

**EFFECTIVENESS OF THE ‘PHOENIX WAILER’ AT DETERRING  
GREY-HEADED FLYING-FOXES FROM ROOSTING IN THE FERN  
GULLY, ROYAL BOTANIC GARDENS, MELBOURNE - A PILOT STUDY.**

Rodney van der Ree<sup>1</sup>, Helena Bender<sup>2</sup>, and John Nelson<sup>3</sup>

<sup>1</sup>Australian Research Centre for Urban Ecology, Royal Botanic Gardens Melbourne. C/- School of Botany, University of Melbourne, 3010, Vic.

<sup>2</sup>Department of Zoology, University of Melbourne, 3010, Vic.

<sup>3</sup>Department of Biological Sciences, Monash University, Clayton, 3168, Vic.



**Australian Research Centre  
for Urban Ecology**

## **INTRODUCTION**

Sound deterrent systems are used extensively to repel animals in a wide range of contexts, including the reduction of damage to crops by birds and other browsing animals, preventing bird and deer-strikes with aircraft at airports and deterring rats, mice and mosquitoes from the home (Bomford and O'Brien 1990; Haag-Wackernagel 2000; Jensen *et al.* 2000). Grey-headed Flying-foxes (GHFF) (*Pteropus poliocephalus*) have recently (early – mid 1980s) established a permanent year-round roost within the Fern Gully of the Royal Botanic Gardens, Melbourne (RBGM) (Menkhorst and Dixon 1985). The number of GHFF within the camp varies seasonally, accommodating approximately 5000 individuals during winter and up to 20,000 in summer (RBGM and NRE, unpub. data). Damage caused to the trees used by the GHFF for roosting is significant and becoming more widespread as the population increases. To prevent further damage from occurring to the vegetation, effective methods are needed to deter GHFF from continuing to roost in the Fern Gully. In this study, we tested the effectiveness of the Phoenix Wailer at deterring GHFF from roosting in the Fern Gully at RBGM.

## **AIM**

The aim of this trial was to test the effectiveness of the Phoenix wailer at deterring Grey-headed Flying-foxes from roosting on trees in the Fern Gully at the Royal Botanic Gardens, Melbourne and over what distances the sounds are effective as a deterrent.

## **METHODS**

### **The Fern Gully**

The Fern Gully at the RBGM is approximately 60 m wide (east to west) and 120 m long (north to south), with an irrigated creek that flows northwards along its length. The Fern Gully was designed and established by Guilfoyle in the late 1800s to recreate a tropical experience (Seddon 1997) and is presently characterised by many large trees, shrubs and palms, some of which are at least 100 years old.

### **Sound playback**

Sounds were broadcast to GHFF in the Fern Gully via a set of three speakers suspended from a cable set at a height of 10 m above the ground. The cable was oriented east-west and divided the Fern Gully in half. Speakers were positioned approximately equal distances (20 m) apart and faced north. Speakers were connected to the sound generator via wires that were fixed to the cable with

cable ties. The sound generator and 12-volt battery were stored in a box at the base of the east support pole. The playback of sounds was programmed to run automatically from 0500 hrs to 0700 hrs for six consecutive days (21 – 26 December 2001). The sounds were programmed to play for approximately 30 seconds, followed by a short period of silence. The order of the individual sounds and playback from the three speakers was randomised. The manufacturer did not provide any information on the characteristics of the sounds produced, however the frequency of all sounds were in the range audible to human hearing (< 20 kHz). The type of sounds included bells and alarm sounds, computer generated tones and calls of GHFF. We analysed the characteristics of each sound from digital video footage used to monitor behavioural responses of GHFF (see below). Sounds were analysed with CoolEdit Pro on a Macintosh computer.

