

FLYING-FOXES



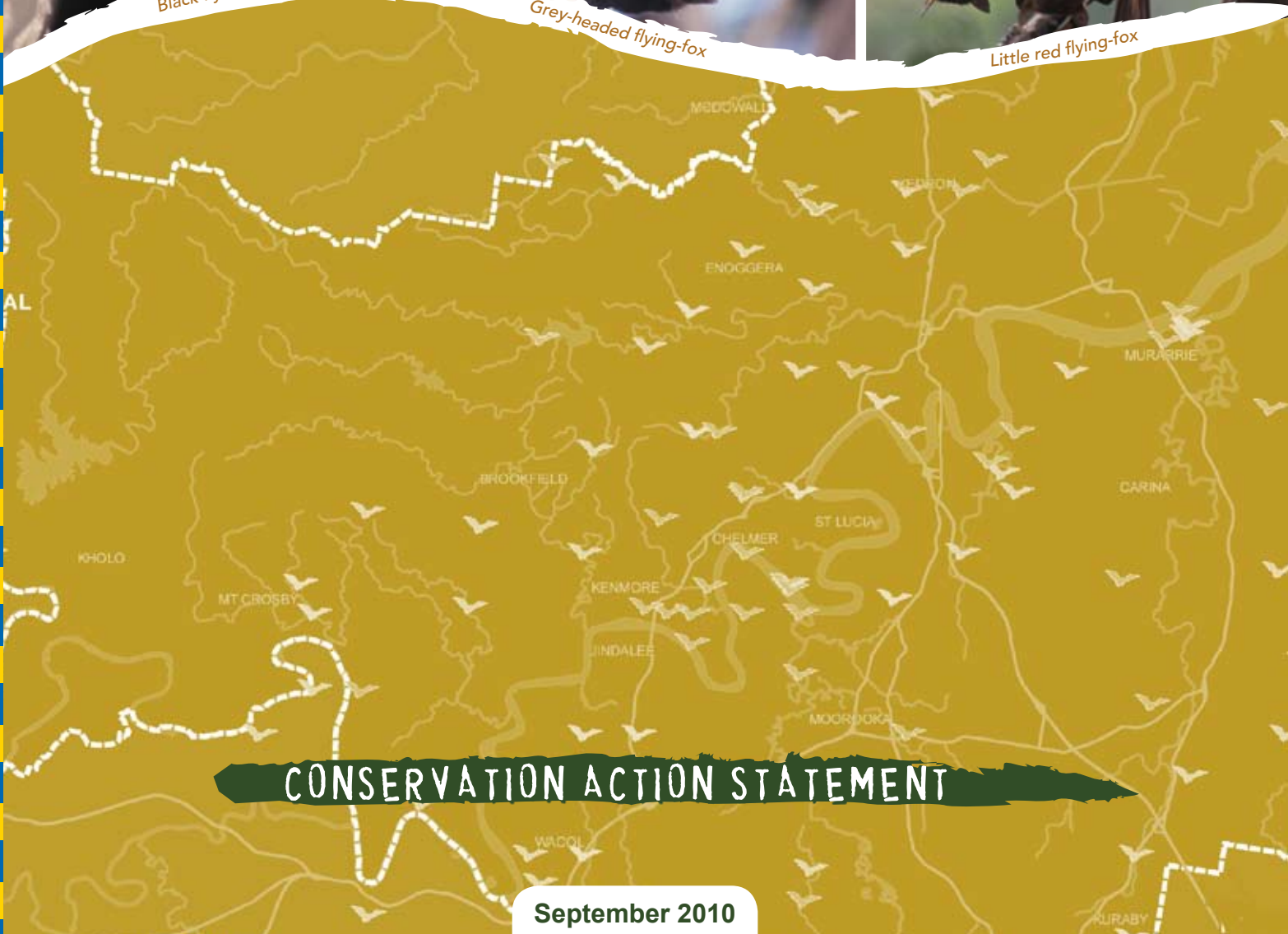
Black flying-fox



Grey-headed flying-fox



Little red flying-fox



CONSERVATION ACTION STATEMENT

September 2010

I ♥ BNE

That's why I'm taking action
to conserve our wildlife.



Dedicated to a better Brisbane

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Photography acknowledgments

- Grey-headed flying-fox, *Pteropus poliocephalus*, ©Queensland Museum, Jeff Wright.
- Black flying-fox, *Pteropus alecto*, ©Queensland Museum, Jeff Wright.
- Little red flying-fox, *Pteropus scapulatus*, ©Queensland Museum, Gary Cranitch.

1 Introduction

This Conservation Action Statement addresses the following flying-fox species, collectively referred to as flying-foxes:



1. Grey-headed flying-fox (*Pteropus poliocephalus*)¹
2. Black flying-fox (*Pteropus alecto*)
3. Little red flying-fox (*Pteropus scapulatus*)

All three species of flying-fox covered by this Conservation Action Statement are not currently listed as 'Significant' within Brisbane in Council's Natural Assets Planning Scheme Policy (Brisbane City Council 2000). However, some flying-fox populations are believed to be in decline. The black and little red flying-foxes are considered important habitat indicators within Brisbane and are also 'Regionally Significant' priority taxa under the Biodiversity Assessment Mapping Methodology (EPA 2002). The grey-headed flying-fox is listed as 'Vulnerable' under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This Conservation Action Statement will be updated as new information becomes available and to report progress on conservation actions. For more information about this or any other Conservation Action Statement, visit Council's website at www.brisbane.qld.gov.au or phone Council on (07) 3403 8888.

Aims

This Conservation Action Statement clearly defines Council's management intent for the long-term protection and conservation of the identified flying-foxes within Brisbane through the following actions:

- Collating **existing information** on the distribution, ecology, physiology, behaviour and management requirements of these species within Brisbane and surrounds.
- Identifying **key threats** that significantly impact upon these species within Brisbane.
- Identifying **gaps in existing knowledge** of the habitat and management requirements of these species, allowing research priorities to be defined.
- Detailing **practical and affordable strategies and actions** that support the long-term protection and conservation of these species within Brisbane.

2 Conservation status

The conservation status of a species will influence how it is managed. 'Threatened' species are typically accorded a more stringent management regime than 'common' species. Various conservation registers identify the status of fauna species at local, state and national levels. The current conservation status of the flying-foxes is provided in Table 1.

