

Ecology and Management of Flying Fox Camps in an Urbanising Region

Issues in Tropical Forest Landscapes



Rainforest CRC



Flying foxes are important pollinators and seed dispersers of many plant species. They play important roles in the reproduction, regeneration and dispersal of plants within rainforests, eucalypt forests, woodlands and wetlands. During the day, flying foxes roost in communal camps, which provide them with a protected environment and a place to socialise and safely rear their young. 'Traditional' campsites can be used for decades. In some cases, cities and towns have been built near the sites of traditional flying fox camps, while in other cases flying foxes have moved into urban areas and formed new camps. Within urban areas, flying fox camps can pose a nuisance for nearby residents.

To help manage flying fox camps in urban areas, the factors that influence the location of camps were studied in southeast Queensland, the fastest growing urban area within Australia. This study found that most flying fox camps in southeast Queensland are located close to waterways in the coastal lowlands – the same zone that is intensively used for urban development. Even within this zone, flying foxes show a preference for locating their camps within patches of suitable vegetation surrounded by urban areas, rather than in extensive forest. Flying fox campsites occur in a range of vegetation types, but most comprise tall trees with a dense understorey, or are located in swamps or mangroves. At the local scale, there may be some potential for managing vegetation to alter its use by flying foxes, either to deter them from occupying certain areas or to provide new areas of suitable habitat.

Flying Foxes of Southeast Queensland

Species and Their Distribution

Three species of flying fox occur in southeast Queensland – the grey-headed flying fox (*Pteropus poliocephalus*), the black flying fox (*P. alecto*) and the little red flying fox (*P. scapulatus*). All are large bats that feed at night on fruit and blossom and roost during the day in communal camps.



Grey-headed flying fox

- Occurs in eastern Australia, primarily in coastal lowlands.
- Listed as Vulnerable by the Commonwealth, New South Wales and Victorian Governments.

Black flying fox

- Widespread across coastal tropical and sub-tropical Australia.
- Also occurs in New Guinea and Indonesia.

Little red flying fox

- Widespread across northern and eastern Australia.
- Also occurs in New Guinea. Species is nomadic; populations follow blossoms.

In northeast Queensland, the grey-headed flying fox is replaced by the spectacled flying fox, *P. conspicillatus*, which also occurs in New Guinea and Indonesia.

Ecology and Behaviour

Flying foxes roost in large communal camps, often within patches of dense vegetation (e.g. rainforest, paperbark swamps or mangroves). These roost sites provide shelter, focal points for social interactions and secure places to rear young.

Camps may be occupied on a permanent or seasonal basis, and can support hundreds to tens of thousands of individuals. The number of flying foxes in a camp can vary at different times of the year, and from one year to the next. In southeast Queensland, grey-headed and black flying foxes are the regular occupants of camps, often occurring together. Camp populations can swell greatly with irregular influxes of little red flying foxes. Over a period of days, individual flying foxes may move between different camps in a local region. Over longer periods they are known to travel larger

distances, sometimes up to hundreds of kilometres. Nevertheless, they still display strong links to 'traditional' campsites. For example, a number of campsites described in the 1930s are still

occupied today. Flying foxes occasionally establish new campsites, often as a result of the destruction or severe disturbance of traditional camps, or harassment of the flying foxes within them.



A flying fox camp within a remnant patch of rainforest.



At night, flying foxes navigate principally by sight. Their excellent sense of smell helps them to locate food. They feed mainly on blossom and fruit from a wide variety of plant species, including the flowers of eucalypts and melaleucas (paperbarks). Flying foxes can migrate long distances to follow the mass flowering of eucalypts and related plants. Sources of fruit include areas of rainforest as well as planted trees in residential and agricultural areas. Large native fig trees may be especially important. The little red flying fox has a more specialised diet, feeding mainly on nectar and pollen.



Flying foxes play important roles as pollinators and seed dispersers in native forests.

Flying foxes use sound to communicate with each other. Their camps are noisiest at dawn and dusk as individuals arrive or prepare to leave. Calls during daylight hours occur mainly during the mating season or in response to disturbances. Males produce a scent to mark their territories, which contributes to the characteristic smell of flying fox camps.

