Review of past flying-fox dispersal actions between 1990-2013.

Prepared by Billie Roberts and Peggy Eby June 2013

To understand the utility of dispersals as a management tool to resolve conflict between humans and flying-foxes, the outcomes of 17 recent camp dispersal attempts were systematically reviewed. The review identified a set of common outcomes of camp dispersals that should guide their use in Australia. A further observation was that the outcomes of dispersals are often not known for several years.

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

There were a few exceptions to these patterns, but they only occurred when there were abundant financial and human resources (e.g. RBG Melbourne and RBG Sydney) and/or specific landscape characteristics (e.g., isolation from neighbours (Batchelor, NT) or habitat link to 'acceptable' location (RBG Melbourne)).

Further reading:

Roberts B.J., Catterall C.C., Eby P., and Kanowski J.K. (2012a) Long-distance and frequent movements of the flying-fox *Pteropus poliocephalus*: implications for management. *PloS ONE,* **7**(8): e42532. doi:10.1371/journal.pone.0042532.

Roberts B.J., Eby P., Catterall C.C., Kanowski J.K. and Bennett G. (2012b) The outcomes and costs of relocating flying-fox camps: insights from the case of Maclean, Australia, pp. 277-287 in *The Biology and Conservation of Australasian Bats*, edited by B. Law, P. Eby, D. Lunney and L. Lumsden. Royal Zoological Society of NSW, Mosman, NSW, Australia.

[1] Local area is defined as the area within a 20 km radius of the original site = typical feeding area of a flying-fox.

Location	Species	FF population estimate at time of dispersal	Method	Did the animals leave the local area?	Did the local population reduce in size?	How far did they move?	Were new camps formed (number of new camps if known)?	Number of separate actions	Cost (if known)	Was conflict resolved at the original site?	Was conflict resolved for the community?	Source+
Royal Botanic Gardens, Melbourne, Vic	G	30,000	NS	no	no	6.5 km	yes (2)	6 mths	$3 million	yes	yes, ongoing management required	13
Royal Botanic Gardens, Sydney, NSW	G	3,000	LNPOW	no	no	4 km	no	ongoing daily actions for 12 mths	>$1 million and ongoing	yes	yes	13,18,19
Singleton, NSW	GR	500	LNUW	no	no	<900 m	no (returned to original site	>3	$117,000 and ongoing	no	no	13,20
Townsville, Qld	BR	35,000	BNS	no	no	400 m	no (returned to original site)	5		no	no	13
Warwick, Qld	GRB (dispersal targeted R)	200,000	NLBP	no	no	≈1 km	no (site known to be previously occupied by GB)	5 days	$28,000	yes	uk (complaints persisted until migration)	8,21,22
Young, NSW	L	<5000	VN	no	no	<600 m	yes (1)	uk		yes	no	23

* G = grey-headed flying-fox; B = black flying-fox; R = little red flying-fox

B = "birdfrite"; F = fog; H = helicopter; L = lights; N = noise; P = physical deterrent; O = odour; S = smoke; U = ultrasonic sound; V = extensive vegetation removal; W = water.

+ 1 Storm Stanford (Wildlife carer, pers comm. 2013); 2 Louise Saunders (Bats Qld, pers comm. 2013); 3 Phillips *et al.* (2007) Displacement of Black flying-foxes *Pteropus alecto* at Batchelor, Northern Territory *Australian Zoologist* 34: 119-124; 4 John McCarthy (Northern Territory Government, pers comm. 2010); 5 Roberts (2006) *Management of Urban Flying-fox Camps: Issues of Relevance to Camps in the Lower Clarence, NSW.* Valley Watch Inc., Maclean; 6 Information from Gladstone Regional Council in 2010 and 2013; 7 Joe Adair (formerly DEHP, pers. comm. 2010); 8 Trish Wimberly (Australia Bat Clinic pers. comm. 2013); 9 Information obtained from Department of Environment and Heritage Protection (DEHP) in 2013; 10 Billie Roberts unpublished data; 11 Scott Sullivan (DEHP, pers. comm. 2010); 12 Information from Charters Towers Regional Council in 2010 and 2013; 13 Roberts *et al.* (2012b) and additional references within; 14 Perry Deeds (Central Highlands Regional Council, pers. comm 2013); 15 Jarmaine (2010) *Species Management Plan,* Mackay Regional Council; 16 Heidi Jarmaine (Mackay Regional Council, pers. comm. 2013); 17 Daryl Barnes (Walkerston resident, per comm. 2013) 18 Peggy Eby (Ecologist, pers comm. 2013) 19 John Martin (RBG, pers comm. 2013); 20 Singleton Council Meeting Minutes; 21 Information from the Southern Downs Regional Council in 2013; 22 Tim Low (pers. comm. 2013); 23 Young Shire Council.

