



Flying Fox (Pteropus spp.)

Risk Assessment: Japanese Gardens, University of Southern Queensland, Toowoomba



March 2009

Prepared for:

University of Southern Queensland (USQ)



DOCUMENT CONTROL RECORD

Queensland Laboratory Pty Ltd		Job No:	MQ08004
Telephone:	1300 138 366	File reference:	MQ08004.1
Facsimile:	(07) 5537 2535	Date of Issue:	31.03.09
Email:	andrew@queenslandlab.com	Project Manager:	Andrew Thompson

Report Details

Title:	Flying Fox (<i>Pteropus</i> spp.) Risk Assessment: Japanese Gardens, University of Southern Queensland, Toowoomba.
Author(s):	Andrew Thompson
Status:	Issue No. 1/1
Client:	The University of Sothern Queensland
Client Contact:	Pam Crawford
Synopsis:	This report presents an initial risk assessment of the increasing flying fox population within the Japanese Gardens located in the grounds of the University of Southern Queensland.

Revision History

Issue No	Date	Issued By	Checked By	Distributed to	No. of Copies
1/1	31/03/09	K. O'Hara	S. Evans	Pam Crawford	1

DISCLAIMER

The management and staff of Queensland Laboratory Pty Ltd have taken every care in compiling the information contained in their reports. As the interpretation of scientific data is often subject to professional judgement it is possible that errors may occur.

In consequence of the often subjective nature of the scientific interpretation of data, Queensland Laboratory Pty Ltd does not guarantee the completeness or accuracy of the information provided and clients are advised that they should not rely entirely upon this information in their making of their commercial decision.

Any opinion, statement, representation or advice given by or on behalf of Queensland Laboratory Pty Ltd is given in good faith on the basis that Queensland Laboratory Pty Ltd, its servants, employees and agents are not subject to any liability whatsoever (whether by reason of lack of due care and attention or otherwise) and the client releases and discharges Queensland Laboratory Pty Ltd and its servants, agents or employees from all actions, suits, claims, demands, causes of action, costs and expenses, legal, equitable, under statute and otherwise, and all other liabilities of any nature (whether or not the parties were or could have been aware of them) which the client may have; or but for this disclaimer, could or might have had, against Queensland Laboratory Pty Ltd and its servants, agents or employees in any way related to the information provided or the circumstances recited in this disclaimer or allegations arising out of or in any way related to the information provided to the client by Queensland Laboratory Pty Ltd.

The information provided is for the benefit and use of the client only and cannot be relied upon by any third party.

TABLE OF CONTENTS

Report Details..... 1

Revision History..... 1

1. Project Background 4

2. Scope..... 4

3 Information on flying foxes5

4. Risk Analysis 7

5. Management Options 8

6. Conclusion 13

7. References 13

Appendix 1 15

1. Project Background

Queensland Laboratory was commissioned by the University of Southern Queensland, Toowoomba Campus to conduct an investigation into the implications for health and well-being that would result from having a large population of flying foxes (*Pteropus* spp.) using the campus' Japanese Gardens as a roost.

The Japanese Gardens are located to the north of the campus which is located on West Street, Toowoomba. The Japanese Gardens are of such a high standard that they are amongst the top twenty-five Japanese gardens outside Japan and are Toowoomba's most significant garden (Mark Flint, pers. comm.). As a result, the gardens attract tourists from all over Australia and they are often used for occasions such as weddings. Although there is no fee for visiting or holding ceremonies in the gardens, there is a donation box from which all proceeds are used in the upkeep of the gardens.