Flying foxes live for up to fifteen years in the wild. Females reach maturity at two to three years of age, and produce only one offspring per year. In grey-headed and black flying foxes, births occur between September and November. Young are raised for three to four months after which they become independent. Little red flying foxes give birth in April and May.

Human Interactions with Flying Foxes

Flying foxes provide a number of 'ecological services' that benefit humans, including pollinating native plants and dispersing their seeds. In some places, the spectacular fly-outs of bats from their campsites support a growing ecotourism industry.

On the other hand, flying foxes can cause considerable damage to commercial fruit crops, which has resulted in their persecution, particularly in rural areas. Farmers and fruit growers use a range of methods to prevent flying foxes from raiding orchards, with exclusion netting being an effective technique.

People living near flying fox camps in urban areas may find the odour, noise, droppings and raids on backyard fruit trees a nuisance. Roosting activities can also cause considerable damage to the vegetation at camp sites, particularly when camps are located within small patches of vegetation.

Like other wild animals, some flying foxes may carry diseases that can be transmitted to humans. Recently, Australian Bat Lyssavirus was identified in some bats. Infection in humans is extremely

unlikely as the virus can only be transmitted through direct contact with an infected bat that results in a bite or scratch. If you come across a sick or injured bat, contact your local wildlife carer or your Parks and Wildlife Service for advice. Only people who have been vaccinated against the virus should handle bats. For more information on bat lyssavirus, search Queensland Health website (www.health.qld.gov.au).

Location and Characteristics of Flying Fox Camps in Southeast Queensland

To guide the management of flying fox camps in the rapidly urbanising region of southeast Queensland (SEQ), researchers of the Rainforest CRC and Griffith University have worked to identify the factors that influence their location. Forty camps were in use by grey-headed and black flying foxes within SEQ at the time of the study (2005). Twenty camps were 'regularly used', that is, they were occupied frequently and had supported large populations (more than two thousand individuals) of flying foxes for most years over the previous decade. The remaining camps were used sporadically or



An aerial photograph of a flying fox camp, circled, in the Gold Coast region of southeast Queensland.



supported fewer flying foxes. Grey-headed and black flying foxes often used the same camps.

Records kept by flying fox researchers show that the numbers of flying foxes in SEQ camps can vary greatly, both in space and time. For example, over the last decade, numbers of grey-headed flying foxes in each of the SEQ camps have ranged from twenty to eighteen thousand individuals, while numbers of black flying foxes have ranged from zero to twelve thousand individuals. These patterns probably reflect the movement of flying foxes in search of food resources.

Landscape Scale Attributes of Flying Fox Camps

Researchers measured the environmental attributes of flying fox camps and compared these with the characteristics of randomly chosen sites to test whether camps were associated with particular attributes. At each site, factors thought to be important to flying foxes were measured, including elevation, distance to nearest waterway, size of the patch of

vegetation in which the camp was located, distance to other flying fox camps, composition of neighbouring plant communities and the amount of surrounding urban land and woody vegetation. Since flying foxes are highly mobile, measurements of the latter factors were made at the 'landscape scale' (mostly a 2-10 kilometre radius) around each site. Comparisons of campsites with random points showed that flying fox camps were preferentially located:

- In coastal lowland areas (eighty percent of campsites in SEQ were less than sixty metres above sea level);
- In close proximity to a river, creek or other drainage line (all within two hundred metres); and
- In a patch of woody vegetation at least one hectare in size.

Only eighteen of the forty campsites in SEQ occurred in areas of intact native vegetation (as defined by the Queensland Environmental Protection Agency), including mangroves, rainforest and sclerophyll forest. The majority of camps occurred in small or disturbed patches of native vegetation and regrowth, often containing many introduced trees and shrubs.