The outcomes and costs of relocating flying-fox camps: insights from the case of Maclean, Australia

Billie J. Roberts[1], Peggy Eby[2], Carla P. Catterall[1], John Kanowski[3] and Gillian Bennett[4]

[1] Griffith School of Environment, Griffith University, Nathan, Queensland, 4111 Australia.
Corresponding author: Billie.Roberts@griffith.edu.au
[2] NSW Department of Environment, Climate Change and Water, 43 Bridge Street, Hurstville, NSW, 2220 Australia.
[3] Australian Wildlife Conservancy, PO Box 392, Malanda, Queensland, 4885, Australia.
[4] PO Box 157, Yamba, NSW, 2464 Australia.

ABSTRACT

Managing flying-fox camps is an increasing challenge for agencies responsible for managing wildlife and residential communities along the east coast of Australia. Conflict has arisen between humans and flying-foxes when camp sites were established in urban areas or when people have settled close to existing camps. People and government agencies have often attempted to disperse the flying-foxes away from these camps in the hope that they will move to different locations, but the success of these attempts has been poorly documented. This paper examines the consequences of a coordinated, government-sponsored attempt to relocate a flying-fox camp in the township of Maclean, northern NSW. This camp was a maternity site that had been occupied regularly for over 100 years. Between 1999 and 2007, the flying-foxes were repeatedly induced to move by subjecting the camp to continuous loud noise. Here we compile records to show that the total cost of this relocation attempt was at least $400,000 including 640 person-hours of effort. Flying-foxes made 23 attempts in those years to return to the original camp, although the frequency of attempts declined over time. Twelve other sites were used during this time as temporary camps, including seven sites not previously occupied. In 2004, flying-foxes established a new continuously-occupied camp in the Iluka township, 16 km north east of Maclean, which was still in use in 2010 (the time of finalising this paper). Residents near to the Iluka camp were by then intensively lobbying governments to disperse the animals from this new location. The outcome after nearly a decade of dispersal attempts at Maclean was that flying-foxes continued to return periodically to the original site, and there were more camp sites established in the region, over a wider area than previously known from historical records, and the number of affected residents experiencing conflict had increased. This experience raises questions of how, and at what spatial and temporal scales, the success of relocation attempts should be determined.

Key words: *Pteropus*, fruit bat, relocation, wildlife management, human–animal conflict, urban economics.

Introduction

The intentional movement of animals or populations from one location to another has become a popular tool to manage wildlife, both for conservation and to resolve human–animal conflicts (Griffith *et al.* 1989; Wolf *et al.* 1996; Fischer and Lindenmayer 2000). In eastern Australia, the relocation of camps of flying-foxes (*Pteropus* spp.) is regularly proposed by some members of the community, typically in cases where these bats have established colonies close to residential areas or when human development occurs too close to established camp sites (Birt *et al.* 1998; Hall and Richards 2000).

The costs of relocating flying-fox camps can be considerable (West 2002; Thiriet 2005; Roberts 2006; Nelson 2008a) and there is ongoing debate around the long-term success of such projects (Hall 2002; Tidemann 2002; West 2002). However, very little effort has been allocated to monitoring the activities involved in previous relocation attempts, or their costs or outcomes, despite their well-established and increasing use in Australia (Hall 2002; Tidemann 2002; West 2002). This paper examines the consequences of attempts to relocate a flying-fox camp at Maclean in north-east New South Wales (NSW). Based on the results, we discuss the utility of relocation as a management tool to resolve conflict between humans and flying-foxes.