### **Counts of the number of roosting Grey-headed Flying-foxes**

Two observers counted the number of roosting GHFF each day in 76 palms (*Livistona australis* Cabbage Tree Palm n = 43; *Archontophoenix cunninghamii* Bangalow Palm n = 32; *Washingtonia filiformis* Washington Palm n = 1) distributed at set distances (0 – 5 m, 5 – 10 m, 10 – 20 m, 20 – 40 m, and > 40 m) from the line of speakers (Table 1). An approximately equal number of palms were selected in front of (north) and behind (south) the line of speakers to assess variation in the number of roosting GHFF as a result of variation in sound pressure level. Palms were selected as the tree of choice for counting the number of GHFF because they were distributed throughout the Fern Gully and thus allowed for replication in each of the distance categories. Palms were selected if they 1) consistently supported roosting GHFF during the pretreatment period; and 2) were clearly visible from the ground so that the number of GHFF roosting in each palm could be counted without disturbing them. A single observer counted on each day and counting commenced between 0830 and 0930 hrs, and lasted for approximately 1.5 – 2 hrs. Pre-treatment counts were conducted for eight consecutive days (13 – 20 December, 2001), treatment counts for six consecutive days (21 – 26 December, 2001) and post-treatment counts for four consecutive days (27 – 30 December, 2001).

### **Behavioural response of Grey-headed Flying-foxes**

On the first morning on which sounds were played, a low-light video recorder was used to record the behavioural response of the flying-foxes to the sounds. Analysis of this footage was used to determine the response of GHFF to certain sounds.

**Table 1. The number of palms in each distance and direction category from the line of speakers in which the abundance of roosting GHFF was assessed.**

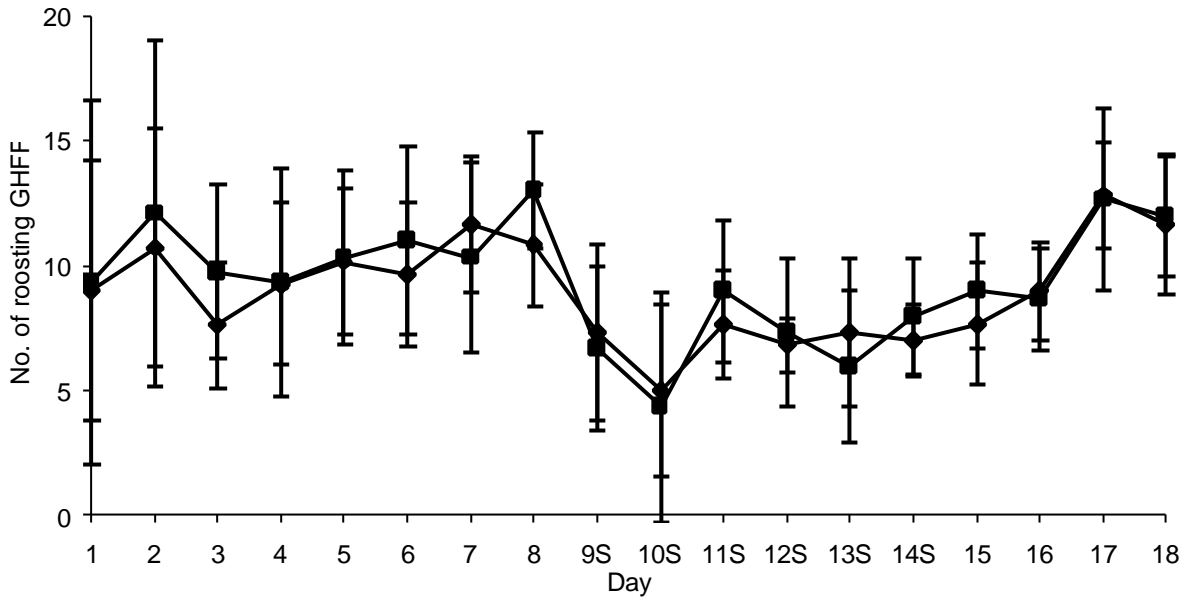
Distance from speaker line (m)	Direction from speaker line		Total
	In front (North)	Behind (South)	
0 – 5	6	3	9
5 – 10	3	6	9
10 – 20	10	11	21
20 – 40	15	11	26
> 40 m	8	3	11
<b>Total</b>	<b>42</b>	<b>34</b>	<b>76</b>