Table 1: Official conservation status of Brisbane's flying-foxes

Species	Brisbane City ¹	South East Queensland ²	Queensland ³	National ⁴
Grey-headed flying-fox	Not listed	Not listed	Least concern (but recommended for listing as Vulnerable by the Scientific Advisory Committee)	Vulnerable
Black flying-fox	Not listed	Regionally significant priority taxa	Least concern	Not listed
Little red flying-fox	Not listed	Regionally significant priority taxa	Least concern	Not listed

¹ Brisbane City Council 2000, *Brisbane City Plan 2000*, Natural Assets Planning Scheme Policy, vol. 2 (2006 Amendments) ² Significant for South East Queensland Bioregion under the Biodiversity Assessment and Mapping Methodology (Environmental Protection Agency 2002) ³ *Nature Conservation (Wildlife) Regulation 2006* under the *Nature Conservation Act 1992* ⁴ *Environment Protection and Biodiversity Conservation Act 1999*

3 Distribution²

National/state

Grey-headed flying-fox

- Endemic to Australia.
- Australian range of about 0.7 million km².
- Currently found in coastal areas from Victoria to Mackay, Queensland, extending inland to the western slopes of the Great Dividing Range (Hall and Richards 2000; Webb and Tidemann 1996).
- Range changes since European settlement; range has expanded south into Victoria during winter months and was thought to have contracted from the north (Birt 2000). Recent evidence suggests that older records from the far north of its range were misidentifications (Roberts *et al.* 2008).
- There are now permanent camps from central Queensland to Victoria, with one in Melbourne established in the mid 1980s.

Black flying-fox

- Found in the northern half of Australia, from south of Port Macquarie in New South Wales down the coast of Western Australia around the Exmouth Gulf, and inland to areas where there is permanent water (Hall and Richards 2000). They have an essentially coastal distribution throughout Queensland.
- Australian range of about 1.6 million km².
- Also found in New Guinea and Indonesia.
- Major range changes since European settlement; range has expanded south along the east coast to Wingham Brush (60km south of Port Macquarie), New South Wales (Ratcliffe 1931; Eby 2004).
- Majority of camps between Brisbane and Maryborough, Queensland, now dominated by black flying-foxes (Birt 2000).

3 Distribution continued...

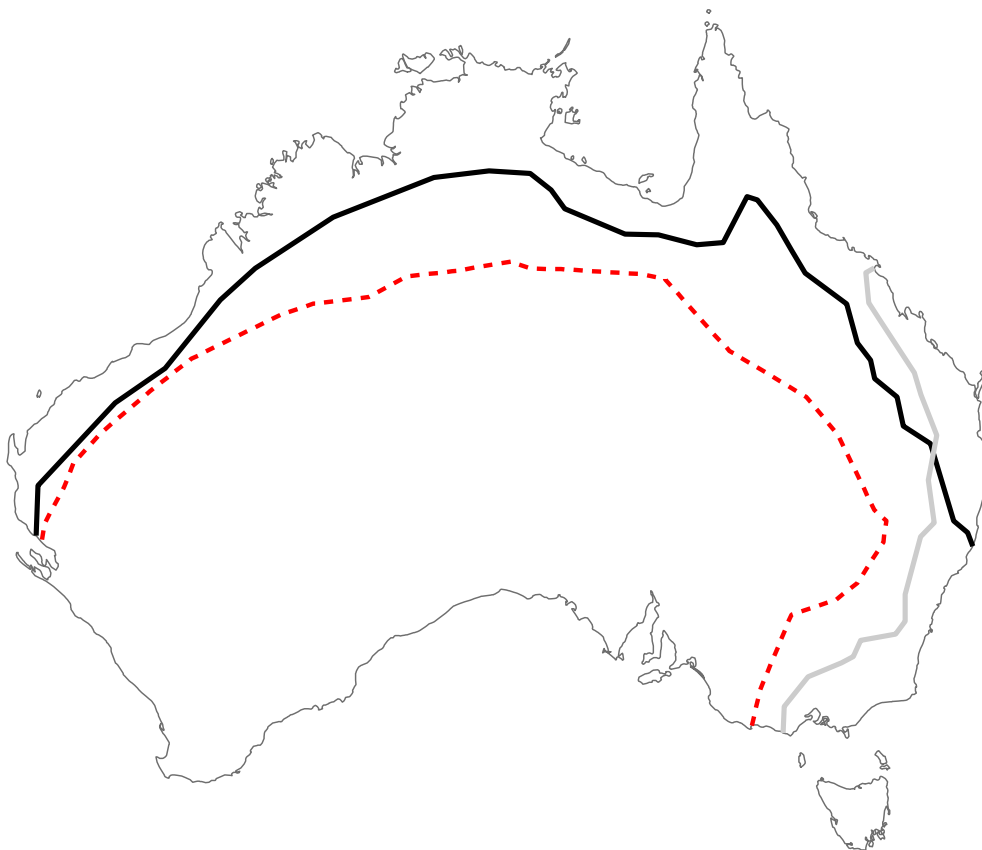
National/state...

Little red flying-fox

- Australian range of about 3.5 million km².
- Near-endemic to Australia, with only one record of this species from New Guinea (Waithman 1979).
- Found where grey-headed and black flying-foxes are also recorded, all three species can occur within the same camp.
- Also distributed further inland into semi-arid areas, along inland rivers.

The map in Figure 1 shows the Australian range of the three flying-fox species covered by this Conservation Action Statement.

Figure 1: Australian range of black, (black line) grey-headed (grey line) and little red (red dashes) flying-foxes³



3 Distribution continued...

Local

Flying-foxes are colonial animals, roosting communally in what are called 'camps'. All three species may be found in a single camp. Camps may contain dozens or up to hundreds of thousands of flying-foxes. When food is scarce flying-foxes can disperse from these camps and may hang individually or in small groups near feeding trees. Some campsites are occupied permanently, some seasonally and others irregularly, such as every few years when a large flowering occurs nearby.

There have traditionally been five permanent flying-fox camps within Brisbane City boundaries located in the suburbs of Indooroopilly, Coorparoo, Hemmant, Stafford and Sandgate.

Currently many of South East Queensland's permanent flying-fox camps have been abandoned (e.g. Indooroopilly) and flying-foxes appear to have broken up into smaller and more dynamic camps throughout the region (Craig Walker, DERM, 2010, pers. comm.). The reason for this is not known or whether this is a temporary or permanent change.