Study region and its flying-foxes

Flying-fox camps in the Lower Clarence region

The Lower Clarence region in north-eastern NSW covers an area of approximately 1,500 km^2. Floodplains in the region have been extensively cleared for cane growing and cattle grazing, however, there are still some small areas of remnant rainforest and other types of native vegetation on the floodplains, and extensive areas of sclerophyll forests in the surrounding region (Figure 1). By the end of the twentieth century the human population of the region was

Pp. 277–287 in *The Biology and Conservation of Australasian Bats*, edited by Bradley Law, Peggy Eby, Daniel Lunney and Lindy Lumsden. Royal Zoological Society of NSW, Mosman, NSW, Australia. 2011.

damage and impacts upon the neighbouring community (Lunney and Moon 1997; Tanton 1999; West 2002). There are numerous reports of private and government sponsored hunts to destroy or disperse the roosting animals using shooting, fires and explosives (West 2002). However, flying-foxes continued to return to this site despite these disturbances. In the early 1990s, as a result of the legal protection of flying-foxes, these disturbances ceased and animals continuously occupied MRR without further harassment until 1999.

Regardless of the presence of flying-foxes in MRR, the rainforest remnant and the surrounding land were set aside for public use by the Municipal Council of Maclean in 1889 (West 2002). As the Maclean township grew, several community facilities were constructed on the land including a cemetery, showground and, in the early 1960s, the local high school. The initial school buildings were positioned 80 m from MRR, but as the human population of Maclean grew, additional classrooms and other education facilities were constructed closer to the reserve, including construction of classrooms within 10 m of the flying-fox camp in 1996 (West 2002). In 1994 and 1996 there were significant influxes of flying-foxes, primarily Little Red Flying-foxes, into the site (West 2002). This situation prompted increased pressure from the school community and nearby residents for the removal of the bats, due to concerns about the odour, noise, faeces and urine associated with the camp, and the perceived threat of disease transfer from the flying-foxes to the local community (Tanton 1999; West 2002). The roosting flying-foxes also caused damage to parts of the canopy in the small patch of remnant rainforest. Other members of the community, including some residents, conservation groups, and welfare organisations, considered the site important for the local flying-fox population and argued that the camp should be protected. There was public discussion of a variety of management options to reduce the conflict, including relocating either the school or the flying-fox colony. By 1998 the NSW government responded to the ongoing conflict by forming a working party to discuss and implement a draft action plan (West 2002). The working party consisted of representatives from local and state government (including the Department of Education and Training (DET), the National Parks and Wildlife Service (NPWS), and Department of Land and Property Management Authority), the Maclean High School, and other sectors of the community (including the Maclean Parents and Citizens Association). The working party

