposure of bat saliva to the mucous membranes (eyes, nose or mouth). Whilst overall the risk of contracting ABL is low, the mortality rate is almost 100%. Bat carers must be fully vaccinated against ABL and have maintained titre levels for effective protection against the virus. Carers and members of the public without this protection should not handle a bat at any time.*

Flying Foxes are also known to carry Hendra virus which can lead to a severe respiratory or neurological infection in horses. Similar disease has occurred in a small number of humans in Queensland who had contact with infected horses. It is believed that horses may be infected through contact with urine or birthing fluids from Flying Foxes infected with Hendra virus. There is no evidence of direct transmission of Hendra virus from Flying Foxes to humans. No vaccine exists for Hendra virus and there is no specific therapy. Avoiding direct contact with Flying Foxes and thoroughly washing wounds inflicted by Flying Foxes are the only preventive measures available. Although to date there is no evidence that Flying Foxes in South Australia carry Hendra virus, it is wise to take a precautionary approach.

Please refer to "Zoonotic diseases" for further information on ABL & Hendra virus.

Any bat found on the ground must be handled as a potential ABL carrier. Carers should be alert for any central nervous system signs in a bat, although ABL may show in other signs. Any bat suspected of carrying ABL should only be handled by fully vaccinated carers using either gloves or a wrapping cloth.

Enclosures shall be constructed of such materials and be maintained in sufficiently good repair to ensure that they will contain the animals at all times and are to be safe for the animals and carers.

To arrange for the disposal of any dead Flying Foxes, contact the Head of Veterinary Conservation Programs at Adelaide Zoo on (08) 8230 1274.

4.20 Zoonotic diseases

Zoonotic diseases are diseases which can be transferred from animals to humans. Animals infected with zoonotic diseases do not always show signs and may not appear to be sick.

Some zoonotic diseases are extremely serious and potentially life-threatening, while others cause only transient, mild disease. Carers should become familiar with the signs of infectious disease and ensure that hygiene protocols are in place to restrict the spread of any outbreak.

Around the world, bats are the source of lyssa (rabies), Hendra, Nipah, SARS, Ebola and Marburg viruses (among others), all of which are RNA viruses and all of which cause incurable diseases in humans with high fatality rates. As host populations for these pathogens, bats are both reservoirs and conduits for significant human diseases through direct transmission and indirect transmission via other animal species.

NOTE: *While many diseases infecting bats overseas have not yet been recorded in Australia, Nipah virus and Tioman virus has been detected in Spectacled, Bare-backed and Black Flying Foxes in Papua New Guinea. It is possible that other zoonotic diseases may currently exist, or may become established, in Australian Flying Fox populations.*

If a person is bitten or scratched by a Flying Fox or any other bat species, they should immediately wash the wound thoroughly with warm soapy water for five minutes and immediately contact their GP or seek other medical attention immediately as initial treatment is essential, irrespective of any vaccinations held by the person.

If a member of the public calls to report an injured Flying Fox that has bitten or scratched a person, they should be advised to;

- Not further handle the bat and contact the RSPCA on 8231 6931 to organise collection and transport of the animal to the Adelaide Zoo Animal Health Centre.
- Wash the bite or scratch thoroughly in warm soapy water for at least five minutes, then if possible apply 70% alcohol or iodine after washing.
- Seek medical advice as soon as possible.

Pre-exposure rabies vaccination is recommended for all people who are at increased risk of ABL, particularly bat carers and veterinarians.

Zoonotic diseases recorded in Flying Foxes in Australia include;

Australian Bat Lyssavirus (ABL) is a rabies-like virus that has been identified in a wide variety of Flying Foxes and insectivorous bats in Australia. The prevalence of ABL is uncertain, however investigations conducted in 1997 found that approximately 5% of all bats tested were positive for ABL. ABL infections have been recorded within bats that originated from between Melbourne and Darwin. The broad geographic range of the virus and ecological complexity suggests that the virus has been present in Australia for a significant period of time.

ABL was first discovered in Flying Foxes in May 1996, during investigations into the role of Flying Foxes as a reservoir of equine morbillivirus (Hendra virus). To date two people in Australia have contracted the disease, one from a Flying Fox and one from a microbat. The virus is fatal to both the bats and humans, however ABL can only be transmitted to humans when infected bat saliva comes into contact with human tissue through an open wound. Therefore it is important to never handle bats unless you are appropriately trained and have up-to-date ABL vaccinations. In the two recorded cases of ABL deaths, the onset of symptoms ranged from approximately four weeks to 27 months.

