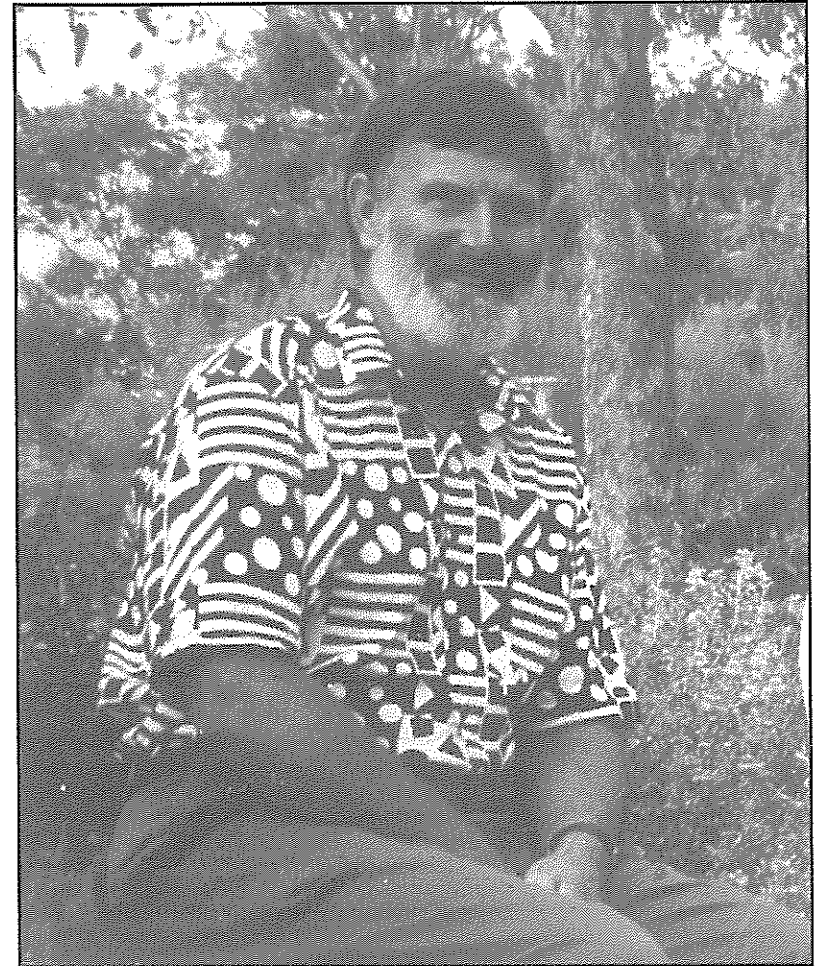


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Initial Results from Bat Roosting Boxes at Organ Pipes National Park

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Background

The Organ Pipes National Park is located 26 km NW of Melbourne. The park is a spectacular example of restoration of natural vegetation, begun in 1972, that has rehabilitated a barren and weed-infested landscape (Kemp and Irvine 1993). The Friends Of Organ Pipes (FOOP) are involved in this revegetation effort and also in encouraging animals back into this regenerated environment.

Early mammal survey

In February 1988, Ray Brereton and Martin Schulz of the Arthur Rylah Institute (Department of Conservation and Natural Resources - DCNR) conducted a mammal survey at the Organ Pipes National Park and reported that bats were the most diverse group of native mammals occurring in the park (Schulz and Brereton 1988). Brereton and Schulz set up harp traps over Jacksons Creek and over three nights they trapped a total of 53 individual bats consisting of six species: Gould's Wattled Bat, Chocolate Wattled Bat, Lesser Long-eared Bat, Large Forest Bat, Southern Forest Bat and Little Forest Bat (Table 1). An additional species, the White-striped Freetail-bat, was recorded in flight by spotlight.

One of their recommendations was that 'To encourage bats further into the area, the possibility of setting up 'bat roost boxes' should be investigated. These have been used with great success in Europe' (Schulz and Brereton 1988).

