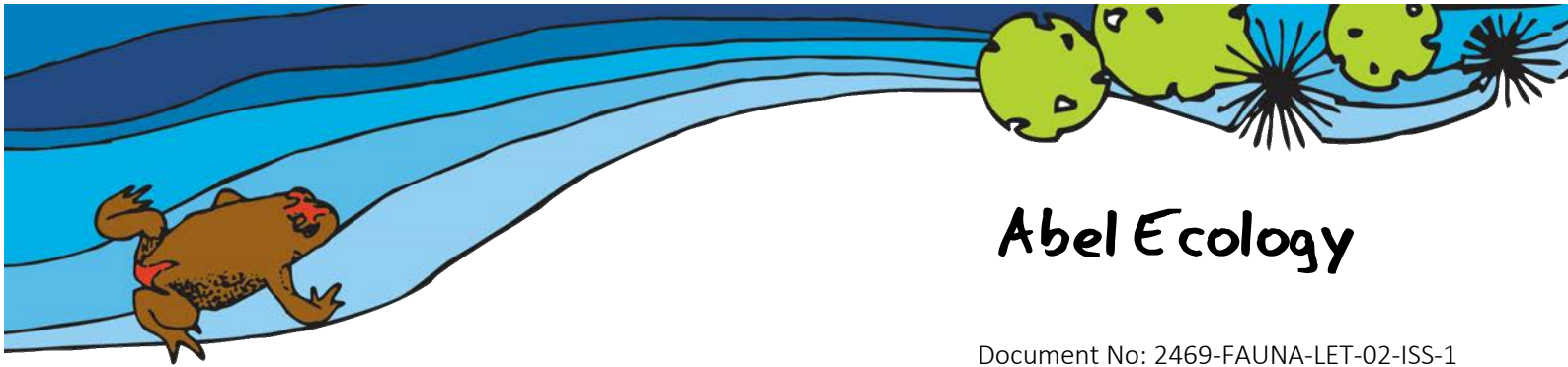




Abel Ecology

Document No: 2469-FAUNA-LET-02-ISS-1

17 February 2023

Chris Buscall

Snow Hydro Ltd
PO Box 332
Cooma NSW 2630

Attention: Chris Buscall

Dear Chris,

RE: Review of Lobs Hole Road fauna underpass remote camera monitoring for the period of 11 August 2022 to 12 December 2022.

This letter presents the results of a review of remote camera photos of fauna detected using purpose-built road underpasses along Lobs Hole Ravine Road, Cabramurra NSW. Fauna underpasses along Lobs Hole Ravine Road were installed in response to potential direct impact on threatened small mammal populations through actions of vehicle strike in relation to Snowy Hydro 2.0 construction works, utilisation of the road. Monitoring of the fauna underpasses is guided by procedures outlined by Snowy 2.0 Main Works – Biodiversity Management Plan (BMP) (Revision I, dated 12 Oct 2020), Table 5-1 - BM02, BM03, and BM22, Appendix B and Appendix G.

There are six fauna underpasses along Lobs Hole Ravine Road, each with two (2) remote Reconyx cameras, one at each entrance to the underpass. This is a total of 12 cameras. There are three monitoring periods presented here and these periods are based on when the camera SD cards were retrieved and downloaded by Snowy Hydro Limited (SHL) staff.

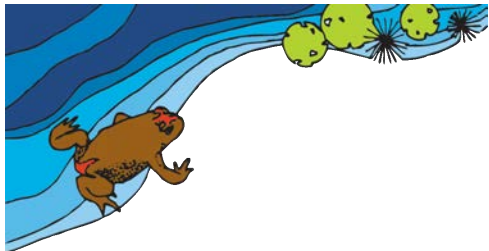
Monitoring periods:

- 11 August – 22 September 2022
- 22 September – 4 November 2022
- 4 November – 12 December 2022.