## RESULTS

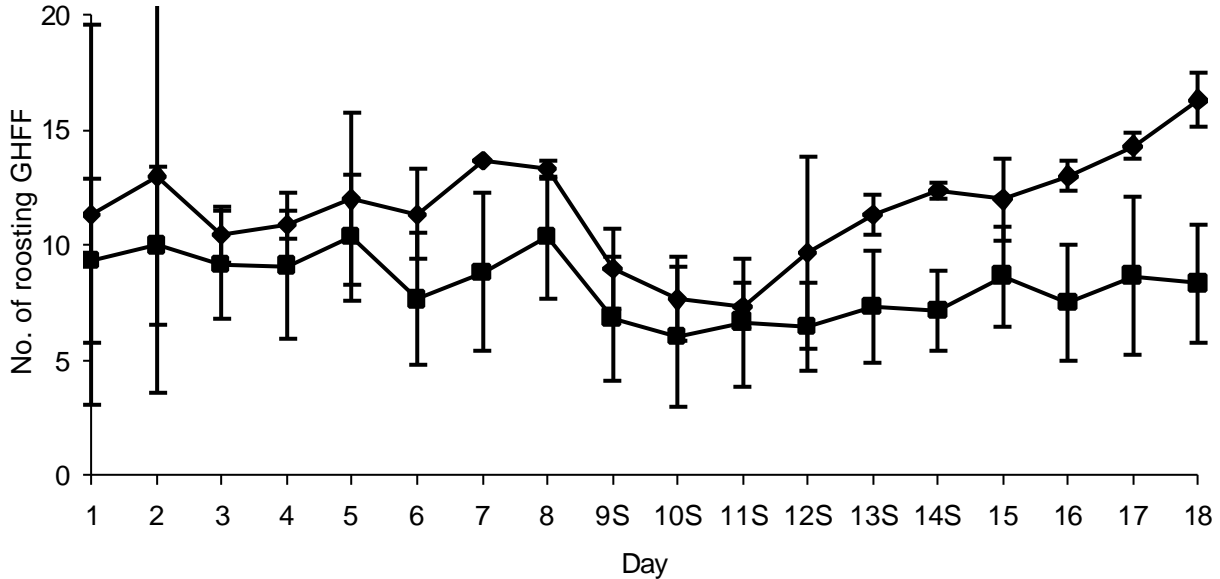
### Number of Grey-headed Flying-foxes roosting in palms

A total of 9659 GHFF was recorded in the 76 palms between 13 – 30 December, 2001. The mean number of GHFF per day roosting in each palm was 7.1 (range 0 - 32). Due to the low daily variation in the number of roosting GHFF during the three phases of the trial (Figs. 1 – 5), the mean number of flying-foxes roosting in palm trees during the six pre-treatment days was compared with the mean number roosting during the six days of treatment (Fig. 6).

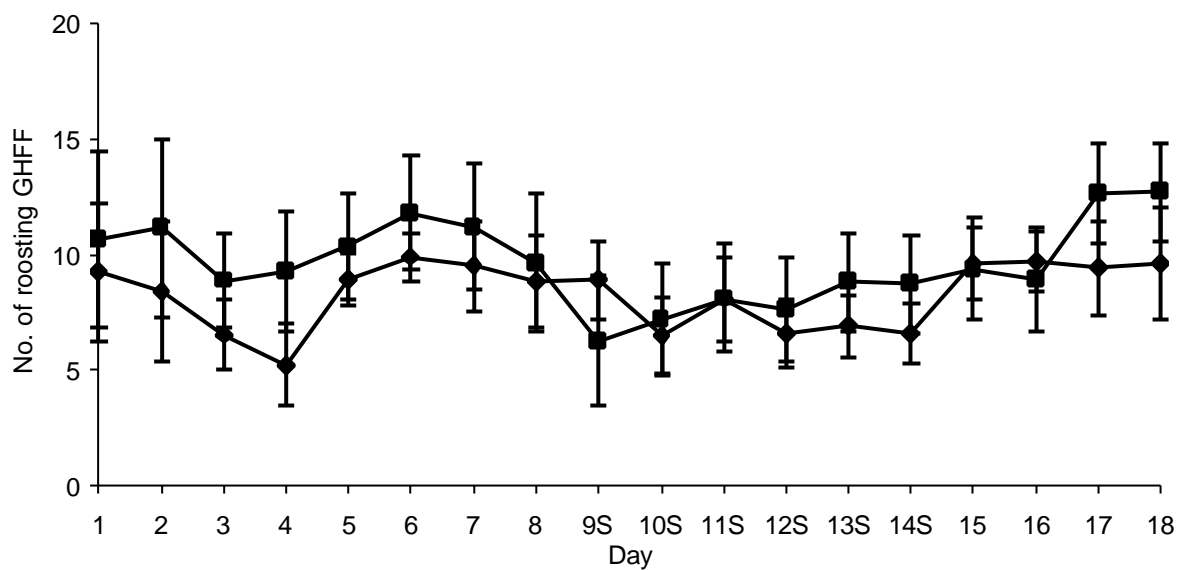
There was a slight decrease in the number of flying foxes roosting in trees within 0 – 5 and 5 – 10 m in front of and behind the line of speaker (Figs. 1, 2 and 6). The highly overlapping error bars ( $\pm 1$  s.e.) in these figures indicate that these differences are not significant.