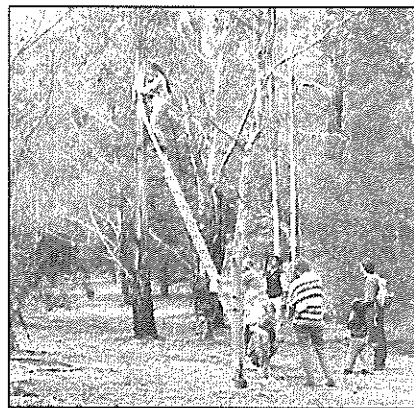
The FOOP decided to follow up these recommendations with a project to build and install roost boxes, then undertake a monitoring program. The project started with an invitation to Ms Lindy Lumsden, also of Arthur Rylah Institute, assisted by other DCNR staff, to do some bat-trapping in the

park. This helped us decide where the roosting boxes would be located.

Trapping was conducted on 3 April 1992 using two harp traps set up along the river track in the area where we proposed to locate the boxes. A total of 23 individuals from four species (Gould's Wattled Bat, Chocolate Wattled Bat, Large Forest Bat and Little Forest Bat) were caught, identified, measured, sexed, weighed and released (see Table 1).

The White-striped Freetail-bat usually forages above the canopy and well above the height of the harp trap, hence they are rarely trapped, but may use the roosting boxes.

Although it is difficult to estimate overall bat numbers from trapping data, it provided an indication of the range of species found in the area. Following the success of this second trapping session it was decided that this part of the river flat would be a good place to locate the roosting boxes. The FOOP successfully applied for a Bird Observers Club of Australia grant to construct ten roosting boxes. The timber used was *Pinus radiata*, which has weathered remarkably well over three years. The rear plate of the box



Habitat and bat roosting box location along river track.

Table 1. Bat species and numbers trapped at OPNP.

Species	Common name	Sex	23/2/88	24/2/88	25/2/88	3/4/92	Total
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	M	1			1	2
		F	1				1
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	M	3	4		1	8
		F	5	1		1	7
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	M		1			1
		F		1			1
<i>Vespadelus darlingtoni</i>	Large Forest Bat	M	3	3		1	7
		F	2	1		3	6
<i>Vespadelus regulus</i>	Southern Forest Bat	M		1			1
		F	1	1			2
<i>Vespadelus vulturnus</i>	Little Forest Bat	M	6	6	1	5	18
		F	6	5		3	14
<i>Tadarida australis</i>	White-striped Mastiff Bat						Spotlit in flight only

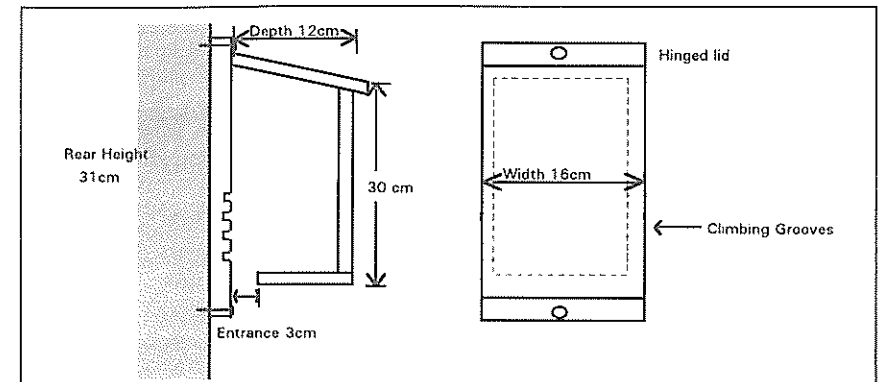


Fig. 1. Dimensions of Bat roosting boxes.

extended above and below the box structure, and was nailed to the tree trunk at both ends (Fig. 1 and Llewellyn 1988).