NOTE: *Bat carers must be fully vaccinated against ABL and have maintained titre levels for effective protection against the virus. Carers and members of the public without this protection should not handle a bat at any time.*

ABL immunity needs to be tested annually to ensure that it has not dropped. If immunity levels have dropped at the point of annual testing a booster will be required to maintain protection.

Many of the bats infected with ABL show few outward signs of the disease, however it may be associated with an inability to fly, hindquarter paralysis, weakness, and sometimes with aggressive behaviour.

Hendra virus (also known as Equine morbillivirus/EMV or Bat Paramyxovirus) has been detected in Flying Foxes in the form of a respiratory disease (similar to a cold or influenza virus). This disease can also be contracted by horses, where the virus becomes dangerous and is usually fatal to the horse. In recent years there have been human deaths associated with the handling of horses infected with this disease. There is a suggestion that the Hendra virus is transmitted to horses by Flying Foxes urinating in horse feed, although conclusive evidence for this or any other method of transmission of the disease to horses is yet to be established.

Hendra virus has not been detected in over a hundred bat carers that were tested for the infection. In each of the three human cases of Hendra virus infection was contracted from infected horses, however bat carers should be

aware of Hendra virus and report the occurrence of severe flu-like illness to their medical practitioner. Hygiene and husbandry protocols sufficient to prevent ABL should protect bat carers from Hendra virus infection.

Menangle virus was first identified in 1997 after a piggery in NSW experienced a high number of stillbirths and deformities during farrowing. Two workers at the piggery came down with an unexplained serious flu-like illness, but subsequently recovered. They later tested positive for Menangle virus antibodies. Investigations of possible hosts revealed that the natural reservoir of this virus is Flying Foxes.

Histoplasmosis (*Histoplasmosis capsulatum*) is an airborne fungus contracted from breathing dust in enclosed areas which contain infected bird or bat guano. Although not reported in Australian Flying Foxes, Histoplasmosis is an environmental fungus capable of causing severe disease and deaths in humans. Care should be taken when working in environments where there are abundant bird or bat faeces. Enclosures should be well ventilated and maintained in a clean, hygienic manner to minimise risks to Flying Foxes and humans alike.

Other: Serological surveys indicate that Flying Foxes have also been exposed to Ross River virus and Murray Valley encephalitis, however they do not appear to act as a reservoir host for these viruses.

5. FURTHER INFORMATION

Captive Husbandry:
Flying Fox Husbandry Manuals and Guidelines;
http://www.australasianzookeeping.org/Husbandry%20Manuals%20-%20Mammals.htm

Behavioural Enrichment Guidelines;
http://www.australasianzookeeping.org/Husbandry%20Manuals%20-%20Rearing,%20Training%20&%20Enrichment.htm#Enrichment_

Hand Rearing Guidelines;
http://www.australasianzookeeping.org/Husbandry%20Manuals%20-%20Rearing,%20Training%20&%20Enrichment.htm#Rearing_

http://www.health.gov.au/internet/main/publishing.nsf/content/cda-pubs-other-bat_lyssa.htm

Contacts:
DENR Fauna Permit Unit
1 Richmond Road,
Keswick, SA, 5035.
Phone: (08) 8124 4972
Fax: (08) 8124 4939
http://www.environment.sa.gov.au/Plants_and_Animals/Permits_and_Licences

List of Suppliers:
Wombaroo Food Products
(Hand Raising Formula and Equipment)
P.O. Box 151,
Glen Osmond, South Australia, 5064.
Ph: (08) 8391 1713
Fax: (08) 8391 1713
Email: Wombaroo@adelaide.on.net
Web: http://www.wombaroo.com.au/

Sharpe Laboratories Pty Ltd.
(Di-Vetelact Hand Raising Formula)
12 Hope Street,
Ermington, New South Wales, 2115.
Ph: (02) 9858 5622
Fax: (02) 9858 5957
Email: admin@sharpelabs.com.au
Web: http://www.sharpelabs.com.au/

Other:
Australasian Bat Society
http://www.abs.ausbats.org.au

A Manual for Frontline Workers Answering Enquiries about Bats in Urban and Rural Areas:
http://www.sydneybats.org.au/cms/download.php?939f887bee270669174b08af855f7f41

