Micro Bat (Microchiroptera) Survey of Kinnairds Wetlands

A report to Kinnairds Wetland Advisory Committee for Moira Shire Council

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Summary

In February 2009, the Australian Research Centre for Urban Ecology was commissioned by Moira Shire Council to undertake a survey of the insectivorous bat species (*Microchiroptera*) present at Kinnairds Wetlands, Numurkah, Victoria. On each of the three nights surveyed, harp traps were positioned in potential flight paths along tracks or watercourses to catch passing bats. Bat trapping was augmented with acoustic monitoring of the high frequency echolocation calls emitted by bats in flight. This combination of survey techniques was employed to ensure a comprehensive species list as each technique alone is subject to its own inherent biases.

During the survey ten species of micro bat were recorded, including almost all bats species that we would have expected to find in this part of Victoria. The only species not found to be present being the Large Forest Bat *Vespadelus darlingtonii*, though our failure to detect this species was likely due to the brevity of the survey. The greatest abundance and diversity of bats was found in along old road reserves where high numbers of large old River Red Gum *(Eucalyptus camaldulensis)* were found.

The mixture of habitats at Kinnairds Wetland reserve, which along with the Red Gum road reserves includes areas of dense regenerating Red Gum, open grassland and wetland in juxtaposition with one another, is cause for the high species diversity recorded during such a brief survey time over so small an area (approximately 70 ha). This survey highlights the importance of maintaining native remnant vegetation, particularly old road reserves, for bats in highly modified agricultural landscapes, and the regional importance of Kinnairds

Wetland site for insectivorous bat species. Management of Kinnairds Wetlands reserve should aim to preserve large old gum trees where present to protect crucial bat roosting structures, particularly along old road reserves. In addition, increasing habitat heterogeneity and patchiness by encouraging the species and structural diversity of native understory vegetation throughout the site will increase invertebrate diversity and improve foraging habitat for bats.

Introduction

More than one fifth of mammalian species belong to the order *Chiroptera*, meaning that bats are major contributors to global mammalian biodiversity (Mickleburgh et al. 2002). Of approximately 1000 species of bat found worldwide across two suborders - the *Megachiroptera* and *Microchiroptera* - 239 are listed as threatened (Jones et al. 2003). Insectivorous *Microchiroptera* (microbats) are dependent on two habitat components for their survival: roost sites and foraging sites. The greatest threats to bat conservation are associated with the modification of these habitat components within increasingly human-altered landscapes (Racey & Entwhistle 2003). Whilst some species are more generalist in their life requirements and therefore better able to adapt to human-dominated surroundings, those with more specialist requirements face the greatest local and global extinction risks (Jones et al. 2003). The loss or reduction in quality of foraging habitat and its fragmentation is a major threat to bat populations (Walsh & Harris 1996, Gerrel & Lundberg 1993). In addition, the use of agricultural pesticides not only results in a reduction of insect numbers, but toxins can accumulate when ingested with prey causing heavy bat mortality (Jeffries 1972; Dunsmore et al. 1974; Geluso et al. 1976, 1979). Maternal roost sites are a key habitat requirement for many species, and therefore may be a limiting resource in highly modified habitats; as most species require large old trees with hollows in which to breed, there is usually higher species diversity in regions with remnant native vegetation (Lumsden 2004).

Kinnairds Wetland is located near the eastern edge of Numurkah township. It is in a natural prior stream depression abutting the northern side of Broken Creek. The predominate over-storey species is River Red Gum (*Eucalyptus calmaldulensis*) with a variety of age classes and structures ranging from areas of mature open woodland through to forests of young trees. There are 20 species of insectivorous bats present in Victoria, twelve of which are found within the Shire of Moira according to Atlas of Victorian Wildlife records (DSE, 2008). Given the largely agriculture-dominated nature of the surrounding landscape, areas such as the Kinnairds Wetland reserve contain significant remnants of comparatively intact native vegetation and a diversity of habitat types including wetland, native grassland, forest and old road reserves. It is therefore highly likely that such areas provide regionally important roosting and foraging opportunities for bats.
The objectives of this survey were to identify as far as possible, all bat species present within the Kinnairds Wetland reserve area to provide baseline data on species compositions, highlight areas of particular importance for local bat species and guide management actions which aid bat conservation. The rationale for the survey is identified by actions in the Kinnairds Wetland Enviromental Management Plan and Monitoring Plan.

