Title

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MONITORING THE USE OF THE SLATY CREEK WILDLIFE UNDERPASS, CALDER FREEWAY, BLACK FOREST, MACEDON, VICTORIA, AUSTRALIA

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Abstract: The Slaty Creek Wildlife Underpass was built into the Calder Freeway, Macedon, Victoria, to facilitate safe passage for species between forest block, now affected by this new section of freeway through the Black Forest. A 12-month monitoring regime was established, consisting of 14 monitoring methods to detect a variety of animals. Intensive sampling was conducted for one week per month, within the underpass, and with two control sites on either side of the underpass, along the Slaty Creek. The monitoring sampled for mammals, reptiles, amphibians and birds, encountering a total of 116 species within the Black Forest region, with most of these also being detected within the underpass.

Introduction

The design of roads to mitigate potential negative effects on animals is a relatively new area of research in Australia. Compared to work done overseas, there are only a few articles published on mitigation structures such as underpasses in Australia (Mansergh and Scotts 1989; Hunt *et al.* 1987; Goosem *et al*. 2001). Given that there is over 800,000 kilometers of roads within Australia (Australian Bureau of Statistics, 2002), there is a great need to develop measures that minimize road impacts on the natural environment. Australia's unique animals and varied environmental conditions require road designs that are effective for both Australian conditions and wildlife.

The Slaty Creek wildlife underpass (figure 1) was built by VicRoads (Victorian Government Roads Corporation) in the Black Forest section of the Calder Freeway in 1997 to mitigate the impacts of a new freeway on wildlife passage. This structure was designed primarily to provide access for wildlife moving between the forest blocks that the freeway bisected, but also allowed for creek flows and access for firefighting crews, maintenance vehicles and pedestrians. The Black Forest section of the Calder Freeway cost approximately (AU) $46 million, with the Slaty Creek underpass cost approximately (AU) $3 million.

Fig. 1. The Slaty Creek Wildlife Underpass.

The Slaty Creek underpass is approximately 70 metres wide at the base and supports a split dual carriageway bridge on two 12-metre piers for each section of carriageway. The distance between the continuous forest patches on either side of the underpass is approximately 100 metres. An important design component of the underpass was the retention of remnant vegetation during the construction of the road and bridges. This enabled some mature Eucalypts and middle and understorey vegetation to be retained within the underpass. Further indigenous species were planted after the completion of construction with the intention of recreating a similar vegetation structure to the adjacent forest.

The Centre for Sustainable Regional Communities, La Trobe University, Bendigo, was contracted by VicRoads for approximately (AUD) $70,000 to:

- Determine what fauna species were using the Slaty Creek underpass (and adjacent culverts and roads).
- Determine whether the animals were using the underpass during day or night.
- Determine the use of the underpass by potential predators such as domestic and feral animals.
- Include an assessment of suitability of the proportions of the underpass for facilitating fauna movement and suggest possible improvements to the underpass which may optimise its use by native fauna and minimize risk of predation.
- Outline requirements for any future monitoring programs or further investigation if required.

This paper reports on only those species that used the Slaty Creek underpass.

Monitoring Sites and Methods

This study examined the presence or absence of mammals, reptiles, amphibians and birds within the underpass and adjacent forest over a 12-month period. The adjacent forest sites measured 50m x 50m in size and were located 320 metres to the west and 100 metres to the east of the underpass along Slaty Creek.

There were four issues that had to be addressed when designing the monitoring regime. Firstly, there was a great variety in the size of species anticipated to use the underpass: sizes varied from 1.5m-tall Eastern Grey Kangaroos (*Macropus giganteus)* to amphibians about 3cm long. Secondly, the animals to be monitored had varying movement techniques, ranging from jumping and running, to gliding and flying. Thirdly, there was variation in the time of day or night that the animals would be active. Fourthly, the underpass was located close to residential properties, which posed a considerable risk of vandalism if expensive monitoring equipment was left unattended on site. The latter factor, in combination with the substantial vegetation covering the underpass floor and the large dimensions of the underpass, effectively precluded the use of cameras. Consequently, the monitoring program was both varied and substantial. A total of 14 monitoring methods was chosen for this study, and a brief outline of the methods and frequency of monitoring is given in table 1. Between July 2002 and June 2003, Rod Abson spent one week each month camping in the Black Forest and collecting the data.