Grey-headed flying-fox

- Populations vary greatly seasonally and year to year.
- Some individuals are resident throughout the entire year and do not migrate.
- More abundant in some seasons with arrival of migrants. Numbers tend to be highest between May and December and lowest in late summer/autumn between February and April.
- Relative abundance is highest during spring/summer, correlating with flowering of various native trees.
- Five permanent Brisbane camps are occupied most of the time by both grey-headed and black flying-foxes.
- There are at least another 16 camps within 100 kilometres of Brisbane, most of them also occupied throughout the year by grey-headed and black flying-foxes. The Woodend camp in Ipswich is the most populous.

Black flying-fox




- Numbers vary in a similar way to grey-headed flying-foxes. Seasonally abundant, with some resident throughout the year.
- Numbers in South East Queensland tend to peak in spring between September and November, and wane in autumn/winter between April and June.
- Occupation of camps by black flying-foxes is more stable and consistent than that of grey-headed and little red flying-foxes.
- Black flying-fox dominate in three of the five permanent Brisbane camps shared with grey-headed flying-foxes.
- Also share occupancy of other camps outside Brisbane.

Little red flying-fox

- Seasonal presence is generally restricted to spring and summer (September to February, sometimes to April/May) at three Brisbane campsites.
- About two-thirds of the 16 camps outside Brisbane are occasionally or seasonally occupied by little red flying-foxes.
- On occasion half a million little red flying-foxes have been recorded visiting the Woodend camp.

Verified flying-fox records for Brisbane City are shown on Map 1.

Flying-foxes

-  Grey-headed flying-fox
-  Black flying-fox
-  Little red flying-fox

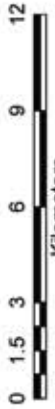


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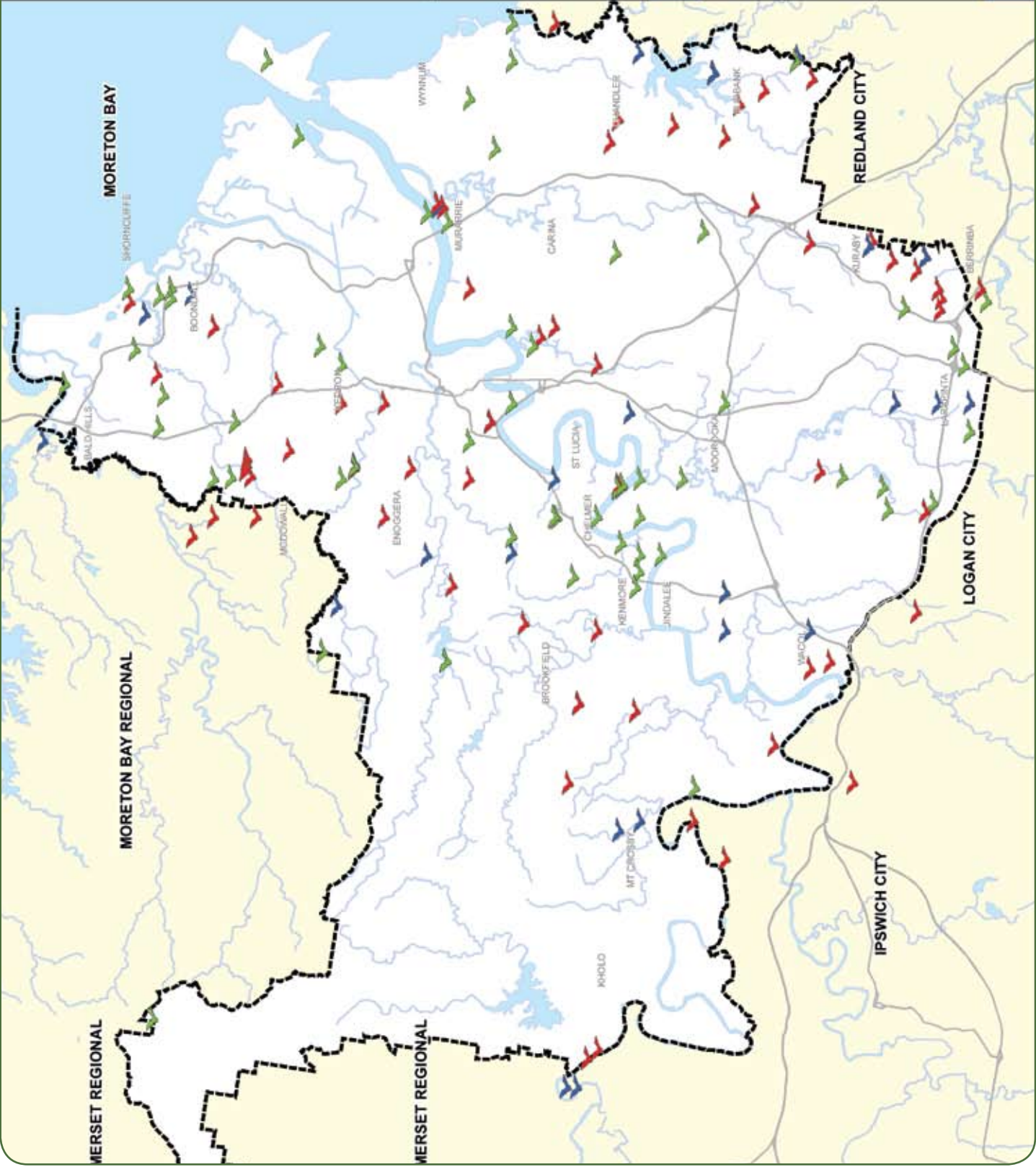


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Conservation Action Statement

Records of flying-foxes in Brisbane

Dedicated to a better Brisbane



4 Ecology

Habitat

Historically the typical flying-fox camp has existed in mangroves, swamps, rainforest or open forest, beside creeks or some other type of waterway. Flying-fox camps these days can be found in or next to urban areas. Before intensive urbanisation, flying-foxes chose secluded and shady areas for their day-time camps (Ratcliffe 1931). There are very few areas like this anymore along the urbanised coastal strip.

Flying-foxes demonstrate remarkable fidelity to camps. Some campsites have been occupied for more than a century. However, regular occupancy does not necessarily determine the importance of an individual campsite. For example, irregularly occupied camps may provide access to vital food resources such as eucalypts that flower only every few years. Other camps may function as vital intermittent transit camps allowing flying-foxes to forage throughout their range.

The selection and organisation of flying-fox campsites is yet to be fully understood. Occupation patterns of flying-fox camps are determined by various age, sex, species and seasonal factors. The results of a tracking study suggest that male flying-foxes may be philopatric, which means they return to their campsite of birth to breed (Tidemann and Nelson 2004).