Bat roosting box design

The species of bats caught in OPNP predominantly roost in tree hollows or behind loose bark (Schulz and Brereton 1988). The optimum roosting box simulates these kinds of roosting sites. As there was no published research on roosting boxes in Australia, overseas research was used to determine the size and design of the boxes. We selected a design (Fig. 1) based on successful European Bat box similar to our bird boxes but without a base or round entry hole at the front. This

design was to make the box dark and to enable bats to enter from below. A series of grooves was machined on the inner surface of the rear plate to make it easier for the bats to climb and cling to the boxes. It was hoped the design would also restrict use of the boxes to bats, as it was believed that other arboreal animals such as possums and birds preferred a side entry, as used on nesting boxes for birds and Sugar Gliders also set up along the creek in the National Park.

Box Location

A range of factors was taken into consideration in deciding on the placement of the roosting boxes. Trapping had shown several

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species were using the forested area by Jacksons Creek (Table 1). It was decided to place boxes about 5 metres above ground, in trees free from crowding branches, sheltered from wind and with a variety of aspects to cater for seasonal temperature variation. Ten boxes were installed in trees on 3 April 1992 in the locations shown (Fig. 2 and Table 2).

Monitoring Inspections, Don't give up hope!

Inspections were conducted in November 1992 and July, October and November 1994. Until the last inspection in November, no bats were found to have been using any of

the boxes and we had come to believe the boxes were unsuccessful, for causes unknown. Possible explanations considered were that the designs were unattractive to bats, box locations were poorly chosen, and the abundant presence of natural hollows were chosen by bats in preference to our artificial boxes.

FOOP were also surprised to find that a number of the roosting boxes had been used by Sugar Gliders *Petaurus breviceps* as shown by the worn entrance where Gliders had squeezed through the narrow slit. Published illustrations of bat roost box designs (e.g. Llewellyn 1988) recommended a

slit dimension of 15 to 20 mm, but we had used 30 mm, apparently allowing larger animals to enter. Two bat roosting boxes contained nests made of eucalypt leaves woven into a hollow ball that is typical of glider nests (Triggs 1984). In the three years before the bat roost boxes were installed, a program of Sugar Glider releases had taken place - 37 Gliders in total; 13 in February 1989, 6 in March 1990, and 18 in April 1990 (FOOP 1989, 1990a, 1990b).

The specifically designed boxes installed for these gliders, were mainly hollow logs with both ends bunged up and a round side entrance which was drilled through the timber. Sugar Glider use of the bat roosting boxes with the narrow slit underneath was unexpected. During 1994, a research project had commenced on social inter-action among Sugar Gliders, some of which were known to be nesting in the bat roosting boxes. The researcher had placed wooden pegs just below the entrance to some bat boxes, for attachment of sensing apparatus to detect glider movements into and out of the nest boxes.

The biggest surprise came on 19 November 1994 when, preparing to remove and relocate the boxes, we found a total of 34 bats (species were not identified) using 5 boxes

in what appeared to be a random mix of aspect, location and tree species (Table 3). In box C5 bats were roosting above the old nesting material of Sugar Gliders which was filling the entrance slit. Bat droppings were found in one additional box.

According to recently released research from North America (Tuttle and Hensley 1993) roosting boxes are normally used in the first season and, if not used within two years, will probably not be used at all. Until the November 1994 inspection, we felt justified in deciding that the boxes would never be used.

Why the slow results?

It may be that the bats were roosting, over winter, in more secure locations in tree hollows and had become more active as the weather warmed up and a plentiful supply of insects appeared, late in spring. The boxes may be too cold during winter, as is suggested by the research of Tuttle and Hensley (1993) in the USA where inland winters are generally harsher than in southern Australia. This emphasises the importance of roost sites being exposed to at least four hours of full sun during winter. All boxes at OPNP are in a densely wooded area, which is un-

Table 2. Box Installation notes and location details.

