The development of strategies for management of the flying-fox colony at the Royal Botanic Gardens, Sydney

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ABSTRACT

This paper summarises 12 months of research at the Royal Botanic Gardens in Sydney to manage a permanent camp of Grey-headed Flying-foxes *Pteropus poliocephalus* that had encamped in an area of culturally significant trees. New and innovative methods came to light from these studies.

Numbers of flying-foxes vary at this site from 1000 - 6000, but data also show that there was always a core group that remained in the site. This indicated that deterrence methods should focus upon the location of the core group, but because the site is a traditional maternity camp, one constraint to testing methods of deterrence was the presence of non-flying young during summer.

Three methods were trialled, including sonic deterrence with a Phoenix Wailer (a crop protection system), olfactory deterrence with python excrement, and taste aversion with prawn paste. Trials with the Phoenix Bat Wailer (operating only from dawn for two hours) successfully removed flying-foxes from groups of heritage trees. Noise levels from the Phoenix Wailer were within the ambient range of the Sydney CBD. The fixation of males to territories on branches was a significant research outcome, and has led to new trials on branch removal as a method to relocate colonies.

Deterrence of bats roosting within isolated trees involved the use of python excrement and fermented prawn paste. Pythons, which reside in camps in the tropics, are a major predator of flying-foxes, and it was suspected that bats may keep their distance from pythons by olfactory cues. Python excrement that was wrapped in mesh and tied to branches used by dominant males was tested against controls with soil and leaves. The bags with the excrement initially created a buffer zone free of flying foxes, whereas the controls had no effect. However, as the aroma declined in intensity, the buffer zone reduced. This method was not pursued because of logistical issues, but it revealed the potential for further research into a synthetic compound that could be sprayed on tree branches.

Prawn paste, when sprayed by hand directly onto bats, had an immediate effect. Delivery of the prawn paste using a commercial irrigation system was then trialled in a single tree with excellent results, but required repetition through the day to keep trees completely free of bats. However, this trial has led to new research into automation methods.

Of relevance to the fruit industry as well as managers of flying-fox camps, is that (apart from the sonic deterrence) none of these new ideas would have been tested without the support of research funding that was specifically allocated to the problem.

Introduction

This paper summarises 12 months of research at the Royal Botanic Gardens in Sydney (RBG-S with my co-investigator Dr L.S. Hall (University of Queensland), and RBG-S staff. Their primary focus was the management of a permanent colony (camp) of Grey-headed Flying-foxes *Pteropus poliocephalus* that had encamped in an area of culturally significant trees. Many of these trees comprised the original plantings from the early 1800s and had a high heritage value. Their crowns had been damaged by the roosting bats (Figure 1).

Pages 196 - 201 in *Managing the Grey-headed Flying-fox as a Threatened Species in New South Wales*, edited by Peggy Eby and Daniel Lunney, 2002. Royal Zoological Society of New South Wales, Mosman NSW.

Figure 1: Tree crown damage from flying-foxes at the Royal Botanic Gardens, Sydney

The research accepted that it is almost impossible to totally remove the camp, so the concept was to instead attempt to reduce tree damage using crop control methods. Some control methods had a proven success record, whereas others were new and innovative applications of methods that had come to light from other research.

Of relevance to flying-fox management is that the new methods and research outcomes are an example of what can be achieved when scientists are provided with appropriate research funding. To date there has been very little financial input from people and organisations that are affected by these animals, and scientists have been expected to address problems within their own budgets. After much consultation with the scientific community, the RBG-S accepted that new funding and logistic support was required, and as a consequence new knowledge has been gained on the biology of the Grey-headed Flying-fox.

Background information

Numbers of flying foxes present in the RBG-S were monitored by staff over several years before this study commenced. Numbers varied from as high as 6000 to less than 1000 with no apparent relationship to time of the year (Figure 2). These fluctuations were attributed by staff and advisors to the flowering patterns in eucalypt forests throughout the east coast range of this species (Eby 1991, 1995; Eby and Palmer 1991; Eby *et al.* 1999; Richards 1995).

However, the data also showed that there was always a core group that remained in the RBG-S and presumably foraged within the Sydney urban area.