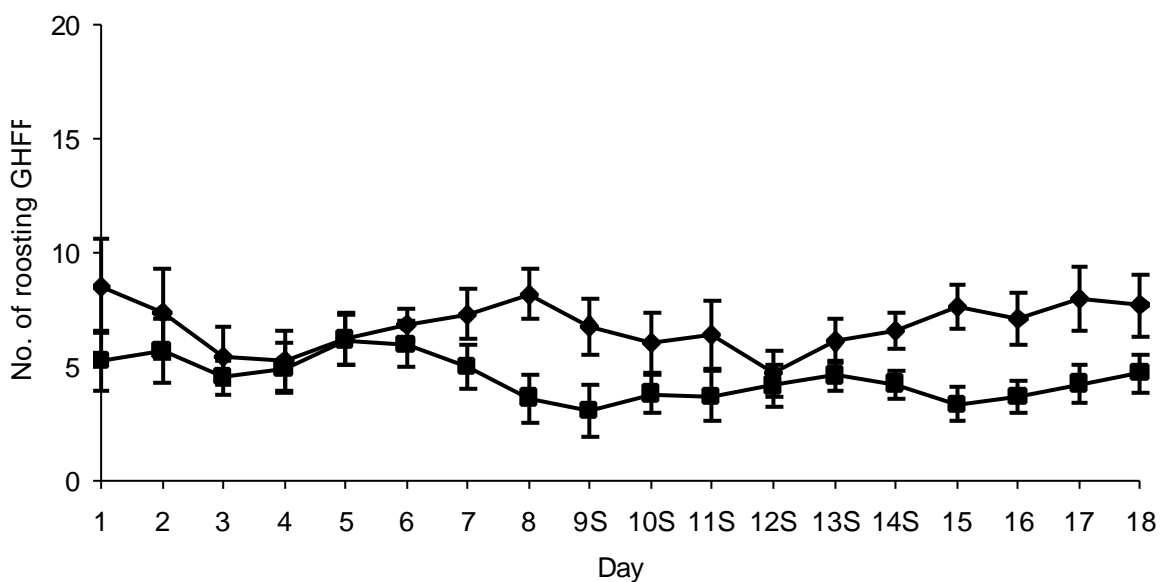
**Figure 1. Mean number of GHFF roosting on palms located 0 – 5 m in front of (denoted by diamonds, n = 6 trees) and behind (squares, n = 3 trees) speakers in the fern gully, RBGM. Phoenix Wailer sound playback (denoted by S) commenced on day 9 and ceased on day 14. Trial commenced 13 December 2001.**