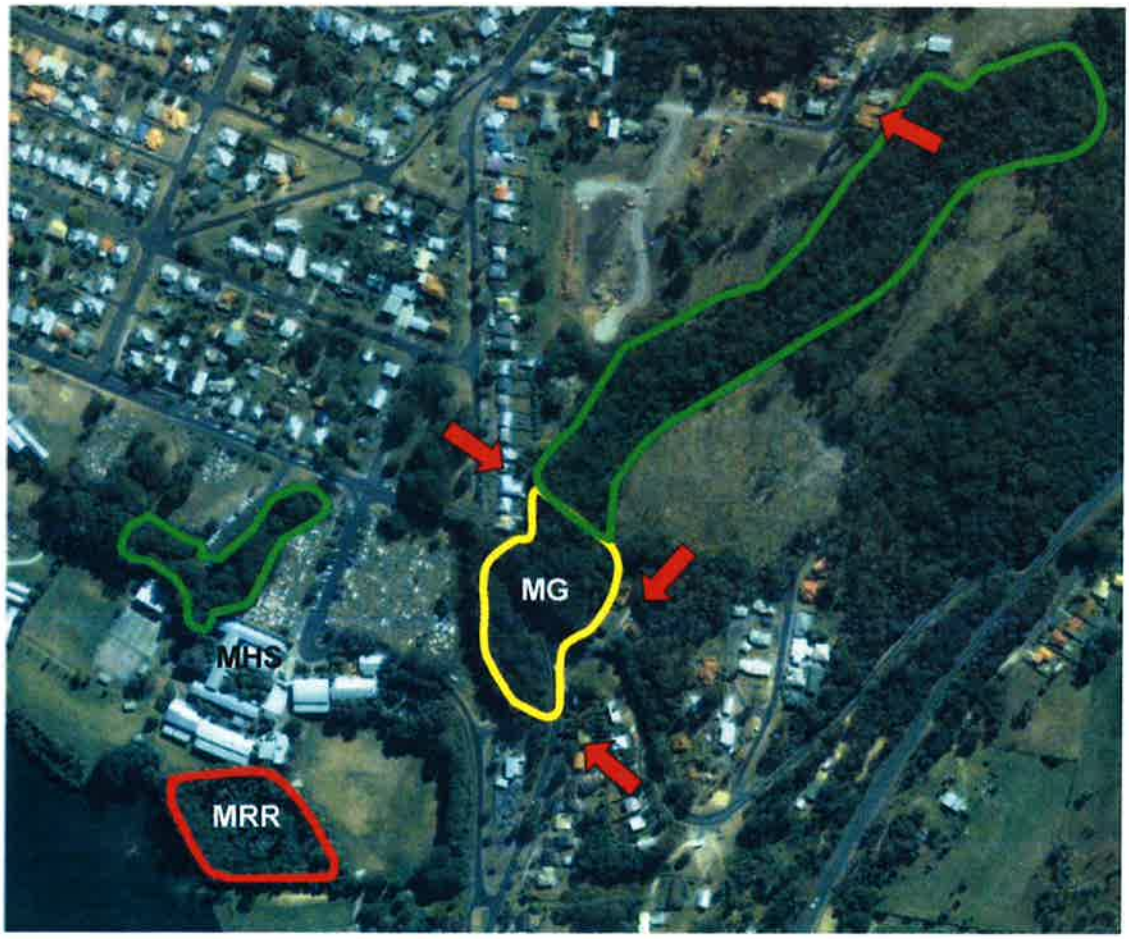

Figure 2: Roost habitat occupied by flying-foxes in the Maclean township. The red outline shows the original site used from at least the early 1890s to 1999 (MRR); the yellow outline shows the lower part of the Maclean gully (MG) occupied continuously since 2007; the green outline shows an additional area occupied at times of maximum population size after 1999 (upper Maclean gully and vegetation adjacent to Maclean High School, MHS). Arrows show residences impacted; further residential development has also been approved for the cleared areas around the Maclean gully.

return to MRR either overnight or once the noise had abated. In most cases, a large proportion of the colony had moved 350 m northeast from MRR into vegetation around a nearby electricity substation and extending into residents' backyards (lower parts of the Maclean gully; Figure 2) (West 2002; Tidemann 2003; B. Roberts pers. obs.). Flying-foxes typically remained in this area for several months, although residents often harassed the animals in an attempt to induce them to move on (B. Roberts pers. obs.).

There were no observations of flying-foxes moving from the MRR to the proposed replacement camp site at Yaegl Nature Reserve nor was there any evidence of an immediate increase in the population of Yaegl at the time of any of the relocations.

After 1999, the frequency of attempts by flying-foxes to re-establish a colony at the MRR progressively declined, although flying-foxes still returned to the site ten years after the initial relocation. Between 2007 and 2009, the bats roosted continuously in the Maclean gully despite frequent unauthorised attempts by local residents to move them. The population size was typically 2,000–7,000, and occasionally reached over 20,000, at which times the roost area expanded 550 m further up the Maclean gully, affecting additional residents (Figure 2). By 2009, flying-foxes were roosting in an area substantially larger than the pre-disturbance camp (i.e., MRR only). At maximum population size, flying-foxes roosted in MRR, both the upper and lower parts of the Maclean gully and spill over into areas around the Maclean High School (Figure 2).