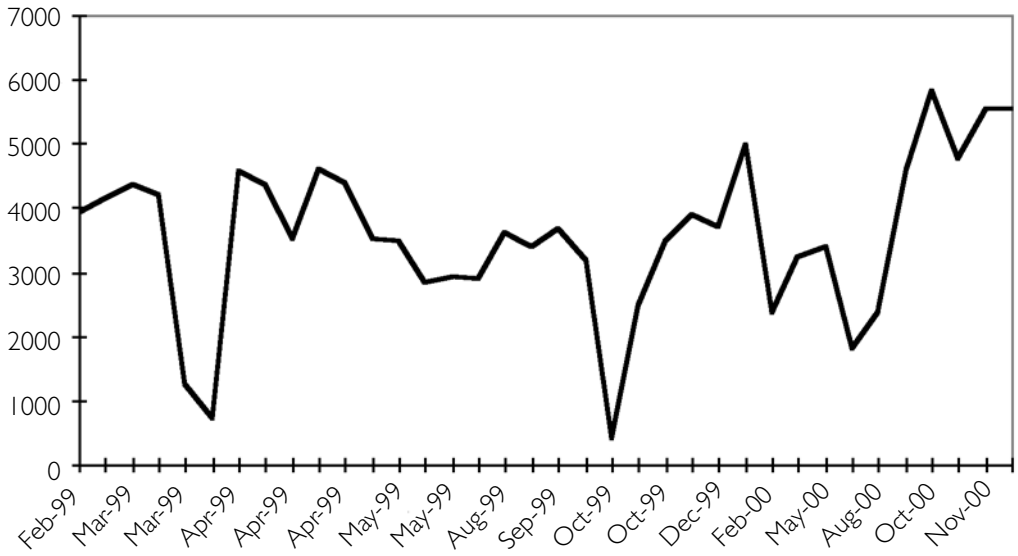

Figure 2: Fluctuations in numbers of flying-foxes in the Royal Botanic Gardens Sydney (RBG data)

This pattern – where a camp comprises a core group of residents as well as immigrants - has been shown in Grey-headed Flying-fox camps elsewhere (Eby 1991). This information indicated that deterrence methods could focus upon the location of the core group within the RBG. Because the site is a traditional maternity camp, other constraints to testing methods of deterrence included the presence of non-flying young during summer.

Plotting the distribution of the colony within the RBG-S showed that the core group occupied an area known as Palm Grove, a heritage area, with other areas having smaller groups of bats in individual trees.

Methods and results

Three methods were trialled during several visits in 2001. These were: sonic deterrence with the Phoenix Wailer', olfactory deterrence with python excrement, and taste aversion with prawn paste. Two of these methods had been successful elsewhere, and the other (python excrement) was an innovation that had been revealed serendipitously by a colleague.

The Phoenix Wailer is a computer-controlled sonic deterrent system that is used throughout the world to deter wildlife pests from crops, airports and oil spills. It comprises a master unit that drives four pairs of speakers, one of each pair is set at a distance and connected by cable. A variety of electronic sounds are played through a speaker pair for several seconds each time, with each pair being selected randomly. This creates a whirling effect of reverberating noises that and creates a 'discomfort zone'. Other 'natural' (that is, familiar) sounds (such as shotgun blasts and distress calls) are programmed to play at selected intervals after the discomfort zone has been created and the target animals presumably acquire a headache. The concept of the Phoenix Wailer system is gradual deterrence, rather than directly scaring the animals. The effects are very benign, and encourage animals to retreat to safer and more comfortable areas.

Sonic Deterrence

An area within the Palm Grove was selected for initial experiments with the Phoenix Bat Wailer, a system that I had developed for the deterrence of flying foxes in stonefruit orchards (Richards 1999).

A Phoenix Wailer system that had been programmed for deterring flying foxes from fruit crops was installed in a test area in Palm Grove. The master unit was positioned in the tree canopy , and four external speakers were positioned on trees at the corners of the test area, linked by cables to the master unit.