Grey-headed flying-fox

- Nominal core habitat areas are represented by preferred areas of seasonal, annually reliable food sources (generally restricted to discrete habitat patches in coastal areas).

Black flying-fox

- Similar to grey-headed flying-foxes, occurring in mixed colonies with either flying-fox species.
- Greater adaptability than the other species may explain increasing dominance over grey-headed flying-foxes.

Little red flying-fox

- Closely tied to flowering food plant distributions.
- Can occur in mixed colonies with other flying-fox species.

Indooroopilly Island Camp

- Located on what was an island prior to 1976, four kilometres south of Brisbane' CBD along the Brisbane River, bordering the Indooroopilly Golf Course.
- Roost site varies but is usually on the original island or the silty bar South East of the island.
- Became the major maternity site in South East Queensland in 1978, when it was occupied by 120,000 grey-headed flying-foxes (Hall 2002). This coincided with the loss of Fisherman's Island campsite due to mangrove clearing for a shipping container terminal.
- Vegetation consists mainly of grey mangroves (*Avicennia marina*) on the island and river mangroves (*Aegiceras corniculatum*) on the now silted channel.
- Occupied by a mixed colony of grey-headed and black flying-foxes, with seasonal occupation by little red flying-foxes.
- Camp occupants tend to move around within the campsite, with observations over 25 years suggesting that most areas of roost are occupied for a maximum of three years (Hall 2002). This allows for some recovery of vegetation.
- Extensive damage to vegetation has been caused when large numbers of little red flying-foxes have roosted there (e.g. in 1978 and 1986) (Hall 2002).
- If hydrological changes take place, many of the grey mangroves may eventually be replaced by shorter, less suitable roosting trees.

4 Ecology continued...

Habitat continued...

Norman Creek Camp

- Located three kilometres south of Brisbane, along two arms of Norman Creek, bounded to the north and south by the grounds of the Anglican Church Grammar School, and to the east by Coorparoo Secondary College and Griffin Park.
- Vegetation consists mostly of grey mangroves.
- Occupied by a mixed colony of grey-headed and black flying-foxes, dominated by black flying-foxes, with occasional visits by little red flying-foxes.
- Stable camp with a large proportion of the residents probably being permanent or relatively permanent.
- Vegetation heavily damaged as an unavoidable consequence of long-term occupancy by a large population of flying-foxes. As more foliage is lost, flying-foxes will be forced to use lower roosts and disperse more widely along the creek.

Sparkes Hill Camp

- Located on Sparkes Hill, seven and a half kilometres northwest of Brisbane near Kedron Brook, in Stafford.
- Brush box (*Lophostemon confertus*) dominated dry sclerophyll forest on the slopes with scattered remnant rainforest trees.
- Usually occupied by equal numbers of grey-headed and black flying-foxes.
- Numbers of both species have been in decline since 1996.
- No little red flying-foxes have been recorded.
- The population moves up and down the hill at various times.

Hemmant Camp

- Located along Doughboy Creek nine kilometres east of Brisbane in an industrial area near the Port of Brisbane, bounded to the north and west by Bulimba Creek and to the south by Lytton Road.
- Vegetation consists entirely of low grey mangroves.
- Occupied mostly by black flying-foxes with a few grey-headed flying-foxes and occasionally little red flying-foxes.
- This isolated stand of mangroves has been occupied for approximately 30 years.

Sandgate Camp

- Located in Curlew Park, Sandgate, close to the Sandgate railway station on a tributary of Cabbage Tree Creek.
- Vegetation is mostly grey mangroves. The flying-foxes also roost in a few eucalypts and a silky oak (*Grevillea robusta*) adjacent to the mangroves on the northern side of the stream.
- Occupied by a mixed colony, dominated by black flying-foxes, with very few grey-headed flying-foxes and seasonal visits from little red flying-foxes.
- From this camp, flying-foxes access food on the islands.

4 Ecology continued...

Diet

The diet of flying-foxes consists mainly of fruit and nectar. Most of the nectar sources utilised by the three species of flying-fox come from the Myrtaceae family, in particular the *Eucalyptus*, *Corymbia*, *Melaleuca* and *Angophora* genera. Other blossom food sources are members of the Proteaceae, Fabaceae, Arecaceae, Elaeocarpaceae, and Xanthorrhoeaceae families. A sample species list of flying-fox nectar sources that occur in Brisbane is provided in Table 2 below. A wide variety of native and exotic fleshy fruits are eaten. Native figs such as Moreton Bay fig (*Ficus macrophylla*) and weeping fig (*Ficus benjamina*) are considered to be particularly important.

Table 2: Sample list of flying-fox food nectar sources in Brisbane

Family	Species	Common name	Grey-headed flying-fox	Black flying-fox	Little red flying-fox	Notes	Time of usual flowering
Myrta-ceae	<i>Angophora floribunda</i>	Rough-barked apple	XX	XX	XX	Medium honey source. Best nectar producer of the Angophoras, best in dry years.	Dec-Jan
	<i>Corymbia gummifera</i>	Red bloodwood	XX	XX	XX	Medium honey source.	Dec-April
	<i>C. intermedia</i>	Pink bloodwood	XX	XX	XX	Minor to medium honey source. The most important of the bloodwoods for beekeepers	Jan-Mar
	<i>Eucalyptus acmenoides</i>	White mahogany	XX	XX	XX	Medium honey source.	Oct-Dec
	<i>E. moluccana</i>	Gum-topped Box	XX	XX	XX	Medium honey source.	Feb-April
	<i>E. siderophloia</i>	Grey ironbark	XX	XX	X	Major honey source. One of most valuable honey sources. Some blossom every year, good yields about every 3 years.	Jul-Dec
	<i>E. tereticornis</i>	Forest red gum	XX	XX	X	Minor-medium honey source. Common and regularly planted, regular blossom, heavy every 3-4 years.	Jul-Nov
	<i>Melaleuca quinquenervia</i>	Broad-leaved paperbark	XX	XX	X	Common and commonly planted, good nectar.	Mar-Jul
Pro-teaceae	<i>Banksia integrifolia</i>	Coast banksia	XX	XX	X	Medium honey source. Ample nectar source.	April-May
	<i>Grevillea robusta</i>	Silky oak	XX	XX	X	Not common as native, but abundantly planted	Sep-Nov

X indicates that the food is eaten by that particular flying-fox species in Brisbane.

XX indicates that the food is likely to be an important or abundant food source for flying-foxes in Brisbane. These judgements have been derived through the assessment by researchers that the nectar production is considered good or the species is abundant.