Box no	Height (metres)	Tree species	Aspect	Sun/ Shade	Comments
C1	4.5	Manna Gum <i>Eucalyptus viminalis</i>	N	Partial sun	Surrounded by trees
C2	4	Yellow Box <i>Eucalyptus melliodora</i>	SE	Shaded	Hillside close to large open area, Ridge Track
C3	4.5	River Red Gum <i>Eucalyptus camaldulensis</i>	N	Sun/ Shaded	Surrounded by trees
C4	4.5	River Red Gum	S		Surrounded by trees
C5	4.5	Manna Gum	SE	Shaded	Surrounded by trees
C6	6	River Red Gum	W	Shaded	Surrounded by trees
C7	4.5	River Red Gum	NE	Shaded	Surrounded by trees
C8	6	River Red Gum	NW	Sun/ Shaded	Near creek, surrounded by trees
C9	4.5	River Red Gum	SE	Shaded	Surrounded by trees
C10	4	River Red Gum	NW	Shaded	Overhanging creek

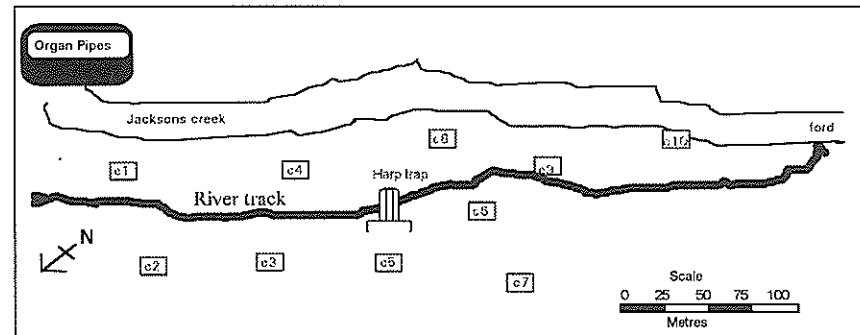


Fig. 2. Location of Bat boxes.

Table 3. Box Inspection results (boxes installed 3/4/92)

CG = *Chalinolobus gouldii*. material = material for Sugar Glider nest (Eucalypt leaves). rt = radio detector indicating tagged Sugar Glider inside. s/glider = Sugar Glider (number in box). worn = entrance slit worn by glider.

Box no.	7 Nov 1992	23 July 1994	8 Oct 1994	29 Oct 1994	19 Nov 1994	22 Dec 1994	25 Feb 1995
C1	empty	material, fresh nest	material	no inspect.	2 s/gliders, large nest	material	material, some ants
C2	empty	empty	worn	no inspect.	worn, bat droppings	worn, 2 bats CG	1 s/glider, nest
C3	empty	empty	empty	7 bats	2 bats, worn	1 s/glider	18 bats CG
C4	empty	empty	empty	no inspect.	material, fresh leaves	empty	2 bats CG
C5	empty	material, rt	material	no inspect.	2 bats, material	2 bats CG material	empty
C6	empty	empty	empty	no inspect.	10 bats	empty	1 s/glider
C7	empty	empty	empty	no inspect.	7 bats	bat droppings	empty
C8	empty	empty	empty	no inspect.	worn, Ant nest	Ant nest	Ant nest
C9	empty	empty	empty	no inspect.	13 bats	1 s/glider	2s/gliders
C10	empty	material, 1 s/glider	material	no inspect.	1 s/glider	material	material, 1 s/glider

likely to provide this source of winter warmth for a sufficient period each day. We just do not know why it took two and a half years for bats to show signs of using our roost boxes.

All four bats found in the boxes in December 1994 were identified as Gould's Wattled Bats and it is believed those found in previous inspections were also of this species.

According to our expert Lindy Lumsden 'The most probable reason for the marked change in numbers found between November and December is that by December, the females would be using maternity roosts. It appears that the boxes are not being used as maternity roosts (the internal microclimate may not be optimal for this purpose), so this leaves only the males to use the boxes'. The other factor that might have an impact was the pegs installed beneath the entrances to boxes C4 and C10 for the purpose of research being conducted on Sugar Glider social inter-actions in the area, over part of this period. These wooden pegs - two placed about 10 cm apart across the entrance slit - would have made the bats' access to the boxes more difficult. Only these two boxes had such pegs in place and eventually bats were found occupying one of these two boxes.

Conclusions and the future

There is now no doubt that bats may use the roosting boxes in the locations where we have installed them, regardless of the aspect, position in relation to sunlight, or tree species in which they are located.