The Wailer was programmed to automatically operate from dawn for two hours. This time period was selected to target the flying-foxes as they returned from feeding, and before they had settled in their daytime positions. It was also the time of day when there was the least human visitation to the RBG-S. From the first day of this trial there was an immediate effect of the Phoenix Wailer, and large numbers of bats dispersed into other areas within the RBG-S, away from Palm Grove.

To address any concerns about the noise of the Phoenix Wailer, an Intertan' digital sound level meter was used around the site at 18 different locations during the January 2001 trial. Although the sonic deterrent system can be heard from ground level, it is high in the tree canopy so the peak sounds are well away from visitors, and did not appear to disturb visitors to the RBG-S. The highest sound recorded was 76 decibels in the test area, and ranged from 66 to 70 decibels elsewhere on the site. The ambient noise level at the site when the Wailer was not operating was around 65 decibels, and a passing truck and tractor was measured at 78 – 80. Sydney traffic noise on nearby roads ranged from 76 to 92 decibels.

The Phoenix Wailer can produce a variety of electronic sounds, as well as 'natural' sounds such as shotgun blasts and distress calls. It was concluded that shotgun blasts were inappropriate at canopy level, and the Wailer was consequently re-programmed to produce only electronic sounds.

The trial was conducted for nine consecutive days, and there was a reduction in numbers of roosting flying-foxes in the target area, in the order of 90% from the pre-deterrence count. The animals that remained in trees appeared to be dominant males that had established mating perches on branches. The potential to mate with females appeared to over-ride the intolerance for the Wailer sounds demonstrated by other bats.

The fixation of males to territories on branches was a significant research outcome, and has led to the proposal for new trials on branch removal as a method to relocate colonies in each tree to "safer" areas with trees less susceptible to damage.

Olfactory Deterrence

The management of the camp required the development of methods for flying fox deterrence in individual trees (as opposed to large areas of trees) so that the RBG-S had "micro-management" tools that can be used in tandem with the "macro-management" of large areas with the sonic deterrent systems.

One of the major predators of flying-foxes are large pythons that reside in camps. It was suspected that flying-foxes may have evolved to cohabit with this predator, that the smell of a python may be known to flying foxes, and that flying foxes would probably keep their distance by visual as well as olfactory cues. The potential for this behaviour to be applied in the conservation of culturally significant trees was tested using python excrement that was obtained from the Australian Reptile Centre, Canberra.

Two lots of python excrement were wrapped in nylon flyscreen mesh and were tied to branches used by dominant males in a *Flindersia schottiana*. These branches were covered with glandular secretions from male bats, and a number of dominant males were present. Two controls consisting of soil and leaves and contained in identical flyscreen mesh were tied to roost perches in a nearby *Nothofagus moorei*. Perches in the control tree were also occupied by dominant male and female Grey-headed Flying-foxes.

This brief trial showed an effect. At the control tree, all flying-foxes were in their usual locations on branches, apart from the absence of one dominant male whose perch was covered by the bag, and his female whose roost was approximately 0.3 m from the bag. However, a noticeable effect was observed at the test tree, and no flying foxes roosted within a 2-3 m radius from either of the two bags that contained the python excrement.

The test trees were checked after nine days of trial and still appeared to be somewhat effective, though the distance of flying-foxes from the bags appeared to have lessened to about 1.5 m. However, it was considered that this deterrent would be logistically undesirable, particularly in obtaining reasonable supplies of the olfactory deterrent, and the logistics of placing the bags in treetops. However, the results of this trial have been encouraging and could lead to the development of a synthetic compound and new methods of application.

Taste Aversion

During research in Borneo, co-investigator L.S. Hall learnt that Malay villagers used fermented prawn paste to deter fruit bats from rambutans. However, it was only effective if it was tasted or ingested by fruit bats, and it did not function as a repellant when applied directly to branches. This was confirmed during a trial in the RBG-S where paste was smeared during the night when flying foxes were absent, and it had no effect when the bats contacted it with their feet.

In another trial, the prawn paste was delivered with a hand-held spray directly to bats (Figure 3). It was expected that the target animals would lick the paste from their fur, discover its unpleasant taste and smell, and hopefully retreat away from their tree of occupancy. When the animals were sprayed, they immediately flew away to another tree and had not returned when the tree was checked later.