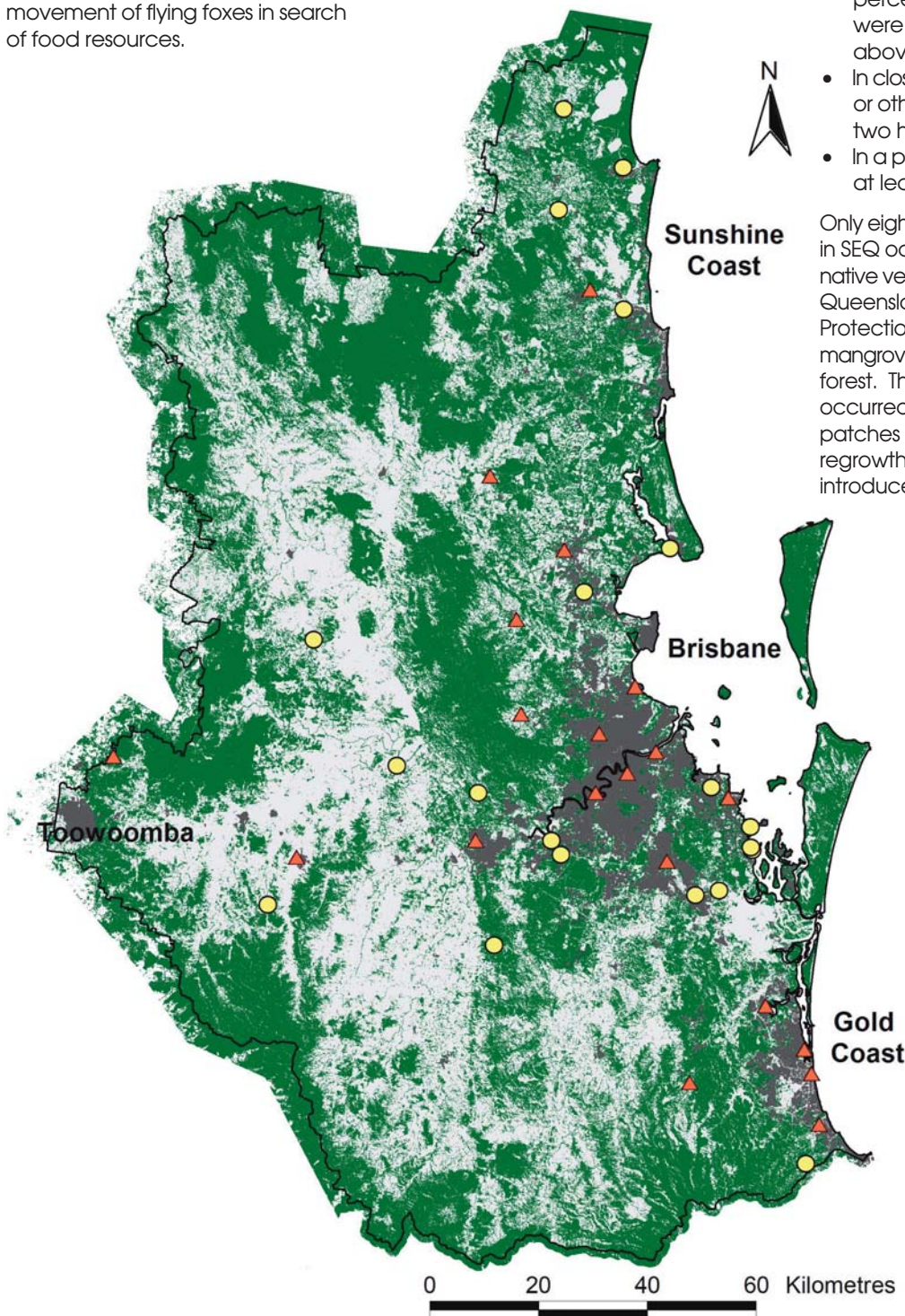


Figure 1: The location of flying fox camps in southeast Queensland, shown in relation to surrounding woody vegetation (green) and urban land (grey). Red triangles represent 'regular' camps; yellow dots represent other camps.