Recently a significant population of flying foxes has been using the Japanese Gardens as a roost between dawn and dusk. The population is made up of Black flying foxes (*Pteropus alecto*), Grey-headed flying foxes (*Pteropus poliocephalus*) and Little red flying foxes (*Pteropus scaputus*) (EPA, Mark Flint, pers. comm.). Originally, approximately six individuals who are believed to have been scouts used the gardens as a roost. At the beginning of 2008 there were 700 individuals roosting in the gardens on a daily basis and as of March 2009 the population has swelled to 2,500 individuals; the population grows noticeably on a fortnightly basis (Mark Flint, pers. comm.). Due to the increasing numbers of flying foxes using the gardens as a roost site the trees are becoming damaged and starting to look thin, especially amongst the higher reaches where most of the flying foxes roost. Consequently, it has become a primary concern of the university that there may be adverse health risks associated with having 2,500 flying foxes roosting in the gardens. Similarly, there are further concerns that the damage being inflicted on the gardens may be irreparable and also that tourist numbers may decrease resulting in fewer donations.

2. Scope

The aim of the investigation was to determine the potential environmental health issues associated with the bat population by visiting the site and conducting a site assessment; interviewing site personnel; desktop research and discussion with the relevant authorities. The information obtained from this investigation will be used to assess the control measures required to minimise health risks due to potential exposure and associated to the bats.

3 Information on flying foxes

There are four flying fox species which are native to Australia. Of these, the Grey-headed flying fox, Black flying fox and Little red flying fox are found in south east Queensland and have been noted in the Japanese Gardens. Flying foxes are considered an important part of Australian ecosystems as they serve to pollinate flowers and disperse seeds of a variety of species (Rainforest CRC, 2006). To assist in the recovery of the species the Grey-headed flying fox is protected under the Environmental Protection and Biodiversity Conservation Act 1999 (Crocker *et al.*, 2005). There is a belief that flying foxes have limited or no predators, however, Roberts (2006) lists a number of species that predate upon them. Such species include “white-bellied sea eagle, Brahminy kites, powerful owls, crows, crocodiles, dingoes, domestic dogs, foxes, goannas and snakes particularly pythons” (Roberts, 2006).

3.1 Camps

Studies conducted in south-east Queensland have shown that flying foxes tend to make their camps in trees approximately ten metres or higher and where urban development is common and woody vegetation is uncommon (Rainforest CRC, 2006). Furthermore, camps are often established where trees fruit reliably due to regular watering regimes to meet aesthetic desires. It has also been shown that flying foxes prefer camp sites which are close to water courses (Crocker *et al.*, 2005). In favourable conditions these camps can harbour populations in the tens of thousands. Moreover, if favourable conditions persist a specific site can be used for decades. There are camps that are being used today that were first described in the 1930s (Rainforest CRC, 2006).

3.2 Public Health

Studies in the past twenty years have discovered that Australian flying foxes carry a number of viruses which are known to infect people (Hanna *et al.*, 2000, McCall *et al.*, 2000, IICAB, CFSPH, 2006, Rainforest CRC, 2006). Viruses such as Hendra virus and Menangle virus cannot be caught directly from bats and are instead transmitted to humans when the virus emerges in other animals such as horses or pigs (IICAB, CFSPH, 2006). However, it is not clear how these viruses are transmitted from flying foxes to such animals.

There is one virus of concern that can be transmitted directly from flying foxes to humans and that is the Australian Bat Lyssavirus (ABL) (Hanna *et al.*, 2000, McCall *et al.*, 2000, Rainforest CRC, 2006). In many ways ABL is very similar to rabies but does have its own distinguishing characteristics (Hanna *et al.*, 2000, McCall *et al.*, 2000, Roberts, 2006). Since being described, ABL has been responsible for the deaths of two people. In the first case an animal handler was bitten by a yellow-bellied sheath-tail bat (not a flying fox species) and became sick 4.5 weeks after the incident (Hanna *et al.*, 2000, McCall *et al.*, 2000). In the second case a woman was bitten by a flying fox after trying to remove it from a child it had flown into; the woman first became sick 27 months after the incident (Hanna *et al.*, 2000, McCall *et al.*, 2000). Although it is advised that it is safe practice to assume that all Australian flying foxes and bats carry ABL (Hanna *et al.*, 2000) it is actually only a small percentage of the population that do possess the disease. A study conducted by McCall *et al.* (2000) revealed that just 6% of sick flying foxes contained ABL while no wild caught flying foxes returned a positive result for ABL. Other studies have shown that less than 1% of the total population actually carries ABL. This statistic coupled with the fact that a cut or a bite needs to be directly infected with saliva means that the risk of infection is very low (Roberts, 2006). It is recommended that if this does occur that the wound is cleaned thoroughly with soap and water and that further medical advice be sought (Hanna *et al.*, 2000).