Figure 3: Co-investigator Leslie Hall operating the prawn paste hand delivery system

Delivery of the prawn paste using a commercial irrigation system was then trialled in a single tree with excellent results. A single sprinkler was operated for 5-10 minutes, and all resident bats departed as soon as the sprinkler was operated. However, while the sprinkler was not operating, after an hour or so a portion of the group returned to the test tree.

Repeated operation of the sprinkler immediately evicted all roosting animals each time, and less returned after cessation of spraying. This led to the conclusion, yet to be tested, that by using an electronic timer with the sprinkler system this method would have an excellent effect.

Discussion

Future management of the Grey-headed Flying-fox camp at the RBG-S will now receive better direction when several of the methods trialled are used on a broader scale. Of pressing relevance to the fruit industry as well as managers of flying-fox camps, is that (apart from the sonic deterrence) none of these new ideas would have been tested without the support of research funding that was specifically allocated to the problem. To my knowledge, there has been very little financial input from to fruit-growing industry to research the problems that exist through the depredations of flying foxes on crops. Considering the high financial losses in this industry, this is a situation that is difficult to understand.

The RBG-S not only supported the project financially, but provided staff and logistics to enable these studies to be conducted efficiently. A prime example of the logistic support is that, for the first time, we were able to study the tree canopy of a colony site with the RBG-S vehicle-mounted cherry picker. This opened up a new world where we were able to examine closely the male territorial sites, which are the basis of social groups that are now known to exist in flying-fox camps (P. Eby, pers. comm. 2001), many of which appear to be centred upon dominant males.

Conclusions

The research project at the Royal Botanic Gardens in Sydney not only allowed the application of deterrence methods used in agricultural situations to be tested at a site where flying-foxes had been present for many years, but produced new biological knowledge of these animals. The new information was applied to the problem, creating innovative methods that showed promise for future management of flying-fox camps.

The potential resolution of a particular problem was possible by the provision of funding to experienced wildlife scientists. It can be concluded from this outcome that the resolution of flying-fox problems in fruit growing areas, that fit the economics of orchardists, will not be forthcoming until substantial research funds are allocated for both short-term projects such as at the RBG-S, and long-term projects such as PhD studies. In this day and age, no industry can expect its problems to be resolved by individuals, universities, or government agencies such as CSIRO, unless there is some financial input from the industry itself.

Acknowledgements

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Footnote: Since the preparation of this paper, several other trials have been carried out. These trials indicated that the use of the sonic deterrent method should be restricted to seasons when maximum effect can be achieved, and not in the mating and birthing season. (G R June2002)

SANDY TEAGLE: Thanks very much Greg.

JOHN ROGERS: Greg, I will address this question to you, but also to the National Parks and Wildlife Service representatives here. I am intrigued that you found the wailer successful. My understanding was the National Parks and Wildlife Service, at the request of the then minister for the environment Pam Allen, had tested the wailer in, I think, 1999 and found it to be unsuccessful in keeping flying foxes out of orchards. Can you comment on that?

GREG RICHARDS: She ran some trials up at Richmond, it is probably best for others to comment. I don't want sound like a salesman, but it works terrifically in stone fruit, apples and other open foliage crops. When the foliage density increases, the sound reverberation reduces and it has little effect. So when it comes to lychees, there is a lot more research needed. But as a general pest deterrent system, it is currently protecting $6 million Black Hawk helicopters at the Defence Department base, vineyards are using it, but I don't want to pursue it that much further, because I don't want to sound like a salesman, which has been the main problem in the past.

DIANNE MACKEY (National Parks): The secretions that the males were putting on the branches from their glands, was I correct in understanding you to say that that was actually causing the death of those branches?

GREG RICHARDS: We think that is the main reason for damage. We asked the question: why don't the leaves grow back again on some of those branches? There are just these sticks in the air all the time. So, we think they are being maintained. As Peggy's data are showing, the same male comes back to his own spot and he stays there throughout the duration of occupation. We are wondering whether that is happening year after year throughout their adult lifetime; or, from the social structure of the camp, do you advance from a crappy branch up to one of these primary spots to attract the females.

SANDY TEAGLE: I'm sorry, no time for more questions, thank you Greg.