FOOP intend to construct additional bat boxes to compare the success rates of different designs and positions. The new roosting boxes will be larger with multiple internal partitions, possibly of different internal dimension, to attract smaller bats than *C. gouldii* (see Fig. 3). They will also have no bases, which we expect will discourage Sugar Gliders which will have no support on which to construct their nests of eucalypt leaves. These designs have been very successful in North America.

We hope these new boxes will be suitable for the bats during winter hibernation as well as at other times of the year. They will be checked on a regular basis and all bats will be banded to investigate the social organisation of the bats. To date, all bats found using the boxes and identified to species have been Gould's Wattled Bats *C. gouldii*, despite the fact that six species have been identified as using the river flat where the boxes have been installed. This is a strong contrast with the distribution of species trapped by Brereton and Schulz in 1988, in

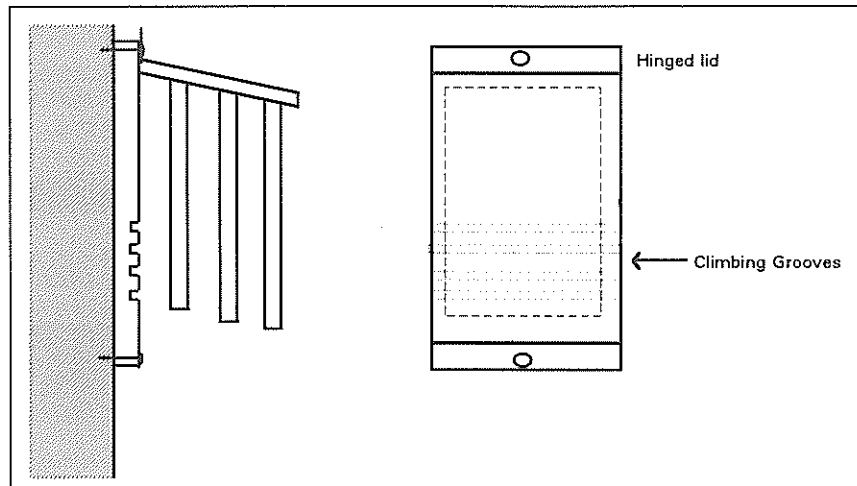


Fig. 3. Proposed new Bat roosting boxes.

which only 3 of the 53 captured bats were Gould's Wattled Bats, though harp traps might not give a representative impression of the proportional mix of species in an area, and *C. gouldii* may have been under-represented by that sampling technique. It is possible that installation of the boxes, so attractive to one species, may have affected the mix of species using the area. The planned monthly series of box inspections through 1995 should help test this possibility. However, it is known that bats such as *C. gouldii* may forage up to 20 km from their roost sites (L. Lumsden, *pers. comm.*), so they may not be using the park for foraging, despite using it for roosting.

Further results will be published when the regular banding and monitoring program seems to warrant a further report.

Acknowledgments

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During 62 years since the appearance, in May 1931, of this State's only other full-length *Flora of Victoria*, immense strides have been made in botanical exploration of the whole region, studies in its ecology, plant communities and habitats. Also, as a result of considerable taxonomic research leading to revisional work, there have been many name changes and the addition of numerous unrecorded taxa. The increase in the number of accepted species is demonstrable no more dramatically than in the orchid family - 149 Victorian species recognised in A.J. Ewart's *Flora of 1931*, 270 in the present *Flora* (1994).

Ewart had managed to squeeze his whole account into a single chunky volume of 1257

pages, selling for 25 shillings, but costs were commensurate with prices at the early years of the Great Depression. Actually, its binding was inadequate for such a weighty tome which, with frequent use, tended to fall in pieces; some owners were wise enough to get this government Printer's production split and re-bound as two separate books.

The new *Flora of Victoria* comprises four volumes of which the first two are already available - Vol. 1 in 1993 and Vol. 2 at the end of 1994. Volume 1 (A\$75, as a special offer) is edited by D.B. Foreman and N.G. Walsh and is entirely introductory. In its 320 pages are ten chapters by sundry specialists - on prehistory of the flora; geology and geo-