4 Ecology continued...

Diet continued...

Grey-headed flying-fox

- Dietary generalist, eating a range of native and exotic blossoms and fruit. One study found at least 54 flower species (nectar and pollen) and 48 fruit species occurring in subtropical rainforests being utilised by the grey-headed flying-fox (Eby *et al.* 1999).
- Figs are a common and important diet plant.
- Primary food source considered to be nectar and pollen from eucalypt-dominated woodlands and forest (Hall and Richards 2000).
- Target a diverse range of rainforest fruit also eaten by birds (i.e. essentially eating a subset of the avian diet) (Eby 2004).
- No significant colour or seed type preference in selection of fruit. Seeds are ingested, spat out or dropped.
- Fruit is harvested by plucking with the teeth. Depending on the size of the fruit, it may be taken whole in the mouth or torn to pieces while manipulated with thumb claws and one foot.
- Differentiation in food preference by individuals may be based on colony hierarchy.
- Summer/autumn food resources are abundant and predictable and found in coastal areas (Eby 1996).
- Spring food resources (important for successful reproduction) are not predictable and scattered over a wider area (Eby 1996).
- Winter food resources are limited, with reliable resources available in a limited number of coastal locations and less predictable resource dispersed over a wide inland area (Eby 1996).
- Studies found that dominant residents in a camp target reliable and predictable foods, mostly figs, close to the camp.
- Also, local migrants targeted a more diverse array of plants, including figs and other rainforest fruits as well as blossom, usually from permanent or annual camps in a local area.
- Similarly, subordinate nomads targeted a much greater diversity of foods, tracking the less reliable and predictable resources over large areas, often staying in occasional camps (Eby 1996).

Black flying-fox

- Similar eating habits to grey-headed flying-foxes, but more inclined to sedentary behaviour.
- Dietary generalist, eating a range of native and exotic blossoms, fruit and occasionally leaves (Churchill 2008).
- Figs are a common and important diet plant.
- More resourceful and flexible in feeding behaviour. Black flying-foxes are prepared to try a greater variety of foods, quicker to find new foods and feed lower in trees than grey-headed flying-foxes.

Little red flying-fox

- Nectar specialist, feeding almost exclusively on blossom, predominantly on nectar of eucalypts, bloodwoods and Angophoras.
- Little red flying-foxes are the only flying-fox world-wide which have an almost exclusive nectarivorous diet (Birt *et al.* 2008).
- Annually track the different flowering eucalypt species over vast areas.
- Their tongue is different from that of other flying-foxes and more similar to nectar-feeding birds (Birt *et al.* 2008).
- Also eat pollen, inadvertently while harvesting nectar (Birt 2004).
- Occasionally eat fruits when nectar resources are deficient, sometimes causing losses of commercial fruits (Birt *et al.* 2008).

4 Ecology continued...

Reproduction

Flying-foxes have a low natural capacity for increase. Flying-fox populations have been previously estimated to have a 'natural' death rate of 20% and adult fecundity of 80% (McIlwee and Martin 2002). However, a recent study of an urban population of grey-headed flying-foxes estimated much higher death rates (35%) and lower fecundity, which led to an estimate of negative population growth rates (Divljan 2008). Extinction of the population could be expected within 84 years without any changes in population dynamics. An additional imposed mortality of 10%, due to culling or other human-based threats, can easily halve flying-fox populations in much less than a decade (McIlwee and Martin 2002).

The seasonality of flying-fox births suggests an evolutionary adaptation to climatic and blossom/fruitlet cycles in Australia (Table 3). The seasonal rigidity (as well as long gestation period) means flying-foxes are more vulnerable to changes in climate and clearance of foraging habitat than opportunistic breeders would be. Evidence suggests that flying-foxes are naturally long-lived, with one captive grey-headed flying-fox living to the age of 23 and many in captivity surviving for well over a decade (Pritchard 2001).

Grey-headed flying-fox

- In southern Queensland they breed between March-April.
- Gestation of six months, birth of a single young in September–November and weaning five to six months after birth.
- The young are carried by their mother (under the body, attached to a nipple) while foraging for about the first three weeks, then left in a crèche, and later in the roost tree.
- At about three months of age, the young are capable of flight and start flying out on foraging trips.
- Females breed in their second or third year.
- Many two-year-olds, however, drop their young and do not successfully rear them. Their success rate is probably only about 20% (McIlwee and Martin 2002).
- Most wild adult females conceive but are prone to abort under stress such as heat waves (Webb and Tidemann 1996).
- Birth rates appear to be greatly affected by food shortages (Eby 2000).

Black flying-fox

- Similar to grey-headed flying-fox.
- In one study, mortality rates for juvenile black flying-foxes were estimated at 43-80% in the wild (Vardon and Tidemann 2000).
- Possibly only one in every three females born reproduces.

Little red flying-fox

- Reproduction calendar is similar to, but out of phase with the other two species by about six months, with births peaking in April to June.

Table 3: Breeding seasons (brown shading indicates peak birthing times, green indicates peak mating times)

Species	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Grey-headed flying-fox												
Black flying-fox												
Little red flying-fox												

4 Ecology continued...

Movement patterns

The patterns of movement of flying-foxes vary considerably between seasons, years, places, species and individual animals, in poorly understood ways. Under normal conditions flying-foxes can move at 25-30km per hour (Hall and Richards 2000) and may move large distances from campsites to feed each night. Such mobility allows flying-foxes to maintain communal roosts despite extensive fragmentation of their foraging habitat. The average distances travelled vary according to season, camp location and the quantity and quality of food (Eby 1991). In urban areas, a great variety of planted, well-watered and fertilized trees allow many flying-foxes to lead quite sedentary lifestyles.