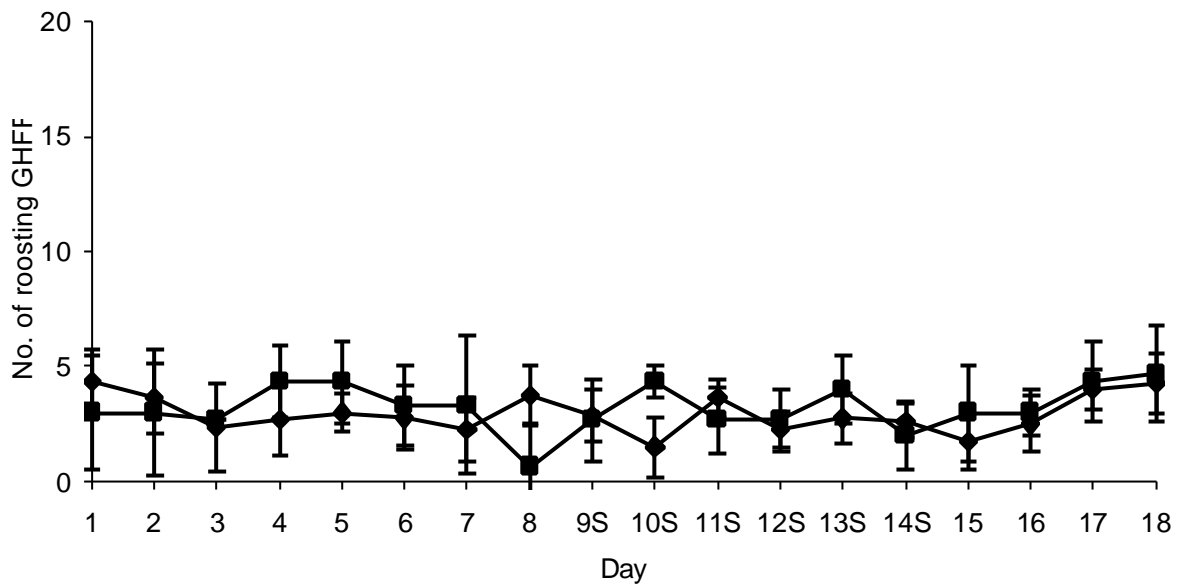
**Figure 2. Mean number of GHFF roosting on palms located 5 – 10 m in front of (denoted by diamonds, n = 3 trees) and behind (squares, n = 6 trees) speakers in the fern gully, RBGM. Phoenix Wailer sound playback (denoted by S) commenced on day 9 and ceased on day 14. Trial commenced 13 December 2001.**



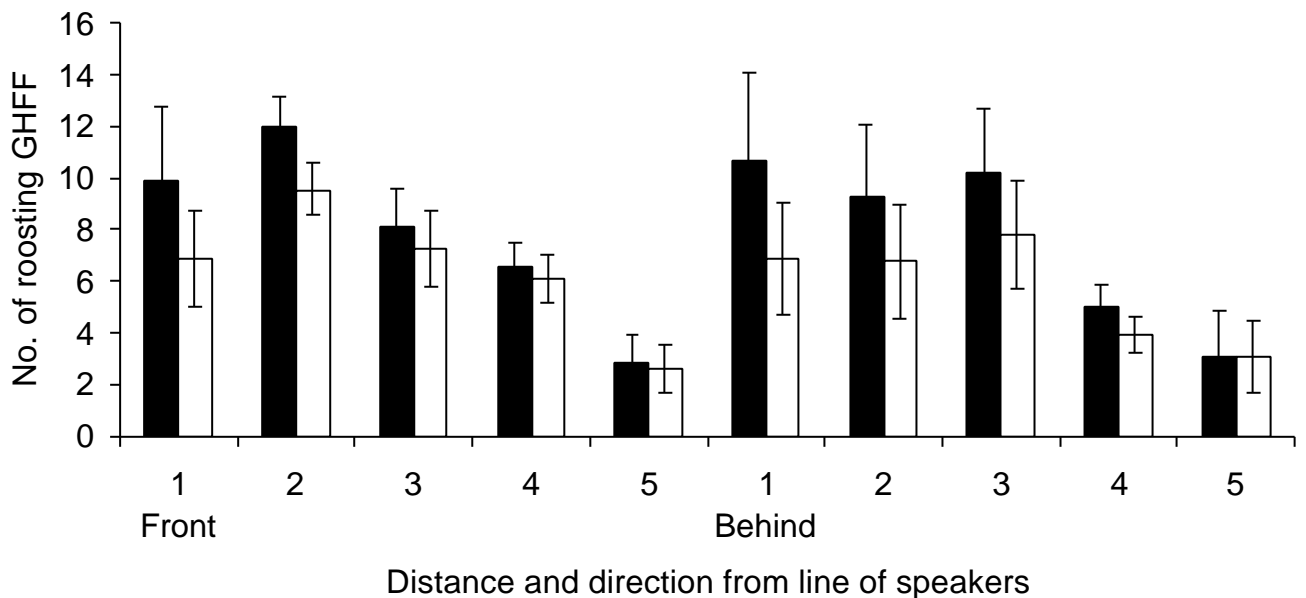
**Figure 3.** Mean number of GHFF roosting on palms located 10 – 20 m in front of (denoted by diamonds, n = 10 trees) and behind (squares, n = 11 trees) speakers in the fern gully, RBGM. Phoenix Wailer sound playback (denoted by S) commenced on day 9 and ceased on day 14. Trial commenced 13 December 2001.