BAMEcology Pty Ltd (T/A Abel Ecology)
2 Samuel 20:18
ACN 626 221 467 – ABN 37 626 221 467

PO Box 495, Springwood, NSW, 2777
Unit 2, 10-11 Ferguson Road,
Springwood, NSW, 2777
56 Sharp Street, Cooma, NSW, 2630

T (02) 4751 9487
E info@abelecolology.com.au
W www.abelbushfire.com.au
W www.abelecolology.com.au



1.1 BioNet Atlas of NSW Wildlife website search

Because direct trapping of fauna is not scheduled to occur to identify animals in the hand through accurate morphometric measurement and also because views of lateral and ventral angles of animals is limited, records from the BioNet Atlas of NSW Wildlife website were accessed using the following search criteria to cross-reference local species records and locations:

Licensed Report of all Valid Records of Exotic listed or Native listed Mammals (Class: Mammalia) for a 20 x 22 km square centred on the site (selected area [North: -35.74 West: 148.32 East: 148.54 South: -35.94]). Records since 01 Jan 1990 until 17 February 2023 returned a total of 3,269 individual records from fifteen (15) exotic fauna and thirty-eight (38) native fauna species. Of these records, species unlikely to use the fauna underpasses or not of interest were eliminated from the results. The cleaned results are presented in Table 1.

Data from the BioNet Atlas website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°). Copyright the State of NSW through the Office of Environment and Heritage.

The species in Table 1 have been considered in analysis of fauna underpass photos.

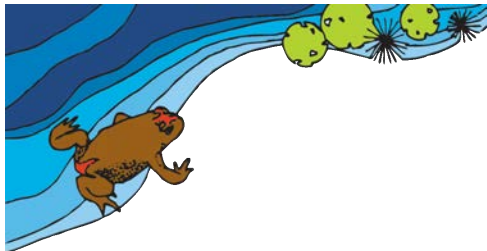


Table 1. Bionet records search results of relevant small mammals likely to use fauna underpasses in the locality.

Scientific Name	Common Name	Bionet records for locality since 1 Jan 1990	NSW status	CommWith. status
<i>Pseudomys fumeus</i>	Smoky Mouse	33	CE	E
<i>Mastacomys fuscus</i>	Broad-toothed Rat	83	V	V
<i>Cercartetus nanus</i>	Eastern Pygmy-Possum	61	V, P	-
<i>Rattus fuscipes</i>	Bush Rat	154	P	P
<i>Antechinus mimetes</i>	Mainland Dusky Antechinus	29	P	P
<i>Antechinus agilis</i>	Agile Antechinus	198	P	P
<i>Antechinus stuartii</i>	Brown Antechinus	1	P	P
<i>Perameles nasuta</i>	Long-nosed Bandicoot	6	P	-
<i>Mus musculus</i> *	House Mouse	45	I	I
<i>Rattus rattus</i> *	Black Rat	11	I	I
<i>Oryctolagus cuniculus</i> *	Rabbit	422	I	I
<i>Vulpes vulpes</i> *	Red Fox	124	I	I
<i>Felis catus</i> *	Feral Cat	49	I	I

Key

P = Protected

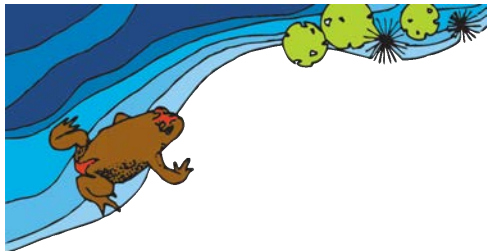
V = Vulnerable

E = Endangered

E1 = Endangered Species

CE = Critically Endangered

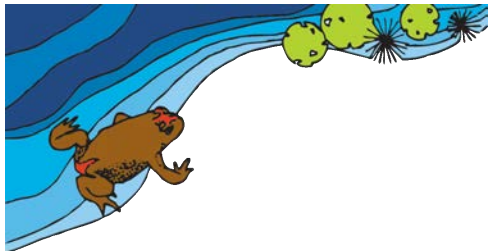
I = Introduced*



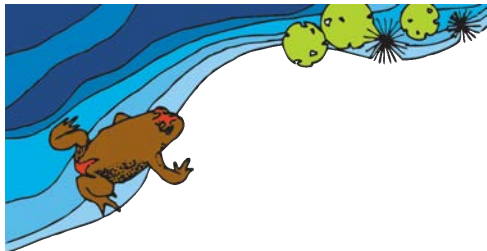
The presence / absence results of the 11 August – 22 September 2022 monitoring period are present in Table 2.

