Why can't flying foxes simply be relocated?

The Grey Headed Flying-fox is a native Australian species considered 'vulnerable' under the NSW *Biodiversity Conservation (BC) Act 2016* and the Commonwealth *Environment Protection and Biodiversity Protection (EPBC) Act 1999*, and the international Red List. The species has an ecologically significant role in seed dispersal and pollination where they make a unique contribution to ecosystem health (Southerton *et al.* 2004). Such activity contributes directly to the reproduction, regeneration and viability of forest ecosystems (DoE 2016a).

Public demands for roost relocations have increased over the past two decades as flying-foxes have been roosting and foraging in urban areas more frequently. This has been occurring due to; displacement of natural habitat from naturally occurring events such as fire, urban expansion and food availability within range of urban areas (DoE 2016a). Flying-fox species inhabiting Australia are the target of community concerns in relation to public health, amenity and impacts on agriculture (Roberts et al. 2012).

Tanton (1999) states that it must be recognised that relocation of a flying-fox camp from one site to a specific alternative site has never been successful. It is well understood that if flying-fox camps are intentionally dispersed from one location and community, they will end up in another community. Such dispersals however may result in new camps establishing in an equally problematic locations and those establishments may only be on a temporary basis (Roberts et al. 2012; West 2002; Roberts *et al*. 2012). In some cases, individuals will remain at the site even when subject to extraordinary levels of human induced disturbances (Thiriet 2005). This is largely due to the species level of strong fidelity to the camp location.

If individuals do move from the location, efforts will be made year after year by the population to return to the original camp location (Roberts 2006). Sometimes, these reoccupation attempts occur monthly (Tidemann 2003). According to Roberts *et al.* (2011) in a review of 10 case studies of dispersal attempts in various locations, it was found that continuous action to prevent the camp returning was necessary many times within and between years. Although some short term dispersal attempts have been successful (Melbourne) ongoing dispersal efforts are required in order for the success to continue (West 2002, Roberts 2006, Phillips *et al.* 2007, Roberts 2008).

For example, following a dispersal attempt of a camp of flying-foxes in one Australian rural town, 12 years of repeated noise disturbances at the original camp site, still did not prevent flying-foxes from regularly returning in large numbers (Roberts *et al*. 2011) These results amongst other studies indicate that roost relocation is likely to be unsuccessful in permanently removing flying foxes from a location.

Roberts and Eby (2013) conducted a review of 17 flying fox camp dispersals between 1990 and 2013. The review of these attempted dispersals indicated;

1. In all cases, **dispersed animals did not abandon the local area**.

2. In 16 of the 17 cases, **dispersals did not reduce the number of flying-foxes** in a local area.

3. **Dispersed animals did not move far** (in approx. 63% of cases the animals only moved <600m from the original site, contingent on the distribution of available vegetation). In 85% of cases, new camps were established nearby.

4. In all cases, it was **not possible to predict where replacement camps would form**.

5. **Conflict was often not resolved**. In 71% of cases conflict was still being reported either at the original site or within the local area years after the initial dispersal actions.

6. **Repeat dispersal actions were generally required** (all cases except extensive vegetation removal).

7. The **financial costs of all dispersal attempts were high** ranging from tens of thousands of dollars for vegetation removal to hundreds of thousands for active dispersals (e.g. using noise, smoke etc).

Any dispersal attempt is costly, will require ongoing commitment and maintenance, is very often unsuccessful and rarely do they result in the desired outcome (Roberts *et al.* 2011). For example, Roberts *et al.* (2012) analysed the minimum cost of the dispersal of a flying fox camp in Melbourne that is today, still perceived to be unsuccessful by many. The dispersal of the Melbourne Royal Botanic Garden camp cost between $2 950 000 and $3 050 000. Years of attempts were made by the flying foxes to return to the original site including monthly attempts for the first 6 months following dispersal. The result of the dispersal was two new camps set up in unexpected locations.

Similarly, the Maclean Rainforest reserve dispersal cost upwards of $400 000 (Roberts *et al.* 2011). The result of the dispersal was the camps re-establishment 350 metres away from the original site and a second camp 16kms away from the original site. This dispersal resulted in additional conflict to the community and regular attempts to reoccupy the original site over many years.

Dispersal of flying foxes also negatively impacts flying fox health and sometimes results in mortality. This is incredibly concerning when the species is considered a threatened species for its ecological significance and decline in population. Mass mortality may occur particularly if conducted during the breeding season when dependent juveniles are affected (OEH 2018). OEH (2018) does not recommend any dispersal attempts during the period September to April reflecting critical reproductive periods and times of elevated temperatures. Dispersal should also not occur during the day when animals are resting and during mating, late pregnancy and when young are nutritionally dependent on their mothers as dispersal efforts will impact on the welfare of species (Australian Bat Society n.d). In the article '*A new threat to already threatened Flying-foxes under the proposed new "Flying-fox Camp Management Policy"'* a concerned resident found that such dispersal attempts at Maclean resulted in individuals dying of starvation and exhaustion caused by the dispersal actions attempts during the day depriving individuals of rest. They therefore were observed to not have enough energy that night to fly out and seek food which ultimately caused mortality within the camp individuals.

Previous studies of flying fox species have suggested that physiological and ecological factors may constitute risk factors for Hendra virus infection (Field 2004; Plowright *et al* 2008; Breed *et al*. 2011; Plowright *et al.* 2015). It is hypothesised that physiological and ecological factors may underpin infection dynamics in flying-foxes, and subsequent spill over to horses and in turn humans (McMichael *et al.* 2017). Although stress is a factor that is hypothesised to cause the increased rate of Hendra, Hendra virus and its relationship with the individual flying fox's level of stress has only been studied minimally and needs further study to support this.