Table 1
Summary of types and frequency of monitoring methods used in this study

Monitoring method	Description	Frequency
Active Searching	Lifting logs and rocks to find reptiles and amphibians at three sites and surrounding forest.	One day every three months
Anabat	An electronic device used to detect and record the echolocation frequencies of bat calls. Used only in the underpass.	Used shortly after dusk on three nights in three different months.
Audio Recordings	A small note taker and directional microphone used to record bird calls during bird surveys, incidental and night frog and bird calls during spotlighting.	Operated during bird surveys and spotlighting each month.
Bird Survey	A 20-minute bird survey conducted at each of the three sites at dusk.	Survey conducted at dusk for three successive days per month for 12 months
Elliott Trap	Seven of these small metal traps were placed on the ground at each of the three sites to catch small mammals.	Checked at dawn and dusk for three successive days each month for 12 months.
Hair Funnel	Tapered half funnels baited at the narrow end and containing a sticky wafer for removal of a small sample of mammal hair when the animal investigates the funnels; five funnels were placed at each of the three sites, two in trees and three on the ground.	Hair funnels were baited and left out for the entire year; the bait and wafer were changed once per month and hair samples were analysed each month for 12 months.
Harp Trap	Five harp traps used for catching bats were placed within the underpass and surrounds.	Used only on one night; not found to be successful and so not used again.
Incidental Observations	Recording of animals that were seen during the time spent in the forest and that did not come under one of the other monitoring methods.	Observations made for one week every month for 12 months.
Nest Boxes	Four nest boxes were placed at each of the three sites to monitor for arboreal mammals; the boxes were designed for Feathertail Glider (1 box per site), Leadbeaters Possum (1 box per site) and Sugar Glider (2 boxes per site).	Checked monthly for signs of use or habitation for 12 months.
Pitfall Trap	Eight pitfall traps of 15cm diameter, 30cm depth with a 4m fence were established at three sites to catch reptiles and amphibians.	Checked at dawn and dusk for three successive days each month for 12 months.
Road Walk	The freeway near the underpass was checked for evidence of animal road kill; both edges of the freeway and the median strip were checked: a length of 2.5 km	One day each month for 12 months.
Sand Tray	An 80m long by 2m wide sand tray was placed along the service road that runs adjacent to the freeway, which ground dwelling animals needed to cross to pass through the underpass.	Checked and raked smooth at dawn and dusk for three days per month for 12 months.
Scat Collection	At each of the three sites, five randomly placed 1 m^2 plots were checked for any signs of animal scats, bones or hair and collected for analysis.	Conducted once per month for 12 months.
Spotlighting	A high-powered red filter spotlight and nightscope were used at night to check for nocturnal animals; this was conducted at each of the three sites.	Approximately 1 hour per night for three nights per month for 12 months.

Results

There were 116 species of fauna detected within the Black Forest region throughout the duration of the study. Table 2 depicts the species groups of animals detected, along with comparisons between the total number of species detected and the number detected within the underpass compared to the surrounding forest or road. Figure 1 shows the number of species in each group detected at each location. The results suggest that the number of animals detected within the underpass is comparable to species found in the adjacent forest.

Table 2:
Species detected during the Slaty Creek underpass fauna survey

Species Group	Total Number of Species Detected	Species Detected in Forest or Road	Species Detected in the Underpass
Amphibians	7	6	6
Bats	12	Not monitored	12
Birds	63	59	37
Introduced medium to large mammals	8	6	6
Koala, Wombat, Echidna	3	3	3
Macropods	2	2	2
Possums & Gliders	7	7	4
Reptiles	8	5	5
Rodents & Dasyurids	5	5	4

Possums and Gliders

A close inspection of the study results has identified that some arboreal animals were detected within the surrounding forest, but not within the underpass (table 2). Based on other underpass studies (Queensland Department of Main Roads 2000), gliders and possums were not expected to move through underpass structures. Gliders and possums demonstrate a reluctance to come to ground, as their preferred movement is through tree canopies.

In this study, the possums and glider species detected within both the underpass and adjacent forest include:

- Sugar Glider (*Petaurus breviceps*)
- Ringtail Glider (*Pseudocheirus peregrinus*)
- Common Brushtail Possum (*Trichosurus vulpecula*)
- Squirrel Glider (*Petaurus norfolcensis*) (a possible recording)

The species that were detected in the forest but not within the underpass included:

- Feathertail Glider (*Acrobates pygmaeus*)
- Mountain Brushtail Possum (*Trichosurus caninus*)
- Greater Glider (*Petauroides volans*) (a possible recording)

These results suggest that the design of the underpass with its large dimensions and retained vegetation is suitable for most species to move through, but may require additional features to become attractive to other species such as possums and gliders.