Infected bats generally display depression but can also be aggressive towards humans and other bats which are normally out of the ordinary. Other symptoms include a reduction in motor skills and also partial paralysis of the hind limbs (McCall *et al.*, 2000). Despite the

chance of infection being increased over the birthing season which occurs in spring and summer, it has been reported that 97% of exposures to contact with flying foxes were provoked by humans and not vice versa. Therefore, even in the birthing season it would be highly unusual to have contact with flying foxes without directly aggravating them.

Although faeces and urine pose no threat to infection from ABL, the faeces from flying foxes may cause another disease known as *Histoplasmosis*. When the faeces are left to dry out and enrich the soil a fungus can grow on them. When this fungus is disturbed it can become airborne and be inhaled. In the most severe cases symptoms of this disease can mimic tuberculosis (Mycology Online, 2007). The chances of infection become more probable in confined spaces such as caves (Conn, 2006).

3.3 Vegetation Damage

As has already become evident in the Japanese Gardens flying foxes can cause damage to vegetation. This due to them moving about the trees often when coming into roost at dawn or leaving at dusk. The damage that is prominent to the taller trees in the south end of the Japanese Gardens has become evident over the past six months and it is feared that the damage may worsen as numbers increase (Mark Flint, pers. comm.). It is often the case that humans recognise the damage being done to the camp long before flying foxes do. Little red flying foxes are known to conduct the most damage as they form camps in excess of 100,000, often forming tight clusters of 30 to a single branch (Roberts, 2006). This can result in branches to brake off (Roberts, 2006).

3.4 Odour

A noticeable aspect of flying fox camps is the odour that surrounds the area. This is largely attributed to the scent used by males to mark their territory (Roberts, 2006) Although initially it is a concern for people, with time it is common to adjust to the odour so that it is not noticeable anymore (pers. obs, Mark Flint, pers. comm.). Hence, this is generally only a concern when camps are establishing.

3.5 Noise

The noise caused by flying foxes is at its peak while they are coming in to roost and leaving to feed. As the time that roosting occurs is approximately 5:00 a.m. (Mark Flint, pers. comm.) it is probable that residents may have their sleep disturbed. Roberts (2006) outlines that although the average noise of roosting flying foxes is approximately at the same level as traffic, levels slightly higher than background noise, while perhaps not enough to wake people, are enough to cause sleep disturbance whether it is noticed or not. Over a prolonged period of time this can have quite severe impacts on both physical and mental health. The Japanese Gardens are also meant for use by students wanting to come to a quiet area to study (Mark Flint, pers. comm.). However, due to the high noise being caused by the flying foxes students are deciding against using the gardens as a study area.

4. Risk Analysis

There are many rumours and beliefs with regards to the health risks associated with flying foxes. Many people believe that they are disease ridden animals and that the chance of being infected with one of these diseases is quite high (EPA, pers. comm.).

Table 1 below outlines the major risks associated with living in proximity to flying foxes. Each risk is rated on its severity and likelihood of occurrence. There are also some preventative measures listed to further reduce the likelihood of the risks occurring.

Table 1. Risks and preventative measures for living with flying foxes

Risk	Consequence	Likelihood	Risk Ranking	Prevention
ABL	High	Unlikely	Moderate	Avoid contact with bats. If a bat is showing symptoms of ABL contact QP&WS or a wildlife handler that has been appropriately vaccinated. Signage is recommended.
Menangle virus	High	Unlikely	Moderate	Be aware symptoms arising in pigs and seek medical advice.
Hendra virus	High	Unlikely	Moderate	Be aware if horses become ill and be sure to check for symptoms. Seek medical advice.
Histoplasmosis	Medium-High	Unlikely	Low	Clean droppings and do not allow to accumulate, especially in enclosed areas.
Falling branches	Low-Medium	Unlikely	Low	Remove sick or dead branches.
Disturbed sleep	Low	Possible	Low	Conduct an acoustic assessment and determine suitable mitigation measures
Decline in tourism to USQ	Medium	Almost Certain	High	Erect signage educating people about the flying foxes and try to incorporate this as part of the experience.
Decline in tourism to Toowoomba	Low	Unlikely	Low	

Legend:

E = Extreme risk; immediate action required.