Survey Methodology

Due to their small body size, nocturnal habits and highly mobile nature, insectivorous bats are notoriously difficult to survey. Therefore three survey methods were employed over three consecutive site visits to meet the objectives of the study. The initial visit was carried out on Friday 20th February 2009 and subsequent visits occurred on the following two nights.

There are two general techniques used to survey insectivorous bats, trapping and ultrasonic detection, each with their own particular biases. Trapping enables positive identification of individuals and allows the collection of data on the abundance, age, sex, reproductive condition and morphometrics of individuals. However, the efficiency of this technique is affected by the structure of the vegetation surrounding traps; open vegetation has less defined flight paths with which to funnel the bats into a trap then dense vegetation, meaning trapping is often a less successful survey method in open habitats (Lumsden & Chick 1999). Biases also relate to the trapability of species because of their behaviour in flight; species that fly slowly, close to the ground and in dense vegetation (e.g. the long-eared bats *Nyctophilus* spp.) are readily caught; whilst species that fly high above the canopy or in open spaces (e.g. the white-striped freetail bat *Tadarida australis*) are rarely caught (Lumsden & Chick 1999, Hourigan et al. 2008).

Identifying bats by the ultrasonic echolocation calls they emit in flight enables species to be recorded without the need for trapping and so this method is useful for detecting species that are not readily trapped. However, identification of species from their calls can be problematic due to overlaps in the call characteristics of several species, and because some species display regional variation in their calls. Acoustic surveying can also only be used to determine species presence, and cannot be used to infer bat abundance, unlike trapping. A further complication with this method is that some microbat species have very faint calls that will only be picked up when close to the detector. When this factor is combined with a reduction in the detection range of acoustic devices caused by dense vegetation, it means acoustic surveys are often biased towards the detection of species with higher intensity calls (Duffy et al. 2000), which tend to be fast-flying bats characteristic of open landscapes.

Acoustic detectors can be used in two ways; 'passive' monitoring involves securing a detector in a location for time periods generally extending from one to several full nights. Bat calls are recorded automatically meaning that several detectors can be used to record simultaneously for long periods without an observer being present. As detectors are static however, they can only record calls from bats as they pass the unit and so are prone to picking up only fragments of calls which may not be identifiable. 'Active' monitoring involves an observer with a handheld detector who is able to follow the flight path of bats and therefore is more effective at recording calls of better quality for identification. The cost to the increased benefit of active monitoring is that an observer needs to be present at all times, therefore limiting the number of simultaneous applications possible in one night, and incurring greater costs in terms of man-hours (Milne et al. 2004).