Commonwealth Department of Health and Ageing, Australian Bat Lyssavirus Guidelines;
http://www.health.gov.au/internet/main/publishing.nsf/content/cda-pubs-other-bat_lyssa.htm

SA Department of Biosecurity web site (Hendra Virus)
http://www.pir.sa.gov.au/biosecuritysa/animalhealth/disease_programs/hendra_virus

SA Department of Health web site – Australian Bat Lyssavirus
http://www.dh.sa.gov.au/pehs/ygw/rabieslyssavirus-pehs-sahealth-2009.pdf

Appendix 1: Wild Diet of Grey-headed Flying Fox in NSW.

Native Blossom Species

Family	Species	Common Name
Arecaceae	*Livistona australis*	Cabbage Palm
Leguminoseae	*Castanospermum australe*	Black Bean
Myrtaceae	*Angophora costata*	Smooth-barked Apple
	Angophora floribunda	Rough-barked Apple
	Angophora subvelutina	Broad-leaved Apple
	Angophora woodsiana	Wood's Apple
	Callistemon citrinus	Crimson Bottlebrush
	Callistemon salignus	White Bottlebrush
	Corymbia eximia	Yellow Bloodwood
	C. gummifera	Red Bloodwood
	C. henryi	Large-leaved Spotted Gum
	C. intermedia	Pink Bloodwood
	C. maculata	Spotted Gum
	C. variegata	Spotted Gum
	Eucalyptus acmenoides	White Mahogany
	E. albens	White Box
	E. amplifolia	Cabbage Gum
	E. andrewsii	New England Blackbutt
	E. baileyana	Bailey's Stringybark
	E. bancroftii	Orange Gum
	E. beyeri	an ironbark
	E. blakeyi	Blakely's Red Gum
	E. botryoides	Southern Mahogany
	E. camaldulensis	River Red Gum
	E. campanulata	a New England blackbutt
	E. carnea	Thick-leaved Mahogany
	E. cayleyi	Cayley's Ironbark
	E. crebra	Narrow-leaved Ironbark
	E. dealbata	Tumbledown Red Gum
	E. deanii	Moutain Blue Gum
	E. fibrosa	Broad-leaved Ironbark
	E. fusiformis	a grey ironbark
	E. grandis	Flooded Gum
	E. haemastoma	Scribbly Gum
	E. longifolia	Woolybutt
	E. macrorhyncha	Red Stringybark
	E. maidenii	Maiden's Gum
	E. melanophloia	Silver-leaved Ironbark
	E. melliodora	Yellow Box
	E. moluccana	Grey Box
	E. paniculata	Grey Ironbark

	E. parramattensis	Parramatta Gum
	E. pilularis	Blackbutt
	E. piperita	Sydney Peppermint
	E. placita	a grey ironbark
	E. propinqua	Small-fruited Grey Gum
	E. punctata	Large-fruited Grey Gum
	E. pyrocarpa	Large-fruited Blackbutt
	E. racemosa	Southern Scribbly Gum
	E. resinifera	Red Mahogany
	E. robusta	Swamp Mahogany
	E. saligna	Sydney Blue Gum
	E seeana	Narrow-leaved Red Gum
	E. siderophloia	Grey Ironbark
	E sideroxylon	Red Ironbark
	E. tereticornis	Forest Red Gum
	E. tessellaris	Carbeen
	E. tetrapleura	a grey ironbark
	E. tricarpa	an ironbark
	E. umbra	Broad-leaved White Mahogany
	Lophostemon confertus	Brush Box
	L. suaveolens	Swamp Turpentine
	Melaleuca quinquenervia	Broad-leaved Paperbark
	Syncarpia glomulifera	Turpentine
Proteaceae	*Banksia integrifolia*	Coast Banksia
	Banksia serrata	Saw Banksia
	Grevillea robusta	Silky Oak
	Stenocarpus sinuatus	Firewheel Tree
Xanthorrhoeaceae	Xanthorrhoea spp.	Grass Tree