Cost of the relocation

Relocation attempts at Maclean cost at least $400,000 between April 1999 and December 2006, including over 640 person-hours of effort (Table 1; Figure 3). The actual total cost of relocations was difficult to obtain due to the lack of records, the time that had elapsed since the initial relocation, and difficulties with estimating the cost of participation by government representatives. Other costs that have not been included in Table 1, but that would have significantly contributed to the total include: the costs of attendance (time, travel and accommodation) for government representatives at several years of community meetings; wages and administration costs for the various government bodies involved in regulating the relocation; the cost of vaccinating (against Lyssavirus) wildlife carers, veterinarians and government staff who monitored the welfare of the animals during the disturbance (a regulatory condition for the relocation attempt); and legal costs incurred when a conservation group (North Coast Environment Council) took the licence holder (DET) to court to prevent disturbances during the maternity season. Works also took place in the late 1990s to reduce the flying-fox impact on Maclean High School (including covered walkways, air-conditioning and double glazing windows). The cost of these was at least $360,000, although this is not a cost of the relocation but rather one of impact mitigation.

Assessment of flying-fox camp sites used since the relocation

After the initial disturbance of the Maclean flying-fox camp in 1999, at least 12 sites were used as campsites by flying-foxes across the Lower Clarence region (Figure 1). Five had been used as camps prior to the 1999 disturbance (Ulgundahi Is., Angourie, Yaegl Nature Reserve, Ashby and Lawrence) and seven appear to be new sites that were only used after the disturbance (Maclean gully, Whyna Is., Sleeper Is., Thorny Is., Bolorobo Is., Iluka, Warregah Is.). Six of these new camp sites (all except the Maclean gully) are situated in small mangrove patches or islands in which tree cover has only recently (last 15 years) developed or re-developed to the extent where it would provide sufficient roost habitat for the establishment of a flying-fox camp (see Roberts 2005 for roost habitat descriptions). Five were temporary camps

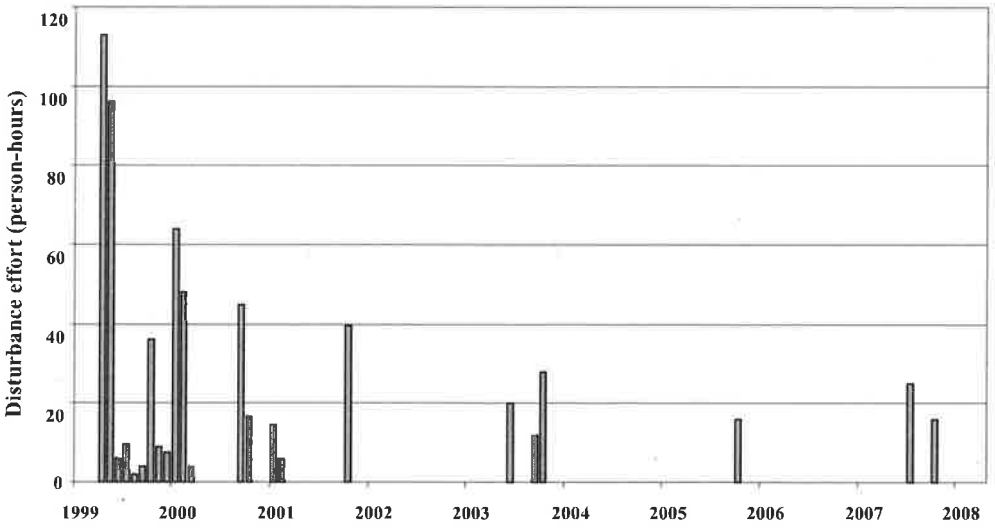

Figure 3 Documented disturbance effort (person-hours) required to disperse flying-foxes from the Maclean Rainforest Reserve during the period of licensed disturbances (April 1999 to December 2007). Note that the data do not include any unauthorised disturbances conducted by residents of Maclean. Data from Tidemann (2003), Clarence Valley Council, and authors.

Table 2 Summary of known documented attempts to relocate Australian f lying-fox camps using non-lethal methods, during 1990 to 2009.