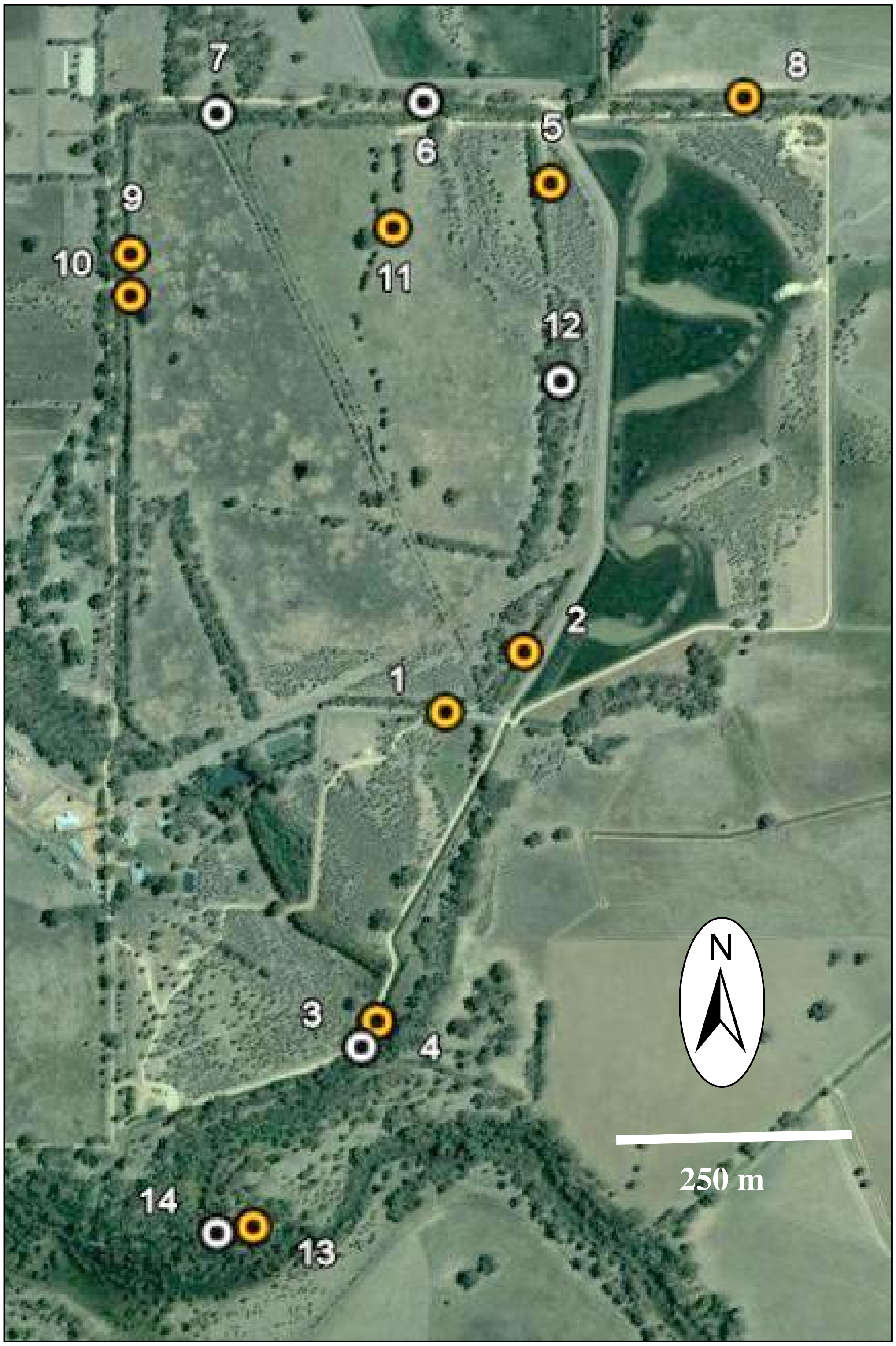
Owing to the respective biases of the two techniques (trapping and detectors) different species groups are often recorded. However, when used in conjunction they compliment each other to provide thorough species compositions, hence our use of both methods in the Kinnairds survey.

Harp Trapping

Multiple harp traps (Austbat, Lower Plenty, Vic) were set at various locations around the Kinnairds wetland site in potential flight paths along roads, tracks and creek-lines on each of the three nights surveyed (Fig. 1). Two traps were set on the first night (20th February 2009), and six traps were set on each subsequent night (21st & 22nd February 2009). Traps were set across a range of available habitats including riparian, grassland, regenerating forest, and old road reserve. Harp traps consist of a large aluminium frame with two banks of fine fishing line strung vertically. The fishing lines are too fine to be detected by passing bats and due to the position of traps across bat flight paths, bats fly into the lines and fall down into a holding bag below where they remain unharmed until removed. All traps were set before dusk and checked before dawn the following day. Any captured bats were removed from traps and held during the day so that data could be collected (species, sex, age, reproductive condition, forearm length and weight) before being released the following night at dusk.

Acoustic Detection

Active acoustic monitoring was conducted for one hour per night on each of the three site visits by an observer using a handheld AnaBat SD1 ultrasonic bat detector (Titley Electronics, Ballina, NSW) linked to a PDA unit on which calls were recorded using AnaPocket software. Whilst actively monitoring bat calls, the observer walked a predetermined transect around the site, pausing briefly to record bat activity where found. Transects followed the main roadways through the site and were planned to ensure that all roads on the entire site were walked at least once over the two nights. Passive acoustic monitoring was employed on the second and third nights of surveying (21st & 22nd February 2009). Each night