**Figure 4.** Mean number of GHFF roosting on palms located 20 – 40 m in front of (denoted by diamonds, n = 15 trees) and behind (squares, n = 11 trees) speakers in the fern gully, RBGM. Phoenix Wailer sound playback (denoted by S) commenced on day 9 and ceased on day 14. Trial commenced 13 December 2001.



**Figure 5.** Mean number of GHFF roosting on trees located > 40 m in front of (denoted by diamonds, n = 8 trees) and behind (squares, n = 3 trees) speakers in the fern gully, RBGM. Phoenix Wailer sound playback (denoted by S) commenced on day 9 and ceased on day 14. Trial commenced 13 December 2001.



**Figure 6.** Mean number ( $\pm 1$  s.e.) of GHFF roosting in palms at each distance (1 = 0 – 5 m, 2 = 5 – 10 m, 3 = 10 – 20 m, 4 = 20 – 40 m, 5 > 40 m) and direction (North is in front of speakers, South is behind line of speakers) category before (solid bars) and during (open bars) Phoenix Wailer sound playback. Trials were undertaken at RBGM from 13 – 30 December 2001.

### **Characteristics of playback sounds**

The sounds tested in this trial were all relatively similar in frequency and shape. All sounds were in the frequency range of 0.26–3.20 kHz and each sound increased in frequency through the cycle (Table 2). For example, Sound 1 commenced at a frequency of 1.37 and increased to 2.92 kHz, with a rise time of 35–40 ms, which was repeated 26 times per second. The calls of GHFF used in this trial could not be analysed from the video footage due to a loss of sound quality.

**Table 2. Characteristics of sounds used in Phoenix Wailer sound playback trials at the RBGM, 13–30 December, 2001.**

Sound Number	Base frequency	Upper frequency	Rise time (ms)	Cycles per second
1	1.37	2.92	35–40	26
2	1.46	2.50	40–44	22–23
3	0.26	1.81	49–50	5
4	0.34	2.67	90–100	6
5	0.35	1.90	20–22	18
6	1.38	3.18	14–17	42
7	0.60	1.55	14–17	67
8	0.34	2.84	150–220	4

### **Behavioral response of GHFF to sounds**

During the playback of the Phoenix Wailer sounds on the first morning of treatment, GHFF did not appear to be distressed by any single sound or combination of sounds emitted from the speakers. Rather, they used the cable from which the speakers were suspended as an artificial roost to investigate the speakers at close range while sounds were playing. A small number of GHFF even suspended themselves from the speakers to investigate the source of the sound.

## DISCUSSION

The number of GHFF roosting in the Fern Gully at RBGM did not alter significantly during the trial of the Phoenix Wailer. The mean number of flying foxes roosting in palms within 10 m of the speakers appeared to be slightly reduced during the treatment phase, however the overlapping error bars indicate that this difference was not significant. The inquisitive or investigative behaviour of the flying foxes towards the speakers during playback suggests that they were not greatly disturbed by the types of sounds used. Nevertheless, the slight reduction in numbers of GHFF close to the speakers during playback may suggest that the noises were disturbing enough to move some individuals elsewhere. The increase in the number of flying-foxes roosting in the palms close to the speakers immediately after the six days of playback ceased, suggest that the dispersed animals did not travel far.