Grey-headed flying-fox

- Some are permanent residents in Brisbane camps, others move locally between camps in the region, while others travel hundreds of kilometres between isolated temporary camps.
- Camp populations do not function as a unit, with individuals or perhaps small groups moving independently of other flying-foxes (Eby 1991).
- Optimal flying speeds are 21-24km/h (Hall and Richards 2000).
- May preferentially move over long distances when there are tail winds (Tidemann and Nelson 2004).
- A foraging range of up to 50 kilometres has been recorded with an average round trip of 28.6 kilometres recorded in Lismore, New South Wales (Eby 1991).
- Likely factors influencing movements include the flowering of eucalypts and related species, the availability of other foods and the reproductive cycle.
- Migratory behaviour now reduced in urban areas where a great variety of foods throughout the year is available (Parry-Jones and Augee 2001).
- From Lismore studies, at least three categories of movement: 'residents' are a small proportion of the population who were resident in camps year-round, 'local migrants' who moved small distances between camps (usually less than 100 kilometres) remaining within 155 kilometres of their capture sites, and 'nomads' who travelled large distances between camps (up to 800 kilometres from the capture site) (Eby 1996).
- Nomads tend to move south in the autumn and north in the winter, following eucalypt flowering.
- Nomads mainly occupy occasional camps. When in mixed camps, nomads are at the bottom of the social hierarchy.
- Grey-headed flying-foxes have demonstrated migration patterns typical of many eastern Australian land birds, due primarily to availability of eucalypt nectar.
- How they locate irregular irruptions of blossoms is unknown, but there is evidence that they do not migrate to areas of flowering below a certain threshold of flowering intensity (Eby *et al.* 1999).

Black flying-fox

- Limited numbers of tracking studies have been undertaken on this species therefore their movement patterns are largely not understood.
- Most probably have similar patterns of movement to grey-headed flying-foxes but appear to be more sedentary.
- Continuous occupation of campsites in South East Queensland is more characteristic of black than grey-headed flying-foxes (Birt 2004).
- Consistently predominant in most campsites, have been found to dominate half of the local permanent campsites.
- In Brisbane some individuals fly an average of less than three kilometres from camp to food (Marcus 2000).
- Radiotracking in Brisbane has shown that some can stay in the same camp and forage in very small areas for months on end (Markus 2000).
- The sedentary lifestyle is supported by reliable food resources in urban areas (Marcus 2000).

4 Ecology continued...

Movement patterns continued...

Little red flying-fox

- Most mobile of all flying-foxes travelling hundreds of kilometres following successive, irregular, pulses of available nectar sources.
- Movements tightly tied to eucalypt flowerings. These movements are very poorly known and understood.
- Generally stay in a campsite only for the few weeks of a particular flowering, although duration of their stay strongly associated with the duration of consecutive flowerings of several species.
- A foraging range of up to 20-30 kilometres has been recorded (Eby 1991).
- An average round trip of 26.5 kilometres was recorded in South East Queensland (Birt 2004).
- Stay in temporary camps, which may include the permanent or seasonal camps of other flying-fox species.
- Regularly occupy camps in South East Queensland during summer months, probably arriving from the west and then flying north to follow the flowering of different eucalypt species.

5 Threats

Habitat loss, fragmentation and simplification

- Since European settlement, an estimated 67,000 hectares, or two-thirds of the original woody vegetation in Brisbane City, has been cleared. This includes approximately 90% of lowland forests and more than 80% of all lowland vegetation (below 100m elevation). Habitat fragmentation is extensive – around 80% of the bushland remnants in the city are less than 20 hectares (Council 2001).
- Smaller remnants of habitat typically present sub-optimal feeding habitat conditions and potentially lead to increased breeding failures, reduced recruitment and possible population collapse. Clearing for coastal development and in central Queensland for pastoralism have deprived flying-foxes of a considerable proportion of their foraging habitats.
- Increasing fragmentation and loss of connectivity between habitat remnants may effectively reduce foraging and breeding habitat. Shortages of winter and spring flowering plants directly impact on reproductive success.
- Roosting site disturbance by human-related activities is more likely in urban areas where campsites are close to residences. Disturbances may force flying-foxes away from roosting sites close to favoured feeding sources.
- Large populations forced to use smaller campsites are causing significant vegetation damage. In urban areas, protected areas where campsites can move or expand into are limited.
- Vegetation damage in existing campsites is forcing flying-foxes to roost lower in trees and use areas outside the original campsites. Campsites in close proximity to residences cause complaints about noise and odour and raise concerns about health issues.

Culling

- Flying-foxes have a low capacity for population increase and are thus vulnerable to even low rates of imposed mortality.
- In 2008 the Queensland Government stopped issuing permits to cull flying-foxes, however illegal culling is likely to occur.
- Culling may encourage colonization of culled areas by flying-foxes from other campsites, as culling usually takes place in favoured feeding sites. This has the overall effect of drawing in the population to be eliminated in the culling area.
- Culling in rural areas may have led to the establishment of flying-fox camps in urban areas within Brisbane City (CRC 2006).

5 Threats continued...

Competition

- Competition for resources between flying-fox species may be impacting on populations. In particular the southern expansion of black flying-foxes may be causing problems for grey-headed flying-foxes.
- The tendency for little red flying-foxes to stay on the coast during winter may cause problems for the other two species. Greater numbers of sedentary flying-foxes puts more pressure on food resources.

Infrastructure and pollutants

- Flying-foxes die from entanglements with barbed wire, powerlines and drape netting over fruit trees.
- Most deaths are caused by thin, dark-coloured nylon netting draped loosely over trees. Many entanglements will be fatal.
- Lead poisoning may be a health problem for flying-foxes in urban areas, particularly those roosting near major roads.
- Birth abnormalities have been caused by unknown agents; possible factors include pathogens, food shortages and toxins such as pesticides.

Health and community perceptions

- Community attitudes to flying-foxes are negatively impacted by fears about diseases carried by flying-foxes.
- Flying-foxes are likely natural hosts to Australian Bat Lyssavirus (ABL), Hendra and Menangle viruses. There have been five documented human fatalities from these viruses however, only one is known to have been from contact with flying-foxes (ABL). Immunisation is available for ABL and is recommended for flying-fox carers. Transmission of other viruses to humans is rare.
- Menangle and Hendra viruses have been detected in other mammals such as horses and pigs. Transmission mechanisms are unknown.
- A lot more research is still required in this area as there is no conclusive evidence to suggest that transmission of some viruses to humans is facilitated by flying-foxes.

Weather and climate

- Natural catastrophic events such as droughts and heat waves can cause thousands of flying-foxes to die.
- Climate change may result in an increased number and intensity of heat waves and drought in the future. Black flying-foxes, particularly juveniles, are much more affected by heat waves than either of the other two species, dying in far greater numbers.
- Flying-foxes are long range pollinators, providing a crucial service to the ecologically significant trees in Brisbane. Flying-foxes transfer pollen southwards which will help native flora species produce well adapted off-spring in light of climate change and the effects of a changing climate.
- Little red flying-foxes track flowering eucalypts and paperbarks over large areas of Queensland and are possibly the most important pollinators for Brisbane trees under climate change. The protection of long-range pollinators, including all three flying-fox species covered by this Conservation Action Statement, is a high priority for Council.