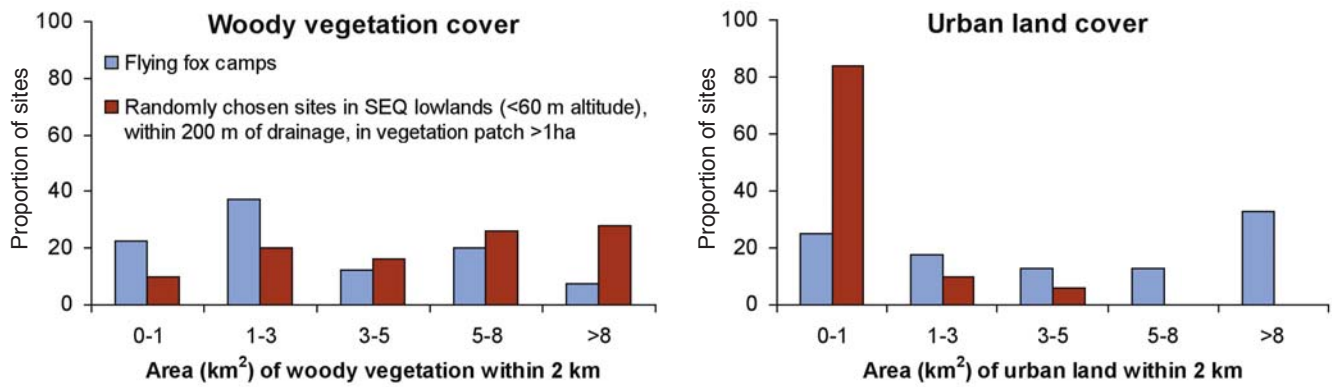


Figure 2: Analysis of land cover surrounding flying fox camps in the lowlands of southeast Queensland. The graphs show the proportion of flying fox camps (light blue bars, n = 40) and random sites (dark red bars, n = 50) surrounded by different amounts of woody vegetation and urban land within a two-kilometre radius. Camps tended to be surrounded by less woody vegetation and more urban land than random sites. Similar trends were evident in analyses of cover within five and ten kilometres of camps, although the negative association of camps with woody vegetation cover was not significant at the ten-kilometre scale.

To determine whether flying fox camps were preferentially associated with particular landscapes in the coastal lowlands, further analyses were conducted with random sites constrained to the coastal lowlands within two hundred metres of water and in patches of vegetation more than one hectare in size. This analysis found that, even in the coastal lowlands, flying fox camps tended to be surrounded by land in which:

- Urban development was common, e.g. two thirds of camps, but less than ten percent of random sites, were surrounded by more than three square kilometres of urban land within a two kilometre radius; and
- Woody vegetation was uncommon, e.g. seventy percent of random sites, but only forty percent of camps, were situated in areas which had more than four square kilometres of woody vegetation within a two kilometre radius).

Camps used regularly by flying foxes were surrounded, on average, by twice the amount of urban land when compared to the less regularly used camps.

There are several possible (but not tested) reasons why flying foxes may prefer to camp in urban areas. First, many trees that have been planted in streets, gardens and parks provide food for flying foxes. For example, flying foxes feed on the fruits of fig trees and the nectar of eucalypts throughout urban areas. Furthermore, these trees may fruit

and flower reliably in urban areas because of frequent watering and fertile (or fertilised) soils. Second, well-lit features of urban areas such as roads and other infrastructure may provide flying foxes with navigational cues. Third, the persecution of flying foxes in rural areas by humans may have led to the establishment of some camps in cities.

The tendency for flying fox camps to be located in areas with relatively low woody vegetation cover does not mean that native forests are not important for flying foxes. Flying foxes can forage large distances from camps (often up to twenty kilometres) and could potentially camp and forage in different parts of the landscape.



Flying foxes often camp in patches of tall trees with a dense understorey.



Local Scale Attributes of Flying Fox Camps

The vegetation structure and composition of eighteen 'regularly used' flying fox camps were examined in detail. The attributes assessed included the density of woody stems, foliage cover, height of the vegetation, and the height and species of roost trees.

Flying fox camps were generally located in tall trees (more than ten metres high). The trees used for roosting usually grew above a dense understorey of small trees and shrubs, except where the campsites were subject to periodic inundation by surface water (e.g. Melaleuca swamps and mangroves). There was little evidence of selection for particular tree species or types of trees for roosting.