H = High risk; senior management attention needed.

M = Moderate risk; management responsibility must be specified.

L = Low risk; manage by routine inspections

(refer to appendix 1 for Qualitative Measures of Likelihood and Consequence and Corresponding Overall Risk Matrix)

Although the consequences for being infected with ABL are high, the chances of being infected are low. Therefore, the overall risk of ABL associated with living with flying foxes is also low. If a flying fox is displaying symptoms such as those described in section 2.2.1 Queensland Parks & Wildlife Services or a wildlife handler that has been vaccinated accordingly against ABL should be contacted.

The risk associated with other viruses such as Hendra virus and Menangle virus are also low; perhaps even lower than the risk associated with ABL as they cannot be transmitted directly. Horses should be monitored for symptoms such as fever, respiratory problems and foamy discharge from nose and mouth (NSW DPI, 2005a). Similarly, pigs should be monitored for decreases in birth rates and increases in stillborn piglets as these can be symptoms of Menangle virus (NSW DPI, 2005b).

While the risks associated with Histoplasmosis are medium to high, the flying fox droppings in the Japanese Gardens are cleaned throughout the day to meet aesthetic desires (Mark Flint, pers. omm..) and there are no enclosed areas such as caves. Therefore the risk of infection from Histoplasmosis is low.

Small branches falling may occur as individual Grey-headed flying foxes fly through the trees and knock sick or dead parts of the tree down. This can pose a risk to people walking in the gardens however the level of risk is very low. This risk level increases to medium however when there is the possibility of larger branches falling on people. This may be caused by Little Red flying foxes overcrowding branches and causing them to snap. However, as there have only been a small number of Little red flying foxes observed in the gardens (EPA, Mark Flint, pers. omm..), the chance of this happening is low unless the population of this species increases dramatically.

The risk associated with sleep disturbance is considered low and the most likely possible short term effects would include fatigue, exhaustion and general annoyance. However, it has been shown that this can have severe impact on physical and mental health over prolonged periods of time (Roberts, 2006). To alleviate this problem, sound barriers such as those built on busy highways could be erected to muffle the noise. However, this would only be effective when the flying foxes are on the opposite side of the barrier and not when flying over head. Other possible options include double glazing or laminating windows or insulating walls to reduce noise (Roberts, 2006).

It is quite likely that the flying foxes will have a negative impact upon tourism. Already people attending weddings in the Japanese Gardens have stated that both the odour and noise caused by the flying foxes is terrible and distasteful (J. Kerr, pers. omm..). If this becomes a common opinion amongst visitors then it is highly likely that the number of people visiting the gardens will decline, resulting in less donations. Therefore there will be less money available to conduct the increasing level of maintenance required on the gardens due to the damage being caused. There is also the possibility of an impact on surrounding businesses such as cafés and restaurants as there would be less patronage with a decline in tourism, but this is thought to be a low risk with a low chance of occurrence.

5. Management Options

As shown in section 4.0 the risk assessment provides a list of mitigation measures for managing bats. As all bats are protected species, it is illegal to harm or destroy native wildlife and heavy fines can be issued to anyone killing bats or potentially harming flying fox populations. Also, any relocation attempts or omm. ze other than that of normal activities

that may deter the flying foxes from their roost site must have the approval of the Environmental Protection Agency.

5.1 Previous relocation attempts

There have been many attempts to relocate flying foxes due to disturbances or annoyances. Although careful planning has been behind all attempts, many have failed and all have been expensive (Rainforest CRC, 2006, Roberts, 2006, EPA, pers. omm..).