Table 2. Results from monitoring period 11 August – 22 September 2022.

Underpass Location	Species detected	East	West
1	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	-	●
	White-browed Scrubwren (<i>Sericornis frontalis</i>)	-	●
2	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	House mouse	●	●
	Bush Rat	●	●
	Brown Antechinus	●	-
3	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	Grey Fantail (<i>Rhipidura albiscapa</i>)		●
4	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●



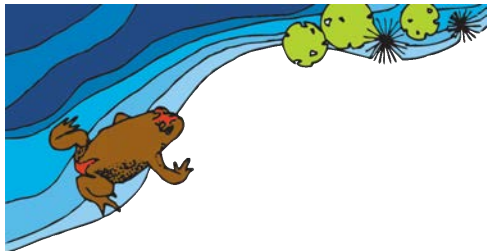
5	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
6	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	Rabbit	●	●
	Brown Antechinus	-	●
	Bird sp.	-	●



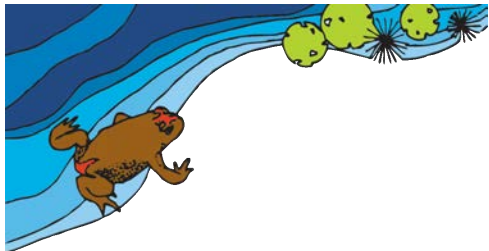
The presence / absence results of the 22 September – 4 November 2022 monitoring period are present in Table 3.

Table 3. Results from reporting period 22 September – 4 November 2022.

Underpass Location	Species detected	East	West
1	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	House mouse	-	-
	Feral Cat	-	-
	Bush Rat	●	●
2	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	House mouse	●	-
	Bush Rat	●	●
	Bird sp.	●	-
	<i>Lampropholis delicata</i> Garden Skink	-	●
3	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	House mouse	-	-
	Bush Rat	●	●
	<i>Lampropholis delicata</i> Garden Skink	●	-



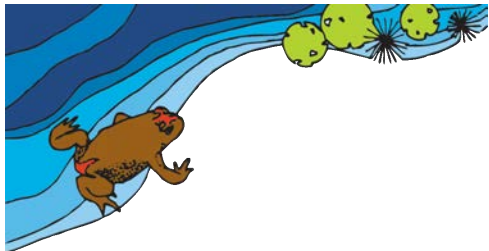
4	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	House mouse	●	●
	Red Fox	-	-
	Feral Cat	-	-
	<i>Lampropholis delicata</i> Garden Skink	●	-
5	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	House mouse	-	-
	Red Fox	-	-
6	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	House mouse	-	-
	Red Fox	-	-
	Feral Cat	-	-
	Brown Antechinus	-	-



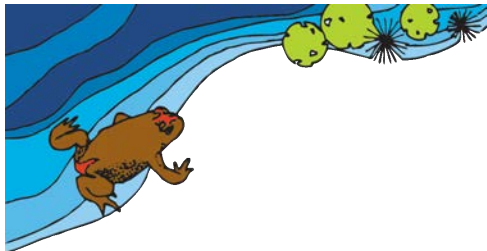
The presence / absence results of the 4 November – 12 December 2022 monitoring period are present in Table 4.

Table 4. Results from monitoring period 4 November – 12 December 2022.

Underpass Location	Species detected	East	West
1	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Brown Antechinus	-	-
	Bush Rat	●	●
	<i>Austrelaps ramsayi</i> Highlands Copperhead	●	●
	<i>Lampropholis delicata</i> Garden Skink	●	-
2	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Brown Antechinus	-	-
	Bush Rat	●	●
	<i>Lampropholis delicata</i> Garden Skink	-	●
3	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Eastern Pygmy Possum <i>Cercartetus nanus</i>	-	●
	Bush Rat	●	●
	<i>Lampropholis delicata</i> Garden Skink	-	●
	<i>Lampropholis guichenoti</i>	-	●



	Grass Skink		
4	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	<i>Lampropholis guichenoti</i> Grass Skink	●	●
	<i>Lampropholis delicata</i> Garden Skink	●	●
	House mouse	●	●
5	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	Black Rat <i>Rattus rattus</i>	●	●
6	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	●	●
	Brown Antechinus	-	-
	<i>Lampropholis guichenoti</i> Grass Skink	-	●