Location	Spp*	Population at initial action	Method#	No. of years' disturbance 1990 – 2009	No. of disturbance actions	Dist. (m) moved from initial site	Use of pre-identified site (Distance)	Acceptable new location? (duration of action)	No. of new camps created	Maximum population in 2008–09	Conflict reported during 2008–09?	Source+
Batchelor, NT	B	200	BNS	2	2	<400	none identified	yes (3 months)	1	2,000	no	1,2
Boyne Island, Qld	BR	25,000	LNS	3	3+	<500	temporarily (400 m)	yes (9 months)	unknown but at least 2	nil	at related site	3,4,5
Charters Towers, Qld	BR	40,000	HLNPOW	9	10+	200	none identified	no	unknown	40,000	yes	6,7
Dallis Park, NSW	BG	28,000	V	2	2	300	none identified	no	2	nil	at related site	8,9
Maclean, NSW	BGR	20,000	NS	6	23	350	no (3 km)	no	7	>20,000	yes	10
Mataranka, NT	BR	>200,000	BHLNOSW	10	9+	<300	none identified	no	unknown	>200,000	yes	11,12,13
Royal Botanic Gardens, Melbourne, Vic	G	30,000	NS	4	7	<500	no (8 km)	yes (6 months)	2	nil	no	14,15,16
Royal Botanic Gardens, Sydney, NSW	G	3,000	LNPOW	7	10	<900	none identified	no	0	20,000	yes	11,16,17
Singleton, NSW	GR	500	LNUW	2	3	max 900	none identified	no	0	14,000	yes	3,16,18, 19
Townsville, Qld	BR	35,000	BNS	3	2–5	400	none identified	no	unknown	20,000	yes	6, 20

* G = Grey-headed Flying-fox; B = Black Flying-fox; R = Little Red Flying-fox

B = "birdfrite"; H = helicopter; L = lights; N = noise; P = physical deterrent; O = odour; S = smoke; U = ultrasonic sound; V = vegetation destruction; W = water.

+ 1 Phillips *et al.* 2007, 2 J. McCarthy (Northern Territory Government, pers comm. 2010), 3 Roberts 2006, 4 Queensland Parks and Wildlife Service 2002, 5 J. Adair (Department of Environment and Resource Management, pers. comm. 2010), 6 S. Sullivan (Department of Environment and Resource Management, pers. comm. 2010), 7 Charters Towers Regional Council (pers. comm. 2010), 8 Welbergen 2005, 9 Roberts 2008, 10 This study, 11 Vardon *et al.* 1997, 12 Carol Palmer (Northern Territory Government, pers. comm. 2010), 13 Eddie Webber (Northern Territory Government, pers. comm. 2010), 14 Tanton 1999, 15 Toop 2004, 16 van der Ree and North 2009, 17 Richards 2002, 18 Singleton City Council 2008, 19 Stevenson 2004, 20 Billabong Sanctuary (pers. comm. 2010).

defined. In particular, the extent of responsibility of the proponent undertaking the relocation to the broader community (e.g., ensuring that any replacement camp is not a source of conflict) needs to be explicitly identified. The length of commitment to relocation also needs to be clearly understood by proponents, given that flying-foxes show high fidelity to traditionally-used camp sites (Ratcliffe 1931; Nelson 1965; Eby 1995; Richards 1995; Tidemann 1999; Tidemann *et al.* 1999). The continued attempts by flying-foxes to re-establish the Maclean camp may be related to the role of the site as a maternity camp. As flying-foxes can live for over 15 years in the wild (Martin and McIlwee 2002; Divljan *et al.* 2006), attempts to re-establish the MRR camp may continue for another few years (if sites are occupied on the basis of individual memory), or indefinitely (if sites are occupied on the basis of habitat attributes or cultural transmission). Such factors need to be considered and addressed in decisions to disperse or relocate flying-fox camps.

Future relocation attempts also need to be accompanied by an adequate monitoring program, to record the actions taken and their costs, and also to determine the short- and long-term outcomes of the disturbance. Monitoring of the outcomes could include both tracking the individual movements of affected animals (for example, with satellite- or radio-telemetry) over the first 12 months, and regularly monitoring of both the original site (i.e., species present, their abundance, breeding status) and other sites in the region. Without such monitoring, there is a significant risk that attempts at relocation will continue to be represented by proponents as 'successful', when in fact they have simply shifted the problem to other places or to the future, rather than solved it.