5.1.1 Maclean Rainforest Reserve, Maclean, NSW

Roberts (2000) describes the problem with flying foxes in Maclean in the early 1980s, which is comparable to the current situation in the Japanese Gardens in Toowoomba. A large population of flying foxes began causing problems for residents as they roosted in the Maclean Rainforest Reserve which bordered the Maclean High School. Residents were concerned about the various health implications for living with flying foxes outlined in section 2.2. Moreover, residents were disturbed with the damage that was being inflicted upon the Maclean Rainforest Reserve by the flying foxes.

A site was identified 3 kilometres away and it was assumed that the flying foxes could successfully be relocated there by deterring them from their previous roost through the use of loud noises for 30 minutes before dawn and dusk. As a result of this the flying foxes pushed through the reserve and into residents' yards. Similar methods were used again and the flying foxes were essentially chased between these two sites for weeks. However, after around 6 months the flying foxes began inhabiting new areas, some which had not been used before. Nevertheless, they continued to return to the reserve almost every year during the noise disturbance program. The last attempt for relocation occurred 6.5 years after the initial attempt and even now flying foxes still endeavor to use this site. Currently about 1000 individuals will roost in the reserve for a night and are subsequently chased off by making similar noises for three to four hours per day for two days. The cost of this relocation program was in excess of \$756,000 over seven years.

5.1.2 Royal Botanical Gardens, Melbourne, Vic

Flying foxes had been using the Royal Botanical Gardens in Melbourne as a permanent roost for 18 years and were causing severe damage to the vegetation including "botanically and historically significant trees" (Roberts, 2006). Therefore, it was decided that in order to protect the gardens it was essential to relocate the colony and a site nearby was identified as an ideal location for the population to be moved to.

In order to attract the bats to the new location many attractants such as enclosures containing flying foxes and artificial roosts were erected, and the site was revegetated and irrigated in order to make it more appealing to flying foxes (Roberts, 2006). In conjunction with this a program was developed to repel or deter the flying foxes from their roosting site in the Royal Botanical Gardens. This involved using loud noises early in the mornings as they were coming back into roost (Naomi, Royal Botanical Gardens, pers. omm..), similar to the techniques used in the Maclean instance. The result was not entirely successful. The flying foxes were eradicated from their initial roosting site; however, they ended up being scattered across many parks throughout Melbourne which made the project larger. Eventually, the population ended up in two new sites, one of which was at Yarra Bend Park which initially caused an outcry from residents who were against having a large bat population in close proximity (Roberts, 2006). This site was eventually modified so that the flying foxes would not cause adverse effects to the vegetation and signage was created to educate residents about the flying foxes (Roberts, 2006). While the entire project cost \$3.05 million, the flying foxes

have not returned to the roosting site in the gardens since 2003. However, due to the lifespan of flying foxes being around 15 years this is still a recent event (Roberts, 2006).

5.1.3 Other cases in the Darling Downs and surrounding regions

Through communication with the EPA, Toowoomba it is evident that recently there have been a number of cases in the Darling Downs and surrounding regions where large populations of flying foxes begin roosting. It is usually the case that they are deterred, sometimes with unfavourable consequences, or eventually move on of their own accord.

- Stanthorpe, Inglewood and Warwick all had populations, some that numbered as high as 30,000, that migrated elsewhere for reasons unknown.
- In Allora, a population of 14,000 were attracted to a significant flowering of eucalypts and eventually moved on when the feed decreased. Only a few hundred now remain.
- An attempt to drive out a separate population of flying foxes in Allora was successful by playing loud music as a deterrent. However, in this instance the flying foxes moved to a nearby creek with riparian vegetation nearby which did not border residential properties.
- In another case in Allora approximately two years ago, scare guns and smoke bombs were used in an attempt to remove flying foxes from a park. This was successful in the removal of flying foxes; however the population moved close by into a resident's property and destroyed their garden. In the commotion mothers dropped their young along the way resulting in a number of dead juvenile flying foxes, which needed to be located and cleaned up.
- An interesting case in Esk required the development of a Conservation Plan for 8,000-10,000 flying foxes that were roosting on the edge of town close to a caravan park. The nuisance was such that it was affecting the caravan park's business.