6 Conservation

Flying-foxes are a native species to Australia and provide valuable ecological services that benefit humans. They are important pollinators and seed dispersers of many native plant species and play an integral role in the reproduction, regeneration and dispersal of plants within numerous natural environments around Brisbane (CRC 2006).

Several Council biodiversity initiatives are contributing to the protection and management of flying foxes and their habitat across the city. The following are key initiatives.

- Bushland Acquisition program. Through this program more than 2700 hectares of the city's most significant lowland habitats have been purchased and protected to date.
- Wildlife Conservation Partnerships program. More than 600 private properties have established conservation partnerships with Council, covering some 2000 hectares of principally lowland habitat in significant flying-fox habitat areas.
- Conservation Reserve Estate. More than 13,700 hectares of parkland including 7755 hectares of bushland and wetland reserves are managed and protected. This reserve network provides habitat for Brisbane's significant species.
- *Natural Assets Local Law (2003)*. Over 61,000 hectares of significant native vegetation is covered by the Natural Assets Local Law.
- *Brisbane City Plan (2000)*. The *City Plan* designates a green space system throughout the city to recognise and protect the contribution of open space areas to ecological functions. The plan's Biodiversity Code and supporting Ecological Assessment Guidelines provide performance criteria and acceptable solutions to protect significant biodiversity values on, or adjacent to, proposed development. *City Plan* also includes statutory schedules of flora and fauna species considered significant in Brisbane. These schedules recognise the conservation significance of species at a citywide and/or regional level.

7 Research

There have been some detailed studies relating to flying-foxes in Brisbane and South East Queensland. Contemporary investigations relevant to Brisbane's flying-foxes include:

- A project to rank natural foraging habitats of grey-headed flying-foxes, and preparation of the national recovery plan (Eby 2004).
- An unpublished study: *Patterns of reproductive output in Grey-headed Flying-foxes*, (Eby 2005).
- An unpublished study *Behavioural Responses of Three Species of Flying-fox to an Acute Heatwave, Brisbane*, (Markus and Hall unpublished).
- *Conservation Status Review of Flying-foxes in Brisbane City*, a report to the Natural Environment and Sustainability, Urban Management Division, Brisbane City Council (Booth and Low 2005).
- *Mutualistic interactions between the nectar-feeding Little Red Flying-fox Pteropus scapulatus (Chiroptera: Pteropodidae) and flowering eucalypts (Myrtaceae): habitat utilisation and pollination*, PhD thesis University of Queensland (Birt 2004).
- *Foraging Behaviour of the Black Flying-fox (Pteropus alecto) in the Urban Landscape of Brisbane, Queensland*, (Markus and Hall 2004).
- 'Ecology and Management of Flying-fox Camps in an Urbanising Region' Rainforest CRC. *Issues in Tropical Forest Landscapes*. Issue 5 June 2006 (CRC 2006).
- 'Recent Historical Changes to the Distribution, and Declines in the Abundance of the Grey-headed Flying-fox in South East Queensland'. In *Grey-headed Flying-fox Workshop* (Hall 2000)
- *Ecology and Behaviour of the Black Flying-fox Pteropus alecto in an Urban Environment*, PhD thesis, University of Queensland (Marcus 2000)

8 Management intent

Strategies

Council intends to contribute to the long-term conservation of the city's significant flying-foxes through the following.

- Adopting and encouraging innovative voluntary and statutory mechanisms that protect important habitats and movement corridors.
- Securing and long-term protection of important habitat areas for flying-foxes.
- Ensuring appropriate ecological assessment, reporting and survey procedures are adopted in development, planning and management activities.
- Encouraging land management practices that avoid or at least minimise direct and indirect impacts on flying-foxes and their habitats on both public and private lands.
- Ensuring the timely availability of accurate, adequate and contemporary information for policy, planning and management decisions and actions.
- Facilitating research that targets priority information gaps and contributes positively to the conservation of Brisbane's flying-foxes and their habitats.
- Providing the Brisbane community with appropriate information and opportunities to contribute in a practical way to better understand and protect Brisbane's flying-foxes.

Table 4 describes priority conservation actions that Council will pursue with its partners to address the stated strategies. These priority actions have been drawn from studies undertaken for Council by recognised flying-fox experts and from consultation with a range of stakeholders. Actions will be undertaken as funds become available through Council's budgetary process. It should be recognised that Council must consider the timing of these actions against other priorities across the whole of the city.

Table 4: Management actions

Management aspect	Action	Timing	Lead agent & key stakeholders *
Habitat protection	Conserve and protect important flying-fox habitat on privately owned land within Brisbane, through Council acquisition of significant habitat (Bushland Acquisition program) and through conservation partnerships (Wildlife Conservation Partnerships program).	Ongoing	Council, private landowners
	Fragmented habitat in key locations reconnected through revegetation projects and the acquisition of land with a focus on increasing bushland remnants to produce significant, intact habitat.	Ongoing	Council, catchment and Habitat Brisbane groups

8 Management intent continued...

Strategies continued...

Table 4: Management actions continued

Management aspect	Action	Timing	Lead agent & key stakeholders *
Habitat management	Protect and enhance known food sources for flying-foxes in Brisbane, particularly winter and spring foods. Identify winter and spring flowering trees from Table 2.	Ongoing	Council, catchment and Habitat Brisbane groups, private landowners
	Conserve roosting habitat for flying-foxes in Brisbane. All existing permanent roost sites to be protected from urban development impacts.	Ongoing	Council, private landowners, private industry
	Work towards reducing mortality of flying-foxes in Brisbane caused by powerlines, barbed wire and drape netting through education and awareness programs.	Ongoing	Council, community bat care and rescue groups, private industry, Energex
	Investigate opportunities to enhance buffer zones between flying-fox camps and major roads and other infrastructure to provide protection for flying-foxes from lead poisoning and birth defects due to other pollutants.	Ongoing	Council, DTMR, private industry
	Buffer zones between permanent flying-fox camps and residential areas to minimise disturbance to flying-foxes and local residents.	Ongoing	Council, private industry, catchment and Habitat Brisbane groups
Research	Monitor all roost sites annually to assess status and condition of the camp.	Commence 2010	Council, DERM
	Contribute to monitoring and research on flying-foxes to better inform management strategies, including factors that influence the establishment of campsites and movement patterns/cycles.	2011	Council, universities, QM
Information management	Develop a centralised database for the collation of monitoring data.	Underway	Council
	Investigate options to reduce electrocution of flying-foxes on powerlines in Brisbane with Energex (e.g. use of aerial bundled cabling or more widely spaced wires).	Commence 2010	Council, Energex
	Regular consultation with the Rainforest CRC and Griffith University Environmental Futures Centre who have completed an encompassing study of the location and characteristics of flying-fox camps in South East Queensland.	Ongoing	Council, GU, CRC

8 Management intent continued...

Strategies continued...