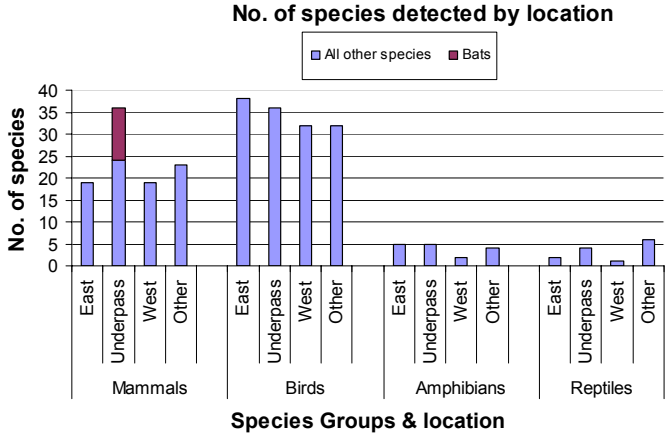

Fig. 1. Number of species detected at each location: 'East' = 50m x 50m quadrant 100 east of the underpass; 'Underpass' = within the Slaty Creek underpass; 'West' = 50m x 50m quadrant 320 west of the underpass; ' Other' = other location within a 1.2km radius of the underpass.

Introduced species

A variety of introduced animals were detected within the underpass and surrounding forest. Introduced animals were detected predominantly using the underpass at night. Although it has been suggested that predators use underpass structures as prey traps, no evidence was found to suggest that was happening at the Slaty Creek underpass. Small native and introduced animals, which would be suitable prey for predators such as foxes, cats and dogs, were regularly detected within the underpass. Table 3 presents data on predator scats collected from within the underpass and surrounding forest, and demonstrates that introduced mammals prey on both native and introduced species. However, it was not possible to determine the exact location of the predation event, as some prey species (cow and sheep) were never physically present in the underpass. This suggests that predators range quite widely for their prey and operate independently of underpass structures for their prey.

Table 3:
Predator and prey analysis based on scats collected within the underpass and surrounding Black Forest

Predator		**Prey**	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
*Cat	*Felis catus*	Ringtail Possum	*Pseudocheirus peregrinus*
*Dog	*Canis lupus familiaris*	Ringtail Possum	*Pseudocheirus peregrinus*
		*Sheep	*Ovis aries*
*Fox	*Vulpes vulpes*	*Black Rat	*Rattus rattus*
		Bird sp.	
		*Cow	*Bos taurus*
		Mountain Brushtail Possum	*Trichosurus caninus*
		Ringtail Possum	*Pseudocheirus peregrinus*
		Swamp Wallaby	*Wallabia bicolor*

* Introduced species

Bats

Up to 12 species of bats were detected moving through the underpass. There is scope for bat roosts similar to those successfully installed in bridge structures in the United States (Keeley and Tuttle 1999) to be fitted to the bridges spanning Slaty Creek.

Vegetation

Vegetation monitoring within the Slaty Creek Underpass, and comparisons with the forest structure surrounds identified imbalances in the vegetation structure through the underpass, which could be a factor influencing animal choice to move through the underpass.

The forest surrounding the Slaty Creek Underpass is almost entirely privately owned. While it is currently provides some high quality habitat, the long-term effectiveness of the underpass will be relative to the surrounding environment.

Fencing

The entire Black Forest Section of the Calder Freeway is fenced with 2m-high chain wire fencing, with colorbond corrigated sheet metal on the forest side of the fence to prevent arboreal mammals from climbing the fence.

The base of the fence has a 30cm skirting of chain wire fencing pegged to the ground to prevent animals burrowing beneath the fence. Koala escape poles were placed on the inside of the fence, so that if a Koala were to access the roadway, there would be opportunity for them to scale the fence from the road side.

Recommendations

While the Slaty Creek Underpass has been found to be used by a large variety of fauna, there are still some works that could enhance its use, which include:

- The construction of rope canopy bridges and glider poles for arboreal animals
- Fitting bat roosts into the bridge structure
- Additional revegetation of indigenous species within the underpass, particularly middle storey species, to replicate the forest structure

- The design and maintenance of fencing that minimises road kill
- Involvement of community environmental groups in ongoing monitoring
- Ensuring the integrity of surrounding forest is maintained in perpetuity

Biographical Sketch: Rodney Abson has been employed as a research assistant with La Trobe University, Bendigo, to monitor the Slaty Creek Wildlife Underpass, in Macedon, Victoria. This has also contributed to his masters in environmental management, which he is currently completing. Rodney also has a bachelor of arts in nature tourism from La Trobe University.

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