5.2 Management options for the Japanese Gardens, USQ, Toowoomba

Aside from health concerns the other major problem is for the welfare of the Japanese Gardens. As has been shown with previous attempts in Maclean and Melbourne any attempt to successfully relocate this population of flying foxes would be difficult and costly. Nevertheless, there are a few potential options.

5.2.1 Do nothing and wait for flying foxes to leave of their own accord

The first option is to do nothing and let the flying foxes move on in their own time which, in accordance with the regulations of the EPA, would seem like the only option.

It has been recommended that if the population decreases then it might be appropriate to implement a deterrent (EPA, pers. omm..). However, this may not solve the issue as it would allow further destruction of the Japanese Gardens as flying foxes do not omm. z the damage they are doing and will often only move on after severe or irreparable damage has been done. However, as some of the trees in the gardens are 25 years old (Mark Flint, pers. omm..), if the flying foxes do not move on for a couple of years the damage caused may be drastic and omm. ze the world status of the Japanese Gardens. Furthermore, this has the potential to have negative impacts upon tourism for Toowoomba. On the other hand, during the winter of 2008 the flying foxes did leave the gardens for a period of time before returning (Mark Flint, pers. omm..). It is not understood why this happened or where they went but a possible explanation is that they migrated to a warmer location as the winter was felt to be colder than average (Mark Flint pers. omm..). Coming in to winter the flying foxes should be monitored to see if they again leave the Japanese Gardens for another site and perhaps even tracked to identify where they are moving. Moreover, if the entire population leaves then perhaps deterrents can be implemented in the Japanese Gardens to make the site undesirable should they return (EPA, pers. omm..). A highly successful deterrent which

is used by farmers to protect orchards is to erect netting to exclude flying foxes (Rainforest CRC, 2006, Qld DPI&F, N.D.). For further deterrents, view the Environmental Protection Agency's *Damage Mitigation Methods for Flying Fox (Information Sheet – Wildlife Management)* publication 14.07.08.

5.2.2 Relocate the population to an existing site

The second option is to attempt a relocation program with the support of the EPA. Although these have shown to be very expensive in other attempts (\$3 million in Melbourne) the cost for a potential relocation program could be reduced by encouraging environmental and biological students from the university to volunteer and gain some experience. As there are three groups of flying foxes that are living in three different areas of the gardens (Mark Flint, pers. omm.), it would be a good experiment to try different deterrents or exclusion techniques in various parts of the gardens before attempting to exclude the entire population all together.

It is understood that in the past the flying foxes have roosted in the vegetation behind Springs Garden Centre on Spring Street when not omm. ze the Japanese Gardens as a roost. It was initially thought that this might be a suitable spot for relocation as it is a site that is familiar and already used. However, after communication with Gayle from Springs Garden Centre it was discovered that the flying foxes are not desired there either. This is due to the fact that there is a restaurant to the rear of the complex near the roosting site and patrons were being disturbed by the odour and the noise, especially around dusk when the flying foxes were leaving the roost to feed. Interestingly, it has been noted that since the flying foxes have been roosting at the Japanese Gardens a number of ibises and egret-like birds have begun using the location as habitat. It is understood that the birds and flying foxes do not cohabit (Gayle, pers. omm.) and it is possible that one may be a deterrent for the other.

Although Springs Garden Centre is now known not to be a preferable relocation site because it would just shift the problem from one place to the other, there is a park opposite the Springs Garden Centre that may well prove to be a suitable site. The park, where the miniature rail is located, consists of many tall eucalypts and pines in the canopy which the flying foxes should find desirable to roost in (pers. Obs.). The midstorey consists of pines, *Callistemons* and other species while the groundcover consists only of well kept lawn (pers. Obs.). There is also a pond of considerable size located adjacent to the park which is surrounded by trees of a medium height (pers. Obs.). Hence, this park land is quite similar to the structure of the Japanese Gardens. Although this area is located alongside a road which often has a consistent flow of traffic, it is not believed that this factor would deter the flying foxes from roosting in this site as they have often been seen roosting in large trees right next to main roads before (pers. Obs.). Though this may seem like an ideal solution to the problem there are three main issues that would hinder the attempt to relocate flying foxes to this site.