The use of multiple speakers in designing this deterrent system precluded the use of suitable controls within the confines of the Fern Gully camp making our results inconclusive. The total number of GHFF roosting in the RBGM (estimated from flyout counts; RBGM and NRE, unpub. data) increased from 5668 GHFF on 3 December 2001 to 10300 on 9 January 2002, a doubling of the population size. Therefore, the slight decrease in numbers of GHFF roosting in palms < 10 m from the speakers is most likely due to movement of individual GHFF around the camp, rather than a reduction in the total number of GHFF within the camp.

We were unable to test the relative merits of each individual sound because they were designed to play in combination with each other and could not be isolated, which was further hampered by not receiving information from the manufacturer about the characteristics of each sound played. Our post-trial analysis of the sounds indicated all sounds played were in the frequency range of 0.3–3.2 kHz, which is at and below the lower end of the hearing range of GHFF (2–54 kHz, Calford *et al.* 1985). Importantly, sounds 3, 5 and 7 are below the lower frequency limit of the GHFF, suggesting these sounds are unlikely to cause a response in GHFF. Furthermore, we were unable to determine if the sound pressure level of the Phoenix Wailer system at > 10 m from the speakers was adequate to disturb GHFF. Therefore, to determine if acoustic deterrents have a role in reducing the number of GHFF roosting in the RBGM, individual sounds need to be trialed. Future trials should focus on identifying which specific sounds cause a behavioural response in GHFF, such as increased alertness or flight. Distress calls of GHFF may be a useful deterrent because GHFF communicate vocally (Nelson 1964; Christesen and Nelson 2000) and animals may habituate to distress calls more slowly than artificial sounds (Bomford and O'Brien 1990). The characteristics of each sound (e.g. frequency, waveform and sound pressure level) must also be recorded to allow for the

characterisation of each sound and the creation of digital sounds. Future trials should also test the effectiveness of visual stimuli, which may include kites, pyrotechnics, or other stimuli at the canopy level.

## ACKNOWLEDGEMENTS

This is a publication from the Australian Research Centre for Urban Ecology, The Royal Botanic Gardens, Melbourne. Bill Johnston assisted with the construction and operation of the Phoenix Wailer. We thank staff at the RBGM for their assistance. Mark McDonnell and Phil Moors provided comments on an earlier draft. The use of auditory deterrents to reduce the number of GHFF in the RBGM was approved by the Department of Natural Resources and Environment (Wildlife Permit # 10001415).

## REFERENCES

- Bomford, M. and O'Brien, P. H. (1990). Sonic deterrents in animal damage control: a review of device tests and effectiveness. *Wildlife Society Bulletin*, **18**: 411-422.
- Calford, M. B., Wise, L. Z. and Pettigrew, J. D. (1985). Audiogram of the grey-headed flying-fox, *Pteropus poliocephalus* (Megachiroptera: Pteropodidae). *Australian Mammalogy*, **8**: 309-312.
- Christesen, L. S. and Nelson, J. (2000). Vocal communication in the Grey-headed Flying-fox *Pteropus poliocephalus* (Chiroptera: Pteropodidae). *Australian Zoologist*, **31**: 447-457.
- Haag-Wackernagel, D. (2000). Behavioural responses of the feral pigeon (Columbidae) to deterring systems. *Folia Zoologica*, **49**: 101-114.
- Jensen, T., Lampman, R., Slamecka, M. C. and Novak, R. J. (2000). Field efficacy of commercial antimosquito products in Illinois. *Journal of the American Mosquito Control Association*, **16**: 148-152.
- Menkhorst, P. M. and Dixon, J. M. (1985). Influxes of the grey-headed flying fox *Pteropus poliocephalus* (Chiroptera, Pteropodidae) to Victoria in 1981 and 1982. *Australian Mammalogy*, **8**: 117-121.
- Nelson, J. E. (1964). Vocal communication in Australian Flying Foxes. *Sonderdruck aus Zeitschrift fur Tierpsychologie*, **21**: 857-870.
- Seddon, G. (1997). *Landprints: reflections on place and landscape*. Cambridge University Press, Melbourne.