Fugure 1: Aerial photograph of Kinnairds wetlands showing locations of harp trapping sites © DigitalGlobe 2009. Trap sites coloured orange had bat captures, whereas those coloured white were unsuccessful. Trap numbers refer to trapping results presented in Table 1.

three static detectors were set up to record bat calls passively for an entire night from dusk until dawn. Detectors were located next to harp traps (trap numbers 4, 5, 9 on the first night; 11, 12, 13 on the second), but angled so that they did not pick up the calls from any trapped bats. Detector microphones were raised to a height of 1m and angled at 45˚ from the ground, oriented along bat flight paths. Recorded calls were identified to species where possible by comparison of call characteristics to those of reference calls collected within northern Victoria (L. Lumsden, *unpublished data*) using AnaScheme software (Gibson & Lumsden 2003).

Climatic Conditions

Climatic conditions can affect bat activity, trapability and detectability, therefore to account for any anomalous trapping or detector results, weather data were collected for each night of the survey using temperature and relative humidity data loggers (HOBO Pro V2 data logger, Onset Computer Corporation, Pocasset, MA, USA) placed at sites where both harp traps and detectors were set up.

Results

Number & species of bats from trapping

In total, fifty-seven individuals from nine species were trapped during fourteen trapnights (Table 1). The species composition from trapping (Fig. 2) shows that Gould's wattled bat *Chalinobus gouldii* (Fig. 3) were the most frequently captured bats, followed by the Eastern broadnose bat *Scotorepans balstoni* (Fig. 4) and bats of the Mormopterus genus (Fig. 5). Each of these species are characterised by

Table 1: Number of each species caught in harp traps during 14 trap nights. Traps 1 and 2 were set on 20th Feb. 2009, traps 3 to 8 were set on21st Feb. 2009, and traps 9 to 14 were set on 22nd Feb. 2009.

		Trap Number														
Common Name	**Scientific Name**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**Total**
Gould's Wattled Bat	*Chalinobus gouldii*	1			2				2	7		1				13
Chocolate Wattled Bat	*Chalinobus morio*		1						4							5
Freetail Bat (eastern form)	*Mormopterus sp. 1*								1	4	2					7
Southern Freetail Bat (long penis)	*Mormopterus sp. 4*								3							3
Lesser Long Eared Bat	*Nyctophilus geoffroyi*				1	4				1		1				7
Gould's Long Eared Bat	*Nyctophilus gouldi*		1													1
Inland Broadnose Bat	*Scotorepans balstoni*								1	8		1				10
Southern Forest Bat	*Vespadelus regulus*								3					1		4
Little Forest Bat	*Vespadelus vulturnus*	1	3						1	1	1					7
Number of individual bats trapped		2	5		3	4			15	21	3	3		1		57
Number of bat species trapped		2	3		2	1			7	5	2	3		1		9