Table 4: Management actions continued

Management aspect	Action	Timing	Lead agent & key stakeholders *
Community involvement	Increase Brisbane residents' understanding and tolerance of flying-foxes and support local 'friends of the flying-fox' and bat care and rescue groups to assist with monitoring, management and community relations.	Ongoing	Council, community bat care and rescue groups
	Develop an educational program about flying-foxes for Brisbane residents including information about living with flying-foxes in urban areas, the detrimental impact of cocos palms (a declared council weed) and the valuable ecological role flying-foxes play in the natural environment.	Ongoing	Council, catchment and Habitat Brisbane groups, community bat care and rescue groups
	Provide and promote information about safe fruit protection methods for backyards on Council's website and support the promotion of flying-fox safe backyard netting practices.	2010	Council, RSPCA, DERM, community bat care and rescue groups

*Council: Brisbane City Council, GU: Griffith University, CRC: Cooperative Research Centre – Rainforest, DERM: Queensland Department of Environmental Resource Management, DTMR: Queensland Department of Transport and Main Roads, QM: Queensland Museum.

Guidelines

The habitat protection and management guidelines detailed in Table 5 are provided to assist environmental planners, land owners, land managers, private industry and the broader community. These guidelines will be refined as more information about these species and their habitat requirements becomes available.

Table 5: Habitat protection and management guidelines

Issue	Guideline	Explanatory notes
Protect and enhance food sources	Protect identified priority flying-fox food trees, including remnant old growth and planted trees.	Remnant vegetation provides for the most productive food resources for flying-foxes in Brisbane.
	Use priority flying-fox food trees in plantings for streets and parks where appropriate (refer to Table 2).	Revegetation using appropriate species (i.e. identified priority food trees), in parks and along roadways will provide additional food resources for flying-foxes. However, not all species will be appropriate for street tree planting and the placement in parks needs to be considered (e.g. not around playgrounds or car parks).
	Include priority flying-fox food trees in the revegetation of Council's bushland areas.	Priority food trees for flying-fox include trees from the Myrtaceae family, (i.e. <i>Eucalyptus</i> , <i>Corymbia</i> , <i>Melaleuca</i> , <i>Angophora</i> and <i>Syncarpia</i> genera) as well as fruiting trees such as <i>Ficus</i> species. Table 2 contains a sample list of flying-fox nectar-resource trees native to Brisbane. Ensure that catchment and Habitat Brisbane groups are also encouraged to plant priority food tree species in suitable locations.

8 Management intent continued...

Guidelines continued...

Table 5: Habitat protection and management guidelines continued

Issue	Guideline	Explanatory notes
Minimise flying-fox camp disturbance	Flying-fox campsites should be protected by a 300m vegetation buffer wherever possible. Buffers should be free of disturbance and maintained in, or restored to, the natural (pre-clearing) state where possible.	Buffers are an established management tool designed to protect sensitive areas from unnecessary disturbance, particularly during the breeding season. Flying-foxes and local residents will benefit from appropriate buffering where campsites are in close proximity to residential areas. Buffers should be included and identified in relevant management and operational plans.
	Disturbance to roosting flying-foxes or flying-fox camps is not permitted during any season unless approved under the Queensland <i>Nature Conservation Act 1994</i> (NCA).	Under the Queensland <i>Nature Conservation Act 1994</i> , disturbance to roosting flying-foxes or to flying-fox camps is prohibited, unless the person is an authorised person or the disturbance is authorised under the Act. Maintenance works and other activities conducted in the vicinity of flying-fox camps needs to undertaken with care to avoid disturbance. It is advisable expert knowledge is sought before commencing any works likely to disturb the flying-fox camp.
	Pre-start surveys of existing roosting site buffers are to be undertaken prior to the commencement of work near roosting sites. Surveys must be conducted by a suitably trained professional.	Buffer areas should be searched to establish whether specific design and/or scheduling considerations are required to minimise significant impacts on the habitat and/or species.
	Works within a buffer area are to take place outside the breeding season (refer to Table 3).	Maintenance of existing infrastructure or new works should be scheduled to avoid the breeding season. Where this is not possible, works should be timed to occur after the young are weaned.
Reduce mortality caused by infrastructure	Ensure fencing on all Council properties is safe for flying-foxes where appropriate.	Replace barbed wire with plain wire (preferable) or render barbed wire more visible with plastic or metal signals to avoid injury and/or mortality to flying-foxes.
	Ensure fruit tree netting in backyards is one of the three recognised safe solutions for flying-foxes.	Safe netting for flying-foxes include shade cloth tied over the tree or a rectangular frame or cross frame using white, knitted netting. Black, thin nylon netting is to be avoided at all costs. Netted trees should be checked daily and in case of flying-fox entanglement call DERM or the RSPCA and they will direct all calls to the nearest qualified wildlife carer.

8 Management intent continued...

Guidelines continued...

Table 5: Habitat protection and management guidelines continued

Issue	Guideline	Explanatory notes
Habitat tree retention	Live habitat trees are to be retained for roosting purposes.	Potential campsites would need to be within 200m of a waterway and several hectares in size to allow the colony to move around the patch over time. Roost sites on previously cleared land would need to include a mix of tall emergent trees and dense understorey (CRC 2006).
Fire management	Prescribed burns should be scheduled outside the breeding season and birthing time. Use of mosaic burning regimes. Where practical consideration should be given to flowering food trees for timing of prescribed burns.	Disturbance from prescribed burns in the vicinity of flying-fox camps may cause unnecessary disturbance which may lead to the fatality of young. Mosaic burning regimes may better maintain vegetation at various stages, ensuring continuation of food supply and roosting sites.

9 Further information

Agencies

- Brisbane City Council (www.brisbane.qld.gov.au)
- Queensland Museum (www.qm.qld.gov.au)
- Department of Environment and Resource Management (Queensland) (www.derm.qld.gov.au)
- Department of Environment, Water, Heritage and the Arts (Commonwealth) (www.environment.gov.au)
- Australasian Bat Society (<http://batcall.csu.edu.au/abs/absmain.htm>)

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