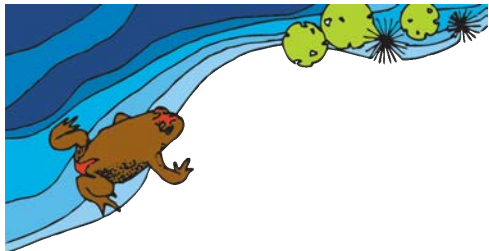
2 Discussion

With a reasonable level of confidence, no presences of Smoky Mouse or Broad-toothed Rat were recorded using the fauna underpasses during the 11 August 2022 to 12 December 2022 reporting period. Species recorded that are similar in size and shape were House Mouse and Bush Rat. All mouse sized individuals recorded were brown to light-brown in colour, no image recorded provided the diagnostic features to confirm the present of Smoky Mouse. Similarly, the Bush Rats caught on camera were quite dark brown as opposed to descriptions of lighter coloured individuals from reference text. No image recorded provided the diagnostic features to confirm the present of Broad-toothed Rat. This conclusion also reflects the spatial distribution of public species records for Broad-toothed Rat and Bush Rat within the Snowy Hydro 2.0 project area. Broad-toothed Rat has not previously been recorded along Lobs Holes Ravine Road (EMM 2020; BMP 2020).

As would be expected, the level of fauna activity within the fauna underpasses increased as the average air temperature at the site during the day increased, being the natural transition from winter into spring. AE is delighted to report Eastern Pygmy-Possum was detected once at Underpass 3 West (Figure 1). The most frequently detected species using the fauna underpasses during all reporting periods was Bush Rat (Figure 3 and Figure 4). AE is also delighted to report no feral predators (red fox Figure 9 and cats Figure 10) were detected 'within' the fauna underpass entrances during this reporting period, and this coincided with a significant drop in the detection of House Mouse (Figure 7). It is unclear if introduced predators were able to move freely through the fauna underpasses and the presence of a grill (shadow) was detected in photos from Underpass 4 East on 20 October 2022. AE has not been informed when grills on the outside of fauna underpasses were installed. The presence of foxes and cats appears to be linked to the presence of House Mouse, as no foxes or cats were recorded in the fauna underpasses after 21 June 2022 as previously reported. The design of the fauna underpasses was to have obstructive habitat within the underpasses to facilitate threatened fauna movement through the underpasses and to exclude feral predators. This design feature is currently being real-world tested by onsite feral predators. Previously AE recommended that a site inspection is made to determine if improvements can be made to deny predator entry into the fauna underpasses past the camera positions. It would appear the addition of a grill on the outside of the fauna underpass entrances has helped to deter feral predators, as the detection frequency of potential prey species has not decreased during the reporting periods presented here.

A significant amount of water was detected in the images returned from Underpass 4 West. It is unclear if this is a significant deterrence to Smoky Mouse and Broad-toothed Rat from using the fauna underpass. Management of run-off water may be needed at Underpass 4 West in the future, AE recommends monitoring of this issue to continue to determine if management action is required.

The detection of six native species (Eastern Pygmy-Possum, Brown Antechinus [Figure 2], Bush Rat, Highlands Copperhead, *Lampropholis delicata*, and *L. guichenoti*) using the fauna underpasses is a positive outcome, and this is an event that SHL should strive to maintain and improve. The detection of Eastern Pygmy-Possum using the fauna underpass (Underpass 3 West, Figure 1) is a significant accomplishment for the project and should be acknowledged.



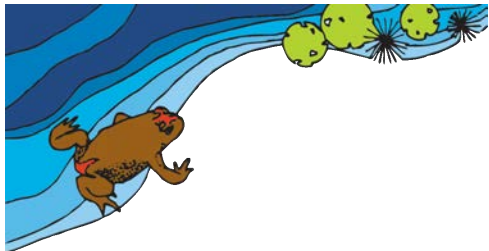
Incidental records of Grey Fantail and White-browed Scrubwren within the fauna underpass entrances were interesting and unexpected. Small birds are not expected to forage or to go beyond the entrance to pass through the underpass. *Lampropholis* sp. (skinks) and Cooperheads (snakes, Figure 5), were also interesting observations; the skinks and the snakes using the fauna underpass as habitat. Both reptile species would use the fauna underpass as shelter and the Cooperheads would also use the underpass for hunting the skinks. Snakes preying on mice could not be ruled out.