Native Fruit Species

Family	Species	Common Name
Arecaceae	*Livistona australis*	Cabbage Palm
	Archontophoenix cunninhamiana	Bangalow Palm
Podocarpaceae	*Podocarpus elatus*	Plum Pine
Cunoniaceae	*Schizomeria ovata*	Crabapple
Davidsoniaceae	*Davidsonia pruriens*	Davidson's Plum
Ebenaceae	*Diospyros pentamera*	Myrtle Ebony
Ehretiaceae	*Ehretia acuminata*	Koda

Elaeocarpaceae	*Elaeocarpus obovatus*	Hard Quandong
	Elaeocarpus reticulatus	Blueberry Ash
Escalloniaceae	*Polyosma cunninghamii*	Featherwood
	Mallotus discolor	White Kamala
Icacinaceae	*Pennantia cunninghmaii*	Brown Beech
Meliaceae	*Melia azedarach*	White Cedar
Monimiaceae	*Hedycarya angustifolia*	Native Mulberry
Moraceae	*Ficus coronata*	Creek Sandpaper Fig
	F. fraseri	Sandpaper Fig
	F. macrophylla	Moreton Bay Fig
	F. microcarpa	Small-fruited Fig
	F. obliqua	Small-leaved Fig
	F. rubiginosa	Rusty Fig
	F. suberba	Deciduous Fig
	F. virens	White Fig
	F. watkinsiana	Strangler Fig
Myrtaceae	*Acmena hemilampra*	Broad-leaved Lilly Pilly
	Acmena ingens	Red Apple
	Acmena smithii	Lilly Pilly
	Rhodamnia argentea	Malletwood
	Syzygium australe	Brush Cherry
	Syzygium corynanthum	Sour Cherry
	Syzygium crebrinerve	Purple Cherry
	Syzygium luehmanii	Riberry
	Syzygium oleosum	Blue Lilly Pilly
	Syzygium paniculatum	Magenta Lilly Pilly
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum
Rhamnaceae	*Alphitonia excelsa*	Red Ash
Sapindaceae	*Diploglottis australis*	Native Tamarind
	Toechima dasyrrhache	Blunt-leaved Steelwood
Sapotaceae	*Planchonella australis*	Black Apple
Urticaceae	*Dendrocnide excelsa*	Stinging Tree
	Dendrocnide photinophylla	Shining-leaved Stinging Tree
Viscaceae	*Notothixos cornifolius*	Kurrajong Mistletoe

Anonaceae	*Rauwenhoffia leichardtii*	Zig Zag Vine
Apocynaceae	*Melodinus australis*	Southern Melodinus
Moraceae	*Maclura cochinchinensis*	Cockspur Thorn
Passifloraceae	*Passiflora spp*.	Native passionfruit species
Rubiaceae	*Morinda jasminoides*	Morinda
Vitidaceae	*Cissus antarctica*	Water Vine
	Cissus hypolglauca	Five-leaf Water Vine

Leaves

Family	Species	Common Name
Avicenniaceae	*Avicennia marina*	Grey Mangrove
Salicaceae	*Populus sp.*	Poplar

Exotic Fruits

Family	Species	Common Name
Anacardiaceae	*Harpephyllum caffrum*	South African Wild Plum
	Mangifera indica	Mango
Annonaceae	*Annona spp.*	Custard Apple
Caricaceae	C*arica papaya*	Papaya
Ebenaceae	*Diospyros spp.*	Persimmon
Moraceae	*Morus nigra*	Mulberry
Musaceae	*Musa sp.*	Banana
Myrtaceae	*Psidium guajava*	Guava
Oleaceae	*Ligustrum lucidum*	Large-leaved Privet
	Ligustrum sinsense	Small-leaved Privet
Palmae	*Phoenix canariensis*	Canary Island Date Palm
	Arecastrum romanzoffianum	Cocos Palm
Rosaceae	*Malus spp*.	Apple
	Prunus armeiaca	Apricot
	P. persica	Peach
	P persica var nectarina	Nectarine

	Prunus spp.	Cherry
	Prunus spp.	Plum
Rutaceae	*Citris reticulata*	Mandarin
	Citris spp.	Orange
Sapindaceae	*Litchi chinensis*	Lychee
Solanaceae	*Solanum mauritianum*	Wild Tobacco
Ulmaceae	*Celtis sinense*	Chinese Nettle Tree
Vitaceae	*Vitis sp.*	Grape

From: Diet list for Grey-headed Flying Fox Pteropus poliocephalus, Australasian Bat Society, 2001.