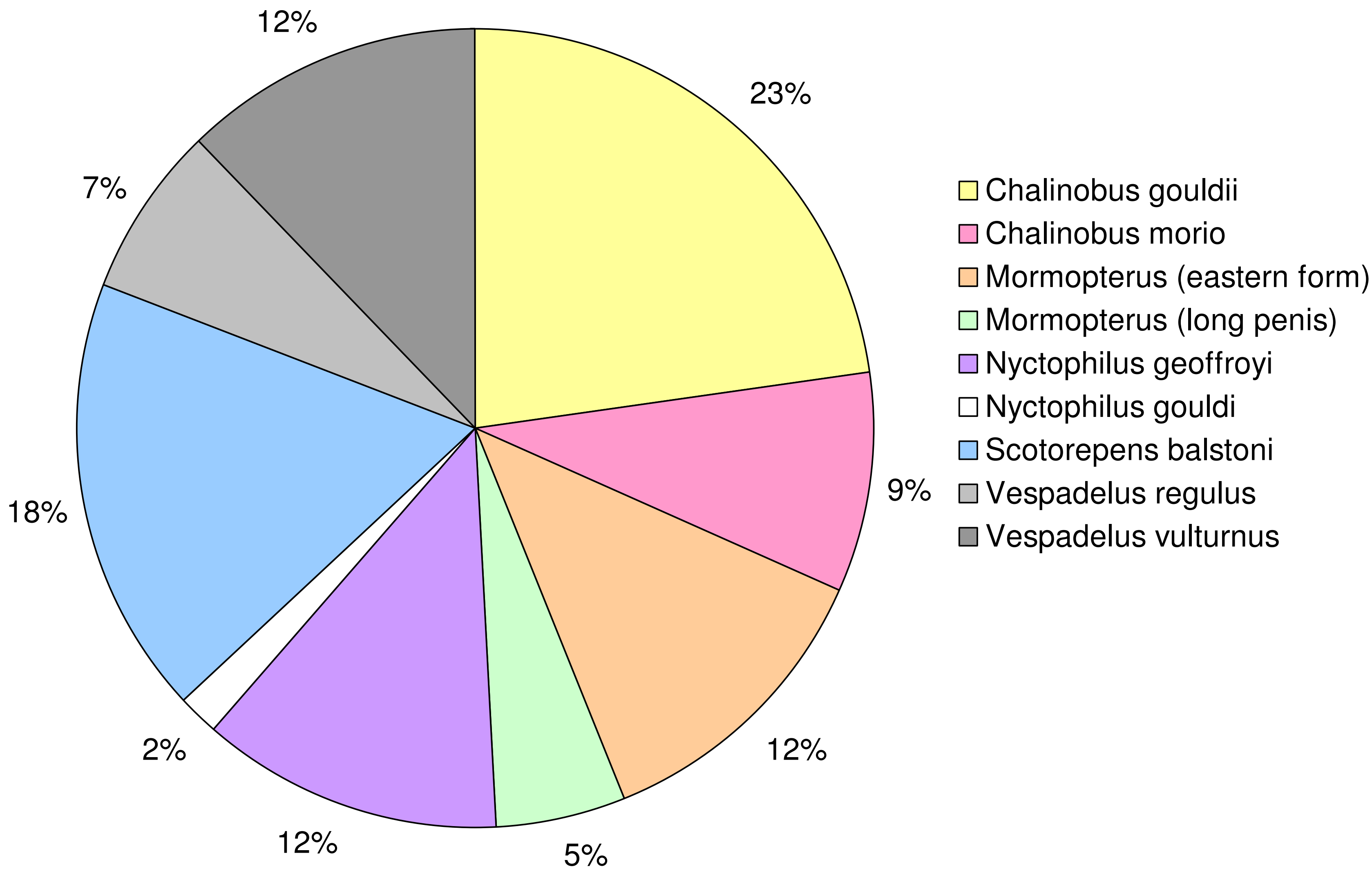


Figure 2: The composition of bats species captured during three nights trapping. Total captures = 57.


Figure 3: *Chalinobus gouldii*. Photo F. Caryl


Figure 4: *Scotorepans balstoni*. Photo L. Evans


Figure 5: *Mormopterus* sp. Photo L. Evans


Figure 6: *Nyctophilus gouldi*. Photo L. Evans

fast-flight over open spaces where they aerially hawk for prey. These species were predominantly located along old road reserves to the north and west of the site where a combination of old growth river-red gums in proximity to an ecotone with open grassland provides ideal roost locations as well as suitable foraging habitat. Indeed, the greatest diversity of bats was located in these road reserves. Both the greatest number of species and abundances of captures were obtained from traps 8 and 9 which followed the line of the old road reserve (see Fig. 1). A single individual of the Gould's long-eared bat *Nyctophilus gouldi* was recorded (Fig. 6). This species is a habitat specialist of cluttered dense vegetation, which hovers and gleans its prey from vegetative surfaces rather than taking prey in aerial pursuit. High numbers of the closely related Lesser long-eared bat *N. geoffroyi* were obtained throughout the site, but particularly at trap 5 where there was a dense avenue of young re-growth.

The vast majority (79%) of bats trapped were males. Of the females, five showed signs of lactating or recently lactating. Microbats in Victoria will usually give birth in December, and lactation continues for 6-8 weeks before young are independent. During this time the females leave young in the roost whilst foraging, and return several times during the night to feed them (Lumsden & Chick 1998).