Rabbit/s (Figure 8) were recorded from one fauna underpass (#6) during the 11 August – 22 September 2022 monitoring period. The fauna underpass would offer temporary shelter to rabbits. A new introduced species was detected being Black Rat *Rattus rattus* (Figure 6) at Underpass 5 during the 4 November – 12 December 2022 reporting period.

It is essential that the area of the fauna underpass within the photo frame of the cameras be cleared of debris (e.g. habitat rocks) so the animals are 'in-focus' when the photo/s are taken. The removal of habitat rocks this reporting period generated many in-focus images of fauna, and AE would maintain our recommendation that >90% of the photo frame of the cameras be cleared of debris. It is essential that cover (e.g. habitat rocks) are maintained or increased to strongly inhibit predator movement through the fauna underpasses and provide habitat connectivity for native fauna.

To improve the success of the fauna underpass monitoring program the installation of timber or metal rulers (30cm) is recommended within the photo frame of the cameras. This is to ensure AE captures a reliable scale of the animals using the fauna underpasses. A marking (paint or tag) to indicate the direction of the underpass entrance within the photo frame of the remote cameras is recommended. Additionally, a marking (paint or tag) within the photo frame of the cameras to indicate which fauna underpass camera the photo was taken at is also recommended. These recommendations have been made previously, and from what AE can determine have not yet been implemented.

A successful movement will be determined through an animal being detected on both cameras at around the same time period. The success of this performance criteria has not been analysed or reported here.

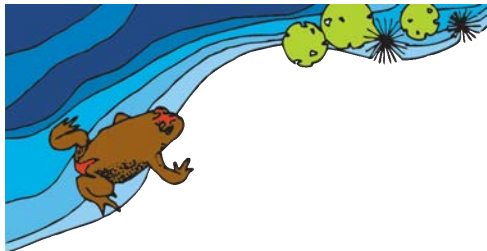


3 Conclusion

The six fauna underpasses are functioning as a corridor for small mammal movement. The target species - Smoky Mouse and Broad-toothed Rat have not yet been recorded utilising the fauna underpasses. Eastern-Pygmy Possum *Cercartetus nanus* was recorded during this reporting period. The detection of Eastern Pygmy-Possum using the fauna underpass (Underpass 3 West, Figure 1) is a significant accomplishment for the project and should be acknowledged.

The detection of six native species (Eastern Pygmy-Possum, Brown Antechinus [Figure 2], Bush Rat, Highlands Copperhead, *Lampropholis delicata*, and *L. guichenoti*) using the fauna underpasses is a positive outcome, and this is an event that SHL should strive to maintain and improve.

No items of significant concern were detected during the monitoring periods reported here. The presence of feral predators, which appear to be focusing on the fauna underpasses during periods of a high or dispersing House Mouse population have not been detected since after 21 June 2022 and is a positive outcome.



4 Recommendations

For the continued monitoring of six fauna underpasses along Lobs Hole Ravine Road, Cabramurra NSW, the following recommendations are made in accordance with the Snowy Hydro Limited document Snowy 2.0 Main Works – Biodiversity Management Plan (BMP), Biodiversity Monitoring Program and Fauna Strike Mitigation Strategy:

1. Presence and pressure from feral predators has not been detected at any fauna underpass since after 21 June 2022. AE continues to recommend a site inspection is made to determine if improvements can be made to deny feral predator entry into the underpasses past the camera positions. It would appear the addition of a grill on the outside of the fauna underpass entrances has helped to deter feral predators.
2. The installation of timber or metal rulers (30cm) is recommended within the photo frame of the remote cameras. This is to ensure AE captures a reliable scale of the animals using the fauna underpasses. AE recommends two (2) rulers running parallel to the underpass, one on either side of the photo frame. Rulers and glue were provided to SHL (Emily Martin) by Abel Ecology for installation 1 July 2022. It is unclear if this recommendation has been implemented.
3. A marking (paint stencil or tag) to indicate the direction of the fauna underpass entrance within the photo frame of the remote cameras. Additionally a marking (paint stencil or tag) within the photo frame of the remote cameras to indicate which fauna underpass camera the photo was taken at. It is unclear if this recommendation has been implemented.
4. A significant amount of water was detected in the images returned from Underpass 4 West. It is unclear if this is a significant deterrence to Smoky Mouse and Broad-toothed Rat from using the fauna underpass. Management of run-off water may be needed at Underpass 4 West in the future, AE recommends monitoring of this issue to continue to determine if management action is required.
5. Continue small terrestrial mammal presence/absence monitoring as per Table 5-2 of site BMP (2020) in the vicinity of the fauna underpasses.
6. Continue feral animal presence/absence monitoring as per Table 8-1 of site BMP (2020).
7. Implement Smoky Mouse and Broad-toothed Rat pest animal mitigation strategies as per Table 5-3 of site BMP (2020).

Yours faithfully,

Mark Mackinnon

Abel Ecology

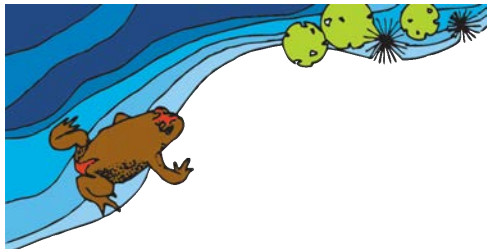


Figure 1. Remote camera image of Eastern-Pygmy Possum *Cercartetus nanus* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during December 2022.



Figure 2. Remote camera image of Brown Antechinus *Antechinus stuartii* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during June 2022.

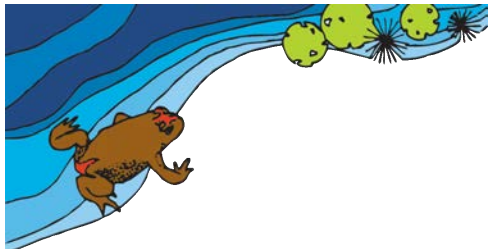


Figure 3. A regular user of the fauna underpasses along Lobs Hole Ravine Road, Cabramurra NSW is the Bush Rat *Rattus fuscipes*.



Figure 4. A regular user of the fauna underpasses along Lobs Hole Ravine Road, Cabramurra NSW is the Bush Rat *Rattus fuscipes*.

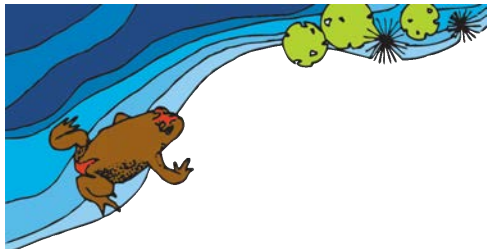


Figure 5. Remote camera image of Highlands Copperhead *Austrelaps ramsayi* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during November 2022.



Figure 6. Remote camera image of Black Rat *Rattus rattus* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during December 2022.

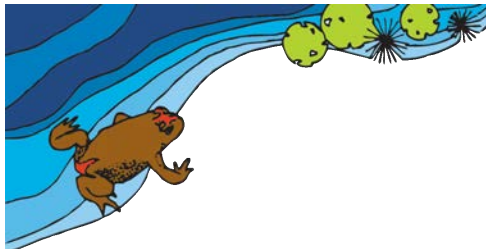


Figure 7. Remote camera image of House Mouse *Mus musculus* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during May 2022.



Figure 8. Remote camera image of Rabbit *Oryctolagus cuniculus* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during September 2022.

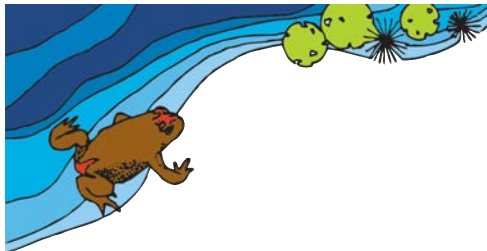


Figure 9. Remote camera image of Red Fox *Vulpes vulpes* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during May 2022.



Figure 10. Remote camera image of Feral Cat *Felis catus* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during May 2022.