Some recently established camps (less than twenty years old) occurred in areas where all native vegetation other than some eucalypt trees had once been cleared for pasture. In these sites, the removal of stock had allowed a dense understorey to develop, often composed of introduced shrubs. Flying foxes may prefer this type of habitat because it provides them with a variety of roost locations, including cool positions on hot days and sunny, sheltered positions on cold days. The dense understorey may also provide some protection from disturbance from land-based animals and humans.

Management Implications

The location of flying fox camps may depend on a range of factors including:

- A suitable climate;
- Access to abundant and reliable food and water resources;
- The availability of roost sites that offer favourable microclimates or protection from land-based predators; and
- Proximity to rivers, roads and other 'navigational aids'.

In a rapidly urbanising landscape, many of these factors may change over time (e.g. with the development of new suburbs), altering the suitability of particular campsites for flying foxes.

There are some ways in which the impacts of flying fox camps on suburban residents might be reduced, such as through the creation of new campsites away from residential areas or by altering the suitability of existing campsites. A number of attempts have been made to relocate urban flying fox camps in Australia, however, many have been unsuccessful and all have been costly. Over \$2 million was spent removing a flying fox camp from Melbourne's Royal Botanic Gardens in 2003.

The results of this study suggest some guidelines for the creation of flying fox campsites in southeast Queensland. Potential new campsites would need to be located in lowland areas within two hundred metres of a waterway, and be at least several hectares in size to allow the colony to move around the patch over time. Campsites developed on previously cleared land would need to include a mix of tall emergent trees and a dense understorey. Alternatively, a dense shrubby understorey could be established beneath existing tall, scattered trees.

Measures aimed at deterring flying foxes from occupying parts of a camp near residential areas could include removing the lower branches of trees and clearing the understorey, to create a buffer between roosting animals and surrounding residents. Such actions would need to be undertaken carefully, preferably in conjunction with the extension or creation of suitable habitat elsewhere, and subject to a monitoring program.

Further research into the factors influencing the establishment and persistence of flying fox camps is required to help solve conflicts between flying foxes and humans in urban areas.

CONTACTS



Queensland Parks and Wildlife Service

Telephone 1300 130 372
Email csc@epa.qld.gov.au
www.epa.qld.gov.au



Centre for Innovative Conservation Strategies Griffith University

Telephone (07) 3735 5394
Facsimile (07) 3735 5014
Email CICS@griffith.edu.au
www.griffith.edu.au/centre/cics



CRC Research

Telephone (07) 4042 1246
Facsimile (07) 4042 1247
Email rainforestcrc@jcu.edu.au
www.rainforest-crc.jcu.edu.au

FURTHER READING

Eby, P. and Lunney, D. (eds) (2002) *Managing the Grey-headed Flying Fox as a Threatened Species in New South Wales*. Royal Zoological Society of NSW, Mosman, NSW.

Hall, L. S. and Richards, G. (2000) *Flying Foxes: Fruit and Blossom Bats of Australia*. University of New South Wales Press, Sydney.

Markus, N. and Hall, L. S. (2004) Foraging behaviour of the black flying fox (*Pteropus alecto*) in the urban landscape of Brisbane, Queensland. *Wildlife Research* 31, 1-11.

Roberts, B. (2005) *Habitat characteristics of flying fox camps in south-east Queensland*. BSc. (Hons.) Thesis, Griffith University, Brisbane.

ACKNOWLEDGEMENTS

This paper was prepared by Billie Roberts, John Kanowski, and Carla Catterall of the Rainforest CRC and Environmental Sciences, Griffith University, with support from a Griffith University Community Partnerships grant and the Queensland Parks and Wildlife Service. We acknowledge the assistance of Brett Kerr, Peggy Eby, Les Hall, Shannon Hogan and Gail Spina, and the contributions of a large number of naturalists and flying fox enthusiasts who supplied information on roosting habits and locations. Data in Figures 1 and 2 from SLATS (Department of Natural Resources and Mines 2003). Photographs courtesy of Vivien Jones.