Conclusion

The resolution of conflicts between humans and flying-foxes is important to the conservation and management of flying-foxes in Australia. The use of disturbance to induce camp relocation is currently commonly proposed as a management tool to reduce conflicts between humans and flying-foxes. However, such relocation attempts have largely been carried out in an *ad hoc* fashion and have lacked systematic documentation, costing and monitoring. Further, most relocations have had limited success in moving the flying-foxes to new sites, in some cases these new sites have been in unanticipated and undesirable locations, and relocation attempts may be costly. The location of flying-fox camps in urban areas is likely to continue to be an issue of community conflict and conservation concern in the future. A better understanding of flying-fox relocations will significantly assist organisations responsible for managing flying-fox camps and help identify long-term management solutions that are both ecologically-sound and acceptable to the entire community.

Acknowledgements

Thanks to Valley Watch Inc. for commissioning the work, and for the additional assistance of NSW Department of Environment, Climate Change and Water, and the Department of Land (DECCW) and Property Management Authority. We would like to acknowledge the many people who contributed to the production of this work by providing information related to the relocation of the Maclean flying-fox camp and/ or usage of camps in the surrounding area including C. West, J. Clowes, J. Storock, H. Naylor, B. Sansom, M. Forester (Clarence Valley Council), N. Greenup (previously of Clarence Valley Council), and M. Williams (DECCW). We also wish to thank the Lower Clarence Flying-fox steering committee for their advice and expertise; P. Baumann (Department of Land and Property Management Authority), K. Laurie (Birrigan-Gargle Local Aboriginal Land Council), J. Kennedy (DECCW), I. Tiley (Clarence Valley Council), P. Wrightson (Valley Watch Inc.), H .Tyas Tunggal (Valley Watch Inc.), and Dr K. Vernes (University of New England). Thanks also to Joe Adair and Scott Sullivan (Department of Environment and Resource Management), Carol Palmer, Eddie Webber and John McCarthy (Northern Territory Government), staff at Billabong Sanctuary and Charters Towers Regional Council for providing information for Table 1. Martin Smith, an anonymous reviewer and members of the Wildlife Discussion Group at Griffith University provided useful comments on the draft manuscript.

References

Birt, P., Markus, N., Collins, L., and Hall, L.S. 1998. Urban flying-foxes. Nature Australia 26(2): 54–59.

Coffs Harbour City Council 2007. *Coffs Creek Flying-fox Camp Strategy.* Coffs City Council, NSW.

Department of Sustainability and Environment 2005. *Flying-fox Campsite Management Plan. Yarra Bend Park.* http://www.dse.vic.gov.au.

Divljan, A., Parry-Jones, K. and Wardle, G.M. 2006. Age Determination in the Grey-Headed Flying-fox. *Journal of Wildlife Management* 70(2): 607–611.

Eby, P. 1991. Seasonal movements of Grey-headed Flying-foxes, *Pteropus poliocephalus* (Chiroptera: Pteropodidae), from two maternity camps in northern New South Wales. *Wildlife Research* 18: 547–559.

Eby, P. 1995. *The biology and management of flying-foxes in NSW: Species management, report no.18.* New South Wales National Parks and Wildlife Service, Sydney, 72 pp.

Eby, P. 2002. Using New South Wales planning instruments to improve conservation and management of Grey-headed Flying-fox camps. Pp 240–250 in *Managing the Grey-headed Flying-fox as a Threatened Species in NSW*, edited by P. Eby and

van der Ree, R. and North, J.M. 2009. *Public Environment Report. Proposed relocation of a camp of Grey-headed Flying-foxes (Pteropus poliocephalus) from the Royal Botanical Gardens Sydney.* Botanical Gardens Trust, Sydney.

Vardon, M.J., Simpson, B.K., Sherwell, D. and Tidemann, C.R. 1997. Flying-foxes and tourists: a conservation dilemma in the Northern Territory. *Australian Zoologist* **30(3):** 310.

Welbergen, J.A. 2005. The social organisation of the grey-headed flying fox (*Pteropus poliocephalus*). PhD thesis, Department of Zoology. University of Cambridge, Cambridge, UK.

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.

Wolf, C.M., Griffith, B., Reed, C., and Temple S.A. 1996. Avian and mammalian translocations: update and reanalysis of 1987 survey data. *Conservation Biology* 10(4): 1142–1152.