Species recorded using acoustic detectors

Acoustic monitoring added only a single species to the species list for the site; demonstrating that though they weren't captured in traps, white-striped freetail bats were also present on the site. These bats were particularly active along "Red Gum Walk" towards the north of the site where they were heard during active monitoring flying high above the canopy of the trees as is typical of their behaviour. Active monitoring demonstrated that there was a high level of feeding activity from Gould's wattled bats near traps 3 and 4, which were located along the creek line at the southern end of the site. It was surprising that more bats were not caught in these two traps given the level of activity observed, which highlights the difficulty in placing successful traps where vegetation density lessens and habitats open out.

Climatic Conditions

Data from temperature and relative humidity loggers showed that there were no large discrepancies between weather conditions found on each of the three nights surveyed (Table 2); each night was warm with clear skies, no precipitation and light to moderate breezes.

Table 2: Mean, minimum and maximum temperature (TEMP) and relative humidity (RH) recorded every 15 minutes during the hours of bat survey between dusk (at c. 7.30 pm) and dawn (at c. 7.30 am) on each night surveyed.

	20-Feb-09		21-Feb-09		22-Feb-09	
	TEMP (°)	RH (%)	TEMP (°)	RH (%)	TEMP (°)	RH (%)
MIN	15.7	49.9	13.5	38.6	11.5	22.0
MAX	31.1	52.9	27.9	87.4	36.9	74.9
MEAN	22.8	51.3	17.9	69.6	18.2	51.7

Discussion

During the survey at Kinnairds Wetlands, Numurkah, ten species of microbat were recorded, including almost all bats species that we would have expected to find in this area based on expert opinion (*L. Lumsden personal communication*) and Atlas data; the only exception being Large forest bats *Vespadelus darlingtonii*, which we did not find to be present. Our failure to detect this species does not mean that the species is absent, only that we were not able to record it given the brevity of our survey.

The most frequently occurring species were *C. gouldii*, which formed almost a quarter of bats trapped. This species is physically adapted to fast efficient flight and is therefore capable of dispersing wide distances. As such, it is often found in highly fragmented landscapes. Other commonly captured species in our survey were those with similar foraging and flight behaviours to *C. goudlii*, such as *S. balstoni* and *Mormopterus* spp., reflecting that the surrounding landscape is highly fragmented with respect to forested habitat. These species are less prone to being captured in traps, so the high trapping success rate demonstrates that high numbers of bats are using Kinnairds for both roosting and foraging. Also present in high numbers were species associated with more densely vegetated habitats, such as *N. geoffroyi* and the *Vespadelid* bats. Harp traps are usually successful at recording these species which fly slowly and close to the ground. The least frequently occurring species, *N. gouldi*, is one of the microbats species of greatest conservation interest. This species is becoming increasingly rare across Victoria, particularly in human-altered and fragmented landscapes. A recent study into the likelihood of mammalian species going extinct around Melbourne predicted that this was one of the most at threat microbats (van der Ree & McCarthy 2005).

Why *N. gouldi* is doing so unsuccessfully while the closely-related and morphologically similar *N. geoffroyi* is seemingly abundant remains unclear, but the former seems particularly unable to disperse long distances away from native habitat. Any form of management which preserves and enhances connectivity between remnant patches of vegetation will therefore benefit this species.

The fact that there is a mixture of habitats, including old river red gums, dense regenerating red gum, open grassland and wetland, in juxtaposition with one another at the Kinnairds site is cause for such a comprehensive species list in such a brief survey time over so small an area. We recommend that efforts be made to retain as many large old river red gums as possible, particularly those with 'spouts' (hollowed dead branches) which serve as prime roost locations (Lumsden & Chick 1998). Some species, such as *N. geoffroyi*, prefer roosting in dead trees rather than live trees, so retention of standing deadwood is crucial. Many microbat species alternate roosts, shifting between multiple roost sites every few days, therefore need multiple suitable roost trees. Finally, encouraging understory diversity will increase invertebrate diversity which will improve foraging habitat for bats. Habitat heterogeneity and patchiness increases the diversity of the prey base, providing food sources for different bat species.

Management Recommendations

- Retain large, old river red gums, particularly those along old road reserves which create natural bat flyways.
- Retain any standing dead trees, and also any hollowed 'spouts' on live trees.
- Encourage understory diversity to increase insect diversity and biomass.
- Maintain a mosaic of habitat patches from dense re-growth, open grassland and old, large trees to provide habitat for multiple species.

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