The first is that the park land may be privately owned and the owner may not want the flying foxes roosting in the park. Toowoomba City Council should be contacted to further determine the suitability of this park as a relocation site.

Secondly, the EPA must give approval for any relocation attempts or the implementing of deterrents to go ahead and without this there is not anything that can be done outside of day to day activities that may cause a disturbance to the flying foxes (EPA, Mark Flint, pers. omm.).

Finally, consultation with residents living in close proximity to the park land should be undertaken to determine their feelings on the situation. Roberts (2006) outlines that a buffer zone of 300 metres between residents and roosts is ideal to omm. ze the conflict between

humans and flying foxes, however, this is often not possible in urban areas. As a secondary option a buffer zone of 100 metres can suffice as it has been shown that residents living under 100 metres of a roost often have a “strong negative attitudes towards flying foxes” (Larsen *et al.*, 2002 in Roberts, 2006). The majority of residents living near the park land on Spring Street are at least 100 metres from the potential roost site however there are some residents next to Springs Garden Centre that are just 50 metres from the closest trees in the park. These are the residents whose opinions should be considered carefully before attempting to relocate any flying foxes to Spring Street as it may just be a case of moving the problem from one place to another.

5.2.3 Construct a new roost for flying foxes

This option should be considered if the relocation attempts outlined in 4.2.2 fail. Again Toowoomba City Council and the EPA would need to be consulted for approval and to determine the location of an appropriate site to effectively grow a new roost. As Toowoomba is an urban area it is possible that this may require purchasing a portion of a land from a private owner, and as such this person would need to be receptive to the idea. Nevertheless it has been estimated that it would take approximately five to ten years to grow an appropriate flying fox habitat which would be reminiscent of existing roosts (Roberts, 2006). The most obvious problem with this solution is the possibility that in those five to ten years the flying fox population may continue to live and grow in numbers at the Japanese Gardens, resulting in further damage. Therefore, it could be suggested that in conjunction with the planting of trees to create a new flying fox habitat, saplings be planted in the Japanese Gardens as a means of insurance against damage caused to larger, older trees. It is possible though that even if an ideal flying fox habitat is constructed elsewhere it may not be used as a roost. This occurred in Melbourne after large amounts of time and money had been spent creating a roost that was thought to be ideal (Roberts, 2006, Naomi, Royal Botanical Gardens, pers. omm..).

5.3 Public Health Management

In lieu of conducting the abovementioned mitigation techniques, management of the potential risks at the site should be considered. Considering the associated health risks, the following measures are recommended:

- Install signage throughout the gardens or in a prominent position for visitors entering the site. The signage should state the species of bats, potential dangers, contact phone numbers, times of occupation and other information. The signage should not be intended to scare public but rather educate them
- Ensure that cleansing of droppings across the gardens is conducted regularly, particularly in enclosed area. Suitable PPE may be required to conduct these duties.
- Regularly check the limbs of trees and ensure that any damaged overhanging limbs or branches are removed.
- Regularly check the grounds to ensure that there are no sick or deceased bats located in the gardens. Should there be a bat found, the QP&WLS or wildlife handler appropriately vaccinated should be contacted.
- Should there be employees that are in regular direct contact with the bats, vaccination should be considered.
- Should the population continue to grow, reassessment of the risks may be required .