References

A new threat to already threatened Flying-foxes under the proposed new "Flying-fox Camp Management Policy" n.d viewed 22nd March 2018 <https://www.cec.org.au/local/NewThreatToFlying-Foxes.pdf>.

Australian Bat society n.d.*' ABS PositionStatement Flying-fox camp dispersal'* file:///C:/Users/ejuhasz/Downloads/ABS%20Position%20statement_Flying%20Fox%20Camp%20Dispersal%20(1).pdf (Australian Bat Society n.d).

*Billie Roberts and Peggy Eby June 2013. '*Review of past flying-fox dispersal actions between 1990-2013**.'**

Breed AC, Breed MF, Meers J, Field HE. Evidence of endemic Hendra virus infection in flying-foxes (Pteropus conspicillatus)–Implications for disease risk management. PLoS ONE. 2011; 6(12):1–7.

DoE 2016a, *Pteropus poliocephalus in Species Profile and Threats Database*, Australian Government Department of the Environment, Canberra, viewed 12 January 2016, www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=186.

Field HE. The ecology of Hendra virus and Australian bat lyssavirus. PhD thesis, The University of Queensland, Brisbane, Australia. 2004.

McMichael L, Edson D, Smith C, Mayer D, Smith I, et al. (2017) Physiological stress and Hendra virus in flying-foxes (*Pteropus* spp.), Australia. PLOS ONE 12(8): e0182171. https://doi.org/10.1371/journal.pone.0182171

OEH 2018. '*Camp disturbance or dispersal (Level 3) actions', Australia Office of Envrinoment and Heritage.* < **http://www.environment.nsw.gov.au/animals/flying-fox-dispersal.htm**

Plowright RK, Field HE, Smith C, Divljan A, Palmer C, Tabor G, et al. Reproductive and nutritional stress are risk factors for Hendra virus infection in little red flying foxes (Pteropus scapulatus). Proceedings of the Royal Society Biological Sciences. 2008; 275(1636):861–869. https://doi.org/10.1098/rspb.2007. 1260 PMID: 18198149

Plowright RK, Eby P, Hudson P, Smith I, Westcott D, Bryden W, et al. Ecological dynamics of emerging bat virus spillover. . Proc. R. Soc. B. 2015; 282: 20142124. https://doi.org/10.1098/rspb.2014.2124 PMID: 25392474

Phillips, P. Hauser, P. & Letnic,M. (2007). Displacement of Black Flying Foxes (Pteropus alecto) from Batchelor, Northern Territory.. Australian Zoologist. 34. 10.7882/AZ.2007.009.

Roberts, B. Catterall, C. Eby, P & Kanowski, J. 2012 'Long-Distance and Frequent Movements of the Flying-Fox Pteropus poliocephalus: Implications for Management' PLoS ONE, 7 (8) (2012), p. e42532, 10.1371/journal.pone.0042532 (Roberts et al. 2012).

Roberts, B.J. 2006. Management of Urban Flying-fox Camps: Issues of Relevance to Camps in the Lower Clarence, NSW. Valley Watch Inc., Maclean. http://www.clarencevalleywatch.com/currentprojectst12.htm

Roberts, B.J. 2008. Assessment of habitat of the grey-headed flying-fox (Pteropus poliocephalus) on Lots 14 (DP808228) and 6 (DP863080) Dunbible, NSW and the Tweed Shire Council Reserve, Dallis Park, NSW. A report prepared for the Department of Environment, Water, Heritage and the Arts.

Roberts, B. Catterall, c. Eby, P & Kanowski. J (2012.). Long-distance and frequent movements of the flying-fox Pteropus poliocephalus: Implications for management. PLoS ONE, 7(8), E42532.

Roberts BJ, Eby P, Catterall CP, Kanowski J, Bennett G (2011) The outcomes and costs of relocating flying-fox camps: insights from the case of Maclean, Australia. In: Law B, Eby P, Lunney D, Lumsden L, editors. The biology and conservation of Australasian bats. Mosman, NSW: Royal Zoological Society of NSW. 277–287. (Roberts et al. 2011b)

Southerton, SG, Birt, P, Porter, J and Ford, HA 2004, 'Review of gene movement by bats and birds and its potential significance for eucalypt plantation forestry', *Australian Forestry*, vol. 67, no. 1, pp. 45–54.

Tanton, M.T. 1999. Maclean Precinct Plan Draft, Version 18/4/99. Report for Maclean Flying-fox Working Party

Tidemann, C. R. (2003). Displacement of a flying fox camp using sound. Ecol. Manage. Restor. 4: 5–7.

Thiriet, D. 2005. The relocation of flying-fox colonies in Queensland. Environmental and Planning Law Journal 22(3): 231 – 239.

Tidemann, C., & Nelson, J. (2004). Long-distance movements of the grey-headed flying fox (Pteropus poliocephalus). Journal of Zoology, 263(2), 141-146. doi:10.1017/S0952836904004960 (Tidemann & Nelson 2004).

West, C. 2002. Contemporary issues in managing flying-fox camps. Pp. 176–195 in Managing the Grey-headed Flying-fox as a Threatened Species in NSW, edited by P. Eby and D. Lunney. Royal Zoological Society of NSW, Mosman.