6. Conclusion

The bat population roosting within the Japanese Gardens as a roost have caused concern for public health and safety along with the welfare of the gardens. Although flying foxes have been reported to carry a number of fatal diseases such as Australian Bat Lyssavirus (ABL), Hendra virus and Menangle virus, the likelihood of contracting these viruses is unlikely, and therefore, the risk of infection to people who enter the gardens is quite low. There are a number mitigation measures that are mentioned to aid in minimizing the potential risk to the public, however the associated risk does not make any of these options compulsory. The damage that is being caused to the gardens is still at an early stage but it is probable that the damage will worsen as numbers increase. In response to the identified issues and results of site inspection, three main management options have been identified in an effort to protect the Japanese Gardens from further damage and possible destruction. For any of these options to be successful they must have the full support from all relevant stakeholders such as the EPA, Toowoomba City Council, members of the community of USQ and residents, and it must also have official approval from the EPA. Studies focusing on the interaction between humans and flying foxes are still relatively minimal; as are studies into relocation programs. Consequently there are no common solutions to such issues and there is a need for more research in order to better understand the ecology of flying foxes so that similar problems can be managed effectively.

7. References

- Conn, P.M. 2006. *Handbook of Models for Human Aging* p. 441.
- Crocker, R., Abbott, D. and Kern, L. 2005. *Flying-fox Campsite Management Plan Yarra Bend Park*. State of Victoria, Department of Sustainability and Environment.
- Hanna, J.N., Carney, I.K., Smith, G.A., Tannenberg, A.E.G., Deverill, J.E., Botha, J.A., Serafin, I.L., Harrower, B.J., Fitzpatrick, P.F. and Saerle, J.W. 2000. Australian bat lyssavirus infection: a second human case, with a long incubation period. *MJA* **172**: 597-599
- Heary, M. 2008. *Bid to move flying foxes to new camps*. St George & Sutherland Shire Leader.
- Institute for International Cooperation in Animal Biologics, CFSPH. 2006. *Menangle*. Centre for Food Security and Public Health.
- McCall, B.J., Epstein, J.H., Neill, A.S., Heel, K., Field, H., Barrett, J., Smith, G.A., Selvey, L.A., Rodwell, B. and Lunt, R. 2000. *Potential Human Exposure to Australian Bat Lyssavirus, Queensland, 1996-1999*. Emerging Infectious Diseases.
- Mycology Online. 2007. *Histoplasmosis*. The University of Adelaide.
- NSW Department of Primary Industries. 2005a. *Hendra virus*. State of New South Wales.
- NSW Department of Primary Industries. 2005b. *Menangle virus infection*. State of New South Wales.

- Qld Department of Primary Industries & Fisheries. N.D. *Flying fox control methods research findings*. State of Queensland.
- Rainforest CRC. 2006. *Ecology and Management of Flying Fox Camps in an Urbanising Region*. Issues in Tropical Landscapes.
- Roberts, B.J. 2006. *Management of Urban Flying-fox Camps: Issues of Relevance to Camps in the Lower Clarence, NSW*. Valley Watch Inc., Maclean

Appendix 1

Table 1 – Qualitative Measures of Likelihood and Consequence and Corresponding Overall Risk Matrix

Qualitative measures of likelihood				
Level	Descriptor		Description	
A	Almost certain		Is expected to occur in most circumstances	
L	Likely		Will probably occur in most circumstances	
P	Possible		Could occur	
U	Unlikely		Could occur but not expected	
Qualitative measures of impact				
Level	Descriptor		Example detail description	
1	Major		Exposure of individual/property to hazards including disease outbreak to public/major financial loss/ infrastructure damage/ ecological loss.	
2	High		Loss of operational capability, detriment to health and amenity, causes high financial loss and damage to infrastructure	
3	Medium		Some loss of operational capability, potential detriment to health and amenity, causes medium financial loss and damage to infrastructure	
4	Low		Negligible loss of operational capability, low risk to health, minimal loss of amenity, causes low financial loss and damage to infrastructure	
Qualitative risk analysis matrix: Level of risk				
Likelihood	Consequence			
	Major	High	Medium	Low
Almost certain	E	E	H	H
Likely	E	H	H	M
Possible	H	H	M	L
Unlikely	H	M	L	L

Legend:

E = Extreme risk; immediate action required.

H = High risk; senior management attention needed.

M = Moderate risk; management responsibility must be specified.

L = Low risk; manage by routine inspections